



**An Overview of
Perioperative Medicine 2013:**
*From Outpatient Preoperative Assessment to
Inpatient Postoperative Care*

October 9-12, 2013

Grand Hyatt Seattle
Seattle, Washington

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CME Activity Description

An Overview of Perioperative Medicine 2013 has been a successful collaboration of Mayo Clinic and Jefferson Medical College. This merger of two of the nation's most comprehensive perioperative courses features a collaborative faculty of multi-specialty experts in perioperative medicine from both Mayo Clinic and Jefferson Medical College.

This course is intended to update general internists, internist-sub specialists, family medicine specialists, and other health care providers on perioperative assessment and management. This course will focus on the practical, clinical side of preoperative assessment and postoperative management.

CME Activity Objectives

Upon conclusion of this program, participants should be able to:

- Apply a systematic approach to guide preoperative assessment.
- Recommend appropriate perioperative cardiac testing using the current ACC / AHA guidelines and risk calculators.
- Manage anticoagulants and antiplatelet agents in the perioperative setting.
- Discuss the management of the new oral anticoagulants in the perioperative setting.
- Assess risk factors for postoperative pulmonary complications and recommend measures most effective in reducing perioperative pulmonary risk.
- Select appropriate prophylactic regimens for deep venous thrombosis in the perioperative setting based on patient risk and current guidelines.
- Recommend the appropriate continuation and discontinuation of medications and nutraceuticals in the perioperative setting.
- Assess the patient with chronic liver disease for surgery.
- Manage chronic kidney disease in the perioperative setting.
- Recognize and manage postoperative delirium.
- Identify risks and benefits of perioperative blood transfusion.
- Recommend appropriate bridging therapy in patients who are on chronic anticoagulation.
- Manage diabetes in the perioperative setting.
- Manage patients with obstructive sleep apnea in the perioperative setting.

Attendance at this Mayo Clinic activity does not indicate nor guarantee competence or proficiency in the performance of any procedures which may be discussed or taught in this activity.

Continuing Education Credit

College of Medicine, Mayo Clinic, is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

College of Medicine, Mayo Clinic, designates this live activity for a maximum of 22.25 *AMA PRA Category 1 Credit(s)*[™]. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

AAFP

This Live activity, Mayo Clinic's An Overview of Perioperative Medicine, with a beginning date of 10/09/2013, has been reviewed and is acceptable for up to 22.25 Prescribed credit(s) by the American Academy of Family Physicians. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Other Health Care Professionals

A record of attendance will be provided to other health care professionals for requesting credits in accordance with state nursing boards, specialty societies, or other professional associations.

CME Record of Attendance

A Record of Attendance is provided to you during on-site registration. The Record of Attendance allows attendees to calculate their own credits of participation in the educational activity.

The total number of credits participants can earn per day is noted on the Record of Attendance. Below each day is a line to record the actual number of credits during which you participated in the educational activity. It is recommended that you record your actual credits daily as you proceed through the CME activity.

Upon conclusion of the CME activity, please total the number of credits you have recorded on the top half of the form, sign it, and return it with your evaluation to the registration desk.

The bottom half of the form represents your Record of Attendance, which **you must retain** for your records. Please make sure the number of credits claimed in both sections coincide. No other documentation is provided to you after this CME activity. The Record of Attendance has replaced the certificate.

The Record of Attendance can be used for requesting credits in accordance with state licensing boards, specialty societies, or other professional associations.

CME Activity Evaluation

The overall CME activity evaluation will be emailed following the activity to the email address that was provided when you registered. The CME activity evaluation is brief and will only take a few minutes to complete.

Faculty evaluation forms were offered to a sampling of the registrants. Completed faculty evaluation forms should be returned to the registration desk at the conclusion of the CME activity. If you wish to participate in evaluating the faculty, please stop at the registration desk to inquire if extra evaluation forms are available.

Your feedback is very important to us and will be used for planning future programs, as well as identifying faculty strengths and opportunity for growth.

Syllabus and Internet Access

An electronic syllabus will be provided to all attendees. Participants are invited to bring their laptops to the meeting room(s). Due to copyright issues or revisions, some slides may be shown during a presentation, but not provided within the syllabus.

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Electronic Devices

Please turn all electronic devices (cellular telephones, pagers, etc.) to silent mode. As a courtesy to the presenters and other participants, phone calls should be taken outside of the general session.

Faculty

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Senior VP & CMO, Thomas Jefferson University
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Jennifer A. Whitaker, M.D.

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Amy W. Williams, M.D.

Susan M. Moeschler, M.D.

Program Schedule

An Overview of Perioperative Medicine 2013: From Outpatient Preoperative Assessment to Inpatient Postoperative Care

WEDNESDAY, OCTOBER 9, 2013

6:00 a.m.	Continental Breakfast and Registration	
7:30 a.m.	Welcome and Introductions	
7:40 a.m.	Role and Responsibility of the Medical Consultant	21
	<i>Margaret Beliveau, M.D.</i>	
	<ul style="list-style-type: none">• What are roles of the medical consultant?• What are some key tips for successful consultation?• What should a preoperative evaluation include?	
8:00 a.m.	Anesthesia 101 for the Non-Anesthesiologist	27
	<i>David R. Danielson, M.D.</i>	
	<ul style="list-style-type: none">• What are the basics of the anesthesia process?• What hemodynamic and physiologic processes occur during anesthesia?• Do we need to perform neck flexion and extension films for patients with RA or Down Syndrome anymore?• Which patients are appropriate for outpatient surgery?• What are the current fasting guidelines?	
8:30 a.m.	Cardiac Risk Assessment: Using Guidelines to Direct Practice and Choosing the Appropriate Stress Test	47
	<i>Karen F. Mauck, M.D.</i>	
	<ul style="list-style-type: none">• How do I apply ACC/AHA guidelines to preoperative cardiac risk assessment?• How do I use the Gupta cardiac risk calculator?• How do I decide which stress test to order?	
9:15 a.m.	Cardiac Risk Reduction Strategies – Medical and Interventional	59
	<i>Howard H. Weitz, M.D.</i>	
	<ul style="list-style-type: none">• How long after an MI is it recommended to wait before non-cardiac surgery?• What are the risks of general vs spinal anesthesia with respect to cardiac outcomes?• What is the evidence for perioperative beta-blocker, statin and alpha-2-agonist use?• When is cardiac revascularization indicated prior to non-cardiac surgery?• How long after revascularization is it recommended to wait before non-cardiac surgery?	
10:15 a.m.	Question and Answer Session	
	<i>Margaret Beliveau, M.D., David R. Danielson, M.D., Karen F. Mauck, M.D., and Howard H. Weitz, M.D.</i>	
10:30 a.m.	Refreshment Break	

10:45 a.m.	Perioperative Medication Management: Prescription & Non-Prescription Medication 77 <i>Moderator: Karen F. Mauck, M.D.</i> <i>Panel: Geno J. Merli, M.D., Howard H. Weitz, M.D., Margaret Beliveau, M.D., and David R. Danielson, M.D.</i> <ul style="list-style-type: none"> • What issues need to be considered with perioperative medication management? • What are the drugs that need to be held for surgery? • What drugs need to be given before surgery? • If certain medications are held preoperatively, how should they be restarted postoperatively? • What should I recommend to my patients regarding dietary supplements perioperatively?
11:45 a.m.	Preoperative Testing: What is Really Needed? 87 <i>Robert H. Lohr, M.D.</i> <ul style="list-style-type: none"> • What standard preoperative screening laboratory testing is indicated? • When are specific laboratory tests indicated preoperatively? • Which patients need a preoperative ECG? • Which patients need a preoperative CXR? • When should pregnancy testing be done preoperatively?
12:15 p.m.	Question and Answer Session <i>Robert H. Lohr, M.D., Geno J. Merli, M.D., Howard H. Weitz, M.D., and Margaret Beliveau, M.D.</i>
12:30 p.m.	Lunch on your own
2:30 p.m.	Management of Non-CAD Heart Disease in Non-Cardiac Surgery 97 <i>Howard H. Weitz, M.D.</i> <ul style="list-style-type: none"> • How do I manage a patient with valvular heart disease perioperatively? • What issues need to be considered for a patient with heart failure preoperatively? • What are the issues with preoperative hypertension? • What are the preoperative issues for patients with chronic atrial fibrillation? • What perioperative issues need to be considered in a patient with hypertrophic cardiomyopathy? • What perioperative issues need to be considered in a patient with pulmonary hypertension? • What are the indications for a temporary pacemaker in the perioperative period? • How do I manage pacemakers and AICDs in the perioperative period?
3:30 p.m.	Clinical Short: Urinalysis Prior to Joint Replacement 117 <i>Stuart L. Gordon, M.D.</i> <ul style="list-style-type: none"> • Do we need to perform preoperative urinalysis on patients scheduled to undergo joint replacement surgery? What is the evidence?
3:45 p.m.	Preoperative Pulmonary Risk Stratification and Risk Reduction Strategies 119 <i>Margaret Beliveau, M.D.</i> <ul style="list-style-type: none"> • Which factors contribute to pulmonary risk in non-cardiac surgery? • How can I best estimate the risk of postoperative pulmonary complications—are there good risk calculators available?

- When is pulmonary testing recommended preoperatively?
- What measures can be employed to help minimize postoperative pulmonary complications in at-risk patients?
- What are the basic tests to consider when evaluating a patient for lung resection surgery?
- Which patients should be referred to a pulmonary specialist for preoperative evaluation?

4:30 p.m. Question and Answer Session
Howard H. Weitz, M.D., Stuart L. Gordon, M.D., and Margaret Beliveau, M.D.

4:45p.m. Complete Evaluation Forms / Adjourn

THURSDAY, OCTOBER 10, 2013

6:30 a.m. Continental Breakfast

7:55 a.m. Announcements

8:00 a.m. Managing Postoperative Cardiac Complications I and II 131
Howard H. Weitz, M.D.

- How do I manage hyper- and hypotension postoperatively?
- What are the precipitating factors for postoperative arrhythmias and conduction disorders and how do I manage them?
- Which surgeries and patients have high risk for postoperative atrial fibrillation? Are there ways to prevent postoperative atrial fibrillation? How do I manage postoperative atrial fibrillation?
- Which patients should have ECG and/or troponin surveillance for postoperative MI?
- How do I diagnose and manage postoperative myocardial ischemia and infarction?
- What special perioperative management is needed for patients with heart failure (systolic heart failure and heart failure with preserved ejection fraction)?

8:45 a.m. Management of Documented or Suspected Obstructive Sleep Apnea in Patients Undergoing Non-Cardiac Surgery 147
Eric J. Olson, M.D.

- What are the consequences of OSA in the perioperative period?
- What factors increase risk of postoperative complications in patients with OSA?
- How should patients be screened for OSA?
- Which patients at high risk need to be tested prior to surgery to decrease the risk of potential complications?
- Which patients at high risk can be treated as “presumed” OSA and proceed with surgery with additional precautions?
- Are there guidelines available to help guide management of patients with OSA in the perioperative period?
- What postoperative monitoring is recommended for patients with suspected or confirmed OSA?

9:30 a.m. Question and Answer Session
Howard H. Weitz, M.D. and Eric J. Olson, M.D.

9:45 a.m.	Refreshment Break	
10:00 a.m.	DVT/PE Prophylaxis in the Surgical Patient I: The ACCP Guidelines and the Internist's Perspective.....	157
	<i>Geno J. Merli, M.D.</i>	
	<ul style="list-style-type: none"> • What are the patient- and surgery-related risk factors for perioperative DVT? • What do the ACCP guidelines recommend for DVT prophylaxis in surgical patients? • When is extended DVT prophylaxis indicated? • How does renal function affect the management of DVT prophylaxis? • What is new in the 2012 ACCP Guidelines? • How do I use the Caprini Score and the Roger's Score to determine DVT risk in general and abdominal/ pelvic surgery? 	
10:45 a.m.	DVT/PE Prophylaxis in the Surgical Patient II: The AAOS Guidelines and the Orthopedist's Perspective.....	167
	<i>Stuart L. Gordon, M.D.</i>	
	<ul style="list-style-type: none"> • What concerns do orthopedists have about DVT prophylaxis as recommended by the AACCP? • What are the AAOS Guideline recommendations for DVT prophylaxis in orthopedic surgical patients? • When is extended DVT prophylaxis indicated and which agent is best? 	
11:15 a.m.	Perioperative Management of Antiplatelet Agents.....	173
	<i>Howard H. Weitz, M.D.</i>	
	<ul style="list-style-type: none"> • How do I manage patients with coronary artery disease who are taking antiplatelet agents during the surgical period? • How do I manage patients with cerebrovascular disease who are taking antiplatelet agents? • Do I manage aspirin therapy differently perioperatively based on whether it is taken for primary or secondary prevention? • How do I determine which patients need to have antiplatelet therapy stopped versus those who need to have antiplatelet therapy continued in the perioperative period? 	
11:45 p.m.	Clinical Short: How do I manage patients who are DNR/DNI who are going to surgery?	185
	<i>Molly A. Feely, M.D.</i>	
	<ul style="list-style-type: none"> • Do DNR orders need to be suspended prior to surgery? • If they are suspended, when should DNR orders be reinstated postoperatively? 	
12:00 p.m.	Question and Answer	
	<i>Geno J. Merli, M.D., Howard H. Weitz, M.D., Stuart L. Gordon, M.D., and Molly A. Feely, M.D.</i>	
12:15 p.m.	Lunch on your own	
2:00 p.m.	Perioperative Management of Anticoagulants: To Bridge or Not to Bridge	189
	<i>Paul R. Daniels, M.D.</i>	
	<ul style="list-style-type: none"> • Which patients with atrial fibrillation need bridging anticoagulation perioperatively? • Which patients with mechanical heart valves need bridging anticoagulation perioperatively? 	

- Can you recommend an approach to anticoagulation dosing and the timing of bridging?
- How and when should anticoagulation be restarted after surgery?

2:30 p.m. Perioperative Management of the New Oral Anticoagulants 199
Geno J. Merli, M.D.

- How long should I hold dabigatran, rivaroxaban or apixaban before surgery?
- When should the newer oral anticoagulants be restarted postoperatively?
- How do I manage prolonged DVT prophylaxis in patients who are also taking dabigatran, rivaroxaban or apixaban?
- How should we reverse these agents if major bleeding occurs?

3:00 p.m. Perioperative Management of the Patient with Liver Disease 211
William Sanchez, M.D.

- How do I approach preoperative risk assessment in a patient with liver disease?
- Which patients with liver disease may not be good candidates for elective surgery due to significant increase perioperative morbidity and mortality?
- What is the appropriate timing for transplant referral prior to surgery?
- What are the common postoperative management challenges for patients with advanced liver disease?

**3:30 p.m. Managing Patients with Neurologic Disease
in the Perioperative Period 219**
Andrea N. Leep Hunderfund, M.D.

- How do I manage patients with seizure disorder in the perioperative period?
- How do I manage patients with Parkinson’s Disease perioperatively?
- What do I do if I find an asymptomatic carotid bruit during a preoperative evaluation?
- How do I determine appropriate timing for elective surgery after ischemic stroke?
- What are the symptoms and risk factors for serotonin syndrome in the perioperative setting?

4:00 p.m. Clinical Short: Preoperative Evaluation in Cancer Patients 231
Molly A. Feely, M.D.

- What chemotherapies are cardiotoxic?
- What additional preoperative testing should be considered in the cancer patient?

4:15 p.m. Question and Answer Session
Paul R. Daniels, M.D., William Sanchez, M.D., Geno J. Merli, M.D., Andrea Leep Hunderfund, M.D., and Molly A. Feely, M.D.

4:30 p.m. Complete Evaluation Forms / Adjourn

FRIDAY, OCTOBER 11, 2013

6:30 a.m. Continental Breakfast

7:00 a.m. Meet the Professor Case Discussions: Informal Q & A with selected course faculty at breakfast

7:55 a.m.	Announcements	
8:00 a.m.	Understanding the Perioperative Stress Response/ Fluid Management	235
	<i>John B. Bundrick, M.D.</i>	
	<ul style="list-style-type: none"> • What is unique about fluid management perioperatively? • Which is better-- liberal or restrictive fluid management? • What is the physiologic effect of cytokine and catecholamine release in the perioperative period? 	
8:30 a.m.	Managing the Diabetic Patient in the Perioperative Period	243
	<i>James A. Fink, M.D.</i>	
	<ul style="list-style-type: none"> • Should I be screening for diabetes preoperatively in patients who are at risk? • When would I recommend postponing an elective surgical procedure because of poor diabetic control? • How should I manage patients on insulin therapy in the perioperative period? • How should I manage patients on oral hypoglycemics in the perioperative period? • How should I manage patients on insulin pumps in the perioperative period? • What is the optimal glycemic control in the postop setting? 	
9:15 a.m.	Perioperative Management of the Patient with Kidney Disease	253
	<i>Amy W. Williams, M.D.</i>	
	<ul style="list-style-type: none"> • What perioperative issues do I need to consider for a patient with advanced kidney disease? • How do I prevent acute kidney injury in the perioperative period? • Who is at risk for contrast nephropathy and how can it be prevented? 	
10:00 a.m.	Postoperative Delirium: Risk Factors, Diagnosis, and Management	265
	<i>Margaret Beliveau, M.D.</i>	
	<ul style="list-style-type: none"> • What are the risk factors of postoperative delirium? • How do I diagnose postoperative delirium? • What is the difference between hyperactive and hypoactive delirium? • Are there preventive measures that have been shown to decrease the risk of postoperative delirium? • What diagnostic workup is recommended for patients with suspected postoperative delirium? • How is delirium managed in the postoperative setting? 	
10:30 a.m.	Question and Answer Session	
	<i>John B. Bundrick, M.D., James A. Fink, M.D., Amy W. Williams, M.D., and Margaret Beliveau, M.D.</i>	
10:45 a.m.	Refreshment Break	
11:00 a.m.	Perioperative Management of Endocrine Issues: Stress Dose Steroids, Adrenal Insufficiency, Thyroid Disease	277
	<i>James A. Fink, M.D.</i>	
	<ul style="list-style-type: none"> • What issues do I need to consider in patients with hypothyroidism or hyperthyroidism in the perioperative period? • Who is at risk for adrenal insufficiency perioperatively? • How do I determine the need for and the dose of stress dose steroids in the surgical patient? 	

11:30 a.m.	Perioperative Considerations in the Patient with Rheumatologic Disease 285 <i>Brian F. Mandell, M.D.</i>
	<ul style="list-style-type: none"> • What special issues do I need to consider for patients with rheumatologic disease who are undergoing surgery? • How should I manage antirheumatic drugs and biologic agents perioperatively? • How do I diagnose and manage acute crystalline arthritis in the surgical patient?
12:00 p.m.	Perioperative Infectious Disease Issues 293 <i>Jennifer A. Whitaker, M.D.</i>
	<ul style="list-style-type: none"> • How do I approach the postoperative patient with fever? • Which patients need antibiotic prophylaxis perioperatively and for how long? • How are patients with penicillin allergy managed in the perioperative period? • How do I manage common postoperative infectious disease issues? • What special management do I need to consider for a patient on HIV drugs perioperatively?
12:30 p.m.	Question and Answer Session <i>James A. Fink, M.D., Brian F. Mandell, M.D., and Jennifer A. Whitaker, M.D.</i>
12:45 p.m.	Complete Evaluation Forms / Adjourn


SATURDAY, OCTOBER 12, 2013

6:30 a.m.	Continental Breakfast
7:00 a.m.	Meet the Professor Case Discussions: Informal Q & A with selected course faculty at breakfast
7:55 a.m.	Announcements
8:00 a.m.	Common Hematology Issues in the Perioperative Period 299 <i>Rajiv K. Pruthi, MBBS</i>
	<ul style="list-style-type: none"> • Which patients should have hemostasis assessment preoperatively? • Which transfusion strategy is best in the perioperative period—conservative or liberal? • What should trigger transfusion in the postop period? • When is FFP indicated preoperatively? • How do I diagnose and treat heparin induced thrombocytopenia in the perioperative period? • How do I manage patients with Von Willebrands disease perioperatively? • How do I manage patients with sickle cell disease perioperatively?
8:45 a.m.	Management of Postoperative Pulmonary Complications 311 <i>Richard A. Oeckler, M.D., PhD.</i>
	<ul style="list-style-type: none"> • What physiologic effects do anesthesia and surgery have on the respiratory system? • What are the most common postoperative pulmonary complications and how are they managed?

9:30 a.m.	Pain Management in the Perioperative Period 323 <i>Susan M. Moeschler, M.D.</i>
	<ul style="list-style-type: none"> • What are the commonly used opioids in the postoperative setting and what issues should I consider when prescribing these? • What are the common PCA doses for postoperative pain control? • How do I manage chronic pain patients who have uncontrolled postoperative pain? • When should I consider adjunctive analgesic therapies to help with pain control? • How should patients on multiple sedating medications postoperatively be monitored? • For patients with epidural or spinal anesthesia, how should anticoagulant DVT prophylaxis be managed?
10:15 a.m.	Management of Postoperative Gastrointestinal Complications 331 <i>Marianne T. Ritchie, M.D.</i>
	<ul style="list-style-type: none"> • How do I prevent and manage postoperative nausea and vomiting? • How should I evaluate a patient with postoperative diarrhea? • What agents are recommended to prevent stress related mucosal disease in the surgical patient? • How do I manage postoperative constipation and postoperative ileus?
10:45 a.m.	Question and Answer Session <i>Rajiv K. Pruthi, MBBS, Richard A. Oeckler, M.D., PhD., Susan M. Moeschler, M.D., and Marianne T. Ritchie, M.D.</i>
11:00 a.m.	Complete Evaluation Forms/Adjourn

MAYO CLINIC

An Overview of
Perioperative Medicine 2013:
Roles and Responsibilities of the
Consultant



Mayo School of Continuous Professional Development

Margaret M. Beliveau MD
Mayo Clinic, Rochester, MN

Disclosures

- Nothing to disclose

What is a Consultation?

- A request to another physician for an opinion regarding diagnosis or management.
- Physicians should obtain consultation whenever they believe that it would be medically indicated in the care of the patient or when requested by the patient or the patient's representative. (AMA Code of Ethics)
- Consultations are primarily for the patient's benefit.

Potential Roles of the Medical Consultant

- Pure consultant (outpatient and inpatient)
 - Recommendations made and communicated
 - Surgical team is primary and writes all orders
- Co-manager (inpatient)
 - Direct involvement of the consulting physician in implementing the management plan
 - Surgical team and medical consultant both manage and write orders

Surgical Co-management

- The practice of allotting specific responsibilities of patient care to designated caregivers (AMA Code of Ethics)

Ethical Principles- Surgical Co-management

- Co-management arrangements should ensure the highest quality care.
- Responsibilities should be delineated according to each physician's scope of expertise.
- A single physician should be ultimately responsible for ensuring that the care is delivered in a coordinated and appropriate manner.

Ethical Principles- Surgical Co-management

- The treating physicians are responsible for ensuring that the patient has consented not only to take part in the surgical co-management arrangement but also to the services that will be provided within the arrangement.
- Physicians should ensure that their surgical co-management arrangements do not violate the ethical or legal restrictions on self-referral.
- Referrals to another caregiver should be based only on that caregiver's skill and ability to meet the patient's needs and not on expected further referrals or other self-serving bases



What is NOT a "Useful" Preoperative Consultation?

- "Clearing" the patient for surgery
 - The decision to proceed with surgery is based on the information included in the consultation
- Indicating the type of anesthesia to be used
- Recommending intraoperative monitoring
- Qualitative advice ("Avoid hypotension and tachycardia")
- Don't tell the surgical and anesthesia teams what they already know!



What is in a "Useful" Preoperative Consultation?

- Information about the medical problems and how bad they are.
 - Severe COPD, oxygen dependent
- Preoperative tests that will help optimize the patient's medical condition
 - Known history of chronic kidney disease, check electrolytes and creatinine
- What can we do to prevent complications?
 - SBE prophylaxis should be given, because of prosthetic mitral valve



What is in a "Useful" Preoperative Consultation?

- Guidelines for managing *oral* drug regimens
 - Hold Lasix on the morning of surgery and restart POD#1
- Pertinent anticoagulation recommendations
 - Patient will require bridging anticoagulation because of recent DVT
- Details on coronary stents- when, where, type



What is in a "Useful" Preoperative Consultation

- Information on implanted devices
 - AICDs, pacemakers
- Recommendations about management of rare diseases, blood disorders, brittle diabetes
- Information/explanation when recommendations differ from guidelines

Lubasky D. Clev Clin Journal of Med. Suppl. 4. 2009. S32-36.



Be Systematic to Avoid Omitting Important Recommendations

- Cardiac risk
 - Many people stop here!
- Pulmonary risk
- DVT risk
- Delirium risk
- Perioperative medication management
- Other medical problems—perioperative recommendations



ACC/AHA Guidelines

- A critical role of the consultant is to determine the stability of the patient's cardiovascular status and whether the patient is in optimal medical condition, within the context of the surgical illness. The consultant may recommend changes in medication, suggest preoperative tests or procedures, or propose higher levels of postoperative care.

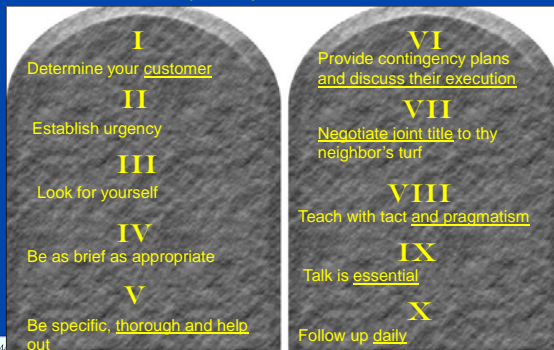


ACC/AHA Guidelines

- (the consultant should) provide a clinical risk profile that can be used in making treatment decisions...



Ten Commandment of Effective Consultation (2006)



Salerno, S. M. et al. Arch Intern Med 2007;167:271-275



V Be Specific, Thorough, and Willing to Help

- Express the perioperative plan concisely.
- Give specific instructions.
 - Don't write: Give beta-blocker
 - Instead: Begin Metoprolol 50mg po BID starting tonight. Titrate dose perioperatively to keep HR 55-65 as blood pressure tolerates.
- Avoid leaving a laundry list of suggestions.
 - The higher the number of recommendations, the less likely that all will be read
- Ask the requesting physician if they need help with writing orders



VI Provide Contingency Plans and Discuss Their Execution

- Patients are dynamic. Recommendations for this morning may not be applicable this afternoon.
- Provide "if, then" statements.
 - E.g. If the systolic BP is >150 after maximum beta blockade (HR 55-65), then consider adding clonidine 0.1mg po Q 12 hrs.
- Be available if your help is needed.



IX Talk is Cheap, Effective...and Essential

- There is no substitute for direct personal contact with the referring team.
- Recommendations are more likely to be followed if they are verbally communicated.
- Don't document that the surgery should be postponed or cancelled unless you have spoken with the surgeon first.



What would you do?

- You have been consulted for co-management of a patient on the orthopedic service. The patient is a 75 year old man , who has suffered a right hip fracture after a fall. The patient has a history of CAD. 2 months ago, he had an episode of severe chest pain with dyspnea, and was found to have a non-STEMI. He underwent cardiac catheterization, with **drug eluting stents** placed in his LAD and obtuse marginal. He is currently taking aspirin and clopidogrel.



What would you do?

- The surgeon insists that the antiplatelet agents be stopped before the surgery. You discuss the situation with the surgeon, and explain the risk of perioperative stent thrombosis if the antiplatelet agents are discontinued. You provide the surgeon with a paper outlining the high mortality associated with stent thrombosis. (**Teach with tact**)
- The surgeon thanks you for your input and discontinues the antiplatelet agents.



What would you do?

1. Immediately sign off the case.
2. Write an order restarting the antiplatelet agents, since you have been asked to co-manage
3. Document your recommendations and agree to disagree with the surgeon
4. Call the legal department and see if you can have the surgeon removed from the case
5. Transfer the patient to your service



What would you do?

- The patient is admitted at 11PM and is scheduled for surgery as the 3rd case the next day. You see the patient on rounds in the morning. He is quite concerned that he has not been given his aspirin and clopidogrel, as he paid close attention when he was told that these should not be stopped for at least 1 year.



What would you do?

1. Avoid answering the question and have the patient discuss this with the surgeon.
2. Tell the patient that you recommended that these medications be continued, but that the surgeon stopped them. Explain the high risk to him.
3. Tell the patient that you will immediately restart these medications, and write the order without telling the surgeon.
4. Obtain a cardiology consult to “break the tie”.
5. Have a joint discussion with the patient and the surgeon



AMA Ethical Principles- Role of the Consultant

- One physician should be in charge, and the attending physician has overall responsibility for the patient's care.
- The consultant should not assume primary care of the patient without consent of the referring physician.
- The consultation should be done in a timely manner. (**Most hospitals have guidelines for this: ASAP for urgent, 24 hours for routine**)



AMA Ethical Principles- Role of the Consultant

- Discussions during the consultation should be with the referring physician and only with the patient by prior consent of the referring physician.
- Conflicts of opinion should be resolved by a second consultation or withdrawal of the consultant. However, the consultant has the right to give his or her opinion to the patient **in the presence of the referring physician.**



Remember...

- The decision to proceed with a surgical procedure is ultimately between the patient, the surgeon and the anesthesiologist. The role of the consultant is to outline the risks and assist with minimizing the risk.



References

- *Ten Commandments for Effective Consultations.* Goldman L, et al. Arch Intern Med. 1983; 143: 1753-5
- *Principles of Effective Consultation: An Update for the 21st-Century Consultant.* Salerno SM, et al. Arch Intern Med. 2007; 167:271-5
- *Role of the Medical Consultant.* Merli GJ and Weitz HH. Clin in Chest Med. 1993; 14 (2): 205-10.



References

- *Principles of Effective Consultation: An Update for the 21st Century Clinician.* Salerno S. Arch Int Med. 167: 271-275.
- *Giving anesthesiologists what they want: How to write a useful preoperative consult.* Cleveland Clinic Journal of Medicine. 76: S32-S36.




Thank You!

- Beliveauficalora.margaret@mayo.edu



MAYO CLINIC

An Overview of
Perioperative Medicine 2013:
 From Outpatient Preoperative Assessment
 to Inpatient Postoperative Care



Mayo School of Continuous Professional Development

David R. Danielson, M.D.
 Mayo Clinic Department of Anesthesiology,
 October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

**Anesthesia 101 for the
 Non-Anesthesiologist**

October 9, 2013

David R. Danielson, M.D.
 Department of
 Anesthesiology
 Director, Pre-Operative
 Evaluation
 Mayo Clinic

Anesthesia 101 for the Non-Anesthesiologist


- DISCLAIMERS
 - 1. No money from anyone.
 - 2. I have biases; they are obvious.
 - 3. I may mention brand names. They are not endorsements, merely examples.
 - 4. I may mention off-label use. You're smart enough to beware.

Anesthesia 101 for the Non-Anesthesiologist

- Objectives: To Discover
 - What's happened in the OR since you rotated there in medical school.
 - The physiologic changes that occur with the modern anesthesia drugs.
 - Why anesthesiologists are so interested in systems and patient flow.
 - A few pre-op pearls about odd things.


Anesthesia 101 for the Non-Anesthesiologist

- Let's start with propofol.
- "The Michael Jackson drug."
- Pentothal is no longer manufactured!



Anesthesia 101 for the Non-Anesthesiologist

- Propofol -
- Why are we (in anesthesia) so possessive?
- A dose large enough to be effective may produce **APNEA**



Anesthesia 101 for the Non-Anesthesiologist

- Alternatives for induction:
 - Inhalation
 - Sevoflurane
 - Ketamine
 - Etomidate



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Anesthesia 101 for the Non-Anesthesiologist

- Next is airway.
 - Face mask
 - LMA
 - No paralysis



Glidescope



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Anesthesia 101 for the Non-Anesthesiologist

- Definitive airway.
 - Trach
 - ETT
- VIDEO Laryngoscopy



Glidescope



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Anesthesia 101 for the Non-Anesthesiologist

- Why VIDEO Laryngoscopy?
 - Neck stays neutral
 - Less trauma
 - Teeth
 - Lips
 - Tongue
 - Easier!
 - Teaching



Glidescope



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Anesthesia 101 for the Non-Anesthesiologist

- Because of VIDEO Laryngoscopy and other advanced techniques --
 - Do **NOT** need consults ahead of operative day solely for airway issues



Glidescope Olympus Bronchoscope



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Anesthesia 101 for the Non-Anesthesiologist

- But wait – that's not all!
 - Do **not** need flexion/extension films for
 - Down's
 - RA
 - s/p trauma



Glidescope Olympus Bronchoscope



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Anesthesia 101 for the Non-Anesthesiologist

- Maintenance
 - IV (TIVA)
 - Narcotics (bolus or drip)
 - Propofol drip
 - Etc.
 - Inhaled
 - Desflurane
 - Sevoflurane
 - Isoflurane



Anesthesia 101 for the Non-Anesthesiologist

- What do these drugs do?
 - Narcotics (bolus or drip)
 - Lower BP & pulse, analgesia
 - Propofol drip
 - Lower BP (NO analgesia)
 - Benzos
 - Lower BP, wipe short-term memory
 - Ketamine
 - Bronchodilator, analgesia, hallucinations



Anesthesia 101 for the Non-Anesthesiologist

- What do these drugs do?
 - Desflurane, Sevoflurane, Isoflurane
 - ↓ SVR → lowers BP
 - Bronchodilators
 - Analgesia
 - Amnesia



Anesthesia 101 for the Non-Anesthesiologist

- What do I do about these drugs?
 - They all can cause ↓ BP!!
 - Wait for "Surgipress"
 - Give α agonist (phenylephrine)
 - Give Volume
 - Trendelenburg position
 - Have patient hold ACEI pre-op



Anesthesia 101 for the Non-Anesthesiologist

- What can you do about these drugs?
 - They all can cause ↓ BP!!
 - Wait for "Surgipress"
 - Give α agonist (phenylephrine)
 - Give Volume
 - Trendelenburg position
 - Have patient hold ACEI pre-op



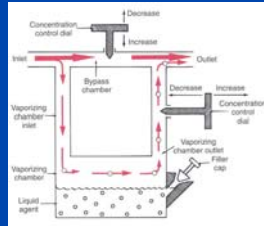
Anesthesia 101 for the Non-Anesthesiologist

- What happens upon emergence?
 - Stimulation
 - Tachycardia
 - Hypertension (What about that skipped ACEI pill?)
 - Need to balance analgesia with respiratory drive
 - Respiratory aids – **CPAP machine**



Anesthesia 101 for the Non-Anesthesiologist

- Machine is different.
- All electronic
- No flowmeter knobs
- No vaporizer dials



Anesthesia 101 for the Non-Anesthesiologist

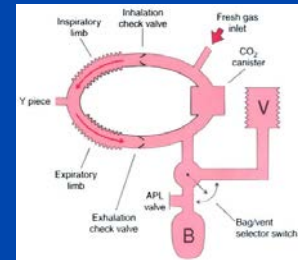


Anesthesia 101 for the Non-Anesthesiologist



Anesthesia 101 for the Non-Anesthesiologist

- What's the same?
- Breathing circuit
- CO2 absorber
- Ventilator bellows



Anesthesia 101 for the Non-Anesthesiologist

- What about monitors?
- ECG
- Pulse ox
- BP
- Invasive lines




Anesthesia 101 for the Non-Anesthesiologist

- What about brain monitors?
- EEG
- Processed EEG
- Do they work?



Anesthesia 101 for the Non-Anesthesiologist


- What about BIS?
 - Aspect Medical Systems , now Covidien
- EEG processed via a proprietary formula
 - From frontal lead only
 - Dimensionless #



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Anesthesia 101 for the Non-Anesthesiologist

- BIS Monitor
- Now 3 studies
 - Prospective
 - Non-industry funded
 - Well-designed
- No different from ETAG
 - References at end




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Anesthesia 101 for the Non-Anesthesiologist

What about regional anesthesia?


IS IT SAFER TO HAVE A SPINAL?



MAYO CLINIC

Anesthesia 101 for the Non-Anesthesiologist

Spinal and epidural anesthesia have fewer side effects and risks than **general anesthesia** (asleep and pain-free). Patients usually recover much faster and can go home sooner.



Medline Plus update 2011


MAYO CLINIC

Anesthesia 101 for the Non-Anesthesiologist

Is this true? (side effects)

Not if one uses modern drugs/techniques.

- Fast on/Fast off
- More TIVA
- Multi-modal analgesia
- Desflurane helps



MAYO CLINIC

Anesthesia 101 for the Non-Anesthesiologist

Is Spinal/Epidural safer than General?

- Death, stroke, MI = NO
- DVT/PE, especially total joints = YES

BUT strongest data pre-dates aggressive prophylaxis

MAYO CLINIC

Anesthesia 101 for the Non-Anesthesiologist

What about side effects?

- GA
 - PONV
 - Delirium – esp. elderly
- SAB/Epi
 - Spinal headache – esp. young
 - Hearing things



Anesthesia 101 for the Non-Anesthesiologist

What does Spinal/Epidural do?

- Dose dependent sensory block/motor
- Sympathetic blockade!!!
 - Fore-warned is fore-armed
- Nothing to the airway



Anesthesia 101 for the Non-Anesthesiologist

How to choose?

It depends. . .

- Operation
- Co-morbidities
- Patient position
- Coagulation status



Anesthesia 101 for the Non-Anesthesiologist

When to choose?

The morning of operation

So – helpful to introduce both possibilities in selected cases



Anesthesia 101 for the Non-Anesthesiologist

Can my patient have a spinal if s/he is on aspirin?

YES

- Horlocker TT, Wedel DJ, et al
Anesth Analg. 1995;80(2):303.



Anesthesia 101 for the Non-Anesthesiologist

Can my patient have a spinal if s/he is on clopidogrel or. . . ?

See ASRA guidelines

Regional Anesthesia in the Patient Receiving Antithrombotic or Thrombolytic Therapy: American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines (Third Edition)

Regional Anesthesia and Pain Medicine: January/February 2010 - Volume 35 - Issue 1 - pp 64-101



Anesthesia 101 for the Non-Anesthesiologist

What about all those other blocks?

Very effective for the right operation

Ultrasound has boosted success rates!!!



APSF Newsletter 2011

Anesthesia 101 for the Non-Anesthesiologist

- The 3 O's
 - Operating Room Suite
 - "Outfield"
 - Office-based



APSF Newsletter 2011

Anesthesia 101 for the Non-Anesthesiologist

- Where is the "Outfield?"
 - GI Suite
 - Cardiac lab
 - Emergency room
 - Radiology (MRI suite)



APSF Newsletter 2011

Anesthesia 101 for the Non-Anesthesiologist

- Is the Outfield more dangerous than the Operating Room??
 - Yes and No
- Look at ASA Closed Claims database



APSF Newsletter 2011

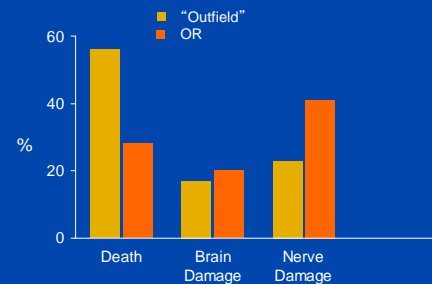
Anesthesia 101 for the Non-Anesthesiologist

- Look at ASA Closed Claims database
 - Closed Malpractice Cases
 - Mined for information, trends
- Generates safety advice for the specialty



APSF Newsletter 2011

Anesthesia Risk in Remote Locations From ASA Closed Claims Data Base



Adapted from APSF Newsletter, 2011

Anesthesia 101 for the Non-Anesthesiologist

- “Outfield” dangers
 - Older (20% ≥ 70)
 - Sicker (69% ASA 3-5)
 - Emergent (36%)
 - Pt. expects “Totally asleep”



APSF Newsletter 2011

Anesthesia 101 for the Non-Anesthesiologist

- “Outfield” Pearls from Closed Claims
 - O2 sat ≠ ventilation!!!!
 - O2 delivery may delay recognition
 - GETA may be safer than MAC!!!!



Adapted from APSF Newsletter 2011

Anesthesia 101 for the Non-Anesthesiologist

- Remember the learning goal about systems and patient flow?
- Death in the GI Suite may only occur once in your career, or my career.
- Multiply by how many GI docs or anesthesiologist at your hospital
- ↑Safety from system change; not individual practice change



Adapted from APSF Newsletter 2011

“Outfield” (and Office) Anesthesia

- What are the needs for ??
 - anesthesia equipment
 - safety equipment
 - pre-anesthesia assessment
 - MH drugs (dantrolene, mannitol)
 - resuscitation capabilities
 - etc., etc.

• **EXACTLY THE SAME**



Who can't be an outpatient?



- Very young
- Very old
- Severe pre-existing disease
- High ASA physical status



Who can't be an outpatient at the U of Chicago? (Historic list)

- Unstable ASA 3 or 4
- MH
- On MAOI
- Morbid Obesity (What BMI?)
- Acute substance abuse
- Psychosocial difficulties



Who can't be an outpatient?

- Unstable ASA 3 or 4
- MH
- On MAOI
- Morbid Obesity (What BMI?)
- Acute substance abuse
- Psychosocial difficulties
- It's NOT doing the case!!!
- It's that we do NOT have Level 1 Recovery facility and extra personnel



Addendum

- Remind your outpatients
 - Bring someone along
 - Leave valuables at home
 - Forget driving for 24 hrs.



What keeps outpatients in hospital?

- Pain
- Nausea and vomiting
- Wound problems
- Change in surgical plan



What keeps outpatients in hospital?

- Pain
- Nausea and vomiting
- Wound problems
- Change in surgical plan



What keeps outpatients in hospital?

- Pain
- Nausea and vomiting
- Wound problems
- Change in surgical plan
- Triple Whammy
 - Ondansetron
 - Steroid
 - Droperidol
- Scopolamine patch




Gadgets, Gizmos, Etc.

- 37 y/o female for lap chole
- No meds
- Never had anesthesia



Gadgets, Gizmos, Etc.

- What is this?
- Sea Band
- P6 Acupuncture site
- Hx of motion sickness
 - Boat
 - Plane
 - Car



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Gadgets, Gizmos, Etc.


P6 Accupressure

100 ASA I & II for laparoscopic operations

P6 accupressure band

vs.

Sham = band without the bead



White et al, Anesth Analg 2012; 115:31-37

MAYO CLINIC

Gadgets, Gizmos, Etc.


P6 Accupressure

PON→V @ 24 hrs

10% vs. 26% (Sham)

Pt. satisfaction

84% vs. 66% (Sham)



White et al, Anesth Analg 2012; 115:31-37

MAYO CLINIC

Gadgets, Gizmos, Etc.


P6 Accupressure

NO difference in

Hospital discharge

Time to normal activities

Return to work




White et al, Anesth Analg 2012; 115:31-37

MAYO CLINIC

Gadgets, Gizmos, Etc.

What to do?

1. Keep it in place
2. Double the droperidol dose
3. Acupuncture consult post-op
4. Take it off



MAYO CLINIC

Gadgets, Gizmos, Etc.

What to do?

1. Keep it in place
2. Double the droperidol dose
3. Acupuncture consult post-op
4. Take it off

MAYO CLINIC

NPO Rules

- This is current rule (1999 ASA)
- 2 – 4 – 6 – 8
 - 8 hours “heavy” meal
 - 6 hours “light” meal
 - 4 hours breast milk
 - 2 hours clear liquids

Anesth 90:896-905; 1999



NPO Rules

- Clear Liquids 2 hrs ahead
 - Water
 - Juice (no pulp)
 - Coffee (no lightener)
 - Jello, popsicle, soda.



NPO Rules

- What about these??
- Newer sports drinks on the market
 - Carbohydrates
 - Proteins
 - Caffeine



Sports Drinks

- Gatorade Prime 01 contains 25 grams of carbohydrates (100 calories), 110 mg sodium, 35 mg potassium, and 10% Daily Value of the B vitamins.

<http://www.gatorade.com/>



Sports Drinks

Gatorade Perform 02 contains water, 14 grams of carbohydrates, 110 mg sodium, 30 mg potassium, and coloring.

<http://www.gatorade.com/>



Sports Drinks

A 16.9-oz. bottle of Gatorade Recover 03 contains 16 g of [whey] protein to help promote muscle recovery, as well as 14 g of carbohydrate (130 calories), 250 mg of sodium, and 95 mg of potassium.

<http://www.gatorade.com/default.aspx?product?=recover>



What about booze?



- Not the morning of surgery!
- Night before OK (in moderation)
- Less problem than a sleeping pill

Gadgets, Gizmos, Etc.

- What is this?
- E-cigarette
- Electronic cigarette
- Vapor cigarette
- E-cig



Gadgets, Gizmos, Etc.

- What does it do?
- Vaporizes . . .
 - Propylene glycol
 - Glycerine
 - Polyethylene glycol
- . . . into a mist



Gadgets, Gizmos, Etc.

- What does the mist contain in addition to the diluent?
 1. Flavors, Nicotine
 2. Flavors
 3. Nicotine
 4. Who knows?



Gadgets, Gizmos, Etc.

- What does the mist contain in addition to the diluent?
 1. Flavors, Nicotine
 2. Flavors
 3. Nicotine
 4. Who knows?

Gadgets, Gizmos, Etc.

- How does it work?
- The battery and micro-circuitry produce heat
- The heat atomizes the liquid from the cartridge
- The mist is inhaled (and the end glows)



Gadgets, Gizmos, Etc.

- Is it safe?
- Sort of . . .
- Safer than smoking
- Dangerous if it gets you to start
- Varying doses of nicotine
- (Think nicotine gum)



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Gadgets, Gizmos, Etc.

- Is it legal?
- Sort of . . .
- FDA must regulate it like tobacco, not like a drug.
- States are lining up to ban sales to minors.



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Gadgets, Gizmos, Etc.

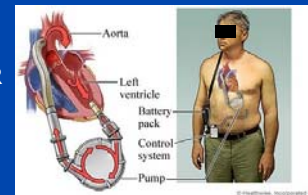
- What do I tell my patient?
- Stop it at midnight before surgery
- Quit all tobacco products



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Gadgets, Gizmos, Etc.

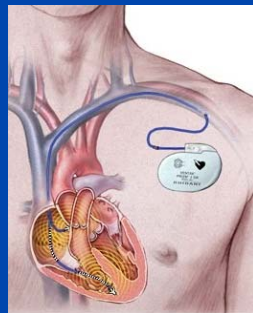
- LVAD
- Always comes to OR with technician



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Gadgets, Gizmos, Etc.

- Pacemaker (CIED)
- What does it do?
 - Speeds up things
 - Runs on battery
 - Programmable

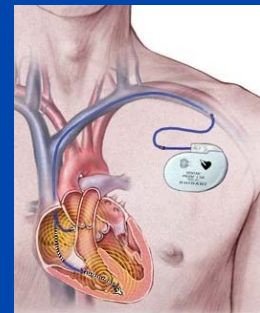


Anesth 114:247-61;2011

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Gadgets, Gizmos, Etc.

- Pacemaker (CIED)
- What needs documentation pre-op? (Within 6 months)
 - Settings
 - Battery level
 - Dependency?
 - Magnet effect



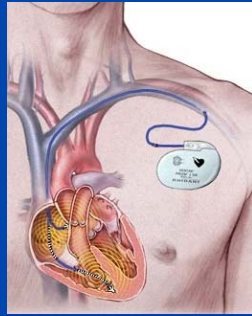
Anesth 114:247-61;2011

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Gadgets, Gizmos, Etc.

Doesn't have to be on the day of operation!

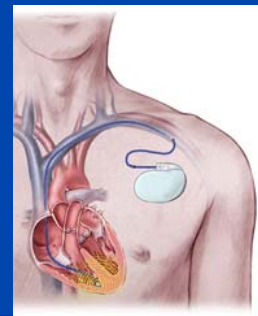
- Battery level
- Dependency?
- Magnet effect



Anesth 114:247-61;2011

Gadgets, Gizmos, Etc.

- ICD (CIED)
- What does it do?
 - Senses bad rhythms
 - Stops bad rhythms
- Always accompanied by a pacemaker
- So, what does the magnet do?



Gadgets, Gizmos, Etc.

- ICD (CIED)
- The magnet
 1. Turns off the shock mode; sets pacer to VOO of 60 beats/min
 2. Turns off the shock mode; leaves pacer "as is"
 3. Turns off the shock mode; turns off the pacer



Gadgets, Gizmos, Etc.

- ICD (CIED)
- The magnet
 1. Turns off the shock mode; sets pacer to VOO of 60 beats/min
 2. Turns off the shock mode; leaves pacer "as is"
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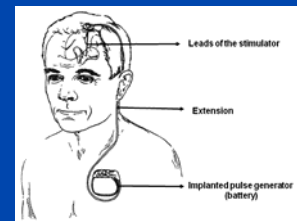
Gadgets, Gizmos, Etc.

- Circular magnet
- For Pacer
 - Sets to VOO or DOO
- For ICD
 - Turns off shock mode
 - Leaves pacer as is



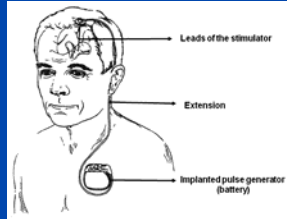
Gadgets, Gizmos, Etc.

- What is it?
- Deep Brain Stimulator
- Generator in chest
- Battery pack
- Leads into the brain



Gadgets, Gizmos, Etc.

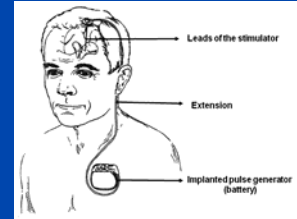
- What does it do?
- Decreases movement
 - Parkinson's
 - Familial tremor
 - Dystonias
- New uses
 - Epilepsy
 - Depression
 - Etc.



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Gadgets, Gizmos, Etc.

- What do we need to do?
- 1. Electrically shield it
- 2. Turn it off
- 3. Call Neurosurgeon
- 4. Let someone else do the case
- 5. Ignore it



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Gadgets, Gizmos, Etc.

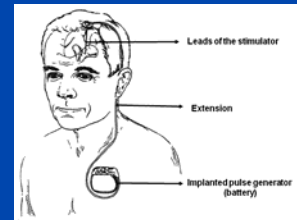
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Gadgets, Gizmos, Etc.

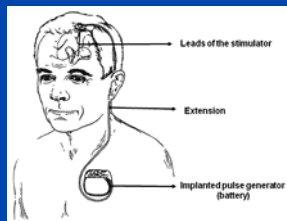
- Can think of it like a PM
- Bi-polar cautery = OK
- Any cautery below the umbilicus = OK
- Head, neck, chest case = turn it off



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Gadgets, Gizmos, Etc.

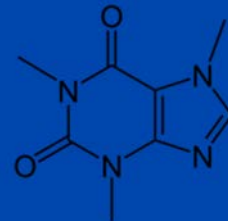
- What else?
- If Parkinson's patient – take all meds up to the last minute!



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Gadgets, Gizmos, Etc.

- Recent media attention
- The issue is **caffeine** toxicity
- How much is too much?
- Can it be fatal?



Gadgets, Gizmos, Etc.

- 14 y/o Maryland female died December, 2011 after drinking poorly specified amount of Monster Energy drink
- Mother is bringing suit because coroner's report implicates "cardiac arrhythmia due to caffeine toxicity" which exacerbated an existing heart problem.

The New York Times
October 22, 2012

Monster Energy Drink Cited in Deaths

MAYO CLINIC

Gadgets, Gizmos, Etc.

- The teenager also is stated to have had Ehlers-Danlos syndrome
- Amount of Monster Energy?
 - 24 ounce can
 - 240 mg caffeine
 - = 10 mg/oz.
 - Stated to have had 2 cans over 2 days

The New York Times
October 22, 2012

Monster Energy Drink Cited in Deaths

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- Unknown from the article
 - Vascular type of E-D?
 - EtOH or other drugs?
 - Time frame between the 2nd can of Energy and the cardiac event
- How to interpret this when patients ask about it?

The New York Times
October 22, 2012

Monster Energy Drink Cited in Deaths

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Energy Drinks


- TAURINE
- GLUCURONOLACTONE
- CAFFEINE (80 mg)
- B-GROUP VITAMINS
- SUCROSE
- GLUCOSE



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What about Pepsi?


- A can of Pepsi (12 fl ounces) has
 - 41 grams of carbohydrates
 - 30 mg of sodium
 - 38 mg of caffeine and
 - 150 calories



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Energy Drinks

- Drip Coffee (8 oz.)
- CAFFEINE (80- 120 mg)
- What about larger servings?

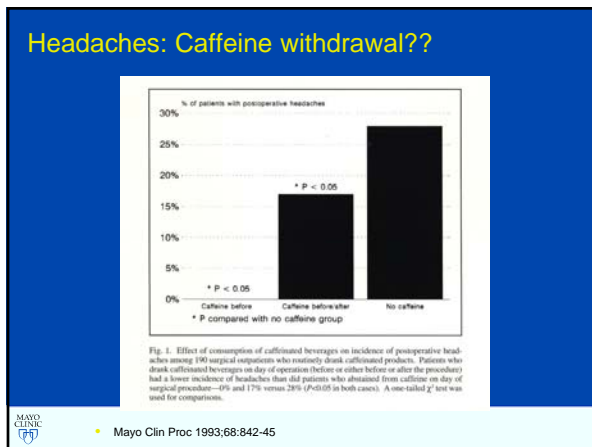


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Energy Drinks

- What to tell patients?
- Don't worry, be caffeinated.



Gadgets, Gizmos, Etc.

- What is this guy doing?
- 1. Vaping an e-cig
- 2. Applying lip gloss
- 3. Huffing crazy glue
- 4. Inhaling caffeine

Gadgets, Gizmos, Etc.

- What is this guy doing?
- 1. Vaping an e-cig
- 2. Applying lip gloss
- 3. Huffing crazy glue
- 4. Inhaling caffeine

Gadgets, Gizmos, Etc.

A new fad – inhaled caffeine

Is it really inhaled???

100mg OF CAFFEINE.

THE SAME AS ONE LARGE CUP OF COFFEE.

Each AeroShot contains 100 mg of caffeine—the same as one large cup of coffee. You are putting in a fine powder that falls out of the air and dissolves directly in your mouth. It's safe, healthy, and unlike most energy drinks, there are no calories.

Shoots a fine powder into the mouth, then one swallows it.

Gadgets, Gizmos, Etc.

- FDA warning March, 2012
 - Marketing at students (minors)
 - Not really inhaled



Gadgets, Gizmos, Etc.

- “Air-based Energy Shot”
- \$2.99 Online price (Accessed August, 2013)



Gadgets, Gizmos, Etc.

“Inhaled” caffeine

What if my patient does this in the pre-op waiting area?

1. Cancel the case
2. Postpone the case 2 hours
3. Go ahead
4. Check ECG; then go ahead.



Gadgets, Gizmos, Etc.

“Inhaled” caffeine

What if my patient does this in the pre-op waiting area?

1. Cancel the case
2. Postpone the case 2 hours
3. Go ahead
4. Check ECG; then go ahead.



Anesthesia 101 for the Non-Anesthesiologist

Big question from patients. . .

- What about risks?
 - Overall risk of death from GA
 - Is it safer than riding home in my car?
- 1980 risk ~ 1/5000
- 2000 risk ~ 1/20,000
- 2004 risk (annual) MVA death ~ 1/19,000
 - Annualized risk vs. single events



Multiple sources, including JAMA, NSC data, and several anesthesia textbooks

- Questions?
- Want to start an e-mail conversation?

- danielson.david@mayo.edu



Anesthesia 101 for the Non-Anesthesiologist

- The next three slides are the references for BIS Monitor vs. the measurement of ETAG = End-Tidal Anesthesia Gas concentrations.
- All three studies showed ETAG to be equal or better at predicting recall.
- These three studies were NOT industry funded.



Anesthesia 101 for the Non-Anesthesiologist

The NEW ENGLAND JOURNAL of MEDICINE

established in 1812 march 13, 2008 vol. 358 no. 11

Anesthesia Awareness and the Bispectral Index

Michael S. Avidan, M.B., B.Ch., Lini Zhang, M.D., Beth A. Burnside, B.A., Kevin J. Finkel, M.D., Adam C. Searleman, B.S., Jacqueline A. Selvidge, B.S., Leif Saager, M.D., Michelle S. Turner, B.S., Srikar Rao, B.A., Michael Bottros, M.D., Charles Hantler, M.D., Eric Jacobsohn, M.B., Ch.B., and Alex S. Evers, M.D.



Anesthesia 101 for the Non-Anesthesiologist

The NEW ENGLAND JOURNAL of MEDICINE

established in 1812 august 18, 2011 vol. 365 no. 7

Prevention of Intraoperative Awareness in a High-Risk Surgical Population

- Michael S. Avidan, M.B., B.Ch., Eric Jacobsohn, M.B., Ch.B., David Glick, M.D., M.B.A., Beth A. Burnside, B.A., Lini Zhang, M.D., Alex Villafranca, M.S., Leah Karl, B.A., Saima Kamal, M.D., Brian Torres, B.S.N., Michael O' Connor, M.D., Alex S. Evers, M.D., Stephen Gradwohl, B.S., Nan Lin, Ph.D., Ben J. Palanca, M.D., Ph.D and George A. Mashour, M.D., Ph.D., for the BAG-RECALL Research Group.*



Anesthesia 101 for the Non-Anesthesiologist

Next Round = Unselected patients

3 hospitals at U of Michigan

18,000 pts. BIS vs. ETAG

Same results → ETAG ≈ BIS

Mashour *et al*, *Anesth* 2012; 117:717-25



Anesthesia 101 for the Non-Anesthesiologist Don't forget about **MULTIPLE end-users** . . .

- Why might your pre-op consult need to be multi-faceted?
- Multiple end-users may need different info!
 - The surgeon pre-op (changes in meds)
 - ME (Pre-op, Intra-op, and Recovery Room)
 - The surgeon post-op (continuing care of medical issues)
 - The Hospitalist (unique circumstances of this patient)



Pre-op (NPO) Instructions

- Aspiration risk
 - 67:215,488 = **1:3,216**
 - Vent ≥ 6 hrs = **1:16,576**
 - 3 died = **1:71,829**
- Warner, Warner, Weber. *Anesth* 1993;78:56-62



Pre-op (NPO) Instructions

- MI risk
 - Non-cardiac surgery
 - Within 30 days
 - 0.3% = 1:334
- Cardiac arrest (OR & PACU)
 - 1:2,324
- Sprung et al. Anesth 2003; 99:259-69



Pre-op (NPO) Instructions

- Cardiac arrest (OR & PACU)
 - 1:2,324
- Hospital survival \leq 50%
 - Death is ~1:5,000
- Sprung et al. Anesth 2003; 99:259-69




Pre-op (NPO) Instructions

- So, Which is riskier?
 - Liberal NPO rules, OR
 - Missing cardiac drugs
 - Beta Blocker
 - Statin
 - Rhythm drug



MAYO CLINIC

**Cardiac Risk Assessment:
Using Guidelines to Direct Practice and
Choosing the Appropriate Stress Test**



Mayo School of Continuous Professional Development

Karen F. Mauck, MD, MSc, FACP
Assistant Professor of Medicine
Consultant, Division of General Internal Medicine, Mayo Clinic, Rochester, MN
October 9-12 • Seattle Washington

Important Disclosures

- No industry conflict of interest
- I will not advocate the off-label use of FDA approved drugs

Clinical Questions

- How do I use the ACC/AHA guidelines for preoperative cardiac risk assessment?
- How do I use the Gupta cardiac risk calculator?
- How do I decide which stress test to order?

Purpose of Preoperative Cardiac Evaluation

- **Evaluate/assess/quantify** cardiac risk for both patient and surgeon
- **Optimize** appropriateness of testing and intervention
- **Direct** perioperative care in order to decrease cardiac risk

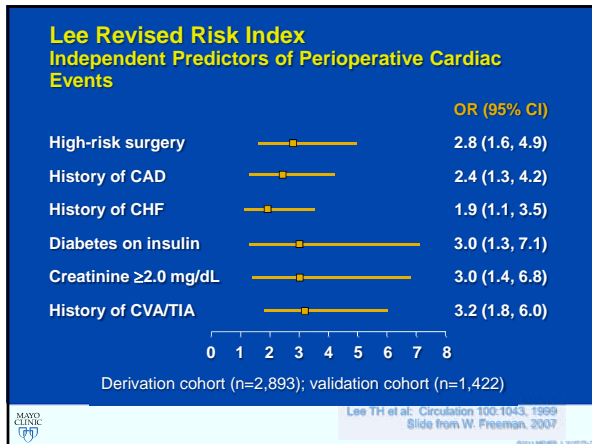
What Do We Need to Know for Cardiac Risk Assessment?

- **Patient specific risk**
 - Clinical risk factors for CAD
 - Functional capacity
- **Surgery specific risk**
 - Type or duration of surgery

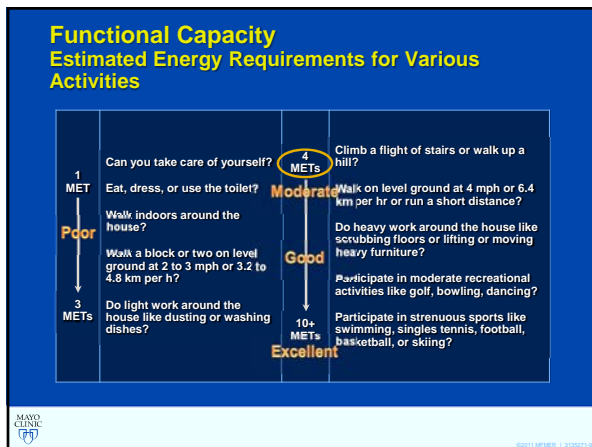
Clinical Risk Factors (RCRI*)

- History of ischemic heart disease
- History of compensated or prior HF
- History of cerebrovascular disease
- Diabetes
- Renal insufficiency

*Lee et al. Circulation 100:1043, 1999



- ### What Do We Need to Know for Cardiac Risk Assessment?
- **Patient specific risk**
 - Clinical risk factors for CAD
 - Functional capacity
 - **Surgery specific risk**
 - Type or duration of surgery



- ### What Do We Need to Know for Cardiac Risk Assessment?
- **Patient specific risk**
 - Clinical risk factors for CAD
 - Functional capacity
 - **Surgery specific risk**
 - Type or duration of surgery

Surgical Risk Cardiac Risk* Stratification for Noncardiac Procedures

High >5%	Emergent major operations, particularly in elderly Aortic and major vascular surgery Peripheral vascular surgery Prolonged surgery, large fluid shifts or blood loss
Intermediate >1%, <5%	Carotid endarterectomy Head and neck surgery Intraperitoneal or intrathoracic surgery Orthopedic surgery Prostate surgery
Low <1%	Endoscopic procedures Superficial procedures Cataract surgery Breast surgery

*Combined incidence of cardiac death and nonfatal MI

- ### Putting It All Together Using a Stepwise Approach
- ACC/AHA Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery – 2007

Overriding Theme

- Surgical or percutaneous intervention is **rarely necessary** simply to lower the risk of surgery unless the intervention is indicated irrespective of the preoperative context
- The patient is not “cleared for surgery” rather, **“the patient is medically optimized from a cardiac standpoint and does not require additional testing prior to planned surgical procedure”**



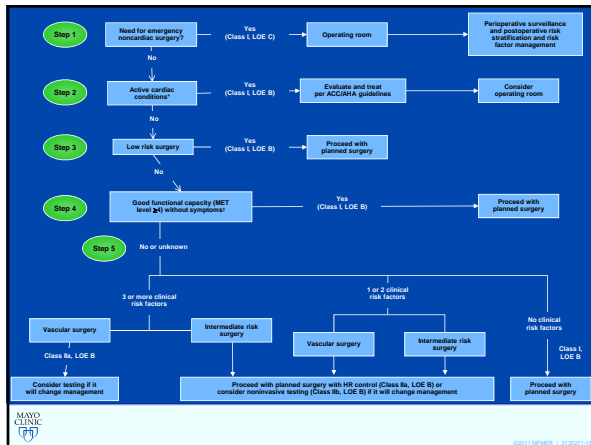
*Lee et al. Circulation 100:1043, 1999

Overriding Theme

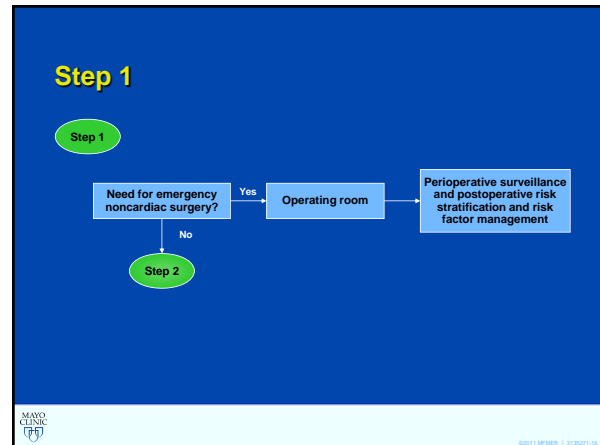
- **No testing should be performed unless it is likely to influence patient treatment**
- **The ultimate decision regarding care of a particular patient must be made by the physician and patient in light of all the specific clinical circumstances**



*Lee et al. Circulation 100:1043, 1999

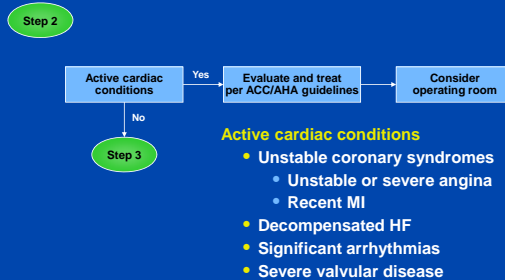


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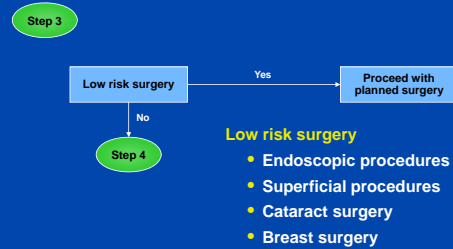
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Step 2

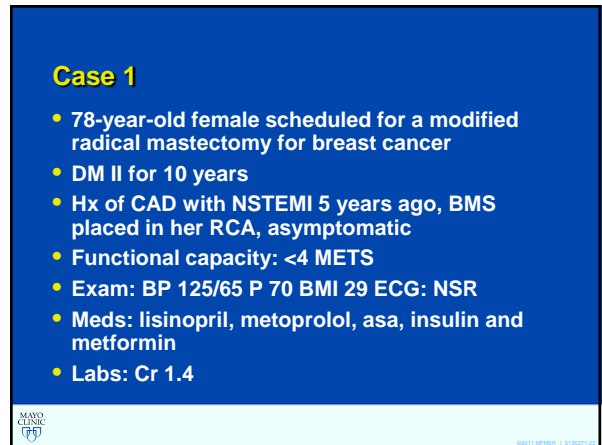
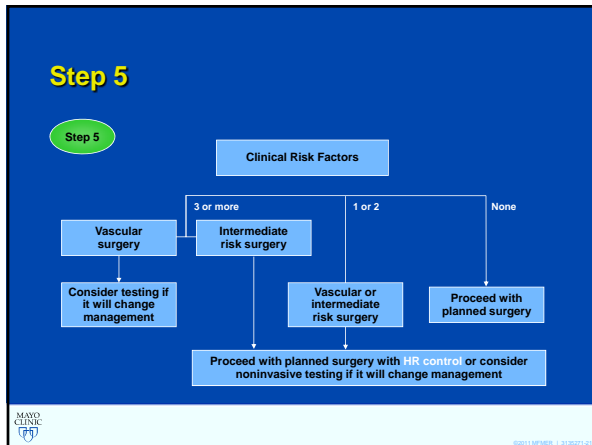
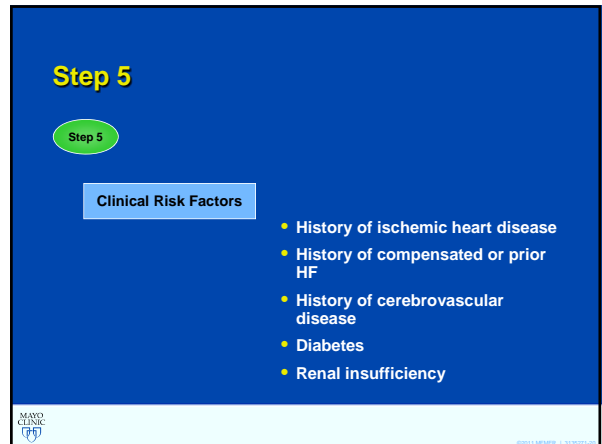
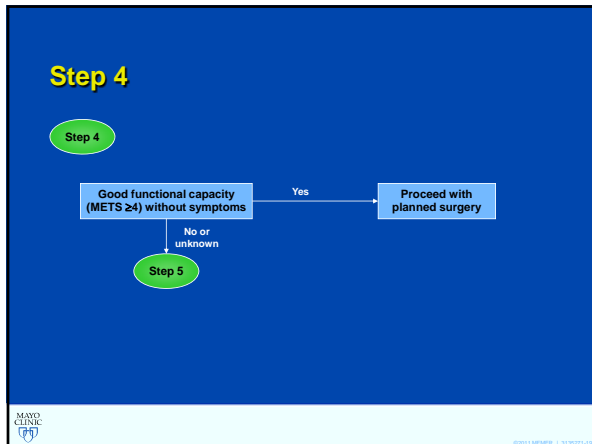


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Step 3

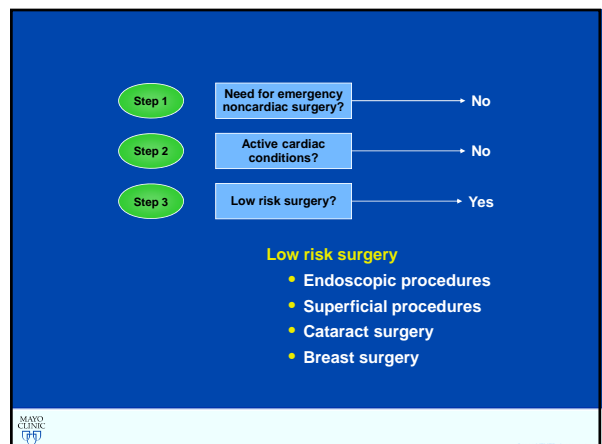


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What Would You Recommend With Respect to Preoperative Cardiac Risk Assessment?

- No additional cardiac testing, proceed with planned surgery
- Exercise stress test
- Dobutamine stress Echo
- Cardiology consult



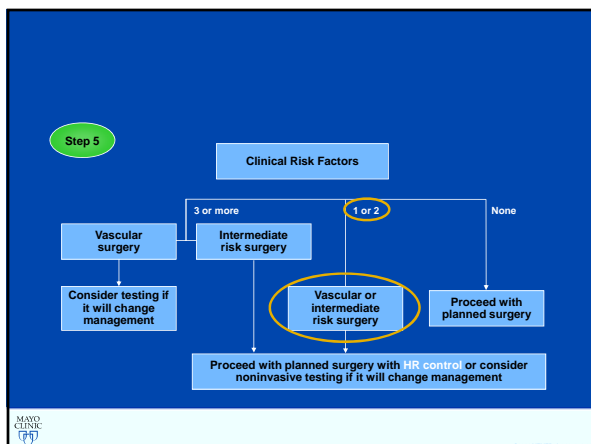
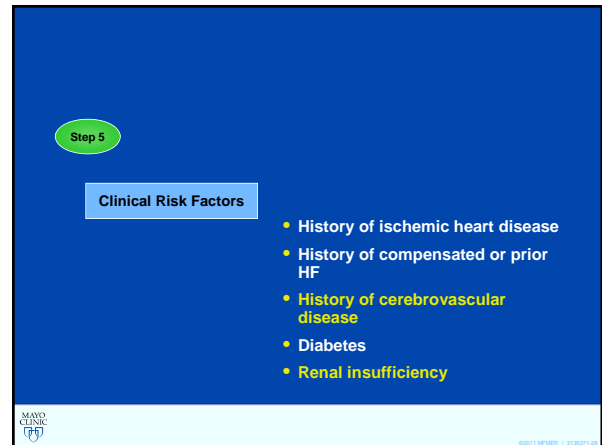
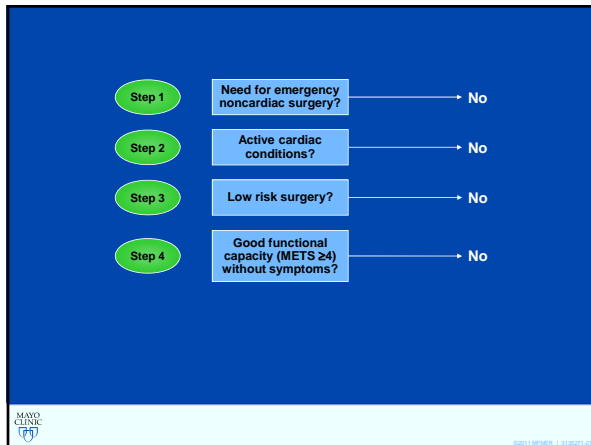
Case 2

- 68-year-old female is scheduled for an elective total hip arthroplasty
- PMH: HTN, CRI with baseline Cr of 2.1, past CVA with no residual deficits, no CAD
- Functional capacity <4 METS
- Exam: BP 140/85; P 55; normal
- ECG: 1st degree AV block, normal
- Medications: lisinopril, metoprolol, lasix, ASA, simvastatin, tramadol



What Would You Recommend With Respect to Preoperative Cardiac Risk Assessment?

- No additional cardiac testing, proceed with planned surgery
- Exercise stress test
- Dobutamine stress Echo
- Cardiology consult



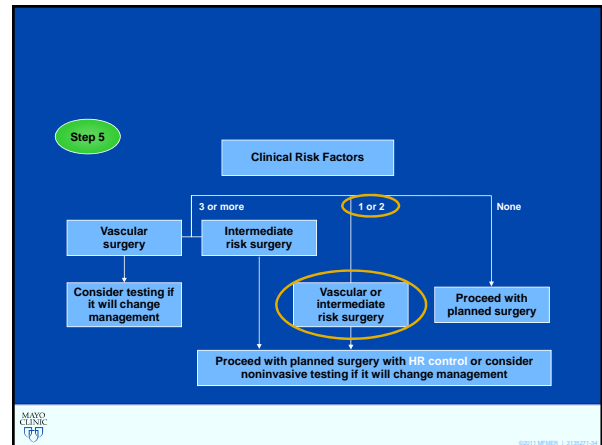
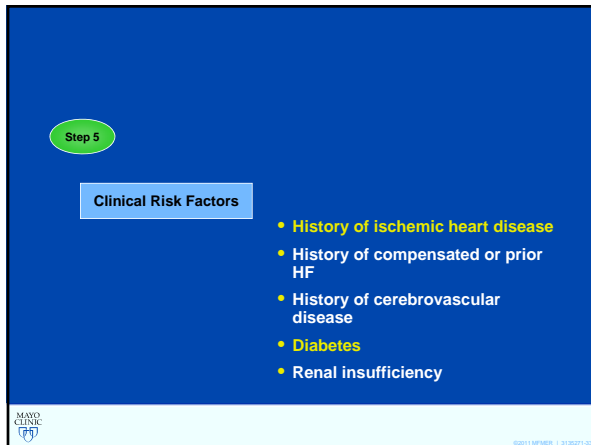
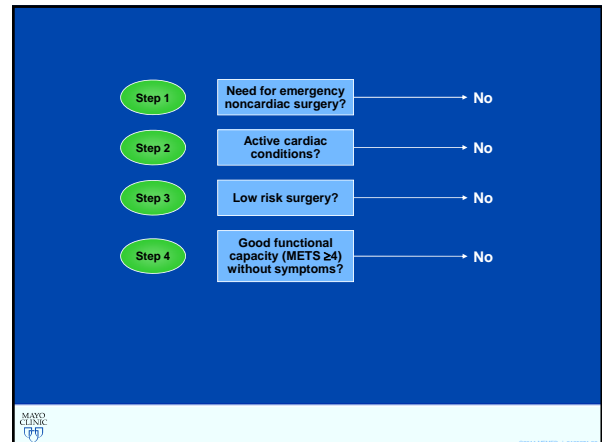
Case 3

- 71-year-old male scheduled for a R aorto-femoral bypass for claudication
- PMH: hypertension, hyperlipidemia, diabetes, and COPD – still smoking, no known CAD.
- Functional capacity: <4 METS (dyspnea and claudication)
- Exam: 140/75; P 82 regular; normal except prolonged expiration phase with scattered rhonchi and diminished pulses distal RLE
- ECG: Q waves in II, III, AVF (no old ECG available to compare); Labs: NL
- Meds: pravastatin, insulin, metformin, lisinopril, Ipratropium MDI, albuterol MDI



What Would You Recommend With Respect to Preoperative Cardiac Risk Assessment?

- A. No additional cardiac testing, proceed with planned surgery; no beta blockade because of COPD
- B. No additional cardiac testing, proceed with planned surgery with beta blockade to keep heart rate 55-65 bpm
- C. Dobutamine Stress Echo
- D. Ask his profession: lawyer or cardiologist –stress test; other – Beta Blocker and proceed



Case 3

- I would stress this patient prior to this elective high risk surgery
 - Aggressive beta blockade is not protective in patients with significant ischemia who undergo high risk vascular surgery
 - This patient has not had prior evaluation of his heart – and we have found evidence on ECG of CAD
 - I would evaluate his CAD regardless of surgery



Take Home Message

- Guidelines are **not** meant to be prescriptive
- Sound clinical judgment which considers each patient's specific clinical circumstances should prevail



Gupta Perioperative Cardiac Risk Calculator

Cardiovascular Surgery

Development and Validation of a Risk Calculator for Prediction of Cardiac Risk After Surgery

Prateek K. Gupta, MD, Himani Gupta, MD, Abhishek Sundaram, MBBS, MPH, Mani Kaushik, MD, Xiang Fang, PhD, Weldon J. Miller, MS, Dennis J. Esterbrooks, MD, Claire B. Hunter, MD, Inakis I. Piptinos, MD, Jason M. Johanning, MD, Thomas G. Lynch, MD, R. Armour Forse, MD, PhD, Syed M. Mohiuddin, MD, Aryan N. Massou, MD

Background—Perioperative myocardial infarction or cardiac arrest is associated with significant morbidity and mortality. The Revised Cardiac Risk Index is currently the most commonly used cardiac risk stratification tool; however, it has several limitations, one of which is its relatively low discriminative ability. The objective of the present study was to develop and validate a predictive cardiac risk calculator.

Methods and Results—Patients who underwent surgery were identified from the American College of Surgeons' 2007 National Surgical Quality Improvement Program database, a multicenter (>250 hospitals) prospective database. Of the 211 410 patients, 1371 (6.5%) developed perioperative myocardial infarction or cardiac arrest. On multivariate logistic regression analysis, 5 predictors of perioperative myocardial infarction or cardiac arrest were identified: type of surgery, dependent functional status, abnormal creatinine, American Society of Anesthesiologists' class, and increasing age. The risk model based on the 2007 data set was subsequently validated on the 2008 data set (n=257 385). The model performance was very similar between the 2007 and 2008 data sets, with C statistics (also known as area under the receiver operating characteristic curve) of 0.884 and 0.874, respectively. Application of the Revised Cardiac Risk Index to the 2008 National Surgical Quality Improvement Program data set yielded a relatively lower C statistic (0.747). The risk model was used to develop an interactive risk calculator.

Conclusions—The cardiac risk calculator provides a risk estimate of perioperative myocardial infarction or cardiac arrest and is anticipated to simplify the informed consent process. Its predictive performance compares that of the Revised Cardiac Risk Index. (Circulation. 2011;124:382-7)

Key Words: myocardial infarction ■ cardiac arrest ■ risk ■ assessment ■ perioperative period

Gupta et al. Circulation, 2011;124:382-7



Development and Validation of a Risk Calculator for Prediction of Cardiac Risk After Surgery

Gupta PK et al. Circulation 2011; 124:281-7

- Historical cohort study
- **Participants:** 469,000 patients from the NSQIP database undergoing variety of surgical procedures 2007-2008
- **Outcomes:**
 - 30-day Postop Intraoperative or Postoperative MI or Cardiac Arrest



Outcomes, continued..

- **Cardiac Arrest:**
 - absence of cardiac rhythm causing LOC and initiation of ACLS
- **Myocardial Infarction**-- one of the following:
 - ECG changes of acute MI
 - New elevation in troponin greater than 3 times normal in the setting of suspected myocardial ischemia



Results: 5 factors contributed to risk of MI and cardiac arrest

- Age
- Creatinine
- ASA class
- Procedure Type
- Dependent Functional Status



ASA Class

Classification	Description
Class I	Normal, healthy patient
Class II	Patient with mild systemic disease—a mild to moderate systemic disorder related to the condition to be treated or to some other, unrelated process
Class III	Patient with severe systemic disease that limits activity but is not incapacitating
Class IV	Patient with incapacitating systemic disease that is life threatening
Class V	Moribund patient not expected to survive 24 hr without an operation



Results, continued..

	N	C-statistic
Gupta Derivation Cohort	211,410	0.88
MI/CA 0.65%		
Gupta Validation Cohort	257,385	0.87
MI/CA 0.54%		
RCRI Applied to Validation Cohort	257,385	0.75



Perioperative Cardiac Risk Calculator Compared to the Lee RCRI

	Gupta	Lee RCRI
YEAR	2011	1999
Cohort size	400,000	4315
C statistic	0.874	0.765
Surgery specific	YES	NO



Gupta et. al. Circulation, 2011;124:382-7

Perioperative Myocardial Infarction or Cardiac Arrest Risk Calculator

Age: Enter: actual age in years. Estimated risk probability for perioperative MICA: **1.8%**

ASA Class: Enter: 1-5 for American Society of Anesthesiologists' Class

Creatinine (preoperative): Enter: 2 for missing value; 1 for <=1.3 mg/dL; 0 for <1.3 mg/dL

Functional Status (preoperative): Enter: 2 for patients with totally dependent functional status; 1 for patients who have partially dependent functional status; 0 for those who are totally independent

Procedure: Enter: 1 for Anorectal; 2 for Aortic; 3 for Bariatric; 4 for Brain; 5 for Breast; 6 for Cardiac; 7 for ENT (except Thyroid/Parathyroid); 8 for Foregut/Gastroesophageal; 9 for Gallbladder, appendix, adrenal and spleen; 10 for Gynecology (vaginal, femoral); 11 for Hematologic; 12 for Neck (Thyroid and Parathyroid); 13 for Obstetric/Gynecologic; 14 for Orthopedic and Non-vascular Extremity; 15 for Other abdominal; 16 for Peripheral Vascular; 17 for Skin; 18 for Spine; 19 for non-esophageal Thoracic; 20 for Vain; 21 for Urology

Authors: Praveen K Gupta, MD; Arman Gupta, MD; Ashraf Sundeem, MD. Methodology: Circulation. 2011 Jul 26;124(9):907-17. Epub 2011 Jul 3.

Where Can I Find the Calculator?

- Qx Calculate
 - <http://www.qxmd.com>
 - Free app for phone
- <http://www.surgicalriskcalculator.com>
 - Free download for desktop
 - Request for password accepts anything



Take Home Points– Gupta Cardiac Risk Calculator

- Surgery specific
- Exact model based estimate of risk is provided in a smartphone app format or on the web
- Has not been externally validated and may underestimate risk because of how postoperative MI was defined in the database
- Has not been incorporated into updated guidelines, so decisions on management based on risk is not defined



Choosing the Best Stress Test

- Cases to illustrate
- For each case recommend the best stress test



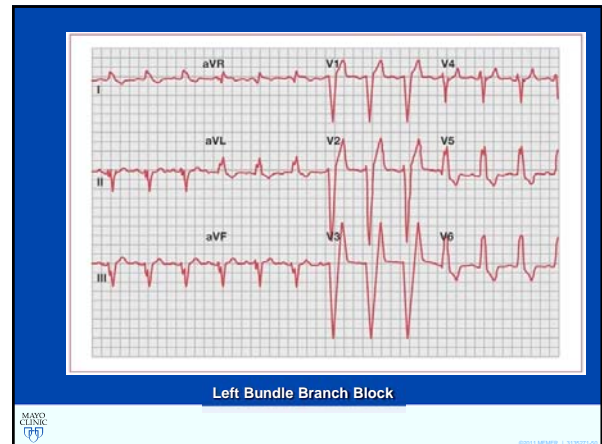
Case 4

- 65-year-old male with known CAD is evaluated for preoperative cardiac risk assessment
- After review of the history, you have decided that he needs to have a cardiac stress test preoperatively to help you further risk stratify him prior to AAA repair
- Medications
 - Lisinopril 20 mg; ASA 81 mg; Pravastatin 40 mg; Metoprolol 50 mg BID



Case 4 (cont)

- NSTEMI 3 yrs ago with 80% LAD lesion, treated with bare metal stenting
- Echo 1 year ago: No wall motion abnormalities; EF 65%
- Occasional mild angina with exertion since the MI
- Functional capacity: < 4 METS by history
- BP: 140/80; pulse 60 regular
- ECG: shown



Which Stress Test Would You Recommend for this Patient?

- Exercise ECG with no imaging
- Exercise ECG with thallium
- Exercise ECG with sestamibi imaging
- Dobutamine stress Echo
- Pharmacologic vasodilator stress (dipyridamole or adenosine) with sestamibi imaging



Stress Testing in Left Bundle Branch Block

- Tachycardia induced by **exercise** may result in reversible septal defects even in the absence of LAD artery disease
- Also reported with dobutamine*
- Vasodilator stress with myocardial perfusion studies recommended

*DSE can be used in LBBB, but may be less accurate in the setting of LAD disease



Stress Testing in LBBB

	Sensitivity (rule out)	Specificity (rule in)	Accuracy
Exercise perfusion imaging	75%	33%	36-60%
Dobutamine Stress Echo (LAD DZ)	91% (83%)	92% (92%)	92% (79%)
Vasodilator stress/with imaging	98%	84%	88-92%

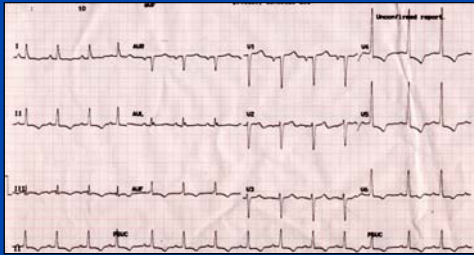


Case 5

- 64-year-old non-obese female needs elective 9.5 cm AAA repair
- No history of CAD
- BP 180/95
- No exercise limitations
- No lung disease
- ECG



Case 5 (cont)



LVH with strain pattern



Which Stress Test Would You Recommend for this Patient?

- A. Exercise stress test with no imaging
- B. Exercise stress test with thallium or sestamibi imaging
- C. Dobutamine stress Echo
- D. No stress testing because of concern for AAA rupture



Issues to consider

- She can exercise
 - AAA not a contraindication to exercise
- Abnormal ECG
 - LV hypertrophy with “strain” pattern, or digitalis effect, stress with **cardiac imaging** should be done because the exercise ECG is non-diagnostic
- Significant hypertension
 - Avoid dobutamine



Case 6

- 72-year-old male with moderate COPD scheduled for a lower extremity revascularization for claudication
- On exam you hear scattered wheezes and rhonchi
- Patient taking multiple inhalers and theophylline for his COPD
- BP 130/75
- METs <4 due to claudication



Which Stress Test Would You Recommend for this Patient?

- A. Exercise stress echo
- B. Dobutamine stress Echo
- C. Exercise ECG with thallium or sestamibi imaging
- D. Pharmacologic vasodilator stress (dipyridamole or adenosine) with thallium or sestamibi imaging



Issues to consider

- Patient cannot exercise
- Avoid dipyridamole and adenosine in patients:
 - On theophylline
 - With significant bronchospasm
 - With critical carotid stenosis



Echo vs Nuclear Imaging

- **Echo imaging**
 - More specific
 - Gives more extensive info on cardiac anatomy and function
 - Costs less
 - Superior to nuclear perfusion in obese patients – Echo travels through adipose quite well
 - Limited by poor Echo windows in some patients
 - Technician dependent
- **Nuclear perfusion imaging**
 - More sensitive – especially for single vessel CAD involving the LCX
 - Quantifies extent of ischemia more reproducibly
 - More accurate in assessing ischemia when multiple resting RWMA's present
 - More expensive
 - Soft tissue attenuation of nuclear trace in obese patients



Diagnostic Performance of Exercise Stress Testing Meta-Analyses: Coronary Angio Correlation

	Sensitivity	Specificity
TMET ECG	68%	77%
Stress Echo	85%	77%
Stress SPECT	87%	64%
Dob Echo	85%	84%
Adeno SPECT	89%	79%

Fleischman KE et al: JAMA 280:915, 1998
Gibbons RJ et al: JACC 41:159, 2003



Don't Forget

- Standard exercise treadmill testing is a viable option for preoperative cardiac risk stratification for patients who:
 - Normal ECG
 - No prior revascularization
 - Not taking digoxin
 - Able to exercise at least 5 minutes on Bruce protocol



Parting Pearls

- Surgical or percutaneous intervention is rarely necessary simply to “get the patient through surgery”
- Only test if it will change management
- Patients with adequate functional capacity (≥ 4 METs) can usually go to surgery without additional testing
- Patients scheduled for low risk surgery usually do not need additional testing
- Choose your stress test based on the specific clinical situation



Reference

Fleisher LA, et al. ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2007;50:e159 –242.



Thank You

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Cardiac Risk Reduction Strategies:

Medical and Interventional An Overview of Perioperative Medicine

October 2013

Howard Weitz, M.D.
Jefferson Medical College
Thomas Jefferson University Hospitals

The Plan

- Risk Reduction Strategies
 - Timing of surgery
 - Anesthesia
 - Monitoring
 - Medications
 - Interventions

Timing of Surgery Post MI

Myocardial Infarction After General Anesthesia

Sait Tarhan, MD; Emerson A. Moffitt, MD;
William F. Taylor, PhD; and Emilio B. Giallani, MD

During 1967 and 1968, a total of 32,877 patients had general anesthesia at the Mayo Clinic; 422 had previous myocardial infarction. Of these 6.6% experienced another infarction during the first postoperative week. There was no relationship between incidence of postoperative reinfarction and type or duration of anesthesia. However, operations on the thorax and upper abdomen were followed by three times as many reinfarctions as operations at other sites. Patients who were operated on within three months of infarction had a 37% reinfarction rate. This rate decreased to 16% in patients at three to six months after infarction, and remained at 4% to 5% when infarction had occurred more than six months previously. A significantly higher number of myocardial infarctions occurred during the third postoperative day.

Patients Studied and Method
During the years 1967 and 1968, a total of 32,877 patients, 30 years of age and over, underwent some form of operation or diagnostic procedure under general anesthesia at our institution. (Cardiac operations were not included.) Among them, 422 patients had evidence of previous myocardial infarction (indicated by medical history or by electrocardiography before operation). The yearly distribution is shown in Table 1. Twenty-eight of them (6.6%) experi-

Tarhan S, et al. JAMA 1972

Timing of Surgery Post MI

Thirty-seven percent of patients operated on within three months of myocardial infarction had postoperative reinfarctions. This decreased to 16% in patients between three and six months after infarction, and remained 4% to 5% in patients more than six months after previous infarction.

During 1967 and 1968, a total of 32,877 patients had general anesthesia at the Mayo Clinic; 422 had previous myocardial infarction. Of these 6.6% experienced another infarction during the first postoperative week. There was no relationship between incidence of postoperative reinfarction and type or duration of anesthesia. However, operations on the thorax and upper abdomen were followed by three times as many reinfarctions as operations at other sites. Patients who were operated on within three months of infarction had a 37% reinfarction rate. This rate decreased to 16% in patients at three to six months after infarction, and remained at 4% to 5% when infarction had occurred more than six months previously. A significantly higher number of myocardial infarctions occurred during the third postoperative day.

Tarhan S, et al. JAMA 1972

Timing of Surgery Post MI

Journal of the American College of Cardiology
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ACC/AHA GUIDELINE

Current management of MI provides for risk stratification during convalescence (49). If a recent stress test does not indicate residual myocardium at risk, the likelihood of reinfarction after noncardiac surgery is low. Although there are no adequate clinical trials on which to base firm recommendations, it appears reasonable to wait 4 to 6 weeks after MI to perform elective surgery.

Lee A. Fleisher, MD, FACC, FAHA, Chair; Joshua A. Beckman, MD, FACC; Kenneth A. Brown, MD, FACC, FAHA; Hugh Calkins, MD, FACC, FAHA; Elliott Chaikof, MD; Kristen E. Fleischmann, MD, MPH, FACC; William K. Freeman, MD, FACC; James B. Froehlich, MD, MPH, FACC; Edward K. Kasper, MD, FACC; Judy R. Kersten, MD, FACC; Barbara Riegel, DNSc, RN, FAHA; John F. Robb, MD, FACC

Timing of Surgery Post MI

FEATURE

Risk of Surgery Following Recent Myocardial Infarction

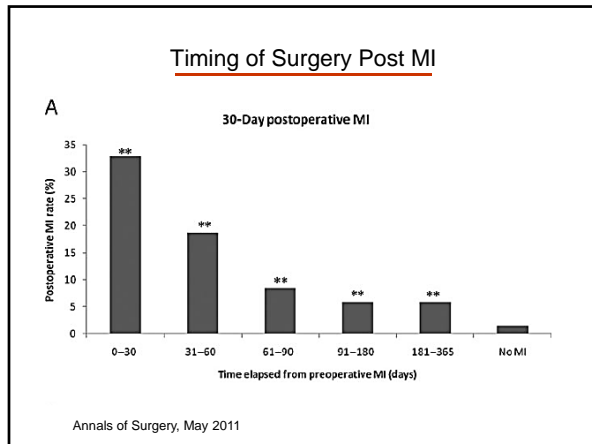
Masha Livshits, MD,* Clifford Y. Ko, MD,* Michael J. Lesmarodi, MD,* David S. Zingmond, MD,† Melinda Maggard Gibbons, MD,*‡§ and Christian de Virgilio, MD*¶

Objective: We aimed to assess the impact of recent myocardial infarction (MI) on outcomes after subsequent surgery in the contemporary clinical setting.
Background: Prior work shows that a history of a recent MI is a risk factor for complications following noncardiac surgery. However, this data does not reflect current advances in clinical management.
Methods: Using the California Patient Discharge Database, we retrospectively analyzed patients undergoing hip surgery, cholecystectomy, colectomy, elective abdominal aortic aneurysm repair, and lower extremity amputation from 1999 to 2004 (n = 363,842). Postoperative 30-day MI rate, 30-day mortality, and 1-year mortality were compared for patients with and without a recent MI using univariate analyses and multivariate logistic regression. Relative risks (RR) with 95% confidence intervals were estimated using bootstrapping with 1000 replications.

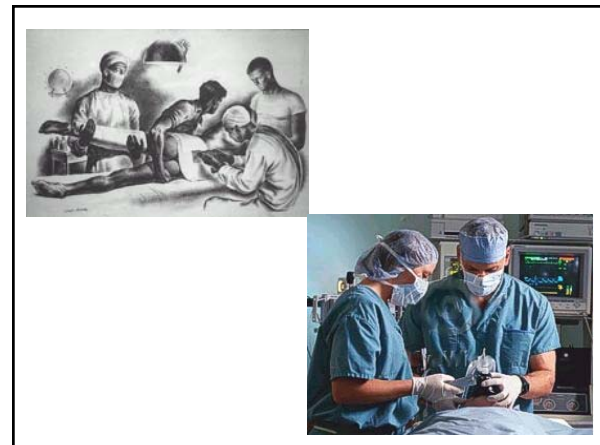
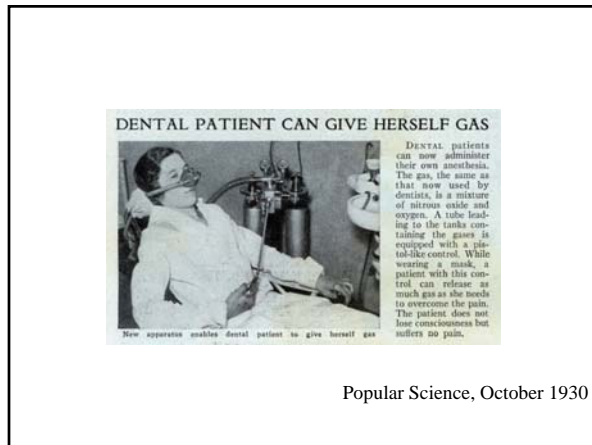
Conclusion: There are no contemporary studies assessing the risk of surgery for patients with a history of a recent MI. Many recent advances aimed at reducing operative complications for high-risk patients have been achieved including preoperative screening, clinical optimization, and close intraoperative monitoring by anesthesia. Preoperative initiation of β -blocker therapy^{1,2} and HMG-CoA reductase inhibitors^{3,4} reduce postoperative morbidity and mortality in patients with cardiac risk factors, although the studies on β -blockers have been mixed and the overall benefit is currently unknown. Coronary revascularization (either coronary artery bypass grafting or percutaneous coronary angioplasty and stenting) is indicated for symptoms of ongoing ischemia before nonemergent surgery.
† Use of intravenous anesthetic techniques for noncardiac cardiac

Hip surgery, cholecystectomy, AAA repair, colectomy, amputation

Annals of Surgery, May 2011



- ### Timing Dual Antiplatelet Rx post MI
- BMS: min 4 weeks, ideal 12 months
 - DES: min 12 months
 - Thrombolytic rx: up to 12 months
 - No reperfusion therapy: 9-12 months



- ### Anesthesia: General vs. Regional
- No difference morbidity - mortality
 - ADVANTAGES of regional in the cardiac pt.
 - Less myocardial, respiratory depression
 - Avoid endotracheal intubation (autonomic stimulation)
 - DISADVANTAGES of regional:
 - Anxiety → catecholamine release → ↑ MVO₂
 - Spinal → vasodilation → ↓ BP

- ### Role of spinal / epidural anesthesia
- Rogers et al, BMJ, December 2000
 - Meta analysis (141 trials, 9559 patients)
 - Trials with randomization to:
 - **Neuraxial blockade** (spinal or epidural)
 - **General anesthesia**
 - Note: 43% of neuraxial blockade group also received general anesthesia.

Rodgers Results Neuraxial blockade outcome

- 33% reduced mortality
- 44% reduced DVT
- 55% reduced pulmonary embolus
- 39% reduced pneumonia
- 33% reduced MI
- Is the benefit due to neuraxial blockade or to absence of general anesthesia?
- Does neuraxial blockade alter stress response?

Rodgers Results Criticism

- Studies are heterogeneous – meta analysis validity ?
- Meta analysis overestimates “treatment effect” (positive trial publication bias)
- Postop management has changed making benefit of neuraxial anesthesia less important
- Many studies did not use Troponin as an MI marker – MI under diagnosed

Rodgers Results Criticism

- Large Multicenter retrospective studies (2001, 2002) showed no mortality benefit and only minimal morbidity benefit from combined epidural/general anesthesia.

Review article

Does the evidence support the use of spinal and epidural anesthesia for surgery?

Jane C. Ballantyne MB BS, FRCA (Associate Professor, Chief)^{a,b,*},
 Bruce Kupelnick BA (Research Assistant)^c,
 Bucknam McPeck MD (Associate Professor, Anesthetist)^a,
 Joseph Lau MD (Professor)^c

Benefits of neuraxial anesthesia and analgesia
 Less blood loss
 Superior pain control
 Decreased ileus
 Fewer pulmonary complications

No Mortality benefit
No definite improvement in cardiac outcome
No fewer thromboembolic events when DVT prophylaxis used

2008 retrospective database review Lancet 2008, 372:562

Articles

Epidural anaesthesia and survival after intermediate-to-high risk non-cardiac surgery: a population-based cohort study

Summary Background Although epidural anaesthesia and analgesia have numerous benefits, their effects on postoperative survival are unclear. We therefore undertook a population-based cohort study to determine whether postoperative epidural anaesthesia or analgesia is associated with improved 30-day survival.
Methods We used population-based linked administrative databases to do a retrospective cohort study of 270,077 patients, aged 40 years or older, who underwent selected elective intermediate-to-high risk non-cardiac surgical procedures between April 1, 1994, and March 31, 2004, in Ontario, Canada. Propensity score methods were used to construct a matched-pairs cohort that reduced important baseline differences between patients who received epidural anaesthesia or analgesia as opposed to those that did not. We then determined the association of epidural anaesthesia with 30-day mortality within these matched-pairs.
Findings Of the 270,077 patients, 76,576 (28%) received epidural anaesthesia. Within the matched-pairs cohort (n=88,158), epidural anaesthesia was associated with a small reduction in 30-day mortality (0.7% or 2.0% relative risk 95% CI 0.81–0.98, p=0.02).
Interpretation Epidural anaesthesia and analgesia were associated with a small improvement in 30-day survival, but this effect should be interpreted cautiously. The estimate had borderline significance, despite a large sample size. Its absolute magnitude was also small, corresponding to a number needed to treat of 477. Our study, therefore, does not provide compelling evidence that epidural anaesthesia improves postoperative survival. Nonetheless, our results support the safety of preoperative epidural anaesthesia when used for indications other than improving survival (eg, improving postoperative pain relief, preventing postoperative pulmonary complications).

2008 retrospective database review Lancet 2008, 372:562

Articles

Epidural anaesthesia and survival after intermediate-to-high risk non-cardiac surgery: a population-based cohort study

Perioperative epidural anaesthesia or analgesia is associated with a small improvement in 30-day survival after elective intermediate-to-high risk non-cardiac surgery. Based on the large number needed to treat and borderline significance of this treatment effect, our study **does not support the routine use of epidural anaesthesia to prevent postoperative mortality**. Nonetheless, our results suggest that, when used for better-proven indications, such as **improving postoperative pain control or preventing pulmonary complications**, epidural anaesthesia is safe and might offer a small survival benefit.
 Perioperative epidural anaesthesia or analgesia when used for indications other than improving survival (eg, improving postoperative pain relief, preventing postoperative pulmonary complications).

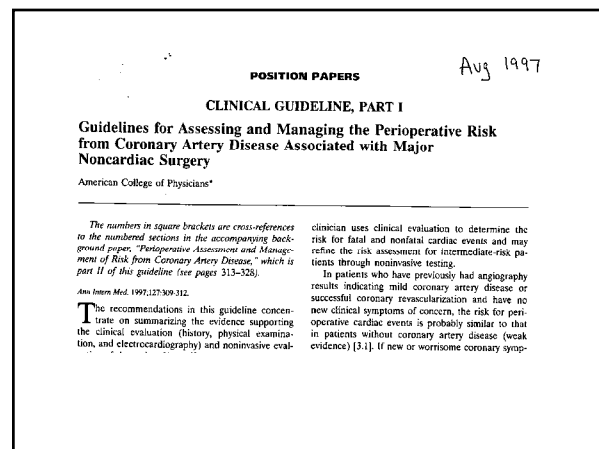
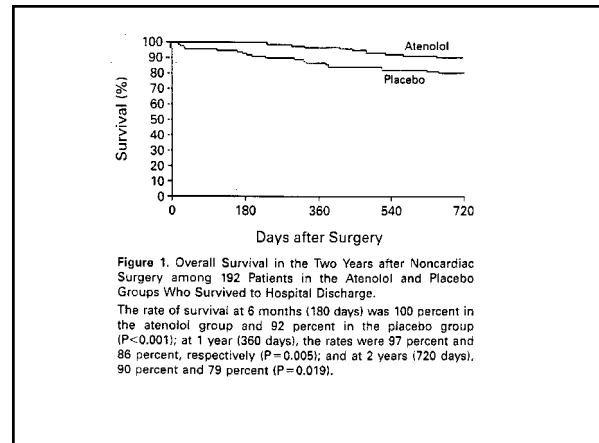
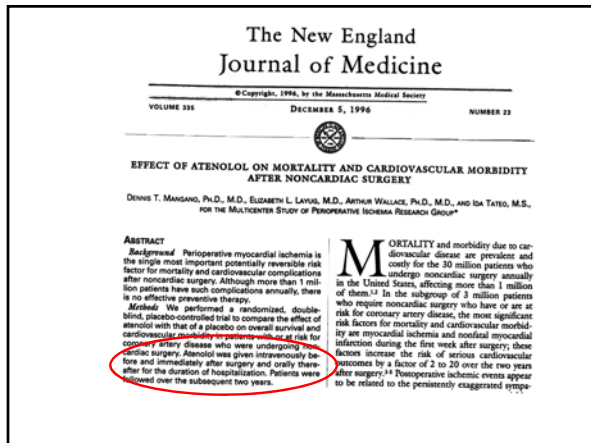
Anesthesia for the Consultant: Summary

itoring. In addition, no study has clearly demonstrated a change in outcome from the routine use of the following techniques: a PAC, ST-segment monitor, transesophageal echocardiography (TEE), or intravenous nitroglycerin. Therefore, the choice of anesthetic technique and intraoperative monitors is best left to the discretion of the anesthesia care team. Intraoperative management may be influenced by the perioperative plan, including the need for postoperative

ACC / AHA Guideline 2007

Perioperative Beta Blockers

What really is the evidence?



EFFECT OF BISOPROLOL ON MORBIDITY AND MORTALITY IN PATIENTS UNDERGOING VASCULAR SURGERY

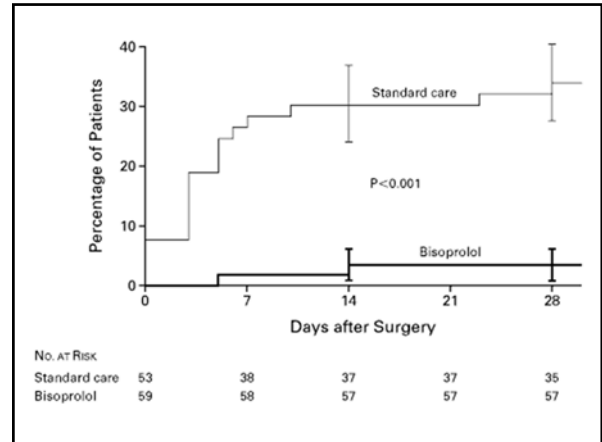
THE EFFECT OF BISOPROLOL ON PERIOPERATIVE MORTALITY AND MYOCARDIAL INFARCTION IN HIGH-RISK PATIENTS UNDERGOING VASCULAR SURGERY

DOH POLDERMAN, Ph.D., ERIC BOERMA, Ph.D., JURGEN J. BAK, Ph.D., IAN R. THOMSON, Ph.D., LOUIS M.M. VAN DE VEN, Ph.D., JAN D. BLANKENBURG, Ph.D., HUBERT F. BAARS, M.D., TIELEN YU, Ph.D., GIUSEPPE TRONCO, M.D., CARLO VIGNA, M.D., JOSE R.T.C. RIZOVANI, Ph.D., AND HENK VAN LEE, Ph.D., FOR THE DUTCH ECHOCARDIOGRAPHIC CARDIAC RISK EVALUATION APPLYING STRESS ECHOCARDIOGRAPHY STUDY GROUP*

ABSTRACT
Background: Cardiovascular complications are the most important causes of perioperative morbidity and mortality among patients undergoing major vascular surgery.
Methods: We performed a randomized, multicenter trial to assess the effect of perioperative blockade of beta-adrenergic receptors on the incidence of death from cardiac causes and nonfatal myocardial infarction within 30 days after major vascular surgery in patients at high risk for these events. High-risk patients were identified by the presence of both clinical risk factors and positive results on dobutamine echocardiography. Eligible patients were randomly assigned to receive standard perioperative care or standard care plus perioperative beta blockade with bisoprolol.
Results: A total of 1351 patients were screened, and 848 were found to have one or more cardiac risk factors. Of these 848 patients, 173 had positive results on dobutamine echocardiography. Fifty patients were randomly assigned to receive bisoprolol, and 53 to receive standard care. Fifty-three patients were excluded from randomization because they were already taking a beta blocker, and eight were excluded

High risk

N Engl J Med 1999;341:1789-94



In the absence of major contraindications, therapeutic doses of beta-adrenergic antagonists should be given to patients with an intermediate or high risk of cardiac complications. Patients who are not already receiving beta-blockers should be given one of these agents. Even if the drug causes complications, such as fatigue or impotence, these side effects can be tolerated during the perioperative period. Patients who are already receiving a beta-blocker should be evaluated to ensure that therapeutic serum concentrations have been achieved.

Lee, T.: Reducing Cardiac Risk in Noncardiac Surgery, N Engl J Med: 341:1838-40, 1999

Perioperative Beta Blockers
 What really is the evidence?

The New England Journal of Medicine

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VOLUME 335 DECEMBER 4, 1996 NUMBER 23

EFFECT OF ATENOLOL ON MORTALITY AND CARDIOVASCULAR MORBIDITY AFTER NONCARDIAC SURGERY

DENNIS T. MANGANO, Ph.D., M.D., EDUARDO L. LAYUS, M.D., ARTHUR WALLACE, Ph.D., M.D., AND DA TAITO, M.S., FOR THE MULTICENTER STUDY OF PERIOPERATIVE TENSINA RESEARCH GROUP*

ABSTRACT
Background: Perioperative myocardial ischemia is the single most important potentially reversible risk factor for mortality and cardiovascular complications after noncardiac surgery. Although more than 1 million patients have such complications annually, there is no effective preventive therapy.
Methods: We performed a randomized, double-blind, placebo-controlled trial to compare the effect of atenolol with that of a placebo on overall survival and cardiovascular morbidity in patients with or at risk for coronary artery disease who were undergoing noncardiac surgery. Atenolol was given intravenously before and immediately after surgery and orally thereafter for the duration of hospitalization. Patients were followed over the subsequent two years.
Results: Mortality and morbidity due to cardiovascular disease are prevalent and costly for the 30 million patients who undergo noncardiac surgery annually in the United States, affecting more than 1 million of them.^{1,2} In the subgroup of 3 million patients who require noncardiac surgery who have or are at risk for coronary artery disease, the most significant risk factors for mortality and cardiovascular morbidity are myocardial ischemia and nonfatal myocardial infarction during the first week after surgery; these factors increase the risk of serious cardiovascular outcomes by a factor of 2 to 20 over the two years after surgery.^{3,4} Postoperative ischemic events appear to be related to the persistently exaggerated sympathetic

Mangano, 1996

- "In hospital" post op adverse events not counted.
 - "In hospital" atenolol group 4 deaths, control group 2 deaths. If included the difference in death between the two groups not significant
- Did beta blocker withdrawal favor the beta blocker group?
 - 8 patients taken off beta blocker to enter placebo group
- 40% did not tolerate full dose atenolol, 15% did not tolerate any atenolol
- Trend toward sicker patients (prior MI, angina, diabetes, prior coronary revasc) in placebo group.
- Atenolol group trended toward more comprehensive cardiac therapy (ie ACE inhibitors) at discharge

EFFECT OF BISOPROLOL ON MORBIDITY AND MORTALITY IN PATIENTS UNDERGOING VASCULAR SURGERY

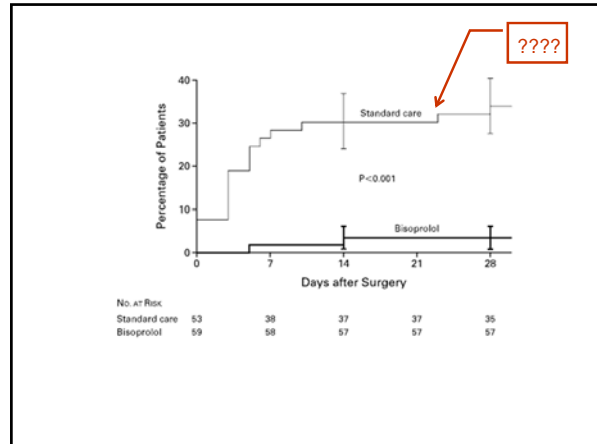
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59 pts beta blocker
53 pts std care 59 p

N Engl J Med 1999;341:1789-94



McCullough P. Failure of B-blockers in the reduction of Perioperative events. Where did we go wrong? AHJ November 2006

Figure 1

Pre 2001

- Stone, 1985, n = 128
- Margolis, 1996, n = 209
- Poldermans, 1999, n = 112 (unblinded)
- Raby, 1999, n = 26
- Zweig, 1999, n = 63 (no placebo)
- Grison, 2000, n = 107
- Total N = 636

Post 2004

- POISE, 2006, n = 103
- MAVS, 2005, n = 296
- DIPOM, 2005, n = 821
- 1st blinded, placebo-controlled
- Total N = 1320

Summary of randomized trials of beta-blockade in the reduction of perioperative cardiac events in patients undergoing noncardiac surgery. Trials are summarized from Refs. [2-5].

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 doi:10.1016/j.jacc.2006.03.029

ACC/AHA PRACTICE GUIDELINES

ACC/AHA 2006 Guideline Update on Perioperative Cardiovascular Evaluation for Noncardiac Surgery: Focused Update on Perioperative Beta-Blocker Therapy

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery)
 Developed in Collaboration With (organizations to be added post approval)

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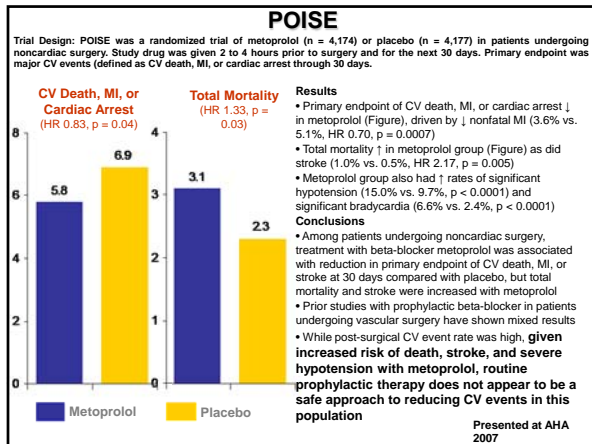
www.acc.org March 11, 2006

ACC / AHA 2006 Perioperative Beta Blocker Update

- Most trials inadequately powered
- Few randomized trials of medical therapy to prevent perioperative cardiac complications
- Few randomized trials examined therapy titration
- Few randomized trials re: role of periop beta blockers
- Studies lacking to determine role of beta blockers in intermediate and low risk populations
- No studies have addressed how, when, by whom perioperative beta blockade should be implemented or monitored

Perioperative Beta Blockers POISE Trial

- PeriOperative ISchemic Evaluation
 - Canadian Institutes of Health Research
 - Noncardiac surgery
 - Hx: cad, pvd, cva, chf within 3 yrs of surgery, or vascular surgery
 - 30 days of controlled release metoprolol
 - Metoprolol CR 100 mg 2-4 hrs preop
 - IV or po metoprolol 6 hrs postop (equiv metoprolol CR 100mg)
 - Metoprolol CR 200 mg daily for 30 days
 - Outcomes: cardiovascular death; fatal MI; non-fatal MI
 - 190 centers, 23 countries
 - Goal 10000 patients (final enrollment 8351)



POISE trial online release; Lancet May 13, 2008

Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): a randomised controlled trial

POISE Study Group*

Summary

Background Trials of β blockers in patients undergoing non-cardiac surgery have reported conflicting results. This randomised controlled trial, done in 190 hospitals in 23 countries, was designed to investigate the effects of perioperative β blockers.

Methods We randomly assigned 8351 patients with, or at risk of, atherosclerotic disease who were undergoing non-cardiac surgery to receive extended-release metoprolol succinate (n=4174) or placebo (n=4177), by a computerised randomisation phone service. Study treatment was started 2–4 h before surgery and continued for 30 days. Patients, health-care providers, data collectors, and outcome adjudicators were masked to treatment allocation. The primary endpoint was a composite of cardiovascular death, non-fatal myocardial infarction, and non-fatal cardiac arrest. Analyses were by intention to treat. This trial is registered with ClinicalTrials.gov, number NCT00132019.

Findings All 8351 patients were included in analyses; 8331 (99.8%) patients completed the 30-day follow-up. Fewer patients in the metoprolol group than in the placebo group reached the primary endpoint (244 [5.8%] patients in the metoprolol group vs 290 [6.9%] in the placebo group; hazard ratio 0.84, 95% CI 0.76–0.95, p=0.0399). Fewer patients in the metoprolol group than in the placebo group had a myocardial infarction (76 [4.2%] vs 239 [5.7%] patients; 0.73, 0.60–0.89; p=0.0017). However, there were more deaths in the metoprolol group than in the placebo group (329 [7.9%] vs 97 [2.3%] patients; 1.33, 1.03–1.74; p=0.0327). More patients in the metoprolol group than in the placebo group had a stroke (41 [1.0%] vs 19 [0.5%] patients; 2.17, 1.26–3.74; p=0.0053).

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 May 13, 2008
 DOI:10.1016/S0140-6736(08)60464-2
 See this article online
 DOI:10.1016/S0140-6736(08)60464-2
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- ### POISE
- Metoprolol prevented MI but increased risk of stroke, death.
 - Metoprolol decreased incidence Afib.
 - Metoprolol increased hypotension, bradycardia.

- ### POISE: Metoprolol sustained release 1000 patients
- **PREVENT**
 - 15 MI
 - 3 Coronary revasc
 - 7 Afib

- ### POISE: Metoprolol sustained release 1000 patients
- | | |
|--|---|
| <ul style="list-style-type: none"> • PREVENT <ul style="list-style-type: none"> – 15 MI – 3 Coronary revasc – 7 Afib | <ul style="list-style-type: none"> • CAUSE <ul style="list-style-type: none"> – 8 Death – 5 Stroke – 53 sig hypotension – 42 significant bradycardia |
|--|---|

Why didn't the beta blocker decrease mortality in POISE?

POISE

- ? Started too soon before surgery to have a plaque stabilizing effect.
 - POBBLE and DIPOM both started beta blocker less than 24 hours preop and showed no protective beta blocker effect)
- High dose beta blocker
- Doses not titrated
- Beta blocker only stopped if systolic BP dropped < 100 mm Hg
- Beta blocker related significant hypotension contributed to 37% of deaths
- Beta blocker related significant hypotension was most common prelude to stroke

PRACTICE GUIDELINE: FOCUSED UPDATE

2009 ACCF/AHA Focused Update on Perioperative Beta Blockade

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine, and Society for Vascular Surgery

2009 Writing Group to Review New Evidence and Update the 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

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Perioperative beta blockade Class I recommendation (2009)

(evidence / agreement that treatment is beneficial, useful, effective)

- Beta blockers should be **continued for patients who are receiving them** to treat angina, symptomatic arrhythmia, hypertension, or other Class I guideline indications.

Perioperative beta blockade Class IIa recommendation

(evidence / opinion in favor of usefulness, effective)

- Beta blockers when used should be titrated to heart rate and blood pressure.
- Beta blockers **probably** for vascular surgery when high risk due to **CAD or ischemia on preop testing**.
- Beta blockers **probably** for vascular surgery in patients at **high cardiac risk** (defn: presence of > 1 clinical risk factor).
- Beta blockers **probably** for patient with **CAD or high cardiac risk** (defn >1 clinical risk factor) who is to undergo **intermediate-risk surgery**.

Clinical risk factors: Ischemic heart disease; CHF; Cerebrovasc disease; DM; Renal insuf

Perioperative beta blockade Class IIb recommendation

(usefulness, efficacy uncertain)

- Intermediate-risk or vascular surgery with a **single clinical risk factor in the absence of CAD**
- Vascular surgery with no clinical risk factors and who are **not currently taking beta blocker**.

Clinical risk factors: Ischemic heart disease; CHF; Cerebrovasc disease; DM; Renal insuf

Perioperative beta blockade Class III recommendation

(treatment should **NOT** be administered)

- Patient has absolute contraindication to beta blocker
- Routine administration of high dose beta blockers in the absence of dose titration is not useful and may be harmful to patients not currently taking beta blockers who are undergoing noncardiac surgery.

When to start the beta blocker?

Pre-Operative Management

Timing of Pre-Operative Beta-Blocker Treatment in Vascular Surgery Patients

Influence on Post-Operative Outcome

Willem-Jan Flu, M.D., Jan-Peter van Kuijk, M.D., Michel Chrochod, M.D., Tamara A. Winkel, M.D., Hans J. M. Verhaagen, M.D., Jeroen J. Bax, M.D., Don Poldermans, M.D.
Rotterdam and Leiden, the Netherlands, and Havana, Cuba

Objective: This study evaluated timing of β -blocker initiation before surgery and its relationship with (1) pre-operative heart rate and (2) long-term mortality (stroke, mortality, and 30-day post-operative outcome).

Background: Perioperative guidelines recommend β -blocker initiation days to weeks before surgery, on the basis of expert opinion.

Methods: In 342 vascular surgery patients, pre-operative heart rate and β -blocker levels were recorded, next to timing of β -blocker initiation before surgery (0 to 1-, 1 to 4-, and ≥ 4 weeks). Pre- and post-operative troponin-T, creatinine levels, and electrocardiograms were performed routinely. 30-day cardiac events (myocardial infarction, stroke, mortality) and long-term mortality were recorded. Multivariate regression analysis adjusted for cardiac risk factors, evaluated the relation between duration of preoperative treatment and outcome.

Results: The β -blockers were initiated 0 to 1-, 1 to 4-, and ≥ 4 weeks before surgery in 138 (72%), 202 (42%), and 288 (84%) patients, respectively. Median heart rate at 0 hours was 74 (17) beats/min, 76 (15) beats/min, and 81 (15) beats/min ($p < 0.001$, comparing treatment initiated ≥ 4 with < 1 week pre-operatively), and β -blocker was 0.31 (0.16) ng/L, 0.41 (0.17) ng/L, and 0.41 (0.17) ng/L ($p < 0.001$, respectively). Treatment initiated ≥ 4 weeks before surgery was associated with a lower incidence of 30-day cardiac events (odds ratio 0.46, 95% confidence interval 0.22 to 0.97, $p = 0.04$), stroke (odds ratio 0.46, 95% confidence interval 0.22 to 0.97, $p = 0.04$), and long-term mortality (hazard ratio 0.52, 95% confidence interval 0.21 to 1.27, $p = 0.02$) compared with treatment initiated < 1 week pre-operatively.

Conclusion: Our results indicate that β -blocker treatment initiated ≥ 4 weeks before surgery is associated with lower pre-operative heart rate and improved outcome, compared with treatment initiated < 1 week pre-operatively. No reduction of mortality for 30 days was observed in patients receiving β -blocker treatment < 1 week compared with patients in whom treatment was initiated between 1 and 4 weeks before surgery. © Ann Intern Med 2010; 152(12): 761-767. DOI: 10.1093/ajph/100.12.1912

Table 2 Timing of β -Blocker Initiation Before Surgery and Post-Operative Outcome

Post-Operative Outcome	Timing of β -Blocker Initiation Before Surgery			p Value*
	0-1 Week (n = 158)	>1-4 Weeks (n = 393)	>4 Weeks (n = 389)	
30-day outcome				
Troponin-T release	40 (25)	54 (14)	56 (14)	0.032
Mortality	6 (4)	8 (2)	11 (3)	0.495
Stroke	3 (19)	2 (0.5)	2 (0.5)	0.021
Cardiovascular events	42 (27)	58 (15)	62 (16)	<0.001
Long-term outcome				
Mortality	30 (19)	55 (14)	57 (15)	0.039

Values are n (%). *p value: comparison of groups >1 to 4 weeks and < 4 weeks taken together with group 0 to 1 week.

Flu et al.; JACC 2010, 56:1922

Our Approach 2013

- Continue beta blockers for those already receiving
- Initiate beta blockers prior to surgery (cautiously) for patients who would otherwise need them
 - Begin as early as possible- >1 week - not day of surgery
 - Titrate to heart rate (60-80) and BP
- Carefully follow those on beta blockers in the postoperative period
 - Hypotension
 - Bradycardia

Statins

- Retrospective studies suggestive of benefit of postoperative statins:
 - Poldermans et al.: Statins are associated with a reduced incidence of perioperative mortality in patients undergoing major noncardiac surgery. *Circulation*. 2003;107:1848-1851.
 - Lindenauer PK et al.: Lipid lowering therapy and in hospital mortality in major non cardiac surgery. *JAMA* 2004;291(17):2092-9.

The NEW ENGLAND JOURNAL OF MEDICINE

ORIGINAL ARTICLE

Fluvastatin and Perioperative Events in Patients Undergoing Vascular Surgery

Olaf Schouten, M.D., Ph.D., Eric Boersma, Ph.D., Sanne E. Hoeks, M.Sc., Robert Benner, Ph.D., Hero van Urk, M.D., Ph.D., Marc R.H.M. van Sambeek, M.D., Ph.D., Hence J.M. Verhaagen, M.D., Ph.D., Nisar A. Khan, Ph.D., Martin Dunkelgrun, M.D., Ph.D., Jeroen J. Bax, M.D., Ph.D., and Don Poldermans, M.D., Ph.D., for the Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography Study Group

ABSTRACT

Fluvastatin 80 mg daily begun 37 days preop

N Engl J Med 2009

The NEW ENGLAND JOURNAL OF MEDICINE

B Perioperative Death from Cardiovascular Causes or Nonfatal Myocardial Infarction

ABSTRACT

Fluvastatin 80 mg daily begun 37 days preop

N Engl J Med 2009

2007 Guideline: Perioperative Statins

7.2.2. Perioperative Statin Therapy

Recommendations for Statin Therapy

CLASS I

1. For patients currently taking statins and scheduled for noncardiac surgery, statins should be continued. (Level of Evidence: B)

CLASS IIa

1. For patients undergoing vascular surgery with or without clinical risk factors, statin use is reasonable. (Level of Evidence: B)

CLASS IIIb

1. For patients with at least 1 clinical risk factor who are undergoing intermediate-risk procedures, statins may be considered. (Level of Evidence: C)

Effect of Statin Withdrawal on Frequency of Cardiac Events After Vascular Surgery

Olaf Schouten, MD^a, Sanne E. Hoeks, MS^b, Gijb M.J.M. Welten, MD^a, Jean Davignon, MD^a, John J.P. Kostelien, MD^a, Radosław Vidaković, MD^a, Hans H.H. Frings, MD^a, Martin Dunkelgrun, MD^a, Ron T. van Domburg, PhD^a, Jansen J. Bax, MD^a, and Don Poldermans, MD^{a,c}

The discontinuation of statin therapy in patients with acute coronary syndromes has been associated with an increase of adverse coronary events. Patients who undergo major

This study showed that acute statin withdrawal in the perioperative period is associated with an increased risk for perioperative cardiac events compared with statin continuation in long-term users. The extended-release formula of fluvastatin appeared to have beneficial effects over other statins in patients who discontinued statin therapy.

end points. Statin discontinuation was associated with an increased risk for perioperative troponin release (hazard ratio 4.6, 95% confidence interval 2.2 to 9.6) and the combination of myocardial infarction and cardiovascular death (hazard ratio 7.5, 95% confidence interval 2.8 to 20.1). Extended-release fluvastatin was associated with fewer perioperative cardiac events compared with atorvastatin, simvastatin, and pravastatin. In conclusion, the present study showed that statin withdrawal in the perioperative period is associated with an increased risk for perioperative adverse cardiac events. Furthermore, there seemed to be better outcomes in patients who received statins with extended-release formulas. © 2007 Elsevier Inc. All rights reserved. (Am J Cardiol 2007;100:316-320)

Effect of Perioperative Statins on Death, Myocardial Infarction, Atrial Fibrillation, and Length of Stay

A Systematic Review and Meta-analysis

Vincent Chopra, MD, MSc; David H. Wesorick, MD; Jeremy B. Sussman, MD; Todd Greene, PhD; Mary Rogers, PhD; James B. Froehlich, MD; Kim A. Eagle, MD; Sanjay Sant, MD

Conclusions: Perioperative statin treatment in statin-naïve patients reduces atrial fibrillation, myocardial infarction, and duration of hospital stay. Wider use of statins to improve cardiac outcomes in patients undergoing high-risk procedures seems warranted.

perioperative statin in statin-naïve patients undergoing cardiac and noncardiac surgery were included.

Study Selection: Two investigators independently selected eligible studies from original research published in any language studying the effects of statin use on perioperative outcomes of interest.

Data Extraction: Two investigators performed independent article abstraction and quality assessment.

Data Synthesis: Filters randomized controlled studies involving 2292 patients met the eligibility criteria.

hospital stay (standardized mean difference, -0.32, 95% CI, -0.53 to -0.11) but had no effect on length of intensive care unit stay (standardized mean difference, -0.08, 95% CI, -0.25 to 0.10).

Conclusions: Perioperative statin treatment in statin-naïve patients reduces atrial fibrillation, myocardial infarction, and duration of hospital stay. Wider use of statins to improve cardiac outcomes in patients undergoing high-risk procedures seems warranted.

Arch Surg. 2012;147(2):181-189

Effect of Perioperative Statins on Death, Myocardial Infarction, Atrial Fibrillation, and Length of Stay

A Systematic Review and Meta-analysis

Vincent Chopra, MD, MSc; David H. Wesorick, MD; Jeremy B. Sussman, MD; Todd Greene, PhD; Mary Rogers, PhD; James B. Froehlich, MD; Kim A. Eagle, MD; Sanjay Sant, MD

Objective: To assess the influence of perioperative statin treatment on the risk of death, myocardial infarction, atrial fibrillation, and hospital of stay in statin-naïve patients undergoing cardiac surgery.

Data Sources: MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials via Ovid. Additional studies were identified by hand searching of bibliographies, trial Web sites, and clinical conference abstracts. Randomized controlled trials reporting the effect of perioperative statin in statin-naïve patients undergoing cardiac and noncardiac surgery were included.

Study Selection: Two investigators independently selected eligible studies from original research published in any language studying the effects of statin use on perioperative outcomes of interest.

Data Extraction: Two investigators performed independent article abstraction and quality assessment.

Data Synthesis: Filters randomized controlled studies involving 2292 patients met the eligibility criteria.

Noncardiac surgery 1236

DECREASE III, IV 1030

according to the method and Land. Perioperative risk of atrial fibrillation in surgery (relative risk 0.69; number needed to treat 1030) reduced the risk of myocardial infarction, myocardial infarction, and duration of hospital stay (standardized mean difference, -0.32, 95% CI, -0.53 to -0.11) but had no effect on length of intensive care unit stay (standardized mean difference, -0.08, 95% CI, -0.25 to 0.10).

Conclusions: Perioperative statin treatment in statin-naïve patients reduces atrial fibrillation, myocardial infarction, and duration of hospital stay. Wider use of statins to improve cardiac outcomes in patients undergoing high-risk procedures seems warranted.

Arch Surg. 2012;147(2):181-189

Table 1 Summary of key findings of the Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography (DECREASE) series of studies

Trial	Risk category	Conclusion
DECREASE I	High	In high-risk patients undergoing non-cardiac surgery, perioperative beta-blockade with bisoprolol significantly reduces cardiac death and MI in the short- and long-term.
DECREASE II	Low, intermediate, high	Patients identified as intermediate risk on the basis of a single clinical assessment do not need pre-operative echocardiographic cardiac stress testing, provided that they receive bisoprolol to maintain resting heart rate at 40-65 b.p.m.
DECREASE III	High	In high-risk patients undergoing major vascular surgery, fluvastatin XL significantly reduces myocardial ischemia and the combined endpoint of cardiovascular death and MI.
DECREASE IV	Intermediate	In intermediate-risk patients, bisoprolol significantly reduces cardiac death and MI, with a non-significant trend towards a beneficial effect of fluvastatin XL.
DECREASE V	High	In high-risk patients with extensive stress-induced ischemia, coronary revascularization (added to tight heart rate control with bisoprolol) does not produce any additional reduction in death and MI and delays surgery.

Reference numbers to be added when references are finalized.

~~DECREASE VI in progress, preoperative NT-pro BNP for the identification of patients who May benefit from additional preoperative testing prior to vascular surgery.~~

Erasmus Universiteit ontslaat hoogleraar na 'fraude'

ontslag 17 november 2011 12:23

Het Erasmus Medisch Centrum in Rotterdam heeft hoogleraar in de geseekunde Don Poldermans ontslagen. De hoogleraar heeft volgens de universiteit onderzoeksdata verzonnen en het vertrouwen van patiënten geschaad.

Dat maakt **ORC** handdoekdakt

Prof. dr. D. Poldermans

De universiteit heeft Poldermans ontslagen nadat de integriteitscommissie fraude aan het licht bracht. Poldermans, bijzonder hoogleraar perioperative cardiale zorg, heeft spijl bezogen en de onderzoeksresultaten op hoofdlijnen bevestigd. Hij ontrent data te hebben verzonnen, maar geeft toe dat niet aan notitiepen te hebben gehouden.

Bloed afgenomen

De hoogleraar heeft voor zijn onderzoek bloed afgenomen en **halftuig** gemaakt bij patiënten die daaronder geen schriftelijke toestemming hadden gegeven. Het protocol schrijft dat voor.

Patiënten zijn niet frisk geschaad

Sensatief decaan en bestuurder Huub Pals: Hij zag diep geschokt te zijn over de zaak. Patiënten die aan het laatste onderzoek

Denkbeeld Stapel

- Therapie protocol **veront** dekt, is niet actief gesteld
- Onvoldoende **veeronderzoek** uitgevoerd op verzoek
- **aanrijfe** lange Stapel verlegde 'zwe' omvangrijke 'fraude'
- **Erasmus** steun in deving verlegde **gezondheids** nood

ANESTHESIOLOGY NEWS
THE INDEPENDENT MONTHLY NEWS PAPER FOR ANESTHESIOLOGISTS
Last Update: December 16, 2011

Web Exclusives

POSTED: NOVEMBER 17, 2011

Dutch Researcher Poldermans Ousted in Misconduct Investigation

Cardiology expert alleged to have fabricated data

by Adam Marcus

Erasmus Medical Center in The Netherlands has fired noted cardiologist Don Poldermans, MD, PhD, over allegations that the researcher fabricated data and committed other misconduct in his studies.

A [statement](#) posted on the Website of Erasmus, in Rotterdam, said Dr. Poldermans was dismissed on Wednesday.

"Erasmus MC dismissed Prof. D. Poldermans on 16 November because of violation of [academic integrity](#). Research carried out under his leadership was not always performed in accordance with current standards.

An inquiry committee on Academic Integrity concluded that the professor was [careless](#) in collecting the data for his research. In one study it was found that he used patient data [without written permission](#), used [fictitious data](#), and that two reports were submitted to conferences which included [knowingly submitted data](#).

Regret

Podcast Series

Focus on Inhaled Anesthesia

Table 1 Summary of key findings of the Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography (DECREASE) series of studies

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DECREASE IV	Intermediate	In intermediate-risk patients, bisoprolol significantly reduces cardiac death and MI, with a non-significant trend towards a beneficial effect of fentanyl XL.
DECREASE V	High	In high-risk patients with extensive stress-induced ischemia, coronary revascularization (added to tight heart rate control with bisoprolol) does not produce any additional reduction in death and MI and delays surgery.

Reference numbers to be added when references are finalized.

~~DECREASE VI in progress. preoperative NT-pro BNP for the identification of patients who may benefit from additional preoperative testing prior to vascular surgery.~~

Beta blockers inhibit peripheral effect of catecholamines

Alpha-2 agonists inhibit catecholamine release

Am. J. Med. 2003;114:742-752

SPECIAL ARTICLE

Alpha-2 Adrenergic Agonists to Prevent Perioperative Cardiovascular Complications: A Meta-analysis

Duminda N. Wijesundera, MD, Jennifer S. Naik, MD, W. Scott Beattie, MD, PhD

PURPOSE: To investigate the effects of α_2 adrenergic agonists on perioperative mortality and cardiovascular complications in adults undergoing surgery.

METHODS: MEDLINE (1966 to May 2002), EMBASE (1980 to May 2002), the Cochrane Clinical Trials Register, the Science Citation Index, and bibliographies of included articles were searched without language restriction. Randomized trials comparing preoperative, intraoperative, or postoperative (but 48 hours) administration of clonidine, dexmedetomidine, or misotricin with controls were included. Studies had to report any of the following outcomes: mortality, myocardial infarction, stroke, myocardial ischemia, and arrhythmias.

RESULTS: 23 trials, 3395 patients were included. Alpha-2 adrenergic agonists significantly reduced mortality (RR = 0.89; 95% CI 0.83 to 0.95; $P = 0.001$) and ischemia (RR = 0.76; 95% CI 0.63 to 0.91; $P = 0.003$) significantly. They also reduced mortality (RR = 0.47; 95% CI 0.25 to 0.90; $P = 0.02$) and myocardial infarction (RR = 0.66; 95% CI 0.46 to 0.94; $P = 0.02$) during vascular surgery. During cardiac surgery, α_2 adrenergic agonists reduced ischemia (RR = 0.71; 95% CI 0.54 to 0.92; $P = 0.01$) and were associated with trends toward lower mortality (RR = 0.86; 95% CI 0.12 to 1.98; $P = 0.3$) and a reduced risk of myocardial infarction (RR = 0.83; 95% CI 0.35 to 1.96; $P = 0.7$).

CONCLUSIONS: Alpha-2 adrenergic agonists reduce mortality and myocardial infarction following vascular surgery. During

23 trials, 3395 patients
Cardiac, Vascular, Noncardiac surgery

Alpha-2 agonists

- Clonidine
 - Single dose 2 to 6 ug/kg oral or iv preop
- Dexmedetomidine ("Precedex" iv sedation in the ICU)
 - 1-6 ug/kg iv bolus during or postop, then 0.2-0.7 ug/kg/hr for 48 hours
- Mivazerol
 - 4ug/kg iv bolus preop, then 1.5 ug/kg/hr for 72 hours

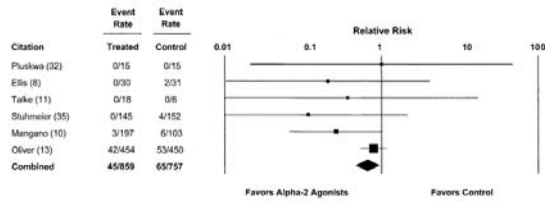
Mortality effect in vascular surgery

Alpha-2 adrenergic agonists to prevent perioperative cardiovascular complications/Wijesundera et al

Citation	Event Rate		Relative Risk
	Treated	Control	
Elke (8)	0/30	1/31	
Talke (11)	0/18	0/6	
Subramar (35)	1/145	2/152	
Quinlan (34)	0/11	1/10	
Manganu (10)	4/197	1/103	
Oliver (13)	8/454	20/450	
Talke (36)	0/22	1/19	
Combined	13/877	28/771	

Favors Alpha-2 Agonists Favors Control

Effect on myocardial infarction in vascular surgery



Impression: Encouraging for vascular surgery risk reduction

POISE-2 Trial

Week 1, 2010

POISE-2 Trial

PeriOperative ISchemic Evaluation-2 Trial

A large, international, placebo-controlled, factorial trial to assess the impact of clonidine and acetylsalicylic acid (ASA) in patients undergoing noncardiac surgery who are at risk of a perioperative cardiovascular event

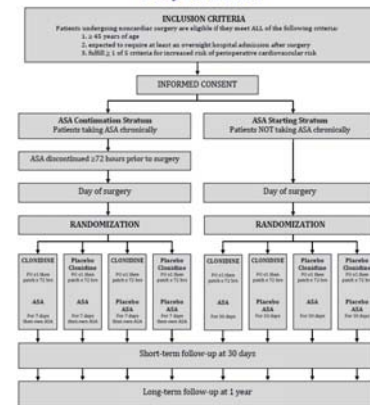
An International Collaborative Initiative

Initiated July 2010
Final data November 2013
Results November 2014

POISE – 2 Trial

Inclusion Criteria	Patients undergoing noncardiac surgery are eligible if they:
	1. are ≥ 45 years of age;
	2. are expected to require at least an overnight hospital admission after surgery; AND
	3. fulfill one or more of the following 5 criteria
	A. history of coronary artery disease;
	B. history of peripheral vascular disease;
	C. history of stroke;
	D. undergoing major vascular surgery; OR
	E. any 3 of the following 9 criteria: undergoing major surgery (i.e. intraperitoneal, intrathoracic, or major orthopedic surgery), history of congestive heart failure, transient ischemic attack, diabetes and currently taking an oral hypoglycemic agent or insulin, age ≥ 70 years, hypertension, serum creatinine $> 175 \mu\text{mol/L}$ ($> 2.0 \text{ mg/dl}$), history of smoking within 2 years of surgery, undergoing urgent/emergent surgery

Study Flow Chart

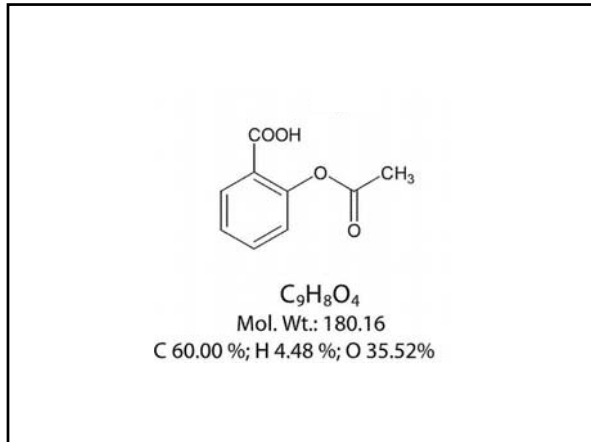


ACE Inhibitors

- Hypotension risk under anesthesia
- Hypotension less frequent when ACE-I discontinued day before OR
- ??? Discontinue day preop when ACE-I used to Rx hypertension

Other medications

- Nitrates
- Calcium channel blockers
- Aspirin cessation



Clinical research
Coronary heart disease

A systematic review and meta-analysis on the hazards of discontinuing or not adhering to aspirin among 50 279 patients at risk for coronary artery disease

Giuseppe G.L. Biondi-Zoccai^{1*}, Marzia Lotrionte², Pierfrancesco Agostoni³, Antonio Abbate⁴, Massimiliano Fusaro⁵, Francesco Burzotta⁶, Luca Testa⁷, Imad Sheiban⁸, and Giuseppe Sangiorgi⁹

¹Interventional Cardiology, Division of Cardiology, University of Turin, corso Bramante 88/90, 10126 Turin, Italy; ²Institute of Cardiology, Catholic University, Rome, Italy; ³Antwerp Cardiovascular Institute Middelheim, AZ Middelheim, Antwerp, Belgium; ⁴Department of Medicine, Medical College of Virginia Campus, Virginia Commonwealth University, Richmond, VA, USA; ⁵Hemodynamics and Cardiovascular Interventions Service, Abano Terme Hospital, Abano Terme, Italy; and ⁶EMO Centro Cure Columbus, Milan, Italy

Received 21 September 2006; accepted 3 October 2006; online publication ahead of print 19 October 2006

KEYWORDS
Aspirin
Coronary artery disease
Discontinuation
Meta-analysis
Systematic review

Aims The role of aspirin in patients with coronary artery disease (CAD) is well established, yet patients happen to discontinue aspirin according to physician's advice or unapproved. We thus undertook a systematic review to appraise the hazards inherent to aspirin withdrawal or non-compliance in subjects at risk for or with CAD.

Methods and results Electronic databases were systematically searched (updated January 2006). Study designs, patient characteristics, and outcomes were analyzed. Pooled estimates for risk ratios (RR) were computed according to random-effect methods. From the 417 screened studies, six were selected (82 179 patients). One study (31 700 patients) focused on adherence to aspirin therapy in the secondary prevention of CAD, two studies (2546 on aspirin discontinuation in acute CAD, two studies (31 786) on adherence to aspirin therapy before or shortly after coronary artery bypass grafting) and another (2229) on aspirin discontinuation among patients undergoing drug-eluting stenting. Overall, aspirin non-adherence/withdrawal was associated with three-fold higher risk of major adverse cardiac events (OR = 3.34 [1.75–5.81], $P < 0.0001$). This risk was magnified in patients with intracoronary stents, as discontinuation of antiplatelet treatment was associated with an even higher risk adverse events (OR = 86.78 [21.96–309.82]).

Conclusion Non-compliance or withdrawal of aspirin treatment has ominous prognostic implication in subjects with or at moderate-to-high risk for CAD. Aspirin discontinuation in such patients should be advocated only when bleeding risk clearly outweighs that of atherothrombotic events.

ASA withdrawal assoc with 3- fold higher risk of major cardiac event

Journal of Internal Medicine 2005; 257: 399–414

REVIEW

Low-dose aspirin for secondary cardiovascular prevention – cardiovascular risks after its perioperative withdrawal versus bleeding risks with its continuation – review and meta-analysis

W. BERGER¹, J.-M. CHEMNITZ², G. D. KNEISSL¹ & G. RÜCKER³

From the ¹Department of Interventional Cardiology, St Georg Hospital, Leipzig; ²Cardiology Practice, Waldkrankenhaus; and ³Department of Rehabilitative and Preventive Sports Medicine, Medical Clinic, University of Freiburg, Freiburg, Germany

Meta-analysis of 41 studies
ASA increased risk of bleeding complications 1.5 fold
ASA withdrawal preceded 10% of Acute Coronary Syndromes
Time interval from ASA withdrawal to ACS was 8.5 days

Conclusion: ASA should be discontinued only if low dose ASA may cause bleeding risk with associated mortality

Impact of Prior Use or Recent Withdrawal of Oral Antiplatelet Agents on Acute Coronary Syndromes

J.P. Collet, MD, PhD; G. Montalescot, MD, PhD; B. Blanchet, MD; M.L. Tangy, MD; J.L. Golmard, MD, PhD; R. Choussat, MD; F. Beygui, MD; L. Payot, MD; N. Vignolles, BSc; J.P. Metzger, MD; D. Thomas, MD

Background—Oral antiplatelet agents (OAA) can prevent further vascular events in cardiovascular disease. How prior use or recent discontinuation of OAA affects clinical presentation of acute coronary syndromes (ACS) and clinical outcomes (death, myocardial infarction [MI]) is unclear.

Methods and Results—We studied and followed up for up to 30 days a cohort of 1358 consecutive patients admitted for a suspected ACS; of these, 930 were nonusers, 355 were prior users of OAA, and 73 had recently withdrawn OAA. Nonusers were at lower risk, more frequently presented with ST-elevation MI on admission, and more frequently had Q-wave MI at discharge than prior users (36.6% versus 17.5%, $P < 0.001$, and 47.8% versus 28.2%, $P < 0.001$, respectively). However, there was no difference regarding the incidence of death or MI at 30 days between nonusers and prior users (10.3% versus 12.4%, $P = NS$). In addition, prior users experienced more major bleeds within 30 days compared with nonusers (3.4% versus 1.4%, respectively; $P = 0.04$). Recent withdrawers were admitted on average 11.0 days after OAA withdrawal. Interruption was primarily a physician decision for technical causes ($n = 27/73$). Despite a similar cardiovascular risk profile, recent withdrawers had higher 30-day rates of death or MI (21.9% versus 12.4%, $P = 0.04$) and bleedings (13.7% versus 5.9%, $P = 0.03$) than prior users. After multivariate analysis, OAA withdrawal was found to be an independent predictor of both mortality and bleedings at 30 days.

Conclusions—Among ACS patients, prior users represent a higher-risk population and present more frequently with non-ST-elevation ACS than nonusers. Although patients with a recent interruption of OAA resemble those chronically treated by OAA, they display worse clinical outcomes. (Registration: 2004-10-2361-2367.)

Key Words: acute coronary syndromes ■ aspirin ■ risk factors ■ thrombolysis

**ACC/AHA Guideline - 2002
Philosophy**

- Preoperative intervention is rarely necessary to simply lower operative risk.
- Identify most appropriate testing and treatment strategies to optimize patient care and assess short and long term risk.
- Avoid unnecessary testing in this era of cost containment.

**Maintenance of Normothermia
Associated with reduced perioperative cardiac events.**

- Frank, S.M., et al. JAMA 277 (14), 1997
 - Randomized controlled trial
 - 300 patients: abdominal, thoracic, vascular surgery
 - Known CAD or high risk for CAD
 - Outcome: Unstable angina, ischemia, MI, arrest, Ventricular tachycardia

**Maintenance of Normothermia
Associated with reduced perioperative cardiac events.**

Cardiac event	Normothermic	1.4%
	Hypothermic	6.3%
Vent tachycardia	Normothermic	2.4%
	Hypothermic	7.9%

**The NEW ENGLAND
JOURNAL of MEDICINE**

ESTABLISHED IN 1812 JANUARY 2, 2003 VOL. 348 NO. 1

**A Randomized, Controlled Trial of the Use
of Pulmonary-Artery Catheters in High-Risk Surgical Patients**

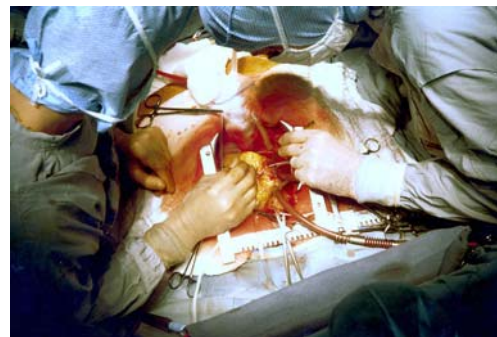
James Dean Sandham, M.D., Russell Douglas Hull, M.B., B.S., Rollin Frederick Brant, Ph.D., Linda Knox, R.N., Graham Frederick Pineo, M.D., Christopher J. Doig, M.D., Denny P. Laporta, M.D., Sidney Yinet, M.D., Louise Passerini, M.D., Hugh Devitt, M.D., Ann Kirby, M.D., and Michael Jacka, M.D., for the Canadian Critical Care Clinical Trials Group*

**The NEW ENGLAND
JOURNAL of MEDICINE**

ESTABLISHED IN 1812 JANUARY 2, 2003 VOL. 348 NO. 1

**A Randomized, Controlled Trial of the Use
of Pulmonary-Artery Catheters in High-Risk Surgical Patients**

James Dean Sandham, M.D., Russell Douglas Hull, M.B., B.S., Rollin Frederick Brant, Ph.D., Linda Knox, R.N., Graham Frederick Pineo, M.D., Christopher J. Doig, M.D., Denny P. Laporta, M.D., Sidney Yinet, M.D., Louise Passerini, M.D., Hugh Devitt, M.D., Ann Kirby, M.D., and Michael Jacka, M.D., for the Canadian Critical Care Clinical Trials Group*



**The NEW ENGLAND
JOURNAL of MEDICINE**

ESTABLISHED IN 1812 DECEMBER 30, 2004 VOL. 351 NO. 27

**Coronary-Artery Revascularization
before Elective Major Vascular Surgery**

Edward G. McFalls, M.D., Ph.D., Herbert B. Ward, M.D., Ph.D., Thomas E. Moritz, M.S., Steven Goldman, M.D., William C. Kropaki, M.D., Fred Litang, M.D., Gordon Pieper, M.D., Steve Santilli, M.D., Joseph Rapp, M.D., Bruce Hattler, M.D., Kendrick Shunk, M.D., Ph.D., Corinne Jernicke, R.N., B.S.N., Lily Thottapurathu, M.S., Nancy Ellis, M.S., Domenic J. Reba, Ph.D., and William G. Henderson, Ph.D.

ABSTRACT

BACKGROUND:

The benefit of coronary-artery revascularization before elective major vascular surgery is unclear.

METHODS:

We randomly assigned patients at increased risk for perioperative cardiac complications and clinically significant coronary artery disease to undergo either revascularization or no revascularization before elective major vascular surgery. The primary end point was long-term mortality.

RESULTS:

Coronary-artery revascularization before elective major vascular surgery was not associated with a reduction in long-term mortality.

From the Montegale Veterans Affairs (VA) Medical Center (E.G.M., H.B.W., G.P., S.L.C.) and the Department of Medicine, Division of Cardiology (E.G.M., G.P.), and the Department of Surgery (S.S.), Division of Cardiovascular and Thoracic Surgery (H.B.W.), University of Minnesota—All in Minnesota, the Cooperative Studies Program Coordinating Center (J.M., S.S., H.C., D.J.), and the Division of Peripheral Vascular Surgery (F.L.), VA Medical Center, Minneapolis, Minn.; Southern Arizona VA Health Care System and the University of Arizona School of Medicine—Tucson, Ariz. (W.G.H.); and the Department of Surgery, University of Michigan—Ann Arbor, Mich. (H.B.W.).

**Coronary Artery Revascularization
Prophylaxis Trial (CARP)**

- Elective vascular surgery
- Stable CAD, mean LVEF 54%
- Most with 1 or 2 vessel CAD
- Cardiac cath
- Randomized to coronary revasc vs. optimized medical therapy
- Exclusions
 - Left main
 - LVEF < 20
 - Unstable angina
 - Critical AS
 - Hx prior revasc without recurrent ischemia
 - Urgent / emergent surgery

Coronary Artery Revascularization Prophylaxis Trial (CARP)

- **Postoperative outcomes**
 - **Before vasc surg:** 10 deaths revasc grp; 1 death No revasc grp
 - **30 days post vasc surg:** 7 deaths revasc grp; 8 deaths No revasc grp
- **2.7 years post vascular surgery**
 - 22% mortality Revasc Grp
 - 23% mortality No Revasc grp.

Coronary Artery Revascularization Prophylaxis Trial (CARP)

- Coronary revascularization prior to vascular surgery is not of benefit in the patient with stable CAD if treated with beta blockers, aspirin, statins in the absence of:
 - unstable coronary disease
 - left main coronary disease
 - aortic stenosis
 - severe left ventricular dysfunction

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CLINICAL RESEARCH **Clinical Trials**

A Clinical Randomized Trial to Evaluate the Safety of a Noninvasive Approach in High-Risk Patients Undergoing Major Vascular Surgery

The DECREASE-V Pilot Study

Don Poldermans, MD,* Olaf Schouten, MD,† Radouar Veldhous, MD,‡ Jeroen J. Bax, MD,§
Ian R. Thomson, MD,¶ Saime E. Hacks, MSc,|| Hans H. H. Feings, MD,||
Martin Donahighios, MD,† Peter de Jaegere, MD,‡ Alexander Maat, MD,¶
Maai R. H. M. van Sandoo, MD,|| Mihailo D. Kostic, MD,† Eric Boersma, PhD,||
for the DECREASE Study Group

Rotterdam and Leiden, the Netherlands and Winnipeg, Canada

Elective vascular surgery in high risk patients.
101 patients
3 or more cardiac risk factors
All with extensive inducible ischemia by stress test
43% with LVEF < 35%
75% with Left main or 3-vd
All received beta blocker titrated to HR 60-65
Antiplatelet agents continued in perioperative period

No benefit of prophylactic coronary revascularization
Two patients died of ruptured AAA following CABG

October 23, 2007

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ACC/AHA GUIDELINE

ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery)

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, and Society for Vascular Surgery

400 new articles reviewed since 2002 guideline

ACC /AHA Preop Guideline Update, 2007: CABG prior to Non-cardiac surgery

Patients undergoing elective noncardiac procedures who are found to have prognostic high-risk coronary anatomy and in whom long-term outcome would likely be improved by coronary bypass grafting (305) should generally undergo coronary revascularization before a noncardiac elective vascular surgical procedure or noncardiac operative procedures of intermediate or high risk (Table 4).

Same Recommendation as 2002 Guideline

ACC /AHA Preop Guideline Update, 2007: CABG prior to Non-cardiac surgery

The indications for preoperative surgical coronary revascularization, therefore, are essentially identical to those recommended by the ACC/AHA 2004 Guideline Update for Coronary Artery Bypass Graft Surgery and the accumulated data on which those conclusions were based (306).

PTCA Prior to Noncardiac Surgery (planned)

“...PCI before noncardiac surgery is of no value in preventing perioperative cardiac events, except in those patients in whom PCI is independently indicated for an acute coronary syndrome.”

ACC /AHA Preop Guideline Update, 2007:
PTCA prior to Non-cardiac surgery

Circulation
Journal of the American Heart Association



2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention: Executive Summary: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Society for Cardiovascular Angiography and Interventions

Writing Committee Members: Glenn N. Levine, Eric R. Bates, James C. Blankenship, Steven R. Bailey, John A. Bittl, Bojan Cercek, Charles E. Chambers, Stephen G. Ellis, Robert A. Guyton, Steven M. Hollenberg, Umesh N. Khot, Richard A. Lange, Laura Mauri, Roxana Mehran, Issam D. Moussa, Debabrata Mukherjee, Brahmajee K. Nallamothu and Henry H. Ting

Circulation. 2011;124:2574-2609; originally published online November 7, 2011;
doi: 10.1161/CIR.0b013e31823a5596
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Class III: HARM

1. Routine prophylactic coronary revascularization should not be performed in patients with stable CAD before noncardiac surgery.^{228,229} (Level of Evidence: B)

PTCA Prior to Noncardiac Surgery (planned)

The findings from individual studies and systematic reviews of PCI versus medical therapy can be summarized as follows:

- PCI reduces the incidence of angina (370,387,392,395, 396,413).
- PCI has not been demonstrated to improve survival in stable patients (407,409,410).
- PCI may increase the short-term risk of MI (370,409,413,414).
- PCI does not lower the long-term risk of MI (370,404, 407,409,410,414).

ACC /AHA CABG Guideline, 2011

How about the patient who has already received a stent and requires noncardiac surgery ?

Drug eluting stent related issues

- Stent thrombosis
 - ASA + clopidogrel
- Hemorrhage
 - ASA + clopidogrel

The **NEW ENGLAND**
JOURNAL of MEDICINE

ESTABLISHED IN 1922 OCTOBER 2, 2009 VOL. 360 NO. 14

Sirolimus-Eluting Stents versus Standard Stents in Patients with Stenosis in a Native Coronary Artery

Jeffrey W. Moses, M.D., Martin B. Leon, M.D., Jeffrey J. Popma, M.D., Peter J. Fitzgerald, M.D., Ph.D., David R. Holmes, M.D., Charles O'Shaughnessy, M.D., Ronald P. Caputo, M.D., Dean J. Kereiakes, M.D., David O. Williams, M.D., Paul S. Teirstein, M.D., Judith L. Jang, B.A., and Richard E. Kuntz, M.D., for the SIRIUS Investigators*

ABSTRACT

BACKGROUND

Preliminary reports of studies involving simple coronary lesions indicate that a sirolimus-eluting stent significantly reduces the risk of restenosis after percutaneous coronary revascularization.

From the Lenox Hill Heart and Vascular Institute of New York, New York (J.W.M., M.B.L.); Brigham and Women's Hospital, Boston (J.J.P., R.E.K.); Stanford University

ASA 325 mg + Clopidogrel 75 mg daily / three months

**The NEW ENGLAND
JOURNAL of MEDICINE**

ESTABLISHED IN 1812 JANUARY 15, 2004 VOL. 350 NO. 3

**A Polymer-Based, Paclitaxel-Eluting Stent in Patients
with Coronary Artery Disease**

Gregg W. Stone, M.D., Stephen G. Ellis, M.D., David A. Cox, M.D., James Hermiller, M.D.,
Charles O'Shaughnessy, M.D., James TFR Mann, M.D., Mark Tarns, M.D., Ronald Caputo, M.D., Patrick Bergin, M.D.,
Joel Greenberg, M.D., Jeffrey J. Popma, M.D., and May E. Russell, M.D., for the TAXUS-IV Investigators*

ABSTRACT

BACKGROUND: Restenosis after coronary stenting necessitates repeated percutaneous or surgical revascularization procedures. The delivery of paclitaxel to the site of vascular injury may reduce the incidence of restenosis.

RESULTS: From the Cardiovascular Research Foundation and Lenox Hill Heart and Vascular Institute, New York (G.W.S.), the Cleveland Clinic Foundation, Cleveland (S.G.E.), Mid Carolina Cardiology, Charlotte, N.C. (D.A.C.); St. Vincent's Hospital, Indianapolis

ASA 325 mg + Clopidogrel 75 mg daily / six months

Lancet, October 23, 2004 **Research Letters**


Late thrombosis in drug-eluting coronary stents after discontinuation of antiplatelet therapy

Enghe P McFadden, Eugenio Stabile, Evelyn Roger, Edward Chaves, Andrew T Li Ong, Timothy Kincaid, William O Suddith, Neil Weissman, Rebecca Ferguson, Kenneth McKerr, August D Pichard, Lowell F Suttie, Ron Wakeman, Patrick W Senygey

Lancet 2004, 364: 1519-21
See comment page 1490
Thrombotic Events
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Although the safety profiles of coronary stents eluting sirolimus or paclitaxel do not seem to differ from those of bare metal stents in the short-to-medium term, concern has arisen about the potential for late stent thromboses related to delayed endothelialisation of the stent struts. We report four cases of angiographically-confirmed stent thrombosis that occurred late after elective implantation of polymer-based paclitaxel-eluting (343 and 442 days) or sirolimus-eluting (135 and 175 days) stents, and resulted in myocardial infarction. All cases arose soon after antiplatelet therapy was interrupted. If confirmed in systematic long-term follow-up studies, our findings have potentially serious clinical implications.

Metallic coronary stents are implanted in more than 1.5 million patients per year. Polymer-based coronary stents eluting sirolimus or paclitaxel substantially reduce the need for repeat percutaneous intervention compared with bare-metal stents, and drug-eluting stents are rapidly replacing bare-metal stents. A meta-analysis of 11 randomised trials (2013 patients) showed no evidence angiography showed an isolated proximal lesion of the left anterior descending artery (figure 1A). Electrophysiological investigations were negative. The patient underwent percutaneous intervention with one paclitaxel-eluting stent (3.5 mm diameter, 16 mm long; Taxus Express 2), in April, 2003 (figure 1B and 1C) and was subsequently asymptomatic. In June, 2004, a patient



September 14, 2006: FDA initial warning
December 7,8 2006: Circulatory Systems Device Advisory Panel Hearings

January 4, 2007: FDA online announcement of package insert revision.
Optimal duration of antiplatelet therapy (especially clopidogrel) is 12 months for patients at low risk of bleeding.

Prevention of Premature Discontinuation of Dual Antiplatelet Therapy in Patients With Coronary Artery Stents

A Science Advisory From the American Heart Association, American College of Cardiology, Society for Cardiovascular Angiography and Interventions, American College of Surgeons, and American Dental Association, With Representation From the American College of Physicians*

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Peter B. Lockhart, DDS, FDS RCSEd; David J. Moliterno, MD, FAHA, FSCAI, FACC;
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On-line release January 24, 2007

Joint Advisory Recommendations and Noncardiac Surgery

- Consider bare metal stent if patient requires PCI and is likely to require invasive or surgical procedure within next 12 months.
- Educate patient prior to discharge re: risk of premature antiplatelet discontinuation.
 - Instruct patient to contact treating cardiologist before antiplatelet discontinuation
- Healthcare providers who perform surgical or invasive procedures must be made aware of catastrophic risks of premature antiplatelet discontinuation and should contact the treating cardiologist to discuss optimal management strategy

Joint Advisory Recommendations and Noncardiac Surgery


- Defer elective procedures for which there is bleeding risk until completion of antiplatelet course
 - 1 month bare metal stent
 - 12 months drug eluting stent
- For patient with drug eluting stent who are to undergo procedures that mandate discontinuation of thienopyridine (eg, clopidogrel), continue aspirin if at all possible and restart thienopyridine as soon as possible
- No evidence for "bridging therapy" with antithrombins, warfarin, or glycoprotein IIb/IIIa agents

Key Points

- Clearance. Perform evaluation and make recommendations that will relate to perioperative and long – term issues.
- Tests only if likely to influence treatment.
- Preoperative coronary revascularization if independently indicated.
- Selective use of beta blockers. (beware bradycardia)
- Statins
- Beware of premature antiplatelet discontinuation in the patient post PTCA stent.
- Continue beta blocker, aspirin, statins,

MAYO CLINIC

An Overview of
Perioperative Medicine 2013:
Perioperative Medication Management



Mayo School of Continuous Professional Development

Karen F. Mauck, M.D.
 Margaret Beliveau, M.D., Geno Merli, M.D., Howard H. Weitz, M.D.,
 David R. Danielson, M.D.
 October 9-12 • Seattle, Washington

Perioperative Medication Management Objectives

- Understand the level of evidence for continuing or discontinuing medications in the perioperative period
- Review general principles
- Discussion of cases

Perioperative Medication Management Disclosures

Disclaimer

- Limited clinical trial outcome data in regards to perioperative medication management
- Substantial variation in clinical practice
- The following recommendations are expert opinion based on available evidence, clinical experience, and theoretical considerations

General Principals

- Accurate and complete medication history is essential—prescription meds, OTC meds, supplements, illicit drugs, alcohol
- Consider drug pharmacokinetics and the potential adverse effects in the perioperative setting

General Principals

- Individualize recommendations
 - Medical co-morbidities
 - Type and extent of surgical procedure
 - Indication for the medication
 - Absorption, half-life, metabolism, elimination and withdrawal risks for each medication and the potential drug-drug interaction

General Principals

- Communication is key
 - Which medications should be held and for how long prior to surgery
 - Which medications should be taken on the morning of surgery and which should not
 - For medications that are held, indicate when they can be restarted
 - Write it down



Perioperative Physiological Changes

- **Surgical stress response**
 - ↑ Secretion of ACTH, growth hormone, vasopressin, cortisol and aldosterone
 - ↓ Secretion of insulin and thyroxine
 - ↑ Sympathetic activity
- **Gut response**
 - ↓ Gastric emptying
 - ↓ Absorption (decreased splanchnic blood flow, edema, decreased mucosal transport)
 - ↓ Motility (ileus)



Pass SE, 2004 Am J Health-Syst Pharm:61(9) pg:899-912

Bottom Line

- Most medications are tolerated well through surgery and do not interfere with anesthetic administration
- Therefore, continue most medications through the morning of surgery unless totally unnecessary or contraindicated



Cases to Consider

- Audience response
- Panel response/ discussion
- Purposefully omitting (covered later in course)
 - Anticoagulant/ antiplatelet drugs other than ASA/ NSAIDs
 - Anti-rheumatic agents/ Biologic agents
 - Diabetic agents
 - Parkinson's meds/ Seizure meds



Case 1

- 68 year old male scheduled for an elective total hip replacement
- Hx of hypertension, controlled on HCTZ 25mg/d, lisinopril 20 mg/d, amlodipine 20 mg/d; BPH on tamsulosin 0.4 mg/d
- No history of DM, CAD, CHF or CVA
- Exam: Pulse 68, reg; BP 165/95; Lungs clear, Heart RRR, no murmurs; Extremities with no edema
- Labs: Cr 1.0 mg/dl; K 4.2 mg/dl



What do you recommend regarding his medications on the morning of surgery?

1. Take all medications
2. Take amlodipine, lisinopril and tamsulosin; hold HCTZ
3. Take amlodipine and tamsulosin; hold lisinopril and HCTZ
4. Take amlodipine only; hold all others
5. Hold all medications



Panel—Take or Hold?

- Amlodipine
- Hydrochlorothiazide
- Lisinopril
- Tamsulosin



Case 2

- 73 year old female scheduled for a right hemicolectomy for colon cancer
- Hx of type 2 DM on insulin
- Chronic renal insufficiency with baseline creatinine 1.7 mg/dl
- Hx of CAD: s/p MI with DES to LAD 2 yrs ago, no new sx
- NYHA class 2 CHF: EF 35% on last echo



Case 2 continued

- Medications: Insulin, aspirin 150 mg/ d, metoprolol 50 mg/dl; lisinopril 20 mg/dl; furosemide 20 mg daily
- Exam: P 70 bpm; BP 110/72 mmHg
- Lungs and heart exam unremarkable, trace lower extremity edema



What do you recommend regarding her medications on the morning of surgery?

1. Take all medications
2. Take metoprolol, lisinopril and aspirin; hold furosemide
3. Take metoprolol and lisinopril; hold aspirin and furosemide
4. Take metoprolol and aspirin only; hold lisinopril and furosemide
5. Hold all medications



Panel—Take or Hold?

- Metoprolol
- Lisinopril
- Furosemide
- Aspirin



Summary Antihypertensive Agents

Medication	Preop Mgmt	Comments
Alpha-2-Agonists (Clonidine, Guanfacine, Methyldopa)	Take	<ul style="list-style-type: none"> • Central acting sympatholytic which may improve postop cardiac outcomes • Decreases stress response to surgery; anxiolytic and analgesic effects • Withdrawal associated with rebound hypertension and tachycardia • Convert clonidine patch to oral dosing
Alpha-1-Receptor Antagonists (Alfuzosin, Doxazosin, Prazosin, Terazosin, Tamsulosin)	Take	<ul style="list-style-type: none"> • Cataract surgery; risk of intraoperative floppy iris syndrome; modification to surgical technique may be necessary
Beta Blockers (Acebutolol, Atenolol, Bisoprolol, Metoprolol, Nadolol, Nebivolol, Propranolol, Sotalol)	Take	<ul style="list-style-type: none"> • Beta blockers reduce ischemia and may help prevent or control arrhythmias • Increased risk of ischemia with withdrawal of beta blockade • Use judiciously in patients with SBP < 110

Summary Antihypertensive Agents

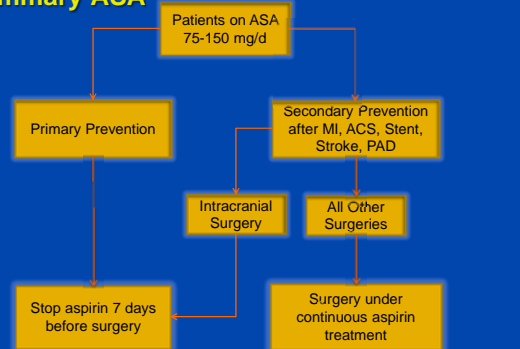
Medication	Preop Mgmt	Comments
ACE Inhibitors (Captopril, Enalapril, Ramipril, Quinapril, Perindopril, Lisinopril, Benazepril, Monopril)	Take/ Hold	<ul style="list-style-type: none"> Consider holding if BP is low, renal function is impaired and/or large surgery with fluid shifts Holding preop can be associated with significant, often refractory hypertension postop
Angiotensin Receptor Blockers (Candesartan, Eprosartan, Irbesartan, Telmisartan, Valsartan, Losartan, Olmesartan)	Take/ Hold	<ul style="list-style-type: none"> Consider holding if BP is low, renal function is impaired and/or large surgery with fluid shifts Holding preop can be associated with significant, often refractory hypertension postop
Calcium Channel Blockers (Amlodipine, Diltiazem, Felodipine, Isradipine, Nicardipine, Nifedipine, Nisoldipine, Verapamil)	Take	<ul style="list-style-type: none"> Take unless preop blood pressure is low



Summary Antihypertensive Agents

Medication	Preop Mgmt	Comments
Diuretics (Chlorothiazide, Hydrochlorothiazide, Indapamide, Metolazone, Bumetanide, Ethacrynic acid, Furosemide, Torsemide, Amiloride, Eplerenone, Spironolactone, Triamterene)	Hold	<ul style="list-style-type: none"> Potential for volume depletion and electrolyte issues For outpatient surgery or minor surgical procedures, probably OK to take thiazide diuretics on the morning of surgery
Nitrates (Isosorbide dinitrate, Isosorbide mononitrate, Nitroglycerin)	Take/ Hold	<ul style="list-style-type: none"> Take if oral Hold nitropaste or nitropatch (transcutaneous absorption is unreliable intraoperatively)
Vasodilators (Hydralazine, Minoxidil)	Take	<ul style="list-style-type: none"> Take unless preop blood pressure is low

Summary ASA



Chassof PG BJA 99:316-28, 2007



Case 3

- 55 year old male with long standing bipolar disorder presents for preop eval prior to planned partial bowel resection for colon cancer
- Bipolar disorder well controlled on lithium 600 mg BID and aripiprazole 15 mg/day
- Anxiety treated with clonazepam 2 mg/day
- No history of significant medical problems other than colon cancer and hypertension
- Creatinine is 1.5 mg/dl, electrolytes and TSH nl
- He is expected to be NPO for 2-4 days postop



What do you recommend regarding his psychiatric medications perioperatively?

- Take all medications on AM of surgery, continue periop with meds per NG if needed
- Take lithium on AM of surgery, hold aripiprazole and clonazepam, resume when taking PO
- Hold lithium 2-3 days preop, take aripiprazole and clonazepam on the morning of surgery and resume via NG postop, resume lithium when renal function and electrolytes stable postop
- Hold all medications preop, resume when taking PO



Panel—Take or Hold?

- Lithium
- Aripiprazole
- Clonazepam



Case 4

- 75 year old female scheduled for lumbar decompression of L3-L4 tomorrow
- Past history includes depression—currently treated with paroxetine 20 mg/d, bupropion 150 mg BID
- She also has a history of peripheral neuropathy and is taking nortriptyline 50 mg/d (HS)
- Exam: unremarkable
- ECG: normal; creatinine and electrolytes normal



What do you recommend regarding her psychiatric medications perioperatively?

1. Take nortriptyline the evening before surgery and take both paroxetine and bupropion on the morning of surgery, continue all throughout the periop period via NG if needed
2. Hold nortriptyline the evening before and take paroxetine and bupropion on the morning of surgery, resume all when taking PO
3. Take nortriptyline the evening before, hold paroxetine and bupropion and resume all when taking PO
4. Hold all three medications preoperatively, resume **when taking PO**



Panel—Take or Hold?

- Paroxetine
- Bupropion
- Nortriptyline



Summary Psychiatric Agents

Medication	Preop Mgmt	Comments
Antipsychotics <ul style="list-style-type: none"> • Conventional (Prochlorperazine, Haloperidol, Loxapine, Thioridazine, Molidone, Thithixene, Fluphenazine, Pimozide, Trifluoperazine, Chlorpromazine, Perphenazine) • Atypical (Aripiprazole, Asenapine Maleate, Clozapine, Iloperidone, Lurasidone, Olanzapine, Paliperidone, Quetiapine, Risperidone, Ziprasidone) 	Take/ Hold	<ul style="list-style-type: none"> • Withdrawal symptoms similar to cholinergic rebound seen when antipsychotics are stopped abruptly • Use of conventional and atypical antipsychotic agents associated with arrhythmias and sudden death; monitor for ECG changes • Consider holding preop for minor surgical procedures or outpatient surgery because of the risk of excessive sedation limiting ability to safely discharge • Caution: Using multiple drugs with sedative properties is associated with adverse postop outcomes; antipsychotic agents can potentiate the effect of narcotics



Summary Psychiatric Agents

Medication	Preop Mgmt	Comments
Benzodiazepines (Alprazolam, Chlordiazepoxide, Clonazepam, Clorazepate, Diazepam, Estazolam, Flurazepam, Halazepam, Lorazepam, Midazolam, Oxazepam, Prazepam, Quazepam, Temazepam, Triazolam, Zaleplon, Zolpidem)	Take	<ul style="list-style-type: none"> • Abrupt withdrawal from a patient on chronic therapy can lead to excitatory state, including delirium and seizures • Consider holding preop for minor surgical procedures or outpatient surgery because of the risk of excessive sedation limiting ability to safely discharge • Caution: Using multiple drugs with sedative properties is associated with adverse postop outcomes
Cholinesterase Inhibitors (Donepezil, Galantamine, Rivastigmine)	Take	<ul style="list-style-type: none"> • Cholinesterase inhibitors may interact with muscle relaxants given during general anesthesia
NMDA Receptor Antagonists (Memantine, Amantadine)		



Summary Psychiatric Agents

Medication	Preop Mgmt	Comments
Lithium	Take/ Hold	<ul style="list-style-type: none"> • May potentiate the effect of pancuronium and succinylcholine • Clearance reduced and toxicity increased by negative fluid balance, negative sodium balance, and decreased glomerular filtration rate • Toxicity of lithium can be increased by drugs that reduce lithium excretion or increase reabsorption in the kidney; drugs such as NSAIDs, ACE-inhibitors, thiazide diuretics, and metronidazole • Assess TSH, Na, K and Cr preop for any patient taking lithium • Hold 2-3 days before major surgery and resume when renal function and electrolyte levels are stable postop • For minor surgical procedures, OK to take on the morning of surgery



Summary Psychiatric Agents

Medication	Preop Mgmt	Comments
SSRIs (Citalopram, Escitalopram, Fluvoxamine, Paroxetine, Fluoxetine, Sertraline) SNRIs (Desvenlafaxine, Duloxetine, Milnacipran, Nefazodone, Sibutramine, Venlafaxine) Aminoketones (Bupropion) Other (Buspirone)	Take	<ul style="list-style-type: none"> Withdrawal associated with dizziness, GI complaints, palpitations, sleep disturbance, anxiety, agitation May increase transfusion with surgery due to platelet aggregation effect Continue perioperatively, but monitor for drug-drug interactions



Summary Psychiatric Agents

Medication	Preop Mgmt	Comments
Tricyclic / Tetracyclic Antidepressants (Amitriptyline, Amoxapine, Clomipramine, Desipramine, Doxepin, Imipramine, Maprotiline, Nortriptyline, Protriptyline, Trimipramine)	Take/ Hold	<ul style="list-style-type: none"> Abrupt withdrawal of tricyclic antidepressants can lead to insomnia, nausea, headache, increased salivation, and sweating TCAs potentiate the circulatory effects of adrenaline and noradrenaline; risk for hypertensive crisis related to the amine reuptake-blocking properties Caution: TCAs lower seizure threshold, prolong QT, increase the risk for arrhythmias in combination with some volatile anesthetics or sympathomimetic agents Caution: Using multiple drugs with sedative properties is associated with adverse postop outcomes For major surgery, it can be stopped, but needs to be tapered over 2 weeks For outpatient or minor surgical procedures, probably OK to take on the morning of surgery

Summary Psychiatric Agents

Medication	Preop Mgmt	Comments
Monoamine Oxidase Inhibitors <ul style="list-style-type: none"> Reversible MAOIs (none in US) Irreversible MAOIs (Phenelzine, Isocarboxazid, Tranylcypromine) 	Hold/ Take	<ul style="list-style-type: none"> Serotonergic risk and hemodynamic instability; Serotonergic risk can be minimized by avoiding drugs that prevent presynaptic uptake of serotonin; Hemodynamic instability risk is much less controllable MAOIs interact with other psychoactive substances in addition to tryptamines; effects of amphetamines, general anaesthetics, sedatives, anti-histamines, alcohol, potent analgesics and anticholinergic and antidepressant agents are prolonged and intensified (particularly in patients taking irreversible MAOIs) Hold reversible MAOIs 24 hours before surgery; Hold irreversible MAOIs for 2 weeks preop (consult psychiatry for assistance); resume both when hemodynamically stable and taking po postop For minor surgical procedures, OK to take on the morning of surgery; just make anesthesiologist aware



Case 5

- 55 year old male is scheduled for an elective L2-L4 fusion
- Past history includes hypertension, mixed hyperlipidemia, CAD, paroxysmal atrial fibrillation and DJD
- Lipid medications include atorvastatin 40 mg/d, fish oil 2000 mg BID, and cholestyramine 4 g BID
- He takes all of his medications in the morning



What do you recommend regarding his lipid medications perioperatively?

- Take all medications on the morning of surgery
- Take atorvastatin and fish oil on the morning of surgery; hold the cholestyramine
- Take atorvastatin on the morning of surgery, hold fish oil and cholestyramine
- Hold all lipid medications on the morning of surgery



Panel—Take or Hold?

- Atorvastatin
- Fish Oil
- Cholestyramine



Summary Lipid Lowering Agents

Medication	Preop Mgmt	Comments
Bile Sequestrant Drugs (Cholestyramine, Colesevelam, Colestipol)	Hold	<ul style="list-style-type: none"> May interfere with bowel absorption of drugs
Ezetimibe	Hold	<ul style="list-style-type: none"> Theoretic: rhabdomyolysis
Fibrates (Clofibrate, Fenofibrate, Gemfibrozil)	Hold	<ul style="list-style-type: none"> Theoretic: rhabdomyolysis
Fish Oil	Take	<ul style="list-style-type: none"> May decrease risk of postop afib May be associated with increased bleeding risk if given with other anticoagulants
Niacin	Hold	<ul style="list-style-type: none"> Theoretic: rhabdomyolysis
Statins (Atorvastatin, Fluvastatin, Lovastatin, Pitavastatin, Pravastatin, Simvastatin, Rosuvastatin)	Take	<ul style="list-style-type: none"> May prevent vascular events through mechanisms other than cholesterol lowering (eg, plaque stabilization, reduction in inflammation, decreased thrombogenesis) Withdrawal may be associated with increased risk of adverse cardiac outcomes.

Case 7

- 72 year old male scheduled for bilateral inguinal hernia surgery
- Past history significant for BPH for which he takes finasteride and doxazosin
- Also takes oxybutynin for overactive bladder

What do you recommend regarding his urologic medications perioperatively?

- Take all medications on the morning of surgery
- Take finasteride and doxazosin preoperatively, but hold oxybutynin
- Take oxybutynin, hold finasteride and doxazosin
- Take finasteride and oxybutynin but hold doxazosin

Panel—Take or Hold?

- Finasteride
- Doxazosin
- Oxybutynin

Summary Urologic Agents

Medication	Preop Mgmt	Comments
Alpha-1-Receptor Antagonists (Alfuzosin, Doxazosin, Prazosin, Terazosin, Tamsulosin)	Take	<ul style="list-style-type: none"> Cataract surgery; risk of intraoperative floppy iris syndrome; modification to surgical technique may be necessary
Oxybutynin / Tolterodine	Hold	<ul style="list-style-type: none"> Increases anticholinergic side effects (urinary retention, confusion, constipation, slowed gastric emptying) Increases sedative side effects of CNS depressant during periop period Resume when these potential risks are no longer an issue postop
5-Alpha Reductase Inhibitors (Finasteride, Dutasteride)	Take	<ul style="list-style-type: none"> Cataract surgery; case reports of increased risk of intraoperative floppy iris syndrome

Case 9

- A 45 year old male is seen for preop evaluation prior to a planned total hip arthroplasty
- History significant for hiatal hernia and gastroesophageal reflux treated with omeprazole BID
- Has a history of Crohn's disease for which he takes sulfasalazine—symptoms controlled
- Uses Ibuprofen 800 TID for arthritis pain
- Electrolytes and creatinine normal

What do you recommend regarding his GI medications perioperatively?

1. Take omeprazole and sulfasalazine on the morning of surgery, hold the ibuprofen 3 days prior to surgery
2. Take omeprazole, hold sulfasalazine on the morning of surgery and ibuprofen 3 days prior to surgery
3. Take sulfasalazine, hold omeprazole on the morning of surgery and ibuprofen 3 days prior to surgery
4. Hold all three medications on the morning of surgery



Panel—Take or Hold?

- Omeprazole
- Sulfasalazine
- Ibuprofen



Summary GI Agents

Medication	Preop Mgmt	Comments
Aminosalicylates (Balsalazide, Mesalamine, Olsalazine, Sulfasalazine)	Hold/ Take	<ul style="list-style-type: none"> • Renally cleared • Discontinue before surgery with resumption 3 days after surgery • For outpatient surgery or minor surgical procedures, OK to take on the morning of surgery
H2 Blockers (Cimetidine, Famotidine, Nizatidine, Ranitidine)	Take	<ul style="list-style-type: none"> • Cimetidine can alter the metabolism of several drugs
Hyoscylamine	Hold	<ul style="list-style-type: none"> • Increases anticholinergic side effects (urinary retention, confusion, constipation, slowed gastric emptying) • Resume when these potential risks are no longer an issue postop • Increases risk of regurgitation during induction of anesthesia



Summary GI Agents

Medication	Preop Mgmt	Comments
Metoclopramide	Take	<ul style="list-style-type: none"> • Mild anticholinergic side effects • Multiple drug-drug interactions
Promethazine	Hold	<ul style="list-style-type: none"> • Increases anticholinergic side effects (urinary retention, confusion, constipation, slowed gastric emptying) • Caution: Using multiple drugs with sedative properties is associated with adverse postop outcomes
Proton Pump Inhibitors (Dexlansoprazole, Esomeprazole, Lansoprazole, Omeprazole, Pantoprazole, Rabeprazole)	Take	<ul style="list-style-type: none"> • GI protection • Decrease risk of chemical pneumonitis with aspiration



Summary NSAIDs/ Pain Medications

Medication	Preop Mgmt	Comments
NSAIDs (Celecoxib, Diclofenac, Diflunisal, Etodolac, Ibuprofen, Indomethacin, Ketoprofen, Ketorolac, Meloxicam, Nabumetone, Naproxen, Oxaprozin, Piroxicam, Salsalate, Sulindac, Tolmetin)	Hold	<ul style="list-style-type: none"> • Reversible inhibition of platelet cyclooxygenase (COX), diminished thromboxane A2 production, diminished platelet aggregation, can increase bleeding risk • Can increase risk of acute kidney injury periop • Hold NSAIDs 3 days before surgery, especially in surgical procedures at high risk for bleeding complications
Tramadol/ Tapentadol	Take	<ul style="list-style-type: none"> • Lowers seizure threshold • If chronic use (stable dose > 4 weeks), these should be continued perioperatively • Caution: Using multiple drugs with sedative properties is associated with adverse postop outcomes



Summary Opiates

Medication	Preop Mgmt	Comments
Opiates (Buprenorphine, Codeine, Fentanyl, Hydrocodone, Hydromorphone, Morphine, Oxycodone, Oxymorphone)	Take	<ul style="list-style-type: none"> • If chronic use (stable dose > 4 weeks), these should be continued periop • Will likely need higher opioid doses postop for adequate pain control • Holding opiates in patients on chronic treatment often results in difficult to control pain postoperatively • Withdrawal syndrome associated with GI symptoms, diaphoresis, irritability, sleep disturbance and rhinorrhea • Caution: For patients at high risk for pulmonary complications, may consider reducing or holding dose preop • Caution: Using multiple drugs with sedative properties is associated with adverse postop outcomes
Methadone	Take	<ul style="list-style-type: none"> • Get pain medicine involved for patients taking methadone and undergoing surgery

Case 13

- 54 year old postmenopausal female is scheduled for a total abdominal hysterectomy with bilateral salpingo-oophorectomy tomorrow
- Past medical history significant for DJD and gout
- Medications include conjugated estrogen 0.3 mg/ day and medroxyprogesterone acetate 2.5mg/ day for hot flashes and allopurinol 300 mg/ day



What do you recommend regarding her medications perioperatively?

1. Take all medications on the morning of surgery
2. Take hormones, but hold allopurinol on the morning of surgery
3. Take allopurinol, but hold hormones on the morning of surgery
4. Hold all medications on the morning of surgery



Panel—Take or Hold?

- Conjugated estrogen
- Medroxyprogesterone acetate
- Allopurinol



Summary Gout Agents

Medication	Preop Mgmt	Comments
Allopurinol	Take	<ul style="list-style-type: none"> • Try to avoid interruption of treatment to prevent gout flare • If held, resume as soon as possible when taking po
Colchicine	Take	<ul style="list-style-type: none"> • Continue if patient is taking chronically, but monitor liver and renal function and for symptoms of toxicity • Do not start this medication in the perioperative setting
Febuxostat	Take	<ul style="list-style-type: none"> • Try to avoid interruption of treatment to prevent gout flare • If held, resume as soon as possible when taking po



Summary Hormonal Agents

Medication	Preop Mgmt	Comments
Estrogen Replacement Therapy	Take/Hold	<ul style="list-style-type: none"> • Modest increase in DVT risk • If stopped to decrease risk of DVT, needs to be stopped for 4-6 wks preop; resume 2-4 weeks postop
Oral Contraceptives	Take	<ul style="list-style-type: none"> • Modest increase in DVT risk • Most often, these are just continued without interruption perioperatively • If stopped to decrease risk of DVT, needs to be stopped for 6 wks preop; resume 2-4 weeks postop
Selective Estrogen Receptor Modifiers (SERMS) (Raloxifene, Tamoxifen, Toremifene)	Take/Hold	<ul style="list-style-type: none"> • Increased risk of DVT • If taken for osteoporosis or breast cancer prevention, OK to hold (4 wks preop); resume 2-4 weeks postop • If taken for breast cancer treatment consult with oncologist • Toremifene associated with prolonged QT and Torsades. • Monitor magnesium, potassium




Summary Hormonal Agents

Medication	Preop Mgmt	Comments
GnRH Antagonists (Leuprolide, Goserelin, Buserelin, Degarelix)		<ul style="list-style-type: none"> • Increased risk of thromboembolism • Prolongation of the QT interval may occur (Leuprolide)
Antiandrogens (Flutamide, Bicalutamide, Nilutamide)		<ul style="list-style-type: none"> • Increased risk of thromboembolism • Anemias, leukopenias, thrombocytopenias: check CBC
Aromatase Inhibitors (anastrozole, letrozole, exemestane)		<ul style="list-style-type: none"> • Increased risk of thromboembolism • Anemias, pancytopenias, leukopenias: check CBC



MAYO CLINIC

An Overview of
Perioperative Medicine 2013:
 From Outpatient Preoperative Assessment
 to Inpatient Postoperative Care



Mayo School of Continuous Professional Development

Robert H. Lohr, MD
 Pre-operative testing: What is really needed?
 October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

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Disclosures

- No financial disclosures
- No discussion of “off label” use of drugs

MAYO CLINIC

Objectives

- To understand the rationale for evidence based preoperative testing
- To understand when preoperative testing is not indicated...Most of the time!

MAYO CLINIC

Today's Outline

- Background
- Cases
- Discussion/rationale
- Back to our cases
- Questions

MAYO CLINIC

Is Preoperative Testing a Problem

- Yes, and a big one
 - It wastes valuable resources
 - It exposes patients to needless blood work and procedures
 - It can create anxiety for patients
 - It is costly...\$30 billion/year (1987 \$)
 - It is still a problem-
 surgeons>anesthesiologists>preoperative directors
- Katz, Anesth Analg 2011
- Roizen, Anesthesiol Clin North Am 1987

MAYO CLINIC

Why Should we Test?

- To identify or verify a condition which could affect anesthetic care
- To help formulate or modify anesthetic care of the patient
- Can the identified risk be mitigated?
 - Cardiac
 - Pulmonary
 - Drugs
 - Bleeding, clotting, and bridging
 - DM
 - Other (liver, kidneys, endocrine)

Anesthesiology 2012 (ASA Practice Advisory for Preanesthesia Evaluation)

MAYO CLINIC

How Do You Decide?

- My last case (that went south...)
- What my chief resident told me to do
- EBM
- Guidelines...which ones?
- Hospital policies...who develops?



Case 1

- You are asked to see a 43 year old male for a preoperative medical evaluation. He is scheduled for an inguinal hernia repair next week
- His past medical history is notable only for obesity (BMI 32) and an uncomplicated ORIF of a tib-fib fracture at age 14
- He has never used tobacco and has 1-2 oz of EtOH/week



Case 1

- He does construction work and can easily exceed > 4 METS of activity
- He takes only a men's multivitamin daily
- His exam is noteworthy for his weight and an easily reducible R inguinal hernia.



Case 1

- For preoperative testing you order:
 - A) An ECG and CBC
 - B) An ECG and creatinine
 - C) A CBC and creatinine
 - D) A CBC and INR
 - E) No tests



Case 2

- You are asked to see a 78 year old female for a preoperative medical evaluation. She is scheduled for an elective R TKA tomorrow
- Her past medical history is noteworthy for hypertension, hyperlipidemia, obesity, DJD, and coronary artery disease for which she received 2 drug eluting stents 4 years ago.



Case 2

- She has had a hysterectomy and carpal tunnel repair in the past without complication
- Her medications include lisinopril/HCTZ, simvastatin, metoprolol, aspirin
- She is limited in her activity due to her knee, but was able to do >4METS of activity within the past several months



Case 2

- Her exam reveals a BP of 143/80, P 60, BMI of 37, and a moderate effusion on the R knee. Cardiovascular and pulmonary exams are normal
- You have an ECG available (NSR, non-specific lateral ST changes) from 3 months ago
- You have no other laboratory data available



Case 2

- Preoperatively you order:
 - A) An ECG, electrolytes, creatinine
 - B) Electrolytes, creatinine
 - C) An ECG, electrolytes, creatinine, and INR
 - D) Electrolytes, creatinine, ECG, and a dobutamine stress Echo
 - E) No testing



Case 3

- You are asked to see a 58 year old male for a preoperative medical evaluation. He is scheduled for a R TSA next week
- His past medical history is significant for hepatitis C but no history of cirrhosis. He had an inguinal hernia repaired as a child without complication. He has had no recent follow up regarding his liver.
- Medications include a multivitamin



Case 3

- His functional capacity is excellent, exceeding 4 METS
- His exam is normal except for a decreased range of motion of his R shoulder



Case 3

- Preoperatively you order:
 - A) An ECG, electrolytes, creatinine
 - B) Electrolytes, LFT, creatinine
 - C) LFT, INR, creatinine
 - D) INR and aPTT
 - E) No studies



Case 4

- You are asked to do a pre-operative evaluation for a 23 year old female college basketball point guard for repair of a torn L ACL
- She reports herself to be in excellent health, no prior surgery, having irregular menstrual periods felt secondary to her level of physical activity
- She is taking no medicines and her physical exam is normal except for her L knee



Case 4: You order pre-operatively

- CBC
- EKG
- PT/PTT
- Pregnancy testing
- No testing



Should we test?

The Usefulness of Preoperative Laboratory Screening

Eric B. Kaplan, MD; Lewis B. Shainer, MD; Alison J. Boeckmann, MS; Michael F. Holzer, MD; Stuart L. Beal, PhD; Stephen N. Cohen, MD; C. Diana Nicol, MD, PhD

• We assessed the usefulness of routine laboratory screening of preoperative patients. Computer-readable laboratory, demographic, and discharge diagnostic data were assembled for 2,000 patients undergoing elective surgery over a four-month period, and randomly selected samples of patients were studied. Several tests ordered by protocol and performed by the laboratory at the time of admission were examined in these samples, including complete blood cell count, differential cell count, prothrombin time, partial thromboplastin time, platelet count, six-factor automated multiple analysis, and glucose level.

Sixty percent of these routinely ordered tests would not have been performed if testing had only been done for recognizable indications, and only 0.22% of these revealed abnormalities that might influence perioperative management. Chest x-rays indicated that these few abnormalities were not acted on nor did they have adverse surgical or anesthetic consequences. In the absence of specific indications, routine preoperative laboratory tests contribute little to patient care and could reasonably be eliminated. (JAMA 1989;263:3576-3581)

• Routine preoperative laboratory screening of patients is a common practice. For this study, we performed a retrospective analysis of 2,000 patients undergoing elective surgery over a four-month period. Several tests ordered by protocol and performed by the laboratory at the time of admission were examined in these samples, including complete blood cell count, differential cell count, prothrombin time, partial thromboplastin time, platelet count, six-factor automated multiple analysis, and glucose level. Sixty percent of these routinely ordered tests would not have been performed if testing had only been done for recognizable indications, and only 0.22% of these revealed abnormalities that might influence perioperative management. Chest x-rays indicated that these few abnormalities were not acted on nor did they have adverse surgical or anesthetic consequences. In the absence of specific indications, routine preoperative laboratory tests contribute little to patient care and could reasonably be eliminated. (JAMA 1989;263:3576-3581)



Preoperative testing: Should we do anything?

- Narr et al.
 - Randomized 1044 patients who had **NO** preoperative testing, age 0-95, median 21
 - Deaths: 0.0%
 - 17 intraoperative lab tests; 3 abnormal
 - No testing done intraoperatively or postoperatively changed management
 - Narr. Mayo Clin Proc 1997;72:505-509



Should we Test?

- Preoperative testing should be dictated by the patient's clinical condition and abnormal findings on history or exam
- Preoperative testing is **NOT INDICATED** unless there is a specific reason to perform the test and the result will change management, or mitigate perioperative risk



The Preoperative ECG

- No prospective, randomized clinical controlled trials
- No good, prospective outcome data for or against
- Lots of retrospective reviews, case series, cohort studies
- Lots of complicated, conflicting consensus statements regarding pre-operative ECG
- Main cardiovascular risk assessment guidelines use ECG to risk stratify



Pre-op ECG

- The prevalence of an abnormal ECG increases with age with up to 75% of people older than 75 having an abnormal ECG
 - There is evidence suggesting poorer outcomes in patients with abnormal ECGs
 - RR 4.5 (3.3-6.0) of death
 - However, absolute risk reduction only 0.5% with low and intermediate risk surgery
- Noordzij. Am J Cardiol 97(7): 1103-1106



ECGs?

- Conflicting recommendations amongst consensus organizations
 - ACC/AHA
 - ASA
 - ICSI
 - ESC/ESA



ECGs?

ECG YES

- CV symptoms/signs
- Known stable cardiac disease
- Risk factors and intermediate or high risk surgery
 - RCRI ≥ 1
 - CAD equivalent



ECGs?

ECG NO

- Low risk surgery and low risk patient
- Cataract surgery

ECG MAYBE

- Low risk patient and intermediate risk surgery
- Risk factors and low risk surgery



Coagulation Studies?

- Coagulation studies only as indicated by H&P
- What about high risk surgery e.g. neurosurgery: "Patient history was as predictive as lab testing for all outcomes (and had) higher sensitivity"
Seicean, J Neurosurg 2012
 - Known h/o bleeding disorder or previous bleeding complications
 - On current anticoagulation
 - H&P suggests bleeding or coagulation problems



CBC?

- H&P findings suggestive of abnormality
 - Known cytopenia
 - Recent chemo
 - h/o bleeding
 - pallor
- ? Anticipated large surgical blood loss
- ? Situation where even mild anemia could be significant



Electrolytes, Creatinine?

- Lytes, creatinine
 - Patients on diuretics
 - Patients with known renal failure
 - ? Patients on digoxin



CXR?

- Frequent abnormalities --- 10-23.1%
- Rarely influence management --- < 0.1-3%
- Predictable from H&P
- Who follows up on the abnormality? --- source for missed opportunity, "falling through the cracks"
 - Qaseen A et al. *Ann Intern Med.* 2006; 144: 575-580



Albumin?

- Powerful predictor of perioperative complications
 - Pulmonary complications increased
 - Infectious complications increased
 - Wound healing issues
 - In some settings the strongest predictor of morbidity and mortality
- Gibbs J et al. *Arch Surg.* 1999;134:36-42



Albumin?

- Consider serum albumin
 - If modifiable risk factor present
 - AND it would change your perioperative management



Glucose?

- No good evidence for or against
- Will it change my management?
 - Would I delay surgery if it was high?
 - Would my perioperative management change?



LFTs?

- Play it again Sam...only if there is suspicion of liver disease on the basis of history, exam, or previous liver function abnormality
 - www.nature.com/clinicalpractice/gasthep
- If there are indications to perform LFTs, include INR, bilirubin, creatinine in order to calculate MELD score which predicts post operative mortality due to liver disease
 - *Gastroenterology* 2007;132:1261-1269



Pregnancy Testing

- 2056 women of child bearing age tested before elective ambulatory surgery
 - 7 had + pregnancy testing (0.3%)
 - Cost of pregnancy discovered: \$2879
 - All cancelled their surgery
 - 2558 women of child bearing age tested before elective orthopaedic surgery
 - 5 had + pregnancy testing (0.2%)
 - Cost of discovered pregnancy: \$3273
- Anesthesiology 1995
Anesth Analg 2008



Pregnancy Testing

- "...the literature is inadequate to inform patients or physicians on whether anesthesia causes harmful effects on early pregnancy. Pregnancy testing may be offered to female patients of childbearing age and for whom the result would alter the patient's management."

Anesthesia 2012 (ASA Practice Advisory for Preanesthesia Evaluation)



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Case 2

- She has had a hysterectomy and carpal tunnel repair in the past without complication
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- She is limited in her activity due to her knee, but was able to do >4METS of activity within the past several months



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 - B) **Electrolytes, creatinine**
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Case 3

- His functional capacity is excellent, exceeding 4 METS
- His exam is normal except for a decreased range of motion of his R shoulder



Case 3

- Preoperatively you order:
 - A) An ECG, electrolytes, creatinine
 - B) Electrolytes, LFT, creatinine
 - C) **LFT, INR, creatinine**
 - D) INR and aPTT
 - E) No studies



Case 4

- You are asked to do a pre-operative evaluation for a 23 year old female basketball guard for repair of a torn L ACL
- She reports herself to be in excellent health, no prior surgery, having irregular menstrual periods felt secondary to her level of physical activity
- She is taking no medicines and her physical exam is normal except for her L knee



Case 4: You order pre-operatively

- CBC
- EKG
- PT/PTT
- Pregnancy testing
- No testing



Take Home Points

- ALL PREOPERATIVE TESTING SHOULD BE DICTATED BY YOUR HISTORY AND EXAM



Thank You

- QUESTIONS



The Patient with Non – CAD Cardiac Disease

An Overview of Perioperative Medicine 2013
October 2013

Howard Weitz, M.D.
Jefferson Medical College
Thomas Jefferson University Hospitals

Valvular Heart Disease

- Aortic stenosis
- Mitral regurgitation
 - Beware of left ventricular dysfunction.
- Aortic regurgitation
 - Bradycardia may increase regurgitant flow.
- Mitral stenosis
 - Tachycardia will impair left ventricular filling.

The New England Journal of Medicine

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MULTIFACTORIAL INDEX OF CARDIAC RISK IN NONCARDIAC SURGICAL PROCEDURES

LEE GOLDMAN, M.D., M.P.H., DEBRA L. CALDERA, R.N., SAMUEL R. NUSBAUM, M.D.,
FREDERICK S. SOUTHWICK, M.D., DONALD KROGGSTAD, M.D., BARBARA MURRAY, M.D.,
DONALD S. BURKE, M.D., TERRANCE A. O'MALLEY, M.D., ALLAN H. GOROLL, M.D.,
CHARLES H. CAPLAN, M.D., JAMES NOLAN, M.D., BLASE CARABELLO, M.D.,
AND EVE E. SLATER, M.D.

Abstract To determine which preoperative factors might affect the development of cardiac complications after major noncardiac operations, we prospectively studied 1001 patients over 40 years of age. By multivariate discriminant analysis, we identified nine independent significant correlates of life-threatening and fatal cardiac complications: preoperative third heart sound or jugular venous distention; myocardial infarction in the preceding six months; more than five premature ventricular contractions per minute documented at any time before operation; rhythm other than sinus or presence of premature atrial contractions on preoperative electrocardiogram; age over 70 years; intraperitoneal, intrathoracic or aortic operation; emergency operation; important valvular aortic stenosis; and poor general medical condition. Patients could be separated into four classes of significantly different risk. Ten of the 19 postoperative cardiac fatalities occurred in the 18 patients at highest risk. If validated by prospective application, the multifactorial index may allow preoperative estimation of cardiac risk independent of direct surgical risk. (N Engl J Med 297:845-850, 1977)

23 patients
17% risk major
Cardiac complication
RR 3.2

Table 3. Computation of the Cardiac Risk Index.

Criteria*	MULTIVARIATE DISCRIMINANT FUNCTION COEFFICIENT	"Points"
1. History		
(a) Age >70 yr	0.191	5
(b) MI in previous 6 mo	0.384	10
2. Physical examination:		
(a) S ₃ gallop or JVD	0.451	11
(b) Important VAS	0.119	3
Electrocardiogram:		
(a) Rhythm other than sinus or PAC's on last preoperative ECG	0.281	7
(b) > 5 PVC's/min documented at any time before operation	0.278	7
General status:		
Po < 80 or Pco ₂ > 50 mm Hg, K < 3.0 or HCO ₃ < 20 meq/liter, BUN > 50 or Cr > 3.0 mg/dl, abnormal SGOT, signs of chronic liver disease or patient bed ridden from noncardiac causes	0.132	3
3. Operation:		
(a) Intraperitoneal, intrathoracic or aortic operation	0.123	3
(b) Emergency operation	0.167	4
Total possible		53 points

*MI denotes myocardial infarction, JVD jugular-ven distention, VAS valvular aortic stenosis, PAC's premature atrial contractions, ECG electrocardiogram, PVC's premature ventricular contractions, Po arterial pressure of oxygen, Pco₂ partial pressure of carbon dioxide, K, potassium, HCO₃ bicarbonate, BUN blood urea nitrogen, Cr creatinine, & SGOT serum glutamic oxaloacetic transaminase.

From Goldman, et al.: N Engl J Med, 1977

Aortic Stenosis: An Underestimated Risk Factor for Perioperative Complications in Patients Undergoing Noncardiac Surgery

Miklos D. Kertai, MD, Manolis Bountiokous, MD, Eric Boersma, PhD, Jeroen I. Bax, MD, Ian R. Thomson, MD, Fabiola Sozzi, MD, Ian Klein, MD, Jos R.T.C. Roelandt, MD, Don Poldermans, MD

PURPOSE: To determine the incidence of perioperative events in patients with aortic stenosis undergoing noncardiac surgery. **METHODS:** We studied 198 patients with moderate (mean gradient, 25 to 49 mm Hg) or severe (mean gradient, ≥50 mm Hg) aortic stenosis and 216 controls who underwent noncardiac surgery between 1991 and 2000 at Erasmus Medical Center. Controls were selected based on calendar year and type of surgery. Details of clinical risk factors, type of surgery, and perioperative management were retrieved from medical records. The main outcome measure was the composite of perioperative mortality and nonfatal myocardial infarction. **RESULTS:** There was a significantly higher incidence of the composite endpoint in patients with aortic stenosis than in patients without aortic stenosis (14% [15/108] vs. 2% [4/216], P < 0.001). This rate of perioperative complications was also substantially higher in patients with severe aortic stenosis compared with patients with moderate aortic stenosis (31% [5/16] vs. 11% [10/92], P = 0.04). After adjusting for cardiac risk factors, aortic stenosis remained a strong predictor of the composite endpoint (odds ratio = 3.2; 95% confidence interval: 1.6 to 17.0). **CONCLUSION:** Aortic stenosis is a risk factor for perioperative mortality and nonfatal myocardial infarction, and the severity of aortic stenosis is highly predictive of these complications. (Am J Med. 2004;116:8-13. ©2004 by Excerpta Medica Inc.)

Vascular 46%
Orthopedics 21%
Abdominal 12%
GU 7%
Head – Neck 2%

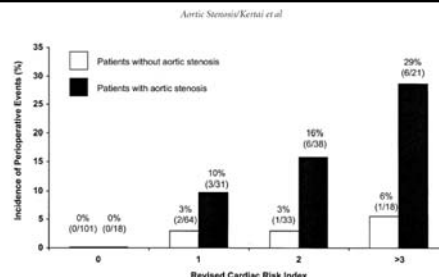


Figure. Incidence of perioperative mortality and nonfatal myocardial infarction in patients with aortic stenosis and controls. Results are based on the absence or presence of aortic valve stenosis, and on the Revised Cardiac Risk Index, which assigns 1 point to each of the following characteristics: high-risk type of surgery, chronic heart disease, history of heart failure, history of cerebrovascular disease, insulin therapy for diabetes, and preoperative serum creatinine level >2.0 mg/dL.

Moderate AS (mean gradient 25-49 or valve area 0.7 – 1.0): 11% complication
Severe AS (mean gradient > 50 or valve area < 0.7): 31% complication

Original Article

Impact of Aortic Stenosis on Postoperative Outcomes After Noncardiac Surgeries

Shikhar Agarwal, MD, MPH, CPH¹; Anitha Rajamanickam, MD²; Naskarabir S. Bajaj, MD; Brian P. Griffin, MD; Thadeo Catacusan, MD; Lars G. Svensson, MD, PhD; Abdel G. Anabawsi, MD; E. Murat Tuzcu, MD; Samir R. Kapadia, MD

Background—Preoperative management of patients with aortic stenosis (AS) who need noncardiac surgery (NCS) remains controversial. We sought to determine the impact of AS on the postoperative outcomes after NCS.

Methods and Results—Patients undergoing NCS with moderate AS (valve area: 1.0–1.5 cm²) or severe AS (valve area: <1.0 cm²) were identified using the surgical and the echocardiographic databases. Using propensity score analysis, we obtained 4 matched control patients without AS for each patient with AS undergoing NCS. The propensity score matching used the 6 revised cardiac risk index criteria, in addition to age and sex. Primary outcome was a composite of 30-day mortality and postoperative myocardial infarction. We matched 634 patients with AS undergoing NCS to 2536 controls. There were 244 patients with severe AS and 390 patients with moderate AS. Thirty-day mortality was 2.1% for AS patients compared with 1.0% in non-AS controls (P=0.036). Postoperative myocardial infarction was more frequent in patients with AS compared with controls (3.0% versus 1.1%; P=0.001). Combined primary outcome was significantly worse for both moderate and severe AS patients compared with respective controls (4.4% versus 1.7%; P=0.002; and 5.7% versus 2.7%; P=0.02, respectively). High-risk surgery, symptomatic severe AS, coexisting mitral regurgitation, and preexisting coronary disease were significant predictors of primary outcome in patients with AS.

Conclusion—Presence of AS adversely affects postoperative outcomes among patients undergoing NCS, evidenced by a higher 30-day mortality and postoperative myocardial infarction after NCS. (Circ Cardiovasc Qual Outcomes. 2013;6:193–200.)

Key Words: aortic stenosis ■ noncardiac surgery ■ postoperative mortality ■ postoperative myocardial infarction ■ propensity score

Aortic stenosis and Noncardiac Surgery 2013

- Increased short term mortality or postop MI in patients with moderate or severe AS
- Risk highest with:
 - High risk surgery
 - Severe symptomatic AS
 - Coexisting mitral regurgitation
 - Preexisting CAD

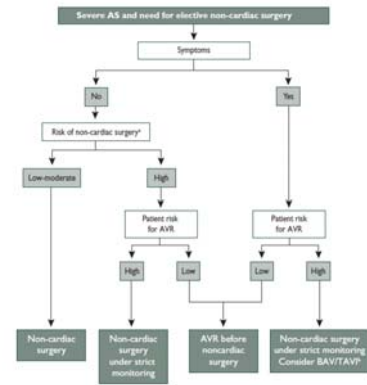
European Heart Journal (2012) 33, 2461–2496
doi:10.1093/eurheartj/ehs349

ESC/EACTS GUIDELINES

Guidelines on the management of valvular heart disease (version 2012)

The Joint Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Authors/Task Force Members: Alec Vahanian (Chairperson) (France)¹, Ottavio Alfieri (Chairperson) (Italy), Felicità Andreotti (Italy), Manuel J. Antunes (Portugal), Gonçalo Barros-Espadas (Spain), Helmut Baumgartner (Germany), Michael Andrew Borger (Germany), Thierry P. Carrel (Switzerland), Michele De Bonis (Italy), Arturo Evangelista (Spain), Volkmar Falk (Switzerland), Bernard Jung (France), Patricio Lancellotti (Belgium), Luc Pierard (Belgium), Soumya Prasad (UK), Hans-Joachim Schäfers (Germany), Gerhard Schuler (Germany), Janina Stepinska (Poland), Karl Swedberg (Sweden), Johanna Takkenberg (The Netherlands), Ulrich Otto Van Ouytsel (UK), Stephan Windecker (Switzerland), Jose Luis Zamorano (Spain), Marcin Zembala (Poland)



ESC 2012

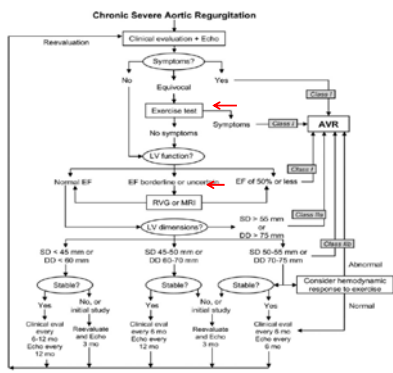
Mitral regurgitation

- When severe, LV function is the issue
- Ejection fraction is key

Mitral stenosis

- Mitral annulus calcification in the elderly
- Rheumatic
- Increased heart rate = decreased diastolic filling time
- Atrial fibrillation

Chronic Severe Aortic Regurgitation (ACC / AHA 2008 Valvular Heart Disease Guideline)



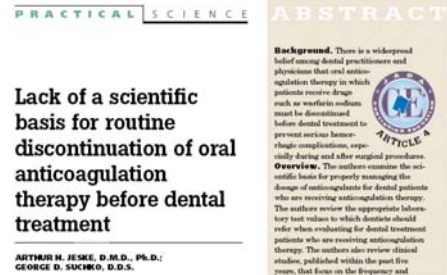
Aortic Regurgitation

- If severe know symptoms / LV function
- ?? Beta blocker issue
 - Decreased heart rate = increased diastolic filling time

Antithrombotic Therapy in Patients with Mechanical Valves who Require Interruption of Warfarin Therapy for Noncardiac Surgery

- Continue antithrombotic therapy for procedures where bleeding inconsequential:
 - Skin
 - Eye surgery
 - Dental
 - Cleaning
 - Caries
 - GI endoscopy
 - Diagnostic (??? Mucosal biopsy)
 - ERCP without sphincterotomy

Journal of the American Dental Association, November 2003



Review of clinical studies: anticoagulants and dental procedures
Warfarin and Low dose aspirin (100 mg/d)

Journal of the American Dental Association, November 2003

Review of clinical studies: anticoagulants and dental procedures Warfarin Low dose aspirin (100 mg/d)

“The weight of evidence in the dental literature does not support the long-held belief that an oral anticoagulant regimen must be altered or discontinued before most dental procedures, including oral surgery.”

“Currently the INR does not require alteration of the therapy regimen unless the INR value is greater than 4.0, provided that local hemostatic measures are used.”

“Articles that document oral surgery experiences of patients taking aspirin alone or in combination with clopidogrel have not reported any cases of unusual intraoperative or postoperative bleeding problems. This experience is anecdotal.”

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PRACTICE GUIDELINE

2008 Focused Update Incorporated Into the ACC/AHA 2006 Guidelines for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines
(Writing Committee to Revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease)

Endorsed by the Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons

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CLASS I

1. In patients at low risk of thrombosis, defined as those with a bileaflet mechanical AVR with no risk factors,* it is recommended that warfarin be stopped 48 to 72 h before the procedure (so the INR falls to less than 1.5) and restarted within 24 h after the procedure. Heparin is usually unnecessary. (Level of Evidence: B)

2. In patients at high risk of thrombosis, defined as those with any mechanical MV replacement or a mechanical AVR with any risk factor, therapeutic doses of intravenous UFH should be started when the INR falls below 2.0 (typically 48 h before surgery), stopped 4 to 6 h before the procedure, restarted as early after surgery as bleeding stability allows, and continued until the INR is again therapeutic with warfarin therapy. (Level of Evidence: B)

Low risk of valve thrombosis

Bileaflet aortic valve
Normal LV function
Sinus rhythm

**Stop warfarin 48-72 hours before procedure
Restart warfarin within 24 hours after**

*Risk factors: atrial fibrillation, previous thromboembolism, LV dysfunction, hypercoagulable conditions, older-generation thrombogenic valves, mechanical tricuspid valves, or more than 1 mechanical valve.

CLASS I

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High risk of valve thrombosis:
mitral valve
tricuspid valve

Aortic valve AND
atrial fibrillation
prior thromboembolism
hypercoagulable
older generation valve
LVEF < 30%
a second mechanical valve

**therapeutic unfractionated heparin
when INR < 2.0
Restart as soon as possible**

*Risk factors: atrial fibrillation, previous thromboembolism, LV dysfunction, hypercoagulable conditions, older-generation thrombogenic valves, mechanical tricuspid valves, or more than 1 mechanical valve.

CLASS IIa

1. It is reasonable to give fresh frozen plasma to patients with mechanical valves who require interruption of warfarin therapy for emergency noncardiac surgery, invasive procedures, or dental care. Fresh frozen plasma is preferable to high-dose vitamin K1. (Level of Evidence: B)


CLASS IIb Usefulness / efficacy less well established by evidence / opinion

1. In patients at high risk of thrombosis, therapeutic doses of subcutaneous UFH (15 000 U every 12 h) or LMWH (100 U per kg every 12 h) may be considered during the period of a subtherapeutic INR. (Level of Evidence: B)

CLASS III

1. In patients with mechanical valves who require interruption of warfarin therapy for noncardiac surgery, invasive procedures, or dental care, high-dose vitamin K1 should not be given routinely, because this may create a hypercoagulable condition. (Level of Evidence: B)

LMWH



CHEST Supplement
ANTITHROMBOTIC THERAPY AND PREVENTION OF THROMBOSIS, 9TH ED. ACCP GUIDELINES

Perioperative Management of Antithrombotic Therapy

Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines

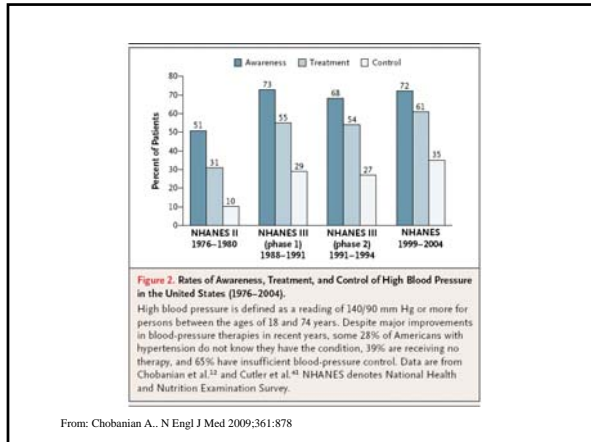
James D. Douketis, MD, FCCP, Alex C. Spyridopoulos, MD, FCCP, Frederick A. Spencer, MD, Michael Maye, MD, Amir K. Jaffer, MD, FHM, Mark H. Eckman, MD, Andrew S. Dixon, MD, and Regina Konec, MD, MSE (Epi)

Mechanical valve: Bridge anticoag ACCP 9th ed

Thromboembolic risk	Bridge
Low	None
Moderate	Maybe
High	Yes

Patients at high risk for arterial thromboembolism (> 10%/yr) may include those with one or more of the following: (1) a mitral valve prosthesis; (2) an older-generation (caged-ball or tilting disk) aortic valve prosthesis; and (3) a recent (within 6 months) stroke or transient ischemic attack. Patients at moderate risk for thromboembolism (4 to 10%/yr) may include those with a bileaflet aortic valve prosthesis and one of the following: (1) atrial fibrillation; (2) prior stroke or transient ischemic attack; and (3) other stroke risk factors (hypertension, diabetes, congestive heart failure, age > 75 years). Patients at low risk for thromboembolism (< 4%/yr) may include those with a bileaflet aortic valve prosthesis without atrial fibrillation and who do not have other risk factors for stroke.

High Risk for thromboembolism
Mitral prosthesis Older aortic prosthesis Recent TIA, stroke
Moderate Risk for thromboembolism
Bileaflet aortic valve AND atrial fibrillation prior stroke, TIA Other CHADS2 risks
Low Risk for thromboembolism
Bileaflet aortic valve



Chronic hypertension

- Is chronic hypertension really a risk factor for perioperative complication?
- Is elevated BP prior to surgery a risk?
- What evidence supports delaying elective surgery in the patient with poorly controlled hypertension?
- How much BP control is needed and for how long preop?

Prys-Roberts et al.: Studies of anaesthesia in relation to hypertension. Br J Anaesth 1971

- 34 patients elective anesthesia + surgery
 - 15 “normotensive”
 - 19 hypertensive (treated and untreated)
 - Mean BP similar in both groups
- Untreated had greater decrease in BP at induction
- Untreated had more myocardial ischemia
- No adverse events in either group
- Implication: Defer surgery to treat hypertension

British Journal of Anaesthesia 92 (4): 570-83 (2004)
DOI: 10.1093/bja/aeh091

REVIEW ARTICLE

Hypertension, hypertensive heart disease and perioperative cardiac risk[†]

S. J. Howell¹*, J. W. Sear² and P. Foex²

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²Nuffield Department of Anaesthetics, University of Oxford, John Radcliffe Hospital, Headley Way, Headington, Oxford OX3 9DU, UK

*Corresponding author. E-mail: s.howell@leeds.ac.uk

The evidence for an association between hypertensive disease, elevated admission arterial pressure and perioperative cardiac outcome is reviewed. A systematic review and meta-analysis of 30 observational studies demonstrated an odds ratio for the association between hypertensive disease and perioperative cardiac outcomes of 1.35 (1.17-1.56). This association is statistically but not clinically significant. There is little evidence for an association between admission arterial pressures of less than 180 mm Hg systolic or 110 mm Hg diastolic and perioperative complications. The position is less clear in patients with admission arterial pressures above this level.

Meta analysis of 30 studies
No evidence that preoperative hypertension directly affects periop outcome

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ACC/AHA PRACTICE GUIDELINES—FULL TEXT

ACC/AHA Guideline Update on Perioperative Cardiovascular Evaluation for Noncardiac Surgery

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1996 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery)

COMMITTEE MEMBERS
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Kirsten E. Fleischmann, MD, MPH, FACC	Robert C. Schlant, MD, FACC
Lee A. Fleisher, MD, FACC	William L. Winters, Jr, MD, MACC

No perioperative risk
Stage I BP (140-159 / 90-99)
Stage II BP (160-179 / 100-109)

Control BP Preop
Stage III BP (≥180 / ≥110)

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ACC/AHA PRACTICE GUIDELINES—FULL TEXT

ACC/AHA Guideline Update on Perioperative Cardiovascular Evaluation for Noncardiac Surgery

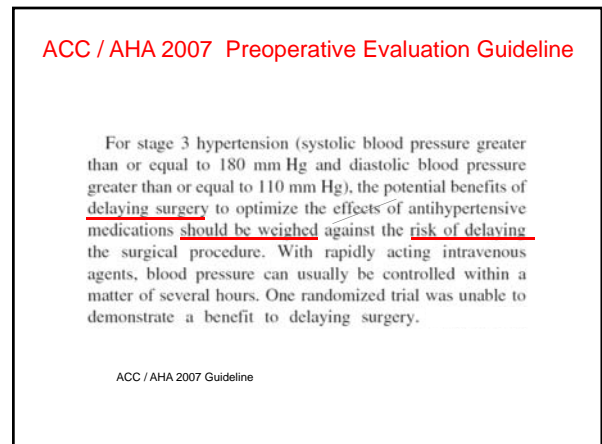
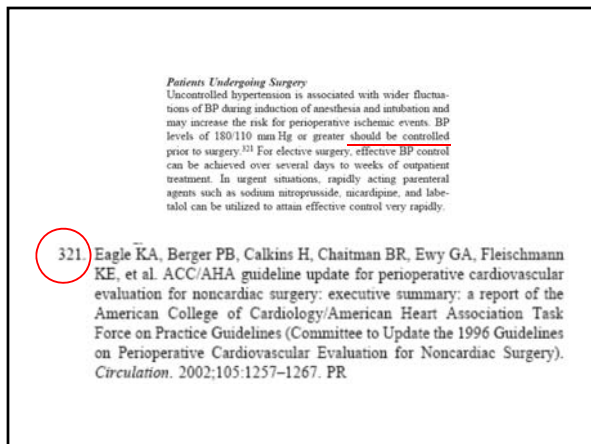
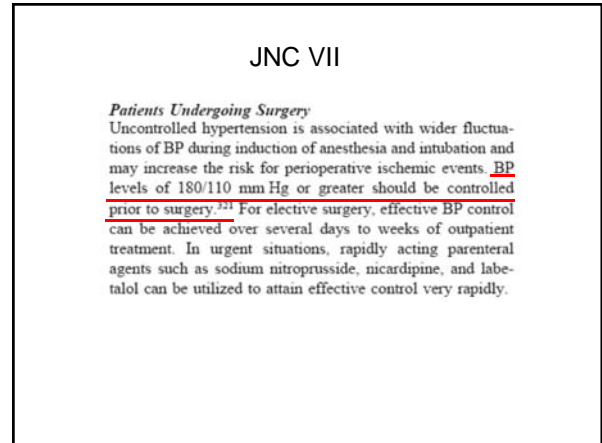
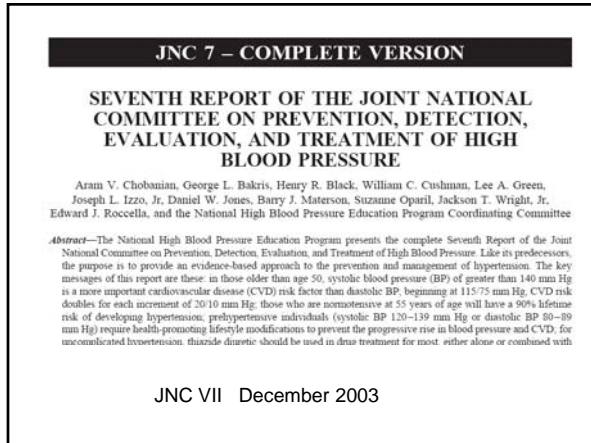
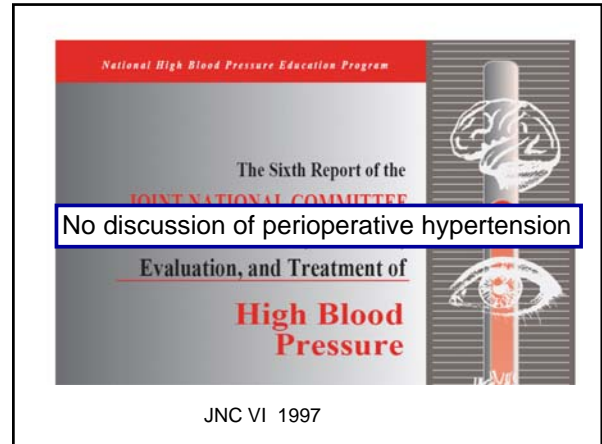
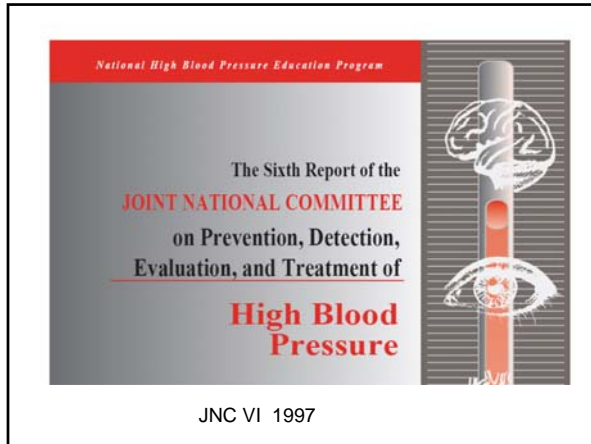
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No perioperative risk
Stage I BP (140-159 / 90-99)
Stage II BP (160-179 / 100-109)

Control BP Preop
Stage III BP (≥180 / ≥110) **NO Supportive evidence**



The Eighth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 8)

Expected Release Date: Summer 2010

The Eighth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 8)

Expected Release Date: Summer 2010

Blood Pressure in Adults: Systematic Evidence Review from the Joint National Committee (JNC)

Status of Systematic Review to Enable Guideline Development

Background

Guideline Executive Committee Policy for Managing Potential Conflicts of Interest and Relationships with Industry

Expert Panel Members

Blood Pressure, Cholesterol Guidelines Face More Delays

MIAMI, Fla. — The Institute of Medicine (IOM) in 2001. One recommendation that agencies within the U.S. Department of Health and Human Services... The National Heart, Lung, and Blood Institute (NHLBI) published guidelines since the 1970s and routinely has produced updates every five years. The current version, however, are roughly a decade old. The last with input of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC) 7... published in 2003 and the Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Pressure in Adults (NCEP ATP III) appeared in 2002, with an update in 2005. Expert panels at the NHLBI have also been working on creating guidelines for other chronic and acute assessment. Over the past several years, cardiologists and heart health programs have been hearing from guideline expert committee members at meetings of the American Heart Association (AHA), the American College of Cardiology (ACC), and the American Society of Hypertension (ASH) that updates were necessary and new publications would be needed to address the needs of the field. That has not happened. The latest update came in June 15 when the NHLBI reported it was getting out of the guideline writing business by terminating the publishing systematic evidence reviews, which could be used by appropriate scientific associations such as the AHA, ACC, and ASH to create their own guidelines (Gibbons et al. in Circulation. 2005; 110:1000-1001). According to the NHLBI, the impact for the decision was publication of 3 reports by... The spirit of this is to enhance public health through collaboration. The June announcement came at a time when many had expected to see that the guidelines would be published. There is no wrong time to do the right thing, and it is possible along the right way to bring our public health mission and AHA/ACC/ASH... to create the best possible guidelines. Lower risk. The NHLBI has been planning on concentrating on advisory services for at least a year when at June 2002 termination of the systematic evidence review council, the council...

Major issues of chronic hypertension

- Too aggressive control of BP a problem
- Increased periop hemodynamic lability
- More comorbidities
 - CAD
 - CHF
 - CRF
- Medication management
 - “perioperative continuation of medications”

Angiotensin System Inhibitors in a General Surgical Population

Thomas Comfere, MD*, Juraj Sprung, MD, PhD*, Matthew M. Kumar, MD*, Myoungso Draper, BSN*, Diana P. Wilson, BSN*, Brent A. Williams, MS*, David R. Danielson, MD*, Lavonne Liedl, RRT*, and David O. Warner, MD*

*Department of Anesthesiology and †Division of Biostatistics, Mayo Clinic College of Medicine, Rochester, Minnesota

Wrestled the relationship between the timing of discontinuing chronic angiotensin-converting enzyme inhibitors (ACEI) and angiotensin II receptor subtype 1 antagonists (ARA) and hypotension after the induction of general anesthesia in a general surgical population. We retrospectively studied 207 hypertensive patients receiving chronic ACEI/ARA therapy undergoing elective non-cardiac surgery under general anesthesia. During preop-

for patients who took their last ACEI/ARA therapy <10 h and ≥10 h before surgery. During the first 30 min after anesthetic induction, moderate hypotension was more frequent in patients whose most recent ACEI/ARA therapy was taken <10 h (60%) compared with those who stopped at ≥10 h (46%) before induction (P = 0.02). The adjusted odds ratio for moderate hypotension was 1.74 (95% confidence in-

Anesth Analg 2005;100:636-44

- Retrospective
- During first 30 minutes post induction moderate hypotension (syst BP ≤ 85mm Hg) were likely if ACE or ARB taken during prior 10 hours
- No difference in postop complications
- Discontinuation of ACE / ARB at least 10 hrs pre induction associated with reduced risk of immediate post induction hypotension

ACC / AHA 2007 Preoperative Evaluation Guideline

Several authors have suggested withholding ACE inhibitors and angiotensin receptor antagonists the morning of surgery (97-99). Consideration should be given to restarting ACE inhibitors in the postoperative period only after the patient is euvolemic, to decrease the risk of perioperative renal dysfunction. (ACC / AHA 2007 Guideline)

ACC / AHA 2007 Guideline



Chronic atrial fibrillation Preoperative issues

- Rhythm control (restoration of sinus rhythm) not superior to maintenance of afib with rate control in the asymptomatic patient.
- Patients with AF should receive antithrombotic therapy (warfarin (INR 2-3)) unless they are at low risk of thromboembolism.
- Novel anticoagulants
- Beta blockers commonly used to control rate.
- “Controlled” rate on no A-V nodal blockers suggests A-V nodal conduction disease.

Chronic atrial fibrillation Preoperative issues

- Rhythm control (restoration of sinus rhythm) not superior to maintenance of afib with rate control in the asymptomatic patient
- Patients with AF should receive antithrombotic therapy (warfarin (INR 2-3)) unless they are at low risk of thromboembolism.
 - Who is at low risk?
- Novel anticoagulants
- Beta blockers commonly used to control rate.
- “Controlled” rate on no A-V nodal blockers suggests A-V nodal conduction disease.

Who requires anticoagulation ?

Recommendation 2: Patients with atrial fibrillation should receive chronic anticoagulation with adjusted-dose warfarin, unless they are at low risk of stroke or have a specific contraindication to the use of warfarin (thrombocytopenia, recent trauma or surgery, alcoholism). Grade: 1A

Annals of Internal Medicine, 2003;139;1009-1017

How do we determine stroke risk ?

- CHADS2 (Gage, et al.: JAMA 2001)
 - Congestive heart failure - 1pt
 - Hypertension - 1pt
 - Age > 75 - 1 pt
 - Diabetes - 1pt
 - Stroke or TIA - 2 pts
- 0 points – low risk (1.2-3.0 strokes per 100 patient years)
- 1-2 points – moderate risk (2.8-4.0 strokes per 100 patient years)
- ≥ 3 points – high risk (5.9-18.2 strokes per 100 patient years)



CHEST

Original Research
THROMBOEMBOLISM

Refining Clinical Risk Stratification for Predicting Stroke and Thromboembolism in Atrial Fibrillation Using a Novel Risk Factor-Based Approach

The Euro Heart Survey on Atrial Fibrillation

Gregory Y. H. Lip, MD, Robby Nieuwlaet, PhD, Ron Pieters, MD, Deirdre A. Lane, PhD, and Harry J. G. M. Crijns, MD

Lip Y, et al. Chest 2010, 137(2):263

Table 2—The 2009 Birmingham Schema Expressed as a Point-Based Scoring System, With the Acronym CHA₂DS₂-VASc

Risk Factor	Score
Congestive heart failure/LV dysfunction	1
Hypertension	1
Age ≥ 75 y	2
Diabetes mellitus	1
Stroke/TIA/TE	2
Vascular disease (prior myocardial infarction, peripheral artery disease, or aortic plaque)	1
Age 65-74 y	1
Sex category (ie female gender)	1

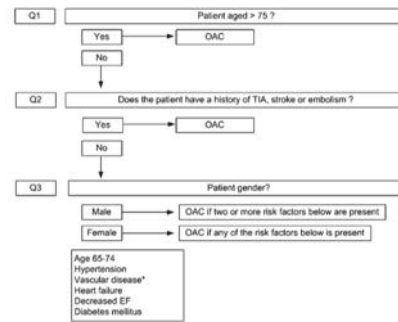
Lip Y, et al. Chest 2010, 137(2):263

CHADS₂ vs. CHA₂DS₂-VASc

- CHADS₂ score 0: 1.4% events
- CHA₂DS₂-VASc 0: 0 events
- CHA₂DS₂-VASc score 1: 0.6% events
- CHA₂DS₂-VASc score 2: 1.6% events

Our approach: anticoagulation when Isch stroke risk > 0.9%/year

CHA₂DS₂-VASc



*Myocardial infarction, peripheral artery disease or aortic plaque

CHEST

Official publication of the American College of Chest Physicians



Antithrombotic Therapy for Atrial Fibrillation: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines

John J. You, Daniel E. Singer, Patricia A. Howard, Deirdre A. Lane, Mark H. Eckman, Margaret C. Fang, Elaine M. Hylek, Sam Schulman, Alan S. Go, Michael Hughes, Frederick A. Spencer, Warren J. Manning, Jonathan L. Halperin and Gregory Y. H. Lip

Chest 2012;141:e531S-e575S
DOI 10.1378/chest.11-2304

February 2012

Results: For patients with nonrheumatic AF, including those with paroxysmal AF, who are (1) at low risk of stroke (eg, CHADS₂ [congestive heart failure, hypertension, age ≥ 75 years, diabetes mellitus, prior stroke or transient ischemic attack] score of 0), we suggest no therapy rather than antithrombotic therapy, and for patients choosing antithrombotic therapy, we suggest aspirin rather than oral anticoagulation or combination therapy with aspirin and clopidogrel; (2) at intermediate risk of stroke (eg, CHADS₂ score of 1), we recommend oral anticoagulation rather than no therapy, and we suggest oral anticoagulation rather than aspirin or combination therapy with aspirin and clopidogrel; and (3) at high risk of stroke (eg, CHADS₂ score of ≥ 2), we recommend oral anticoagulation rather than no therapy, aspirin, or combination therapy with aspirin and clopidogrel. Where we recommend or suggest in favor of oral anticoagulation, we suggest dabigatran 150 mg bid rather than adjusted-dose vitamin K antagonist therapy.

Conclusions: Oral anticoagulation is the optimal choice of antithrombotic therapy for patients with AF at high risk of stroke (CHADS₂ score of ≥ 2). At lower levels of stroke risk, antithrombotic treatment decisions will require a more individualized approach.

Chronic atrial fibrillation Preoperative issues Risk for embolization

- CHADS2 Score
 - CHF (any hx) – 1
 - Hypertension – 1
 - Age ≥ 75 – 1
 - Diabetes – 1
 - Stroke or TIA – 2

0 low risk
1-2 Intermediate risk
≥ 3 High risk

Chronic atrial fibrillation Preoperative issues

- Major bleeding rare while receiving warfarin:
 - Dental procedures
 - Arthroscopy
 - Cataract surgery
 - Diagnostic endoscopy

Baker RI, et al.: Med J Australia 2004;18:492-7

Chronic atrial fibrillation Preoperative issues

- Periop anticoagulation management

8.1.4.2.6. INTERRUPTION OF ANTICOAGULATION FOR DIAGNOSTIC OR THERAPEUTIC PROCEDURES. From time to time, it may be necessary to interrupt oral anticoagulant therapy in preparation for elective surgical procedures. In patients with mechanical prosthetic heart valves, it is generally appropriate to substitute unfractionated or low-molecular-weight heparin to prevent thrombosis (479,480). In patients with AF who do not have mechanical valves, however, based on extrapolation from the annual rate of thromboembolism in patients with nonvalvular AF, it is the consensus of the Writing Committee that anticoagulation may be interrupted for a period of up to 1 wk for surgical or diagnostic procedures that carry a risk of bleeding without substituting heparin. In high-risk patients (particularly those with prior stroke, TIA, or systemic embolism) or when a series of procedures requires interruption of oral anticoagulant therapy for longer periods, unfractionated or low-molecular-weight heparin may be administered intravenously or subcutaneously.

Mechanical valve: substitute heparin

Most patients: anticoag withdrawal for up to 1 week

High risk: heparin

Multiple procedures: heparin

From Fuster et al. 2006 ACC/AHA/ESC 2006 Guideline for the Management of Patients with Atrial Fibrillation

**The NEW ENGLAND
JOURNAL of MEDICINE**

ESTABLISHED IN 1812 SEPTEMBER 17, 2009 VOL. 361 NO. 12

Dabigatran versus Warfarin in Patients with Atrial Fibrillation

Stuart J. Connolly, M.D., Michael D. Ezekowitz, M.B., Ch.B., D.Phil., Salm Yusuf, F.R.C.P.C., D.Phil., John Eikelboom, M.D., Jonas Oldgren, M.D., Ph.D., Amit Parekh, M.D., Janice Pogue, M.Sc., Paul A. Reilly, Ph.D., Ellison Thorneles, B.A., Jeanne Varrone, M.D., Susan Wang, Ph.D., Marco Alings, M.D., Ph.D., Denis Xavier, M.D., Jun Zhu, M.D., Rafael Diaz, M.D., Basil S. Lewis, M.D., Harald Darius, M.D., Hans-Christoph Diener, M.D., Ph.D., Campbell D. Joyner, M.D., Lars Wallentin, M.D., Ph.D., and the RE-LY Steering Committee and Investigators*

ABSTRACT

BACKGROUND
Warfarin reduces the risk of stroke in patients with atrial fibrillation but increases the risk of hemorrhage and is difficult to use. Dabigatran is a new oral direct thrombin inhibitor.

METHODS
In this noninferiority trial, we randomly assigned 18,113 patients who had atrial fibrillation and a risk of stroke to receive, in a blinded fashion, fixed doses of dabigatran—110 mg or 150 mg twice daily—or, in an unblinded fashion, adjusted-dose warfarin. The median duration of the follow-up period was 2.0 years. The primary outcome was stroke or systemic embolism.

From the Population Health Research Institute, McMaster University and Hamilton Health Sciences, Hamilton, ON, Canada (S.J.C., S.Y., J.P., E.T.); Lundberg Institute for Medical Research and the Heart Center, Wynewood, PA (M.D.), A.P.; Uppsala Clinical Research Center, Uppsala, Sweden (J.O., L.W.); Boehringer Ingelheim Pharmaceuticals, Ridgefield, CT (P.A.R., J.V., S.W.); Working Group on Cardiovascular Research the Netherlands, Utrecht, the Netherlands (M.A.S.); John's National Academy of Health Sciences,

Perioperative atrial fibrillation rate control

- Is there an “optimal” atrial fibrillation ventricular response following surgery?
- Is there a benefit to “tight” control of atrial fibrillation ventricular response?

NEW ENGLAND JOURNAL of MEDICINE

April 15, 2010

ORIGINAL ARTICLE

Lenient versus Strict Rate Control in Patients with Atrial Fibrillation

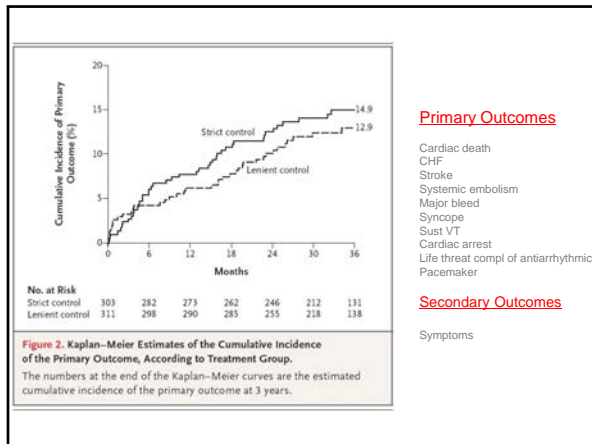
Isabelle C. Van Gelder, M.D., Hessel F. Groenewold, M.D., Harry G.M. Cozijn, M.D., Ype S. Tassinga, M.D., Jan G.P. Tijssen, Ph.D., A. Marco Alings, M.D., Hans L. Hillego, M.D., Jihanna A. Bergman-Korff, M.Sc., Jan H. Cornel, M.D., Otto Kamp, M.D., Raymond Tuijthuis, M.D., Hans A. Bosker, M.D., Dink J. Van Veldhuisen, M.D., and Maarten P. Van den Berg, M.D., for the RACE II Investigators*

ABSTRACT

BACKGROUND
Rate control is often the therapy of choice for atrial fibrillation. Guidelines recommend strict rate control, but this is not based on clinical evidence. We hypothesized that lenient rate control is not inferior to strict rate control for preventing cardiovascular morbidity and mortality in patients with permanent atrial fibrillation.

METHODS
We randomly assigned 684 patients with permanent atrial fibrillation to undergo a lenient rate-control strategy (targeting heart rate <110 beats per minute) or a strict rate-control strategy (targeting heart rate <80 beats per minute and heart rate during moderate exercise <110 beats per minute). The primary outcome was a composite of death from cardiovascular causes, hospitalization for heart failure, and stroke, systemic embolism, bleeding, and life-threatening arrhythmic events. The duration of follow-up was at least 2 years, with a maximum of 3 years.

From the Department of Cardiology (I.C.V.G., H.F.G., H.L.H., G.P.T., M.P.B.) and the Trial Coordination Center, Department of Epidemiology (H.L.H., J.A.R.-B.), University Medical Center Groningen, University of Groningen, Groningen; the Interuniversity Cardiology Institute of the Netherlands, Utrecht (I.C.V.G.); Maastricht University Medical Center, Maastricht (H.G.M.C.); Drenthe Hospital, Drenthe (I.C.T.); Academic Medical Center, University of Amsterdam, Amsterdam (G.P.T.); and VU University Medical Center (D.J.)—both in Amsterdam; Amalia Hospital, Beeld & Hoor (M.A.); Medical Center Alkmaar (J.H.C.); Rijnstate Hospital, Herten (R.T.); and Rijnstate Hospital, Arnhem (H.A.B.)—all in the Netherlands. Address correspondence to Dr. Van den Berg.



Primary Outcomes

- Cardiac death
- CHF
- Stroke
- Systemic embolism
- Major bleed
- Syncope
- Sust VT
- Cardiac arrest
- Life threat compl of antiarrhythmic
- Pacemaker

Secondary Outcomes

- Symptoms

ACCF/AHA/HRS Focused Update

2011 ACCF/AHA/HRS Focused Update on the Management of Patients With Atrial Fibrillation (Updating the 2006 Guideline) A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

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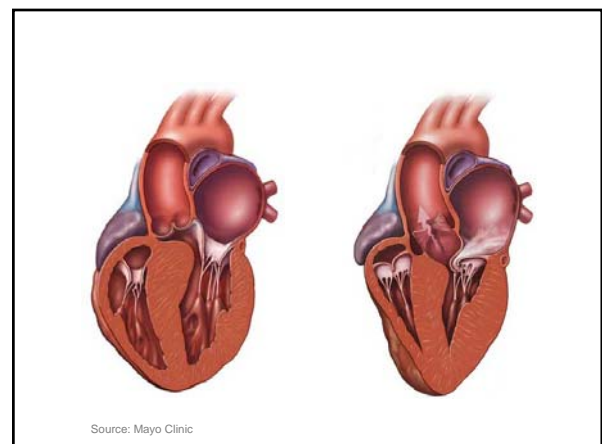
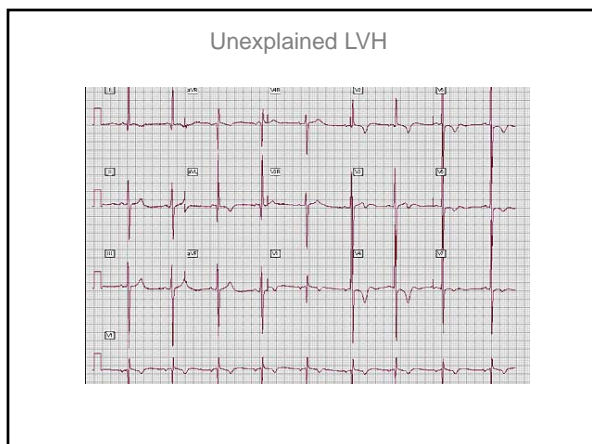
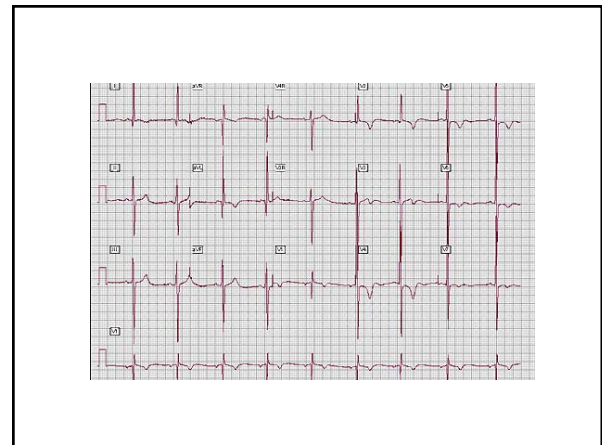
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Circulation Jan 4, 2011

ACCF / AHA / HRS 2011

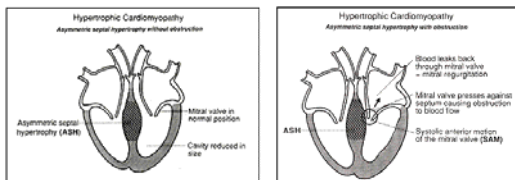
Table 2. Recommendation for Rate Control During Atrial Fibrillation

2011 Focused Update Recommendation	Comments
Class III—No Benefit	
1. Treatment to achieve strict rate control of heart rate (<80 bpm at rest or <110 bpm during a 6-minute walk) is not beneficial compared to achieving a resting heart rate <110 bpm in patients with persistent AF who have stable ventricular function (left ventricular ejection fraction >0.40) and no or acceptable symptoms related to the arrhythmia, though uncontrolled tachycardia may over time be associated with a reversible decline in ventricular performance. ³ (Level of Evidence: B)	New recommendation



Hypertrophic Cardiomyopathy

- Symmetric vs. Asymmetric
- Obstructive vs. Nonobstructive



Drawing credits: The Cardiomyopathy Assn. www.cardiomyopathy.org

Hypertrophic Cardiomyopathy

- Dynamic LV outflow gradient
 - “small LV cavity worsens obstruction”
- Avoid reduction of ventricular volume
 - Tachycardia
 - Hypovolemia
 - Increased catecholamines – inotropes
 - Increased intrathoracic pressure – decreased venous return

Hypertrophic Cardiomyopathy

- Approach to perioperative hypotension
 - Volume expansion
 - Peripheral vasoconstrictors
 - alpha sympathomimetics

Mr. H

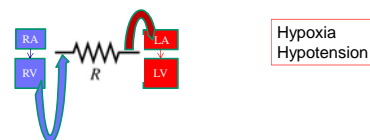
- 75 yo to undergo cystoscopy to eval painless hematuria
- COPD
- Exam:
 - BP 120/70, nsr
 - Increased JVP
 - II/VI holosystolic apical murmur
 - II/VI midsystolic murmur LSB increases with inspiration
- Ecg: sinus rhythm, no chamber hypertrophy

Mr. H

- Echo report
 - Normal LV size and function
 - Mild dilatation RV, normal RV function
 - Moderate MR, mild-mod TR
 - PA systolic 54mmHg: Moderate pulmonary hypertension

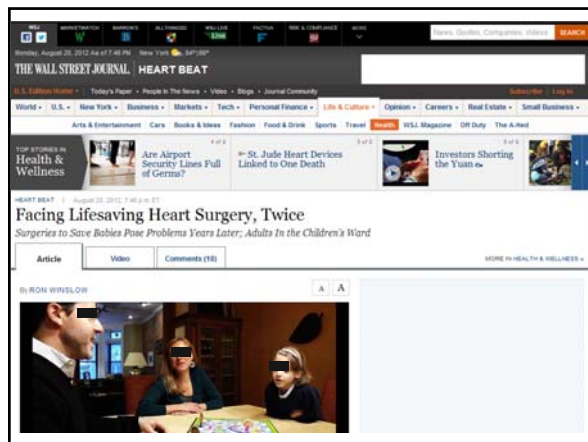
Pulmonary Hypertension

- Noncardiac surgery issues
 - Oxygenation
 - Right ventricular failure



Pulmonary Hypertension

- Preoperative risk factors for 30 day M+M
 - NYHA Functional class \geq II
 - History pulmonary embolism
 - History obstructive sleep apnea
 - Intermediate or high risk surgery
 - Anesthesia > 3 hours
- Preoperative warning “signs”
 - RVH on ecg
 - RVSP / SBP > 0.66



Outcome of Operated and Unoperated Adults With Congenital Cardiac Disease Lost to Follow-Up for More Than Five Years

Annette Wacker, MD, Harald Kaemmerer, PhD, Regina Hollweck, MSc, Michael Hauser, PhD, Marc Andre Dautsch, MS, Silke Brodherr-Heberlein, MD, Andreas Eicken, MD, and John Hess, PhD

Many patients with congenital cardiac disease need a regular cardiologic follow-up (FU) even after successful primary treatment. Nevertheless, many of them are lost to FU. The present study verifies for the first time the outcome of adults with congenital cardiac disease lost to FU of a specialized institution for >5 years. ©2005 by Excerpta Medica Inc. (Am J Cardiol 2005;95:776-779)

The objective of the present study was to evaluate the rate and outcome of surgically treated and nonsurgically treated adults with congenital cardiac disease (CCD) who were lost to follow-up (FU) for

In 2003, the registry of the German Heart Center in Munich contained >10,500 patients diagnosed and/or treated for CCD or referred for suspicion of CCD who reached adulthood (≥ 18 years). All surgically treated and nonsurgically treated adults with CCD who failed to return for a scheduled FU visit for >5 years were contacted, were sent letters of explanation, and requests to fill in enclosed written questionnaires. The questionnaires dealt with the health situation, sports, education, occupation, and medical care. Medical records of the included adults were reviewed for patient demographics and diagnosis. Patients were classified according to the proposals of

Majority of patients with congenital heart disease lost to followup
96% regarded themselves as "health and fit".
68% had no regular medical care.

Adult with CHD

- Elective vs. emergency surgery
- Complicated
- Cyanotic CHD
 - Increased RBC mass, hematocrit
 - Hyperviscosity
 - Worse with preop fasting
 - Tpenia, platelet dysfunction, abnormal coags
 - Pulmonary issues

ACC / AHA 2008 Adult Congenital Heart Disease Guideline

JACC Vol. 52, No. 23, 2008
December 2, 2008;43-263

Table 7. Congenital Cardiac Lesions and Perioperative Risk for Noncardiac Surgery

High risk
Pulmonary hypertension, primary or secondary
Cyanotic congenital heart disease
New York Heart Association class III or IV
Severe systemic ventricular dysfunction (ejection fraction less than 35%)
Severe left-sided heart obstructive lesions
Moderate risk
Prosthetic valve or conduit
Intracardiac shunt
Moderate left-sided heart obstruction
Moderate systemic ventricular dysfunction

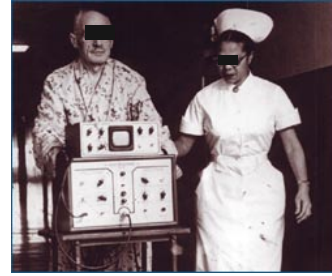
From: ACC / AHA 2008 Guidelines for the Management of Adults with Congenital Heart Disease, Dec 2008

Adult with CHD Even “routine” is complex

- History of “routine” ASD closure
 - Residual pulmonary hypertension
 - MR if primum ASD
 - Increased incidence atrial arrhythmias

Adult with CHD

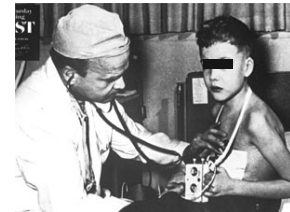
- **Noncardiac surgery**
 - Strongly recommend evaluation by cardiologist experienced in the care of the patient's disease
 - Patients with high risk congenital heart disease undergo surgery at centers with expertise
 - Old records essential
 - Emergency: consult with anesthesia, cardiac anesthesia
 - Arrange for post discharge cardiac followup



"Back at the garage, I dug out a back issue of Popular Electronics magazine in which I recalled seeing a circuit for an electronic, transistorized metronome. The circuit transmitted clicks through a loudspeaker; the rate of the clicks could be adjusted to fit the music. I simply modified that circuit and placed it, without the loudspeaker, in a four-inch-square, inch-and-thick metal box with terminals and switches on the outside - and that, as they say, was that."



Earl Bakken



C. Walton Lillehei



Earl Bakken
1997

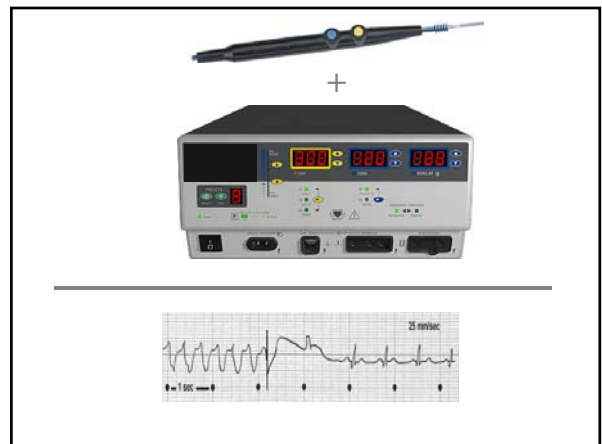
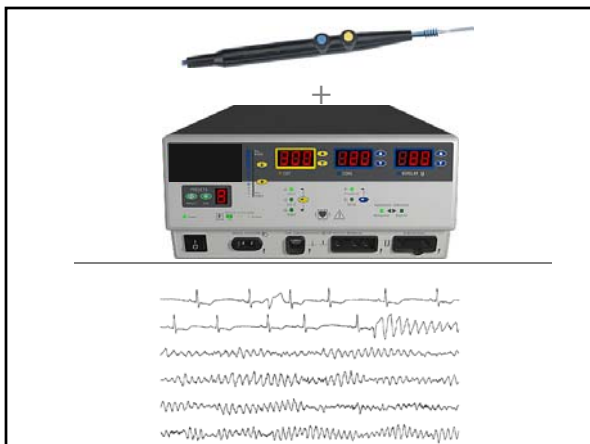


Temporary Pacemaker: Indications

- Symptomatic sinus bradycardia
- Sinus pause > 3 seconds or causing symptoms
- Symptomatic 2^o A-V block (Mobitz I)
- Infranodal 2^o A-V block (Mobitz II)
- New bifascicular block in acute MI
- Complete heart block
- LBBB in patient who is to undergo PA catheter placement

Permanent Pacemaker

- Pacemaker inhibition by electrocautery
 - If pacemaker dependent reprogram to asynchronous mode (or put magnet over the device)
- Rate adaptive unit may increase rate if respiratory rate increased or if mechanical stimulation of the generator.
- No industry standard to response to electromagnetic interference
- Interrogate pacemaker post op.



Implantable Cardioverter Defibrillator

- **Electrocautery**
 - May inhibit ICD
 - May be sensed as malignant arrhythmia
 - ICD shock function should be deactivated preop if electrocautery planned
 - If pacemaker dependent program pacing function to asynchronous mode
 - Response to magnet different than pmaker
 - temporarily disables shock function
 - Doesn't affect pacing function

Radiation therapy for the patient with a pacemaker or AICD

Methodology 2005; 133: 106-18
© 2005 American Society of Hematology, Inc. Update 4/2006 R. Wilson, M. D.

Practice Advisory for the Perioperative Management of Patients with Cardiac Rhythm Management Devices: Pacemakers and Implantable Cardioverter-Defibrillators

A Report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Rhythm Management Devices

Methodology
A Definition of Cardiac Rhythm Management Devices
For this advisory, a cardiac rhythm management device (CRM) refers to any permanently implanted cardiac pacemaker or any implantable cardioverter-defibrillator (ICD). The term CRM also refers to any cardiac resynchronization device. The term CRT refers to a CRM that provides cardiac resynchronization therapy using biventricular pacing techniques. Generic pacemaker and defibrillator codes are provided in appendix 1. Note that every ICD includes both pacing and shock therapies for the management of bradyarrhythmias and tachyarrhythmias.

Radiation therapy for the patient with a pacemaker or AICD

The Task Force believes that radiation therapy can be safely performed for CRM patients.^{1,2} The device must be outside the field of radiation. Therefore, some pulse generators will require surgical relocation before commencing radiation. Most manufacturers recommend verification of pulse generator function during and at the completion of radiation. Problems may include pacemaker failure and runaway pacemaker.^{1,2}

Annals of Internal Medicine

ORIGINAL RESEARCH

A Prospective Evaluation of a Protocol for Magnetic Resonance Imaging of Patients With Implanted Cardiac Devices

Saman Nazarian, MD, Bassem Hameed, RN, MPH, Amir Rajavi, MD, PhD, Doris Galanter, MD, Marilekha M. Zeman, PhD, Albert C. Lardo, PhD, Brian S. Caffo, PhD, Kevin D. Fink, PhD, MA, Michael A. Ward, MD, PhD, Rob R. Kanter, MD, PhD, Hugh Collins, MD, Ronald D. Berger, MD, PhD, David A. Bluemel, MD, PhD, and Henry B. Hahn, MD, MA

Background: Magnetic resonance imaging (MRI) is avoided in most patients with implanted cardiac devices because of safety concerns.
Objective: To define the safety of a protocol for MRI at the commonly used magnetic strength of 1.5 T in patients with implanted cardiac devices.
Design: Prospective nonrandomized trial (ClinicalTrials.gov registration number: NCT01302882).
Setting: One center in the United States (94% of examinations) and one in Israel.
Patients: 438 patients with devices (54% with pacemakers and 46% with defibrillators) who underwent 505 MRI studies.
Intervention: Pacing mode was changed to asynchronous for pacemaker-dependent patients and to demand for others. Tachyarrhythmia functions were disabled. Blood pressure, electrocardiography, oxygen, and symptoms were monitored by a nurse with experience in cardiac life support and device programming who had immediate backup from an electrophysiologist.
Measurements: Activation or inhibition of pacing, symptoms, and device variables.
Results: In 3 patients (0.7%, 0.9%, CL 0% to 1.5%), the device reverted to a transient lock-up programming mode without long-term effects. Right ventricular (RV) sensing median change, 0 mV (interquartile range [IQR], -0.7 to 0 V) and atrial and right and left ventricular lead impedance (median change, -2 Ω [IQR, -13 to 0 Ω], -4 Ω [IQR, -16 to 0 Ω], and -11 Ω [IQR, -40 to 0 Ω], respectively) were reduced immediately after MRI. At long-term follow-up (60% of patients), decreased RV sensing (median, 0 mV; IQR, -1.5 to 0.3 mV), decreased RV lead impedance (median, -3 Ω [IQR, -29 to 15 Ω]), increased RV capture threshold (median, 0 V, IQR, 0 to 0.2 Ω), and decreased battery voltage (median, -0.01 V, IQR, -0.04 to 0 V) were noted. The observed changes did not require device revision or reprogramming.
Limitations: Not all available cardiac devices have been tested. Long-term in-person or telephone follow-up was unavailable in 43 patients (10%), and some data were missing. Those with missing long-term capture threshold data had higher baseline right atrial and right ventricular capture thresholds and were more likely to have undergone thoracic imaging. Defibrillation threshold testing and random assignment to a control group were not performed.
Conclusion: With appropriate precautions, MRI can be done safely in patients with selected cardiac devices. Because changes in device variables and programming may occur, electrophysiologic monitoring during MRI is essential.
Primary Funding Source: National Institutes of Health.
See www.annals.org for author affiliations, and end of text.

October 4, 2011

ARTICLE IN PRESS

Determining the Risks of Magnetic Resonance Imaging at 1.5 Tesla for Patients With Pacemakers and Implantable Cardioverter Defibrillators

Jennifer D. Cohen, MD, Heather S. Costa, PhD, and Robert J. Russo, MD, PhD*

Conventional pacemaker and implantable cardioverter-defibrillator product labeling currently cautions against exposure to magnetic resonance imaging (MRI). However, there is a growing clinical need for MRI, without an acceptable alternative imaging modality in many MRI and review MRI from cont or le Dec V in statistically significant differences between the MRI and control groups for the mean change in pacing lead impedance (-6.2 ± 23.9 vs $3.0 \pm 22.1 \Omega$) and left ventricular pacing threshold (-0.1 ± 0.3 vs 0.1 ± 0.2 V); these differences were not clinically important. In conclusion, MRI in patients with cardiac devices resulted in no device or lead failures. A small number of clinically relevant changes in device parameter measurements were noted. However, these changes were similar to those in a control group of patients who did not undergo MRI. © 2012 Elsevier Inc. All rights reserved. (Am J Cardiol 2012;xxx:xxx)

Online release ahead of print Sept 13, 2012

MUSIC IS USED BY SURGEONS TO EASE OPERATIONS

Music has been found of value in surgical operations to ease patients during



Photograph Supplying Music During a Surgical Operation at a Brooklyn, New York, Hospital

and after the administration of ether. Melodies are supplied by a phonograph, or instrumental selections are rendered by an artist. Several demonstrations have been made at a Brooklyn, N. Y., hospital.

Popular Mechanics, June 1924

Journal of Clinical Anesthesia (2007) 19, 47–54

Journal of Clinical Anesthesia

ELSEVIER

Review article

Patient comfort during regional anesthesia

Philip Hu FCARCSI (Specialist Registrar)^{a,*},
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Received 21 October 2005; revised 20 February 2006; accepted 21 February 2006

Favorable music via a headset decreases patient-controlled sedation requirements in awake patients undergoing surgical procedures performed with regional anesthesia [81,82]. Intraoperative music chosen by the patient may assist by providing a familiar auditory environment, distracting the patient during the procedure. The use of headsets can screen out background operating theatre noise.

Ipod and Pacemaker Interference

Heart Rhythm Society, May 2007



Jay Flaker
High School Senior

100 pacemaker patients
 iPod 2 inches from chest for 5-10 seconds
 50% pacemaker interference (sensing)
 1 case pacemaker inhibition

BioMedical Engineering OnLine

Research Open Access

Low frequency magnetic emissions and resulting induced voltages in a pacemaker by iPod portable music players

Howard Bassen

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 Received 19 September 2007
 doi:10.1186/1475-2875-7-7
 Accepted 1 February 2008
 BioMedical Engineering OnLine 2008, 7:7
 This article is available from: <http://www.biomedical-engineering-online.com/content/7/1/7>

Conclusion: Our measurements of the magnitude and the spatial distribution of low frequency magnetic flux density emissions by 4 different models of iPod portable music players. Levels of less than 0.2 μ T exist very close (1 cm) from the case. The measured voltages induced inside an 'instrumented-can' pacemaker were below the noise level of our instruments. Based on the observations of our in-vitro study we conclude that no interference effects can occur in pacemakers exposed to the iPod devices we tested.

So who are you going to believe?

Clinically significant magnetic interference of implanted cardiac devices by portable headphones

Sinjin Lee, MD,¹ Kevin Fu, PhD,² Tadayoshi Kohno, PhD,³ Benjamin Ransford, BS,¹ William H. Maisel, MD, MPH, FHRS^{4*}

From the ¹Medical Device Safety Institute and ²Cardiovascular Institute, Department of Medicine, Beth Israel Deaconess Medical Center, Boston, Massachusetts, ³Department of Computer Science, UMass Amherst, Amherst, Massachusetts, and ⁴Department of Computer Science and Engineering, the University of Washington, Seattle, Washington.

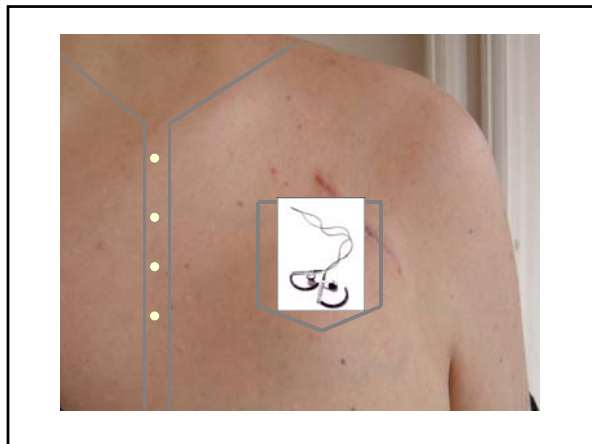
CONCLUSION Clinically significant magnetic interference can occur when portable headphones are placed in close proximity to implanted PMs and ICDs. Patients with such a device should be advised to keep portable headphones at least 3 cm from their device.

RESULTS Clinically relevant magnetic interference from portable headphones occurred in 30 (30%) of 100 patients and more commonly affected ICD than PM patients (21/55 [38.2%] vs 9/45 [20.0%]; $P = .048$). All patients affected by magnetic interference experienced a magnet response, characterized by asynchronous pacing in PM patients and by inhibition of tachyarrhythmia detection in ICD patients. In all but one of the 30 cases of magnetic interference, removal of the headphones

KEYWORDS Pacemaker; Implantable cardioverter-defibrillator; Electromagnetic interference; Electromagnetic field; Gaussmeter; Neodymium; iPod; MP3 player; Headphones; Earphones

ABBREVIATIONS EMI = electromagnetic interference; ICD = implantable cardioverter-defibrillator; PM = pacemaker
 (Heart Rhythm 2009;8:1432-1436) © 2009 Heart Rhythm Society. All rights reserved.





CLINICAL INVESTIGATIONS
 Anesthesiology 2008, 108:559-567 Copyright © 2008, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

Impact of Heart Failure on Patients Undergoing Major Noncardiac Surgery

Bradley G. Hannall, M.S.,¹ Lesley H. Curtis, Ph.D.,¹ Elliott Bennett-Guerrero, M.D.,¹ Christopher M. O'Connor, M.D.,² James G. Jollis, M.D.,¹ Kevin A. Schulman, M.D.,² Adrian F. Hernandez, M.D., M.H.S.¹

Background: Changes in the demographics and epidemiology of patients with cardiovascular comorbidities who undergo major noncardiac surgery require an updated assessment of which patients are at greater risk of mortality or readmission. The authors evaluated short-term outcomes among patients with heart failure, coronary artery disease (CAD), or neither who underwent major noncardiac surgery.

Methods: Patients were aged 65 and older, had Medicare fee-for-service coverage, and underwent 1 of 13 major noncardiac procedures from 2000 through 2004, excluding patients with end-stage renal disease and patients who did not have at least 1 yr of Medicare fee-for-service eligibility before surgery. Main outcome measures were operative mortality and 30-day all-cause readmission.

ADVANCES in preoperative risk stratification, perioperative management, and surgery have led to substantial improvements in outcomes among patients undergoing major noncardiac surgical procedures over the past 30 yr. Previous research has outlined important steps for evaluating patients at risk for cardiovascular complications, especially patients with known coronary artery disease (CAD) and patients at risk for ischemic events.¹⁻³ Professional guidelines inform strategies for preventing cardiovascular events, largely based on evaluation for ischemia in high-risk patients and use of β -blockers in

Heart failure admission or > 3 outpt heart failure visits during prior 20 months

er risk for both are who undergo higher risks of than other patients admitted for the operative care are needed for the growing population of patients with heart failure undergoing major noncardiac surgery.

Values are expressed as the percentage of procedures with the event.

CLINICAL INVESTIGATIONS
 Anesthesiology 2008, 108:559-567 Copyright © 2008, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

Impact of Heart Failure on Patients Undergoing Major Noncardiac Surgery

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CME This article and its accompanying editorial have been selected for the Anesthesiology CME Program. After reading both articles, go to <http://www.waonline.org/journals> to take the test and apply for Category 1 credit. Complete instructions may be found in the CME section at the back of this issue.

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with heart failure were at significantly higher risk for both outcomes compared with patients with CAD.

Conclusions: Elderly patients with heart failure who undergo major surgical procedures have substantially higher risks of operative mortality and hospital readmission than other patients, including those with coronary disease, admitted for the same procedures. Improvements in perioperative care are needed for the growing population of patients with heart failure undergoing major noncardiac surgery.

ADVANCES in preoperative risk stratification, perioperative management, and surgery have led to substantial improvements in outcomes among patients undergoing major noncardiac surgical procedures over the past 30 yr. Previous research has outlined important steps for evaluating patients at risk for cardiovascular complications, especially patients with known coronary artery disease (CAD) and patients at risk for ischemic events.^{1,2} Professional guidelines inform strategies for preventing cardiovascular events, largely based on evaluation for ischemia in high-risk patients and use of β -blockers in

Table 3. Outcomes by Disease Group, Overall, and for Each Procedure

Outcome	Heart Failure	Coronary Artery Disease	Comparison Group	P Value
Operative mortality	8.0	3.1	2.4	<0.001
Above-knee amputation	25.8	18.0	16.0	<0.001
Below-knee amputation	12.8	10.4	7.2	0.001
Carotid endarterectomy	2.5	1.2	0.9	<0.001
Colon cancer resection	11.9	6.3	5.4	<0.001
Hip replacement	6.4	3.9	2.8	<0.001
Knee replacement	6.9	0.4	0.3	<0.001
Laparoscopic cholecystectomy	5.8	2.1	1.8	<0.001
Lower extremity bypass	8.1	3.7	4.1	<0.001
Open abdominal aortic aneurysm repair	10.3	5.8	4.8	<0.001
Open cholecystectomy	15.9	7.7	6.9	<0.001
Other abdominal cancer resections	11.8	4.3	4.9	<0.001
Pulmonary cancer resections	10.2	6.0	5.1	0.003
Spinal fusion	3.8	2.1	1.3	<0.001
30-Day readmission	17.1	10.8	8.1	<0.001
Above-knee amputation	25.2	21.6	18.9	0.008
Below-knee amputation	24.1	23.4	19.9	0.143
Carotid endarterectomy	15.2	10.8	8.7	<0.001
Colon cancer resection	18.0	13.2	10.5	<0.001
Hip replacement	16.6	10.3	8.0	<0.001
Knee replacement	9.9	6.2	4.7	<0.001
Laparoscopic cholecystectomy	16.4	10.1	8.4	<0.001
Lower extremity bypass	27.2	18.2	16.2	<0.001
Open abdominal aortic aneurysm repair	14.8	11.3	10.4	0.040
Open cholecystectomy	17.3	12.6	11.8	<0.001
Other abdominal cancer resections	20.0	17.4	13.3	<0.001
Pulmonary cancer resections	17.4	15.5	11.3	0.001
Spinal fusion	13.3	9.4	7.7	<0.001

Values are expressed as the percentage of procedures with the event.



Tibor Farkas photographer. Image from History of Medicine, National Library of Medicine

EXTENDED REPORT

Patterns of cardiovascular risk in rheumatoid arthritis

D H Solomon, N J Goodson, J N Katz, M E Weinblatt, J Avorn, S Setoguchi, C Canning, S Schneeweiss

Ann Rheum Dis 2006;65:1608-1612. doi: 10.1136/ard.2005.050277

Background: Although it is known that rheumatoid arthritis is associated with an increased risk of cardiovascular disease (CVD), the pattern of this risk is not clear. This study investigated the relative risk of myocardial infarction, stroke and CVD mortality in adults with rheumatoid arthritis compared with adults without rheumatoid arthritis across age groups, sex and prior CVD event status.

Methods: We conducted a cohort study among all residents aged ≥ 18 years residing in British Columbia between 1999 and 2003. Residents who had visited the doctor at least three for rheumatoid arthritis (International Classification of Diseases-714) were considered to have rheumatoid arthritis. A non-rheumatoid arthritis cohort was matched to the rheumatoid arthritis cohort by age, sex and start of follow-up. The primary composite end point was a hospital admission for myocardial infarction, stroke or CVD mortality.

Results: 25 385 adults who had at least three diagnoses for rheumatoid arthritis during the study period were identified. During the 5-year study period, 375 patients with rheumatoid arthritis had a hospital admission for myocardial infarction, 363 had a hospitalization for stroke, 437 died from cardiovascular causes and 1042 had one of these outcomes. The rate ratio for a CVD event in patients with rheumatoid arthritis was 1.6 (95% confidence interval [CI] 1.3 to 1.7), and the rate difference was 7.19 (95% CI 4.7 to 9.4) per 1000 person-years. The rate ratio decreased with age, from 2.3 in patients aged 18-29 years to 1.6 in those aged ≥ 75 years. However, the rate difference was 1.2 per 1000 person-years in the youngest age group and increased to 19.7 per 1000 person-years in those aged ≥ 75 years. Among patients with a prior CVD event, the rate ratios and rate differences were not increased in rheumatoid arthritis.

Conclusions: This study confirms that rheumatoid arthritis is a risk factor for CVD events and shows that the rate ratio for CVD events among subjects with rheumatoid arthritis is higher in young adults and those without known prior CVD events. However, in absolute terms, the difference in event rates is highest in older adults.

See end of article for authors' affiliations

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Accepted 9 June 2006
 Published Online First 22 June 2006

Increased Unrecognized Coronary Heart Disease and Sudden Deaths in Rheumatoid Arthritis

A Population-Based Cohort Study

Hilal M. Allman, et al.

Conclusion. Patients with RA have a significantly higher risk of CHD when compared with non-RA subjects. RA patients are less likely to report symptoms of angina and more likely to experience unrecognized MI and sudden cardiac death. The risk of CHD in RA patients precedes the ACR criteria-based diagnosis of RA, and the risk cannot be explained by an increased incidence of traditional CHD risk factors in RA patients.

Methods. We studied a population-based cohort of subjects aged 28-18 years who first fulfilled the American College of Rheumatology (ACR) 1987 criteria for RA between January 1, 1955 and January 1, 1995, and 605 age- and sex-matched non-RA subjects. All subjects were followed up through their complete inpatient and outpatient medical records, beginning at age 18 years until death, migration, or January 1, 2001. Data were collected on CHD events and traditional CHD risk factors (diabetes mellitus, hypertension, dyslipidemia, body mass index, smoking) using established diagnostic criteria. CHD risk estimates were compared with non-RA subjects. After the RA incidence date, RA patients were twice as likely to experience unrecognized MIs (hazard ratio [HR] 2.13, 95% CI 1.13-4.03) and sudden deaths (HR 1.94, 95% CI 1.06-3.55) and less likely to undergo coronary artery bypass grafting (HR 0.36, 95% CI 0.16-0.80) compared with non-RA subjects. Adjustment for the CHD risk factors did not substantially change the risk estimates.

EULAR evidence-based recommendations for cardiovascular risk management in patients with rheumatoid arthritis and other forms of inflammatory arthritis

M. J. L. Peters, D. P. M. Symmons, D. McCarney, B. A. C. Dijkman, P. Nicola, T. K. Kvien, I. B. McInnes, H. Haentzschel, M. A. Gonzalez-Gay, S. Provan, A. Semb, P. Sidiropoulos, G. Kitas, Y. M. Smallders, M. Soubrier, Z. Szekanecz, N. Sattar, M. T. Nurmohamed

ABSTRACT
Objectives: To develop evidence-based EULAR recommendations for cardiovascular (CV) risk management in patients with rheumatoid arthritis (RA), ankylosing spondylitis (AS) and psoriatic arthritis (PsA).
Methods: A multidisciplinary expert committee was convened as a task force of the EULAR Standing Committee for Clinical Affairs (ESCCA), comprising 18 members including rheumatologists, cardiologists, internists and epidemiologists, representing nine European countries. Problem areas and related keywords for evidence-based research were identified. A literature search was performed to identify relevant literature. The evidence was graded according to the GRADE system. The recommendations were developed and validated by the expert committee. The final recommendations were approved by the EULAR Board of Directors.

Ann Rheum Dis, 2010 (69), p. 325-331

EULAR evidence-based recommendations for cardiovascular risk management in patients with rheumatoid arthritis and other forms of inflammatory arthritis

1. RA increases CV risk (AS, PsA ?)

- Mortality 1.5X
- Control disease activity to lower risk

2. Use local guidelines to decrease risk

3. When selecting CV meds favor antiinflam

- Statin, ACE
- Minimal corticosteroid dose as possible
- Smoking cessation

EULAR evidence-based recommendations for cardiovascular risk management in patients with rheumatoid arthritis and other forms of inflammatory arthritis

M. J. L. Peters, D. P. M. Symmons, D. McCarney, B. A. C. Dijkman, P. Nicola, T. K. Kvien, I. B. McInnes, H. Haentzschel, M. A. Gonzalez-Gay, S. Provan, A. Semb

No mention of perioperative risk evaluation

ABSTRACT
Objectives: To develop evidence-based EULAR recommendations for cardiovascular (CV) risk management in patients with rheumatoid arthritis (RA), ankylosing spondylitis (AS) and psoriatic arthritis (PsA).
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ACC/AHA GUIDELINE

ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery)

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, and Society for Vascular Surgery

400 new articles reviewed since 2002 guideline

Step 5

Step 5

Clinical Risk Factors

- History of ischemic heart disease
- History of compensated or prior HF
- History of cerebrovascular disease
- Diabetes
- Renal insufficiency

??? Rheumatic disease

Non-CAD Cardiac Issues


- Valvular heart disease
- Chronic hypertension
- Chronic atrial fibrillation
- Hypertrophic cardiomyopathy
- Pulmonary hypertension
- Congenital heart disease
- Pacemaker
- ICD
- Chronic heart failure
- Rheumatologic disease

MAYO CLINIC

Urinalysis Prior to Joint Replacement:

Evidence Based or Expected Standard Practice?

October 9-12, 2013



Mayo School of Continuous Professional Development

Stuart L. Gordon, M.D.
Chief of Hip and Knee Division
Cooper University Hospital
Camden, NJ

October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Disclosures

I have no disclosures to make regarding this presentation.

Rationale of Pre-op Screening Urinalysis

- Detect unrecognized UTI or Renal Disease which may increase risk of wound infection or other complication after total joint replacement
- UTI -> Bacteriuria -> Prosthetic joint infection
- Provide opportunity to reduce risk by executing therapeutic strategy and avoid delaying planned surgery

Expected Standard Practice

- Knee Society/Hip Society
- American Academy of Orthopaedic Surgeons
- American Association of Hip/Knee Surgeons
- Practice Websites University/Community TJR Surgeons
- (All support pre-op urinalysis screening)

"I believe you should never order a U/A in an asymptomatic patient with the exception of patients undergoing GU or GYN manipulation. Ordering a U/A before TJR has been promoted in the orthopaedic literature on the theoretical basis that bacteria might somehow seed and colonize the joint. Orthopaedic surgeons like to do it (but I disregard their request for it)"

-Steven L Cohn, M.D., B.A.
Cleveland Clinic Case Studies in Perioperative Management 2009

Glynn 1984	David 2000
Ritter 1987	Kovlouraris (Hospital for Special Surgery) 2009

- No Correlation of Pre-op positive UTI with PJI (Prosthetic Joint Infection)
- Asymptomatic Bacteriuria (100,000 Colony Count)
 - Did NOT cause seeding of joint
- No patient sample of untreated symptomatic patients

JBJS British 2012 Study

- Possible correlation with UTI/PJI
- Study included superficial wound swabs-dubious criterion
- 558 patients
 - 85% (+) dipstick bacteria
 - 7% (+) Cultures
- UTI may be indicative of subset of sicker, more debilitated patients rather than a discrete risk factor for PJI



Urinalysis Screening

- No evidence-based support to screen patients who have no symptoms of bladder irritation (cystitis), obstruction, or pyelonephritis
- Accepted as a practice standard



My University Practice

- All TJR patients have U/A and Cultures
- Nurse practitioner checks all results
- Asymptomatic UTI: Treat with appropriate antibiotics
- **DO NOT DELAY SURGERY!**
- Symptomatic UTI: Treat with appropriate antibiotics, treat until symptoms resolved




- Remove Foley Catheter within 24 hours after surgery
- Mobilize patient early and often
- Use multi-modal "comfort" protocol to accelerate rehab process minimizing opiates



MAYO CLINIC

An Overview of
 Perioperative Medicine 2013:
 Preoperative Assessment of the
 Patient with Pulmonary Disease



Mayo School of Continuous Professional Development
 Margaret Beliveau MD
 October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Preoperative Pulmonary Risk Assessment

2 purposes:

- **Predict** the risk of postoperative pulmonary complications (PPC's)
- Provide strategies to **reduce the risk** of PPC's

Clinical Significance

- PPC's are a major source of postoperative morbidity and mortality
- 2-19% in non-cardiothoracic surgery
- 8-35% in cardiothoracic surgery
- Similar incidence to postoperative cardiac complications
- Little good clinical data, so more uncertainty in perioperative risk management

Why Don't We Do This More Often?

- We don't know what the assessment can predict
- We don't have guidelines for which tests we should do in particular patients
- Shouldn't we try to reduce the risk of PPC's in **all patients**?

Postoperative Pulmonary Complications

General complications

- Atelectasis
 - Lung opacification w/ shift of diaphragm or mediastinum
- Respiratory infection
 - Antibiotics, fever, X-ray changes, ↑WBC
- Bronchospasm
 - New wheezing, treated with bronchodilators
- Exacerbation of underlying chronic lung disease
- Respiratory failure
 - SaO₂ < 90%, requiring oxygen
- Pleural Effusion
- Pneumothorax
- Aspiration pneumonia

Postoperative Pulmonary Complications

Specific cardiothoracic surgical complications

- Phrenic nerve injury
- Pleural effusion
- Bronchopleural fistula
- Sternal wound infection and empyema
- Gastroesophageal anastomotic leak
- Postoperative arrhythmias

The Literature...

- Lawrence VA, Cornell JE, Smetana GW. *Strategies to Reduce Postoperative Pulmonary Complications after Noncardiothoracic Surgery: Systematic Review for the American College of Physicians.* Ann Intern Med 2006; 144:596-608.



The Literature...

- Qaseem A, Snow V, Fitterman N et al. *Risk Assessment and Strategies to Reduce Perioperative Pulmonary Complications for Patients Undergoing Noncardiothoracic Surgery: A Guideline from the American College of Physicians.* Ann Intern Med 2006; 144:575-580



The Literature...

- Canet J, Gallart L et al. Prediction of Postoperative Pulmonary Complications in a Population-based Surgical Cohort. Anesthesiology 2010; 113: 1338-50.



Perioperative Pulmonary Physiology

- Reduction in lung volumes
- Thoracic and upper abdominal surgery:
 - Vital capacity reduced 50-60%, may take up to 1 week to return to normal
 - FRC reduced about 30%
 - Diaphragmatic dysfunction
- Residual effects of anesthesia and opiates may suppress respiratory drive



Case 1

- A 39 yo obese woman (BMI 32) has a long-standing history of asthma. She is scheduled for laparoscopic cholecystectomy for symptomatic gallstones.
- On exam, her lungs are clear.
- Medications: Flovent inhaler 220 mcg BID; albuterol inhaler prn, last used 2 months ago



Case 1

- What is the best strategy for preoperative evaluation to prevent postoperative pulmonary complications?
1. Chest X-ray
 2. Spirometry and ABG
 3. Steroids for 5 days preoperatively
 4. No further workup needed



Case 2

- A 75 year old man with COPD, who smokes 1 PPD, scheduled for open prostatectomy for prostate cancer
- Currently uses Spiriva inhaler
- Has failed multiple attempts at smoking cessation
- Chronic cough, but walks 2-3 miles daily without symptoms
- Exam: Lungs clear



Case 2

- Which of the following should be ordered preoperatively?
 1. Spirometry and ABG
 2. Spirometry without ABG
 3. Send to surgery without further testing
 4. Delay surgery for 2 months until patient has stopped smoking
 5. Pulmonary consult



Risk Assessment

- Patient related factors
- Surgery related factors- often more important in predicting risk of PPC's vs postoperative cardiac complications



Patient Related Risk Factors

- Age
- Smoking
- Chronic obstructive pulmonary disease
- Functional status
- Asthma
- Obesity
- Low serum albumin
- Obstructive sleep apnea
- Neurologic status
- ASA classification
- Pulmonary hypertension



Patient Related Risk Factors

- Asthma: no longer considered a risk factor for PPC's
- Patients should be at "personal best" before elective surgery
- Tracheal intubation can trigger bronchospasm in some patients
- ? Pretreat with steroids and β agonists



Age

- Good evidence that advanced age is an important risk factor for PPC's
- **Not** a modifiable risk factor
- ? Influence of co-morbidities



Smoking

- 44 million Americans smoke
- 1 in 5 deaths attributed to smoking
- Active smoking linked to increased risk of perioperative cardiovascular, pulmonary and wound healing complications
- Smoking at the time of surgery associated with inferior long-term surgical outcomes



Khullar D, Maa J. J Am Coll Surg; 2012; 215, 418-26.

Smoking

- Shouldn't all patients stop smoking before surgery?
- Even brief preoperative smoking cessation can reduce the risk of complications
- We should seize any opportunities to help patients stop smoking.



Specialty	Complications
General surgery	Superficial and deep wound infections, sepsis, anastomotic leak, myocardial infarction, pneumonia, prolonged intubation, stroke
Cardiac	Pulmonary complications, sternal wound infection, vein graft failure, prolonged ventilator support, ICU readmission
Plastic	Increased scarring and asymmetry, delayed wound healing, reduced skin flap survival, implant loss (breast reconstruction), lower rates of successful digital replantation (microsurgery)
Orthopedic	Pneumonia, surgical site infections, impaired bone healing, increased postoperative pain, stroke
Pediatric (parent smoking)	Anesthesia-related respiratory complications



Khullar D, Maa J. J Am Coll Surg; 2012; 215, 418-26.

Chronic Obstructive Pulmonary Disease

- Major risk factor for PPC's
- Chronic respiratory muscle fatigue may be exacerbated by the effects of surgery and anesthesia
- No incremental increase in risk with worsening airflow obstruction
- Increased risk of postoperative arrhythmias in cardiothoracic surgery



Chronic Obstructive Pulmonary Disease

- Preoperative history should focus on recent exacerbations, sputum production, presence of dyspnea at rest
- Physical exam should focus on signs of acute exacerbation or pneumonia
- Try to have patients at their **"personal best"** prior to elective surgery



Functional Status

- Total dependence: inability to perform **any** activities of daily living
- Partial dependence: need for equipment and assistance of another person
- These patients are at almost **twice** the risk of PPC's
- Not a modifiable risk factor



Obesity

- Postoperatively, decreased lung volume in most patients
- Obese patients may have restrictive physiology based on obesity
- Most studies found that obese patients, even morbidly obese patients, **did not have an increased risk of PPC's**
- Potentially modifiable, but impractical in the perioperative setting
- Should not impact decision to proceed with a surgical procedure



Obstructive Sleep Apnea (OSA)

- Stay tuned for Dr. Olson



Neurologic Status

- Impaired sensorium and previous stroke
- Increased risk of both pneumonia and respiratory failure
- Functional dependence
- Aspiration risk



ASA Classification

- I- A normally healthy patient (PPC's 1.2%)
- II- A patient with mild systemic disease (PPC's 5.4%)
- III- A patient with systemic disease which is not incapacitating (PPC's 11.4%)
- IV- A patient with an incapacitating disease that is a constant threat to life (PPC's 10.9%)
- V- A moribund patient not expected to survive 24 hours, with or without operation



ASA Classification

- Higher ASA classification was associated with increased risk of PPC's



Nutrition

- Low serum albumin (as a marker for overall nutritional status) is a risk factor for postoperative respiratory failure
- 30 day mortality risk increases as albumin falls below 4.0mg/dL
- Potentially a modifiable risk factor, but often not feasible



Pulmonary Hypertension

- Defined as RVSP >35mm Hg
- Increased risk of postoperative complications if
 - NYHA functional status >2
 - History of pulmonary embolism
 - OSA
- Most complications occur in the OR or within 48 hours after procedure



Pulmonary Hypertension

- Postoperative complications include:
 - Respiratory failure
 - Congestive heart failure
 - Cardiac ischemic events
 - Arrhythmias
 - Hepatic dysfunction
 - Renal dysfunction
 - Need for inotropic or vasopressor support



Pulmonary Hypertension

- High incidence of complications, even in patients with mild-to-moderate PH
- Risk increased if:
 - Longer surgery
 - Emergency and major procedures
 - General anesthesia
- Patients with worse functional status have more complications



Surgery Related Risk Factors

- Surgical site
- Type (general vs regional) of anesthesia
- Duration of anesthesia
- Neuromuscular blockade (Pancuronium use)
- Emergency surgery



Surgical Site

- Increased risk of postoperative pneumonia and respiratory failure:
- Abdominal aortic aneurysm repair (highest risk)
 - Thoracic
 - Upper abdominal
 - Neck



Anesthesia

- Insufficient evidence in favor of neuraxial blockade vs general anesthesia
- Postoperative analgesia: PCA has advantage over on request



Assessment of Risk

- History and Physical exam
- Imaging
- Spirometry
- Special measures of lung function
- ABG
- Exercise testing



Table 6. RESPIRATORY FAILURE RISK INDEX

Preoperative Predictor	Point Value
Type of surgery	
Abdominal aortic aneurysm	27
Thoracic	21
Neurosurgery, upper abdominal, or peripheral vascular	14
Neck	11
Emergency surgery	11
Albumin (<30 g/L)	9
Blood urea nitrogen (>30 mg/dL)	8
Partially or fully dependent functional status	7
History of chronic obstructive pulmonary disease	6
Age (years)	
≥70	6
60-69	4

Multifactorial Risk Index for Predicting Postoperative Respiratory Failure in Men After Major Noncardiac Surgery.
 Ibrahim, Ahsan, MD, MPH; Daley, Jennifer; Henderson, William; Khar, Shari
 Annals of Surgery, 2002;235(2):242-253, August 2000.



Respiratory Failure Index

Class (score)	Risk of respiratory failure
1 (< 10)	0.5%
2 (11-19)	1.8%
3 (20-27)	4.2%
4 (28-40)	10.1%
5 (>40)	26.6%



Table 6. Independent Predictors of Risk for PPCs Identified in the Logistic Regression Model

	Multivariate Analysis OR (95% CI)	β Coefficient	Risk Score†
n = 1,624*			
Age, yr			
≤50	1		
51-80	1.4 (0.6-3.3)	0.331	3
≥80	5.1 (1.9-13.3)	1.619	16
Preoperative SpO ₂ , %			
≥95	1		
91-95	2.2 (1.2-4.2)	0.802	8
≤90	10.7 (4.1-29.1)	2.375	24
Respiratory infection in the last month	5.5 (2.6-11.5)	1.698	17
Preoperative anemia (≤10 g/dl)	3.0 (1.4-6.5)	1.105	11
Surgical incision			
Peripheral	1		
Upper abdominal	4.4 (2.3-8.5)	1.480	15
Intrathoracic	11.4 (4.9-26.0)	2.431	24
Duration of surgery, h			
≤2	1		
>2 to 3	4.9 (2.4-10.1)	1.593	16
>3	9.7 (4.7-19.9)	2.268	23
Emergency procedure	2.2 (1.0-4.5)	0.768	8

* Because of a missing value for some variables, three patients were excluded. Logistic regression model constructed with the development subsample; c-index = 0.90; Hosmer-Lemeshow chi-square test = 7.862; P = 0.447. † The simplified risk score was the sum of each β logistic regression coefficient multiplied by 10, after rounding off its value.

CI = confidence interval; OR = odds ratio; PPC = postoperative pulmonary complications; SpO₂ = oxyhemoglobin saturation by pulse oximetry breathing air in supine position.

Carrat J, Colart L. Anesthesiology, 2010, 1338-50.



Risk Assessment

- Low risk: < 26 points
- Intermediate risk: 26-44 points
- High risk: >44 points



So what tests do we need to assess pulmonary risk?



Spirometry

- Good **diagnostic** tool for COPD
- Has never been shown to be better than clinical data (history and physical exam) for predicting risk of PPC's
- No absolute threshold of prohibitive risk



Spirometry

- ACP Guidelines: Preoperative spirometry should **not** be used **routinely** for predicting risk of postoperative pulmonary complications



Spirometry

Consider in:

- Patients who are heavy smokers
- Patients complaining of inexplicable dyspnea or cough
- Abnormal lung exam
- Upper abdominal or aortic surgery
- Lung resection or lung reduction surgery



Chest X-ray

- Studies have looked at how CXR findings changed perioperative management, **not** how well they predicted PPC's
- Most studies show that a preoperative CXR **rarely** (0.1%) changes perioperative management
- Abnormalities could often be predicted on the basis of history and physical exam



Chest X-ray

- ACP Guidelines: Preoperative chest X-ray should **not** be used **routinely** for predicting risk of postoperative pulmonary complications



Case 3

- 77 yo woman with "moderate" COPD, discovered to have a 6.1cm abdominal aortic aneurysm on a community based screening exam
- COPD diagnosed 3 years ago after admission for an exacerbation; quit smoking at that time



Case 3

- Currently on Spiriva inhaler, rare albuterol use
- Walks on a treadmill 3-4 times/week, weight training, very physically active
- Rarely, some dyspnea on exertion
- Normal exam



Case 3

Which of the following tests would be helpful preoperatively to assess risk of PPC's?

1. Chest X-ray
2. Spirometry
3. Arterial blood gas
4. Serum albumin
5. Cardiopulmonary exercise testing



How Do We Reduce the Risk of Postoperative Pulmonary Complications?



Case 4

- A 70 yo man is being seen preoperatively for a left nephrectomy for suspected renal cell cancer
- He has a 60 pack-year smoking history, still smokes ½ PPD
- Daily cough with production of sputum
- Last known FEV1 was 2 years ago= 1 L



Case 4

- Requires nocturnal oxygen
- Currently on long-acting beta-agonist inhaler and steroid inhaler
- Last exacerbation was 6 months ago, currently feels that he is at his baseline
- Exam: increased AP diameter, scattered wheezes
- Surgery scheduled in 5 days



Which of the following will help decrease his risk of postoperative pulmonary complications?



1. Smoking cessation
2. Lung expansion modalities
3. Pulmonary artery catheterization
4. Pre- and post- operative total parenteral nutrition
5. Nasogastric tube decompression for 3 days postoperatively



Lung Expansion Modalities

- Incentive spirometry, chest physical therapy, deep breathing exercises, cough, intermittent positive-pressure breathing (IPPB), continuous positive-airway pressure (CPAP)



Lung Expansion Modalities

- For abdominal surgery, studies suggest that **any** type of lung expansion is better than no attempt at prophylaxis
- Combining modalities may not increase efficacy
- Nasal CPAP in patient who are unable to comply with other modalities



Pulmonary Artery Catheterization

- No beneficial effect in reducing PPC's



Nutrition

- Studies of nutritional support have **not** shown a benefit for TPN over enteral nutrition or no intervention except possibly for patients with severe malnutrition



Nasogastric Tube Decompression

- **Selective** use: postoperative nausea and vomiting, severe abdominal distention
- **Routine** use: standard use after surgery until gastrointestinal motility returns
- **Selective** use of NG tube decompression probably beneficial in decreasing risk of PPC's



Case 1- Asthma

- What is the best strategy for preoperative evaluation to prevent postoperative pulmonary complications?
- 1. Chest X-ray
- 2. Spirometry and ABG
- 3. Steroids for 5 days preoperatively
- 4. **No further workup needed**



Case 2- COPD, Smoker

- Which of the following should be ordered preoperatively?
- 1. Spirometry and ABG
- 2. Chest X-ray, spirometry and a 6 minute walk test
- 3. Spirometry without ABG
- 4. **Send to surgery without further testing**
- 5. Delay surgery for 2 months until patient has stopped smoking



Case 3- COPD, AAA

Which of the following tests would be helpful preoperatively to assess risk of PPC's?

1. Chest X-ray
2. Spirometry
3. Arterial blood gas
4. **Serum albumin**
5. Cardiopulmonary exercise testing



Case 4- Smoker, COPD

1. Smoking cessation
2. **Lung expansion modalities**
3. Pulmonary artery catheterization
4. Pre- and post- operative total parenteral nutrition
5. Nasogastric tube decompression for 3 days postoperatively



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Questions?

- Thank you.
- Beliveauficalora.margaret@mayo.edu



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Perioperative Cardiac Complications
in
Noncardiac Surgery

I and II

An Overview of Perioperative Medicine
October, 2013

Howard Weitz, M.D.
Jefferson Medical College
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Perioperative Complications

- Hypertension
- Hypotension
- Arrhythmias
- Myocardial ischemia - infarction
- Heart failure

Perioperative Hypertension

- Preop diastolic < 110 mm Hg not a risk factor.
- ? Risk of preop systolic hypertension
- No clear evidence perioperative hypertension related to post op death.
- Periop hypertension or hypotension occurs in 25% of hypertensive patients who undergo surgery.
- Carotid, abdominal aortic, vascular, abdominal, thoracic.

Perioperative Hypertension Occurrence

- **Laryngoscopy - induction**
 - Sympathetic stimulation
- **Intraoperative**
 - Sympathetic stimulation
 - Visceral traction

Perioperative Hypertension Occurrence

- **Immediately post op**
 - Pain
 - Hypothermia
 - Hypoxia
 - Volume overload
 - Cessation of positive pressure ventilation

Perioperative Hypertension Occurrence

- **48 hours post op**
 - Fluid mobilization
 - Medication withdrawal

Perioperative Hypertension Treatment

- **Prevention**
 - Beware of medication withdrawal
 - substitute with long acting agents
 - parenteral agents
- **Is the BP “correct” ?**

Perioperative Hypertension Treatment

- **Prevention**
 - Beware of medication withdrawal
 - substitute with long acting agents
 - parenteral agents
- **Is the BP “correct” ?**



Perioperative Hypertension Treatment

- **Are there precipitating factors?**
 - Pain
 - Cold
 - Antihypertensive medication withdrawal
 - Cocaine
 - Alcohol withdrawal

Perioperative Hypertension Treatment

- **First, do no harm !!!**
- **Does the BP really require lowering and how quickly ?**
- **Is there evidence to support urgent BP lowering?**

Our Approach to Urgency of Perioperative BP Control



There is not an easy answer to this dilemma. One of the first axioms learned in the study of medicine, namely “FIRST, DO NO HARM,” is applicable. The compulsive need to treat reaches the pathological in some physicians, especially during the early years in their careers. If the urge to treat asymptomatic hypertension becomes overwhelming, use an agent that lowers blood pressure gradually over time and ensure that the patient understands the need and has an opportunity for early and adequate follow-up. This approach should be safe for the patient and will satisfy the concern that you will be sued if you do nothing. For the majority of these patients, ensuring good follow-up as an outpatient will suffice.

From: Matthews J. The hypertensive patient in the emergency department. J Emerg Med 2000;19:379

Perioperative Hypertension Indications for Treatment

- Myocardial ischemia, CHF, cerebral ischemia, aortic dissection
- ??MAP 20 mm Hg above baseline in diabetic.
- “Significant” sustained elevation
- AVOID too rapid control

Perioperative Hypertension Medical Rx

- Nitroprusside
- Nicardipine
- Beta blockers
- Enalapril
- Nitroglycerine
- Alpha methyldopa
- Diuretics
- NO Nifedipine

Perioperative hypertension: medical mgmt

- Clevidipine
 - CCB
 - IV
 - T1/2 3 minutes
 - No hepatic or renal metabolism
 - Arterial vasodilator
 - Cardioprotective

Hypotension: Myocardial ischemia

- Transient systolic 50%
- Systolic ↓ 33% > 10 minutes
- MAP < 20 mm Hg in diabetic hypertensive 1 hour.

Perioperative Hypotension: Causes

- Acute
 - Iatrogenic
 - Vasodilation
 - Myocardial depression
 - Volume depletion
 - anesthesia (vasodilation/ myocardial depression)
- Delayed
 - Acute pulmonary embolism
 - Sepsis

Perioperative Arrhythmias

- 84% incidence - 5% significant
- Types
 - wandering atrial pacemaker
 - isorhythmic A-V dissociation
 - nodal rhythm
 - sinus tachycardia / bradycardia
 - Atrial premature contractions
 - Ventricular premature contractions

Perioperative Arrhythmias Etiology

- Altered autonomic tone
- Sympathetic stimulation
- Hypoxia
- Hypercarbia
- ?? Hypokalemia

Supraventricular arrhythmia: Risk

- Age > 70
- Pre op rales
- abdominal, thoracic, vascular surgery
- concurrent medical problems

4181 pts. major, nonemergent, NCS
317 perioperative SVA

SVA 33% increase length of stay

Table 3. Multivariate Analysis of Preoperative Clinical Correlates of Perioperative Supraventricular Arrhythmias*

Predictor	Odds Ratio (95% CI)	P Value
Age > 70 years	1.3 (1.0-1.7)	0.05
Male sex	1.3 (1.0-1.7)	0.04
Congestive heart failure†	1.7 (1.1-2.7)	0.01
Significant valvular disease on physical examination (murmur grade ≥II)	2.1 (1.2-3.6)	0.006
History of supraventricular arrhythmia		
Receiving digoxin	6.2 (3.9-9.8)	<0.001
Not receiving digoxin	2.2 (1.4-3.4)	0.001
History of asthma	2.0 (1.2-3.1)	0.002
Premature atrial complexes on preoperative ECG	2.1 (1.3-3.4)	0.003
ASA class III or IV	1.4 (1.1-1.9)	0.009
Type of procedure‡		
Intrathoracic, receiving digoxin	1.8 (0.4-7.7)	>0.2
Intrathoracic, not receiving digoxin	10 (7.4-14)	<0.001
Abdominal aortic aneurysm	3.9 (2.4-6.3)	<0.001
Abdominal	2.5 (1.7-3.6)	<0.001
Vascular	1.6 (1.1-2.4)	0.02

* ASA = American Society of Anesthesiologists; ECG = electrocardiography.
† Congestive heart failure defined as history of congestive heart failure, pulmonary edema, or polysymptomatic nocturnal dyspnea; physical examination showing bilateral rales or S₃ gallop; or chest radiograph showing pulmonary vascular redistribution.
‡ Reference group: orthopedic, head, neck, and other procedures.

Polanczyk, et al.: Ann Intern Med. 1998;129:279-285

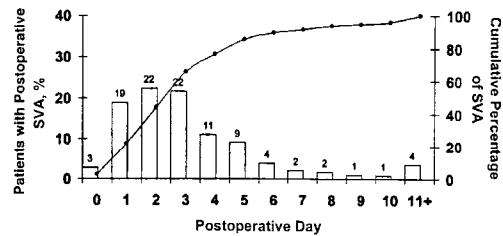


Figure. Distribution of supraventricular arrhythmias (SVA) according to the time of first occurrence among the 256 patients who developed arrhythmias after surgery.

Polanczyk, et al.: Ann Intern Med. 1998;129:279-285

Prediction Rule for Atrial Fibrillation After Major Noncardiac Thoracic Surgery

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Northwestern University Feinberg School of Medicine and the Feinberg Cardiovascular Institute, Chicago, Illinois, and Memorial Sloan-Kettering Cancer Center, New York, New York

Background. Atrial fibrillation (AF) is a common complication after major noncardiac thoracic surgery and increases the cost and morbidity of these operations. We sought to derive and validate a clinical prediction rule to risk-stratify patients for postoperative AF.

Methods. For a cohort of cancer patients who underwent noncardiac thoracic surgery, we examined the association of preoperative clinical variables with development of postoperative AF. Logistic regression identified multivariable predictors of AF and a clinical risk score was developed by assigning weighted point scores for the presence of each significant variable. An independent data set was used for validation purposes.

Results. Of the 816 patients, 487 (59.7%) developed postoperative AF. Male gender (odds ratio [OR] 1.7, 95% confidence interval [CI] 1.2 to 2.6), advanced age (68 to 74 years OR 4.4, 95% CI 2.0 to 9.8; 67 to 75 years OR 3.2, 95% CI

3.9 to 21.5), and preoperative heart rate greater than or equal to 72 beats per minute (OR 1.7, 95% CI 1.2 to 2.5) were independent predictors of postoperative AF. A risk score was assigned with male gender and heart rate greater than or equal to 72 beats per minute each receiving 1 point, and age 65 to 74 and greater than or equal to 75 years receiving 3 and 4 points, respectively. The risk of postoperative AF ranged from 0% (0 points) to 34.6% (6 points) ($p < 0.001$). The score-based risk in both derivation and validation sets was similar ($p = 0.66$).

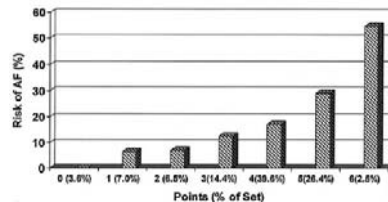
Conclusions. A prediction rule using clinical variables can be used to predict the risk of postoperative AF after noncardiac thoracic surgery. This information can be used to guide prophylactic therapy.

(Ann Thorac Surg 2005;79:1698-1700)
© 2005 by The Society of Thoracic Surgeons

Table 4. Logistic Regression Analysis and Weighted Score for Prediction of Atrial Fibrillation

Variable	Coefficient	p Value	Points for Risk Score
Male Gender	0.7	0.01	1
Heart rate \geq 72 bpm	0.6	0.01	1
Age 55-74 yr	1.6	<0.01	3
Age \geq 75 yr	2.2	<0.01	4

bpm = beats per minute.



From Passman R, et al. Ann Thorac Surg, 2005

Supraventricular Arrhythmia: Rx

- Unstable vs. Stable
- PSVT
- Atrial flutter
- Atrial fibrillation

2001

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ACC/AHA/ESC PRACTICE GUIDELINES—FULL TEXT

ACC/AHA/ESC Guidelines for the Management of Patients With Atrial Fibrillation

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines and Policy Conferences (Committee to Develop Guidelines for the Management of Patients With Atrial Fibrillation)
Developed in Collaboration With the North American Society of Pacing and Electrophysiology

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Recommendations follow the format of previous ACC/AHA guidelines for classifying indications, summarizing both the evidence and expert opinion:

Class I:

Conditions for which there is evidence for and/or general agreement that the procedure or treatment is useful and effective.

Class II:

Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.

Class IIa:

The weight of evidence or opinion is in favor of the procedure or treatment.

Class IIb:

Usefulness/efficacy is less well established by evidence or opinion.

Recommendations for Prevention and Management of Postoperative AF

Class I

1. Treat patients undergoing cardiac surgery with an oral beta-blocker to prevent postoperative AF, unless contraindicated. *(Level of Evidence: A)* **Prophylactic Beta blocker (Cardiac surgery)**
2. In patients who develop postoperative AF, achieve rate control by administration of AV nodal blocking agents. *(Level of Evidence: B)* **Rate control**

Class IIa

1. Administer sotalol or amiodarone prophylactically to patients at increased risk of developing postoperative AF. *(Level of Evidence: B)* **Prophylaxis (cardiac surgery)**
2. Restore sinus rhythm in patients who develop postoperative AF by pharmacological cardioversion with ibutilide or direct-current cardioversion, as recommended for nonsurgical patients. *(Level of Evidence: B)* **Restore sinus rhythm**
3. In patients with recurrent or refractory postoperative AF, attempt maintenance of sinus rhythm by administration of antiarrhythmic medications, as recommended for patients with CAD who develop AF. *(Level of Evidence: B)* **Antiarrhythmics for recurrent / refractory**
4. Administer antithrombotic medication in patients who develop postoperative AF, as recommended for nonsurgical patients. *(Level of Evidence: B)* **Antithrombotics**

ACC/AHA/ESC Practice Guidelines

ACC/AHA/ESC 2006 Guidelines for the Management of Patients With Atrial Fibrillation

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Revise the 2001 Guidelines for the Management of Patients With Atrial Fibrillation)

Developed in Collaboration With the European Heart Rhythm Association and the Heart Rhythm Society

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Circulation and J Am Coll Cardiol August 15, 2006
Online www.acc.org

ACC / AHA / ESC 2006 Guidelines for the Management of Patients With Atrial Fibrillation

Although AF may occur after noncardiac surgery, the incidence of atrial arrhythmias including AF after open-heart surgery is between 20% and 50% (823–825), depending on definitions and methods of detection. The incidence of postoperative AF is increasing, perhaps more because of the age of surgical patients than because of technical factors, and this is associated with increased morbidity and costs.

Class I

1. Unless contraindicated, treatment with an oral beta blocker to prevent postoperative AF is recommended for patients undergoing cardiac surgery. (Level of Evidence: A)
2. Administration of AV nodal blocking agents is recommended to achieve rate control in patients who develop postoperative AF. (Level of Evidence: B)

Class IIa

1. Preoperative administration of amiodarone reduces the incidence of AF in patients undergoing cardiac surgery and represents appropriate prophylactic therapy for patients at high risk for postoperative AF. (Level of Evidence: A)
2. It is reasonable to restore sinus rhythm by pharmacological cardioversion with ibutilide or direct-current cardioversion in patients who develop postoperative AF as advised for nonsurgical patients. (Level of Evidence: B)
3. It is reasonable to administer antiarrhythmic medications in an attempt to maintain sinus rhythm in patients with recurrent or refractory postoperative AF, as recommended for other patients who develop AF. (Level of Evidence: B)
4. It is reasonable to administer antithrombotic medication in patients who develop postoperative AF, as recommended for nonsurgical patients. (Level of Evidence: B)

Class IIb

Prophylactic administration of sotalol may be considered in patients at risk of developing AF following cardiac surgery. (Level of Evidence: B)

Cardiac surgery – prophylactic beta blocker

Postop afib rate control

Cardiac surgery- amiodarone prophylaxis

Sinus rhythm restoration as for nonsurgical pts

Antiarrhythmics as for nonsurgical patients

Antithrombotics as for nonsurgical patients

Cardiac surgery –prophylactic sotalol

New onset periop afib

- High risk procedures
 - Thoracotomy (> 65 years old)
 - VATS (video assisted thoracoscopy) (> 80 years old)
- ?? Afib prophylaxis
 - Beta blocker
 - Calcium channel blocker (diltiazem, verapamil)
 - Amiodarone
 - Evidence in cardiac surgery
 - No better than diltiazem in thoracic surgery

Arrhythmias/Electrophysiology

Randomized Trial of Atorvastatin for Reduction of Postoperative Atrial Fibrillation in Patients Undergoing Cardiac Surgery

Results of the ARMYDA-3 (Atorvastatin for Reduction of Myocardial Dysrhythmia After Cardiac Surgery) Study

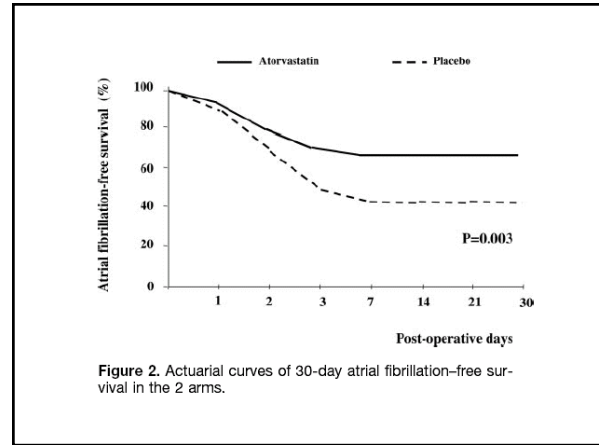
Giuseppe Patti, MD; Massimo Chello, MD; Dario Candara, MD; Vincenzo Pasceri, MD; Andrea D'Ambrosio, MD; Elio Covino, MD; Germano Di Sciscio, MD

Background—Atrial fibrillation (AF) after cardiac surgery is associated with increased risk of complications, length of stay, and cost of care. Observational evidence suggests that patients who have undergone previous statin therapy have a lower incidence of postoperative AF. We tested this observation in a randomized, controlled trial.

Methods and Results—Two hundred patients undergoing elective cardiac surgery with cardiopulmonary bypass, without previous statin treatment or history of AF, were enrolled. Patients were randomized to atorvastatin 40 mg/d (n=101) or placebo (n=99) starting 7 days before operation. The primary end point was incidence of postoperative AF; secondary end points were length of stay, 30-day major adverse cardiac and cerebrovascular events, and postoperative C-reactive protein (CRP) variables. Atorvastatin significantly reduced the incidence of AF versus placebo (35% versus 57%, P<0.001). Accordingly, length of stay was longer in the placebo versus atorvastatin arm (9.1±1.4 versus 6.3±1.2 days, P<0.001). Peak CRP levels were lower in patients without AF (P<0.01), irrespective of randomization assignment. Multivariate analysis showed that atorvastatin treatment conferred a 63% reduction in risk of AF (odds ratio 0.36, 95% confidence interval 0.18 to 0.67, P<0.001), whereas high postoperative CRP levels were associated with increased risk (odds ratio 2.0, 95% confidence interval 1.2 to 3.6, P<0.01). The incidence of major adverse cardiac and cerebrovascular events at 30 days was similar in the 2 arms.

Conclusions—Treatment with atorvastatin 40 mg/d initiated 7 days before surgery significantly reduces the incidence of postoperative AF after elective cardiac surgery with cardiopulmonary bypass and shortens hospital stay. These results may influence practice patterns with regard to adjunct pharmacologic therapy before cardiac surgery. (Circulation. 2006;114:1605-1614.)

Key Words: thoracic surgery • statin • statin • atrial fibrillation



Statin Use Is Associated With a Reduction in Atrial Fibrillation After Noncardiac Thoracic Surgery Independent of C-Reactive Protein*

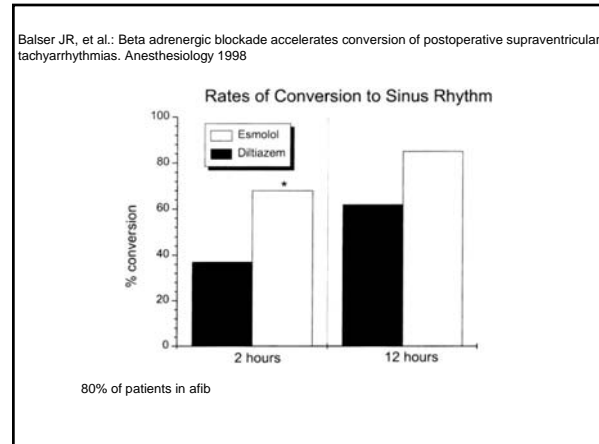
Darsh Amar, MD; Hui Zhang, MD; Paul M. Heerth, MD, PhD; Bernard Park, MD; Martin Fleisher, PhD; and Howard T. Thaler, PhD

Study objectives The level of C-reactive protein (CRP) has been shown to be elevated in patients with atrial fibrillation/flutter (AF) unrelated to surgery, and statins are known to lower the CRP level. To determine whether an elevated CRP level predisposes the patient to postoperative AF and whether statin use is associated with a reduced AF incidence, we studied a consecutive group of patients who were at risk for AF after undergoing thoracic surgery (age ≥ 60 years).

Design and setting A prospective study in a tertiary care cancer center of 131 patients (mean [± SD] age, 73 ± 6 years) who had undergone major lung or esophageal resection. High-sensitivity CRP and interleukin (IL)-6 levels were measured before surgery, on arrival at the postoperative care unit, and on the first morning after surgery. Continuous telemetry was used for 72 to 96 h to detect AF.

Results AF occurred in 38 of 131 patients (29%) at a median time after surgery of 3 days. Although CRP and IL-6 levels increased significantly (p < 0.001) in response to surgery, patients with or without AF did not differ in perioperative values. In a stepwise logistic regression, statin use was associated with a threefold decrease in the odds of developing AF (odds ratio [OR], 0.28; 95% confidence interval [CI], 0.08 to 0.82; p = 0.022) and a greater FR interval (OR, 1.11 per 3-mg increments; 95% CI, 1.01 to 1.22; p = 0.027) predicted an increase in the risk of AF.

Conclusions The preoperative use of statins was associated with a protective effect against postoperative AF independent of CRP levels. In contrast to AF in the general population, early markers of inflammation did not predict the postoperative occurrence of AF. (Chest. 2005; 128:3421-3427)



How do we determine stroke risk ? (Who requires anticoagulation to prevent stroke?)

- **CHADS2** (Gage, et al.: JAMA 2001)
 - Congestive heart failure - 1pt
 - Hypertension - 1pt
 - Age > 75 - 1 pt
 - Diabetes - 1pt
 - Stroke or TIA - 2 pts
- 0 points – low risk (1.2-3.0 strokes per 100 patient years)
- 1-2 points – moderate risk (2.8-4.0 strokes per 100 patient years)
- ≥ 3 points – high risk (5.9-18.2 strokes per 100 patient years)

Perioperative atrial fibrillation: Rx

- **Atrial fibrillation**
 - Majority (85%) will spontaneously convert
 - 98% in sinus rhythm 4-8 weeks postop
 - Rate control (beta blocker, Ca channel blocker)
 - Anticoagulation if > 48 hrs
 - CHADS2
 - Cardioversion (DC shock; ibutilide; TEE guided)

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ACC/AHA/ESC PRACTICE GUIDELINES—FULL TEXT

ACC/AHA/ESC Guidelines for the Management of Patients With Supraventricular Arrhythmias^{2*}

A Report of the American College of Cardiology/American Heart Association Task Force and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Patients With Supraventricular Arrhythmias)

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ACC/AHA/ESC Practice Guidelines 35

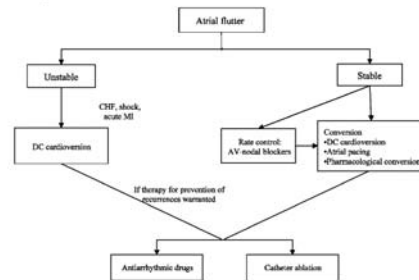


Figure 14. Management of atrial flutter depending on hemodynamic stability. Attempts to selectively revert atrial flutter to sinus rhythm should be preceded and followed by anticoagulant precautions, as per AF. AF indicates atrial fibrillation; AV, atrioventricular; CHF, congestive heart failure; DC, direct current; MI, myocardial infarction.

Ventricular Arrhythmias

- Significance related to underlying heart disease.
- Rx: hemodynamically significant ectopy;
- Antiarrhythmic metabolism and excretion may be altered in perioperative period.

Ventricular Arrhythmias

- Study Group: Men with known CAD or high CAD risk
- VPCs common
 - 44% had frequent or complex VPCs
 - Preop 21%
 - Intraop 16%
 - Postop 31%
- No sustained Vtach or Vfib

O' Kelley, 1992

The Incidence and Outcome of Ventricular Arrhythmias After Noncardiac Thoracic Surgery

David Amar, MD, Hao Zhang, MD, and Nancy Roistacher, MD*

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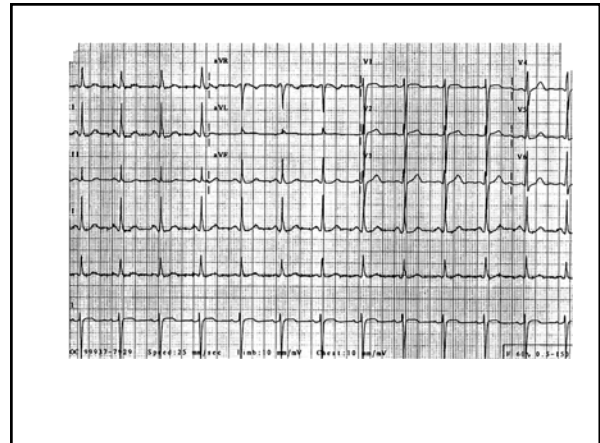
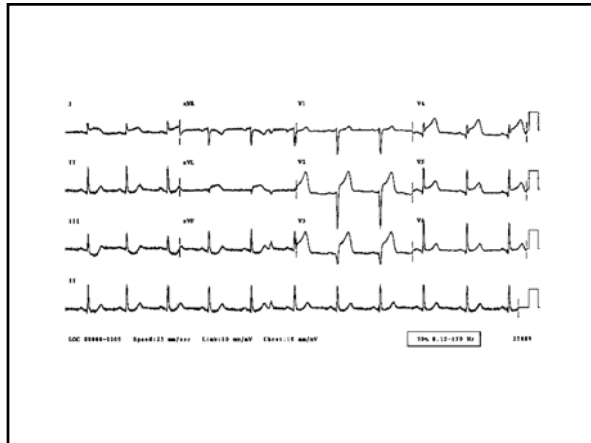
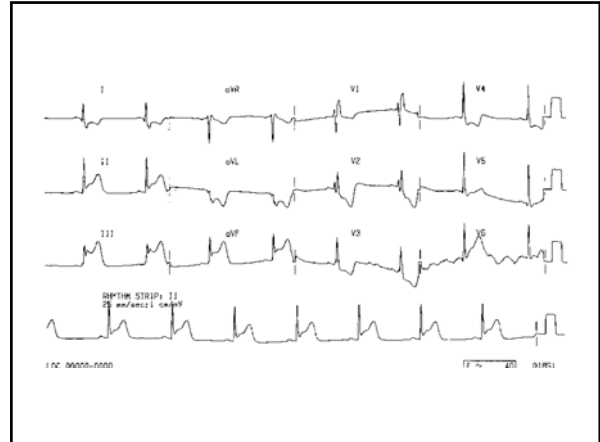
Atrial arrhythmias are common after thoracic surgery, but the incidence and significance of ventricular arrhythmias early after such surgery are not well established. Our goal was to determine the incidence and outcome of this complication from a continuing prospective database in 412 patients who had lobectomy (n = 243) or pneumonectomy (n = 169) and were continuously monitored with Holter recorders for 72-96 h postoperatively. The primary end point of the study was the occurrence of ventricular tachycardia (VT) defined as three or more consecutive wide-complexes. Sixty-one of 412 patients (15%) developed 1 or more episode of VT. There were no episodes of sustained (>30 s) VT and no patient required treatment for hemodynamic compromise associated with any VT episode. Patients with VT had a more frequent incidence of a preoperative left bundle branch block (P = 0.01) but did not differ in other clinical characteristics, operative data, or core temperature on arrival to the postanesthesia care unit.

when compared with those without VT. Patients who developed VT had significantly more atrial premature contractions (P < 0.001), ventricular premature contractions (P < 0.001), ventricular couplets (P < 0.001), and postoperative atrial fibrillation, 21 of 61 (34%) versus 50 of 351 (15%), (P = 0.001), than those without VT, respectively. Multivariate logistic regression analysis revealed that only postoperative atrial fibrillation occurrence was independently associated with VT (relative risk, 2.6, 95% confidence intervals 1.4 to 4.8, P = 0.002). We conclude that nonsustained VT after noncardiac thoracic surgery occurs frequently but is not associated with poor outcome. The strong association of atrial and ventricular arrhythmogenesis with VT suggests that rapid withdrawal and/or adrenergic hyporeactivity may have a role in precipitating these events in the early postoperative period.

(Anesth Analg 2002;95:537-43)

**Retrospective
412 patients lobectomy or pneumonectomy
Continuous monitoring 72-96 hours**

**NSVT in 15%- no effect on 30 day outcome
Four patients perioperative MI: No VT**



International Journal of Cardiology 57 (1996) 37-44

Pathology of fatal perioperative myocardial infarction: implications regarding pathophysiology and prevention

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Abstract

The aim of this study was to determine the pathology of fatal perioperative myocardial infarction (MI) and compare it with that of non-operative myocardial infarction. Histopathological analysis of coronary arteries and myocardium were performed on autopsy heart specimens (n=67), and clinical histories were studied. Findings of **perforated MI (n=42)** were compared to those of non-operative MI (n=25). Significant atherosclerotic obstruction (>50% cross-sectional narrowing) was observed in the majority of patients (93%). Left main (>50% cross-sectional narrowing) and/or three-vessel coronary artery disease were especially common (64%) in this group. Evidence of unstable plaque with disruption was noted in 55% of perioperative MI patients (n=23); plaque hemorrhage was found in 43% (n=10). Predicting the site of infarction based on severity of atherosclerosis would have been uninformative in those that had **fatal perioperative MI**. **Plaque rupture and thrombus formation** were the primary events leading to the fatal event in the two groups. **Plaque rupture and thrombus formation** were the primary events leading to the fatal event in the two groups. **Plaque rupture and thrombus formation** were the primary events leading to the fatal event in the two groups. **Plaque rupture and thrombus formation** were the primary events leading to the fatal event in the two groups.

Plaque rupture + Thrombus (decreased myocardial blood supply)

Am J Card 77, 1996

Angiographic Correlates of Cardiac Death and Myocardial Infarction Complicating Major Nonthoracic Vascular Surgery

Stephen G. Ellis, MD, Norman R. Herzog, MD, Jess R. Young, MD, and Savin Brenner, MD

Approximately 350,000 major vascular operations are performed annually in the U.S., and 4% to 10% are complicated by death or clinically detected nonfatal myocardial infarction.¹⁻³ Although many factors have been identified that increase the cardiac risk of noncardiac and vascular surgery,⁴⁻⁷ little is known about the coronary anatomy predisposing to major complications.⁸ The association found in most studies of inducible ischemia with perioperative risk⁴ might suggest that high-grade stenoses impart risk. However, in the nonurgent setting, 30% to 70% of lesions leading to infarction in patients undergoing angiography in the preceding 12 months have been found to be <50% narrowed at the earlier study.⁹ In the absence of data from a randomized trial, it is therefore difficult to know when, or in what form, to advise preoperative coronary revascularization in this population,⁸ and the low incidence of cardiac complications in patients undergoing major vascular surgery who had previously undergone successful coronary bypass surgery,^{8,10} during these years many patients referred for vascular surgery often underwent preoperative coronary angiography. One thousand five hundred twenty-two patients (42% of the entire population of the database) were reported to have had coronary studies within 6 months of vascular surgery. Subsequently, after chart review and case request a further 1.1% and 17.5% of patients were eliminated because of ongoing or recent myocardial ischemia immediately before vascular surgery and lack of cineangiograms performed within 6 months of surgery for review, respectively. Thus 1,242 patients form the cohort from which our study patients were drawn. All patients with preoperative

Angiography avg 6 days prior to vascular surgery. 1242 pts. Followed for subsequent MI or cardiac death postop. (21 pts) Collateralized total occlusions and nonobstructive lesions most common substrate. Were "inadequate collaterals" the cause (increased myocardial O2 demand) ?

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EXPERT CONSENSUS DOCUMENT

Third Universal Definition of Myocardial Infarction

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Allan S. Jaffe
Maarten L. Simoons
Bernard R. Chaitman and

Harvey D. White: the Writing Group on behalf of the Joint ESC/ACC/AHA/WHF Task Force for the Universal Definition of Myocardial Infarction

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Myocardial infarction associated with non-cardiac procedures

evolving myocardial necrosis (88). Studies of patients undergoing major non-cardiac surgery strongly support the idea that many of the infarctions diagnosed in this context are caused by a prolonged imbalance between myocardial oxygen supply and demand, against a background of CAD (89,90). Together with a rise and/or fall of cTn values, this indicates MI type 2. However, one pathological study of fatal perioperative MI patients showed plaque rupture and platelet aggregation, leading to thrombus formation, in approximately half of such events (91), that is to say, MI type 1. Given the differences that probably exist in the therapeutic approaches to each, close clinical scrutiny and judgment is needed.

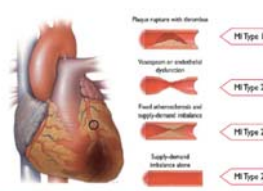


Figure 2. Differentiation between myocardial infarction (MI) types 1 and 2 according to the condition of the coronary arteries.

1418 CORONARY ARTERY OCCLUSION—MASTER ET AL. 1415

tabulation of deaths from rheumatic heart conditions. The application of these changes began with the tabulation for January 1932.

Physicians throughout the United States are requested to report deaths from rheumatic heart disease as such and to qualify the terms when possible by specifying the anatomic lesion in accordance with the nomenclature listed in the table.

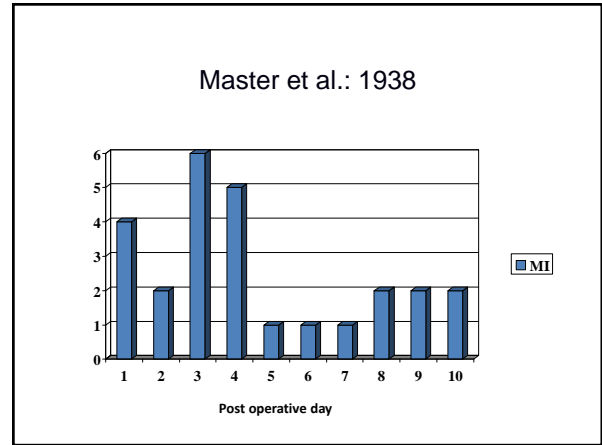
POSTOPERATIVE CORONARY ARTERY OCCLUSION
ARTHUR M. MASTER, M.D.
SIMON DACK, M.D.
and
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NEW YORK

For some years we have been impressed by the association of operation and coronary artery occlusion in patients over 50 years of age. In our previous paper¹ evidence was presented indicating that there was no relationship between the onset of coronary occlusion and exertion, excitement, meals, rest and the like. Operation, on the other hand, was considered probably a precipitating factor. In order to investigate this problem more fully we have collected records of all cases of postoperative occlusion observed at the Mount Sinai Hospital in New York during the years 1931 to 1932. They emphasize the importance of operation in inducing occlusion, and the following analysis attempts to determine which elements of the surgical procedure lead to it.

ANALYSIS OF CASES IN WHICH THERE WAS POSTOPERATIVE OCCLUSION
Incidence and Diagnosis.—During the years 1931 to 1932, 625 attacks of coronary artery occlusion were treated in the Mount Sinai Hospital. Thirty-five, or 5.6 per cent, of these attacks followed an operation in the hospital (table 1). In every instance the presence of the occlusion was proved by postmortem examination or by electrocardiogram. Thirteen additional cases in which coronary occlusion was diagnosed by the surgeon or medical consultant have been omitted because of the lack of postmortem and electrocardiographic examination.

The diagnosis of coronary artery occlusion following operation is frequently difficult, since the very severe pain ordinarily associated with this condition may be absent; it was present in only two fifths of our cases. This disparity may be accounted for, in part, by the local use of narcotics and sedatives after operation. Postoperative coronary occlusion is usually ushered in by shock, with dyspnea and cyanosis, and must therefore be differentiated from surgical shock and, in particular, from shock resulting from pulmonary embolism, a differentiation which may be responsible clinically. In certain cases of pulmonary embolism, even the electrocardiogram, if only one is obtained, may resemble that recorded in cases of infarction of the posterior surface of the heart. Because of this uncertainty in clinical diagnosis our report includes only the thirty-five cases in which the electrocardiogram was definite or postmortem examination was performed.

Age and Sex.—Almost two thirds of the patients were



Master, 1938

- Perioperative MI 1931-1937
- Shock 60%
- Mortality 66%
- Most without chest pain

Perioperative Myocardial Ischemia in Patients Undergoing Noncardiac Surgery—II: Incidence and Severity During the 1st Week After Surgery

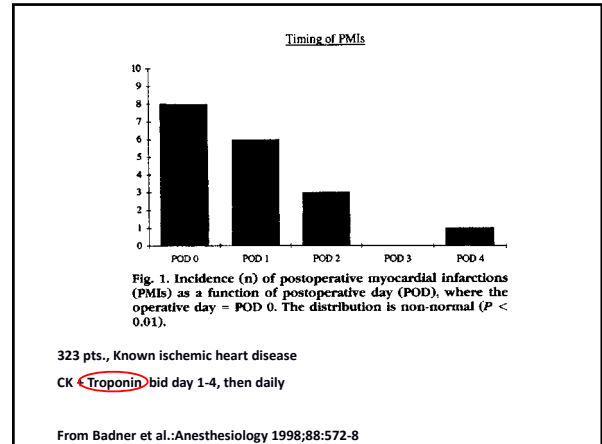
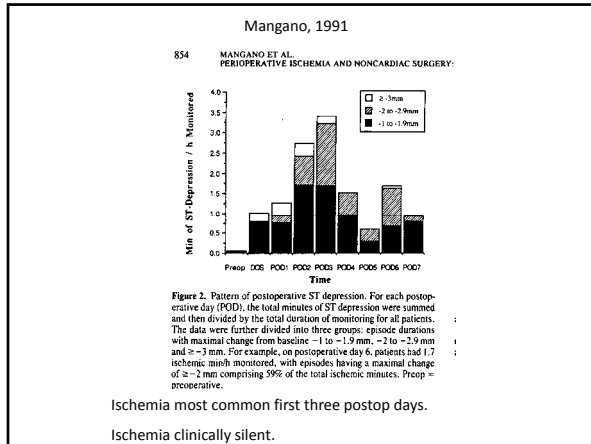
DENNIS T. MANGANO, PH.D. MD, MARTIN G. WONG, BS, R.DMS, MARTIN J. LONDON, MD, JULIO F. TUBAU, MD, JOSEPH A. RAPP, MD AND THE STUDY OF PERIOPERATIVE ISCHEMIA (SPI) RESEARCH GROUP*

San Francisco, California

Because of the importance of postoperative myocardial ischemia and because substantial physiologic changes can occur for prolonged periods postoperatively, the incidence, severity and temporal course of myocardial ischemia were studied in 108 high-risk patients during the 1st week after major noncardiac surgery. Electrocardiographic (ECG) changes consistent with ischemia were continuously monitored using ambulatory wide area ECG in the 100 patients with at risk for coronary artery disease. Ischemic episodes were defined as reversible ST segment depression ≥ 1 mm or elevation ≥ 2 mm above the baseline value, with the baseline adjusted for respiratory and positional variation and T-wave drift. All ischemic episodes were confirmed by three independent blinded investigators using hard-copy recordings. Twenty-seven patients (27%) developed 437 episodes of ischemia during the 1st week after surgery. The total duration of ischemia was 16,688 min, or 1.2 min of ischemia/h monitored. Ischemia was most severe during the early (days 0 to 3) versus late (days 4 to 7) postoperative period. The mean ST-segment depression was 1.2 mm of ischemia. The greatest severity occurred on postoperative day 3: 199 episodes, 3.4 min of ischemia/h monitored, 1.5 mm mean ST change and 130 min mean duration. However, in 85% of patients, severe episodes also occurred late: postoperative day 6 = 44 episodes, 1.7 mm of ischemia/h monitored, 1.3 mm mean ST change (98% ≥ 2 mm) and 92 min mean duration. Most ischemic episodes (95%) were associated with tachycardia. Eighty-four percent of episodes were silent, unaccompanied by symptoms of angina, pulmonary congestion or syncope. All the severe adverse cardiac outcomes (myocardial infarction, myocardial infarction or cardiac death) were preceded by postoperative ischemia occurring ≤ 1 day before the outcome.

It is concluded that in at-risk patients undergoing noncardiac surgery: 1) postoperative ECG ST changes consistent with myocardial ischemia are most common during the 1st 3 days after surgery, with changes persisting for ≥ 1 week; 2) postoperative ischemia is clinically silent throughout the entire period and therefore difficult to detect; 3) postoperative ischemia may be related to the persistently elevated heart rate during the 1st week after surgery; and 4) an association between both early and late postoperative ischemia and severe cardiac outcomes is suggested.

(*J Am Coll Cardiol* 1991;17:851-7)



Perioperative MI 2011

Annals of Internal Medicine ORIGINAL RESEARCH

Characteristics and Short-Term Prognosis of Perioperative Myocardial Infarction in Patients Undergoing Noncardiac Surgery

A Cohort Study

P.J. Devereaux, MD, PhD; Devin Kavir, MD, MSc; Javier Pagan, MSc; Gordon Guyatt, MD, MSc; Alban Siemieni, MD; Ignazio Garutti, MD, PhD; Kate Laine, MD, MSc; Pamela Ram-Medrano, MSc; Sue Chiu-Lavigne, RN; Homer Yang, MD; Colin MacDonald, MD; Alvaro Avanzas, MD, PhD; Luc Lavigne, MD, MSc; Weijiang Hu, MD; and Selim Yusuf, MBBCh, DPM, on behalf of the POISE (Perioperative Ischemic Evaluation) Investigators

Background: Each year, millions of patients worldwide have a perioperative myocardial infarction (MI) after noncardiac surgery.

Objective: To examine the characteristics and short-term outcome of perioperative MI.

Design: Cohort study (ClinicalTrials.gov registration number: NCT01020209).

Setting: 190 centers in 23 countries.

Patients: 8351 patients included in the POISE (Perioperative Ischemic Evaluation) trial.

Measurements: Four cardiac biomarker or enzyme assays were measured within 3 days of surgery. The definition of perioperative MI included either autopsy findings of acute MI or an elevated level of a cardiac biomarker or enzyme and at least 1 of the following defining features: ischemic symptoms, development of pathologic Q waves, ischemic changes on electrocardiography, coronary artery intervention, or cardiac imaging evidence of MI.

Results: Within 30 days of random assignment, 415 patients (5.0%) had a perioperative MI. Most MIs (74.1%) occurred within 48 hours of surgery; 69.3% of patients did not experience ischemic symptoms. The 30-day mortality rate was 11.6% (48 of 415 patients) among patients who had a perioperative MI and 2.2% (178 of 7936 patients) among those who did not ($P < 0.001$). Among patients with a perioperative MI, mortality rates were elevated and similar between those with (9.7%; adjusted odds ratio, 4.76 [95% CI, 2.68 to 8.43] and without (12.5%; adjusted odds ratio, 4.00 [CI, 2.65 to 6.16]) ischemic symptoms.

Limitations: Cardiac markers were measured only until day 3 after surgery, and additional asymptomatic MIs may have been missed.

Conclusion: Most patients with a perioperative MI will not experience ischemic symptoms. Data suggest that routine monitoring of troponin levels in at-risk patients is needed after surgery to detect most MIs, which have an equally poor prognosis regardless of whether they are symptomatic or asymptomatic.

Primary Funding Source: Canadian Institutes of Health Research.

Ann Intern Med 2011;154:623-628. www.annals.org

Perioperative MI 2011

Annals of Internal Medicine ORIGINAL RESEARCH

Characteristics and Short-Term Prognosis of Perioperative Myocardial Infarction in Patients Undergoing Noncardiac Surgery

A Cohort Study

P.J. Devereaux, MD, PhD; Ignazio Garutti, MD, PhD; Colin MacDonald, MD; on behalf of the POISE I

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Perioperative Myocardial infarction

- Autopsy
- Cardiac marker (+) and:
 - Symptoms
 - New Q waves
 - Ischemic ECG changes
 - Coronary intervention
 - Cardiac imaging c/w new MI

Perioperative MI 2011

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Perioperative Myocardial Infarction

- 30 days postop
 - 5% incidence periop MI
 - 74% of MI first 48 hrs postop
 - Asymptomatic 65%
 - Mortality 11.6%
 - Majority NSTEMI
 - Many not treated with meds to decrease risk of recurrent MI

Perioperative MI surveillance

- Cardiac troponins more specific than CPK-MB (rise 3 hrs post injury).
- Surveillance for known CAD, high risk for CAD, intermediate-to-high risk for event:
 - ECG: baseline, immed post op, POD 1,2,3
 - Troponin:
 - POD 1 and 4
 - Detects > 90% but ? Delayed detection
 - Evening post op and daily for 4 days
- Marker of risk for months post op

Perioperative MI - ?

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STEMI FOCUSED UPDATE

2007 Focused Update of the ACC/AHA 2004 Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines
Developed in Collaboration With the Canadian Cardiovascular Society
Endorsed by the American Academy of Family Physicians

2007 Writing Group to Revise New Evidence and Update the ACC/AHA 2004 Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction, Writing on Behalf of the 2004 Writing Committee

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Perioperative MI - ?

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ACC/AHA GUIDELINE REVISION

ACC/AHA 2007 Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction)
Developed in Collaboration With the American College of Emergency Physicians, the Society for Cardiovascular Angiography and Interventions, and the Society of Thoracic Surgeons
Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation and the Society for Academic Emergency Medicine

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Perioperative MI - ?

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PRACTICE GUIDELINE

2011 ACCF/AHA Focused Update of the Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction (Updating the 2007 Guideline)

A Report of the American College of Cardiology Foundation/
American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Emergency Physicians,
Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons

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Perioperative MI : 0

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PRACTICE GUIDELINE

2012 ACCF/AHA Focused Update of the Guideline for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction (Updating the 2007 Guideline and Replacing the 2011 Focused Update)

A Report of the American College of Cardiology Foundation/
American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Emergency Physicians,
Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons

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Perioperative MI: 0

ACCF/AHA Guideline

2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Emergency Physicians and
Society for Cardiovascular Angiography and Interventions

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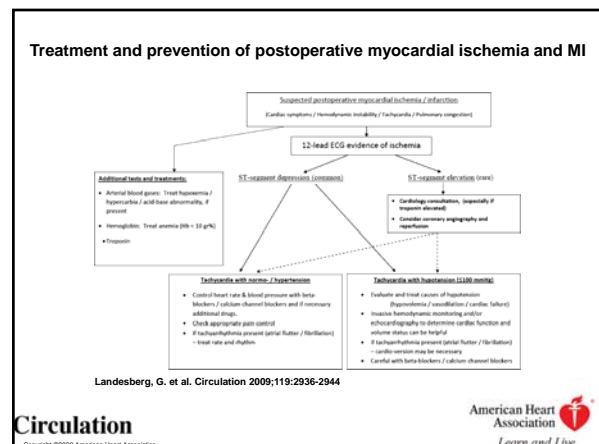
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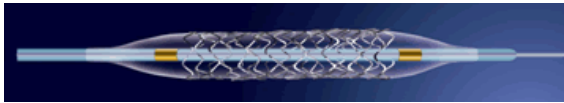
Perioperative Troponin Elevation

- Myocardial necrosis (lab diagnosis; many causes)
- Myocardial infarction (clinical diagnosis; few causes)

Perioperative Troponin Elevation

- Myocardial necrosis (lab diagnosis; many causes)
 - MI
 - Infection
 - Sepsis
 - Pulmonary embolus
 - Heart failure
 - Renal failure
- Myocardial infarction (clinical diagnosis; few causes)
 - MI

Is preoperative antiplatelet discontinuation a risk for perioperative MI?



Is preoperative antiplatelet discontinuation a risk for perioperative MI?

Journal of Internal Medicine 2005; 257: 399-414

REVIEW

Low-dose aspirin for secondary cardiovascular prevention – cardiovascular risks after its perioperative withdrawal versus bleeding risks with its continuation – review and meta-analysis

W. BURGER¹, J.-M. CHEMNITZ², G. D. KNEISSL¹ & G. RÜCKER³
From the ¹Department of Interventional Cardiology, St Georg Hospital, Leipzig; ²Cardiology Practice, Wölfnitztal; and ³Department of Rehabilitative and Preventive Sports Medicine, Medical Clinic, University of Freiburg, Freiburg, Germany

Burger et al 2005

- Retrospective meta-analysis Poor data
- Case reports re: ASA withdrawal – periop events
- Retrospective data ASA withdrawal – cardiovascular events (stroke, acute coronary syndrome, limb ischemia)
 - 10% of events followed aspirin discontinuation (8.5 days)
- Perioperative hemorrhagic fatalities on ASA
 - Neurosurgery
 - Prostatectomy

Journal of Internal Medicine 2005; 257: 399-414

REVIEW

Low-dose aspirin for secondary cardiovascular prevention – cardiovascular risks after its perioperative withdrawal versus bleeding risks with its continuation – review and meta-analysis

W. BURGER¹, J.-M. CHEMNITZ², G. D. KNEISSL¹ & G. RÜCKER³
From the ¹Department of Interventional Cardiology, St Georg Hospital, Leipzig; ²Cardiology Practice, Wölfnitztal; and ³Department of Rehabilitative and Preventive Sports Medicine, Medical Clinic, University of Freiburg, Freiburg, Germany

Meta-analysis of 41 studies

ASA increased risk of bleeding complications 1.5 fold

ASA withdrawal preceded 10% of Acute Coronary Syndromes

Time interval from ASA withdrawal to ACS was 8.5 days

Conclusion: ASA should be discontinued only if low dose ASA may cause bleeding risk with associated mortality

European Heart Journal (2008) 29, 2647–2654
doi:10.1093/eurheartj/ehn334

Clinical research
Coronary heart disease

A systematic review and meta-analysis on the hazards of discontinuing or not adhering to aspirin among 50 279 patients at risk for coronary artery disease

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KEYWORDS
Aspirin; Coronary artery disease; Discontinuation; Meta-analysis; Systematic review

Aims The rate of aspirin in patients with coronary artery disease (CAD) is well established, yet patients happen to discontinue aspirin according to physician's advice or unpermitted. We thus undertook a systematic review to appraise the hazards inherent to aspirin withdrawal or non-compliance in subjects at risk for or with CAD.

Methods and results Electronic databases were systematically searched (updated January 2008). Study designs, patient characteristics, and outcomes were abstracted. Pooled estimates for odds ratios (OR) were computed according to random effect methods. From the 412 screened studies, six were selected (32 278 patients). One study (31 796 patients) focused on adherence to aspirin therapy in the secondary prevention of CAD, two studies (2596) on aspirin discontinuation in acute CAD, two studies (31 796) on adherence to aspirin therapy before or shortly after coronary artery bypass grafting, and another (2279) on aspirin discontinuation among patients undergoing drug-eluting stenting. Overall, aspirin non-adherence/withdrawal was associated with three-fold higher risk of major adverse cardiac events (OR = 3.14 [1.75–5.41], $P = 0.0001$). This risk was magnified in patients with intracoronary stents, as discontinuation or inadequate treatment was associated with an even higher risk of adverse events (OR = 8.78 [2.95–269.48]).

Conclusions Non-compliance or withdrawal of aspirin treatment has serious prognostic implications in subjects with or at moderately-high risk for CAD. Aspirin discontinuation in such patients should be advocated only when bleeding risk clearly overweighs that of atherothrombotic events.

ASA withdrawal assoc with 3-fold higher risk of major cardiac event

ORIGINAL CONTRIBUTION

Incidence of Death and Acute Myocardial Infarction Associated With Stopping Clopidogrel After Acute Coronary Syndrome

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Context It is unknown whether patients are at increased short-term risk for adverse events following clopidogrel cessation.

Objective To assess the rates of adverse events after stopping treatment with clopidogrel in a national sample of patients with acute coronary syndrome (ACS).

Design, Setting, and Patients Retrospective cohort study of 2127 patients with ACS discharged from 127 Veterans Affairs hospitals between October 1, 2003, and March 31, 2005, with postdischarge treatment with clopidogrel.

Main Outcome Measure Rate of all-cause mortality or acute myocardial infarction (AMI) after stopping treatment with clopidogrel.

Results Mean (SD) follow-up after stopping treatment with clopidogrel was 196 (152) days for medically treated patients with ACS without events ($n = 1548$) and 203 (148) days for patients with ACS treated with percutaneous coronary intervention (PCI) ($n = 1569$). Among medically treated patients, mean (SD) duration of clopidogrel treatment was 302 (151) days and death or AMI occurred in 17.1% ($n = 268$) of patients, with 60.8% ($n = 163$) of events occurring during 0 to 90 days, 21.3% ($n = 67$) during 91 to 180 days, and 9.7% ($n = 26$) during 181 to 270 days after stopping treatment with clopidogrel. In multivariable

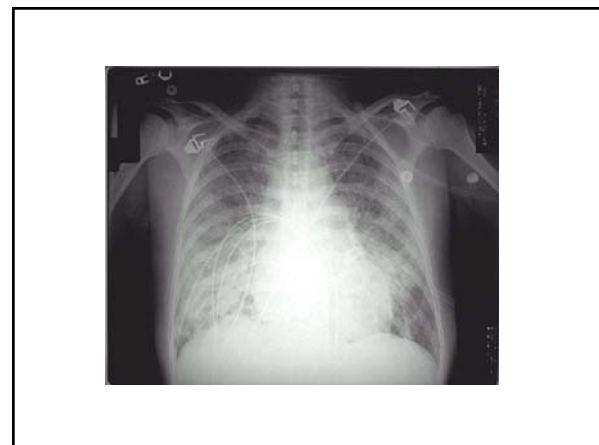
RANDOMIZED CONTROLLED trials have established the efficacy of clopidogrel therapy following hospitalizations for acute coronary syndrome (ACS) for pa-

JAMA Feb 5, 2008

Figure. Risk-Adjusted Instantaneous Incidence Rates of Death or AMI Over Time After Stopping Treatment With Clopidogrel Among Medically Treated and PCI-Treated Patients With ACS Using Multivariable Cox Regression Models.

Conclusions We observed a clustering of adverse events in the initial 90 days after stopping clopidogrel among both medically treated and PCI-treated patients with ACS, supporting the possibility of a clopidogrel rebound effect. Additional studies are needed to confirm the clustering of events after stopping clopidogrel, including associations with cardiovascular mortality and reasons for stopping clopidogrel, as well as to determine the mechanism of this phenomenon, and to identify strategies to reduce early events after clopidogrel cessation.

JAMA. 2008;299(5):532-539 www.jama.com



Postoperative HF

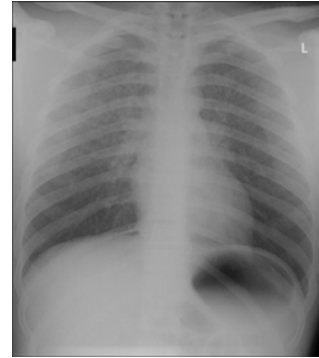
- Systolic LV dysfunction
- HF with preserved ejection fraction (diastolic dysfunction)

Perioperative Pulmonary Edema

- **Predictors:** diabetes, postop ischemia, arrhythmia (Mangano,1990)
- **Occurrence**
 - 70% first hour post extubation.
 - 24-48 hours post op
- **Treatment**

Perioperative Pulmonary Edema

- **Predictors:** diabetes, postop ischemia, arrhythmia (Mangano, 1990)
- **Occurrence**
 - 70% first hour post extubation.
 - 24-48 hours post op
- **Treatment**
 - Control blood pressure
 - Control afib ventricular response
 - Diuretics (cautious if HR-PEF)
 - Ischemia eval if no other cause



Negative pressure pulmonary edema Postobstructive pulmonary edema

- Young
- Obese
- Difficult intubation
- Postop laryngospasm
- Pulmonary edema within 90 minutes
- Supportive care, diuretic
- Noncardiac

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Outcomes in Heart Failure Patients After Major Noncardiac Surgery

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OBJECTIVES The purpose of this study was to evaluate mortality and readmission rates of heart failure (HF) patients after major noncardiac surgery.

BACKGROUND There is a lack of generalizable outcome data on HF patients undergoing major noncardiac surgery because previous studies have been limited to a few academic centers or have not focused on this group of patients.

METHODS Using the 1997 to 1998 Standard Analytic File 9% Sample of Medicare beneficiaries, we identified patients with HF who underwent major noncardiac surgery. A multivariable logistic regression model was used to provide adjusted mortality and readmission rates in patients after noncardiac surgery. Patients with coronary artery disease (CAD) and all other remaining patients (Control) who had similar surgery served as reference groups.

RESULTS Of 23,340 HF patients and 28,710 CAD patients, 1,532 (6.56%) HF patients and 1,757 (6.12%) CAD patients underwent major noncardiac surgery. There were 44,512 patients in the Control group with major noncardiac surgery. After accounting for demographic characteristics, type of surgery, and comorbid conditions, the risk-adjusted operative mortality (death before discharge or within 30 days of surgery) was HF 11.7%, CAD 6.6%, and Control 6.2% (HF vs. CAD, $p < 0.001$; CAD vs. Control, $p = 0.518$). The risk-adjusted 30-day readmission rate was HF 20.0%, CAD 14.2%, and Control 11.0% ($p < 0.001$).

CONCLUSIONS In patients of any age and ability, HF patients undergoing major noncardiac surgery suffer substantial morbidity and mortality despite advances in perioperative care, whereas patients with CAD without HF have similar mortality compared with a more general population. (J Am Coll Cardiol 2004;44:1446-55) © 2004 by the American College of Cardiology Foundation

Operative and 30 day postoperative mortality:
Heart failure (admission during prior year): 11.7%
CAD (admission during prior year): 6.6%
Control: 6.2%

Perioperative cardiac arrest

Predictors of Survival following Cardiac Arrest in Patients Undergoing Noncardiac Surgery

A Study of 518,294 Patients at a Tertiary Referral Center

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Christopher M. Beilgray, M.S.,§ Gregory A. Wilson, C.C.R.P.,‡ David O. Warner, M.D.*

Background: The authors determined the incidence of cardiac arrest and predictors of survival following perioperative cardiac arrest in a large population of patients at a tertiary referral center.

Methods: Medical records of patients who experienced cardiac arrest in the perioperative period surrounding noncardiac surgery between January 1, 1990, and December 31, 2000, were reviewed. Logistic regression identified characteristics associated with in-hospital (in 1 h) and hospital survival, with $P < 0.01$ considered statistically significant.

Results: Cardiac arrest occurred in 223 of 518,294 anesthetics (4.3 per 10,000) during the study period. Frequency of arrest for patients receiving general anesthesia decreased over time (7.8 per 10,000 during 1990-1992, 3.2 per 10,000 during 1998-

the incidence depending on the study period reported, on how the perioperative period was defined (intraoperative only,^{1,2} intraoperative and recovery from anesthesia,³ first 24 postoperative hours,^{4,5} first 2 postoperative days,⁶ 7 postoperative days,³ or 30 postoperative days)¹¹ and whether cardiac arrest was a direct complication of anesthesia^{12,13} or whether anesthesia was just a contributing factor.^{14,15} Furthermore, incidence of cardiac arrest and mortality may depend on the surgical population; some studies examine all types of surgery,^{1,2,11} while others exclude cardiac surgery¹⁶ or obstetrical surgery.⁹ Most authors believe that the incidence of anesthesia-

Sprung J, et al

- Noncardiac surgery (1990 – 2000)
- Cardiac arrest = chest compressions or open cardiac massage
- After initiation of anesthesia – until – discharge from recovery room or transfer of care to ICU staff

Sprung J, et al

- 518294 anesthetics
- 223 cardiac arrests (4.3 per 10,000)

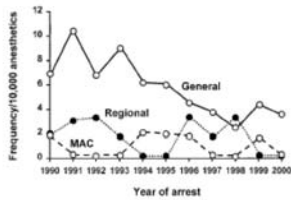


Fig. 1. Frequency of cardiac arrests by calendar year and type of anesthesia. MAC = monitored anesthesia care.

Anesthesiology, V 99, No 2, Aug 2003

Sprung J, et al

- 98 (44%) due to cardiac causes
- 78 (35%) due to bleeding
- 24 (11%) due to anesthesia (asystole most common rhythm)
 - 13 (54%) medications
 - 11 (46%) airway / ventilation

Sprung J, et al


- 79% (19/24) of those whose arrests due to anesthesia survived to be discharged.
- 29% (58/199) of those whose arrest not due to anesthesia survived to discharge.
- Arrests due to loss of airway had worst outcome.
- Likelihood of survival greater if arrest occurred during standard working hours.
 - ? more comprehensive response to arrest

Perioperative Complications

- Hypertension
- Hypotension
- Arrhythmias
- Myocardial ischemia - infarction
- Heart failure

MAYO CLINIC

Management of Documented or Suspected Obstructive Sleep Apnea (OSA) in Patients Undergoing Non-Cardiac Surgery



Mayo School of Continuous Professional Development

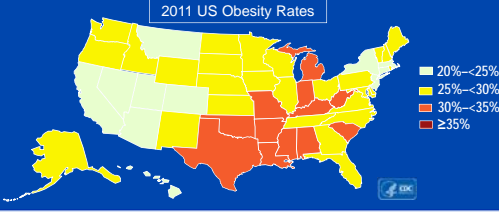
Eric J. Olson, MD
 Center for Sleep Medicine, Mayo Clinic Rochester
 An Overview of Perioperative Medicine 2013
 October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Disclosures

- No financial disclosures
- No discussion of “off label” use of drugs

OSA: Increasingly Common in Peri-op Period

- Apnea-hypopnea index (AHI) > 15: ♂ 15% ♀ 9%¹
- ↑ disease recognition, yet 70% still undiagnosed²
- ↑ obesity prevalence



2011 US Obesity Rates

■ 20%–25%
 ■ 25%–30%
 ■ 30%–35%
 ■ ≥35%

¹Young T. N Engl J Med 1993; 328:1230
²Finkel KJ. Sleep Med 2009; 10:753

Case

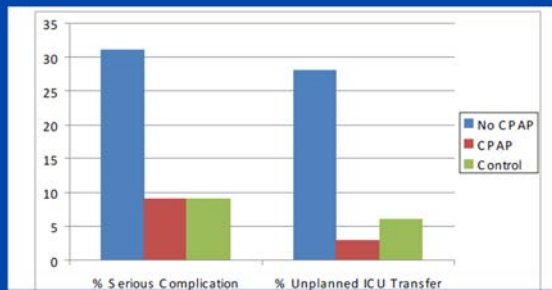
- 58 M
- DJD; seeking knee arthroplasty
- Wife: witnessing loud snoring, apneas, gasping
- Patient: no sleep concerns
- Hypertension
- BMI: 46 kg/m² BP: 152/92
- Neck: 18"
- OSA suspected; Sleep evaluation advised
- Pt resistant. “I just want my knee fixed!”

- What are the consequences of OSA in the peri-op period?

Peri-op Complications Attributed to OSA: Initial Case Reports/Small Case Series

- Difficult intubation and extubation
- Large blood pressure fluctuations
- Profound desaturation → myocardial ischemia, arrhythmias
- Delirium
- Postobstructive pulmonary edema (breathing efforts against closed upper airway)
- Respiratory arrest
- Death

OSA Status and Complication Rates in Lower Extremity Joint Replacements



Gupta RM. Mayo Clin Proc 2001; 76:897

Peri-op Complications Attributed to OSA: Recent, Larger Series

- Complication rates 2-7x ↑ in OSA
- Serious complication rates 14-24%
- ↑ risk in OSA for:
 - Unplanned ICU stays
 - Reintubation
 - Aspiration pneumonia
 - Venous thromboembolism in ortho patients
 - Longer length of stay

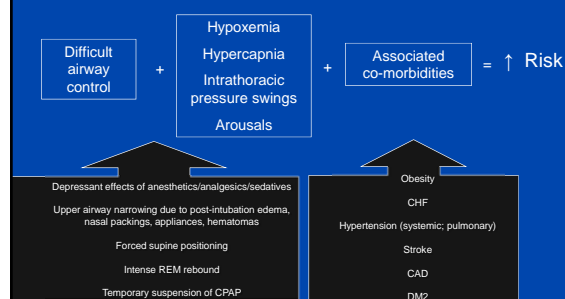


Kaw R. Chest 2012; 141:436. Memtsoudis S. Anesth Analg 2011; 112:113. Liao P. Can J Anesth 2009; 56:819

- What factors ↑ risk of post-op complications in OSA patients?



Factors that ↑ Post-op Risk in OSA



- How should patients be screened for OSA?



Pre-op Considerations

- OSA is highly prevalent
 - Most cases undiagnosed
 - Potentially devastating complications if untreated
- } All pre-op evals should look for OSA!
- History
 - Physical exam
 - Clinical screening tool to sieve out high risk pts



Berlin Questionnaire for OSA: Category 1

1. Do you snore?
Yes (1)
No
Don't know

2. Your snoring is:
Slightly louder than breathing
As loud as talking
Louder than talking (1)
Very loud-can be heard in other rooms (1)

3. How often do you snore?
Almost every day (1)
3-4 times per week (1)
1-2 times per week
1-2 times per month
Rarely

4. Has your snoring ever bothered other people?
Yes (1)
No
Don't know

5. Has anyone noticed that you stop breathing during your sleep?
Almost every day
3-4 times per week (2)
1-2 times per week (2)
1-2 times per month
Rarely or never

Score: "+" if ≥ 2

MAYO CLINIC (75) Netzer N. Ann Intern Med 1999; 131:485

Berlin Questionnaire for OSA: Category 2

6. How often do you feel tired or fatigued after your sleep?
Almost every day (1)
3-4 times per week (1)
1-2 times per week
1-2 times per month
Rarely or never

7. During your waking time, do you feel tired, fatigued or not up to par?
Almost every day (1)
3-4 times per week (1)
1-2 times per week
1-2 times per month
Rarely or never

8. Have you ever nodded off or fallen asleep while driving a vehicle?
Yes (2)
No

Score: "+" if ≥ 2

MAYO CLINIC (75) Netzer N. Ann Intern Med 1999; 131:485

Berlin Questionnaire for OSA: Category 3 and Interpretation

10. Do you have high blood pressure?
Yes (1)
No

11. BMI
> 30 (1)
< 30

"High risk" for OSA: ≥ 2 categories "+"
"Low risk" for OSA: < 2 categories "+"

Score: "+" if either hypertension or obesity

MAYO CLINIC (75) Netzer N. Ann Intern Med 1999; 131:485

STOP-BANG

Snoring: Do you snore loudly (heard through closed doors)? Y N

Tired: Do you often feel tired, fatigued, or sleepy during day? Y N

Observed: Has anyone observed you stop breathing? Y N

Pressure: Do you have or are you being treated for high blood pressure? Y N

BMi: > 35? Y N

Age: > 50? Y N

Neck circumference: > 40 cm? Y N

Gender: Male? Y N

"High risk" for OSA: ≥ 3 questions "yes"
"Low risk" for OSA: < 3 questions "yes"

MAYO CLINIC (75) Chung F. Anesthesiology 2008; 108:812

For Patients with Moderate-Severe OSA (AHI > 15):

	Berlin	STOP-BANG
Sensitivity	79%	93%
Specificity	51%	43%
PPV	51%	52%
NPV	78%	90%

Sensitivity favored at expense of specificity; "Low risk" patients may proceed to surgery with usual peri-op care

MAYO CLINIC (75) Chung F. Anesthesiology 2008; 108:822
Chung F. Anesthesiology 2008; 108:812

Sleep Apnea Clinical Score

Prediction of OSA (Circle the patient's score.)

Historical Features
1. Habitual snoring
2. Partner witnessed gasping, choking, or snoring

Sleep Apnea Clinical Score (SACS)

Neck Circ (cm)	Historical Features*					
	Not Hypertensive			Hypertensive		
	None	One	Both	None	One	Both
<30	0	0	1	0	1	2
30/31	0	0	1	1	2	4
32/33	0	1	2	1	3	5
34/35	1	2	3	2	4	8
36/37	1	3	5	4	6	11
38/39	2	4	7	5	9	16
40/41	3	6	10	8	13	22
42/43	5	8	14	11	18	30
44/45	7	12	20	15	25	42
46/47	10	16	28	21	35	58
48/49	14	23	38	29	48	80
>49	19	32	53	40	65	110

Flemons WW. Am J Respir Crit Care Med 1994; 150:1279

Prediction Formulas: Which is Best?

- “No clinical model is recommended for use to predict severity of sleep apnea”

AASM. Sleep 2005; 28:499

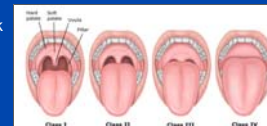
- Screening tool decision lies with clinicians and their institutional experience



Pearls for Pre-op OSA Detection

- Seek bed partner input
 - Consider overnight oximetry if no collateral history
- History of difficult intubation predicts OSA and vice versa

- ↑ Mallampati predicts ↑ OSA risk



- ↑ serum bicarb + BMI ≥ 30 → possible obesity hypoventilation



Back to our Patient...

Prediction of OSA (Circle the patient's score.)						
Historical features 1. Habitual snoring 2. Partner witnessed gasping, choking, or snorting	Sleep Apnea Clinical Score (SACS)					
	Not Hypertensive			Hypertensive		
	Historical Features*			Historical Features*		
Neck Circ (cm)	None	One	Both	None	One	Both
<30	0	0	1	0	1	2
30/31	0	0	1	1	2	4
32/33	0	1	2	1	3	5
34/35	1	2	3	2	4	8
36/37	1	3	5	4	6	11
38/39	2	4	7	5	9	16
40/41	3	6	10	8	13	22
42/43	5	8	14	11	19	30
44/45	7	12	20	15	25	42
46/47	10	16	28	21	35	58
48/49	14	23	38	29	48	80
>49	19	32	53	40	66	110



Flemons WW. Am J Respir Crit Care Med 1994; 150:1279

Question

What would you advise?

- Proceed to surgery
- Screening overnight oximetry
- Referral to Sleep for polysomnogram
- Surgery now with empiric auto-CPAP post-op



- Which patients with **suspected** OSA need sleep testing before surgery?



Pre-op Sleep Testing vs Presumptive Treatment of “High Risk for OSA” Patients

- Case-by-case decision with all stakeholders
- Consider:
 - Urgency of surgery
 - Invasiveness of surgery
 - Type of anesthesia
 - Post-op opioid needs
 - Suspected severity of OSA
 - Co-morbidity burden
 - Likely use of PAP by Rx-naïve patient



Back to our Patient...

- Sleep evaluation advised:
 - Elective surgery
 - Strong suspicion for OSA (*oxi unlikely to change this*)
 - General anesthesia
 - Post-op IV opioids likely
 - Hypertension not tightly controlled
- Polysomnogram: severe OSA
 - AHI: 49 events/hr
 - Lowest SpO₂: 70%
 - % time SpO₂ < 90%: 18%



- If presumptive management: peri-op care should be same as for known mod-severe OSA
- If pre-op tested and OSA confirmed → CPAP
 - Face validity, yet impact on post-op complications not well defined
 - Optimal pre-op use unclear; suggest 1 week
 - Non-PAP options not well studied



- How about the pre-op assessment of patients with known OSA?



Pre op Evaluation: Known OSA

- ↑ OSA severity → ↑ risk
- Instruct to bring treatment modality to hospital!
- Referral to sleep center if:
 - Symptomatic despite CPAP
 - CPAP non-compliance
 - > 10% weight change since CPAP titration
 - No recent Sleep f/u
 - Reassessment of non-CPAP options



Seet E. Can J Anesth 2010; 57:849

- Are there guidelines for management of OSA in peri-op period?




Publications on Peri-op OSA Management

- AASM: Sleep 2003; 26:1060
- ASA: Anesthesiology 2006; 104:1081
- CAS: Can J Anesth 2010; 57:849
- Review: Chest 2010; 138:1489




- Inpatient or outpatient surgery?




ASA Checklist: An Aid to Assess Risk

- A. Severity of sleep apnea based on sleep study or clinical indicators:
 - None (0)
 - Mild (1)
 - Moderate (2)
 - Severe (3) ←
- B. Invasiveness of surgery and anesthesia
 - Superficial surgery w/o sedation (0)
 - Superficial surgery w sedation or GA (1)
 - Peripheral surgery with spinal/epidural (1)
 - Peripheral surgery with GA (2)
 - Airway surgery, moderate sedation (2)
 - Major surgery, GA (3) ←
 - Airway surgery, GA (3)
- C. Post-operative opioid requirements
 - None (0)
 - Low-dose opioids (1)
 - High-dose oral opioids, parenteral, or neuraxial (3) ←
- D. Estimation of peri-operative risk: A + (B or C [whichever higher])
 - High risk: 5-6
 - 6


Anesthesiology 2006; 104:1081

Surgery Location: General Principles^{1,2}


- Case-by-case decision
- Ambulatory surgery center considered:
 - Any OSA status: procedures with NO post-op IV narcotics anticipated
 - Mild OSA or low-risk for OSA: procedures with only post-op ORAL narcotics anticipated
- Hospital-based surgery:
 - All procedures with post-op IV narcotics anticipated
 - Known OSA (any severity) or high-risk for OSA: upper airway surgery and lap upper abdominal surgery



¹Bolden N. J Clin Anesth 2009; 21:286
²Anesthesiology 2006; 104:1081


Intra-op Considerations for Known or Suspected Mod-Severe OSA

- Avoid sedating pre-meds
- If no intubation:
 - Provide pt's usual OSA treatment
 - If moderate sedation:
 - Administration by properly trained personnel
 - Continuous SpO₂, CO₂ monitoring
- If intubated:
 - ASA Difficult Airway Guideline¹
- Anesthesia:
 - Poorly studied
 - Local, regional options, if possible
 - Ideal GA not known; short-acting agents preferable



¹Anesthesiology 2003; 98:1269

Extubation

- Airway resources immediately available
- Ensure sufficient patient wakefulness, cooperation
- Verify reversal of neuromuscular blockade
- Maximal head of bed elevation
- Prompt initiation of PAP



- Which known or suspected OSA patients require closer monitoring?



2-Step Process for Identifying Patients at Risk for Post-op Complications from OSA

1. Calculate pre-op Sleep Apnea Clinical Score
2. Monitor for recurrent events in PACU



Gali B. Anesthesiology 2009; 110:869

PACU Evaluation for OSA

	Evaluation Period		
	Initial	2 nd	3 rd
Bradypnea: < 8 respirations/minute (3 episodes needed for yes)	30 min. after extubation	30 min. after initial eval.	30 min. after 2nd eval.
Apnea: ≥ 10 seconds (only 1 episode needed for yes)	or PACU admit (whichever occurs later)	60 min after extubation or PACU admit	90 min after extubation or PACU admit
Desaturations: Pulse Ox <90% with nasal cannula (3 episodes needed for yes)			
Pain/Sedation mismatch: RASS score -3 thru -5 <i>and</i> Pain scale score > 5 (only 1 episode needed for yes)			

RASS = Richmond Agitation-Sedation Scale
Pain Score=Visual Analog Score
Recurrent events if any event occurs at more than one eval period (not necessary to be same event)



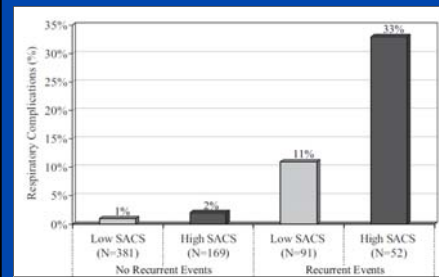
Gali B. Anesthesiology 2009; 110:869

Evaluation Period (see criteria definition below)	Initial Eval. Period 30 min. after extubation or PACU admit (whichever occurs later)	2nd Eval. Period 30 min. after 2nd eval. (60 min after extubation or PACU admit)	3rd Eval. Period 30 min. after 3rd eval. (90 min after extubation or PACU admit)
Time of evaluation	_____	_____	_____
Hypoventilation ≤ 8 respirations/minute (3 episodes needed for yes)	___ 0=no 1=yes	___ 0=no 1=yes	___ 0=no 1=yes
Apnea ≥ 10 seconds (only 1 episode needed for yes)	___ 0=no 1=yes	___ 0=no 1=yes	___ 0=no 1=yes
Desaturations Pulse Ox <90% with nasal cannula **It is critical to assess pt. for a nasal cannula, consider an airway** (3 episodes needed for yes)	___ 0=no 1=yes	___ 0=no 1=yes	___ 0=no 1=yes
Pain/Sedation mismatch RASS score -3 through -5 <i>and</i> Pain scale score > 5 (only 1 episode needed for yes)	___ RASS ___ Pain	___ RASS ___ Pain	___ RASS ___ Pain
Highest FiO₂ requirement each period			
PACU Instructions	If any of the above occur, inform anesthesiologist if possible, need for monitored admission	If any of the above occur, keep in PACU another 30 min., inform anesthesiology and ICU if possible admit	If any of the above continue, inform anesthesiologist and ICU of monitored admission



Gali B. Anesthesiology 2009; 110:869

2-Step Process for Identifying Patients at Risk for Post-op Complications from OSA



OR for post-op resp complications:
High SACS: 3.5
↑ PACU events: 21



Gali B. Anesthesiology 2009; 110:869

Post-op Setting for High-Risk Patients

- Monitored bed
 - Continuous pulse oximetry with local *and* remote monitoring via telemetry
 - Early nursing intervention possible
 - ICU
 - Step-down unit
 - Bed close to RN station on ward



Other Post-op Considerations

- Inconsistent post-op CPAP use in known OSA
 - Auto-CPAP may be an option
- Breakthrough snoring on PAP means obstruction occurring
- Caution with PCA
 - Monitoring must be in place
 - Consider eliminating basal infusion
- Regional, multimodality analgesia to minimize opioids
- Minimize sedative/hypnotics
- Lateral or up-right positioning preferred, if possible



Back to our Patient...

- Extubated in PACU; immediate CPAP initiation
- Post-op nausea → nasogastric tube
- You are called for desaturations during sleep despite CPAP

MAYO CLINIC

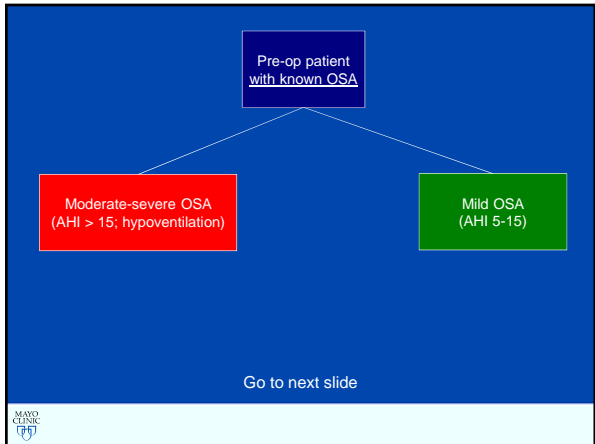
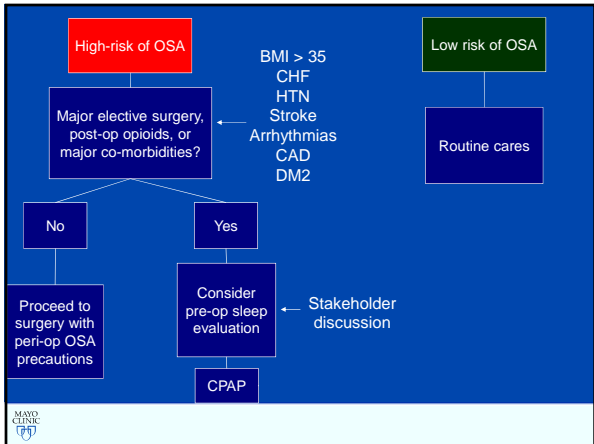
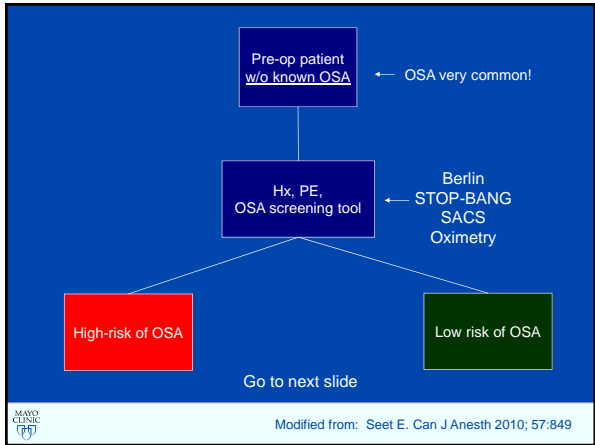
Post-op Desaturations Despite CPAP

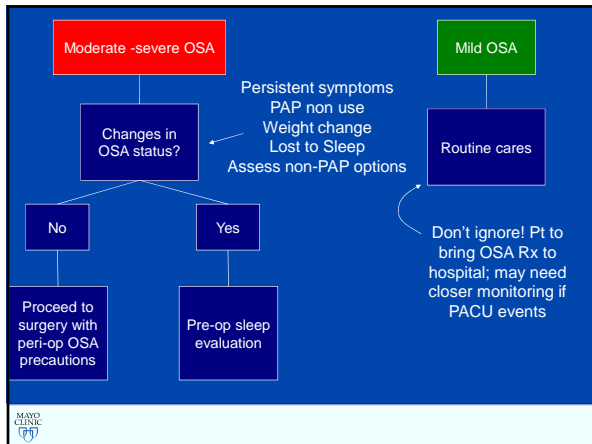
- Inadequate pressure
 - Consider if breakthrough snoring
 - Empiric ↑ pressure; auto-CPAP; ↓ meds
- Interface issues due to tubes, packings
 - Full face mask
- Central sleep apnea from opioids
 - ↓ meds
- Other post-op pulmonary complications

MAYO CLINIC

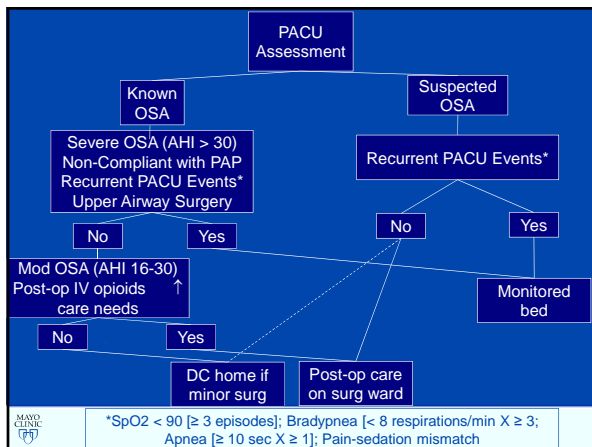
- Putting it all together...

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- ### Peri-op Precautions for *Known or Suspected Moderate-Severe OSA*
- Hospital-based surgery if post-op opioids (IV or PO) anticipated
 - Prepare for difficult intubation
 - Anesthesia: regional, short-acting GA agents
 - Extubate only in safe location when patient awake, in non-supine position, and neuromuscular blockade reversed
 - Analgesia: multimodality; minimize opioids
 - Early reinitiation of PAP
- Mayo Clinic logo



- ### Thanks for your attention
- olson.eric@mayo.edu
- Mayo Clinic logo

Update VTE Prophylaxis 2013 Surgical Patient

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Disclosure Financial Relationships

- Geno J. Merli, MD, MACP, FHM, FSVM
 - Bayer: Research, Scientific Advisory
 - Bristol-Meyer Squibb: Research, Scientific Advisory
 - Sanofi-Aventis: Research
 - Portola: Research

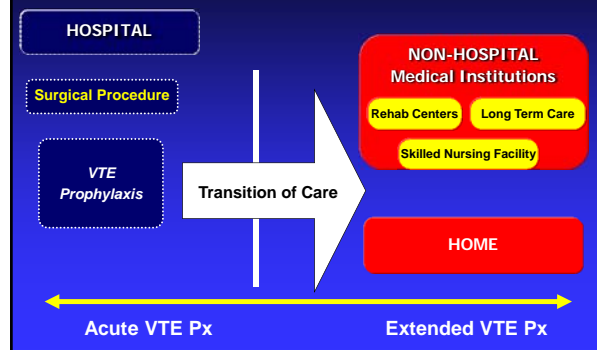
Current Recommendations At-Risk Surgical Patients



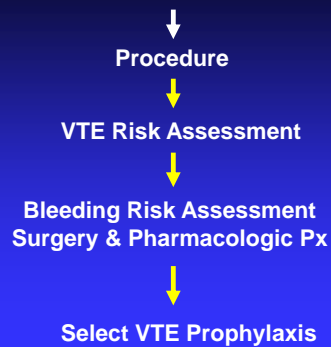
Gould M, et al Chest 2012;141:227S-277S

International Consensus, Inter Angiology 2013;32:111

Managing Surgical Patients Continuum of Care



Surgical Patient



VTE Risk Assessment Tools Exclusion Model VS Risk Assessment Models

Risk Factors VTE

- Surgery
- Trauma
- Immobility, lower extremity paresis
- Cancer (active or occult)
- Cancer therapy (hormonal, chemotherapy, angiogenesis, inhibitors, radiotherapy)
- Venous compression (tumor, hematoma, arterial abnormality)
- Previous VTE
- Increasing age
- Pregnancy and the postpartum period
- Estrogen-containing oral contraceptives or hormone replacement therapy
- Selective estrogen receptor modulators
- Erythropoiesis-stimulating agents
- Acute medical illness
- Inflammatory bowel disease
- Nephrotic Syndrome
- Myeloproliferative disorders
- Paroxysmal nocturnal hemoglobinuria
- Obesity
- Central venous catheter
- Inherited or acquired thrombophilia

Geerts, et al. CHEST 2008;133:381S-453S.

VTE Levels of Risk

Level of Risk	Approximate DVT Risk without Prophylaxis %
Low Risk Minor surgery, Mobile Patient	< 10 %
Moderate Risk Most general surgery, open GYN or Urologic procedures	10% to 40%
High Risk Hip or Knee Arthroplasty, HFS, Major Trauma, SCI, Cancer	40% to 80%

Geerts, et al. CHEST 2008;133:381S-453S.

Caprini Risk Index

Venous Thromboembolism Risk Factor Assessment

Patient's Name: _____ Age: _____ Sex: _____ Wgt: _____ (BMI = Wgt (kg) / Hgt (m)²)

Choose All That Apply

Each Risk Factor Represents 1 Point

- Age 41-60 years
- Minor surgery planned
- History of prior major surgery
- Varicose veins
- History of inflammatory bowel disease
- Swollen legs (current)
- Obesity (BMI > 30)
- Acute myocardial infarction (< 1 month)
- Congestive heart failure (< 1 month)
- Stress (< 1 month)
- Chronic lung disease incl. pneumonia (< 1 month)
- Abnormal pulmonary function (COPD)
- Medical patient currently at bed rest
- Leg plaster cast or brace
- Other risk factor

Each Risk Factor Represents 3 Points

- Age over 75 years
- Major surgery lasting 2-3 hours
- BMI > 50 (venous stasis syndrome)
- Family history of DVT/PE
- Present cancer or chemotherapy
- Positive Factor V Leiden
- Positive Prothrombin 20210A
- Elevated serum homocysteine
- Positive Lupus anticoagulant
- Elevated anticardiolipin antibodies
- Heparin-induced thrombocytopenia (HIT)
- Other thrombophilia

Each Risk Factor Represents 2 Points

- Age 60-74 years
- Major surgery (> 60 minutes)*
- Arthroscopic surgery (> 60 minutes)*
- Laparoscopic surgery (> 60 minutes)*
- Previous malignancy
- Central venous access
- Morbid obesity (BMI > 40)

Each Risk Factor Represents 5 Points

- Elective major lower extremity arthroplasty
- Hip, pelvic or leg fracture (< 1 month)
- Stroke (< 1 month)
- Multiple trauma (< 1 month)
- Acute spinal cord injury (paralysis) (< 1 month)
- Major surgery lasting over 3 hours

For Women Only (Each Represents 1 Point)

- Oral contraceptives or hormone replacement therapy
- Pregnancy or postpartum (< 1 month)
- History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score

*Select only one Revised August, 2008 WWW.venousdisease.com

Caprini Score & Risk

Total Score	Risk Level	Incidence DVT
0 - 1	Low Risk	2%
2	Moderate Risk	10% - 20%
3 - 4	High Risk	20% - 40%
5 or more	Highest Risk	40 - 80%

Rogers Risk Assessment

Risk factor	Risk score points
Operation type other than endocrine	
Respiratory and hemic	9
Thoracoabdominal aneurysm, embolectomy/thromboectomy, venous reconstruction, and endovascular repair	7
Aneurysm	4
Mouth, palate	4
Stomach, intestines	4
Integument	3
Hernia	2
ASA physical status classification	
3, 4, or 5	2
2	1
female gender	1
Work RVU	
> 17	3
10-17	2
Two points for each of these conditions	2
Disseminated cancer	
Chemotherapy for malignancy within 30 d of operation	
Preoperative serum sodium > 145 mmol/L	
Transfusion > 4 U packed RBCs in 72 h before operation	
Ventilator-dependent	
One point for each of these conditions	1
Wound class (clean/contaminated)	
Preoperative hematocrit ≤ 38%	
Preoperative fibrinogen > 1.0 mg/dL	
Dyspnea	
Albumin ≤ 3.5 mg/dL	
Emergency	
Zero points for each of these conditions	0
ASA physical status class 1	
Work RVU < 10	
Male gender	

Rogers S, et al J Am Coll Surg 2007;204:1211-1221

Rogers VTE Risk Assessment

- Operation other than endocrine**
 - Resp & hemic [9]
 - Thoracoabdominal aneurysm, embolectomy/thromboectomy, venous reconstruction, endovascular repair [7]
 - Aneurysm [4]
 - Mouth palate [4]
 - Stomach, intestines [4]
 - Integument [3]
 - Hernia [2]
- ASA Physical Status Class**
 - 3, 4 or 5 [2]
 - 2 [1]
- Female Gender [1]**
- Work RVU**
 - > 17 [3]
 - 10-17 [2]

Rogers S, et al J Am Coll Surg 2007;204:1211-1221

Rogers VTE Risk Assessment

- **Two Points** for each of these conditions
 - Disseminated cancer
 - Chemotherapy for malignancy with 30 days of surgery
 - Preoperative Na > 145 mmol/L
 - Transfusion > 4U PRBCs in 72 hrs prior to surgery
 - Ventilator Dependent
- **One Point** for each of these conditions
 - Wound class (clean/contaminated)
 - Preop Hematocrit < 38%
 - Preop Bilirubin > 1 mg/dL
 - Dyspnea
 - Albumin < 3.5 mg/dL
 - Emergency

Rogers S, et al J Am Coll Surg 2007;204:1211-1221

Rogers VTE Risk Assessment

- **Zero points** for each of these conditions
 - ASA physical status Class I
 - Work RVU < 10
 - Male gender

Rogers S, et al J Am Coll Surg 2007;204:1211-1221

Rogers VTE Risk Assessment

Risk level	Score range	Development			Validation		
		n	Predicted VTEs (%)	Actual VTEs (%)	n	Predicted VTEs (%)	Actual VTEs (%)
Low	< 7	26,332	0.100	0.103	26,289	0.099	0.110
Medium	7-10	37,602	0.501	0.436	37,569	0.502	0.474
High	> 10	27,469	1.370	1.456	27,450	1.374	1.315

C-indices for the risk index were 0.7544 (development) and 0.7305 (validation). C-indices for the 3-level risk categories were 0.7201 (development) and 0.7033 (validation).

Rogers S, et al J Am Coll Surg 2007;204:1211-1221

Rogers VTE Risk Assessment

Risk Level	Score	No Pts	Predicted VTE %	Actual VTE %
Low	< 7	26,289	0.099	0.110
Moderate	7-10	37,569	0.502	0.474
High	> 10	27,450	1.374	1.315

Rogers S, et al J Am Coll Surg 2007;204:1211-1221

Caprini vs Rogers Actual VTE Rate

Risk Level	Caprini	Rogers
Low	0%	0.110 %
Moderate	0.7%	0.474%
High	0.97%	1.315%
Highest	1.94%	N/A

Risk Assessment Models Caprini & Rogers

- Populations studied varied or excluded groups
- Did not differentiate Asymptomatic vs Symptomatic VTE
- Rogers not externally validated
- Implementation barriers

Bleeding Risk

General Bleeding Risk Factors

- Active Bleeding
- Previous Major Bleeding
- Known or Untreated Bleeding Disorder
- Severe Renal or Hepatic Failure
- Thrombocytopenia
- Acute Stroke
- Uncontrolled Systemic Hypertension
- Lumbar Puncture, Epidural, Spinal Anesthesia (previous 4 hrs or next 12 hrs)
- Concomitant use of anticoagulants, antiplatelet agents, thrombolytics

Gould M, et al Chest 2012;141:227S-277S

Procedure Related Risk Factors

- **Abdominal Surgery**
 - Male sex, preop Hgb < 13 g/dL, malignancy, complex surgery defined as 2 or more procedures, difficult dissection, more than one anastomosis
- **Pancreaticoduodenectomy**
 - Sepsis, pancreatic leak, sentinel bleed
- **Hepatic Resection**
 - Number of segments, concomitant extra hepatic organ resection, primary liver malignancy, lower preoperative hemoglobin level, low platelets

Gould M, et al Chest 2012;141:227S-277S

Procedure Related Risk Factors

- **Cardiac Surgery**
 - Use of ASA, Clopidogrel within 3 days of surgery
 - BMI > 25 kg/m², non-elective surgery, placement of 5 or my grafts, older age
 - Older age, renal insufficiency, operation other than CABG, longer bypass time
- **Thoracic Surgery**
 - Pneumonectomy or extended resection

Gould M, et al Chest 2012;141:227S-277S

Procedure Related Severe Consequences of Bleeding

- Craniotomy
- Spinal Surgery
- Spinal Trauma
- Reconstructive procedures involving free flaps

Gould M, et al Chest 2012;141:227S-277S

Jefferson Approach

- ACCP VTE Risk Guideline (Exclusion Model)
 - Low
 - Moderate
 - High
- Assess Bleeding Risk (ACCP Model)
- CPOE System that requires all patients to be risk assessed and VTE prophylaxis ordered before remainder of order set can be completed

Frequently Asked Questions

Aspirin

7th ACCP Recommendation

For all patients we do not recommend ASA for prophylaxis, because other measures are more efficacious (1A)

8th ACCP Recommendation

Recommend against the use of ASA as prophylaxis against VTE in any patient group (1A)

9th ACCP Recommendation

Recommend use of ASA as prophylaxis in Orthopedic surgery. Better than NO Px

Gould M, et al Chest 2012;141:227S-277S

Mechanical Thromboprophylaxis

- High-Risk surgery patients with multiple risk factors, pharmacologic method combined with mechanical method (2C)
- High Bleeding Risk (1A), when bleeding risk decreases substitute or add pharmacological thromboprophylaxis (2C)



Gould M, et al Chest 2012;141:227S-277S



Mobile Mechanical Compression Total Hip Arthroplasty

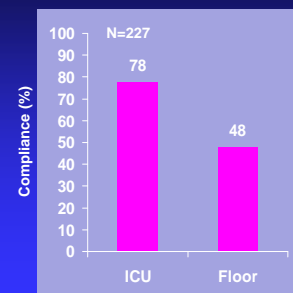
Group	No Pts	DVT/PE	Major Bleed
Mobile: IPC	199 pts	10 (5%) 8 DVTs 2 PEs	0 P=0.0004
Enoxaparin	196	10 (5%) 8 DVTs 2 PEs	11 (6%)

Treatment Phase 14 days
Endpoint: 10-12 days Bilateral Lower Extremity US
Lovenox 30mg, Q12hrs until discharge then 40 mg Qday
Mobile: IPC 20 hrs per day with 60% receiving 81 mg ASA

Colwell C, et al JBJS 2010;9:527-535

Mechanical DVT Prophylaxis Medical Patients

- Advantages
 - No bleeding risk
- Disadvantages
 - Supportive data in medical patients lacking (only ~200 studied)
 - Continuous application necessary
 - Compliance problematic



Comerota AJ, et al. Am J Surg. 1992;164:265-268.

IPC Use

Thomas Jefferson University Hospitals

IPC Device on Patient	Number	Percent (%)
No	250	73.75 %
Yes	89	26.25 %
Total	339	100 %

All patients 7 th floor day and night shift x 4 days

Intermittent Pneumatic Compression Use at TJUHs

Response	Percentage Use
No	74%
Yes	26%

All Patients Three shift x 4 days

Gardiner D, Kelly B, Hosp Pract 2013

Jefferson Reason IPC Non-Use

Reason Non-Use	Number	Percent %
Patient in Chair	17	6.77 %
No IPC devices in room	97	36.65 %
Other reasons	2	0.80 %
Patient out of room	9	3.59%
Unknown	125	49.8 %
Patient refused	0	0
Total	250	100 %

All patients 7th floor day and night shift x 4 days

Combination VTE Prophylaxis General Surgery

Group	VTE Incidence (%)	Number of Patients
Fondaparinux + IPC	1.7%	7/424
Placebo + IPC	5.3%	22/418

Combined Modalities
RR 0.31, 95% CI 0.12 - 0.69
P = 0.004

Major Bleeding: Fond 1.6% vs Placebo 0.2%
Proximal DVT: 0.2% vs 1.7%

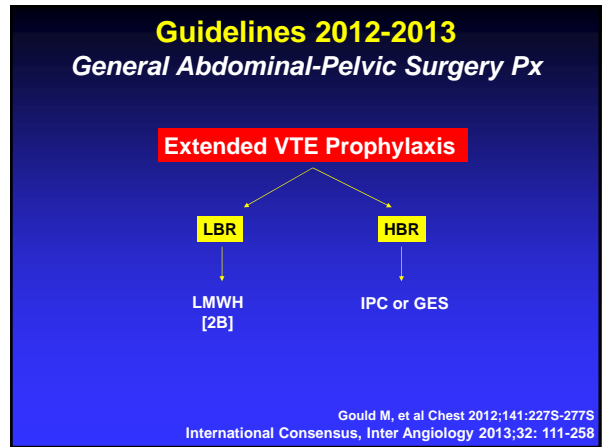
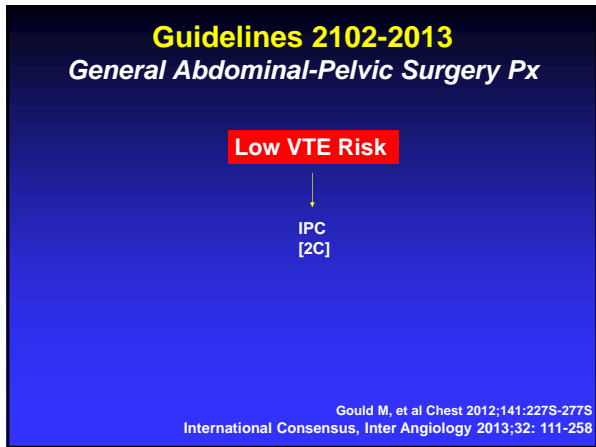
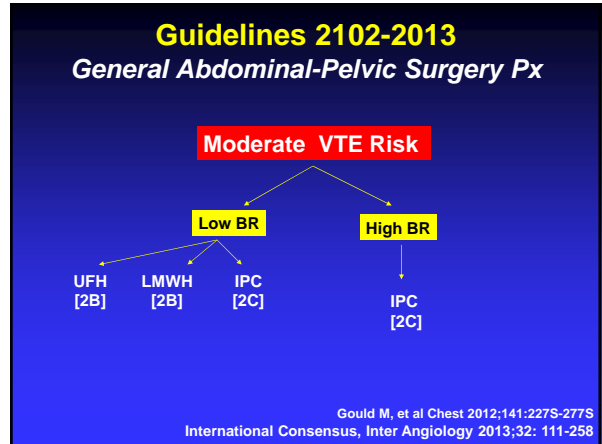
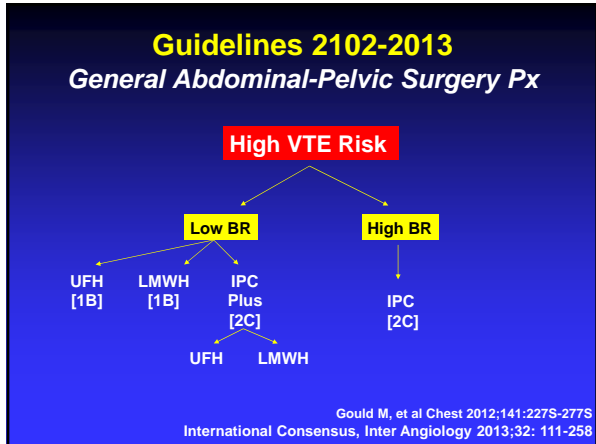
Turpie AG, et al. J Thromb Haemost. 2007;5:1854-1861

VTE Prophylaxis Non-Orthopedic Surgery

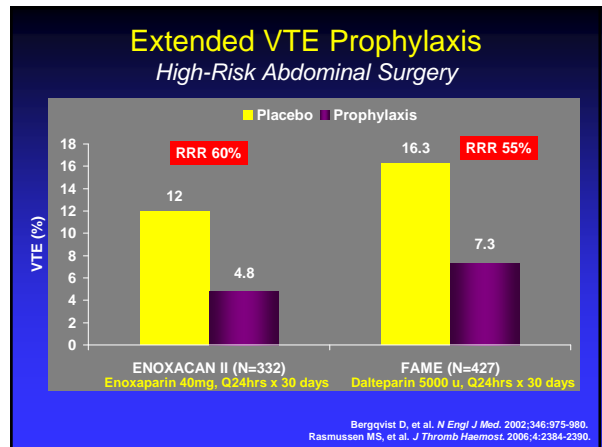
VTE Incidence No Px & Surveillance

Surgery	No Studies	No Pts	VTE	95% CI
Gen Surgery	54	4310	1084 (25%)	24%-26%
GYN Malignant	6	400	90 (22.5%)	19%-27%
GYN Benign	4	460	63 (14%)	11%-17%
Urology	11	469	159 (33%)	29%-38%

International Consensus, Intern Angiology 2013;32: 111-258



Extended VTE Prophylaxis Cancer Surgery



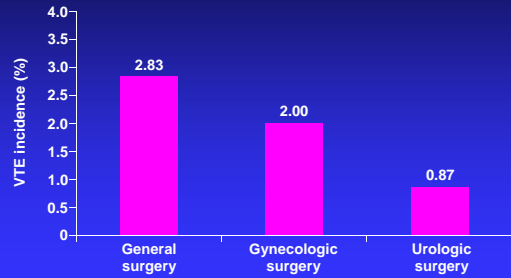
CANBESURE Study Abdominal & Pelvic Cancer Surgery

Group	No Pt	VTE+Death	RRR (95% CI)
Bemiparin	248	21 (8.5%)	36.5 (-6.9 – 62.3)
Placebo	240	32 (13.3%)	

Major Bleeding Bemiparin 2 (0.6%)
Placebo 2 (0.6%)

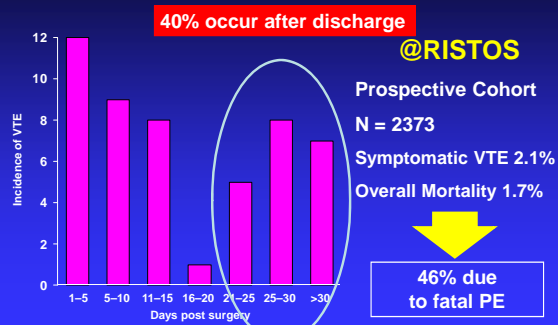
Kakkar VV, et al J Thromb Haemost 2010;8:1223-1229

The @RISTOS Project Clinical Outcomes After Cancer Surgery



Agnelli G, et al. Ann Surg. 2006;243:89-95.

Surgical Cancer Patients



Agnelli G, et al. Ann Surg. 2006;243:89-95.

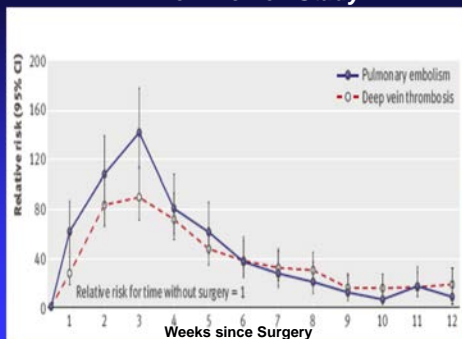
Risk Factors for VTE in Cancer Surgery @RISTOS Project

Risk Factors VTE	Odds Ratio	95% CI
Age >60 years	2.63	1.27-5.71
Previous VTE	5.98	2.13-16.80
Advanced Cancer	2.68	1.37-5.24
Anesthesia >2 hours	4.50	1.06-19.04
Bed Rest >3 days	4.37	2.45-7.78

The Odds Ratio were the same for late VTE

Agnelli G, et al Ann Surg 2006;243:89-95

Relative Risk From Time of Surgery Million Women Study



Sweetland et al, BMJ 2009;339:b4583

VTE Following Surgery Million Women Study

Indication for surgery and type of surgery	Inpatient surgery	
	Incidence rate per 1000 person months	No who develop VTE over 12 weeks
No surgery	0.058*	1 in 6200
After surgery†:		
Cancer surgery	4.27	1 in 85
Hip or knee replacement	7.74	1 in 45
Fracture	3.78	1 in 95
Other orthopaedic surgery	1.87	1 in 195
Vascular surgery	3.07	1 in 115
Gynaecological surgery	0.99	1 in 365
Gastrointestinal surgery	2.19	1 in 165
Other surgery	1.30	1 in 275

VTE=venous thromboembolism.
*Equal to 0.70 per 1000 person years.
†Incidence rates are averages over the first 12 postoperative weeks.

Sweetland et al, BMJ 2009;339:b4583

ACCP Guidelines 2008

Extended VTE Px Cancer Surgery

- In **Selected High-Risk General Surgery** patients including those who have undergone major cancer surgery, suggested post-hospital discharge prophylaxis with LMWH [2A]
 - Enoxaparin 40mg, SC, Q24hrs
 - Dalteparin 5,000 IU, SC, Q24hrs
- Patients undergoing **Gynecologic Cancer Surgery** and who are >60 years of age or have previously experienced a VTE recommend continuing prophylaxis for 2 to 4 weeks [2C]
 - Enoxaparin 40mg every 24 hours
 - Dalteparin 5000 IU every 24 hours

Geerts W, et al Chest 2008;133:381S-453S.

Extended VTE Prophylaxis

Abdominal-Pelvic Cancer Surgery

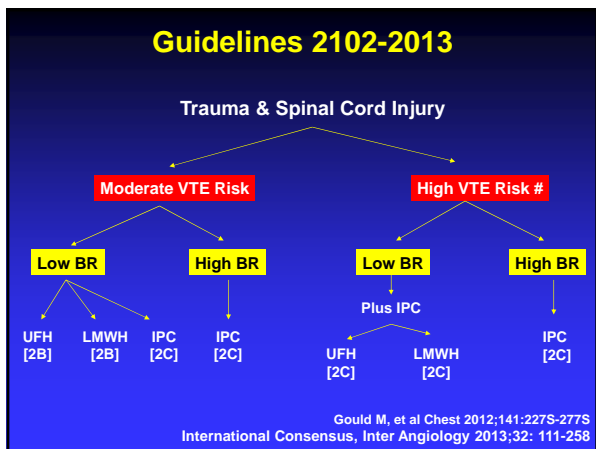
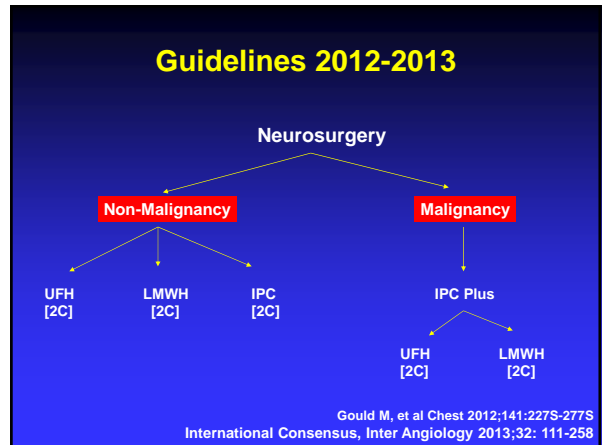
- High Risk patient undergoing abdominal or pelvic surgery for cancer who are not high risk for major bleeding [1B]
 - Extended prophylaxis 4 weeks with LMWH
 - Dalteparin 5,000 U, Q24 hrs
 - Enoxaparin 40 mg, Q24 hrs

Gould M, et al Chest 2012;141:227S-277S
International Consensus, Inter Angiology 2013;32: 111-258

VTE Incidence


Neurosurgery, Multiple Trauma, Acute SCI

Surgery	No Studies	No Pts	VTE	95% CI
Neurosurg	6	330	77 (23%)	19%-28%
Multiple Trauma	4	536	270 (50%)	46%-55%
Spinal Cord Injury	9	458	160 (35%)	31%-39%



MAYO CLINIC

DVT/PE Prophylaxis in the Surgical Patient II: The AAOS Guidelines and the Orthopedist's Perspective
October 9-12, 2013



Mayo School of Continuous Professional Development

Stuart L. Gordon, M.D.
Chief of Hip and Knee Division
Cooper University Hospital
Camden, NJ

October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Disclosures

I have no disclosures to make regarding this presentation.

- 775,000 total joint replacements performed in U.S. yearly
 - Revision cases are increasing in an accelerated pace
- Over 65 population projected to double from 35 million to 72 million by 2030
- Hospitalist/Joint surgeons are in high demand
 - Need for dedicated orthopaedic hospitalist

DVT Facts 101

- Historical data: 40-60% lower extremity total joint replacements will develop DVT (Venogram Positive) or PE without chemoprophylaxis
- Without prophylaxis but with early mobilization and modern TJR surgical techniques, risk of symptomatic DVT reduced to 4.3%
- With chemoprophylaxis added, rate reduced 0.7-1.5% within 35 days of TJR
- Fatal PE risk equals 0.1-0.5% regardless of drug agent used

Agents Used for Chemoprophylaxis

- Dextran
- Adjusted dosed Heparin
- Aspirin (81mg/325mg) BID
- Coumadin (WARFarin)
- Low molecular weight Heparins
- Factor Xa inhibitors
- Oral rivaroxaban (Xarelto)

Mechanical Agents for DVT Prophylaxis

- TEDS compression stockings below knee
- Calf/foot pumps: sequential, graded compression
- Sterile compression pumps on operated limb
- Ankle dorsiflexion exercises in bed
- Early mobilization post-op day 1
- Leg elevation
- Avoidance of prolonged sitting

Bleeding Risk

- Joint replacement involves aggressive reaming, cutting, and drilling of vascular bone and soft tissues
- Any significant manipulation of coagulation pathways may create wound or GI bleeding events



Effects on TJR with Excessive Wound Bleeding/Hematoma

- ↑↑ Risk of Infection (Human Petri Dish)
- Decrease in range of motion
- ↑↑ Pain
- Increase in Transfusion Risk
- Decrease Patient Satisfaction (bleeding trail in bed/room/hall)
- Delays patient discharge



Balance

Efficacy vs Safety
↓ DVT Risk vs Minimize bleeding risk



Evolution of Clinical Practice Guidelines (CPG)

- SCIP (Surgical Care Improvement Project) 2006
 - "DVT prophylaxis ordered according to current guidelines and given within 24 hours after surgery"
- Clinical Practice Guidelines
 - AAOS 2007
 - risk stratification to prevent SYMPTOMATIC PE and wound bleeding
 - Graded recommendations presented with aspirin included as a sole agent
 - Strategies to reduce bleeding risk emphasized



Evolution of Clinical Practice Guidelines (CPG)

- AACP 2004, 2008
 - Focus on choosing best prophylactic agent in preventing ASYMPTOMATIC DVT, ASA not included
 - No consideration for bleeding risk
 - Recommendations based on randomized drug trials (mostly pharmaceutical funded)



Evolution of Clinical Practice Guidelines (CPG)

“The Grand Merger”

- AAOS 2011/AACP 2012
 - Both guidelines emphasize balancing efficacy and safety for the selection of DVT prophylactic agents
 - AAOS emphasis on prevention of symptomatic DVT
- AACP 2012 CPG includes aspirin and some newer agents, but unlike the 2008 CPG, does not offer specific dosage protocol



Evolution of Clinical Practice Guidelines (CPG)

- CMS (Center for Medicare and Medicaid Services) 2006
 - Mandated quality measures for hospital care with SCIP guidelines, ASA not included
 - Present SCIP measure based on outdated 2004, 2008 AACP guideline, ASA not indicated for quality measure
 - January 2014 – projected updated SCIP guidelines to include aspirin as sole agent (finally!)



The Battle of the Mighty Aspirin Tablet

- Joint Surgeon/Hospitalist vs “The Quality Measures Committee”



“Note to self...”

- “...there is a high risk of bleeding associated with this TJR surgery and I have chosen aspirin as the DVT prophylactic agent”



AAOS Guideline 2011

- Use drug agent and/or mechanical agent; however no specific recommendations are given for “best drug” or duration of use
- Assess patient for known bleeding disorder or active liver disease
- No need for routine use of post-op duplex ultrasound screening for DVT
- Mobilize patient early and often



AAOS Guideline 2011

- Use neuraxial anesthesia: decreases blood loss
- Questions use of IVC filters
- Discontinue anti-platelet agents perioperatively (aspirin/plavix)
- For patients with high risk of bleeding use mechanical compression devices, drug agents?
- Patient with prior DVT, use drug agent and mechanical compression device



AAOS 2011 Clinical Practice Guideline

- Balance risk of bleeding with symptomatic DVT prophylaxis
- Encourage orthopaedic surgeons to engage in discussion of DVT strategy with patient, hospitalist, internist, cardiologist, and hematologist



How I Manage DVT/Bleeding Risk

- Pre-op risk assessment with office consultation questionnaire given by nurse/student and personally reviewed by surgeon
 - "Have you or any blood relative ever had a DVT/PE?"
 - Explain if the event was provoked or otherwise? recurrent? IVC filter?
 - Thrombophilic disorder?
 - Anemia – correct if present
 - Diabetes – Obtain A1c Hemoglobin
 - History of Lupus/AVN



How I Manage DVT/Bleeding Risk

- Office consultation (Continued)
 - Estrogen replacement
 - Smoking history and suggest smoking cessation program
 - Morbid/super-morbid obesity (ability for post-op rehab?)
 - Lymphedema/pretibial edema (vascular consult, compression stockings, and diuretics)
 - Bleeding disorders (von Willebrand Disease, ITP, Thrombocytopenia, Liver Disease, Hepatitis C, HIV)
 - Coronary Artery Disease/Stents
 - Baby aspirin through surgery, stop Plavix 10 days pre-op



Drug Agents

- Aspirin 325 mg po bid (90% of my practice)
- Lovenox (renal dosed)
- Xarelto (rivaroxaban)
- Coumadin
- Lovenox bridged with Coumadin
- Aspirin, add Plavix with baby aspirin 10 days post-op



Day of Surgery

- Holding area
 - Apply below knee stockings
- OR
 - Regional block (not indwelling epidural pain catheter)
- Foot mechanical pumps – sterile compression boot with sterile tubing
- Measure twice, cut once!
- Limit TKR tourniquet time/limit leg rotation during THR to avoid kinking of the femoral vein
- IV toradol with aspirin DVT prophylaxis
- Do not use IV toradol with Lovenox/Coumadin/Factor Xa Inhibitors because risk of bleeding



No Toradol for you!

Lovenox, Coumadin, DVT prophylaxis



PACU

“Your bed is your exercise mat!”

- Patient instructed to do quad sets and ankle pumps in the recovery room



Floor to Discharge

- Comfortable compression stockings below knee
- Leg elevation with anesthesia head pillow
- Bed exercises posted on foot of bed
- Foot mechanical pumps continuous in bed and sitting on side of bed
- No sitting more than 45 minutes out of bed or on side of bed



Post-Discharge Regimen

All hospital patients receive multi-modal comfort protocol (celebrex/IV toradol (if on aspirin)/IV acetaminophen, TKR-FNB x2 days or Liposomal bupivacaine

- If aspirin: 325 mg EC bid x4-6 weeks
- If lovenox: renal dosing, start morning after surgery q 12 hours or once daily for 2-3 hospital days, then 10-12 days home/SNIF, then aspirin 325 mg EC x2-4 weeks



Post-Discharge Regimen

- If rivaroxaban: 10 mg po daily, start 6AM POD#1 through hospital stay, then 10-12 days at home/SNIF, then aspirin x2-4 weeks
- If coumadin: 5 mg 9PM night of surgery, titrate to INR of 2.0-2.3. Lovenox bridge with renal dosing started 6AM morning after surgery. Stop lovenox when INR reaches 1.6



Things That Go Bump in the Night

- Anesthesia/Hospitalist/Non-Joint Team Member gives Toradol/NSAID other than Celebrex
 - COMMUNICATE!!
- Medical Team adds ASA for coronary risk to Coumadin/Lovenox regimen
- Failure to anticoagulate within 24 hours of surgical event
- Failure to plan rational, safe AAOS guidelines
- EMR medication hold errors – computer glitch



Things That Go Bump in the Night

- Post-op TJR specific order set not employed
- Surgeon/Nursing/Medicine Service overlooks (missing) anticoagulation order
- Voluminous discharge instructions for home or SNIF unit
 - “Was I supposed to be taking aspirin after I left the hospital?”



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Thank you!



Perioperative Management of Antiplatelet Agents in Cardiac Patients

An Overview of Perioperative Medicine

October 2013

Howard Weitz, M.D.
Jefferson Medical College
Thomas Jefferson University Hospitals

Ask: Why receiving antiplatelet agents???

- Primary prevention
- Secondary prevention: with or without revascularization
- Aspirin, Clopidogrel, Ticagrelor, Prasugrel
- Post stent
- Post CVA

Case 1

- 65 year old man for dental extraction.
- Inferior wall MI 5 years ago. Underwent coronary angiography and found to have occluded RCA. No intervention done.
- Hypertension, hyperlipidemia
- Meds: beta blocker, ace-I, aspirin 81 mg daily
- Dentist wishes to stop aspirin 2 weeks prior to dental extraction.

Case 1

- You advise:
 - A. stop aspirin 2 weeks prior to dental extraction
 - B. stop aspirin 1 week prior to dental extraction
 - C. stop aspirin 5 days prior to dental extraction
 - D. do not stop aspirin prior to dental extraction

Case 1

- You advise:
 - A. stop aspirin 2 weeks prior to dental extraction
 - B. stop aspirin 1 week prior to dental extraction
 - C. stop aspirin 5 days prior to dental extraction
 - D. do not stop aspirin prior to dental extraction**

Journal of the American Dental Association, November 2003

PRACTICAL SCIENCE ABSTRACT

Lack of a scientific basis for routine discontinuation of oral anticoagulation therapy before dental treatment

ARTHUR H. JESSE, D.M.D., Ph.D.
GEORGE D. SUCINCO, D.D.S.

Background. There is a widespread belief among dental practitioners and physicians that oral anticoagulation therapy in which patients receive drugs such as warfarin sodium must be discontinued before dental treatment to prevent serious hemorrhagic complications, especially during and after surgical procedures. **Overview.** The authors examine the scientific basis for properly managing the dosage of anticoagulants for dental patients who are receiving anticoagulation therapy. The authors review the appropriate laboratory test values to which dentists should refer when evaluating for dental treatment patients who are receiving anticoagulation therapy. The authors also review clinical studies, published within the past five years, that focus on the frequency and

Review of clinical studies: anticoagulants and dental procedures
Warfarin and Low dose aspirin (100 mg/d)

Review of clinical studies: anticoagulants and dental procedures Warfarin Low dose aspirin (100 mg/d)

“The weight of evidence in the dental literature does not support the long-held belief that an oral anticoagulant regimen must be altered or discontinued before most dental procedures, including oral surgery.”

“Currently the INR does not require alteration of the therapy regimen unless the INR value is greater than 4.0, provided that local hemostatic measures are used.”

“Articles that document oral surgery experiences of patients taking aspirin alone or in combination with clopidogrel have not reported any cases of unusual intraoperative or postoperative bleeding problems. This experience is anecdotal.”

European Heart Journal (2006) 27, 2647–2654
doi:10.1093/eurheartj/ehk324

Clinical research
Coronary heart disease

A systematic review and meta-analysis on the hazards of discontinuing or not adhering to aspirin among 50 279 patients at risk for coronary artery disease

Giuseppe G.L. Biondi-Zoccai¹*, Marzia Lotrionte², Pierfrancesco Agostoni³, Antonio Abbate⁴, Massimiliano Fusaro⁵, Francesco Burzotta⁶, Luca Testa⁷, Imad Sheiban⁸, and Giuseppe Sangiorgi⁹

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Received 21 September 2006; accepted 5 October 2006; online publish-ahead-of-print 19 October 2006

KEYWORDS
Aspirin
Coronary artery disease
Discontinuation
Meta-analysis
Systematic review

Aims The role of aspirin in patients with coronary artery disease (CAD) is well established, yet patients happen to discontinue aspirin according to physician's advice or unappreciated. We thus undertook a systematic review to appraise the hazards inherent to aspirin withdrawal or non-compliance in subjects at risk for or with CAD.

Methods and results Electronic databases were systematically searched (updated January 2006). Study designs, patient characteristics, and outcomes were abstracted. Pooled estimates for odds ratios (ORs) were computed according to random-effect methods. From the 417 screened studies, six were selected (82 179 patients). One study (31 700 patients) focused on adherence to aspirin therapy in the secondary prevention of CAD, two studies (2594) on aspirin discontinuation in acute CAD, two studies (13 786) on adherence to aspirin therapy before or shortly after coronary artery bypass grafting, and another (2229) on aspirin discontinuation among patients undergoing drug-eluting stenting. Overall, aspirin non-adherence/withdrawal was associated with three-fold higher risk of major adverse cardiac events (OR = 3.34 [1.75–5.81], $P < 0.0001$). This risk was magnified in patients with intracoronary stents, as discontinuation of antiplatelet treatment was associated with an even higher risk of adverse events (OR = 86.76 [21.90–340.82]).

Conclusion Non-compliance or withdrawal of aspirin treatment has serious prognostic implications in subjects with or at moderate-to-high risk for CAD. Aspirin discontinuation in such patients should be advocated only when bleeding risk clearly outweighs that of atherothrombotic events.

ASA withdrawal assoc with 3- fold higher risk of major cardiac event

REVIEW

Low-dose aspirin for secondary cardiovascular prevention – cardiovascular risks after its perioperative withdrawal versus bleeding risks with its continuation – review and meta-analysis

W. BERGER¹, J.-M. CHEMNITZ², G. D. KNEISSL¹ & G. RÜCKER³
From the ¹Department of Interventional Cardiology, St Georg Hospital, Leipzig; ²Cardiology Practice, Waldkrankenhaus; and ³Department of Rehabilitative and Preventive Sports Medicine, Medical Clinic, University of Freiburg, Freiburg, Germany

Meta-analysis of 41 studies
ASA increased risk of bleeding complications 1.5 fold
ASA withdrawal preceded 10% of Acute Coronary Syndromes
Time interval from ASA withdrawal to ACS was 8.5 days

Conclusion: ASA should be discontinued only if low dose ASA may cause bleeding risk with associated mortality

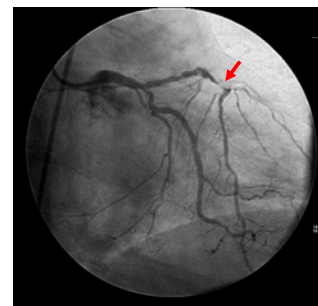
Perioperative aspirin use

- Minimal evidence re: bleeding
- Minimal evidence re: safety
- Surgery site specific issues (neurosurgery, prostate)
- Primary prevention: no evidence that asa cessation a problem (stop 5-7 days pre-op)
- Secondary prevention: continue aspirin if possible

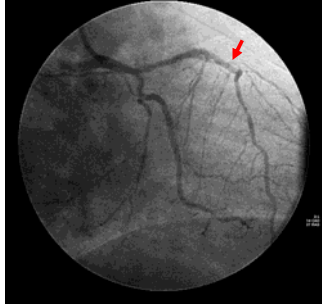
85 year old man left colectomy

- NSTEMI 11 months ago
- Diabetes (insulin), Cr 2.1
- Hgb 10.8 at time of NSTEMI
- Cath
 - 95% proximal LAD stenosis
 - No other significant cad
 - PTCA of LAD: Drug eluting stent

Cardiac cath post NSTEMI 11 months ago



PTCA post NSTEMI 11 months ago



85 year old man
left colectomy

- Presents now with fatigue
- Stool heme (+)
- Hgb 9.2, Hgb A1C 12, Cr 2.1
- Colonoscopy without biopsy reveals fungating mass left colon

We have been requested to assess him for surgery.

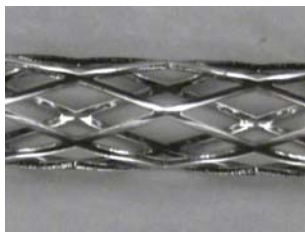
Our concerns relate to:

- a. Management of his antiplatelet therapy in the peri-colonoscopy period**
- b. Management of his antiplatelet therapy in the perioperative period**

What is best approach at this time?

- A. Stop asa + clopidogrel and perform colonoscopic biopsy
- B. Consult with GI and see if they can perform colonoscopic bx on asa + clop
- C. Consult with GI and see if they can perform biopsy on asa
- D. Consult with surgery and see if they can perform colectomy on asa
- E. Wait 1 month, then approach off asa-clopidogrel

The Problem: Balancing the risk of hemorrhage vs. stent thrombosis



September 14, 2006: FDA initial warning
December 7,8 2006: Circulatory Systems Device Advisory Panel Hearings

January 4, 2007: FDA online announcement of package insert revision.
Optimal duration of antiplatelet therapy (especially clopidogrel) is 12 months for patients at low risk of bleeding.

PRACTICAL ADVICE: DUAL ANTIPLATELET THERAPY

At the FDA Circulatory Devices Advisory Board meeting on December 7th and 8th, 2006 the panel recommended the continuation of dual antiplatelet therapy for 12 months after implantation of drug-eluting stents, based, in large part, on the ACC/AHA/SCAI Class I indication already in existence for PCI in patients who are not at high-risk for bleeding [15]. We support that recommendation. We also recommend operators seri-

Society for Cardiovascular Angiography Clinical Alert, Jan 2007

Patients with previously implanted DES who are currently taking dual antiplatelet therapy present a significant management challenge to the interventional cardiologist or primary care provider when a situation arises that requires cessation or interruption of anti-platelet therapy (for example, when elective or urgent surgery is required). There are no existing studies that examine alternative management strategies. Each practitioner must therefore rely on personal knowledge of the individual patient, the specific reason(s) for anti-platelet therapy discontinuation and other relevant factors in making the recommendation for how to manage the situation.

Society for Cardiovascular Angiography Clinical Alert, Jan 2007

Joint Advisory Recommendations and Noncardiac Surgery

- Consider bare metal stent if patient requires PCI and is likely to require invasive or surgical procedure within next 12 months.
- Educate patient prior to discharge re: risk of premature antiplatelet discontinuation.
 - Instruct patient to contact treating cardiologist before antiplatelet discontinuation
- Healthcare providers who perform surgical or invasive procedures must be made aware of catastrophic risks of premature antiplatelet discontinuation and should contact the treating cardiologist to discuss optimal management strategy

Joint Advisory Recommendations and Noncardiac Surgery

- Defer elective procedures for which there is bleeding risk until completion of antiplatelet course
 - 1 month bare metal stent (risk increased for up to 90 days)
 - 12 months drug eluting stent
- For patient with drug eluting stent who are to undergo procedures that mandate discontinuation of thienopyridine (eg, clopidogrel), continue aspirin if at all possible and restart thienopyridine as soon as possible
- No evidence for “bridging therapy” with antithrombins, warfarin, or glycoprotein IIb/IIIa agents

Figure. Flow chart to determine the risk of stent thrombosis.



Riddell J W et al. Circulation 2007;116:e378-e382



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Risk Factors for Stent Thrombosis

- Advanced age
- Diabetes mellitus
- Renal insufficiency
- Multivessel cad
- Stent placed in setting of acute coronary syndrome
- Stent
 - Bifurcation lesion
 - Stent placed to treat in-stent restenosis
 - Multiple stents
 - Small stent dia
 - Stent malposition or underexpansion
 - LAD

Risk Factors for Stent Thrombosis

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JACC White Paper


Management of Platelet-Directed Pharmacotherapy in Patients With Atherosclerotic Coronary Artery Disease Undergoing Elective Endoscopic Gastrointestinal Procedures

Richard C. Becker, MD,* James Scheiman, MD,† Harold L. Dauerman, MD,‡ Frederick Spencer, MD,§ Sunil Rao, MD,¶ Marc Sabatine, MD,¶ David A. Johnson, MD,¶ Frances Chan, MD,** Neena S. Abraham, MD,†† Eamonn M. M. Quigley, MD,‡‡ in collaboration with the American College of Cardiology and the American College of Gastroenterology
Durham, North Carolina; Ann Arbor, Michigan; Burlington, Vermont; Hamilton, Ontario, Canada; Boston, Massachusetts; Norfolk, Virginia; Hong Kong, China; Houston, Texas; and Cork, Ireland

JACC White Paper

- Retrospective evidence that aspirin does not increase post polypectomy bleeding
- No evidence to aid in estimation of risk of endoscopic biopsy bleeding on clopidogrel or aspirin + clopidogrel

American Society For Gastrointestinal Endoscopy



Guideline on the management of anticoagulation and antiplatelet therapy for endoscopic procedures

This is one of a series of statements discussing the practice of gastrointestinal endoscopy in common clinical situations. It is intended to aid endoscopists in determining the appropriate use of endoscopic procedures in conjunction with anticoagulation and/or antiplatelet therapy. Guidelines for the appropriate practice of endoscopy are based on critical review of the available data and expert consensus. Controlled clinical studies would be beneficial to clarify some aspects of this statement and revision might be necessary as new data appear. Clinical consideration may justify a course of action at variance from these specific recommendations.

INTRODUCTION

Anticoagulation therapy with warfarin is used to reduce the risk of thromboembolic events in patients with certain cardiovascular conditions, deep vein thrombosis (DVT), and hypercoagulable states. Anticoagulation therapy complicates the management of anticoagulation therapy are proposed. Last, the risk of bleeding related to the use of aspirin or other NSAIDs in the periendoscopic period is reviewed and recommendations for management are provided.

ACUTE GASTROINTESTINAL HEMORRHAGE IN THE ANTICOAGULATED PATIENT


The most common site of significant bleeding in patients receiving oral anticoagulation therapy is the gastrointestinal tract.¹ A history of prior gastrointestinal bleeding, but not a history of peptic ulcer disease alone, is associated with an increased risk of major gastrointestinal hemorrhage during warfarin therapy (30% at 3 years versus 5% in those with no prior bleeding history).² The risk of gastrointestinal bleeding is also increased when the international normalized ratio (INR) is above the therapeutic range (see "Condition Risks") and by concomitant aspirin use. Gastrointestinal hemor-

J Gastro Endos 2002

2002 Guideline on the Management of anticoagulation and antiplatelet therapy for endoscopic procedures

- In the absence of pre-existing bleeding disorders endoscopic procedures may be performed on patients taking aspirin and NSAIDs in standard doses.
- Colonoscopy with biopsy is a low risk procedure

GUIDELINE



ASGE guideline: the management of low-molecular-weight heparin and nonaspirin antiplatelet agents for endoscopic procedures

This is one of a series of statements discussing the utilization of GI endoscopy in common clinical situations. The Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy prepared this text. In preparing this guideline, a MEDLINE literature search was performed, and additional references were obtained from the bibliographies of the identified articles and from recommendations of expert consultants. When little or no data exist from well-designed prospective trials, emphasis is given to results from large series and reports from recognized experts. Guidelines for appropriate use of endoscopy are based on a critical review of the available data and expert consensus. Further controlled clinical studies are needed to clarify aspects of this statement, and revision may be necessary as new data appear. Clinical consideration may justify a course of action at variance to these recommendations.

INTRODUCTION

(Fragmin, Pfizer, New York, NY), enoxaparin (Lovenox, Aventis Pharmaceuticals Inc, Bridgewater, NJ), and tinzaparin (Innohep, Pharmion Corporation, Boulder, Colo), not all for the same indications.⁶

Pharmacology

Both UFH and LMWH exert their anticoagulant activity by activating antithrombins and inhibiting factor Xa. Unlike UFH, LMWH yields a greater selective activity against factor Xa and has a lower affinity for antithrombin.⁷ As a result, LMWHs do not significantly alter the activated partial thromboplastin time, and this test is not useful to monitor their effects.⁸

LMWH produces a more predictable anticoagulant response, has a better bioavailability, has a longer half-life, and has a dose-independent clearance mechanism compared with UFH.⁹ In addition, LMWH has been demonstrated to cause less bleeding than UFH, because it binds less avidly to platelets, does not increase microvascular permeability, and is less likely to interfere

J Gastro Endos 2005

Management of antiplatelet medication (clopidogrel or ticlopidine) in patients undergoing endoscopic procedures

Procedure risk	Recommendation
High	Consider discontinuation 7-10 d before procedure
Low	No change in therapy

Patients on combination therapy (eg, clopidogrel and aspirin) may be at an additional increased risk of bleeding.

For acute GI hemorrhage in the patient on clopidogrel or ticlopidine, the decision to transfuse platelets should be individualized, usually weighing the risk of an acute cardiovascular event against the risk of continued bleeding.

Reinstitution of clopidogrel or ticlopidine should be individualized.

Procedure risk

High-risk procedures	Low-risk procedures
Polypectomy	Diagnostic
Biliary sphincterotomy	EGD ± biopsy
Pneumatic or bougie dilation	Flexible sphincterotomy ± biopsy
PEG placement	Colonoscopy ± biopsy

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PEG placement	Colonoscopy ± biopsy

GUIDELINE

Management of antithrombotic agents for endoscopic procedures

This is one of a series of statements discussing the use of GI endoscopy in common clinical situations. The Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy (ASGE) prepared this text. This guideline combines and updates 2 previously issued guidelines, "Guideline on the management of antithrombotic and antiplatelet therapy for endoscopic procedures" and "ASGE guideline: the management of low-molecular-weight heparins and nonparenteral antiplatelet agents for endoscopic procedures." To prepare this guideline, a search of the medical literature was performed using PubMed. Studies or reports that described fewer than 10 patients were excluded from analysis if multiple series with more than 10 patients addressing the same issue were available. Additional references

Antithrombotic agents include anticoagulants (eg, warfarin, heparin, and low molecular weight heparin) and antiplatelet agents (eg, aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs), thienopyridines (eg, clopidogrel and ticlopidine), and glycoprotein IIb/IIIa receptor inhibitors). Antithrombotic therapy is used to reduce the risk of thromboembolic events in patients with certain cardiovascular conditions (eg, atrial fibrillation and acute coronary syndromes), deep venous thromboses (DVT), hypercoagulable states, and endoprosthesis. The most common site of significant bleeding in patients receiving oral anticoagulation therapy is the GI tract. The antithrombotic drug classes with duration of action and routes for reversal are described in Table 2.

Before performing endoscopic procedures on patients

J Gastrointest Endos 2009

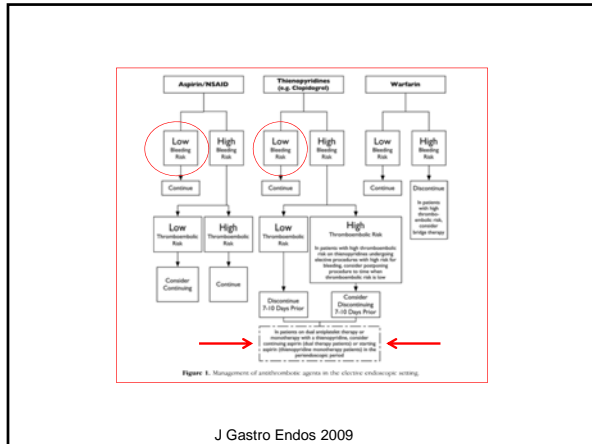
TABLE 3. Procedure risk for bleeding

Higher-risk procedures	Low-risk procedures
Polypectomy	Diagnostic (EGD, colonoscopy, flexible sigmoidoscopy) including biopsy
Biliary or pancreatic sphincterotomy	ERCP without sphincterotomy
Pneumatic or bougie dilation	EUS without FNA
PEG placement	Enteroscopy and diagnostic balloon-assisted enteroscopy
Therapeutic balloon-assisted enteroscopy	Capsule endoscopy
EUS with FNA	Enteral stent deployment (without dilation)
Endoscopic hemostasis	
Tumor ablation by any technique	
Cytogastrostomy	
Treatment of varices	

J Gastrointest Endos, 2009

TABLE 4. Condition risk for thromboembolic event

Higher-risk condition	Low-risk condition
Atrial fibrillation associated with valvular heart disease, prosthetic valves, active congestive heart failure, left ventricular ejection fraction <35%, a history of a thromboembolic event, hypertension, diabetes mellitus, or age > 75 y	Uncomplicated or paroxysmal nonvalvular atrial fibrillation
Mechanical valve in the mitral position	Bioprosthetic valve
Mechanical valve in any position and previous thromboembolic event	Mechanical valve in the aortic position
Recently (<1 y) placed coronary stent	Deep vein thrombosis
Acute coronary syndrome	
Nonstented percutaneous coronary intervention after myocardial infarction	



Can we get by with short term antiplatelet discontinuation?

- Eisenberg, MJ Circ 2009;119:1634-42

Interventional Cardiology

Safety of Short-Term Discontinuation of Antiplatelet Therapy in Patients With Drug-Eluting Stents

Mark J. Eisenberg, MD, MPH, FACC, FRCR, Richard B. Sticco, MD, Daniel Liberman, PhD, Kristian B. Filbin, MD

Background:—Antiplatelet therapy is often discontinued in patients with drug-eluting stents who are undergoing surgical procedures. However, discontinuation of antiplatelet therapy is an important risk factor for late stent thrombosis. Our objective was to evaluate the safety of short-term discontinuation of antiplatelet therapy.

Methods and Results:—We prospectively enrolled Medicare fee-for-service patients in our late stent thrombosis and very late stent thrombosis published between January 2005 and July 2006. We restricted our search to Academic Research Consortium–defined adverse events. We identified 103 cases of late stent thrombosis or very late stent thrombosis from 34 articles (79 stent case reports, 63 from registries, and 21 from randomized clinical trials). Patients had a mean age of 68.1±14.4 years and 64% were male. A total of 70 cases occurred in patients who were receiving dual antiplatelet therapy at the time of the event. If patients stopped both antiplatelet agents simultaneously, the median time to event was 7 days. If patients had previously stopped a thienopyridine with an oral effect and subsequently stopped aspirin/ASA, the median time to event was also 7 days from the time of aspirin/ASA withdrawal. In contrast, if the thienopyridine was stopped first with aspirin/ASA not maintained, the median time to event was 122 days. Among the 48 patients who stopped both agents, 36 cases (75%) occurred within 10 days. Among the 14 patients who discontinued a thienopyridine but continued aspirin/ASA, only 6 cases (43%) occurred within 10 days.

Conclusions:—If aspirin/ASA withdrawal is maintained, short-term discontinuation of a thienopyridine may be relatively safe in patients with drug-eluting stents. *Circulation*. 2009;119:1634-42.

Key Words: aspirin • antiplatelet therapy • drug-eluting stents • percutaneous coronary intervention

Eisenberg MJ, Circulation 2009

		Time to stent thrombosis
Stop ASA, stop thienopyridine		Median 7 d
Continue ASA, stop thienopyridine		Median 122 d (6% within 10 d)

Our patient

- Multiple risks for stent thrombosis
- High risk of hemorrhage colonoscopic biopsy

What happened

- Biopsy done 12 months post stent
 - Clopidogrel discontinued 5 days prior
 - Aspirin continued because of multiple risks for stent thrombosis
 - Adenocarcinoma
- Partial colectomy
 - Aspirin continued
 - No bleeding

Case

Resection of a large symptomatic meningioma

80 years old
 multivessel coronary artery disease
 1989: triple vessel coronary artery bypass as treatment of refractory angina.

Case

Recurrent angina last year led to repeat catheterization. Cath revealed:

1. **left internal mammary artery bypass** that was anastomosed to the left anterior descending was patent but the distal lad was diffusely diseased and not thought amenable to intervention.
2. **vein graft to the right coronary artery** was occluded and the right coronary artery was diffusely diseased and not amenable to intervention.
3. **Vein graft to the circumflex** was occluded and the circumflex diffusly disease and not amenable to intervention.

Case

Following cath his medical antianginal regimen was maximized.

He feels well and only has angina if he over exerts. He can predict this and for 6 months has been able to take prophylactic nitroglycerine to prevent episodes. Episodes have been infrequent and he has been stable. He is unable to climb one flight of stairs due to severe degenerative joint disease.

Case

He has chronic renal insufficiency (analgesic related) Cr. 2.2

Medications: metoprolol 100 mg po twice daily, lisinopril 20 mg daily, aspirin 325 mg daily, nitroglycerine

Bp 105/70 HR 58
Exam unremarkable.

ECG: Normal sinus rhythm. Old diaphragmatic infarct.
Unchanged from prior ecg

Case

He is going to neurosurgery. Regarding his aspirin you recommend

- A. Continue aspirin in the perioperative period
- B. Discontinue aspirin in the perioperative period
- C. Discuss with the neurosurgeon and recommend that aspirin be continued if at all possible
- D. Pharmacologic stress test
- E. None of the above

Case

He is going to neurosurgery. Regarding his aspirin you recommend

- A. Continue aspirin in the perioperative period
- B. **Discontinue aspirin in the perioperative period**
- C. Discuss with the neurosurgeon and recommend that aspirin be continued if at all possible
- D. Pharmacologic stress test
- E. None of the above

Will results of stress test change management?
(Would a positive stress test change management?)

- He has diffuse coronary artery disease felt not amenable to repeat revascularization 1 year ago
- He has chronic stable angina
- Surgery is not elective

How about his aspirin in the perioperative period ?

Journal of Cardiology
 Letter to the Editor
Myocardial infarction after aspirin cessation in stable coronary artery disease patients
 Jean-Philippe Collet MD^{1,2}, Dominique Hainhot MD¹, Philippe G. Steg MD³
¹Department of Cardiology, Centre Hospitalier Universitaire (CHU) de Québec, 47 Boulevard de l'Église, 1001 Québec, Québec, Canada
²Department of Cardiology, Centre Hospitalier Universitaire de Montréal, 3841 Avenue Lacombe, 1001 Montréal, Québec, Canada
 Received 29 June 2005; accepted 15 September 2005

Abstract
 Discontinuation of chronic aspirin therapy in stable coronary artery disease patients may lead to acute myocardial infarction within 10 days of withdrawal as a consequence of the progressive necrosis of the plaque (reorganization activity) which exposes to a sublethal effect leading to acute coronary thrombosis. © 2005 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Myocardial infarction; Aspirin; Platelets
 475 previously stable pts admitted with MI
 11 had discontinued ASA 9.5 days prior to MI

How about his aspirin ?

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EXPRESS PUBLICATION
Coronary Syndromes Following Aspirin Withdrawal
A Special Risk for Late Stent Thrombosis
 Emanuele Ferrati, MD, Mostapha Benhamou, MD, Pierre Corboni, MD, Bankouy Marcel, MD
 Nice, France

OBJECTIVES We sought to determine whether aspirin withdrawal is an exceptional situation in coronary disease patients who relapsed.
BACKGROUND Despite the recognized benefits of aspirin in coronary disease, and because of the threat of bleeding or poor compliance, aspirin intake is sometimes stopped. It is not known whether withdrawal of aspirin can be harmful in coronary-disease patients.
METHODS Between September 1999 and April 2002, a total of 1,236 patients hospitalized for acute coronary syndrome (ACS) were questioned in order to determine whether aspirin intake had been interrupted.
RESULTS Fifty-one of these ACSs occurred within 1 month after aspirin withdrawal. This represents 4.1% of coronary events but 13.3% of recurrences. Among those patients who relapsed, the incidence of ST-segment elevation ACS was higher in those who stopped aspirin when compared to the 132 patients who did not stop aspirin (19% vs. 10%; $p = 0.002$). Ten (20%) cases involved a thrombosis of an uncoated stent implanted on average 15.5 ± 6.5 months previously. Mean delay between aspirin withdrawal and the acute coronary event was 10 ± 1.9 days. Reasons for aspirin withdrawal included minor surgery in 7 cases, fibroscopy in 8 cases, dental treatment in 13 cases, bleeding in 3 cases, and patient non-compliance in 20 cases. Our results support the hypothesis that aspirin withdrawal in coronary patients may represent a real risk for the occurrence of a new coronary event. Many cases involved late uncoated-stent thrombosis. Assessment of the exact incidence of coronary recurrences after aspirin withdrawal will need prospective studies. (J Am Coll Cardiol 2005;45:456-9) © 2005 by the American College of Cardiology Foundation

1236 ACS admissions
 51 within 1 month after ASA withdrawal
 10 BMS thrombosis
 28 related to procedures
 ACS 10 days post ASA

How about his aspirin ?

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 DOI: 10.1016/j.jacc.2004.11.046

EXPRESS PUBLICATION
Coronary Syndromes Following Aspirin Withdrawal
A Special Risk for Late Stent Thrombosis
 Emanuele Ferrati, MD, Mostapha Benhamou, MD, Pierre Corboni, MD, Bankouy Marcel, MD
 Nice, France

previously. Mean delay between aspirin withdrawal and the acute coronary event was 10 ± 1.9 days. Reasons for aspirin withdrawal included minor surgery in 7 cases, fibroscopy in 8 cases, dental treatment in 13 cases, bleeding in 3 cases, and patient non-compliance in 20 cases. Our results support the hypothesis that aspirin withdrawal in coronary patients may represent a real risk for the occurrence of a new coronary event. Many cases involved late uncoated-stent thrombosis. Assessment of the exact incidence of coronary recurrences after aspirin withdrawal will need prospective studies. (J Am Coll Cardiol 2005;45:456-9) © 2005 by the American College of Cardiology Foundation

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Journal of Internal Medicine 2005; 257: 399-414
REVIEW

Low-dose aspirin for secondary cardiovascular prevention – cardiovascular risks after its perioperative withdrawal versus bleeding risks with its continuation – review and meta-analysis

W. BURGER¹, J.-M. CHEMNITZ², G. D. KNEISSL¹ & G. RÜCKER¹
 From the ¹Department of Interventional Cardiology, St Georg Hospital, Leipzig; ²Cardiology Practice, Wolfenbüttel; and ³Department of Rehabilitative and Preventive Sports Medicine, Medical Clinic, University of Freiburg, Freiburg, Germany

Meta-analysis of 41 studies
 ASA increased risk of bleeding complications 1.5 fold
 ASA withdrawal preceded 10% of Acute Coronary Syndromes
 Time interval from ASA withdrawal to ACS was 8.5 days

Conclusion: ASA should be discontinued only if low dose ASA may cause bleeding risk with associated mortality

What would the neurosurgeon say?

Acta Neurochir (Wien) (2006) 148: 1159-1176
 DOI 10.1007/s00701-006-0864-4
 Acta Neurochirurgica
 Printed in Austria

Neurosurgical Concept
Low-dose aspirin before intracranial surgery – results of a survey among neurosurgeons in Germany

M. C. Koriath
 Department of Neurosurgery, University Hospital RWTH, Aachen, Germany

Received May 4, 2006; accepted June 26, 2006; published online September 21, 2006
 © Springer-Verlag 2006

Summary
Background: Increasing number of patients presenting for intracranial surgery are receiving concurrent medication with low-dose aspirin, leading to intraoperative bleeding problems, which might increase the perioperative risk of bleeding.

Majority of neurosurgeons require ASA stopped 7.3 days preop

Bleeding Risk Associated With Different Surgical Procedures With Regard to Antiplatelet Therapies

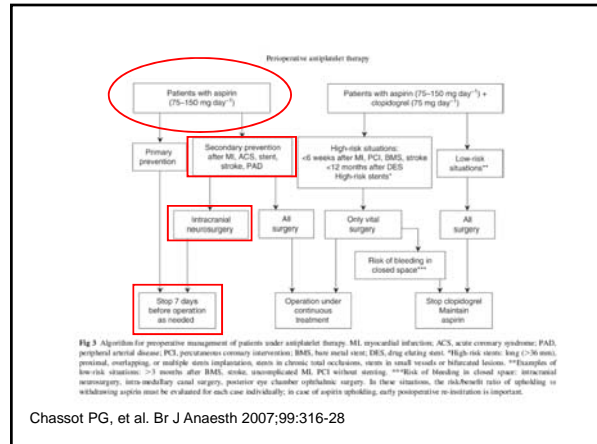
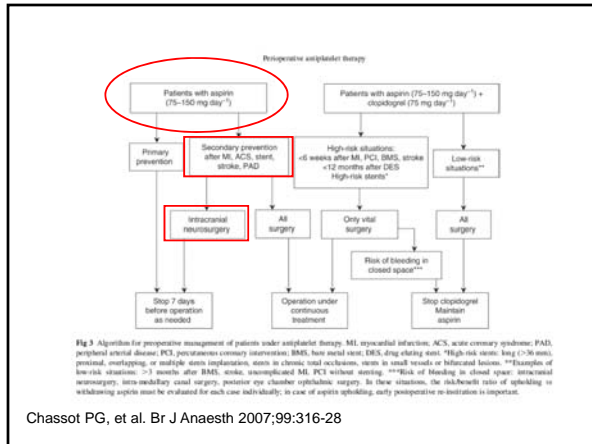
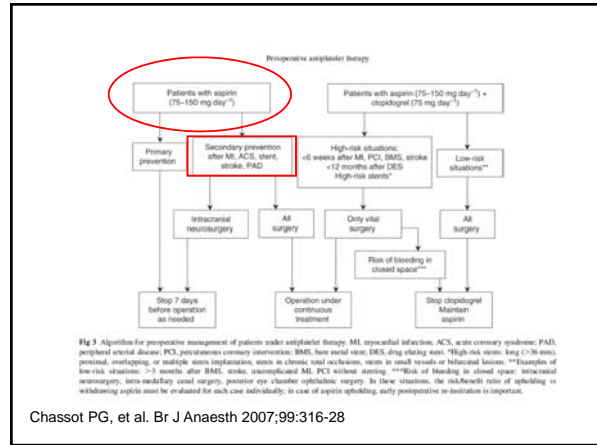
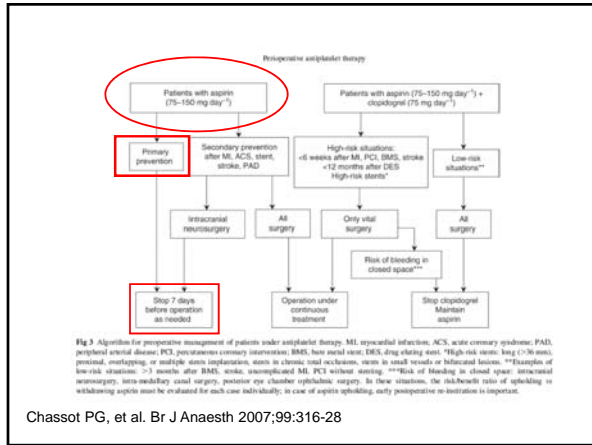
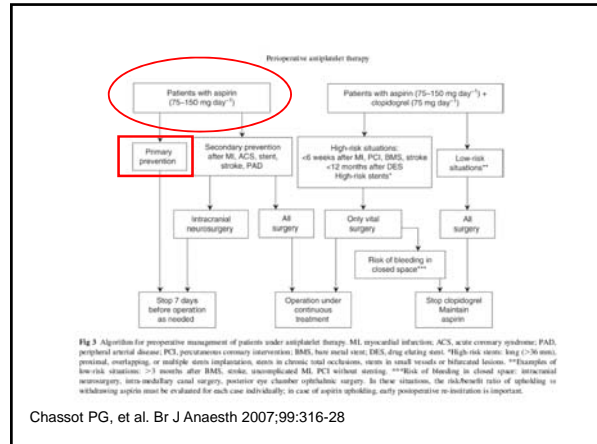
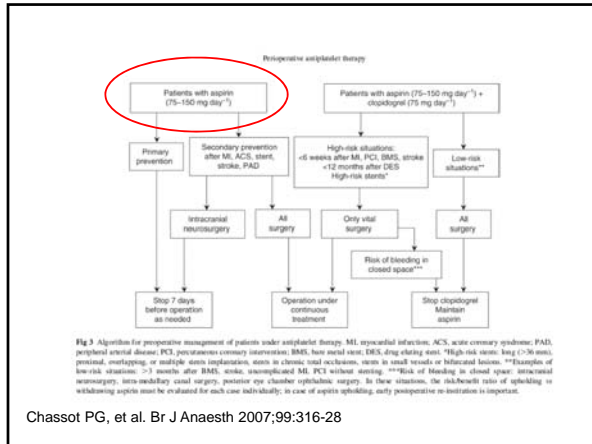
Table 3. Bleeding Risk Associated With Different Surgical Procedures With Regard to Antiplatelet Therapies^{1,2}

Type of Surgery	Drug Therapy	Situation	Hemorrhagic Risk	Level of Evidence
Cardiac surgery	Aspirin and NSAIDs	Preoperative	Modest increase in risk with few changes in transfusion rates	2-4
	Thrombolytics	Preoperative	Possible increase in risk and exposure to transfusion	4
	Abciximab (plus aspirin)	Preoperative	Possible increase in risk and exposure to transfusion	3
Carotid artery surgery	Aspirin	Preoperative	No increased risk of cervical hematoma or intracranial bleeding	3
Transurethral prostatic resection	Ticlopidine hydrochloride	Preoperative or postoperative	Increased risk and transfusion requirements	2
Gastrointestinal and general surgery	Aspirin and other NSAIDs	Preoperative	Contradictory findings	2-3
	NSAIDs if patient is <75 y	Postoperative	No increased risk or revision procedures for hemostasis	3
Spinal surgery	Thrombolytics	Preoperative	High increase in risk	3-4
	All platelet function inhibitors	Preoperative	Increased risk	3-4

Abbreviation: NSAID, nonsteroidal anti-inflammatory drug.
¹Reproduced with permission from the Canadian Journal of Anaesthesia.¹¹

O'Riordan, J. M. et al. Arch Surg 2009;144:69-76.

ARCHIVES OF SURGERY



Post MI Antiplatelet Rx

- BMS: min 4 weeks, ideal 12 months
- DES: min 12 months
- Thrombolytic rx: up tp 12 months
- No reperfusion -or- intervention:
 - Prior to 2011: ASA
 - 2011: ASA + second antiplatelet (ticagrelor or prasugrel rather than clopidogrel)
 - 2012 ASA + (clopidogrel or ticagrelor)

2011 ACCF/AHA Focused Update of the Guidelines for the Management of Patients With Unstable Angina/ Non-ST-Elevation Myocardial Infarction (Updating the 2007 Guideline)

A Report of the American College of Cardiology Foundation/ American Heart Association Task Force on Practice Guidelines

The last version of the guidelines recommended the use of **clopidogrel** in patients with UA/NSTEMI because it was the only US Food and Drug Administration (FDA)-approved thienopyridine agent at that time. Since the publication of the last guidelines (2), the FDA has approved a second thienopyridine agent for use in patients with UA/NSTEMI. The FDA approved the use of **prasugrel** based on data from a head-to-head comparison with clopidogrel, in which prasugrel was superior in reductions in clinical events but at the expense of an increased risk of **bleeding**.

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PRACTICE GUIDELINE

2012 ACCF/AHA Focused Update of the Guideline for the Management of Patients With Unstable Angina/ Non-ST-Elevation Myocardial Infarction (Updating the 2007 Guideline and Replacing the 2011 Focused Update)

A Report of the American College of Cardiology Foundation/ American Heart Association Task Force on Practice Guidelines

Class I

1. For UA/NSTEMI patients treated medically without stenting, aspirin* should be prescribed indefinitely (60,61,63,64) (Level of Evidence: A); clopidogrel (75 mg per day) or ticagrelor† (90 mg twice daily) should be prescribed for up to 12 months (9,10,14). (Level of Evidence: B)

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ACCF/AHA Guideline

2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Emergency Physicians and Society for Cardiovascular Angiography and Interventions

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Antiplatelet agents in cardiac patients in the perioperative period

- Balancing risk of hemorrhage vs. thrombosis vs. delay surgery
- Minimal data re: surgery specific bleeding risk
- Small amount of blood in a closed space is bad
- All stent situations are not alike. What is the patient’s risk for stent thrombosis
- Stented patient: Perform surgery on at least aspirin if at all possible
- BMS patient probably at increased risk of stent thrombosis for up to 90 days (ESC and Cardiac Society of Australia and New Zealand Guideline)
- Very late DES thrombosis does occur
- Its not just stents

Effect of Discontinuing Aspirin Therapy on the Risk of Brain Ischemic Stroke

Alexandre Balgans Maslaj, MD; Daniel C. Bezerra, MD; Patrik Michel, MD; Jules Boguslavsky, MD

Background: Aspirin, or acetylsalicylic acid, is widely used to prevent ischemic vascular disease. Clinical and experimental data suggest that a rebound effect occurs 4 or fewer weeks after interruption of aspirin therapy.

Objective: To study the discontinuation of aspirin therapy as a risk factor for ischemic stroke (IS).

Design: Case-control study.

Setting: Stroke unit.

Participants: Three hundred nine patients with IS or transient ischemic attack undergoing long-term aspirin treatment before their index event and 309 age-, sex-, and antiplatelet therapy-matched controls who had not had an IS in the previous 6 months.

Methods: We compared the frequency of aspirin therapy discontinuation during the 4 weeks before an ischemic

cerebral event in patients and the 4 weeks before interview in controls.

Results: The 2 groups had a similar frequency of risk factors, except for coronary heart disease, which was more frequent in patients (36% vs 18%; P<.001). Aspirin use had been discontinued in 13 patients and 4 controls. Aspirin interruption yielded an odds ratio for IS/transient ischemic attack of 3.4 (95% confidence interval, 1.08-10.63; P<.005) after adjustment in a multivariable model.

Conclusions: These results highlight the importance of aspirin therapy compliance and give an estimate of the risk associated with the discontinuation of aspirin therapy in patients at risk for IS, particularly those with coronary heart disease.

Arch Neurol. 2005;62:1217-1220

Case

He is going to surgery. Regarding his aspirin you recommend

- A. Continue aspirin in the perioperative period
- B. Discontinue aspirin in the perioperative period
- C. Discuss with the neurosurgeon and recommend that aspirin be continued if at all possible
- D. Pharmacologic stress test
- E. None of the above



Clinical Short: How do I manage patients who are DNR going to surgery?

Molly Feely MD

Disclosure

Relevant Financial Relationships

None

Off-Label/Investigational Uses

None

Learning Objectives

- Clarify the ethics of DNR in the perioperative setting
- Define the dilemma that of managing DNR patients perioperatively
- Propose a framework for preparedness planning

Mrs. L

- Patient is a 97 y.o. female with multiple medical comorbidities
 - ESRD on HD thrice weekly
 - HTN, hypothyroidism, DJD
- Functional status is impaired
 - Lives in assisted living
 - Family present daily to assist in ADL's
 - Family or MOW provides all meals
 - Ambulatory with a walker

Which of the following statements is true?

- A. An institutional policy requiring full code status for surgery is ethically sound
- B. Medical personnel may ethically rescind her DNR status for emergency surgery
- C. It makes no ethical sense to be DNR and have surgery
- D. All available guidelines recommend a discussion with the patient or surrogate re-examining wishes regarding resuscitation in the perioperative period

Which of the following statements is true?

- A. An institutional policy requiring full code status for surgery is ethically sound
- B. Medical personnel may ethically rescind her DNR status for emergency surgery
- C. It makes no ethical sense to be DNR and have surgery
- D. All available guidelines recommend a discussion with the patient or surrogate re-examining wishes regarding resuscitation in the perioperative period

The ethics

- Patient autonomy
- Patient right to self-determination
- Patient right to refuse
- DNR does not mean “do not treat”
- Ethics vs morality
- Reflected in all guidelines
 - ACS
 - ASA
 - AORN



The Dilemma

- Dying of disease or dying of iatrogenic intervention?
- Resuscitation is more successful in the OR
- Patients who are DNR have increased mortality post-operatively
 - “failure to rescue”
 - what is the definition of “success”



So, what should we do with patients who are DNR and need surgery?

Preparedness Planning

- Attempts to define “success” and “failure”
- Aligns expectations
- Establishing goals of care for a specific intervention
 - “What are you hoping this surgery will do for you?”
 - “What would you want us to know if things didn’t go as well as we hope?”
 - “What’s the worst thing that could happen from this surgery?”
 - “XXX is a likely complication from this surgery. How should we address XXX if it happens to you?”



Preparedness Planning

- Once goals of care are established, the rest flows easily
 - Able to negotiate care decisions that align with goals
 - Make recommendations
 - May avoid the smorgasbord of options



Back to Mrs. L

- Patient is a 97 y.o. female with multiple medical comorbidities
 - ESRD on HD thrice weekly
 - HTN, hypothyroidism, DJD
- Functional status is impaired
 - Lives in assisted living
 - Family present daily to assist in ADL’s
 - Family or MOW provides all meals
 - Ambulatory with a walker



Mrs. L

- Presents to ER with abdominal pain
- CT shows ruptured AAA
- Patient is DNR




Take Home Points

- It is ethically permissible to be DNR in the OR
- Preparedness planning is a way to align expectations going forward
- Negotiate care decisions based on goals of care



MAYO CLINIC

Perioperative Management of Warfarin



Mayo School of Continuous Professional Development

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 Assistant Professor of Medicine
 Mayo Thrombophilia Center

October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Disclosures

- Relevant Financial Relationships
 - NONE
- Off Label Usage
 - Low molecular weight heparins for bridging therapy

Goal

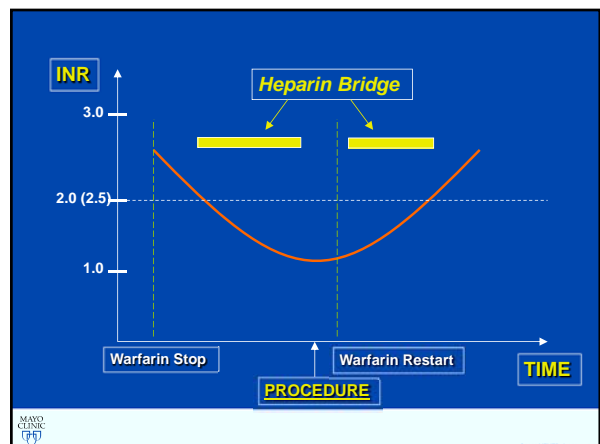
Provide a framework for managing a patient's warfarin anticoagulation around the time of an invasive procedure

Objectives

1. Recognize when bridging therapy is recommended
2. Estimate post-procedure bleeding risk when anticoagulation used
3. Demonstrate an approach to anticoagulation dosing and timing in bridging situations

Definition of Bridging Therapy

- Substitution of another anticoagulant (typically heparin) when warfarin is interrupted for an invasive procedure



Warfarin Interruption for Invasive Procedures

- IF NO BRIDGING GIVEN:
 - There will be 7 – 10 day window of time without therapeutic anticoagulation
- Bridging therapy minimizes the window
- Thrombotic risk related to underlying indication for anticoagulation and the “prothrombotic” surgical state
 - Thromboembolism in 1%
- Bridging therapy can contribute to risk of perioperative bleeding complications
 - Bleeding rates about 2 – 3X thrombosis rates



Approach to Bridging Therapy: Three Key Questions

1. Need to stop warfarin?
2. Need bridging therapy?
3. How and when to restart anticoagulation after a procedure?
 - Preoperative management is the easy part



QUESTION 1: Need to Stop Warfarin?

- Some procedures can be done without stopping or with INR at low end of target range
 - Examples:
 - EMG, Cataract surgery, Dental surgery
- QI opportunity
 - Establish what level INR acceptable for different procedures and standardize



QUESTION 2: Need to Give Bridging Therapy?

- American College of Chest Physicians (ACCP) 2012 Guidelines on Antithrombotic and Thrombolytic Therapy
 - Guidelines for atrial fibrillation, mechanical heart valves, and venous thromboembolism
- Risk strata with annual thrombosis risk
 - Low: < 5%
 - Moderate: 5 – 10%
 - High: > 10%



Chest 2012; 141(2) (Suppl):e326S – e350S

71 year old woman taking warfarin due to atrial fibrillation has hypertension and type 2 diabetes mellitus; she had a stroke 8 years ago.

She has no history of congestive heart failure or rheumatic heart disease.

She has been diagnosed with breast cancer and will undergo a mastectomy.

Would you give this patient bridging therapy?

1. YES
2. NO



The CHADS₂ Score: Risk of Stroke in Atrial Fibrillation Without Anticoagulation

- One point each
 - CHF
 - HTN
 - Age > 75
 - DM
- Two points
 - Stroke

Score	N	Adjusted Stroke Rate (per 100 patient-years)
0	120	1.9
1	463	2.8
2	523	4.0
3	337	5.9
4	220	8.5
5	65	12.5
6	5	18.2



Gage et al, JAMA. 2001;285:2864-2870

ACCP Risk Stratification 2012: Bridging Therapy for Atrial Fibrillation

Risk level	Characteristics	Bridging therapy?
High	<i>Any one of the following:</i> <ul style="list-style-type: none"> • CHADS score 5 or 6 • Recent (within 3 months) stroke or TIA • Rheumatic valvular heart disease 	YES
Moderate	CHADS 3 or 4	YES
Low	CHADS 0 – 2 (no history of stroke or TIA)	NO

MAYO CLINIC Chest 2012; 141(2) (Suppl):e326S – e350S

Mayo Clinic Thrombophilia: Bridging Therapy for Atrial Fibrillation

Risk level	Characteristics	Bridging therapy?
High	<i>Any one of the following:</i> <ul style="list-style-type: none"> • CHADS score 4 - 6 • Previous cardioembolic stroke or TIA • Intracardiac thrombus • Rheumatic valvular heart disease 	YES
Low	CHADS score 0 – 3 (and no history of cardioembolic stroke/TIA)	NO

MAYO CLINIC Wysokinski et al. Mayo Clinic Proc. June 2008;83(6): 639-645

Back to the patient

- CHF = 0
- Hypertension = 1
- Age > 75 = 0
- Diabetes mellitus = 1
- Stroke history = 2
- CHADS2 Score = 4

YES TO BRIDGING

MAYO CLINIC

Influence of the Perioperative State on Stroke Risk

- If average stroke incidence in non-valvular atrial fibrillation = 4.5 per 100 person-years
 - Estimated risk in one week off warfarin = 0.1%

Stroke rate – within 30 days of procedure			
	Chronic AFib (N= 69,202)	NO AFib (N= 2,470,649)	Adjusted Odds Ratio (95% CI)
All Cases	1.8 %	0.6 %	2.1 (2.0-2.3)

Cardiovascular and Neurosurgery procedures highest risk

MAYO CLINIC Kaatz et al. J Thromb Haemost. 2010;8: 884-890

66 year old man taking warfarin for a history of deep vein thrombosis and pulmonary embolism ten years ago that was "unprovoked"; he has not had any recurrent thrombotic events.

He now has rectal adenocarcinoma and is scheduled for rectosigmoid colon resection.

Would you give this patient bridging therapy?

1. YES
2. NO

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ACCP Risk Stratification 2012: Bridging Therapy for Venous Thromboembolism

Risk level	Characteristics	Bridging heparin?
High	One of the following: <ul style="list-style-type: none"> •Recent (within 3 months) VTE •"Severe" thrombophilia 	YES
Moderate	One of the following: <ul style="list-style-type: none"> •VTE within past 3 to 12 months •"Nonsevere" thrombophilia (Factor V Leiden OR prothrombin gene heterozygote) •Recurrent VTE •Active cancer (treated in last 6 months or palliative) 	YES
Low	Single VTE > 12 months ago and no additional risk factors	NO

MAYO CLINIC Chest 2012; 141(2) (Suppl):e326S – e350S

Mayo Clinic Thrombophilia: Bridging Therapy for Venous Thromboembolism (VTE)

Risk level	Characteristics	Bridging therapy?
High	One of the following: <ul style="list-style-type: none"> Recent (within 6 months) VTE "Severe" thrombophilia Active cancer or cancer treatment 	YES
Low	Last VTE event > 6 months ago and no additional risk factors	NO

McBane et al. Arterioscler Thromb Vasc Biol. June 2010;30: 442-448

"Severe" Thrombophilia – a la ACCP

- Protein C or S deficiency
- Antithrombin deficiency
- Anti-phospholipid antibodies
- Multiple defects or homozygous Factor V Leiden or Prothrombin 20210 gene mutation

Chest June 2008 133:6 suppl 299S – 339S

Back to the patient

- Recent VTE? NO
 - Thrombophilia? Unknown
 - Recurrent VTE? NO
 - Active cancer? YES
- Risk of thromboembolism = moderate – high
- YES TO BRIDGING

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Prosthetic Heart Valves



Caged-Ball
(ex. Starr-Edwards)



Tilting Disc
(ex. Bjork-Shiley, Medtronic-Hall)



Bi-leaflet
(ex. St Jude, Carbomedics)

Mayo Clinic logo and footer text.

Thrombosis Risk of Mechanical Heart Valves Without Anticoagulation

CHARACTERISTIC	LOWER RISK	HIGHER RISK
Number of Valves	Single	Multiple
Position of Valve	Aortic	Mitral
Type of Valve	Bi-leaflet	Tilting disk & Caged-ball
Other	-	Atrial fibrillation, low ejection fraction, prior embolism

Cannegieter SC et al. Circulation. 1994;89:635-641

72 year old man with a bileaflet mechanical aortic valve due to calcific aortic stenosis.

He has atrial fibrillation but no prior thromboembolism, rheumatic heart disease or congestive heart failure.

He is scheduled for a total hip arthroplasty for degenerative joint disease.

Would you give this patient bridging therapy?

1. YES
2. NO

Mayo Clinic logo and footer text.

ACCP Risk Stratification 2012: Bridging Therapy for Mechanical Heart Valves

Risk level	Characteristics	Bridging heparin?
High	<ul style="list-style-type: none"> Any mitral MHV Caged-ball or tilting disk aortic MHV Recent (within 6 months) stroke or TIA 	YES
Moderate	Aortic bileaflet MHV and any one of the following: <ul style="list-style-type: none"> Atrial fibrillation, Prior stroke or TIA, HTN, DM, Age > 75 yrs 	YES
Low	Aortic bileaflet MHV without AFib and no additional risk factors	NO



Mayo Clinic Thrombophilia: Bridging Therapy for Mechanical Heart Valves (MHV)

Risk level	Characteristics	Bridging therapy?
High	<ul style="list-style-type: none"> Any mitral MHV Older (caged-ball or tilting disk) aortic MHV History of cardioembolic stroke or TIA Aortic bileaflet AND atrial fibrillation or CHF 	YES
Low	Aortic bileaflet MHV without atrial fibrillation or CHF	NO



Daniels et al. Thrombosis Research. 2009;124: 300-305

Back to the patient

- Number of MHV = 1
- Position of MHV = Aortic
- Type of MHV = Bileaflet
- Other conditions = Atrial fibrillation
- Risk of thromboembolism = moderate
 - YES TO BRIDGING



PRE PROCEDURE MANAGEMENT For those requiring warfarin interruption

- WARFARIN:**
 - stop 5 days before procedure
- BRIDGING THERAPY (If given):**
 - Start Heparin when INR below goal range
 - Discontinue unfractionated heparin (UFH) 4 to 6 hours before procedure
 - Last dose of low molecular weight heparin (LMWH) given 24 hours before procedure



Chest 2012; 141(2) (Suppl):e326S – e350S

Pre-Procedure Low Molecular Weight Heparin (LMWH) Dosing for Bridging

- Start LMWH when INR below goal range
 - Dalteparin 200 IU / kg every 24 hrs
 - Enoxaparin 1 mg / kg SC every 12 hrs
- Last dose of LMWH 24 hours prior to procedure
 - Dalteparin 100 IU / kg SC
 - Enoxaparin 1 mg / kg SC



QUESTION 3: How and when to restart anticoagulation after a procedure?

- Balance:
 - Thrombosis risk of patient/procedure
 - VERSUS bleeding risk related to procedure and patient characteristics
- Utility of moderate vs high thrombosis risk distinction
 - Guides how "aggressively" you will give anticoagulation postprocedure



Risk of Post-Procedure Bleeding: PROSPECT Study Experience With Bridging

- 260 patients with AF or VTE
- Warfarin stopped for:
 - invasive procedure
 - minor surgery
 - or **major surgery (≥ 1 hour duration)**
- Resumed warfarin night of procedure
- Enoxaparin started 12-24 hours post-procedure (dose = 1.5 mg/kg SC daily) – given until therapeutic on warfarin



Dunn et al. J Thromb Haemost 2007;5: 2211-2218

Risk of Post-Procedure Bleeding: PROSPECT Study Experience With Bridging

Procedure (N)	Major Bleeding while on Enoxaparin + 24 hrs (%)
Invasive procedure (148)	0.7
Minor Surgery (72)	0.0
Major Surgery (40)	20.0



Dunn et al. J Thromb Haemost 2007;5: 2211-2218

How to Assess Post-Procedure Bleeding Risk?

Procedure related factors

Patient related factors



Study of a Stratified Approach to Post-Procedure Bridging

- **INCLUSION CRITERIA**
 - Adults (≥ 18)
 - Taking warfarin
 - MHV, AF, Stroke/TIA (embolic)
 - Undergoing invasive procedure
- **EXCLUSION CRITERIA**
 - Creatinine > 2.0 mg/dL
 - Previous HIT
 - Pregnant
 - Treated with AC other than LMWH
 - Minor dental procedure
 - Urgent/emergent surgery
 - Indwelling epidural catheter after spinal anesthesia



Douketis et al. Arch Intern Med. 2004;164:1319-1326

Classifying Bleeding Risk Of Procedures

High Risk	1. Cardiovascular surgery <ul style="list-style-type: none"> • Valve replacement, CABG, AAA repair
	2. Cancer surgery <ul style="list-style-type: none"> • Neurosurgery, Urology, ENT, Breast
	3. Intra-abdominal surgery
	4. Other <ul style="list-style-type: none"> • Bilateral TKA, laminectomy, TURP, kidney biopsy
Non-High Risk	All others



Douketis et al. Arch Intern Med. 2004;164:1319-1326

Bleeding Risk of Procedure	Treatment Strategy	
	Pre-Procedure	Post-Procedure
High	Dalteparin 100 IU/kg SC BID	<u>No Dalteparin</u>
Non-High	Dalteparin 100 IU/kg SC BID	Dalteparin 100 IU/kg SC BID

- **Coumadin**
 - Stopped 5-6 days pre-procedure
 - Started back when patient could take oral medication
- **Outcomes (assessed within 14 days):**
 - thromboembolism, major bleeding, wound related blood loss



Douketis et al. Arch Intern Med. 2004;164:1319-1326

Outcome	% with outcome in each group		
	Non-High Bleeding Risk (N = 542)	High Bleeding Risk (N = 108)	All
Thromboembolism (including possible)	0.37	1.85	0.62
Major Bleeds	0.74	1.85	0.92
Increased Wound Blood Loss	5.9	NA	NA

Mayo Clinic
Douketis et al. Arch Intern Med. 2004;164:1319-1326

Predictors of major bleeding in peri-procedural anticoagulation management

- Mayo Thrombophilia Center Registry
 - Retrospective cohort from 1997 – 2007
- 2182 patients seen for anticoagulation management recommendations for 2484 procedures
 - 1496 patients given bridging therapy
- Major bleeding rates
 - 3% of bridged patients
 - 1% of those not bridged

Mayo Clinic
Tafur et al. J Thromb Haemost 2012;10:261-7.

Predictors of major bleeding in peri-procedural anticoagulation management

Risk factor	Hazard ratio
Heparin given within 24 hours post procedure (among those bridged)	1.9
Previous bleeding history	2.6
Mitral mechanical valve	2.2
Active cancer	1.8
Platelet count < 150,000	2.3

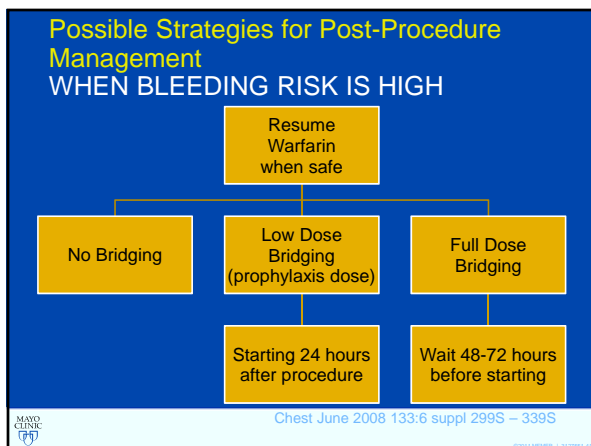
Mayo Clinic
Tafur et al. J Thromb Haemost 2012;10:261-7.

Strategy for Post-Procedure Management WHEN BLEEDING RISK IS LOW

Resume Warfarin when safe

Full Dose Bridging: Wait 24 hours before starting

Mayo Clinic
Chest June 2008 133:6 suppl 299S – 339S



Low Dose Versus Full Dose Bridging Heparin

- "Low dose"
 - Thromboprophylaxis dosing of LMWH or UFH
 - Example: Dalteparin 5000 units SC daily OR Enoxaparin 40 mg SC daily
 - Not specifically studied
- "Full dose"
 - "Therapeutic" bridging – treatment doses
 - Dalteparin 200 IU / kg every 24 hrs
 - Enoxaparin 1 mg / kg SC every 12 hrs

Mayo Clinic

71 year old woman taking warfarin due to atrial fibrillation has a CHADS score = 4.

By ACCP – MODERATE Thrombosis Risk

Want to give bridging.

Patient will undergo a mastectomy.

Assess post-operative bleeding risk and recommend a strategy for anticoagulation management.

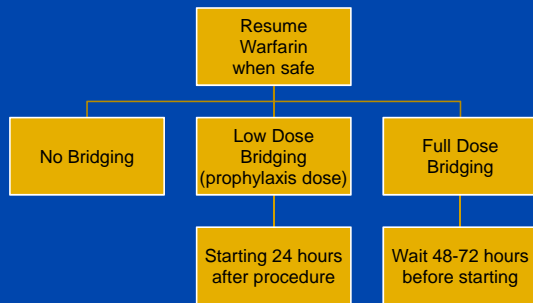


Bleeding risk assessment

- Type of surgery: Cancer surgery, general surgery
- Mechanical mitral valve: NA
- Active cancer: Present
- Thrombocytopenia: No
- TWO BLEEDING RISK FACTORS PRESENT



Possible Strategies for Post-Procedure Management WHEN BLEEDING RISK IS HIGH



Chest June 2008 133:6 suppl 298S – 339S



Comparing UFH and LMWH for Bridging: The REGIMEN Registry

- Multicenter observational study
- All on oral anticoagulation for ≥ 3 months; needing interruption for procedure
- Patients with MHV, AFib, and VTE
- Heparin bridging used Pre and/or Post Procedure for at least 2 days
 - Compared safety and efficacy of UFH vs LMWH as bridging anticoagulants

Spyropoulos et al. J Thromb Haemost 2006;4: 1246-1252.



OUTCOME	N (%) with outcome in each group	
	UFH (N = 164)	LMWH (N = 668)
Arterial Thromboembolism	4 (2.4)	4 (0.6)
Venous Thromboembolism	0 (0.0)	2 (0.3)
Major bleed	9 (5.5)	22 (3.3)
Minor bleed	15 (9.1)	80 (12.0)
Death	2 (1.2)	4 (0.6)
Length of Stay (d)	10.3	4.6
Days of heparin	6.8	8.6

Spyropoulos et al. J Thromb Haemost 2006;4: 1246-1252.



Low Molecular Weight Heparin: Dosing According to Renal Function

Calculated creatinine clearance (mL / minute)	Dose adjustment
> 30	None
20 – 30	Decrease by 50%
< 20	Avoid LMWH Use unfractionated heparin

Nutescu et al. Ann Pharmacother 2009;43: 1064-1083.



Post Procedure Warfarin Dosing

- We often resume at the dose patient was stable on pre-procedure
- **CAUTION:**
 - patients may be more sensitive to warfarin after a procedure (e.g. NPO, antibiotics) so may need a lower dose at re-initiation – do require close monitoring of INR



Putting it Together:

Identify the patients who do not require bridging

Atrial fibrillation	<ul style="list-style-type: none"> •CHADS = 0 - 3 •AND no stroke/TIA history, intra-cardiac thrombus or rheumatic heart disease
Venous thromboembolism	<ul style="list-style-type: none"> •Last event > 6 months ago •AND no cancer or "severe" thrombophilia
Mechanical heart valve	<ul style="list-style-type: none"> •Aortic position only, bileaflet •AND no history of thromboembolism or atrial fibrillation



Putting it Together: Post-Procedure Management

Thrombosis Risk Level	Warfarin	Heparins
LOW	When safe	Not used – No Bridging
HIGH	When safe	Low Bleeding Risk: <ul style="list-style-type: none"> •Full bridging 24 hrs post
		High Bleeding Risk: <ul style="list-style-type: none"> •Full bridging 48 – 72 hrs post •OR low dose bridging •OR no bridging



Perioperative Management New Oral Anticoagulants

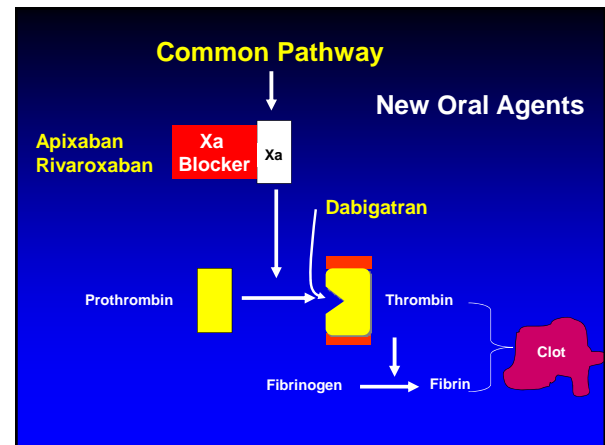
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- Bayer: Research, Scientific Advisory
- Bristol-Meyer Squibb: Research, Scientific Advisory
- Sanofi-Aventis: Research, Scientific Advisory
- Portola: Research

New Agents Oral Anticoagulants



Key Points New Oral Anticoagulants

Key Points	Dabigatran	Rivaroxaban	Apixaban
Target	IIa	Xa	Xa
Half-Life	12-17 hrs	7-11 hrs	12 hrs
Clearance	80% renal	60% Renal 33% Liver	25% Renal 75% Liver
Protein Binding	35%	> 90%	87%
Dialyzable	Yes	No	No

Eriksson BI, et al. Clin Pharmacokinet 2009;48:1-22.
Galani T et al Thromb Thrombolysis 2011;31:310-320

Laboratory Testing New Oral Agents

Lab Tests	Useful Lab Test	Dabigatran	Rivaroxaban	Apixaban
	Strong	ECT	Chromogenic anti-Xa	Chromogenic Anti -Xa
		TT	aPTT, PT	
		aPTT		
	Weak	PT / INR		

Chromogenic Assay not yet available
Jefferson assessing HEMOCLOT

Palladino M et al A J Hem 2012;87 Suppl:S127-S132

Dabigatran

Pre-procedural Management

Stable CrCl (ml/min)	T _{1/2} (range, hrs)	D/C time before minor procedure	D/C time before major procedure or epidural
≥ 80	13 (11-22)	36 hours	4 days
50 - 79	15 (13 – 24)	48 hours	4 days
30 - 49	16 (13 – 23)	3 days	5 days
< 30	27 (22 – 35)	At least 5 *Check PTT	days prior

TJUH Guidelines for use 2012.

Rivaroxaban

Pre-Procedural Management

Stable CrCl (ml/min)	Rivaroxaban t _{1/2} (hours)	D/C Time before minor procedure	D/C Time before major procedure or epidural
≥ 50	8	24 hours	48 hours
15 - 49	9 - 10	48 hours	48 – 72 hours

TJUH Guidelines for use 2012.

Apixaban

Pre-Procedural Management

Minor Procedure*	Major Procedure*
24 hrs	48 hrs

1. Not studied in severe renal (CrCl < 15 ml/min) or hepatic impairment.
2. Elimination may be slower in elderly patients (≥80 yr), weight (≤ 60 kg) or Scr ≥ 1.5 mg/dl.
3. Consider stopping earlier in patients with one or more of these characteristics undergoing procedures associated with a high rate of bleeding
4. Half-life 12 hrs

TJUH Guidelines for use 2012.

Cases

Case 1

- 68 year old woman is scheduled with non-valvular atrial fibrillation on dabigatran is scheduled for hysterectomy for malignancy in 1 week.
- PMHx: Non-Valvular Afib, HBP, HL, No Stroke or TIA, No HF
- Meds: Dabigatran 150mg, BID, atorvastatin 20mg, HCTZ 12.5mg, atenolol 50mg
- PE: BP 122/78, P 78, R 12, BMI 27
 - 68 yr old, well nourished, hispanic, female
 - S1 and S2 normal, irregular-irregular rate 78
 - Remainder examination normal
- Labs: CrCl 60 ml/min, Hgb 12.2, HCT 37, Plt 200k, INR 1, PTT 32s

Case 1

- When should dabigatran be discontinued prior to the elective hysterectomy ?

CHADS2

CHF, HBP, Age, DM, Stroke, TIA

Medical Condition	Assigned Points
History of stroke or TIA	2
Hypertension	1
Diabetes Mellitus	1
Presence of congestive heart failure	1
Age 75 years or older	1

Our Patient HBP = 1 point

Gage BF et al. JAMA 2001;285:2864-2870

CHADS2

CHF, HBP, Age, DM, Stroke, TIA

CHADS2 Score	Stroke Risk	NRAF Stroke Rate (per 1.2 yrs)	Treatment
0	Low	1.9	Option ASA
1	Low	2.8	ASA-W-D-R
2	Moderate	4.0	W-D-R
3	Moderate	5.9	W-D-R
4	High	8.5	W-D-R
5	High	12.5	W-D-R
6	High	18.2	W-D-R

W = warfarin
D = dabigatran
R = Rivaroxaban

Gage BF et al. JAMA 2001;285:2864-2870
You J et al, Chest 2012;141(2):e531S-e575S

ACCP Guidelines 2012

- In patients with atrial fibrillation at low risk for thromboembolism, suggest NO Bridging [2C]

Douketis J, et al Chest 2012;141:e326S-e350S

Discontinuation Dabigatran CrCl & Half-life

CrCL	Dabigatran t ½ hrs	D/C Minor Procedure	D/C Major Procedure, epidural, spinal
> 80	13 (11-22)	1.5 days	4 days
> 50 to < 80	15 (13-24)	2 days	4 days
>30 to < 50	18 (13-23)	3 days	5 days
< 30	27 (22-35)	4 days	5 days

CrCl 60 ml/min = Dabigatran ½ life 15 hrs, Major procedure Stop 4 days prior to procedure

Discontinuation Rivaroxaban

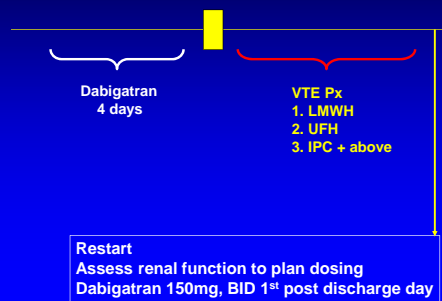
CrCl & Half-life

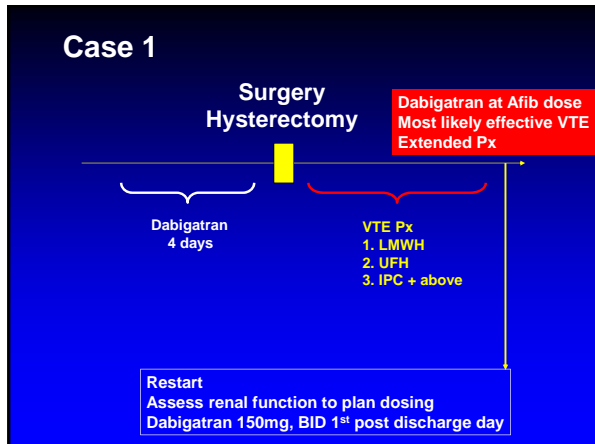
Stable CrCl	Rivaroxaban t ½ Hrs	Discontinuation time before major procedure/epidural
> 50 mL/min	8 hrs	2 days
15 – 49 mL/min	9-10 hrs	3 days

CrCl 60 ml/min = Rivaroxaban ½ life 8 hrs, Major procedure Stop 2 days prior to procedure

Case 1

Surgery
Hysterectomy





ACCP Guidelines 2012

- In patients with atrial fibrillation at low risk for thromboembolism, suggest NO Bridging [2C]
- Patients requiring VTE prophylaxis other than dabigatran, start UFH, LMWH, plus-minus IPCs for duration of prophylaxis then resume these agents post discharge day one. [Jefferson Approach]

Douketis J, et al Chest 2012;141:e326S-e350S

Case 2

- 75 yr old woman scheduled for right TKA in two weeks. The patient has non-valvular atrial fibrillation being treated with atenolol and rivaroxaban.
- Meds: atenolol 25 mg, rivaroxaban 20mg, furosemide 40mg, Insulin
- PMHx: HBP, Afib, Hx TIA 5yrs ago, HF NY II (compensated EF 35%), Diabetes (insulin)

Case 2

- PE: BP 120/80, P 74, R 12, Wt 80 kg
- 72 yr old overweight, white, female
- Heart Irregular-Irregular, no murmurs
- Abdomen: No organ enlargement
- Right knee: + knee effusion, pain ROM
- Labs: Cr 1.2, CrCl 62 ml/min

Case 1

- How would you manage rivaroxaban in the perioperative period in patient undergoing right TKA ?

Step 1

CHADS2

CHF, HBP, Age, DM, Stroke, TIA

Medical Condition	Assigned Points
History of stroke or TIA	2
Hypertension	1
Diabetes Mellitus	1
Presence of congestive heart failure	1
Age 75 years or older	1

Pt = TIA, HBP, DM, HF, Age 75 [6 points]

Gage BF et al. JAMA 2001;285:2864-2870

CHADS2

CHF, HBP, Age, DM, Stroke, TIA

CHADS2 Score	Stroke Risk	NRAF Stroke Rate (per 1.2 yrs)	Treatment
0	Low	1.9	Option ASA
1	Low	2.8	ASA-W-D-R-A
2	Moderate	4.0	W-D-R-A
3	Moderate	5.9	W-D-R-A
4	High	8.5	W-D-R-A
5	High	12.5	W-D-R-A
6	High	18.2	W-D-R-A

Gage BF et al. JAMA 2001;285:2864-2870
You J et al, Chest 2012;141(2):e531S-e575S

ACCP Guidelines 2012

- In patients with Atrial Fibrillation at High Risk for thromboembolism, suggest Bridging Anticoagulation during interruption of warfarin therapy [2C]
- Jefferson Approach: substitute rivaroxaban and follow the Bridging Anticoagulation protocol

Douketis J, et al Chest 2012;141:e326S-e350S

Discontinuation Rivaroxaban

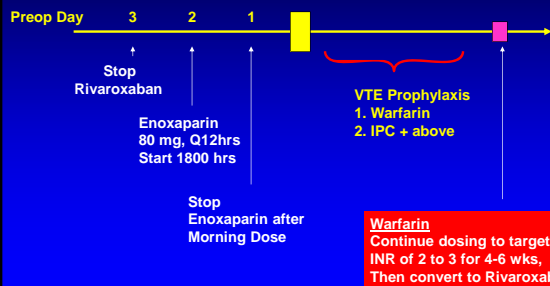
CrCl & Half-life

Stable CrCl	Rivaroxaban $t_{1/2}$ Hrs	Discontinuation time before major procedure/epidural
> 50 mL/min	8 hrs	2 days
15 – 49 mL/min	9-10 hrs	3 days

CrCl 62 mL/min = Rivaroxaban $t_{1/2}$ 8 hrs,
Major procedure
Stop 2 days prior to procedure

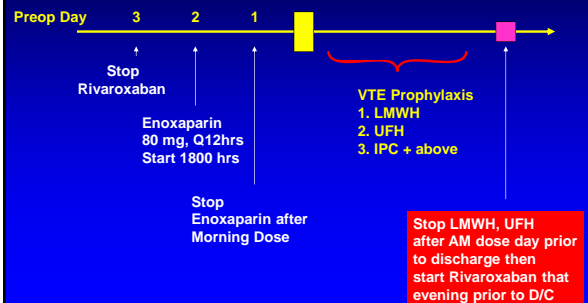
Case 2

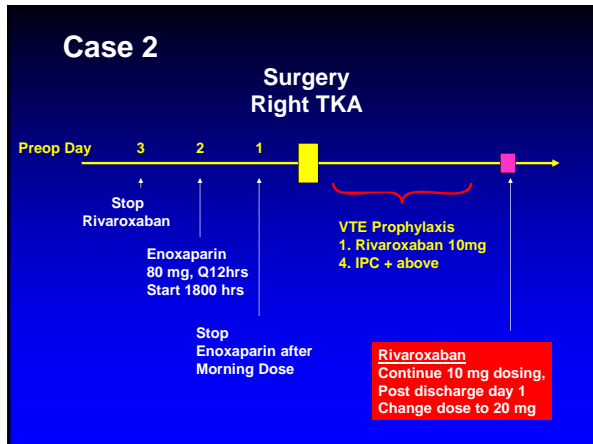
Surgery
Right TKA



Case 2

Surgery
Right TKA





ACCP Guidelines 2012

- In patients receiving Bridging Anticoagulation with therapeutic LMWH and undergoing a high-bleeding risk surgery, suggest resuming therapeutic-dose LMWH 48 to 72 hr after surgery instead of resuming within 24 hrs postop. [2C]
- If the patient cannot restart full dose LMWH because of bleeding risk then continue VTE prophylaxis and reassess patient. [Jefferson Approach]

Douketis J, et al Chest 2012;141:e326S-e350S

Case 3

- Pt is a 64 yr old man undergoing right TKA. His orthopedic surgeon would like to use rivaroxaban for VTE prophylaxis because of the patient's PMHx of DVT after a femoral fracture in skiing accident.
- PMHx: HBP, HL
- Meds: Atenolol 50mg, HCTZ 12.5 mg, atorvastatin 20mg, Qday
- PE: BP132/82, P 66, R 12, BMI 29
 - Lungs clear without crackles
 - Heart regular rhythm, S1 and S2 normal
 - Right knee effusion, decrease ROM
- Labs: normal

Case

- How should rivaroxaban be managed with spinal anesthesia in the postoperative period?

Black Box Warning Rivaroxaban

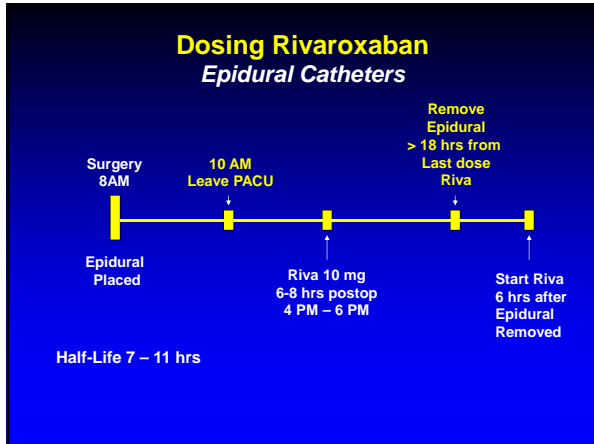
5.3 Spinal/Epidural Anesthesia or Puncture

When neuraxial anesthesia (spinal/epidural anesthesia) or spinal puncture is employed, patients treated with anticoagulant agents for prevention of thromboembolic complications are at risk of developing an epidural or spinal hematoma which can result in long-term or permanent paralysis [see Boxed Warning].

An epidural catheter should not be removed earlier than 18 hours after the last administration of XARELTO. The next XARELTO dose is not to be administered earlier than 6 hours after the removal of the catheter. If traumatic puncture occurs, the administration of XARELTO is to be delayed for 24 hours.

Black Box Warning Rivaroxaban

- Epidural or Spinal Hematoma
 - Use of epidural catheter
 - Concomitant use of NSAID, Anti-platelet
 - Traumatic or repeated spinal puncture
 - History of spinal deformity



Case 4

- Patient is a 62 yr old woman admitted with small bowel obstruction. The patient is on rivaroxaban for stroke prevention for non-valvular atrial fibrillation. Medical consultation is requested for managing the patient's anticoagulation.
- PMHx: A-Fib, HBP
- ROS: no HF, no Stroke/TIA, no DM
- Meds: Rivaroxaban 20 mg, Qday, amlodipine 5 mg, NKA medications

Case 4

- PE: BP 134/78, P 78, R 12, Wt 68 kg
 - Patient is a 62 year old, well nourished, white, female.
 - Lungs clear
 - Heart irregular, irregular rate 78, no murmurs
 - Abdomen distended, absent bowel sounds, no rebound, N/G tube in place
- Labs: CrCl 68 ml/min, WBC 12 K, no shift, Plts 200K, INR 0.9, Ptt 32 sec, H&H normal, Obstruction Series Positive small bowel obstruction

Case 4

- Is there any withdrawal risk for stroke after stopping rivaroxaban abruptly?

Black Box Warning Rivaroxaban

5.1 Increased Risk of Stroke after Discontinuation in Nonvalvular Atrial Fibrillation

Discontinuing XARELTO in the absence of adequate alternative anticoagulation increases the risk of thrombotic events. An increased rate of stroke was observed during the transition from XARELTO to warfarin in clinical trials in atrial fibrillation patients. If XARELTO must be discontinued for a reason other than pathological bleeding, consider administering another anticoagulant [see Dosage and Administration (2.1) and Clinical Studies (14.1)].

CHADS2

CHF, HBP, Age, DM, Stroke, TIA

Medical Condition	Assigned Points
History of stroke or TIA	2
Hypertension	1
Diabetes Mellitus	1
Presence of congestive heart failure	1
Age 75 years or older	1

Our Pt = HBP [1 points]

Gage BF et al. JAMA 2001;285:2864-2870

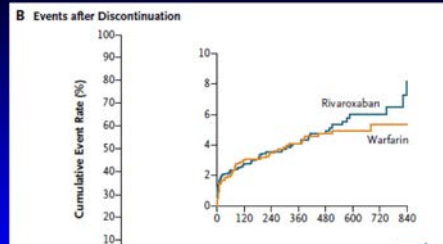
CHADS2

CHF, HBP, Age, DM, Stroke, TIA

CHADS2 Score	Stroke Risk	NRAF Stroke Rate (per 1.2 yrs)	Treatment
0	Low	1.9	Option ASA
1	Low	2.8	ASA-W-D-R
2	Moderate	4.0	W-D-R-A
3	Moderate	5.9	W-D-R-A
4	High	8.5	W-D-R-A
5	High	12.5	W-D-R-A
6	High	18.2	W-D-R-A

Gage BF et al. JAMA 2001;285:2864-2870
You J et al, Chest 2012;141(2):e531S-e575S

ROCKET AF

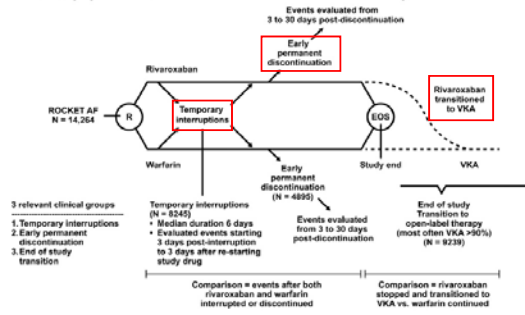


Black Box Warning

1. Discontinuing Rivaroxaban increases thrombotic events
2. After Discontinuing Rivaroxaban start alternative anticoagulant

Patel M et al, NEJM 2011;365:883-891

ROCKET AF Relevant populations for effect after discontinuation/interruptions



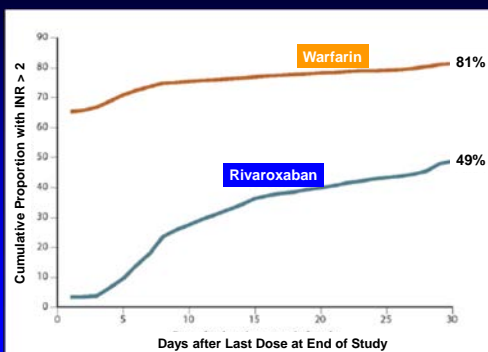
Patel M, et al JACC 2013;61:651-658

Rocket AF Study

Group	Riva	Warfarin	HR	P value
Temporary Interruption	6.2 (9)	5.05 (8)	1.28 0.49-3.31	0.62
Permanent Discontinuation	25.6 (42)	23.28 (36)	1.10 0.71-1.72	0.66
After end of study	6.42 (22)	1.73 (6)	3.72 1.51-9.16	0.004
All Discontinuation + End of study	11.2 (73)	7.57 (50)	1.5 1.05-2.15	0.026

Patel M, et al JACC 2013;61:651-658

Rocket AF Study



Patel M, et al JACC 2013;61:651-658

Case 4

- Patient has low CHADS₂ Score [1]
- No Bridging will be needed
- Because of low CHADS₂ Score, would discuss with orthopedic surgery using rivaroxaban 10 mg as VTE prophylaxis then increase the dose back to 20 mg after 2 weeks.

Case 5

- Patient is a 68 yr old man scheduled for left total hip replacement surgery.

Case 5

- Are patients using dabigatran at risk for acute coronary syndrome with atrial fibrillation in the post joint replacement surgery period ?

REVIEW ARTICLE

ONLINE FIRST

Dabigatran Association With Higher Risk of Acute Coronary Events

Meta-analysis of Noninferiority Randomized Controlled Trials

Ken Uchino, MD, Adrian V. Hernandez, MD, PhD

Background: The original RE-LY (Randomized Evaluation of Long-term Anticoagulation Therapy) trial suggested a small increased risk of myocardial infarction (MI) with the use of dabigatran etexilate vs warfarin in patients with atrial fibrillation. We systematically evaluated the risk of MI or acute coronary syndrome (ACS) with dabigatran compared with warfarin, enoxaparin, or placebo administration. Dabigatran was significantly associated with a higher risk of MI or ACS than that seen with agents used in the control group (dabigatran, 237 of 20 000 [1.19%] vs control, 83 of 10 514 [0.79%]; OR_{MI}, 1.33; 95% CI, 1.03-1.71; P<.01). The risk of MI or ACS was similar when using revised RE-LY trial results (OR_{MI}, 1.27; 95% CI, 0.97-1.67; P=.08).

Methods: We searched MEDLINE, Embase, and Cochrane Central Register of Controlled Trials for randomized controlled trials comparing dabigatran with warfarin, enoxaparin, or placebo in patients with atrial fibrillation. We included trials that reported MI or ACS events.

Results: Seven trials were selected (N=30 514), including 2 studies of stroke prophylaxis in atrial fibrillation, 1 in acute venous thromboembolism, 1 in ACS, and 3 of short-term prophylaxis of deep venous thrombosis. Control arms included warfarin, enoxaparin, or placebo administration. Dabigatran was significantly associated with a higher risk of MI or ACS than that seen with agents used in the control group (dabigatran, 237 of 20 000 [1.19%] vs control, 83 of 10 514 [0.79%]; OR_{MI}, 1.33; 95% CI, 1.03-1.71; P<.01). The risk of MI or ACS was similar when using revised RE-LY trial results (OR_{MI}, 1.27; 95% CI, 0.97-1.67; P=.08).

Conclusions: Dabigatran is associated with an increased risk of MI or ACS in a broad spectrum of patients when tested against different controls. Clinicians should consider the potential of these serious harmful cardiovascular effects with use of dabigatran.

Arch Intern Med. Published online January 9, 2012. doi:10.1001/archinternmed.2011.1666

Uchino K, et al Arch Intern Med 2012;172:397-402

REVIEW ARTICLE

ONLINE FIRST

Dabigatran Association With Higher Risk of Acute Coronary Events

Meta-analysis of Noninferiority Randomized Controlled Trials

Ken Uchino, MD, Adrian V. Hernandez, MD, PhD

Dabigatran compared to control (warfarin, enoxaparin, placebo)

1. Increased absolute risk of MI or ACS 0.27%
2. Increased relative risk of MI or ACS 33%

Uchino K, et al Arch Intern Med 2012;172:397-402

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Thrombosis Research

Journal homepage: www.elsevier.com/locate/thromres

Regular Article

Evaluation of the acute coronary syndrome safety profile of dabigatran etexilate in patients undergoing major orthopedic surgery: Findings from four Phase 3 trials¹²

Bengt I. Eriksson^{A*}, John J. Smith^B, Joseph Caprini^C, Stefan Hantel^D, Andreas Clemens^E, Martin Feuring^F, Janet Schnee^B, Gregory W. Barsness^F

Eriksson B, et al Thromb Res 2012;130:396-402

Dabigatran & ACS Events

Orthopedic Surgery

ACS Events Adjudicated	Dabi 150 mg (2665)	Dabi 220 mg (2611)	Enoxaparin (2639)
MI	1	1	5
Unstable Angina	1	0	0
Cardiac Death	0	0	3
Total Definite ACS	2 (0.8)	1 (0.04)	7 (0.27)

Conclusion: No ACS signal identified

Eriksson B, et al Thromb Res 2012;130:396-402

Case 6

- The patient is an 66 yr old man
- PMHx: HBP, DM, HL
- Meds: rivaroxaban 10mg, Qday, amlodipine, glucophage
- PE: BP 128/88, P 80, R 12, BMI 28
- Labs: PT 11 sec, INR 0.9, PTT 28 sec, Plts 271K, Cr 1.2, CrCl 72 ml/min

Case 6

- Pt was discharged on rivaroxaban for VTE prophylaxis for 30 days.
- On the 16 day postop day the patient complained of dizziness and near syncope.
- At PCP orthostatic, stool heme +, testing then sent to ED
 - CBC: Hgb 5.8, HCT 17.3
 - PT/INR: 23 sec/2.16

Case 6

- How would you manage the prolonged PT/INR ?

Laboratory Testing New Oral Agents

Lab Tests	Useful Lab Test	Dabigatran	Rivaroxaban	Apixaban
	Strong	ECT	Chromogenic anti-Xa	Chromogenic Anti -Xa
		TT	aPTT, PT	
		aPTT		
	Weak	PT / INR		

Palladino M et al A J Hem 2012;87 Suppl:S127-S132

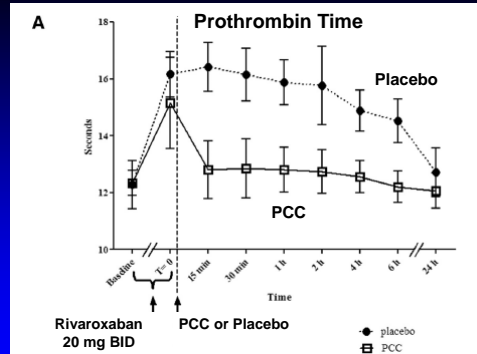
Circulation

American Heart Association
Learn and Live™

Reversal of Rivaroxaban and Dabigatran by Prothrombin Complex Concentrate : A Randomized, Placebo-Controlled, Crossover Study in Healthy Subjects
Elise S. Eerenberg, Pieter W. Kamphuisen, Meerten K. Sijpkens, Joost C. Meijers, Harry R. Buller and Marcel Levi

- COFACT (Prothrombin Complex Concentrate)**
1. Non-activated PCC
 2. Factor II, VII, IX, X
 3. Protein C, S, ATIII
 4. 50 IU PCC/kg dosing

Eerenberg E, et al Circulation 2011;124:1573-1579



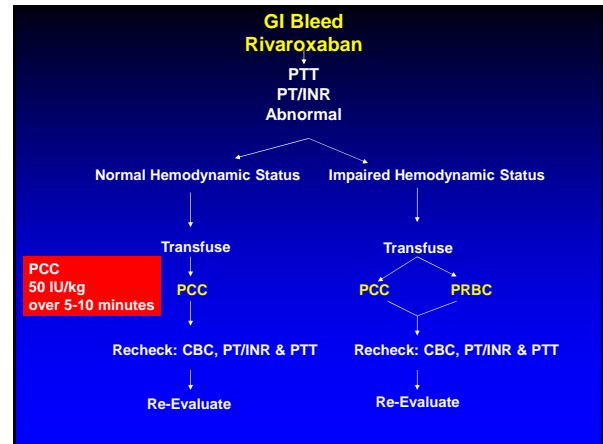
Eerenberg E, et al Circulation 2011;124:1573-1579

Four Factor vs Three Factor PCC Rivaroxaban Reversal

Agent	Reduction PT (sec)
Beriplex (50 IU/kg)	2.5 sec – 3.5 sec
Profilnine (50 IU/kg)	0.6 – 1.0 sec


Rivaroxaban 20mg, BID x 4 days
30 minute following infusion effect noted

Levi M, et al Abstract ISTH July 2013



MAYO CLINIC

Perioperative Management of the Patient with Liver Disease



Mayo School of Continuous Professional Development

William Sanchez, MD
Division of Gastroenterology and Hepatology, Mayo Clinic
October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Disclosure

- Esai Pharmaceuticals, Philips – Investigator/Grant Support
- Off-label Drug Usage – none

Learning Objectives

- Review the pre-operative assessment of patients with chronic liver disease
- Identify patients with liver disease who are at high risk for post-operative morbidity and mortality following surgery
- Review the appropriate timing of referral for transplant evaluation
- Identify common pitfalls in the post-operative management of cirrhotic patients

Background

- Incidence and prevalence rates of chronic liver disease (CLD) continue to climb
 - 3 Million HCV-infected patients in the USA with a growing proportion developing cirrhosis
 - Prevalence of NASH continues to increase with the obesity epidemic
- An increasing proportion of cirrhotics will not be candidates for LT and will need to be managed in the community setting
- Patients with CLD utilize significant health care resources (largely hospital care)

Preoperative Assessment of the Patient with Chronic Liver Disease

- History and Physical exam are critical
 - Detailed alcohol use history
- CBC (platelets > 50K)
 - Thrombocytopenia suggests portal HTN
- Liver labs (includes bilirubin and albumin)
- Prothrombin time (< 1.5 INR)
- Creatinine, electrolytes
- Abdominal US

Case #1

You are asked to see a 46 year old female with autoimmune hepatitis who is scheduled for excision of a indeterminant breast lump. She is not currently on therapy for her hepatitis.

Pre-op labs: ALT 540 U/L, AST 428 U/L, INR, Bilirubin and Albumin are normal. No ascites on exam.

When would you recommend surgery?

- Right away
- ALT and AST <5X ULN
- ALT and AST <2X ULN
- After 8 weeks of prednisone therapy
- Not a surgical candidate

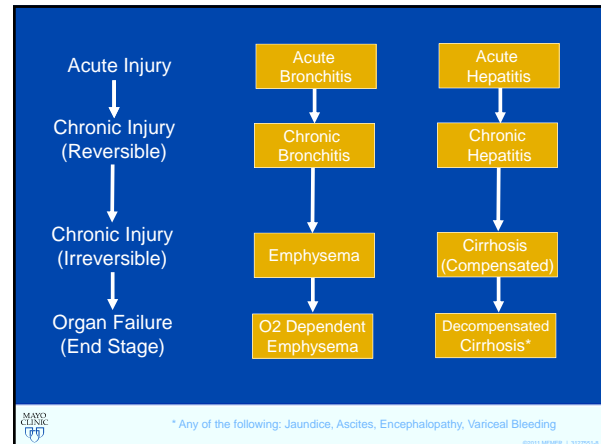
Case #1

You are asked to see a 46 year old female with autoimmune hepatitis who is scheduled for excision of a suspicious breast lump. She is not currently on therapy for hepatitis.

Pre-op labs: ALT 340 U/L, AST 228 U/L. INR, Bilirubin and Albumin are normal. No ascites on exam.

When would you recommend surgery?

- A. Right away
- B. ALT and AST <5X ULN
- C. ALT and AST <2X ULN
- D. After 8 weeks of prednisone therapy
- E. Not a surgical candidate



Acute & Chronic Hepatitis and Surgery

- When possible, the underlying cause of hepatitis should be treated prior to elective surgery
 - Ability to treat depends on underlying disorder
- Increased mortality for patients with acute hepatitis who undergo surgery (10-30%)
- Severe hepatitis (patient jaundiced) should be considered a contraindication to elective surgery
- In general, postpone elective surgery until AST/ALT < 2x ULN, INR & Bilirubin normal



Viral Hepatitis

- Hepatitis A is usually severe but self limiting
 - Postpone elective surgery until resolved
- Hepatitis B (with active hepatitis)
 - Start rapid acting oral antivirals (e.g., tenofovir)
 - Postpone elective surgery until AST/ALT < 2x ULN
 - Chronic inactive carriers (normal LFTs): not a contraindication to surgery



Viral Hepatitis (cont)

- Hepatitis C
 - Common disease: over 3 million chronically infected persons in the USA
 - HCV Rx duration 6-12 months
 - Not reasonable to postpone even the most elective surgery
 - Proceed with surgery irrespective of AST/ALT (unless decompensated cirrhosis)



Autoimmune Hepatitis

- Patients with active disease (untreated or acute flare) should be treated with immunosuppressive Rx prior to elective surgery
 - Usually rapid response (days to few weeks) to steroid Rx
 - Postpone elective surgery until AST/ALT < 2x
- No contraindication to surgery for inactive or controlled disease (unless decompensated cirrhosis)



Alcoholic Hepatitis

- Very high mortality rate from illness and very high peri-operative mortality rate (> 30%)
 - Important to distinguish between alcoholic hepatitis (sick) and alcoholic steatosis (not sick)
- Recommend abstinence > 12 weeks prior to elective surgery
 - Resolution of jaundice required
- Watch-out for AWS!



Non-Alcoholic Fatty Liver Disease

- Increasingly common
- Ranges from simple steatosis to steatohepatitis with cirrhosis
 - Unsuspected cirrhosis in 4%
- PO risk from obesity, diabetes and CV disease
 - Need to identify cirrhotics due to further increase in risk
- No effective Rx besides control of metabolic syndrome
- Proceed with surgery irrespective of AST/ALT (unless decompensated cirrhosis)



Case #2

69 year old female with obesity, diabetes and cirrhosis due to NASH has symptomatic DJD and wants knee replacement. CTP score is 6, MELD 7. What do you recommend?

- A. Proceed with surgery
- B. Surgical risk prohibitive
- C. Transjugular portosystemic shunt (TIPS) prior to surgery
- D. Liver transplant evaluation



Case #2

69 year old female with obesity, diabetes and cirrhosis due to NASH has symptomatic DJD and wants knee replacement. CTP score is 6, MELD 7. What do you recommend?

- A. Proceed with surgery
- B. Surgical risk prohibitive
- C. Transjugular portosystemic shunt (TIPS) prior to surgery
- D. Liver transplant evaluation



Case #3

60 year old male with NASH cirrhosis, diabetes has severe aortic valve stenosis. Dyspnea with minimal exertion, no CHF. Moderate ascites present. CTP score is 8, MELD 17. What do you recommend?

- A. Proceed with surgery
- B. Surgical risk prohibitive
- C. Transjugular portosystemic shunt (TIPS) prior to surgery
- D. Liver transplant evaluation



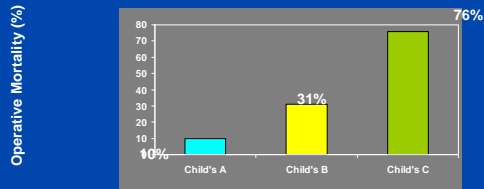
Case #3

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- A. Proceed with surgery
- B. Surgical risk prohibitive
- C. Transjugular portosystemic shunt (TIPS) prior to surgery
- D. Liver transplant evaluation



Cirrhosis and Surgery: CTP Classification



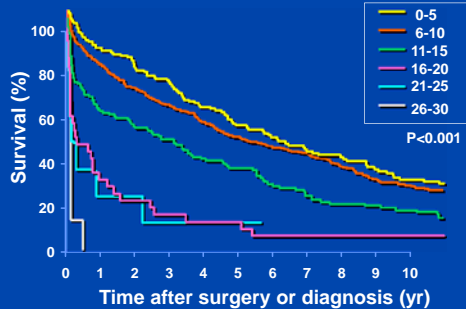
From Garrison, et al. Ann Surg 1984; 199:648-55.

Child-Turcotte-Pugh Classification

Parameter	1	2	3
Encephalopathy	None	Stage 1-2	Stage 3-4
Ascites	Nil	Slight-Mod	Mod-Severe
Bilirubin			
-Cholestatic	<4	4-10	>10
-Non-Cholestatic	<2	2-3	>3
Albumin	>3.5	2.8-3.5	<2.8
INR	<1.7	1.7-2.3	>2.3

Score	CTP Class
5-7	A
8-10	B
11-15	C

MELD Related Post-Operative Survival



Teh SH, et al. Gastro 2007;132(4)

What is the MELD Score?

- (Mayo) Model for End-Stage Liver Disease
- Reliably predicts short-term (3 month) liver-related mortality
 - Because of this now used for allocating donor organs
- Complex equation but incorporates simple laboratory values
 - INR, total bilirubin and creatinine

Web-based MELD Calculator



<http://www.mayoclinic.org/meld/mayomodel6.html>

Postoperative Mortality (%) in Relation to MELD Score

MELD	7 Day	30 Day	90 Day
0-5 (n=163)	0.6%	3.2%	7.1%
6-10 (N=392)	2.8%	8.6%	13.9%
11-15 (N=159)	7.2%	21.9%	30.6%
16-20 (N=35)	14.6%	44.0%	55.8%
21-25 (N=10)	22.2%	55.6%	66.7%
≥26 (N=8)	25.0%	87.5%	87.5%

Mortality is independent of type of procedure (GI, hepatobiliary, orthopedic or cardiac), or whether the procedure is emergency once ASA, MELD, and age are factored in.

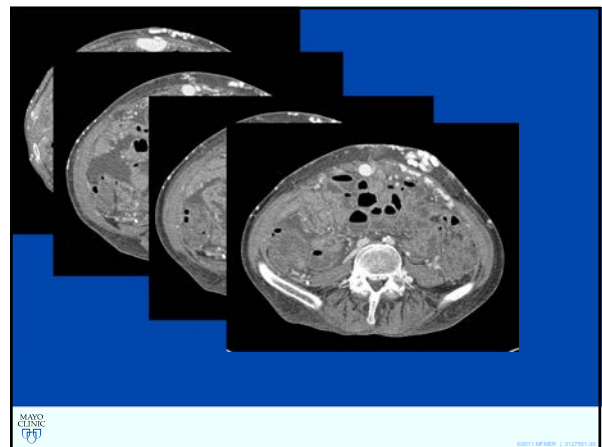
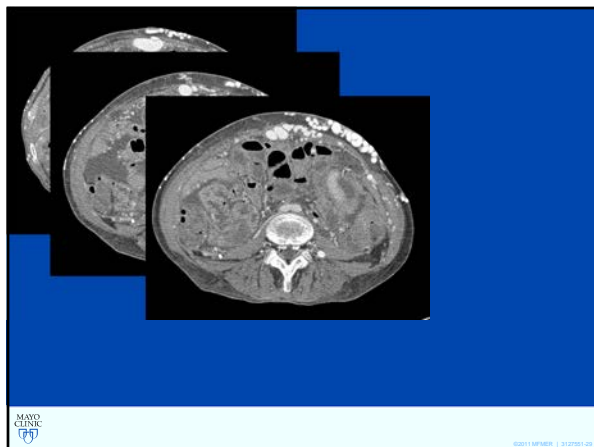
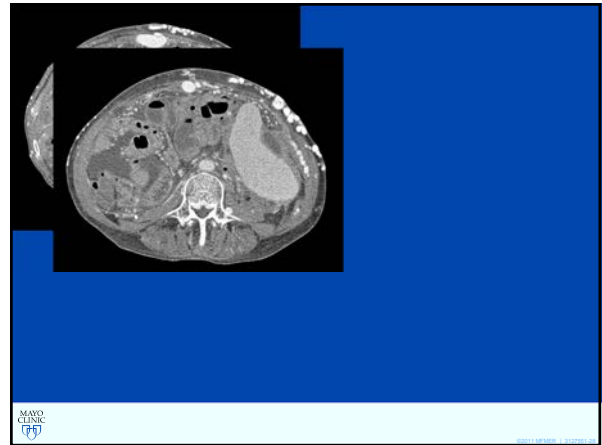
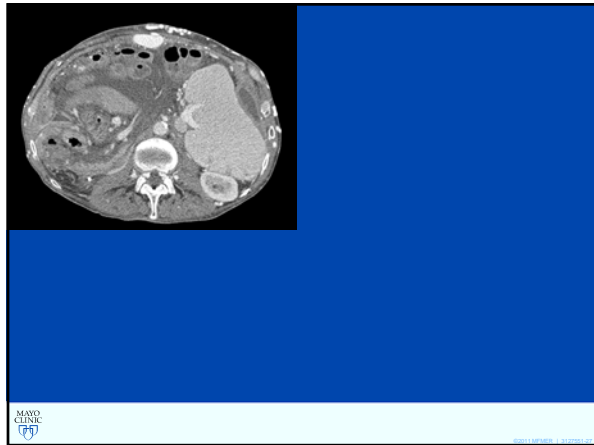
Teh SH, et al. Gastro 2007;132(4)

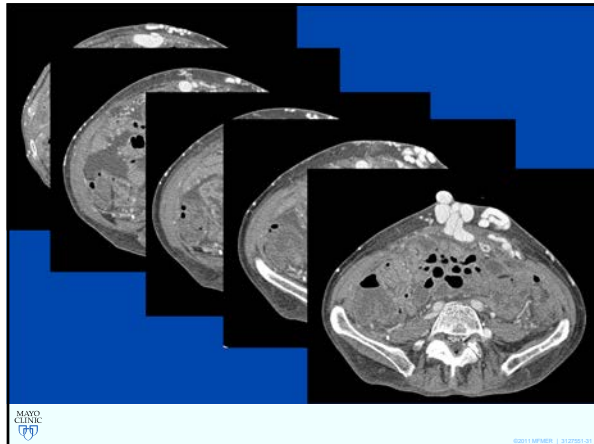
Decompensated Cirrhotics Have a Prohibitively High Perioperative Mortality Rate

Defer All Non-emergent Surgery Until Consultation with Hepatology



Caput Medusae, Umbilical Hernia, Ascites





In Decompensated Cirrhosis Open Abdominal Surgery is Fraught with Complications

Consult with Hepatology and Pursue Minimally Invasive Procedures When Possible

Role of TIPS prior to surgery

- Not recommended by AASLD-NIH consensus, AASLD practice guideline
- Case reports of usefulness in abdominal surgery, renal transplantation
- Esophageal varices may resolve in 3 months
- Gastric varices seldom resolve
- No data to support perioperative use

Transplant Referral

- Patients with decompensated liver disease should be referred for transplant evaluation prior to elective surgery
- Salvage transplant in patients who decompensate following elective surgery
 - Difficult if not impossible if patient has not been evaluated as LT candidate beforehand
- Defer elective surgery in decompensated patients

Patients with Advanced Liver Disease* Should Be Evaluated For Transplantation PRIOR to Elective Surgery

*in the absence of major comorbidities that would preclude LT (eg, metastatic carcinoma)

Case #4

55 year old alcoholic male is S/P emergent repair of ruptured umbilical hernia. Intraoperative course notable for hemorrhage. You are asked to see persistent regarding worsening ascites output, encephalopathy and jaundice. You recommend:

- A. TIPS
- B. Steroids for alcoholic hepatitis
- C. EGD to screen for esophageal varices
- D. Discontinue ketorolac

Case #4

55 year old alcoholic male is S/P emergent repair of ruptured umbilical hernia. Intraoperative course notable for hemorrhage. You are asked to see persistent regarding worsening ascites output, encephalopathy and jaundice. You recommend:

- A. TIPS
- B. Steroids for alcoholic hepatitis
- C. EGD to screen for esophageal varices
- D. Discontinue ketorolac



Cirrhosis and Surgery Postoperative Problems

- Mortality
- Liver failure
- Hepatic encephalopathy
- Renal failure
- Coagulopathy
- Cholestasis
- Sepsis
- Ascites
- Wound dehiscence
- Hypoxemia
- ? Hypoglycemia or hyperglycemia



Cirrhosis and Surgery Postoperative Problems

SEPSIS!



Multi-Organ Failure



Cirrhosis and Surgery Common Management Pitfalls

- Organ failure
 - Often driven by infection – screen aggressively
 - This means tapping ascites to look for SBP
- Ascites
 - Sodium restriction often overlooked, be aware of IV saline
 - Albumin preferred volume expander
- Hepatic Encephalopathy
 - Delayed clearance of sedative/hypnotics and narcotic analgesics
 - Aggravated by narcotic induced constipation



Cirrhosis and Surgery Common Management Pitfalls

- Cholestasis
 - Often multifactorial (infection, antibiotics, TPN)
 - TPN is a frequent contributing factor
 - Transition to enteral feeds ASAP
- Renal Failure
 - Impaired renal function sensitive to NSAIDS
 - Ketorolac (Toradol) often used as an analgesic
- Coagulopathy
 - Often aggravated by broad-spectrum antibiotics and vitamin K deficiency
 - Replace Vitamin K parenterally (SQ)



Take Home Points

- Surgery in patients with liver disease requires a major team effort
- Surgery most safe if MELD < 8
- Consider completing transplant evaluation before surgery in patients with MELD 12-20+
- Avoid surgery in patients with decompensated cirrhosis – involve hepatology (the earlier the better)
- Watch the patient like a hawk post-operatively – the surgeon needs you!



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MAYO CLINIC

Managing Patients with Neurologic Disease in the Perioperative Period



Mayo School of Continuous Professional Development
 Andrea N. Leep, M.D., Assistant Professor of Neurology
 October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Disclosures

- None

Disclosures

Case

- A 32 year old man with a history of epilepsy injures his ACL playing soccer.
- He is scheduled for knee surgery under general anesthesia and expresses the following concern:
 - “Could the anesthesia make me have a seizure?”

ACL = anterior cruciate ligament

What is the approximate risk of perioperative seizure in an adult patient with epilepsy?

1. <1%
2. 3%
3. 5%
4. 10%
5. 20%

Perioperative Seizure Risk

- Niesen et al, 2010
 - Retrospective review of epilepsy patients receiving any type of anesthetic (intracranial surgery excluded)
 - Lower risk in adults:
 - 16 of 568 (2.8%)
 - Higher risk in children:
 - 6 of 73 (8.2%)

Niesen et al, 2010

Perioperative Seizure Risk

- Niesen et al, 2010
 - Risk not influenced by:
 - Type of surgical procedure (intracranial surgeries excluded)
 - Type of anesthesia (general vs. regional)
 - Higher risk if:
 - Frequent seizures at baseline
 - Recent seizure activity

Niesen et al, 2010

Perioperative Seizure Risk

- Benish et al, 2010
 - Retrospective review of epilepsy patients undergoing a procedure under general anesthesia (excluding neurosurgery)
 - Lower risk in adults
 - 1 out of 104 (<1%)
 - Higher risk in children:
 - 5 out of 132 (3.8%)



Benish SM, et al 2010

Perioperative Seizure Risk

- Risk likely driven more by the:
 - Severity of the patient's underlying epilepsy and
 - Baseline seizure frequency
- ...than by the type of surgery (apart from intracranial surgery, which has a higher risk) or type of anesthesia



Benish SM, et al 2010

Perioperative Seizure Risk

- Perioperative factors that could increase risk
 - Withdrawal of antiepileptic drugs while patient NPO prior to surgery
 - Sleep deprivation
 - Use of pro-convulsant medications
 - Altered GI absorption or inability to take pills
 - Altered timing of medication administration
 - Electrolyte disturbances



Niesen et al, 2010
NPO = non per os or "nothing by mouth"

Perioperative Seizure Risk

- New seizures in the post-operative patient without a prior history of epilepsy should not simply be blamed on general anesthesia!
- Need to consider other causes...
 - Drug or alcohol withdrawal
 - Metabolic derangements
 - Hypoglycemia
 - Posterior reversible encephalopathy syndrome (PRES)
 - Many others...



Voss LJ, et al. 2008

Case

- A 25 year old man with developmental delay and longstanding refractory epilepsy is seeing you prior to an upcoming surgery
- His antiepileptic regimen includes
 - Valproic acid (Depakote)
 - Levetiracetam (Keppra)
 - Lamotrigine (Lamictal)
 - Clonazepam (Klonopin)



Case

- His medications are continued up through the morning of surgery, which goes well.
- After surgery, however, he develops a prolonged ileus with severe nausea and vomiting.
- He is unable to keep down any pills.



General Principles

- Continue anti-epileptics before surgery and resume as quickly as possible after surgery
- Consider alternative delivery routes
 - Intravenous
 - Liquid or orally dissolving
 - Others (rectal, intramuscular, etc.)
- If switching antiepileptics, give loading dose of the new drug



Intravenous Anti-Epileptics

Drug	Oral to IV conversion	Typical loading dose
Phenytoin (Dilantin)	1:1 oral phenytoin to IV or IM fos-phenytoin*	20 mg/kg IV Should achieve total blood level of 20 mcg/mL Therapeutic range 10-20
Valproic acid (Depakote)	1:1 oral valproic acid to IV valproate	15-25 mg/kg IV Should achieve total blood level of 100-150 mcg/mL Therapeutic range 40-100
Levetiracetam (Keppra)	1:1 oral to IV levetiracetam	1000 to 4000 mg IV Can also load orally (1500 mg)*

*Koubeissi MZ, et al 2008



Intravenous Anti-Epileptics

- IV fos-phenytoin requires continuous ECG monitoring (IM does not)
 - Cardiac conduction delay / asystole
 - Hypotension
- Phenobarbital and Lacosamide are also available IV
 - Typically used when patient is already on these medications as part of their outpatient therapy



Other Formulations

Drug	Alternative Formulation
Carbamazepine	Suspension
Clonazepam	Orally disintegrating tablet
Lamotrigine	Orally disintegrating tablet
Levetiracetam	Solution
Oxcarbazepine	Suspension
Phenobarbital	Solution
Phenytoin	Suspension
Valproic acid	Syrup or Sprinkles

MicroMEDEX



Which anti-epileptic medication is LEAST likely to cause drug-drug interactions?

1. Levetiracetam (Keppra)
2. Phenobarbital
3. Phenytoin (Dilantin)
4. Valproic acid (Depakote)
5. Carbamazepine (Tegretol)



A mnemonic...

- These medications have higher potential for drug-drug interactions, so...
- “PPrescribe Very Carefully!”
 - P = phenytoin
 - P = phenobarbital
 - V = valproic acid
 - C = carbamazepine



When a Seizure Happens...

- Goal of treatment is to
 - Stop seizure(s) quickly
 - Prevent recurrent seizures
 - Identify and treat underlying cause
 - Prevent injury and complications



MicroMEDEX

Acute Treatment for Seizures

- Lorazepam 1-2 mg IV every 5 minutes to as high as 0.1 mg/kg
 - Need to consider airway at higher doses...
- If no IV access...
 - Rectal diazepam (0.2-0.5 mg/kg)
 - Midazolam via subcutaneous, nasal, intramuscular, rectal, or buccal routes (0.15-0.3 mg/kg)



MicroMEDEX

RAMPART Trial

- "Rapid Anticonvulsant Medications Prior to Arrival Trial"
 - Compared 4 mg IV lorazepam to 10 mg IM midazolam as initial treatment for seizures by EMTs (hence, patients without an IV)
 - Doses halved for children < 40 kg
 - More patients seizure free upon arrival to the hospital with IM midazolam (73% vs. 63%)



Silbergleit R et al, 2012

Case

- A 74 year old man with advanced Parkinson's disease will be undergoing a hernia repair
- His medications include
 - Carbidopa / levodopa (Sinemet) 25/100 mg 3 tablets every 4 hours
 - Entacapone (Comtan) 200 mg with each dose of carbidopa / levodopa



Case

- He is listed as the first surgical case of the day
- You advise him to stop taking his Parkinson's medications the night before



How long does it take for the effects of carbidopa / levodopa to completely wear off?

1. 4 to 6 hours
2. 12 to 24 hours
3. 1 to 2 days
4. 3 to 5 days
5. 7 to 10 days



Carbidopa / Levodopa: Duration of Effect

- Carbidopa/levodopa has both a **short duration** (onset over ~30 minutes, lasts hours) and a **long duration** response (builds over 7-10 days)
- With a missed dose...
 - Short-term response lost right away
 - Long-term response declines over several days
 - Hence, consequences of missed doses increase over time!



Case

- Surgery goes well, and the patient's medications are resumed shortly thereafter.
- On hospital day 2, however, he develops a severe post-operative delirium and appears to be hallucinating.
- The patient's family is very upset and confused by the situation.



Post-Operative Delirium / Hallucinations

- Parkinson's patient are predisposed to this (discuss pre-operatively!)
- Dopamine agonists are 3x more likely to provoke hallucinations*
- Adjunctive medications also increase risk
 - Entacapone
- **Levodopa least likely offender!**



*Rascol O, et al 2000

If absolutely necessary, which is the best anti-psychotic to use in this situation?

1. Haloperidol (Haldol)
2. Risperidone (Risperdal)
3. Olanzapine (Zyprexa)
4. Quetiapine (Seroquel)
5. Ziprasidone (Geodon)



Case

- Despite the best efforts of his care providers, the patient refuses to swallow pills due to his delirium.



Other Options

Drug	Alternative Formulation
Carbidopa / levodopa (immediate release)	Crushed in water Orally dissolving tablet
Rotigotine	Transdermal patch (taken off the market in US)
Apomorphine	Intravenous (requires monitoring for orthostasis) Inhaled formulation in the works?*



*Grosset KA (abstract) 2011

Perioperative Parkinson's Disease

- Delirium
- Swallowing
- Nausea
- Post-operative pain
- Orthostatic hypotension / syncope
- Loss of parkinsonism control



Nausea

- Avoid anti-emetics that are anti-dopaminergic
 - Prochlorperazine (Compazine)
 - Metoclopramide (Reglan)
- Ondansetron (Zofran) acceptable
- Rare for a patient who previously tolerated levodopa to then develop nausea (consider other causes)



Post-Operative Pain

- Levodopa off-states associated with reduced pain thresholds*
- Optimize levodopa to better manage post-op pain



*Gerdelat-Mas A, et al 2008

Orthostatic Hypotension / Syncope

- Parkinson's disease itself can cause orthostatic hypotension
- Levodopa can also lower standing blood pressure for 3-4 hours after each dose
- Monitor standing blood pressure
 - Should be > 90 mm Hg



Loss of parkinsonism control

- **Formulation mix-up**
 - Need 30-50% more continuous release carbidopa/levodopa for given dose of immediate-release formulation
- **Giving with meals**
- **Inappropriate dose timing**
 - Time levodopa dosing to response duration
 - There is no cumulative toxicity from adding doses!!!



Yeh 1989; Ahiskog 1988

Other Issue to Consider

- Severe tremor or dyskinesias can interfere with some types of surgery and procedures where patient is awake and it's important to hold still
 - Dental work
 - Cataract surgery
 - MRI scans



Case

- You are seeing a 60 year old man for a PAME prior to prostate surgery.
- You note a right carotid bruit.
- He denies any prior history of stroke or transient neurologic symptoms including vision loss.

PAME = pre-anesthesia medical examination

Which of the following is true?

1. A carotid bruit is highly predictive of an underlying severe stenosis (70-99%)
2. Patients with an asymptomatic carotid bruit have a higher risk of ischemic stroke
3. Patients with an asymptomatic carotid bruit have a higher risk of perioperative stroke
4. All patients over age 65 should undergo carotid ultrasonography prior to surgery regardless of the presence of a bruit

Asymptomatic Carotid Bruit

- Only 30-40% of patients with a carotid bruit have an underlying severe carotid stenosis
- Risk of stroke associated with an asymptomatic carotid bruit is 1.5-2.0% per year*
- No evidence that general surgery increases risk**
- Hence, patient could be screened at some point, but does not need to be done before surgery

*Wiebers 1990; Chambers & Norris 1986; **Ropper et al 1982

Case

- After leaving the room, your resident asks, "But what if he really did have a severe carotid stenosis?"

PAME = pre-anesthesia medical examination

Situation	Perioperative Risk
Adults undergoing non-vascular surgery under general anesthesia	~0.5% (stroke)
Carotid stenosis of 50 - 99% with bruit or prior symptoms undergoing general surgery*	~3.6% (stroke)
Carotid endarterectomy done for asymptomatic carotid stenosis of 60 - 99%**	2.7% (stroke or death)
Carotid stenting***	4.1% (stroke)
Surgery following prior carotid endarterectomy	"Not likely to be less than that of the general population"**

*Evans & Wijdicks 2001; **ACAS (Asymptomatic Carotid Artery Stenosis) Trial 1995; ***CREST trial 2010

Case

- Your next patient is a 71 year old man seeing you prior to upcoming coronary artery bypass grafting.
- He also has a carotid bruit.
- Would your answer to the resident be different?

PAME = pre-anesthesia medical examination

Does the Type of Surgery Matter?

- For asymptomatic carotid stenosis, the risk of perioperative stroke is not high enough to justify the risks of endarterectomy for general surgery.
- The same might not be true for cardiac surgery, including coronary artery bypass grafting (CABG).



PAME = pre-anesthesia medical examination

But the issue is tricky...

- Main mechanisms of stroke associated with CABG are hypoperfusion or embolism from the aortic arch
 - Neither preventable by carotid endarterectomy!
- Example: 239 patients with >50% carotid stenosis
 - 18 perioperative strokes (7.5%) with CABG
 - Only 4 of these strokes referable to a carotid artery, of which 3 were occluded & hence not amenable to surgery



Li et al, 2009

Coronary Artery Bypass Grafting

Situation	Perioperative Risk (selected examples)	
Overall CABG	1.4-3.0%	
CABG + unilateral >50% stenosis	3.0%	
CABG + unilateral >80% stenosis	3.4%	2004
CABG + bilateral >50% stenosis	5%	2011
CABG + stenosis >50% + occlusion	7-11%	
CABG + symptomatic stenosis	5-8.5%	



ACC/AHA Guidelines 2011; Mahmoudi 2011; Naylor 2002; Schwartz 1995; Blacker 2004

Coronary Artery Bypass Grafting

• ACC/AHA Guidelines 2011

Carotid revascularization may be considered in patients scheduled to undergo CABG if...

- Bilateral severe (70-99%) stenoses
- Unilateral severe stenosis with a contralateral occlusion
- Symptomatic stenosis (50-99%)



CABG = coronary artery bypass grafting; ACC = American College of Cardiology; AHA – American Heart Association, ACC/AHA Guidelines 2011

Why not unilateral severe stenosis?

- 2011 study by Mahmoudi, et al

Asymptomatic patients with...	≥75% stenosis (n=117)	<75% stenosis (n=761)
Risk of in-hospital stroke	3.4%	3.6%
Risk of in-hospital mortality	3.4%	4.2%

Conclusion: "Severe carotid artery stenosis alone is not a risk factor for stroke or mortality in pts undergoing CABG"



Mahmoudi et al, 2011

Coronary Artery Bypass Grafting

• ACC/AHA Guidelines 2011

Screening is reasonable in selected patients with high risk features such as:

- Age > 65 years*
- Left main coronary stenosis
- Peripheral arterial disease
- Smoking
- Diabetes
- Hypertension
- Prior TIA/stroke*
- Carotid bruit*



ACC/AHA Guidelines 2011

Case

- A 62 year old woman is scheduled to have a lumbar spine surgery for severe spinal stenosis and disabling pseudoclaudication.
- She has chronic rate-controlled atrial fibrillation on warfarin anticoagulation.
- Her warfarin (Coumadin) is stopped in anticipation of surgery.



PAME = pre-anesthesia medical examination

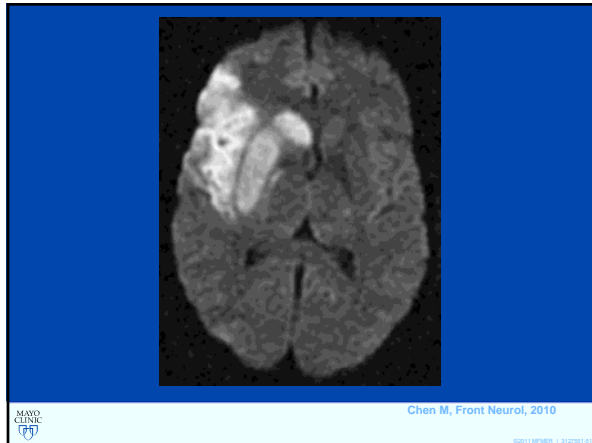
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Case

- Two days before surgery, she develops sudden onset left facial droop and left hand weakness.
- When the symptoms are still present the next morning, she goes to the local ED.
- Initial head CT and carotid ultrasounds are negative, but an MRI shows an acute infarct corresponding to the anterior division of the right middle cerebral artery.



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Chen M, Front Neurol, 2010

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How long should you tell her to wait before having her back surgery?

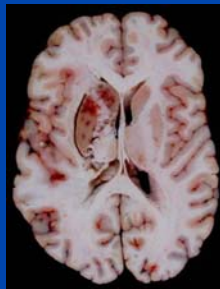
1. Don't wait, proceed as planned
2. 1 week
3. 2 weeks
4. 4 weeks
5. 6 weeks



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Where does the concern come from?

- Brain may be more susceptible to infarction during the first few weeks after an ischemic stroke
- Hemodynamic stressors of surgery / anesthesia
- Impaired cerebral autoregulation

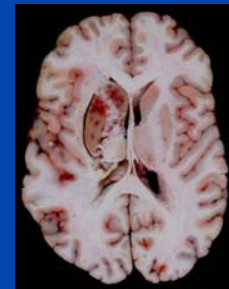


Thank you to Joseph Parisi, MD for sharing gross brain photo

©2011 Mayo Clinic

Where does the concern come from?

- Risk of hemorrhagic conversion
- Procedures involving thrombolytics, anticoagulation, or antiplatelet agents
- Reperfusion injury



Thank you to Joseph Parisi, MD for sharing gross brain photo

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General Recommendations

- Promptly evaluate all stroke patients
- Defer non-essential surgery until this evaluation is complete
- Optimize medical management
- Promptly address symptomatic carotid stenosis before patient undergoes surgery



Blacker et al 2004

General Recommendations

- If possible, advise patient to wait at least 1 month before undergoing non-urgent / elective surgery
 - Especially for larger strokes (greater than 1/3rd of the middle cerebral artery territory)



Blacker et al 2004

Does the Evidence Support This?

- Rerkasem 2009 systematic review

Timing of Carotid Surgery (cut off for early vs. late)	Perioperative Risk of Stroke or Death	
	Before	After
1 day	4.2%	1.9%
1 week	6.8%	6.3%
2 weeks	6.7%	6.3%
3 weeks	6.3%	4.3%
4 weeks	5.3%	4.8%
6 weeks	4.1%	1.8%



Rerkasem et al 2009

ACC / AHA Guidelines 2011

- “When revascularization is indicated for patients with TIA or stroke and there are no contraindications to early revascularization, intervention within 2 weeks of the index event is reasonable rather than delaying surgery.”
 - Class IIa
 - Level of Evidence B



Factors to Consider

Ischemia-related variables Surgery related variables

- | | |
|---|--|
| <ul style="list-style-type: none"> • Stage of ischemia • Size of stroke • Underlying cause | <ul style="list-style-type: none"> • Type of surgery • Urgency of surgery • Timing of surgery |
|---|--|



What else is going on?

- Medical management / Other comorbidities



Case

- A 78 year old woman is admitted following a severe right hip fracture requiring surgical repair
- A fentanyl PCA is started for post-operative pain control with prochlorperazine available as needed for nausea.
- Several hours later you are called to see the patient because she is “somnolent, rigid, and posturing”



Case

- Examination reveals:
 - Somnolent patient that can be aroused with strong stimuli but cannot follow commands
 - Sinus tachycardia on monitor
 - Increased tone in all extremities with frequent myoclonic jerks
 - Brisk reflexes throughout with upgoing toes and four beats of clonus at each ankle



What is going on?

1. Acute delirium
2. Alcohol withdrawal
3. Neuroleptic malignant syndrome
4. Opioid-induced seizure
5. Serotonin syndrome



Serotonin Syndrome

- Caused by increased serotonergic activity in the central nervous system
- A clinical diagnosis that sometimes requires a high index of suspicion
- Broad spectrum of manifestations that range from mild to life threatening



Serotonin Syndrome

- Core clinical features*
 - **Mental status changes**
 - **Autonomic hyperactivity**
 - Hypertension, hyperthermia, tachycardia, sweating, diarrhea
 - **Neuromuscular hyperactivity**
 - Tremor, rigidity, clonus, myoclonus, and hyperreflexia (most prominent in legs)

*Mason PJ, et al. 2000



Serotonin Syndrome

- Requires exposure to a serotonergic medication
 - Most cases of serotonin syndrome present **within 6 hours** of a change or initiation of a serotonergic drug*

*Mason PJ, et al. 2000



Fentanyl does which of the following?

1. Increases serotonin formation
2. Increases serotonin release
3. Impairs reuptake of serotonin
4. Inhibits serotonin metabolism
5. Acts as direct serotonin agonist
6. Increases sensitivity of serotonin receptor



Back to the patient

- Patient's daughter reported that the nurse was pushing the fentanyl PCA button frequently (even after the patient became somnolent) in order to "stay on top of the pain"
- Fentanyl was discontinued and with supportive cares the patient returned to baseline over the next 24 hours



Summary

- Risk of perioperative seizure
- Perioperative management of anti-epileptic medications
- Perioperative issues in Parkinson's disease
- Asymptomatic carotid bruit
- Timing of surgery after ischemic stroke
- Serotonin syndrome



Thank You to...

- Content experts who reviewed this talk
 - Eric Ahlskog, MD, PhD (Parkinson's disease)
 - Jeffrey Britton, MD (Epilepsy)
 - Alejandro Rabinstein, MD (Stroke)



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Clinical Short: Preoperative Evaluation in Cancer Patients

Molly Feely MD

Disclosure

Relevant Financial Relationships

None

Off-Label/Investigational Uses

None

Learning Objectives

- Identify who should have a preoperative ECG
- Clarify perioperative VTE prophylaxis for patients with CNS tumor
- Address preoperative pain medication management

Ms. V

- 49 y.o. ♀ presents for preoperative evaluation in anticipation of bilateral breast reconstruction.
- Breast cancer history
 - Abnormal mammogram
 - Ductal carcinoma, triple +, node +
 - Bilateral mastectomy
 - Systemic chemotherapy with doxorubicin, cyclophosphamide and 5-FU followed by trastuzumab (Herceptin)

Which of the following factors increases Ms. V's perioperative cardiac risk

- A. Doxorubicin chemotherapy
- B. Cyclophosphamide chemotherapy
- C. Trastuzumab chemotherapy
- D. All of the above

Perioperative Cardiac Risk in Cancer

Risk due to cancer

- Pericardial disease
 - Pericardial effusion/tamponade
 - Pericardial mets
- SVC syndrome
- Hypercoagulability of malignancy

Risk due to treatment

- Cardiotoxic chemotherapy
 - Cardiomyopathy/CHF
 - Hypercoagulability
 - Pericardial disease
 - CAD
- XRT to the chest
 - Premature CAD
 - Valvular heart disease
 - Constrictive pericarditis
 - Restrictive cardiomyopathy

Cardiotoxic Chemotherapy

Cardiomyopathy	HTN	CAD	Dysrhythmia	Hypercoagulable
Anthracyclines Doxorubicin Daunorubicin Epirubicin Idarubicin Cyclophosphamide Trastuzumab Sunitinib Sorafenib	Bevacizumab sunitinib sorafenib vatalanib Pazopanib motesanib axitinib aflibercept	Capecitabine 5-FU Bevacizumab paclitaxel docetaxel sorafenib sunitinib Vincristine Vinblastine	Anthracycline paclitaxel docetaxel Capecitabine 5-FU gemcitabine trastuzumab cetuximab arsenic trioxide thalidomide interleukin-2	Bevacizumab Thalidomide lenalidomide



Adão, R et. Al. Rev Port Cardiol. 2013;32:395-409.

Ms. V

- PMH None
- Functional Status
 - Fatigued, generally weak and mildly dyspneic with activity. Household ambulation
- Medications
 - Levothyroxine
 - Colace
 - Tamoxifen



In addition to a thorough H&P, what testing should Ms. V have preoperatively?

- None
- ECG
- Echocardiogram
- Stress test
- All of the above



Preop cardiac assessment in Cancer Patients

- **THOROUGH** History
 - Dyspnea, orthopnea, edema, chest pain, syncope
- **THOROUGH** Physical Exam
 - JVD, rales, PMI, S3, S4, tamponade physiology, edema
- ECG
 - If equivocal functional status, risk factors and no recent testing



TAKE HOME POINTS

- Cancer and its treatment can increase cardiac morbidity even in young patients
- H&P still the most important screening tool
- Consider pre-op ECG if functional status equivocal



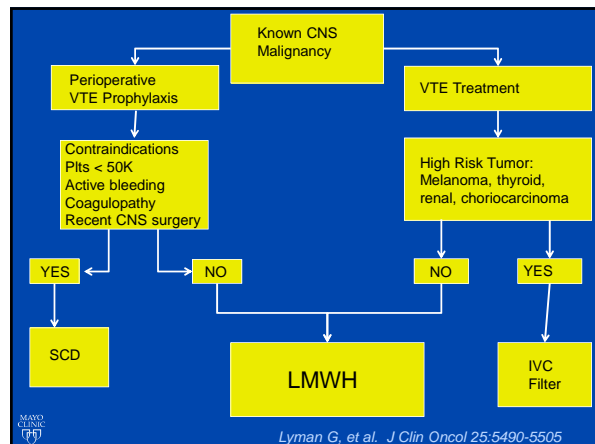
Mr. N

- 37 y.o. male with known widely metastatic multiple myeloma
 - Brain and liver mets
 - Stable disease on treatment
- Admitted after MVA with right femoral neck fracture
- Planned hemiarthroplasty in the am



Which of the following statements is correct regarding VTE prophylaxis

- A. Because of the high risk of hemorrhage melanoma brain mets, he should only receive pneumatic compression devices
- B. Because of the high risk of hemorrhage in melanoma brain mets, he should receive a prophylactic IVC filter
- C. Because of the high risk of VTE due to malignancy, he should receive pharmacologic VTE prophylaxis



TAKE HOME POINTS

- Patients with CNS tumors should receive the same perioperative VTE prophylaxis as those without CNS disease



Ms. B

- Ms. B is a 40 y.o. female with metastatic ovarian cancer and malignant small bowel obstruction
- Chronic cancer related pain well managed on stable regimen prior to current illness
- Plan is for exploratory lap tomorrow



Ms. B

- MEDS
 - Gabapentin 900mg po tid
 - MS Contin 200mg po tid
 - Morphine 75mg po q4h prn pain



In addition to recommending post-op consultation with pain medicine, how would you manage her pain meds pre-op

- A. Take her pain medication as usual the morning of surgery
- B. Stop her MS Contin the night before surgery
- C. Switch her to a fentanyl patch pre-op
- D. Cut her MS Contin in half the day before surgery



Opiate tolerance and perioperative period

- Inadequate pain control increases morbidity
- Inadequate pain control increases length of stay
- Inadequate pain control is unnecessary
- Tolerance \neq addiction



TAKE HOME POINT

- Don't mess with the pain meds pre-op!



RECAP


- Consider pre-op ECG for cancer patients with equivocal functional status, risk factors and no recent evaluation
- Patients with CNS tumors should receive the same perioperative VTE prophylaxis as those without CNS disease
- Don't mess with the pain meds pre-op!



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MAYO CLINIC

Understanding the Perioperative Stress Response



Mayo School of Continuous Professional Development

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 Consultant, Division of General Internal Medicine
 Mayo Clinic Rochester
 October 2013 • Seattle

Disclosures:

- None

Road Map

- Perioperative fluid shifts (major focus)

Briefly noted:

- Catecholamines

Road Map

Not covered in this talk (will be in others):

- Beta blockers
- Thrombogenic effect of surgery
- Corticosteroid stress dosing
- Postoperative fever

Case 1

- 72 yo male is 12 hrs post ORIF R hip fx and you are called by his nurse to assess for possible hypovolemia.
- Urine output for past four hours has averaged 20 cc/hr and the urine appears concentrated.

Type the footnote/source in this space

Case 1

- Blood loss with surgery = 420 cc
- Fluids with surgery = 3.8 L crystalloid (Lactated Ringers).
- Wt is 72.9 kg, up 2.9 kg from pre-op

Case 1

- PMH:
 - HTN, controlled with amlodipine 5 mg/d
 - No other meds



Case 1

- Exam: BP 125/72 P 76/reg R 14
 - Alert and oriented
 - Heart normal, lungs clear, oxysat 92% RA
 - Tongue moist
 - 3 mm pitting edema R mid tib; 1 mm L
 - JVP 2 cm > clavicle at 30 degrees



Case 1

Labs:

	Current	Preop
Hgb	11.2	13.5
Na+	133	137
K+	4.1	4.6
Creatinine	1.0	1.0



Type the footnote/source in this space

Case 1

How would you manage this patient?

1. 500 cc IV bolus of 0.9 saline
2. 25 grams of IV albumin
3. 20 mg of IV furosemide
4. Recheck creatinine in 12 hours



Perioperative fluids and the stress response

- Normal distribution of body fluids:
 - 50% (women) to 60% (men) of lean body wt = total body water (TBW)



Perioperative fluids and the stress response

- Normal distribution of body fluids:
 - 50% (women) to 60% (men) of lean body wt = total body water (TBW)
 - **2/3 of TBW is intracellular**
 - **1/3 of TBW is extracellular (ECV)**



Perioperative fluids and the stress response

- Normal distribution of body fluids:
 - 50% (women) to 60% (men) of lean body wt = total body water (TBW)
 - **2/3 of TBW is intracellular**
 - 1/3 of TBW is extracellular (ECV)
 - **1/5 of ECV is plasma volume (1/15 or 7% of TBW)**



Perioperative fluids and the stress response

- 1/5 of ECV is plasma volume (1/15 or 7% of TBW) → **except in the acute postop setting...where the plasma volume is significantly less**



Perioperative fluids and the stress response

- 1/5 of ECV is intravascular volume (1/15 or 7% of TBW) → **except in the acute postop setting...where the plasma volume by proportion is significantly less**
- Primarily related to capillary leak from IL-6 and other pro-inflammatory cytokines



Perioperative fluids and the stress response

Time Course

- Several stress hormones act to conserve fluid:
 - ACTH, cortisol, plasma renin-aldosterone are all fairly short-lived, <24 hrs peak effect



Type the footnote/source in this space

Perioperative fluids and the stress response

Time Course

- Several stress hormones act to conserve fluid:
 - ACTH, cortisol, plasma renin-aldosterone are all fairly short-lived, <24 hrs peak effect
 - ADH and IL-6 are potently stimulated by surgical stress and may linger for 3 days or longer



Type the footnote/source in this space

Perioperative fluids and the stress response

Clinical Response

- Oliguria with concentrated urine is very common in the first 12-24 hours
- No correlation with postop renal failure in this context



Alpert RA, Roizen MF, Hamilton WK, et al. *Surgery*. 1984;95(6):707-711.

Perioperative fluids and the stress response

Clinical Response

- Oliguria with concentrated urine is very common in the first 12-24 hours
- No correlation with postop renal failure in this context
- Generally by 48-72 hours the patient will begin to auto-diurese



Type the footnote/source in this space

Perioperative fluids and the stress response

Therapeutic Implications

- It is generally best to avoid diuretics in the first 24-48 hrs postop



Type the footnote/source in this space

Perioperative fluids and the stress response

Clinical Studies of Intraoperative Fluids

- Some fluid is good:
- RCT in lap choley shows 3 L of Ringer's lactate are better than 1 L in terms of:
 - Exercise capacity
 - Subjective outcomes (fatigue, nausea)
 - Lower aldosterone and ADH



Type the footnote/source in this space

Perioperative fluids and the stress response

Clinical Studies of Intraoperative Fluids

- Too much fluid may not be so good:
- Literature is complex and results somewhat mixed...



Type the footnote/source in this space

Perioperative fluids and the stress response

Clinical Studies of Intraoperative Fluids

- Too much fluid may not be so good:
- Literature is complex and results somewhat mixed...
- However, "liberal" (~5L) vs "restrictive" (~2L):
 - More cardiopulmonary complications
 - Tissue healing complications
 - Prolonged post-op ileus



Type the footnote/source in this space

Perioperative fluids and the stress response

Clinical Studies of Intraoperative Fluids

- Too much fluid may not be so good:
- Literature is complex and results somewhat mixed...
- However, "liberal" (~5L) vs "restrictive" (~2L):
 - More cardiopulmonary complications
 - Tissue healing complications
 - Prolonged post-op ileus
- It takes an average of 7 days to resolve 6L excess



Holte K. Dan Med Bull. 2010;57(7):B4156.

Perioperative fluids and the stress response
Clinical Studies of Intraoperative Fluids

- Goal-directed management seems optimal
- This usually involves transesoph Doppler in most studies – fluid boluses are given until cardiac output hits the flat part of Starling curve



Type the footnote/source in this space

Perioperative fluids and the stress response
Clinical Studies of Intraoperative Fluids

- Goal-directed management seems optimal
- This usually involves transesoph Doppler in most studies – fluid boluses are given until cardiac output hits the flat part of Starling curve
- ...but this is not practical at the bedside...so what's a clinician to do?



Type the footnote/source in this space

Perioperative fluids and the stress response
Postoperative management

- Some things are easy:
 - Hypotension
 - Tachycardia
 - Blood loss, severe anemia



Type the footnote/source in this space

Perioperative fluids and the stress response
Postoperative management

- Some things are not so easy:
 - Hypotension and tachycardia insensitive (especially in supine position)
 - Oliguria in first 12-24 hours nonspecific
 - JVP is a helpful indicator of CVP, though more for IV volume excess (and may not always be clearly visible)



McGee S. JAMA 1999;281:1022-1029.

Perioperative fluids and the stress response
Postoperative management

Back to the bedside basics:

- Fluid balance – (periop fluid, weight)
- Comorbidities – (esp CHF)
- Physical exam – (oxysat, JVP) (After 1st day --- tongue moisture)



Type the footnote/source in this space

Perioperative fluids and the stress response
Postoperative management

- Timing is everything:
- In first 24-48 hrs, bias should (paradoxically) generally be towards avoiding BOTH:
 - Further excess of *total* fluid AND
 - *IV volume* depletion (no Lasix unless forced)



Type the footnote/source in this space

Perioperative fluids and the stress response

Postoperative management

- Timing is everything:
- In first 24-48 hrs, bias should (paradoxically) generally be towards avoiding BOTH:
 - Further excess of fluid AND
 - IV volume depletion (no Lasix unless forced)
- Generally this means giving maintenance IV fluids only, until auto-diuresis commences at 48-72 hours.



Type the footnote/source in this space

Perioperative fluids and the stress response

Postoperative management

- Timing is everything:
- After 48 hrs, similar principles apply but to lesser degree:
 - Fluid should still be minimized, though may be required for orthostatic tolerance
 - Lasix should still generally be avoided unless necessary (or patient on it preop), as auto-diuresis should help



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Perioperative fluids and the stress response

Which fluid?

- Ringer's Lactate is often used in intraop setting, due to concern for hyperchloremic acidosis with large infusions of saline
- This is thought to not be clinically significant for volumes <5L.



Type the footnote/source in this space

Perioperative fluids and the stress response

Which fluid?

- Ringer's Lactate is often used in intraop setting, due to concern for hyperchloremic acidosis with large infusions of saline
- This is thought to not be clinically significant for volumes <5L.
- RCTs of colloid vs crystalloid are not conclusive in favor of either.



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Case 2 – Catecholamine control

- 55 yo asthmatic with CAD undergoing lap choley for symptomatic gallstones.
- Has had moderately severe bronchospasm with beta blockers in the past.
- Are there other options for managing the catecholamine cardiac stress?



Perioperative Clonidine

- Ideal for patients who would otherwise be candidates for beta blocker, but have significant reactive airways disease
- Regimen:
 - place 0.2 mg patch night prior to surgery, along with a 0.2 mg oral dose
 - repeat oral dose in AM; remove patch on day four



Perioperative Clonidine

- RCT of 190 pts with CAD (or at risk)
- Major vascular and intraabd surgeries
- Postop myocardial ischemia: 14% rx vs 31% for placebo
- Postop mortality to two years: 15% rx vs 29% for placebo
- More bradycardia in rx group (12% vs 2%)

Wallace AW, Galindez D, et al. Anesthesiology 2004; 101:284-93.

Perioperative Clonidine

- A meta-analysis of randomized trials of alpha-2 agonists in over 3000 patients undergoing surgery confirmed similar results, with a 36% relative risk reduction in mortality.

Wijeyesundera DN, Naik JS, Beattie S. Am J Med 2003; 114:742-752.

The Perioperative Stress Response Summary

- Surgery induces significant fluid shifts which tend to increase ECV and decrease plasma volume.



The Perioperative Stress Response Summary

- Surgery induces significant fluid shifts which tend to increase ECV and decrease plasma volume.
- ADH is potently stimulated by surgical trauma and may remain elevated for 3 days or longer.



The Perioperative Stress Response Summary

- Surgery induces significant fluid shifts which tend to increase ECV and decrease plasma volume.
- ADH is potently stimulated by surgical trauma and may remain elevated for 3 days or longer.
- Oliguria is common in the early postop period and is not necessarily indicative of renal insufficiency in that context.



The Perioperative Stress Response Summary

- Loop diuretics should generally be avoided in the first 12-24 hours postop.



Type the footnote/source in this space

The Perioperative Stress Response Summary

- Loop diuretics should generally be avoided in the first 12-24 hours postop.
- Autodiuresis generally begins with waning of ADH levels (48-72 hours).



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The Perioperative Stress Response Summary

- Loop diuretics should generally be avoided in the first 12-24 hours postop.
- Autodiuresis generally begins with waning of ADH levels (48-72 hours).



Type the footnote/source in this space

The Perioperative Stress Response Summary

- In patients for whom beta blockers are indicated for reduction of perioperative CV risk, yet who cannot tolerate them due to risk of bronchospasm, clonidine may be a useful option.



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Thank you!

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MAYO CLINIC

An Overview of
Perioperative Medicine 2013:
 From Outpatient Preoperative Assessment
 to Inpatient Postoperative Care



Mayo School of Continuous Professional Development


James Fink, MD, MPH
 October 9 - 12, 2013 • Grand Hyatt • Seattle, Washington

Perioperative Management of Diabetes

Disclosures

- None

Literature Updates 2013:



Diabetes
Perspective

- most common endocrinopathy in western society
- 15-20 million Americans: 7-8 % of US pop.
- 20+ % of US surgical patients
- Greater perioperative risks of:
 - stroke
 - MI
 - renal insufficiency
 - wound complications/infection

Diabetes and Surgery:

Scenario 1 - Outpatient:
 Elective → Surgical outpts → pre-op assessment → Hospital admission → OR & recovery
 → post-op care → discharge

Scenario 2 - Inpatient:

```

  Urgent      Hospital Admission
  →
  Emergent   Pre-op assessment
  →
  OR & recovery → post-op care → discharge
  
```

Diabet. Med. 29, 420-433 (2012)

Question 1.

- A colleague calls (knows you're interested in perioperative medicine) asking about a diabetic patient going for elective surgery
- A diabetic patient on oral hypoglycemics is due for an elective TKR. HbA1c is 7.5% and steady
- This colleague wants to know what pre-op HbA1c is recommended for elective surgery



Based on your extensive knowledge of the evidence, you advise you colleague to target?

- 1) < 6%
- 2) < 7%
- 3) < 9%
- 4) < 12%



Answer:

- 1) < 6%
- 2) < 7%
- 3) < 9%
- 4) < 12%



History

- Medication management
 - Insulin vs. oral/others
 - Compliance/Adherence
- Hypoglycemia awareness
- Other DM related co-morbidities
 - Gastroparesis/Autonomic dysfunction
- Prior surgery – issues/complications



"Prayer Sign" - Cheiroarthropathy



Predictor of complications associated with "stiff joint" syndrome

Increasing Interphalangeal gap → difficult laryngoscopy

Sens 50's – 86%, Sens 50's – 75%, PPV 90.5%, NPV 67%



<http://emedicine.medscape.com/article/284451-overview>
J Anaesth Clin Pharmacol 2005;21(3):261-264

Pre-op Investigations

- Preoperative resting 12-lead ECG may be reasonable in patients with at least 1 clinical risk factor who are undergoing intermediate-risk operative procedures. (Level of Evidence: B)
- Consider 'silent' CAD in patients with autonomic neuropathic sx
 - (may include further risk stratification for CAD)



Conroy, LE & Coursin, DB. Assessment and therapy of selected endocrine disorders. Anesthesia Clin N Am. 2004; 22:93-123
ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery: Executive Summary

Pre-op HbA1c

- Guidelines:
- Check in patients presenting with hyperglycemia
- Known DM without record of HbA1c in last 2-3 months



JCEM 2012
ADA 2010

Pre-op BSL / HbA1c – targets?

- Dr Google:
- Elective surgery goal < 6%
- “Involve diabetes team” \geq 8.5 - 9%
- “Consideration should be given to improving control prior to surgery” > 12%



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Evidence linking elevated pre-op BSL or HbA1c with post-op complications

- Arch Surg 2006;141:375-380
 - HbA1c <7% decreased surgical infections
 - J Thorac Cardiovasc Surg 2008;136:631-640
 - HbA1c > 8.6% associated with a 4 fold increase in mortality in patients undergoing CABG
 - Can J Anaes 2010;57:565-572
 - HbA1c >6% in *non-diabetics* increased mortality in cardiac surgery
-
- Ann Surg 2011;253:158-165
 - Preoperative random BSL and HbA1c not associated with postoperative infection
 - Euro J Cardio-Thoracic Surg 2012;41:102-107
 - Decreased incidence of post-CABG Atrial fib with increasing HbA1c



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Utility of pre-op HbA1c

- Determine post-op and discharge management

HbA _{1c} level	Treatment
Less than 7%	Can be discharged on the same outpatient therapy.
7%-9%	Restart prior oral glucose-lowering agents and discharge on glargine at 50%-80% of hospital total daily dose.
More than 9%	Discharge with basal bolus insulin at the same hospital dose or with prior doses of oral agents plus glargine at 80%-100% of hospital total daily dose.

Note: Based on a 12-week follow-up of 224 inpatients with type 2 diabetes.
Source: Dr. Urquiza



<http://www.ehospitalistnews.com/>

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Pre-op BSL targets/evidence

TABLE 3. Comparisons between Boston Medical Center and Yale New Haven Protocols.

Protocol leadership	Boston medical center Endocrinology, anesthesiology, nursing, pharmacy, and surgery	Yale new haven Endocrinology, intensivist, anesthesiology, nursing, pharmacy, surgery, and administrators
Target intraoperative glucose range	120-180 mg/dL	120-180 mg/dL
Threshold for treatment of perioperative hyperglycemia	>180 mg/dL	>200 mg/dL (pre-op) >180 mg/dL (intra- and post-op)
Threshold for evaluation of metabolic stability preoperatively	>300 mg/dL	At the discretion of the practitioner
Recommendation for cancellation of nonurgent surgery*	>500 mg/dL	>400 mg/dL

*See text for details. Surgery could also be cancelled at the discretion of the provider at a different glucose level based on surgical urgency and procedure risk.

Reasons for elevated pre-op BSL

- Inadequate long-term glycemic control
- Inappropriate discontinuation of preoperative antidiabetic therapy
- Preoperative stress response
- May be caused by the illness for which the patient needs surgery!



Alexanian, S et. al. Anesthesiology Research and Practice 2011
Review Article: Creating a Perioperative Glycemic Control Program

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Take Home: Pre-op BSL / HbA1c

- Insufficient data to specifically recommend preoperative fasting BSL or HbA1c above which elective ambulatory surgery patients should be postponed
- Surgery should be postponed if significant complications of hyperglycemia are present
 - Severe dehydration, ketoacidosis, hyperosmolar nonketosis



Anesth Analg 2010;111:1378-87
AAACE Diabetes Mellitus Guidelines, Endocr Pract. 2007;13(Suppl 1) 2007 63

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Pre-op summary

- History
 - control/adherence
 - complications
 - hypoglycemia awareness
- Exam
 - neuropathies
 - cardiovascular abnormalities (micro/macrovacular)
- Investigations
 - BSL
 - HbA1c
 - ECG



Case #2

- 42yo female planned elective cholecystectomy after an episode of acute cholecystitis 1 mo ago
- Type II DM
- Meds:
 - 30units BD 70/30 insulin
 - Metformin 1000mg BD
 - Lisinopril 5mg daily
- Sees Dr regularly, no known complications, reportedly good control
- First on the OR list in 7 days time



How do you manage her diabetic medications on the morning of surgery?

- 1) Half the dose of 70/30 and metformin the AM of surg
- 2) Hold metformin, continue 70/30 insulin without change
- 3) Hold both, check BSL's post -op
- 4) Withold metformin, give 1/2 of the intermediate (NPH) component of the 70/30 insulin



Answer:

- 1) Half the dose of 70/30 and metformin the AM of surg
- 2) Hold metformin, continue 70/30 insulin without change
- 3) Hold both, check BSL's post -op
- 4) Withold metformin, give 1/2 of the intermediate (NPH) component of the 70/30 insulin



Perioperative Diabetes

Oral Hypoglycemics/Others

- sulfonylureas - Glipizide, Glyburide, Chlorpropramide
- short acting insulin secretagogues - Nateglinide(starlix)Repaglinide(prandin)
- biguanides - Metformin
- thiazolidinediones - Pioglitazone
- carbohydrase inhibitors - Acarbose, Miglitol
- DPP4 inhibitor - Sitagliptin (Januvia)
- GLP1 agonists - Exenatide (Byetta)
- SGLT2 inhibitors - Canagliflozin



Bottom Line

- **Hold all** oral hypoglycemics/newer agents on the AM of surgery
- resume only when taking adequate PO



Perioperative Diabetes
Management of Oral Hypoglycemics


metformin (cont)

- contraindication rigidly defined (in U.S.):
 - Serum creatinine > 1.5 ♂, > 1.4 ♀
 - Creatinine clearance < 60 mL/min
- CHF, hypoperfusion, old age (≥80), chronic pulmonary disease
- **HOLD:**
 - 48 hrs prior to radiocontrast; 24 hrs prior to OR
- **RESTART:**
 - 24-48 hrs post procedure if renal function OK

MAYO CLINIC
 Metformin Drug Information
 Arch Intern Med 2002;162:434-437

Risk of fatal and nonfatal lactic acidosis with metformin use in type 2 diabetes mellitus (Review)

Adjuik V, Coates T, Pennell GA, Sjoquist S, Imhoffen EE



Main results

Pooled data from 347 comparative trials and cohort studies revealed no cases of fatal or nonfatal lactic acidosis in 70,490 patient-years of metformin use or in 55,451 patient-years in the non-metformin group. Using Poisson statistics the upper limit for the true incidence of lactic acidosis per 100,000 patient-years was 6.3 cases in the metformin group and 5.4 cases in the non-metformin group. There was no difference in lactate levels, either as mean treatment levels or as a set change from baseline, for metformin compared to non-metformin therapies.

Authors' conclusions

There is no evidence from prospective comparative trials or from observational cohort studies that metformin is associated with an increased risk of lactic acidosis, or with increased levels of lactate, compared to other anti-hyperglycemic treatments.

MAYO CLINIC
 The Cochrane Collaboration 2010

Perioperative Diabetes
Management of Oral Hypoglycemics

"...Recent evidence continues to indicate that lactic acidosis is a rare complication despite the relative frequency of risk factors. However, in the hospital, where the risk of hypoxia, hypotension and renal insufficiency is increased, it is prudent to avoid the use of metformin in most patients..."

MAYO CLINIC
 Clement, S et al. Diabetes Care 2004;27(2):553-591

Perioperative Diabetes
Oral Hypoglycemics: Management

sulfonylureas

- **HOLD:**
 - Glipizide/Glyburide - night before or morning of procedure
 - Nateglinide/Repaglinide - (short acting) morning of procedure
- **RESTART:**
 - when taking adequate PO

MAYO CLINIC

Perioperative Diabetes
Management of Oral Hypoglycemics

thiazolidinediones:

- slow onset and long duration of action
- **HOLD/RESTART:**
 - can be continued morning of, and throughout periop period
 - Caution: Hemodynamic changes/CHF or hepatic dysfunction

MAYO CLINIC
 Clement, S et al. Diabetes Care 2004;27(2):553-591
 Marks, JB. AAFP 2003;67(1):93-100

Perioperative Diabetes
Newer Agents

- Sitagliptin (Januvia) – DPP4 Inhibitors
- Exenatide (Byetta) – GLP1 agonists
- No formal guidelines, hold both perioperatively!

MAYO CLINIC
 Med Clin N Am 2009;93:1031-1047
 CCM 2009;7(6):suppl4):e33-e39
 Research communications, K. Evidence 1/2010

Hold 'em



Perioperative Diabetes
Glycemic control considerations

- Duration of procedure
- Pre-op diabetes control
- Post-op complications and/or expected LOS



Perioperative Diabetes
Preop Insulin Management

- basal insulin (Lantus/Glargin)
 - continued without dose change
 - consider decrease by 50% in type 2 DM
- intermediate acting insulin (NPH)
 - 1/2 to 2/3 of the usual dose the evening before and morning of surgery
- fast acting/immediate (regular/Lispro)
 - not given the morning of surgery



CC:BJ 2006;73(11):95-99
Anesthesia Clin N Am. 2004; 22:93-123

Case #2

- Given 20 units NPH on AM of surgery
- Metformin held AM
- Post – op day #0 - receives an additional 20 units of NPH in evening – resumes fluids
- Post - op day #1 – resume 70/30 insulin
- continue to hold vs. restarting metformin (check creatinine, dehydration status)



Case #3

- 55yo male sent to ER by local free medical clinic due to concerns about his infected foot
- Hx of poorly managed DM, CAD, HTN...
- Meds ?
- SH: + tobacco, + alcohol



Case #3

- Admitted for surgical debridement
- Medicine consult – HELP!



Case #3

- Exam:
- T: 98, P:100, BP: 170/95
- BSL – 305mg/dl



Case #3 Question

How should we manage this patient's diabetes perioperatively?

- 1) Sliding Scale Insulin
- 2) NPH or Lantus insulin + bolus correction
- 3) Continuous insulin infusion (CII) with a target BSL between 140 – 180 mg/dl
- 4) CII with a target insulin < 110mg/dl (< 6.2mmol/L)

Answer:

- 1) Sliding Scale Insulin
- 2) NPH or Lantus insulin + bolus correction
- 3) Continuous insulin infusion (CII) with a target BSL between 140 – 180 mg/dl
- 4) CII with a target insulin < 110mg/dl (< 6.2mmol/L)

Considerations

- Multiple risks – including presumed CKD
- Poor control pre-op
- Neuropathies – peripheral, autonomic/gastroparesis

Perioperative glycemic control

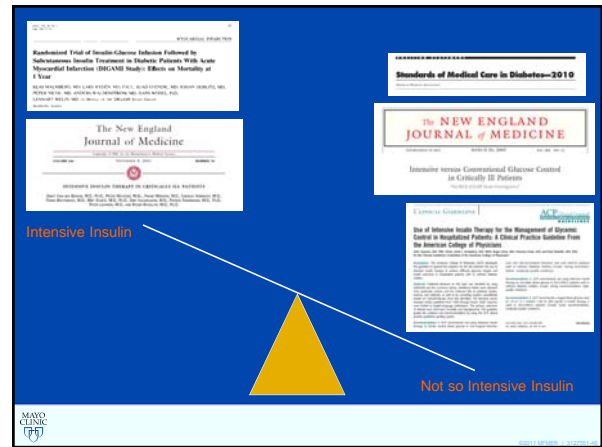
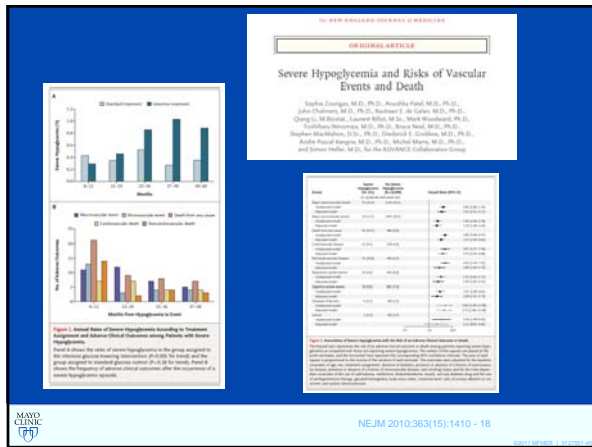
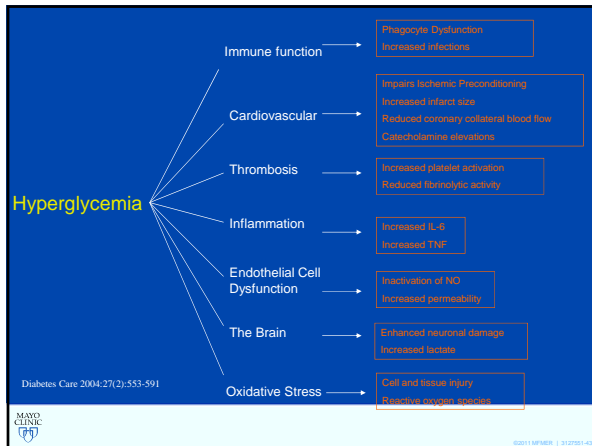
- Start insulin infusion
 - Suspect poor control
 - Oral hypoglycemics inadequate + unpredictable hospital LOS, fasting...
 - Easiest to adjust to proper BSL targets
- What are our targets?

Perioperative Diabetes

Hyperglycemia/Insulin Management

Continuous Insulin Infusion (CII):

- best way to maintain glycemic control in perioperative period
- start 2 hours prior to surgery
- frequent glucose monitoring Q1-2 hrs and as needed
- monitor electrolytes



- ## Insulin Therapy in Hospitalized Patients
- Critically Ill:**
 - initial target < 180 mg/dl (10 mmol/l)
 - 140 – 180 mg/dl on IV insulin therapy
 - “somewhat lower in some patients”
 - < 110 mg/dl (6.2 mmol/l) not recommended
 - Noncritically Ill:**
 - Premeal < 140mg/dl (7.8 mmol/l)
 - Random < 180 mg/dl
- Diabetes Care 2010;33(6):1111-1111

- ## Sample Insulin Infusion
- Start Insulin Infusion
 - 1 unit per hour for patient who was previously diet controlled, taking oral agent, or using less than 30 units of insulin per day
 - 1.5 units per hour for patient taking greater than 30 units of insulin per day
 - Other: _____ units per hour
 - Note: patient or clinical circumstances may force higher initial insulin infusion rates and greater incremental adjustments.
 - Adjust insulin infusion as follows (glucose values presented as mg/dL):
 - Glucose < 60 Stop infusion and call house officer. Administer 50 mL of Dextrose 50%. Do not re-start insulin until glucose is greater than 100. Repeat every 15 minutes until glucose is greater than 100
 - Glucose 60-79 Decrease infusion by 50%
 - Glucose 80-109 Decrease infusion by 1 unit/hour
 - Glucose 110-119 Decrease infusion by 0.6 units/hour
 - Glucose 120-139 Decrease infusion by 0.3 units/hour
 - Glucose 140-179 No change in drip rate
 - Glucose 180-209 Increase infusion by 0.3 units/hour
 - Glucose 210-249 Increase infusion by 0.6 units/hour
 - Glucose >249 Increase infusion by 1 unit/hour
 - * If glucose is greater than 249 and has not decreased despite 4 hourly increases in the infusion rate, then notify the house officer to determine if larger increase is warranted

Perioperative Diabetes Odds & Ends + Special situations

MAYO CLINIC

Perioperative Diabetes Insulin Sliding Scale

- “corrective” insulin
- avoid as only means of glucose control
- useful adjunct to long acting regimens
- Basal / Bolus / Boost!

MAYO CLINIC

Clinical Care/Education/Nutrition/Psychosocial Research Randomized Study of Basal-Bolus Insulin Therapy in the Inpatient Management of Patients With Type 2 Diabetes Undergoing General Surgery (RABBIT 2 Surgery)

SSI 4x / day

Glargine & glulisine

- Prospective trial
- Type 2 DM
- Pre-op antidiabetic meds discontinued
- SSI vs. Glargine / glulisine
- 0.5 U/kg/day divided into G & g

Diabetes Care 34:256–261, 2011

MAYO CLINIC

Rabbit II Surgery Results:

Decreased composite complications in G & g group

Increased hypoglycemic episodes

Variable	SSI	Basal-bolus	P-value
Major infections	14	11	0.276
Pneumonia	7	3	0.247
Acute respiratory failure	6	11	0.213
Acute renal failure	15	11	0.186
Reintubation	3	2	0.999
Number of patients with complications	35	28	0.003
Mortality	2	1	0.6
Postoperative ICU admission (%)	14	10.6	0.23
Length of stay (days)	2.18 ± 1.00	2.19 ± 2.14	0.985
ICU	0.8 ± 0.9	0.5 ± 0.8	0.223
Hospital	6.8 ± 6.9	6.5 ± 5.8	0.223

Variable	SSI	Basal-bolus	P-value
Number of patients	231	127	0.84
Number of ICU stays	5,779	1,825	1,932
No. of hypoglycemic events	4 (1.7%)	0	0.007
Number of patients (%)	1.7	0	0.20
Number of events (%)	14 (3.5)	2 (1.6)	0.305
Number of patients (%)	0.43	0.13	0.77
Number of events (%)	27	2	0.51
No. of hypoglycemic events	29 (12.6%)	14 (11.1%)	<0.001
Number of patients (%)	48	0	0.001
Number of events (%)	1.28	0.13	1.85

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Perioperative Diabetes Insulin Pump Management

- Limited data, no trials specific for pump management
- Management dependent on:
 - type of surgery
 - duration
 - anesthesiology familiarity/comfort
- Communication essential
- Generally:
 - discontinue insulin pump preoperatively and start continuous insulin infusion IV
 - restart insulin pump when patient is alert & awake and taking adequate PO

MAYO CLINIC

Perioperative Glycemic Management in Insulin Pump Adult Patients Undergoing Noncardiac Surgery

Current Pharmaceutical Design 2012;18:6204-6214

MAYO CLINIC

Perioperative Diabetes
Hyperglycemia with TPN

- Total Parenteral Nutrition (TPN)
 - Majority of patients require insulin
 - higher insulin requirements than enteral (lack of GLP -1)
 - Consider cutting insulin dose by 1/2 when changing from TPN to enteral
- Start IV infusion with TPN x 24hrs
- Add 60-80% of 24 hour total to TPN bag then correct every 4-6hrs with fast or rapid acting insulin

CCJM 2006;73(1):595-599
 "Perioperative Management of Endocrine Disorders" in Medical Management of the Surgical Patient 2008

Perioperative Diabetes
Hyperglycemia with TF

- Tube Feeding (TF) - complicated by regimen
 - Start with Continuous insulin infusion
- Bolus TF
 - can use basal/bolus regimen
- overnight or continuous TF
 - 70/30 insulin one time vs Q8H with regular insulin coverage Q4H
 - Q6H regular insulin + sliding scale for continuous TF

CCJM 2006;73(1):595-599
 "Perioperative Management of Endocrine Disorders" in Medical Management of the Surgical Patient 2008

Perioperative Diabetes
Steroid Induced Hyperglycemia

- Common & complicated
 - dose of steroid, duration, patient's understanding, degree of hyperglycemia
- Pathogenesis
 - ↑hepatic gluconeogenesis
 - ↑peripheral insulin resistance
- Often manifests as post-prandial hyperglycemia
- 2-3 fold increase in total daily insulin dose may be required with high dose steroid therapy

Diabetes Care 2004;27(2):553-591

Perioperative Diabetes
Steroid Induced Hyperglycemia

- Insulin is drug of choice
 - Prandial insulin with short acting agents
 - Glargine – if longer acting steroid, (dexamethasone)
 - NPH – if using prednisone; maximize AM dose, minimize PM dose
 - 50:50 Basal: Bolus - normal insulin therapy
 - 30:70 Basal: Bolus - steroid induced hyperglycemia
- Other Literature Recommendations - Oral agents
 - Repaglinide (prandin) with meals
 - Glipizide in AM

"Perioperative Management of Endocrine Disorders" in Medical Management of the Surgical Patient 2008
 Personal communication, K. Furlong, 1/2010. J Hosp Med 2007;26(1):23-32

CPD exacerbations on Prednisone with Continuous Glucose Monitoring (CGM)

FIG. 2. Average hourly interstitial glucose concentration in 13 controls with COPD without known diabetes admitted for other indications and not treated with glucocorticoids (group 1), 40 patients without known diabetes admitted to hospital with an exacerbation of COPD and treated acutely with prednisolone (group 2), and seven diabetic COPD patients treated with prednisolone (group 3). Values represent mean \pm SE. The x-axis signifies time of day in military time.


FIG. 3. Average hourly interstitial glucose concentration in 13 controls with COPD without known diabetes admitted for other indications and not treated with glucocorticoids (group 1), 40 patients without known diabetes admitted to hospital with an exacerbation of COPD and treated acutely with prednisolone (group 2), and seven diabetic COPD patients treated with prednisolone (group 3). Values represent mean \pm SE. The x-axis signifies time of day in military time.

NPH

J Clin Endocrinol Metab 96: 1789–1796, 2011

MAYO CLINIC


An Overview of
Perioperative Medicine 2013:
 From Outpatient Preoperative Assessment
 to Inpatient Postoperative Care



Mayo School of Continuous Professional Development
 Amy W. Williams, MD
 October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

MAYO CLINIC

**Perioperative Nephrology
 Issues**



Mayo School of Continuous Professional Development
 Amy W. Williams MD
 Division of Nephrology and Hypertension
 Mayo Clinic, Rochester, MN

- Disclosures
 None to report

Case #1

85 year old woman on hemodialysis three times a week via a left arm AV fistula. Her left arm is massively swollen due to a proximal stenosis. She has now developed a nonhealing ulcer on her left hand.

She is scheduled for ligation of the left AV fistula and creation of a right arm AV fistula under general anesthetic

She refuses to have general anesthetic as someone told her never to have it because she would die

Case #1

Significant medical history

- Atrial fibrillation since 2007, not currently on warfarin due to fall risk.
- S/P permanent pacemaker placement for sick sinus syndrome (2007) which was subsequently removed 7/2008 due to endocarditis.
- S/P lumbar osteomyelitis

Case #1

What do you tell her ?

- Her risk of perioperative death is < 10%.
- Her risk of perioperative death is 45%.
- Her risk of perioperative death is high and there is nothing that can be done to improve it.
- Dialysis right after surgery will improve her risk.
- Transfusions to get her Hemoglobin to a normal level will decrease her perioperative risk of death

Perioperative Nephrology Issues

ESRD patients

increased surgical mortality

- Elective general surgery 4% mortality
- Cardiac surgery 10% mortality
- Emergency surgery 45% mortality
- Causes: Sepsis & CVD



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Why is this important?

- > 300,000 people in the US on dialysis
- > 26 million people in the US have CKD
- 11 million have stage 3 CKD (GFR < 60 mL/min/1.73m²)
 - 6.6 million age > 60 years have stage 3 CKD
- 10-16% of the world population has CKD



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Risks can be present in CKD

Causes of perioperative morbidity

- Decreased ability to:
 - Regulate sodium and volume
 - Handle acid loads
 - Excrete potassium
 - Excrete medications
- Anemia
- Platelet dysfunction – bleeding
- Arrhythmias
- Infections
- CVD



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Stages of Chronic Kidney Disease & Recommended Clinical Action

Stage	Description	GFR mL/min/1.73m ²	Action
0	At Increased risk	>90 with CKD risk factors	Screening CKD risk reduction
1	Kidney damage with normal or ↓ GFR	≥ 90	Dx & Rx of common conditions Slow progression, CVD risk ↓
2	Kidney damage with Mild ↓ GFR	60 - 89	Estimating progression
3	Moderate ↓ GFR	30 - 59	Evaluating and treating complications
4	Severe ↓ GFR	15 - 29	Preparation for renal replacement therapy
5	Kidney failure	<15 or dialysis	Replacement if uremia present

NKF, Am J Kidney Dis. 2002;39(suppl 1):S1-S266



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Stages of Chronic Kidney Disease & Recommended Clinical Action

Stage	Description	GFR	Action
0	At Increased Risk for Cardiovascular & Cerebrovascular disease	>90	Screening risk reduction
1	Kidney normal or ↓ GFR	≥ 90	Dx & Rx of common conditions Slow progression, CVD risk ↓
2	Kidney damage with Mild ↓ GFR	60 - 89	Estimating progression
3	Moderate ↓ GFR	30 - 59	Evaluating and treating complications
4	Severe ↓ GFR	15 - 29	Preparation for renal replacement therapy
5	Kidney failure	<15 or dialysis	Replacement if uremia present

NKF, Am J Kidney Dis. 2002;39(suppl 1):S1-S266



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Increased surgical risk: Advanced CKD & ESRD multi-system involvement

- Co-morbid illnesses
 - Diabetes Mellitus
 - HTN
 - CAD/heart disease
 - PVD
 - Autonomic dysfunction
 - Cerebral VD
 - Pulmonary disease
 - Immune mediated diseases
- Malnutrition
- Multiple medications
- Altered volume status
- Electrolyte /acid-base imbalances
- Abnormal coagulation



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Major Adverse Cardiac & Cerebrovascular Events after Non-Cardiac Surgery – Can you predict who is at risk?

3387 patients: 4.3% had at least one MACCE

- Arrhythmia
- CHF
- Angina
- Stroke
- MI
- Non-fatal cardiac arrest
- 13.7% died from a MACCE

S. Sabate, et al. British Journal of Anesthesia. 107 (6):879-90. 2011



Independent Predictors of MACCE

- History of CAD
- History of CHF
- CKD
- History of Cerebrovascular disease
- Abnormal ECG
- Intraoperative Hypotension
- RBC Transfusions



Independent Predictors of MACCE

- History of CAD
- History of CHF
- **CKD**
- History of Cerebrovascular disease
- Abnormal ECG
- Intraoperative Hypotension
- RBC Transfusions



CKD5 is a major risk factor in patients undergoing elective vascular surgery.

James C. Iannuzzi, MD, University of Rochester, NY

47,704 patients

1324 (2.8%) with CKD5

Mortality CKD5 - 8% vs. 2%; $P < .001$

- 2.92 adjusted odds ratio for mortality
- 3-fold increased risk for cardiac complications
- 50% greater risk for major complications (39% vs. 21%, $P < .001$)
- Hospital stay was approximately twice as long

American College of Surgeons (ACS) 98th Annual Clinical Congress: Abstract NP2012-23767. Presented October 3, 2012.



Predictors of major postoperative complications with CKD5

- Functional status
 - Race - Black
 - Wound class
 - Diabetes
 - Pulmonary co morbidities
 - Cardiac co morbidities
 - Anemia.
 - older than 75 years
 - transfer status.
- multivariate analysis

American College of Surgeons (ACS) 98th Annual Clinical Congress: Abstract NP2012-23767. Presented October 3, 2012.



Perioperative goals for patients

- Euvolemic
- Normotensive
- Normonatremic
- Normokalemic
- Not anemic
- Normal platelet function/coagulation profile



Preparing the ESRD & Advanced CKD Patient for Surgery

- Lab evaluation
 - Nutritional status
 - Anemia
 - Fluid and electrolyte balance
 - Glucose metabolism
- Blood pressure control
- CVD risk evaluation and management
- Correction of bleeding diathesis
- Antibiotic administration
- IV access
- Anesthetic considerations
- ESRD -Dialysis dose/method
- CKD - Prevention of ARF & need for renal replacement



Pre-op Laboratory Evaluation Emergent Attention/Risk Assessment

1. Anemia → Hgb
2. Bleeding diathesis → BUN, Hgb
3. Metabolic Acidosis → Bicarbonate
4. Sodium abnormalities → Sodium
5. Hyperkalemia → Potassium
6. Metabolic bone disease → Calcium, phosphorus, magnesium
7. Uremia → Creatinine, BUN
8. Nutrition → Albumin
9. Diabetes → Glucose



Preoperative Management: ESRD/CKD

Anemia

Goal: Hct 25% - 30%

Treatment:

- Increase erythropoietin pre-op
 - need time for results
- RBC Transfusion → ESRD - best to transfuse on dialysis
 - Improves platelet-vessel wall interaction normalizing bleeding time
 - Large K load: check K pre & post transfusion
 - Significant volume: check volume status pre & post each unit



Uremic Bleeding Diathesis

- Decreased platelet adhesiveness
 - Abnormal factor VIII activity
- When to treat?
- High BUN or evidence of uremia
 - Intra- and post- operative excessive bleeding

Treatment

- Transfuse - HCT 30%
- Dialysis
- Cryoprecipitate (10 bags)
- *L*-desamino-8-arginine vasopressin (DDAVP)
0.3 ug/kg IV or 3.0 ug/kg intranasal



Case #1 continued

The patient normally dialyzes M-W-F. Her surgery is on a Thursday. Based on this, you schedule her dialysis to

1. occur two consecutive days prior to surgery
2. to be longer the day before surgery
3. to occur as usual (no change)
4. occur the AM of surgery
5. occur as usual on Wednesday but without heparin



Preparing the ESRD patient for surgery

- Anemia
- Metabolic acidosis
- Hyperkalemia
- Fluid overload
- Uremia

Treatment is
Dialysis



ESRD Preoperative Management: Dialysis

- Corrects electrolyte imbalances
 - Immediately post dialysis – hypokalemia, hypercalcemia, metabolic alkalosis
- Removes excess fluid
 - If hypovolemic, anesthesia-induced systemic vasodilatation can lead to profound hypotension
- Can transfuse if needed
- Involves heparin use



ESRD Preoperative Management: Dialysis

- Timing before surgery
- Elective surgery - dialyze the day before
- Emergent surgery - can dialyze pre-op with
 - Dialysate prescription to avoid hypokalemia
 - Careful fluid removal
 - Discuss goals for peri-op volume status with surgeon and anesthesiologist
 - No heparin



Fluid & Electrolyte Balance ESRD Perioperative Management

Intra- & Post-operative Abnormalities

Metabolic acidosis

Hyperkalemia

Hypovolemia or Hypervolemia



Fluid & Electrolyte Balance Postoperative Management ESRD Rx: Dialysis

Pre-dialysis

Post-dialysis

Metabolic acidosis ←————→ Metabolic Alkalosis

Hyperkalemia ←————→ Hypokalemia

Hypervolemia ←————→ Hypovolemia

Hyperphosphatemia ←————→ Hypophosphatemia

Hemodynamic instability



Fluid & Electrolyte Balance Postoperative Management ESRD Rx: Dialysis

1. Daily hemodialysis
2. Continuous renal replacement therapy
 - Less electrolyte and osmolality changes
 - Allows for achieving a more true dry weight
 - Improved hemodynamic stability
3. Best to wait 12-24 hours postop for daily or intermittent dialysis
4. Peritoneal dialysis – continuous



Perioperative Management ESRD & CKD

Hyperkalemia

If EKG changes – Rx emergently

ESRD
Most effective

1. Calcium gluconate
2. Insulin/glucose
3. B-adrenergic agonists
4. Bicarbonate

ESRD
Effective only with severe
Metabolic acidosis



Perioperative Management ESRD & CKD

Hyperkalemia

If EKG changes – Rx emergently

To remove K

■ ESRD - dialysis

■ CKD

If urine output -
Loop diuretic and
IV fluid replacement

■ Cation exchange resin

Exchange Resins

Caution

Intestinal Necrosis

Risks:

Decreased motility

Hypertonic sorbitol



Case #2

52 year old ESRD patient develops an acutely incarcerated abdominal wall hernia and needs emergent surgery. He is in extreme pain.

He dialyzes M-W-F and it is now Sunday at 9PM

He is 2L above his dry weight, but lungs are clear and he has no edema.

Labs: Na 132 mmol/L

K 5.9 mmol/L

Creatinine 5.9 mg/dL

BUN 58mg/dL



Case #2

The surgeon feels the patient needs emergent surgery and asks you if anything further needs to be done prior to going to the OR.

You recommend:

1. Emergent dialysis
2. Kayexalate PO
3. Perioperative LR solution at 100cc's hour
4. Emergent ECG
5. Patient go directly to the OR



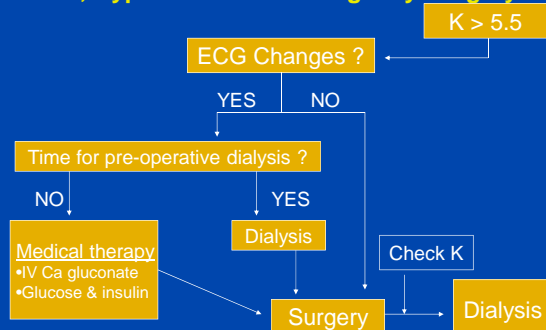
Hyperkalemia and Emergency Surgery

ECG first

- ECG changes result from
 - Changes in transcellular K gradient
 - Not absolute value
- Chronic dialysis patients – tolerance
- ECG changes may not occur until K >6.0



ESRD, Hyperkalemia & Emergency Surgery



Peri-operative fluid management

ESRD

- replace losses
 - 3rd spacing
 - GI losses
 - Insensible losses (including wound)
- No need for maintenance fluids if anuric
- Standard solution: Normal Saline
 - Avoid Lactated Ringers, or other K containing solutions

CKD

+ Urine output



Perioperative Hypertension ESRD and CKD

Pre and Post -Op

- If NPO
 - IV analaprilat → **Caution with advanced CKD**
 - Hydralazine (with B-Blocker)
 - 1. ARF
 - 2. Hyperkalemia
 - labetalol
 - diltiazem
 - Nitroprusside (cyanide poisoning)
- Fluid removal: gently ESRD – dialysis, CKD - loop diuretic



Postoperative Hypertension ESRD and CKD

Post-op and taking PO

- Careful, graduated reinstatement of normal antihypertensive regimen
- Fluid removal – gently
 - ESRD – dialysis, CKD - loop diuretic



Perioperative Hypotension Causes in ESRD & advanced CKD

1. Dialysis
 - Fluid removal
 - Electrolyte, and osmolality changes
2. Left ventricular dysfunction
3. Vasodilation – meds
 - Opioid analgesics
 - Anti-anxiety meds
4. Sympathetic dysfunction due to
 - Diabetic neuropathy
 - Acquired dystonia of recumbency
 - Sympatholytic medications
5. Pericardial tamponade



Postoperative Inter and Intra-dialytic Hypotension

- Too much or too rapid fluid pull on dialysis
- Third spacing
- Increased insensible loss or unrecognized GI losses and drainages
- Myocardial dysfunction
- Antihypertension medications (are all the preop BP meds needed ?)
- Infection
- Pain medication
- Exaggerated peripheral vasodilatation (worsened by anemia)



Evaluation of Cardiac Risk ESRD and CKD

High risk for CVD

- Inflammatory state
- Hypertension
- Coronary Artery Disease
- Impaired Cardiac Function (CHF, LVH)
- Hyperlipidemia
- Anemia
- Hyperphosphatemia, decreased Vit D
- Proteinuria

Mortality from CVD

ESRD = 10 X Non-ESRD
ESRD + DM = 44 X Non-ESRD



Evaluation of Cardiac Risk ESRD & CKD (with CV risks)

Myocardial Function Assessment

- Left ventricular dysfunction increases surgical morbidity and mortality
- Evaluate with Echocardiogram
 - Identifies patients at higher risk
 - Guides perioperative management
 - Fluid management –dialysis management and timing
 - Guide medical management of cardiac function
 - Indicate need for intra- and peri-operative monitoring



Case 4:

62 year old woman on hemodialysis presents to the emergency room with abdominal pain. Her exam is consistent with a small bowel obstruction. She is afebrile and her WBCs is normal. An abdominal film is also consistent with a small bowel obstruction.

BP 160/82 P 76

1+ LE edema

Lungs: Free bibasilar crackles



At this point, which test do you recommend to further evaluate.

- A. CT with contrast
- B. CT without contrast
- C. MRI with gadolinium
- D. CT with contrast with hemodialysis immediately after
- E. Bolus with IV fluids
- F. NSAIDs to control the pain



Gadolinium Nephrogenic Systemic Fibrosis (NSF) Risk Factors

- Proinflammatory states
 - Infection
 - Connective tissue disease
 - Major surgery
- Hypercoagulable state
 - Hepatorenal syndrome
 - Liver transplant
- Liver failure
 - Hepatorenal syndrome
 - Liver transplant
- Metabolic abnormalities
 - Hyperphosphatemia
 - Hypercalcemia
 - Acidosis
 - Iron overload
- Therapeutic agents
 - High dose ESA
 - IV iron



Gadolinium Nephrogenic Systemic Fibrosis (NSF) Risk Factors

- Proinflammatory states
 - Infection
 - Connective tissue
 - Metabolic abnormalities
 - Hyperphosphatemia
 - Hypercalcemia
 - Hepatorenal syndrome
 - Liver transplant
- | CKD stage | risk |
|-----------|----------|
| 1-3 | low |
| 4 | moderate |
| 5 | HIGH |



NSF

Prevention

- Use only macrocyclic gadolinium
- Use lowest dose possible
- Avoid IV iron and ESA before and after gadolinium
- Optimize calcium, phosphorus, acid/base status prior to exposure
- HD post gadolinium exposure



Do you need to worry about Nephrotoxins once on dialysis?

- Residual renal function is important with ESRD
 - Improves survival
 - Improves fluid and electrolyte balance
 - Allows adequate total clearance with less dialysis
 - Avoid nephrotoxins to preserve residual renal function (contrast dye, NSAIDs)
- Dialysis on any kind will not protect against contrast nephropathy



Case #3

78 year old man with squamous cell CA of the tongue is scheduled for extensive ENT surgery. He has stage 4 CKD (GFR 28ml/min, Cr 1.8mg/dL) due to a nephrotic glomerular disease. He never wants to go on dialysis.



Case #3

You discuss the case with the surgeon and recommend which measure(s) to prevent AKI:

1. No real caution needed, this degree of CKD is not a risk for acute kidney injury (AKI)
2. In the perioperative period maintain strict BP control
3. If urine output decreases to < 35cc/hour give IV loop diuretics.
4. There is no increase in mortality until the creatinine doubles.
5. Hypotension is the insult most likely to cause AKI.



Stages of Chronic Kidney Disease & Recommended Clinical Action

Stage	Description	GFR	Action
CKD is a risk factor for Acute Kidney Injury			
2	Kidney damage with Mild ↓ GFR	60 - 89	Estimating progression
3	Moderate ↓ GFR	30 - 59	Evaluating and treating complications
4	Severe ↓ GFR	15 - 29	Preparation for renal replacement therapy
5	Kidney failure	<15 or dialysis	Replacement if uremia present

NKJ, Am J Kidney Dis. 2002;39(suppl 1):S13-S26



AKI in the Hospital

- occurs in 4-7.2% of **all** hospitalized patients
 - 0.3 increase in creatinine = increased mortality
 - >0.5 increase in creatinine = 6.5 x increase in odds of death Cherrow GM. et al. J Am Soc Nephrol 2005;16:3365-70
- most common etiologies of AKI
 - Decreased renal perfusion
 - Medications
 - IV contrast
 - Post-op status
 - Sepsis Nash K. et al. J Am Soc Nephrol 2002;39:930-6



CKD - Prevent AKI & the need for renal replacement

- Maintain renal blood flow
 - Cautiously use ACE/ARB
 - Avoid pre-renal azotemia
 - Avoid NSAID
- Avoid renotoxic medications
 - aminoglycoside
- Avoid electrolyte disturbances
 - Hyperkalemia
 - Metabolic acidosis
 - Hypo- & hypernatremia
- Avoid contrast dye



Contrast Nephropathy

Who Is At Risk?

- Creatinines < 2mg/dl - Diabetics
- Creatinines > 2mg/dl
- Volume depletion
- CHF
- NSAID, Cyclosporin, meds that decrease RBF (ARB, ACE)
- Advanced age > 80 years
- ? Multiple myeloma (nephrotic syndrome)
- Repeated exposure within 72 hours
- Multiple risk factors are additive



Strategies to Prevent Contrast Nephropathy What has **NOT** been proven to work:

- HemoDialysis/hemofiltration post contrast
- Fenoldopam
- Sodium Bicarbonate infusion
- N-Acetylcysteine ? Higher doses



Strategies to Prevent Contrast Nephropathy What **has** been proven to work:

- Hydration IV .9NS or Oral
- Avoid high osmolality contrast
- Avoid repeated exposures

Pannu N. JAMA, 2006
Marenzi G. Curr Opin Crit Care, 2004
From AM, (Abstract) American Society of Nephrology, 2006



Case # 4

58 year old man is s/p mitral and aortic valve replacement due to severe endocarditis which destroyed both valves. His is in respiratory failure - ventilator dependent, on multiple pressors due to a systemic inflammatory response and has developed anuric acute kidney injury requiring continuous renal replacement therapy.

Exam: he is intubated, ventilated, sedated

He has a temporary dialysis catheter in the L IJ, an art line in his R arm and a PICC (triple lumen) in the L arm and a feeding tube in place

BP 89/48 p 68

4+ edema



Which of the following will most negatively impact his survival on long term dialysis?

1. His respiratory failure requiring ventilator support
2. His multisystem failure
3. Requiring continuous renal replacement therapy
4. His PICC line
5. His need for a feeding tube



Hemodialysis access Arteriovenous fistula is the best

- Lack of an AVF is associated with
 - Increased hospitalizations
 - Infections
 - Inadequate dialysis
 - Increased mortality
 - Previous Peripherally inserted central venous catheter (PICC)
- 46-100% incidence of stenosis after subclavian vein puncture
 - unrelated to duration or size of the catheter



AVF vs Graft or Central Venous Catheter

- AVF - better patency rates
- AVF - fewer complications
- AVF – lower mortality
- AVF – improved dialysis adequacy

- CVC – 5x risk of bacteremia



ABIM Foundation/Consumer Reports
Choosing Wisely Campaign
ASN recommendation #4:

“Do not place peripherally inserted central venous catheters (PICC) in stage 3-5 patients without consulting Nephrology”

ABIM Foundation. Choosing Wisely. <http://choosingwisely.org>. Philadelphia, PA, April 4, 2012



Preserve UE veins!

- PICCS and Central Venous Complications
 - 38% incidence of central vein thrombosis
Allen AW, et al. J Vasc Interv Radiol 2000
 - 42% incidence of central vein stenosis
Gonsalves CF, et al. Cardiovasc Intervent Radiol 2003
 - 46-100% incidence of subclavian stenosis after subclavian puncture
Barrett N, et al. Nephrol Dial Transplant 1988, Schwab SJ, et al. Kidney Int 1988 Spinowitz BS, et al. Arch Intern Med 1967
 - Prior PICC is a strong, independent predictor of a lack of a functioning AVF
El Ters M, et al. Am J Kidney Dis 2012



Recommendations to preserve Veins in CKD

- Avoid PICC and subclavian punctures
- Protect the non-dominant arm from blood draws and IV cannulations
- Use only the dorsum of the hand if needed
- Educate patients and health care professionals



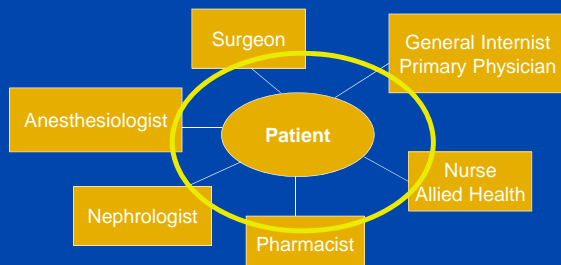
Perioperative Recommendations for Patients with ESRD & CKD

- Document renal function pre-op and monitor for changes in GFR
- Adjust medication doses for GFR
- No aluminum containing medications
- Monitor electrolytes, Mg, Phos
- Avoid K containing IV maintenance fluids
- Careful monitoring and management of blood glucose
- Closely monitor and optimize intravascular volume
- Avoid nephrotoxins (NSAID, contrast)
- Avoid gadolinium when GFR is ≤ 20
- Avoid upper extremity IV access/PICC lines
- Preserve veins for AVF



Perioperative Management of Patients with ESRD & CKD

Multi-disciplinary team approach




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MAYO CLINIC

An Overview of
Perioperative Medicine 2013:
Delirium in the Surgical Patient



Mayo School of Continuous Professional Development

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Disclosures

- No relevant financial disclosures
- I have a second job which generates \$0
- My 15 year old son is the reason that all my hair turned grey!

Objectives

- Discuss the incidence, impact and pathogenesis of postoperative delirium
- Review the risk factors for postoperative delirium
- Understand diagnosis and management of postoperative delirium
- Review persistent delirium and postoperative cognitive dysfunction

Delirium

- An acute change in mental status
- Inattention
- Fluctuating course
- Disorganized thinking

Delirium

- Cognitive deficits
- Perceptual disturbances
- Psychomotor changes
- Altered sleep wake cycle
- Emotional disturbances

Emergence Delirium

- Occurs during the transition from anesthesia to wakefulness
- Characterized by agitation and hyperactivity
- Generally short- lived

Impact

- Increased mortality
- Increased length of stay
- Increased rate of discharge to long term care facilities
- Increased risk of major medical complications
 - MI
 - Pulmonary edema
 - Respiratory failure
 - pneumonia



Impact

- Common cause of postoperative morbidity and mortality
- 50% of all surgeries in the US are done on people over age 65
- Depending on surgery, approximately 10% will develop delirium
- Highest risk in patients having hip fracture surgery and CABG



Impact

- Patients who developed delirium had 62% greater risk of mortality within 1 year after discharge and lived an average of 274 days vs 321 days for those without delirium (Leslie DL. Arch Int Med 2005)
- Total direct healthcare costs attributable to delirium about \$143 billion annually (Leslie DL. JAGS 2011)



Pathophysiology

- Not well understood
- EEG- diffuse slowing of cortical background
- Neuroimaging-generalized disruption of higher cortical function



Pathophysiology

Neurotransmission

- Cholinergic deficiency
- Anticholinergic drugs
- Physostigmine and cholinesterase inhibitors



Pathophysiology

Inflammation

- Increased proinflammatory cytokines increased in delirium
- Cytokines may alter blood-brain barrier and neurotransmission
- ? perivascular edema > hypoxia >
- decreased synthesis of acetylcholine

Hala M. Med Hypotheses 2007



Case 1

- A 76 year old woman undergoes a right L5 foraminotomy and L5-S1 fusion. Past history significant for "Mixed Connective Tissue Disease". Medications preoperatively: Prednisone, Plaquenil, Celebrex, Nortriptyline, Coumadin and Ultram



Case 1

- Postoperatively, she has some mild hypoxemia, thought to be due to narcotics.
- POD #0- no sleep
- AM rounds: easily startled, irritable, restless



What is the best way to determine if this patient has delirium?

1. Request a psychiatry evaluation
2. CAM (Confusion Assessment Method)
3. Folstein mini-mental status exam
4. MRI of her brain
5. MMPI



What is the best way to determine if this patient has delirium?

1. Request a psychiatry evaluation
2. CAM (Confusion Assessment Method)
3. Folstein mini-mental status exam
4. MRI of her brain
5. MMPI



Diagnosis

Diagnostic tools for delirium:

- Folstein MMSE
 - Most helpful if baseline MMSE done previously
 - Very good at predicting cognitive impairment
 - Cannot easily distinguish between delirium and dementia



Diagnosis

- Confusion Assessment Method (CAM)
 - More useful in diagnosing delirium
 - Input from caregivers and family
 - Studied mostly in the assessment of postoperative delirium
 - 94-100% sensitive
 - 90-95% specific



Diagnosis

- Recent JAMA study: CAM is the most reliable instrument for the evaluation of delirium
- Takes about 5 minutes to administer

Wong et al JAMA 2010;304(7):779-786



Diagnosis

1. Acute onset and fluctuating course
2. Inattention
3. Disorganized thinking
4. Altered level of consciousness

Diagnosis of delirium requires the presence of both 1 and 2 and either 3 or 4



Confusion Assessment Method

- Have we met before?
- What surgery have you had done?
- What surgeon did the procedure?
- How long ago was the procedure?
- How are things going today?

Marcantonio JAMA 1994;271:134



Confusion Assessment Method

- Have you had any problems with confusion or disorientation since the operation?
- Have you seen or heard things that aren't really there?
- How much pain are you having on a scale of 1-10?
- Please count backwards from 20-1



Confusion Assessment Method

- Feature 1: Acute onset and fluctuating course
 - Acute change in mental status?
 - Has the behavior fluctuated in the past 24 hours?
- Feature 2: Inattention
 - Difficulty focusing attention?
 - Distractible?
 - Difficulty keeping track of conversation?



Confusion Assessment Method

- Feature 3: Disorganized thinking
 - Speech disorganized or incoherent?
 - Illogical flow of ideas?
- Feature 4: Altered level of consciousness
 - Vigilant
 - Lethargic
 - Stupor
 - Coma



Case 2

- 66 year old woman with multiple medical problems is admitted for repair of a right hip fracture.
- Medical issues include:
 - Hypertension
 - Untreated OSA
 - Atrial fibrillation, history of RVR
 - CAD
 - CHF
 - History of previous perioperative DVT



Case 2

- Medications: Lisinopril, digoxin
- BMI=46
- Unknown functional status
- Possible history of bipolar disorder, and bizarre behavior
- On admission, appeared to be oriented, answered most questions appropriately
- Normal vital signs, heart rate 60, atrial fibrillation
- Labs normal, except UA showed 20-50 WBC's



Which of the following puts her at increased risk for postoperative delirium?

1. Morbid obesity
2. Digoxin use
3. Multiple co-morbidities
4. Atrial fibrillation
5. Family history of Alzheimer's disease



Which of the following puts her at increased risk for postoperative delirium?

1. Morbid obesity
2. Digoxin use
3. Multiple co-morbidities
4. Atrial fibrillation
5. Family history off Alzheimer's disease



Risk Factors

- Predisposing factors- increase a patient's vulnerability to delirium
- Precipitating factors- initiate the delirium
- Vulnerable patients are at increased risk when exposed to precipitating factors



Predisposing Factors-Established

- Age
- Cognitive impairment
- Lower education level
- Sensory impairment
- Decreased functional status
- Comorbid medical illness
- Malnutrition
- Depression

Bagri et al Clin Geriatr Med 24 (2008)



Predisposing Factors- Controversial

- History of prior delirium
- Gender
- Alcohol use or abuse
- Tobacco use
- Apolipoprotein E4 gene carrier status



Box 1: Risk factors for delirium after noncardiac surgery* 11,12.

- Age \geq 70 years (OR 3.3, 95% CI 1.9–5.9)
- Existing cognitive impairment (OR 4.2, 95% CI 2.4–7.3)
- Functional impairment (OR 2.5, 95% CI 1.2–5.2)
- Alcohol abuse (OR 3.3, 95% CI 1.4–8.3)
- Abnormal preoperative level of sodium, potassium or glucose (OR 3.4, 95% CI 1.3–8.7)
- Preoperative psychotropic drug use (OR not available)
- Depression (OR not available)
- Increased comorbidity (OR not available)
- Living in a long-term care facility (OR not available)
- Visual or hearing impairment (OR not available)

*Odds ratios (ORs) and 95% confidence intervals (CIs) are provided where available.

Holroyd-Leduc J M et al. CMAJ 2010;182:465-470



Precipitating Factors- Established

- Orthopedic, vascular, cardiac surgery
- Emergency procedure
- Delayed repair after hip fracture
- Preoperative hemodynamic instability
- Hypoxemia
- Electrolyte disturbance
- Transfusion requirement
- Sleep deprivation
- Urinary catheter



Precipitating Factors- Established

- Immobility
- Poorly controlled pain
- Polypharmacy
- Benzodiazepines
- Anticholinergics
- Meperidine
- ? Longer operations



Precipitating Factors- No Effect

- General vs regional anesthesia
- Route of postoperative analgesia
- Type of opioid



Case 2

- 66 year old woman with multiple medical problems is admitted for repair of a right hip fracture.
- Medical issues include:
 - Hypertension
 - Untreated OSA
 - Atrial fibrillation, history of RVR
 - CAD
 - CHF
 - History of previous perioperative DVT



Case 2

- The patient undergoes surgery without any intraoperative complications.
- She is extubated in the PACU.
- About 30 minutes after extubation, she becomes confused and combative, requiring multiple doses of haloperidol for agitation.



What is the most appropriate strategy to determine the cause of her delirium?

1. Administer a dose of Narcan
2. Obtain a CT of her head
3. Obtain an ABG
4. Obtain an EEG
5. Obtain a psychiatry consultation



Workup

The search for an underlying cause:

- History- Patient may be unreliable, family and caregivers very important
- Prior history of delirium



Workup

Physical exam:

- Vital signs
- Oxygenation
- Hydration
- Trauma
- Infection
- Neurologic exam



Workup

Organ system evaluation:

- CHF, MI
- Acute renal failure
- Liver disease
- Stroke
- COPD, respiratory failure, pulmonary embolism
- Constipation



Workup

- Review of all medications
- ?Potential for withdrawal syndrome
- All have potential, some more common



Drugs Commonly Associated with Delirium

- NSAIDs
- Opioids
- Fluoroquinolones
- Cephalosporins
- Atropine
- **Diphenhydramine**
- Levodopa
- H-2 receptor blockers
- St. John's wort
- Benzodiazepines
- SSRIs
- Tricyclic antidepressants
- Clonidine
- Digoxin



Workup

Diagnostic workup:

- Based on results of history and physical exam
- CBC, electrolytes, renal and liver function, blood sugar, urinalysis
- Drug levels when appropriate
- EKG, *cardiac enzymes*
- Cultures when infection suspected



Workup

- Chest X-ray
- ABG
- Diagnostic tests for pulmonary embolism if suspected



Workup

Neuroimaging should not be part of baseline workup

- New neurologic deficits
- History of head trauma

EEG:

- Not part of baseline workup
- Subclinical seizures



Case 2

- 66 year old woman with multiple medical problems is admitted for repair of a right hip fracture.
- Medical issues include:
 - Hypertension
 - Untreated OSA
 - Atrial fibrillation, history of RVR
 - CAD
 - CHF
 - History of previous perioperative DVT



Case 2

- Since her episode of agitation in the PACU, she remained confused and combative.
- She was noted to be hypercapnic and was started on non-invasive ventilation, with normalization of her pCO₂.
- Urine culture grew E. coli, which was treated with ciprofloxacin
- Electrolytes, creatinine and ECG were all normal or unchanged



How should her agitation and combativeness be managed?

1. Reorient her frequently and use a sleep enhancement protocol
2. Start benzodiazepines and continue to titrate the dose until she is sedated
3. Use vest restraints and give haloperidol until she is sedated
4. Transfer her to the ICU
5. Start her on donepezil



How should her agitation and combativeness be managed?

1. Reorient her frequently and use a sleep enhancement protocol
2. Start benzodiazepines and continue to titrate the dose until she is sedated
3. Use vest restraints and give haloperidol until she is sedated
4. Discontinue all medications
5. Start her on donepezil



Management

Management of delirium:

- Find and treat the underlying cause
- Supportive measures
- Pharmacologic measures for symptom control and safety
- **Prevention**



Management

Supportive care:

- Simplify the environment
- Adequate but not excessive lighting
- Room temperature
- Glasses, dentures, hearing aids
- Adequate nutrition, hydration and oxygenation
- Enlist family members
- Familiar objects, pictures
- Frequent orientation
- Clocks and calendars
- Early mobilization



Management

- Remove urinary catheters as soon as possible
- Encourage participation in self-care
- **Avoid use of restraints except when absolutely necessary**



Management

- Sleep disruption may be a key contributing factor to delirium
- Sleep enhancement may help prevent delirium
- Delirium and sleep deprivation share many clinical and physiological features
 - Inattention
 - Fluctuating mental status
 - Impaired cognition, especially executive function
 - Cholinergic deficiency, dopaminergic excess



Management

- Always try non-pharmacologic strategies first!



Targeted risk factor	Strategy
Cognitive impairment	<ul style="list-style-type: none"> • Orientation protocols • Provision of clocks and calendars
Functional impairment	<ul style="list-style-type: none"> • Early mobilization, including getting patient out of bed regularly and as tolerated starting on postoperative day 1 • Daily physiotherapy with occupational therapy as needed
Fluid and electrolyte imbalances	<ul style="list-style-type: none"> • Restoration of serum sodium, potassium and glucose levels to normal limits • Detection and treatment of dehydration or fluid overload
High-risk medications	<ul style="list-style-type: none"> • Discontinuation or minimization of use of benzodiazepines, anticholinergics, antihistamines and meperidine • Modification of dosage or discontinuation of drugs to minimize drug interactions and adverse effects
Pain	<ul style="list-style-type: none"> • Standing orders for acetaminophen use rather than use as needed • Treatment of breakthrough pain starting with low-dose narcotics; avoidance of meperidine
Impaired vision and hearing	<ul style="list-style-type: none"> • Appropriate use of glasses, hearing aids and adaptive equipment
Malnutrition	<ul style="list-style-type: none"> • Ensurance of proper use of dentures, proper positioning, assistance with eating if required and use of supplements if required
Iatrogenic complications	<ul style="list-style-type: none"> • Removal of urinary catheter by postoperative day 2, with screening for urinary retention and incontinence • Implementation of a skin-care program • Bowel regimen to ensure bowel movements by postoperative day 2 then every 48 hours • Chest physiotherapy and supplemental oxygen if indicated • Appropriate anticoagulation therapy
Sleep deprivation	<ul style="list-style-type: none"> • Screening and treatment of urinary tract infection • Unit-wide strategies to reduce noise • Scheduling of medications and procedures to allow for proper sleep • Use of nonpharmacologic measures to promote sleep

Management

Medications for symptom control:

- Antipsychotics
 - Haloperidol
 - Risperidone or olanzapine
 - Quetiapine
- APA (American Psychiatric Association) recommends low dose haloperidol as the first line agent for episodes of delirium.



Management

- Cochrane Review 2007:
 - No convincing studies that newer antipsychotics are any better than haloperidol
 - Prophylactic low dose haloperidol in hip fracture patients did not decrease the risk of delirium, but did reduce the duration and severity
 - No difference in adverse drug effects between low-dose haloperidol and atypical antipsychotics



Management

- Benzodiazepines only for use in alcohol or sedative withdrawal
- ? nicotine replacement in smokers
 - No good evidence
 - May be some adverse effects on bone grafts
- Some studies suggest that melatonin may be useful in treating postoperative delirium



Management

- Some recent studies looking at the use of cholinesterase inhibitors for management of delirium
- Cochrane Database Review: No evidence that these are effective



Management

- Few intervention studies which demonstrate success
- Most successful interventions involve identifying patients at risk and taking steps to minimize the risk = **Prevention!**



Management

- **Prevention seems to be a matter of excellent medical care**
 - Fluids, electrolytes, nutrition
 - No unnecessary medications
 - Sleep enhancement
 - Early mobilization and rehabilitation
 - Management of the environment



Management

- Importance of pain management
- Significant postoperative pain or increased pain in patients with preoperative pain highly associated with delirium
- Optimal method of treating postoperative pain controversial
- PCA probably better than “on-demand”
- Oral may be better than parenteral
- ? Scheduled oral



Postoperative Cognitive Dysfunction (POCD)

- Occurs weeks to months after surgery
- Affects memory, information processing and executive function
- Patients often discover new difficulties with normal activities at home or work
- Attention impaired, but consciousness normal
- Diagnosis with neuropsychiatric testing



Postoperative Cognitive Dysfunction (POCD)

Risk factors

- Extensive surgical trauma
- Increasing age
- Sleep deprivation
- Postoperative pain
- Systemic inflammation

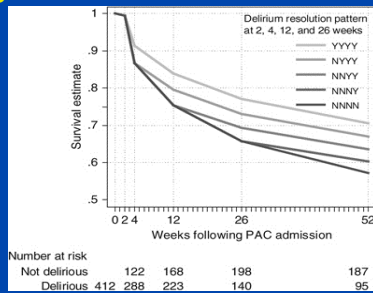


Persistent Delirium

- Patients with persistent delirium were 3x more likely to die in the first year of followup compared to patients whose delirium resolved.
- 1 year cumulative mortality of 39%
- At risk for long term nursing home placement
- Poor quality of life
- Greater healthcare expenditures



Persistent Delirium Predicts Greater Mortality



Journal of the American Geriatrics Society
Volume 57, Issue 1, pages 55-61, 11 DEC 2008
DOI: 10.1111/j.1532-5415.2008.02092.x

Take Home Points

- Postoperative delirium is a medical emergency
- Development of postoperative delirium is associated with increased morbidity and mortality
- The pathogenesis is unknown, but cholinergic deficiency is thought to play a role
- CAM is the most reliable tool for diagnosing delirium

Take Home Points

- Proactive strategies can be used for at-risk patients
- There are pharmacologic and non-pharmacologic interventions for management of delirium
- Delirium makes it difficult to obtain informed consent and to involve patients in their own care

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Thank You!

- Beliveauficalora.margaret@mayo.edu

MAYO CLINIC

**An Overview of
Perioperative Medicine 2013:**
From Outpatient Preoperative Assessment
to Inpatient Postoperative Care



Mayo School of Continuous Professional Development

James Fink MD, MPH
October 9 - 12, 2013 • Grand Hyatt • Seattle, Washington

**Perioperative Management of
Endocrine Issues:**

Stress Dose Steroids, Adrenal Insufficiency, Thyroid Disease

Disclosures

- None

Take Home

- Adrenal Insufficiency/Steroids
 - “Stress Dose” steroids appropriate in certain patients
 - Adjust dose to pre-op condition & surgery
 - Keep it brief!
- Thyroid Disease
 - Don’t test pre-operatively unless clinically indicated
 - Thyroxine $T_{1/2}$ = 6-7 days
 - Be aware Thyroid Storm

FYI

**Surgery in the Patient
with Endocrine
Dysfunction**

Benjamin A. Kohl, MD¹, Stanley Schwartz, MD²

KEYWORDS

- Endocrine • Perioperative • Diabetes • Hyperthyroidism
- Hypothyroidism • Adrenal insufficiency • Pheochromocytoma

Med Clin N Am 2009;93:1031-1047

Case # 1

- 37 yo male with a history of Addison’s and Hypothyroidism
- For elective Back Surgery – lumbosacral and sacroiliac fusion
- Medications
 - Hydrocortisone 20mg/10mg AM/PM
 - Levothyroxine 150 mcg daily

Case # 2
What is the best management for his Addison's disease perioperatively?

- 1) Cease patients regular steroids and give 200mg IV hydrocortisone x 1 pre-op
- 2) Continue patients usual steroids and give 200mg IV hydrocortisone x 1 pre-op
- 3) Continue patients usual steroids and give 25mg of hydrocortisone pre and post-op
- 4) Continue patients usual steroids and give 50 – 100mg of hydrocortisone pre-op and Q8H post-op for 24 -48hrs

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Answer:

- 1) Cease patients regular steroids and give 200mg IV hydrocortisone x 1 pre-op
- 2) Continue patients usual steroids and give 200mg IV hydrocortisone x 1 pre-op
- 3) Continue patients usual steroids and give 25mg of hydrocortisone pre and post-op
- 4) Continue patients usual steroids and give 50 – 100mg of hydrocortisone pre-op and Q8H post-op for 24 -48hrs

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Steroid Supplementation / Stress Dose Steroids

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1942 ADRENAL ATROPHY—FRASER ET AL. JAMA, Aug. 23, 1952

CLINICAL NOTES

ADRENAL ATROPHY AND IRREVERSIBLE SIDING ASSOCIATED WITH CORTISONE THERAPY

Charles G. Fraser, M.D.
 Fred S. Press, M.D.
 and
 Walter D. Rifkind, M.D., Tucson, Ariz.

Recent clinical observations and animal experiments have shown that prolonged administration of cortisone produces adrenal atrophy. According to the adaptation

per 100 in 1300 subjects selected on atherosclerosis. Significant results revealed nothing especially abnormal. The white cell count was 11,000 with 75% neutrophils, 17% lymphocytes, 1% monocytes, 1 basophil, and 2 eosinophils.

Change in the blood—The sodium retained declines up to the time of admission and then slowly rises with the increasing time. Blood urea nitrogen and creatinine, with fractional excretion of creatinine, are approximately normal. The blood osmolarity at the beginning of the operation was 290 and at the end 287. A routine laparotomy of the right hip was performed. During the course of surgery the patient received one blood transfusion. The blood pressure did not fall below 10/60 during the whole procedure. After the first unit of blood was given the second was begun. After the patient received 30 cc. of the second transfusion some muscular twitches were noted, so that transfusion was discontinued to await a further reaction. During the course of the

CASE REPORTS

FATAL ADRENAL CORTICAL INSUFFICIENCY PRECIPITATED BY SURGERY DURING PROLONGED CONTINUOUS CORTISONE TREATMENT*

By Leon Lewis, M.D., P.A.C.P., Berkeley, California, Robert F. Ryan, M.D., Walnut Creek, California, James Yee, M.D., Oakland, California, Lucy A. Hackler, M.D., and George Evans, M.D., Vallejo, California

Introduction

When hyperadrenocorticism is deliberately induced with ACTH or cortisone for the control of disease, the resulting changes in disease activity are accompanied by a wide variety of physiologic and metabolic changes, some desirable and others unfavorable. Among these are alterations in the function of

...of disease is... after cortisone... months there... for adrena... whose pituitary... with the... performs... reported... promptly by ad... daily doses of... of operation. It... of each patient... cortisone... progressive per... to surgery to... change of corti

JAMA 1952;149:1542-1543
 Ann Intern Med 1953;39:116-125

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Periop Steroid Replacement 1953

I. For patients receiving cortisone:

A. Preoperative program:

1. ACTH in doses of 20 to 30 units intramuscularly every six hours for five days before surgery.

or

ACTH in doses of 20 units, by slow intravenous drip (in 1,000ml 5 per cent glucose in water) over periods of 12 to 24 hours daily for three days before surgery.

2. Cortisone intramuscularly, 100mg daily for two days before surgery and again preoperatively on the day of surgery.

B. Postoperative program

1. Normal saline, 1,000 ml, intravenously (or fluids as indicated by electrolyte and hematologic studies).
2. Cortisone intramuscularly, 25 mg every six hours for three days or equivalent amount orally; then resume preoperative oral dosage.
3. ACTH in doses of 20 units intramuscularly every four to six hours for two days, then 15 units every six hours for two days, 10 units twice daily for two days, 5 units twice daily for one day (or modified schedule of gradually diminishing dosage).

II. For patients receiving ACTH:

A. Preoperative program:

1. Cortisone intramuscularly, 100 mg daily for two days before surgery and again preoperatively on the day of surgery.
2. Continue usual ACTH dosage uninterruptedly.

B. Postoperative program

1. Normal saline, 1,000 ml, intravenously (or fluids as indicated by electrolyte and hematologic studies).
2. Cortisone intramuscularly, 25mg. Every six hours for two days, then every eight hours for two days. If oral medication is possible at the end of a few days, continue with 25 mg. every 12 hours for two days, then 25 mg. daily for two days. Otherwise, follow the same dosage schedule by intramuscular route.
3. Continue usual (preoperative) ACTH dosage uninterruptedly.

III. For emergency surgery when above preoperative preparation is impossible: continue usual dosage of hormone and give 500 mg. cortisone intramuscularly. Also give 30 to 50 ml. of aqueous adrenal cortical extract intravenously during surgery, repeated as necessary. Postoperatively give both ACTH by intravenous route and cortisone intramuscularly. The dosage required under these circumstances cannot be estimated accurately, but effective amounts should be used and electrolyte balance should be closely supervised.

Ann Intern Med 1953;39:116-125

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REVIEW ARTICLE

Perioperative Glucocorticoid Coverage
A Reassessment 42 Years After Emergence of a Problem

Michael Salem, M.D., Robert E. Tarish, Jr., M.D., M.P.H., Jonathan Bromberg, M.D., Ph.D., D. Lynn Loriaux, M.D., Ph.D., and Bart Chernow, M.D., F.A.C.P.

From the Surgical Intensive Care Division, Department of Anesthesiology and Critical Care Medicine, the Johns Hopkins University School of Medicine, Baltimore, Maryland; the Department of Anesthesia, Florida Hospital Medical Center, Orlando, Florida; the Department of Surgery, Medical University Hospital, Medical University of South Carolina, Charleston, South Carolina; the Endocrine Division, Department of Medicine, Oregon Health Science University, Portland, Oregon; and the Department of Medicine, Sinai Hospital of Baltimore, and the Departments of Medicine, Anesthesiology, and Critical Care Medicine, the Johns Hopkins University School of Medicine, Baltimore, Maryland.

ANNALS OF SURGERY
 Vol. 176, No. 4, pp. 423-431
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Adrenal Insufficiency

- Primary:
 - adrenal gland dysfunction
 - loss of mineralocorticoid and glucocorticoid
- Secondary:
 - ACTH dependent (adrenal gland intact)
 - usually intact mineralocorticoid function
- Tertiary:
 - hypothalamic/pituitary suppression
 - most common



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Perioperative Adrenal Insufficiency Risk Factors

- Patients with known HPA disease
- patients taking steroids for > 3 weeks in the past year
- examples:
 - transplant recipients
 - chronic lung disease
 - rheumatologic disease
 - IBD
 - collagen vascular disease
 - neurosurgery
 - dermatologic conditions



JAMA 2002;287(2):236-240
Update – The surgical patient taking glucocorticoids
http://www.eric.ycu.edu/home/resources/courses/PreOp_Steroids.pdf

Steroid Supplementation: Agreement

- all patients on chronic steroids require their normal daily corticosteroid therapy
- patients receiving < 5mg Prednisone/day or alternate day therapy usually DO NOT require supplemental therapy
- Patients with HPA insufficiency (1°, 2°) require stress dose supplementation
- no benefit to excessive supplementation or prolonged treatment !



JAMA 2002;287(2):236-240
http://www.eric.ycu.edu/home/resources/courses/PreOp_Steroids.pdf
Med Clin N Am 2009;93:1031-1047

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Steroid Supplementation: Agreement – HPA dysfunction 1

- supplementation individualized according to age, procedure, weight, use of concurrent medications (phenytoin, rifampin, barbiturates)
- typical dose:
 - Hydrocortisone - can be multiple divided doses
- alternative
 - continue pre-procedure therapy and add 0.5mg dexamethasone or 5mg Prednisone/day – (longer T_{1/2})



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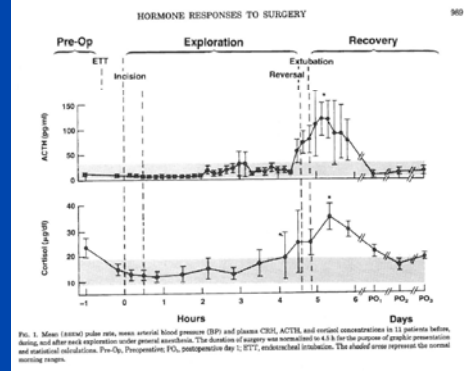
Steroid Supplementation: Agreement – HPA dysfunction 2

- all HPA patients:
 - superficial procedure [< 1 hr in duration under local anesthesia (dental work, skin bx, minor ortho)]
 - requires only the normal daily replacement dose of corticosteroids
- ** production of cortisol normalizes 24 - 48hrs post surgery (taper accordingly)



Med Clin N Am 2009;93:1031-1047

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J Clin Endocrinol Metab 1987;64:986-994

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Steroid Supplementation: Controversy

- Applies to patients at risk of iatrogenic (3°) adrenal insufficiency
- Issues/Questions:
 - To cosyntropin test or not?
 - Dosage of supplementation?
 - Duration of supplementation?



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Perioperative Adrenal Insufficiency Risk Stratification

- **Low Risk:**
 - Patients taking glucocorticoids < 5mg/day or alternate day therapy
 - Inhaled, topical or regional steroids
- **Intermediate Risk:**
 - Patients taking 5 – 20 mg glucocorticoids day > 3 weeks in the past year
- **High Risk:**
 - Patients taking > 20mg/day, > 3 weeks in past year or
 - Patients with Cushing features



Update – The surgical patient taking glucocorticoids
http://www.eric.vcu.edu/home/resources/consults/PreOp_Steroids.pdf
 Med Clin N Am 2009;93:1031-1047

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Perioperative Adrenal Insufficiency Risk Management

- **Low Risk**
 - no further testing, continue standard dose, no supplementation
- **High Risk**
 - no further testing, continue daily dose + supplementation



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Perioperative Adrenal Insufficiency Risk Management Cont'd

- **Intermediate risk:**
 - **Emergent surgery:**
 - no further testing, continue daily dose + supplemental dose
 - **Urgent/Elective:**
 - Cosyntropin stimulation testing of HPA
 - Subnormal response – daily dose + supplementation
 - Normal response – daily dose steroid



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Steroid Management		Patient Risk			
		LOW	INTERMEDIATE Cosyntropin normal	INTERMEDIATE Cosyntropin subnormal	HIGH
Minor	Emergent	No supplementation or 25mg IV Hydrocortisone x 1	No supplementation or 25mg IV Hydrocortisone x 1	25 – 50 mg IV Hydrocortisone x 1	→
	Urgent/Elective	No supplementation	No supplementation		
Moderate	Emergent	No supplementation or 50mg IV Hydrocortisone x 1 then Q6h x 24 – 48hrs	No supplementation or 50mg IV Hydrocortisone x 1 then Q6h x 24 – 48hrs	100 mg IV Hydrocortisone x 1 or 50 mg Q12h for 24hrs	→
	Urgent/Elective				
Major	Emergent	No supplementation or 100 mg IV Hydrocortisone x 1 then 50 – 100mg Q6h x 24 – 48hrs	No supplementation or 100 mg IV Hydrocortisone x 1 then 50 – 100mg Q6h x 24 – 48hrs	100 mg IV Hydrocortisone x 1 and 100 mg IV Q6h x 24 hrs then taper 50%/day to baseline	→
	Urgent/Elective				



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Too Complicated !



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Supplemental perioperative steroids for surgical patients with adrenal insufficiency (Review)

Sung M, Mark F, Espinoza M, Coakland P



AUTHORS' CONCLUSIONS
Implications for practice

There is currently inadequate evidence to support or refute the use of supplemental perioperative steroids in patients with adrenal insufficiency. It is likely that in the majority of adrenal insufficiency patients undergoing surgery, administration of the patient's daily maintenance dose of corticosteroid may be sufficient and that supplemental doses are not required.

Implications for research

There is a need for high quality randomized controlled trials in various surgical settings to assess the requirement for supplemental perioperative steroids when patients with adrenal insufficiency undergo surgery. These trials should clearly define the type of surgery to reflect the amount of physiological stress and type of anaesthetic used. In addition, it would be useful for such trials to assess the steroid dose required and the duration of supplementation.

Cochrane Database of Systematic Reviews, Issue 4, 2009

Periop Steroid Recs 1994

Minor Surgical Stress (inguinal hernia)
Target 25mg hydrocortisone equivalent
Pt taking 5mg Pred every other day for asthma
Give 5 mg prednisone day of procedure

Moderate Surgical stress (joint replacement, hysterectomy)
50 – 75mg/day of hydrocortisone equivalent for 1-2 days
Pt taking 10mg pred/day for SLE
10mg pred pre-op, 50mg hydrocortisone intraop, then 20mg hydrocortisone x 3 POD #1, return to pre-op doses on POD #2

Major Surgical Stress (total colectomy, CABG)
100 – 150 mg hydrocortisone equivalent/day for 2- 3 days
Pt receiving 5 mg prednisone/day for years
5mg pred preoperatively, 25mg hydrocortisone intraoperatively, then 25mg hydrocortisone Q8H for 48 – 72 hrs, then return to normal daily coverage

Operative stress	Corticosteroid dose
Minor Local anesthesia, duration < 1 hr	Hydrocortisone 20 mg IV or methylprednisolone 7 mg IV during surgery
Moderate Joint replacement, lower extremity amputation, open cholecystectomy	Hydrocortisone 50-75 mg IV or methylprednisolone 15-18 mg IV during surgery, tapering to baseline dose in 1-2 days
High Cardiathoracic, Whipple	Hydrocortisone 100 mg IV during surgery and every 8 hours postoperatively, tapering to baseline dose in 2-3 days [†]

*Hydrocortisone has significant mineralocorticoid action at doses over 100 mg/day and should be avoided due to risk of fluid retention.
†Source: Perioperative management of patients treated with glucocorticoids. *Endocrine Metab Clin North Am.* 1994;23:927-943

Corticosteroid coverage for surgery in patients taking exogenous corticosteroids

For minor procedures or surgery under local anesthesia (eg, inguinal hernia repair) take usual morning steroid dose. No extra supplementation is necessary.

For moderate surgical stress (eg, lower extremity revascularization, total joint replacement) take usual morning steroid dose. Give 50 mg hydrocortisone intravenously just before the procedure and 25 mg of hydrocortisone every 8 hours for 24 hours. Resume usual dose thereafter.

For major surgical stress (eg, esophagectomy, total proctocolectomy) take usual am steroid dose. Give 100mg of intravenous hydrocortisone before induction of anesthesia, and 50mg every 8 hours for 24 hours. Taper dose to half per day to maintenance level.

Avn Surg 1994;219(4):416-425

Table 2. Guidelines for Adrenal Supplementation Therapy*

Medical or Surgical Stress	Corticosteroid Dosage
Minor Inguinal hernia repair Colonoscopy Mild febrile illness Mild-moderate nausea/vomiting Gastroenteritis	25 mg of hydrocortisone or 5 mg of methylprednisolone intravenous on day of procedure only
Moderate Open cholecystectomy Hemicolectomy Significant febrile illness Pneumonia Severe gastroenteritis	50-75 mg of hydrocortisone or 10-15 mg of methylprednisolone intravenous on day of procedure Taper quickly over 1-2 days to usual dose
Severe Major cardiathoracic surgery Whipple procedure Liver resection Pancreatitis	100-150 mg of hydrocortisone or 20-30 mg of methylprednisolone intravenous on day of procedure Rapid taper to usual dose over next 1-2 days

JAMA 2002;287(2):236-240

For example, a patient receiving 50 mg of prednisone daily for chronic obstructive pulmonary disease can receive 200 mg of prednisone daily during the perioperative period. This is equivalent to 1000 mg of cortisol each day. For the sake of perspective, it is worth noting that the average cortisol production rate in patients with Cushing's syndrome is 36 mg/day.²¹ This excess of glucocorticoid leads to adverse clinical consequences, such as reduced tissue repair rates, decreased glucose tolerance, and increased susceptibility to infection caused by immune compromise.

Therefore: 40 mg of prednisone x 1 is likely to be more than adequate for most patients/procedures if you have concerns for peri-op adrenal insufficiency.

Case # 2

- 37yo male with Addison's and Hypothyroidism for back surgery
- Hydrocortisone and levothyroxine 150mcg/day
- Some mild adrenal insufficiency findings have occurred post op and the patient remains intubated/NPO 5 days post-OR

How do we manage this patients thyroid medication in this setting?

- 1) Continue to withhold thyroxine until taking PO.
- 2) Give 75mcg thyroxine IV daily
- 3) Give 150mcg thyroxine IV daily
- 4) Give 300mcg of thyroxine IV daily

Answer:

- 1) Continue to withhold thyroxine until taking PO.
- 2) Give 75mcg thyroxine IV daily
- 3) Give 150mcg thyroxine IV daily
- 4) Give 300mcg of thyroxine IV daily



Hypothyroidism Perspective

- prevalence 1%, F > M, increased incidence with ↑age
- Multisystem complications
 - decreased cardiac output
 - anemia
 - hypoventilation/reduced pulmonary responses
 - constipation
 - increase total body water
 - hyponatremia
- myxedema coma



Perioperative Thyroid Disease Hypothyroidism (cont'd)

- Who's at risk?
 - Treated Hyperthyroidism
 - Other hypothalamic/pituitary disorders
 - Lithium
 - Amiodarone
 - Iron
 - Cholestyramine



Up to Date: Nonthyroid surgery in the patient with thyroid disease
Med Clin N Am 2009;93:1031-1047

Perioperative Thyroid Disease Preop Hypothyroidism

Pharmacologic Management

- Mild to moderate – symptomatic!
- If young otherwise healthy
 - Rx thyroxine 1.7ug/kg
- Older patients or cardiopulmonary disease
 - start 25-50ug/day and titrate up every 2-6 weeks



Perioperative Thyroid Disease Periop Hypothyroidism

- Levothyroxine
 - Continued perioperatively
- $T_{1/2}$ – 6-7 days
- if pt is NPO for > 5-7 days: consider IV replacement
 - IV 100% bioavailable; PO 50-80% bioavailable
 - Cut dose in half PO → IV
- newly diagnosed hypothyroidism does not need treatment unless symptomatic



Annals Clin N Am 2009;93:1031-1047
Up to Date: Nonthyroid surgery in the patient with thyroid disease
Med Clin N Am 2009;93:1031-1047

Perioperative Thyroid Disease Myxedema

- clues to diagnosis include:
 - pericardial effusion, CHF, hypothermia, hyponatremia
- therapy
 - 200-500 mcg thyroxine IV +
 - Steroids for occult AI
- increase in total body water but decreased intravascular volume



Hyperthyroidism Perspective

- prevalence 1%, F > M, increased incidence with ↑age
- Multiple systemic effects –
- Cardiovascular - ↑ ionotropic/chronotropic
 ↑ renin/angiotensin system
 ↑ cardiac output
- Chronic stimulation diminishes ability to respond to stress
- Overt
- Subclinical
 - increased nocturnal pulse, increased gut motility, premature atrial contractions, increased peripheral vascular resistance

MAYO CLINIC
 PERIOPERATIVE MANAGEMENT OF ENDOCRINE DISORDERS

Perioperative Thyroid Disease Preop Hyperthyroidism

- Decreased TSH on treatment not necessarily contraindication to surgery if normal T3, free T4
 - TSH can take months to normalize
- pharmacologic management:
 - Elective surg: antithyroid agents
 - Urgent/Emergent: (goal – reduce risk of thyroid storm)
 - Beta blockers
 - Thioamides - Methimazole, PTU
 - SSKI or Lugol's iodine
- take medications on morning of surgery

MAYO CLINIC
 "Perioperative Management of Endocrine Disorders" in
 Medical Management of the Surgical Patient 2008
 Med Clin N Am 2009;83:1031-1047

Perioperative Thyroid Disease Preop Hyperthyroidism (cont'd)

- **Thyrotoxic crisis ("storm")**
- rare
 - often discovered intraoperatively to 48hrs post-op
- if discovered Pre-op
 - procedure should be postponed
 - mortality rate 10 - 75%

MAYO CLINIC
 Anesth Clin N America 22:2004:93-123
 Up to Date: Nonthyroid surgery in the patient with thyroid disease
 Med Clin N Am 2009;83:1031-1047

Perioperative Thyroid Disease Periop Thyrotoxicosis

Issue: Thyroid Storm Management

- Beta Blocker (adrenergic sx, inhibit T4 → T3)
- Methimazole or PTU (PO/PR no IV)
 - Give 1 hour prior to...
- Iodine solution (block thyroid hormone release = Wolff-Chaikoff effect)
- Others:
 - Iodinated radiocontrast agent (inhibit T4-T3)
 - GlucocorticoidS (reduce T4-T3, Rx autoimmune process)

MAYO CLINIC
 PERIOPERATIVE MANAGEMENT OF ENDOCRINE DISORDERS

Perioperative Thyroid Disease Euthyroid Sick Syndrome

- Low T₄, T₃, TSH
- Increased reverse T₃
- Treatment of little benefit - ? Harm
- In critically ill pts - TSH alone is inadequate for assessment of thyroid function
- TFT's should not be assessed in critically ill pts unless pretest probability is high

MAYO CLINIC
 "Perioperative Management of Endocrine Disorders" in
 Medical Management of the Surgical Patient 2008

Our patient, October 1954 – New York

MAYO CLINIC
 PERIOPERATIVE MANAGEMENT OF ENDOCRINE DISORDERS

Management of Adrenocortical Insufficiency During Surgery

JAMES A. MICHAL, M.D.
CHARLES S. BARTON, M.D.
FRANK J. LAMBERT, Ph.D.
WILLIAM B. WELSH, M.D., New York

The data on three of these patients are being presented in this paper to illustrate the methods whereby we managed the problem.

One patient had been receiving intensive hydrocortisone therapy for rheumatoid arthritis when he developed acute appendicitis. A second patient had suppressed adrenocortical function produced by cortisone therapy for psoriasis, and he required an elective femoral replacement arthroplasty of the hip.

CASE 3—Example of a Patient with Adrenal Insufficiency Due to Addison's Disease Requiring Elective Surgery †

A man 37 years of age had Addison's disease for seven years. He had been managed fairly successfully for several years on a program of desoxycorticosterone acetate pellets of 150 mg. implanted every three months and cortisone in doses of 25 mg. daily orally. Owing to a back injury, he had a great deal of pain which interfered with his daily routine. Orthopedic consultation suggested that he might be helped by a lumbosacral fusion together with a sacroiliac fusion. Because of the severe degree of trauma involved in these operations and because of the patient's adrenocortical insufficiency due to Addison's disease, it was deemed dangerous to proceed with these operations. However, since this young man would become incapacitated without surgical intervention, it was decided, reluctantly, to perform the operations by doing the two different procedures at different times if necessary and by having a team versed in endocrinology and surgical physiology help in the management of this patient before, during, and after the operation.

JAMA Arch Surg 1955;71:737-42

Daily Management

150mg desoxycorticosterone pellets Q3Months
 25mg cortisone daily

Pre-op
 24 and 12 hrs - 100mg cortisone IM

Intra-op
 100mg cortisone in 1000ml NS
 2000cc blood

Post-op
 UTI, Transfusion reaction, Angioedema

Though this patient had marked adrenocortical insufficiency, though the magnitude of his surgery was great, and though complications ensued postoperatively, this patient had a smooth postoperative course insofar as no Addisonian crisis ever developed.

JAMA Arch Surg 1955;71:737-42

Corticosteroid Comparison

Drug	Equivalent dose (mg)	Mineralocorticoid potency	Biologic 1/2 life (hrs)	HPA axis suppression (mg) ²
Hydrocortisone	20	2+	8-12	20-30
Cortisone	25	2+	8-12	25-35
Prednisone	5	1+	24-36	7.5
Methylpred	4	0-0.5+	24-36	7.5
Dexamethasone	0.75	0	36-54	1-1.5

Mineralocorticoid: Fludrocortisone 0.05 – 0.20mg /day

www.vhpharmsci.com/VHFormulary/Tools/Systemic-corticosteroid-comparison.htm

PATIENTS with RHEUMATIC DISEASE selected perioperative challenges

Brian F Mandell md phd

Professor and Chairman of Academic Medicine
Department of Rheumatic and Immunologic Diseases
Center for Vasculitis Care and Research
Cleveland Clinic

No relevant conflicts of interest to disclose

Goals for the Pre-operative Visit

- **Be your patient's advocate**
 - Are there disease associated issues; Is disease controlled?
 - Think about rehab in the setting of joint, muscle or neurologic disease
- **Document concisely the RELEVANT history (prior postop flares?) , lab abnormalities, and baseline physical examination, especially pulses and neurologic**
- **Try to recognize potential perioperative problems**
 - Consider disease specific perioperative risks / complications
 - Review medications
 - DVT and infection prophylaxis - "inflammation" = higher risk

PERIOPERATIVE ISSUES Myositis

- **RESPIRATORY MUSCLE FUNCTION**
 - ASPIRATION RISK
 - WEANING - POSITIONING
 - CONSIDER NON-INVASIVE VENTILATION
- **CARDIOPULMONARY STATUS**
 - CONDUCTION DISEASE
 - Dx Of PERIOP MI - baseline labs abnormal ?
 - ILD
- **REHABILITATION POTENTIAL**
 - POSTOPERATIVE DVT and FALLS
- **OCCULT MALIGNANCY**

STEROIDS

PERIOPERATIVE ISSUES Scleroderma

- **Venous access available ?**
- **Severe Raynauds**
 - Caution w/ arterial punctures/lines
 - » Absent ulnar artery
 - Digital O2 monitoring
 - Avoid over-cooling in OR and recovery
- **Reflux - aspiration**
- **Malabsorption and slowed GI motility**
- **Occult pulmonary hypertension**



Preoperative Lab Testing in Patients with Rheumatic Disease

Mix and Match

- 26 yo woman with dx of SLE (+ANA, hx thrombocytopenia, rash and pleurisy) in remission.
 - Preop assessment for THR for AVN.
- **SLE: inactive**
- **Adopted; no other medical or surgical hx**
- **Meds: plaquenil (hydroxychloroquine)**
- **Creatinine 0.8, WBC 2600, Hgb 12.9, Plat 143**

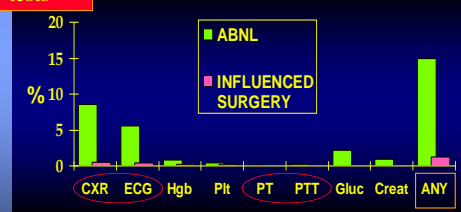
Lab tests: Would you order PT, PTT ?

1. YES
2. NO

**PREOPERATIVE TESTING
3131 ASYMPTOMATIC PATIENTS**

No data to support getting "routine" preop tests

In asymptomatic patients...



Perez et al Br J Anesth 74:250-56, 1995

**Mix and Match:
26 yo woman with dx of SLE**

- PT is normal; PTT is prolonged by 6 seconds (confirmed on retest).
- Mixing test normalizes the PTT

Now what?

Mixing test normalizes the prolonged PTT

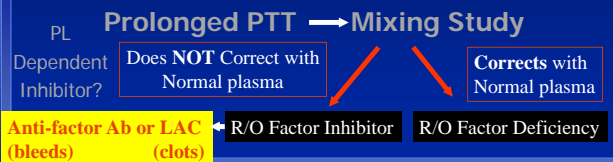
- A. Proceed with surgery using LMW heparin and compression stockings
- B. Proceed with surgery using ASA, LMW heparin and mechanical compression
- C. Delay surgery to do a platelet neutralization test to confirm "lupus" anticoagulant
- D. Delay surgery to look for a factor deficiency
- E. Delay surgery and repeat PTT after stopping hydroxychloroquine

**Mix and Match
Prolonged PTT**

- Factor deficiency – may bleed
- Antibody to factor – may bleed
- Lupus anticoagulant – NOT likely to bleed, may be hypercoagulable

Mix and Match

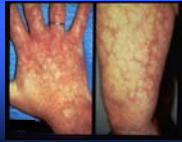
Although PT/PTT are NOT necessary preop tests; when prolonged, they require evaluation – CANNOT ASSUME A LAC – even with SLE.



ANTIPOSPHOLIPID SYNDROME

PERIOPERATIVE MANAGEMENT

- w/ **HISTORY, @ HIGH RISK FOR THROMBOSIS**
 - SAME as FOR PATIENTS with PROSTHETIC HEART VALVES
- **THROMBOCYTOPENIA/HEMOLYSIS**
- **ROUTINE MONITORING of PTT or ACT MAY NOT be RELIABLE***
 - DOSE LMW HEPARIN BY ALGORITHM
 - THROMBIN TIME
 - Xa ACTIVITY
 - HEPARIN LEVEL
 - ALTERNATIVE AGENT (little data)



Bartholomew: Clin Rheum 4:307-11, 1998.
Erkan in Mandell BF(ed), Perioperative management of the patient with rheumatic disease, Springer 2012

Choose elective pre-op lab testing based on DISEASE AND MEDICATIONS

• DISEASE:

- Lupus - creatinine, cbc, pt, ptt, UA, ± CK
- RA / spondylitis - Hgb
- Scleroderma - none
- Vasculitis - creatinine, UA, CBC (medication related changes)
- Myositis - CK with MB, troponin

• Medications

- MTX / Leflunomide / Tofacitinib - CBC, AST
- Anti TNFs, Abatacept, Tocilizumab, - **none**
- Rituximab, Azathioprine, Cyclophosphamide - CBC

Cervical Spine Imaging?

58 yo F with longstanding RA with planned bilateral TKRs. Initially hard to control with early nodulosis and hand deformities. Currently without AM stiffness. Mild fatigue(stable) but limited for many months to using a wheelchair or cane due to knee pain..

S/p uneventful C section, TAH/BSO, cholecystectomy. No cardiovascular, GI, Pulmonary Sx.

NKDA, + smoker.

MEDS: ASA, alendronate 70 qw, Ca/Vit D, HCTZ 25, Enalapril 20, Metformin 500 bid, Atorvastatin 20, MTX 25 qw sq, Folic acid, Adalimumab qow, Pred 5qd and Celecoxib 200 bid.

Labs: Hgb 10.1, Creat 1.2, ESR 18, ASI/ALT normal, glucose 108 fbs

PE: 126/78, HR 82. Skin clear, no thrush, no scleritis, gait not tested, DTRs: 3+= biceps with +Hoffmans and 1+ = knees, 3+ ankles normal Babinski test, neck motion painless, good jaw opening, lungs clear, no murmur/gallop, -HJR, 1+ bilat edema, nl pulses no bruits.

+ ulnar drift bilat with PIP nodulosis, swan neck changes but good grip, no CTS, hips nl, knees valgus with prolif changes and crepitus, valgus ankle changes with pes planus.

RA Preop Assessment Regarding the cervical spine, YOU:

1. Note that cervical films 2 years ago were normal. No need to repeat X-RAYS.
2. Order cervical spine films with flex and extension views
3. 1 or 2 and suggest fiberoptic intubation
4. Alert the anesthesiologist to the RA
5. Delay surgery to obtain C spine MRI with flex/extension views

RHEUMATOID ARTHRITIS THE CERVICAL SPINE.

RADIOGRAPHIC EVIDENCE OF RHEUMATOID CERVICAL SUBLUXATION IS FAR MORE COMMON THAN CLINICAL SYMPTOMS or FINDINGS.

BUT... look for and do not ignore physical findings

58 yo F with longstanding RA with planned bilateral TKRs. Initially hard to control with early nodulosis and hand deformities. Currently without AM stiffness. Mild fatigue(stable) but limited for many months to using a wheelchair or cane due to knee pain. Cannot walk steps.

S/p uneventful C section, TAH/BSO and cholecystectomy, tonsillectomy. No cardiovascular, GI, Pulmonary Sx.

NKDA, + smoker.

MEDS: ASA, alendronate 70 qw, Ca/Vit D, HCTZ 25, Enalapril 20, Metformin 500 bqd, Atorvastatin 20, MTX 25 qw sq, Folic acid, Adalimumab qow, Pred 5qd and Celecoxib 200 bid.

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RHEUMATOID CERVICAL SPINE


THE PREOP QUESTION:

WILL BONE, LIGAMENT, or PANNUS IMPINGE on CERVICAL CORD WITH POSITIONING OF THE NECK?



- DAMAGE in C-SPINE** (PATHOPHYSIOLOGY is SIMILAR to EXTREMITY DAMAGE)
- LAXITY OF CAPSULE
- LAXITY OF SUPPORTING LIGAMENTS
- PANNUS
- ANKYLOSIS

RHEUMATOID CERVICAL SPINE



- ATLANTO-AXIAL
- SUBAXIAL
- "CRANIAL SETTLING"

- CERVICAL SUBLUXATION - UP TO 80% OF PRE-OP PATIENTS (>50% are "SILENT")**
- PAIN**
 - STIFFNESS
 - HEADACHE
 - NECK CLUNK
 - IMPINGEMENT
- RADICULOPATHY
- MYELOPATHY
 - HYPER-REFLEXIA
 - CLUMSINESS
 - TINGLING
 - L' HERMITTES

RHEUMATOID CERVICAL SPINE PRE-OP ASSESSMENT

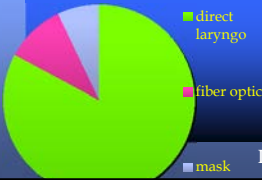
- Have Prior Films Reviewed if They Exist**
- Asymptomatic; Recent or Mild Disease:**
 - Normal Exam; No Films Necessary
 - Alert anesthesiologist
- Proliferative / Erosive Disease**
 - "SYMPTOMATIC" or Abnl Exam → NEUROSURG. CONSULT RADIOGRAPHS/CT/MRI
 - ASYMPTOMATIC → FLEX/ EXTENSION VIEWS (?)

CAREFUL NEUROL. EXAM

Soft collar during transport

Real World impact C Spine imaging in RA


- 176 pts with RA had surgery with general anesthesia at MD Anderson cancer center**
 - 52% had c spine imaging within 2 years (20% of these had C-spine abnormalities)
 - No. neuro or vascular complications in any of the 176



NO association between method of intubation and prior C spine films

Lopez-Olivo et al J Clin Rheum 18:61-66, 2012

Cle Clinic Survey Data



RHEUMATOID CERVICAL SPINE PRE-OP ASSESSMENT
Bottom Line:

Communicate

58 yo F with longstanding RA with planned bilateral TKRs. Had early nodulosis and hand deformities. Currently no AM stiffness. Mild fatigue(stable); but limited for many months to using a wheelchair or cane due to knee pain. Cannot walk steps. S/p uneventful C section, TAH/BSO and cholecystectomy, tonsillectomy. No cardiovascular, GI, Pulmonary Sx. NKDA, + smoker.

MEDS: ASA, alendronate 70 qw, Ca/Vit D, HCTZ 25, Enalapril 20, Metformin 500 bid, Atorvastatin 20, MTX 25 qw sq, Folic acid, Adalimumab qow, Pred 5qd and Celecoxib 200 bid.

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 + ulnar drift bilat with PIP nodulosis, swan neck changes but good grip, no CTS, hips nl, knees valgus with contractures and prolifer changes and crepitus, valgus ankle changes with pes planus.

Meds: would you hold Celecoxib pre-arthroplasty ?

- 1. YES
- 2. NO

NSAIDs and SURGERY

- **PROLONGATION OF BLEEDING TIME**
 - ASPIRIN - IRREVERSIBLE
 - SALICYLATE - MINIMAL IF ANY EFFECT
 - NABUMETONE: ± EFFECT / NO EFFECT ON WARFARIN
 - OTHERS - VARIABLE PROLONGATION, INCREASE INR
 - **COX-2 SELECTIVE DRUGS: CELECOXIB**
 - NO ANTI-PLATELET EFFECT
- **OUTCOME DATA - NON-SELECTIVE NSAIDs**
 - ASA and CORONARY BYPASS SURGERY
 - ASA PLUS HEPARIN IN HIP FRACTURE
 - ABDOMINAL GYN PROCEDURES
 - EYE / NEUROSURGICAL PROCEDURES
 - TONSILLECTOMY - PRE Tx KETOROLAC → **BLEEDING**

COX-2 SELECTIVE NSAIDS

- **EFFECTIVE ANALGESIA**
 - NARCOTIC SPARING - maybe...
- +/- GASTRIC SAFER (no periop data)
- **NO RENAL SAFETY ADVANTAGE**
- **NO ANTI-PLATELET EFFECT**
 - LESS CONCERN OVER POST- OP BLEEDING
 - Little interaction heparin/warfarin
- **?? ANY PRO-THROMBOTIC EFFECT ??**

NSAIDs AND SURGERY

- **Hold for 4-5 half lives of the drug preoperatively**
 - 5 days is usually sufficient
 - Hold piroxicam 10 days preop
 - **Hold aspirin 10-14 days preop**
 - Unless ASA need (ie coronary stent, dvt prophylaxis)
 - **No documented need to hold Cox-2 selective NSAID (celecoxib)**
- NO SAFETY ADVANTAGE with PARENTERAL NSAID THERAPY!**

RA and RISK of POSTOPERATIVE INFECTION: TOTAL ARTHROPLASTY

Which has/have been shown to be associated with an **increased** risk of periop prosthetic joint infection:

- A. Methotrexate >15mg/wk within 2 weeks of surgery
- B. RA as the diagnosis vs. Osteoarthritis
- C. Anti-TNF therapy
- D. Smoking
- E. A, B, and C
- F. B, C and D
- G. All

METHOTREXATE AND POSTOPERATIVE COMPLICATIONS

THERE ARE NO CONSISTENT DATA THAT PERIOPERATIVE USE OF METHOTREXATE CAUSES INCREASED WOUND INFECTIONS OR DECREASED HEALING

Dosing Biologics Periop

DRUG -	Dose interval
Etanercept	q 1 week**
Adalimumab	q 2 week**
Infliximab	q 6-8 week**
Golimumab	q 4 week**
Abatacept ^s	q 1 week (sq)**
Rituximab ^s	20 days (prolonged drug effect)
Tocilizumab ^s	q 4 week**
Anakinra ^s	q day

** Consider holding > 1 dose interval
 s Particularly little periop data

PERIOPERATIVE MEDICATIONS CORTICOSTEROIDS*

- **CONCERN of ADRENAL INSUFFICIENCY**
 - ABNORMAL ADRENAL "RESERVE"
 - BUT.... DO WE NEED TO BE CONCERNED?

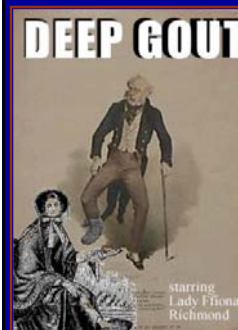
THE PROBLEMS WITH BEING OVERCONCERNED

- **PROLONGED POSTOPERATIVE USE**
 - WOUND HEALING (?) / INFECTION
 - ANTIPYRETIC
 - LEUKOCYTOSIS
 - HYPERGLYCEMIA

* see Coursin and Wood JAMA 287:236-40, 2002

The Decision...

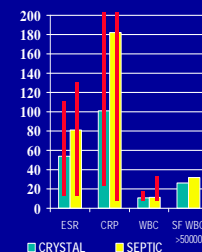
How to manage perioperative gout



How often is a diagnostic arthrocentesis performed to confirm gout (r/o infection)?

Inpatients: 19%*, 25% (by med); 52% (by rheum) **

*J Rheum 34:1566-68, 2007
 ** 36: 1699-04,2009



distinguishing septic from gouty joint

Fever ~ 30-50% in both

Its so obvious...

54yo m renal transplant pt adm. 12/2012 with disseminated cryptococcal infection; on fluconazole therapy for > 2 weeks.

Previously clinically diagnosed with gout, had been on ULT
Developed acutely swollen right / painful elbow and wrist.

Creat acute increase to 5 (had been <2)

Meds incl: mycophenolate 500 bid, tacrolimus 2 bid, pred 5.

Last attack of arthritis ~ year ago knee.

Elbow aspiration: 4cc
(cultures negative)

CPPD

SUA



"I want to go home"

- 48 yo man with hypertensive **cardiomyopathy**, atrial fibrillation, **creatinine 3.8** with chronic **edema**, type 2 **DM** recovering from bout of post-op (lap partial colectomy) **pulmonary edema**. New recurrent flare in gout (tophaceous with current SUA 6.1 mg/dL), 5 days postop.
- Meds: **warfarin**, losartan, furosemide (now 120 mg q12h), nifedipine, minoxidil, metformin, allopurinol (400 mg).
- Acutely swollen, tender bilat midfeet, l ankle, l knee, r wrist. Chronic venous stasis changes, edema, forearm tophi. Bilateral crackles and summation gallop. Unable to bear weight to walk to bathroom.

Treatment option you choose:

1. Morphine IV (or other narcotic) for pain control as needed
2. Colchicine 1.2 mg followed by 0.6 mg po an hour later
3. Celecoxib 200 mg bid 3 days
4. Methylprednisolone 60 mg IV single dose; repeat if needed
5. Anakinra 100mg sq ; repeat daily for 3 days as needed
6. ACTH 40mg IM; repeat in 24 hrs if needed

Treating Acute Attacks

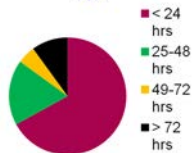
Choose therapy based on patient's co-morbidities

- **NSAID** – any in high dose will work; indomethacin 50mg tid the gold standard – treat few days past resolution..
- **Colchicine** 1.2mg followed by 0.6 in an hour – efficacious at reducing pain with early treatment – outpatient trial demonstrated *effect, did not demonstrate resolution*.
 - 38% got 50% relief by 24hrs (31% used rescue med)
- **Steroid** - efficacious – use enough for long enough
- **IL1 antagonist** – comorbidities or resistant attack – *anakinra*
 - \$\$; no metabolic side effects
 - OFF LABEL USE
- **Narcotics** - **variable efficacy !!**

Treatment of acute gouty arthritis in complex hospitalized patients with **anakinra**

Time to "significant" response
N=40 flares, 26 pts
73% polyarticular

73% resolution by 5 dys



Significant response: move w/o pain & weight bear

15/26 Pts withCKD
5/26 GFR< 30

7 perioperative
4 immunosuppressed
3 had infections (responded to Abx)

7 Pts multiple courses

15/26 had failed steroid therapy


Ghosh et al Arth Care Res 65:1381-84, 2013

Gout Perioperative Pearls

- Try to avoid any discontinuation of hypouricemic therapy
- Try to continue (start?) prophylactic anti-inflammatory therapy e.g. 0.6 colchicine daily
- Peak postoperative gout ~ 4 days
- Postoperative gout can cause fever
- Postoperative gout often polyarticular
- Aspiration for Dx and local steroid therapy as Tx should not be avoided

MAYO CLINIC

An Overview of
Perioperative Medicine 2013:
Perioperative Infectious Disease Issues



Mayo School of Continuous Professional Development
Jennifer Whitaker, MD, MS
October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Disclosures

- Pfizer
 - Pfizer Independent Grants for Learning & Change
- No off-label use of medications will be discussed


Objectives

- Understand how to approach a patient with postoperative fever.
 - Review management of common postoperative infectious disease issues.
- Understand the indications for and the duration of perioperative antibiotic prophylaxis.
 - Review the approach to patients with penicillin allergy.
- Review perioperative management of patients on antiretroviral therapy for HIV.

Objective #1

- Understand how to approach a patient with postoperative fever.
 - Review management of common postoperative infectious disease issues.

Postoperative Fever
General Considerations



- Temperature ≥ 38 C or 100.4 F
- Broad differential of infectious & non-infectious etiologies
- Timing after surgery and duration are important clues
- Type of surgery is key consideration

Case 1:

You are called to evaluate a 50 yo female who was readmitted with fever 6 days after uncomplicated open cholecystectomy surgery. She has been having fever for the past 48 hours. Her medications include ranitidine (new) and HCTZ.

- Temp=38.6 C, HR 100, BP 100/60, RR 22
- Physical exam reveals slight bibasilar crackles, tachycardia with no murmur, mild abdominal tenderness and erythema around surgical site, and 1+ bilateral lower extremity edema. There is no urinary catheter in place.

Case 1:

All of the following conditions should be in your differential diagnosis for etiology of postoperative fever in this patient, except:

- A. Urinary tract infection
- B. Atelectasis
- C. DVT
- D. Surgical site infection
- E. Drug fever







Case 1:

All of the following conditions should be in your differential diagnosis for etiology of postoperative fever in this patient, except:

- A. Urinary tract infection
- B. **Atelectasis**
- C. DVT
- D. Surgical site infection
- E. Drug fever




Modification to the 5 W's you might have learned in medical school...

- Wind---pneumonia, ~~atelectasis~~ 
- Water---urinary tract infection, IV sites (thrombophlebitis, CLABSI) 
- Wound---wound infections 
- Wonder drugs---drug fever
- Walking---thromboembolism 



Engoren M, et al. Chest. 1995;107(1):81.
Mavros MN, et al. Chest. 2011;140(2):418-24.

Postoperative Fever Timing & Differential

- **Immediate fever**—in OR or within few hours of surgery
 - Medications
 - Transfusion reactions
 - Infection present before surgery
 - Malignant hyperthermia 
- **Early postoperative fever**
 - Most commonly due to inflammatory response
 - Cytokine response (IL-6) related to trauma
 - Usually resolves spontaneously (**within 1-3 days**)
 - May last up to weeks if head trauma



Immediate/Early Postoperative Fever Management

- Review OR record. Consider drug reactions & transfusion reactions
- Review records prior to surgery, was infection present before surgery?
- **Malignant hyperthermia**—most likely to be seen in OR—high CO₂, rigidity, tachycardia, tachypnea, fever may come later
 - Rx: **dantrolene**
- **Fever in first 48 hours**, does patient appear well? **Check PE and history**. If no signs of infection and vitals are stable, observe.



Postoperative Fever: Timing & Differential

- **Acute fever**—onset within first week of surgery

Infectious

Nosocomial infections
UTI
Central line associated bloodstream infection (CLABSI)
Pneumonia & VAP
Meningitis after neurosurgery
Surgical site infection (SSI)
Community acquired infections (may have been present before)
Acalculous cholecystitis

Non-infectious

Vascular
DVT, PE, thrombophlebitis
fat embolism, MI
Drug Fever
Surgical site inflammation
hematoma, seroma
Other inflammatory
gout, pseudogout
pancreatitis
parotitis
Endocrine
Addisonian crisis, thyroid storm



Management of Postoperative Fever within 1 Week of Surgery

- **History:** make sure to review all **medications**, determine new medications
- **Physical:** make sure to include current and former IV sites, joints, surgical site, back
- If outside of expected time for fever due to surgery (inflammatory process) itself, patient appears ill, or vitals abnormal:
 - CBC, UA with micro, urine culture, blood cultures, CXR, if abdominal pain, consider liver enzymes, lipase
 - Consider workup for thromboembolism based on risk factors, history, PE
- If patient is hemodynamically unstable, start broad spectrum antibiotics. You can always de-escalate if no infection is found after 48 hours.



Postoperative Fever: Timing & Differential

Subacute fever- onset 1-4 weeks after surgery



Infectious

UTI, CLABSI
Pneumonia
Meningitis after CNS surgery
C. difficile colitis
Sinusitis
Skin/soft tissue infection (SSI)
Acalculous cholecystitis

Specific to surgery type

Device related infections
Mediastinitis
Deep Abscess
Septic thrombophlebitis

Non-infectious

Thromboembolism
Drug Fever
Central fever, in cases of neurosurgery/head trauma
Post-pericardectomy syndrome



Subacute Postoperative Fever Management

- Similar to approach for fever within 1 week of surgery
- Make sure to ask about diarrhea, consider *C. difficile* infection
- Must consider site of surgery, presence of prosthetic material
- Consider deeper sources of infection & order appropriate tests
 - Imaging to evaluate for abscess
 - Appropriate evaluation of cardiac device, prosthetic joints



Postoperative Fever: Timing & Differential

Delayed fever- onset ≥ 4 weeks after surgery

- SSI due to indolent microorganisms
- Infective Endocarditis
- Medication Reaction
- **Consider type of surgery**
 - Postpericardiotomy syndrome
 - Device related infection
 - Deep abscess
 - Infected prosthesis
 - Transplant (wide differential)



Surgical Site Infections



Surgical site infection (SSI)

- infection related to an operative procedure that occurs at or near the surgical incision **within 30 days** of the procedure
- or **within 90 days if prosthetic material** is implanted at surgery
- In recent study, SSIs accounted for 31% of all hospital acquired infections (HAI)
- National Healthcare Safety Network data for 2006-2008 showed an overall SSI rate of 1.9%.



Magill SS, et al. Infect Control Hospital Epidemiol 2012;33(3):283-91.
Yi M, et al. Infect Control Hosp Epidemiol 2011; 2(10):970-986.

Objective #2

- Understand the indications for and the duration of perioperative antibiotic prophylaxis.
 - Review the approach to patients with penicillin allergy.



Why is Perioperative Antibiotic Prophylaxis Given?

- Prevent Surgical Site Infections
 - Antimicrobial prophylaxis is primarily to decrease microbial burden at site of surgery
- Prevent Bacteremia/Bacteremia with Urologic Procedures
 - Ideally urine should be sterilized prior to urologic surgery
- Prevent endocarditis
- Treat Infection present at time of surgery



What Are the Indications for Perioperative Antimicrobial Prophylaxis?

- Patients undergoing procedures with high rate of infection (not clean surgical site) – abdominal/gynecologic surgery
- Implantation of prosthetic material
- Infection potentially catastrophic – neurosurgery, cardiac surgery
- Procedures where prophylaxis has been proven to improve outcomes – surgery for breast cancer



Optimization of Antimicrobial Prophylaxis

- Select active against the most likely pathogens to contaminate the surgical site
- Administer agent in an appropriate dose and at appropriate time to ensure adequate serum and tissue concentrations during the period of potential contamination
- Administer agent for the shortest effective period to minimize adverse effects, emergence of resistance, and cost



Timing of Antimicrobial Prophylaxis



- Generally about 30-60 minutes prior to surgery
 - Exception: vancomycin and fluoroquinolones 120 minutes prior to surgery
- If prolonged procedures or significant blood loss, repeat antibiotic every 1-2 half-lives of drug if renal function is normal
 - cefazolin q 2-5 hrs, vancomycin q 6-12 hrs
- Repeat dosing with short procedures or after wound closure is not necessary



Which Agent?

- For most procedures cefazolin drug of choice
 - Active against streptococci, methicillin-susceptible staphylococci, and some gram-negative organisms
 - Has a long half-life, good safety profile
 - For penicillin allergy, vancomycin/clindamycin are acceptable alternatives
- Bowel procedures
 - Additional anaerobic and gram negative coverage
 - Cefoxitin or cefotetan generally used
 - Elective colorectal surgery: oral neomycin and erythromycin + parenteral antibiotic



Bratzler DW, American Society of Health-System Pharmacists; Infectious Disease Society of America; Surgical Infection Society; Society for Healthcare Epidemiology of America. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm. 2013 Feb 17(23):196-263.

Vancomycin

- No consensus on preoperative MRSA screening for colonization prior to surgery
- Vancomycin can be considered in the following cases:
 - A cluster of SSIs due to MRSA or methicillin-resistant coagulase-negative staphylococci has been detected at an institution
 - A patient is known to be colonized with MRSA
 - A patient is at high risk for MRSA colonization
 - In such cases, a beta-lactam antibiotic (first or second generation cephalosporin) should be added for activity against gram-negative organisms
 - alternatives for patients allergic to cephalosporins include gentamicin, fluoroquinolones, or aztreonam



Case 2:

- A 35 yo female reports documented penicillin allergy resulting in anaphylaxis 10 years ago. She is scheduled for an elective vaginal hysterectomy. What do you recommend for antimicrobial prophylaxis?
 - A. Meropenem
 - B. Vancomycin
 - C. Perform penicillin skin testing prior to making recommendations
 - D. Clindamycin + levofloxacin
 - E. No antimicrobial prophylaxis is required



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Penicillin Allergy



- If questionable allergy reported or unknown reaction/remote history, (not anaphylaxis or exfoliative rash), consider penicillin allergy skin testing
- Penicillin skin testing can be used to:
 - Optimize antibiotic choice
 - Decrease use of more expensive antibiotics
 - Decrease chance of antibiotic resistance



Penicillin Skin Testing Caveats



- Patients with history of anaphylaxis to penicillin should not undergo skin testing without careful weighing of the risk/benefit and only under supervision of an allergist
- Non-IGE mediated reactions can not be tested by skin testing, patients with history of exfoliative skin reactions should not undergo skin testing



Objective #3

- Review perioperative management of patients on antiretroviral therapy for HIV.



Case 3:

A 30 yo male with HIV/hepatitis B coinfection, CD4 150, viral load undetectable, on tenofovir, emtricitabine, atazanavir/ritonavir & trimethoprim/sulfamethoxazole is scheduled for bioprosthetic valve replacement for infective endocarditis & perivalvular abscess. What are your perioperative recommendations?

- A. Proceed with surgery. Hold all ARVs through the perioperative period until patient is reliably taking po. Give TMP/SMX IV for OI prophylaxis.
- B. Delay surgery until CD4 is >200. Continue ARVs and OI prophylaxis.
- C. Proceed with surgery. Continue ARVs and OI prophylaxis through perioperative period (give through NG if necessary).
- D. Continue tenofovir to cover for hepatitis B infection & prevent flare, discontinue other ARVs, continue OI prophylaxis.



Case 3:

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- D. Continue tenofovir to cover for hepatitis B infection & prevent flare, discontinue other ARVs. Continue OI prophylaxis.



Preoperative Evaluation

- Same as for patients not infected with HIV
- With addition of evaluation of:
 - Immunologic status: CD4 count/percentage
 - HIV control: viral load
 - Review current antiretrovirals (ARVs), ARV history, history of opportunistic infections (OI), OI prophylactic medications
- If **elective surgery**, and patient does not have optimal control of HIV (viral load is not suppressed or patient is not on ARVs), consider delay of surgery.



Antiretroviral Therapy

- 2012 DHHS HIV Treatment Guidelines recommend all HIV-infected persons be on antiretroviral treatment
- Carefully review ARV drug-drug interactions prior to anesthesia/surgery. **Monitor addition of new medications after surgery.**
- Ideally continue all antiretrovirals and medications for prophylaxis through the operative period.
 - Exceptions would be inability to tolerate NG medications/feeds, high pressor requirements.
- **If not able to take one antiretroviral, hold all ARVs.**
- Consult HIV expert if patient is expected to be NPO or have issues with absorption for an extended time.

Guidelines for the use of antiretroviral agents in HIV-1-infected adults and adolescents. Department of Health and Human Services. Available at <http://aidsinfo.nih.gov/contentfiles/hvguidelines/AdultandAdolescentGL.pdf>
Accessed: August 18, 2013.



Postoperative Fever in Patients with HIV

- Same differential diagnoses as patients without HIV
- If CD4 <200, then you may also need to consider opportunistic infections, if patient has not been on appropriate prophylaxis
 - PCP CD4 <200
 - Toxoplasmosis CD4 <100
 - Mycobacterium avium complex CD4 <50
 - CMV CD4 <50
 - FUO, consideration of lymphoma
- In patients with CD4 <50, also consider adrenal insufficiency in appropriate clinical scenario



Summary

- Postoperative fever evaluation depends on timing of fever and type of surgery performed.
 - Atelectasis is generally not considered a cause of fever.
- Perioperative antimicrobial prophylaxis usually consists of cefazolin (with additional gram-negative & anaerobic coverage for bowel surgery).
 - Penicillin skin testing can be helpful in clarifying validity of penicillin allergy.




Summary

- In general, ARVs should be continued through the perioperative period unless prolonged period of inability to take oral/NG medications is suspected.
 - Remember to carefully check for drug interactions between new medications and ARVs.



MAYO CLINIC



Peri-operative Medicine
Hematology Issues

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Disclosures

Financial
None

Off label use
None

Did I change my slides?
You betcha!

Objectives

- Pre-operative hemostatic assessment: Who and What
- Perioperative transfusion strategy: conservative or liberal?
- Post-operative transfusion triggers.
- How do I diagnose and treat heparin induced thrombocytopenia in the perioperative period?
- Perioperative management of Von Willebrand's disease
- Perioperative management of sickle cell disease.

Objectives

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Pre-operative hemostatic assessment:

- Who?
 - All patients....but
 - Not everyone needs a laboratory test
- What?
 - Preoperative clinical suspicion of a hemostatic abnormality
 - How do you determine this
 - The patient personal and family hemostatic history
 - Bleeding scores assessment

Preoperative Screening for Hemostasis
Screening Hemostatic History (patient/family)

- Detect underlying congenital and acquired bleeding disorders
 - For a positive history:
 - Consider additional laboratory testing
- Medication history
 - Detect antiplatelet and anticoagulant medicaments
- Herbal preparations
 - Undetected antiplatelet agents

Bleeding Questionnaire

Scoring Key

Significant bleeding	Score	0	1	2	3	4
Epistaxis	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Gum bleeding	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Menstrual bleeding	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Other	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Spontaneous bruising	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Wound healing	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Surgery	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Haemoptysis	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Haematuria	No or mild (bleeds on 1-2 days)	0	1	2	3	4
Other	No or mild (bleeds on 1-2 days)	0	1	2	3	4

Bowman et al JTH 2008;6:2062

Outcomes of condensed bleeding score

- Normal controls: -3.2 to +3.6
- Abnormal cut off: ≥ 4 Bowman et al JTH 2008;6:2062
- Prospective study for VWD diagnosis
 - Sensitivity 100%
 - Positive predictive value: 20%
 - Negative predictive value: 100%
- Abnormal cut off: >3 Tosetto et al JTH 2011;9:1143
 - Positive predictive value: 71%
 - Negative predictive value: 99.6%

Conclusion

- **Best haemostatic screening test**
 - Patient and family history
- **Limitation**
 - Children may not have been exposed to trauma, previous surgery
 - Circumcision related bleeding: not an optimal history (improvements in surgical techniques)
 - Family history will be important

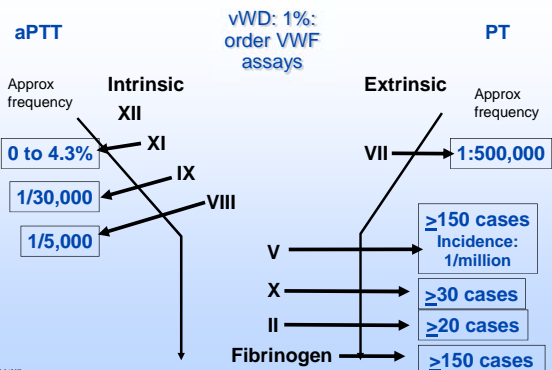


Pre-operative hemostatic assessment: What tests?



Tests of hemostasis

PT and aPTT: What is the point?



Outcomes of Routine Preoperative Prothrombin Time

- Incidence of abnormalities: 0-4.8%
- Significantly abnormal: 0%
- Change in management: 0%



Munro J et al: Health Technology Assessment Vol 1: No.12, 1997

Outcomes of Routine Preoperative Partial Thromboplastin Time

- Incidence of abnormalities: 0-15.6%
- Significantly abnormal: 0%
- Change in management: 0-0.7%



Munro J et al: Health Technology Assessment Vol 1: No.12, 1997

Conclusion PT/aPTT

- No association between an abnormal PT/aPTT and postoperative bleeding
 - Low positive predictive value in the asymptomatic patient
 - Useful for patients with bleeding symptoms
 - Diagnosis and altered management
- Remember, surgical technique is a variable in risk of bleeding



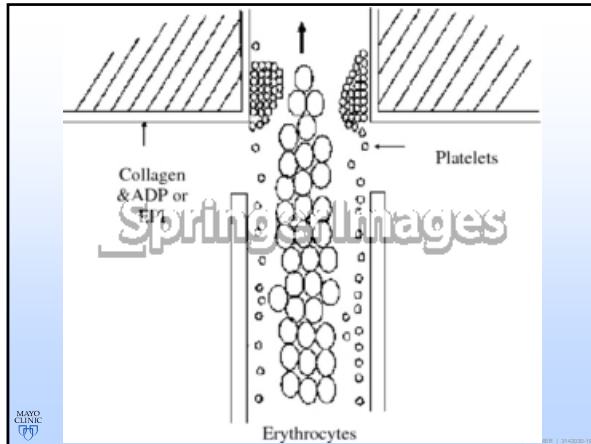
Why are the PT/APTT not good predictors of surgical hemorrhage?

- Majority of surgical hemorrhage is due to technical reasons ('silk deficiency')
- PT/APTT designed to detect static changes in hemostasis, dynamic changes in hemostatic system in surgery/trauma etc
- Intraoperative DIC, fibrinolysis etc cannot be predicted by pre-operative testing
- Most patients with hereditary bleeding disorders have been diagnosed in childhood



Platelet function analyzer-100 (PFA-100)





Role of PFA-100

- Evaluation of bleeding symptoms
 - As an adjunct to hemostatic history and Special Coagulation testing including platelet aggregation
- Not useful for predicting surgical hemorrhage
- Less than 100% sensitive for residual ASA effect
 - Only 68% ASA users had prolonged CT

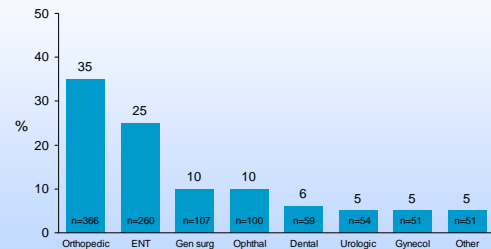
Ortel et al Thromb Haemost 2000;84:94

Outcomes of Patients with no Preoperative Laboratory Tests

- Study period 1994 (56,000 surgical/diagnostic procedures)
- 5,120 patients with no laboratory tests
- Analyzed 1,000 patients (87 pt/month)

Narr et al Mayo CI Proc 72:505, 1997

Types of Procedures



Narr et al Mayo CI Proc 72:505, 1997

Results

- Deaths 0 (0%)
- Transfusions 0 (0%)
- Excess bleeding 1 (0.1%)
 - Sinus surgery; no transfusions
- No role of obtaining routine preoperative tests
- Clinical assessment is essential with additional testing if indicated

Narr et al Mayo CI Proc 72:505, 1997

Results

- Based on H&P if no preoperative indication for laboratory tests determined
 - Safe to proceed with anesthesia/surgery
- Laboratory evaluation
 - based medical and anaesthesia perioperative indications

Narr et al Mayo CI Proc 72:505, 1997

Objectives

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Transfusion thresholds: AABB Guidelines

- Hospitalized hemodynamically stable patients (HHSP)
 - 1) No other co-morbidity
 - 2) with preexisting CV disease
 - 3) with acute coronary syndrome
 - 4) Transfusion criteria: symptoms vs hemoglobin



Carson JL et al Annals Int Med 2012; 157:49-58

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HHSP: no comorbidity

- Restrictive strategy
- Adult/pediatric ICU patients: ≤ 7 g/dL
- Post-operative surgical patient:
 - ≤ 8 g/dL OR
 - Symptomatic patient
 - Chest pain, orthostatic hypotension/tachycardia unresponsive to fluid resuscitation
 - Congestive heart failure
- Quality of evidence: high
- Strength of recommendation: strong



Carson JL et al Annals Int Med 2012; 157:49-58

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Restrictive vs Liberal

- | | |
|---|---|
| <ul style="list-style-type: none">• Trend towards decreased mortality• No evidence of harm | <ul style="list-style-type: none">• Based on statistical analysis, unlikely to decrease mortality |
|---|---|



Carson JL et al Annals Int Med 2012; 157:49-58

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HHSP: with preexisting CV disease

- Restrictive strategy
- Adult/pediatric ICU patients: ≤ 7 g/dL
- Post-operative surgical patient:
 - ≤ 8 g/dL OR
 - Symptomatic patient
 - Chest pain, orthostatic hypotension/tachycardia unresponsive to fluid resuscitation
 - Congestive heart failure
- Quality of evidence: moderate
- Strength of recommendation: weak



Carson JL et al Annals Int Med 2012; 157:49-58

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Restrictive vs Liberal Strategy

- Increase vs decreased incidence of myocardial infarction
 - Conflicting results in the two large trials
 - (TRICC and FOCUS)
- Overall results (all trials):
- no statistically significant increase in
 - Mortality
 - Myocardial infarction



Carson JL et al Annals Int Med 2012; 157:49-58

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HHSP: with acute coronary syndrome

- Restrictive strategy vs liberal: no data
- Quality of evidence: very low
- Strength of recommendation: uncertain



Carson JL et al Annals Int Med 2012; 157:49-58

HHSP transfusion criteria: symptoms vs hemoglobin

- Both
- Quality of evidence: low
- Strength of recommendation: weak



Carson JL et al Annals Int Med 2012; 157:49-58

Objectives

- **Pre-operative hemostatic assessment: Who and What**
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Type II: Immune HIT

- Isolated HIT or HIT with thrombosis (HITTS)
- Based on timing:
 - Classical HIT (day 5 to 14)
 - Rapid onset HIT (<day 5)
 - Delayed HIT (>day 14 to ~4 weeks)
- Atypical HIT
 - Skin necrosis
 - Systemic reactions to UFH infusion
 - HIT-like syndrome



Risk of Thrombosis in Isolated HIT

Study	Wallis et al, 1999	Warkentin and Kelton, 1996	Lewis et al 2003
Design	Retrospective	Retrospective	Prospective
Therapy	D/C heparin, 21/113 received other Rx	D/C heparin or substitute warfarin	D/C heparin and/or substitute warfarin
New thrombosis	21/113 (18%)	32/62 (52%)	32/139 (23%)

- Patients with isolated HIT have high risk of thrombosis
- Prophylactic therapy with a DTI should be considered



CP1210740-42

HIT Pre-Test Probability Scoring

Suspicion of HIT based upon the "4 T's"	Score	Pre-test Probability Score Criteria		
		2	1	0
Thrombocytopenia	<input type="checkbox"/>	nadir 20-100, or >50% platelet fall	nadir 10-19, or 30-50% platelet fall	nadir <10, or <30% platelet fall
Timing of onset of platelet fall	<input type="checkbox"/>	day 5-10, or >day 1 with recent heparin*	>day 10 or timing unclear (but fits with HIT)	<day 1 (no recent heparin)
Thrombosis or other sequelae	<input type="checkbox"/>	proven thrombosis, skin necrosis, or ASRT	progressive, recurrent, or silent thrombosis, erythematous skin lesions	none
Other cause of platelet fall	<input type="checkbox"/>	none evident	possible	definite
Total Pre-test Probability Score	<input type="checkbox"/>	periodic reassessment as new information can change pre-test probability (e.g., positive blood cultures)		

Total Pre-test Probability Score									
High			Moderate				Low		
8	7	6	5	4	3	2	1	1	0
Stop heparin†; give alternative non-heparin anticoagulant (argatroban†† or bivalirudin†† or danaparouin** (or bivalirudin†† or fondaparinux‡‡))			Physician judgment				Continue (LMW) heparin		

Warkentin TE: Sem Thromb Haemost 30(4):273, 2004

CP1210500-10

Emerging Clinical Diagnostic Approach: HIT Expert Probability

1. Magnitude of fall in platelet count (measured from peak platelet count to nadir platelet count since heparin exposure)		
a. <30%		-1
b. 30%-50%		1
c. >50%		3
2. Timing of fall in platelet count – for patients in whom typical onset HIT is suspected		
a. Fall begins <4 days after heparin exposure		-2
b. Fall begins 4 days after heparin exposure		2
c. Fall begins 5-10 days after heparin exposure		3
d. Fall begins 11-14 days after heparin exposure		2
e. Fall begins >14 days after heparin exposure		-1
<i>For patients with previous heparin exposure in last 100 days in whom rapid onset HIT is suspected</i>		
f. Fall begins <48 h after heparin re-exposure		2
g. Fall begins >48 h after heparin re-exposure		-1
3. Other causes of thrombocytopenia (select all that apply)		
a. Presence of a chronic thrombocytopenic disorder		-1
b. Newly initiated non-heparin medication known to cause thrombocytopenia		-2
c. Severe infection		-2
d. Severe DIC (defined as fibrinogen <100 mg/dL ¹ and D-dimer >5.0 µg mL ⁻¹)		-2
e. Involving intra-arterial device (e.g. IABP, VAD, ECMO)		-1
f. Cardiopulmonary bypass within previous 96 h		-1
g. No other apparent cause		3

Role of emerging clinical predictors

- HEP Score:
 - Requires prospective clinical validation prior to routine use

Post CABG Thrombocytopenia

Variables	Clinical scenario	Points
(b) Lillo-Le Louët model		
1. Platelet count time course	Pattern A (Platelet count begins to recover after CPB, but then begins to fall again >4 days after CPB)	2
2. Time from CPB to index date	≥5 days <5 days	2 0
3. CPB duration	≤118 min >118 min	1 0
Total score of ≥2 points, high probability of HIT; <2 points, low probability of HIT		

HIT Laboratory assays

Category	Sensitivity	Specificity
Immunologic	Polytypic IgG-specific PGIA	>95% 50-89%
Functional	SRA HIPA	>90% >90%

Cucker A Curr Op Hem 2011; epub

Treatment Goals in HIT

Interrupt the immune response

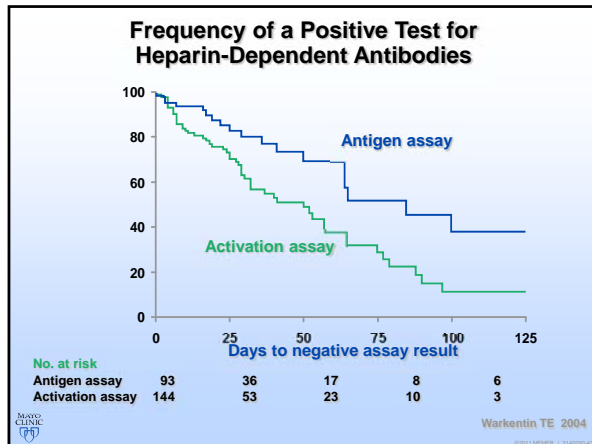
- Discontinue heparin

Inhibit thrombin generation

- Treat existing thrombosis
- Prevent new thrombosis

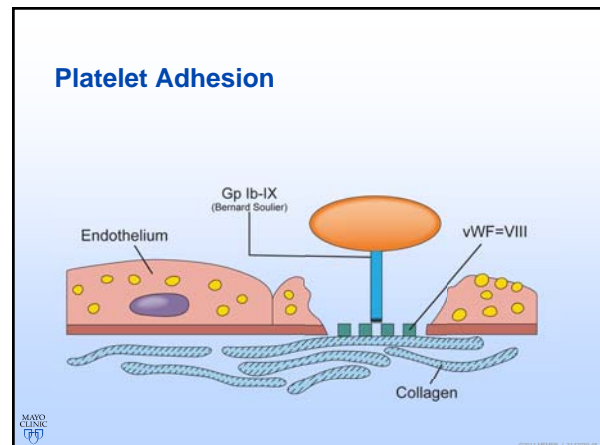
HIT: “Dos and don'ts”

<ul style="list-style-type: none"> • Don't • Increase dose of heparin • Switch to low molecular weight heparin • Start warfarin alone • “Load” the patient with warfarin 	<ul style="list-style-type: none"> • Do • Stop ALL heparin • Consider risks benefits of direct thrombin inhibitors (DTI) • Start DTI especially if there is documented thrombosis • Let patient “cool off” before starting warfarin
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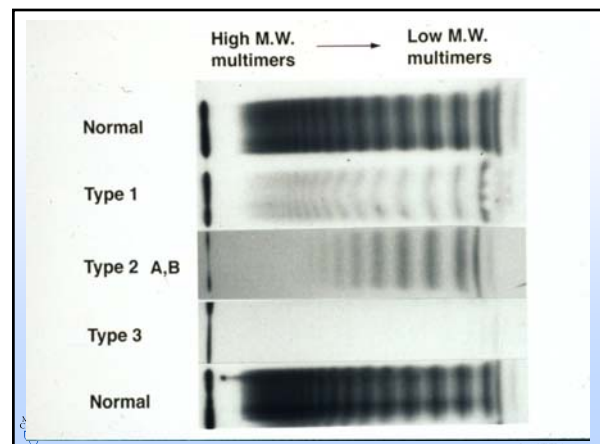


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- ### von Willebrand disease
- Deficiency of von Willebrand factor
 - The most common congenital bleeding disorder
 - Function of vWF
 - mediates platelet adhesion (aggregation) to injured vessel wall
 - carrier for factor VIII



- ### von Willebrand disease
- Testing for vWD:
 - Patient history (family history)
 - Functional assay: VWF activity/Ristocetin cofactor **Low**
 - Antigenic assay: vWF antigen **Low**
 - FVIII activity
 - Multimer pattern: **Distribution**
 - APTT Typically normal (rarely prolonged)



von Willebrand disease: Perioperative management

- Factor replacement options:
 - Desmopressin (DDAVP)
 - Plasma derived VWF concentrate
- General principles
 - Preop: Infuse and measure a post infusion level (lasts 8 to 12 hours)
 - Intraop: depending on length of surgery additional doses may be needed



Postoperative management

- Type 1 (mild)
 - DDAVP once preop
 - Typically switch to VWF concentrate
- Types 2 and 3
- Plasma derived VWF concentrates
 - Check daily AM levels for ongoing dosing
 - Requires quick turn around time of VWF assays
 - Do not dose without checking daily levels



Objectives

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Pathophysiology: Viscosity, %HbS and hematocrit

- At a fixed %HbS:
 - Viscosity increases with hematocrit
- At a fixed hematocrit:
 - Viscosity increases with %HbS
- Simple Transfusions: raise hematocrit and viscosity
 - Reduces oxygen delivery
- Exchange transfusion: raise hematocrit and reduce %HbS
 - Reduces viscosity



The main perioperative question

Simple transfusion vs exchange transfusion

Transfusion in Sickle Cell Disease and surgery: Randomized Trial

- Aggressive regimen (group 1):
 - Target Hb 10 g/dL (9 to 11) AND
 - HbS level of $\leq 30\%$
- Conservative regimen (Group 2):
 - Target Hb 10 g/dL (9 to 11)
 - regardless of the HbS level



Vichinsky et al NEJM 1995;333: 206-213

Types of Surgeries

Variable	Group 1 (n=303)	Group 2 (n=301)
Operations (%)		
Types of surgery		
Cholecystectomy	36	41
Ear, nose, and throat procedure	25	26
Orthopedic procedure	11	13
Orthopedic procedure	11	13
Splenectomy	6	4
Hemiorrhaphy	5	5
Genitourinary procedure	3	2
Obstetrical or gynecologic procedure	3	2
Skin procedure	3	2
Gastrointestinal procedure	2	2
Eye procedure	<1	2
Vascular-access procedure	2	1
Soft-tissue biopsy	2	<1
Craniotomy	<1	0
Arteriography	<1	<1
Other	<1	0
Surgical-risk category [†]		
1	26	23
2	73	77
3	1	0

Vichinsky et al NEJM 1995;333: 206-213

Complication Rate

Complications	Group 1 (n=303)	Group 2 (n=301)
Operations (%)		
Before, during, or after surgery		
Miscellaneous intraoperative event	19	20
Acute chest syndrome	11	10
Fever or infection	7	7
Miscellaneous postoperative event	6	5
Painful crisis	5	7
Neurologic event	1	1
Renal complication	1	<1
Death	1	0
Any complication	31	35
After surgery		
Acute chest syndrome	10	10
Fever or infection	7	5
Miscellaneous postoperative event	6	5
Painful crisis	4	7
Neurologic event	1	<1
Renal complication	1	<1
Death	1	0
Any complication	21	22

[†]Complications associated with transfusions, which are shown in Table 5, are excluded here. The group numbers refer to operations.

Vichinsky et al NEJM 1995;333: 206-213

Perioperative management

- Preoperative:
 - Hydration for 8 hours
- Intraoperative monitoring:
 - Temperature
 - Blood pressure
 - ECG
 - Oxygenation
- Postoperative:
 - Hydration, oxygen, etc

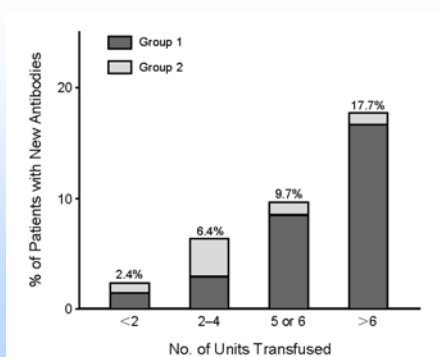
Vichinsky et al NEJM 1995;333: 206-213

Predictors of complications

- Acute chest syndrome (10%):
 - Higher surgical risk category
 - History of pulmonary disease
- Painful crises (5%)
 - Older age
 - Frequent hospitalizations

Vichinsky et al NEJM 1995;333: 206-213

Complications: Alloimmunization Rate



Vichinsky et al NEJM 1995;333: 206-213

The bottom line:

- Aggressive transfusion strategy provided no advantage over simple transfusion for surgery
- Caveats:
 - None of the studied patients underwent CABG



The Transfusion Alternatives Preoperatively in Sickle Cell Disease (TAPS) study: a randomised, controlled, multicentre clinical trial

Jo Howard, Marina Maffey, Charlotte L Ince, Louis e Choo, Bernate Hodge, Tony Johnson, Shajiq Parshil, David C Bess, Louise Taylor, Barbara Wilkie, Karin Fijnvondt, Melanie Kirby Allen, Edlin Spackman, Sally C Davies, Lorna M Williamson



Lancet 2013;381:930

	No preoperative transfusion (n=33)	Preoperative transfusion (n=34)	Overall (n=67)
Number of patients with clinically important complications (%)	13 (39%)	5 (15%)	18 (27%)
Number of clinically relevant complications			
All related to sickle-cell disease	12	3	15
Acute chest syndrome	9	1	10
Acute pain crisis	3	1	4
CNS	0	1	1
Surgery-related	4	1	5
Infection-related	0	1	1
Transfusion-related	0	0	0
Other	0	1	1
Total	16*	6†	22
Number of patients with complications classified as SAEs (%)	10 (30%)	1 (3%)	11 (16%)

CNS=central nervous system; SAEs=serious adverse events. *Three patients had two complications. †One patient had two complications.

Table 2: Numbers of clinically important complications and serious adverse events



Lancet 2013;381:930

Take home messages

- [NHLBI Guidelines](#)
- All sickle cell patients: (regardless of genotype)
 - Rigorous pre/intra/postoperative monitoring:
 - I/O hematocrit, hydration, peripheral perfusion, oxygenation status, blood pressure, cardiac rhythm and rate, respiratory therapy.
- Team awareness



Take home messages

- SCD-SS and SCD-S β -thalassemia
 - simple transfusion: Hb ~10 g/dL
 - all but the lowest risk procedures
- SCD-SC:
 - exchange transfusions avoidance of hyperviscosity complications
- Extended antigen-matched blood
 - K, C, E, S, Fy, and Jk antigens



MAYO CLINIC

An Overview of Perioperative Medicine 2013:

From Outpatient Preoperative Assessment to Inpatient Postoperative Care

Mayo School of Continuous Professional Development
 Management of Post-operative Pulmonary Complications
 Richard A. Oeckler, M.D., Ph.D.
 October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Learning objectives

- Brief review of pulmonary (patho)physiology most relevant to the perioperative period
- Describe the most common post-operative pulmonary complications
- Discuss best practice to minimize or treat pulmonary complications in the postoperative period

Question 1

- The most important risk factor for the development of a post-operative pulmonary complication is:

- a) Smoking history
- b) General anesthesia
- c) Surgical site
- d) Recent pneumonia

Independent predictors of PPCs

- Surgical site (Intrathoracic)
- Pre-op SaO₂ ≤90%
- Surgical duration >3 hours
- Respiratory infection in last month
- Age >80
- Functional status
- Emergency procedure

Highest Risk

 Lower Risk

Independent predictors of PPCs

- Surgical site (Intrathoracic)
- Pre-op SaO₂ ≤90%
- Surgical duration >3 hours
- Respiratory infection in last month
- Age >80
- Functional status
- Emergency procedure

ASA Class	Class Definition	Rates of PPCs by Class, %
I	A normally healthy patient	1.2
II	A patient with mild systemic disease	5.4
III	A patient with systemic disease that is not incapacitating	11.4
IV	A patient with an incapacitating systemic disease that is a constant threat to life	10.9
V	A moribund patient who is not expected to survive for 24 hours with or without operation	NA

* Information is from reference 9. ASA = American Society of Anesthesiologists; NA = not applicable; PPC = postoperative pulmonary complication.

Incidence by surgical procedure/site

- Non-cardiothoracic ~2-7%
- Cardiothoracic ~30-40%

	General and Digestive	Cardiac	Orthopedic	Thoracic	Other	Total
Incidence of patients with at least 1 PPC within specialty, %	7.2	39.6	2.4	31.4	2.4	5.0
days, n (% of patients with PPC)	20 (28.5)	1 (4.8)	2 (10.5)	2 (18.2)	5 (25.0)	30 (24.4)
Patients with at least 1 PPC died at 90 days, n (% of patients with PPC)	27	50	7	2	31	117
Patients with prolonged mechanical ventilation after surgery, n	11 (16.7)	9 (18.0)	0 (0)	0 (0)	7 (22.6)	27 (23.1)

PPC = postoperative pulmonary complication.

Stable incidence despite best practice

VOL. 14
NO. 12
POSTOPERATIVE PULMONARY COMPLICATIONS—MILLAR 973

POSTOPERATIVE PULMONARY COMPLICATIONS*
BY ALBERT H. MILLAR, M.D.†

THE origin of the pulmonary complications which too frequently follow surgical operations is an unsolved problem. Although postoperative pulmonary complications had been noted at autopsy before the advent of anesthesia, they were early ascribed to the irritative effect of ether vapor, with some justice, in view of the then crude methods of administration. Von Mikulicz¹ reporting a higher incidence and mortality of pulmonary complications following local anesthesia, introduced doubt concerning the specific effect of ether vapor in the causation of these complications. Whipple² found the incidence of pneumonia after anesthesia as follows: local, 3.1 per cent; ether, 2.5 per cent; and gas-oxygen, 1.6 per cent. Sise³ found the incidence of lung complications after anesthesia in general surgical cases to be local, 7.5 per cent; ether, 3.1 per cent; and gas-oxygen, 1.8 per cent. While the statistics of Whipple's tabulation of 5,000 cases, found pulmonary complications more frequent after gas-oxygen than following ether. Brown and Debevoise⁴ found carbon dioxide . . . kill less than one patient by explosion for each hundred or more that they probably save from death by postoperative pneumonia.⁵

In our experience, surgical and anesthetic technique has a very profound influence on the occurrence of pulmonary complications. By careful attention to details often neglected, we attempt, with considerable success, to avoid these postoperative mishaps. Respiratory infections already existent are more frequently benefited than made worse by careful general anesthesia; this confirms McCosken's observation that there is uniform lessening in the severity of pneumonia following gas-oxygen administration.

Even the slightest pulmonary complication is important. Even a cough may be a distressing thing for a patient recovering from an operation. When careful search of records fails to show any considerable number of postoperative pulmonary complications, such records are worthy of study in an attempt to learn what feature of technique is responsible for this fortunate result. The series of cases here analyzed com-

Mayo Clinic
N Engl J Med 1937; 216:973-976. June 3, 1937. DOI: 10.1056/NEJM19370603162203

PPCs increase LOS, mortality

Table 4. Postoperative LOS and Mortality According to the Number of PPCs

No. (%) of patients	No. of PPCs				Total No. of Patients
	0	1	2-3	≥4	
Postoperative LOS, median (10-90th percentile), d†	2,341 (95.0) 3 (1-11)	66 (2.7) 10 (3-26.5)	37 (1.5) 11 (3.8-27.8)	20 (0.8) 27 (10.4-105.1)	2,464 (100) 3 (1-12)
30-day mortality, n (%)‡	11 (0.5)	6 (9.1)	11 (29.7)	7 (55.0)	35 (1.4)
90-day mortality, n (%)‡	29 (1.2)	7 (10.6)	12 (32.4)	11 (85.0)	59 (2.4)

* Kruskal-Wallis test for comparing means, $P < 0.0001$. † Mann-Whitney test for mortality trend, $P < 0.0001$.
‡ LOS = length of stay; PPC = postoperative pulmonary complication, a composite outcome in which 1 or more PPCs might be observed.

Canet et al. Anesthesiology, V 113 • No 6 • December 2010 1343

Mayo Clinic
Canet et al. Anesthesiology 2010; 113:1338-80

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Canet et al. Anesthesiology, V 113 • No 6 • December 2010 1343

Mayo Clinic
Canet et al. Anesthesiology 2010; 113:1338-80

Causes of post-op respiratory failure

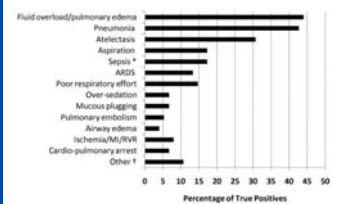


Figure 2. Physician-identified responsible factors for postoperative respiratory failure. Multiple factors can be responsible for a given case. *Sepsis unrelated to pulmonary process. †Includes COPD exacerbations or underlying COPD (n = 2), bronchospasm (n = 1), altered mental status (n = 1), thick secretions (n = 2). Ischemia/MI/RVR, myocardial ischemia/infarction/rapid ventricular response with congestive heart failure.

Mayo Clinic
Borzecki et al. doi:10.1016/j.amcollurg.2010.09.034

Case #1

• 52F with COPD, DM2 undergoes uneventful RUL pulm nodule wedge resection. Develops low-grade fever evening POD #1, and tachypnea (no wheeze), tachycardia, increased secretions, SaO2 90% (preop baseline 96-99%) on POD #2. The most likely diagnosis is:

- HCAP
- Bronchospasm
- Atelectasis
- VTE

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OBSERVATIONS ON THE PREVENTION AND TREATMENT OF POSTOPERATIVE ATELECTASIS AND BRONCHOPNEUMONIA*

CAMERON HAIGHT, M.D.,

AND

HENRY K. RANSOM, M.D.

ANN ARBOR, MICH.

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF MICHIGAN, ANN ARBOR, MICH.

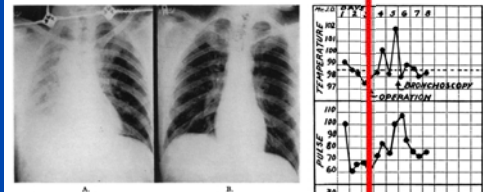


FIG. 3.—A, B. No. 32551. (A) Roentgenogram of chest following bilateral incision bronchotomy, atelectasis, right lung. Bronchotomy performed same day because of unrelieved cough and marked hypoxia. (B) Roentgenogram of chest showing bilateral lung expansion and marked improvement in respiratory status on same day. Two operations by same method on following day with equal favorable results. Chestwound satisfactory thereafter. (C) Roentgenogram six days later reveals no pulmonary atelectasis or infection.

Mayo Clinic
Annals of Surgery, August 1941

Anesthesia and the lung: Set-up for atelectasis

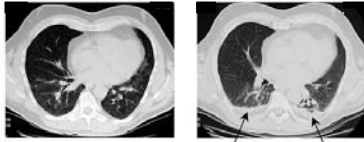
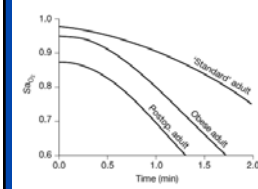


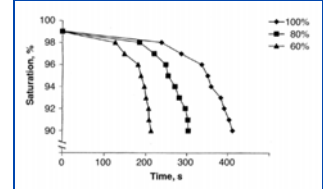
Fig. 1 Examples of CT scans of a patient with healthy lungs, before and after induction of anesthesia. The CT slices are 1 cm above the level of the right diaphragm. Arrows indicate lung densities, thought to represent atelectasis (from Rusca and colleagues¹⁸).

Induction and the benefit of preoxygenation

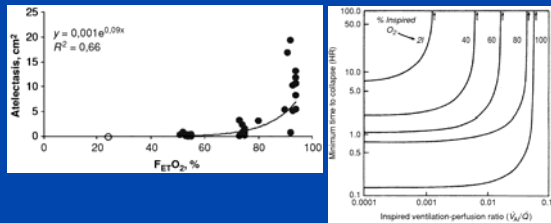
No Preoxygenation



With Preoxygenation

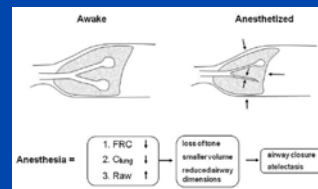


Absorption atelectasis: Negative consequences of high FiO2



Compression atelectasis: Pulmonary mechanics under anesthesia

- Loss of muscle tone
- Altered diaphragm motion
- Cephalad displacement

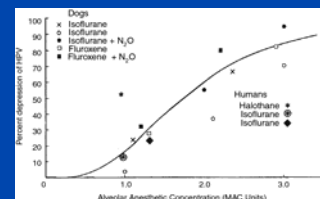


Anesthetics and ventilatory drive

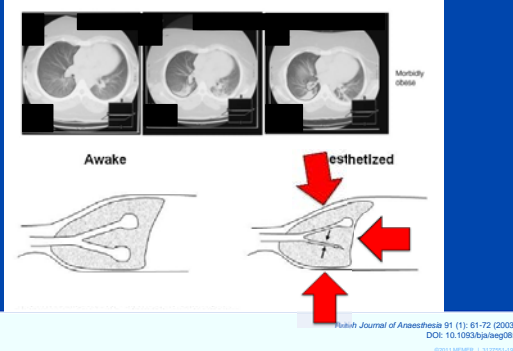
- Ventilatory drive affected by state of arousal, O₂/CO₂/acid-base status
- Blunted ventilatory response to both hypoxemia and hypercarbia
 - Depression of peripheral chemoreceptors
 - Response to O₂
 - Depression of central chemoreceptors
 - Response to PaCO₂

Inhalational anesthetics inhibit hypoxic vasoconstriction

- Exacerbates pre-existing V/Q mismatching
- Compounds shunting due to atelectasis



Obesity: A further mechanical disadvantage



Mayo Clinic
 Polish Journal of Anaesthesia 91 (1): 61-72 (2003)
 DOI: 10.1093/bja/aeg985

The role of postoperative pain in PPCs

Effects of pain

- Poor inspiratory effort
 - Shallow breathing
 - Few deep breaths / sigh maneuvers
 - Reduced ability to recruit
- Ineffectual cough and mucus clearance
 - Retained secretions

Effects of its treatment

- Decreased VE
- Decreased muscle tone
- Opioids and bronchospasm
- Decreased mental status, increased risk of aspiration

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Pneumonitis (Aspiration)

- Chemical injury to the lung, NOT infectious
 - Clinical history
 - Witnessed aspiration
- Decreased consciousness = unprotected airway
 - Anesthesia (Up to 4.5%, general anesthesia)
 - Pain, sedative medications
- Unprotected airway + vomitus = aspiration pneumonitis, potential evolution to PNA?

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Pneumonitis (Aspiration): Prevention

- Pre-procedural fasting (several hours)
- Metoclopramide to enhance gastric emptying
- H2 or PPI to increase gastric contents pH
- Selective use of nasogastric (NG) tubes
 - In symptomatic or with abdominal distension
 - Routine use appears to increase aspiration risk (OR=1.45; 1.08-1.93 v. selective use)

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Approach to the treatment of atelectasis

Excessive Secretions

- Frequent suctioning
 - Bronch for mucus plugging
- Chest physiotherapy
- Up and ambulate
- No evidence for N-AC
- CPAP contraindicated

No secretions

- Trial CPAP*
 - Decreased re-intubation
 - 1% v. 10%
 - Decreased pneumonia
 - 2-3% v. 10%
 - Decreased sepsis
 - 2% v. 9%
- Up and ambulate

Incentive spirometry?

Mayo Clinic
 *Squadrone et al. JAMA. 2005;293(5):589

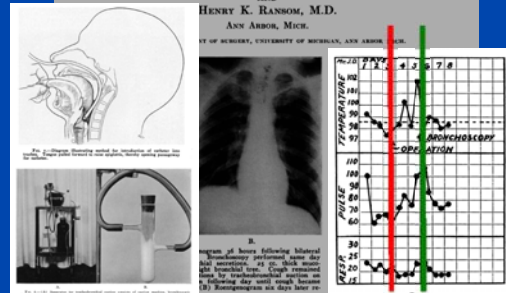
OBSERVATIONS ON THE PREVENTION AND TREATMENT OF POSTOPERATIVE ATELECTASIS AND BRONCHOPNEUMONIA*

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Mayo Clinic
 Annals of Surgery, August 1941

Lung expansion techniques to prevent or treat atelectasis

- Incentive spirometry
- Chest physical therapy
 - including deep breathing exercises, percussion and vibration
- Cough
- Postural drainage
- Ambulation
- PAP (CPAP, BIPAP)



Question #2

- Atelectatic regions of the lung are associated with all of the following except:
- a) Surfactant dysfunction
- b) Increased inflammatory signaling
- c) Ventilator-induced lung injury
- d) An increased V/Q
- e) Low tidal volume lung ventilation



The biophysics of atelectasis

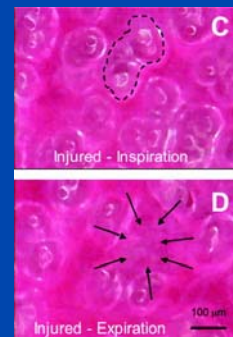
- Pathological changes at the functional respiratory unit (respiratory bronchiole and alveoli) as a result of atelectasis:
 - Barotrauma
 - Biotrauma
 - Surfactant loss
 - Interdependence mechanisms



Atelectrauma

Interfacial stress injury

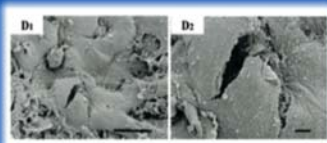
- Cyclical opening and closing of alveoli leads to resident cell injury
- May lead to paradoxical overdistension of open units
- Barrier property changes, fluid shifting
- Inflammatory response



Carney D, et al. Crit Care Med 33:S122-128, 2005

Overdistension

- Resident cell injury
- Basement membrane disruption, loss of compartmentalization, alveolar flooding
- Immune and inflammatory response



Hotchkiss et al. Crit Care Med 2002;30:2368-2370.

Edema / Foam

- Airway flooding, “functional atelectasis”
 - Lower Pcrit, need more force to reopen
- Pressure-gradient injury¹
- Liquid-bridge rupture injury²



1) Oeckler et al. Am J Physiol Lung Cell Mol Physiol. 2010 Dec;299(6):L826-33
2) Huh et al. PNAS. 2007 Nov;104(48):18886-18891

The biophysics of atelectasis

- Pathological changes at the functional respiratory unit (respiratory bronchiole and alveoli) as a result of atelectasis:
 - Barotrauma
 - Biotrauma
 - Surfactant loss
 - Interdependence mechanisms

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Normal Alveolus

Injured Alveolus during the Acute Phase

Key players: Neutrophil and macrophage

- TNF-alpha
- TGF-beta
- IL-1,6,8,10

Compartmental loss = potential systemic effect

Ware & Matthay, NEJM, 2000.

The biophysics of atelectasis

- Pathological changes at the functional respiratory unit (respiratory bronchiole and alveoli) as a result of atelectasis:
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 - Surfactant loss
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Consequences of surfactant loss

- ↑ **Surface tension**
- ↑ Work of breathing
- ↑ Fluid from capillaries to alveolar space (Pulmonary edema)
- ↓ **Innate immunity**

SP-A and SP-D carbohydrate recognition domains coat foreign particles, promote macrophage phagocytosis = decreased bacterial clearance

Martin, Annu Rev Physiol (2001) 63:39-44.

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The biophysics of atelectasis

- Pathological changes at the functional respiratory unit (respiratory bronchiole and alveoli) as a result of atelectasis:
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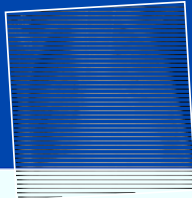
Interdependence

- Biophysics of networked structures
 - Shear stress between neighboring units with different volumes, transmural pressures, mechanical composition
 - Stress concentrations
 - Setup for lung cell and basement membrane failure

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Case #2

- 75M smoker with moderate COPD, CAD, and systolic CHF underwent resection of RUL pulm nodule. Post-op he was extubated but unable to wean off O2. Despite diuresis he has an increasing O2 requirement and is reintubated on POD#3.



Case #2:

- His blood gas on FiO2 0.5 and SaO2 90% is:
 - PaO2 65
 - PaCO2 55
 - pH 7.35
 - HCO3 30

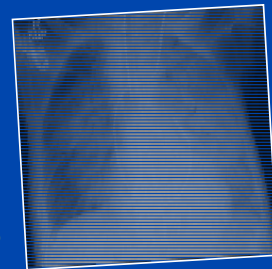
Case #2

Based on the provided information, the diagnosis most consistent with the patient's current respiratory condition is:

- a) Procedural related volume overload / acute exacerbation of CHF
- b) Acute exacerbation of COPD
- c) Acute respiratory distress syndrome
- d) Pneumonia

Acute Lung Injury & the Acute Respiratory Distress Syndrome

- Definition
 - Acute onset (<1 week)
 - B/L pulmonary infiltrates
 - Not primarily due to volume overload / acute exacerbation of CHF (PCWP <18 mmHg)
 - PaO2:FiO2 <300 with PEEP of at least 5 cmH2O



Acute Lung Injury & the Acute Respiratory Distress Syndrome

- Severity Grading
 - Based on PaO2:FiO2
 - Mild 200-300
 - Moderate 100-200
 - Severe <100



Acute lung injury

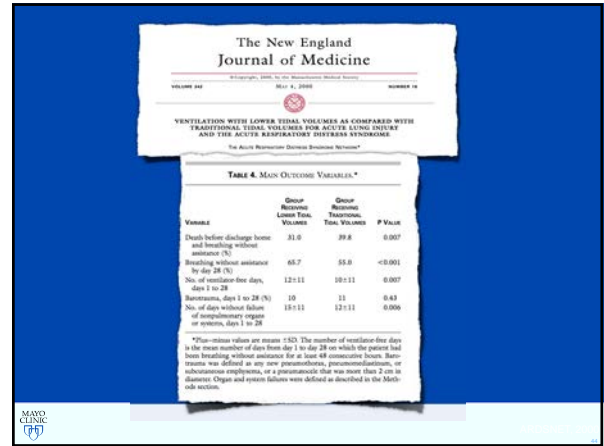
- Ventilator-induced (VILI/VALI)
 - Exposure to mechanical ventilation
 - Barotrauma
 - Biotrauma
 - O₂/ROS/RNS toxicity
- Transfusion-related (TRALI)
 - Immune response to blood products
- Preventable, "Hospital-acquired" conditions ?



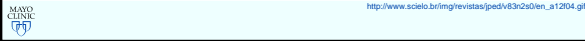
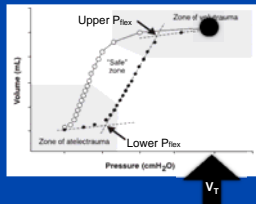
Question #3

Which of the following interventions has been shown to reduce mortality in patients with acute lung injury?

- a) Increasing PEEP from 5 to 10 cm H₂O
- b) Lowering tidal volume from 10 to 6 cc/kg
- c) High frequency oscillatory ventilation
- d) All of the above
- e) None of the above



Low V_T: Minimizing overdistension



Low V_T for everyone?

Association Between Use of Lung-Protective Ventilation With Lower Tidal Volumes and Clinical Outcomes Among Patients Without Acute Respiratory Distress Syndrome: A Meta-analysis

Context Lung-protective mechanical ventilation with the use of lower tidal volumes has been found to improve outcomes of patients with acute respiratory distress syndrome (ARDS). It has been suggested that use of lower tidal volumes also benefits patients who do not have ARDS.

Objective To determine whether use of lower tidal volumes is associated with improved outcomes of patients receiving ventilation who do not have ARDS.

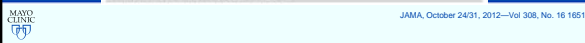
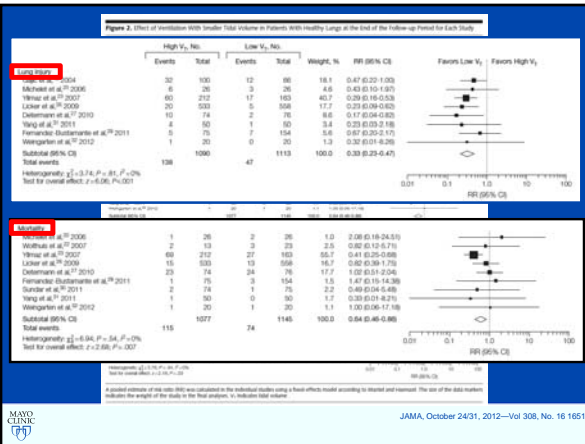
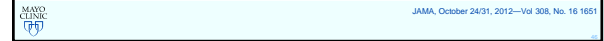
Study Selection Eight studies evaluated use of lower or higher tidal volumes in patients without ARDS at onset of mechanical ventilation and reported lung injury development, overall mortality, pulmonary infection, intubation, and mechanical duration.

Data Sources MEDLINE, CINAHL, Web of Science, and Cochrane Central Register of Controlled Trials up to August 2012.

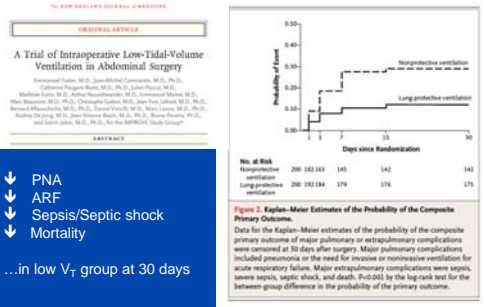
Study Selection Eight studies evaluated use of lower or higher tidal volumes in patients without ARDS at onset of mechanical ventilation and reported lung injury development, overall mortality, pulmonary infection, intubation, and mechanical duration.

Data Extraction Three reviewers extracted data on study characteristics, methods, and outcomes. Disagreement was resolved by consensus.

Data Synthesis Twenty articles (2622 participants) were included. Meta-analysis using a fixed-effects model showed a decrease in lung injury development risk ratio (RR) 0.53, 95% CI, 0.23 to 0.47, *P* < .05, number needed to treat (NNT), 15, and mortality RR.

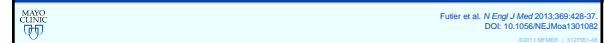


Low V_T in the OR



- ↓ PNA
- ↓ ARF
- ↓ Sepsis/Septic shock
- ↓ Mortality

...in low V_T group at 30 days



PEEP: Minimizing atelectasis & atelectrauma

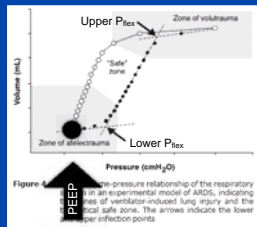
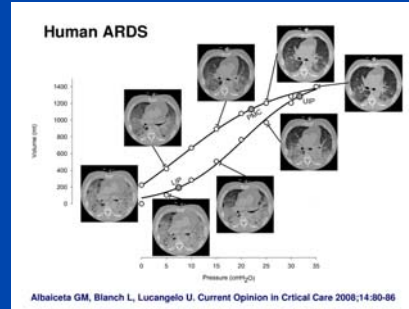


Figure 4. Pressure-volume relationship of the respiratory system with an experimental model of ARDS, indicating the effect of ventilator-induced lung injury and the effect of PEEP. The arrows indicate the lower and upper inflection points.

http://www.scielo.br/rmg/revistas/pep/v33n2/en_a1204.pdf



Lung opening and collapse during a respiratory cycle

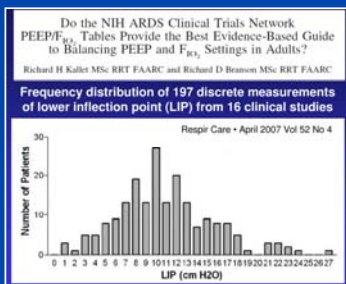


Human ARDS

Albaladejo GM, Blanch L, Lucangelo U. Current Opinion in Critical Care 2008;14:80-86



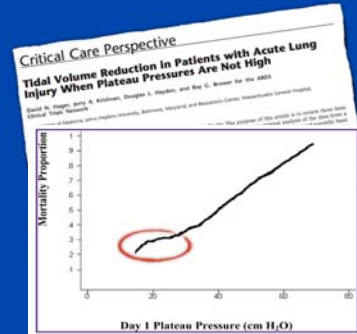
Choosing PEEP: Actuarial Medicine?



Do the NIH ARDS Clinical Trials Network PEEP/F_{IO2} Tables Provide the Best Evidence-Based Guide to Balancing PEEP and F_{IO2} Settings in Adults?
Richard H Kallet MSc RRT FAARC and Richard D Branson MSc RRT FAARC

Frequency distribution of 197 discrete measurements of lower inflection point (LIP) from 16 clinical studies

Respir Care • April 2007 Vol 52 No 4



Critical Care Perspective
Tidal Volume Reduction in Patients with Acute Lung Injury When Plateau Pressures Are Not High

David M. Regehr, MD, PhD, Richard S. Hopton, and Ray C. Taylor, MD, PhD

Journal of Intensive Care Medicine 2008; 23(1): 1-6

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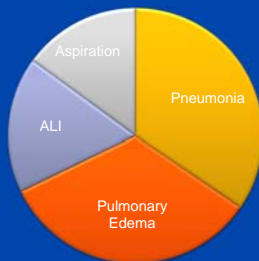
<http://jicm.sagepub.com>

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<http://jicm.sagepub.com>



Etiology of Pulmonary Infiltrates



Singh et al. Chest. 1998;114(4):1129



Postoperative pneumonia

- Usually occurs by POD#5
 - Fever
 - Leukocytosis
 - Infiltrate
 - Dyspnea, tachypnea
 - ± hypoxemia, hypercapnia
- Non-distinct from HAP/VAP in presentation



Postop PNA: Diagnosis

- High level of suspicion
 - Fever, purulent sputum, WBC, WOB/increasing hypoxia
- CXR
- Microbiologic sample
 - Trach secretions
 - BAL
- Biomarkers?

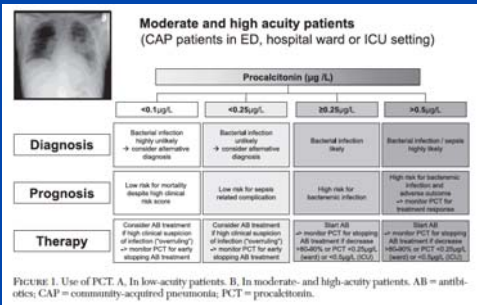


Therapy

- Broad spectrum empiric coverage
 - <50% culture positive
 - GNB (Pseudomonas, Kleb, Acinetobacter) and Staph aureus most common
 - ~30% polymicrobial (Enterobacter + Staph or Strep)
- Adjust based on culture results and course
 - Procalcitonin to de-escalate?



Role for procalcitonin?



Scheutz et al. Chest 2012;141:1063-1073
DOI 10.1378/chest.11-2430

Case #3

- 67M with DM2 and moderate COPD s/p uncomplicated upper abdominal procedure. POD #2 he develops tachypnea, increased WOB, and wheezes throughout all lung fields. All of the following may be a cause of this condition except:

- Aspiration
- Pneumothorax
- Acute exacerbation of underlying COPD
- Opioid pain medications



Bronchospasm: Common causes

- Aspiration
- Reflex SM constriction
 - Tracheal stimulation, secretions, suctioning
- Medications (histamine release)
 - Opiates, atracurium
 - Allergic response
- Exacerbation of underlying disease
 - COPD, asthma



Bronchospasm: Treatment

- "Treat the underlying cause"
 - Stop meds
 - Secretion management
- Short-acting B2 agonist
 - May add anticholinergic for synergy
- For COPDers, asthmatics, manage as you would an exacerbation of the underlying dz



Case #4

- 44M obese smoker s/p Ivor-Lewis esophagectomy for adenoCA is POD#4 and on the general care floor. Despite resting after ambulation during his PT session he continues to be lightheaded and dizzy. His therapist is concerned that this may be due to the PRN dose of oxycodone he took prior to their session. He denies pain or dyspnea, although he is tachypneic and tachycardic. His SpO2 is 91% on 4L NC. BP 95/65 HR 115 RR 26.



Case #4

You immediately recommend:

- a) He remain supine without HOB elevation to help with presyncope and orthostasis
- b) Increase supplemental O2 to maintain saturation >92%
- c) Obtain CT-PE protocol to rule out VTE
- d) Administer 0.4 mg naloxone for presumed opioid overdose



VTE/Pulmonary embolism

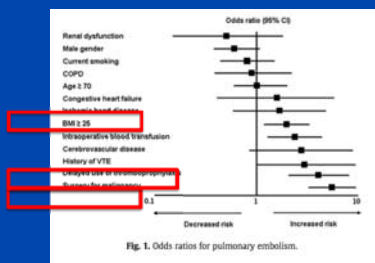


Fig. 1. Odds ratios for pulmonary embolism.

F. van Lier et al. / Thrombosis Research 129 (2012) e14–e17



Pulmonary embolism and pain medications

- Narcotics may blunt, mask or confound:
 - Classical symptoms of discomfort
 - Feelings of dyspnea
 - Findings of hypotension, presyncopal, or syncopal events
 - Acid-base and ABG due to respiratory depression



Pulmonary embolism and pain medications

- Maintain a high level of suspicion
- Low threshold for investigation
- Prophylaxis in all without contraindication
 - SCDs*
 - Pharmacologic



*Ho & Tan. Circulation 2013
DOI: 10.1161/CIRCULATIONAHA.113.002690

A quick note about pleural effusions in the post-operative period

- Up to 50% of abdominal, cardiac surgeries
- Majority benign, resolve spontaneously in 3-5 days
- In clinical context, don't forget association with:
 - Pulmonary embolus
 - Dressler's (Postpericardiotomy) syndrome
- Workup persistent effusion, or with other concerning findings (infiltrate, fever, WBC)
 - Thoracentesis



Exacerbation of OSA

- Apneas, hypopneas
 - Loss of upper airway patency during sleep
 - Episodic awakenings, desaturations
- Worsened postoperatively
 - Anesthesia, opioids, sedatives
 - Muscle relaxation
 - Depression of central, peripheral respiratory centers
 - Supine position post-op may contribute



Take home points: PPCs

- Pulmonary physiology is your key to predicting, preventing, and treating PPCs. Learn it well!
 - Recommend West or Munis (see refs)
- Atelectasis is bad. Prevent it, and you will prevent many PPCs!
 - Compounding effects of obesity, OSA, high FiO_2



Take home points: PPCs

- Over-treating pain is at least as bad as under-treating pain!
 - Undertreat and its too painful to breath or clear secretions
 - Overtreat and they don't feel the need to breath or cough (and they aspirate!)
- Have a high index of suspicion based on timing and differentiate based upon key positive & negative symptoms
 - Atelectasis v. PNA v. overload v. PE



References/Suggested Reading

- PPC risk calculator:
<http://www.surgicalriskcalculator.com/prf-risk-calculator>
- West JB, *Respiratory Physiology: The Essentials*, Eighth Ed. Lippincott Williams Wilkins, 2011.
 - West's online lectures in resp physiology:
http://meded.ucsd.edu/itp/jwest/resp_phys/
- Munis JR, *Just Enough Physiology*, Mayo Clinic Scientific Press, 2012.



Questions?




Mayo School of Continuous Professional Development

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MAYO CLINIC **Peri-operative pain management**
 Susan M. Moeschler, MD
 October 12, 2013



Mayo School of Continuous Professional Development

Goals and Objectives

- ✓ What are the commonly used opioids in the postoperative setting and what issues should I consider when prescribing these?
- ✓ What are the common PCA doses for postoperative pain control?
- ✓ How do I manage chronic pain patients who have uncontrolled postoperative pain?
- ✓ When should I consider adjunctive analgesic therapies to help with pain control?
- ✓ How should patients on multiple sedating medications postoperatively be monitored?
- ✓ For patients with epidural or spinal anesthesia, how should anticoagulant DVT prophylaxis be managed?

Q1. What does JCAHO require from a pain management standpoint?

- A) Patients have a right to be pain-free
- B) Patients have a right to have their pain reduced to 4/10 on the pain numeric rating scale
- C) Opioid therapy is required for any pain > 4/10
- D) Patients are required to try non-opioid analgesics prior to initiating opioid therapy
- E) Pain must be assessed and managed reasonably with periodic reassessments and education

The Joint Commission

Facts about pain management

It is estimated that in the United States more than 76 million people suffer from pain. Pain can be chronic or acute, such as post-surgical pain.

Pain management standards


On January 1, 2001, pain management standards went into effect for Joint Commission accredited ambulatory care facilities, behavioral health care organizations, critical access hospitals, home care providers, hospitals, office-based surgery practices, and long term care providers. The pain management standards address the assessment and management of pain. The standards require organizations to:

- recognize the right of patients to appropriate assessment and management of pain
- screen patients for pain during their initial assessment and, when clinically required, during ongoing, periodic re-assessments
- educate patients suffering from pain and their families about pain management

Taken from http://www.jointcommission.org/assets/1/18/Pain_Management.pdf

41 y.o. Male s/p Lumbar Lami/fusion

- Chronic low back and leg pain x 10 years
 - Baseline pain with medications "8/10"
- BMI 40 with sleep apnea, using CPAP
- DM2 with normal renal function (CrCl 70 mL/min)
- Depression/Anxiety
- Opioids x 6 years
 - Oxycodone SR 40mg BID
 - Oxycodone IR 15mg q4h prn pain
 - Gabapentin 1200mg TID



Oral Morphine Equivalents (OME) Conversions

- Oxycodone SR 40mg BID
- Oxycodone IR 15mg q4h prn pain
- Morphine 1:1
 - OXYCODONE, MORPHINE IR,
 - Percocet, lortab, vicodin
- Hydromorphone 1:5
- Oxymorphone 1:10

- $40 \times 2 = 80$
- $15 \text{ mg} \times 6 = 90$
- $80 + 90 = 170 \text{ OME}$

A tumultuous course...

- While in PACU, "10/10" pain requiring significant amounts of IV fentanyl, hydromorphone, midazolam, ketamine
- Sedated, wakes up only to mumble "10/10"
- Localizes pain to lumbar spine and legs
 - Lumbar incisional pain
 - Back muscle spasms
 - Burning, tingling pain down both legs (similar to baseline)
- P.Ox 90% on 2L O2 NC, CPAP initiated
- Family is upset
 - "the doctor needs to do something about his pain..."



What are our pain issues?

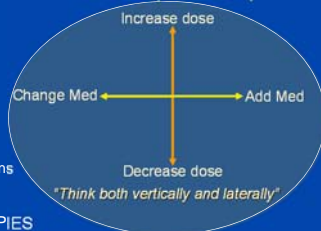
- Chronic pain "8/10" with opioid tolerance
- Different pain generators
 - Incisional pain
 - Myofascial spasm
 - Neuropathic pain (radiculopathy)
- Anxiety
- Sedation
 - General Anesthetic
 - PACU medications
- Reduced renal function
- OSA requiring CPAP

EMOTIONAL ←————→ SENSORY



What tools are available to treat this patient's pain?

- MEDICATIONS
 - Opioid Analgesics
 - Non-opioid Analgesics
 - NSAIDs
 - Anticonvulsants
 - Topical agents
 - Antidepressants
 - Antipsychotic Medications
- PHYSICAL THERAPY
- PSYCHOLOGIC THERAPIES
- COMPLIMENTARY AND INTEGRATIVE MEDICINE TECHNIQUES
- REGIONAL ANESTHESIA
- ADVANCED INTERVENTIONAL PAIN THERAPIES



Patient found in room in cardiorespiratory arrest, cold and blue

- For anxiety...
 - lorazepam 1mg IV q8h PRN
- For spasms...
 - valium 5-10mg PO TID
 - baclofen 10mg PO TID
- For insomnia...
 - zolpidem 10mg PO QHS
- For nausea/vomiting...
 - phenergan 6.25mg IV q6h PRN

Watch out for polypharmacy



Q4. When is the most likely time period for postoperative respiratory depression/arrest to occur?

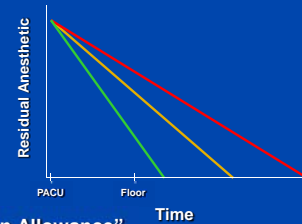
- In the immediate preoperative period
- 0-24 hours postoperatively
- 24-48 hours postoperatively
- 48-72 hours postoperatively
- Immediately post-dismissal from the hospital



Complex Pharmacology: First 24 hours

Polypharmacy/resolving anesthesia:

- Opioids
- Benzodiazepines
- Barbiturate
- Muscle relaxants
- Volatile anesthetic
- Antiemetics



Assess: "Sedation Allowance"



How do you take care of chronic pain patients that always report "10/10" pain?

- Document patient's "baseline" pain rating
- Reassure patient that you are treating the pain
- Set realistic patient expectations
- Consider using alternate pain measurement scale ("better or worse", "tolerable or intolerable") rather than NRS
- Try to assess physical pain vs. emotional suffering
- Maintain pre-hospital medications if possible, especially antipsychotics, antidepressants and anxiolytics
- Put in the face time



Case #2

- 82 y/o female: "Aches and Pains"
- 10/10 left leg pain- to undergo total hip arthroplasty
- Neurontin and Tramadol for pain
- Post-operative Plan?
 - Oxycodone?
 - Hydromorphone?
 - Morphine?

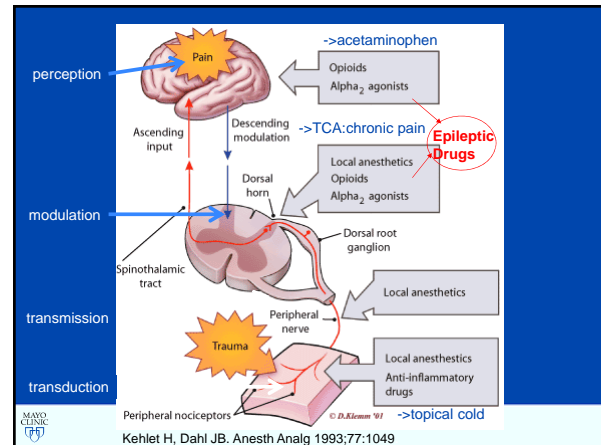


What is an appropriate peri-operative pain regimen?

- What was her pre-operative pain scale?
- What analgesics was she using?

What is an appropriate post-operative pain regimen?

- Is she adequately controlled at this time?
- Is she on other sedating medications?
- Is she nauseated? Taking orals?
- What adjuvants are reasonable for this patient?



Tools in the "toolbox"

- Opioids
- NSAIDs
- Local Anesthetics
- Adjuvant meds
 - antiepileptic
 - antidepressants
 - NMDA antagonists (ketamine)
 - alpha 2 agonists (clonidine)
- Non-pharmacologic treatments



Opioid Requirements

- Education
- Gender/Age
- Culture
- Psychological
 - Depression/Affective disorder
 - Anxiety disorder
 - Drug/EtOH abuse (may not admit)
- Pre-existing pain conditions
- Actual Pain Problem
- Renal/Hepatic function
- Attitude of patient
- Genetic predisposition



Opioid	Metabolism	Excretion	Active Metabolite	Pearl
Morphine	Liver P450-UGT2B7	Renal	Morphine-6 GL Morphine-3 GL	Poor choice in Renal failure
Hydrocodone #1 drug prescribed	Liver P450-CYP2D6	Renal	Hydro-morphone	Screen will show hydro-morphone
Oxycodone	Liver P450-CYP2D6/3A4	Renal	Oxymorphone	Screen will show Oxymorphone
Oxymorphone	Liver	Renal	3-glucuronide, 6-hydroxy (both active)	Reduce Dose if CrCl <50ml/min
Hydro-morphone	Liver P450-	Renal	NONE Active	Better choice if renal insuff.
Fentanyl	Liver P450-CYP3A4	Renal (redistribution to fat)	None	Caution w CYP3A4 inhibitor drugs
Codeine	Liver CYP-2D6	Renal	Morphine	Ultrafast or Ultraslow metabolizers

Opioid Therapy: Routes of Administration

- **Oral and transdermal** - preferred – if patient has/can use gut → then use it
- **Parenteral** – (SQ) and **IV** preferred for acute post-op and (long-term - hospice) therapy
- **Oral transmucosal** - fentanyl – cancer
- **Rectal route** – peds/ acetaminophen
- **Epidural** – peri-op/hospice
- **Intrathecal** – peri-operative/ ITP for oncology/ hospice/ rarely non-malignant pain

Patient case #3

- 43 y/o otherwise healthy female (60 kg) comes for an abdominal TAH/BSO; her main concern is pain during and after surgery. What is your plan for peri-operative pain management?
- Intra-operative opioids:
 - Intrathecal hydromorphone 100 mcg
100 mcg = 0.1 mg

OME conversions

Oral	Intravenous	Epidural	Intrathecal
30	10	1	0.1

Assume same opioid/concentration

Pain Consult: 43 y/o writhing in pain, with nausea and vomiting

Patient has received oxycodone 5-10 mg 6 hours- Increased pain? → 20 mg q 4 hours and patient is vomiting-

help!

Plan?

Anti-emetics: Zofran, droperidol, Phenergan

Pain Control?:

IV: PCA

Standard PCA Parameters for Opioid Naïve Adult Patients

	Morphine	Hydromorphone	Fentanyl
1X (single strength)	1 mg/ml	0.2 mg/ml	10 mcg/ml
Bolus (optional)	1-3 mg	0.4 mg	25-50 mcg
PCA Dose	2 mg	0.2 mg 0.4 mg	10 mcg 20 mcg
Lockout	10 min	10 min	10 min
Total Dose (4 hours)	40 mg	4 mg 8 mg	200 mcg 400 mcg

P.atient C.ontrolled A.nalgesia

- Fentanyl:
 - 10/10/200 mcg
 - 20/10/400
 - Hydromorphone
 - 0.2/10/4 mg
 - 0.4/10/8
 - Morphine:
 - 2/10/40 mg
- Limit Basal Rates
 - Continuous Pulse Oximetry- "with remote monitoring"
 - Review med list for other potentially sedating agents
 - Assume that no one has canceled other pain med orders, ie. Post-op tramadol



Case #4

- 59 y/o male with metastatic colorectal cancer: s/p subtotal colectomy, POD #1
- PCA: fentanyl 20/20/400 mcg
- He used 1200 mcg/ 24 hours: falls asleep once comfortable but wakes up in pain- what are the options?
- Basal Rate vs Patch
- 1200 mcg/24 hours ~
- 50 mcg/hour=> 25 mcg patch



Fentanyl

- IV = Transdermal
- 50 mcg patch= ??? Dose/hour?
- Patch x 2.5 = OME
- OME/3 = Patch



Switching Opioids

- Plan for incomplete cross-tolerance
 - 25-50% typical (+/- based on clinical scenario)
- Opioid calculators- *estimates, at best*
 - Formulas based on opioid naïve, white, cancer dx
 - Fentanyl difficult

Underdose- can always increase



Case #5

- Mrs. Smith 61 y/o with chronic low back pain is going to surgery in 7 days for lumbar spine revision
 - Out-Patient pain meds:
 - Methadone 10 mg TID
 - Hydromorphone 8 mg q 4 hours prn
- What are your recommendations going into surgery?
- A. Stop opioids for more optimal post-op pain control
 - B. Stop the methadone, continue the hydromorphone
 - C. Stop the hydromorphone, continue the methadone
 - D. Continue the methadone and hydromorphone



What is the patient's Daily Oral Morphine Equivalents (DOME)?

- Methadone: ~ 30 X 10 = 300 OME
- Hydromorphone:
 - 8 tabs x 8 mg x 5 (convert to morphine)= 320 OME
- **Post-operatively: The patient will require their baseline DOME + more**
- **Continue Methadone + hydromorphone PCA**



Methadone

- 1:3 to 1:20 (when converting to methadone)
- > 1000 OME use 1:20 and decrease by 30 % for cross tolerance.
- PO:IV → 2:1
- Long acting: *Methadone via pharmacokinetics*



Opioid Therapy: Drug Selection

Methadone

- Useful *loooooong-acting drug* with mu-agonist and NMDA-antagonist activity
- Potency greater than expected based on single-dose studies
- When used for pain: twice a day or three times a day
- Do not change doses < q 3 days
- Patient admitted on methadone → continue same dose
- **NOT** a “prn” medication
- Order ECG to monitor QTc- when changing dose



24 y/o on suboxone admitted for fevers and “not feeling well”- bacteremic- s/p dental extraction.

- Pain control? Acetaminophen and NSAIDS
- Mitral valve replacement in 7 days? Now what?
- Options regarding agonists/antagonists:
 - 1- Discontinue 7 days prior to surgery (POE)
 - 2- Provide “short-acting” opioids
Con’t butrans and add short acting opioids
 - 3-Transition Butrans to methadone



Butrans (buprenorphine transdermal)



Worn for 7 days

Buprenorphine

- Mixed agonist (mu) – antagonist (kappa)
- High affinity binding
 - Withdrawal symptoms less
 - slow disassociation from receptors
- Safer?
 - Less abuse potential
 - Less risk of respiratory depression
- NOT for acute pain



Opioids are great, *but*, side effects

- Nausea: stimulation of *dopamine receptors in chemoreceptor zone of 4th ventricle*
 - Tx: *Kytril, droperidol, phenergan*
- Constipation: methylaltrexone 12 mg SQ
 - (*confirm no bowel obstruction*)
- Pruritis: mu receptor- nalbuphine/naloxone
- Respiratory depression/apnea.Tx?
Naloxone 40 mcg



42 y/o female undergoing ACL repair

- PMHx: depression, chronic headaches
- Medications: tramadol prn, ibuprofen, paroxetine
- Uncomplicated operative case-
 - recovering in 23 hour observation unit
- Page: Patient was confused- seizure activity
- Tx: benzodiazepine
- Cause? Patient had received fentanyl in PACU + tramadol and paroxetine @ home



Serotonin Syndrome

Mild

- tachycardia
- mydriasis
- diaphoresis
- myoclonus
- hyperreflexia/clonus

Moderate

- Hypertension
- Hyperthermia (40 C)

Severe

- Agitated Delirium
- Severe HTN/Hyperthermia
- Shock

Classic Triad of Symptoms

- Altered Mental Status
- Neuromuscular abnormality
- Autonomic Dysfunction



Tramadol

- Chemically unrelated to opioids
- Racemic mixture (+ and – enantiomers)
 - (+) 4X more potent mu agonist
 - (-) responsible for NE/5HT reuptake inhibitor
- treat pain, anxiety, & depression
- (Mild) NMDA antagonism
- Drug Interaction significance
 - serotonin syndrome when used with SSRIs



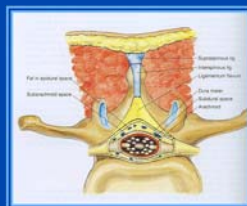
72 y/o male undergoing left THA

- **Mr. Jones has been taking 2-3 percocet/day for hip pain**
- **Plan:** Epidural for post-operative pain control and general anesthesia
- **What DVT prophylaxis should Mr. Jones receive?**



Neuraxial procedures and DVT prophylaxis

- The Danger is catheter movement- ie: Placement and removal



- ASA is ok
- UFH- BID
- LMWH- Qday-
 - Prophylaxis only



Black Box Warning

Epidural or spinal hematomas may occur in patients who are anticoagulated with low molecular weight heparins (LMWH) or heparinoids and are receiving neuraxial anesthesia or undergoing spinal puncture. These hematomas may result in long-term or permanent paralysis. Consider these risks when scheduling patients for spinal procedures.

Factors that can increase the risk of developing epidural or spinal hematomas in these patients include:

- Use of indwelling epidural catheters
- Concomitant use of other drugs that affect hemostasis, such as non-steroidal anti-inflammatory drugs (NSAIDs), platelet inhibitors, other anticoagulants.
- A history of traumatic or repeated epidural or spinal punctures
- A history of spinal deformity or spinal surgery

Consider the benefits and risks before neuraxial intervention in patients anticoagulated or to be anticoagulated for thromboprophylaxis



American Society of Regional Anesthesia

- Epidural analgesia can be maintained when patient taking prophylaxis doses of unfractionated heparin (UH) BID or single daily dosing of low molecular weight heparin (LMWH)
- Patients should not receive TID dosing of subcutaneous UFH or BID dosing of LMWH while the epidural catheter is maintained

 Horlocker TT, et al. Regional Anesthesia & Pain Medicine: 2010: 35;


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THANK YOU



MAYO CLINIC

Management of Postoperative Gastrointestinal Complications:
An Overview of Postoperative Medicine 2013
October 12, 2013



Mayo School of Continuous Professional Development

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Clinical Assistant Professor
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October 9-12, 2013 • Grand Hyatt Seattle • Seattle, Washington

Disclosures

I have no disclosures to make regarding this presentation.

Perioperative GI Issues

- Post operative nausea and vomiting
- Postoperative ileus, pseudo-obstruction
- Postoperative diarrhea
- Stress-related mucosal injury

A 45 year old woman is seen prior to laparoscopic myomectomy for preoperative consultation. Which element of her history puts her at higher than normal risk for post operative nausea and vomiting?

- A. Anxiety disorder
- B. Female gender
- C. Increased BMI
- D. Tobacco use
- E. Use of total intravenous anesthesia

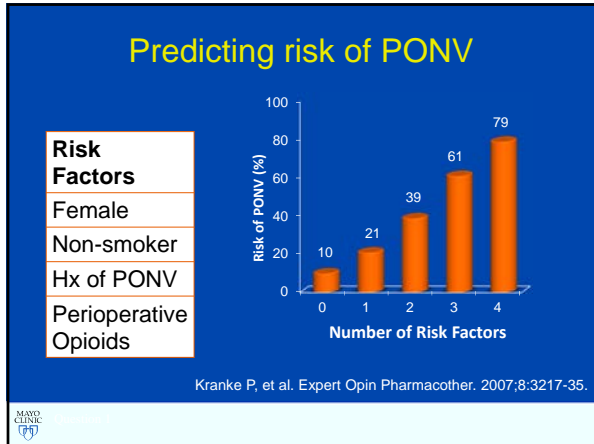
Risk factors for PONV

Strong evidence	Good evidence
Female gender	Young age
Hx motion sickness	Nitrous oxide
Hx PONV	Muscle relaxants
General anesthesia	
Volatile anesthetics	
Non-smoking status	
Duration of anesthesia	
Postoperative opioids	

Risk factors for PONV

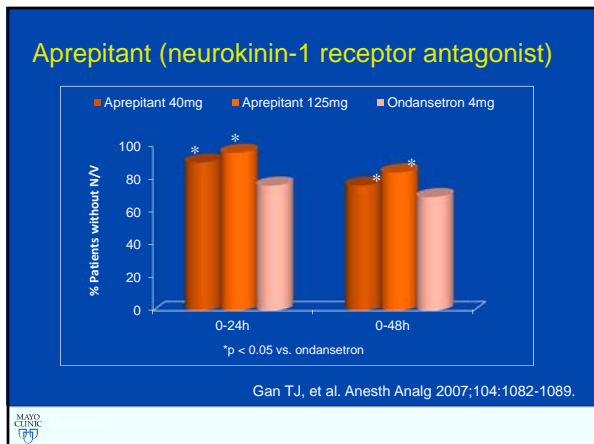
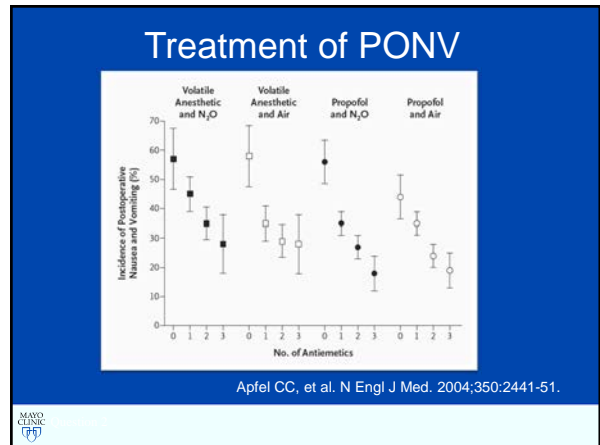
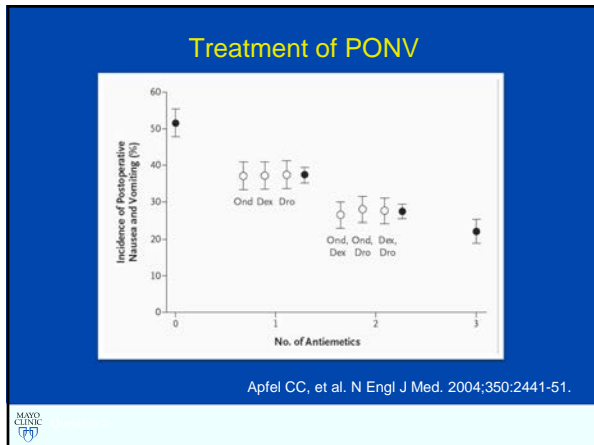
Conflicting results	Poor data or disproved
Site of surgery	Pain
Menstrual cycle	Movement
Experience of anesthetist	Anxiety or personality
NG tube during surgery	BMI

Kranke P, et al. Expert Opin Pharmacother. 2007;8:3217-35.



Despite receiving balanced anesthesia and perioperative prophylactic ondansetron (4 mg IV), the patient experiences nausea and vomiting in the PACU. Which treatment is most likely to be effective in ameliorating her symptoms?

- A. Dexamethasone
- B. Metoclopramide
- C. Propofol
- D. Propranolol
- E. Tropisetron

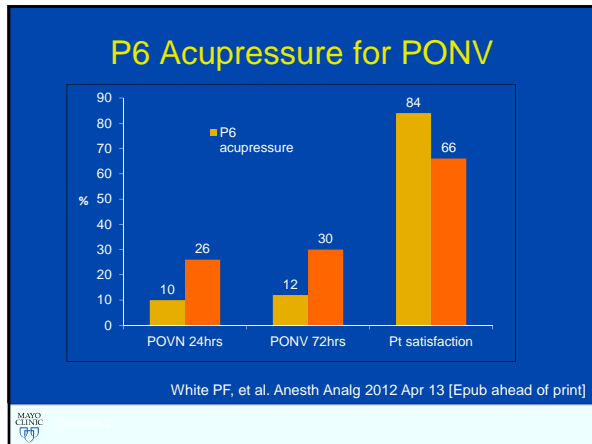


QUICK THREE STEP PLACEMENT

- Align (P) Limit on Inner (V)!
- Measure Patient's (P) (P) (V) (S)!
- Apply (S) (V) (V) (V)!

Pressure Right is one of the easiest and most cost-effective methods for managing Postoperative Nausea and Vomiting (PONV). It's an adjunct (Rx) medical device which helps bring all antiemetic options together to develop optimal PONV prevention for surgery patients.

www.pressureright.com



- ### PONV
- Incidence as high as 30%
 - Common patient complaint and cause of dissatisfaction
 - Prolongs recovery room time, length of stay and overall costs
 - Treatment dependent on pre-op risk assessment
 - Multiple modality approach most efficacious

A 73 year old man is scheduled for elective surgery for recurrent bouts of diverticulitis. Which postoperative recommendation will most likely decrease his chance of prolonged postoperative ileus?

- Amitriptyline
- Epidural anesthesia
- Nasogastric intubation
- Nifedipine for BP control
- PCA pump

Prevention of Post-Op Ileus

Treatment modality	Effect on POI	Level of evidence*
<i>Nonpharmacological methods</i>		
Nasogastric decompression	no demonstrable benefit shown increased overall complications	Ia
Minimally invasive surgery	probably beneficial	Ia
Early ambulation	no demonstrable benefit shown	Ib
Early enteral feeding	modestly beneficial	Ia
Gum chewing ('sham-feeding')	possibly beneficial	Ia
<i>Pharmacological methods</i>		
Stop routine preoperative bowel preparation	beneficial	Ia
Limited intravenous fluids administration	probably beneficial	Ib
Epidural analgesia	beneficial	Ia
Preoperative probiotics administration	possibly beneficial	II
Preoperative carbohydrate loading	probably beneficial	Ib
Preoperative COX-2 inhibitors	probably beneficial	II
Postoperative administration of opioid antagonists	probably beneficial	Ib
Prokinetic agents	may be beneficial	Ia
Multimodal fast-track approaches	beneficial	Ib

* Levels of evidence categories taken from the World Health Organization <http://www.euro.who.int>.

Story SK, et al. Dig Surg 2009;26:265-75.

Peripherally-acting mu-opioid antagonists (PAM-OR)

- Methylnaltrexone
 - Approved for opioid-induced constipation in patients with advanced illness
 - Under investigation for POI
- Alvimopan
 - Approved for accelerating recovery from bowel resection with primary anastomosis

Viscusi ER, et al. Anesth Analg 2009;108:1811-22

Alvimopam for post-operative ileus

Time to recovery

	Alvimopa m 6 mg (n = 155)	Alvimopa m 12 mg (n = 165)	Placebo (n = 149)
Hazard Ratio	1.28	1.54	-
p value	0.046	< 0.001	-
Mean hours	105	98	120
Δ vs. placebo	(-15)	(-22)	-

Leslie JB. Ann Pharmacother 2005;39:1502-10

Chewing Gum – Time to Flatus

Parameter	Mean (SD)	95% CI
Time to flatus (min)	11.1 (10.1)	10.1-12.1
Time to BM (min)	11.1 (10.1)	10.1-12.1
Time to first stool (min)	11.1 (10.1)	10.1-12.1
Time to first void (min)	11.1 (10.1)	10.1-12.1
Time to first walk (min)	11.1 (10.1)	10.1-12.1
Time to first oral intake (min)	11.1 (10.1)	10.1-12.1
Time to first discharge (min)	11.1 (10.1)	10.1-12.1
Time to first shower (min)	11.1 (10.1)	10.1-12.1
Time to first bathroom visit (min)	11.1 (10.1)	10.1-12.1
Time to first walk with assistance (min)	11.1 (10.1)	10.1-12.1
Time to first walk independently (min)	11.1 (10.1)	10.1-12.1
Time to first oral intake (min)	11.1 (10.1)	10.1-12.1
Time to first discharge (min)	11.1 (10.1)	10.1-12.1
Time to first shower (min)	11.1 (10.1)	10.1-12.1
Time to first bathroom visit (min)	11.1 (10.1)	10.1-12.1
Time to first walk with assistance (min)	11.1 (10.1)	10.1-12.1
Time to first walk independently (min)	11.1 (10.1)	10.1-12.1

Fitzgerald JEF, et al. World J Surg 2009;33:2557-66

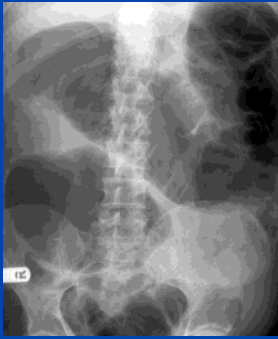
Chewing Gum – Time to BM

Parameter	Mean (SD)	95% CI
Time to flatus (min)	11.1 (10.1)	10.1-12.1
Time to BM (min)	11.1 (10.1)	10.1-12.1
Time to first stool (min)	11.1 (10.1)	10.1-12.1
Time to first void (min)	11.1 (10.1)	10.1-12.1
Time to first walk (min)	11.1 (10.1)	10.1-12.1
Time to first oral intake (min)	11.1 (10.1)	10.1-12.1
Time to first discharge (min)	11.1 (10.1)	10.1-12.1
Time to first shower (min)	11.1 (10.1)	10.1-12.1
Time to first bathroom visit (min)	11.1 (10.1)	10.1-12.1
Time to first walk with assistance (min)	11.1 (10.1)	10.1-12.1
Time to first walk independently (min)	11.1 (10.1)	10.1-12.1


Fitzgerald JEF, et al. World J Surg 2009;33:2557-66

Despite reduction in opiate analgesia, correction of electrolyte abnormalities, avoidance of anticholinergic drugs, increased mobilization of the patient and nasogastric/rectal intubation, the patient becomes more distended. [Radiograph] Which is the most appropriate treatment?

- Barium enema
- Endoscopic decompression
- Exploratory laparotomy
- Metoclopramide
- Neostigmine



www.radiology.co.uk/srs-x/cases/103/b.jpg



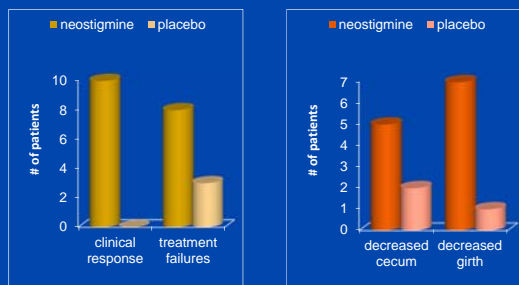
Sir Heneage Ogilvie Maj-Gen KBE, MD, MCh, FRCS, 1887- 1971

Acute colonic pseudo-obstruction [Ogilvie Syndrome]

- Gross dilatation of cecum and right colon without mechanical obstruction
- ~35% cases are post-surgical
- Risk of ischemia, perforation, and death
- Conservative therapy: bowel rest, body positioning, treatment of underlying cause
- Pharmacologic therapy for non-response

Elsner JL, et al. Ann Pharmacother 2012;46:430-5

Neostigmine for acute colonic pseudo-obstruction



Saunders MD, Kimmey MB. Aliment Pharmacol Ther 2005;22:917-25.



Contraindications for neostigmine

- Bradycardia
- Severe cardiac disease
- Hypotension
- Active bronchospasm
- Renal insufficiency
- Pregnancy



A 55 year old woman is seen 3 days following ORL surgery for loose stool, approximately 5-6 times per day. There is no nausea, nor has there been blood in the stool. Medications include cefazolin, furosemide and amlodipine. On exam she has a nasogastric feeding tube and hyperactive bowel sounds. Which is the most likely cause of her diarrhea?

- Clostridium difficile infection
- Enteral support formula
- Irritable bowel syndrome
- Ischemic colitis
- Medications



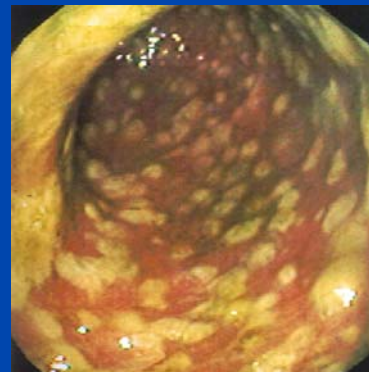
Medications that can cause diarrhea

- Antibiotics
 - Almost all
- Antineoplastics
 - Doxorubicin, 5FU, interferon, MTX
- CNS Agents
 - Alprazolam, fluoxetine, lithium, valproate
- Cardiovascular
 - ACE-I, β -blockers, digoxin, hydralazine, quinidine
- Other
 - Loop diuretics, colchicine, glipizide, magnesium, misoprostil, thyroxine

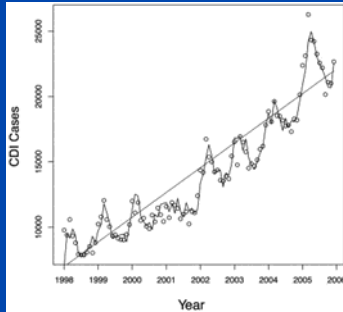


The patient is given a regular diet; antibiotics and loop diuretics are discontinued, but the diarrhea progresses to 10-12 episodes of watery stool, now with progressive nausea. [endoscopic photo] Which is the most appropriate treatment?

- Bacterial enemas
- Metronidazole IV
- Metronidazole PO
- Vancomycin IV
- Vancomycin PO



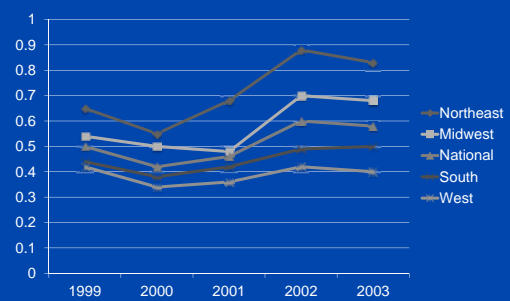
Clostridium difficile in the US



Polgreen PM, et al. Infect Control Hosp Epidemiol 2010;31:382-7.



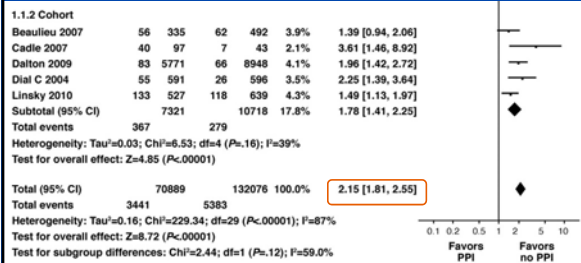
Annual occurrence of C. Difficile by region



Zerey M, et al. Surg Infect 2007;8:557-66.



PPI and Risk of C. diff



Deshpande A, et al. Clin Gastro Hepatol 2012;10:225-33.



Cost of Postsurgical C. difficile

	estimate	OR	95% CI	p
LOS	16.0	NA	15.6-16.4	<0.0001
Charges	\$77,483	NA	75K-80K	<0.0001
Death		3.37	3.2-3.77	<0.0001

Estimated annual cost ~\$1 billion

Zerey M, et al. Surg Infect 2007;8:557-66.



Risk factors for postsurgical C. difficile

- Patient factors
 - Older
 - Female
 - Medicare
- Hospital factors
 - Northeast
 - Large
 - Urban
 - Teaching

Zerey M, et al. Surg Infect 2007;8:557-66.



Risk factors for postsurgical C. difficile

- Highest risk
 - Colectomy
 - Small bowel resection
 - Gastric resection
- Lowest risk
 - Cholecystectomy
 - Appendectomy

Zerey M, et al. Surg Infect 2007;8:557-66.





A 46 year old man is seen in the ICU prior to surgery. He is mechanically ventilated, but hemodynamically stable. Which is the most appropriate recommendation regarding peptic ulcer prophylaxis?

- A. Antacids
- B. H₂-receptor antagonist
- C. No prophylaxis indicated
- D. Proton pump inhibitor
- E. Sucralfate

- ### Risk for Stress Ulcers
- Neurosurgery
 - Burns
 - Sepsis
 - Mechanical Ventilation
 - Coagulopathy
 - Multiple organ failure

Risk for Stress Ulcer

Risk Factor	Simple Regression		Multiple Regression	
	OR	p	OR	p
Respiratory failure	25.5	<0.001	15.6	<0.001
Coagulopathy	9.5	<0.001	4.3	<0.001
Hypotension	5.0	0.03	3.7	0.08
Sepsis	7.5	<0.001	2.0	0.17
Hepatic failure	6.5	<0.001	1.6	0.27
Renal failure	4.6	<0.001	1.6	0.26
Enteral feeding	3.8	<0.001	1.0	0.99
Steroids	3.7	<0.001	1.5	0.26
Transplant	3.6	0.006	1.5	0.45
Anticoagulation	3.3	0.004	1.1	0.88

- ### ICU stress ulcer prophylaxis
- Recommended by many professional organizations
 - Joint Commission “core quality measure”
 - Data is for H₂RA, but PPI are equivalent by meta-analysis
 - Increase risk of *C. diff*, pneumonia
 - May not be necessary with early enteral feeding (in fact, may worsen outcome)

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Question	Answer
1	A
2	A
3	B
4	E
5	B
6	C
7	D

