The Forgotten Ventricle: Assessment of the Right Ventricle

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SPECTRUM HEALTH

Objectives

The Challenge of the RV

Review Normal RV measurements

Doppler Assessment

What we are doing in GR

Case 1

75 year old man who presented with progressive dyspnea and fevers.

PMH: Rheumatic MV Disease who is status post 3 mitral valve replacements over 35 years, most recently in 2003.

Permanent atrial fibrillation on anti-coagulation.

RV Function?

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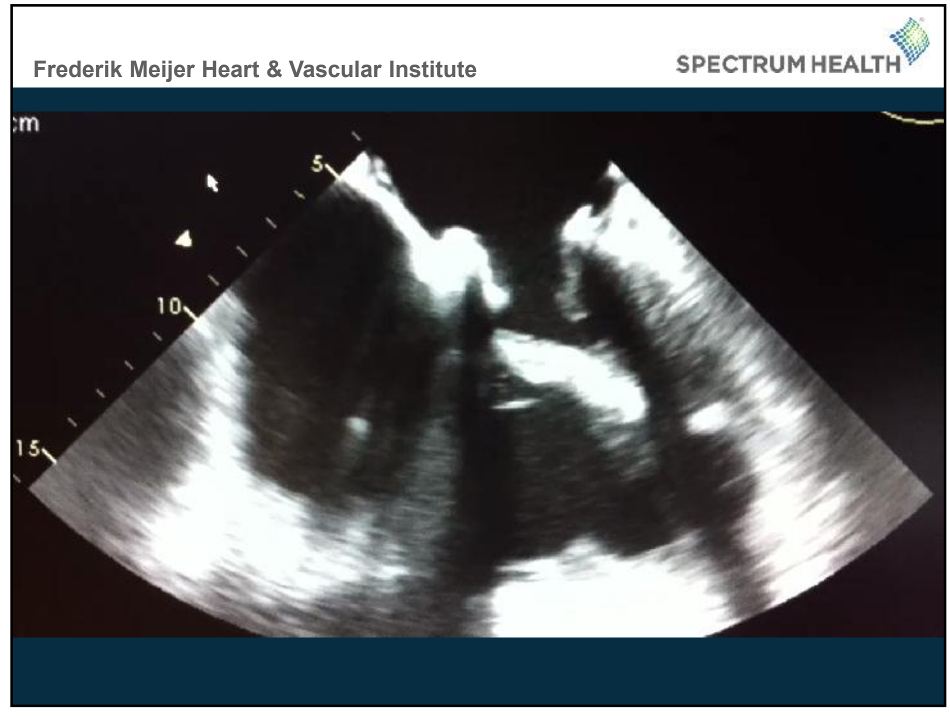
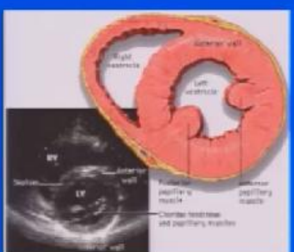
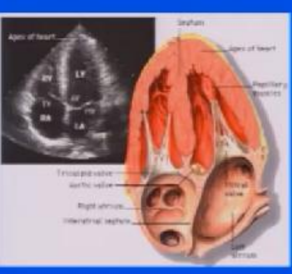


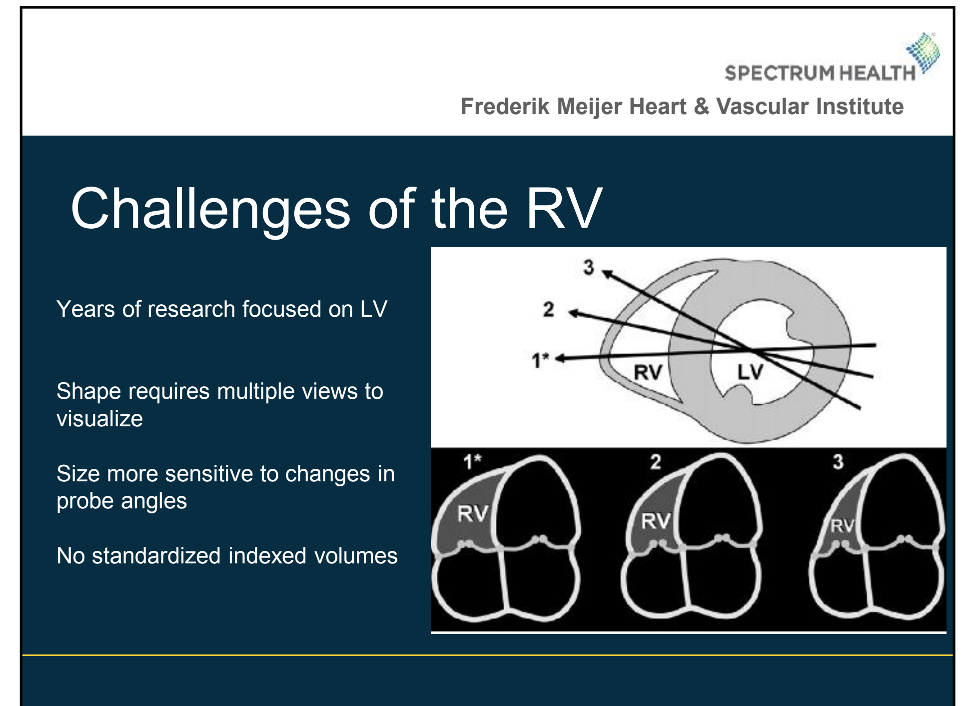
Right Ventricle

- Irregular shape
  - Incompletely seen in any single view
- More apical insertion of tricuspid valve compared to mitral valve
- Moderator band
- Trabeculations
- Muscular outflow tract
- Thin-walled
- 3 papillary muscles
- Lower pressure, more compliant chamber
- Longitudinal fiber orientation





Tighe, Dennis. ASCeXAM Review Course



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The Basics of RV Assessment

- RA Size
- RV Size
- RV Function (fractional area change, TAPSE, S', or myocardial performance index)
- Right Sided Pressure
  - IVC to Assess RA pressure
  - PA End Diastolic Pressure
  - Septum

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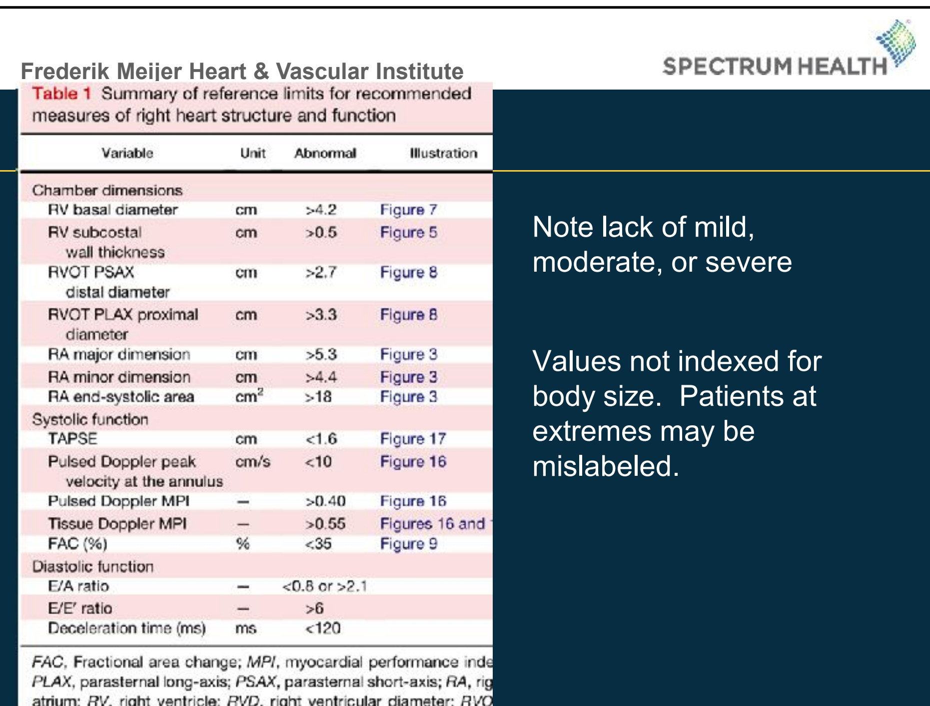


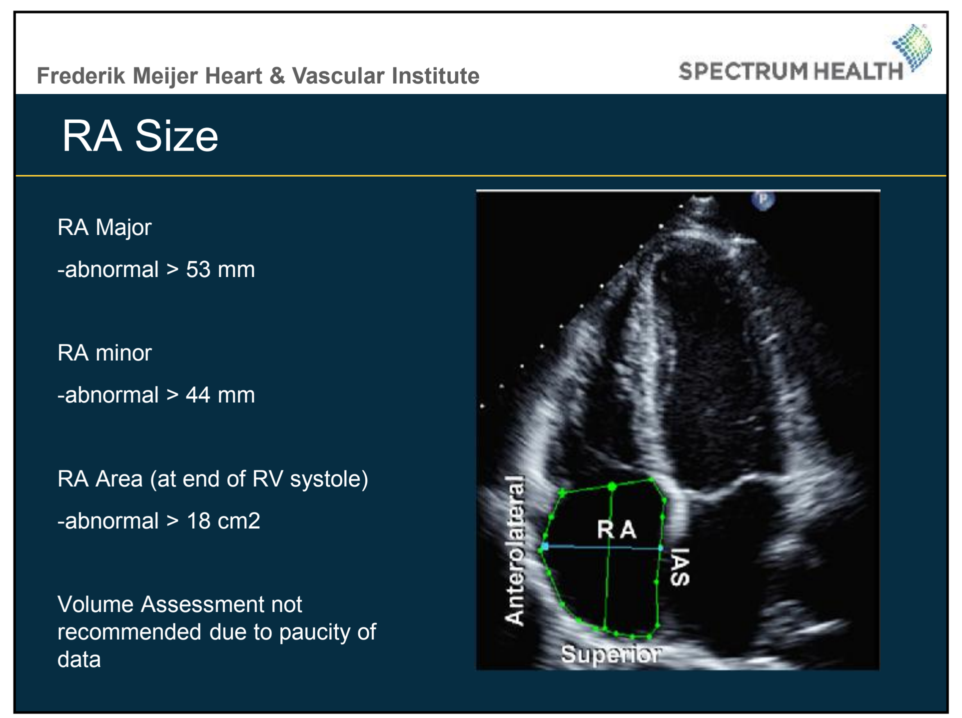
Table 1 Summary of reference limits for recommended measures of right heart structure and function

Variable	Unit	Abnormal	Illustration
Chamber dimensions			
RV basal diameter	cm	>4.2	Figure 7
RV subcostal wall thickness	cm	>0.5	Figure 5
RVOT PSAX distal diameter	cm	>2.7	Figure 8
RVOT PLAX proximal diameter	cm	>3.3	Figure 8
RA major dimension	cm	>5.3	Figure 3
RA minor dimension	cm	>4.4	Figure 3
RA end-systolic area	cm^2	>18	Figure 3
Systolic function			
TAPSE	cm	<1.6	Figure 17
Pulsed Doppler peak velocity at the annulus	cm/s	<10	Figure 16
Pulsed Doppler MPI	—	>0.40	Figure 16
Tissue Doppler MPI	—	>0.55	Figures 16 and
FAC (%)	%	<35	Figure 9
Diastolic function			
E/A ratio	—	<0.8 or >2.1	
E/E′ ratio	—	>6	
Deceleration time (ms)	ms	<120	

FAC, Fractional area change; *MPI*, myocardial performance inde
PLAX, parasternal long-axis; *PSAX*, parasternal short-axis; *RA*, rig
atrium; *RV*, right ventricle; *RVD*, right ventricular diameter; *RVO*

Note lack of mild, moderate, or severe

Values not indexed for body size. Patients at extremes may be mislabeled.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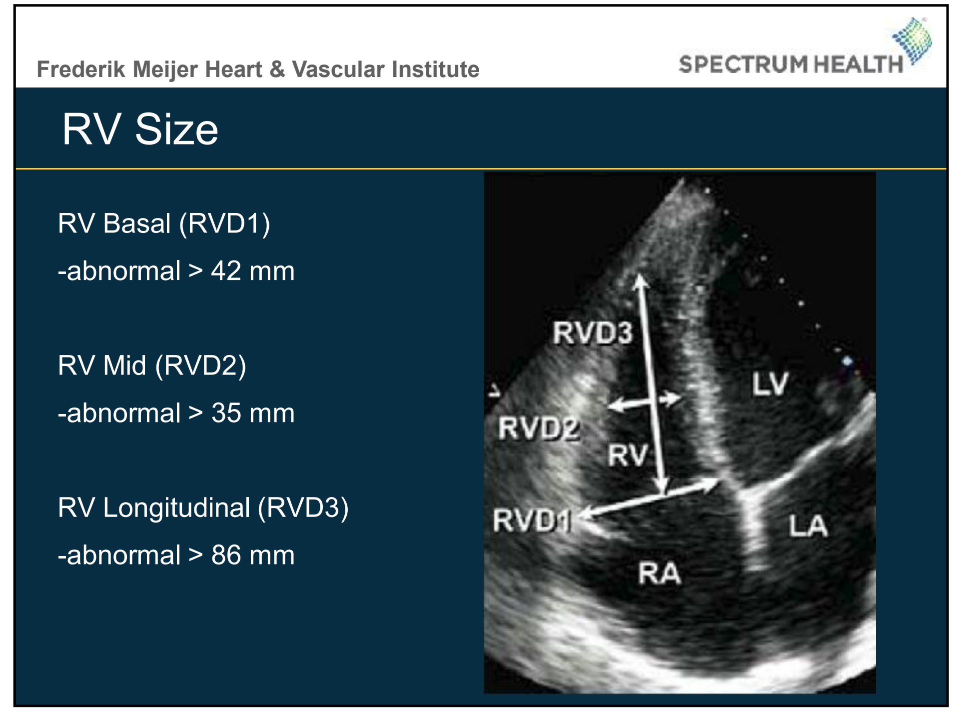
RA Size
RA Major
-abnormal > 53 mm
RA minor
-abnormal > 44 mm
RA Area (at end of RV systole)
-abnormal > 18 cm2
Volume Assessment not recommended due to paucity of data
RA
Anterolateral
IAS
Superior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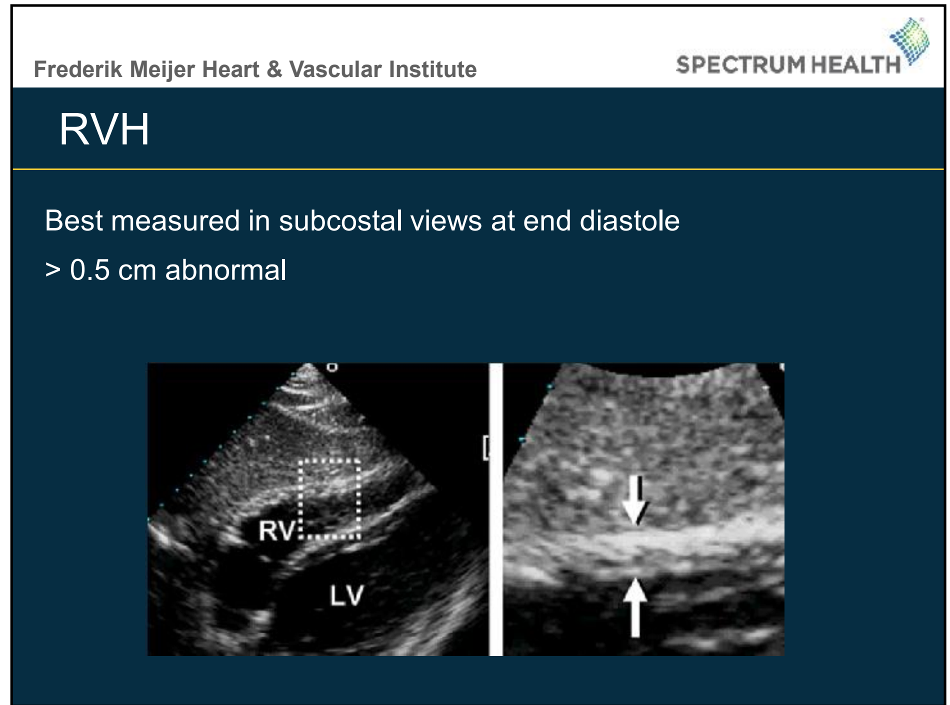
RV Size
RV Basal (RVD1)
-abnormal > 42 mm
RV Mid (RVD2)
-abnormal > 35 mm
RV Longitudinal (RVD3)
-abnormal > 86 mm
RVD3
LV
RVD2
RV
RVD1
LA
RA



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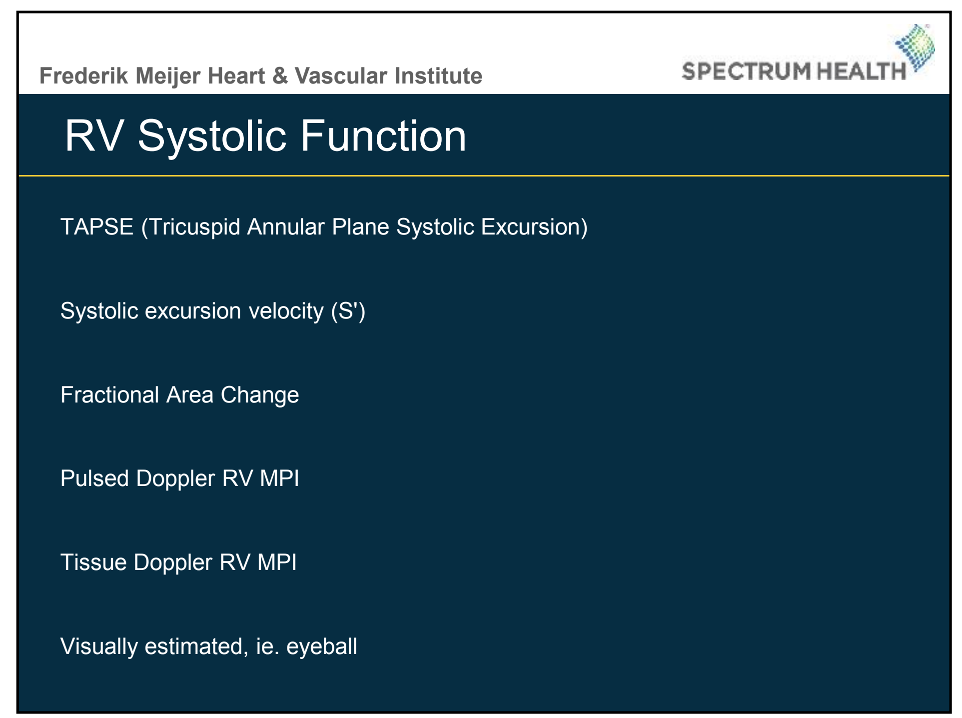
RV Size Pearls

The eyeball: RV should be about 2/3 LV

Central TR suggest RV or annulus 'too big'

RV Basal most helpful in determining if TV Ring should be placed during MV surgery (literature suggests > 40 mm)

If RV is apex forming, it's way too big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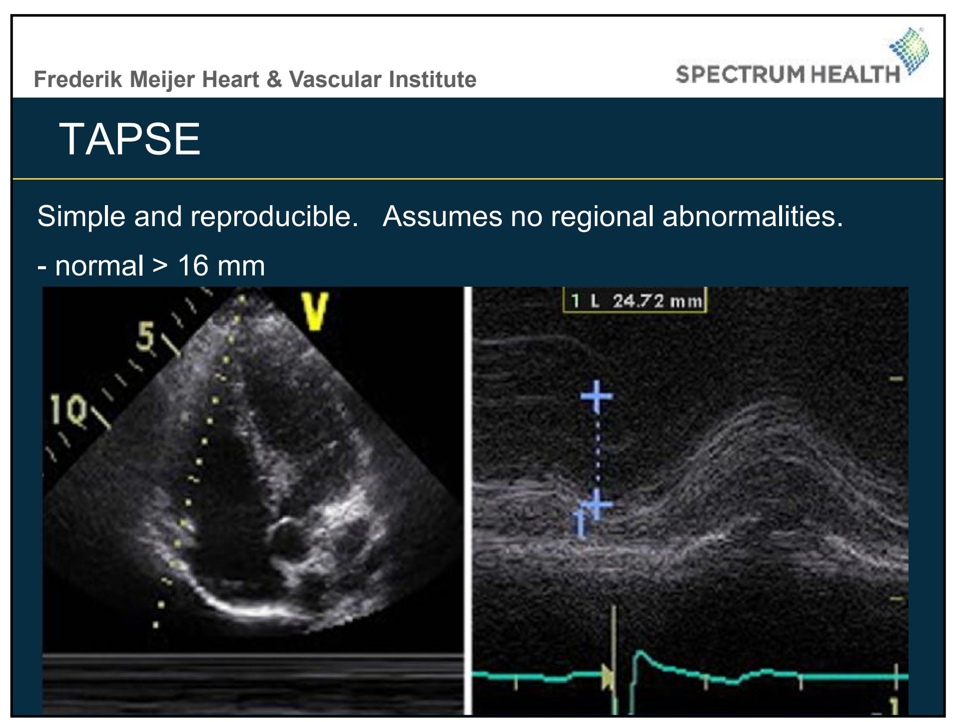
RV Systolic Function
TAPSE (Tricuspid Annular Plane Systolic Excursion)
Systolic excursion velocity (S')
Fractional Area Change
Pulsed Doppler RV MPI
Tissue Doppler RV MPI
Visually estimated, ie. eyeball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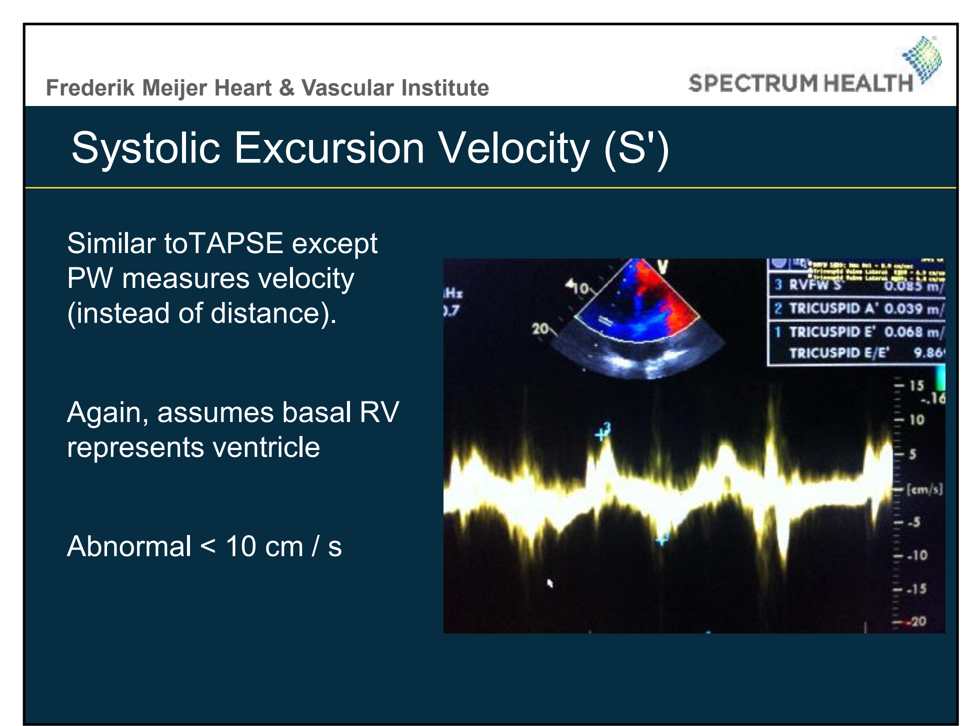
TAPSE
Simple and reproducible. Assumes no regional abnormalities.
- normal > 16 mm
1 L 24.72 mm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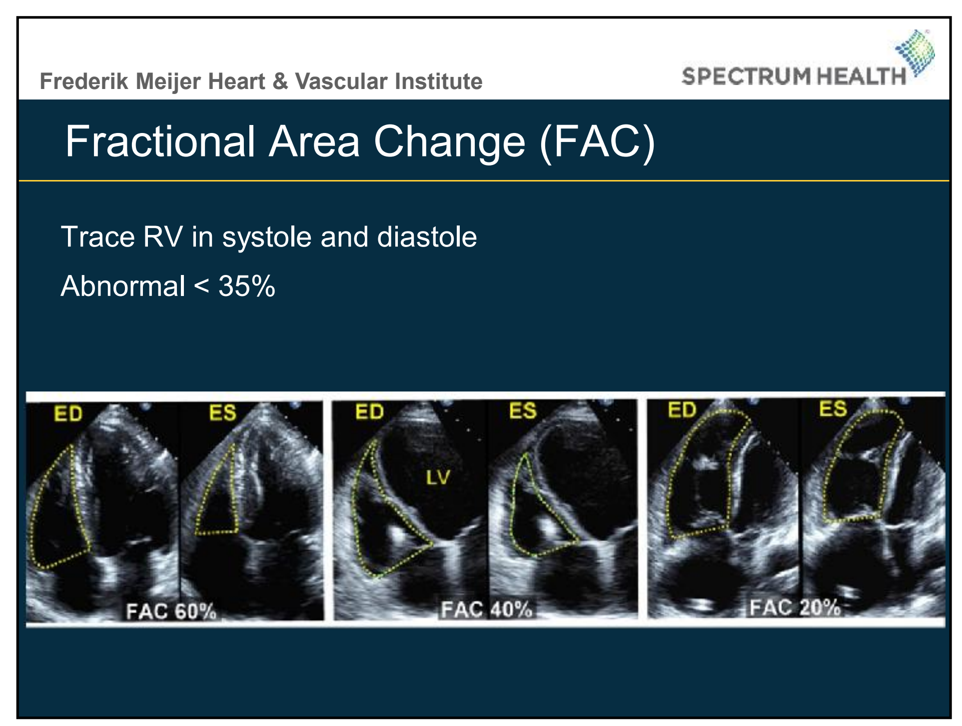
Systolic Excursion Velocity (S')
Similar toTAPSE except PW measures velocity (instead of distance).
Again, assumes basal RV represents ventricle
Abnormal < 10 cm / s
3 RVFW S' 0.085 m/
2 TRICUSPID A' 0.039 m/
1 TRICUSPID E' 0.068 m/
TRICUSPID E/E' 9.86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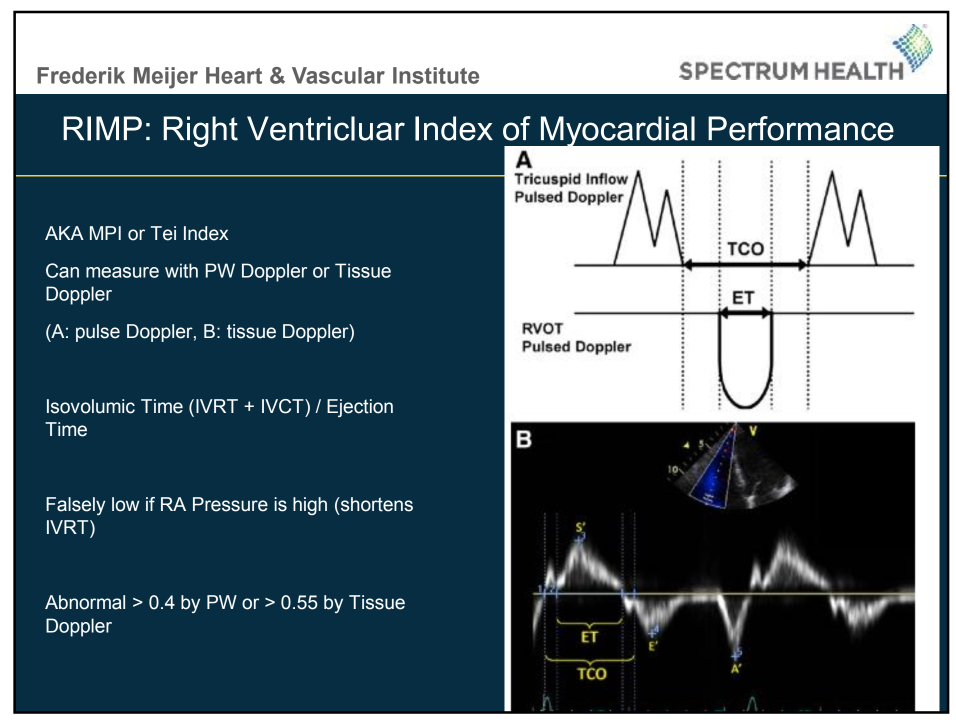
Fractional Area Change (FAC)
Trace RV in systole and diastole
Abnormal < 35%
ED
ES
FAC 60%
ED
LV
ES
FAC 40%
ED
ES
FAC 20%



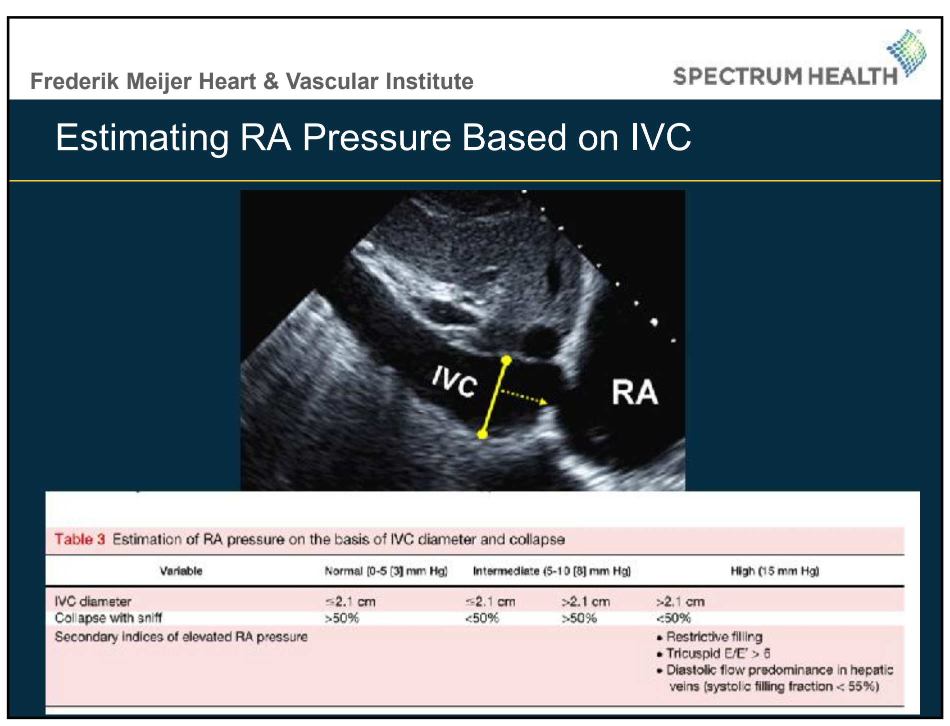
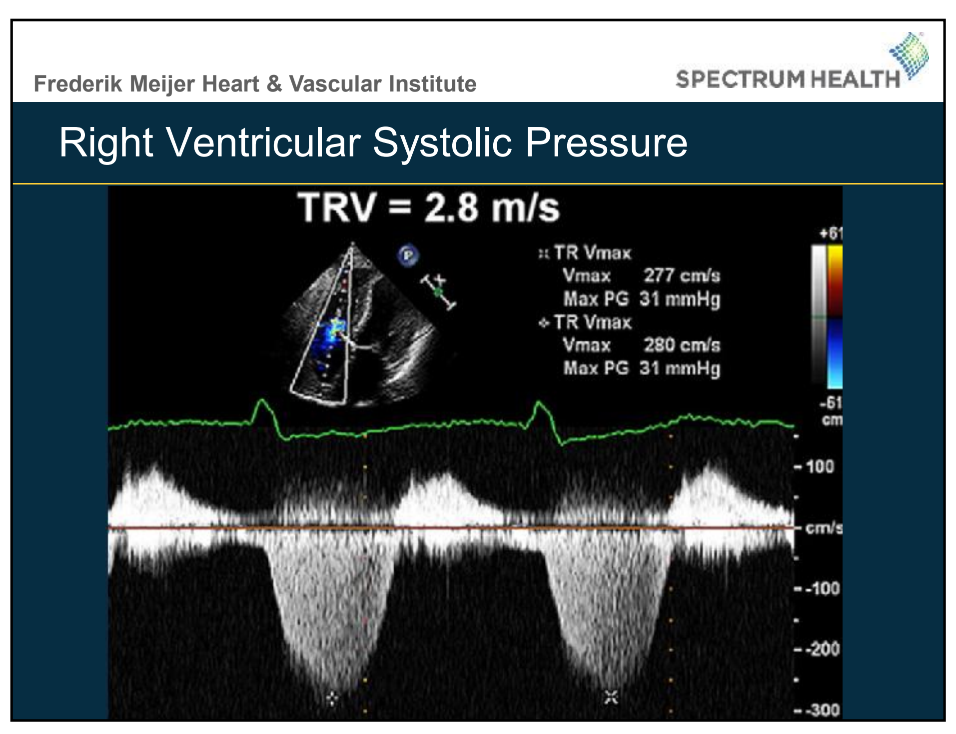


Table 3 Estimation of RA pressure on the basis of IVC diameter and collapse

Variable	Normal (0-5 [3] mm Hg)	Intermediate (5-10 [8] mm Hg)		High (15 mm Hg)
IVC diameter	≤2.1 cm	≤2.1 cm	>2.1 cm	>2.1 cm
Collapse with sniff	>50%	<50%	>50%	<50%
Secondary indices of elevated RA pressure				• Restrictive filling • Tricuspid E/E' > 6 • Diastolic flow predominance in hepatic veins (systolic filling fraction < 55%)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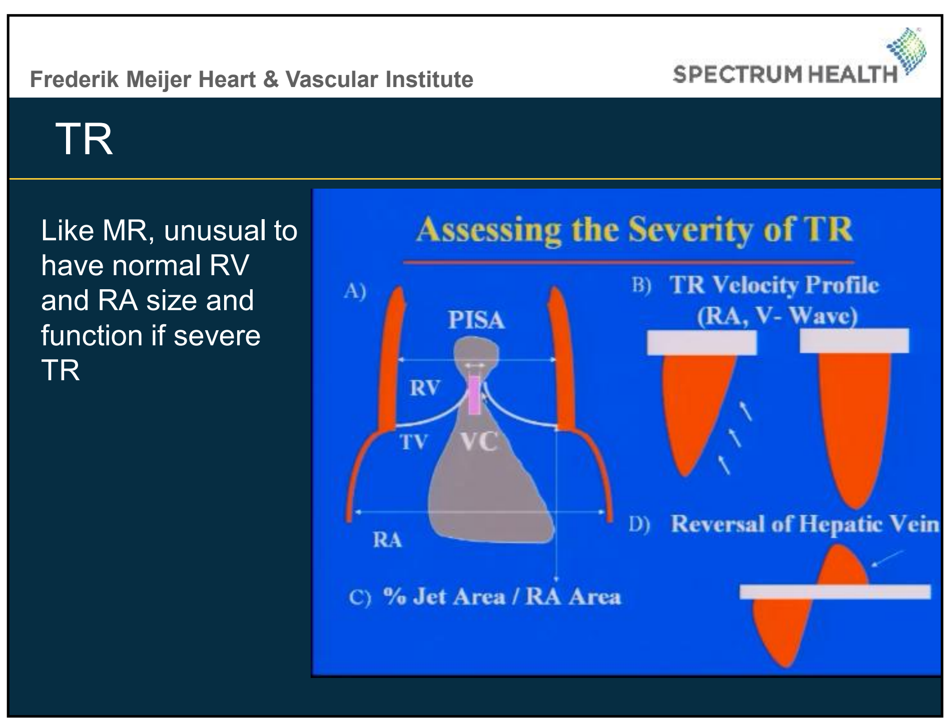
Right Ventricular Systolic Pressure
TRV = 2.8 m/s
TR Vmax
Vmax 277 cm/s
Max PG 31 mmHg
TR Vmax
Vmax 280 cm/s
Max PG 31 mmHg
-100
cm/s
--100
--200
--300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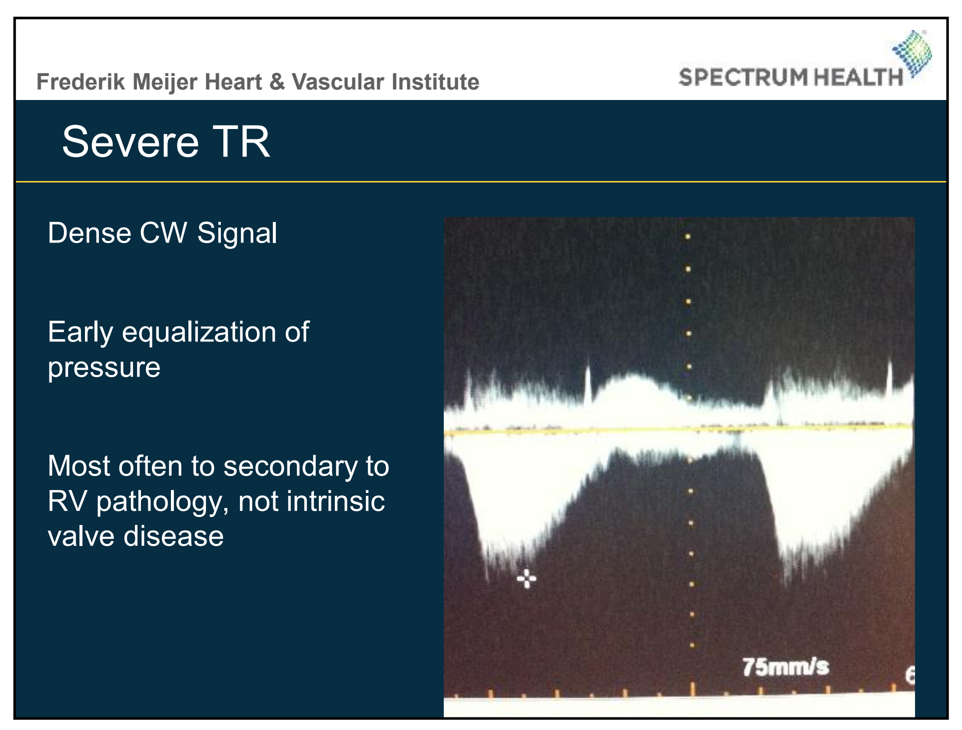
TR
Like MR, unusual to have normal RV and RA size and function if severe TR
Assessing the Severity of TR
A)
PISA
RV
TV
VC
RA
B) TR Velocity Profile
(RA, V- Wave)
C) % Jet Area / RA Area
D) Reversal of Hepatic Vein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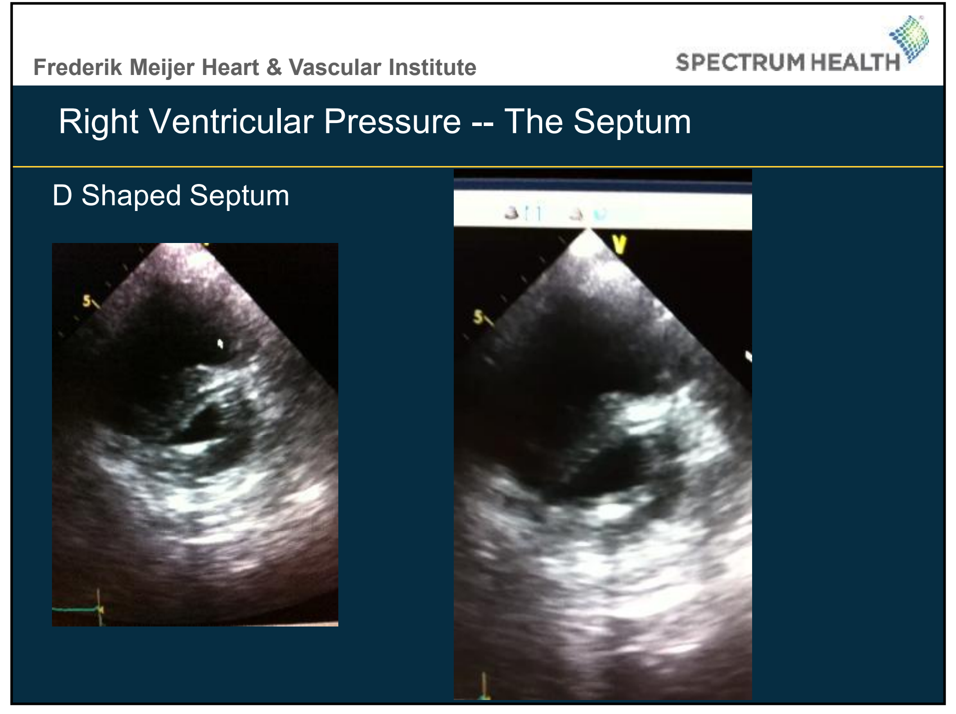
Severe TR
Dense CW Signal
Early equalization of pressure
Most often to secondary to RV pathology, not intrinsic valve disease
75mm/s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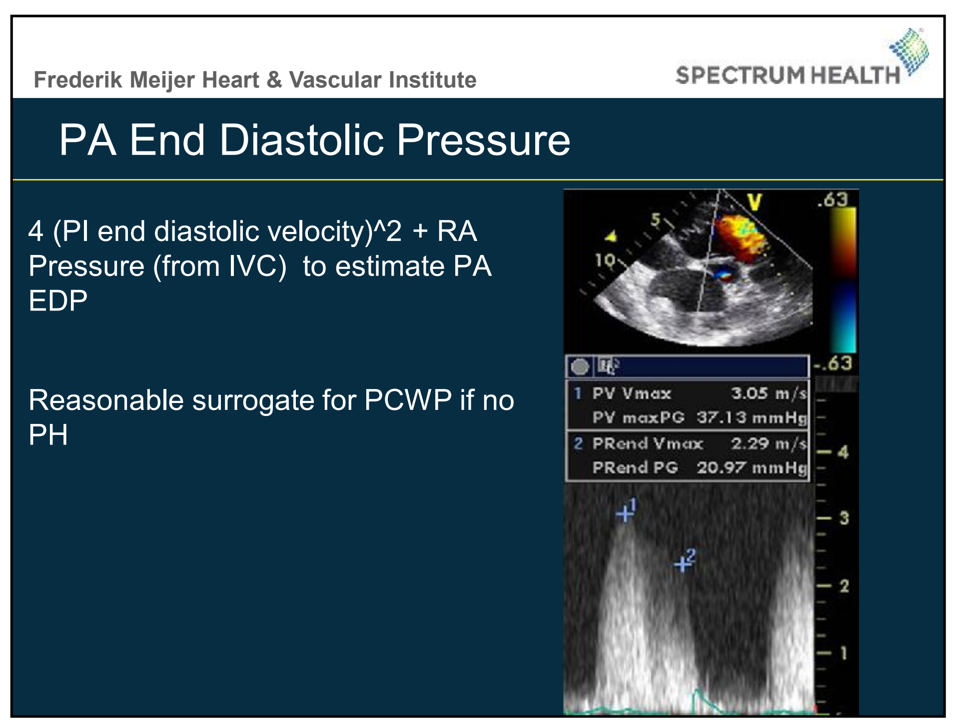
Right Ventricular Pressure -- The Septum
D Shaped Septum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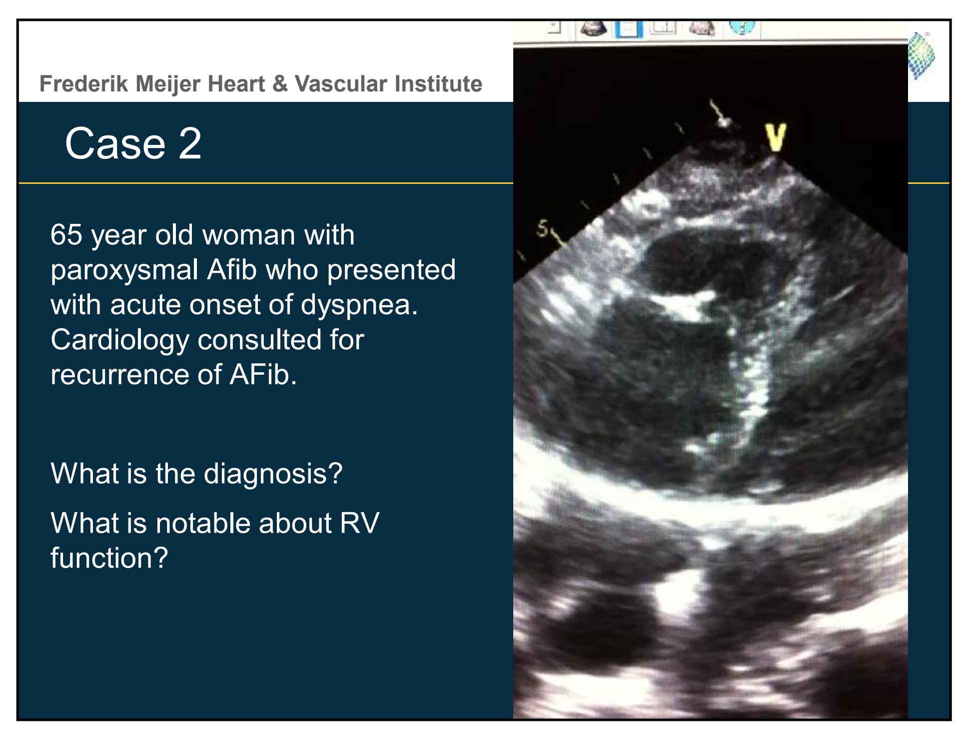
PA End Diastolic Pressure
4 (PI end diastolic velocity)^2 + RA Pressure (from IVC) to estimate PA EDP
Reasonable surrogate for PCWP if no PH
PV Vmax 3.05 m/s
PV maxPG 37.13 mmHg
PRend Vmax 2.29 m/s
PRend PG 20.97 mmHg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Case 2
65 year old woman with paroxysmal Afib who presented with acute onset of dyspnea. Cardiology consulted for recurrence of AFib.
What is the diagnosis?
What is notable about RV function?

McConnell's Sign

Regional wall motion abnormality seen in acute PE:

-RV Free wall akinesis

-preserved function of RV apex

Probably a result of acute RV dysfunction and tethering of RV to LV

Inadequate sensitivity or specificity to be terribly useful

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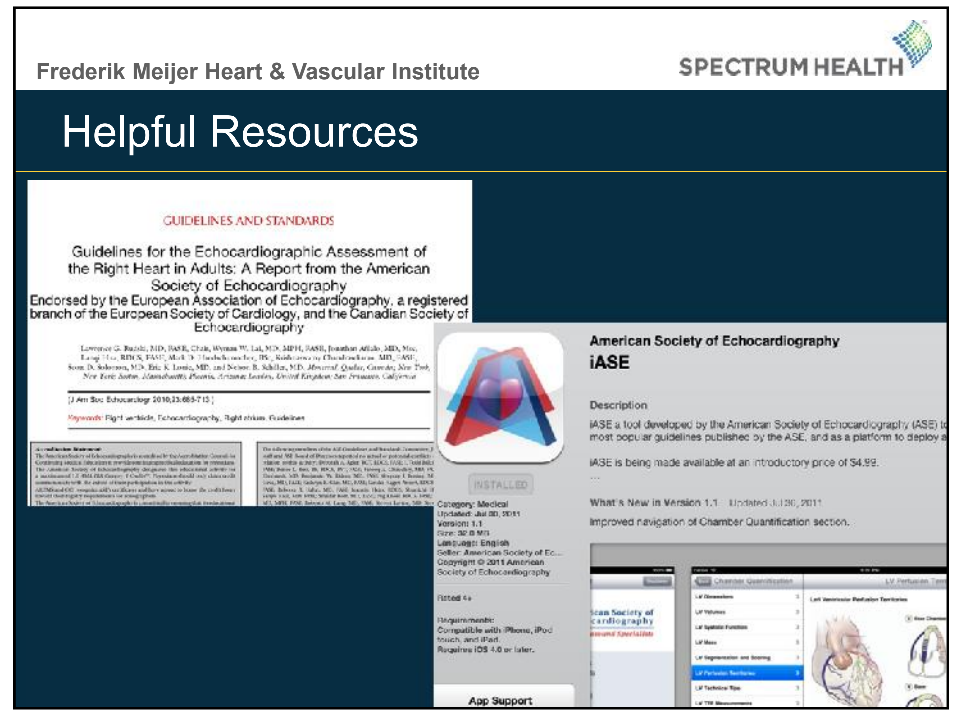
Clinical Practice

Eyeball size compared to LV. RV should be a little smaller.

If size and function, IVC and RVSP clearly normal, move on.

If clearly abnormal, do not perseverate. Mild - Moderate - Severe in the eyes of beholder.

In tweeners, multifactorial approach with RV basal diameter, a functional assessment (?leaning toward S' or TAPSE), functional TR



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Helpful Resources
GUIDELINES AND STANDARDS
Guidelines for the Echocardiographic Assessment of the Right Heart in Adults: A Report from the American Society of Echocardiography
Endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography
(J Am Soc Echocardiogr 2010;23:685-713.)
American Society of Echocardiography
iASE
Description
iASE is being made available at an introductory price of $4.99.
What's New in Version 1.1
Improved navigation of Chamber Quantification section.
INSTALLED
Category: Medical
Version: 1.1
Language: English
App Support