Heart Failure with Preserved Ejection Fraction: Myths and Misconceptions

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• We pronounce HFpEF: “huff-puff”
8 MYTHS AND MISCONCEPTIONS
Myth #1: Diastolic dysfunction, diastolic HF, and HFpEF are all the same.
DD vs. DHF vs. HFpEF

**DD**
Pathophysiologic condition: impaired relaxation, ↓compliance, ↑LV filling pressures

**DHF**
Normal LVEF plus sign/symptoms of HF due to DD

**HFpEF**
Normal LVEF plus signs/symptoms of HF (excluding severe valve disease, prior ↓LVEF, constriction)
DD vs. DHF vs. HFpEF
DD vs. DHF vs. HFpEF

Pure diastolic HF is actually a rare syndrome

“pure” DHF
HFpEF: A debilitating syndrome

- TOPCAT trial (spironolactone vs. placebo):
  » N=3445
  » At baseline:
    - Activity level very low (9.3 MET-hr/week)
    - Poor QOL similar to ESRD
    - 27% with moderate or greater depression

Shah SJ, et al. Circ Heart Fail 2013
HFpEF: prevalence increasing

GWTG-HF: N=110,621 patients hospitalized with HF
P<0.0001 for trend of increased HFpEF prevalence

Oktay AA, Rich JD, Shah SJ. Curr Heart Fail Rep 2013
HFpEF: prevalence increasing

GWTG-HF: N=110,621 patients hospitalized with HF
P<0.0001 for trend of increased HFpEF prevalence

By 2020, 65% of hospitalized HF pts will have EF > 40%

Oktay AA, Rich JD, Shah SJ. Curr Heart Fail Rep 2013
HFpEF survival: poor

Dismal 35% survival at 5 years after HF hospitalization, regardless of LVEF

Myth #2: Diagnosing HFpEF is difficult
Diagnosis of HFpEF?

• It’s not as complicated as you think:
  » 1. Signs and symptoms of CHF and
  » 2. Objective evidence of a cardiac problem
    — Elevated BNP or
    — Left atrial enlargement or
    — Elevated PCWP (> 15 mmHg) or
    — Elevated LV end-diastolic pressure (> 15 mmHg)

• That’s really it! That’s all you need!!
Diagnosis of HFpEF?

- Diastolic dysfunction (DD) on echo:
  - Not required for the diagnosis
  - Often uninterpreted or misinterpreted
  - Grade 2 (moderate) or grade 3 (severe) DD helpful but not required for diagnosis
  - Patients can have HFpEF with “normal” diastolic function or “mild” DD

- When in doubt: do a right heart cath!
Myth #3: A normal BNP rules out HFpEF as a diagnosis
Your typical HFpEF patient…

- 63-year-old man
- Morbid obesity, HTN, DM
- Admitted with SOB, DOE, leg swelling
- ?JVP “thick neck”, lungs clear, severe LE edema
- BNP 42 pg/ml, Cr 1.2 mg/dl
- IV diuresis, negative 3L by hospital day #3
- Echo: normal EF, ?filling pressures, ?DD grade
- Hospital day #4: HCO₃ 42, Cr 1.6 mg/dl… stop diuretics??
Your typical HFpEF patient...

- Cardiology consult team:
  - Stop diuretics, give fluids, swelling all lymphedema “he’s dry”
Your typical HFpEF patient...

- Cardiology consult team:
  - Stop diuretics, give fluids, swelling all lymphedema “he’s dry”

- STOP! Do a cardiac catheterization
  - RA 18, PA 64/28, PCWP 28, LVEDP 28
  - Lasix gtt started, diuresed 20L further
  - “I’ve never felt better, doc!”
BNP for the diagnosis of HFpEF

• BNP data in HFpEF limited
  » Most BNP and NT-proBNP data:
    – HF w/reduced EF or diastolic dysfunction
  » BNP < 100 pg/ml, NT-proBNP < 120 pg/ml:
    – Thought to have good negative predictive value

• Obesity:
  » Very common in HFpEF
  » Known to be associated with ↓BNP
Normal BNP in HFpEF

- Prospective study of HFpEF patients:
  - 159 confirmed HFpEF patients
  - All met Framingham criteria for HF
- All underwent cardiac catheterization and BNP measurement
  - PCWP > 15 mmHg or LVEDP > 15 mmHg in all patients

Anjan V...Shah SJ. Am J Cardiol 2012
Normal BNP in HFpEF

- 46/159 (29%) had BNP < 100 pg/ml
  - Younger
  - More obese
  - High PCWP in both groups: 25 mmHg vs. 27 mmHg
  - Better outcomes (HR 0.25 for CV hosp/death)

- BNP < 100 pg/ml:
  - Present in up to 1/3 of HFpEF
  - Associated with less severe HFpEF
    - BUT STILL SYMPTOMATIC, PCWP ~25 mmHg

Anjan V…Shah SJ. Am J Cardiol 2012
Myth #4: HFpEF is a single disease
The many faces of HFpEF
The many faces of HFpEF

HFpEF: not 1 single “disease”
Pathophysiologic contributors to HFpEF

- Diastolic dysfunction
- Longitudinal systolic dysfunction
- Chronotropic incompetence
- Extra-cardiac causes of volume overload
- Arterial stiffness
- Abnormal ventricular-arterial coupling
- Pulmonary hypertension / RV failure
- Autonomic dysfunction
- Endothelial dysfunction

Cancer vs. heart failure

**Optimal targeted approach**

**Cancer**
- Tissue biopsy
- Imaging
- Phenotypic analysis
  - Tumor size, extent
  - Histologic analysis
- Gene expression

**Targeted therapy**

**Sub-optimal one-size-fits-all approach**

**HF**
- Imaging, ECG, PEX
- Phenotypic analysis
  - Quantify LVEF
  - Functional class
  - Fluid status
  - QRS duration

**Non-targeted therapy**
Phenomapping of HFpEF: machine learning analyses of dense phenotypic data

3 types of HFpEF presentation

- **ENVIRONMENT, DIET**
- **COMORBIDITIES**
- **GENETIC SUSCEPTIBILITY**

**VULNERABLE HEART, VULNERABLE PATIENT**

**HFpEF**

- **EXERCISE-INDUCED ↑LA PRESSURE**
- **VOLUME OVERLOAD**
- **PULMONARY HTN, RV FAILURE**

Shah SJ. JACC 2013
Risk profile, BNP vary by type of HFpEF presentation

EXERCISE-INDUCED DIASTOLIC DYSFUNCTION

VOLUME OVERLOAD

PULMONARY HYPERTENSION RV FAILURE

Clinical course

BNP LEVEL

Shah SJ. JACC 2013
HFpEF patient types: examples

**SAMPLE PATIENTS**

- **72-year-old woman**
  - Long-standing HTN
  - NYHA II
  - Exercise intolerance
  - Minimal fluid retention
  - No HF hospitalizations
  - LVEF 70%, 2+ LAE
  - Grade I DD
  - PASP 30 mmHg at rest
  - Exercise E/e’ = 14

- **66-year-old woman**
  - HTN, CAD s/p CABG
  - NYHA III
  - Severe DOE
  - 2+ LE edema
  - Recent HF hospitalization
  - LVEF 50%, 3+ LAE
  - Grade III DD
  - PASP 45 mmHg at rest
  - 2+ MR, 2+ AR

- **59-year-old woman**
  - HTN, DM2, CKD, obese
  - NYHA III
  - Severe SOB, DOE
  - 3+ edema, ascites
  - Frequent HF hospitalizations
  - LVEF 65%, 4+ LAE
  - Grade II DD
  - PASP 60 mmHg at rest
  - RVH + RV dysfunction
Clinical categories of HFpEF

1. “Garden-variety” HFpEF (HTN, DM, obesity, CKD)
2. CAD-HFpEF
3. Right heart failure-HFpEF
4. A-fib predominant HFpEF
5. HCM-like HFpEF
6. High-output HFpEF
7. Valvular HFpEF (multiple 2+ lesions)
8. Rare causes of HFpEF (“zebras”)

Myth #5: PH in HFpEF is due to pulmonary vascular disease
Waldo has WHO Group I PAH. Where's Waldo??
Etiology of PH found on echo

- Single echo lab, Australian community of 165,450
- Etiology of PH when found on echocardiogram

- Left heart disease, 67.9%
- Unknown, 15.4%
- Miscellaneous, 2.7%
- Lung disease, Sleep-related hypoventilation, 9.3%
- CTEPH, 2.0%
- PAH, 2.7%

N=936 of 10,314 patients with echo PASP >40 mm Hg.
PH is common in HFrEF

↑LA pressure → ↑pulm. venous pressures → ↑PA pressures

83% of patients with HFrEF have ↑PASP

Lam CS, et al. JACC 2009
PH in HFpEF: non-invasive

Lam CS, et al. JACC 2009
PH in HFP EF: non-invasive

Lam CS, et al. JACC 2009

\[ p < 0.001 \]

PCWP > PASP??

Lam CS, et al. JACC 2009
PH in HFpEF: invasive

- Consecutive hospitalized HFpEF patients, studied post-discharge as outpatients
- All with confirmed ↑LV filling pressures
  - All PCWP > 15 mmHg
  - Mean PCWP 24 mmHg

Northwestern HFpEF Cohort (N=211 with invasive hemodynamics)

Burke MA, Shah SJ. ACC 2011
PH in HFpEF: invasive

- Consecutive hospitalized HFpEF patients, studied post-discharge as outpatients
- All with confirmed ↑LV filling pressures
  - All PCWP > 15 mmHg
  - Mean PCWP 24 mmHg

70% have PH
(mPAP > 25 mmHg)

Burke MA, Shah SJ. ACC 2011
PH in HFpEF: invasive

- Consecutive hospitalized HFpEF patients, studied post-discharge as outpatients
- All with confirmed ↑LV filling pressures
  - All PCWP > 15 mmHg
  - Mean PCWP 24 mmHg
- 18% have PVR > 3 Wood units

Burke MA, Shah SJ. ACC 2011
PH in HFpEF: invasive

- Consecutive hospitalized HFpEF patients, studied post-discharge as outpatients
- All with confirmed ↑LV filling pressures
  - All PCWP > 15 mmHg
  - Mean PCWP 24 mmHg

Only 5% have PADP-PCWP > 5 mmHg

Burke MA, Shah SJ. ACC 2011
**TPG** or **↑PVR ≠ reactive PH!**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Typical PH-HFpEF</th>
<th>True “mixed” PH-HFpEF + PAH*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA pressure</td>
<td>70/25 (40) mmHg</td>
<td>70/40 (50) mmHg</td>
</tr>
<tr>
<td>PCWP</td>
<td>25 mmHg</td>
<td>25 mmHg</td>
</tr>
<tr>
<td>TPG (mPAP-PCWP)</td>
<td>15 mmHg</td>
<td>25 mmHg</td>
</tr>
<tr>
<td>Cardiac output</td>
<td>4 L/min</td>
<td>4 L/min</td>
</tr>
<tr>
<td>PVR</td>
<td>3.8 WU</td>
<td>6.3 WU</td>
</tr>
<tr>
<td>PADP-PCWP gradient</td>
<td>0 mmHg</td>
<td>15 mmHg</td>
</tr>
</tbody>
</table>

*Now known as combined post- and pre-capillary PH (CpcPH)*
PADP-LVEDP: key to diagnosis of “reactive” PH in HFpEF

PASSIVE PH

PADP-LVEDP = 0 mmHg
HFpEF with PVH

REACTIVE PH

PADP-LVEDP = 8 mmHg
HFpEF with PVH+PAH
PADP-LVEDP: key to diagnosis of “reactive” PH in HFpEF

**PADP-PCWP gradient is key!**

**PASSIVE PH**

- PADP-LVEDP = 0 mmHg
- HFpEF with PVH

**REACTIVE PH**

- PADP-LVEDP = 8 mmHg
- HFpEF with PVH+PAH
PH in HFpEF: invasive

PASP closely associated with PCWP

Pulmonary artery systolic pressure (mmHg)

Pulmonary capillary wedge pressure (mmHg)

PASP closely associated with PCWP

Burke MA...Shah SJ. JACC 2011 [abstract]
Proximal PA stiffening in HFpEF

![Graph showing pressure (mm Hg) vs. PVR (Wood units) with PASP, mPAP, and PADP lines. PAPP is indicated by an arrow between PASP and mPAP.](image)
Aortic pulse pressure (mm Hg)

Pulmonary artery pulse pressure (mm Hg)

R=0.32, P<0.0001
PH in HFpEF: importance of CKD

Burke MA…Shah SJ.  JACC 2011 [abstract]
PH in HFpEF: importance of CKD

**PH, CKD, and HFpEF: Disordered Ca^{2+}/PO_4 homeostasis?**

### Graphs:

**Mean PA pressure (mmHg)**
- **Normal**
- **CKD**
- **CKD+PTX**

**Calcium content of lungs**
- **Normal**
- **CKD**
- **CKD+PTX**

*Akmal et al. Kidney Int 1995*
“Psychoanalytic view” of the RV

**LV:** “narcissistic personality disorder”

**RV:** “passive-aggressive”
RV: #1 pathophys predictor in HFpEF
Myth #6: Differentiating HFpEF (PVH) from PAH requires invasive hemodynamics
PAH vs PVH: Practical tips on echo

Normal LVEF + ↑PASP?
Think PVH (HFpEF) until proven otherwise
PAH vs PVH: Practical tips on echo

Normal LVEF + ↑PASP?
Think PVH (HFpEF) until proven otherwise

Left atrial enlargement (LA size > RA size)
PAH vs PVH: Practical tips on echo

Normal LVEF + ↑PASP?
Think PVH (HFpEF) until proven otherwise

Left atrial enlargement (LA size > RA size)

Interatrial septum bows from left to right
PAH vs PVH: Practical tips on echo

Normal LVEF + ↑PASP?
Think PVH (HFpEF) until proven otherwise

Left atrial enlargement
(LA size > RA size)

Interatrial septum bows from left to right

Grade 2+ diastolic dysfunction (↑E/A ratio)
PAH vs PVH: Practical tips on echo

Normal LVEF + \( \uparrow \) PASP?
Think PVH (HFpEF) until proven otherwise

- Left atrial enlargement (LA size > RA size)
- Interatrial septum bows from left to right
- Grade 2+ diastolic dysfunction (\( \uparrow \) E/A ratio)
- Decreased lateral e’
- Elevated lateral E/e’
PAH vs PVH: Practical tips on echo

Think PVH (HFpEF) until proven otherwise

Normal LVEF + PASP?

Left atrial enlargement (LA size > RA size)

Interatrial septum bows from left to right

Grade 2+ diastolic dysfunction (↑E/A ratio)

Decreased lateral e’

Elevated lateral E/e’
Respiratory variation in PCWP
Respiratory variation in PCWP

End-expiratory PCWP = 27 mmHg

Lung disease

Morbid obesity
Myth #7:
There are no proven treatments for HFpEF
State-of-the-art in 2015: Treatment of HFpEF
HFpEF: “no treatments”

Borlaug BA, Redfield MM. Circulation 2011;123:2006-2014
Why have treatments failed?

- Multiple potential risk factors
- Difficult diagnosis
- Poor recognition of presence/prognosis
- Heterogeneity of HFpEF syndrome
- Care by multiple different providers
- Comorbidity burden is high
  » Cause of death often not related to progressive heart failure
Why have treatments failed?

- Several pathophysiologic mechanisms:
  - Diastolic dysfunction
  - Abnormal ventricular-arterial coupling
  - Abnormal systolic cardiac mechanics
  - Pulmonary hypertension / RV failure
  - Chronotropic incompetence
  - Extracardiac causes of fluid overload
Rx Step #1:
Prevent HFpEF before it even occurs
Stages of heart failure

Stage A
High risk for development of HF
HTN, CAD, DM, obesity

Stage B
Asymptomatic HF
(abnormal cardiac structure/function)

Stage C
Symptomatic HF

Stage D
End-stage, refractory HF

How can we prevent Stage B (and Stage C) heart failure?

HFpEF can be prevented...

**HYVET trial**
indapamide resulted in 64% reduction in HF hosp. compared to placebo

*Beckett NS, et al. NEJM 2008*
HFpEF can be prevented...

**ALLHAT-HFpEF**: chlorthalidone best for HFpEF prevention

![Graph showing cumulative HF rate over years to HF]

- Amlodipine, lisinopril
- Chlorthalidone

Rx Step #2:
Before treating, remember the zebras.
HFpEF: Know your zebras

• Assessment of HFpEF: a diagnostic mystery until proven otherwise
• Careful history, physical examination
• Clues to zebras:
  » Kussmaul’s sign: ↑JVP with inspiration
  » ↓Voltage ECG with ↑LV wall thickness
  » Careful evaluation of echo is essential

Oktay AA, Shah SJ. Curr Cardiol Rev 2014
50-year-old woman with SOB

Low voltage, pseudoinfarct pattern
50-year-old woman with SOB

Thick LV, “texture” of myocardium consistent with infiltrative cardiomyopathy
50-year-old woman with SOB

High E velocity, elevated E/A ratio, reduced E’, ↓E deceleration time

Grade III (severe) LV diastolic dysfunction due to cardiac amyloidosis
HFpEF: Know your zebras

- **Restrictive cardiomyopathy:**
  - Sparkling myocardium
  - Severely decreased tissue Doppler S’ or E’
  - Preserved radial function, reduced longitudinal function

- **Constrictive pericarditis:**
  - Septal bounce
  - Preserved E’ velocity
  - Respiratory variation in mitral inflow

Oktay AA, Shah SJ. *Curr Cardiol Rev* 2014
**HFpEF: Know your zebras**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Restriction</th>
<th>Constriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral tissue Doppler e’ velocity</td>
<td>Severely reduced</td>
<td>Normal</td>
</tr>
<tr>
<td>Hepatic vein imaging</td>
<td>Flow reversal during <em>inspiration</em></td>
<td>Flow reversal during <em>expiration</em></td>
</tr>
<tr>
<td>Simultaneous LV/RV tracings</td>
<td>Concordance</td>
<td>Discordance</td>
</tr>
</tbody>
</table>

Oktay AA, Shah SJ. *Curr Cardiol Rev* 2014
44-year-old man with chronic ascites
44-year-old man with chronic ascites
44-year-old man with chronic ascites

Thickened, enhancing pericardium
Zebras can be treated!

- **Cardiac amyloid:** *not a death sentence*
  - Primary (AL) amyloidosis:
    - Stem cell transplantation *or*
    - Cardiac transplant followed by stem cell tx
  - Familial or wild-type TTR amyloidosis:
    - Several novel drugs in pipeline (TTR stabilizers, RNA interference, RNA anti-sense molecules)
    - Heart-liver transplant

- **Constrictive pericarditis:**
  - Pericardial stripping can be curative
Primary (AL) cardiac amyloid: improved survival with stem-cell tx

Northwestern chemo+SCT (N=19)
Northwestern all patients (N=26)
Northwestern chemo only (N=7)
Historical controls (N=24)

Dubrey et al. Heart 1997

Northwestern chemo only vs. chemo+SCT: Log-rank $P=0.0008$

Friedman J….Shah SJ. ACC 2014
Rx Step #3:
Treat comorbidities, BP, fluid overload
HFpEF treatment algorithm

• Diagnose HFpEF accurately
  » Remember that HFpEF is extremely common
  » Make sure you’re not dealing with a “zebra”
  » Low threshold for cardiac catheterization, CAD eval
• Treat the underlying cause of HFPEF
• Treat BP, fluid overload
• Treat comorbidities aggressively
• CHF education, chronic disease management
Carvedilol
Bumetanide
Chlorthalidone
Lisinopril
Spironolactone

HFpEF “poly-pill”
Step #4:
Tailor treatment to the type of HFpEF
EXERCISE-INDUCED ↑LA PRESSURE

- Exercise training
- Nitrates? NEAT-HFpEF clinical trial
- Ivabradine? *Not available in the U.S.*
- Late Na+ current inhibitors (e.g., ranolazine)?
Interatrial shunt device for HFpEF

Creation of L-to-R shunt = ↓↓LAp at rest/exercise = ↓↓symptoms in HFpEF

InterAtrial Shunt Device: Concept

Transcatheter implant to create a small permanent interatrial shunt (Qp:Qs ratio 1.2-1.3)

Implant 19mm OD 8 mm ASD

Animal explant

Courtesy of Finn Gustafsson, MD, PhD, DMSci
• Elevated Cr during diuresis? Consider hemoconcentration
• Spironolactone
• Hemodynamic monitoring for tailored diuretic therapy
• Neprilysin inhibition? (PARAGON-HF trial)
• sGC stimulator therapy? (SOCRATES trial)
• Serelaxin for acute HF? (RELAX-AHF2 trial)
Spironolactone

- Great for volume overload, RV failure
- ALDO-DHF and RAAM-PEF:
  - Mineralocorticoid receptor antagonists probably don’t work in exercise-induced DD
- TOPCAT (N=3445):
  - Spironolactone vs. placebo for HFpEF
  - More volume overloaded than ALDO-DHF
  - ↓ hospitalization but missed 1° endpoint
  - In Americas, spironolactone = better outcomes
CHAMPION TRIAL

LA pressure = improved outcomes in HF

PULMONARY HYPERTENSION
RV FAILURE

• Aggressive diuresis, ultrafiltration often needed
• May need to discontinue systemic vasodilators
• Midodrine for low BP during diuresis (if not contraindicated)
• Digoxin to RV inotropy
• PDE5 inhibition if PADP-PCWP gradient > 5 mmHg
• Hemodynamic sensor for careful titration of diuretics
Treatment of PH-HFpEF

Treatment targets: LA, PA, RV

RV therapies
- Digoxin?
- Ranolazine?
- Istaroxime?
- Myosin activators?

Pulmonary vasodilators
- sGC stimulators?
- PDE5 inhibitors?
- ERAs?
- Prostacyclins?

LA assist device?
Treatment of PH-HFpEF

Treatment targets: LA, PA, RV

RV therapies
- Digoxin?
- Ranolazine?
- Istaroxime?
- Myosin activators?

Pulmonary vasodilators
- sGC stimulators?
- PDE5 inhibitors?
- ERAs?
- Prostacyclins?

LA assist device?
Left atrial assist device for PH-HFpEF?

Circulite Synergy Micro-Pump (investigational device)

Left atrial inlet cannula

http://www.mylvad.com/lvad-devices/circulite-synergy
Renal venous congestion in PH-HFpEF

Many PH-HFpEF patients have RV failure:

- RA pressure $=$ renal venous pressure
- CO $=$ systemic BP
- renal blood flow

$\uparrow$ RA pressure $+$ $\downarrow$ CO $=$ $\downarrow$ renal blood flow $\Rightarrow$ $\downarrow$ transrenal pressure gradient
Renal venous congestion in PH-HFpEF

Many PH-HFpEF patients have RV failure:

\[
\uparrow RA \text{ pressure} = \uparrow \text{renal venous pressure} \\
+ \\
\downarrow CO = \downarrow \text{systemic BP} \\
\downarrow \text{renal blood flow}
\]

\[= \downarrow \text{transrenal pressure gradient} \]

• **Diuretics**
• **Stop anti-HTN meds**
• **Midodrine**
• **Pulmonary vasodilators?**
HFpEF treatment pearls

1. “Garden-variety”-HFpEF: Rx BP, DM, obesity, refer for clinical trial; If AF → trial of cardioversion
2. CAD-HFpEF: Rx like HF w/reduced EF (BB, ACE-I/ARB, revasc)
3. Right heart failure-HFpEF: diuresis / ultrafiltration, digoxin, sildenafil?
4. HCM-HFpEF: verapamil, diltiazem, long-acting metoprolol
5. High-output HFpEF: Rx underlying cause; diuretics/UF
6. Valvular HFpEF: Rx valve disease if possible
7. Rare causes of HFpEF: clinical trial, Rx underlying cause
Myth #8: HFpEF clinical trials are doomed
HFpEF survival: poor

Dismal 35% survival at 5 years after HF hospitalization, regardless of LVEF

HFpEF survival: poor

T4 NSCLC (Stage 3B or worse)


HFpEF survival: comparable to T4 non-small cell lung cancer, stage 3B or worse
“Matchmaking” for optimizing HFpEF clinical trials

THEORETICAL “MATCHED” THERAPIES

- Ivabradine
- Exercise training
- Aldosterone blocker
- Neprilysin inhibitor
- PDE5 inhibitor
- Hemodynamic sensor

Shah SJ. JACC 2013
“Matchmaking” for optimizing HFpEF clinical trials

EXERCISE-INDUCED DIASTOLIC DYSFUNCTION ↔ VOLUME OVERLOAD ↔ PULMONARY HYPERTENSION RV FAILURE

THEORETICAL “MATCHED” THERAPIES

- Ivabradine
- Interatrial shunt device
- Aldosterone blocker
- PDE5 inhibitor
- PARAGON
- SOCRATES
- Exercise training
- Nitrates (NEAT)
- Hemodynamic sensor

Shah SJ. JACC 2013
STOP!
1. Make sure you didn’t miss dx of HFpEF
2. Don’t forget the zebras
3. Categorize by type of HFpEF presentation and tailor treatment
4. There are treatment options for HFpEF!
5. Enroll in HFpEF clinical trials
HFpEF: to “huff and puff”

**huff and puff**

*Fig.* to breathe very hard; to pant as one exerts effort. *John came up the stairs huffing and puffing. He huffed and puffed and finally got up the steep hill.*

See also: and, huff, puff


**huff and puff**

1. to breathe noisily, usually because you have been doing physical exercise *They're so unfit they start huffing and puffing if they have to run further than twenty yards.*
2. (informal) to complain noisily about something but not be able to do anything about it *They huffed and puffed about the price, but eventually they paid up.*

See also: and, huff, puff


**huff and puff**

1. to breathe in a noisy manner *He was on the top of the hill long before I came up huffing and puffing behind him.*
2. to complain *The owners will huff and puff about their financial problems and then not do anything to solve them.*

See also: and, huff, puff

huff and puff

1. to breathe in a noisy manner. *He was on the top of the hill long before I came up huffing and puffing behind him.*

2. to complain. *The owners will huff and puff about their financial problems and then not do anything to solve them.*

See also: and, huff, puff

thank you!