Congestive Heart Failure

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Disclosures
Consultant:
• Novartis Pharmaceuticals
• Boston Scientific
• Intel, Inc.
• Relypsa, Inc.

Research Grants:
• AtCor Medical, Inc.

Congestive Heart Failure: Learning Objectives
• Discuss epidemiology and prevalence of heart failure
• Outline approach to diagnosis and evaluation of heart failure patients
• Apply evidenced-based therapy to the population with heart failure and reduced EF
• Outline a management approach to heart failure with preserved EF (HF-PEF)

Heart Failure: The Numbers
• Staggering in scope
  – Almost 5 million Americans...500,000 cases annually
  – Most frequent cause of hospitalization in elderly
  – $38 billion (5.4% total healthcare cost)
• For comparison
  – 15,000 AIDS deaths
  – 550,000 Cancer deaths
  – One million hospital discharges > all cancer admissions
• A Deadly Disease
  – 250,000 deaths annually
  – Ten year mortality following initial diagnosis is 90%
  – Following an MI, ¼ of men and ½ of women will eventually be disabled by heart failure

Pathology of Heart Failure

Trends in HF prevalence 1987-2001

Aurigemma, Zile, Gaasch Circulation 2006; 113; 296-304

### Epidemiology of HF by EF

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Preserved EF (n=2167)</th>
<th>Depressed EF (n=2429)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>74.4 yrs</td>
<td>71.7 yrs</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Male gender</td>
<td>44.3%</td>
<td>65.4%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI &gt; 30</td>
<td>41.4%</td>
<td>35.5%</td>
<td>0.002</td>
</tr>
<tr>
<td>HTN</td>
<td>62.7%</td>
<td>48.0%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CAD</td>
<td>52.9%</td>
<td>63.7%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>33.1%</td>
<td>34.3%</td>
<td>0.61</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>41.3%</td>
<td>28.5%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Owan TE, et al. NEJM 2006; 355:251-9

### Survival following HF Hospitalization, by EF

2802 pts with CHF, EF assessment Ontario Province 1999-2001

- Mortality, EF<40% vs. EF>50%
  - 30 days 7% vs. 5% (p=0.00)
  - 1 year 26% vs. 22% (p=0.07)

Readmission rates at 1 year:
- 16.1% vs. 13.3% (p=0.05)


### Diagnosis of Heart Failure

**Major criteria**
- Orthopnea / PND
- Venous distension
- Rales
- Cardiomegaly
- Acute pulm edema
- JVD > 16 cm
- HJR
- S3

**Minor criteria**
- Ankle edema
- Night cough
- Exertional dyspnea
- Hepatomegaly
- Pleural effusion
- Tachycardia (>120)
- Decreased VC
- Wgt loss w/ CHF tx

CHF = 2 major or 1 major + 1 minor

Framingham criteria

### BNP for Diagnosis

1586 pts presenting to EW with dyspnea

- **BNP > 100 pg/mL:** Diagnostic Accuracy 83.4%
- **BNP < 50 pg/mL:** Negative Predictive Value 96%

Maisel AS, et al. NEJM 2002;347:161

### Limitations of BNP

- **Biologic Variability**
  - Levels may increase with age, female gender, pressure overload, renal failure
  - Levels decrease with obesity, treatment (e.g., carvedilol, spironolactone)
- Levels are lower in HF with preserved EF
- Insufficient specificity for use as a screening tool
- Incremental benefit over clinical evaluation is small (diagnostic accuracy of Framingham criteria 73%)
- Limited correlation with PCWP
- Gold standard in all studies of BNP is a cardiologist opinion!
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The measurement of BNP is primarily useful when there is diagnostic uncertainty

'Staging' the severity of Heart Failure

<table>
<thead>
<tr>
<th>Stage</th>
<th>Patient Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>High risk for developing heart failure (HF)</td>
</tr>
<tr>
<td>B</td>
<td>Asymptomatic HF</td>
</tr>
<tr>
<td>C</td>
<td>Symptomatic HF</td>
</tr>
<tr>
<td>D</td>
<td>Refractory end-stage HF</td>
</tr>
</tbody>
</table>

- **Staging**
  - Marked symptoms at rest despite maximal medical therapy (eg, those who are recurrently hospitalized or cannot be safely discharged from the hospital without specialized interventions)
- **Symptomatic HF**
  - Known structural heart disease
  - Shortness of breath and fatigue
  - Reduced exercise tolerance
- **Asymptomatic HF**
  - Previous MI
  - LV systolic dysfunction
  - Asymptomatic vascular disease
- **Refractory end-stage HF**
  - Marked symptoms at rest despite maximal medical therapy (eg, those who are recurrently hospitalized or cannot be safely discharged from the hospital without specialized interventions)

Initial workup of newly diagnosed HF

In all cases:
- History, exam, EKG
- Echo
  - TMR, LVEDD, RV fxn
- Labs
  - TSH, ferritin, Na, Cr
- Exercise testing
  - Prognosis, TTx
- Assessment for CAD
  - one of the few reversible causes

In selected cases:
- Labs
  - Metanephrines
  - BNP?
- Catheterization
  - Cardiac output
  - Endomyocardial biopsy
  - If infiltrative diseases being considered

Etiology of Systolic Dysfunction

<table>
<thead>
<tr>
<th>Etiology</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD</td>
<td>50.3</td>
</tr>
<tr>
<td>Non CAD</td>
<td>49.7</td>
</tr>
</tbody>
</table>

Other causes to consider

- Familial
- Cocaine
- Chagas
- Sarcoïd
- Thyroid
- Hemochromatosis
- Uncontrolled tachycardia (Afib)
- HIV

*Adapted from Redfield, Mayo Clin*

Ejection Fraction is Poor Predictor of Survival in Advanced Heart Failure

<table>
<thead>
<tr>
<th>Ejection Fraction</th>
<th>Survival w/o urgent transplant</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF&lt;25%, n=53</td>
<td></td>
</tr>
<tr>
<td>EF&lt;30%, n=404</td>
<td></td>
</tr>
<tr>
<td>EF&lt;35%, n=847</td>
<td></td>
</tr>
<tr>
<td>EF&lt;40%, n=123</td>
<td></td>
</tr>
</tbody>
</table>

*Stevenson, Circ 1996*
Clinical Class Remains the #1 Predictor Of Mortality in Heart Failure

- 6 minute walk (300-450m)
- Oxygen consumption (10,14cc/kg/min)
- Exercise CO (5xVO2+3L/min)

Pathophysiology of Systolic Heart Failure

Neurohormonal Balance in HF

Neurohormonal system:

- RAAS
- SNS
- AVP
- Endothelin
- ANP
- BNP
- Prostaglandins
- Nitric Oxide
- Vasoconstrictive
- Fluid Retentive
- Vasodilatory
- Natriuretic/Diuretic

Treatment Algorithm for Systolic Heart Failure

Heart Failure: Use of Diuretics

Cortex

- Inhibits active exchange of Cl-Na in the cortical diluting segment of the ascending loop of Henle

Medulla

- K-sparing Diuretics
- Inhibit exchange of Cl-Na-K in the cortical convoluted and collecting tubule

Loop diuretics

- Inhibit exchange of Cl-Na-K in the thick segment of the ascending loop of Henle

Loop of Henle

Collecting tubule

Non-ACE pathways (eg, chymase)

Angiotensinogen

Angiotensin I

Angiotensin II

ACE

Cough, Angioedema

Benefits?

Bradykinin Inactive fragments

renin

ACE-I

ARB

AT1

Mineralocorticoid Receptor Activation

ACE-Inhibitors in Heart Failure

- Improve symptoms, clinical status, and exercise capacity
- Improve cardiac function
- Reduce hospitalizations
- Attenuate remodeling
- Prolong survival
- Reduce vascular events (ie. HOPE)

Outcome Trials of ACE Inhibitors in Heart Failure

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients (n)</th>
<th>NYHA Class</th>
<th>Placebo Mortality</th>
<th>Hazard ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-HeFT II</td>
<td>804</td>
<td>I-III</td>
<td>25%</td>
<td>0.72</td>
</tr>
<tr>
<td>CONSENSUS</td>
<td>255</td>
<td>IV</td>
<td>44%</td>
<td>0.66</td>
</tr>
<tr>
<td>SOLVD Tx</td>
<td>2569</td>
<td>II-III</td>
<td>40%</td>
<td>0.84</td>
</tr>
<tr>
<td>SOLVD Pm</td>
<td>4228</td>
<td>I</td>
<td>16%</td>
<td>0.91</td>
</tr>
<tr>
<td>SAVE</td>
<td>2231</td>
<td>Post MI EF&lt;40%</td>
<td>25%</td>
<td>0.81</td>
</tr>
<tr>
<td>ISIS-IV</td>
<td>58,050</td>
<td>24h post MI</td>
<td>7.7%</td>
<td>0.93</td>
</tr>
</tbody>
</table>

ARBs in Heart Failure

- ACEI does not produce long-term suppression of Angiotensin II ("escape phenomenon")
- Angiotensin II can be generated by other pathways
- Circulating Ang II inhibition may not be equivalent to tissue Ang II inhibition
- 8-12% of pts cannot tolerate ACEI

ARB Trials in Heart Failure

<table>
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<tr>
<td>ELITE I/II</td>
<td>722/3152</td>
<td>Both better</td>
<td>↓ Mort. w/ β-blocker</td>
</tr>
<tr>
<td>VIHEFT</td>
<td>5010</td>
<td>Both better</td>
<td>↓ Mort. w/ β-blocker</td>
</tr>
<tr>
<td>CHARM</td>
<td>2540</td>
<td>After MI 4</td>
<td>↓ Mort. w/ β-blocker</td>
</tr>
<tr>
<td>OPTIMAAL</td>
<td>5477</td>
<td>Acute M/HF</td>
<td>↓ Mort. w/ β-blocker</td>
</tr>
<tr>
<td>VALIANT</td>
<td>14,808</td>
<td>Acute M/HF</td>
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ARBS are excellent and proven alternatives to ACE inhibitors

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Optimal Dosing of RAAS Antagonists

ATLAS

- Lisinopril 2.5-5.0mg
- Lisinopril 32.5-35.0mg
  - HR 0.88 (0.82-0.8) P=0.002

HEAAL

- Losartan 150mg
- Losartan 50mg
  - HR 0.90 (0.82-0.99), p=0.027

Time to Death or Hospitalization
Favors High Dose

Titrate as Tolerated to Doses Achieved in Clinical Trials

How Do Beta Blockers Improve Heart Failure?

- Upregulation of beta receptors
- Improved coupling of beta receptors to secondary intracellular signals
- Alterations in myocardial metabolism
- Improved calcium transport
- Increased protein synthesis and message expression
- Inhibition of renin-angiotensin system
- Inhibition of endothelin and cytokine release

β-Blocker Trials in Symptomatic HF

<table>
<thead>
<tr>
<th>Trial</th>
<th>Target Dose (mg/d)</th>
<th>Mean Dose (mg/d)</th>
<th>Control</th>
<th>β-blocker (%)</th>
<th>Annual Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bisoprolol CIBIS I</td>
<td>5</td>
<td>3.8</td>
<td>11.0</td>
<td>8.7</td>
<td>N/S</td>
</tr>
<tr>
<td>CIBIS II</td>
<td>10</td>
<td>7.5</td>
<td>13.2</td>
<td>8.8</td>
<td>34</td>
</tr>
<tr>
<td>Bucindolol BEST</td>
<td>100-200</td>
<td>76</td>
<td>17</td>
<td>15</td>
<td>N/S</td>
</tr>
<tr>
<td>Metoprolol MDC</td>
<td>100-150</td>
<td>108</td>
<td>11.1</td>
<td>11.9</td>
<td>N/S</td>
</tr>
<tr>
<td>MERIT-HF</td>
<td>200</td>
<td>159</td>
<td>11.0</td>
<td>7.2</td>
<td>34</td>
</tr>
<tr>
<td>Carvedilol US Carvedilol</td>
<td>12.5-100</td>
<td>45</td>
<td>14.4</td>
<td>5.9</td>
<td>65</td>
</tr>
<tr>
<td>COPERNICUS</td>
<td>50</td>
<td>37</td>
<td>18.5</td>
<td>11.4</td>
<td>38</td>
</tr>
</tbody>
</table>

Effect of Beta Blockade on Ejection Fraction over Time

- LVEF
- p<0.0001
- p<0.05
- p<0.05

Clinical Pharmacology of Beta-Adrenergic Antagonists

<table>
<thead>
<tr>
<th>β1/β2 Receptor Selectivity</th>
<th>Vasodilator Mechanism</th>
<th>Lipid Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bisoprolol 120</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metoprolol 75</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Carvedilol 10-40</td>
<td>α, antagonist</td>
<td>++</td>
</tr>
<tr>
<td>Bucindolol 1</td>
<td>Direct</td>
<td>++</td>
</tr>
<tr>
<td>Labetalol 1</td>
<td>α, antagonist</td>
<td>++</td>
</tr>
</tbody>
</table>

β-blockers are contraindicated in acutely decompensated heart failure

Hall, JACC 1995

Bristow, Am J Card 1993
COMET
Is Carvedilol Better than Metoprolol?

> 3029 pts NYHA II-III
> Carvedilol 25mg bid (31.8 mg)
> Metoprolol tartrate 50 mg bid (85 mg)
  • Same resting HR in both groups
> MERIT-HF
  o Metoprolol succinate 200 mg (159 mg)
    Metoprolol tartrate 105 mg
> Composite endpt (mortality
  • 74% Carvedilol
  • 76% Metoprolol
  • p = 0.122


Which drug first?
ACE-I vs. Beta Blocker

CIBIS III
1010 pts, new dx HF
NYHA II-III, EF≤35%
Monotherapy for 6 mos, followed by combination Rx
  • In ITT population, bisoprolol-first strategy was noninferior to enalapril-first

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Deleterious Effects of Aldosterone in HF

AT-II, AVP, TKAldosterone
Renal
  Na/H2O retention
  K and Mg loss
  (proarrhythmic)
Neurohormonal
  SNS activation
  Proarrhythmic Parasympathetic inhibition
  Baroreceptor dysfunction
Hemodynamic
  ↓ Arterial compliance
  ↓ Endothelial dysfunction
Cellular
  ↑ Inflammation
  ↑ Fibrosis/ Remodeling
  ↑ PAI-1 (pro-thrombotic)


Aldosterone Receptor Antagonists in
Severe Symptomatic Heart Failure

1063 patients with LVEF ≤ 35%, NYHA III-IV heart failure randomized to spironolactone 25 mg vs. placebo
  • 35% All-Cause Mortality
  • 33% HF Hospitalization


Aldosterone Receptor Antagonists in post-
MI Heart Failure

6632 patients 3-14 days p.m.I with EF ≤ 40% and HF or Diabetes randomized to eplerenone 50 mg vs. placebo
  • 13% All-Cause Mortality
  • 13% CV Death or CV Hospitalization
  • 23% HF Hospitalization

The ‘missing link’

Post MI HF/LVSD  Reduced EF NYHA I-II Reduced EF NYHA III-IV

EPHESUS EMPHASIS-HF RALES

EMPHASIS-HF: Primary outcome

HR 0.63 (0.54-0.74) P<0.001

94% on ACEi/ARB, 87% on Beta-Blocker


Aldosterone Antagonists: Safety

Rate of Hospital Admission for Hyperkalemia among Patients Recently Hospitalized for Heart Failure Who Were Receiving ACE Inhibitors (before/after RALES)

Parameter

Odds Ratio (95% CI) for Clinically Important Hyperkalemia

Age ≥ 75 yrs
Diabetes
ACE-inhibitor Use
Spironolactone Use
Male Gender
Creatinine ≥ 2.0
Potassium ≥ 5.0

1.5 (1.0-2.3)
1.2 (0.8-1.7)
2.2 (1.0-4.6)
1.6 (1.0-2.4)
1.3 (0.8-1.9)
3.4 (2.1-5.7)
2.6 (1.7-4.0)


Aldosterone Receptor Antagonists

• Consider in most patients with symptomatic heart failure and EF ≤ 40%, after optimization of ACEi/ARB and Beta-Blocker
• Monitor potassium and renal function frequently
• Avoid in patients with prior hyperkalemia or advanced CKD
• Caution in subgroups at high risk, such as diabetes, elderly
• Avoid combination of ACEi + ARB + spironolactone
• Spironolactone likely equivalent to eplerenone as long as dosing is adequate

Taylor A, et al. NEJM 2004; 351: 2049-2057

Predictors of Hyperkalemia

CHARM-Overall, North American Cohort (n=2675)

Parameter

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1.3 (0.8-1.9)
3.4 (2.1-5.7)
2.6 (1.7-4.0)


Alternative Vasodilator Strategies: The A-HeFT Trial (Hydralazine/Isordil)

• 1050 NYHA III/IV AA pts
• Composite endpt (death, HF hosp, QOL), Terminated early
• Bidil (Hydralazine 37.5 mg + Isordil 20 mg) 2 tablets tid
  – 68% at target
  – Mean dose 3.8 tablets
• Contemporary bkgd Rx
  – ACEi/ARB 87 %
  – Beta blkers 75 %
  – Spironolactone 40 %
• Adverse events common
  – HA 44%  - Dizziness 29%

**Digoxin: Improvement in Symptoms But Not Survival**

- Placebo n=93
- DIGOXIN Withdrawal

**OVERALL MORTALITY**

- Placebo
- DIGOXIN

*p = 0.001

**Placebo n=3403**

**DIGOXIN n=3397**

**p = 0.8**

**Digoxin: HFSA recommendations**

- Digoxin should be considered for pts who have symptomatic CHF caused by systolic dysfunction
  - No clinical trial data for NYHA IV
- In the majority of pts, the dose should be 0.125 - 0.25 mg daily
  - Beneficial neurohormonal effects occur at lower doses
  - Digoxin levels reserved for change in renal function, drug interactions, confirmation of toxicity (not for titration)
- Rate control of atrial fibrillation w/ doses of digoxin greater 0.25 mg daily is not recommended

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**CORONA: Statins do not Reduce Mortality in HF Patients**

- 5011 pts, Age>60 yrs, NYHA II-IV, ischemic CMP, LVEF ≤40%
- Cardiovascular mortality, nonfatal MI, nonfatal stroke

**Heart Failure Management: More Than Just Drugs**

- dietary counseling
- patient education
- physical activity
- medication compliance
- aggressive follow-up
- nonpharmacologic therapies
  - CRT
  - sleep disordered breathing
- management of related risks
  - sudden death (ICD implantation)
  - thromboembolism/stroke
**WARCEF: Warfarin vs. Aspirin in Heart Failure**

- 2305 patients
- LVEF <= 0.35
- Warfarin (INR 2.0-3.5) vs. ASA 325 mg qd
- Primary Endpoint: Ischemic Stroke + ICH + Death


**Prevention of Thromboembolism in Heart Failure**

- Anticoagulants in patients with HF who have paroxysmal or chronic atrial fibrillation or a previous thromboembolic event
  - Class I (Level of Evidence: A)
- Anticoagulation in patients with HF who do not have atrial fibrillation or a previous thromboembolic event
  - Class Ib (Level of Evidence: B or C)
- Anticoagulation in patients with HF and specific conditions
  - Peripartum cardiomyopathy
  - Adriamycin cardiomyopathy
  - Acute myocarditis

**European Study Group on “Diastolic” Heart Failure**

To diagnoses diastolic heart failure, three conditions must be simultaneously satisfied:

1) Signs and symptoms of CHF are present (Possible)
2) Left ventricular systolic function is normal or only mildly abnormal at time of diagnosis (Probable)
3) Evidence of abnormal LV relaxation, abnormal LV filling, diastolic distensibility, or diastolic stiffness should be present (Definite)

**“Diastolic” CHF is Still A Diagnosis of Exclusion**

- CAD
- Valvular disease
- Arrhythmias
- Secondary causes of hypertension
- Pulmonary disease
- Anemia
- Obesity/deconditioning
- Pulmonary hypertension
- Pericardial disease

**Two very different faces of HF**

<table>
<thead>
<tr>
<th>HF with Reduced EF</th>
<th>HF with Preserved EF</th>
</tr>
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<tbody>
<tr>
<td>Robust Animal Models</td>
<td>Poor Animal Models</td>
</tr>
<tr>
<td>Pathophysiologic Understanding</td>
<td>Limited Understanding of Pathophysiology</td>
</tr>
<tr>
<td>Targeted Drug Therapy</td>
<td>Few Targeted Treatments</td>
</tr>
<tr>
<td>Multiple Clinical Trials</td>
<td>Few Clinical Trials</td>
</tr>
<tr>
<td>Evidence-Based Medicine</td>
<td>Consensus-Based Guidelines</td>
</tr>
</tbody>
</table>

**HF and Preserved EF: What Little We Know**

**Class I**
- Control hypertension
- Chronotropic control
- Judicious use of diuretics

**Class II**
- Revascularization
- Restoring sinus rhythm
- Beta blockers, CaCh blockers

### Completed or Pending Trials of RAAS Antagonists in HF-PEF

<table>
<thead>
<tr>
<th>Trial</th>
<th>Drug (target dose)</th>
<th>Size</th>
<th>Inclusion Criteria</th>
<th>Endpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPLETED</td>
<td></td>
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<tr>
<td>CHARMM-Preserved</td>
<td>Candesartan (32 mg)</td>
<td>3023</td>
<td>NYHA II-IV HF, EF &gt; 40%</td>
<td>CV Death/HF Hospitalization</td>
</tr>
<tr>
<td>PEP-CHF</td>
<td>Perindopril (4 mg)</td>
<td>850</td>
<td>NYHA II-IV HF, DD Preserved EF</td>
<td>All-Cause Death/HF Hospitalization</td>
</tr>
<tr>
<td>I-Preserve</td>
<td>Irbesartan (300 mg)</td>
<td>4138</td>
<td>NYHA II-IV HF, EF ≥ 45%, HF hospitalization or substrate for HF</td>
<td>All-cause Death/CV Hospitalization</td>
</tr>
<tr>
<td>ONGOING</td>
<td></td>
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<td></td>
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<tr>
<td>TOPCAT</td>
<td>Spironolactone (30 mg)</td>
<td>~4500</td>
<td>EF ≥ 45%, NYHA II-IV HF, CHF hospitalization or elevated BNP</td>
<td>CV Death/HF Hospitalization</td>
</tr>
</tbody>
</table>

I-PRESERVE: All Cause Death or CV Hospitalization

![Graph showing outcome over time](image)


### HF-PEF: Noncardiac Factors Are Also Important

- Hypertension
- Atherosclerosis
- Diabetes
- Loss of compliance
- Aging
- Impaired relaxation
- Apoptosis
- Infarction/Ischemia
- Celluluar dysfunction
- Worsening Renal Function

### Update in Congestive Heart Failure

**Summary I**

- Heart failure is a clinical diagnosis
- BNP may be helpful when diagnosis of heart failure is uncertain but should not replace clinical assessment
- Digoxin is not what it used to be
- ACE inhibitors remain the cornerstone of therapy for heart failure
- ARBs are useful in ACEI intolerant patients
- Beta blockers are effective and should be carefully titrated to goal doses

**Summary II**

- Aldosterone antagonists are increasingly the favored ‘second-line’ after ACE/ARB and beta-blocker
- Hydralazine/Isordil is an alternative for the ACE/ARB intolerant and may be added for those still symptomatic on ACE/Beta-blocker
- Device Therapy (ICD +/- CRT) is appropriate for many symptomatic HF patients with LVEF ≤ 35%
- Heart failure with preserved EF remains a poorly understood, heterogeneous disorder

**Update in Congestive Heart Failure**

A 52 year old man with longstanding hypertension presents with increasing fatigue and shortness of breath. His breathing at night is also labored, but aided by propped up on three pillows. His only medications are hydrochlorothiazide 25 mg/d and atenolol 50 mg/d.

On examination, his pulse is 104 bpm and BP is 134/84 mm Hg. The jugular venous pressure is elevated to 14 cm H20. The lung fields are clear to auscultation. The apical cardiac impulse is laterally displaced with a systolic 5/6 holosystolic murmur radiating to the axilla. There is trace pedal edema.

Which of the following diagnostic tests is most appropriate?

A. B-type Natriuretic Peptide  
B. Echocardiogram  
C. Cardiac MRI  
D. Endomyocardial biopsy  
E. Coronary Angiogram

**QUESTION 1**
A 52 year old man with longstanding hypertension presents with increasing fatigue and shortness of breath. His breathing at night is also labored, but aided by propped up on three pillows. His only medications are hydrochlorothiazide 25 mg/d and atenolol 50 mg/d.

On examination, his pulse is 104 bpm and BP is 134/84 mm Hg. The jugular venous pressure is elevated to 14 cm H20. The lung fields are clear to auscultation. The apical cardiac impulse is laterally displaced with an audible S3 gallop and a 2/6 holosystolic murmur radiating to the axilla. There is trace pedal edema.

Which of the following diagnostic tests is most appropriate?
A. B-type Natriuretic Peptide
B. Echocardiogram
C. Cardiac MRI
D. Endomyocardial biopsy
E. Coronary Angiogram

QUESTION 1

An 80 year old woman presents for evaluation of progressive dyspnea. Her past history is notable for poorly controlled hypertension and paroxysmal atrial fibrillation as well as recurrent hospitalizations for decompensated heart failure.

On examination, his pulse is 80 bpm and regular and BP is 150/90 mm Hg. The jugular venous pressure is elevated to 14 cm H20. The lung fields are clear to auscultation. The apical cardiac impulse is palpable in the mid-clavicular line and there is an audible S4. There is 1+ pitting edema of the ankles.

ECG reveals sinus rhythm with voltage criteria for LVH and associated repolarization abnormalities. Echocardiogram confirms normal LV size and function with concentric ventricular hypertrophy. There is no significant valvular disease.

Which of the following treatments is associated with reduced mortality in her condition?
A. Carvedilol
B. Verapamil
C. Digoxin
D. Candesartan
E. Perindopril
F. None of the Above

QUESTION 2