Diastolic Heart Failure and Indications for Echocardiography in the Asian Population

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Objectives

• Define diastolic heart failure and differentiate from heart failure with “normal” ejection fraction (HFnEF) and from diastolic dysfunction.

• Understand the epidemiology and etiologies of HFnEF in the general community and Asian population.

• Become familiar with the role of echocardiogram in diastolic heart failure and HFnEF.

• Understand the treatment and “prevention” of HFnEF.

Heart Failure: Historical Perspective

“...those forms of cardiac insufficiency which are due to inadequate diastolic filling of the heart (hypodiastolic failure) [and] the far more common ones in which the heart fills adequately but does not empty to the normal extent (hyposystolic failure).”


Heart Failure: Historical Perspective

“...a condition in which the heart fails to discharge its contents adequately.”


Systolic Heart Failure: Definitions

“...a pathophysiological state in which an abnormality of cardiac function is responsible for the failure of the heart to pump blood at a rate commensurate with the requirements of the metabolizing tissues.”

Diastolic Heart Failure: Definitions

"...a condition resulting from an increased resistance to filling of one or both ventricles leading to symptoms of congestion due to an inappropriate upward shift of the diastolic pressure-volume relation (that is, during the terminal phase of the cardiac cycle)."

"...a clinical syndrome characterized by the symptoms and signs of heart failure, a preserved ejection fraction, and abnormal diastolic function."

Diastolic Heart Failure: Other Definitions

• “Heart failure with preserved systolic function”
• “Heart failure (HF) with normal or near normal ejection fraction”

[Table showing characteristics of diastolic heart failure, normal, and systolic failure]

The Spectrum of Heart Failure

Heart failure with normal EF ≠ Diastolic heart failure
Diastolic dysfunction ≠ Diastolic heart failure

HF with “Normal” EF: Diagnosis

“...when the rate of ventricular relaxation is slowed; this physiological abnormality is characteristically associated with the finding of an elevated LV filling pressure in a patient with normal LV volumes and contractility.”

“In practice, the diagnosis is generally based on the finding of typical symptoms and signs of HF in a patient who is shown to have a normal LVEF and no valvular abnormalities (aortic stenosis or mitral regurgitation, for example) on echocardiography.”

HF with Normal EF: Diagnostic Criteria

- Symptoms and signs of CHF
- Normal or preserved EF on echocardiogram
- Exclusion of:
  - Valvular disease
  - Congenital heart disease (e.g., ASD)
  - Disease extrinsic to myocardium:
    - Constrictive pericarditis
    - Pulmonary arterial hypertension with right heart failure
- ± evidence of diastolic dysfunction on echo

HFnIEF: Role of Echocardiography

- Left ventricular ejection fraction
- Left ventricular size
- Left ventricular mass
- Left atrial size
- Diastolic function

Diastolic Heart Failure vs. Systolic Heart Failure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Diastolic Heart Failure</th>
<th>Systolic Heart Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left ventricular cavity size</td>
<td>Normal or increased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Left ventricular mass</td>
<td>Normal or decreased</td>
<td>Increased</td>
</tr>
<tr>
<td>Mitral regurgitation</td>
<td>Increased</td>
<td>Normal or decreased</td>
</tr>
<tr>
<td>Pulmonary artery pressure</td>
<td>Increased</td>
<td>Increased</td>
</tr>
<tr>
<td>Pulmonary artery pressure</td>
<td>Increased</td>
<td>Normal or decreased</td>
</tr>
<tr>
<td>Left atrial size</td>
<td>Normal or increased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Diastolic function</td>
<td>May be present or absent</td>
<td>Present</td>
</tr>
</tbody>
</table>

Diastolic Dysfunction: Echo Dx
HFNI/EF: Prevalence and Incidence

- ADHERE registry
  - Database of >100,000 hospitalizations for acute decompensated heart failure
  - Preserved EF (≥40%) vs. reduced EF (<40%)
    - 50.4% of patients with preserved EF
    - Older (73.9 ± 13.2 vs. 69.8 ± 14.4)
    - Women > men
    - Hypertension and diabetes mellitus more common
    - CAD/MI less common
    - In-hospital death (2.8 vs. 3.9%)

- OPTIMIZE-HF registry
  - Preserved EF (≥40%) vs. reduced EF (<40%)
  - 51.2% of patients with preserved EF
  - Baseline characteristics
    - Older, women, HTN, and DM more likely in preserved EF
  - Preserved EF BP (systolic 149 ± 33, diastolic 76 ± 13 mmHg)
  - In-hospital death (2.9 vs. 3.9%)
  - 60-90 day death (9.5 vs 9.8%)
  - Rehospitalization (29.2 vs 29.9%)

Yancy CW et al. JACC 2006;47:76-84.
Fonarow GC et al. JACC 2007;50:768-77.

Heart Failure and Diastolic Dysfuntion and BNP: Olmstead County

<table>
<thead>
<tr>
<th>Baseline characteristics</th>
<th>Preserved EF</th>
<th>Reduced EF</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>68.6 ± 11.0</td>
<td>69.8 ± 14.4</td>
<td>0.01</td>
</tr>
<tr>
<td>Gender (male)</td>
<td>39%</td>
<td>43%</td>
<td>0.13</td>
</tr>
<tr>
<td>BP (mmHg)</td>
<td>Systolic 149 ± 33, Diastolic 76 ± 19</td>
<td>Systolic 154 ± 31, Diastolic 79 ± 15</td>
<td>0.001</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>31%</td>
<td>36%</td>
<td>0.04</td>
</tr>
<tr>
<td>Coronary Artery Disease</td>
<td>32%</td>
<td>36%</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Bursi F et al. JAMA 2006;296:2209-16.

Out-of-Hospital Survival: Olmstead County

- No difference in mortality between preserved and reduced EF


HF with Normal EF: “Risk Factors”

- Age
- Gender
- Hypertension
- Coronary artery disease
- Diabetes mellitus
- Atrial fibrillation
- Chronic kidney disease
- Cerebrovascular disease
- Obesity
- Anemia
**HF with Normal EF: Comorbidities**

- Hypertension (55-77%)
- Coronary artery disease (36-53%)
- Atrial fibrillation (32-41%)
- Diabetes mellitus (32-45%)
- Chronic kidney disease (23-26%)
- Cerebrovascular disease (15%)


**Ethnic Disparities in Trials**

200 consecutive patients hospitalized at Prince of Wales Hospital (HK) with heart failure
- 25 patients with valvular disease
- HF with normal EF (>45%) vs. reduced EF (<45%)
  - 75% with “normal” EF
  - No significant differences in baseline characteristics


**Multi-Ethnic Study of Atherosclerosis (MESA)**

- Cohort study of 6814 participants
  - Caucasian – 38.5%
  - African American – 27.8%
  - Hispanic – 21.9%
  - Chinese American – 11.8%
- Baseline history of cardiovascular disease – excluded
Hypertension in China

In 2002, ~153 million individuals in China were hypertensive (18% of the population)

HTN in China

- Awareness is low.
- Control of hypertension is poor.
- Salt consumption is high, especially northern Chinese.
Atrial Fibrillation in HFnlEF

- 238 patients hospitalized for HF
  - Preserved EF (≥50%) – 146 patients (42 with AF)
  - Reduced EF – 92 patients (30 with AF)
- AF vs sinus rhythm (preserved EF)
  - Higher NYHA class
  - Lower 6-minute walk distance
  - Worse QOL scores
  - Associated with more severe diastolic dysfunction
  - Higher recurrent HF hospitalization or death


Other Established Risk Factors

- South Asians
  - Diabetes mellitus
  - Coronary artery disease
- Migrant Asians
  - Urbanization leads to increase in obesity, diabetes mellitus, and metabolic syndrome

Treatment

- Absence of controlled clinical trials
- Principles of treatment:
  - Control of physiological factors contributing to ventricular relaxation
    - Blood pressure
    - Heart rate
    - Blood volume
    - Myocardial ischemia
  - Symptom reduction
    - Reduce cardiac filling pressures at rest and during exertion

Hong Kong Diastolic Heart Failure Study

- 150 patients with HFnlEF (LVEF >45%)
- Randomized to:
  - Diuretic
  - Diuretic + Irbesartan
  - Diuretic + Ramipril
- Results:
  - QOL improved similarly in all 3 groups
  - Slight but insignificant increase in 6 min walk distance
  - Recurrent hospitalization rates equal (10-12%)
  - BNP levels elevated and decreased in ramipril and irbesartan groups
HK Diastolic HF Study

- DHF patients
  - Larger LV, LA
  - Greater LV mass
  - Lower E/A
  - Longer DT
  - Lower e'
  - Higher E/e'

Other Treatment Trials

- Blockage of renin-angiotensin-aldosterone system does not add incremental value
  - PEP-CHF (perindopril)
  - CHARM-Preserved (candesartan)
  - I-PRESERVE (irbesartan)

- Trials pending
  - TOPCAT (spironolactone)

Conclusions

- Heart failure consists of a spectrum of systolic and diastolic dysfunction and HF with reduced and “normal” ejection fraction.
- HFnIEF represents up to 50% of heart failure presentations.
- HFnIEF is associated with older age, female gender, and multiple comorbidities (HTN, CAD, AF, DM, CKD, cerebrovascular disease, obesity, anemia).
- Treat heart failure with “normal” ejection fraction by treating comorbidities!