Echocardiography for Aortic Dissection

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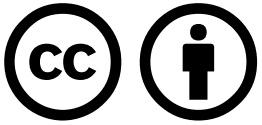

Competing Interests

No financial disclosures :(

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Objectives

At the completion of this presentation participants will be able to

1. Visualize & describe the **anatomical relationships** between thoracic aortic segments, tracheobronchial tree & esophagus to identify imaging **windows and blind spots** for TEE

2. Describe primary complications of acute TAD and corresponding **clinical objectives of intraoperative TEE** during emergency repair surgery

3. Describe the **basic echocardiographic assessment** of aortic dissection.

Intraoperative Echocardiography for Aortic Dissection

Acute Type A Dissection
for emergency repair

Subacute Type A Dissection

Iatrogenic Type A Dissection

Traumatic Aortic Dissection

Type B Dissection

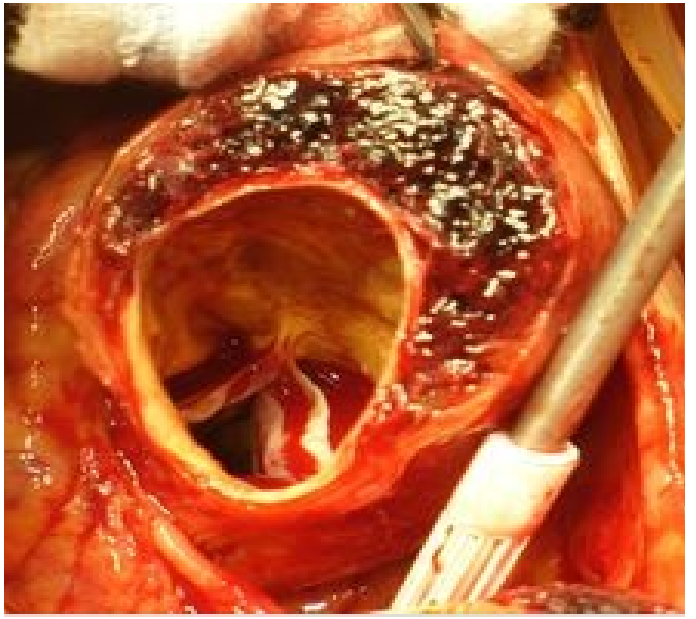
Outline

1. Pathophysiology

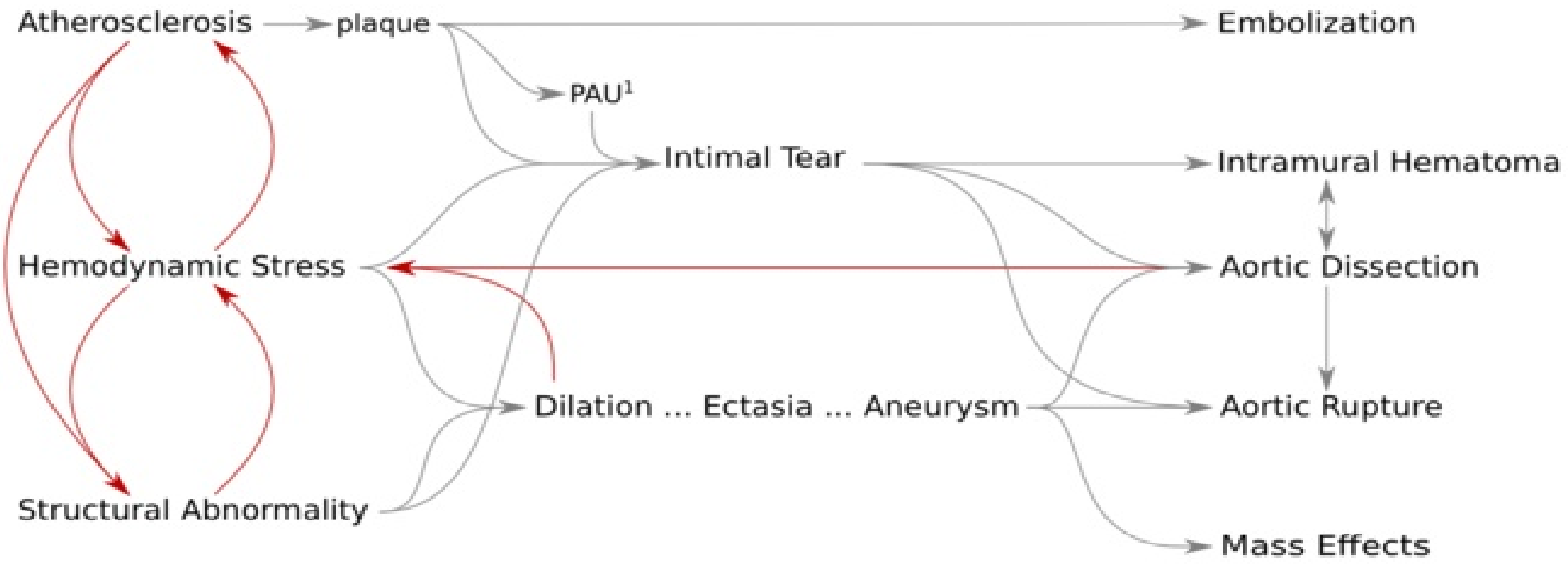
2. Anatomy

3. TEE for emergency repair of ATAD

   - Diagnosis
   - Surgical planning
   - Procedural guidance
   - Post operative assessment

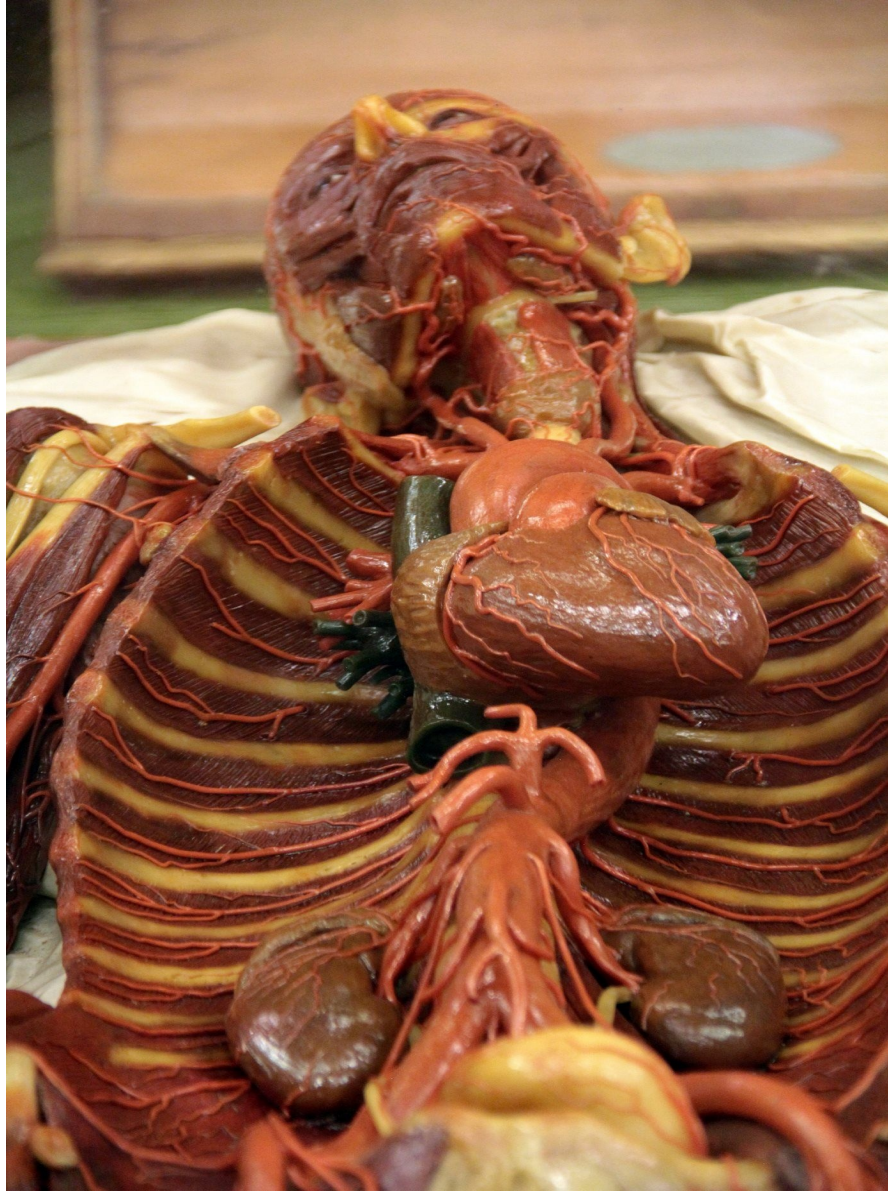


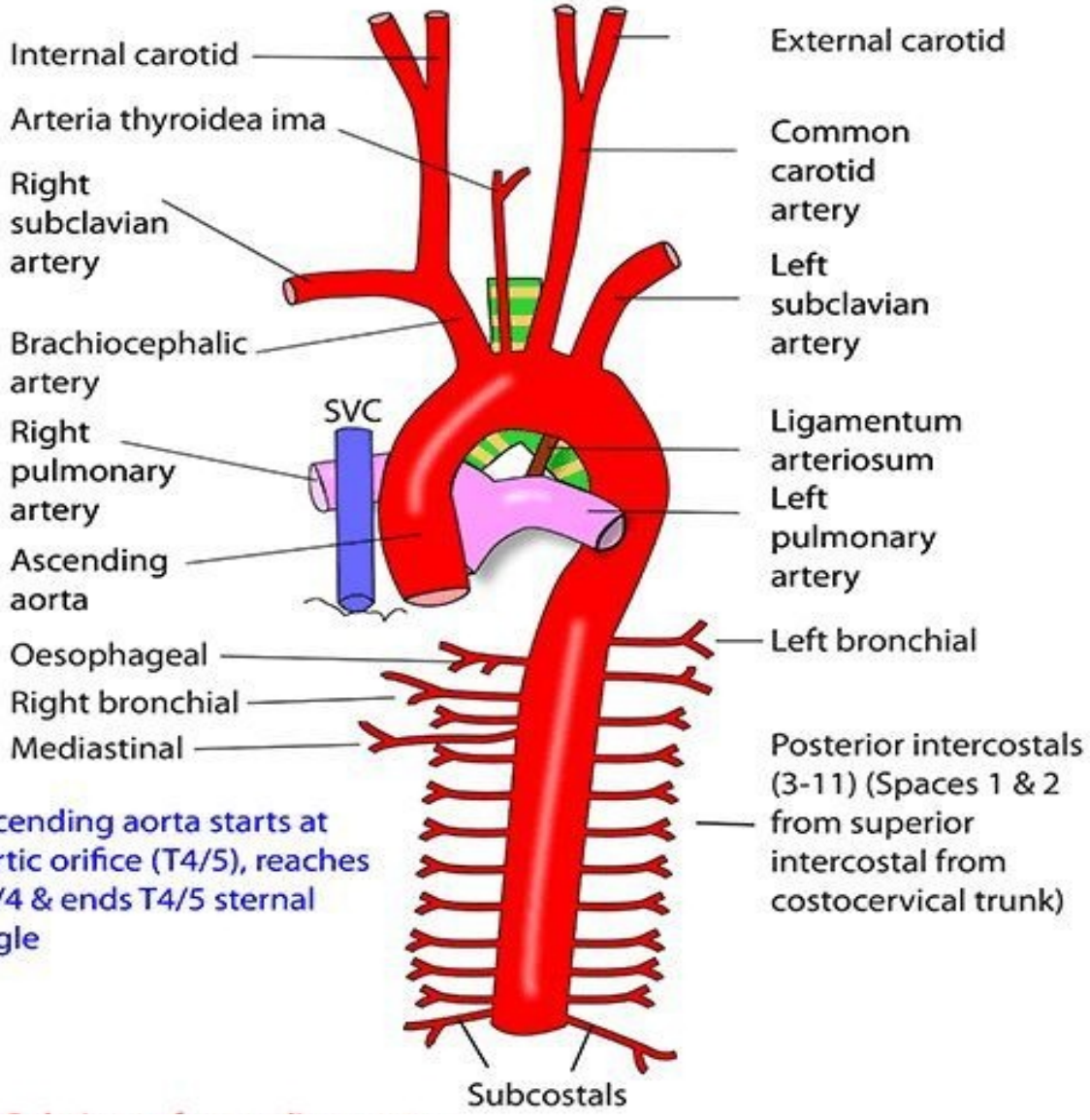
Pathophysiology of Aortic Diseases

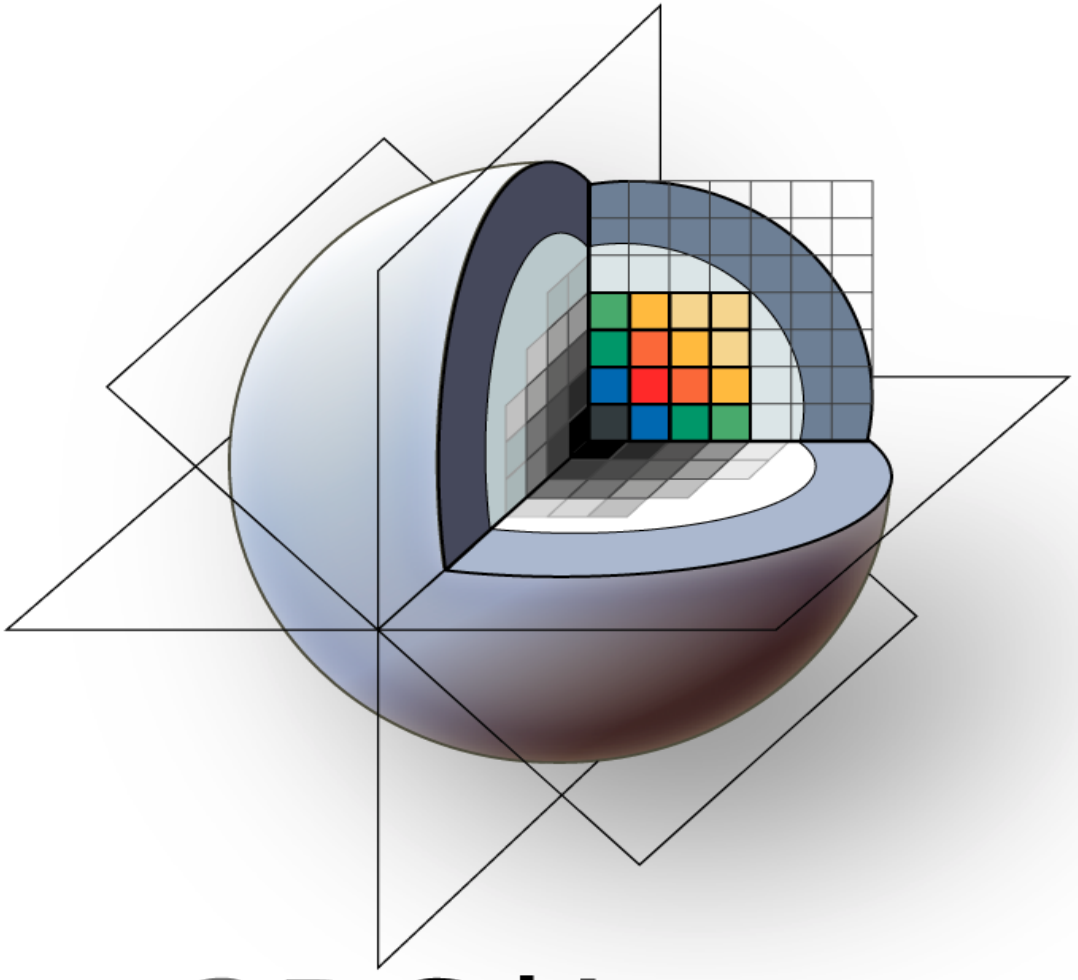


[1] PAU: penetrating atherosclerotic ulcer
[2] intramural hematoma

Anatomy







3DSlicer

TEE

in Emergency Repair of Acute Type A Dissection

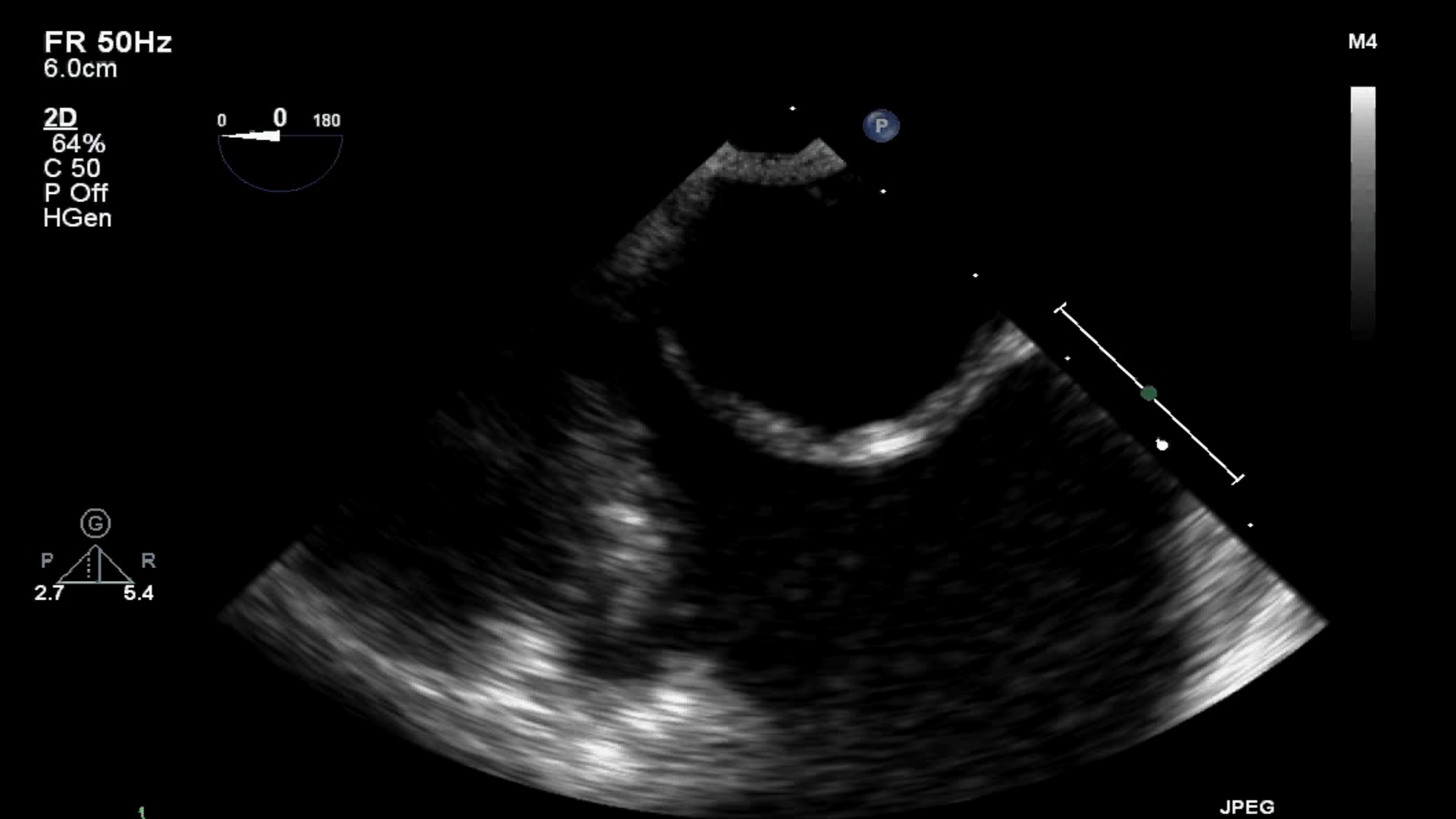
"The primary purpose of intraoperative TEE is to **detail the anatomy of the dissection and to better define its physiologic consequence**" - Goldstein et al JASE 2015 Feb;28(2):119–82

Goals of TEE in Emergency Repair of ATAD

1. **Diagnosis**: Define anatomy & physiologic consequences of ATAD
2. **Procedural planning**: Provide information relevant to key surgical decisions
3. **Monitoring & guidance**
4. **Post-operative assessment**

Goals: Diagnosis

- Assess presence of **pericardial or pleural effusion** suggestive of aortic rupture
- Identify location of **intimal tears**
- Identify **false & true lumens**
- Define **extent** of dissection
- Asses **aortic insufficiency**
- Assess **ventricular function**
- Assess **perfusion** of branching vessels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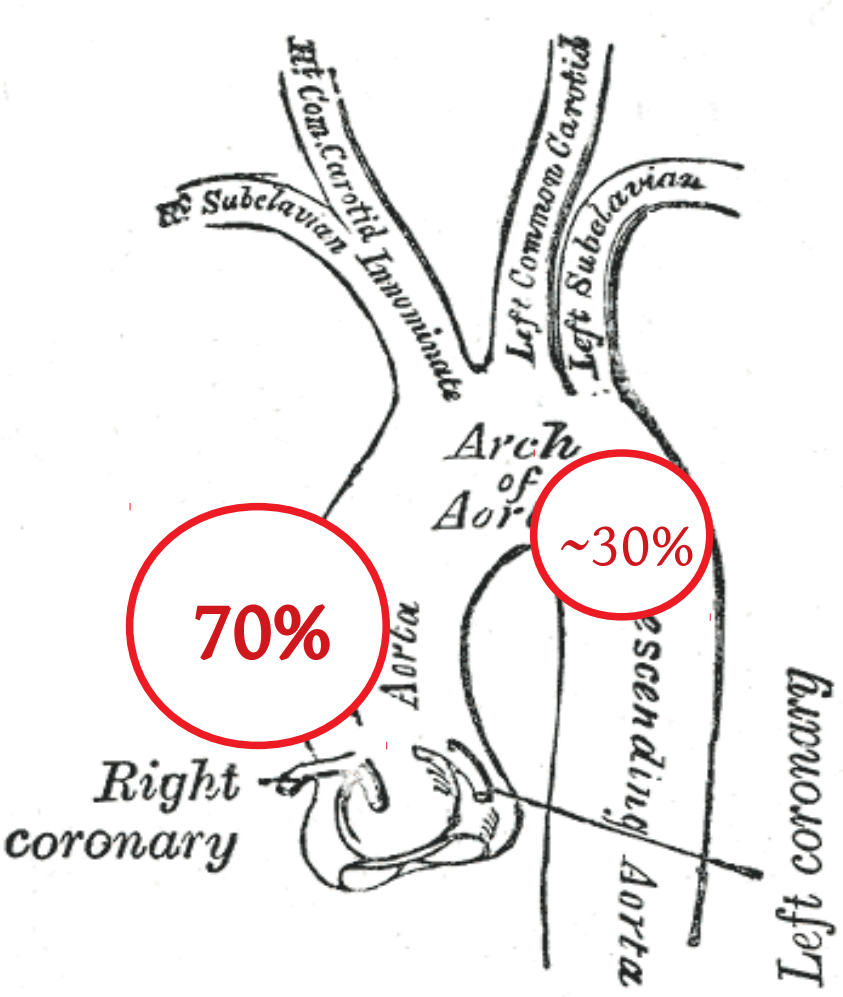

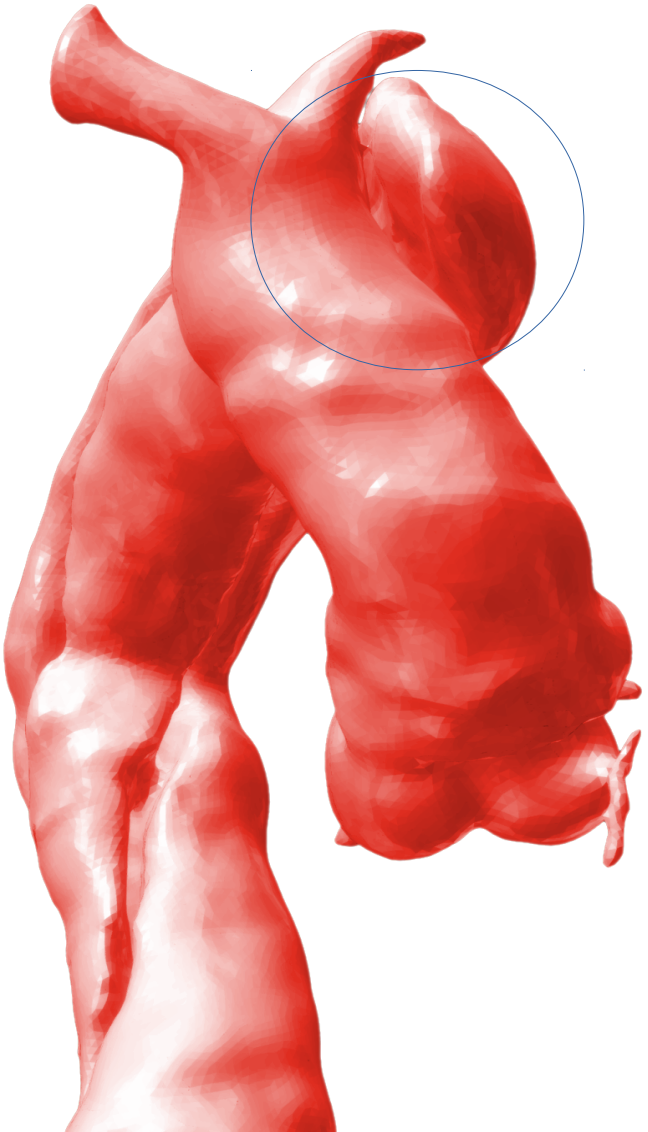

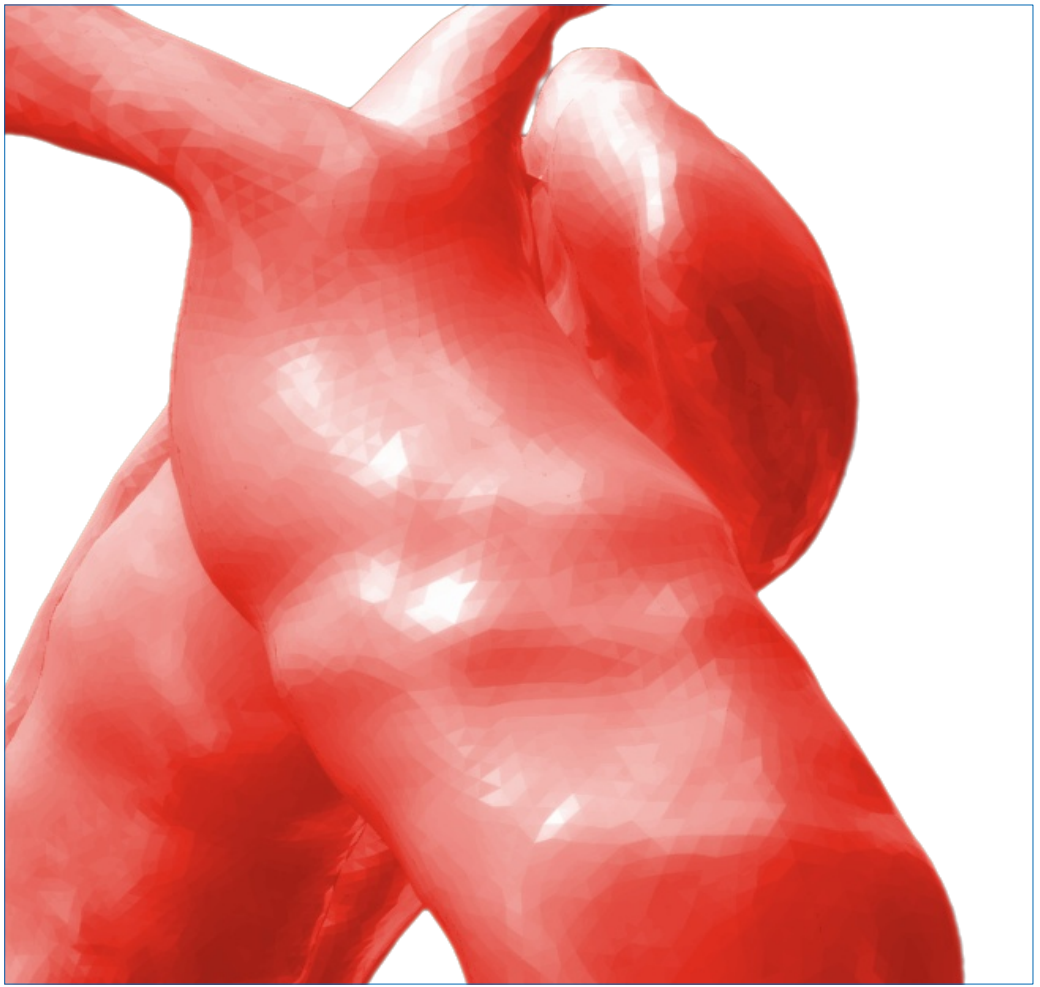

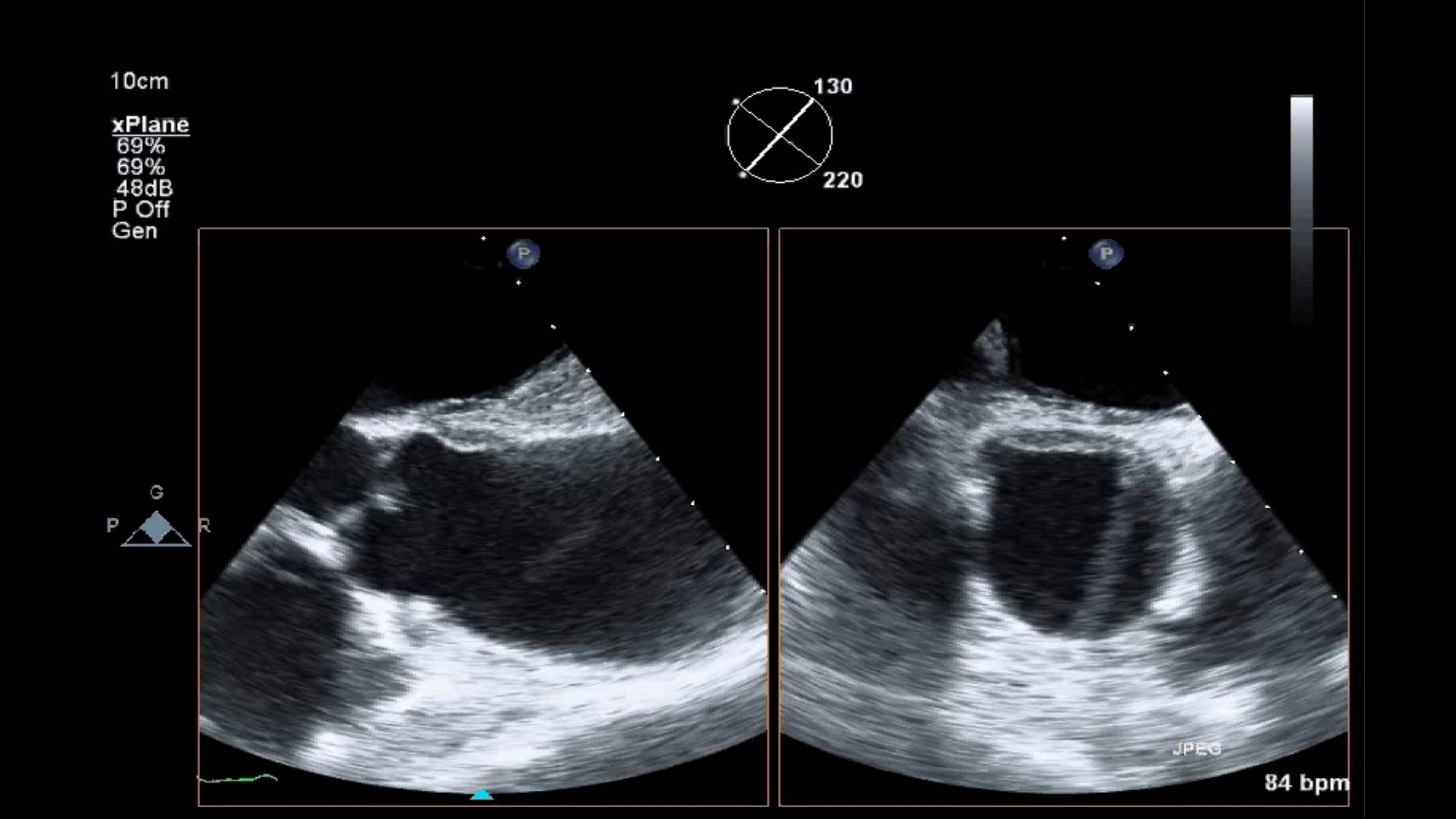
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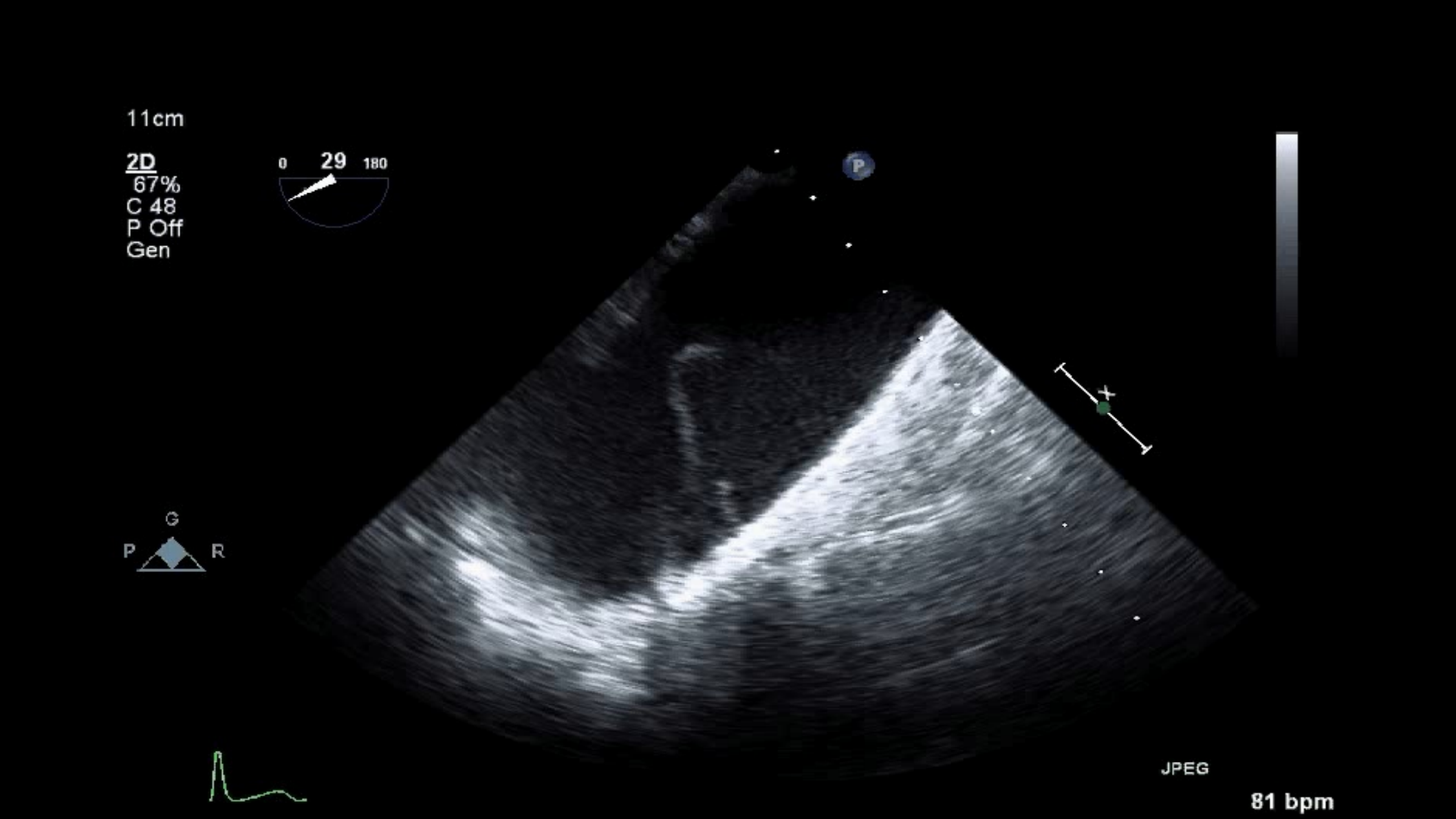
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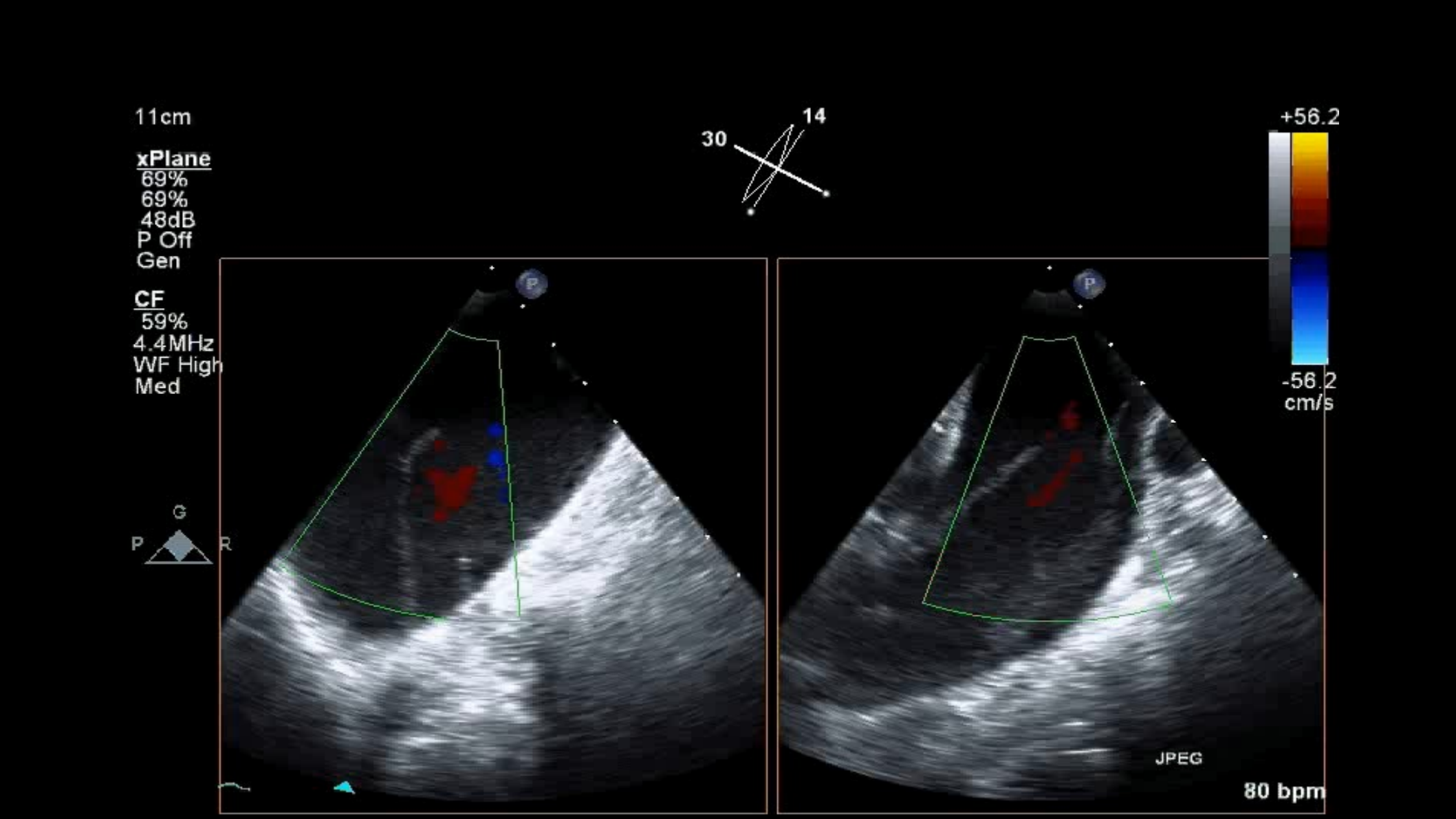
Goals: Diagnosis – Luminal Truth

Table 3 **Differentiation between true and false lumina**

	True lumen	False lumen
Size	True < false	Most often: false > true lumen
Pulsation	Systolic expansion	Systolic compression
Flow direction	Systolic antegrade flow	Systolic antegrade flow reduced or absent, or retrograde flow
Communication flow	From true to false lumen in systole	
Contrast echo flow	Early and fast	Delayed and slow

Evangelista et al. Echocardiography in aortic diseases. Eur J Echocardiography. 2010 Sep;11(8):645–58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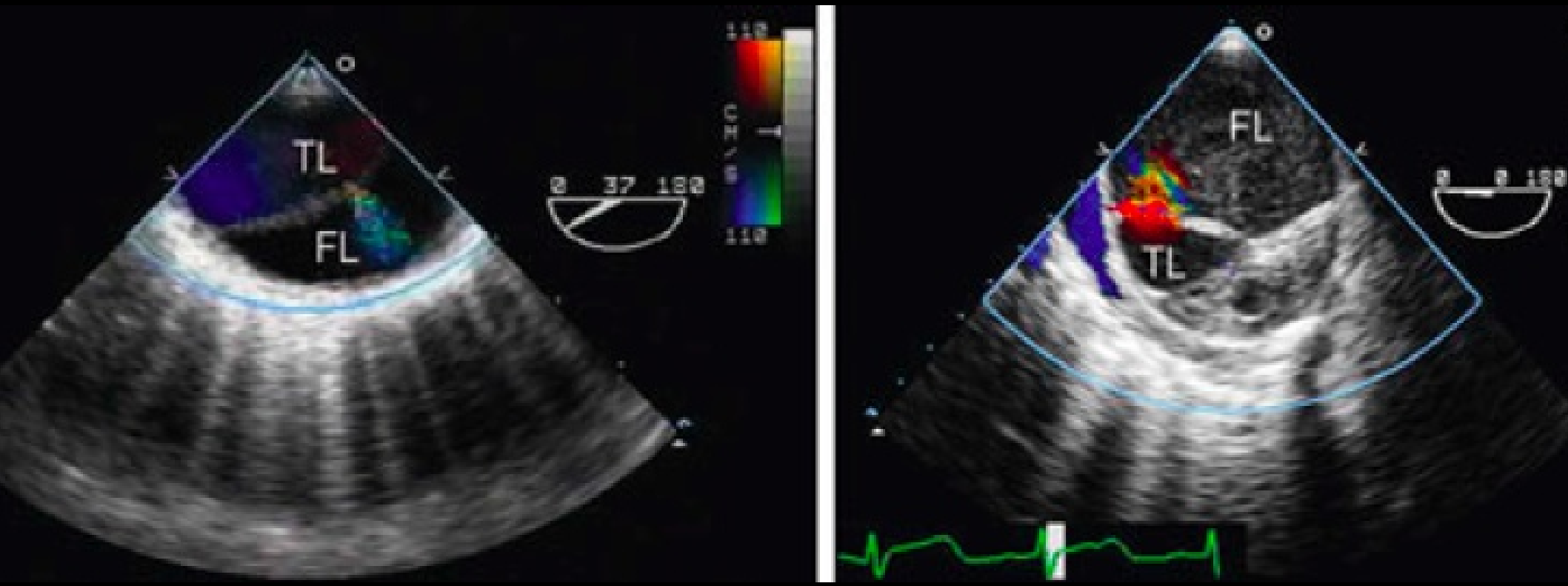
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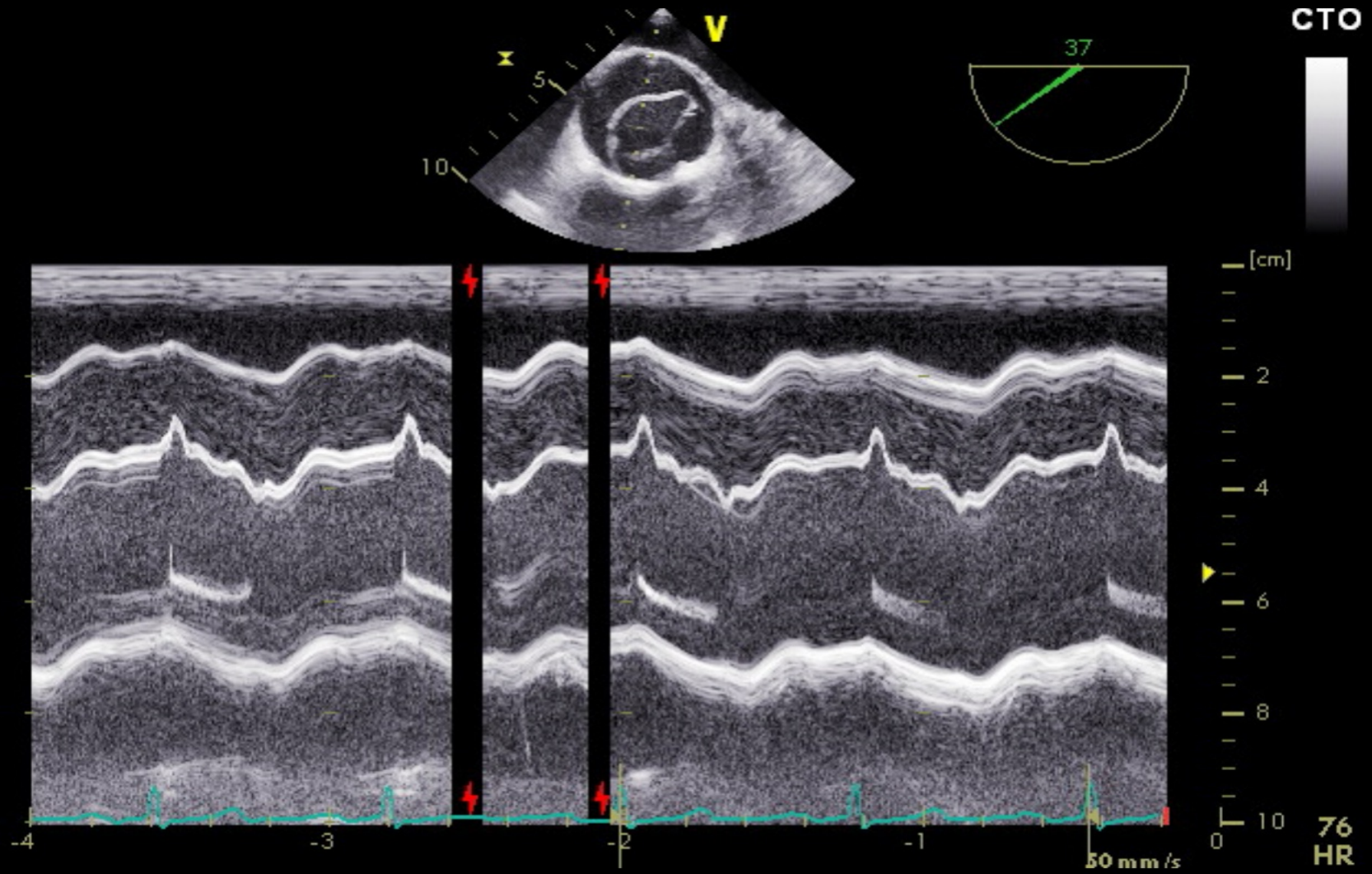
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Question

In what situation does the intimal flap move towards **the true lumen in systole**?

Which other typical findings of TL vs FL do not apply in this situation?

Goals: Diagnosis

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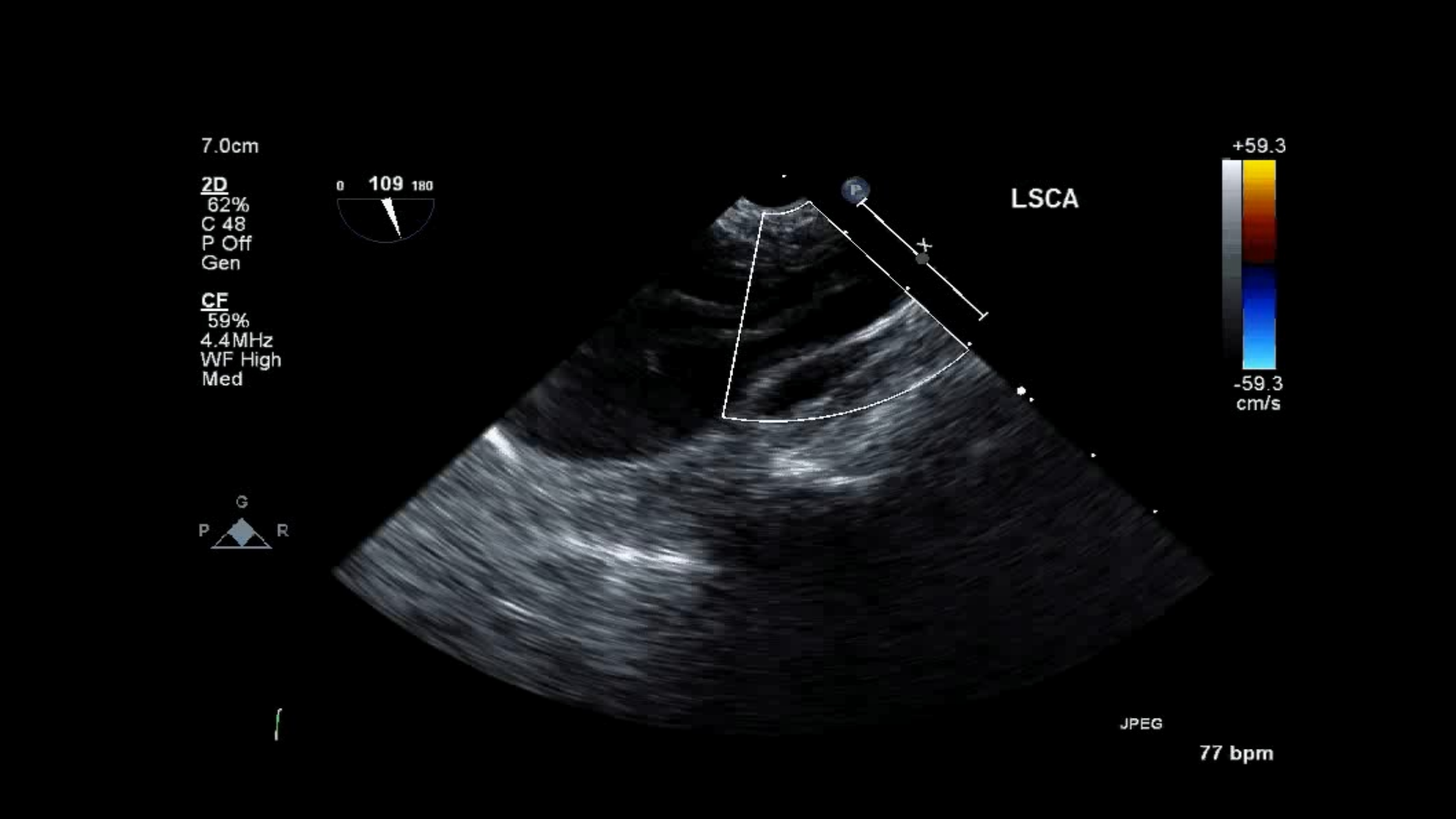
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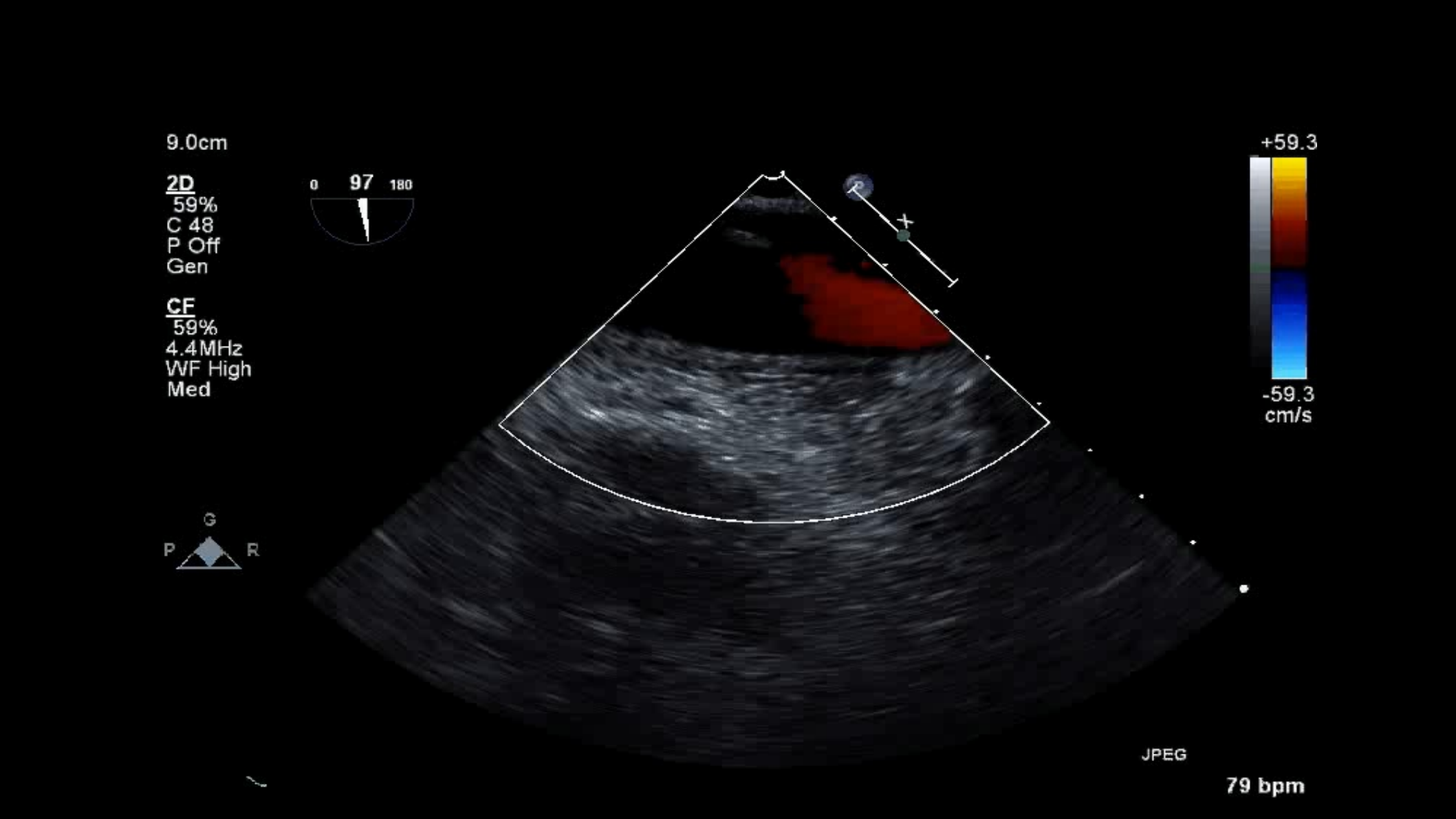
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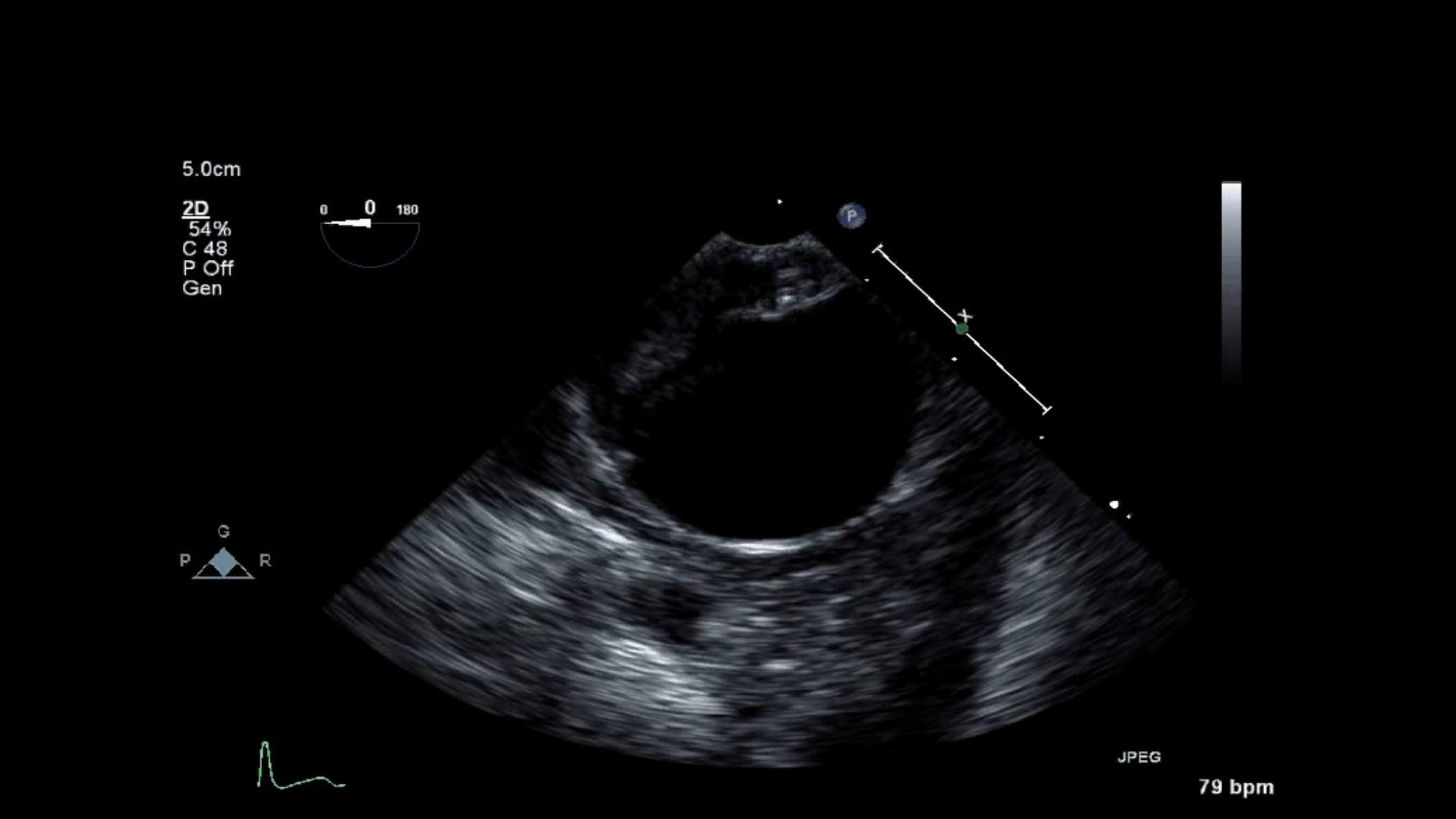
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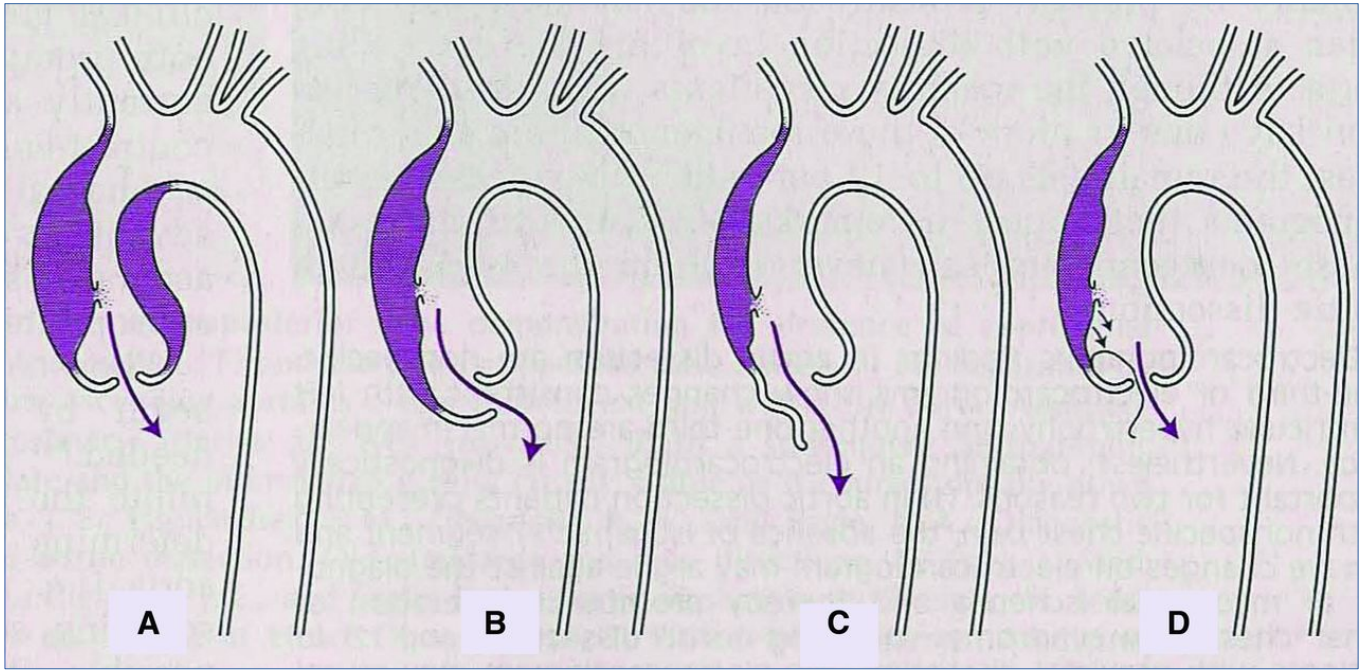
Goals: Diagnosis – Aortic Insufficiency



A: Tear dilates Ao root & annulus – failure of coaptation

B: Asymmetric dissection depressed one leaflet below coaptation line

C: Annular support disrupted, resulting in flail leaflet

D: Prolapse of intimal flap through aortic valve in diastole, preventing coaptation

Yasmin S. Hamirani et al. Circulation. 2012;126:1121-1126

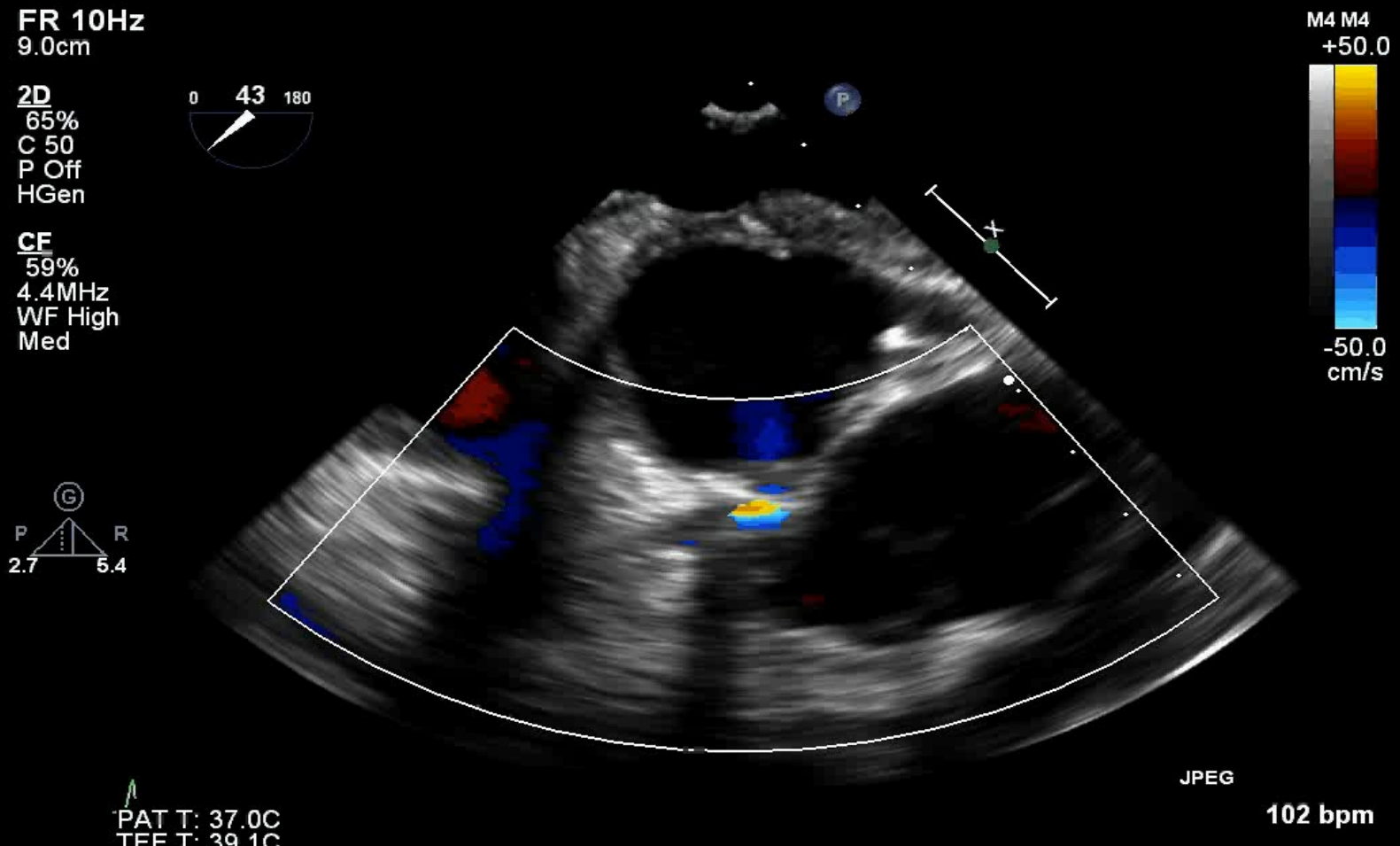
Goals: Diagnosis – Ventricular Function

Generalized dysfunction associated with Acute AI

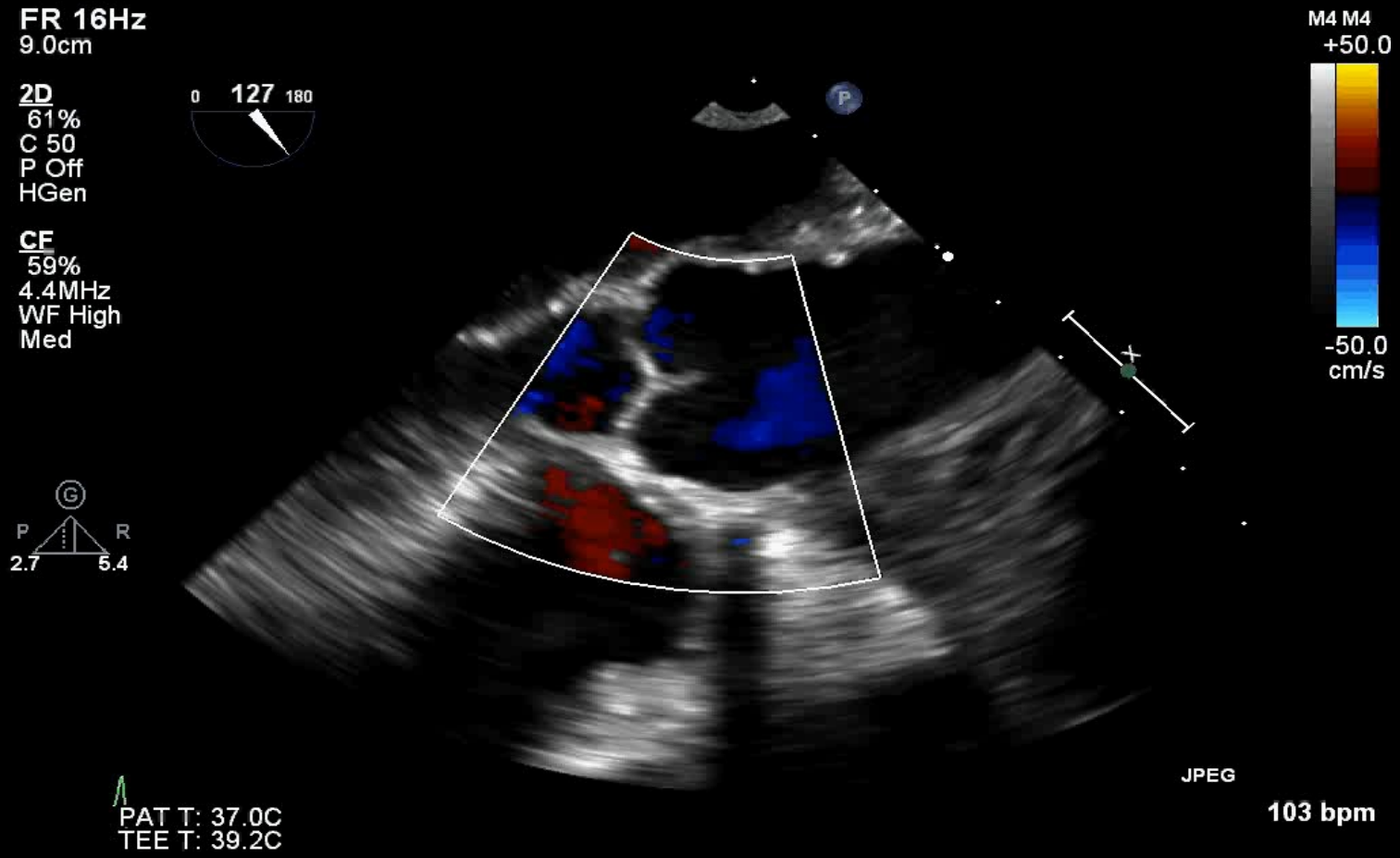
Regional dysfunction associated Coronary artery injury/obstruction

Coronary involvement: R > L

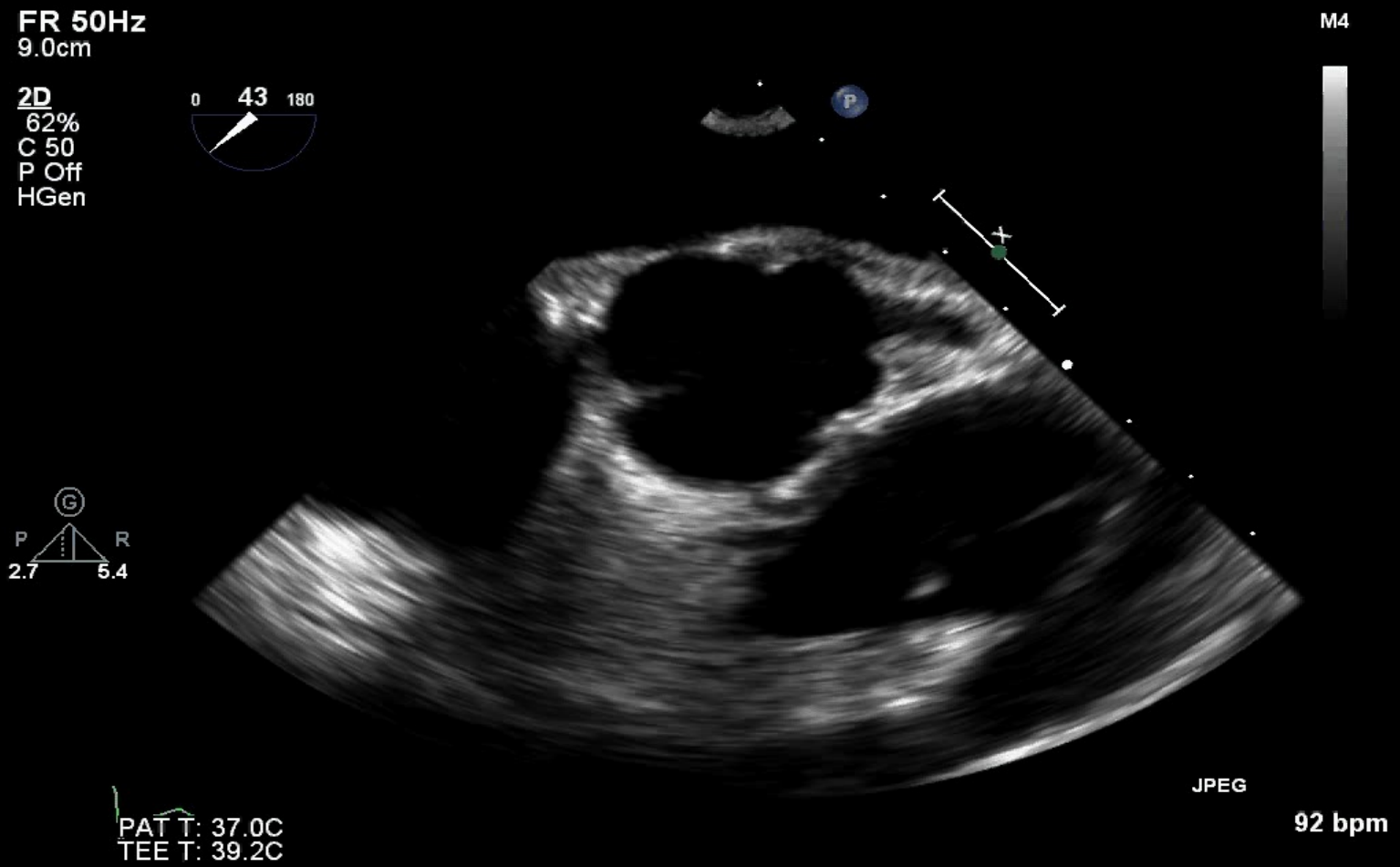
Right Coronary Artery



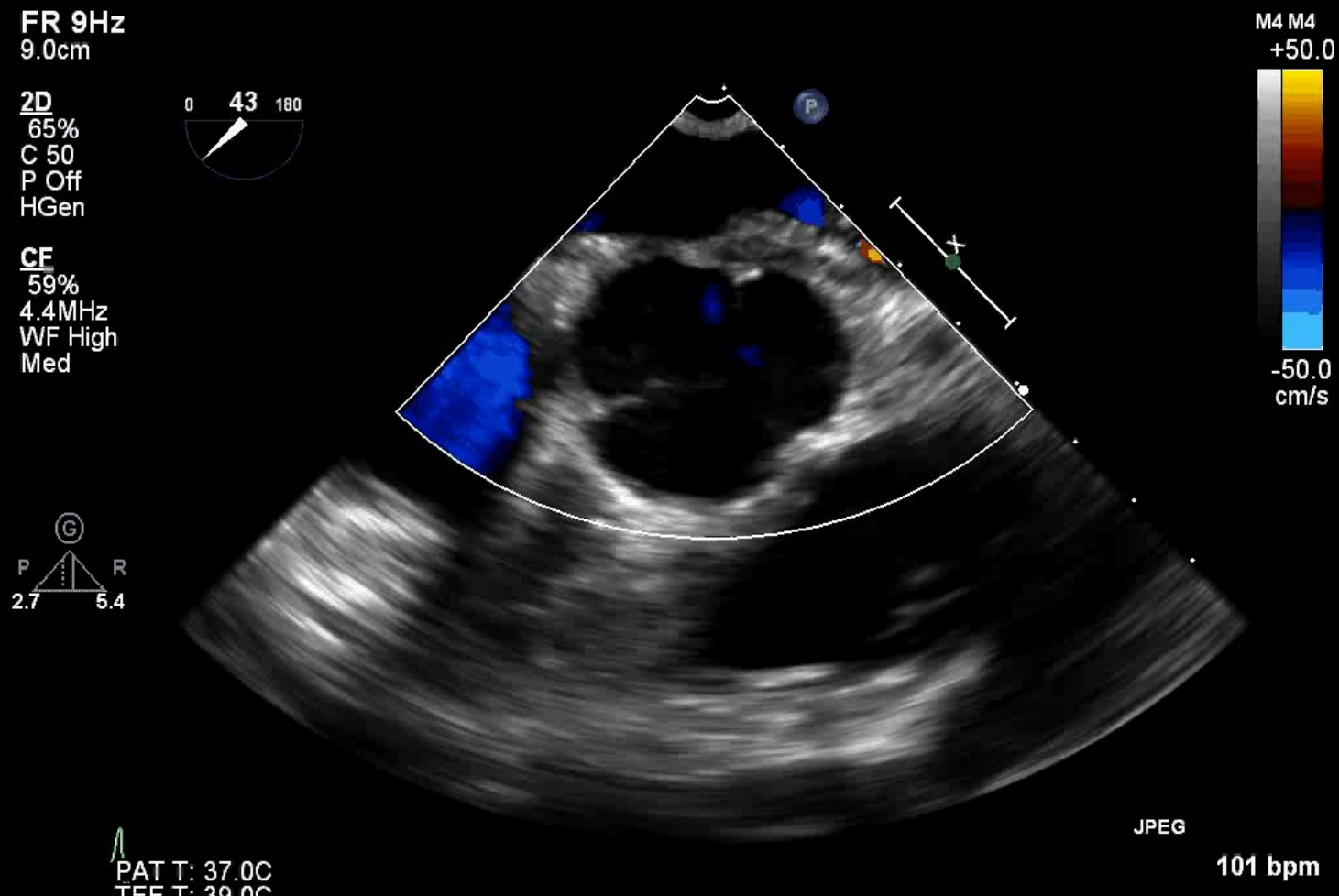
Right Coronary Artery



Left Main Coronary Artery



Left Main Coronary Artery



Goals: Diagnosis – Perfusion of Branches

Arch & Visceral vessels

- Dynamic obstruction: Compression of TL by FL
- Static obstruction: Extension of dissection into or avulsion of branch

Caused by interposition of air-filled structures
(tracheobronchial tree, lung)

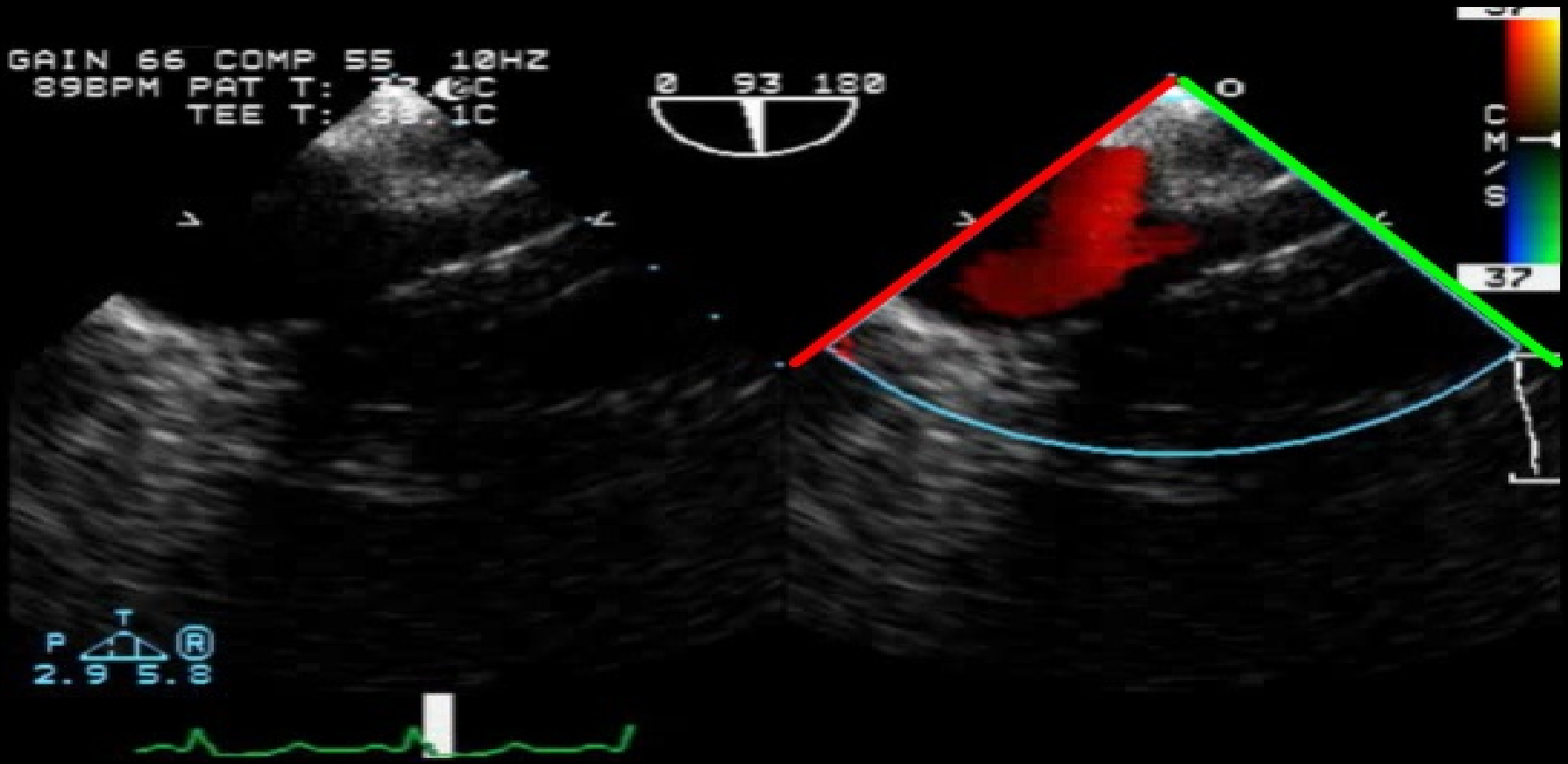
Often includes **bracheocephalic & L common carotid**

Very rare for dissections to start or be limited to this area

Dealing with the blindspot

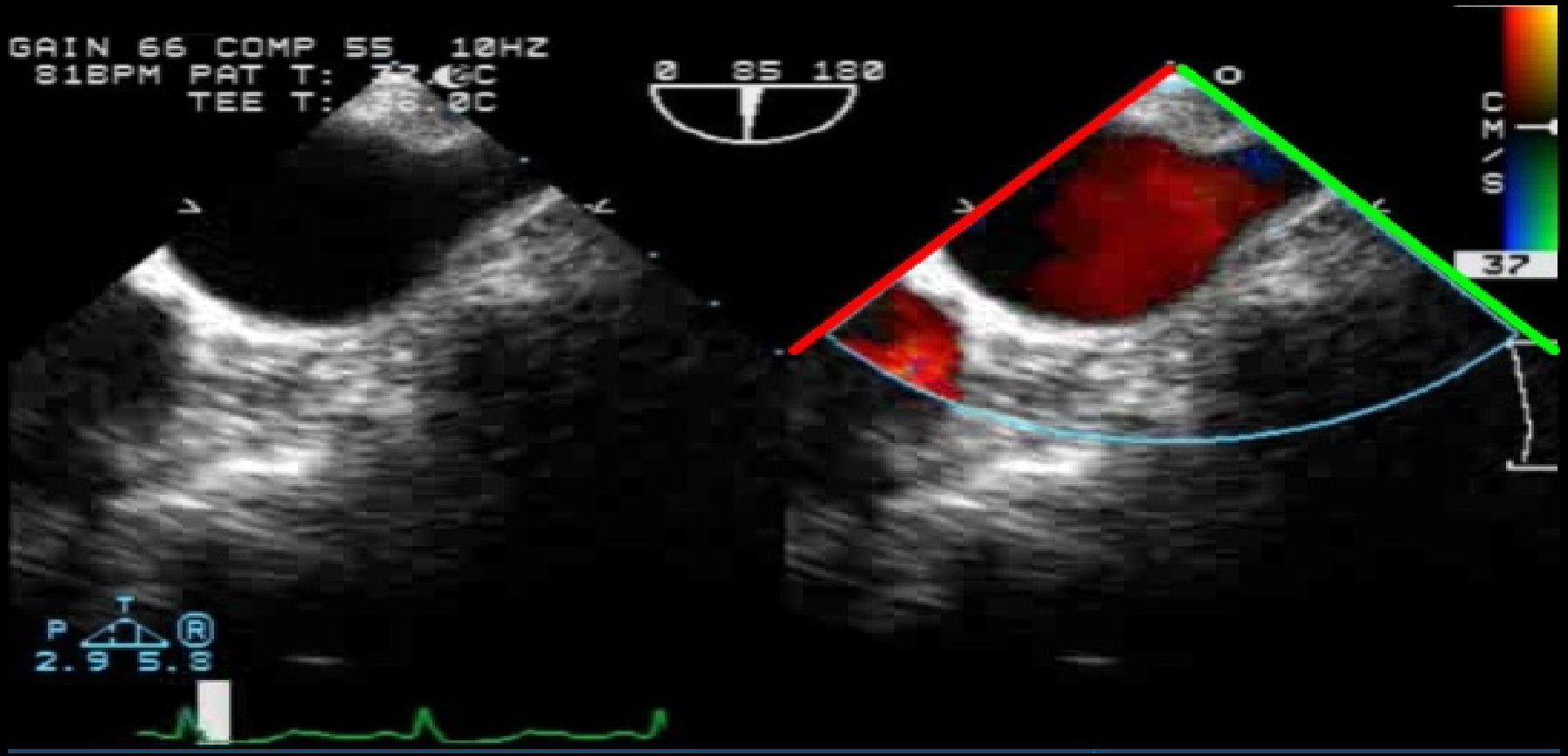
- TTE suprasternal notch view
- Epiaortic imaging
- Bronchial balloon (“A-view” catheter)

Left subclavian artery

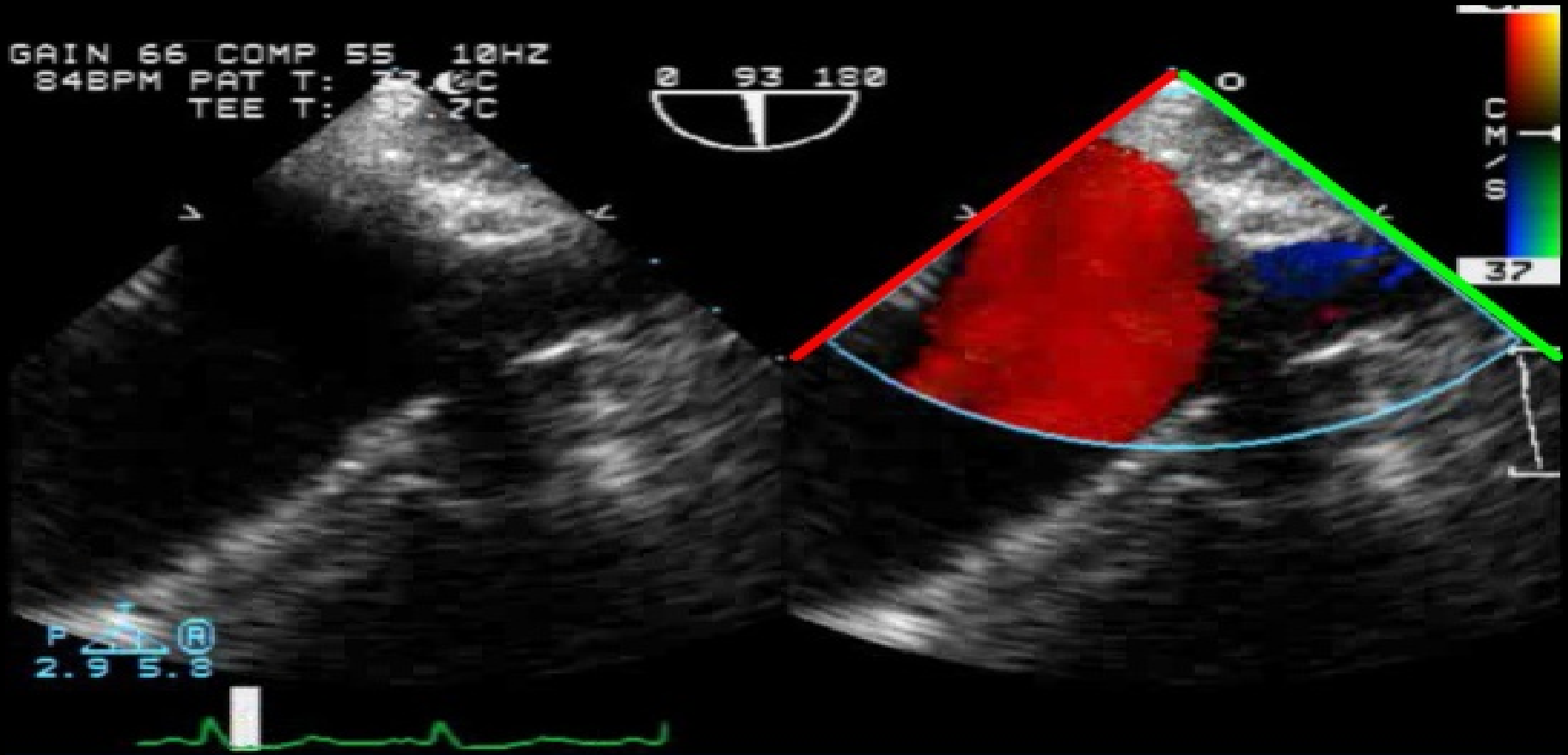


http://pie.med.utoronto.ca/TEE/

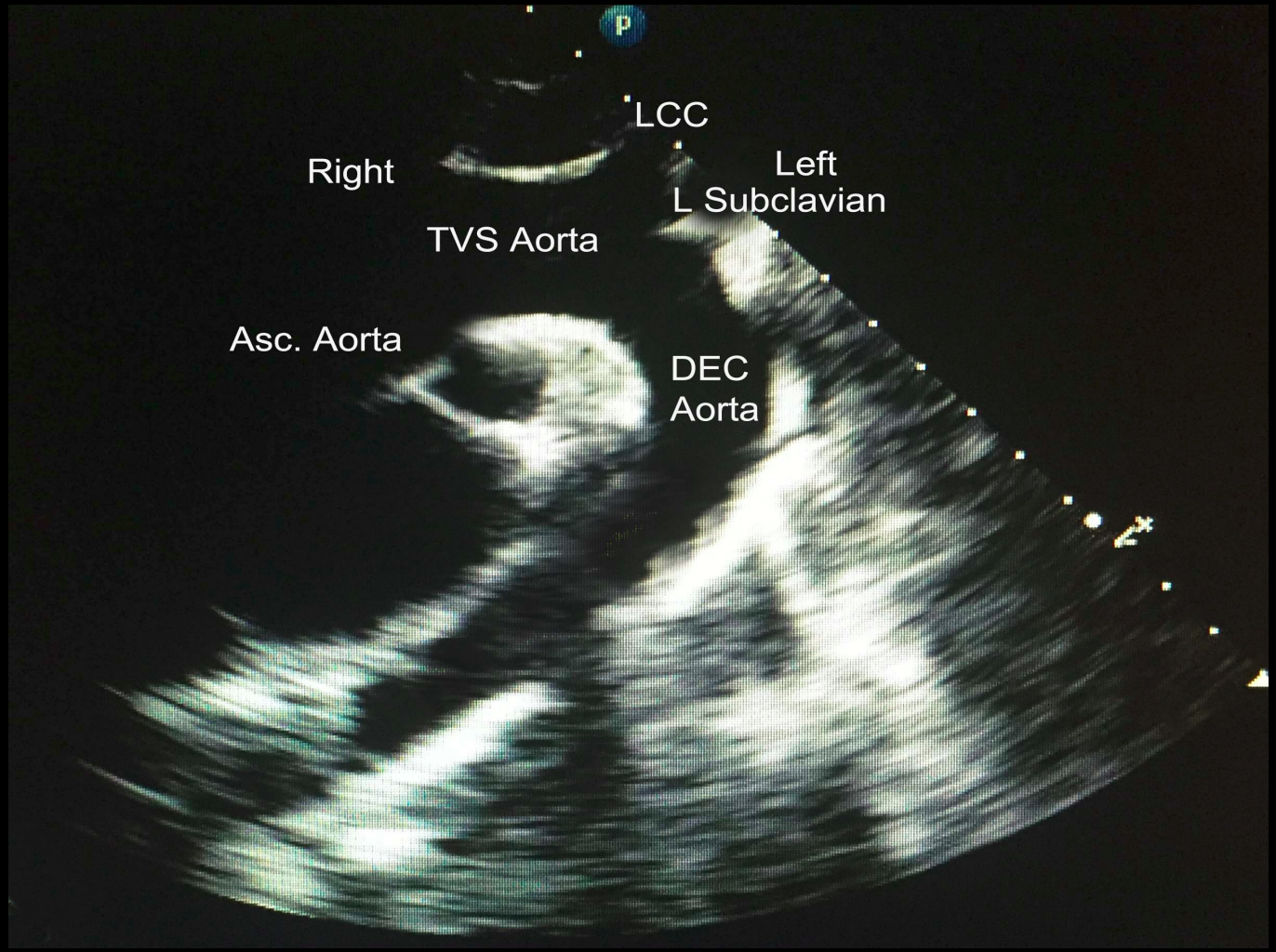
Left common carotid



Inominate artery



Supresternal Notch View (TTE)



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Goals: **Procedural Planning**

Assist with Key Surgical Decisions

- Cannulation:
  - Venous: Central or femoral?
  - Arterial: Axillary or femoral?
- Arch repair?
- Aortic root repair/replacement?
- Aortic valve?
- Coronary bypass?
- Should pathology in descending aorta be addressed acutely?

Goals: **Monitoring & Procedural Guidance**

Dynamic process: extent & physiologic consequences can evolve

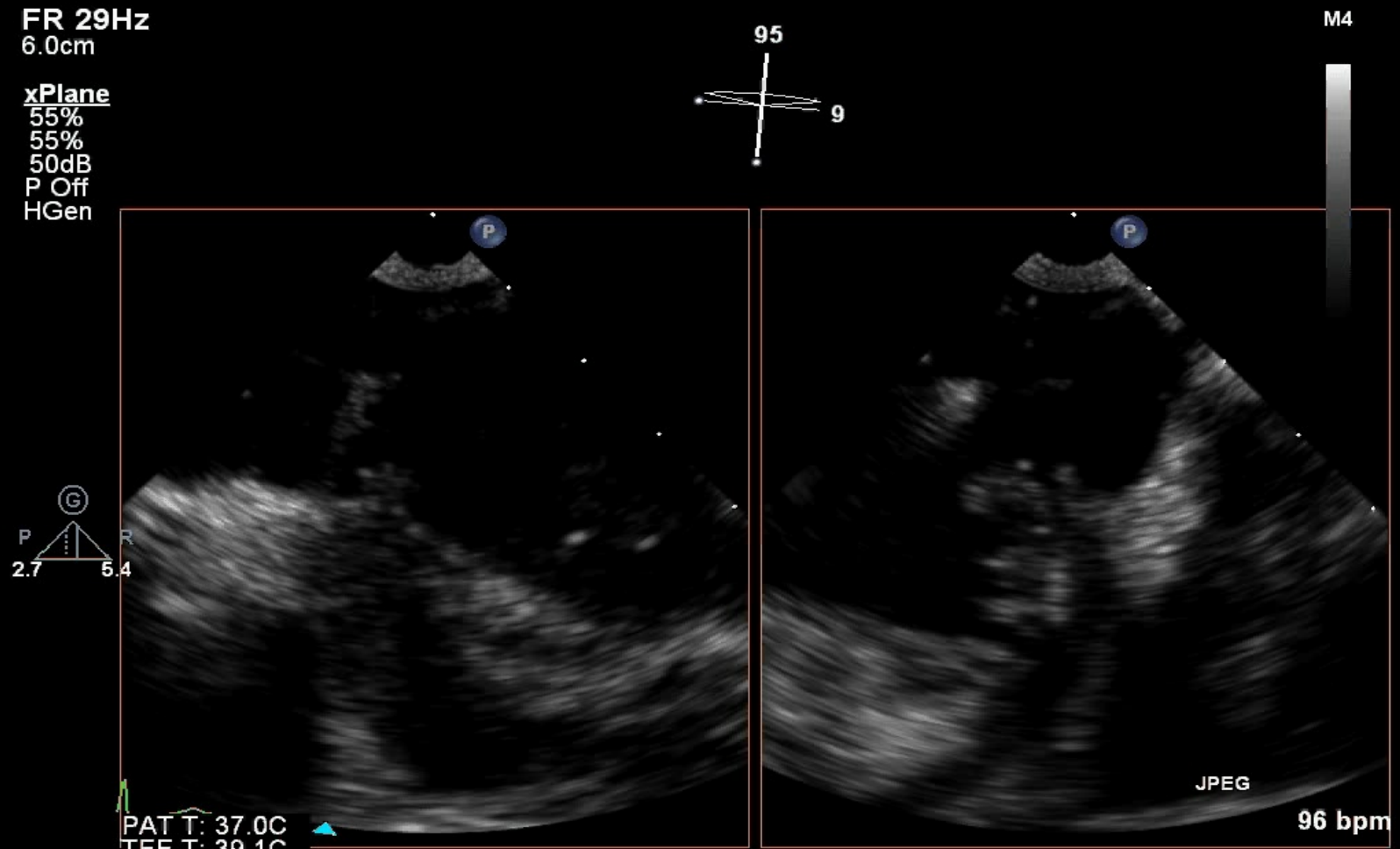
Femoral cannulation: confirmation of wire and cannula position

Retrograde cardioplegia cannula

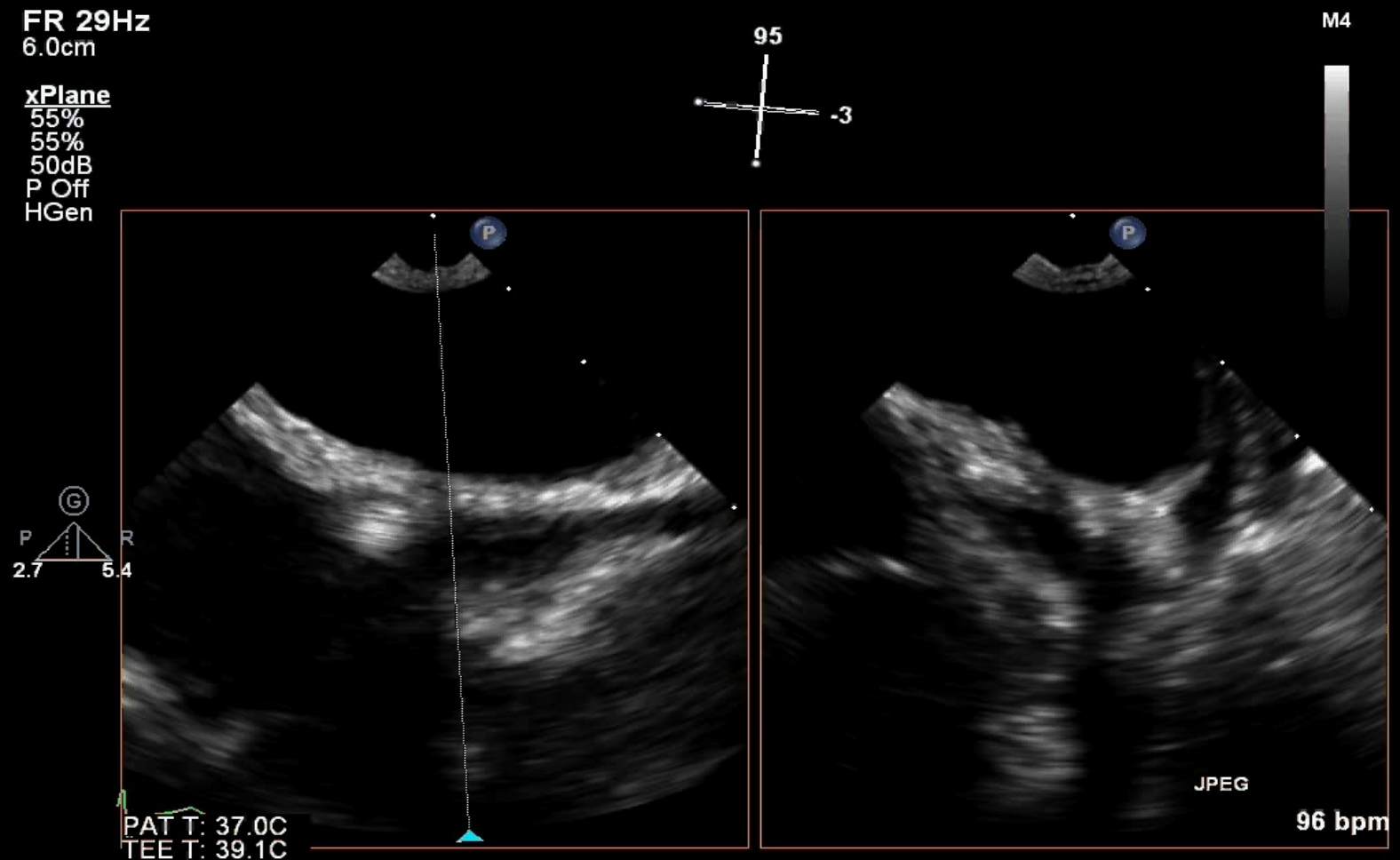
EVAR guidance

- TEE can distinguish false &true lumens
- Avoid protruding plaques in landing zone

Two stage femoral venous cannula placement: guidewire



Two stage femoral venous cannula placement: guidewire



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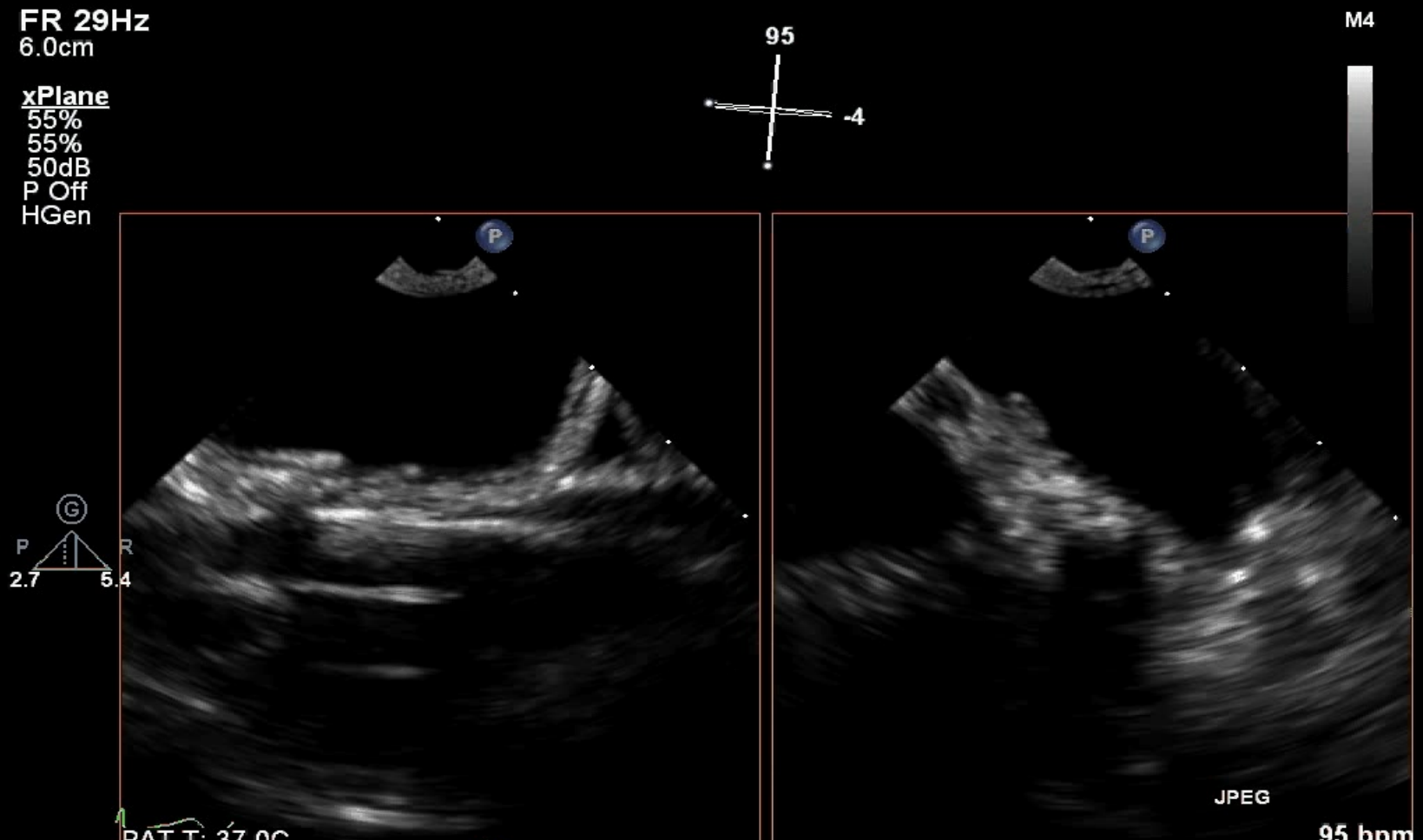

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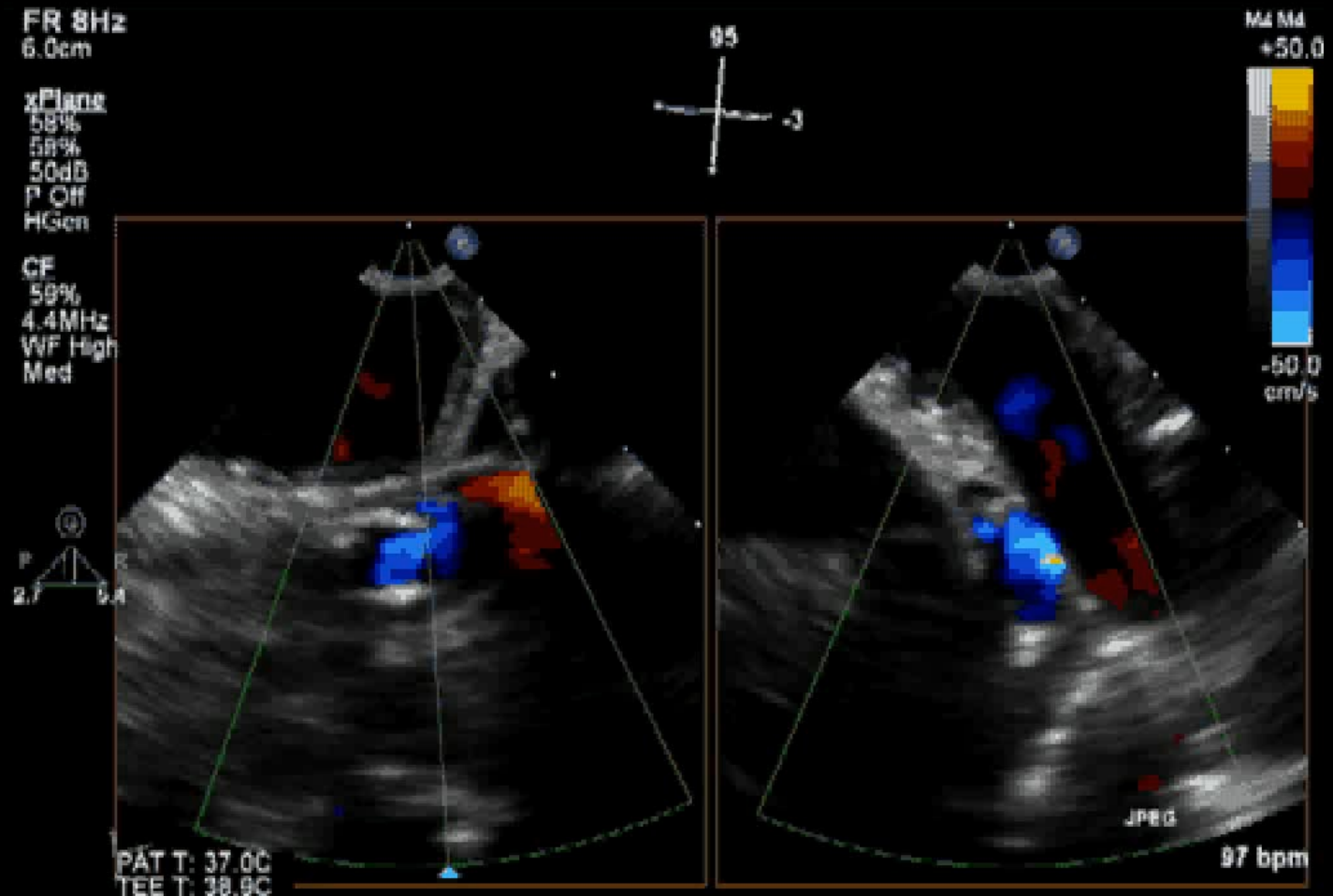

Goals: Post Operative Assessment

- Confirm exclusion of entry tear and any proximal
- Ventricular function
- Aortic valve function
- Adequacy of flow in descending thoracic aorta

References

- Goldstein et al. **Multimodality Imaging of Diseases of the Thoracic Aorta in Adults**. JASE 2015 Feb;28(2):119–82.
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open software

The Lynn & Arnold Irwin APIL Advanced Perioperative Imaging Lab

open hardware

APIL.ca

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