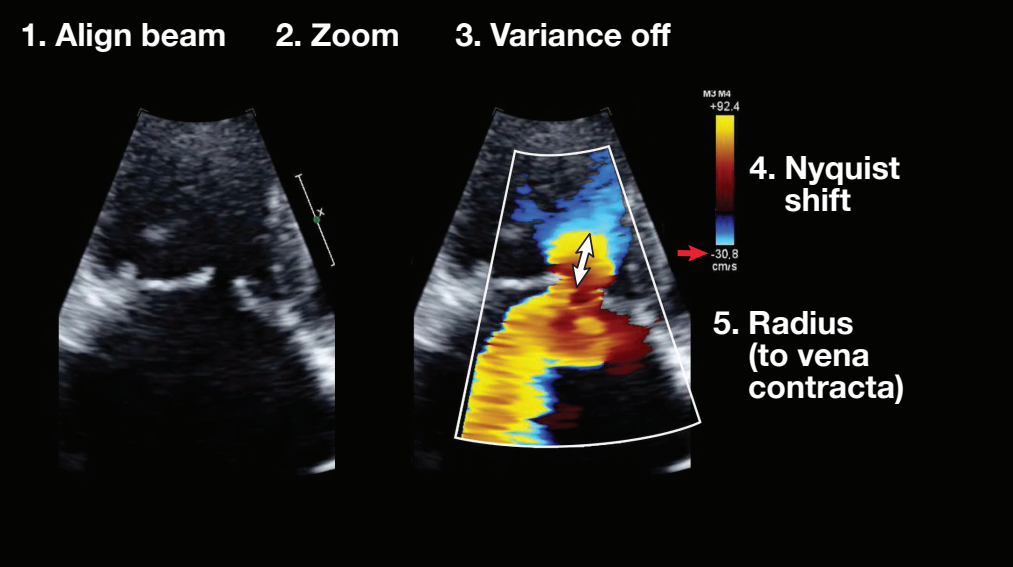


Tricuspid Regurgitation

A. Color Flow Doppler (2D and 3D)

Proximal Flow Convergence

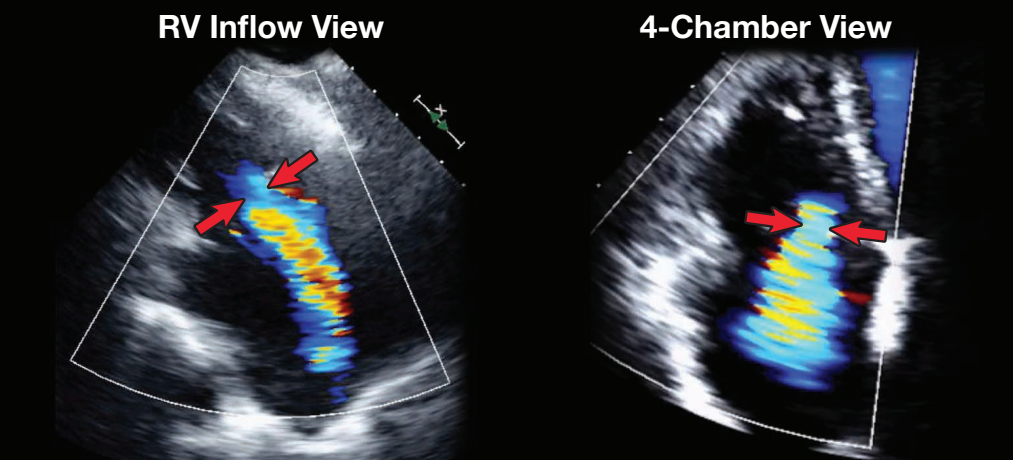
1. Align direction of flow with insonation beam
2. Zoomed view
3. Variance off
4. Change baseline of Nyquist limit in the direction of the jet and adjust to obtain hemispheric flow convergence (typically ~28 cm/s)
5. Measure the radius (white arrow in image) from the point of color aliasing to the vena contracta



- Advantage:**
- Rapid qualitative assessment
- Disadvantages:**
- Multiple jets
 - Non-hemispheric shape

Vena Contracta

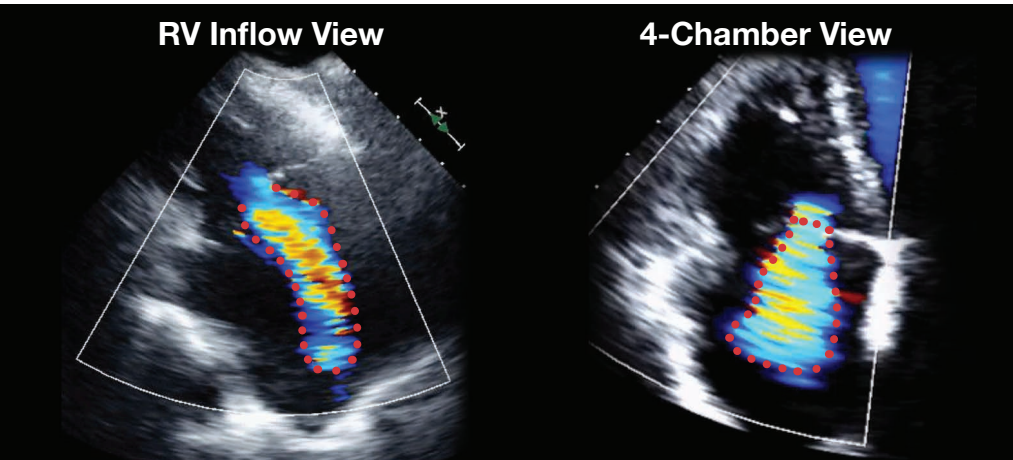
1. Zoomed view
2. Apical 4 ch view
3. RV Inflow view



- Advantages:**
- Surrogate for regurgitant orifice size
 - Independent of flow rate and driving pressure for a fixed orifice
 - Less dependent on technical factors
 - Good at identifying severe TR (>0.7cm)
- Disadvantages:**
- Underestimates severity with multiple jets
 - Imaging of convergence zone for measurement

Jet Area:

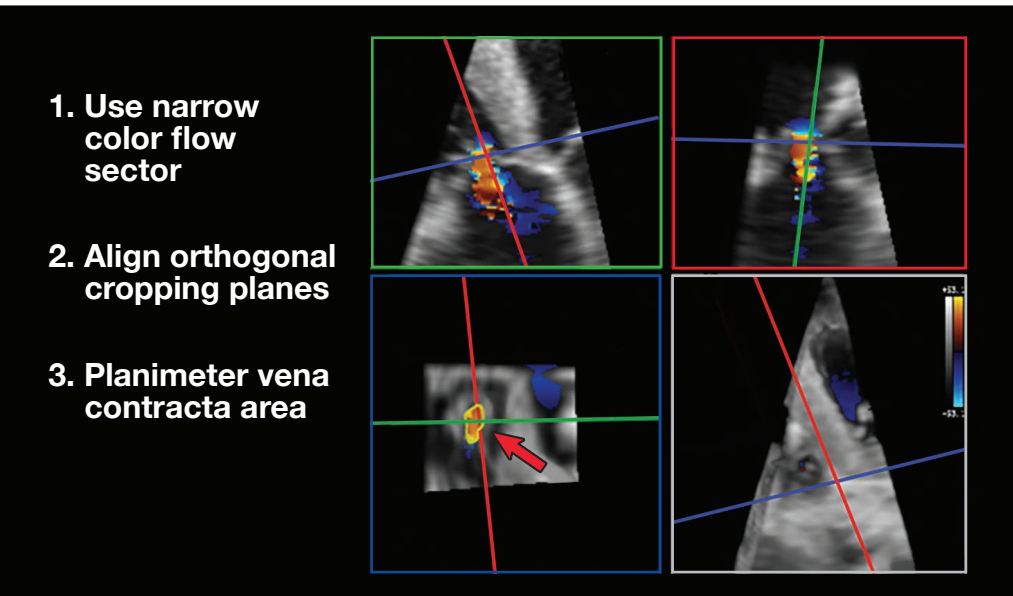
1. 4 ch, RV inflow or subcostal views



- Advantage:**
- Easy to measure
- Disadvantages:**
- Dependent on the driving pressure and jet direction
 - Direction and shape of jet may overestimate (central entrainment) or underestimate (eccentric, wall-impinging) jet area

3D Vena Contracta

1. Color flow sector should be narrow
2. Align orthogonal cropping planes along the axis of the jet
3. Choose a mid-systolic cycle and planimeter the vena contracta area

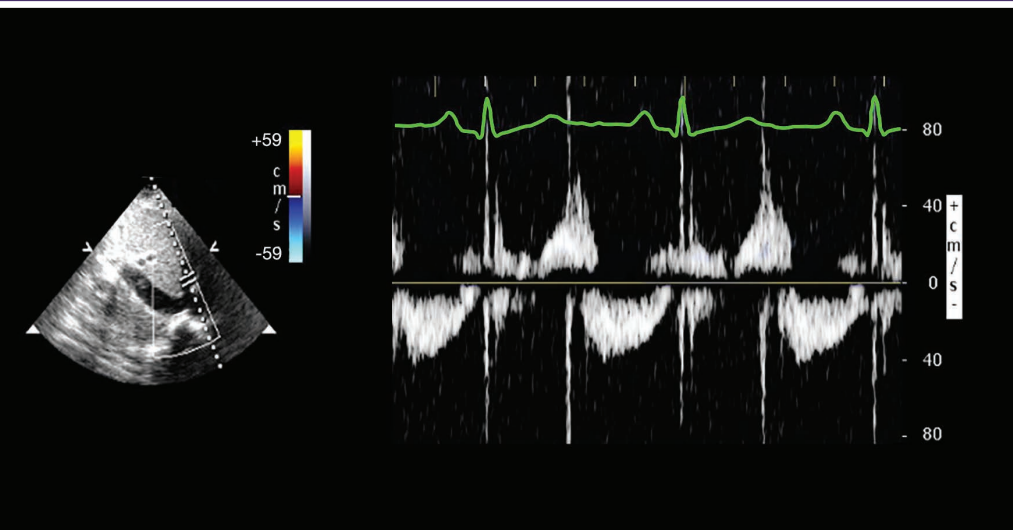


- Advantage:**
- Multiple jets of differing directions may be measured
- Disadvantages:**
- Dynamic jets may be over- or underestimated
 - Time consuming
 - Limited spatial resolution will lead to overestimation

B. Pulsed Wave Doppler

Hepatic Vein Flow Reversal

1. Align insonation beam with the flow in the hepatic vein

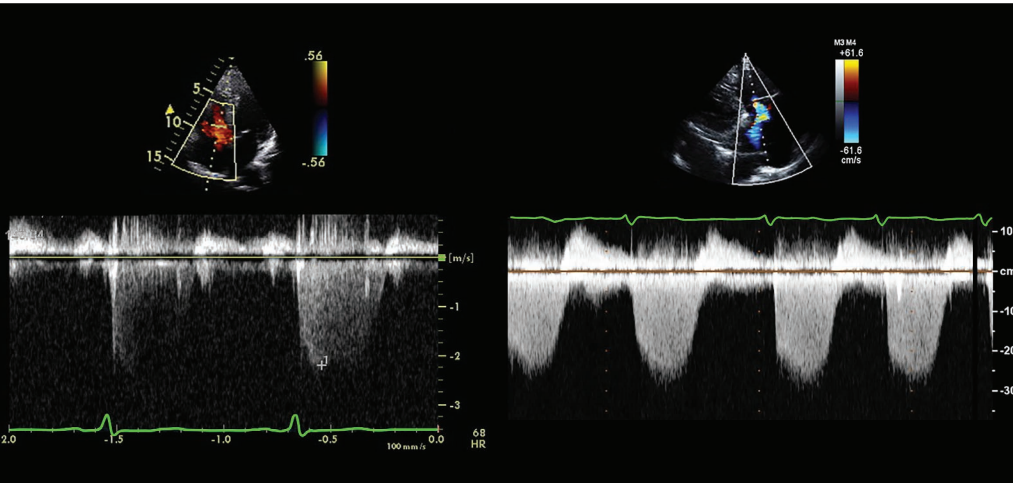


- Advantages:**
- Simple supportive sign of severe TR
 - Can be obtained with both TTE and TEE
- Disadvantages:**
- Depends on compliance of the right atrium
 - May not be reliable in patients with atrial fibrillation, paced rhythm with retrograde atrial conduction

C. Continuous Wave Doppler

Density of Regurgitant Jet

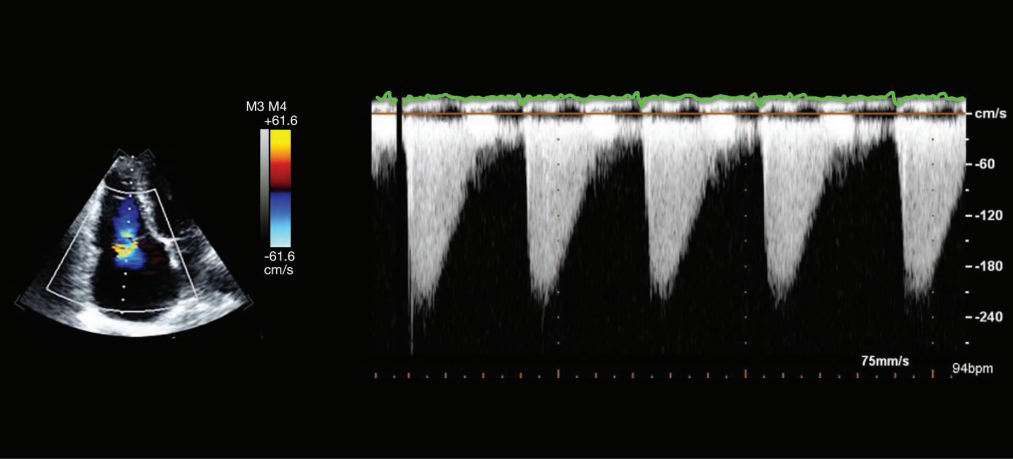
1. Align insonation beam with the flow



- Advantages:**
- Simple
 - Density is proportional to the number of red-blood cells reflecting the signal
 - Faint or incomplete jet is compatible with mild TR
- Disadvantages:**
- Qualitative
 - Perfectly central jets may appear denser than eccentric jets of higher severity
 - Overlap between moderate and severe TR

Jet Contour

1. Align insonation beam with the flow

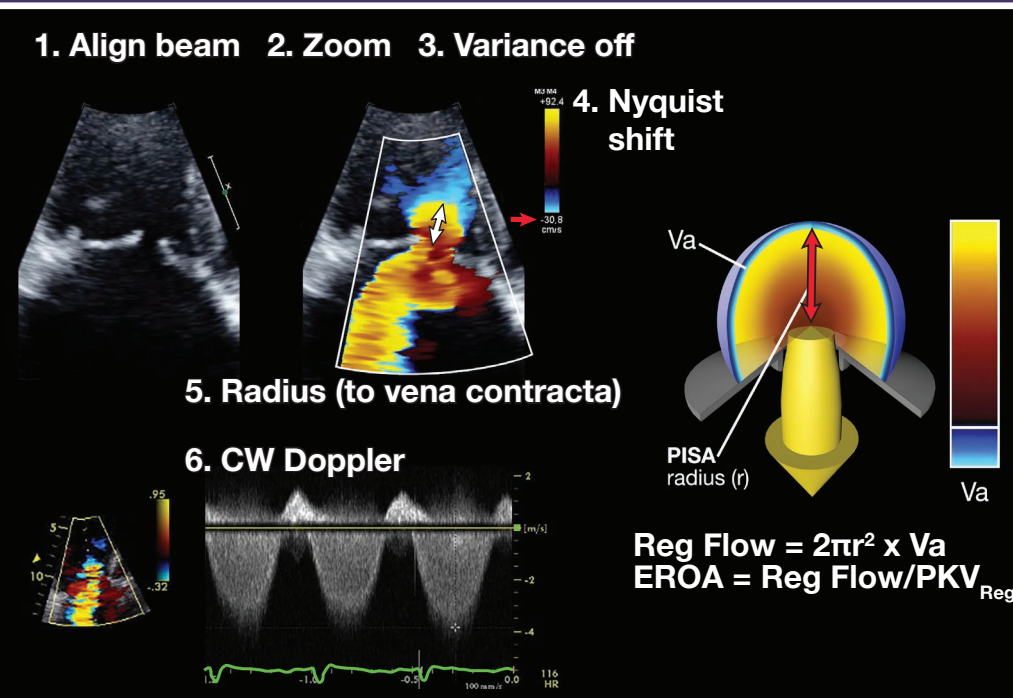


- Advantages:**
- Simple
 - Specific sign of pressure equalization in low velocity, early peaking dense TR jet
- Disadvantages:**
- Qualitative
 - Affected by changes that modify RV and RA pressures

D. Quantitative Doppler: EROA, Regurgitation Volume

PISA:

1. Align direction of flow with insonation beam
2. Zoomed view
3. Variance off
4. Change baseline of Nyquist limit in the direction of the jet and adjust to obtain hemispheric flow convergence (typically ~28 cm/s)
5. Measure the radius (white arrow) from the point of color aliasing to the vena contracta
6. CW Doppler of regurgitant jet for peak velocity and VTI



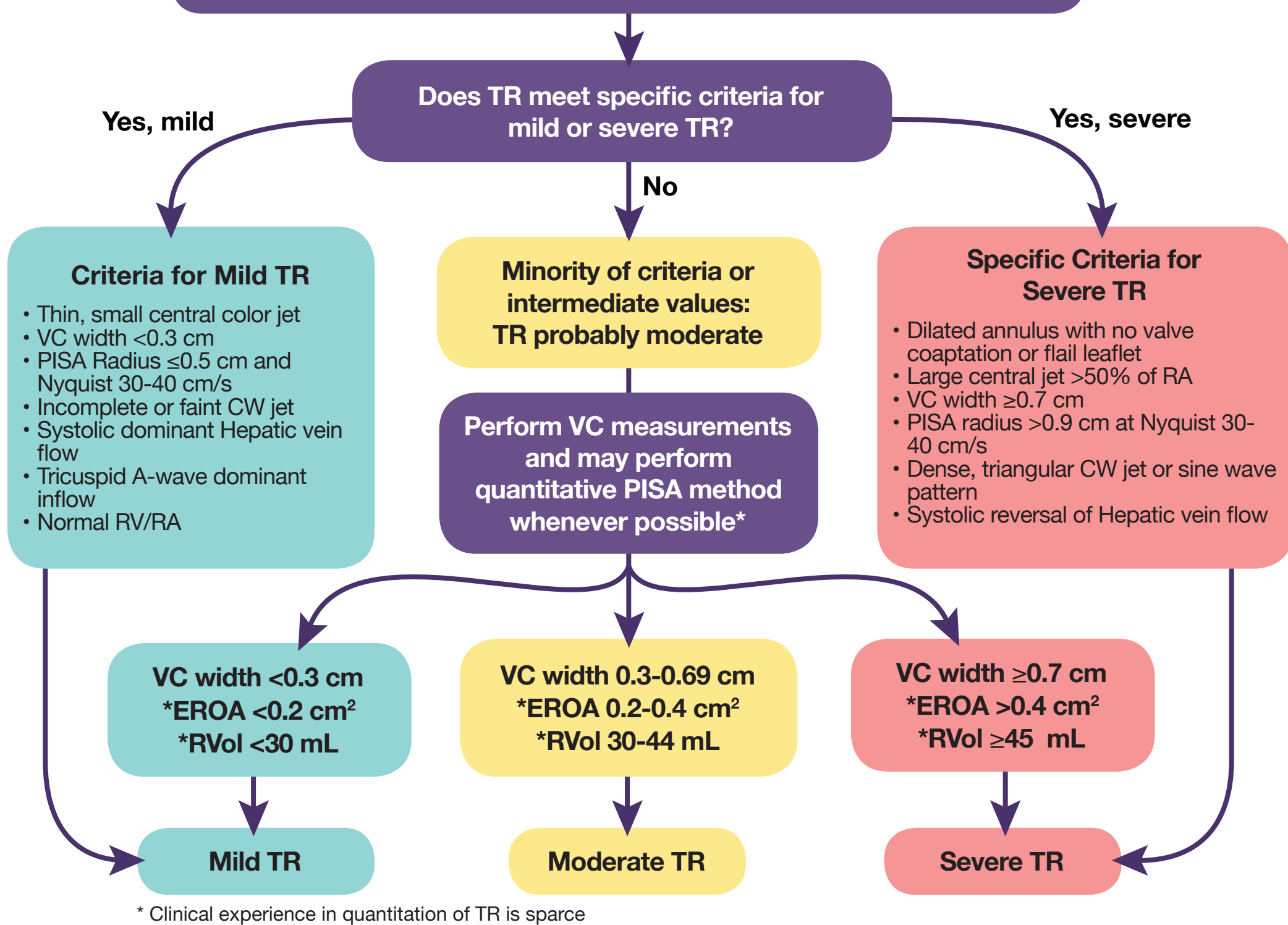
- Advantage:**
- Quantitative assessment of lesion severity (EROA) and volume overload (RVol)
- Disadvantages:**
- Not valid for multiple jets, less accurate in eccentric jets
 - Limited experience and evidence
 - Typically lower RV pressures (than LV) lead to greater contour flattening and underestimation in proportion to the ratio of the aliasing velocity to the peak TR velocity

Grading the Severity of Chronic TR by Echocardiography¹

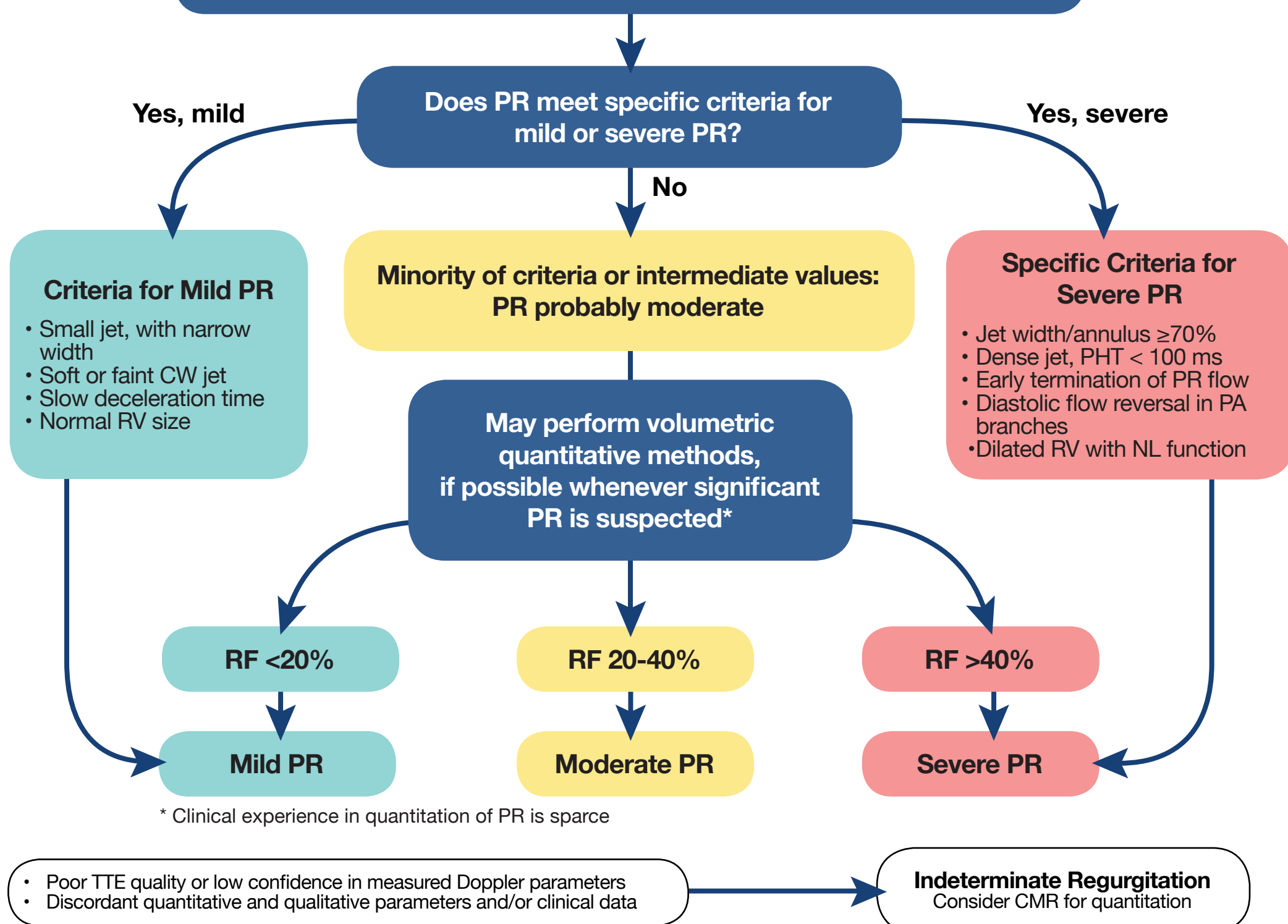
Parameters	Mild	Moderate	Severe
Structural			
TV morphology	Normal or mildly abnormal leaflets	Moderately abnormal leaflets	Severe valve lesions (e.g., flail leaflet, severe retraction, large perforation)
RV and RA size	Usually normal	Normal or mild dilation	Usually dilated ²
Inferior vena cava diameter	Normal <2cm	Normal or mildly dilated 2.1-2.5cm	Dilated >2.5cm
Qualitative Doppler			
Color flow jet area ³	Small, narrow, central	Moderate central	Large central jet or eccentric wall-impinging jet of variable size
Flow convergence zone	Not visible, transient or small	Intermediate in size and duration	Large throughout systole
CWD jet	Faint/partial/parabolic	Dense, parabolic or triangular	Dense, often triangular
Semi-quantitative			
Color flow jet area (cm ²) ³	Not defined	Not defined	>10
VCW (cm) ³	<0.3	0.3-0.69	≥0.7
PISA radius (cm) ⁴	≤0.5	0.6-0.9	>0.9
Hepatic vein flow ⁵	Systolic dominance	Systolic blunting	Systolic flow reversal
Tricuspid inflow ⁵	A-wave dominant	Variable	E-wave >1.0m/sec
Quantitative			
EROA (cm ²)	<0.20	0.20-0.39 ⁶	≥0.40
RVol (mL/beat)	<30	30-44 ⁶	≥45

- RA, Right Atrium
 1. Bolded signs are considered specific for their TR grade.
 2. RV and RA size can be within the "normal" range in patients with acute severe TR.
 3. With Nyquist limit >50-70 cm/sec.
 4. With baseline Nyquist limit shift of 28 cm/sec.
 5. Signs are nonspecific and are influenced by many other factors (RV diastolic function, atrial fibrillation, RA pressure).
 6. There are little data to support further separation of these values.

Chronic Tricuspid Regurgitation by Echocardiography



Chronic Pulmonic Regurgitation by Echocardiography



- Poor TTE quality or low confidence in measured Doppler parameters
 - Discordant quantitative and qualitative parameters and/or clinical data
- Indeterminate Regurgitation**
Consider CMR for quantitation