SaludMadrid

Hospital Universitario Ramón y Cajal

Comunidad de Madrid

Imaging TR

JL Zamorano

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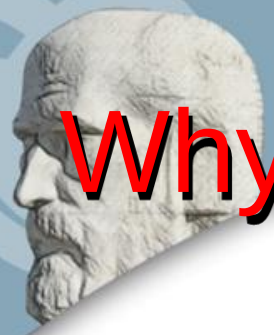
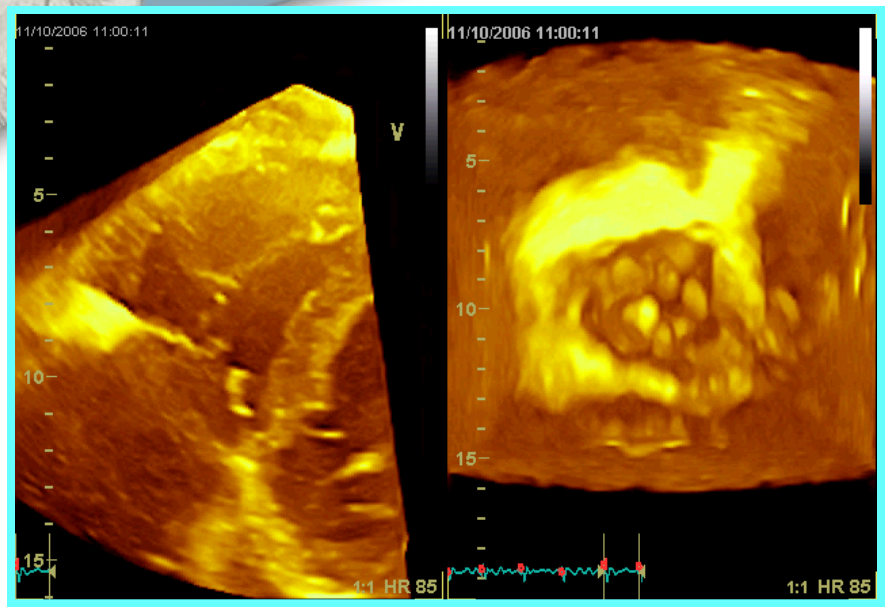


Why is it difficult to quantify TR?

- **The tricuspid valve is often neglected**
- **It has a complex & variable anatomy**
- **TR is load dependent**
- **No gold standard (invasive quantification has many limitations)**
- **Lack of outcome studies relating to TR quantification**

ANATOMY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1:1 HR 85
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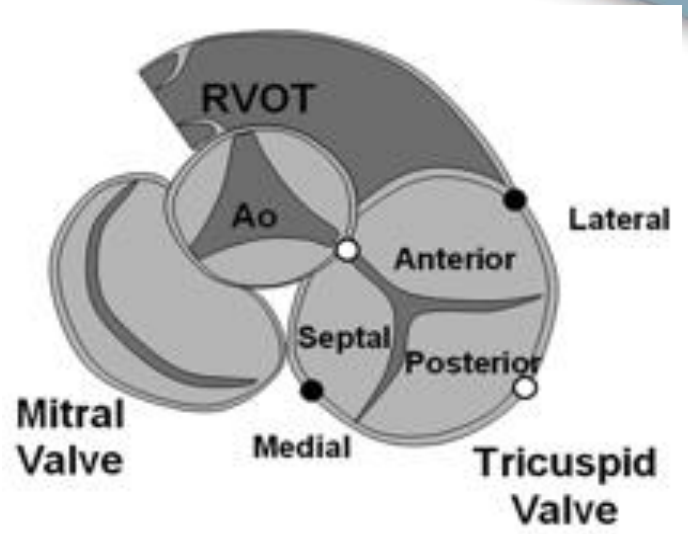
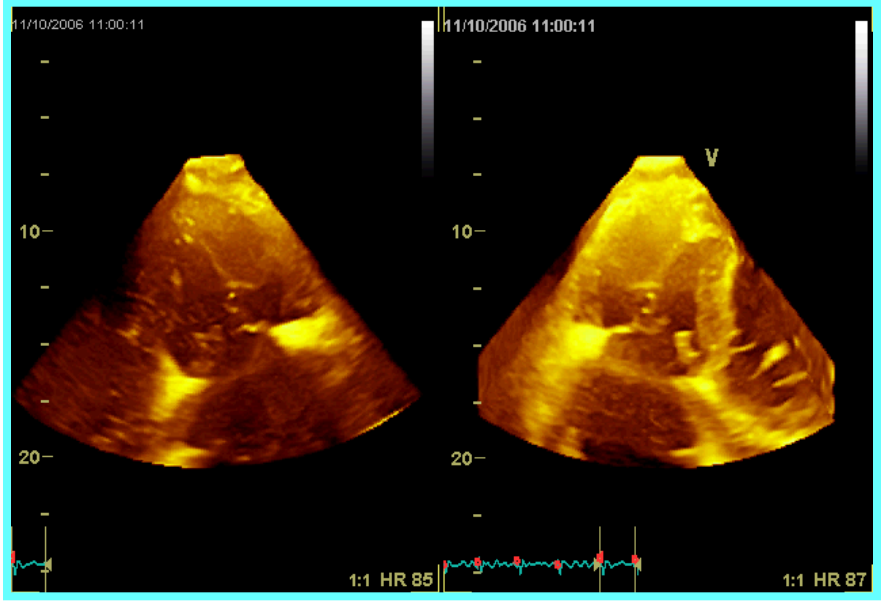

RVOT
Ao
Lateral
Anterior
Septal
Posterior
Mitral Valve
Medial
Tricuspid Valve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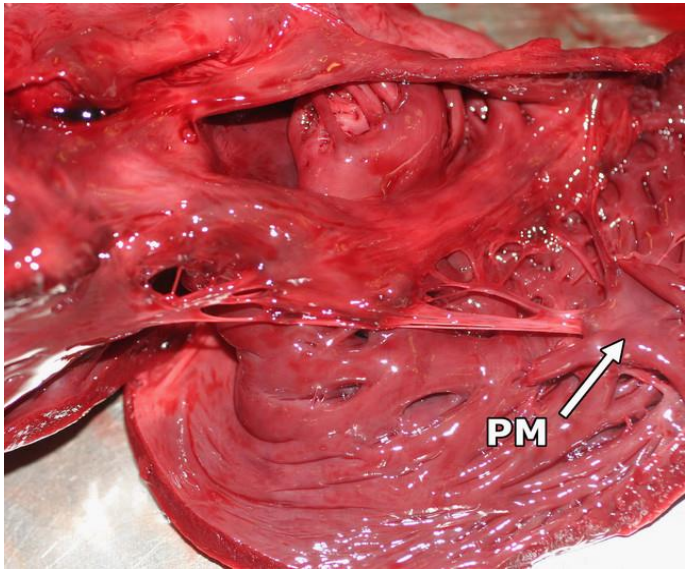
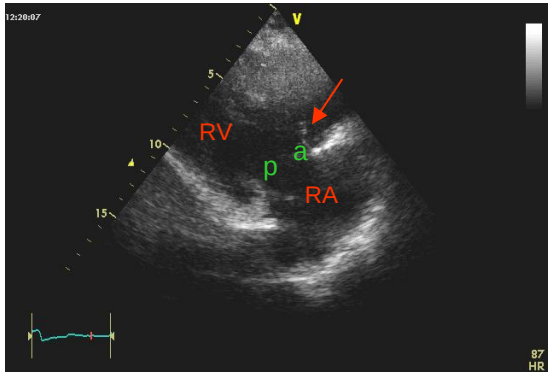
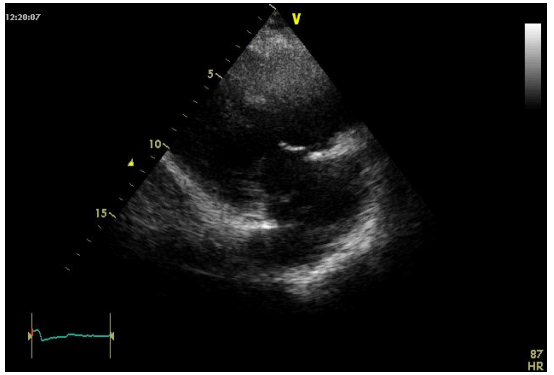

PM

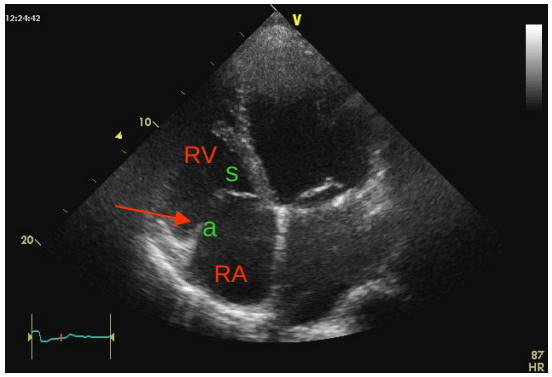
TTE images for tricuspid valve

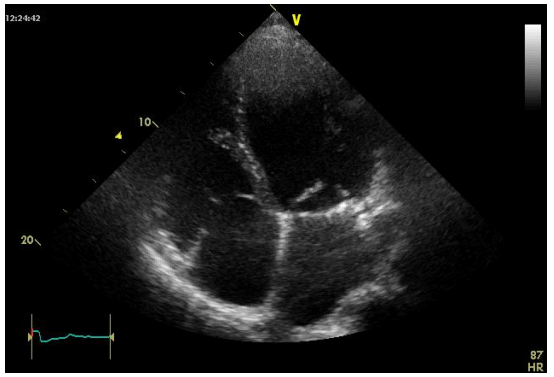
Parasternal view



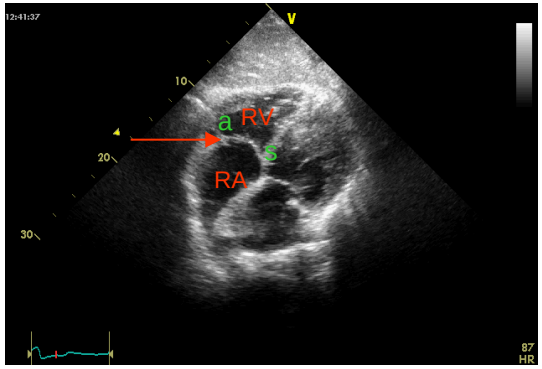


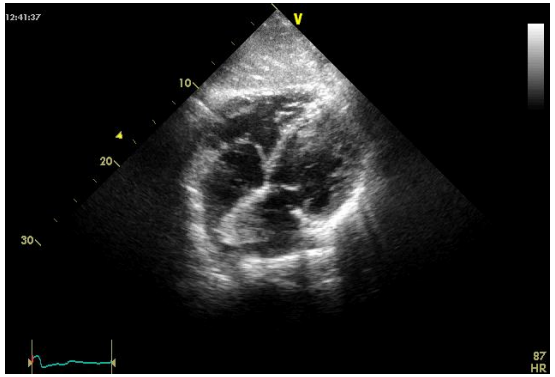
Four chamber view



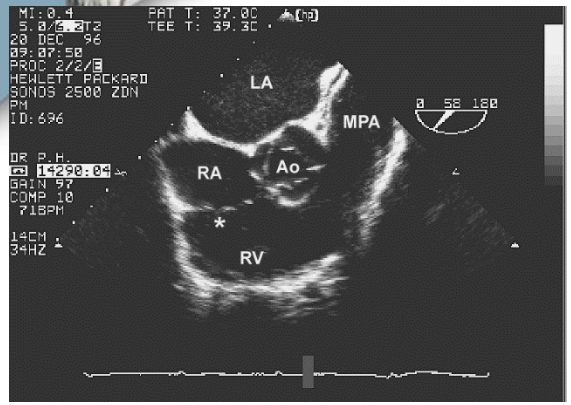


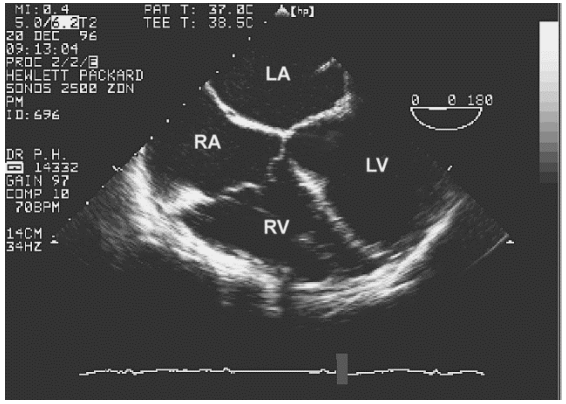
Subcostal view

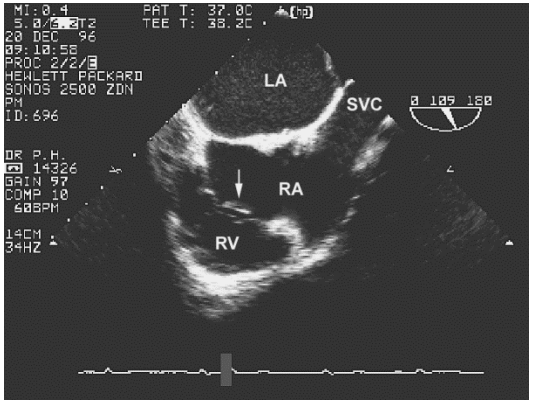


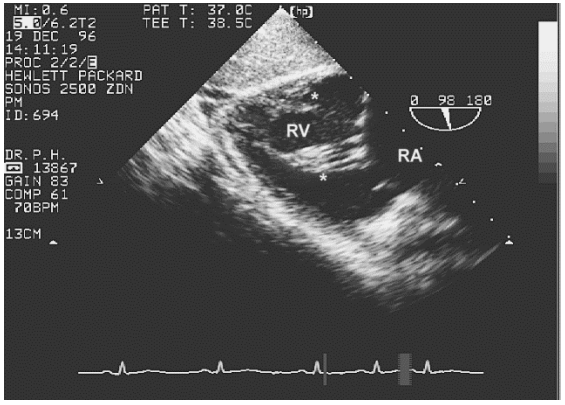


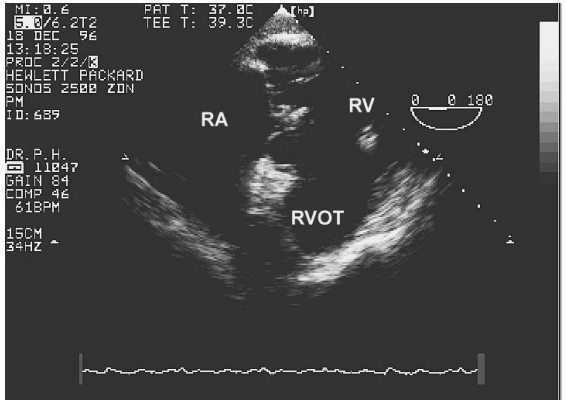
TEE images for tricupsid valve

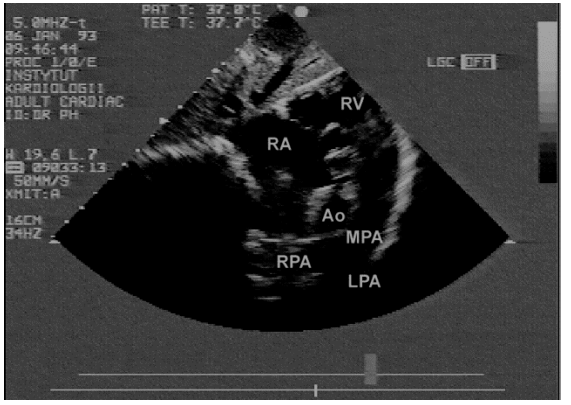




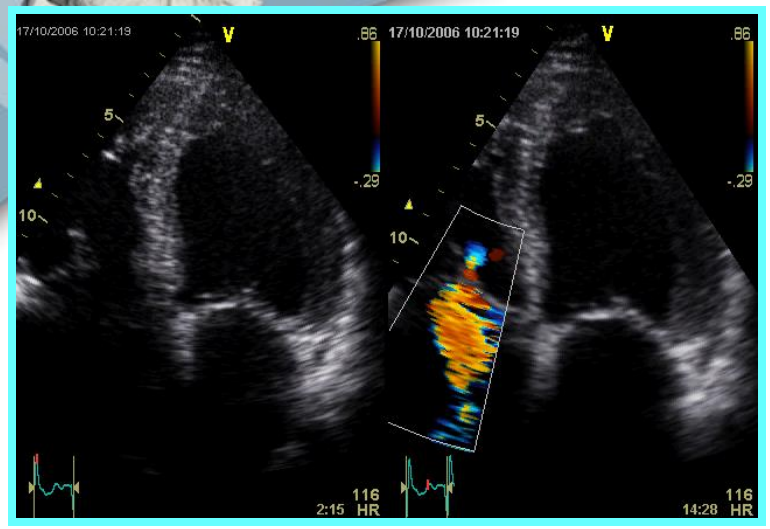








ETIOLOGY

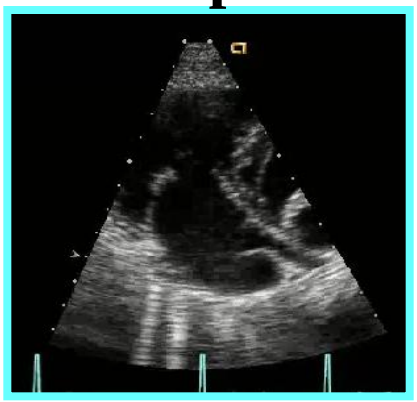


Functional TR

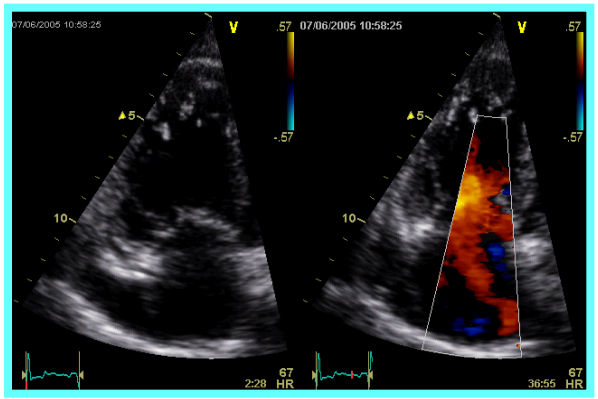
- The most common
- No structural lesion
  - RV pressure overload
  - RV volume overload

Primary TR

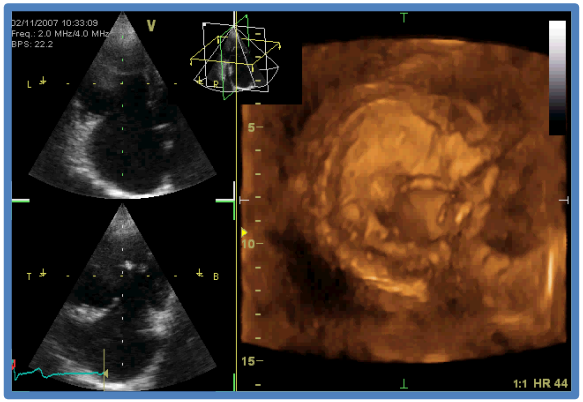
Prolapse



Organic TR

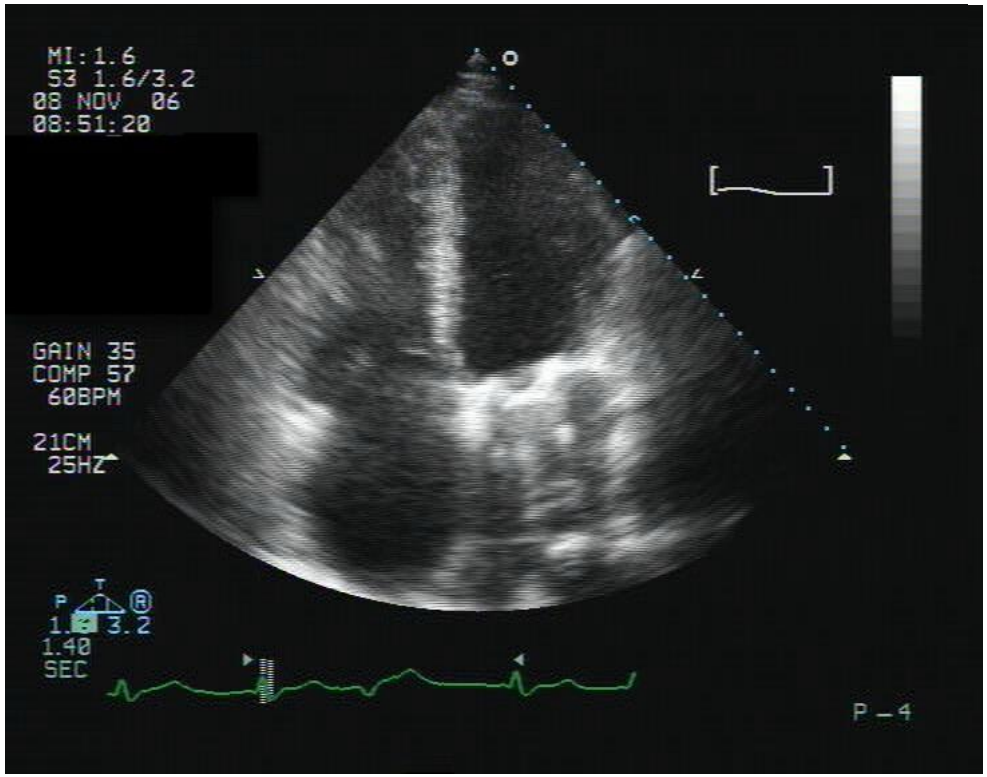


Carcinoid TV

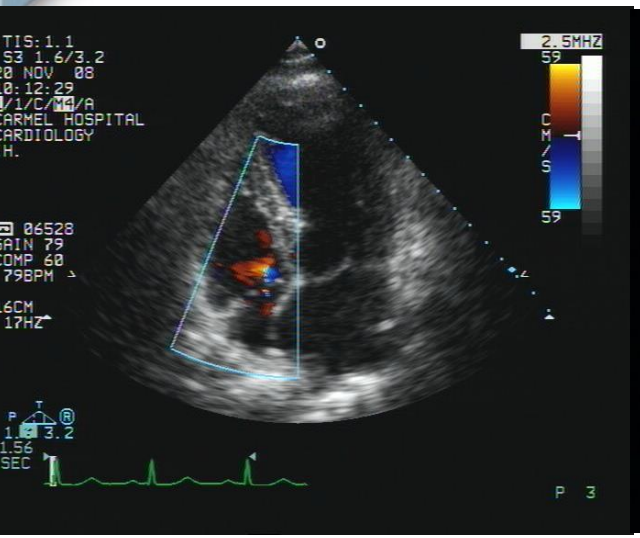
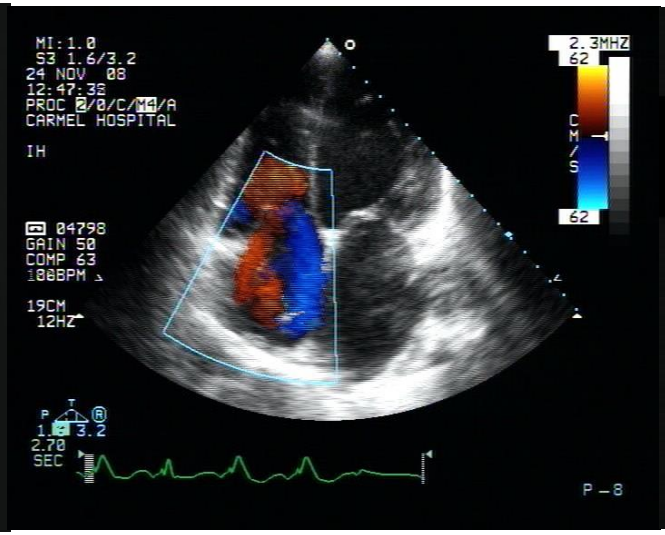
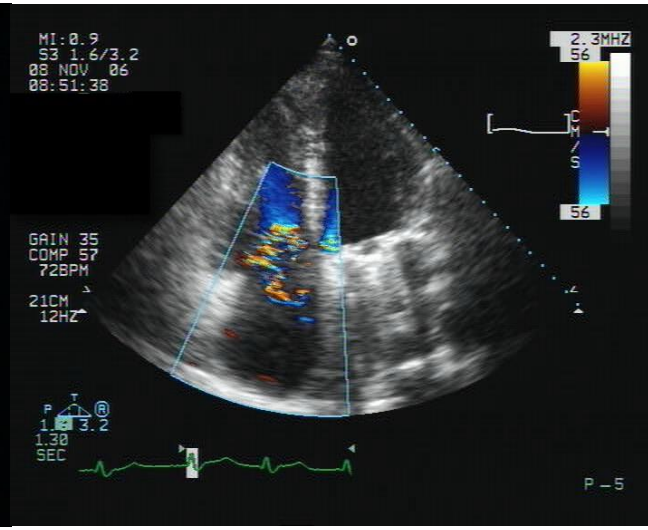


2D Echo signs of TR severity

- RA, RV & IVC dilatation
- Paradoxical septal motion
- TV anatomy
- TV annulus



Color flow Doppler

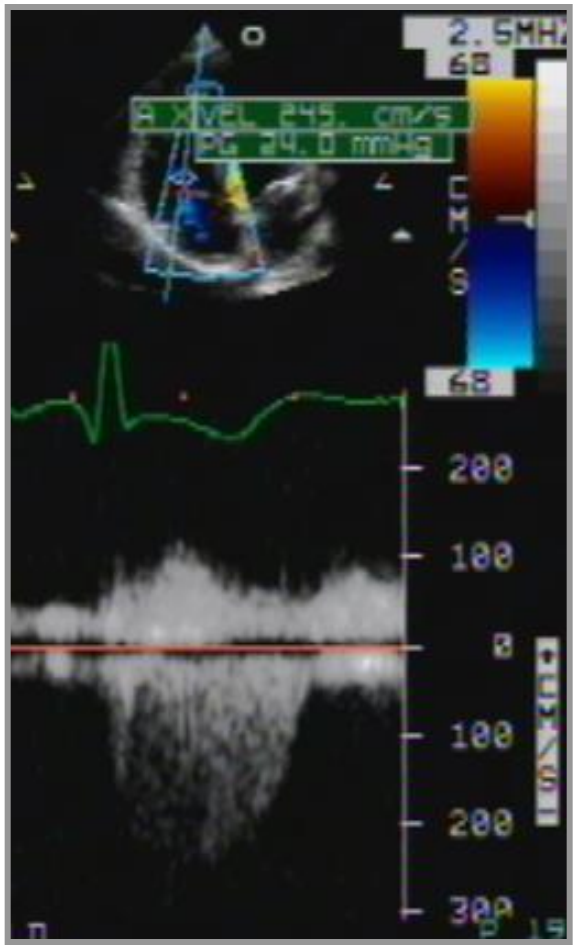
Mild	moderate	severe
		
JA: <5cm^2	5cm^2 -10cm^2	>10cm^2
JA/RAA: <20%	20%-40%	>40%

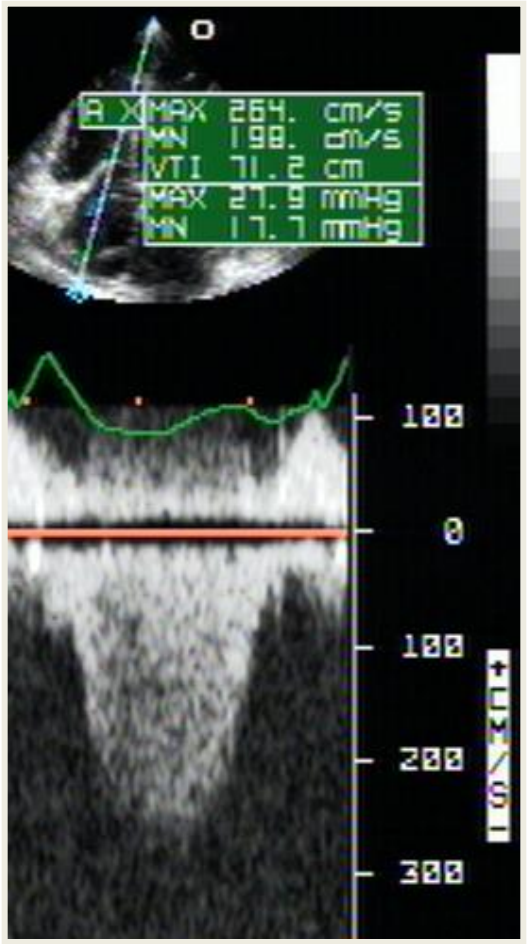
Limitations of color flow Doppler

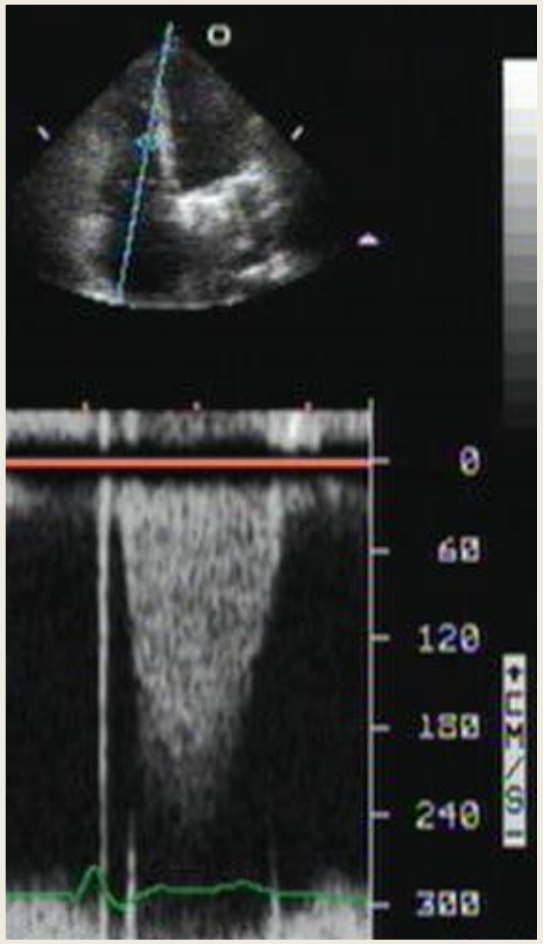
- Central Vs. eccentric jets
- Gain settings & aliasing velocity
- Loading conditions
- JA/RAA: RA enlargement with severe TR
- Considered less accurate then other quantitative methods (VC, PISA)
- Still…

TR severity by CW Doppler

Mild **Moderate** **Severe**







TR Jet – CW Doppler

- **A efull CW Doppler envelope indicates more severe TR than a faint signal**

- **A triangular CW contour with an early peak velocity indicates elevated RA pressure or prominent pressure wave in the RA due to severe TR**

- **The velocity of TR does not reflect the severity of TR**

  - **Massive TR: often associated with a low jet velocity = near egalization of RA and RV pressure**
  - **Mild TR + severe pulmonary hypertension : possible high velocity jet**

- SOME TIPS ¡¡

Tricuspid E-wave peak velocity (n=118)

- **E ≥65 cm/sec identified severe TR**

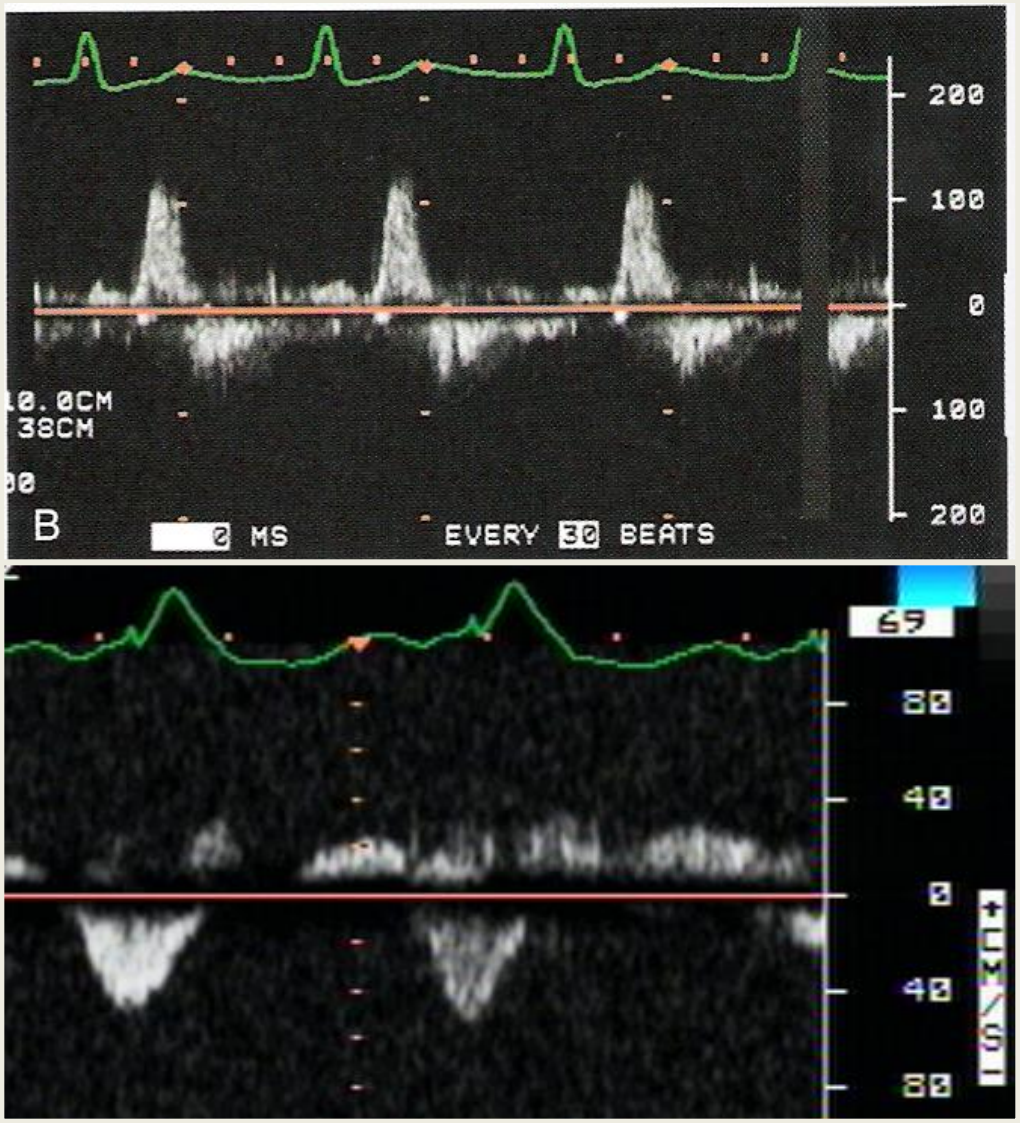
  sensitivity=73%

  specificity=88%

Danicek et al, AJC 2006

Hepatic veins systolic flow reversal

severe TR



Correlation with clinical TR:

- **PPV=91%**
- **NPV=78%**

moderate TR

Shapira et al, JASE 1998

Vena Contracta

- Apical 4CV or parasternal RV inflow view
- Optimize gain settings
- High aliasing velocity
- High frame rate
- Zoom in, mid systole
- Observe all 3 components of the regurgitant flow

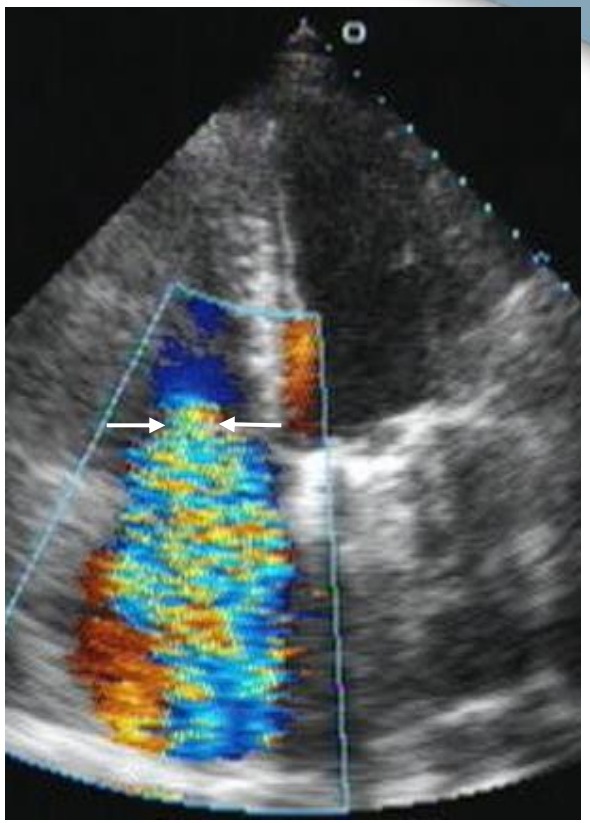
Vena Contracta

Mild TR: VC<0.3?

Moderate TR: 0.3 ? <VC<7mm

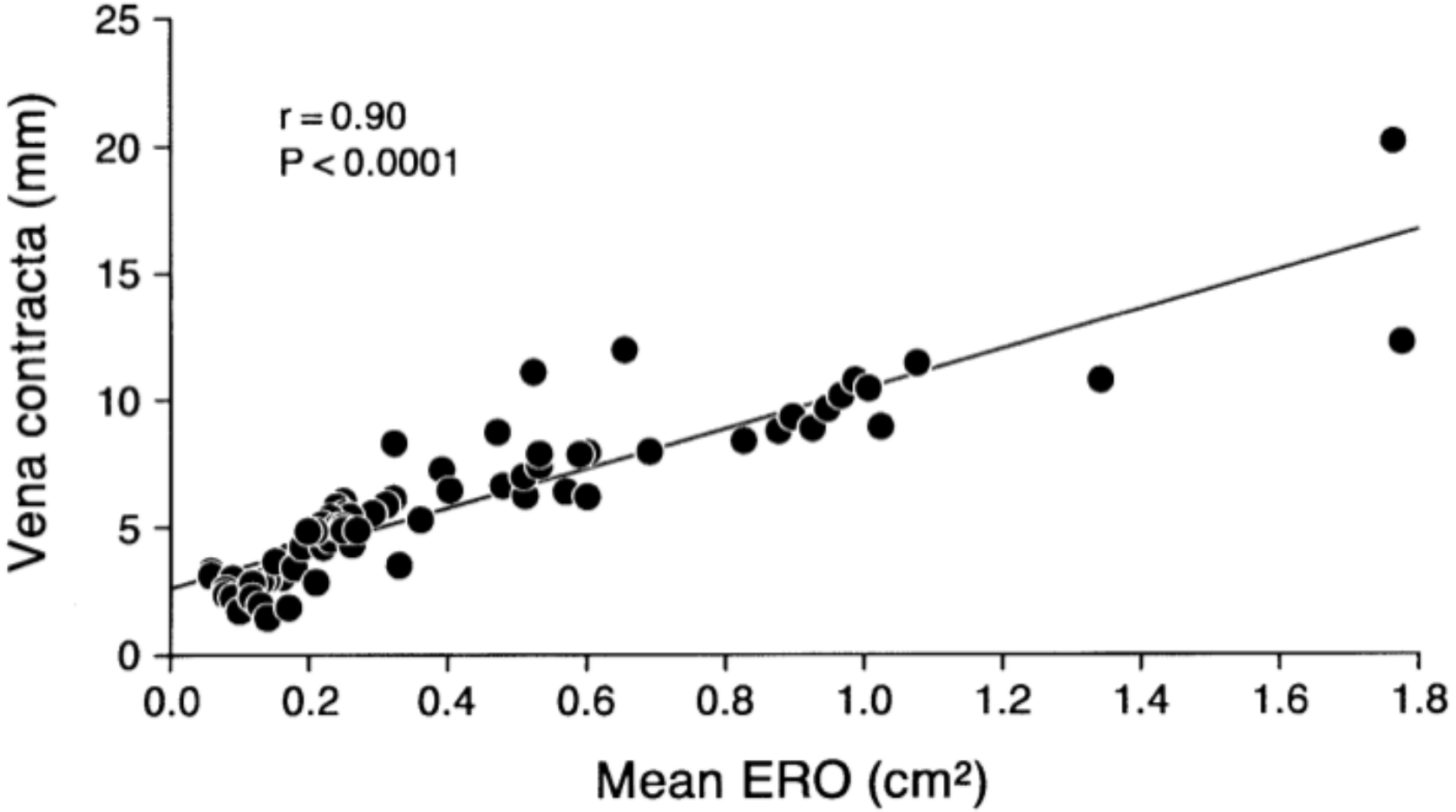
Severe TR: VC>7mm

VC=4.5mm



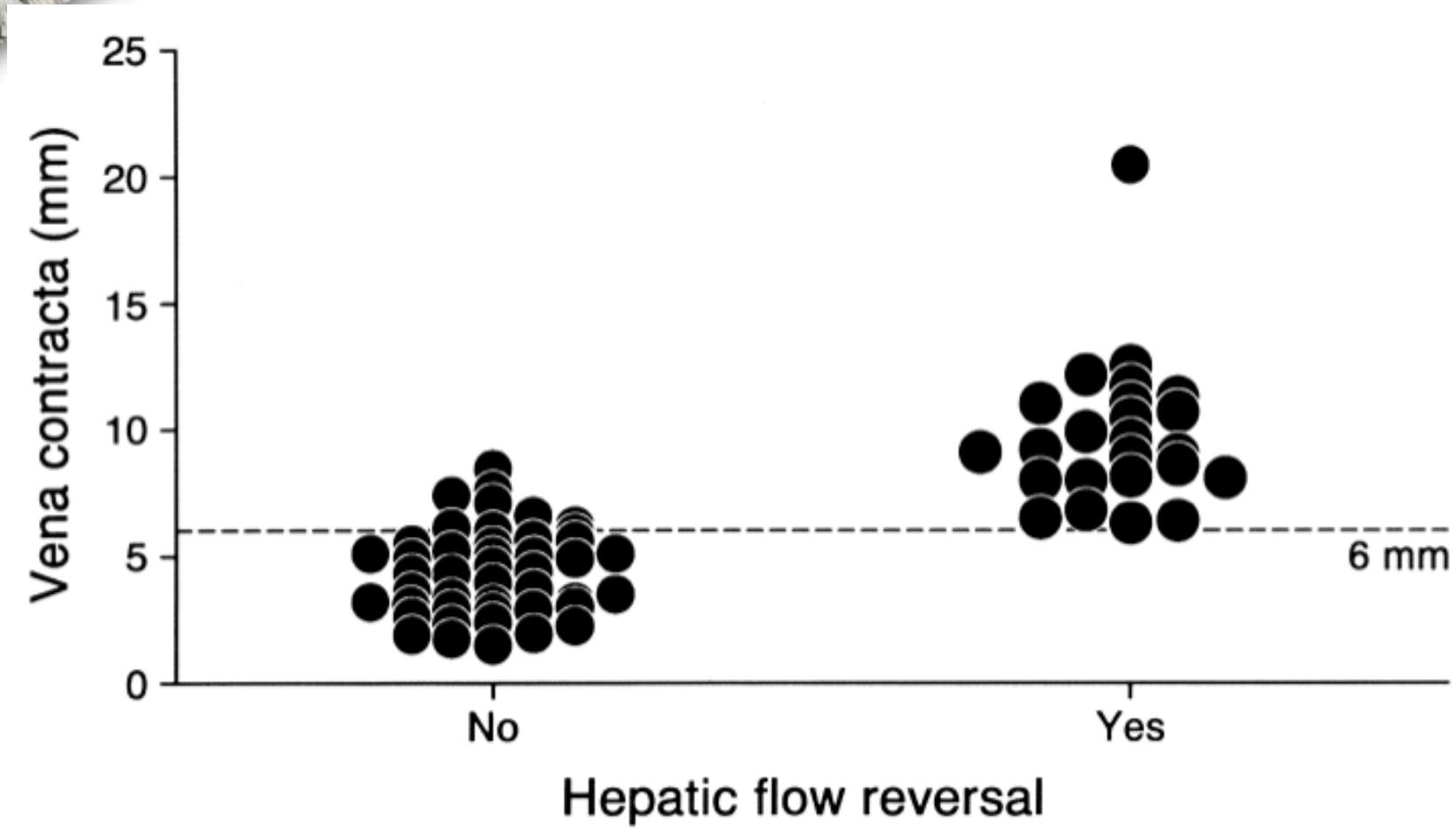
VC=12mm

Vena Contracta Vs. PISA EROA
(n=71)



Tribouilloy et al, JACC 2000

Vena Contracta Vs. Hepatic Flow Reversal

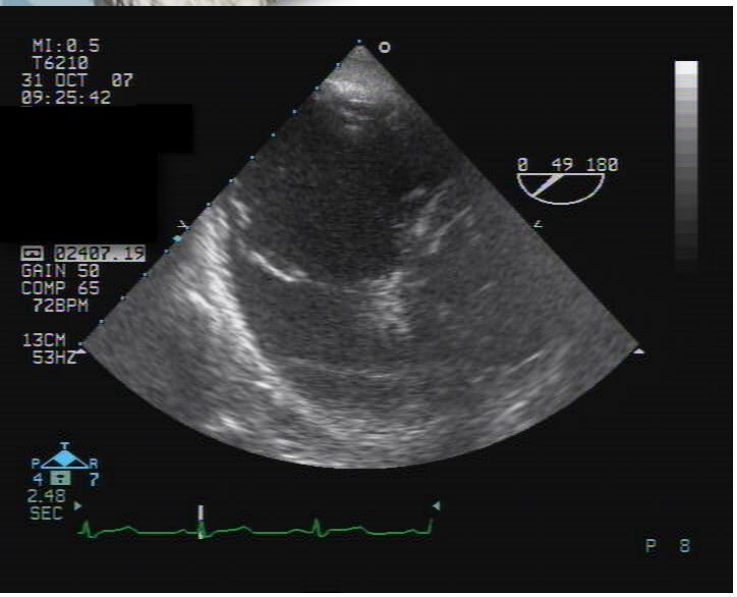


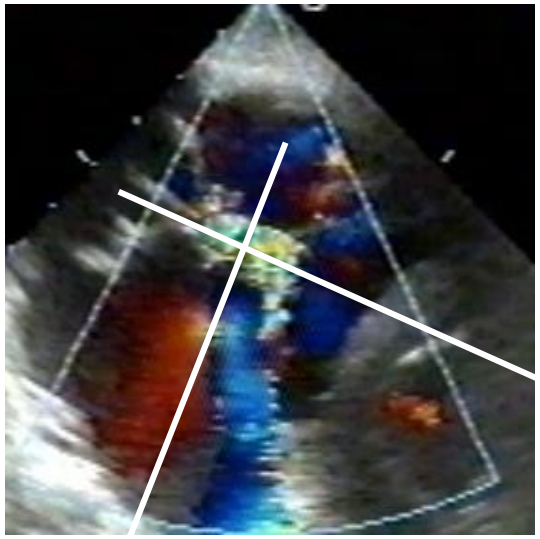
Tribouilloy et al, JACC 2000

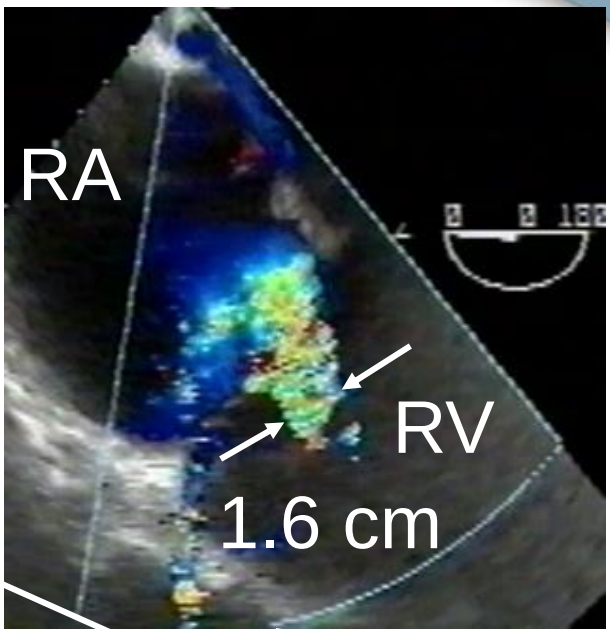
Limitations of Vena Contracta

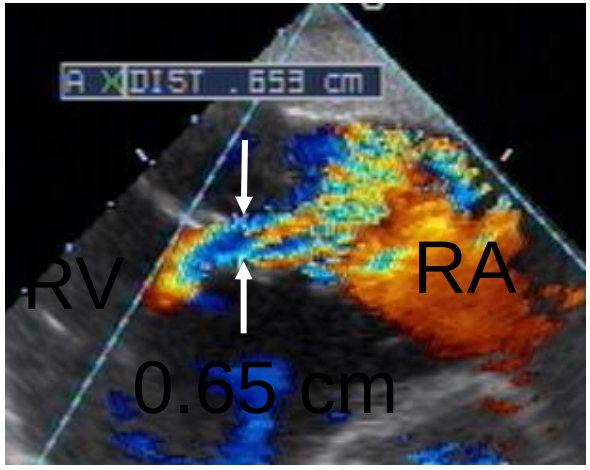
- Small measurements (each pixel makes a difference…)
- Overlap in values for small/moderate/severe TR
- Non circular
- When there is more than one TR jet
- Is it really better than color jet area? (outcome studies?)

Non Circular Vena Contracta









3D VENA CONTRACTA

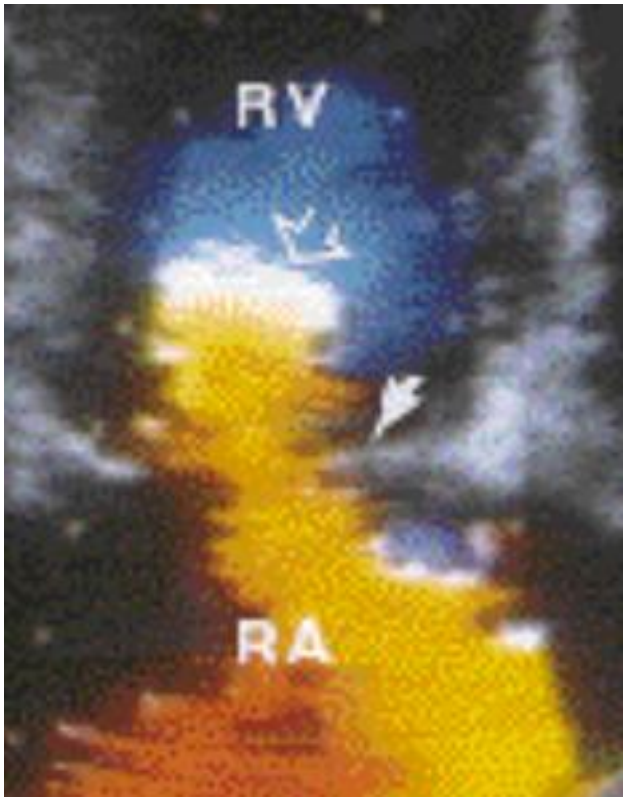
Practical Estimation of TR by PISA

At V_{ng} = 28 cm/sec:

- **Mild TR:** r < 0.5 cm
- **Moderate TR:** 0.6 cm < r < 0.9 cm
- **Severe TR:** r > 0.9 cm

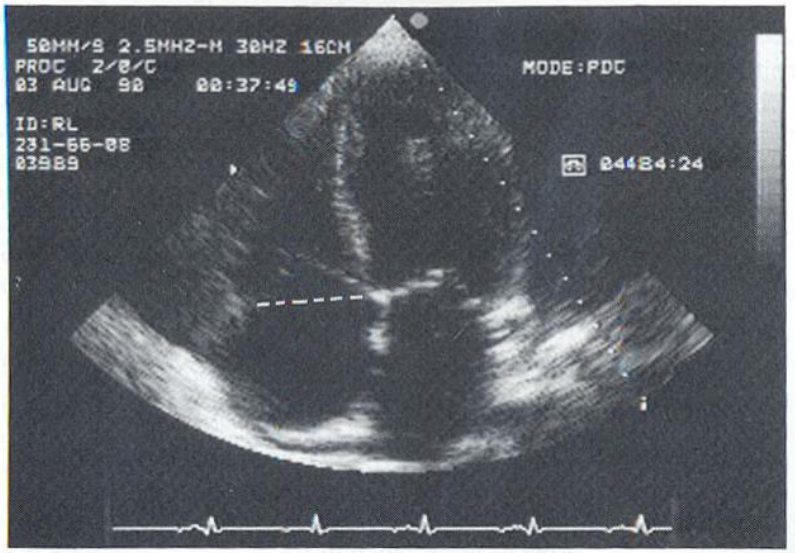
Problems with PISA

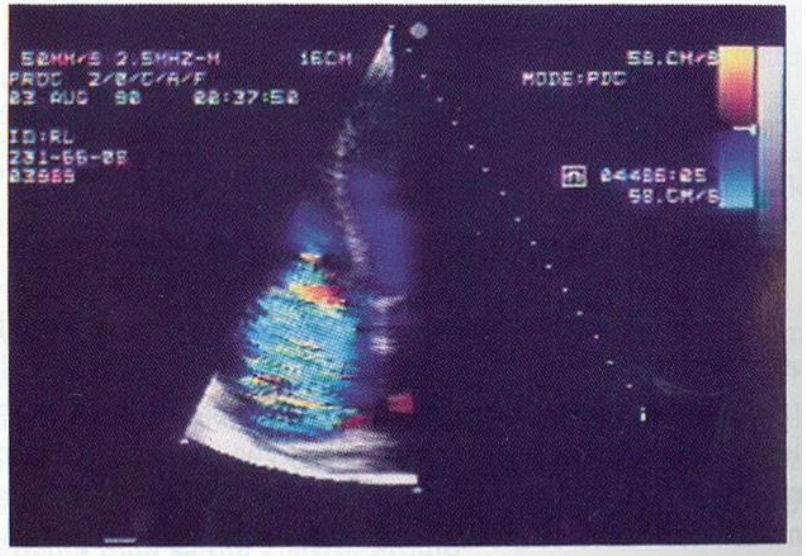
- Localizing the regurgitant orifice
- Irregular rhythms
- Biological variability



Tricuspid annulus diameter (TAD) and TR

- **TAD (cm)**
  - **Normal= 2.8±0.5**
  - **TR=4.4±0.7**
- **TAD was the best determinant of TR (not PAP or RVD)**



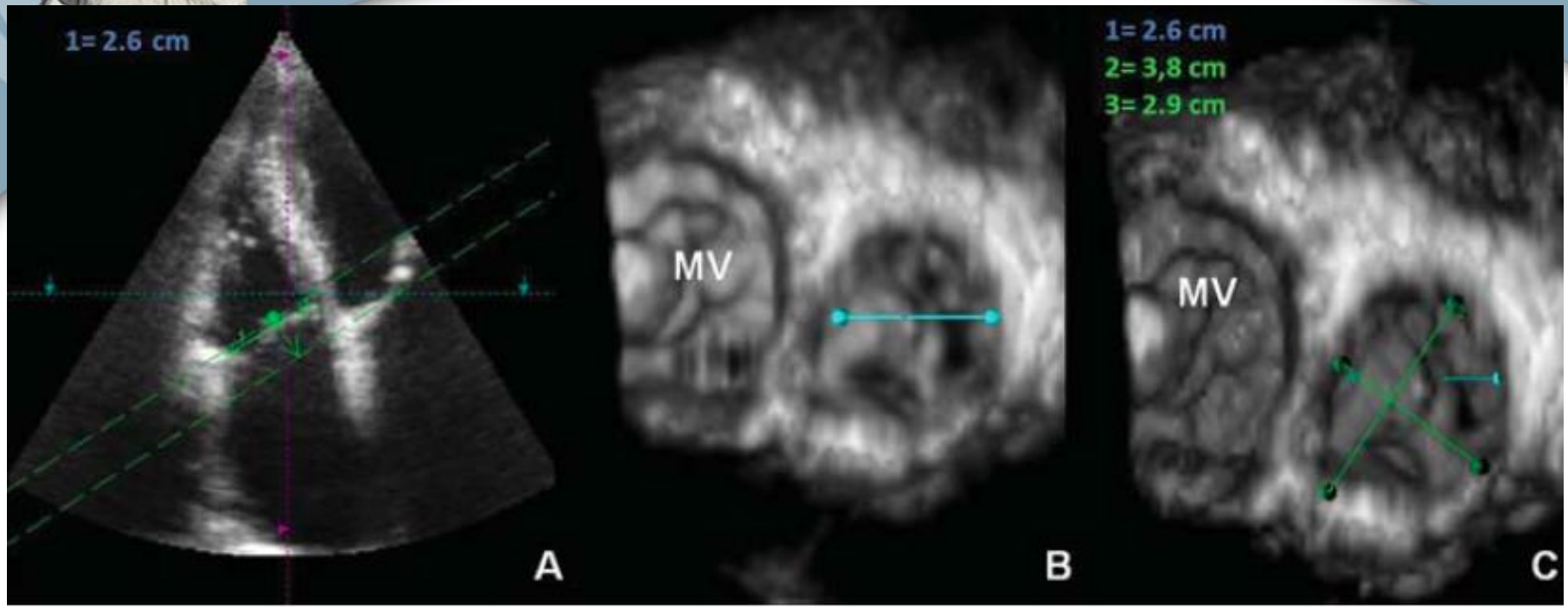


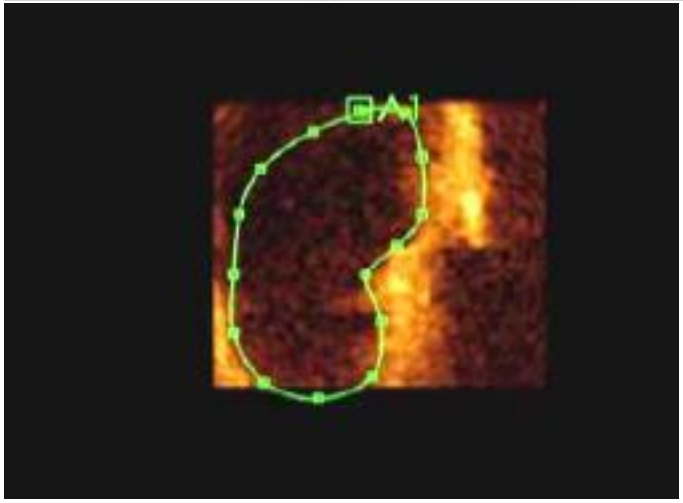
Correlation between TAD and TR grade

Anwar Int J Cardiovasc Imag 2007

Sagie et al, JACC 1994

2D vs 3D Tricuspid Annulus Dimensions





The tricuspid annulus shape is not circular but oval, with a minor and a major diameter

65% of pts with normal TAD at 2DE showed grade 1–2 TR compared with 30% of pts with normal TA size at 3DE

Echocardiographic detection of clinical TR

	Sensitivity	Specificity
Jet area≥ 9cm^2	92%	71%
JA/RAA≥ 37%	66%	61%
VC≥ 8mm	71%	71%
HV systolic flow reversal	82%	89%

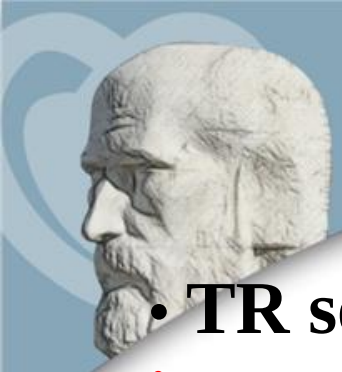
Shapira et al, JASE 1998

Echocardiography for evaluation of TR severity

Parameter	Utility/Advantages	Limitations
RV/RA/IVC size	Enlargement sensitive for chronic significant TR. Normal size virtually excludes significant chronic TR.	Enlargement seen in other conditions. May be normal in acute significant TR
TV leaflet alterations	Flail valve specific for significant TR	Other abnormalities do not imply significant TR
Paradoxical septal motion (volume overload pattern)	Simple sign of severe TR	Not specific for TR
Jet area–Color flow	Simple, quick screen for TR	Subject to technical and hemodynamic factors. Underestimates severity in eccentric jets
Vena contracta width	Simple, quantitative, separates mild from severe TR	Intermediate values require further confirmation
PISA method	Quantitative	Validated in only a few studies
Flow quantitation –PW	Quantitative	Not validated for determining TR regurgitant fraction
Jet profile –CW	Simple, readily available	Qualitative, complementary data
Peak tricuspid E velocity	Simple, usually increased in severe TR	Depends on RA pressure and RV relaxation, TV area, and atrial fibrillation; Complementary data only
Hepatic vein flow	Simple; Systolic flow reversal is sensitive for severe TR	Influenced by RA pressure, atrial fibrillation.

CW, Continuous wave Doppler; *EROA*, effective orifice regurgitant area; *IVC*, inferior vena cava; *PISA*, proximal isovelocity surface area; *PW*, pulsed wave Doppler; *RA*, right atrium; *RV*, right ventricle; *TV*, tricuspid valve; *TR*, tricuspid regurgitation.

Recommendtaions for Evaluation of the Severiy of Native Valvular Regurgitation with Two-dimensional and Doppler Echocardiography



CONCLUSIONS

- **TR severity assessment should be performed in an integrative manner +++ using qualitative and quantitative parameters**

- **Vena Contracta Width ++ / EROA (R Vol) ++**

- **Serial assessments of TR are recommended because TR severity can be affected by multiple factors, such as volume status and afterload**

- **Severe TR: role of RV shape and function analysis**