



MULTIPLE VALVE DISEASES

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Multiple Valve Diseases



General Remarks

- Very limited data
- Large number of potential combinations
- Each case must be considered individually
- Look for the dominant lesion
(LV, RV morphology)
- Rheumatic, degenerative or sec.
- 15% pts. undergoing valve surgery in the EuroHeart Survey
- 8.6% of all valvular surgical interventions



Causes of multivalve heart disease



Acquired

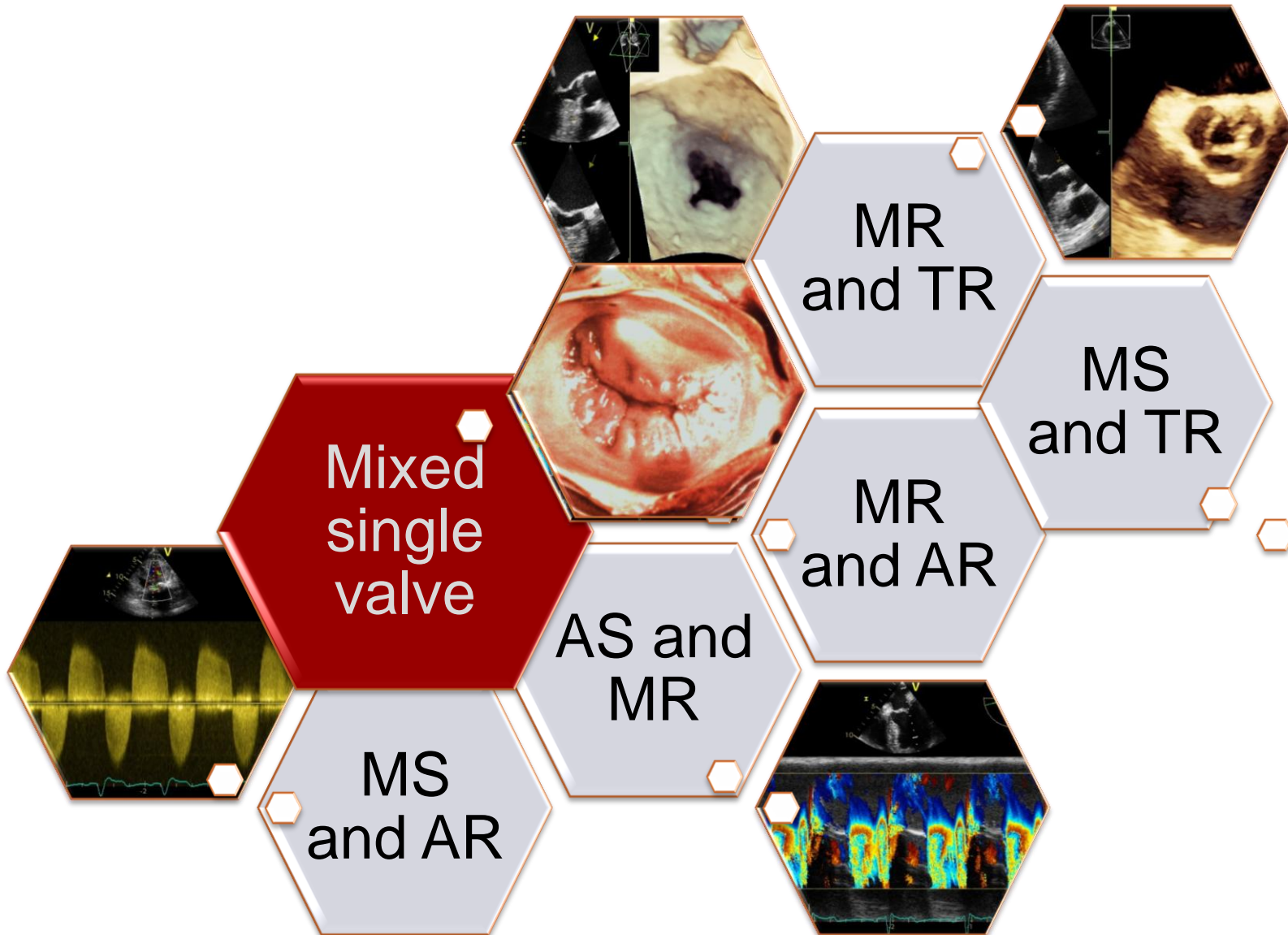
Cardiac diseases	Rheumatic heart disease
	Infective endocarditis
	Degenerative calcific
	Cardiac remodelling/dilatation (functional)
Adverse effects of treatment	Thoracic/mediastinal radiation therapy
	Adverse drug effects (ergot agonist, anorectic agents)
Non-cardiac systemic diseases	End-stage renal disease on haemodialysis
	Carcinoid heart disease

Congenital

Connective tissue disorders	Marfan syndrome
	Ehlers–Danlos syndrome
Other (rare)	Trisomy 18, 13 and 15
	Ochronosis (alkaptonuria)
	Shone's anomaly
	Congenital polyvalvular cardiac disease,



Multiple Valve Diseases



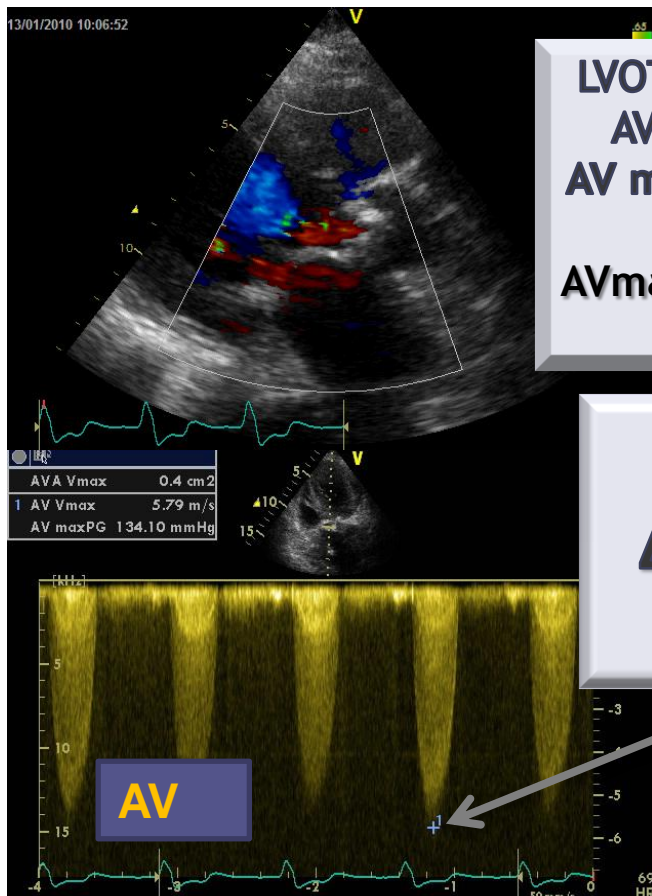


Simple MVD

Mixed single valve

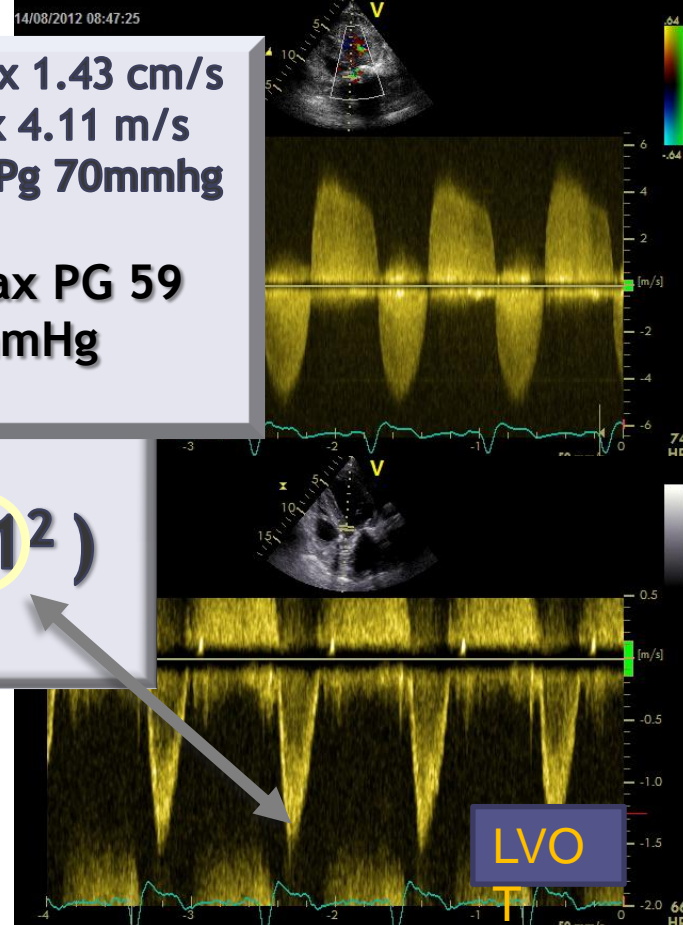


Significant stenosis and regurgitation on the same valve



LVOT max 1.43 cm/s
AV max 5.79 m/s
AV max Pg 134mmhg
AVmax PG 120 mmHg

LVOT max 1.43 cm/s
AV max 4.11 m/s
AV max Pg 70mmhg
AV max PG 59 mmHg



$$\Delta P = 4 \times (v_2^2 - v_1^2)$$



Mixed single valve



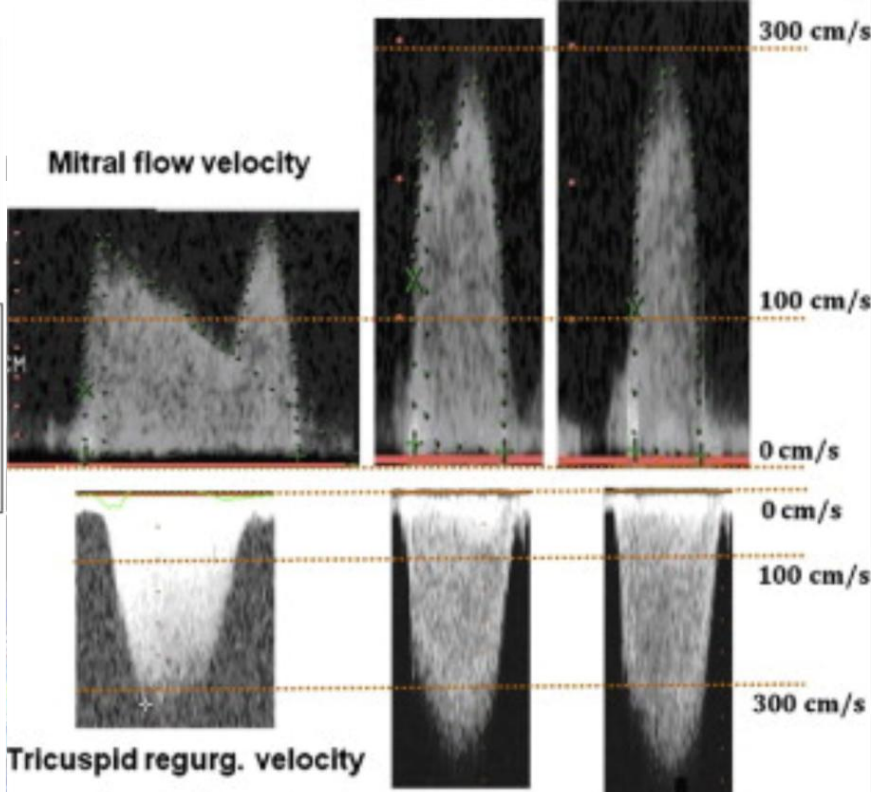
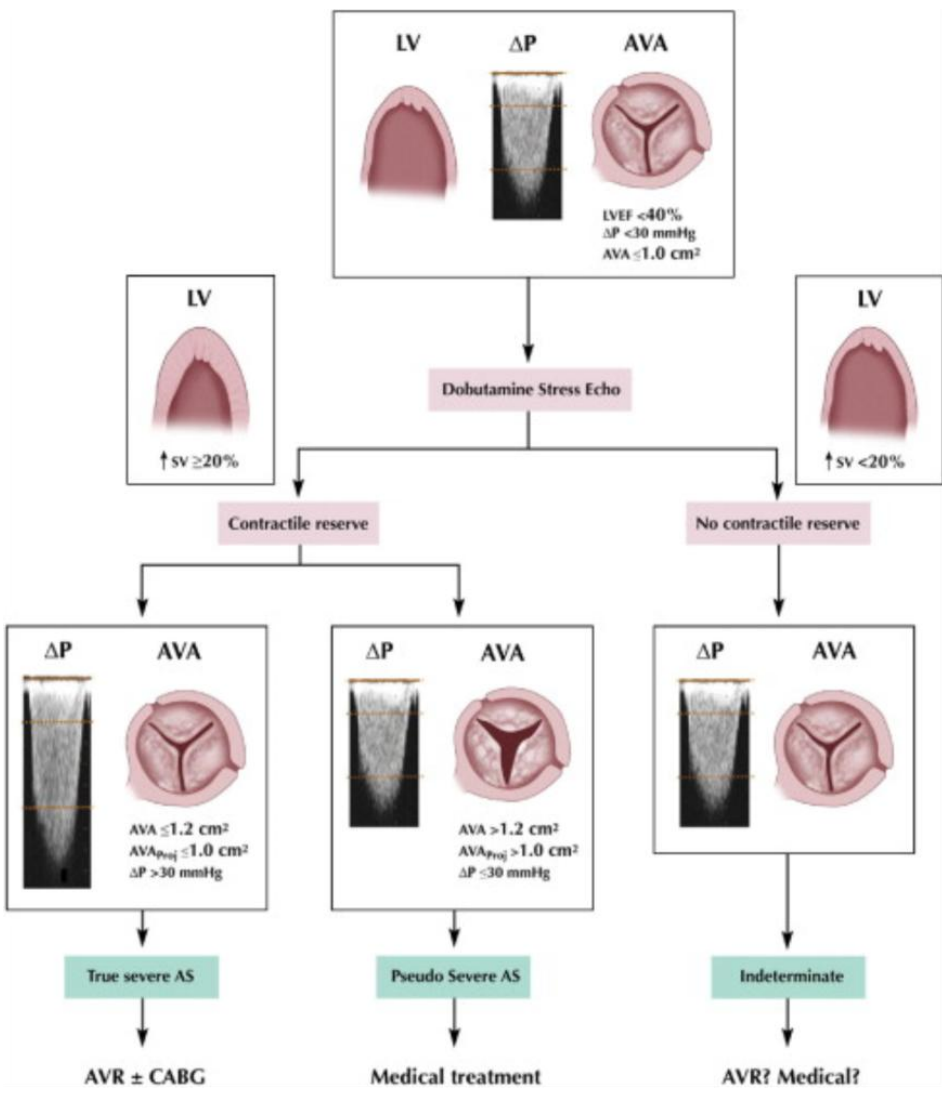
- Look for the dominant lesion
- In dominant regurgitation expect “high” gradients across the valve
- Timing of intervention depends on symptoms or signs of LV dysfunction
- 3D Valve area more accurate than gradients

Use stress
hemodynamic
response (SPAP)
to assess
combined effect
of non-severe
lesions





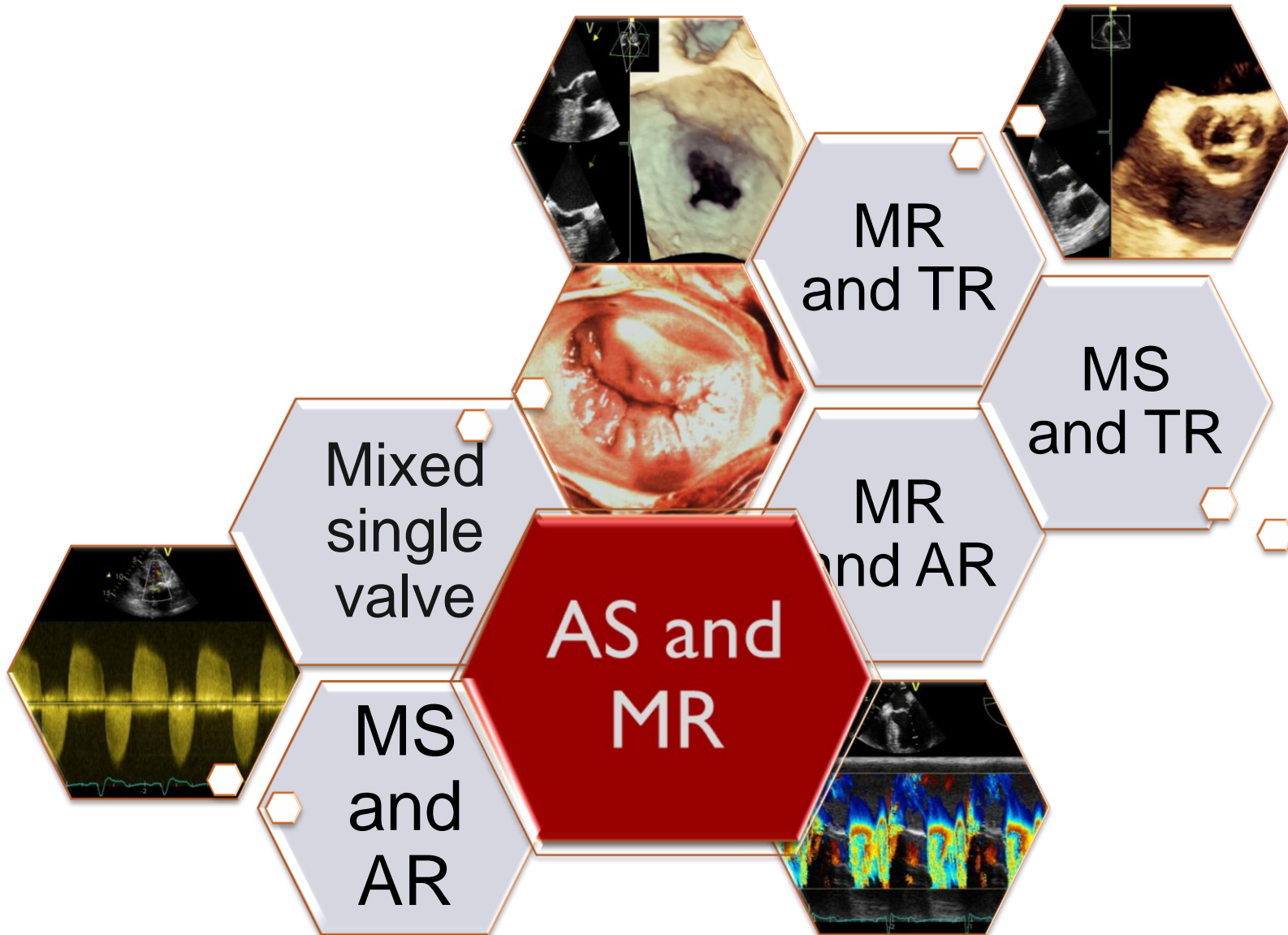
Mixed single valve



	<u>Rest</u>	<u>30-Watts</u>	<u>Peak Exercise</u>
HR (b/min):	55	116	159
DFT (ms):	607	228	200
SV (ml):	66	59	57
Q _{mean} (ml/s):	109	259	284
ΔP _{mean} (mmHg):	5	23	27
TTPG (mmHg):	42	69	74



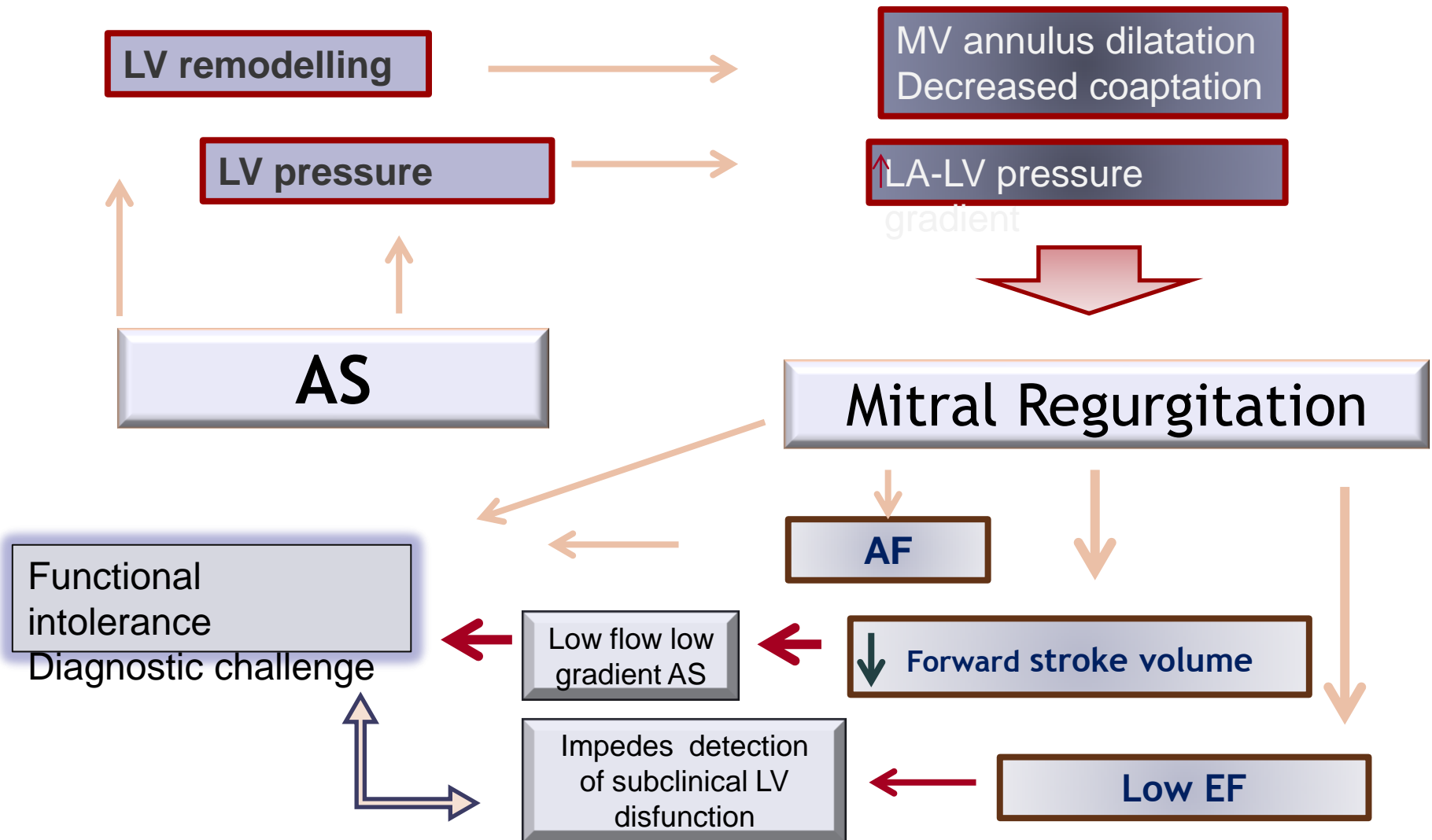
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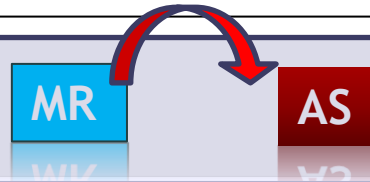
AS and MR

Functional MR

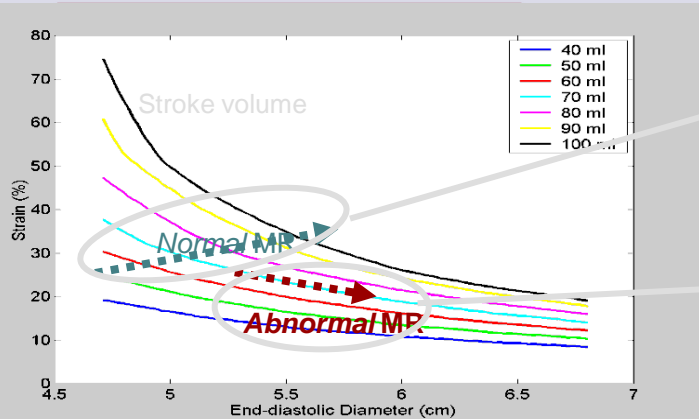




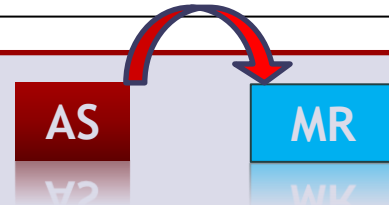
AS and MR



MR overestimates LV EF
masking LV systolic
dysfunction caused by AS



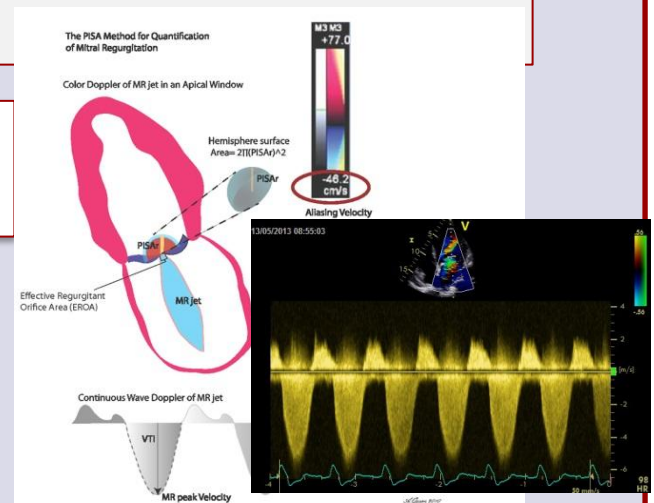
Decreased contractility
in MR
same RV, less deformation
and more LV dilatation !



Severe AS
worsen the degree of MR

High intraventricular
pressure may result in
higher RV whereas
ERO is less affected

RV by
EROA





AS and MR

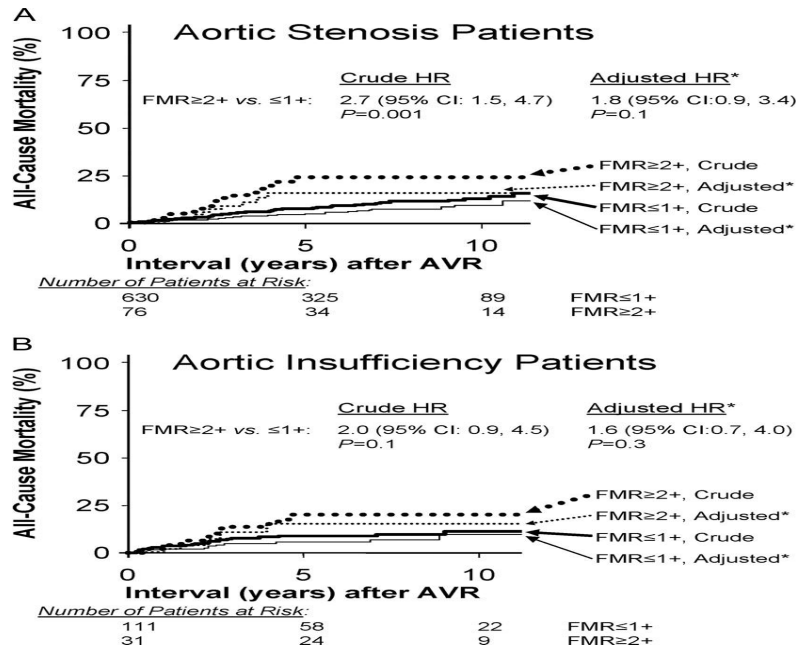
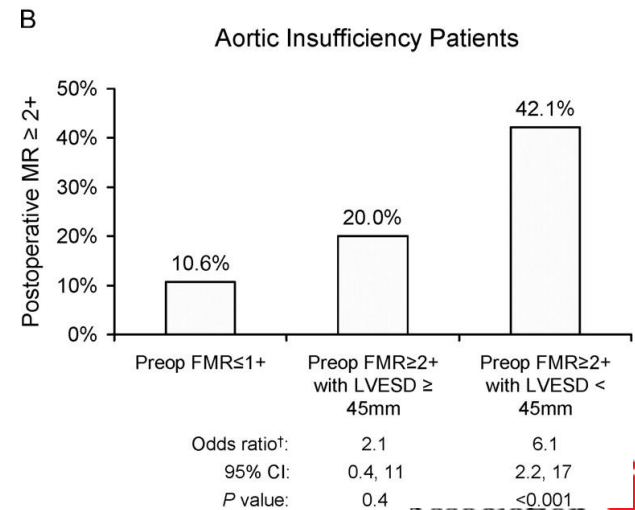
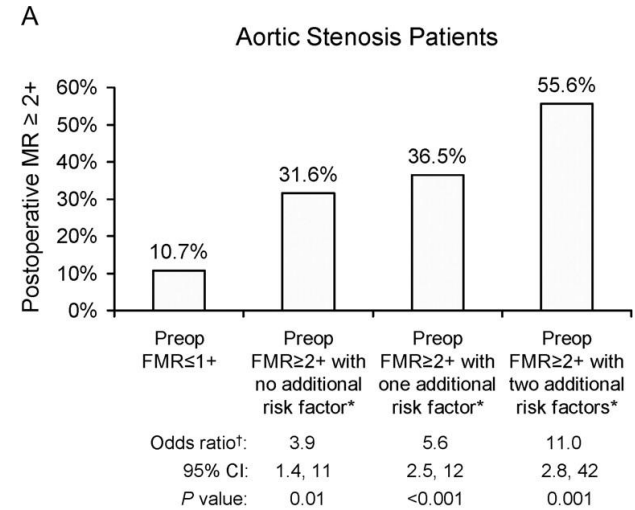
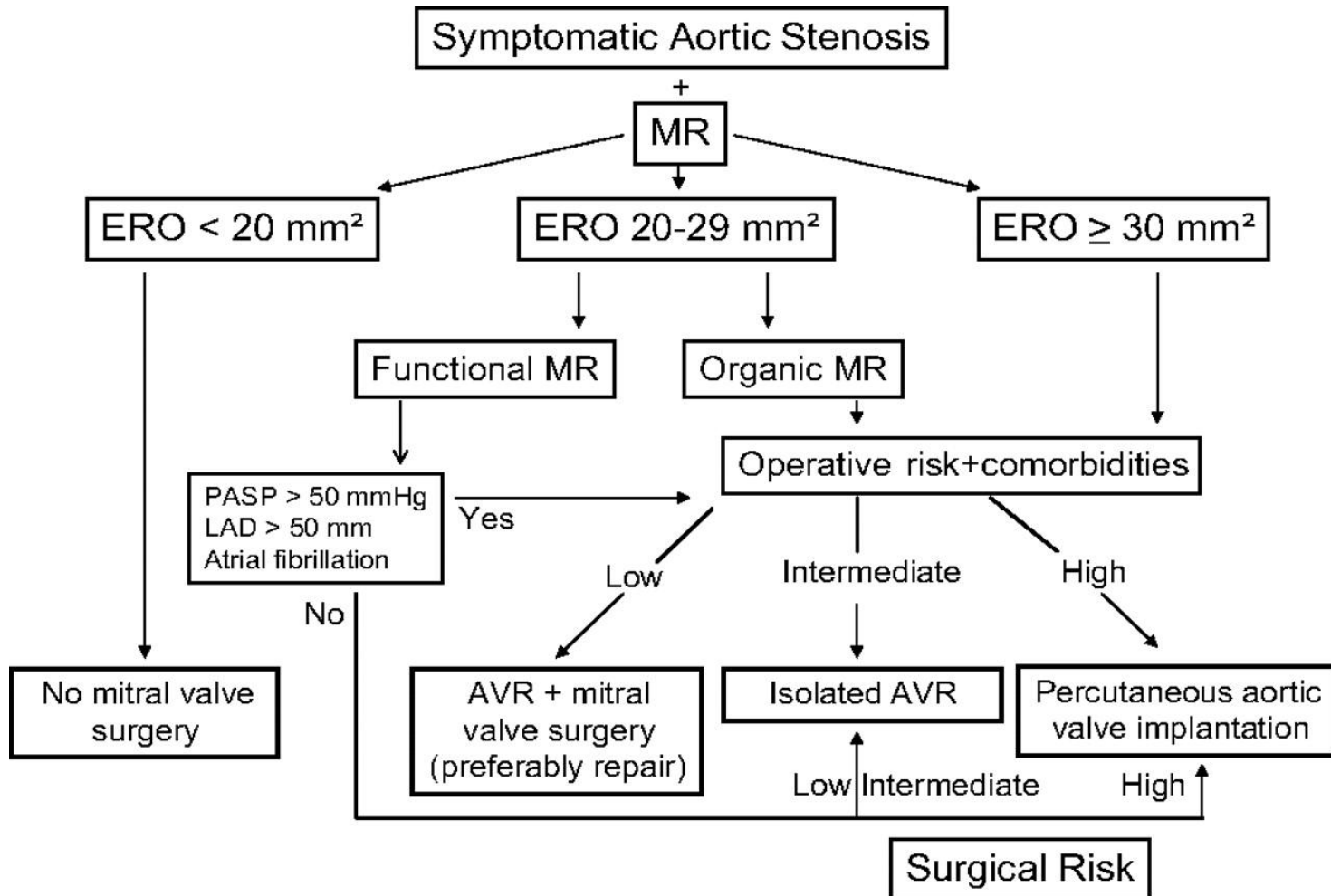


Figure 1. Crude and adjusted mortality after aortic valve replacement for aortic stenosis (AS) or aortic insufficiency (AI), according to the presence of concomitant functional mitral regurgitation (FMR) \geq 2+ at the time of operation.



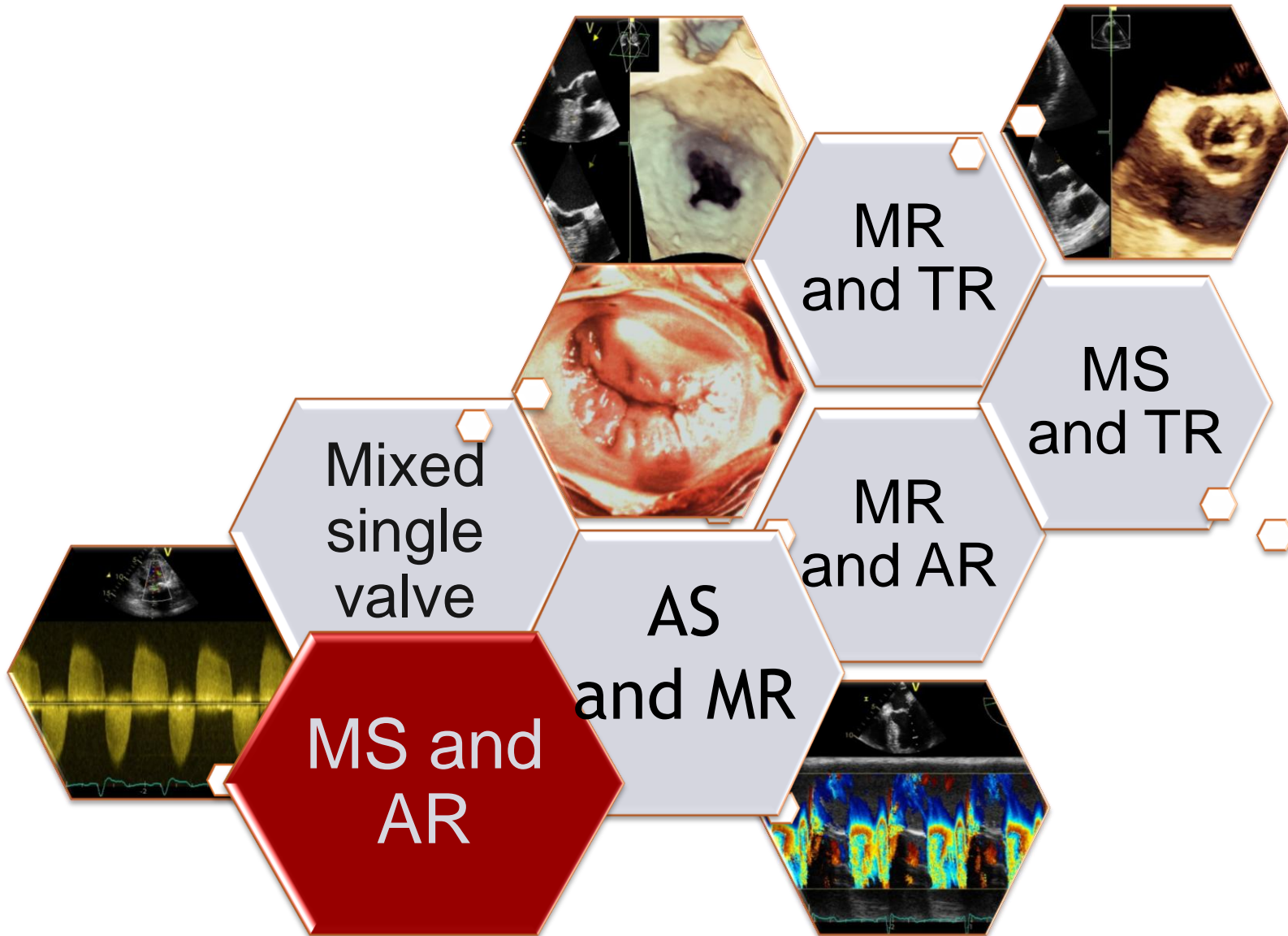


AS and MR





Multiple Valve Diseases

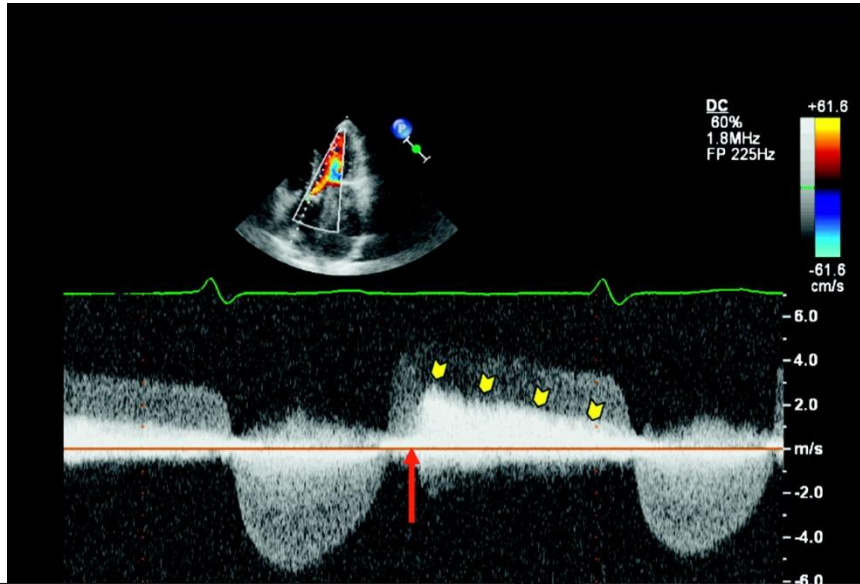




MS + AR

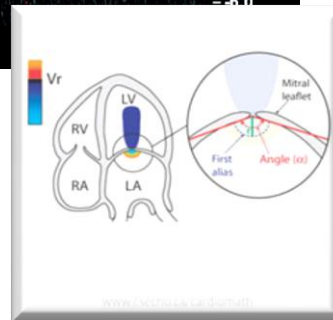
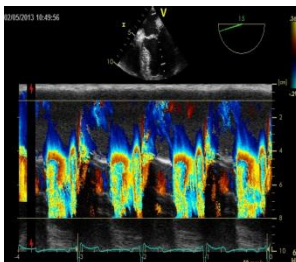


How to evaluate MS



CSA_{MVA}

$$= CSA_{LVOT} \times VTI_{LVOT} / VTI_{MV}$$



Doppler PHT

as a semi-quantitative method:

- < 130 ms good valve opening
- 130 ms does not allow any conclusion

Continuity equation

In AR not accurate MVA estimation

PISA method

In AR (or MR) not accurate MVA estimation

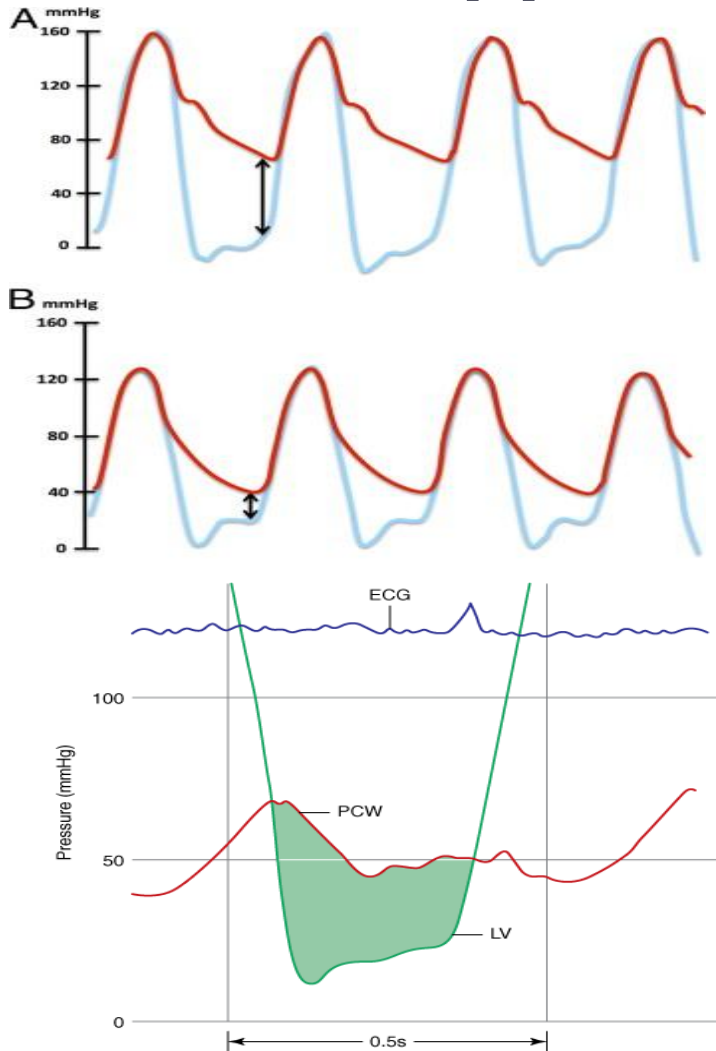
3D MVA planimetry

is the reference method



MS and AR

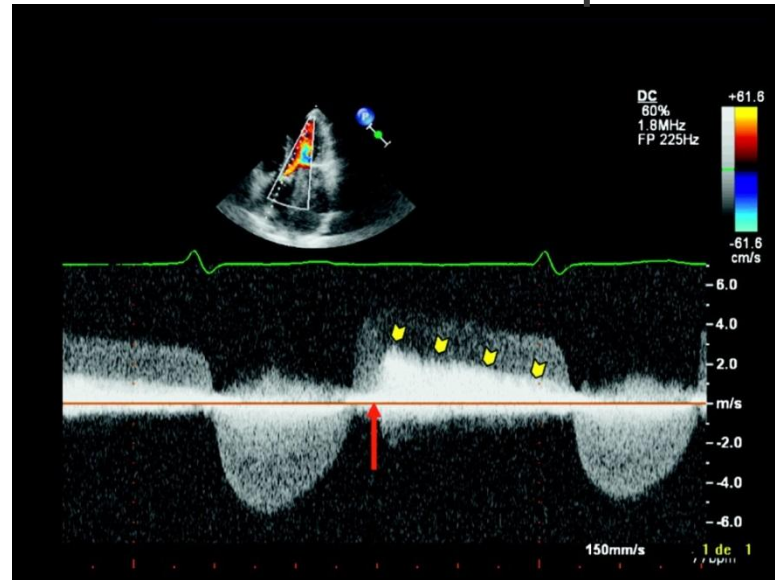
Doppler ECHO unreliable



Source: Fauci AS, Kasper DL, Braunwald E, Hauser SL, Longo DL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine*, 17th Edition: <http://www.accessmedicine.com> Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

AR MS

MS severity underestimation

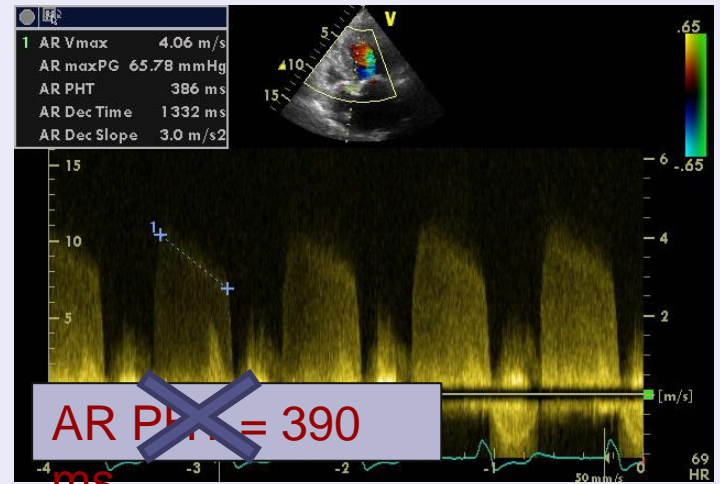
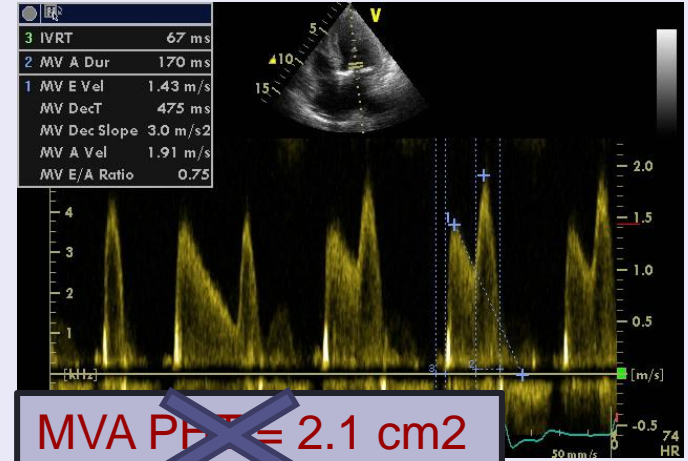
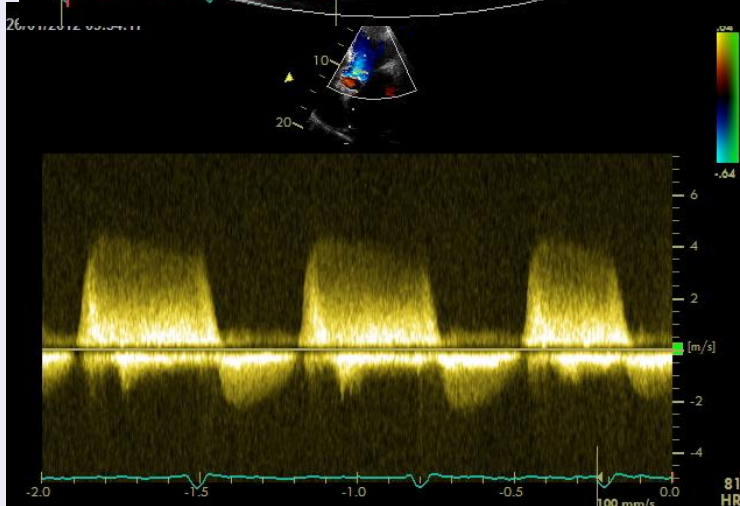
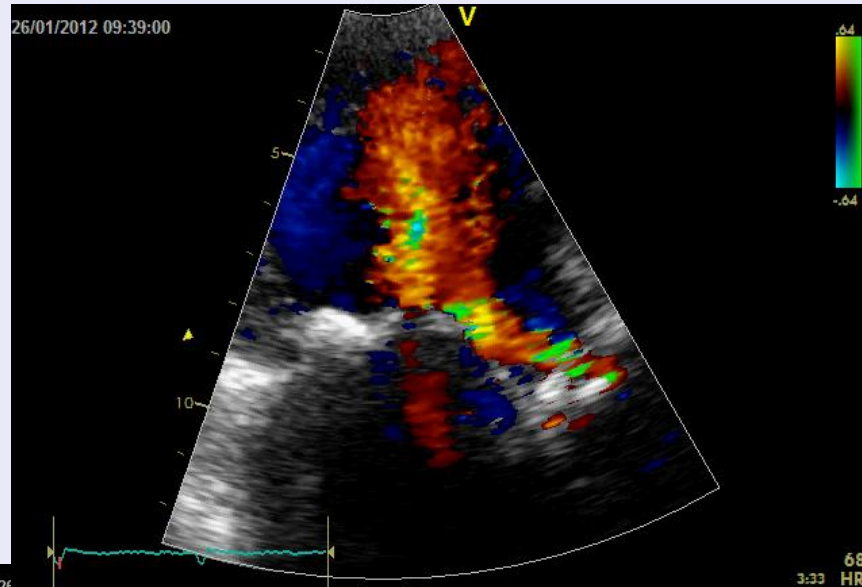


MS AR

AR severity underestimation



MS and AR



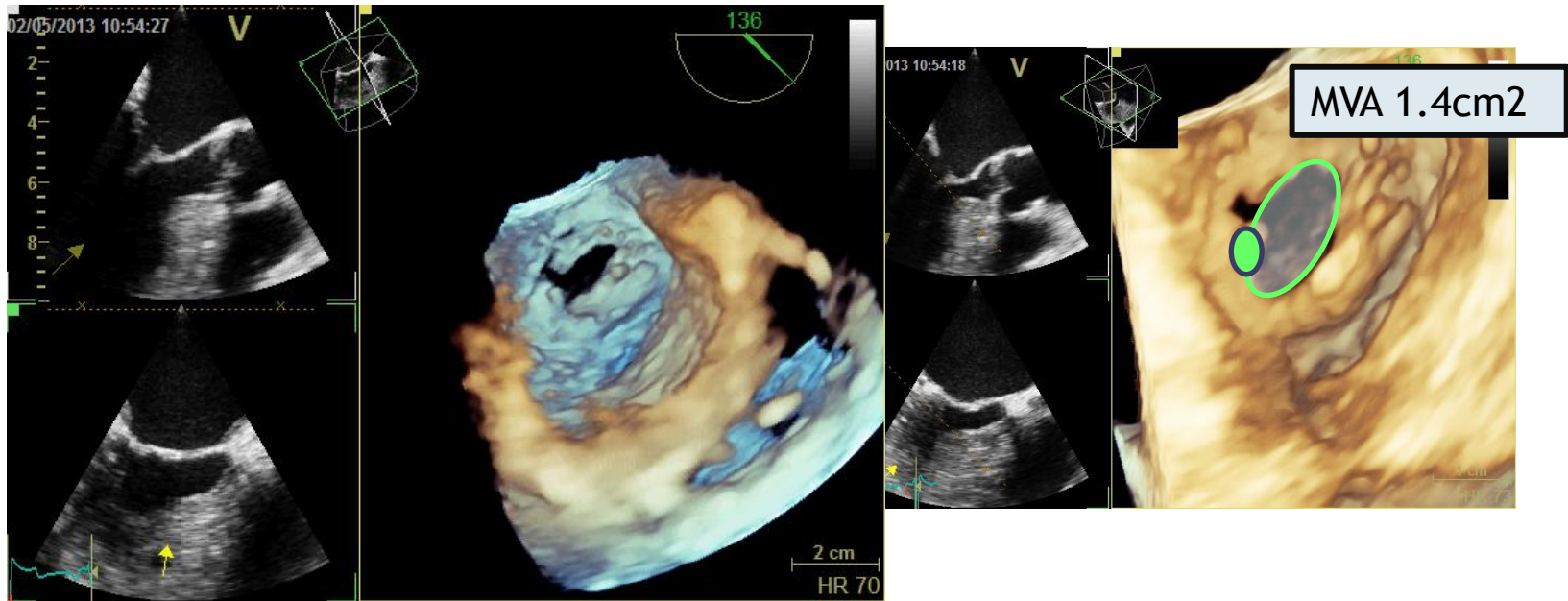
Flachskampf FA, J Am Coll Cardiol.
1990 .



MS and AR



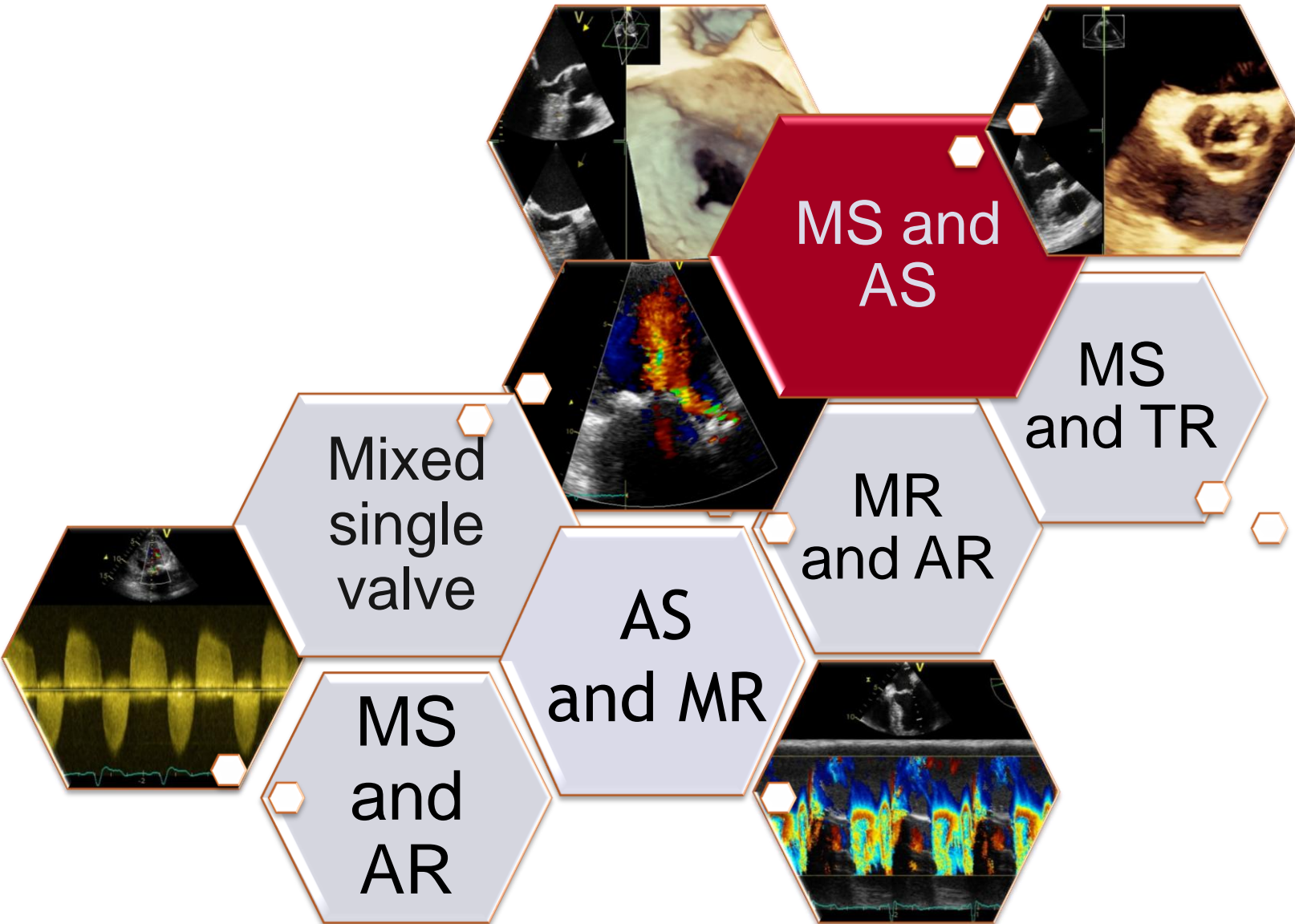
- 3D Valve area may be more accurate!



- Mitral valvotomy might delayed AVR
- When both severe;
MS restricts LV filling blunting the effect of AR on LV volume



Multiple Valve Diseases





MS and AS

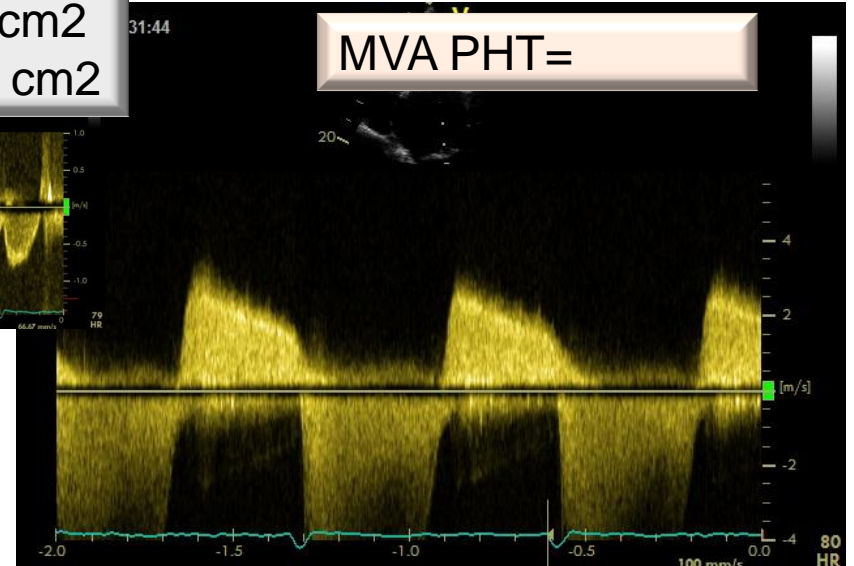
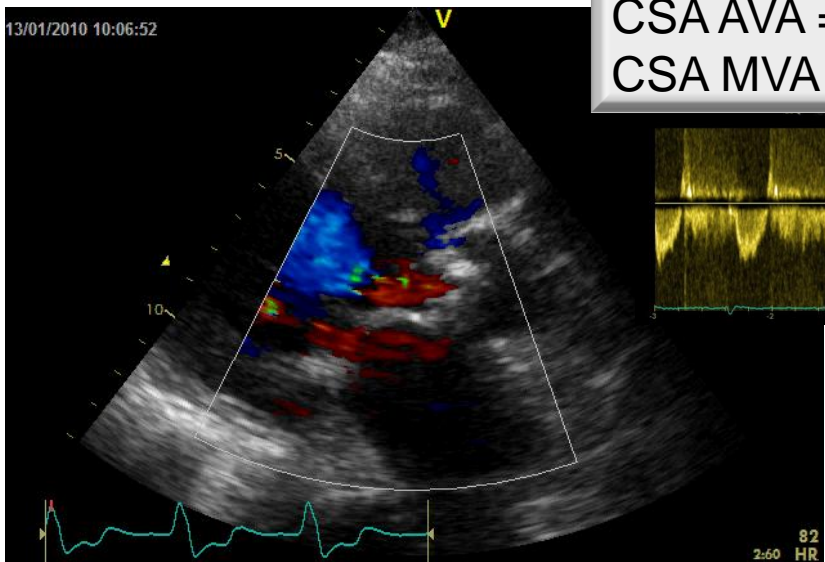
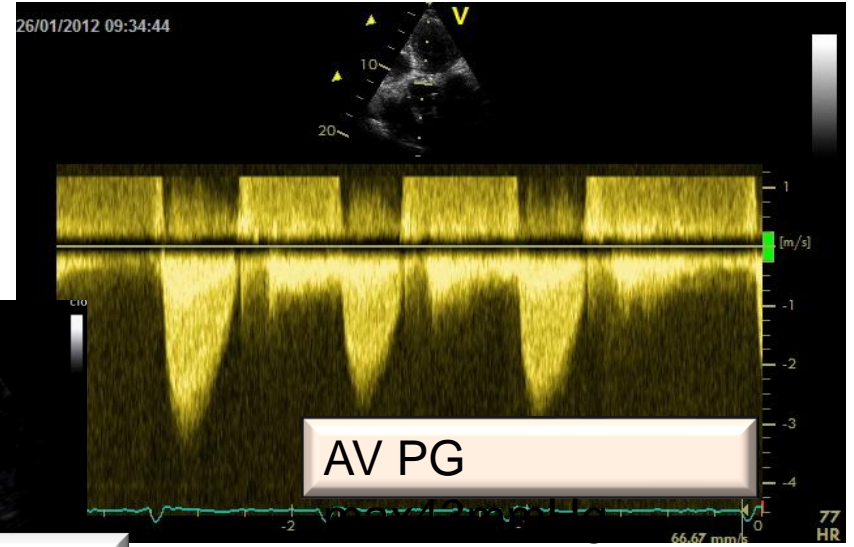
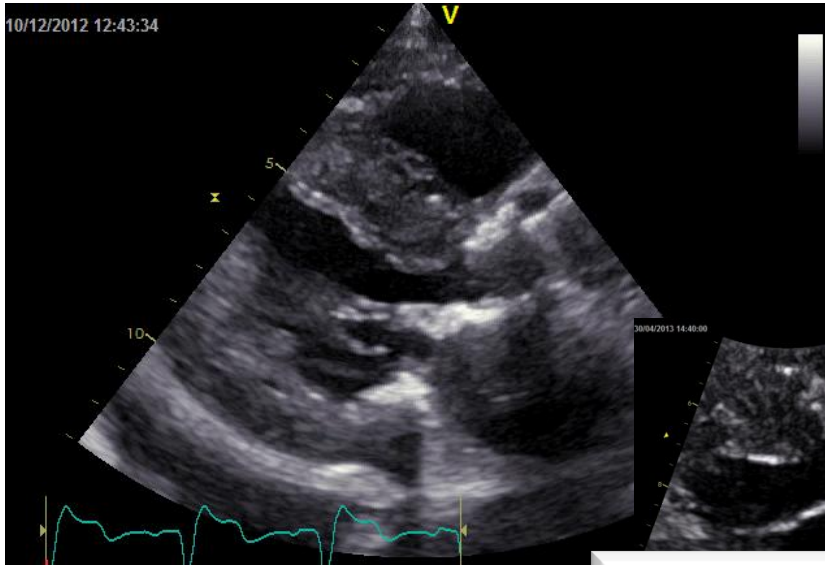


- MV Obstruction = low-flow/low-gradient AS
- Physical findings of AS generally dominate
- MS may be overlooked whereas the symptoms are usually those of MS
- Is MV acceptable for balloon valvotomy?

If valvotomy is successful, AV should be re-evaluated



MS and AS



CSA AVA = 0.6 cm²
CSA MVA = 1.1 cm²

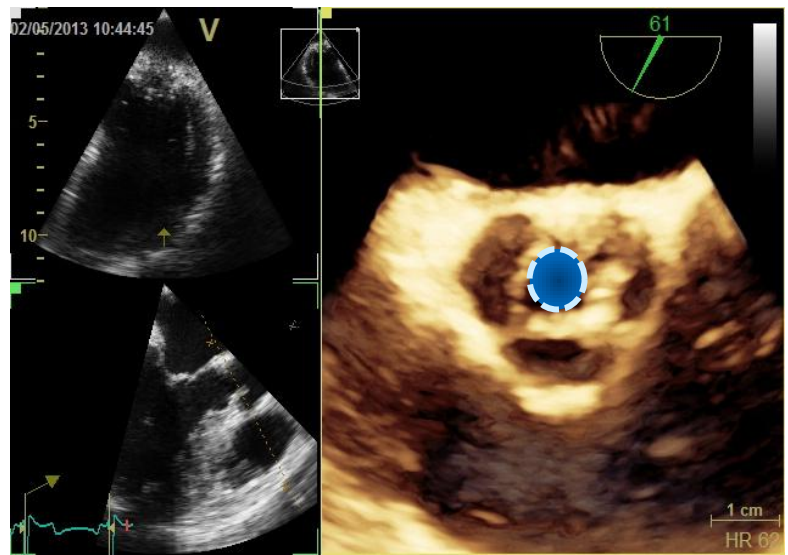
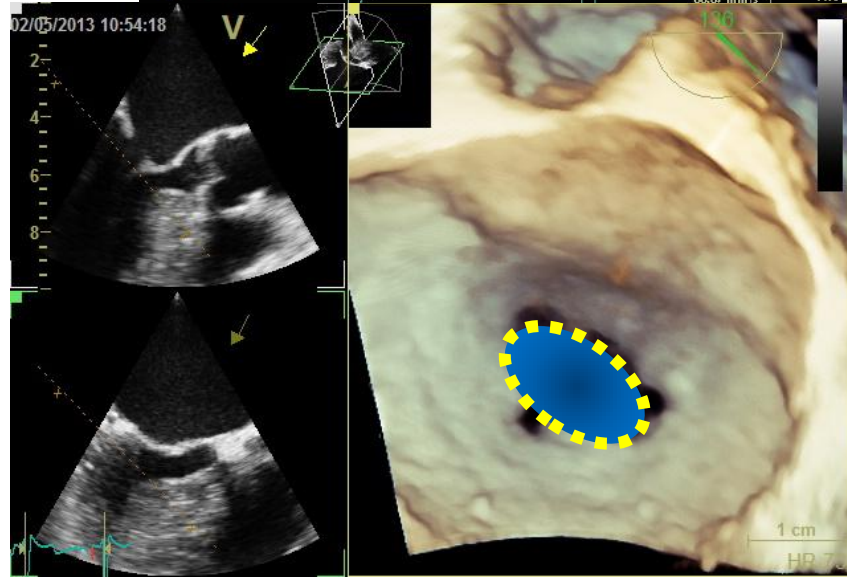
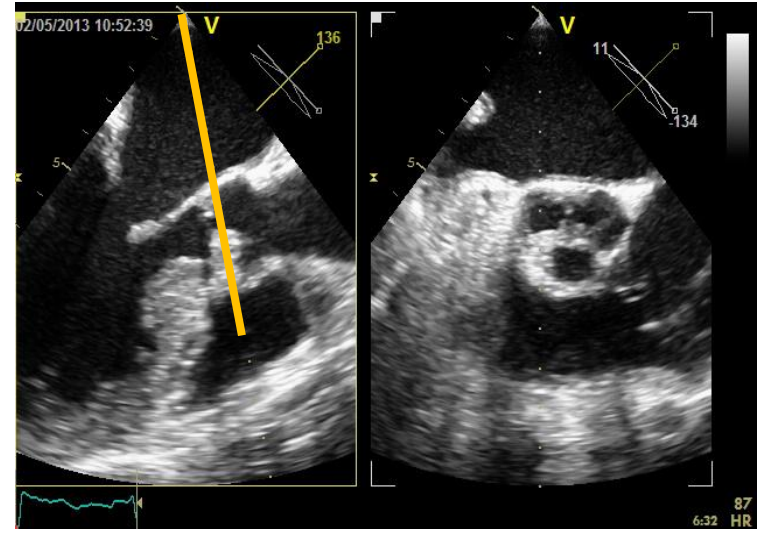
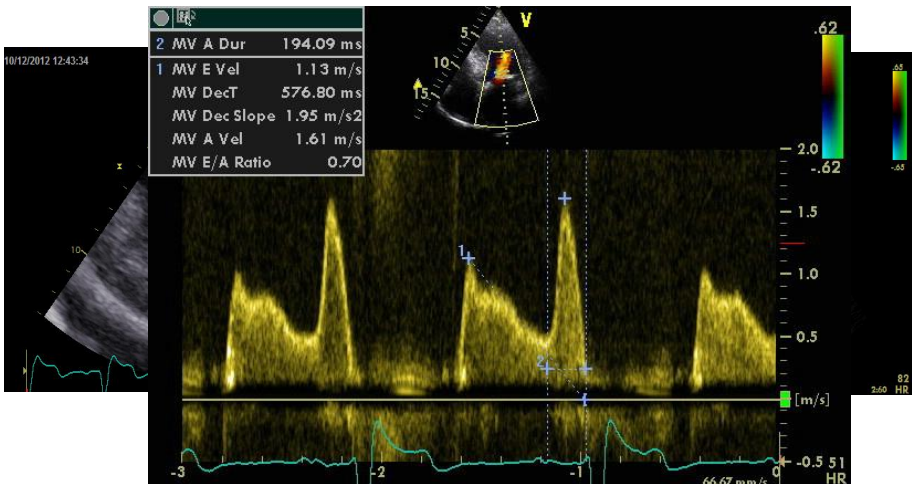
MVA PHT=



MS and AS



LOW FLOW LOW GRADIENT MS!!





MS and AS

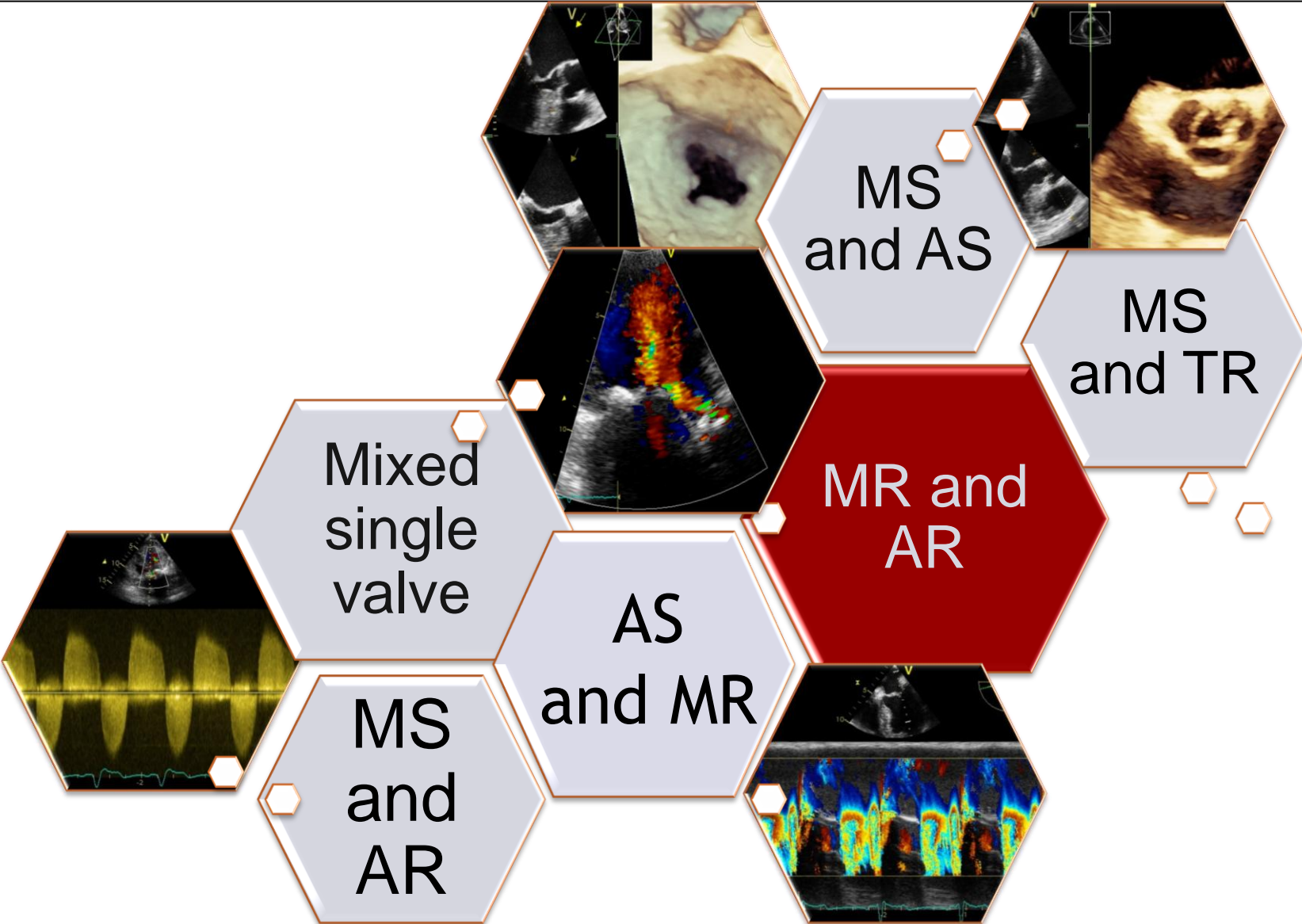


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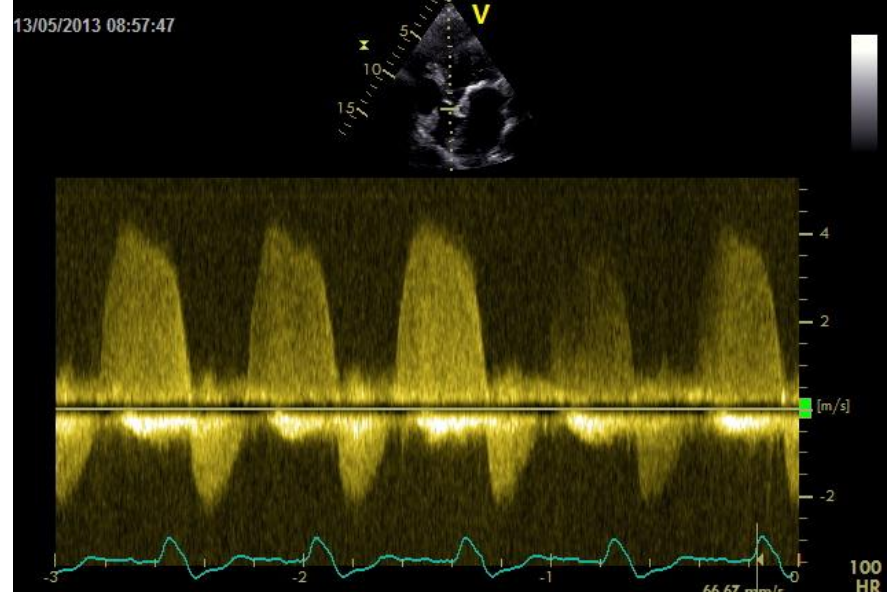
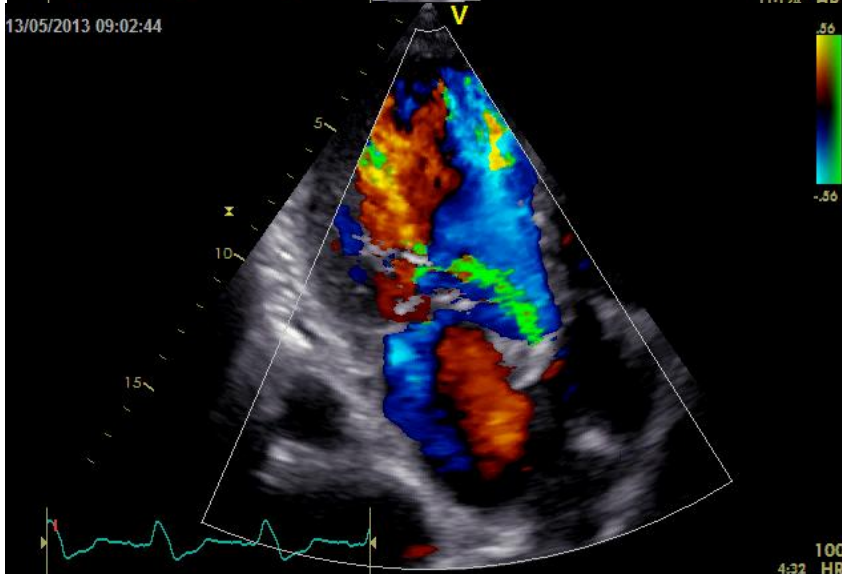
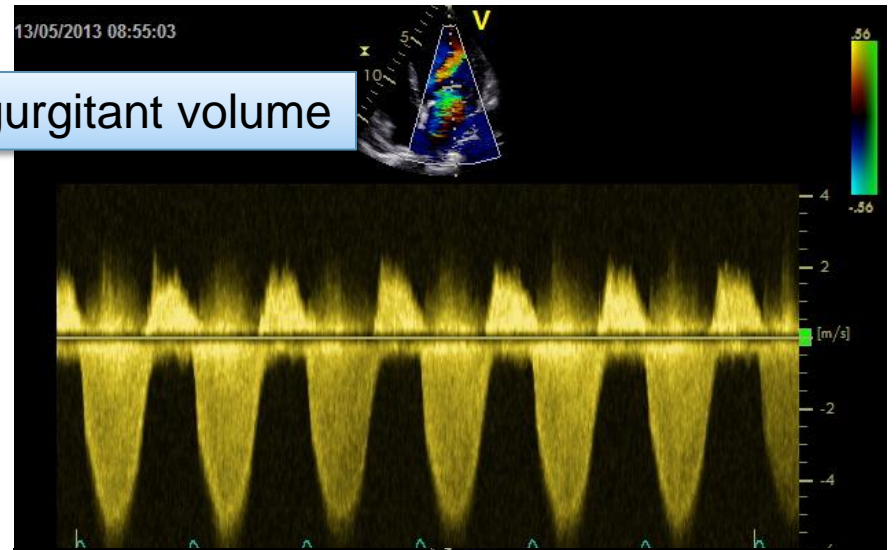
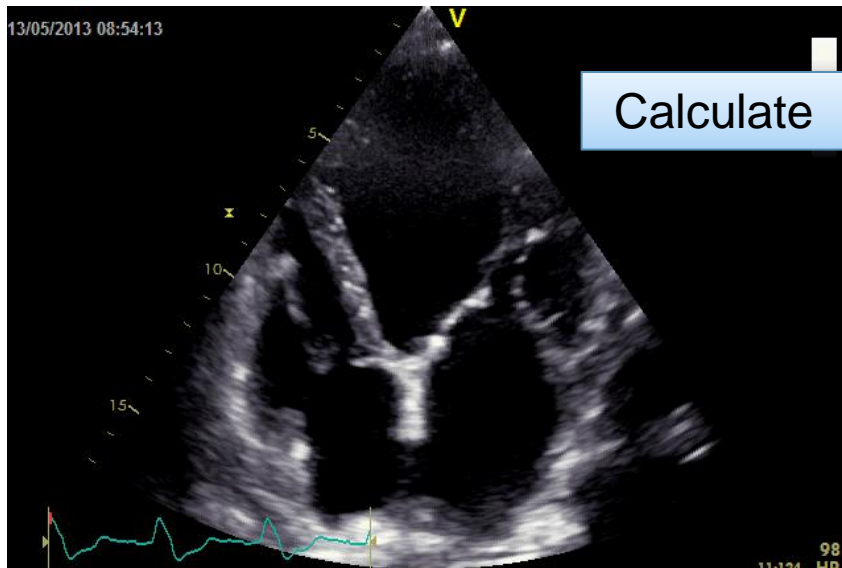




MR and AR




Calculate regurgitant volume





MR and AR



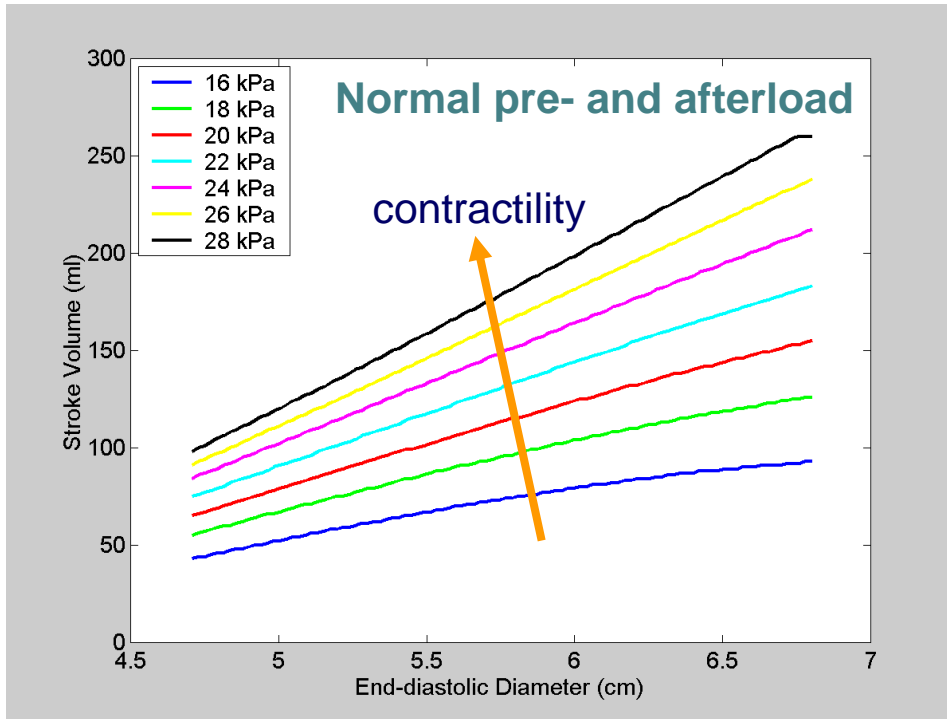
- Both lesions produce LV dilatation !
- AR  systemic systolic hypertension
increase in LV wall thickness
- treat primarily according to dominant lesion
- AVR plus MV repair is the preferred strategy
- [Am Coll Cardiol](#). 2013 Feb 28. pii: S0735-1097(13)00798-5. doi: 10.1016/j.jacc.2013.01.064. Mitral Valve Enlargement in Chronic Aortic Regurgitation as a Compensatory Mechanism to Prevent Functional Mitral Regurgitation in the Dilated Left Ventricle.



MR and AR



Stroke volume and Dilatation



VENTRICULAR DILATATION



INCREASED stroke volume
(valve regurgitation)
or
SAME SV with less contractility
(heart failure)

- Mechanism:
1. Less shortening needed to produce the same stroke volume
 2. Wall stress \uparrow with \uparrow diameter / \downarrow with increasing thickness.

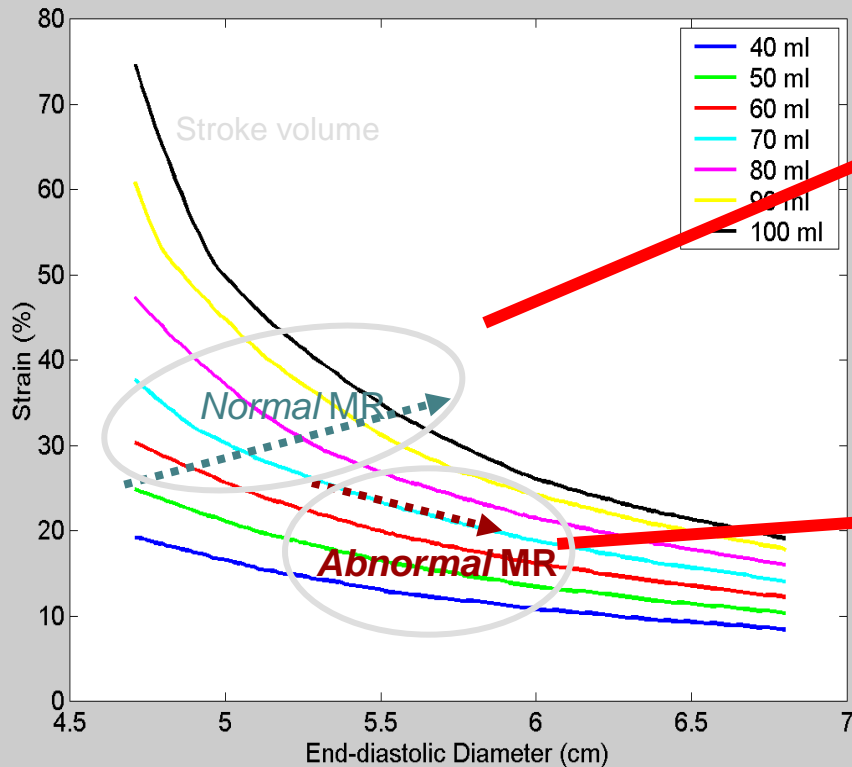
With dilatation (and hypertrophy) one can keep stroke volume with less contraction force.



MR and AR



Ventricular function in Volume overload



↑ normal contractility
and increasing regurgitant
volume:

- dilatation to cope with ↑ SV
- hypertrophy to ↑ strain and thus SV

decreasing contractility:

- compensate ↓ strain with ↑
dilatation

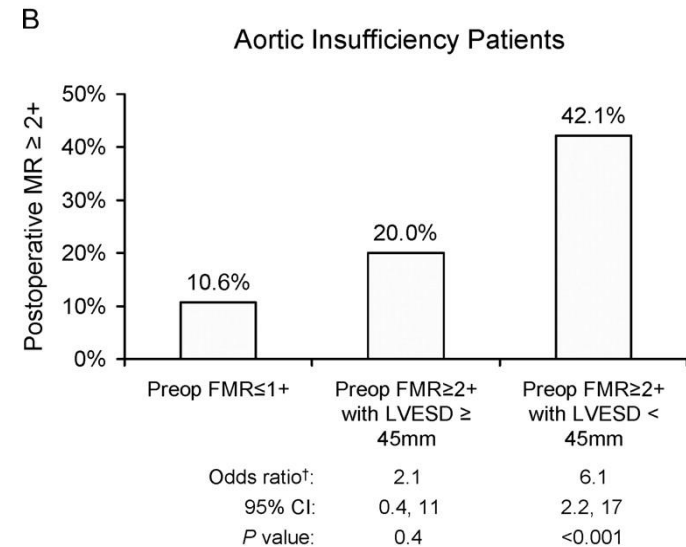
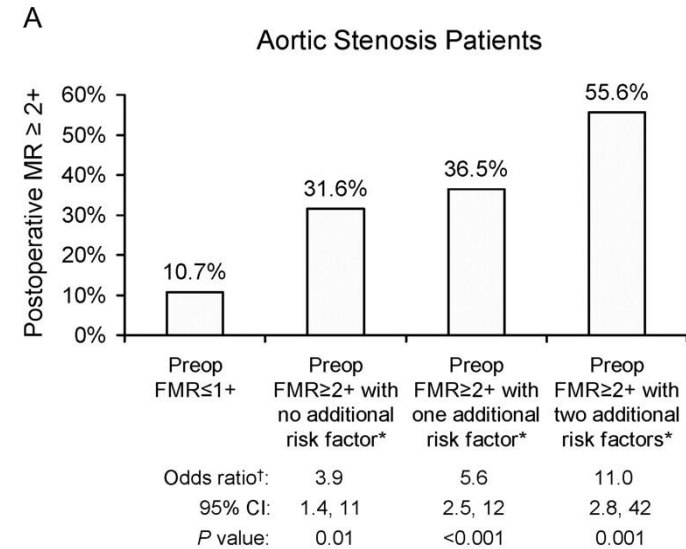
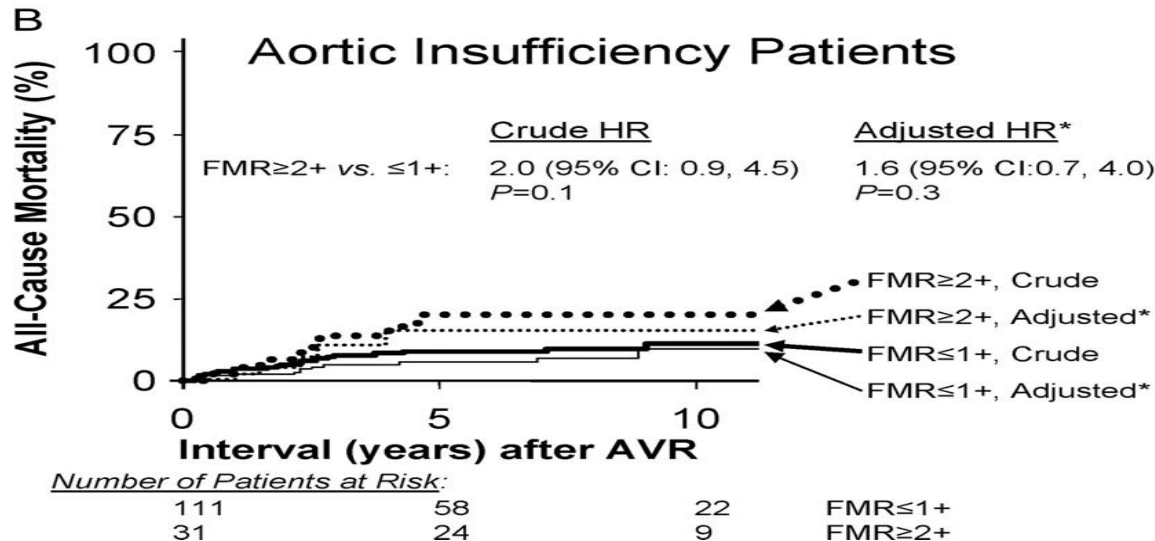
Decreased contractility in valve regurgitation = same RV, less deformation and more LV dilatation !



MR and AR

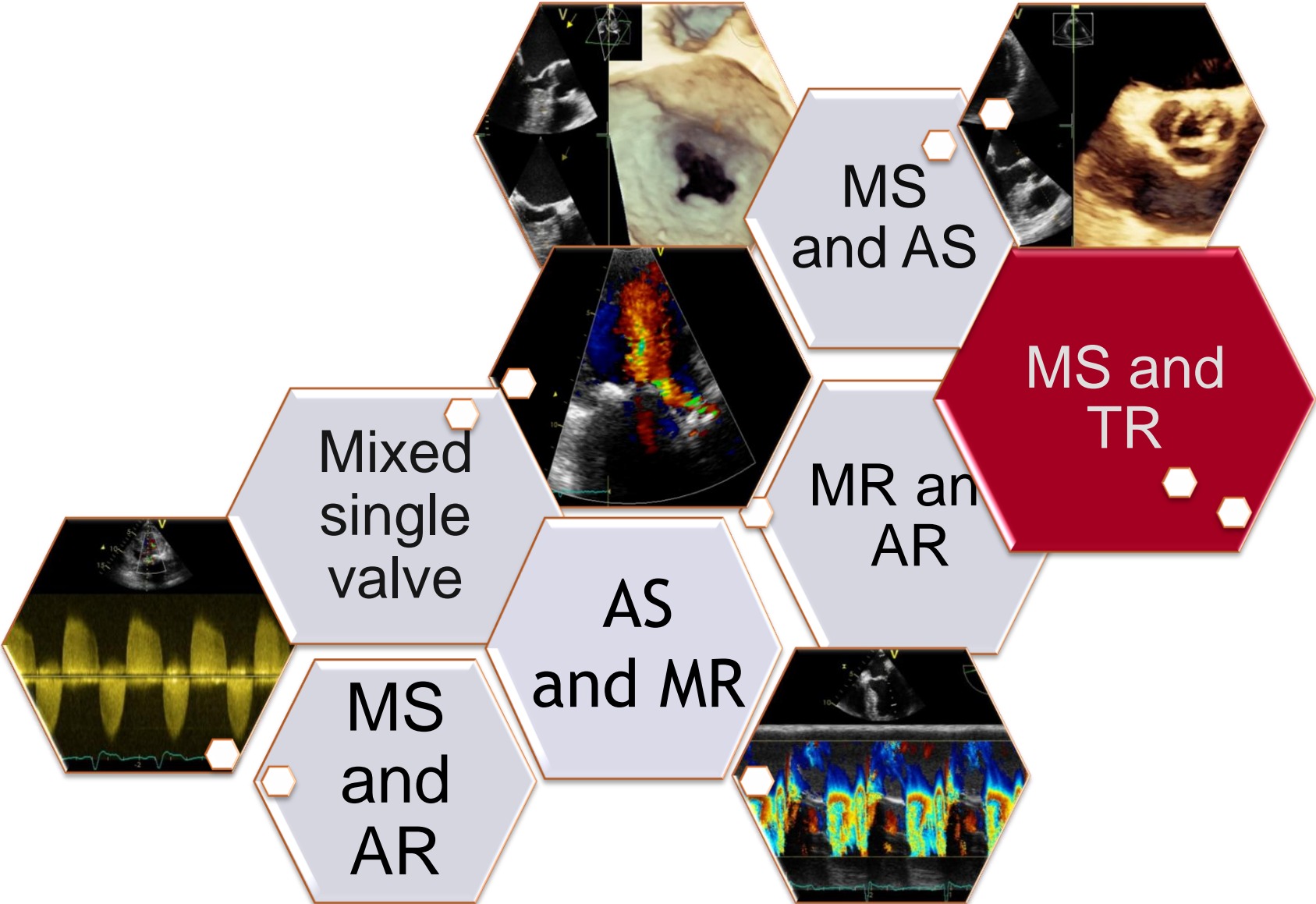


Figure 1. Crude and adjusted mortality after aortic valve replacement for aortic stenosis (AS) or aortic insufficiency (AI), according to the presence of concomitant functional mitral regurgitation (FMR) $\geq 2+$ at the time of operation.





Multiple Valve Diseases





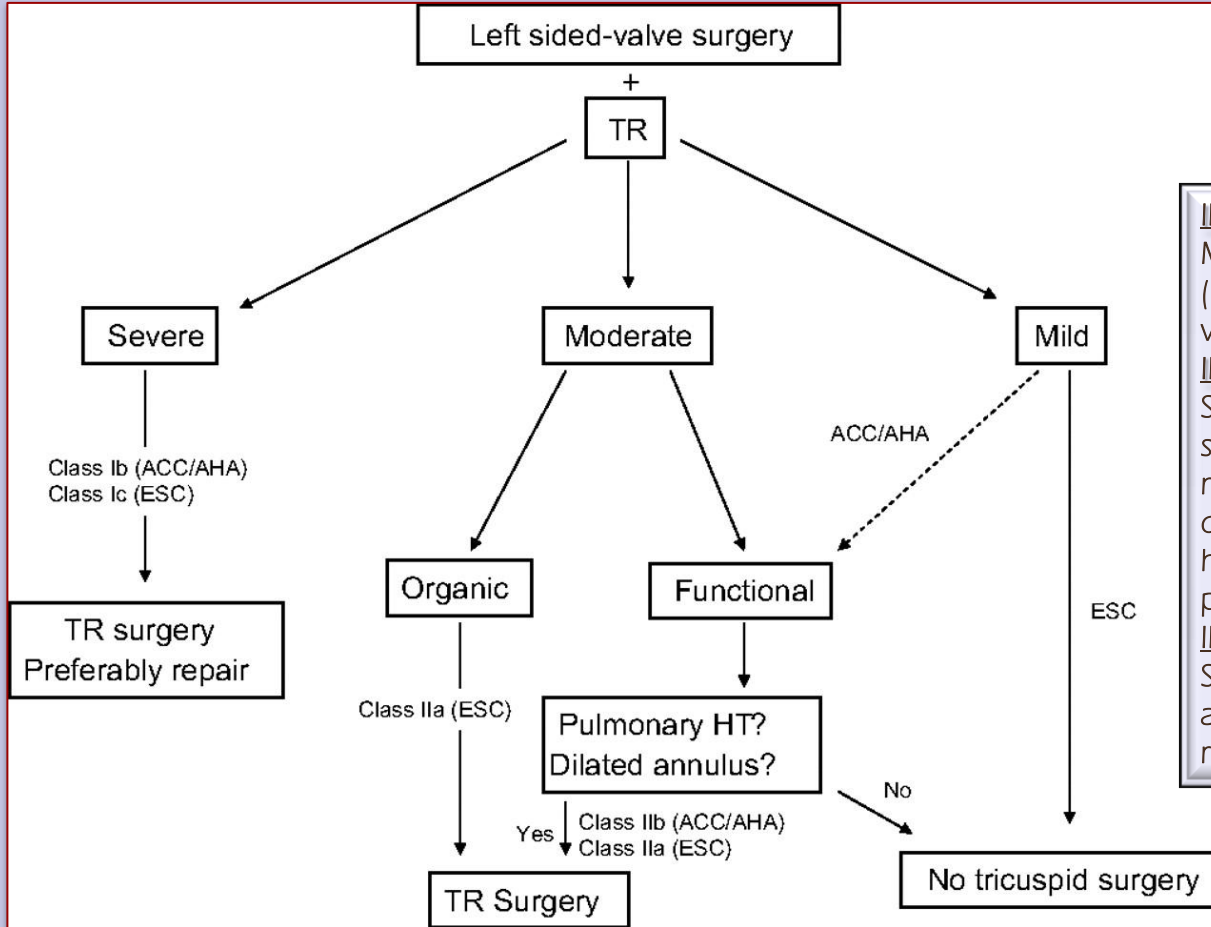
MS and TR



- Difficult to predict TR after correction of MS
- Improvement in TR if TV anatomy is not distorted
 - severe rheumatic deformity of the TV
 - dilatation of the tricuspid annulus,
 - severe TR,
 - ➔ competence is to be restored by surgery
- If MV surgery is performed, concomitant tricuspid annuloplasty should be considered.



MS and TR



IlaC
Moderate secondary TR with dilated annulus (.40 mm) in a patient undergoing left-sided valve surgery

IlaC
Severe TR and symptoms, after left-sided valve surgery, in the absence of left-sided myocardial, valve, or right ventricular dysfunction and without severe pulmonary hypertension (systolic pulmonary artery pressure . 60 mmHg)

IlaC
Severe isolated TR with mild or no symptoms and progressive dilation or deterioration of right ventricular function



Diagnostic caveats in patients with multivalve lesions



		Impacts on the diagnosis of:			
		AS	AR	MR	MS
The presence of:	AS		Prolonged PHT if left ventricular hypertrophy with impaired relaxation	High intraventricular pressure may result in higher RV whereas ERO is less affected	Low-flow low-gradient MS. Prolonged PHT if impaired left ventricular relaxation
	AR	Gorlin formula using thermodilution technique invalid. Owing to high transaortic volume flow rate, maximum velocity, and pressure gradients may be higher than expected for a given valve area		Not significantly affected	Owing to increased anterograde aortic flow, there is an overestimation of MVA by the continuity equation. Overestimation of MVA with PHT method. This approach is not valid
	MR	MR could favour a low-flow, low-gradient state. Aortic valve area calculation remains accurate. High-velocity MR jet may be mistaken for the AS jet (MR is longer in duration)	Not significantly affected		Owing to increased anterograde mitral flow, there is an underestimation of MVA by the continuity equation. MVA may be underestimated with PHT method
	MS	Low-flow low-gradient state. Aortic valve area calculation remains accurate	Blunted hyperdynamic circulation	Not significantly affected	
	TR	Gorlin formula invalid	Not affected	Not affected	Gorlin formula invalid

AR, aortic regurgitation; AS, aortic stenosis; ERO, effective regurgitant orifice; MR, mitral regurgitation; MS, mitral stenosis; MVA, mitral valve area; PHT, pressure half-time; RV, regurgitant volume; NA, not applicable.



Conclusion



➤ Stenosis = regurgitation

inter

➤ > > Sten

follo

➤ Interac

unc

➤ Combin

loa

➤ ! Extra

➤ Surgica

presence of the other VHD

ESC GUIDELINES MULTIPLE – VD

There is a lack of data on mixed and multiple valve diseases

This does not allow for evidence-based recommendations