

Common Mistakes with Doppler Waveform Interpretation

**Eighth Noninvasive Vascular Lab Symposium
Atlantic Health System
April 27, 2018
West Orange, New Jersey**

Susan Gustavson RVT RDMS

Common Mistakes with Doppler Waveform Interpretation

The interpreter should recognize the clues

Stenosis upstream or downstream

Asymmetry

CCA vs. ICA stenosis

Technical: Auto-trace and steering

The reader may or may not have all of the clues, but should use caution:

Technical: Steering, misaligned beam, attenuation, wall filter, scales, crosstalk, probe compression, SV location

Mirror and specular reflection

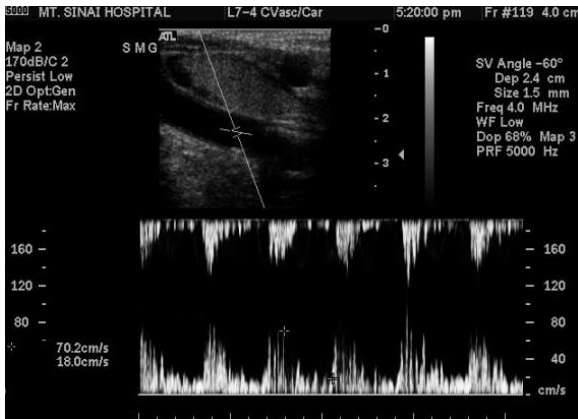
Tortuosity

Mistaken anatomy

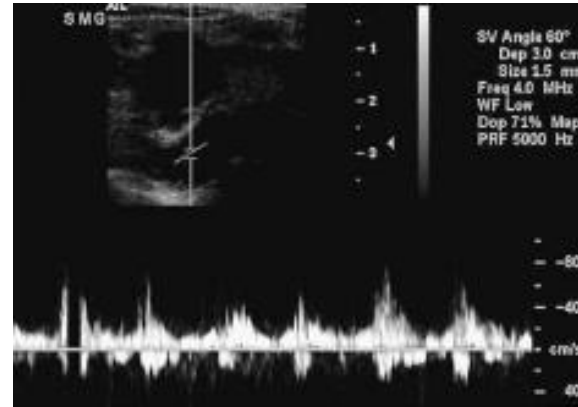
Occlusions, string signs, attenuation

Which statement is correct?

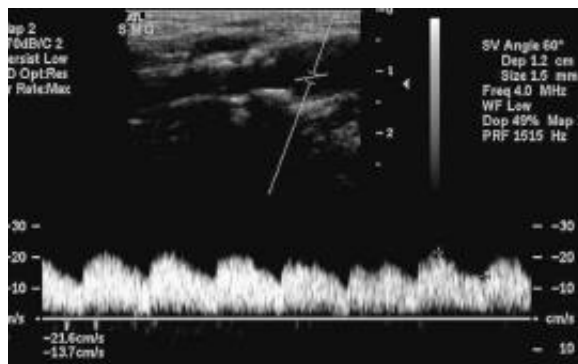
Right CCA Proximal



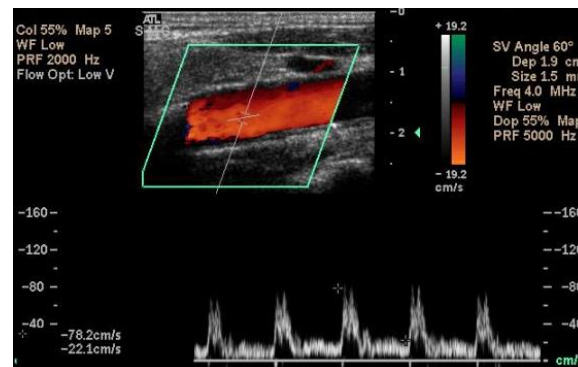
Right Subclavian Proximal



Right CCA Distal



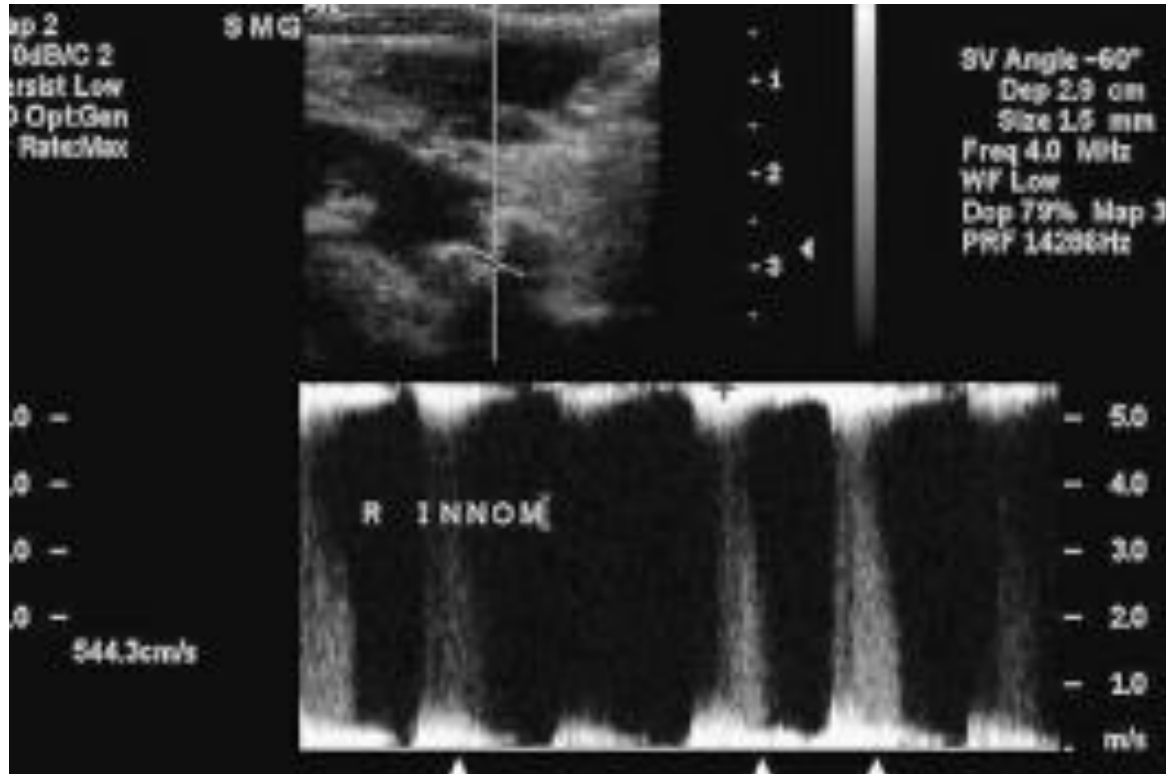
Left CCA Distal



1. Spontaneous right carotid dissection
2. Severe stenosis of the right proximal common carotid artery
3. Innominate artery stenosis
4. Giant cell arteritis
5. Aortic stenosis

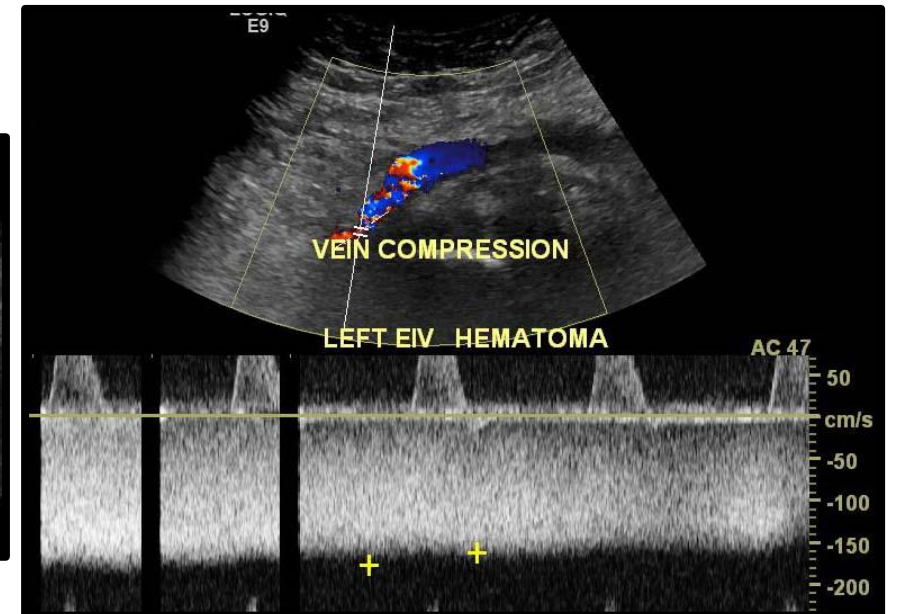
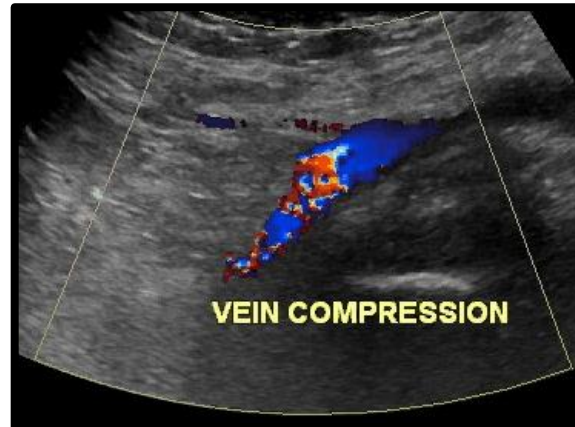
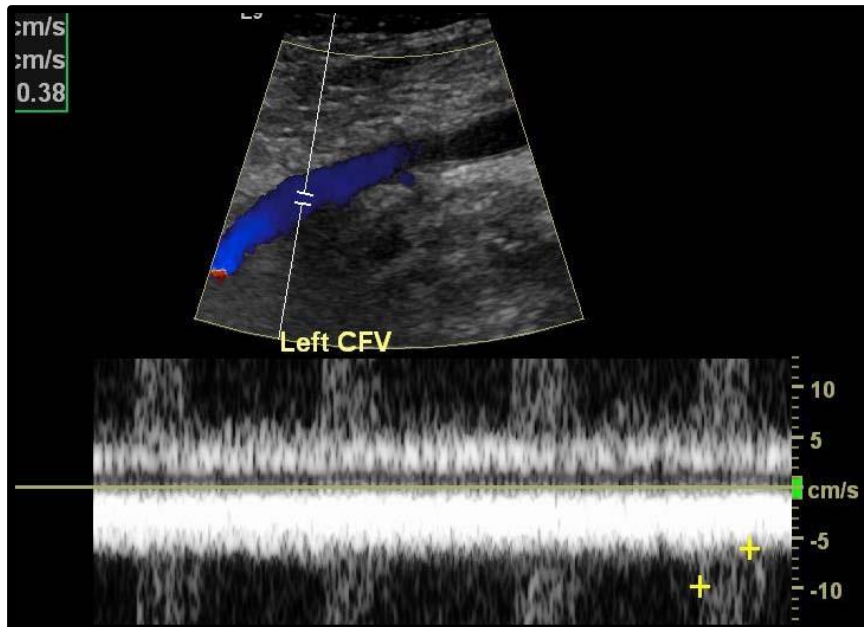
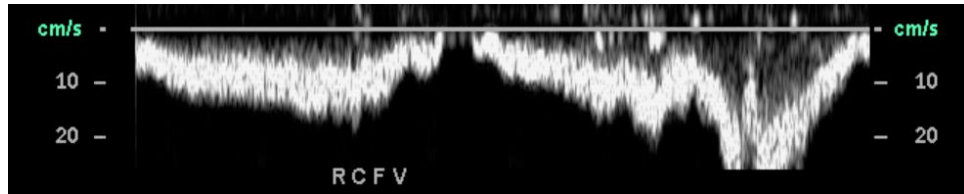
ANSWER

Innominate



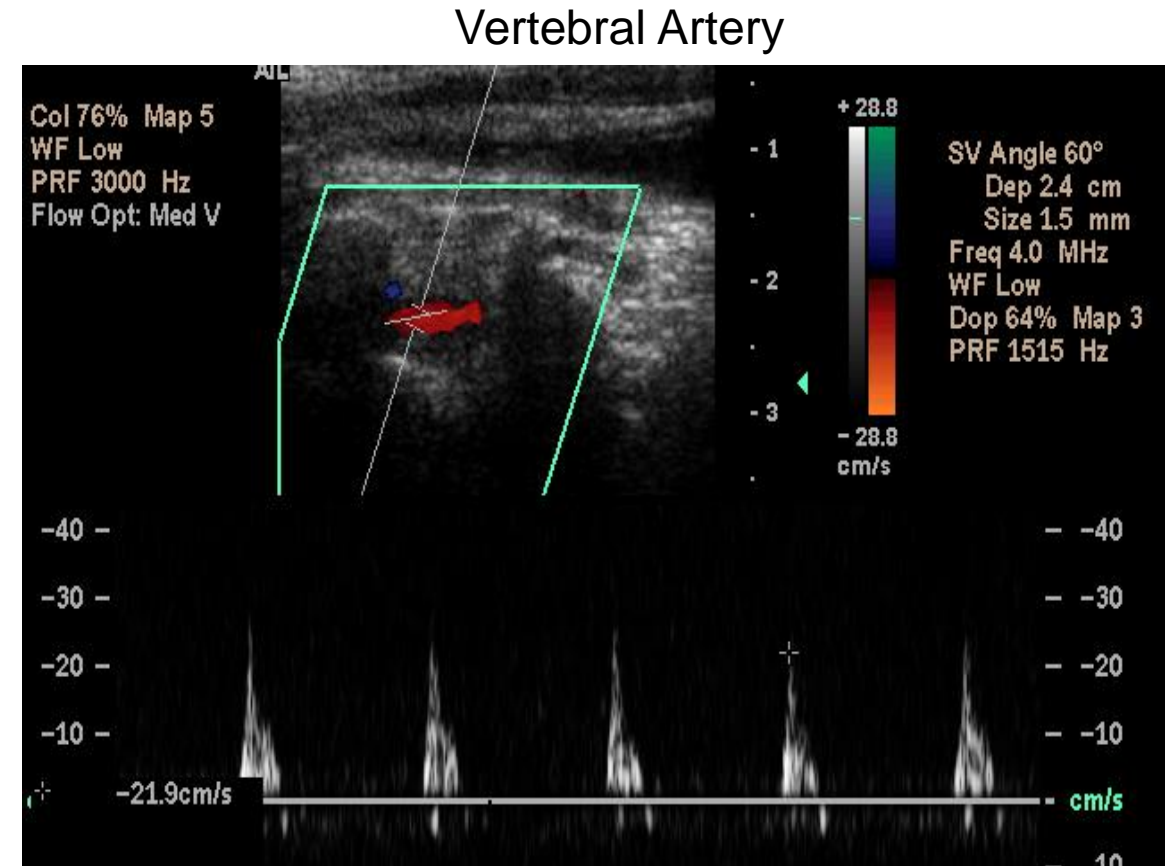
1. Spontaneous right carotid dissection
2. Severe stenosis of the right proximal common carotid artery
3. **Innominate artery stenosis**
4. Giant cell arteritis
5. Aortic stenosis

NO DVT FOUND proximal to the LCFV



Which statement is most accurate?

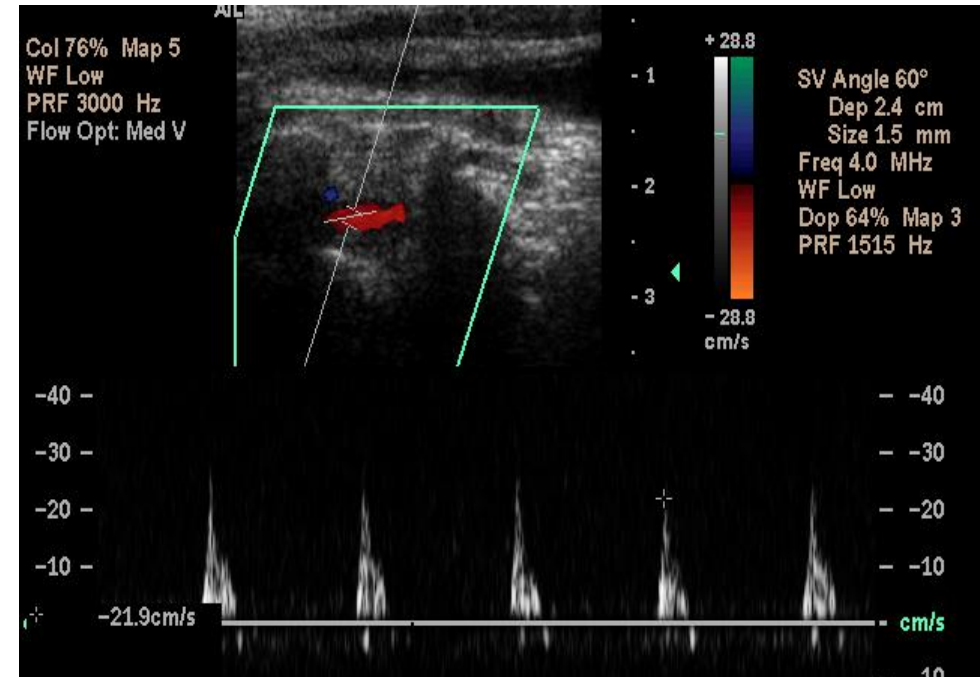
1. The patient has subclavian steal
2. There is a severe stenosis or occlusion in the distal vertebral artery
3. There is a stenosis at the origin of the vertebral artery
4. This is not the vertebral artery but a branch of the external carotid artery
5. This is an example of insonification artifact

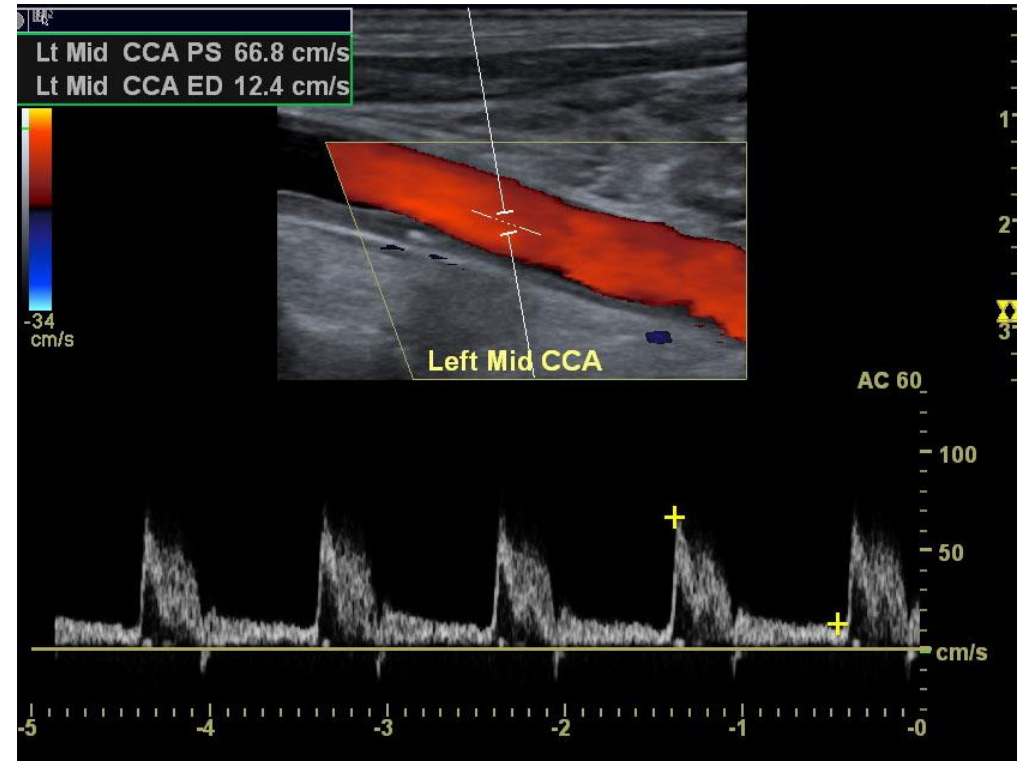
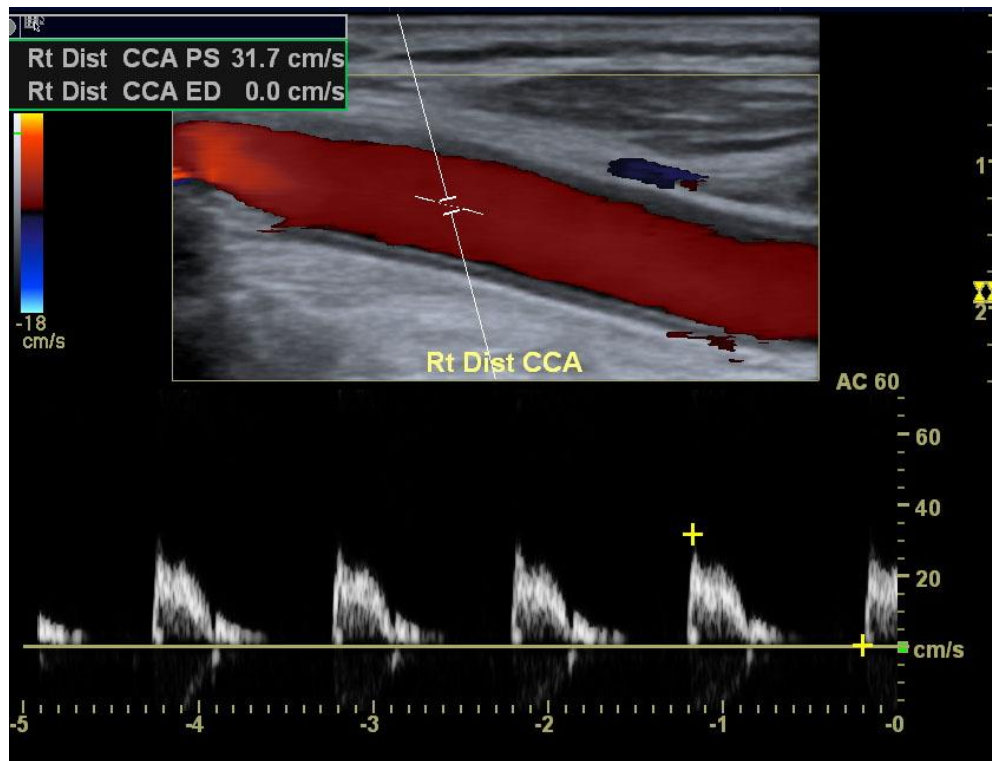


ANSWER

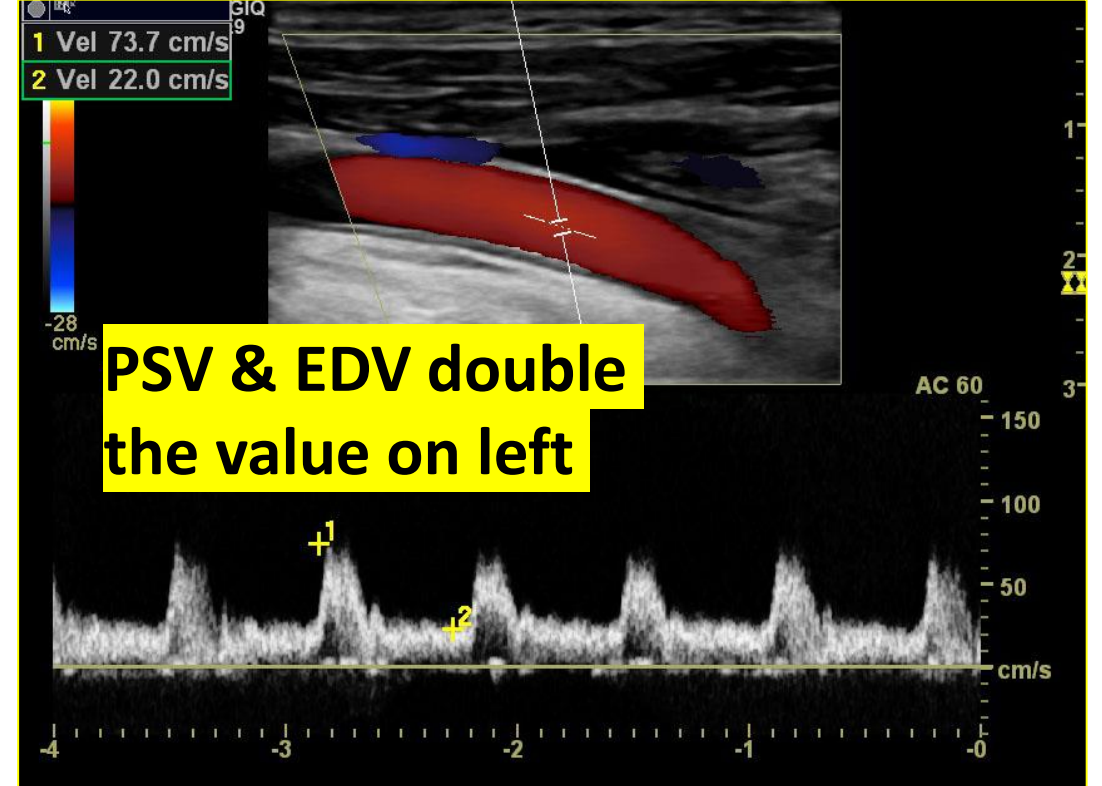
1. The patient has subclavian steal
2. **There is a severe stenosis or occlusion in the distal vertebral artery**
3. There is a stenosis at the origin of the vertebral artery
4. This is not the vertebral artery but a branch of the external carotid artery
5. This is an example of insonification artifact

Vertebral Artery

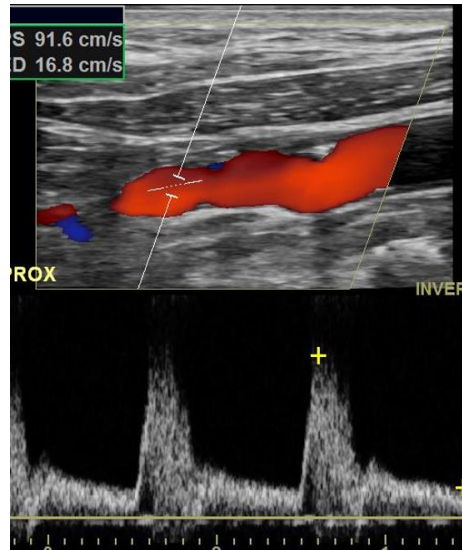
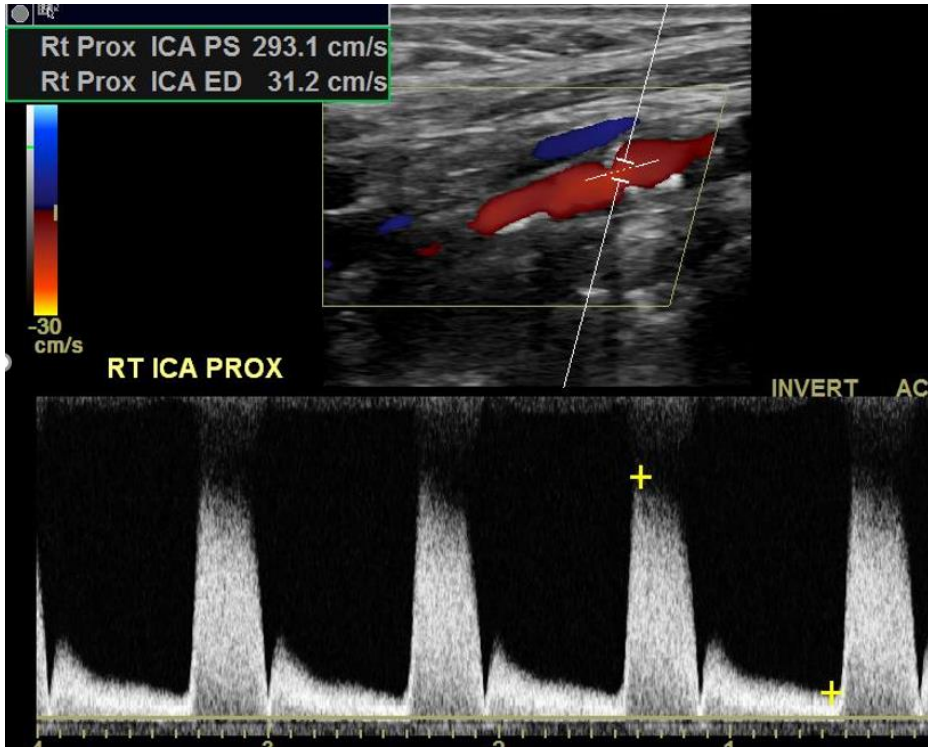
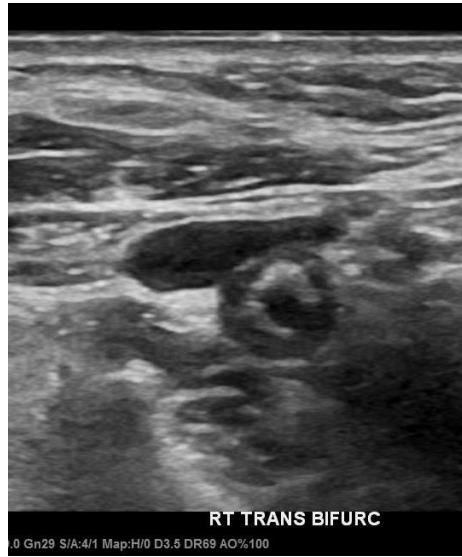
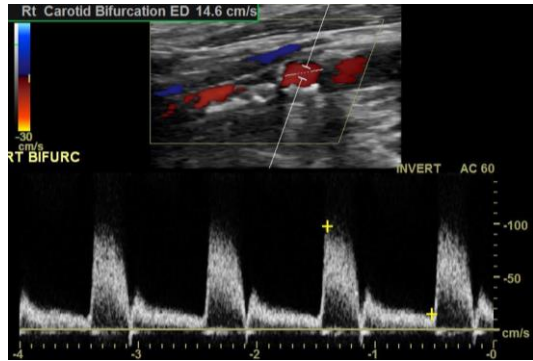
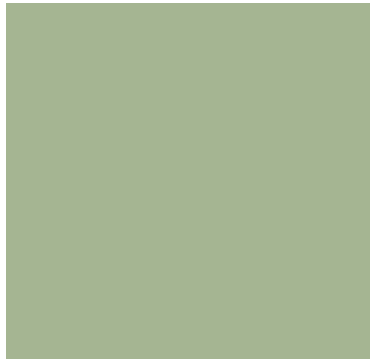




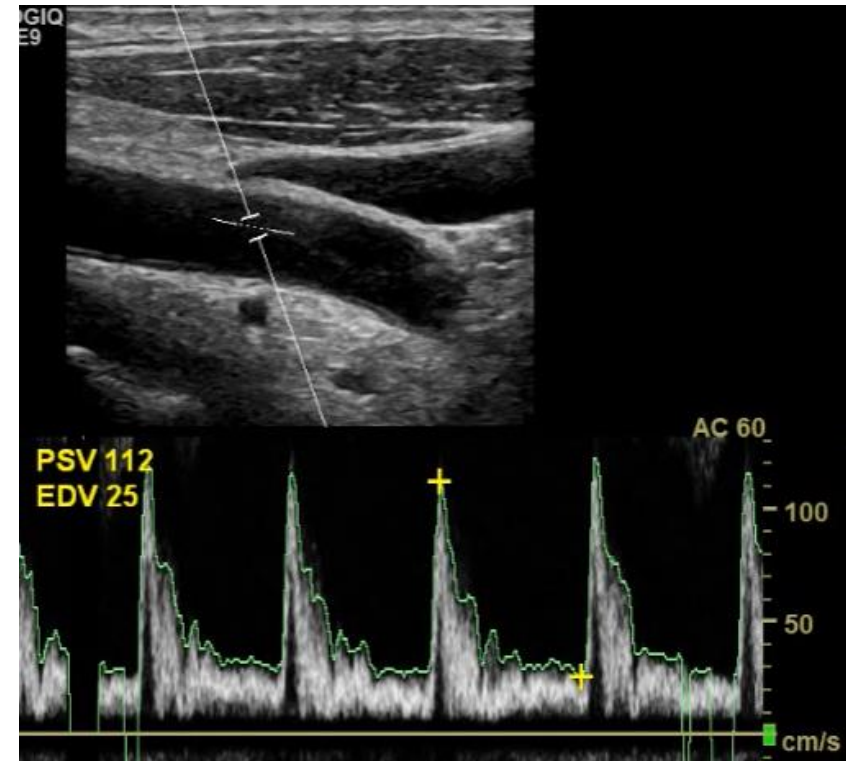
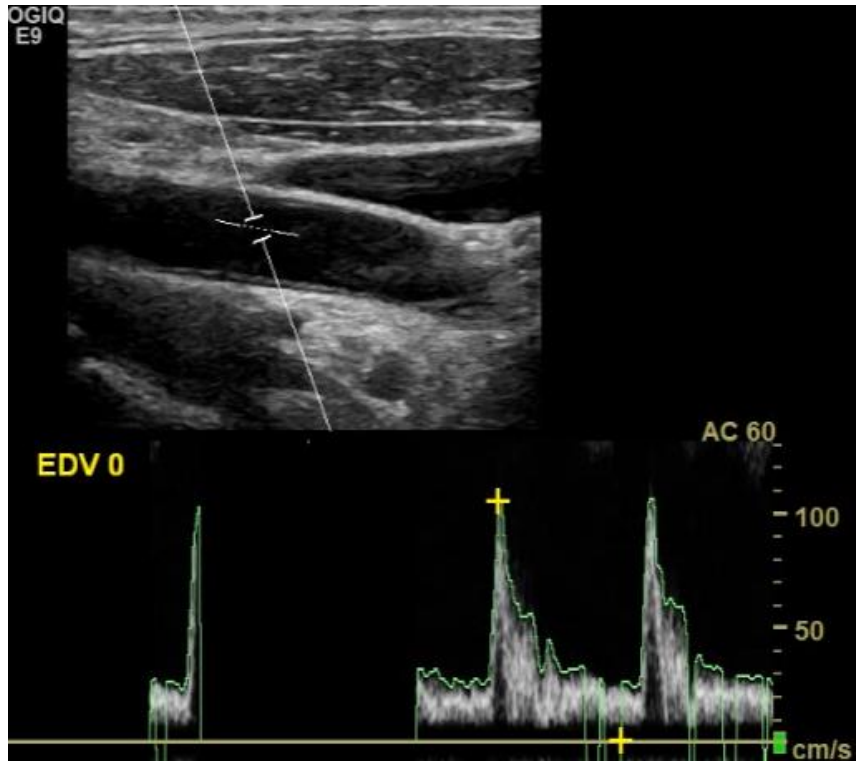
Obvious Asymmetry



Subtle Asymmetry

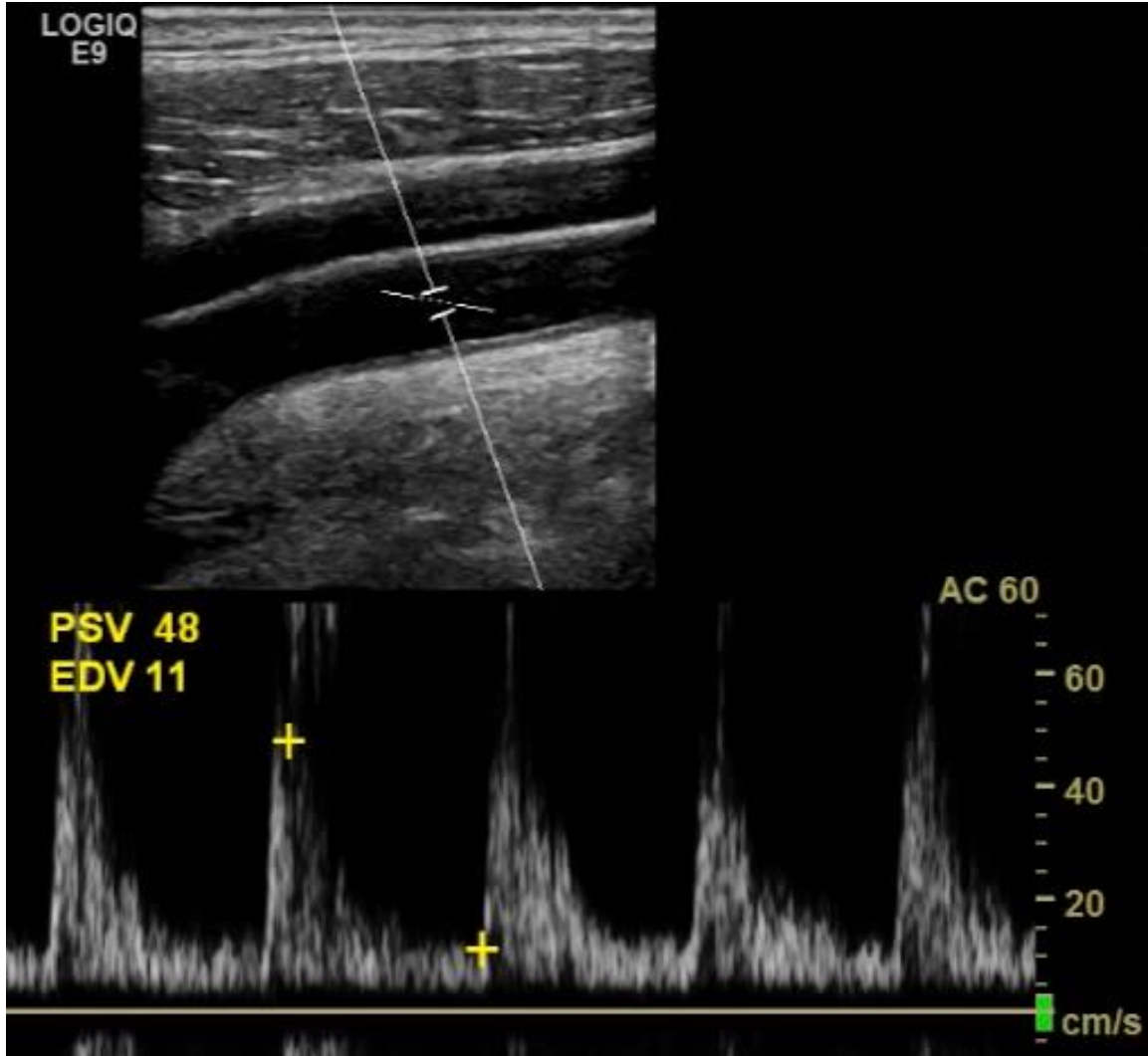


>50% ICA
Stenosis?

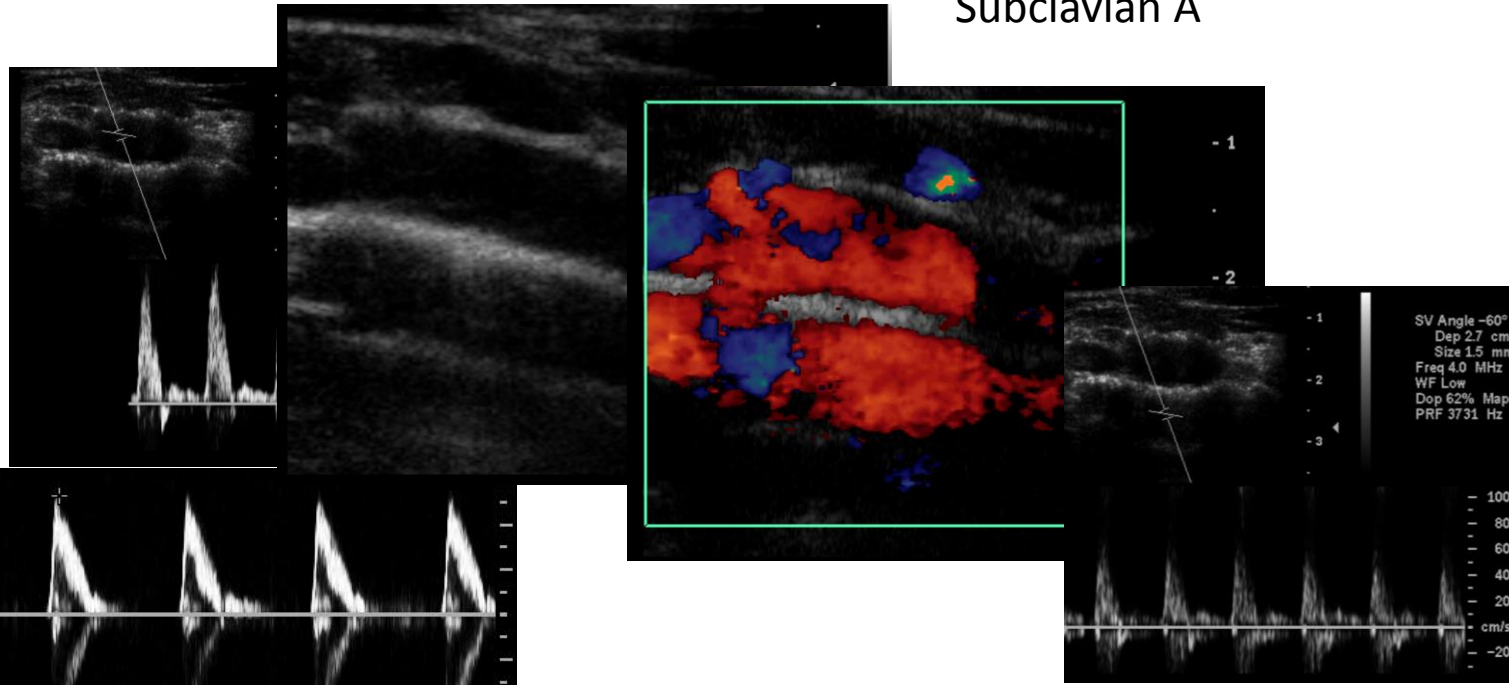


Recognizing limitations of auto-trace

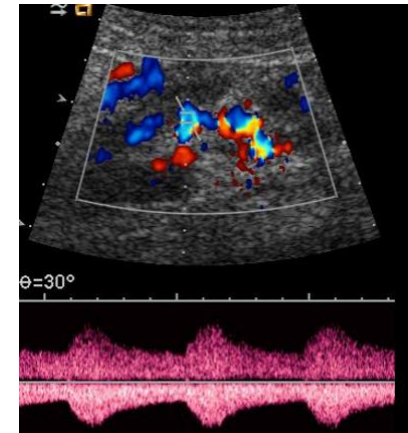
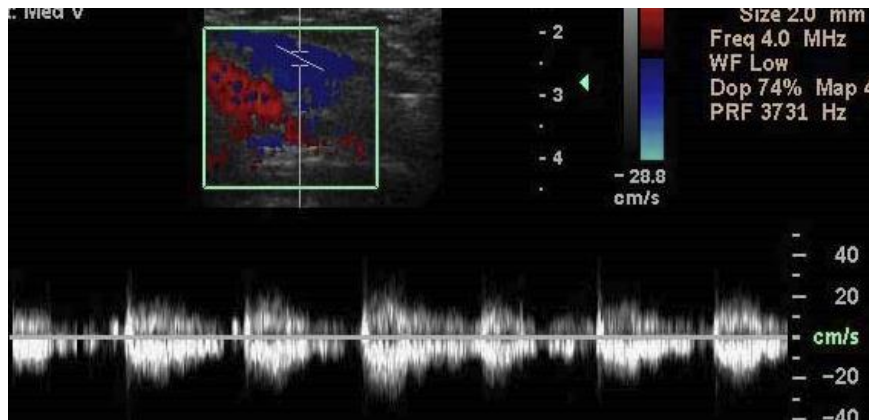
Misalignment of the PW Flow Indicator



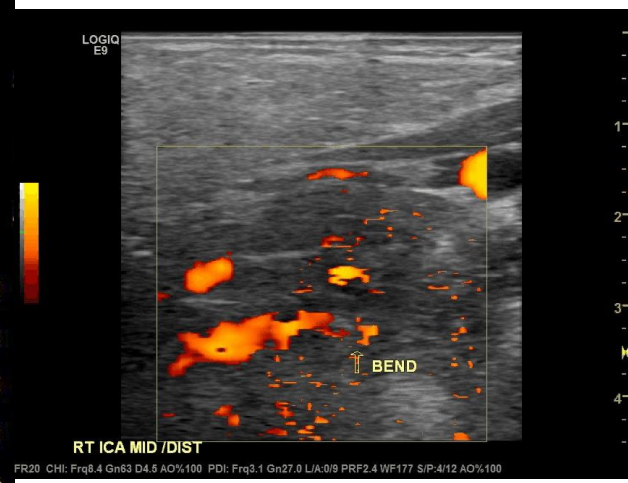
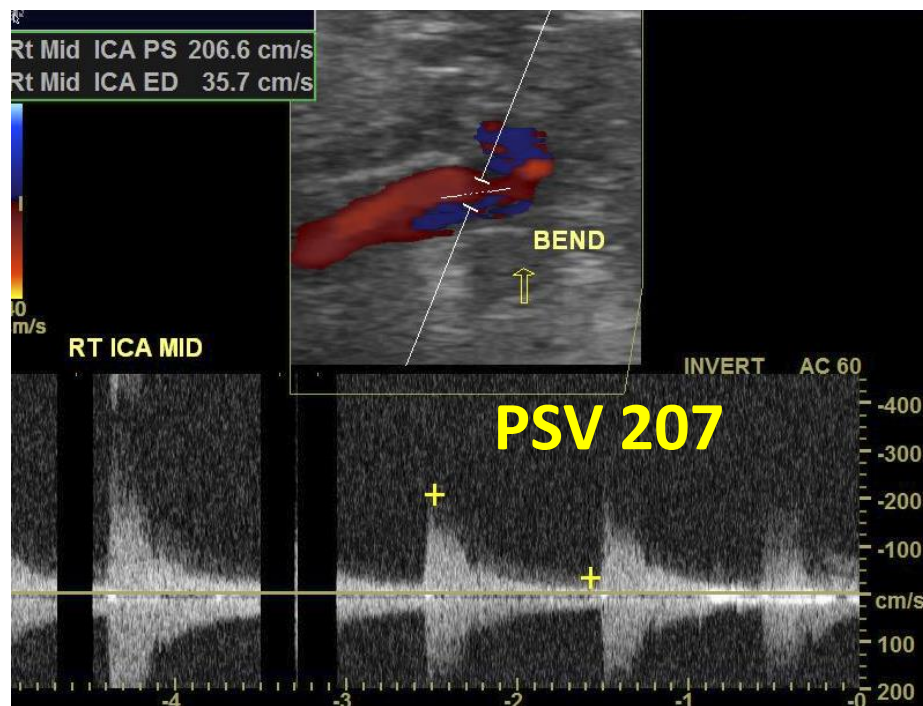
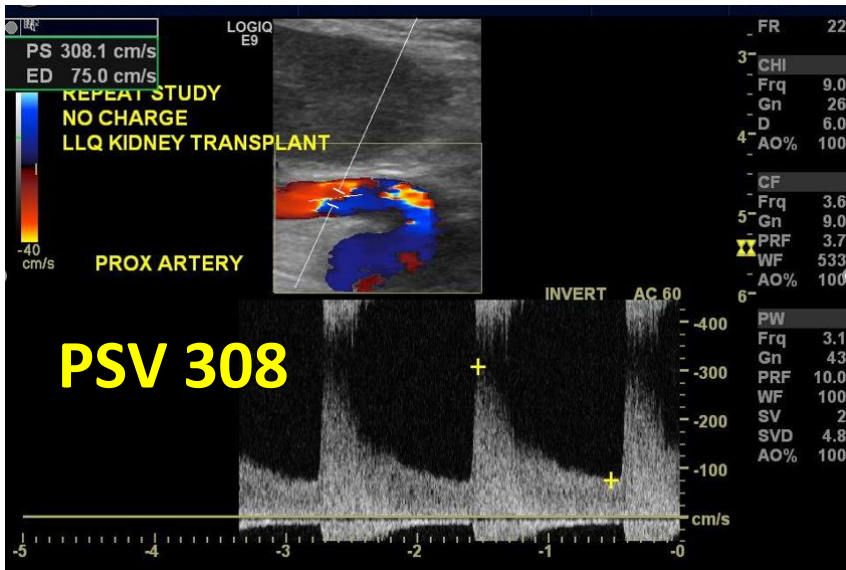
Mirror Image

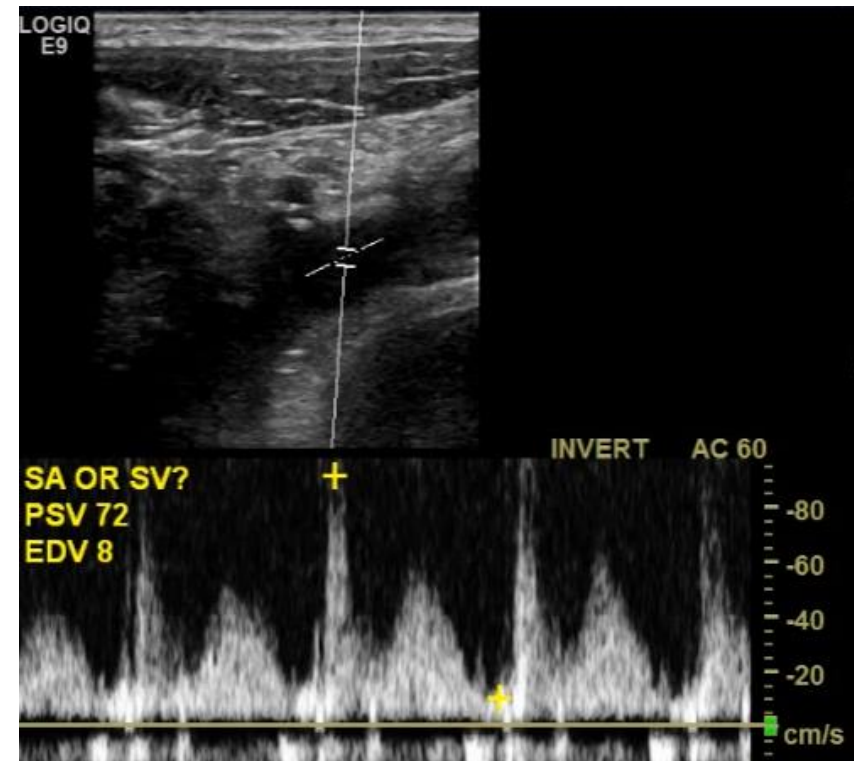
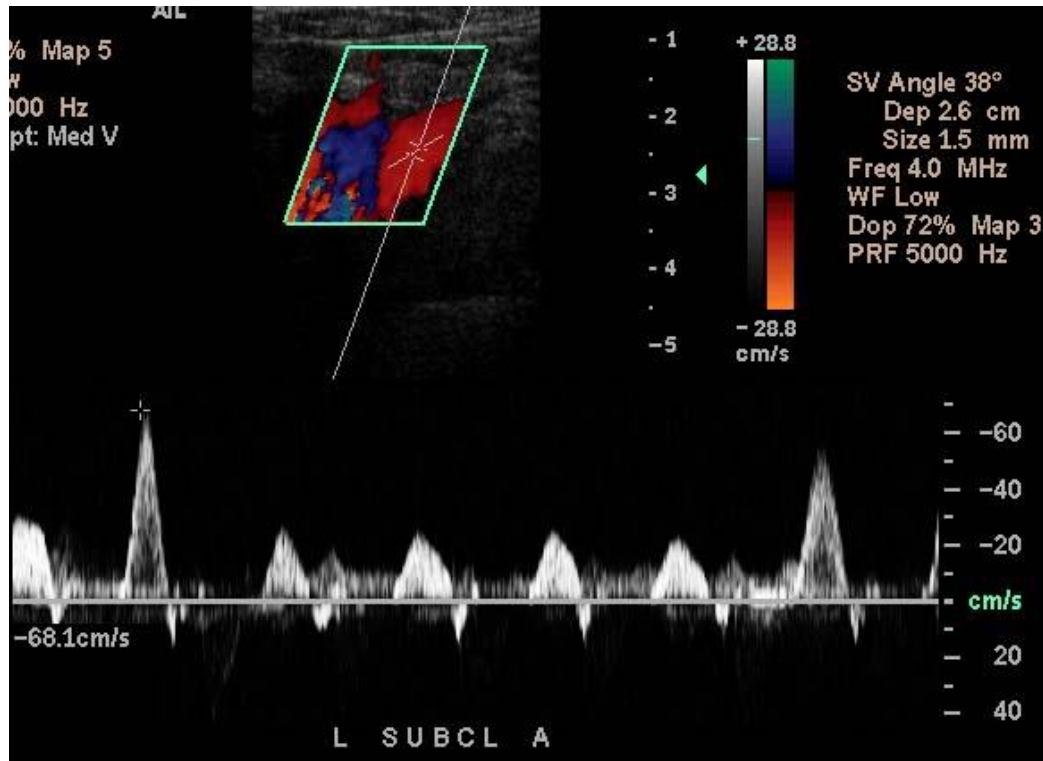


Axillary Vein



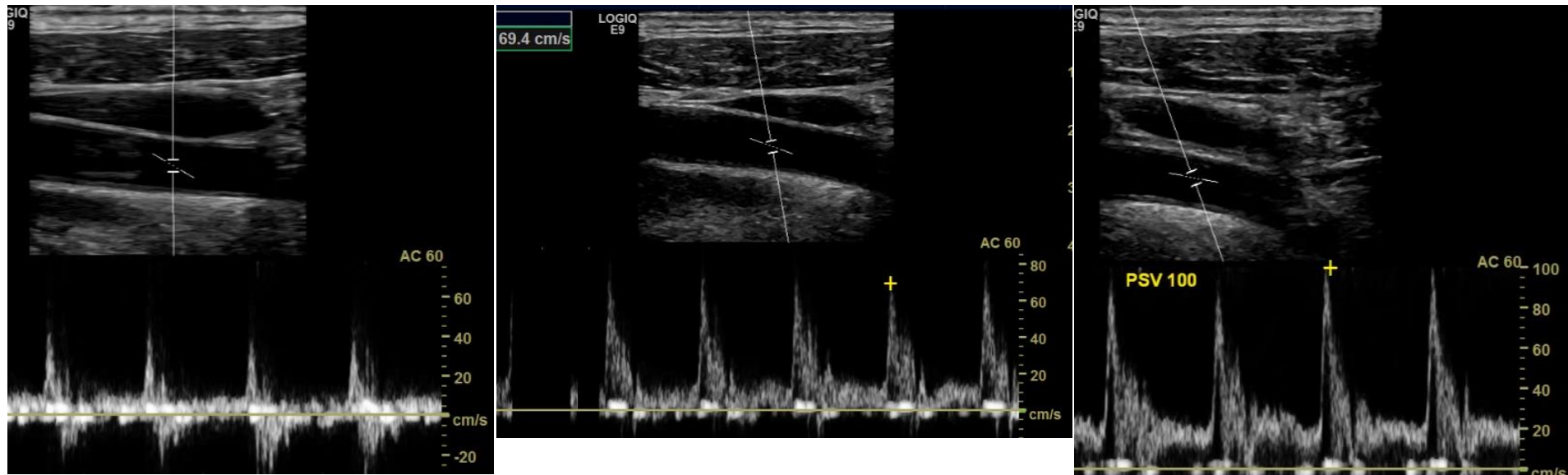
Tortuosity





The Case of 'Mistaken Identity'

Spectral Broadening (AGAIN!) Velocity Underestimation



PSV 40

PSV 70

PSV 100

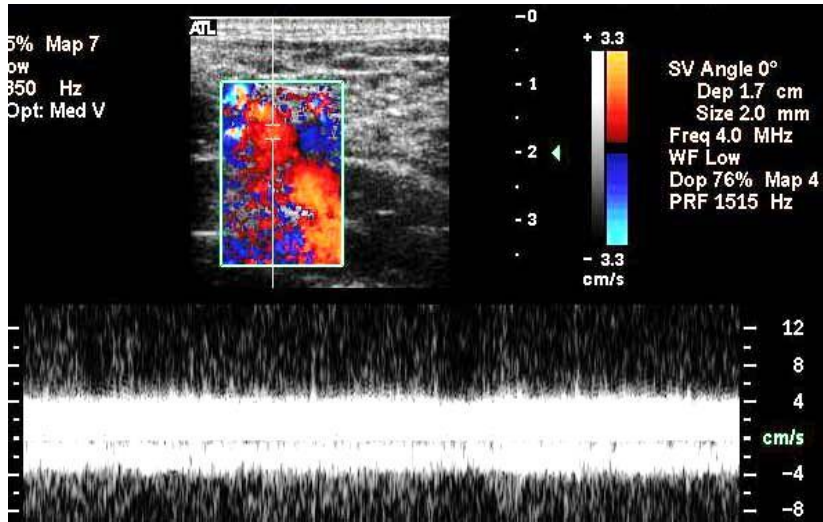
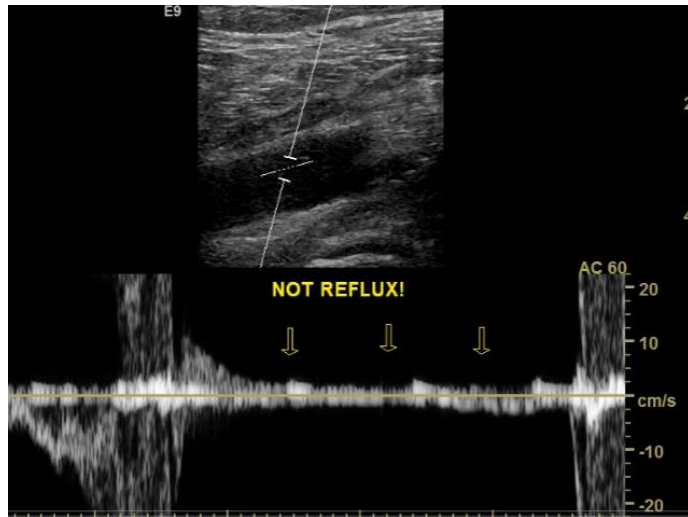


Image Optimization: Crosstalk



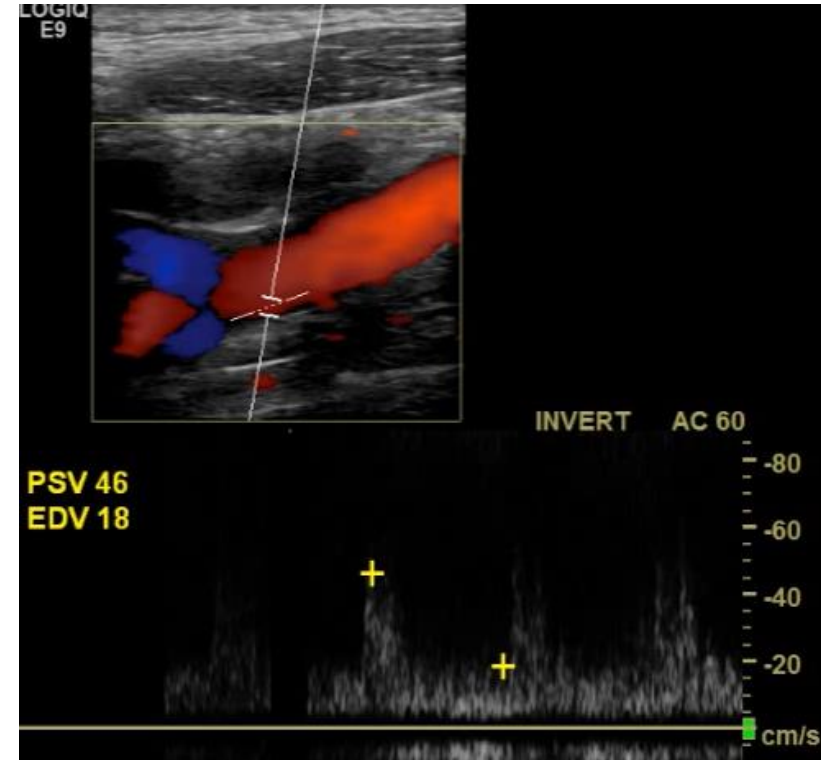
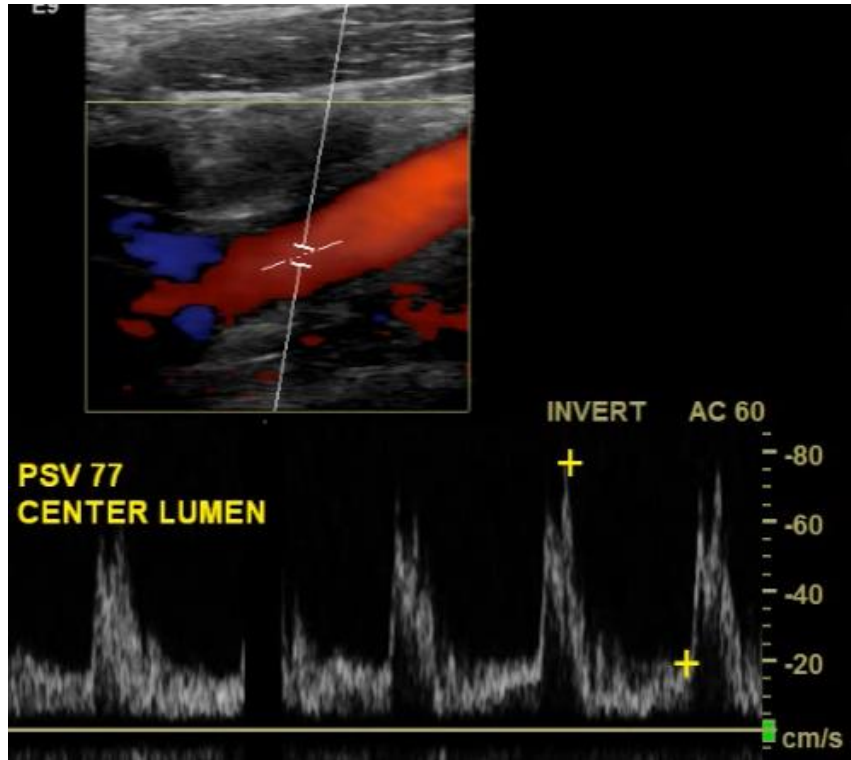


Image Optimization: Sample Location

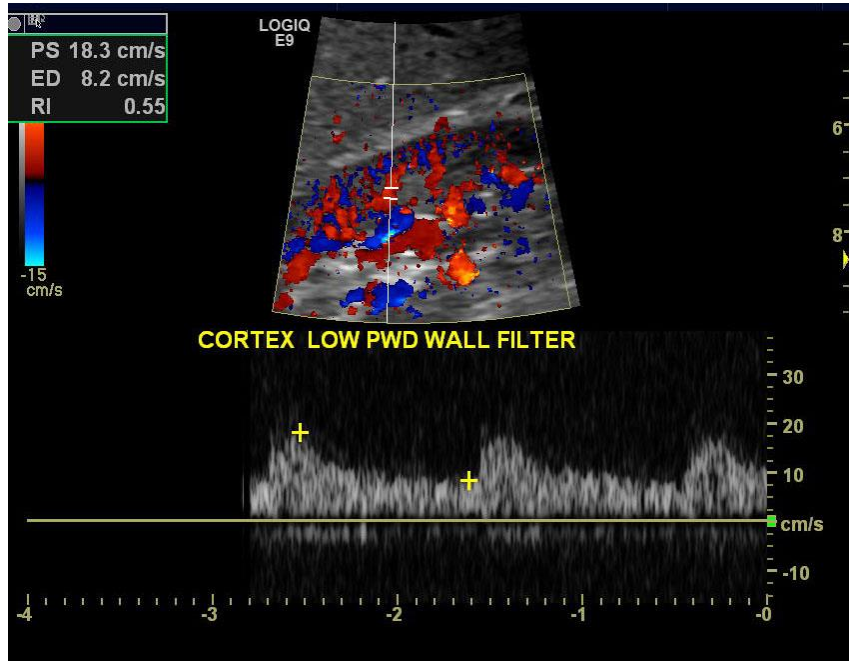
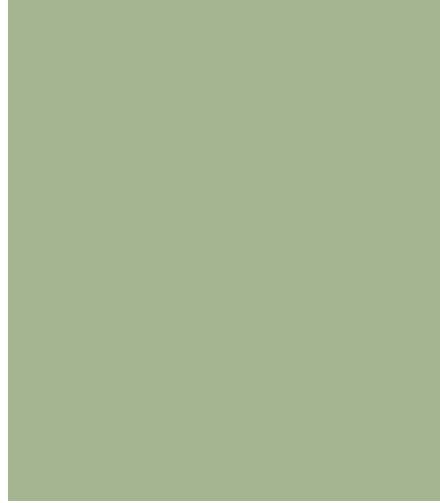
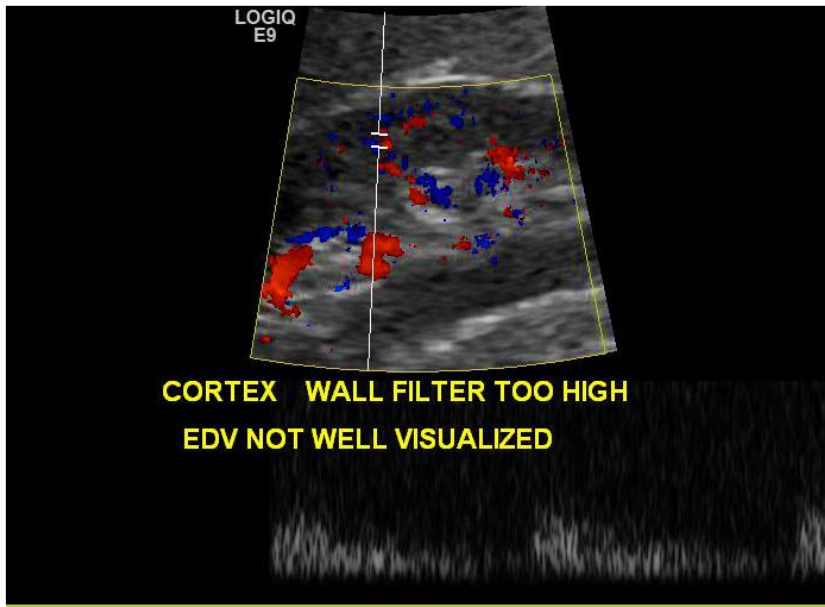
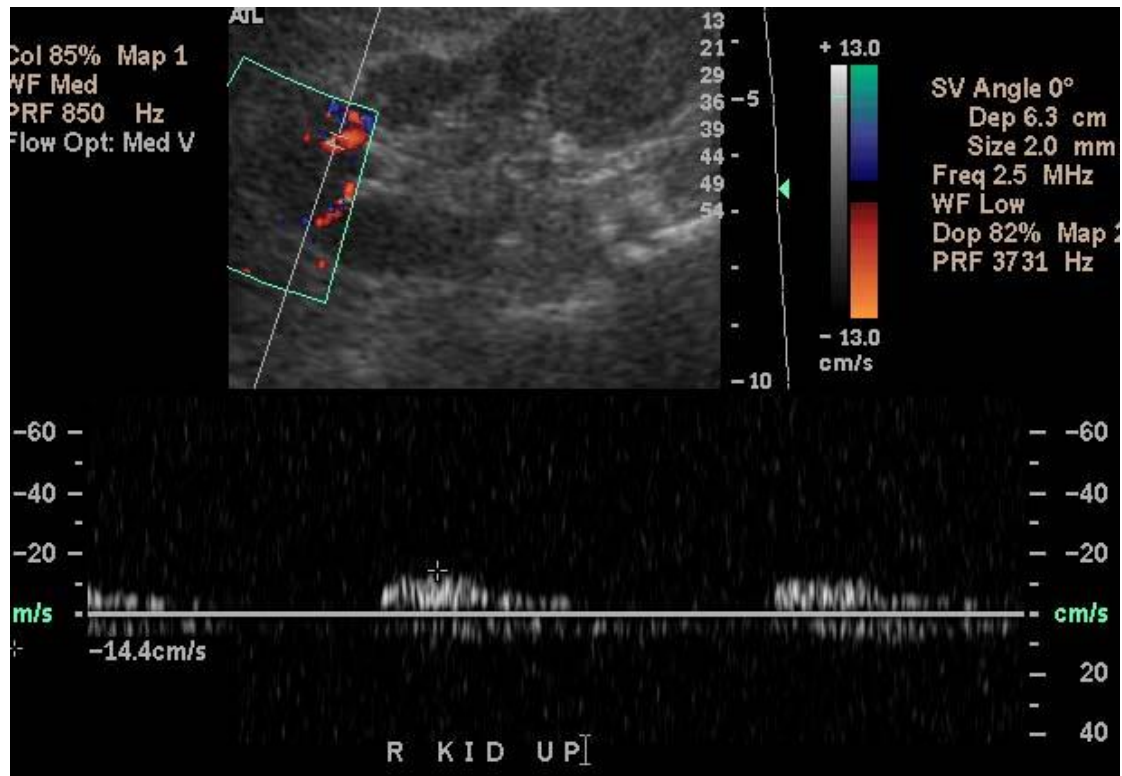


Image Optimization: Wall Filter

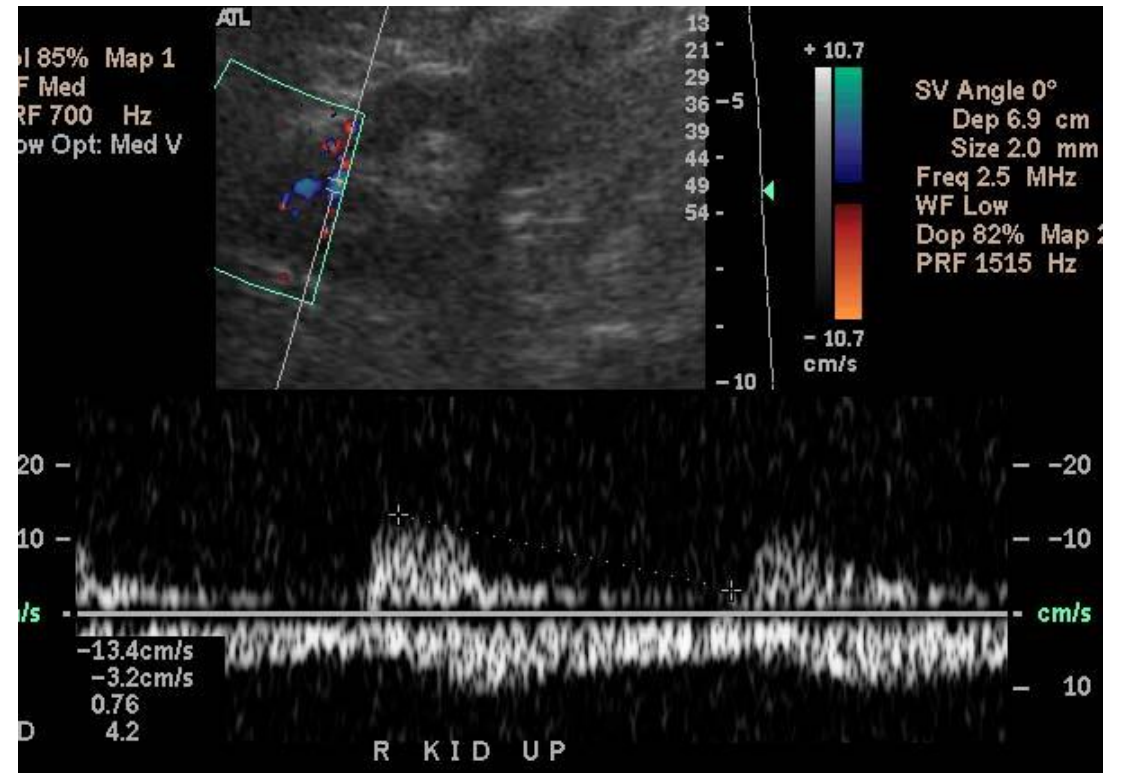


WAVEFORM TOO SMALL

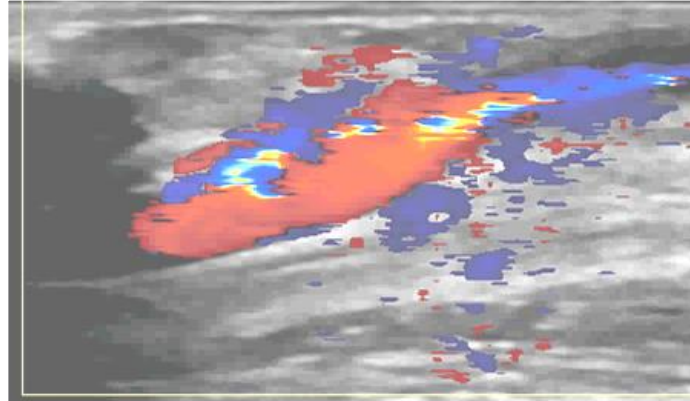
NO DIASTOLIC FLOW



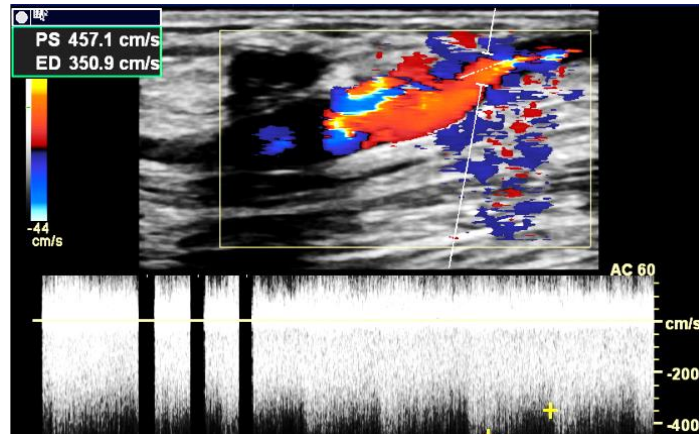
PRF REDUCED, DIASTOLIC FLOW
PRESENT



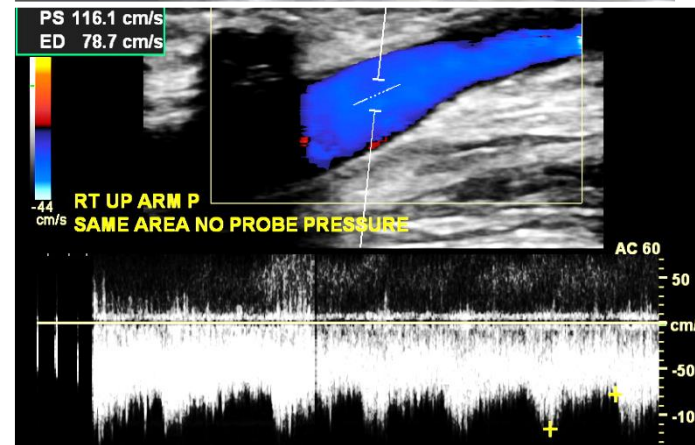
Probe Pressure – superficial structures (including carotids!)



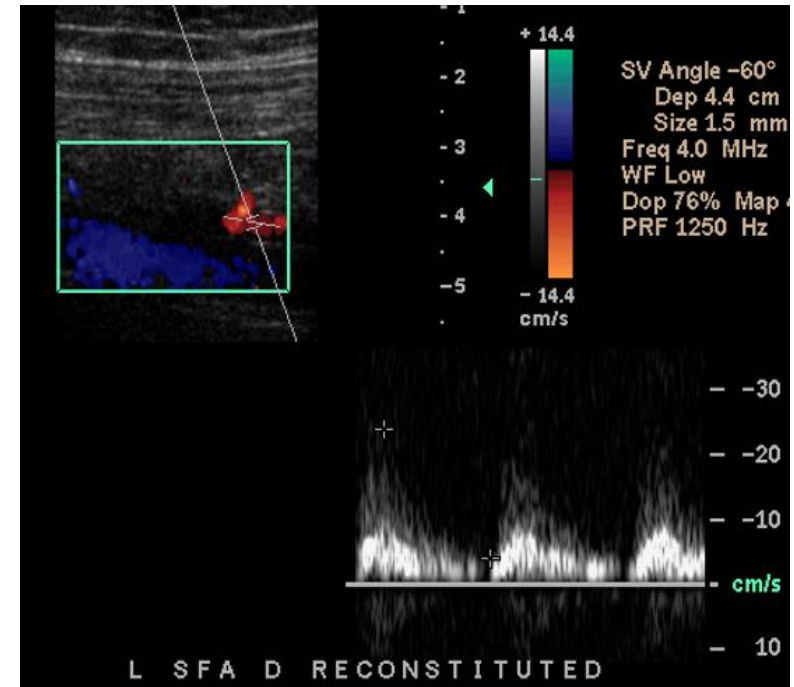
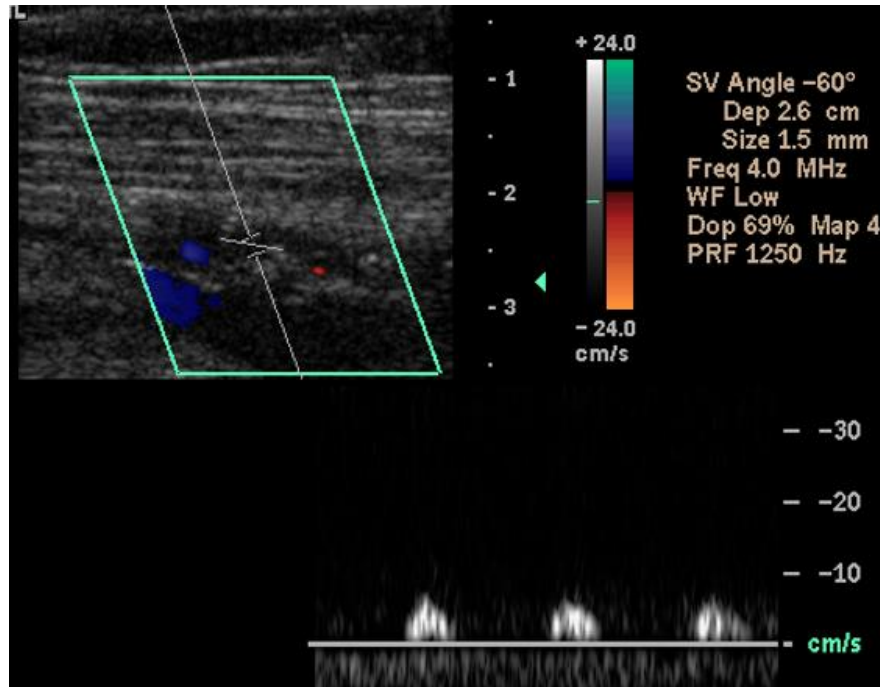
PSV 457



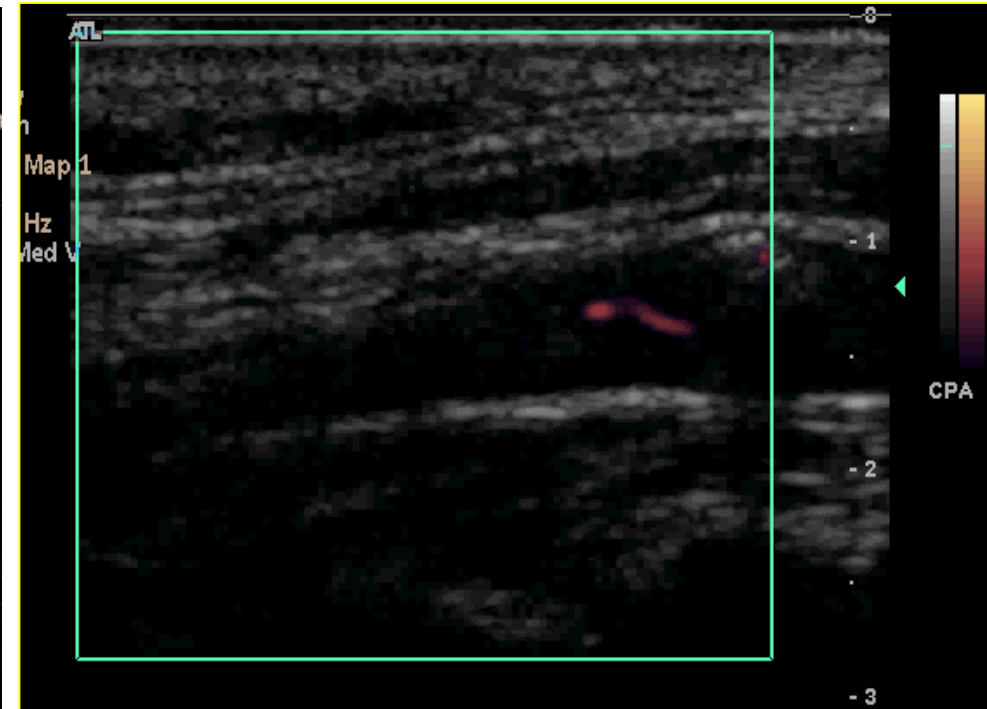
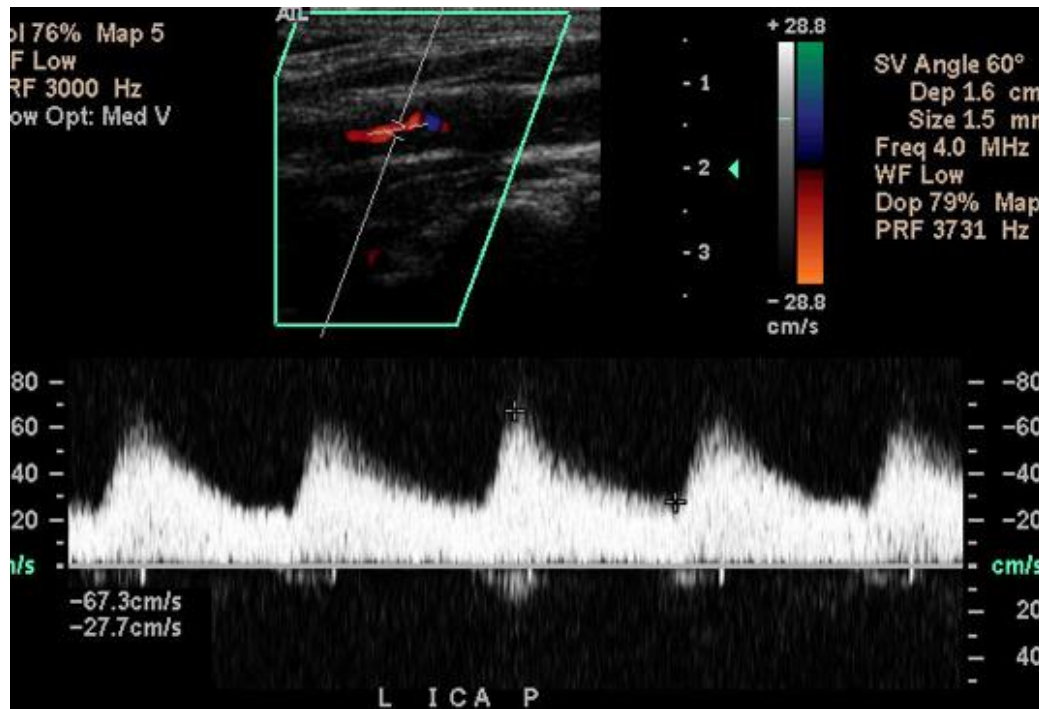
PSV 116



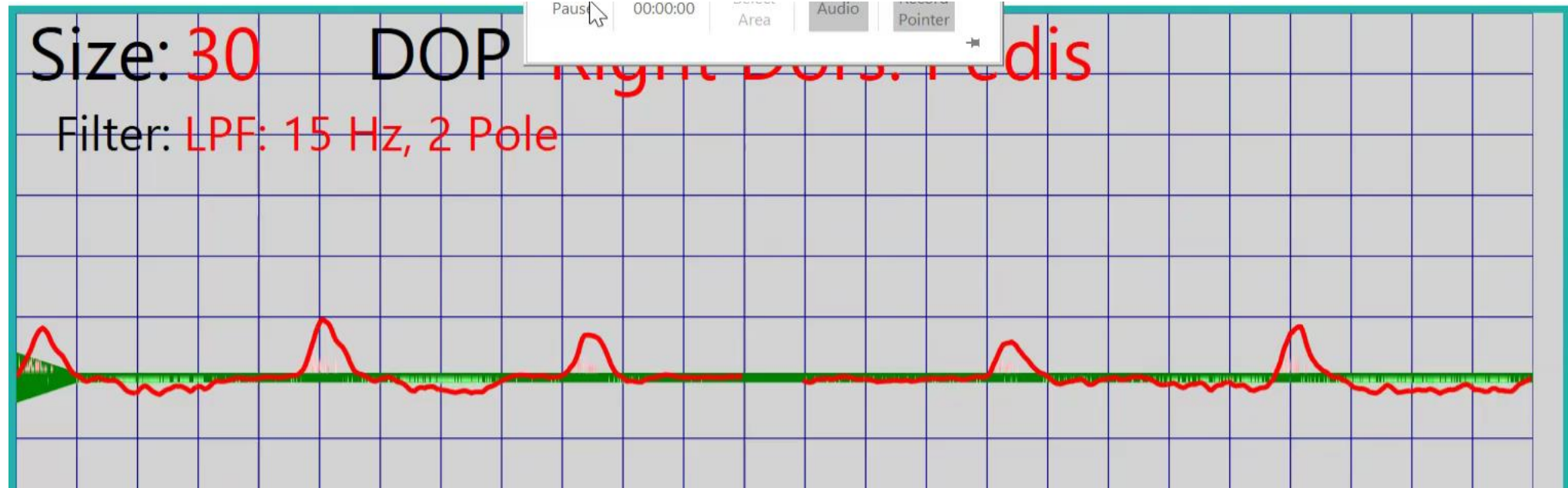
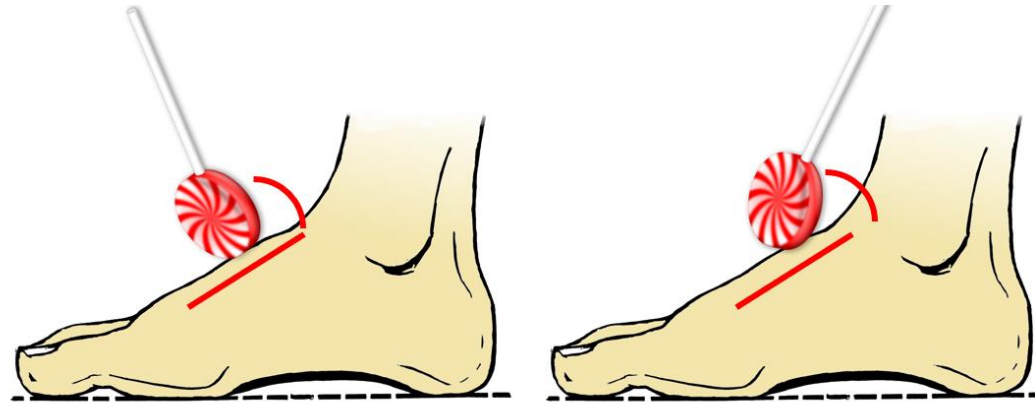
Occlusion, String Sign, Attenuation?



ICA velocity with normal limits



Misalignment of CW Beam, Non-Imaging

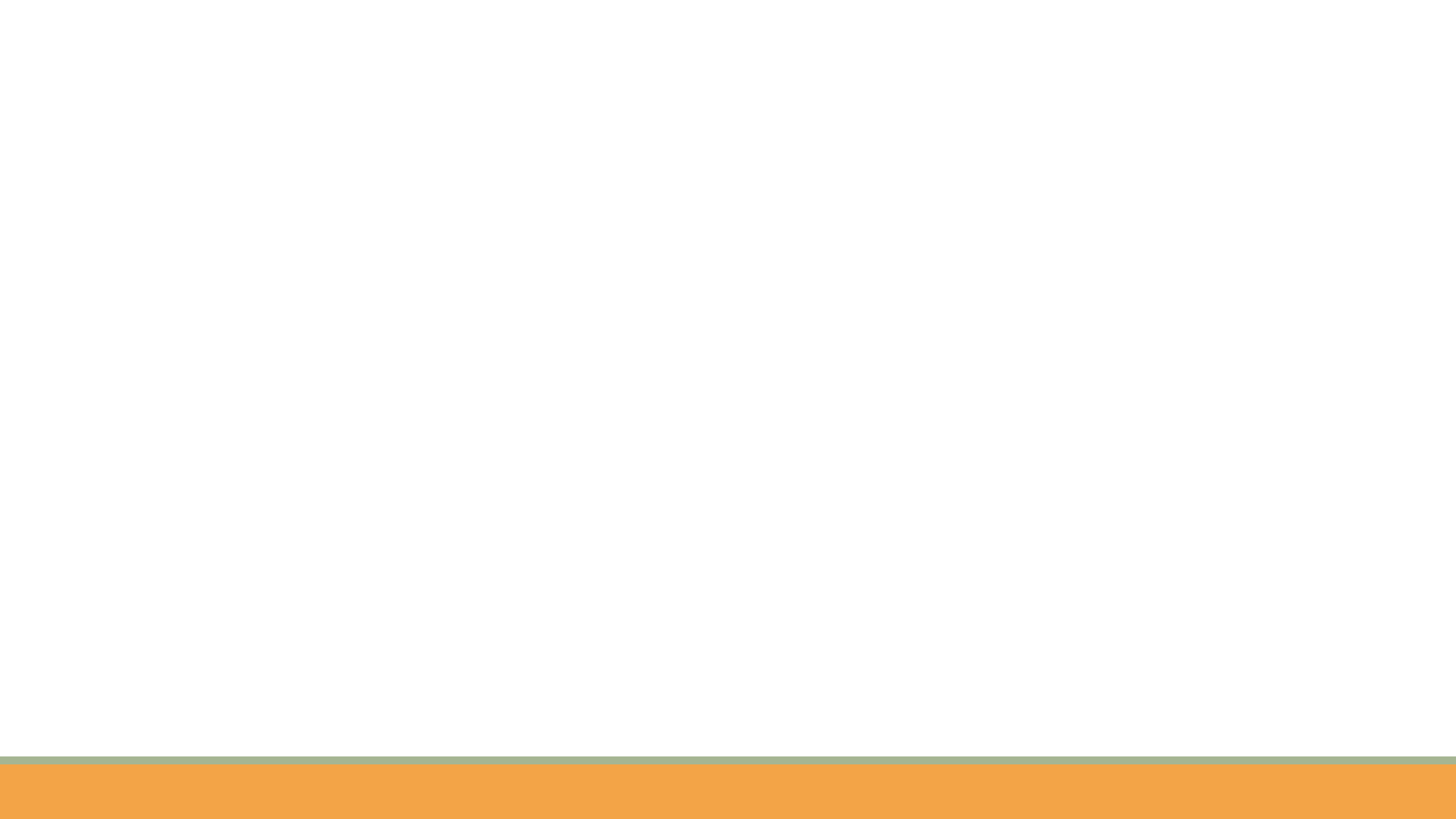




<http://www.mediscene.co.uk>

Conclusion: While many obvious Doppler waveform misinterpretations can be traced back to experience (and opinions!) of the interpreter, there are other things that potentially mask important information embedded within the waveform. It all begins with the choices made by the operator and the limitations of the available equipment.

THANK YOU!



Disclosures

**US Vascular
ACI Medical**

Common Mistakes with Doppler Waveform Interpretation

Potential sources of error:

Interpreter side

Operator/Equipment side

Or a combination of BOTH

What would cause a Doppler waveform of a vessel to be misinterpreted?

Obvious example: Suboptimal beam-to-flow alignment creating false turbulence...clearly this is OPERATOR ERROR!

What about Experience of the interpreter?

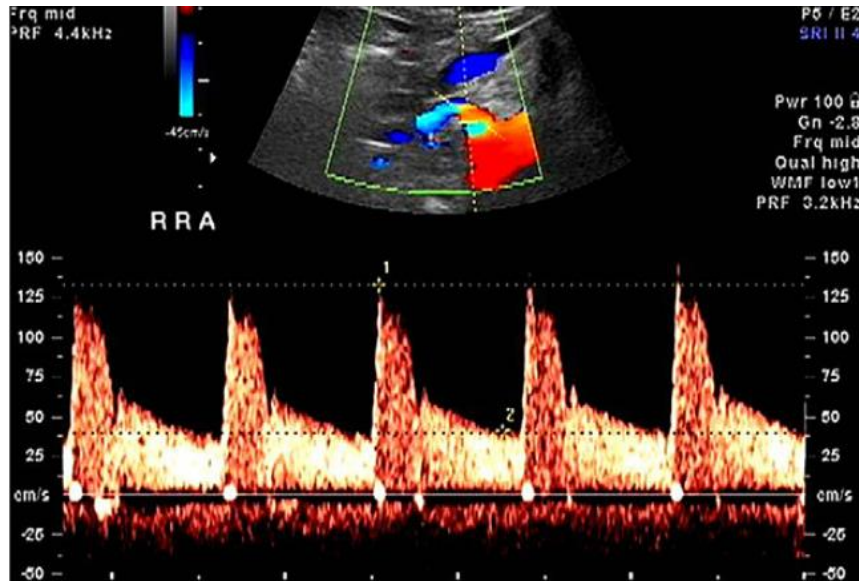
If I asked you what would lead to someone NOT DETECT a stenosis that is more proximal in the arterial tree, your answer might be “equipment, patient, operator choices, or perhaps all 3.”

But what if I changed the question to:

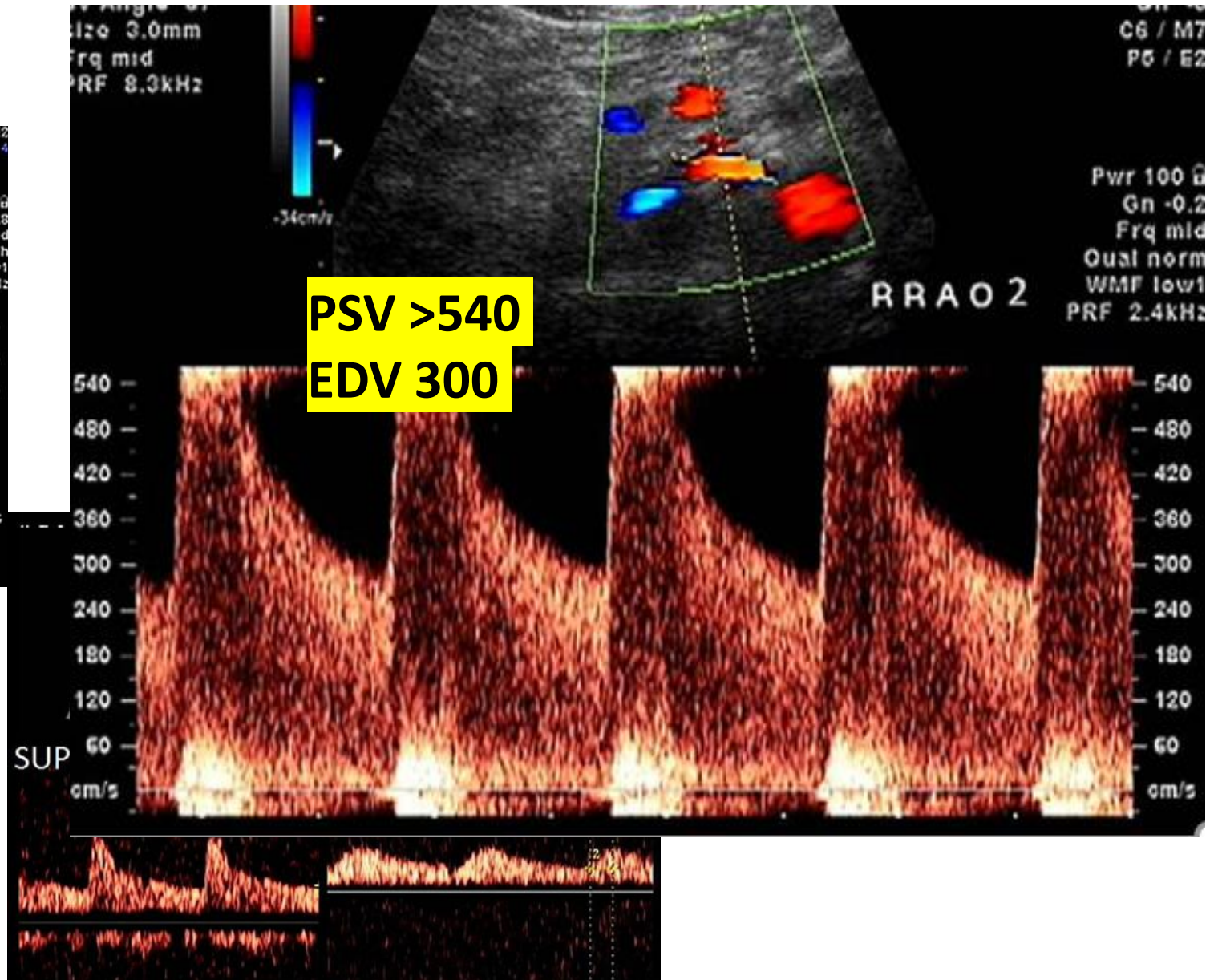
What would lead someone to OVERLOOK a more proximal stenosis? Then your answer might change to “failure to recognize the subtle clues”

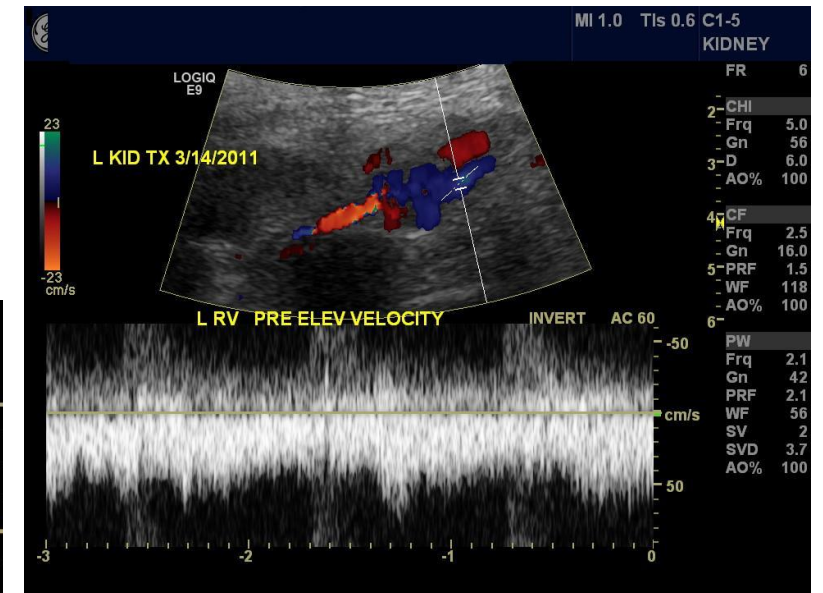
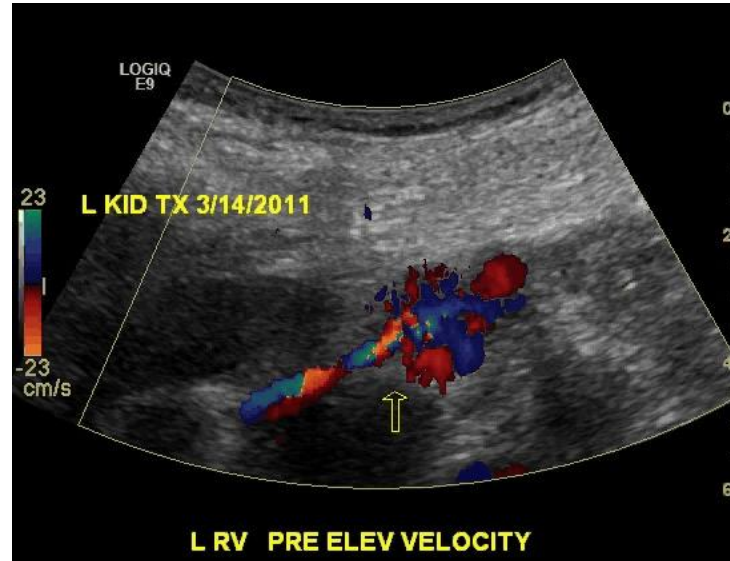
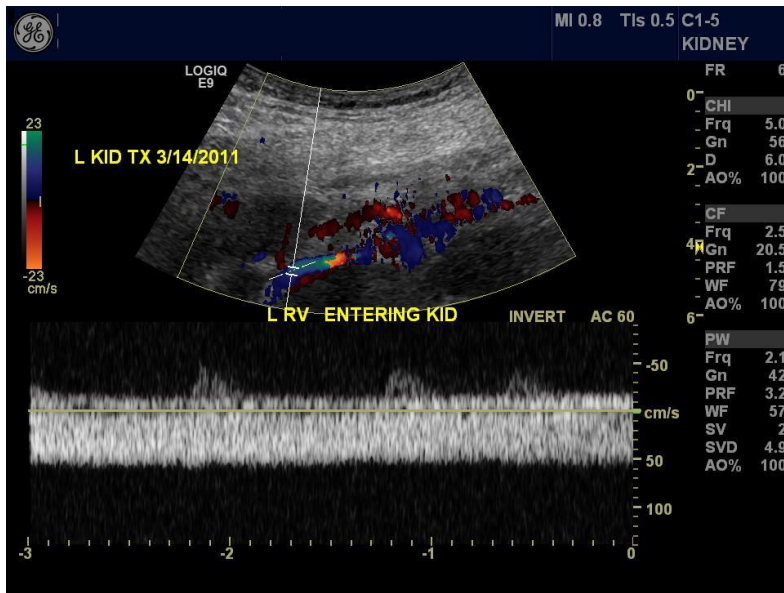
Interpreter should
recognize the clues

Right Renal Artery Proximal



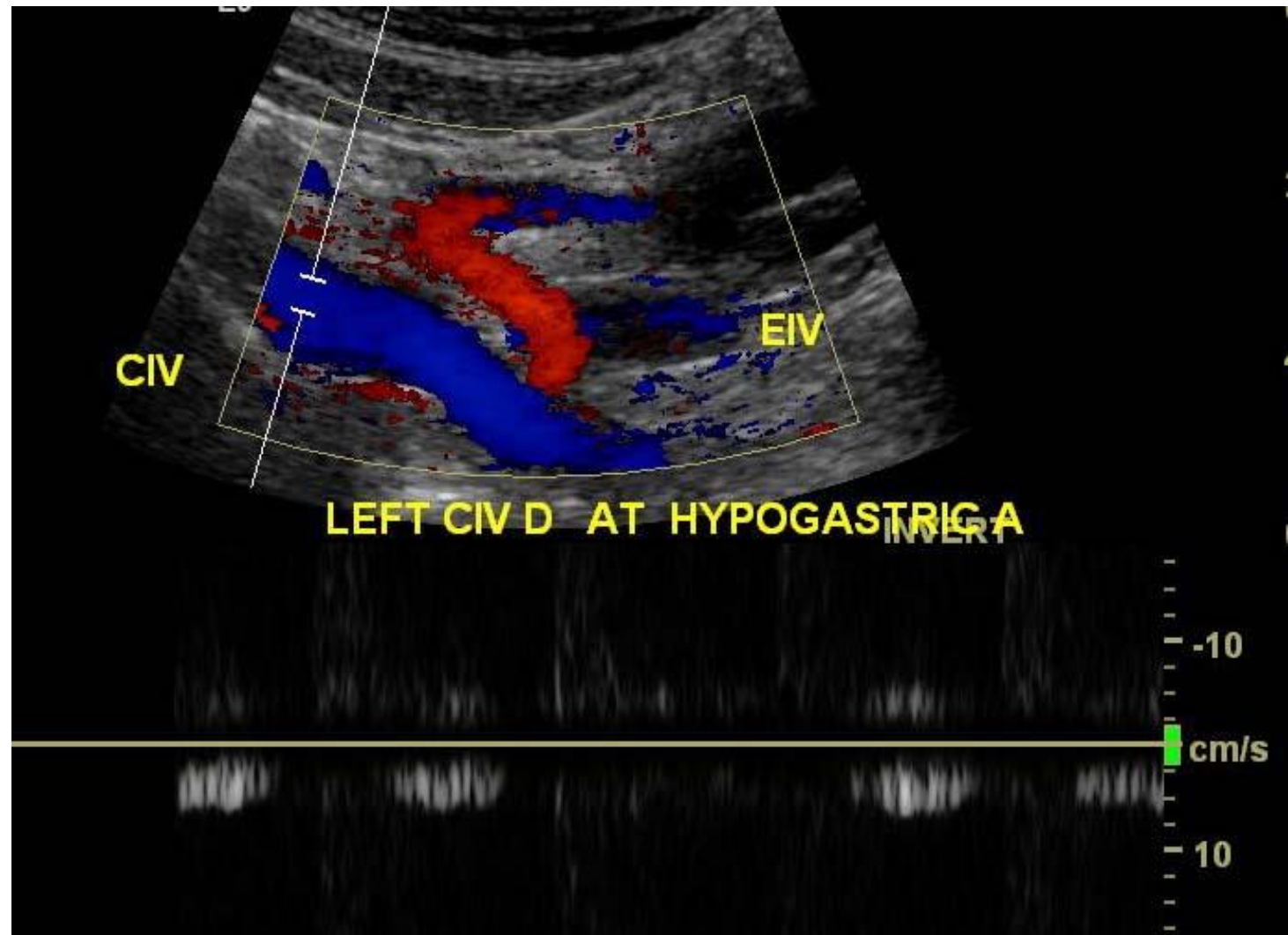
Right Renal Artery Distal Superior and Inferior Branches





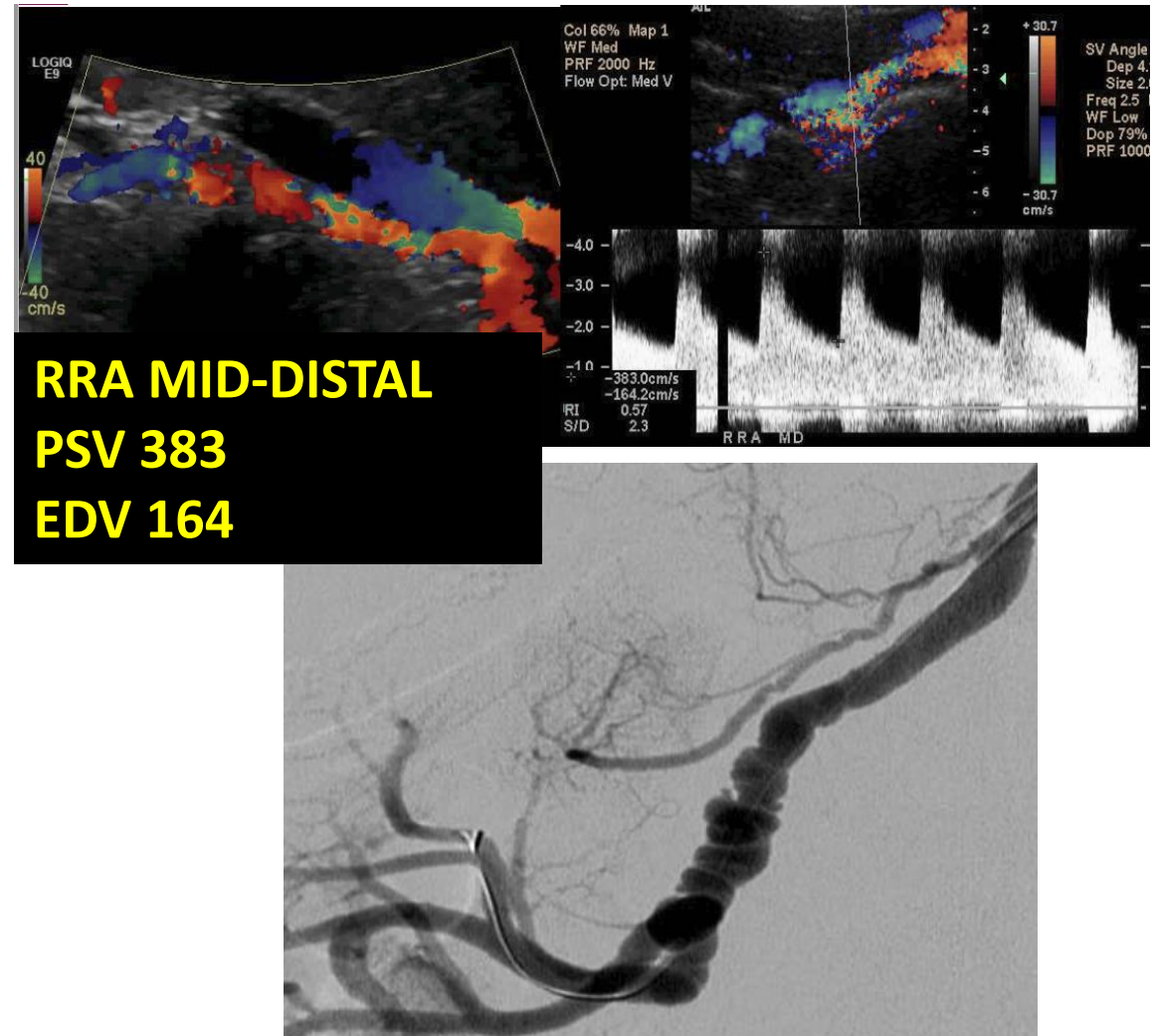
PATENT RENAL ARTERY,
BUT...

LOOK MORE
PROXIMAL!!



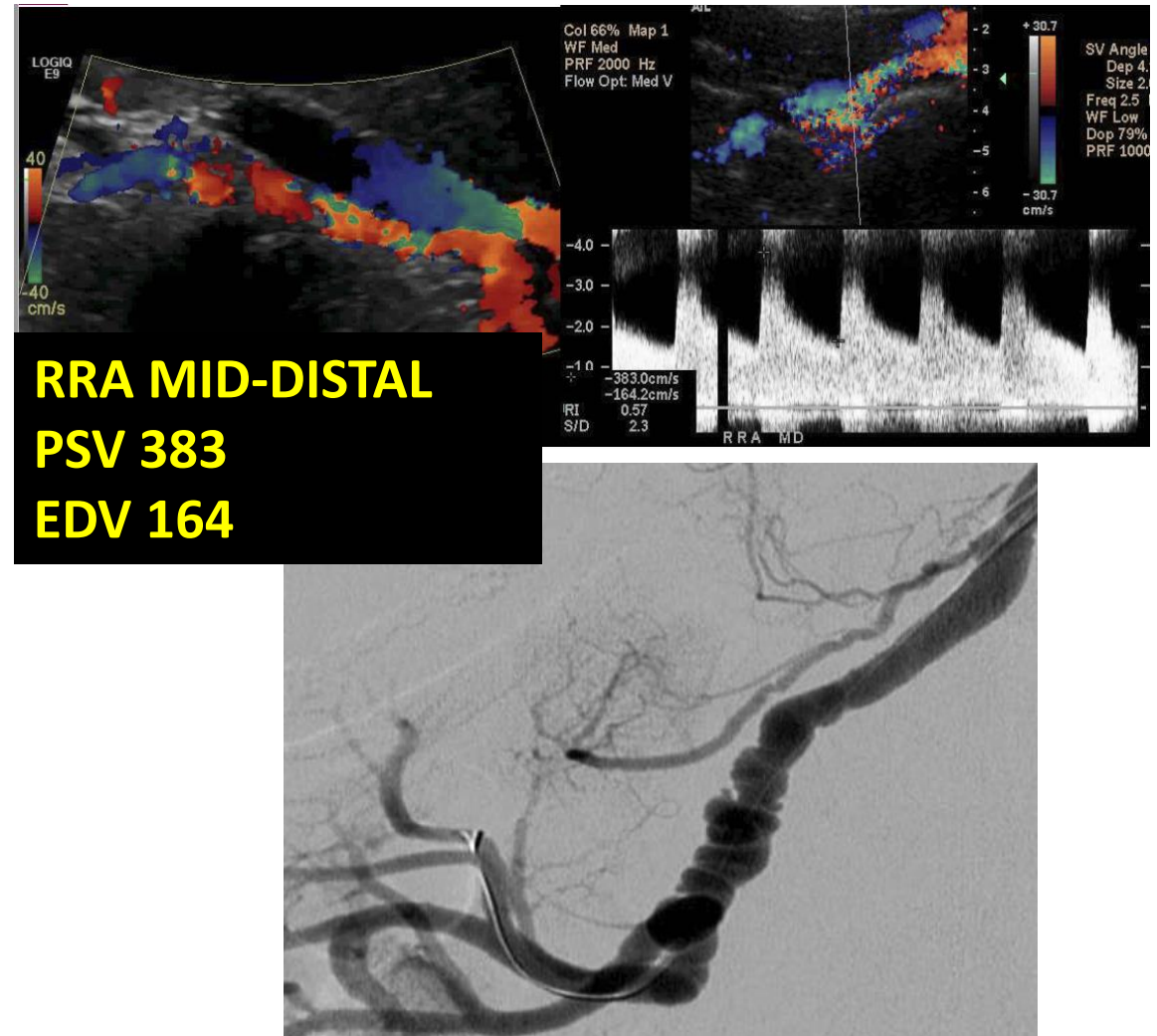
ANSWER

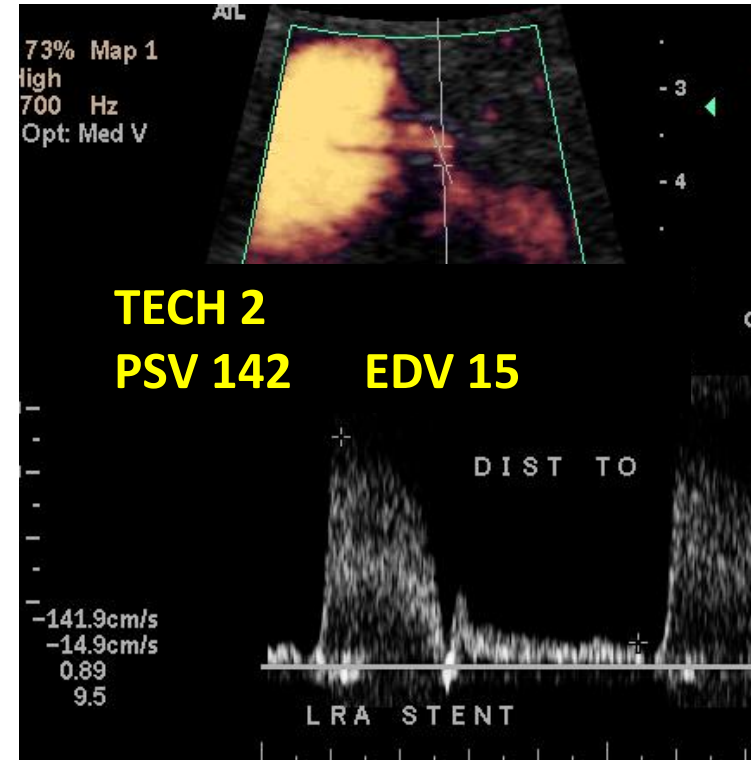
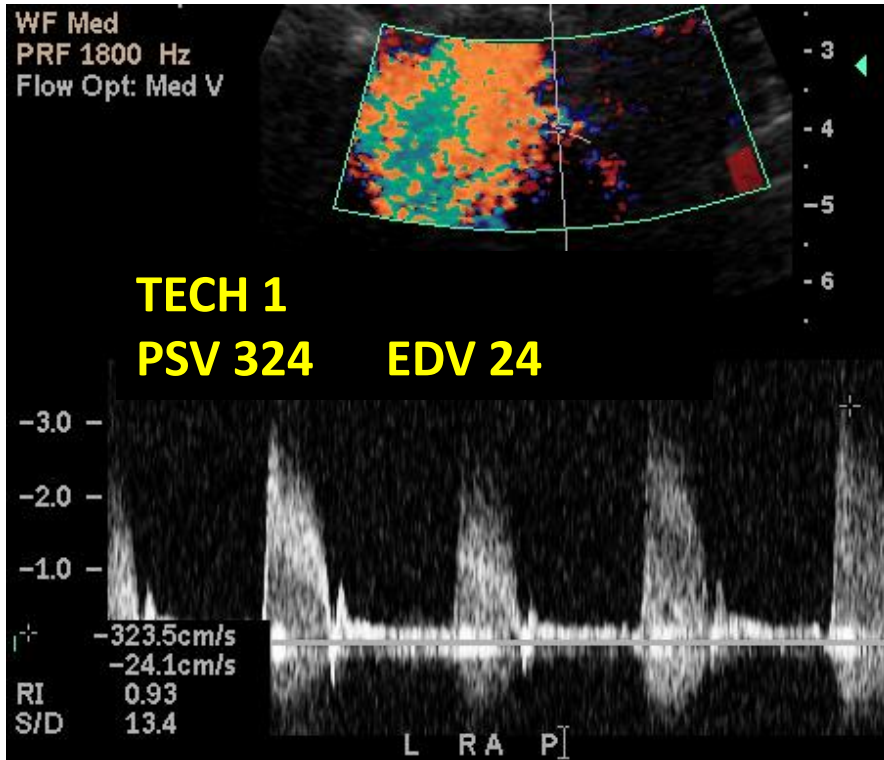
1. This is a subcostal view of the right renal artery
2. There is marked turbulence in the mid and distal renal artery
3. There is a 60-99% stenosis of the right renal artery. The EDV of 164 cm/sec suggests a stenosis of greater than 80%
4. **There is elevated velocity and turbulence in the mid and distal renal artery. The degree of stenosis cannot be determined**



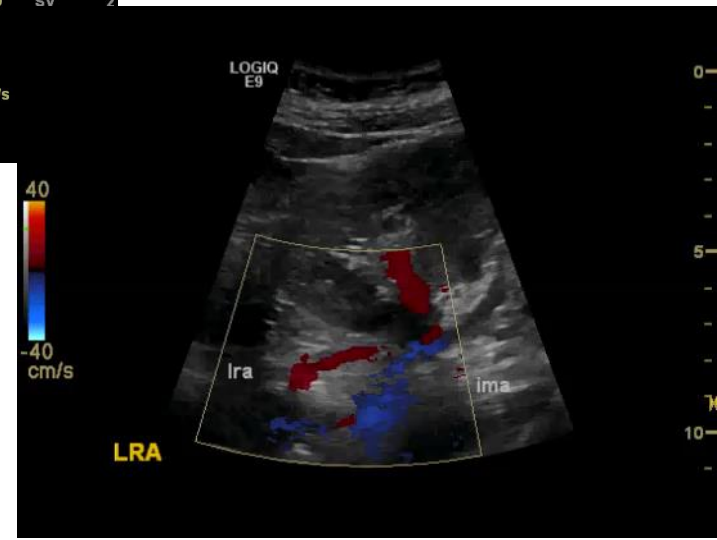
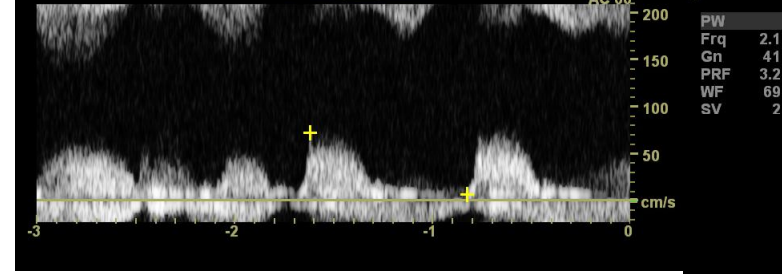
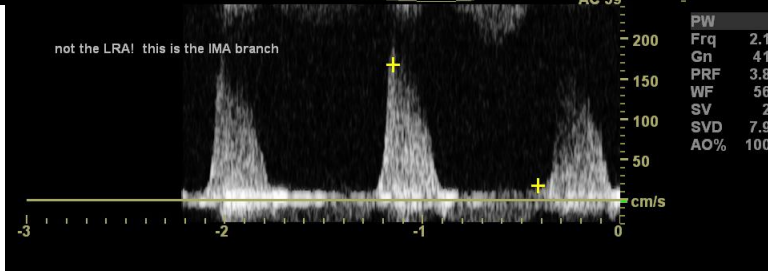
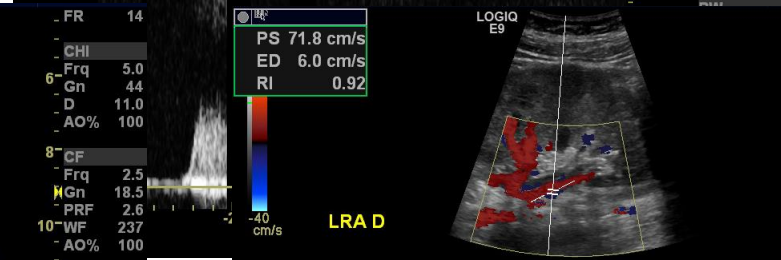
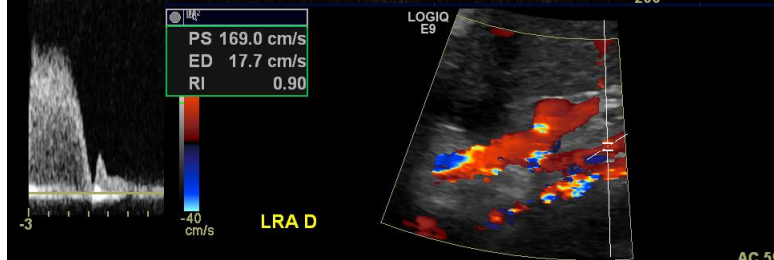
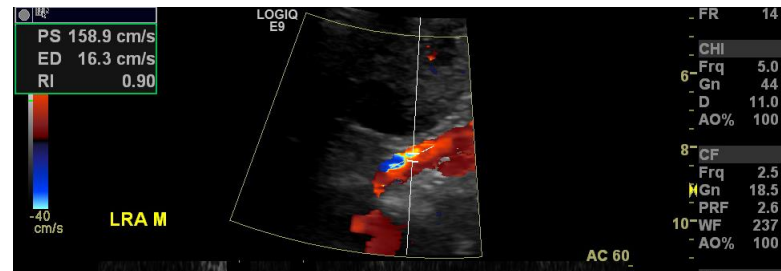
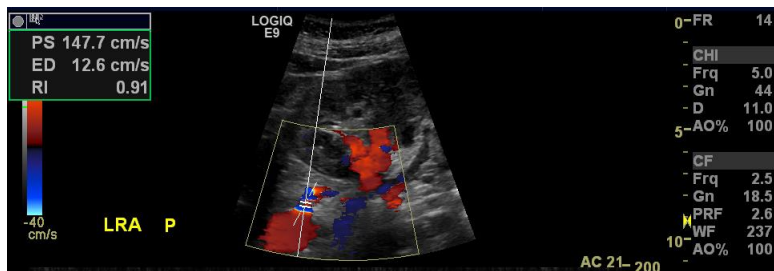
Which statement is correct?

1. This is a subcostal view of the right renal artery
2. There is marked turbulence in the mid and distal renal artery
3. There is a 60-99% stenosis of the right renal artery. The EDV of 164 cm/sec suggests a stenosis of greater than 80%
4. There is elevated velocity and turbulence in the mid and distal renal artery. The degree of stenosis cannot be determined



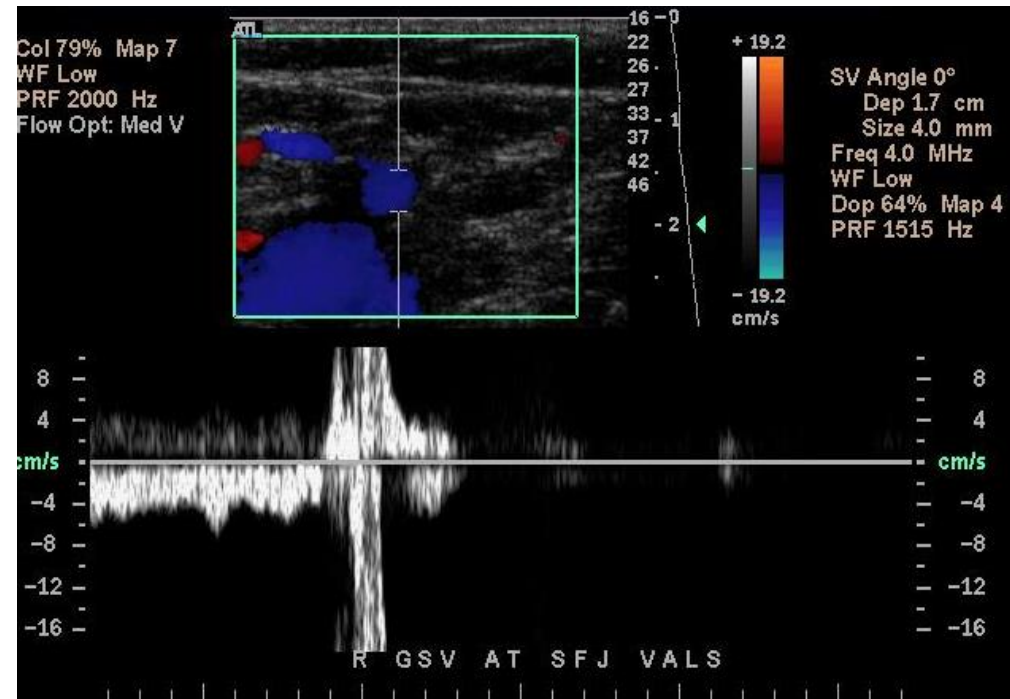
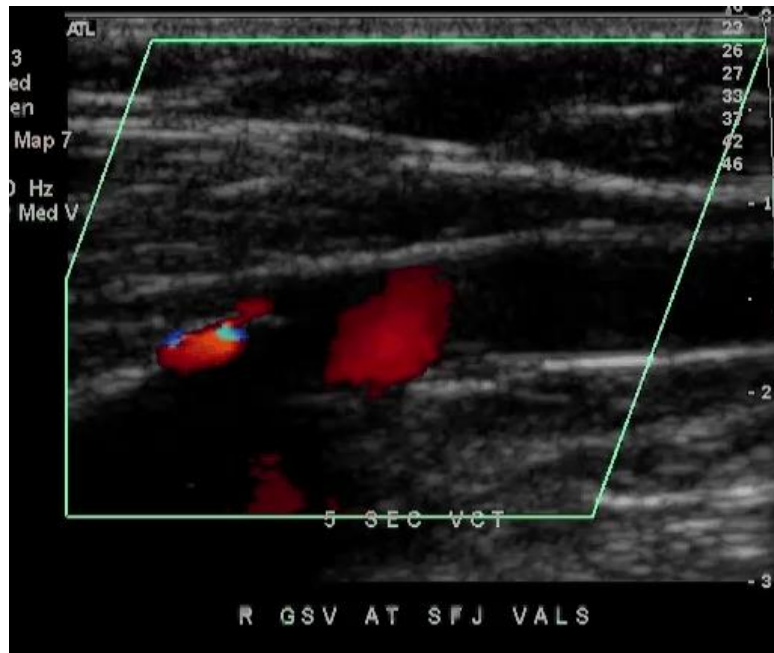


Same vessel, same day, different tech!

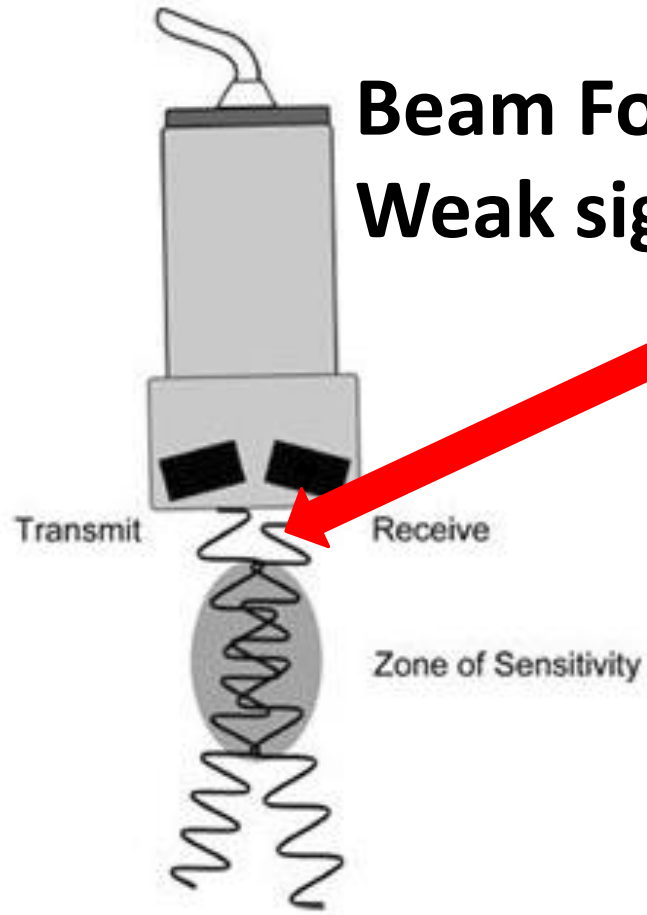


Mistaken Identity

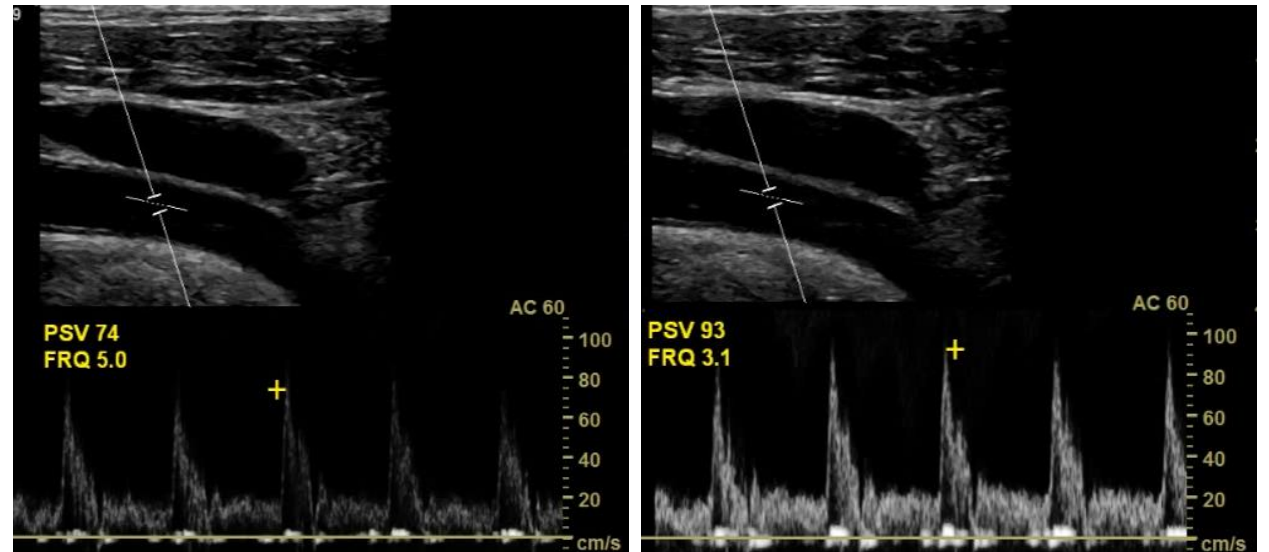
Mistaken Identity (sort of)

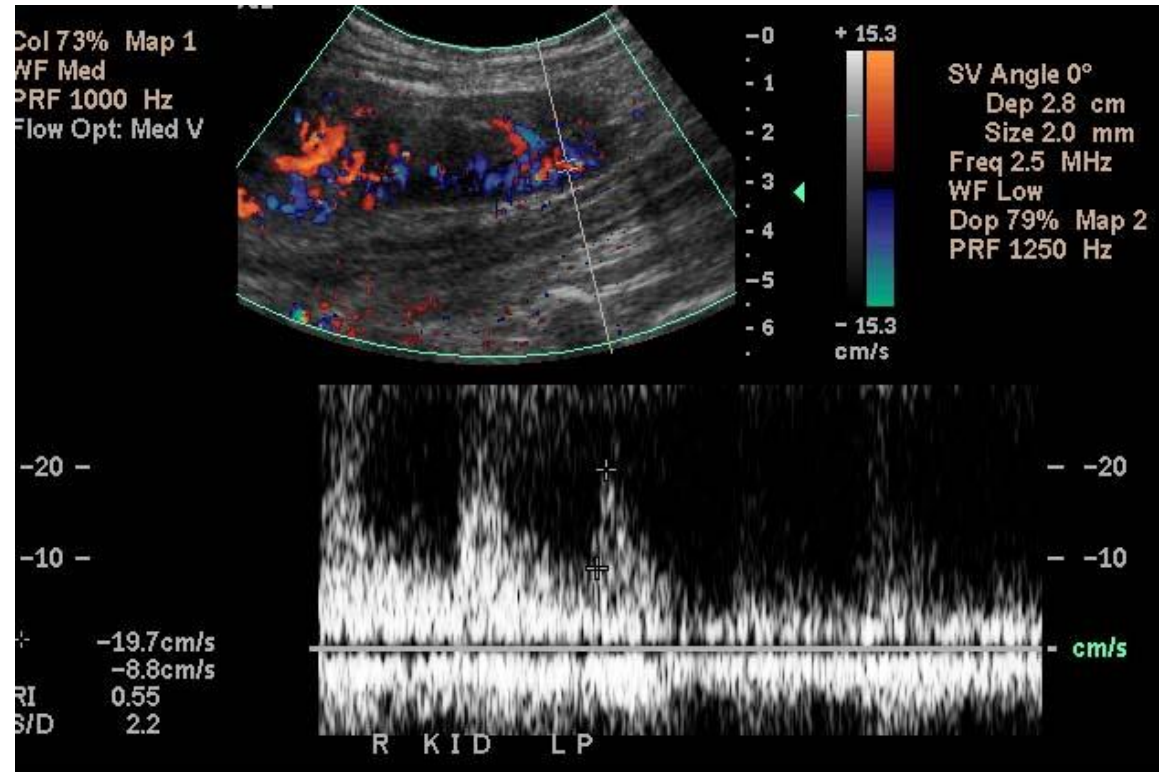


Beam Focus, Vessel Depth: Weak signal from superficial artery?



**Attenuation: Weak or NO
signal...Doppler frequency too high**



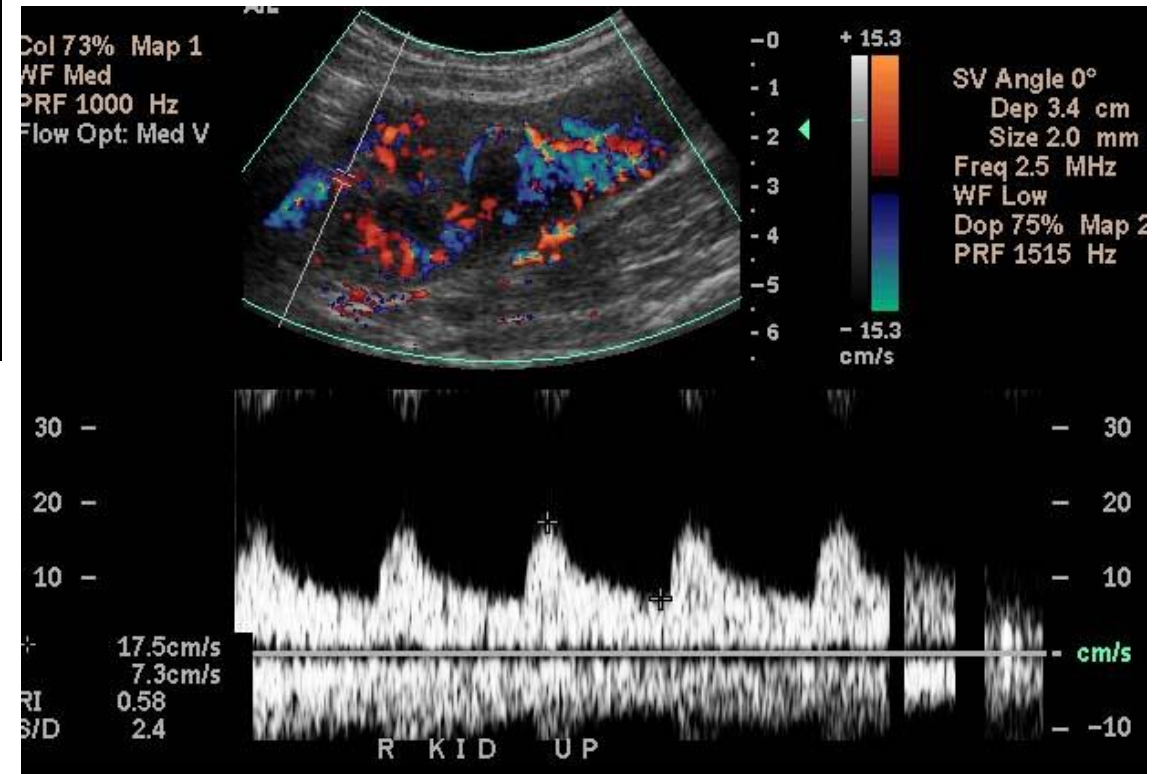


NO BREATH-HOLD

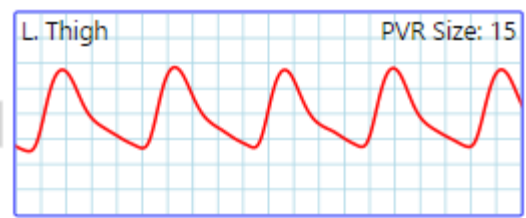
INACCURATE



WITH BREATH-HOLD



Left	
Brachial	151
Thigh	175 - 1.15
Calf	173 - 1.14
Ankle (PT)	171 - 1.13
Ankle (DP)	170 - 1.12

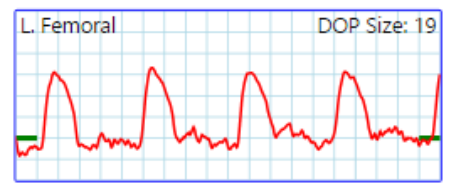
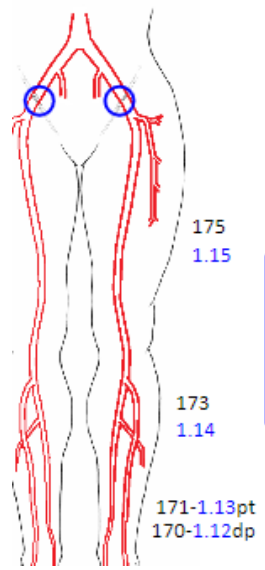


Normal thigh index, normal thigh PVR waveform, normal exercise ABI

Arterial Waveforms

Segmental BP

2 - Brachial - 151



What's wrong with the femoral CW Doppler waveform?

Interpreter may or may
not have all of the clues,
USE CAUTION!