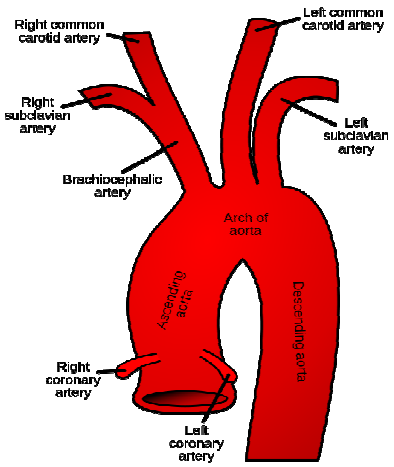
HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

Subclavian and Vertebral Arterial Duplex Case Presentation

Scott Manchester MGH Technical Director (Boston)

MASSACHUSETTS GENERAL HOSPITAL
FIREMAN VASCULAR CENTER

Anatomy



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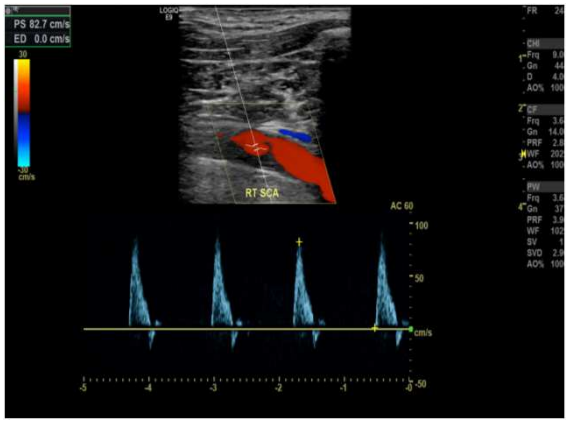
Normal Subclavian Artery Flow



- Laminar flow
- Sharp upstroke
- Sharp systolic peaks
- Little to no flow throughout the diastole
- Normal peak systolic velocity (PSV): 90–100 cm/sec

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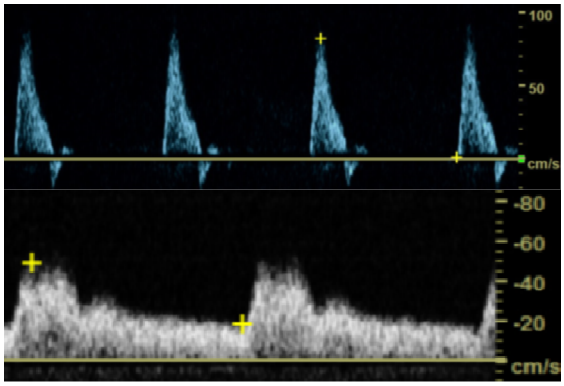
Subclavian Artery Doppler Spectral Waveform

HIGH RESISTANCE



LOW RESISTANCE

Diastolic flow
- Resistance to flow
- Demand of distal bed

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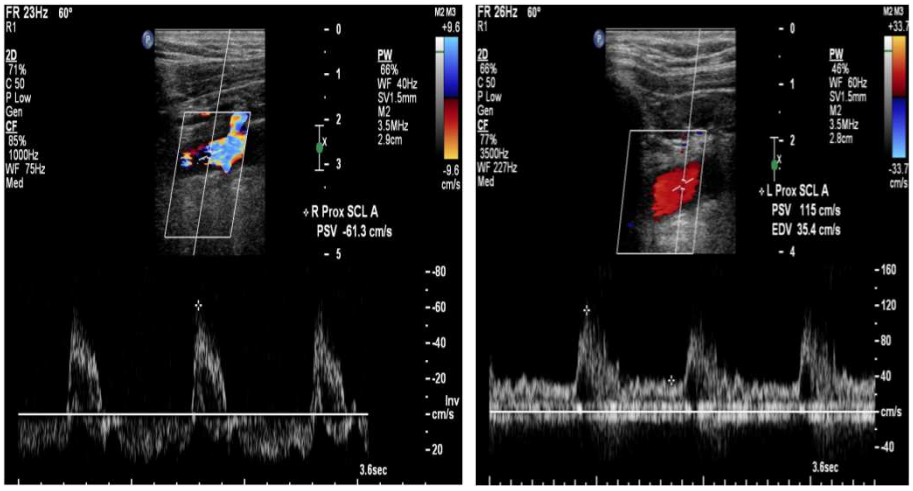
Subclavian Artery Flow Waveforms



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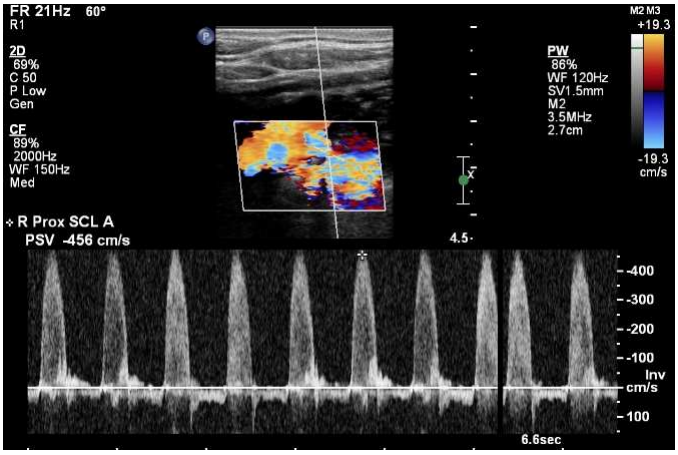
Subclavian Stenosis



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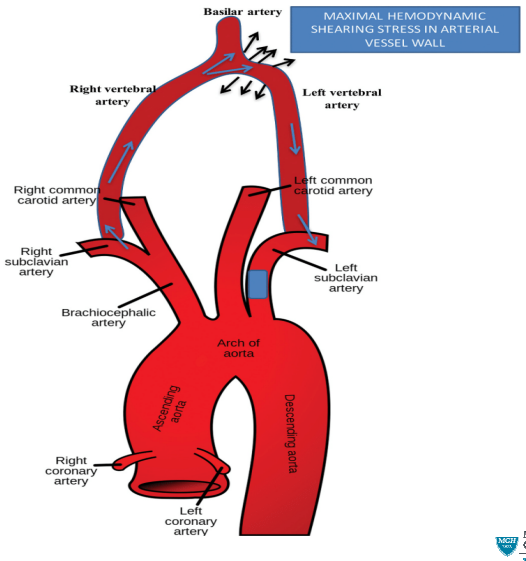
Subclavian Steal Physiology



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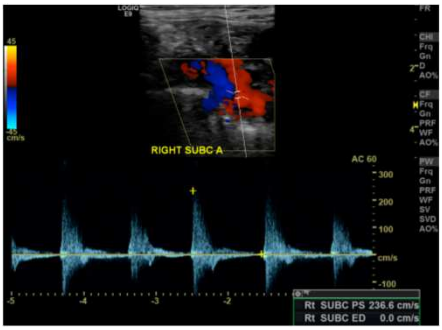
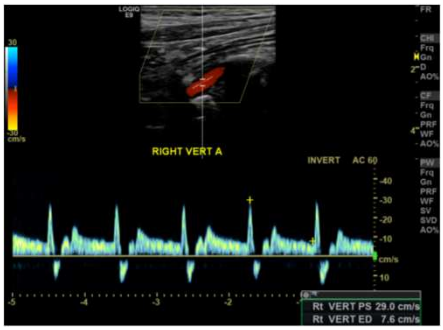
Waveforms often seen with Subclavian Steal





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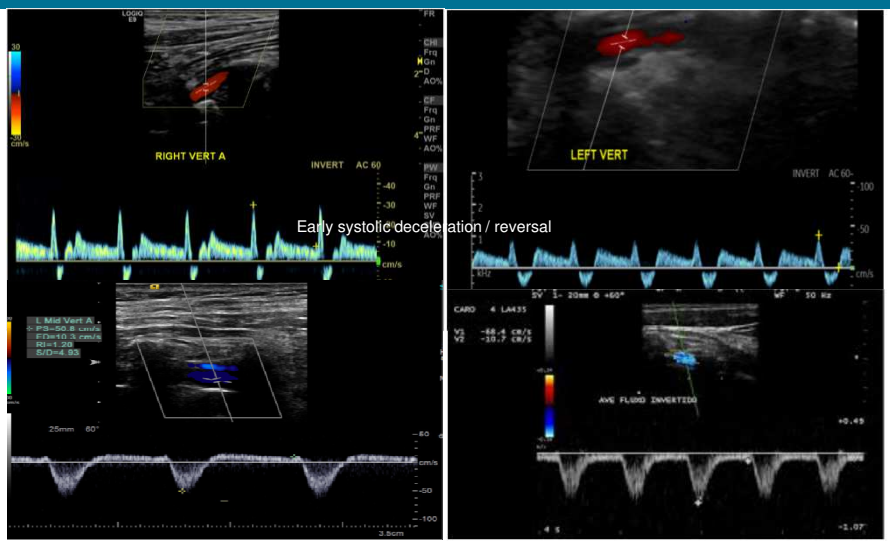
Vertebral Artery Flow Waveforms



Bidirectional flow in severe subclavian artery stenosis

Flow reversal

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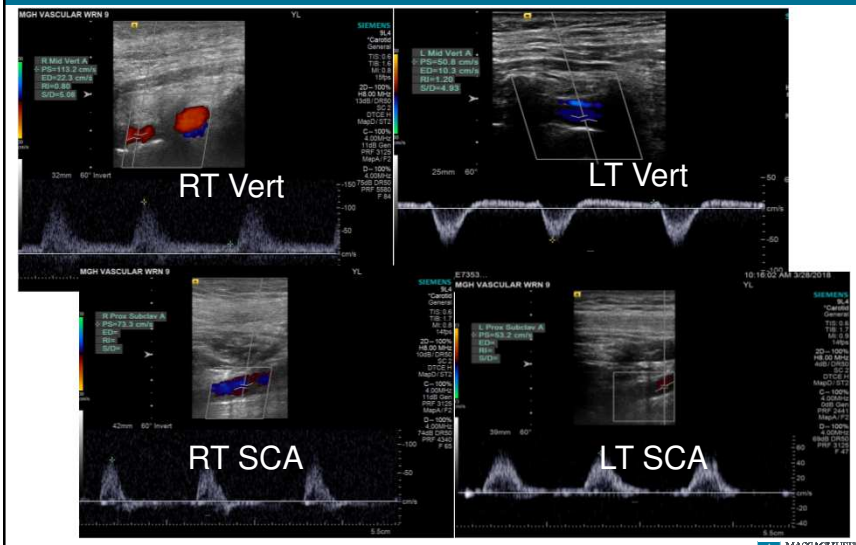
Subclavian Steal Physiology



BP:
RT
169/75
LT
115/71

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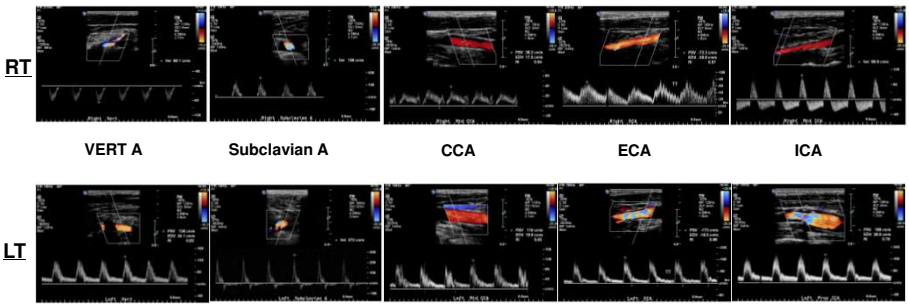
Innominate Artery Severe Stenosis



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Case 1

- 51-Year-Old Male. 6' 340 lbs.
- History: Type A aortic dissection s/p ascending aorta and hemi arch replacement in 2015. Residual distal arch and proximal descending thoracic aortic aneurysm w/ progressive degeneration.
- Pre-Op: L carotid-subclavian bypass + vert transposition prior to total arch replacement.
- Post-Op: left upper extremity pseudoaneurysm repair arising from the brachial artery.

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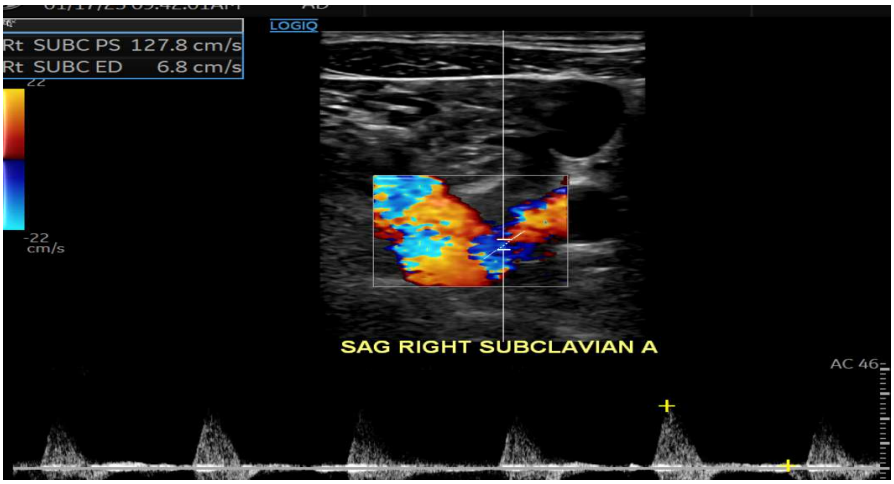
Carotid Ultrasound Pre op performed 1/23



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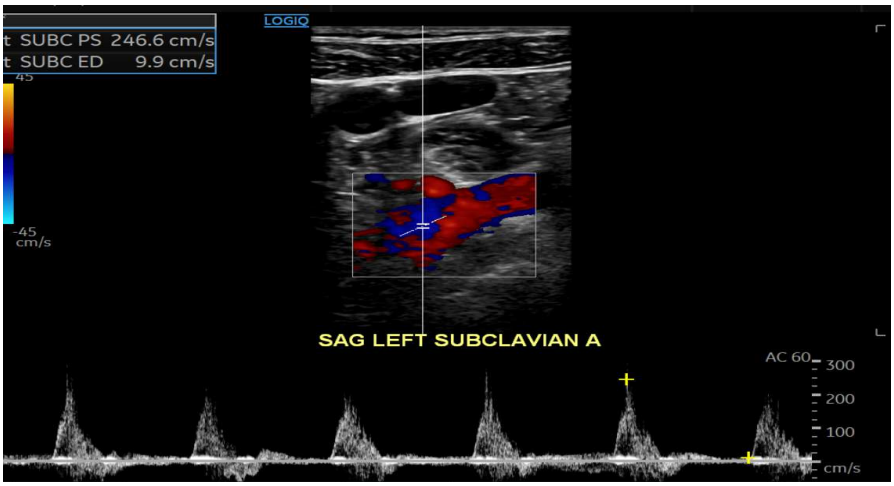
Carotid Ultrasound Pre op performed 1/23



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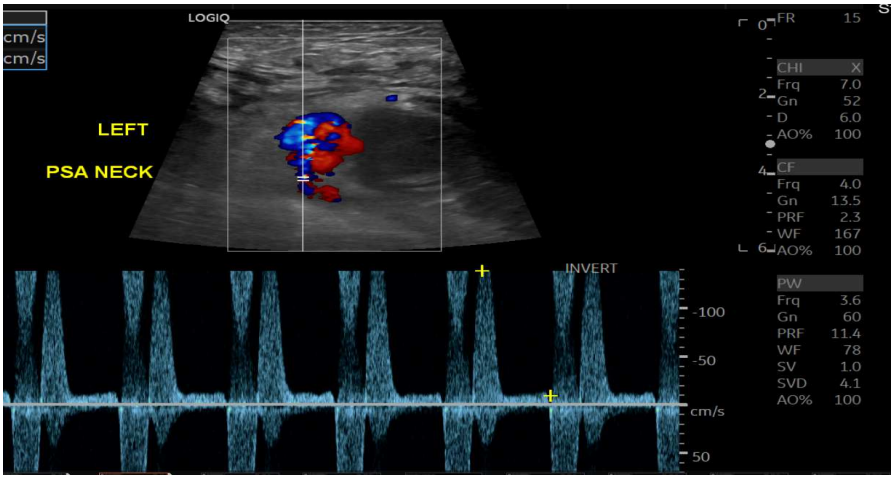

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Case 2

- 70-Year-Old Male 5’ 4” 160 lbs.
- History: Patient presented with stroke symptoms 8/19. At the time, received treatment with tPA and was found to have occluded left and right internal carotid arteries w/ distal flow. Current Smoker
- 1/2022 Underwent a Carotid Angio, Lower Extremity Angio and Coronary Artery Angio

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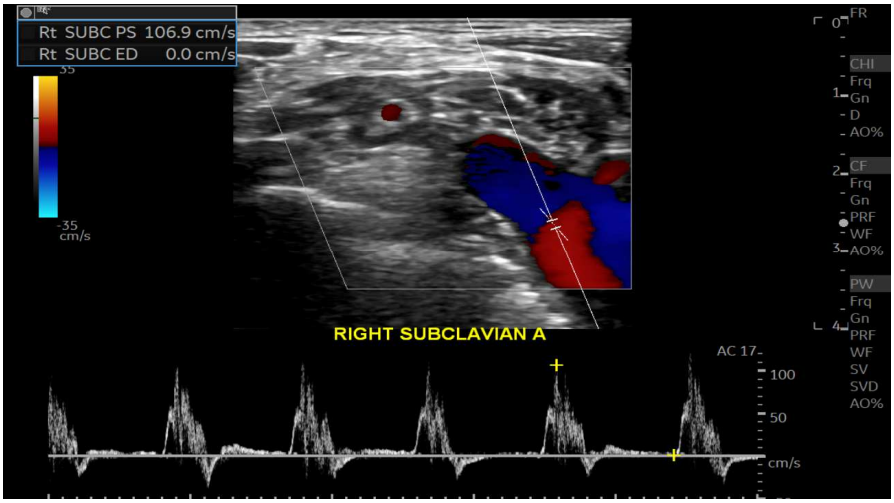
Carotid Ultrasound Performed 2/22



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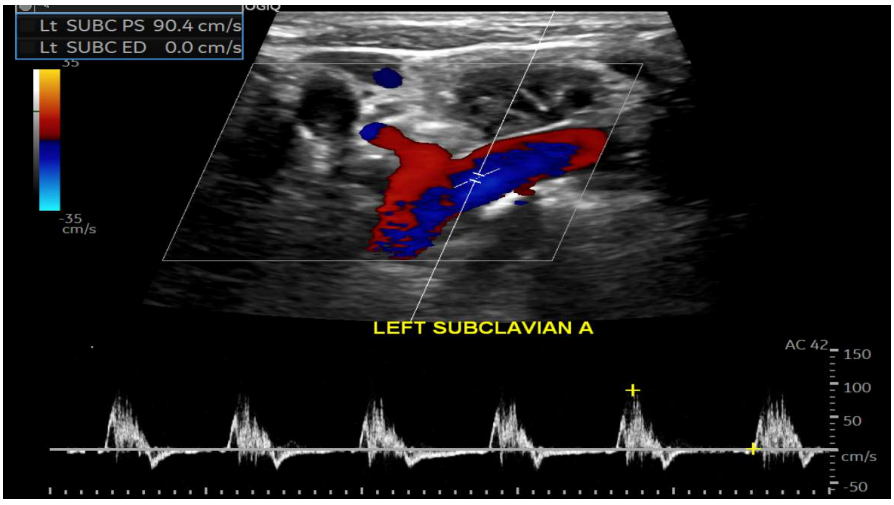
Carotid Ultrasound Performed 2/22



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Case 3

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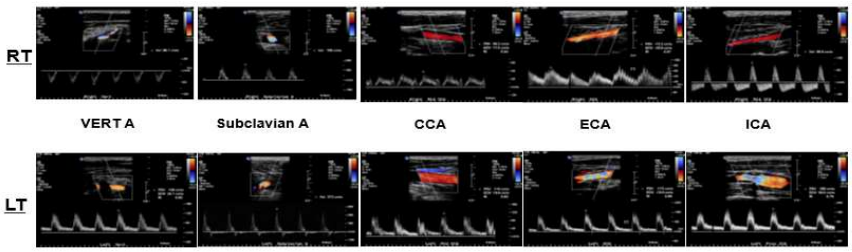
- History of Innominate artery stenosis, Bilateral carotid artery stenosis, Aorto-Bifemoral bypass, Atherosclerosis of nonbiological bypass graft of both lower extremities with intermittent claudication



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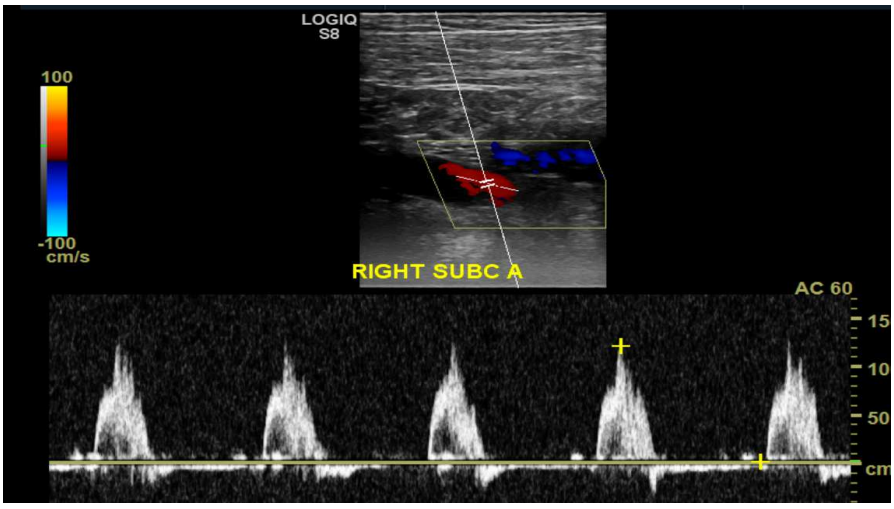
Carotid Ultrasound Performed 7/20



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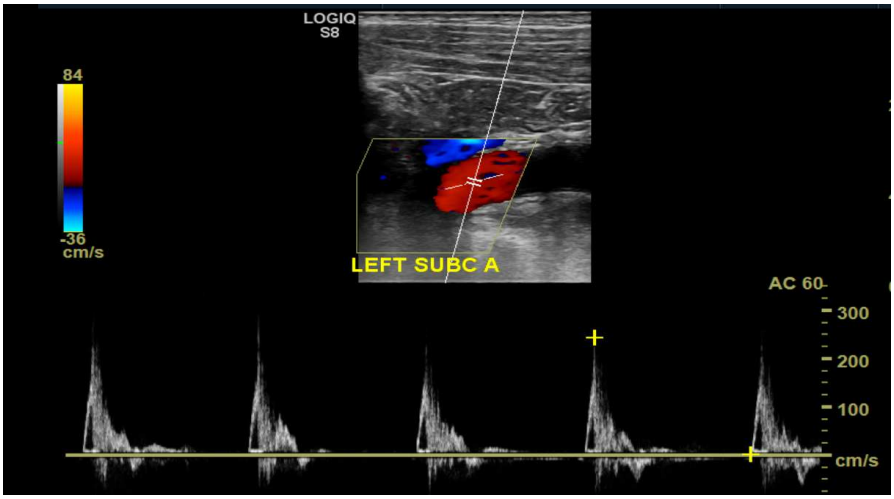
Carotid Ultrasound Performed 7/20



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Case 4

- 46-Year-Old Female 195 lbs.
- Bow-Hunter syndrome, evaluation including CT was unrevealing. She experiences dizziness when rotating the head.
- Lyme Disease

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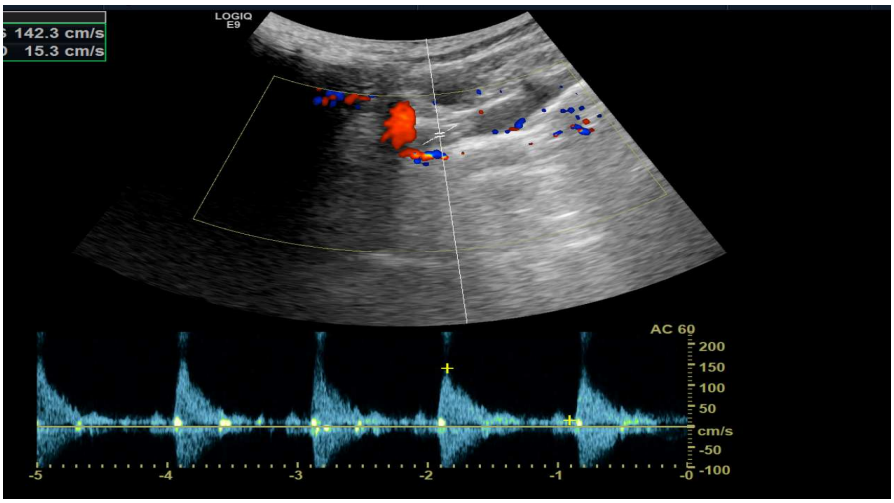
Carotid Ultrasound Performed 7/21



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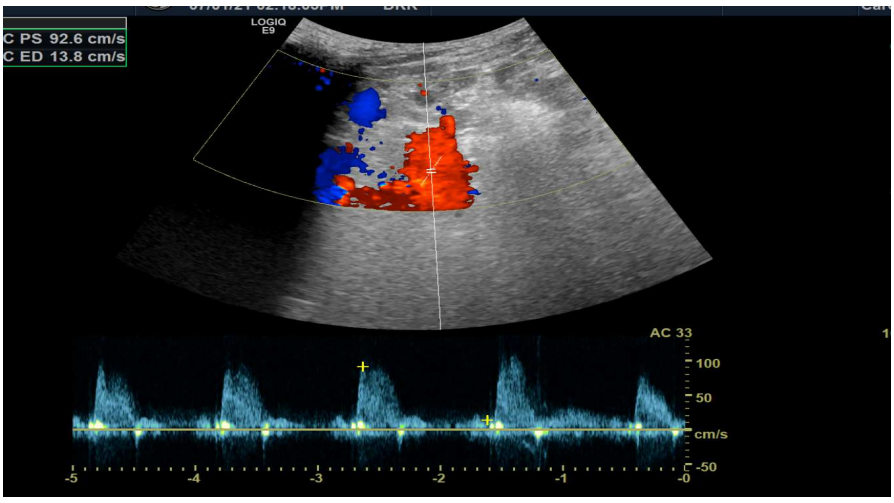
Carotid Ultrasound Performed 7/21



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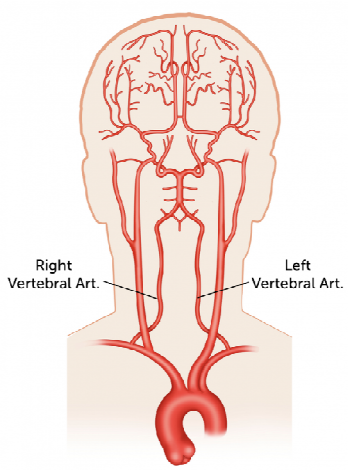
Anatomy



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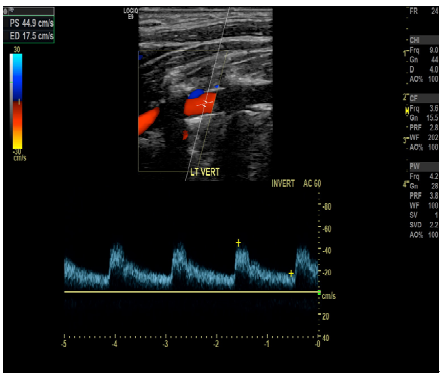
Normal Vertebral Artery Flow



- Laminar flow
- Narrow envelope of velocities
- Brisk upstroke
- Broad systolic peaks
- A large amount of flow throughout the diastole
- Normal peak systolic velocity (PSV): 20–60 cm/sec

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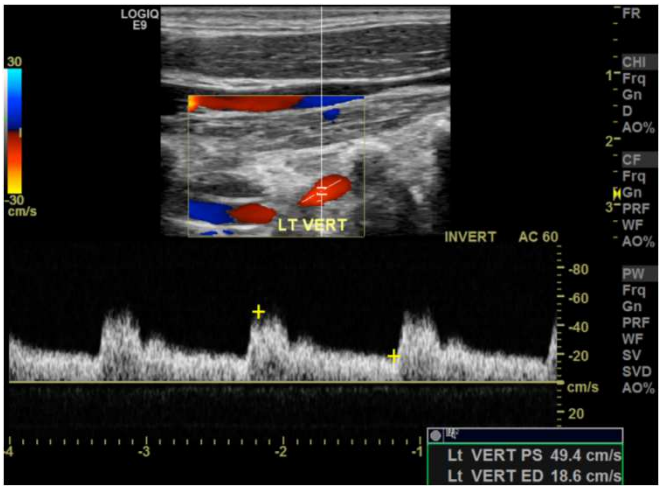
Spectral Broadening Flow Waveforms in Normal Vertebral Artery



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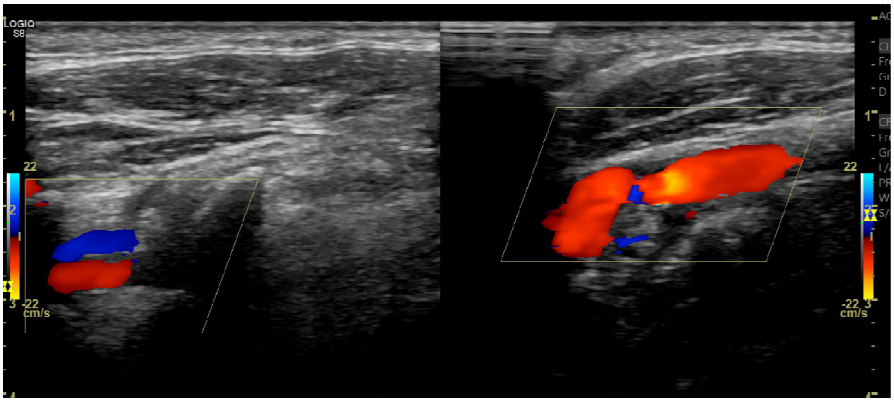
Flow Direction in Vertebral Artery



Vertebral Artery / Vein

CCA

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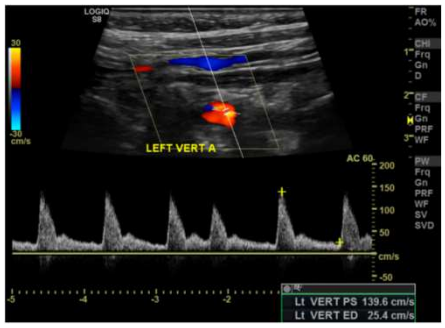
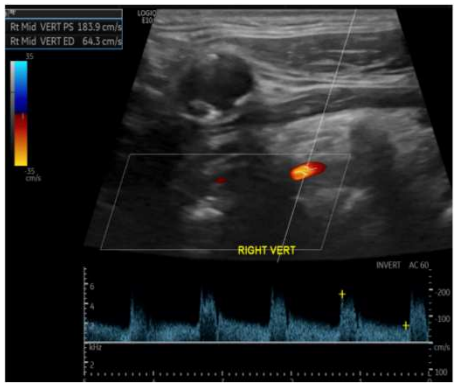
Vertebral Artery Stenosis



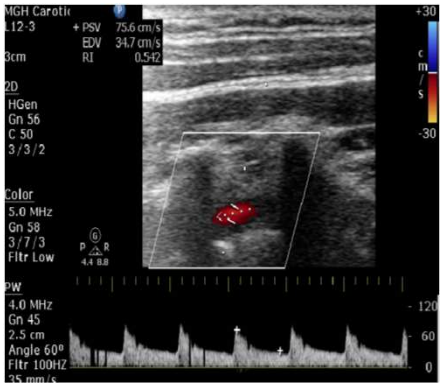
- PSV > 100 cm/sec

Vertebral Artery Stenosis

PSV 184
CM/SEC

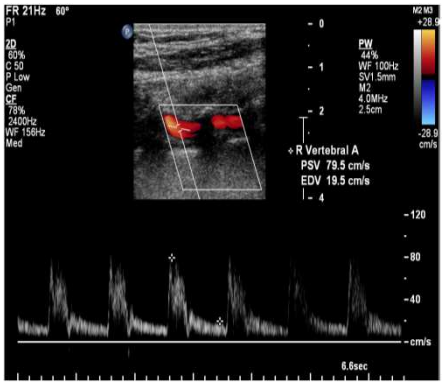


PSV 161
CM/SEC



Vertebral Artery Stenosis Cont.

Tardus Parvus flow waveforms



Post stenting:
Flow spectrum and velocity

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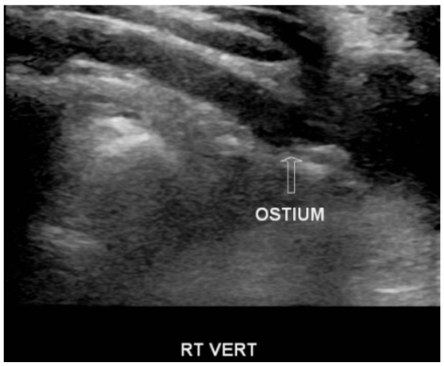
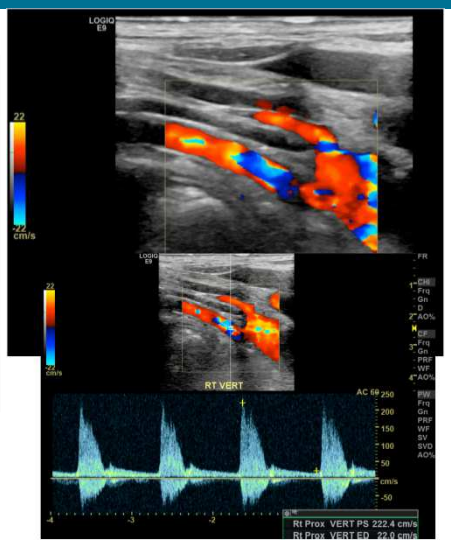
Vertebral Artery Ostium Stenosis – CTA confirmed



- Technically challenging
- 80% RT and 2/3 of the LT vert ostia can be visualized



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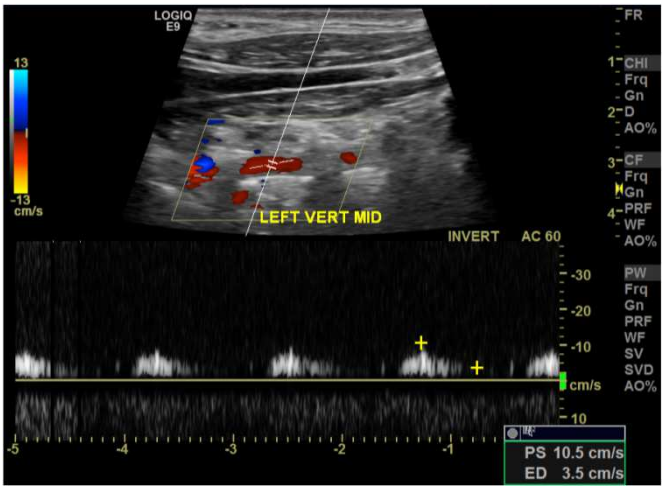
Vertebral Artery Ostium Stenosis



CTA: Confirmed Critical stenosis at ostium

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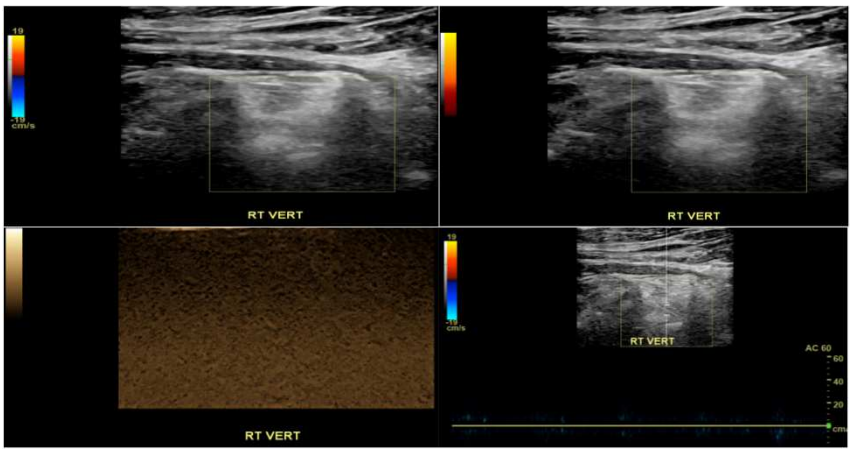
Vertebral Artery Occlusion on CTA since 2019



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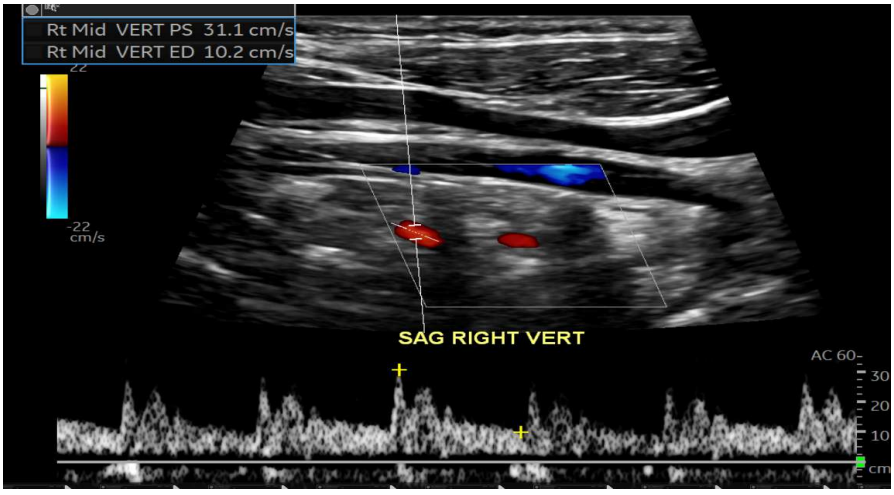
Carotid Ultrasound Pre op performed 1/23



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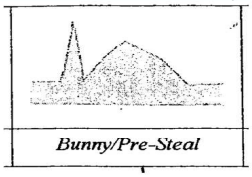
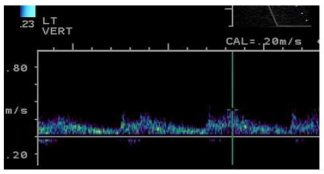
Latent or occult subclavian steal

Vertebral artery flow:

- **Initial systolic peak with antegrade flow**
- **Brief retrograde flow/ systolic deceleration or 'pre-steal"**
- **Prolonged antegrade diastolic flow**





Convert: to a complete steal with reactive hyperemia via a BP cuff applied for 3 min [with release] or arm exercise

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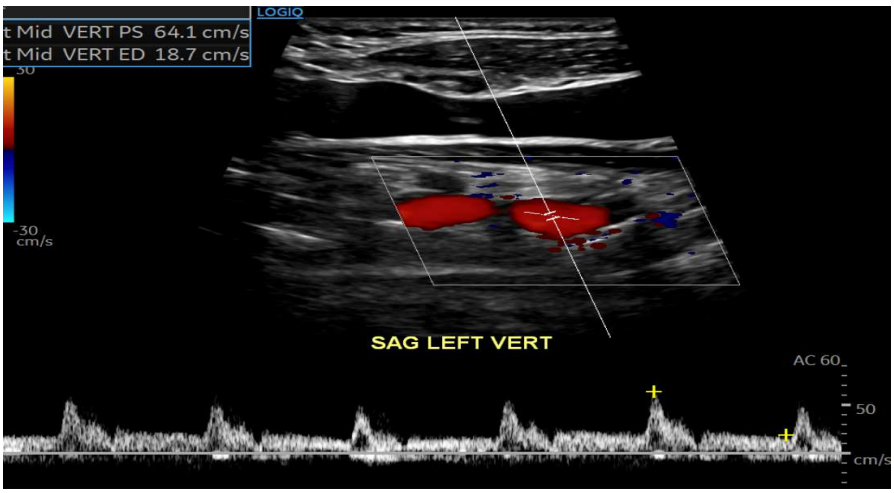
Carotid Ultrasound Pre op performed 1/23



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Case 2

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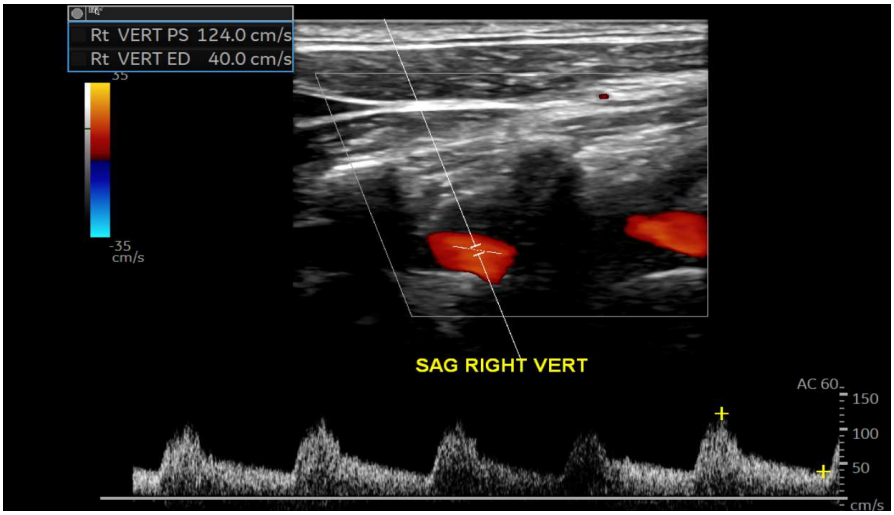
Carotid Ultrasound Performed 2/22



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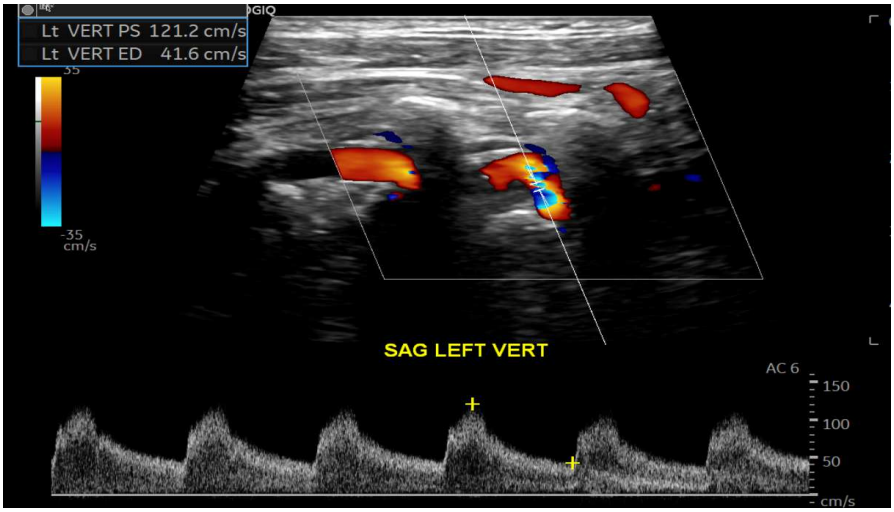

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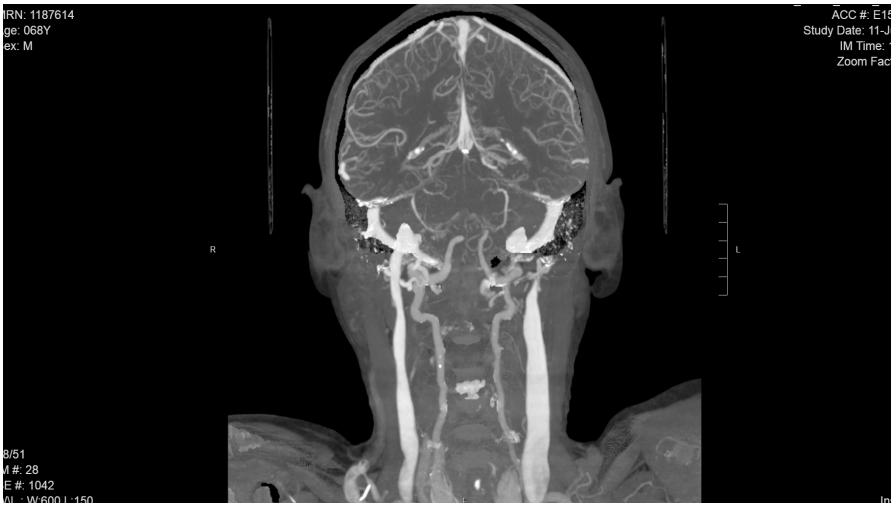
CT Performed 6/20



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Case 3

- 72-Year-Old Male 5’ 8” 170 lbs.
- History of Innominate artery stenosis, Bilateral carotid artery stenosis, Aorto-Bifemoral bypass Atherosclerosis of nonbiological bypass graft of both lower extremities with intermittent claudication
- Type 2: By Ultrasound
  - Vertebral artery- retrograde flow
  - Right common carotid artery- systolic deceleration

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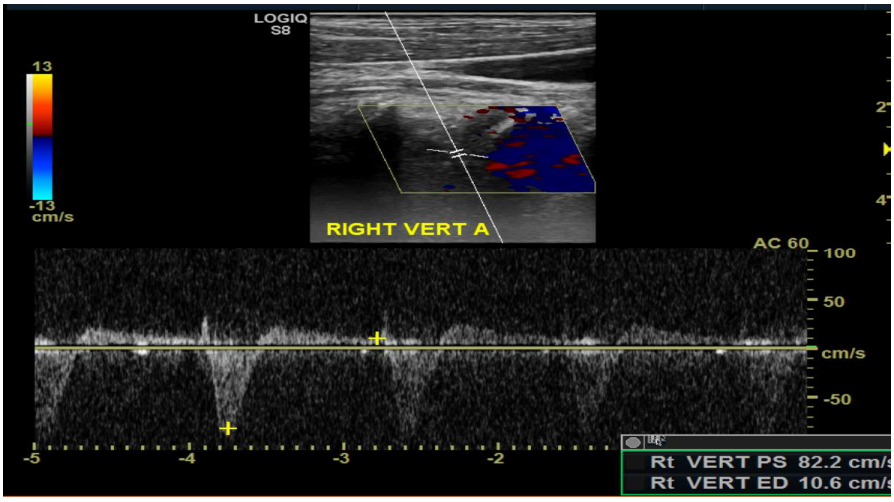
Carotid Ultrasound Performed 7/20



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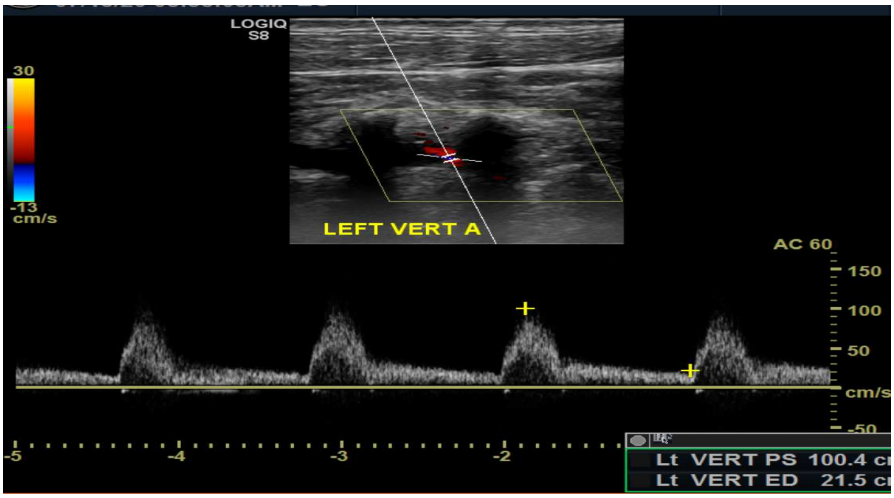

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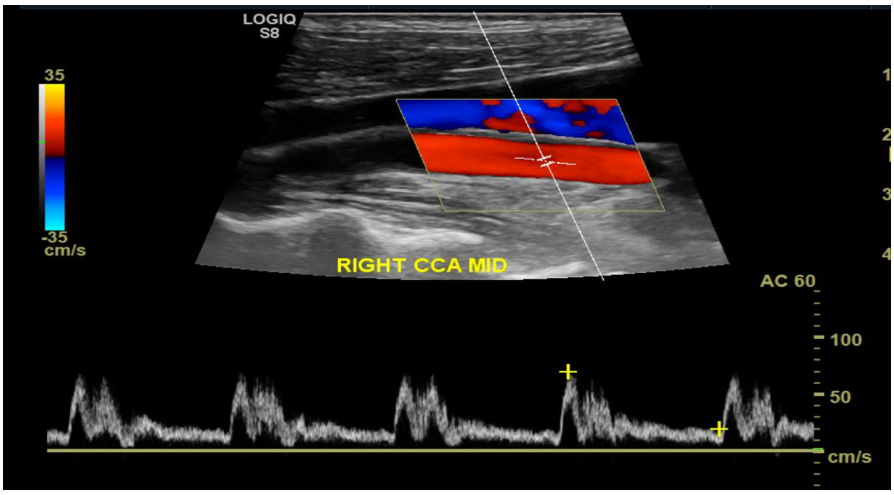
Carotid Ultrasound Performed 7/20



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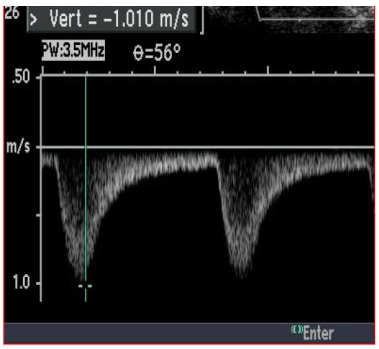
So, when you see….



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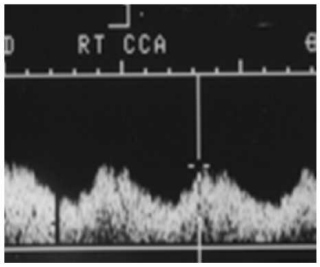

Think severe stenosis/occlusion of the innominate artery!!!

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Case 4

- 46-Year-Old Female 195 lbs.
- Bow-Hunter syndrome evaluation including CT was unrevealing. She experiences dizziness when rotating the head.
- Lyme Disease
- Bow Hunter's syndrome also known as Rotational Vertebral artery Syndrome (RVAS)
- Rotational vertebral artery syndrome, or colloquially "bow hunter syndrome," is **a rare cause of vertebrobasilar insufficiency**. In patients with bow hunter syndrome, rotation of the head and neck can lead to compression of the vertebral artery at the axial levels in the spine.

* On Exam Patient was symptomatic with head turned left. May suggest positional flow reduction or RVAS.

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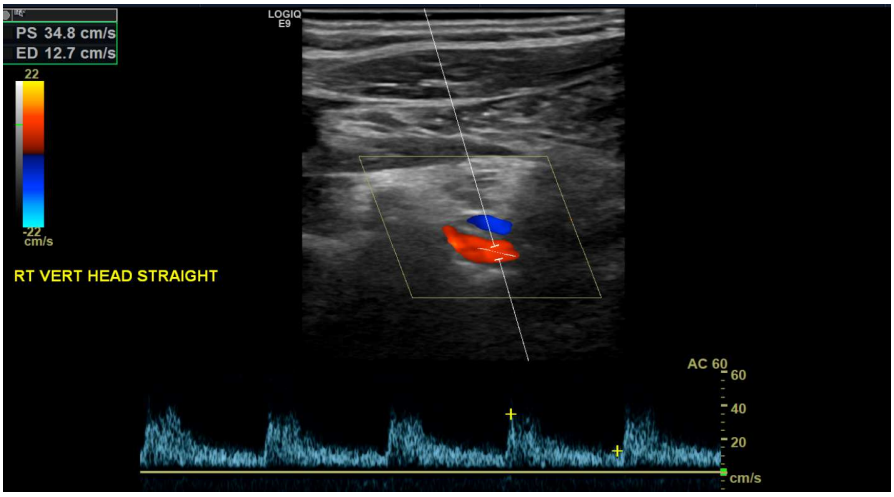
Carotid Ultrasound Performed 7/21



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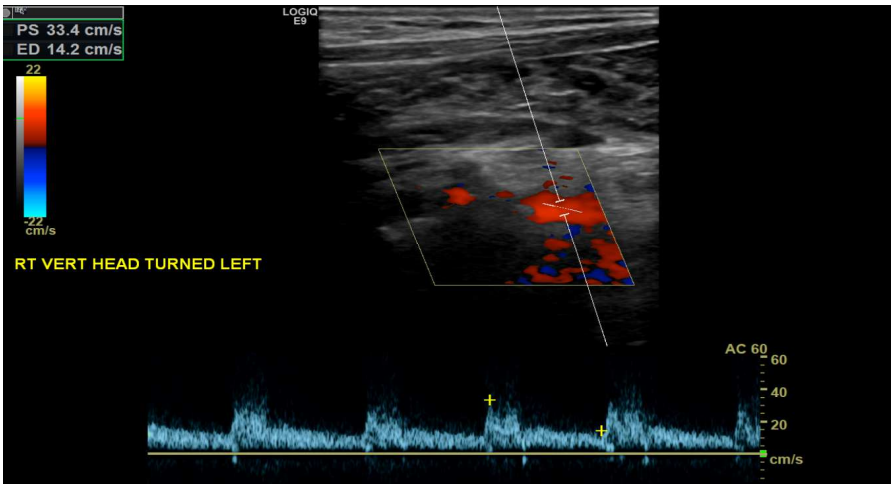
Carotid Ultrasound Performed 7/21



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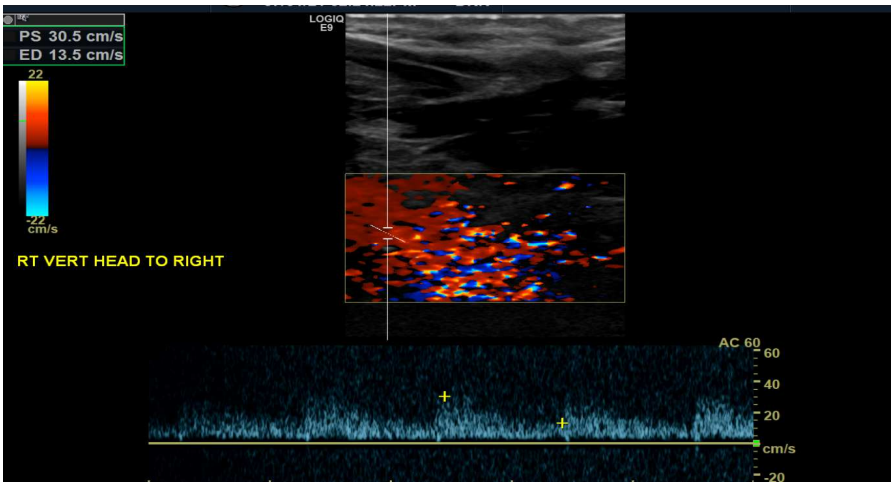
Carotid Ultrasound Performed 7/21



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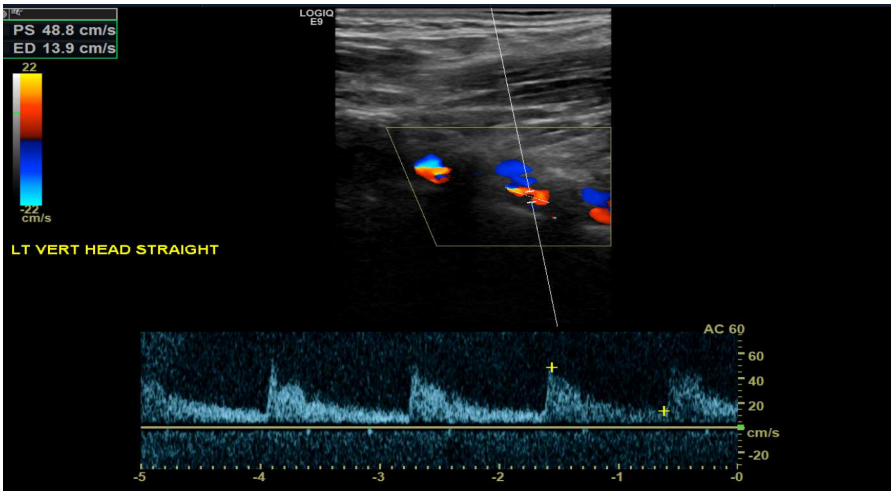

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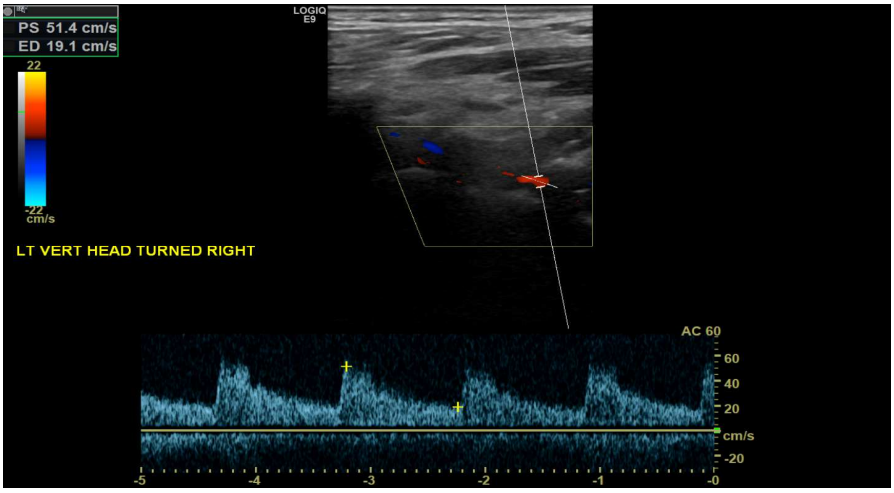

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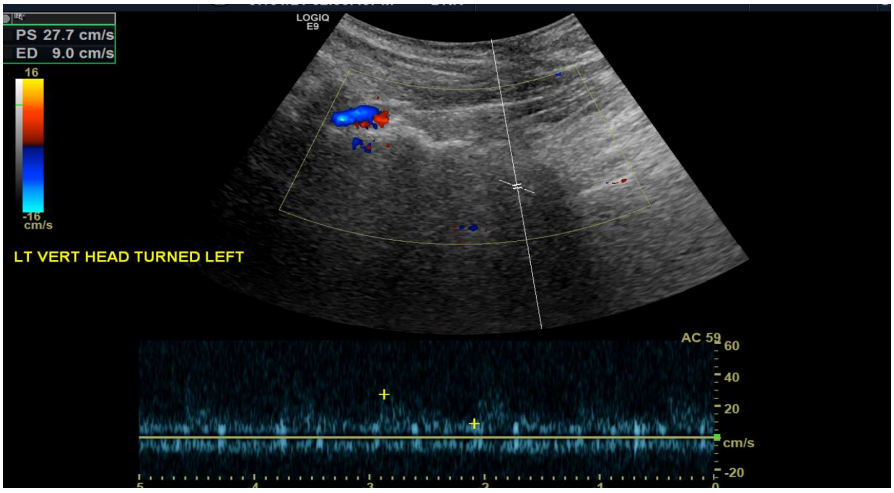
Carotid Ultrasound Performed 7/21



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