DIU ECHOCARDIOGRAPHIE MODULE REANIMATION 2009

Rôles de l' ETO per-opératoire dans la chirurgie reconstructrice mitrale

A.Berrebi

Dépt de Chirurgie CV (A.Deloche-JN Fabiani) – HEGP - Paris

Mitral Valve Reconstruction a ≈ 40 year's technique

LA PRESSE MEDICALE — 251 — 77, N° 7, 8 Février 1969

TECHNIQUE CHIRURGICALE

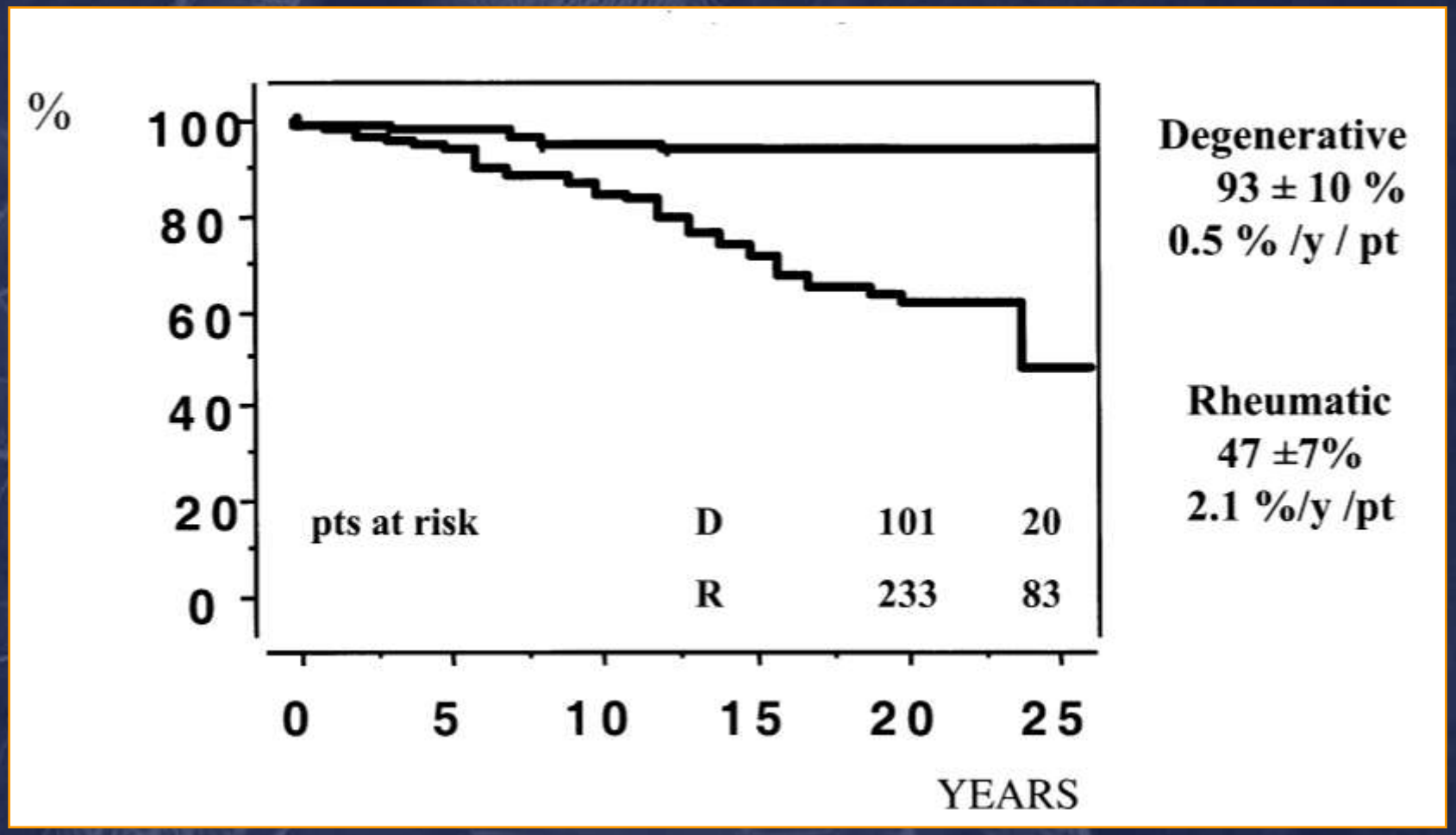
sous la Direction de J.-C. PATEL

La valvuloplastie reconstitutive

Une nouvelle technique de valvuloplastie mitrale

Par Alain CARPENTIER (Paris)

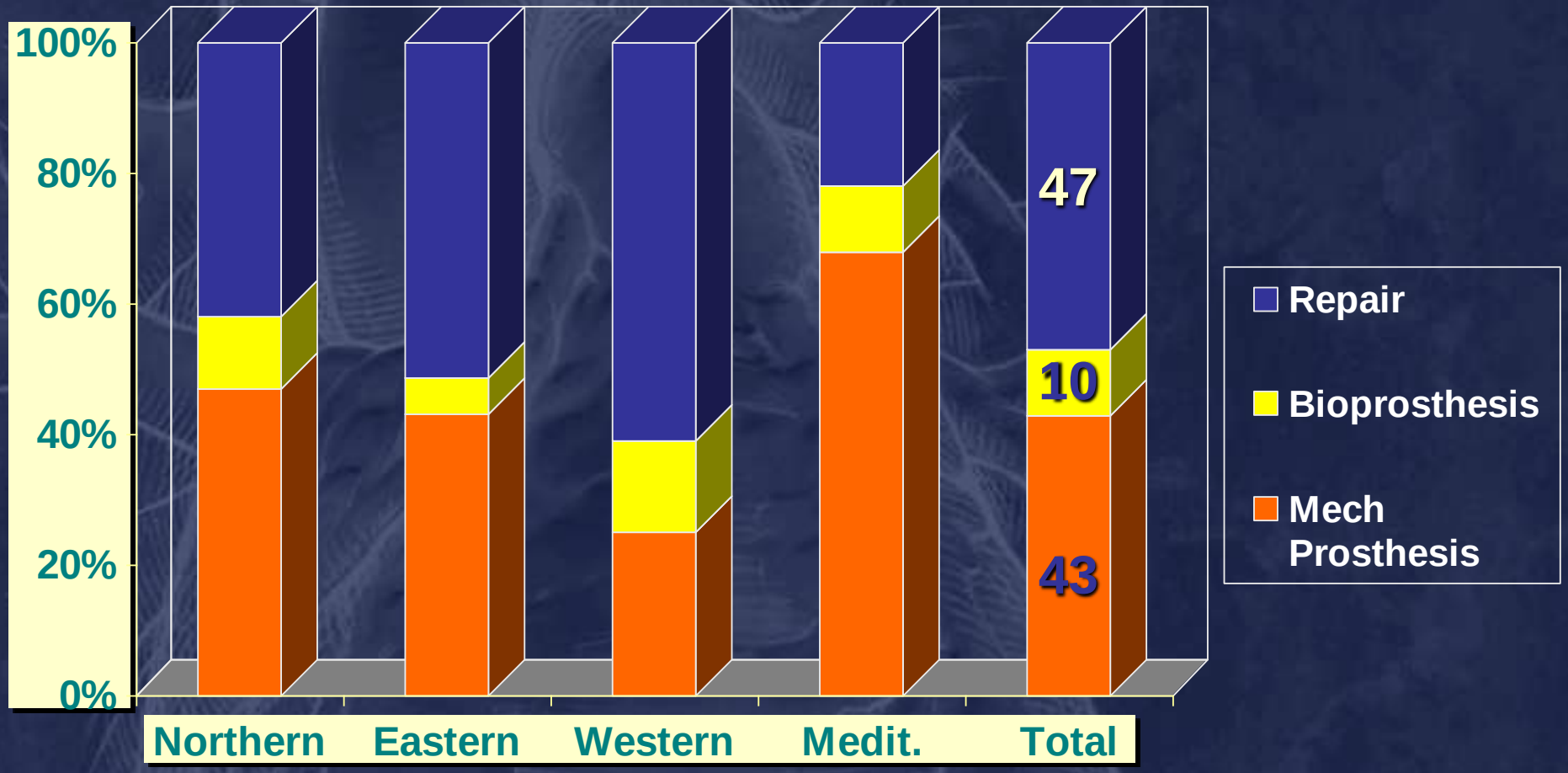
Third Decade with Carpentier's techniques - reoperation-



Braunberger et al. Circulation 2001;104: I8-I11.

Type of Intervention in MR

Regional Variation in Euro Heart Survey



Iung et al. Eur Heart J. 2003;24:1231-43

ACC/AHA 2006 Guidelines for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease)

Developed in Collaboration With the Society of Cardiovascular Anesthesiologists (Endorsements pending)

Asymptomatic Degenerative Chronic Severe MR

Class IIa — **"prophylactic" surgery**

MV repair is reasonable in experienced surgical centers for asymptomatic patients with chronic severe MR* with preserved LV function (ejection fraction greater than 0.60 and end-systolic dimension less than 40 mm) in whom the likelihood of successful repair without residual MR is greater than 90%. *(Level of Evidence: B)*

J Am Coll Cardiol 2006;48:598-675

Avoiding the Babel Syndrome

Myxomatous Disease,
Flail Leaflet, Partial-Flail,
Mitral Valve Prolapse Syndrome,
Billowing, Floppy valve …..

Valve Analysis:a common language

Etiology → **Lesions** → **Dysfunction**

The Cause of Valve Disease

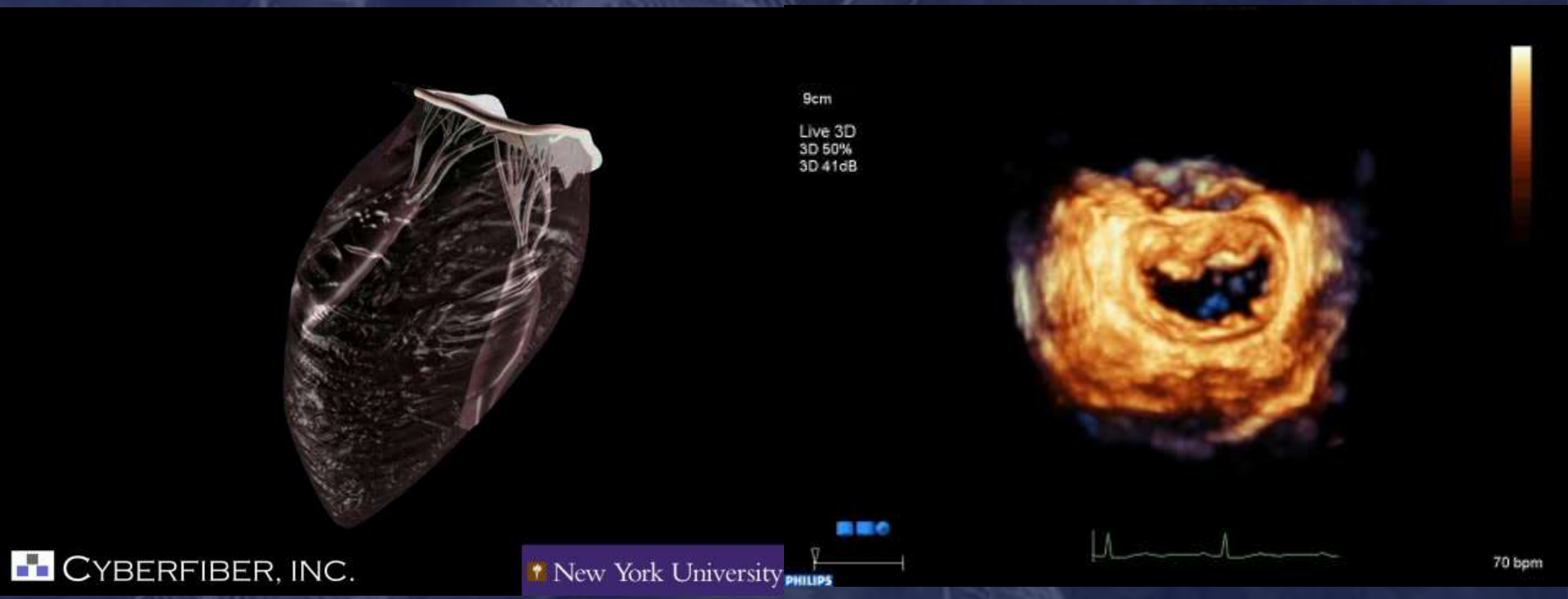
The Result of the Disease Process

The Result of the Lesions

Respective roles

	Etiology	*Lesion*	*Dysfunction*
Echo	++	+	+++
Surgeon	++	+++	+

The Mitral Functional Unit



The Surgeon's Needs in Mitral Repair

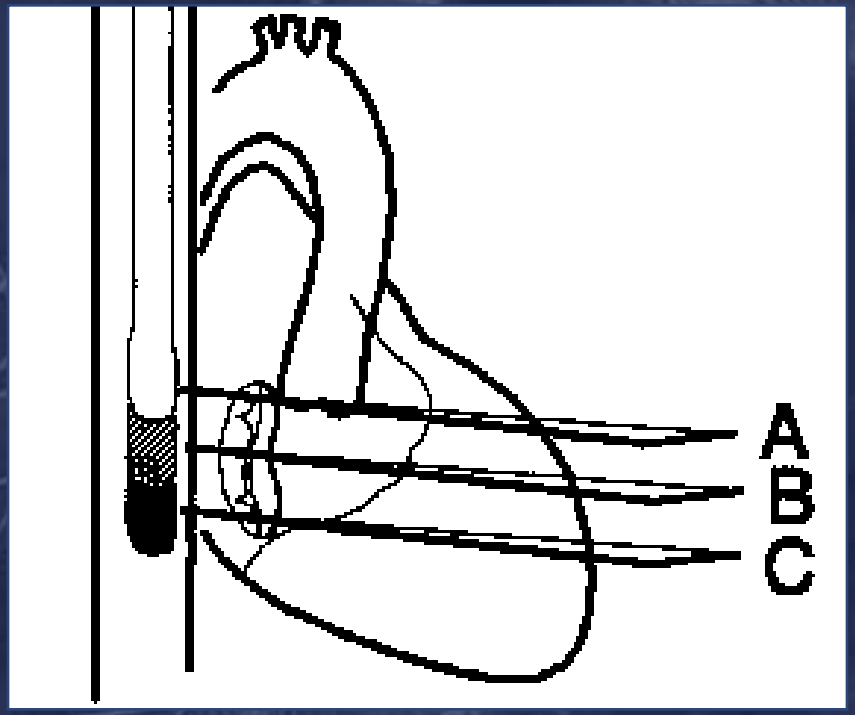
- ✓ Leaflet motion ?
- ✓ Which scallop ?
- ✓ Calcification – Annular Dilatation ?
- ✓ Etiology
- ✓ Risk of SAM ?
- ✓ Tricuspid ?
- ✓ Intra-op control ?

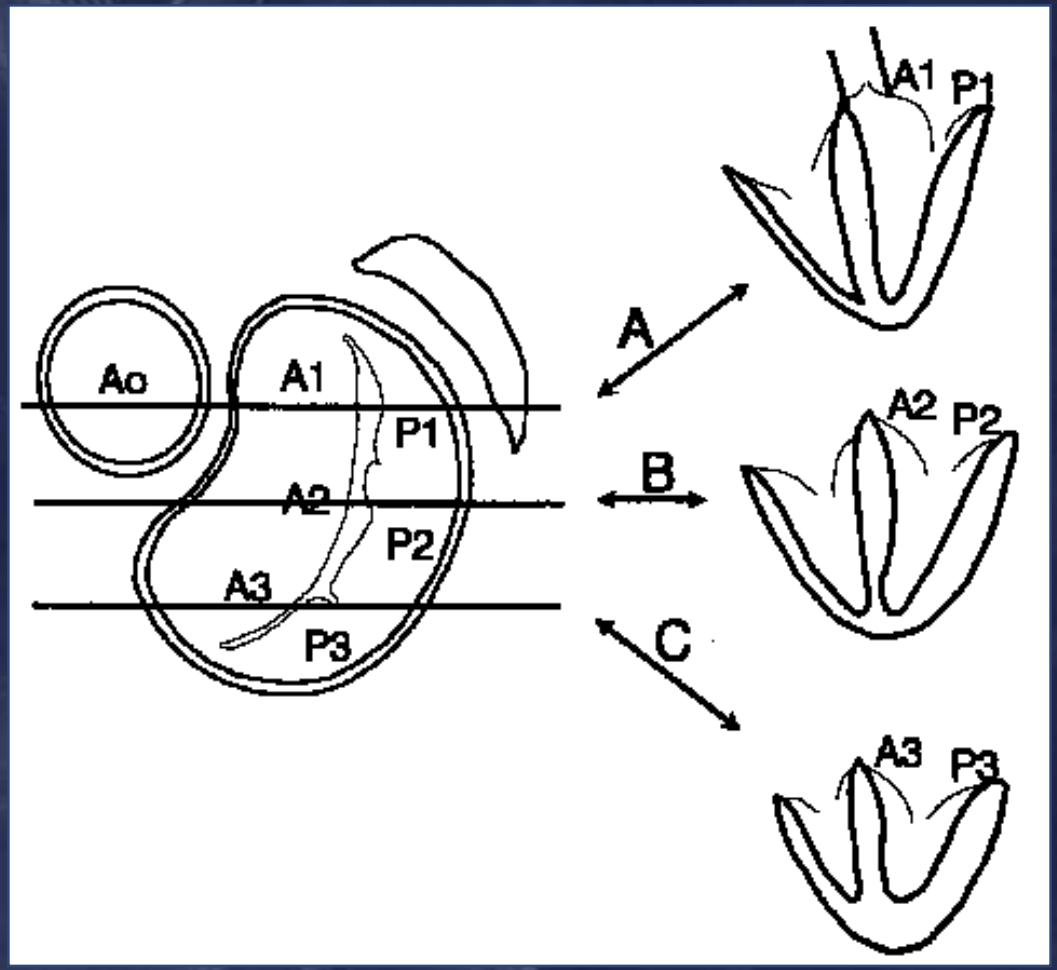
Functional Analysis

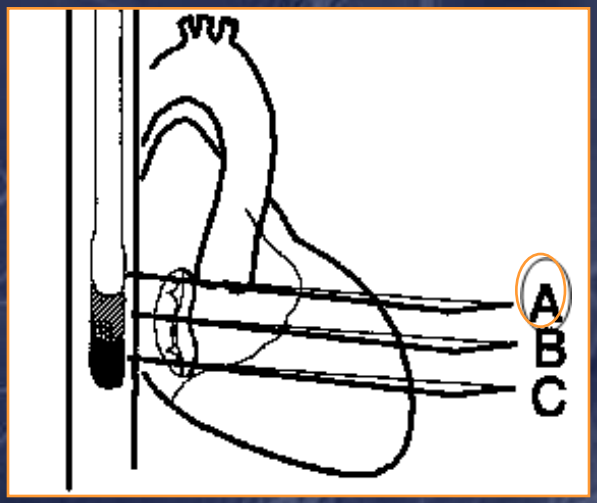
The Surgeon's Needs in Mitral Repair

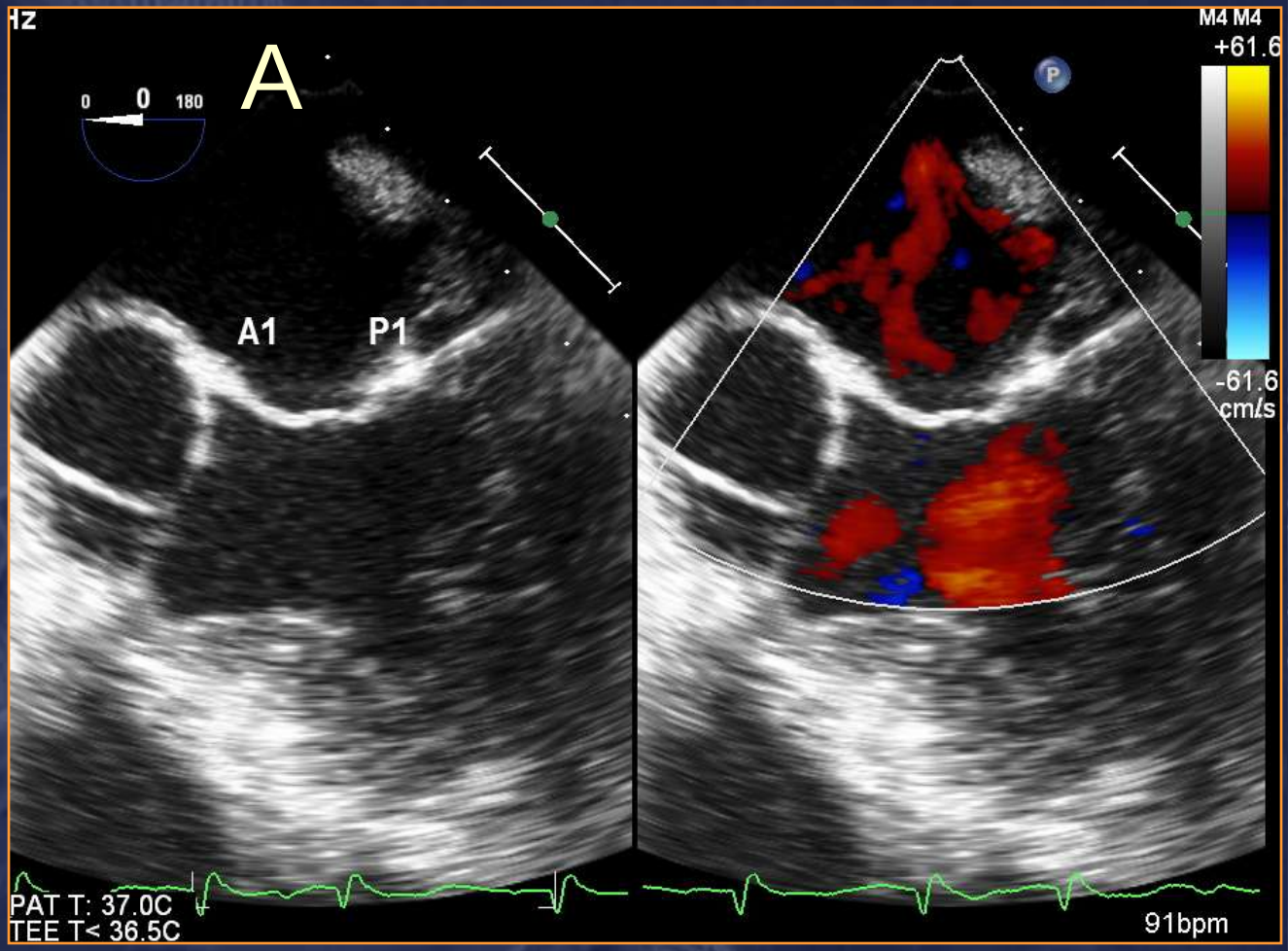
- ✓ Leaflet motion ?
- ✓ Which scallop ?
- ✓ Calcification – Annular Dilatation ?
- ✓ Etiology
- ✓ Risk of SAM ?
- ✓ Tricuspid ?
- ✓ Intra-op control ?

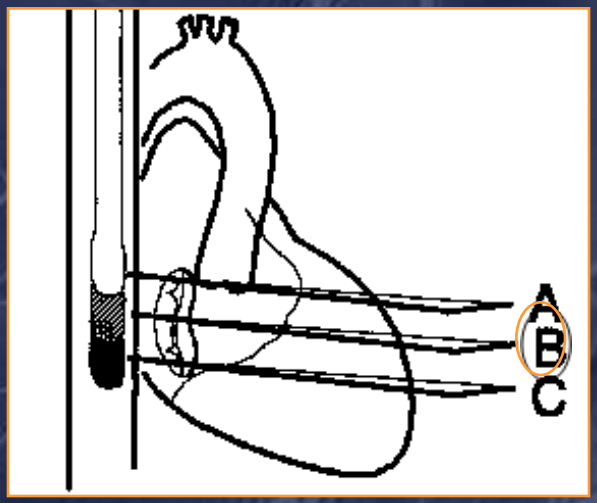
Segmental Approach TEE (0°)

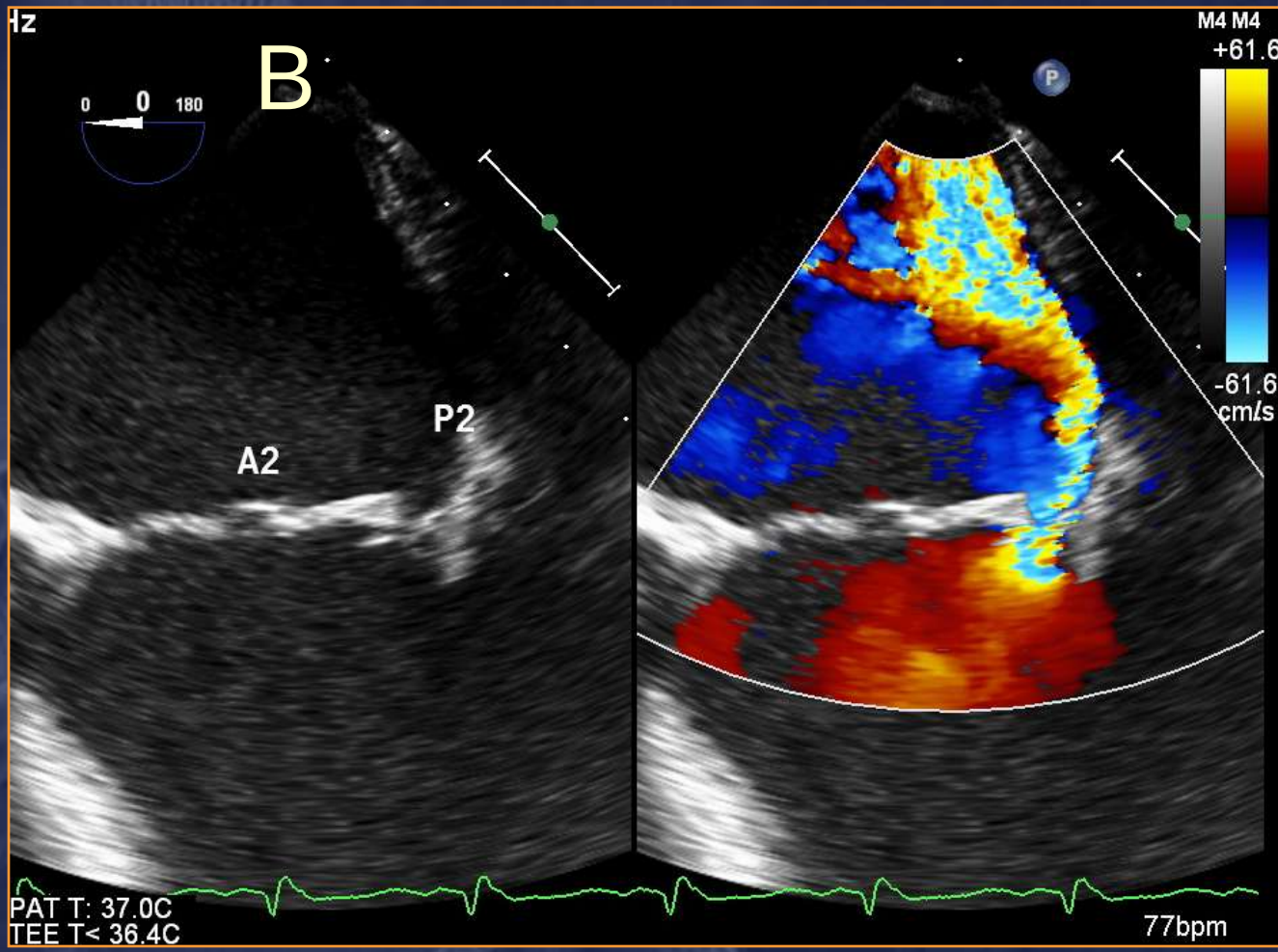





A
B
C


Hz
A
0
0
180
A1
P1
M4 M4
+61.6
-61.6
cm/s
PAT T: 37.0C
TEE T< 36.5C
91bpm


A
B
C


Hz
B
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0
180
P2
A2
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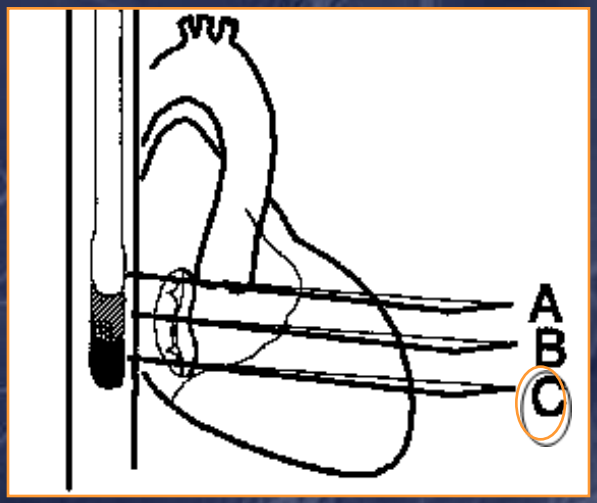
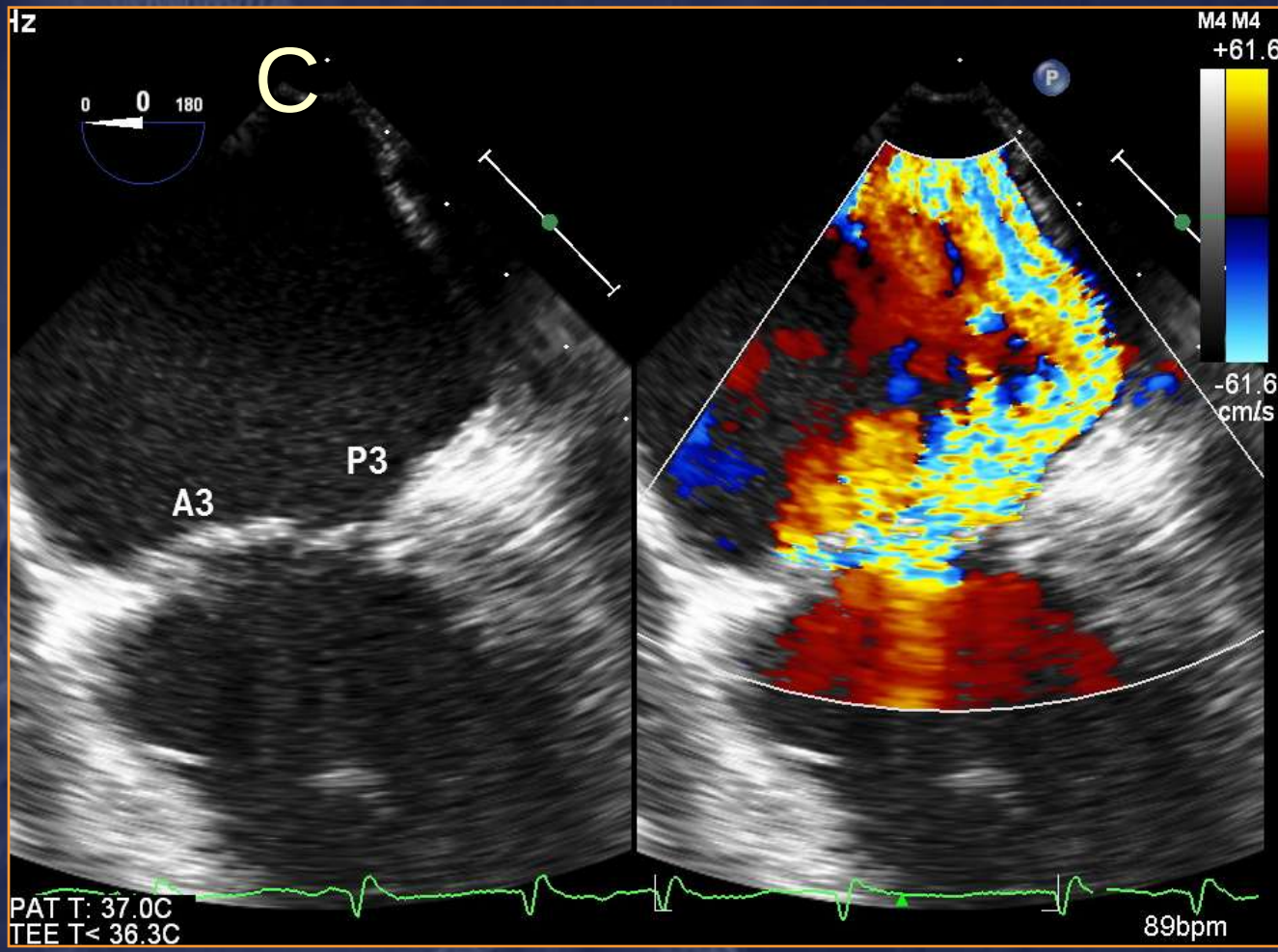
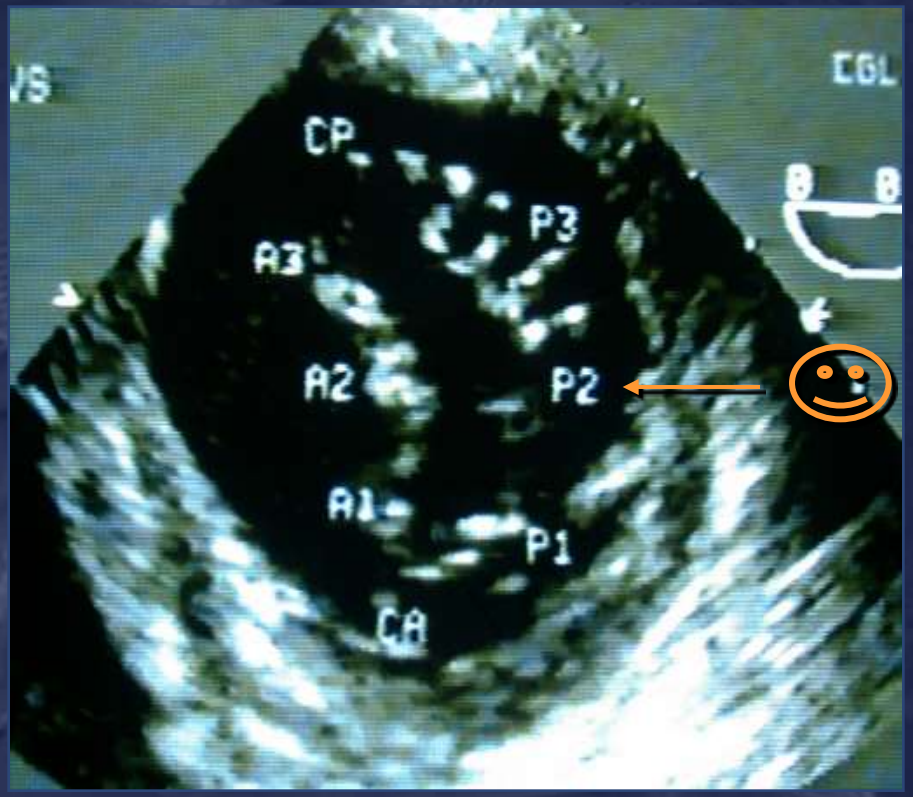
-61.6
cm/s
PAT T: 37.0C
TEE T< 36.4C
77bpm


A
B
C

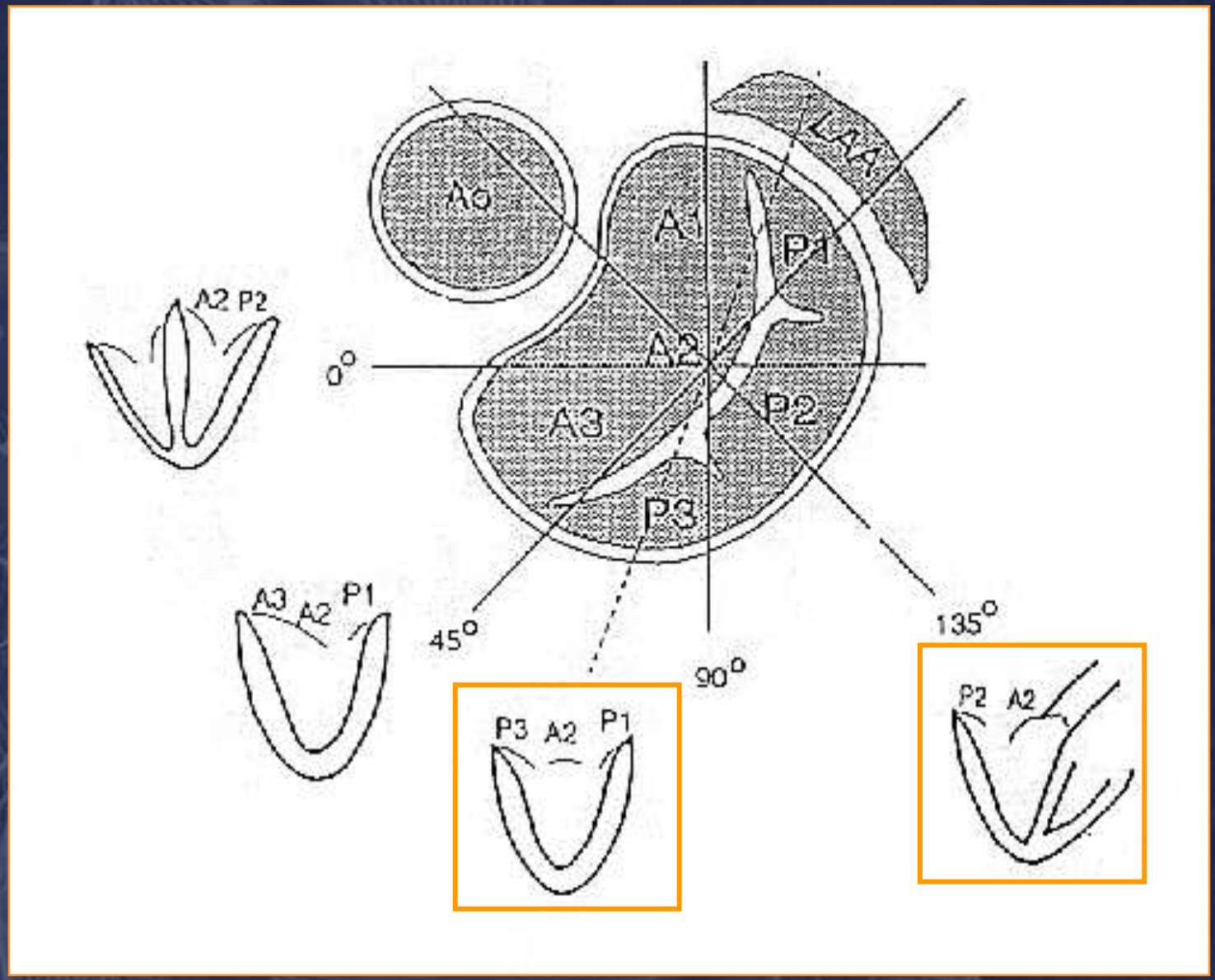

Hz
C
0
0
180
M4 M4
+61.6
-61.6
cm/s
P3
A3
PAT T: 37.0C
TEE T< 36.3C
89bpm

TEE (0°)
Trangastric view




T ETO: 37.4°C
CGL NOR
0 0 180
AO

Multiplane TEE




T ETO: 37.4°C
CGL NON
0 93 180

ANALYSE SEGMENTAIRE CHIRURGICALE

The Surgeon's Needs in Mitral Repair

- ✓ Leaflet motion ?
- ✓ Which scallop ?
- ✓ Calcification – Annular Dilatation ?
- ✓ Etiology
- ✓ Risk of SAM ?
- ✓ Tricuspid ?
- ✓ Intra-op control ?

Calcifications

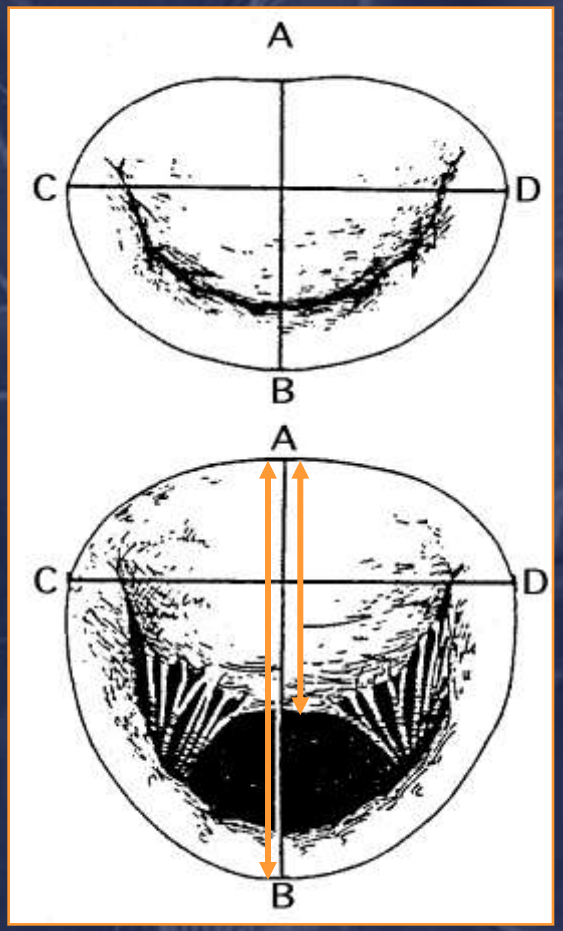
Location

Extent (ventricle)

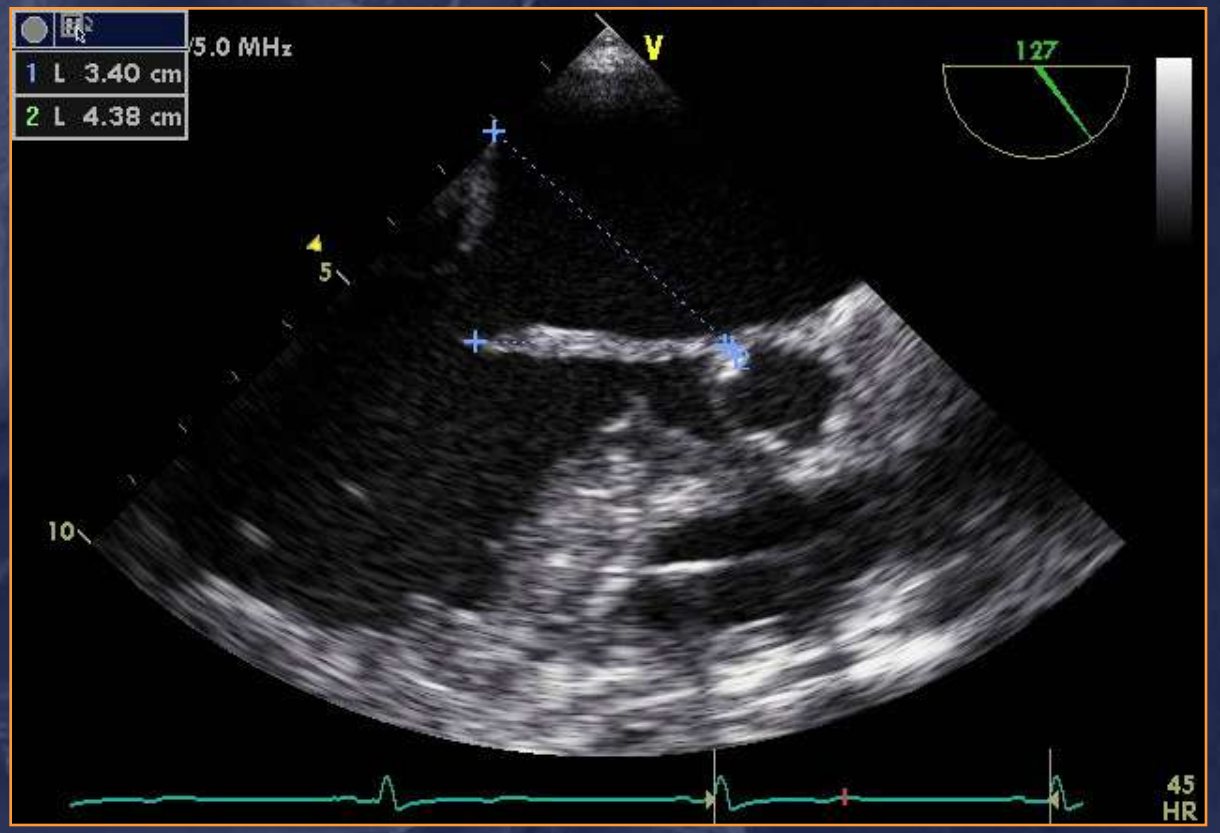
TTE ++

Annular dilatation

Involves vertical diameter ++



$$\frac{\text{Annulus diameter}}{\text{Height of A2}} > 1.3$$



The Surgeon's Needs in Mitral Repair

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- ✓Etiology
- ✓Risk of SAM ?
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- ✓Intra-op control ?

Etiology

- Degenerative valve diseases
  - ✓Barlow (billowing valve)
  - ✓Fibroelastic deficiency
  - ✓Marfan
- Rheumatic valve disease
- Bacterial endocarditis
- Calcified valve

- Cardiomyopathies

The Surgeon's Needs in Mitral Repair

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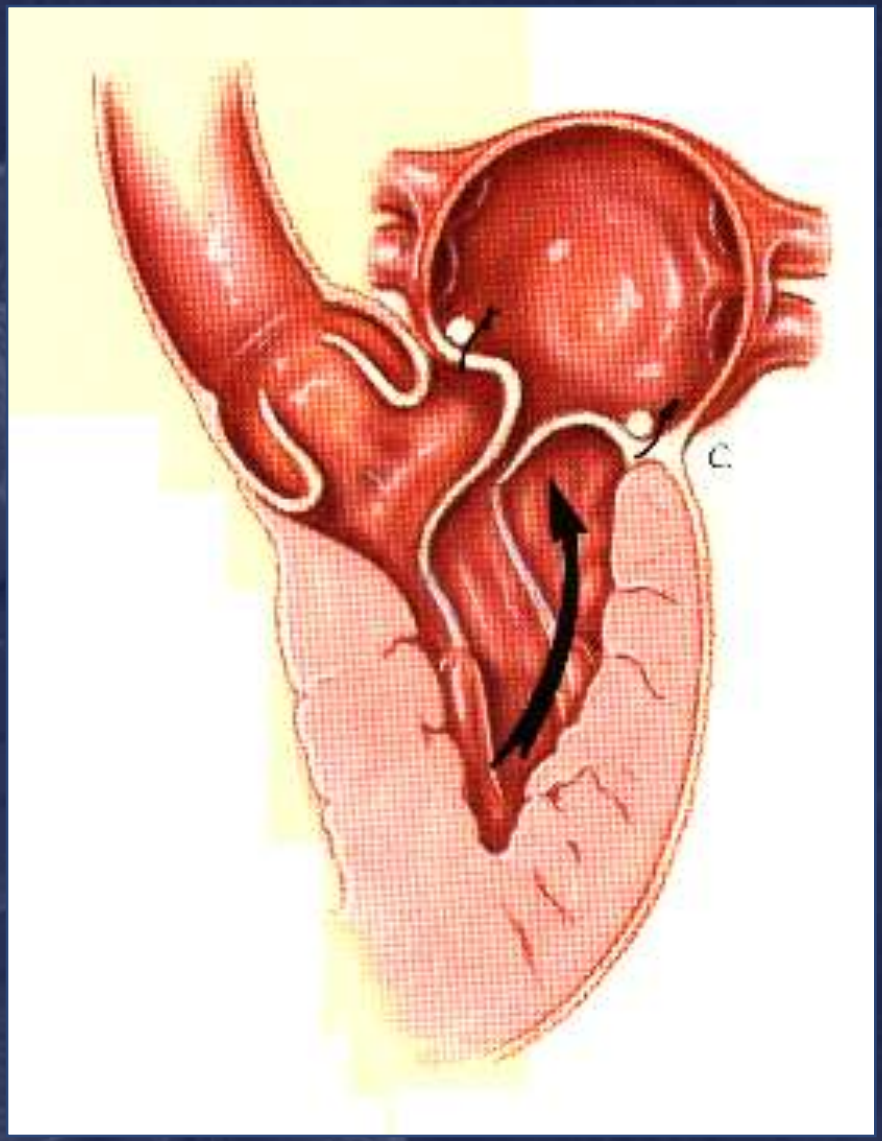
- ✓ Risk of SAM ?
- ✓ Tricuspid ?
- ✓ Intra-op control ?

Risk of SAM

High excess of tissue (Barlow)

Narrow mitro-aortic angle (<130°)

Small LV



Mihaileanu S.Circulation 1988;78 (suppll):I78-I84

The Surgeon's Needs in Mitral Repair

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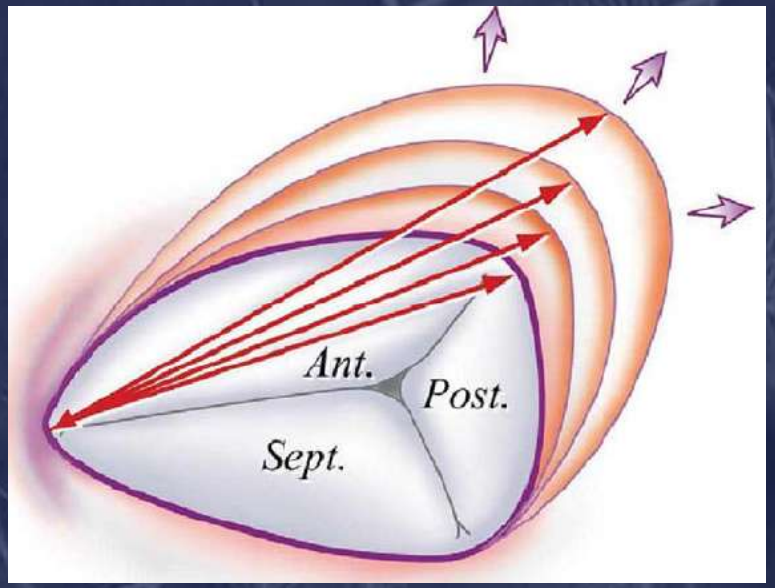
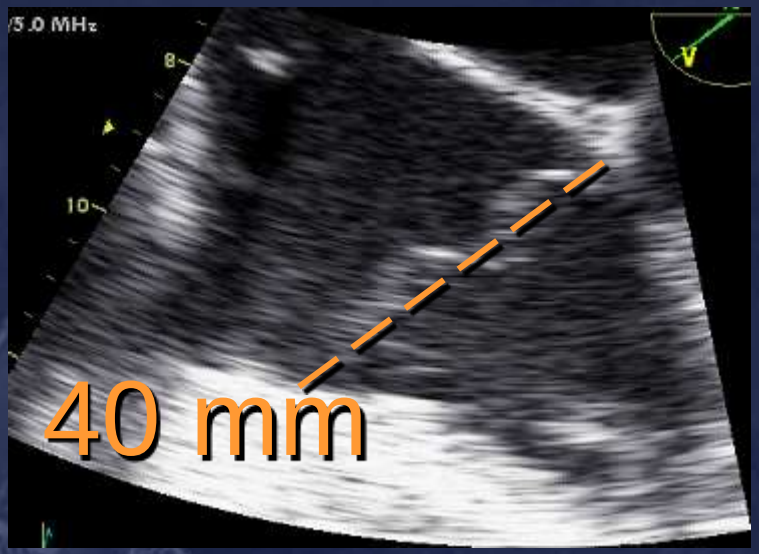
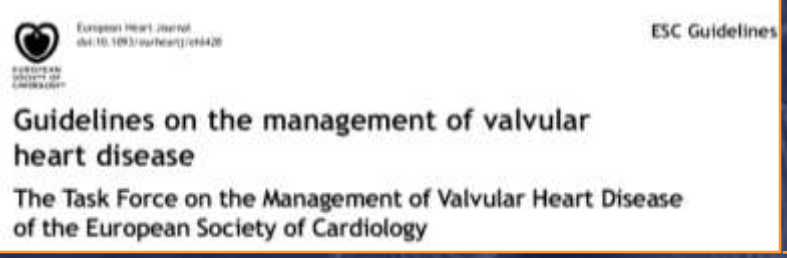




Dreyfus G and al. Ann Thorac Surg 2005;79:127–32



Tricuspid – ESC 07

Moderate organic TR in a patient undergoing left-sided valve surgery	IIaC
Moderate secondary TR with dilated annulus (>40 mm) in a patient undergoing left-sided valve surgery	IIaC
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)	IIaC

Vahanian et al. Eur Heart J. 2007;28(2):230-68


PHILIPS
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X7-2t/ECHO
CI 6Hz
5.4cm
C4
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3D 33dB
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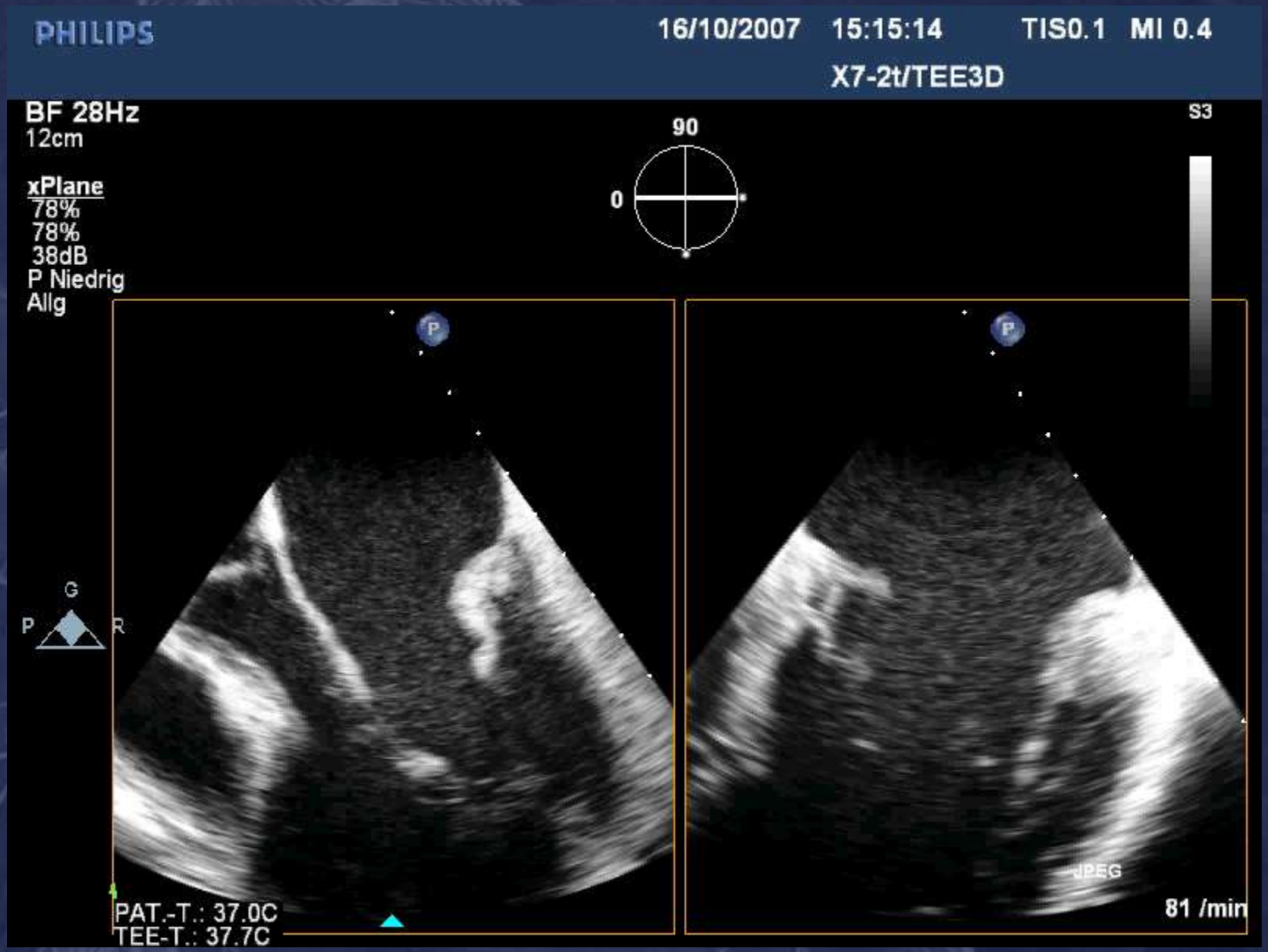
*** bpm
T PAT: 37.0C
T ETO: 39.3C

Valve Analysis in MR

Clinical Cases

Case 1

- ✓ Mr T, 46 yr old
- ✓ Murmur known for 20 yrs
- ✓ Asymptomatic
- ✓ Murmur 4/6
- ✓ Severe MR: ERO 54mm2
- ✓ Valve Analysis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PAT.-T.: 37.0C
TEE-T.: 37.7C
JPEG
81 /min

Etiology ?

A -FED

B -Barlow

C -Endocarditis

D -Ischemic

E -Rheumatic

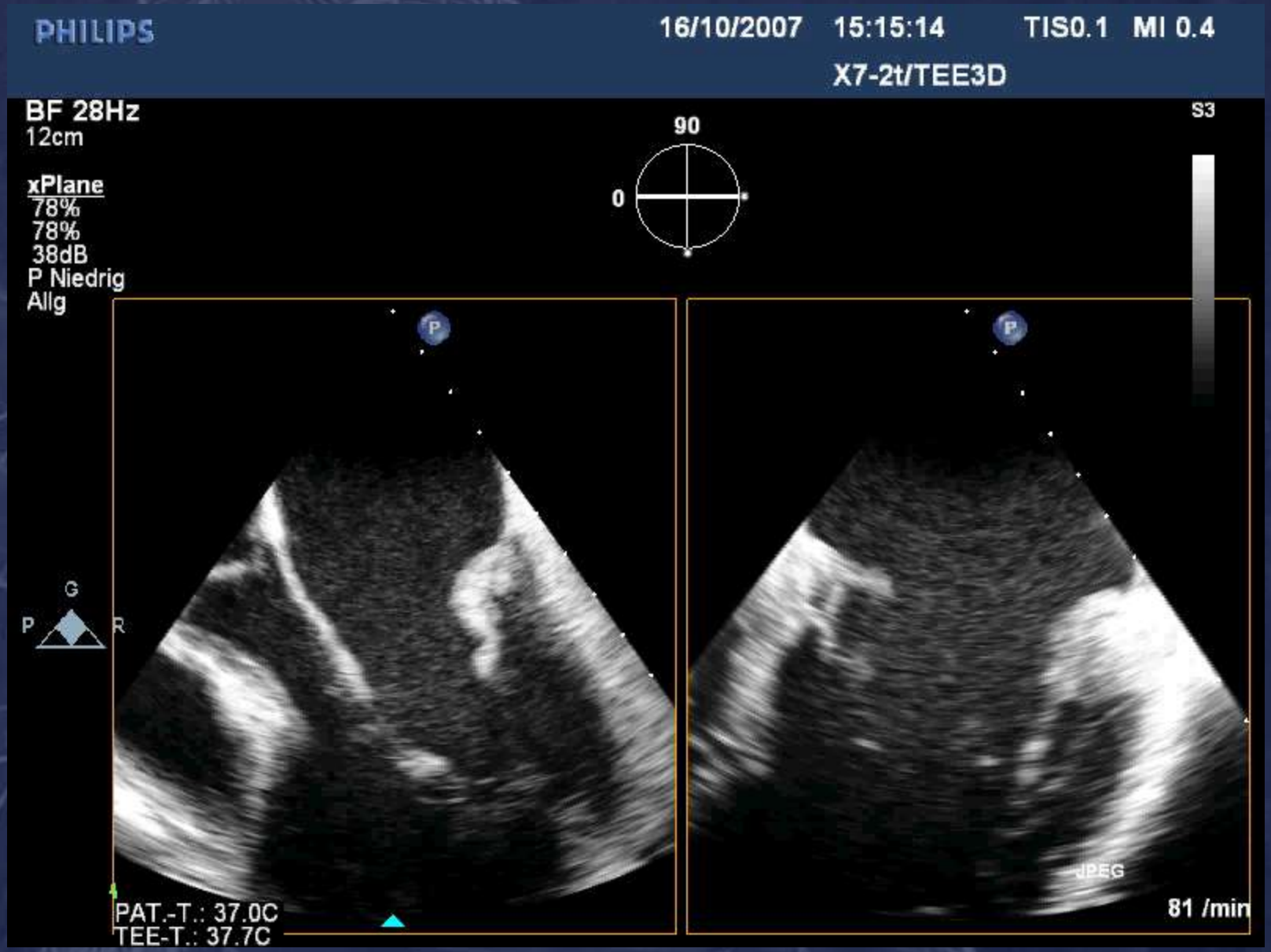
2- Dysfunction ?

A-No billowing - no prolapse

B-Billowing - no prolapse

C-No billowing - prolapse of all scallops

D-Billowing - prolapse of all scallops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BF 28Hz
12cm
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38dB
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S3
G
P
R
PAT.-T.: 37.0C
TEE-T.: 37.7C
JPEG
81 /min

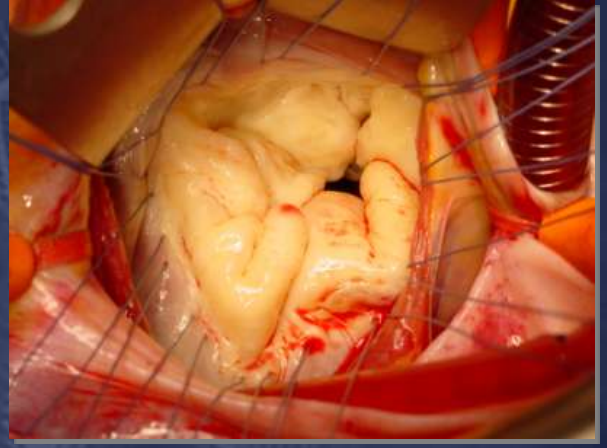
2- Dysfunction ?

A-No billowing - no prolapse

B-Billowing - no prolapse

C-No billowing - prolapse of all scallops

D-Billowing - prolapse of all scallops

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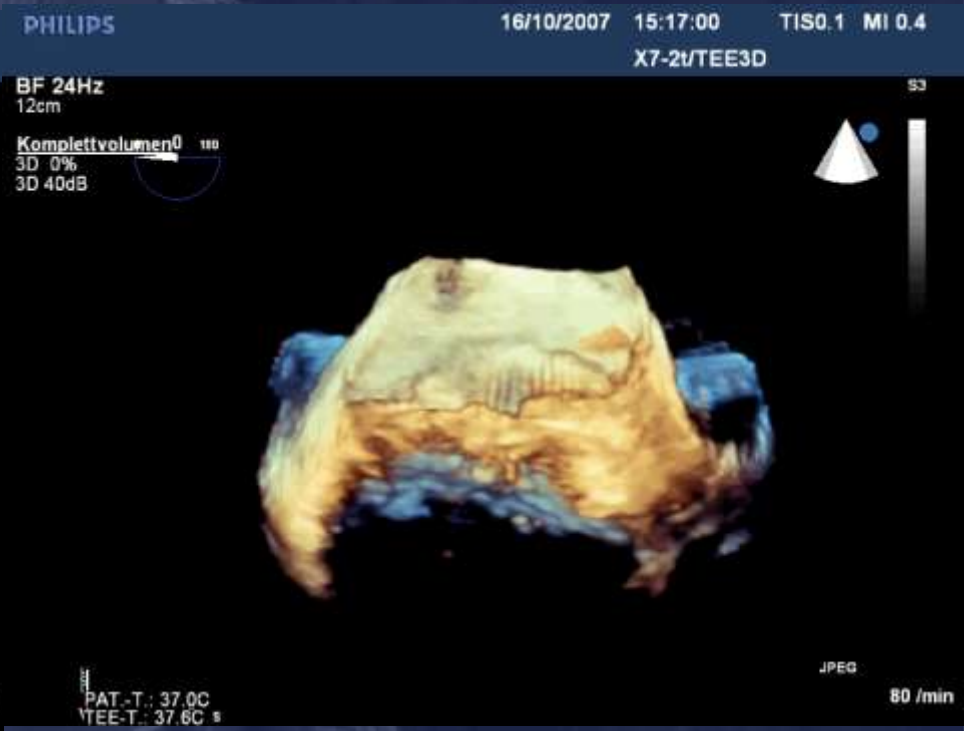
3D 40dB
JPEG
87 /min
PAT.-T.: 37.0C
TEE-T.: 37.3C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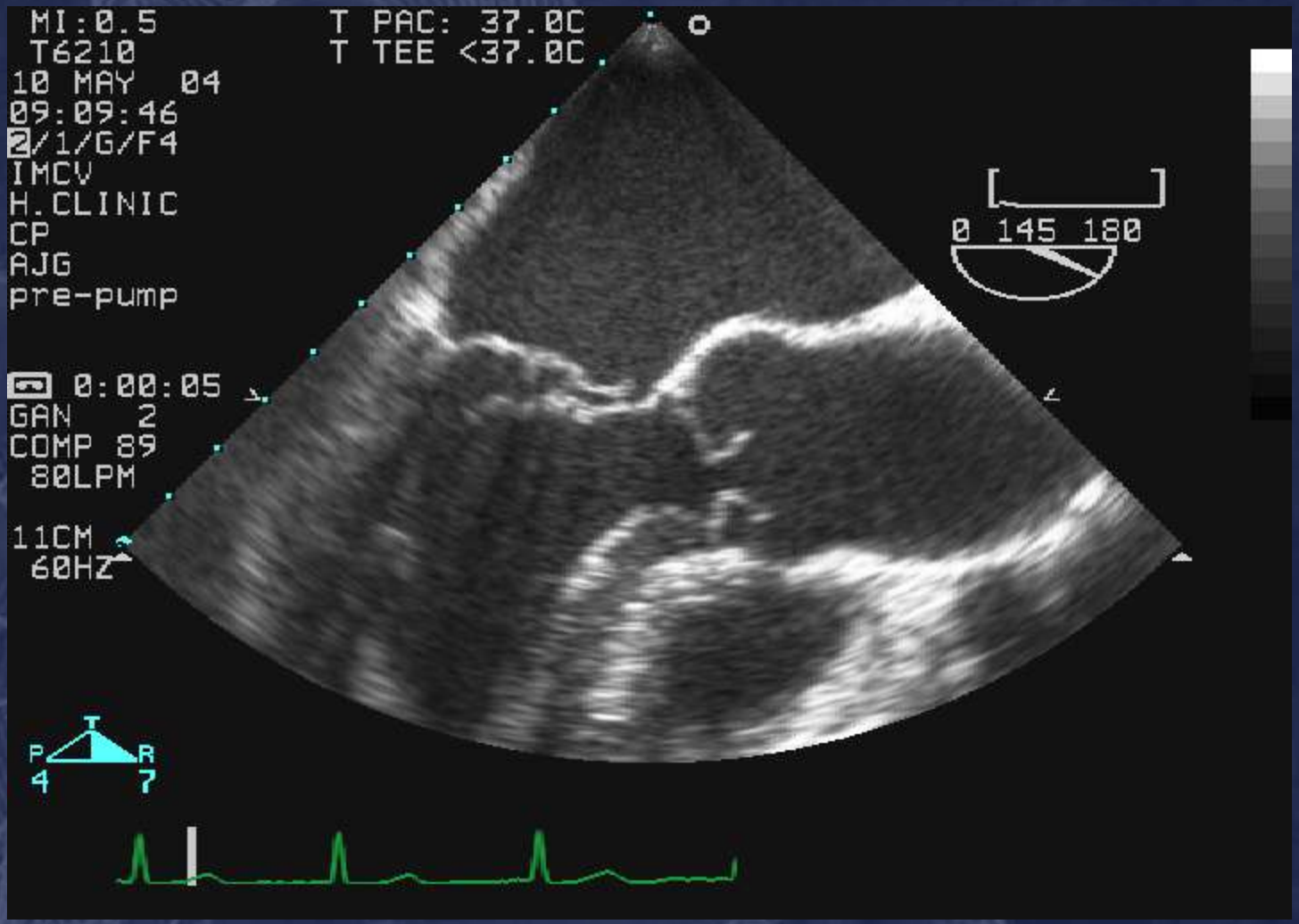
3D 40dB
JPEG
80 /min
PAT.-T.: 37.0C
TEE-T.: 37.6C

Case 2

- ✓Mrs R, 76yr old
- ✓Murmur recently diagnosed during acute pulmonary edema
- ✓NYHA II
- ✓Tx ACE Inhibitors and Diuretics
- ✓Echo: Severe MR (ERO 62 mm2)
- ✓Valve Analysis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2/1/G/F4
IMCV
H.CLINIC
CP
AJG
pre-pump
T PAC: 37.0C
T TEE <37.0C
0 145 180
0:00:05
GAN 2
COMP 89
80LPM
11CM
60HZ
T
P
R
4
7

1 - Etiology ?

A -FED

B -Barlow

C -Endocarditis

D -Ischemic

E -Rheumatic

Etiology ?

A -FED

B -Barlow

C -Endocarditis

D -Ischemic

E -Rheumatic

Dysfunction ?

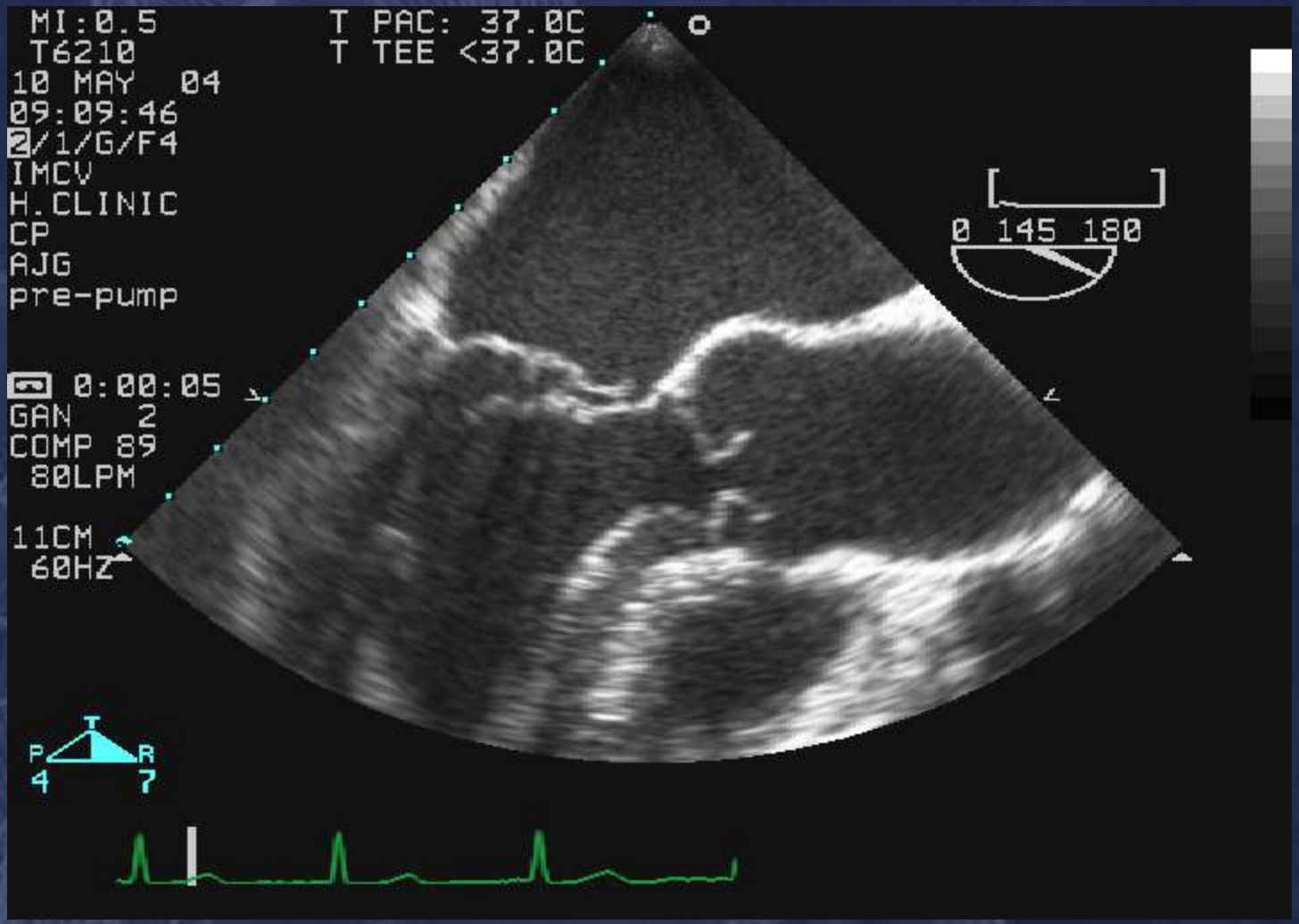
A- II P1

B- II P2

C- II P3

D- II Ant Com

E- II Post Com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H.CLINIC
CP
AJG
pre-pump
T PAC: 37.0C
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GAN 2
COMP 89
80LPM
11CM
60HZ
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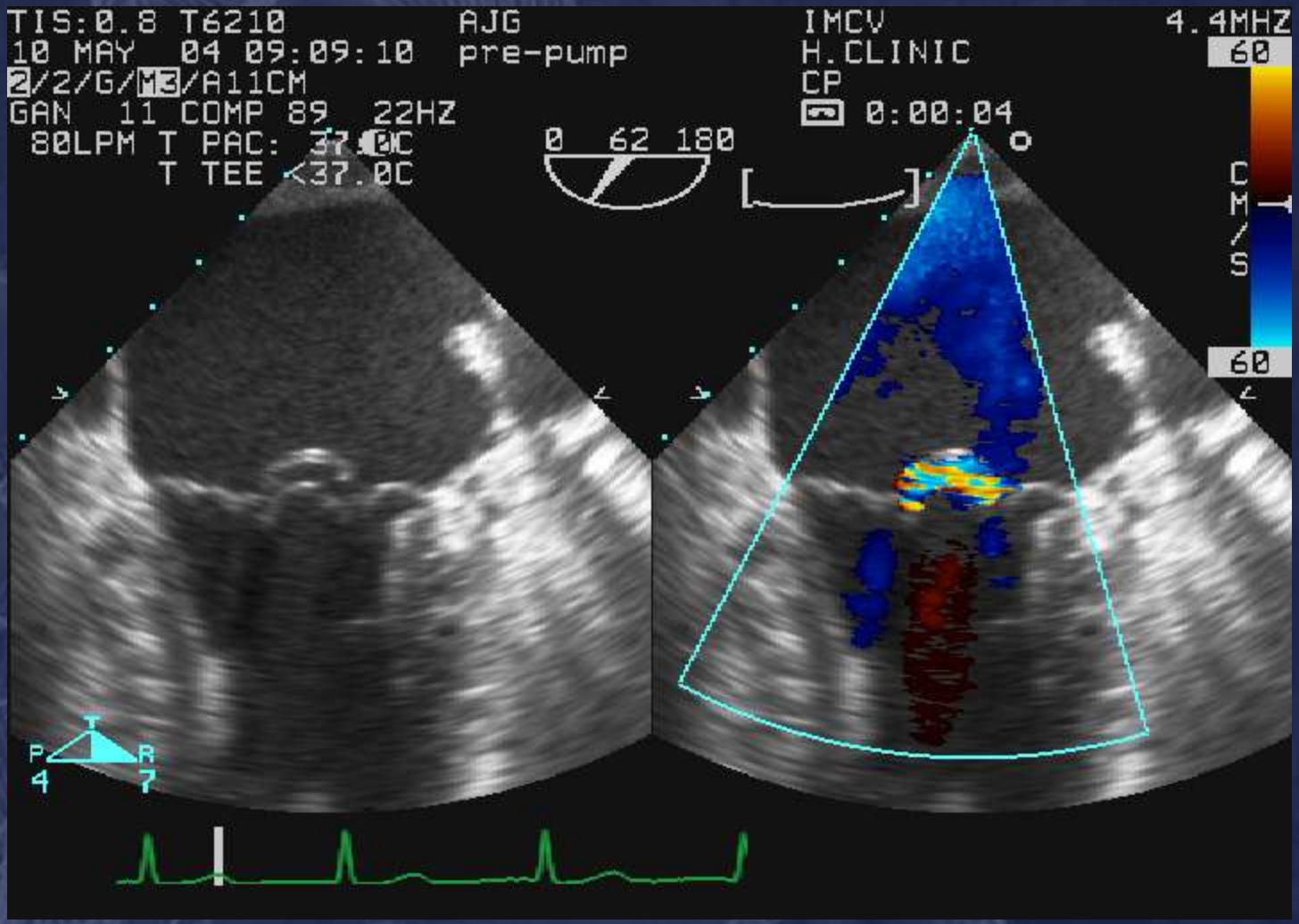
4
7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GAN 11 COMP 89 22HZ
80LPM T PAC: 37.0C
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AJG
pre-pump
0 62 180
IMCV
H.CLINIC
CP
0:00:04
4.4MHZ
60
C
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4
R
7

Dysfunction ?

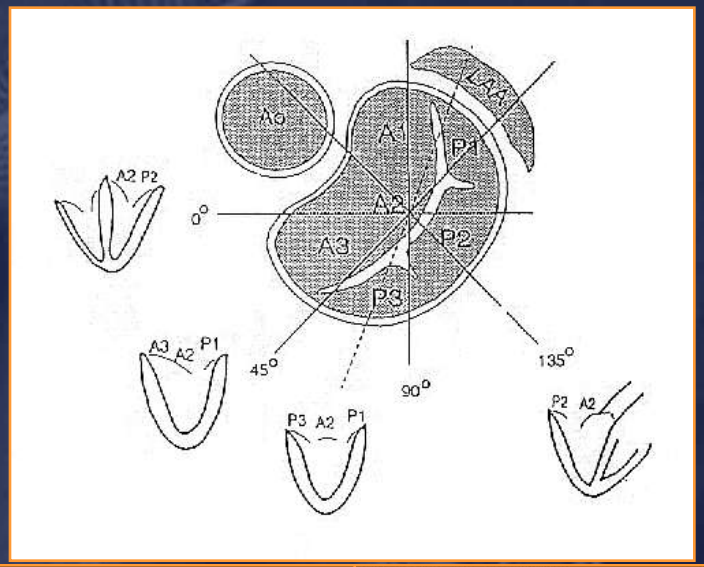
A- II P1

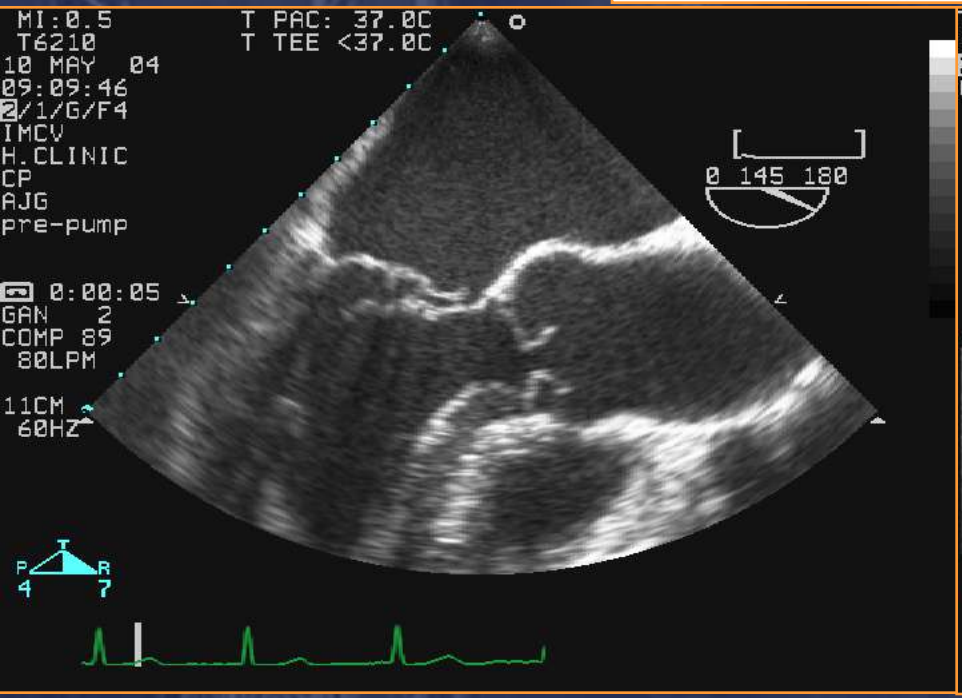
B- II P2

C- II P3

D- II Ant Com

E- II Post Com


Ao
LAA
A1
P1
A2 P2
0°
A2
A3
P2
P3
A3 A2 P1
45°
90°
135°
P3 A2 P1
P2 A2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T6210
10 MAY 04
09:09:46
2/1/G/F4
IMCV
H.CLINIC
CP
AJG
pre-pump
0:00:05
GAN 2
COMP 89
80LPM
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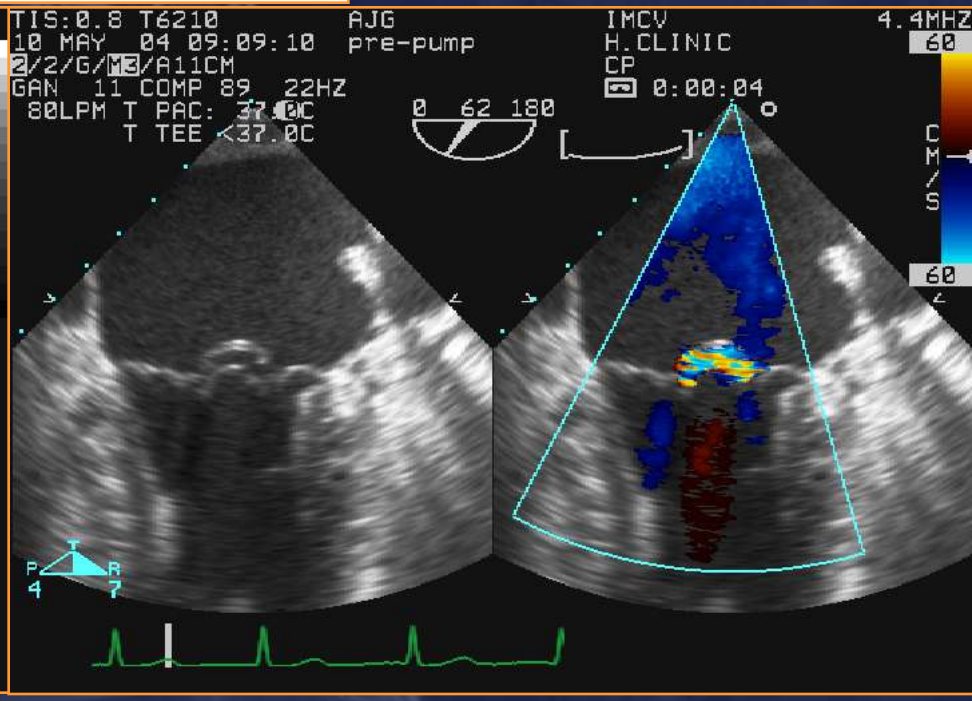
60HZ
T PAC: 37.0C
T TEE <37.0C
0 145 180
P R
4 7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GAN 11 COMP 89 22HZ
80LPM T PAC: 37.0C
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pre-pump
0 62 180
IMCV
H.CLINIC
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4.4MHZ
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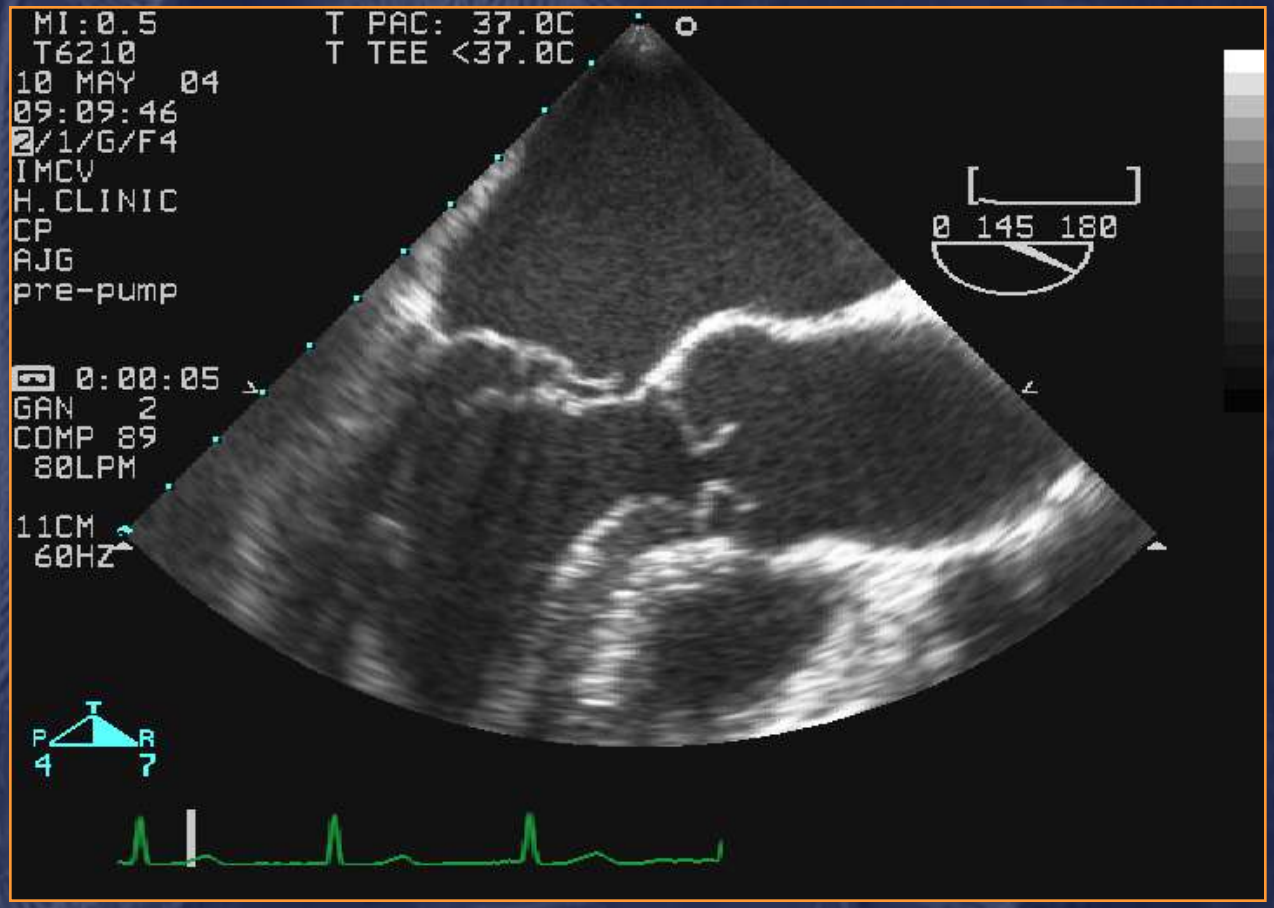
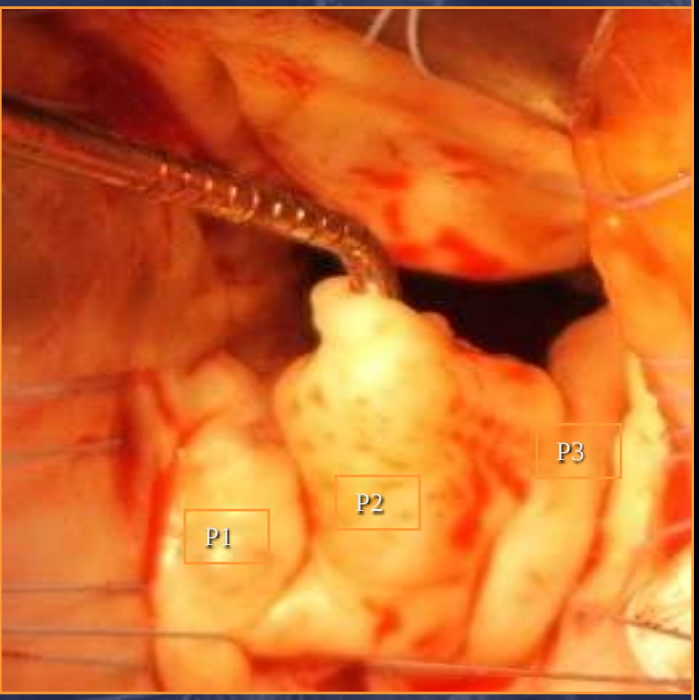
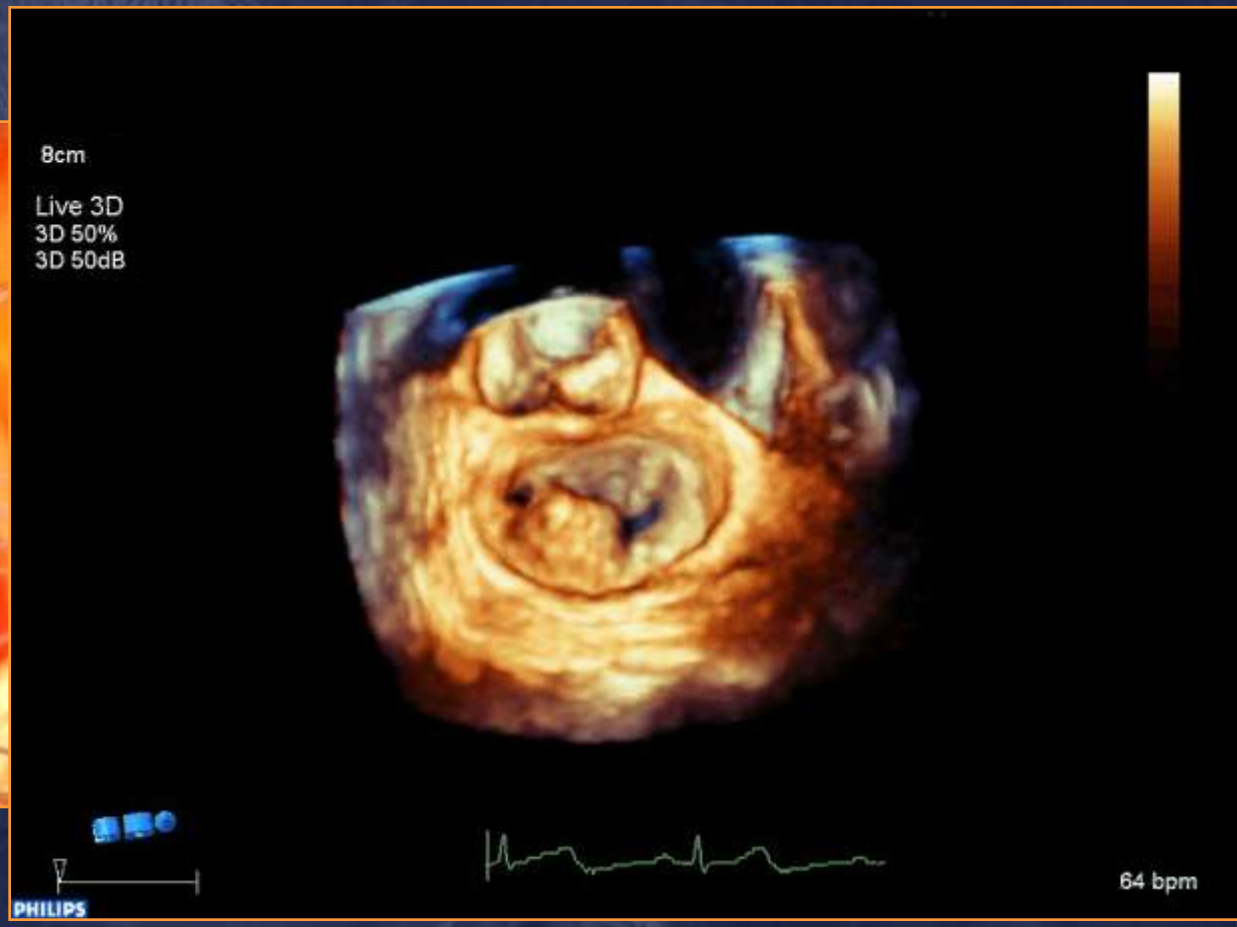
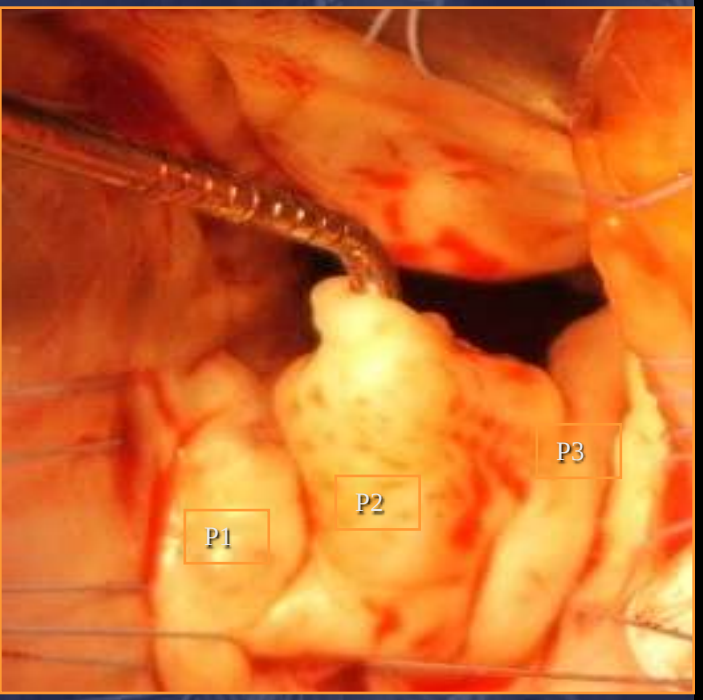
3- Lesion ?



Chordae Rupture

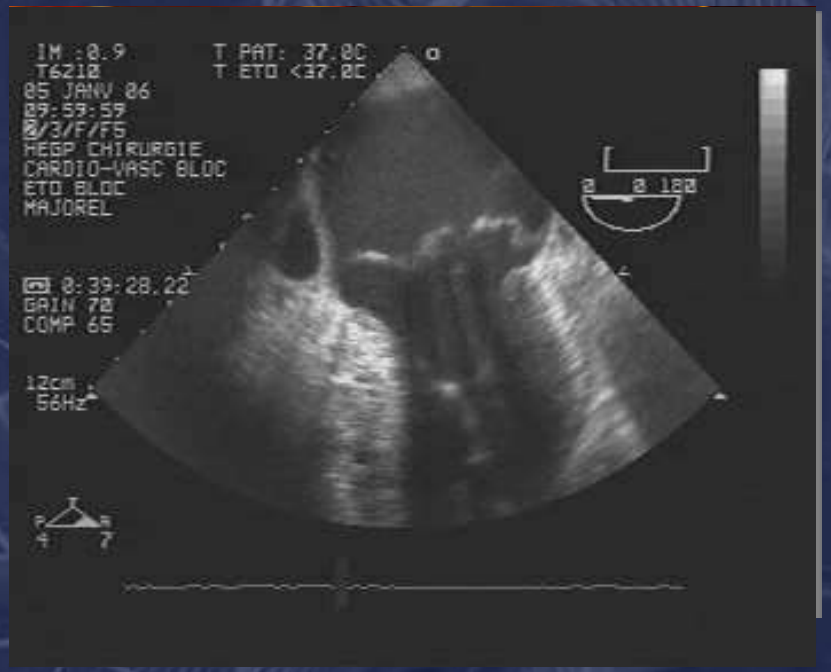

P1
P2
P3


8cm
Live 3D
3D 50%
3D 50dB
64 bpm
PHILIPS


P1
P2
P3


PHILIPS
16/10/2007 08:18:06 TIS0.2 MI 0.5
11/03/1957
X7-2t/TEE3D
BF 14Hz
8.8cm
Live 3D
3D 22%
3D 40dB
Allg
0 65 180
S4
JPEG
77 /min
PAT.-T.: 37.0C
TEE-T.: 39.9C

Barlow*

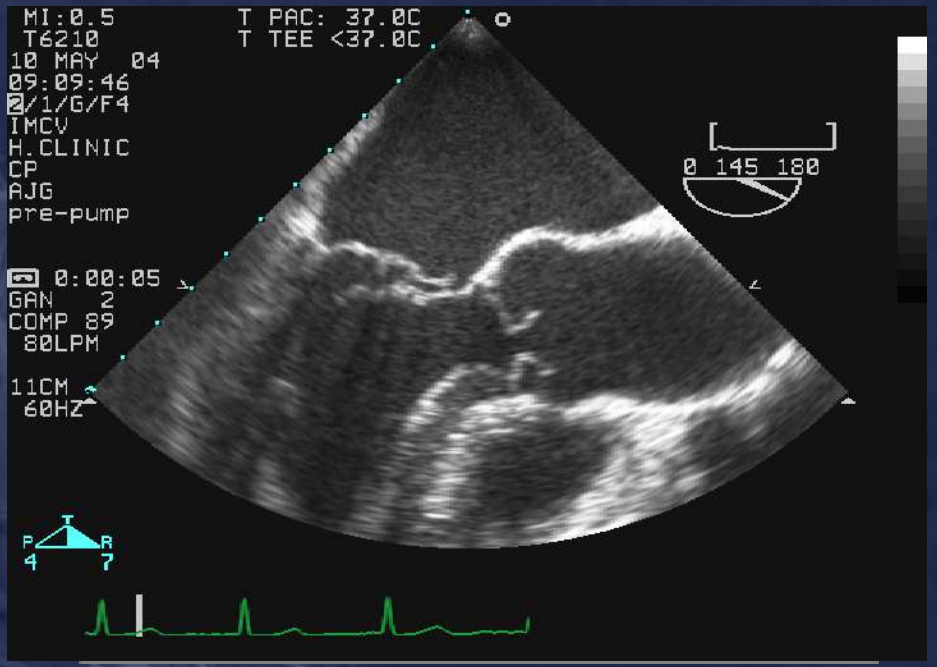


Age < 60 yrs
Long history of murmur > 5yrs

Excess of tissue
Billowing valve

**Barlow 1965*

FED**



Age > 60 yrs
Brief history of murmur (few yrs)
No excess of tissue
No billowing

***Carpentier 1974*

Case 3

1 - Etiology ?

A -FED

B -Barlow

C -Endocarditis

D -Ischemic

E -Rheumatic

1 - Etiology ?

A -FED

B -Barlow

C -Endocarditis

D -Ischemic

E -Rheumatic

Dysfunction ?

A- II P1

B- II P2

C- II P3

D- II A2

E- II A3


20/05/2005 07:28:51
Freq.: 5.0 MHz/5.0 MHz
FPS: 98.6
V
62
5
10
53
HR

Dysfunction ?

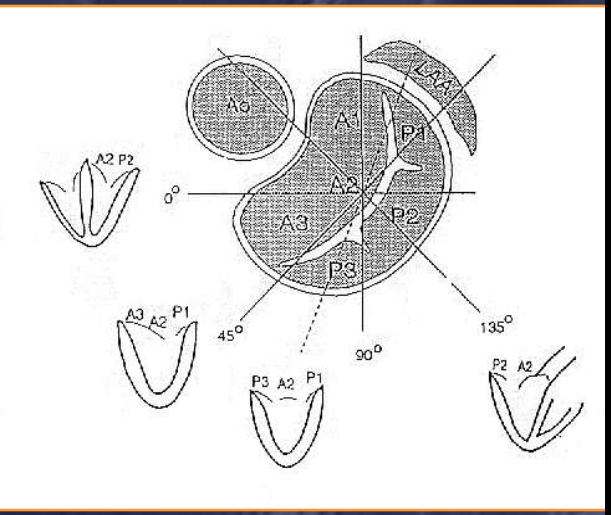
A- II P1

B- II P2

C- II P3 +++

D- II A2 +

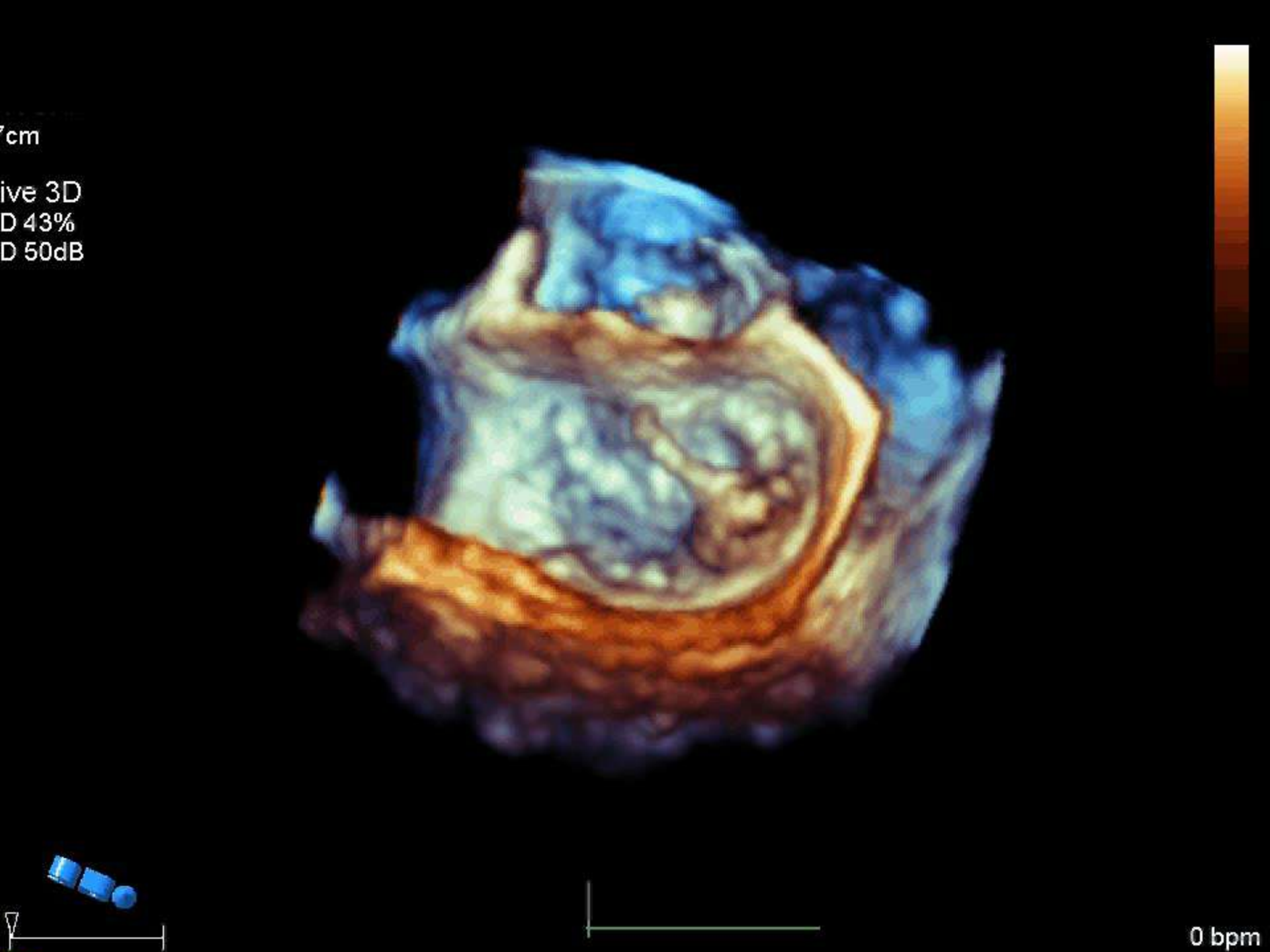
E- II A3


Ao
LAA
A1
P1
A2
P2
A3
P3
0°
45°
90°
135°
A2 P2
A3 A2 P1
P3 A2 P1
P2 A2

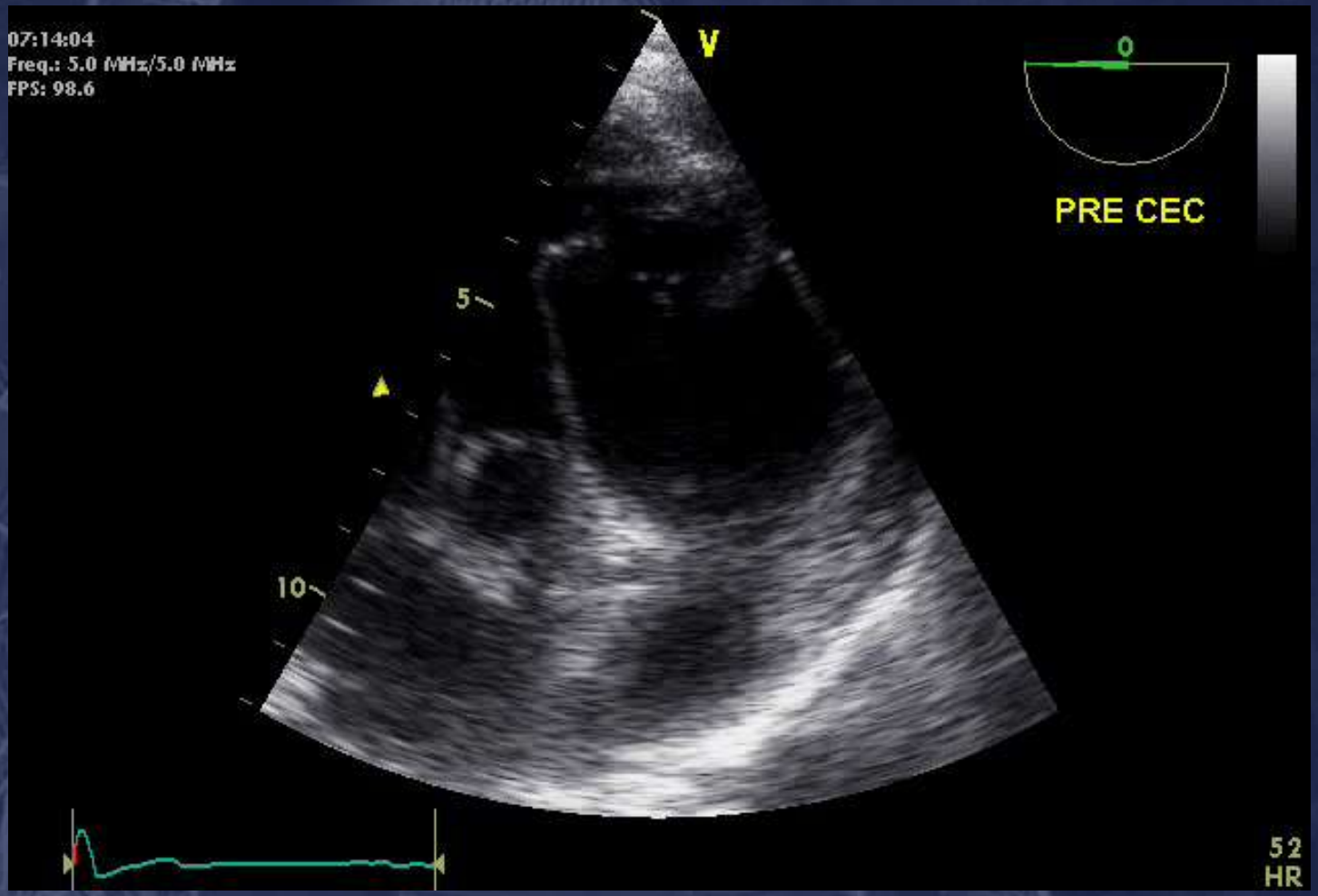

20/05/2005 07:28:51
Freq.: 5.0 MHz/5.0 MHz
FPS: 98.6
62
5
10
53
HR

Lesions ?

Chordae Rupture


'cm
ive 3D
D 43%
D 50dB
0 bpm

Case 4



Dysfunction ?

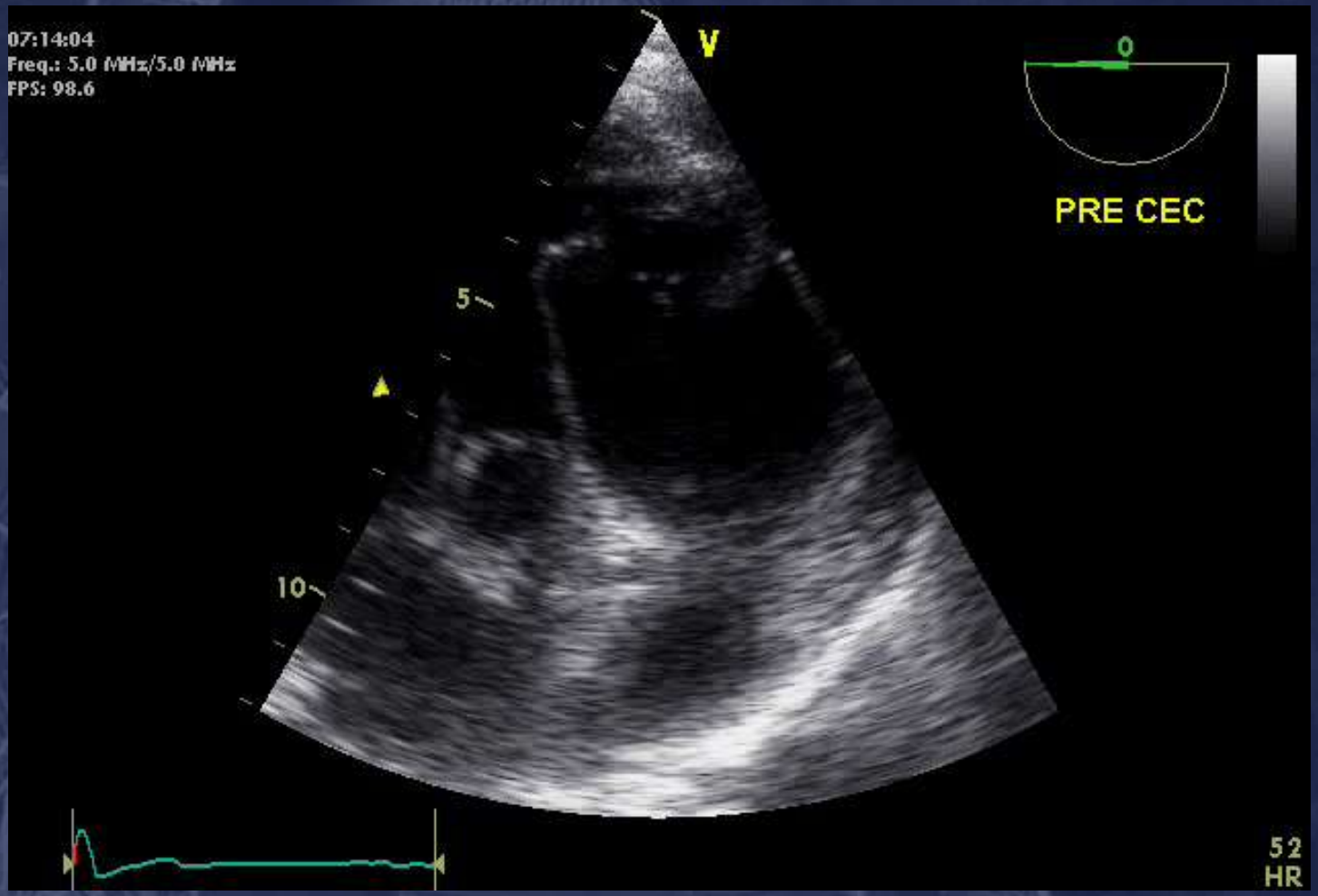
A- II P1

B- II P2

C- II P3

D- II Ant Com

E- II Post Com


07:14:04
Freq.: 5.0 MHz/5.0 MHz
FPS: 98.6
V
0
PRE CEC
5
10
52
HR

Dysfunction ?

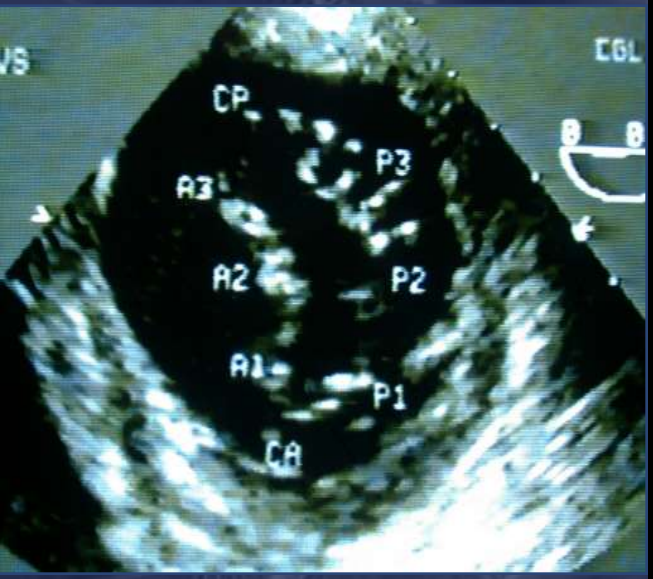
A- II P1

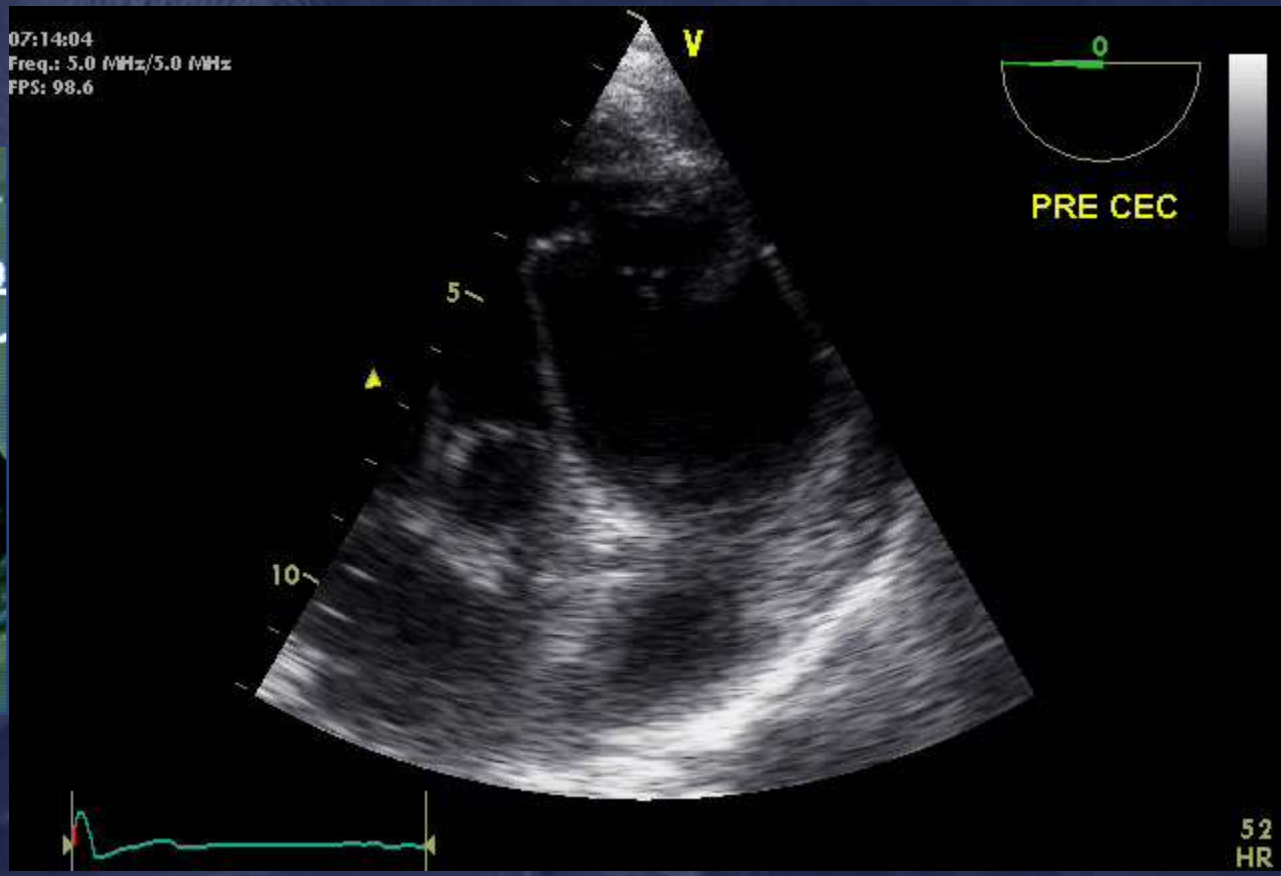
B- II P2

C- II P3

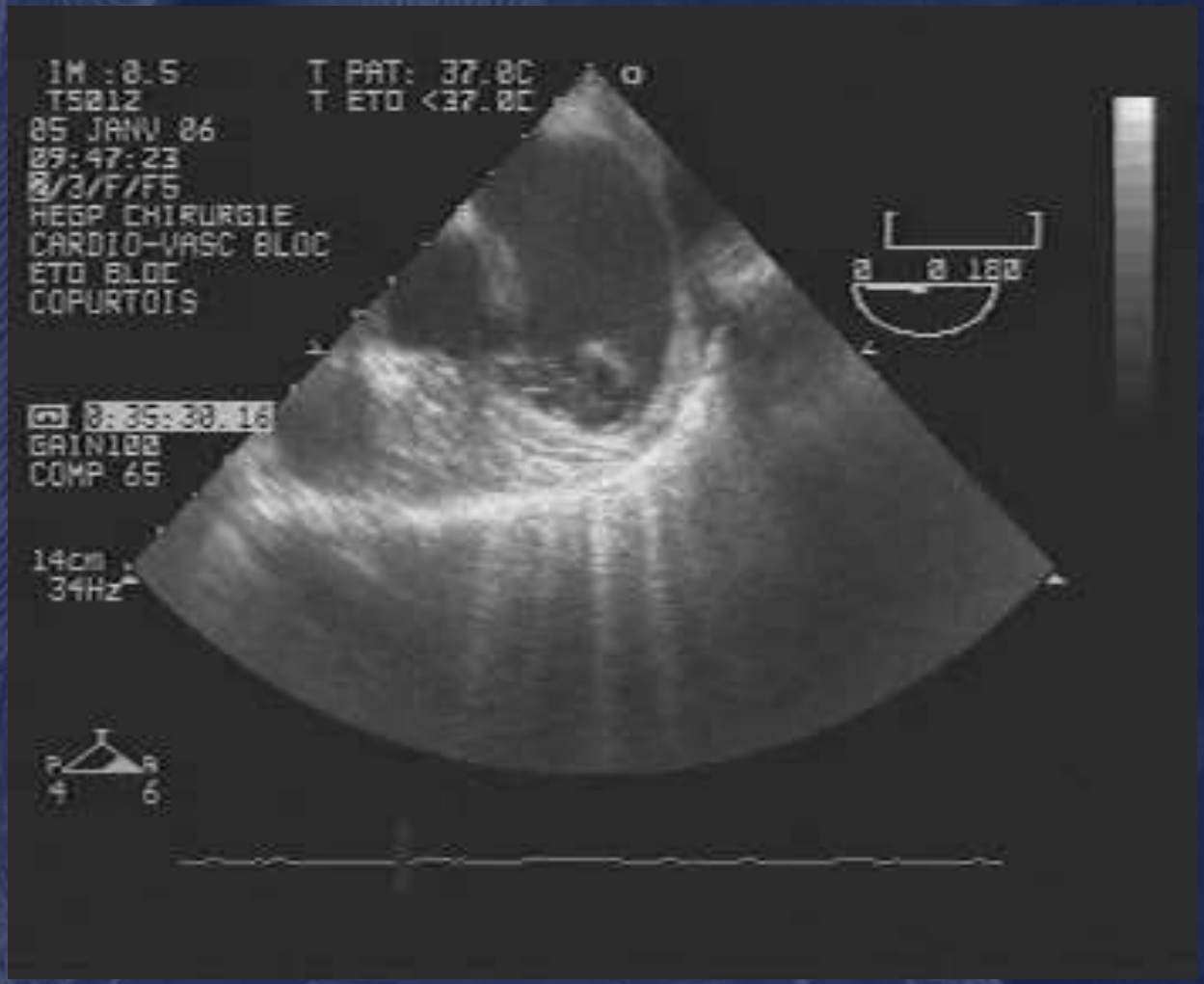
D- II Ant Com

E- II Post Com


VS
CGL
CP
P3
A3
A2
P2
A1
P1
CA


07:14:04
Freq.: 5.0 MHz/5.0 MHz
FPS: 98.6
V
0
PRE CEC
5
10
52
HR

Case 5


IM :0.5
T5012
05 JANV 06
09:47:23
2/3/F/F5
HEGP CHIRURGIE
CARDIO-VASC BLOC
ETO BLOC
COPURTOIS
T PAT: 37.0C
T ETO <37.0C
0 0 180
0:35:30.16
GAIN100
COMP 65
14cm
34Hz
P
A
4
6

Dysfunction ?

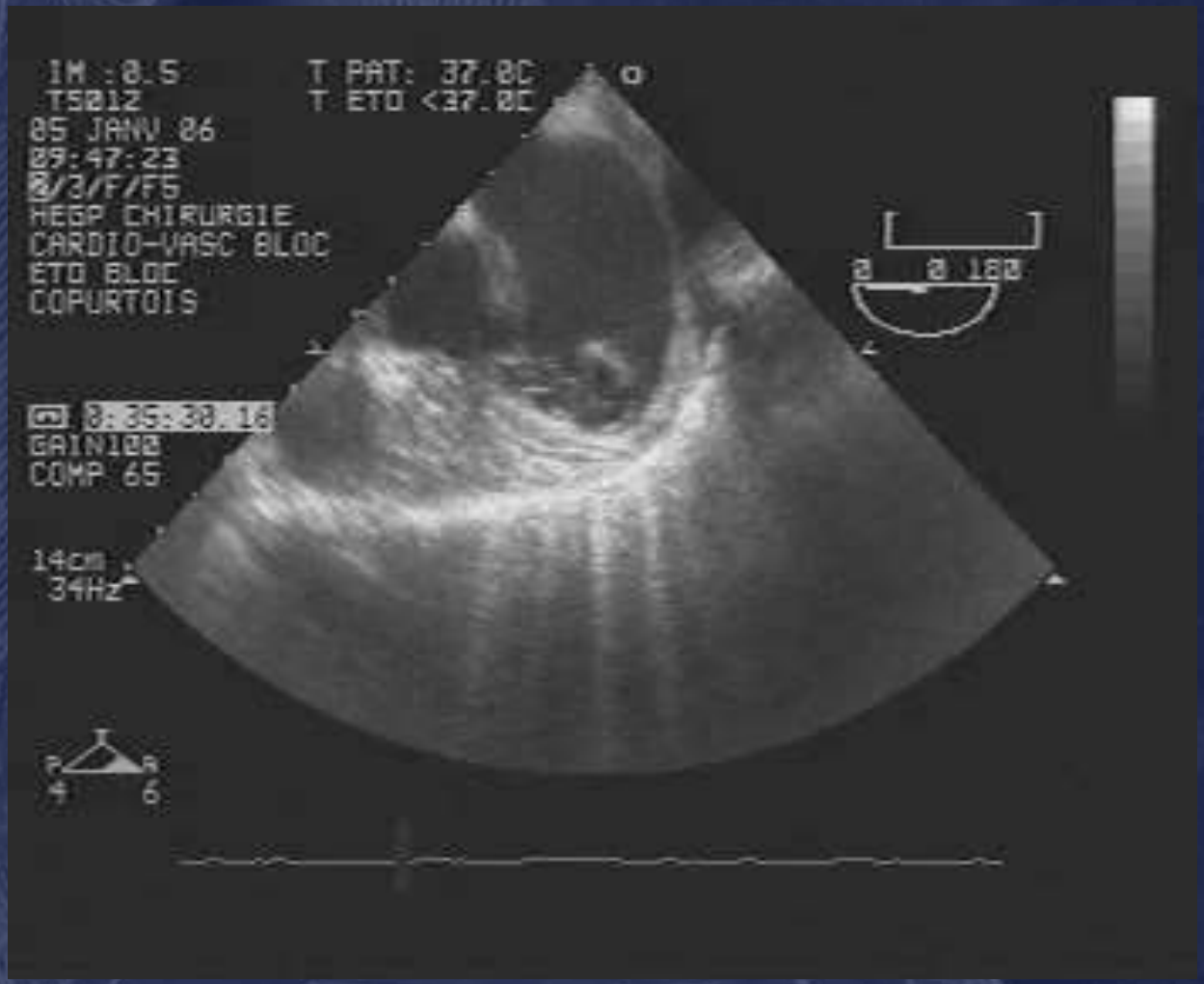
A- II P1

B- II P2

C- II P3

D- II Ant Com

E- II Post Com


IM :0.5
T5012
T PAT: 37.0C
T ETO <37.0C
05 JANV 06
09:47:23
2/3/F/F5
HEGP CHIRURGIE
CARDIO-VASC BLOC
ETO BLOC
COPURTOIS
0 0 180
0:35:30.16
GAIN100
COMP 65
14cm
34Hz
P
A
4
6

Dysfunction ?

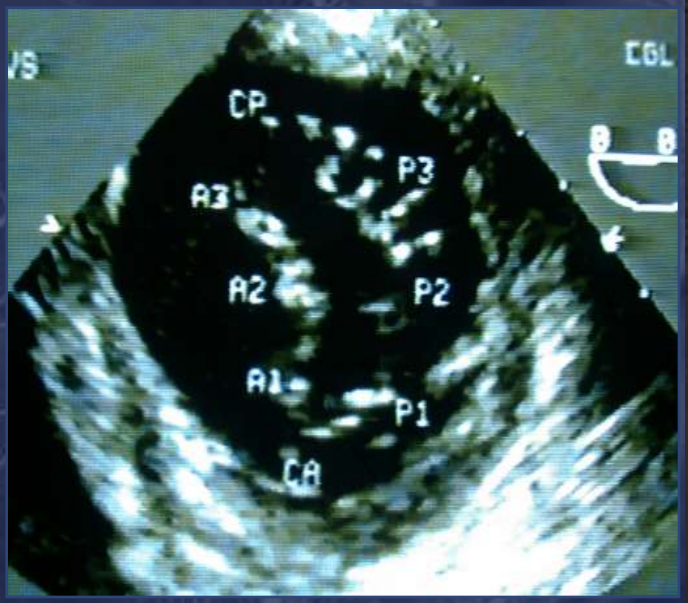
A- II P1

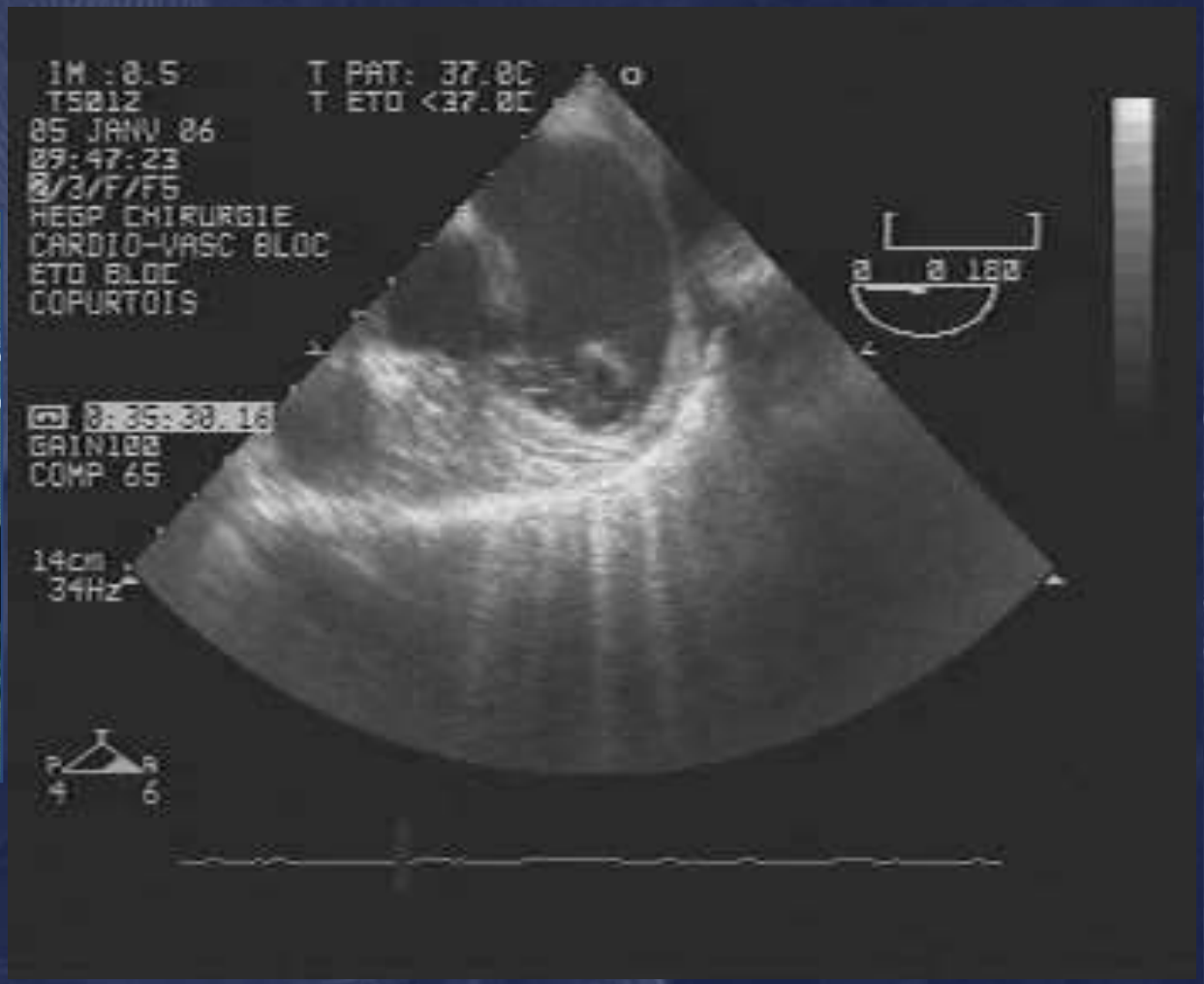
B- II P2

C- II P3

D- II Ant Com

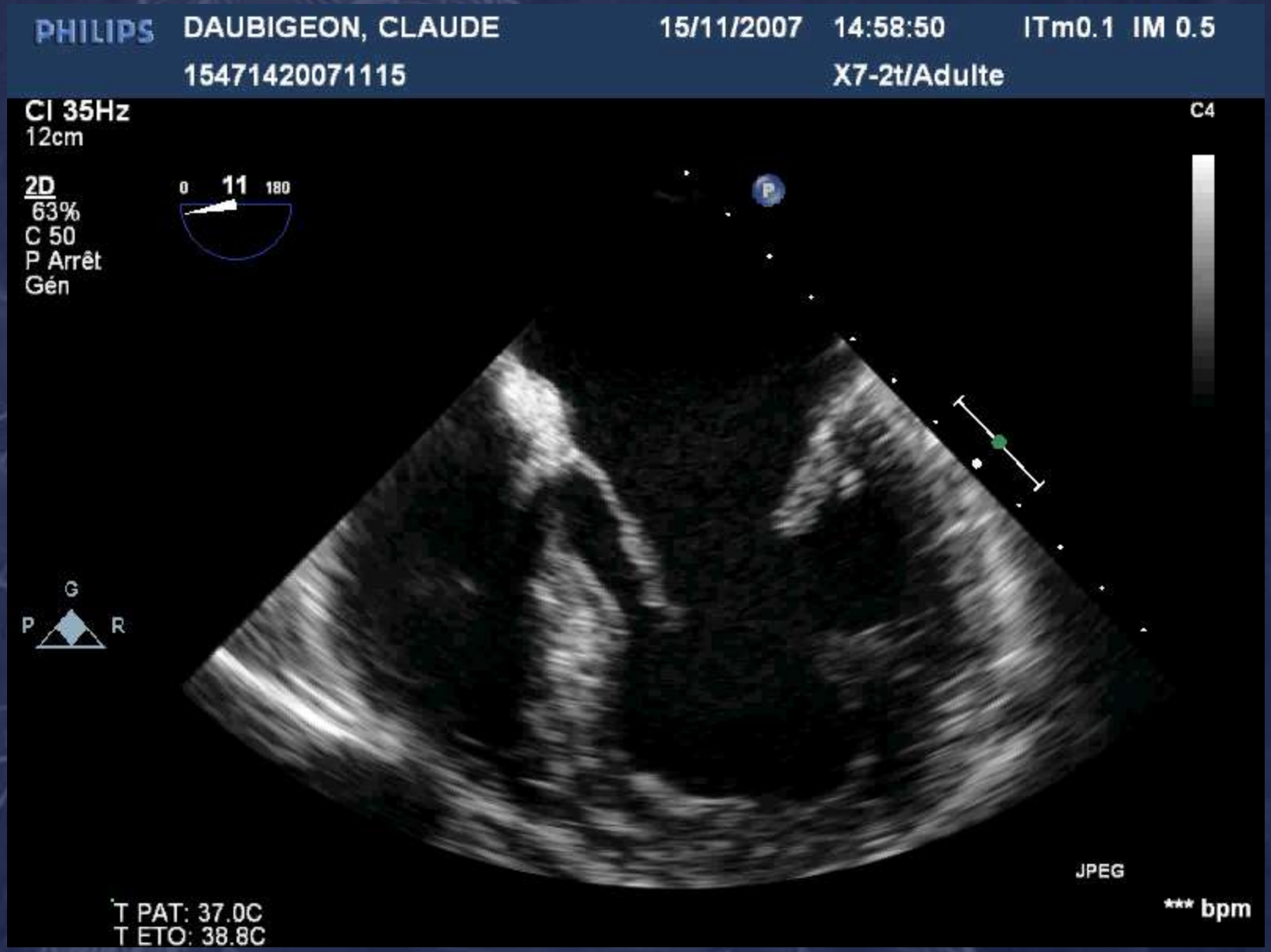
E- II Post Com


CP
P3
A3
A2
P2
A1
P1
CA


IM :0.5
T501Z
T PAT: 37.0C
T ETO <37.0C
05 JANV 06
09:47:23
0/3/F/F5
HEGP CHIRURGIE
CARDIO-VASC BLOC
ETO BLOC
COPURTOIS
0:35:30.16
GAIN100
COMP 65
14cm
34Hz

Case 6

- ✓ Mr M, 55 yr old
- ✓ Symptomatic NYHA III
- ✓ Severe MR ERO 56 mm2
- ✓ Echo (ext) Isolated Type II P2


PHILIPS
DAUBIGEON, CLAUDE
15471420071115
15/11/2007
14:58:50
ITm0.1 IM 0.5
X7-2t/Adulte
CI 35Hz
12cm
C4
2D
63%
C 50
P Arrêt
Gén
0
11
180
G
P
R
JPEG
T PAT: 37.0C
T ETO: 38.8C
*** bpm

1- Etiology ?

A -FED

B -Barlow

C -Marfan

D -Ischemic

E -Rheumatic

1- Etiology ?

A -FED

B -Barlow

C -Marfan

D -Ischemic

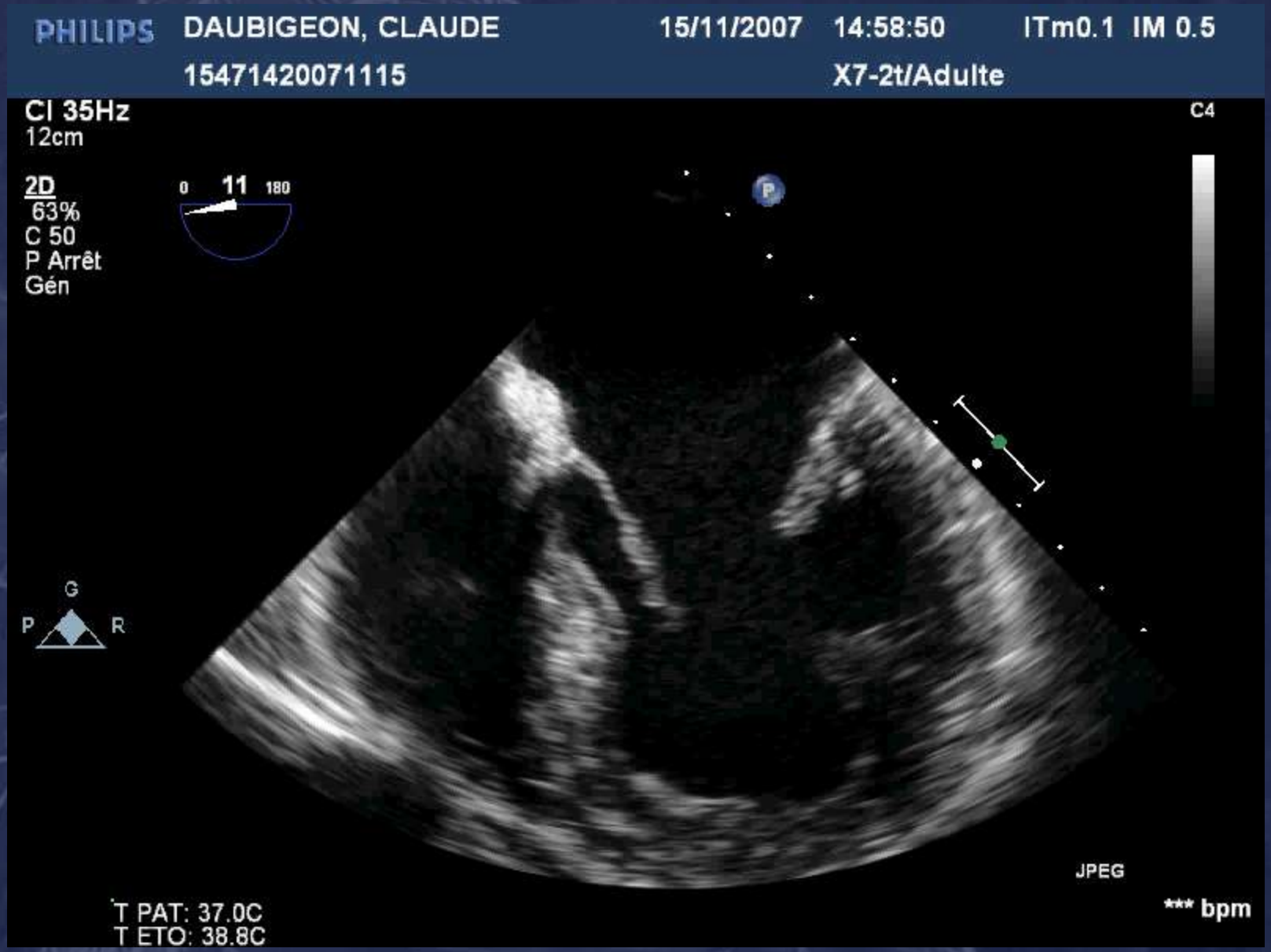
E -Rheumatic

2- Dysfunction ?

A. II P2

B. II A2

C. II P2 and A2

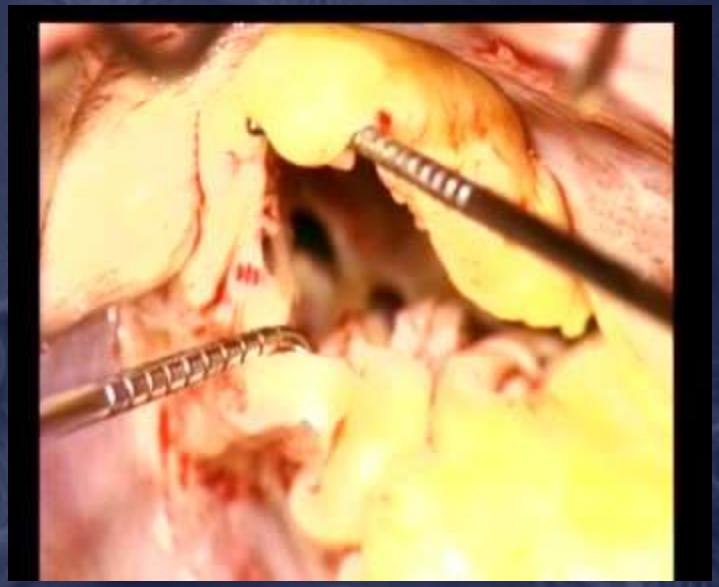

PHILIPS
DAUBIGEON, CLAUDE
15471420071115
15/11/2007
14:58:50
ITm0.1 IM 0.5
X7-2t/Adulte
CI 35Hz
12cm
C4
2D
63%
C 50
P Arrêt
Gén
0
11
180
G
P
R
JPEG
T PAT: 37.0C
T ETO: 38.8C
*** bpm

2- Dysfunction ?

A. II P2

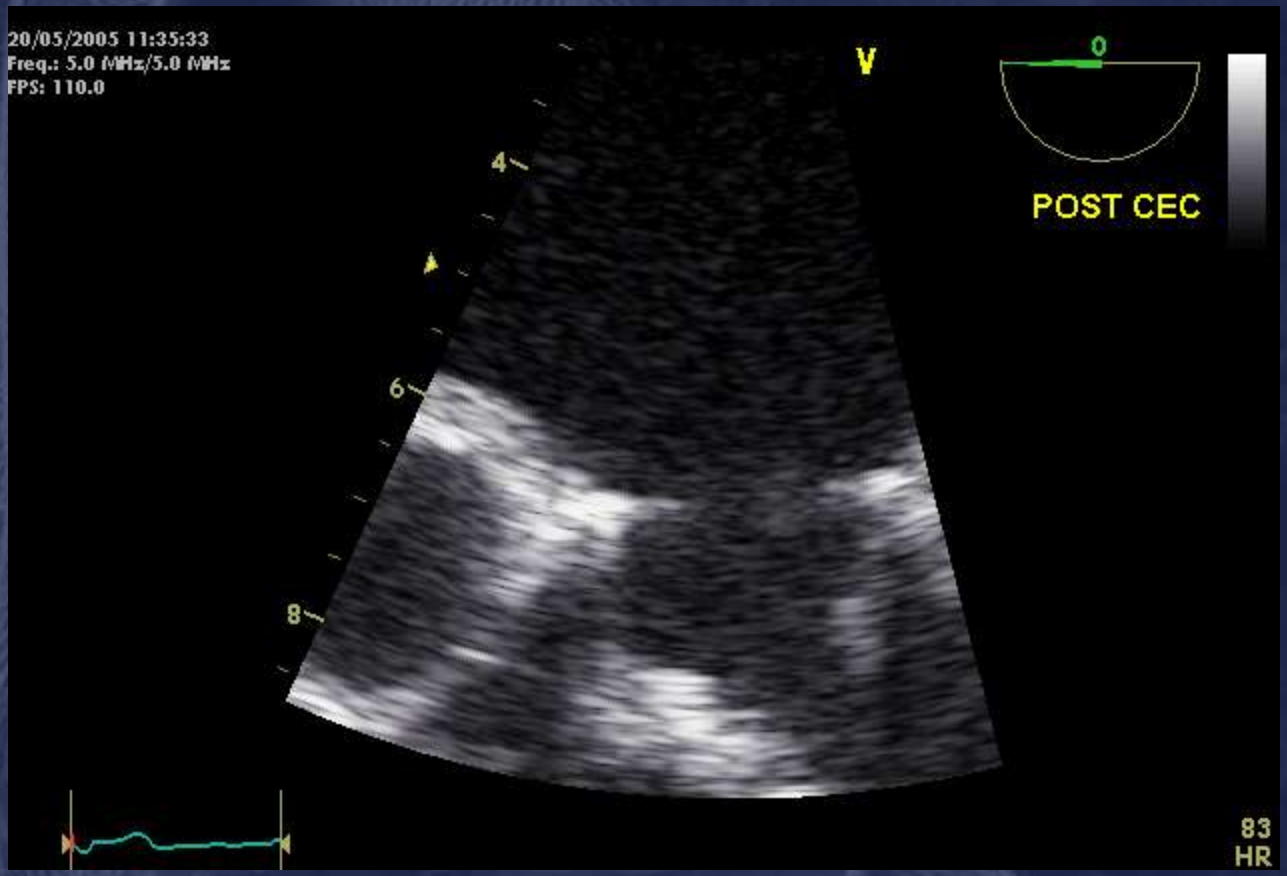
B. II A2

C. II P2 and A2

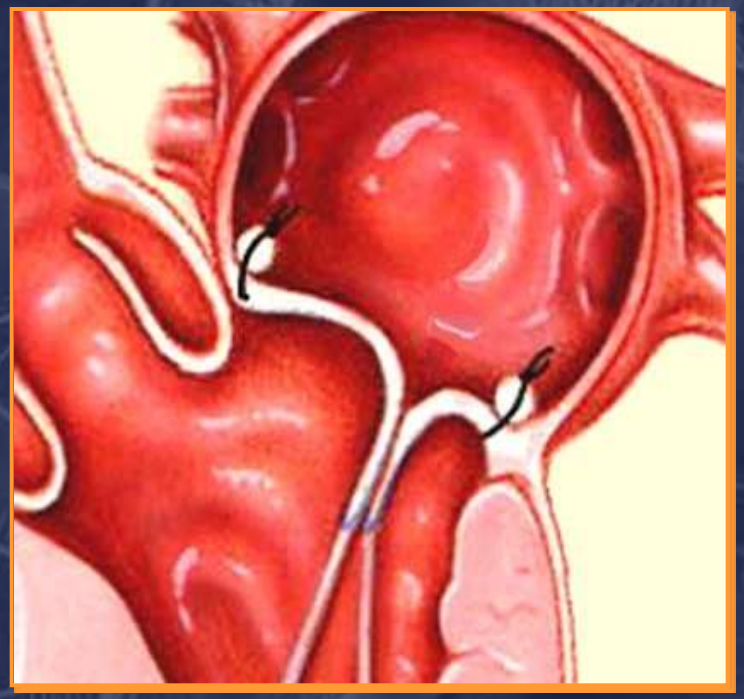


The Surgeon's Needs in Mitral Repair

- ✓ Leaflet motion ?
- ✓ Which scallop ?
- ✓ Calcification – Annular Dilatation ?
- ✓ Etiology
- ✓ Risk of SAM ?
- ✓ Tricuspid ?
- ✓ Intra-op control ?


20/05/2005 11:35:33
Freq.: 5.0 MHz/5.0 MHz
FPS: 110.0
V
0
POST CEC
4
6
8
83
HR

Large Surface of Coaptation



8 mm or 1/3 of ant leaflet

Post Pump Intra-op Echo in Mitral Repair

To detect 3 main potential complications:

- ✓Residual mitral regurgitation
- ✓Systolic Anterior Motion (SAM)
- ✓Left ventricular dysfunction, injuries…

A safety net ++

Residual MR: Correct or Neglect ?

- ✓ A team approach:an experienced echocardiographist and a compliant surgeon
- ✓ Conditions of evaluation

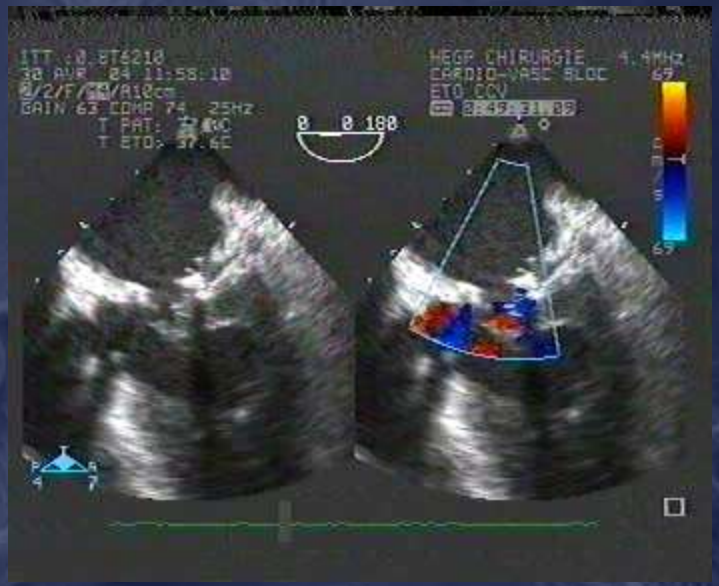
Conditions of evaluation

- ✓Hemodynamic
- ✓Wean-off by pass ?
- ✓LV Contractility ?
- ✓Volemia ?
- ✓Inotropic drugs ?
- ✓Rhythm ? Pacing ?
- ✓Mitral canulae (vent) removed ?
- ✓Which techniques ?
- ✓Syringe bulb test ?

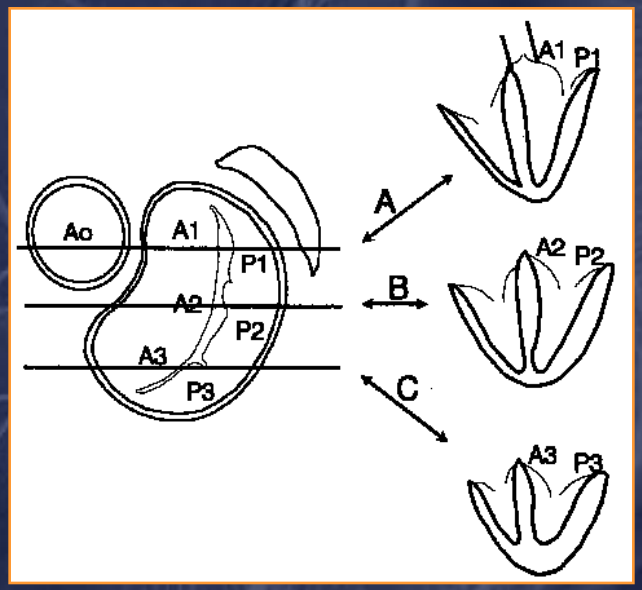
Type I: Normal Leaflet Motion

- ✓ central jet: trivial MR with good coaptation & syringe test (irregularities of leaflets) - neglect ++
- ✓ leaflet jet : identify the segment involved and mechanisms - correct ++
- ✓ commissural jet - correct
- ✓ peri-annular jet: correct ++

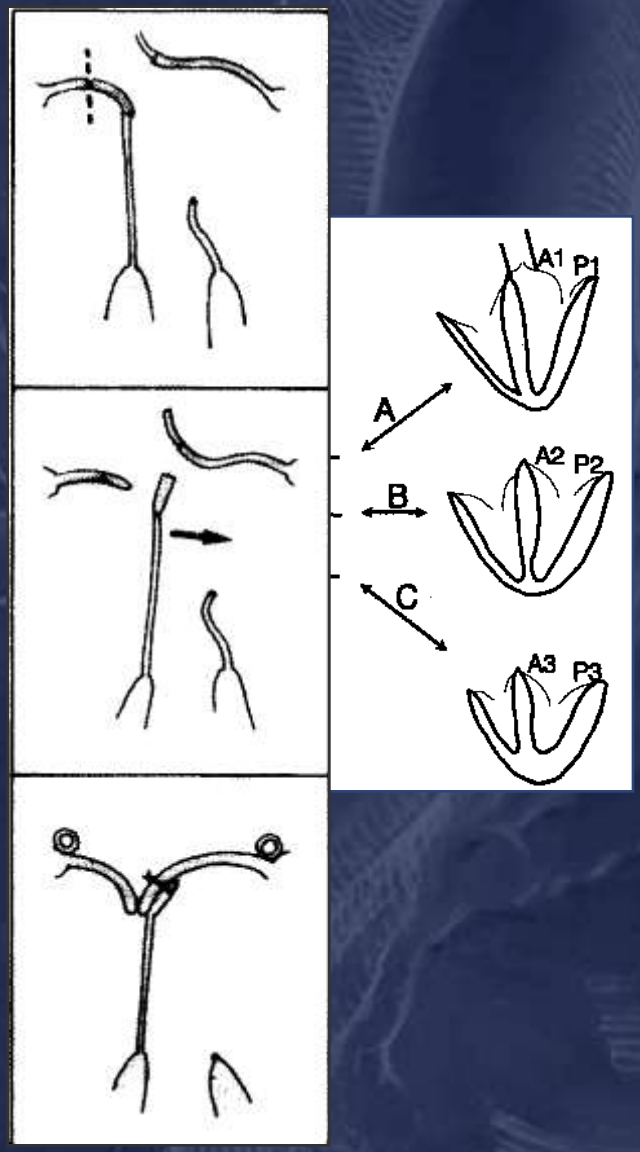
Case 1


ITT :0 BT6210
30 AVR 04 11:58:10
GAIN 63 COMP 74 25Hz
T PAT: 37.4C
T ETO: 37.4C
HEGP CHIRURGIE 4.4MHz
CARDIO-VASC BLOC
ETO CCN
0 0 180

Intraop control after correction of type IIA2 (chordal transfert)

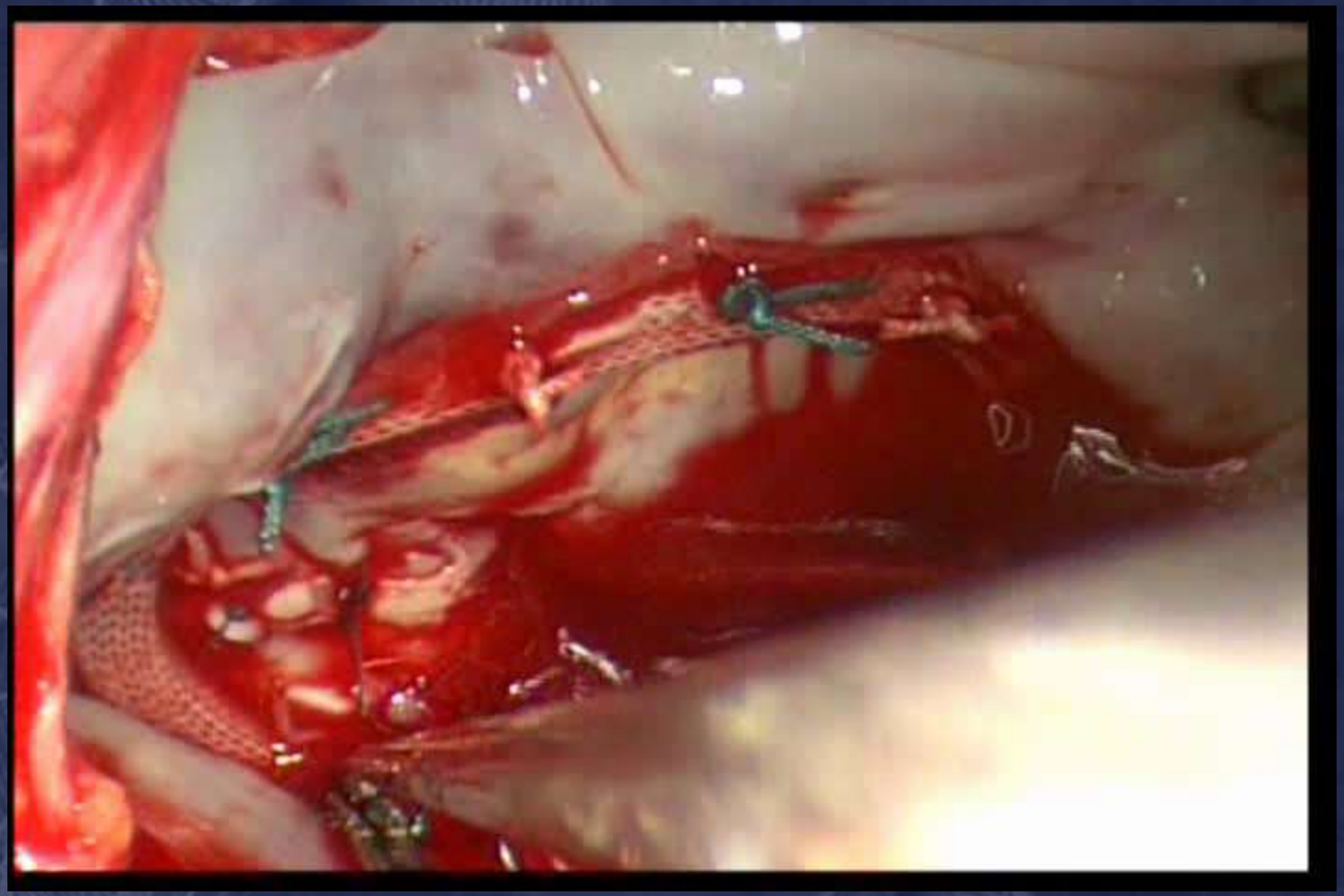


Intraop control after correction of type IIA2 (chordal transfer)



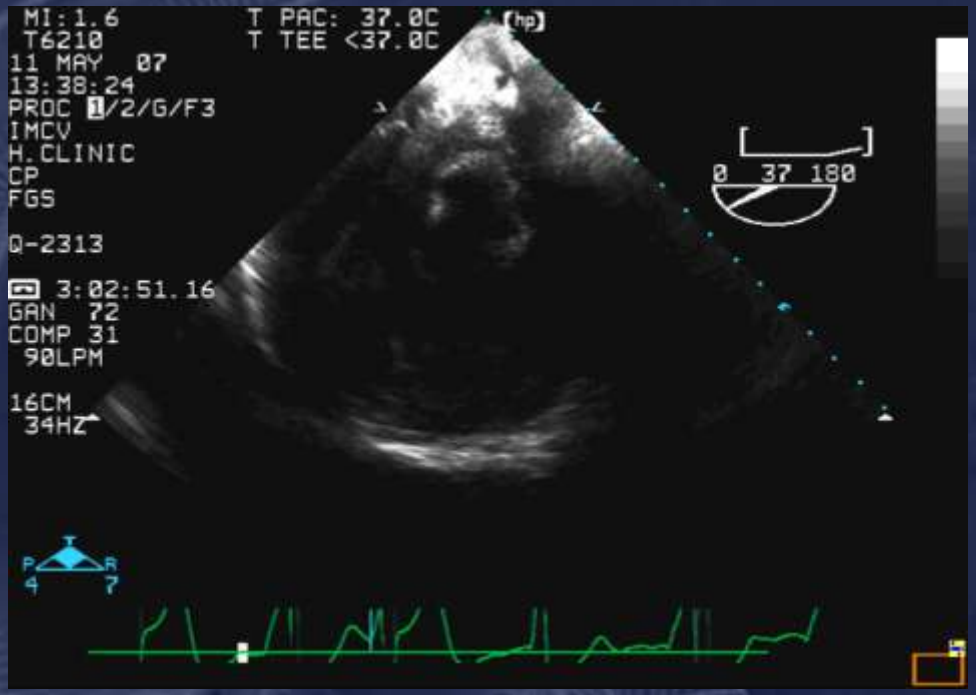
Case 2

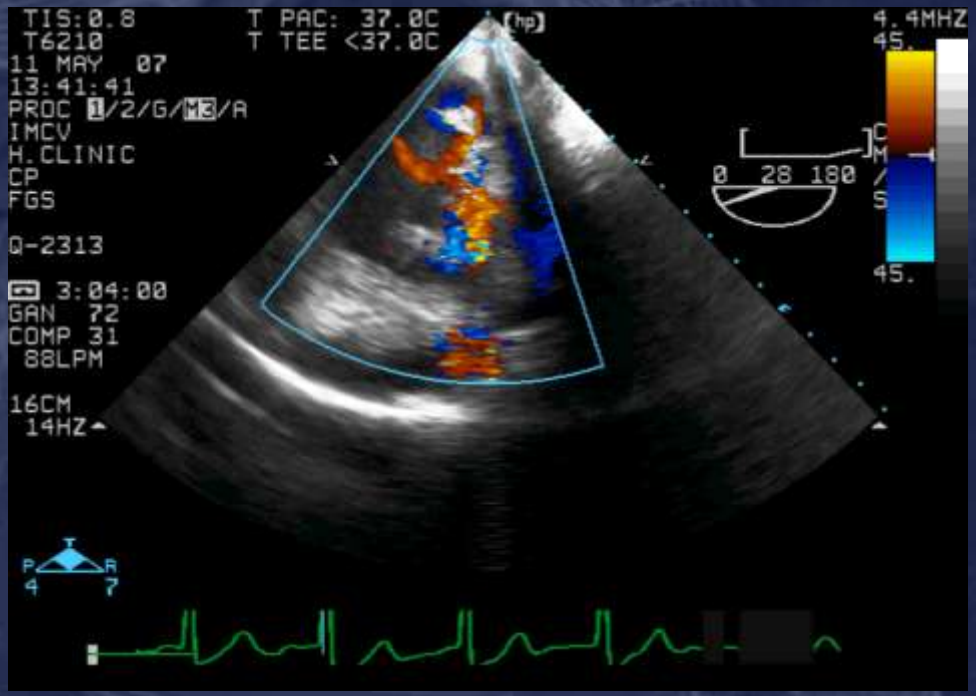

▲=JPEG Lossy 17:1
MT. SINAI MEDICAL CENTER - DEPARTMENT OF ANES Page 2/14
19:14:51
.92
.92
0°
TE-V5M 15Hz
7.0MHz 90mm
TEE
General /V
Pwr=0dB
MIcd=.71 TIS=0.2
Lens Temp<37.0°C
T1/-2/ 0/V:3
1/2 CD:3.5MHz
CD Gain = 50
Store in progress
No R Trig
100%▲
Seconds
Show: All/Selected
Unselect
Show Pagina
Set Speed



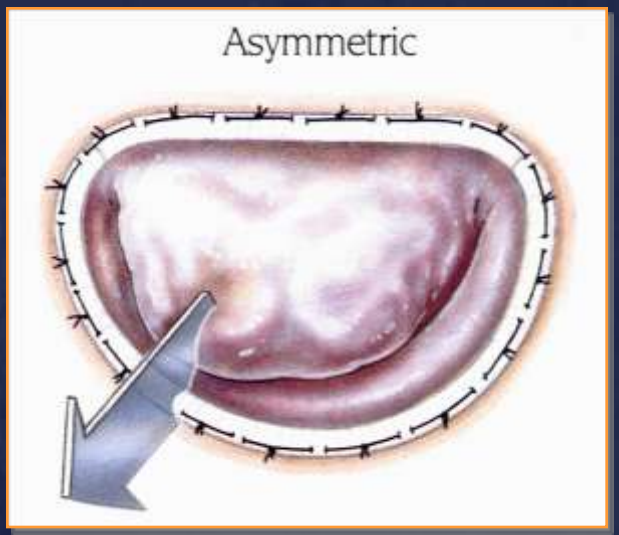
Case 3


T15:0.0
T6210
11 MAY 87
13:30:03
PROC B/2/S/M/A
IMOV
H.CLINIC
CP
F65
Q-2313
3:01:00.11
GAN 49
COMP 31
86LPM
16CM
15HZ
T PRO: 37.0C
T TEE: 38.0C
4.4MHZ
45
0 30 180
5
45


MI:1.6
T6210
11 MAY 07
13:38:24
PROC 1/2/G/F3
IMCV
H.CLINIC
CP
FGS
Q-2313
3:02:51.16
GAN 72
COMP 31
90LPM
16CM
34HZ
T PAC: 37.0C
T TEE <37.0C
0 37 180
P
R
4
7

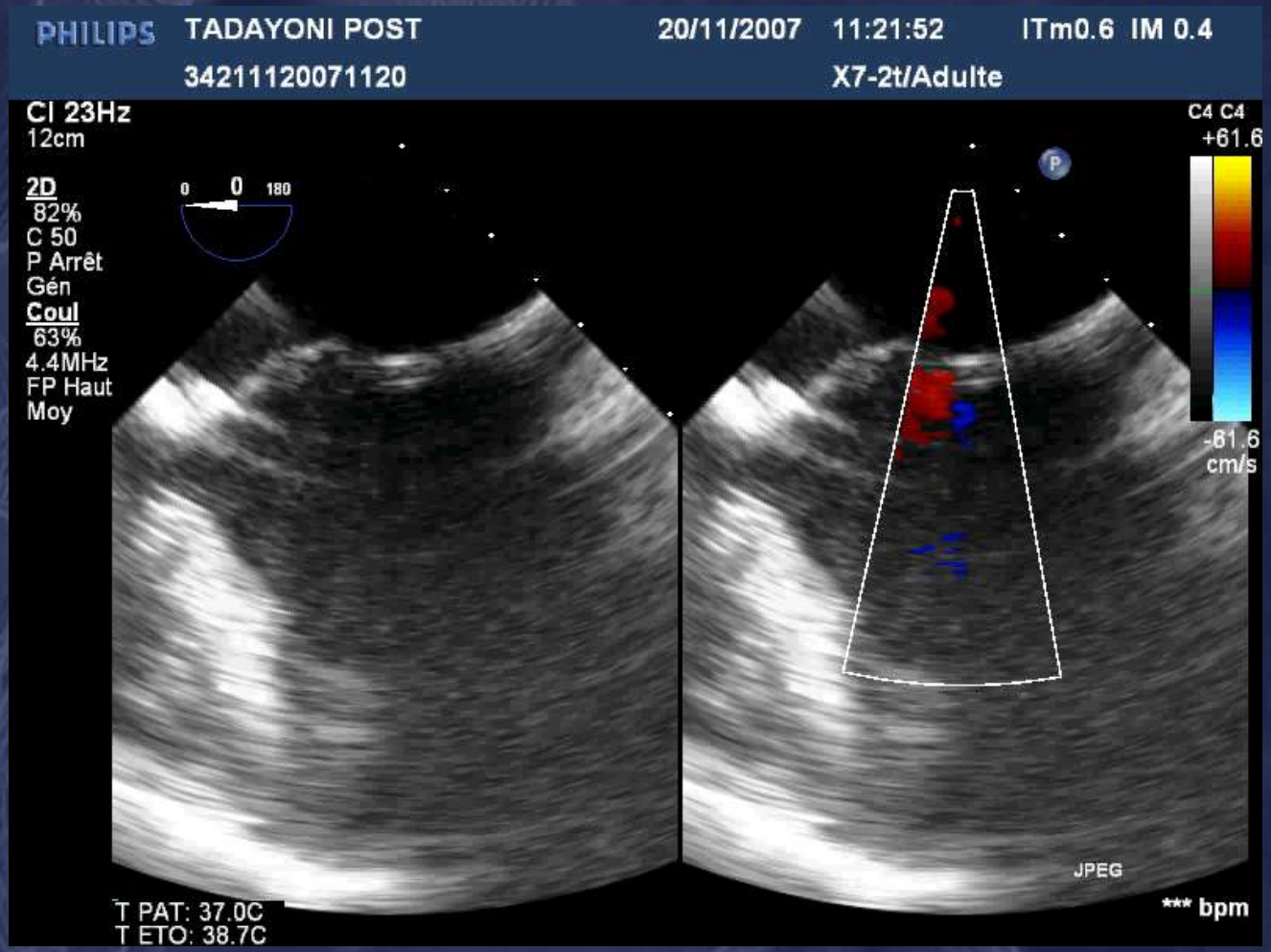

TIS:0.8
T6210
11 MAY 07
13:41:41
PROC 1/2/G/M3/A
IMCV
H.CLINIC
CP
FGS
Q-2313
3:04:00
GAN 72
COMP 31
88LPM
16CM
14HZ
T PAC: 37.0C
T TEE <37.0C
0 28 180
4.4MHZ
45.
45.
P
R
4
7

Type II: Residual prolapse



- ✓Not recognized at syringe test
- ✓Differentiate IIIb (false prolapse)
- ✓Assess mechanisms
  - ✓Chordal rupture
  - ✓Chordal elongation

Correct ++


PHILIPS
TADAYONI POST
34211120071120
20/11/2007 11:21:52
ITm0.6 IM 0.4
X7-2t/Adulte
CI 23Hz
12cm
2D
82%
C 50
P Arrêt
Gén
Coul
63%
4.4MHz
FP Haut
Moy
0 0 180
C4 C4
+61.6
-61.6
cm/s
JPEG
T PAT: 37.0C
T ETO: 38.7C
*** bpm

Type III: Restrictive Motion

IIIb ant

Overcorrection of type II ant ++
(artificial chordae too short)

CORRECT ++

IIIb post

LV Dysfunction (transient)

WAIT and REASSESS ++

Clinical Experience: 62 pts

12 (19.3%) had *transient* residual MR:

- -2pts ectopic rythms:
- -2 pts epicardial pacing:
- -2pts hypovolemia
- -5 pts: IIIb temporary LV dysfunction
- -1 pt SAM with LVOT obstruction:

Mihaileanu S et al. Eur Heart J 1991,12:(suppl.B):26-29

Post Pump Intra-op Echo in Mitral Repair

To detect 3 main potential complications:

- ✓ Residual mitral regurgitation
- ✓ Systolic Anterior Motion (SAM)
- ✓ Left ventricular dysfunction, injuries…


SAM

Intra-op SAM after Repair: a Team approach with TEE monitoring

- ✓ 1st step: identify hemodynamic consequences: MR and/or gradient and their severity
- ✓ 2nd step: Volume loading, stop any inotropic support, beta blockers (esmolol)
- ✓ 3rd step: TEE control (15-30mn): 3 scenarios

3 scenarios

- ✓ 1- Complete resolution of SAM as well as MR and gradient – no reoperation –

- ✓ 2- Persistance of SAM with MR and/or a peak gradient > 40 mmHg:
  - identify 2 potential surgical mechanisms
  - immediate reoperation (repair)
- ✓ 3- Persistance of SAM with trivial MR and no significant gradient – medical tt or second look if clear surgical mechanism -

SAM : Mechanism

« SAM is the result of a discrepancy between the surface area of the mitral leaflets and the surface area of the mitral valve orifice »*

Post Pump Intra-op Echo in Mitral Repair

To detect 3 main potential complications:

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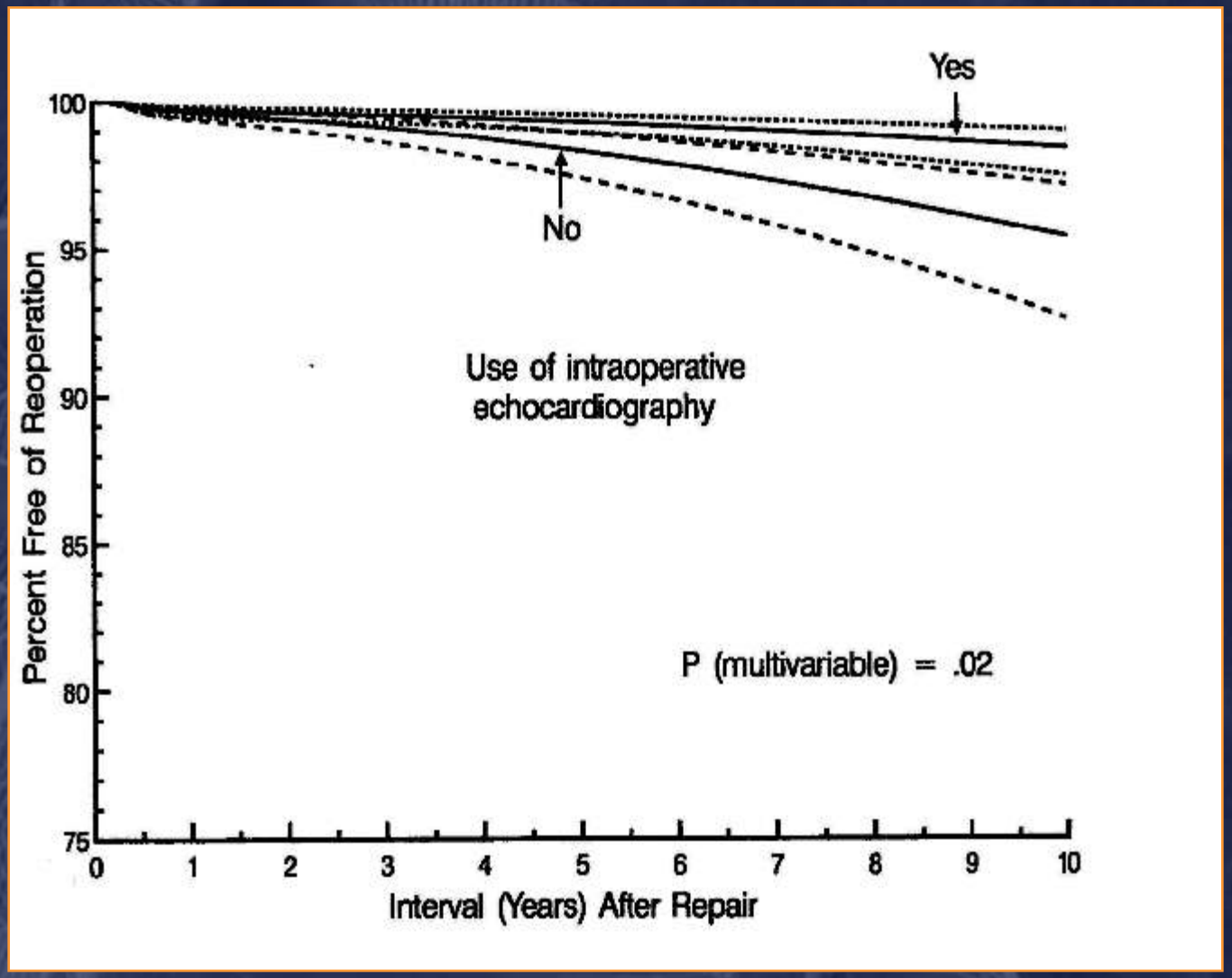
- ✓Systolic Anterior Motion (SAM)
- ✓Left ventricular dysfunction, injuries…

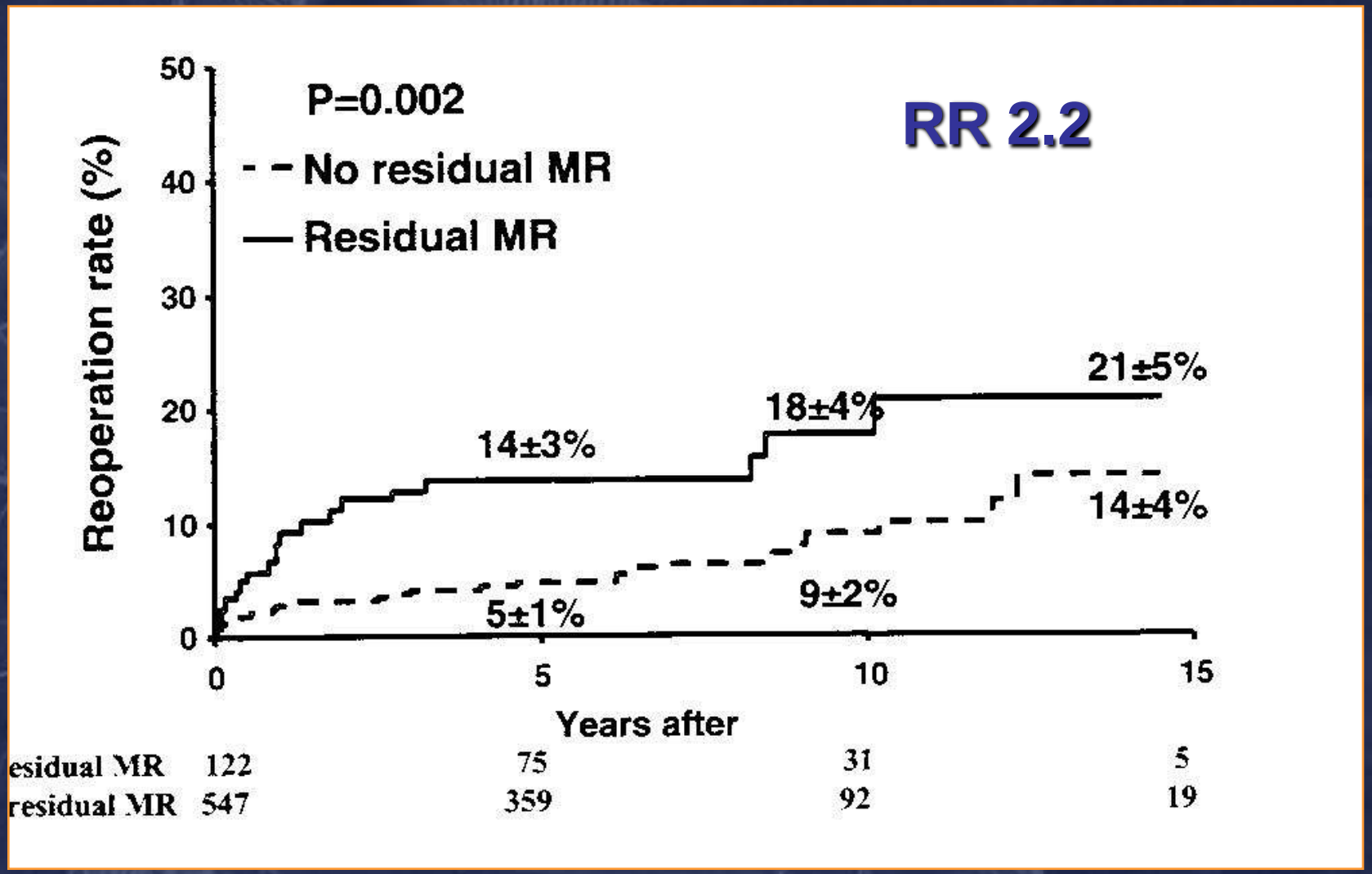
A safety net ++

Clinical Impact: Reoperation



Gillinov et al. JTCS.1998;116(5):734-43

Impact on prognosis



Mohty et al. Circulation.2001;104:I1-I7

Conclusion

Think repair but…

…in a team approach !