**HPI**
- 20 y/o gentleman, no significant PMEDHx
- 05/14 presentation to Millard Fillmore Suburban Hospital
- CC: Six week history of abdominal pain with nausea, vomiting, and lower extremity edema.
  - had been seen in community hospital in Pennsylvania
  - complained of dizziness with position change
  - DOE
  - PND
  - orthopnea

**Course**
- Admitted to ECMC
- Rx: IV furosemide, captopril, digoxin, spironolactone, IV dobutamine
- LVEF 7%, extensive LV thrombus (mobile), mod-severe TR
- Enoxaparin and warfarin initiated
- THC positive
- Discharged 05/20

**2013 ACCF/AHA Guideline for the Management of Heart Failure: Executive Summary:**

*HFSA 2010 Comprehensive Heart Failure Practice Guideline*

Key Recommendations
http://www.heartfailureguideline.org
Prevalence of Heart Failure

- 6 million people affected in the U.S.
- 400,000-700,000 new cases of congestive heart failure (CHF) each year
- HF affects 10 out of every 1,000 over age 65 in the U.S.
- By year 2030, estimated 10 million Americans will be affected
- Cost $39.2 billion in 2010
- 2nd only to hypertension as outpatient diagnosis

Definition:

- Abnormality in cardiac function that leads to an inability of the heart to pump blood at a rate commensurate with the metabolic requirements.
- Results in a clinical syndrome or condition characterized by:
  a) volume overload
  b) manifestations of inadequate tissue perfusion

Does the heart muscle have to be weak?

- Systolic: most common; contractile failure
- Diastolic: increased filling pressures required to maintain cardiac output despite normal contractile function

Appropriate Treatment is based on cause of Heart Failure—ASK WHY!

- Coronary Artery Disease
- Idiopathic Dilated Cardiomyopathy
- Hypertension
- Valvular Heart Disease
- Toxic/Drug
- Congenital
- Metabolic
- Other: infiltrative (amyloid, sarcoid) and re

Definition of Heart Failure

<table>
<thead>
<tr>
<th>Classification</th>
<th>Ejection Fraction</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 (HFrEF)</td>
<td>≥50%</td>
<td>Also referred to as diastolic HF. Several different criteria have been used to further define HFrEF. The diagnosis of HFrEF 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. HFrEF, 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 HFrEF.</td>
</tr>
<tr>
<td>b. HFrEF, Improved</td>
<td>&gt;40%</td>
<td>It has been recognized that a subset of patients with HFrEF 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>

Treating Hypertension to Prevent HF

Aggressive blood pressure control:

- Decreases risk of new HF by ~ 50%
- 56% in DM2

Aggressive BP control in patients with prior MI:

- Decreases risk of new HF by ~ 80%
**Pathophysiology**

- **CURRENT CONCEPTS**
  - a) Ventricular Remodeling
  - b) Neurohumoral and Endocrine Activation

  • What the body means to be adaptive initially, becomes maladaptive long term.

---

**Ventricular Remodeling**

- Change in ventricular shape and dimension
- Regional or global
- Increased ventricular volume
  - Changes are occurring at cellular level:
    - Myocyte hypertrophy, increase intracellular sarcomere
    - Myocyte slippage
    - Myocardial interstitial fibrosis, increased collagen deposition

**Neurohormonal Model**

• Major components
  - Naturetic Peptide System
    - BNP
  - Sympathetic Nervous System
  - Renin-Angiotensin System
  - Aldosterone

---

**Causes for Elevated Natriuretic Peptide Levels**

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Noncardiac</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Heart failure, including RV syndromes</td>
<td>• Advancing age</td>
</tr>
<tr>
<td>• Acute coronary syndrome</td>
<td>• Anemia</td>
</tr>
<tr>
<td>• Heart muscle disease, including LVH</td>
<td>• Renal failure</td>
</tr>
<tr>
<td>• Valvular heart disease</td>
<td>• Pulmonary causes: obstructive sleep apnea, severe pneumonia, pulmonary hypertension</td>
</tr>
<tr>
<td>• Pericardial disease</td>
<td>• Critical illness</td>
</tr>
<tr>
<td>• Atrial fibrillation</td>
<td>• Bacterial sepsis</td>
</tr>
<tr>
<td>• Myocarditis</td>
<td>• Severe burns</td>
</tr>
<tr>
<td>• Cardiac surgery</td>
<td>• Toxic-metabolic insults, including cancer chemotherapy and envenomation</td>
</tr>
<tr>
<td>• Cardioversion</td>
<td></td>
</tr>
</tbody>
</table>

---

**Sympathetic Nervous System**

1. Direct Stimulation of RAAS
2. Stimulate Beta 1 to increase contractility
3. Norepinephrine stimulates arteriolar and venous constriction
4. Increase in afterload leads to decreased cardiac output and ventricular performance
5. Increased myocardial oxygen consumption
6. Tachycardia leads to increased consumption and decreased diastolic filling time
Other bad actors

- Cytokines: depress cardiac function
  - Tumor necrosis alpha: proinflammatory; cardiac cachexia
- Interleukin 6
- Peripheral Changes: Endothelial Derived factors

Key Treatment Paradigm

- Expert HF disease management program
- Excellent Self Care: sodium, weight, compliance
- Pharmacology: ACE/BBlockers
- Mechanical Therapies: AICD/BiV-CRT

Classification of Heart Failure

<table>
<thead>
<tr>
<th>ACC/AHA Stages of HF</th>
<th>NYHA Functional Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF.</td>
</tr>
<tr>
<td>B</td>
<td>Ordinary physical activity. Ordinary physical activity does not cause symptoms of HF.</td>
</tr>
<tr>
<td>C</td>
<td>Ordinary physical activity. Ordinary physical activity does not cause symptoms of HF.</td>
</tr>
<tr>
<td>D</td>
<td>Ordinary physical activity. Ordinary physical activity results in symptoms of HF.</td>
</tr>
<tr>
<td>E</td>
<td>Ordinary physical activity. Ordinary physical activity results in symptoms of HF.</td>
</tr>
</tbody>
</table>

Stages, Phenotypes and Treatment of HF
Table 4.3. Symptoms Suggesting the Diagnosis of HF

<table>
<thead>
<tr>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>dyspnea at rest or on exertion</td>
</tr>
<tr>
<td>reduction in exercise capacity</td>
</tr>
<tr>
<td>orthopnea</td>
</tr>
<tr>
<td>PND or nocturnal cough</td>
</tr>
<tr>
<td>edema</td>
</tr>
<tr>
<td>ascites or scrotal edema</td>
</tr>
</tbody>
</table>

Less specific presentations

- wheezing or cough
- unexplained fatigue
- early satiety, nausea/vomiting, abdominal discomfort
- confusion/delirium
- depression/weakness (esp. in elderly)

Table 4.4. Signs to Evaluate in Patients Suspected of Having HF

<table>
<thead>
<tr>
<th>Cardiac Abnormality and fluid overload</th>
<th>Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>cardiac filling pressures</td>
<td>elevated jugular venous pressure (JVP)</td>
</tr>
<tr>
<td>and fluid overload</td>
<td>S3 gallop</td>
</tr>
<tr>
<td></td>
<td>rales</td>
</tr>
<tr>
<td></td>
<td>hepatojugular reflux</td>
</tr>
<tr>
<td></td>
<td>ascites, edema</td>
</tr>
</tbody>
</table>

Cardiac enlargement

- laterally displaced or prominent apical impulse
- murmurs suggesting valvular dysfunction

---

**Recommendation 4.8**

It is recommended that patients with a diagnosis of HF undergo evaluation as follows (Table 4.6):

- assess clinical severity of HF by history and physical examination
- assess cardiac structure and function
- determine the etiology of HF
- evaluate for coronary disease and myocardial ischemia
- identify any exacerbating factors for HF
- identify co-morbidities which influence therapy
- identify barriers to adherence and compliance

**Strength of Evidence = C**

**Recommended Evaluation**

**ECG**

**Recommendation 4.13**

It is recommended that all patients with HF have an ECG performed to:

- assess cardiac rhythm and conduction (in some cases, using Holter monitoring or event monitors)
- assess electrical dyssynchrony (wide QRS or bundle branch block) especially when LVEF < 35%
- detect LV hypertrophy or other chamber enlargement
- detect evidence of myocardial infarction or ischemia
- assess QTc interval, especially with drugs that prolong QT int.

**Strength of Evidence = B**

---

**Cardiopulmonary Exercise Testing**

“VO2 Max” - normal - athletes

mL O2/kg/min

---

**Recommendation 8.1**

It is recommended that patients with HF and their family members or caregivers receive individualized education and counseling that emphasizes self-care.

This education and counseling should be delivered by providers using a team approach in which nurses with expertise in HF management provide the majority of education and counseling, supplemented by physician input and, when available and needed, input from dietitians, pharmacists and other health care providers.

**Strength of Evidence = B**
**HFSA 2010 Practice Guideline**

**Patient Education**

**Recommendation 8.2**

**It is recommended** that patients’ literacy, cognitive status, psychological state, culture, and access to social and financial resources be taken into account for optimal education and counseling.

Because cognitive impairment and depression are common in HF and can seriously interfere with learning, patients should be screened for these.

Patients found to be cognitively impaired need additional support to manage their HF.

**Strength of Evidence = B**

**HFSA 2010 Practice Guideline**

**Nonpharmacologic—Dietary Sodium**

**Recommendation 6.2**

**Dietary sodium restriction (2-3 g daily) is recommended** for patients with the clinical syndrome of HF and preserved or depressed LVEF.

– Further restriction (< 2 g daily) may be considered in moderate to severe HF.

**Strength of Evidence = C**

**HFSA 2010 Practice Guideline**

**Nonpharmacologic—Fluid Intake**

**Recommendation 6.3**

**Restriction of daily fluid intake to < 2 liters:**

– **Is recommended** in patients with severe hyponatremia (serum sodium < 130 mEq/L)

– **Should be considered** for all patients demonstrating fluid retention that is difficult to control despite high doses of diuretic and sodium restriction.

**Strength of Evidence = C**

**HFSA 2010 Practice Guideline**

**Nonpharmacologic—Nutrition in Advanced HF**

**Recommendation 6.4**

**It is recommended** that specific attention be paid to nutritional management of patients with advanced HF and unintentional weight loss or muscle wasting (cardiac cachexia).

– Measurement of nitrogen balance, caloric intake, and prealbumin may be useful in determining appropriate nutritional supplementation.

– **Caloric supplementation is recommended.**

– Anabolic steroids are **not recommended** for cachexic patients.

**Strength of Evidence = C**

**HFSA 2010 Practice Guideline**

**Nonpharmacologic—CPAP**

**Recommendation 6.7**

**Continuous positive airway pressure to improve daily functional capacity and quality of life is recommended** in patients with HF and obstructive sleep apnea documented by approved methods of polysomnography.

**Strength of Evidence = B**

**HFSA 2010 Practice Guideline**

**Nonpharmacologic—Oxygen**

**Recommendation 6.8**

**Supplemental oxygen, either at night or during exertion, is not recommended** for patients with HF in the absence of an indication due to underlying pulmonary disease.

**Patients with resting hypoxemia or oxygen desaturation during exercise should be evaluated for residual fluid overload or concomitant pulmonary disease.**

**Strength of Evidence = B**
**HFSA 2010 Practice Guideline**  
Nonpharmacologic—Sexual Dysfunction

**Recommendation 6.12**  
- It is recommended that treatment options for sexual dysfunction be discussed openly with both male and female patients with HF.  
- The use of phosphodiesterase-5 (PDE5) inhibitors such as sildenafil may be considered for use for sexual dysfunction in patients with chronic stable HF.  
  - These agents are not recommended in patients taking nitrate preparations.  
  Strength of Evidence = C

**HFSA 2010 Practice Guideline**  
Nonpharmacologic—Depression

**Recommendation 6.10**  
- It is recommended that screening for endogenous or prolonged reactive depression in patients with HF be conducted following diagnosis and at periodic intervals as clinically indicated.  
- For pharmacologic treatment, selective serotonin receptor uptake inhibitors (SSRIs) are preferred over tricyclic antidepressants, because the latter have the potential to cause ventricular arrhythmias, but the potential for drug interactions should be considered.  
  Strength of Evidence = B

**HFSA 2010 Practice Guideline**  
Nonpharmacologic—Smoking & Alcohol

**Recommendation 6.13**  
- It is recommended that patients with HF be advised to stop smoking and to limit alcohol consumption to ≤ 2 standard drinks per day in men or ≤ 1 standard drink per day in women.  
- Patients suspected of having an alcohol-induced cardiomyopathy should be advised to abstain from alcohol consumption.  
- Patients suspected of using illicit drugs should be counseled to discontinue such use.  
  Strength of Evidence = B

**HFSA 2010 Practice Guideline**  
Nonpharmacologic—Vaccinations

**Recommendation 6.14**  
- Pneumococcal vaccine and annual influenza vaccination are recommended in all patients with HF in the absence of known contraindications.  
  Strength of Evidence = B

**HFSA 2010 Practice Guideline**  
Nonpharmacologic—NSAIDs

**Recommendation 6.16**  
- NSAIDs, including COX-2 inhibitors, are not recommended in patients with chronic HF.  
  - The risk of renal failure and fluid retention is markedly increased in the setting of reduced renal function or ACE inhibitor therapy.  
  Strength of Evidence = B
Pharmacology

1. ACE Inhibitors/ Angiotensin Receptor Blockers
2. Beta Blockers
3. Aldosterone Inhibition
4. Digoxin
5. Others: Hydralazine/Nitrates, amiodarone
6. Diuretics

ACE Inhibitors

- ACE inhibitors interfere with the RAAS by inhibiting the enzyme responsible for the conversion of angiotensin I to angiotensin II.
- lisinopril, altace, enalapril, captopril
- Monitor for hypotension, renal failure, hyperkalemia, cough and angioedema

ACE Inhibitors Used in Clinical Trials

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Trade Name</th>
<th>Initial Daily Dose</th>
<th>Target Dose</th>
<th>Mean Dose in Clinical Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captopril</td>
<td>Capoten</td>
<td>6.25 mg tid</td>
<td>50 mg tid</td>
<td>122.7 mg/day</td>
</tr>
<tr>
<td>Enalapril</td>
<td>Vasotec</td>
<td>2.5 mg bid</td>
<td>10 mg bid</td>
<td>10.6 mg/day</td>
</tr>
<tr>
<td>Fosinopril</td>
<td>Monopril</td>
<td>5-10 mg qd</td>
<td>80 mg qd</td>
<td>N/A</td>
</tr>
<tr>
<td>Lisinopril</td>
<td>Zestril, Prinivil</td>
<td>2.5-5 mg qd</td>
<td>20 mg qd</td>
<td>4.5 mg/day, 33.2 mg/day*</td>
</tr>
<tr>
<td>Quinapril</td>
<td>Accupril</td>
<td>5 mg bid</td>
<td>80 mg qd</td>
<td>N/A</td>
</tr>
<tr>
<td>Ramipril</td>
<td>Altace</td>
<td>1.25-2.5 mg qd</td>
<td>10 mg qd</td>
<td>N/A</td>
</tr>
<tr>
<td>Trandolapril</td>
<td>Mavik</td>
<td>1 mg qd</td>
<td>4 mg qd</td>
<td>N/A</td>
</tr>
</tbody>
</table>

ACE Inhibitors Used in Clinical Trials

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Trade Name</th>
<th>Initial Daily Dose</th>
<th>Target Dose</th>
<th>Mean Dose in Clinical Trials</th>
</tr>
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<tr>
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<td>Vasotec</td>
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<tr>
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<td>Monopril</td>
<td>5-10 mg qd</td>
<td>80 mg qd</td>
<td>N/A</td>
</tr>
<tr>
<td>Lisinopril</td>
<td>Zestril, Prinivil</td>
<td>2.5-5 mg qd</td>
<td>20 mg qd</td>
<td>4.5 mg/day, 33.2 mg/day*</td>
</tr>
<tr>
<td>Quinapril</td>
<td>Accupril</td>
<td>5 mg bid</td>
<td>80 mg qd</td>
<td>N/A</td>
</tr>
<tr>
<td>Ramipril</td>
<td>Altace</td>
<td>1.25-2.5 mg qd</td>
<td>10 mg qd</td>
<td>N/A</td>
</tr>
<tr>
<td>Trandolapril</td>
<td>Mavik</td>
<td>1 mg qd</td>
<td>4 mg qd</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Evidence-Based Treatment Across the Continuum of Systolic LVD and HF

<table>
<thead>
<tr>
<th>Control Volume</th>
<th>Improve Clinical Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diuretics</td>
<td>ACEI or ARB</td>
</tr>
<tr>
<td>β-Blocker</td>
<td>Aldosterone Antagonist or ARB</td>
</tr>
<tr>
<td>CRT ± an ICD*</td>
<td>HDZN/ISDN*</td>
</tr>
</tbody>
</table>

Treat Residual Symptoms

Digoxin

HFSA 2006 Practice Guideline (7.2)
Pharmacologic Therapy: Substitutes for ACEI

It is recommended that other therapy be substituted for ACE inhibitors in the following circumstances:

- In patients who cannot tolerate ACE inhibitors due to cough, ARBs are recommended. Strength of Evidence = A
- The combination of hydralazine and an oral nitrate may be considered in such patients not tolerating ARBs. Strength of Evidence = C
- Patients intolerant to ACE inhibitors due to hyperkalemia or renal insufficiency are likely to experience the same side effects with ARBs. In these cases, the combination of hydralazine and an oral nitrate should be considered. Strength of Evidence = C
Beta-Adrenergic Receptor Blockers

- Interfere with the actions of the endogenous neurohormonal system, inhibiting the effects of the SNS
- Beta1, Beta1 and 2, and Beta1, 2 and alpha1
- Only 3 agents approved for use in HF: Toprol XL, Coreg, Zebeta
- Monitor for hypotension, fluid retention, fatigue, heart rhythm and sexual function
- **Patient education extremely important with this therapy**

### Beta Blockers Used in Clinical Trials

<table>
<thead>
<tr>
<th>Drug</th>
<th>Brand Name</th>
<th>Initial Daily Dose</th>
<th>Target Daily Dose</th>
<th>Mean Dose in Clinical Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bisoprolol</td>
<td>Zebeta</td>
<td>1.25 mg qd</td>
<td>10 mg qd</td>
<td>8.6 mg/day</td>
</tr>
<tr>
<td>Carvedilol</td>
<td>Coreg</td>
<td>3.125 mg bid</td>
<td>25 mg bid</td>
<td>27 mg/day</td>
</tr>
<tr>
<td>Carvedilol</td>
<td>Coreg CR</td>
<td>10 mg qd</td>
<td>60 mg qd</td>
<td></td>
</tr>
<tr>
<td>Metoprolol succinate CR/XL</td>
<td>Toprol XL</td>
<td>12.5-25 mg qd</td>
<td>200 mg qd</td>
<td>159 mg/day</td>
</tr>
</tbody>
</table>

**HFSA 2010 Practice Guideline (7.11)**

**Pharmacologic Therapy: Beta Blockers**

- **SYMPTOMATIC EXACERBATION**
  - **Continuation of beta blocker therapy is recommended** in most patients experiencing a symptomatic exacerbation of HF during chronic maintenance treatment, unless they develop cardiogenic shock, refractory volume overload, or symptomatic bradycardia.
    - Temporary dose reduction **may be considered**
    - Avoid abrupt discontinuation
    - Reintroduce gradually prior to discharge
    - Titrate dose to previously tolerated dose as soon as possible

### Effect of Beta Blockade on Outcome in Patients With HF and Post-MI LVD

<table>
<thead>
<tr>
<th>Study</th>
<th>Drug</th>
<th>HF Severity</th>
<th>Target Dose (mg)</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Carvedilol</td>
<td>carvedilol</td>
<td>mild/moderate</td>
<td>25 BID</td>
<td>↓ 48% disease progression (p &lt;.001)</td>
</tr>
<tr>
<td>CIBIS-II</td>
<td>bisoprolol</td>
<td>moderate/severe</td>
<td>10 QD</td>
<td>↓ 34% mortality (p &lt;.001)</td>
</tr>
<tr>
<td>MERIT-HF</td>
<td>metoprolol succinate</td>
<td>mild/moderate</td>
<td>200 QD</td>
<td>↓ 34% mortality (p &lt; .0062)</td>
</tr>
<tr>
<td>COPERNICUS</td>
<td>carvedilol</td>
<td>severe</td>
<td>25 BID</td>
<td>↓ 36% mortality (p &lt; .0014)</td>
</tr>
<tr>
<td>CAPRICORN</td>
<td>carvedilol</td>
<td>post-MI LVD</td>
<td>25 BID</td>
<td>↓ 25% mortality (p = .031)</td>
</tr>
</tbody>
</table>

HFSA 2006 Practice Guideline (7.10)
Pharmacologic Therapy: Angiotensin Receptor Blockers

**ARBS are recommended** for routine administration to symptomatic and asymptomatic patients with an LVEF ≤ 40% who are intolerant to ACE inhibitors for reasons other than hyperkalemia or renal insufficiency.

*Strength of Evidence = A*


---

**Angiotensin Receptor Blockers Used in Clinical Trials**

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Trade Name</th>
<th>Initial Daily Dose</th>
<th>Target Dose</th>
<th>Mean Dose in Clinical Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candesartan</td>
<td>Atacand</td>
<td>4-8 mg qd</td>
<td>32 mg qd</td>
<td>24 mg/day</td>
</tr>
<tr>
<td>Losartan</td>
<td>Cozaar</td>
<td>12.5-25 mg qd</td>
<td>150 mg qd</td>
<td>129 mg/day</td>
</tr>
<tr>
<td>Valsartan</td>
<td>Diovan</td>
<td>40 mg bid</td>
<td>160 mg bid</td>
<td>254 mg/day</td>
</tr>
</tbody>
</table>

---

**HFSA 2010 Practice Guideline (7.14-7.15)
Pharmacologic Therapy: Aldosterone Antagonists**

- An aldosterone antagonist **is recommended** for patients on standard therapy, including diuretics, who have:
  - NYHA class IV HF (or class III, previously class IV) HF from reduced LVEF (≤ 35%)
- One should be considered in patients post-MI with clinical HF or diabetes and an LVEF < 40% who are on standard therapy, including an ACE inhibitor (or ARB) and a beta blocker.

*Strength of Evidence = A*


---

**HFSA 2006 Practice Guideline (7.19)
Pharmacologic Therapy: Hydralazine and Oral Nitrates**

A combination of hydralazine and isosorbide dinitrate **is recommended** as part of standard therapy, in addition to beta-blockers and ACE-inhibitors, for African Americans with LV systolic dysfunction:

- NYHA III or IV HF *Strength of Evidence = A*
- NYHA IIHF *Strength of Evidence = B*


---

**HFSA 2006 Practice Guideline (7.23)
Loop Diuretics**

<table>
<thead>
<tr>
<th>Agent</th>
<th>Initial Daily Dose</th>
<th>Max Total Daily Dose</th>
<th>Elimination: Renal - Met.</th>
<th>Duration of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furosemide</td>
<td>20-40mg qd or bid</td>
<td>600 mg</td>
<td>65%-R-35%M</td>
<td>4-6 hrs</td>
</tr>
<tr>
<td>Bumetanide</td>
<td>0.5-1.0 mg qd or bid</td>
<td>10 mg</td>
<td>62%-R-38%M</td>
<td>6-8 hrs</td>
</tr>
<tr>
<td>Torsemide</td>
<td>10-20 mg qd</td>
<td>200 mg</td>
<td>20%-R-80%M</td>
<td>12-16 hrs</td>
</tr>
<tr>
<td>Ethacrynic acid</td>
<td>25-50 mg qd or bid</td>
<td>200 mg</td>
<td>67%-R-33%M</td>
<td>6 hrs</td>
</tr>
</tbody>
</table>

Digoxin

- not a first line drug
- DIG Trial: little effect on survival
- assists with heart rate control in atrial fibrillation

Positive Inotropes

- Mechanism
  - ↑ cAMP → ↑ Ca influx 
  - ↑ contractility
- Available agents
  - Dobutamine
  - Milrinone
  - Dopamine

Dobutamine

- $\beta_1$, $\beta_2$ agonist
  - Inotropy & vasodilation
- Effects
  - ↑ CI, ↑ SV, ↓ SVR, ↓ PCWP
  - Intravascular depletion: ↓ BP & ↑ HR
- Dosing
  - Initial infusion dose: 2.5 mcg/kg/min
  - Maintenance: 2-20 mcg/kg/min
  - May need higher dose if on outpatient $\beta$-blocker
- Monitoring
  - Heart rate/ECG
  - MAP
  - Electrolytes

Milrinone

- Phosphodiesterase inhibitor Type III
  - Increases cAMP by inhibiting the conversion of cAMP to AMP
  - Inotropy & vasodilation
- Results:
  - ↑ CI, ↓ SVR, ↓ PCWP
  - May lead to hypotension & tachycardia
- Dosing
  - Maintenance: 0.25-0.75 mcg/kg/min
  - Consider lower initial dose in renal dysfunction
Milrinone

- Caution
  - Arrhythmias
  - Thrombocytopenia
  - T½ ~2-2.5 hrs → Risk of ADEs persists after infusion stopped
- Monitoring
  - Blood pressure
  - Heart rate
  - ECG/Arrhythmias
  - Electrolytes
  - Platelet count

Guidelines for Outpatient Milrinone Infusion at URMC

- Only adjust rate with large weight changes after discharge
- Labwork
  - If single lumen cath: peripheral labs. Do not interrupt infusion
  - Normal saline flushes ONLY, no heparin in any patient that is bridging to either transplant or LVAD: Heparin Induced Thrombocytopenia can be life threatening and will eliminate patient’s candidacy for transplant!!
  - No rotation of lines if double lumen cath; avoid routine interruption
  - VS Parameters/Troubleshooting of line patency
  - Weekly dressing change
  - If PICC pulls back, okay to run as deep peripheral temporarily
  - Heplock if line DC’d

PARADIGM-HF

- LCZ696
  - Oral, BID
  - ARNI: Angiotensin Receptor Neprilysin Inhibitor (Valsartan/Neprilysin combo)
  - Inc. Natriuretic Peptide and Suppress RAAS
  - 09/11/2014 NEJM

HFSA 2010 Practice Guideline (9.1, 9.4)

Device Therapy: Prophylactic ICD Placement

- Prophylactic ICD placement should be considered in patients with an LVEF ≤35% and mild to moderate HF symptoms:
  - Ischemic etiology
  - Non-ischemic etiology
  - Strength of Evidence = A
- In patients who are undergoing implantation of a biventricular pacing device, use of a device that provides defibrillation should be considered.
  - Strength of Evidence = A
- Decisions should be made in light of functional status and prognosis based on severity of underlying HF and comorbid conditions, ideally after 3-6 mos. of optimal medical therapy.
  - Strength of Evidence = C

MADIT II: Prophylactic ICD in Ischemic LVD (LVEF ≤30%)

- Number at Risk
  - Defibrillator: 742
  - Conventional: 486
  - Year
    - 1: 593 (91)
    - 2: 374 (84)
    - 3: 170 (78)
    - 4: 63 (60)

HFSA 2010 Practice Guideline
End-of-Life Care in Heart Failure

• End-of-life care should be considered in patients who have advanced, persistent HF with symptoms at rest despite repeated attempts to optimize pharmacologic, device, and other therapies, as evidenced by one or more of the following:
  – HF hospitalization
  – Chronic poor quality of life with inability to accomplish activities of daily living
  – Need for continuous IV inotropic therapy support

Strength of Evidence = C

HFSA 2010 Practice Guideline
End-of-Life Care

• Recommendation 8.16 (NEW in 2010)
  – It is recommended that, as part of end-of-life care, patients and their families/caregivers have a plan to manage a sudden decompensation, death, or progressive decline.
  – Inactivation of an implantable defibrillation device should be discussed in the context of allowing natural death at end of life. A process for deactivating defibrillators should be clarified in all settings in which patients with HF receive care.

Strength of Evidence = C

Clinical Events and Findings Useful for Identifying Patients With Advanced HF

- Repeated (≥2) hospitalizations or ED visits for HF in the past year
- Progressive deterioration in renal function (e.g., rise in BUN and creatinine)
- Weight loss without other cause (e.g., cardiac cachexia)
- Intolerance to ACE inhibitors due to hypotension and/or worsening renal function
- Intolerance to beta blockers due to worsening HF or hypotension
- Frequent systolic blood pressure <90 mm Hg
- Persistent dyspnea with dressing or bathing requiring rest
- Inability to walk 1 block on the level ground due to dyspnea or fatigue
- Recent need to escalate diuretics to maintain volume status, often reaching daily furosemide equivalent dose >160 mg/d and/or use of supplemental metolazone therapy
- Progressive decline in serum sodium, usually to <133 mEq/L
- Frequent ICD shocks
Thank you for your attention!

• Please do not hesitate to contact the Program in Advanced Heart Failure and Transplantation for additional questions or if you wish to discuss a specific patient scenario.
  • 585-273-3760