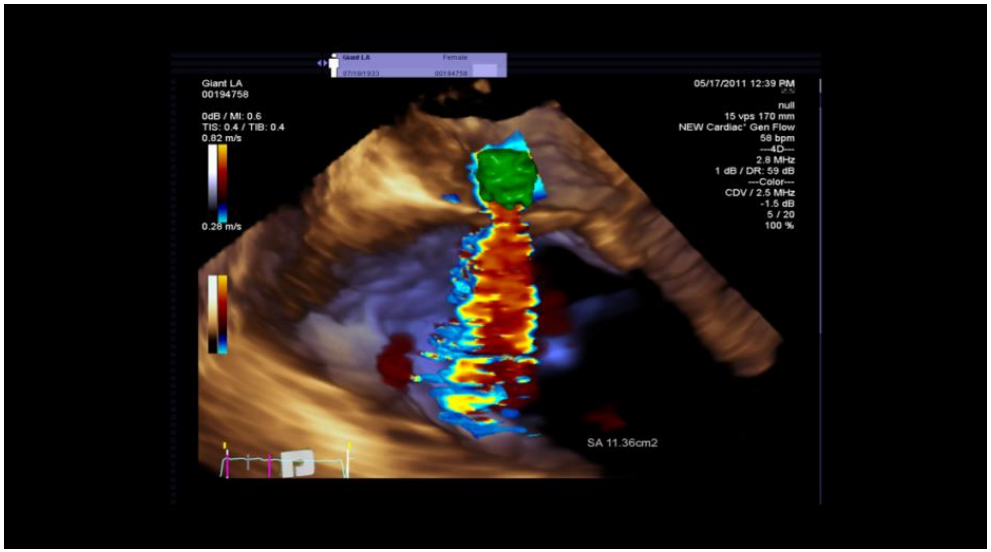
2D Pitfalls in assessing MR



Gilbert Habib
La Timone Hospital
Marseille - France

EuroValves – Brussels - March 10, 2016

Assessment of Mitral Regurgitation

1. **Quantification**
2. **Pitfalls**
3. **Solutions**

EACVI guidelines 2013

Lancellotti P - Europ Heart J Cardiovasc Im 2013; 14, 611–644

Table 3 Grading the severity of organic mitral regurgitation

Parameters	Mild	Moderate	Severe
Qualitative			
MV morphology	Normal/Abnormal	Normal/Abnormal	Flail lefleat/Ruptured PMs
Colour flow MR jet	Small, central	Intermediate	Very large central jet or eccentric jet adhering, swirling and reaching the posterior wall of the LA
Flow convergence zone[a]	No or small	Intermediate	Large
CW signal of MR jet	Faint/Parabolic	Dense/Parabolic	Dense/Triangular
Semi-quantitative			
VC width (mm)	<3	Intermediate	≥7 (>8 for biplane)[b]
Pulmonary vein flow	Systolic dominance	Systolic blunting	Systolic flow reversal[c]
Mitral inflow	A wave dominant[d]	Variable	E wave dominant (>1.5 cm/s)[e]
TVI mit /TVI Ao	<1	Intermediate	>1.4
Quantitative			
EROA (mm^2)	<20	20–29; 30–39[f]	≥40
R Vol (mL)	<30	30–44; 45–59[f]	≥60
+ LV and LA size and the systolic pulmonary pressure[g]			

EACVI guidelines 2013

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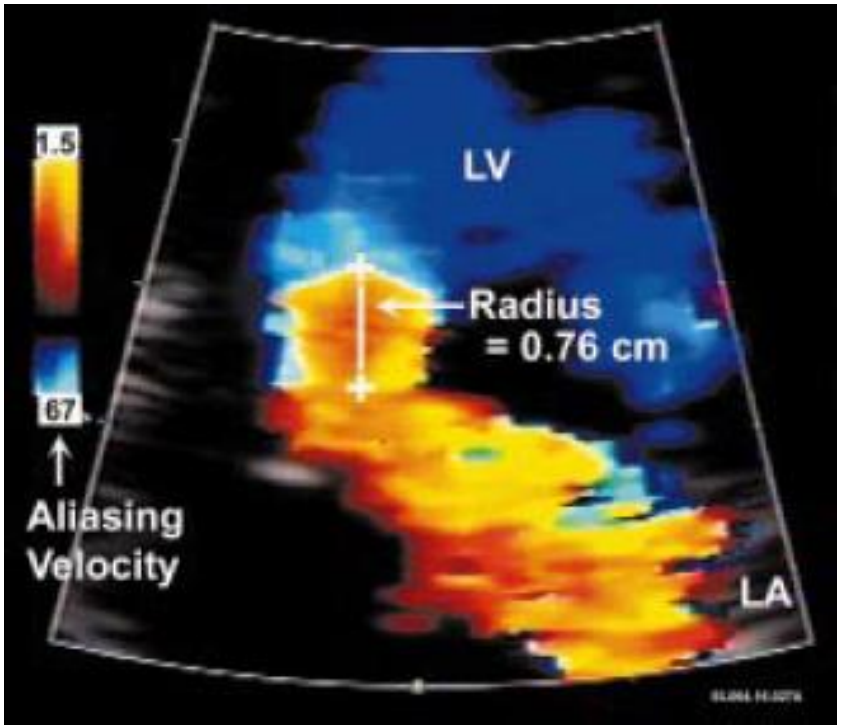
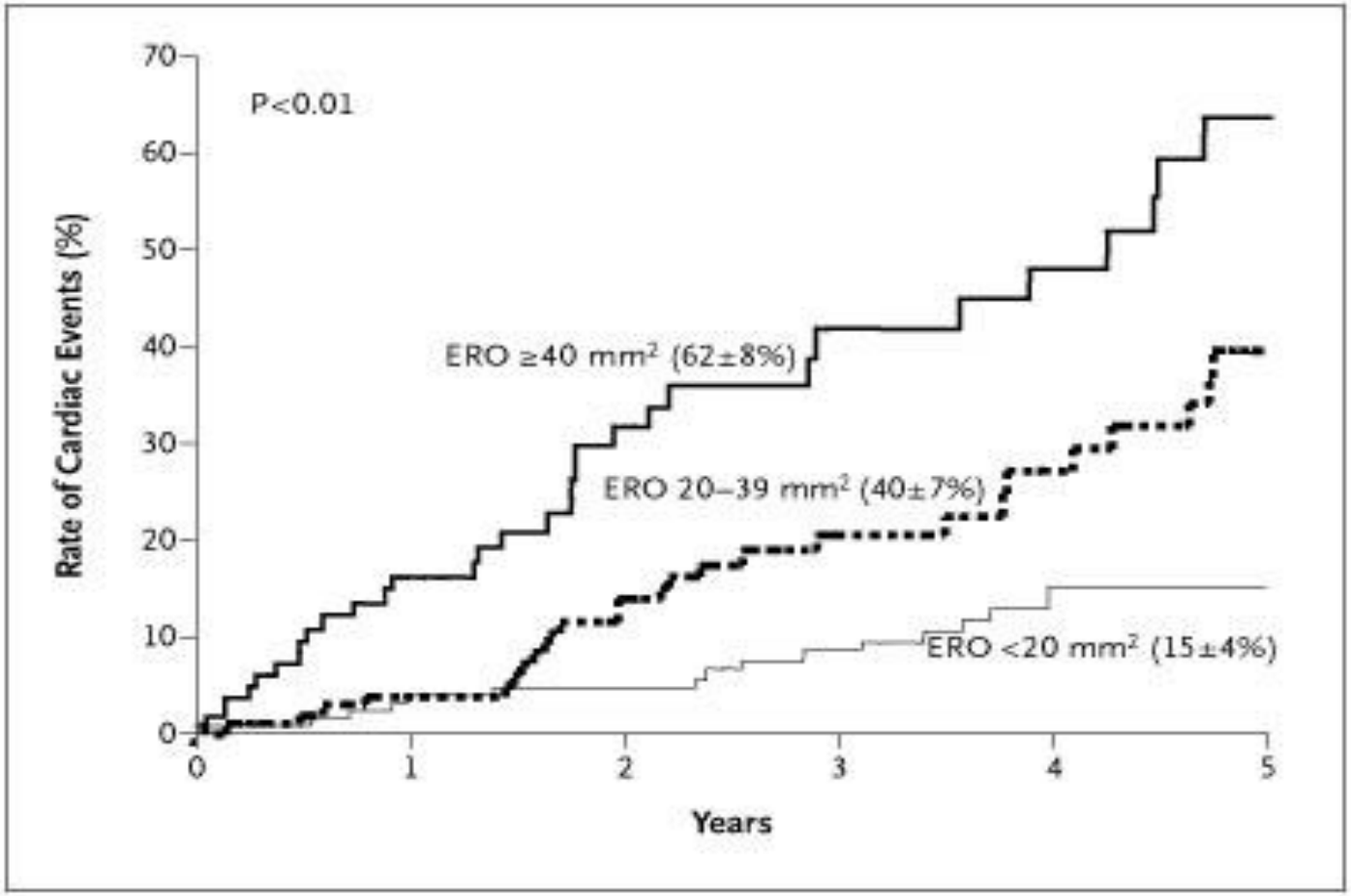
What is a severe MR ?



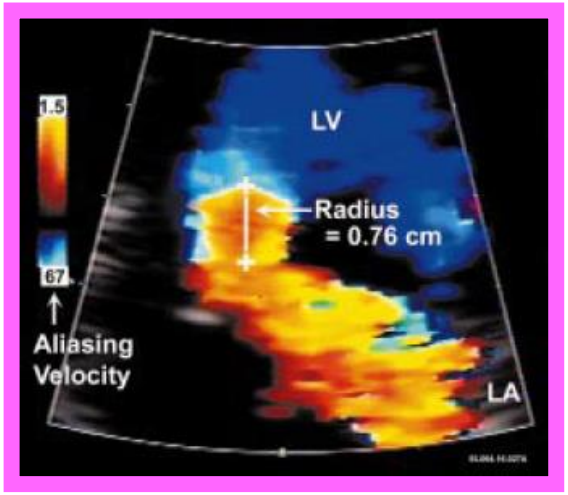
RV (ml)	RO (mm^2)
≥60	≥40

Prognosis of asymptomatic MR

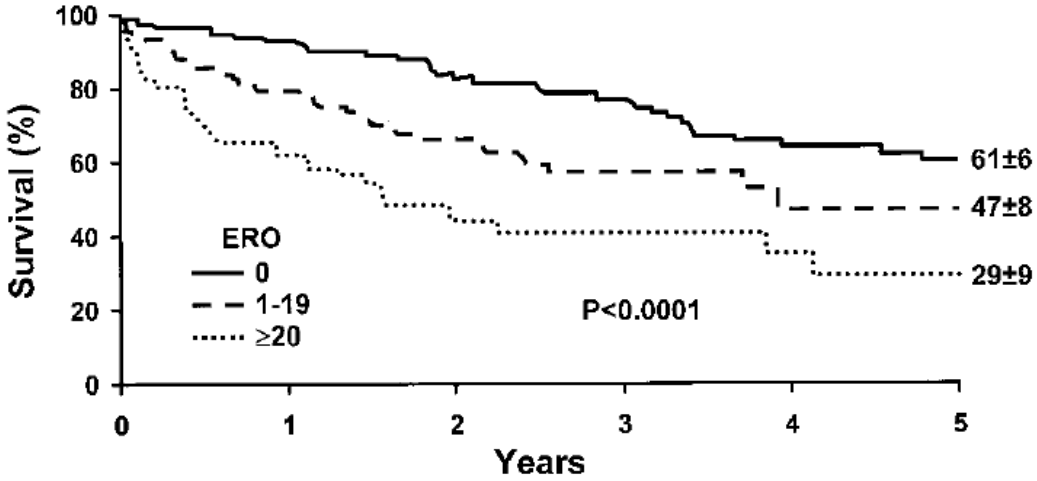
Sarano – NEJM 2005



What is a severe ischemic MR?

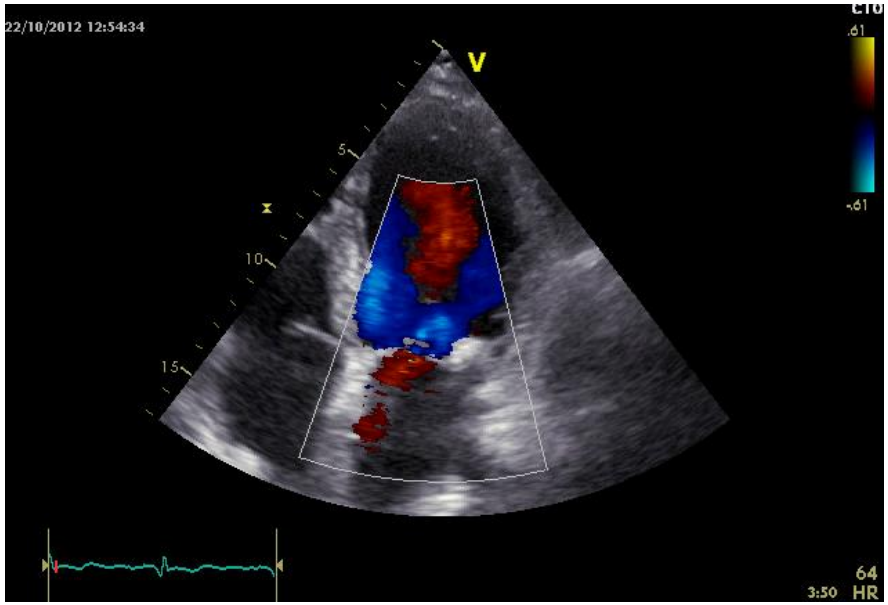


- **Reg Vol > 30 ml**
- **ERO > 20 mm²**

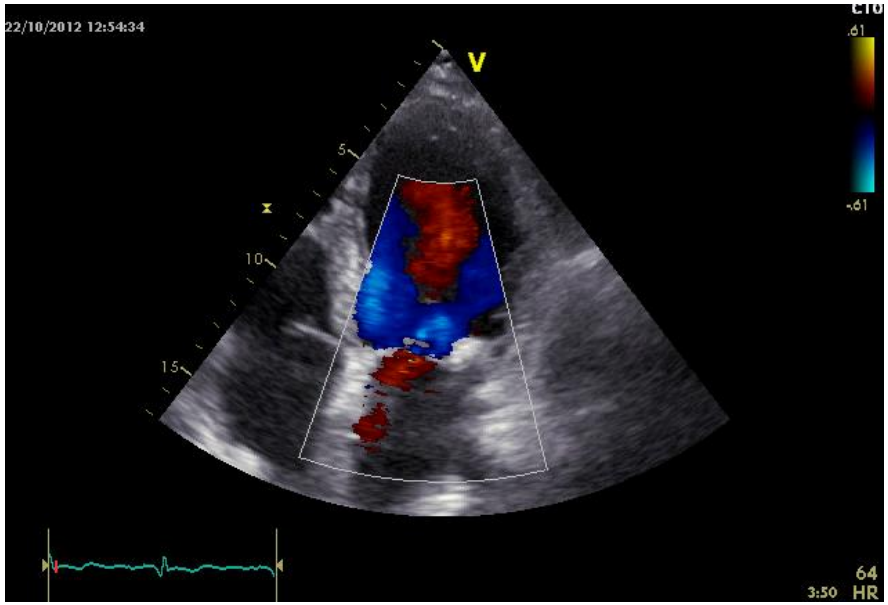
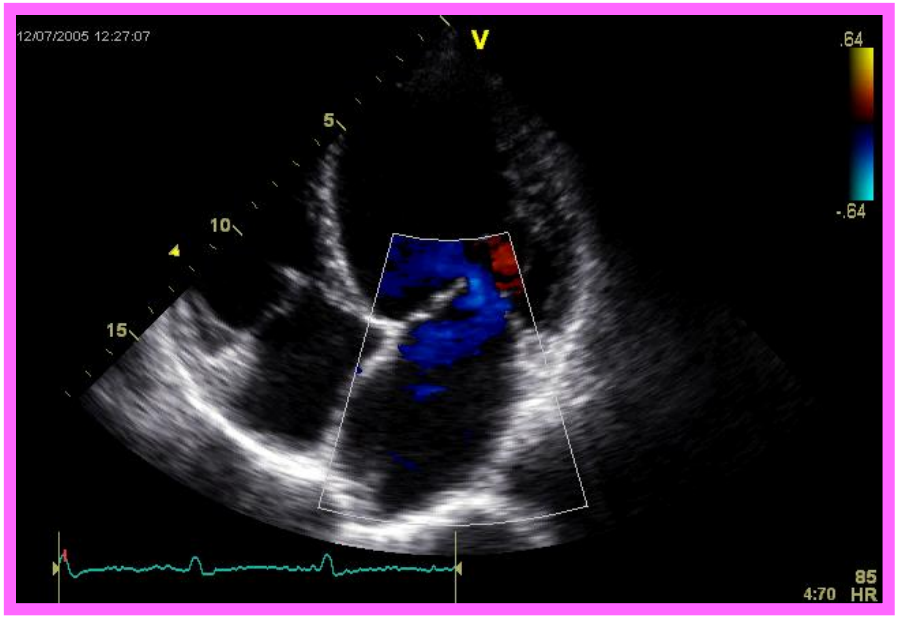


Grigioni F – Circulation 2001

Chronic mitral regurgitation

Organic MR (primary) type II	Functional MR (secondary) type IIIb
	

Chronic mitral regurgitation

Organic MR (primary) type II	Functional MR (secondary) type IIIb
	

Chronic mitral regurgitation

Organic MR (primary) type II	Functional MR (secondary) type IIIb
• Reg Vol > 60 ml • ERO > 40 mm²	• Reg Vol > 30 ml • ERO > 20 mm²

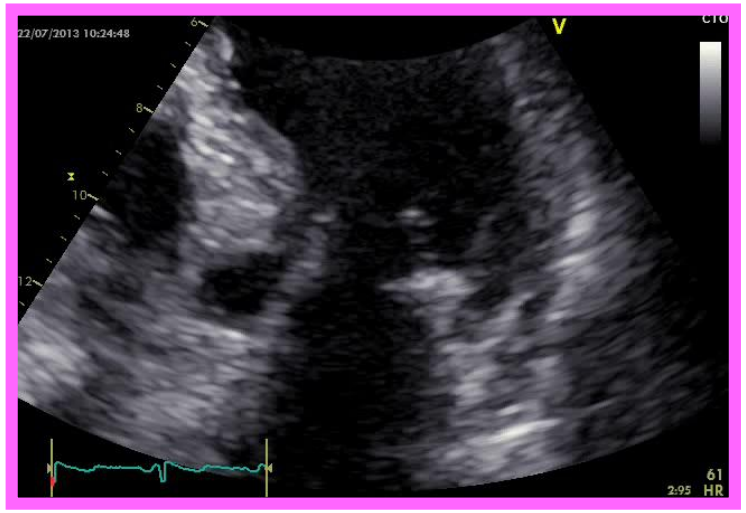
Assessment of Mitral Regurgitation

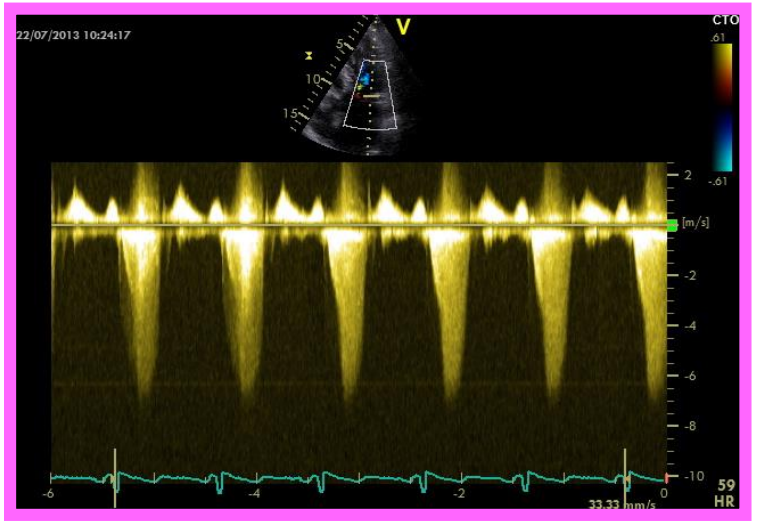
1. **Quantification**
2. ***Pitfalls***
3. **Solutions**

Pitfalls in MR quantification

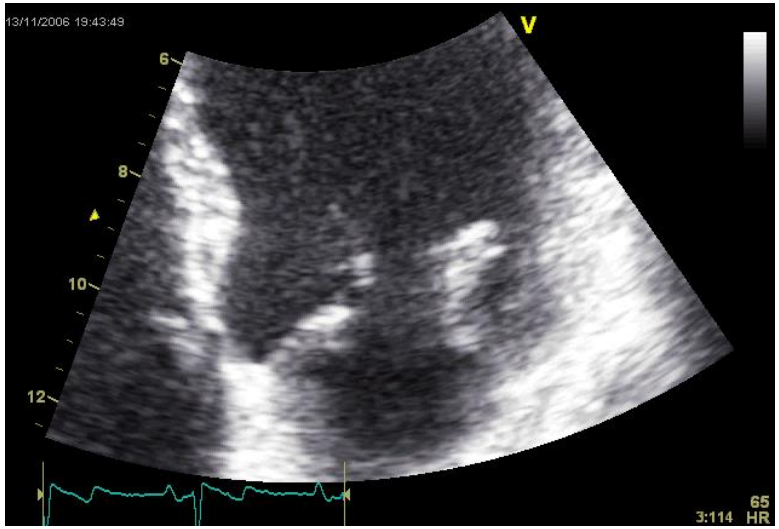
- non optimal CW doppler signal
- non optimal PISA
  - Flow convergence confinement
  - Non hemispheric PISA
  - Fusion with LVOT outflow in HCOM
- double / multiple jets
- variations of ERO
- non holosystolic MR
- transient / changing MR

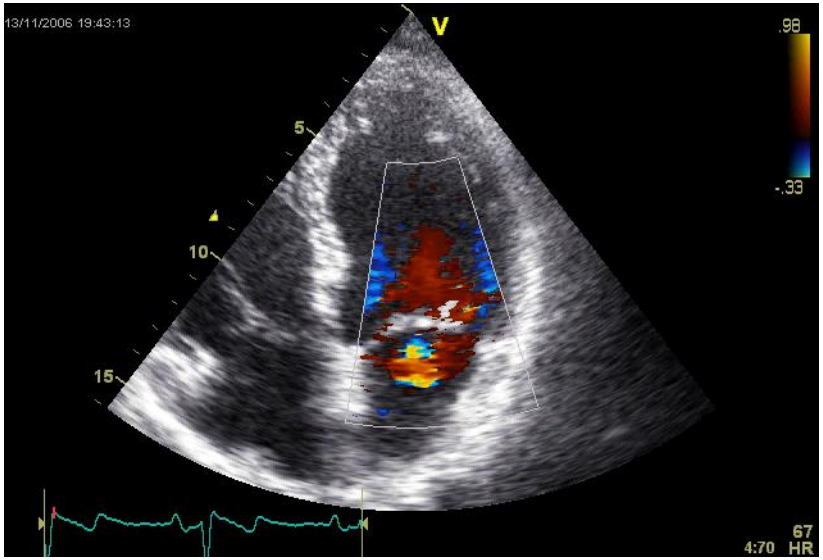
Fusion with LVOT outflow

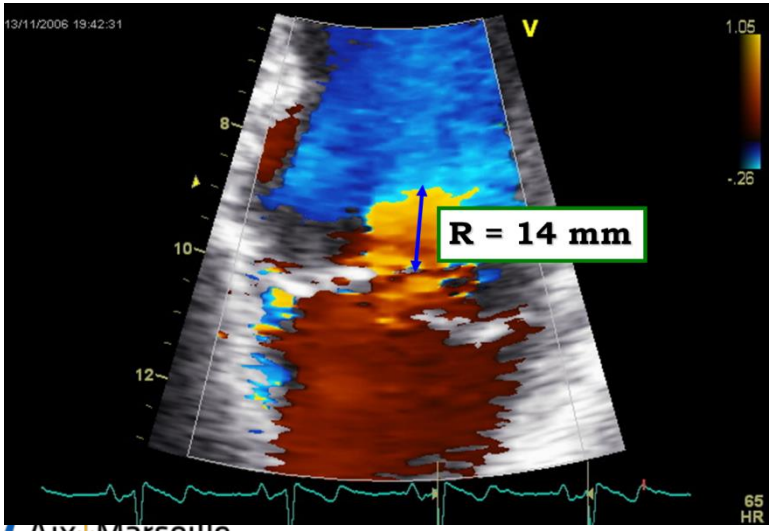


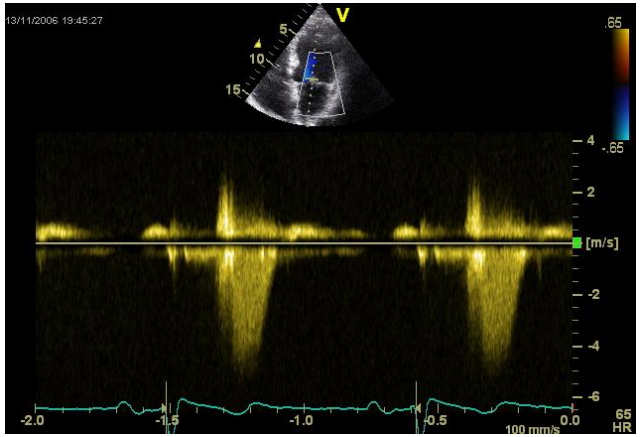


Non holosystolic MR

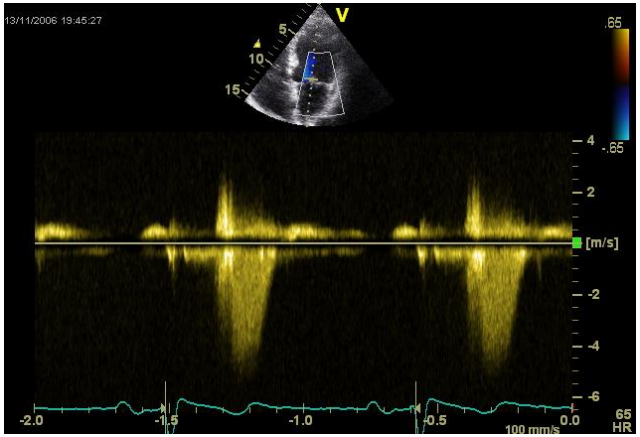


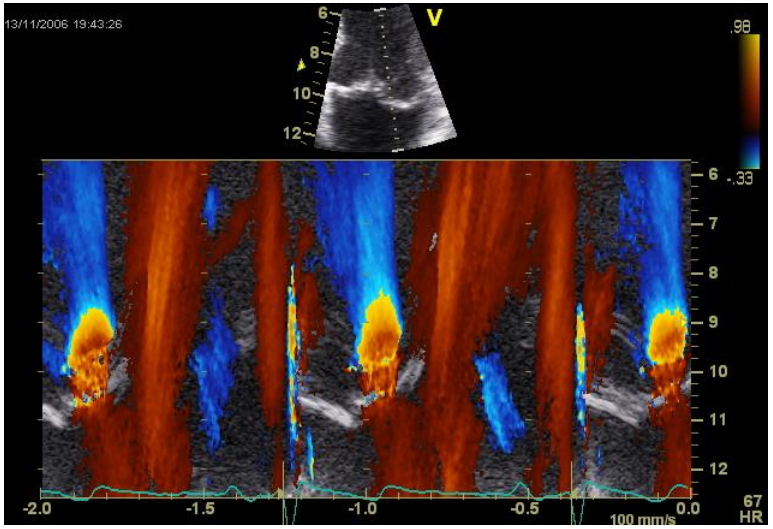






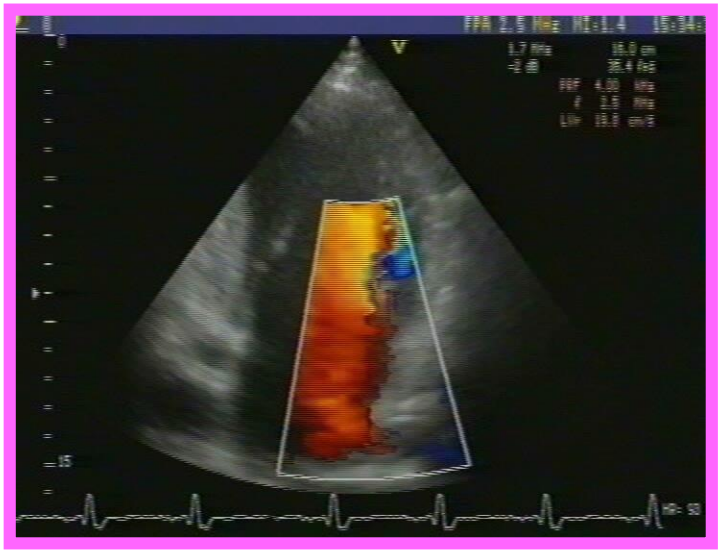
Non holosystolic MR

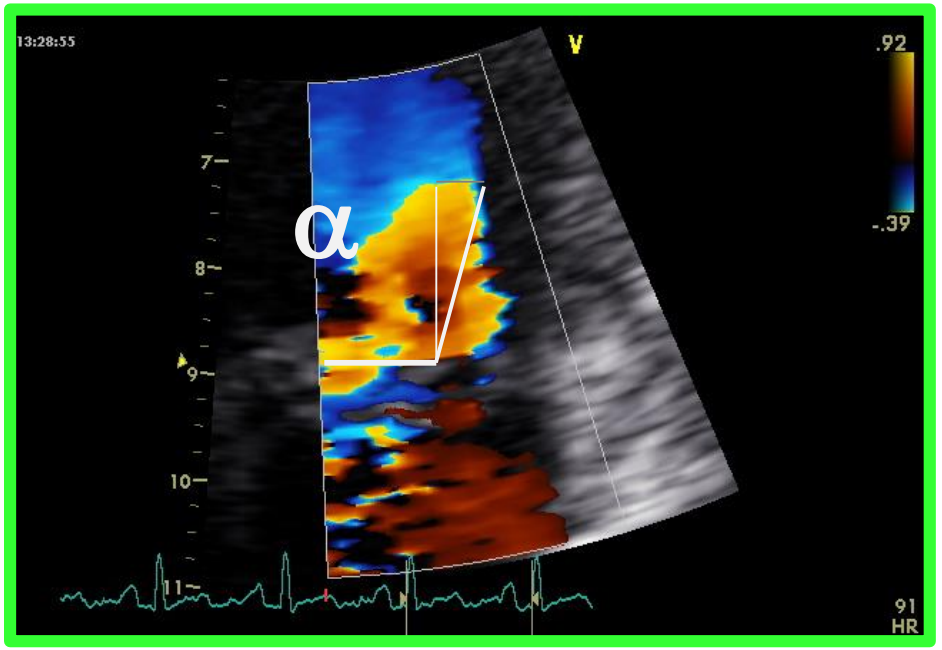




- Instantaneous ERO in mid-late-systole does not reflect severity of MR
- Use Regurgitant volume
- and careful TVI tracing
- or another quantitative method

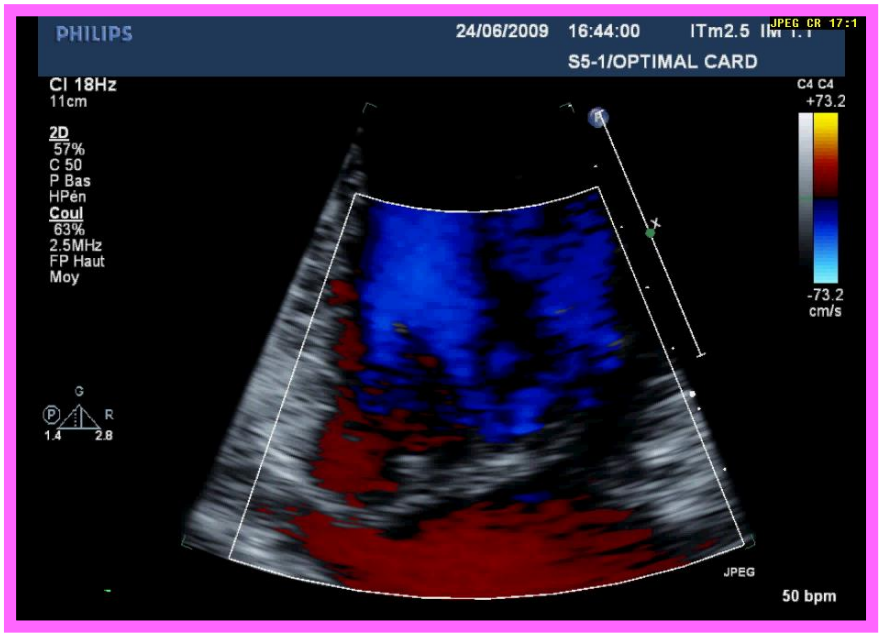
Flow convergence confinement





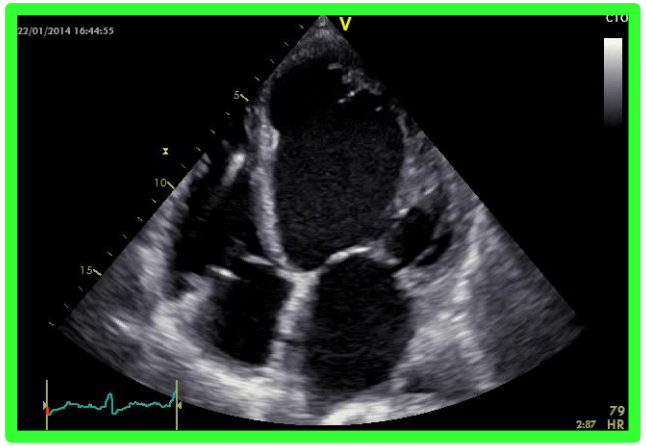
$$ERO = \frac{2\,\pi\,r^2\ X\ Va \quad x\ \alpha\ /\ 180}{Vmax}$$

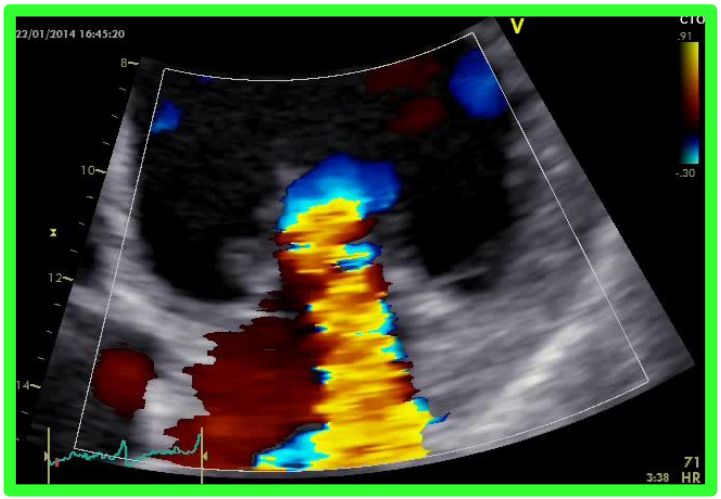
Multiple regurgitant jets

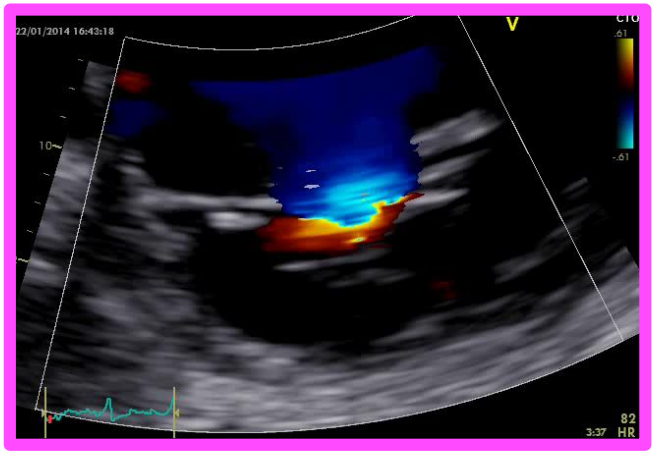


- If distant ERO and distinct CWD
- Then calculate each ERO and regurgitant volume separately
- Total Regurgitant Volume is the sum of both

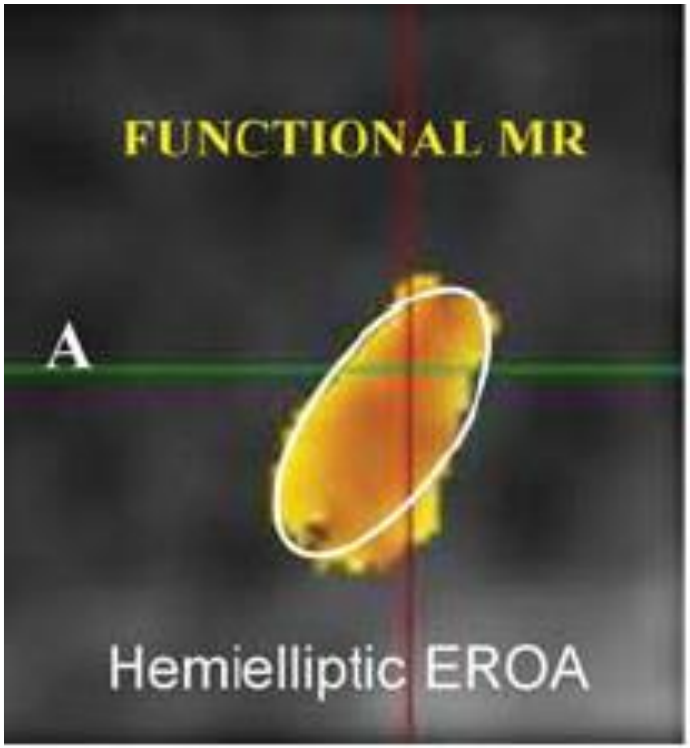
Functional MR

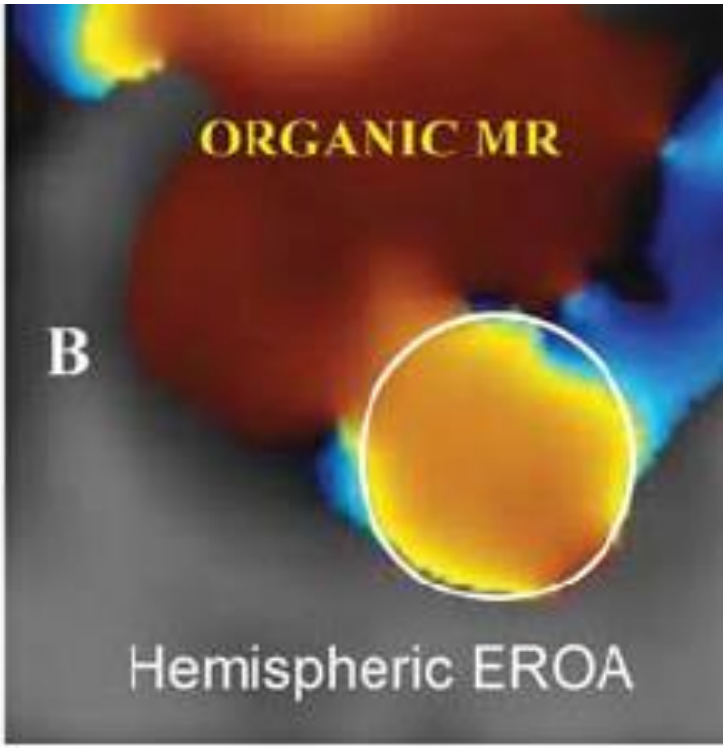






Hemielliptic ERO in functional MR

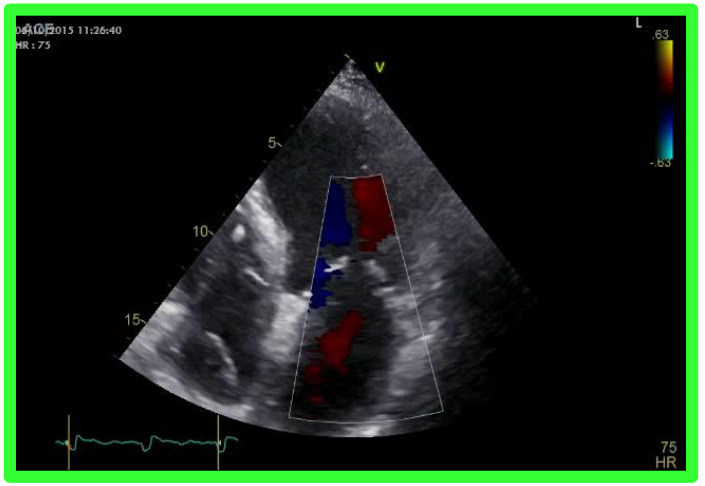




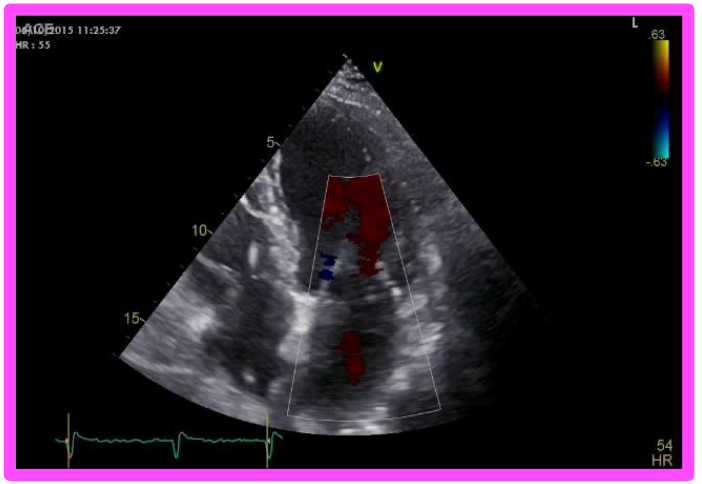
- PISA shape affected
  - by the aliasing velocity
  - in case of non-circular orifice
  - by systolic changes in regurgitant flow
  - by adjacent structures (flow constrainment)
- PISA is more a hemi-ellipse
- Errors in PISA radius measurement are squared
- Inter-observer variability
- Not valid for multiple jets

Changes in ERO with stimulation

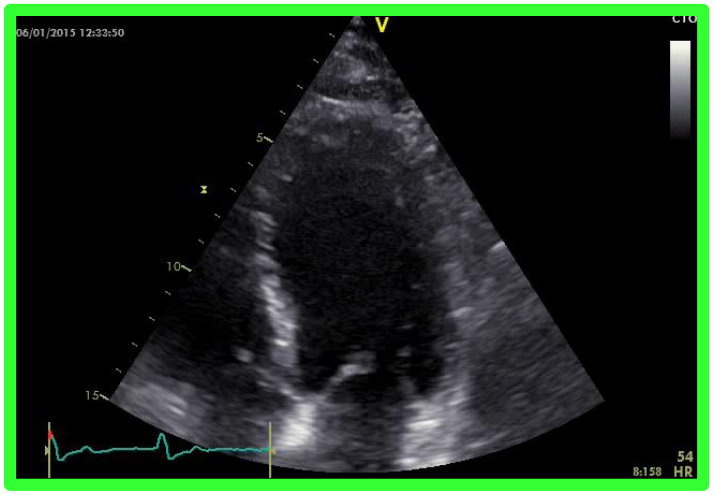
RV stimulation
HR = 75 bpm



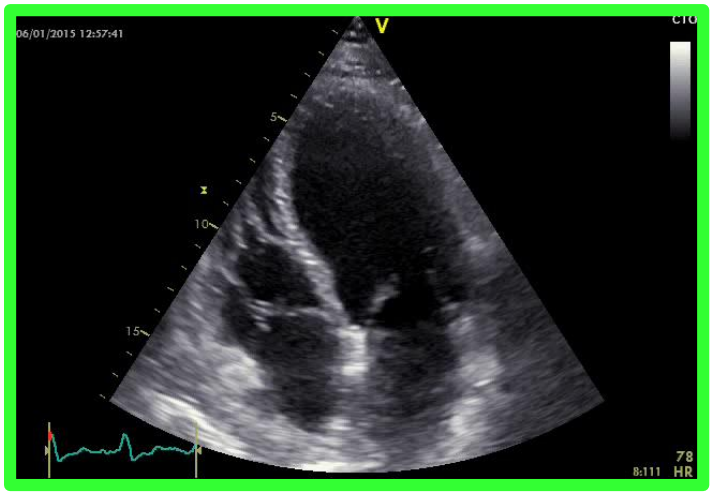
Pacemaker off
HR = 55 bpm



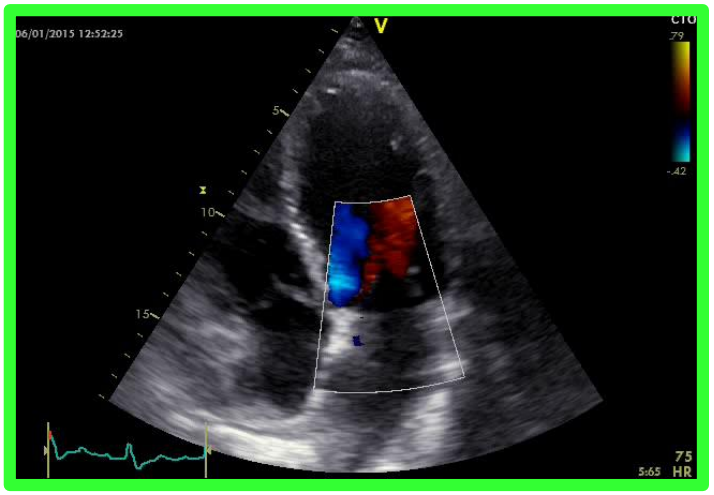
Spontaneous changes in ERO



12:33 a.m.



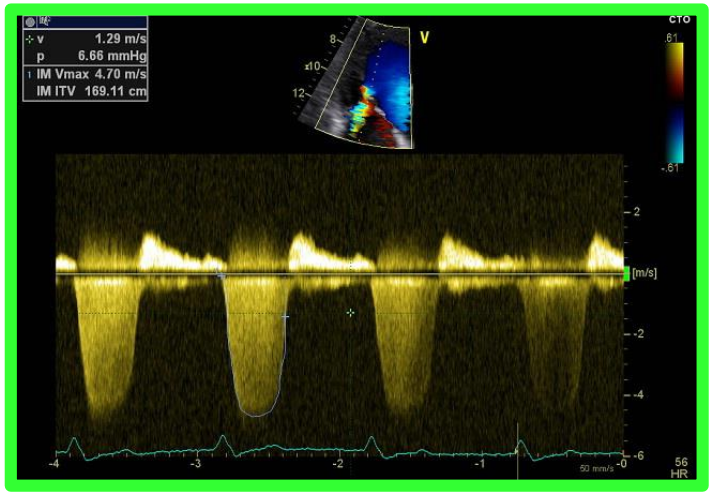
12:50 a.m.

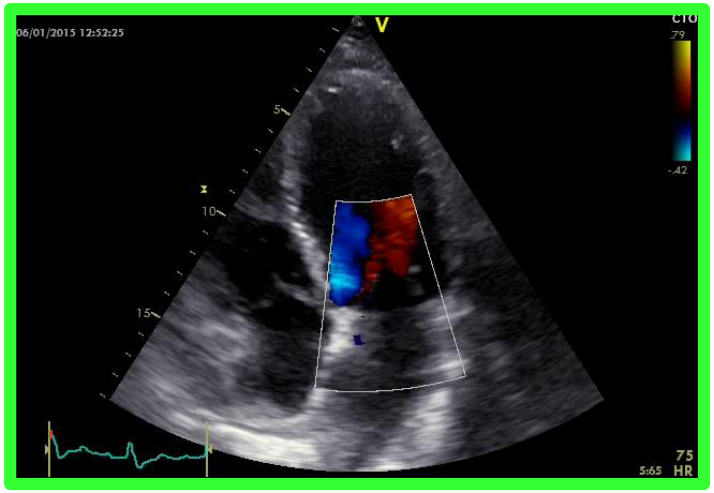


Eclipsed MR

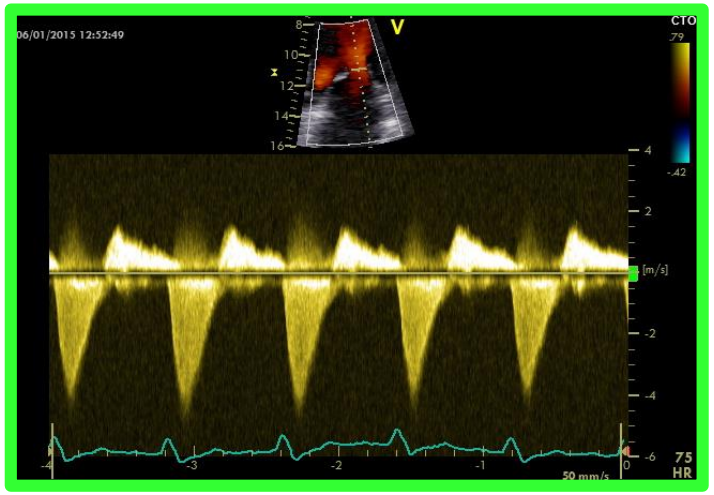
Avierinos JF - Cardiology 2008;110:29–34

12:33 a.m.
HR = 55 bpm





12:50 a.m.
HR = 75 bpm



Aix*Marseille université

FACULTÉ DE MÉDECINE DE MARSEILLE

Assessment of Mitral Regurgitation

1. **Quantification**

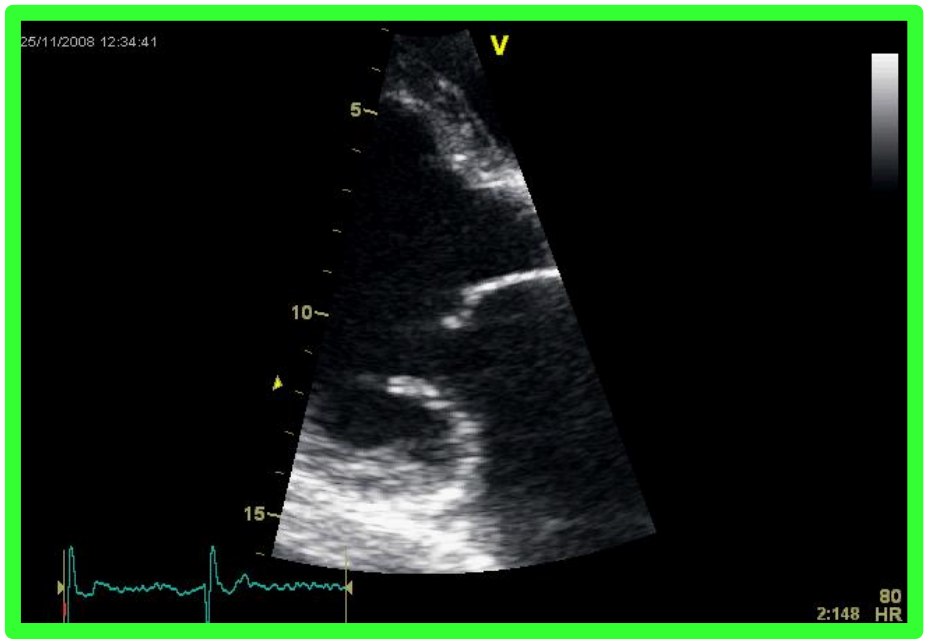
2. **Pitfalls**

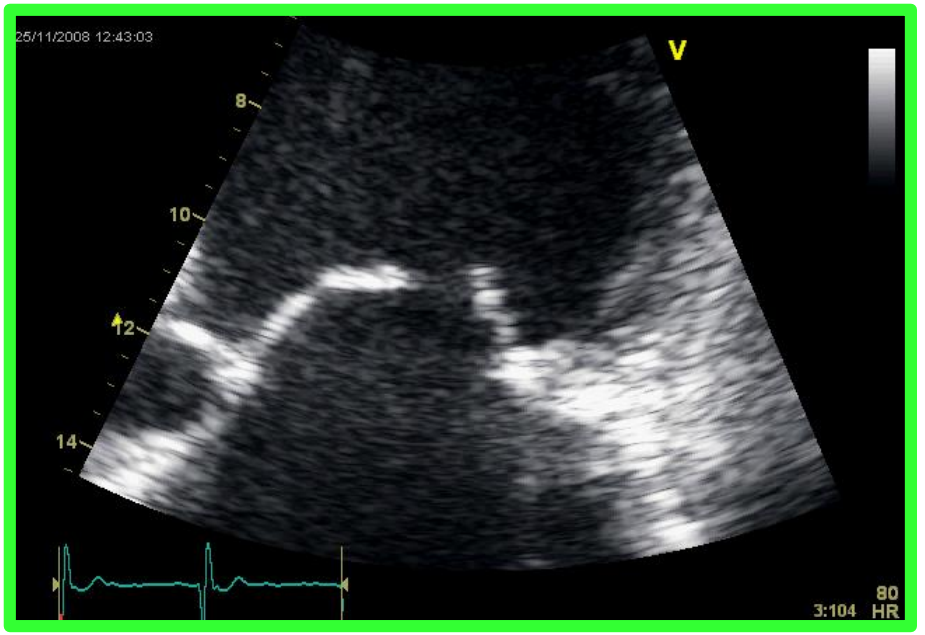
3. ***Solutions***

Solutions

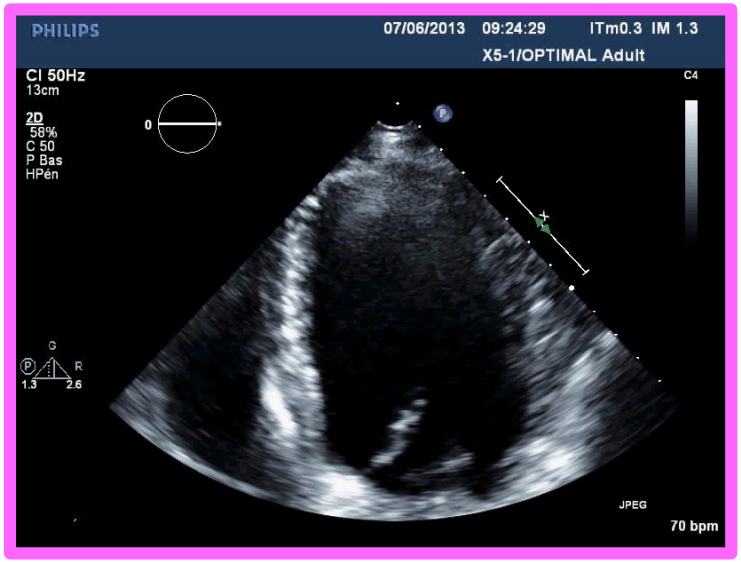
- qualitative tricks
  - 2D visible diastasis
  - Spontaneous flow convergence
  - Dense CW doppler signal
  - LV volumes
- vena contracta width
- quantitative 2D echocardiography
- TOE
- 3D echocardiography
  - Proximal isovelocity surface area
  - Vena contracta area
  - Anatomical regurgitant orifice area
  - Volumetric method/Stroke volume

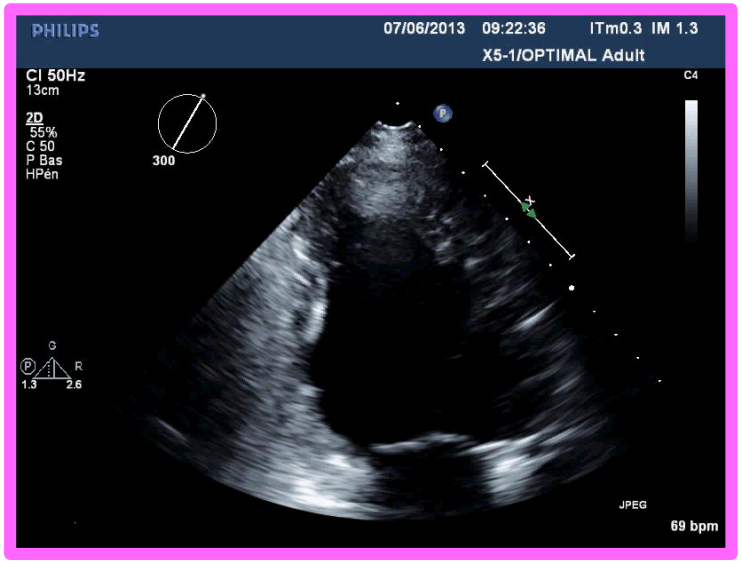
Solution 1: look at the valve

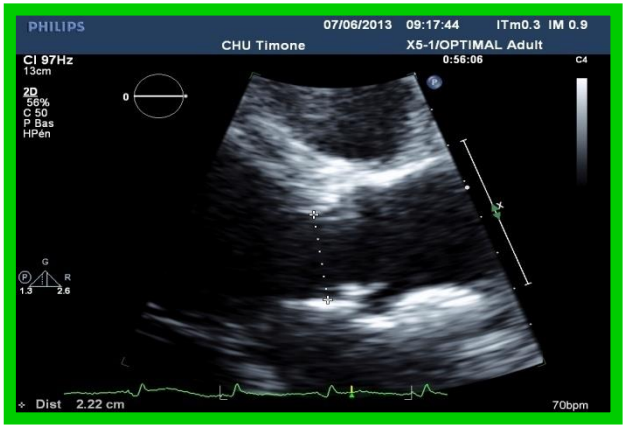


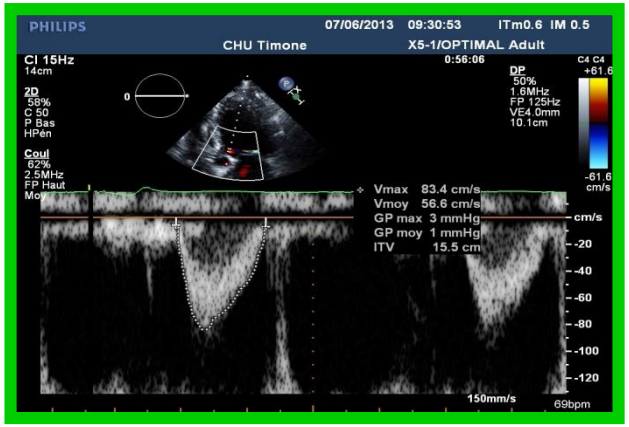


Solution 2: use quantitative echo









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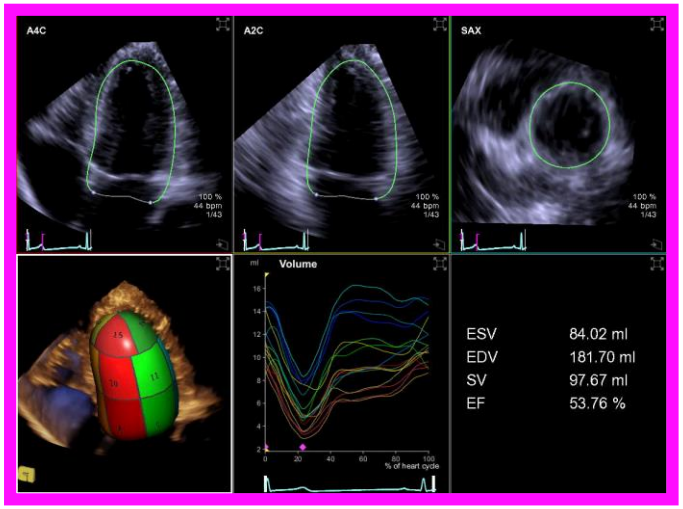
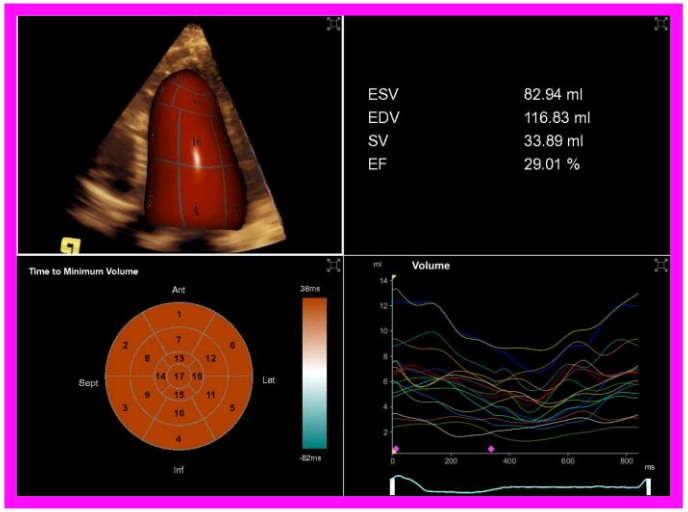
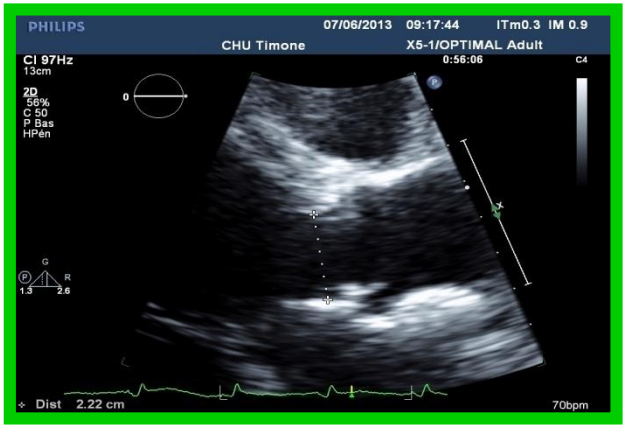
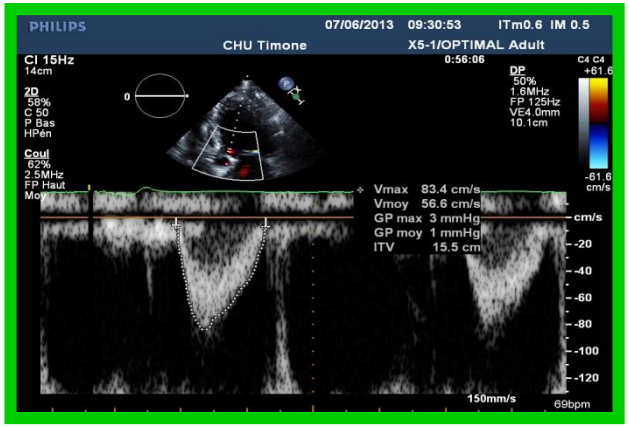
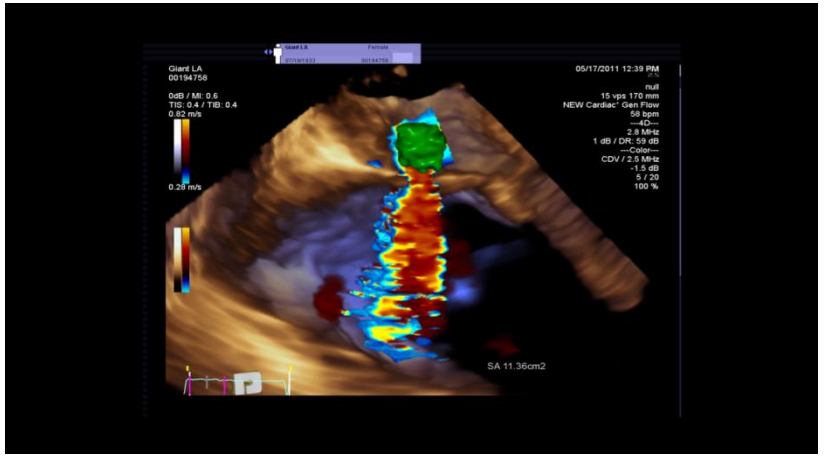


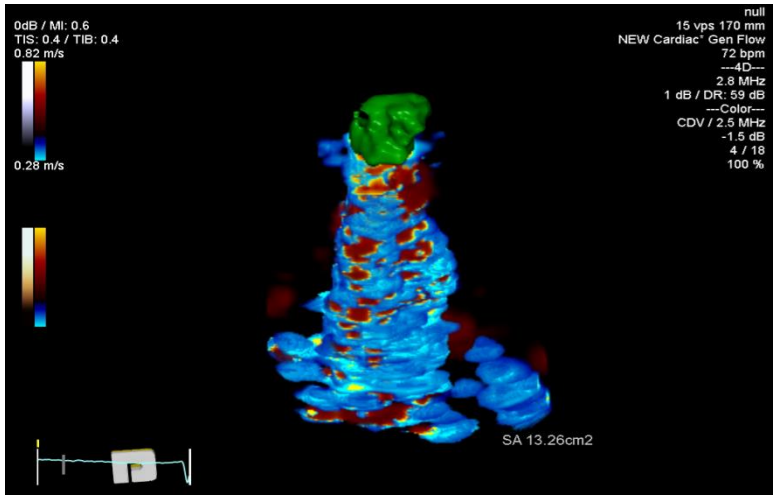




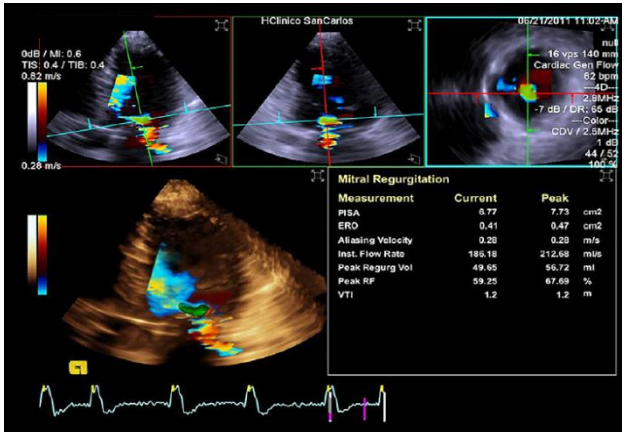


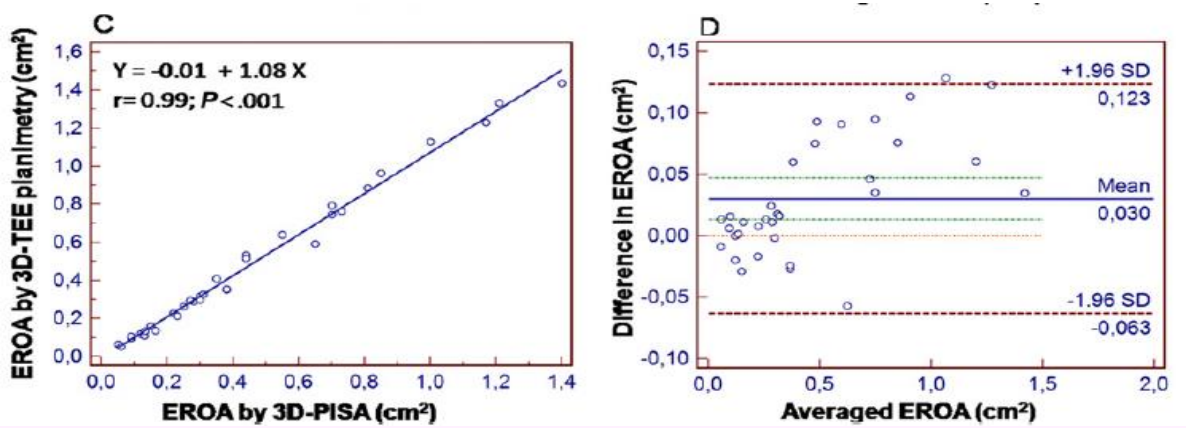
Solution 3: use 3D echo



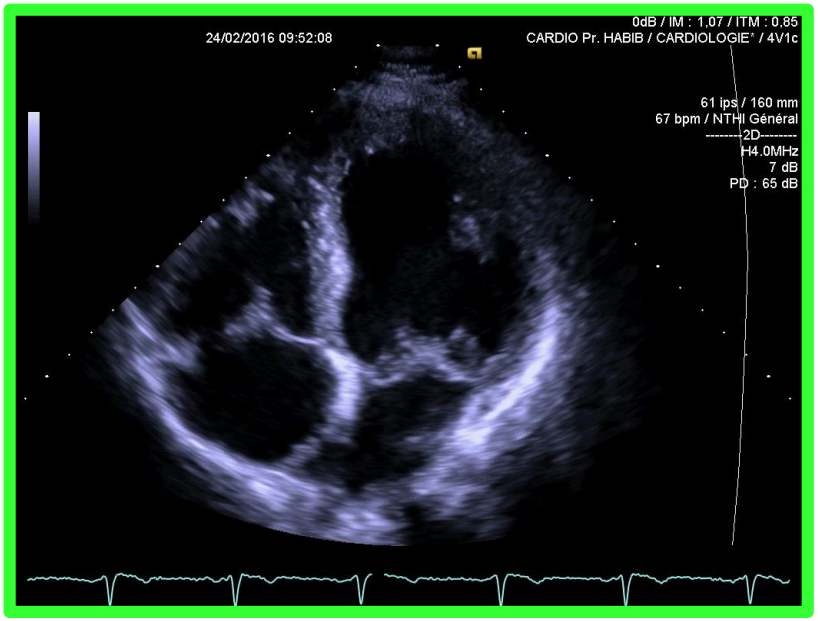


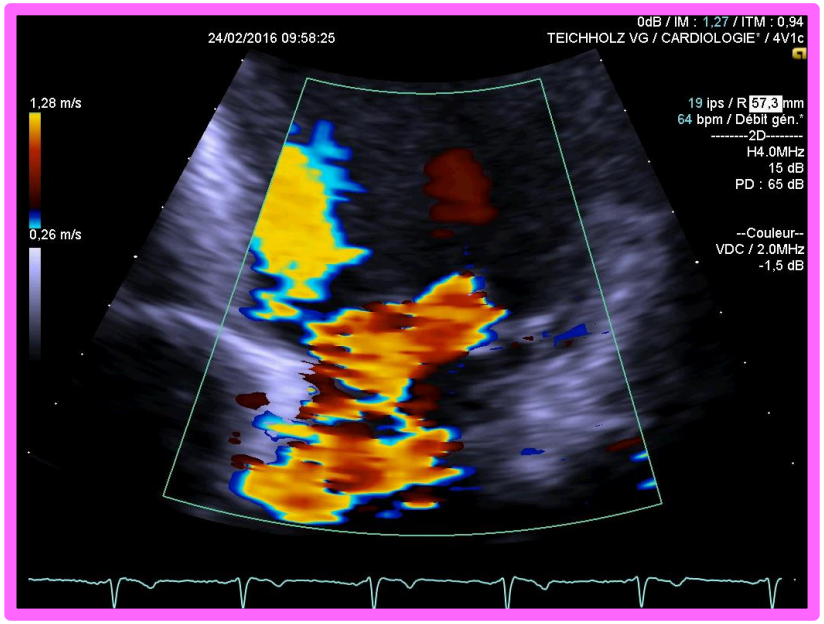
De Agustin et al, JASE, 2012





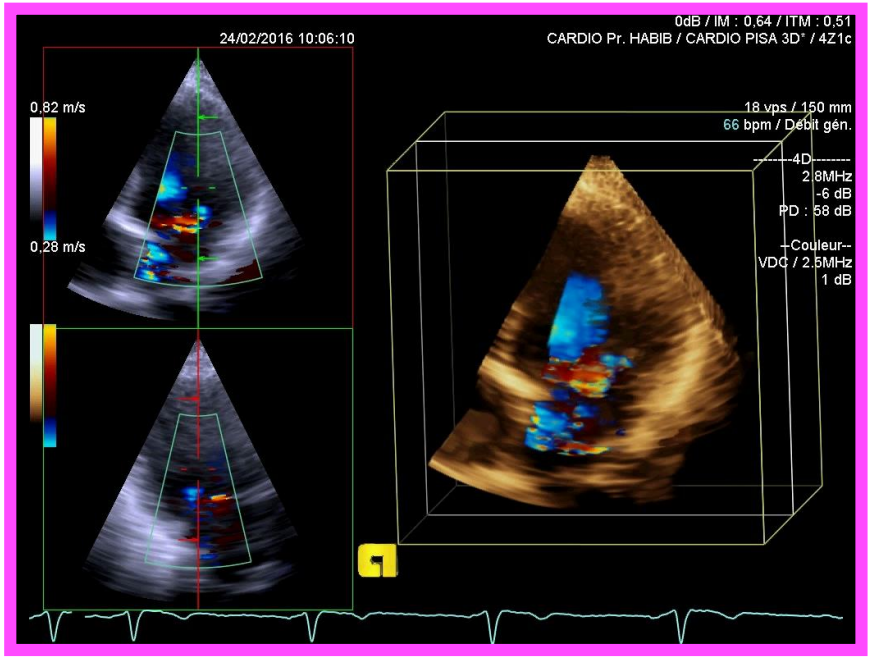
Solution 3: 3D echo – organic MR

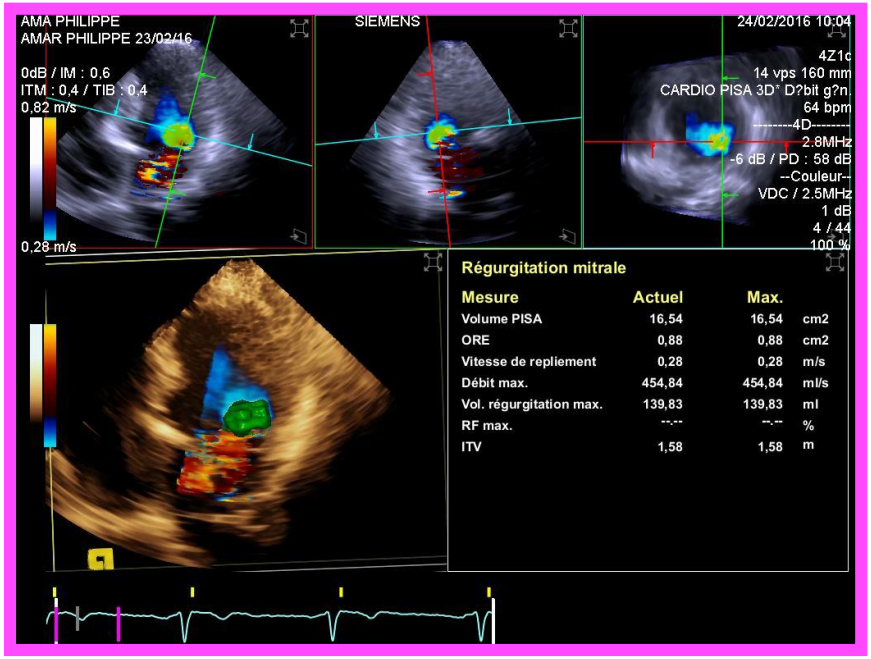




- **mitral ERO = 45 mm²**
- **regurgitant volume = 70 ml**

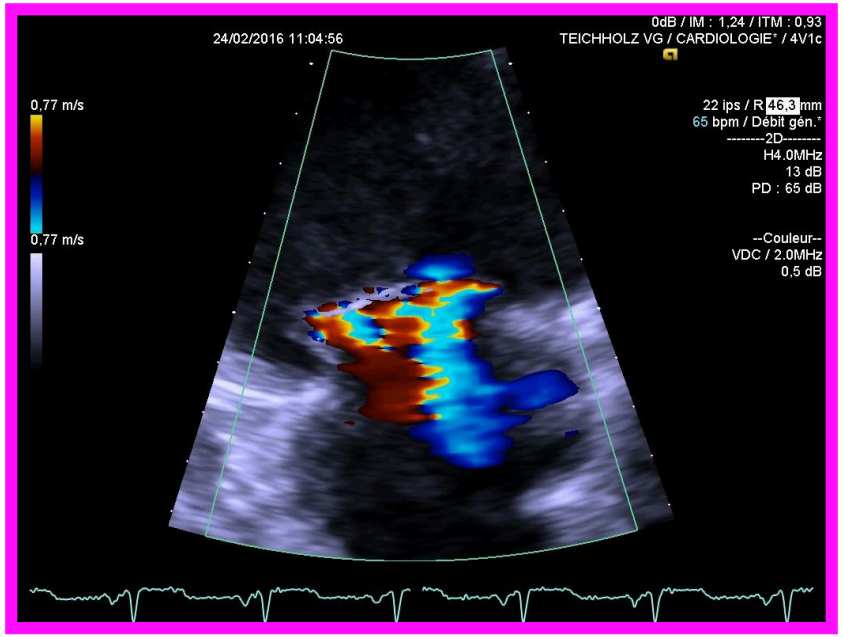
Solution 3: 3D echo – organic MR

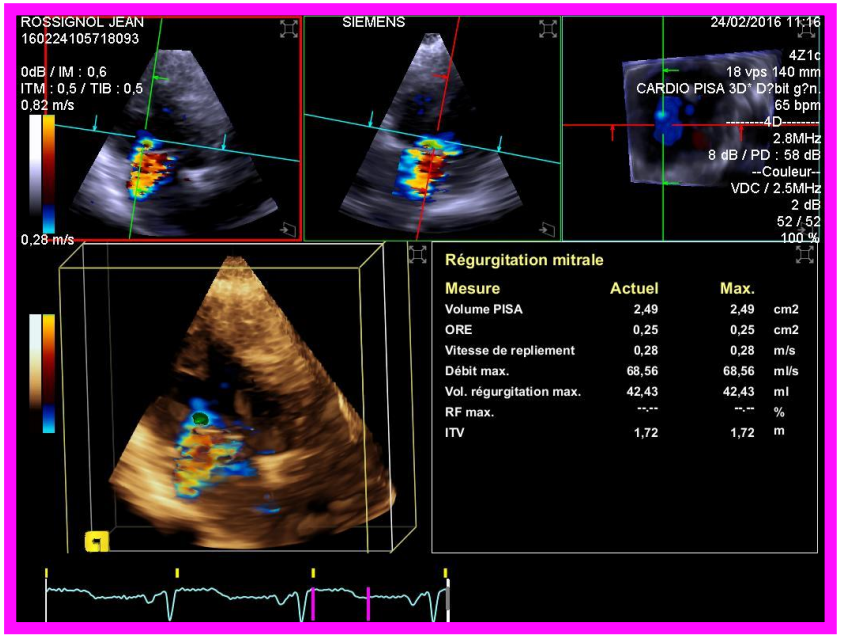




- **mitral ERO = 88 mm²**
- **regurgitant volume = 140 ml**

Solution 3: use 3D:functional MR





- mitral ERO = ?
- regurgitant volume = ?

- mitral ERO = 25 mm^2
- regurgitant volume = 42 ml

Quantification of MR

1. Integrative approach critical for assessing MR severity

2. Using all pertinent 2D criteria, both qualitative (anatomy, CWD) and quantitative

3. PISA should be compared to other quantitative method when non optimal shape, multiple jets, non constant ERO or non-holosystolic MR

4. Contribution of 3D echo (3D FC, Vena C Area and 3D volumes)