Heart Failure with Preserved Ejection Fraction

Duke Heart Failure Symposium
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10-5-13

Disclosures: None
Objectives

• Review pathophysiology as it relates to management

• Rational approach to work-up & treatment
Talk Overview

- Prevalence/Definition
- Pathophysiology
- Diagnosis
- Treatment
HFpEF is Increasingly Prevalent

Steinberg et al Circulation 2012
What is Heart Failure with Preserved Ejection Fraction?

Heart Failure with Preserved Ejection Fraction
Heart Failure with Normal Ejection Fraction
Diastolic Heart Failure
Non-systolic Heart Failure

Clinical Syndrome of Heart Failure

Normal/Near Normal Ejection Fraction
Normal/Near Normal LV dimensions
Abnormalities in Relaxation

“A rose by any other name would smell as sweet”
- William Shakespeare
HFpEF is the result of thick & non-compliant hearts?

- Hypertension
- Concentric Hypertrophy
- Diastolic Dysfunction

Adapted from Shah Nat Rev 2012
Current Paradigm of HFpEF

- Normal
- Concentric Remodeling
- Concentric Hypertrophy
- Eccentric Hypertrophy

Diastolic Dysfunction
Arterial Stiffness
VV coupling
Diminished Reserve
Chronotropic Incompetence
Pulmonary Hypertension

Diabetes
Obesity
Hypertension
Renal Dysfunction
Deconditioning

Adapted from Shah Nat Rev 2012
Prolongation of Diastole and Increased Ventricular Stiffness in HFpEF

Zile et al NEJM 2004
Increased Contractility & Arterial Stiffness
Exaggerated BP response

Kawaguchi et al Circulation 2003
Figure adapted from Borlaug EHJ 2011
Exercise Intolerance in HFPpEF patients
Diminished Cardiac Reserve

Borlaug et al Circulation HF 2010
Diminished Heart Rate Response in HFpEF patients

Borlaug et al. Circulation 2006
Association between HFpEF and Pulmonary Hypertension

Lam et al JACC 2009
### Implications of HFpEF physiology

<table>
<thead>
<tr>
<th>Pathophysiology</th>
<th>Clinical Manifestation</th>
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<tbody>
<tr>
<td>1) Prolonged Relaxation &amp; Ventricular Stiffness</td>
<td>- Intolerance to tachycardia or volume loading</td>
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<tr>
<td>2) Increased Contractility &amp; Arterial Stiffness</td>
<td>- Large swings in BP with changes in afterload/preload</td>
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<td>3) Diminished Systolic &amp; Diastolic Reserve</td>
<td>- Exercise intolerance; absence of abnormalities at rest</td>
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<td>4) Chronotropic Incompetence</td>
<td>- Exercise intolerance; poor response to $\beta$-blockade</td>
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<td>5) Pulmonary Hypertension</td>
<td>- Augmented RHF symptoms; ventricular interdependence</td>
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Echo Measures of Diastolic Dysfunction

28 y/o F no HF

40 y/o M with Diastolic HF
Echo Measures of Diastolic Dysfunction

- LV Press
- LA Press
- Mitral Doppler Velocity
- Pulmonary Vein Velocity
- Doppler Tissue Imaging

Zile & Brutsaert Circulation 2002
Echo Measures of Diastolic Dysfunction

Zile & Brutsaert Circulation 2002
Elevated E/e’ correlated with LV stiffness

Normal

HFpEF

E/e’(lateral) ≥ 8
Sensitivity 83%; Specificity 92%
Area under ROC 0.901

Kasner Circulation 2007
Diagnostic Approach for HFpEF

HFpEF

Dilated LV

- Valve Dz. AR; MR
- No Valve Dz. High output

Non-Dilated LV

- Increased Wall Thickness
  - Mitral Obs. MS; myxoma
  - No Mitral Obs.
- Normal Wall Thickness
- RV Dysfxn.
  - RVMI
  - PH

Increased Wall Thickness

- <QRS Voltage
  - Infiltrative CM
  - No AoV disease
  - AoV stenosis
- >QRS Voltage
  - Hypertensive CM
  - No HTN HOCM; Fabry’s
  - HTN

Ischemia

- No Ischemia
  - Restrictive; Collagen-vascular; chemo/radiation; infiltrative, comorbid dz.; non-cardiac

Adapted from HFSA 2010 Guidelines
HFrEF therapies with little efficacy in HFpEF

ACEI

SOLVD
NEJM 1991

CHARM-ALT
Lancet 2003

β-Blockers

OPTIMIZE-HF
JACC 2009

HFpEF

PEP CHF
EHJ 2006

IPRESERVE
NEJM 2008
## Tailored HFpEF therapies

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Exercise Intolerance</th>
<th>Pulmonary Hypertension</th>
<th>Ventricular Stiffness</th>
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<tbody>
<tr>
<td><strong>Exercise</strong></td>
<td>Exercise</td>
<td>Sildenafil</td>
<td>Spiro</td>
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<tr>
<td><strong>V02</strong></td>
<td>+</td>
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<tr>
<td><strong>Diastolic fxn</strong></td>
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<td>+</td>
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<td><strong>Remodeling</strong></td>
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<td>+</td>
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<tr>
<td><strong>Arterial Stiffness</strong></td>
<td>=</td>
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<td>?</td>
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Kitzmann et al JACC 2013  
Taylor et al Int J. Card. 2012  
Redfield et al JAMA 2013  
Edelmann et al JAMA 2013
Guidelines based treatment of HFpEF

• Control Hypertension (I,A)
• Slow Ventricular Rate in Atrial fibrillation (I,C)
• Treat Congestion/Edema (I,C)
• Treat/Prevent Ischemia (IIA,C)
• Restore/Maintain sinus rhythm (IIB,C)
• Using β-blockers, ACEI, ARB, CCB when HTN controlled (IIB, C)
• Use of digoxin (IIB,C)

AHA/ACC Guidelines 2009
Clinical Pearls for Managing HFpEF

- Careful management of fluid (weight checks)
- Counseling on dietary sodium intake
- Starting an exercise program
- Consider exercise testing when dx is unclear
- Close examination of LV geometry, valvular fxn and pericardial disease
- Mindful of β-blockade in the setting of chronotropic incompetence and RV dysfunction
- Aggressive treatment of HR in atrial fibrillation and cardiac ischemia may be beneficial
- Treatment with vasodilators and spironolactone may have advantages in loading and stiffness
Summary

- HFpEF is characterized by abnormalities in relaxation, contractility, vascular stiffness, cardiovascular reserve and pulmonary pressures.
- Non-invasive dx. of diastolic dysfunction - diastolic blood flow across and movement of MV.
- HFpEF can be caused by numerous etiologies.
- Current therapies aimed at HFrEF have little role in HFpEF.
- Exercise and Spironolactone may be beneficial.
Questions