When to Invasively Measure Pressures in HFpEF?

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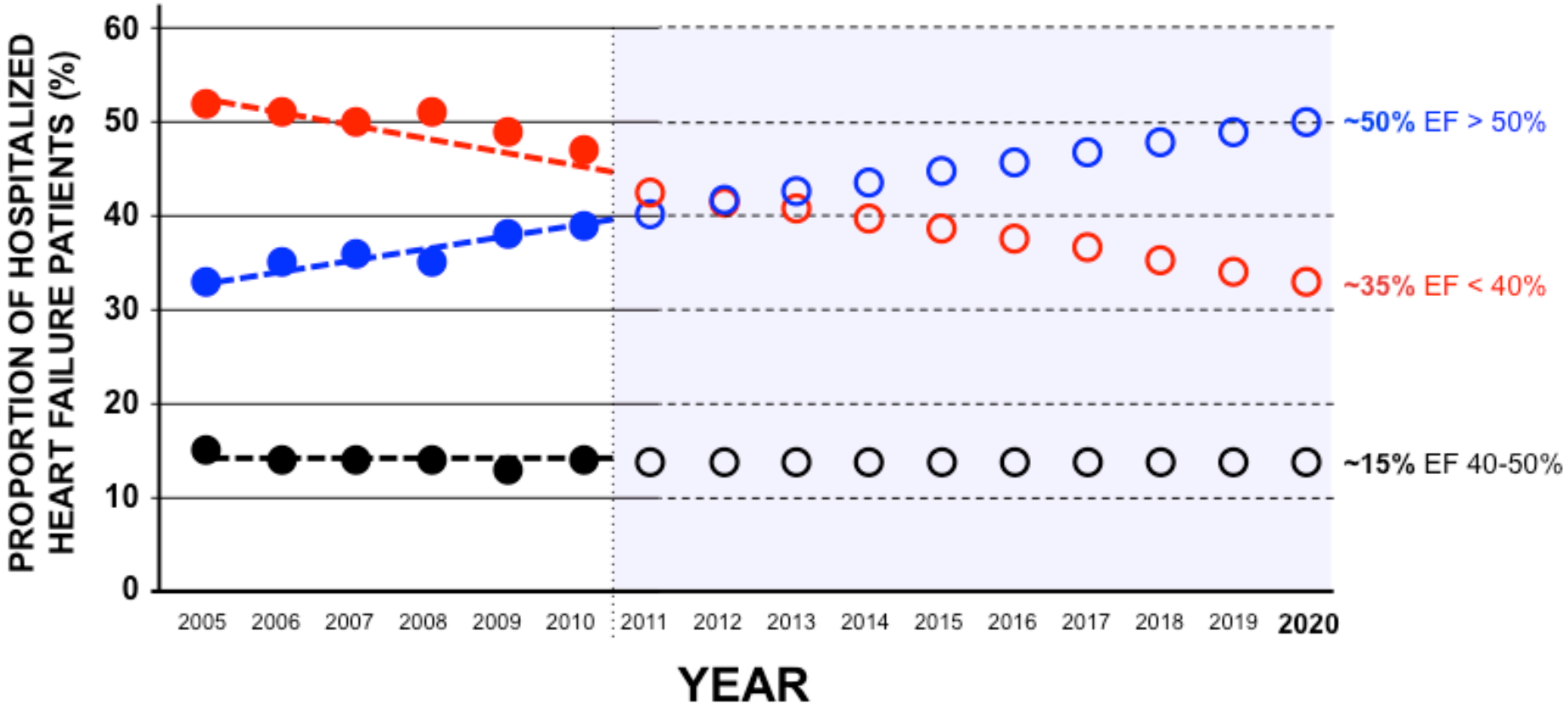
Objectives

- Patient Case
- HFpEF Definitions
- Evolving Demographics of HFpEF
- Hemodynamics testing in HFpEF
- Summary

HFpEF Epidemiology: Rising Prevalence



Oktay AA, Rich JD, Shah SJ. *Curr Heart Fail Rep* 2013

Patient F.S.

- 61 yo F referred to JHU HFpEF Clinic
- PMH: HTN, obesity, OSA, pre-DM
- HPI:
  - 2 years of progressive dyspnea with walking
  - 2 pillow orthopnea
  - bendopnea
  - occasional PND

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Exam

- BMI 40.1
- BP 150/70, HR 75
- Obese, AA Female
- Labored breathing getting up on exam table
- JVP 10, positive HJR
- Lungs clear
- S1/S2, no murmurs, no gallops
- Minimal non-pitting edema of legs

Patient Case: Studies

- Na 143, K 4.4
- Creat 1.4
- Hgb 14.6
- TSH 1.50
- HgbA1c 6.2
- Trop-I negative
- **NT-proBNP 32**

- EKG: NSR, HR 70

- **Echocardiogram:**
  - EF 75%
  - LVDD 4.21
  - IVSd 1.5 cm
  - LA diam 3.7 cm
  - E/e' 8.6
  - "normal diastolic filling pattern for age"
  - normal RV size

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Next Steps?

- Is this HFpEF?
- Empirically treat?
- Is more testing needed…?

YES!

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ACC/AHA 2013 Definition

Classification	EF (%)	Description
I. Heart failure with reduced ejection fraction (HF*r*EF)	≤40	Also referred to as systolic HF. Randomized controlled trials have mainly enrolled patients with HF*r*EF, and it is only in these patients that efficacious therapies have been demonstrated to date.
II. Heart failure with preserved ejection fraction (HF*p*EF)	≥50	Also referred to as diastolic HF. Several different criteria have been used to further define HF*p*EF. The diagnosis of HF*p*EF 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.
a. HF*p*EF, borderline	41 to 49	These patients fall into a borderline or intermediate group. Their characteristics, treatment patterns, and outcomes appear similar to those of patients with HF*p*EF.
b. HF*p*EF, improved	>40	It has been recognized that a subset of patients with HF*p*EF previously had HF*r*EF. 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.

EF indicates ejection fraction; HF, heart failure; HF*p*EF, heart failure with preserved ejection fraction; and HF*r*EF, heart failure with reduced ejection fraction.

Yancy et al. 2013 *Circulation*. 62:e147-239

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ESC 2016 Definition

Table 3.1 Definition of heart failure with preserved (HFpEF), mid-range (HFmrEF) and reduced ejection fraction (HFrEF)

Type of HF		HFrEF	HFmrEF	HFpEF
CRITERIA	1	Symptoms ± Signs[a]	Symptoms ± Signs[a]	Symptoms ± Signs[a]
	2	LVEF <40%	LVEF 40–49%	LVEF ≥50%
	3	–	1. Elevated levels of natriuretic peptides[b]; 2. At least one additional criterion: a. relevant structural heart disease (LVH and/or LAE), b. diastolic dysfunction (for details see Section 4.3.2).	1. Elevated levels of natriuretic peptides[b]; 2. At least one additional criterion: a. relevant structural heart disease (LVH and/or LAE), b. diastolic dysfunction (for details see Section 4.3.2).

Ponikowski P, et al. EHJ 2016;37:2129-200

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In the real world… JHU HFpEF Clinic

- LVEF ≥ 50% *and*
- Signs and symptoms of CHF *and*
- Objective evidence of a cardiac problem
  - Elevated BNP *or*
  - Structural heart disease (LAE, LVH, DD) *or*
  - Elevated PAWP (≥ 15 mmHg) *or*
  - Elevated LV end-diastolic pressure (≥ 15 mmHg)
- Additional: Rise in PAWP with exercise to ≥ 20-25 mmHg

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Patient Case: Exercise RHC

Supine bicycle exercise test

- Baseline:
  - RA 8
  - PA 23/13 (16)
  - PAWP 11
  - PA sat 66.7%
  - CO 4.63 / CI 1.97
  - PVR 1.08
- Peak exercise, 35W
  - RA 21
  - PA 45/28 (34)
  - PAWP 25
  - PA sat 54%,
  - CO 10.3 / CI 4.38
  - PVR 0.58

Diagnosis: Exercise-induced HFpEF

Patient Case: Treatment

- Blood pressure management
- Initiated on Spironolactone
- Low-dose diuretic
- Exercise program
- Screened for clinical trial enrollment

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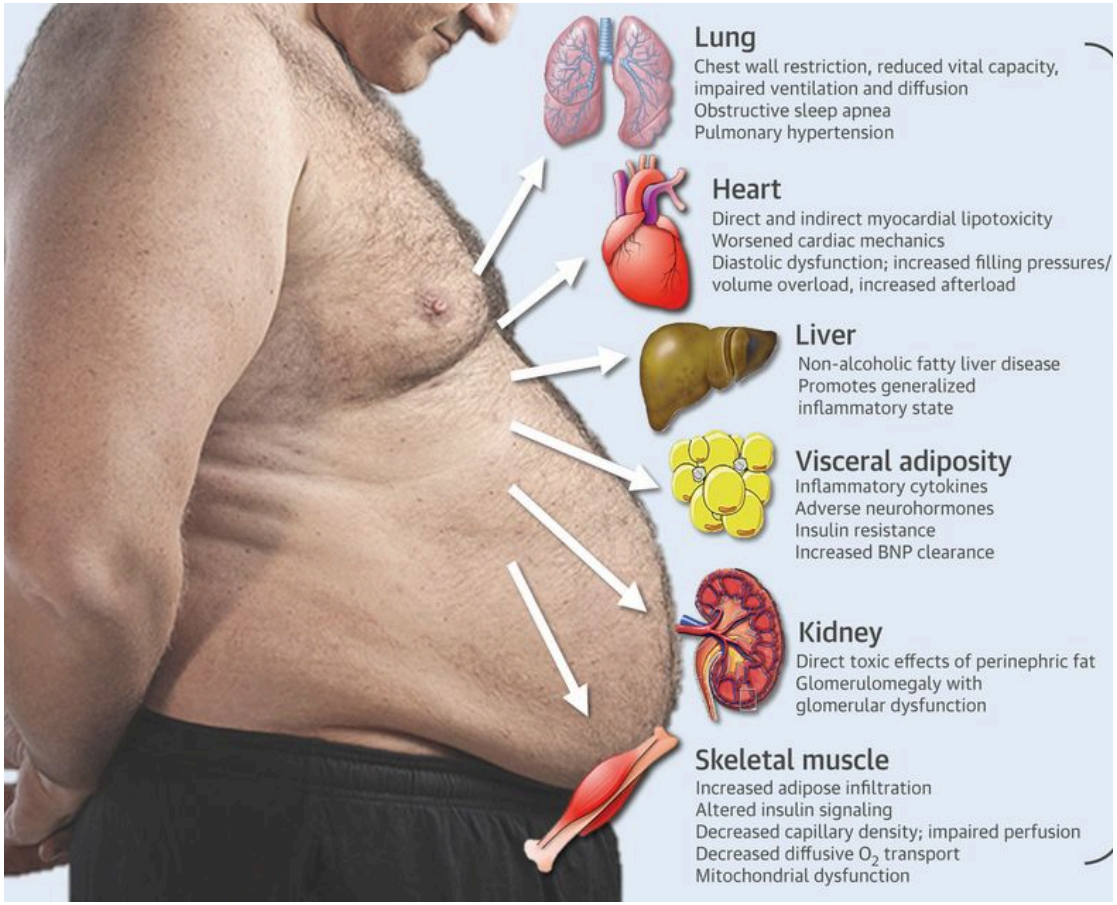
Evolving Demographics in HFpEF

ROPA-DOP Cohort	Total (n=90)
Age, years	66 (13)
Female, (%)	61
AA, (%)	56
HTN, (%)	85
Diabetes, (%)	53
A Fib, (%)	32
BMI	40.8
eGFR	58
NT pro-BNP, pg/mL	2132



Sharma K, et al. JACC-HF 2018;6:859–70;
Kitzman D, Shah S JACC 2016;68:200-203

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Hemodynamics in Real World Practice

	HFpEF (91)
Invasive Hemodynamics	
RA (mmHg)	10
PASP (mmHg)	44
PADP (mmHg)	20
mPA Pressure (mmHg)	29
PCWP (mmHg)	18
CO, thermodilution (L/min)	5.73
CI, thermodilution (L/min/m2)	2.50
Biomarkers	
NT-proBNP (pg/mL)	312
6 minute walk distance	
6MW Distance (m)	201.3

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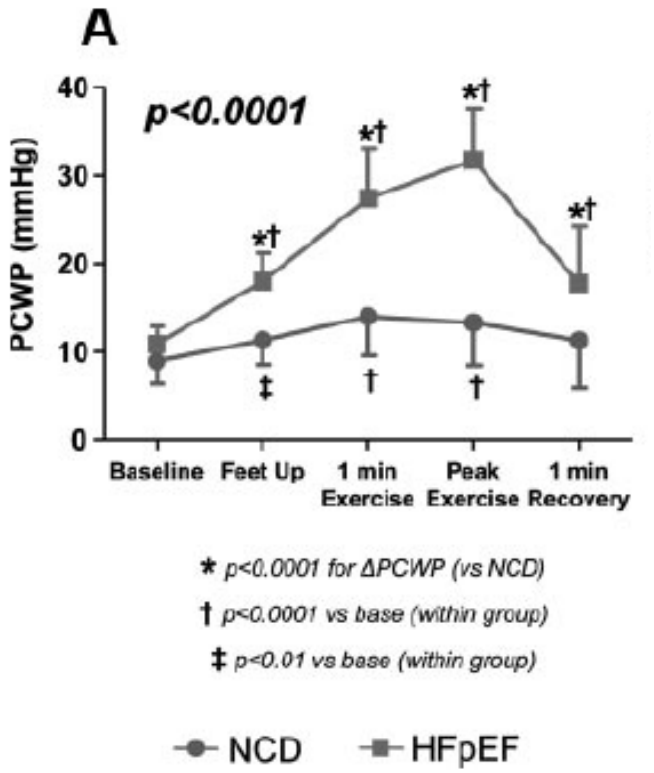
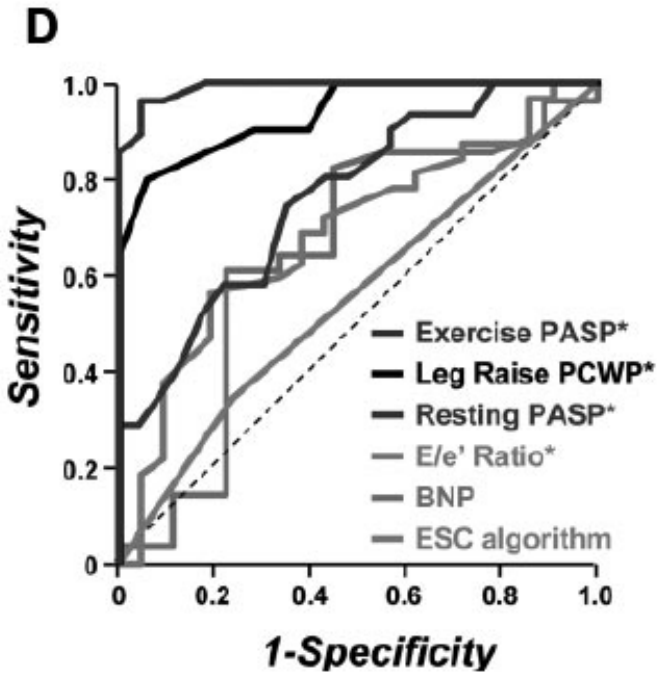
Exercise Hemodynamics

- Patients with exertional dyspnea, EF > 50% were referred for RHC
- Those with no significant CAD, normal NPs, and normal resting hemos underwent exercise study.





Borlaug et al. 2010 Circulation;3:588-595.

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Phenotype-based Treatment Approach to HFpEF

HFpEF Predisposition Phenotypes	HFpEF Clinical Presentation Phenotypes					
		Lung Congestion	+Chronotropic Incompetence	+Pulmonary Hypertension (CpcPH)	+Skeletal muscle weakness	+Atrial Fibrillation
	Overweight/obesity/ metabolic syndrome/ type 2 DM	• **Diuretics (loop diuretic in DM)** • **Caloric restriction** • Statins • Inorganic nitrite/nitrate • Sacubitril • Spironolactone	+Rate adaptive atrial pacing	+Pulmonary vasodilators (e.g. PDE5I)	**+Exercise training program**	+Cardioversion + Rate Control **+Anticoagulation**
	+Arterial hypertension	+ACEI/ARB	+ACEI/ARB +Rate adaptive atrial pacing	+ACEI/ARB +Pulmonary vasodilators (e.g. PDE5I)	+ACEI/ARB **+Exercise training program**	+ACEI/ARB +Cardioversion + Rate Control **+Anticoagulation**
	+Renal dysfunction	+Ultrafiltration if needed	+Ultrafiltration if needed +Rate adaptive atrial pacing	+Ultrafiltration if needed +Pulmonary vasodilators (e.g. PDE5I)	+Ultrafiltration if needed **+Exercise training program**	+Ultrafiltration if needed +Cardioversion + Rate Control **+Anticoagulation**
	+CAD	+ACEI +Revascularization	+ACEI +Revascularization +Rate adaptive atrial pacing	+ACEI +Revascularization +Pulmonary vasodilators (e.g. PDE5I)	+ACEI +Revascularization **+Exercise training program**	+ACEI +Revascularization +Cardioversion + Rate Control **+Anticoagulation**

Shah S, Paulus W et al. *Circulation* 2016

Take Home Messages – When to use hemodynamic testing in HFpEF?

- Routinely! This is the gold standard test for HFpEF diagnosis.
- Echo and NP often are not enough.
- Consider exercise hemos in those with normal resting numbers, on diuretic therapy, symptoms out of proportion to exam/ RHC, to evaluate for concomitant PAH.
- Clinical trial enrollment, targeted therapeutics.

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THANK YOU!

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