How could interatrial shunting be beneficial in heart failure and pulmonary hypertension?

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Mechanisms of Exercise Intolerance in Heart Failure With Preserved Ejection Fraction

Barry A. Borlaug, MD

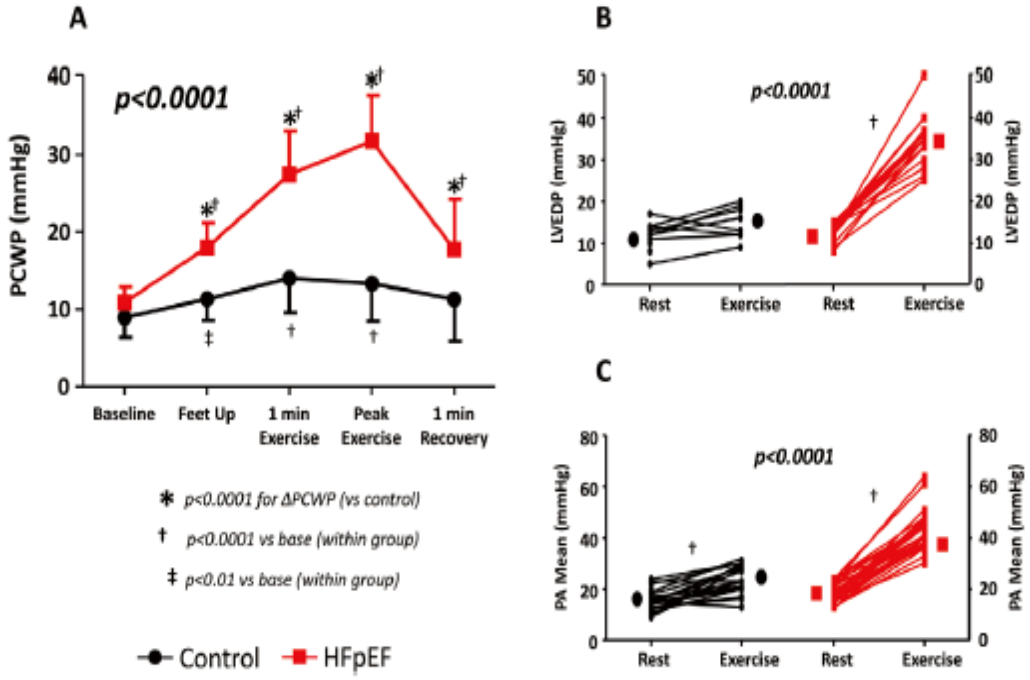
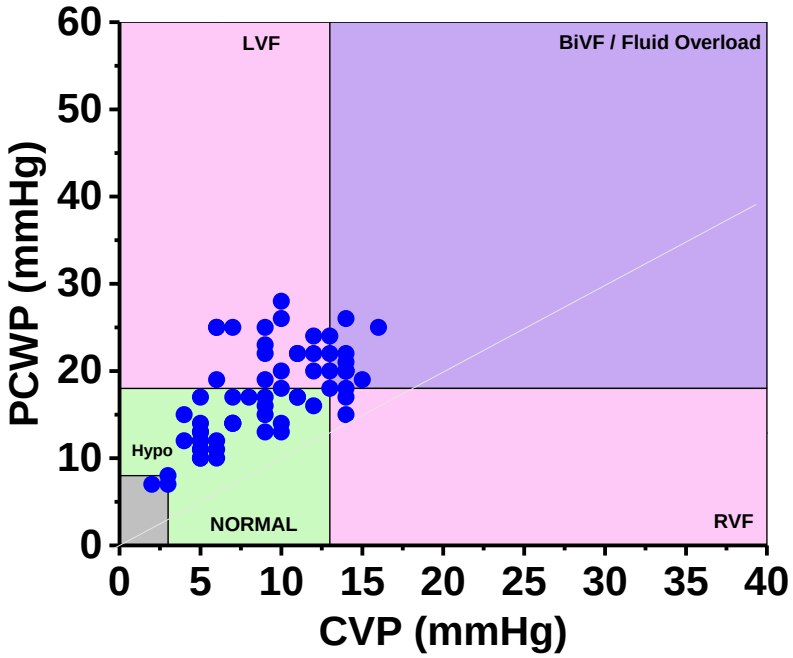


Figure 2. Filling pressures and pulmonary artery (PA) pressures during exercise in early heart failure with preserved ejection fraction (HFpEF). (**A**) Despite normal resting pulmonary capillary wedge pressures (PCWP), patients with early-stage HFpEF develop a dramatic elevation in PCWP with even 1 min of low level (20 Watts) exercise, that rapidly returns to baseline values with cessation of exercise. (**B**) This increase in PCWP is secondary to exercise-induced elevation in LV end-diastolic pressure (LVEDP) in HFpEF and is coupled with secondary, passive elevation in PA pressures (**C**), causing exercise-induced PA hypertension. (Adapted with permission from Borlaug et al.[49])

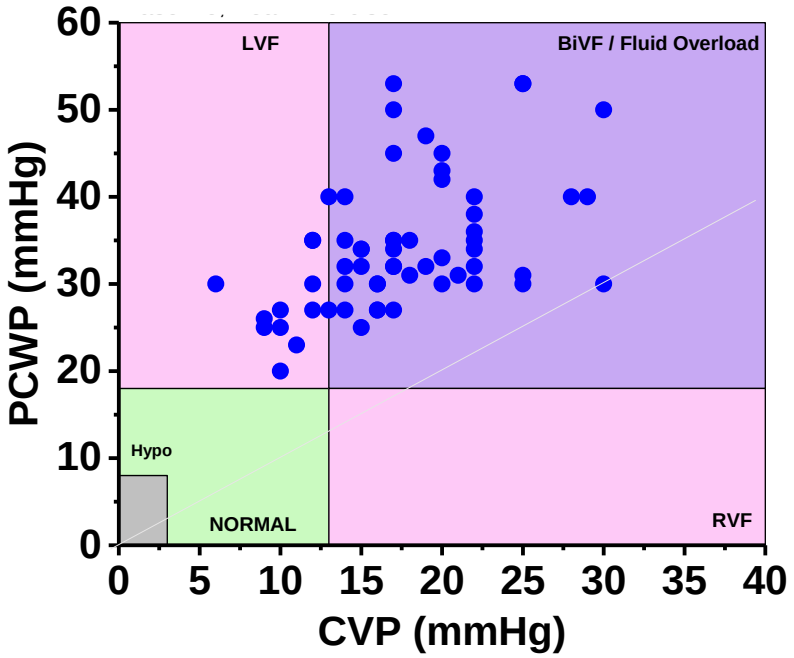
PCWP rises quickly and profoundly in HFpEF and may be the mechanism underlying effort intolerance

CVP versus PCWP in HFpEF

Rest

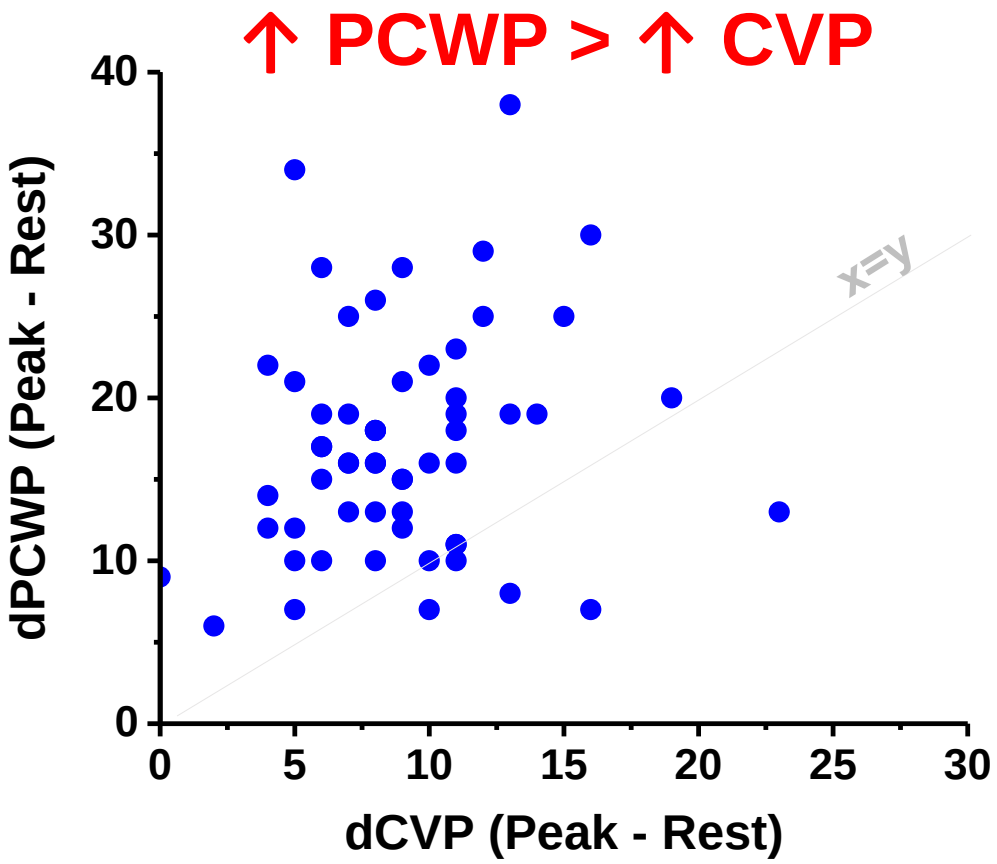


Peak Exercise



PCWP and CVP increase during exercise in HFpEF

CVP versus PCWP in HFpEF



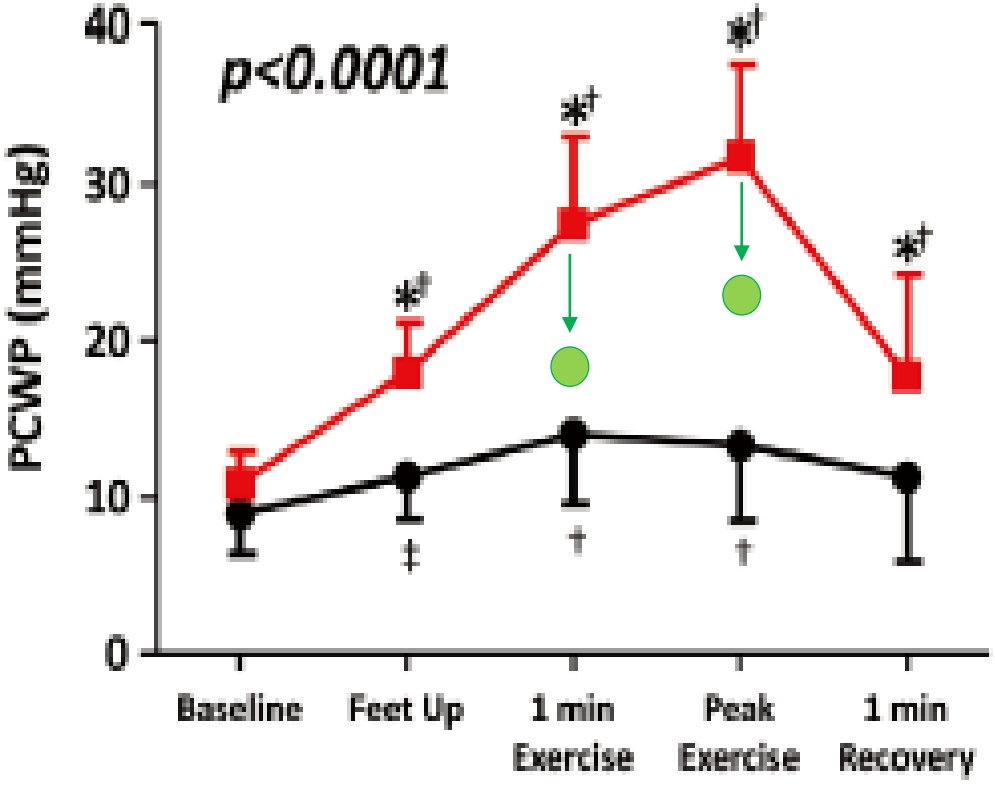
LA-RA Pressure gradient increases during exercise

What is the Cause of the Profound Increase of PCWP and CVP?

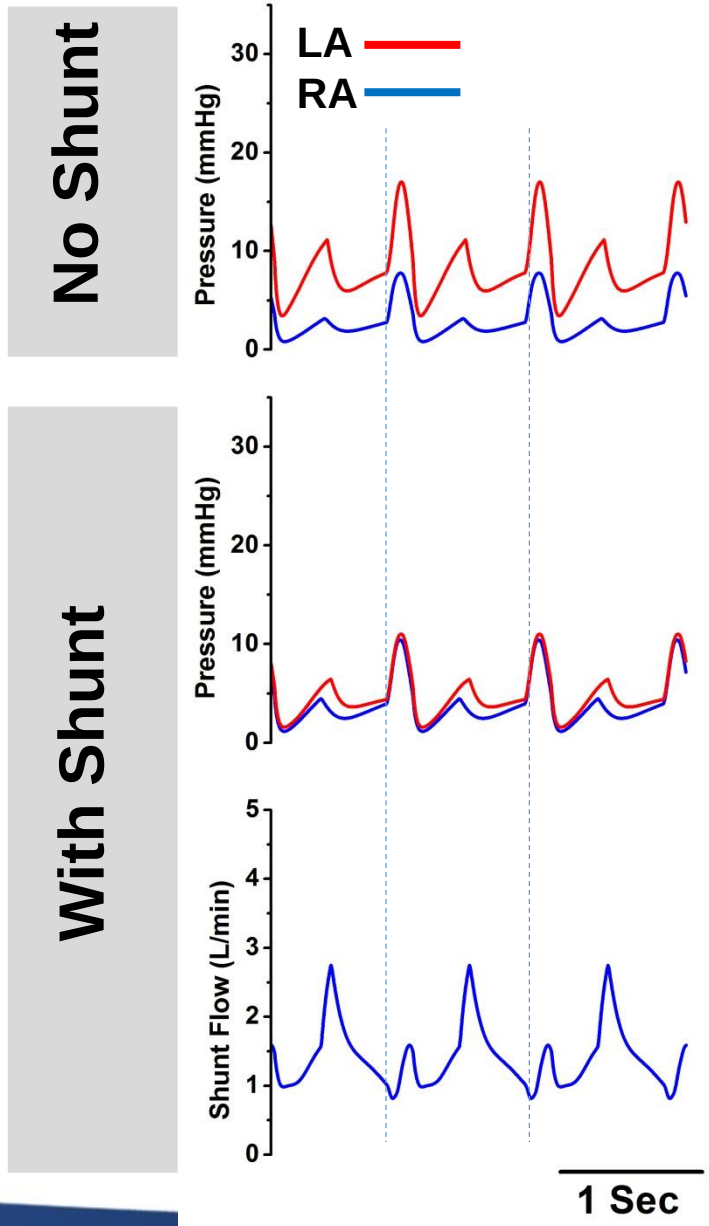
1. LV Diastolic Dysfunction ?
2. RV or LA Dysfunction ?
3. Autonomic-mediated vasoconstriction ?
   - Veno constriction
     - Volume shift from peripheral to central compartment
   - Arterial constriction
     - Hypertension
4. Pericardial Constraints ?

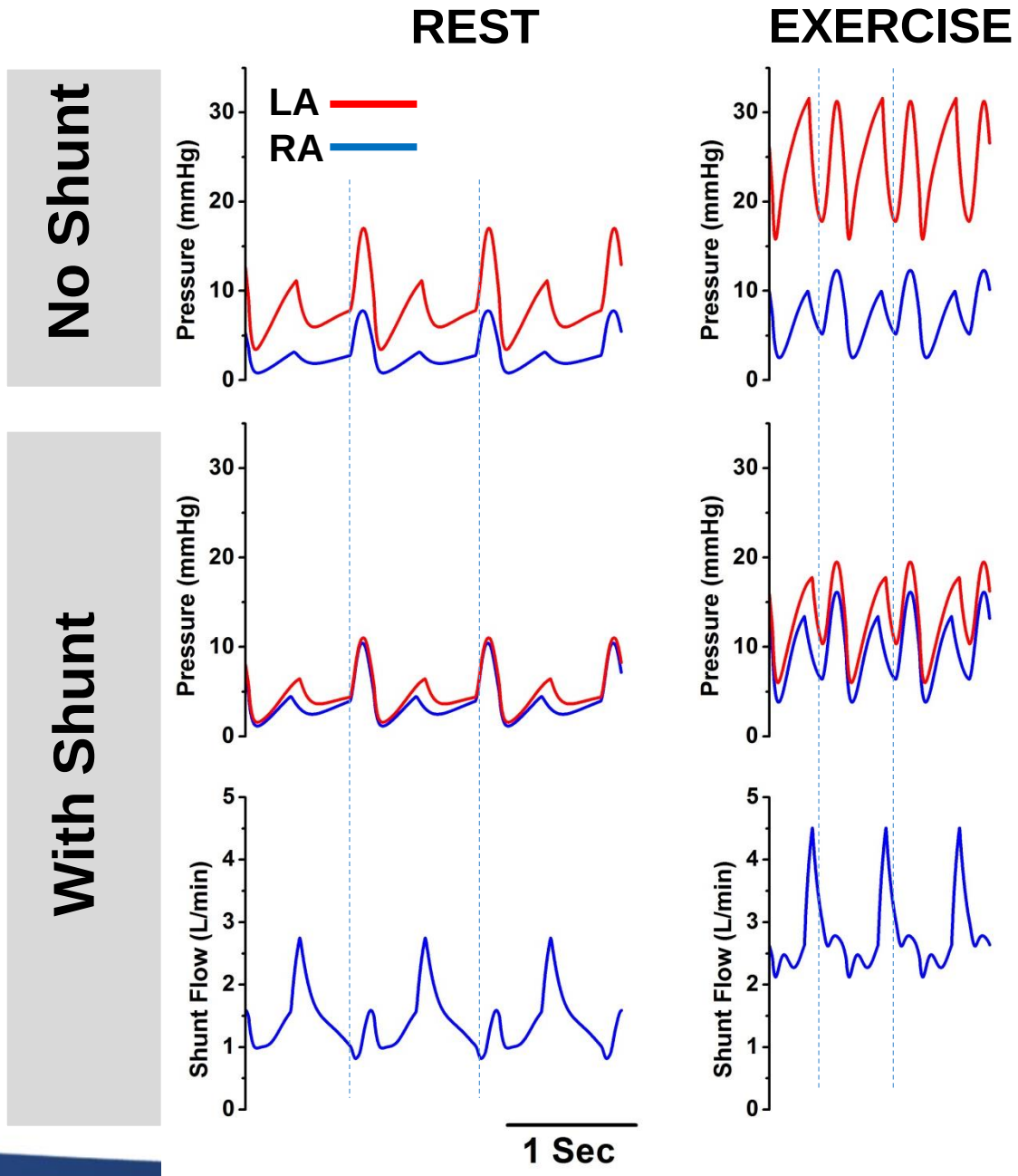
Hypothesis

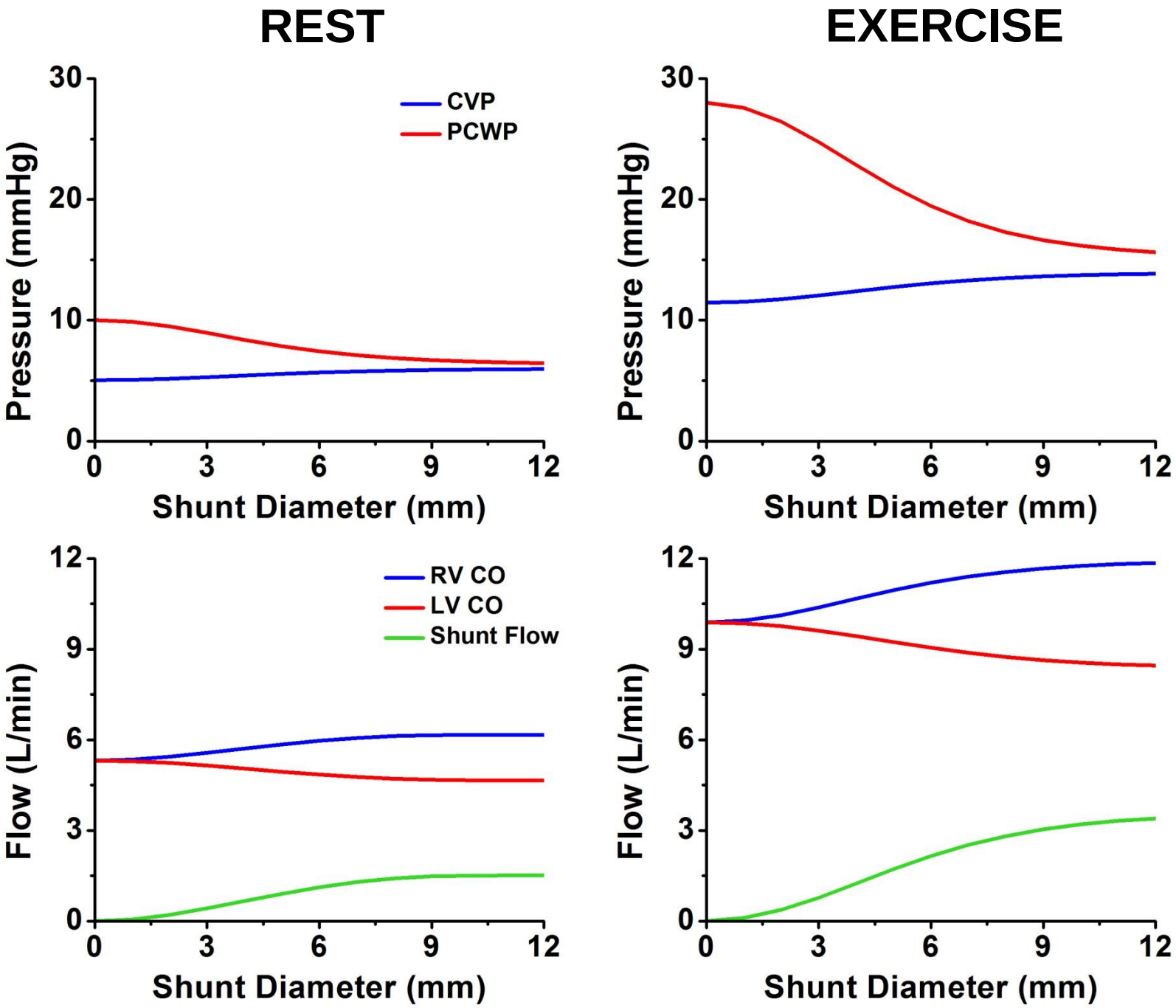
Interatrial shunt can reduce PCWP at a given workload



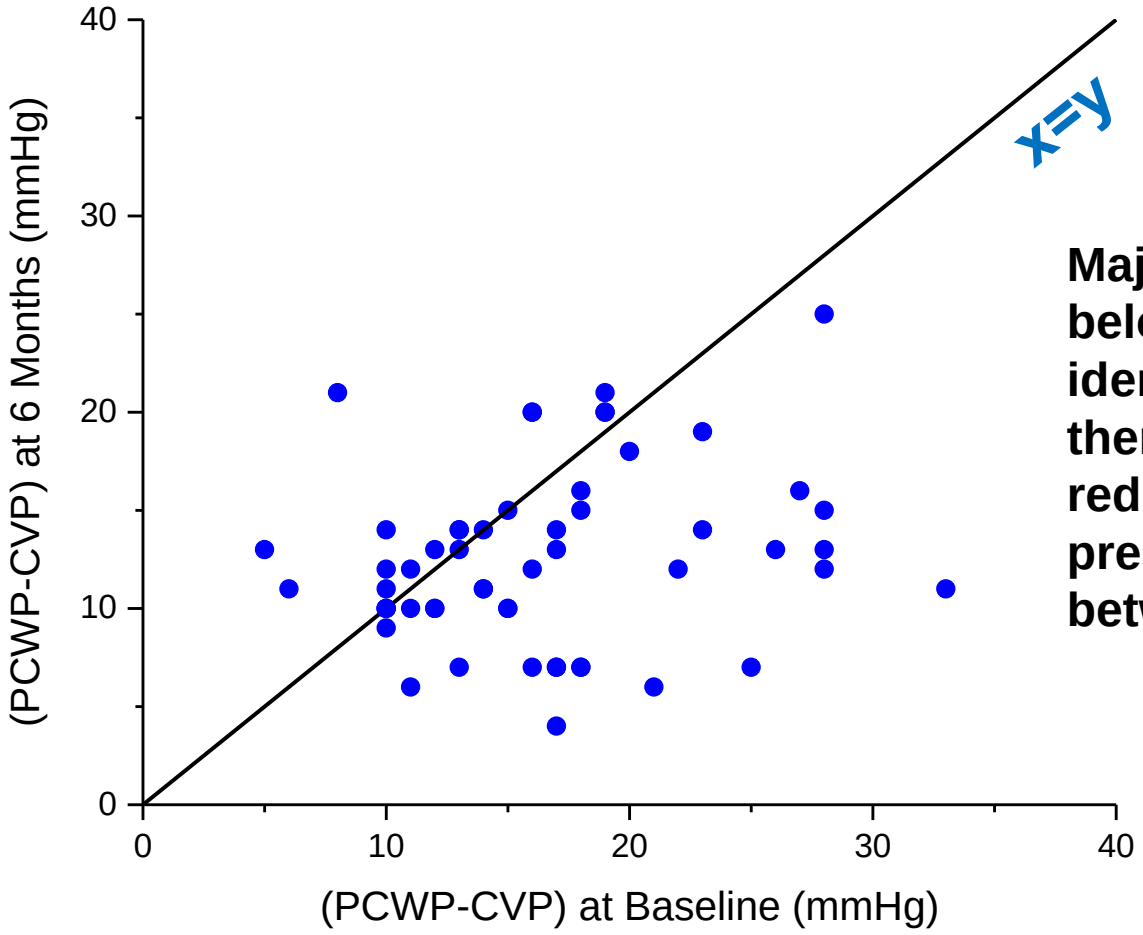
REST


No Shunt
With Shunt
LA
RA
Pressure (mmHg)
30
20
10
0
Pressure (mmHg)
30
20
10
0
Shunt Flow (L/min)
5
4
3
2
1
0
1 Sec


REST
EXERCISE
No Shunt
With Shunt
LA
RA
Pressure (mmHg)
Shunt Flow (L/min)
0
10
20
30
1
2
3
4
5
1 Sec


REST
EXERCISE
CVP
PCWP
Pressure (mmHg)
Shunt Diameter (mm)
RV CO
LV CO
Shunt Flow
Flow (L/min)
0
3
6
9
10
12
20
30

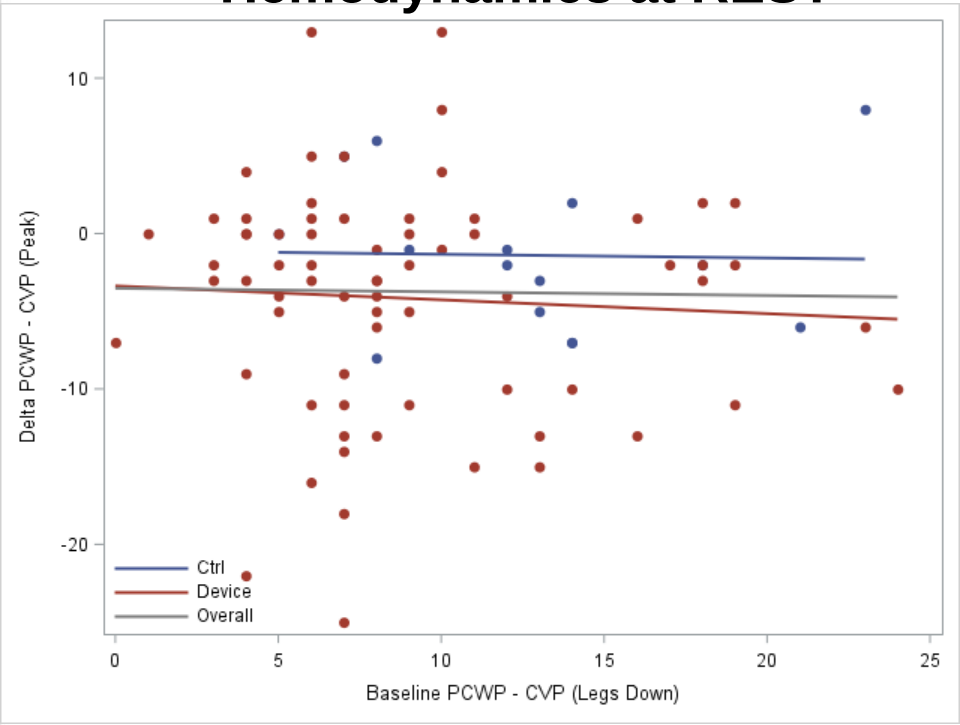
IASD® PCWP-CVP Difference at Peak Exercise Baseline vs. 6 Months



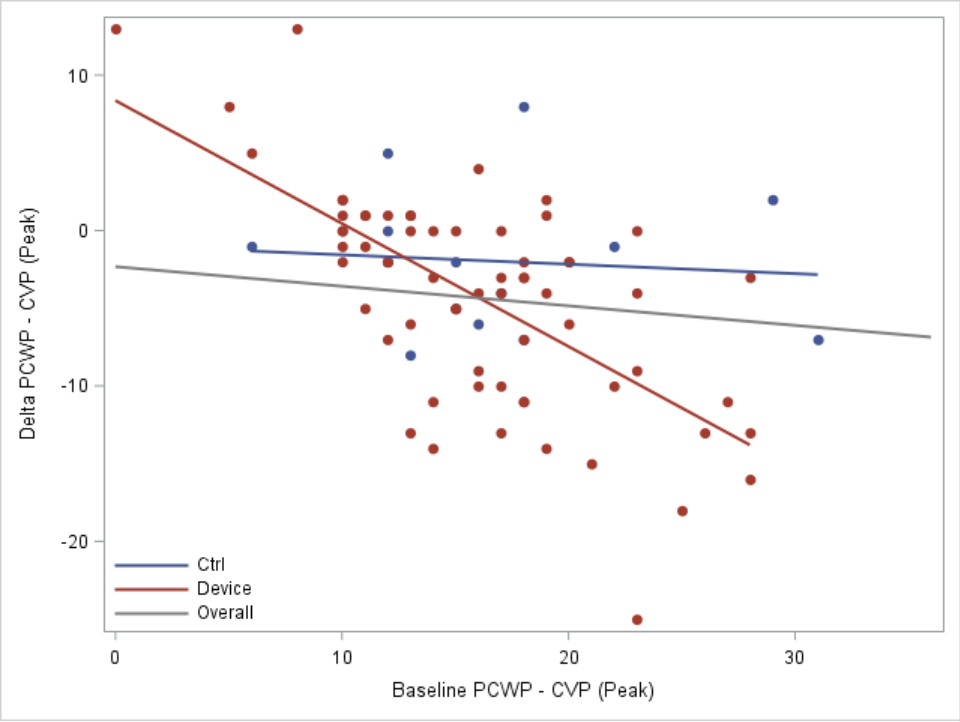
Majority of points below line of identity indicating there is a significant reduction in the pressure gradient between LA and RA

BASELINE (PCWP-CVP) correlates with Reduction of PCWP-CVP during EXERCISE but NOT at REST

Hemodynamics at REST



Hemodynamics during Exercise

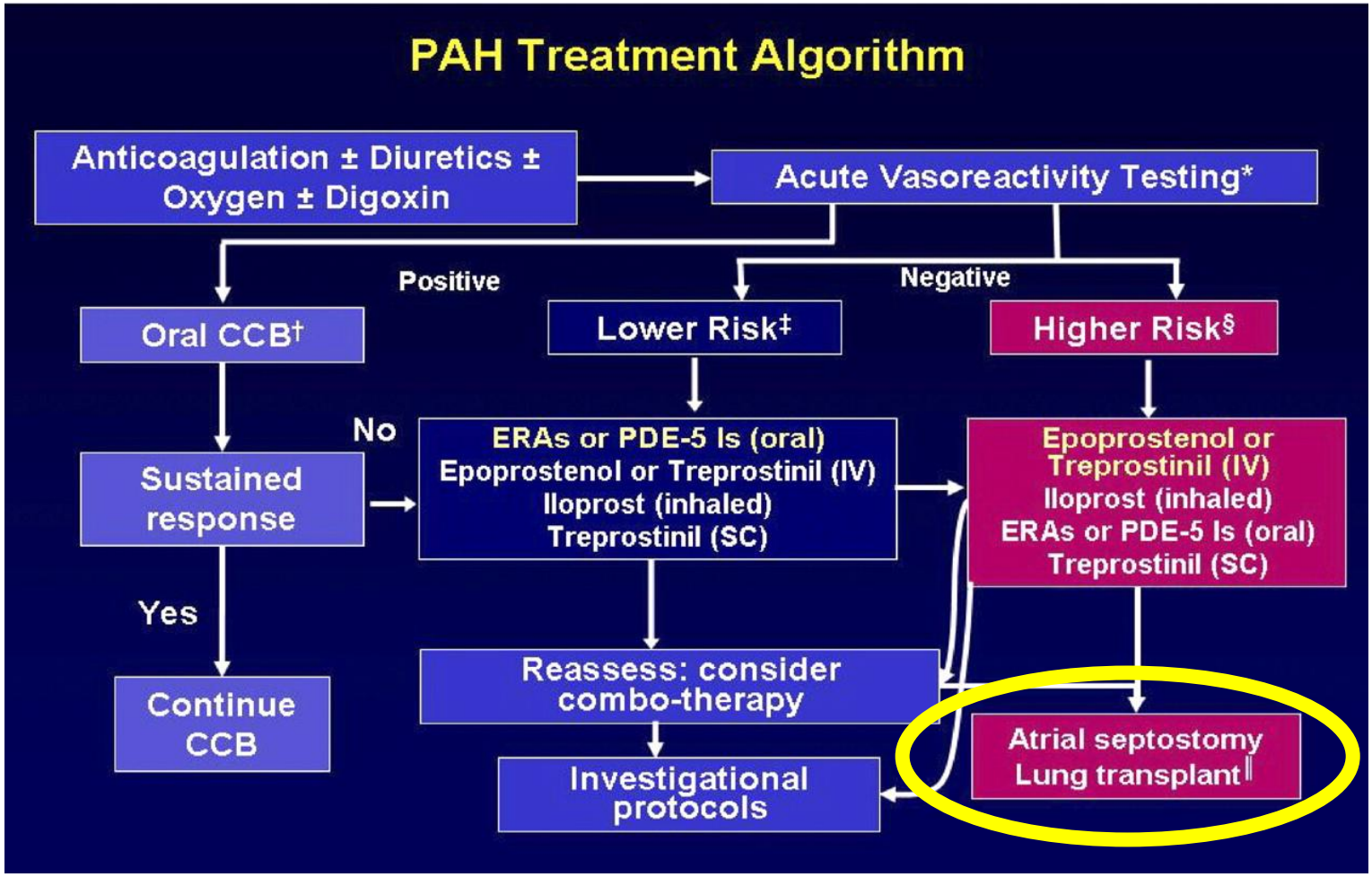


Control

IASD

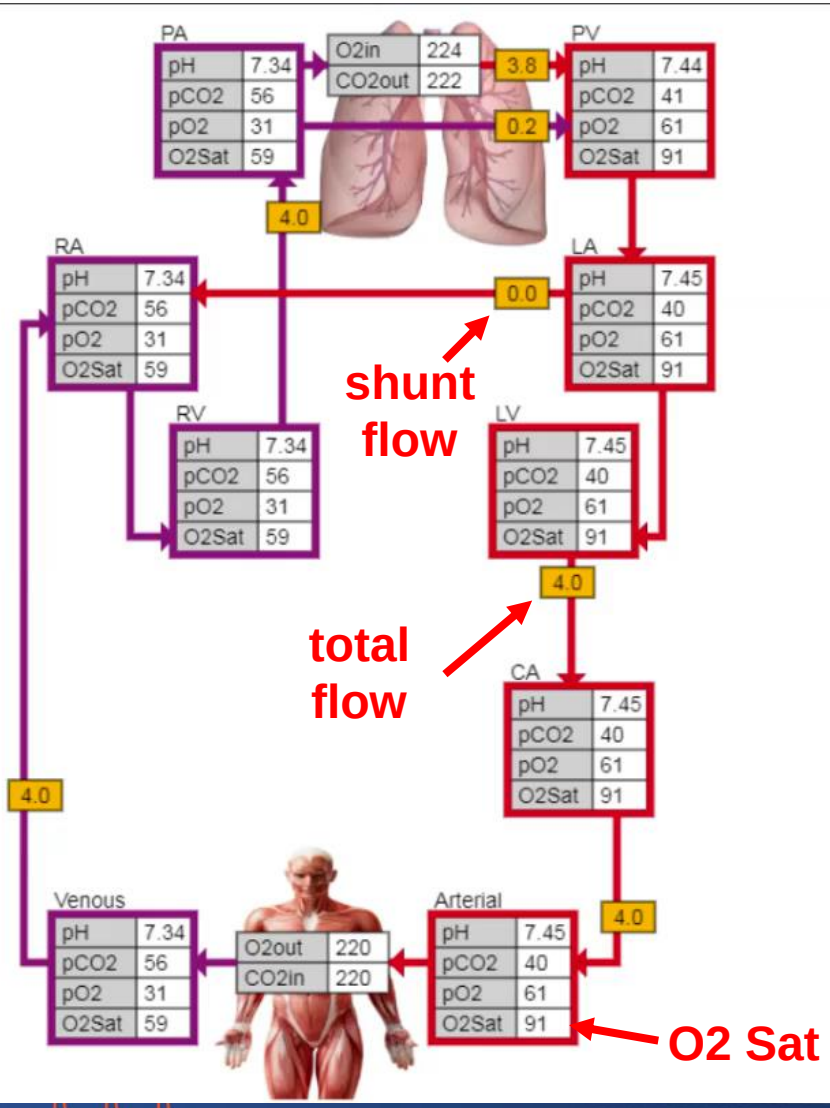
Atrial Septostomy in PAH?

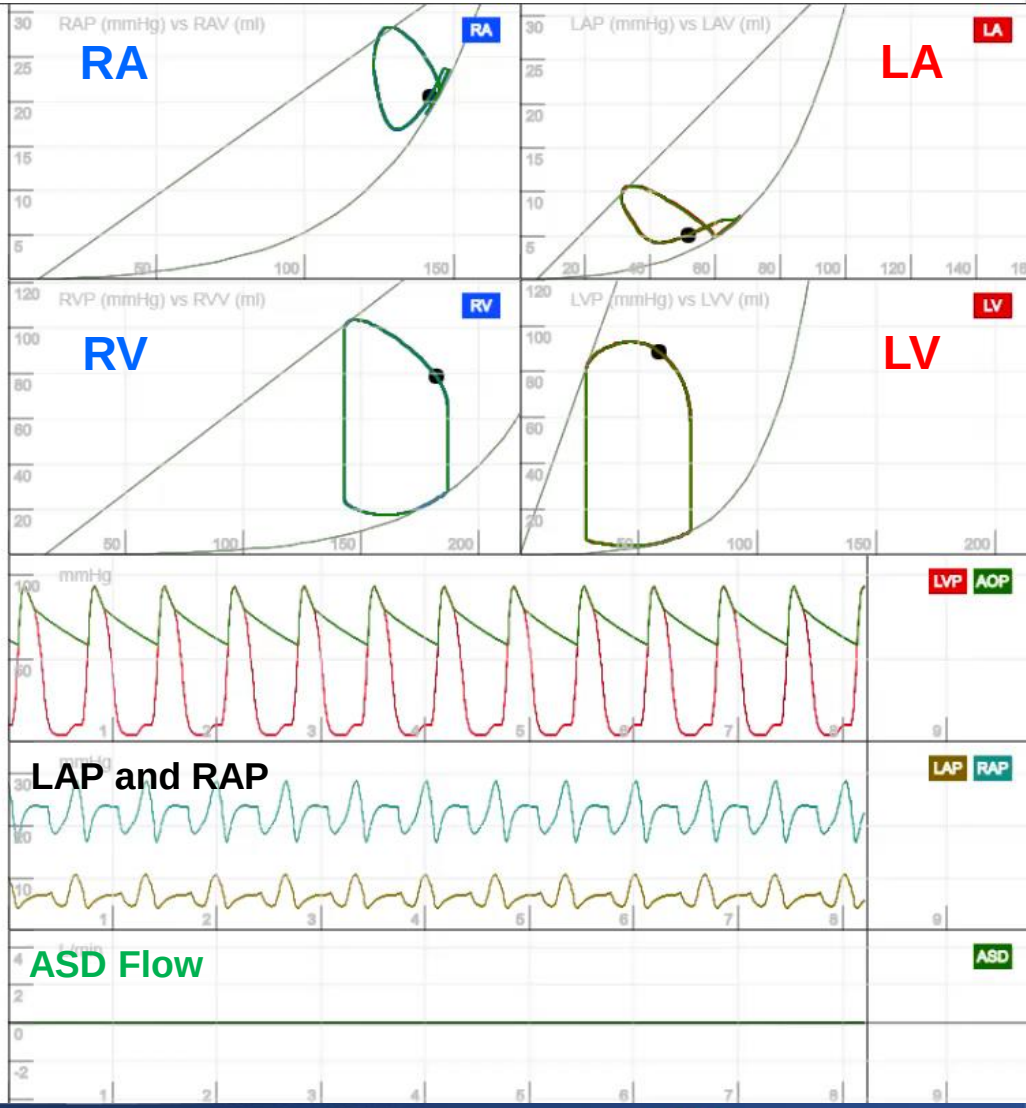
Atrial Septostomy for Pulmonary Hypertension



McLaughlin, V.V., et al., Circulation, 2009. 119(16): p. 2250-94

Impact of ASD size on R→L Shunting on Pressures and O2 Saturations





Interatrial Shunt Devices for HF and PAH

Interatrial shunting in congenital heart disease: indication, technique and results	Dietmar Schranz
Corvia trial results and current/future studies	Sanjiv J. Shah
V-Wave trial results and current/future studies	Stephan von Haehling
V-Wave shunt design and implantation procedure	Sameer Gafoor
Corvia shunt design, procedure and results	Franz X. Kleber
Occlutech Atrial Flow Regulator for left heart failure	Stefan Anker
Atrial shunt as a treatment option for right heart failure/pulmonary hypertension	Nikolaus Haas
Occlutech Atrial Flow Regulator – Recorded case	Nikolaus Haas