ARTIFACTS: THEORY AND ILLUSTRATIVE EXAMPLES

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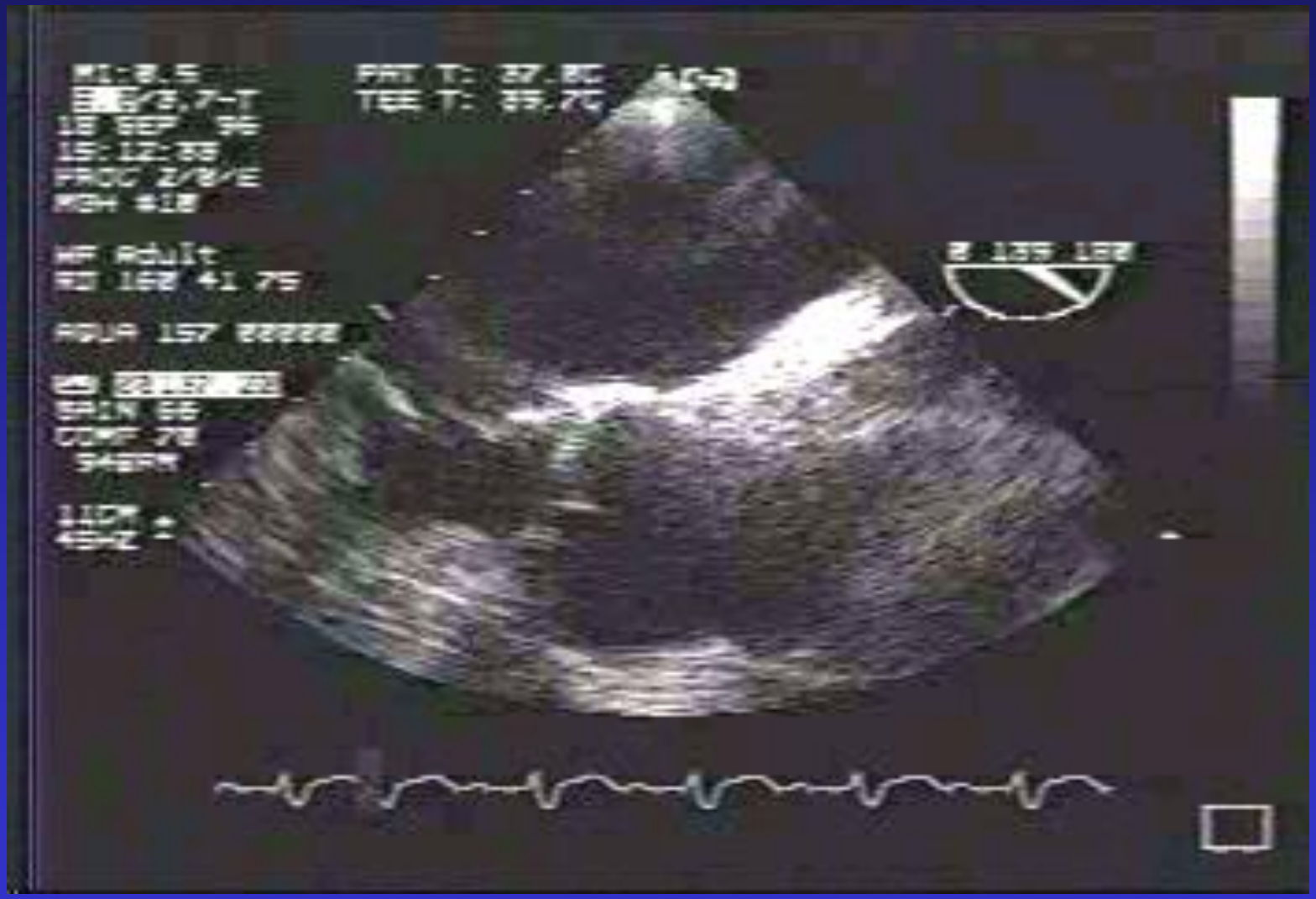
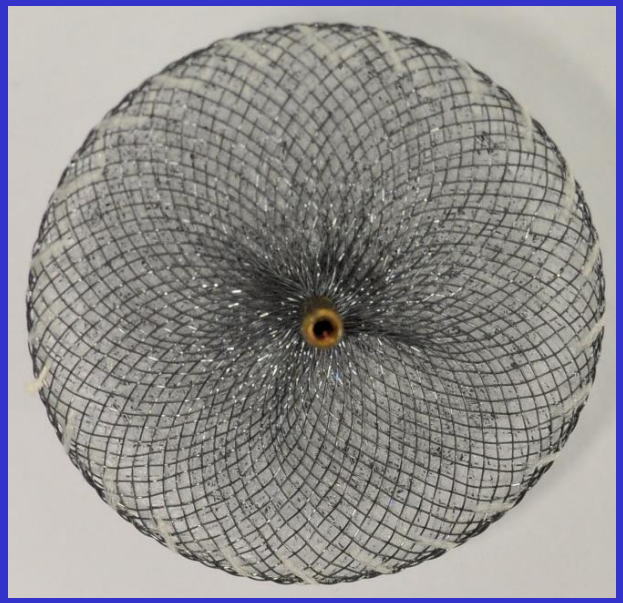
60 year old man
Cardiac source of embolus?

NAME THAT MASS!

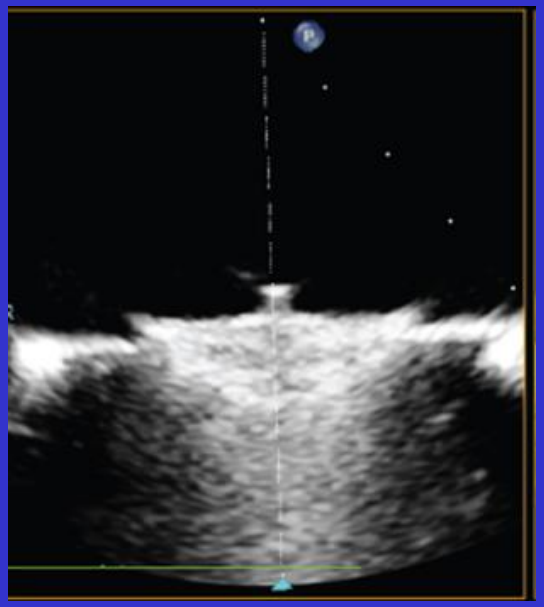
NAME THAT MASS!

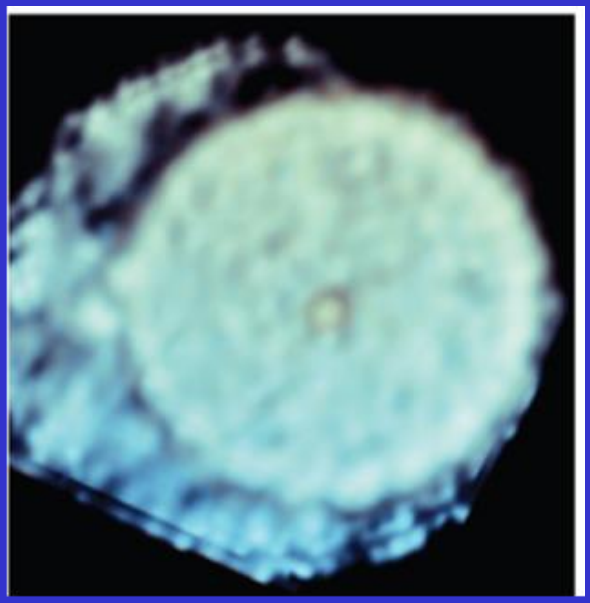


LA APPENDAGE CLOSURE DEVICES



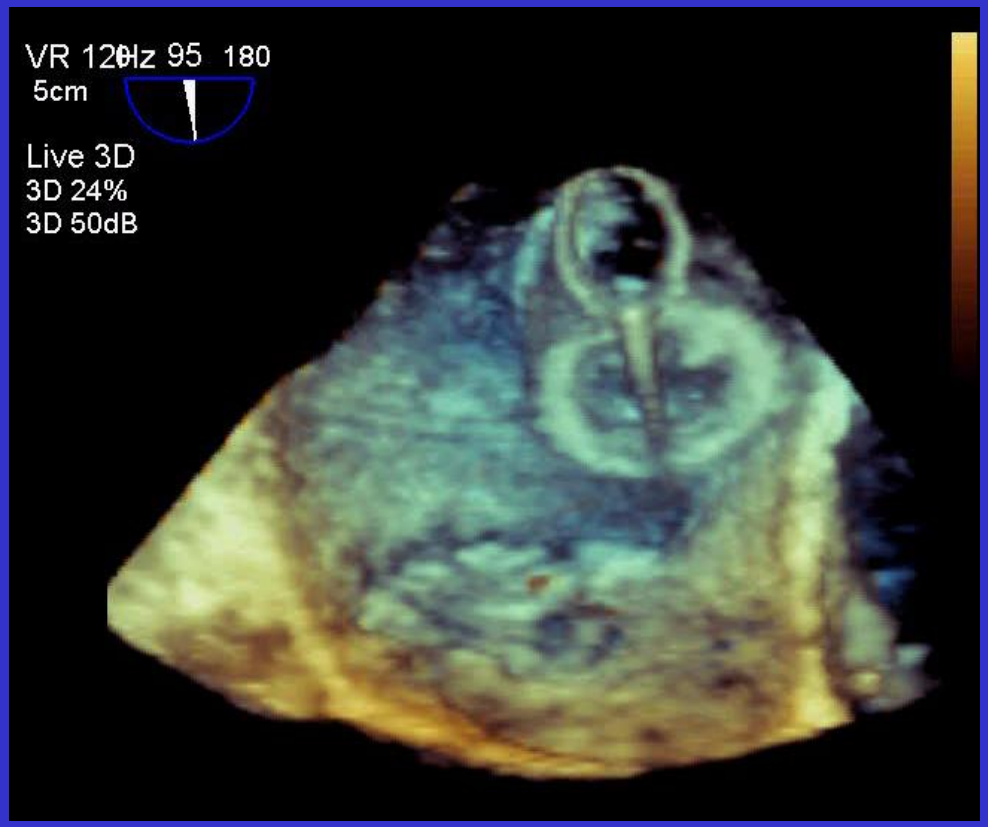
AMPLATZER

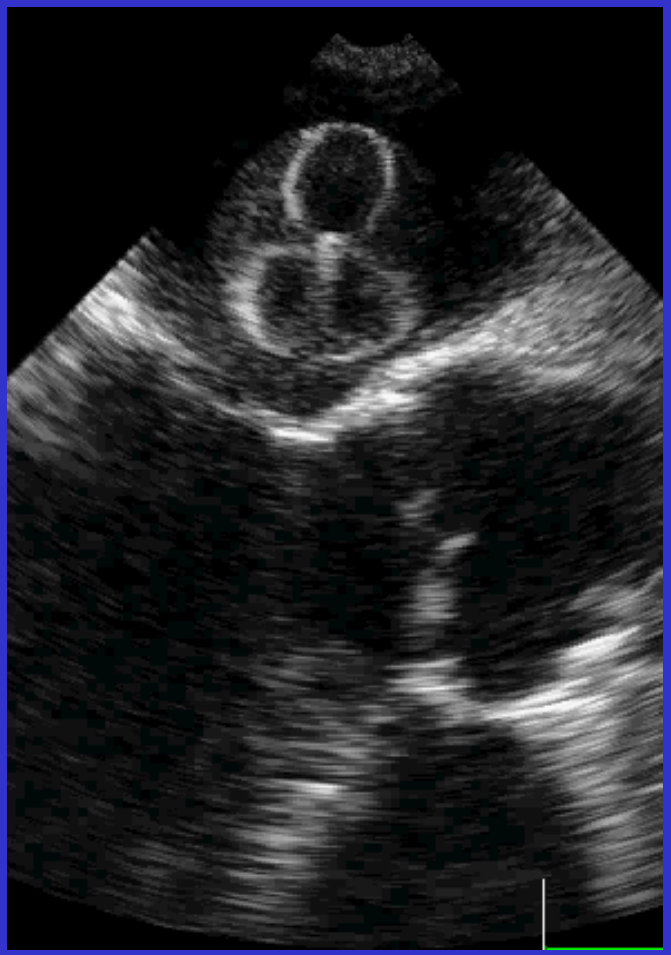




3D ECHO FRONTAL VIEW

Apical TTE and TEE: What type of device?





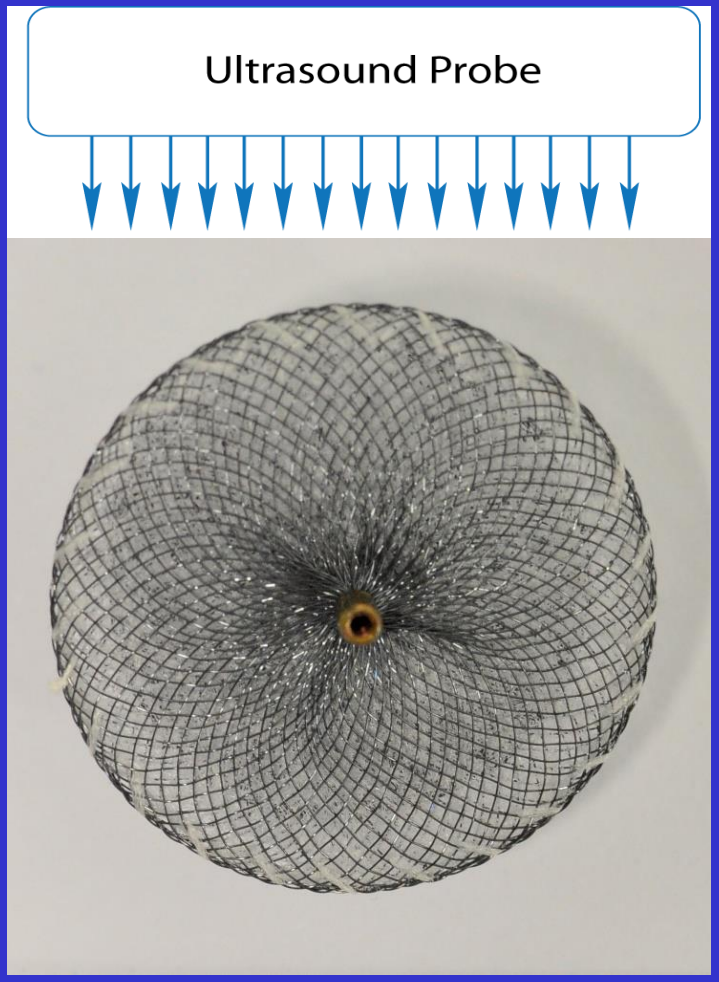
ECHOCARDIOGRAPHY IN LA APPENDAGE CLOSURE

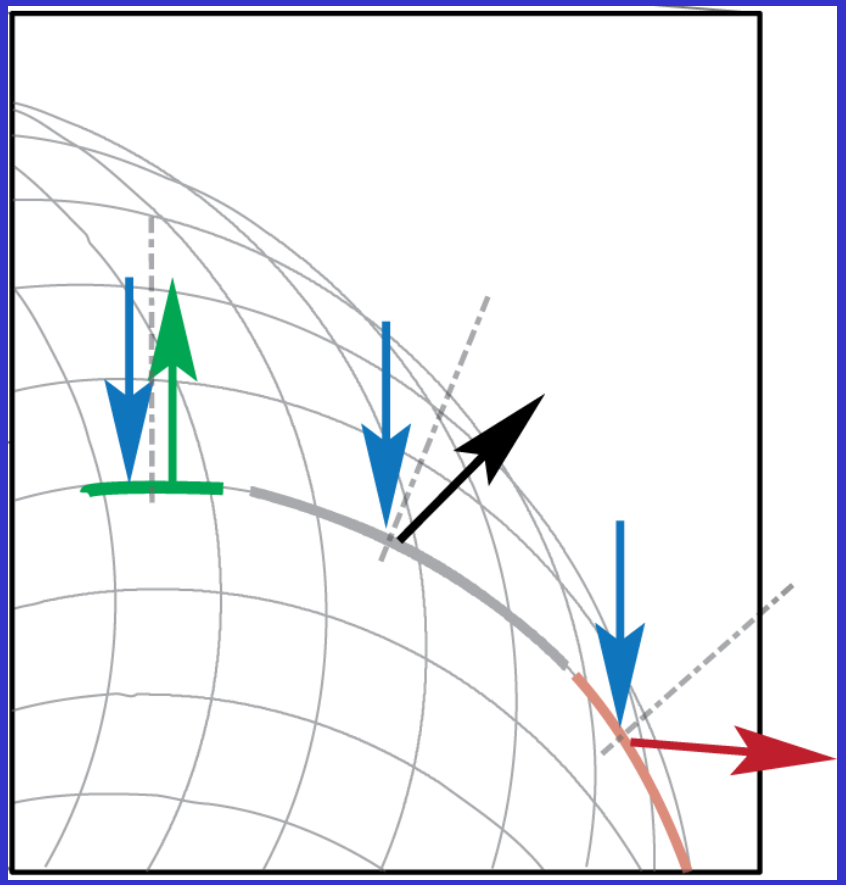
Etiology and Relevance of the Figure-of-Eight Artifact on Echocardiography after Percutaneous Left Atrial Appendage Closure with the Amplatzer Cardiac Plug

Philippe B. Bertrand, MD, MSc, Lars Grieten, MSc, PhD, Pieter De Meester, MD, Frederik H. Verbrugge, MD, Wilfried Mullens, MD, PhD, David Verhaert, MD, Maximo Rivero-Ayerza, MD, PhD, Werner Budts, MD, PhD, and Pieter M. Vandervoort, MD, *Genk, Hasselt, and Leuven, Belgium*

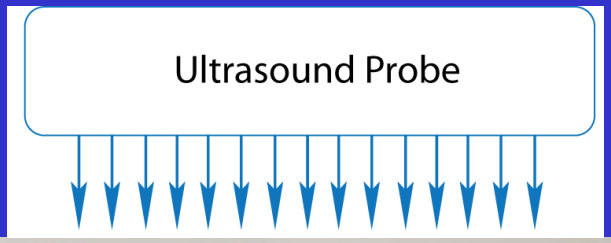
JASE 2014; 27:323-8

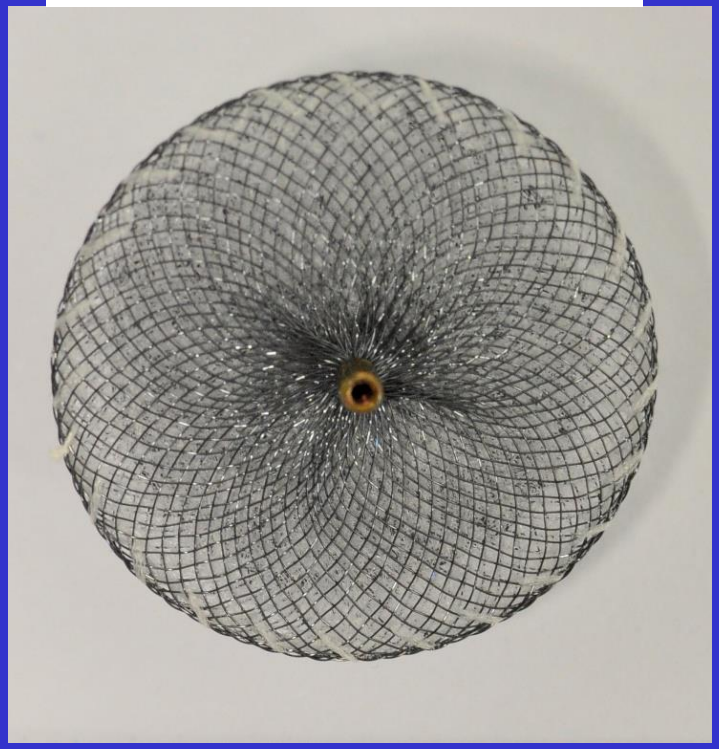
Physics principle: Angle of reflection = angle of incidence for a specular reflector

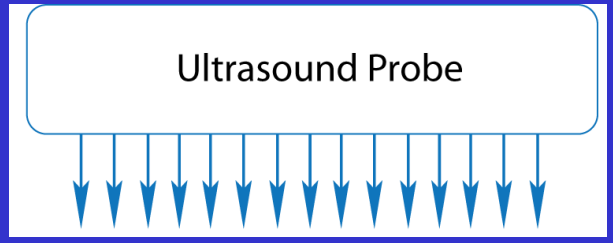


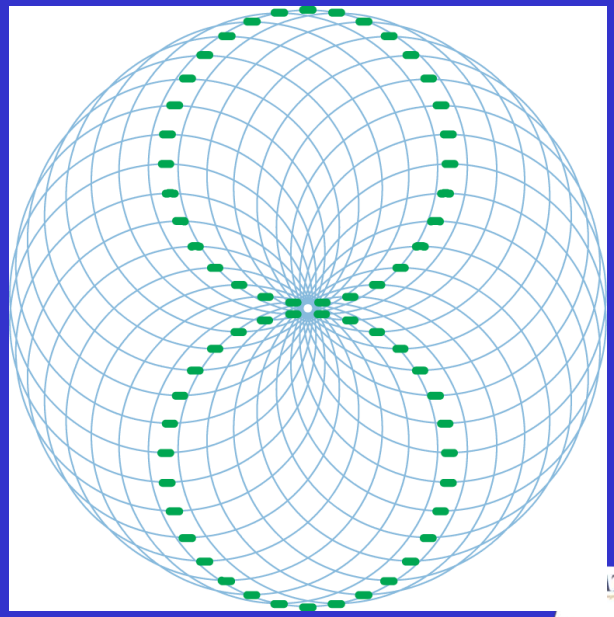


Result: Figure-of-8 artifact

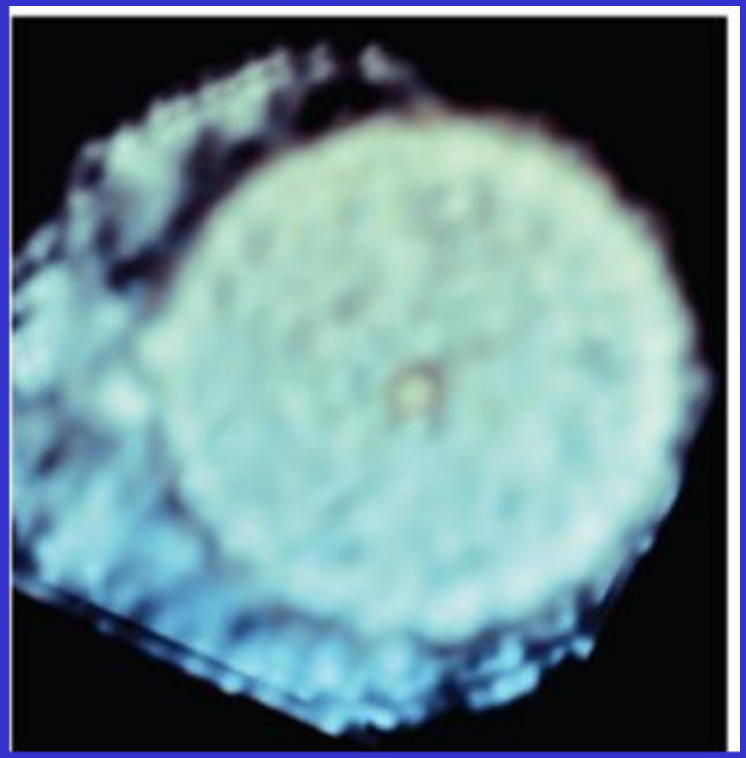


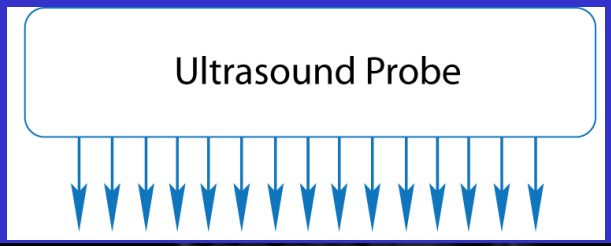


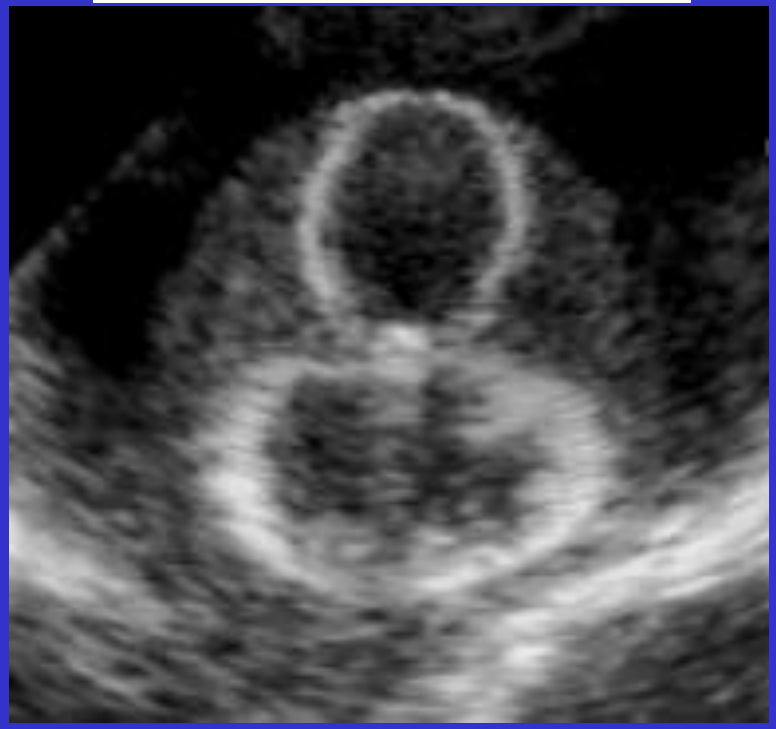




Result: Figure-of-8 artifact versus true shape when beam views device en face







BASIC PRINCIPLES OF ARTIFACTS

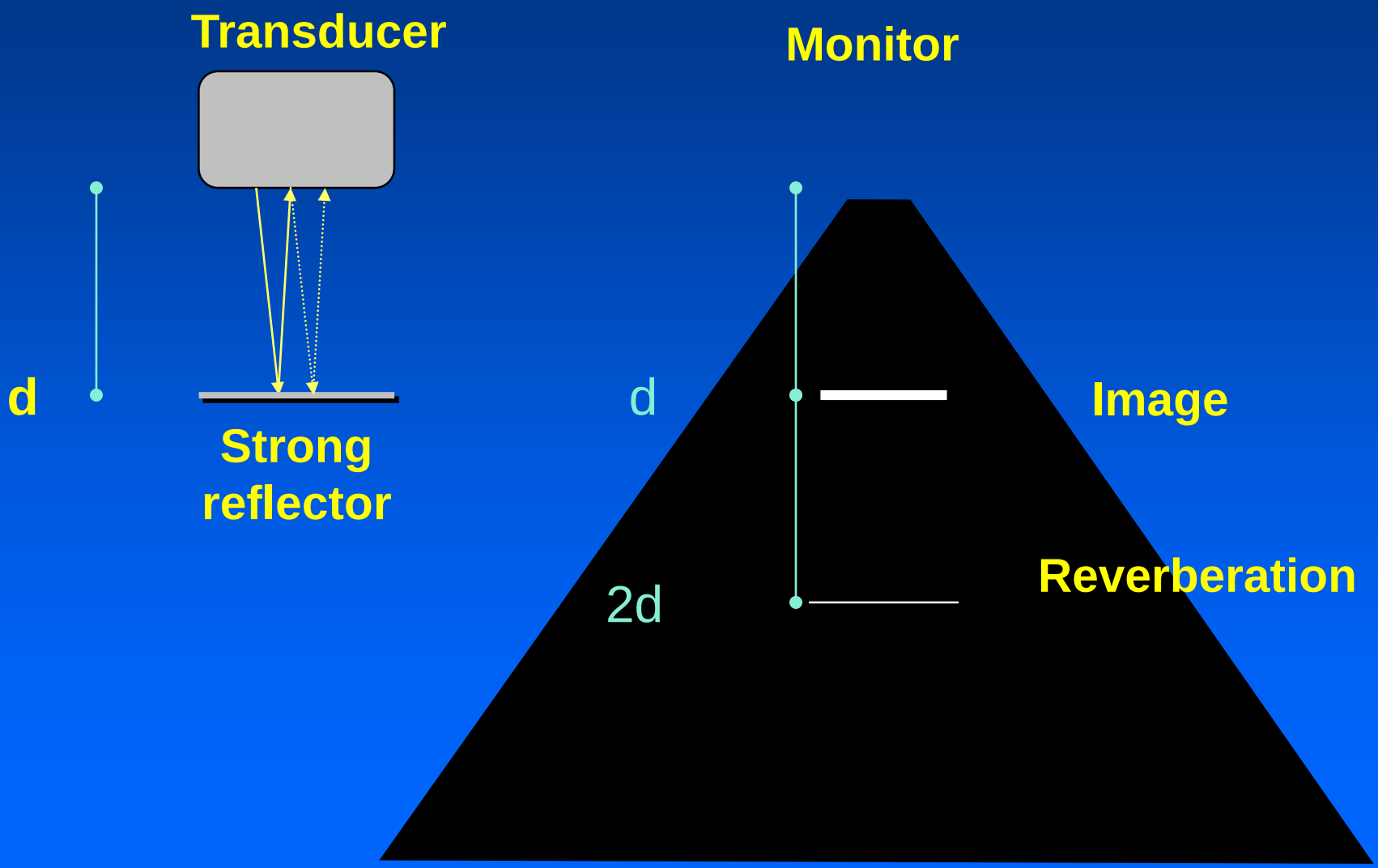
- The machine ascribes all returning sound to the direction in which it is “looking” (sending out a beam).
- The distance to a reflector is determined from the time it takes for sound to return.

TYPES OF ARTIFACTS

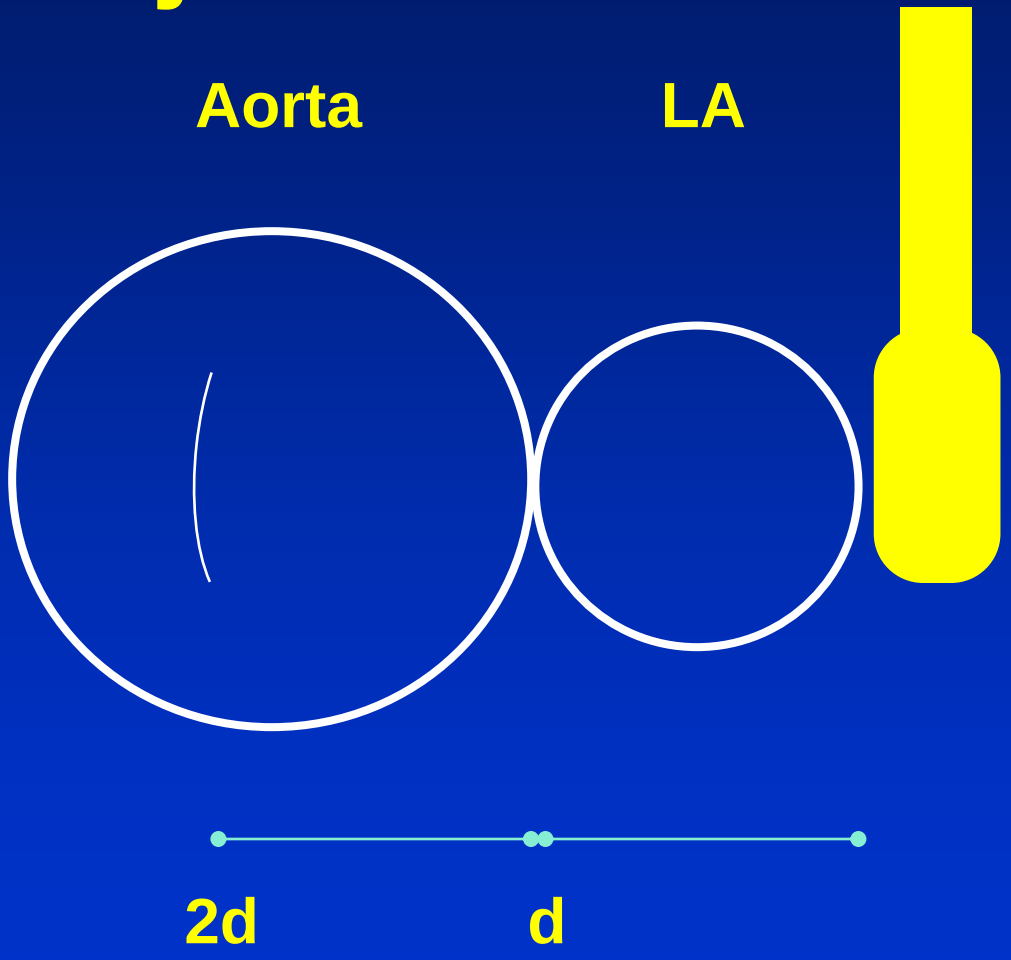
- More distant than the object
  - Parallel motion: Reverberation
  - Opposite motion: Mirror image

- Same distance as the object
  - Beam width
  - Side lobe
  - Refraction (lens)

Reverberations

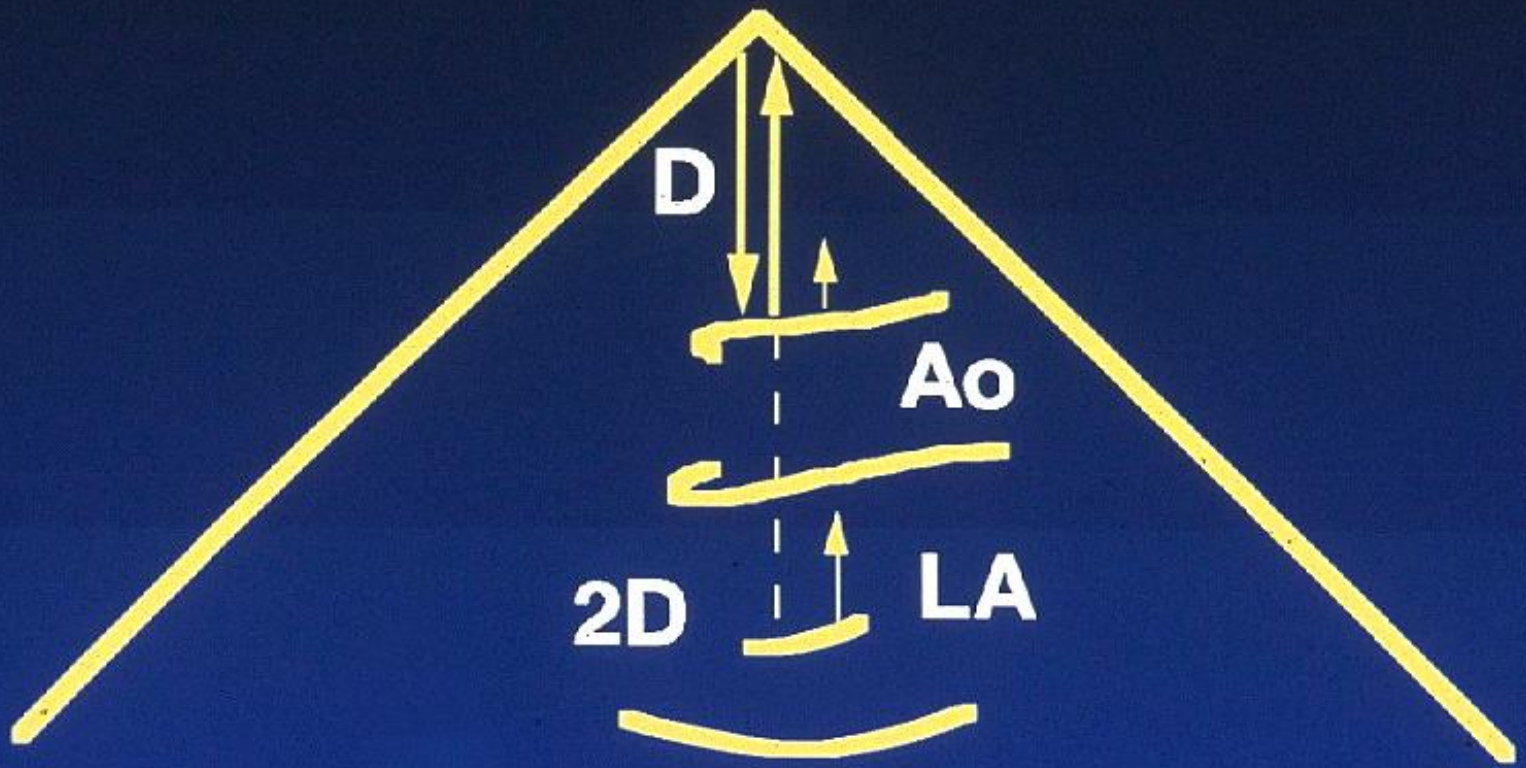


Reverberation Artifacts: Adjacent Cavities




PT:
ID:
12 JAN 92
21:02
CINELOOP (R) REVIEW
8TEE 5 MHZ L
OUT 70.79 %
50DB C2 E2
FR 42 HZ
LA
Ao
1 2.66 CM
2 2.68
DISTANCE = 2.68 CM
LA
Ao
B

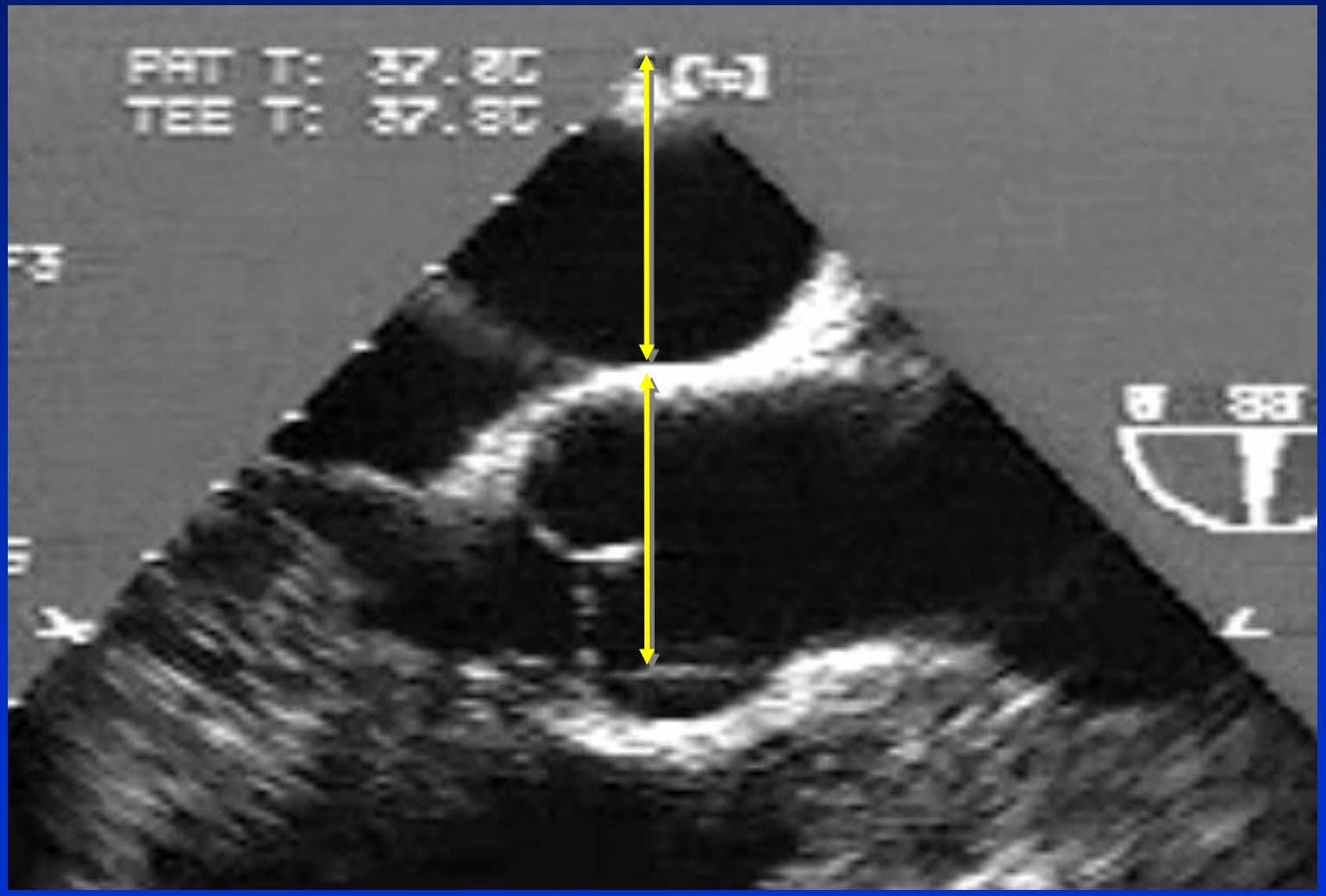
REVERBERATION



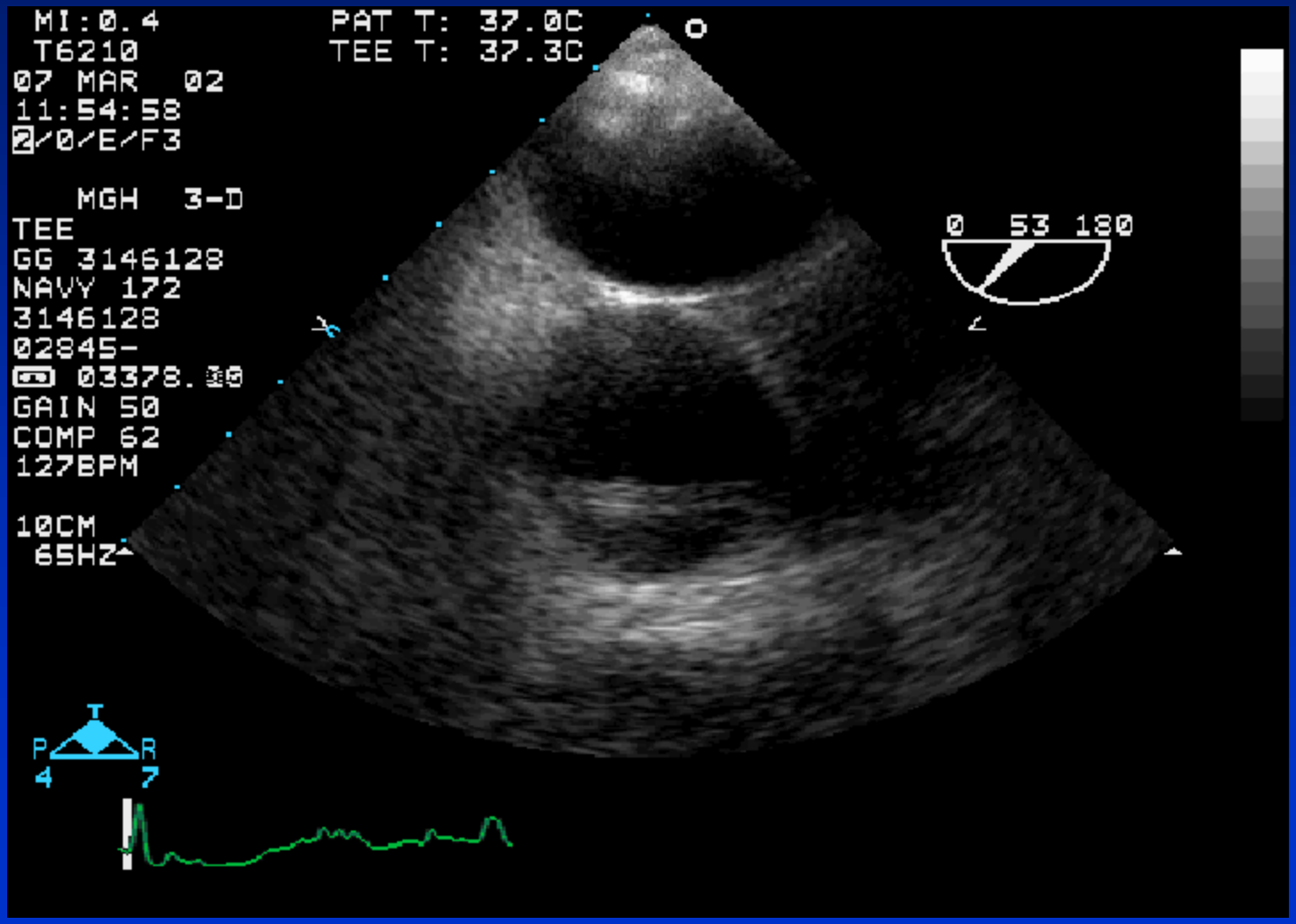
If an object is an artifact, color flow signals:

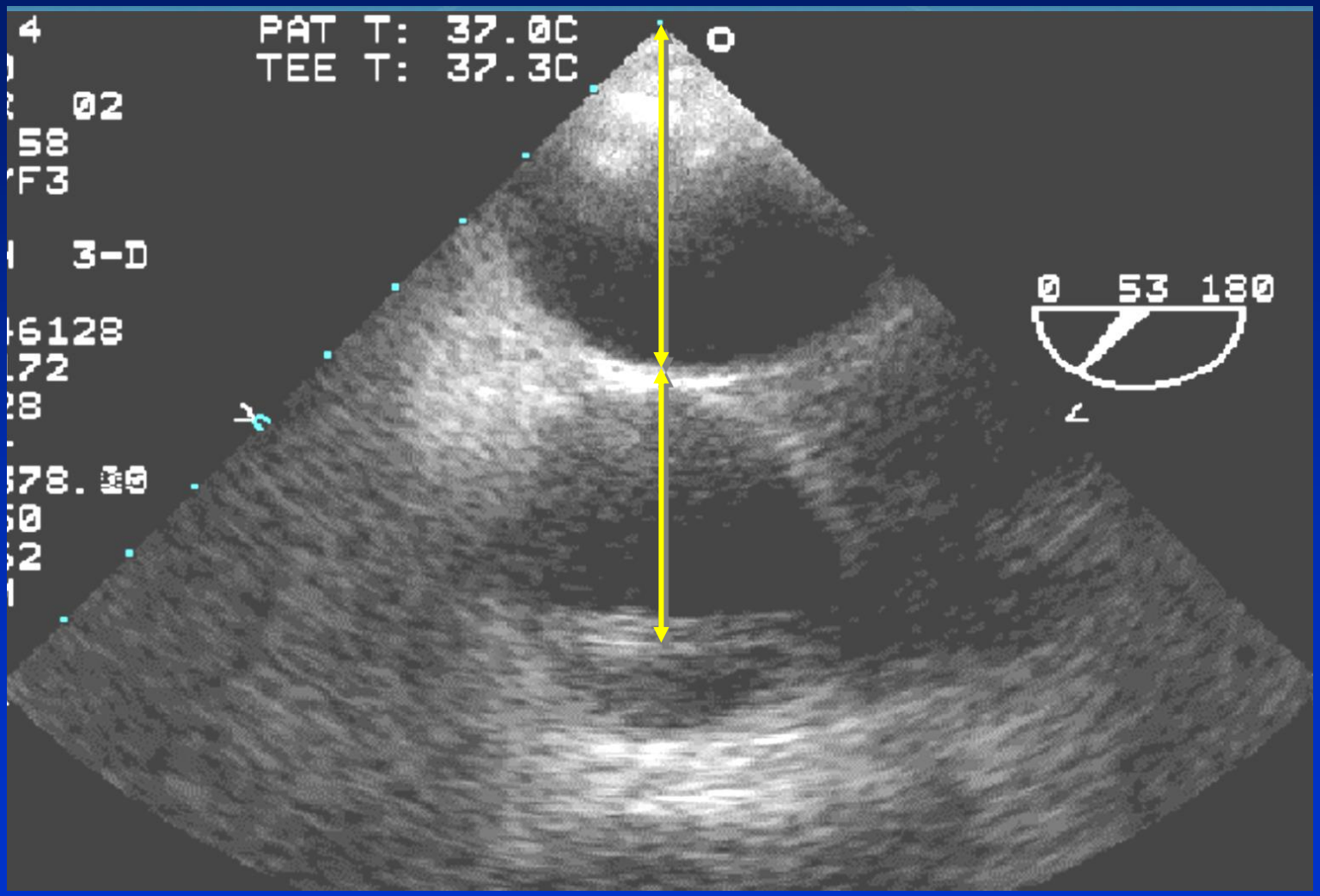
1. Can be seen to pass through it
2. Demonstrate flow reversal near the artifact
3. Do not become turbulent in its vicinity
4. Display patterns of flow that are altered by its presence

Reverberation Artifact: Ascending Aorta in Long Axis



Reverberation Artifact: Ascending Aorta in Short Axis




PAT T: 37.0C
TEE T: 37.3C
0 53 180

Take Home Lessons

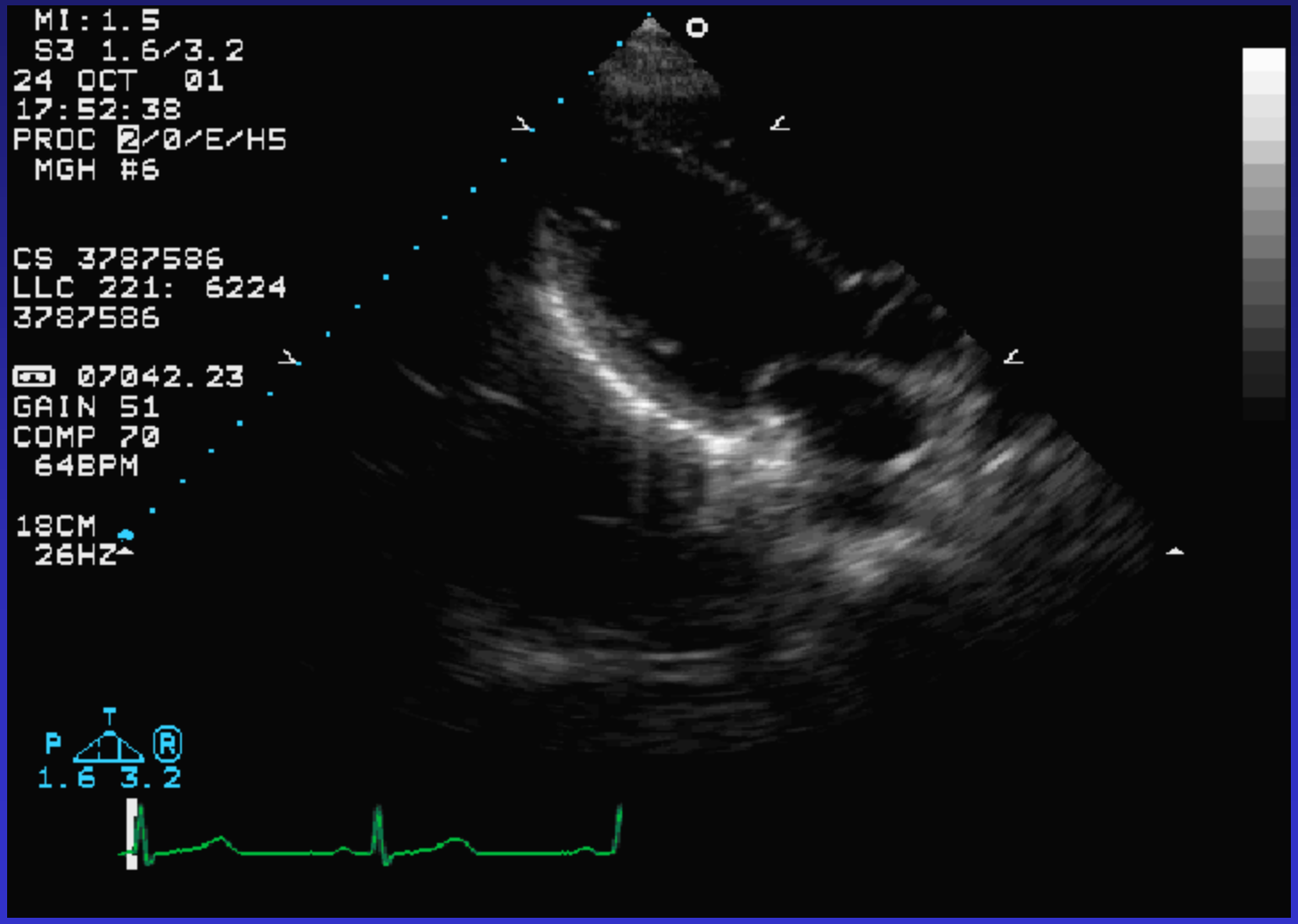
- Beware of linear structures in the ascending aorta on TEE
- Always confirm the anatomy of linear structures in multiple views and with color flow
- Take your time in drawing a conclusion

TYPES OF ARTIFACTS

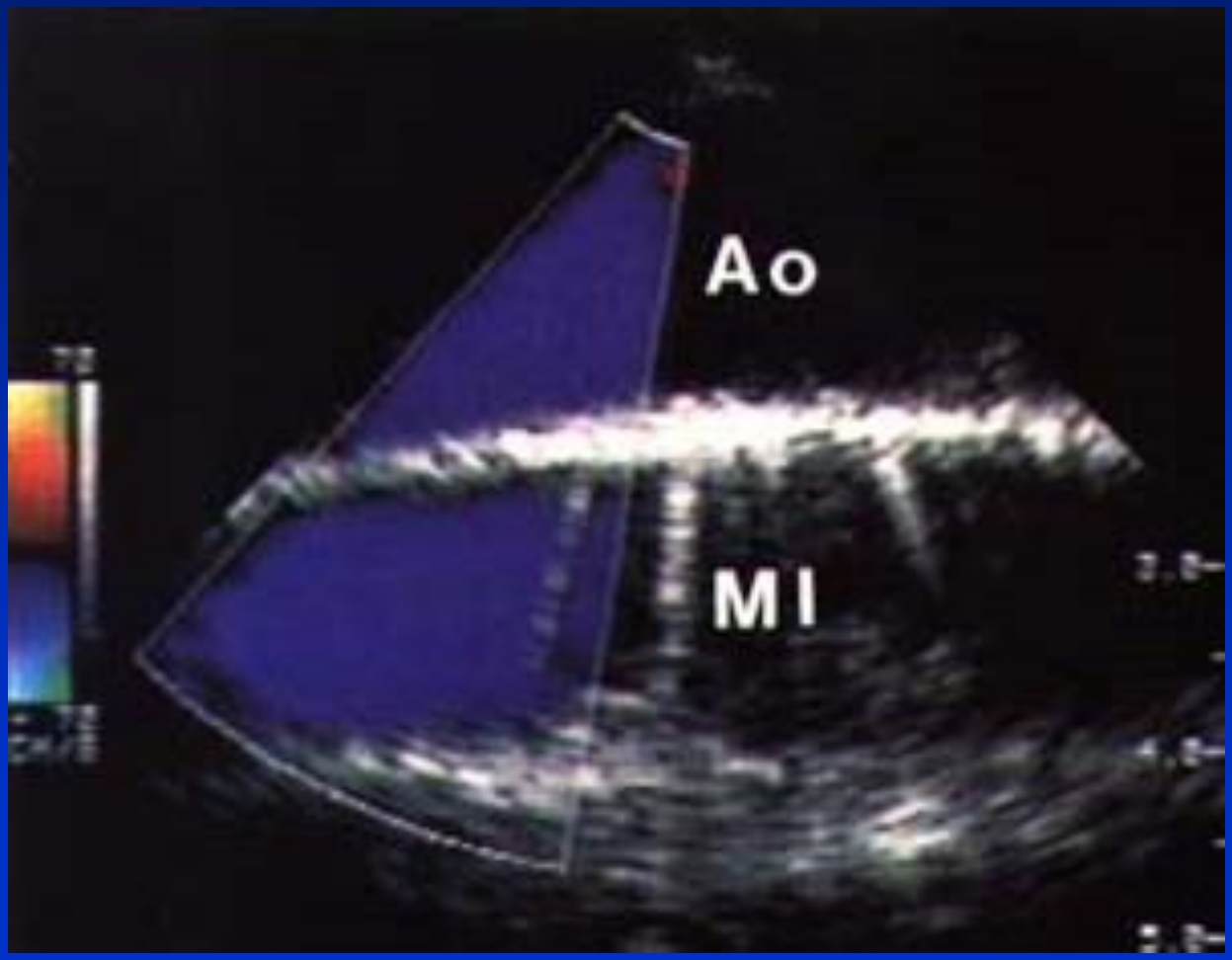
- More distant than the object
  - Parallel motion: Reverberation
  - Opposite motion: Mirror image

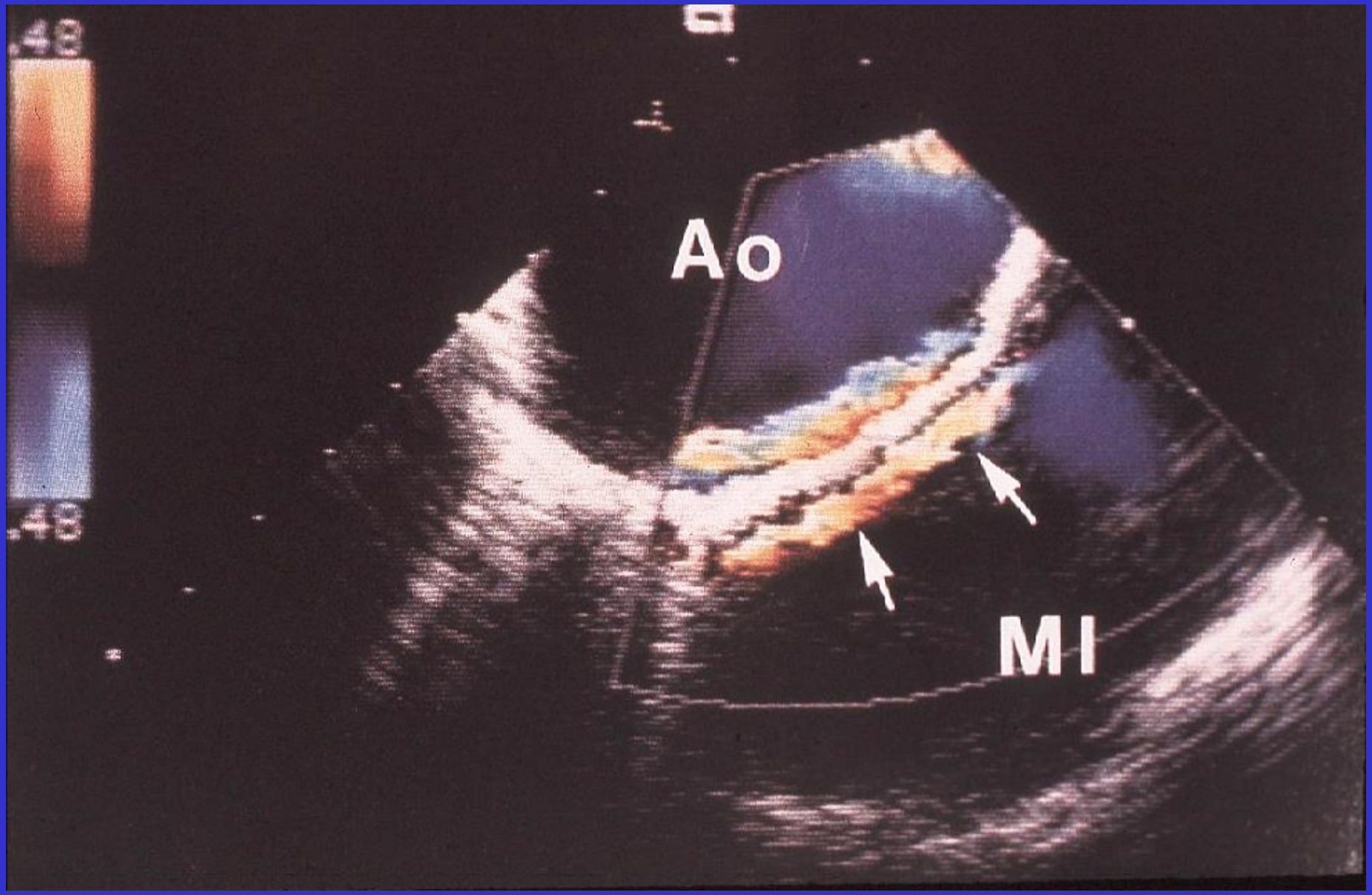
- Same distance as the object
  - Beam width
  - Side lobe
  - Refraction (lens)

What is behind the Heart?



Mirror Image of Descending Thoracic Aorta



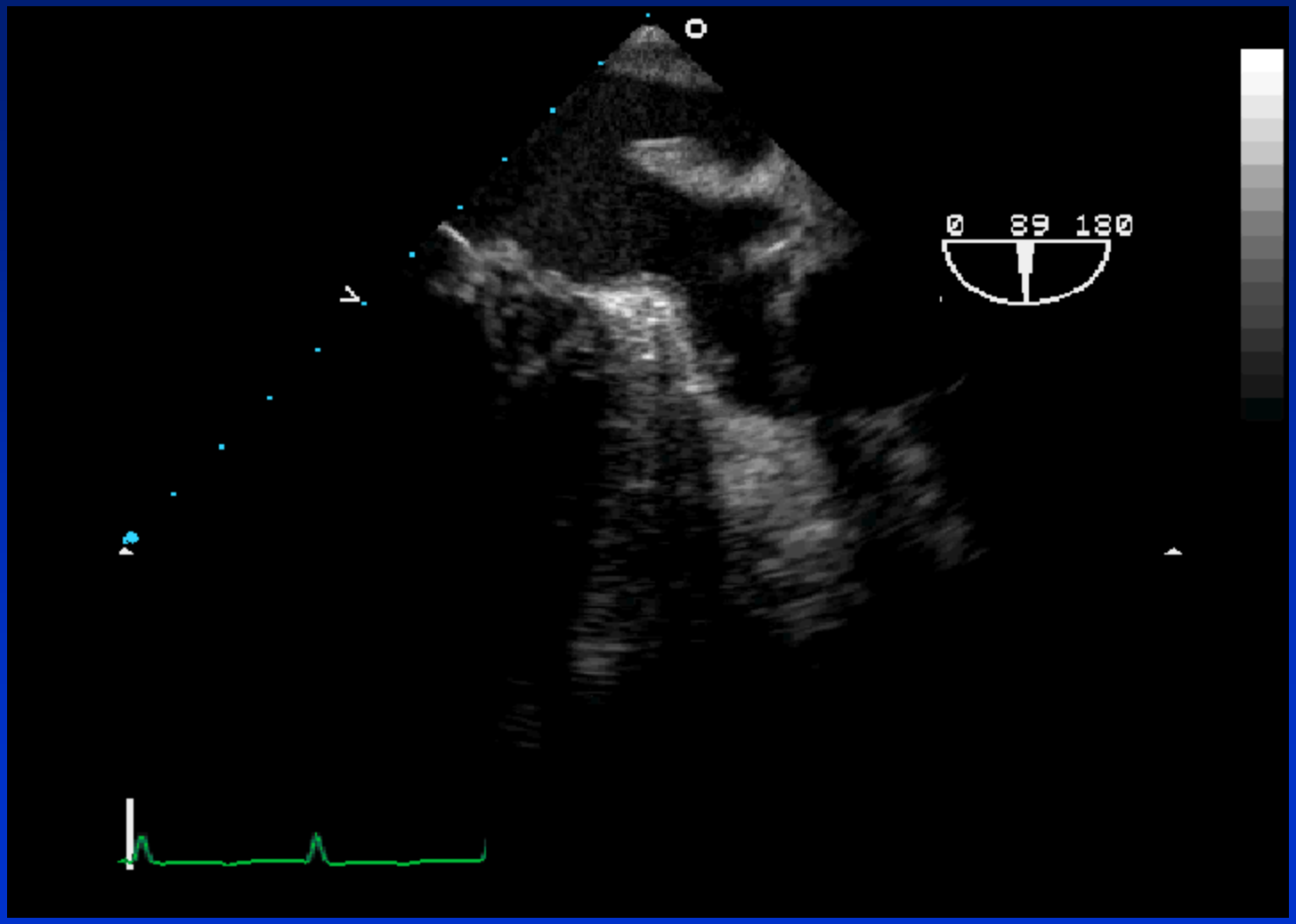

Ao
MI

CASE

- 52 male with AFib for 1 month
- Sent for cardioversion (TEE)
- You must decide right now:

  Shock or not?

The Challenge of the LA Appendage



The patient awaits cardioversion. How would you proceed?

1. Begin heparin and cardiovert
2. Cardiovert off heparin
3. Begin Coumadin and re-echo in 2 months
4. Order MRI to rule out thrombus

TAKE HOME LESSONS

- Beware of artifacts in the LA appendage
- Reverberations, side lobes, and pectinate muscles – common
- Practice looking at normals

TYPES OF ARTIFACTS

- More distant than the object
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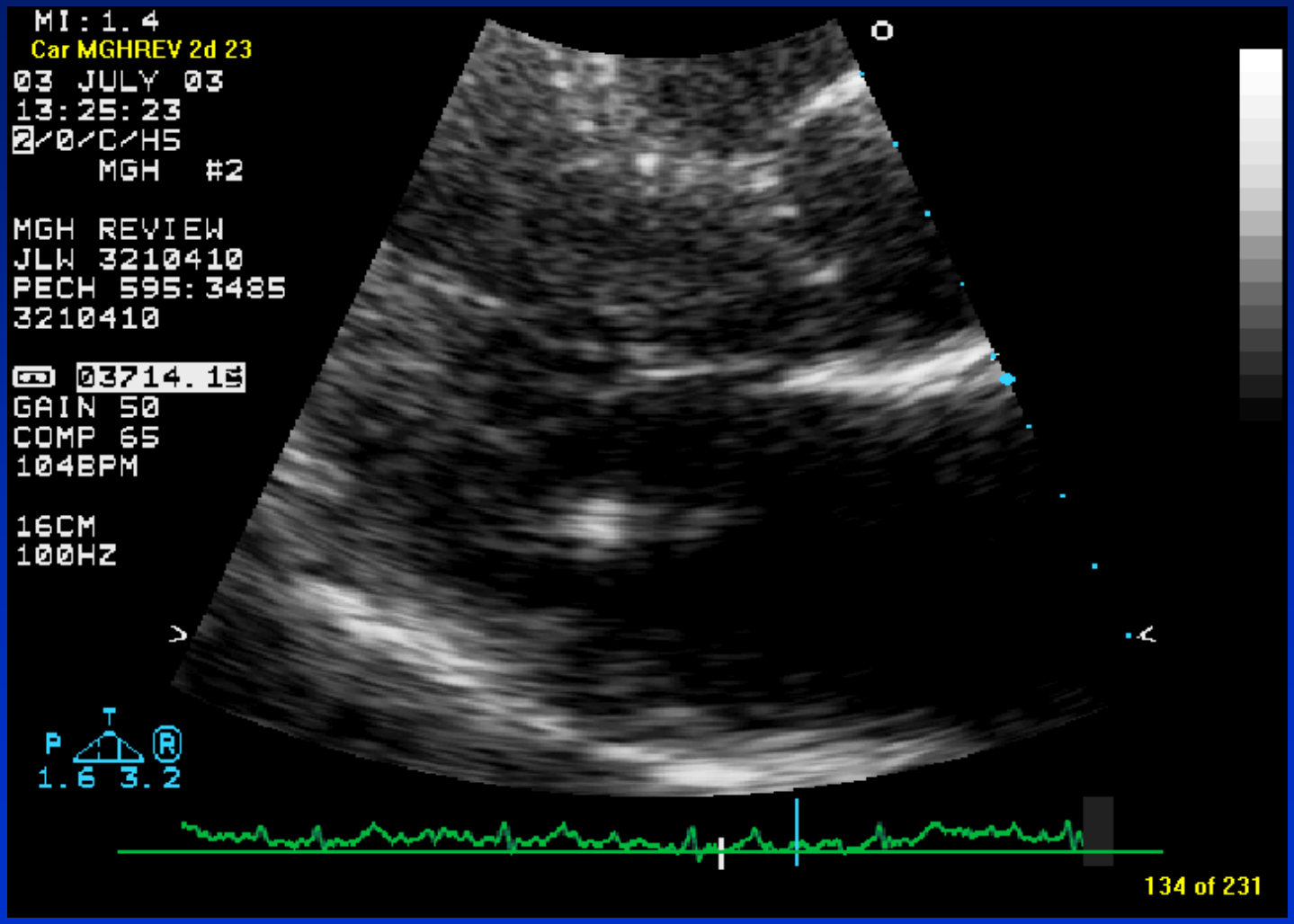
- Same distance as the object
  - Beam width
  - Side lobe
  - Refraction (lens)

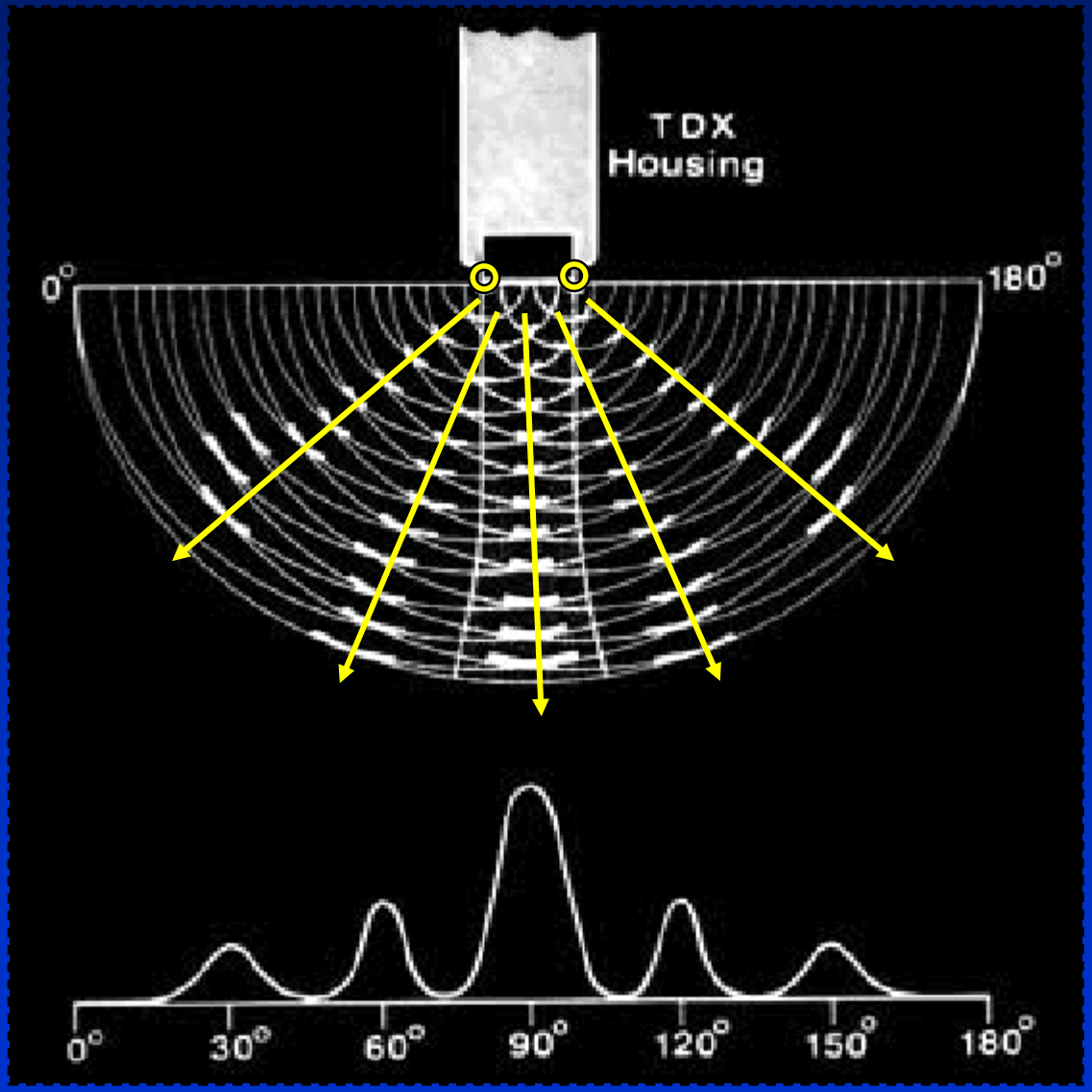
Case

- 51 year old female with fevers and one blood culture bottle positive for gram positive cocci in clusters
- TTE to rule out endocarditis

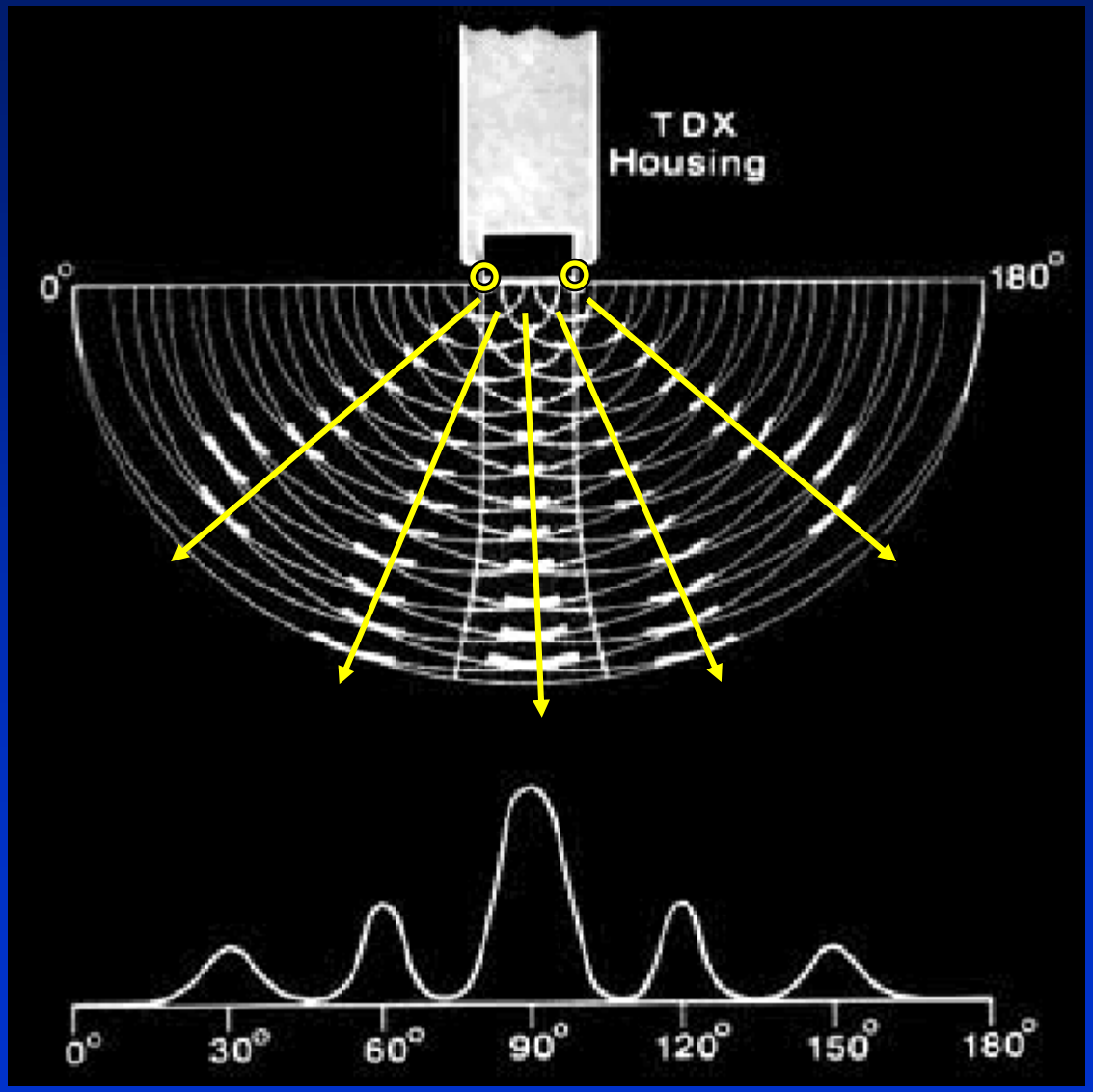
Case: Rule out SBE



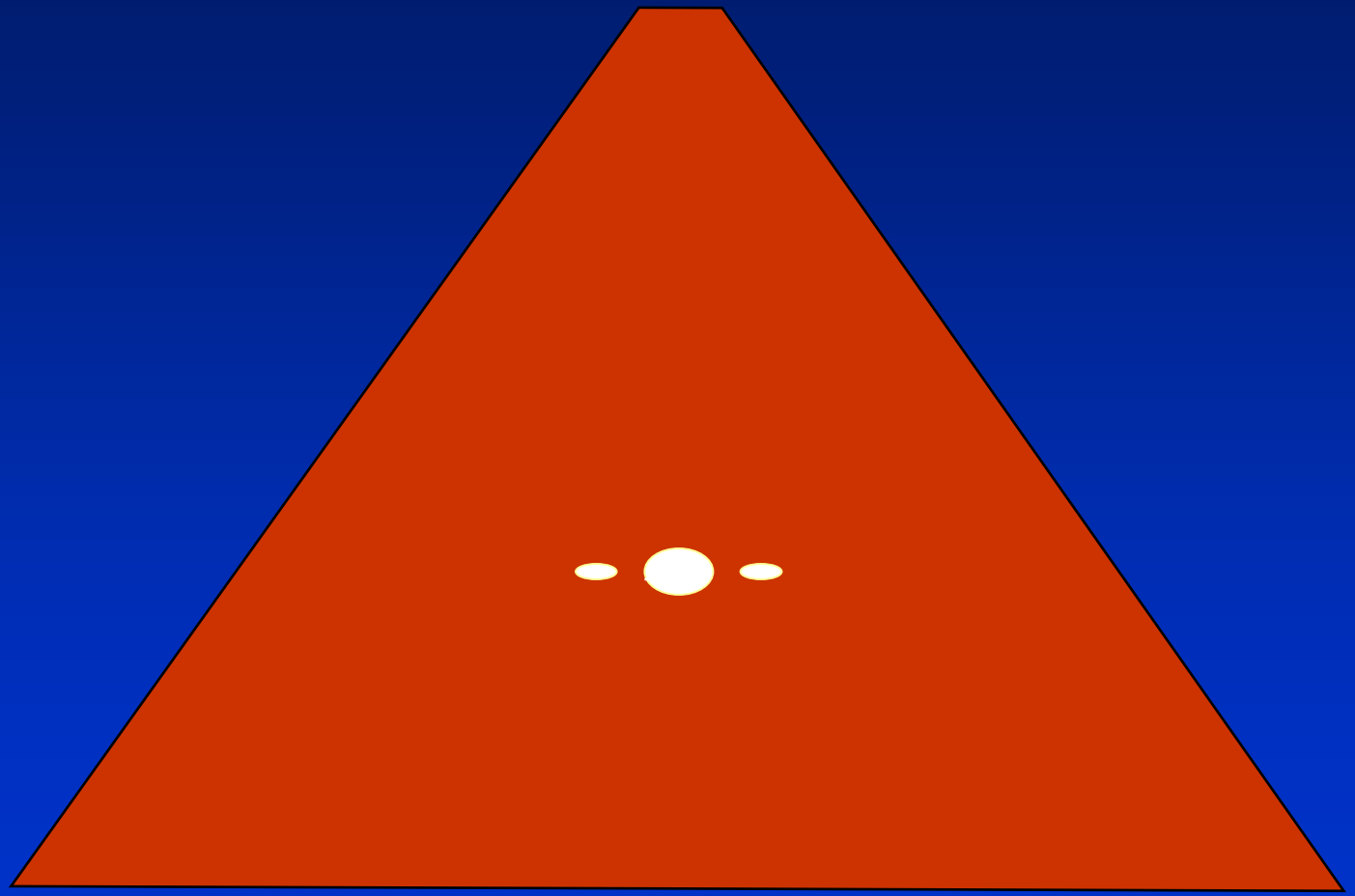
Side lobes: Laterally directed ultrasound energy arising from transducer edges



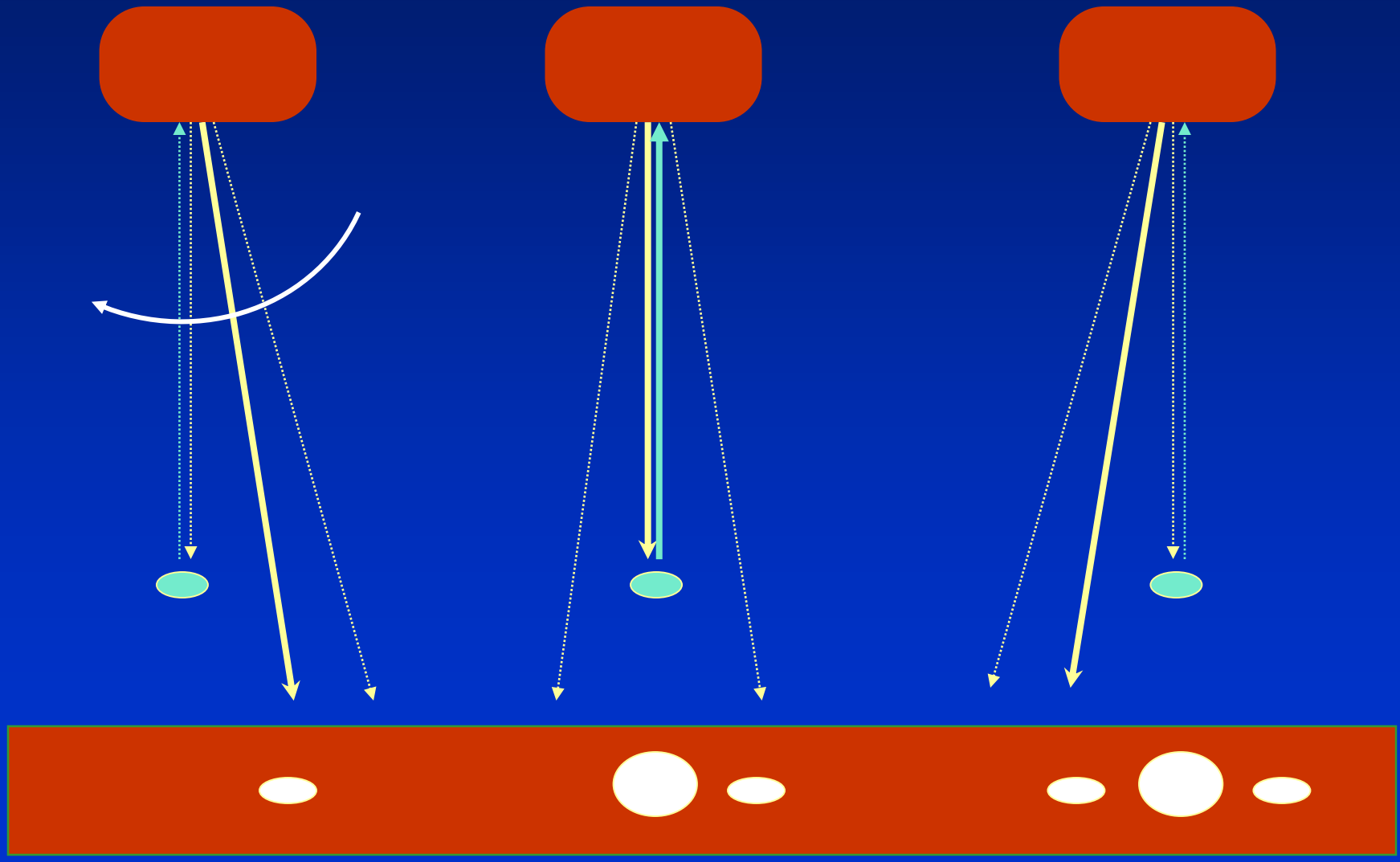
Side lobe energy returning to transducer is displayed as if originating centrally



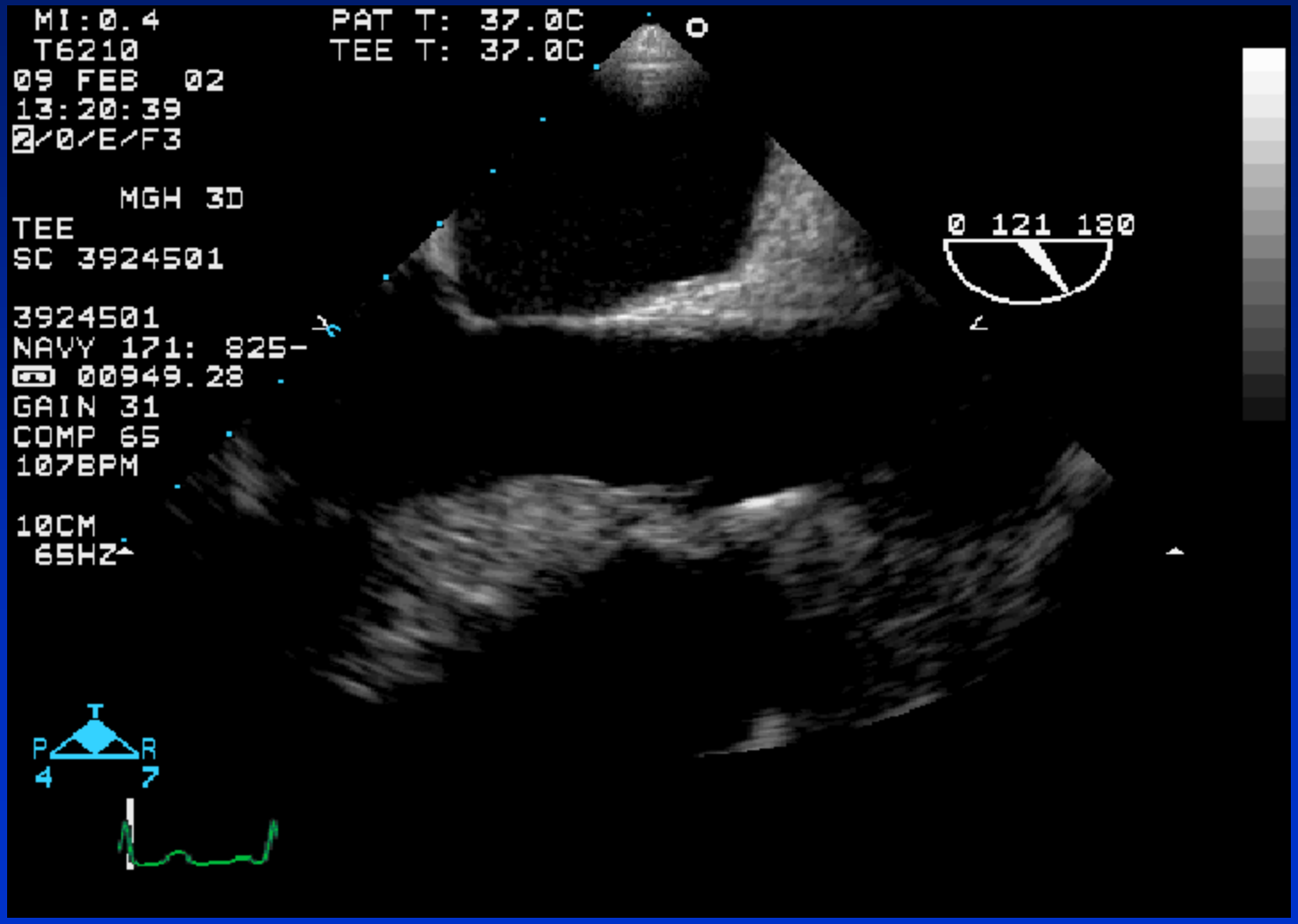
Echo Map of True Object and Side Lobe Artifacts



Generation of Side Lobe Artifacts



TEE: Aortic Dissection or Not?

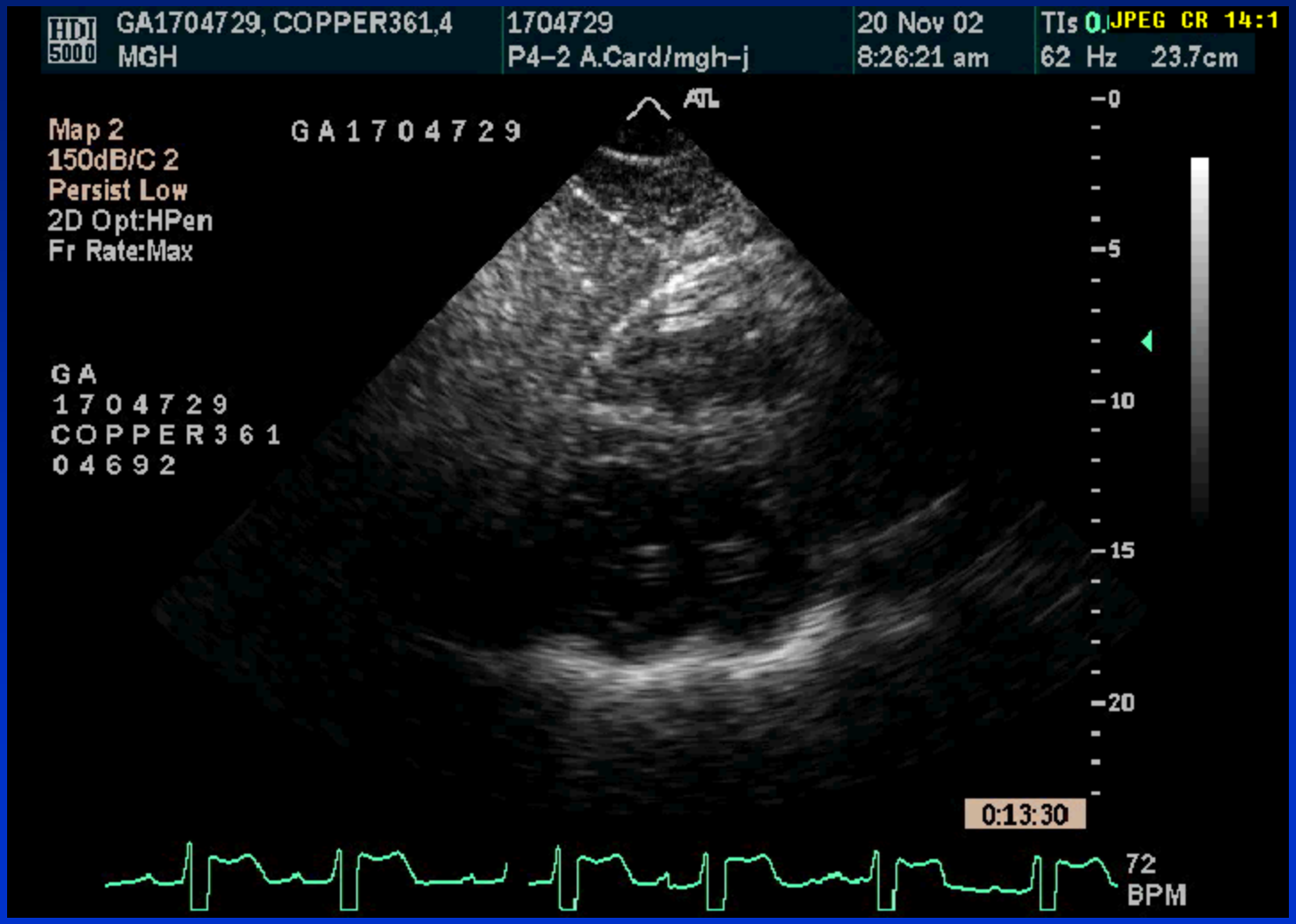


LA Appendage Thrombus?

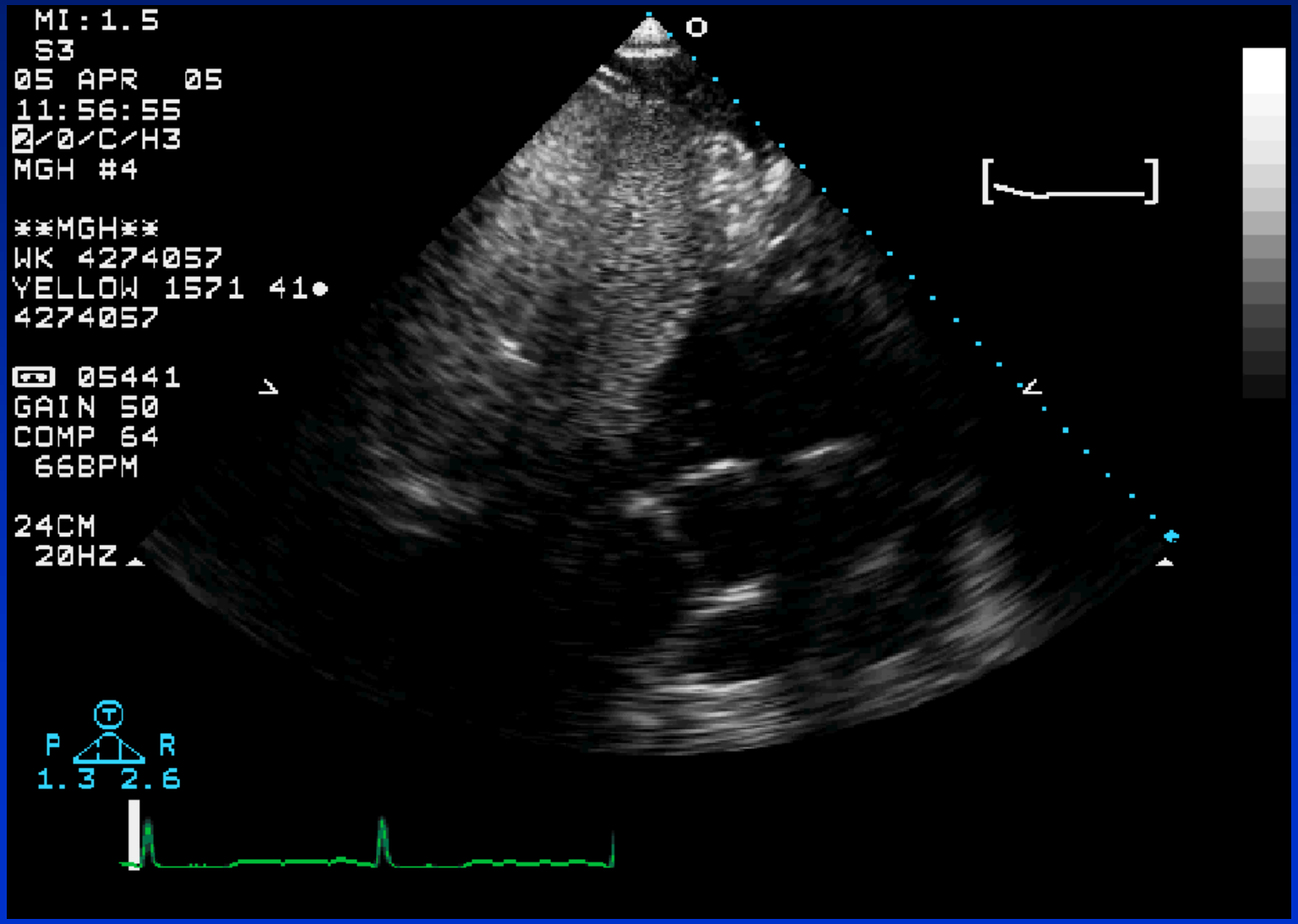
Case

- Another common finding on TTE that you may never have noticed

How Many Left Ventricles Does He Have?



How Many Aortas Does He Have?



TYPES OF ARTIFACTS

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- Same distance as the object
  - Beam width
  - Side lobe
  - Refraction (lens)

Case

- 75 M underwent TEE for question of dissection involving the ascending aorta

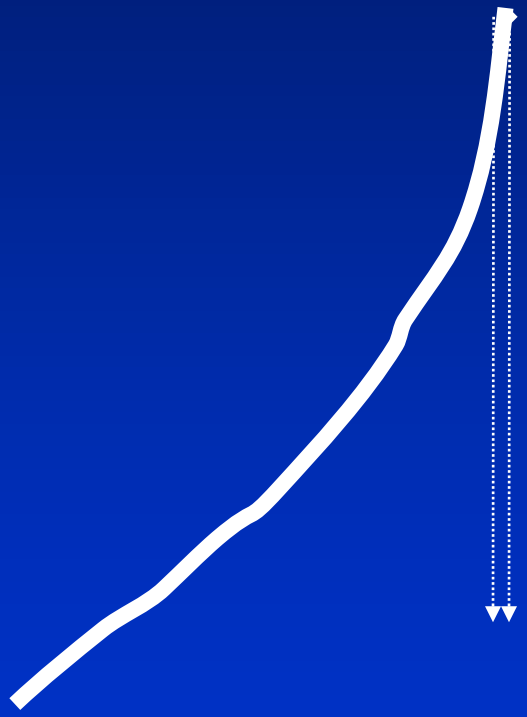
- Referred to the MGH Thoracic Aortic Center for elective aortic repair

DISSECTION FLAPS

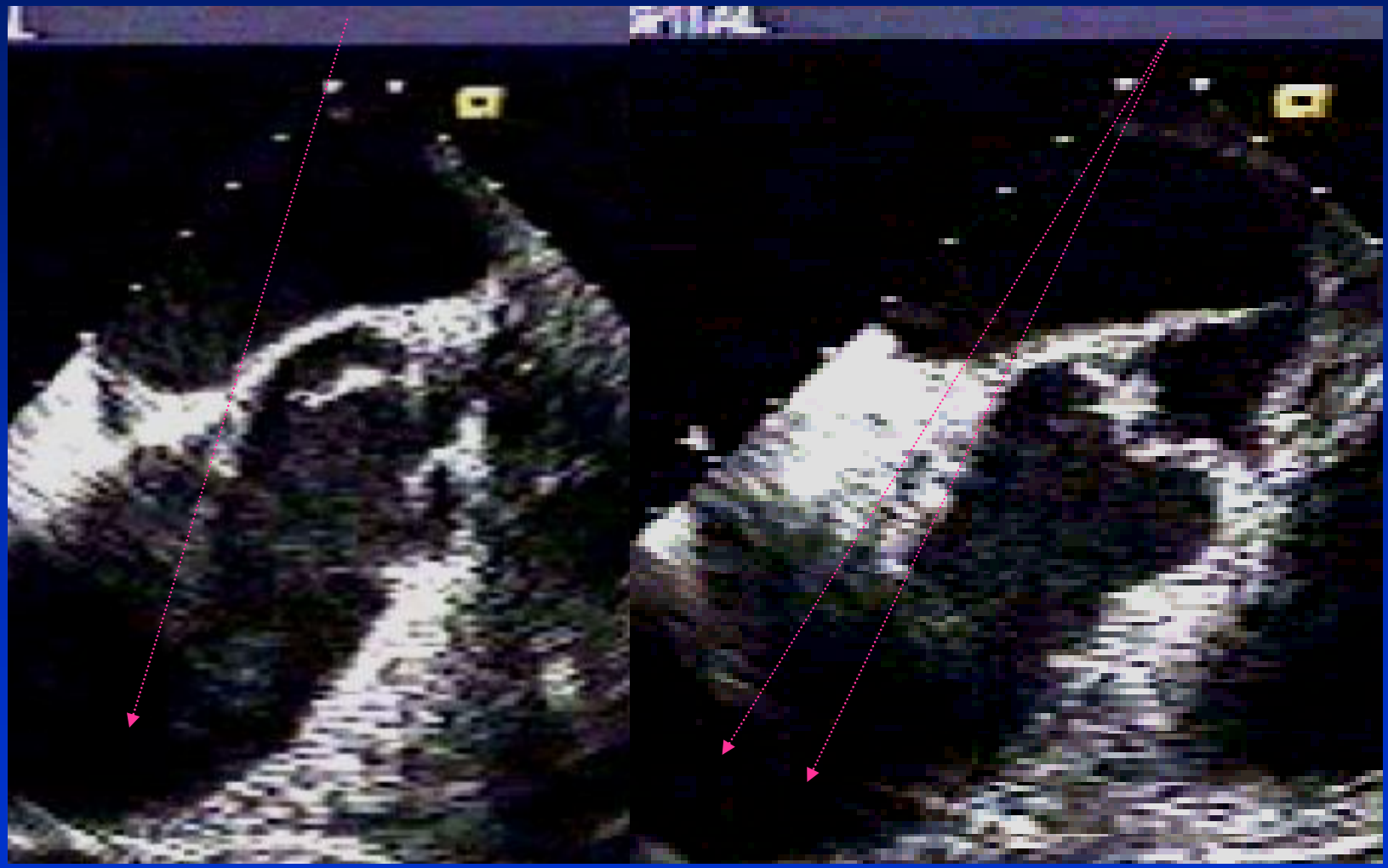
- Occur in a dilated aorta
- Have independent mobility (unless hematoma)
- Cannot pass through a wall
- Attached, not free-floating
- Act as flow dividers

Case: Referral for Surgery for Aortic Dissection

Reverberations Within an Object: Linear Structures Struck En Face by Beam



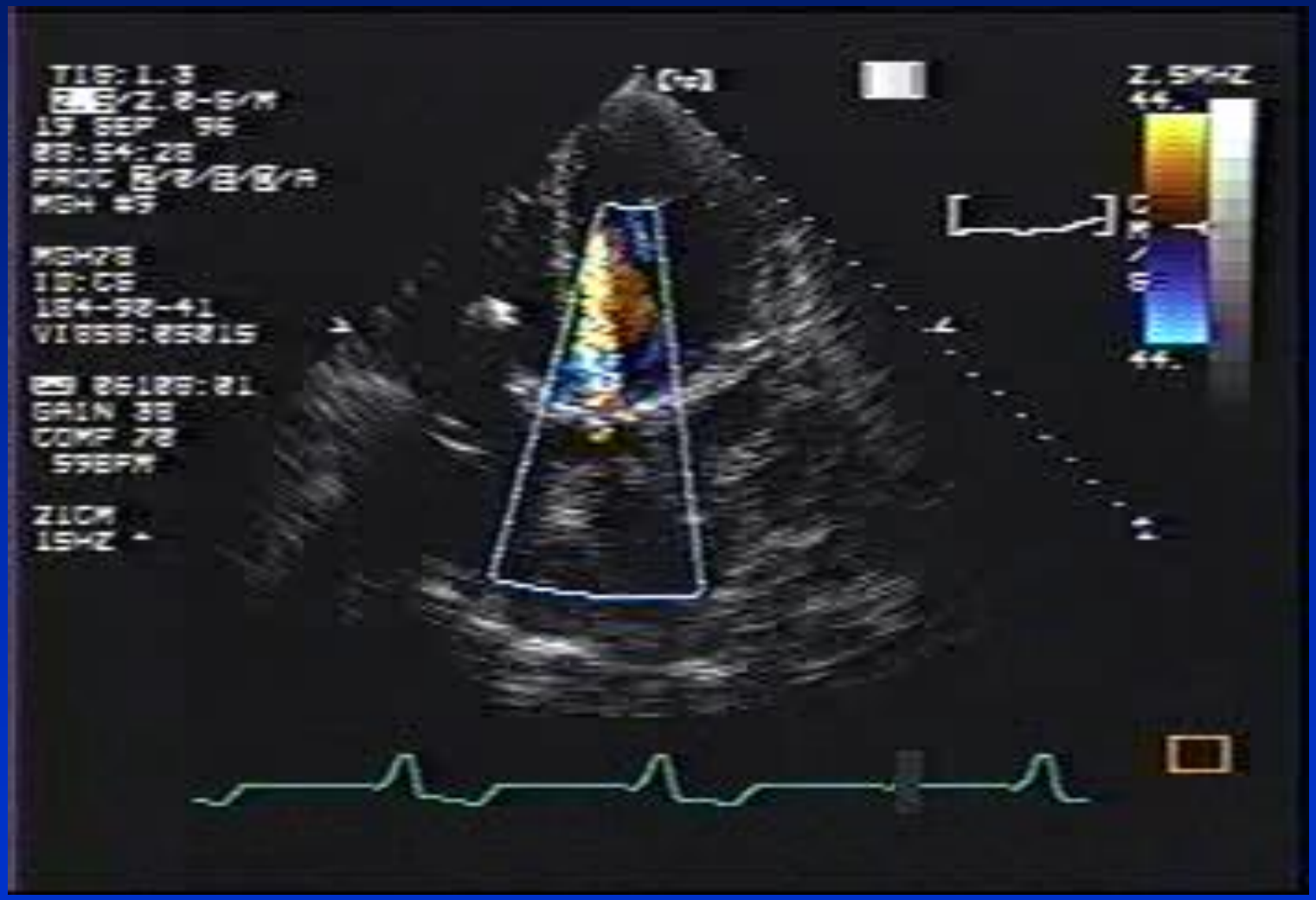
Linear Artifacts from Reverberations



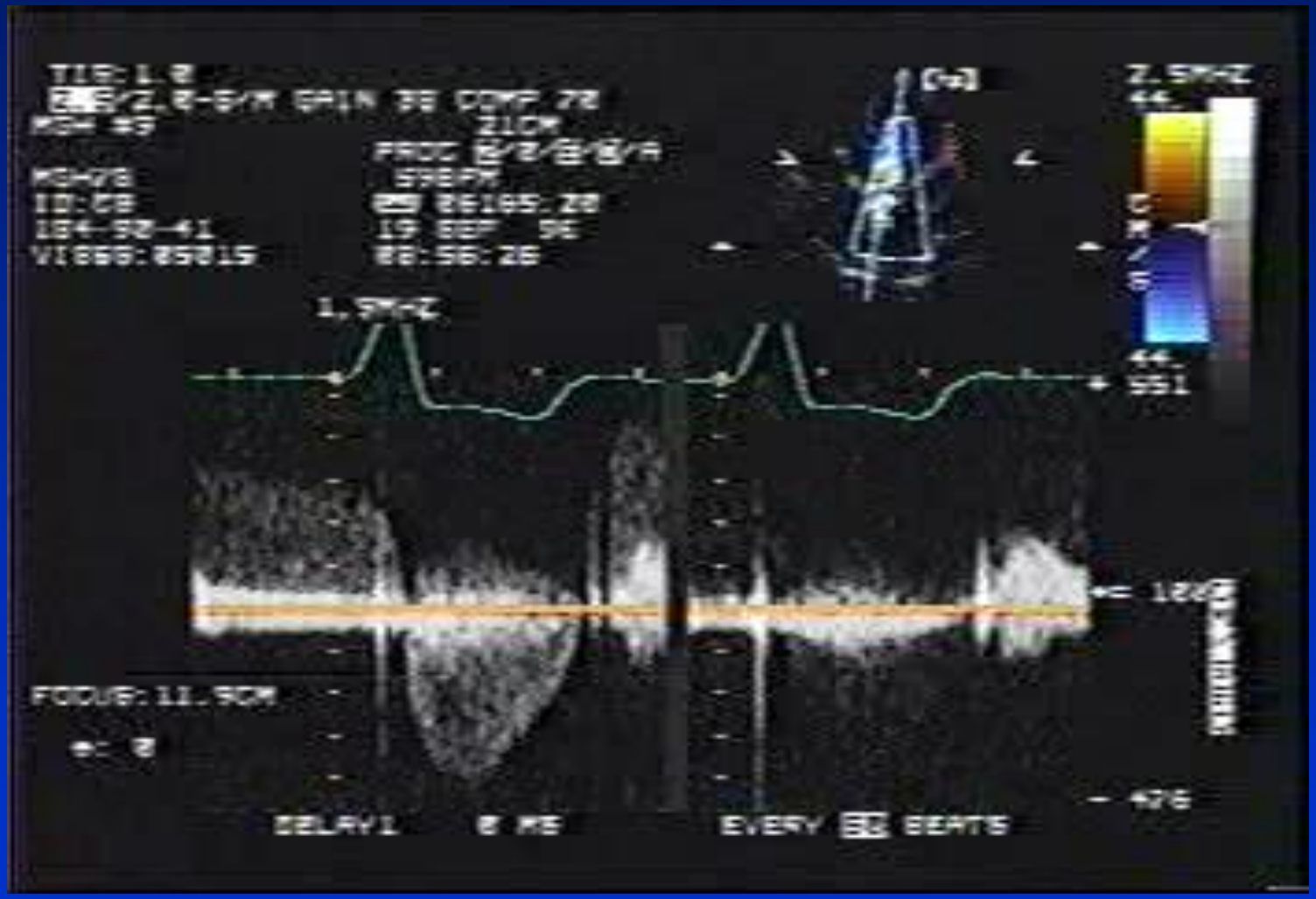
Case

- 68 F S/P St. Jude MVR 8 years ago
- Also has known mild-moderate aortic stenosis
- Now presents with shortness of breath and a systolic murmur that radiates across precordium
- ? Severe AS
- ? Prosthetic MR

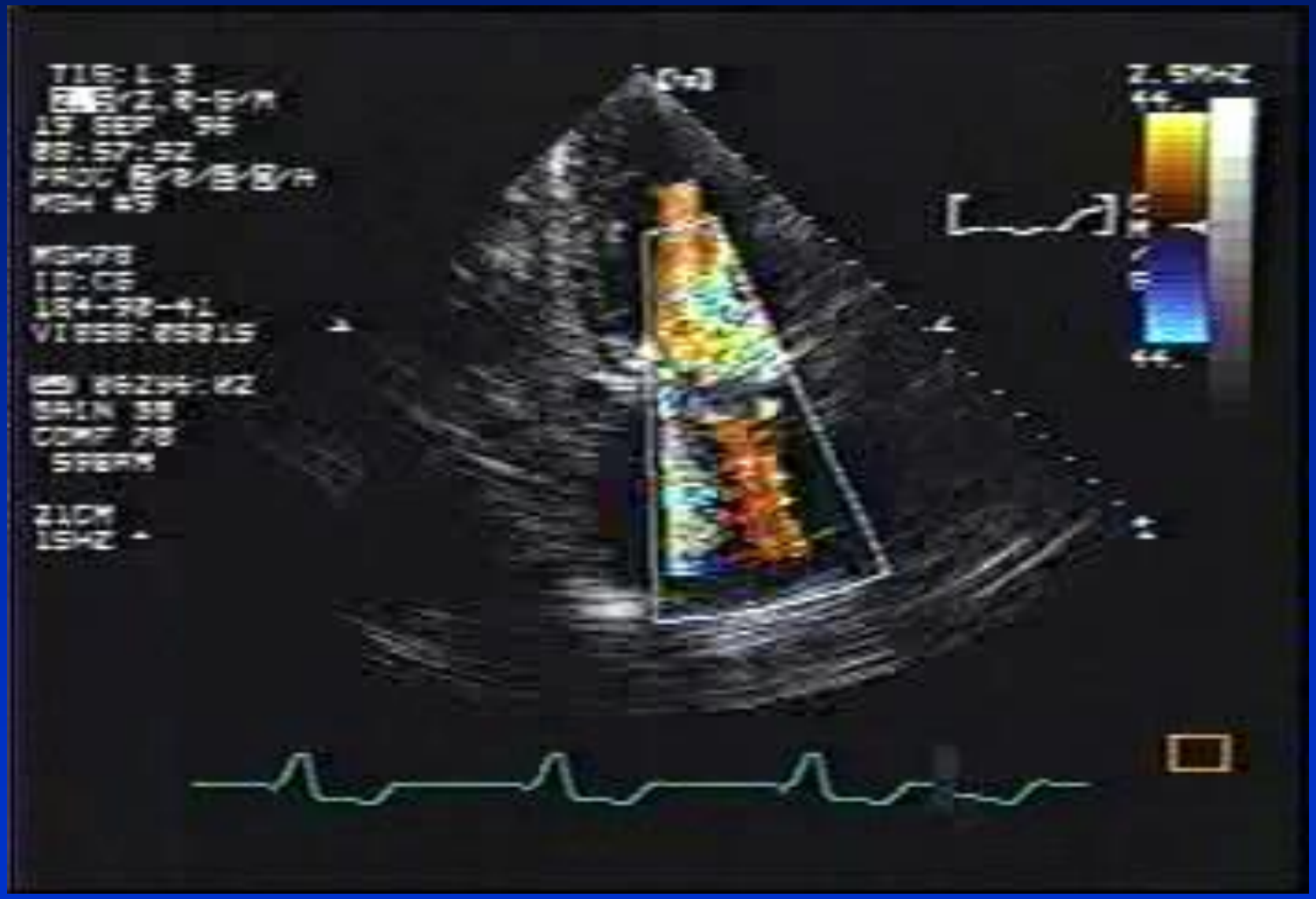
Case: St. Jude MVR, ?MR



Case: St. Jude MVR, ?MR

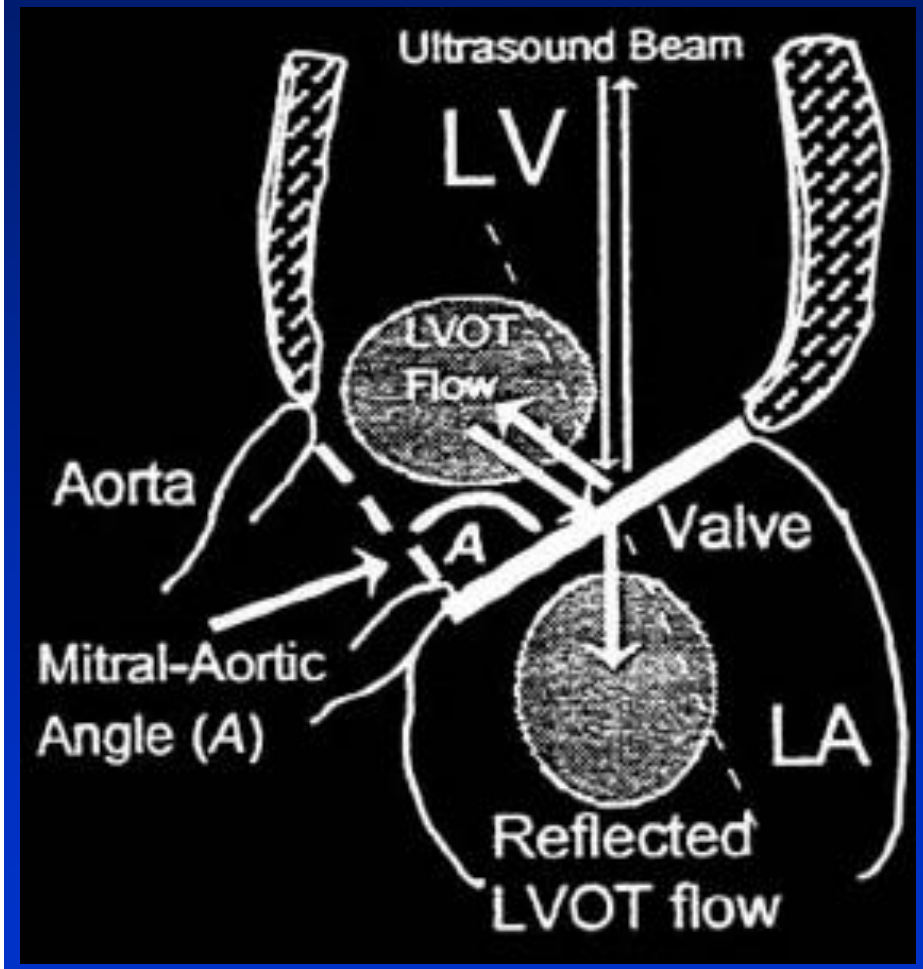


Case: St. Jude MVR, ?MR

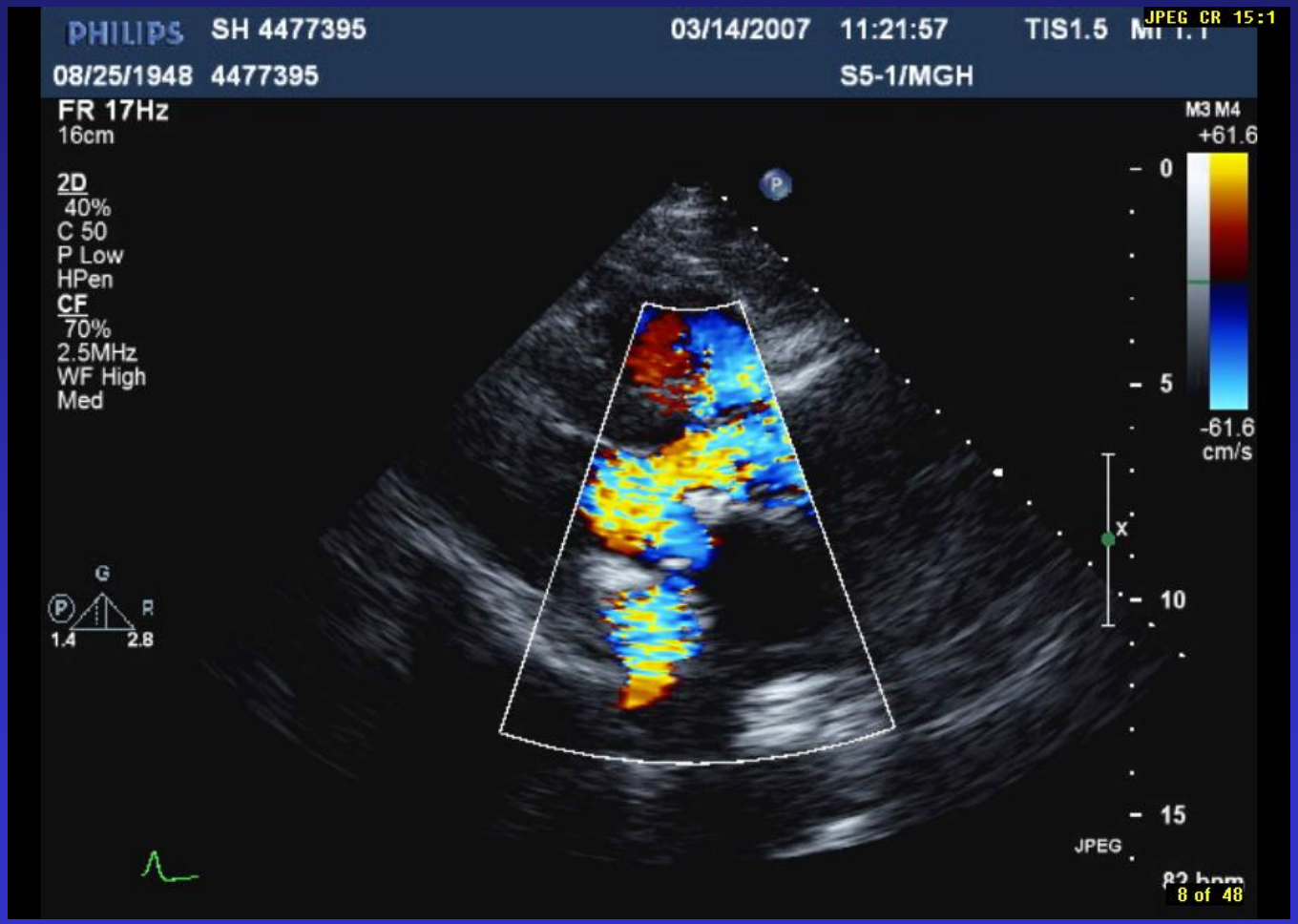


Pseudo-MR: Principles

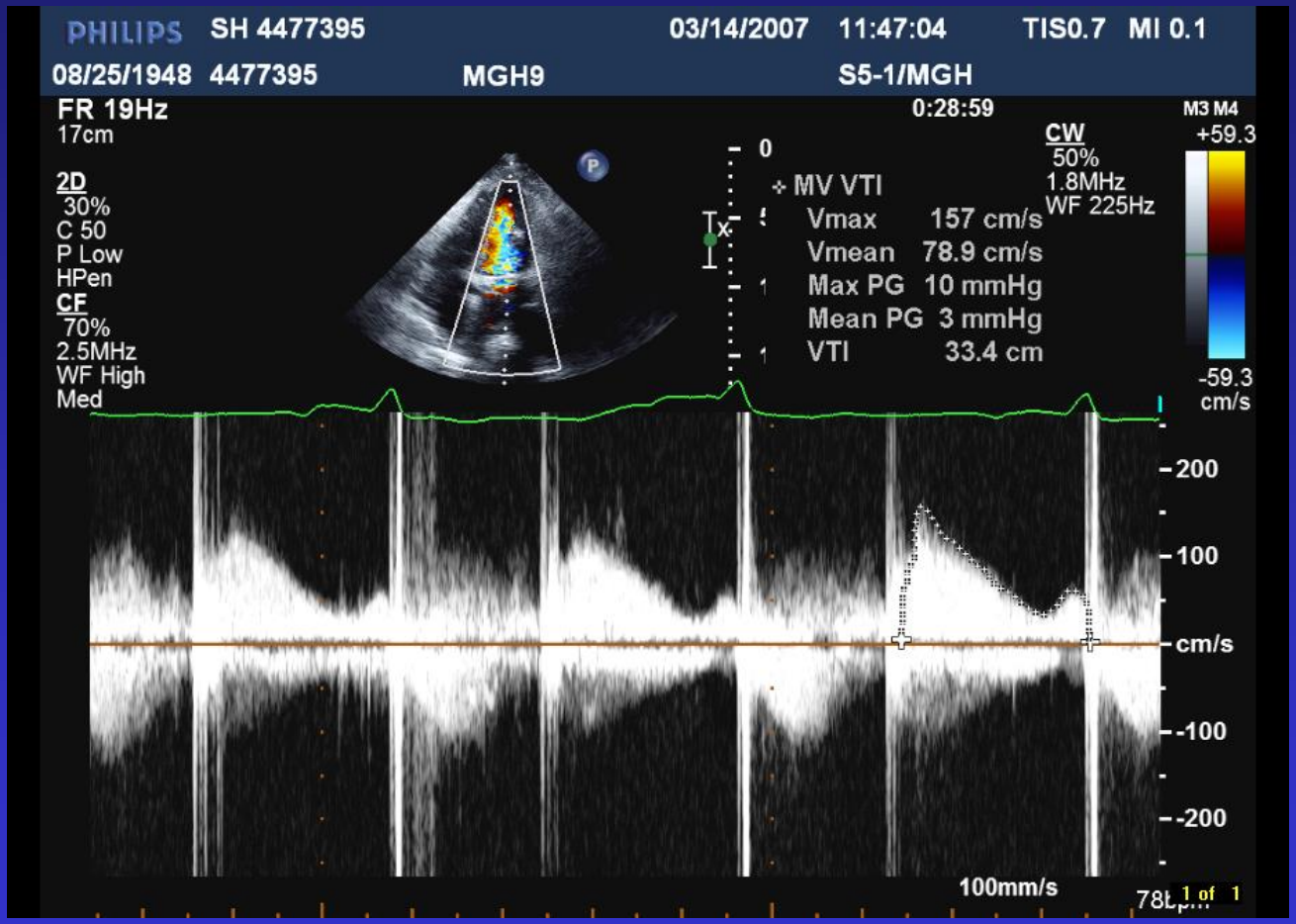
- The metallic prosthesis acts as an acoustic mirror
- The timing of the color in the left atrium matches that in the LVOT
- Proximal flow acceleration is absent
- Flow is separated from prosthesis



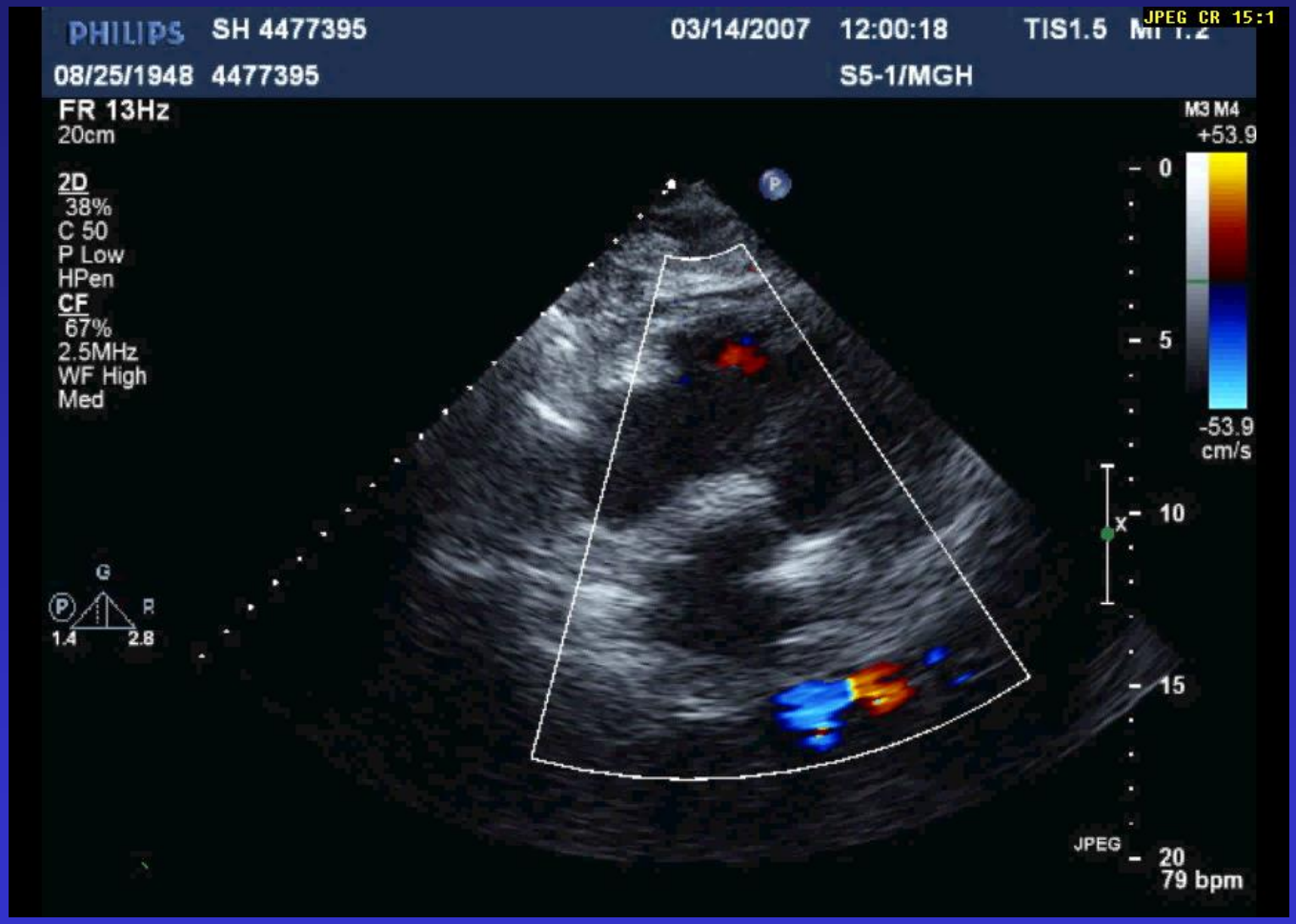
Test: Real MR or Pseudo-MR?



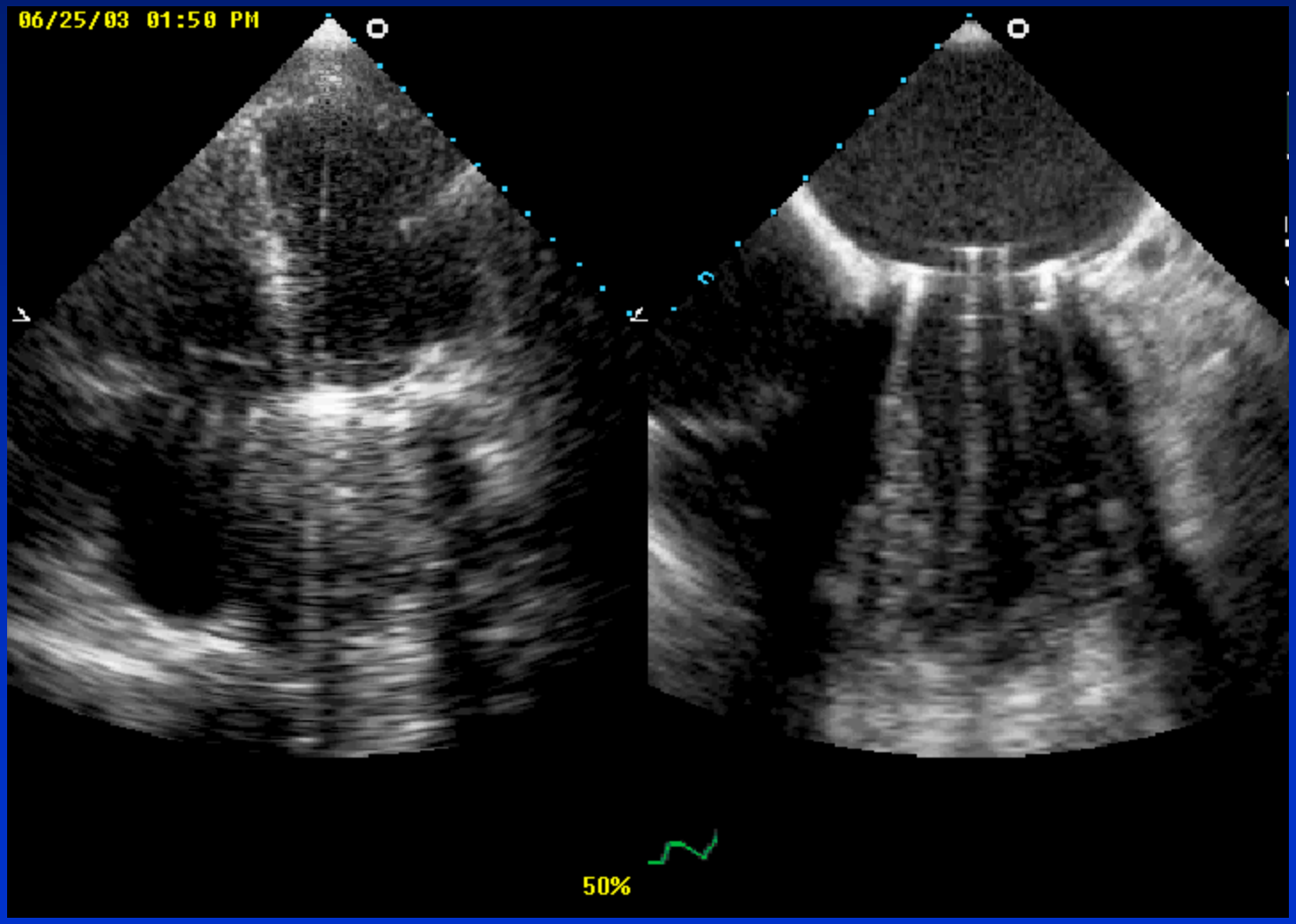
Test: Real MR or Pseudo-MR?



Test: Real MR or Pseudo-MR?



Additional Mechanical Prosthetic Valve Artifacts

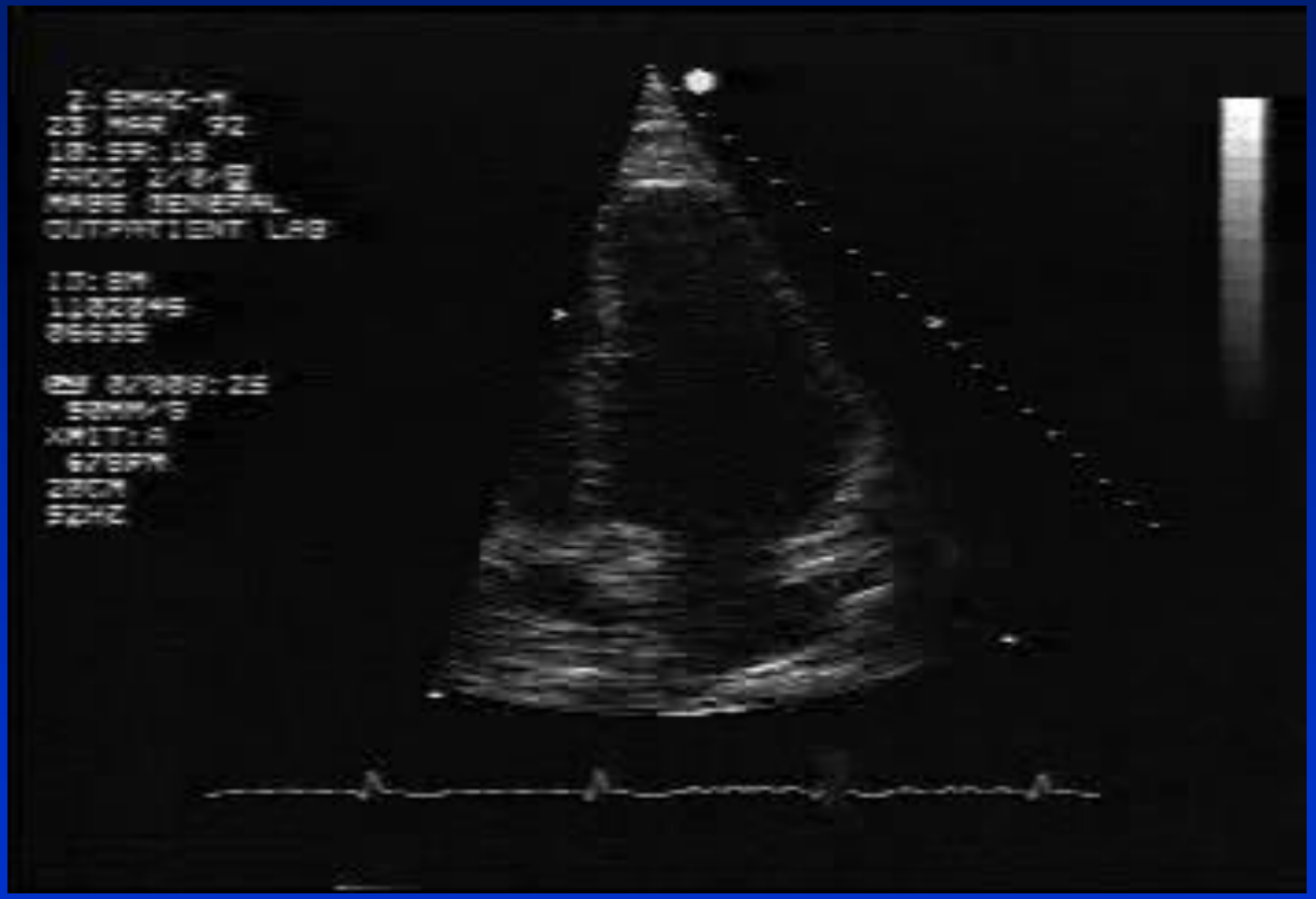


PROBLEMS WITH INTERPRETATION

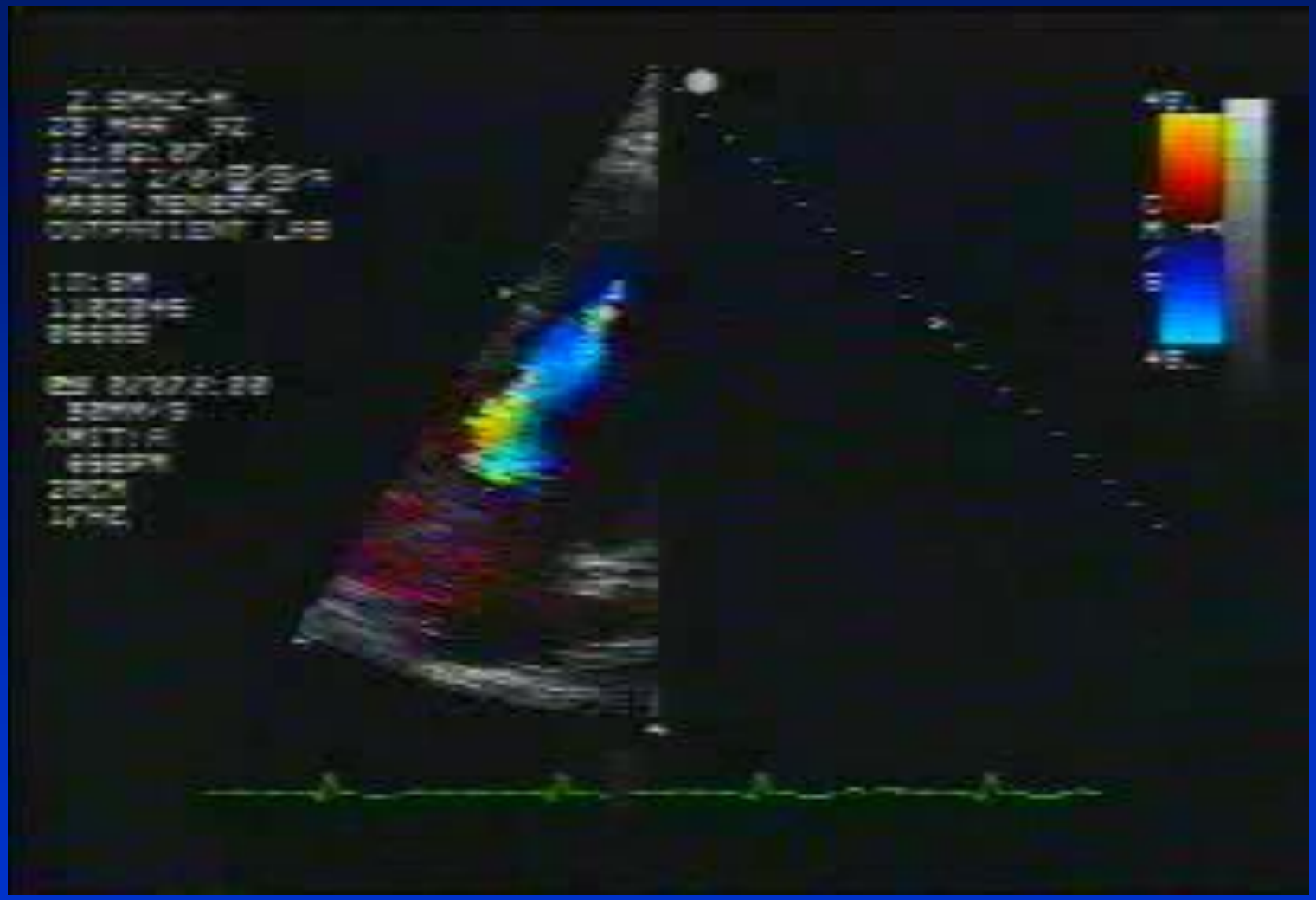
Case

- 48 M with shortness of breath and PVC's on monitor
- Abnormal EKG
- TTE to assess LV

Assess LV Function



Assess LV Function



Assess LV Function

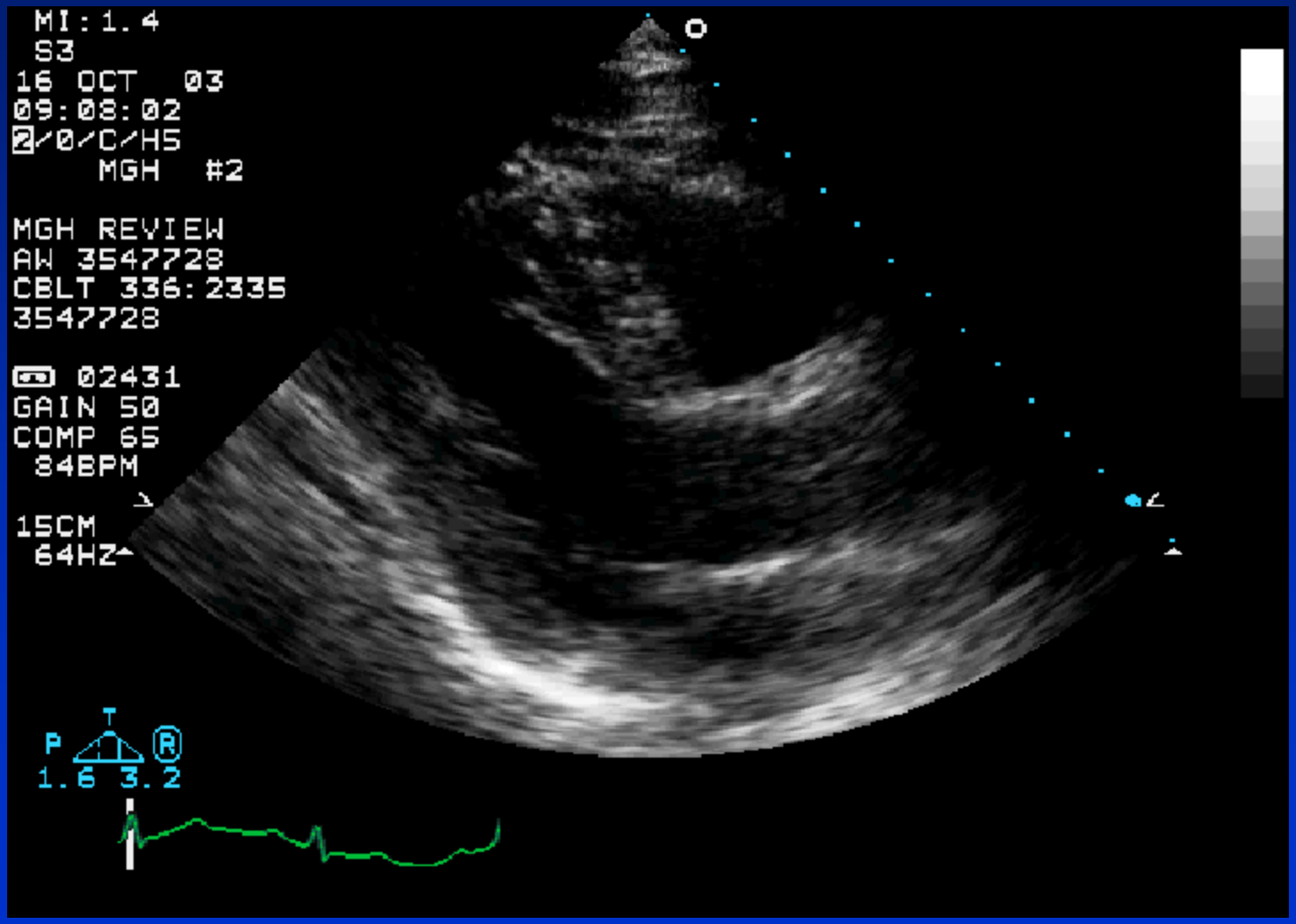
Take Home Lessons

- Don’t be fooled by lack of epicardial motion, especially at the apex
- Use color as a contrast agent to define the endocardial borders
- If color is ineffective, use IV echo-contrast agent

Case

- 64 M with HTN presents with mild pulmonary edema
- CPK negative, troponin-T borderline
- Echo to assess LV function

Case: Name the Wall Motion Abnormality



Test: Recognizing segmental LV dysfunction

A. Posterior dyskinesis

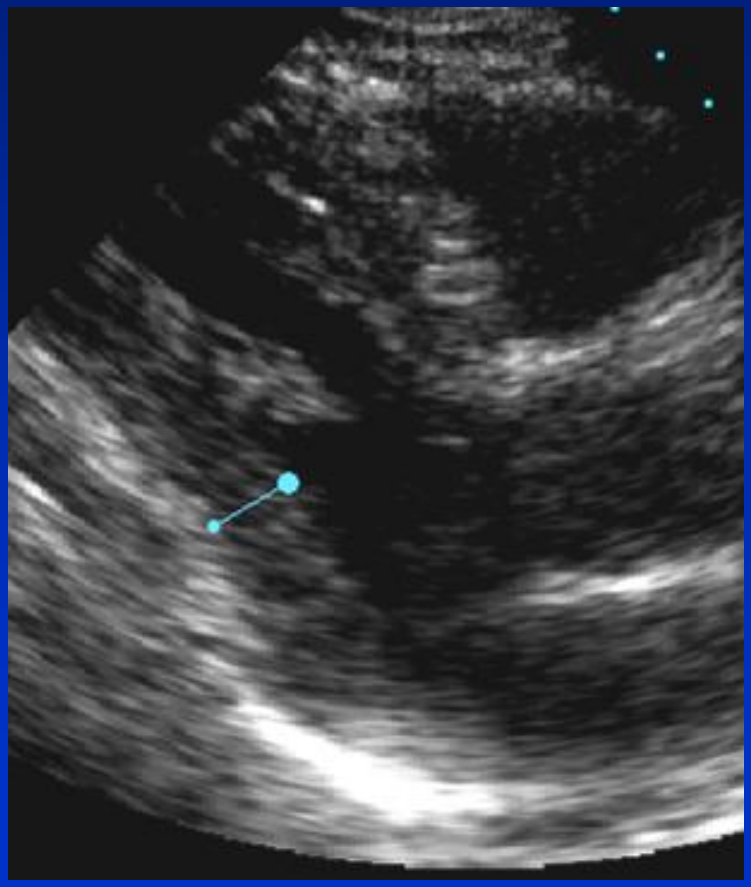
B. Posterior dyssynergy

C. Normal posterior wall motion

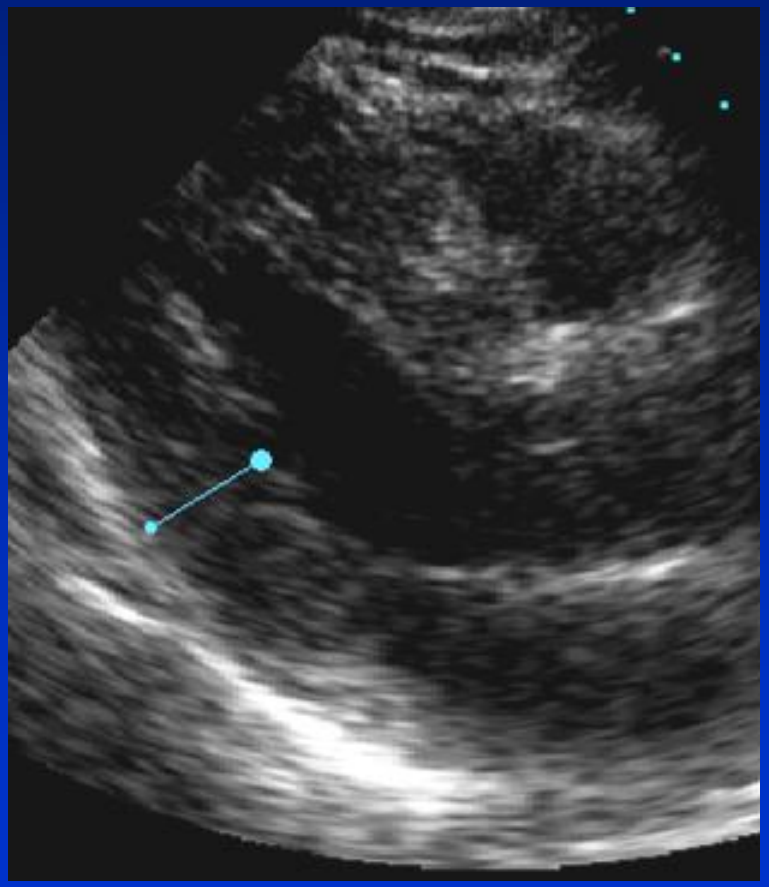
D. Normal posterior wall contraction

Wall Motion vs. Wall Thickening

Diastole

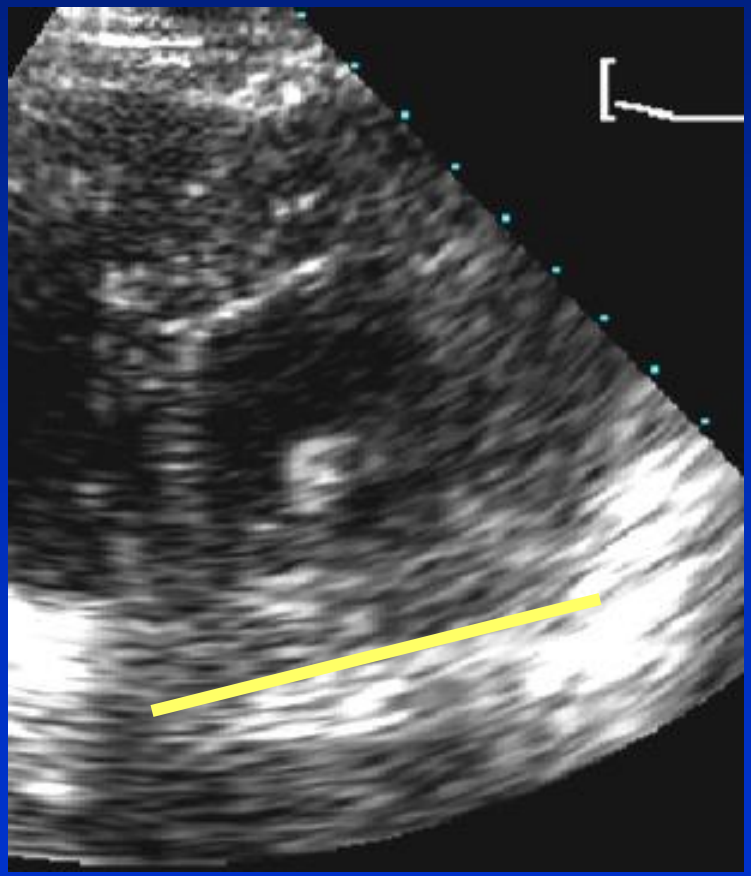


Systole

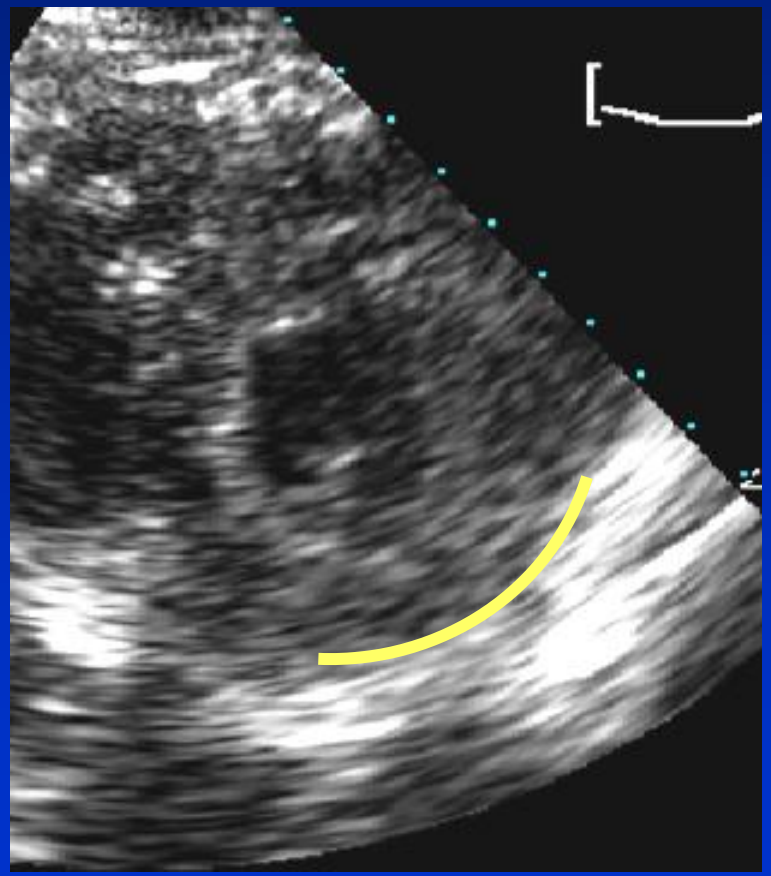


Abnormal Wall Motion despite Normal Thickening = "Pseudodyskinesis"

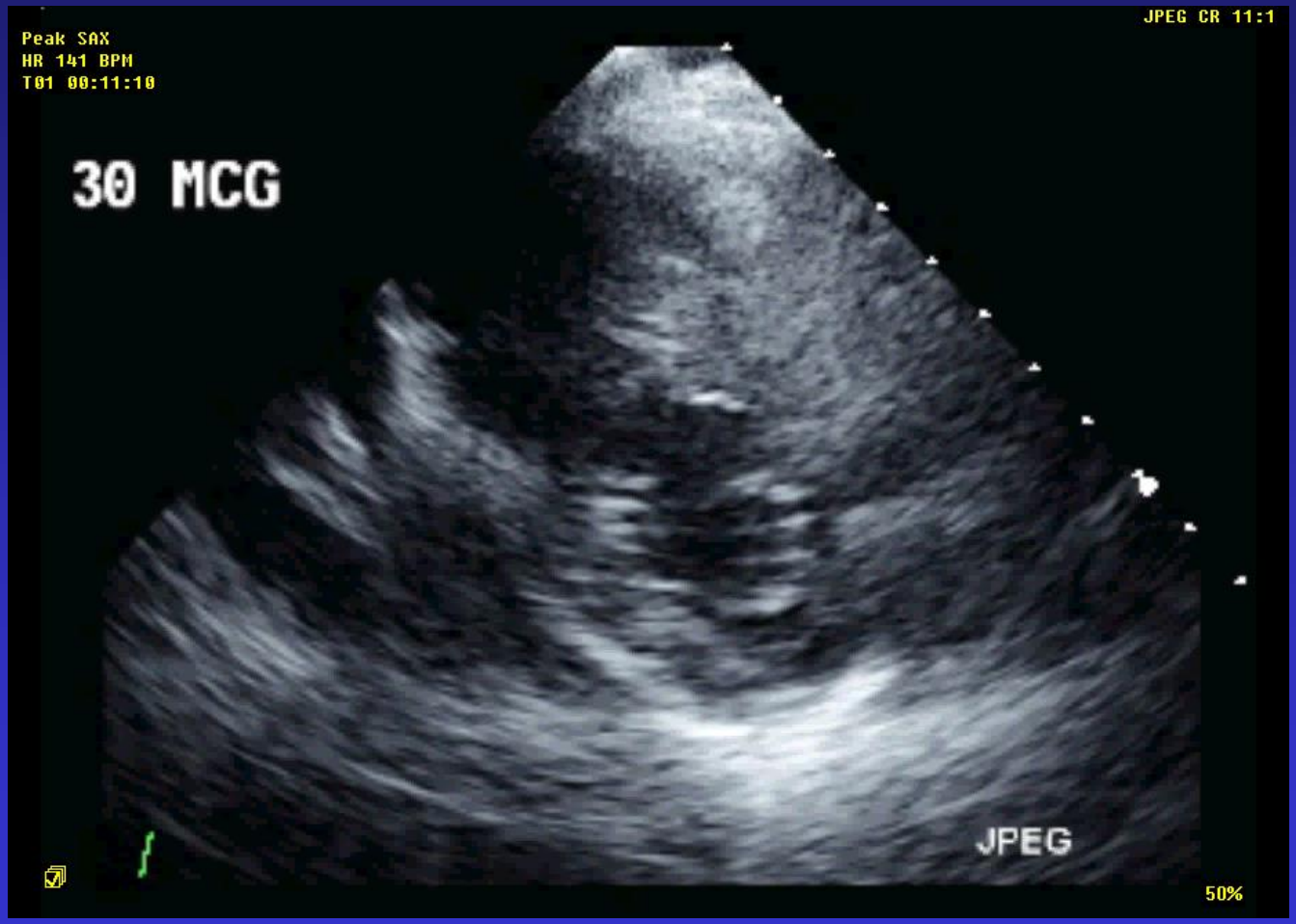
Diastole



Systole



Wall Motion Abnormality?



Endocardial motion does not equal LV thickening

Take Home Message

- Look closely at wall thickening; don't get distracted by the motion
- Abnormal thickening is what indicates myocardial dysfunction, not abnormal motion
- Be especially cautious assessing the basal inferior and posterior walls

Clues to the Presence of An Artifact

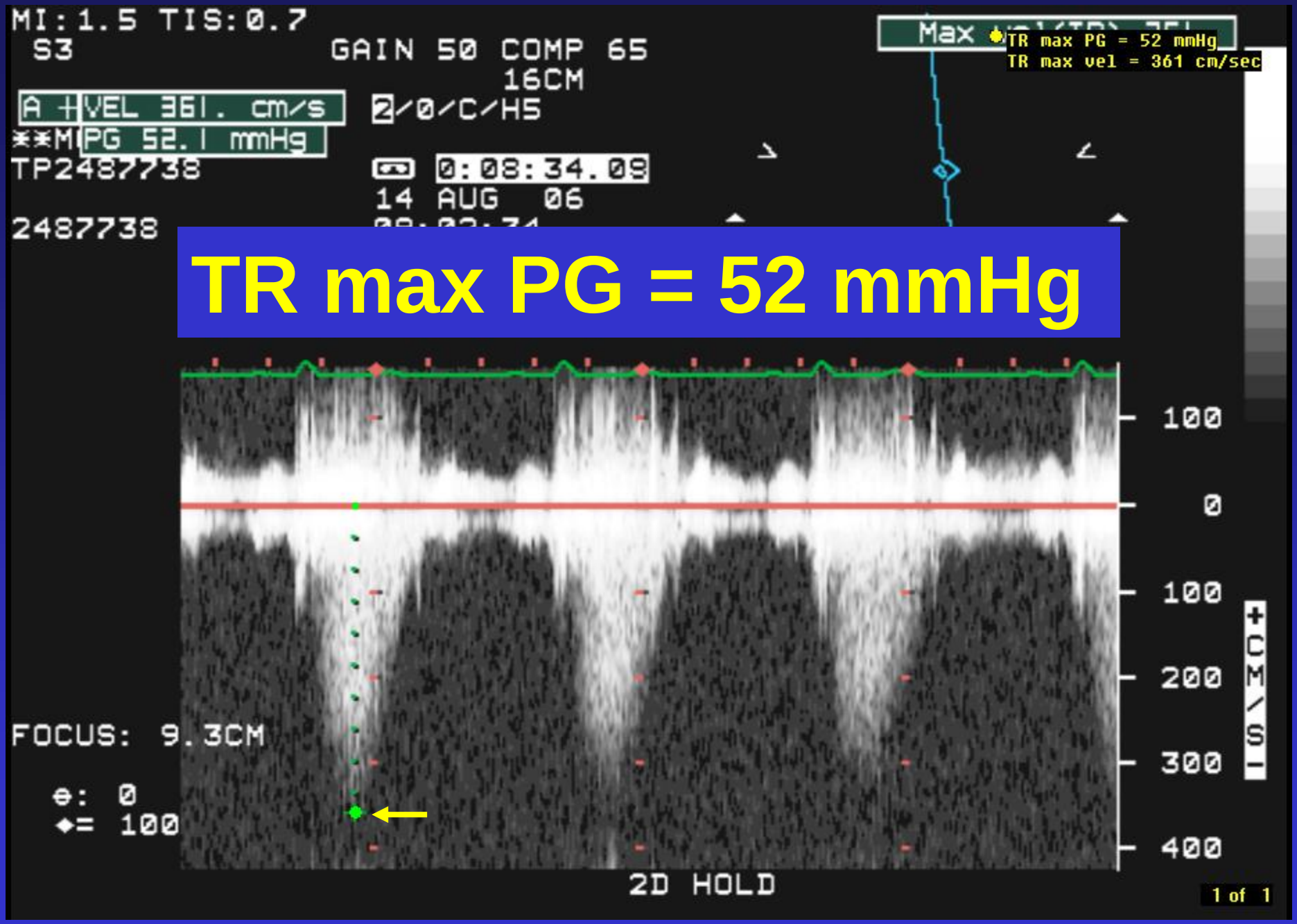
- Structures are often linear, lack well-demarcated borders
- Artifacts may appear to pass through other solid structures
- Motion identical to a real structure
  - Parallel or mirror image
- May not be reproduced in an orthogonal view
- Color flow not affected by it
- Does not have clear attachments

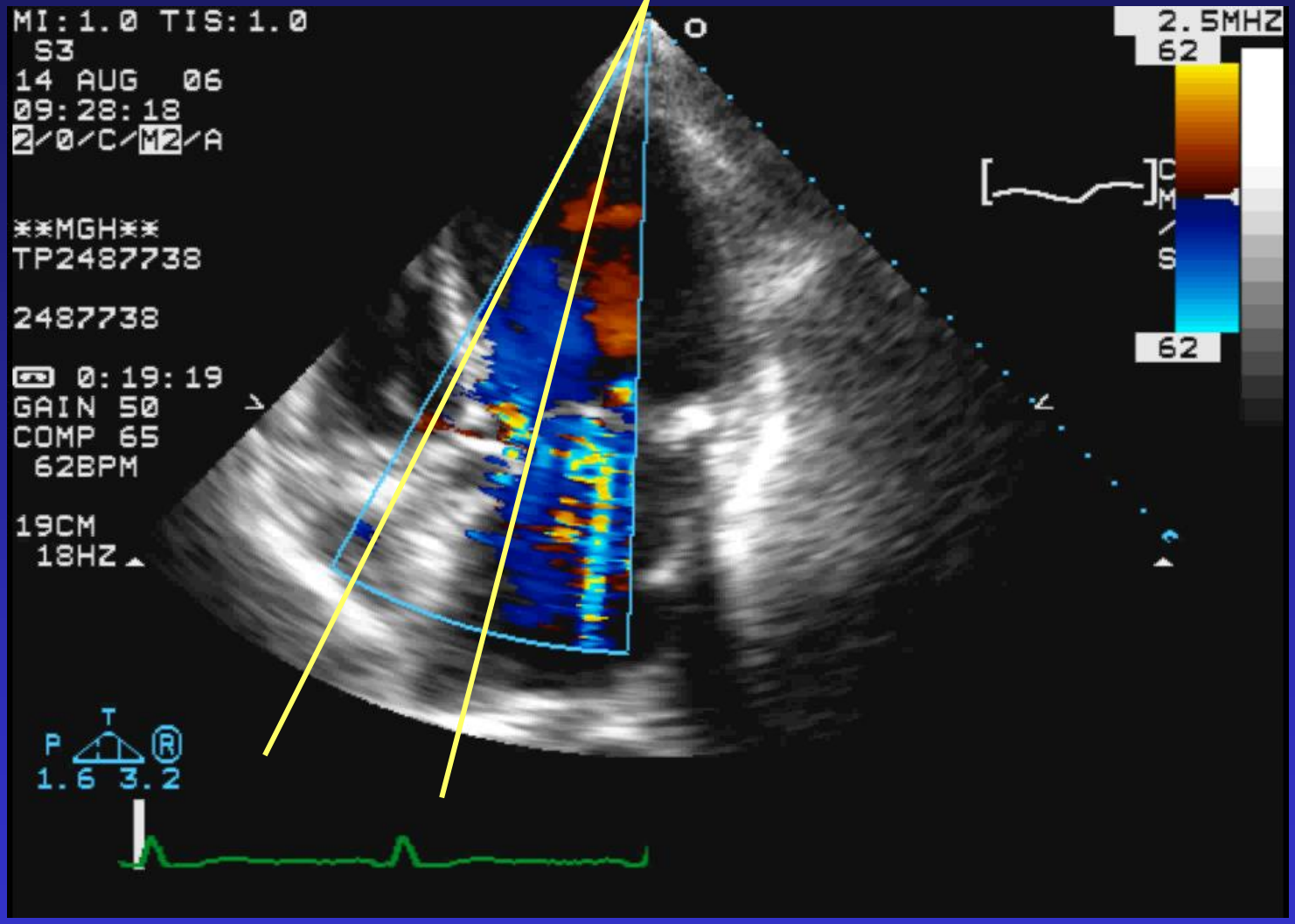
Clues to Real Structures

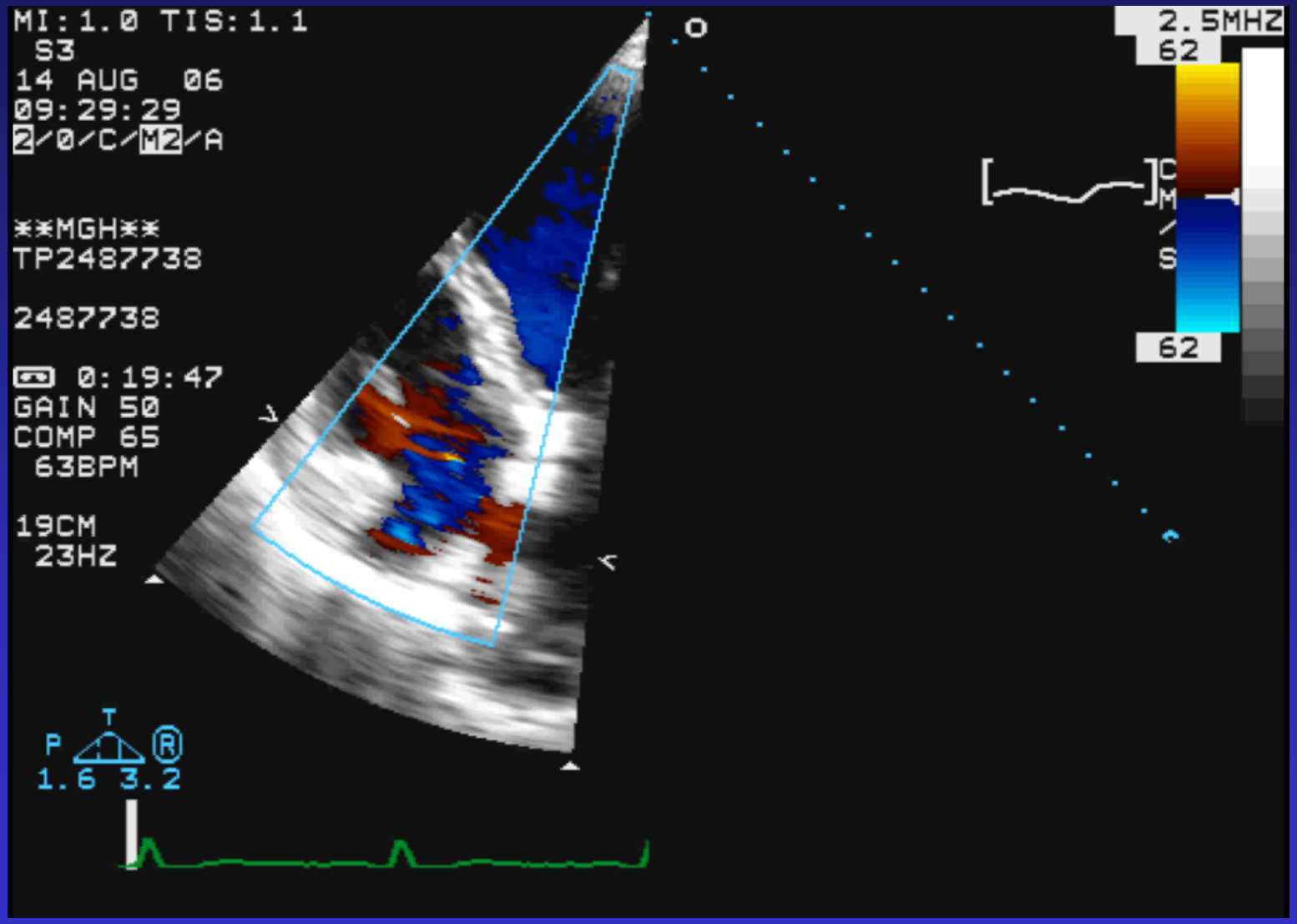
- Distinct edges (unless thrombus)
- Independent motion
- Seen consistently in multiple views
- Color flow affected by structures
- Attached to other structures
- Usually have logical anatomic relationships

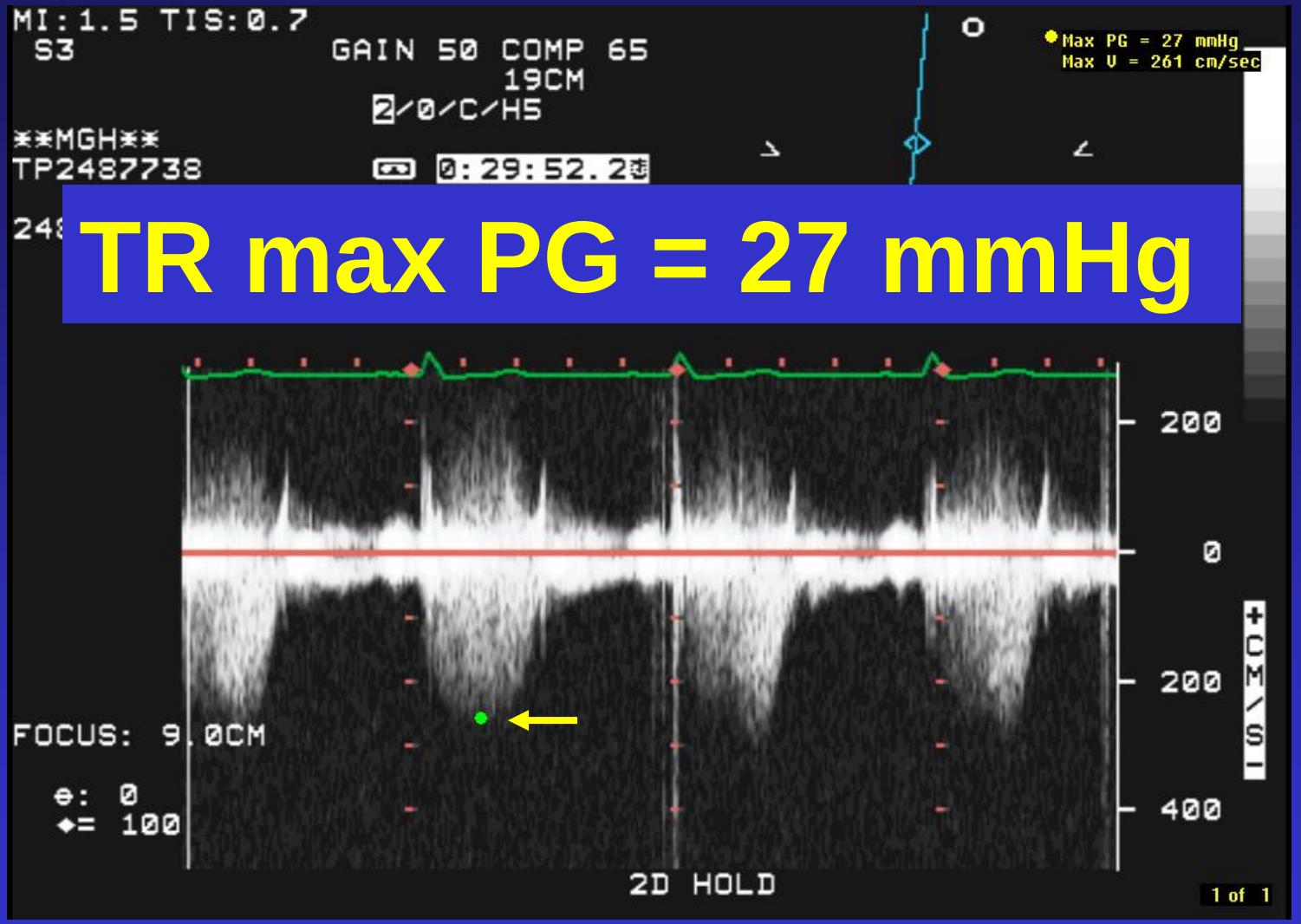
Bonus Case

- 55 year old professor with MVP and MR referred for surgery for the indication of PHTN
- Request for second opinion


MI:1.5 TIS:0.7
S3
GAIN 50 COMP 65
16CM
A + VEL 361. cm/s
2/0/C/H5
**M PG 52.1 mmHg
TP2487738
0:08:34.09
14 AUG 06
2487738
Max
TR max PG = 52 mmHg
TR max vel = 361 cm/sec
TR max PG = 52 mmHg
100
0
100
200
300
400
cm/s
FOCUS: 9.3CM
0: 0
100
2D HOLD
1 of 1


MI:1.0 TIS:1.0
S3
14 AUG 06
09:28:18
2/0/C/M2/A
MGH
TP2487738
2487738
0:19:19
GAIN 50
COMP 65
62BPM
19CM
18HZ
2.5MHZ
62
62
P
T
R
1.6 3.2


MI:1.0 TIS:1.1
S3
14 AUG 06
09:29:29
2/0/C/M2/A
MGH
TP2487738
2487738
0:19:47
GAIN 50
COMP 65
63BPM
19CM
23HZ
P T R
1.6 3.2
2.5MHZ
62
62


MI:1.5 TIS:0.7
S3
GAIN 50 COMP 65
19CM
2/0/C/H5
MGH
TP2487738
0:29:52.2
Max PG = 27 mmHg
Max V = 261 cm/sec
TR max PG = 27 mmHg
200
0
200
400
CM/S
FOCUS: 9.0CM
0: 0
= 100
2D HOLD
1 of 1

Take Home Message:

Doppler detects flow within the full width of the beam, in and out of the plane.