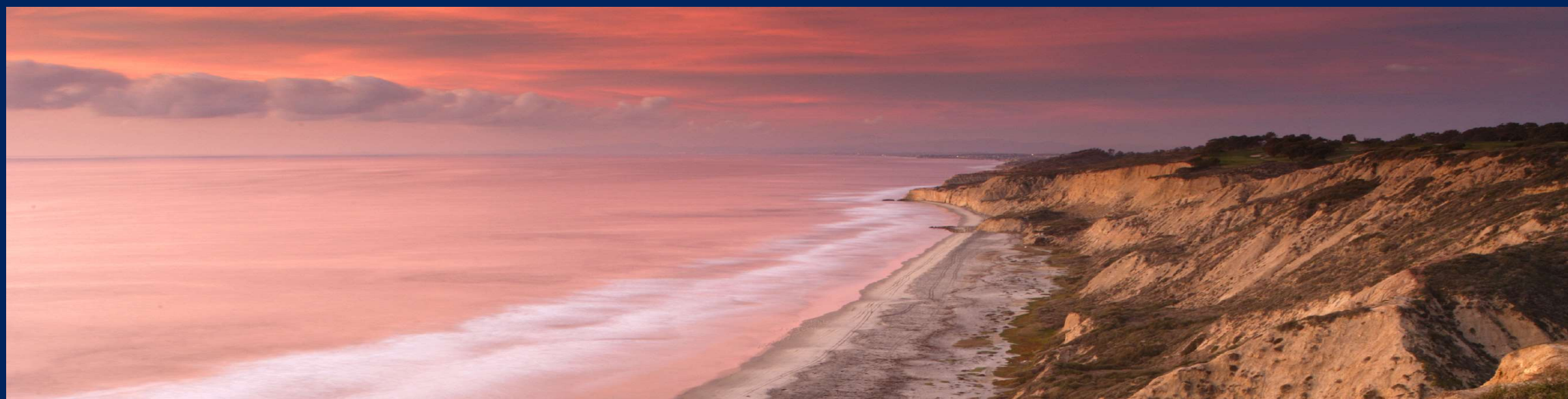




Rescue Echo: TEE as a Compass

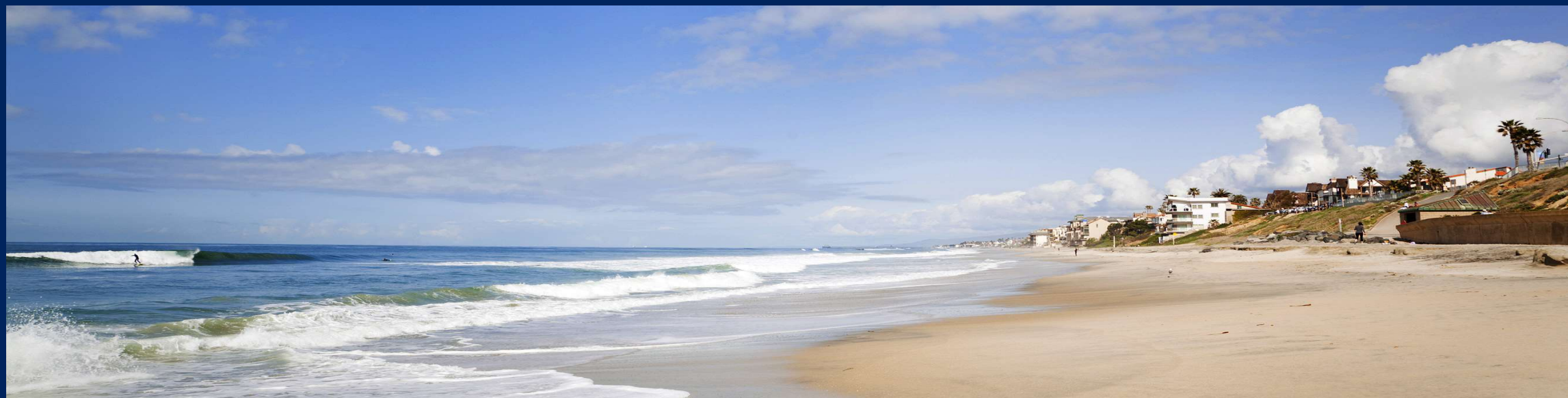
Timothy M. Maus, MD

Clinical Professor of Anesthesiology

Director of Perioperative Echocardiography

Where discoveries are delivered.SM

UC San Diego
SULPIZIO CARDIOVASCULAR CENTER



Disclosures

None

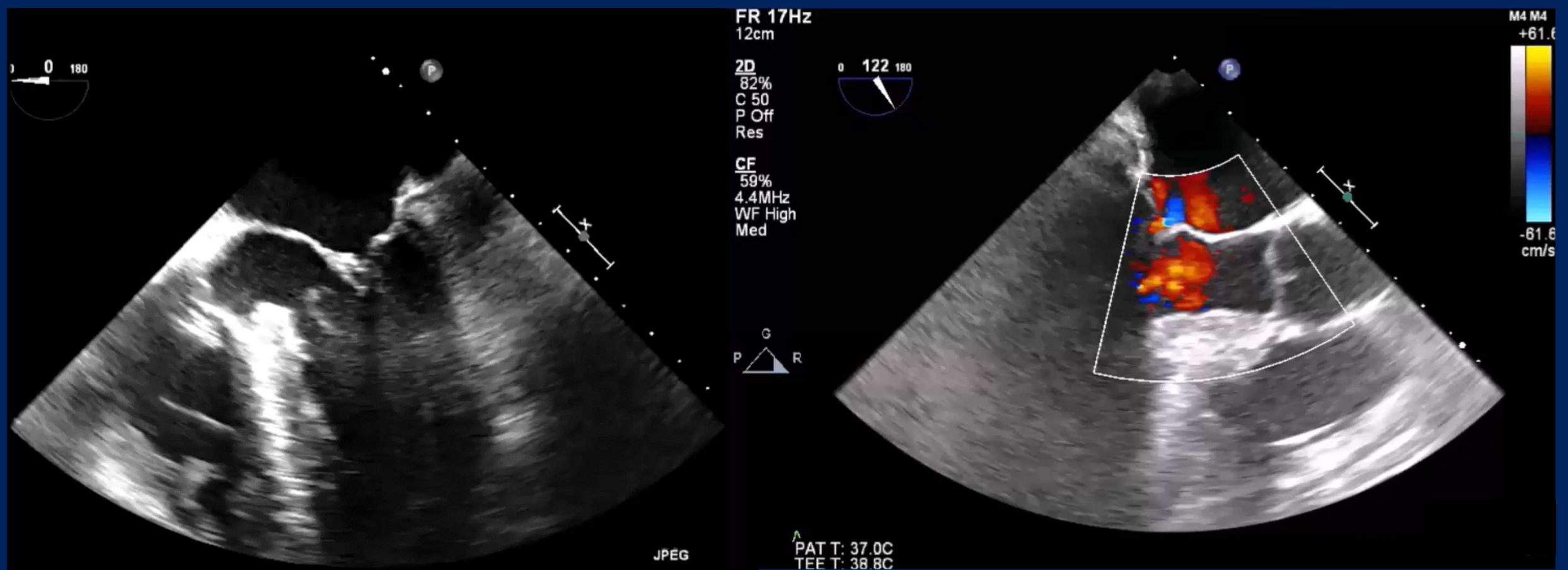
Where discoveries are delivered.SM

UC San Diego
SULPIZIO CARDIOVASCULAR CENTER

Rescue Echo

- **74 y/o F** with PMHx - HTN, HL, DM
- s/f **Hemicolectomy** for Colon CA
- Induced with Lido, Fentanyl, Propofol and Rocuronium
- BP **60/40**, HR 130, Sinus Tachycardia
- Escalating doses of:
 - **Phenylephrine**
 - **Ephedrine**
 - **Epinephrine (plus gtt)**

Rescue Echo



Rescue Echo

Rescue Echo

- **Lecture Objectives**

- Describe the utility of perioperative echo in hemodynamic instability
- Identify common indications for TEE in noncardiac surgery
- Develop a protocol for image acquisition and interpretation
- Review clinical cases

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**

Anesthesiology 2010; 112:1-1

- Updated Guidelines – June 2010
 - Specifically addresses – Non Cardiac Surgery
 - “TEE may be used when the nature of the **planned surgery** or the patient’s known or suspected **cardiovascular pathology** might result in severe hemodynamic, pulmonary, or neurologic compromise.”

Practice Guidelines for Perioperative Transesophageal Echocardiography

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Anesthesiology 2010; 112:1-1

- Updated Guidelines – June 2010
 - Specifically addresses – Non Cardiac Surgery
 - “TEE should be used when **unexplained life-threatening circulatory instability** persists despite corrective therapy.”

- Basic TEE Exam Offers....

INITIAL CERTIFICATION IN ANESTHESIOLOGY

This content outline covers the
In-Training, BASIC, and ADVANCED Examinations

Revised April 2022

The Content Outline for Initial Certification in Anesthesiology reflects the subject matter within the specialty of anesthesiology and provides the framework for the assessment of knowledge. It is the basis for the written examinations (BASIC, ADVANCED, and In-Training) of the core specialty. The Content Outline will serve as a resource in the preparation for the written components of initial board certification as board-certified anesthesiologists are expected to have knowledge within each of the topics.



Definition

- Mobile Diagnostic Modality
 - Relatively non-invasive
- Indicated for Acute Hemodynamic Instability
 - *Persistent Hypotension*
 - *Persistent Hypoxia*
- Quick Diagnosis - **GROSS ABNORMALITIES**
 - *Rapid & Qualitative (not quantitative)*
 - *Not a snapshot, it's a process*
- Institution of Corrective Therapy
- Re-evaluation of Therapy Success

Guidelines for Performing a Comprehensive Transesophageal Echocardiographic Examination: Recommendations from the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists

Rebecca T. Hahn, MD, FASE, Chair, Theodore Abraham, MD, FASE, Mark S. Adams, RDCS, FASE, Charles J. Bruce, MD, FASE, Kathryn E. Glas, MD, MBA, FASE, Roberto M. Lang, MD, FASE, Scott T. Reeves, MD, MBA, FASE, Jack S. Shanewise, MD, FASE, Samuel C. Siu, MD, FASE, William Stewart, MD, FASE, and Michael H. Picard, MD, FASE, *New York, New York; Baltimore, Maryland; Boston, Massachusetts; Rochester, Minnesota; Atlanta, Georgia; Chicago, Illinois; Charleston, South Carolina; London, Ontario, Canada; Cleveland, Ohio*

Table 5. Procedure Classification of Patients Receiving Perioperative "Rescue" Echocardiography

Surgical Procedure Classification	Count (N = 31)	Percent
Abdominal	13	41.90

Table 6. Perioperative "Rescue" Echocardiographic Results

Rescue Echocardiographic Findings	Number of Patients (N = 31)	Percentage of Patients*
LV dysfunction	16	52
Systolic dysfunction	14	45
Mild dysfunction, EF 50%-41%	0	0
Moderate dysfunction, EF 40%-21%	4	13
Severe dysfunction, EF ≤20%	10	32
Diastolic dysfunction	7	23
Mild dysfunction (E < A, S > D)	2	6
Moderate dysfunction (E > A, S < D)	1	3
Severe dysfunction (E: A > 2)	4	13
RV dysfunction	9	29
Mild dysfunction, EF 50%-41%	1	3
Moderate dysfunction, EF 40%-21%	4	13
Severe dysfunction, EF ≤20%	4	13
Hypovolemia	5	16
Segmental WMAs	4	13
Cardiac tamponade	1	3
Pulmonary embolism	5	16

Abbreviations: RHF, right-heart failure; WMAs, wall motion abnormalities.

*Note some totals equal >100%; many patients were found to have multiple abnormalities on echocardiographic examination.

Obstetric	1	3.20
Cesarean section		
Otolaryngology	1	3.20
Sinus endoscopy		

Basic Perioperative Transesophageal Echocardiography Examination: A Consensus Statement of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists

Scott T. Reeves, MD, FASE, Alan C. Finley, MD, Nikolaos J. Skubas, MD, FASE,
Madhav Swaminathan, MD, FASE, William S. Whitley, MD, Kathryn E. Glas, MD, FASE,
Rebecca T. Hahn, MD, FASE, Jack S. Shanewise, MD, FASE, Mark S. Adams, BS, RDCS, FASE,
and Stanton K. Shernan, MD, FASE, for the Council on Perioperative Echocardiography of the American Society
of Echocardiography and the Society of Cardiovascular Anesthesiologists, *Charleston, South Carolina; New York,
New York; Durham, North Carolina; Atlanta, Georgia; Boston, Massachusetts*

Anesth Analg. 2018 Jun

Development for Noncardiac

Genevieve E. Staudt, MD

Intraoperative
dynamic comp
Echo Protocol
rescue TEE. W
throughout the
surgical servic
management,
(Anesth Analg

Rescue Echo Protocol

Indications:

Refractory Hypotension
Hypoxia
EKG changes
Arrhythmias
Cardiac Arrest

Contraindications:

Esophageal stricture
Esophageal trauma
Esophagectomy

Events to Exclude

Shock state
Hypovolemic
Distributive
Cardiogenic

Tamponade

Tension Pneumothorax

Pulmonary Embolism

Myocardial Infarction

SAM/HOCM

Aortic Dissection

PFO (Hypoxia)

Exam Sequence



ME 4 Chamber



ME AV LAX



ME Bicaval



TG SAX



Aorta



Developed by Genevieve Staudt, MD and
Ken Shelton, MD.

BRIEF REPORT

hy Protocol

ol when hemo-
ion, a Rescue
l performing a
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c compromise.

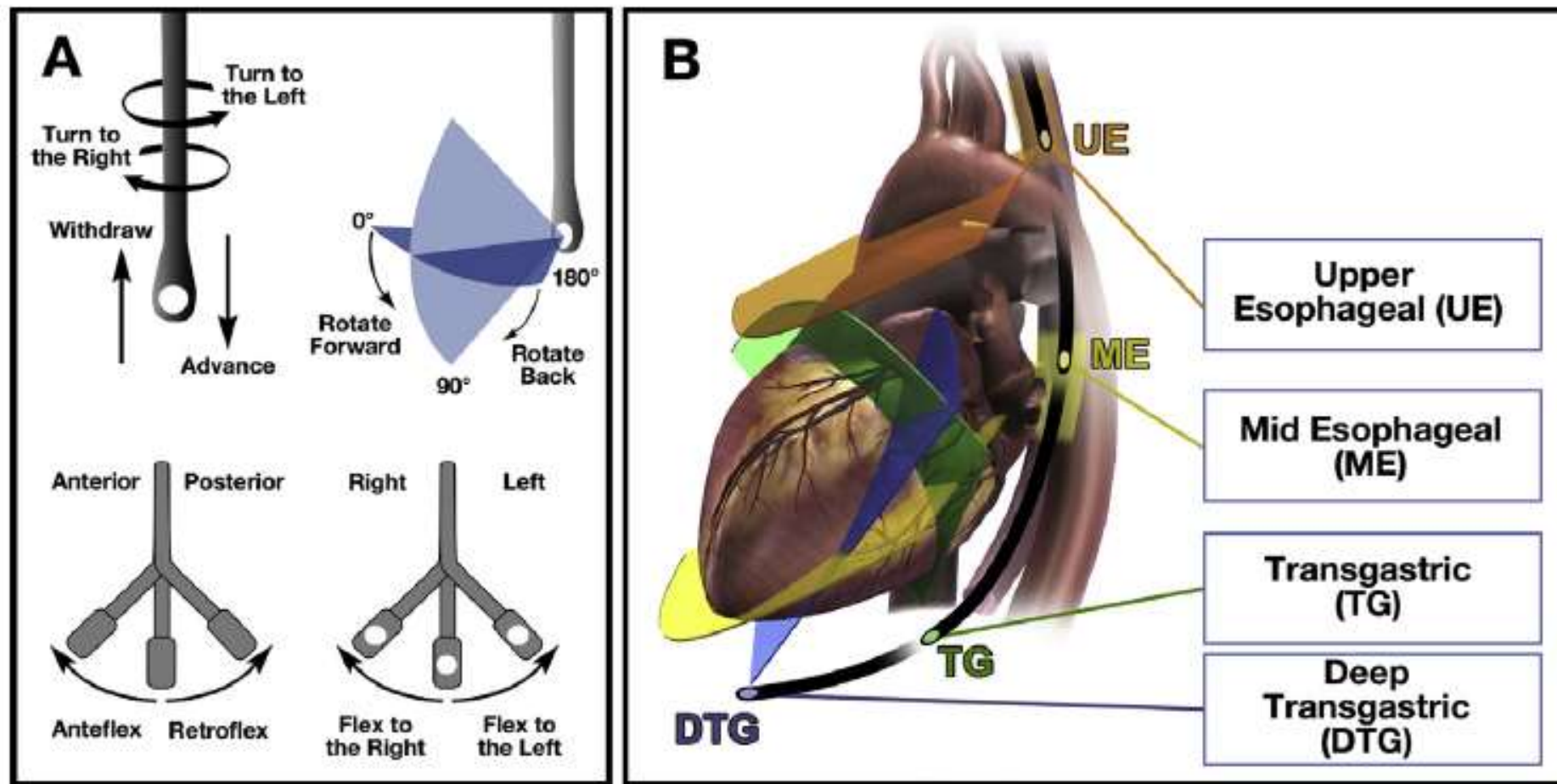
5

Intervention^a

Cardiac catheterization	2	4.2
Cardiology consult	7	14.6
Case cancellation	6	12.5
ECMO	1	2.1
Fluid resuscitation	5	10.4
Imaging study	2	4.2
Inotropic support	2	4.2
Surgical intervention	4	8.3
Upgraded level of care	9	18.7
Vasopressor support	4	8.3
Other ^c	3	6.3
No change	13	27.1

The Rescue TEE Exam

Probe and Manipulation

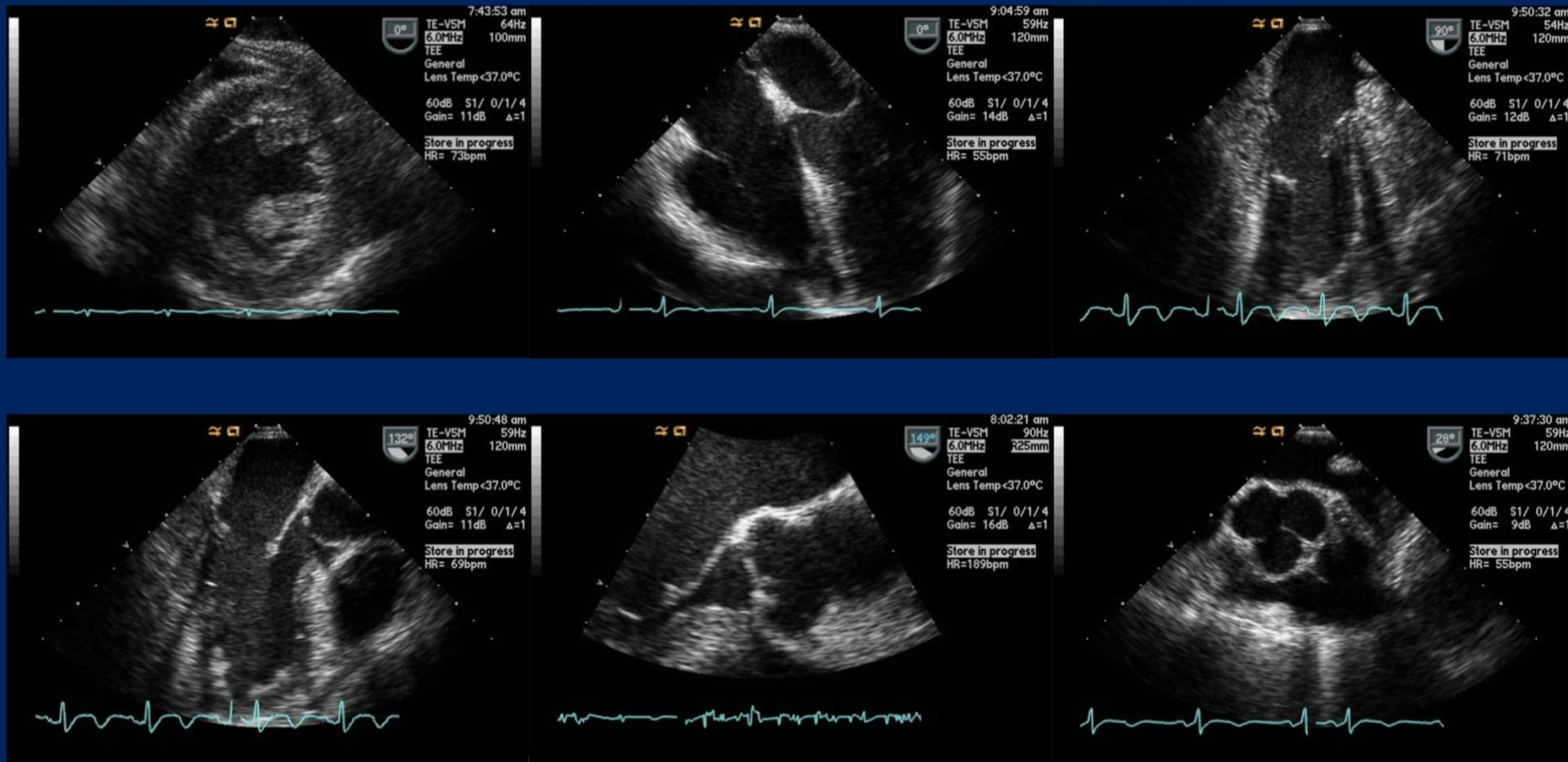


UCSD Rescue Echo Protocol

- 6 Initial View Exam
 - **GROSS ABNORMALITIES**
 - Rapidly identifies major causes, allows prompt treatment
- 5 Additional Views
 - If diagnosis still unclear
- Comprehensive Exam
 - Once patient stability allows
 - Probe positions & Omniplane Angles are simply guides...

UCSD Rescue Echo Protocol

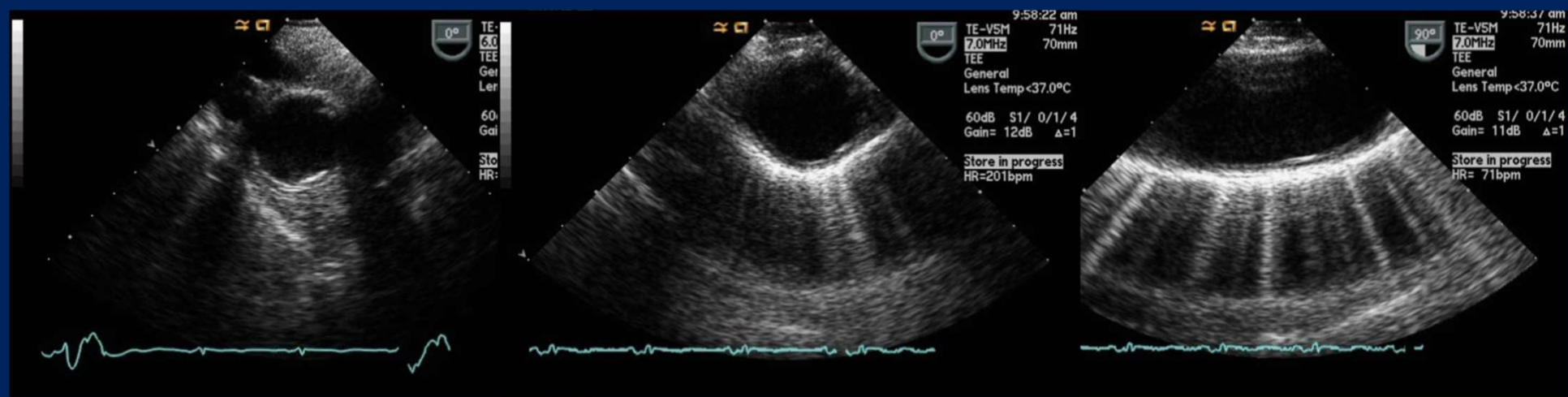
- 6 Initial View Exam



If diagnosis unclear...

5 additional views

5 Additional Views



Utilizing TEE in Hemodynamic Instability

- **Global and Regional LV Function**
- **RV Function**
- **Basic Valvular Lesions**
- **Pulmonary Embolism**
- **Venous Air Embolism**
- **Pericardial Effusion**
- **Simple Congenital Heart Disease**

EXPERT CONSENSUS STATEMENT

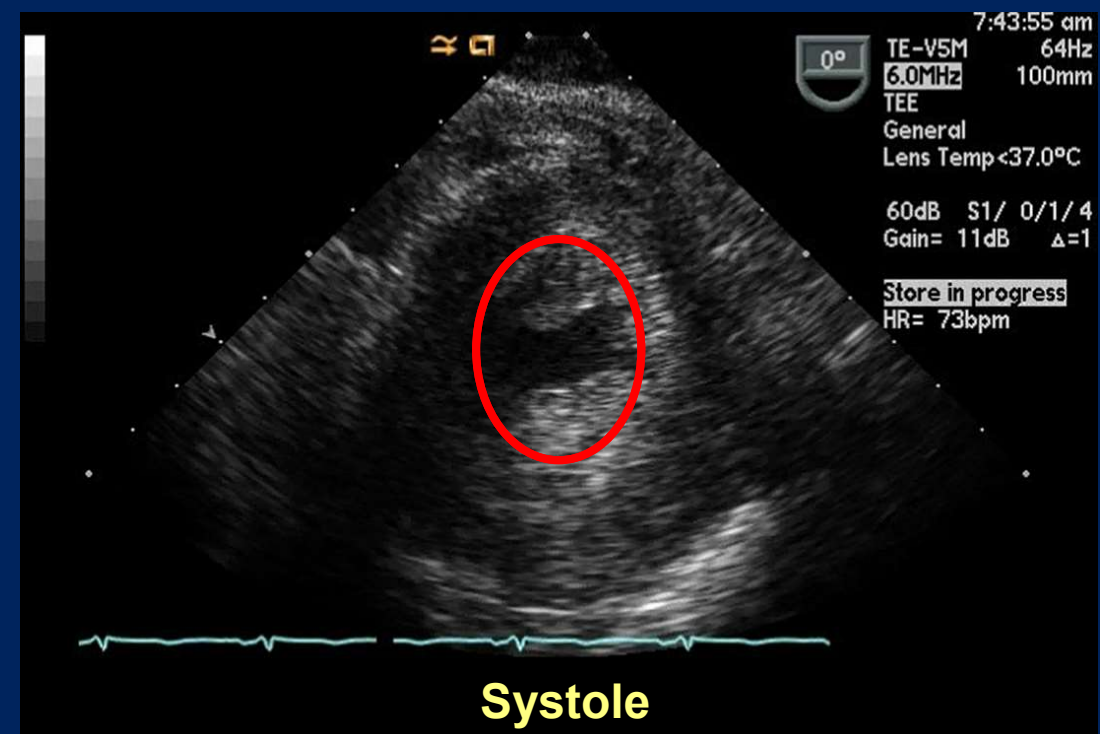
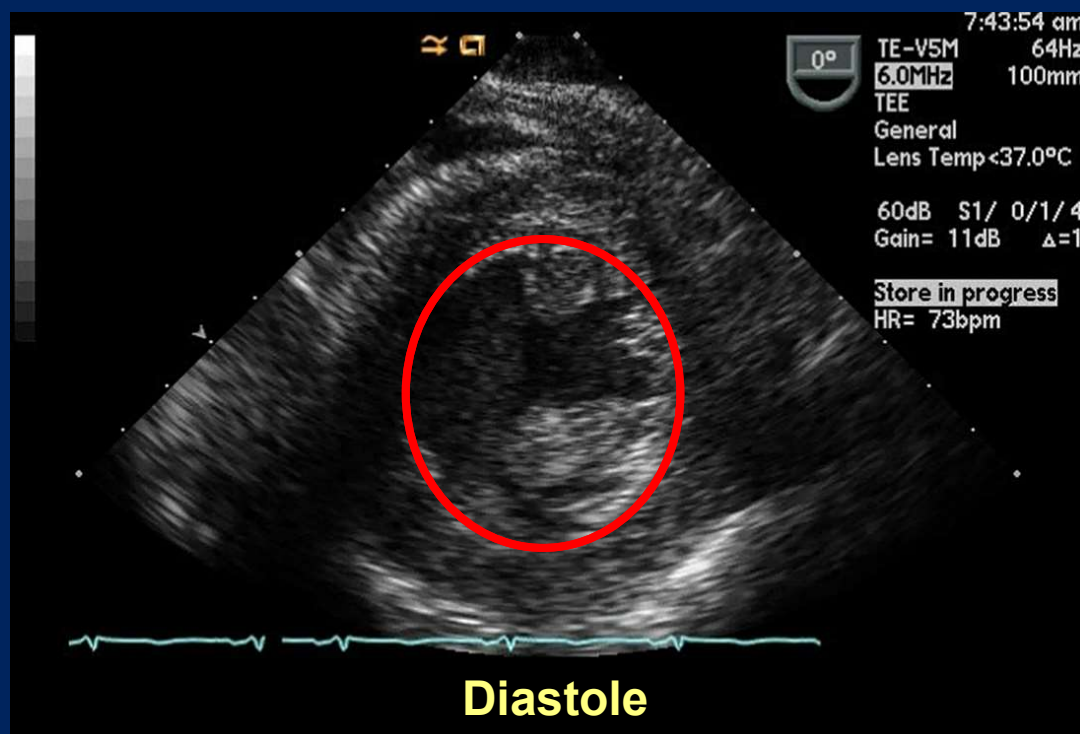
Basic Perioperative Transesophageal Echocardiography Examination: A Consensus Statement of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists

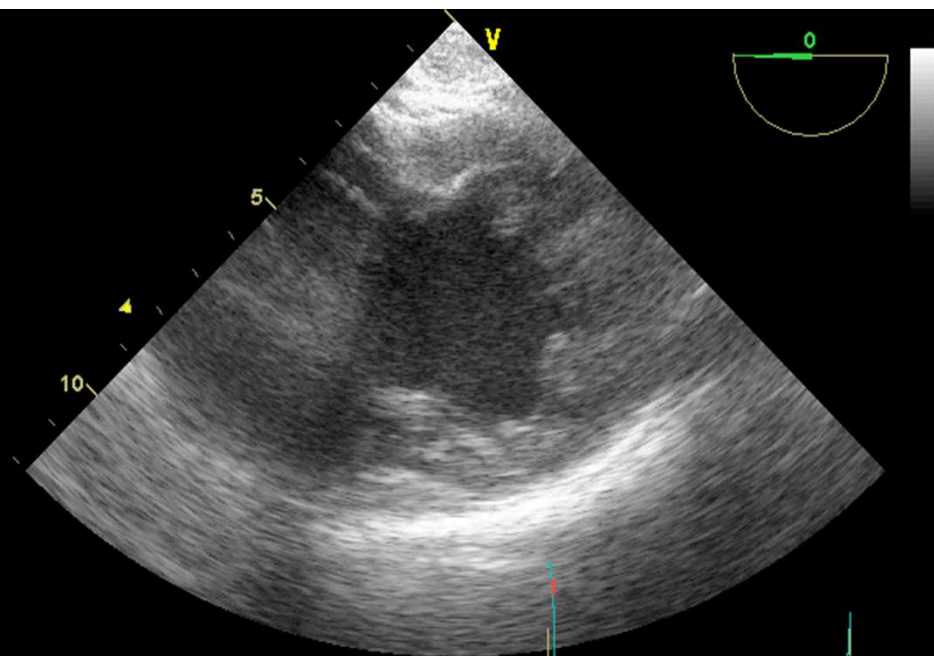
Scott T. Reeves, MD, FASE, Alan C. Finley, MD, Nikolaos J. Skubas, MD, FASE, Madhav Swaminathan, MD, FASE, William S. Whitley, MD, Kathryn E. Glas, MD, FASE, Rebecca T. Hahn, MD, FASE, Jack S. Shanewise, MD, FASE, Mark S. Adams, BS, RDCS, FASE, and Stanton K. Shernan, MD, FASE, for the Council on Perioperative Echocardiography of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists, *Charleston, South Carolina; New York, New York; Durham, North Carolina; Atlanta, Georgia; Boston, Massachusetts*

(J Am Soc Echocardiogr 2013;26:443-56.)

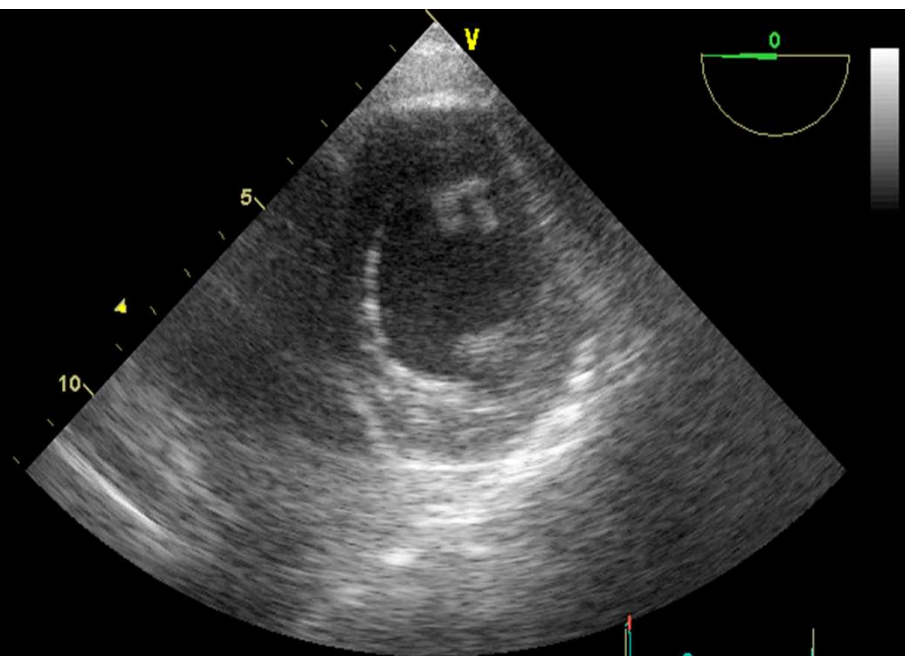
Global LV Function

- Most common indication for basic echo exam
- Qualitative visual estimation

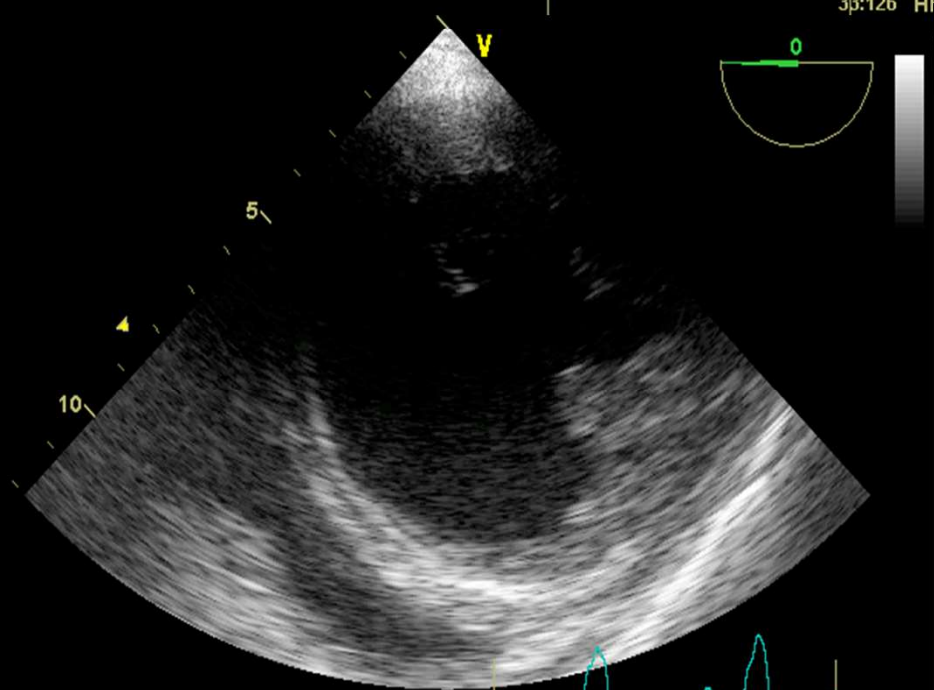




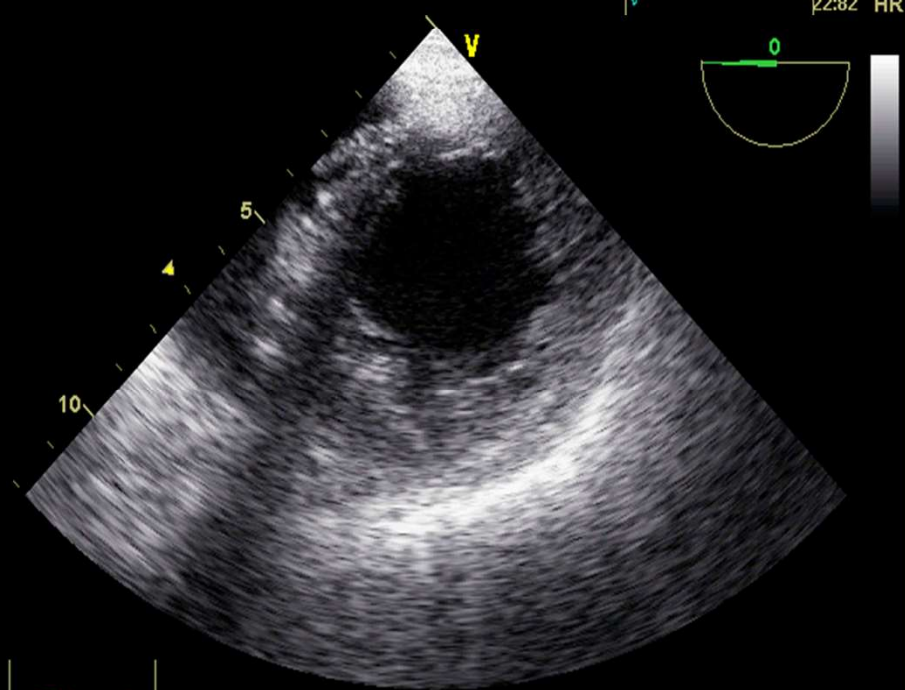
4:33:126 HI



65 HR 22:82

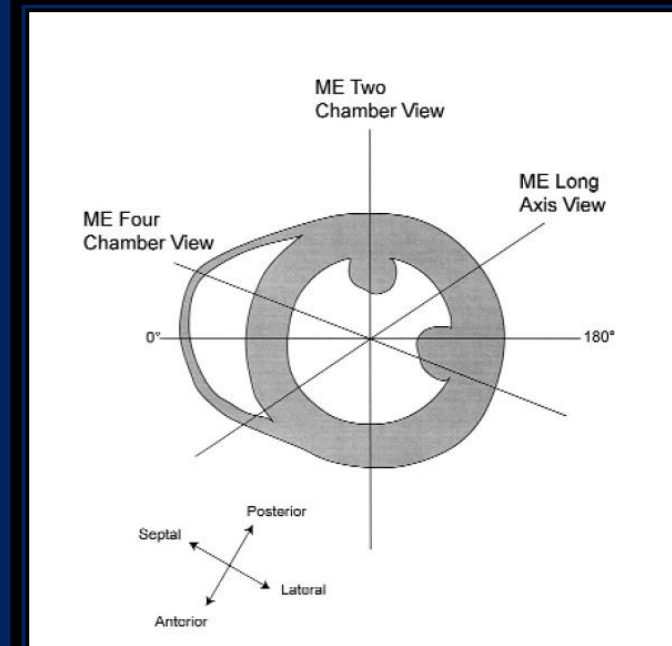
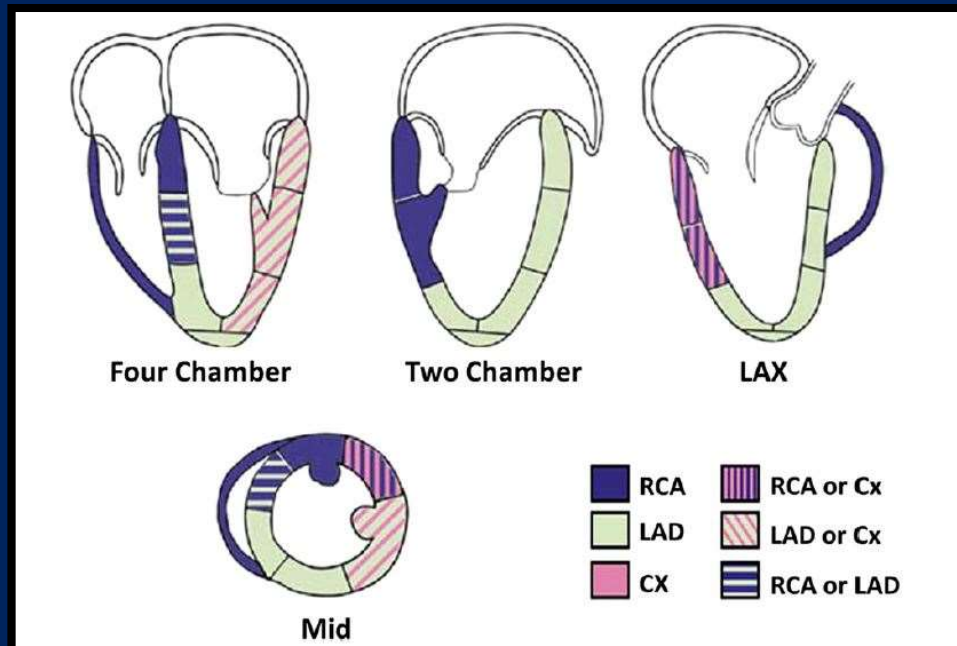


1:73



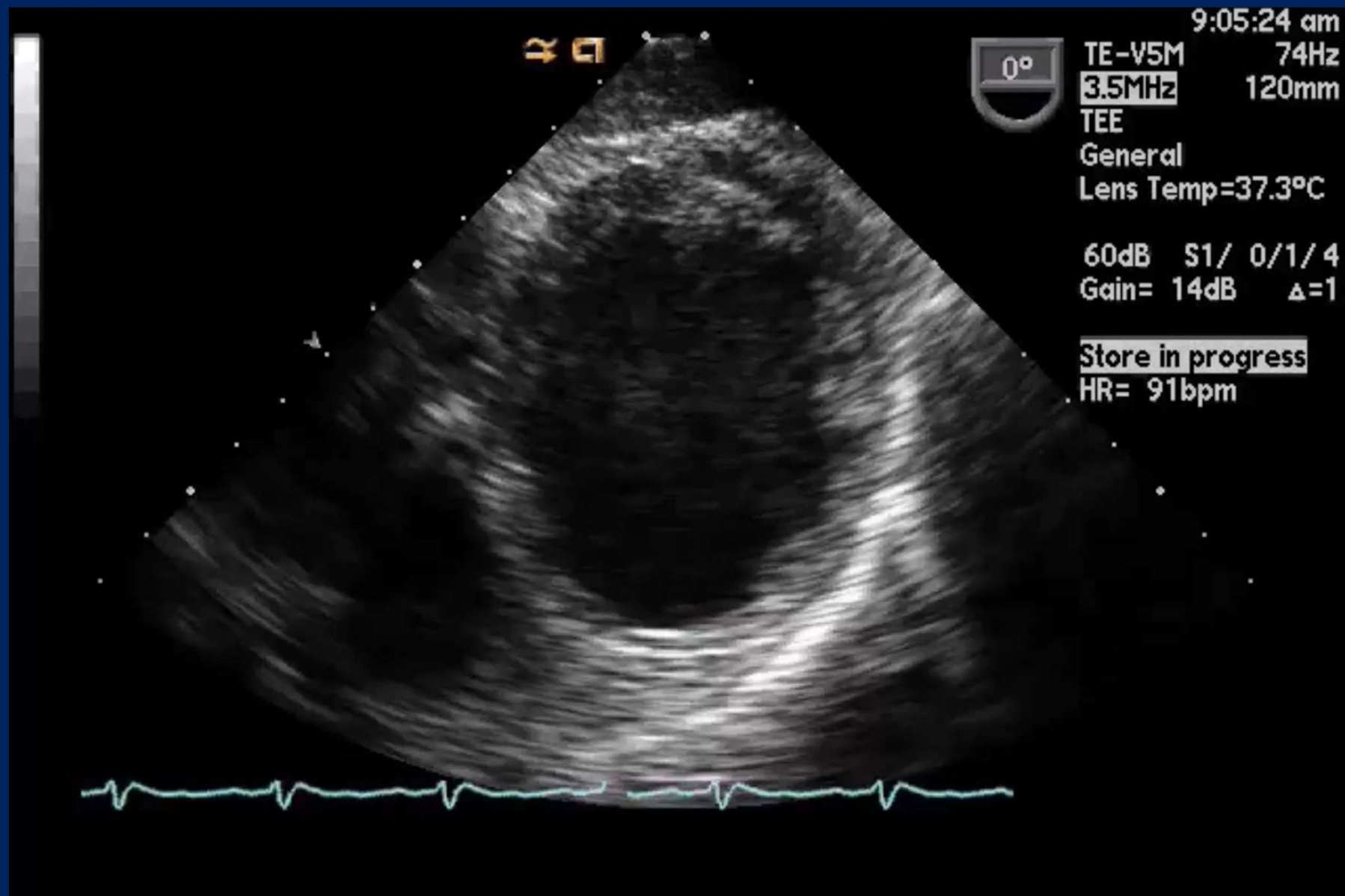
86 HR 3:58

Regional LV Function

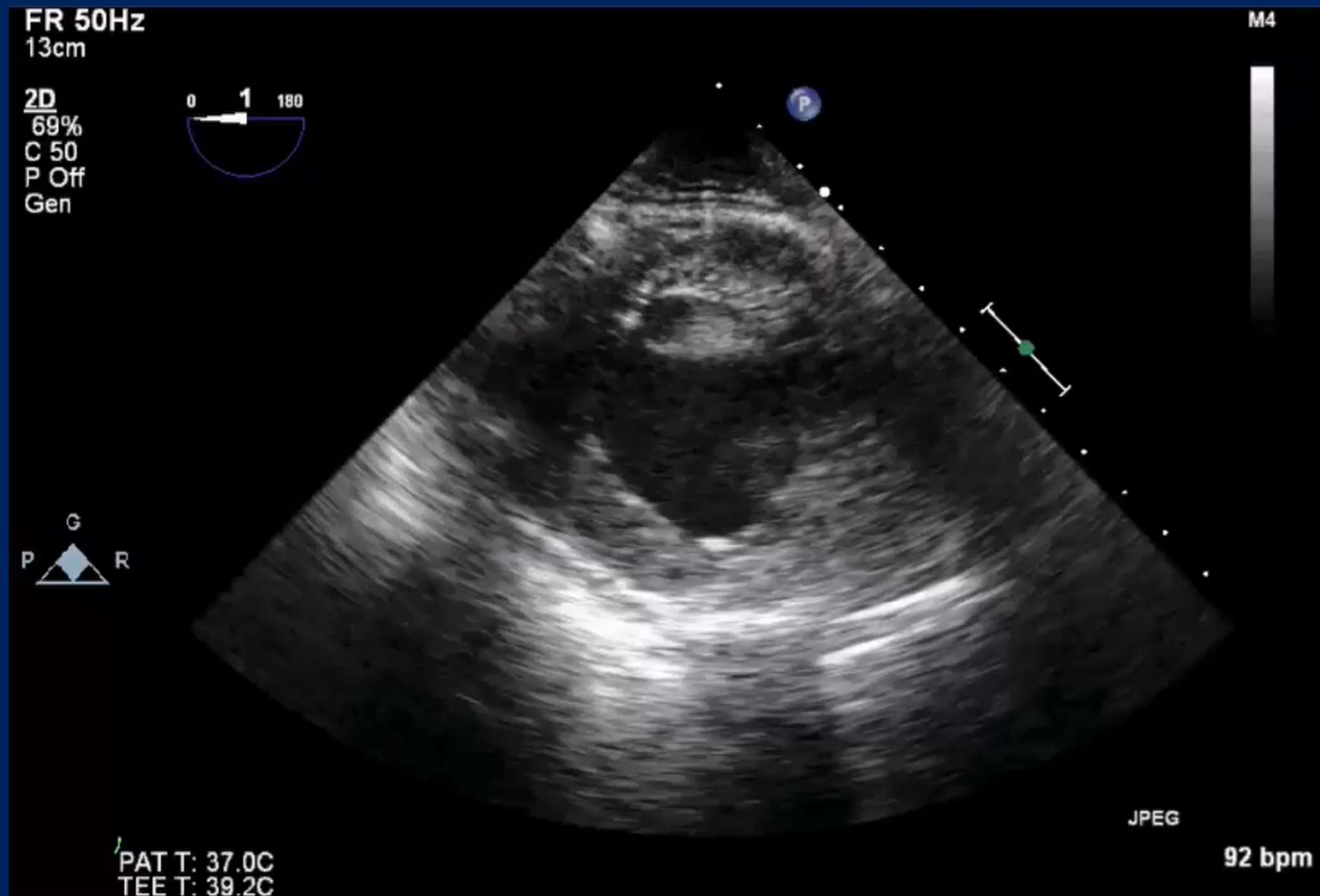


Grade	Endocardial Motion (%)	Wall Thickening (%)
Normal	> 30	30 – 50
Hypokinesis	10 – 30	<30
Akinesis	None	< 10
Dyskinesis	Outward movement	Absent or systolic thinning

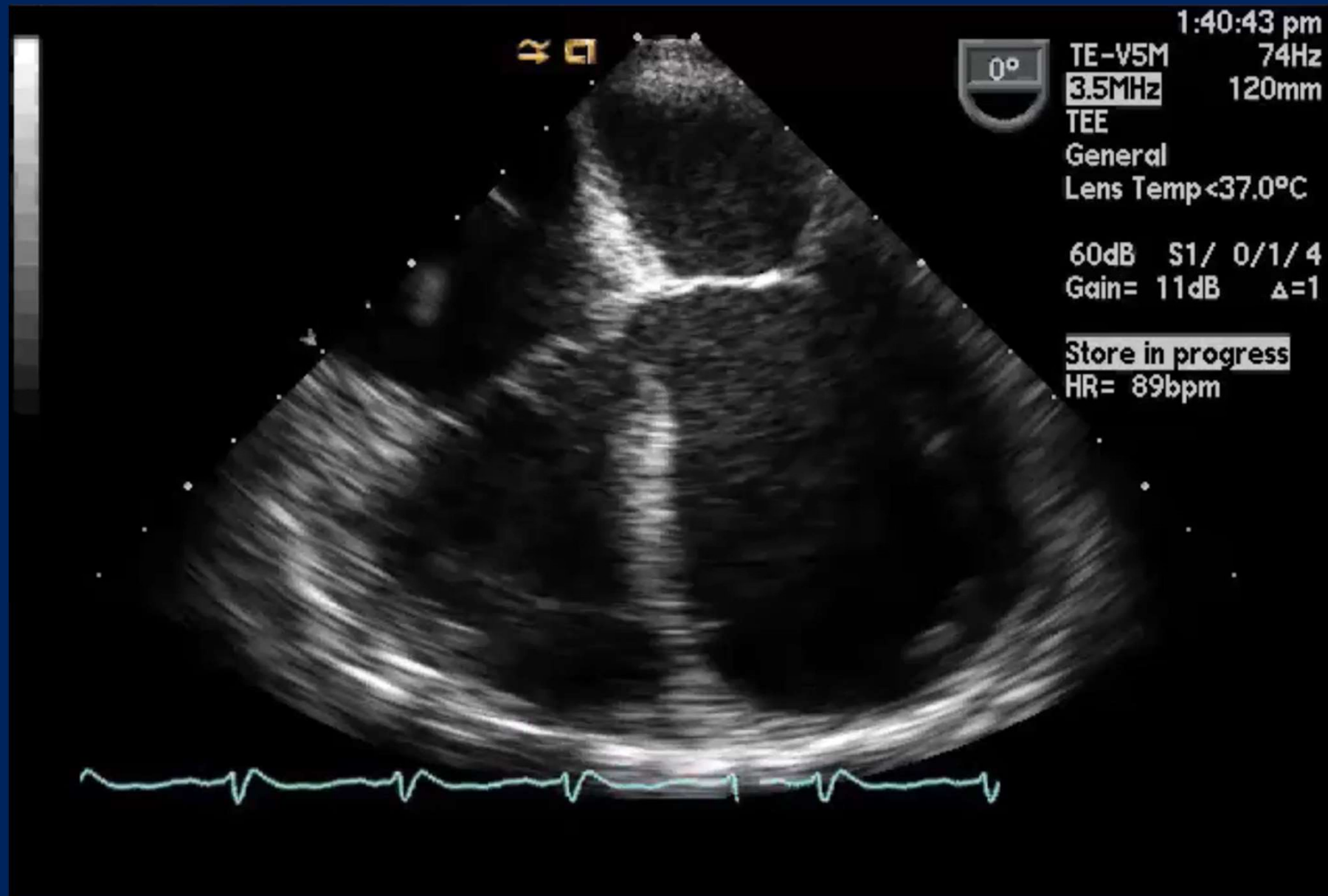
Regional LV Function



Regional LV Function



Regional LV Function



Regional LV Function

FR 52Hz
14cm

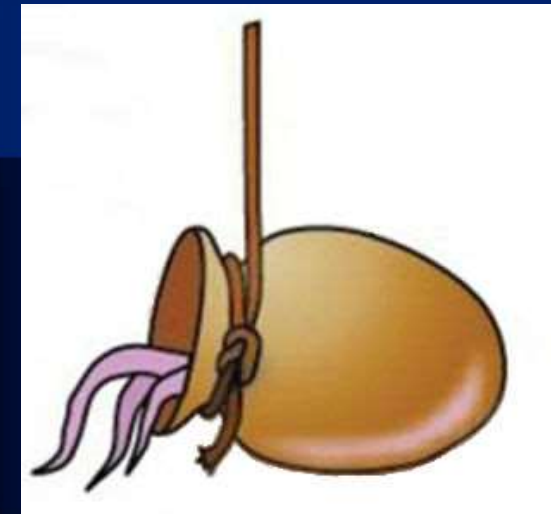
2D
72%
C 50
P Off
Gen



PAT T: 37.0C
TEE T: 39.6C

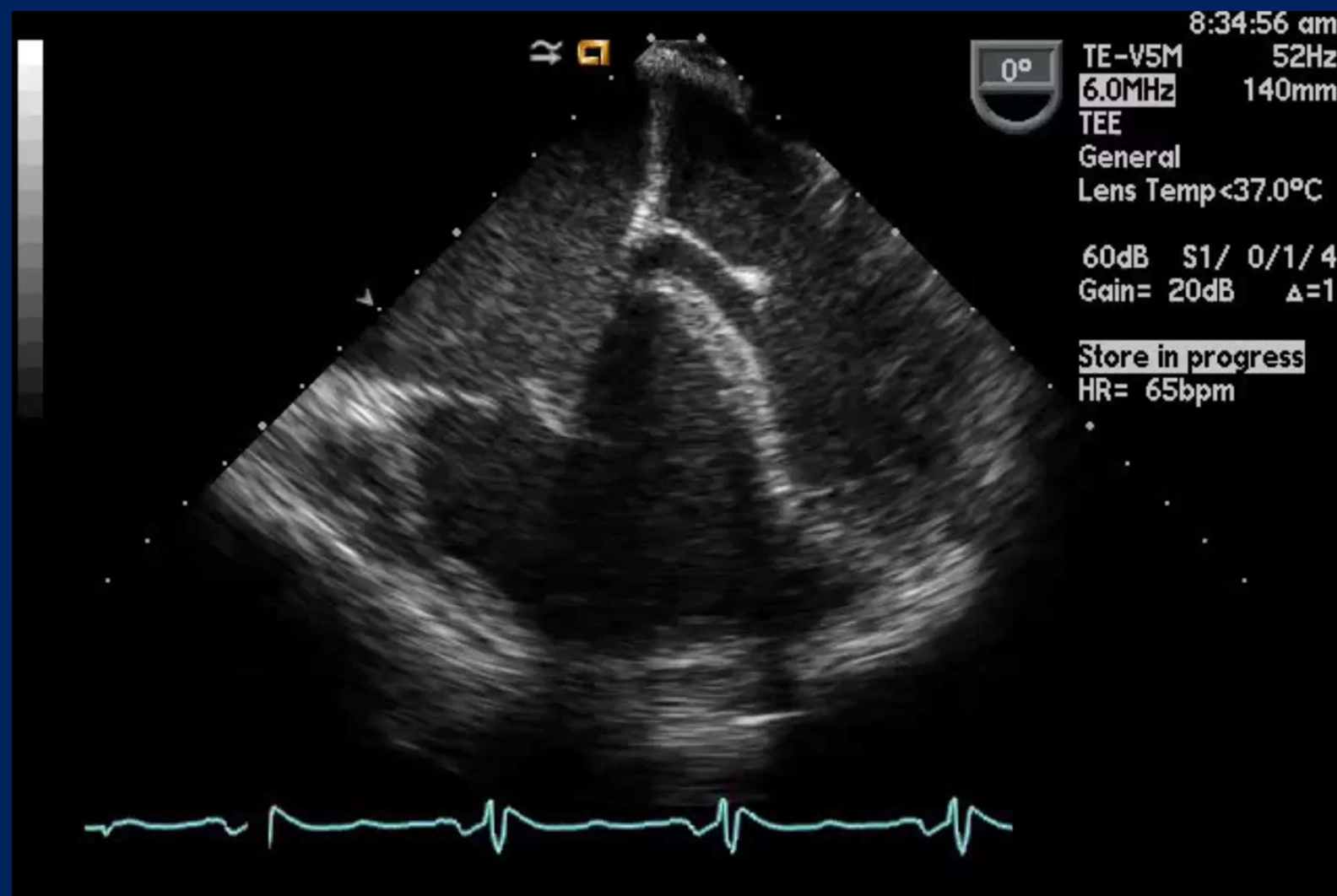
JPEG

81 bpm



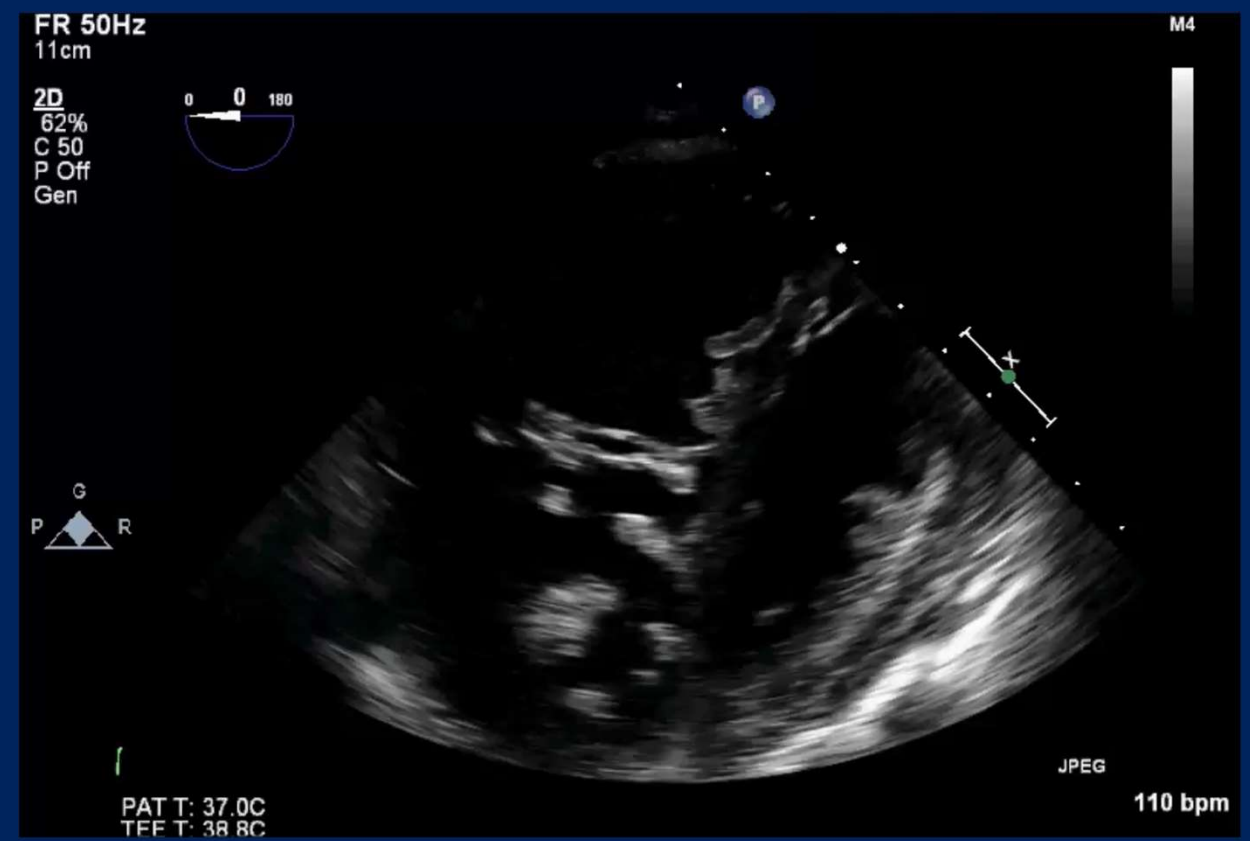
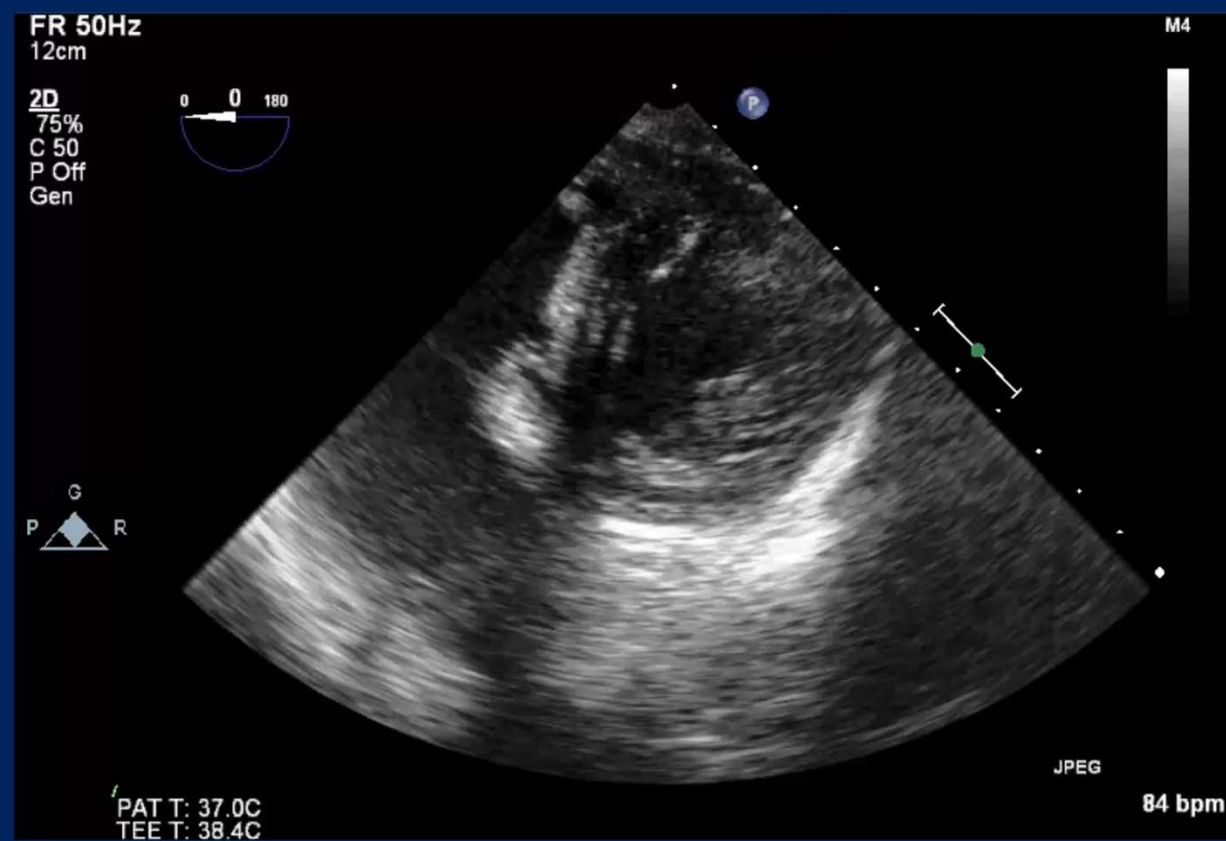
RV Function

- **RV Size**
- **TAPSE (NI > 17mm)**



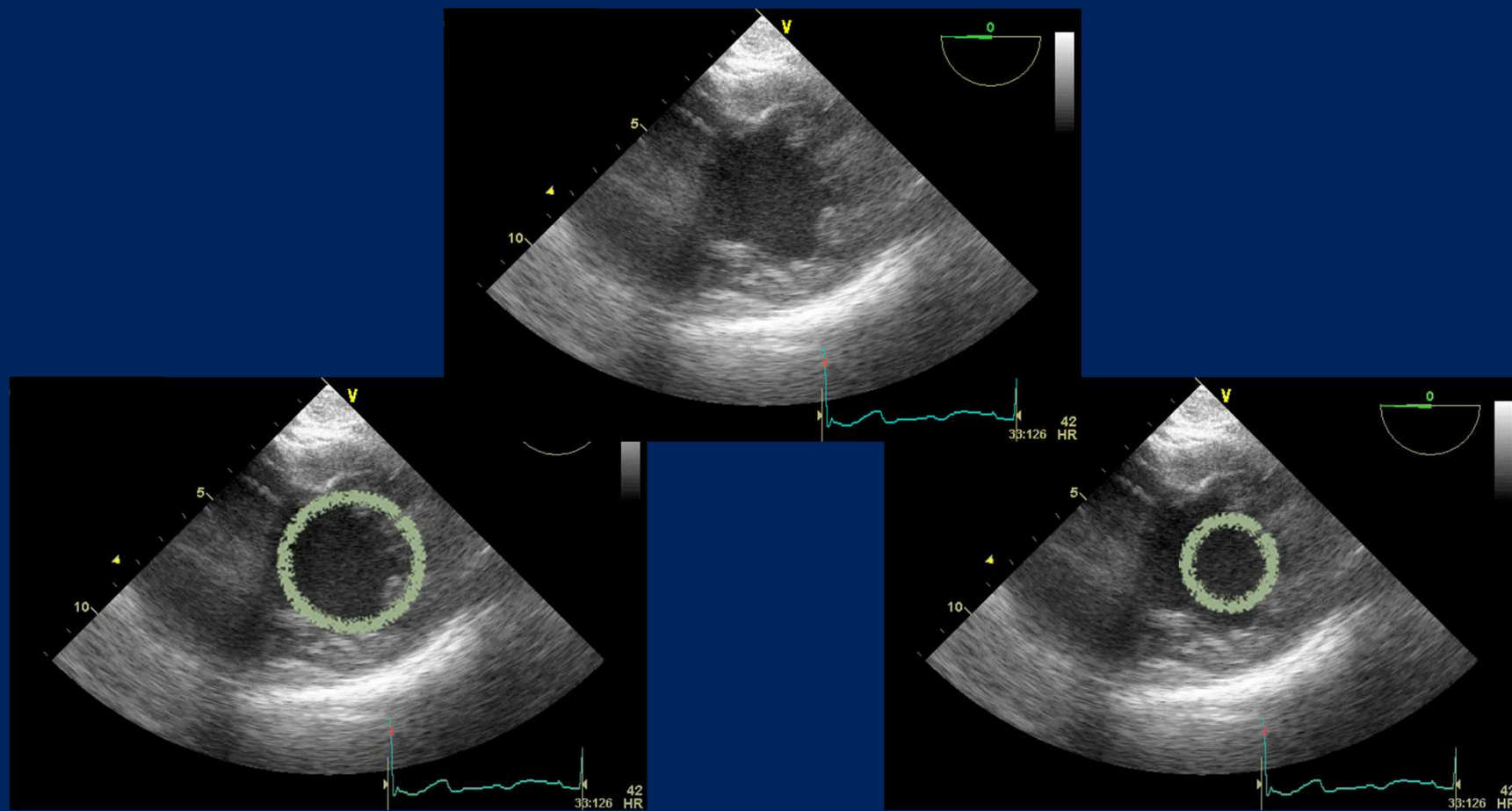
RV Function

- **Septal Shift**



Hypovolemia vs. Low SVR

- “Kissing Papillary Muscles”



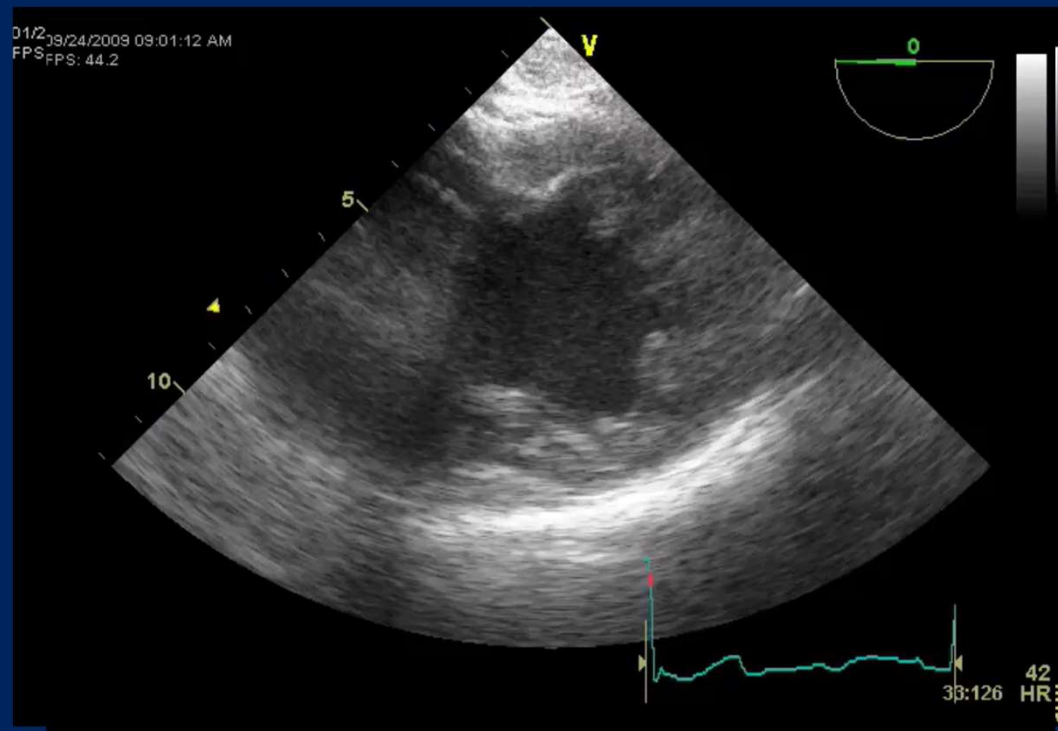
Hypovolemia vs. Low SVR

- “Kissing Papillary Muscles”

	Diastole	Systole
Normal		
Low SVR		
Hypovolemia		

Hypovolemia vs. Low SVR

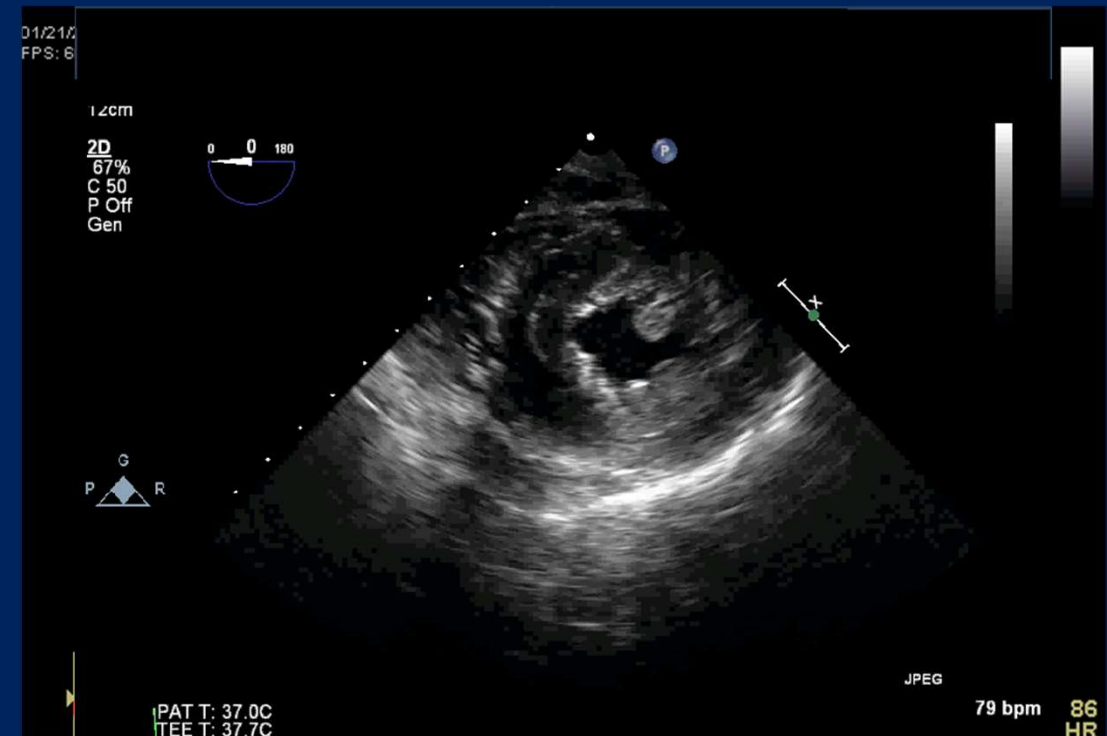
- “Kissing Papillary Muscles”



Normal

Normal EDA

Small ESA



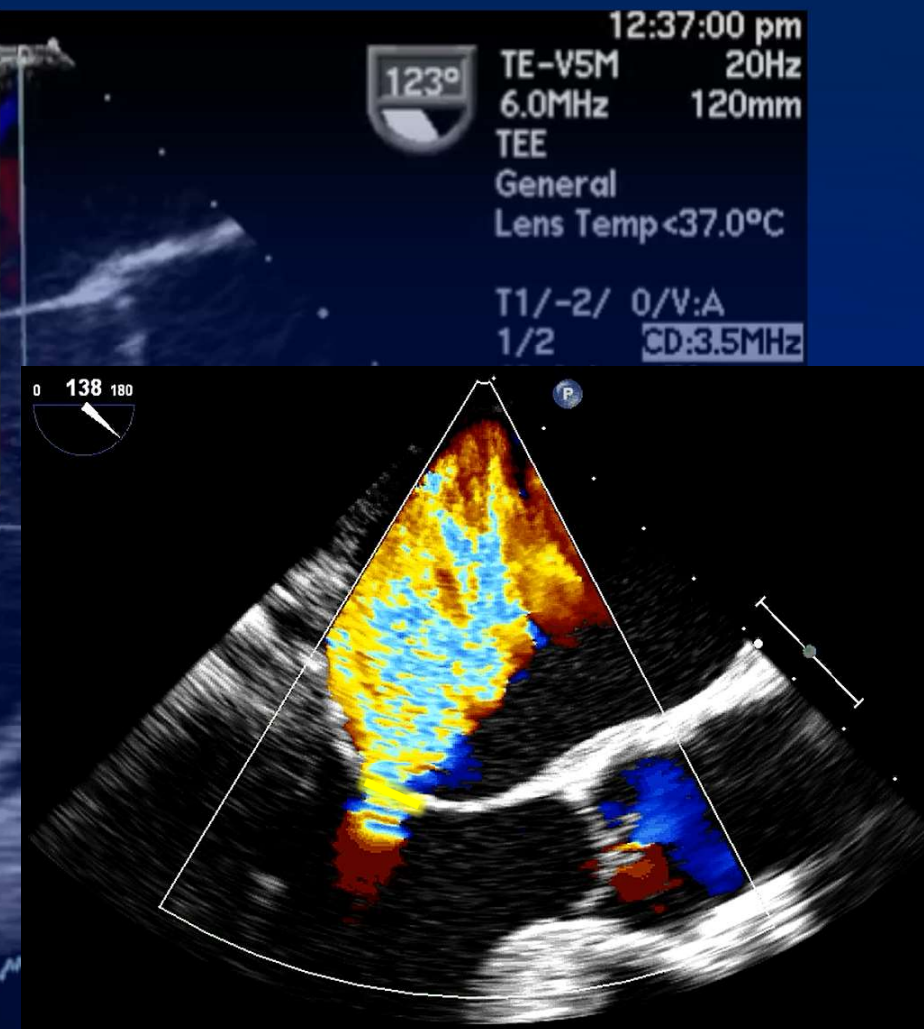
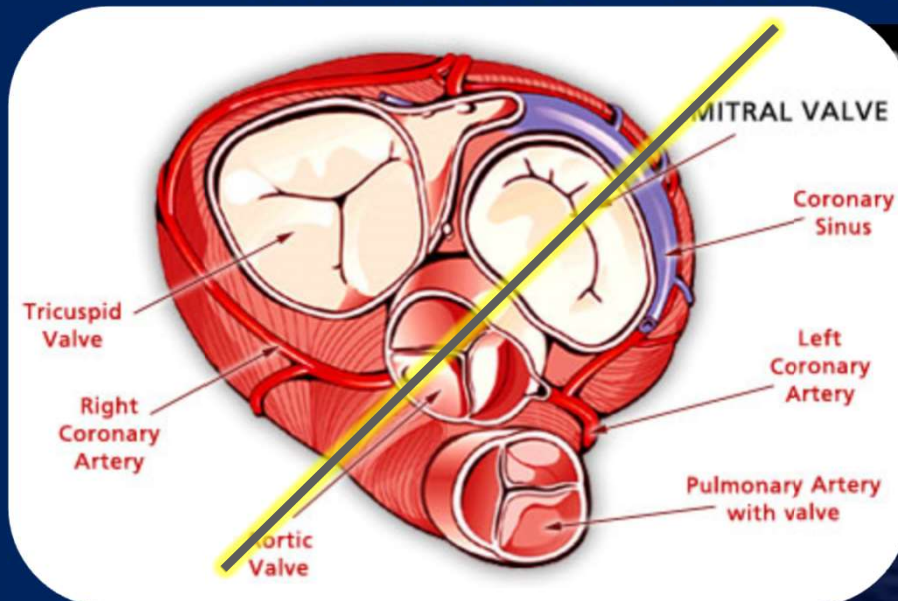
Low SVR

Small EDA

Small ESA

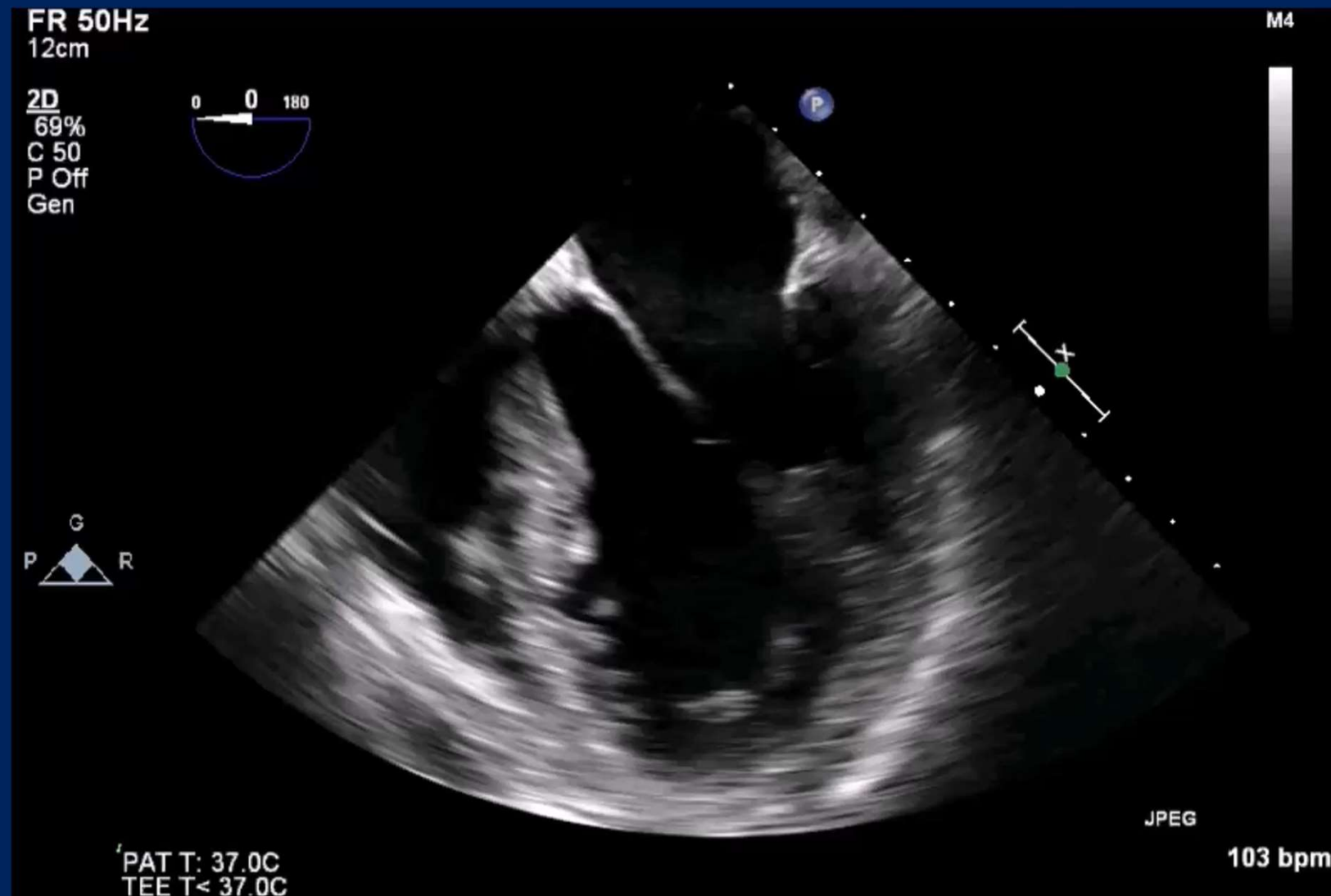
Valvular Heart Disease

- Regurgitation – Mitral Valve
 - Vena Contracta = Severe >7 mm



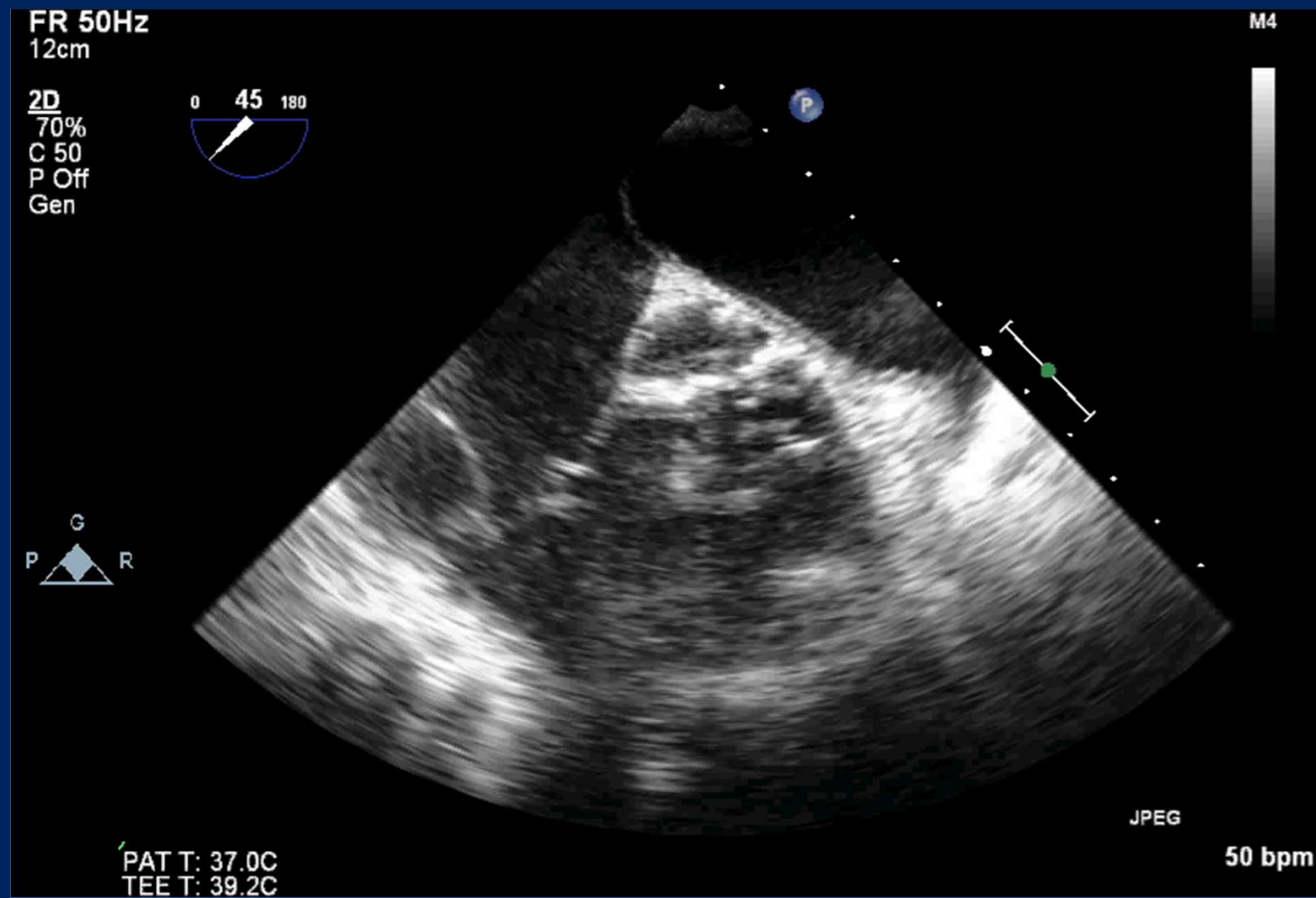
Valvular Heart Disease

- Regurgitation – Mitral Valve



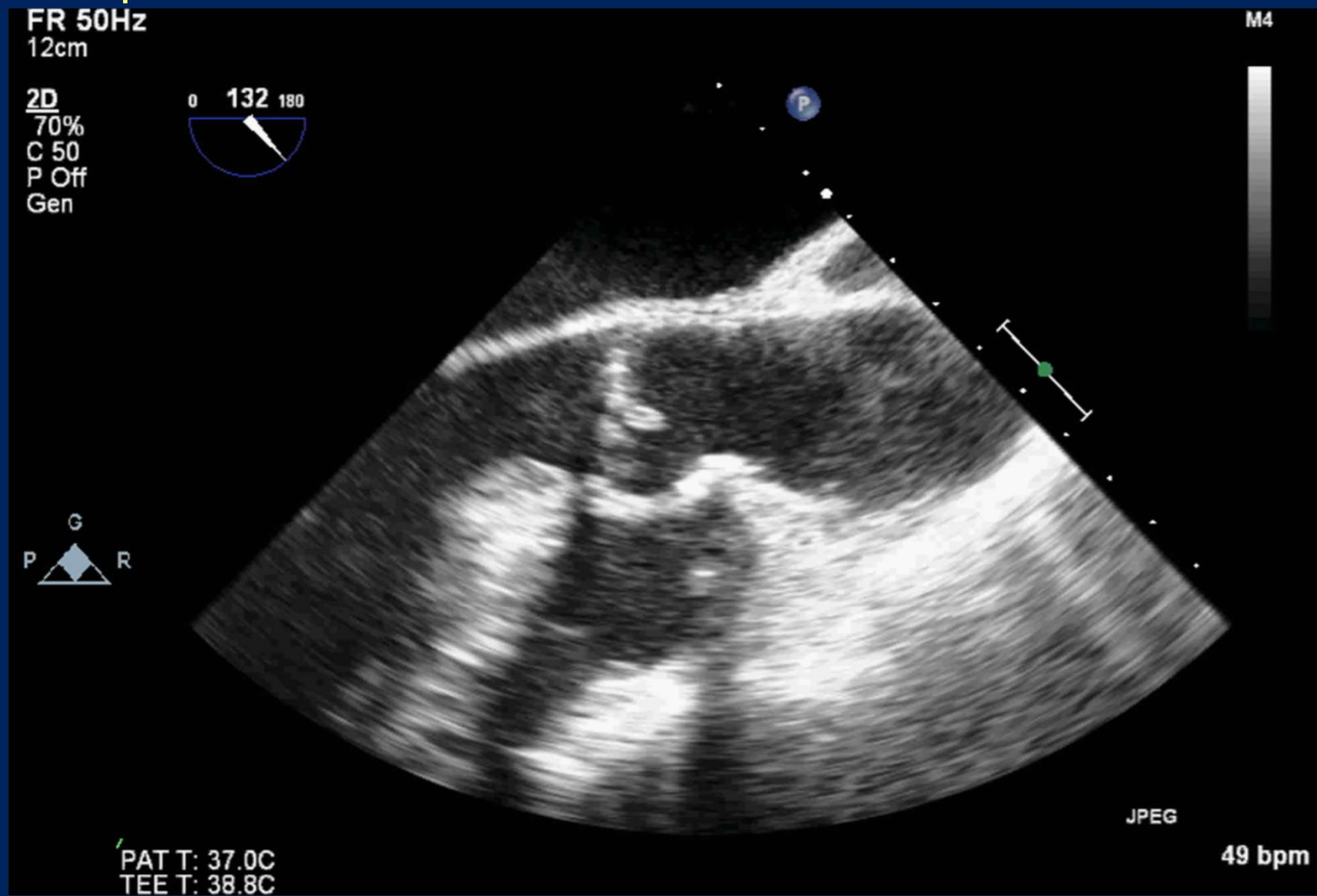
Valvular Heart Disease

- Aortic Stenosis



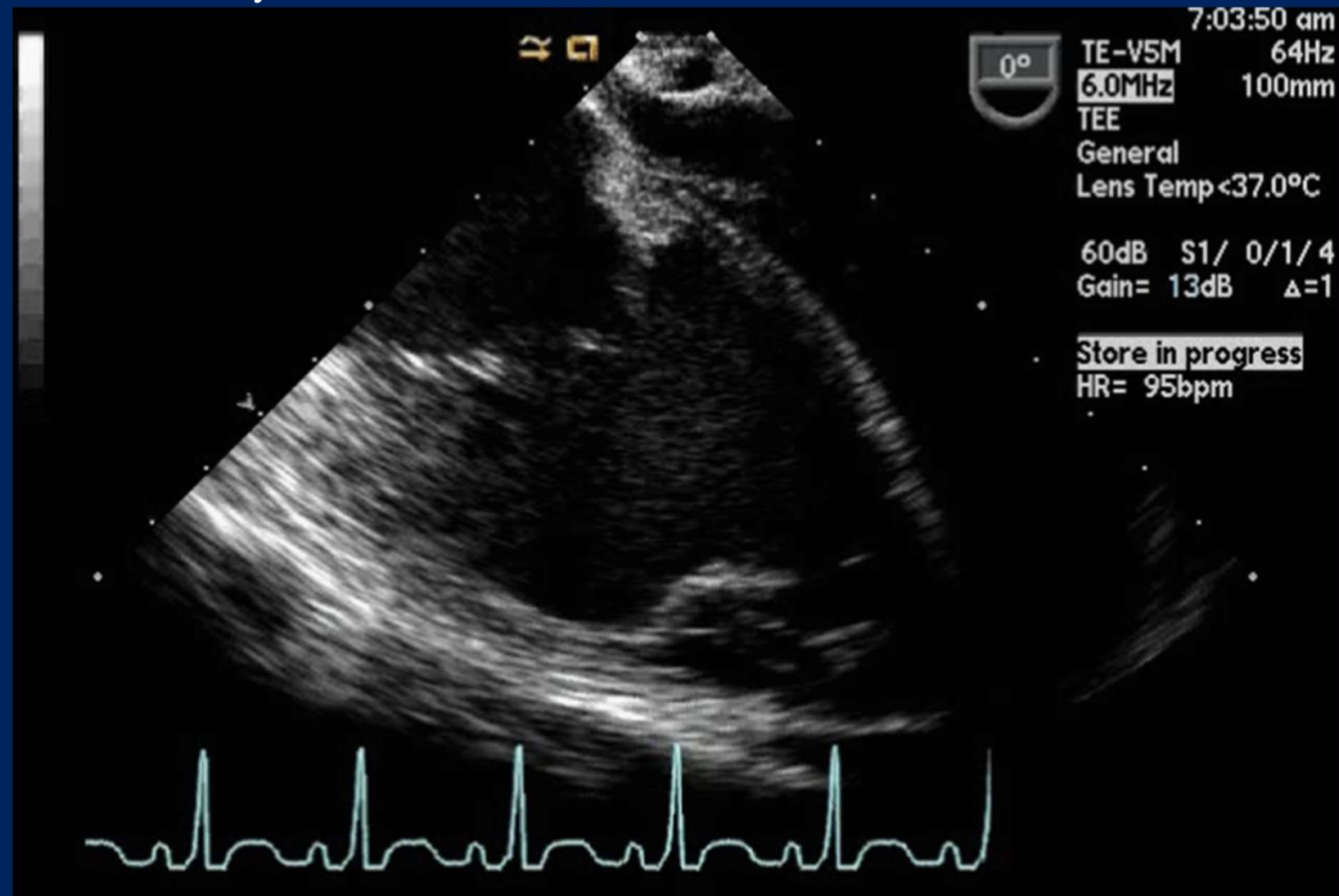
Aortic Stenosis

- Separation < 8mm – 100% PPV for **Mod – Severe AS**



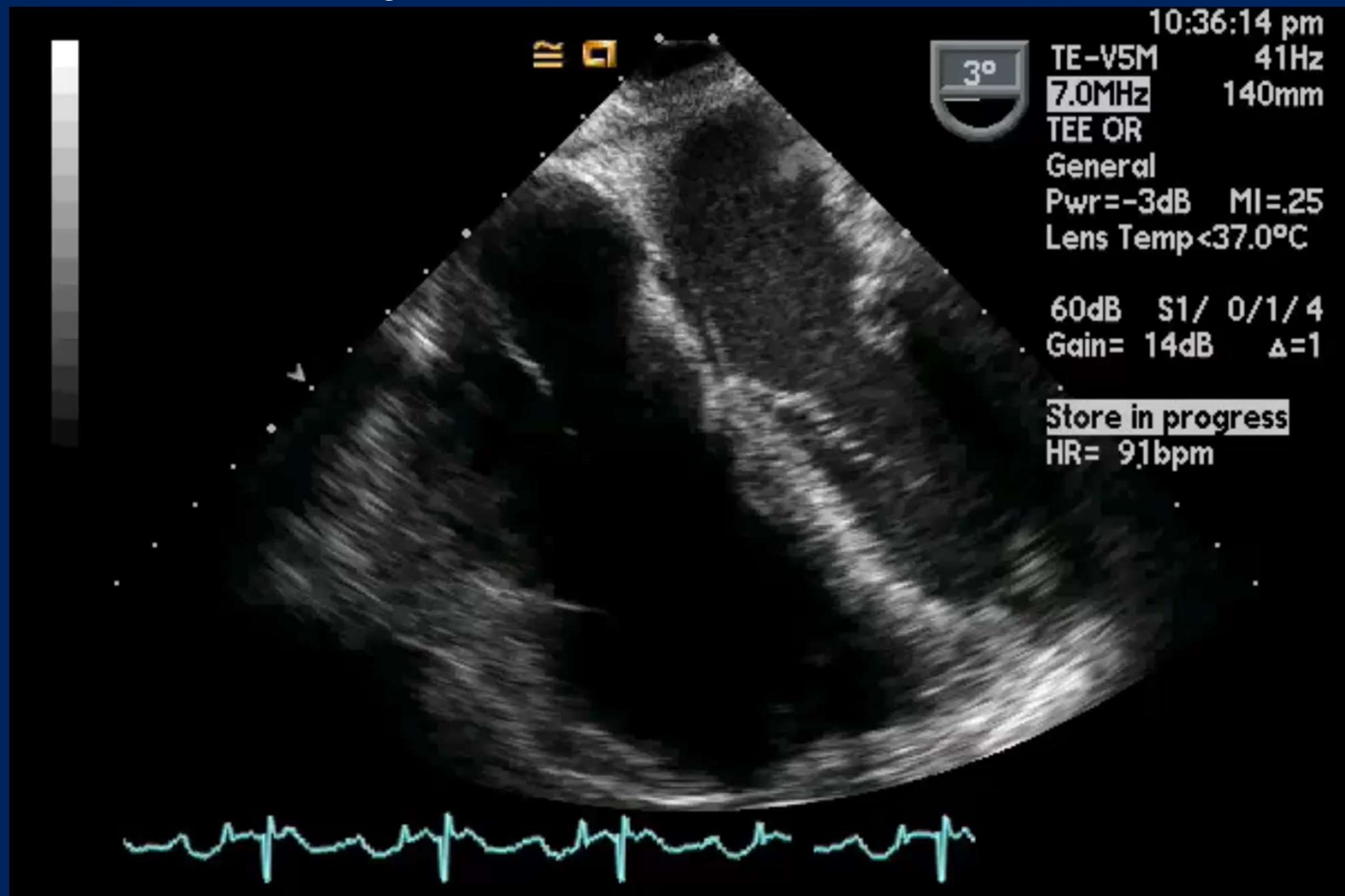
Pulmonary Embolism

- Often Indirect evidence
 - RV dysfunction, new TR



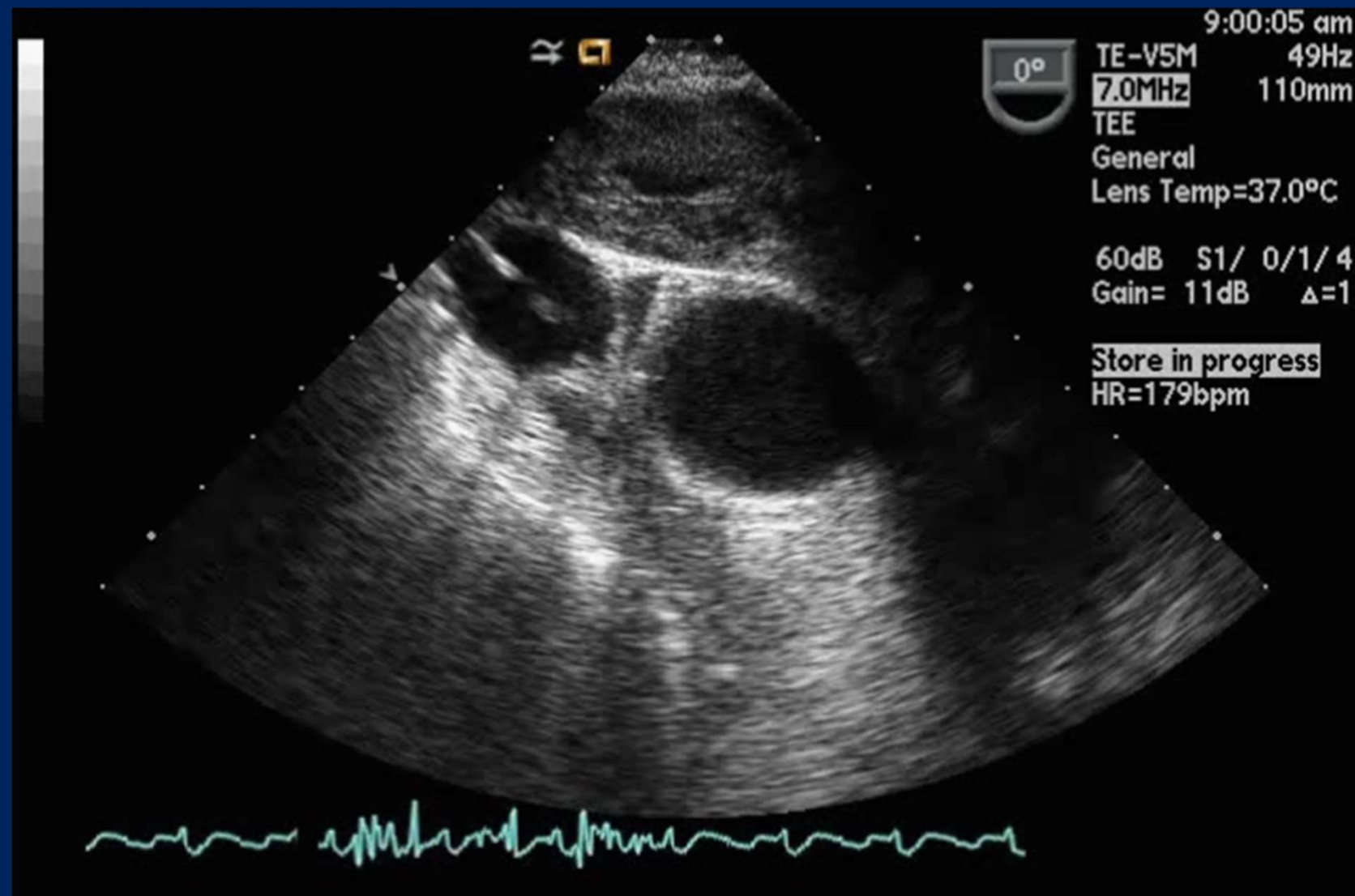
Pulmonary Embolism

- McConnell's Sign



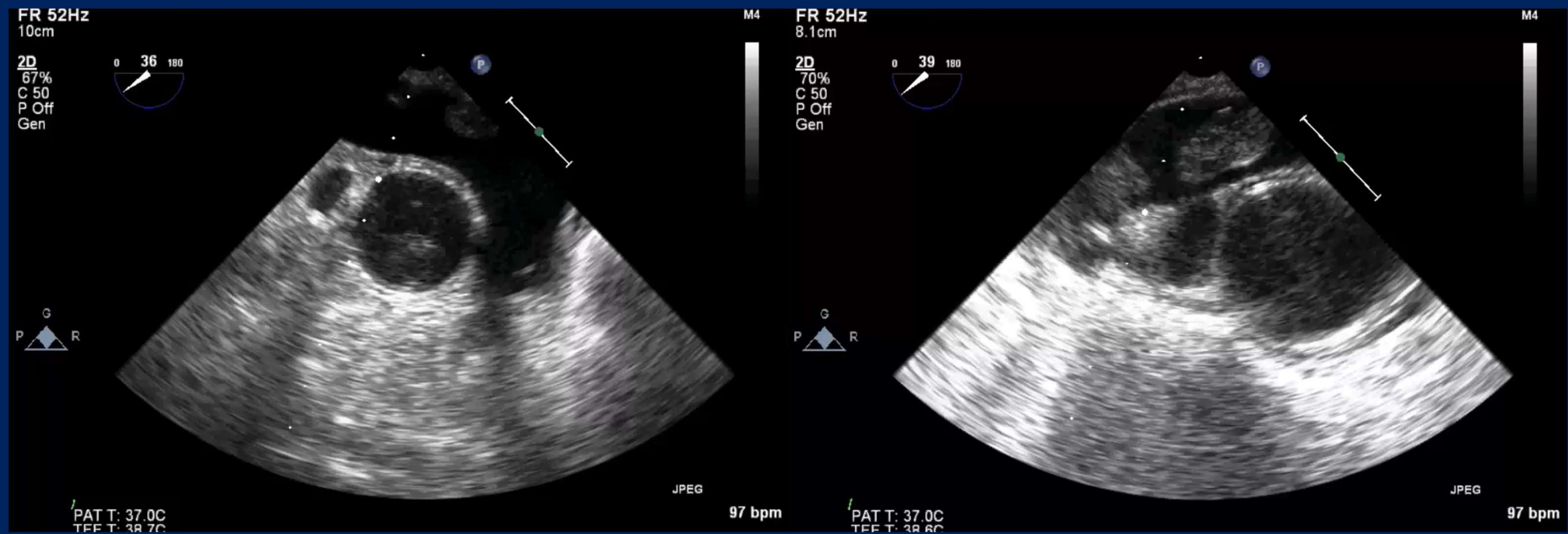
Pulmonary Embolism

- **Direct evidence**
 - Saddle Embolism or Thrombus In Transit



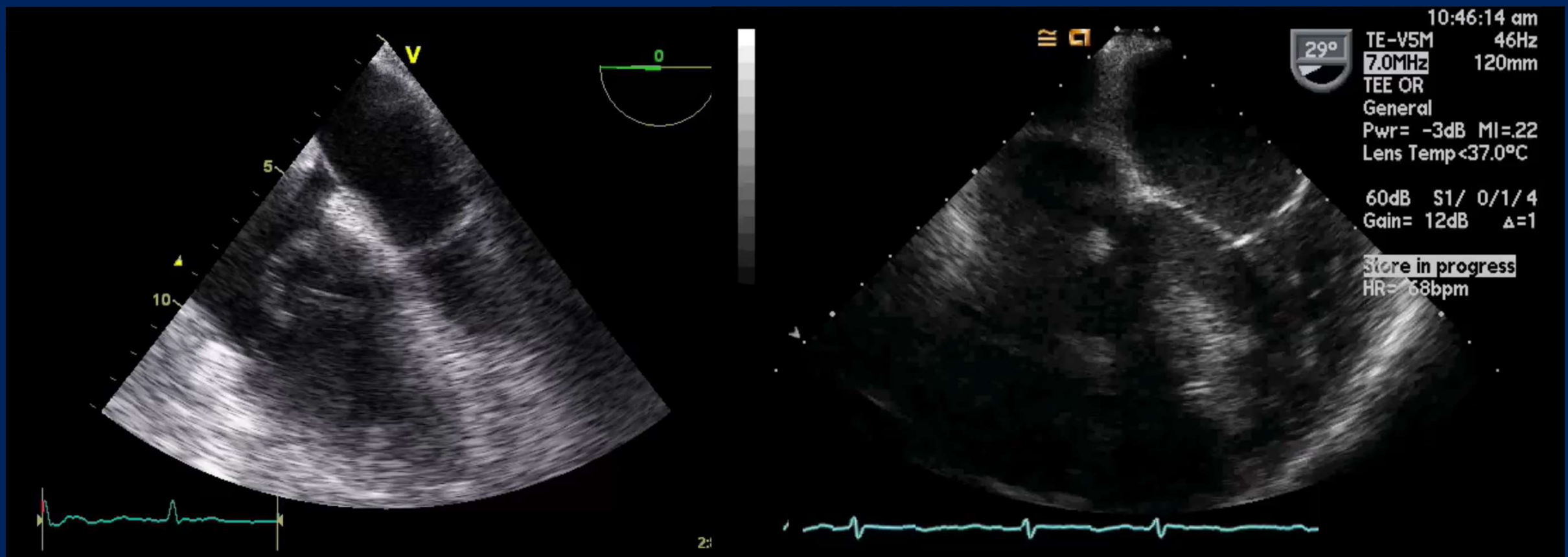
Pulmonary Embolism

- **Direct evidence**
 - Saddle Embolism or Thrombus In Transit

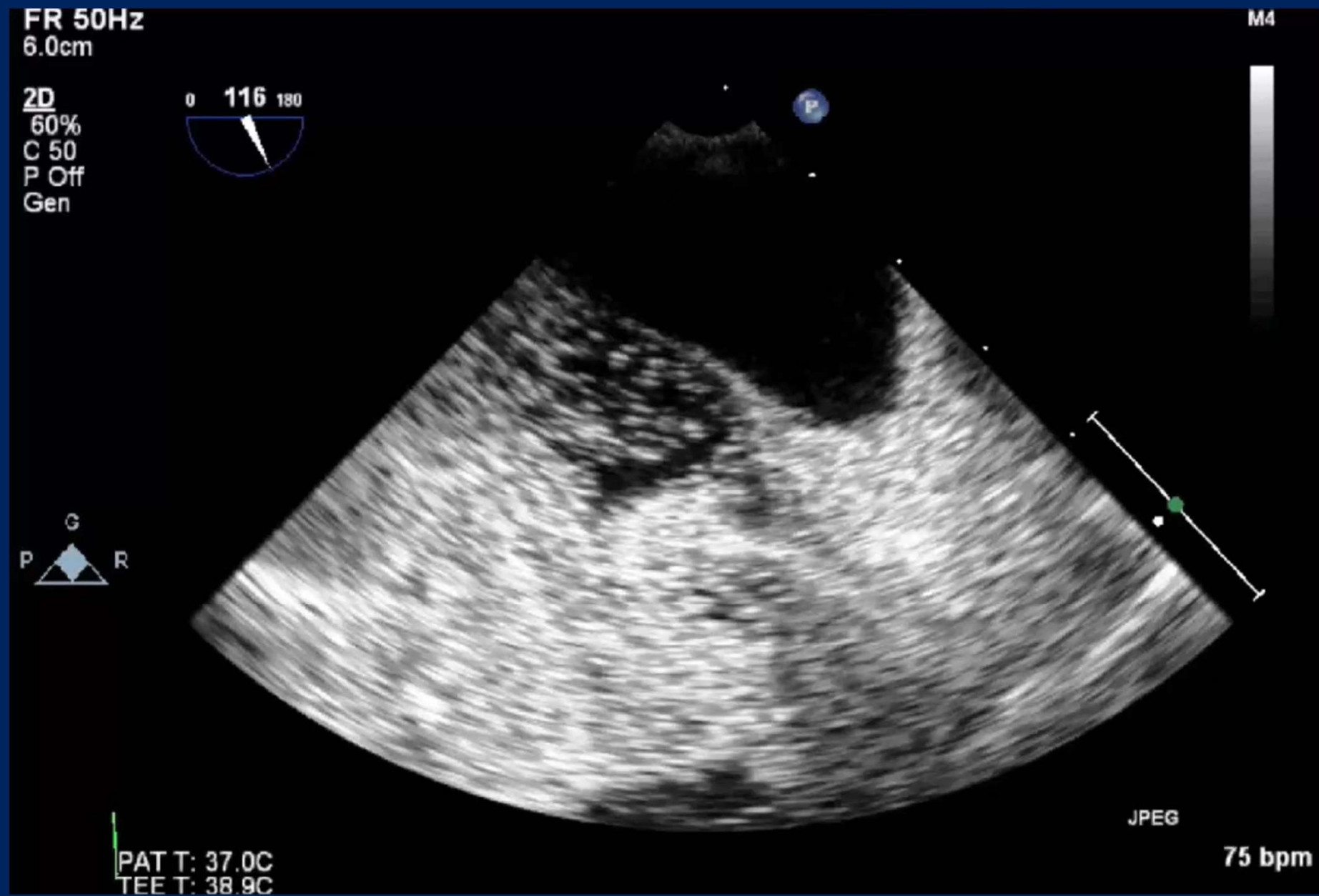


Pulmonary Embolism

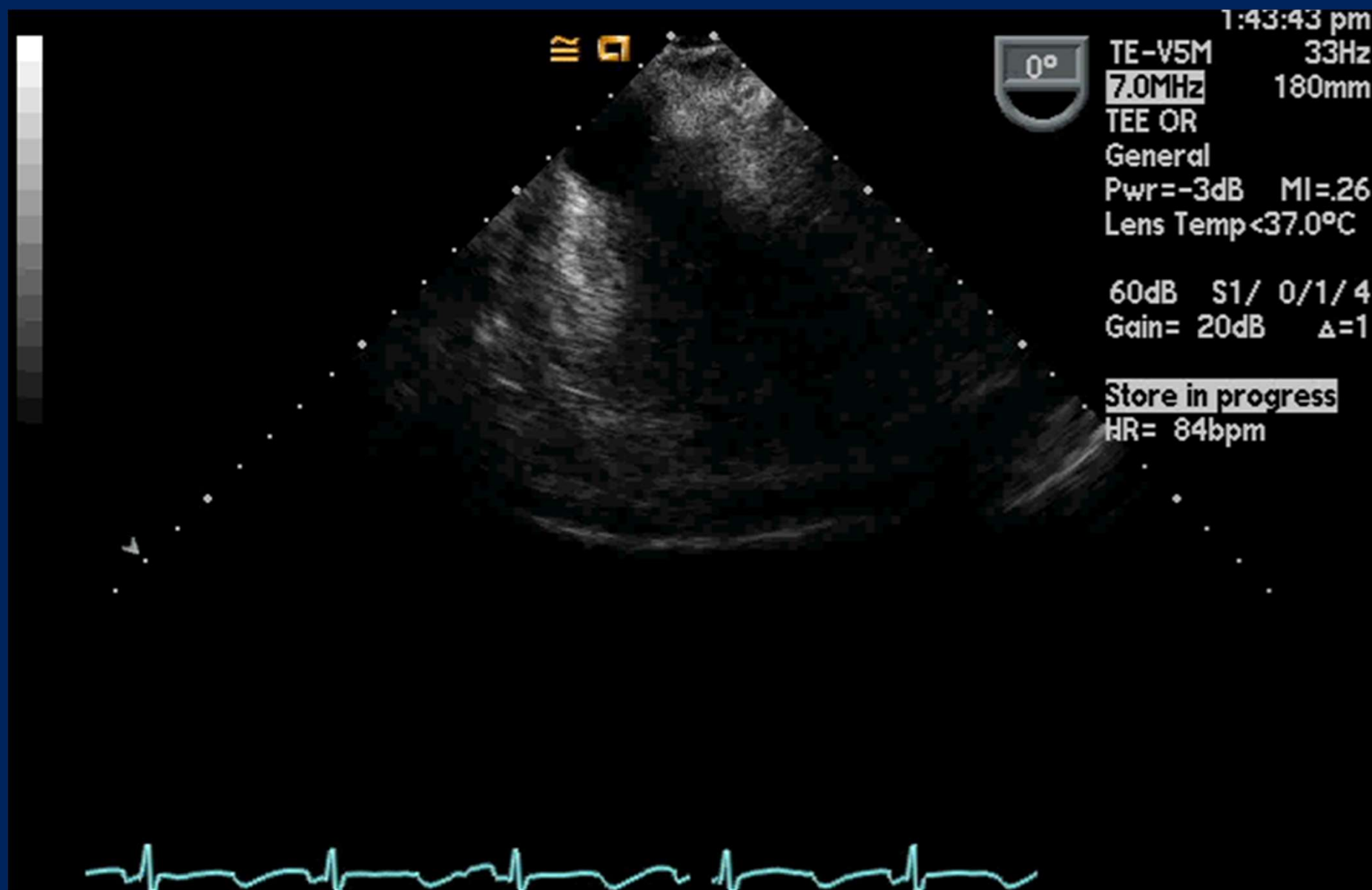
- **Direct evidence**
 - Saddle Embolism or Thrombus In Transit



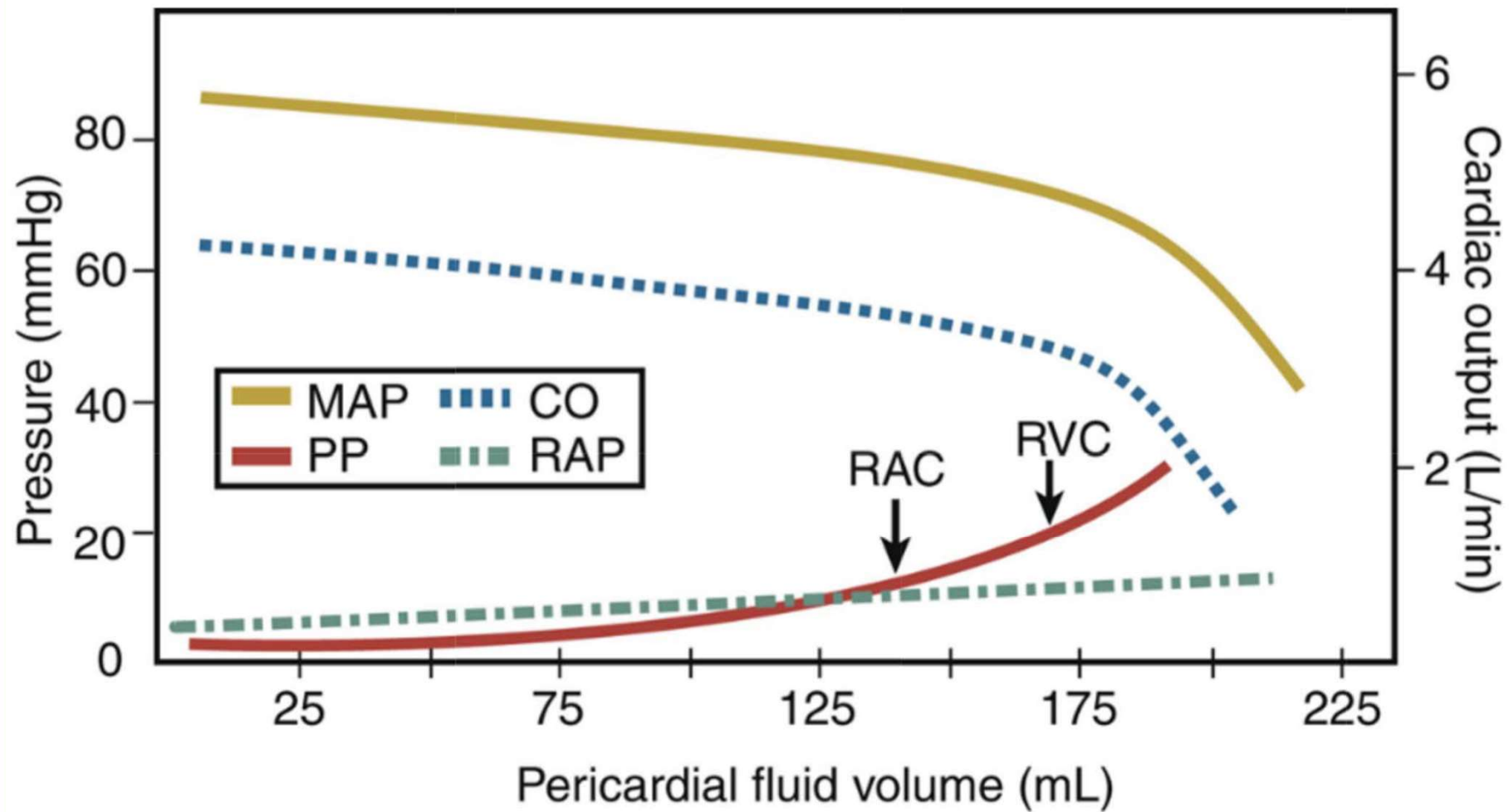
Venous Air Embolism



Pericardial Effusion



Pericardial Tamponade



Pericardial Tamponade

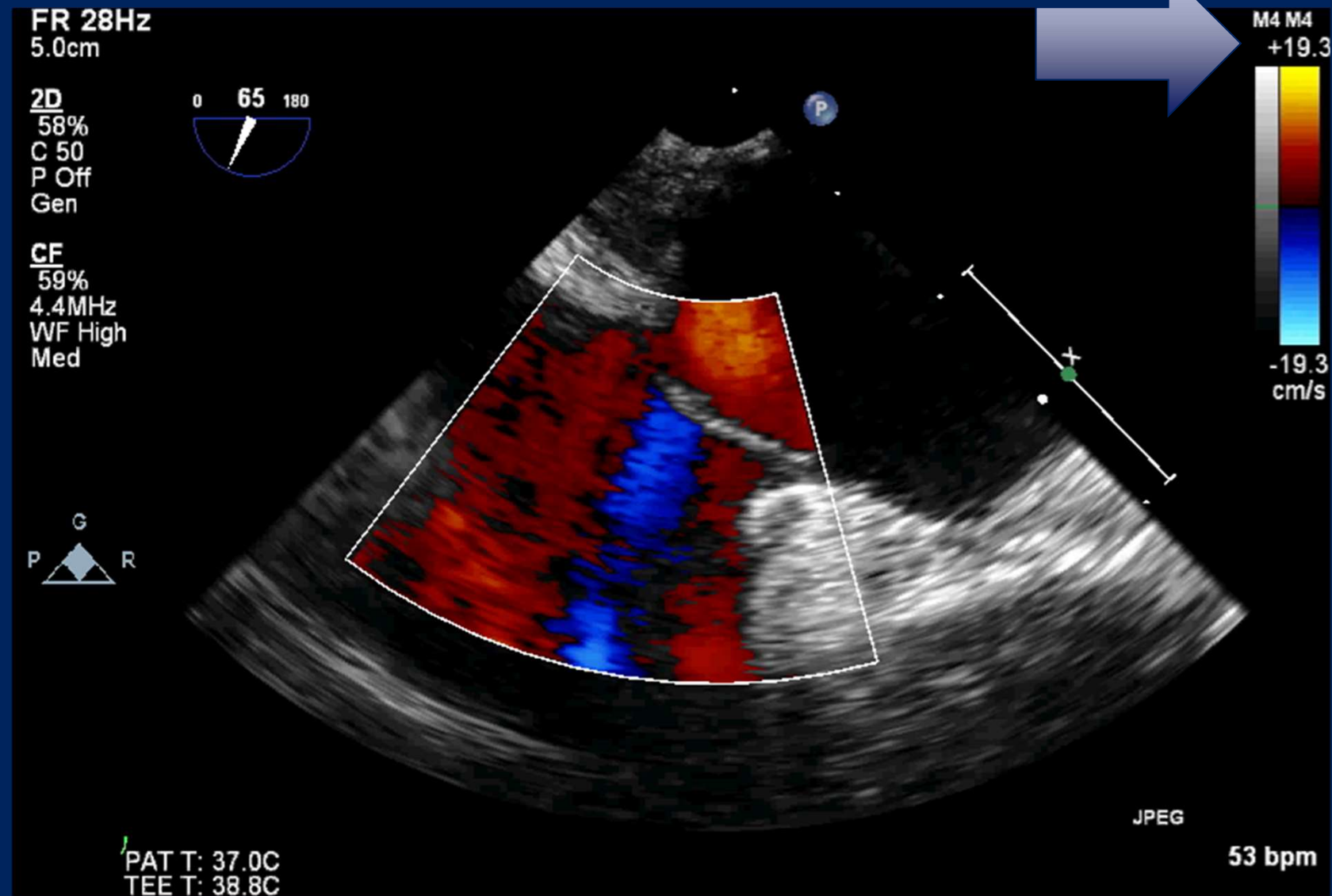
- RA Systolic Collapse – highly sensitive/specific



- **Clinical Diagnosis**

Basic Congenital Heart Disease

- Patent Foramen Ovale (PFO)



- **Global and Regional LV Function**
- **RV Function**
- **Basic Valvular Lesions**
- **Pulmonary Embolism**
- **Venous Air Embolism**
- **Pericardial Effusion**
- **Basic Congenital Heart Disease**

EXPERT CONSENSUS STATEMENT

Basic Perioperative Transesophageal Echocardiography Examination: A Consensus Statement of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists

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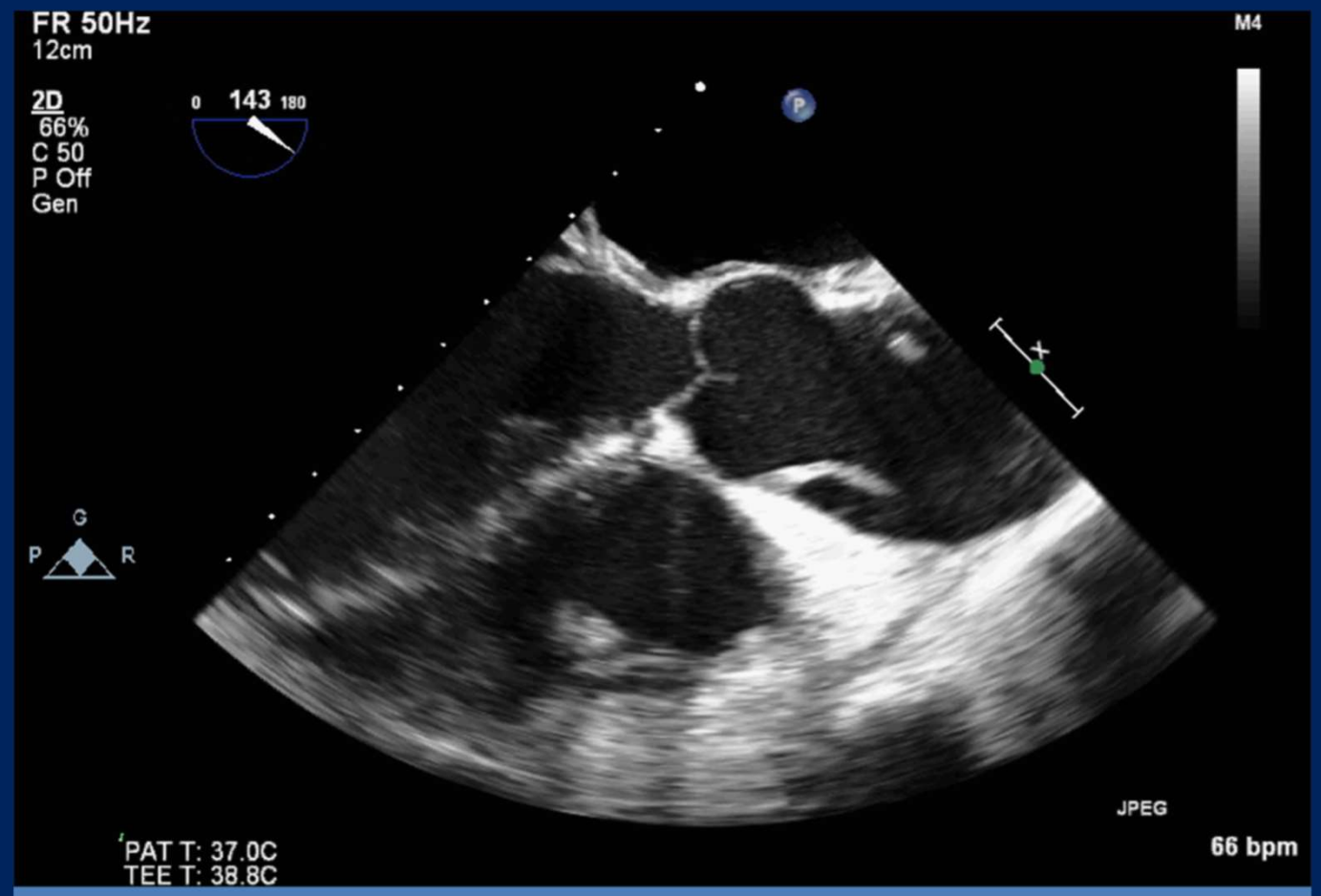
Rescue Echo

Clinical Case Examples...

- 74 M s/f IM nail for right femur fracture s/p fall
 - Syncopal event lead to fall, CT head negative
 - Hypotensive Intra Op, TEE placed

- Ascending Dissection

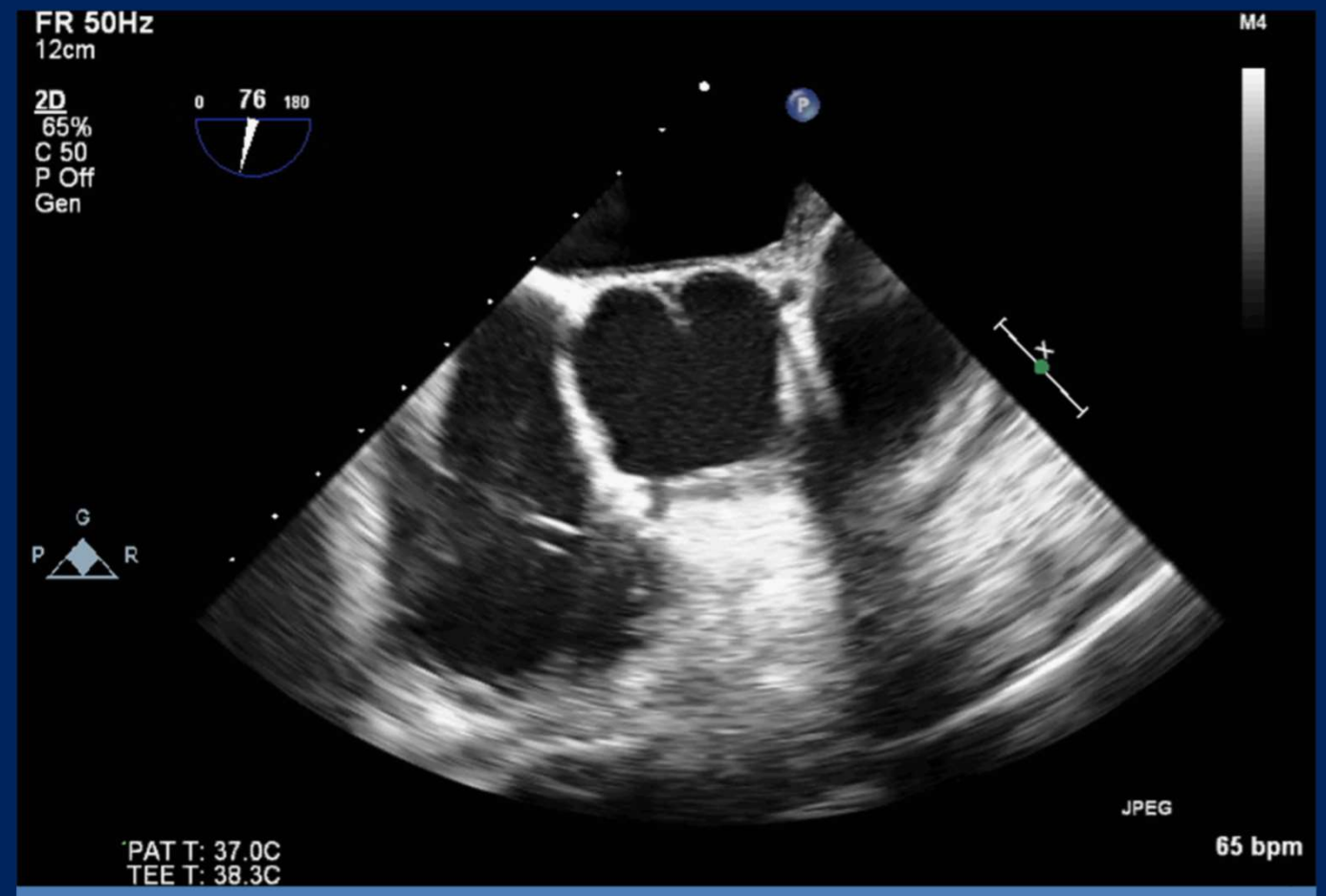
- Coronaries
- AI
- Pericardial Effusion



- 74 M s/f IM nail for right femur fracture s/p fall
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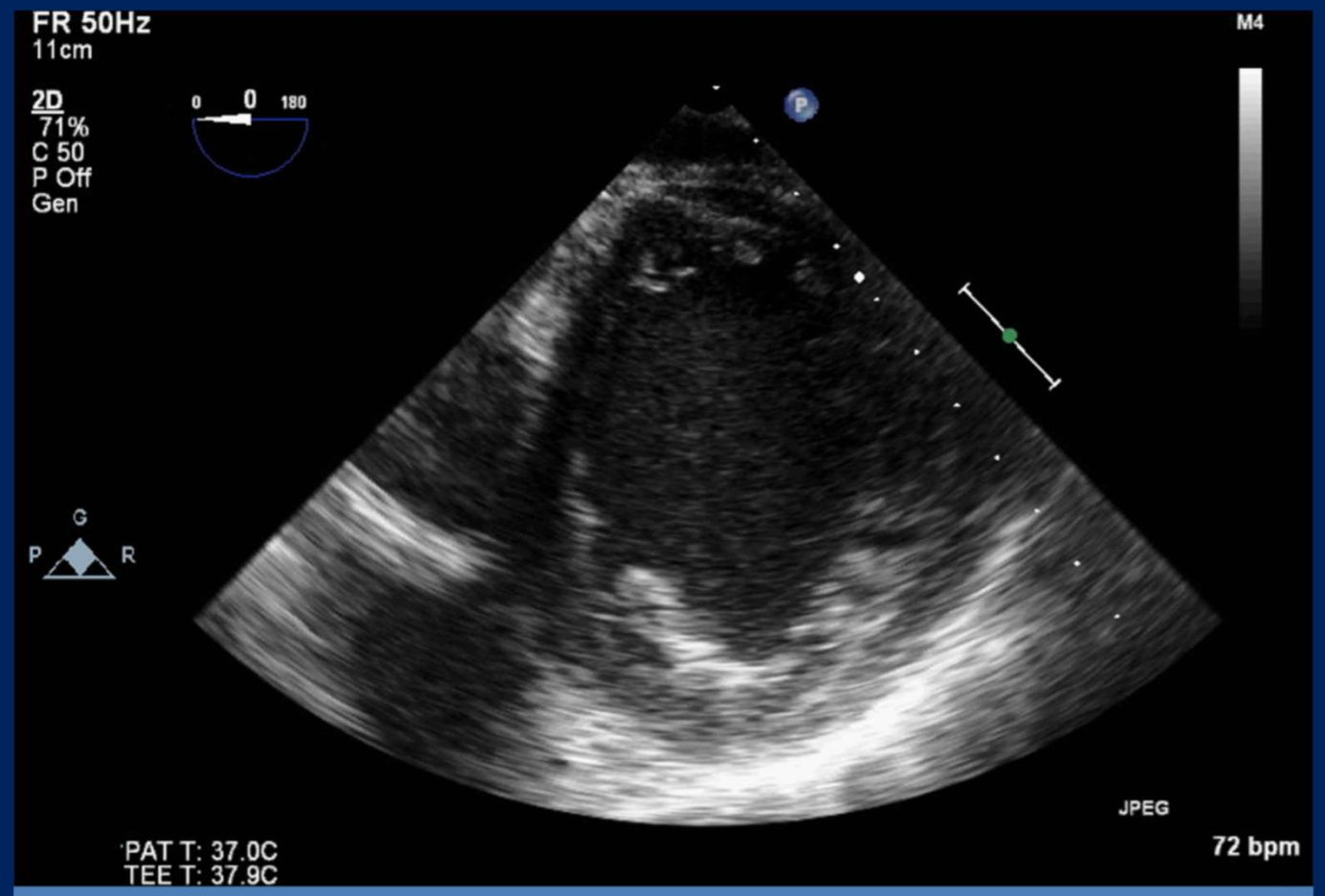
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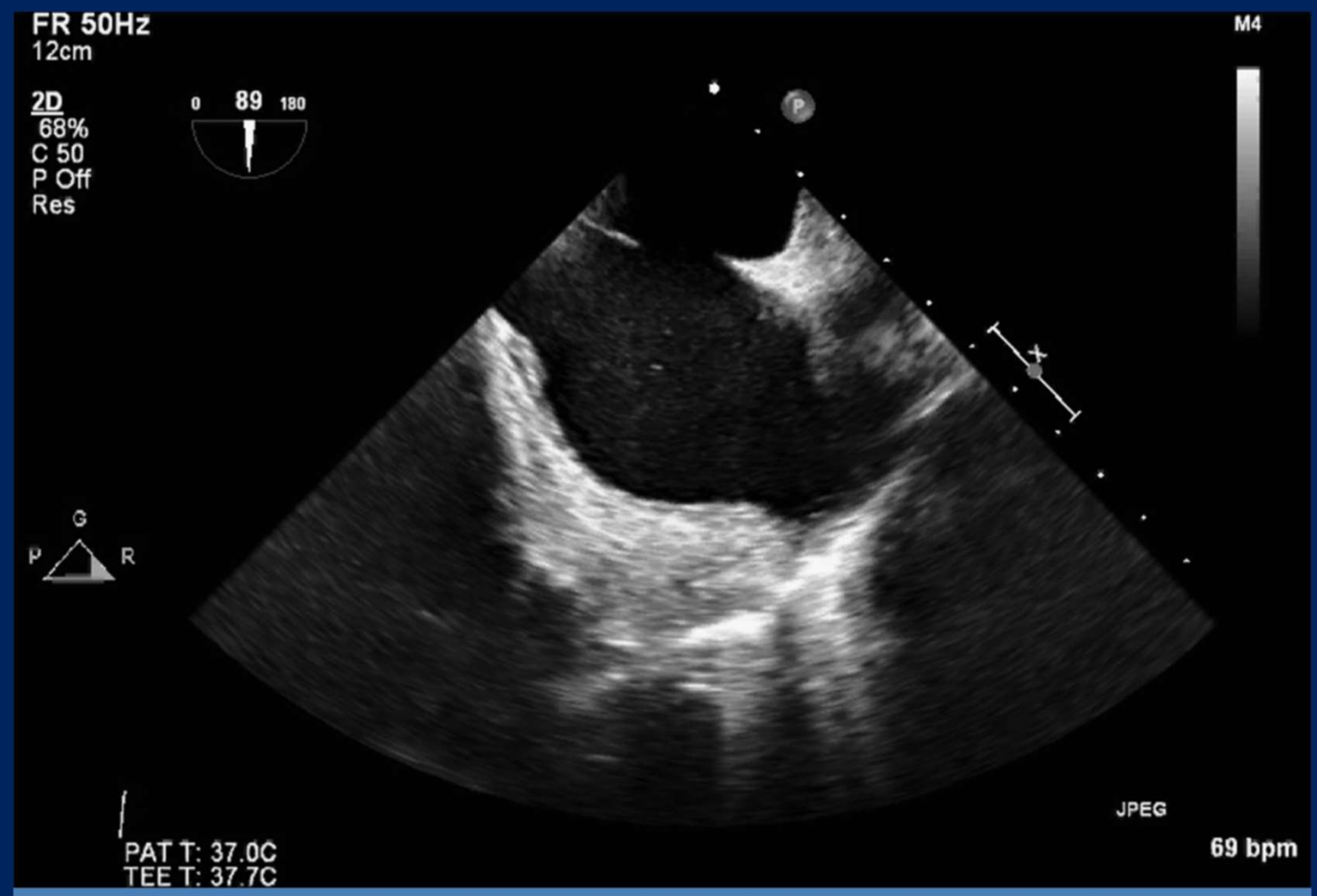
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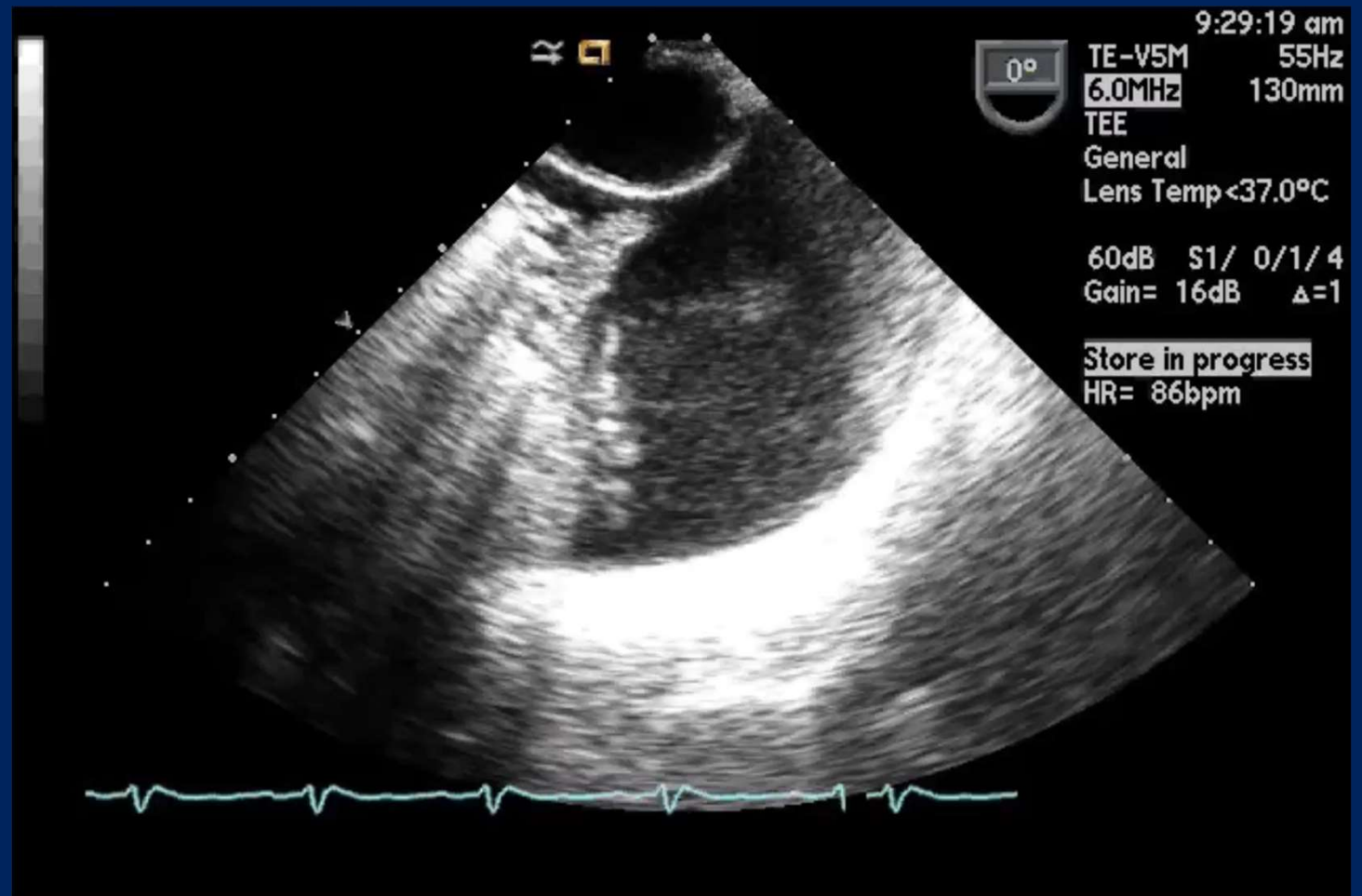
- Coronaries
- AI
- Pericardial Effusion



- 46 y/o M previously healthy undergoing abdominal laparoscopy
 - Intermittent hypoxic episodes with insufflation/position changes
- Intracardiac Shunt
 - CFD identifies direction
 - Secundum ASD



- 68 y/o F with hx of pancreatic CA undergoing Whipple Procedure
 - Post Intubation Hypoxia – SpO₂ 78% on 1.0 FiO₂
- Pleural Effusion
 - Anterior to Aorta

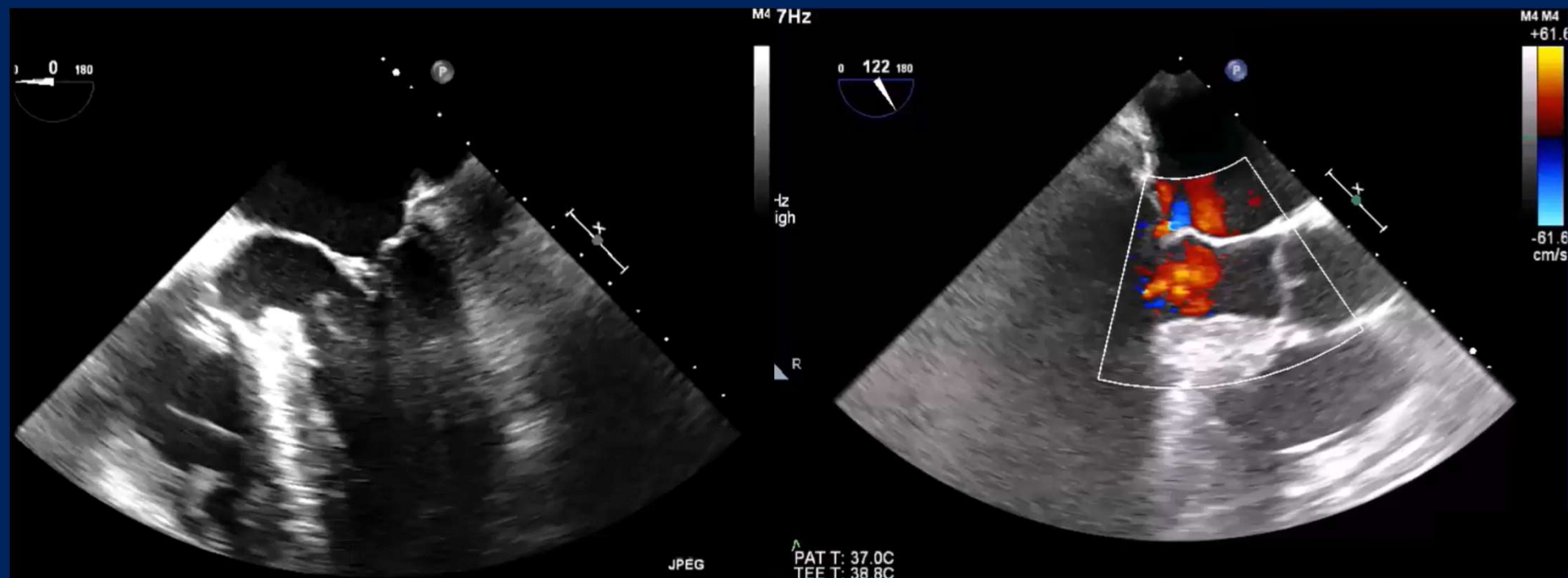


Rescue Echo

- **74 y/o F** with PMHx - HTN, HL, DM
- s/f **Hemicolectomy** for Colon CA
- Induced with Lido, Fentanyl, Propofol and Rocuronium
- BP **60/40**, HR 130, Sinus Tachycardia
- Escalating doses of:
 - **Phenylephrine**
 - **Ephedrine**
 - **Epinephrine (plus gtt)**

Rescue Echo

LVOT Obstruction / MV Systolic Anterior Motion



- Inotropes D/C'd
- Volume Loaded
- Phenylephrine Infusion
- BP Improved to 120s/70s, HR 80s

Rescue Echo

- **Lecture Objectives**

- Describe the utility of perioperative echo in hemodynamic instability
- Identify common indications for TEE in noncardiac surgery
- Develop a protocol for image acquisition and interpretation
- Review clinical cases



Thank you!

tmaus@ucsd.edu

Where discoveries are delivered.SM

UC San Diego
SULPIZIO CARDIOVASCULAR CENTER