The Role of Echocardiography for the Diagnosis and Treatment of Prosthetic Valve Emergencies in the ICCU - Alik Sagie MD

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Prosthetic valve emergencies in the ICU

- Acute dysfunction of prosthetic valves may cause hemodynamic deterioration resulting in pulmonary edema or cardiogenic shock and should be considered in its differential diagnosis.

Valvular emergencies in the ICU

- A rapid diagnosis of a valvular etiology in a patient with acute hemodynamic deterioration is very important because emergency interventions such as:
  - intensive medical therapy,
  - emergent valve replacement
  - new percutaneous valve procedures

can be effective, and, at times, life saving

Diagnosis of PV Emergencies

- Clinical clues (from the patient's history, symptoms and signs) suggesting valvular etiology are very important but often difficult to get in patient in pulmonary edema or cardiogenic shock

Diagnostic tools in prosthetic valve emergensies

- Therefore, echocardiography (TTE, TEE or 3D echo) is the best imaging modality to diagnose the etiology of acute hemodynamic deterioration and should be performed as soon as possible.

- This diagnostic tool can be done at bedside without the need to transfer the patient a way form the intensive care setting to CT or MRI laboratory where monitoring of the patient is not ideal

Bedside availability

TTE Vs. TEE in Prosthetic valve Emergencies

TTE in patients with prosthetic valve malfunction

- TTE is safe and fast in identifies **MANY** of cardiac causes of a shock or pulmonary edema in a critically ill patient in the ICU, **however**, in case of **prosthetic valve malfunction** especially in mechanical valves it is limited due to many artifacts and usually TEE is needed to complete the study

Josef MZ et al, *Chest.* 2004;126:1592

TEE Advantages

- TEE has the following **advantages** over TTE:
  - Patients on respirators
  - Post-cardiac surgery patients
- **Better diagnostic capabilities and definition in:**
  - **Prosthetic valve complications**
  - **Acute IE**
  - **Acute MR and AR**
  - Aortic dissection and mural hematoma
  - Pulmonary emboli

Disadvantages of TEE in critical ill patients in the CCU

- It require **sedation**, which may compromise the borderline respiratory and hemodynamic status of the critically ill patient.
- **TEE-related complications (rare):**
  - aspiration pneumonia,
  - esophageal injury
  - Bronchospasm
  - Dislodgment of endotracheal tube
  - Unsafe in severe coagulopathy
  - Difficult to conduct in facial trauma

Limitations of 2D TTE/ TEE

- Analysis of complex anatomic structures
- Spatial orientation
- Relationship between structures and devices

Advantages of real time 3D TEE

- Real time 3D visualization of cardiac anatomy without any reconstruction
- Getting surgical views of the valves
- Enhanced analysis of the relationship between cardiac structures and devices
- Improvement in guidance of complex procedures

PV Emergencies in ICCU
Aortic prosthesis

- **Prosthetic valve regurgitation**
  - Endocarditis
  - Degenerated biologic valves
  - Stuck mechanical valve
  - Severe paravalvular leak
- **Prosthetic valve stenosis –stuck valve**
  - Valve thrombosis
  - Valve Pannus
  - Endocarditis

Acute aortic valve prosthesis regurgitation

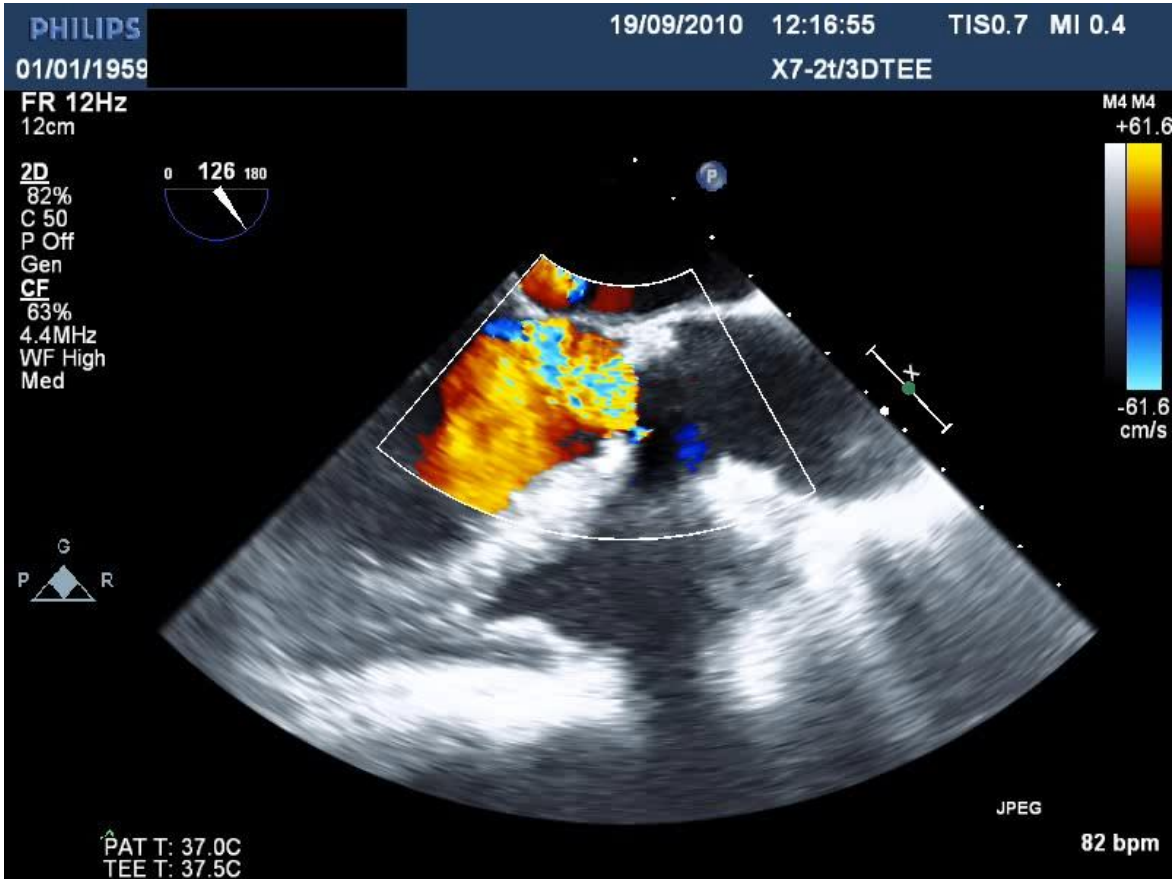
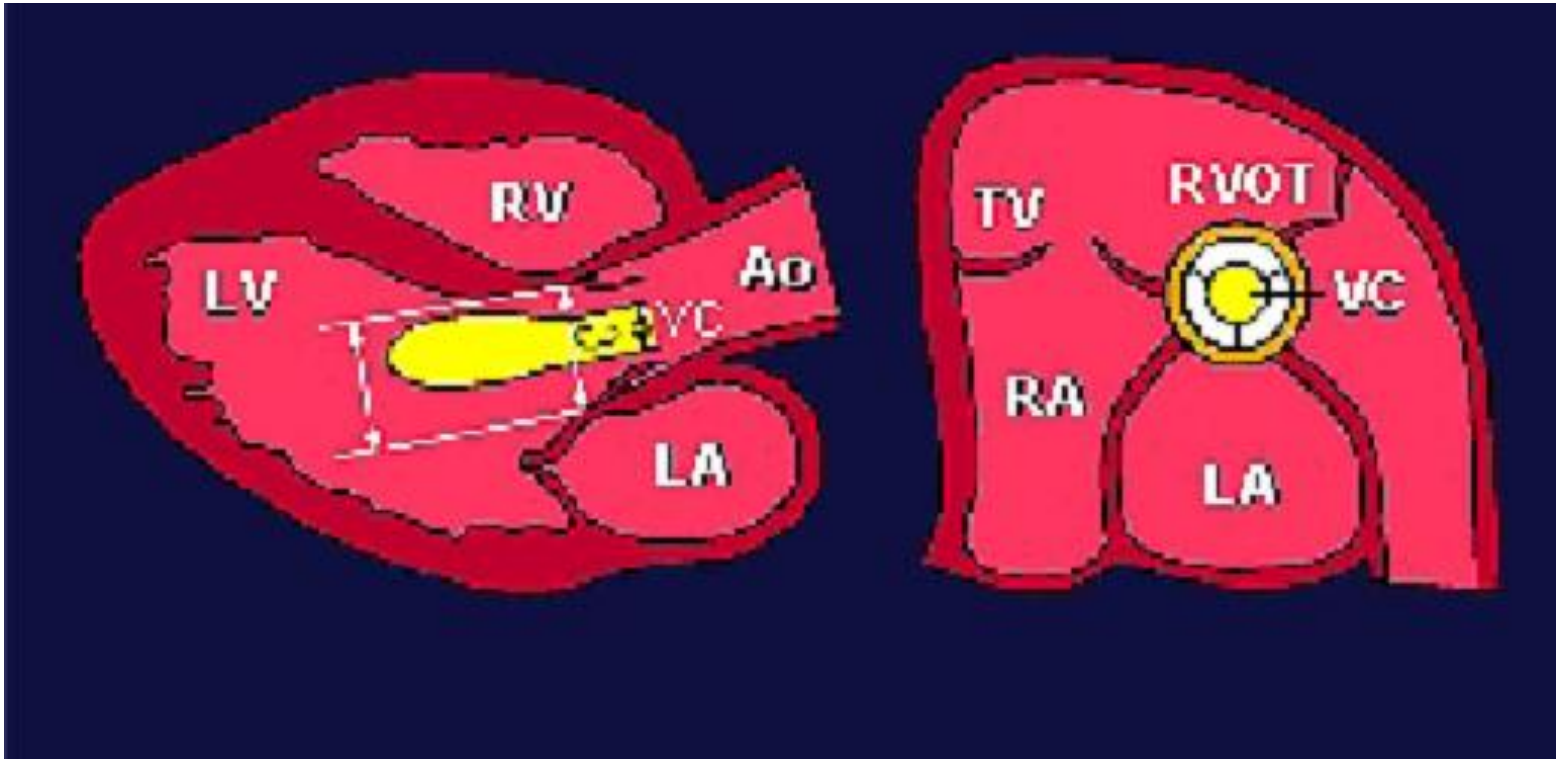


TABLE II. Comparison of Findings in Severe Acute and Chronic Aortic Regurgitation

Variable	Aortic Regurgitation	
	Acute	Chronic
Auscultatory		
Diastolic murmur	Soft, early	Holodiastolic, decrescendo
S_1	Soft	Normal or diminished
S_2	Loud P_2	Normal
S_3	Present	Absent
Hemodynamic		
Cardiac output	Decreased	Normal
Pulse pressure	Normal or decreased	Increased
Systolic pressure	Decreased	Increased
LVEDP	Severely increased	Normal
Left ventricular size	Normal	Increased

Echocardiographic evaluation of AR

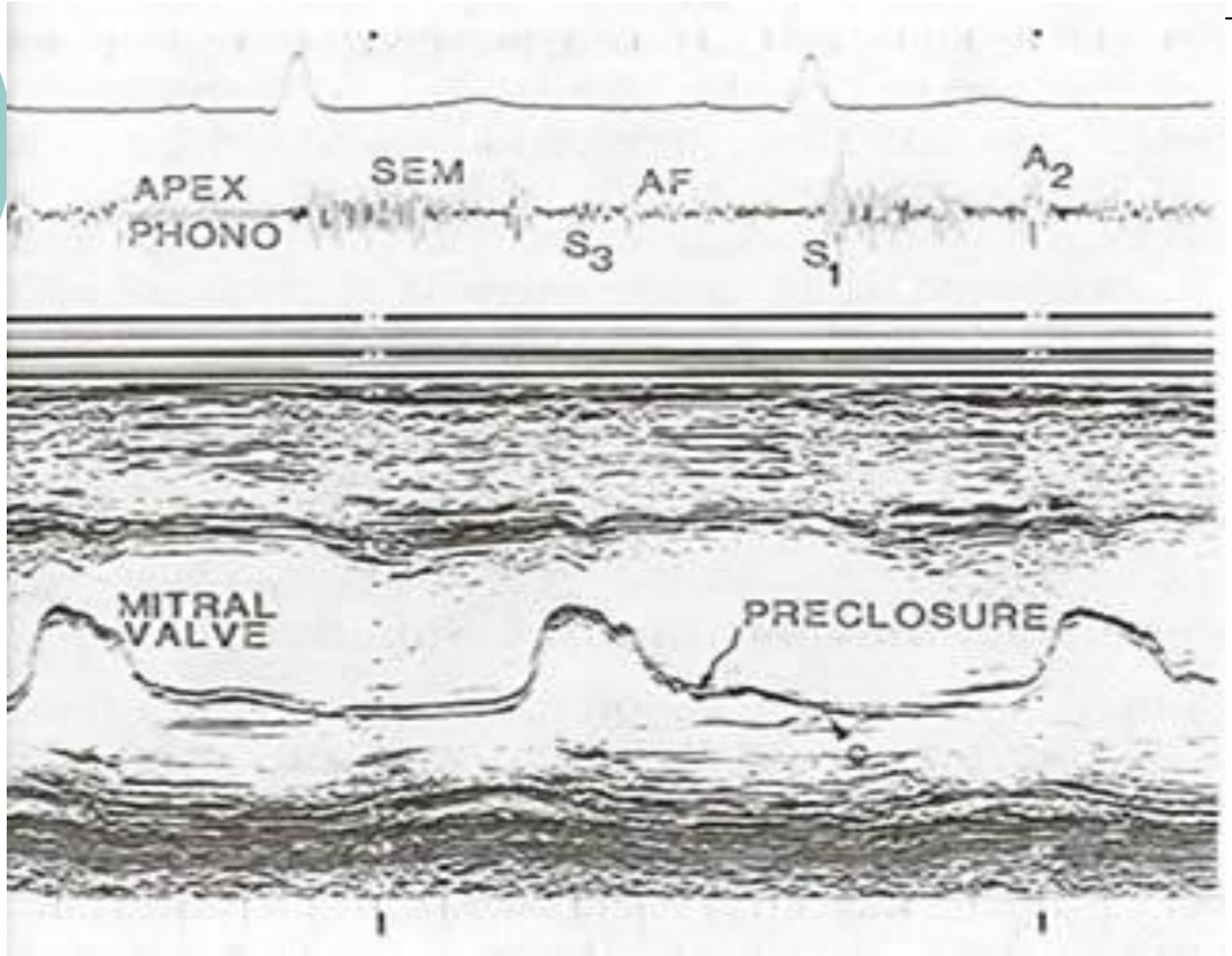
AR - regurgitant jet



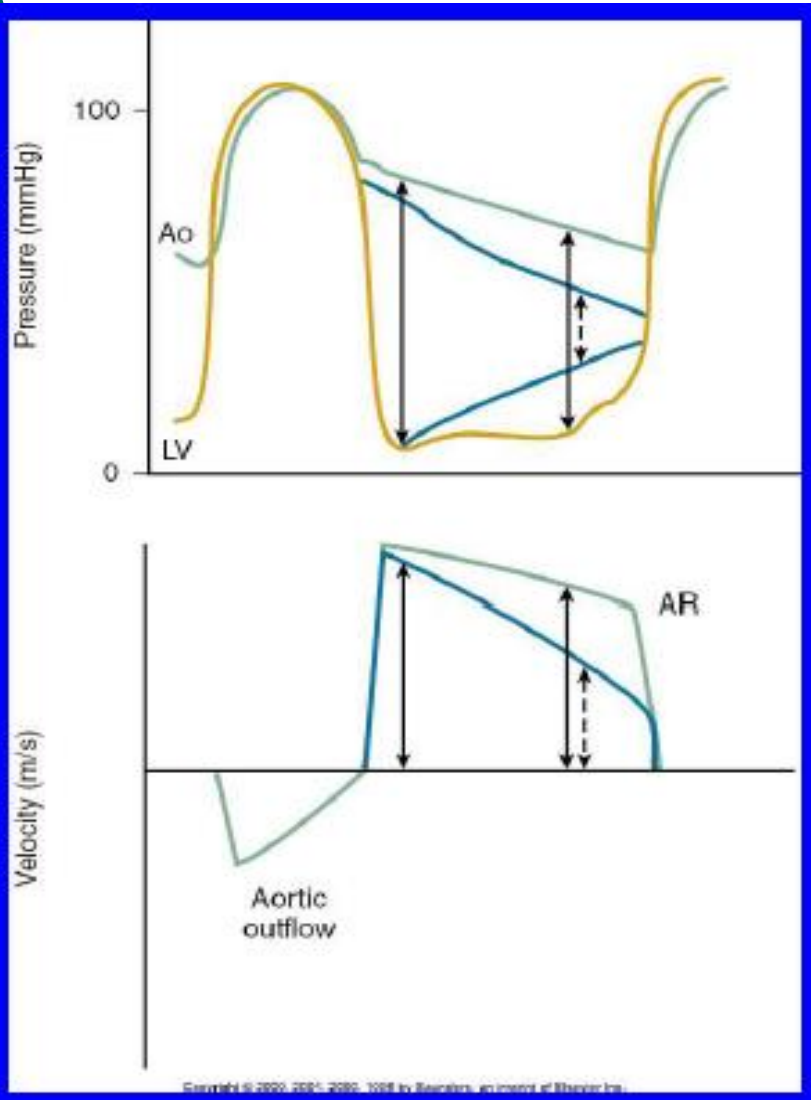
Aortic regurgitation severity

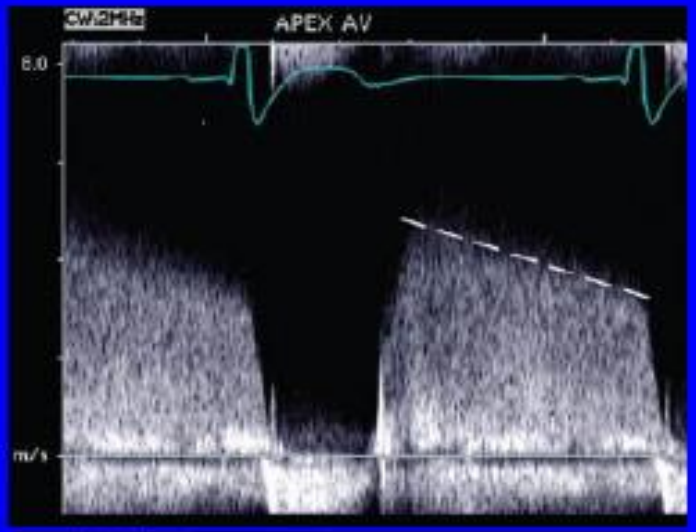
	Mild	Moderate	Severe
Angio	1 +	2+	3-4+
Doppler jet area	<25% LVOT	25% - 65%	>65%
Vena Con	< 3 mm	3-6 mm	>6mm
Reg Vol	<30 ml	30 -60 ml	>60 ml
ERO cm^2	< 0.1	O.1- 0.29	> 0.3

Premature mitral valve closure in acute aortic regurgitation by M-mode echo

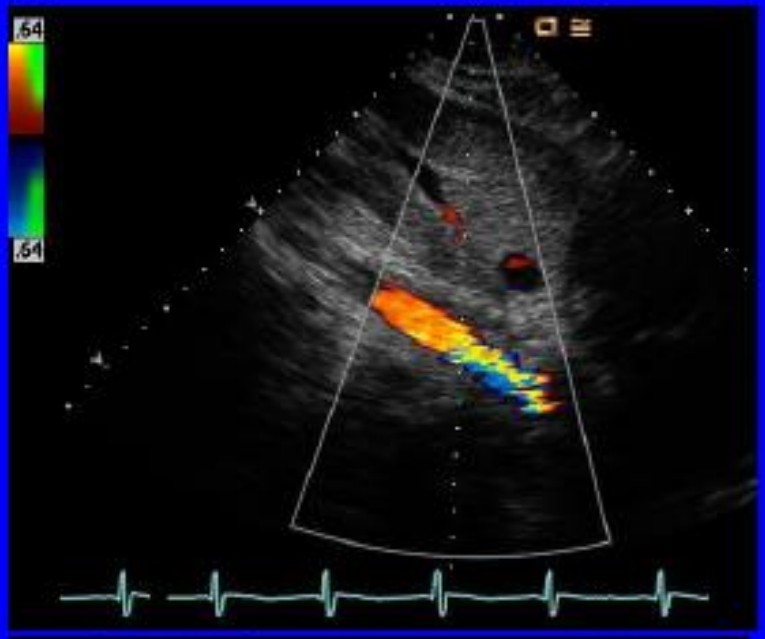


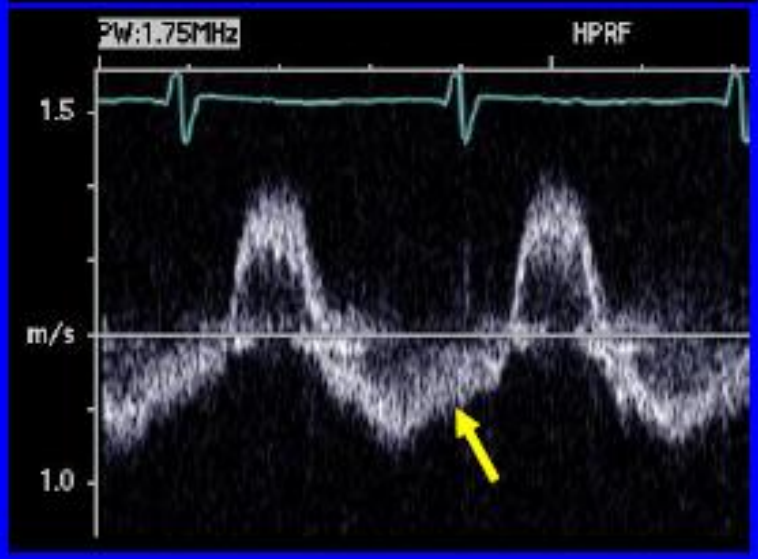
Valve hemodynamics: Acute vs. Chronic AR

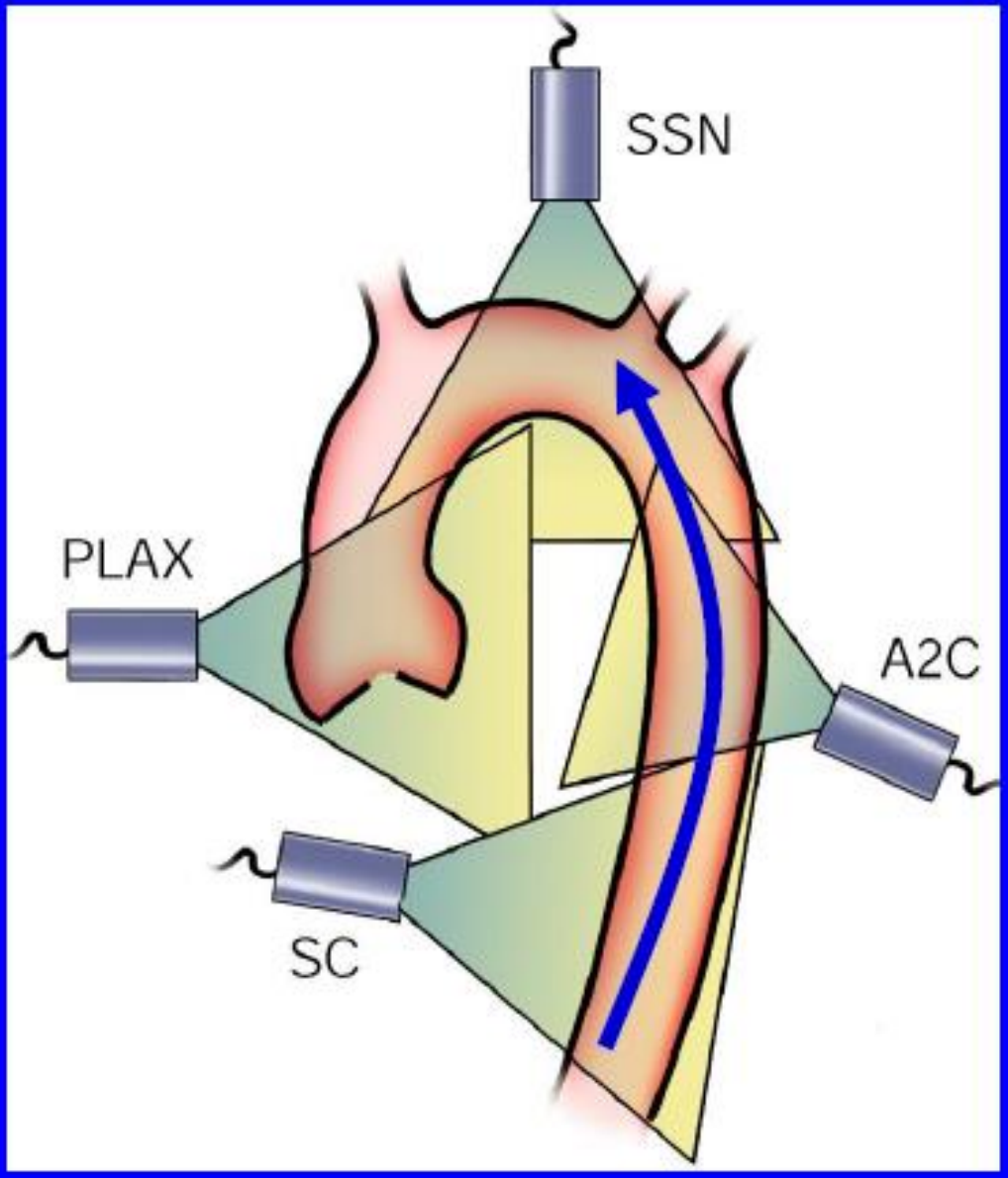




Holo-diastolic flow reversal in the distal aorta





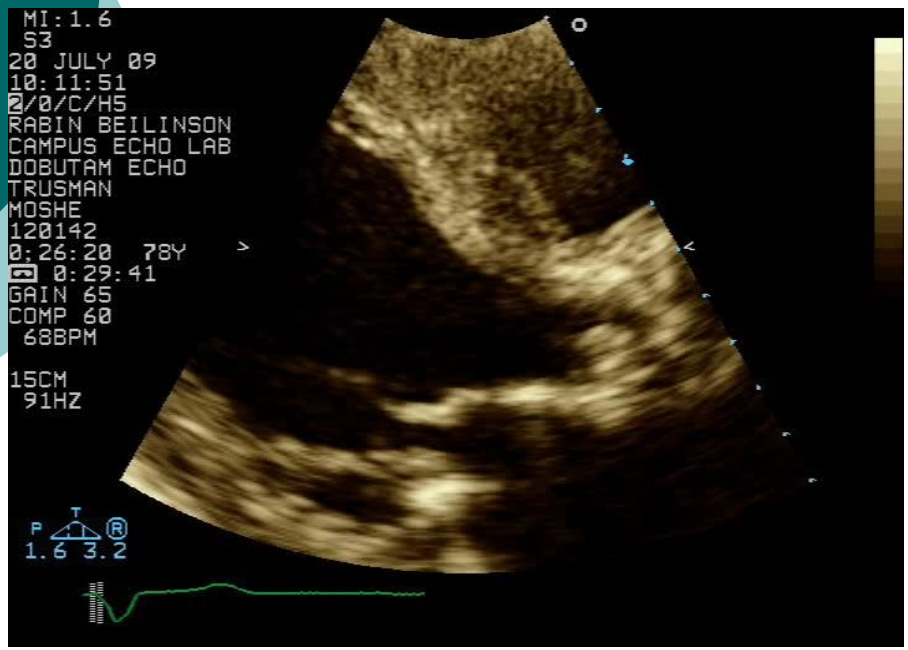


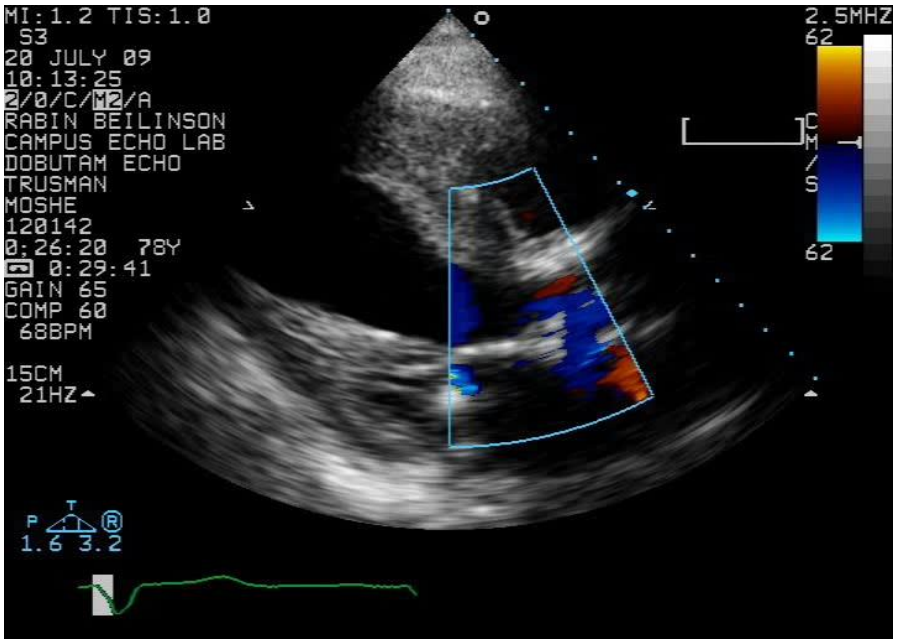
Clinical examples

Acute AR due to degenerated xenograft

- A 76 old man underwent AVR- xenograft 11 years ago
- Admitted to the ICCU with Pulmonary edema and hypotension
- History of significant **COPD**
- 6 month before index hospitalization routine echocardiogram reveal moderate AR due to degenerated xenograft and he was clinically stable at that time

TTE

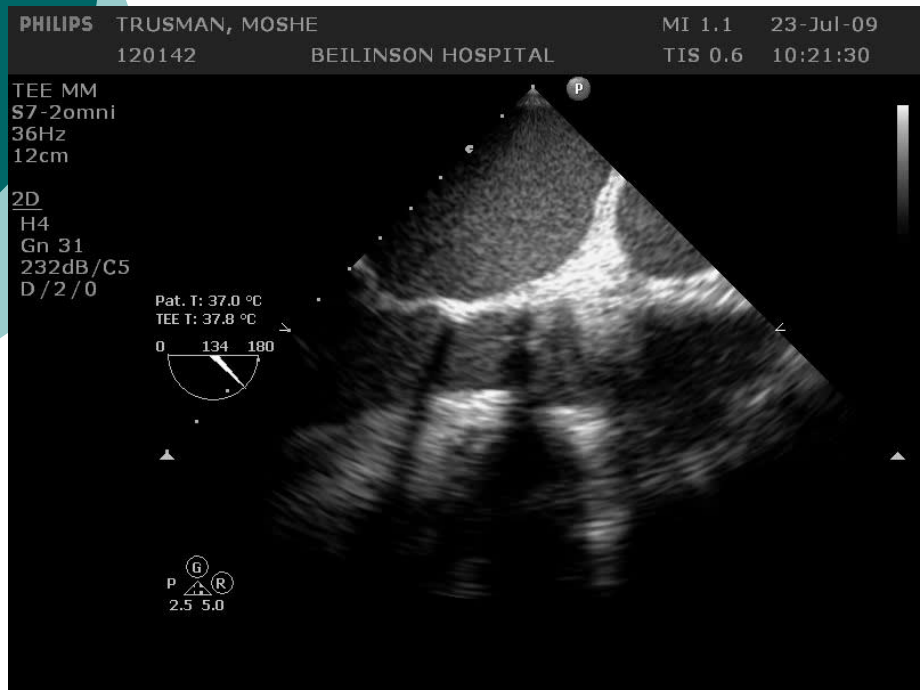


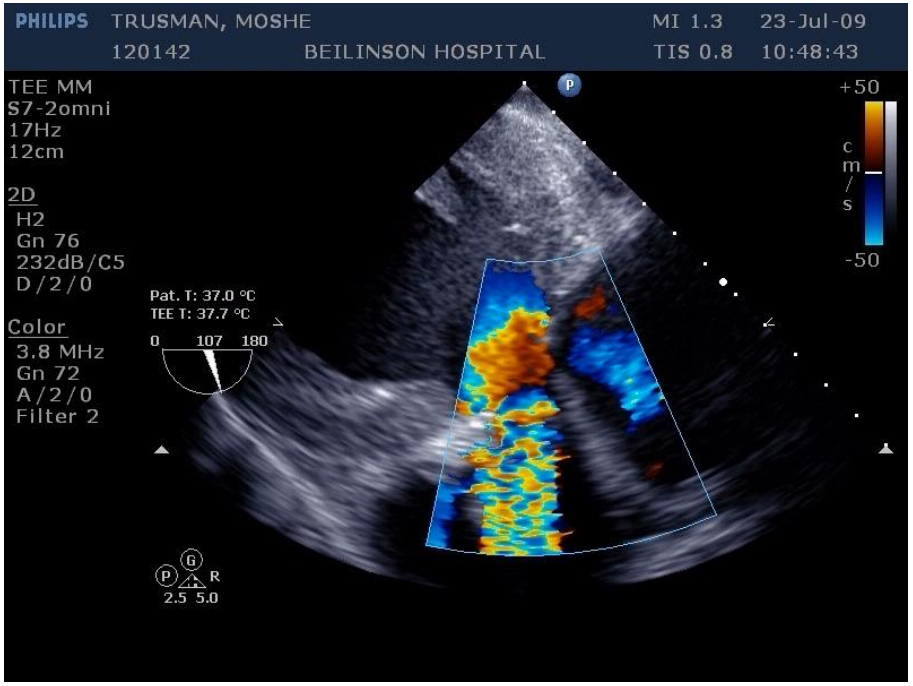


DD: Acute AR due to Degenerated valve with mobile torn leaflets

Acute AR due to IE with mobile vegetations

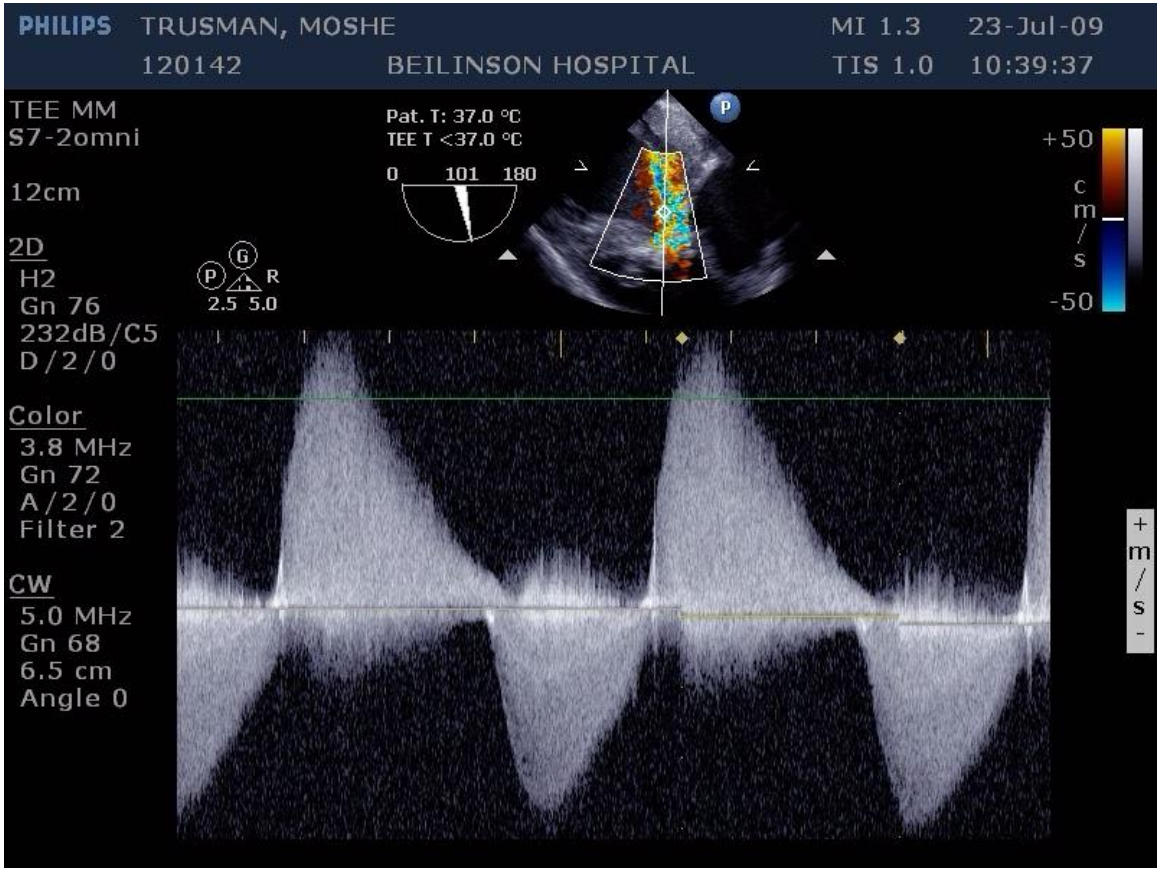
2D –TEE – Severe AR





VC= 9 mm

Doppler trace of acute AR



Follow up

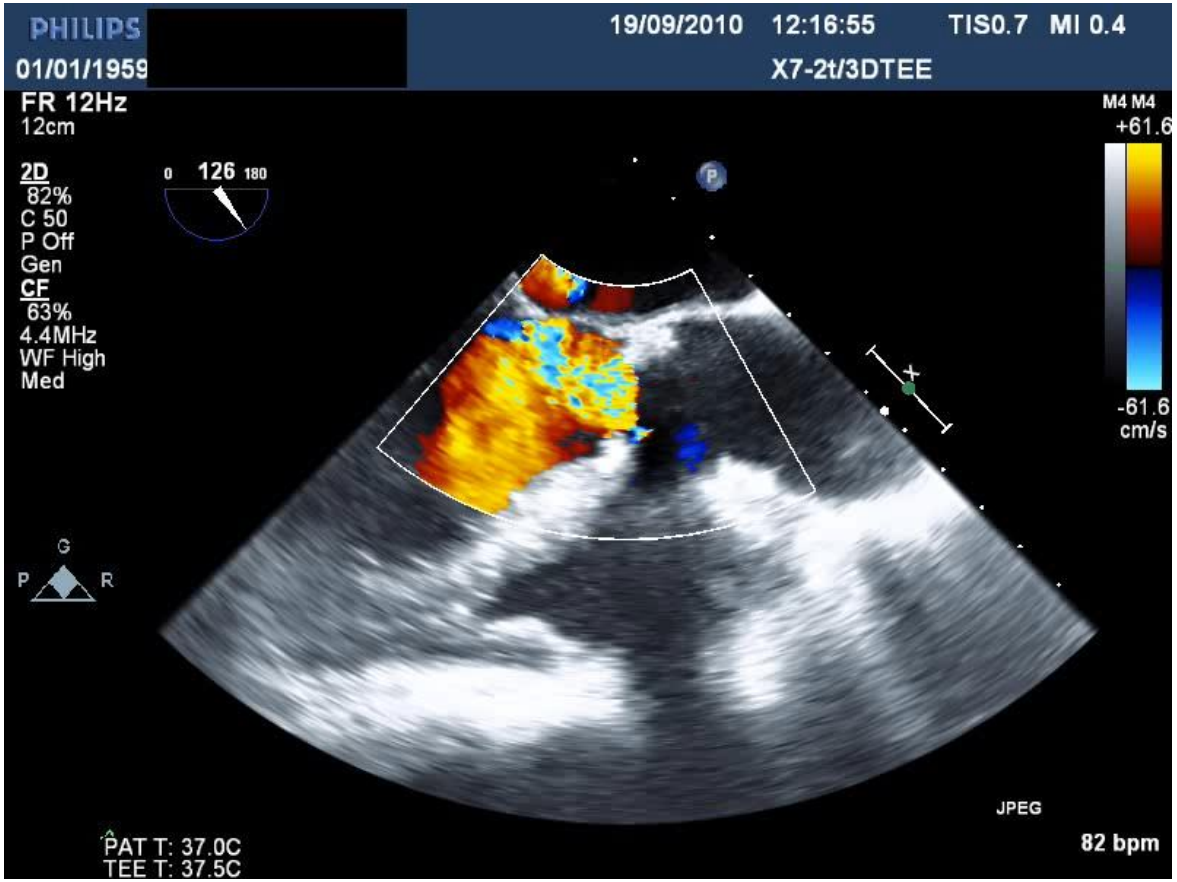
- The patient was referred to emergent AVR (within 24 Hr) and recovered slowly after long hospitalization due to respiratory complications
- Today in the era of percutaneous valve interventions “ transfemoral “Valve in Valve” implantation could be a good alternative in an elderly patient with severe COPD

Lesson

- When a patient with bioprosthesis develops bioprosthesis malfunction degenreation, the natural history is unpredicted and its better to plan an elective operation earlier rather than waiting for acute emergency such as happened in this patient

An elderly patient with mechanical prosthesis who presents to the ICCU with pulmonary edema and hemolysis

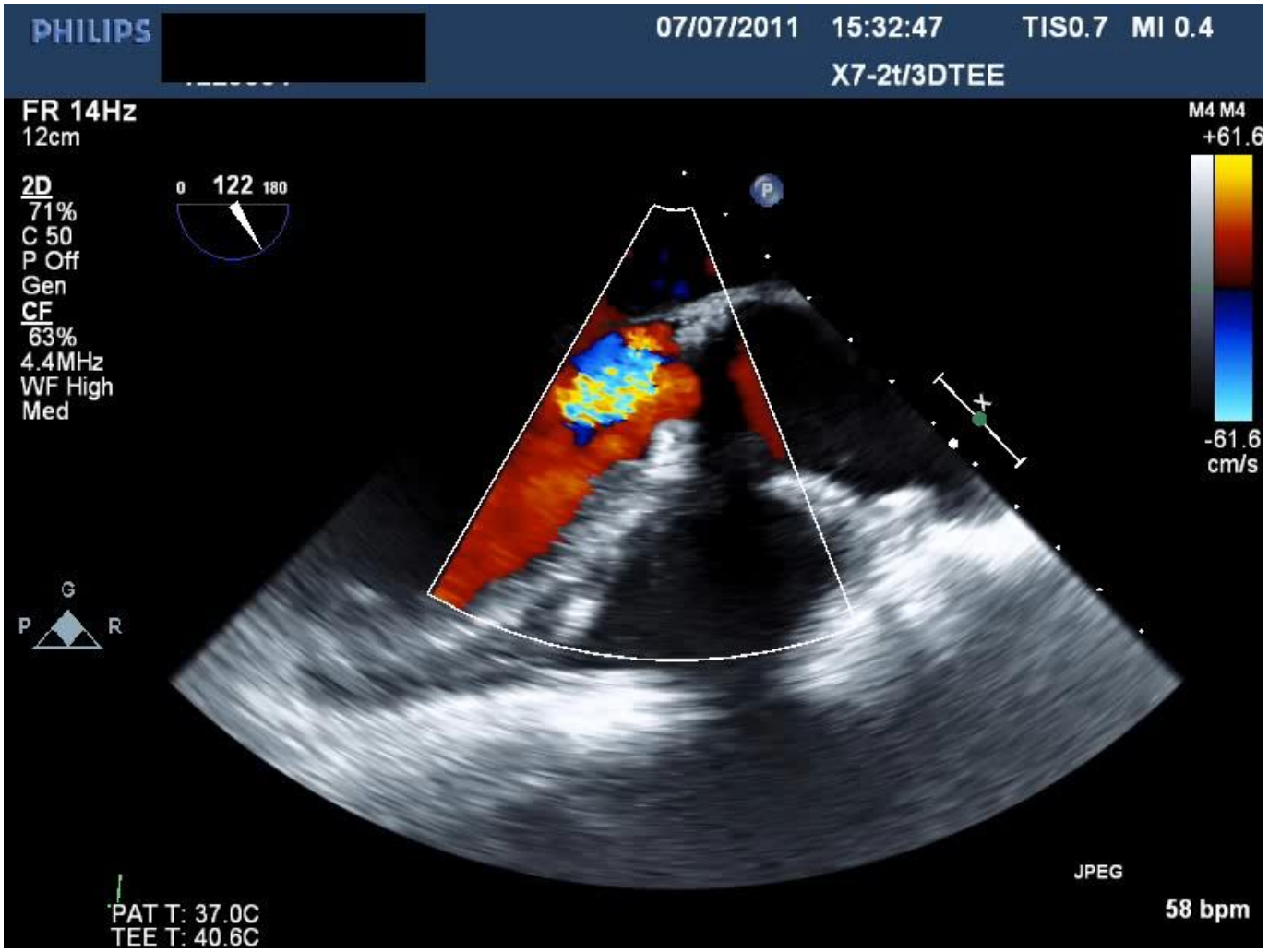
DD:
Intravalvular
vs.
Perivalvular
leak



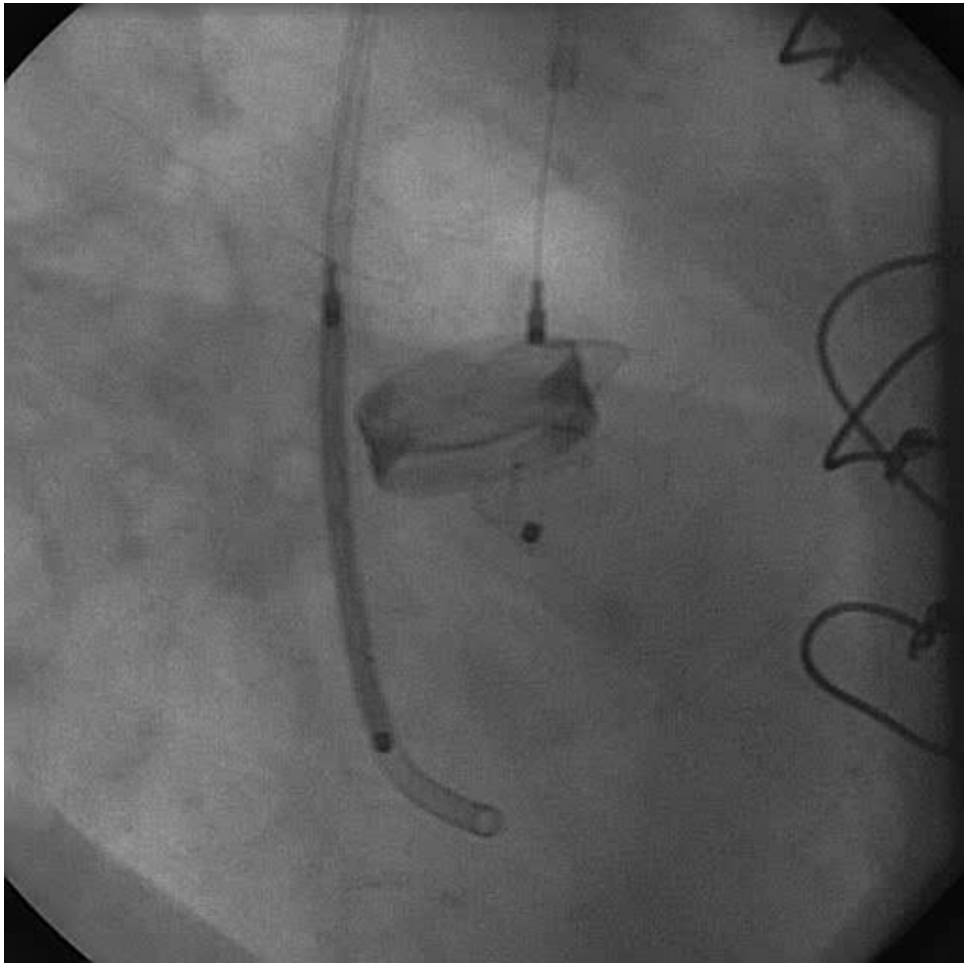
3D TEE COLOR FLOW

Percuatenous paravalvular leak closure
First device in place- residual AR

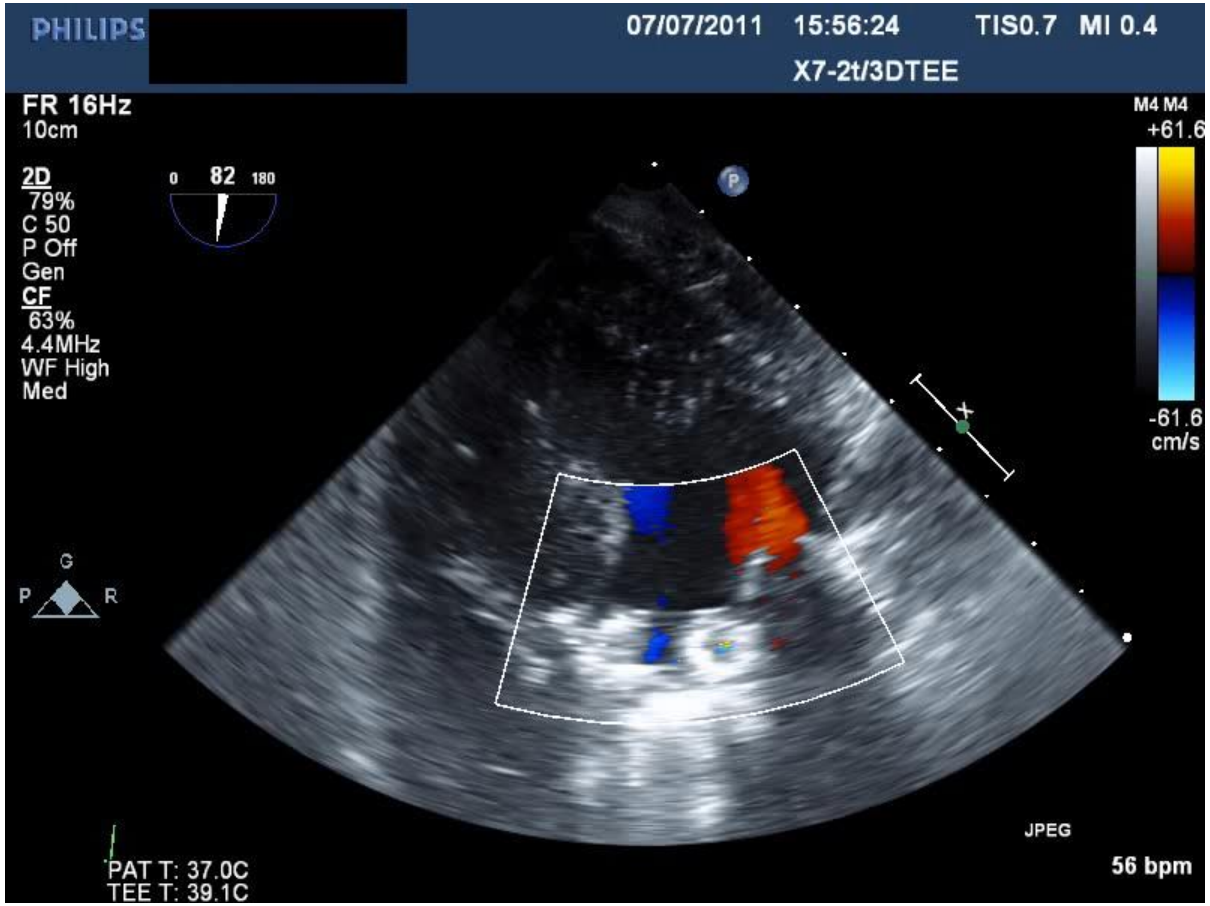
Residual AR after first device by color TEE



Catheter in second paravalvular hole



2 devices in place by 2D color flow TEE



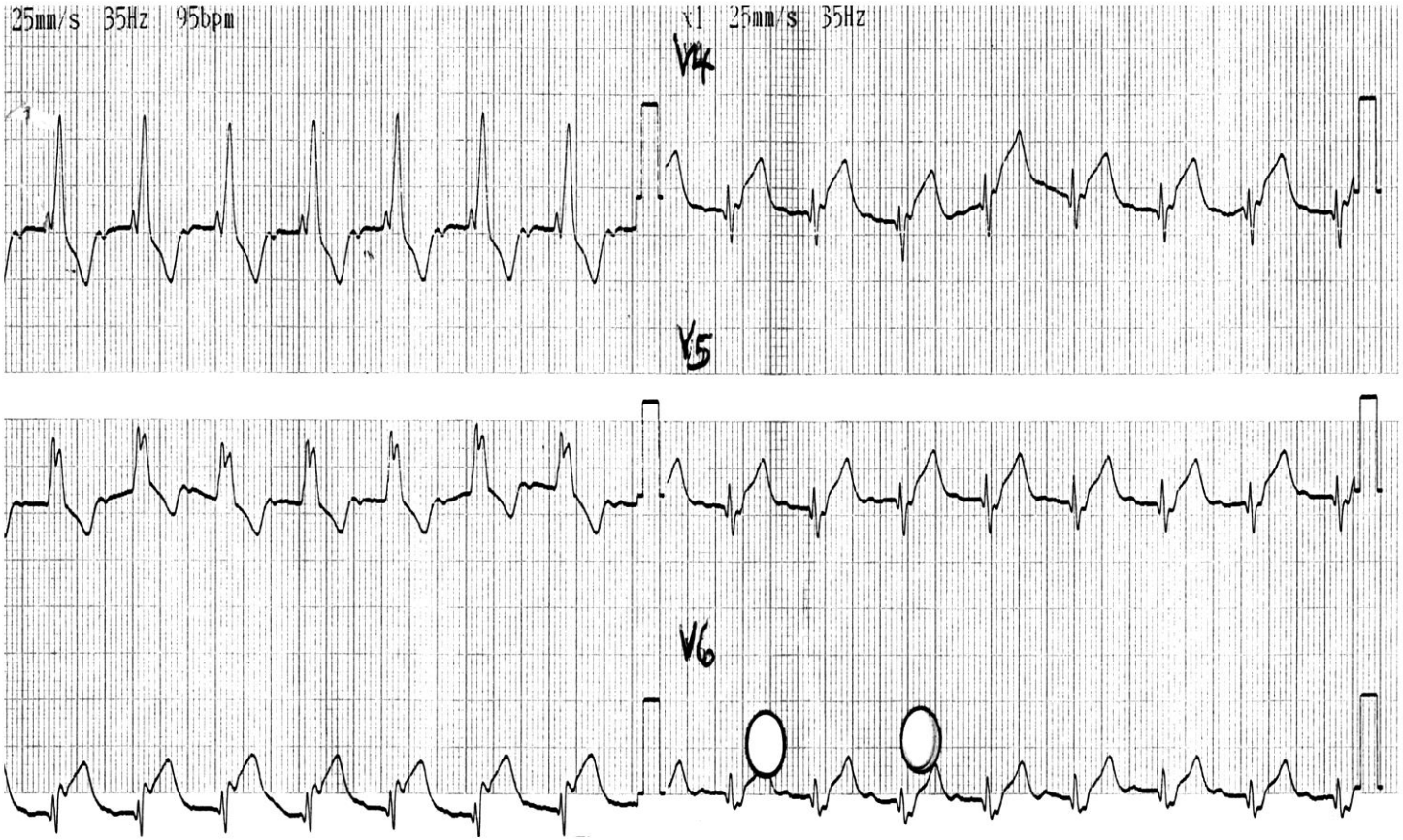
Acute STEMI in a patient after AVR

- 52 years old woman with coronary risk factors
- 7 years ago she underwent AVR – bileaflet SJ mechanical prosthesis.
- She was admitted with typical angina and ECG consisted with anterior wall STEMI
- Coumadin therapy was interrupted for several days due to small surgery
- LAB results: troponin 0.6; CPK-440;

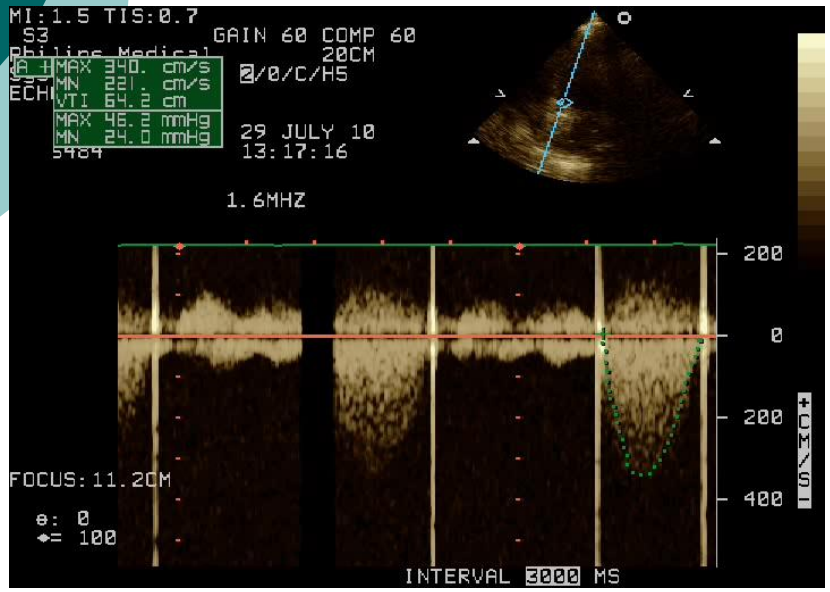
  INR 2.1

ECG on presentation

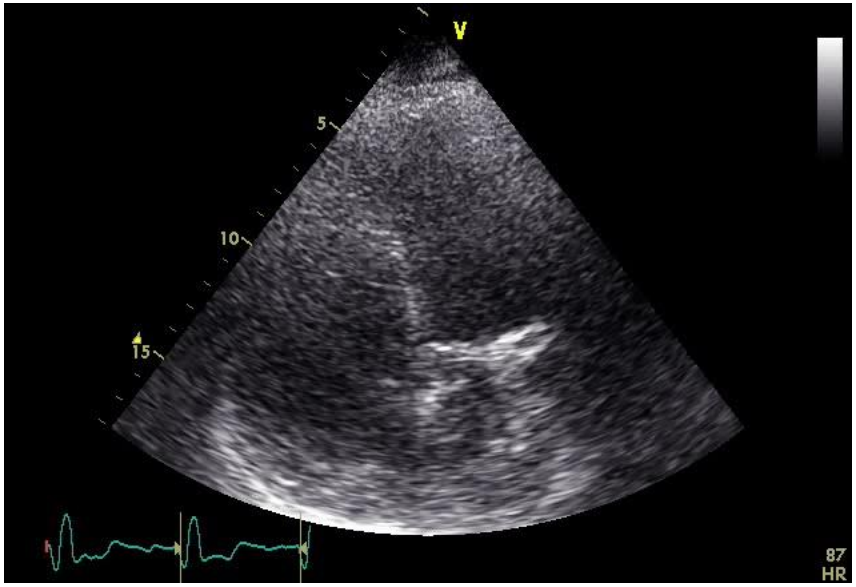
RBBB +
ST elevation
V3-V6



TTE
Technically difficult study

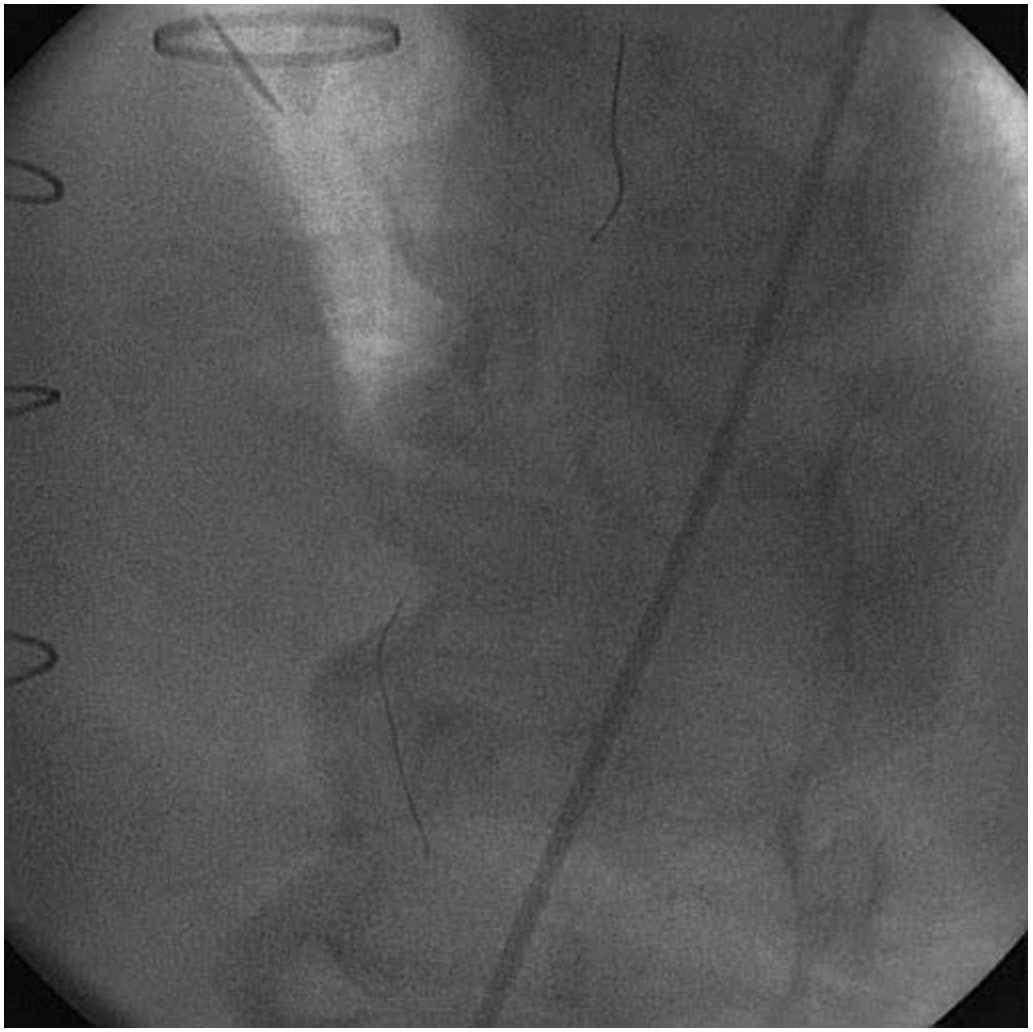


Prosthetic gradients
Peak = 46 mean= 24 mmHg

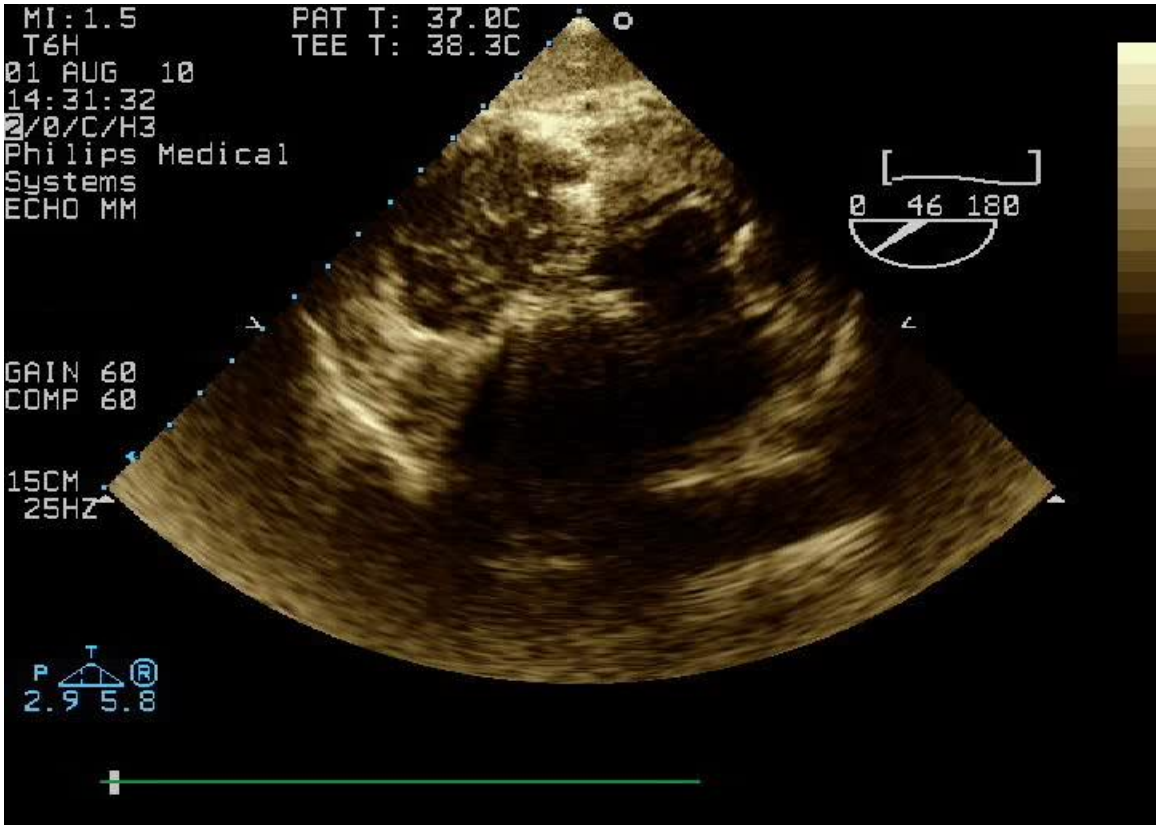


Apical akinesia

Cardiac Catheterization

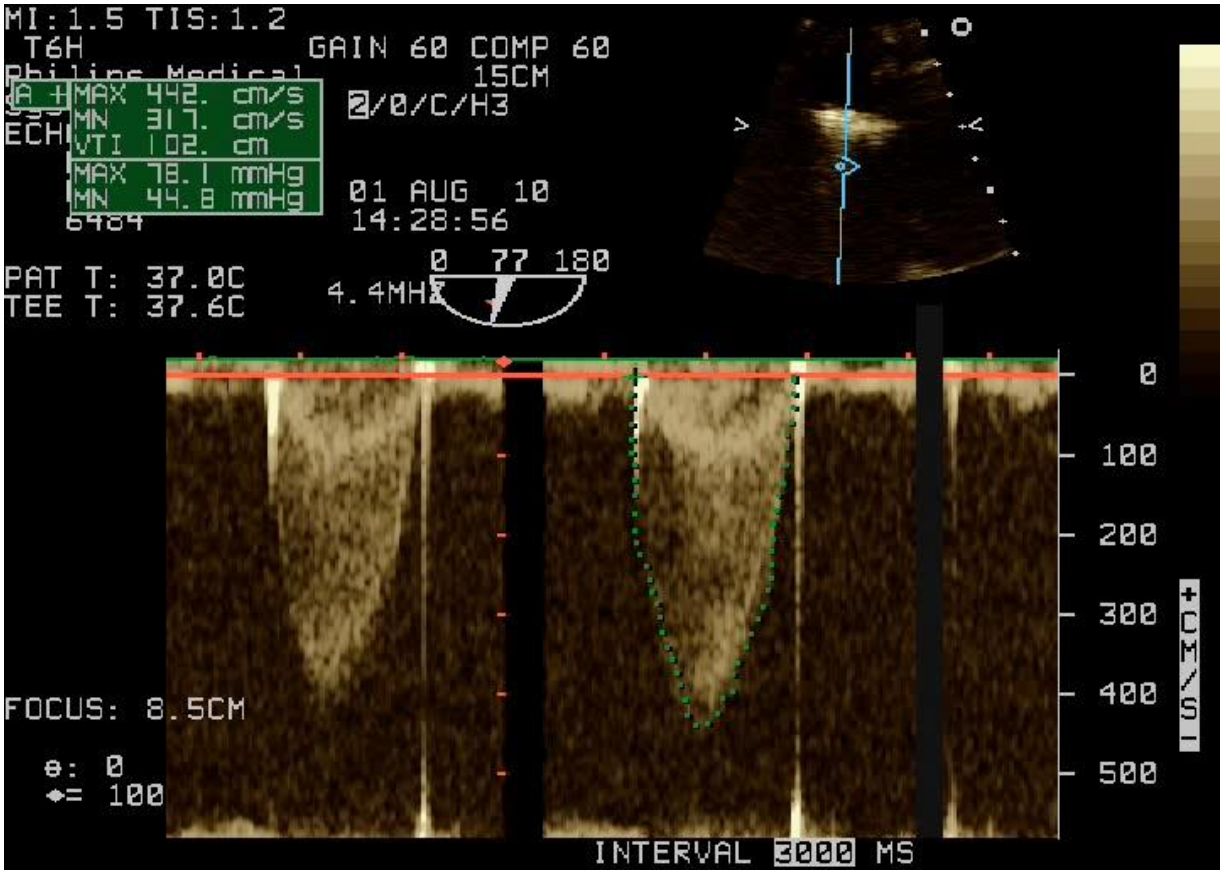


2D transgastric TEE

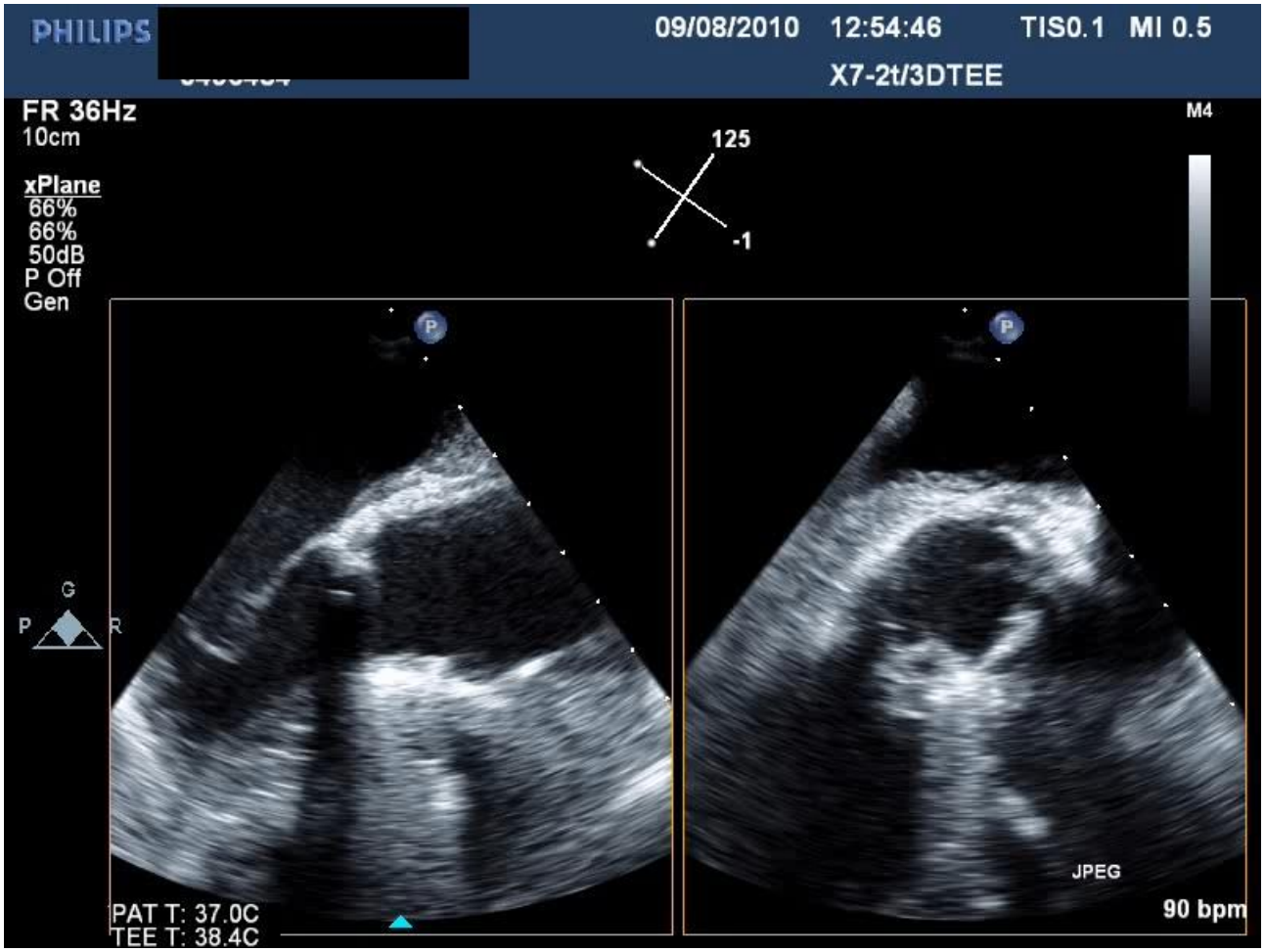


Prostheic gradients on TEE

Prosthetic gradients
Peak = 78
mean = 45
mmHg



3D TEE


PHILIPS
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10cm
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66%
50dB
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125
-1
M4
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P
R
JPEG
90 bpm
PAT T: 37.0C
TEE T: 38.4C

3D TEE

PHILIPS
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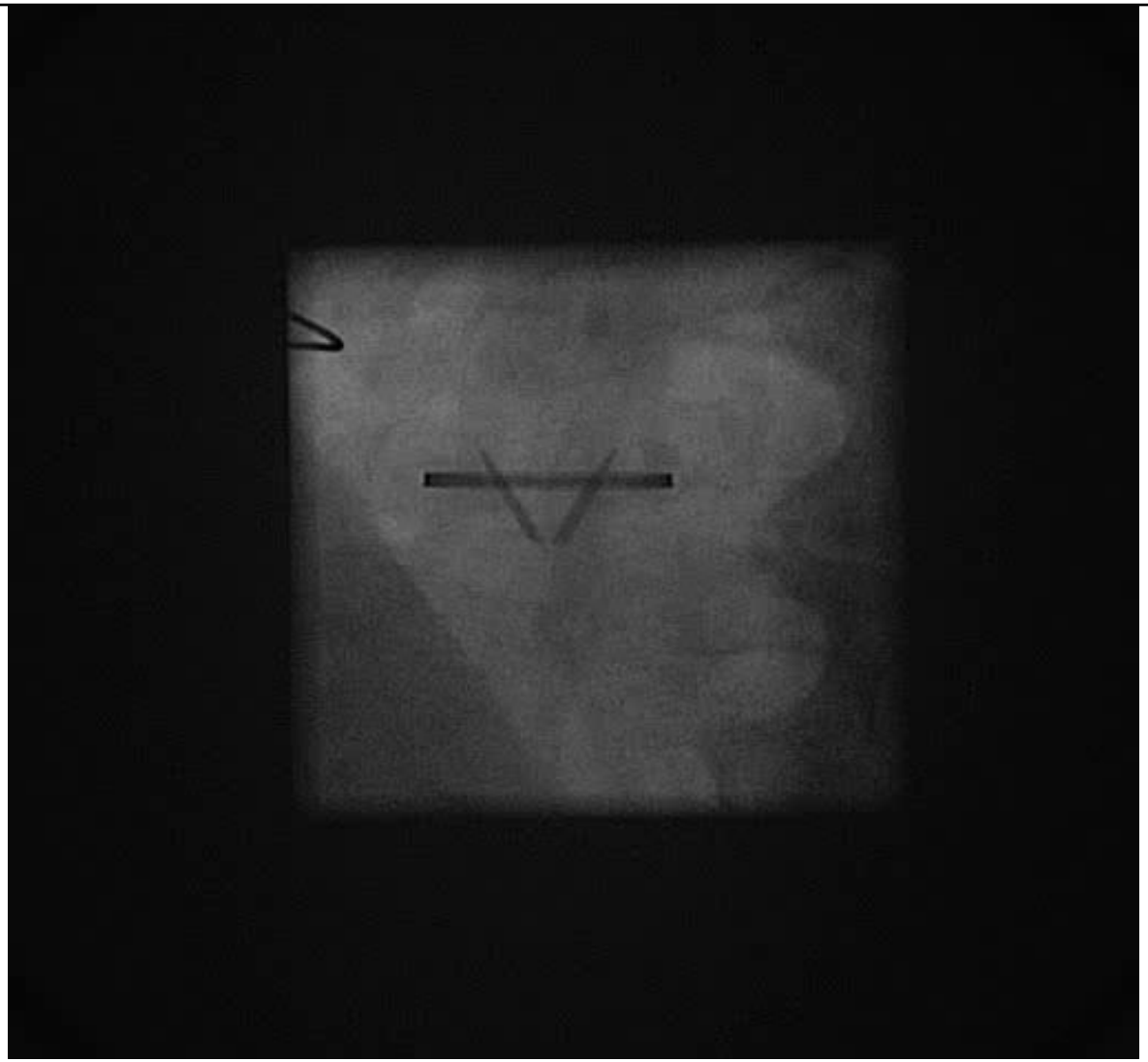
TEE T: 38.3C

Fluoroscopy



Treatment option

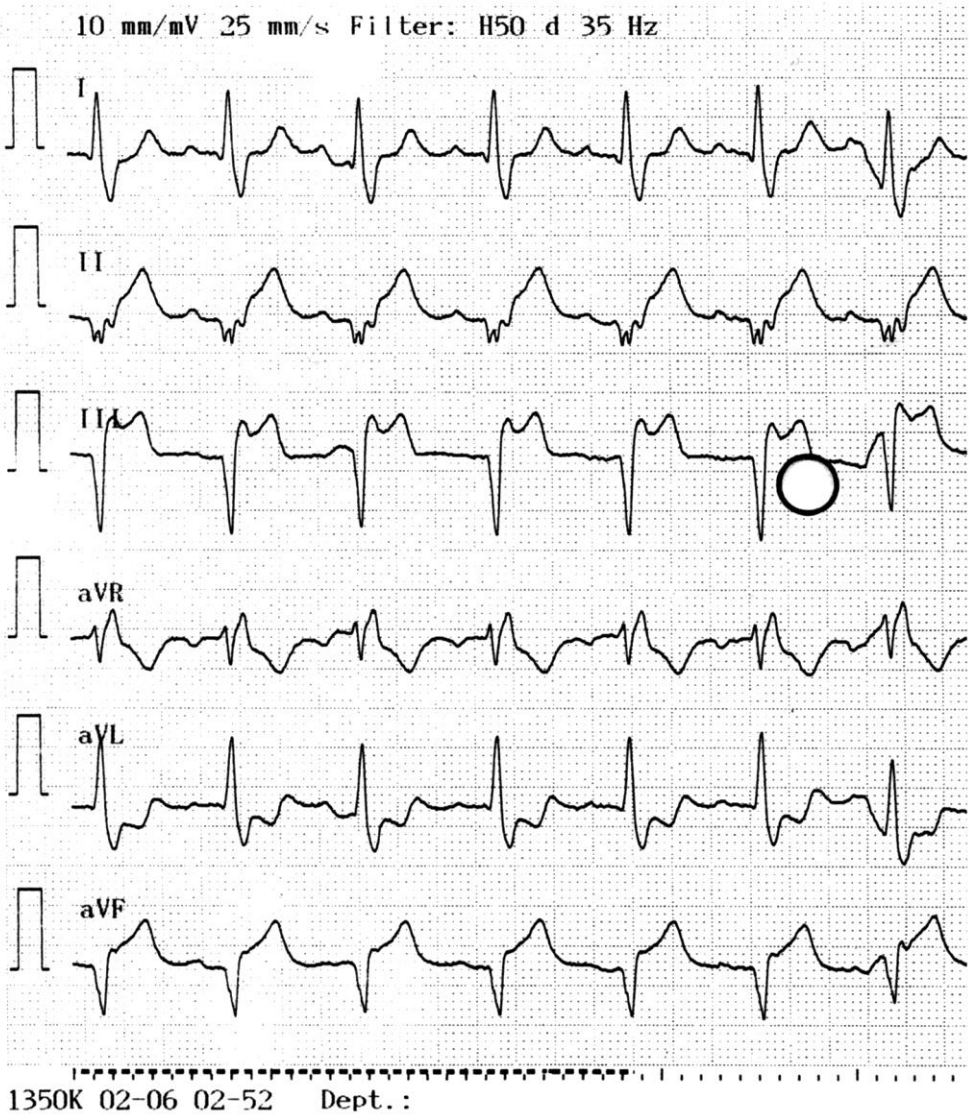
- Redo AVR
- High dose heparin
- Thrombolysis

Follow -up

- Initially high dose heparin was given with PTT over 80 second – no improvement in leaflets motions
- Thrombolytic treatment was than given – TPA 100 mg within 3 hours
- After 1 hour the patient developed severe chest pain
- On ECG ST elevation on inferior wall leads

ECG during thrombolytic therapy and chest pain

ST elevation inferior wall leads

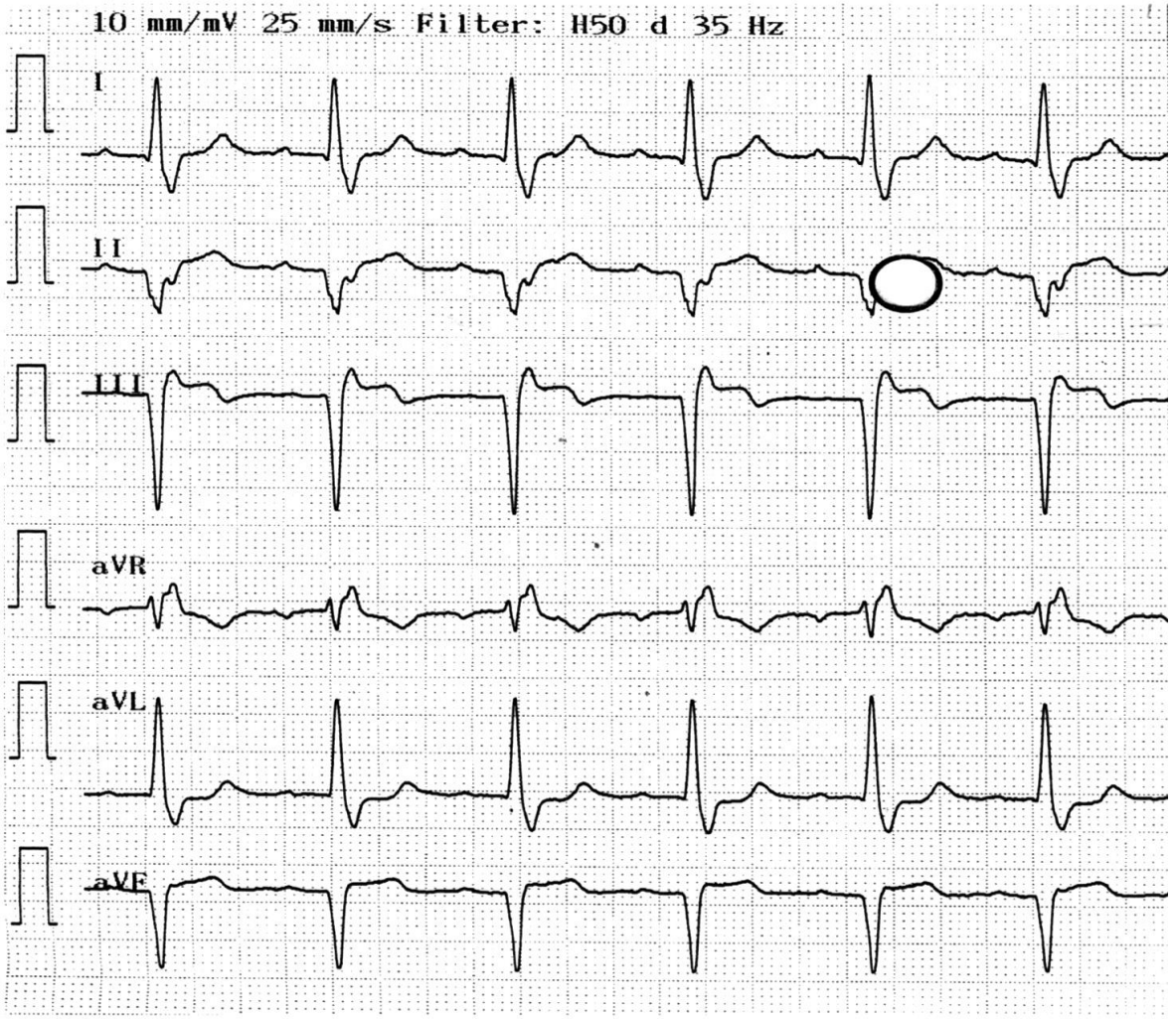


Follow – up

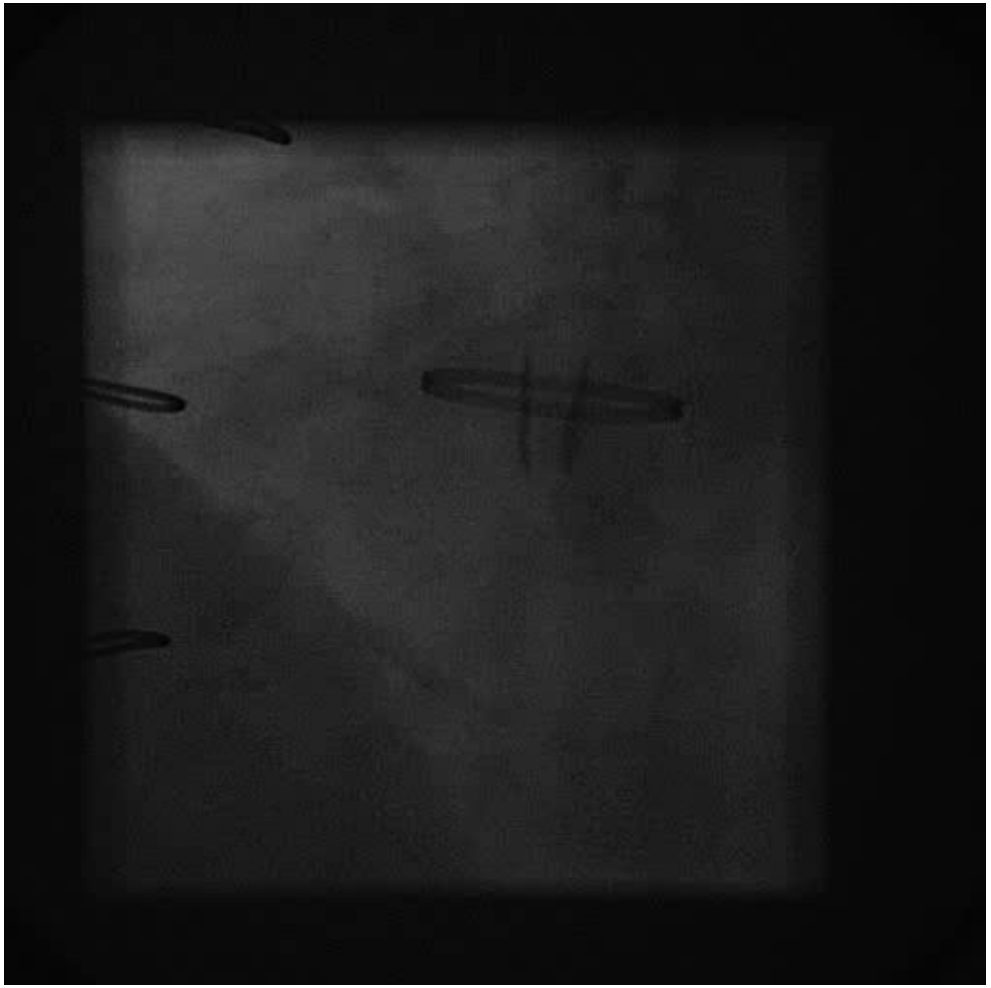
- Thrombolytic therapy continued with the rational that the ischemic episode is due to emboli released from the prosthesis to obstruct RCA\CX artery.
- After completing thrombolysis treatment chest pain subsided and ST elevation resolved

ECG post thrombolysis

ST elevation
Resolved



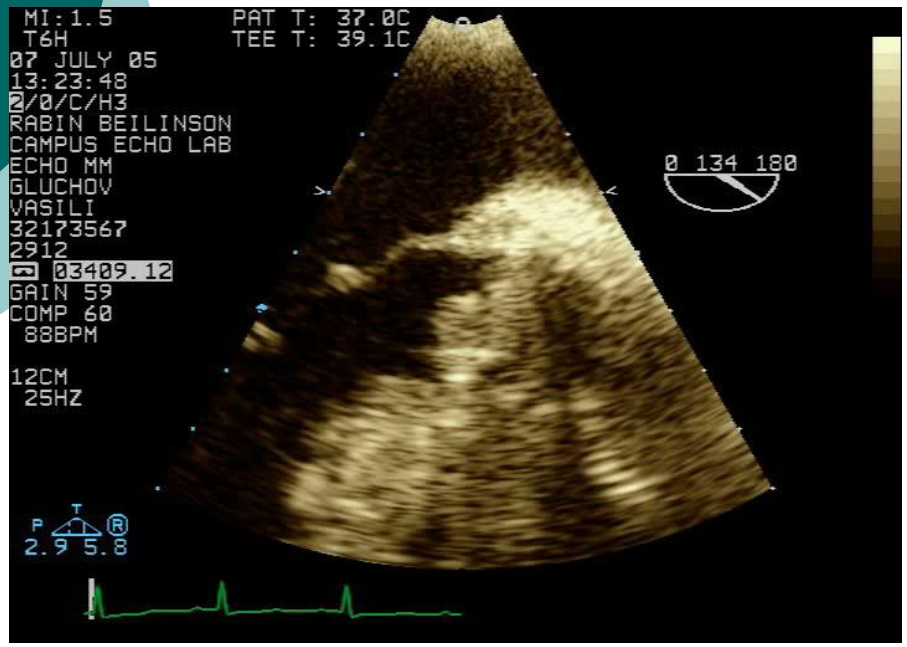
Fluoroscopy post thrombolysis

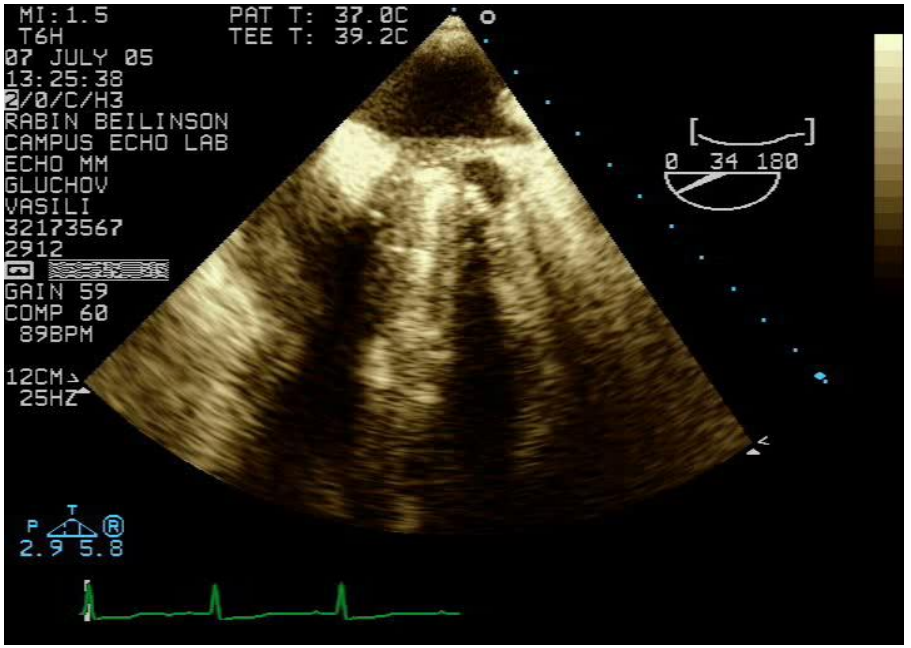


Acute aortic bio-prosthesis obstruction due to infective endocarditis

- A 64 yrs old patient with was admitted to the ICCU with shortness of breath and high fever
- He underwent AVR (xenograft) **a year ago**.

TEE

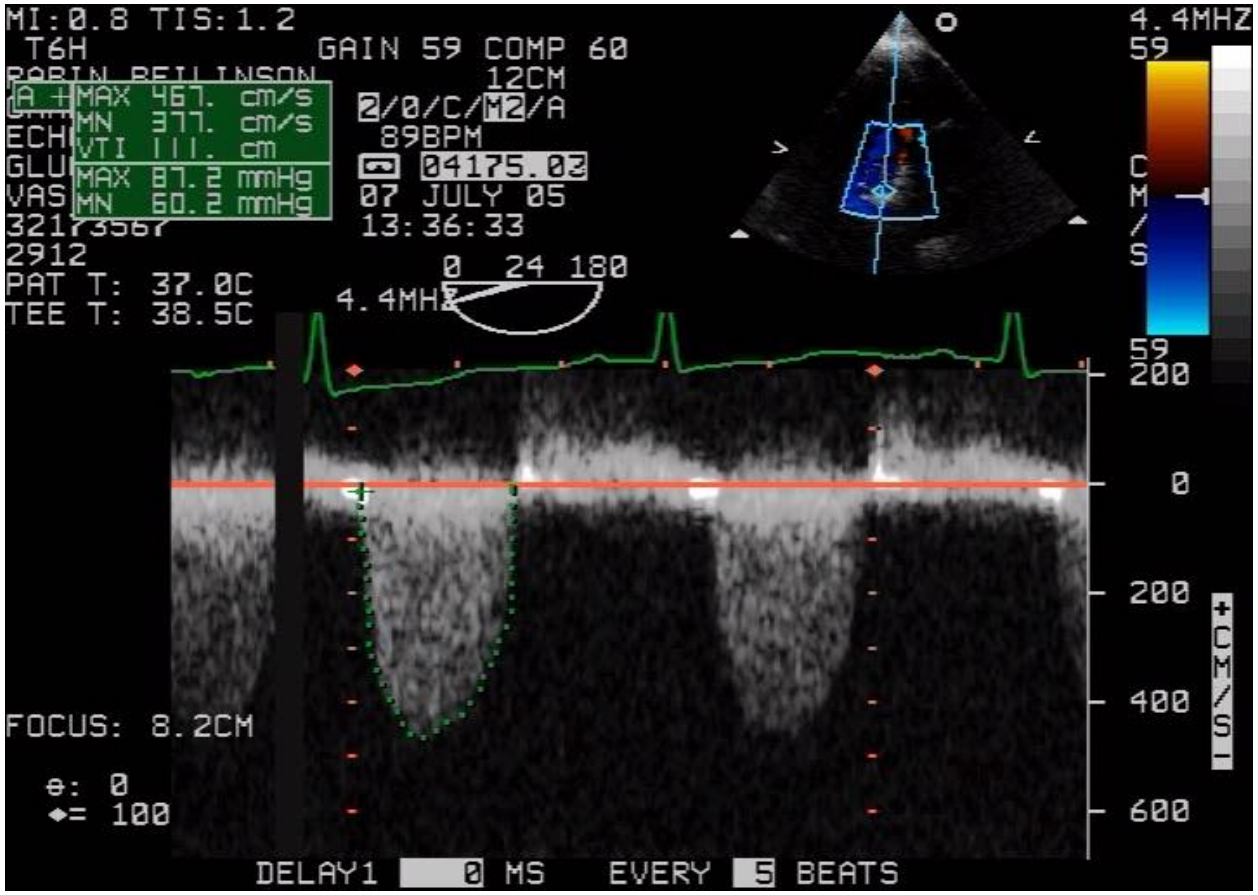




DD: Large obstructive vegetation
Large obstructive thrombus

Doppler TEE

PG = 87 mmHg
MG = 60 mmHg



Clinical course

- Blood cultures revealed gram positive bacilli
- **Endocarditis** causing severe prosthetic valve stenosis was diagnosed.
- IV Antibiotics were started
- The patient was scheduled to surgery after the weekend since he was hemodynamically stable and it was felt by the surgeon that 3 days of IV antibiotics before surgery are important.

Follow-up

- 1 day later the patient suddenly developed shortness of breath cardiogenic shock and died

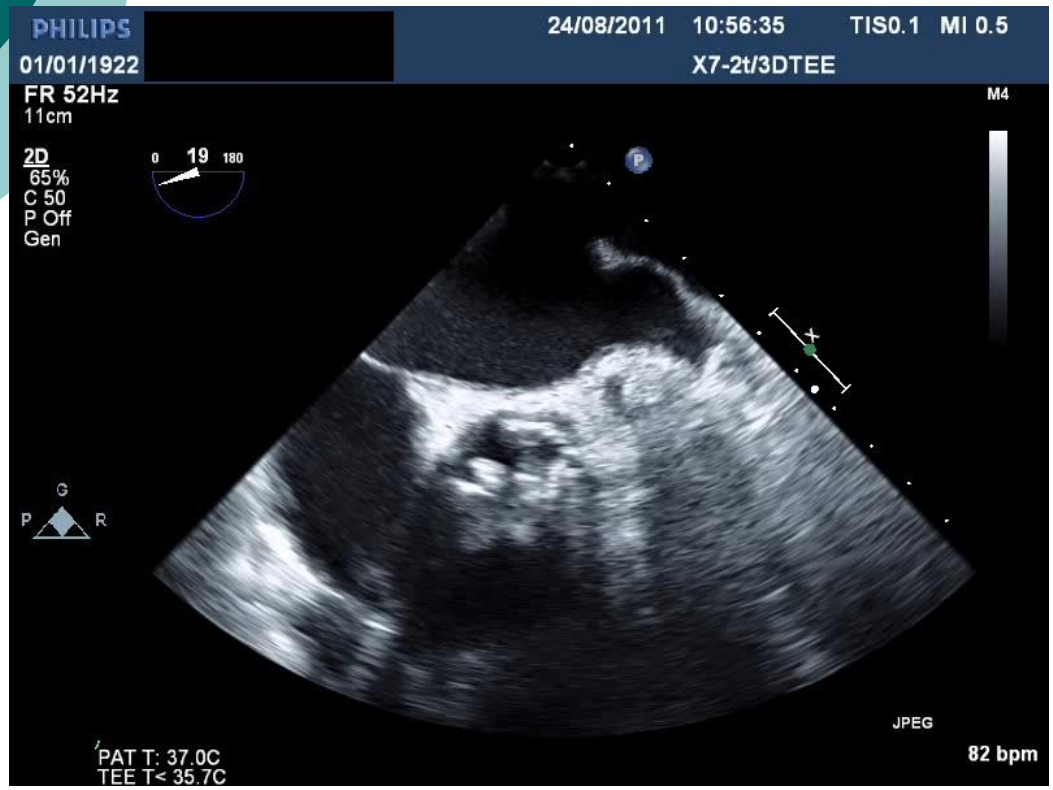
Lesson

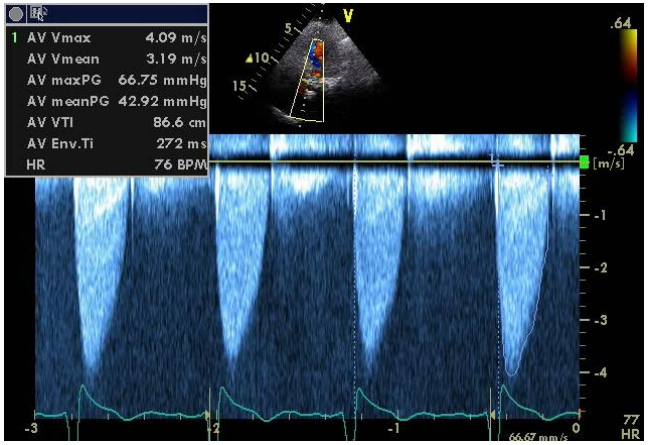
- Biological valve obstruction due to large mass of infectious material is a **true emergency** situation (like stuck mechanical valve). Surgery should be performed immediately.

Emergent valve in valve implantation in a patients severe prosthetic valve stenosis

- A 88 years old woman.
- S/P CABG X 2 and AVR -bioprosthesis 9 years ago
- Admitted because of intractable HF

TEE of degenerated bioprosthesis stenosis





PG = 67 mmHg
MG = 42 mmHg

Contrast injection after Core valve implantation

Summary

- **Echocardiography** is the imaging tool of choice for diagnosing valvular emergencies in the CCU
- **TTE** is usually enough to diagnose the main reason for the patients hemodynamic deterioration

Summary

- **TEE** has a better diagnostic capabilities especially in patients on respirator or post cardiac surgery and in special clinical setting such as prosthetic valve complications and SBE
- **Real time 3D TEE** is a new tool that has some advantages for diagnosis of complex pathologies and monitoring interventions but its added value especially in the ICCU setting is still need to be evaluated

Summary

- Since surgical mortality rates remain high, new interventions such as:
- **Thrombolysis** in stuck mechanical valve
- **Valve in valve** implantation in degenerated bioprosthesis or
- **Percutaneous closure** of severe AR due to paravalvular leaks

May be a good alternative in selected cases

Thank you
מגדל גור שאשא
GOUR SHASHA TOWER
מרכז הלן שניידר לבריאות האישה
مركز هيلين شنايدر لصحة المرأة
Helen Schneider Comprehensive Women's Health Center

Valvular Emergencies in ICCU
Prosthetic Mitral Valve

- **Acute Prosthesis regurgitation**
  - Endocarditis
  - Degenerated biologic valves
  - Stuck mechanical valve
  - Severe paravalvular leak

- **Prosthetic stenosis –stuck valve**
  - Valve thrombosis
  - Valve Pannus
  - Endocarditis

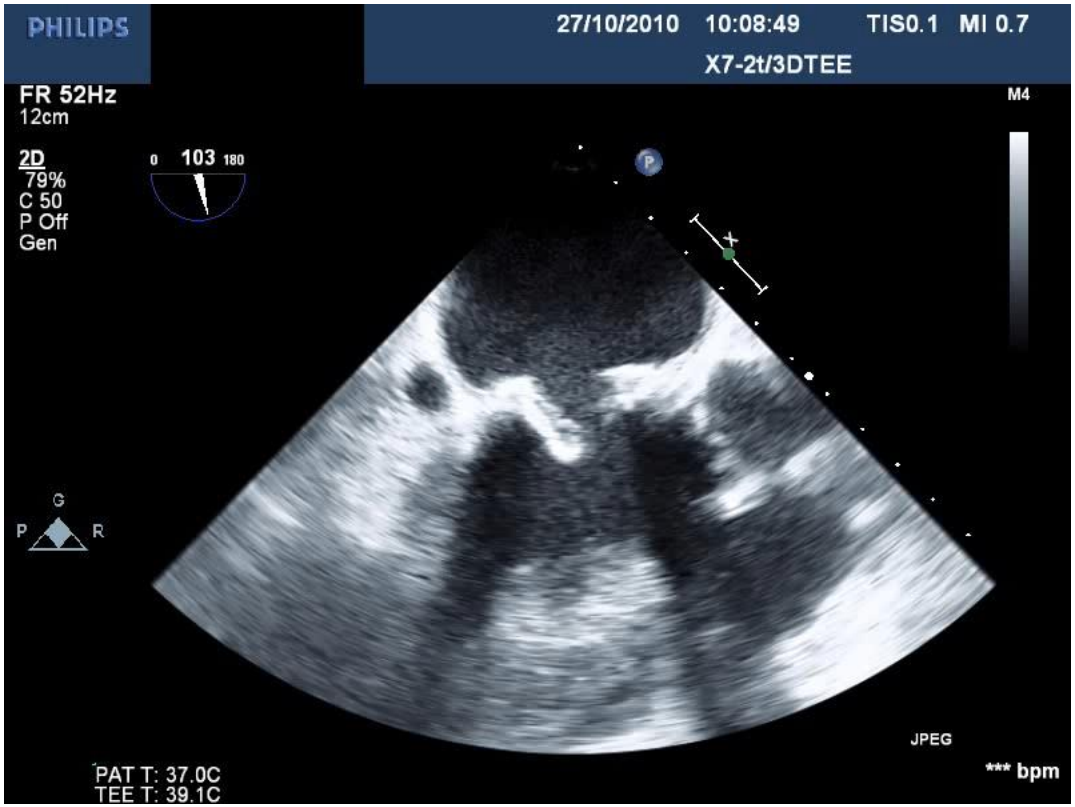
Prosthetic valve Regurgitation

Intra valvular regurgitation in mitral bio-prosthesis

Case history

- A 50 years old women with RHD after 4 valve replacements surgery (redo MVR + TVR).
- Last operation was MVR 12 years ago and a bioprosthesis was implanted
- She was admitted with pulmonary edema

2D TEE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12cm
M4
2D
79%
C 50
P Off
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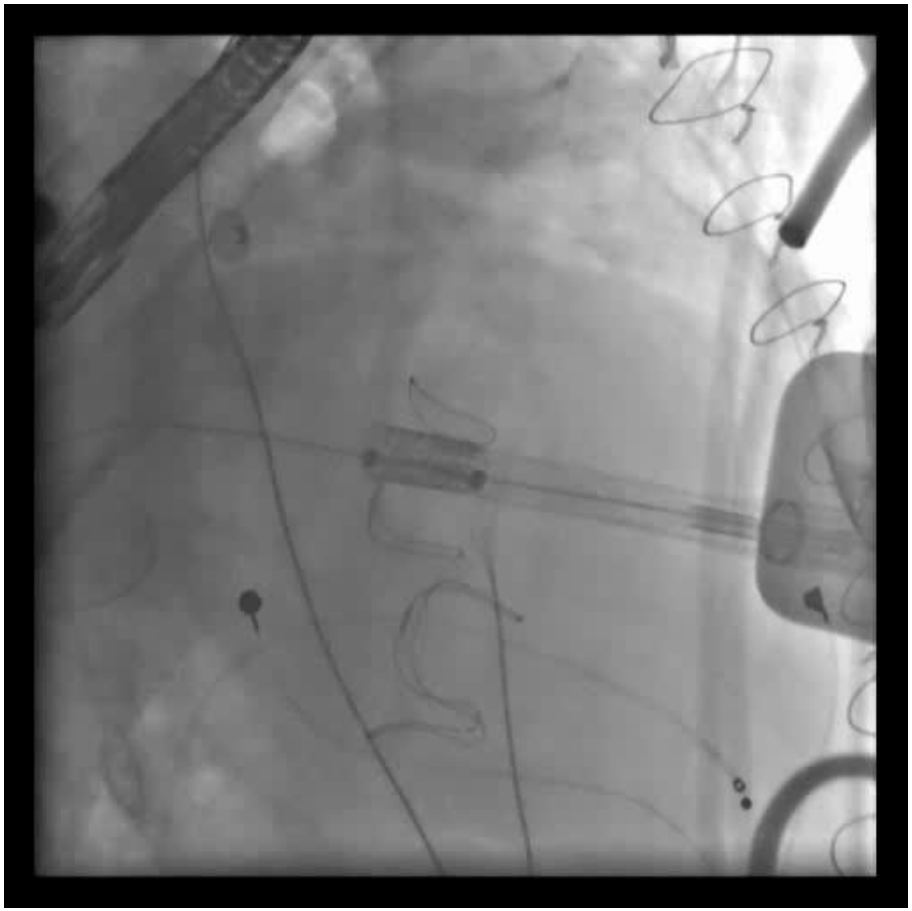
P R
JPEG
PAT T: 37.0C
TEE T: 39.1C
*** bpm

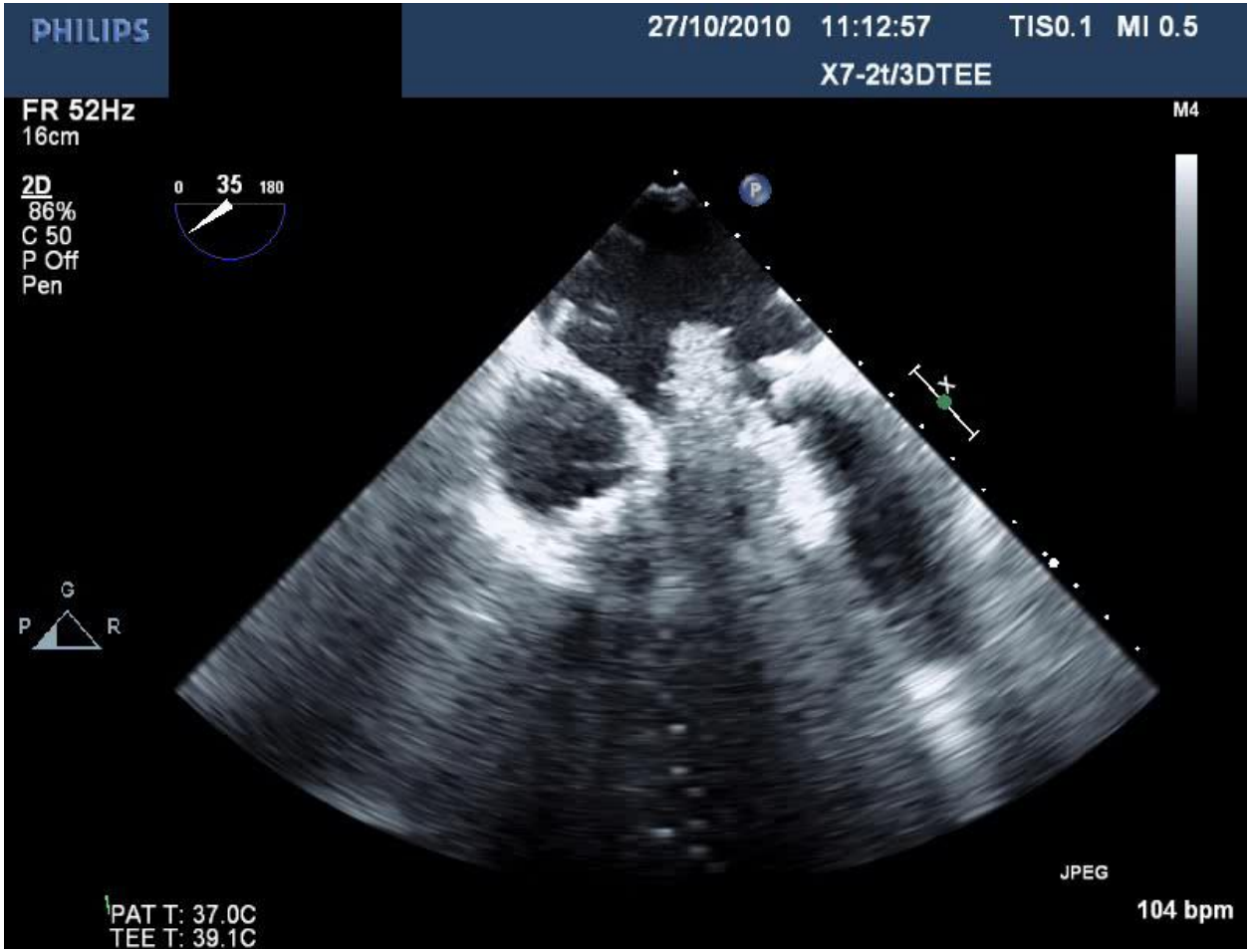
Real time 3D TEE

Valve in valve implantation



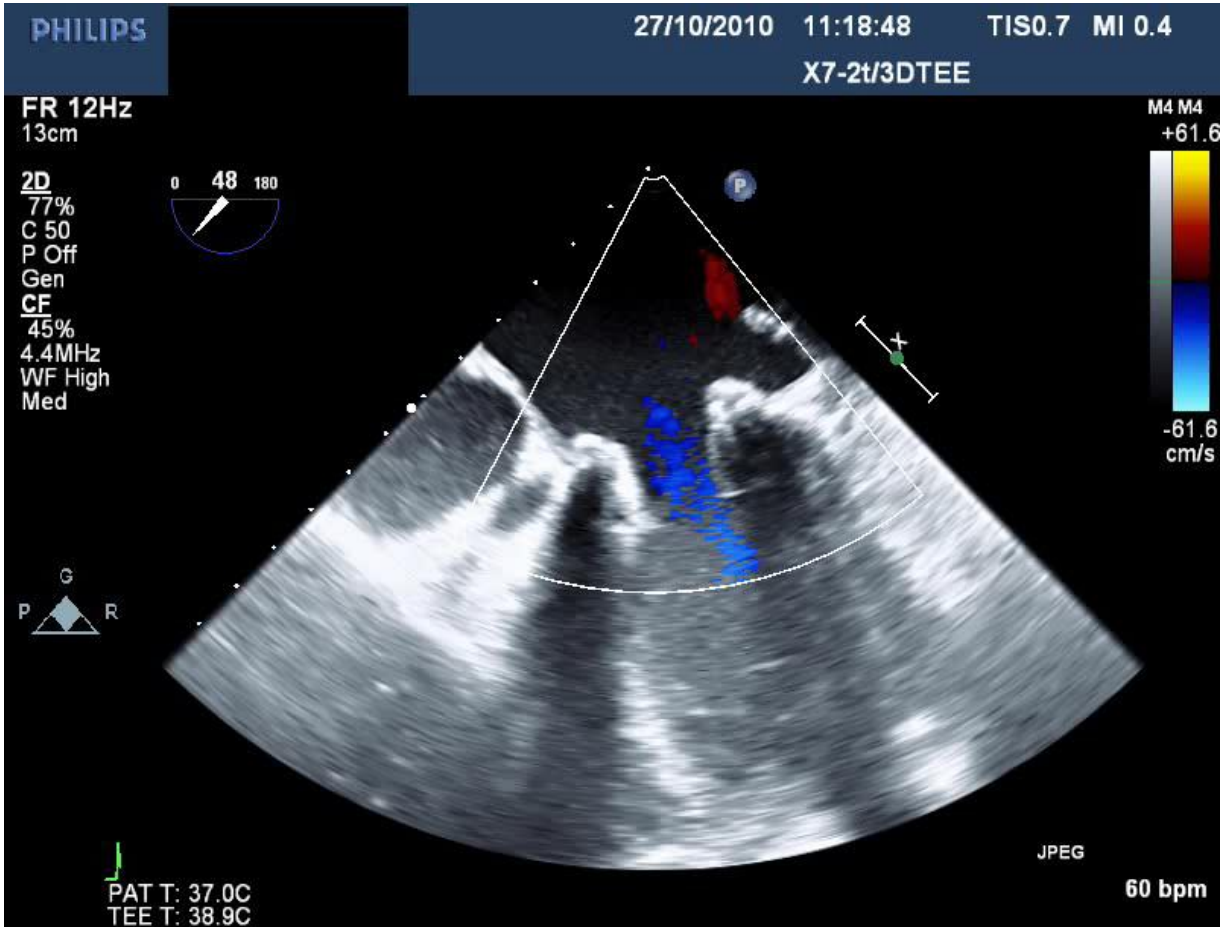
Live 3D echo during procedure

TEE during valve implantation

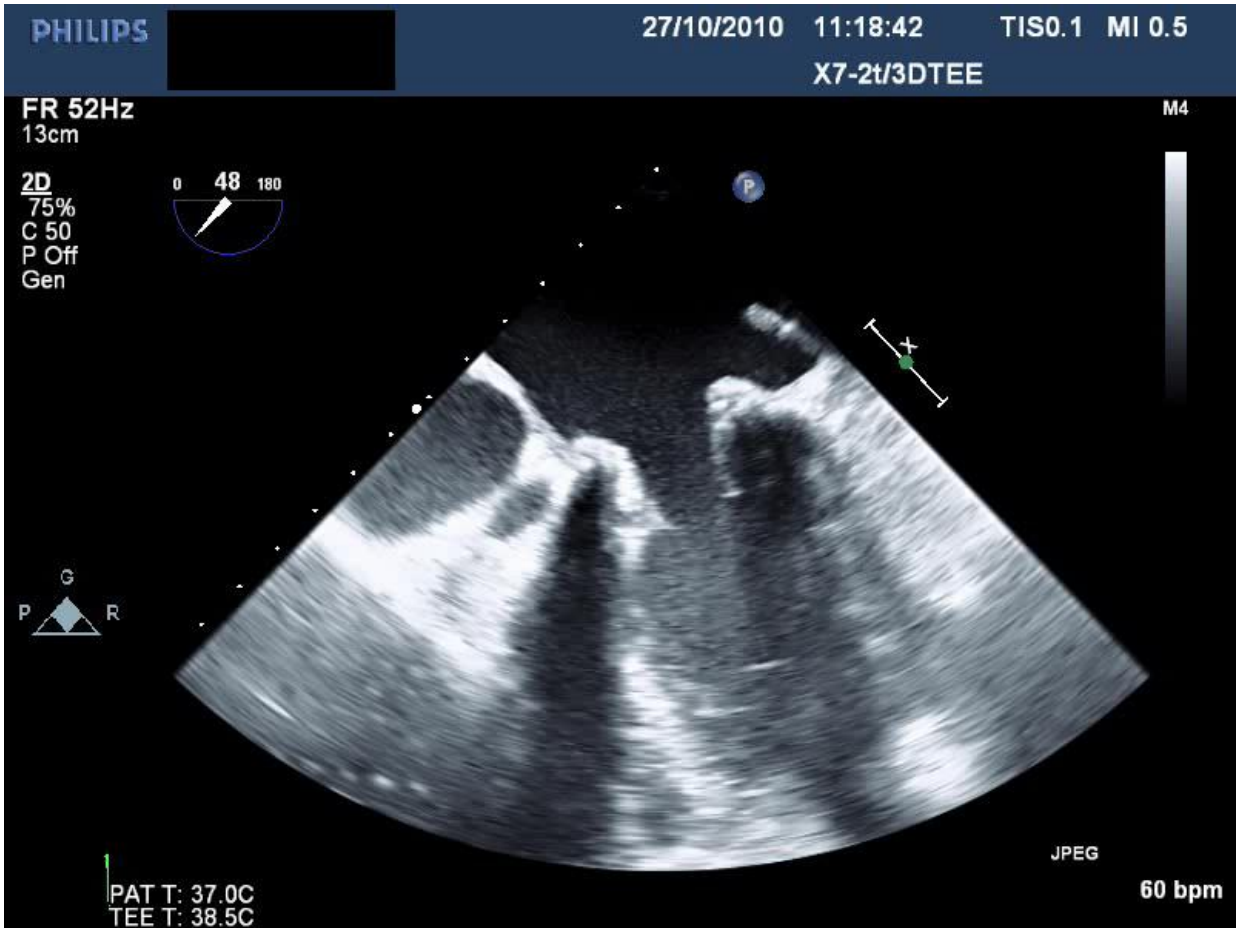


Balloon expandable valve implantation

Color TEE after valve in valve implantation



TEE post valve in valve implantation



3D TEE- POST

PHILIPS
27/10/2010 11:14:55 TIS0.2 MI 0.5
X7-2t/3DTEE
FR 10Hz
8.6cm
M4
Live 3D
3D 0%
3D 40dB
Pen
0 35 180
JPEG
PAT T: 37.0C
TEE T: 39.5C
30 bpm

FOLLOW -UP

- The patient went home after 3 days
- 2years after the procedure she is in FC 1