“L’analisi della mitrale con insufficienza organica: valutazione del grado di IM , descrizione del meccanismo di insufficienza, dimensioni dell’anulus , dei lembi, lunghezza delle corde “

L’ecocardiogramma è fondamentale per il CCh che deve riparare la valvola

Maurizio Tusa

Laboratorio di Ecocardiografia

Istituto Clinico S. Ambrogio Milano

Ecocardiochirurgia , Milano 5-7 maggio 2014

Eziologia insufficienza mitralica

Funzionale (secondaria): valvola integra, insuff. relata a dilatazione regionale/globale vs

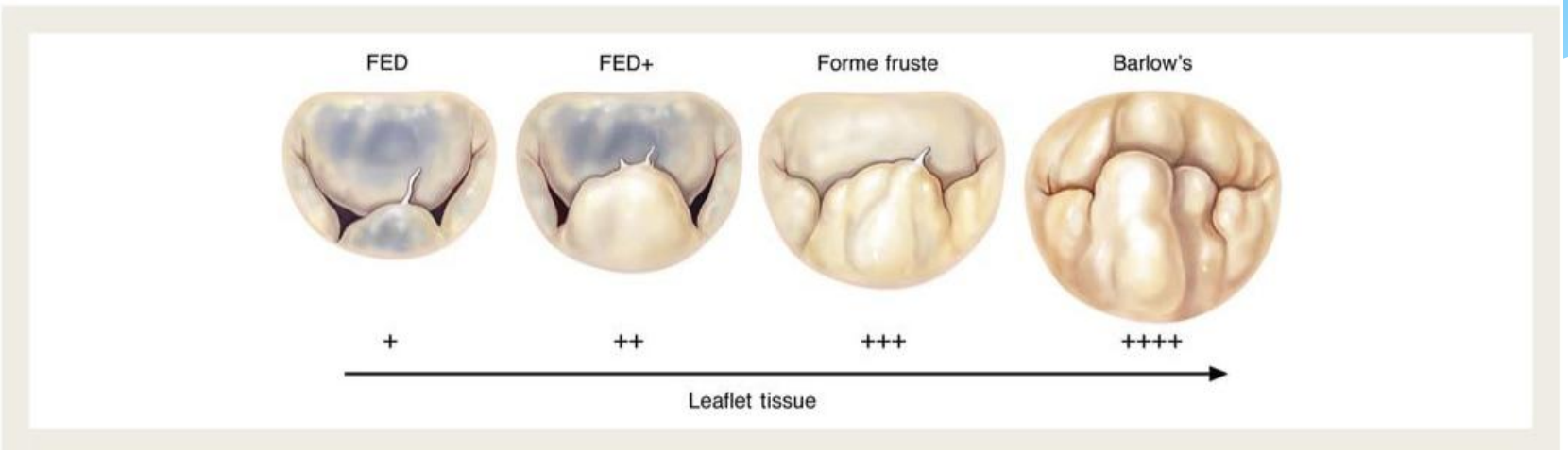
Organica (primaria) : intrinseca malattia apparato mitralico

- Malattie degenerative (Barlow, degenerazione fibroelastica, Marfan, calcificazione anello)

- Malattia reumatica
- Endocardite
- Rottura muscolo papillare post ima

Malattia degenerativa (60-70%)

Adams eur heart j 2010



	FED	BD
Annulus	Normal or near normal valve size (annulus <32 mm)	Severely dilated annulus
Leaflets	Thin transparent w/o excess tissue	Thick w/ excess tissue
	Single segment involvement	Multisegmental involvement
	Involved segment is thick and distended	
Chords	Elongated in the affected segment, w/ or w/o rupture	Thickened, calcified, elongated, restricted w/ or w/o rupture
Billowing characteristics	No billowing of the adjacent segments	Multisegmental billowing

Glower Jacc 2012

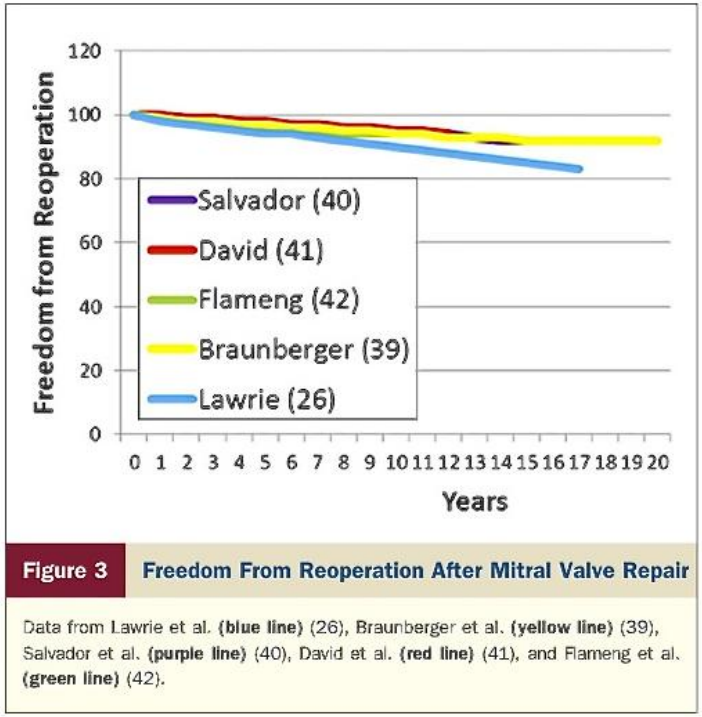


Figure 3 **Freedom From Reoperation After Mitral Valve Repair**

Data from Lawrie et al. **(blue line)** (26), Braunberger et al. **(yellow line)** (39), Salvador et al. **(purple line)** (40), David et al. **(red line)** (41), and Flameng et al. **(green line)** (42).

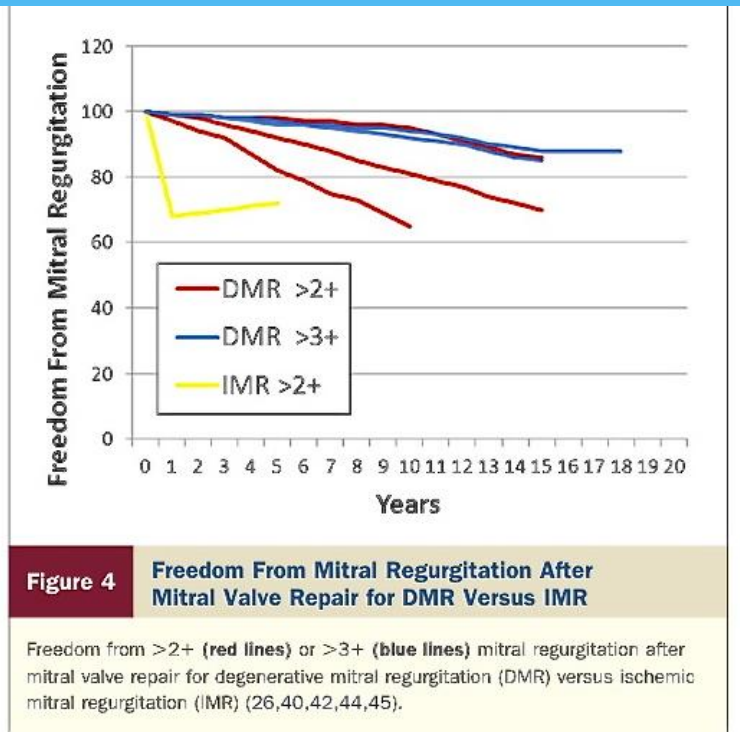


Figure 4 **Freedom From Mitral Regurgitation After Mitral Valve Repair for DMR Versus IMR**

Freedom from >2+ **(red lines)** or >3+ **(blue lines)** mitral regurgitation after mitral valve repair for degenerative mitral regurgitation (DMR) versus ischemic mitral regurgitation (IMR) (26,40,42,44,45).

F.U. 10 y valvole mixomatose :
im almeno moderata 15-30%
im severa nel 5-10%

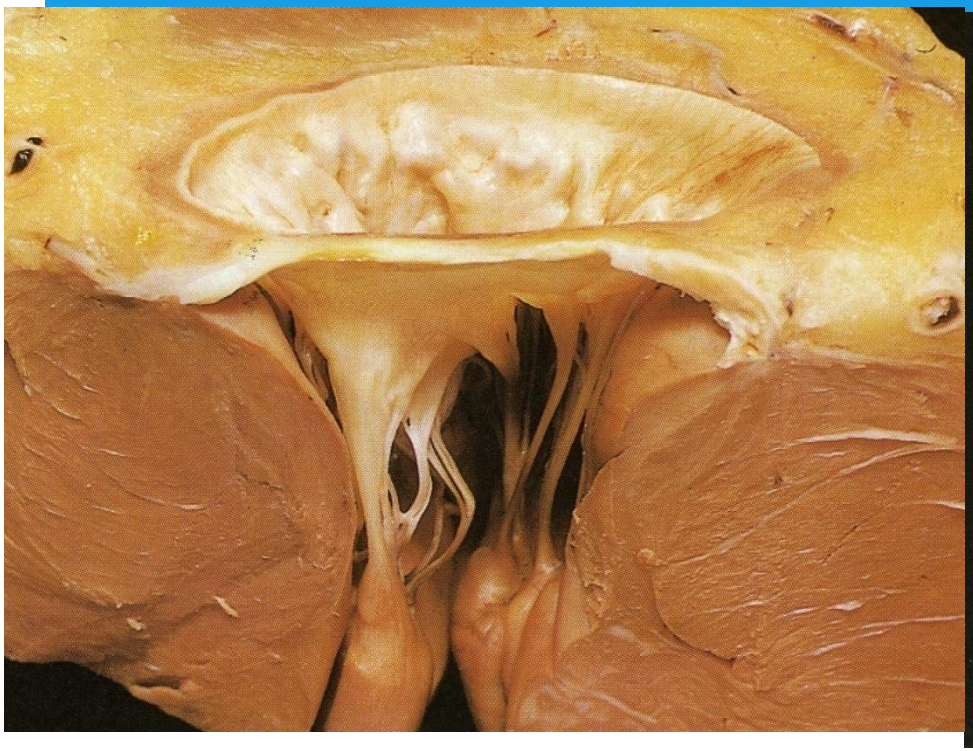
F.U. 5 y im funzionale
IM moderata severa nel 20-30%

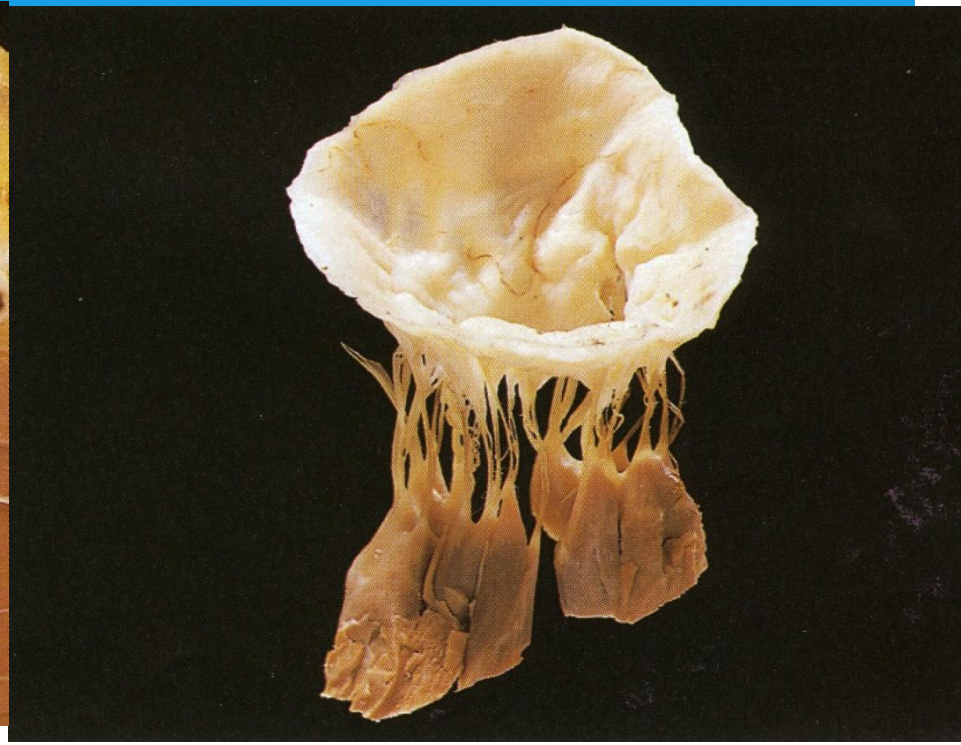
European journal of echocardiography 2010

Mitral valve analysis: recommendations

(1) TTE is recommended as the first-line imaging modality for mitral valve analysis.
(2) TEE is advocated when TTE is of non-diagnostic value or when further diagnostic refinement is required.
(3) 3D-TEE or TTE is reasonable to provide additional information in patients with complex mitral valve lesion.
(4) TEE is not indicated in patients with a good-quality TTE except in the operating room when a mitral valve surgery is performed.

- Anatomia delle varie componenti apparato mitralico
- Gravità insufficienza mitralica
- Meccanismo del rigurgito
- Altre valvulopatia associate
- ventricolo sx , atrio sx

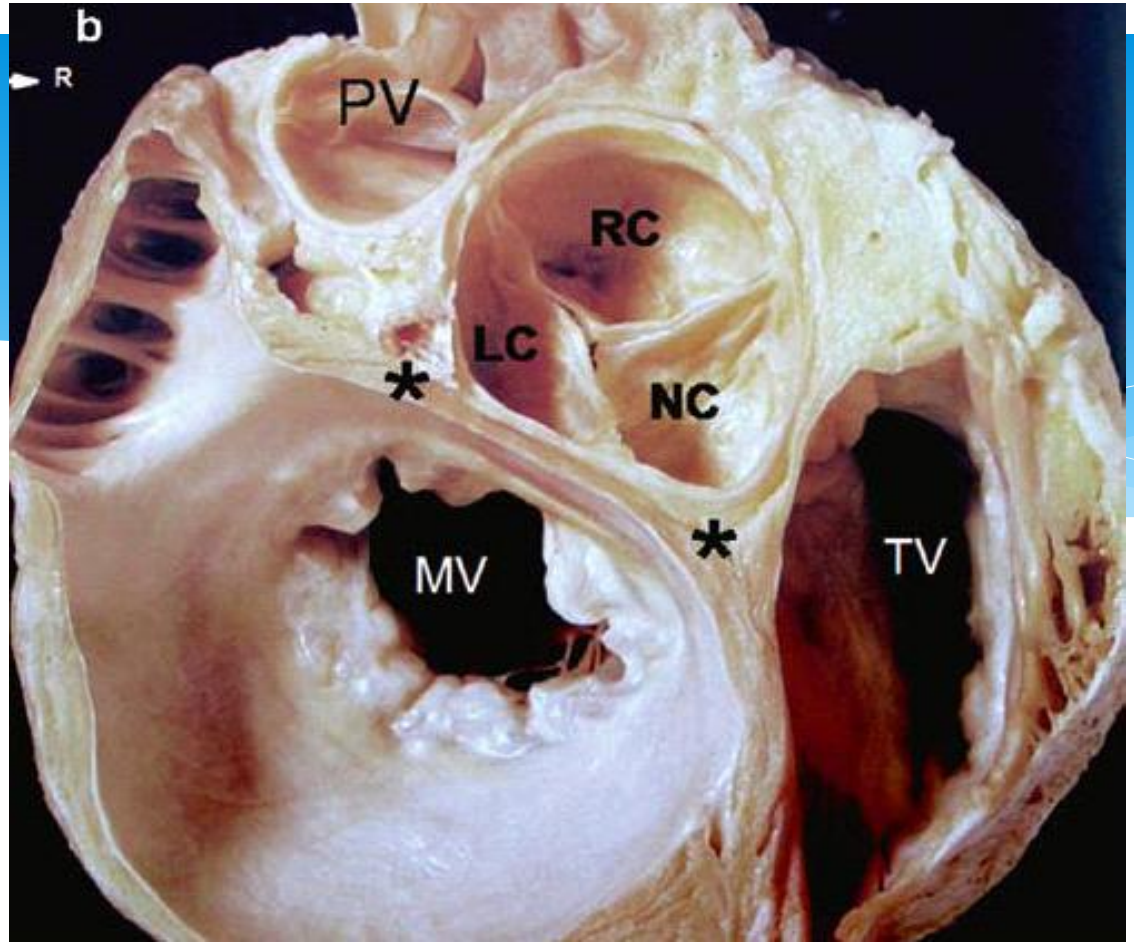




I° ordine: marginali – commissurali

2 ° ordine: strut chordae , particolare disposizione sul lma

3° ordine: solo sul LMP per ridure la mobilità

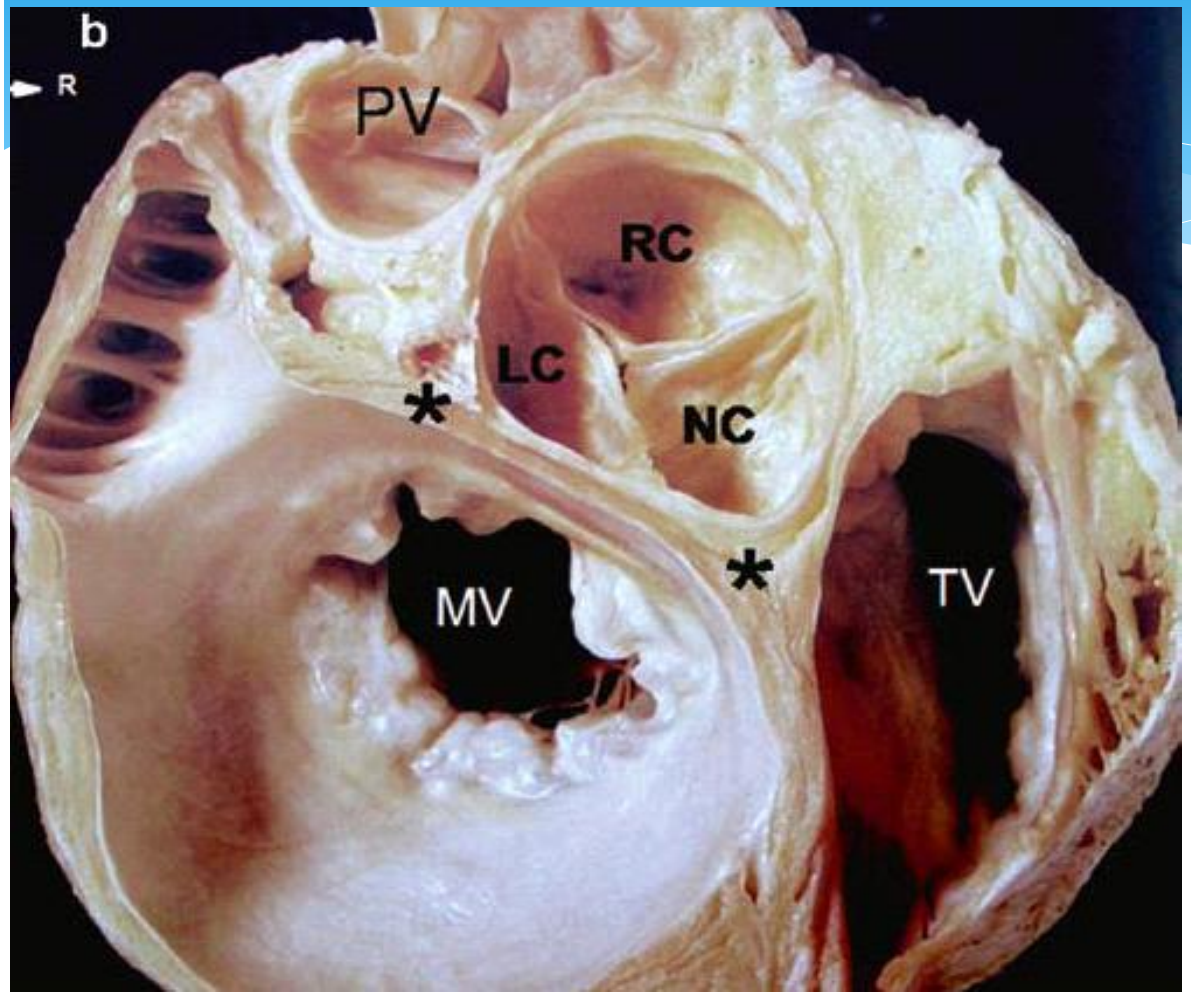


LMA. 1/3 anulus; 3 cm, H 1.5-2.5 cm , ruolo pars rugosa /liscia

LMP: 2/3, 5 cm, h 1 cm, area = ant, , rapporto pars rugosa liscia 4:1

- Estesa superficie coaptazione
- Meccanismo a volta
- Riserva valvolare

Anulus, Giunzione mitro-aortica, Trigoni

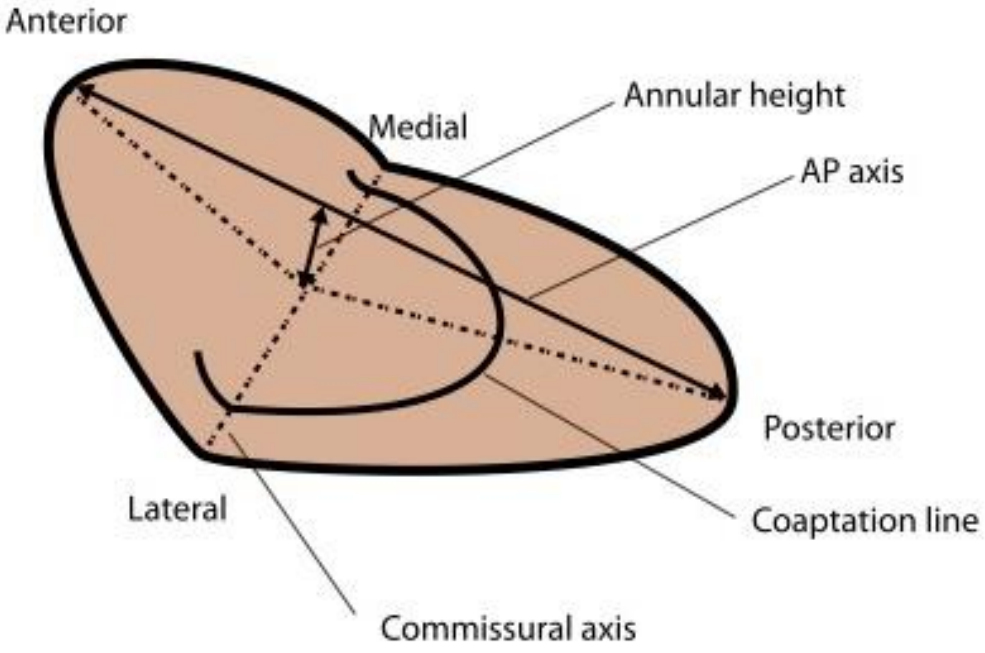


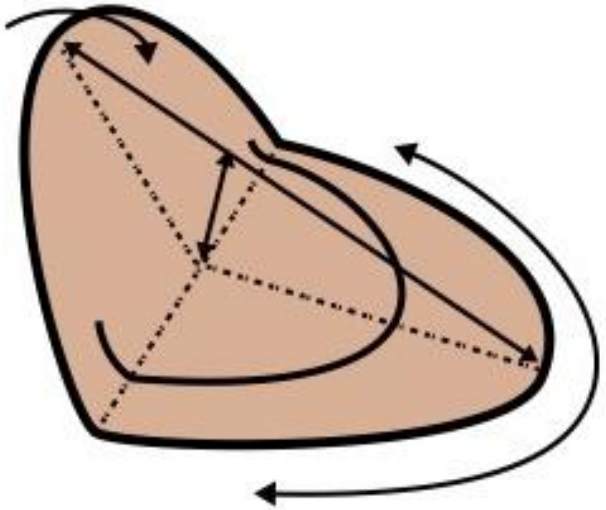
- Azione sfinterica(A-P)
- Invariato diametro C-C
- Struttura a sella

- Riduzione area
- invariata circonferenza

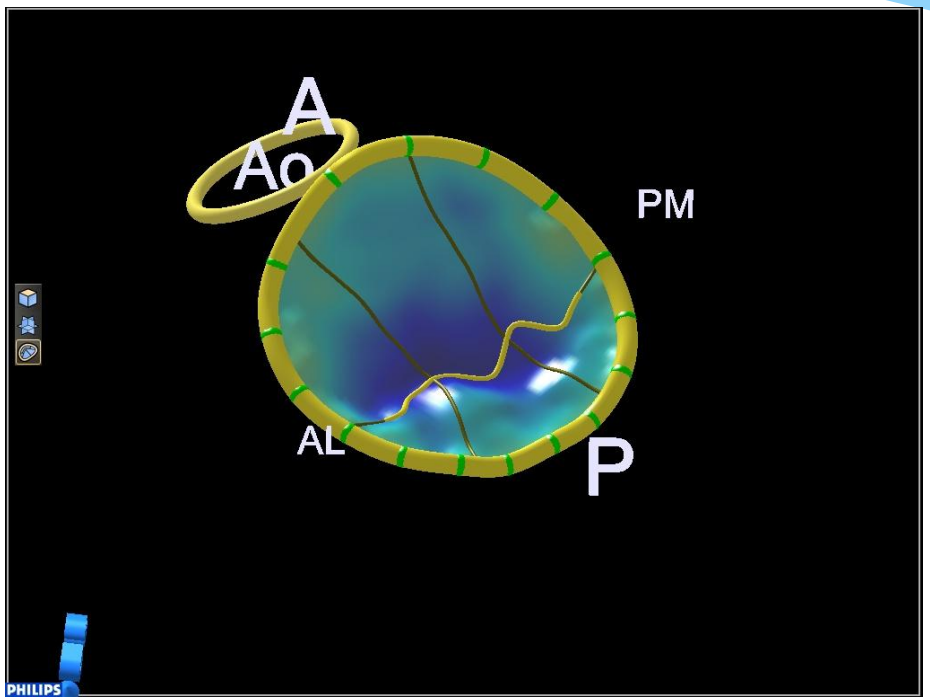
End-diastole

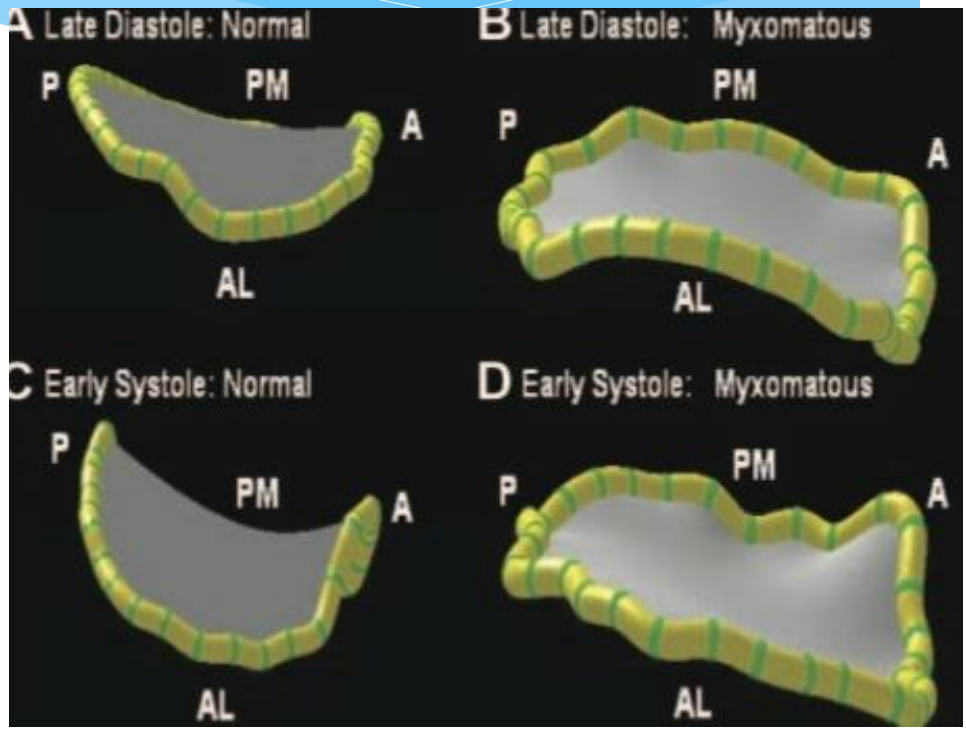
Mid-systole





Real time 3D full volume transesophageal echocardiography (RT3DE)

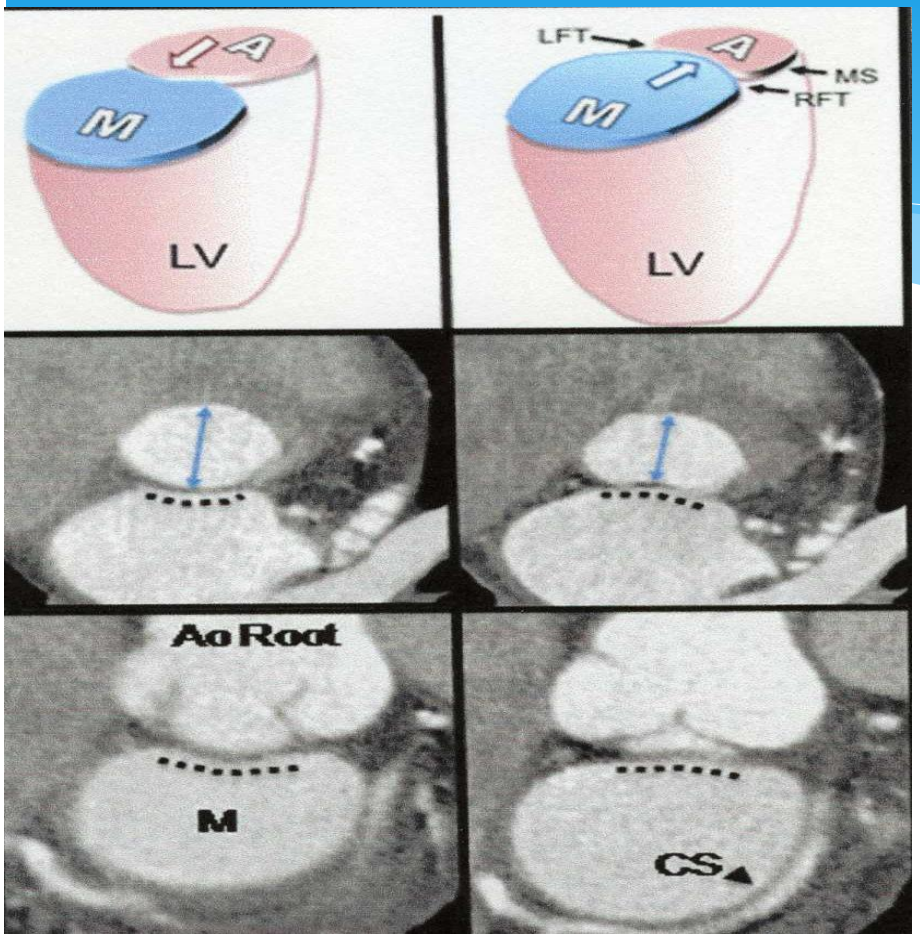




H sella : v.n. 7-10 mm Circonferenza anulus: v.n. 6-10 cm

Area media : v.n. 7 cm2

Functional anatomy of the ao annulus: valvular interdependence



Schwammenthalacc 1/2012

systolic ← diastolic

Increase ant post diameter

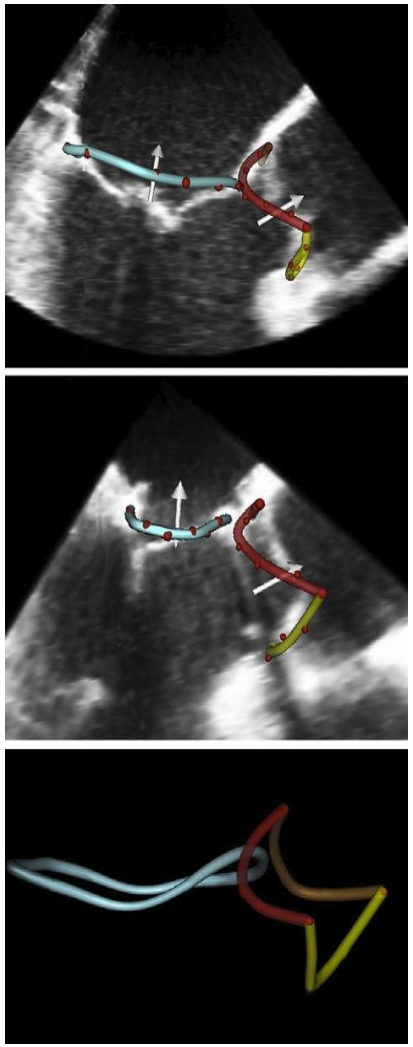
Mediolaterally diameter remains constant

Cyclic conformational changes of anulus : variation in the degree of its ellipticity,area,diameters

Mechanical propriety of the annulus allow only minimal stretch ,particularly in calcified valves

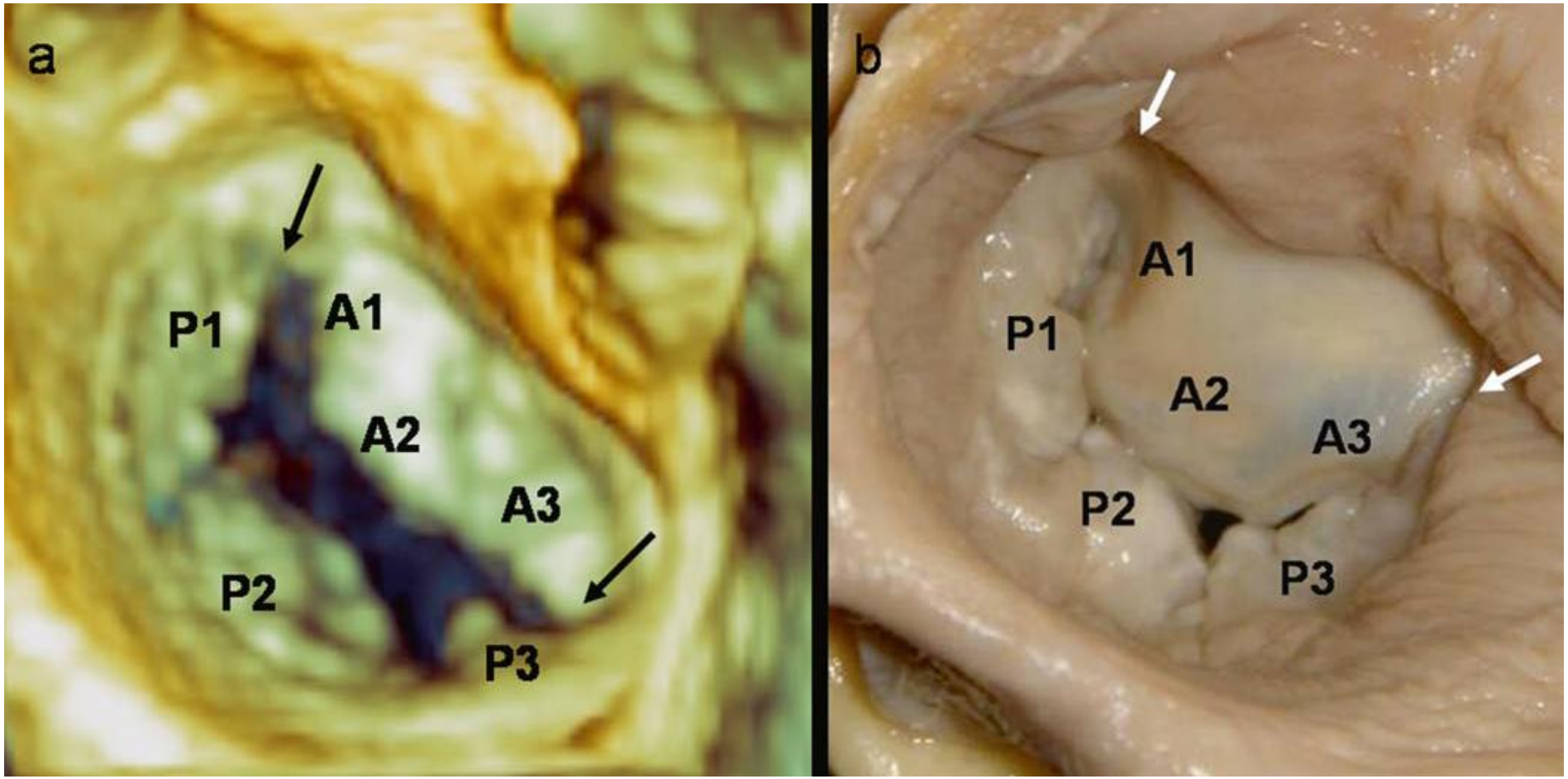
Effect of mitral valve repair on mitral-aortic coupling: a real time three-dimensional transesophageal echocardiography study

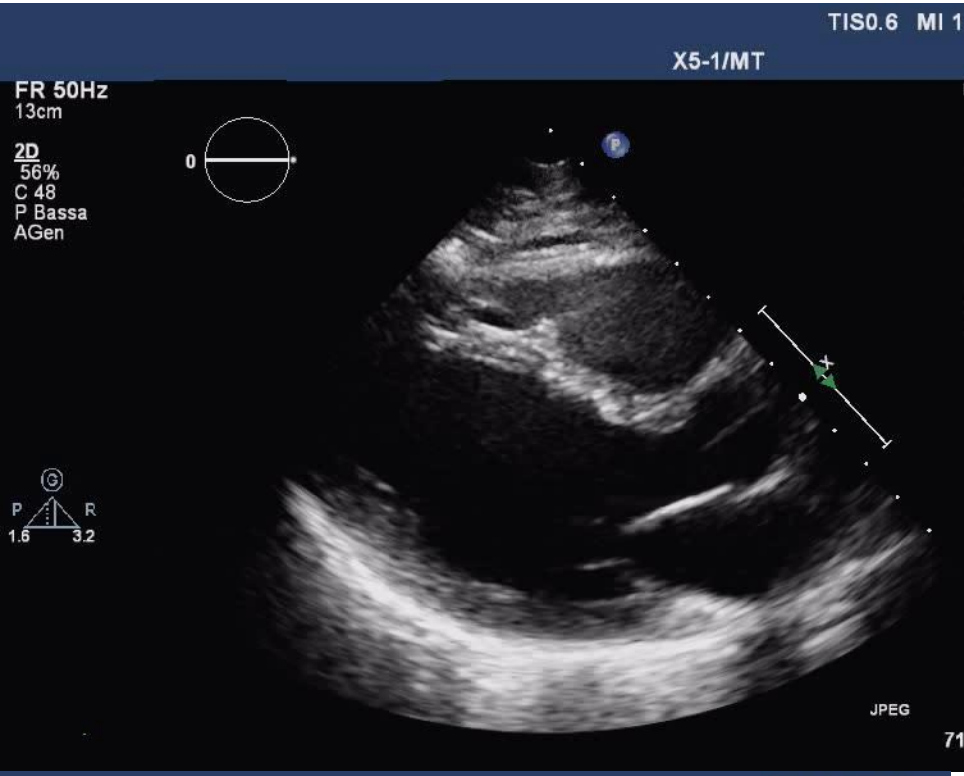
Veronesi , J Am Soc Echocardiogr

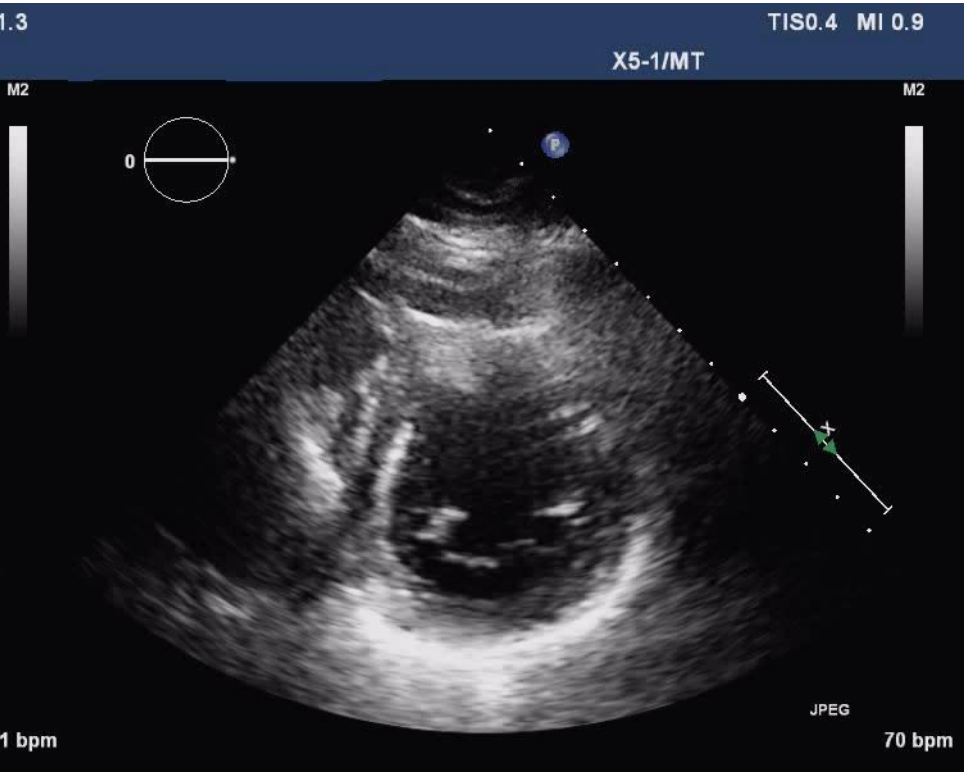


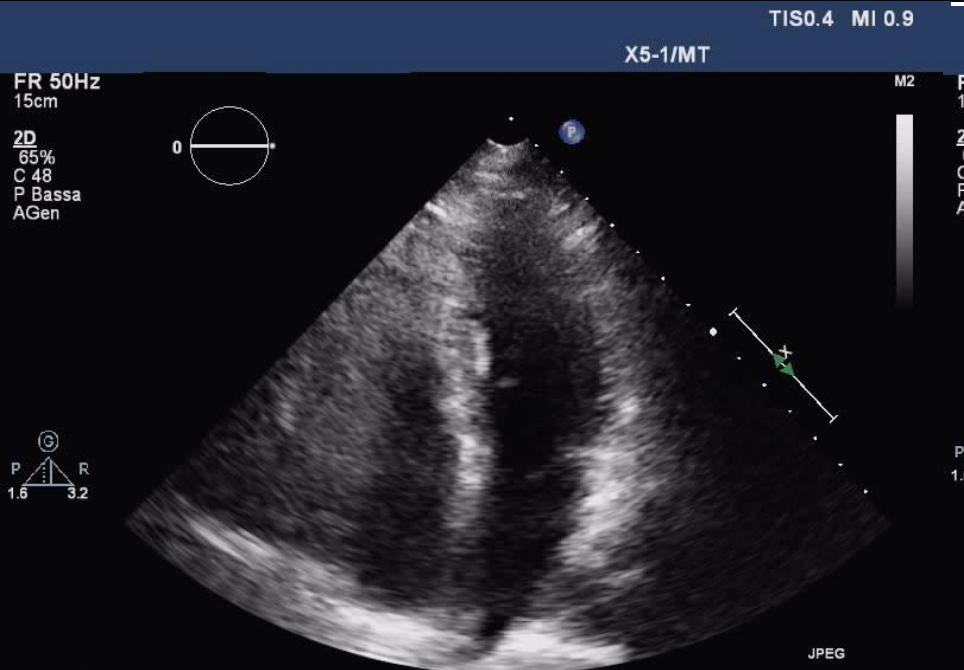
Mitral valve repair with annuloplasty ring

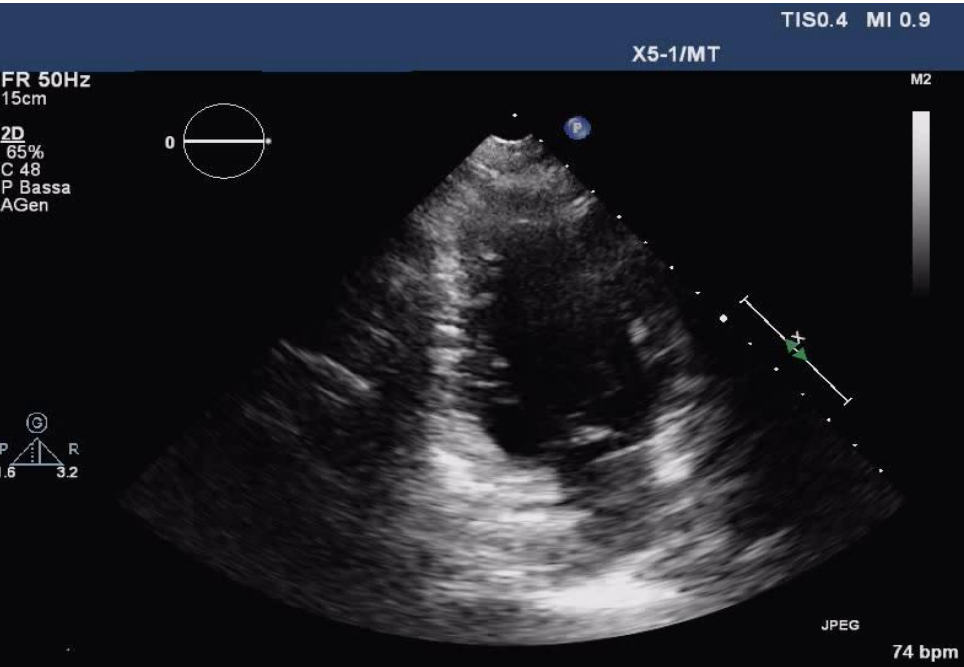
- Unexpected changes in Ao annular function
- Aortic annulus became < pulsatile < mobile

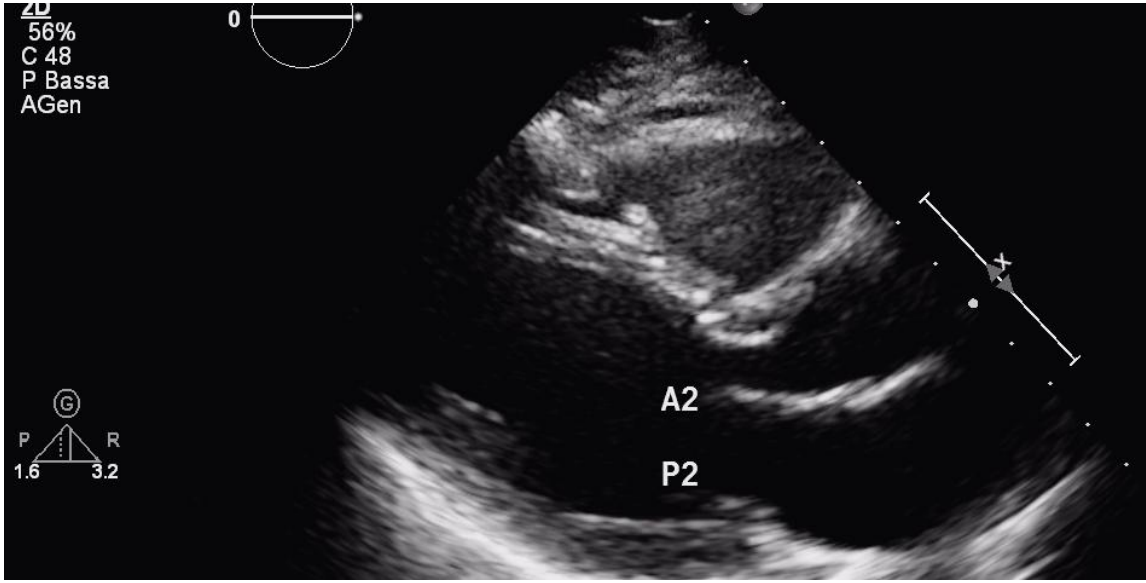

a
P1
A1
A2
A3
P2
P3
b
A1
P1
A2
A3
P2
P3

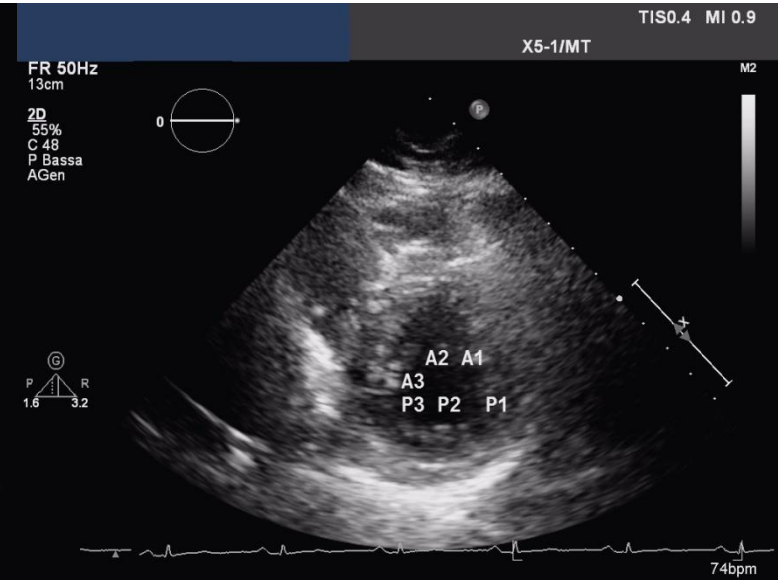

TIS0.6 MI 1.3
X5-1/MT
FR 50Hz
13cm
2D
56%
C 48
P Bassa
AGen
M2
P
R
1.6
3.2
JPEG
71 bpm

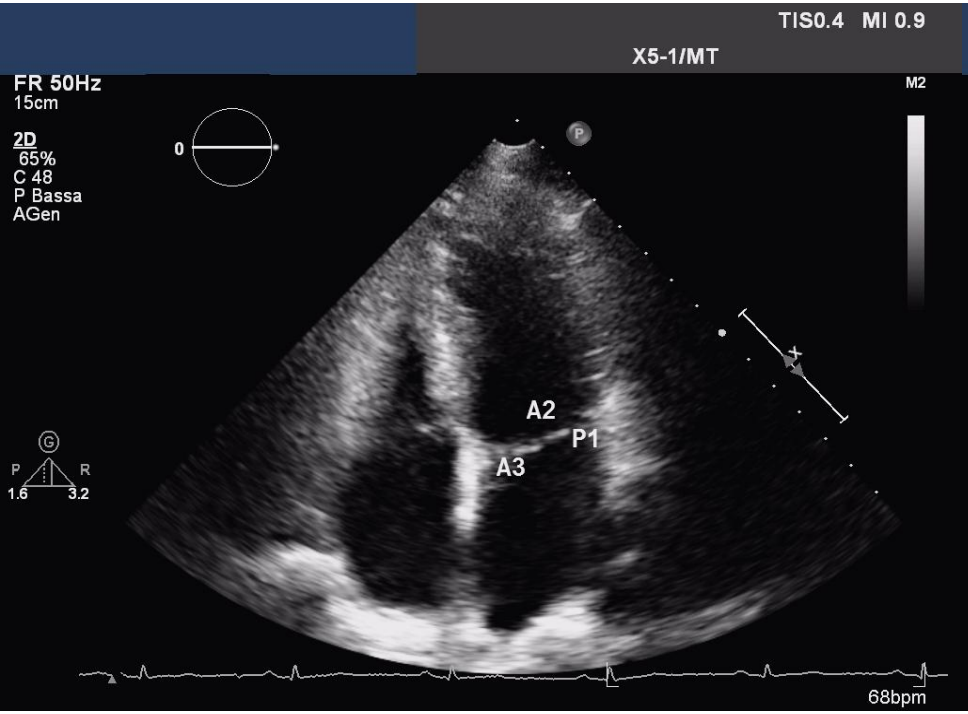

TIS0.4 MI 0.9
X5-1/MT
M2
JPEG
70 bpm

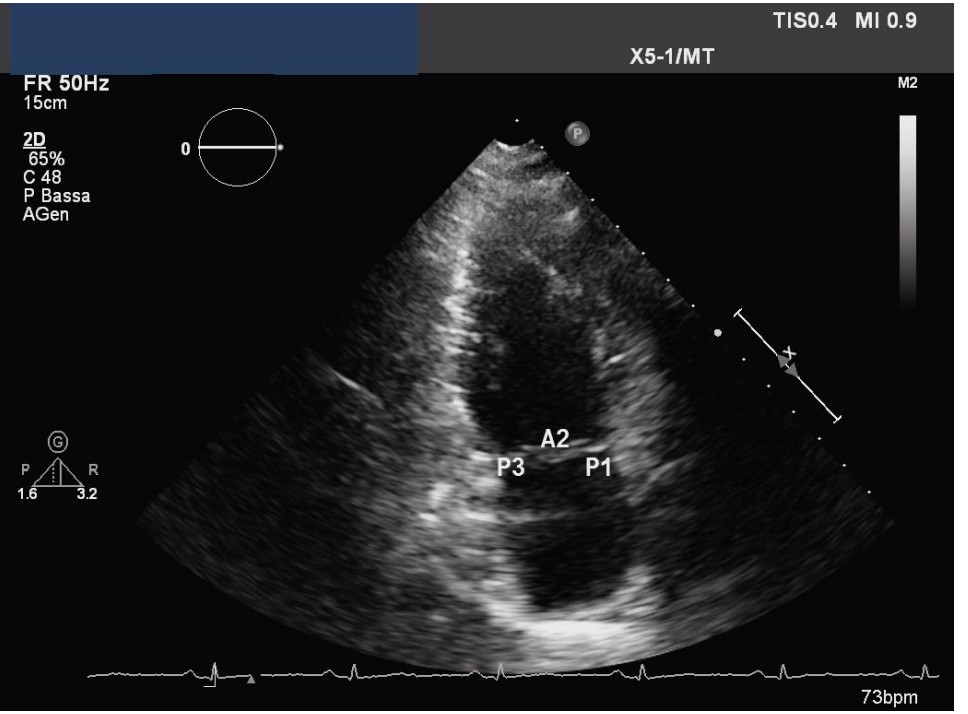

TIS0.4 MI 0.9
X5-1/MT
FR 50Hz
15cm
2D
65%
C 48
P Bassa
AGen
M2
P
R
1.6
3.2
JPEG

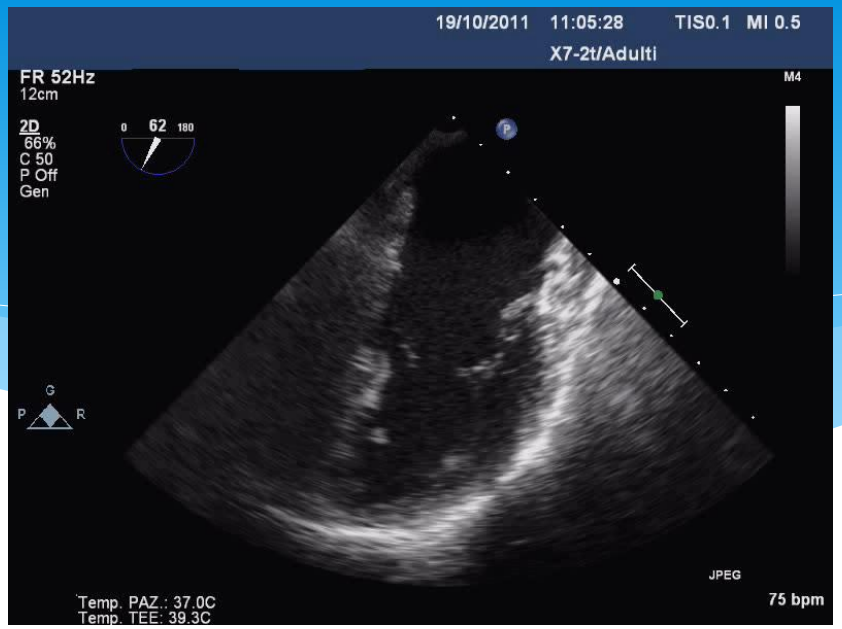

TIS0.4 MI 0.9
X5-1/MT
FR 50Hz
15cm
2D
65%
C 48
P Bassa
AGen
M2
P
R
1.6
3.2
JPEG
74 bpm

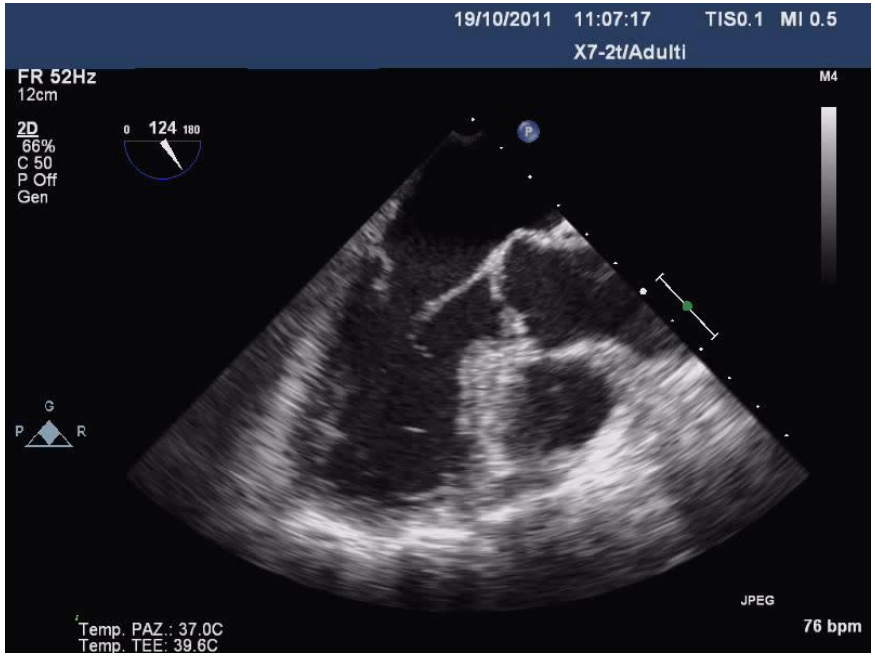

2D
56%
C 48
P Bassa
AGen
A2
P2
P
R
1.6
3.2

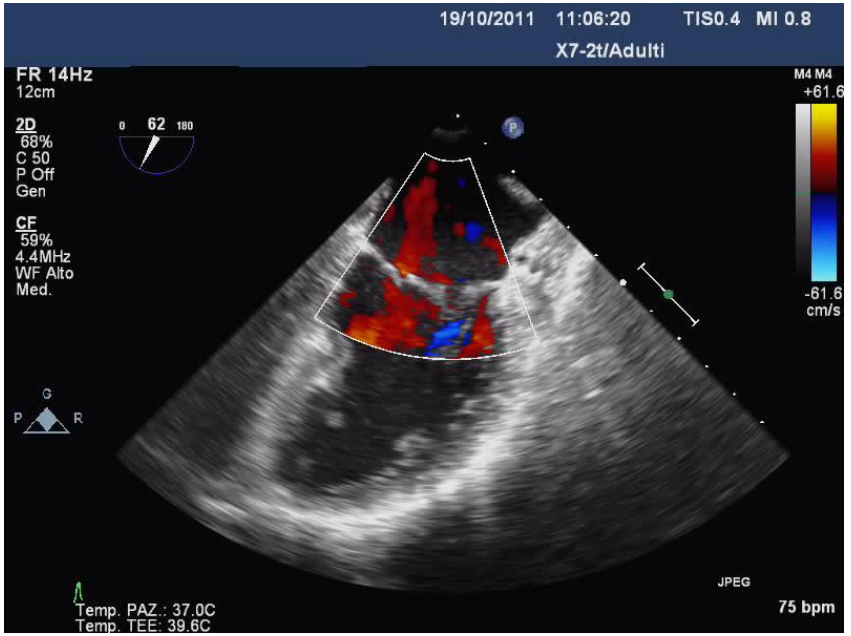

TIS0.4 MI 0.9
X5-1/MT
FR 50Hz
13cm
2D
55%
C 48
P Bassa
AGen
M2
A2 A1
A3
P3 P2 P1
74bpm


TIS0.4 MI 0.9
X5-1/MT
FR 50Hz
15cm
2D
65%
C 48
P Bassa
AGen
M2
A2
P1
A3
68bpm

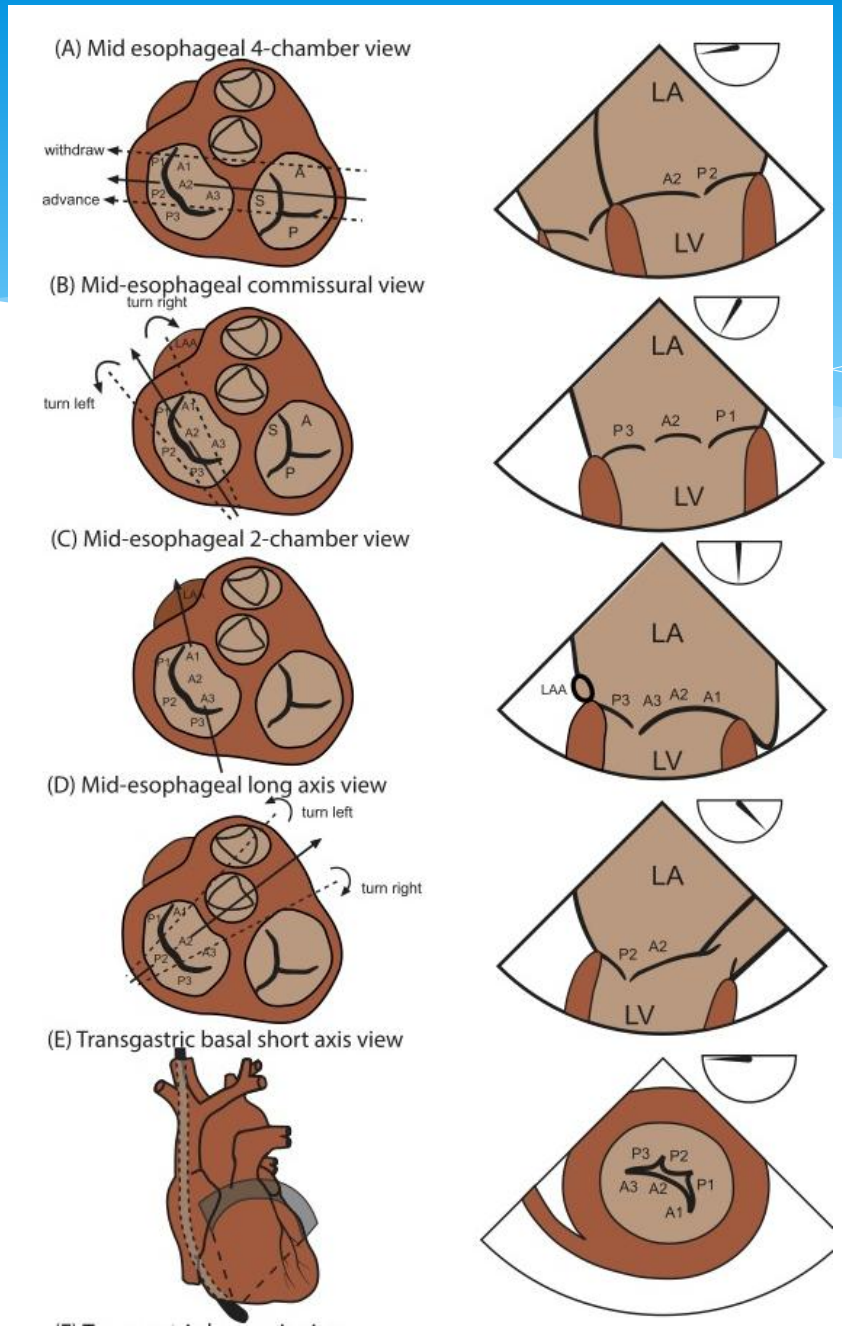

TIS0.4 MI 0.9
X5-1/MT
FR 50Hz
15cm
2D
65%
C 48
P Bassa
AGen
M2
A2
P3
P1
73bpm



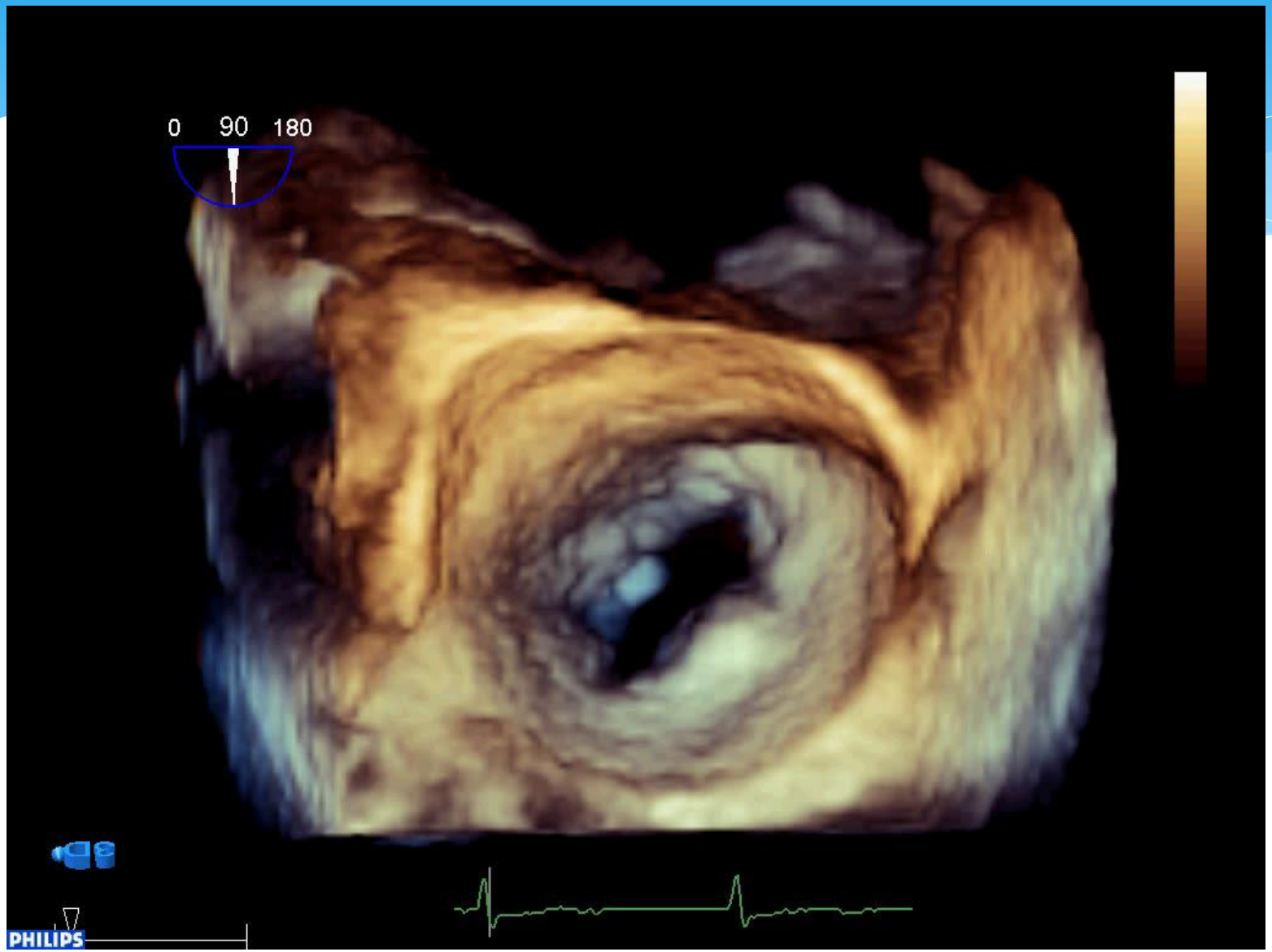


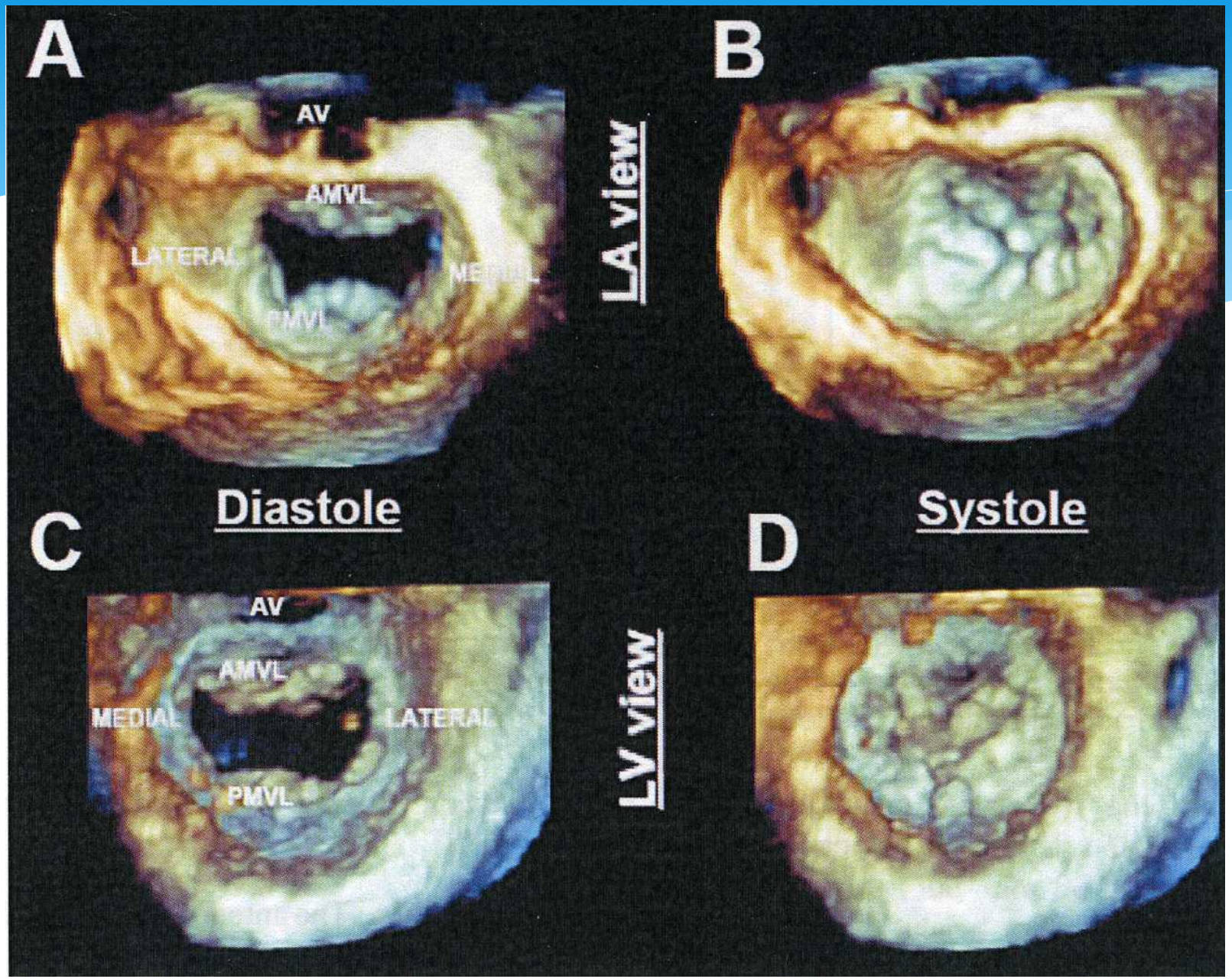


V.C. 80 y prolasso entrambi i lembi, piccola rct lma, 3 jet

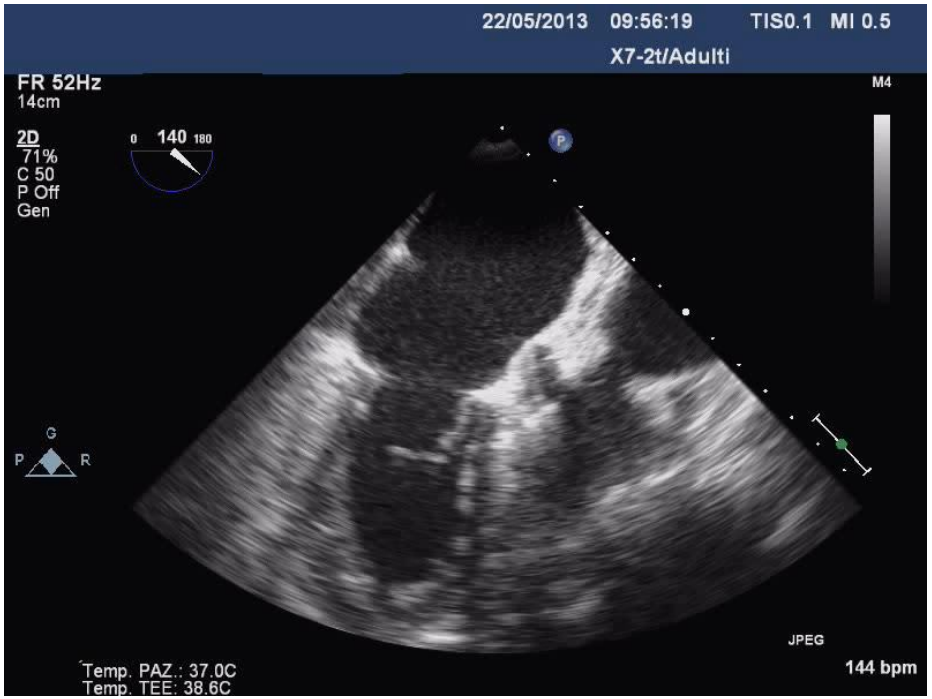

(A) Mid esophageal 4-chamber view
withdraw
advance
A1
A2
A3
P1
P2
P3
A
S
P
LA
A2
P2
LV
(B) Mid-esophageal commissural view
turn right
turn left
LAA
A1
A2
A3
P1
P2
P3
S
A
P
LA
P3
A2
P1
LV
(C) Mid-esophageal 2-chamber view
LAA
A1
A2
A3
P1
P2
P3
LA
LAA
P3
A3
A2
A1
LV
(D) Mid-esophageal long axis view
turn left
turn right
A1
A2
A3
P2
P3
LA
P2
A2
LV
(E) Transgastric basal short axis view
P3
P2
A3
A2
P1
A1

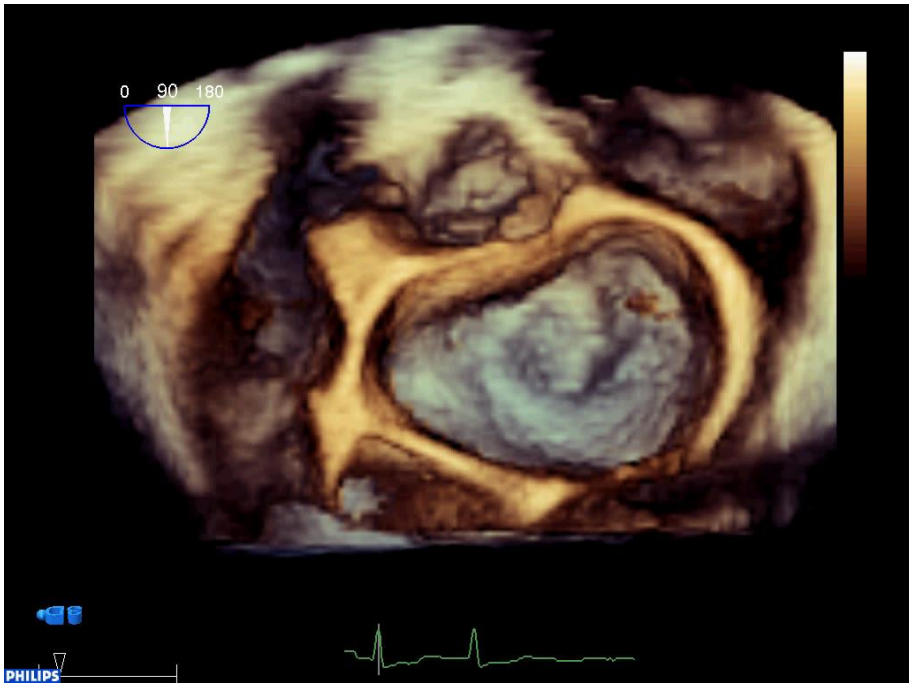
3D LA view (surgical view)



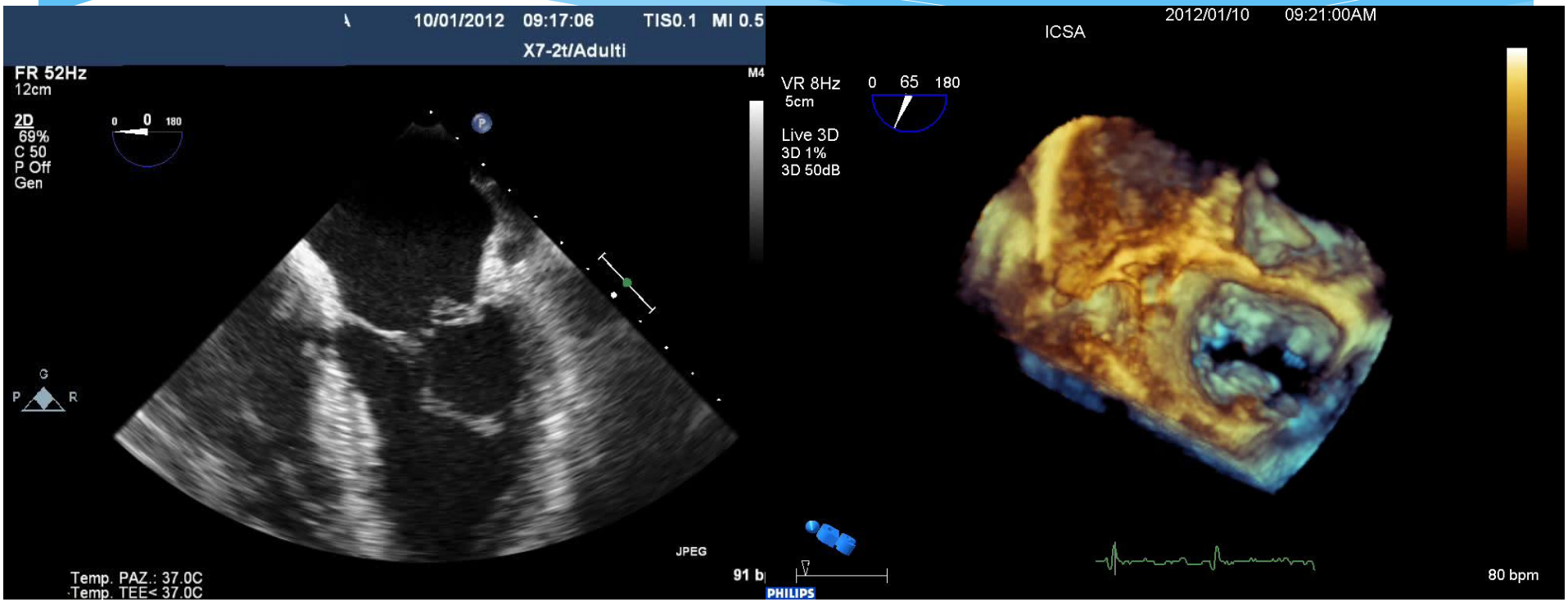

A
AV
AMVL
LATERAL
PMVL
LA view
B
Diastole
Systole
C
AV
AMVL
MEDIAL
LATERAL
PMVL
LV view
D

Rct A2

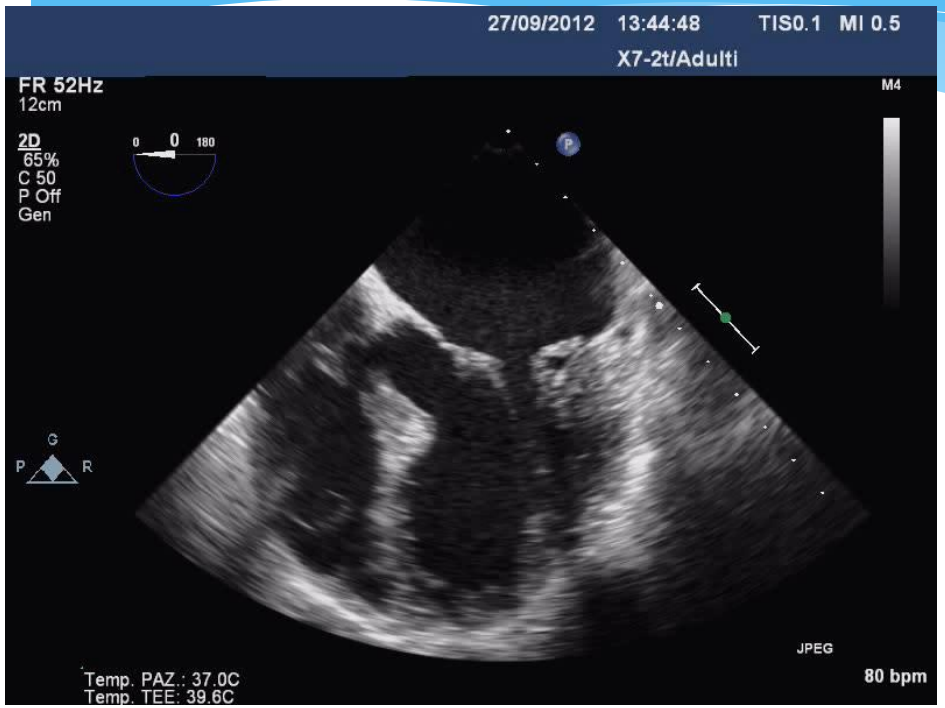

22/05/2013 09:56:19 TIS0.1 MI 0.5
X7-2t/Adulti
FR 52Hz
14cm
2D
71%
C 50
P Off
Gen
0 140 180
M4
G
P R
JPEG
144 bpm
Temp. PAZ.: 37.0C
Temp. TEE: 38.6C

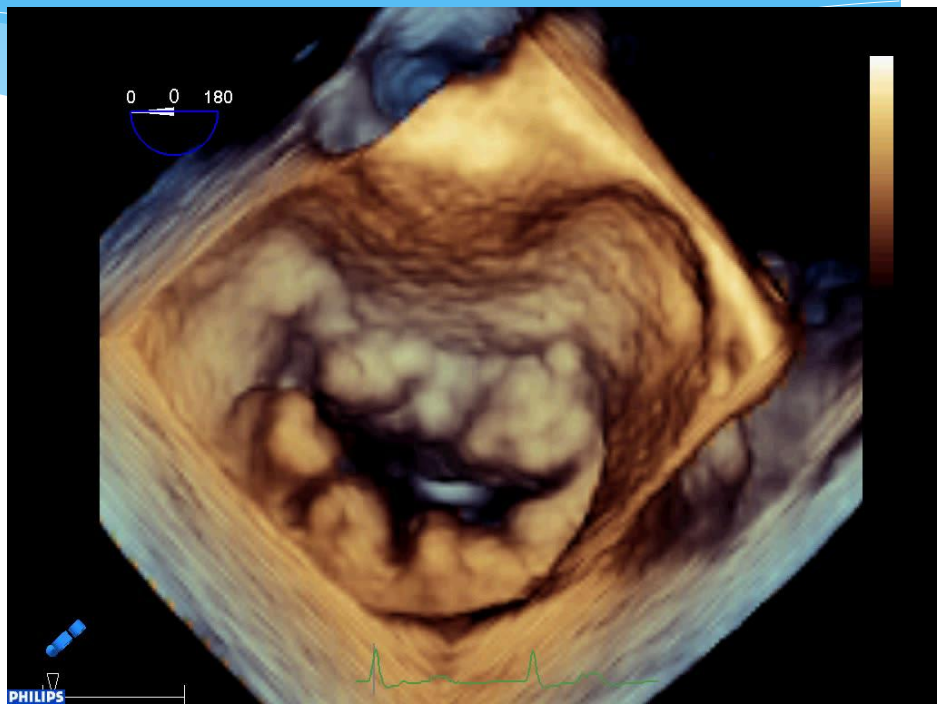

0 90 180
PHILIPS

Rct P2

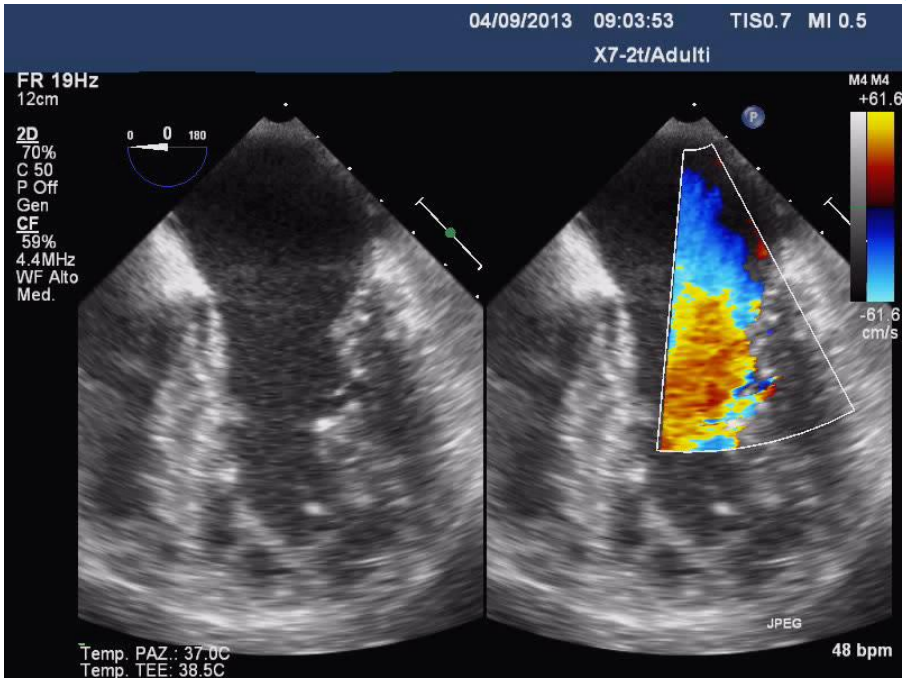

10/01/2012 09:17:06 TIS0.1 MI 0.5
X7-2t/Adulti
FR 52Hz
12cm
2D
69%
C 50
P Off
Gen
M4
Temp. PAZ.: 37.0C
Temp. TEE< 37.0C
JPEG
91 b
PHILIPS
2012/01/10 09:21:00AM
ICSA
VR 8Hz
5cm
Live 3D
3D 1%
3D 50dB
0 65 180
80 bpm

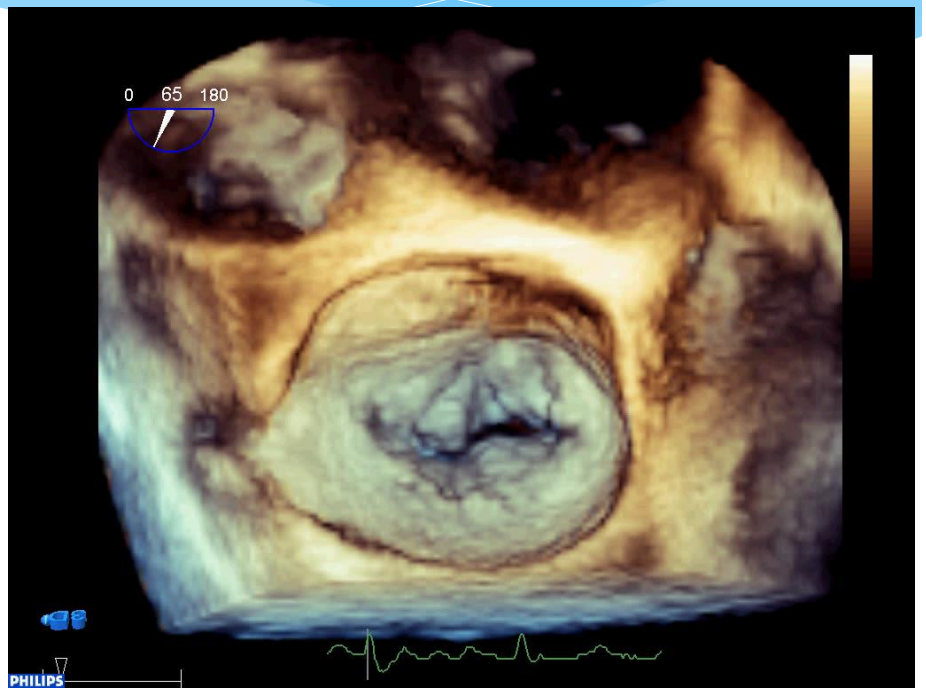
Prolasso complesso LMA e LMP



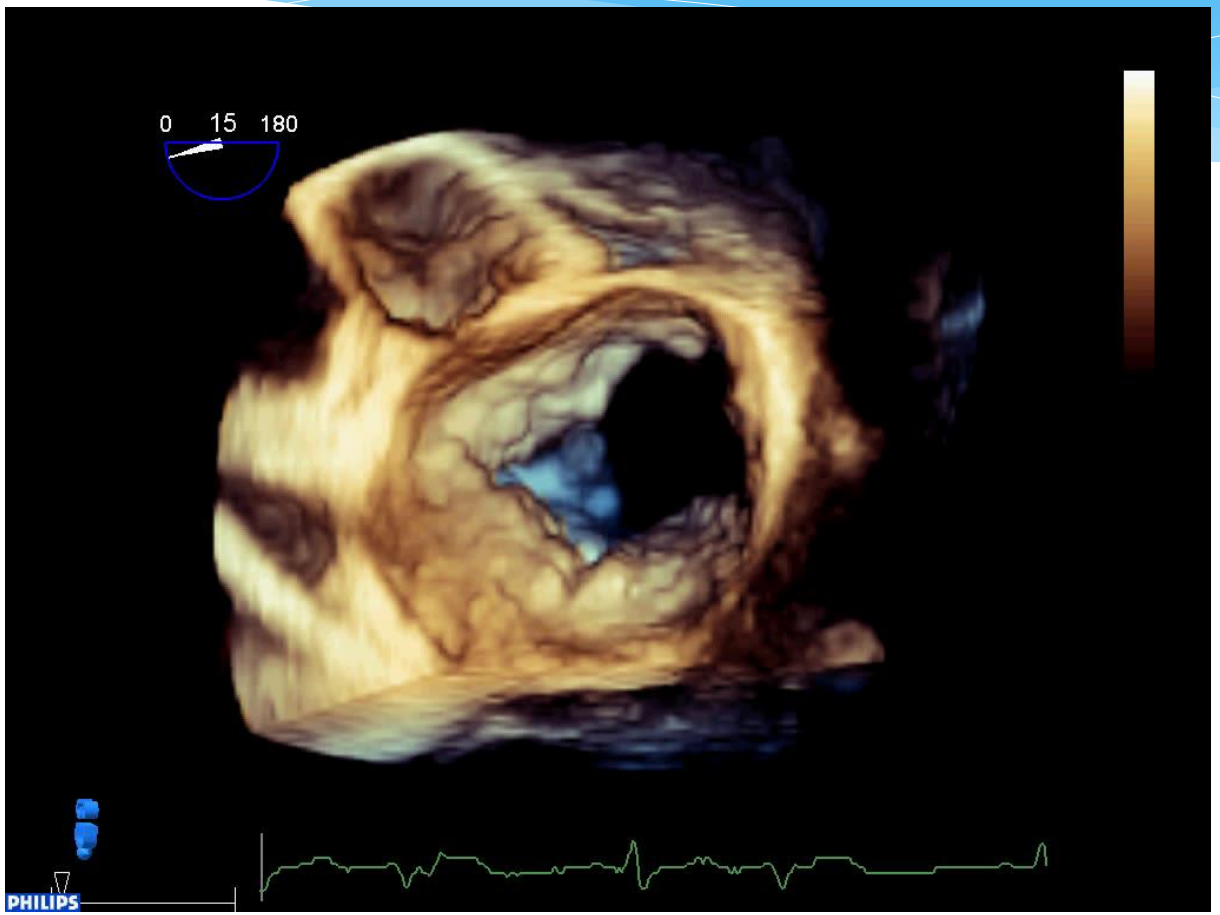


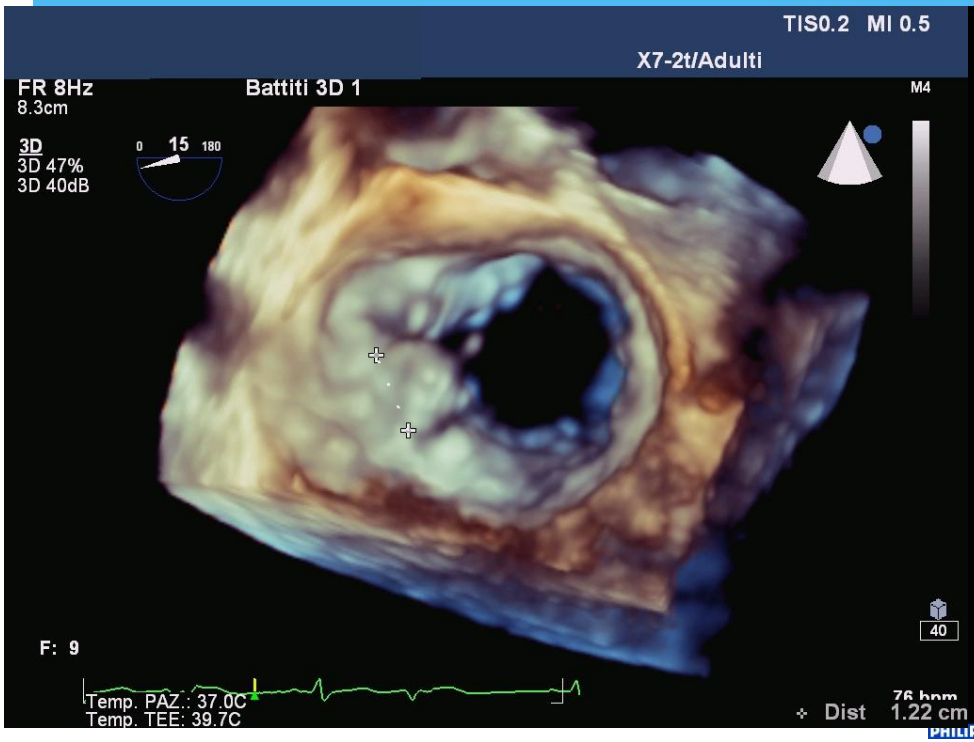
Prolasso complesso: Rct P2 prolasso A2 A3 P3

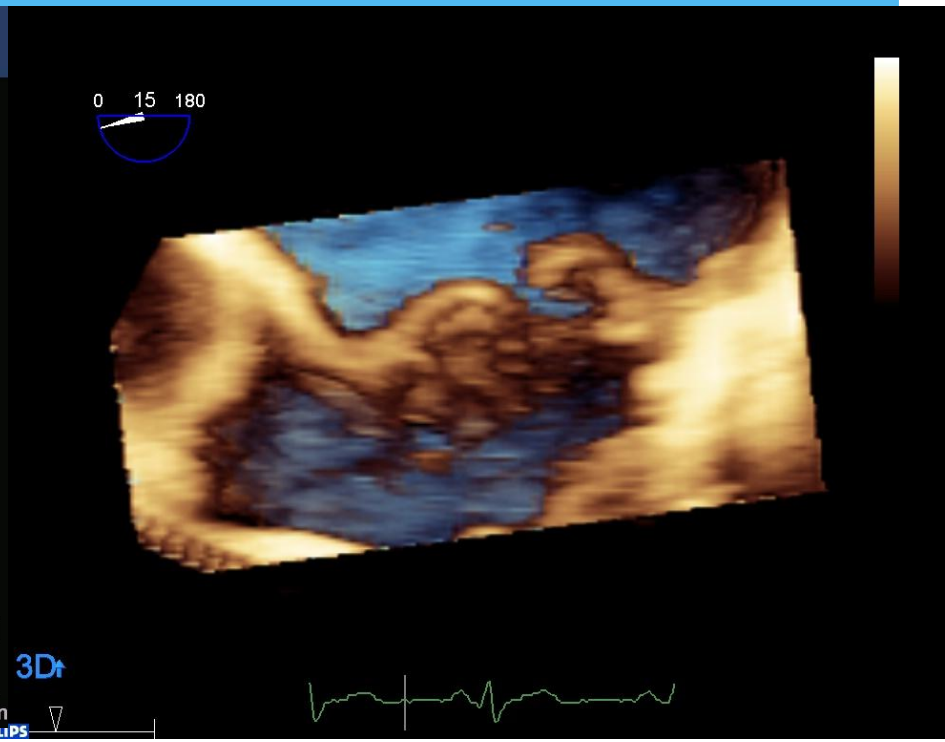




Prolasso complesso : Rct P1 Prolasso A1

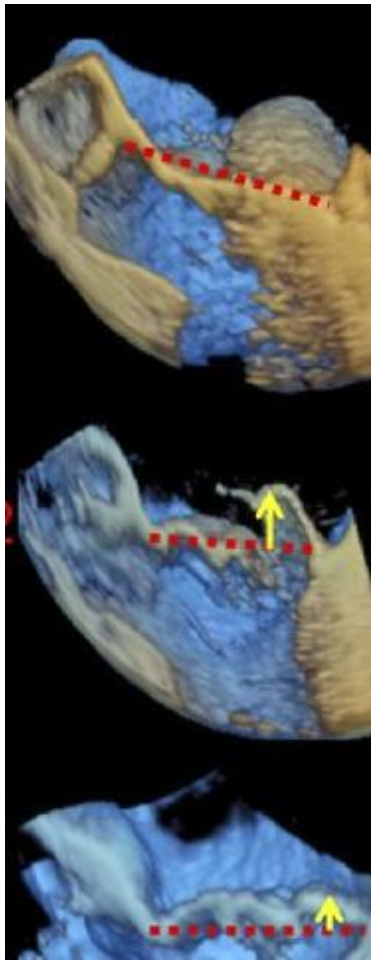


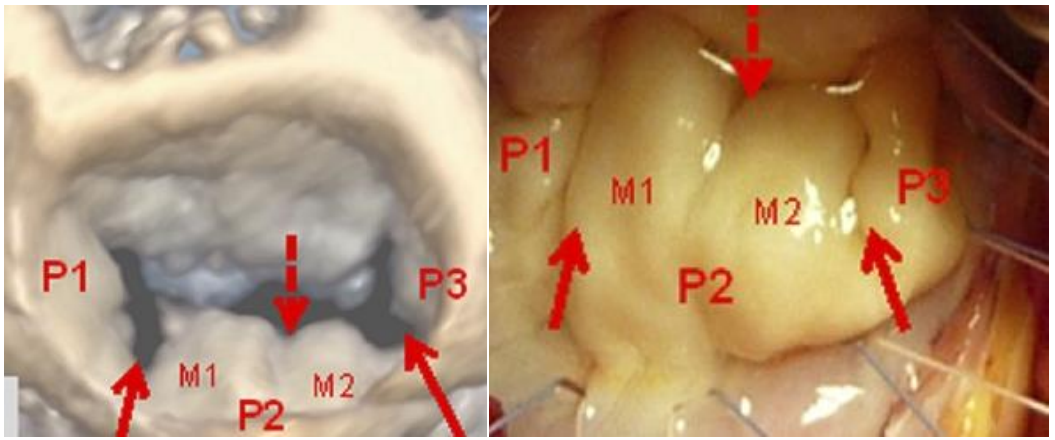

TIS0.2 MI 0.5
X7-2t/Adulti
FR 8Hz
8.3cm
Battiti 3D 1
M4
3D
3D 47%
3D 40dB
0 15 180
F: 9
40
Temp. PAZ.: 37.0C
Temp. TEE: 39.7C
Dist 1.22 cm


0 15 180
3D
PHILIPS

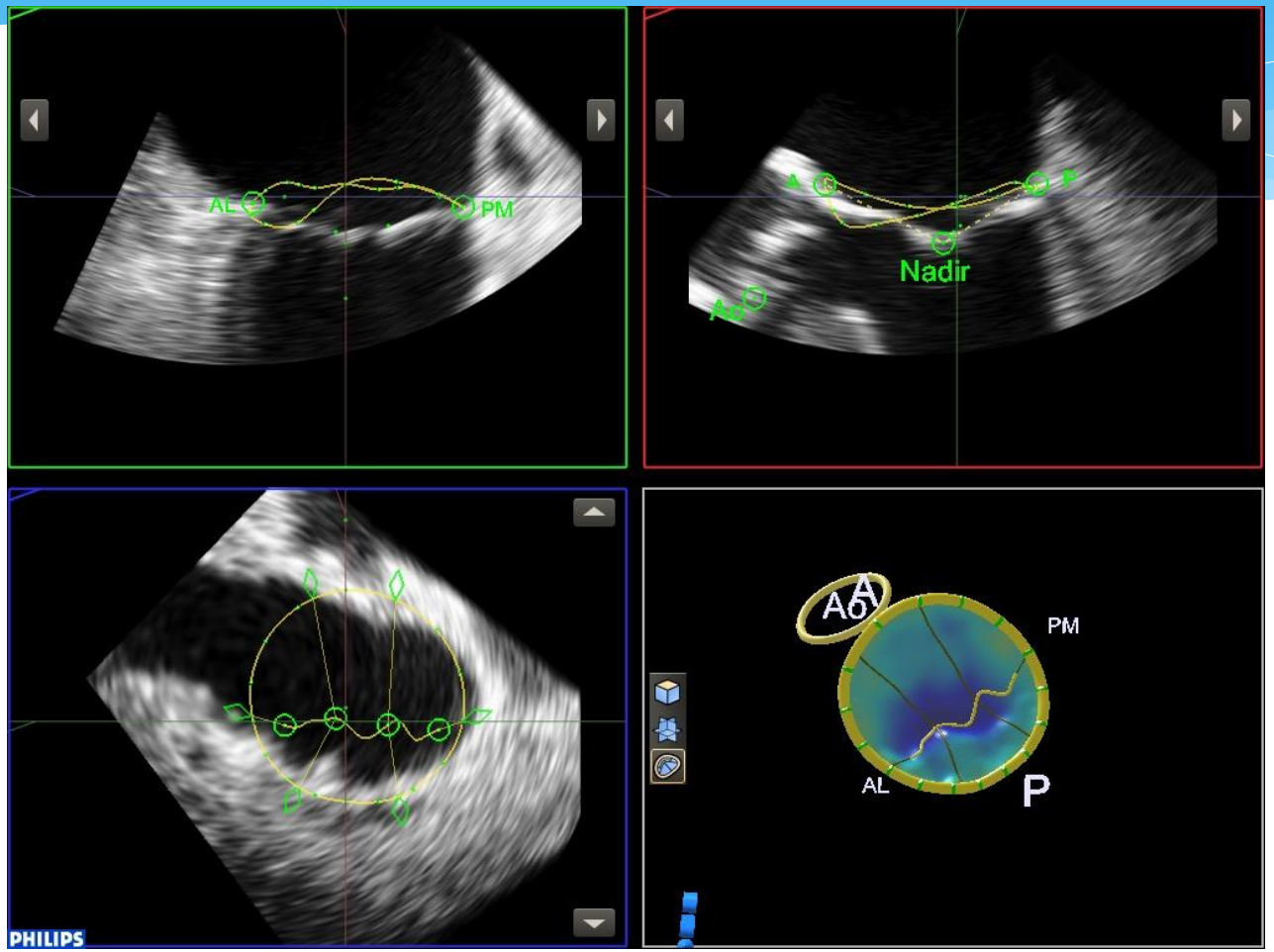
Real-Time Three-Dimensional Transesophageal Echocardiography for Assessment of Mitral Valve Functional Anatomy in Patients With Prolapse-Related Regurgitation

La canna , Am J Cardiol 2011

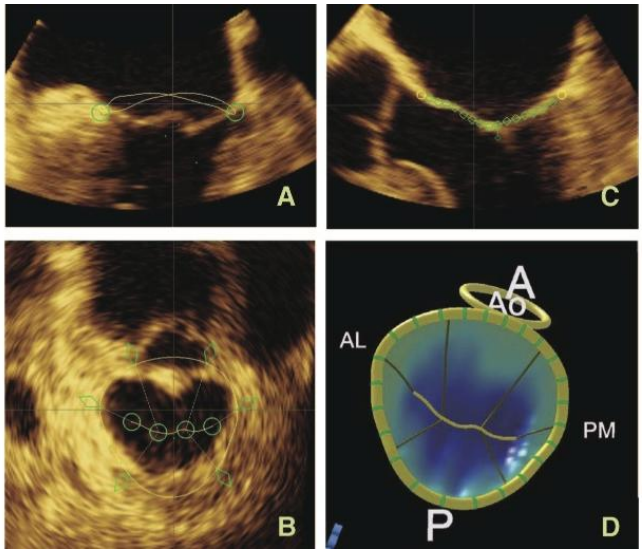


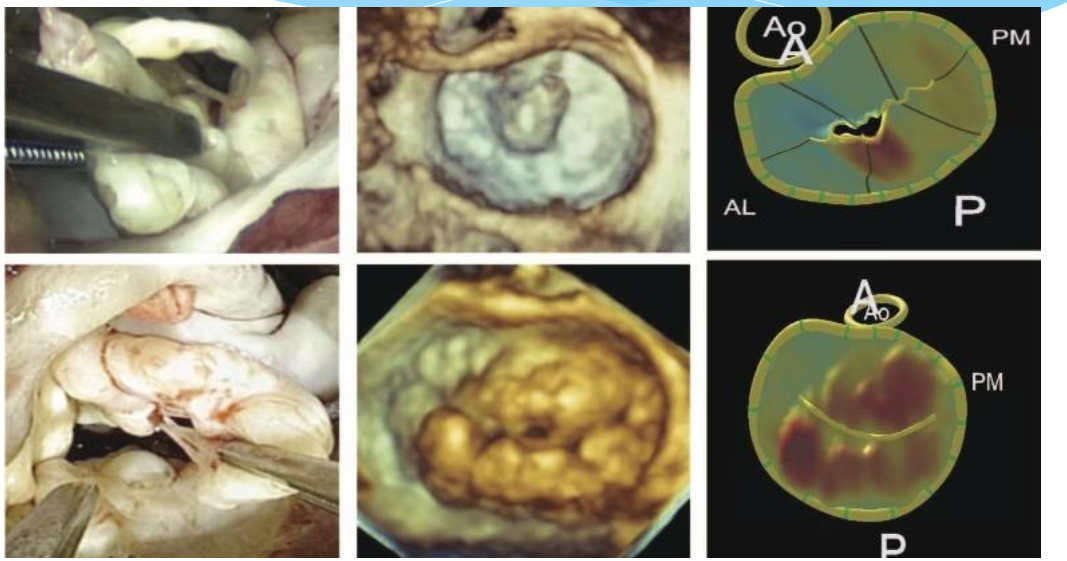


Prolassi dominanti > 5 mm
Prolassi secondari > 2 < 5 mm


AL
PM
A
P
Nadir
Ao
A
Ao
PM
AL
P
PHILIPS

Lang, Circ Cardiovasc imaging 2011





Billowing height mm : v.n < 1 mm

Billowing volme ml: v.n. < 1,15 ml

Mitral Valve Anatomy Report

Annulus

MV AL-PM Diam	40.1	mm
MV AP Diam	40.4	mm
MV Ann Height	7.6	mm
MV Ann3D Circ	133.9	mm
MV Ann2D Area	1316.8	mm²

Leaflet Area

MV A Leaf 3D Area	974.7	mm²
MV P Leaf 3D Area	523.6	mm²
MV MR Orifice Area	0.0	mm²

Leaflet Volume

MV Tenting Vol	3.3	ml
MV Prolapse Vol	0.0	ml

Leaflet Len./Ang.

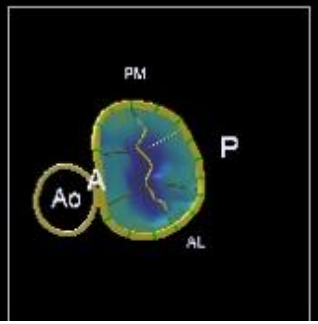
MV A2	30.5	mm
MV P2	15.3	mm
MV Ant Leaf Angle	26.5	°
MV Post Leaf Angle	32.1	°
MV Nonplanar Angle	121.4	°
MV Tenting Height	7.1	mm
MV Prolapse Height	0.3	mm

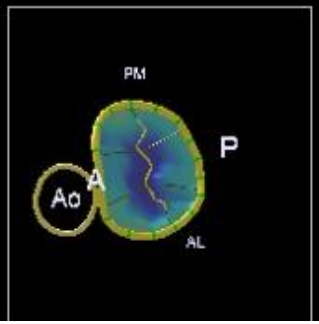
Coaptation

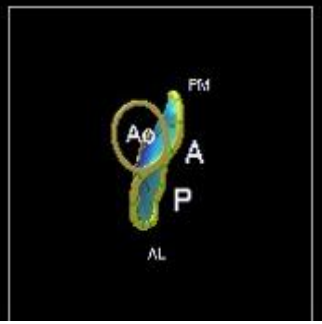
MV Coapt 2D	34.4	mm

Aortic-Mitral

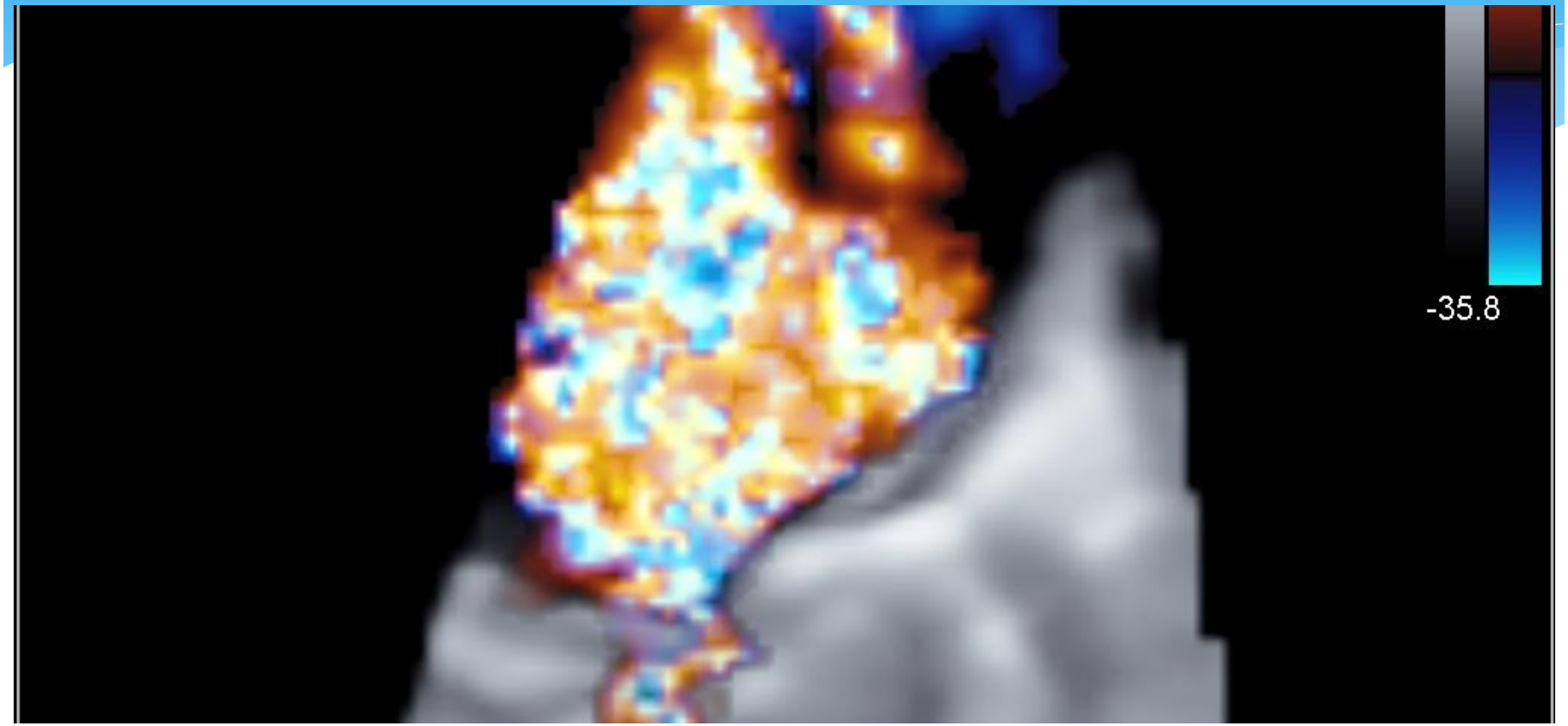
MV Ao-Mitral Ang	121.9	°







Color flow imaging



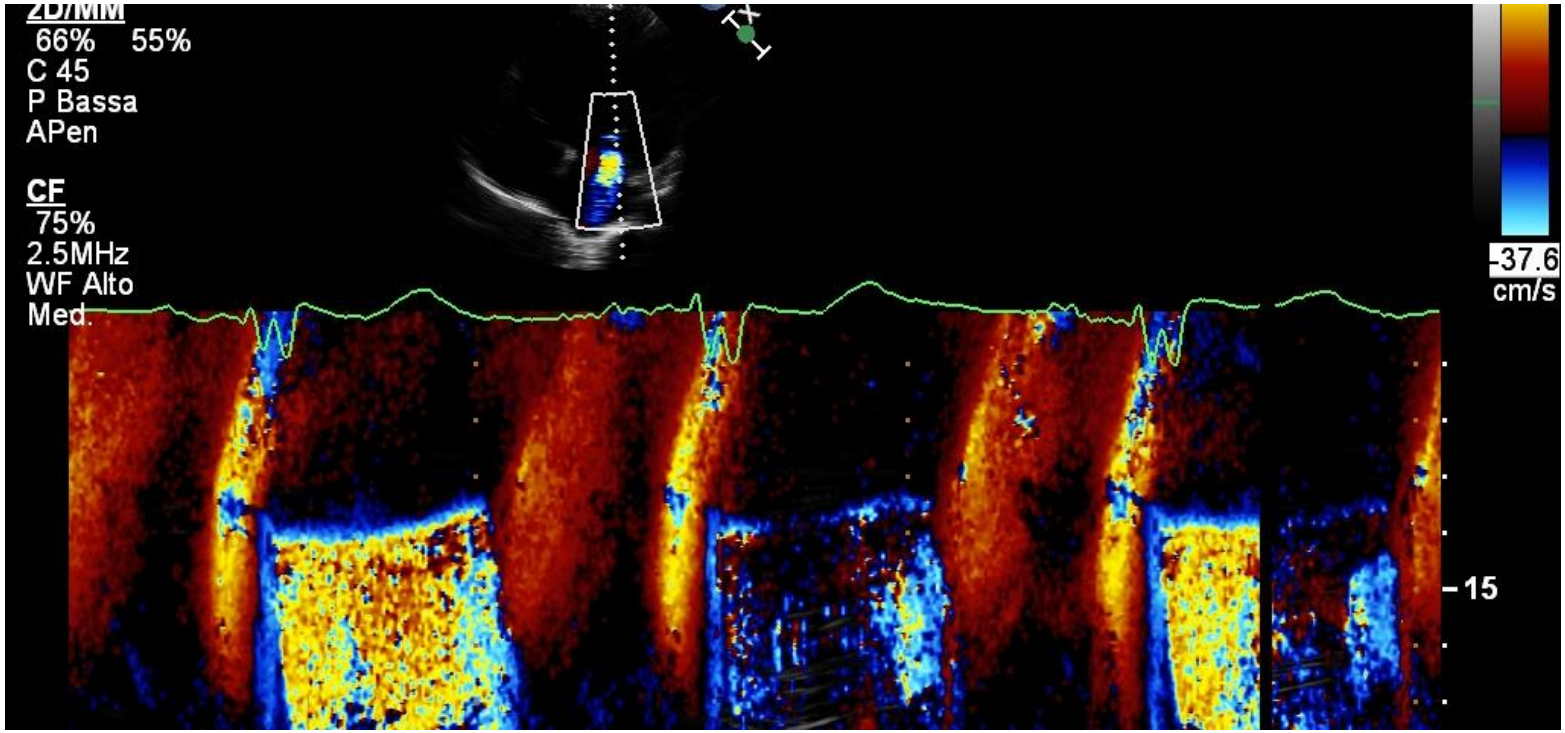
recomendation for the echocardiographic assessment of native valvular regurgitation

Table 8 Grading the severity of primary MR

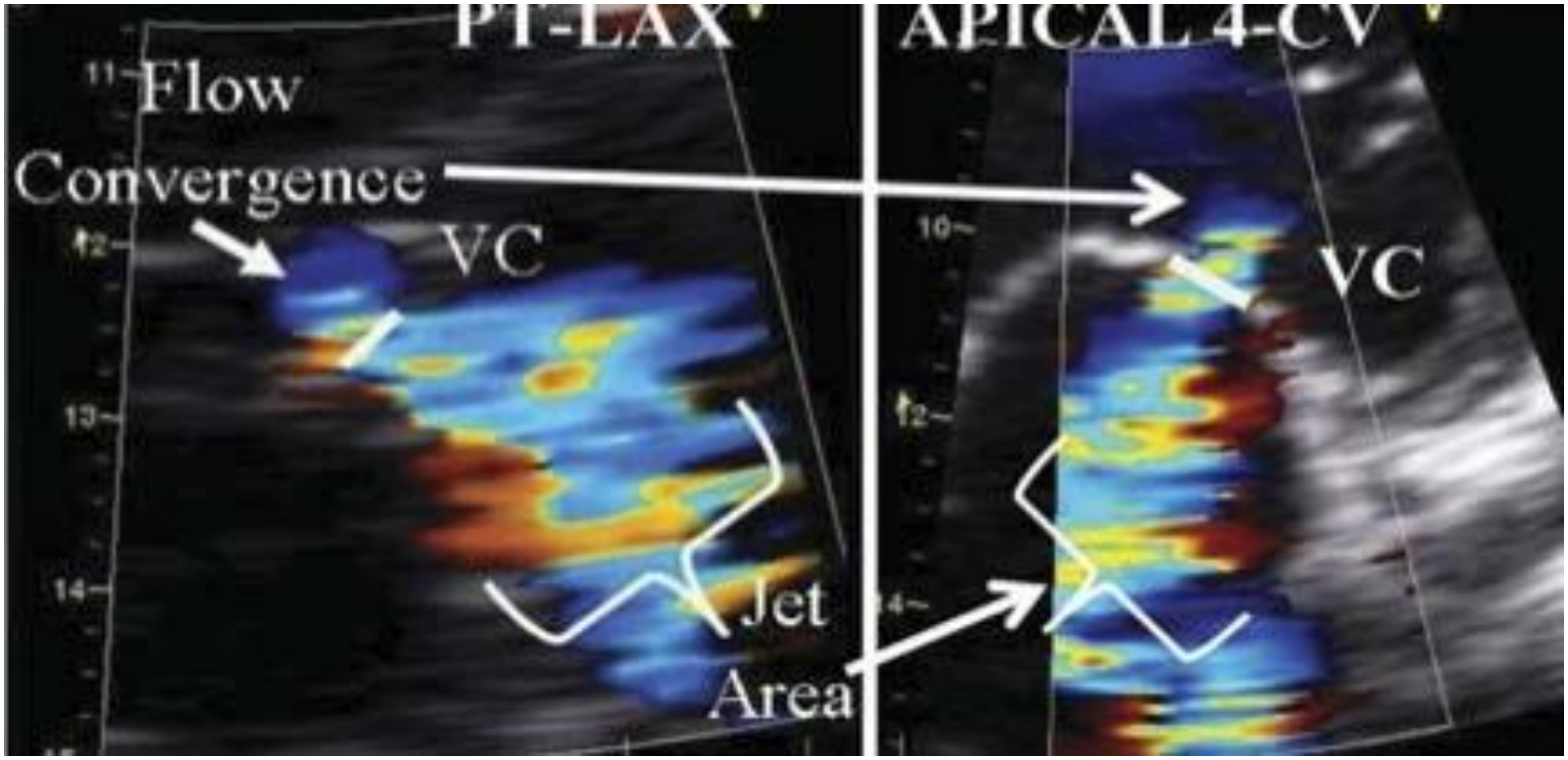
Parameters	Mild	Moderate	Severe
Qualitative			
MV morphology	Normal/abnormal	Normal/abnormal	Flail leaflet/ruptured PMs
Colour flow MR jet	Small, central	Intermediate	Very large central jet or eccentric jet adhering, swirling and reaching the posterior wall of the LA
Flow convergence zone[a]	No or small	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 m/s)[e]
TVI mit /TVI Ao	<1	Intermediate	>1.4
Quantitative			
EROA (mm^2)	<20	20–29; 30–39[g]	≥40
R Vol (mL)	<30	30–44; 45–59[g]	≥60

Lancellotti, Eur cardiovascular imaging 2013

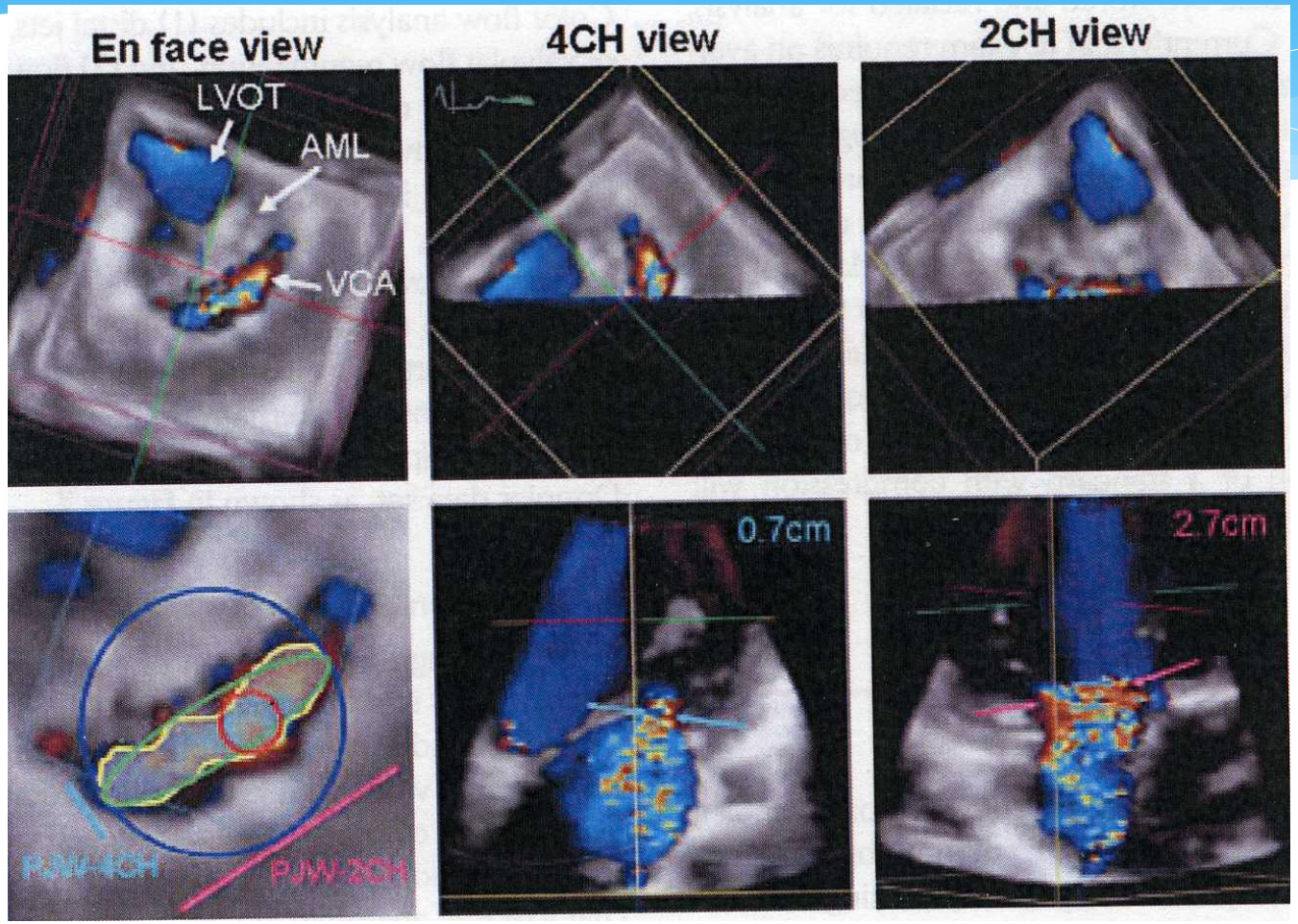
ICSA

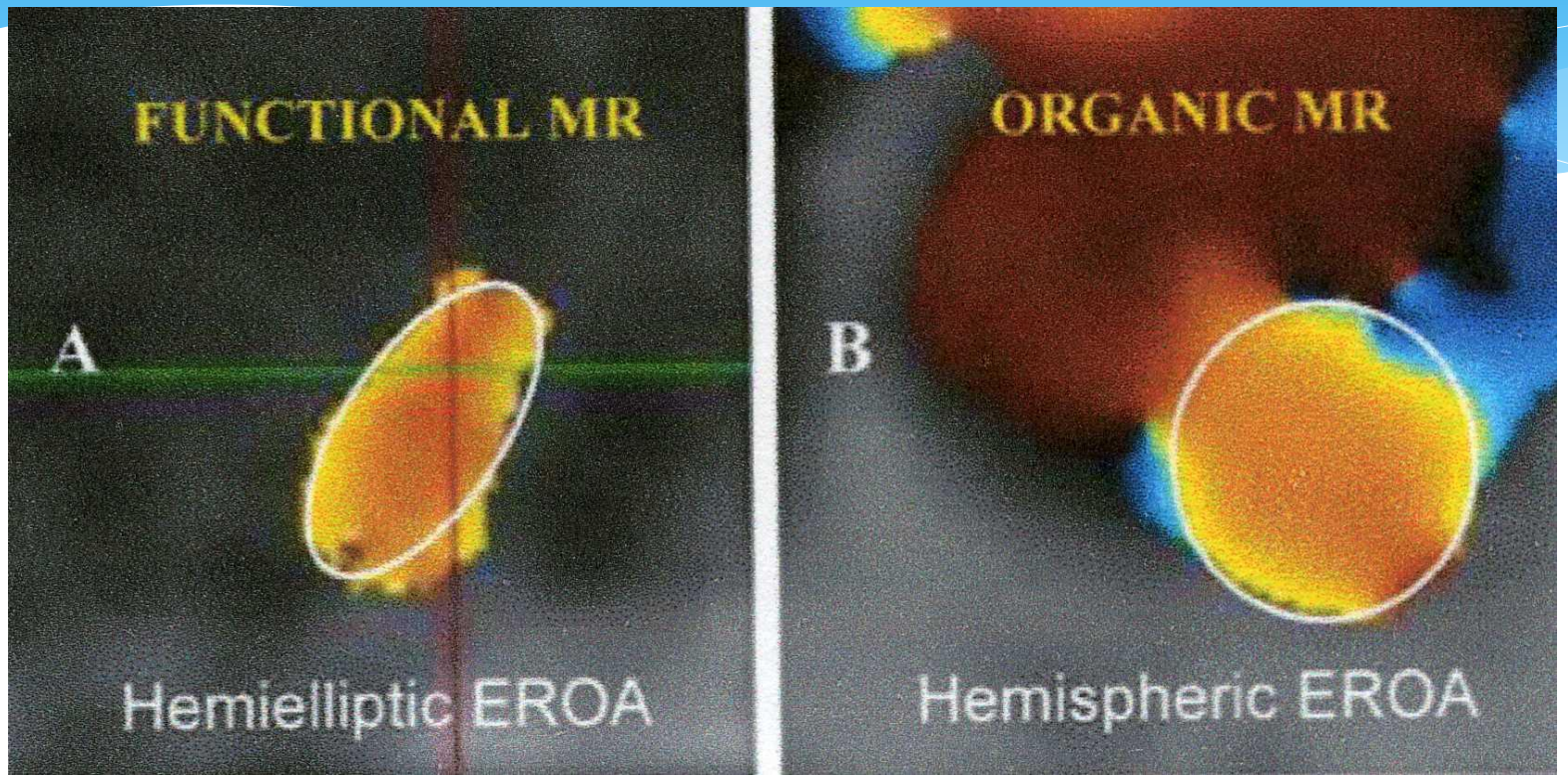

2D/MM
66% 55%
C 45
P Bassa
APen
CF
75%
2.5MHz
WF Alto
Med.
-37.6
cm/s
-15

Vena contracta larghezza

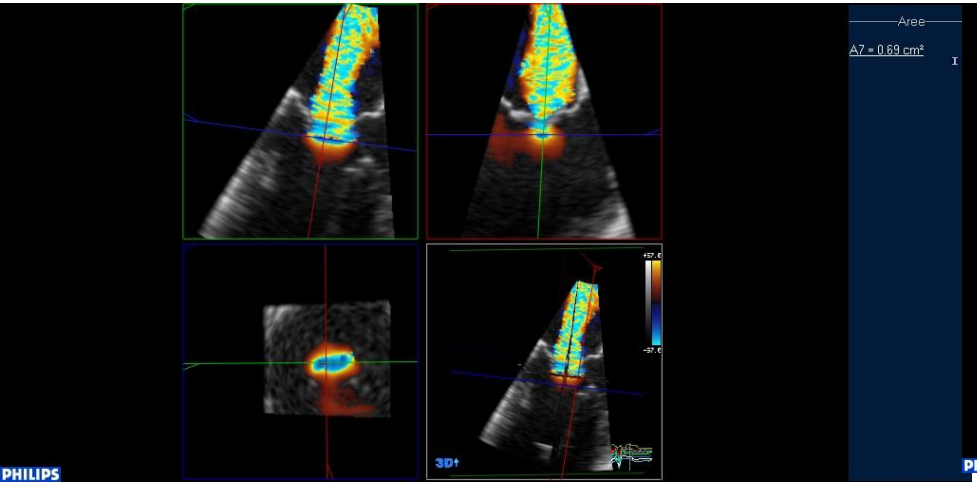


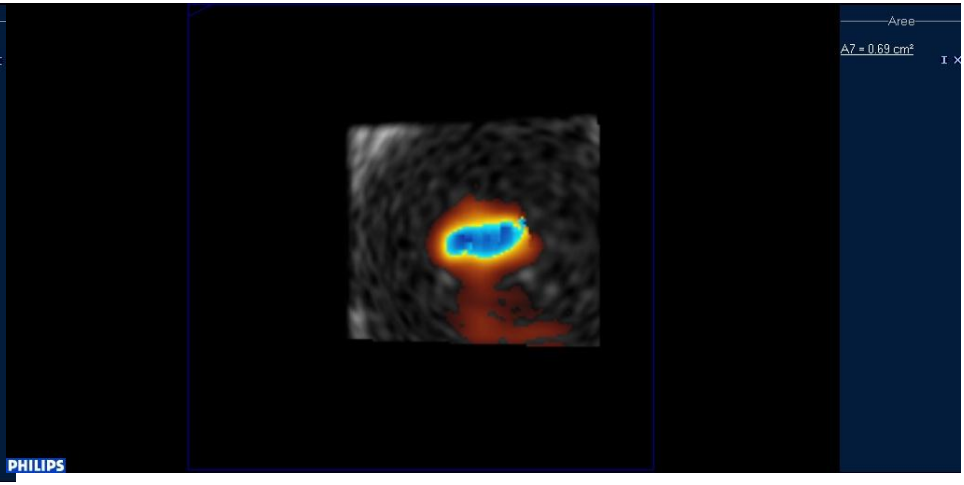
Vena contracta 3 D



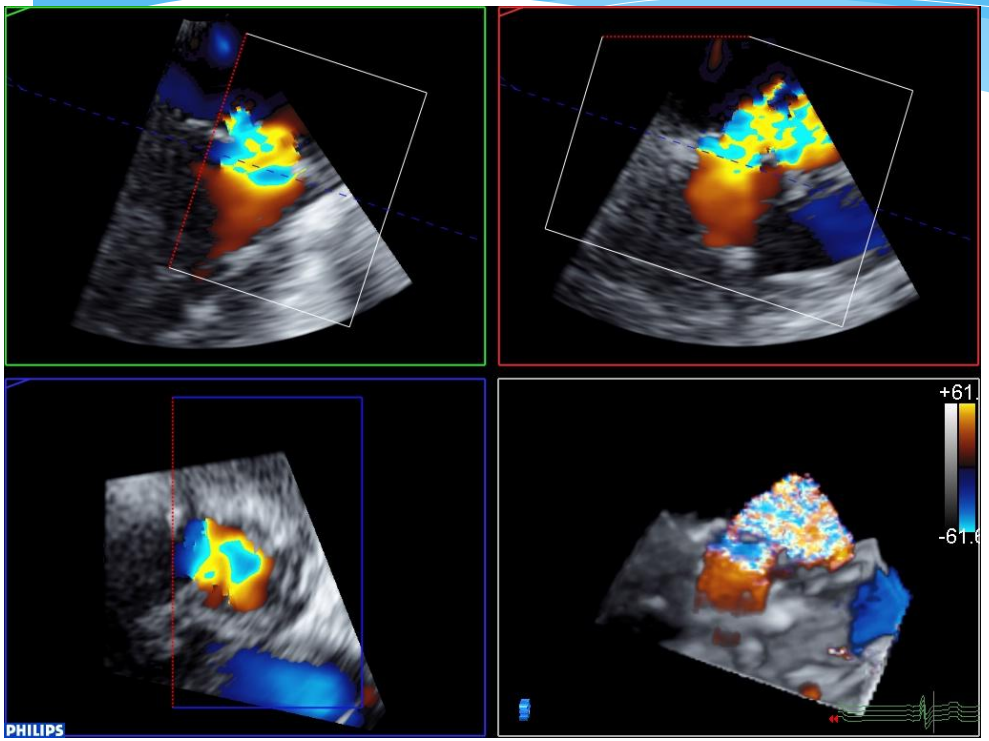

FUNCTIONAL MR
A
Hemielliptic EROA
ORGANIC MR
B
Hemispheric EROA

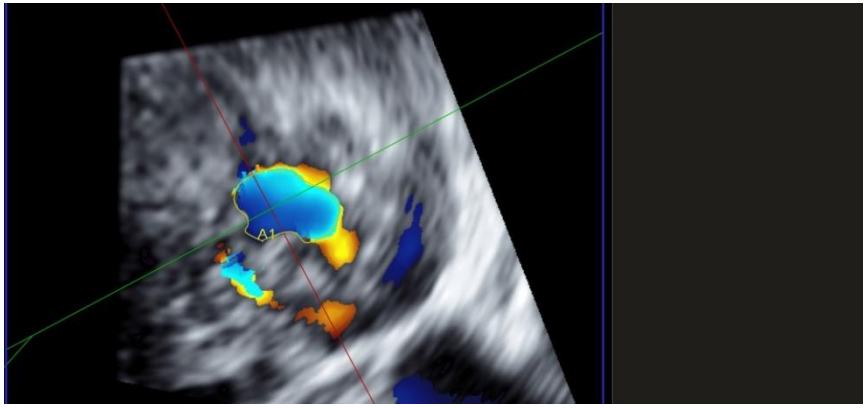
Vena contracta area: ricostruzione multiplanare





Eroa con 3 D

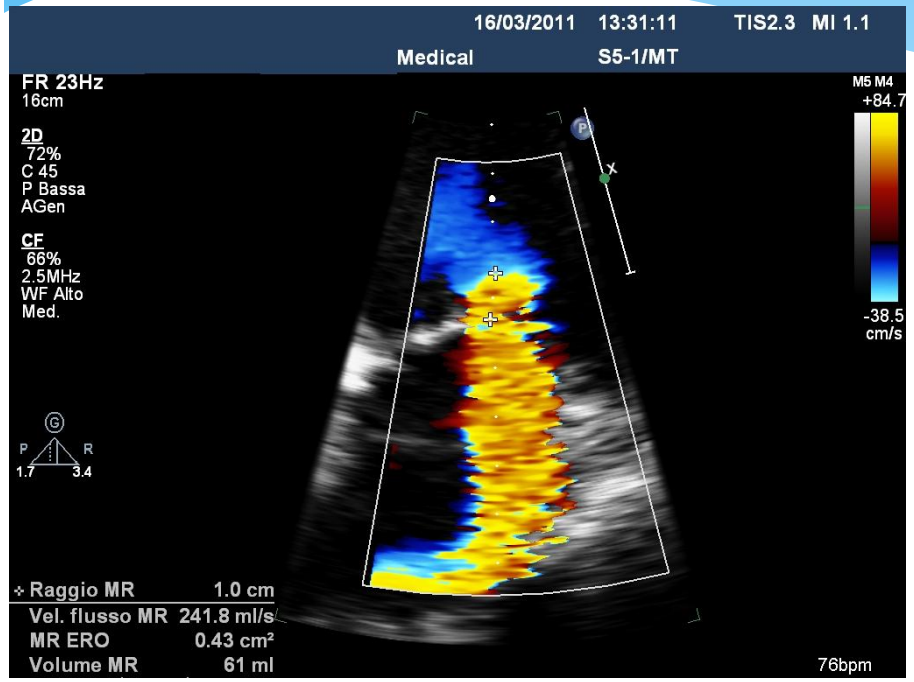


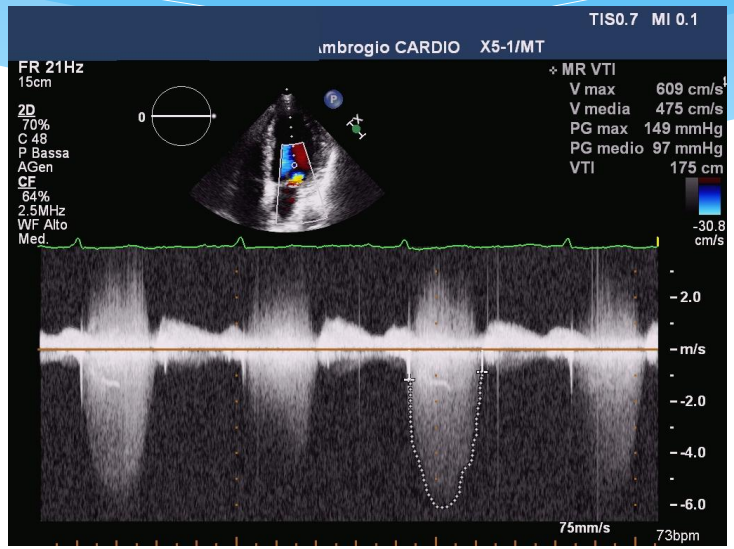


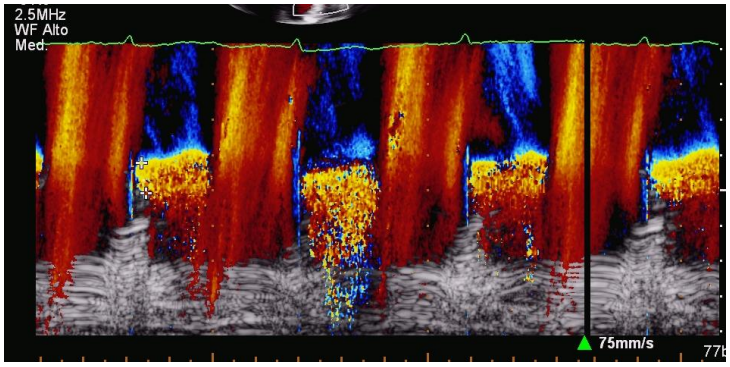
Non interferenze di flusso
Non necessità orifici circolari

Bassa risoluzione spaziale
Cambia secondo frame sistolico

FLOW CONVERGENCE METHOD : PISA







Roa= Flow/peak velocity

Eroa= (2x 3,14x r2 x Vel aliasing)/peack vel

R Vol: EROA X TVI

Table 9 Reference limits and partition values for left atrial dimensions/volumes

	Women				Men			
	Reference Range	Mildly Abnormal	Moderately Abnormal	Severely Abnormal	Reference Range	Mildly Abnormal	Moderately Abnormal	Severely Abnormal
Atrial dimensions								
LA diameter (cm)	2.7–3.8	3.9–4.2	4.3–4.6	≥4.7	3.0–4.0	4.1–4.6	4.7–5.2	≥5.2
LA diameter/BSA (cm/m^2)	1.5–2.3	2.4–2.6	2.7–2.9	≥3.0	1.5–2.3	2.4–2.6	2.7–2.9	≥3.0
RA minor axis dimension (cm)	2.9–4.5	4.6–4.9	5.0–5.4	≥5.5	2.9–4.5	4.6–4.9	5.0–5.4	≥5.5
RA minor axis dimension/BSA (cm/m^2)	1.7–2.5	2.6–2.8	2.9–3.1	≥3.2	1.7–2.5	2.6–2.8	2.9–3.1	≥3.2
Atrial area								
LA area (cm^2)	≤20	20–30	30–40	>40	≤20	20–30	30–40	>40
Atrial volumes								
LA volume (ml)	22–52	53–62	63–72	≥73	18–58	59–68	69–78	≥79
LA volume/BSA (ml/m^2)	**22 ± 6**	**29–33**	**34–39**	**≥40**	**22 ± 6**	**29–33**	**34–39**	**≥40**

Values in bold are recommended and best validated.

- Diametro anello A-P: v.n. 18-26 tele diastole 11-12 mm telesistole
- % accorciamento anello : D diast –D sist /D diast x 100 v.n. 15-33%
- Diametro > 35 mm severa dilatazione
- Distanza tetto LA –piano valvolare > 55 mm
- Indice circolarizzazione anulus: D AP/D C-C (v.n. 0,83)

Table 5 Reference limits and partition values of left ventricular size

	Women				Men			
	Reference range	Mildly abnormal	Moderately abnormal	Severely abnormal	Reference range	Mildly abnormal	Moderately abnormal	Severely abnormal
LV dimension								
LV diastolic diameter	3.9–5.3	5.4–5.7	5.8–6.1	≥6.2	4.2–5.9	6.0–6.3	6.4–6.8	≥6.9
LV diastolic diameter/BSA (cm/m^2)	2.4–3.2	3.3–3.4	3.5–3.7	≥3.8	2.2–3.1	3.2–3.4	3.5–3.6	≥3.7
LV diastolic diameter/height (cm/m)	2.5–3.2	3.3–3.4	3.5–3.6	≥3.7	2.4–3.3	3.4–3.5	3.6–3.7	≥3.8
LV volume								
LV diastolic volume (ml)	56–104	105–117	118–130	≥131	67–155	156–178	179–201	≥201
LV diastolic volume/BSA (ml/m^2)	**35–75**	**76–86**	**87–96**	**≥97**	**35–75**	**76–86**	**87–96**	**≥97**
LV systolic volume (ml)	19–49	50–59	60–69	≥70	22–58	59–70	71–82	≥83
LV systolic volume/BSA (ml/m^2)	**12–30**	**31–36**	**37–42**	**≥43**	**12–30**	**31–36**	**37–42**	**≥43**

Values in bold are recommended and best validated.

- ESD ≥ 45mm ESV ≥ 50 ml/m2
- EF % < 60%

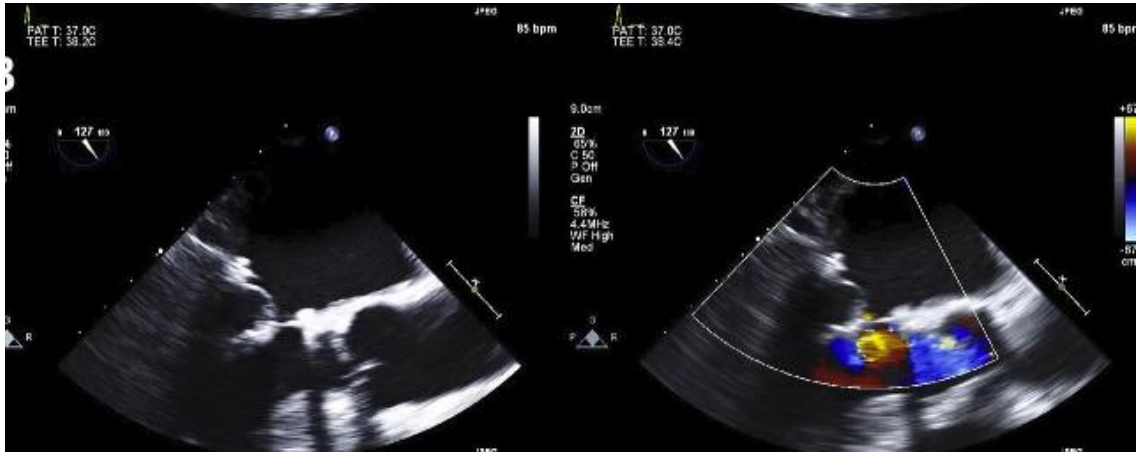
- indice disfunzione vs subclinica:

  Vel lat anulus : < 10.5 cm

  GLS. < 18 %

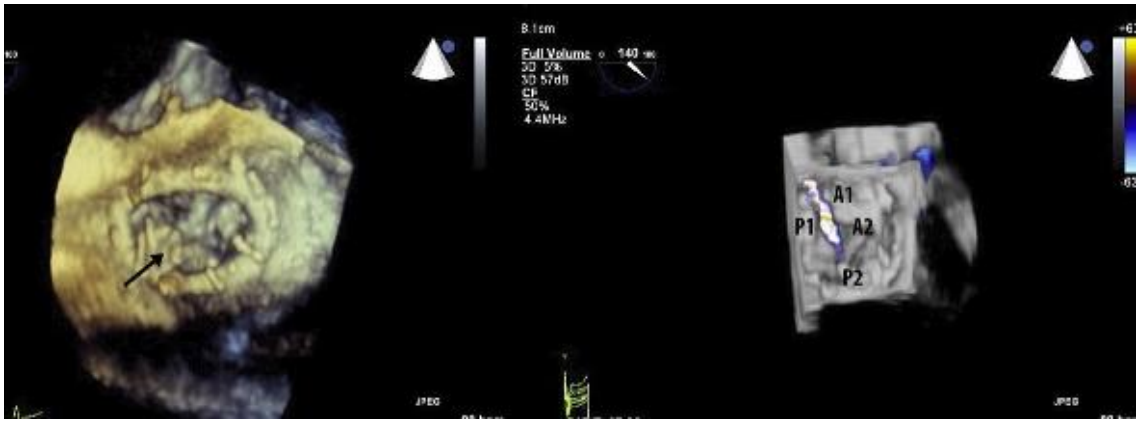
TEE intra-op post riparazione

Resezione quadrangolare P2 + anello



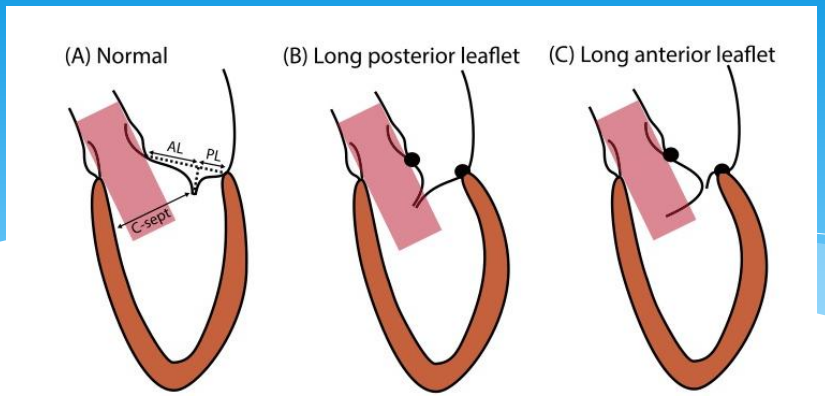
Neo corde su P2

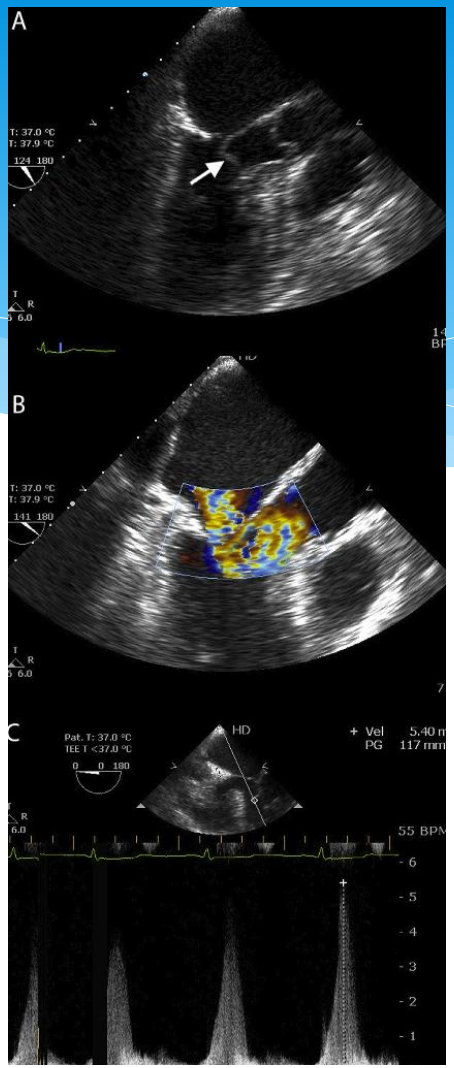
- Altezza coaptazione > 8 mm
- Movimento dei lembi
- Residua IM valutata in telesistole
- Escludere SAM



Predittori negativi di riparazione

- Coinvolgimento LMA; bileaflet
- Altezza LMP
- Severa dilatazione e/o calcificazione anulus

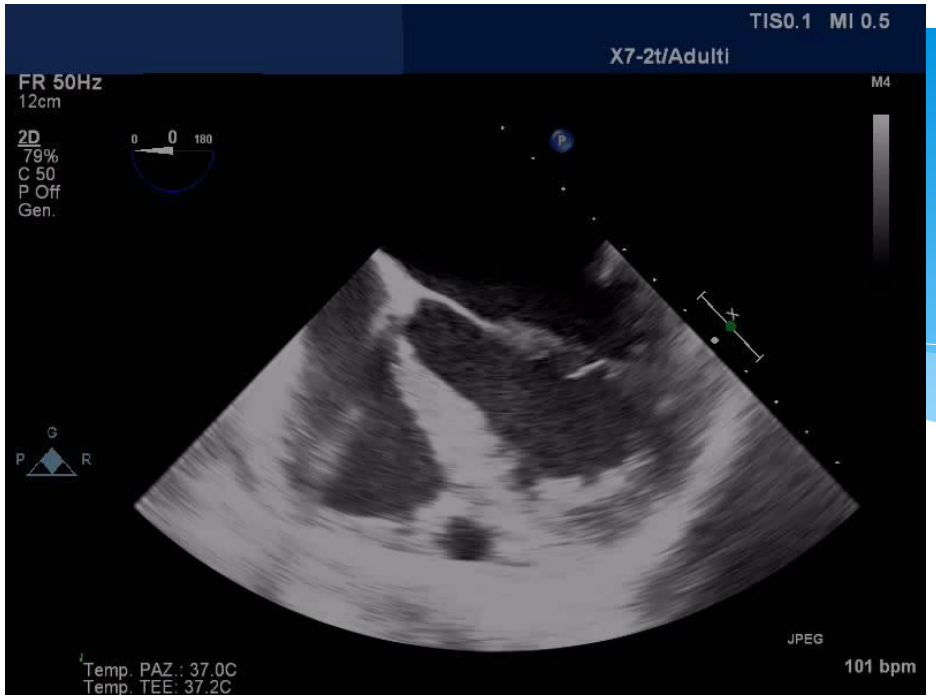


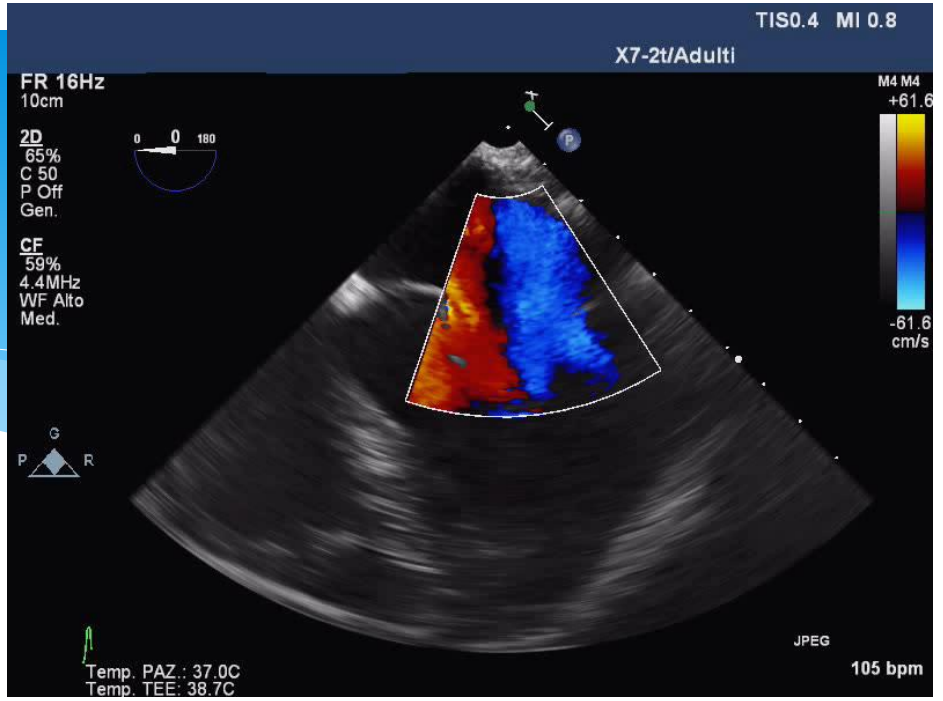


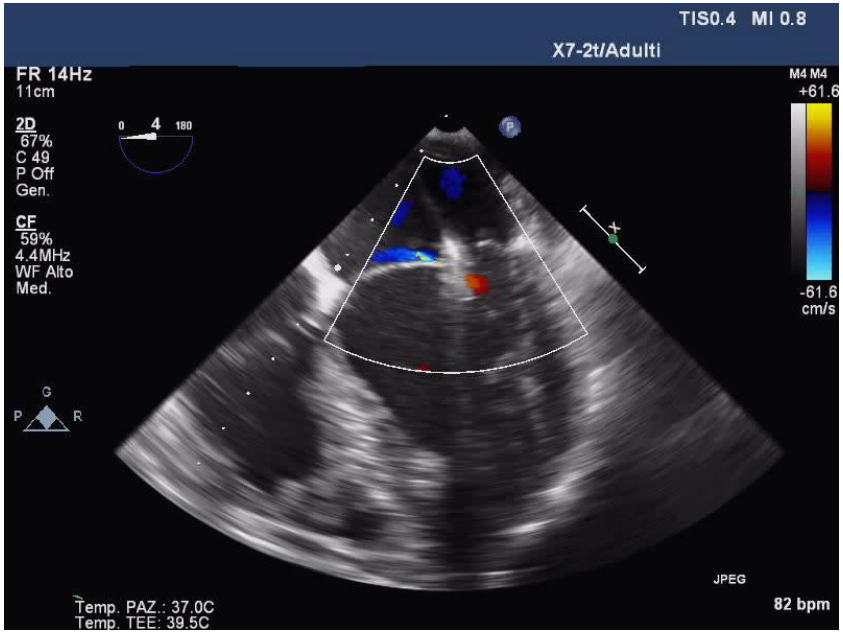
- Rapporto LMA/ lmp < 1.3
- Distanza punto coaptazione- setto < 25 mm
- Eccesso tessuto lembi rispetto anello
- Ipertrofia SIV basale
- VS piccolo

- Ipovolemia
- Aumentata contrattilità LV
- Farmaci inotropi
- Low left ventricular afterload

Sidebotham,J. Am Soc echocardiography april 2014


TIS0.1 MI 0.5
X7-2t/Adulti
FR 50Hz
12cm
2D
79%
C 50
P Off
Gen.
M4
JPEG
Temp. PAZ.: 37.0C
Temp. TEE: 37.2C
101 bpm


TIS0.4 MI 0.8
X7-2t/Adulti
FR 16Hz
10cm
2D
65%
C 50
P Off
Gen.
CF
59%
4.4MHz
WF Alto
Med.
M4 M4
+61.6
-61.6
cm/s
JPEG
Temp. PAZ.: 37.0C
Temp. TEE: 38.7C
105 bpm


TIS0.4 MI 0.8
X7-2t/Adulti
FR 14Hz
11cm
2D
67%
C 49
P Off
Gen.
CF
59%
4.4MHz
WF Alto
Med.
M4 M4
+61.6
-61.6
cm/s
JPEG
Temp. PAZ.: 37.0C
Temp. TEE: 39.5C
82 bpm

Conclusioni:

- Stima del meccanismo, sede, entità del rigurgito
- Pianificazione del tipo di intervento chirurgico
- Valutazione fattibilità opzioni alternative (clip)
- Immediata valutazione del risultato
- Nuove tecnologie, nuovi parametri e misure

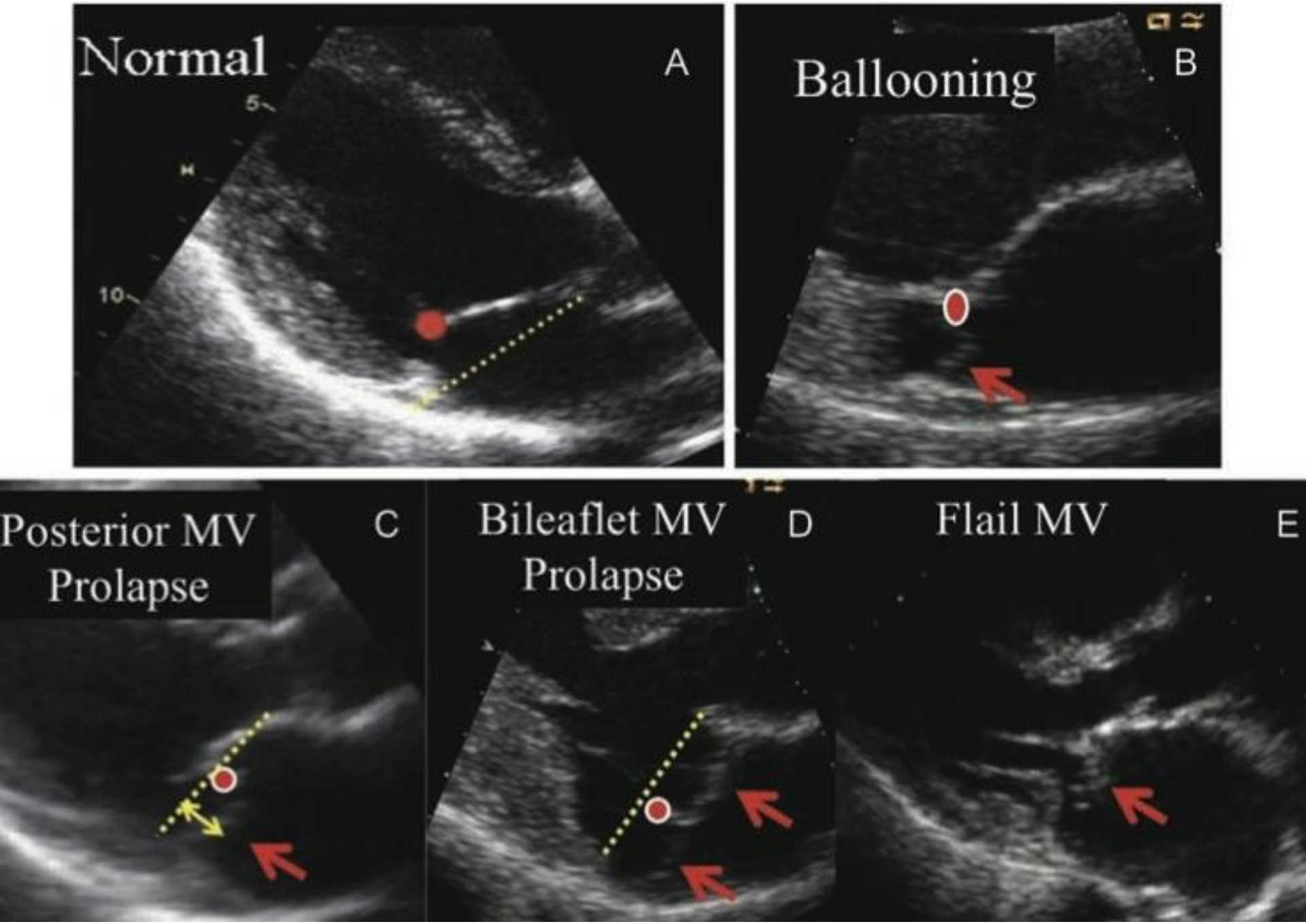
Malattia degenerativa

Billowing valve: una parte lembo protrude in LA ma la coaptazione è sopra anulus

Floppy valve: lembi ispessiti ridondanti

Prolasso lembo/i : coaptazione sotto/ al piano valvolare

Flail lembo: eversione in atrio sx


Normal
A
Ballooning
B
Posterior MV Prolapse
C
Bileaflet MV Prolapse
D
Flail MV
E