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Department of Anesthesia and Pain Management

Toronto General Hospital- UHN

University of Toronto

UHN Toronto General Toronto Western Princess Margaret Toronto Rehab
COURAGE LIVES HERE

UNIVERSITY OF TORONTO

3D TEE Clinical Cases IV : Paravalvular Leak

17th Annual Toronto Perioperative TEE Symposium

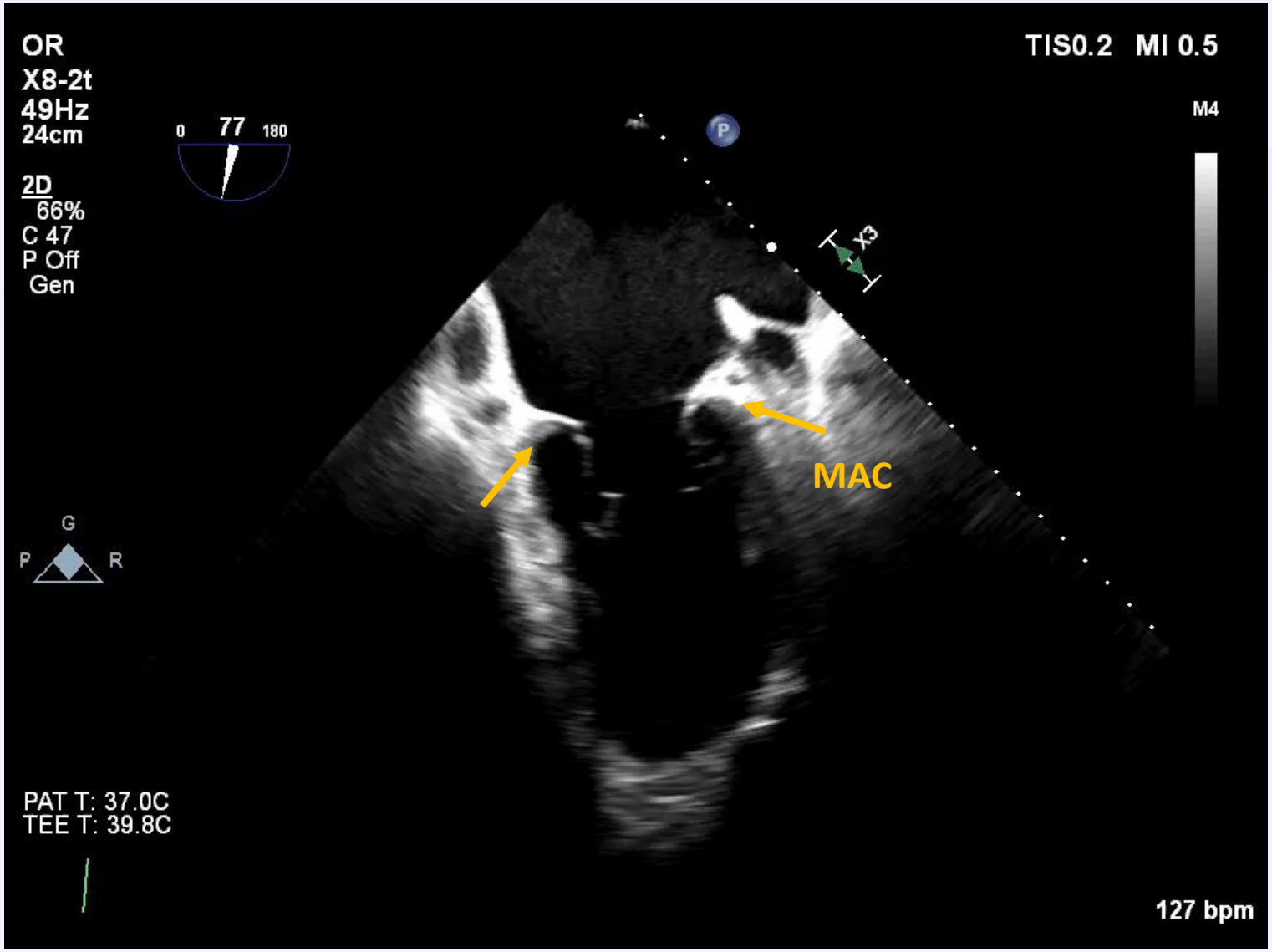
3D TEE Course

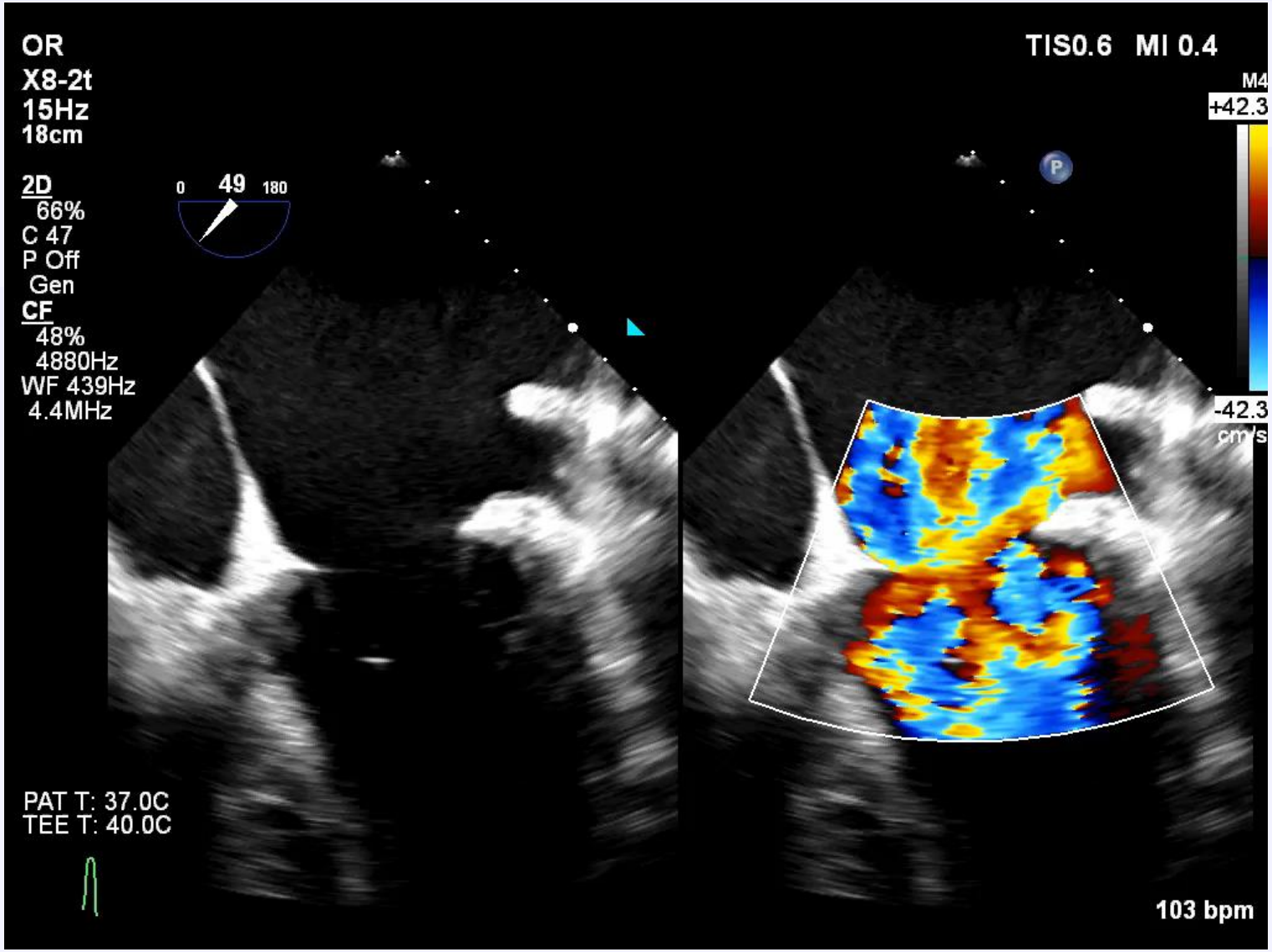
November 1, 2019
Toronto General Hospital- UHN, Toronto, Canada

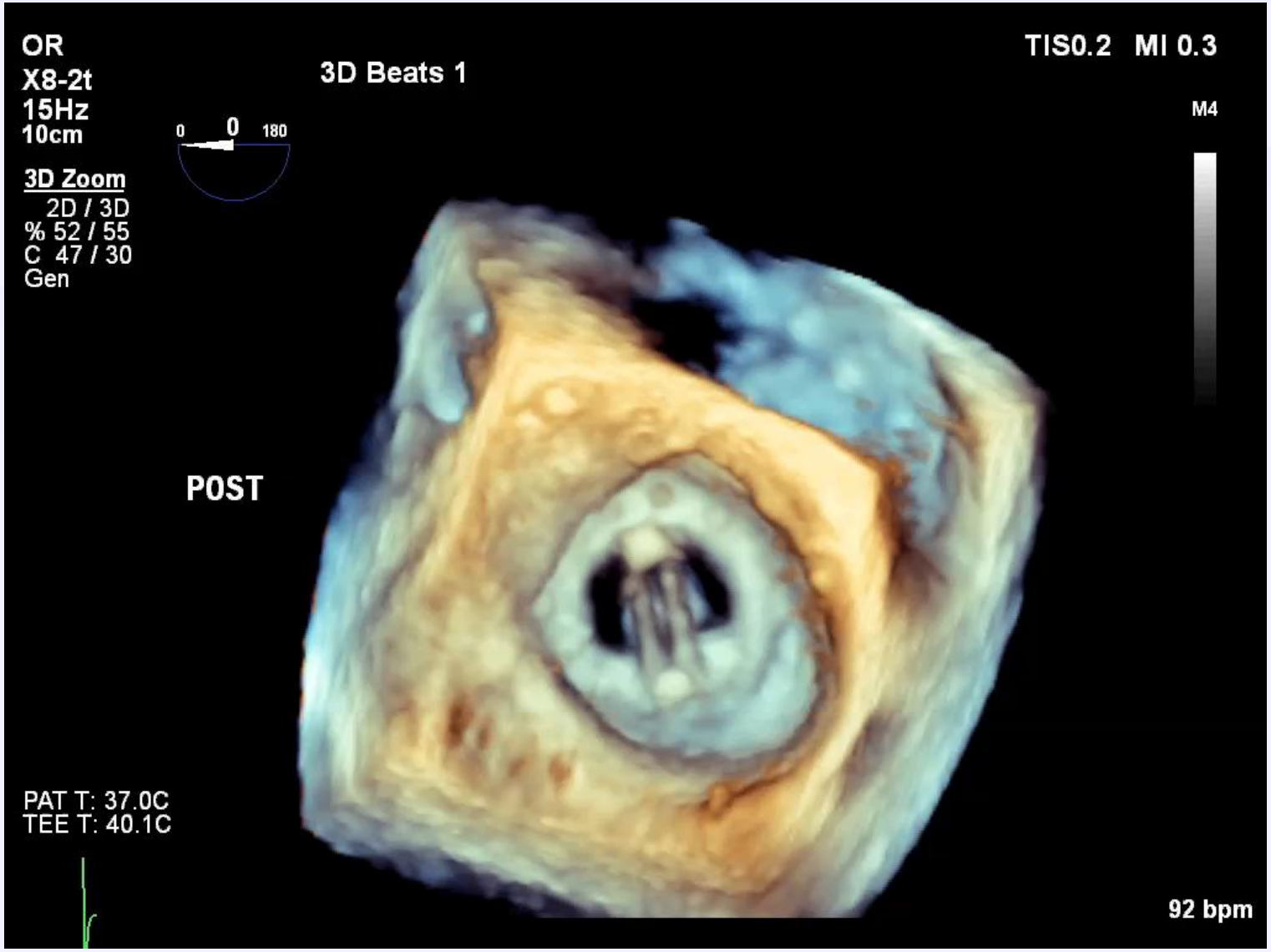
I have no disclosure.

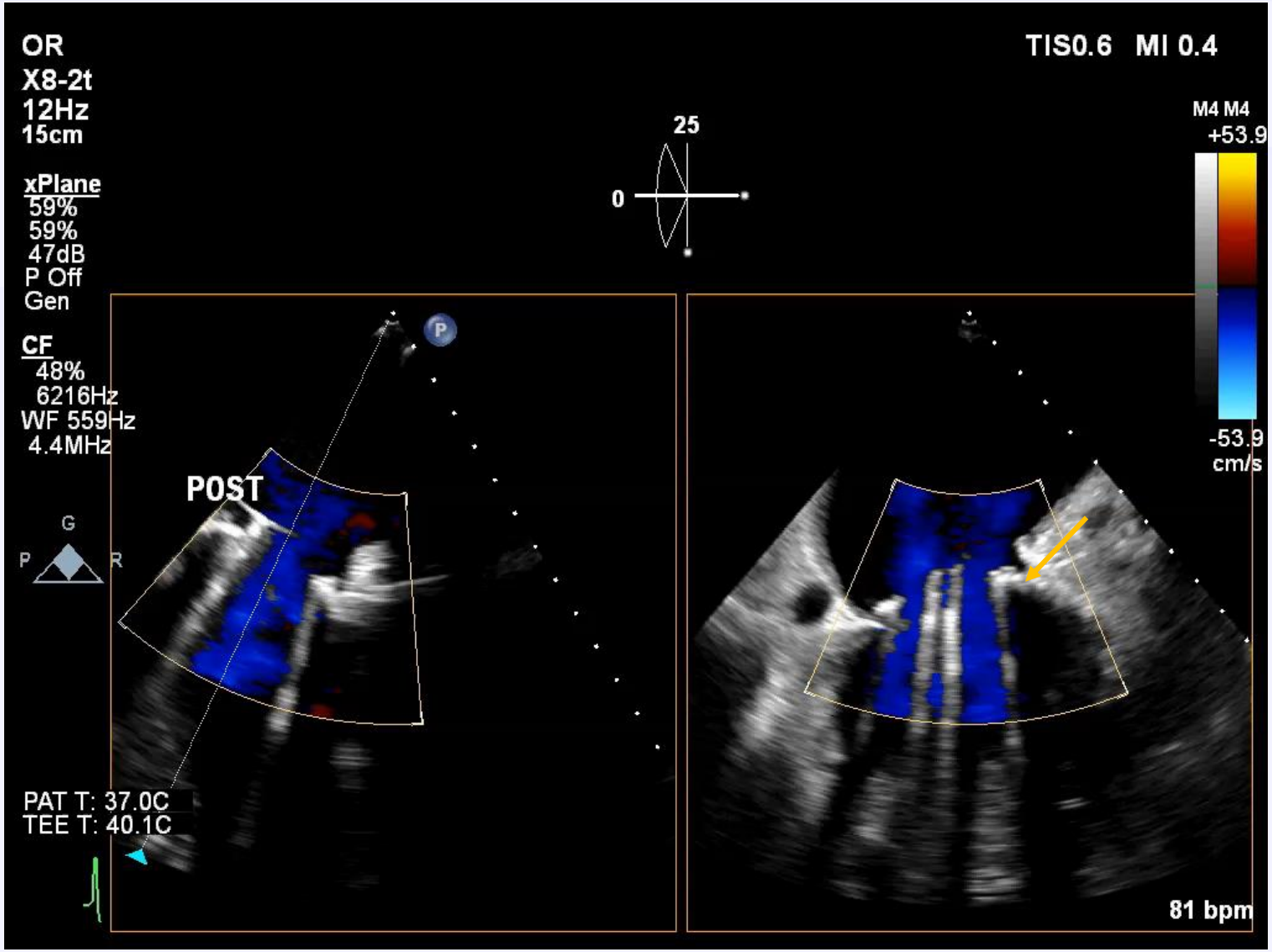
Case 1

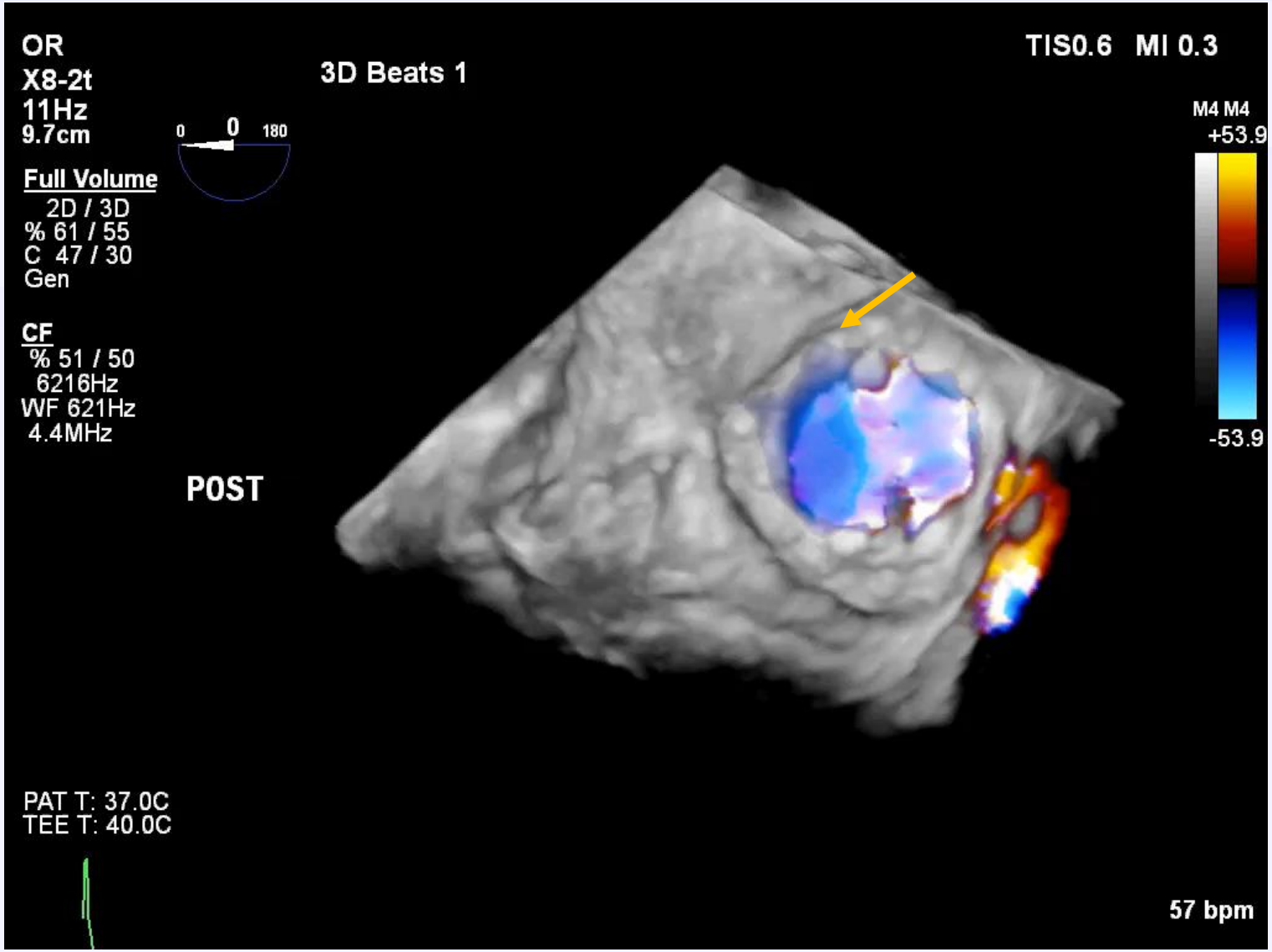
- 44-year-old man, presented to our center with severe MR due to mitral valve endocarditis

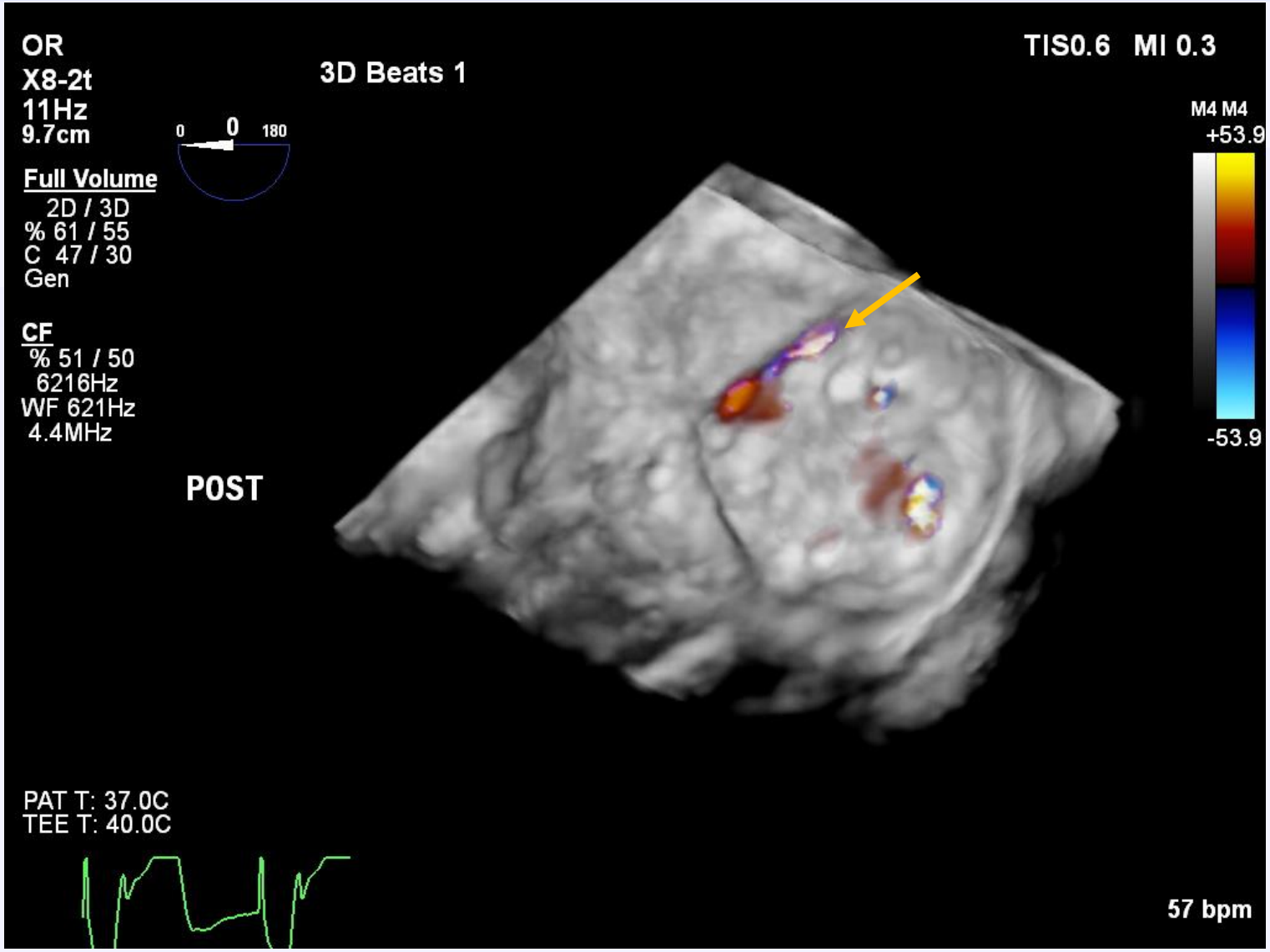

OR
X8-2t
49Hz
24cm
2D
66%
C 47
P Off
Gen
0
77
180
TIS0.2 MI 0.5
M4
MAC
G
P
R
PAT T: 37.0C
TEE T: 39.8C
127 bpm


OR
X8-2t
15Hz
18cm
2D
66%
C 47
P Off
Gen
CF
48%
4880Hz
WF 439Hz
4.4MHz
0
49
180
TIS0.6 MI 0.4
M4
+42.3
-42.3
cm/s
PAT T: 37.0C
TEE T: 40.0C
103 bpm


OR
X8-2t
15Hz
10cm
3D Zoom
2D / 3D
% 52 / 55
C 47 / 30
Gen
0 0 180
3D Beats 1
TIS0.2 MI 0.3
M4
POST
PAT T: 37.0C
TEE T: 40.1C
92 bpm


OR
X8-2t
12Hz
15cm
xPlane
59%
59%
47dB
P Off
Gen
CF
48%
6216Hz
WF 559Hz
4.4MHz
TIS0.6 MI 0.4
25
0
M4 M4
+53.9
-53.9
cm/s
POST
G
P
R
PAT T: 37.0C
TEE T: 40.1C
81 bpm


OR
X8-2t
11Hz
9.7cm
0 0 180
Full Volume
2D / 3D
% 61 / 55
C 47 / 30
Gen
CF
% 51 / 50
6216Hz
WF 621Hz
4.4MHz
3D Beats 1
TIS0.6 MI 0.3
M4 M4
+53.9
-53.9
POST
PAT T: 37.0C
TEE T: 40.0C
57 bpm


OR
X8-2t
11Hz
9.7cm
0 0 180
Full Volume
2D / 3D
% 61 / 55
C 47 / 30
Gen
CF
% 51 / 50
6216Hz
WF 621Hz
4.4MHz
POST
3D Beats 1
TIS0.6 MI 0.3
M4 M4
+53.9
-53.9
PAT T: 37.0C
TEE T: 40.0C
57 bpm

Early paravalvular leak

- Trace to mild early paravalvular leak can be seen in the OR in about 20% of patients after AVR, MVR or double valve replacement
- Early leaks are mainly due to technical challenges and are more frequent in:
  - Smaller body size patient
  - Bioprosthetic valve replacement
  - Debridement of annular calcification
  - Older patients
  - Redo valvular surgery
  - Reconstruction of the aortic and mitral annulus
  - Slightly more common in MVR than AVR (22.6% vs 17.7%)

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Valve Surgery

JACC 2001

Outcome of Mild Periprosthetic Regurgitation Detected by Intraoperative Transesophageal Echocardiography

Daniel J. O'Rourke, MD, MS, FACC,* Robert T. Palac, MD, MS, FACC,†
David J. Malenka, MD, FACC,† Charles A. S. Marrin, MB, BS,‡ Brenda E. Arbuckle, BA,†
Jonathan F. Plehn, MD, FACC§

White River Junction, Vermont; Lebanon, New Hampshire; and Roslyn, New York

OBJECTIVES The goal of this study was to determine the outcome of trivial or mild periprosthetic regurgitation (PPR) identified by intraoperative transesophageal echocardiography (TEE).

BACKGROUND The clinical significance, natural history and correlates of trivial or mild PPR detected early after surgery are unknown.

METHODS Between 1992 and 1997, 608 consecutive patients underwent isolated aortic valve replacement or mitral valve replacement at Dartmouth-Hitchcock Medical Center. Of these, 113 patients (18.3%) were found to have trivial or mild PPR at surgery by TEE. Follow-up transthoracic echocardiograms (early TTEs) were obtained within six weeks of surgery in 99.0% of patients and late TTEs (mean 2.1 years) in 54.3%. Clinical, intraoperative and

Results: At mean follow up of 2.1 years only one patient of the original 113 patients with trivial or mild paravalvular leak (out of total 608 pts with surgery) , progressed to severe and had to go for have redo-AVR, 3 years after initial valve implantation.

Late paravalvular leak

Rizzoli et al followed 2680 patient who received ≥ 1 mechanical prosthesis for the development of complications requiring reoperation. Follow-up included 18523 patient/years. 251 patients had reoperation due to malfunction of mechanical prosthesis. Indications for reoperation were:

1. Mechanical valve dehiscence (PVL) 131pts (0.5% of total)
2. Pannus formation 48 pts
3. Valve thrombosis 27 pts

Rizzoli G, et al. European Journal of Cardio-thoracic Surgery 1990

GUIDELINES AND STANDARDS

Recommendations for Evaluation of Prosthetic Valves With Echocardiography and Doppler Ultrasound

A Report From the American Society of Echocardiography's Guidelines and Standards Committee and the Task Force on Prosthetic Valves, Developed in Conjunction With the American College of Cardiology Cardiovascular Imaging Committee, Cardiac Imaging Committee of the American Heart Association, the European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography and the Canadian Society of Echocardiography, Endorsed by the American College of Cardiology Foundation, American Heart Association, European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography, and Canadian Society of Echocardiography

JASE 2009

GUIDELINES AND STANDARDS

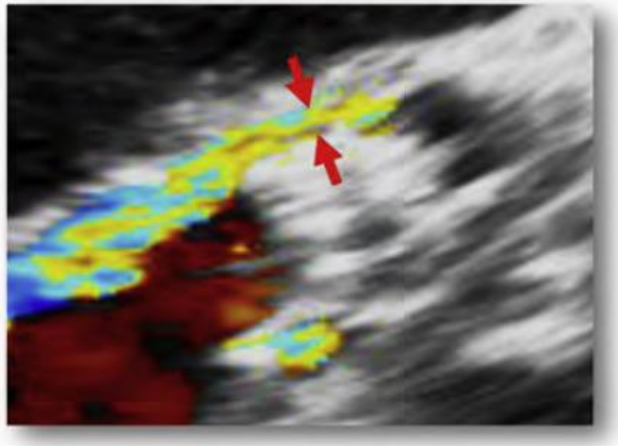
Guidelines for the Evaluation of Valvular Regurgitation After Percutaneous Valve Repair or Replacement

A Report from the American Society of Echocardiography Developed in Collaboration with the Society for Cardiovascular Angiography and Interventions, Japanese Society of Echocardiography, and Society for Cardiovascular Magnetic Resonance

William A. Zoghbi, MD, FASE, (Chair), Federico M. Asch, MD, FASE, Charles Bruce, MBChB, FASE, Linda D. Gillam, MD, MPH, FASE, Paul A. Grayburn, MD, FASE, Rebecca T. Hahn, MD, FASE, Ignacio Inglessis, MD, Ashequl M. Islam, MD, MPH, FSCAI, Stamatios Lerakis, MD, FASE, Stephen H. Little, MD, FASE, Robert J. Siegel, MD, FASE, Nikolaos Skubas, MD, DSc, FASE, Timothy C. Slesnick, MD, FASE, William J. Stewart, MD, FASE, Paaladinesh Thavendiranathan, MD, MSc, FASE, Neil J. Weissman, MD, FASE, Satoshi Yasukochi, MD, JCC, SJSUM, and Karen G. Zimmerman, BS, ACS, RDCS, RVT, FASE, *Houston and Dallas, Texas; Washington, District of Columbia; Rochester, Minnesota; Morristown, New Jersey; New York, New York; Boston and Springfield, Massachusetts; Los Angeles, California; Cleveland, Ohio; Atlanta, Georgia; Toronto, Ontario, Canada; Nagano, Japan; and Morgantown, West Virginia*

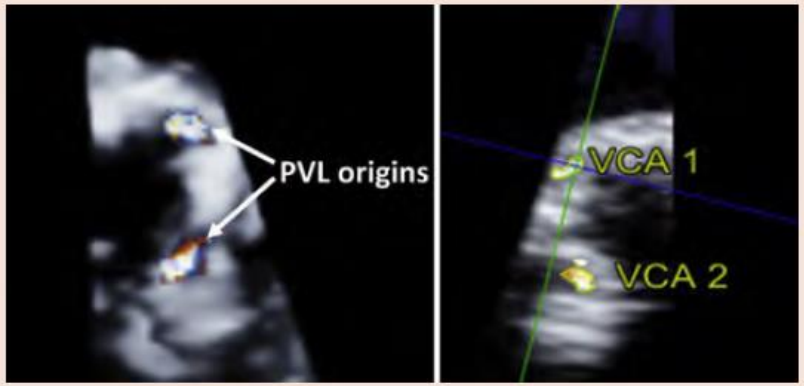
JASE 2019

Vena contracta width (VCW)



VCW >0.6 cm specific for severe AR; severity of multiple smaller jets more difficult to evaluate

Vena contracta area (VCA)

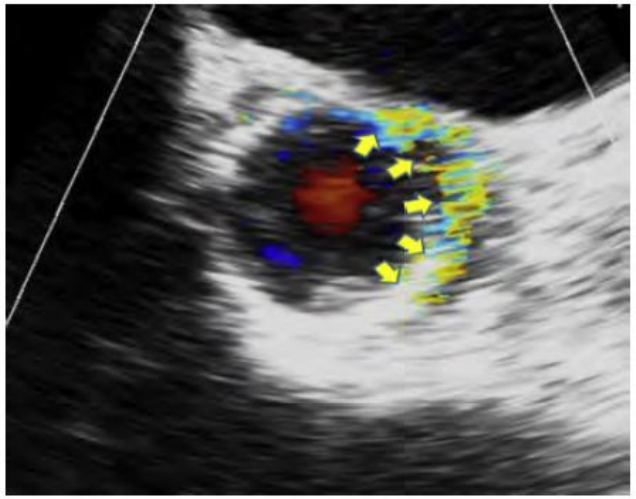


- May allow addition of multiple jets
- Prone to blooming artifacts
- Accuracy limited by spatial resolution for small jets

VCA ≥ 0.30 cm2 is c/w severe AR

TTE/TEE parameters determining AR severity after TAVR

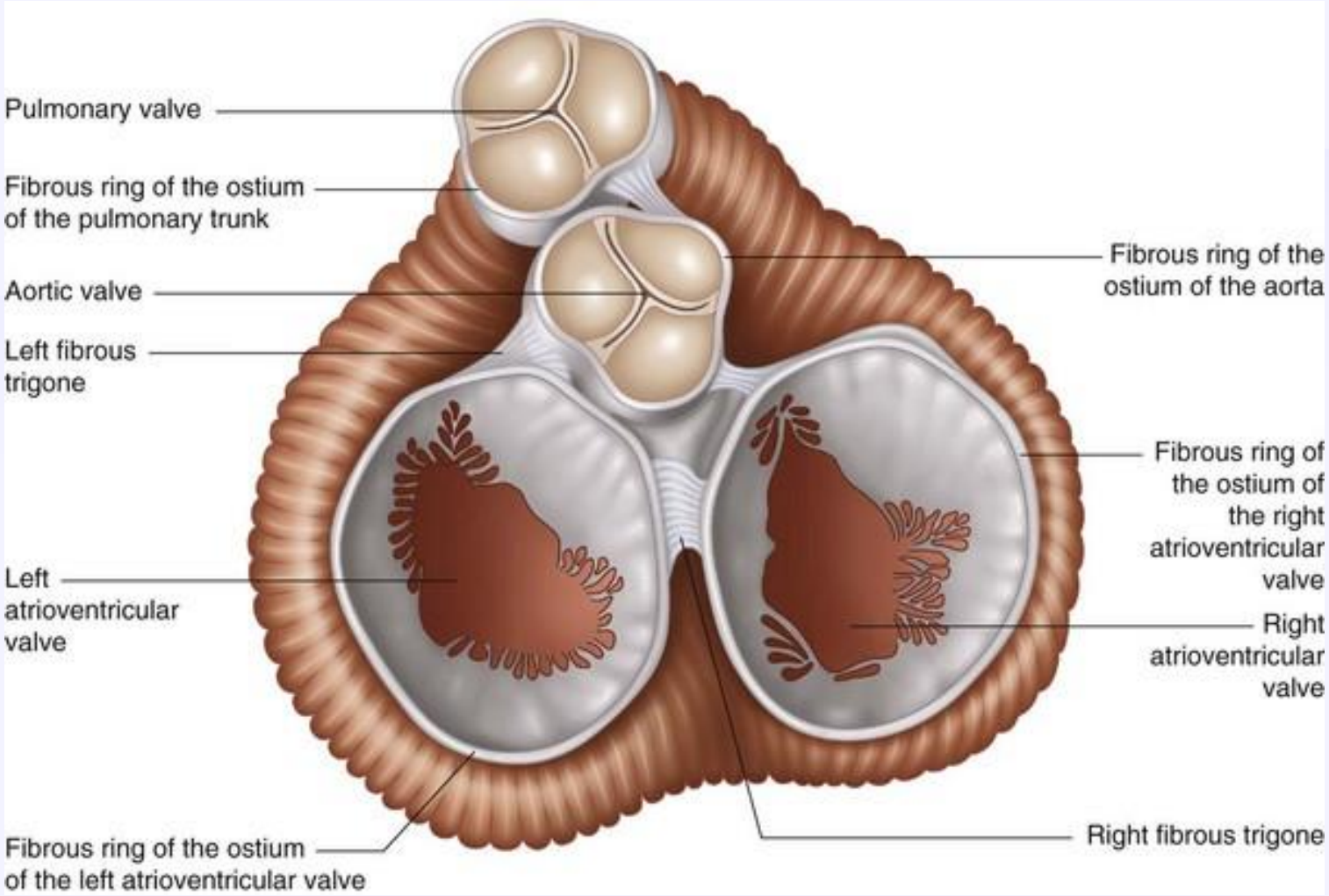
Circumferential extent (%)



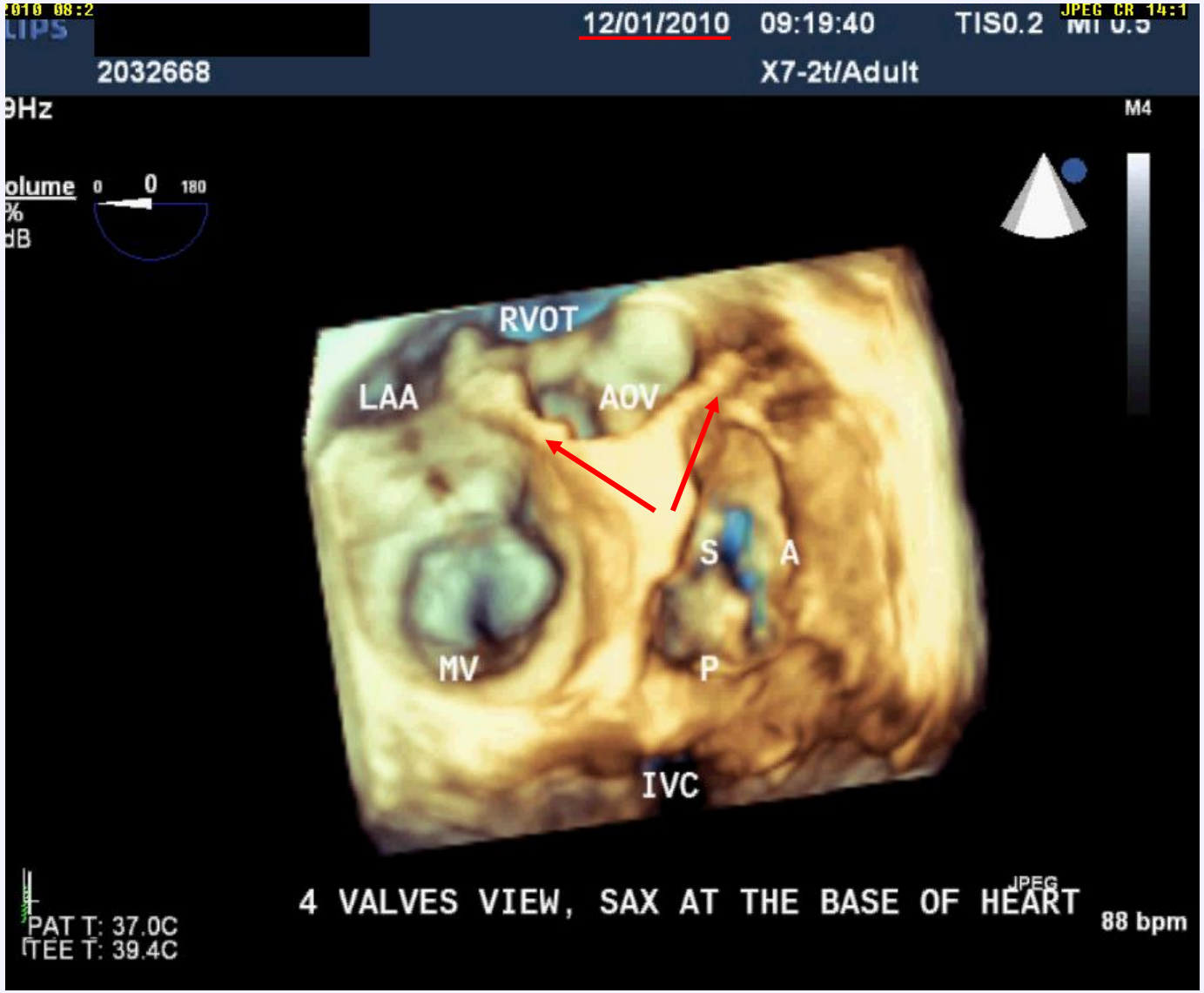
- Continuous circumferential extent of AR of >30% indicative of severe AR
- Circumferential extent of few, smaller discrete jets more difficult to assess

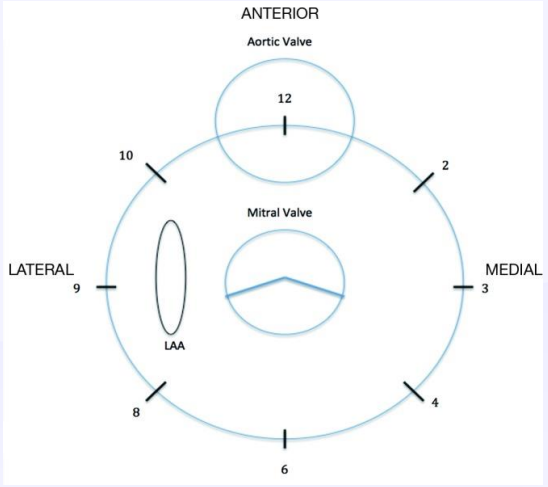
Flow convergence

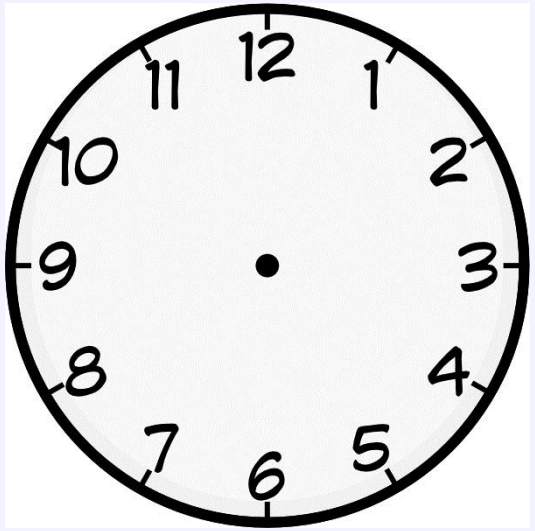
Large flow convergence in aorta indicative of severe AR



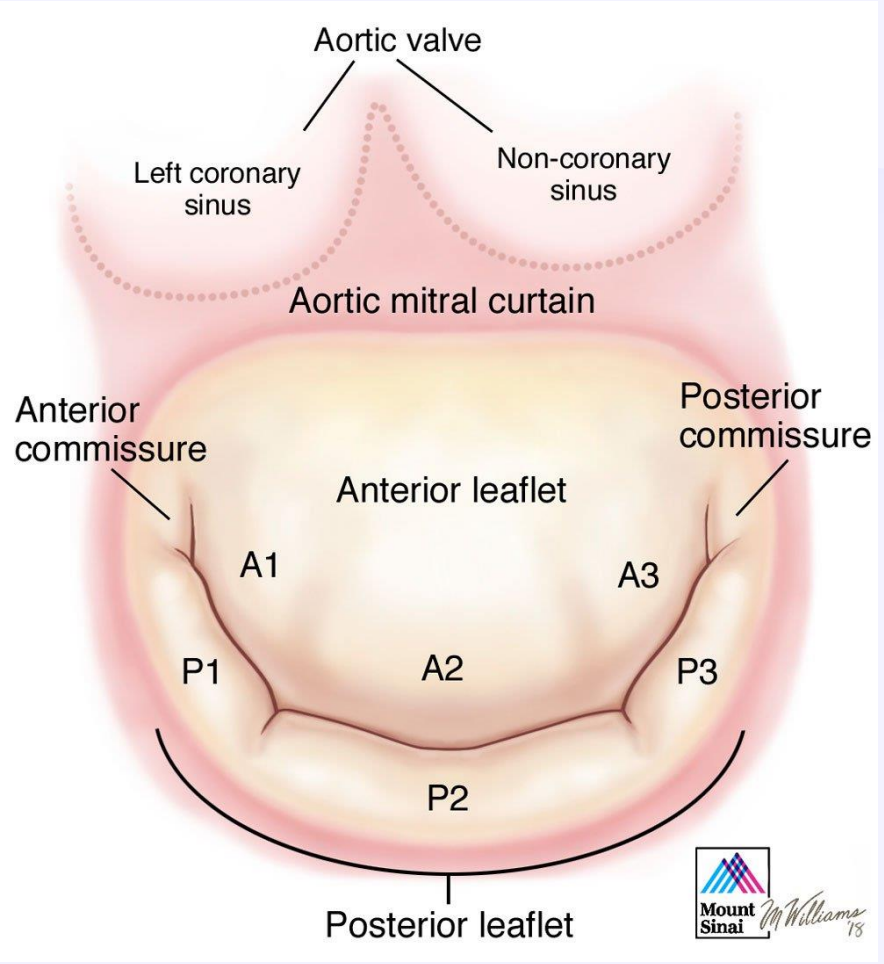
Anatomic orientation of the valves (bound by fibrous skeleton)


12/01/2010
09:19:40
TIS0.2
2032668
X7-2t/Adult
M4
RVOT
LAA
AOV
S
A
MV
P
IVC
4 VALVES VIEW, SAX AT THE BASE OF HEART
88 bpm
PAT T: 37.0C
TEE T: 39.4C

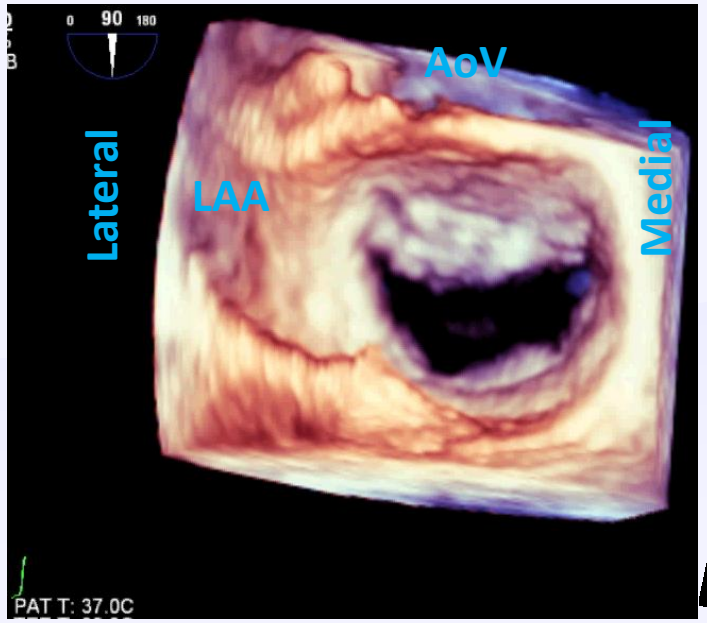




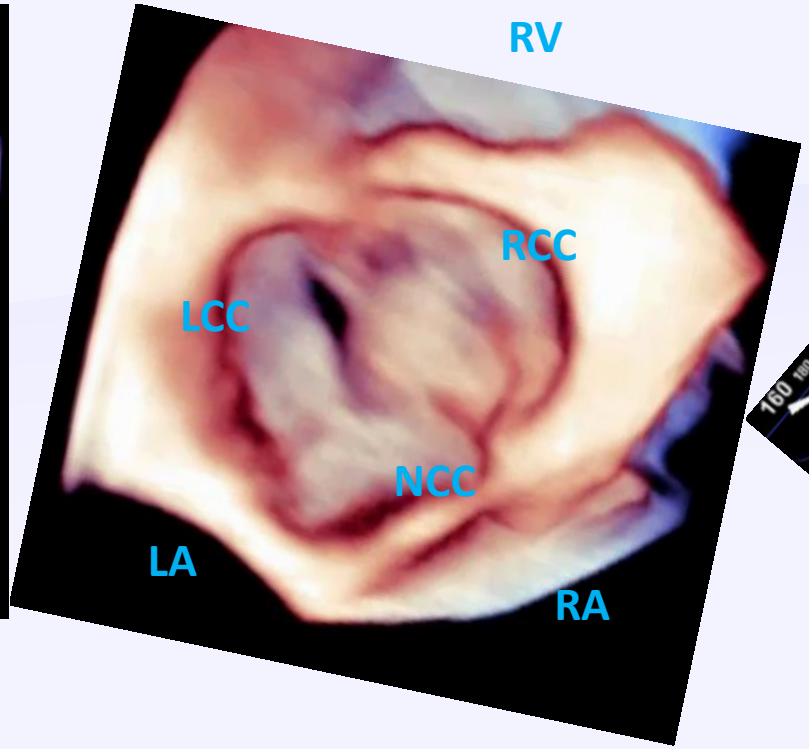
Clock face orientation



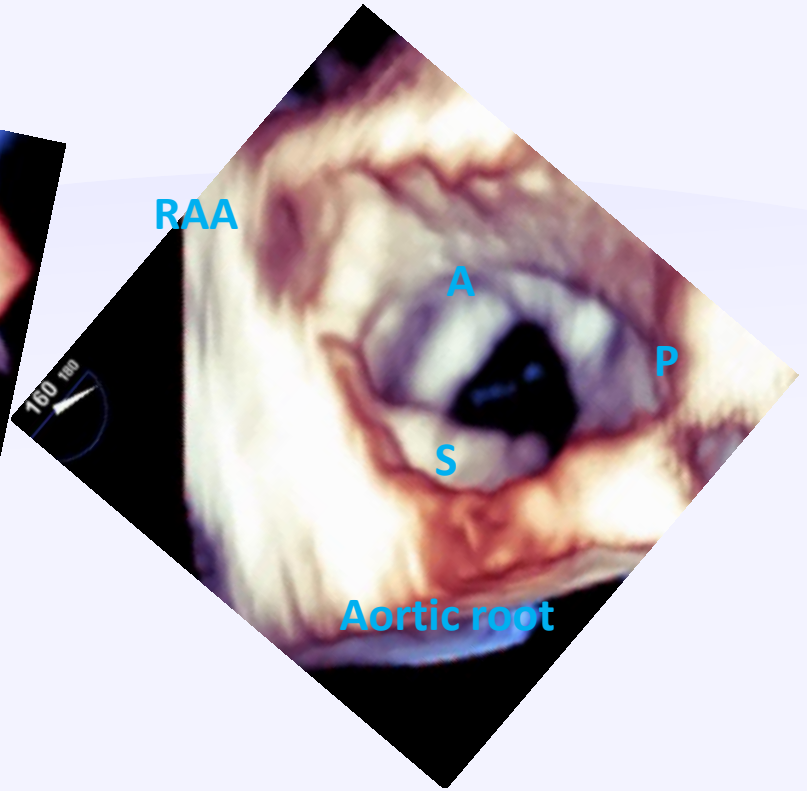
Surgical view of the mitral valve and relation with aortic root



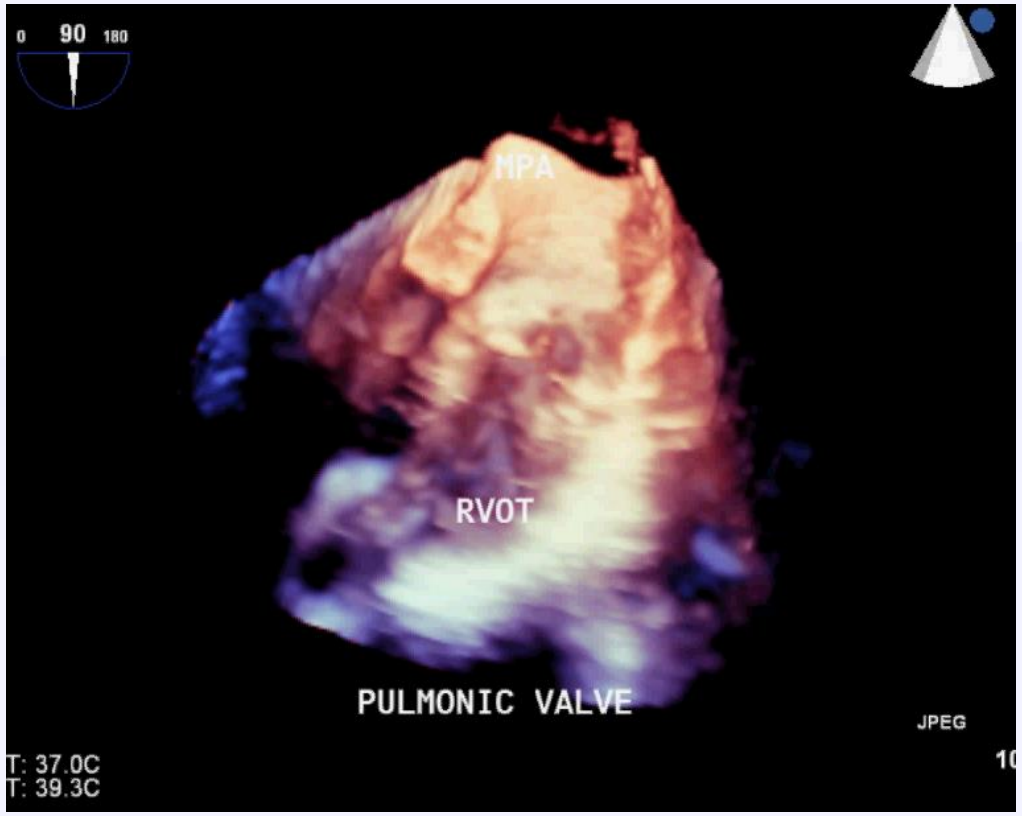
Surgical view of the MV
(from LA side)



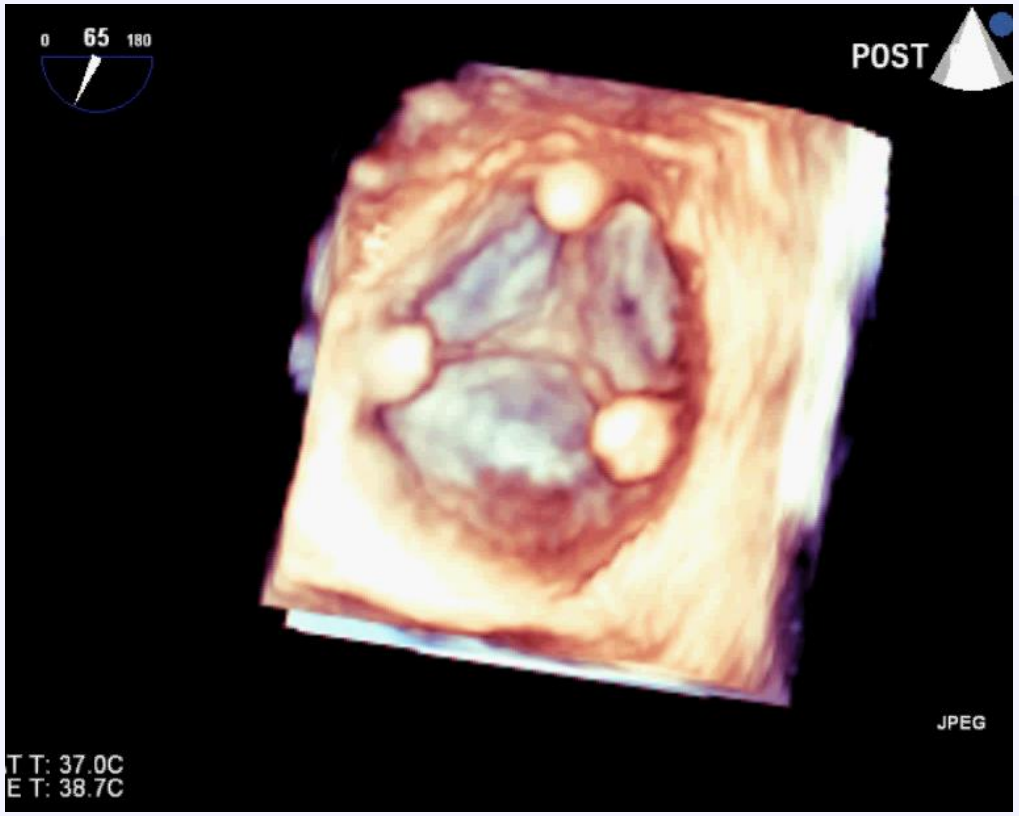
Surgeon's view of the AoV



Surgical view of the tricuspid valve



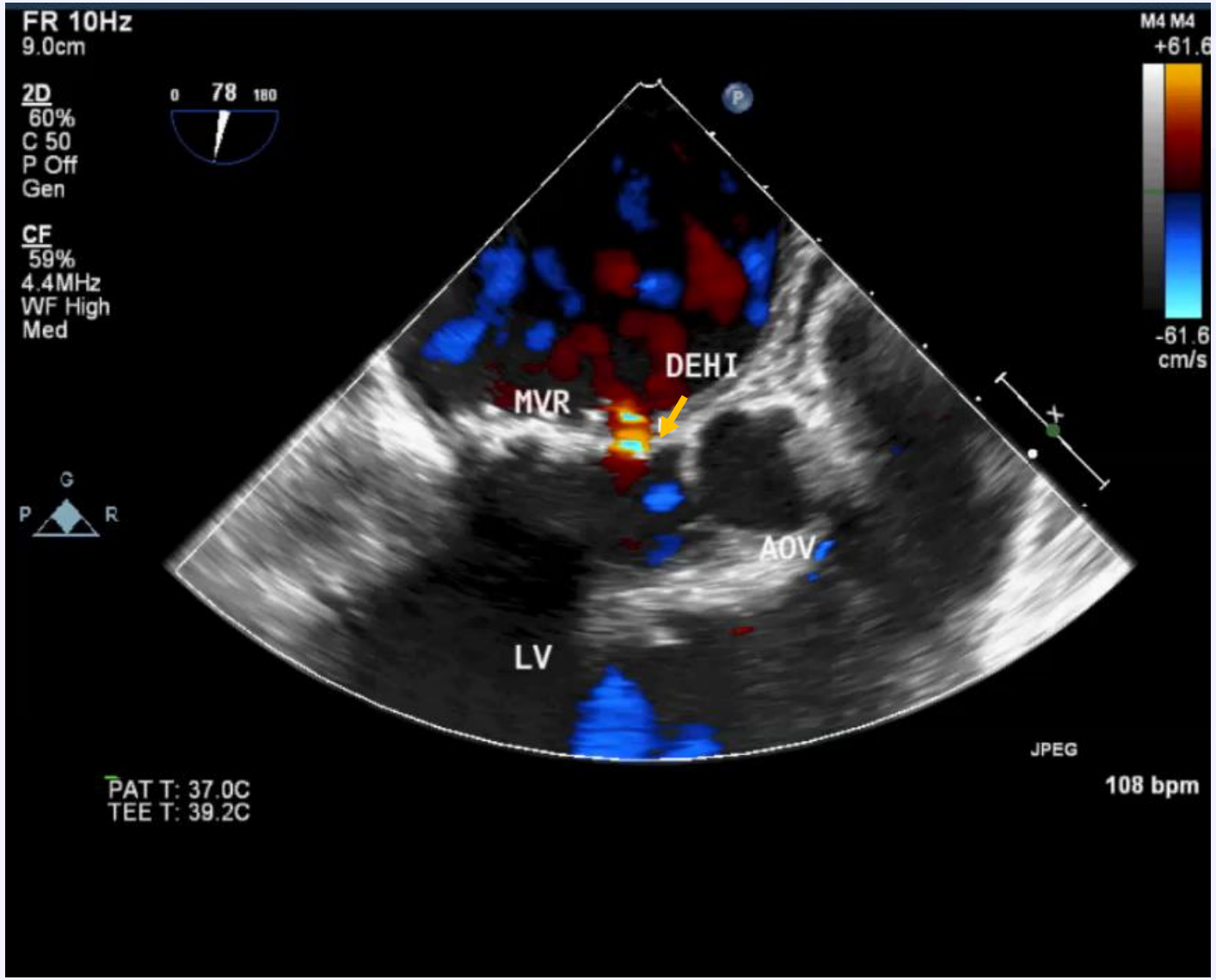
3D zoom mode of pulmonic valve



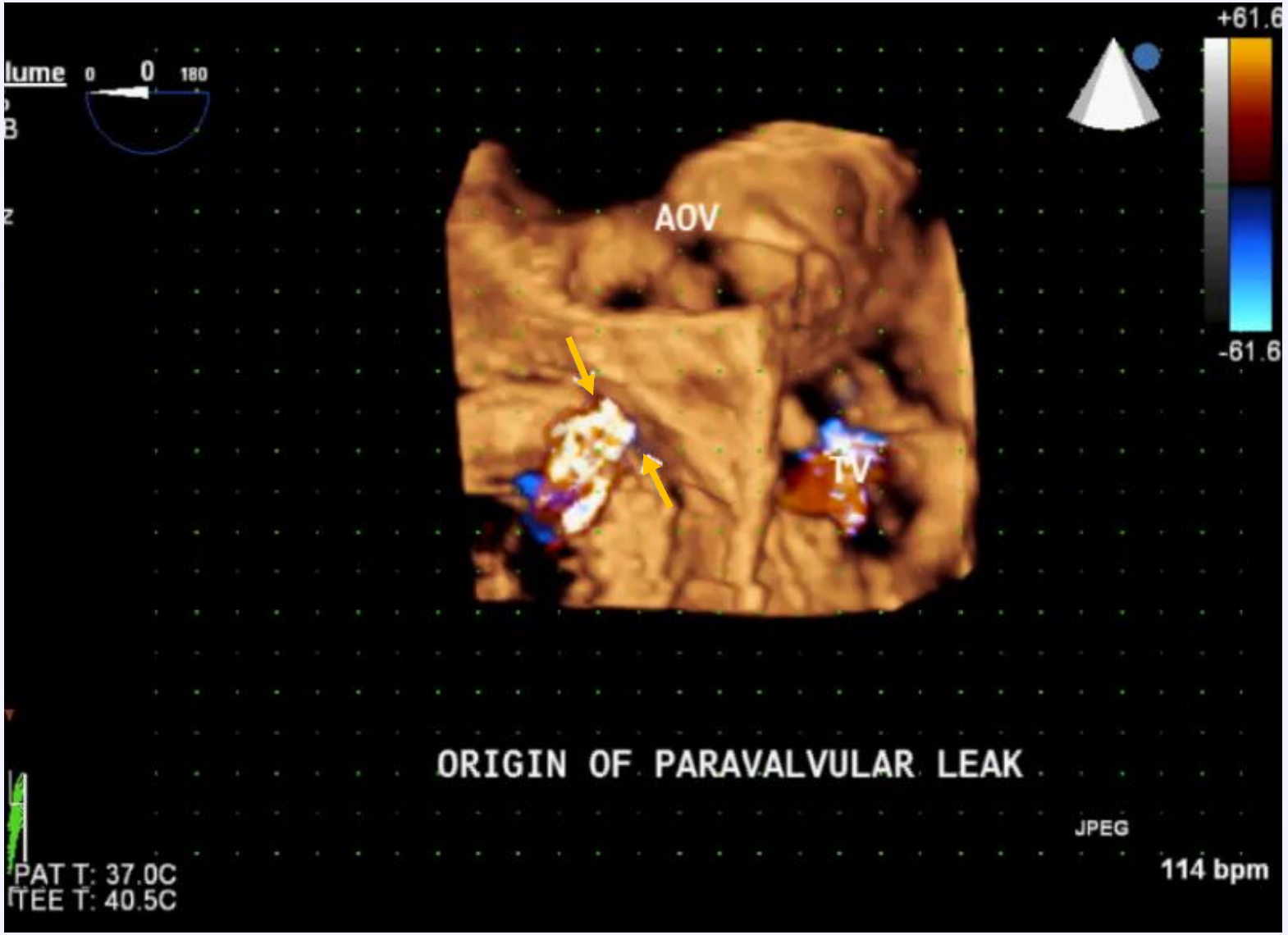
En-face view of a bioprosthetic pulmonic valve

Case 2

- 65-year-old female, presented with SOB 2 month after bio MVR, TV repair, and CABG


FR 10Hz
9.0cm
2D
60%
C 50
P Off
Gen
CF
59%
4.4MHz
WF High
Med
0
78
180
M4 M4
+61.6
-61.6
cm/s
DEHI
MVR
AOV
LV
G
P
R
JPEG
108 bpm
PAT T: 37.0C
TEE T: 39.2C


PHILIPS
11/11/2009
11:19:05
TIS1.0
2262061
X7-2t/Adult
FR 14Hz
5 mm
9.0cm
Full Volume
3D 11%
3D 40dB
CF
50%
4.4MHz
M4 M4
+61.6
-61.6
AOV
TV
ORIGIN OF PARAVALVULAR LEAK
JPEG
114 bpm
PAT T: 37.0C
TEE T: 40.5C

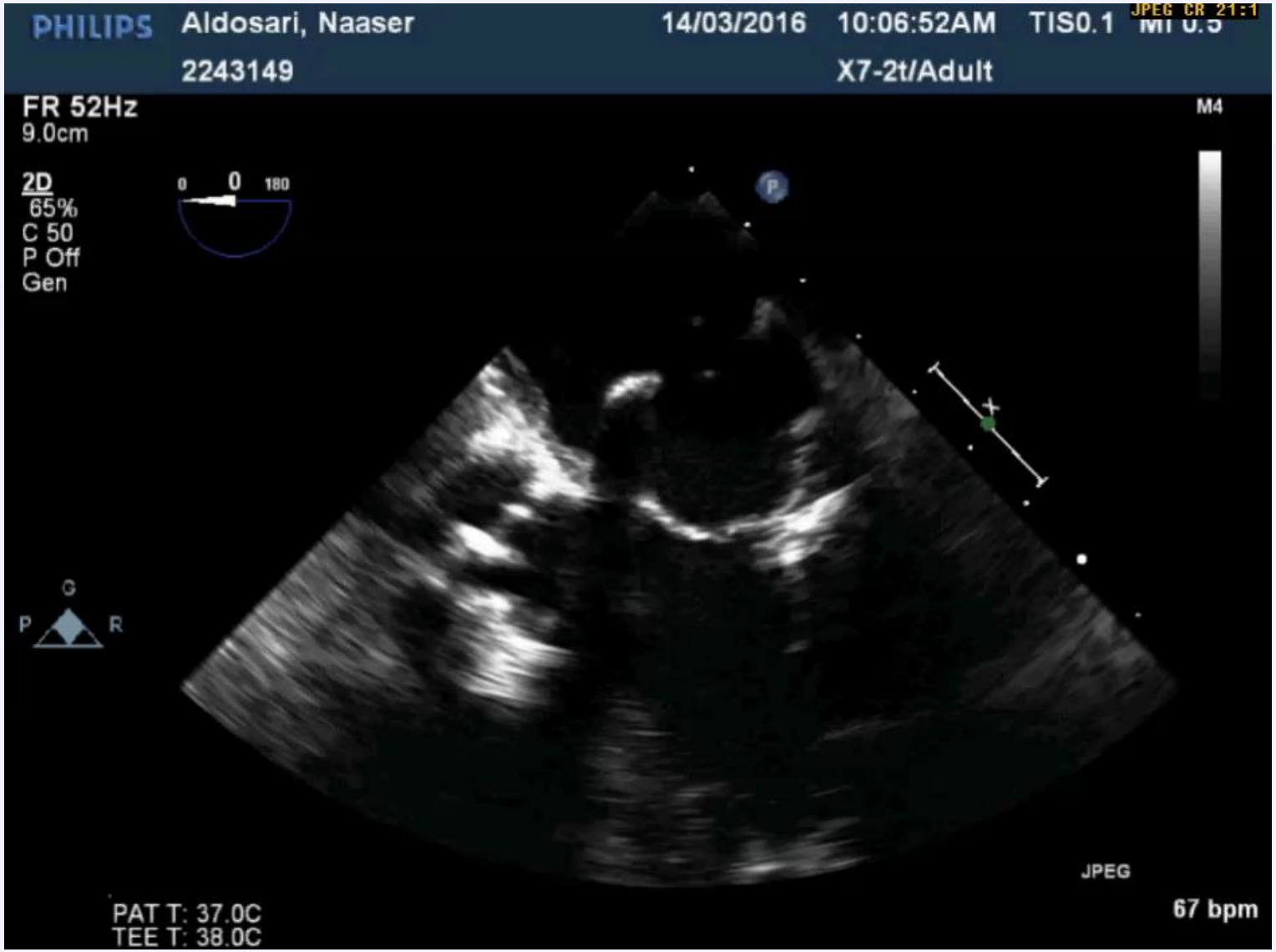

lume
0
0
180
+61.6
-61.6
AOV
TV
ORIGIN OF PARAVALVULAR LEAK
JPEG
114 bpm
PAT T: 37.0C
TEE T: 40.5C

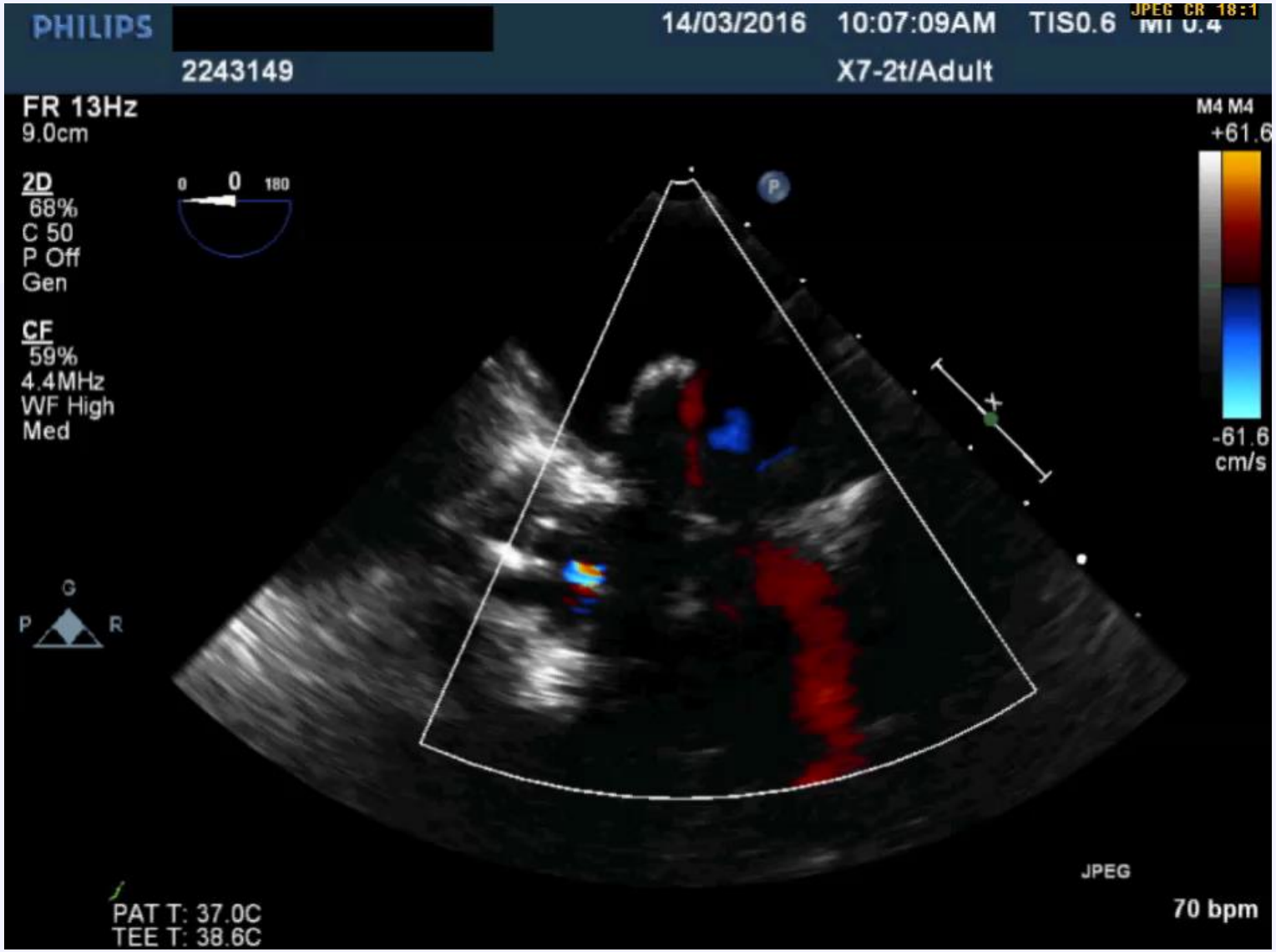

lume
0
120
180
B
+46.2
-46.2
DEVICE
NO RESIDUAL LEAK
JPEG
69 bpm
PAT T: 37.0C
TEE T: 40.0C

Case 3

- 68-year-old man underwent bioprosthetic MVR in our center 3 years ago. His MVR was implanted as top-hat position due to severe MAC (supra-annular position in the LA to avoid removal of the MAC)

- He presented back after 3 years with severe SOB


PHILIPS
Aldosari, Naaser
2243149
14/03/2016
10:06:52AM
TIS0.1
X7-2t/Adult
JPEG CR 21:1
FR 52Hz
9.0cm
M4
2D
65%
C 50
P Off
Gen
0
0
180
P
R
JPEG
PAT T: 37.0C
TEE T: 38.0C
67 bpm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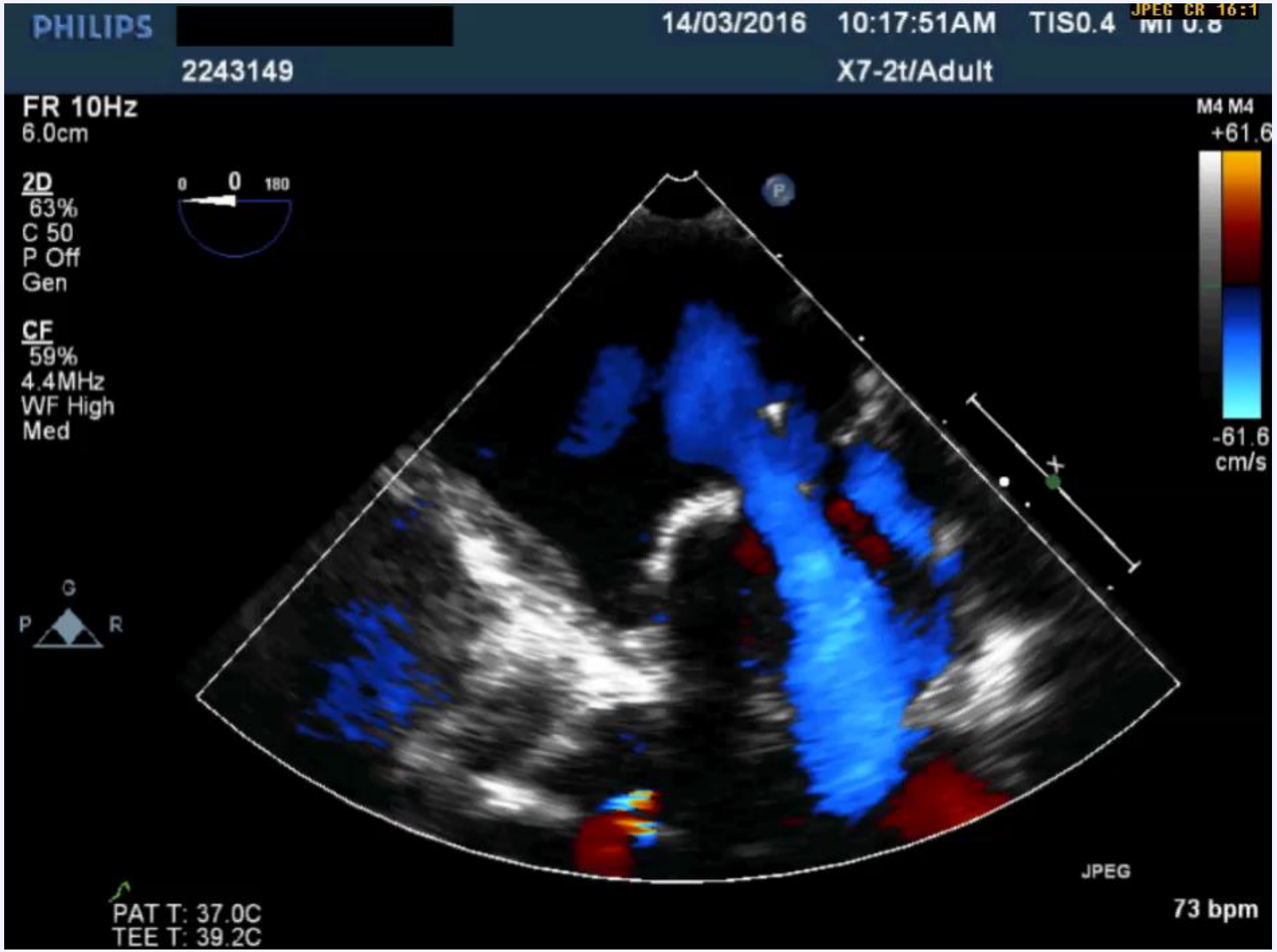
2D
68%
C 50
P Off
Gen
CF
59%
4.4MHz
WF High
Med
M4 M4
+61.6
-61.6
cm/s
JPEG
PAT T: 37.0C
TEE T: 38.6C
70 bpm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2243149
X7-2t/Adult
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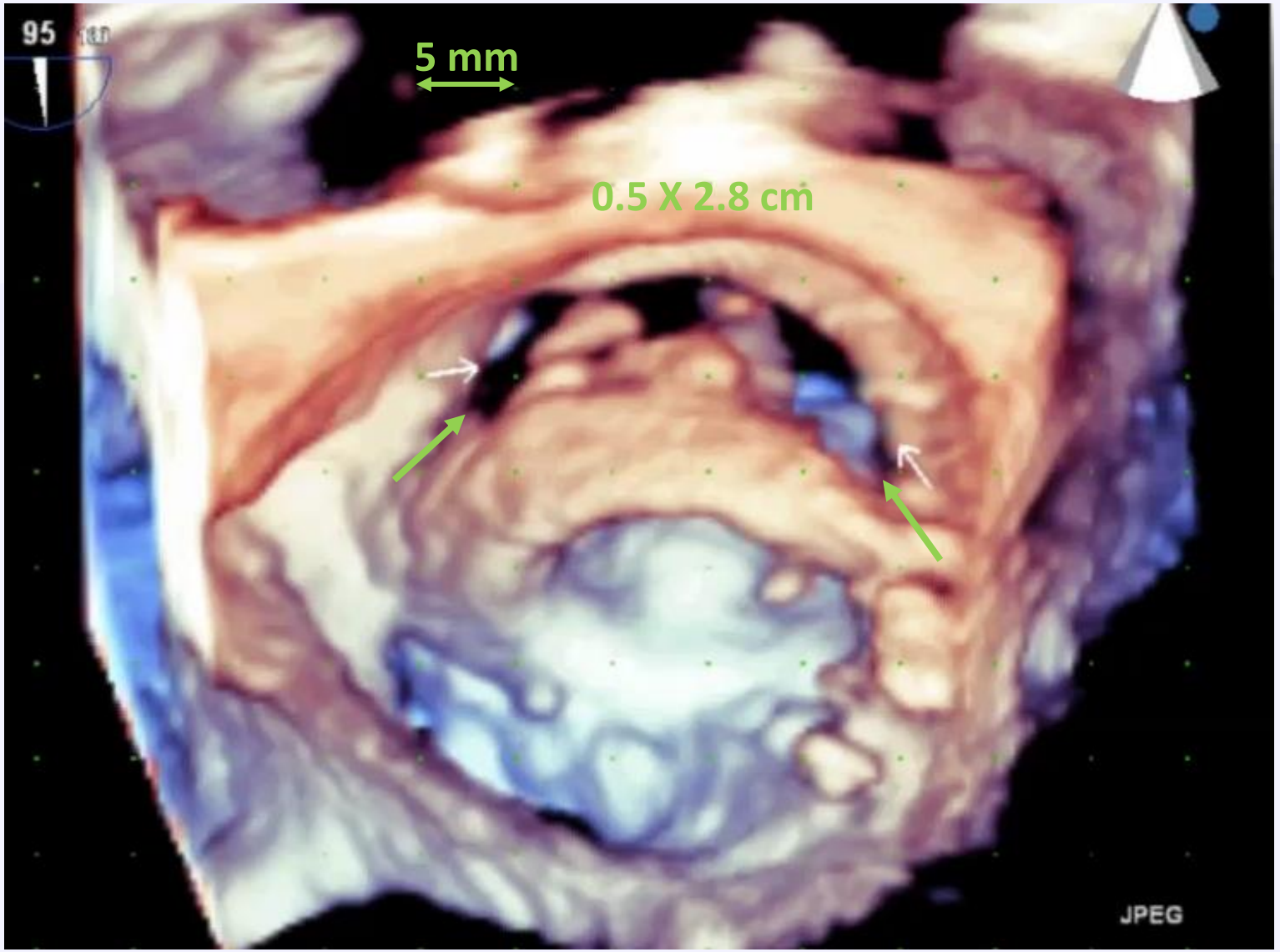
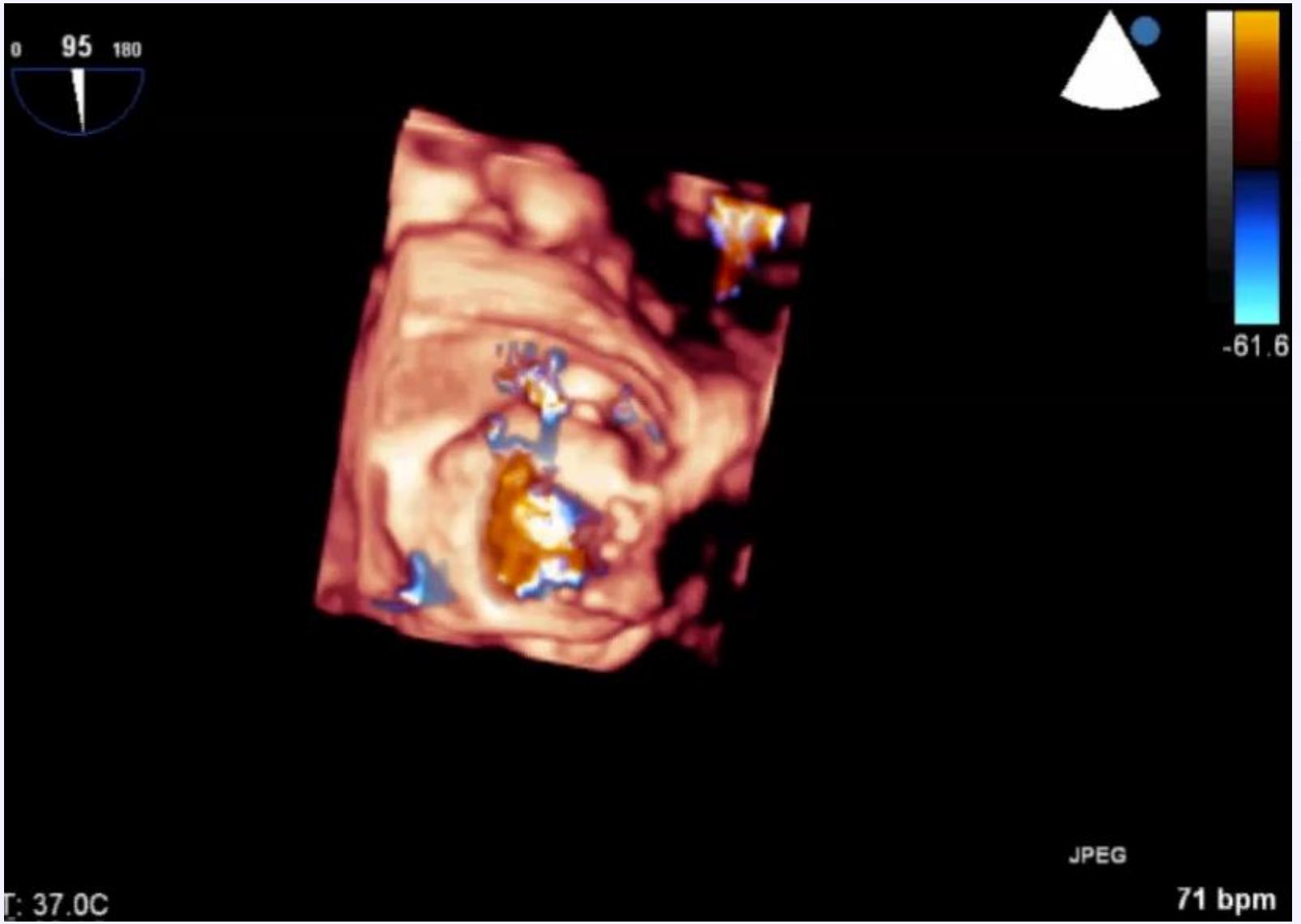
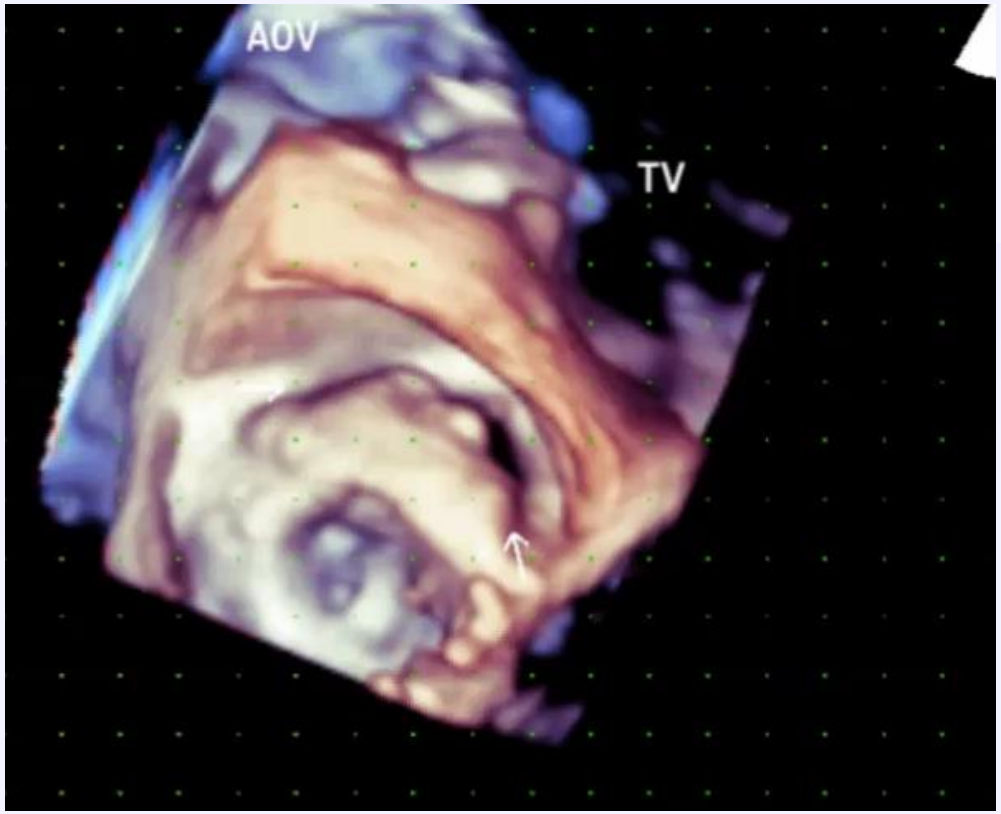
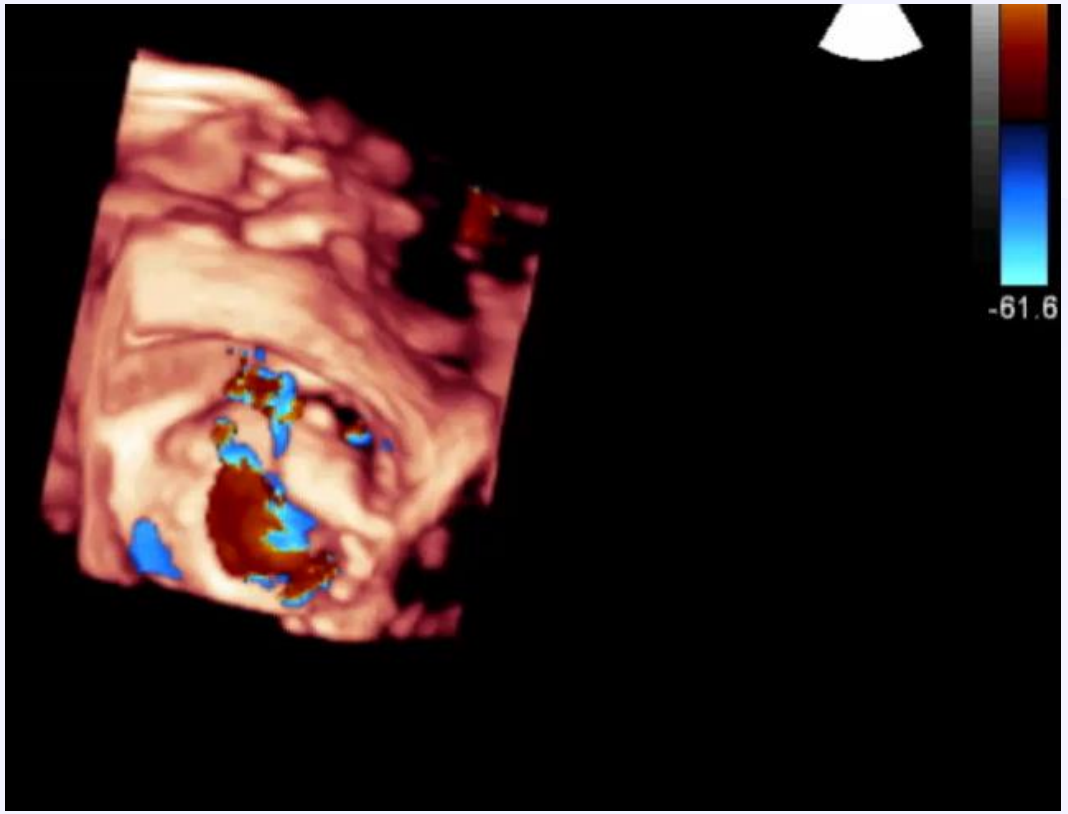
6.0cm
2D
63%
C 50
P Off
Gen
CF
59%
4.4MHz
WF High
Med
M4 M4
+61.6
-61.6
cm/s
JPEG
PAT T: 37.0C
TEE T: 39.2C
73 bpm

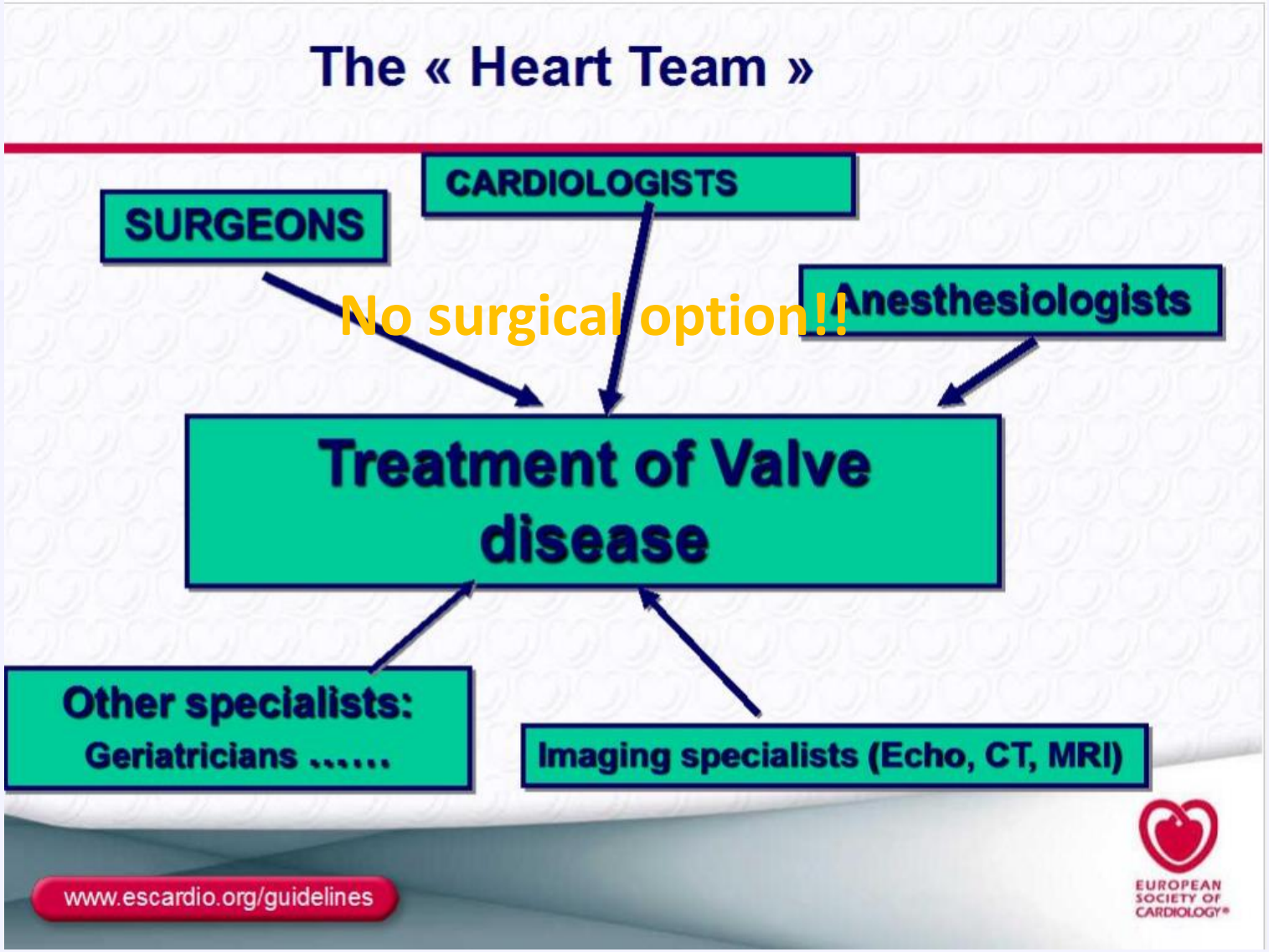

PHILIPS
14/03/2016 10:19:56AM TIS0.3
JPEG CR 10:1
2243149
X7-2t/Adult
FR 9Hz 5 mm
7.3cm
M4
Live 3D
3D 35%
3D 0dB
Gen
0 95 180
RING DEHISCENCE
JPEG
PAT T: 37.0C
TEE T: 39.2C
112 bpm


95
5 mm
0.5 X 2.8 cm
JPEG


0
95
180
-61.6
JPEG
71 bpm
T: 37.0C


AOV
TV

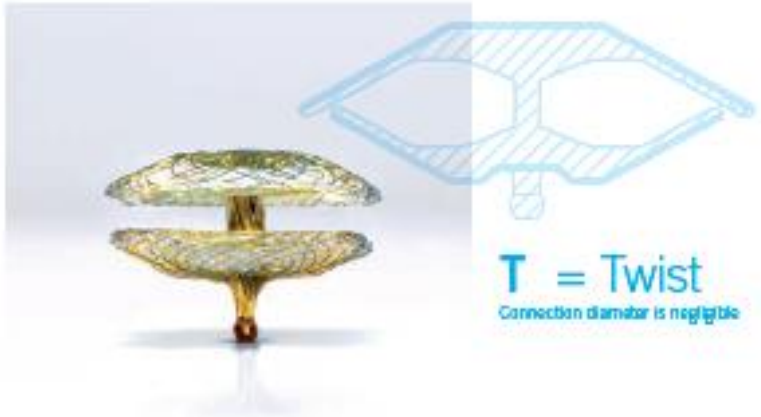

-61.6


The « Heart Team »
CARDIOLOGISTS
SURGEONS
Anesthesiologists
No surgical option !!
Treatment of Valve disease
Other specialists:
Geriatricians .....
Imaging specialists (Echo, CT, MRI)
www.escardio.org/guidelines
EUROPEAN SOCIETY OF CARDIOLOGY®

Waist & Twist

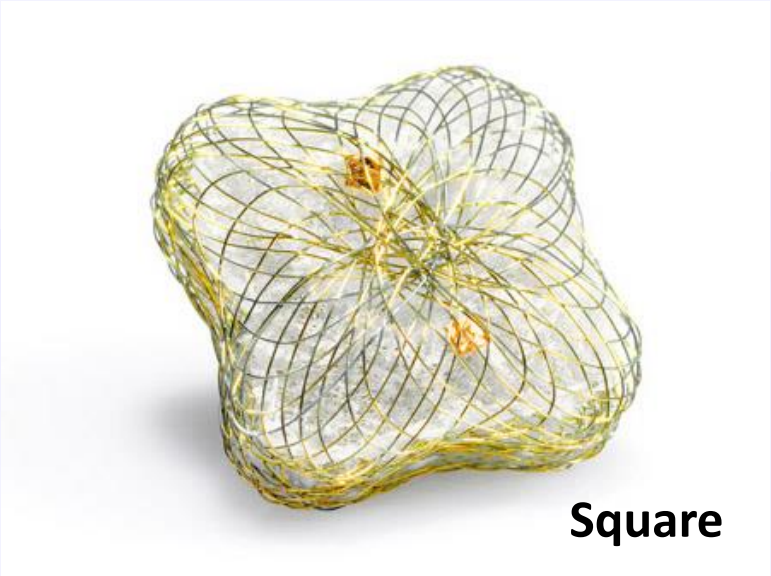
The Occlutech PLD is available with two types of connections between the discs, **Waist** or **Twist**. Example below shown on a Occlutech PLD Square.

W = Waist



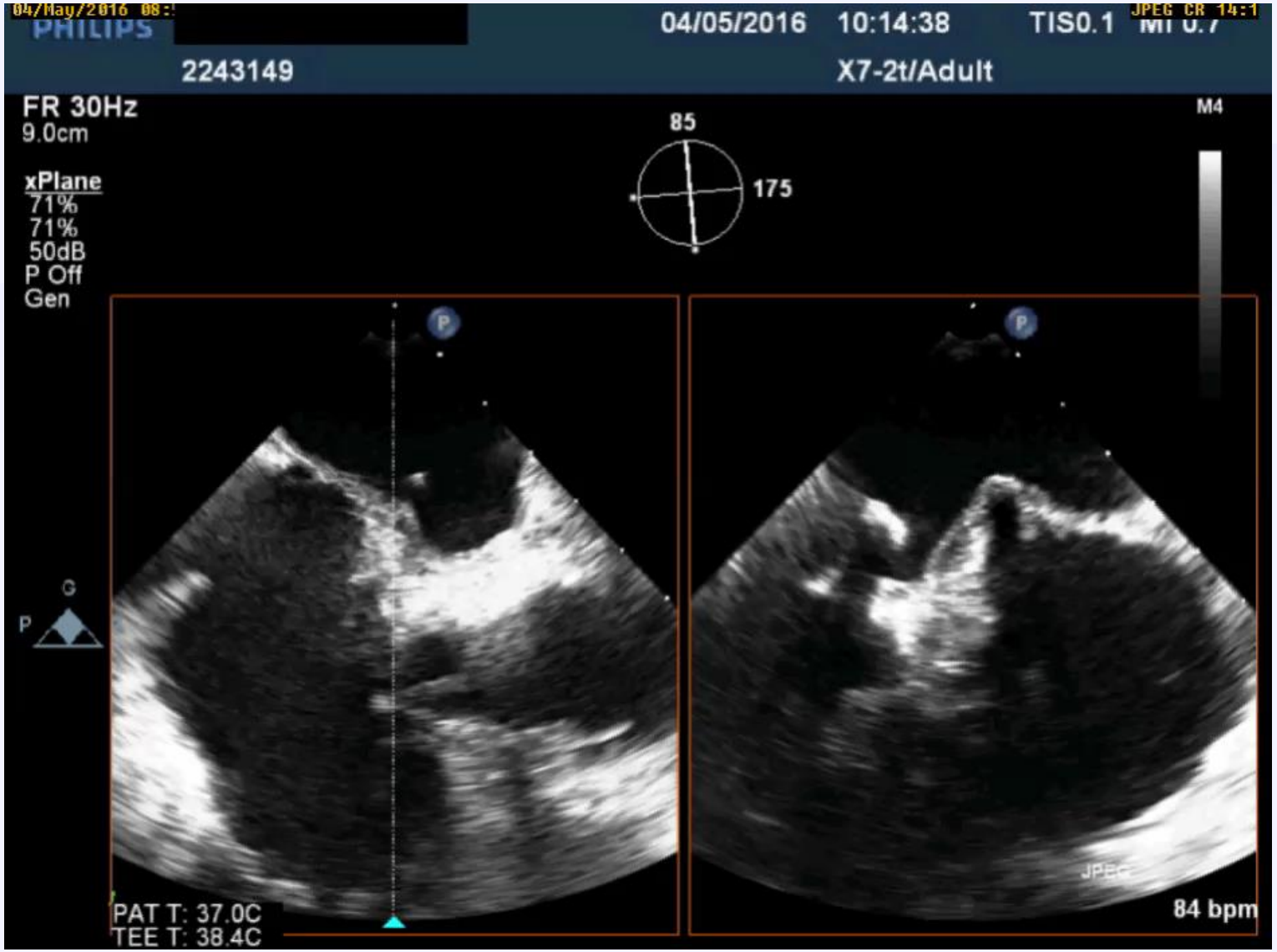
T = Twist

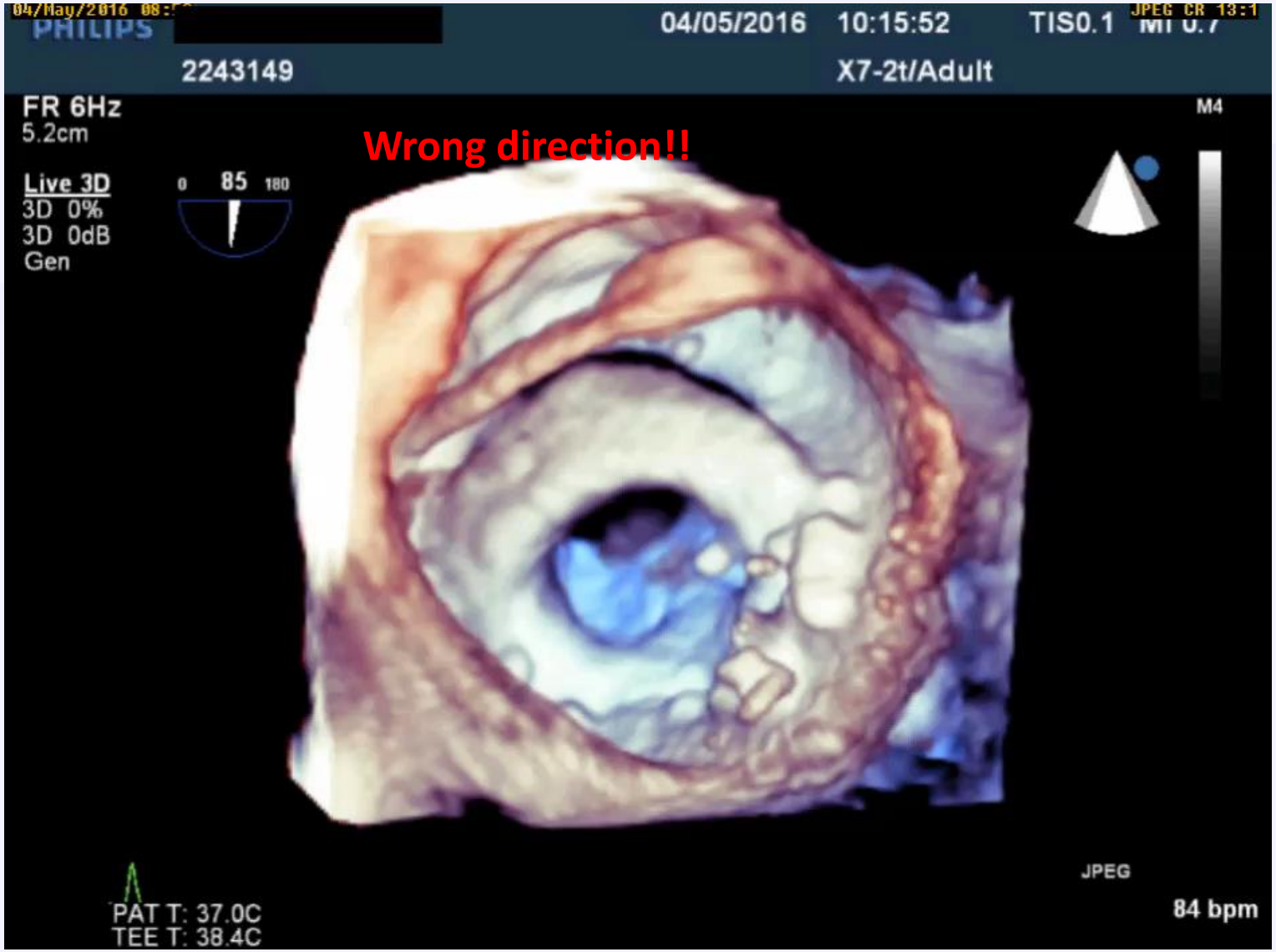
Connection diameter is negligible

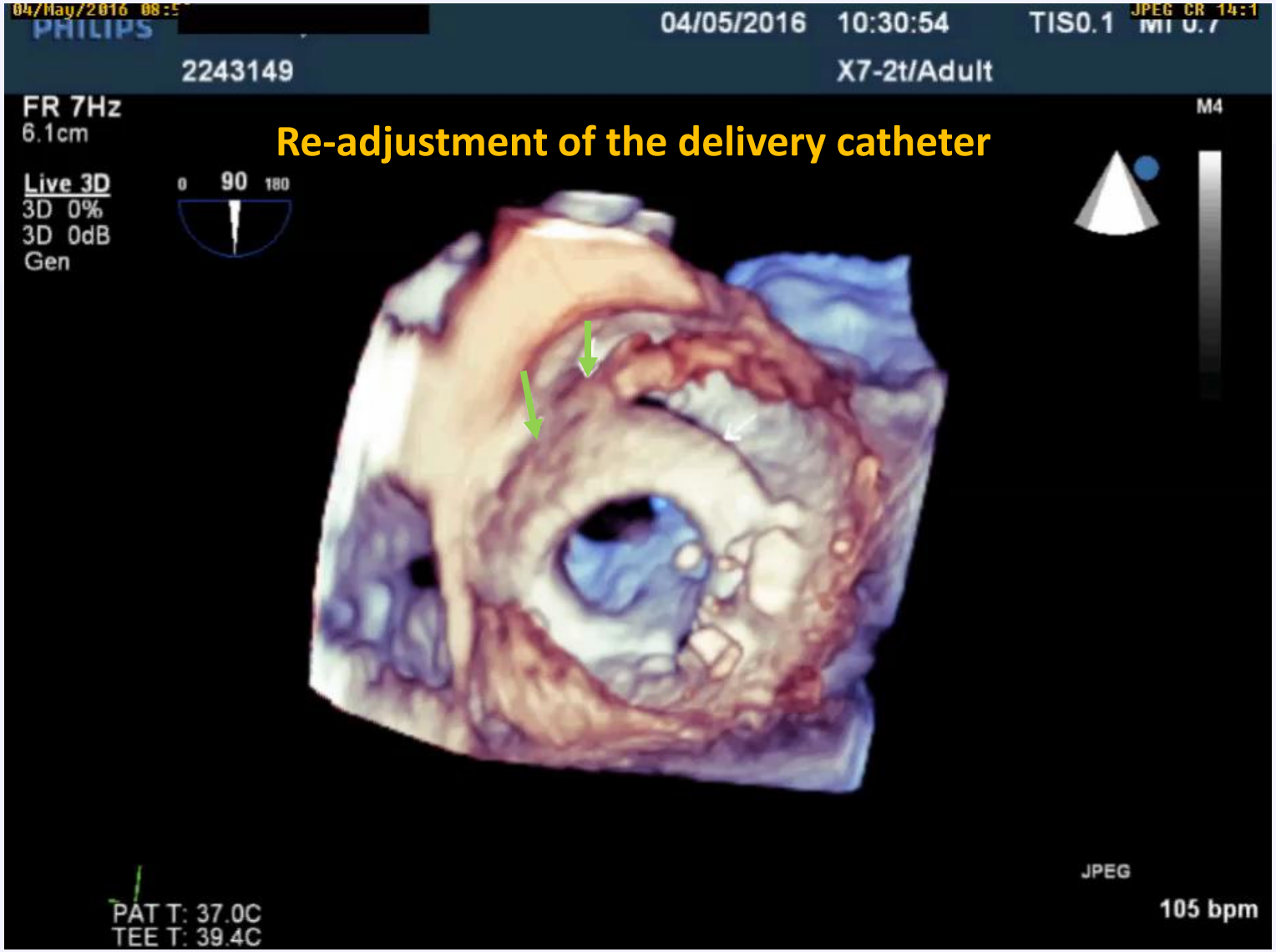


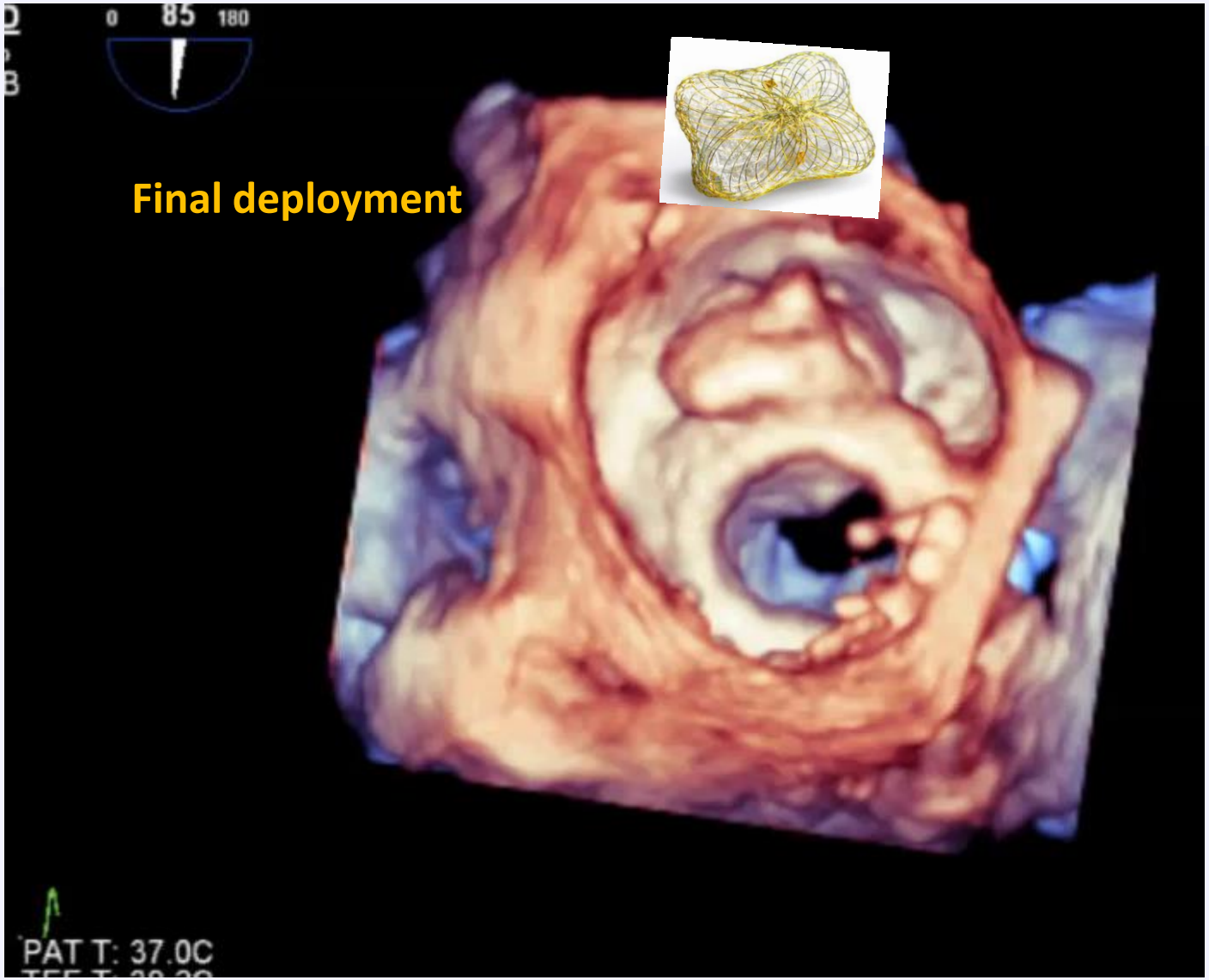
Square

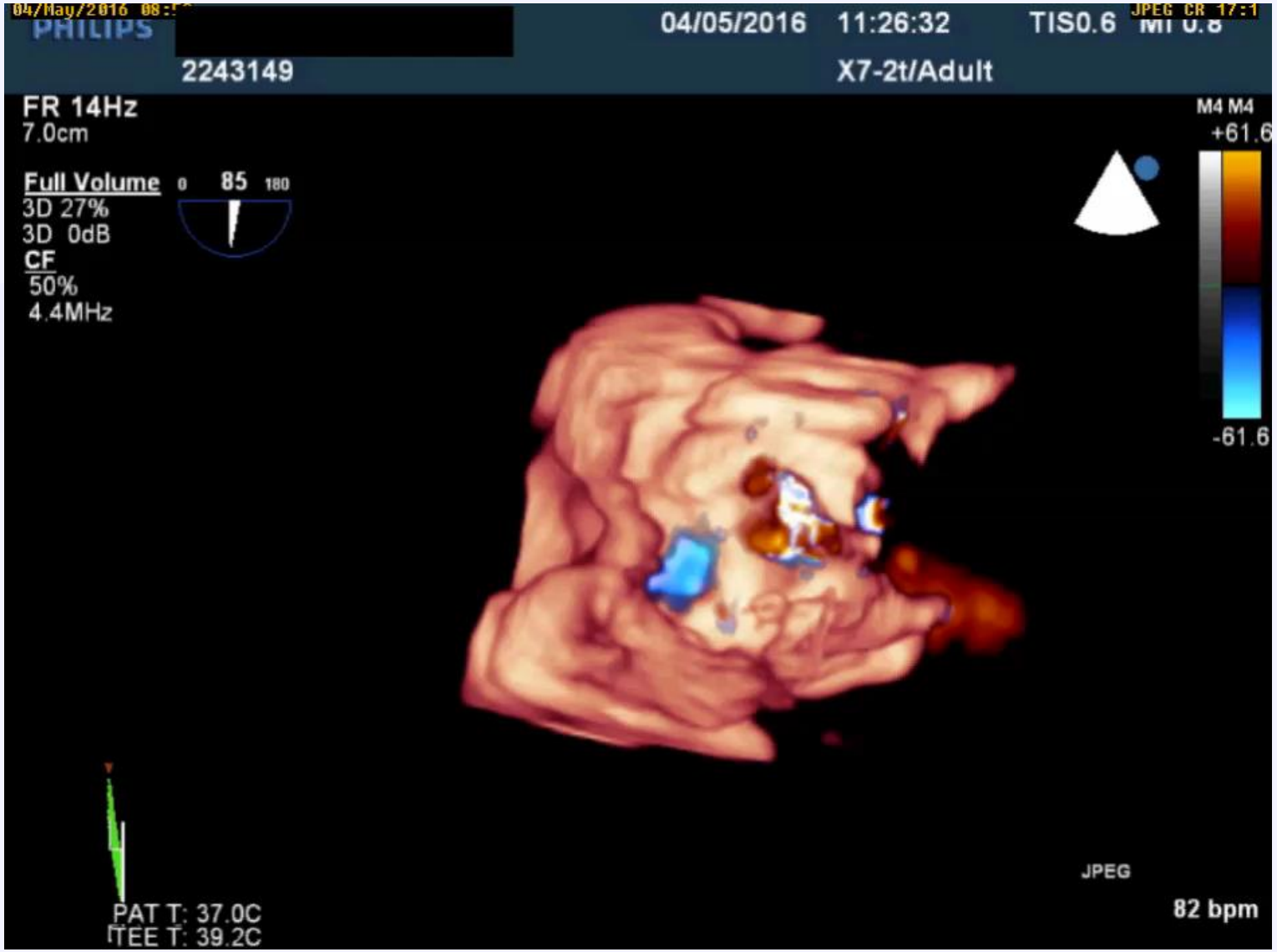
Rectangular


04/05/2016 10:14:38 TIS0.1
2243149
X7-2t/Adult
FR 30Hz
9.0cm
xPlane
71%
71%
50dB
P Off
Gen
85
175
M4
PAT T: 37.0C
TEE T: 38.4C
84 bpm


PHILIPS
04/05/2016
10:15:52
TIS0.1
JPEG CR 13:1
2243149
X7-2t/Adult
FR 6Hz
5.2cm
Wrong direction!!
M4
Live 3D
3D 0%
3D 0dB
Gen
0
85
180
JPEG
PAT T: 37.0C
TEE T: 38.4C
84 bpm

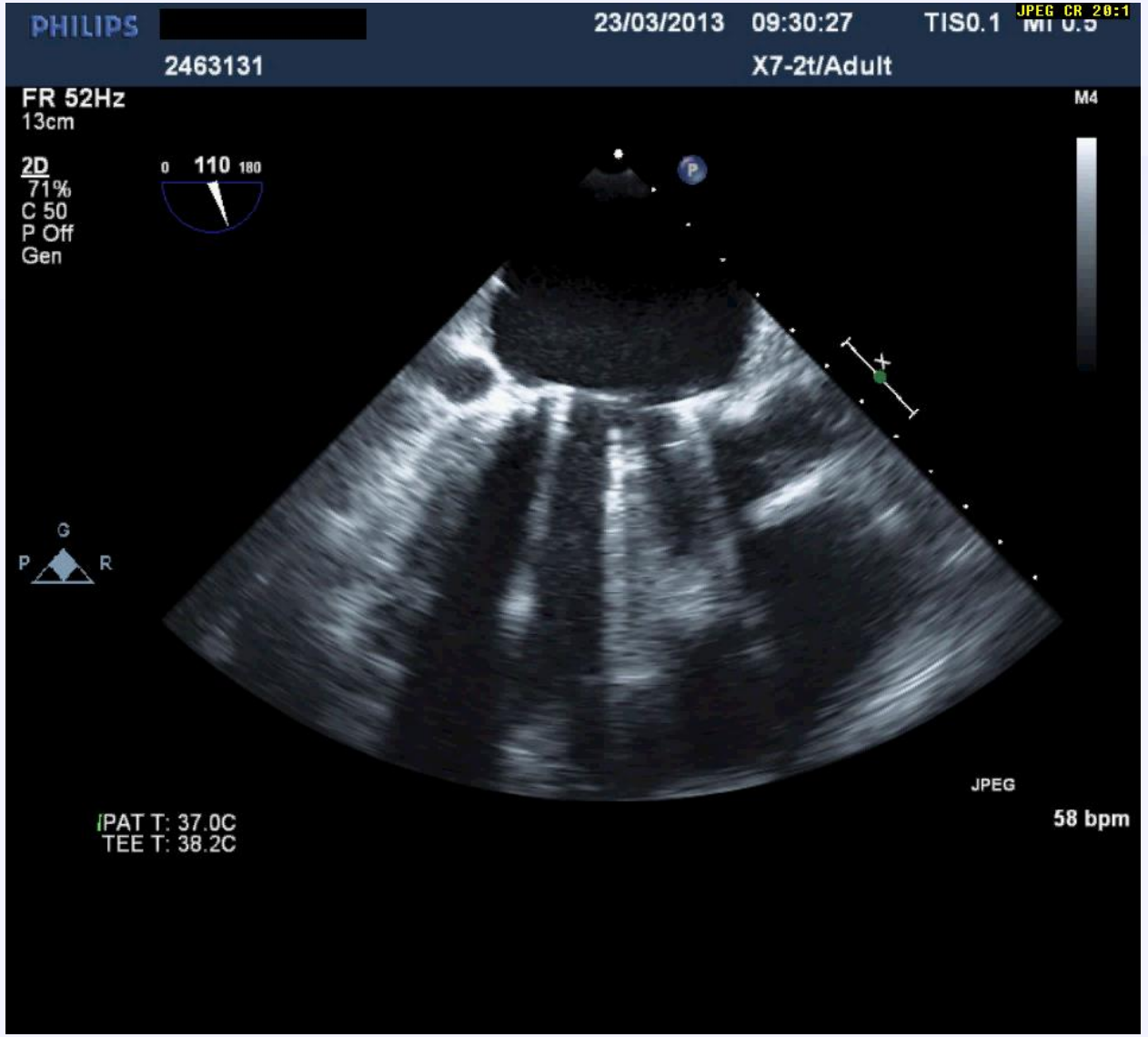

PHILIPS
04/05/2016 10:30:54
TIS0.1
2243149
X7-2t/Adult
FR 7Hz
6.1cm
Re-adjustment of the delivery catheter
M4
Live 3D
3D 0%
3D 0dB
Gen
0 90 180
JPEG
PAT T: 37.0C
TEE T: 39.4C
105 bpm

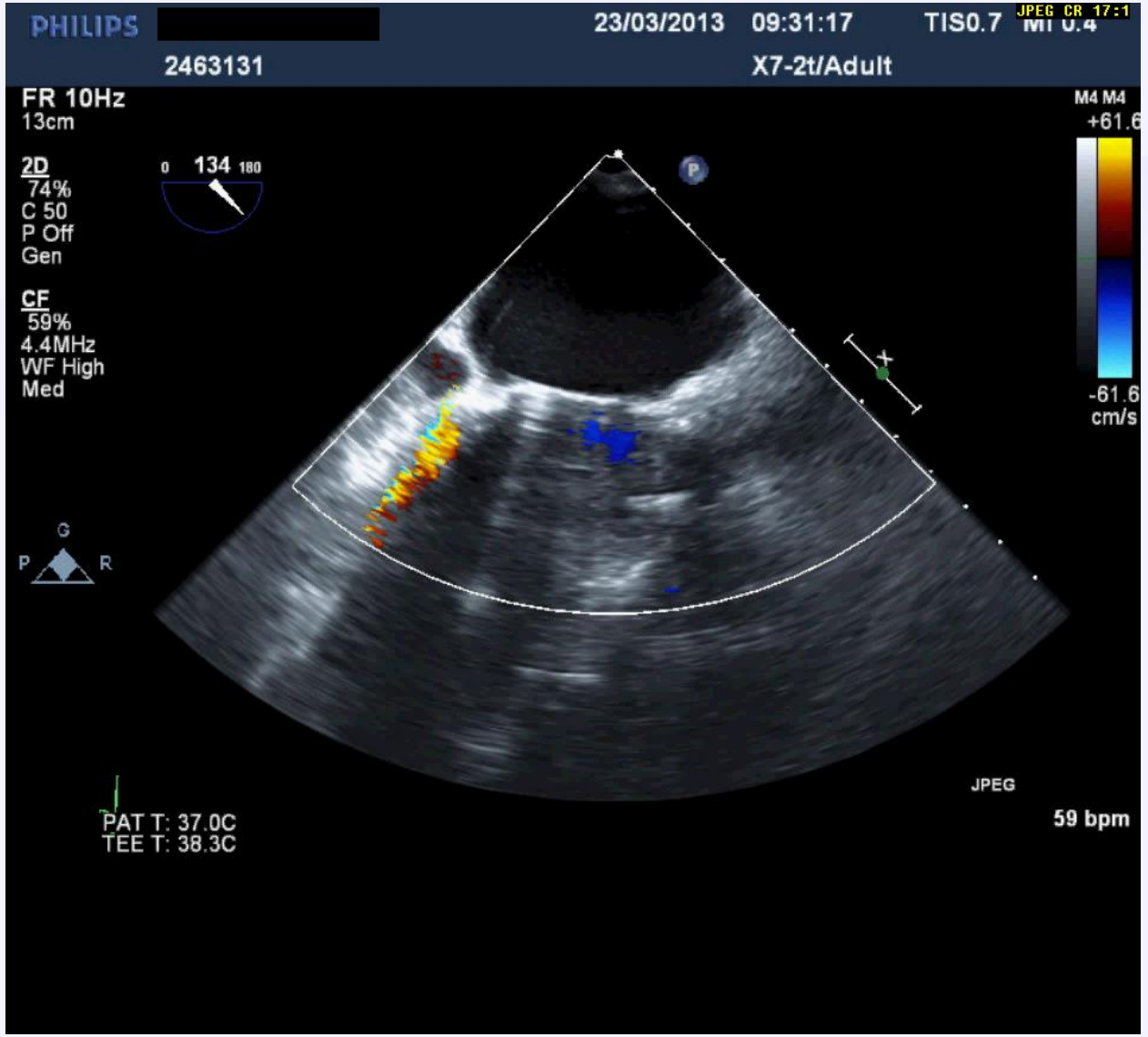

0
85
180
Final deployment
PAT T: 37.0C

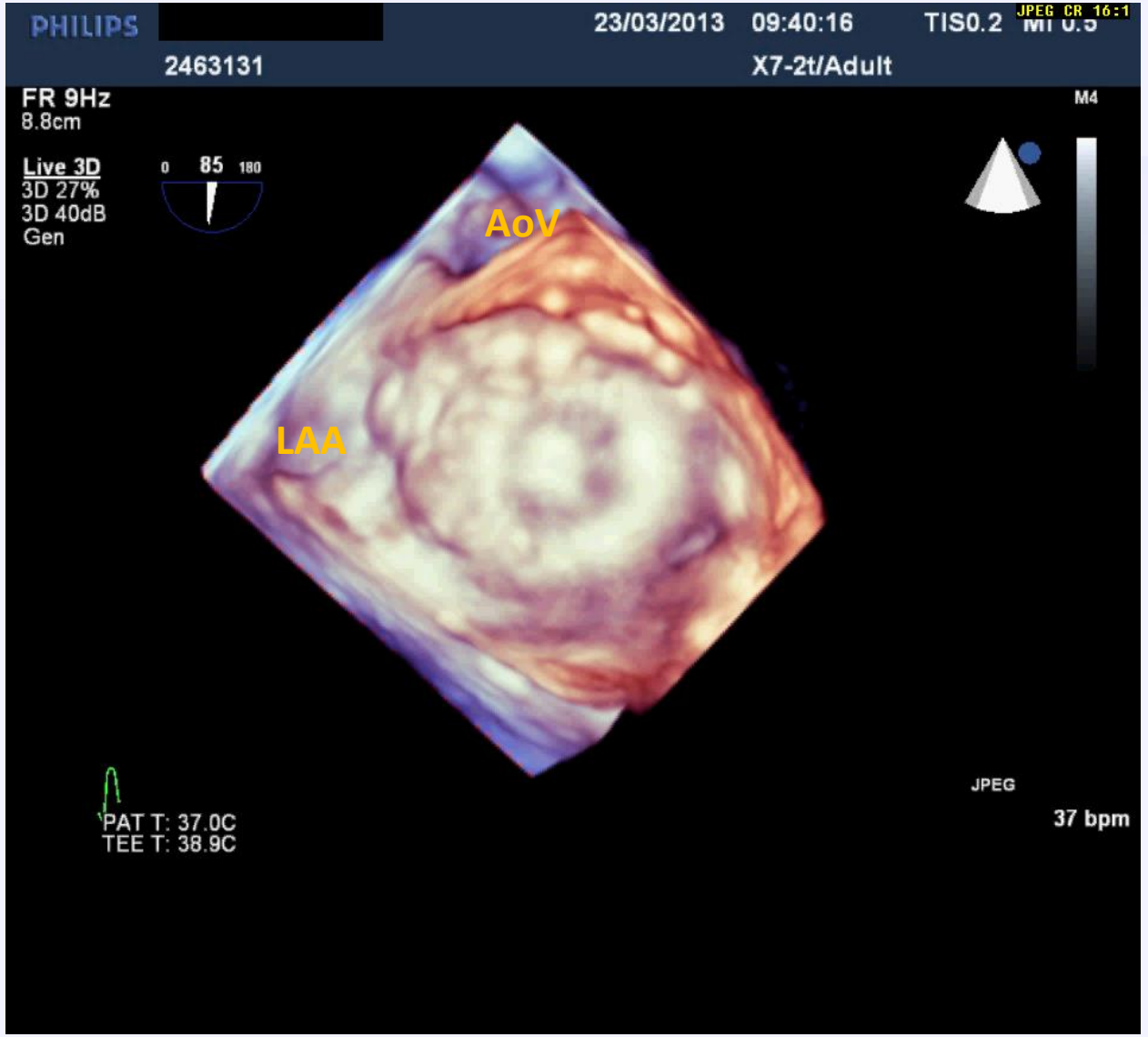

PHILIPS
04/05/2016 11:26:32 TIS0.6
2243149
X7-2t/Adult
FR 14Hz
7.0cm
Full Volume
3D 27%
3D 0dB
CF
50%
4.4MHz
0 85 180
M4 M4
+61.6
-61.6
JPEG
82 bpm
PAT T: 37.0C
TEE T: 39.2C

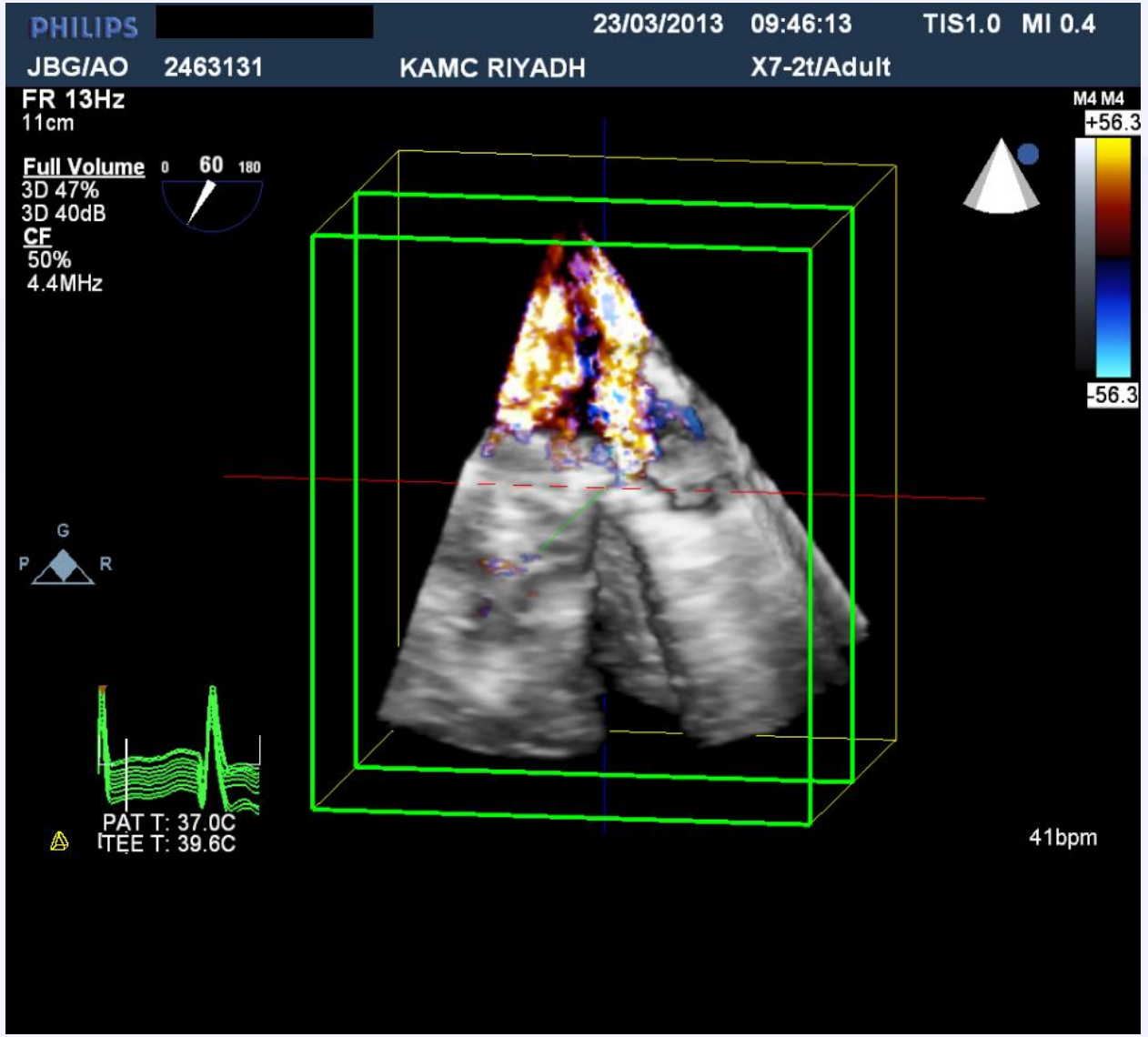
Case 4

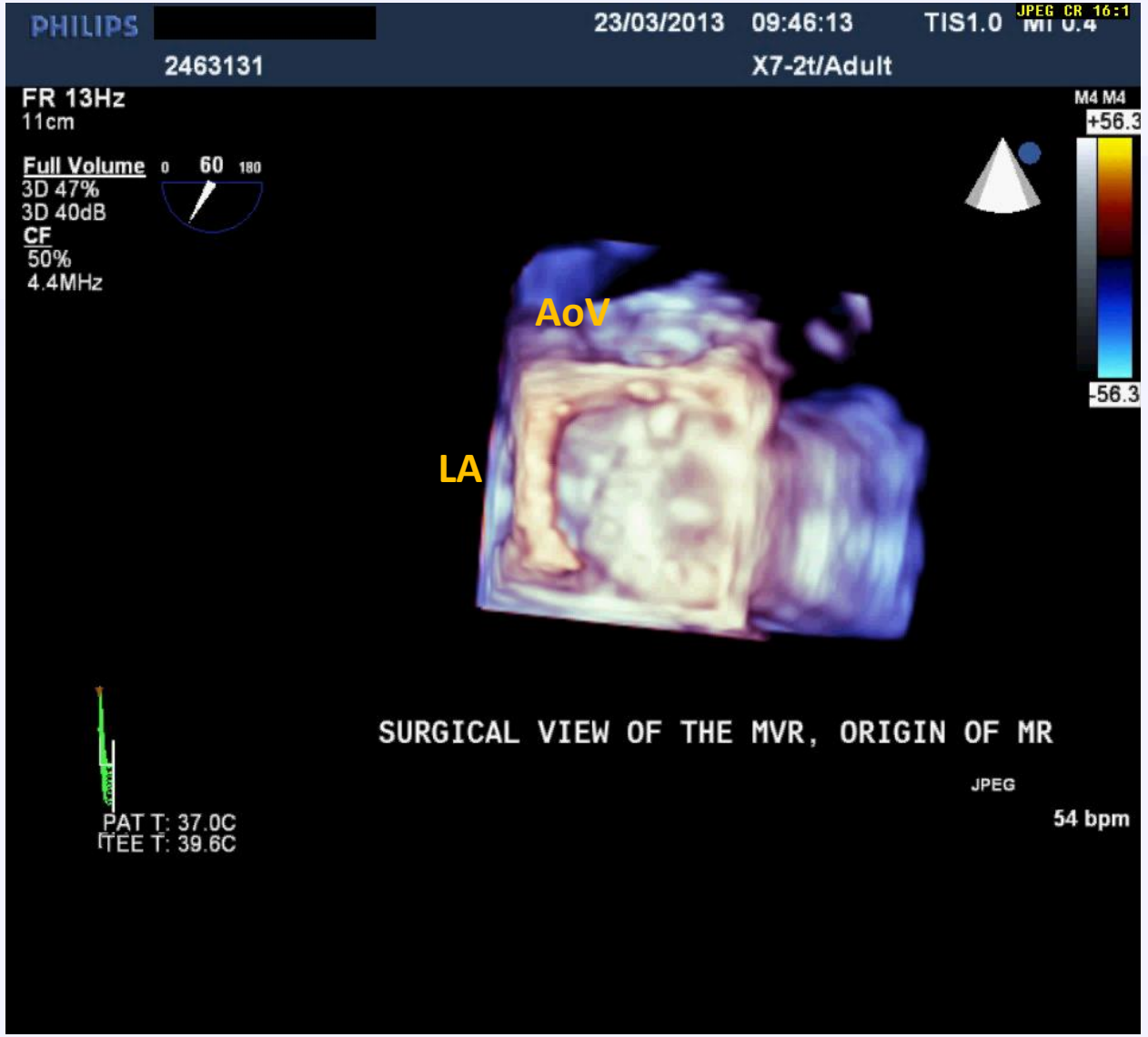
- 47-year-old female with a history of MVR, and TV repair 16 years ago presented to our center with severe SOB


PHILIPS
23/03/2013 09:30:27 TIS0.1
JPEG CR 20:1
2463131
X7-2t/Adult
FR 52Hz
13cm
M4
2D
71%
C 50
P Off
Gen
0 110 180
G
P R
JPEG
iPAT T: 37.0C
TEE T: 38.2C
58 bpm


PHILIPS
23/03/2013 09:31:17 TIS0.7
JPEG CR 17:1
2463131
X7-2t/Adult
FR 10Hz
13cm
2D
74%
C 50
P Off
Gen
0 134 180
CF
59%
4.4MHz
WF High
Med
M4 M4
+61.6
-61.6
cm/s
G
P R
JPEG
PAT T: 37.0C
TEE T: 38.3C
59 bpm


PHILIPS
23/03/2013
09:40:16
TIS0.2
JPEG CR 16:1
2463131
X7-2t/Adult
FR 9Hz
8.8cm
Live 3D
3D 27%
3D 40dB
Gen
0
85
180
M4
AoV
LAA
PAT T: 37.0C
TEE T: 38.9C
JPEG
37 bpm

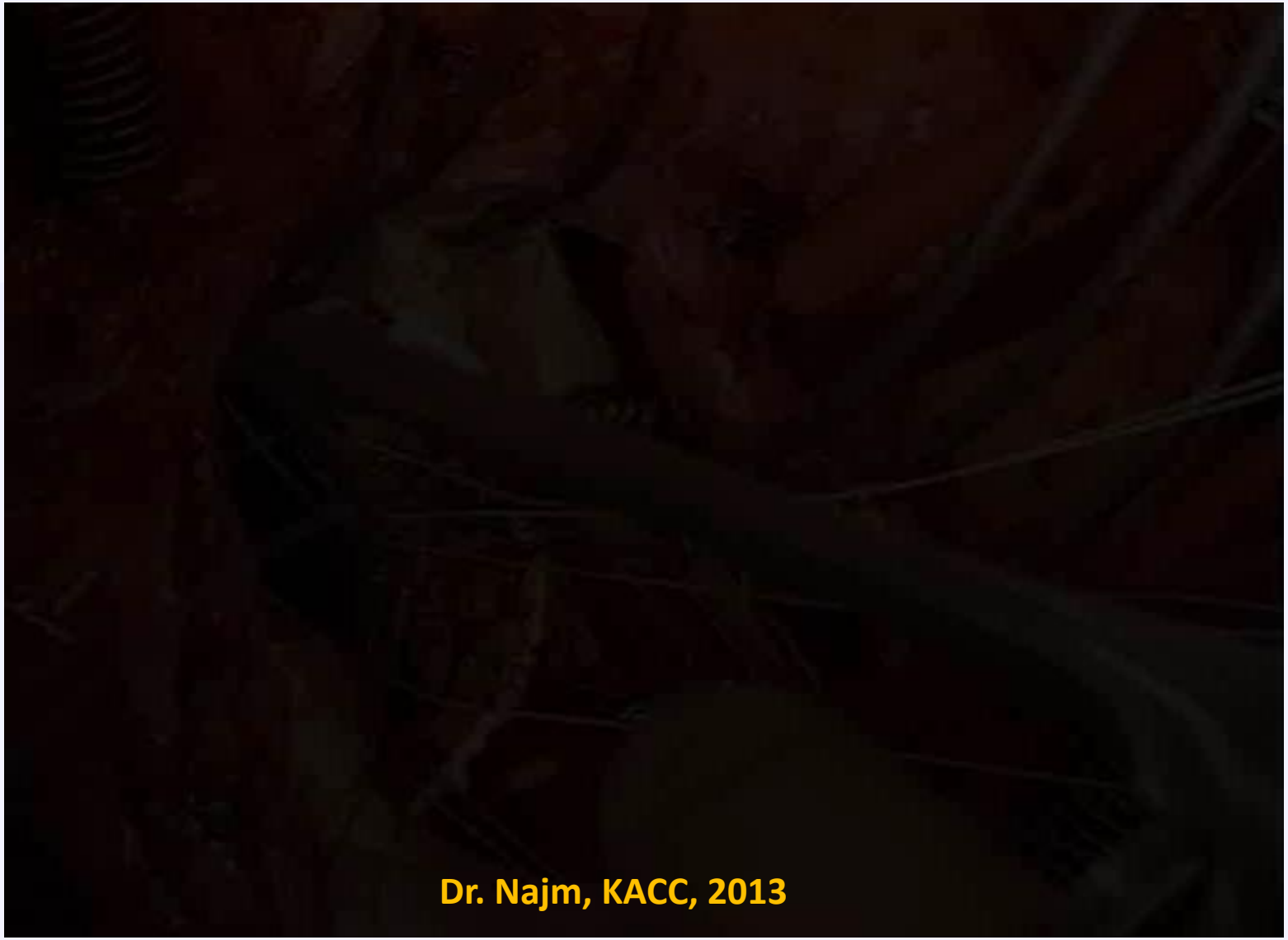

PHILIPS
23/03/2013 09:46:13 TIS1.0 MI 0.4
JBG/AO 2463131 KAMC RIYADH X7-2t/Adult
FR 13Hz
11cm
Full Volume
3D 47%
3D 40dB
CF
50%
4.4MHz
0 60 180
M4 M4
+56.3
-56.3
G
P R
PAT T: 37.0C
TEE T: 39.6C
41bpm


PHILIPS
23/03/2013 09:46:13 TIS1.0
JPEG CR 16:1
2463131
X7-2t/Adult
FR 13Hz
11cm
Full Volume
3D 47%
3D 40dB
CF
50%
4.4MHz
0 60 180
M4 M4
+56.3
-56.3
AoV
LA
SURGICAL VIEW OF THE MVR, ORIGIN OF MR
JPEG
54 bpm
PAT T: 37.0C
TEE T: 39.6C


PHILIPS
[redacted]
23/03/2013 09:46:13 TIS1.0
JPEG CR 15:1
2463131
X7-2t/Adult
FR 13Hz
11cm
Full Volume
3D 47%
3D 40dB
CF
50%
4.4MHz
0 60 180
M4 M4
+56.3
-56.3
SURGICAL VIEW OF THE MVR, ORIGIN OF MR
JPEG
54 bpm
PAT T: 37.0C
TEE T: 39.6C


PHILIPS
23/03/2013 09:46:13 TIS1.0
JPEG CR 15:1
2463131
X7-2t/Adult
FR 13Hz
11cm
Full Volume
3D 47%
3D 40dB
CF
50%
4.4MHz
0 60 180
M4 M4
+56.3
-56.3
PAT T: 37.0C
TEE T: 39.6C
SURGICAL VIEW OF THE MVR, ORIGIN OF MR
JPEG
54 bpm
10 of 10


PHILIPS
23/03/2013 09:46:13 TIS1.0
JPEG CR 14:1
2463131
X7-2t/Adult
FR 13Hz
11cm
Full Volume
3D 47%
3D 40dB
CF
50%
4.4MHz
0 60 180
M4 M4
+56.3
-56.3
AOV
SURGICAL VIEW OF THE MVR, ORIGIN OF MR
JPEG
54 bpm
PAT T: 37.0C
TEE T: 39.6C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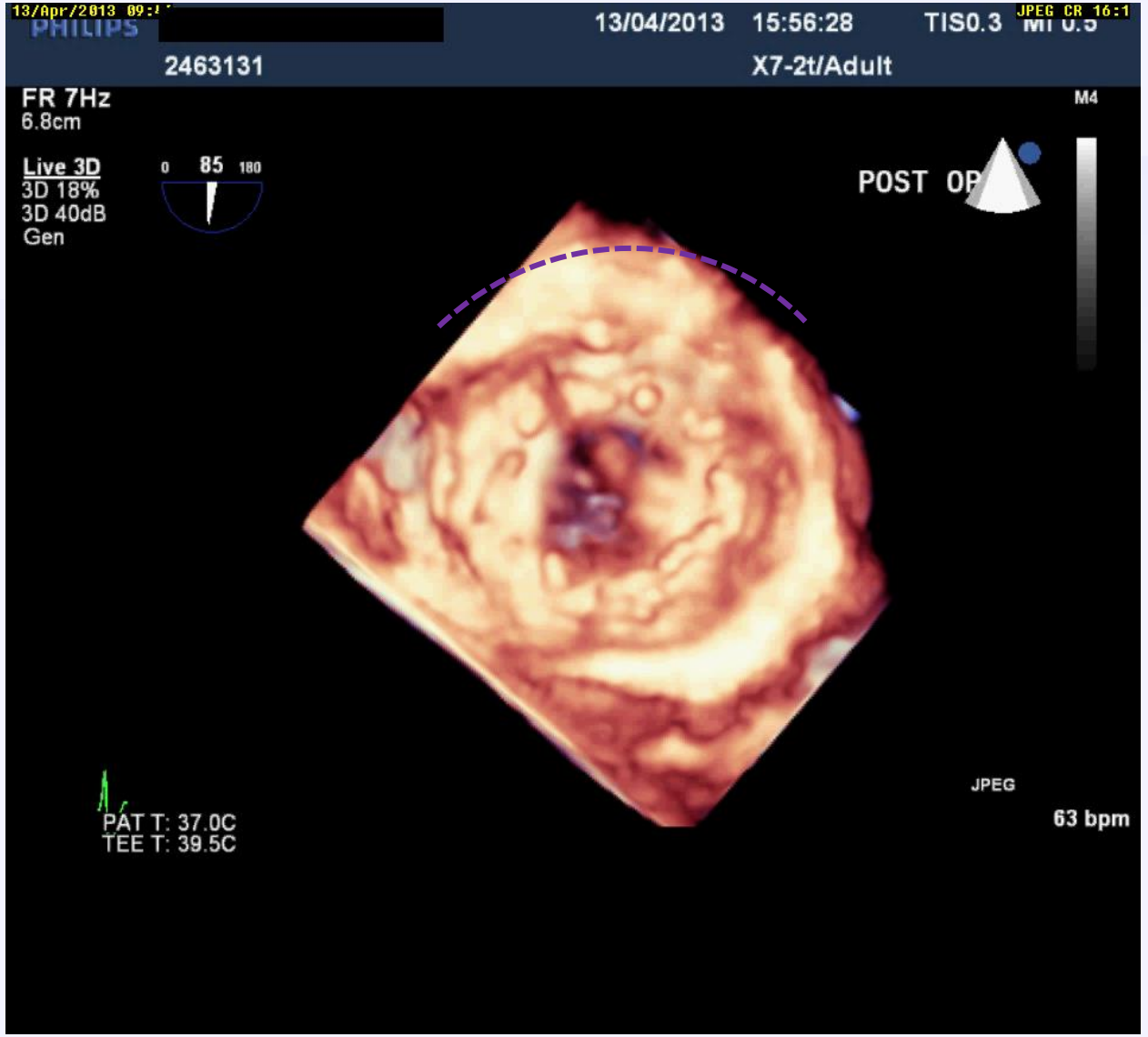
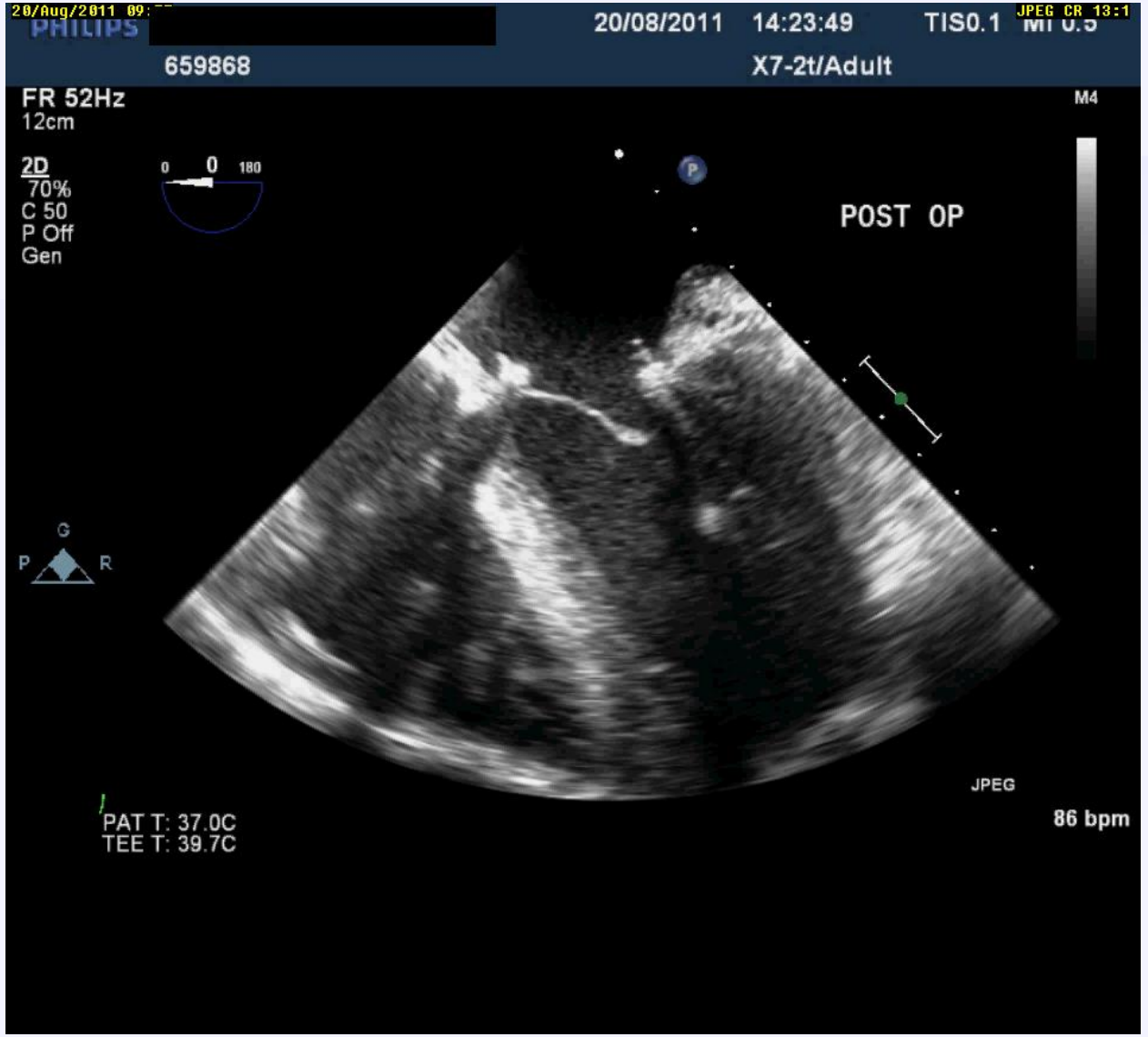
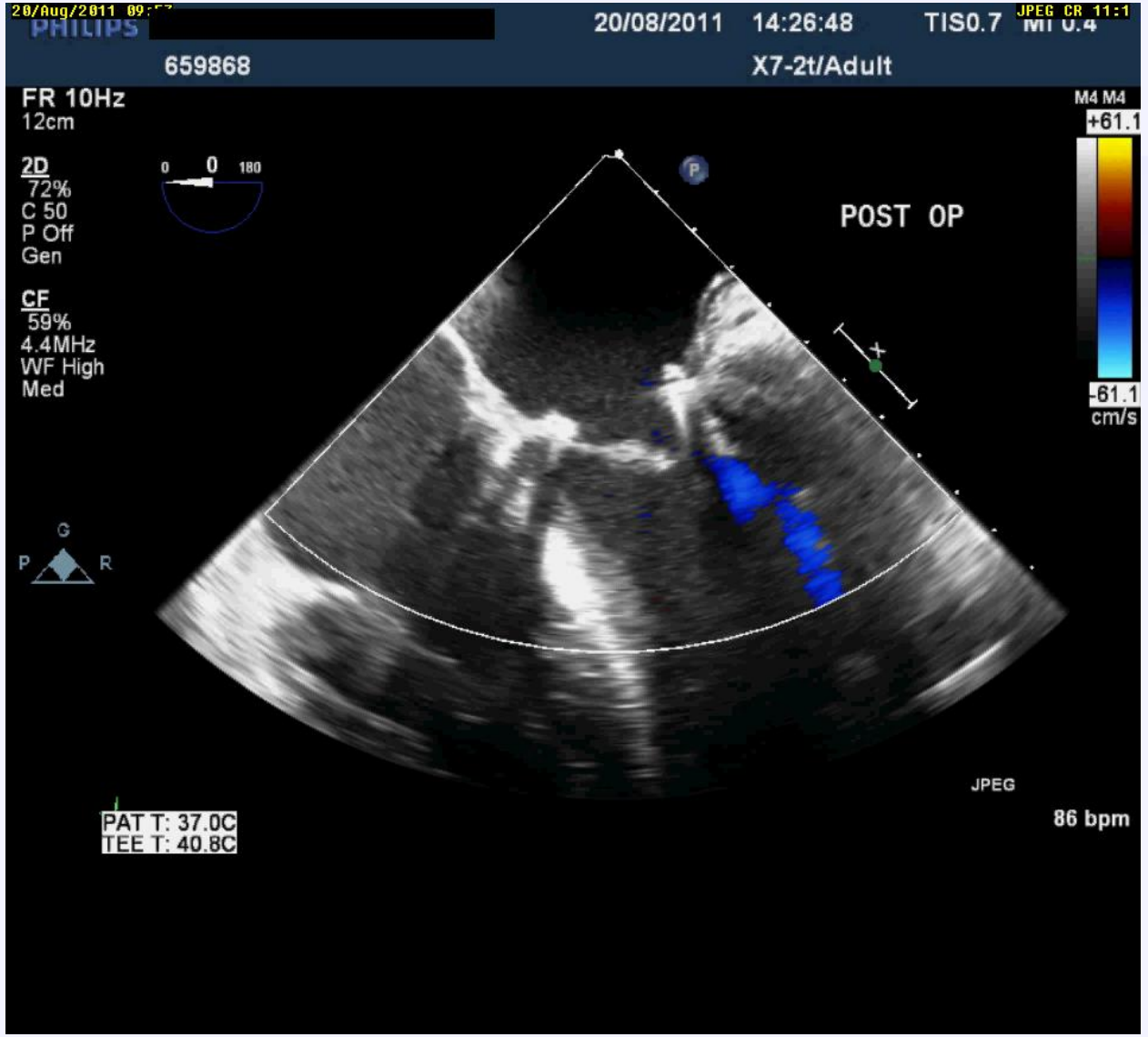

PHILIPS
13/04/2013 15:56:28 TIS0.3
JPEG CR 16:1
2463131
X7-2t/Adult
FR 7Hz
6.8cm
M4
Live 3D
3D 18%
3D 40dB
Gen
0 85 180
POST OP
JPEG
63 bpm
PAT T: 37.0C
TEE T: 39.5C


PHILIPS
13/04/2013 16:00:23 TIS1.0
JPEG CR 18:1
2463131
X7-2t/Adult
FR 14Hz
9.0cm
Full Volume
3D 15%
3D 40dB
CF
50%
4.4MHz
0 120 180
POST OP
M4 M4
+61.6
-61.6
No paravalvular leak!
PAT T: 37.0C
TEE T: 39.5C
JPEG
62 bpm

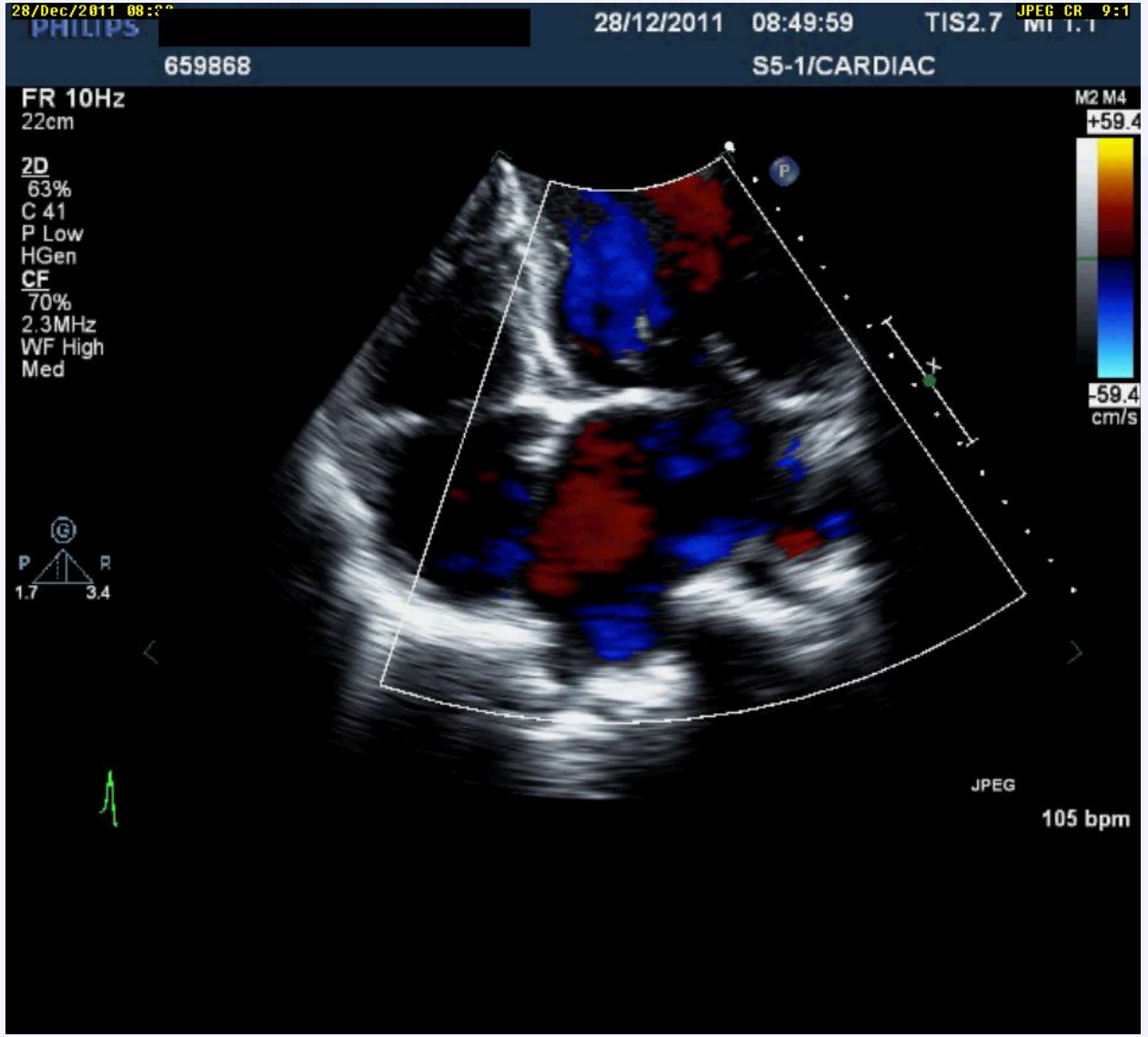
Case 5

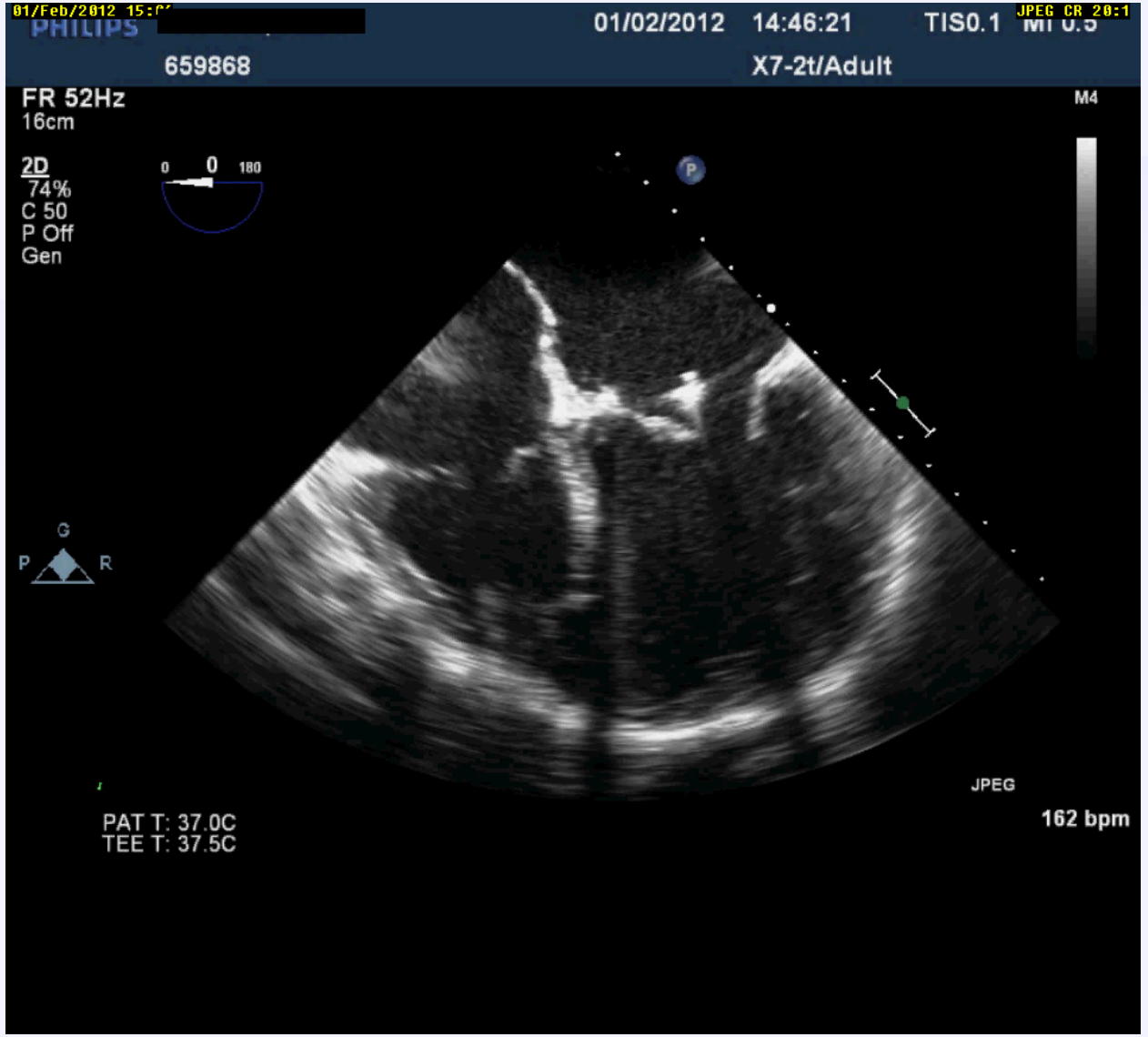
- 18-year-old boy with endocarditis of aortic and mitral valve underwent mechanical AVR + MV repair with a Physio annuloplasty ring


20/Aug/2011 09:
PHILIPS
20/08/2011 14:23:49 TIS0.1
JPEG CR 13:1
659868
X7-2t/Adult
FR 52Hz
12cm
M4
2D
70%
C 50
P Off
Gen
0 0 180
POST OP
G
P R
JPEG
PAT T: 37.0C
TEE T: 39.7C
86 bpm

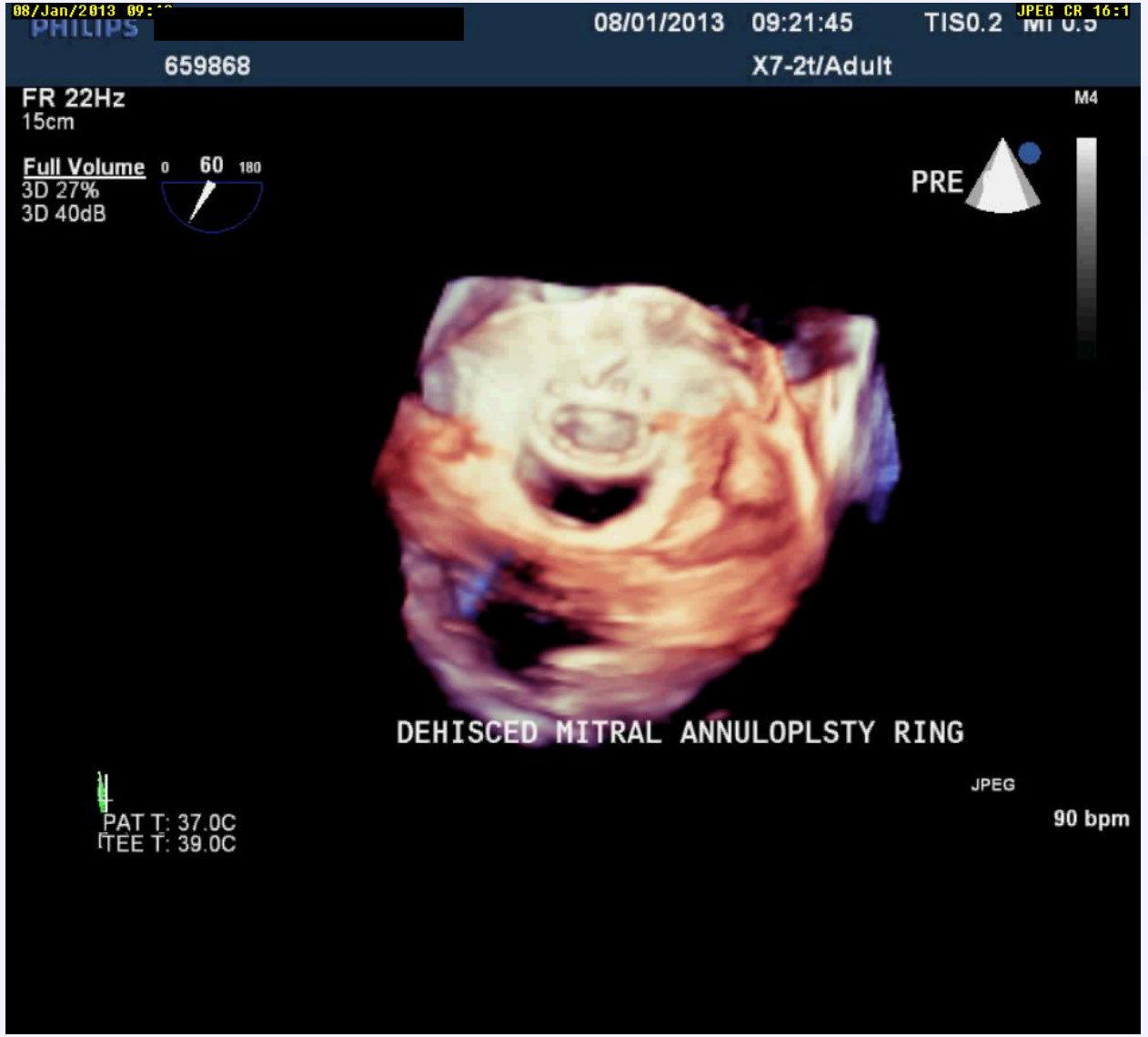

PHILIPS
20/08/2011
14:26:48
TIS0.7
JPEG CR 11:1
659868
X7-2t/Adult
FR 10Hz
12cm
2D
72%
C 50
P Off
Gen
CF
59%
4.4MHz
WF High
Med
M4 M4
+61.1
-61.1
cm/s
POST OP
JPEG
PAT T: 37.0C
TEE T: 40.8C
86 bpm

He presented again 1 year later with severe SOB

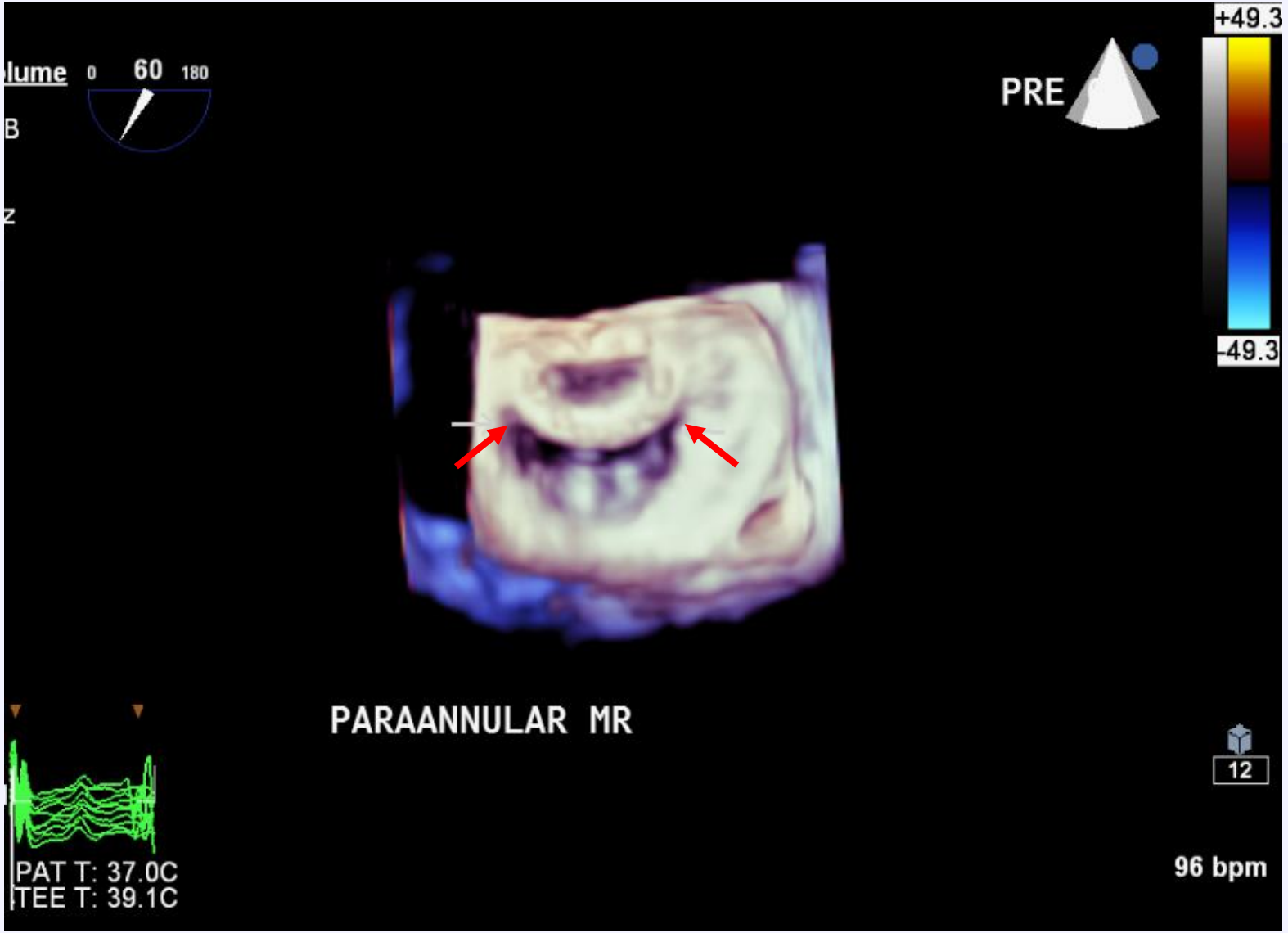

28/12/2011 08:49:59
TIS2.7
JPEG CR 9:1
659868
S5-1/CARDIAC
FR 10Hz
22cm
2D
63%
C 41
P Low
HGen
CF
70%
2.3MHz
WF High
Med
M2 M4
+59.4
-59.4
cm/s
1.7
3.4
JPEG
105 bpm


01/Feb/2012 15:0[redacted]
PHILIPS
01/02/2012 14:46:21
TIS0.1
JPEG CR 20:1
659868
X7-2t/Adult
FR 52Hz
16cm
M4
2D
74%
C 50
P Off
Gen
0 0 180
G
P
R
JPEG
PAT T: 37.0C
TEE T: 37.5C
162 bpm

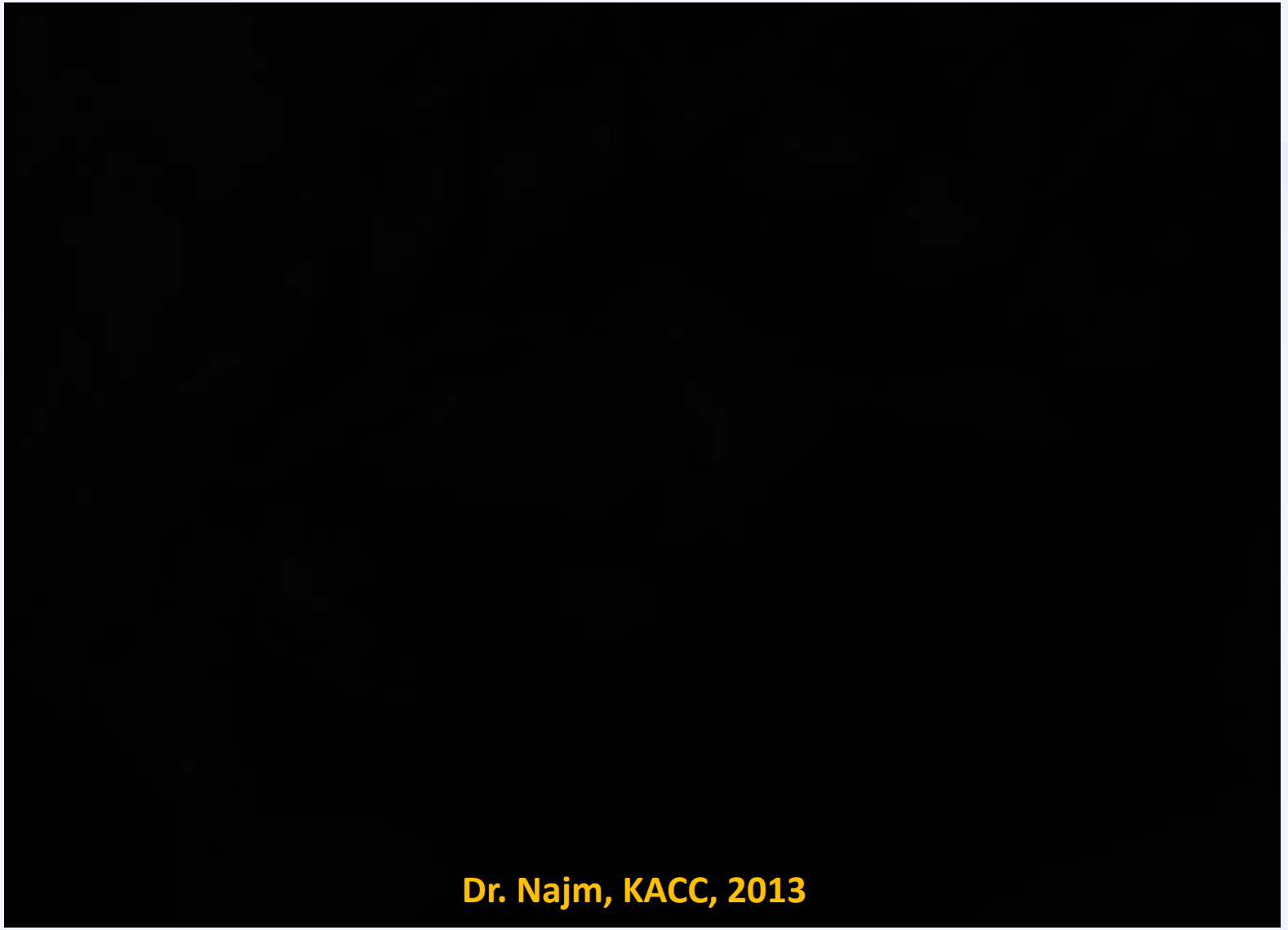

01/Feb/2012 15:06
PHILIPS
01/02/2012 14:48:51 TIS0.2 MI 0.5
JPEG CR 15:1
659868
X7-2t/Adult
FR 8Hz
11cm
Live 3D
3D 0%
3D 40dB
Gen
0 70 180
M4
JPEG
PAT T: 37.0C
TEE T: 38.9C
139 bpm


08/Jan/2013 09:
PHILIPS
08/01/2013 09:21:45 TIS0.2
JPEG CR 16:1
659868
X7-2t/Adult
FR 22Hz
15cm
M4
Full Volume
3D 27%
3D 40dB
0 60 180
PRE
DEHISCED MITRAL ANNULOPLSTY RING
JPEG
PAT T: 37.0C
TEE T: 39.0C
90 bpm


08/01/2013
09:22:07
659868
X7-2t/Adult
FR 11Hz
15cm
Full Volume
3D 9%
3D 40dB
CF
50%
4.4MHz
PRE
+49.3
-49.3
PAT T: 37.0C
TEE T: 39.1C
JPEG
96 bpm


lume
0
60
180
B
z
PRE
+49.3
-49.3
PARAANNULAR MR
12
96 bpm
PAT T: 37.0C
TEE T: 39.1C


lume
0
60
180
B
z
PRE
+49.3
-49.3
PARAANNULAR MR
12
PAT T: 37.0C
TEE T: 39.1C
96 bpm



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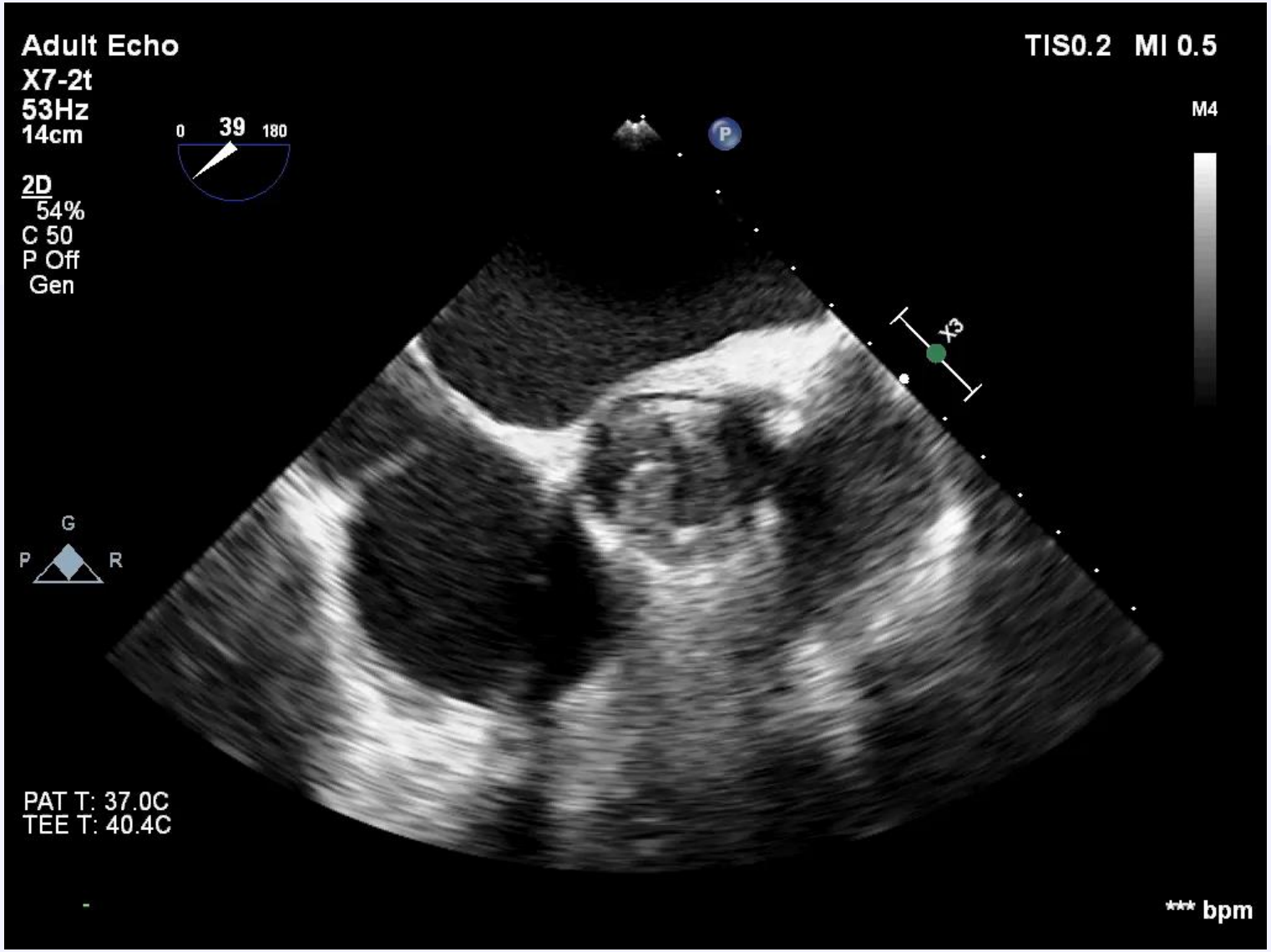
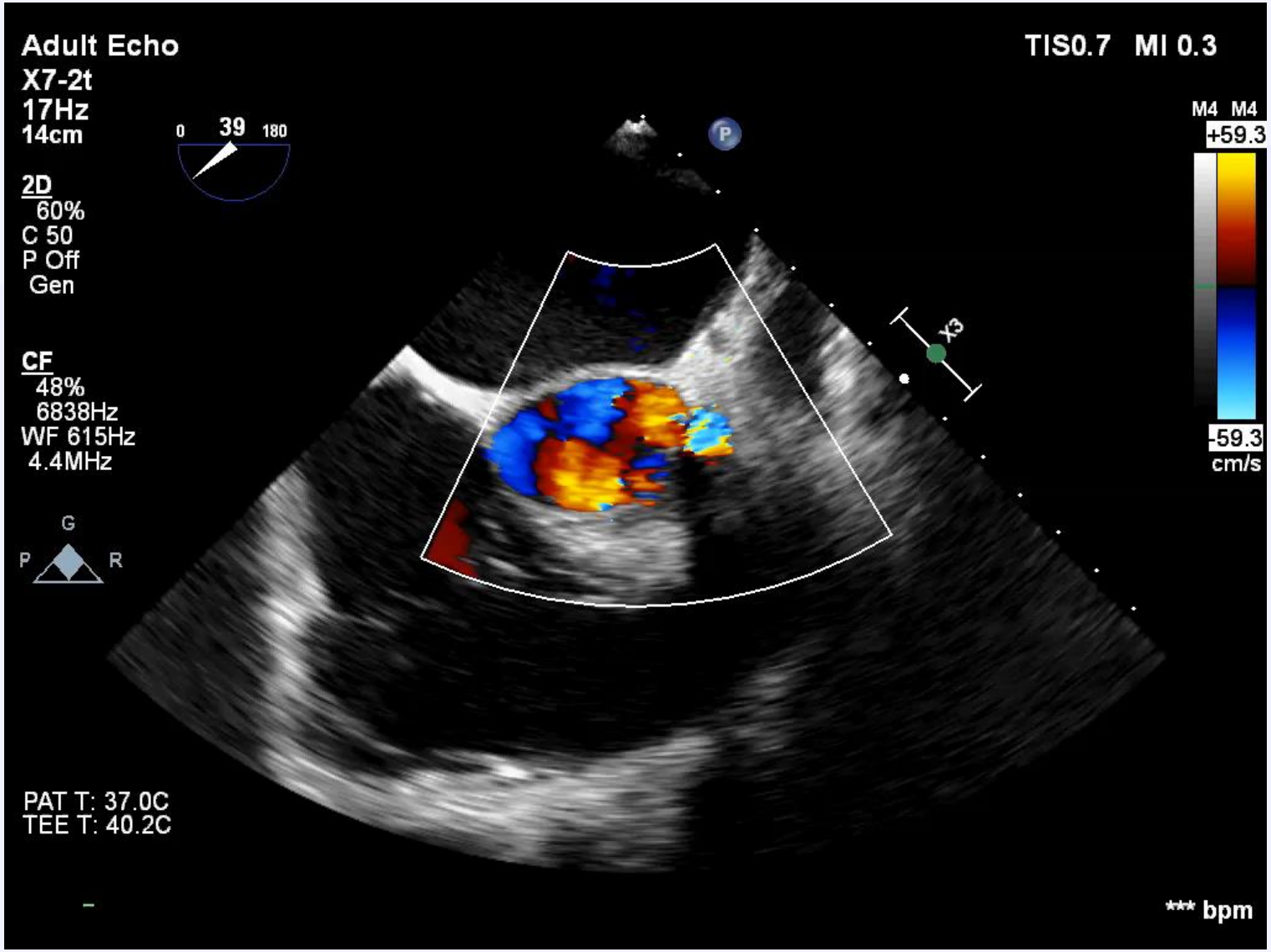
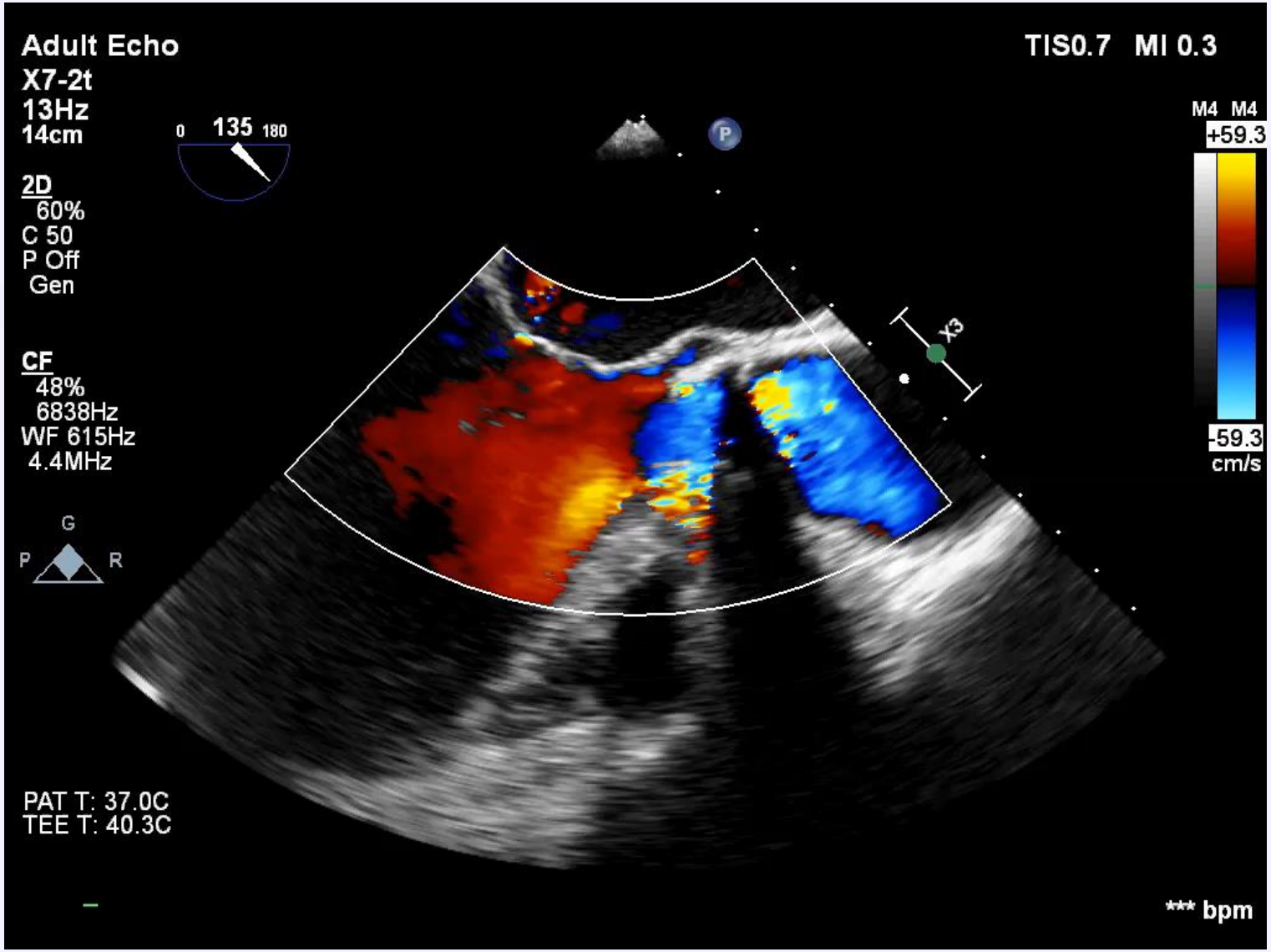
Case 6

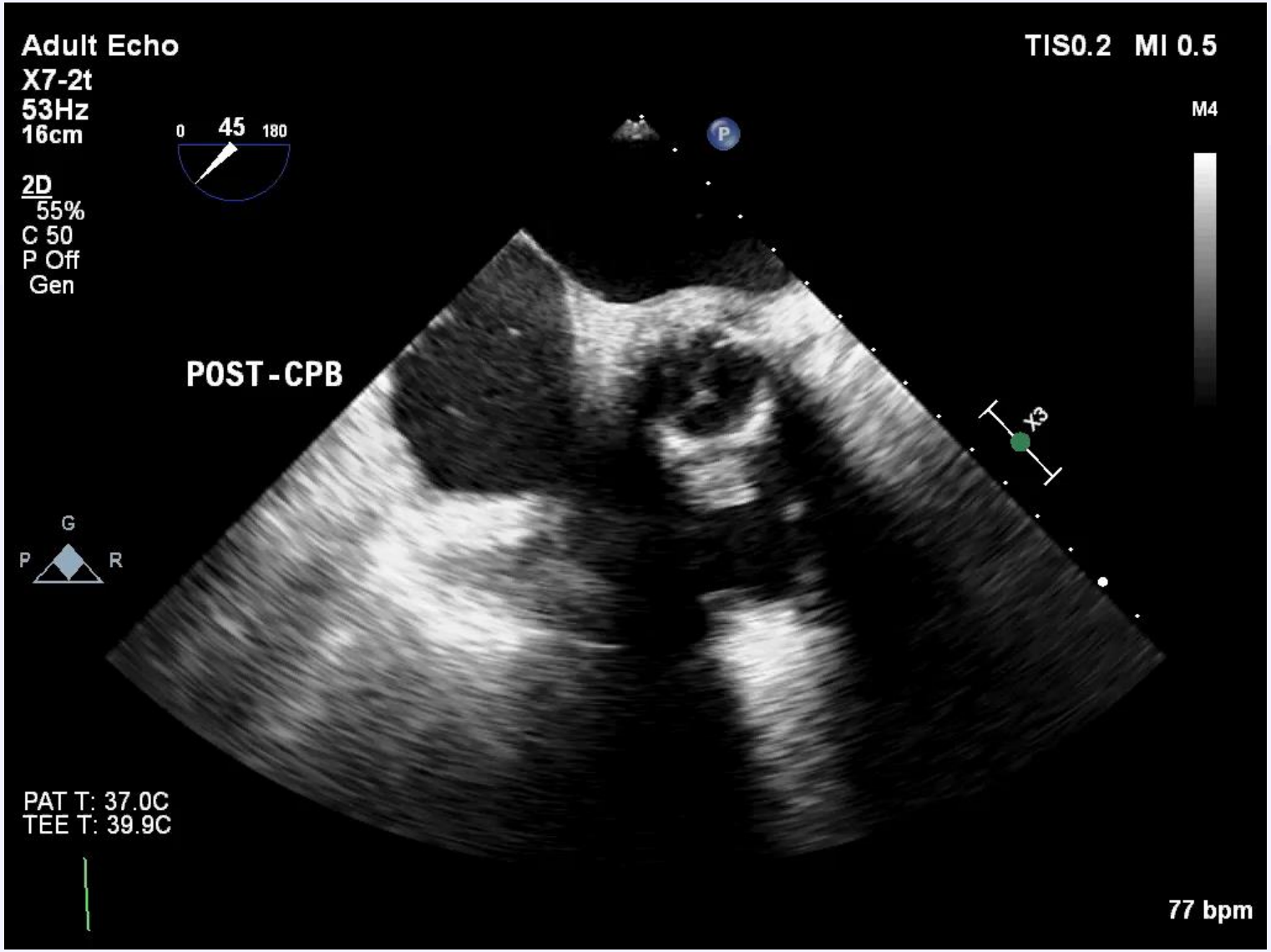
- 55-year-man with history of mechanical AVR 1 year ago

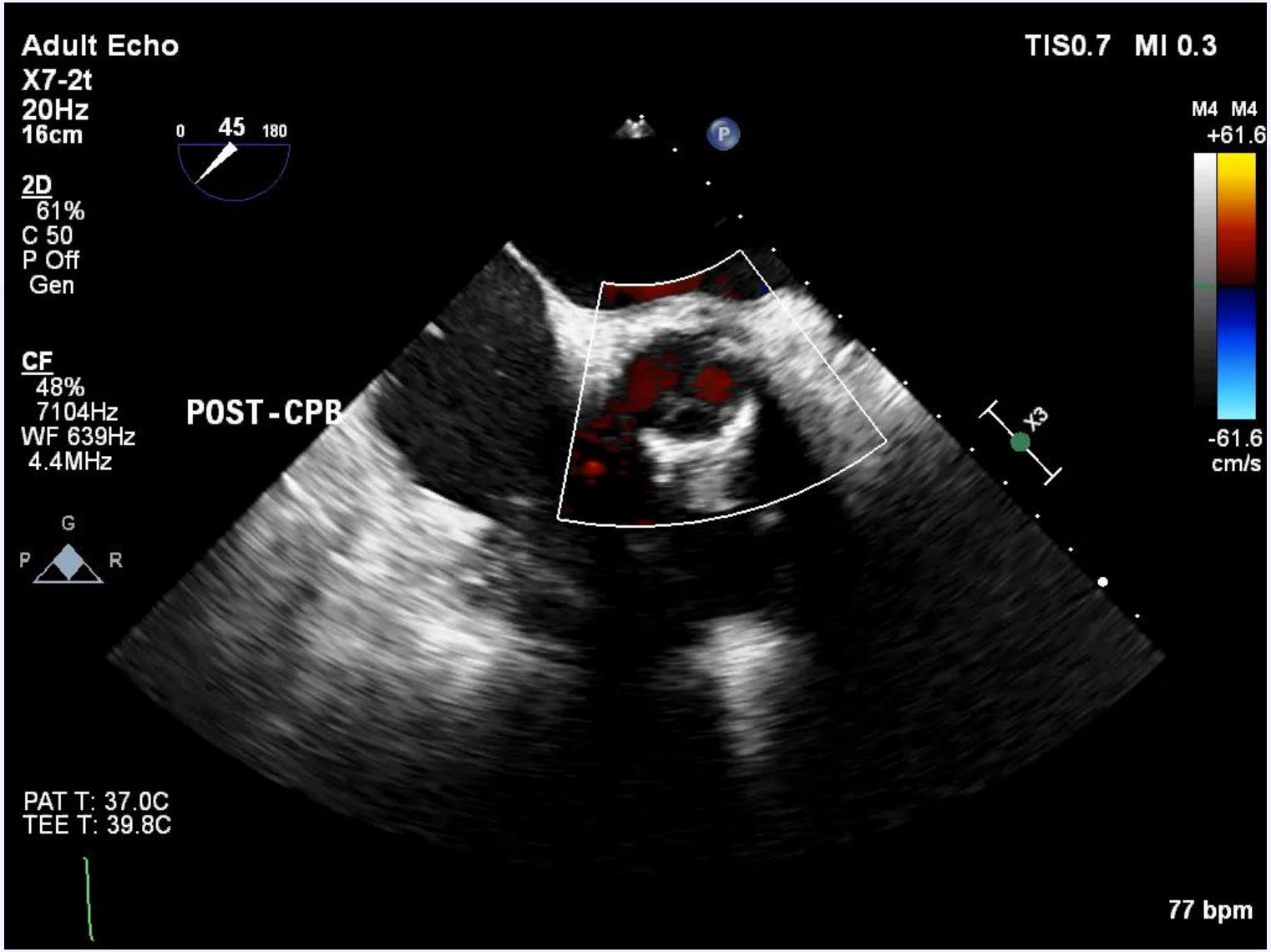

Adult Echo
X7-2t
53Hz
14cm
0
39
180
2D
54%
C 50
P Off
Gen
TIS0.2 MI 0.5
M4
X3
G
P
R
PAT T: 37.0C
TEE T: 40.4C
*** bpm

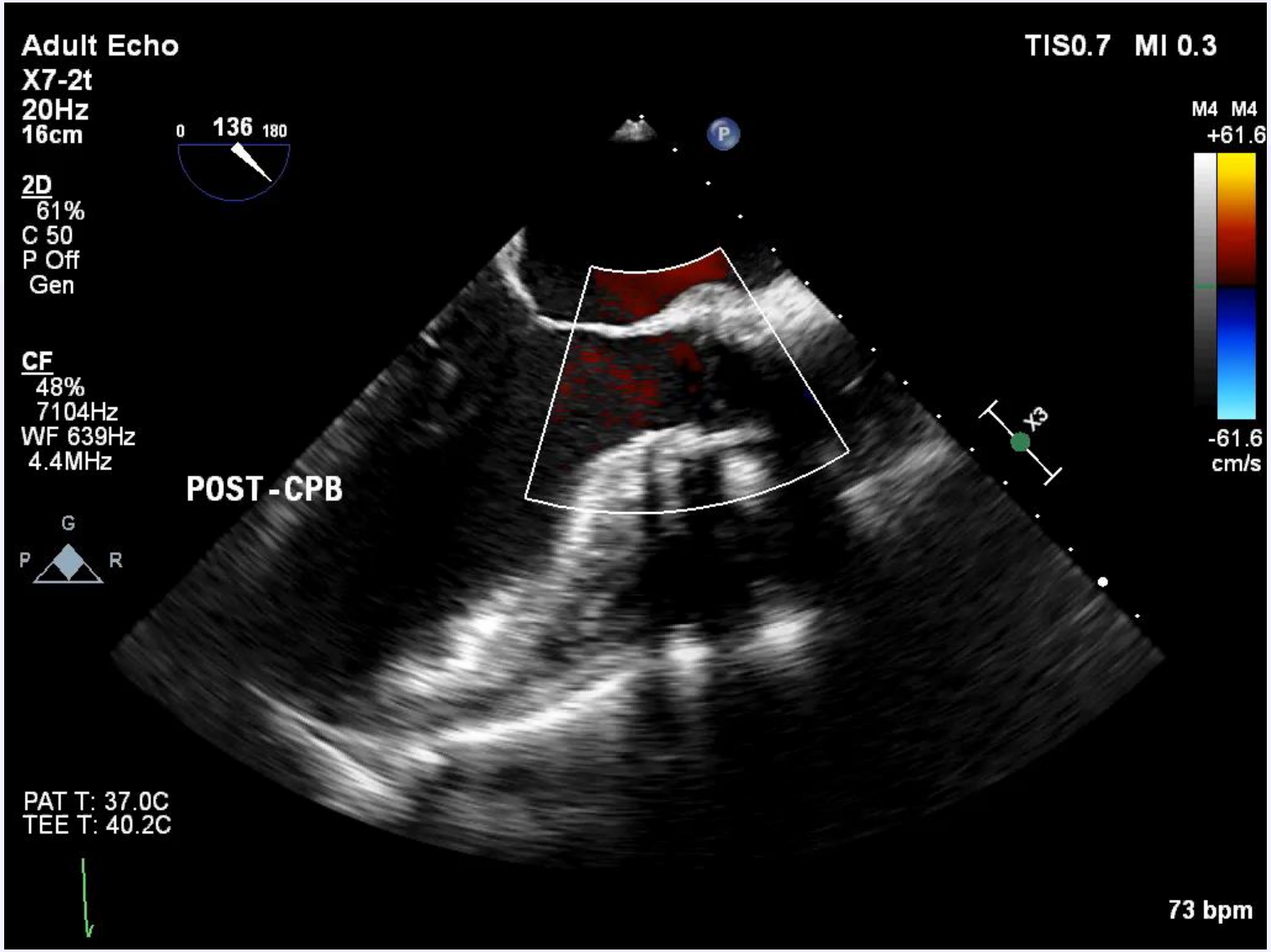

Adult Echo
X7-2t
17Hz
14cm
0 39 180
2D
60%
C 50
P Off
Gen
CF
48%
6838Hz
WF 615Hz
4.4MHz
G
P
R
TIS0.7 MI 0.3
M4 M4
+59.3
-59.3
cm/s
X3
PAT T: 37.0C
TEE T: 40.2C
*** bpm


Adult Echo
X7-2t
13Hz
14cm
0 135 180
2D
60%
C 50
P Off
Gen
CF
48%
6838Hz
WF 615Hz
4.4MHz
G
P
R
TIS0.7 MI 0.3
M4 M4
+59.3
-59.3
cm/s
X3
PAT T: 37.0C
TEE T: 40.3C
*** bpm

Post op


Adult Echo
X7-2t
53Hz
16cm
2D
55%
C 50
P Off
Gen
0
45
180
TIS0.2 MI 0.5
M4
POST-CPB
X3
G
P
R
PAT T: 37.0C
TEE T: 39.9C
77 bpm


Adult Echo
X7-2t
20Hz
16cm
0 45 180
2D
61%
C 50
P Off
Gen
CF
48%
7104Hz
WF 639Hz
4.4MHz
POST-CPB
G
P R
TIS0.7 MI 0.3
M4 M4
+61.6
-61.6
cm/s
X3
PAT T: 37.0C
TEE T: 39.8C
77 bpm


Adult Echo
X7-2t
20Hz
16cm
0 136 180
2D
61%
C 50
P Off
Gen
CF
48%
7104Hz
WF 639Hz
4.4MHz
POST-CPB
G
P
R
TIS0.7 MI 0.3
M4 M4
+61.6
-61.6
cm/s
X3
PAT T: 37.0C
TEE T: 40.2C
73 bpm

Summary

- Trivial or mild paravalvular leak (PVL) is a common finding in intraoperative TEE. The clinical outcome and natural history of the trace to mild PVL is benign in the majority of cases.
- Late PVL due to dehiscence of the valves is the most common indication for reoperation in long-term F/U of patients with mechanical valves.
- Cardiac imaging techniques, especially 3D TEE plays as essential role in the diagnosis, spatial orientation of the leak, guidance of surgical or percutaneous intervention, and evaluation of the outcome.


Toronto
Thank you.