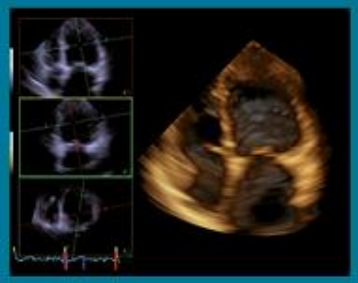


EuroValve

October 24-25, 2014

Challenging clinical situations

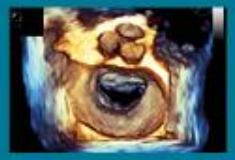
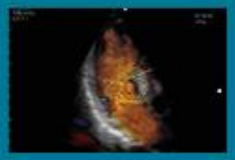
A patient with multiple valve disease

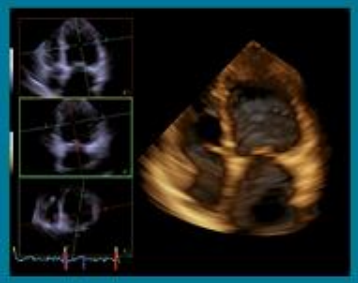
Philippe Unger

CHU Saint-Pierre

Brussels, BE





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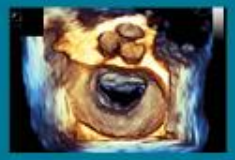
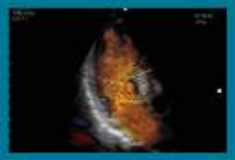
Faculty disclosure

Philippe Unger

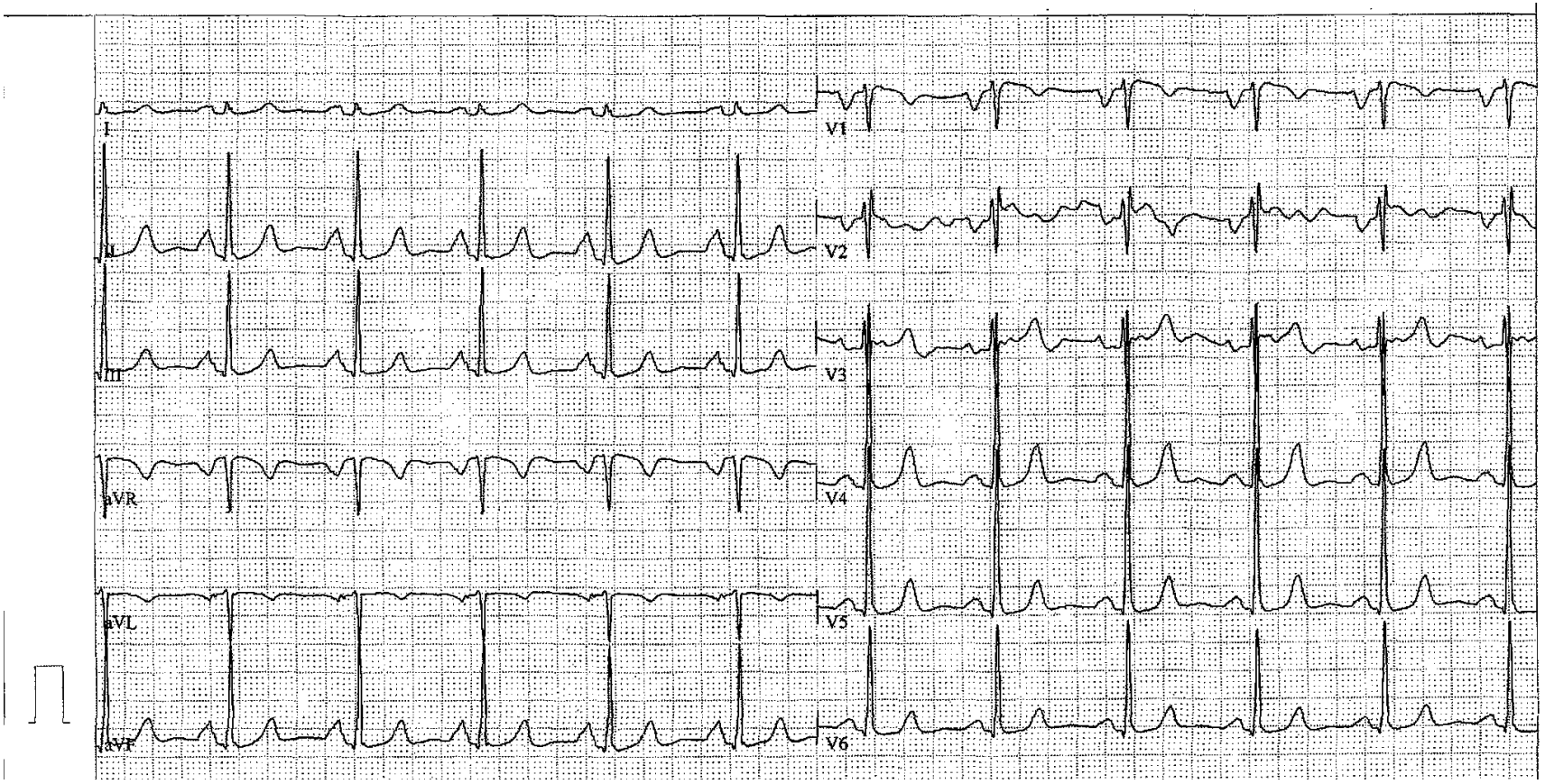
I have **no financial relationships** to disclose.



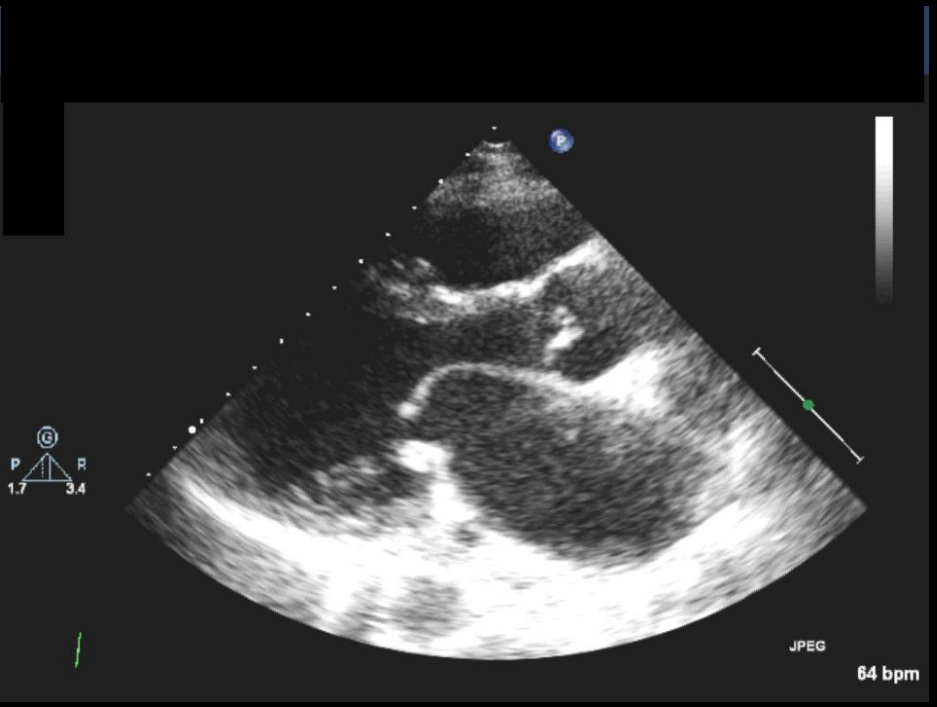



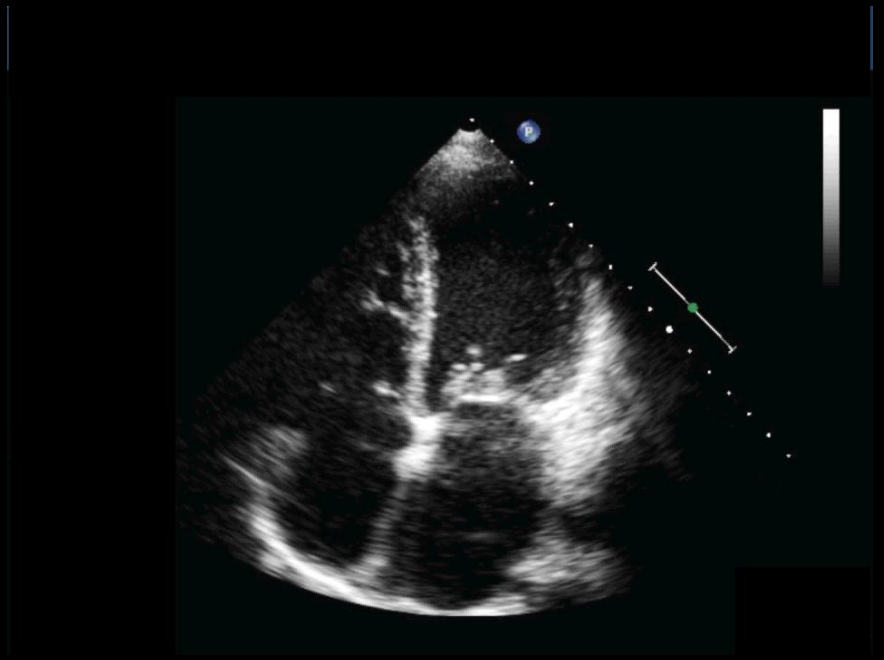
www.eurovalvecongress.com

- 28 y-o woman
- Born in Morocco, lives in Belgium, two children
- h/o rheumatic heart disease
- Increasing dyspnea during the last years; currently s.o.b. on minimal exertion

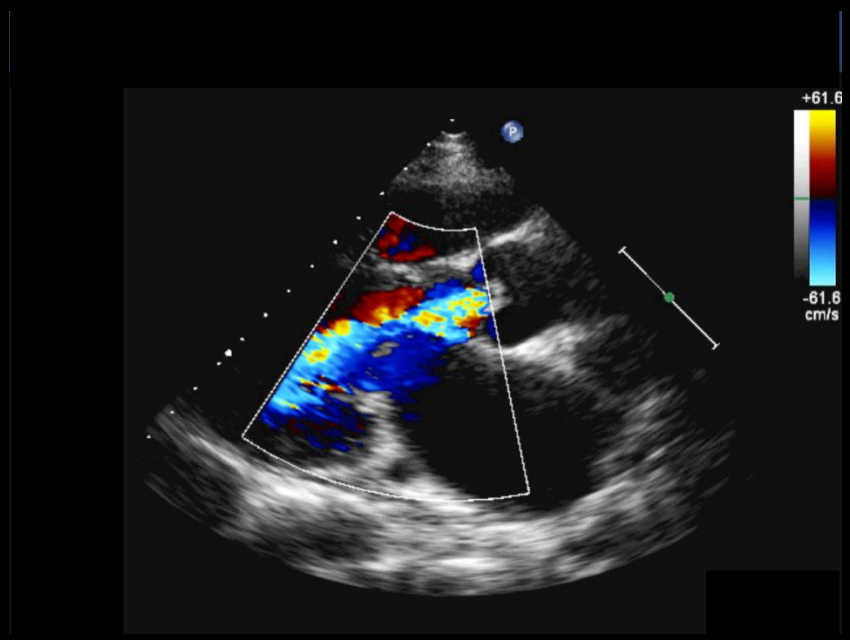

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

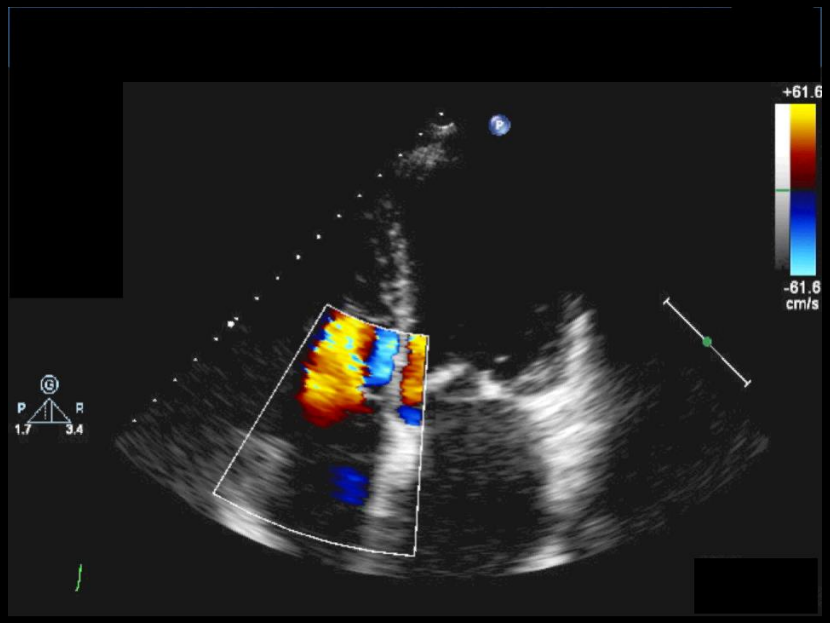
Rheumatic heart disease



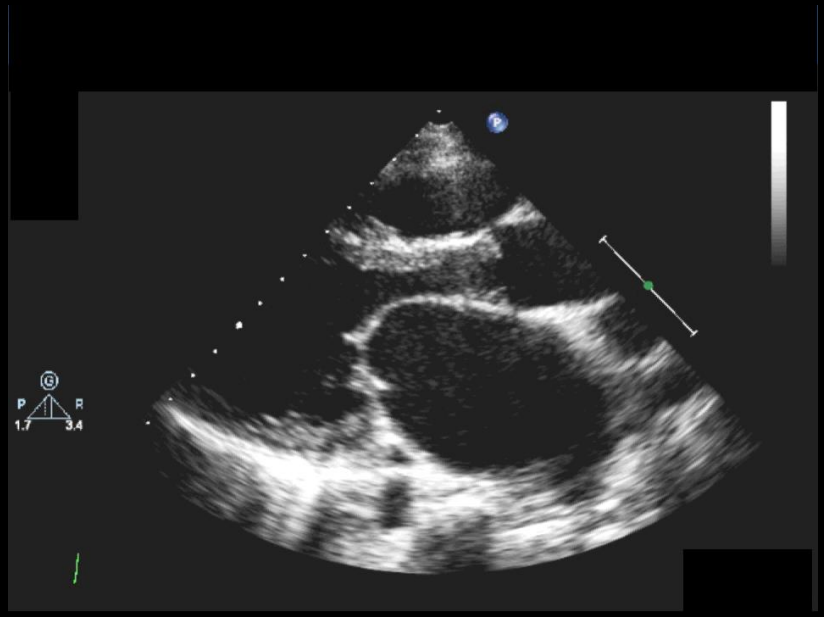


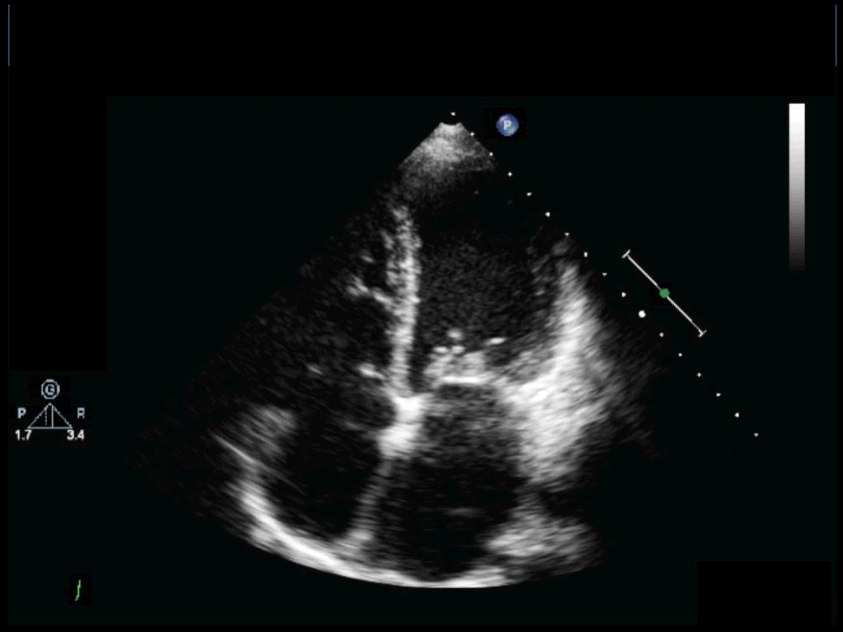
Rheumatic heart disease

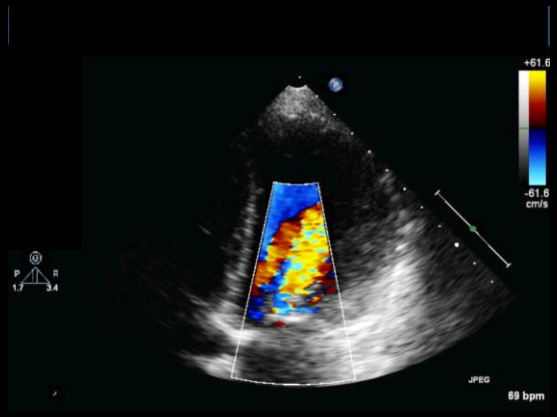




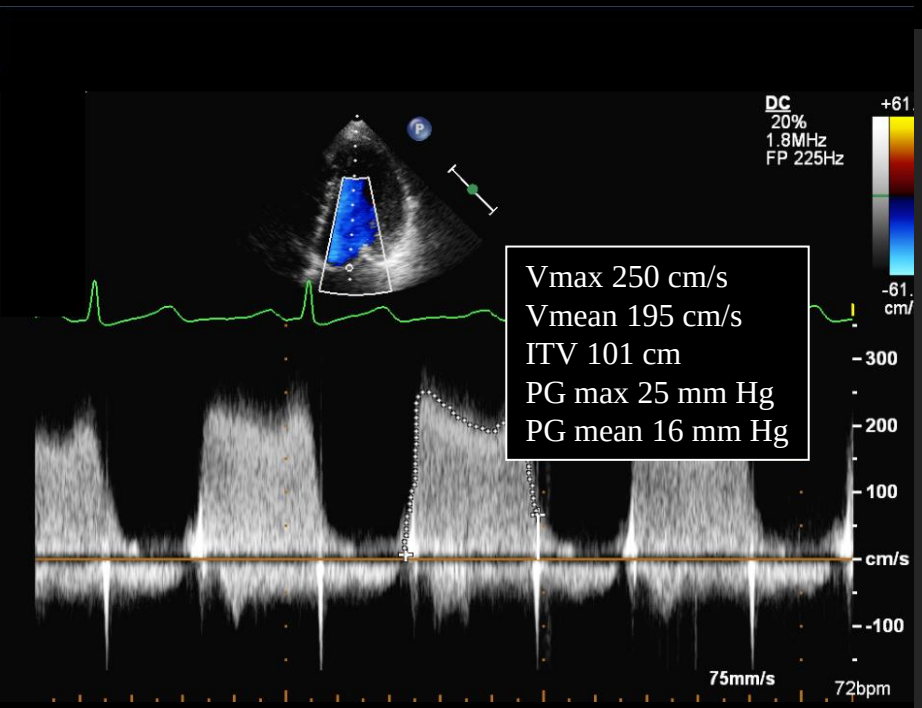
Mitral valve

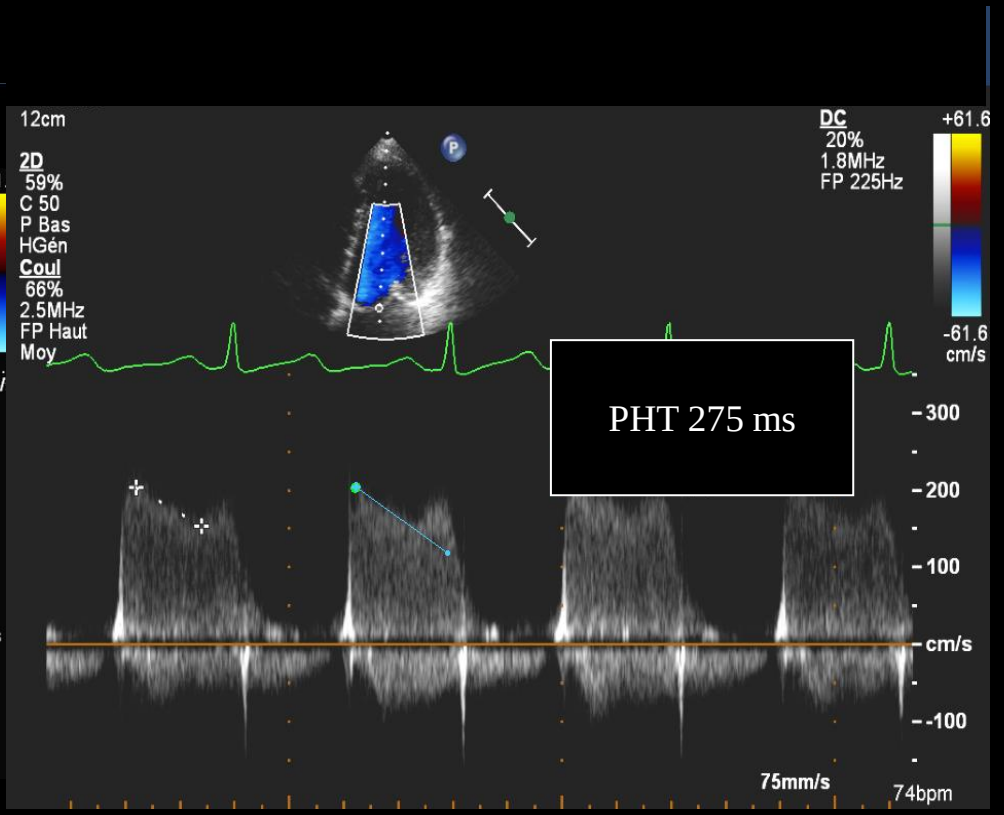




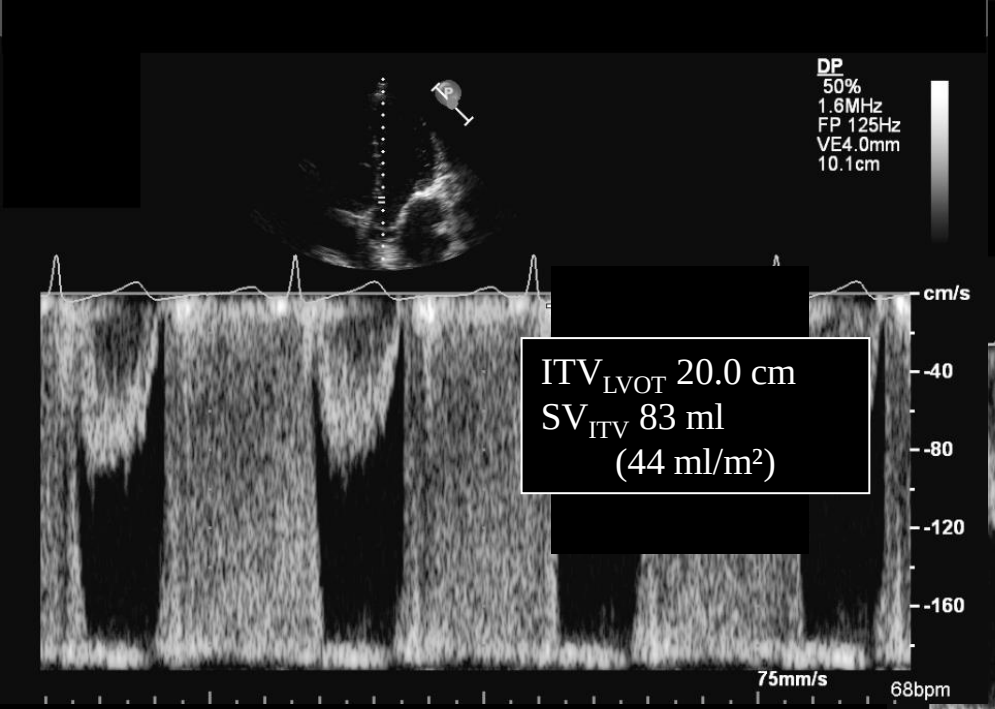


Mitral stenosis

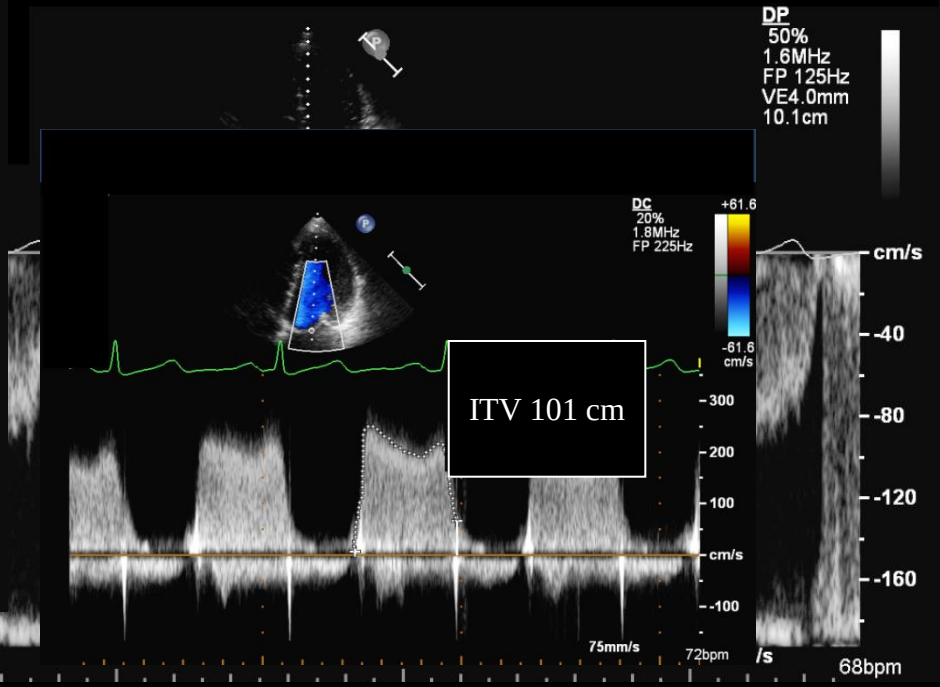




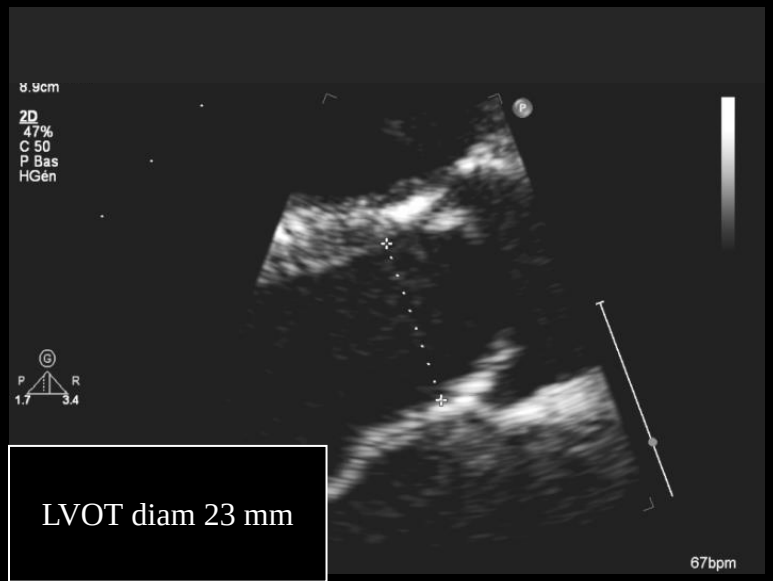
MVA (PHT): 0.80 cm^2



ITV_{LVOT} 20.0 cm
SV_{ITV} 83 ml
(44 ml/m²)



ITV 101 cm



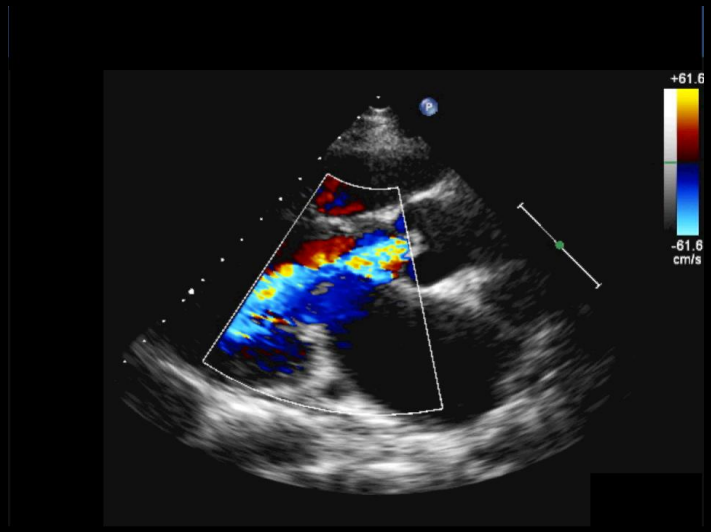
LVOT diam 23 mm

MVA (continuity): 0.82 cm²

Rheumatic MS+AR

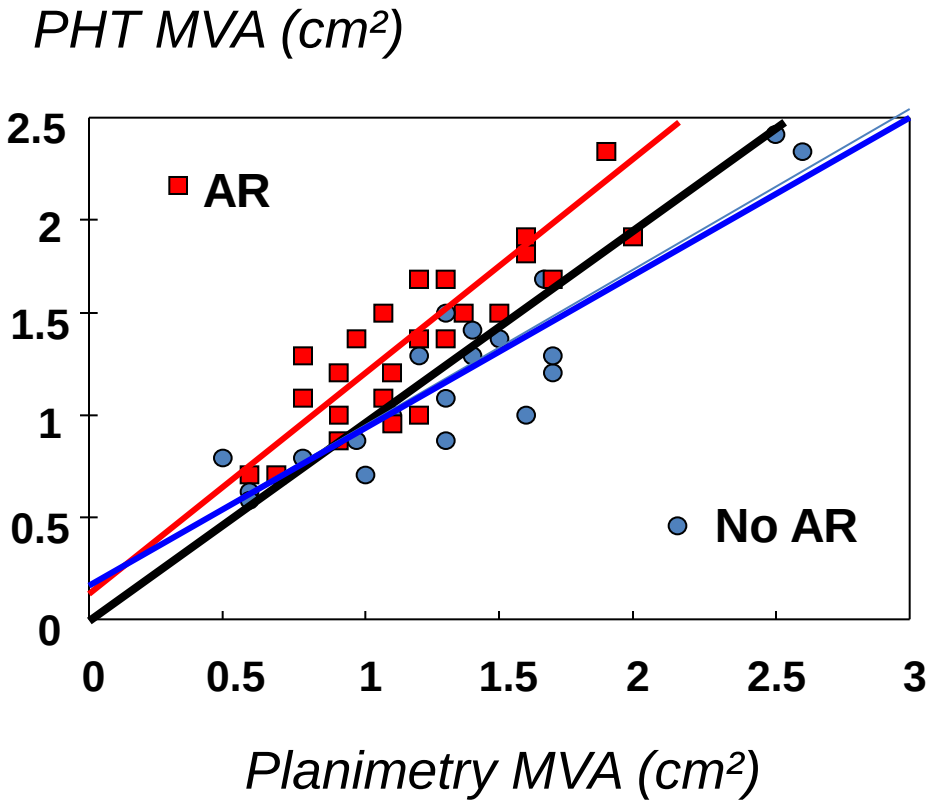
1. Continuity equation is accurate to assess MVA
2. Pressure half-time method is accurate to assess MVA
3. Both methods are accurate
4. None of these methods are accurate

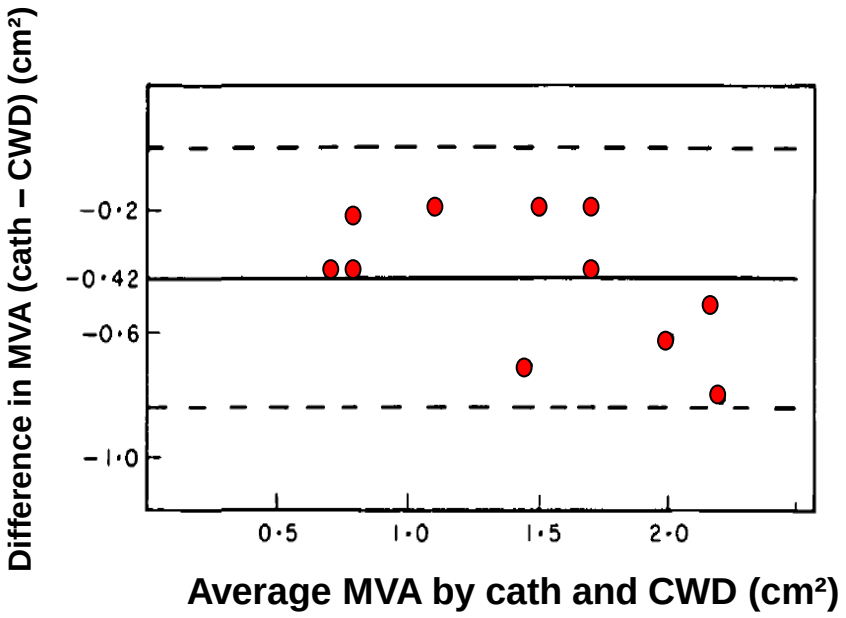
In the presence of AR, MVA is overestimated by the continuity equation



$$MVA = \frac{\text{LVOT diameter} \times \text{LVOT TVI}}{\text{Mitral TVI}}$$

In the presence of AR, MVA is overestimated by the pressure half-time method





Flachskampf FA et al. *J Am Coll Cardiol*. 1990;16:396

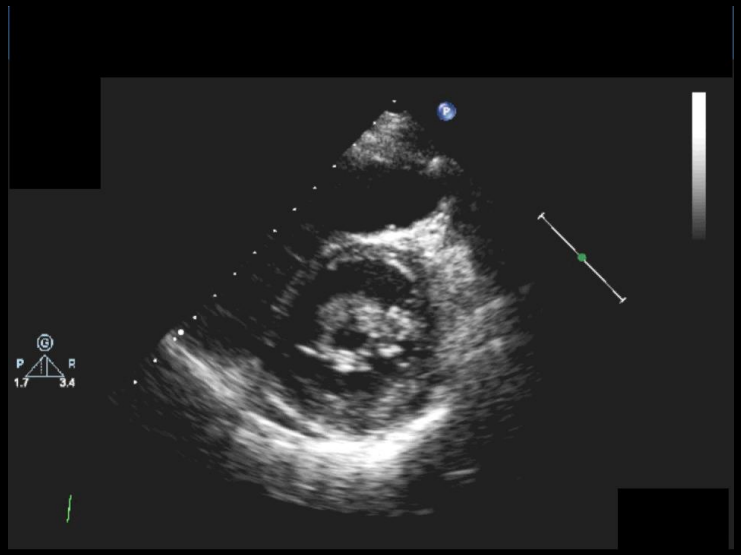
Moro E et al. *Eur Heart J* 1988;9:1010

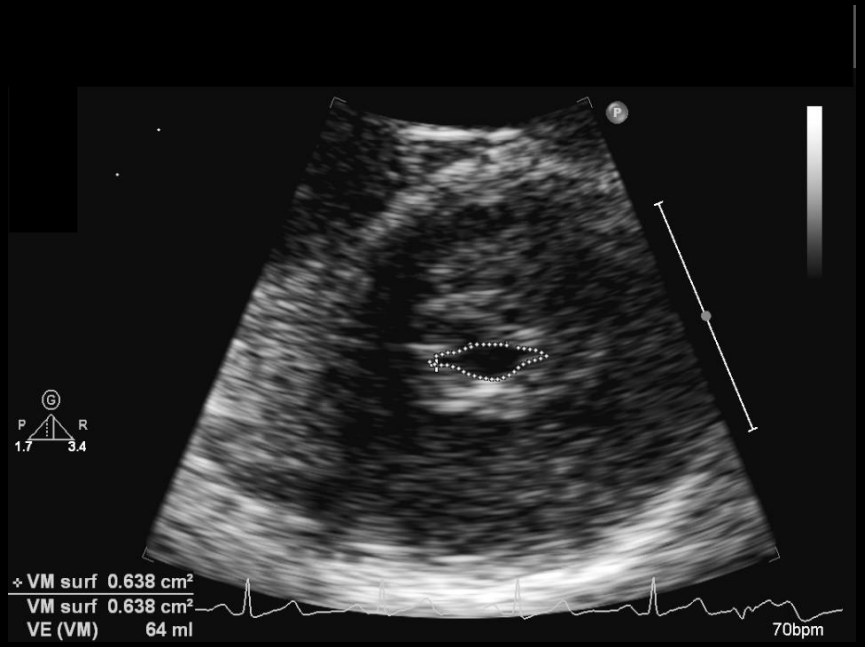
Main diagnostic caveats in multiple and mixed valve disease

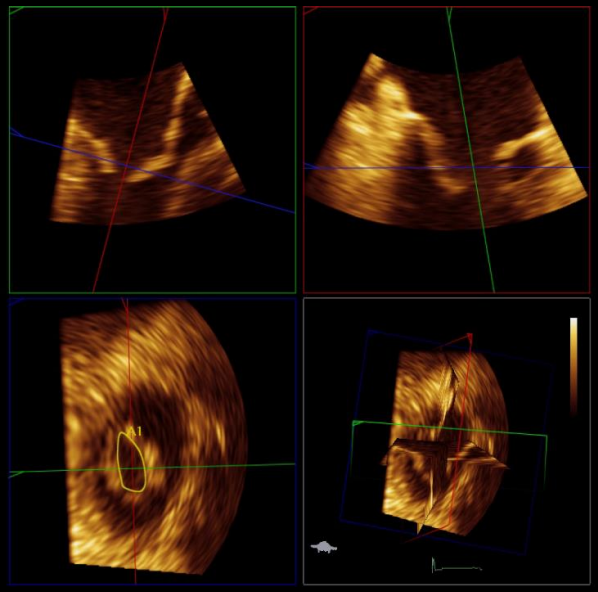
		…the diagnosis of the following lesion might be impaired			
		AS	**AR**	**MS**	**MR**
In the presence of	**AS**		Pressure half-time method unreliable	Low flow low gradient MS Pressure half-time method unreliable	High RV; increased area of mitral regurgitant jet using CF mapping ERO less affected
	AR	Simplified Bernoulli equation may be inapplicable Gorlin formula using thermodilution invalid		AR jet should be mistaken of MS jet Continuity equation unreliable Pressure half-time method unreliable	Doppler volumetric method inapplicable
	MS	Low flow low gradient AS	MS may blunt the hyperdynamic clinical picture		Not significantly affected
	MR	Low flow low gradient AS MR jet should not be mistaken for the AS jet	Doppler volumetric method inapplicable Pressure half-time method may be unreliable	Continuity equation unreliable Pressure half-time method unreliable Gorlin formula using thermodilution invalid	

Unger P, Rosenhek R, Lancellotti P et al. *Heart* 2011;97:272

Mitral valve planimetry

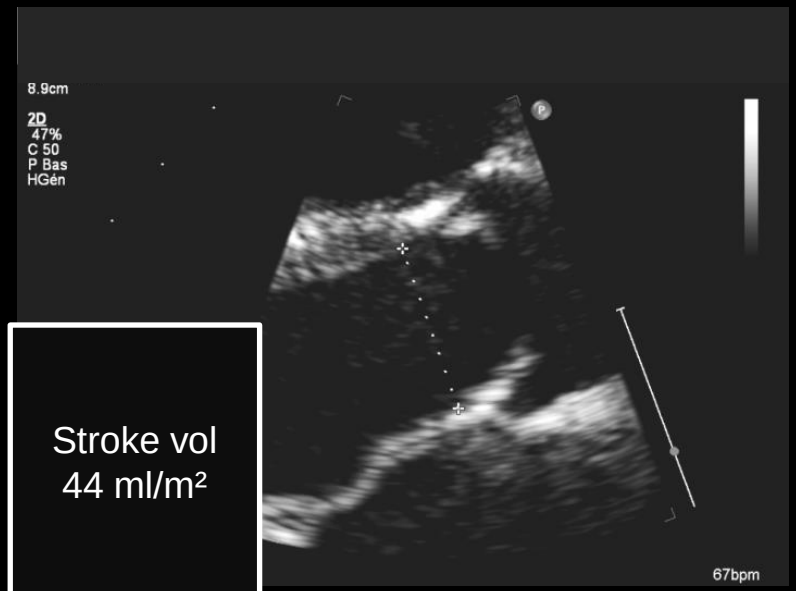




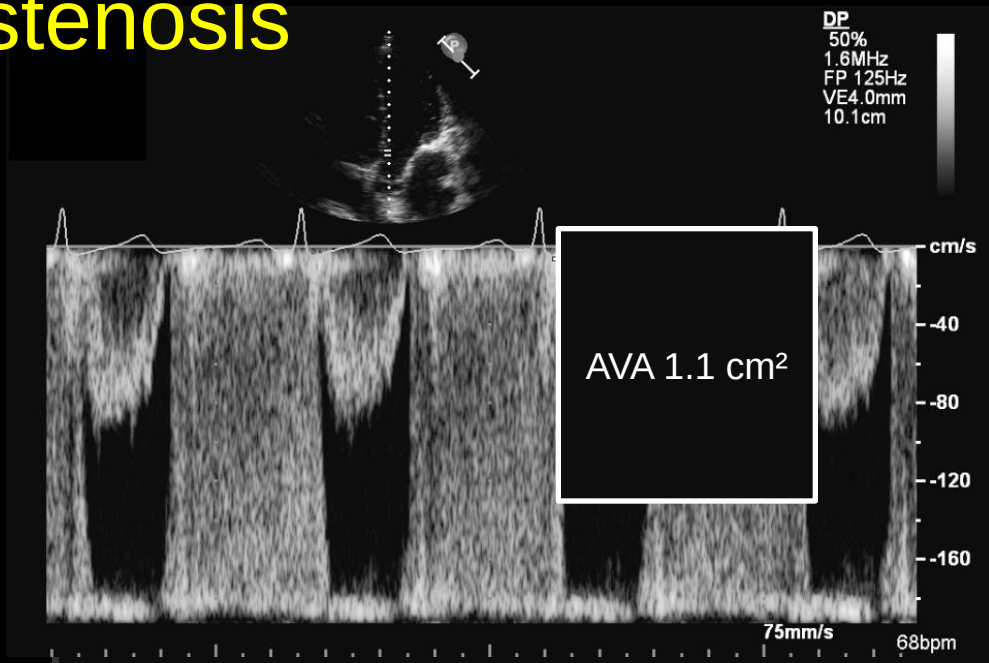


MVA (planimetry): 0.64 cm²

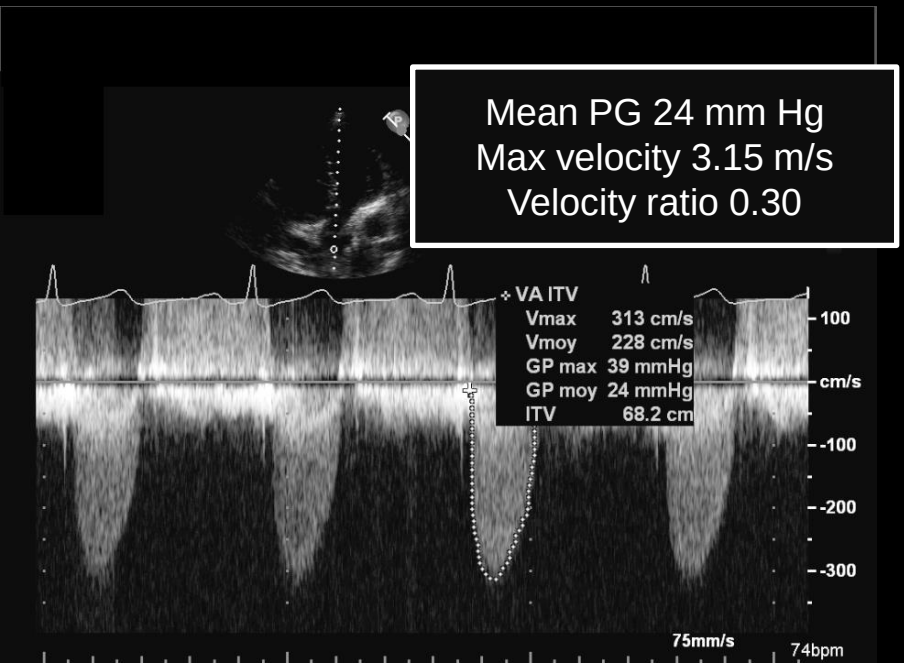
Aortic stenosis



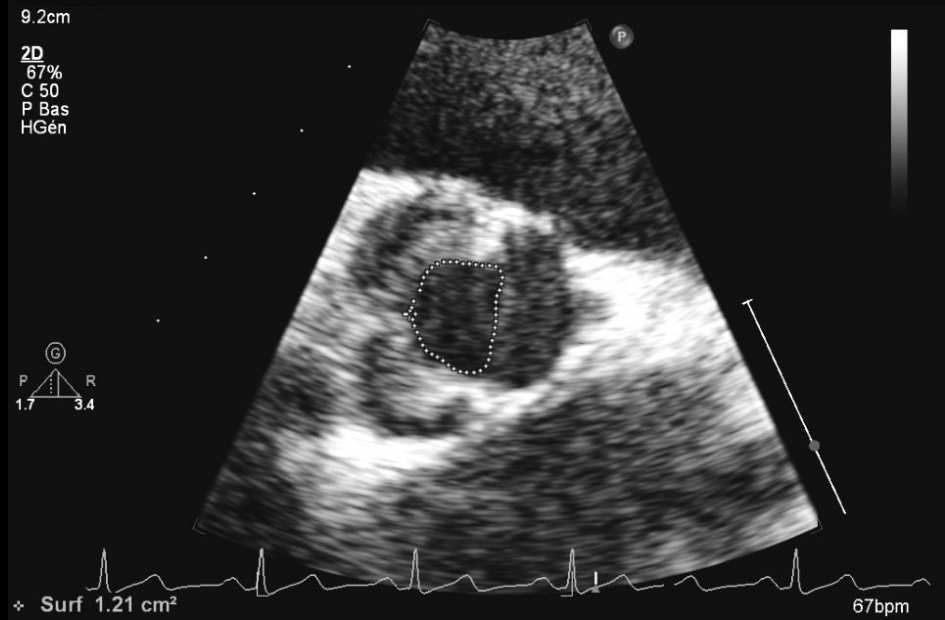
Stroke vol
44 ml/m²



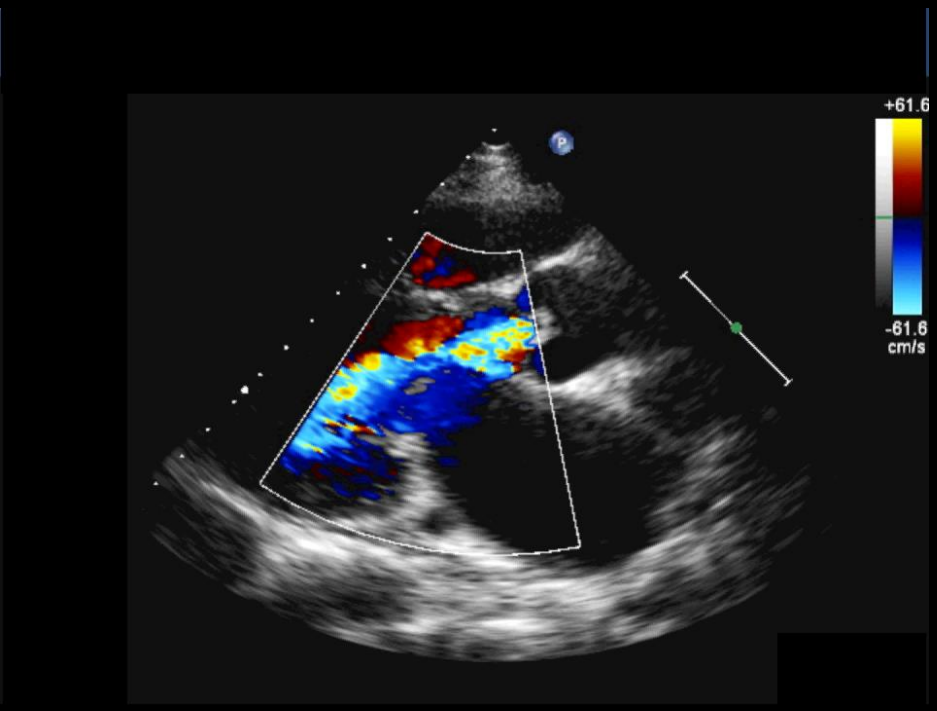
AVA 1.1 cm²

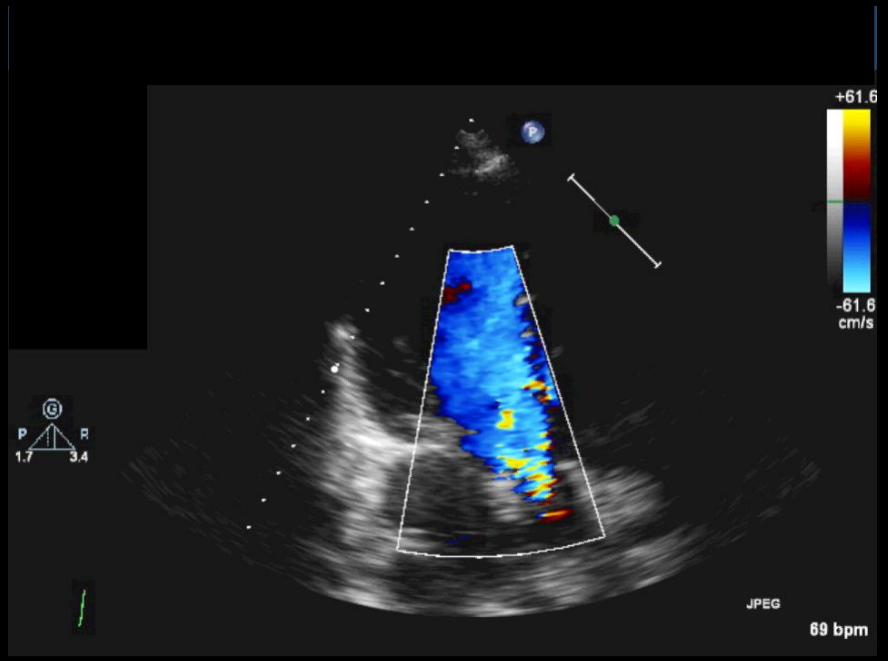


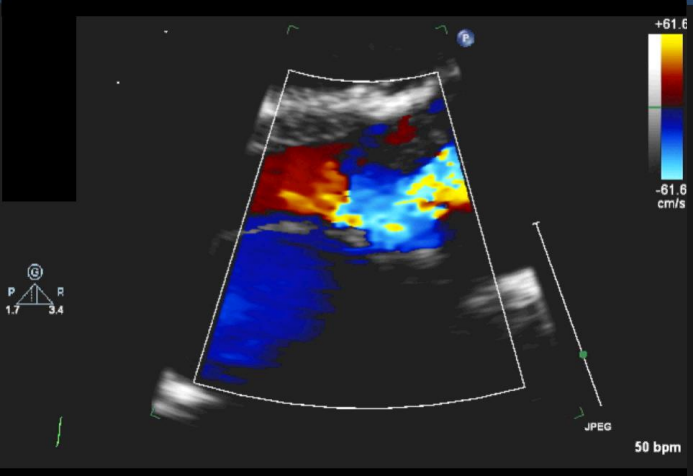
Mean PG 24 mm Hg
Max velocity 3.15 m/s
Velocity ratio 0.30

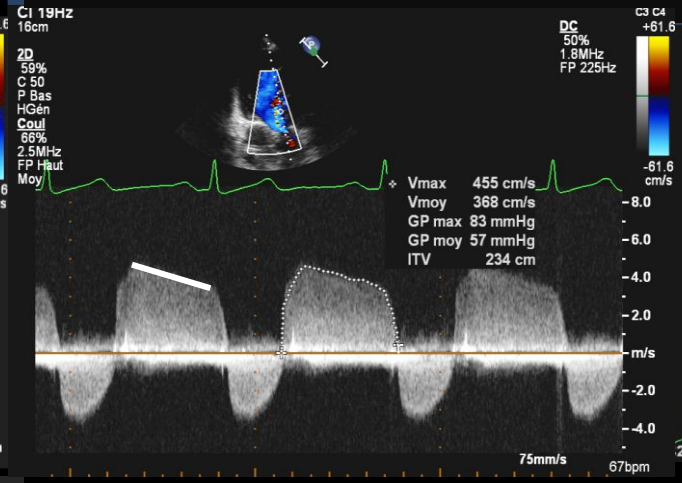


Aortic regurgitation

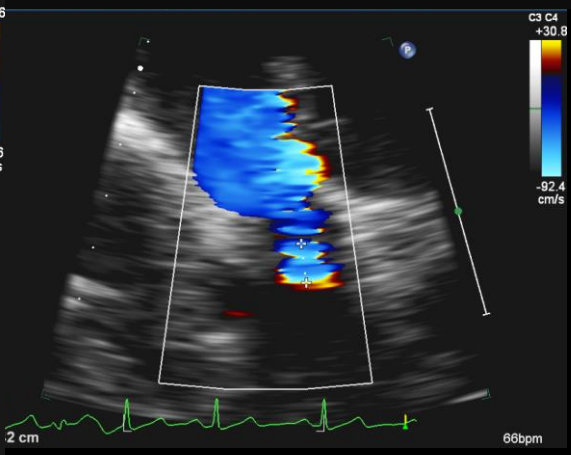




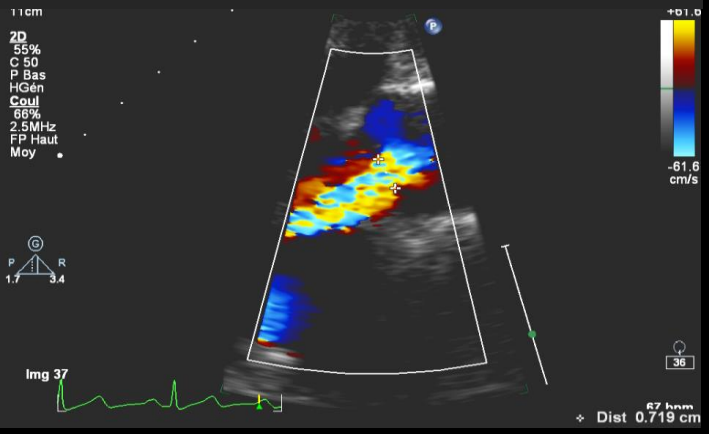




PHT 455 ms



ERO 23 mm²
R Vol 55 ml

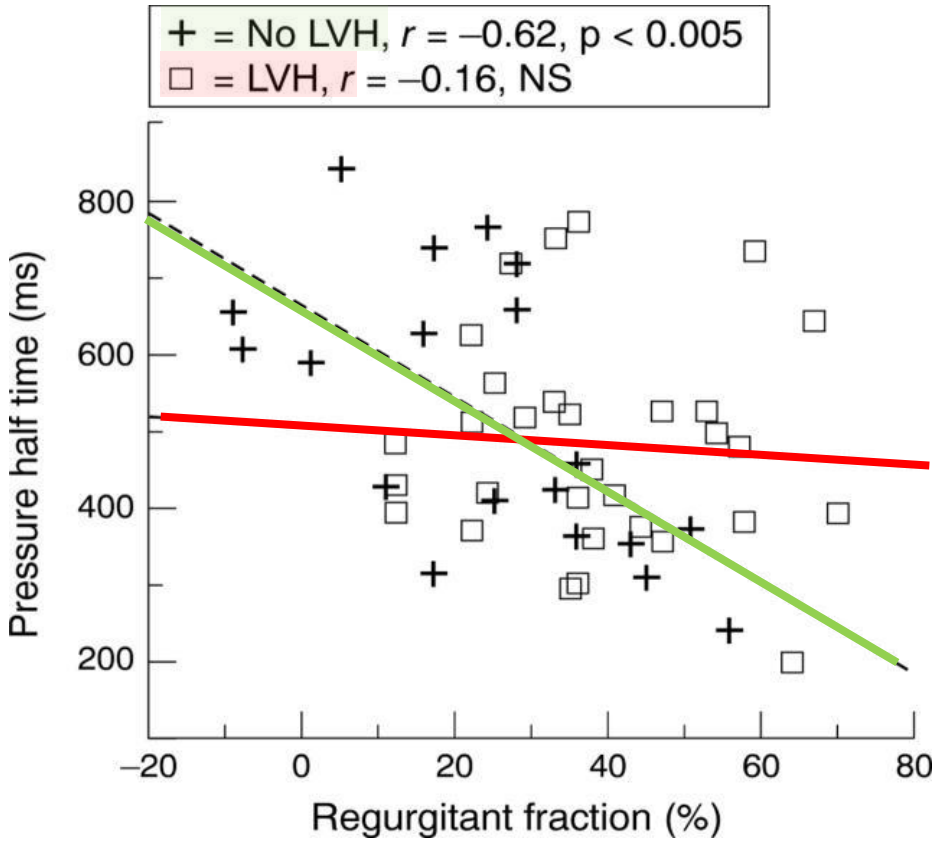


Vena contracta width 7 mm

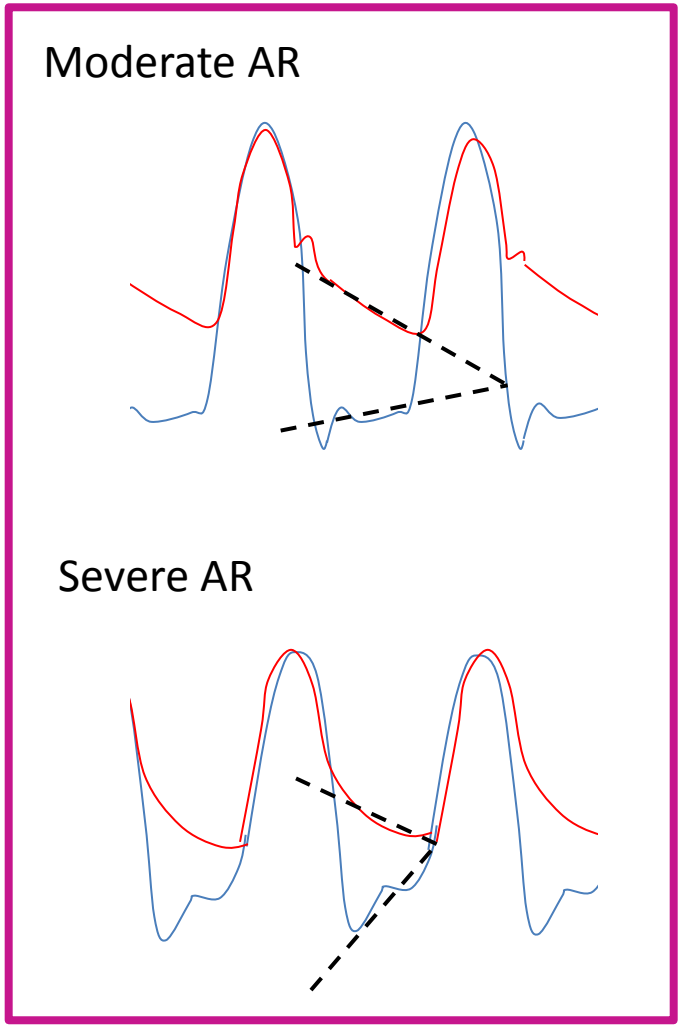
Quantification of AR severity

	Mild	Moderate	Severe
PHT, ms	>500	200-500	<200
VC width, mm	<3	3-6	>6
EROA, cm²	<10	10-30	≥30
R Vol, ml	<30	30-60	≥60

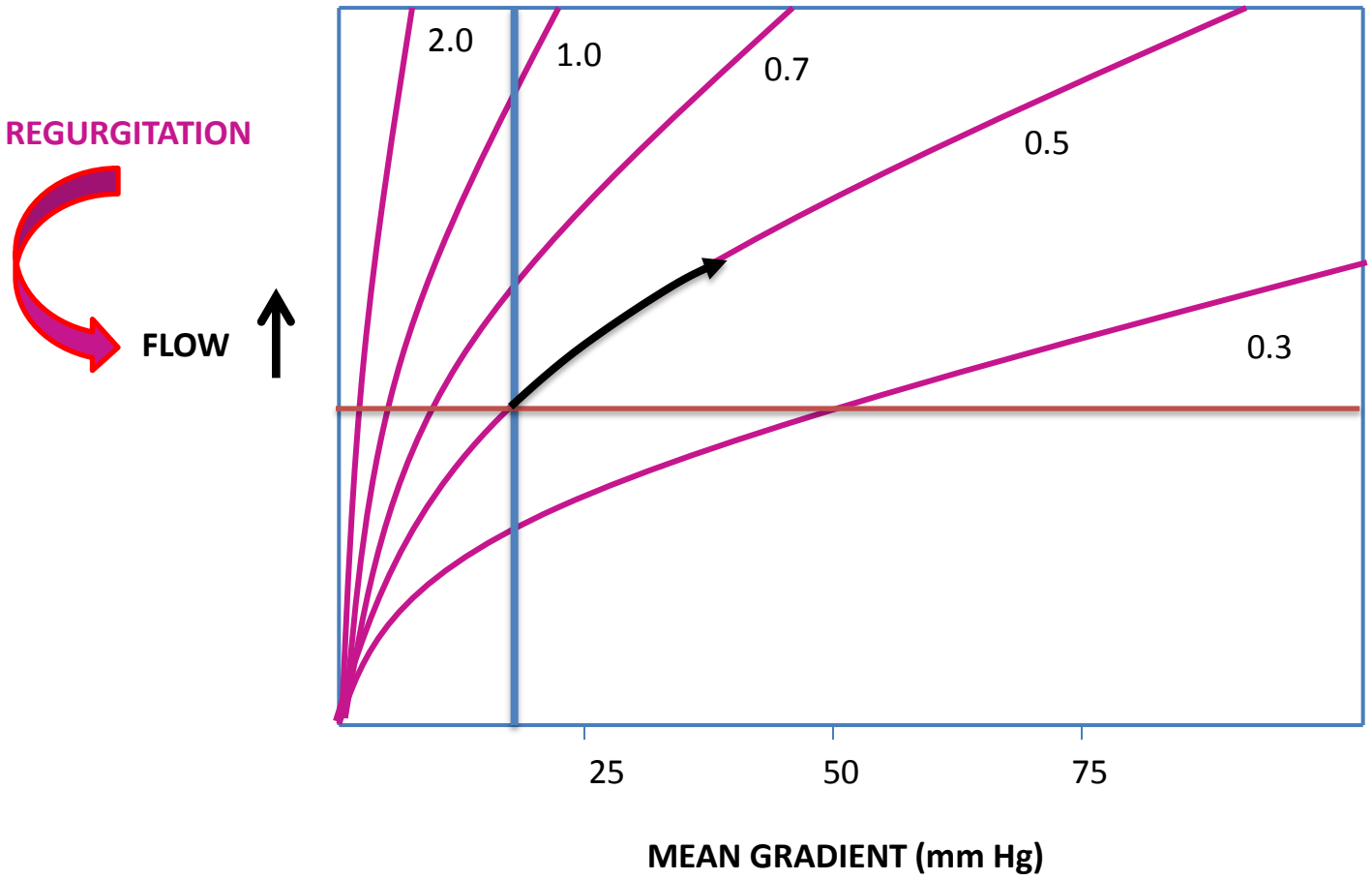
Pitfalls in mixed aortic valve disease: pressure half-time



de Marchi et al. Heart 1999;82:607



Pitfalls in mixed aortic valve disease: gradient and flow



Pitfalls in mixed aortic valve disease: Bernoulli's equation

$$\Delta P = 1/2\rho(V^2_{max} - V^2_{prox}) + \rho(dv / dt)\, dx + R(v)$$

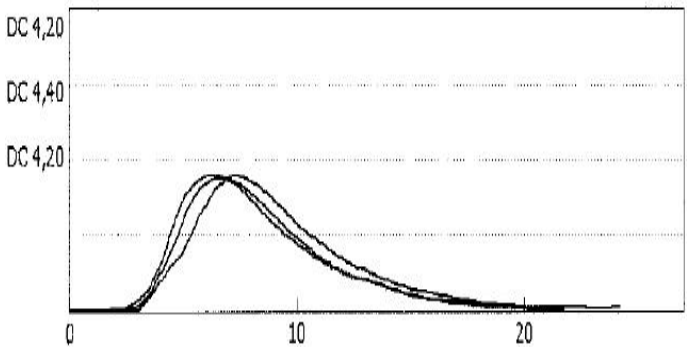
Convective acceleration | Flow acceleration | Viscous friction

$$\Delta P = 4(V_2^2)$$

$$\Delta P = 4(V_2^2 - V_1^2)$$

Pitfalls in mixed aortic valve disease: catheterization

$$AVA = CO/44.5 \times SEP \times \sqrt{\text{mean PG}}$$



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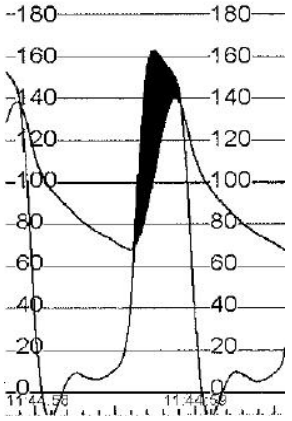
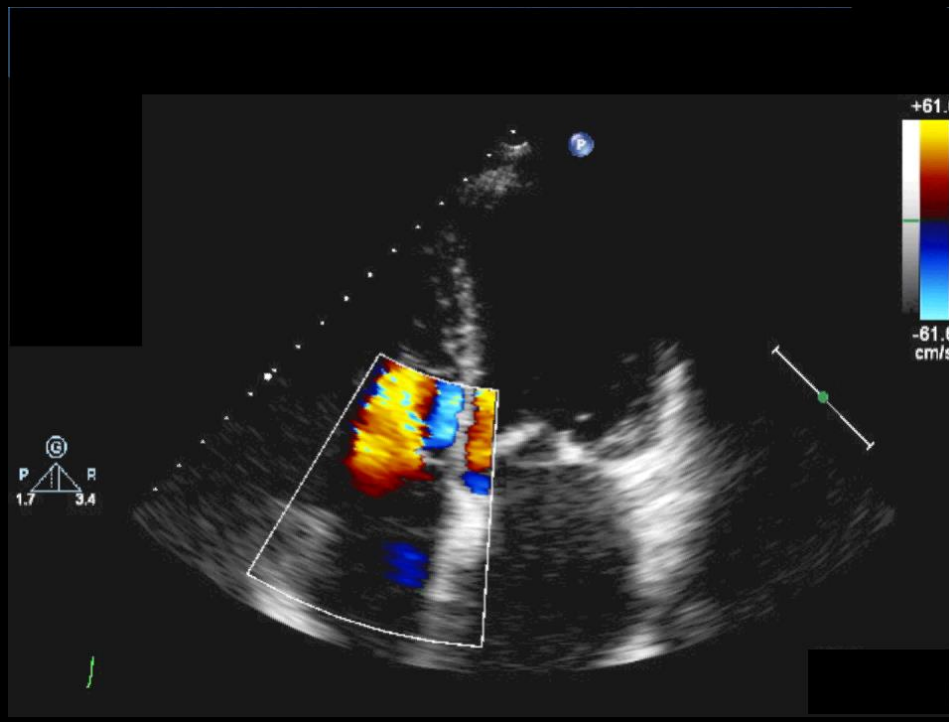


Thermodilution
Right heart level

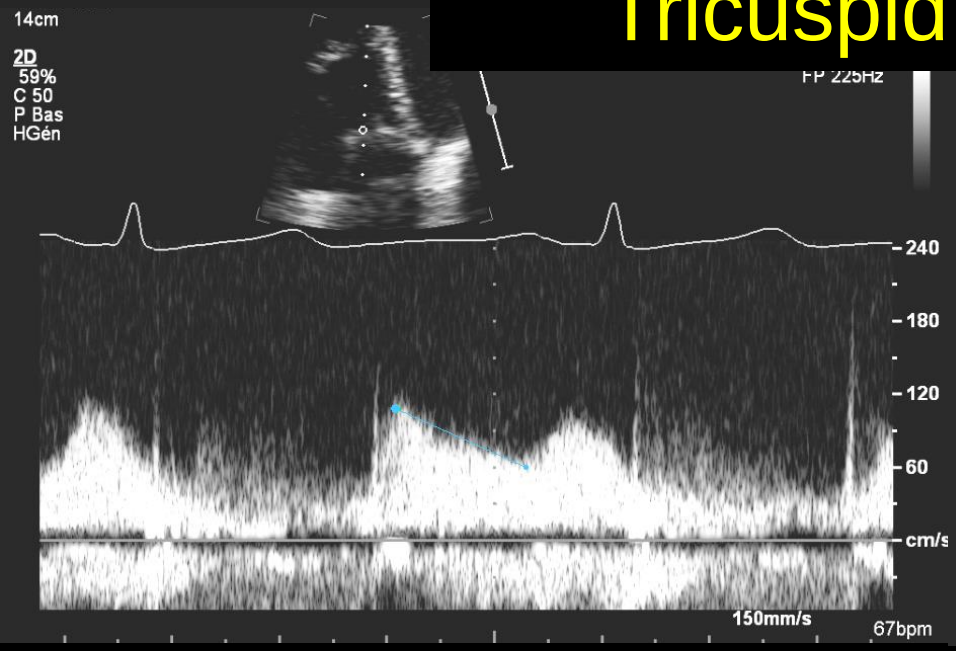
Pressure gradient
Aortic valve level

GORLIN R, GORLIN SG Am Heart J 1951;41(1):1

Tricuspid valve



Tricuspid stenosis



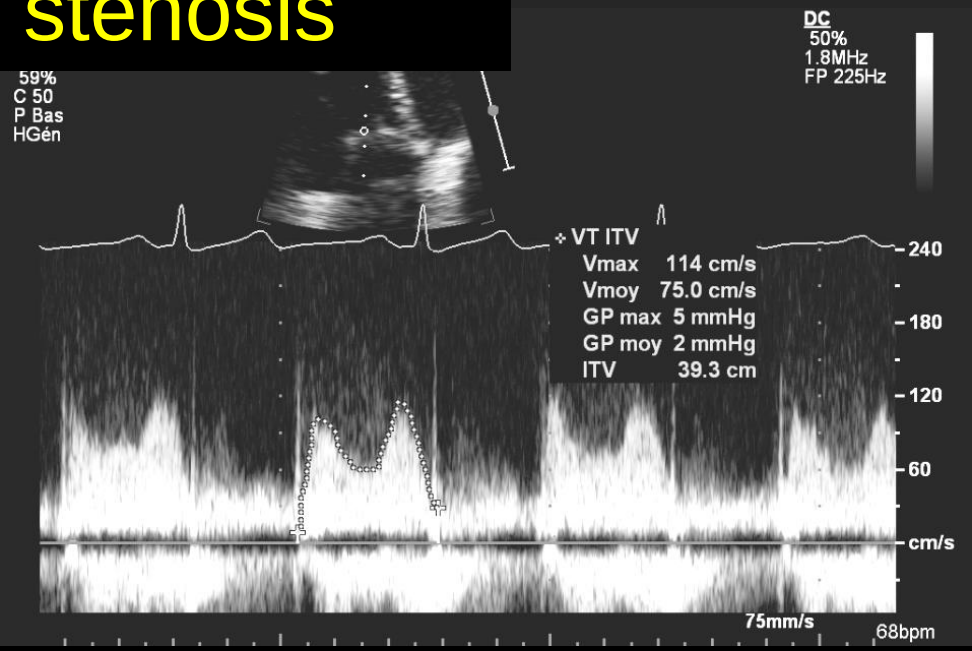


Table 10 Findings indicative of haemodynamically significant tricuspid stenosis

Specific findings	
Mean pressure gradient	≥5 mmHg
Inflow time–velocity integral	>60 cm
$T_{1/2}$	≥190 ms
Valve area by continuity equation[a]	≤1 cm^{2a}
Supportive findings	
Enlarged right atrium ≥moderate	
Dilated inferior vena cava	

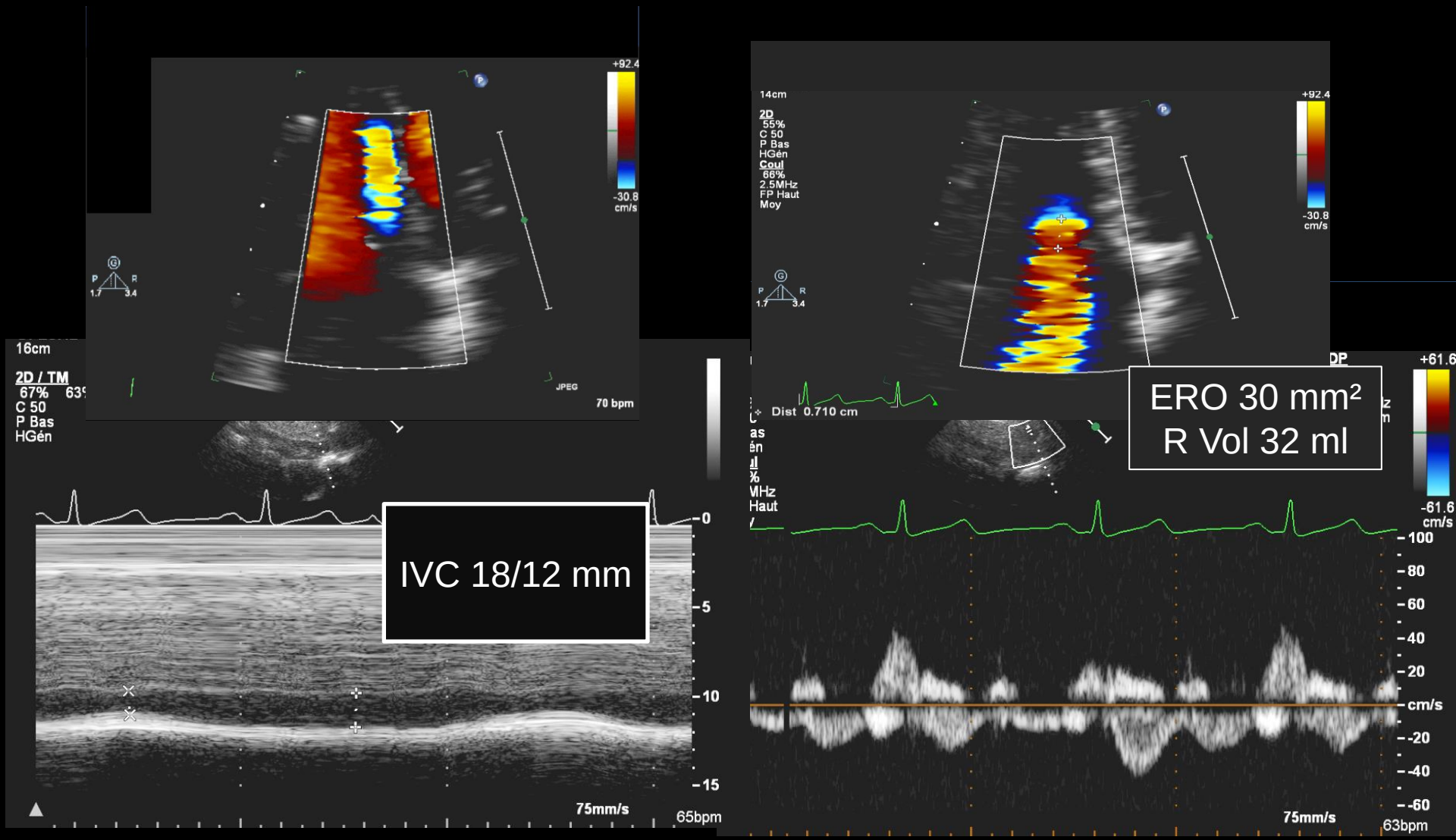
[a]Stroke volume derived from left or right ventricular outflow. In the presence of more than mild TR, the derived valve area will be underestimated. Nevertheless, a value ≤1 cm^2 implies a significant haemodynamic burden imposed by the combined lesion.

2 mm Hg
39.3 cm
170 ms
1.9 cm^2

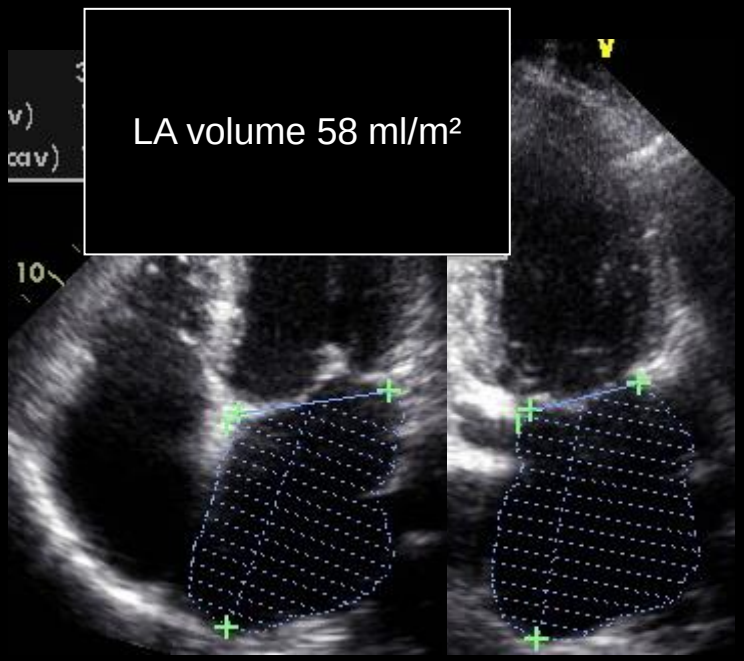
Haemodynamically non significant TS

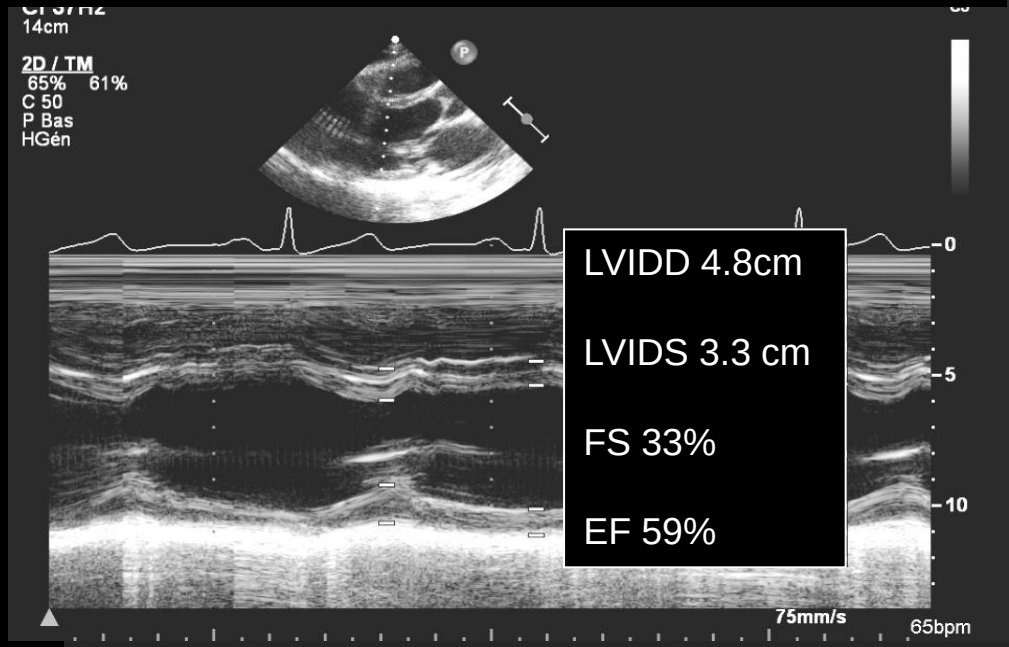
EAE/ASE RECOMMENDATIONS
Eur J Echocardiogr 2009;10,1

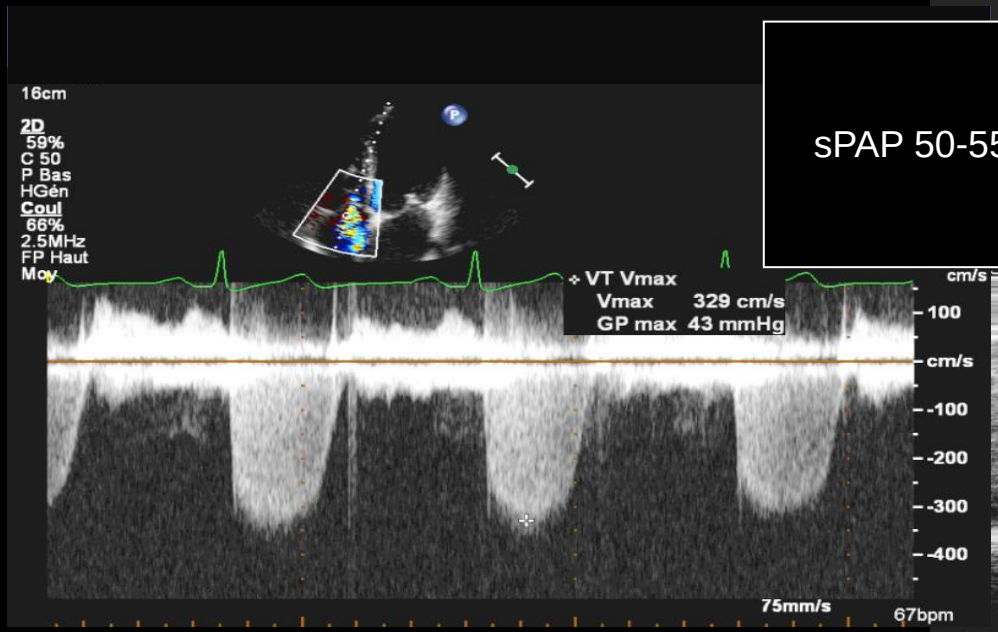
Tricuspid regurgitation

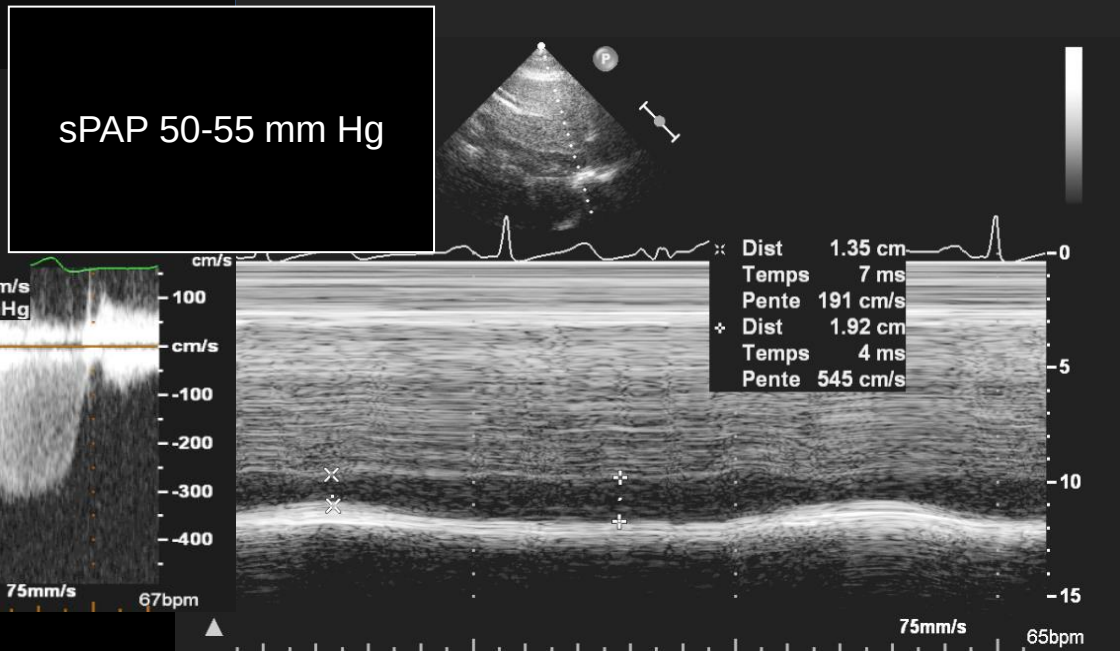


Moderate TR


LA volume 58 ml/m²


14cm
2D / TM
65% 61%
C 50
P Bas
HGén
LVIDD 4.8cm
LVIDS 3.3 cm
FS 33%
EF 59%
75mm/s
65bpm


16cm
2D
59%
C 50
P Bas
HGén
Coul
66%
2.5MHz
FP Haut
Moy
VT Vmax
Vmax 329 cm/s
GP max 43 mmHg
cm/s
100
-100
-200
-300
-400
75mm/s
67bpm


sPAP 50-55 mm Hg
Dist 1.35 cm
Temps 7 ms
Pente 191 cm/s
Dist 1.92 cm
Temps 4 ms
Pente 545 cm/s
75mm/s
65bpm

Summary

28 y-o woman; symptomatic RHD

Valve	Lesion	Additional findings
Mitral	(very) severe MS	Sinus rhythm LA dilatation sPAP 50-55 mm Hg No LV dilatation; EF 60%
Aortic	Moderate AS Moderate-to-severe AR	
Tricuspid	Moderate *primary* TR Non severe TS	

Which treatment?

1. Watchfull waiting under medical treatment
   beta-blocker, diuretics, VKA

2. Double valve surgery
   AVR + MVR (or surgical commissurotomy)

3. Triple valve surgery
   AVR + MV surgery + TVR

4. Percutaneous mitral commissurotomy

Guidelines on the management of valvular heart disease (version 2012)

Combined and multiple valve diseases

- “ There is a lack of data on mixed and multiple valve diseases. This does not allow for evidence-based recommendations »
- Predominant VHD? Follow the recommendations
- Non-severe multiple lesions ? Should be based on a global assessment of the consequences of the different valve lesions. Intervention can be considered if associated with symptoms or with LV impairment.

Indications for PMC in MS with MVA ≤1.5 cm^2

	Class [a]	Level [b]	Ref [c]
PMC is indicated in symptomatic patients with favourable characteristics.[d]	I	B	160, 170

Contraindications to PMC

- Mitral valve area >1.5 cm^2
- Left atrial thrombus
- More than mild mitral regurgitation
- Severe or bicommissural calcification
- Absence of commissural fusion
- Severe concomitant aortic valve disease, or severe combined tricuspid stenosis and regurgitation
- Concomitant coronary artery disease requiring bypass surgery

← Non-severe multiple lesions?

Guidelines on the management of valvular heart disease. Eur Heart J 2012;33,2451

Bouleti C et al. *Circulation* 2012;125:2119
Cruz-Gonzalez et al. *Am J Med* 2009;122:581.e11

Indications for aortic valve replacement in *moderate* aortic stenosis

	Class[a]	Level[b]	Ref[c]
AVR should be considered in patients with moderate AS[d] undergoing CABG, surgery of the ascending aorta or another valve.	IIa	C	

Moderate AS defined as AVA 1.0–1.5 cm2 (0.6 cm^2/m^2 to 0.9 cm^2/m^2 BSA) or mean aortic PG 25–40 mmHg in the presence of normal flow conditions

Indications for aortic valve replacement in *moderate* aortic regurgitation

…In patients with moderate AR, who undergo […] mitral valve surgery, the decision to treat the aortic valve should be based on the aetiology of the AR, age, worsening of LV function, and the possibility of valve repair…

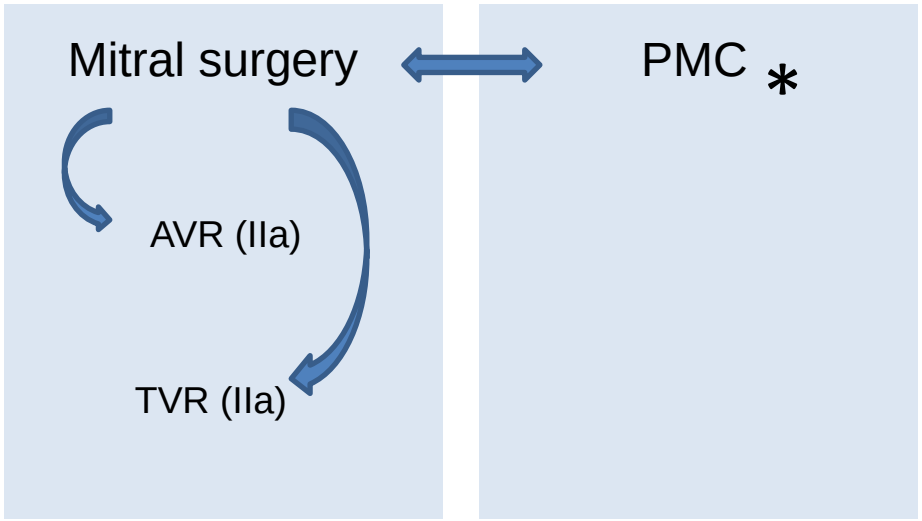
Guidelines on the management of valvular heart disease. Eur Heart J 2012;33,2451

Indications for surgery in tricuspid valve disease

	Class [a]	Level [b]
Surgery is indicated in symptomatic patients with severe TS.[c]	I	C
Surgery is indicated in patients with severe TS undergoing left-sided valve intervention.[d]	I	C
Surgery is indicated in patients with severe primary or secondary TR undergoing left-sided valve surgery.	I	C
Surgery is indicated in symptomatic patients with severe isolated primary TR without severe right ventricular dysfunction.	I	C
Surgery should be considered in patients with moderate primary TR undergoing left-sided valve surgery.	IIa	C
Surgery should be considered in patients with mild or moderate secondary TR with dilated annulus (≥40 mm or >21 mm/m²) undergoing left-sided valve surgery.	IIa	C
Surgery should be considered in asymptomatic or mildly symptomatic patients with severe isolated primary TR and progressive right ventricular dilatation or deterioration of right ventricular function.	IIa	C
After left-sided valve surgery, surgery should be considered in patients with severe TR who are symptomatic or have progressive right ventricular dilatation/dysfunction, *in the absence* of left-sided valve dysfunction, severe right or left ventricular dysfunction, and severe pulmonary vascular disease.	IIa	C

Guidelines on the management of valvular heart disease. Eur Heart J 2012;33,2451

Lesion
(very) severe MS
Moderate AS Moderate-to-severe AR
Moderate primary TR Non severe TS

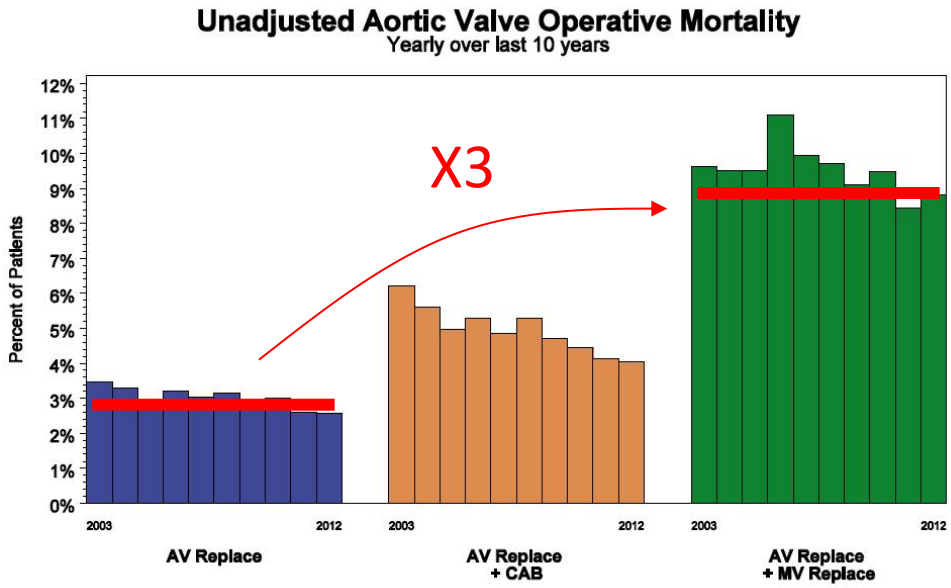


* In cases with severe MS with moderate aortic valve disease, PMC can be performed as a means of postponing the surgical treatment of both valves…"

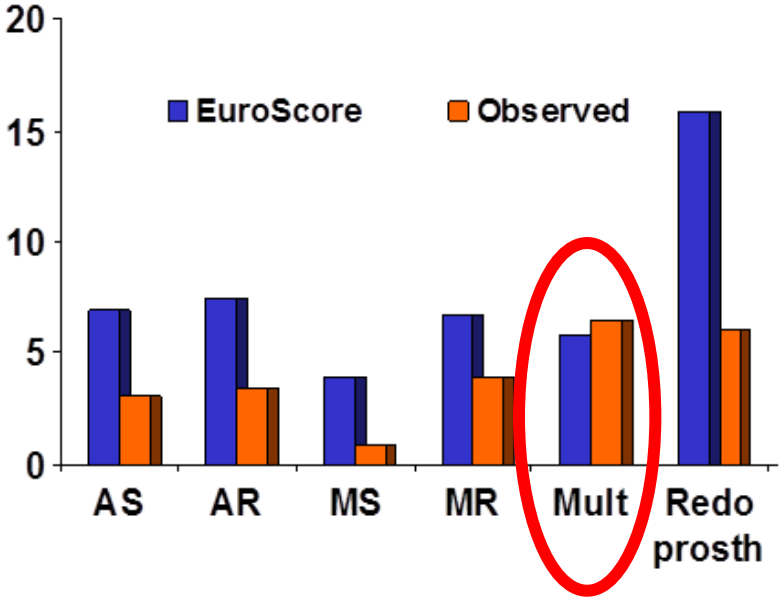
Guidelines on the management of valvular heart disease. Eur Heart J 2012;33,2451

"The decision to intervene on multiple valves should take into account the extra surgical risk of combined procedures"

Guidelines on the management of valvular heart disease (version 2012)



STS Database

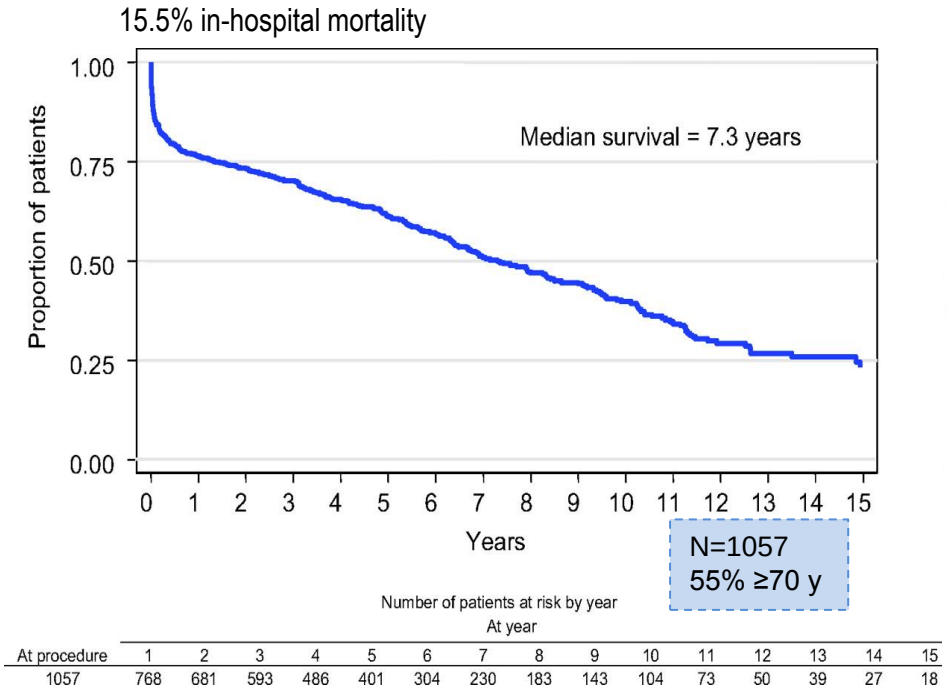


Euro Heart Survey

Courtesy B. Iung

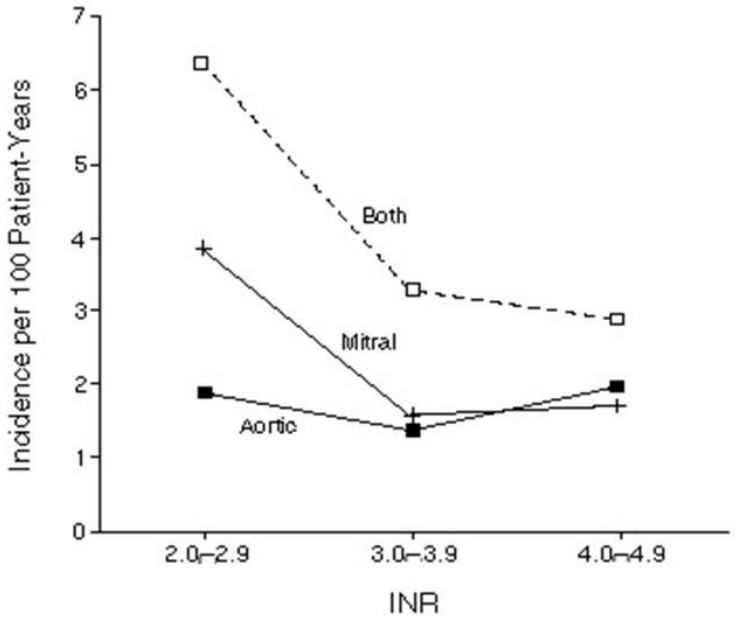
STS database 2013
http://www.sts.org/sites/default/files/documents/2013_3rdHarvestExecutiveSummary.pdf
Iung B, et al. EuroHeart Survey

Long-term survival after double valve surgery



Leavitt BJ et al. Circulation 2009;120:S155-62

Incidence of major thrombo-embolic and bleeding events according to INR level and valve position

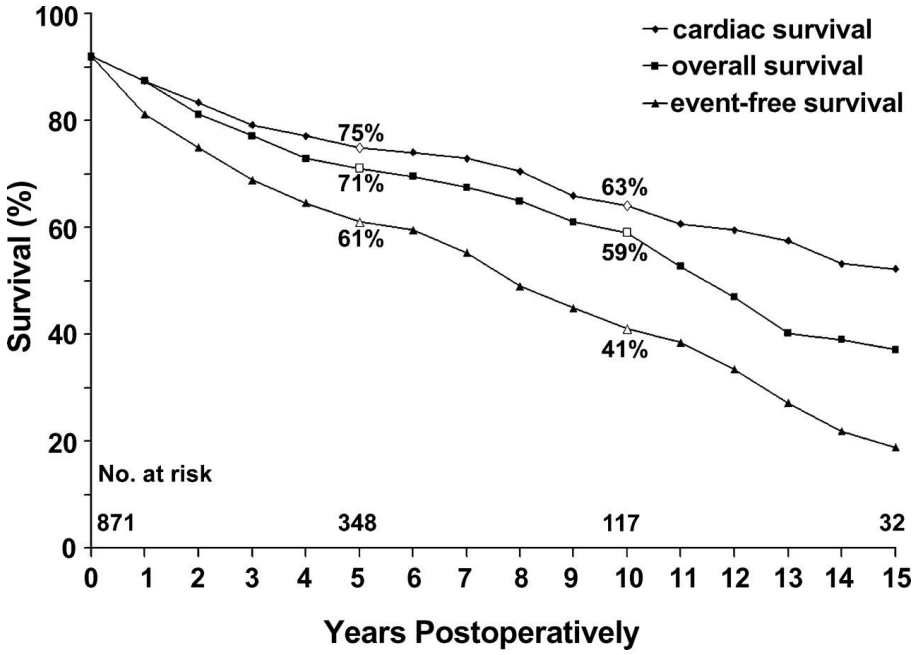


Cannegieter S et al. N Engl J Med 1995;333:11-7.

Long-term survival after triple-valve surgery

- N = 871 (RHD)
- mean age 42 ± 11 y-o (range 7-64)

8% (30 day) in-hospital mortality



Median overall survival 11.5 yrs

Multivariate analysis in early and late mortality

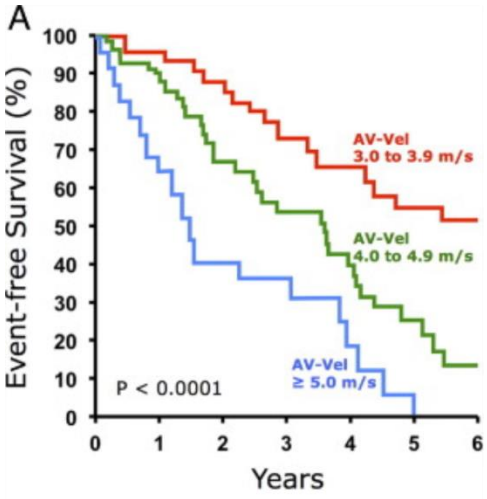
Risk factors	OR	95% CI	*P* value
Early mortality			
Ascites	10.7	1.6–68	<0.0001
NYHA class IV	3.1	1.5–8.9	<0.001
Lower LVEF (<0.4)	2.2	1.4–7.2	<0.001
Late mortality			
Advanced age	1.09	1.02–1.17	0.03
NYHA class IV	3.7	1.3–9.8	0.007
Lower LVEF (<0.4)	4.1	1.4–10.6	0.002

OR: odds ratio; CI: confidence interval; NYHA: New York Heart Association; LVEF: left ventricular ejection fraction.

Han Q et al. *Eur J Cardiothorac Surg* 2007;31:845-850

Outcome of Combined Stenotic and Regurgitant Aortic Valve Disease

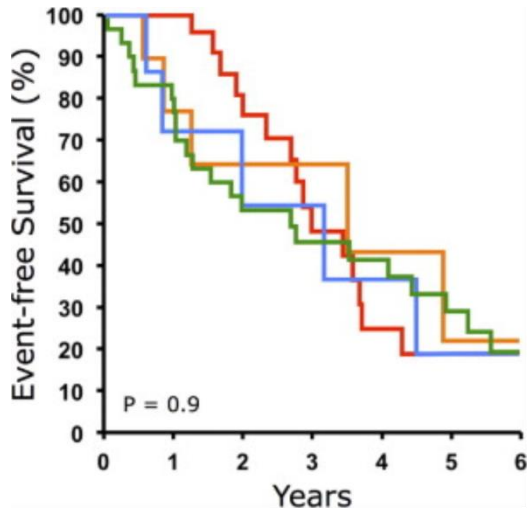
Event-Free Survival Stratified by Peak Aortic Jet Velocity at entry



71 asymptomatic patients prospectively followed with ≥moderate AS + ≥moderate AR and LVEF ≥ 55%

p < 0.0001

Event-free survival stratified by severity of AS and AR



moderate AS + moderate AR

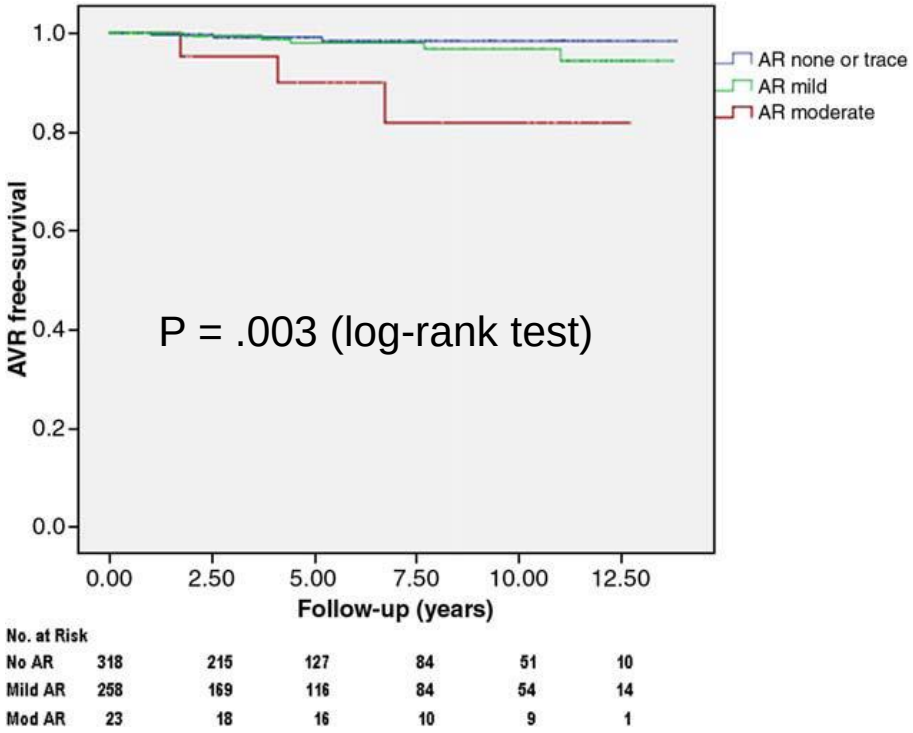
severe AS + moderate AR

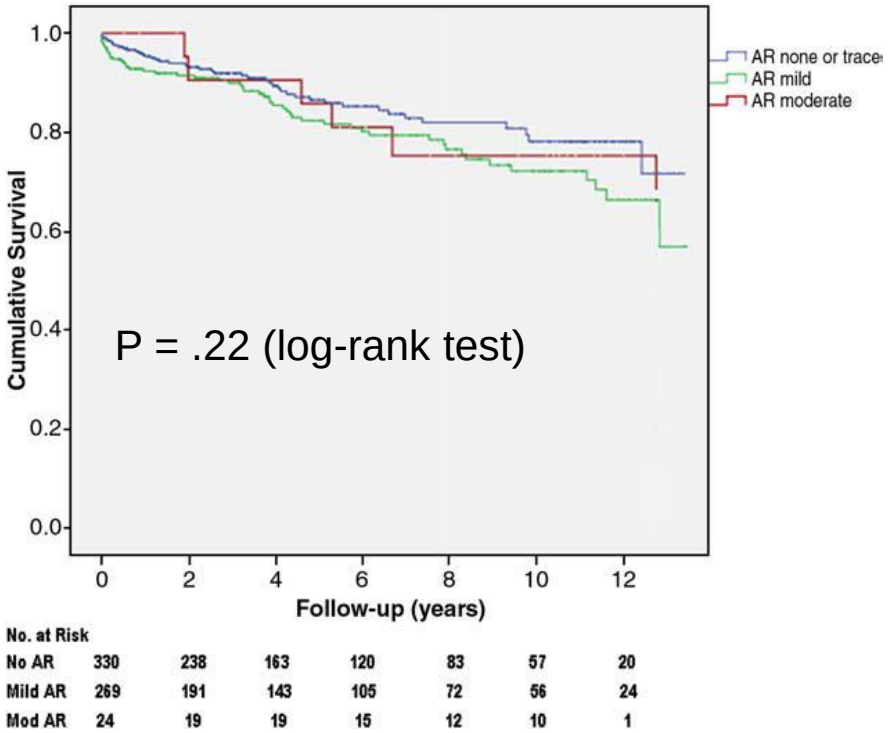
moderate AS + severe AR

severe AS + severe AR

Zilberszac R et al. *J Am Coll Cardiol*. 2013;61:1489

AVR-free survival and cumulative survival according to AR severity in patients undergoing PMC

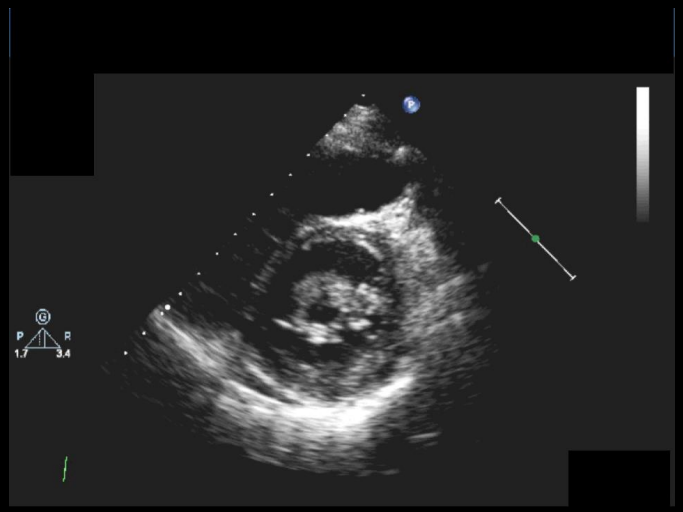


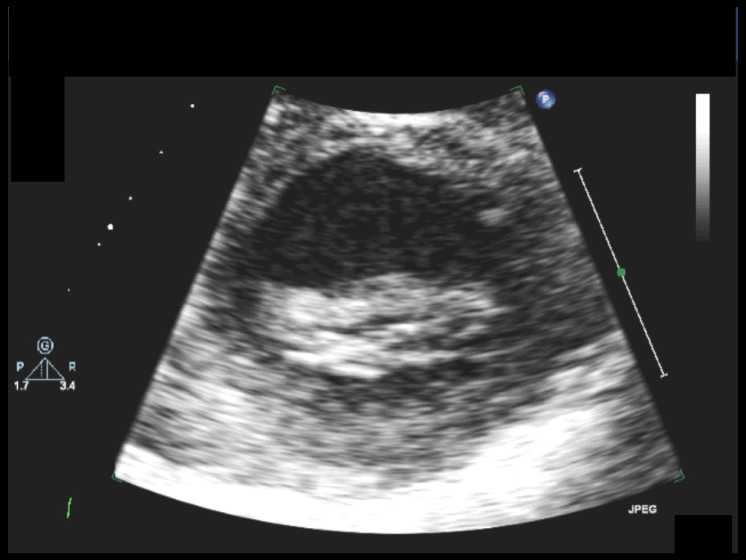


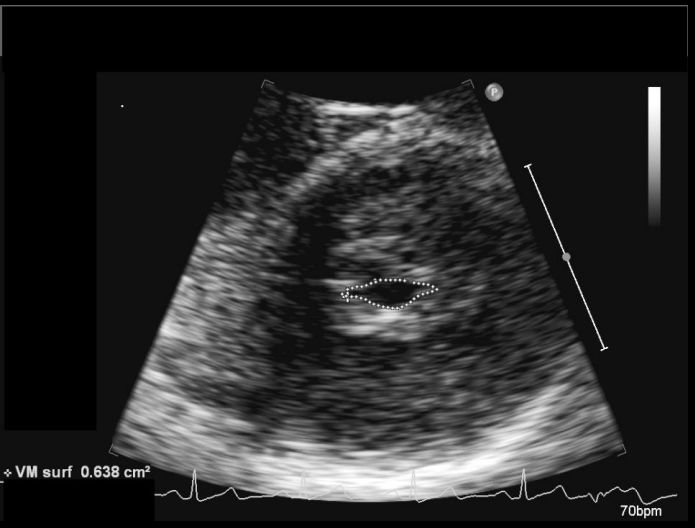
Mean age 55.1 ± 14.7yrs
(Moderate AR: 49.3 ± 6.2yrs)

Sanchez-Ledesma et al. *Am heart J* 2008;156:361

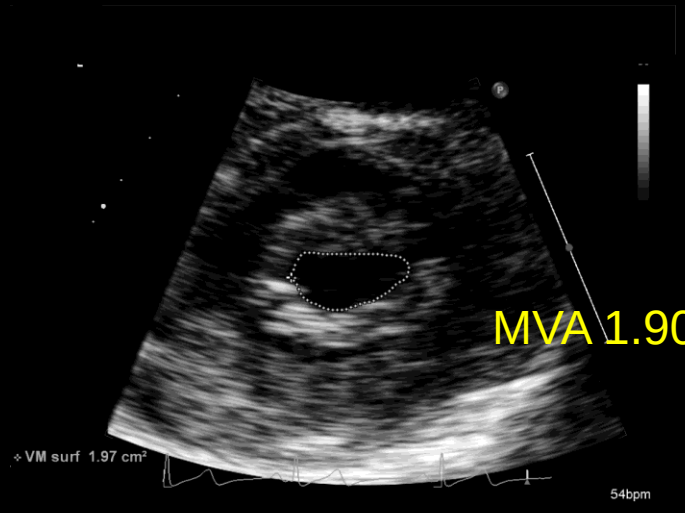
PMC



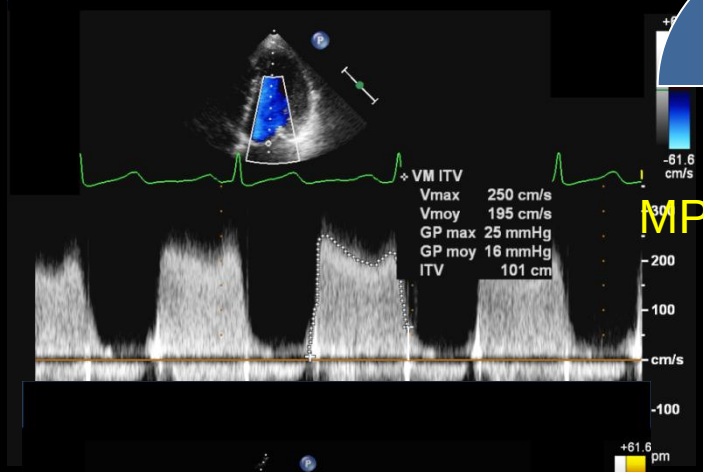




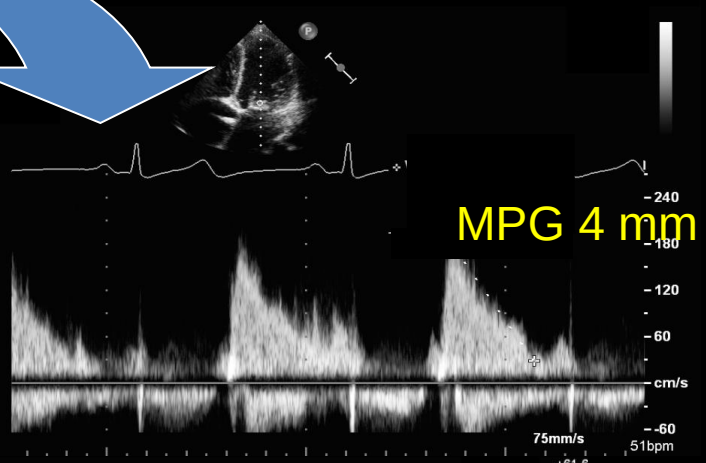
MVA 0.64 cm²



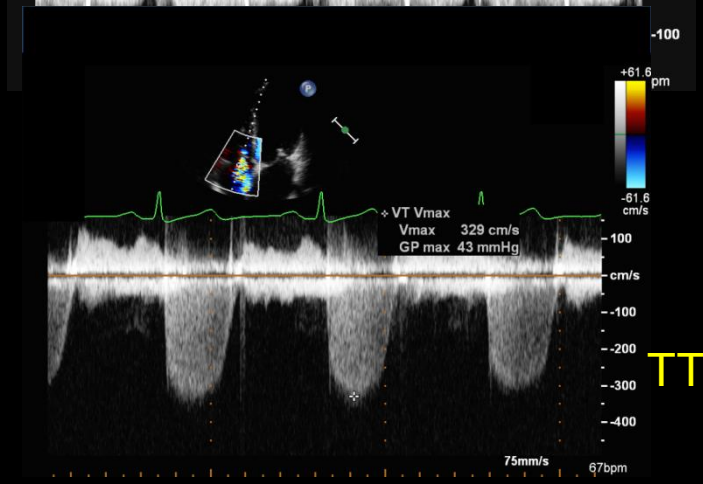
MVA 1.90 cm²



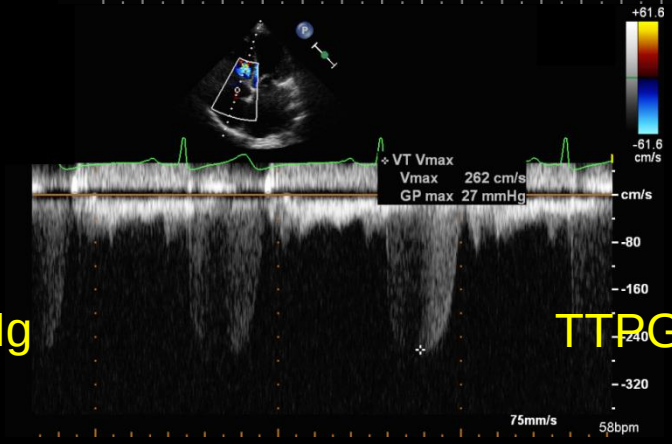
MPG 16 mm Hg



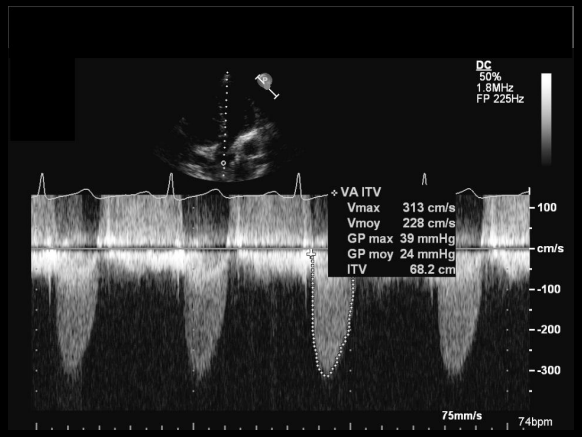
MPG 4 mm Hg



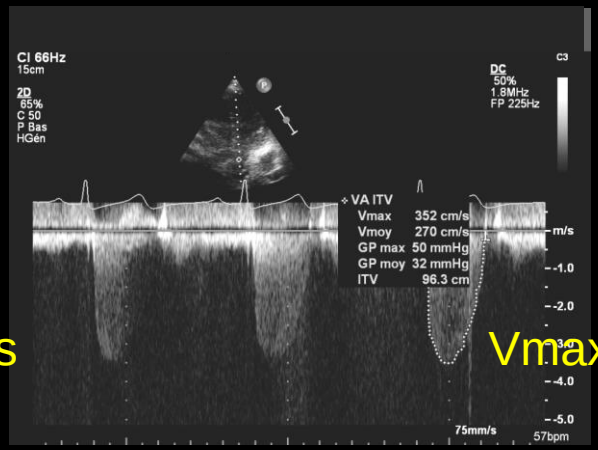
TTPG 43 mm Hg



TTPG 27 mm Hg



Vmax ao 313 cm/s

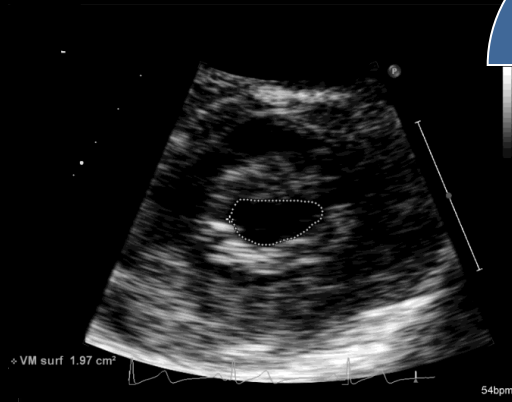


Vmax ao 352 cm/s

4 year follow-up…

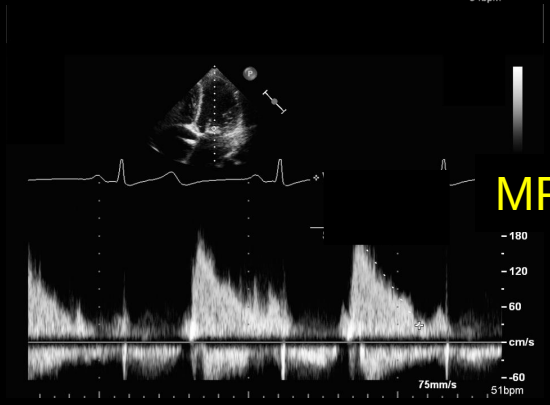
2010

2014

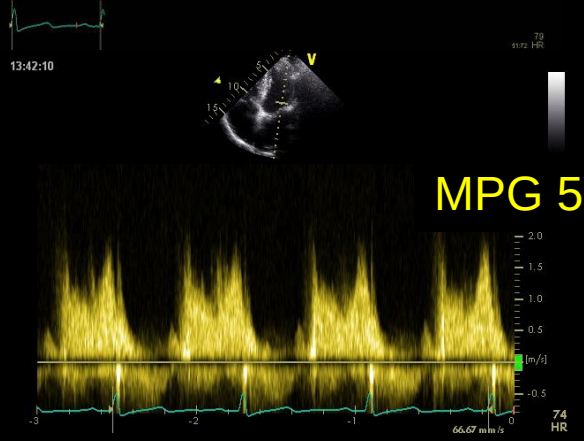


MVA 1.9 cm²

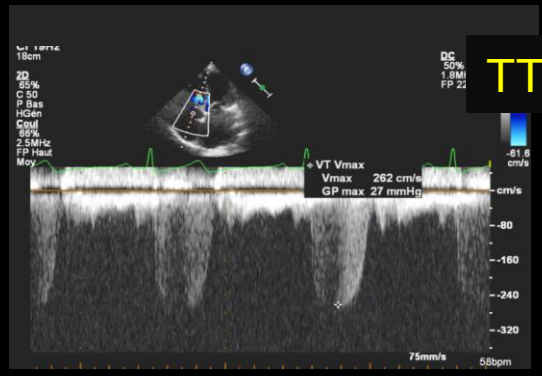
MVA 1.5cm²



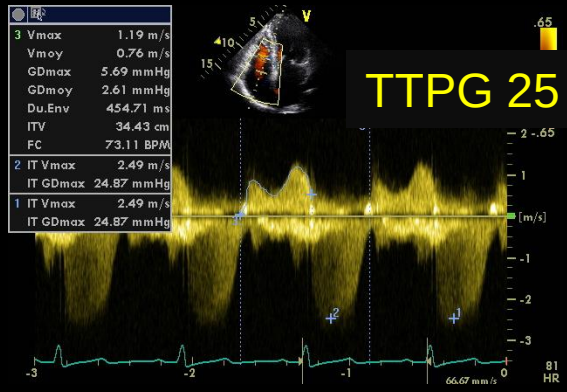
MPG 4 mm Hg



MPG 5 mm Hg



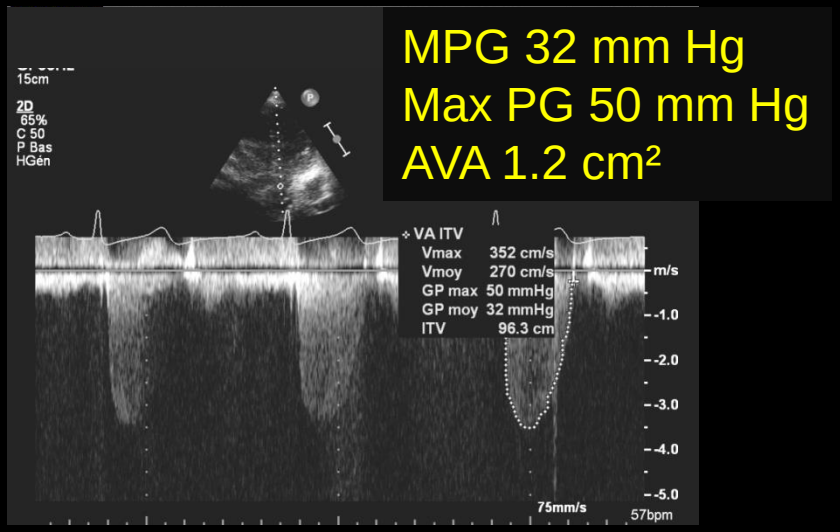
TTPG 27 mm Hg



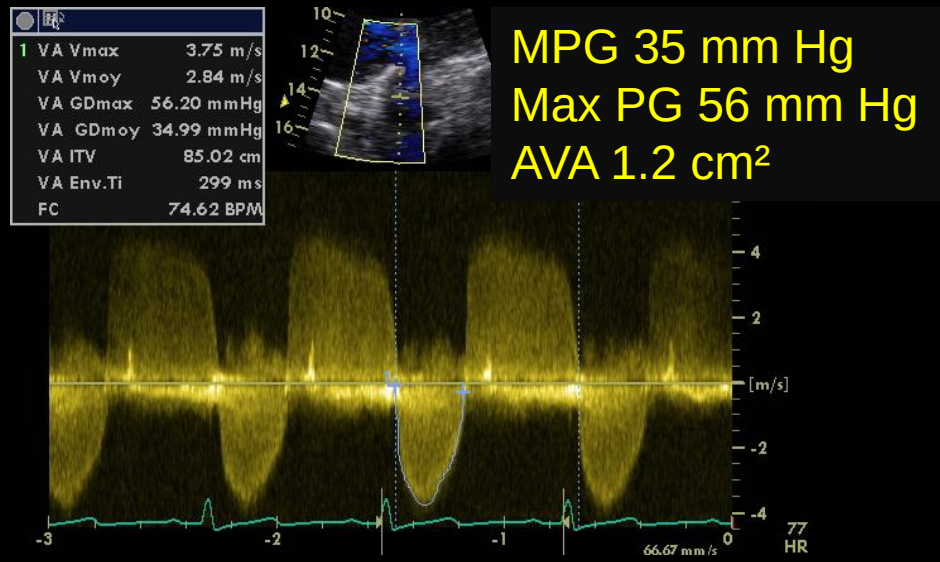
TTPG 25 mm Hg

2010

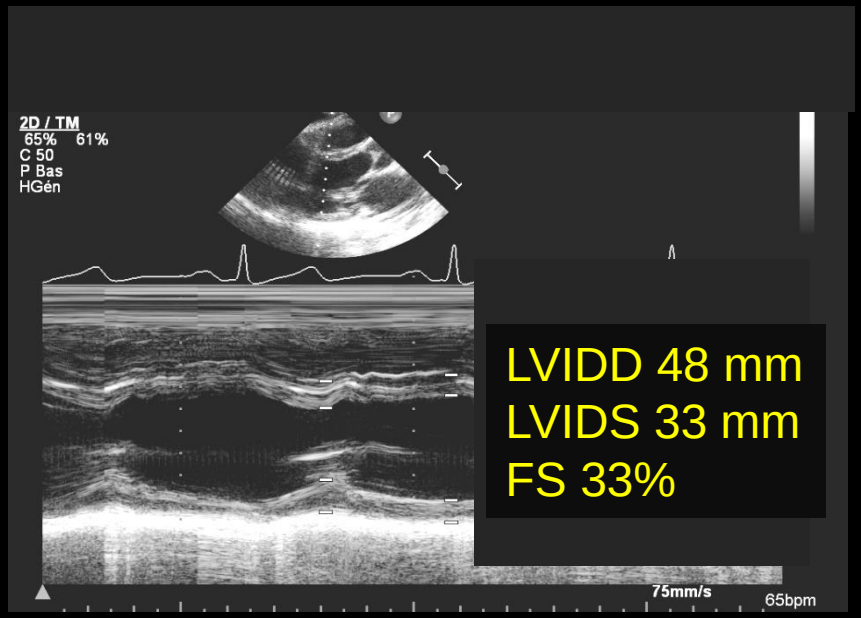
2014



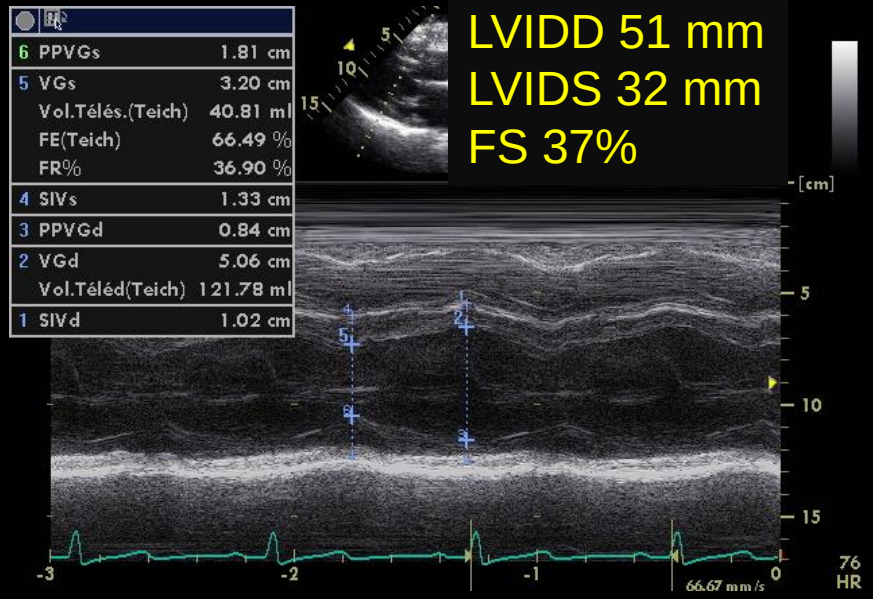
MPG 32 mm Hg
Max PG 50 mm Hg
AVA 1.2 cm²



MPG 35 mm Hg
Max PG 56 mm Hg
AVA 1.2 cm²



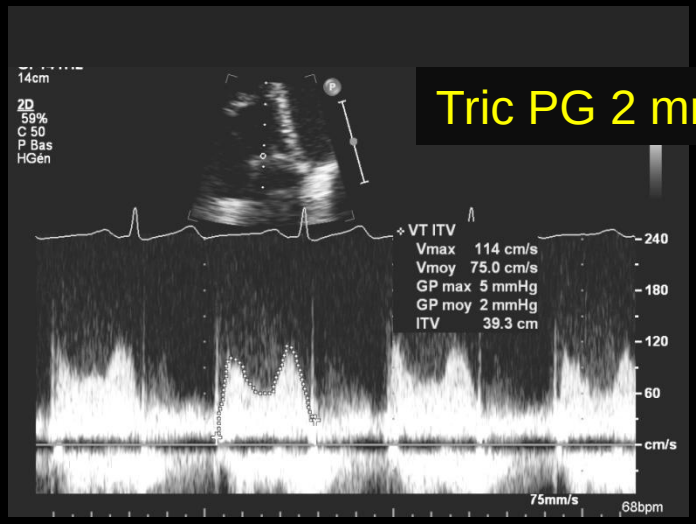
LVIDD 48 mm
LVIDS 33 mm
FS 33%



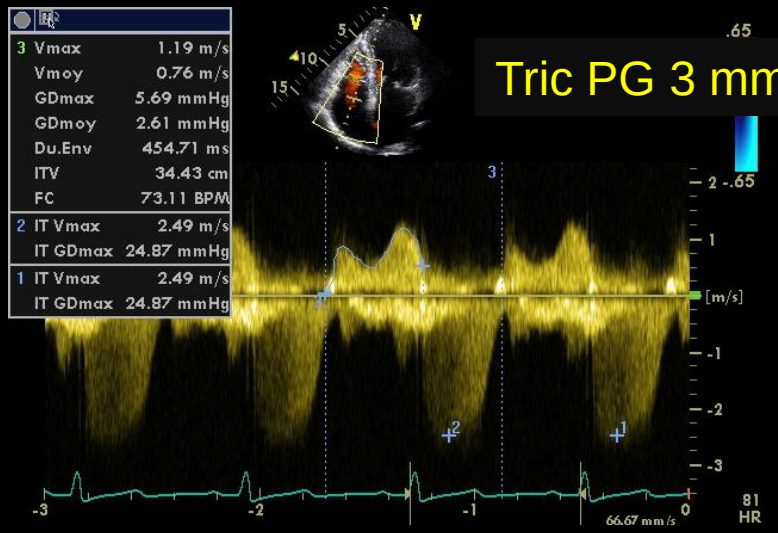
LVIDD 51 mm
LVIDS 32 mm
FS 37%

2010

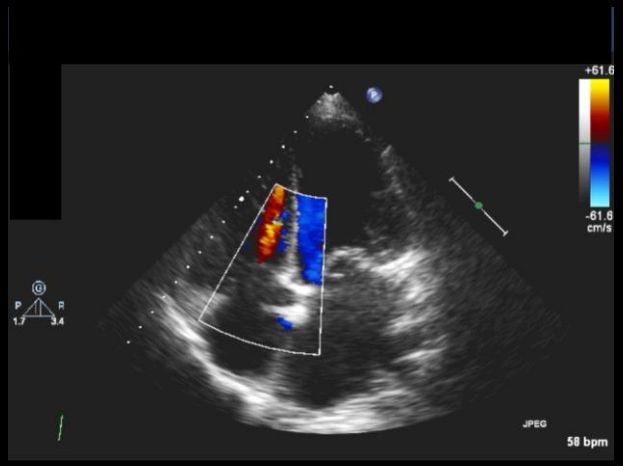
2014



Tric PG 2 mm Hg



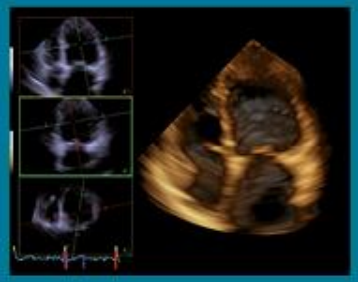
Tric PG 3 mm Hg



Take home messages

- Be aware of the diagnostic pitfalls
  - mainly due to haemodynamic interactions
  - prefer load independent indices
- The decision to intervene on multiple valves should take into account
  - the extra surgical risk of combined procedures
  - the risk of leaving a significant lesion untreated/of future reoperation
  - the natural history of the native valve disease
  - the long-term complications of multiple prosthesis

… Heart Team…

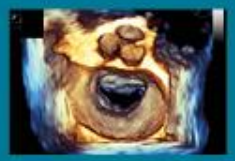
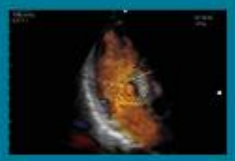


EuroValve

October 24-25, 2014

Thank you for your attention!



www.eurovalvecongress.com