Ultrasound

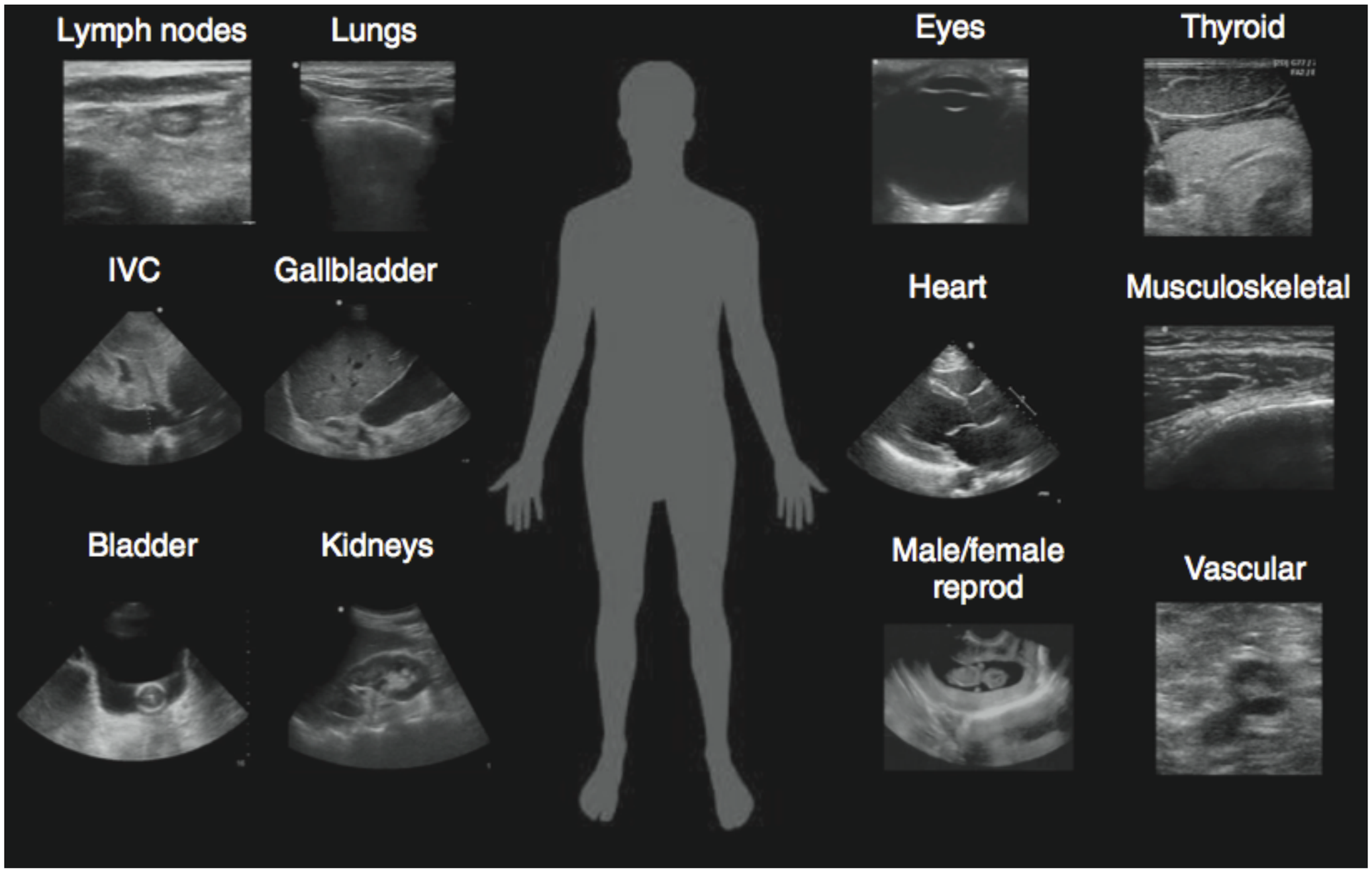
physics, knobs & probes

Chen, Kuo-Chih M.D.

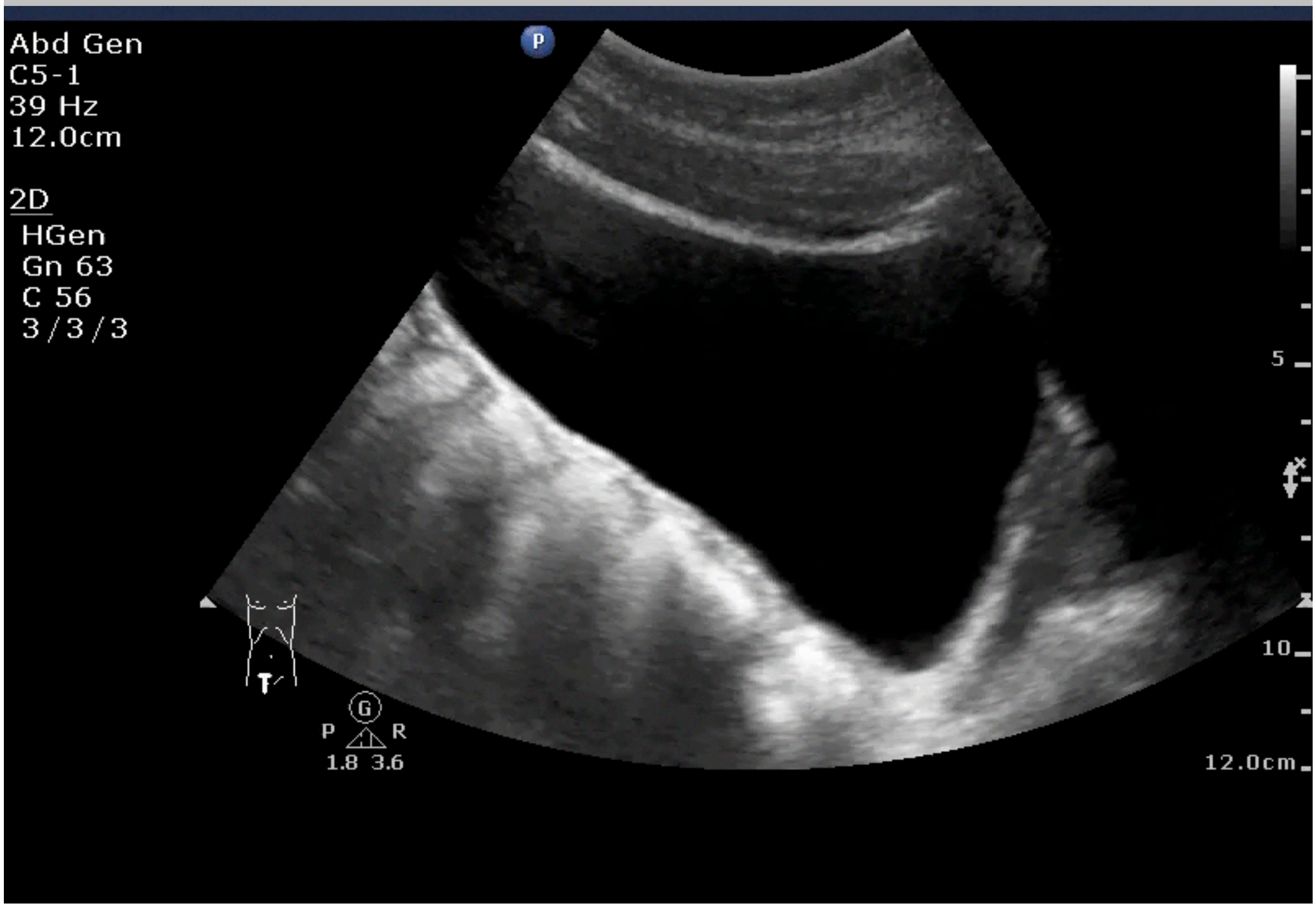
Director of Emergency Ultrasound Training Centre

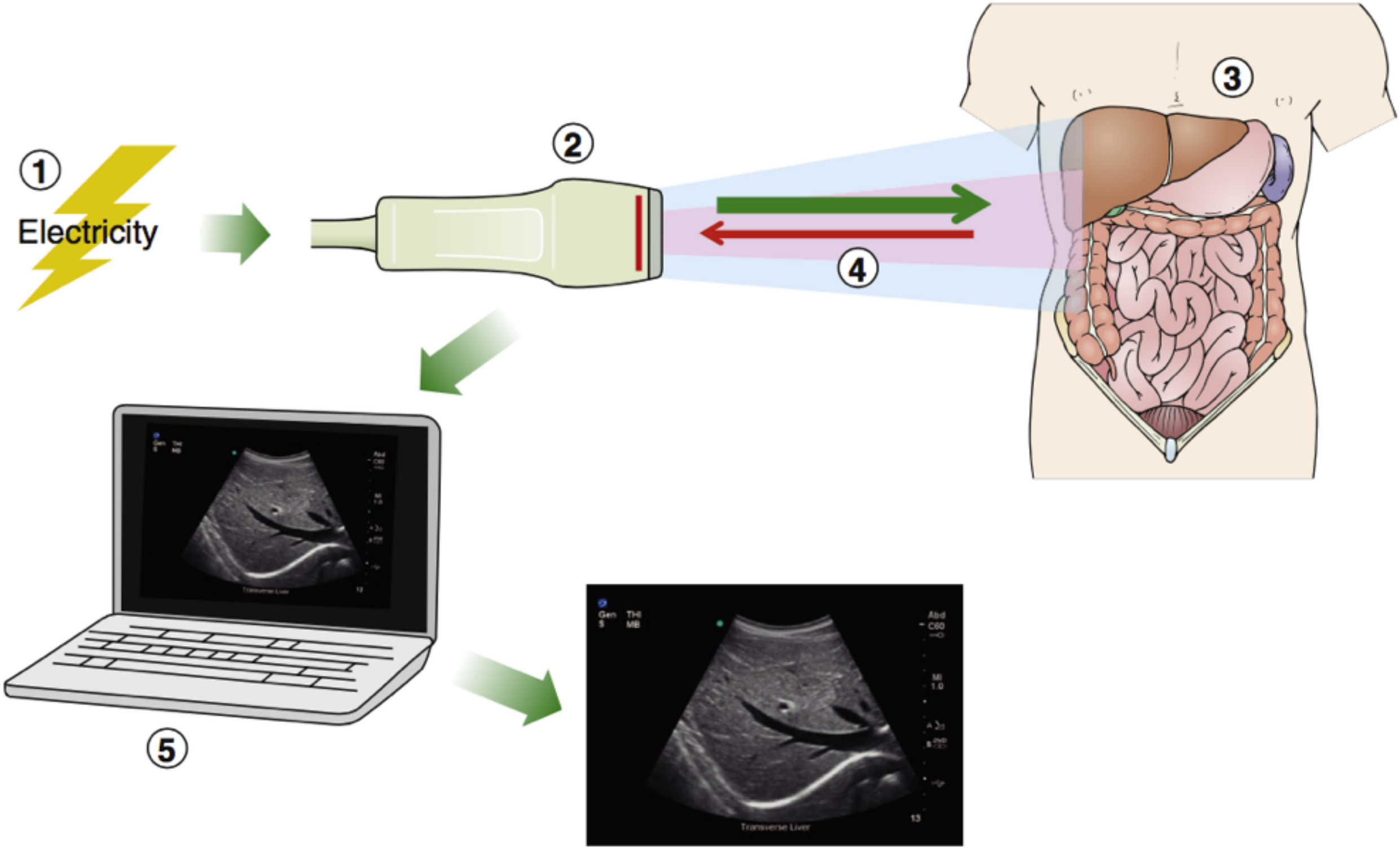
Shin Kong WHS Memorial Hospital, Taipei, Taiwan

POCUS

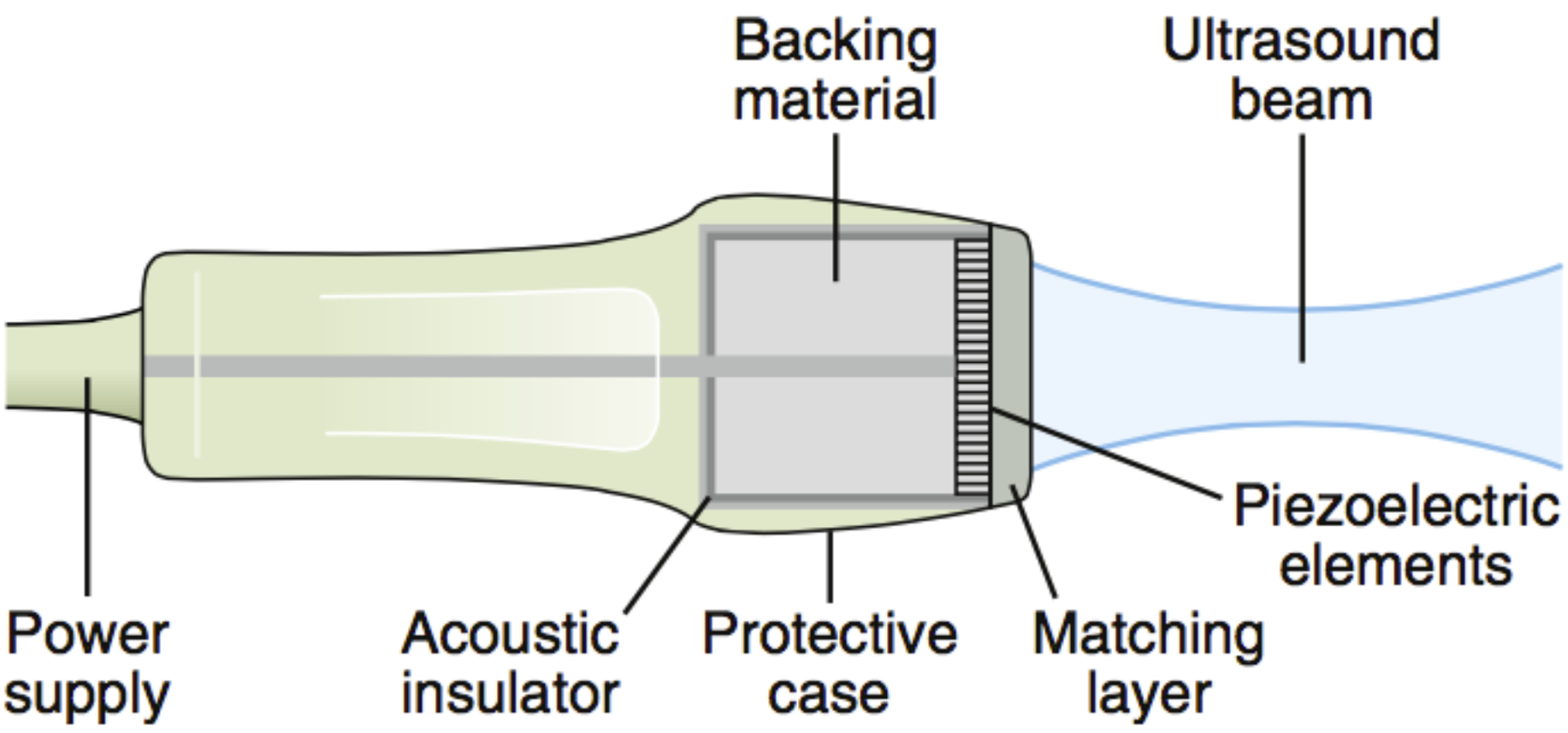

Lymph nodes
Lungs
Eyes
Thyroid
IVC
Gallbladder
Heart
Musculoskeletal
Bladder
Kidneys
Male/female reprod
Vascular

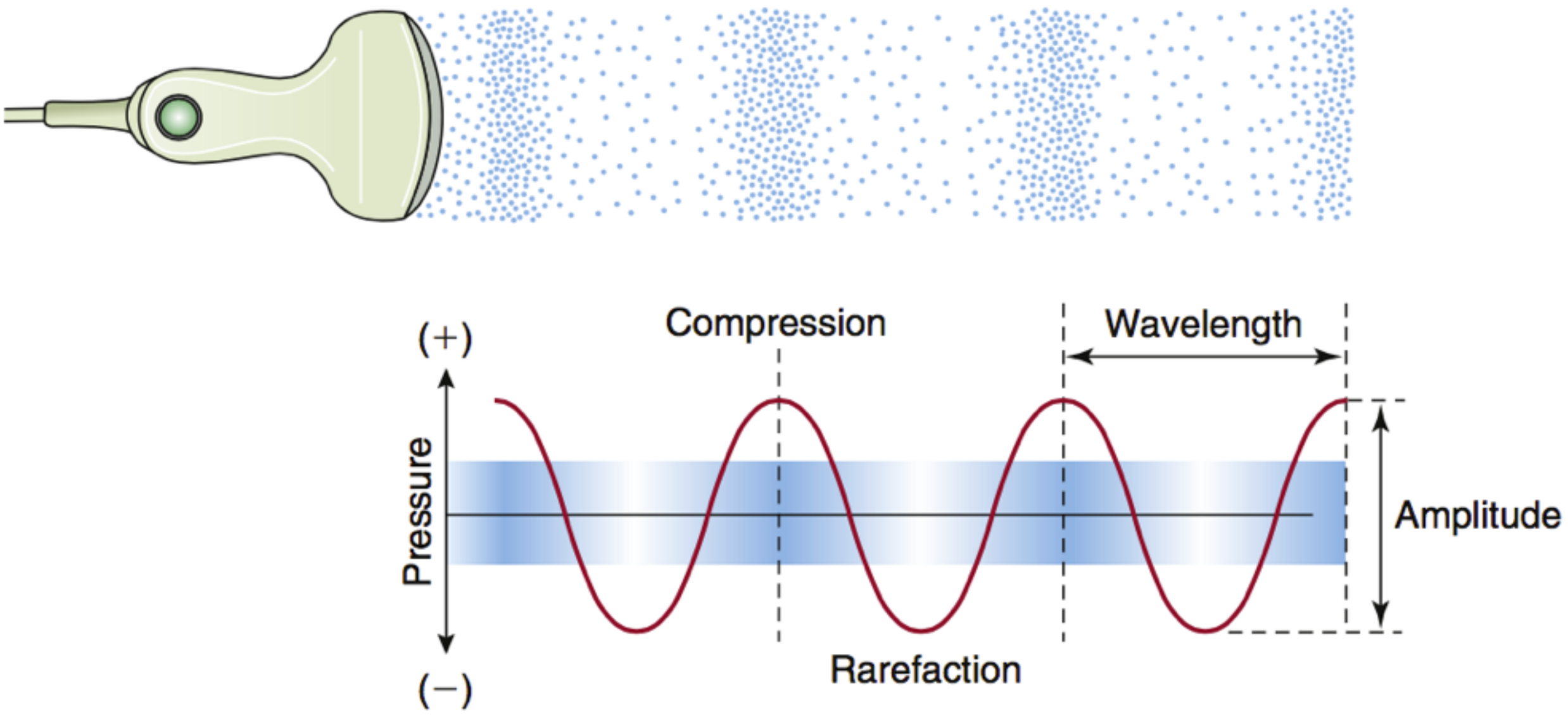
Interpret


Abd Gen
C5-1
39 Hz
12.0cm
2D
HGen
Gn 63
C 56
3/3/3
P
5
10
12.0cm
G
P
R
1.8 3.6

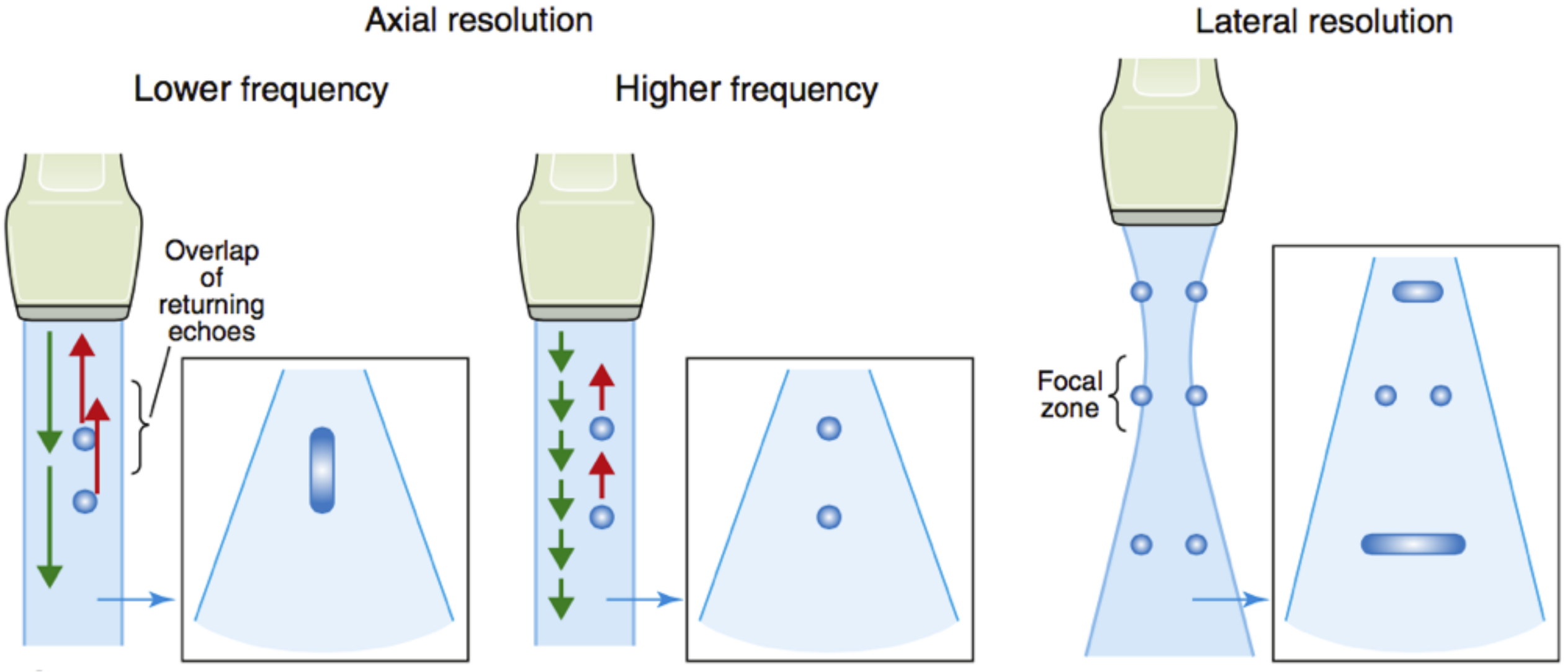

1
Electricity
2
3
4
5
Gen THI
5 MB
Abd
C60
MI
1.0
Transverse Liver
13

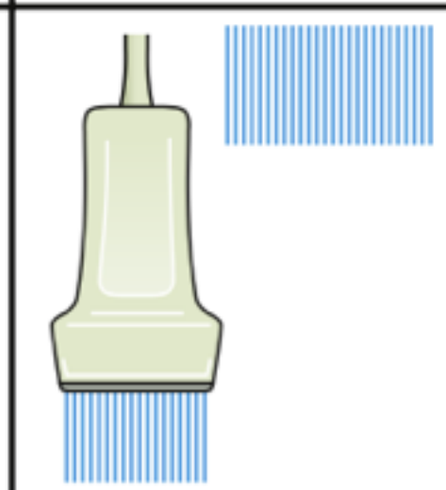
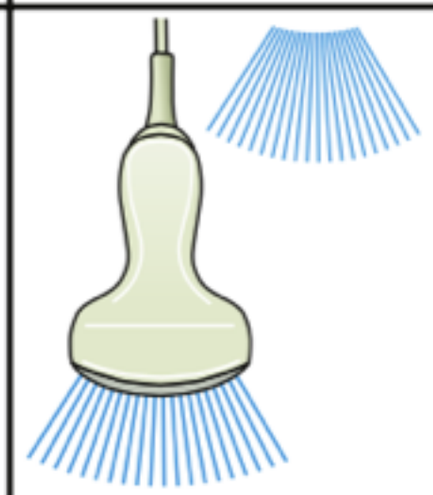
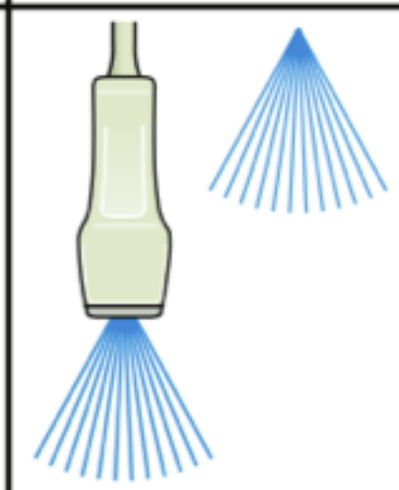
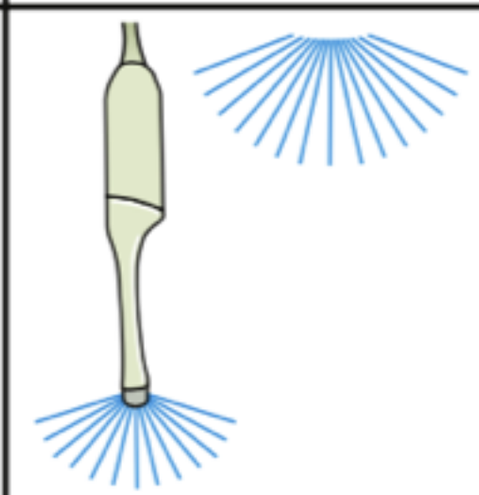
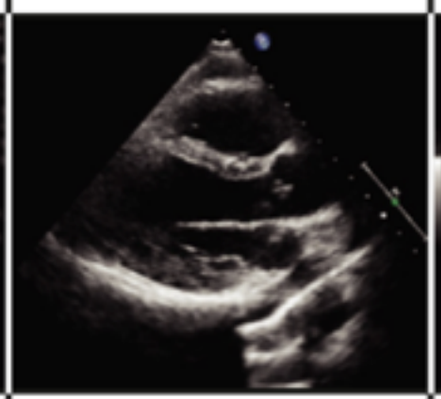
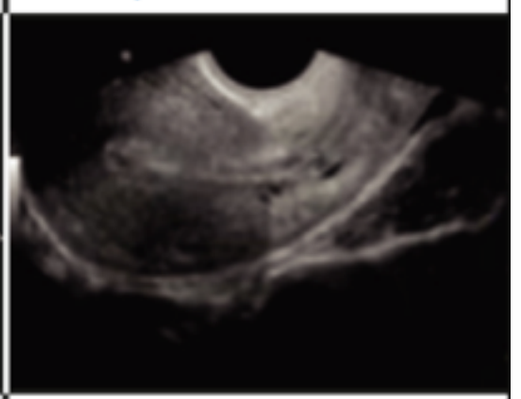
Transducer

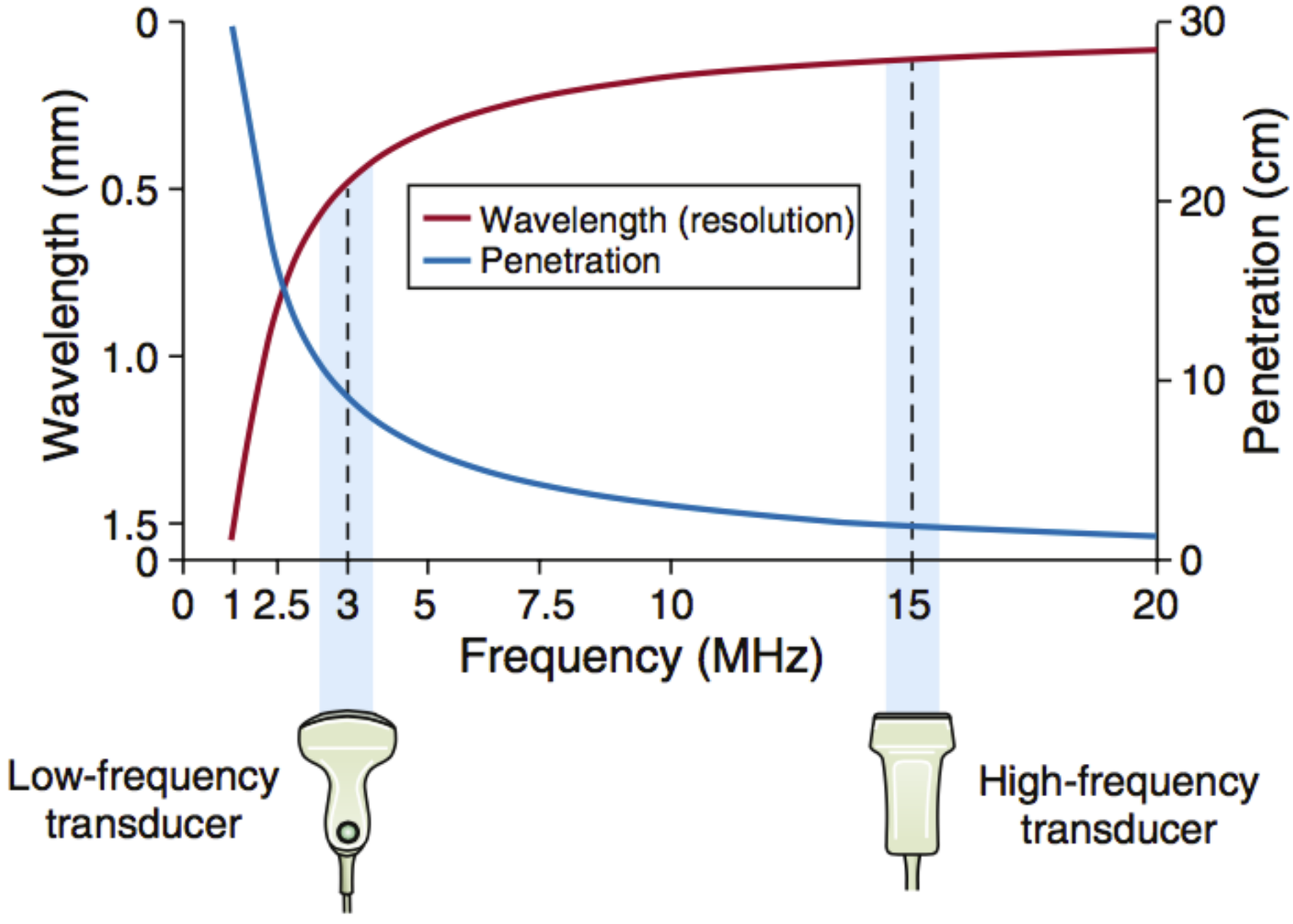

Backing material
Ultrasound beam
Piezoelectric elements
Power supply
Acoustic insulator
Protective case
Matching layer


(+)
Compression
Wavelength
Pressure
Amplitude
Rarefaction
(−)

Resolution


Axial resolution
Lower frequency
Higher frequency
Lateral resolution
Overlap
of
returning
echoes
Focal
zone

Transducer type	Linear	Curvilinear	Phased array	Intracavitary
				
Frequency range	5–10 MHz	2–5 MHz	1–5 MHz	5–8 MHz
Imaging depth	9 cm	30 cm	35 cm	13 cm
Footprint				
Image				
Applications	Arteries/veins Procedures Pleura Skin/soft tissues Musculoskeletal Testicles/hernia Eyes Breast	Gallbladder Liver Kidney Bladder Abdominal aorta Abdominal free fluid Uterus/ovaries	Heart Inferior vena cava Lungs Pleura Abdomen	Uterus/ovaries Pharynx


Wavelength (mm)
0
0.5
1.0
1.5
0
Penetration (cm)
30
20
10
0
Wavelength (resolution)
Penetration
0 1 2.5 3 5 7.5 10 15 20
Frequency (MHz)
Low-frequency transducer
High-frequency transducer

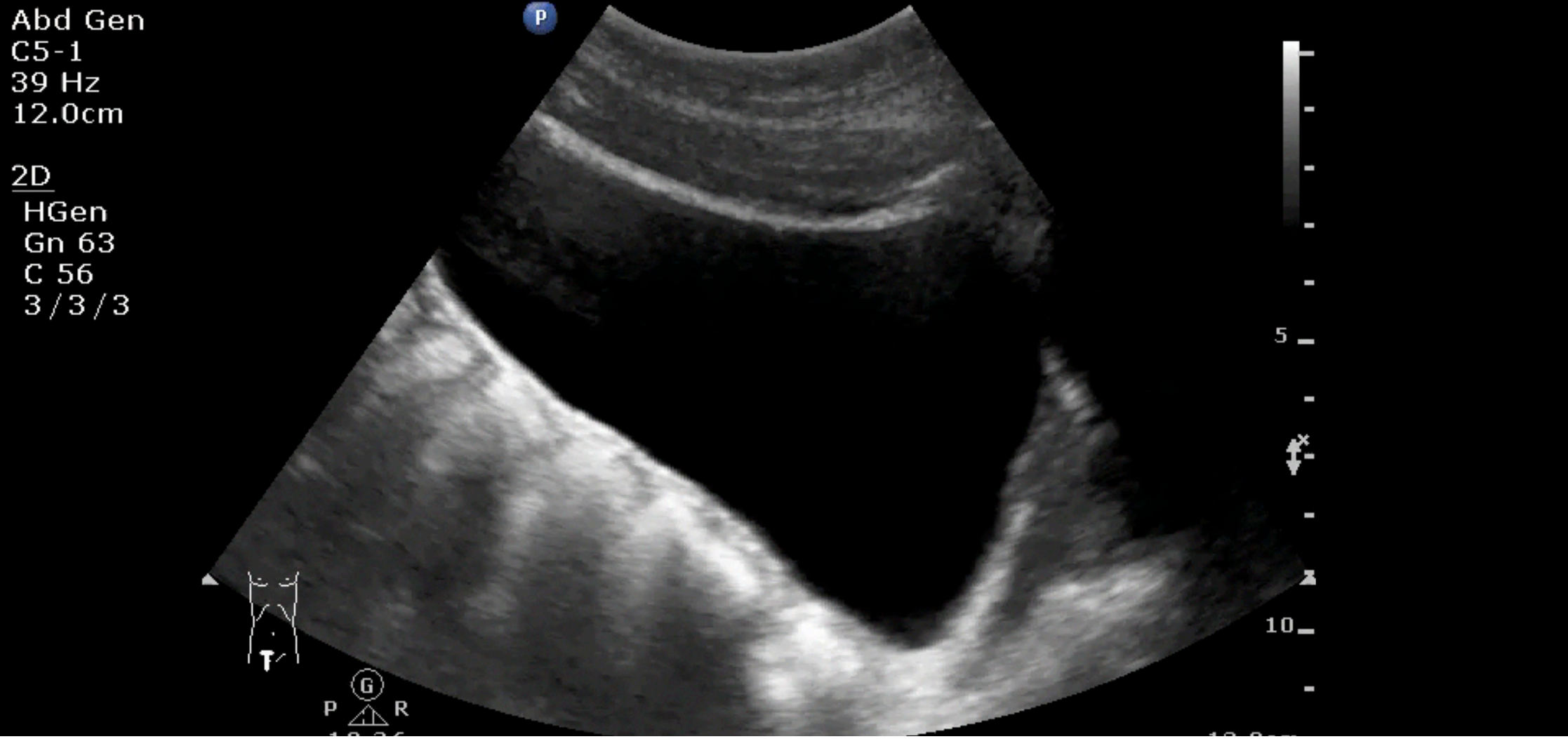
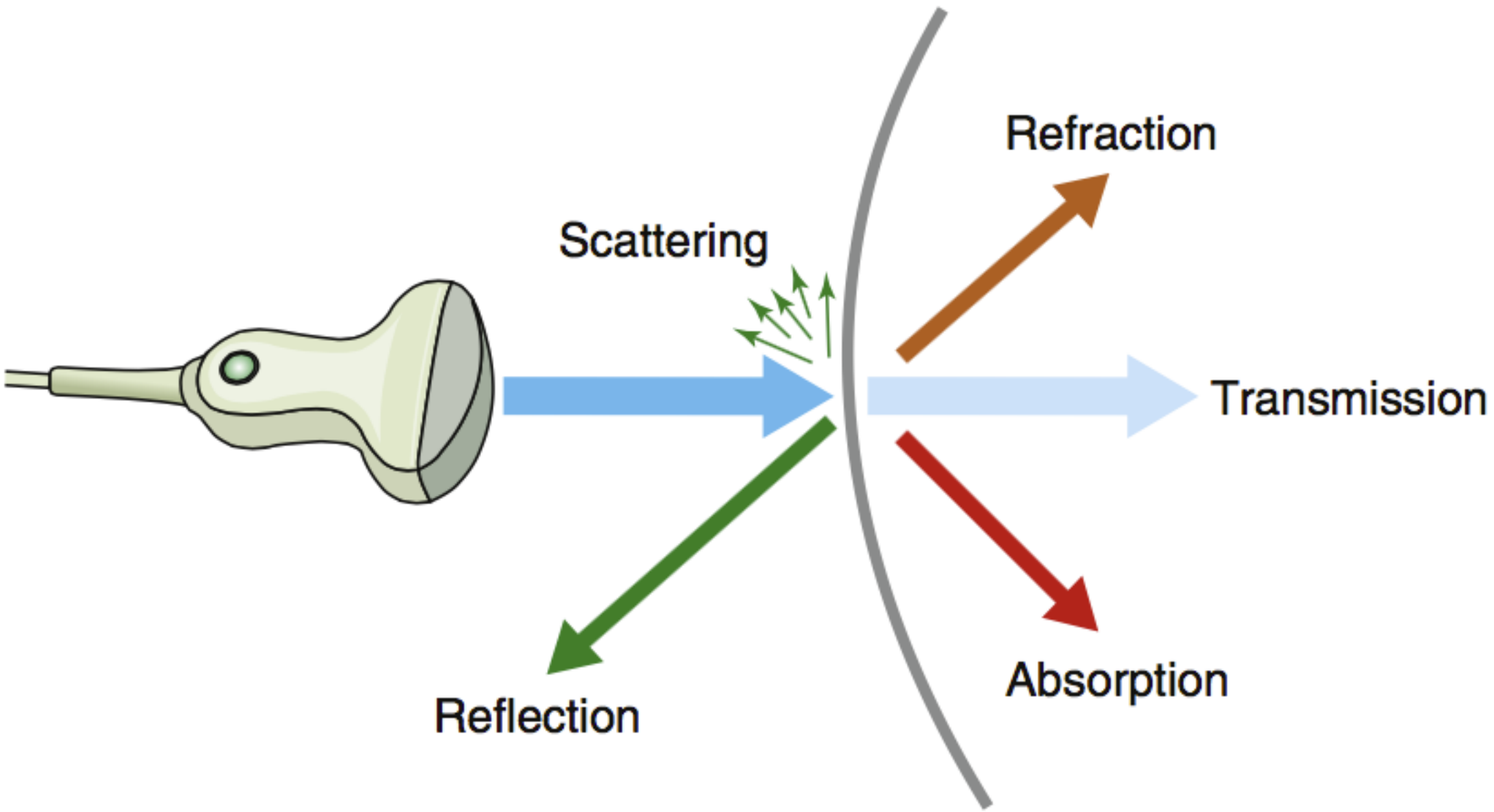


TABLE 2.1 ■ **Acoustic Impedance of Different Tissues**[6–8]

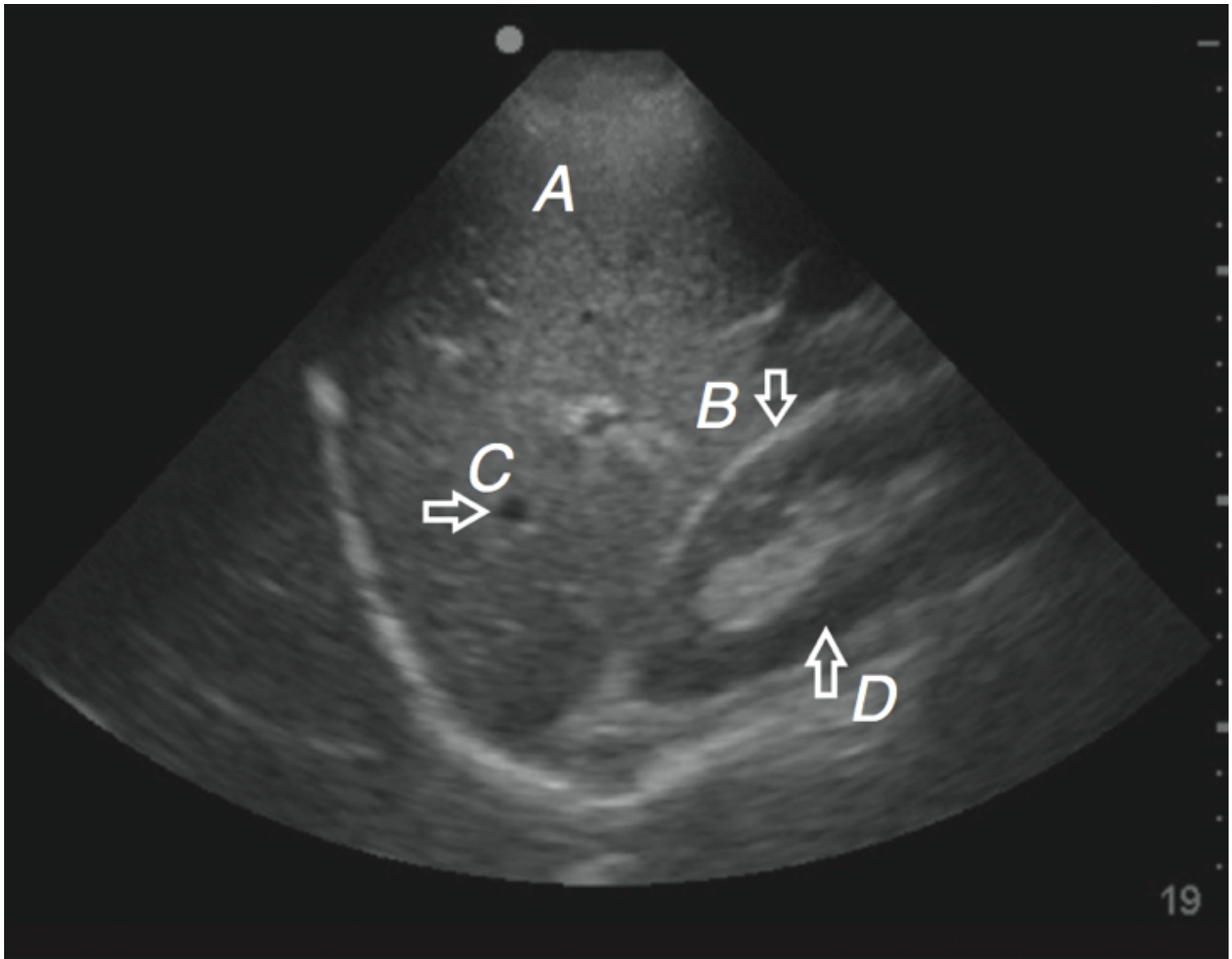
Tissue or Material	Density (g/cm^3)	Speed of Sound (m/s)	Acoustic Impedance ($kg/(s\ m^2)$) × 10^6
Air	0.001225	340	0.0004
Fat	0.95	1450	1.38
Blood	1.055	1575	1.66
Liver	1.06	1590	1.69
Bone	1.9	4080	7.75
Metal (e.g., titanium)	4.5	5090	22.9

TABLE 2.2 ■ Attenuation Coefficients of Different Materials

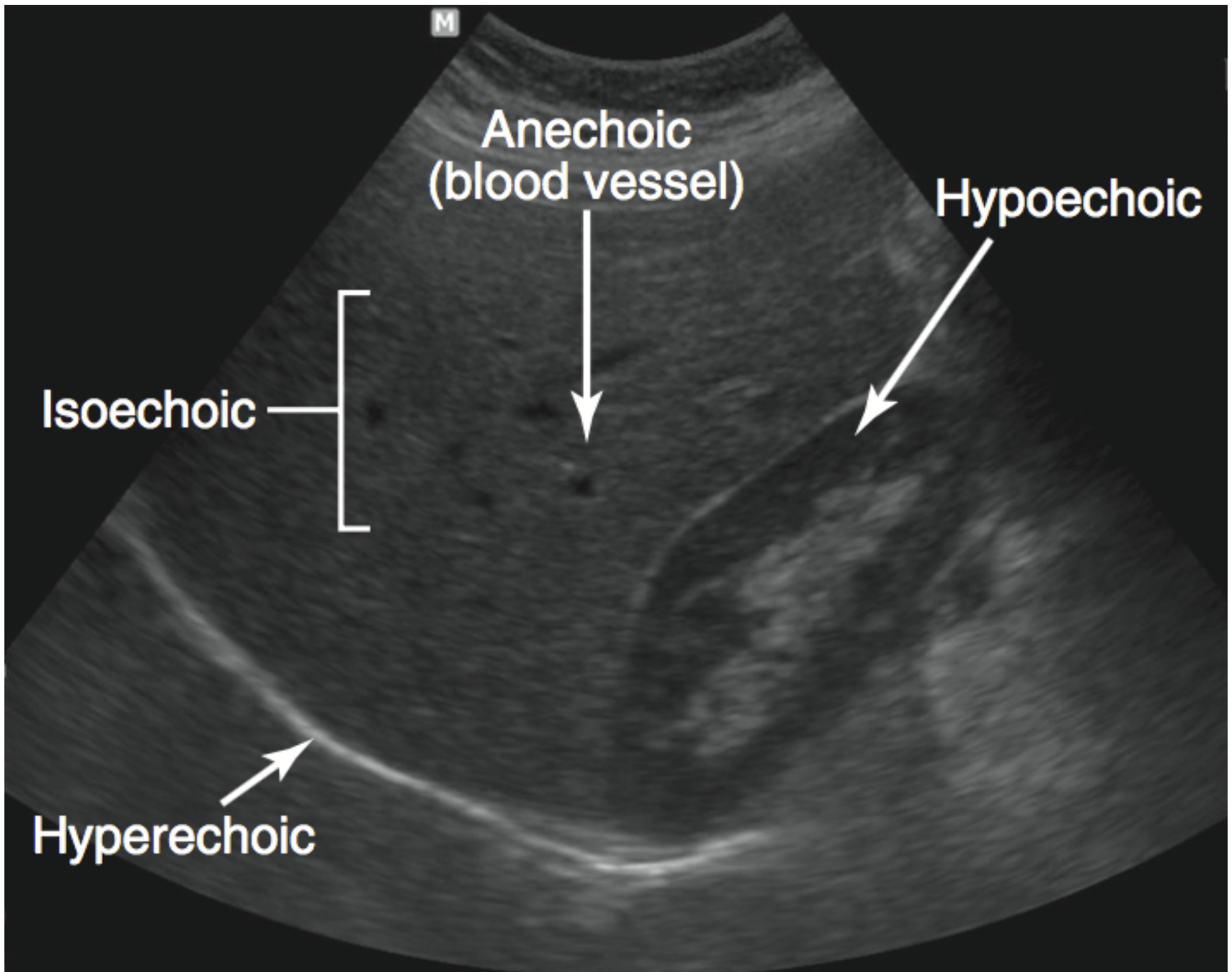
Tissue or Material	Attenuation (dB/cm/MHz)
Water	0.0022
Blood	0.15
Soft tissues	0.75
Air	7.50
Bone	15.00


Refraction
Scattering
Transmission
Reflection
Absorption

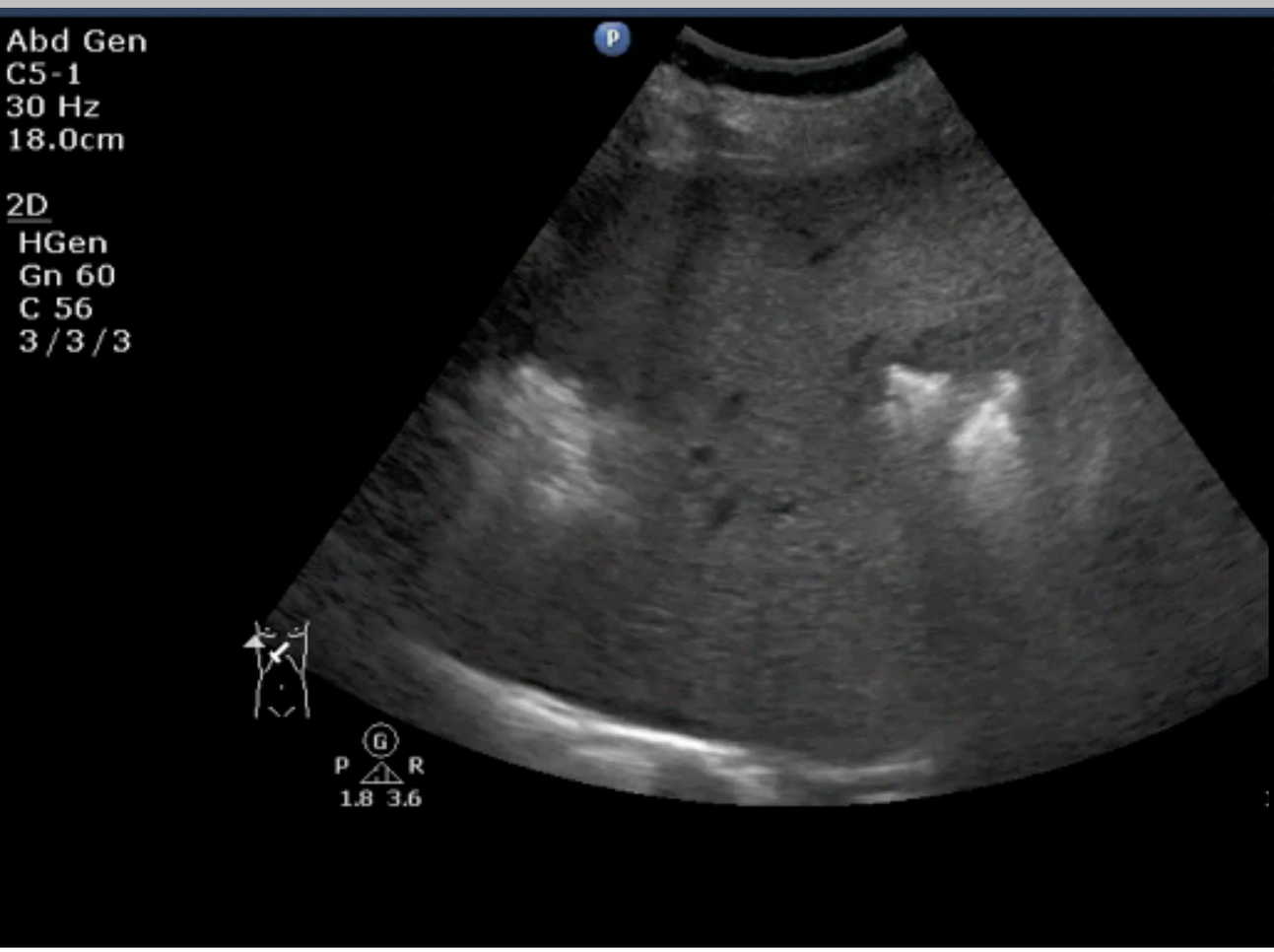
Mode & Echogenicity ?

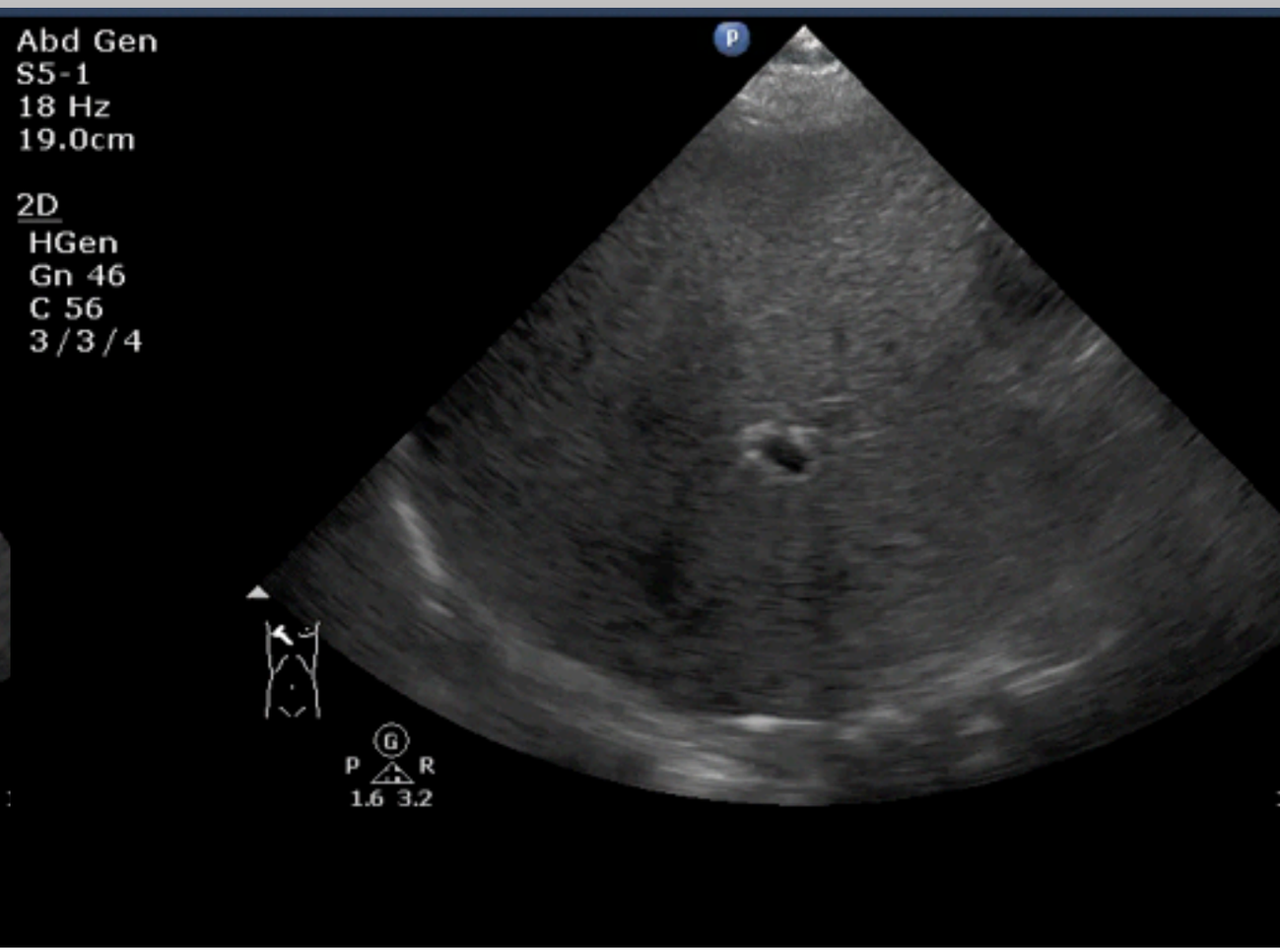


Brightness mode

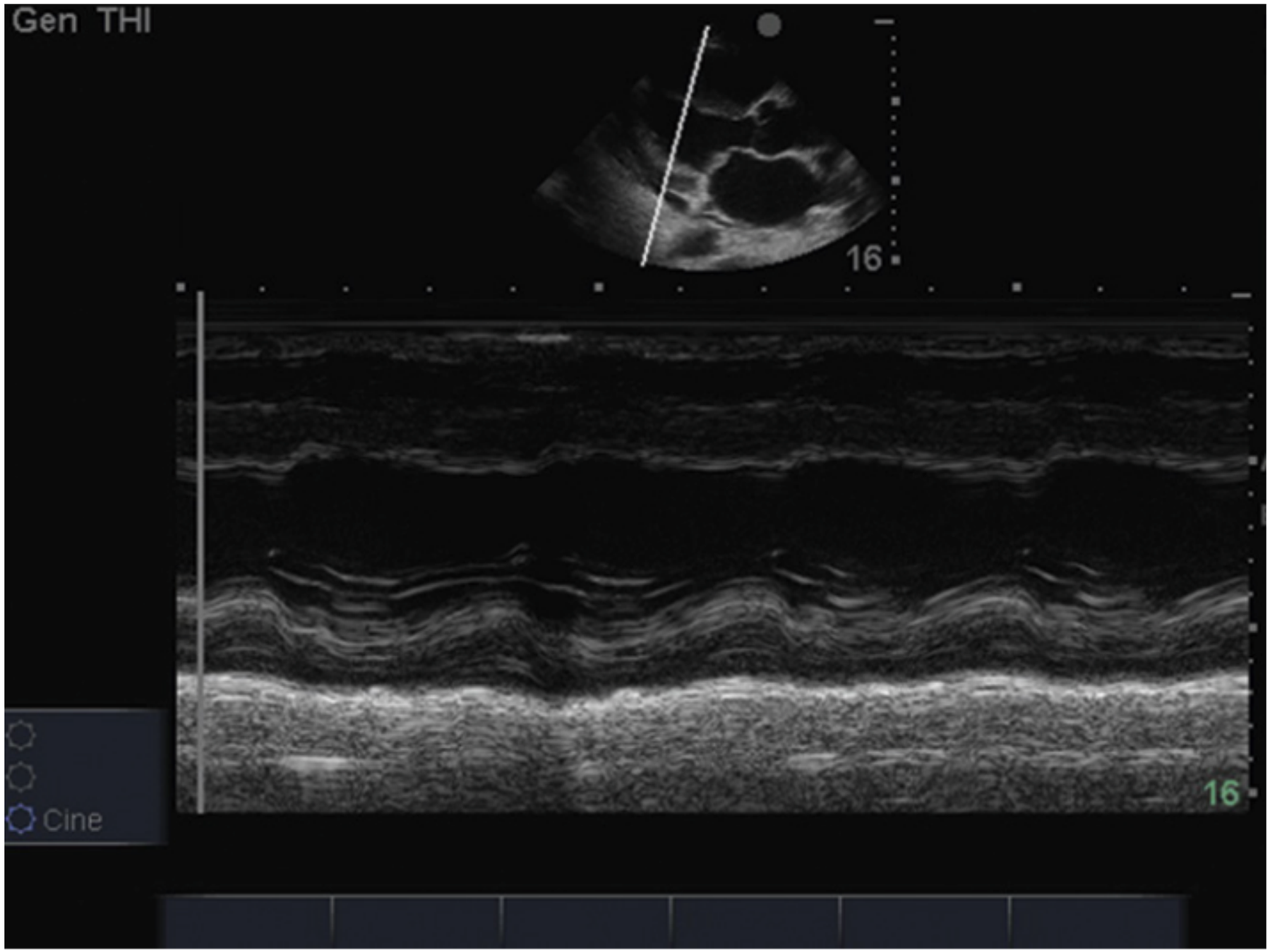


Which probe is better ?

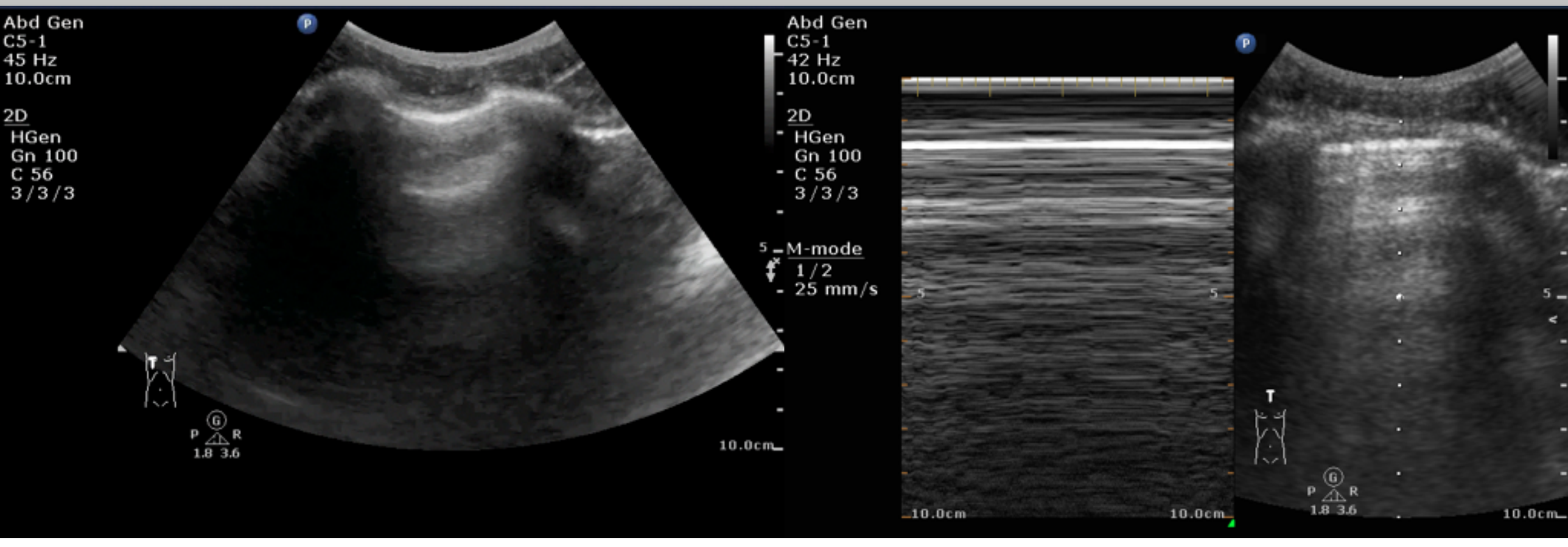




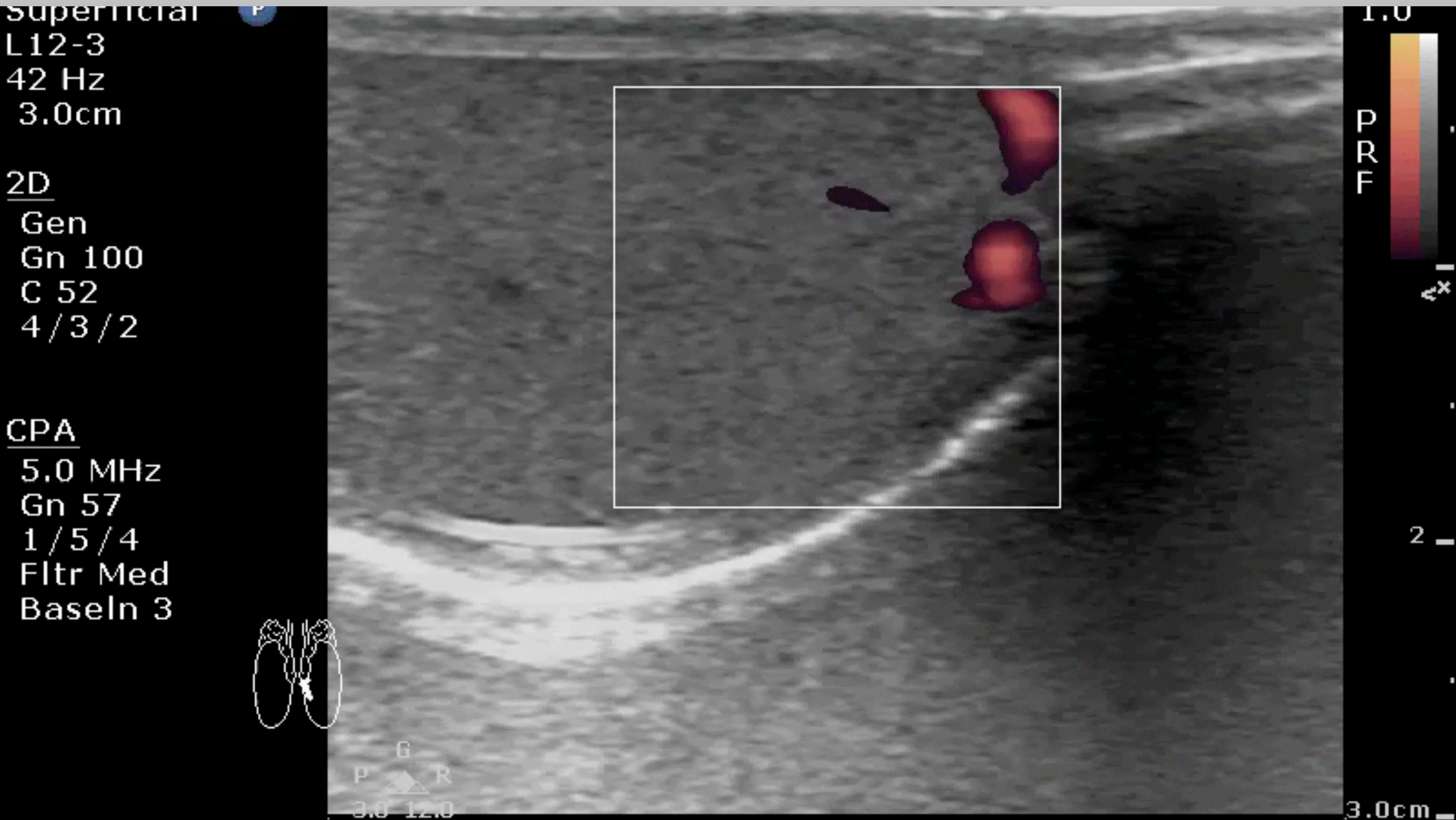
Mode ?



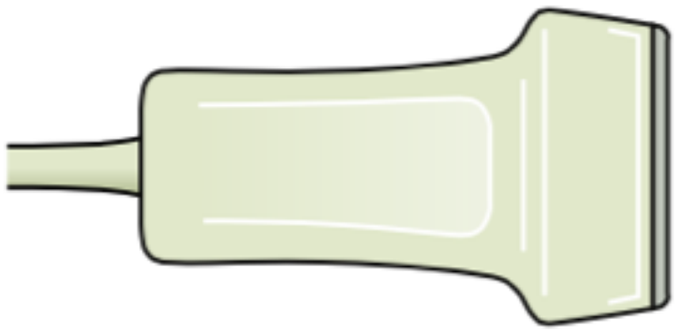
To record **motion**



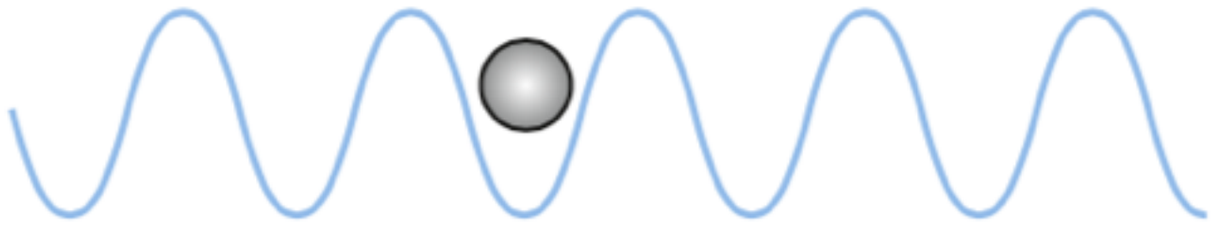
Power Doppler for low flow



Stationary transducer

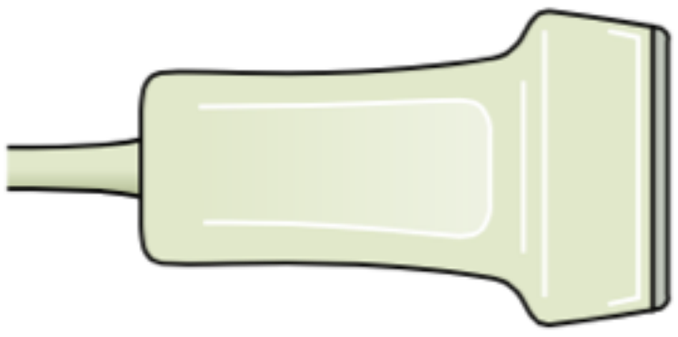


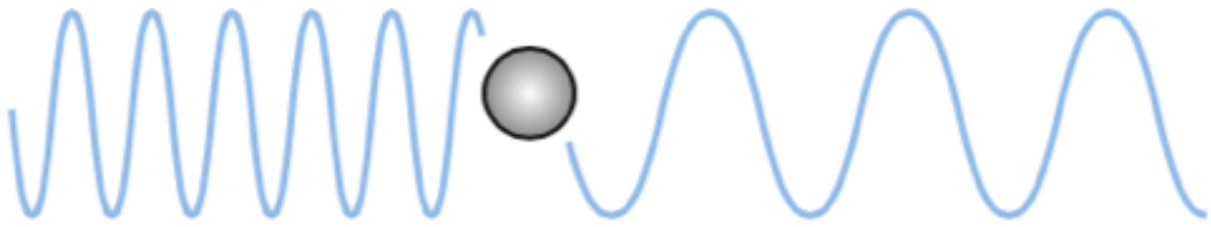
Stationary reflector



No change in frequency

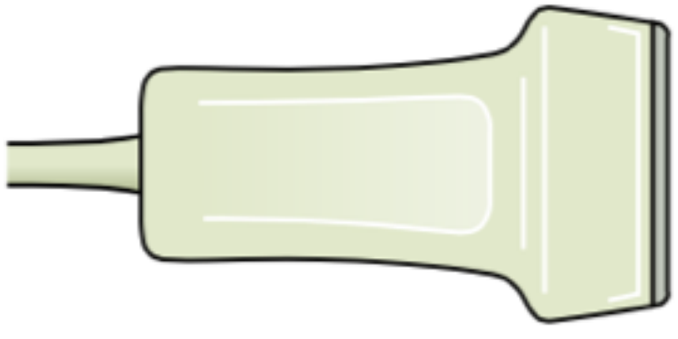
Reflector moving toward transducer

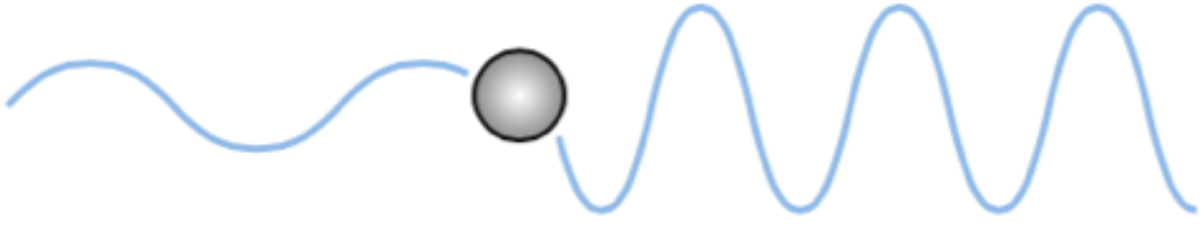




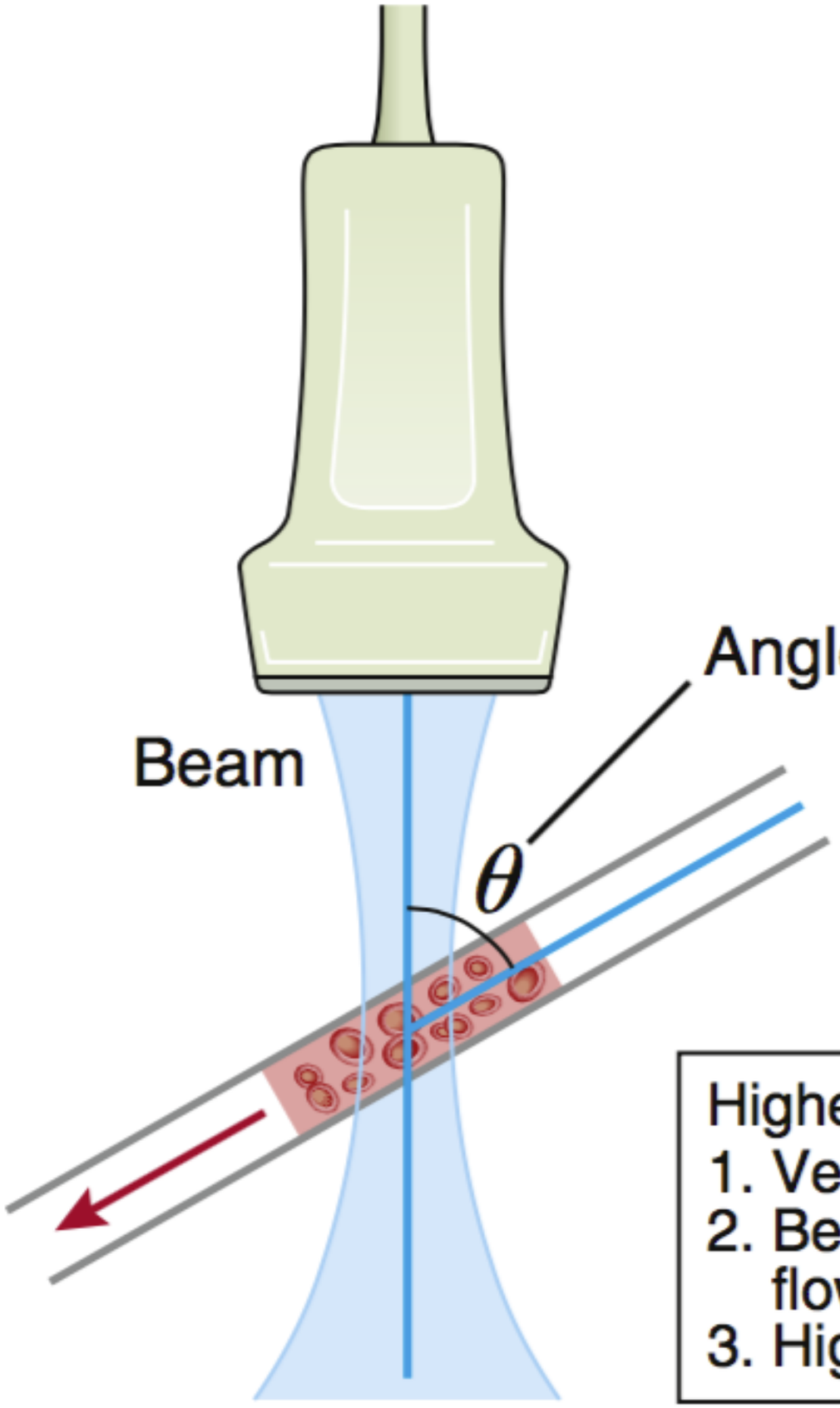
Frequency increased

Reflector moving away from transducer



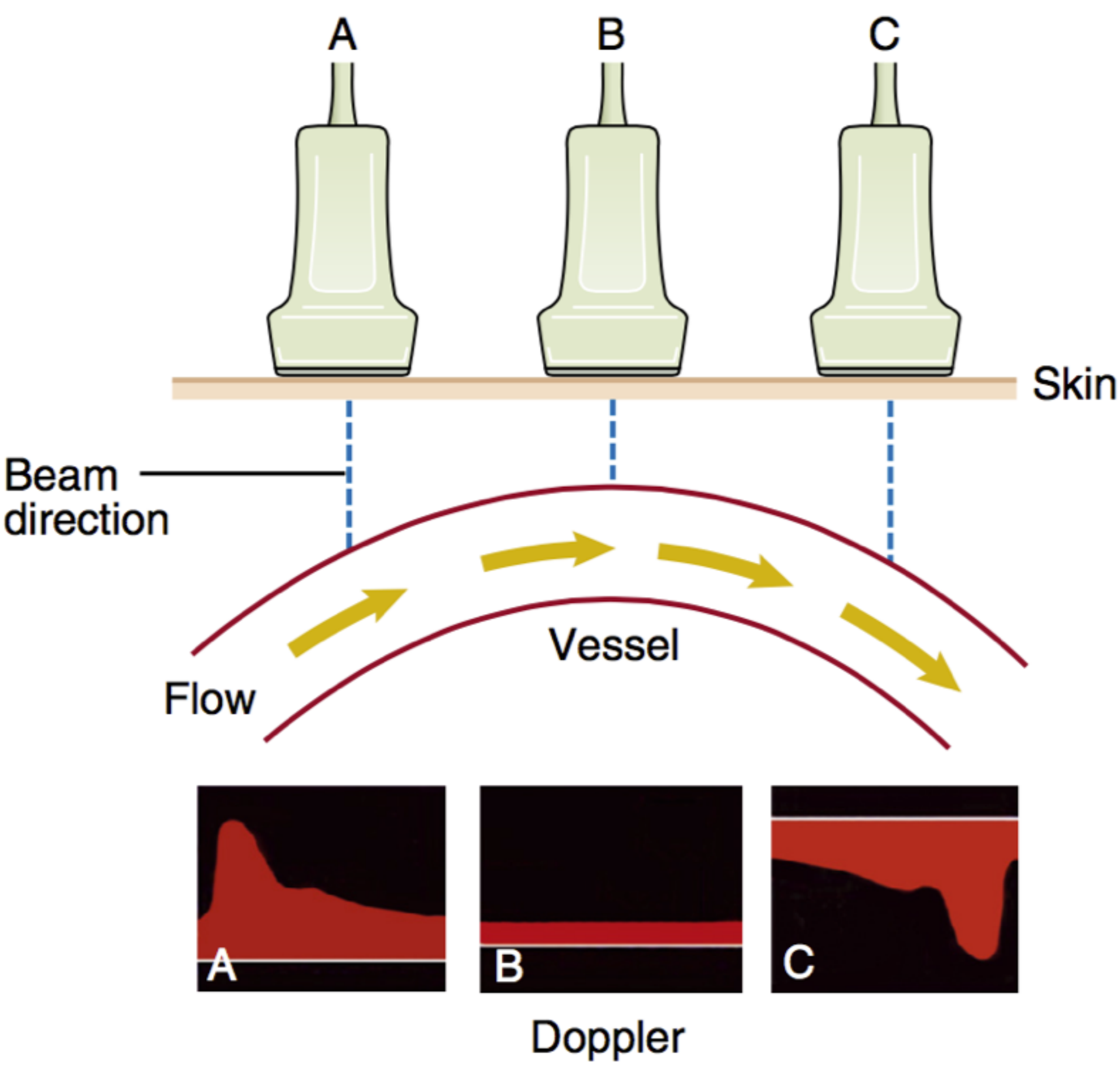


Frequency decreased

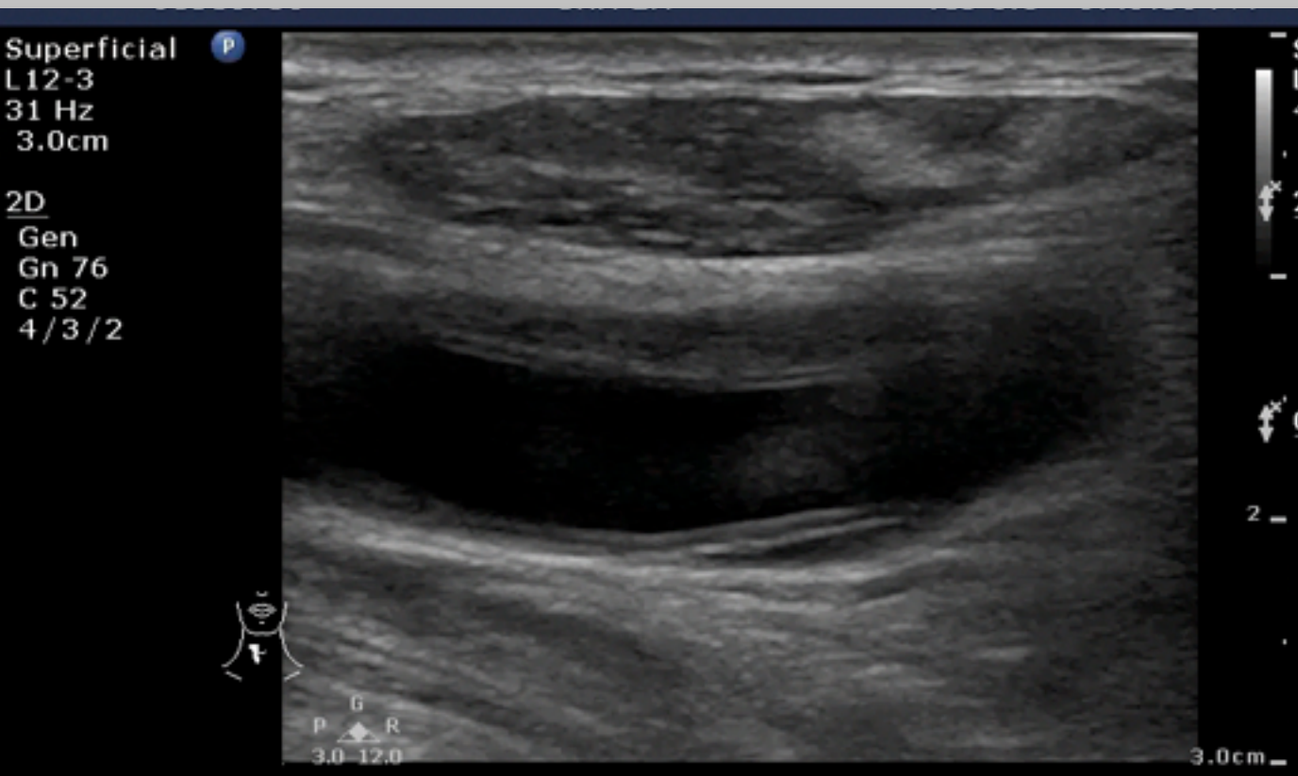


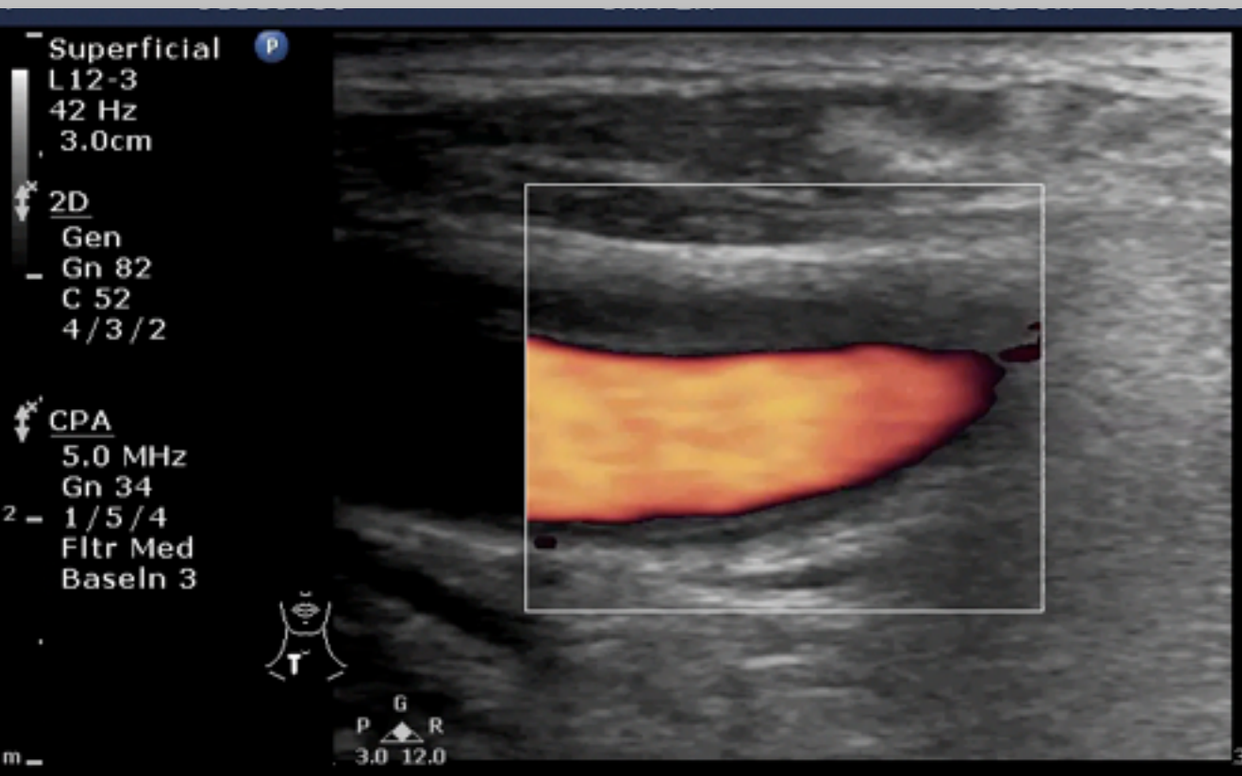
Higher Doppler frequency obtained if:

1. Velocity is increased
2. Beam is aligned parallel to flow direction
3. Higher frequency is used

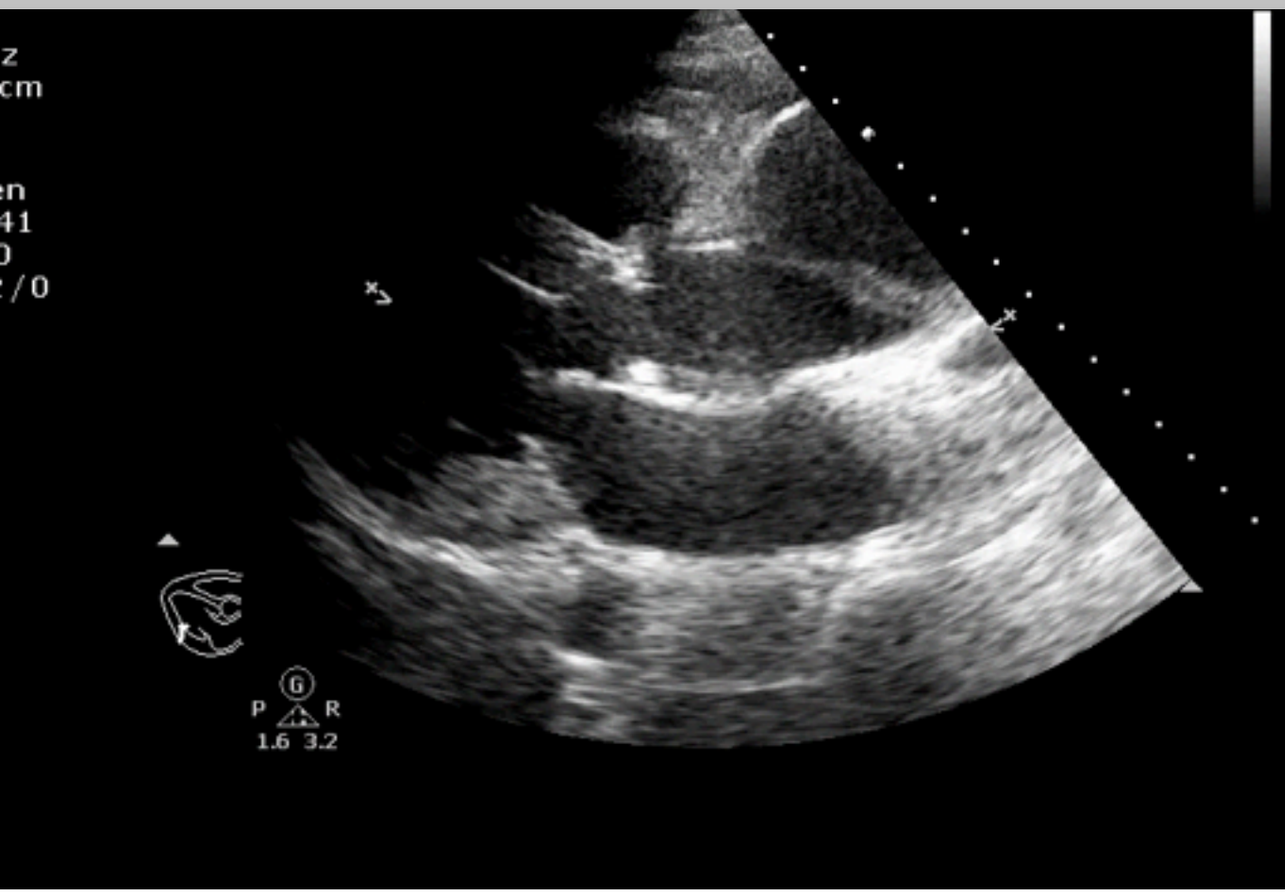

A
B
C
Skin
Beam direction
Vessel
Flow
A
B
C
Doppler

Stroke with R weakness

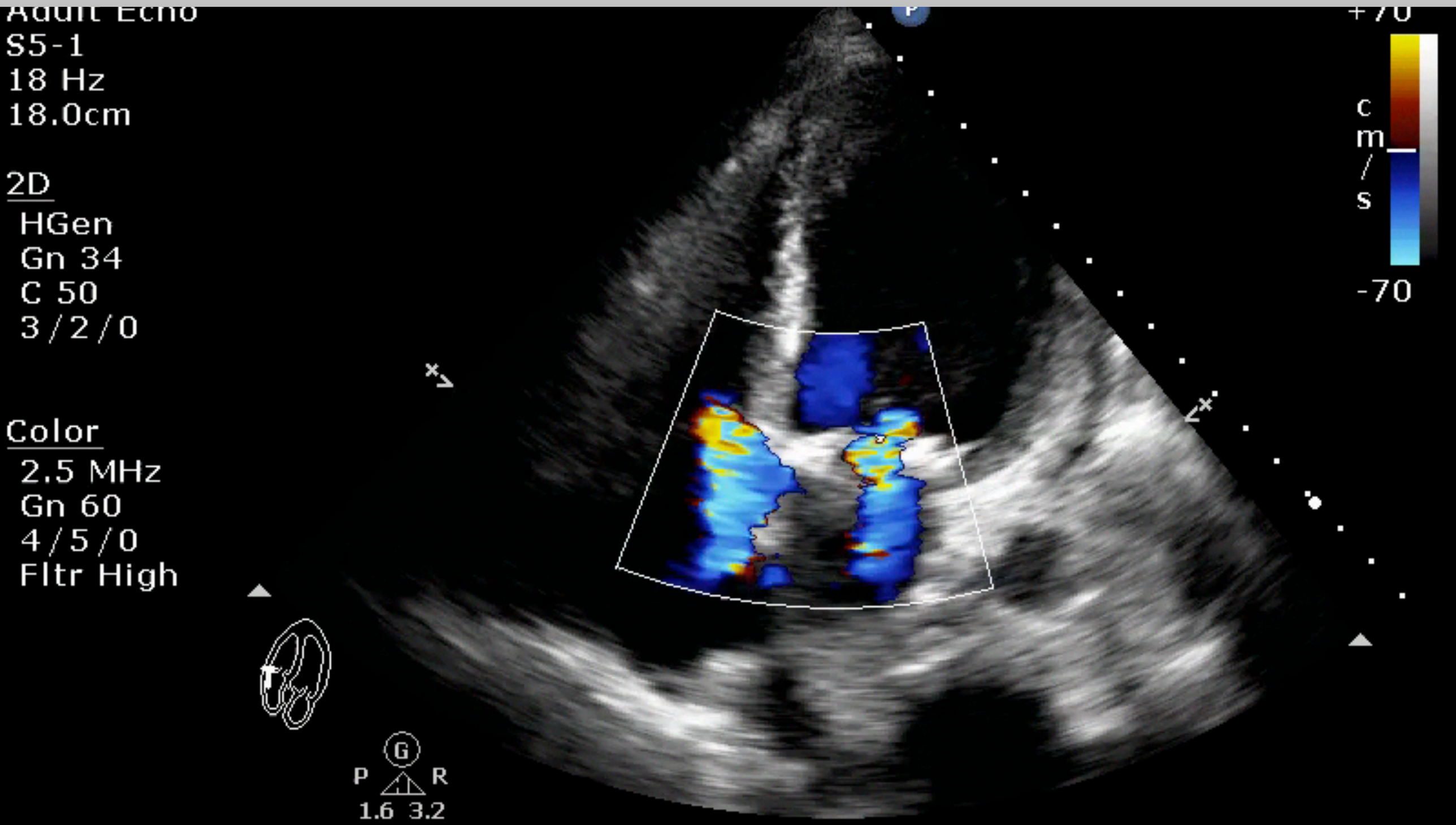




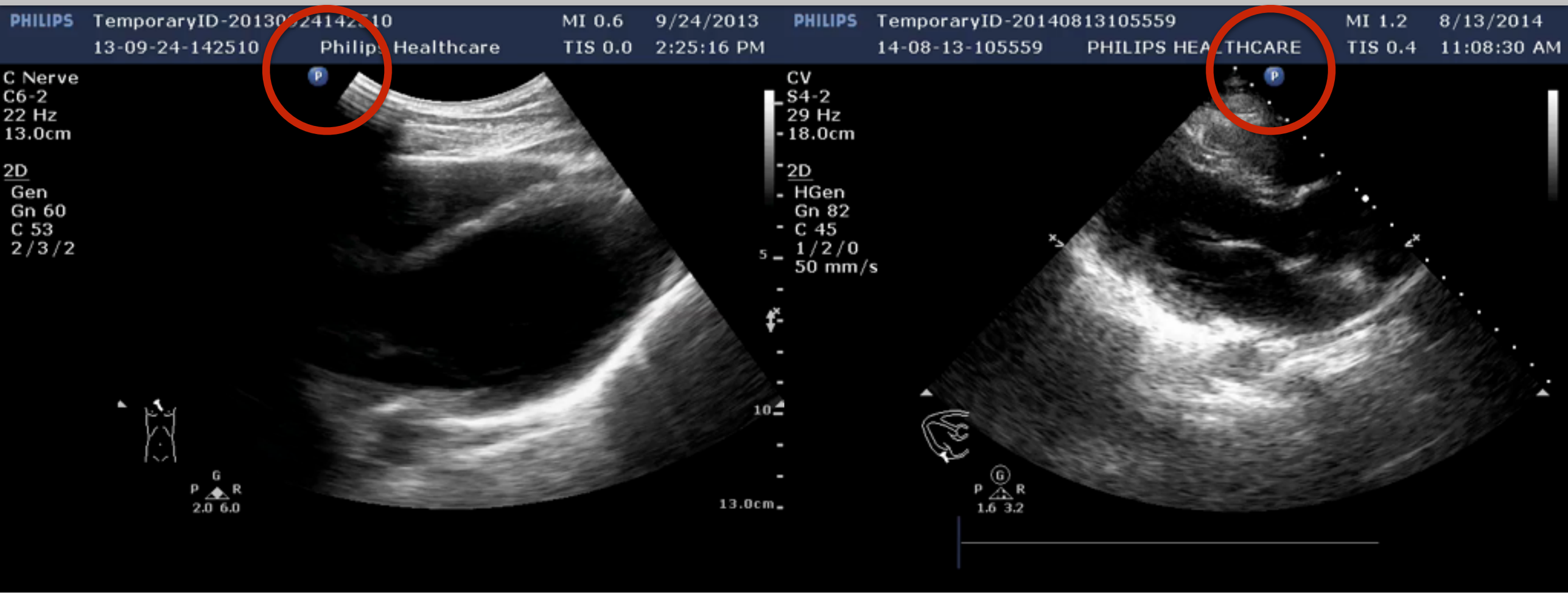
Stroke with R weakness

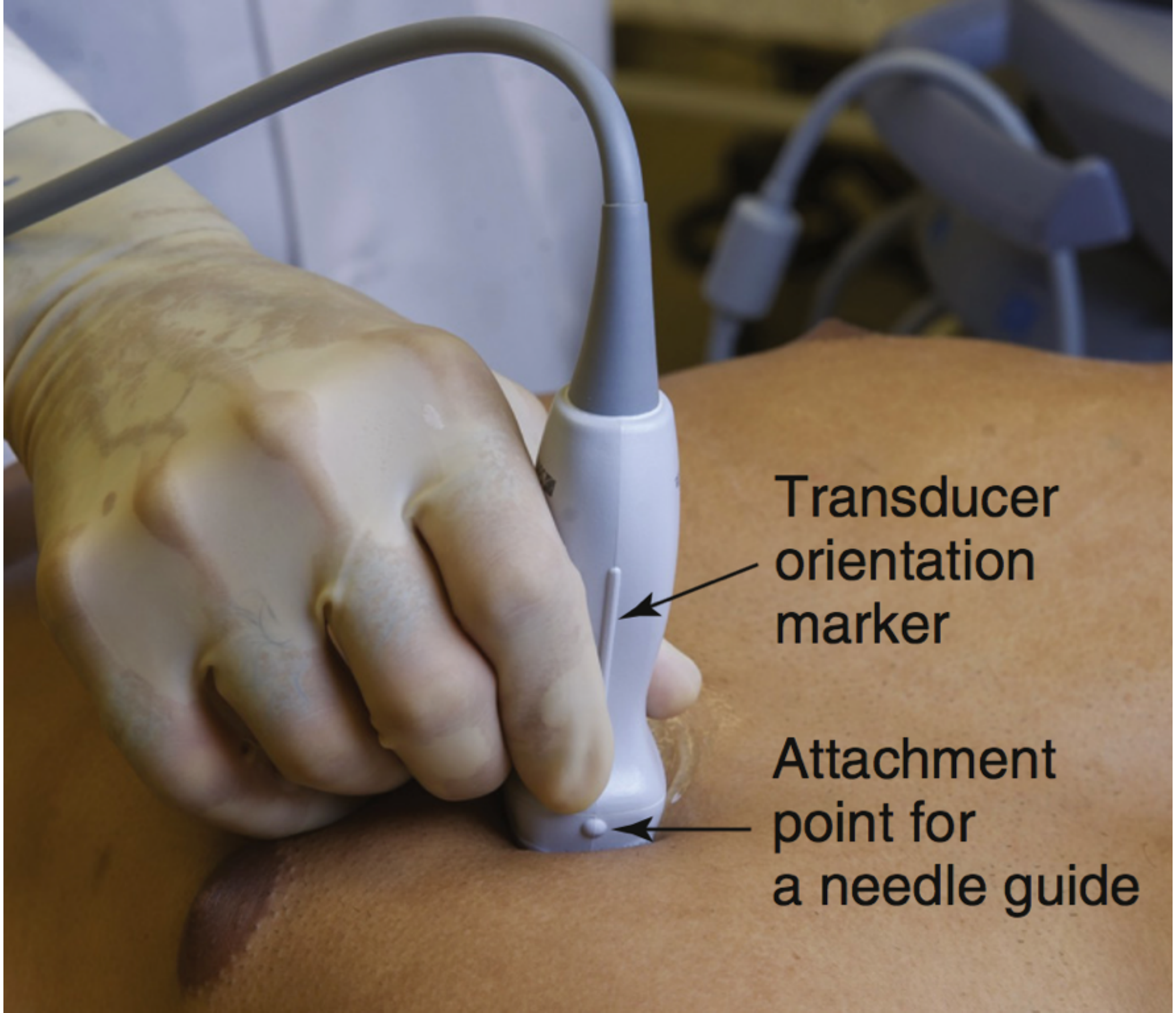


Color Doppler with directions

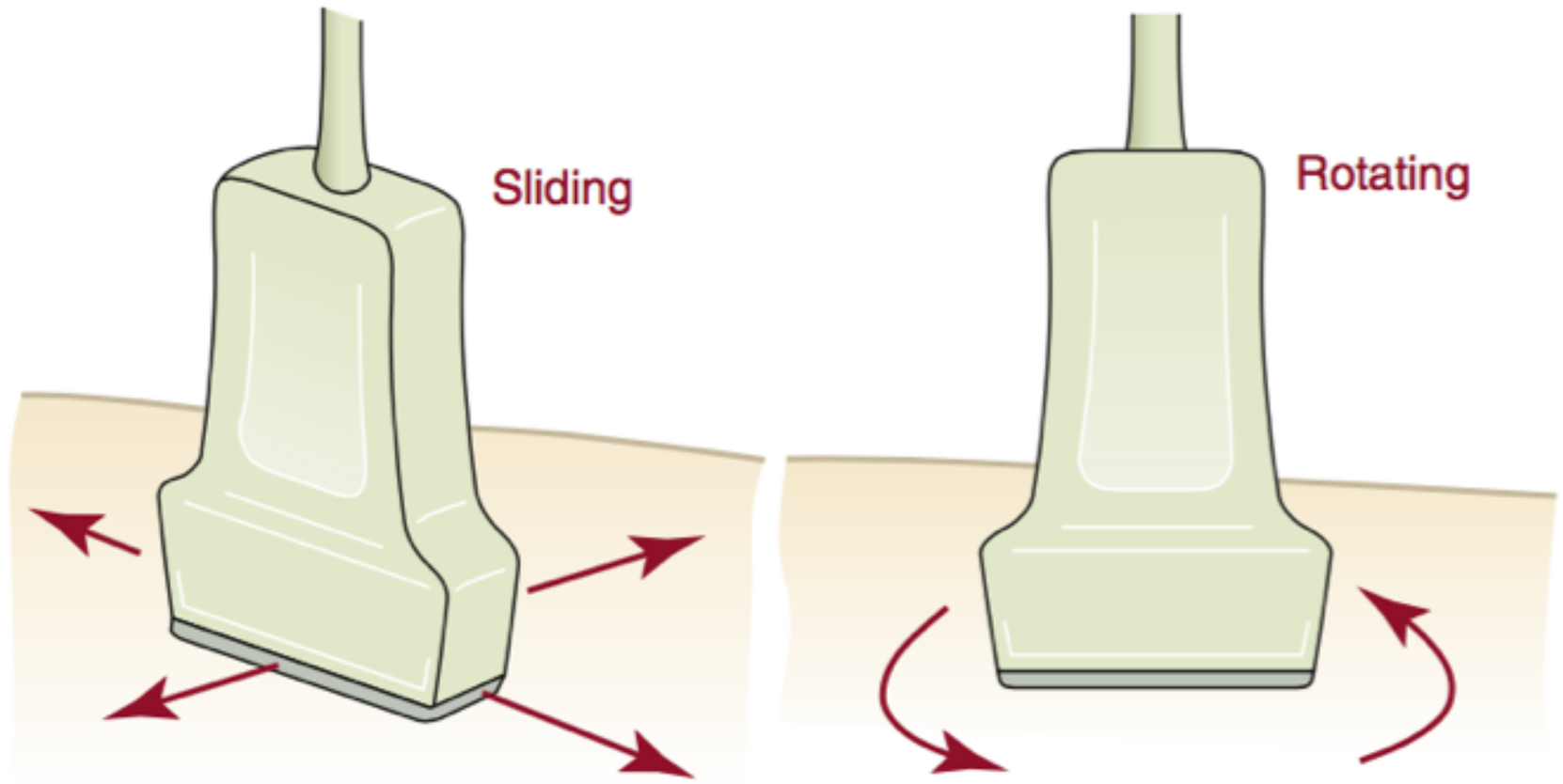


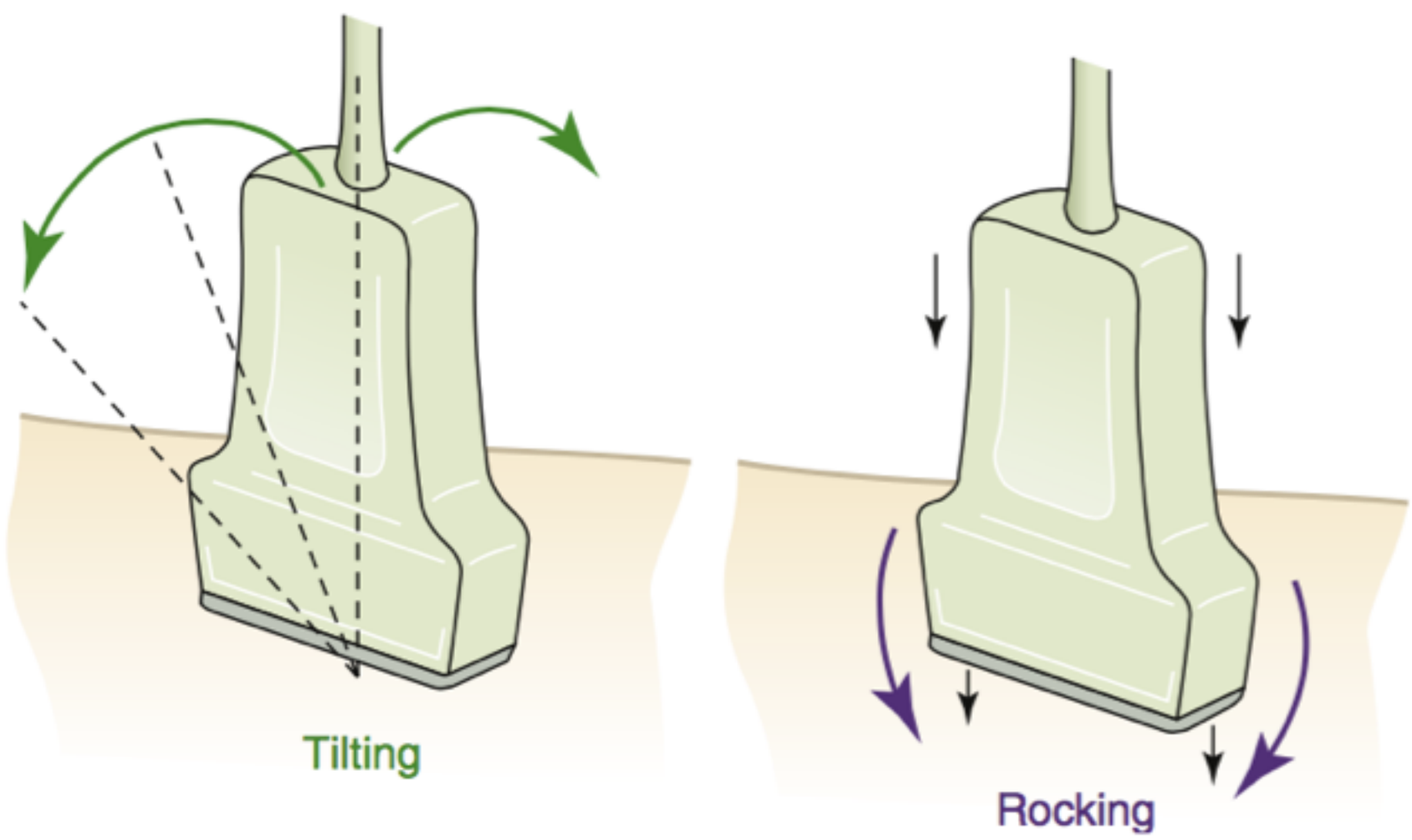
General v.s. Cardiac

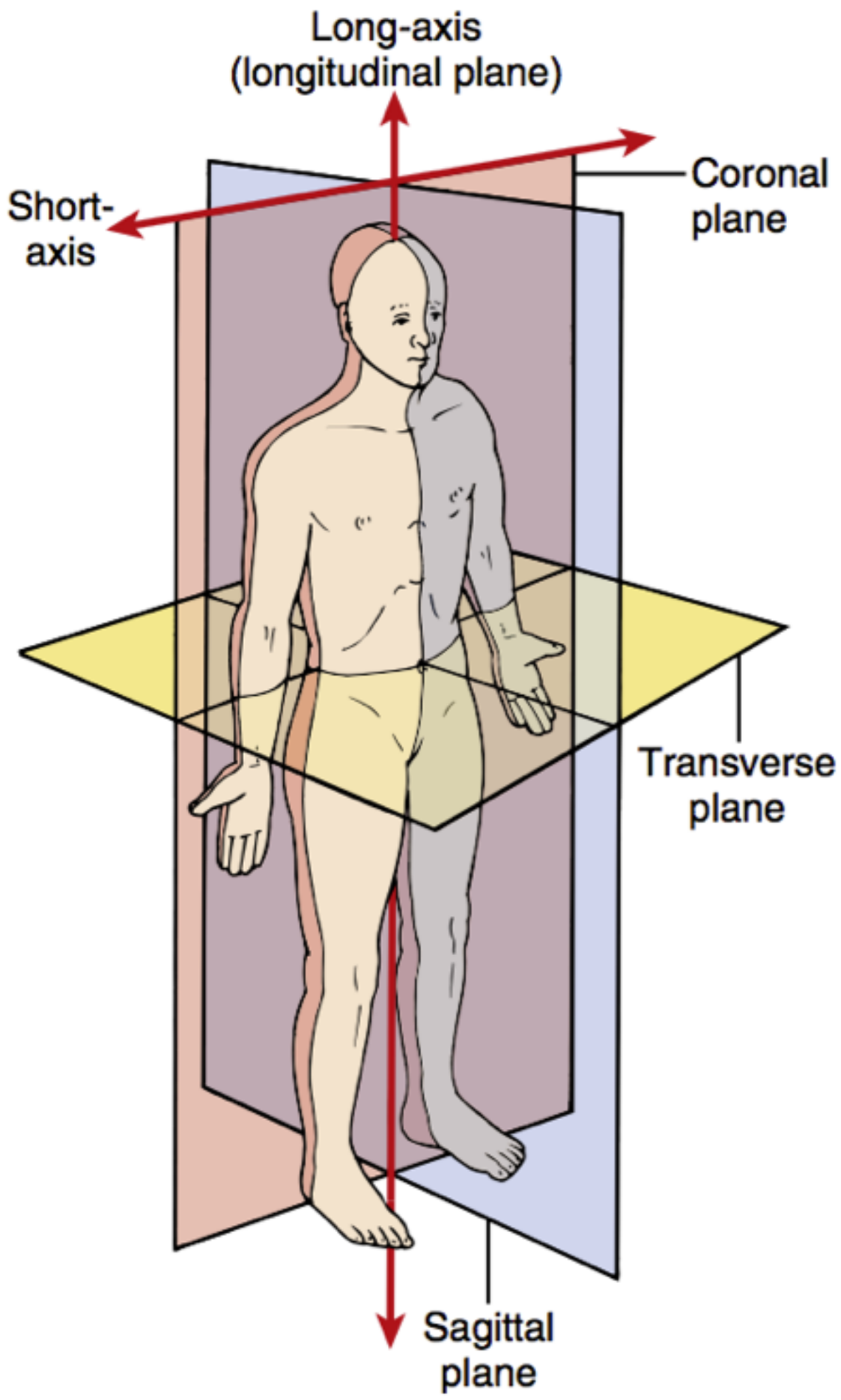



Transducer
orientation
marker
Attachment
point for
a needle guide

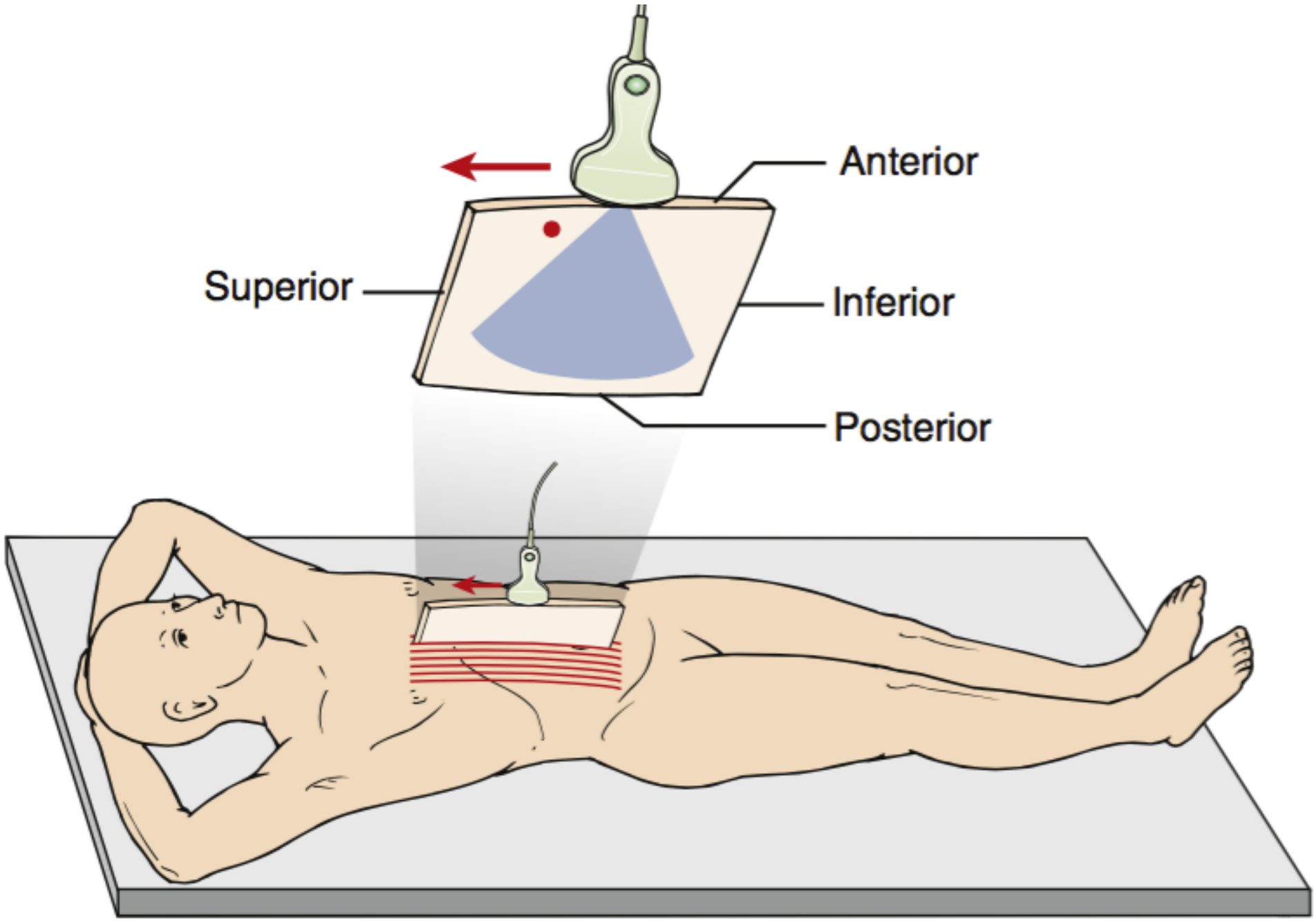
Transducer Movements



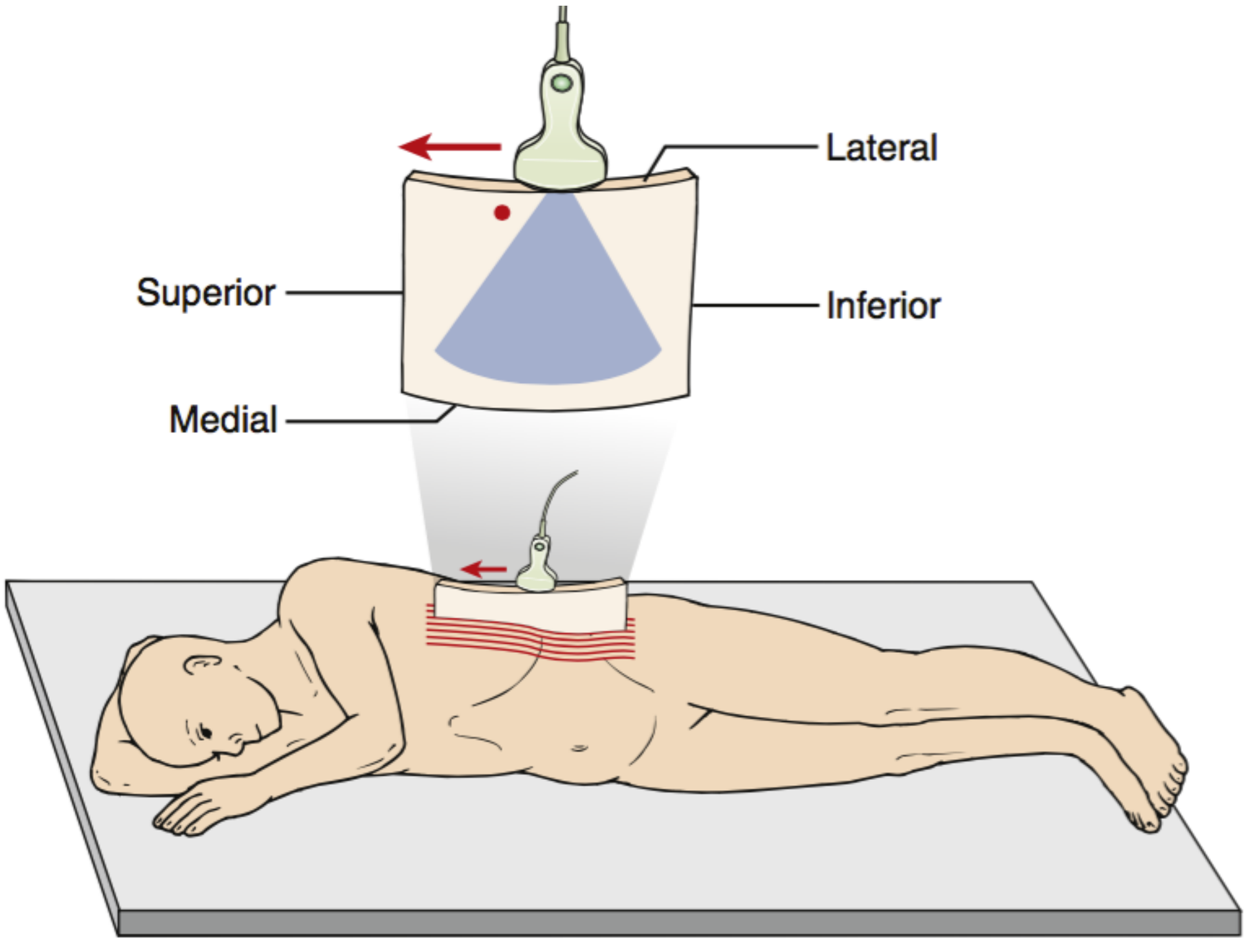



Long-axis
(longitudinal plane)
Short-
axis
Coronal
plane
Transverse
plane
Sagittal
plane

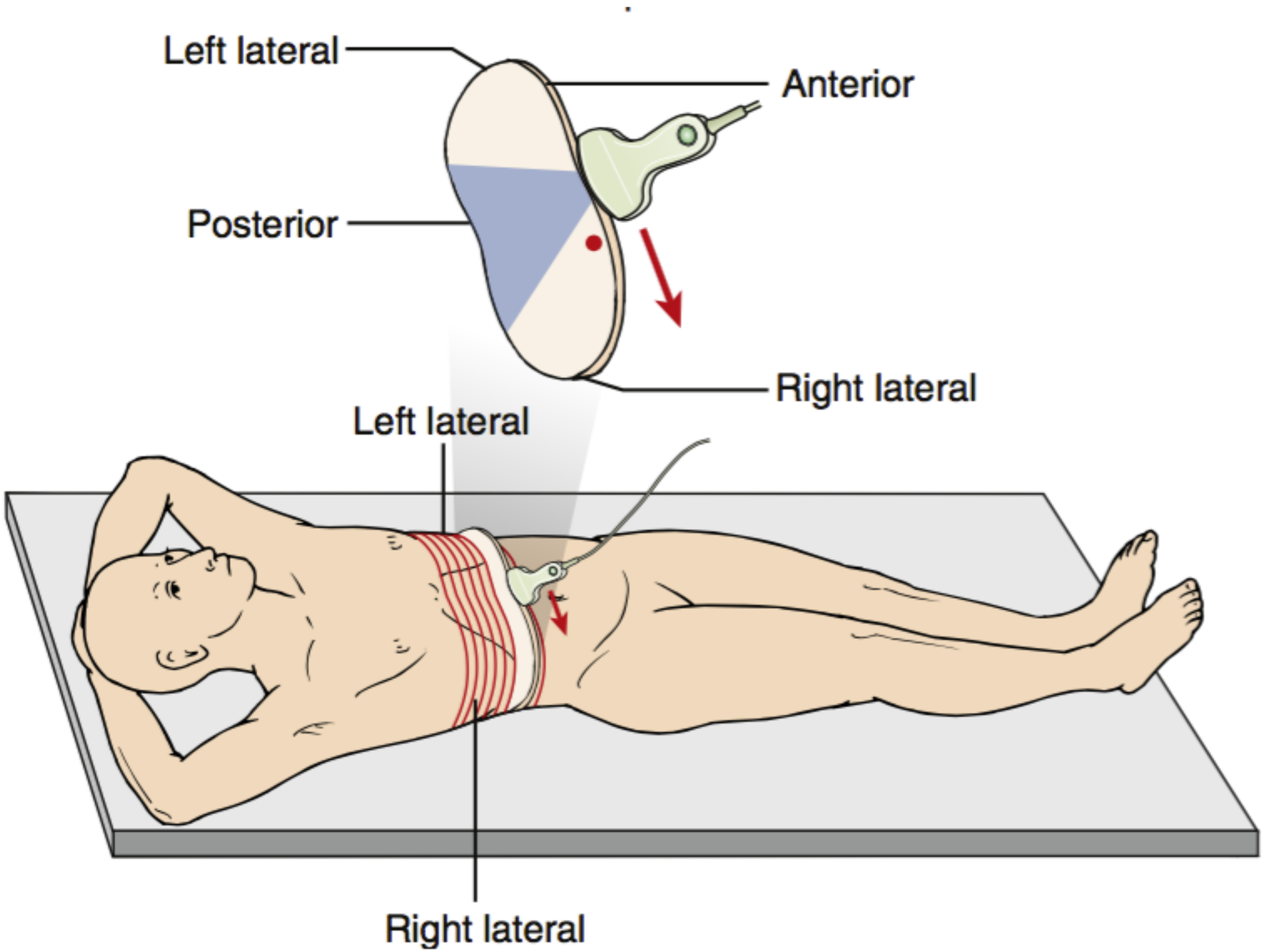
Plane ?



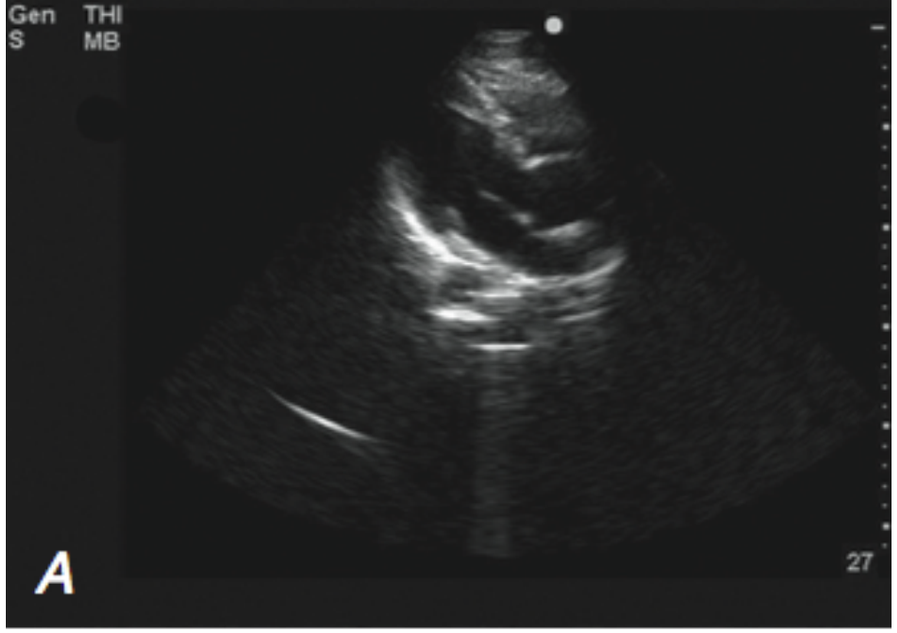
Plane ?

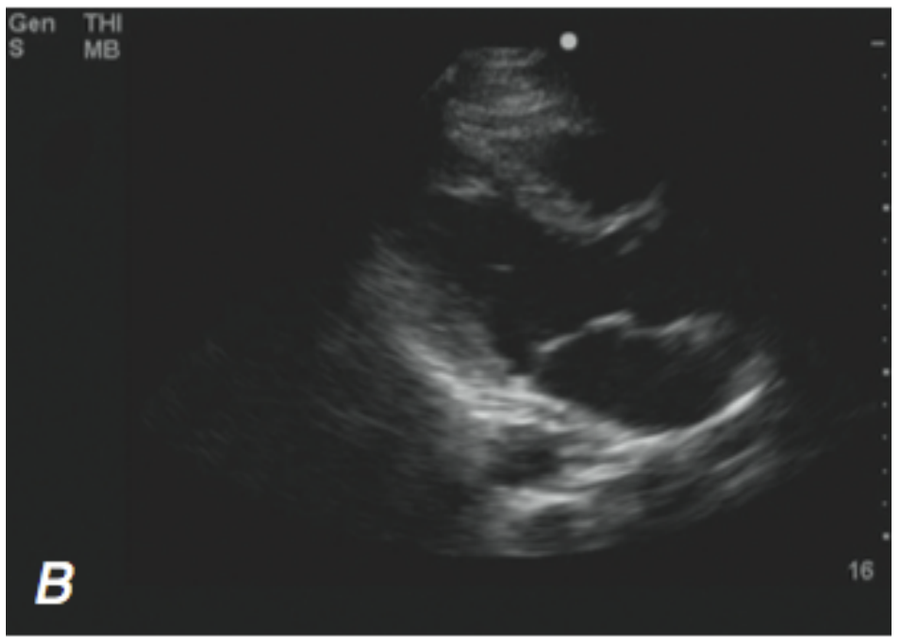


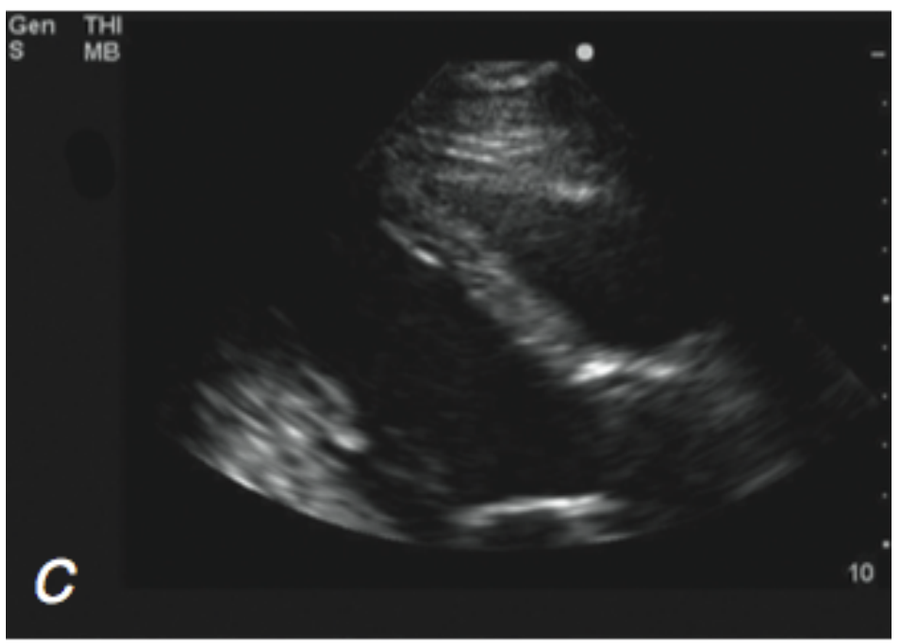
Plane ?


Left lateral
Anterior
Posterior
Right lateral
Left lateral
Right lateral

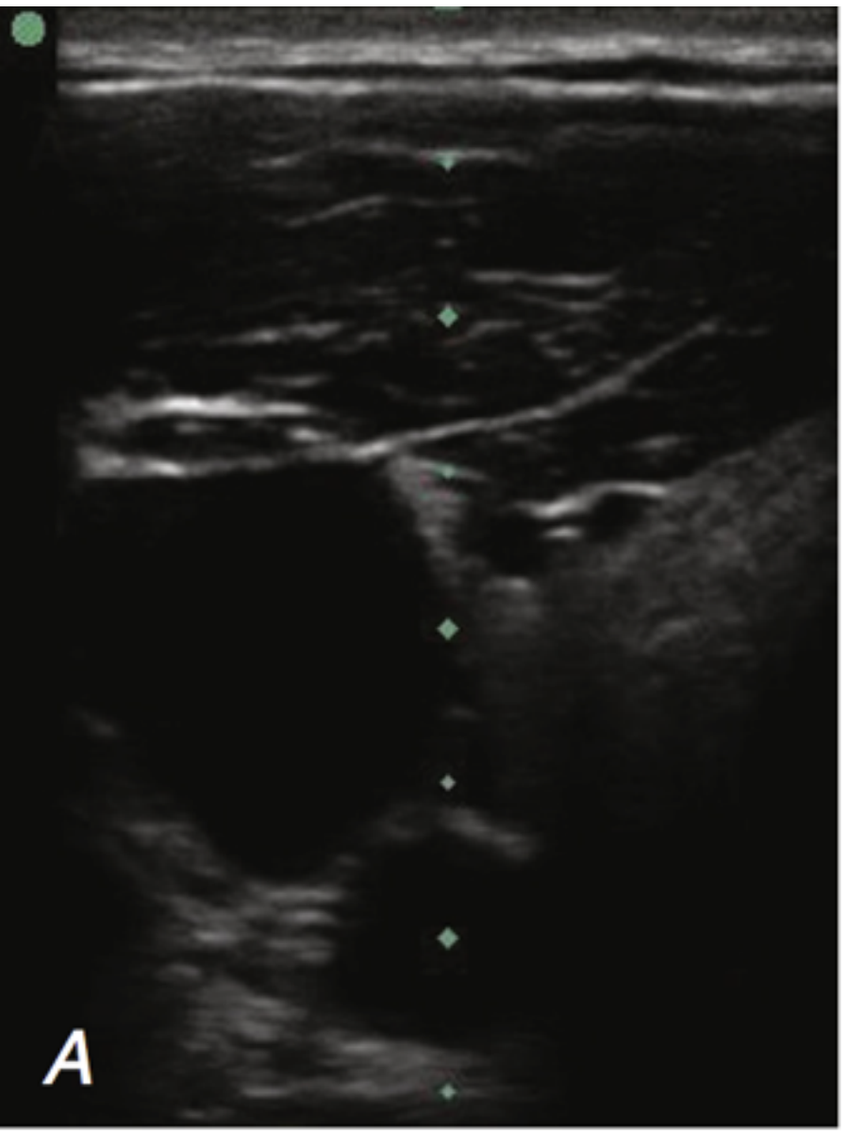
Best ?

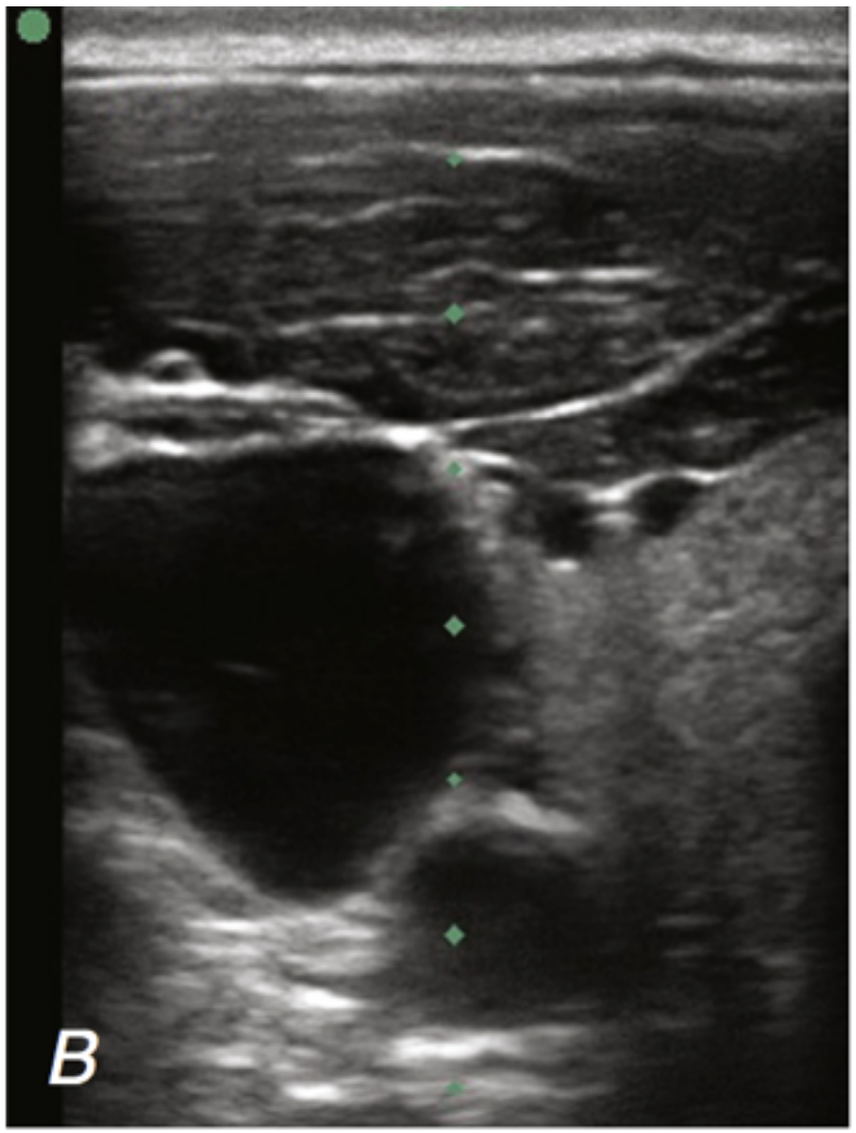


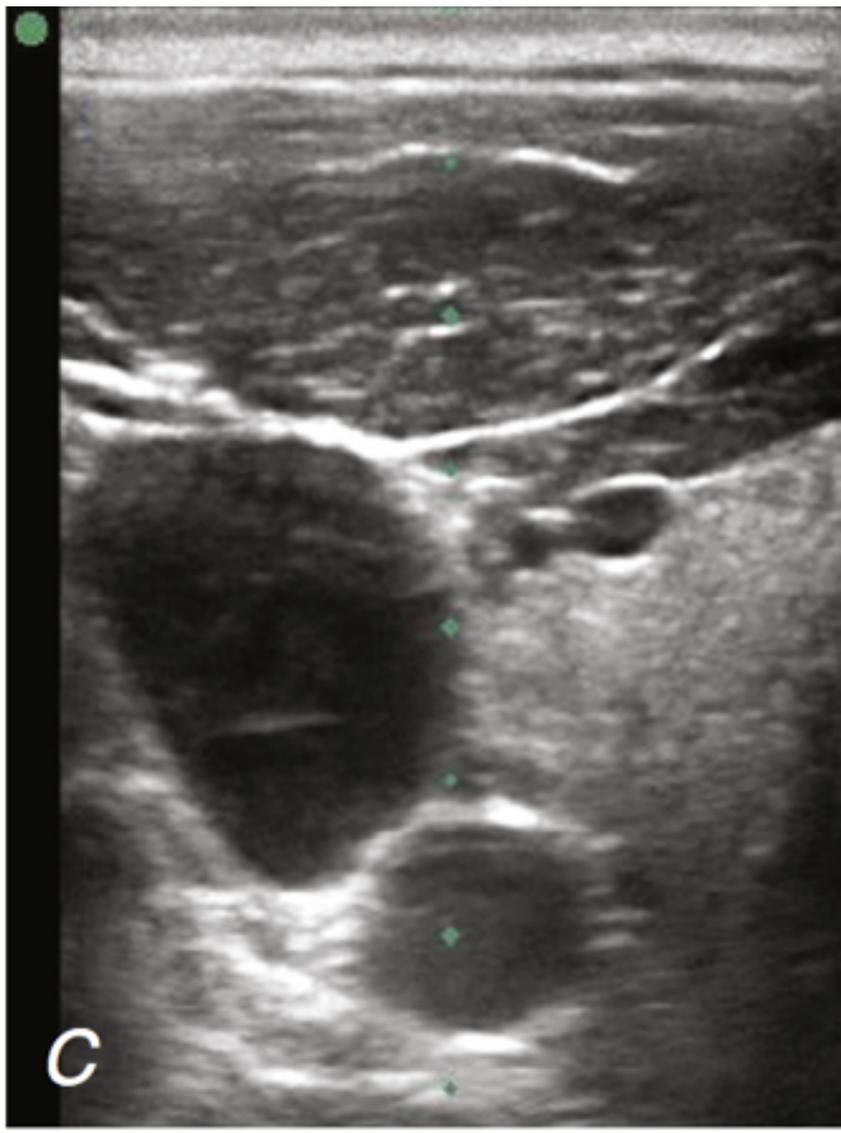




Best gain ?

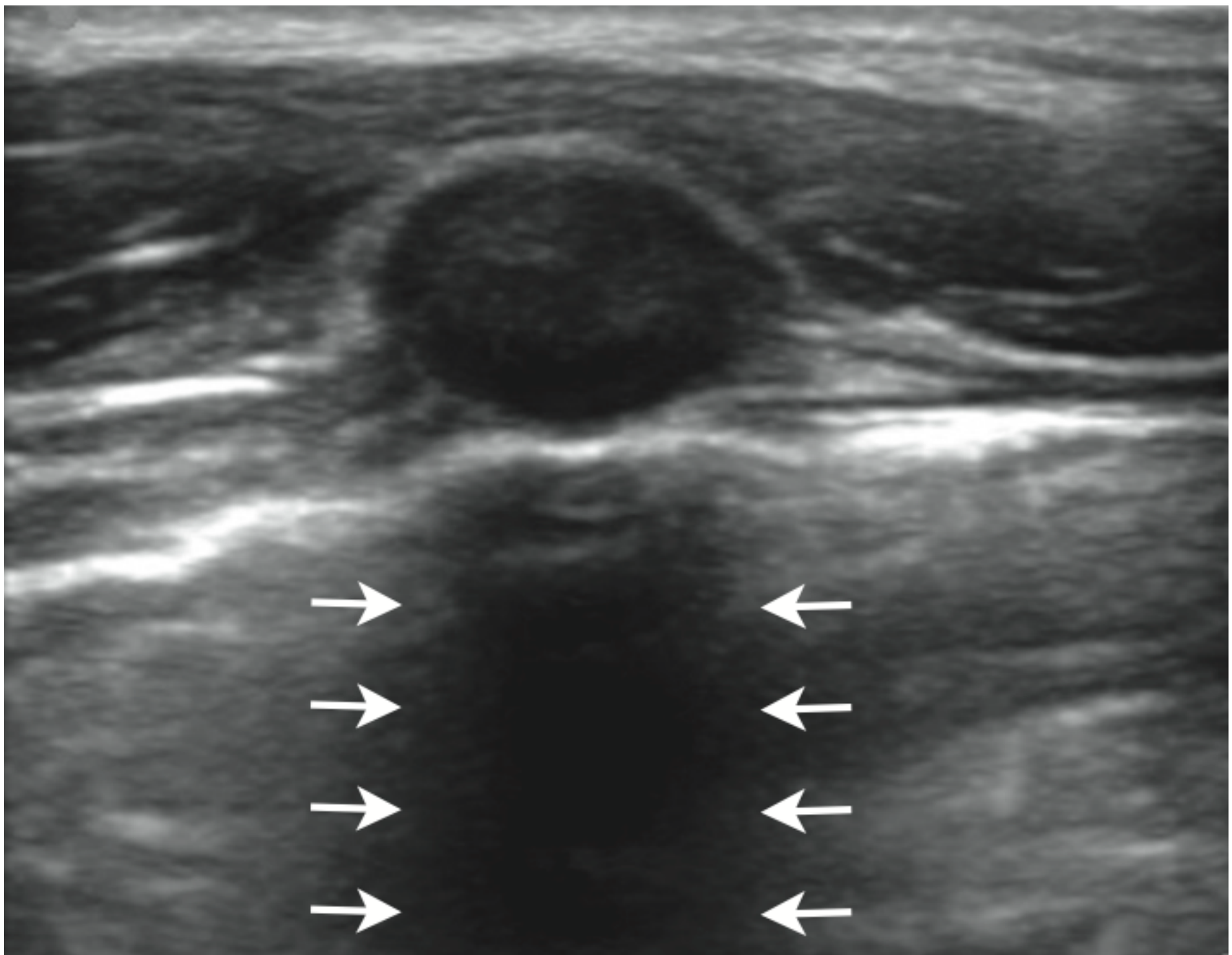




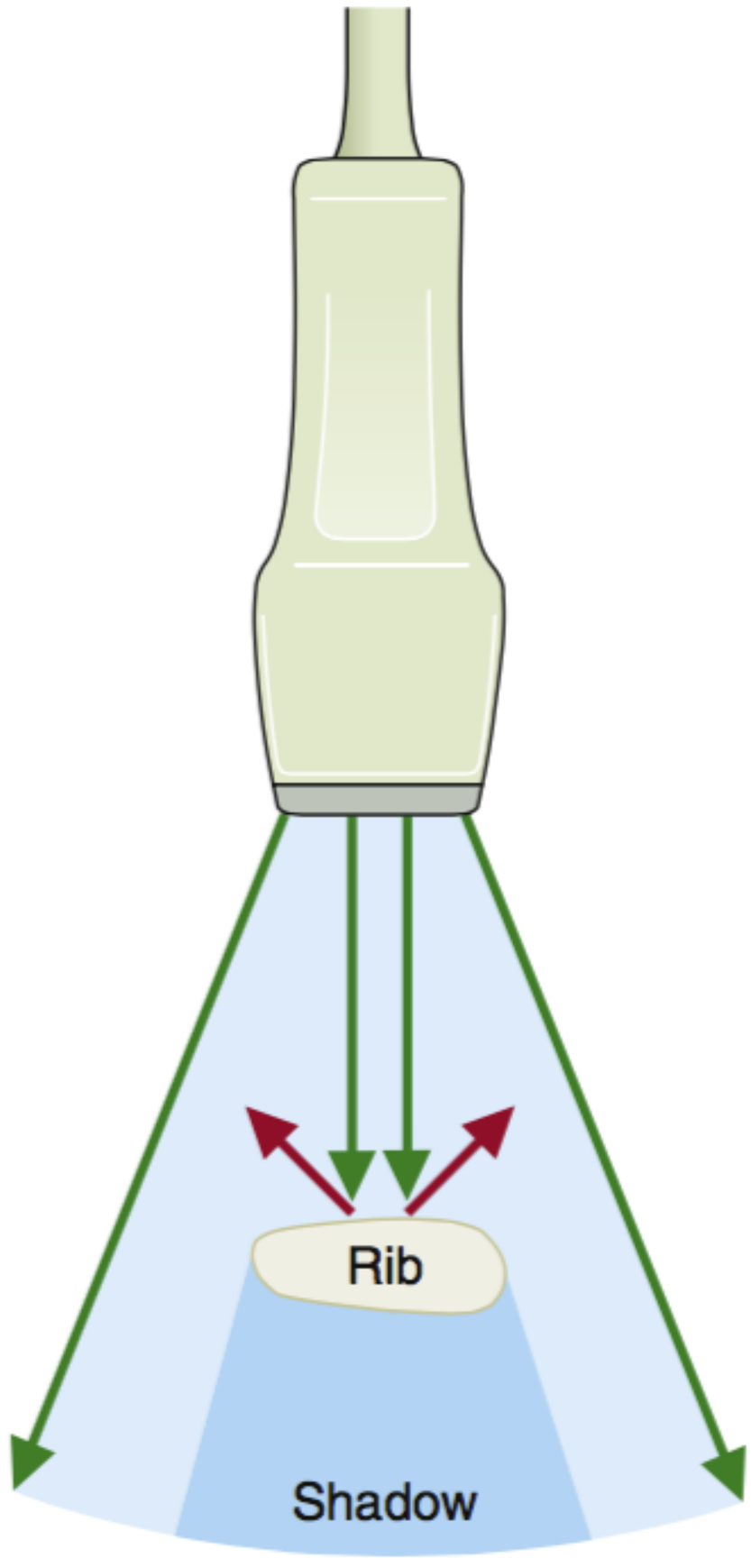


彩色
放大
深度
聚焦
計算
打字
測量
確認
動態模式
血流
儲存
雙畫面
凍結畫面
列印

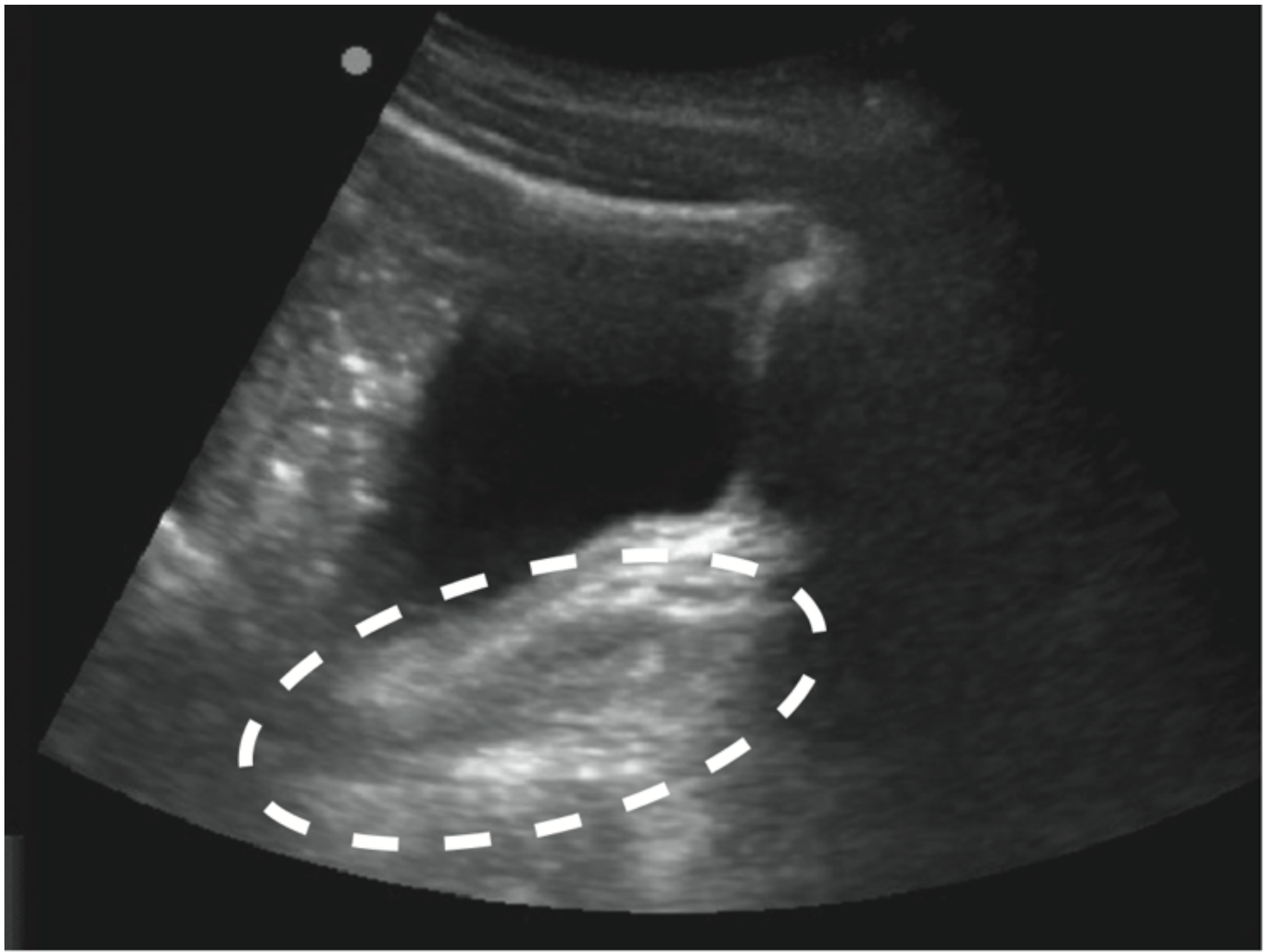
Artifact ?



Acoustic shadowing



Artifact ?



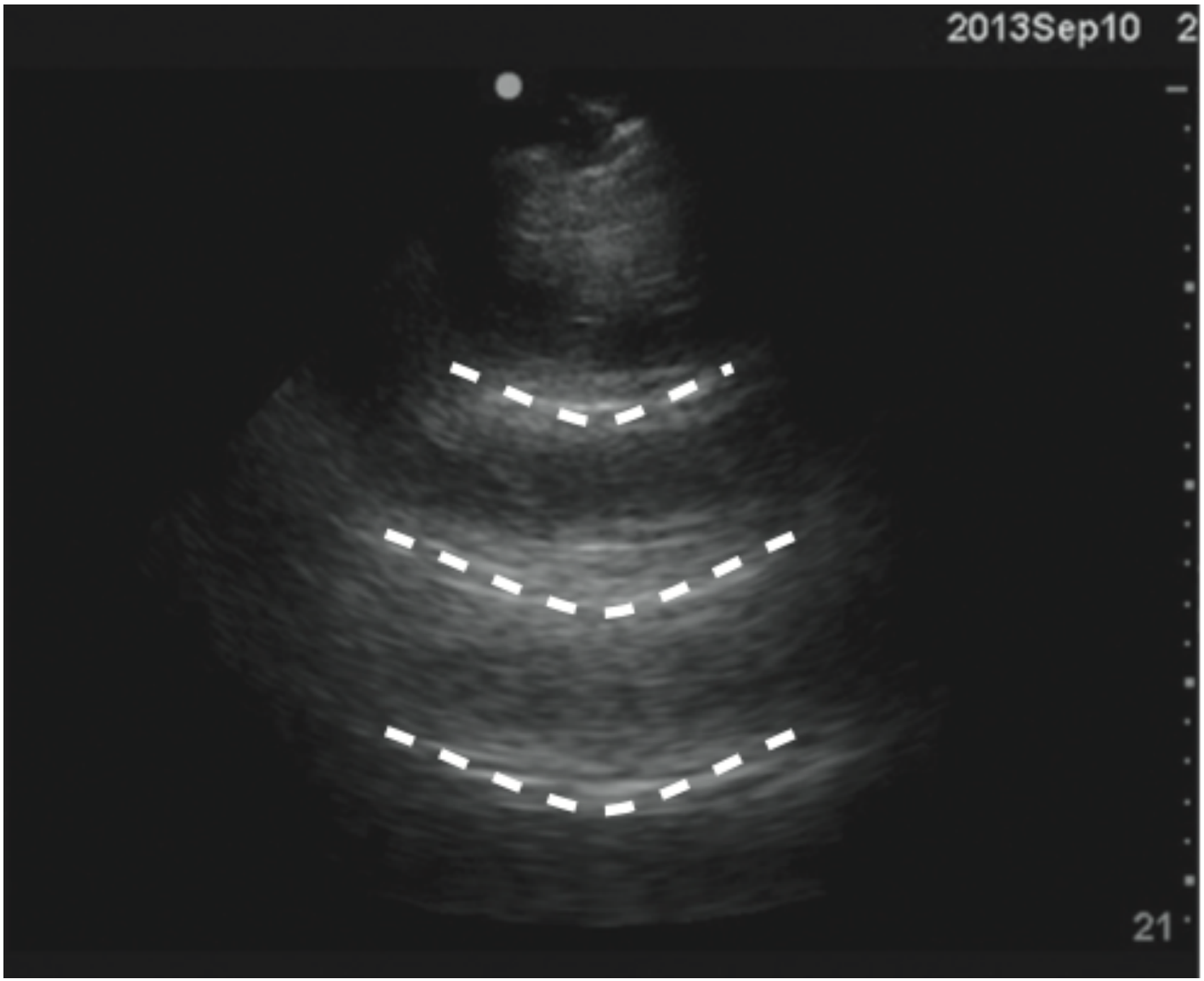
Soft
tissue

Attenuation

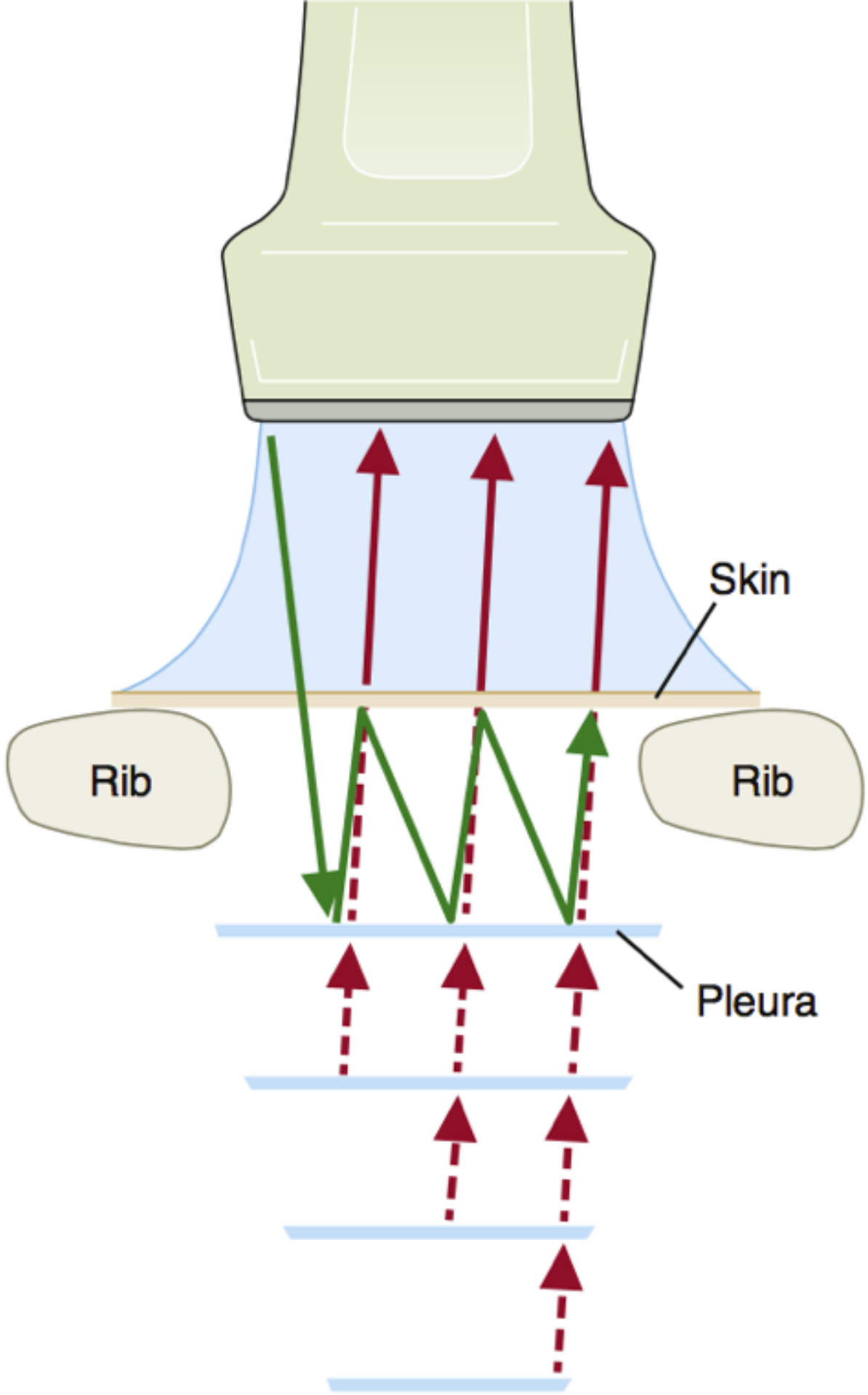
Fliud

Acoustic
enhancement

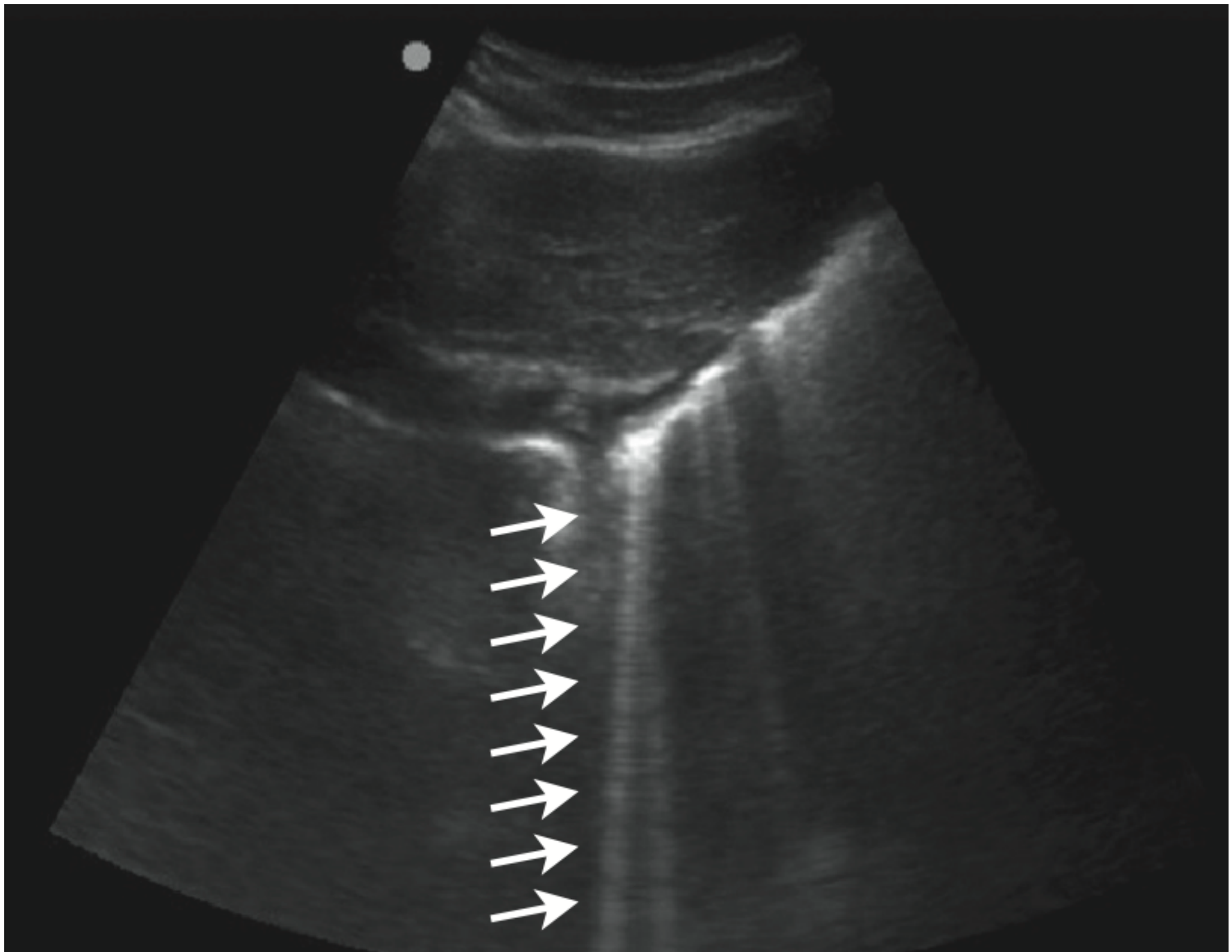
Artifact ?



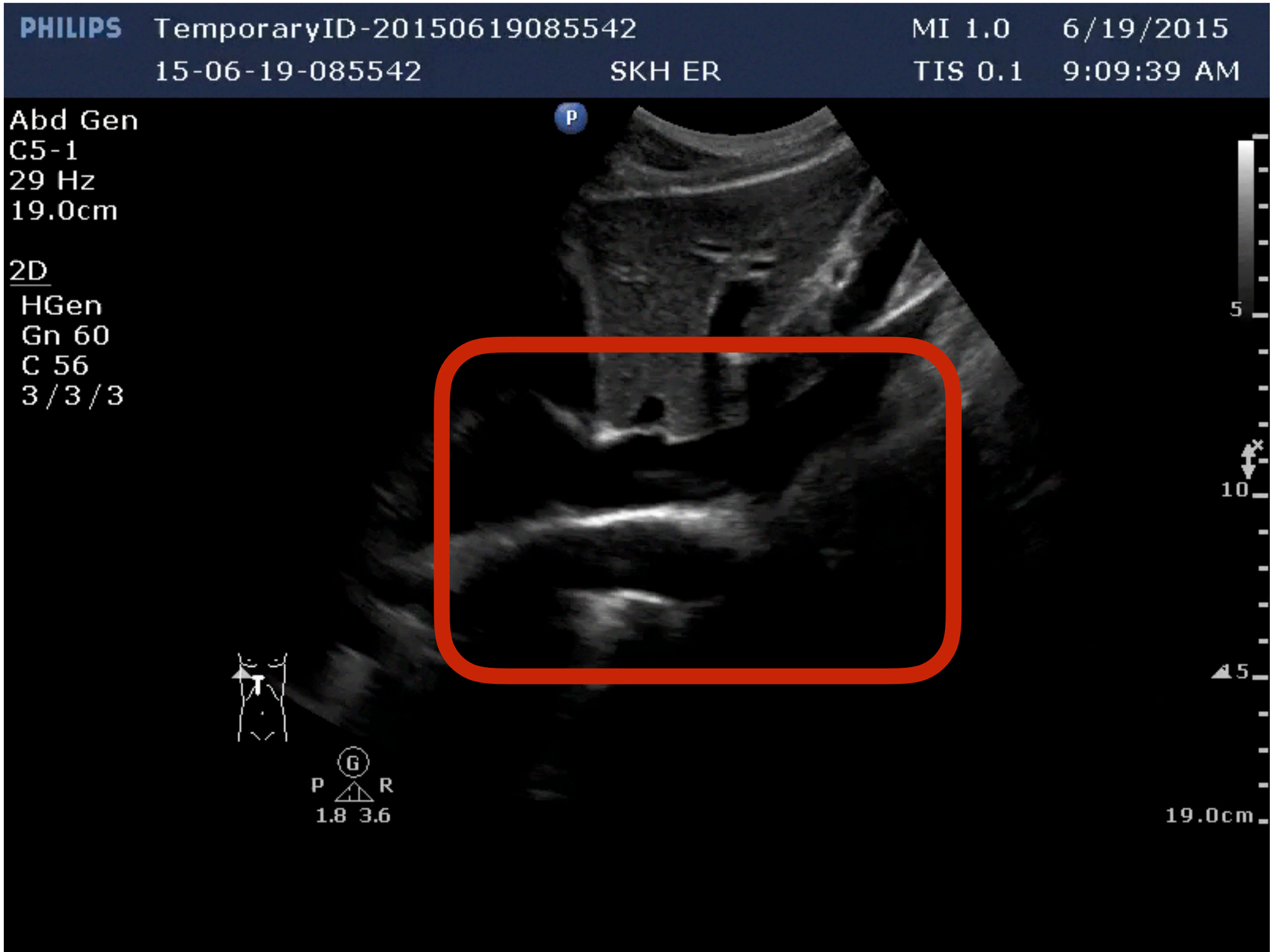
Reverberation

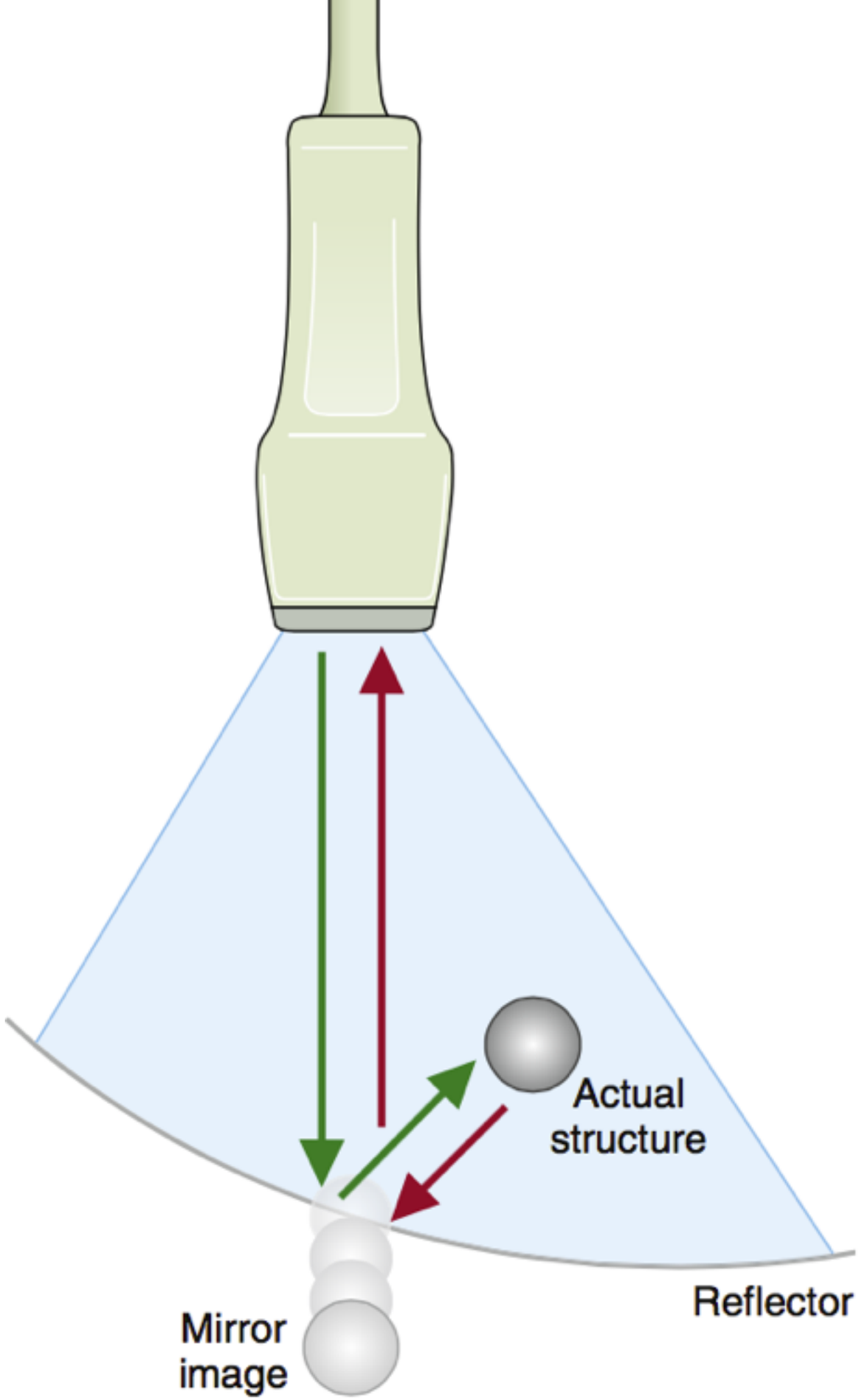


Ring-down artifact

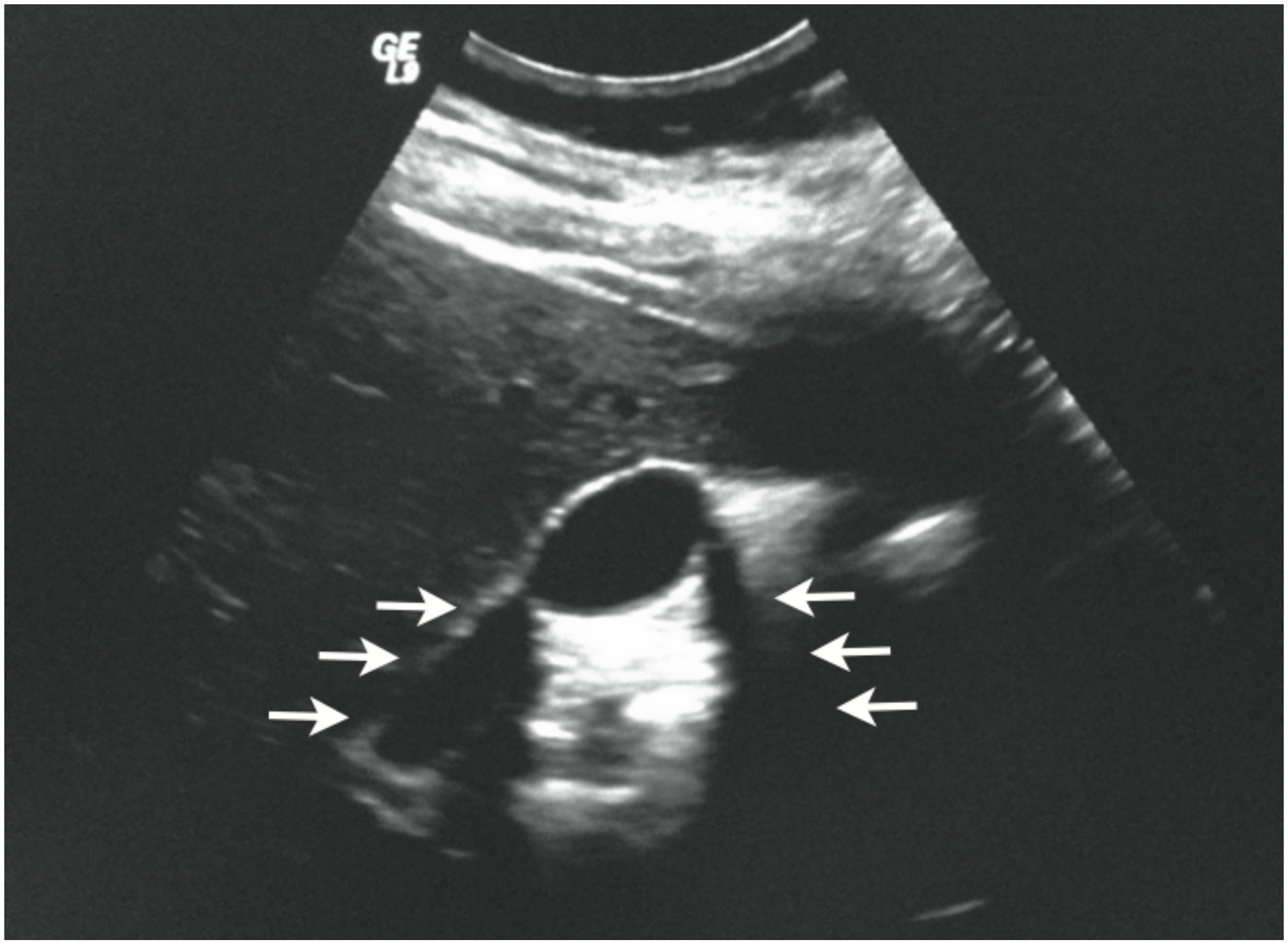


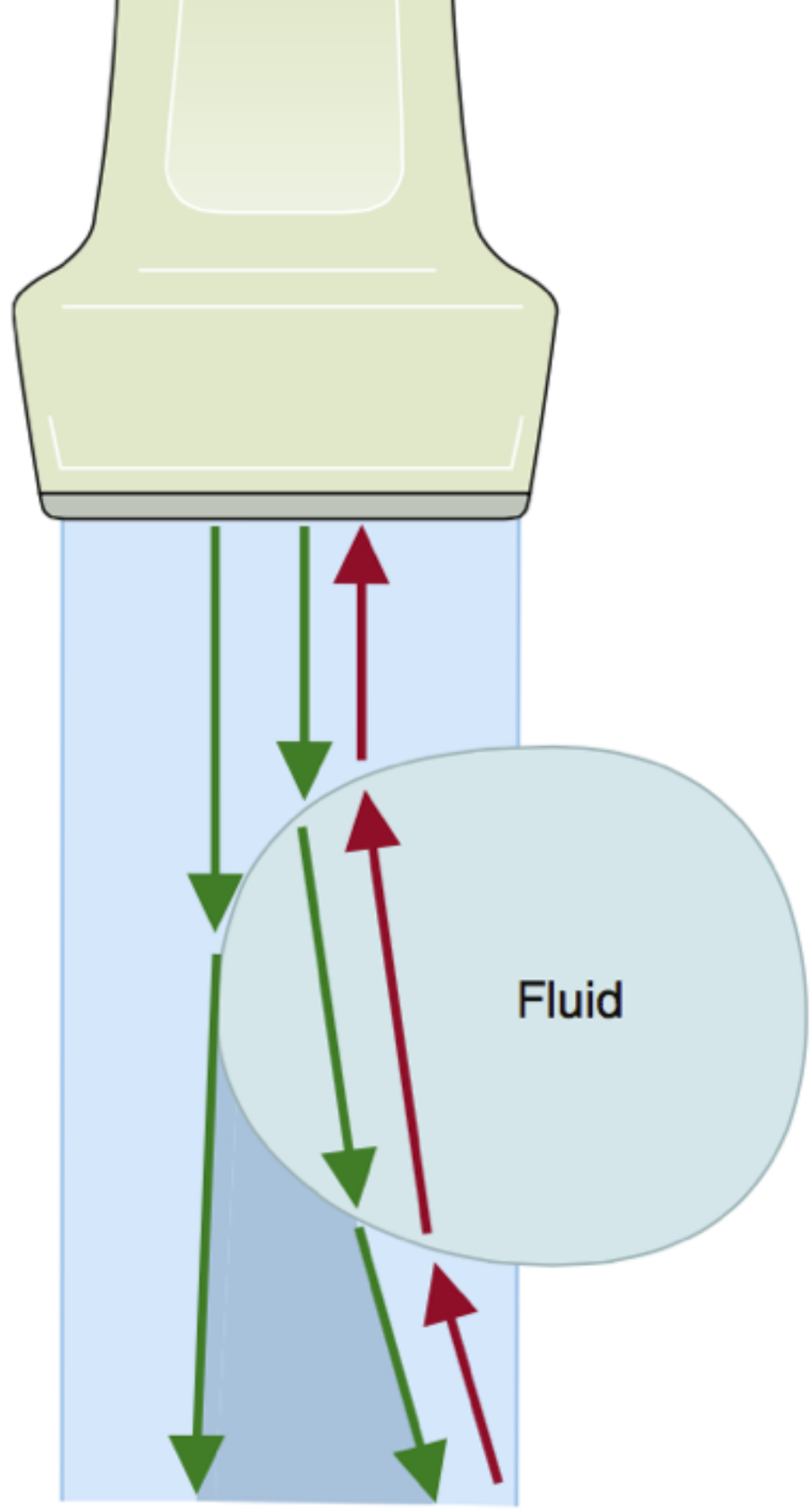
Artifact ?


PHILIPS
TemporaryID-20150619085542
MI 1.0
6/19/2015
15-06-19-085542
SKH ER
TIS 0.1
9:09:39 AM
Abd Gen
C5-1
29 Hz
19.0cm
2D
HGen
Gn 60
C 56
3/3/3
P
5
10
5
19.0cm
G
P
R
1.8 3.6


Actual
structure
Reflector
Mirror
image

Artifact ?




Fluid
Edge
shadow

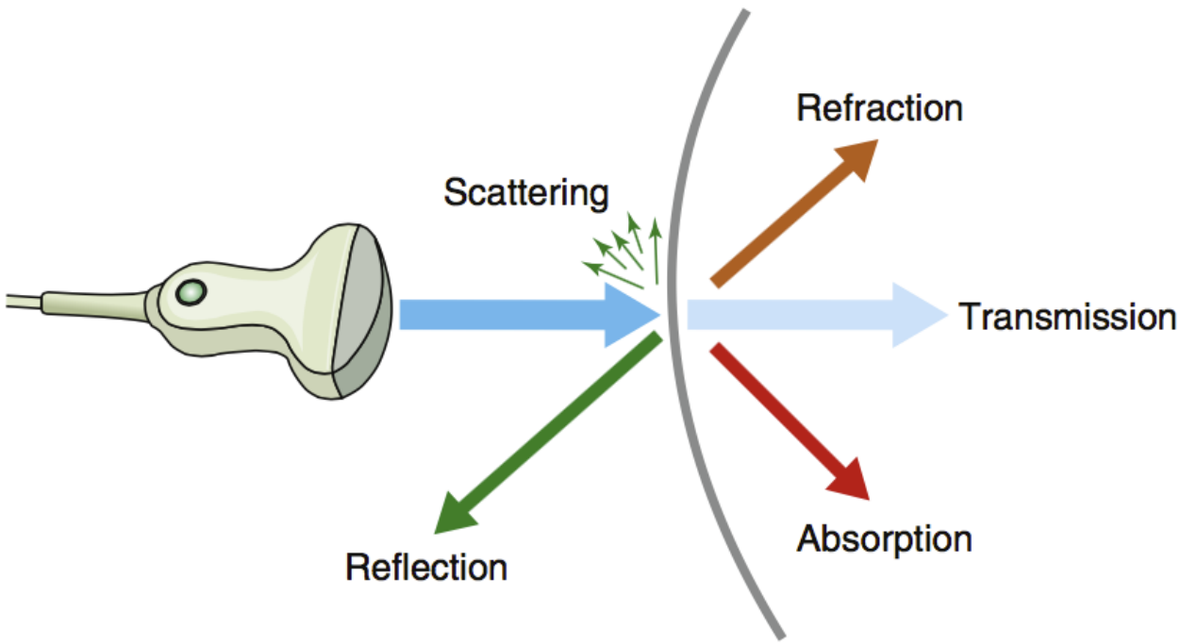
Probes

Knobs


15.0cm
Off
2D Size
L/R Invert
U/D Invert
Loop Type Time
Loop Time 3 secs
Harmonics On
2D Opt High
Focal Zones 1
XRES On
SonoCT On
Res/Speed 51
PureWave
Patient
Transdcr
Preset
Review
Report
End Exam
Physio
Hide ID
Protocol
Setup
Help

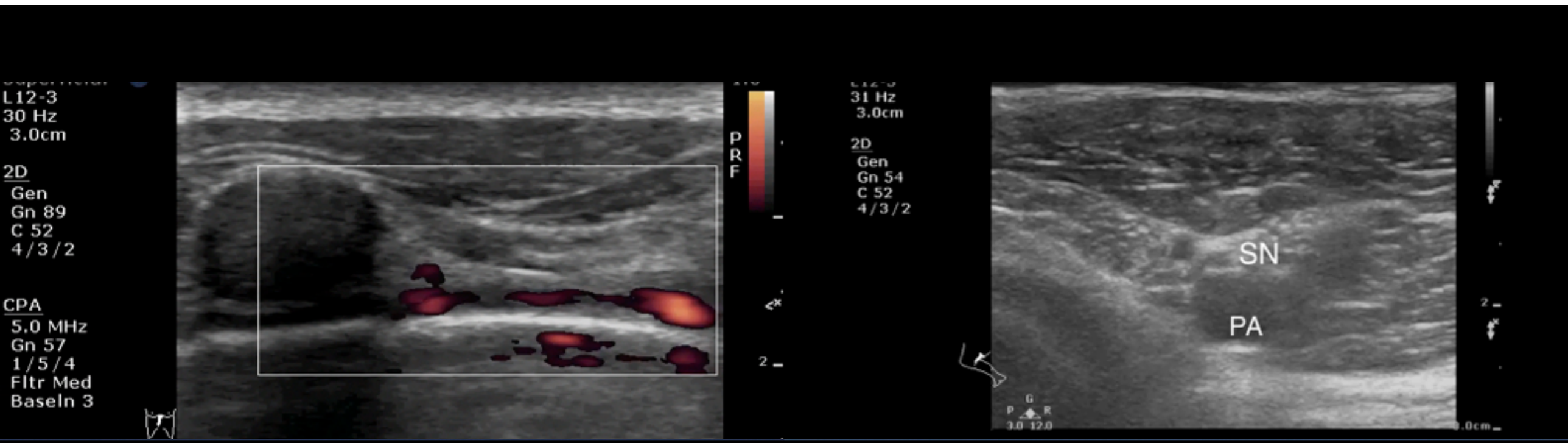

Tab
Caps Lock
Shift
Esc
Ctrl
Alt
Ins
Del
彩色
放大
深度
聚焦
計算
打字
測量
確認
自流
儲存
凍結畫面
列印
雙畫面

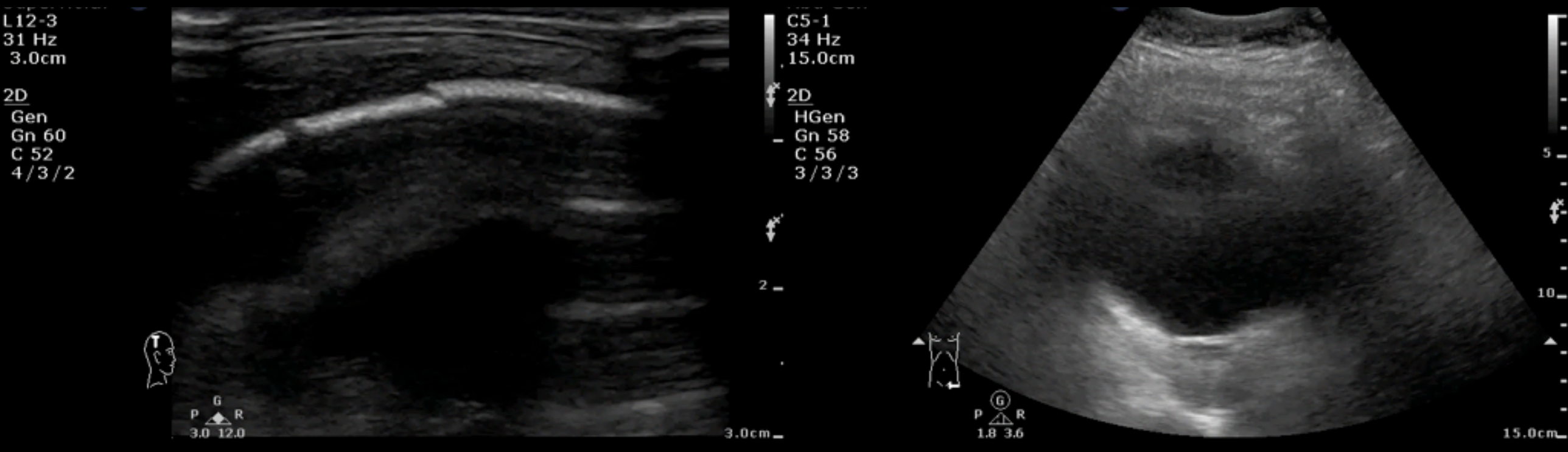
Physics



Impedance
Attenuation
Resolution
Mode
Doppler

Artifacts


L12-3
30 Hz
3.0cm
2D
Gen
Gn 89
C 52
4/3/2
CPA
5.0 MHz
Gn 57
1/5/4
Fltr Med
Baseln 3
PRF
31 Hz
3.0cm
2D
Gen
Gn 54
C 52
4/3/2
SN
PA
G
P R
3.0 12.0


L12-3
31 Hz
3.0cm
2D
Gen
Gn 60
C 52
4/3/2
G
P R
3.0 12.0
3.0cm
C5-1
34 Hz
15.0cm
2D
HGen
Gn 58
C 56
3/3/3
G
P R
1.8 3.6
15.0cm

POCUS Academy

Point-of-care ultrasound is the visual stethoscope in the 21st century

pocusacademy.com
juice119@gmail.com