Inpatient Heart Failure Management

Pragnesh Parikh, M.D.
Department of Cardiovascular Diseases
Mayo Clinic Florida
Inpatient Medicine for NPs & PAs: Hospital Care from Admission to Discharge
October 20, 2016
Disclosures

• None
Objectives

• Epidemiology of ADHF
• Goals of acute management
• Pharmacologic management
  • Diuretics
  • Inotropes
  • Vasodilators
  • Beta-blockers in the hospital
• Goals and strategies for discharge
EPIDEMIOLOGY

Acute Decompensated Heart Failure
## Definitions of HFrEF and HFpEF

<table>
<thead>
<tr>
<th>Classification</th>
<th>EF (%)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Heart failure with reduced ejection fraction (HFrEF)</td>
<td>≤40</td>
<td>Also referred to as systolic HF. Randomized clinical trials have mainly enrolled patients with HFrEF, and it is only in these patients that efficacious therapies have been demonstrated to date.</td>
</tr>
<tr>
<td>II. Heart failure with preserved ejection fraction (HFpEF)</td>
<td>≥50</td>
<td>Also referred to as diastolic HF. Several different criteria have been used to further define HFpEF. The diagnosis of HFpEF is challenging because it is largely one of excluding other potential noncardiac causes of symptoms suggestive of HF. To date, efficacious therapies have not been identified.</td>
</tr>
<tr>
<td>a. HFpEF, borderline</td>
<td>41 to 49</td>
<td>These patients fall into a borderline or intermediate group. Their characteristics, treatment patterns, and outcomes appear similar to those of patients with HFpEF.</td>
</tr>
<tr>
<td>b. HFpEF, improved</td>
<td>&gt;40</td>
<td>It has been recognized that a subset of patients with HFpEF previously had HFrEF. These patients with improvement or recovery in EF may be clinically distinct from those with persistently preserved or reduced EF. Further research is needed to better characterize these patients.</td>
</tr>
</tbody>
</table>

EF indicates ejection fraction; HF, heart failure; HFpEF, heart failure with preserved ejection fraction; and HFrEF, heart failure with reduced ejection fraction.
# Classification of Heart Failure

<table>
<thead>
<tr>
<th>ACC/AHA Heart Failure Stage</th>
<th>NYHA Functional Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. At risk for heart failure but without structural heart disease or symptoms</td>
<td>None</td>
</tr>
<tr>
<td>B. Structural heart disease but without heart failure</td>
<td>I. Asymptomatic</td>
</tr>
</tbody>
</table>
| C. Structural heart disease with prior or current heart failure symptoms | II. Symptomatic with moderate exertion  
III. Symptomatic with minimal exertion |
| D. Refractory heart failure requiring specialized interventions | IV. Symptomatic at rest |

Farrell MH. JAMA 2002; 287:890-897.
## Epidemiology and Economic Burden of HF

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2030 (est)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incidence</strong></td>
<td>825,000/year</td>
<td></td>
</tr>
<tr>
<td><strong>Prevalence</strong></td>
<td>5.1 million (2.1%)</td>
<td>8 million</td>
</tr>
<tr>
<td><strong>Hospitalizations</strong></td>
<td>~1,000,000 per year</td>
<td></td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td>57,757 (58% female)</td>
<td></td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>$30.7 billion</td>
<td>$69.7 billion</td>
</tr>
</tbody>
</table>
Estimated Direct/Indirect Costs of HF: $30.7 Billion

Lifetime Costs of Medical Care After Heart Failure Diagnosis. Circulation: Cardiovascular Quality and Outcomes. 2011; 4: 68-75.
What is a “Typical” Presentation of ADHF?

- Median age: 75
- HTN: 72%
- DM: 44%
- COPD: 31%
- CKD: 30%
- AF: 31%
- Reduced EF: ~50%

NYHA class at admission: (N=11,555)
- I: 2%
- II: 11%
- III: 40%
- IV: 47%

Systolic Blood Pressure at admission (N=104,573)
- <90 mmHg: 2%
- 90-140 mmHg: 48%
- >140 mmHg: 50%
FIRST ACUTE DECOMPENSATED HEART FAILURE
ANNUAL EVENT RATES PER 1000
(FROM ARIC COMMUNITY SURVEILLANCE 2005-2010)

ADHF Precipitating Factors: OPTIMIZE-HF Registry

- PNEUMONIA/ RESPIRATORY PROCESS: 15.3%
- ISCHEMIA/ ACS: 14.7%
- ARRHYTHMIA: 13.5%
- UNCONTROLLED HYPERTENSION: 10.7%
- NONADHERANCE TO MEDICATIONS: 8.9%
- WORSENING RENAL FUNCTION: 6.8%
- NONADHERANCE TO DIET: 5.2%
- OTHER: 12.7%

Number of Precipitating Factors

- 0: 38.7%
- 1: 42.2%
- 2: 13.6%
- 3: 4.2%
- ≥4: 1.4%
A Sick Group of People

Mortality After 1st Hospitalization for Heart Failure:

- In-hospital: 3%
- 30-day: 10.4%
- One year: 22%
- Five years: 40-60%

5 Year Mortality by Stage:

- Stage A: 3%
- Stage B: 4%
- Stage C: 25%
- Stage D: 80%

*50% 6 month readmission rate!!

References:
Summary

• Incidence of ADHF is skyrocketing. Huge strain on hospitals and health care financing
• Patients are extremely sick
• There are not enough cardiologists to manage ADHF
• Generalists will need to become expert in managing all but the sickest patients with ADHF
INITIAL EVALUATION

Acute Decompensated Heart Failure
Initial Evaluation

1. Determine adequacy of systemic perfusion
   - Extremities warm versus cool/cold
   - Urine output
   - Mental status

2. Determine volume status
   - Exam
     - JVP (best single indicator)
     - Edema (pretibial, presacral)
     - Lung exam
   - CVP
   - IVC appearance on echo (dilated, collapsible?)
   - CXR, BNP
Initial Evaluation

3. Determine the contribution of precipitating factors or co-morbidities
   - acute coronary syndromes/coronary ischemia
   - severe hypertension
   - atrial and ventricular arrhythmias
   - Infections
   - pulmonary emboli
   - renal failure
   - medical or dietary noncompliance

4. Determine the ejection fraction (preserved or reduced)
Figure 1.
A bedside assessment allows for definition of a patient's hemodynamic profile, integrating signs and symptoms of both perfusion and congestion.

Evidence for Congestion
(Elevated Filling Pressure)

- Orthopnea
- High Jugular Venous Pressure
- Increasing SaO2
- Loud P2
- Edema
- Ascites
- Rales (Uncommon)
- Abdominojugular Reflux
- Vasalva Square Wave

Evidence for Low Perfusion

- Narrow Pulse Pressure
- Pulsus Alternans
- Cool Forearms and Legs
- May Be Sleepy, Obtunded
- ACE Inhibitor-Related
- Symptomatic Hypotension
- Declining Serum Sodium Level
- Worsening Renal Function

Congestion at Rest?

<table>
<thead>
<tr>
<th>Low Perfusion at Rest?</th>
<th>Congestion at Rest?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Warm and Dry</td>
</tr>
<tr>
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<tr>
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<td>Cold and Dry</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

EKG

- Important to look for underlying
  - Ischemia
  - Arrhythmias
PHARMACOLOGIC MANAGEMENT

Acute Decompensated Heart Failure
Goals of Acute Management

• Rapidly improve symptoms while preserving end organ function
• Restore function to pre-morbid levels/ Improve quality of life
• Educate patient and family
• Initiate therapies/interventions shown to reduce long-term mortality
• Reduce the risk of rehospitalization
• Control costs
Basic Treatment Strategies

- Continue PO Outpt Treatment (GDMT)
- Inotropes +/- IV Fluids

<table>
<thead>
<tr>
<th>Low Perfusion at Rest?</th>
<th>Congestion at Rest?</th>
<th>PCWP</th>
<th>Diuretics Vasodilators</th>
<th>Diuretics Inotropes</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>PCWP &lt;18</td>
<td>Warm and Dry</td>
<td>NO</td>
</tr>
<tr>
<td>&gt;2.2L/min/m²</td>
<td></td>
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<td>Cold and Wet</td>
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</tbody>
</table>
Basic Treatment Strategies

• Traditional Therapies:
  • Diuretics
  • Vasodilators: nitroglycerin, nitroprusside, nesiritide
  • Inotropes: dobutamine, milrinone, dopamine, digoxin

• Novel Agents/ therapies:
  • Ultrafiltration
Clinical Vignette #1

64 year-old male with non-ischemic dilated cardiomyopathy, EF=25-30%

• Returned from vacation 2 days ago
• Previously able to walk 2 miles, currently cannot walk more than 10 feet before developing dyspnea
• PND 3 times per night, 4 pillow orthopnea, increasing lower extremity edema, 10 lb weight gain
• Exam: alert and oriented, JVP=17cm H2O, bibasilar rales, 2+ pitting edema, warm extremities, BP=115/78, P=82
• Creat=1.6 (baseline=1.2), BNP=2,048 ng/L, troponin i=0.10 (ULN=0.04)
What is the best initial therapy?

A. Stop beta blocker and ACE inhibitor
B. Start IV furosemide at 1-2.5x the home oral equivalent dose
C. Start nesiritide drip
D. Instruct the patient to not take any more vacations
Basic Treatment Strategies

![Diagram showing treatment strategies based on PCWP and CI values](image-url)
DIURETICS
Diuresis

• IV loop diuretics
  • Institute early in the ER
  • Dose should equal or exceed PO dose
  • For ineffective diuresis:
    • Increase dose/ frequency
    • Add second diuretic (metolazone, chlorthalidone, chlorothiazide, spironolactone, etc)
    • Continuous infusion of a loop diuretic
Diuresis

• To enhance diuretic effectiveness:
  • Limit sodium intake (?)
  • Multiple dosings of the diuretic (limit rebound resorption of sodium)

• If all diuretic strategies are unsuccessful:
  • Ultrafiltration is reasonable (class 2b)
  • Low dose dopamine (class 2b)
Diuretic Pearls

• Loop Diuretics
  • Torsemide and bumetanide more reliably absorbed in oral doses, most notably in patients with edema of GI tract (right heart failure)
  • Furosemide: renally excreted, ~50% orally absorbed
    • Variable absorption: 10-100% in various patients
  • Torsemide/ Bumetanide hepatically metabolized, 80-100% orally absorbed
Diuretic Pearls

- Patients on torsemide have fewer hospitalizations and a better QOL than patients treated with furosemide

- Diuretic Tolerance
  - “Braking”: decreased response after 1st dose
  - Long term: increased distal reabsorption of sodium
    - Counteracted by concomitant use of thiazide diuretics

- If a sulfa allergy exists, ethacrynic acid may be used — no sulfa moiety

NEJM 1998; 339: 387-395
J Gen Int Med 1998; 13 supp 18: abstract
Diuretic Pearls
Diuretic Pearls

• May use thiazide with a loop—synergistic response
  • Absorption of metolazone is slower and less predictable than other thiazides; therefore, other thiazides may be preferable to metolazone when in conjunction with loop diuretic
  • Chlorothiazide if IV thiazide needed
Diuretic Pearls

- K+ sparing diuretics may work synergistically with loop diuretics; response can be predicted by measuring urine electrolytes
  - If urine Na+ and K+ are both low, then the amount of Na+ delivered to the distal nephron is not sufficient for the diuretic to take effect.
  - If urine Na+ is low and urine K+ is high, then Na+ is being exchanged for K+ distally, and the K+ sparing diuretic will have an effect.

NEJM 1998; 339: 387-395
In administration of loop diuretics in ADHF, which statement is correct?

A. Bolus dosing results in less diuresis and less clinical improvement than continuous infusion.
B. Continuous infusion results in worsened renal function compared to bolus dosing.
C. Higher dose of diuretic results in faster weight loss and a shorter hospital stay than a lower dose of diuretic.
D. None of the above
Diuretic Strategies in Patients with Acute Decompensated Heart Failure (DOSE Study)

• Prospective, double blind, randomized trial
• 308 patients with ADHF- 2x2 design
  • Bolus every 12 hours versus continuous infusion
  • Low dose (equivalent to patient’s previous oral dose) versus high dose (2.5x the previous oral dose)
• Primary endpoints:
  • Patients’ global assessment of symptoms
  • Change in serum creatinine over 72h
• Baseline characteristics evenly matched

DOSE: Primary Outcomes

Figure 1. Patients' Global Assessment of Symptoms during the 72-Hour Study-Treatment Period.

Patients' global assessment of symptoms was measured with the use of a visual-analogue scale and quantified as the area under the curve (AUC) of serial assessments from baseline to 72 hours. Mean (±SD) AUCs are shown for the group that received boluses every 12 hours as compared with the group that received a continuous infusion (Panel A) and for the group that received a low dose of the diuretic (equivalent to the patients' previous oral dose) as compared with the group that received a high dose (2.5 times the previous oral dose) (Panel B). Plus–minus values are means ±SD.

## DOSE: Secondary Outcomes

<table>
<thead>
<tr>
<th>End Point</th>
<th>Bolus Every 12 Hr (N = 156)</th>
<th>Continuous Infusion (N = 152)</th>
<th>P Value</th>
<th>Low Dose (N = 151)</th>
<th>High Dose (N = 157)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUC for dyspnea at 72 hr</td>
<td>4456±1468</td>
<td>4699±1573</td>
<td>0.36</td>
<td>4478±1550</td>
<td>466±1496</td>
<td>0.04</td>
</tr>
<tr>
<td>Freedom from congestion at 72 hr</td>
<td>22/153 (14)</td>
<td>22/144 (15)</td>
<td>0.78</td>
<td>16/143 (11)</td>
<td>28/154 (18)</td>
<td>0.09</td>
</tr>
<tr>
<td>Charge in weight at 72 hr — lb</td>
<td>−6.8±7.8</td>
<td>−8.1±10.3</td>
<td>0.20</td>
<td>−6.1±9.5</td>
<td>−8.7±8.5</td>
<td>0.01</td>
</tr>
<tr>
<td>Net fluid loss at 72 hr — ml</td>
<td>4237±3208</td>
<td>4249±3104</td>
<td>0.89</td>
<td>3575±2635</td>
<td>4899±3479</td>
<td>0.001</td>
</tr>
<tr>
<td>Change in NT-proBNP at 72 hr — pg/ml</td>
<td>−1316±4364</td>
<td>−1773±3828</td>
<td>0.44</td>
<td>−1194±4094</td>
<td>−1882±4105</td>
<td>0.06</td>
</tr>
<tr>
<td>Worsening or persistent heart failure — no./total no. (%)</td>
<td>38/154 (25)</td>
<td>34/145 (23)</td>
<td>0.78</td>
<td>38/145 (26)</td>
<td>34/154 (22)</td>
<td>0.40</td>
</tr>
<tr>
<td>Treatment failure — no./total no. (%)†</td>
<td>59/155 (38)</td>
<td>57/147 (39)</td>
<td>0.88</td>
<td>54/147 (37)</td>
<td>62/155 (40)</td>
<td>0.56</td>
</tr>
<tr>
<td>Increase in creatinine of ≥0.3 mg/dl within 72 hr — no./total no. (%)</td>
<td>27/155 (17)</td>
<td>28/146 (19)</td>
<td>0.64</td>
<td>20/147 (14)</td>
<td>35/154 (23)</td>
<td>0.04</td>
</tr>
<tr>
<td>Length of stay in hospital — days</td>
<td>5</td>
<td>5</td>
<td>0.97</td>
<td>5</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interquartile range</td>
<td>3–9</td>
<td>3–8</td>
<td>4–9</td>
<td>3–8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alive and out of hospital — days</td>
<td>51</td>
<td>51</td>
<td>0.36</td>
<td>50</td>
<td>52</td>
<td>0.42</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

*Plus−minus values are means ±SD. To convert pounds to kilograms, divide by 2.2. AUC denotes area under the curve, and NT-proBNP N-terminal pro-brain natriuretic peptide.

†Treatment failure was defined as the development of any one of the following during the 72 hours after randomization: increase in serum creatinine level of more than 0.3 mg per deciliter (26.5 μmol per liter), worsening or persistent heart failure, clinical evidence of excessive diuresis requiring intervention (e.g., administration of intravenous fluids), or death.

• Benefits of outpatient sodium restriction in heart failure is well substantiated; benefits/ lack thereof not known for inpatients

• Adult inpatients with ADHF, LVEF<45%
  • Exclusions: creatinine clearance <30mL/min/m2; shock; etc

• Intervention:
  • Group 1 (n=38): fluid restricted to 800mL/ day; sodium restricted to 800mg/ day
  • Group 2 (n=37): standard hospital diet (fluid at least 2.5L/ day; sodium 3-5g/ day)
Sodium Restriction

30 days:
- Hospital readmission and ER visits (p=0.41)
  - 800mg/d group: 29%
  - 3-5g/day group: 19%

Table 4. CCS at the End of the Study and at 30-Day Follow-up and the Difference Between These Periods in the IG and CG

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>800mg/d</th>
<th>Mean (SD)</th>
<th>3-5g/d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IG</td>
<td></td>
<td>CG</td>
</tr>
<tr>
<td>CCS at study end</td>
<td>6.4 (3.0), n = 38</td>
<td>7.1 (2.6), n = 37</td>
<td></td>
</tr>
<tr>
<td>CCS at 30-d follow-up</td>
<td>7.9 (3.8), n = 37</td>
<td>6.0 (3.0), n = 34</td>
<td></td>
</tr>
<tr>
<td>∆CCS_{End-30d}</td>
<td>1.5 (3.6)</td>
<td>1.2 (3.3)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: CCS, clinical congestion score; CG, control group; ∆CCS_{End-30d}, difference in CCS between 30-day follow-up and the end of the study; IG, intervention group.

aDifference significant at P = .002; adjusted covariance matrix for correction of different CCS at hospital day 7.
Clinical Vignette #2

28 year-old female previously in normal health, no medications

• 4 day history of increasing dyspnea, orthopnea, PND, dizziness. 2 syncopal episodes in last 24 hours. Had a viral URI last week.

• Physical Exam: mildly confused, cold extremities, BP=80/45, P=105, JVD to angle of jaw, bibasilar rales

• Echocardiogram shows EF=10-15%
What is the next best step?

A. Start on esmolol drip
B. Myocardial biopsy
C. Give 500cc NS bolus
D. Start dobutamine
INOTROPES
Inotropes

Evidence for Low Perfusion:
- Narrow Pulse Pressure
- Pulsus Alternans
- Cool Forearms and Legs
- May Be Sleepy, Obtunded
- ACE Inhibitor-Related
- Symptomatic Hypotension
- Declining Serum Sodium Level
- Worsening Renal Function

Low Perfusion at Rest?

Congestion at Rest?

PCWP:
- NO
  - Warm and Dry
- YES
  - Warm and Wet

CI:
- >2.2 L/min/m²
  - Cold and Dry
- <2.2 L/min/m²
  - Cold and Wet


2013 ACC/AHA Heart Failure Guidelines:

“In patients with clinical evidence of hypotension associated with hypoperfusion and obvious evidence of elevated cardiac filling pressures (e.g., elevated jugular venous pressure; elevated pulmonary artery wedge pressure), intravenous inotropic or vasopressor drugs should be administered to maintain systemic perfusion and preserve end-organ performance while more definitive therapy is considered.”
Inotropes in ADHF

<table>
<thead>
<tr>
<th></th>
<th>CO</th>
<th>PCWP</th>
<th>SVR</th>
<th>MAP</th>
<th>HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dobutamine</td>
<td>↑↑↑↑</td>
<td>↓/↔</td>
<td>↓</td>
<td>↓/↔</td>
<td>↑/↔</td>
</tr>
<tr>
<td>Dopamine- moderate</td>
<td>↑↑↑</td>
<td>↑/↔</td>
<td>↑/↔</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Dopamine- high</td>
<td>↑</td>
<td>↑</td>
<td>↑↑↑↑</td>
<td>↑↑</td>
<td>↑↑</td>
</tr>
<tr>
<td>Milrinone</td>
<td>↑↑</td>
<td>↓</td>
<td>↓</td>
<td>↓/↔</td>
<td>↑/↔</td>
</tr>
</tbody>
</table>
Inotropes: Robbing Peter to Pay Paul?

• Pro-arrhythmic

• Increase mortality in ischemic patients
  • Ischemic/injured myocardium may “hibernate” as a protective mechanism
  • Inotropes recruit hibernating myocytes and may hasten cell injury or apoptosis

• Short-term gains appear to be offset by higher mid and long-term mortality
Clinical Vignette #3

58 year-old male with longstanding hypertensive cardiomyopathy, last EF=55-60%, grade 2 diastolic dysfunction, h/o ischemic stroke. Recently stopped CPAP due to mask intolerance

• 2 days of increasing dyspnea, orthopnea, headache

• Physical exam: BP=190/110, P=64, warm extremities, rales halfway up both lung fields, JVP=14cm H2O, trace pretibial edema, hypertensive retinal changes

• Labs: normal CBC/TSH, creatinine=1.9 (baseline=1.4), proteinuria, troponin i=0.18 (ULN=0.04)

• ECG: no ischemia
What is the next step after initiating an iv loop diuretic?

A. Milrinone drip
B. Nitroprusside drip
C. Add metolazone
D. Add lisinopril and amlodipine
VASODILATORS
Vasodilators

Continue PO Outpt Treatment (GDMT)

Inotropes +/- IV Fluids

Diuretics Vasodilators

Diuretics Vasodilators Inotropes

Congestion at Rest? PCWP:

- NO
  - <18
    - Warm and Dry
  - >18
    - Warm and Wet
- YES
  - >2.2L/min/m²
    - Cold and Dry
  - <2.2L/min/m²
    - Cold and Wet
IV Vasodilators: Overview

- Nitroglycerin, Nitroprusside, Nesiritide
- Class IIB recommendation for treatment of ADHF
  - Hypertensive patients
  - Pulmonary congestion not responsive to initial diuretics and standard HF therapy
- Beneficial effects:
  - Decrease BP and improve the efficiency of cardiac work
  - Speed symptom relief
  - Decrease risk for CCU, mechanical ventilation
- No proven change in mortality
Nitroglycerin

- Primarily venodilation
  - Decreased pre-load → decreased pulmonary congestion
  - Preferred in ischemia
  - Less potent arteriolar dilator than nitroprusside
  - May get rebound tachycardia and 20% patients develop resistance
Nitroglycerin

- **Advantages**
  - Effective
  - High comfort level
  - Established safety profile
  - Cost

- **Disadvantages**
  - Rapid tachyphylaxis
  - Frequently underdosed
  - Dose-limiting side effects (20%)
Nitroprusside

- Primary arterial dilator
- Potent
- Most useful in patients with marked hypertension/hypertensive emergency
- Improves symptoms of pulmonary congestion, and signs of peripheral perfusion

- Disadvantages:
  - Cyanide intoxication: metabolic acidosis
  - Thiocyanate toxicity: Hyper-reflexia, seizures, altered mental status. Serum concentration assay available
Nesiritide

- Recombinant brain natriuretic peptide (BNP)
- Significant vasodilator effect (venous and arterial)
- Natriuretic effect
- Suppression of RAAS and catecholamines
- Reduces LV filling pressure, variable effect on CO, urine output, sodium excretion
- Better than diuretics for dyspnea
- Longer t ½ than nitroglycerin or nitroprusside
Nesiritide

- Initial trials:
  - Improved PCWP and symptoms c/w placebo
  - Lower PCWP than NTG, but similar dyspnea
  - No difference in hard outcomes NTG vs nesiritide

- Subsequent retrospective analysis: worsened renal function

- Meta analysis: trend toward increased mortality at 30 days

Sackner-Bernstein et al. JAMA 2005; 293(15) 1900-1905.
Nesiritide: Safety and Efficacy
ASCEND-HF

• Dyspnea ("moderately-markedly improved") at 6 hours:
  • Improved (44.5% versus 42.1%, p=0.03)

• Dyspnea ("moderately-markedly improved") at 24 hours:
  • Improved (68.2% versus 66.1%, p=0.007)

• Death or rehospitalization for HF at 30 days:
  • No difference (9.4% versus 10.1%, p=0.31)

• Renal function:
  • No difference (31.4% versus 29.5%, p=0.11)

• Hypotension:
  • Worse
    • Symptomatic: 7.2% versus 4.0% (p<0.001)
    • Asymptomatic: 21.4% versus 12.4% (p<0.001)

Nesiritide

- Advantages
  - Faster than NTG
  - Easy dosing
  - Few side effects

- Disadvantages
  - Hypotension
  - Cost: $380/day
Vasodilator Algorithm

Class III or IV ADHF AND preserved BP

Immediate
- Impending respiratory failure
- Chest pain

Immediate or early
ADHF and HTN (? first-line)

Expectant
Poor response to diuretics
All of the following are true regarding beta blockers in acute decompensated heart failure except:

A. Starting a beta blocker during a decompensated, volume overloaded state may cause further decompensation or even cardiogenic shock.

B. Carvedilol is superior to metoprolol tartrate (short acting) when started for dilated cardiomyopathy.

C. Decompensated normotensive patients who have their beta blocker stopped at admission for ADHF have better outcomes than patients whose beta blocker is continued during the hospital stay.

D. Beta blockers are better tolerated, and the eventual dose is higher when started at a low dose and titrated slowly over several weeks.
B-CONVINCED

- Randomized, controlled, open label
- Inclusion criteria:
  - Admitted for ADHF
  - EF<40%
  - On stable beta blocker therapy
- Randomized
  - Continuation of beta blocker at admission
  - Stop beta blocker at hospital admission
B-CONVINCED

Table 3: Clinical events

<table>
<thead>
<tr>
<th></th>
<th>Keep BB, n = 69</th>
<th>Stop BB, n = 78</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>During hospitalization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durations (days)</td>
<td>115 ± 8.3</td>
<td>104 ± 9.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Median, range</td>
<td>9 (1–50)</td>
<td>8 (1–62)</td>
<td></td>
</tr>
<tr>
<td>Deaths (n)</td>
<td>1 (HF)</td>
<td>2 (HF)</td>
<td></td>
</tr>
<tr>
<td>Dobutamine (n)</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>After 3 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths, n (%)</td>
<td>6 (9)</td>
<td>6 (8)</td>
<td>0.83</td>
</tr>
<tr>
<td>Rehospit, n (%)</td>
<td>27 (40)</td>
<td>36 (47)</td>
<td>0.43</td>
</tr>
<tr>
<td>For HF</td>
<td>15 (22)</td>
<td>24 (32)</td>
<td>0.19</td>
</tr>
<tr>
<td>For arrhythmia</td>
<td>2 (3)</td>
<td>3 (4)</td>
<td>1</td>
</tr>
<tr>
<td>Receiving BB, n (%)</td>
<td>61 (90)</td>
<td>58 (76)</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Rehospt, rehospitalization; HF, heart failure; BB, beta-blocker.

- (OPTIMIZE-HF registry with similar findings)
HOSPITAL DISCHARGE
Hospital Discharge

- Readmissions scrutinized by payers
  - Average readmission = $9300
- Transitions in care scrutinized by The Joint Commission
  - Patient safety issue
- Good discharge/ follow-up practices decrease readmission and are therefore cost conscious care
- What are “good” discharge practices?
Hospital Discharge: What do the Guidelines Say?

• In all patients hospitalized with HF, both with preserved and low ejection fraction, transition from intravenous to oral diuretics prior to discharge (class I)

• Minimum 24 hours on PO regimen prior to discharge

• With all medication changes, the patient should be monitored for:
  • Supine and upright hypotension
  • Electrolyte disturbances
  • Worsening renal function
  • Worsening HF signs/symptoms
Hospital Discharge: What do the Guidelines Say?

- Comprehensive written discharge instructions for all patients and their caregivers; special emphasis on the following 6 aspects of care:
  - Diet
  - Discharge medications- reconciled
    - Importance of adherence
    - Uptitration to recommended dose of guideline based therapies (ACEI/ARB, BB, aldosterone inhibitor, hydralazine/ntg as indicated) as outpatient
  - Activity level
  - Follow-up appointments
  - Weight monitoring
  - What to do if HF symptoms worsen
Transition to Outpatient American Heart Association Discharge/Transition Tools
Hospital Discharge: What do the Guidelines Say?

• Multidisciplinary care for patients at high risk of readmission (class I)
• Outpatient follow up within 7-14 days (2a)
• Telephone call within 3 days (2a)
• Use of clinical prediction tools and biomarkers to identify high risk patients (2a)
• Performance improvement initiatives for discharge and early outpatient care to optimize use of GDMT
Meta-analysis of the impact of post discharge HF care activities

<table>
<thead>
<tr>
<th>Intervention Arm</th>
<th>All cause mortality</th>
<th>All cause hospitalization</th>
<th>Heart failure hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multidisciplinary heart failure clinic</td>
<td>0.66 (0.42-1.05)</td>
<td>0.76 (0.59-1.01)</td>
<td>0.76 (0.58-0.99)</td>
</tr>
<tr>
<td>Multidisciplinary team providing specialized follow up in non-clinic setting</td>
<td>0.81 (0.65-1.01)</td>
<td>0.81 (0.72-0.91)</td>
<td>0.72 (0.59-0.87)</td>
</tr>
<tr>
<td>Summary for specialized multidisciplinary team follow up</td>
<td>0.75 (0.59-0.96)</td>
<td>0.81 (0.71-0.92)</td>
<td>0.74 (0.63-0.87)</td>
</tr>
<tr>
<td>Telephone follow up</td>
<td>0.91 (0.67-1.29)</td>
<td>0.98 (0.80-1.20)</td>
<td>0.75 (0.57-0.99)</td>
</tr>
<tr>
<td>Enhanced patient care activities</td>
<td>1.14 (0.67-1.94)</td>
<td>0.73 (0.57-0.93)</td>
<td>0.66 (0.52-0.83)</td>
</tr>
<tr>
<td>Total for all interventions</td>
<td>0.83 (0.70-0.99)</td>
<td>0.84 (0.75-0.93)</td>
<td>0.73 (0.66-0.82)</td>
</tr>
</tbody>
</table>
Optimal Outpatient Medical Therapy

<table>
<thead>
<tr>
<th>Classification schemes</th>
<th>B (asymptomatic)</th>
<th>C (symptomatic)</th>
<th>D (refractory symptoms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC/AHA classification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYHA classification</td>
<td>I</td>
<td>II to IIIa</td>
<td>IV (severe)</td>
</tr>
<tr>
<td>Symptom classification</td>
<td>Asymptomatic</td>
<td>Symptomatic with history of rest dyspnea</td>
<td>Symptomatic with rest dyspnea</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pharmacologic treatments</th>
<th>B (asymptomatic)</th>
<th>C (symptomatic)</th>
<th>D (refractory symptoms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE inhibitor*↑</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Beta blocker*</td>
<td>Selected patients‡</td>
<td>Yes</td>
<td>Yes§</td>
</tr>
<tr>
<td>Aldosterone antagonist*</td>
<td>–</td>
<td>After myocardial infarction</td>
<td></td>
</tr>
<tr>
<td>Isosorbide dinitrate/ hydralazine (Bidil)</td>
<td>–</td>
<td>Selected patients¶</td>
<td>Selected patients¶</td>
</tr>
<tr>
<td>Diuretic</td>
<td>–</td>
<td>As needed for congestion</td>
<td>Yes</td>
</tr>
<tr>
<td>ARB</td>
<td>–</td>
<td>As needed**↑↑</td>
<td>As needed↑↑</td>
</tr>
<tr>
<td>Digoxin</td>
<td>–</td>
<td>As needed**</td>
<td>As needed**</td>
</tr>
</tbody>
</table>
Hospitalization Rate Based on Physician Adherence to Guideline Directed Medical Therapy for Heart Failure

Conclusions

• Begin by assessing:
  • Volume status
  • Forward flow/ perfusion
  • Etiology of exacerbation

• Determine what category your patient belongs in

• Treat accordingly
Conclusions

• Diuretics for most
  • For refractory patients, may increase dose/frequency, add a thiazide, add inotrope vs. vasodilator, attempt ultrafiltration

• IV vasodilators are underutilized, especially in “wet” patients with preserved BP who do not respond to diuretics

• For GDMT, start low and go slow

• Good, comprehensive discharges with appropriate handoffs to outpatient care are important
Thank you!
parikh.pragnesh@mayo.edu