Inpatient Heart Failure
Management:
Risks & Benefits

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Inpatient Heart Failure Management

- Most common DRG > 65 years old
- Today’s focus
  - Exacerbation of established CHF
- Not
  - New onset
  - Acute ischemia
  - Mechanical
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Outline

- Indications for hospitalization
- Etiology of exacerbation
- Risk stratification
- Modifications of standard therapy
- Management of refractory CHF
  - IV diuretics
  - Indications for hemodynamic monitoring
  - Vasodilators/Inotropes
  - Mechanical – UF, VAD, IABP
- Discharge planning
Indications for hospitalization

- Congestion – symptoms, weight gain
- Low output – mentation, renal perfusion
- Arrhythmia
- Co-morbid conditions
- Electrolyte abnormalities
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Etiology of exacerbation

- Noncompliance
- Cardiac deterioration
- Toxins – alcohol, medications
- Non cardiac
  - Thyroid
  - Infection
  - Pulmonary
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Risk stratification

Fonarow GC, JAMA 2005; 293: 572
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Decomposition categories
Congestion & output

- Dry & warm
- Wet & warm
- Dry & cold
- Wet & cold

Nohria A, Stevenson L,
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Standard management

- NaCl limitation (2 grams)
- Fluid restrict (2 liters)
- Oxygen
- Diuretics
- Vasodilators
- Beta blockers
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Diuretics

- **Intravenous**
  - Dose IV = 2x oral (except torsemide)
    - Lasix 40 IV = 80 orally
  - Frequency – 2-3x/day bolus
  - Continuous infusion

- “Stacking”
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**Continuous infusion vs. bolus**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Cochrane analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable effect – volume &amp; diuresis</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>Decreased electrolyte toxicity</td>
<td>p 0.50</td>
</tr>
<tr>
<td>Decreased ototoxicity</td>
<td>p 0.005</td>
</tr>
<tr>
<td>Decreased LOS</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Decreased mortality</td>
<td>RR 0.52</td>
</tr>
</tbody>
</table>

Cochrane Database 2004: (1): CD003178
# Inpatient Heart Failure Management

## Renal Physiology & Diuretics

<table>
<thead>
<tr>
<th>Proximal</th>
<th>Loop</th>
<th>Early distal</th>
<th>Late distal</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetazolamide</td>
<td>furosemide</td>
<td>thiazide</td>
<td>spironolactone</td>
</tr>
<tr>
<td>bumetanide</td>
<td>metolazone</td>
<td>eplerenone</td>
<td></td>
</tr>
<tr>
<td>ethacrynic acid</td>
<td></td>
<td>triamterene</td>
<td></td>
</tr>
<tr>
<td>torsemide</td>
<td></td>
<td>amiloride</td>
<td></td>
</tr>
</tbody>
</table>
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Standard therapy modifications

- **Diuretics**
  - Efficacy – symptoms, congestion
  - Toxicity – systemic under perfusion (renal), electrolytes
  - BNP vs. clinically guided

- **Vasodilators**
  - Maximize when “dry”

- **Beta blockers**
  - Continue if possible
  - Reduce dose
  - Stop if sympathomimetic used
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Predischarge initiations of beta blockers in patients hospitalized for decompensated heart failure

Gattis WA JACC 2004; 43: 1534
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Refractory CHF – Phase I

- IV TNG
- Nesiritide (BNP)
- Milrinone
- Dopamine/dobutamine
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Nesiritide in ADHF

- 127 patients
- Hemodynamic monitoring
- Randomized
  - Placebo
  - Nesiritide
- Six hour infusion

<table>
<thead>
<tr>
<th></th>
<th>BNP</th>
<th>Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCWP (mmHg)</td>
<td>↓10%</td>
<td>+2%</td>
</tr>
<tr>
<td>Global clinical</td>
<td>+67%</td>
<td>+14%</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>↓53%</td>
<td>↓12%</td>
</tr>
<tr>
<td>Fatigue</td>
<td>↓38%</td>
<td>↓5%</td>
</tr>
</tbody>
</table>

Colucci WS NEJM 2000; 343: 246
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Short term risk of death after treatment with Nesiritide for DHF

Table 2. Mortality Within 30 Days of Treatment Associated With Nesiritide or Control Therapy With Overall Risk Ratio Calculated by Mantel-Haenszel Test Using a Fixed-Effects Model

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Deaths/Total No. (%) of Patients</th>
<th>Risk Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nesiritide Therapy</td>
<td>Control Therapy</td>
<td></td>
</tr>
<tr>
<td>NSGET</td>
<td>6/85 (7.1)</td>
<td>2/42 (4.8)</td>
<td>1.48 (0.31-7.03)</td>
</tr>
<tr>
<td>VMAC</td>
<td>24/280 (8.6)</td>
<td>12/218 (5.5)</td>
<td>1.56 (0.80-3.04)</td>
</tr>
<tr>
<td>PROACTION</td>
<td>5/120 (4.2)</td>
<td>1/117 (0.9)</td>
<td>4.88 (0.58-41.1)</td>
</tr>
<tr>
<td>Total</td>
<td>35/485 (7.2)</td>
<td>15/377 (4.0)</td>
<td>1.74 (0.97-3.12)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; ND, not determined; NSGET, Nesiritide Study Group Efficacy Trial; PROACTION, Prospective Randomized Outcomes Study of Acutely Decompensated Congestive Heart Failure Treated Initially in Outpatients with Natrecor; VMAC, Vasodilation in the Management of Acute Congestive heart failure.

Sackner-Bernstein JD JAMA 2005; 293: 1600
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Risk of worsening renal function with Nesiritide in patients with ADHF

TABLE 4. Effect of Nesiritide on Development of Worsening Renal Function in Patients With Acutely Decompensated Heart Failure

<table>
<thead>
<tr>
<th></th>
<th>Events, n/N (%)</th>
<th>Nesiritide</th>
<th>Control</th>
<th>RR_{max} (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nesiritide ≤0.03 vs non-inotrope based controls</td>
<td>134/610 (22)</td>
<td>60/389 (15)</td>
<td>1.52 (1.16–2.00)</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Nesiritide ≤0.03 vs all control therapies, including inotropes</td>
<td>163/772 (21)</td>
<td>69/472 (15)</td>
<td>1.54 (1.19–1.98)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Nesiritide ≤0.015 vs non-inotrope based controls</td>
<td>100/442 (23)</td>
<td>60/389 (15)</td>
<td>1.46 (1.09–1.95)</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>Nesiritide ≤0.015 vs all control therapies, including inotropes</td>
<td>99/464 (21)</td>
<td>69/472 (15)</td>
<td>1.47 (1.12–1.93)</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td>Nesiritide ≤0.06 vs non-inotrope based controls</td>
<td>140/635 (22)</td>
<td>60/389 (15)</td>
<td>1.53 (1.16–2.00)</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>Nesiritide ≤0.06 vs all control therapies, including inotropes</td>
<td>169/797 (21)</td>
<td>69/472 (15)</td>
<td>1.54 (1.20–1.99)</td>
<td>0.001</td>
<td></td>
</tr>
</tbody>
</table>

Nesiritide doses refer to infusion rates (µg · kg⁻¹ · min⁻¹) that followed bolus administration.

Sackner-Bernstein JD Circulation 2005; 111: 1487
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Safety and feasibility of using serial infusions of Nesiritide for CHF in outpatients

- 210 patients
- Creatine 1.8
- EF 28%
- Randomized to weekly
  - Placebo
    - 0.005 mcg/kg
  - Nesiritide
    - 0.010 mcg/kg

- Outcomes – NS
  - Significant adverse events – NS
  - Higher risk - ↓ events

Yancy CA AJC 2004; 94: 595
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Effect of Nesiritide vs. Dobutamine on short term outcomes in treatment of patients with ADHF

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Dobutamine Subgroup (n = 58)</th>
<th>Nesiritide (µg/kg per min)</th>
<th>Overall p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median length of stay (days)</td>
<td>4.5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Still hospitalized on day 21</td>
<td>4 (7%)</td>
<td>2 (2%)</td>
<td>4 (4%)</td>
</tr>
<tr>
<td>All-cause readmission (by day 21)</td>
<td>11 (20%)</td>
<td>8 (8%)*</td>
<td>11 (11%)</td>
</tr>
<tr>
<td>CHF readmission</td>
<td>7 (13%)</td>
<td>4 (4%)</td>
<td>4 (4%)</td>
</tr>
<tr>
<td>Six-month mortality rate</td>
<td>18 (31%)</td>
<td>18 (18%)*</td>
<td>24 (24%)</td>
</tr>
<tr>
<td>Lost to follow-up at six months</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>2 (2%)</td>
</tr>
</tbody>
</table>

Silver MA JACC 2002; 39: 798
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Milrinone

- Phosphodisterase inhibitor
- Vasodilator
- Inotrope

**Dose**
- Load 50 mcg/kg
- Drip 0.375 – 0.750 mcg/kg/min
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Short term intravenous milrinone for acute exacerbation of chronic heart failure

<table>
<thead>
<tr>
<th>Table 4. Primary Outcome and Hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome</td>
</tr>
<tr>
<td>Days of hospitalization for cardiovascular causes within 60 days</td>
</tr>
<tr>
<td>Median (IQR)*</td>
</tr>
<tr>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Days of hospitalization from infusion to initial discharge</td>
</tr>
<tr>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Days of hospitalization for cardiovascular causes from discharge to 60 days</td>
</tr>
<tr>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Days of hospitalization for any cause within 60 days</td>
</tr>
<tr>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Death or readmission within 60 days, No./Total (%)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*IQR indicates interquartile range.

Cuffe MS JAMA 2002; 287: 1541
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**Dopamine Dobutamine**

- **General**
  - Sympathomimetics – beta$_1$ > beta$_2$ > alpha
  - Inotropes
  - Increase cardiac output, mild resistance
  - Toxicity dose dependent

- **Specific**
  - Dopamine – renal vascular effects
  - Dobutamine - eosinophilia
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- **Mechanical**
  - Ultrafiltration
  - Biventricular pacing
  - IABP
  - Left ventricular assist

- **Replacement**
  - Heart transplant

- Standard 70%
- Advanced 20%
- End stage 10%
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Indications for hemodynamic monitoring

- Refractory CHF
- Volume status unknown
- Use of any vasoactive agent
- Hypotension (with or without renal insufficiency)
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Patients with heart failure

- 60-90 day mortality 8.6%
- 60-90 day rehospitalization 29.6%

### Mortality
- Age
- Creatinine
- Lung disease
- Liver disease
- Low BP
- Low Na
- Lower wt
- Depression

### Readmission & death
- Creatinine
- BP (systolic)
- Hemoglobin
- Lung disease
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Refractory Heart Failure

All therapies beyond standard treatment increase mortality
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Discharge planning

- Stable weight & electrolytes 24-48 hours
- Off inotropes – 24-48 hours
- Off IV diuretics – 24-48 hours
- Stable oral regimen 24 hours
- Exacerbating etiology corrected
- Patient and family education
- Early follow-up
- Disease management
Inpatient Heart Failure Management

Outline

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- Risk stratification
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