

Intraoperative Transesophageal Echocardiography

Basic concepts
&
Clinical Applications

Έφη Γ. Ρούσκα, MD, PhD



Definition

- Before cardiac surgery
- During cardiac surgery
- After cardiac surgery
- In intensive care unit

*"When expertly
used....."*

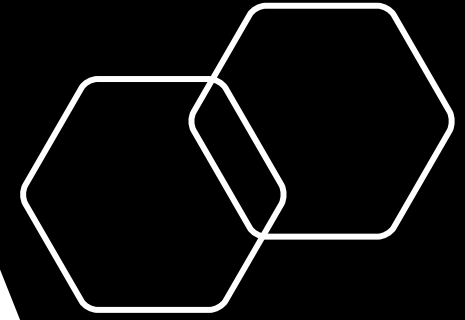
*"Performing a complete
examination"*



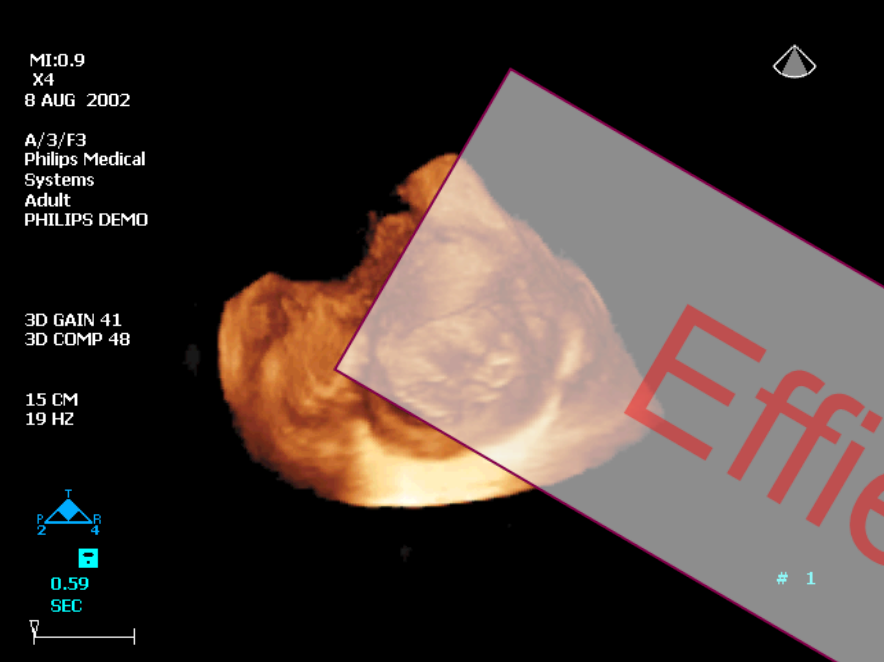
Cahalan MK, et al. American Society of Echocardiography and Society of Cardiovascular Anesthesiologists task force guidelines for training in perioperative echocardiography. *Anesth Analg* 2002;94:1384-8

Shanewise JS. Performing a complete transesophageal echocardiographic examination. *Anesthesiol Clin North America* 2001;19(4):727-67

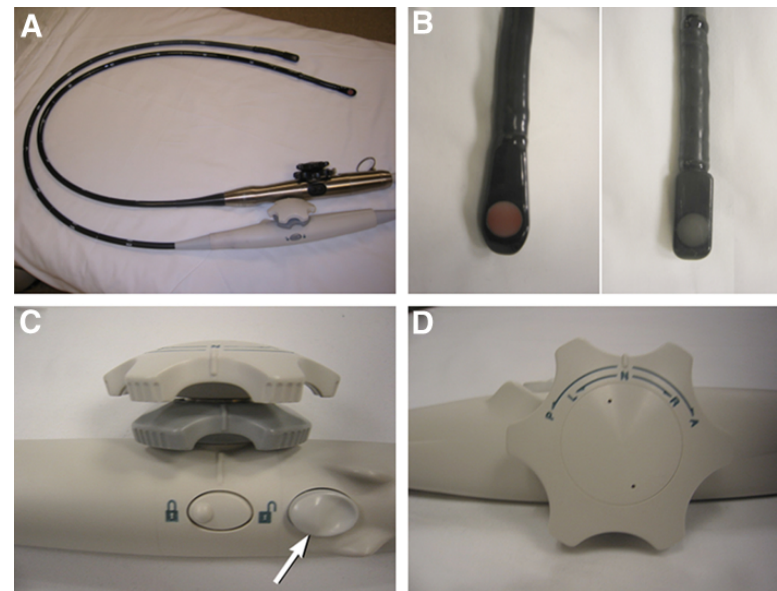
	Early 70's	Early 80's	Late 80's	Since 90's	Since 2002
Epicardial approach		TOE	TOE development IOE moved into the clinical mainstream	ITOE spread beyond academic medical centres	ITOE (2002)
disadvantages		Rigid probes M-mode	Flexible probes 2-D & Doppler	Every day care of cardiac surgical pts	>94% of cardiac anesthesiologists >72% of general anesthesiologists



Effie ROUSKA, MD



3-D TEE probe



ASE POSITION PAPER

3D Echocardiography: A Review of the Current Status and Future Directions

Judy Hung, MD, Roberto Lang, MD, Frank Flachskampf, MD, Stanton K. Sherman, MD, Marti L. McCulloch, RDCS, David B. Adams, RDCS, James Thomas, MD, Mani Vannan, MD, and Thomas Ryan, MD, *Boston, Massachusetts; Chicago, Illinois; Erlangen, Germany; Galveston, Texas; Durham, North Carolina; Cleveland, Ohio; Orange, California*

J Am Soc Echocardiogr 2007;20:213-233.
0894-7317/\$32.00

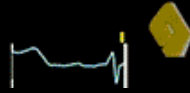
Effie ROUSKA, MD

15 vps / 120 mm

0.61 m/s
0.31 m/s



Ann AP Diam 33.4 mm
Ann AL-PM Diam 39.6 mm



Effie ROUSKA, MD

2021

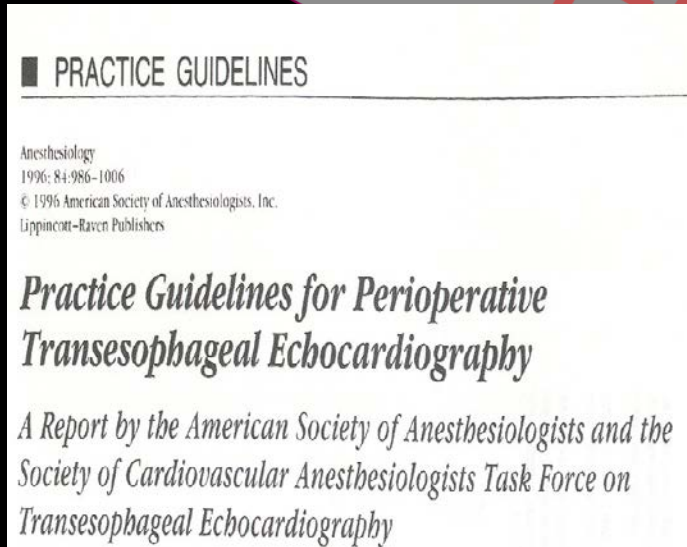
➔ 3D Echocardiography

to Guide Decision Making in all fields of
Interventional Cardiology, Congenital Heart Disease, & Cardiac Surgery

Roberto M. Lang, MD, Karima Addetia, MD, Akhil Narang, MD, Victor Mor-Avi, PhD

JACC: CARDIOVASCULAR IMAGING CME/MOC/ECME

ASA/SCA (1996) 1st Task Force guidelines



ASE/SCA (2003) Definition / Task Force guidelines (revised)

Category I indications

Category II indications

-Category IIa:

-Category IIb:

Category III indications

Based on



**Usefulness/efficacy
established or not
by evidence/opinion**

Thys DM, et al. Practice Guidelines for Perioperative Transesophageal Echocardiography. A report by the ASA and the SCA Task Force on TOE. Anesthesiology 1996;84:986-1006

Cheitlin MD, et al. ACC/AHA guidelines for the clinical application of echocardiography. Circulation 1997;95:1686-1744

Cheitlin MD, et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography. J Am Soc Cardiol 2003;2(5):954-70



The Revolution.....



11th Int. Congress of Cardiothoracic and Vascular Anesthesia

September 14th - 18th, 2008
Charité Convention Center,
Berlin
Germany

Efficient
ROUSKA, MD
Guidelines

We have no reason not to use ITOE as a routine!!

2010 Update

SPECIAL ARTICLES

Anesthesiology 2010; 112:1-1

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Practice Guidelines for Perioperative Transesophageal Echocardiography

*An Updated Report by the American Society of Anesthesiologists and the Society of
Cardiovascular Anesthesiologists Task Force on Transesophageal Echocardiography**

2017

“With the increasing number of patients undergoing less invasive, percutaneous procedures, emerging-delete echocardiographers must be knowledgeable in 3D image acquisitions, familiar with the 3D anatomy of valves, able to communicate pathology effectively, and perform quantitative analysis of the various structural heart diseases encountered”.

Review Article

An update on intraoperative three-dimensional transesophageal echocardiography

Lisa Qia Rong

Department of Anesthesiology, Weill Cornell Medicine, NY, USA

Correspondence to: Lisa Qia Rong, MD, Department of Anesthesiology, Weill Cornell Medical College, 525 East 68th Street, Box 124, New York, NY


10065, USA. Email: lir9065@med.cornell.edu.

2017
EACTA

**Intraoperative
TEE Report Form**

Patient Name: _____ Date: _____ Insertion: Easy / Difficult / Laryngoscopy
 Elective / Emergency: _____ Image Quality: Good / Moderate / Poor
 Day of birth: _____ OR/TEE machine Nr.: _____ Height / Weight: _____ (cm / kg)
 ECG: SR / AFib / Pacer / CPR
 Patient ID: _____

Surgery: _____ Previous echo? Yes / No _____ If yes, (TEE / TEE): _____

Ventricle	Morphology and vol. status n = normal h = hypertrophied d = dilated	Global function 1 = normal 2 = mildly reduced 3 = moderately reduced 4 = severely reduced	Regional wall motion abnormalities (= not scored, 1 = normokinetic, 2 = hypokinetic, 3 = akinetic, 4 = dyskinetic)	Measurements
Left Ventricle				LVIDd (mm) LVIDs (mm) LVEF (%)
Right Ventricle				TASPE (mm) FAC (%)

ATRIUM	Normal	Dilated	Spontaneous echo contrast	Thrombus (Size, location, appearance)	Tumor (Size, location, appearance)	Device (Size, location, appearance)
Left Atrium						
Right Atrium						

Septum	Normal	Hypertrophied	Shunt	Anomaly (VSD, ASD, PFO, Aneurysm)
IVS				
IAS				

Pericardial effusion (mm): _____ Pleural effusion (mm): _____ (left/right)
 (Loculated / Circumferential): _____

Aorta	Normal	Dilated	Diameter of Aneurysm (mm)	Dissection (Location/Entry point)	Thickness of Plaques (mm)	Mobile/Immobile
Ascending						
Arch						
Descending						

**Intraoperative
TEE Report Form**

Valves	Morphology and mobility of leaflets	Diameter/Distance	Stenosis (0 = none 1 = mild 2 = moderate 3 = severe)	Regurgitation (0 = none 1 = mild 2 = moderate 3 = severe)
Mitral Valve		Annulus (mm): AML (mm): PML (mm): C-Sept (mm):	PHT (ms): P max/mean (mmHg): MVA (cm ²): Grade:	VC (mm): EROA (cm ²): Pulmonary veins: (Blunt/Reverse) Grade:
Aortic Valve		Annulus (mm): Sinus (mm): STJ (mm): LVOT (mm):	P max/mean (mmHg): AVA (cm ²): a) Planimetry b) Continuity E. VTI-Ratio: Grade:	VC (mm): PHT (ms): Jet/LVOT (%): Grade:
Tricuspid Valve		Annulus (mm):	P max/mean (mmHg): Grade:	VC (mm): SPAP (mmHg): Grade:
Pulmonary Valve			P max/mean (mmHg): Grade:	Jet width (mm): Grade:

Summary of findings:

Postoperative echo examination including any adverse events:

Signature Supervisor: _____

Signature Echocardiographer: _____

2020 New Guidelines for ITOE

Guidelines for the Use of Transesophageal Echocardiography to Assist with Surgical Decision-Making in the Operating Room: A Surgery-Based Approach

from the American Society of Echocardiography in Collaboration with the Society of Cardiovascular Anesthesiologists and the Society of Thoracic Surgeons

Alina Nicoara, Chair, MD, FASE, Nicholas Shtaya, Co-Chair, MD, DSc, FASE, Nir Ad, MD, Alan Frisley, MD, FASE, Rebecca T. Hahn, MD, FASE, Ferraz Mahmood, MD, FASE, Sunil Maskal, MD, FASE, Charles B. Niman, MBBCh, Francis Pagani, MD, PhD, Thomas R. Porter, MD, FASE, Kent Redford, MD, FASE, Marc Stone, MD, Bradley Taylor, MD, MPH, Annette Vegas, MD, FRCP, FASE, Karen G. Zimmerman, BS, ACS, RDCS (AE, PE), BVT, FASE, William A. Zoghbi, MD, FASE, and Madhav Swaminathan, MD, FASE, Durham, North Carolina; Cleveland, Ohio; Silver Spring and Baltimore, Maryland; Charleston, South Carolina; New York, New York; Boston, Massachusetts; Rochester, Minnesota; Ann Arbor and Traverso City, Michigan; Omaha, Nebraska; York, Pennsylvania; Toronto, Ontario, Canada; Houston, Texas

Intraoperative transesophageal echocardiography is a standard diagnostic and monitoring tool employed in the management of patients undergoing an entire spectrum of cardiac surgical procedures, ranging from "routine" surgical coronary revascularization to complex valve repair, combined procedures, and organ transplantation. Utilizing a protocol as a starting point for imaging in all procedures and all patients enables standardization of image acquisition, reduction in variability in quality of imaging and reporting, and ultimately better patient care. Clear communication of the echocardiographic findings to the surgical team, as well as understanding the impact of new findings on the surgical plan, are paramount. Equally important is the need for complete understanding of the technical steps of the surgical procedures being performed and the complications that may occur, in order to direct the postprocedure evaluation toward aspects directly related to the surgical procedure and to provide pertinent echocardiographic information.

The rationale for this document is to outline a systematic approach describing how to apply the existing guidelines to questions on cardiac structure and function specific to the intraoperative environment in open, minimally invasive, or hybrid cardiac surgery procedures. (J Am Soc Echocardiogr 2020;31:692-734)

Keywords: Intraoperative, Transesophageal echocardiography, Cardiac surgery

News | Cardiovascular Ultrasound | June 04, 2020

New Guideline Outlines Use of Transesophageal Echo to Assist Surgical Decision-making

New ASE document explains role of intra-operative TEE



"The intraoperative echocardiographer should be an integral and active part of the heart team,"

explained chair of the ASE guideline writing group, ASE, associate professor of anesthesiology, Duke University Medical Center. "Utilizing a 'catch-all' protocol as a starting point for imaging in all procedures and all patients enables standardization of image acquisition, reduction in variability in quality of imaging and reporting, and ultimately, better patient care. Clear communication of the echocardiographic findings to the surgical team, as well as understanding the impact of new findings on the surgical plan, are paramount. Equally important is the need for an informed understanding of the technical steps of the surgical procedures being performed and the complications that may occur, in order to direct the post procedure evaluation toward aspects directly related to the surgical procedure and to provide pertinent echocardiographic information."

Editorial

Is Intraoperative TOE
for all cardiac
surgical patients ?



A fleeting trend or
a standard of care?

Anaesthetist 2002;51(2): 79-80

J Am Soc Echocardiogr 2020;33:692-734

ITOE

*will remain a vital component
of the perioperative management of cardiac surgical pts
due to its usefulness
both
as a diagnostic tool and
monitor of cardiac performance!*

“When expertly used.....”

“Performing a complete examination”



Cahalan MK, et al. American Society of Echocardiography and Society of Cardiovascular Anesthesiologists task force guidelines for training in perioperative echocardiography. *Anesth Analg* 2002;94:1384-8

Jeremy J Thaden, et al. Adult Intraoperative Echocardiography: A Comprehensive Review of Current Practice. 2020 American Society of Echocardiography. Published by Elsevier Inc.

ITOE objectives

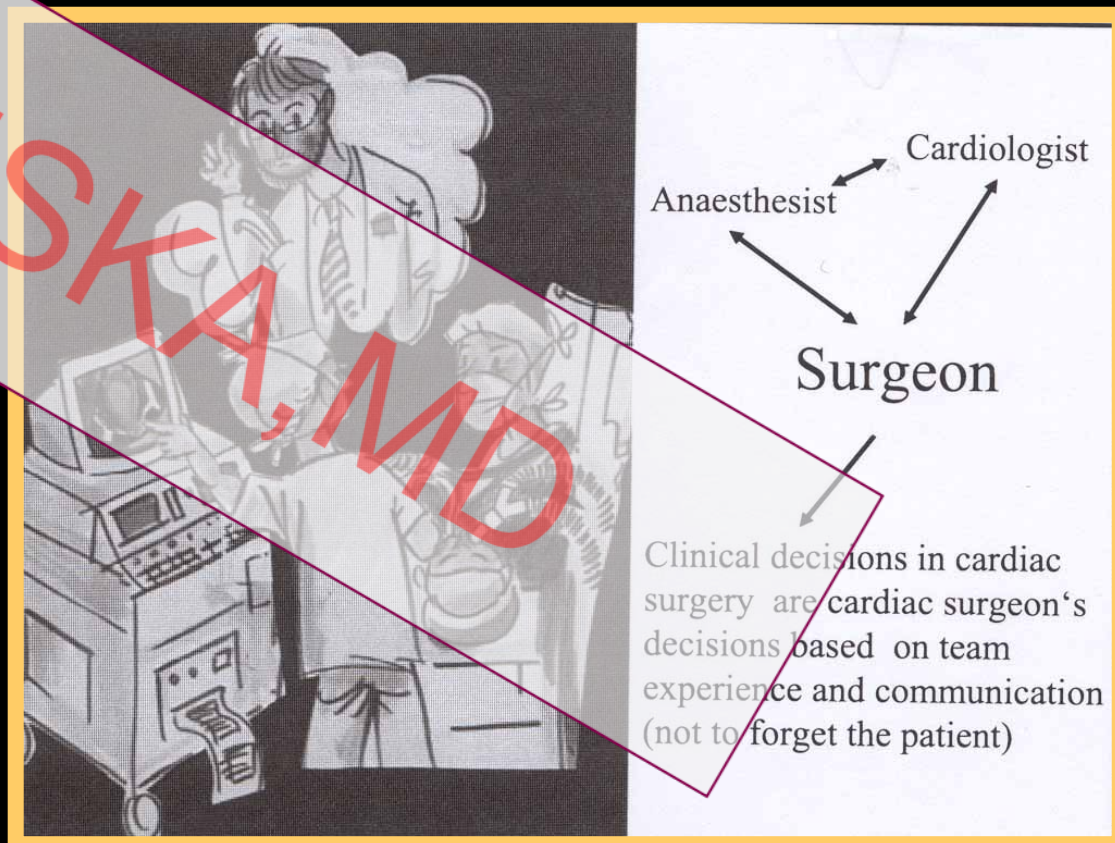
Since all pts are accepted for cardiac surgery on the basis of TTE and/or TEE...
what is the role of ITOE?

- Diagnostic function PRE_OP
 - Refines the diagnosis
 - Sometimes changes the operative plan (new findings)
 - Precise measurements upon the type of the operation
(esp. for the valve repairs)
- Guides surgical manipulations INTRA OP
- Monitoring function
- Assessment of the result POST OP

Defined roles



Team's communication



Defined roles - Team's communication

Cardiologist



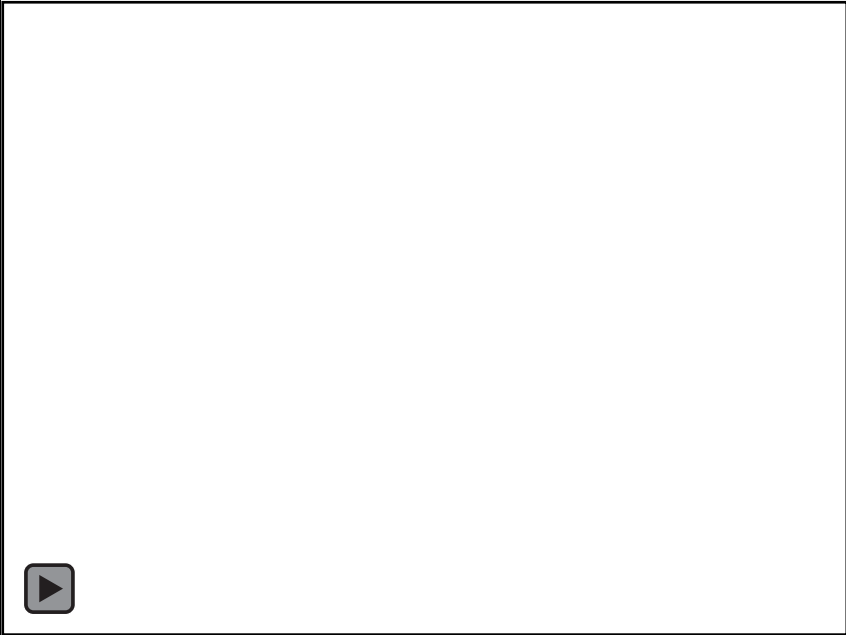
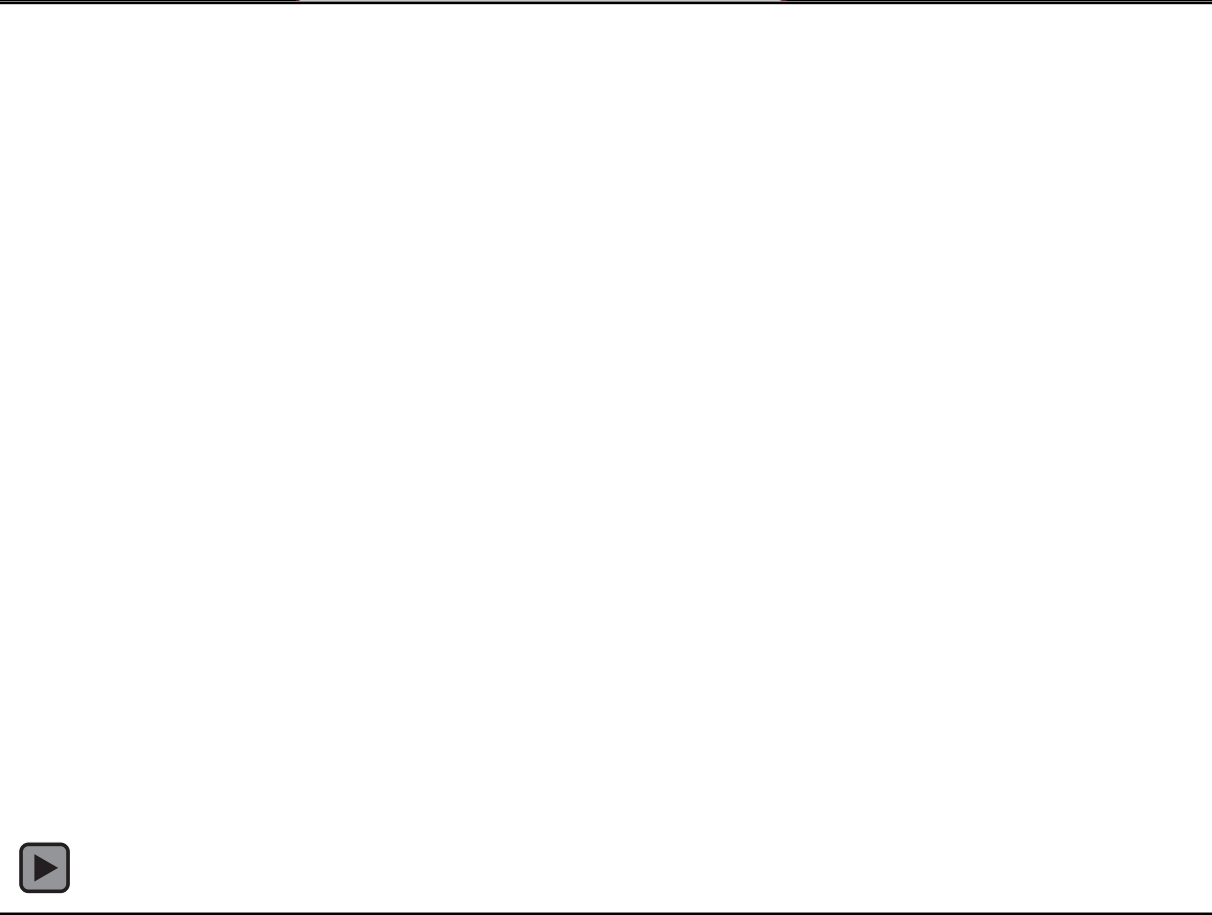
Cardiac Surgeon

Effie ROUSKA, MD

Diathermy



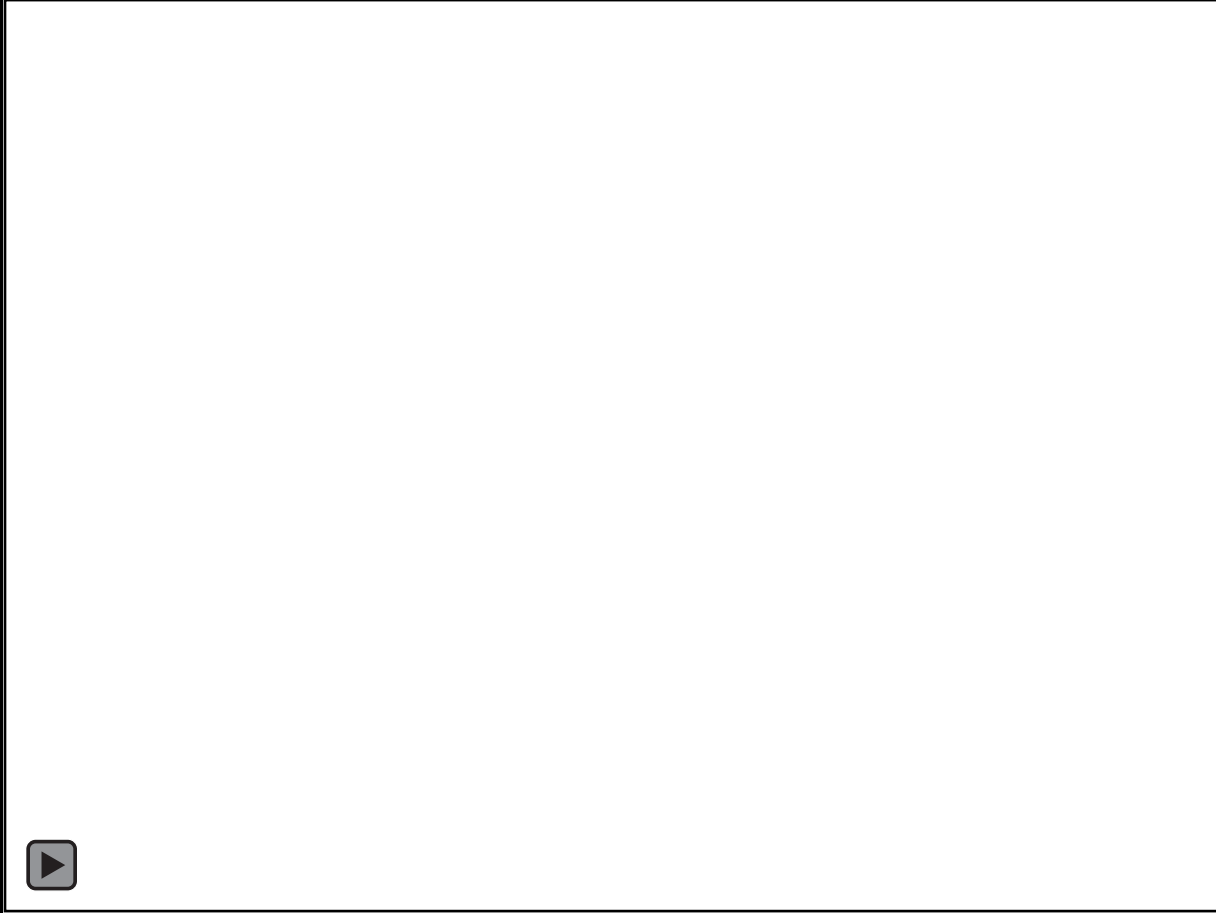
Just pre cardioplegic arrest



ISKA,



De-airing



Immediately post-op



Pre-protamine



Pre-Op
Diagnostic
Function

- To confirm and refine the preoperative diagnosis
- To detect new or unsuspected pathology
- To adjust the anesthetic and surgical plan accordingly
- To provide the surgeon precise measurements upon the type of the operation

Effie ROULSKA, MD

Most frequent pre-bypass TOE findings likely to affect the surgical plan

- ASD, patent foramen ovale
 - Valvular disease: new or absent or of different severity, annulus sizing
 - Global and regional LV and RV function not corresponding to preoperative findings
 - Intracardiac thrombi
 - Tumors
 - Left superior vena cava
 - Aortic atheromatosis
-

Unsuspected TOE findings of major significance and additional TOE-based interventions

Author, yr (no. of pts)	Pre-CPB	Post-CPB	Interventions
Mishra 98 (n = 5,016)	17%	-	17%
Click 00 (n = 3,245)	15%	6%	18%
Schmidlin 01 (n = 1,891)	11%	2%	10%

1. Refines the diagnosis

Young female pt with severe HTN for myxoma removal



Effie ROUSKA, MD

ITOE: suspicion for extracardiac tumor

Surgical findings:

Paraganglioma!!

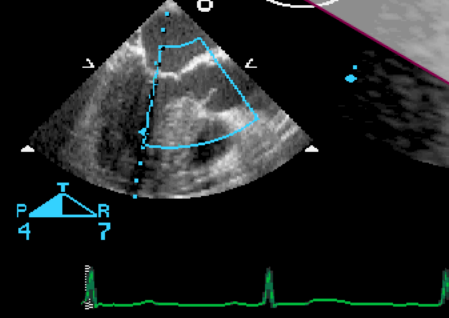
BP normal after surgery!



Differential diagnosis of AS

MI: 0.4 PAT T: 37.0C
T6210 TEE T: 37.6C
26 APR 02
12:37:47
PROC 2/0/E/F2
GLENFIELD HOSP

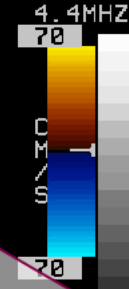
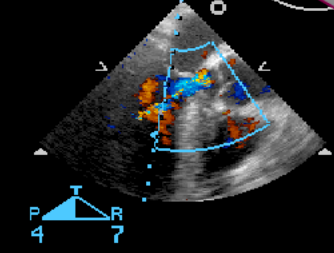
GAIN 25
COMP 81 12CM 0 156 180
103HZ 66BPM



LVOT obstruction
sub-valvular muscular stenosis
sub-aortic membrane

TIS: 0.8 PAT T: 37.0C
T6210 TEE T: 38.2C
26 APR 02
12:39:05
PROC 2/0/E/M3/A
GLENFIELD HOSP

GAIN 25
COMP 81 12CM 0 156 180
21HZ 65BPM

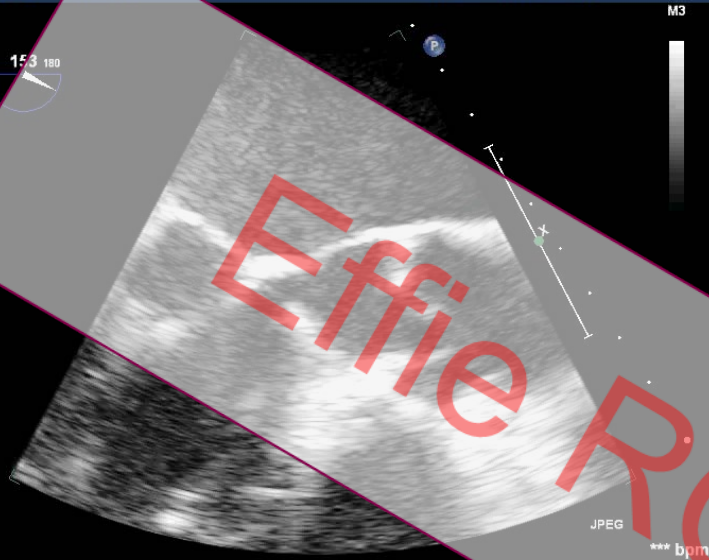


Effie ROUSKA, MD

PHILIPS STATHARAS KONSTANTINOS 17/01/2012 08:45:01 TIS0.5 MI 1.1
21410820120117 S7-2omni/TEEnew

FR 39Hz
12cm

2D
73%
C 47
P Off
HPen



Sub-Aortic membrane

PHILIPS STATHARAS KONSTANTINOS 17/01/2012 08:45:22 TIS1.3 MI 0.7
21410820120117 S7-2omni/TEEnew

FR 16Hz
16cm

2D
75%
C 47
P Off
HPen
GE
70%
4.9MHz
WF High
Med



PHILIPS STATHARAS KONSTANTINOS 17/01/2012 08:49:25 TIS1.2 MI 0.1
21410820120117 EYAGGELISMOS HOSP. S7-2omni/TEEnew

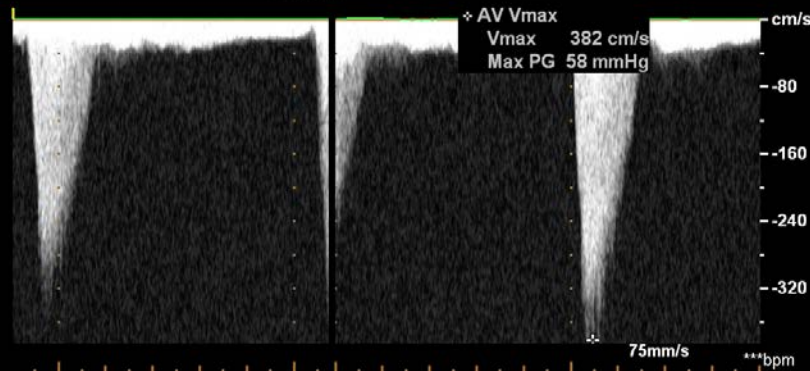
FR 55Hz
18cm

2D
72%
C 47
P Off
HPen



CW
50%
4.0MHz
WF 150Hz

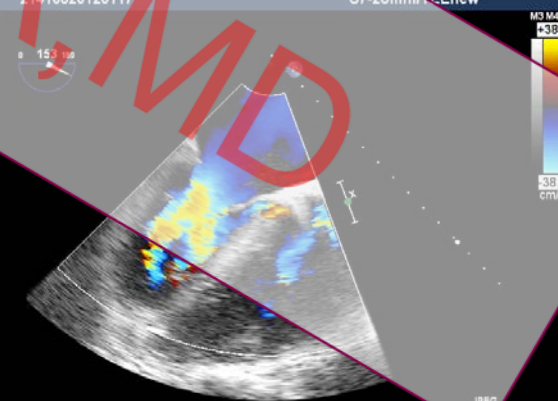
AV Vmax
Vmax 382 cm/s
Max PG 58 mmHg



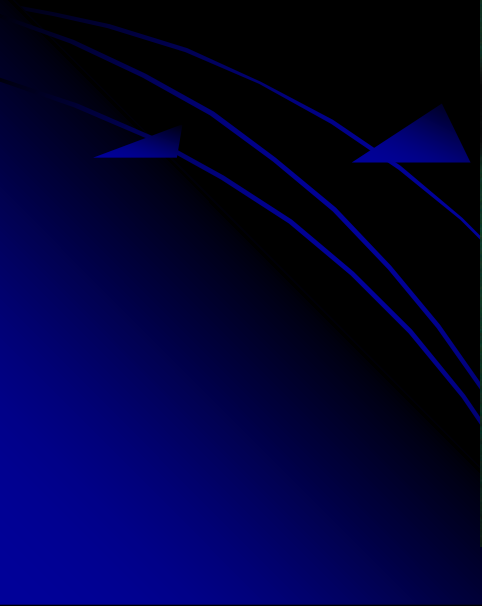
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21410820120117 S7-2omni/TEEnew

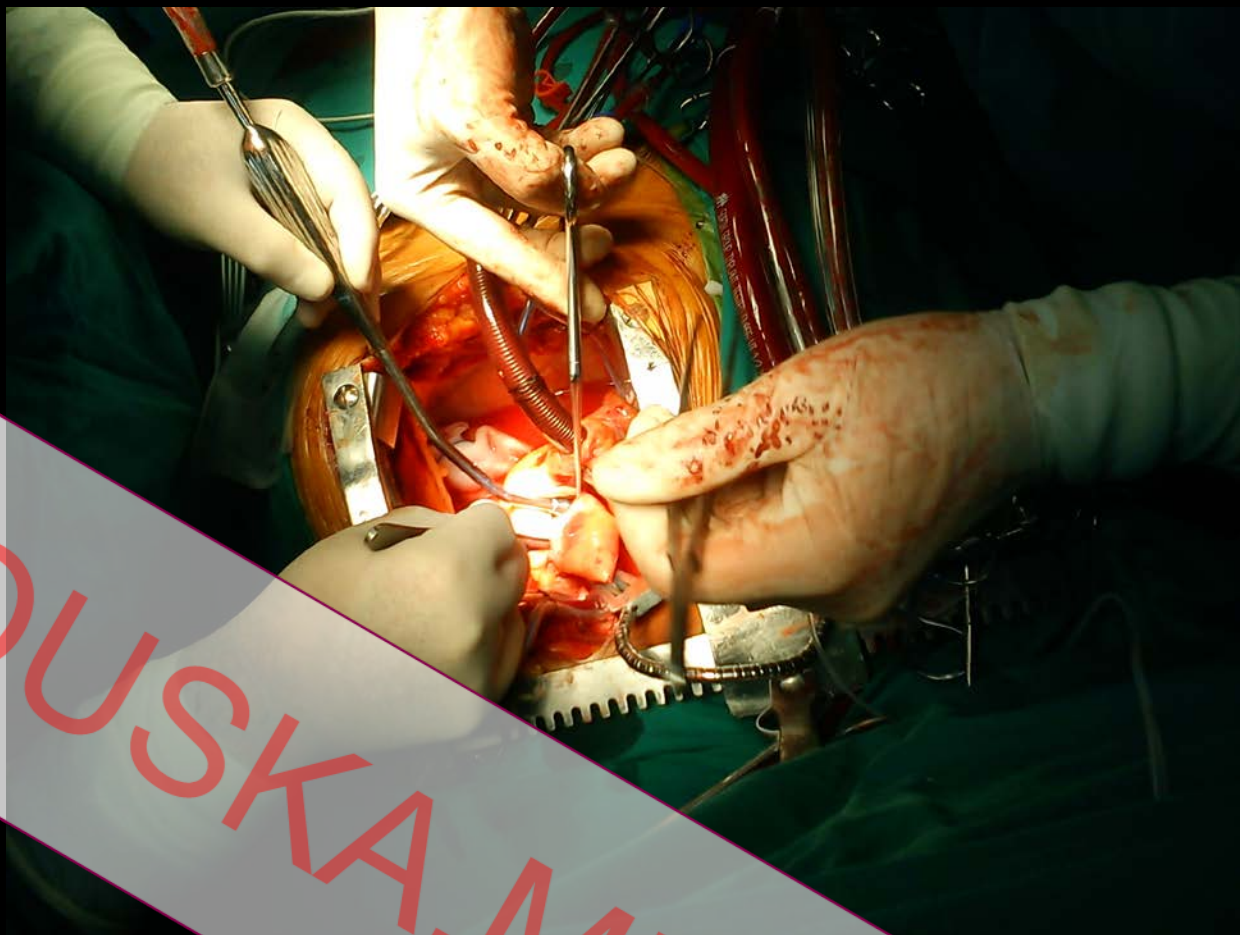
FR 11Hz
16cm

2D
74%
C 47
P Off
HPen
GE
70%
4.9MHz
WF High
Med



Subaortic membrane





Effie ROUSKA, MD

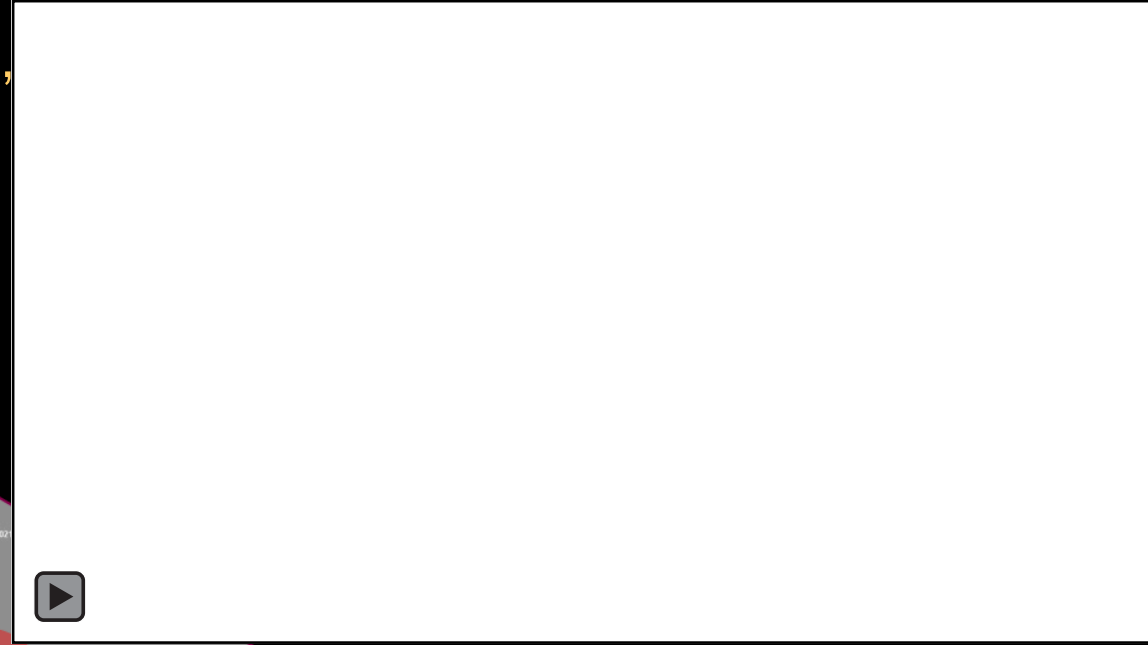
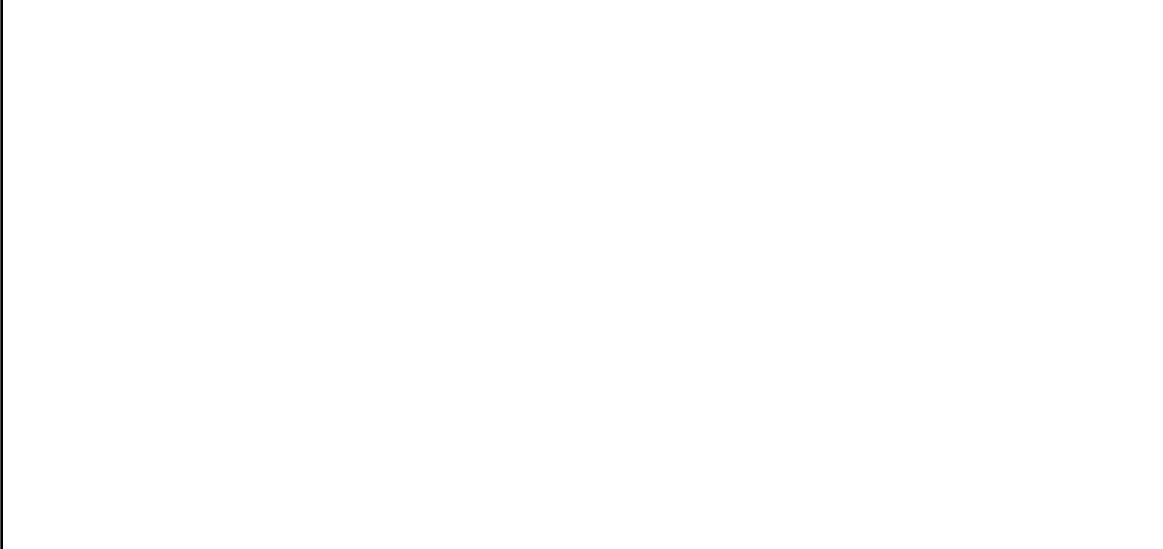
2. New findings – impact on surgery!

Most frequent pre-bypass TOE findings likely to affect the surgical plan

- ASD, patent foramen ovale
 - Valvular disease: new or absent or of different severity, annulus sizing
 - Global and regional LV and RV function not corresponding to preoperative findings
 - Intracardiac thrombi
 - Tumors
 - Left superior vena cava
 - Aortic atheromatosis
-

Decision making in the OR

70 yrs old male, IHD, poor LV CABG,
intraoperative TOE to assess the LV



Change of Surgical plane

Διεγχειρητικό Διοισοφάγειο Υπερηχοκαρδιογράφημα:

Το διεγχειρητικό ΤΟΕ ανέδειξε μέτρια επηρεασμένη συστολική λειτουργία (LVEF 45%) με RWMAs, διατεταμένο Αριστερό κόλπο με αυτόματο contrast, θρόμβο στο Ωτίο του Αριστερού Κόλπου, γεγονός που υποχρέωσε σε τροποποίηση του αρχικού σχεδιασμού και στην πραγματοποίηση της επέμβασης όπως περιγράψαμε. Καλή συστολική λειτουργία της Δεξιάς Κοιλίας. Τρίπτυχη Αορτική βαλβίδα με καλή διάνοιξη και ήπια ανεπάρκεια. Ήπια ανεπάρκεια Μιτροειδούς βαλβίδας.

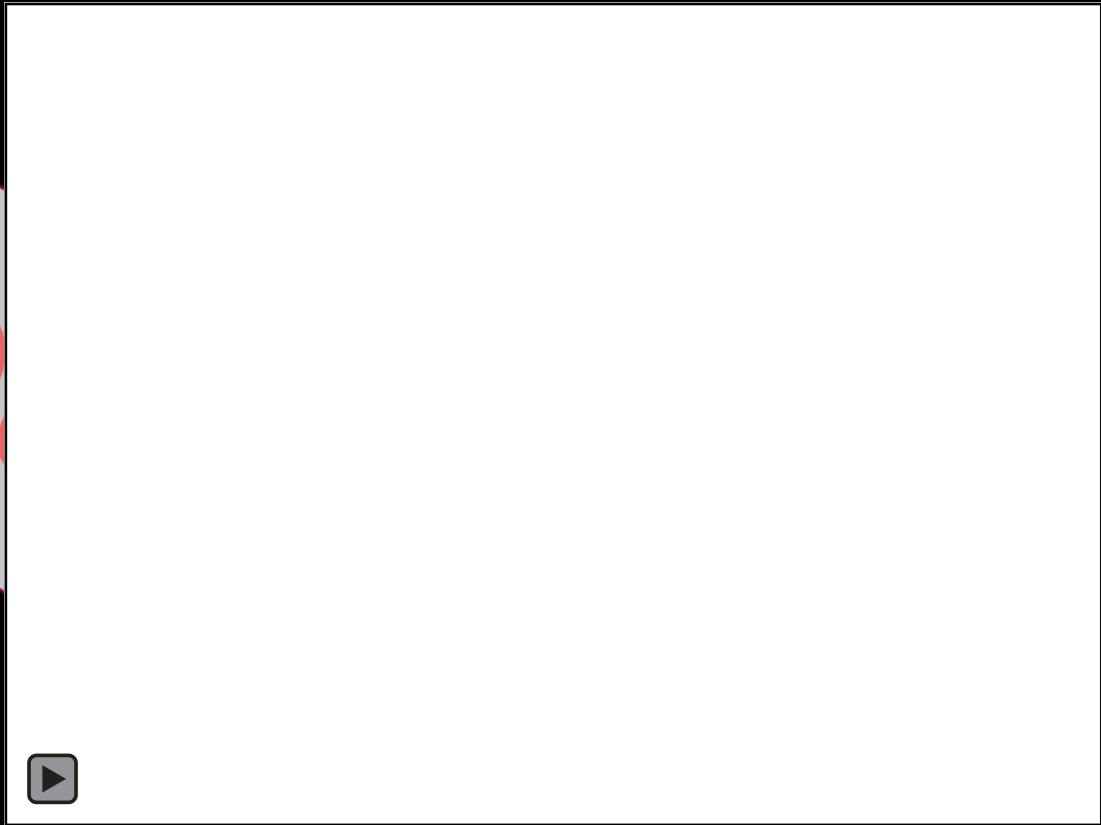
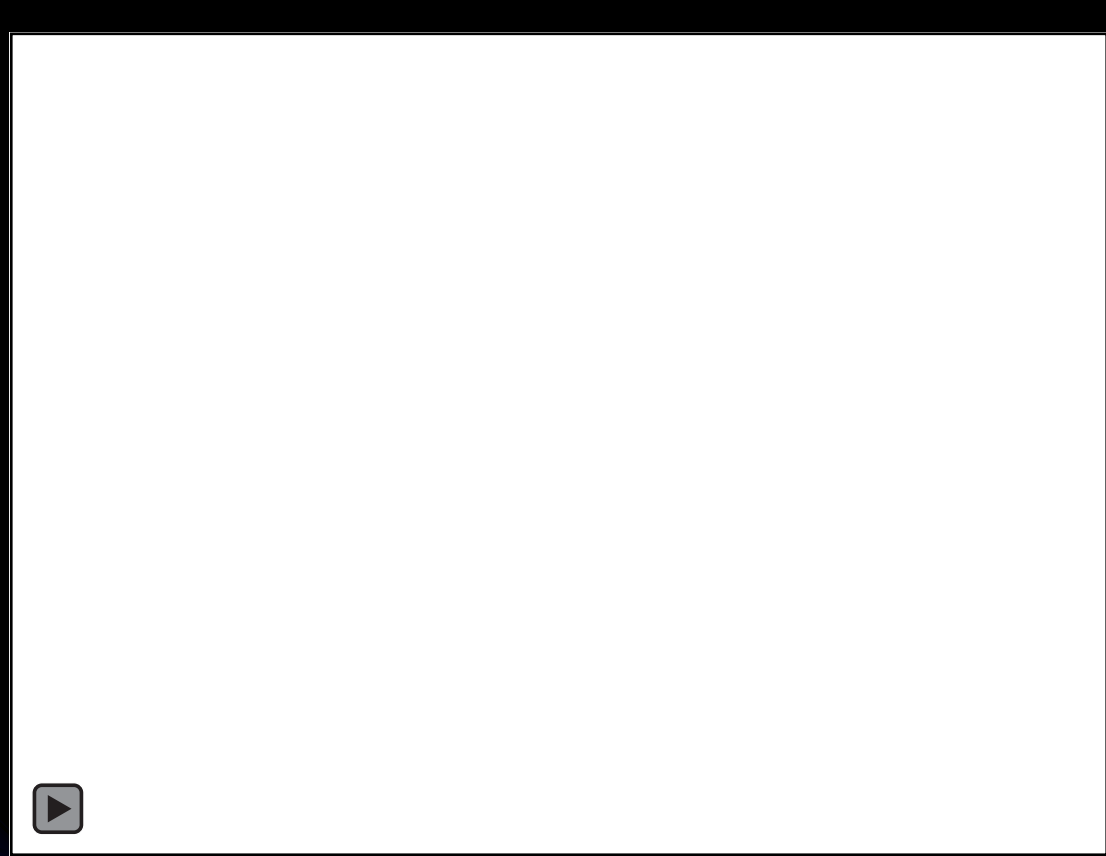
Το μετεγχειρητικό ΤΟΕ επιβεβαίωσε την ικανοποιητική λειτουργικότητα της Αρ.Κοιλίας και την επιτυχή απολίνωση του Ωτίου. Οι ανεπάρκειες Μιτροειδούς και Αορτικής βαλβίδας παρέμειναν ήπιες.

Επέμβαση: Αποκλεισμός αορτής με αορτική λαβίδα και επίτευξη ασυστολίας με ψυχρή αιματική καρδιοπληγία

- 1. Προσπέλαση του αριστερού κόλπου με διαμεσοκοιλιακή τομή (μέσω του ωοειδούς τρήματος), αναγνώριση του αριστερού ωτίου και αφαίρεση του θρόμβου**
- 2. Αποκλεισμός αριστερού ωτίου με τοποθέτηση atriclip No 45**
- 3. Στεφανιαία παράκαμψη:**

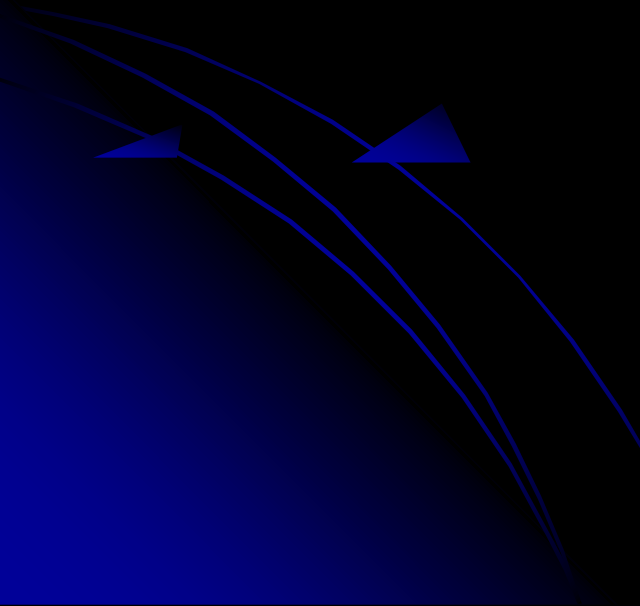
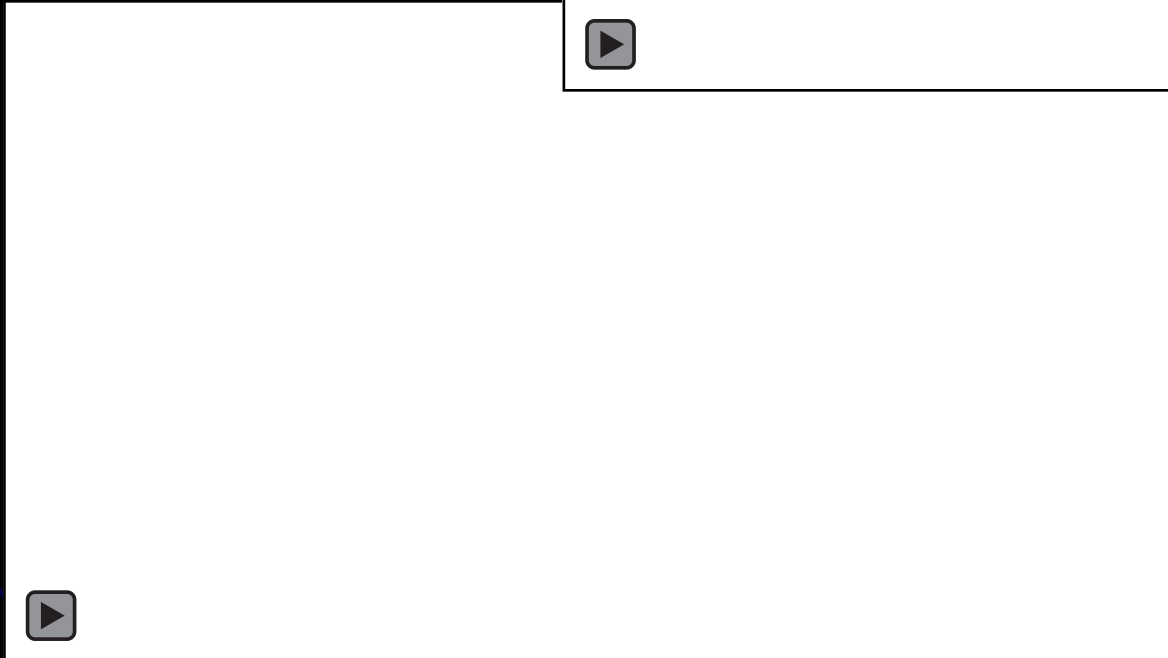
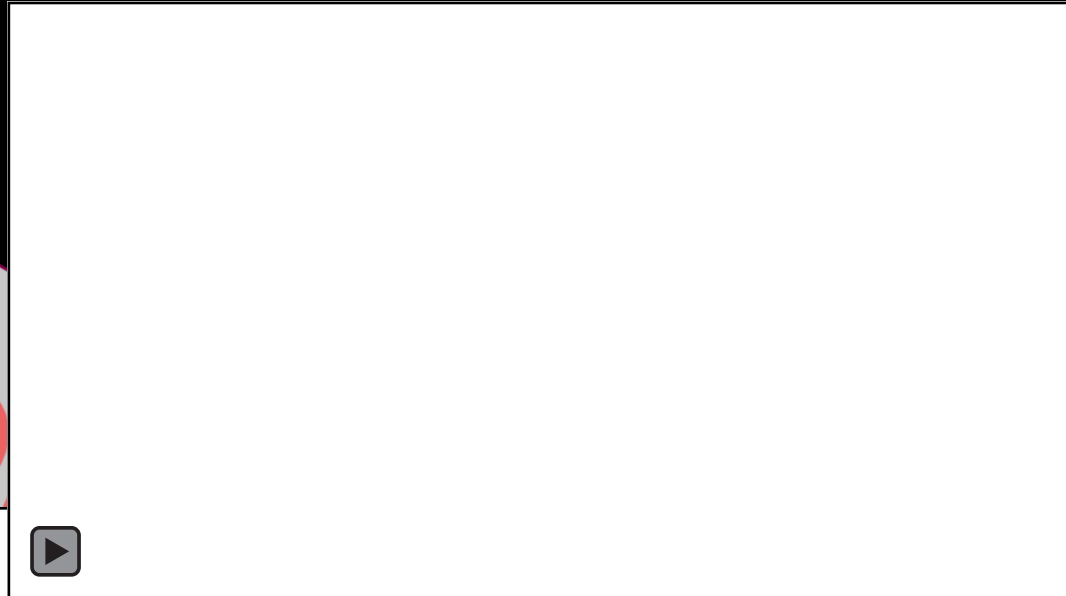
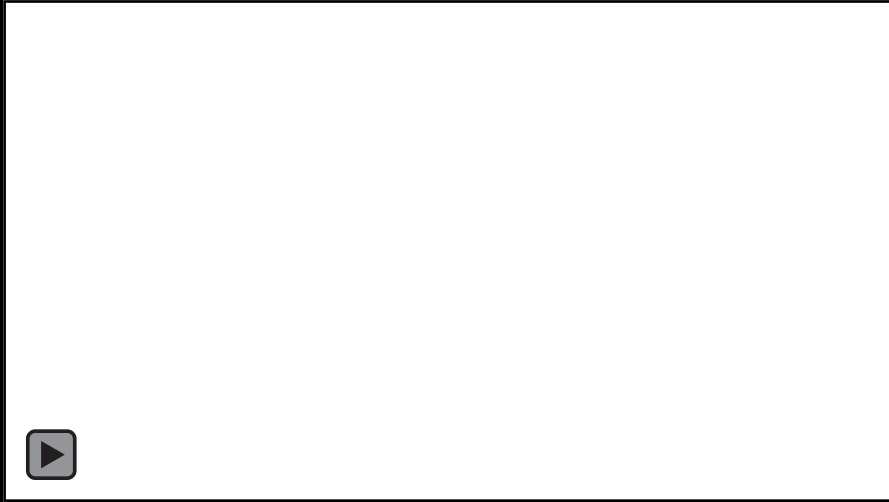
1) OM1: αναστόμωση με το φλεβικό μόσχευμα. Μέγεθος αγγείου περίπου 1,7mm

2) LAD: αναστόμωση με την έμμιση Αριστερή Έσω Μαστική Αρτηρία. Μέγεθος αγγείου περίπου 1,4mm

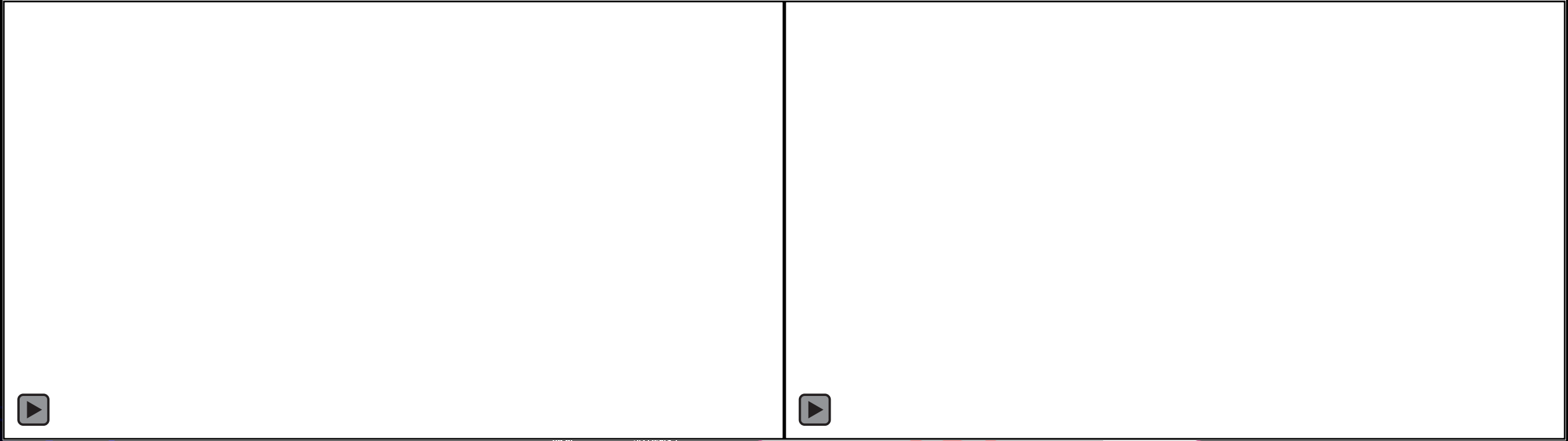


CABG, LA thrombus suction, LAA ligation!

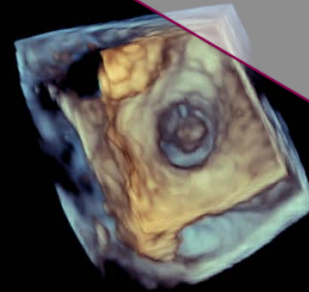
45 yrs old lady, rheumatic MV disease for MVR,
intraoperative TOE to assess MV



Pre-op unexpected findings



X8-2t
31Hz
9.5cm
3D Zoom
3D / 3D
% 52 / 17
C 20 / 30
Gen
XRES ON



WY, MD

PAT T: 37.0C
TEE T: 40.3C
F# 13



26

94 bpm

Unexpected events

- 80 years old female pt from peripheral hospital
- MS,MR, critical LAD stenosis - recent deterioration
- pre-op echo : smoke in LA
- Large thrombus in left atrial appendage

MI:0.6 PAT T: 37.0C [hp]
T5012 TEE T: 37.9C
09 FEB 01
10:28:38
PROC 0/0/E/F3
GLENFIELD HOSP

GAIN 53
COMP 65
79BPM

12CM
56HZ

T
P R
4 6



Effie ROUSKA, MD

During cannulation for bypass

- sudden appearance of dislodged thrombus in LA
- passed through MV, LVOT and AV
- located in ascending aorta

MI: 0.6
T5012
09 FEB 01
10:45:06
PROC 2/0/E/F3
GLENFIELD HOSP

PAT T: 37.0C [hp]
TEE T: 37.7C

GAIN 53
COMP 65
63BPM

13CM
52HZ

P T R
4 6



MI: 0.6
T5012
09 FEB 01
10:45:55
PROC 2/0/E/F3
GLENFIELD HOSP

PAT T: 37.0C [hp]
TEE T: 37.6C

GAIN 53
COMP 65
61BPM

13CM
52HZ

P T R
4 6



0 109 180

- Disappearance of thrombus from ascending aorta
- Patient became unstable
- Immediately on CPB

M1:0.6
T5012
09 FEB 01
10:46:50
PROC 2/0/E/F3
GLENFIELD HOSP

PAT T: 37.0C [hp]
TEE T: 37.7C

0 109 180

GAIN 53
COMP 65
61BPM

13CM
52HZ

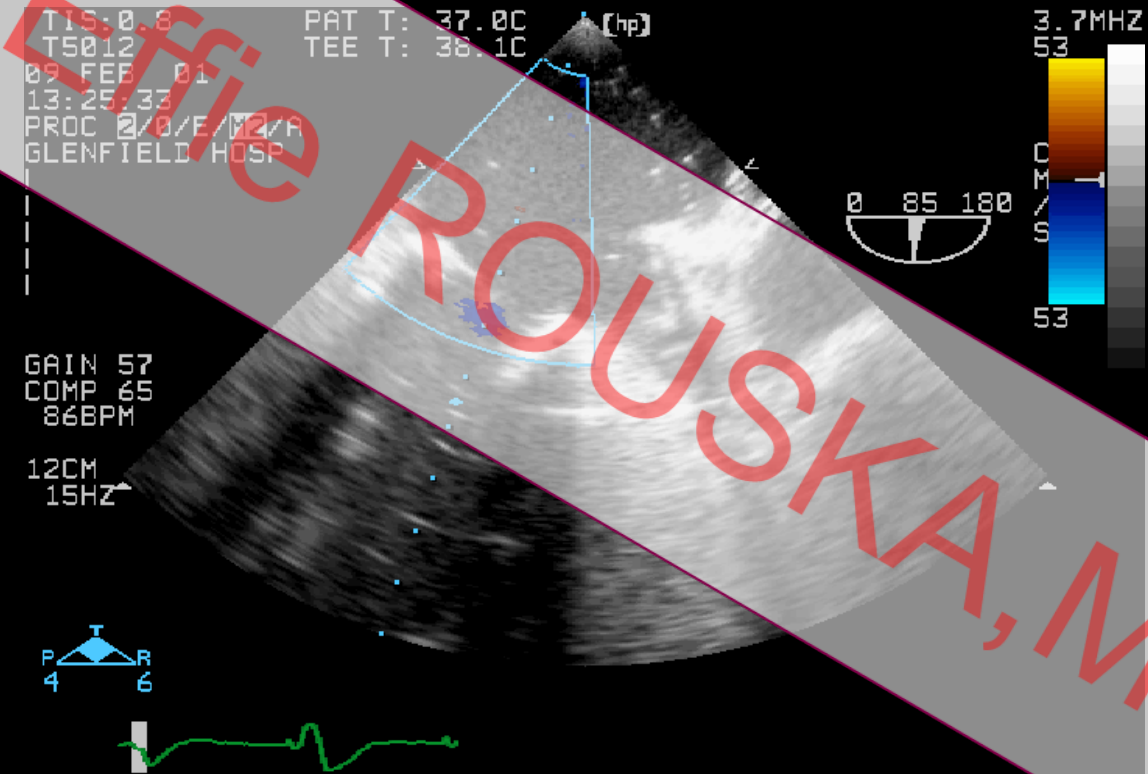
T
P R
4 6



Effie ROUSKA, MD

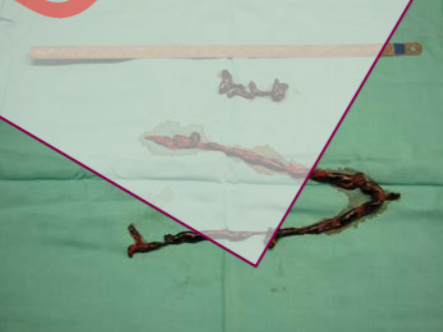
Surgical procedure

- Mitral valve replacement - Tissue Med 27 mm
- Tricuspid valve repair - Cosgrove-Edwards 32 mm
- Single venous graft to LAD

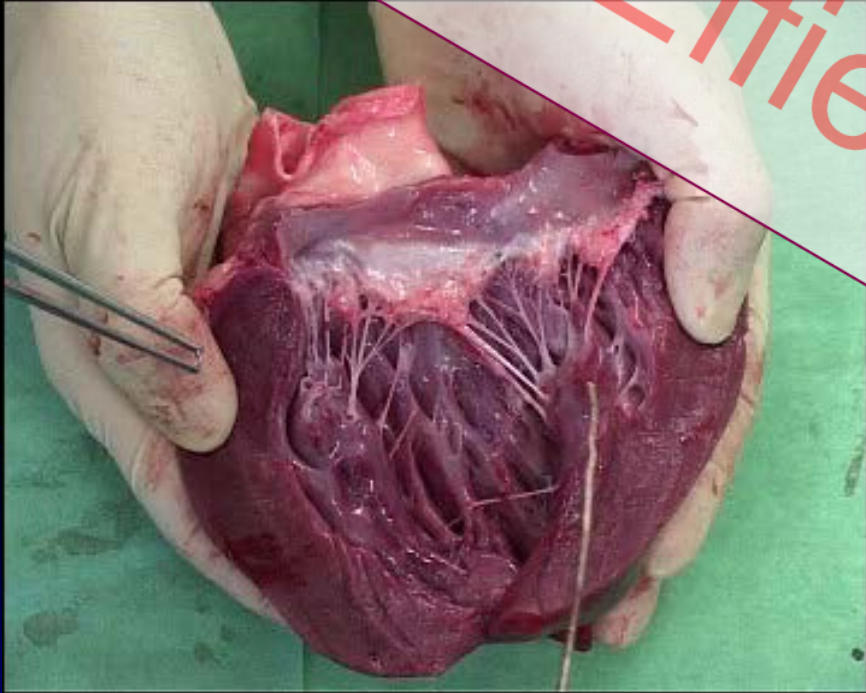


Post op findings

carotid scan
right common carotid artery-thrombus at bifurcation



MV Repair / Replacement



23indeo.avi



Effie ROUSKA, MD

IMR

Mitral regurgitation

Pitfalls

Anaesthesia and IPPV



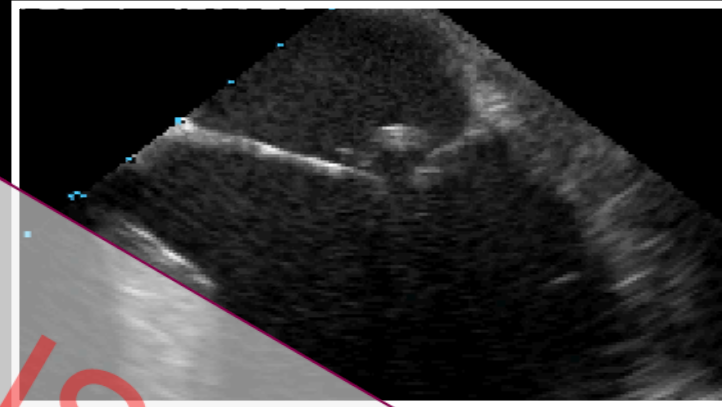
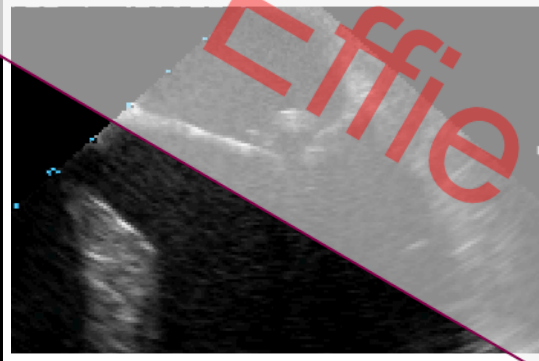
Phenylephrine for restoration of “normal”
haemodynamics?

MR due to myxomatous degeneration or
rheumatic mitral disease less influenced

Bach DS, et al. Am J Cardiol 1995; 76: 508-12; Konstadt SN, et al. J Cardiothorac Vasc Anesth 1994; 8: 19-23 c

Specific measurements are needed upon the type of the operation

Predictors of SAM and LVOT obstruction



- Small AML/PML ratio (<1.0)
- Small coapt-sept distance ($<2.6\text{cm}$)
- Large posterior leaflet height ($>1.5\text{cm}$)
- Greater coapt-annulus distance
- Aortic-mitral angle

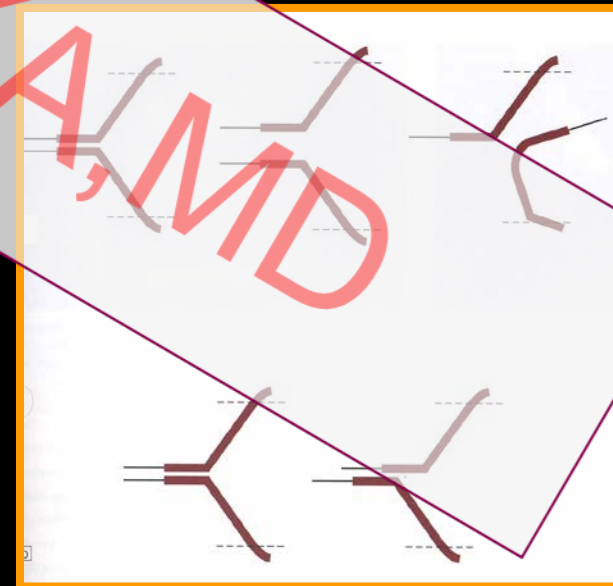
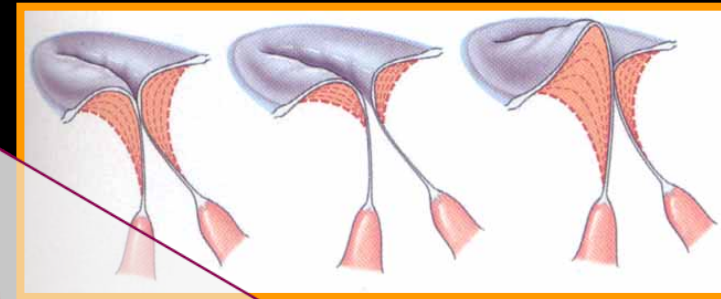
Lee KS, Stewart WJ, Lever HM, et al. Circulation 1993;88:II-24-II-29

Maslow AD, Regan MM, Haering JM, et al. J Am Coll Cardiol 1999; 34: 2096-104

Pre-op IOE evaluation of MV

- Function of MV

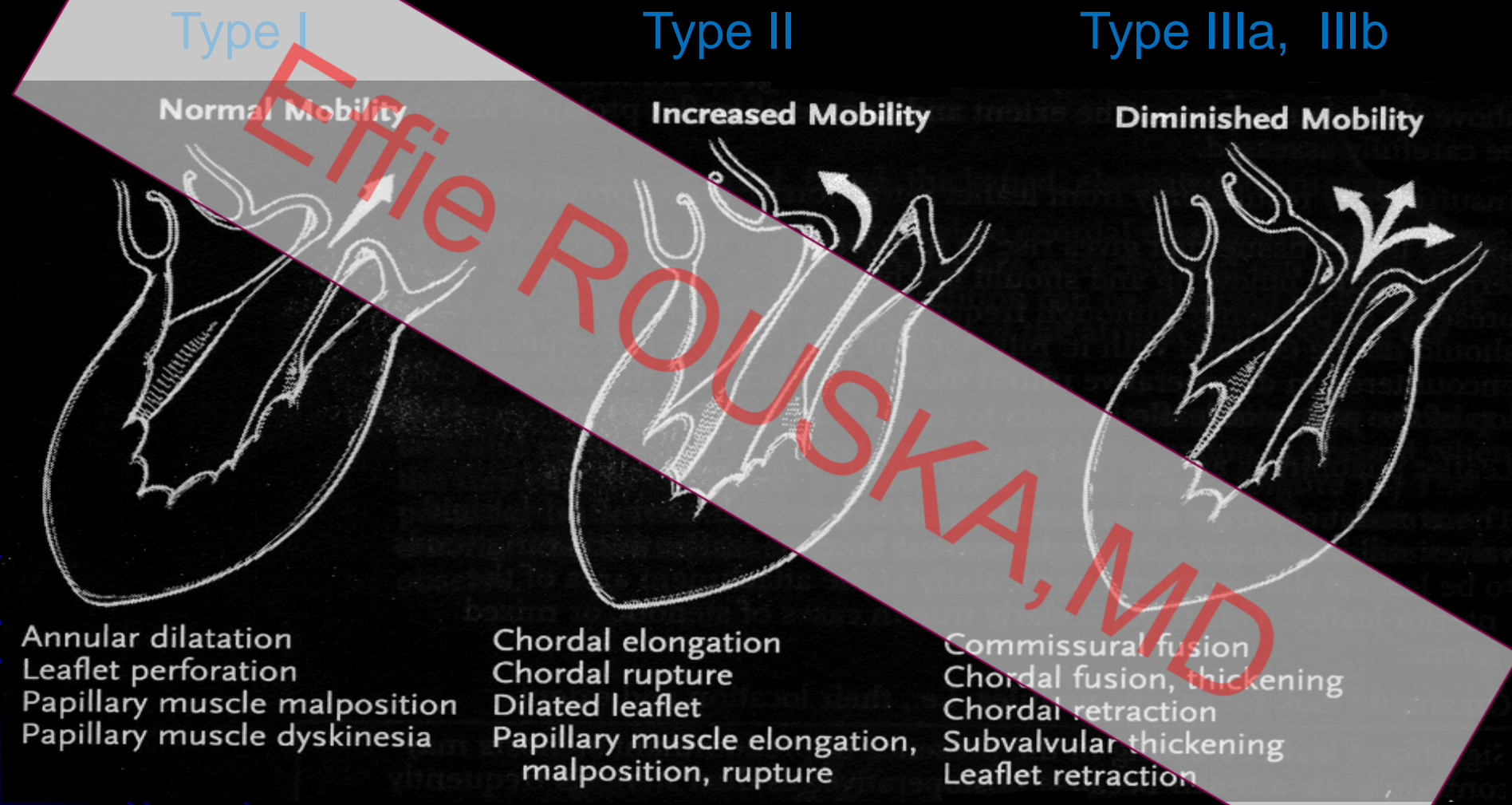
- Position of leaflets
 - *Malcoaptation*
 - *Malapposition*
- Motion of leaflets
 - *Normal*
 - *Excessive*
 - Restricted
- Size of annulus
- Chordal elongation
- Chordal rupture



Effie ROUSKA, MD

Mitral Regurgitation

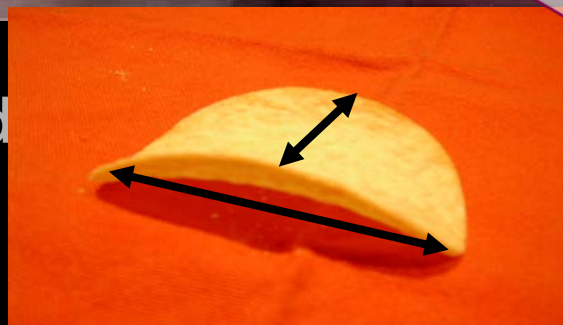
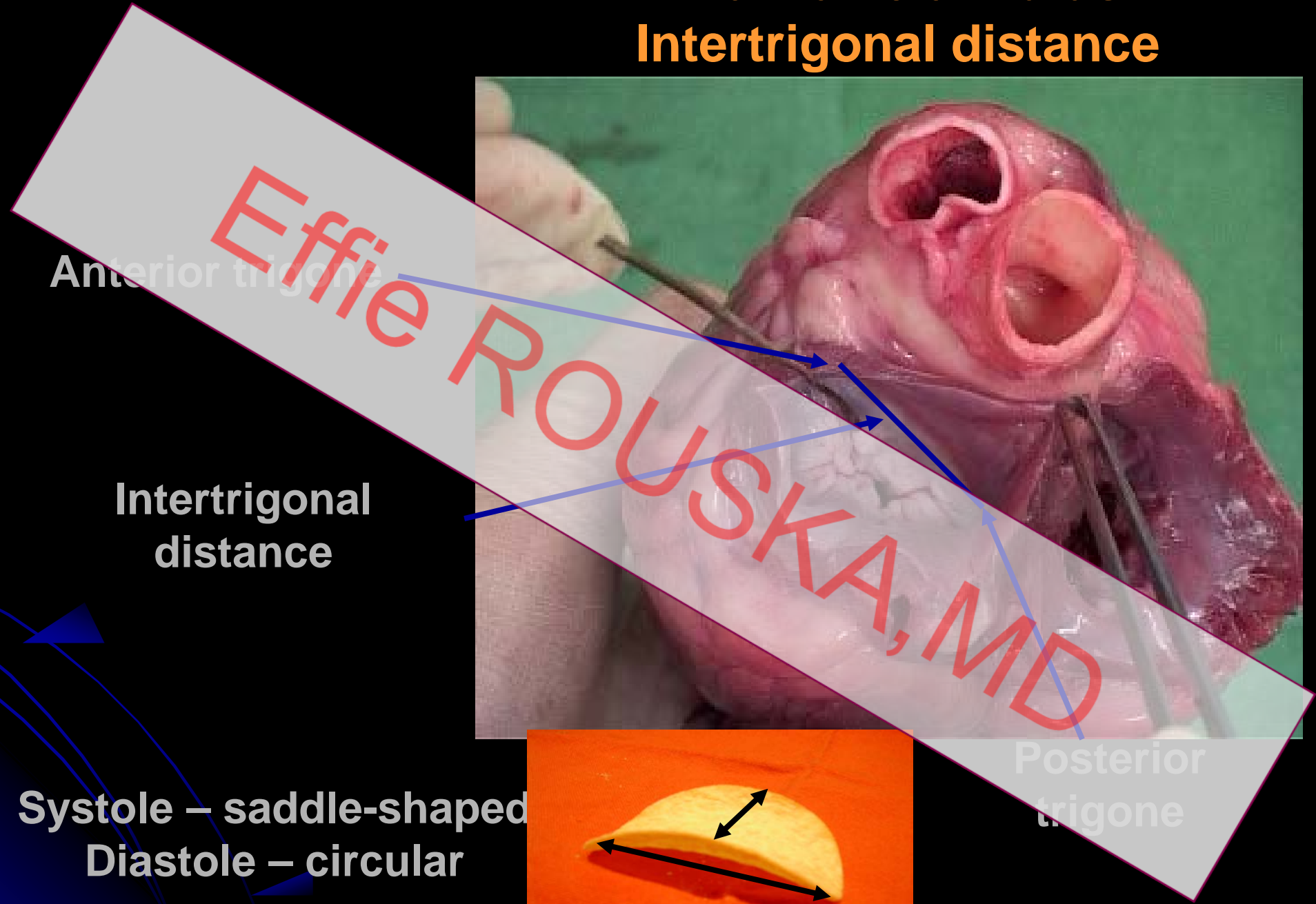
Carpentier classification



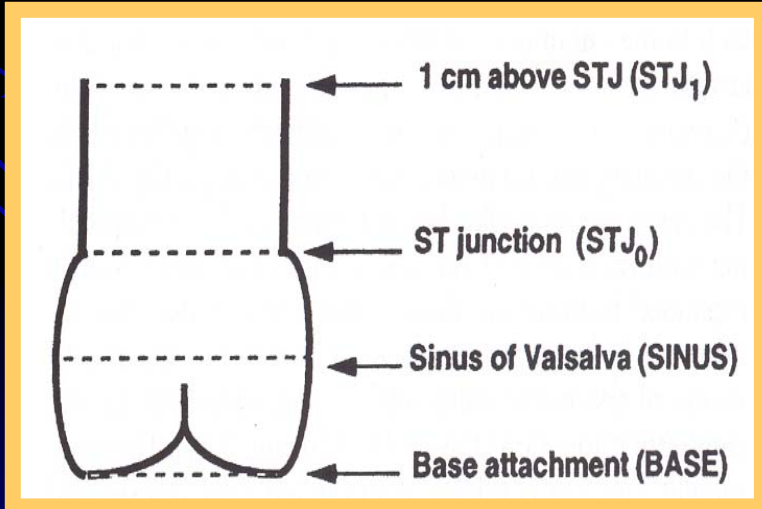
Carpentier A. J Thorac Cardiovasc Surg 1983;86:323-37

Enriquez-Sarano M, et al. Circulation 2003;108:253-256. Mitral regurgitation: What causes the leakage is fundamental to the outcome of valve repair.

Mitral valve annulus – Intertrigonal distance



AV Repair / Replacement



Functional classification for AR

*El Khoury, Rubay, Noirhomme, d'Udekem, et al
University Hospital of Louvain, Brussels, Belgium*

- Type I normal cusp motion (central jet)
 - Type I a STJ dilatation
 - Type I b STJ + sinuses of Valsalva dilatation
?aneurysm, ?Marfan
 - Type I c annular dilatation
poor coaptation and apposition, ?aortic dissection
 - Type I d leaflet defect / perforation
?endocarditis
- Type II cusp prolapse (eccentric jet)
excessive cusp tissue, commissural disruption +
malpositioning, poor coaptation and apposition
?endocarditis
- Type III restricted cusp motion (central jet)
?quadricuspid valve , ?unicuspid valve
?bicuspid valve, ?calcification

Intra-Op
TOE

- Intraoperative monitoring
 - TEE vs PAC or LVEDD vs PCWP/CVP
- Guide to positioning of cannulae / surgical manipulations
- Inadequate venous drainage
- Distribution of cardioplegia (*contrast echo*)
- Minimization of the risk of air embolization
- Assistance in weaning from CPB

Effie ROUSKA, MD

Monitoring Function

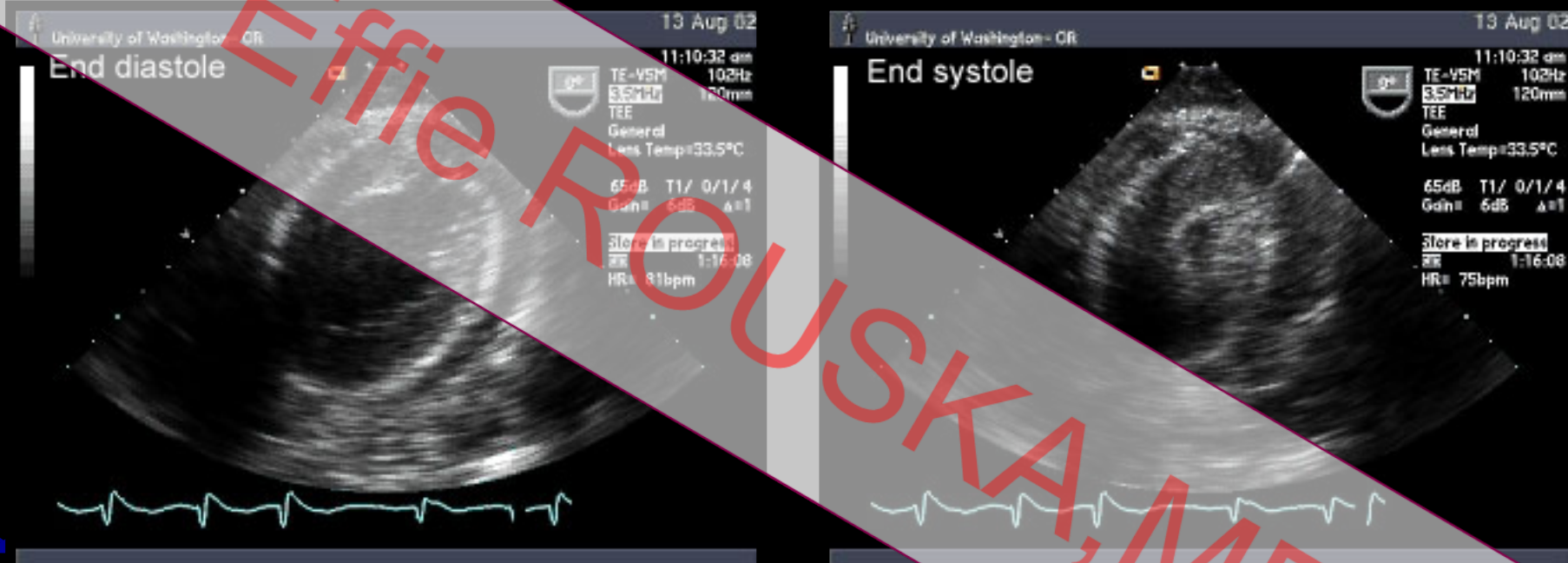
TEE vs PAC or LVEDD vs PCWP/CVP

Typical echocardiographic and PAC findings in haemodynamically unstable pts

	<u>TOE</u>			<u>PAC</u>		
	Contractility	EDA	ESA	FAC	CI	PAWP
Hypovolemia	Vigorous	↓	↓	↔	↓	↓
Reduced LV compliance	Vigorous	↓	↓	↔	↓	↑
Low SVR	Vigorous	↔	↓	↑	↑	↔
Systolic dysfunction	Vigorous	↑	↑	↓	↓	↑

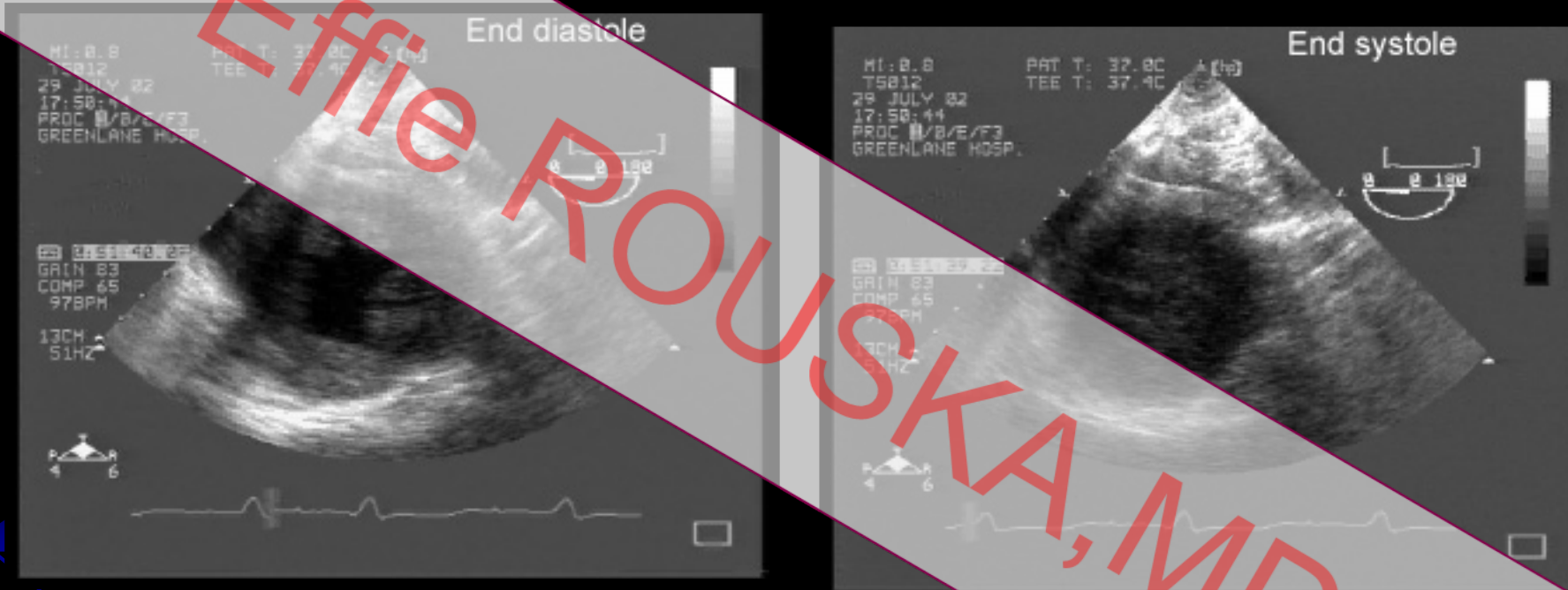
CI=cardiac index, EDA=end diastolic area, ESA=end systolic area, FAC=fractional area change, PAWP=pulmonary artery wedge pressure, SVR=systemic vascular resistance

Low Vascular Resistance



Both hypovolaemia and low systemic vascular resistance are associated with a reduced end systolic area. In this patient the end systolic area is reduced but the end diastolic area is normal, suggesting low systemic vascular resistance.

Hypovolemia



Both hypovolaemia and low systemic vascular resistance are associated with a reduced end systolic area. In this patient, end systolic and end diastolic areas are both reduced, which is consistent with hypovolaemia

Insertion of IABP

CXR – tip of IABP low

Difficult to advance

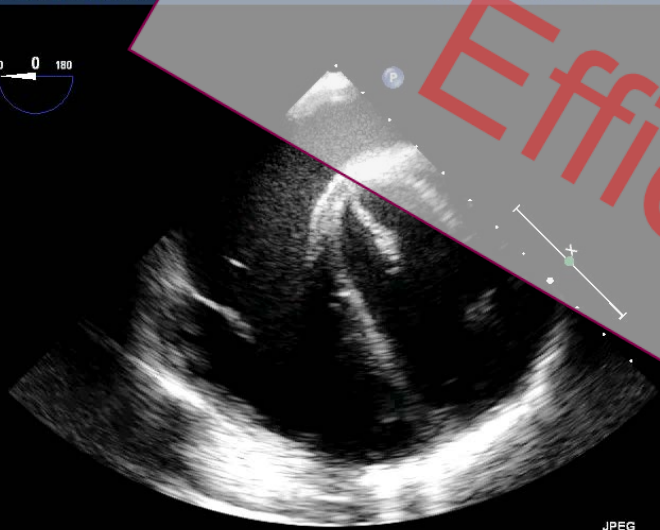
Should it be advanced any further?

Surgeon complaints of having difficulty empty the RA

PHILIPS KATSARAS DIMITRIOS 02/06/2010 08:12:15 TIS0.7 MI 1.1
26520720100602 S7-2omni/TEEnew

FR 39Hz
12cm

2D
72%
C 47
P Off
HPen



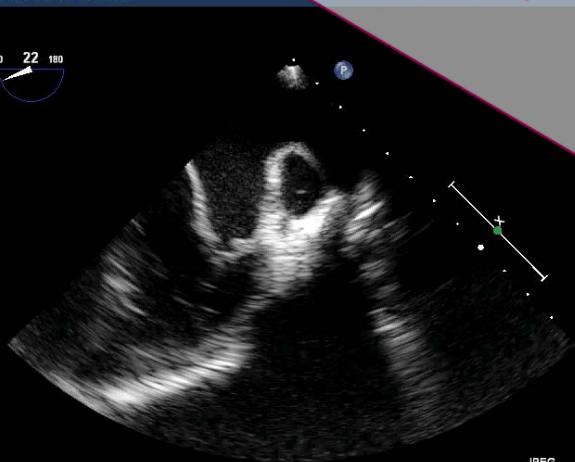
JPEG

47 bpm

PHILIPS KATSARAS DIMITRIOS 02/06/2010 08:13:31 TIS0.7 MI 1.1
26520720100602 S7-2omni/TEEnew

FR 39Hz
12cm

2D
70%
C 47
P Off
HPen



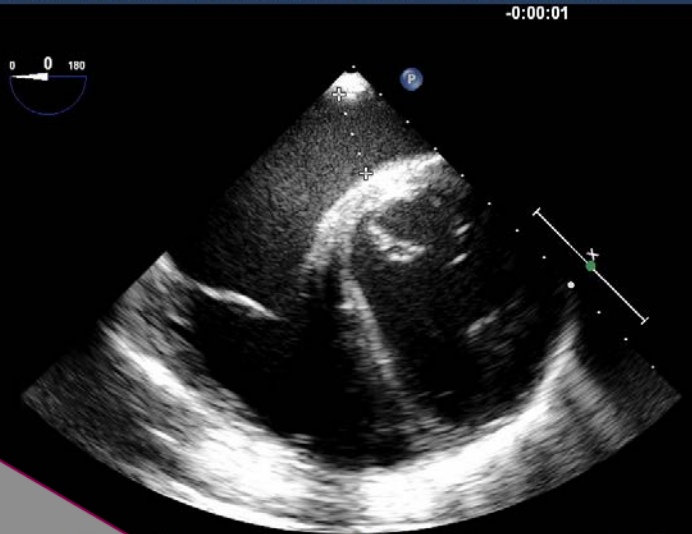
JPEG

82 bpm

PHILIPS KATSARAS DIMITRIOS 02/06/2010 08:12:28 TIS0.7 MI 1.1
26520720100602 EYAGGELISMOS HOSP. S7-2omni/TEEnew

FR 39Hz
12cm

2D
72%
C 47
P Off
HPen



Dist 2.17 cm

51bpm

- Dilated CS
- LSVC

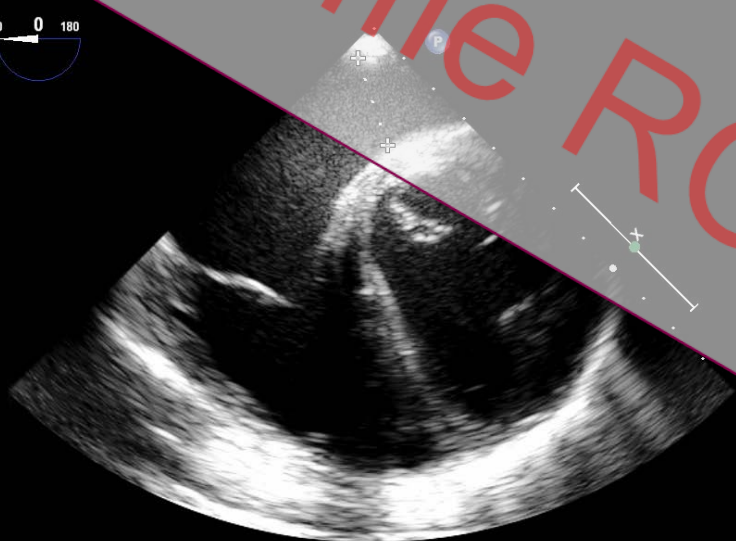
PHILIPS KATSARAS DIMITRIOS 02/06/2010 08:12:28 TIS0.7 MI 1.1
26520720100602 EYAGGELISMOS HOSP. S7-2omni/TEEnew -0:00:01 M3

FR 39Hz
12cm

2D
72%
C 47
P Off
HPen



G
P R
2.8 5.6

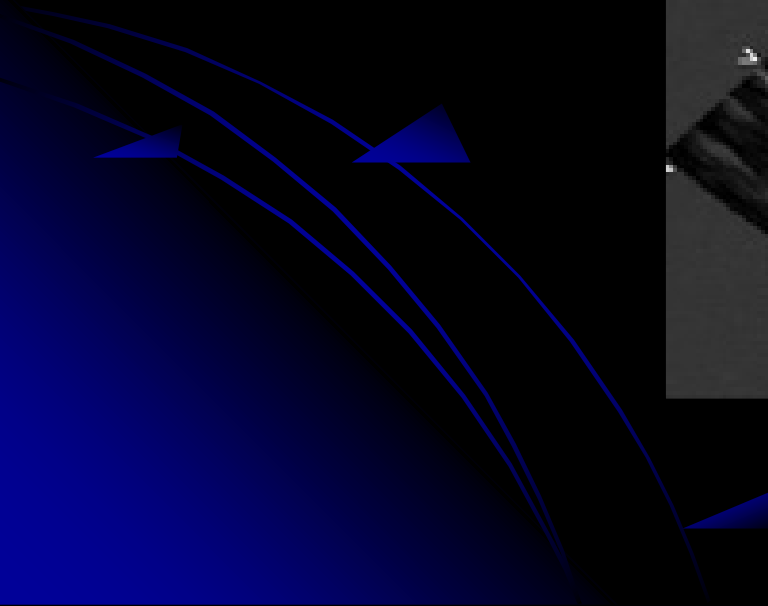
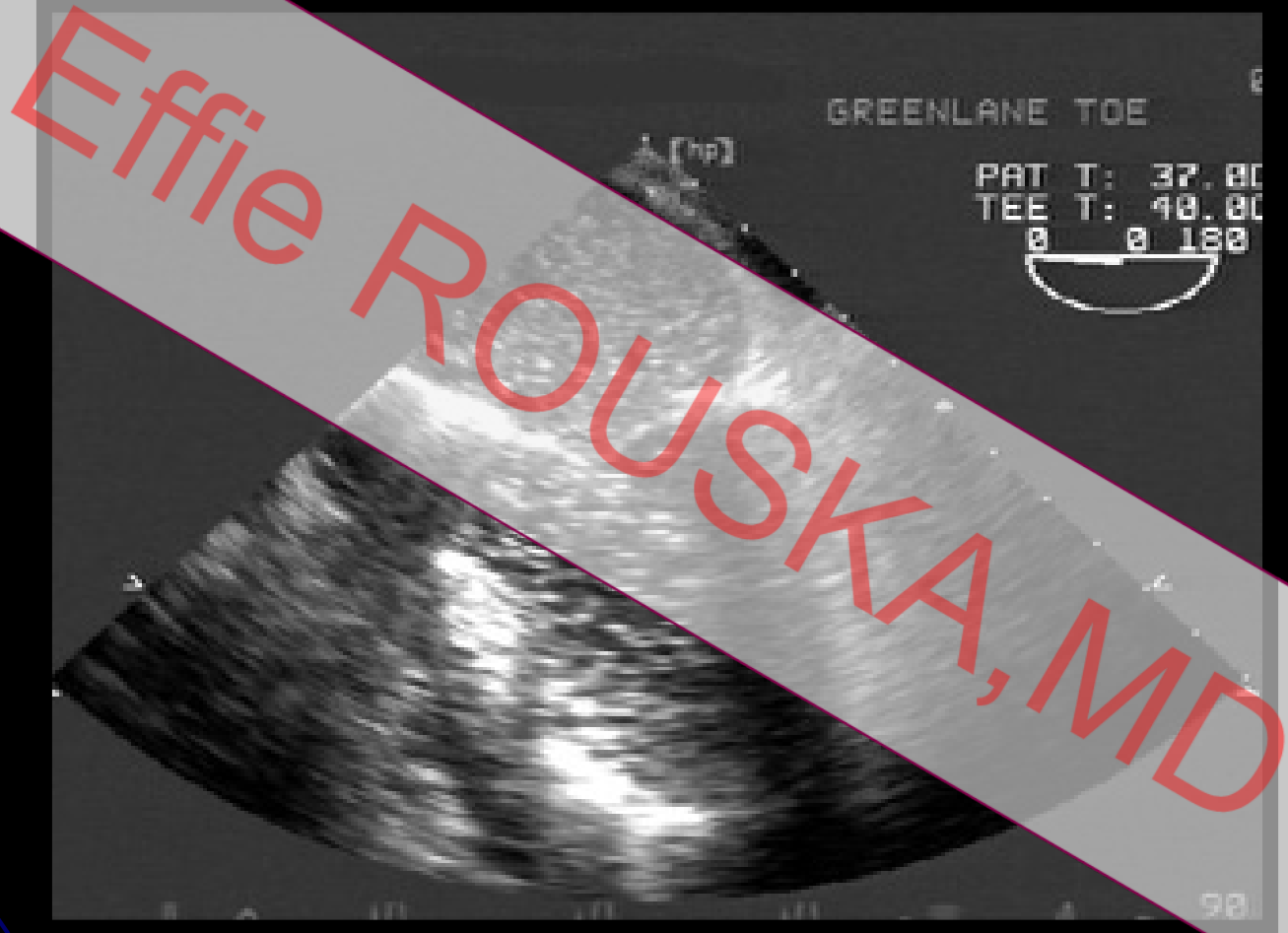


✦ Dist 2.17 cm

51bpm

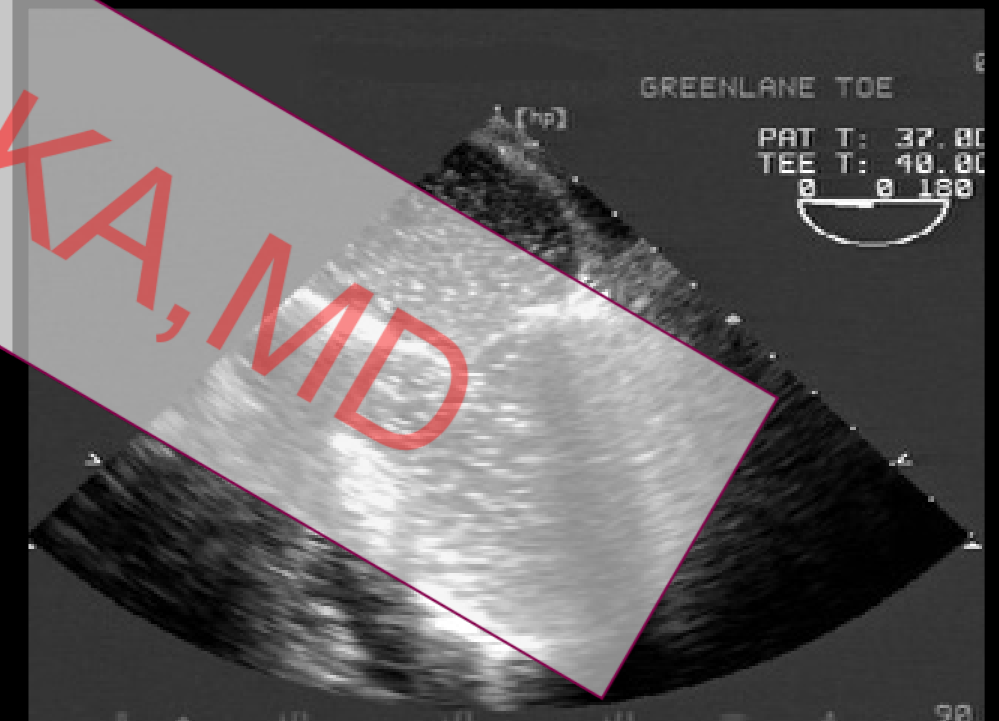
Persistent left SVC –
Left anterior cardinal vein fails to obliterate in fetus
0.3% in healthy population
8% draining into LA – “unroofing of coronary sinus”

Deairing

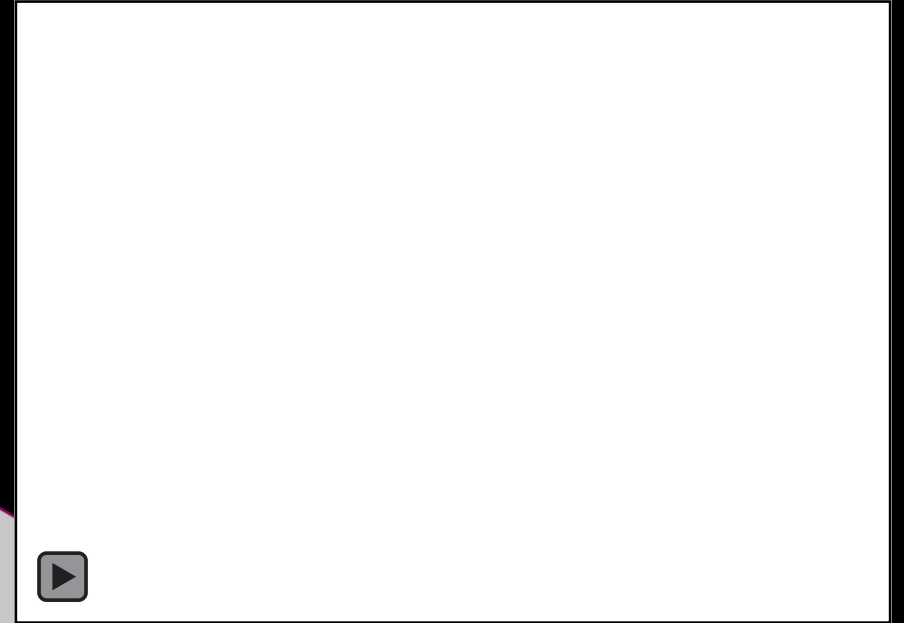
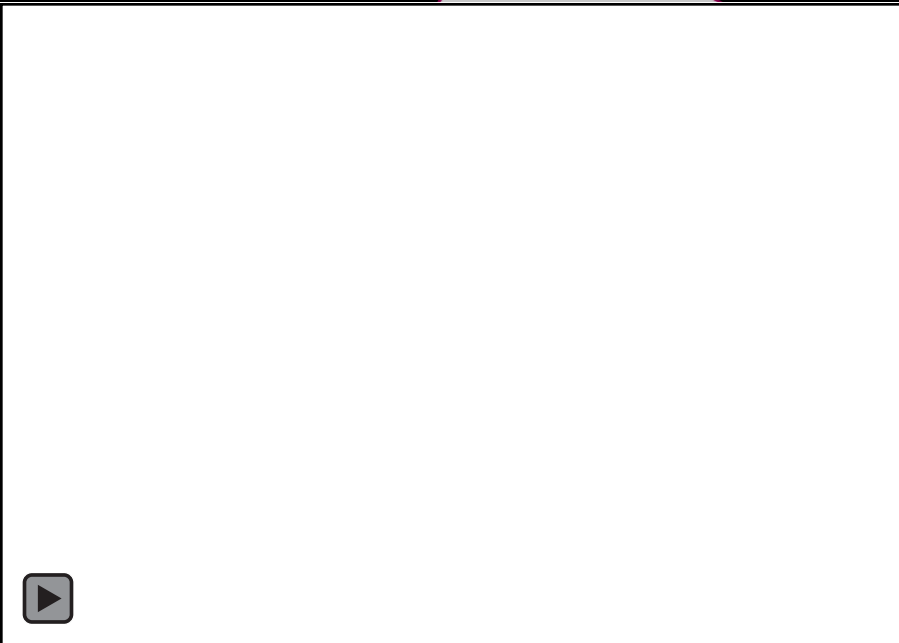


Air in the heart Deairing

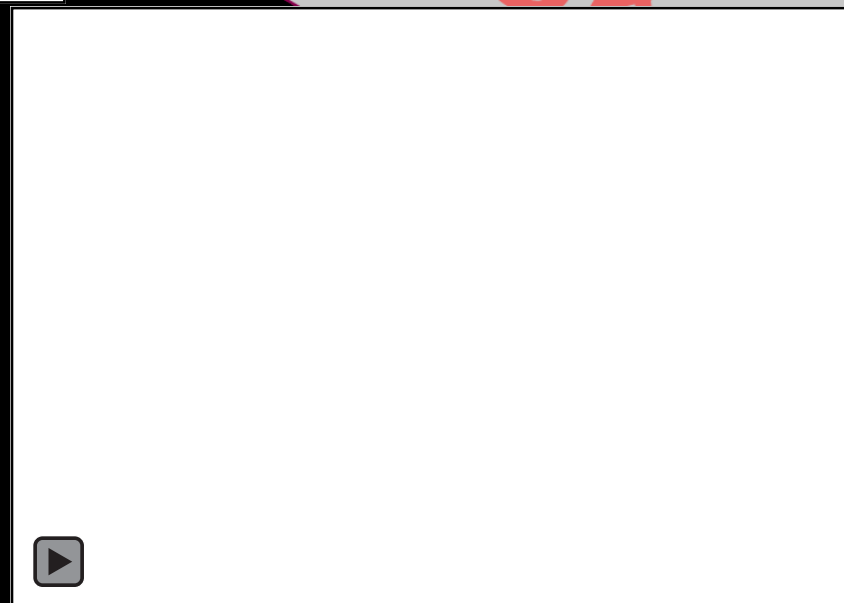
- **J Thorac Cardiovasc Surg** 2009;138:157-162
© 2009 [The American Association for Thoracic Surgery](#)
- **A new de-airing technique that reduces systemic microemboli during open surgery: A prospective controlled study**
- **Faleh Al-Rashidi, MDa, Sten Blomquist, MD, PhDb, Peter Höglund, MD, PhDc, Carl Meurling, MD, PhDd, Anders Roijer, MD, PhDd, Bansi Koul, MD, PhDa,***
- a Department of Cardiothoracic Surgery, University Hospital Lund, Sweden
b Department of Cardiothoracic Anesthesiology, University Hospital Lund, Sweden
c Department of Clinical Research and Competence Center, University Hospital Lund, Sweden
d Department of Cardiology, University Hospital Lund, Sweden



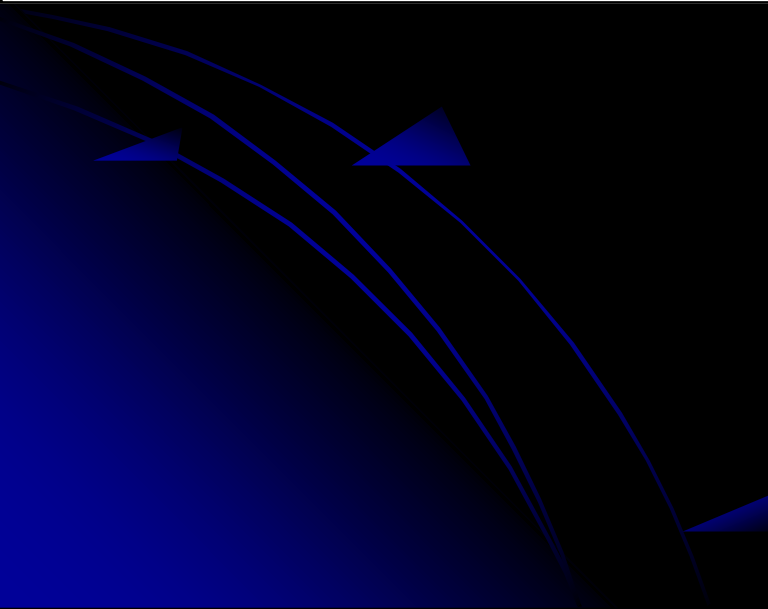
60 yrs old lady for MV repair



PROUSK



MD



Easy separation from CPB
5 minutes post CPB - IABP
Unstable – REASON?

ROLLS

Tingleff J, et al. Intraoperative echocardiographic study of air embolism during cardiac operations. *Ann Thorac Surg* 1995;673-7

Post-Op
ITOE

➤ Direct assessment of the surgical result

➤ New findings

➤ Post op monitoring

➤ Guide to post op management

Effie ROUSKA, MD

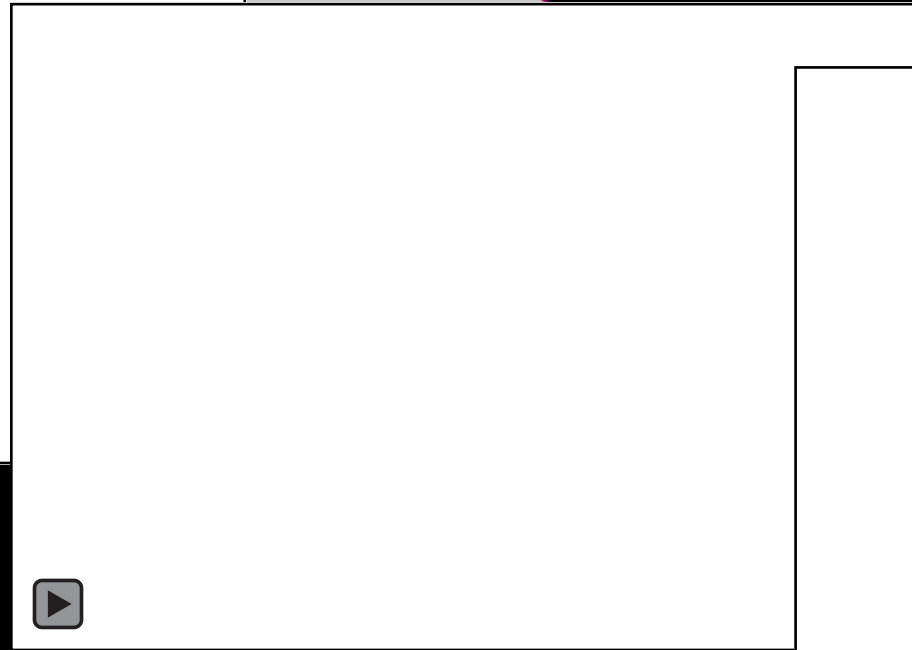
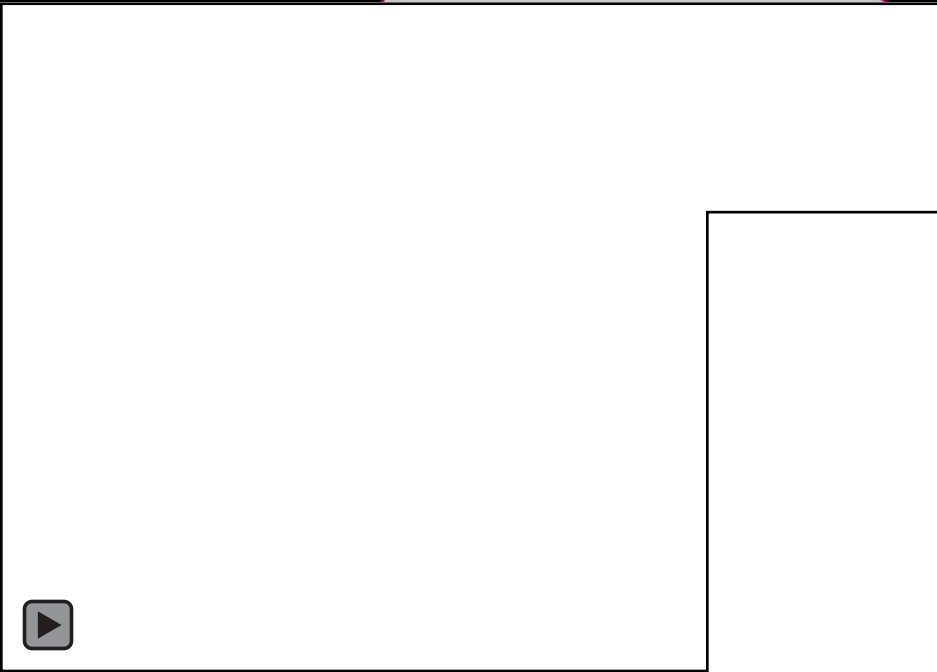
Most frequent post-bypass TOE findings likely to affect the surgical plan

- Coronary artery surgery
 - New wall motion abnormality (ischaemia)
 - Severe impairment in LV/RV function
 - New or worse ischaemic mitral regurgitation
 - Valvular surgery
 - Failed repair, residual lesion
 - Prosthetic dysfunction
 - Paravalvular leak, fistula, rupture
 - LV outflow obstruction, SAM
 - Severe impairment in RV/LV function
-

65 yrs old female with rheumatic MS for MVR

Carpentier-Edwards stented bioprosthesis, LAA ligation

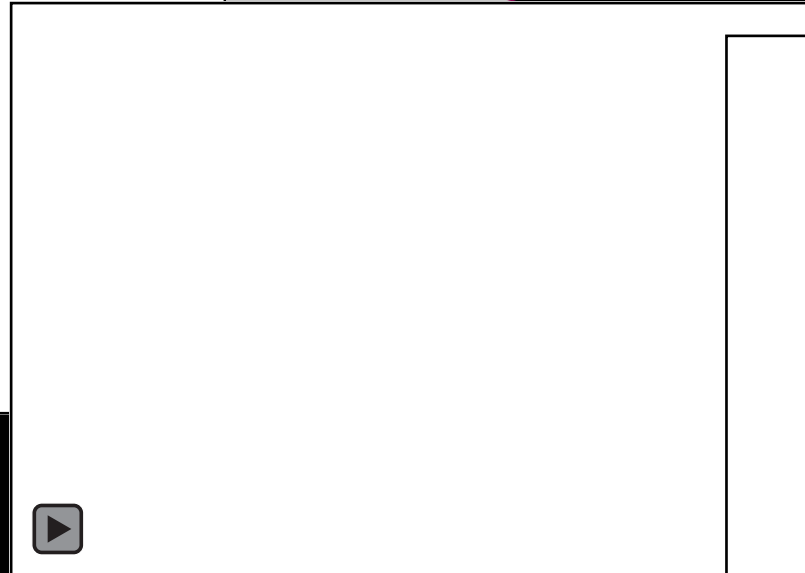
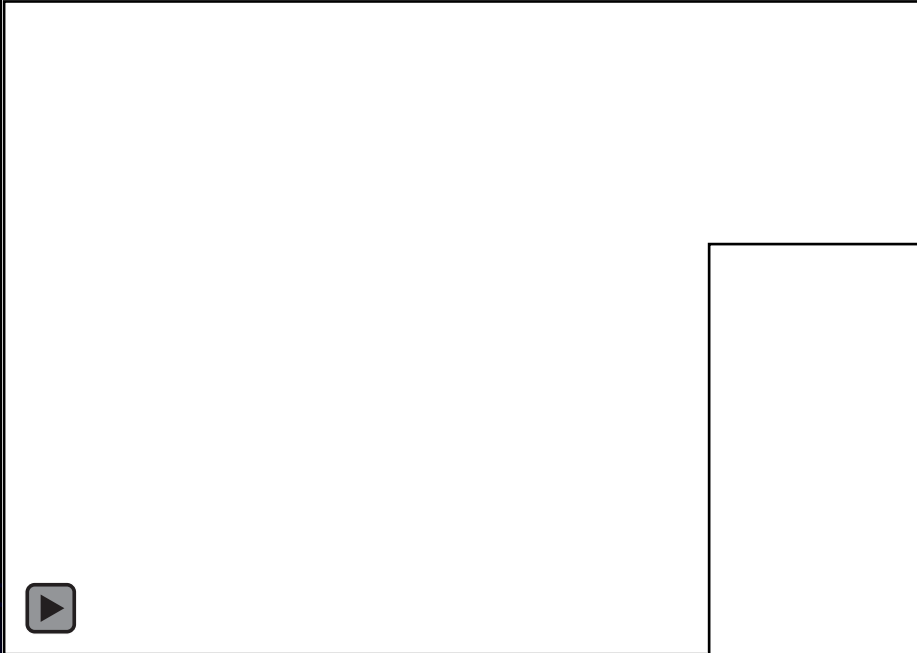
End of procedure after coming off CPB – routine TOE



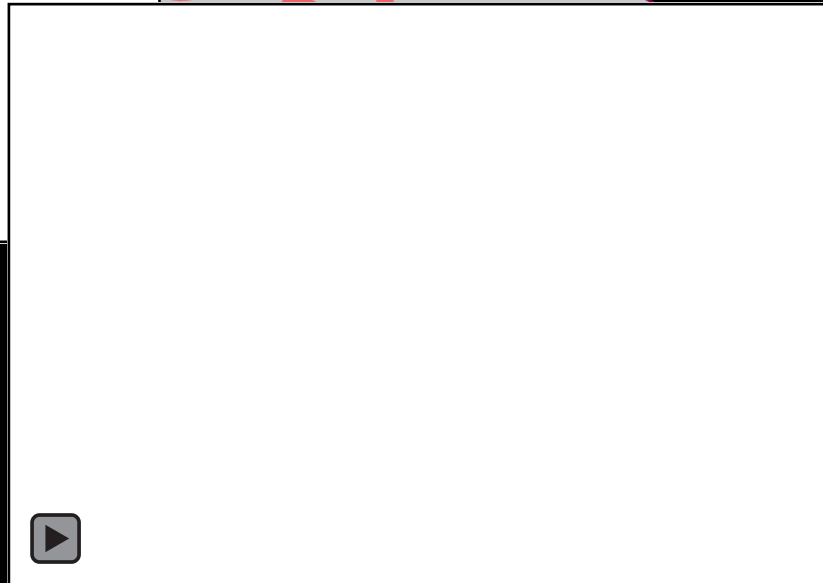
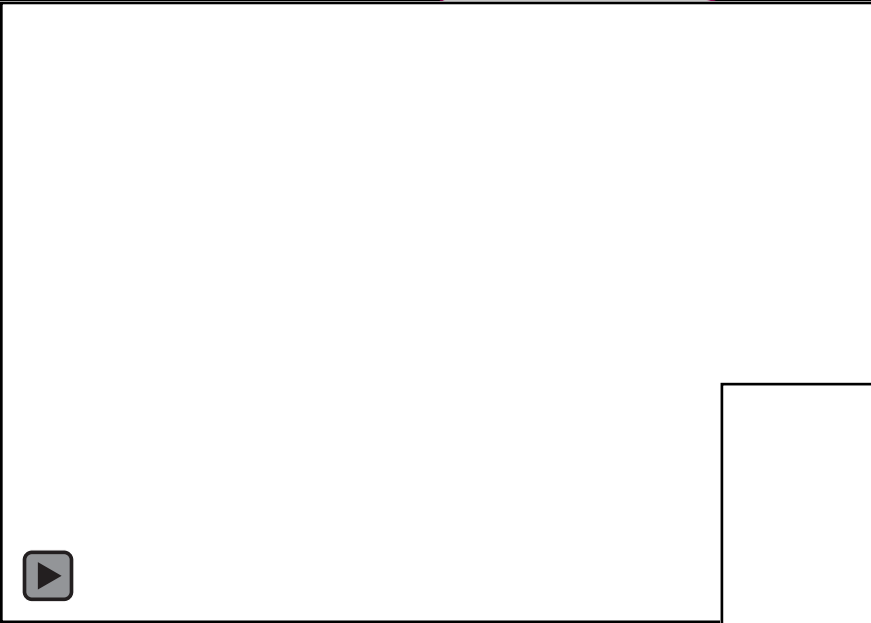
Intra-operative TOE not strongly indicated (Class II indication-ACC/AHA/ASE guidelines)

LUPV obstruction!

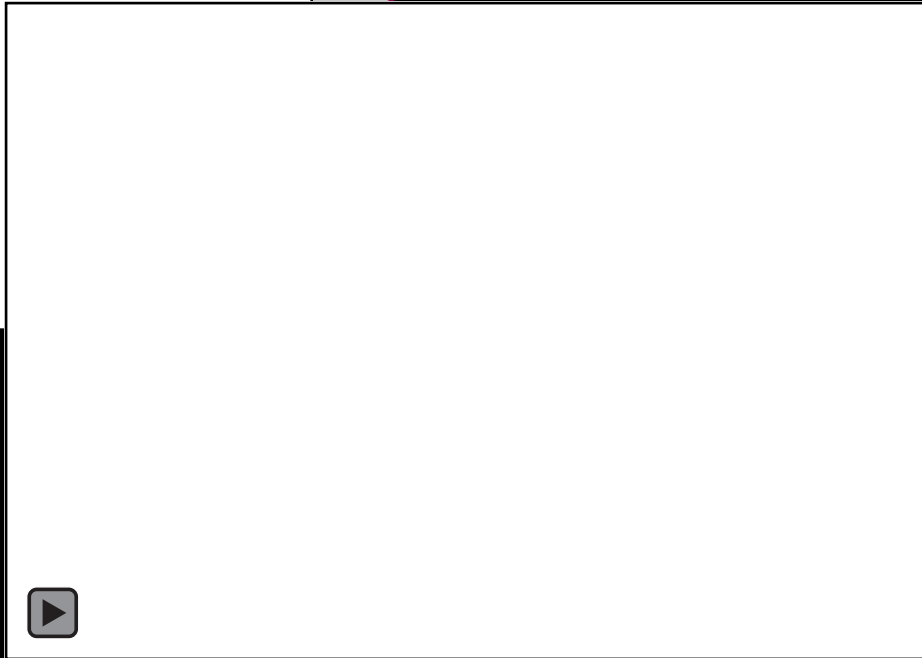
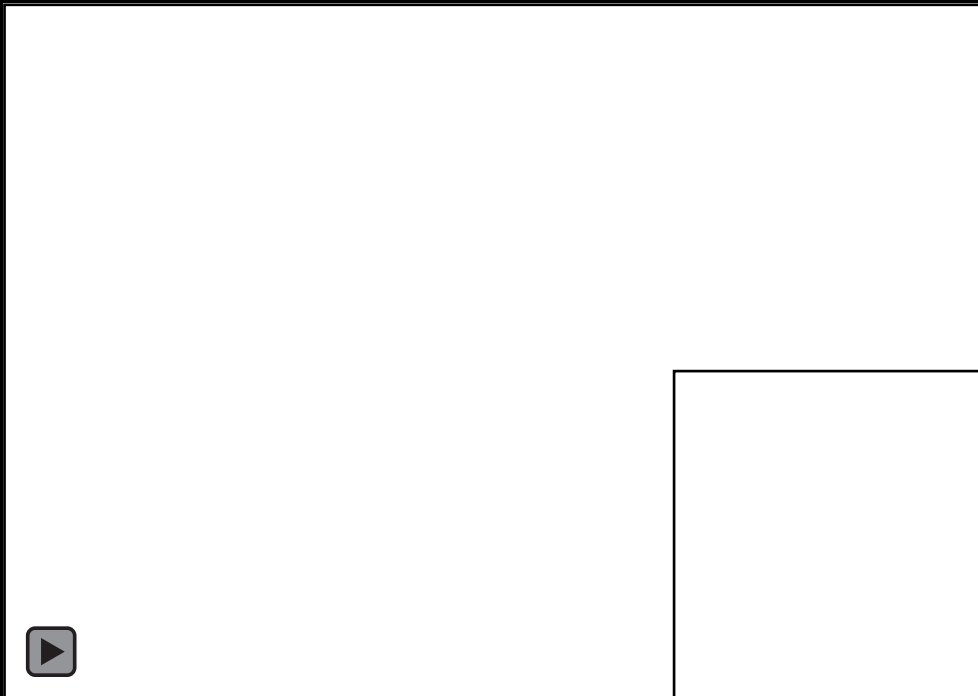
Back on CPB, release LUPV, ligate LAA!



60 yr old female, severe AR for AVR



21mm stented bioprosthetic valve Separation from CPB



Vein graft to RCA!



Vein graft to RCA!

MI: 0.4
T6210
26 JULY 05
19:19:27
2/0/E/F3

PAT T: 37.0C
TEE T: 37.0C

GAIN 50
COMP 65
128BPM

9CM
71HZ

0 126 180

MI: 0.4
T6210
26 JULY 05
19:41:27
2/0/E/F3

PAT T: 37.0C
TEE T: <37.0C

GAIN 50
COMP 65
108BPM

9CM
71HZ

0 0 180

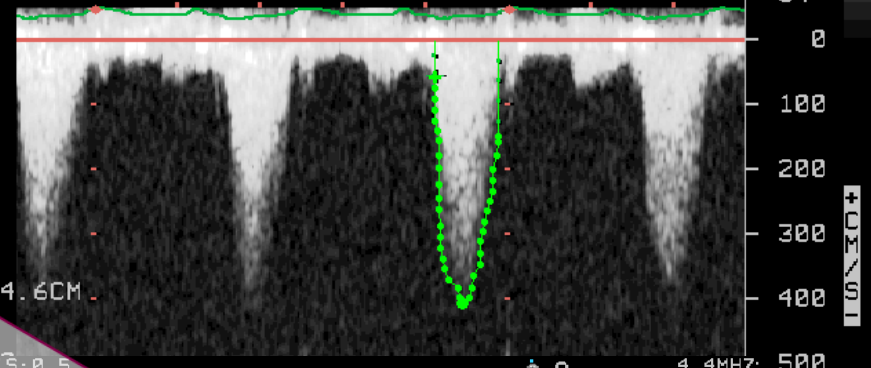
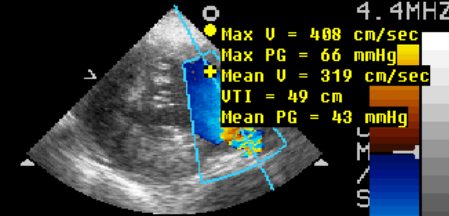
TIS: 0.7
Car TEE CWC
GAIN 50 COMP 65
8CM
2/0/E/M2/A
26 JULY 05
19:23:28
PAT T: 37.0C
TEE T: 37.0C
4.4MHZ

RA + MAX 408. cm/s
MN 319. cm/s
VTI 49.4 cm
MAX 66.6 mmHg
MN 43.4 mmHg

GAIN 50 COMP 65
8CM
2/0/E/M2/A

26 JULY 05
19:23:28

PAT T: 37.0C
TEE T: 37.0C
4.4MHZ



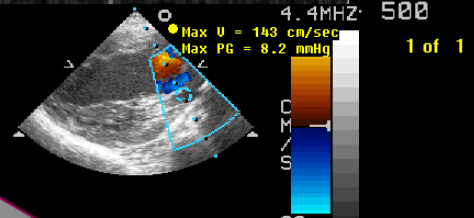
TIS: 0.5
Car TEE PWC
GAIN 50 COMP 65
8CM
2/0/E/M2/A
26 JULY 05
19:22:08
PAT T: 37.0C
TEE T: 37.3C
4.4MHZ

RA + VEL 143. cm/s
PG 8.18 mmHg

GAIN 50 COMP 65
8CM
2/0/E/M2/A

26 JULY 05
19:22:08

PAT T: 37.0C
TEE T: 37.3C
4.4MHZ

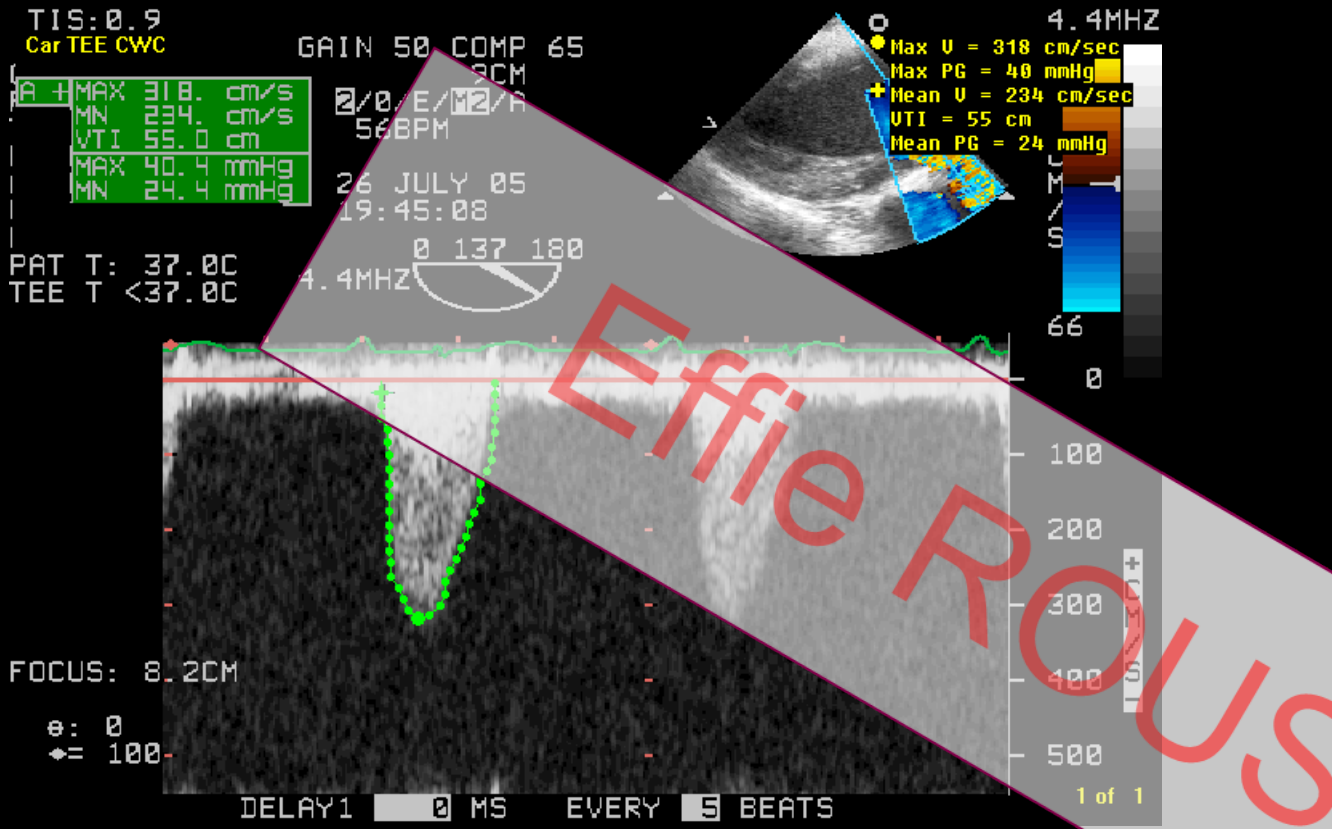


GATE: 4.7CM
LEN: 0.14CM
e: 0
v: 20

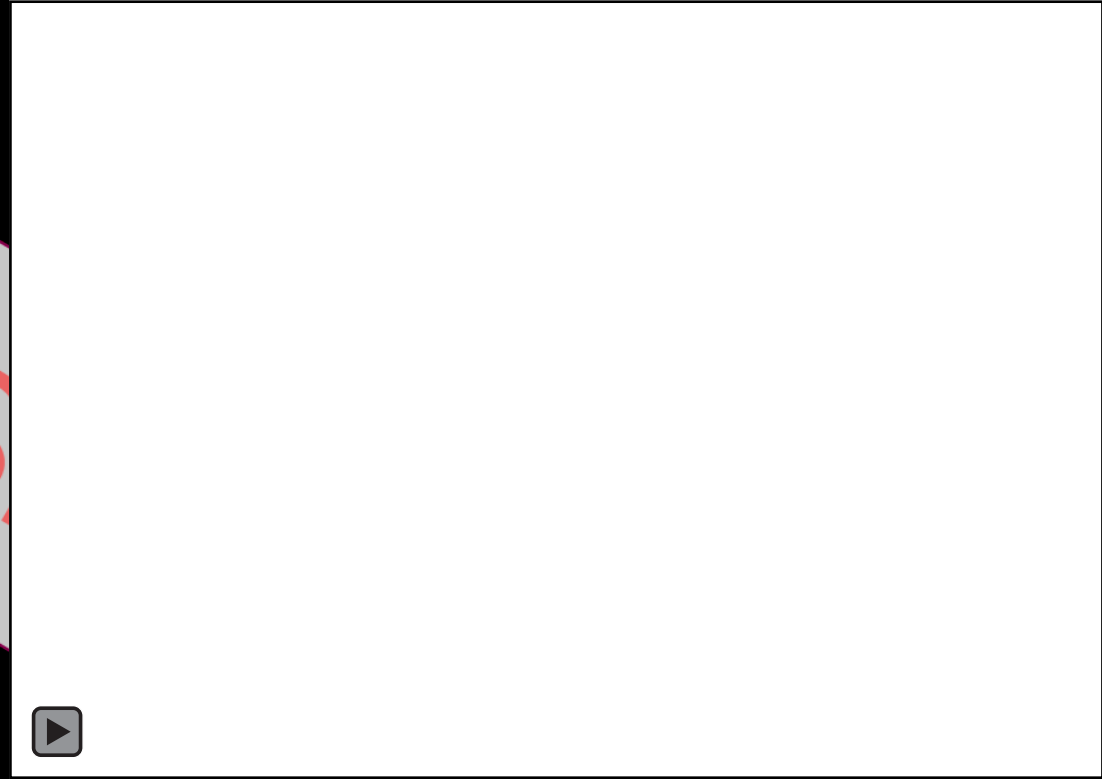
INTERVAL 3000 MS

What about the gradient?
Pressure recovery?

Schroeder RA, Mark JB. Is the valve OK or Not? Immediate evaluation of a replaced aortic valve. Anesth Analg 2005;101:1288-91



Less inotropes
 Better filling
 Decreasing gradient!



Continuity equation
 LVOT/AV velocity ratio
 0.35-0.5

Morocutti G, et al. Intraoperative transesophageal echo-Doppler evaluation of stentless aortic xenografts. Incidence and significance of moderate gradients. *Cardiovasc Surg* 2002;10(4):328-32

Schroeder RA, Mark JB. Is the valve OK or Not? Immediate evaluation of a replaced aortic valve. *Anesth Analg* 2005;101:1288-91

Mitral valve repair

Postbypass evaluation

Residual mitral regurgitation

Arterial blood pressure?

! MR < (\leq) 2+

LVOT obstruction with SAM?

Paraling leak?

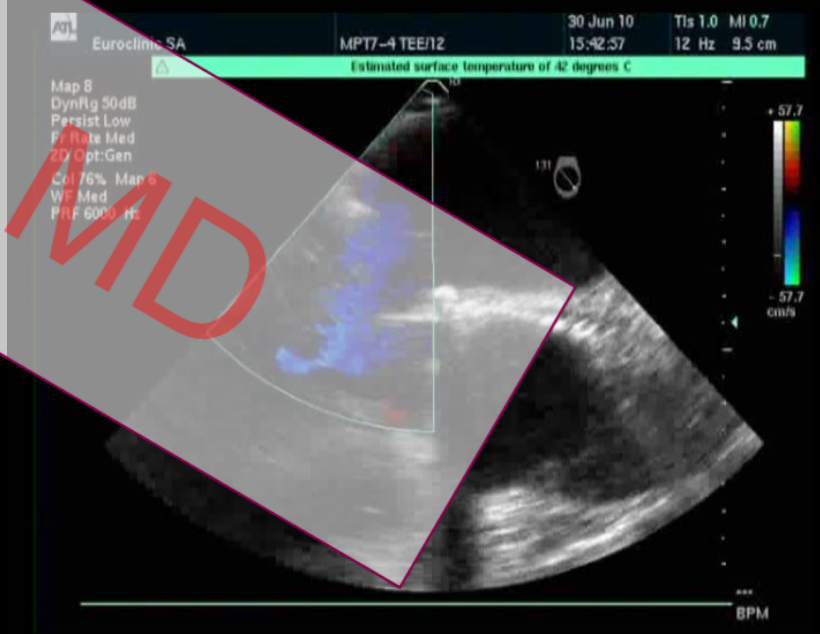
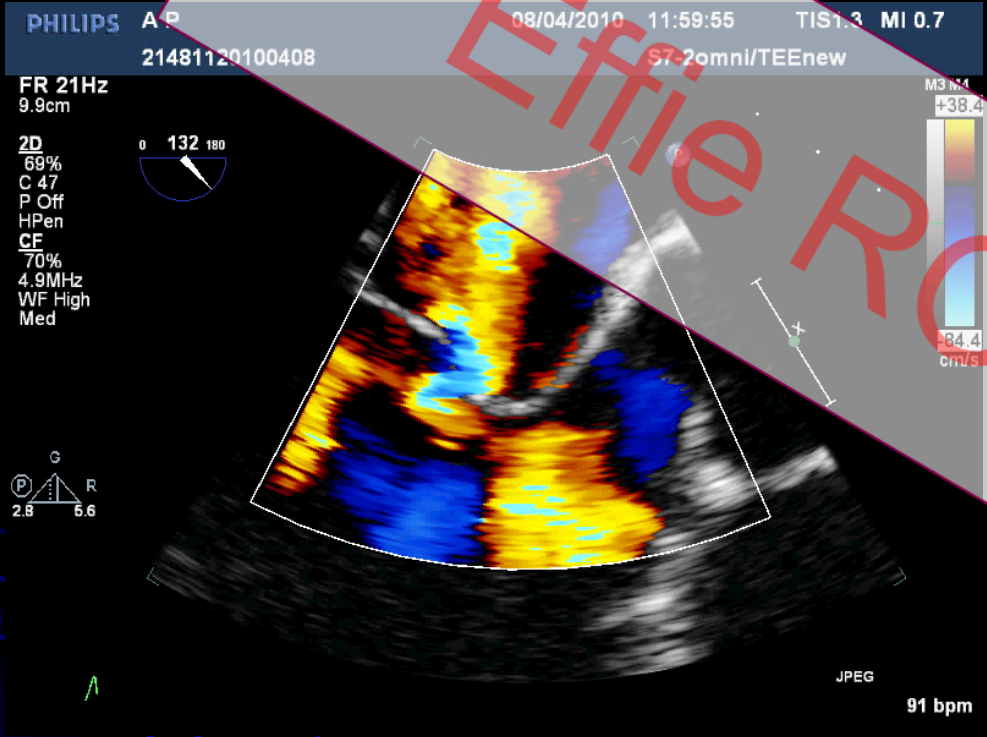
Functional mitral stenosis? (Colour and PW Doppler)

Right ventricular function?

Grimm RA, et al. *Cardiol Clin* 1998; **16**: 477-89; Ammar T, et al. *J Cardiothrac Vasc Anesth* 1996; **10**: 397-405;

Successful MV Repair

Effie ROUSKA, MD



Post-op failure

MI:0.8
T6210
29 JUNE 02
12:43:47
PROC 2/0/E/F3
GLENFIELD HOSP

PAT T: 37.0C
TEE T: 38.6C

GAIN 45
COMP 65
85BPM
16CM
34HZ

MI:0.8
T6210
29 JUNE 02
12:13:21
PROC 2/0/E/F3
GLENFIELD HOSP

PAT T: 37.0C
TEE T: 38.2C

GAIN 45
COMP 65
89BPM
14CM
34HZ

TIS:0.8
T6210
29 JUNE 02
12:15:23
PROC 2/0/E/2/A
GLENFIELD HOSP

PAT T: 37.0C
TEE T: 38.7C

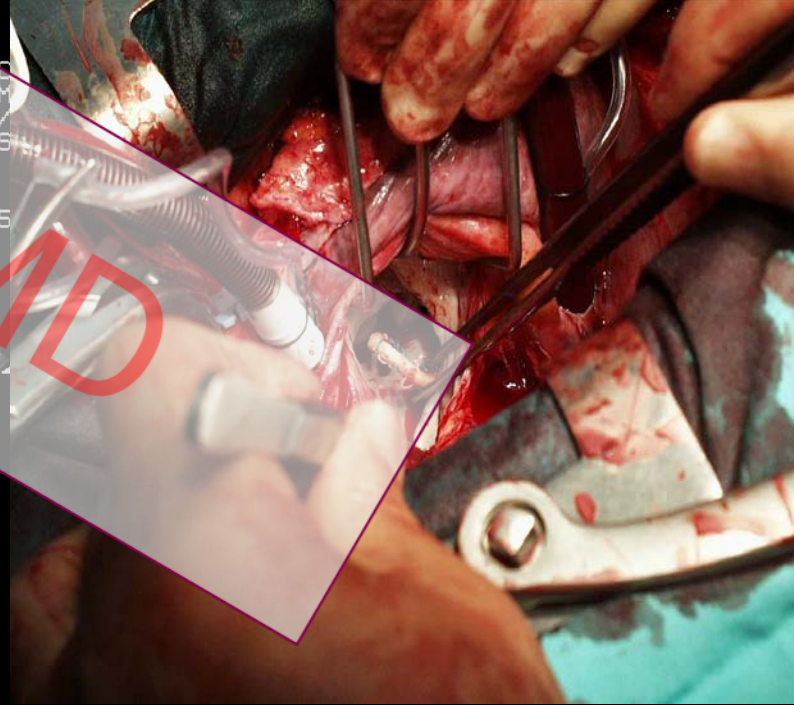
GAIN 45
COMP 65
89BPM
14CM
10HZ

4.4MHZ
52



**Repair not always
a success story!**

Emilie ROUSKY, MD



MV Repair

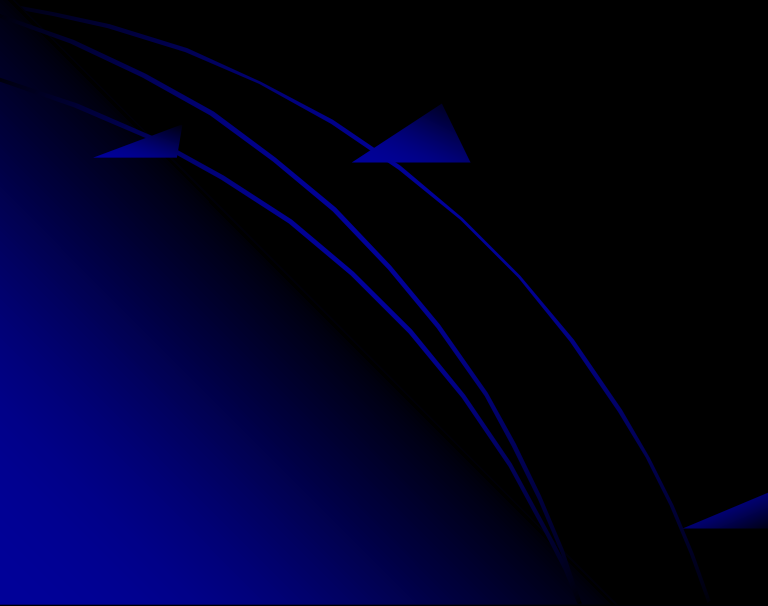
If things go wrong....

Effie ROUSKA, MD

- inadequate repair

too tight

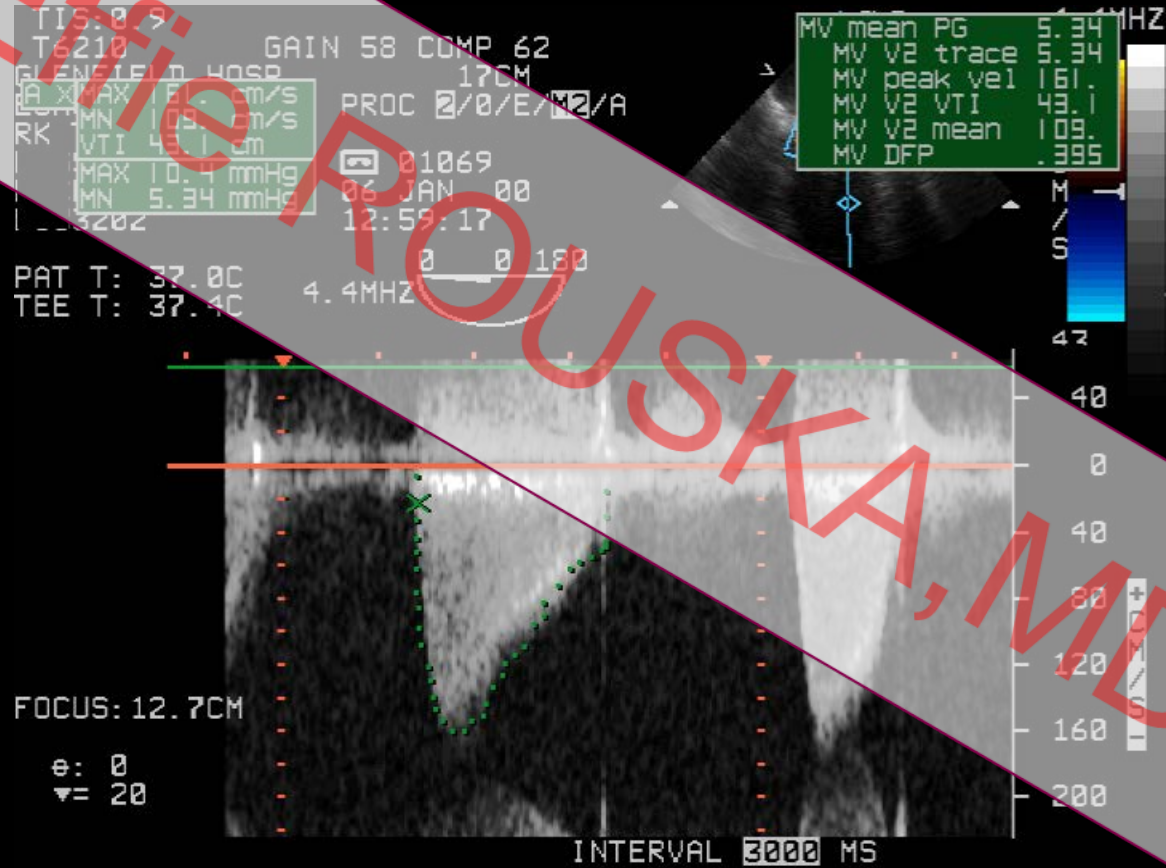
SAM



Too tight ?

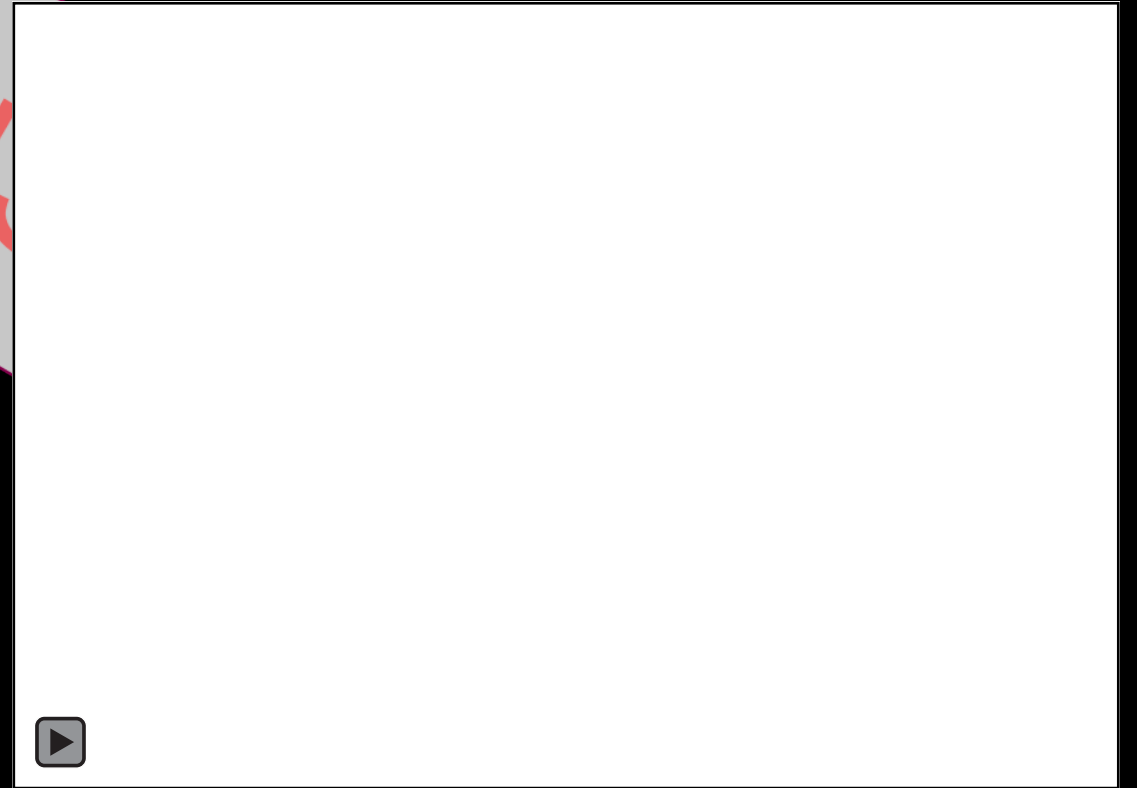
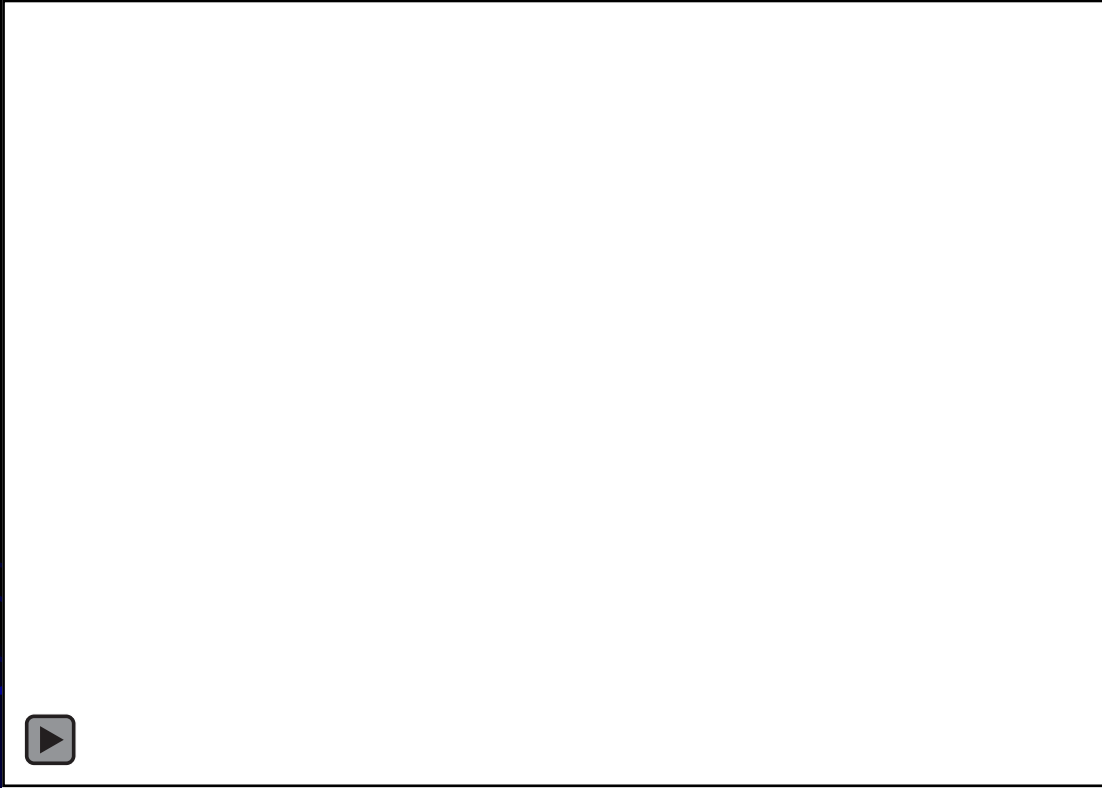
Post-MV repair stenosis

Usually associated with attempted repair of rheumatic disease



Too tight ?

Post MV Replacement complication





A valve stitch, trapped in a strut, obstructed the closure of the leaflets of the valve

Return to Bypass
Replacement with mechanical valve

MVR dysfunction

PHILIPS XALKIADAKH FOTEINH 29/09/2010 09:53:17 TIS0.7 MI 1.2
05260920100929 S7-2omni/TEEnew

FR 39Hz
12cm
2D
55%
C 47
P Off
HPen



JPEG *** bpm

PHILIPS XALKIADAKH FOTEINH 29/09/2010 09:54:42 TIS0.6 MI 1.2
05260920100929 S7-2omni/TEEnew

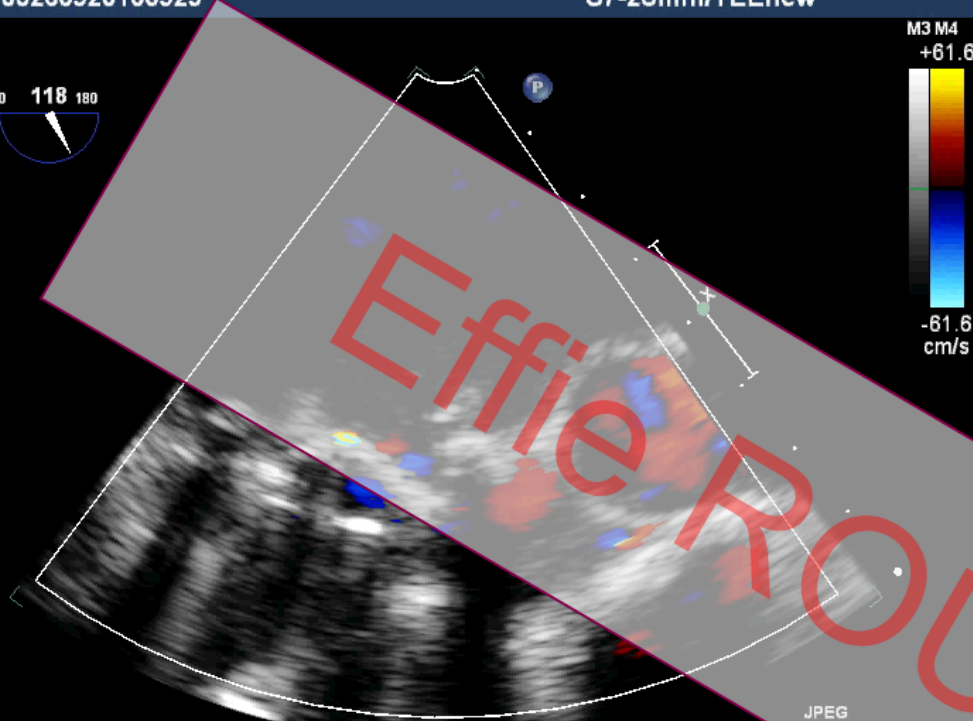
FR 39Hz
8.5cm
2D
55%
C 47
P Off
HPen



JPEG *** bpm

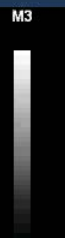
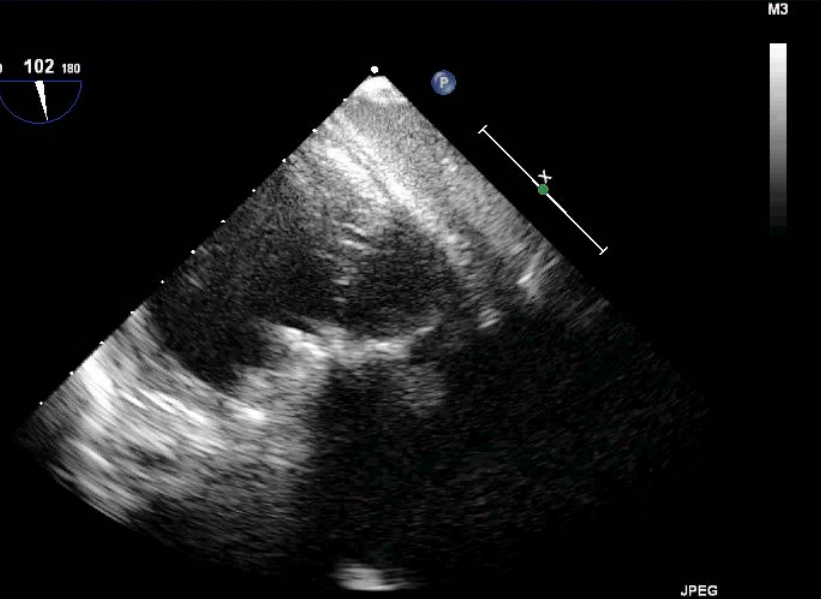
Effie ROUSKA, MD

FR 16Hz
8.5cm
2D 55%
C 47
P Off
HPen
CF 70%
4.9MHz
WF High
Med



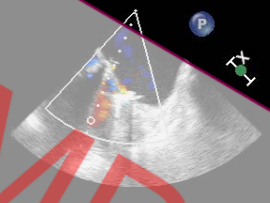
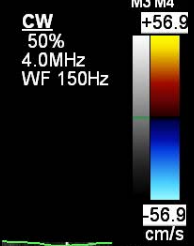
JPEG *** bpm

FR 39Hz
12cm
2D 77%
C 47
P Off
HPen

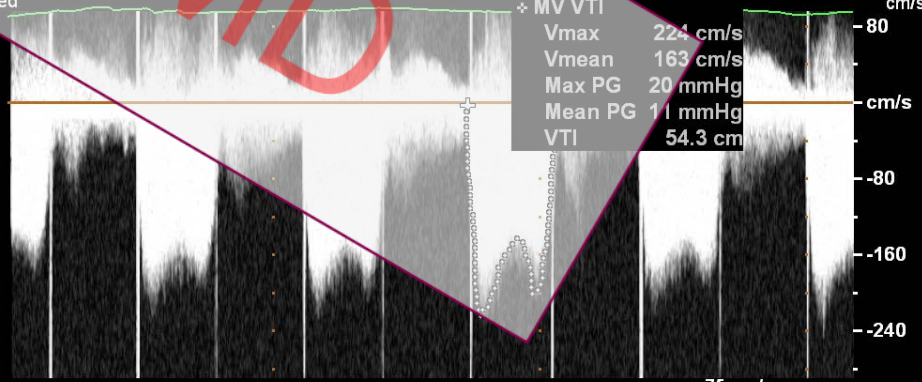


JPEG 91 bpm

FR 17Hz
12cm
2D 66%
C 47
P Off
HPen
CF 70%
4.9MHz
WF High
Med



MV VTI
Vmax 224 cm/s
Vmean 163 cm/s
Max PG 20 mmHg
Mean PG 11 mmHg
VTI 54.3 cm



75mm/s 47bpm

Effie ROUSKA, MD

Paravalvular leaks

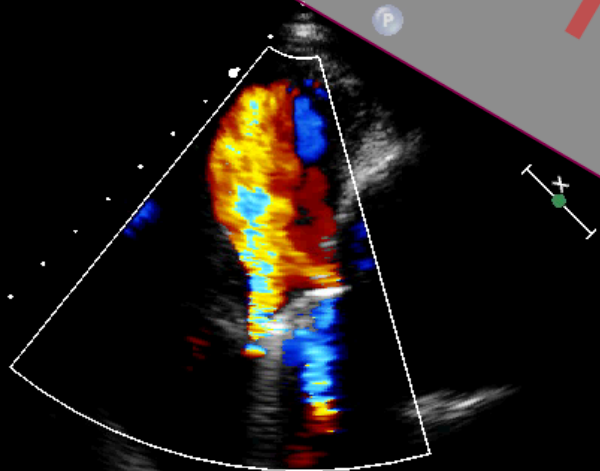
PHILIPS MEPARISVILI LIA 18/01/2010 11:00:01 TIS1.3 MI 0.7
54221020100118 S7-2omni/TEEnew

FR 16Hz
14cm

2D
62%
C 47
P Off
HPen

CF
70%
4.9MHz
WF High
Med

G
P R
2.8 6.6



M3 M4
+51.7
-51.7
cm/s

JPEG

*** bpm

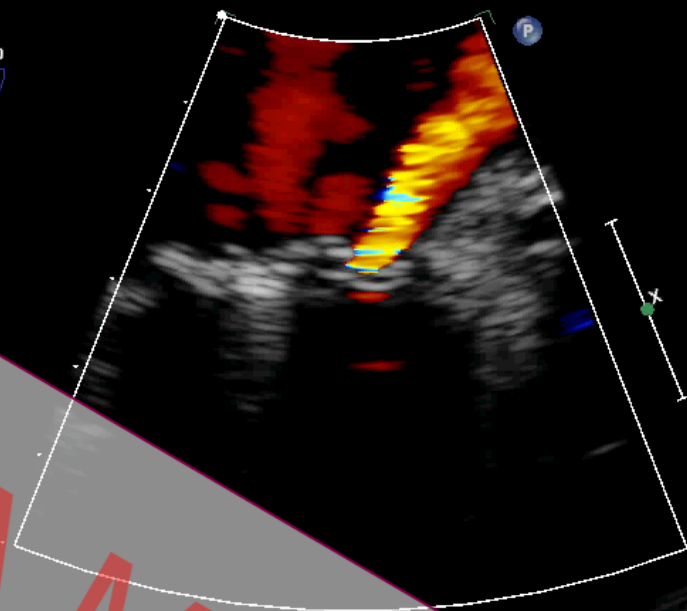
PHILIPS MEPARISVILI LIA 18/01/2010 10:56:14 TIS1.2 MI 0.7
54221020100118 S7-2omni/TEEnew

FR 23Hz
11cm

2D
46%
C 47
P Off
HPen
CF
70%
4.9MHz
WF High
Med

0 51 180

G
P R
2.8 6.6



M3 M4
+54.6
-54.6
cm/s

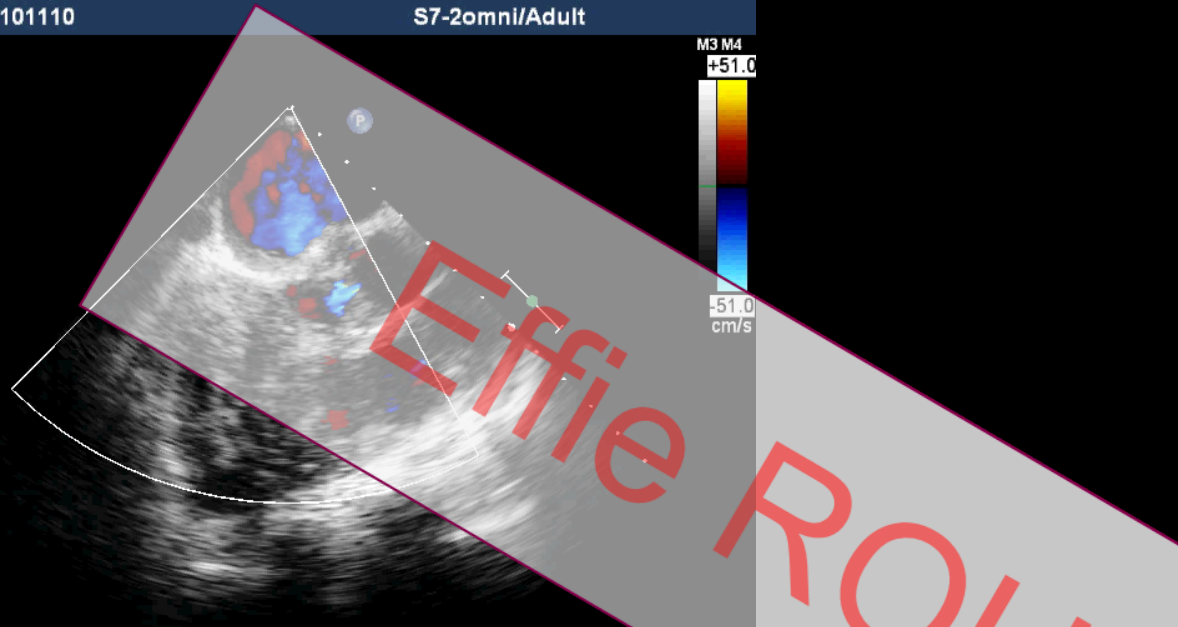
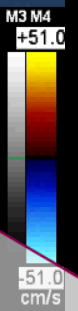
JPEG

*** bpm

PHILIPS NOUSIOU 10/11/2010 19:38:09 TIS1.3 MI 0.7
46351920101110 S7-2omni/Adult

FR 12Hz
14cm

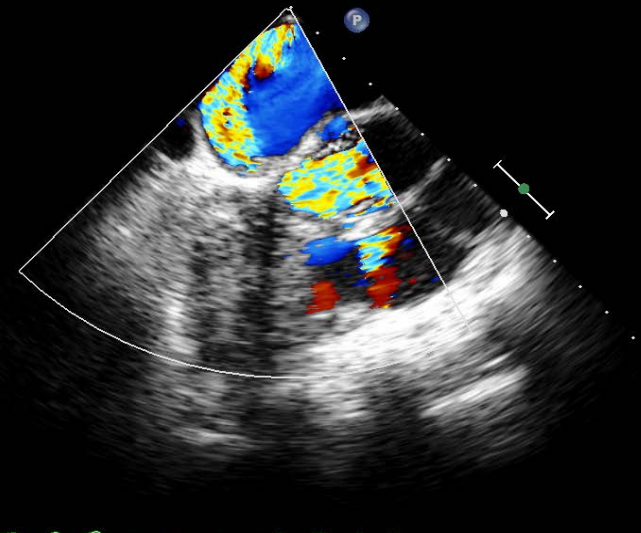
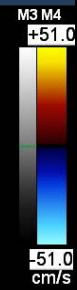
2D
54%
C 50
P Off
Gen
CF
70%
4.9MHz
WF High
Med



PHILIPS NOUSIOU 10/11/2010 19:38:21 TIS1.3 MI 0.7
46351920101110 EYAGGELISMOS HOSP. S7-2omni/Adult

FR 12Hz
14cm

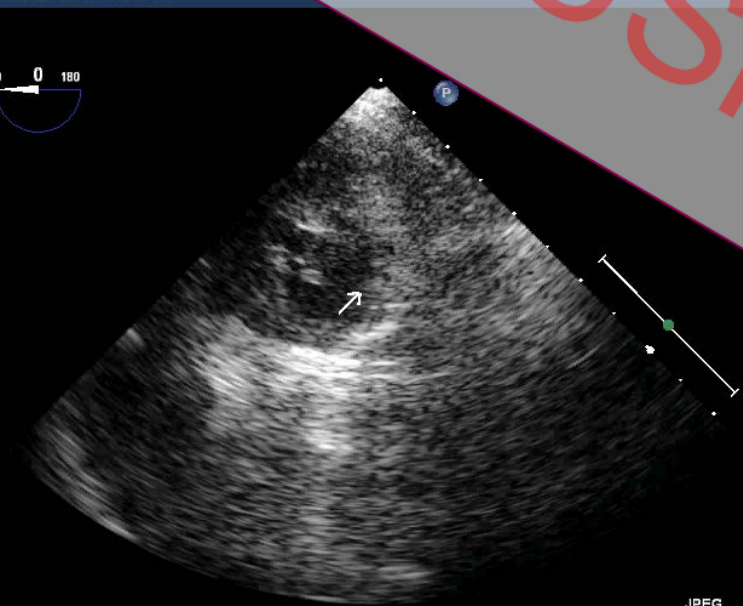
2D
54%
C 50
P Off
Gen
CF
70%
4.9MHz
WF High
Med



PHILIPS NOUSIOU 10/11/2010 19:41:53 TIS1.2 MI 0.6
46351920101110 S7-2omni/Adult

FR 61Hz
11cm

2D
58%
C 50
P Off
Gen



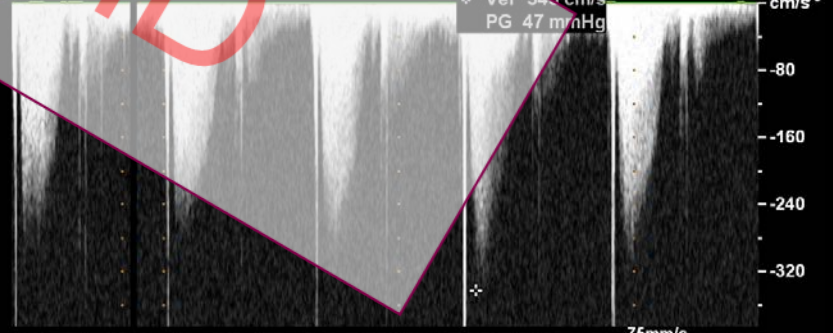
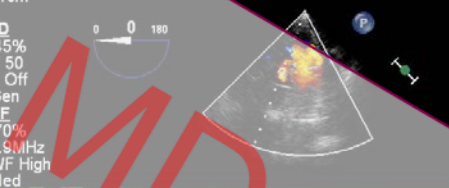
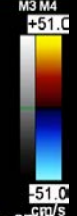
PHILIPS NOUSIOU 10/11/2010 19:45:33 TIS0.9 MI 0.0
46351920101110 EYAGGELISMOS HOSP. S7-2omni/Adult

FR 13Hz
11cm

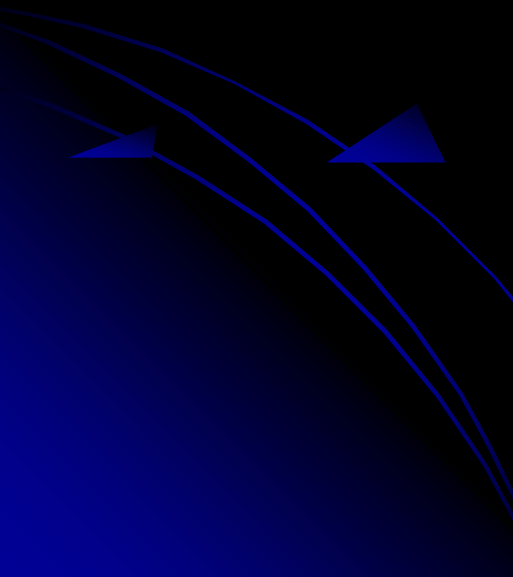
2D
45%
C 50
P Off
Gen
CF
70%
4.9MHz
WF High
Med

CW
50%
4.0MHz
WF 150Hz

Vel 343 cm/s
PG 47 mmHg



Effie ROUSKA, MD



JPEG

*** bpm

***bpm

***bpm

Perioperative
Echo
in the CICU

Effie ROUSKA, MD

➤ Post op monitoring

➤ Guide to post op management

Echo in ICU

Effie ROUSKA, MD

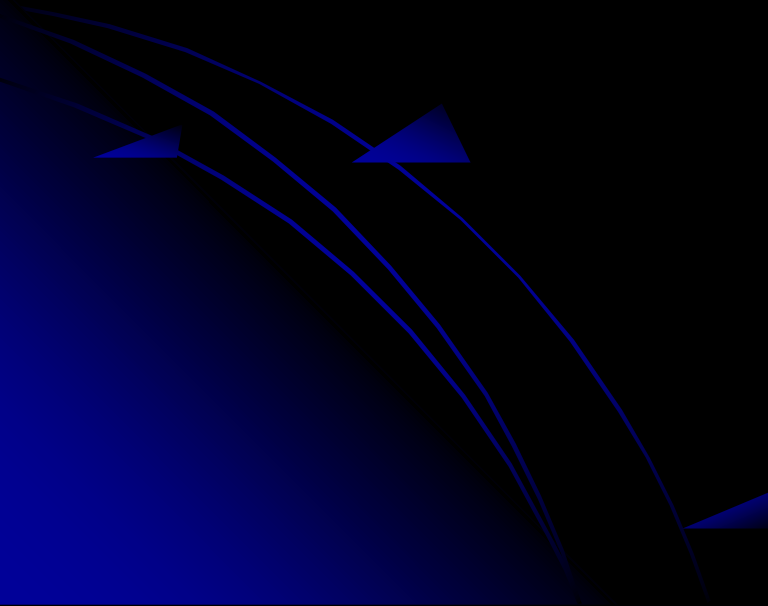
Hemodynamic instability

De-saturation

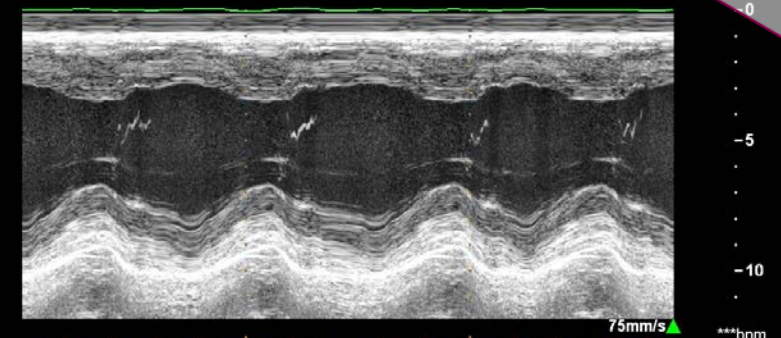
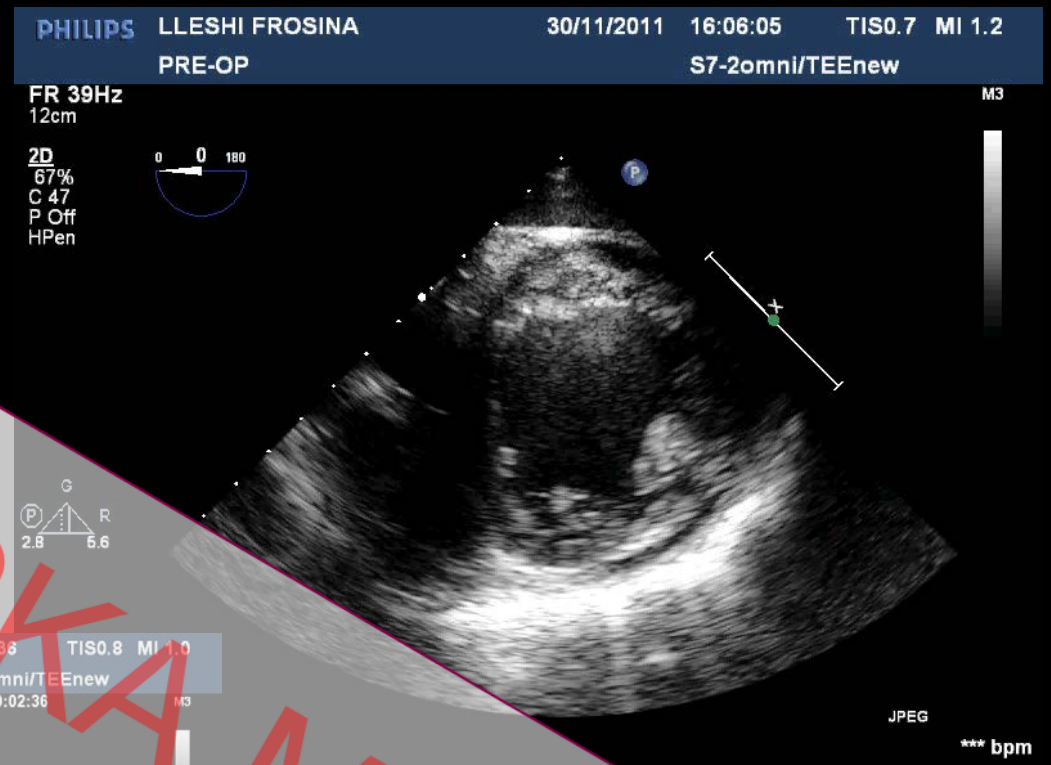
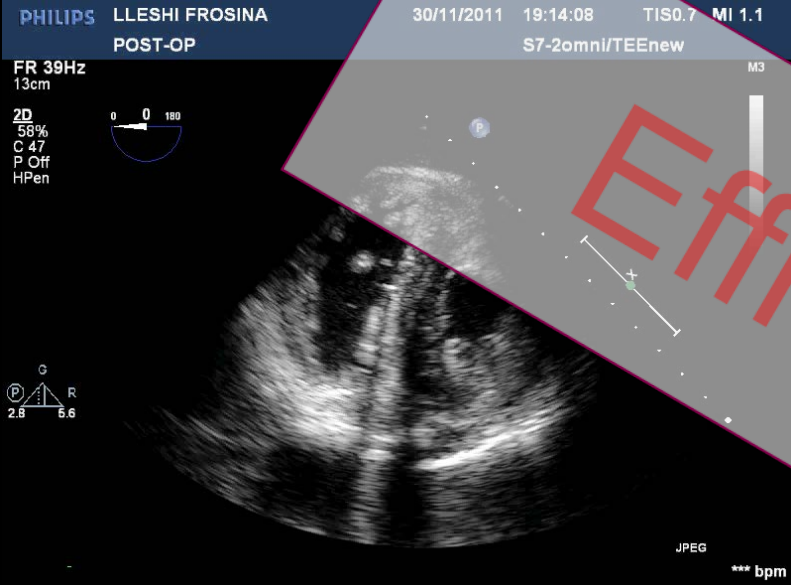
IABP

Post op monitoring

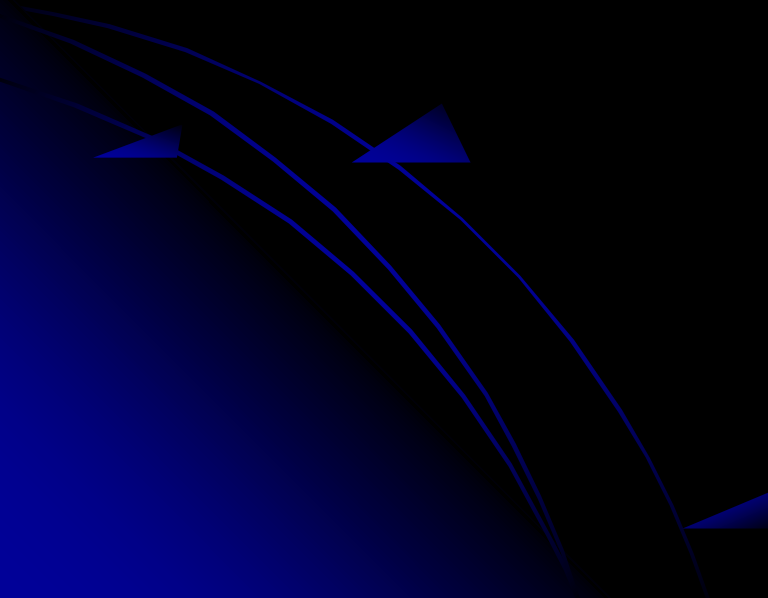
Guide to post op management



Guide to post op management



Effie ROUSKA, MD

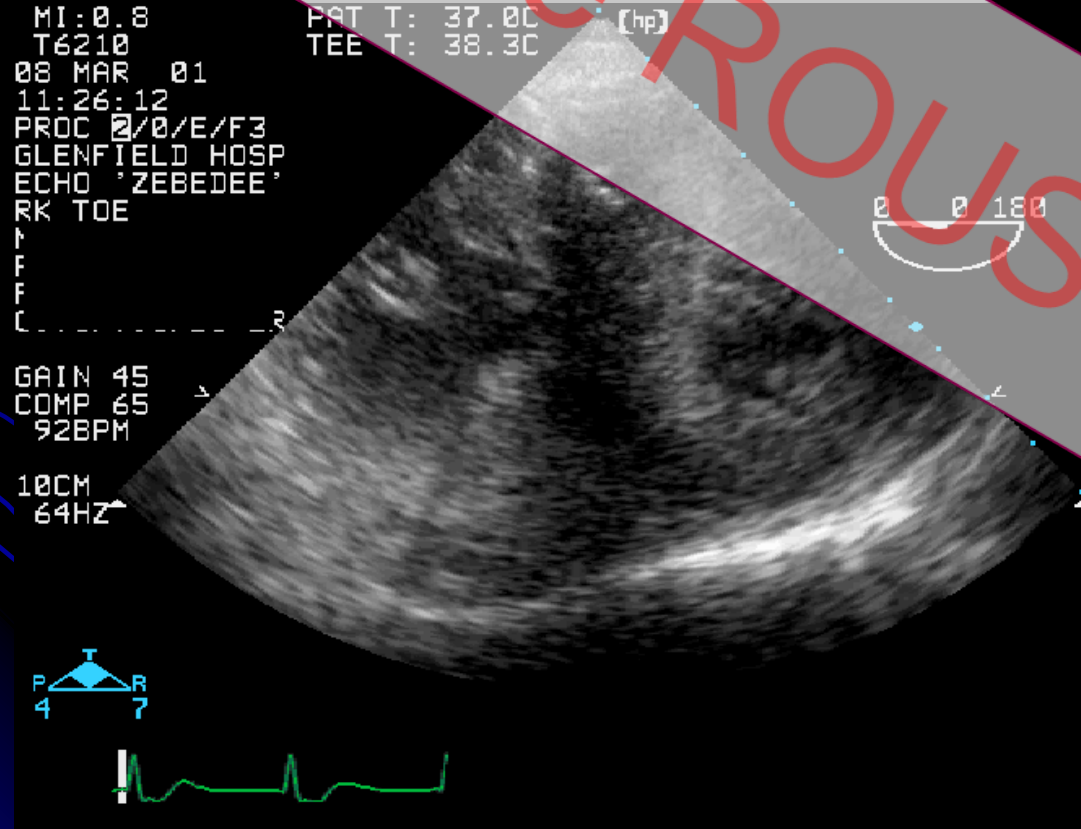


poor LV following surgery

high dose inotropes

hypotensive on CICU

increase in inotropes



Why hypotensive?

Treatment options?

Volume

Decrease inotropes

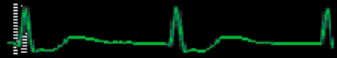
IABP!

Effie ROUSKA, MD

MI:0.9 PAT T: 37.0C
T6210 TEE T: 37.8C
08 MAR 01
11:39:42
PROC 2/0/E/F3
GLENFIELD HOSP
ECHO 'ZEBEDEE'
RK TOE

GAIN 45
COMP 65
91BPM

5CM
78HZ



Effie ROUSKA, MD

MI:0.9 PAT T: 37.0C
T6210 TEE T: 37.8C
08 MAR 01
11:41:37
PROC 2/0/E/F3
GLENFIELD HOSP
ECHO 'ZEBEDEE'
RK TOE

GAIN 45
COMP 65
91BPM

5CM
78HZ



CXR – tip of IABP low

Difficult to advance

Should it be advanced any further?

54 yr old female urgent CABG

Obese – BMI 35

History of heavy smoking, hypertension, angina, & asthma

Post / intra operative cardiac course uneventful

Mild degree of post operative desaturation (90%)

CXR - minor basal atelectasis

Persistently low saturations

Day 7 – SpO₂ 85%

No response to CPAP / physio

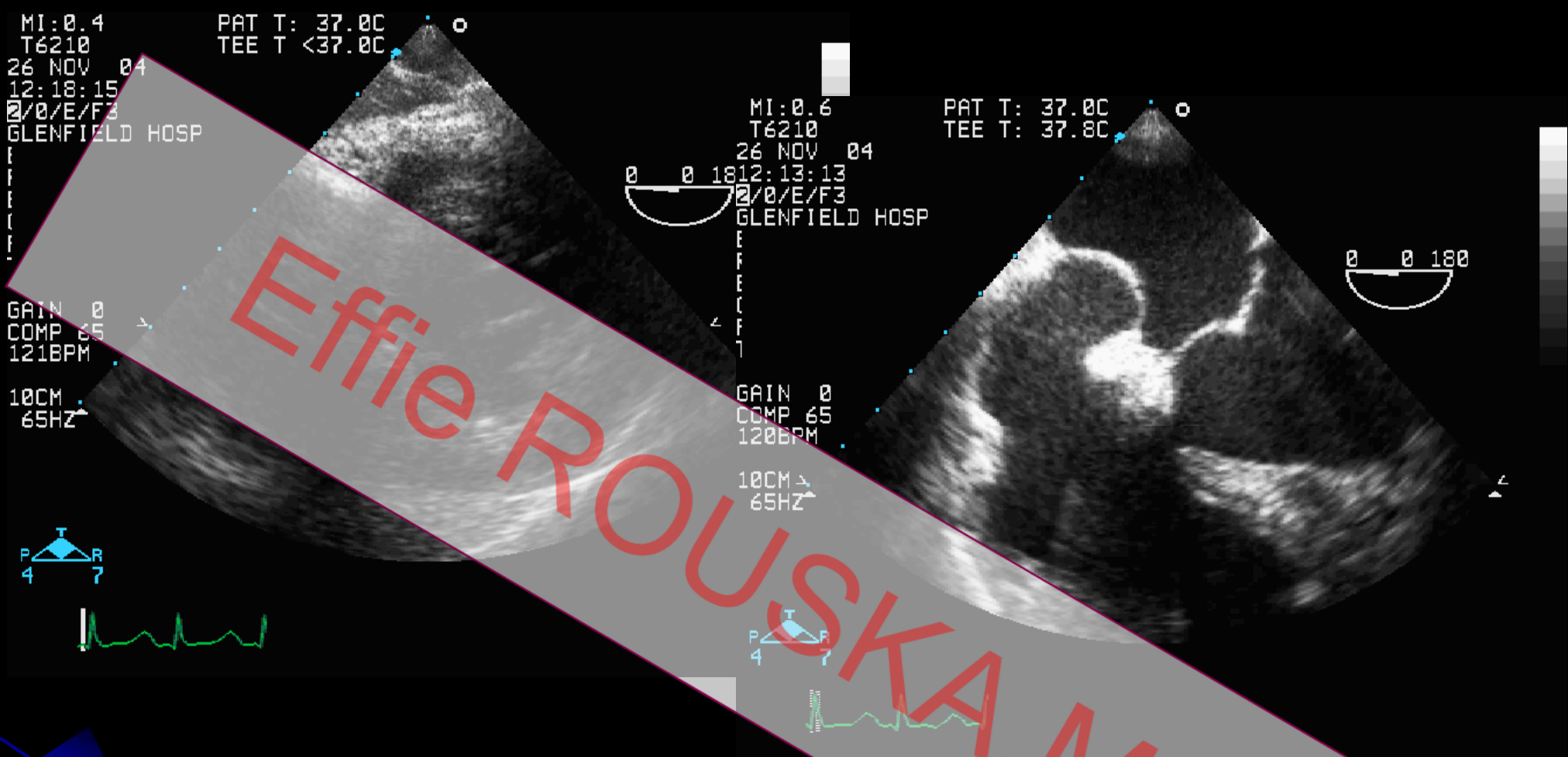
Readmitted to CICU, patient asymptomatic!

CXR - minor basal atelectasis

TTE difficult window/unremarkable

CT PA – No evidence of PE

Etifa ROUSKA, MD

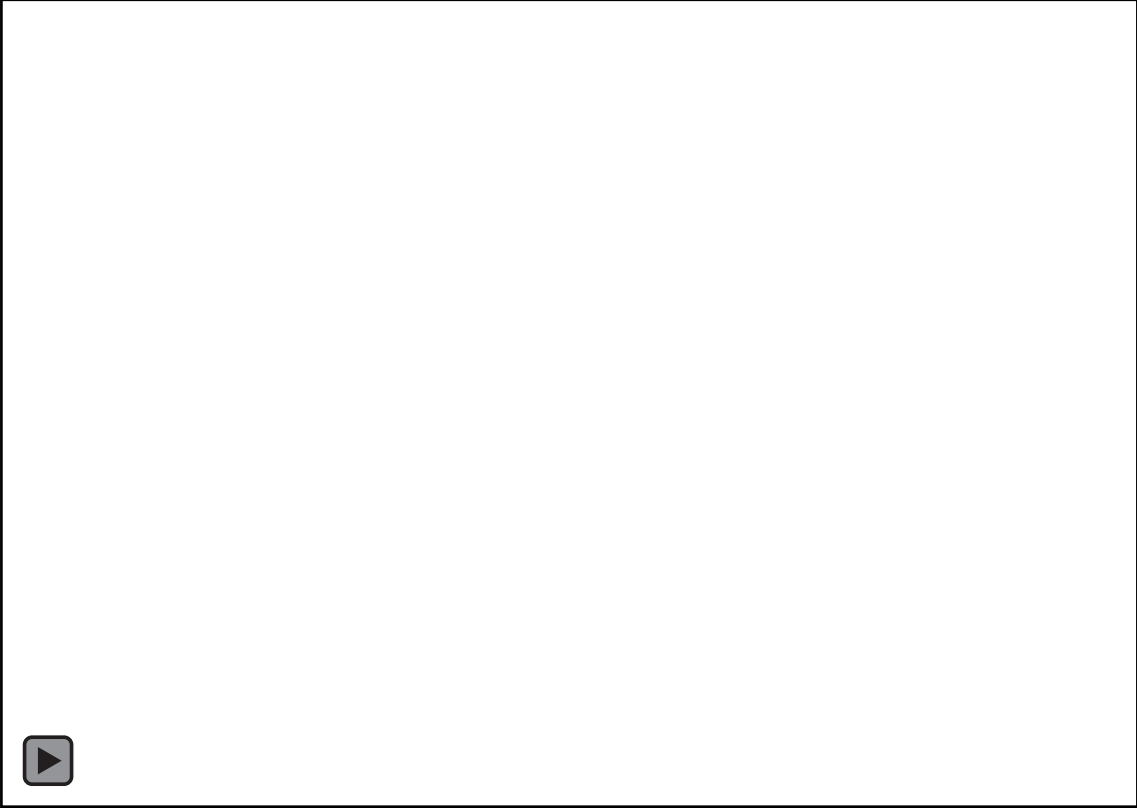


Sternum now infected, required surgical debridement
TOE performed intraoperative

Undetected secundum ASD!

Augoustides JG, et al. Analysis of the interatrial septum by transesophageal echocardiography in adult cardiac surgical patient: anatomic variants and correlation with patent foramen ovale
J Cardiothorac Vasc Anesth 2005;19(2):146-9

Undetected secundum ASD



No PEEP on IPPV
Minimal L to R shunt



PEEP + 10 on IPPV
R to L shunt

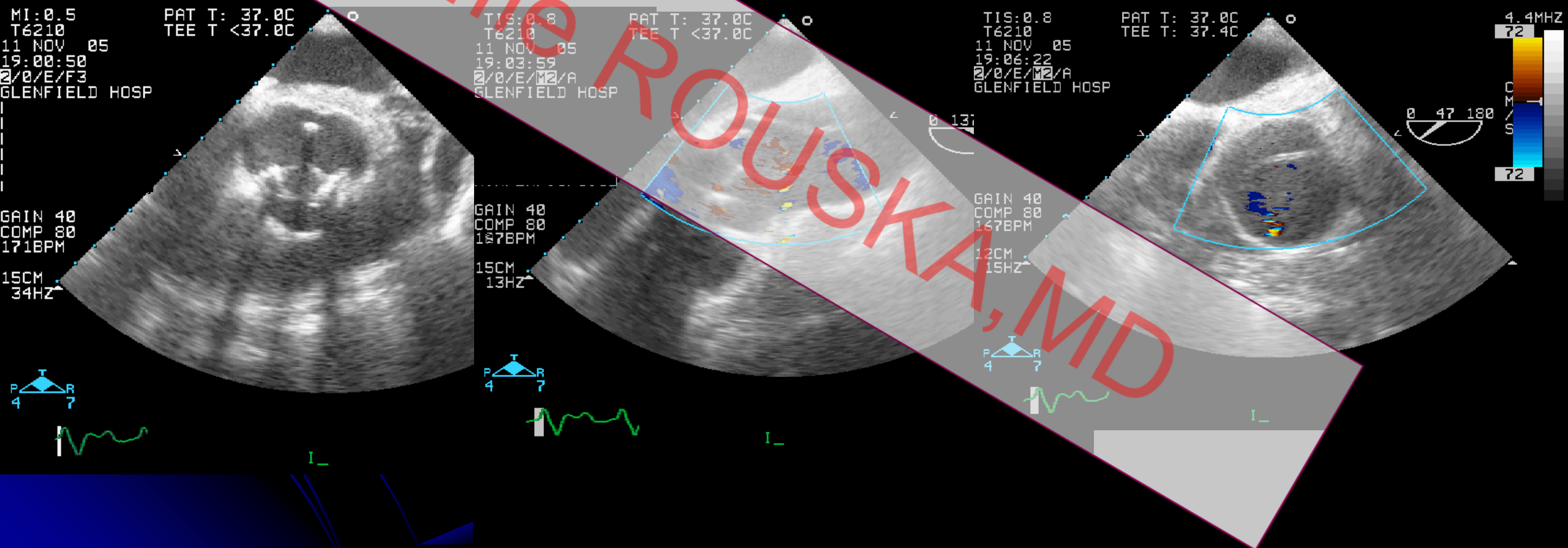
60 yrs old male with severe AR, asc aorta 36 mm

Stented bioprosthesis valve

Immediate postop TOE – insignificant

Concerns about left radial arterial line

2hrs post surgery – anuric on CICU, hemodynamically stable



Stented bioprosthetic AVR – TOE in CICU

TIS:0.8
T6210
11 NOV 05
19:15:55
2/0/E/12/A
GLENFIELD HOSP

PAT T: 37.0C
TEE T: 37.4C

4.4MHZ
69

Back to operating theatre
Dissection repair unsuccessful

MI:0.5
T6210
11 NOV 05
19:28:29
2/0/E/F3
GLENFIELD HOSP

PAT T: 37.0C
TEE T: <37.0C

GAIN 40
COMP 80
155BPM

10CM
12HZ

P 4 T 7 R 7

AORTIC ARCH

GAIN 40
COMP 80
143BPM

15CM
34HZ

P 4 T 7 R 7

MI:0.5
T6210
11 NOV 05
19:21:37
2/0/E/F3
GLENFIELD HOSP

PAT T: 37.0C
TEE T: <37.0C

GAIN 40
COMP 80
196BPM

14CM
34HZ

P 4 T 7 R 7

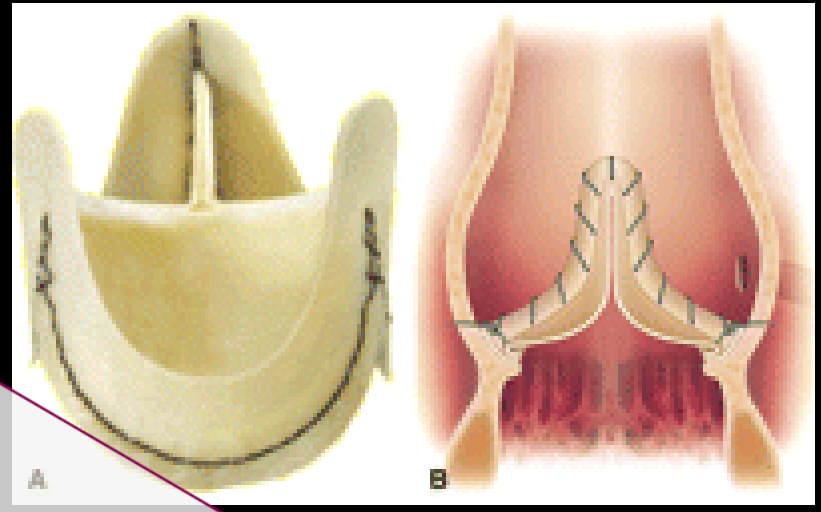
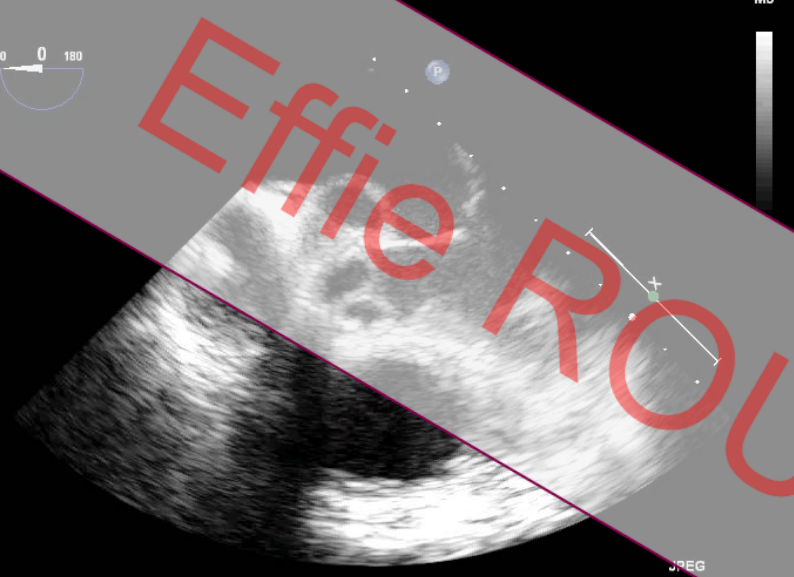
Bruch C, et al. Am J Cardiol 2003;91:510-3

EMERSON ROUSKA, MD

Female patient 75 years old

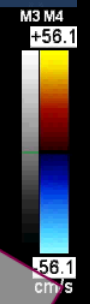
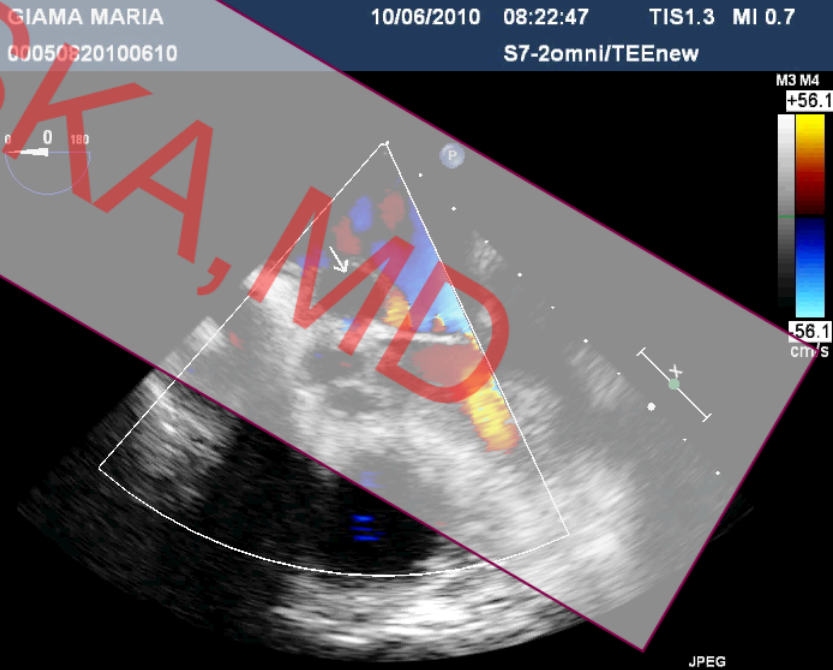
PHILIPS GIAMA MARIA 10/06/2010 08:21:55 TIS0.7 MI 1.1
00050820100610 S7-2omni/TEEnew

FR 39Hz
11cm
2D
61%
C 47
P Off
HPen



PHILIPS GIAMA MARIA 10/06/2010 08:22:47 TIS1.3 MI 0.7
00050820100610 S7-2omni/TEEnew

FR 15Hz
11cm
84 bpm
2D
63%
C 47
P Off
HPen
CF
70%
4.9MHz
WF High
Med



JPEG

83 bpm

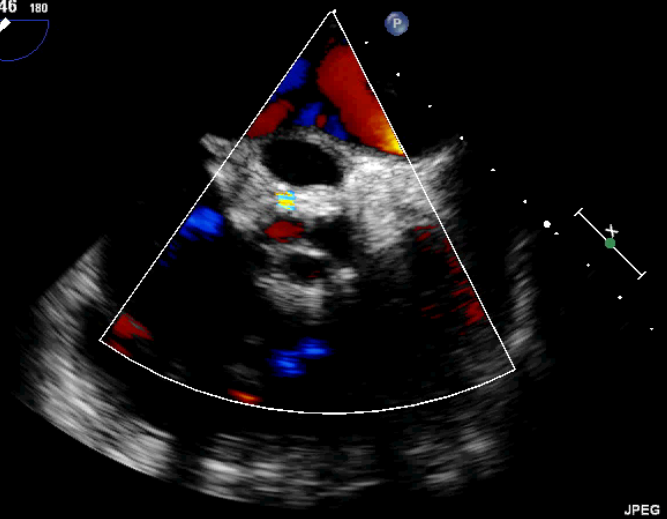
FR 39Hz
11cm
2D
57%
C 47
P Off
HPen



JPEG 73 bpm

FR 16Hz
11cm

2D
59%
C 47
P Off
HPen
CF
70%
4.9MHz
WF High
Med



M3 M4
+57.8
-57.8
cm/s

JPEG 76 bpm

FR 39Hz
11cm

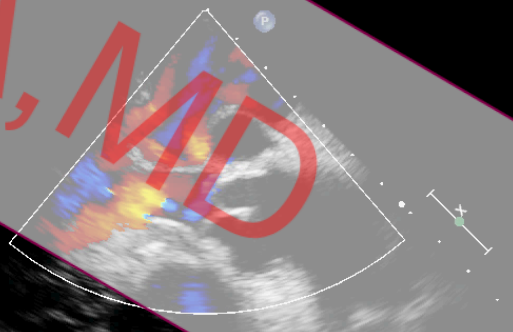
2D
59%
C 47
P Off
HPen



81 bpm

FR 14Hz
11cm

2D
60%
C 47
P Off
HPen
CF
70%
4.9MHz
WF High
Med

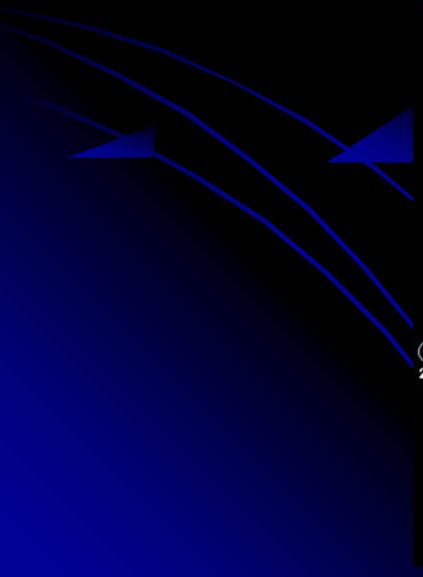


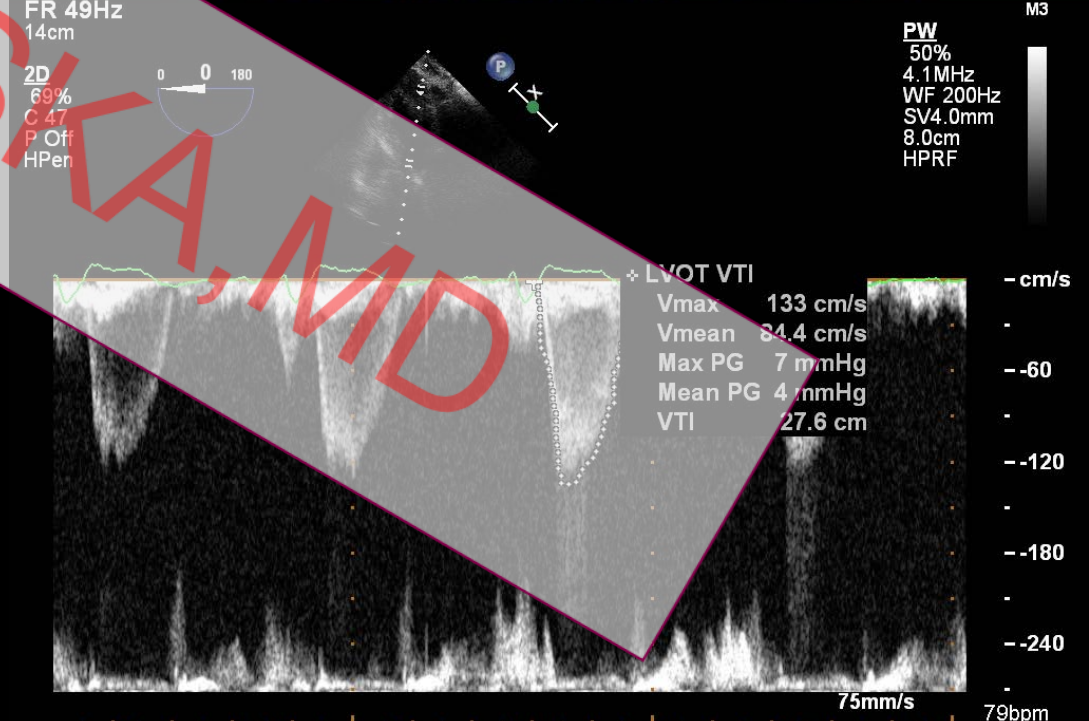
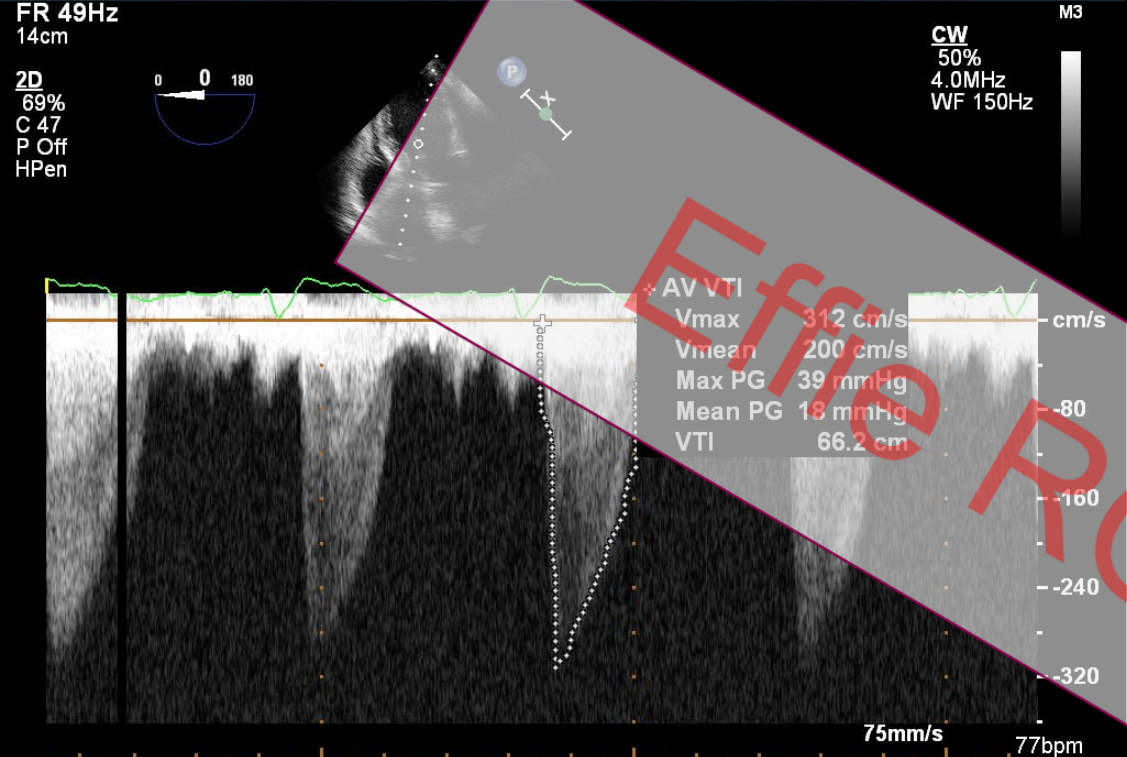
M3 M4
+61.6
-61.6
cm/s

JPEG 74 bpm

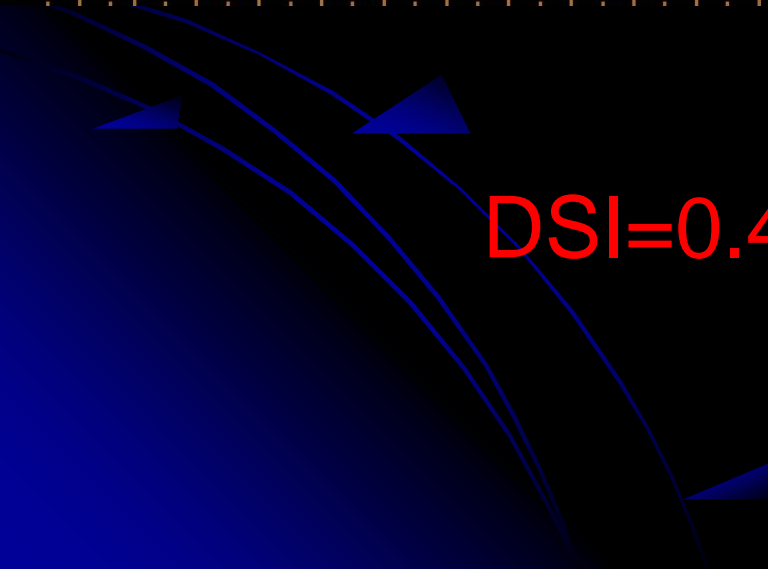
Effie ROUSVA, MD

125° ME view





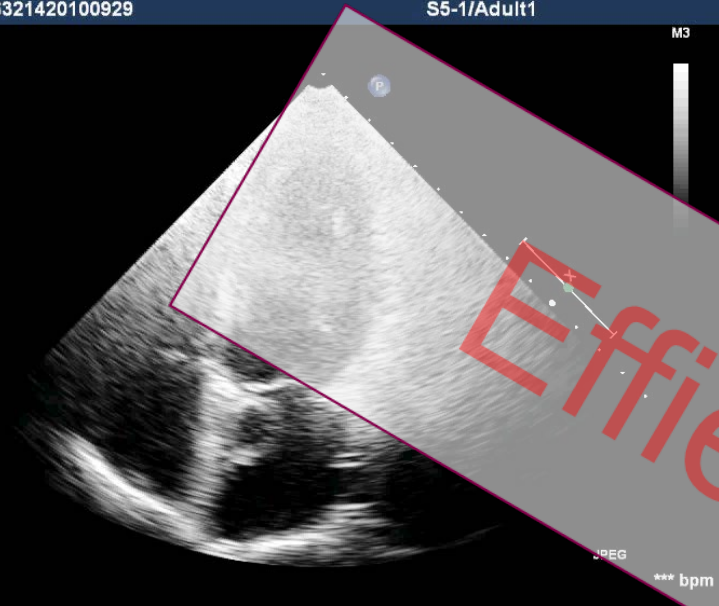
DSI=0.4



PHILIPS GIAMA MARIA 29/09/2010 14:34:20 TIS0.7 MI 1.4
26321420100929 S5-1/Adult1

FR 39Hz
15cm
2D
76%
C 50
P Low
HPen

G
P R
1.4 2.8



6 months post-op TTE

PHILIPS GIAMA MARIA 29/09/2010 14:35:33 TIS0.4 MI 1.4
26321420100929 EYAGGELISMOS HOSP. S5-1/Adult1

FR 39Hz
15cm
2D
78%
C 50
P Low
HPen

G
P R
1.4 2.8



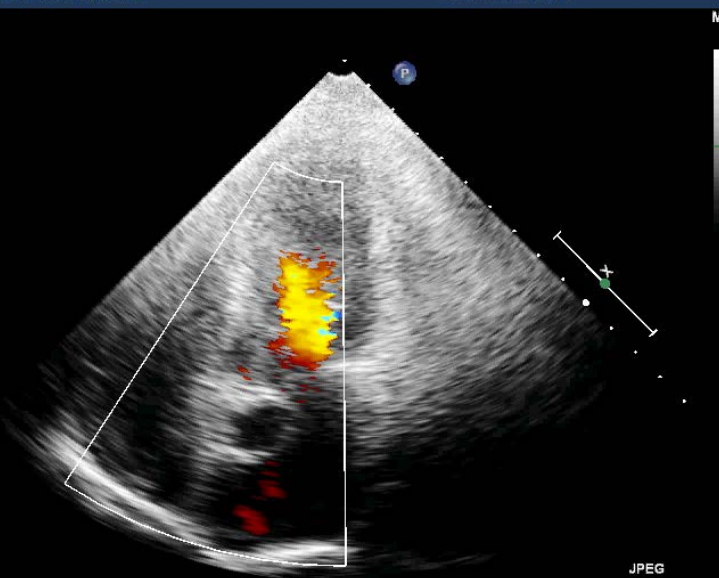
Dist 2.07 cm
Dist 2.01 cm

***bpm

PHILIPS GIAMA MARIA 29/09/2010 14:34:35 TIS2.3 MI 1.2
26321420100929 S5-1/Adult1

FR 17Hz
15cm
2D
72%
C 50
P Low
HPen
CE
86%
2.5MHz
WF High
Med

G
P R
1.4 2.8



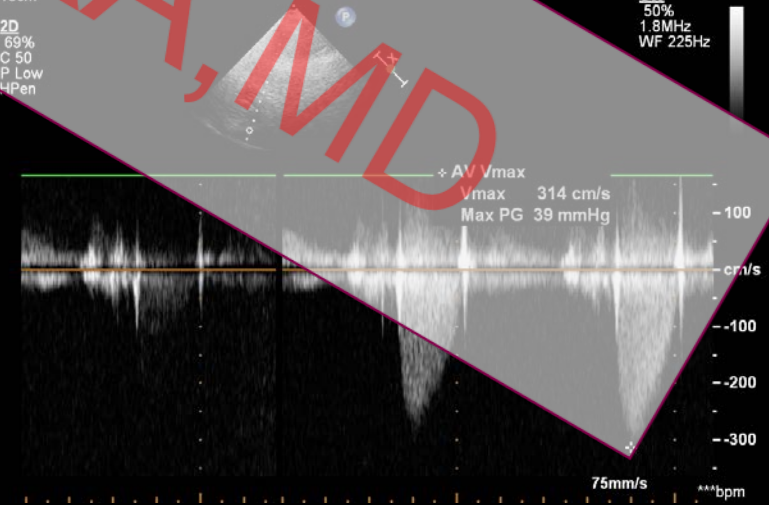
M3 M4
+61.6
-61.6
cm/s

*** bpm

PHILIPS GIAMA MARIA 29/09/2010 14:37:05 TIS0.7 MI 0.1
26321420100929 EYAGGELISMOS HOSP. S5-1/Adult1

FR 50Hz
15cm
2D
69%
C 50
P Low
HPen

CW
50%
1.8MHz
WF 225Hz



+ AV Vmax
Vmax 314 cm/s
Max PG 39 mmHg

75mm/s

***bpm

Effie ROUSKA, MD



GIAMMA MARIA
141800
F
18 Jun 2010
10:22:24.000

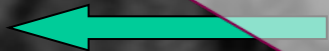
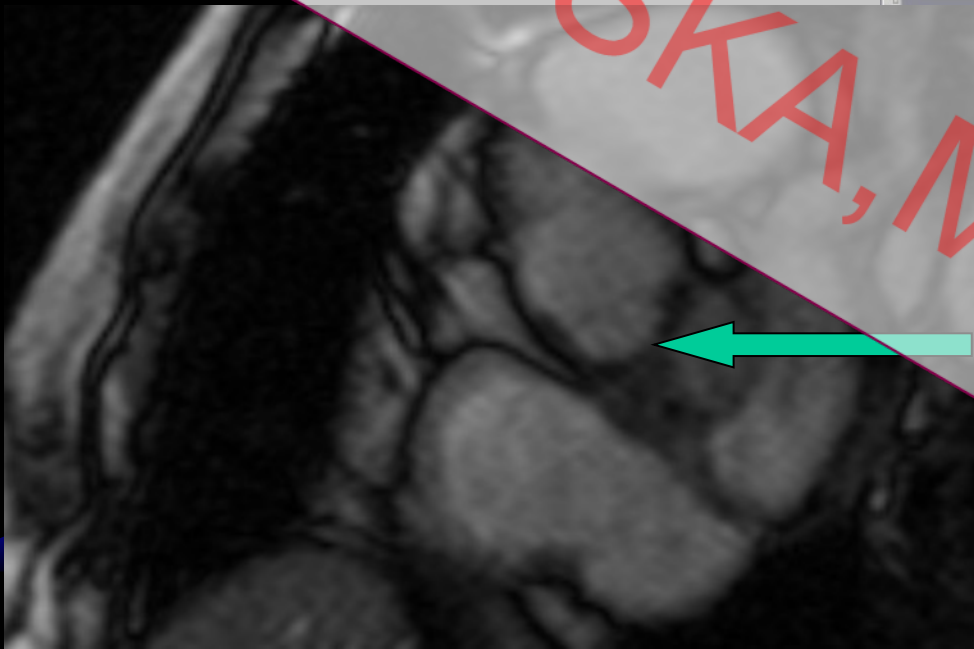
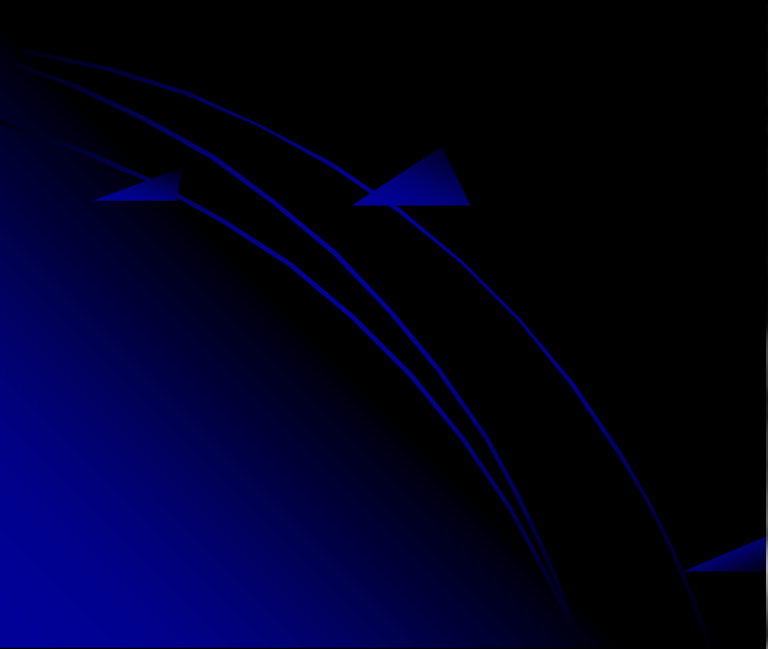
EVANGELISMOS HOSPITAL
CT



kVP:120
mA:400
msec:500
mAs:200
Thk:1 mm
Aquilion

Vitreax®
WL:1000/100
#150

Effie ROUSKA, MD



Other applications of perioperative echocardiography

Epicardial coronary imaging

Substernal echocardiography

Intracardiac echocardiography (ICE)

Intraoperative stress
echocardiography

Contrast echocardiography

3-D echocardiography

Effie ROUSKA, MD

Complications

Complications

Incidence (%)

Odynophagia	0.10
Swallowing abnormality	0.01
Oesophageal abrasions	0.06
No associated pathology	0.03
Upper gastrointestinal haemorrhage	0.03
Oesophageal perforation	0.01
Dental injury	0.03
Endotracheal tube malposition	0.03
Total	0.20

Contraindications

Absolute

Relative

Perforated viscus	Atlantoaxial joint disease
Oesophageal stricture	Prior irradiation to the chest
Active upper gastrointestinal bleeding	Hiatal hernia
Oesophageal tumours	
Oesophageal diverticula	
Oesophageal scleroderma	
Recent upper gastrointestinal surgery	
Oesophageal varices	

Critical role of TEE in:

- 📄 LV reconstruction surgery
(LVEF,ESVI)
- 📄 Minimally invasive surgery
(OPCAB, PORT ACCESS SURGERY, etc)
- 📄 Paediatric cardiac surgery
- 📄 Congenital heart disease surgery

Use of TEE in LVAD

Prebypass

- Patent foramen ovale/ASD (Bubble test!)?
- Aortic regurgitation?
- Right ventricular function?
- Tricuspid regurgitation?
- Intracavity thrombus?

Weaning from bypass

- De-airing
- Inflow graft position
- Right ventricular function?

Postbypass evaluation

- Right ventricular function?
- Inflow/Outflow obstruction?
- Tamponade?



Accuracy of intraoperative interpretation

Training

Accreditations
procedure



Special Article

ASE/SCA Recommendations and Guidelines for Continuous Quality Improvement in Perioperative Echocardiography

Joseph P. Mathew, MD, FASE
Kathryn Glas, MD, FASE
Christopher A. Troianos, MD
Pamela Sears-Rogan, MD, FASE
Robert Savage, MD
Jack Shanewise, MD, FASE
Joseph Kisslo, MD, FASE
Solomon Aronson, MD, FASE
Stanton Sherman, MD, FASE

Cahalan MK, et al. American Society of Echocardiography and Society of Cardiovascular Anesthesiologists task force guidelines for training in perioperative echocardiography. *Anesth Analg* 2002;94:1384-8

Reporting

Duke Perioperative Echocardiography Protocol (updated : July 23, 2010)

Recommendations for a Standardized Report for Adult
Perioperative Echocardiography
From the Society of Cardiovascular Anesthesiologists/American Society of
Echocardiography Task Force for a Standardized Perioperative
Echocardiography Report

Task Force Members
Robert Savage, Zaharia Hillel, Martin London, Martin Goldman, John Gorsan, Julius
Gardin, William Stewart, and Steven Konstadt

2017 EACTA

eacta European Association of
Cardiothoracic Anaesthesiologists

Intraoperative TEE Report Form

Patient Name: _____ Date: _____ Insertion: Easy / Difficult / Laryngoscopy
 Day of birth: _____ Elective / Emergency: _____ Image Quality: Good / Moderate / Poor
 Patient ID: _____ OR/TEE machine Nr.: _____ Height / Weight: _____ (cm / kg)
 ECG: SR / AFib / Pacer / CPR

Surgery: _____ Previous echo? Yes / No _____ If yes, (TTE/TEE): _____

Ventricles	Morphology and vol. status: 1 = normal 2 = hypertrophied & dilated 3 = moderately reduced 4 = severely reduced	Global function 1 = normal 2 = mildly reduced 3 = moderately reduced 4 = severely reduced	Regional wall motion abnormalities (0 = normal, 1 = akinetic, 2 = hypokinetic, 3 = akustic, 4 = dykinetic)	Measurements
Left Ventricle				LVIDd (mm) LVIDs (mm) LVEF (%)
Right Ventricle				TASPE (mm) FAC (%)

ATRIUM	Normal	Dilated	Spontaneous echo contrast	Thrombus (Size, location, appearance)	Tumor (Site, location, appearance)	Device (Site, location, appearance)
Left Atrium						
Right Atrium						

Septum	Normal	Hypertrophied	Shunt	Anomaly (VSD, ASD, PFO, Aneurysm)
IVS				
IAS				

Pericardial effusion (mm): _____ (Loculated / Circumferential): _____ Pleural effusion (mm): _____ (left/right)

Aorta	Normal	Dilated	Diameter of Aneurysm (mm)	Dissection (Location/Entry point)	Thickness of Plaques (mm)	Mobile/Immobile
Ascending						
Arch						
Descending						

eacta European Association of
Cardiothoracic Anaesthesiologists

Intraoperative TEE Report Form

Valves	Morphology and mobility of leaflets	Diameter/Distance	Stenosis (0 = none 1 = mild 2 = moderate 3 = severe)	Regurgitation (0 = none 1 = mild 2 = moderate 3 = severe)
Mitral Valve		Annulus (mm): AML (mm): PML (mm): C-Sept (mm):	PHT (ms): P max/mean (mmHg): MVA (cm ²): Grade:	VC (mm): EROA (cm ²): Pulmonary veins: (Blunt/Reverse) Grade:
Aortic Valve		Annulus (mm): Sinus (mm): STJ (mm): LVOT (mm):	P max/mean (mmHg): AVA (cm ²): a) Planimetry b) Continuity E. VTI-Ratio: Grade:	VC (mm): PHT (ms): Jet/LVOT (%): Grade:
Tricuspid Valve		Annulus (mm):	P max/mean (mmHg): Grade:	VC (mm): SPAP (mmHg): Grade:
Pulmonary Valve			P max/mean (mmHg): Grade:	Jet width (mm): Grade:

Summary of findings:

Postoperative echo examination including any adverse events:

Signature Supervisor: _____ Signature Echocardiographer: _____

To conclude....

“When expertly used.....”

“Performing a complete examination”

*perioperative Echocardiography
leads to improved outcome
in patients requiring cardiac surgery*



Ettilie ROUSKA, MD

Take home messages

- ITOE does not replace the TOE !
- ITOE supports the decision making in cardiac surgery
- ITOE increases the efficiency of the operation
by guiding surgical manipulations
- ITOE allows intraoperative monitoring
- ITOE offers direct assessment of the surgical result
- ITOE needs people well trained and experienced!



Effie ROUSKA, MD