Trauma Wound Care and Infection Control

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Trauma Center ‘has been’
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• 332\textsuperscript{nd} Air Expeditionary Medical Group at the Air Force Theater Hospital in Balad
• Men and Women of Combat Support Hospital rotations at Ibn Sina in Baghdad
Eye Armor

Kevlar

Flack jacket
Protective Equipment – Body Armor
Military Injuries
Level III Care
Historic Infection Rates in Abdominal Trauma of Combat

- World War I (Wallace BMJ 1916, Fraser BMJ 1917)
  - Mortality from colon trauma > 60%
- World War II (Ogilvie SG&O 1944, Imes SG&O 1945)
  - High mortality following abdominal trauma led to Surgeon General requirement that all colon trauma be treated with colostomy
- Urban combat (Fullen JTrauma 1972, Thadepalli SG&O 1973)
  - Abdominal infection rate 30% if antibiotics administered post-op
  - 70% abdominal infection rate in patients with colon injury
  - 43% infection rate with abdominal wounds
  - 5.1% colon injury rate; 16% sepsis rate in those patients
  - 18% mortality with colon injury vs 8% mortality with abdominal trauma without colon injury vs < 3% admitted to USS Comfort
Contributing Factors

- Identified factors for combat trauma-related post-op infection include:
  - Need for blood transfusion
  - Higher penetrating abdominal trauma index score
  - Injury to the colon
  - Concomitant gastric trauma
  - Concomitant pancreatic trauma
  - Delay to definitive care (prolonged time from injury until initial surgical care)

References:
Prevention of Infection After Abdominal Trauma

- Multiple sources from the 1970’s demonstrate that infection can be mitigated:
  - Antibiotics given pre-operatively
  - Spectrum includes anaerobic and aerobic coverage

- Duration of therapy
  - 24 hours is equivalent to 5 days in efficacy
  - Possible detriment to longer duration (MDRO infections)

References:
Historic Infection Rates in Combat-Related Abdominal Trauma con’t

- **Modern combat**
  - 43% infection rate with abdominal wounds
  - 5.1% colon injury rate; 16% sepsis rate in those patients
  - 18% mortality with colon injury vs 8% mortality with abdominal trauma without colon injury vs < 3% admitted to USS Comfort
  - 15/122 with chronic abdominal abscesses
  - Odds ratio 2.7 for development of infection for abdominal injury

Klausner J Trauma 1995
Wound Problems

- Delay in surgery/ inadequate debridement
- Vascular injury with regional tissue ischemia
- Hematoma due to inadequate hemostasis
- Retained foreign body
- Inadequate drainage
- Primary closure war wounds
- Missed hollow viscus injury
- Contaminated by resistant organisms
Other Particulars to War Injuries

- Only way to become familiar with them through “On the Job Training”
  - time lag from wounding to treatment
  - time without close care during transfer
  - interruption in the continuity or care by same physician or team
  - particulars of aeromedical transport
Wound Care Principles

• Aggressive debridement and washout including abundant use of fasciotomy (ENT/Ophtho aggressive washout but minimal debridement only)
• 100% operation rate for every wound (small hole = big frag) and 100% re-operation for every wound operated upon at Level I-II
• Vascular injuries: shunt, vein graft only (no artificial conduit) and fasciotomy as a rule
• Standardized antibiotic prophylaxis regimen adopted
• Wound vac at 2nd operation and antibiotic beads for some (extensive soft tissue injuries or significant open fractures with soft tissue loss)
• Subsequent 3rd washout with vac and final washout with closure over drains
Antibiotics

- Use appropriate antibiotics
  - chose from available drugs in unit stock
- Be sure to have staph, clostridial and strep coverage
- Drugs do not replace adequate and prompt debridement
- Assure tetanus prophylaxis
  - toxoid/ immunoglobulin as indicated
Introduce Negative Pressure Wound Management
Negative Pressure Wound Therapy

- Increased wound blood flow
- Increased granulation tissue formation
- Decreased bacterial counts
- Stimulation of wound healing pathways through shear stress mechanisms
Published Results with Wound Vac

- 77 patients with 88 wounds studied
- 63% IED; 37% GSW
- 65% extremity
- Length of stay = 7.5 days (historical = 30 days)
- Operations = 2.2
- Time from wounding to wound closure = 4.2 days
- 0% wound complication rate (vac = safe)
- 0% infection rate (historical >80%); vac = good

J Trauma Nov 2006
Policies enforced, changed &/or adopted

- 100% compliance with gloves/hand washing for every provider-patient encounter
- Mandatory scrubs/hats/masks/shoe covers for OR
- Plastic draping for all OR entrances
- Initial and weekly (if not more often) OR cleaning (all surfaces, not just between cases)
- Bringing on line CP EMEDS ECU's for OR's and ICU
- Installed HEPA filter fans in the OR's to further clean the air in there all night
Policies enforced, changed &/or adopted

- Instituted a weekly OR ECU filter and duct work cleaning regimen
- Cleaning and 'plasticizing' of entire OR supply, equipment, instrument handling, sterilization areas and strict adherence to ongoing cleanliness of these areas
- Opening a third OR and putting 'dirtier' cases almost exclusively there
- Reserving the Ortho primary OR and primary OR for ENT/Ophtho/Neurosurg for only clean cases
- Opened 3rd ward and decompressed patient overcrowding
Policies enforced, changed &/or adopted

- Ending the practice of wound dressing changes on the ward/ICU (except wounds opened for infection)
- Regimented wound care and antibiotic usage
- Top-to-bottom cleaning of ICU and ward and ED
- Change in linen cleaning process (longer soak, bleach in everything, hotter water)
- Mandatory pressure washing all litters after every patient contact
- Standardized everything: limit inter- and intra-provider variance in clinical practice
Consensus Guidelines

- June 2007 at Institute of Surgical Research sponsored by United States Army Office of the Surgeon General
- Civilian and military experts in:
  - Infectious disease and infection control
  - Trauma
  - Preventive medicine
- Literature review and expert discussion
- Published March 2008 as a supplement
  - Journal of Trauma, volume 64, number 3
Recommendation Rating System

• **Strength of recommendation**
  • A: good evidence to support use
  • B: moderate evidence to support use
  • C: poor evidence to support use
  • D: moderate evidence against use
  • E: good evidence against use

• **Quality of evidence**
  • I: at least one randomized controlled trial
  • II: at least one well-designed clinical trial
  • III: expert opinion
General Guidelines

• Regularly updated antibiograms (AII)
• Introduce and enforce infection control techniques (AII)
• Early (field) use of IV antibiotics for casualties with penetrating trauma to abdomen (TCCC) (AII)
• No need for intra-operative cultures at initial operation (EII)
• Time from injury to surgical care < 6 hours (BII)
• Irrigate abdominal cavity copiously at initial operation (BIII)
Surgical Management

- Following abdominal operation and debridement of non-viable tissue and foreign material, irrigation with at least 6 liters of saline is recommended (BIII)
- Early primary repair is discouraged, especially for those with massive blood transfusion, hypotension, hypoxia, multiple other injuries, etc (BII)
- Leak: 13% in those with colon anastomosis primarily (Steele Dis Col Rec 2007)
Recommendations

- Penetrating abdominal trauma
  - Presumptive, pre-op antibiotics for up to 24 hours (AI)
  - Sufficient gram negative and anaerobic coverage (AI)
  - Choices recommended:
    - Cefoxitin or moxifloxacin as single agent (AI)
    - Levofloxacin or ciprofloxacin + metronidazole (AI)
  - Do not use carbapenems initially [MDRO issues] (CIII)
- Patients undergoing splenectomy should receive immunization (Haemophilus influenzae, pneumococcal and meningococcal) against encapsulated organisms, with booster of at least pneumococcal vaccine every 5 years (CIII)
- Tetanus toxoid and immunoglobulin as necessary (AII)
Implementation of Recommendations

- Joint Theater Trauma System
  - Review recommendations with in-theater consultants and commands
  - Re-review in-theater guidelines and modify accordingly
  - Track antibiotic use and duration
- Joint Theater Trauma Registry
  - Track individual outcomes through established surveillance programs at military treatment facilities
  - Record complications under Performance Improvement tab and develop new module to specifically track infections
  - Regularly query database for trends, corrected for injury severity and type and patient physiology through eventual outcome
Implementation of Recommendations

• Periodic infection control review across facilities in deployed setting
  • Determine obstacles/challenges to infection control
  • Enhance current practices with new developments
  • Reestablish antibiograms

• Doctrine update by all Services
  • Review current supply lists for deployable hospital sets
  • Modify antibiotic formulary to include recommended first and alternate agents as needed
Way Ahead (2007)

- Research and Trauma Coordinator/Registry linkage on Damage Control at all echelons
- Need more research personnel in theater to elucidate
- Devise list of questions to be answered to create prospective database fields
- Level V (US) data just starting to come in and be analyzed.....more to follow
Trauma Infectious Disease Outcome Study (TIDOS)

- 1 June – 31 Aug 2009 Level III-V
- 356 casualties admitted Level IV
- 104 in study cohort
- Follow up = 77-49% at 1-6 months
- 117 unique ID events

J Trauma 71, 1, July 2011s 33-42. Tribble, Conger, Fraser, et al
Trauma Infectious Disease Outcome Study (TIDOS) continued

- Infection types:
  - Wound/soft tissue = 43%
  - Blood stream = 19%
  - Pneumonia = 15%
  - Abdominal = 5%

- Locale:
  - Level IV = pneumonia 10+% 
  - Level V = wounds 17+% 

- First infection:
  - 22% at Level V = must do surveillance at all levels
Bottom Line Military vs Civilian Experience

- Be vigilant and skeptical
- Assess and reassess prevention at all levels
- Involve the entire team
- Follow through and enforce
- MN Trauma is dirty trauma (rural, industrial/agricultural, time delayed, etc)
Comments / Questions