Heart Failure with Preserved Systolic Function-The Last Frontier of HF...

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Clinical Presentation, Management, and In-Hospital Outcomes of Patients Admitted With Acute Decompensated Heart Failure With Preserved Systolic Function

A Report From the Acute Decompensated Heart Failure National Registry (ADHERE) Database

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*Dallas, Texas; †Fremont, San Francisco, and Los Angeles, California; and ‡Boston, Massachusetts
<table>
<thead>
<tr>
<th></th>
<th>Preserved EF</th>
<th>Reduced EF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>73.9</td>
<td>69.8</td>
</tr>
<tr>
<td>Gender (% woman)</td>
<td>62</td>
<td>40</td>
</tr>
<tr>
<td>HTN (%)</td>
<td>77</td>
<td>69</td>
</tr>
<tr>
<td>CAD (%)</td>
<td>50</td>
<td>59</td>
</tr>
<tr>
<td>Renal Disease</td>
<td>26</td>
<td>26</td>
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## Difference between patients with preserved and reduced EF

<table>
<thead>
<tr>
<th></th>
<th>Preserved EF</th>
<th>Reduced EF</th>
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<tbody>
<tr>
<td>Mortality (%)</td>
<td>2.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Length of Stay (days)</td>
<td>4.9</td>
<td>5.0</td>
</tr>
<tr>
<td>Admitted to ICU</td>
<td>18.9</td>
<td>24.7</td>
</tr>
<tr>
<td>Length of ICU stay</td>
<td>2.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Weight loss &gt; 10lb %</td>
<td>79.8</td>
<td>80.7</td>
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</table>
HF-Definition

• “HF is a complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood.”

ACC/AHA Guidelines 2005
Diagnosis of HF

• HF is defined as a clinical syndrome that is characterized by specific symptoms in the medical history and signs on the physical examination. There is not single diagnostic test for HF because it is largely a clinical diagnosis that is based on a careful history and physical examination”

ACC/AHA Guidelines 2005
Framingham Criteria for the Diagnosis of CHF

(1) Concurrent presence of 2 major OR (2) concurrent presence of 1 major and 2 minor criteria

**Major criteria**
- PND or orthopnea
- Neck vein distention
- Rales
- Cardiomegaly
- Acute pulmonary edema
- S₃ gallop

**Minor criteria**
- Ankle edema
- Night cough
- Dyspnea on exertion
- Hepatomegaly
- Pleural effusion
- Vital capacity ↓ 1/3 from max
- Heart rate >120 bpm

**Either major or minor**
- Weight loss >4.5 kg in 5 days in response to treatment

bpm = beats per minute; CHF = congestive heart failure; CVP = central venous pressure; PND = paroxysmal nocturnal dyspnea; S₃ = third heart sound
JVP = 2 + 5
= 7 cm of water

Top of Jugular Vein
Vertical distance above angle of Louis

angle of Louis

Right Atrium

5 cm
Estimating Jugular Venous Pressure

Google “Heywood Neck Vein Video”
Hemodynamic abnormalities are the common denominator of HF of any cause

- Systolic Dysfunction
- Stiff LV or LA
- Increased Filling Pressures
- Valvular Disease

Clinical Heart Failure
Final Common Pathway in Heart Failure

- Cardiac dysfunction leads to elevated filling pressures
- Right Atrial Pressure increases from 2-5 to > 7-20 mmHG-this leads to ascites, liver congestion and peripheral edema
- Left atrial pressure increases from 5-12 to >18-40 mmHG-this results in dyspnea, pulmonary edema and pleural effusions
Signs and Symptoms of HF

Echocardiogram

- EF <40%
  - Systolic Heart Failure

- EF 40-65 LVH
  - HF with Preserved Systolic Function

- Variable EF with Sign valve problem
  - Valvular Heart Failure
What is HFPSE heart failure?

- HFPSE is diagnosed when all of the following apply:
  - Patients have evidence of symptomatic heart failure, ie elevated neck veins, pulmonary congestion and/or edema
  - A normal ejection fraction (EF> 50%)
  - No significant valvular disease (except tricuspid regurgitation)
  - Patients usually pulmonary HTN on echo
Heart Failure with Preserved LV Systolic Function

- LVH secondary to HTN
- Hypertrophic Cardiomyopathy
- Amyloid Heart Disease
- Restrictive Cardiomyopathy (unknown etiology)
- Right Heart Failure (Pul HTN)
- Constrictive Pericarditis
- LA Diastolic Dysfunction
Echo Features of HF with Normal Ejection Fraction

- Normal Ejection Fraction
- Pulmonary Hypertension (PA pressure > 50 mm Hg)
- High RA pressure (dilated IVC)
- Transmitral flow pattern, Pulm Vein Flow suggestive of high LA pressure
Pulmonary Hypertension

Right Heart Catheterization

Mean PA
1. 25 mm Hg
2. Wedge < 15 mm Hg

1. Mean PA > 30 mm Hg
2. Wedge > 15 mm Hg

Pulmonary Arterial HTN

Pulmonary Venous Hypertension
(PHT due to Left heart failure High LA pressure)
Pulmonary Hypertension on Echo

5-10%

Pulmonary **Arterial** HTN
(Wedge < 15 mm Hg)

- Idiopathic
- Collagen Vascular Diseases
- Chronic Pul Embolism
- Liver Disease
- Congenital Heart Disease

Treat with Bosentan, Sildenafil
Inhaled or IV prostaglandins

90-95%

Pulmonary **Venous** HTN
(Wedge > 15 mm Hg)

- High Left Atrial Pressure
- Normal EF HF
- Diuretics
- Nitrates
Diastolic Function by Echo

Ultrasound Probe

Mitral Flow has 2 components
E wave - early passive flow
A wave - late flow with atrial kick

Doppler Tissue Imaging
Of Mitral Annular Velocity
Nml Filling Pattern

Delayed Relaxation
Nml LA pressure

Mild – Mod Increased LA pressure

Significantly Increased LA pressure
So what do I look at in the Echo to Diagnose HF with Preserved EF?

- EF > 50%
- Pulmonary HTN > 50 mm HG****
- Large Left Atrium***
- Dilated RV with significant tricuspid regurgitation
- Large E wave with short deceleration time
- Dilated IVC- High RA pressure***
Treatment of Heart Failure with Preserved Systolic Function
Randomized Placebo Controlled, Double Blind completed trials for the management of diastolic HF

Charm Trial
PRESERVE Trial
TOPCAT
• 3023 patients randomized to candesartan or placebo, target dose 32 mg
• Patients eligible with NYHA II-IV symptoms with a hx of a cardiovasc admission, 68% had been admitted for HF, EF > 40%
• ACEI initially not allowed but subsequently were
<table>
<thead>
<tr>
<th>Number of patients (%)</th>
<th>Candesartan (n=1514)</th>
<th>Placebo (n=1509)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1284 (84.8%)</td>
<td>1290 (81.5%)</td>
</tr>
<tr>
<td>1</td>
<td>132 (8.7%)</td>
<td>157 (10.4%)</td>
</tr>
<tr>
<td>2</td>
<td>54 (3.6%)</td>
<td>59 (3.9%)</td>
</tr>
<tr>
<td>≥3</td>
<td>44 (2.9%)</td>
<td>63 (4.2%)</td>
</tr>
</tbody>
</table>

Number of patients admitted to hospital (number of admissions):

230 (402) vs 279 (566)

*Investigator reported, with CHF as primary reason (p=0.014 for distribution).

Table 3: Numbers of hospital admissions for worsening heart failure

Figure 2: Time to cardiovascular death or hospital admission for CHF
I-Preserve

• Symptomatic heart failure (New York Heart Association [NYHA] class II-IV)
• Left ventricular ejection fraction (LVEF) ≥ 45%
• Age ≥ 60 years
• Hospitalization for heart failure within 6 months or corroborative evidence of heart failure or cardiac substrate for LV dysfunction from electrocardiogram (ECG), echocardiogram, or chest x-ray
I-PRESERVE: Primary Endpoint
Death or protocol specified CV hospitalization

Cumulative Incidence of Primary Events (%)

HR (95% CI) = 0.95 (0.86-1.05)
Log-rank p=0.35

No. at Risk
Irbesartan 2067 1929 1812 1730 1640 1569 1513 1291 1088 816 497
Placebo 2061 1921 1808 1715 1618 1539 1466 1246 1051 776 446
Funded by the US National Heart, Lung and Blood Institute (NHLBI), the Treatment Of Preserved Cardiac function heart failure with an Aldosterone anTagonist (TOPCAT) trial will examine the effects of aldosterone antagonist therapy (spironolactone 15 mg) vs placebo in 4500 adult patients with heart failure.

Patients will be enrolled on the basis of an echocardiographically assessed ejection fraction.

Recruited over a 2.5-year period, treated, and followed for a minimum of 2 years.
General Principles for Treating Heart Failure with Preserved Systolic Function

• Normalize volume status
• Control blood pressure
• Maintain renal function
76 yo woman with 2 admissions for HF, long hx of atrial fibrillation
Volume

Pressure
Pulmonary Venous HTN secondary to Stiff Left Atrial Syndrome

Long standing AF

- Edema
- Tricuspid Regurgitation
- Right Heart Failure
- NonCompliant, Stiff LA
- Increased LA pressures

Clinical Heart Failure

Pulmonary Venous HTN

Right Heart Failure
Usefulness of Left Atrial Volume in Predicting First Congestive Heart Failure in Patients ≥65 Years of Age With Well-Preserved Left Ventricular Systolic Function

Yasuhiko Takemoto, MDd, Marion E. Barnes, MSa, James B. Seward, MDa, Steven J. Lester, MDc, Christopher A. Appleton, MDc, Bernard J. Gersh, MB, ChB, DPhila, Kent R. Bailey, PhDb, and Teresa S.M. Tsang, MDa,*

Figure 1. Kaplan-Meier age-adjusted estimates of CHF-free survival by indexed LA volume tertiles.
Not all Heart Failure with Preserved EF is the Same!!!
Normal EF Heart Failure

• 69 yo woman from Chicago come for second opinion about heart failure
• Neck veins to jaw
• 1-2+ edema
• Echo shows PA pressure of 74
• IVC very dilated
Normal EF Heart Failure

- 74 yo man from Newport Beach come for second opinion about heart failure
- Neck veins to jaw
- 1-2+ edema
- Echo shows PA pressure of 39
- IVC very dilated
Primary Results of the CardioMEMS Heart Sensor Allows Monitoring of Pressure to Improve Outcomes in NYHA Class III Heart Failure Patients (CHAMPION) Trial

William T. Abraham, MD and Philip B. Adamson, MD
On behalf of the CHAMPION Trial Committees and Study Group
CASE REPORTS

A Wireless Pressure Sensor for Monitoring Pulmonary Artery Pressure in Advanced Heart Failure: Initial Experience

Pablo F. Castro, MD, a Roberto Concepción, MD, b Robert C. Bourge, MD, d Alejandro Martinez, MD, a Milton Alcaino, MD, b Carlos Deck, MD, b Marcela Ferrada, RN, a Mario Alfaro, MD, b and Sergio Perrone c

Hemodynamic goals have been used in the past to guide therapy in patients with heart failure (HF). For HF patients whose signs and symptoms of congestion do not resolve with initial therapy it appears reasonable to consider hemodynamic monitoring at experienced sites. It has been suggested that implantable hemodynamic sensors may enable frequent monitoring of hemodynamic changes in HF patients and be used in tailoring vasodilator. We present the first human case of radio-frequency based, wireless pressure sensor for the monitoring of pulmonary artery pressure in patients with advanced HF. This sensor is delivered into the pulmonary artery via percutaneous venous access. J Heart Lung Transplant 2007; 26:85–8. Copyright © 2007 by the International Society for Heart and Lung Transplantation.

Figure 1. Heart failure sensor. The sensor consists of electronic components housed within a hermetically sealed, fused, silica capsule. The capsule is completely encapsulated in medical grade silicone. There are two wired loops made from PTFE-coated nitinol wire to prevent distal migration.
Cumulative HF Hospitalizations Over Entire Randomized Follow-Up Period

- Treatment
- Control

$p < 0.001$, based on Negative Binomial Regression

Days from Implant

At Risk
- Treatment: 270, 262, 244, 209, 168, 130, 107, 81, 28, 5, 1
- Control: 280, 267, 252, 215, 179, 138, 105, 67, 25, 10, 0

6 Months, 15 Months
Show Date Range: Last 6 Months | Last 30 Days | Last 7 Days

Helpful Hint: Try using your arrow keys to navigate across the trend graph.

Systolic  Mean  Diastolic
Heart Failure with Preserved Systolic Fx in One Minute

Is HF present?
Signs of increased dilling pressures, 
Ie high neck veins?

Echocardiogram

Evidence of High Filling Pressures?
Dilated Vena Cava,
Pul HTN
High E wave Vel, short Dec Time
Increased LA size
=Echo evidence of HF
Heart Failure with Preserved Systolic Fx in One Minute

What Kind of HFPSF is it?

- Pul HTN >60
  - Big RV
  - Normal LA
- Years of AF
  - Very large LA
  - RV Dilated
  - High E wave
  - Pul S wave small

- Very dilated IVC
  - LA not too big
  - Very high Neck Veins
  - BNP (200-400)
  - Rule out Constriction
    - R + L H Cath
    - MRI

- Pulm Art HTN
  - RH Cath

- RH Cath
  - Stiff LA
  - Syndrome
Heart Failure with Preserved Systolic Fx in One Minute

What Kind of HFPSF is it?

Severe LVH
Large LA
Low Voltage EKG

Mild Mod LVH
LA enlarged
Mild to Mod Pul HTN
GFR< 30

Consider Amyloid
SPEP
Fat Pad Bx
Endocardial Bx

HF due to Renal Insufficiency

LVH
Enlarged LA
Pul HTN

RH Cath
Restrictive Cardiomyopathy

HF due to Renal Insufficiency
Conclusions-Take away messages

• Heart Failure is now defined by 2 major categories- Systolic Dysfunction (EF<40% and Heart Failure with Preserved Systolic Function (HFPSF)
• Not all HFPSF is LV diastolic dysfunction!
• Look at the Neck Veins!!! When they are abnormal there is something wrong with the heart- Get an echo
Conclusions

• Look beyond the ejection fraction!
• LA size, pulmonary HTN, dilated IVC are key evidence of high filling pressures
• For most patients with Normal EF Heart Failure, just diurese them until the JVP is normal
• If you can’t normalize the JVP with diuretics, refer to cardiologist