Patient Selection Considerations for Trials of Interatrial Shunts

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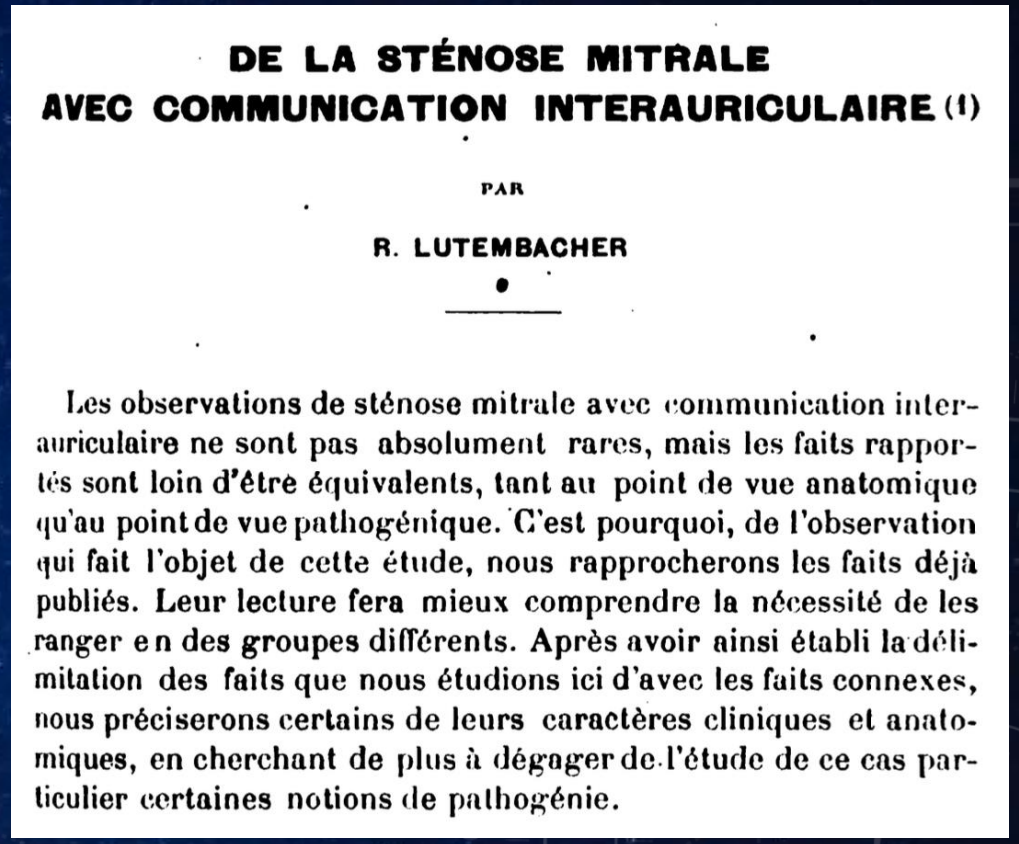
Disclosures

- **Research funding:**
  - ⇢ NIH U54 HL160273, R01 HL107577, R01 HL127028, R01 HL140731
  - ⇢ AHA #16SFRN28780016, #15CVGPSD27260148
  - ⇢ AstraZeneca, Corvia, Pfizer
- **Consulting / advisory board / steering committee:**
  - ⇢ Abbott, Alleviant, AstraZeneca, Amgen, Aria CV, Axon Therapies, BaroPace, Bayer, Boehringer-Ingelheim, Boston Scientific, Bristol-Myers Squibb, CentrusDx, Cytokinetics, Edwards Lifesciences, Eidos, Eon, Gordian, Imara, Impulse Dynamics, Intellia, Ionis, Lilly, Merck, Metabolic Flux, Novartis, Novo Nordisk, Pfizer, Prothena, Regeneron, Rivus, Sardocor, Secretome, Shifamed, Tenax, Tenaya, and Ultromics

ASD in the setting of mitral stenosis

- **Congenital ASD in the setting of mitral stenosis**
  - ⇢ Decompression of ↑LA pressure
  - ⇢ Large reservoir: right atrium, great veins, hepatic veins



DE LA STÉNOSE MITRALE
AVEC COMMUNICATION INTERAURICULAIRE (1)

PAR

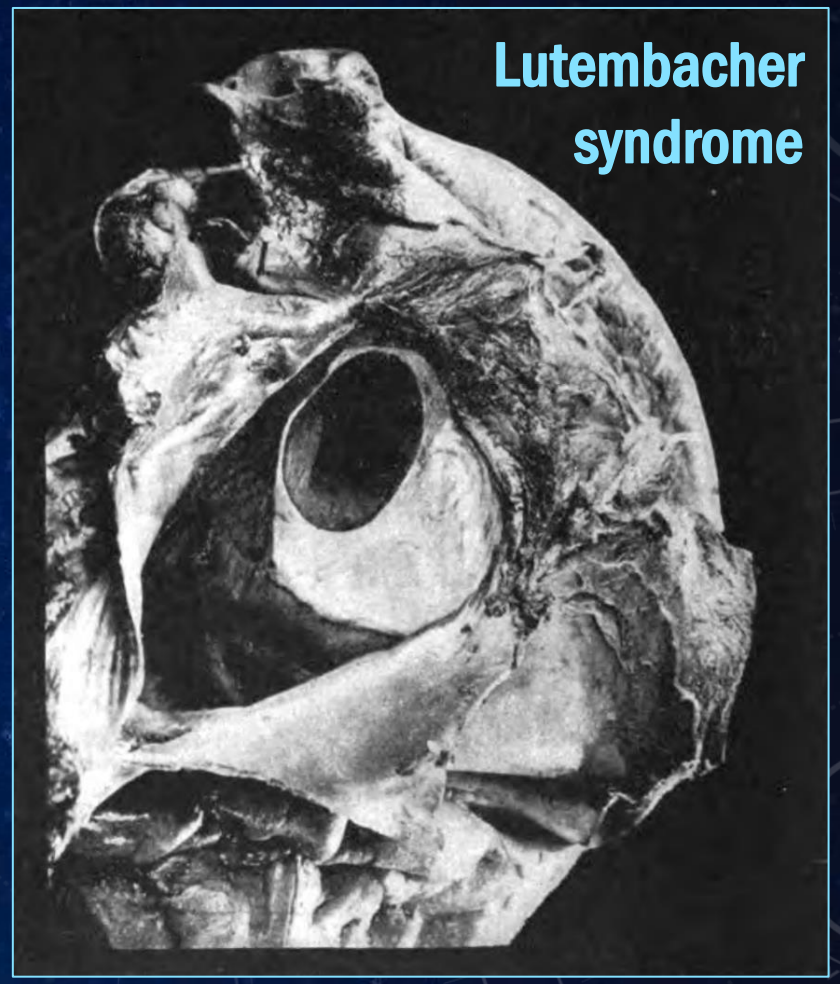
R. LUTEMBACHER

Les observations de sténose mitrale avec communication interauriculaire ne sont pas absolument rares, mais les faits rapportés sont loin d'être équivalents, tant au point de vue anatomique qu'au point de vue pathogénique. C'est pourquoi, de l'observation qui fait l'objet de cette étude, nous rapprocherons les faits déjà publiés. Leur lecture fera mieux comprendre la nécessité de les ranger en des groupes différents. Après avoir ainsi établi la délimitation des faits que nous étudions ici d'avec les faits connexes, nous préciserons certains de leurs caractères cliniques et anatomiques, en cherchant de plus à dégager de l'étude de ce cas particulier certaines notions de pathogénie.

Lutembacher R. Arch Mal Coeur Vaiss 1916

ASD in the setting of mitral stenosis

- **Congenital ASD in the setting of mitral stenosis**
  - ⇢ Decompression of ↑LA pressure
  - ⇢ Large reservoir: right atrium, great veins, hepatic veins
  - ⇢ But if too much L→R shunting → risk of RV failure, worse outcomes



Lutembacher R. Arch Mal Coeur Vaiss 1916

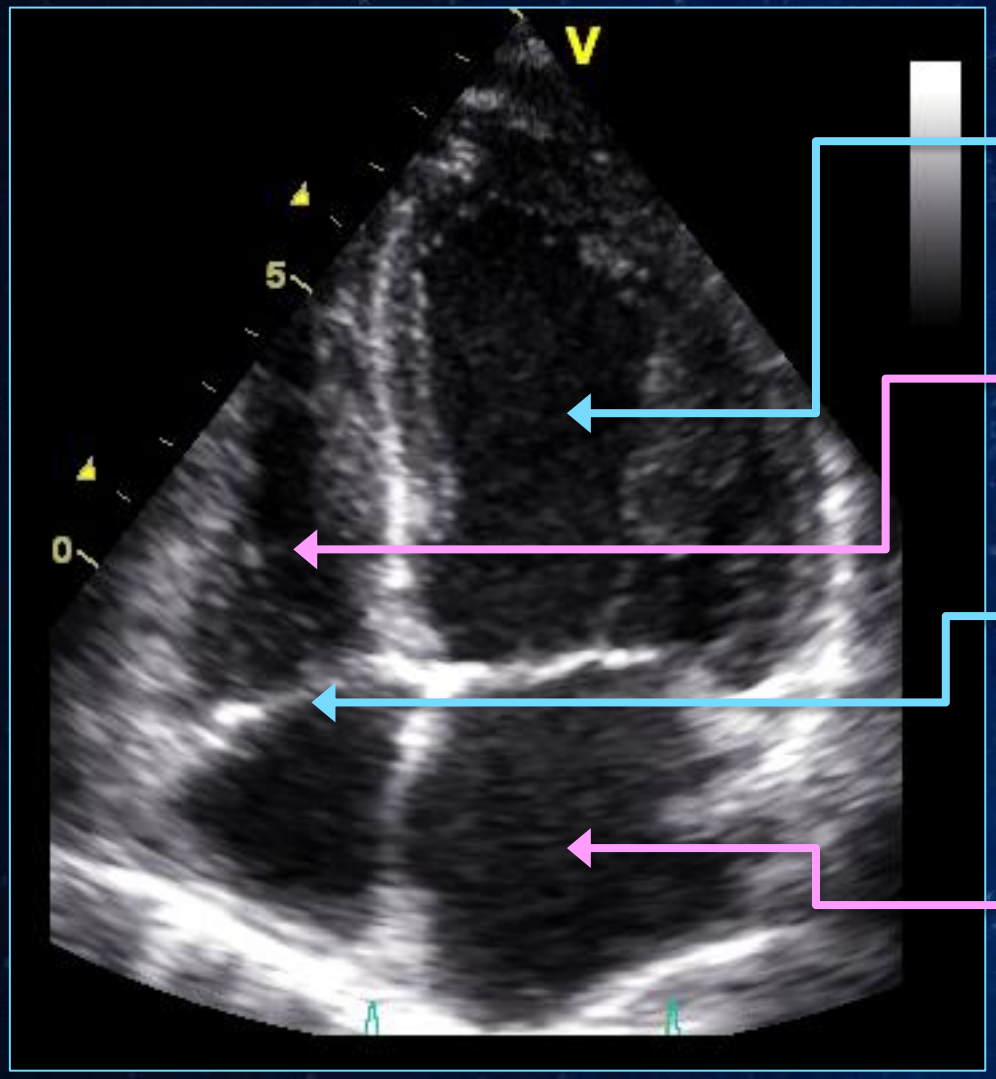
Effects of IASD on the heart

Findings from REDUCE LAP-HF II longitudinal echo analysis (1, 6, 12, 24 mo.)

Summary of changes over time (compared to sham)	Interpretation
LV and LA get smaller	Shunt is unloading left heart
LV longitudinal systolic function gets better	Shunt is unloading left heart
LA emptying fraction gets better	Shunt is unloading LA
LA pressure goes down	Shunt is unloading LA
Degree of MR goes down (-0.2 grades)	Shunt is unloading LA
RA and RV get larger	Shunt is working (LA→RA)
Degree of TR goes up (+0.2 grades)	Effect of RA/RV dilation
No difference in PASP and RA pressure between groups	Shunt ≠ hemodynamic stress
No difference in RV systolic function between groups	RV function is preserved

Patel RB...Shah SJ. JAMA Cardiology 2024 (in press)

Effects of IASD on the heart



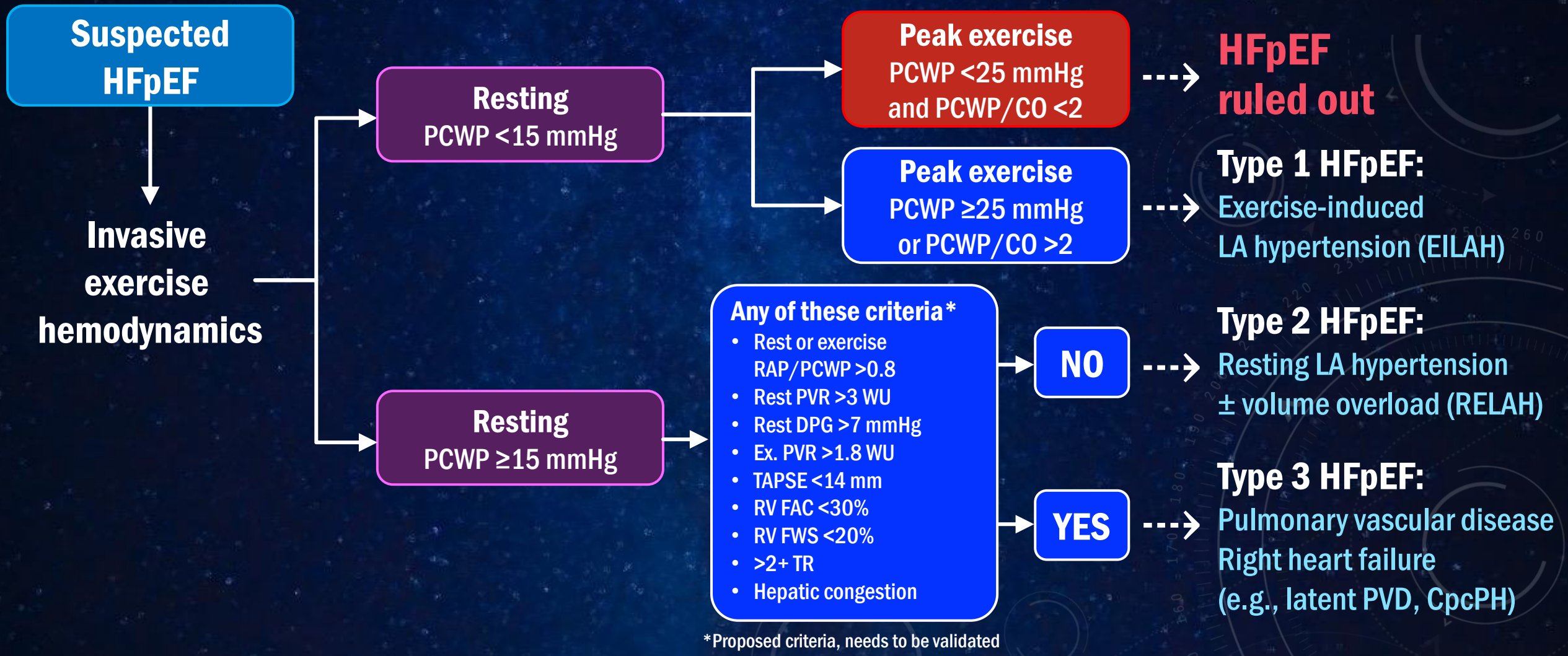
LV and LA get smaller: Avoid HCM, avoid low output states

RV and RA get bigger: Avoid vulnerable RV, overt RV failure, RA failure

Tricuspid annulus will dilate: Avoid moderate or greater TR

Blood needs to get back to left heart: Avoid pulmonary vascular disease, tricuspid/pulmonary valve obstruction

Hemodynamic HFpEF phenotypes



Jagadeesen V, Gray W, Shah SJ. JSCAI 2024

Hemodynamic HFpEF phenotypes

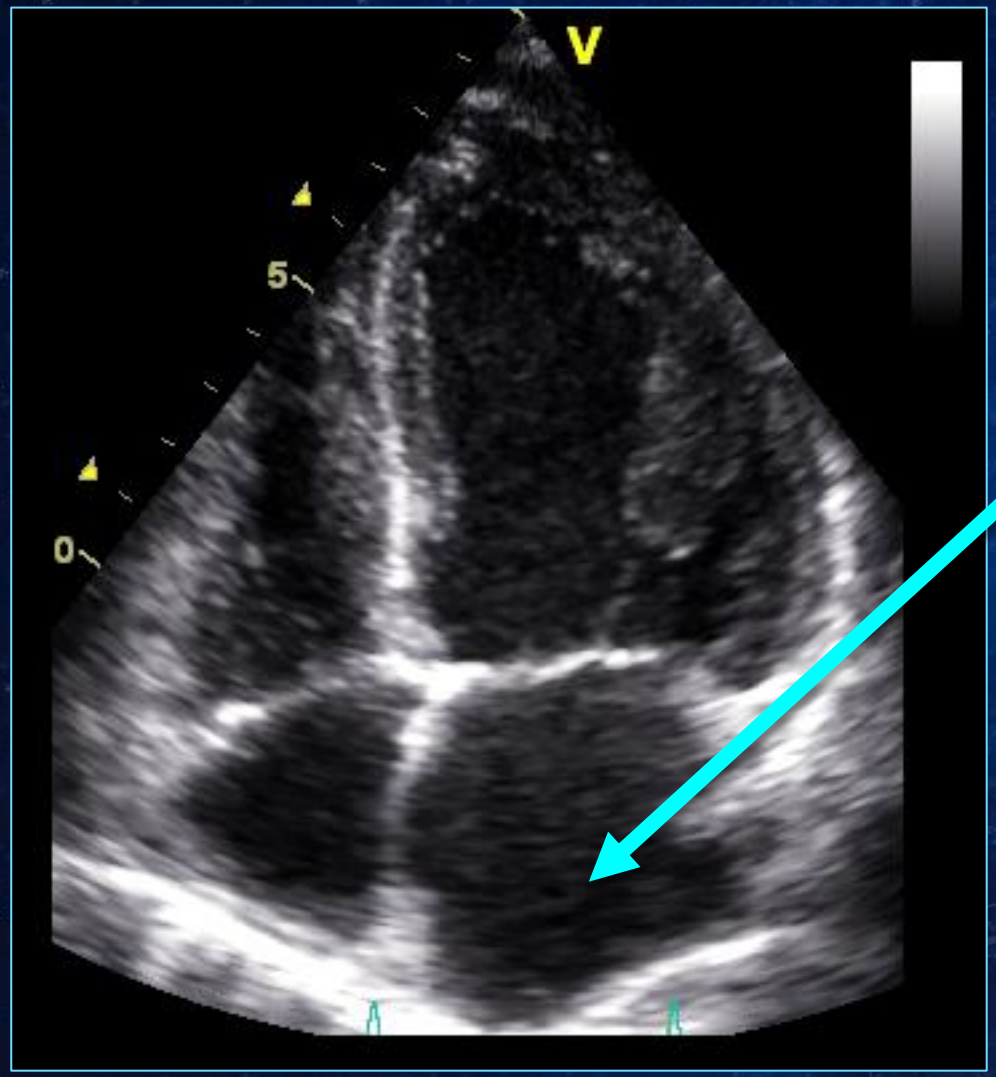
---> **HFpEF ruled out** → **Not an interatrial shunt candidate**

---> **Type 1 HFpEF:**
Exercise-induced LA hypertension (EILAH) → **Evaluate further for interatrial shunt**

---> **Type 2 HFpEF:**
Resting LA hypertension ± volume overload (RELAH) → **Diurese and reevaluate**

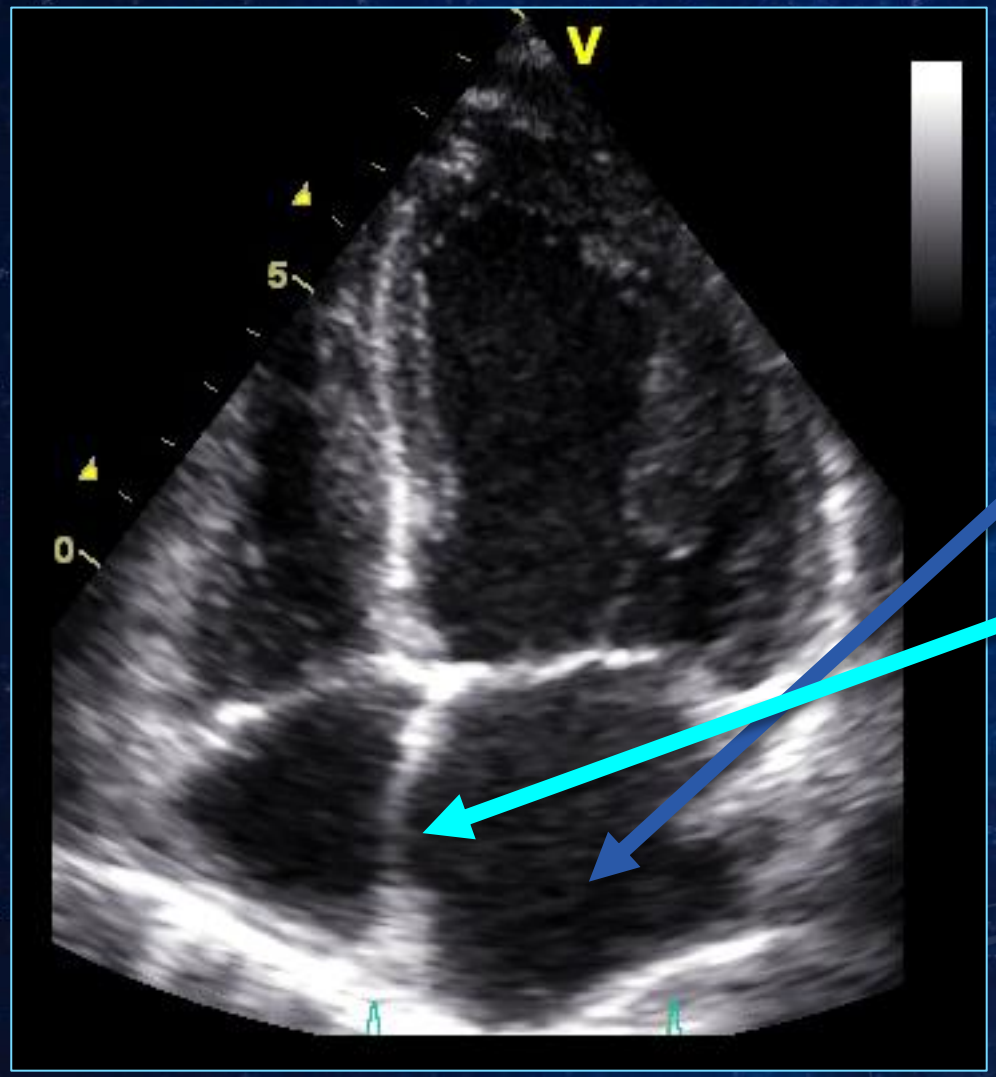
---> **Type 3 HFpEF:**
Pulmonary vascular disease
Right heart failure
(e.g., latent PVD, CpcPH) → **Not an interatrial shunt candidate**

Echo evaluation for optimal candidate



Left atrial enlargement
(LA size > RA size)

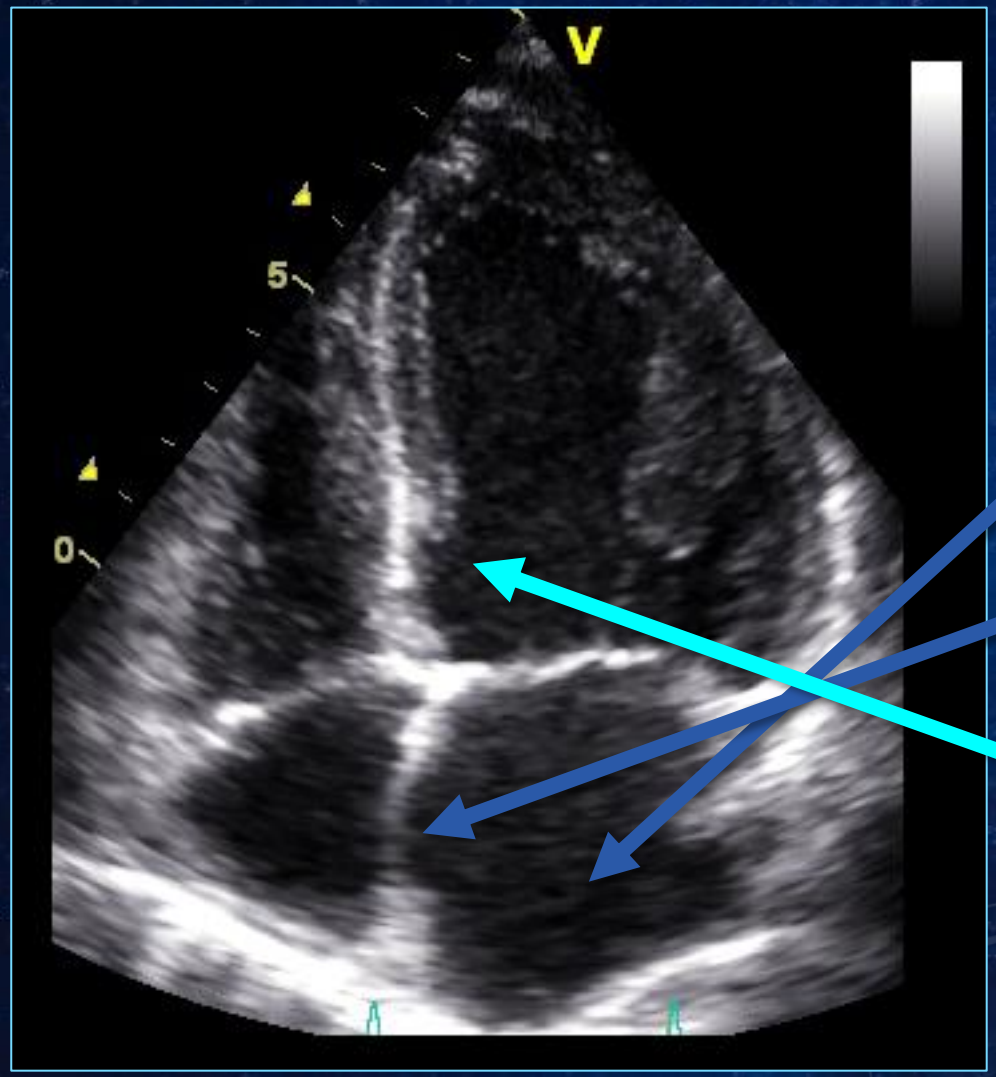
Echo evaluation for optimal candidate



Left atrial enlargement (LA size > RA size)

Interatrial septum bows from left to right

Echo evaluation for optimal candidate

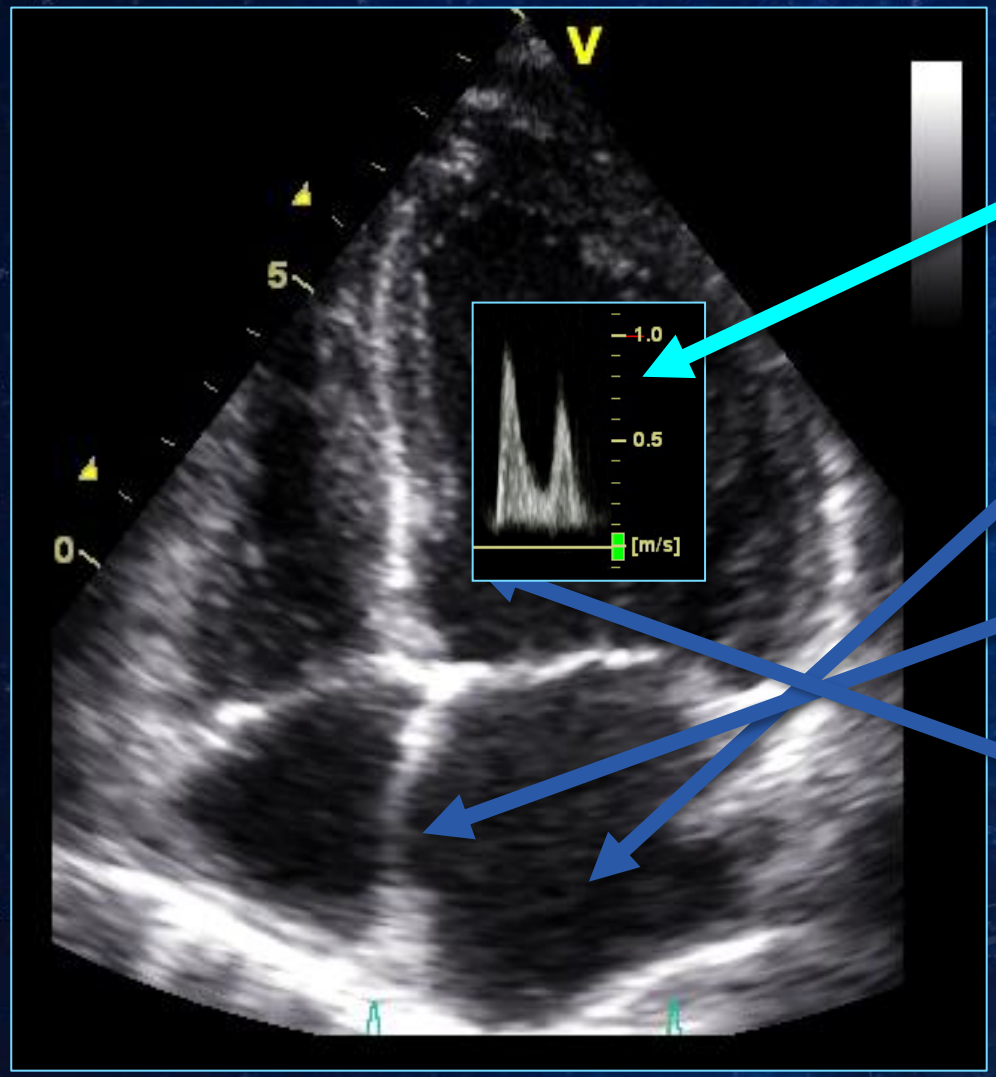


Left atrial enlargement (LA size > RA size)

Interatrial septum bows from left to right

No evidence of septal flattening or septal bounce

Echo evaluation for optimal candidate



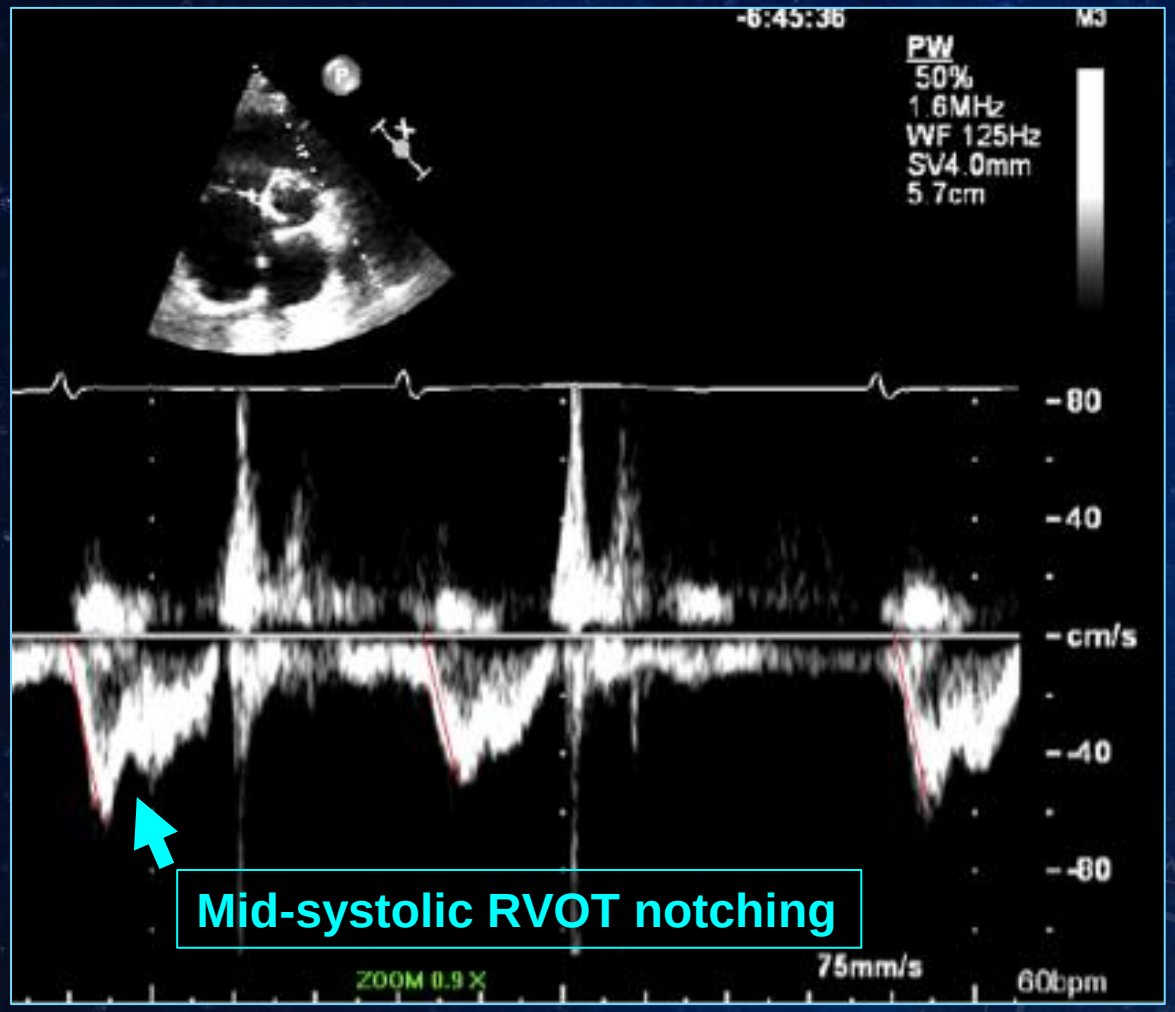
If ↑↑PASP, make sure E/A ratio >1

Left atrial enlargement (LA size > RA size)

Interatrial septum bows from left to right

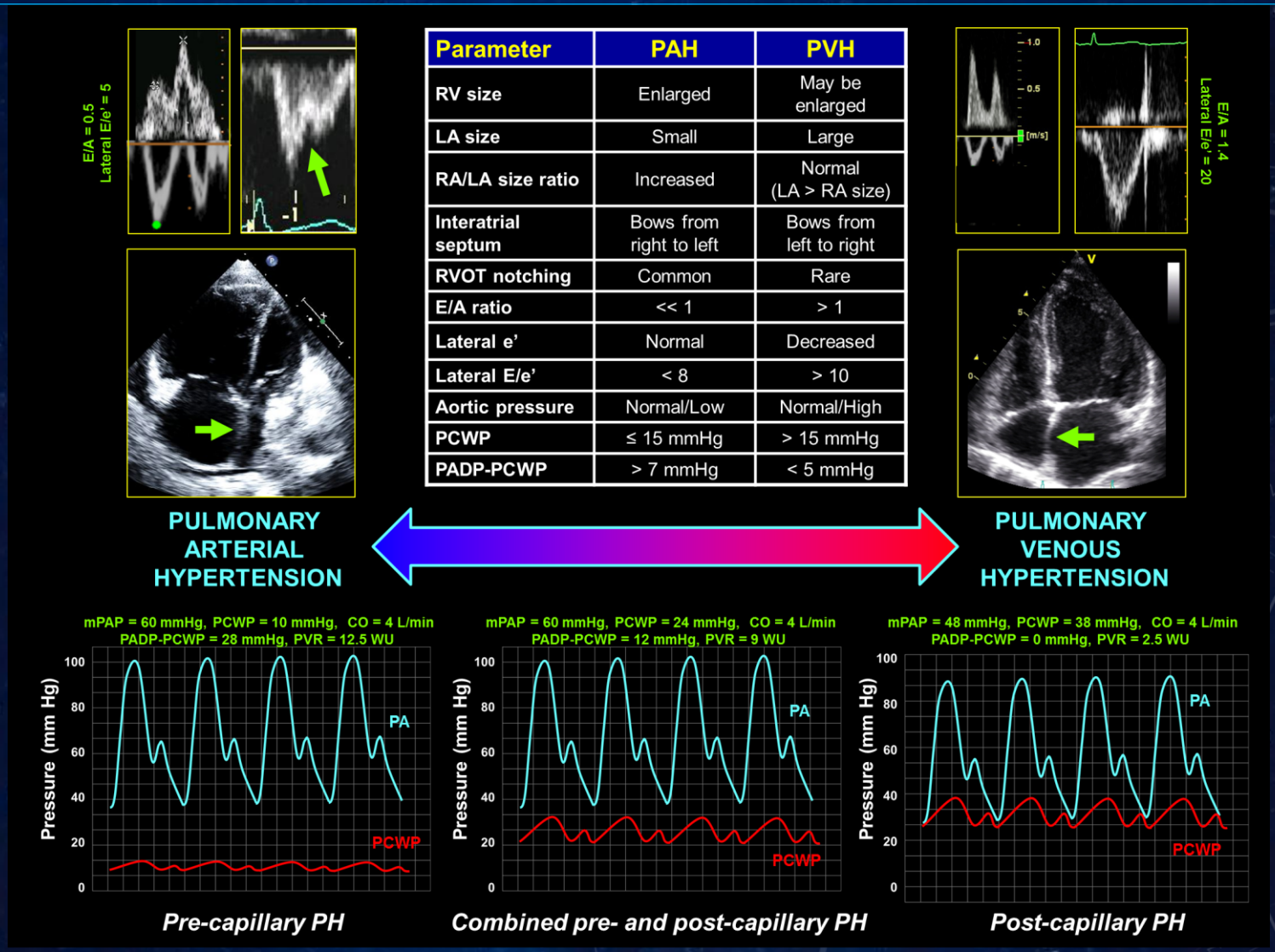
No evidence of septal flattening or septal bounce

Echo evaluation for optimal candidate



RVOT notching on PW Doppler is associated with high PVR: unlikely to benefit from interatrial shunting!

PAH vs. PVH spectrum



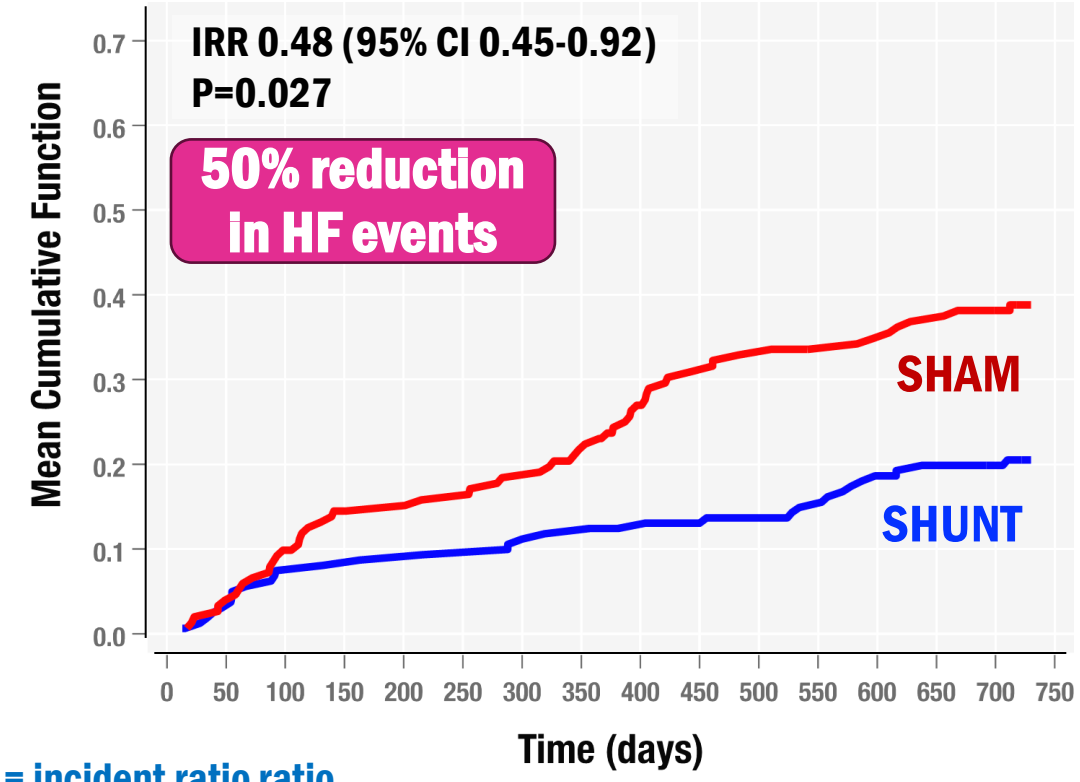
Parameter	PAH	PVH
RV size	Enlarged	May be enlarged
LA size	Small	Large
RA/LA size ratio	Increased	Normal (LA > RA size)
Interatrial septum	Bows from right to left	Bows from left to right
RVOT notching	Common	Rare
E/A ratio	<< 1	> 1
Lateral e'	Normal	Decreased
Lateral E/e'	< 8	> 10
Aortic pressure	Normal/Low	Normal/High
PCWP	≤ 15 mmHg	> 15 mmHg
PADP-PCWP	> 7 mmHg	< 5 mmHg

McLaughlin VV, Shah SJ, et al. JACC 2015

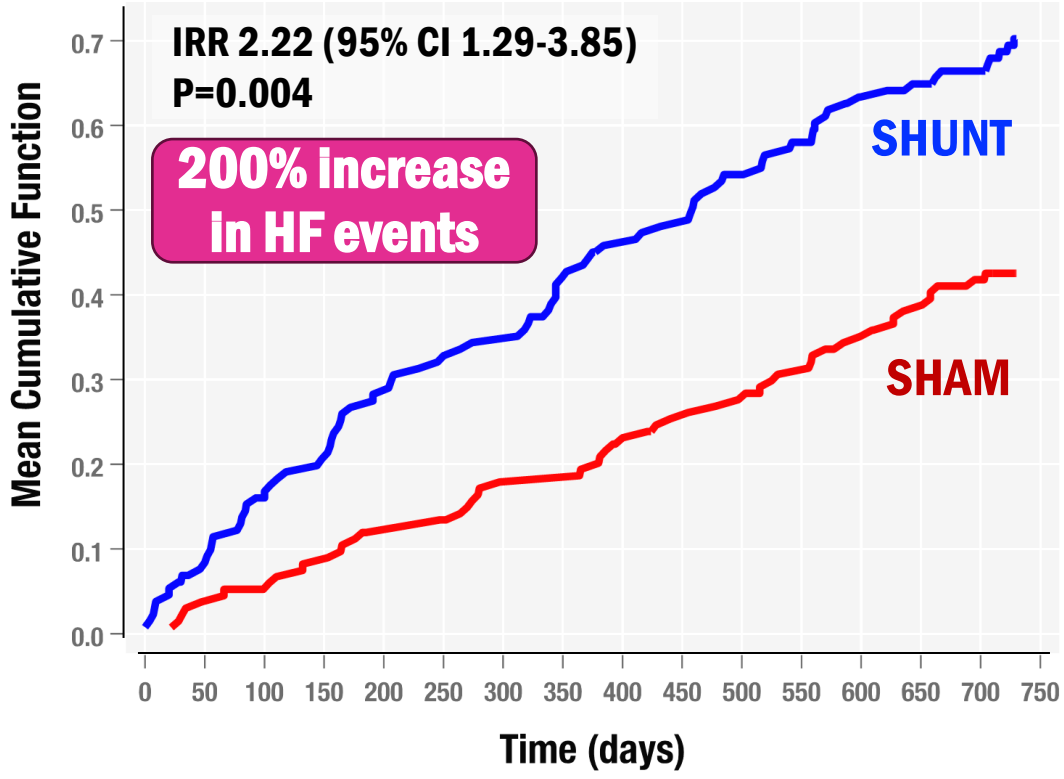
REDUCE LAP-HF II: Responder analysis

24-month recurrent HF events analysis

RESPONDERS (win ratio = 1.36)



NON-RESPONDERS (win ratio = 0.73)



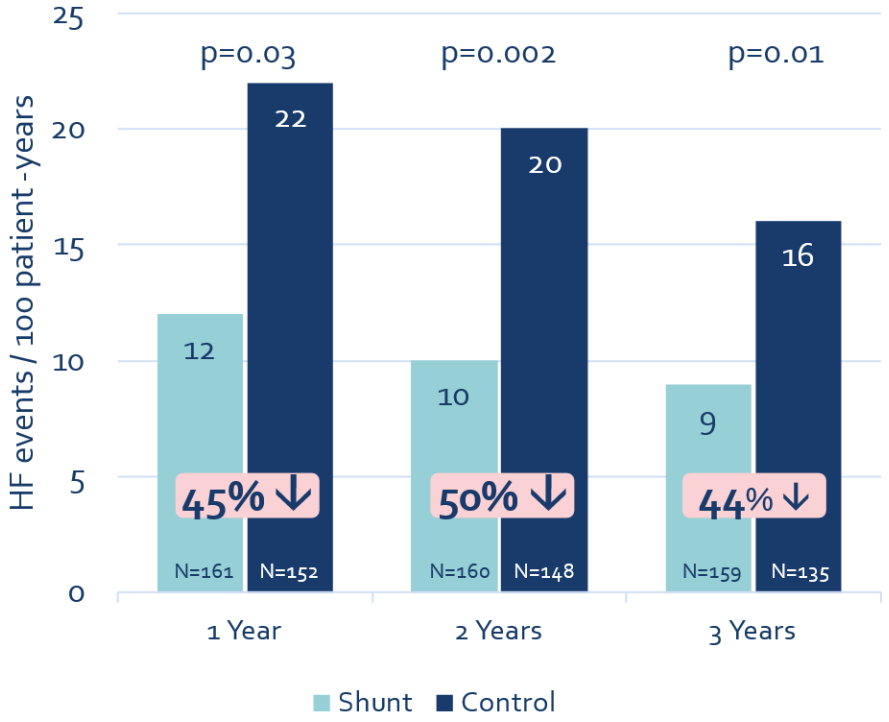
IRR = incident ratio ratio

Gustafsson F...Shah SJ. ESC-HFA 2023

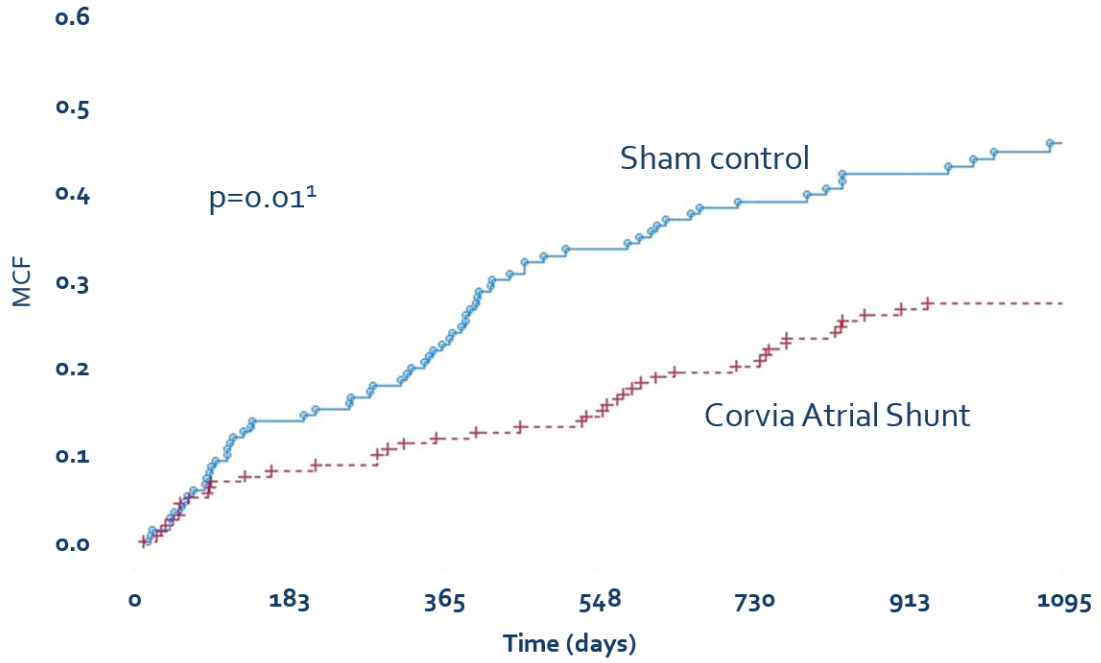
REDUCE LAP-HF II: Responder analysis

3-Year Results in the Responder Group: Shunt vs. Sham

Heart Failure Event Rate



Mean Cumulative Heart Failure Events



Treatment	161	160	160	159	155	150	133
Control	152	150	150	146	139	118	101

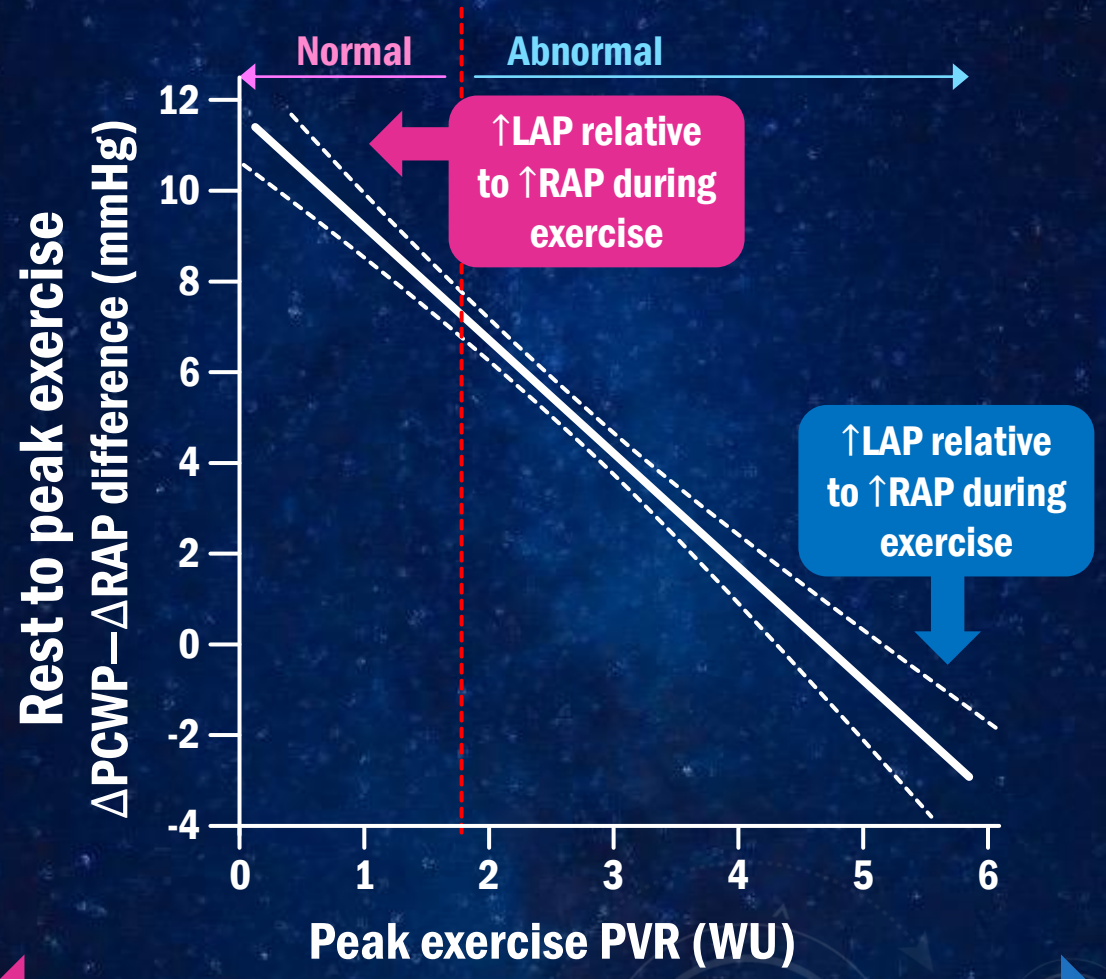
Unpublished data

Latent PVD: Novel HFpEF phenotype

Potential Rx:
- Atrial shunt devices
- Greater splanchnic? nerve ablation?
- Nitrites?

Pathophysiology:
- Excessive ↑LA pressure during exercise → dynamic ↑pulmonary venous pressures but able to augment SV, CO → dyspnea

Lower risk HFpEF phenotype



Potential Rx:
- Levosimendan?
- Sotatercept?
- Pulmonary vasodilators?

Pathophysiology:
- Excessive ↑RA pressure + inability to augment SV during exercise → ↓exercise CO, ↑dead space → dyspnea

Higher risk HFpEF phenotype

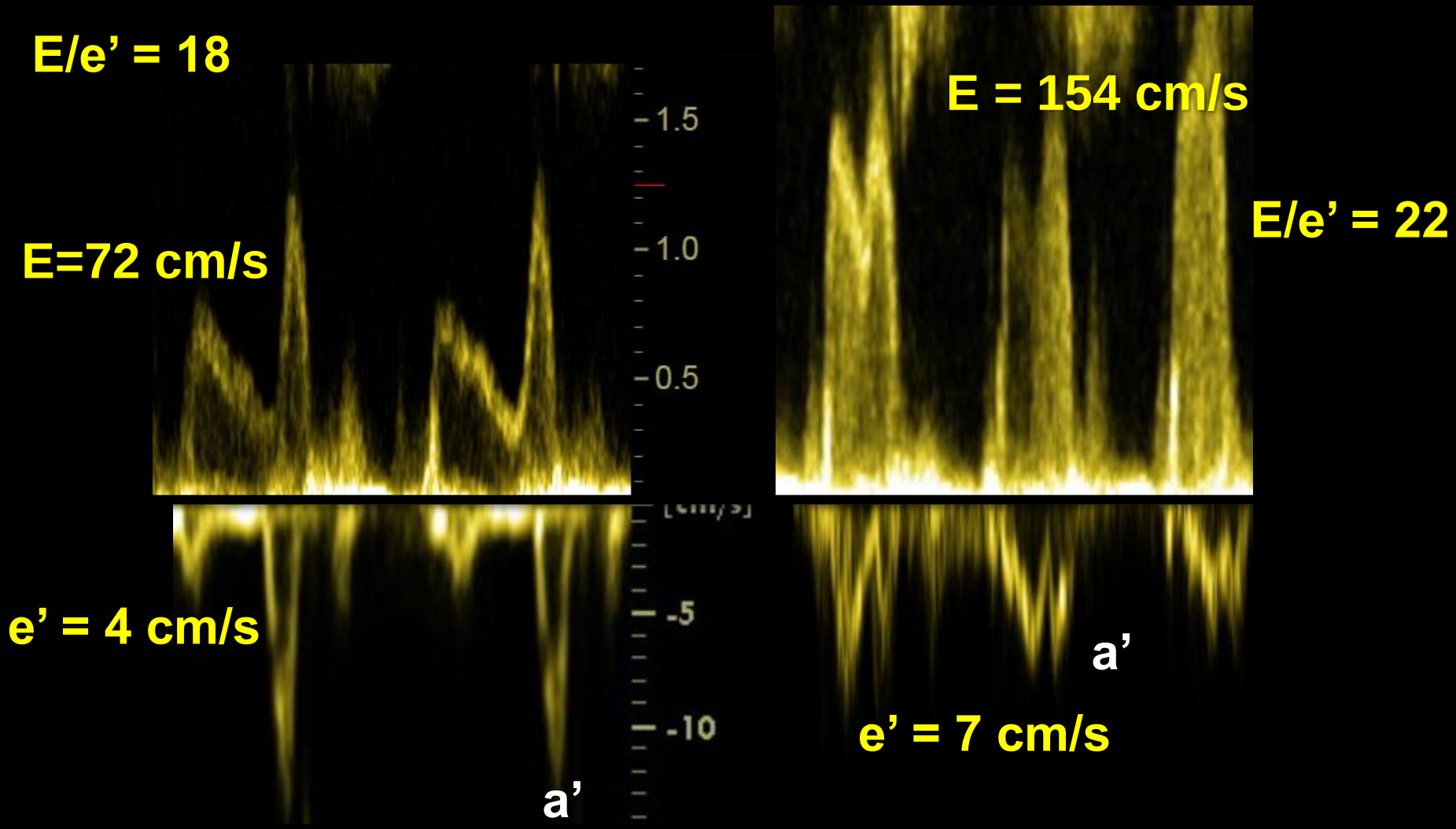
Normal pulmonary vasculature

Phenotypic spectrum of pulmonary vascular disease

Abnormal pulmonary vasculature

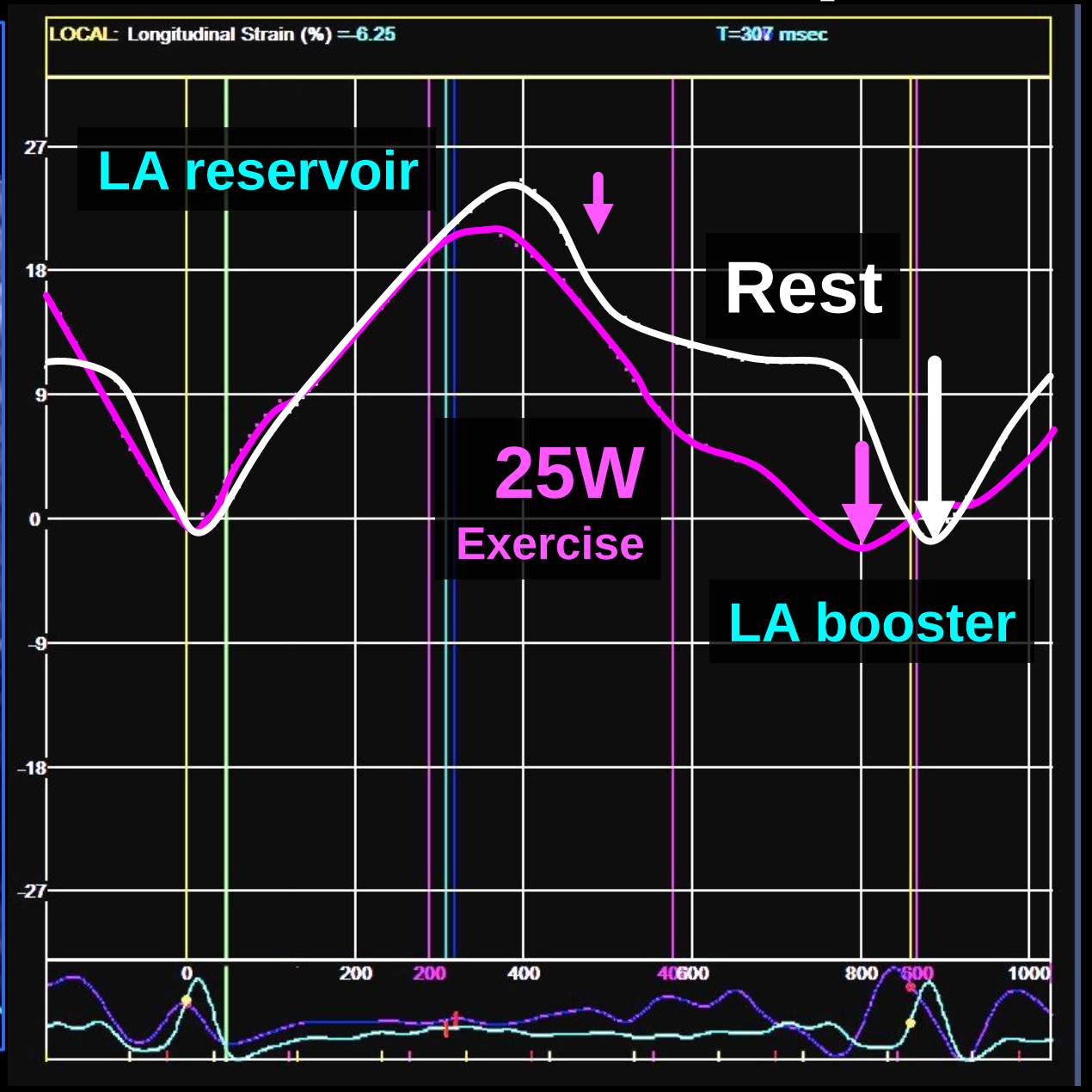
Oakland HT, Shah SJ. JACC Heart Fail 2023

72-year-old woman with HFpEF



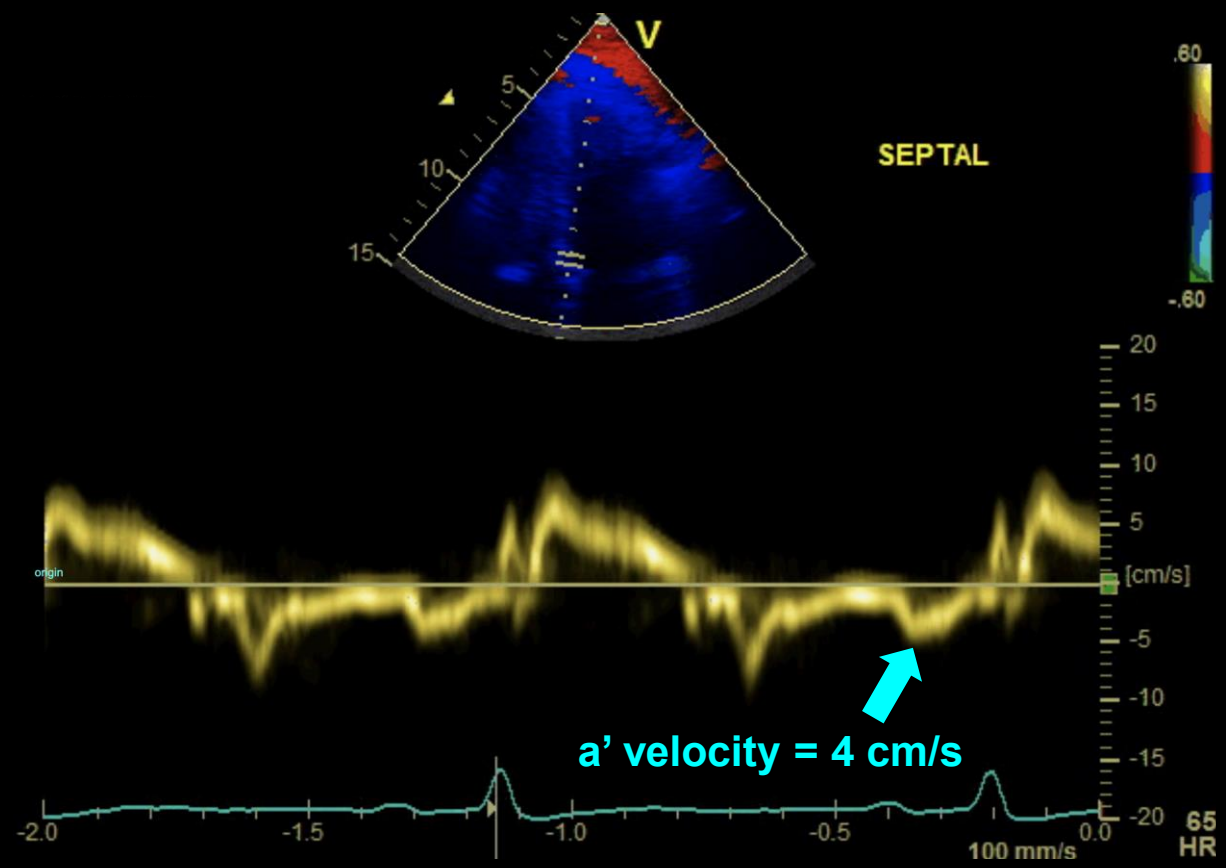
Source: Sanjiv Shah, MD
HFpEF Lab, Northwestern Univ.

72-year-old woman with HFpEF

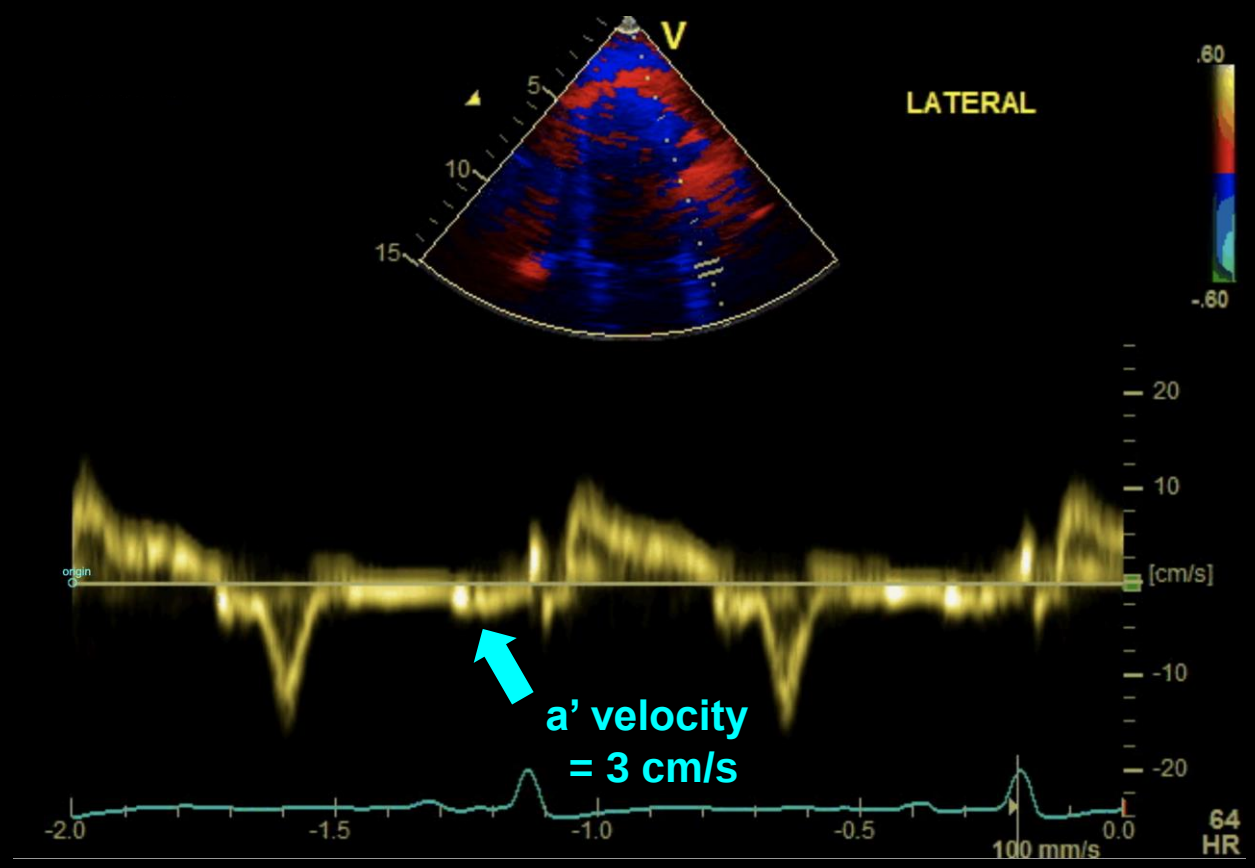


Source: Sanjiv Shah, MD
HFpEF Lab, Northwestern Univ.

3 years later: 75-year-old woman with HFpEF



Septal TDI

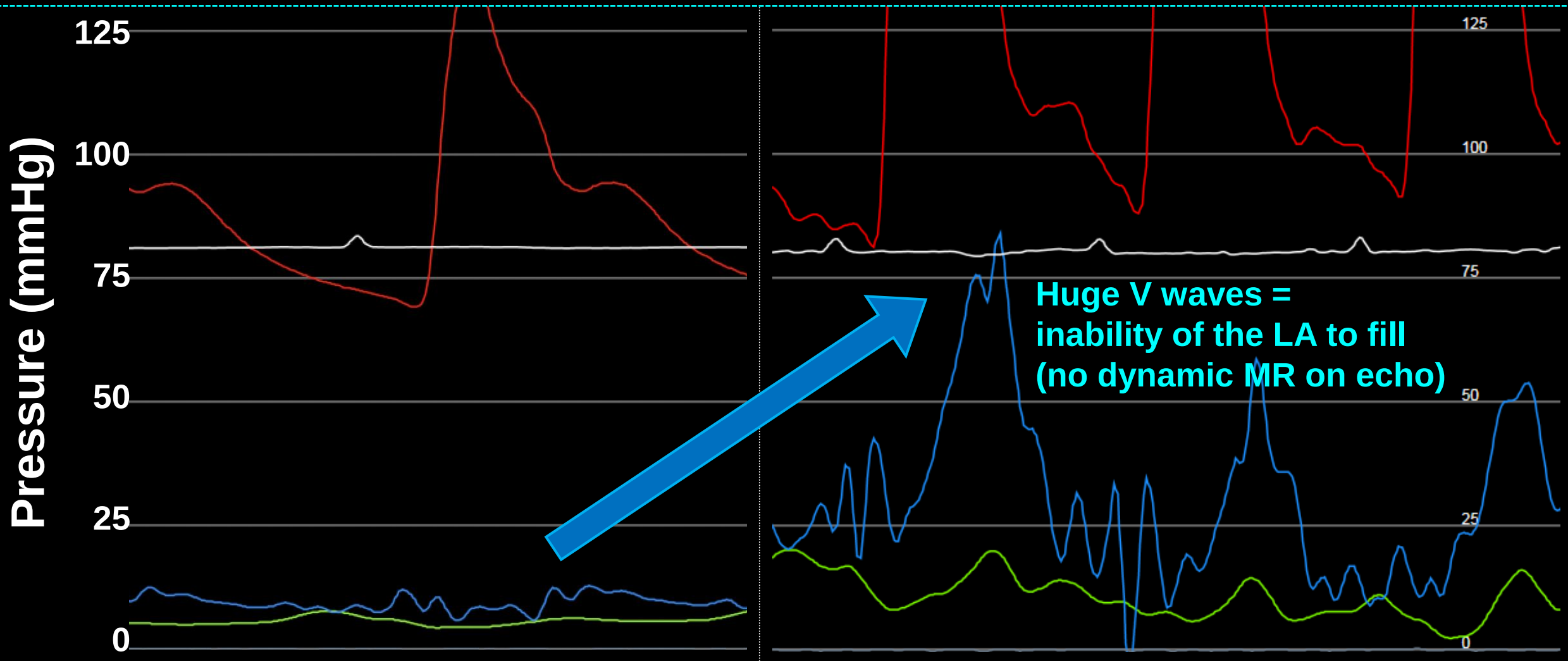


Lateral TDI

Source: Sanjiv Shah, MD
HFpEF Lab, Northwestern Univ.

Severely reduced a' velocities: LA myopathy

3 years later: 75-year-old woman with HFpEF



Rest:

PCWP = 14 mmHg

20W exercise:

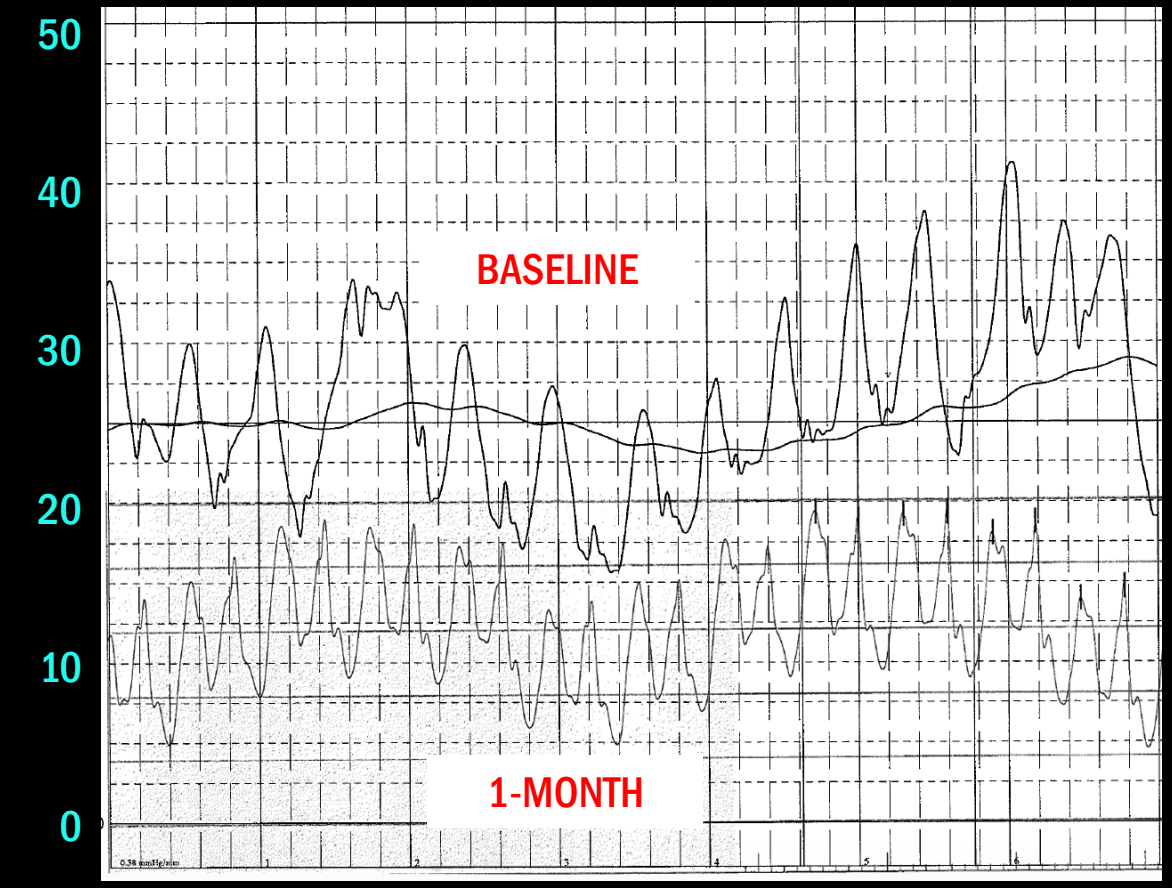
PCWP (V-waves) = 75+ mmHg

Source: Sanjiv Shah, MD
HFpEF Lab, Northwestern Univ.

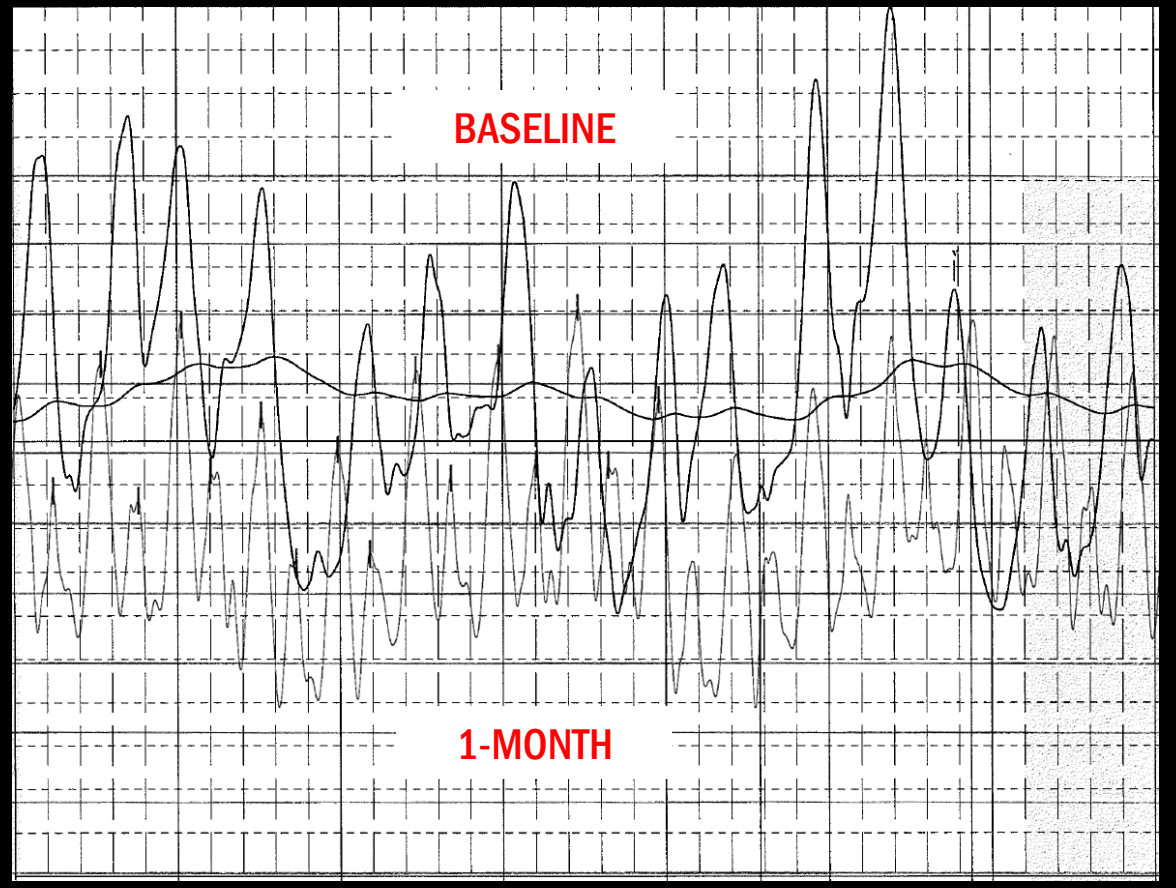
75-year-old woman with HFpEF, LA myopathy

PARTICIPATED IN REDUCE LAP-HF I RCT: RANDOMIZED TO SHUNT DEVICE

Resting PCWP (mmHg)



Peak exercise PCWP (mmHg)

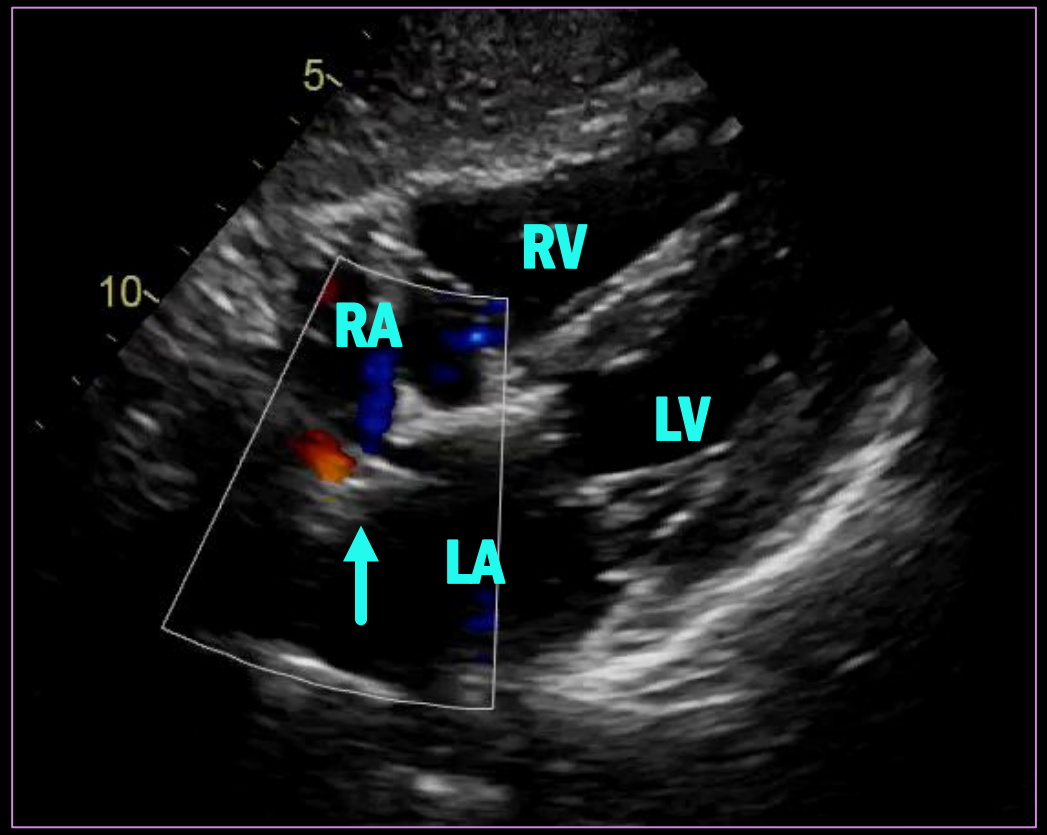


Shah SJ. THT Scientific Sessions 2023

75-year-old woman with HFpEF, LA myopathy

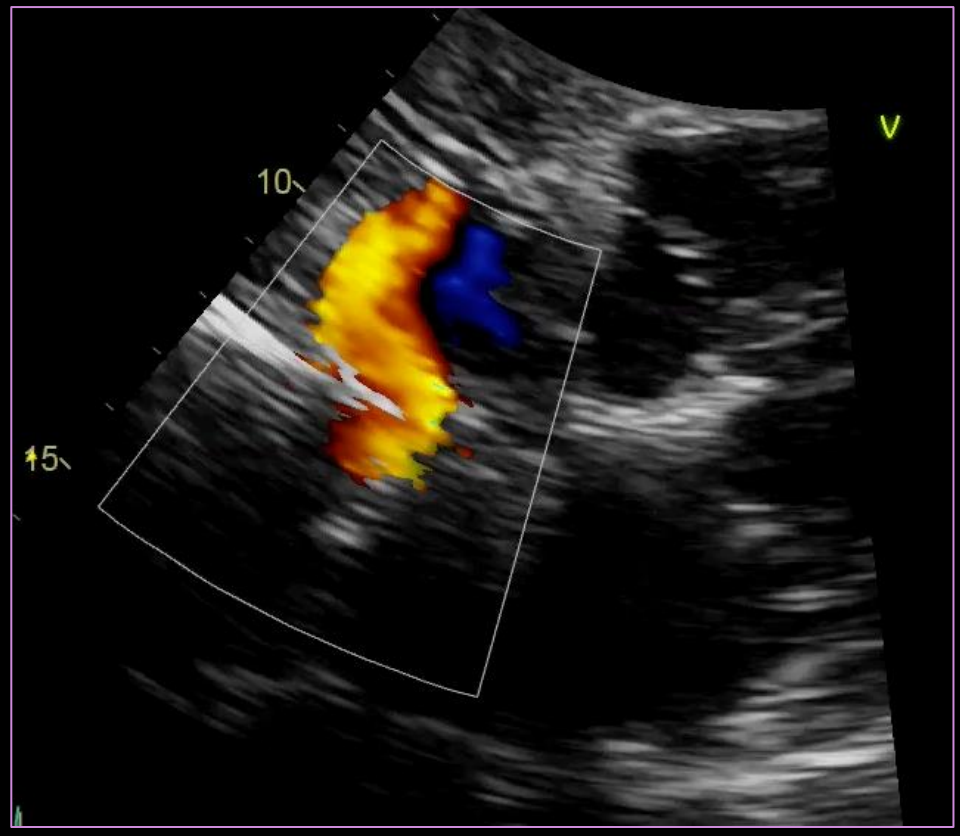
PARTICIPATED IN REDUCE LAP-HF I RCT: RANDOMIZED TO SHUNT DEVICE

Subcostal view



12-month echo

Subcostal view (zoomed)



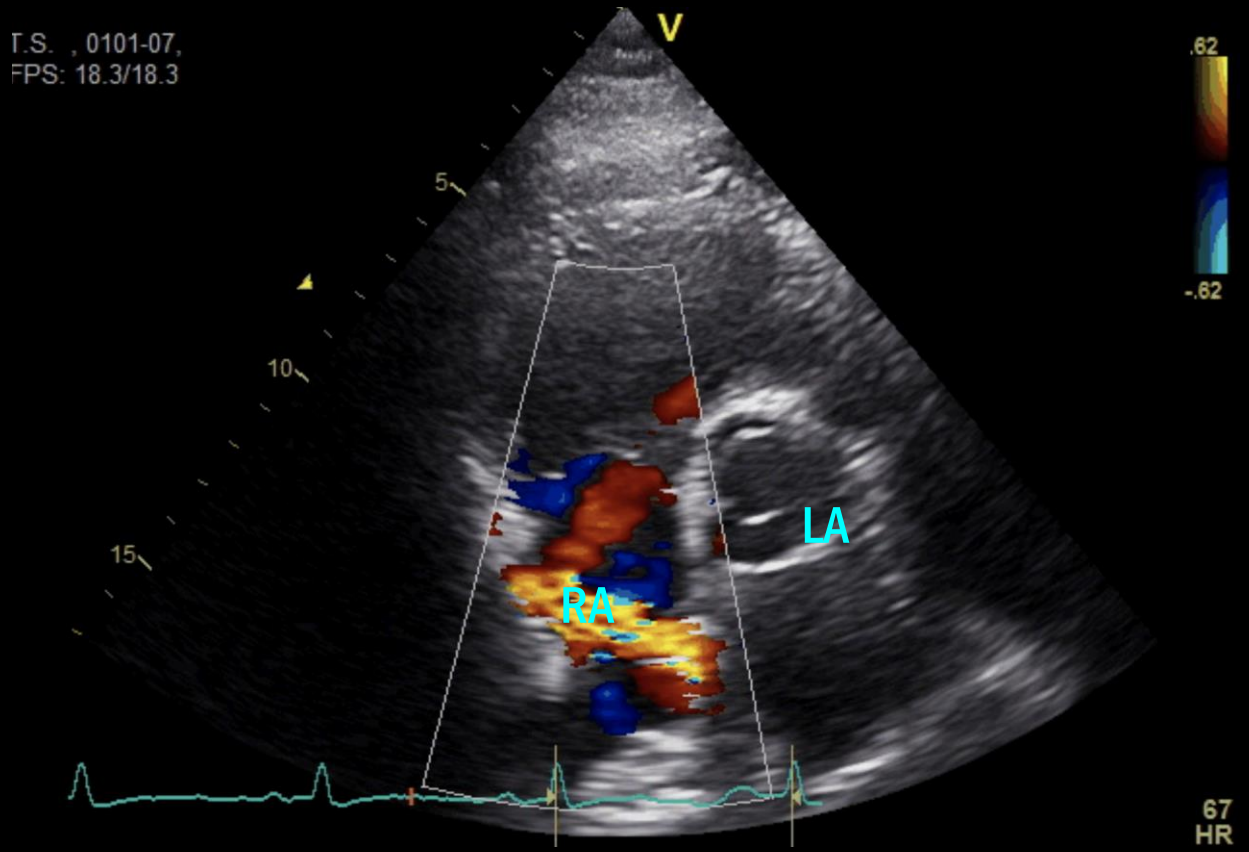
12-month echo

Shah SJ. THT Scientific Sessions 2023

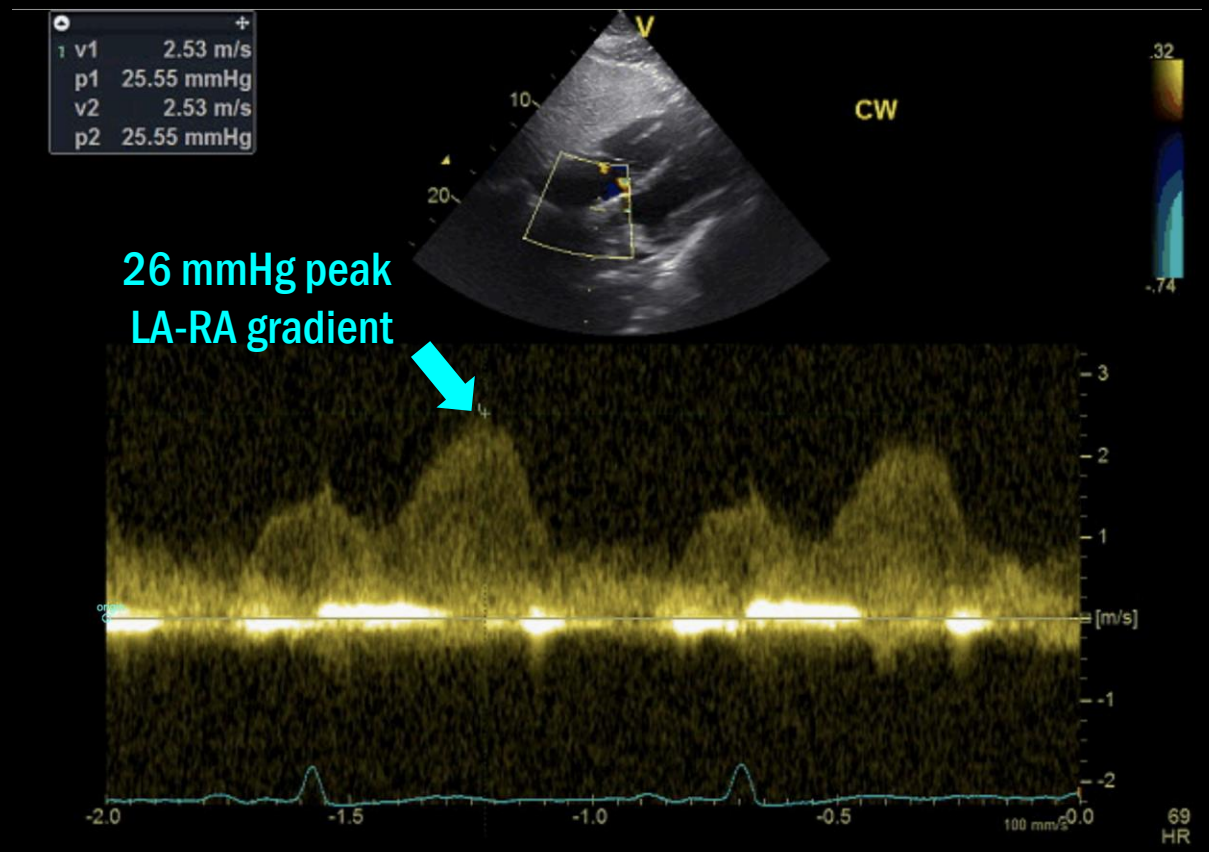
75-year-old woman with HFpEF, LA myopathy

PARTICIPATED IN REDUCE LAP-HF I RCT: RANDOMIZED TO SHUNT DEVICE

3 years after atrial shunt device placement



PSAX Ao valve view



CW Doppler across IASD

Take home points

- **Interatrial shunts:** Promising treatment for **selected** patients with HF… first do no harm!
- **Patient selection is key:** Avoid low output states, obstructive HCM, RA/RV failure, significant TR, prior tricuspid valve intervention, and significant pulmonary vascular disease
- **Look for clues on the echocardiogram:** Interatrial septum bows L→R, LA bigger than RA, normal RA/RV, small IVC, no RVOT notching, less than moderate TR
- **Exercise RHC:** Critical test to determine benefit/harm of shunt