High-Yield Pathologies for the RPVI Exam

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Disclosures

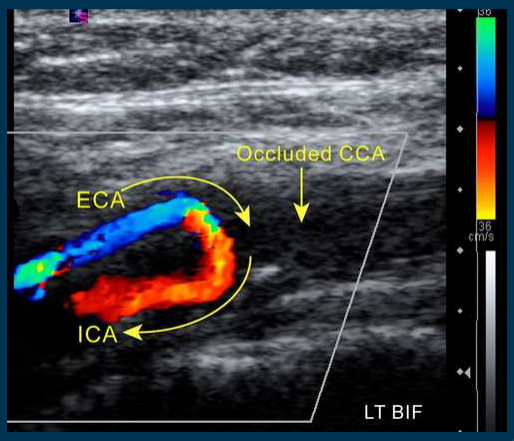
- No disclosures

Overview

- RPVI exam will include both common and uncommon findings on vascular lab studies
- Knowledge of the basics of vascular testing and diagnosis of common vascular conditions is critical to success on the exam
- My objective: discuss specific interesting findings which are likely to appear on the exam

Common Carotid Artery Occlusion

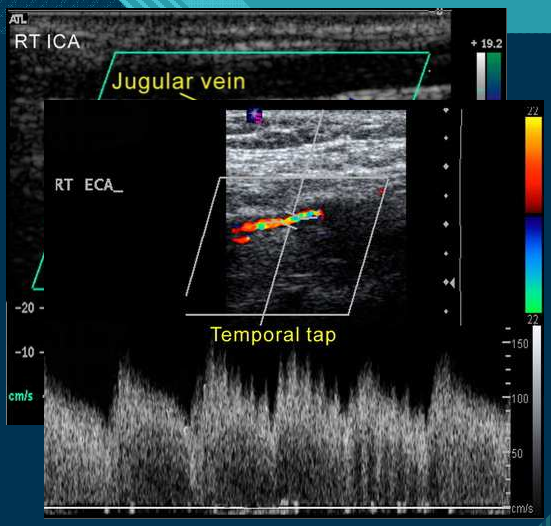
- No color flow in CCA
- Antegrade flow in ICA
- Retrograde flow in ECA
- Pay attention to color flow direction!
- Power Doppler can help identify slow flow vs. no flow



https://pubs.rsna.org/doi/10.1148/rg.256045013

Internal Carotid Artery Occlusion

- Antegrade flow in CCA and ECA
- No flow in ICA
  - "Water hammer" Doppler waveform
- With chronic occlusion: "internalized" ECA waveform
  - ECA-ICA collaterals (e.g. periorbital) form over time, increasing diastolic flow in ECA
  - Temporal tap distinguishes ICA from ECA



https://pubs.rsna.org/doi/10.1148/rg.256045013

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Cardiac Pathology on Carotid Duplex

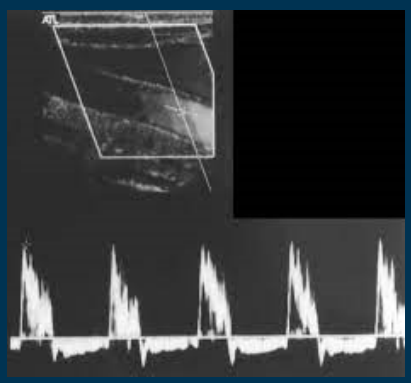
Aortic Stenosis:

Minimal plaque, tardus parvus waveforms throughout

https://pubs.rsna.org/doi/10.1148/rg.256045013

Aortic Insufficiency:

Diffuse pattern of reversal of flow after systolic upstroke



https://www.ajronline.org/doi/10.2214/ajr.181.6.1811695

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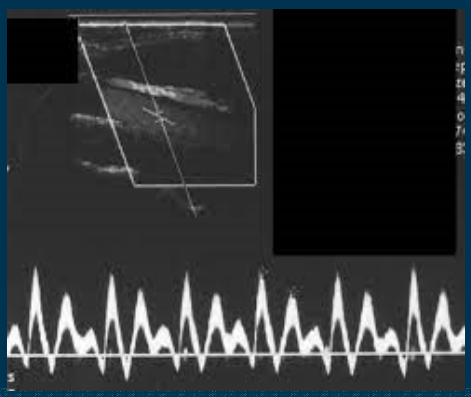
Cardiac Pathology on Carotid Duplex (cont.)

Intra-Aortic Balloon Pump:

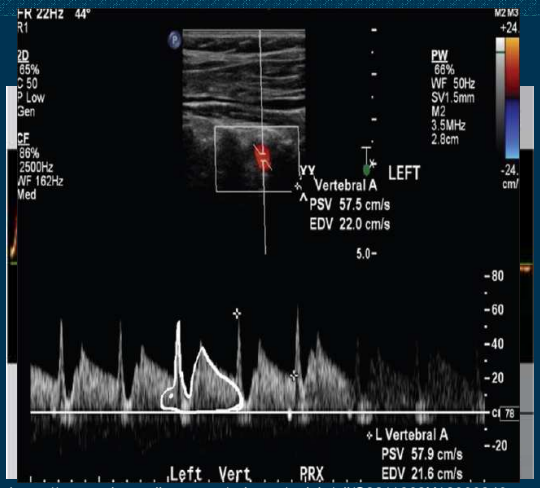
Diffuse pattern of multiple upstrokes per cardiac cycle



https://www.ajronline.org/doi/10.2214/ajr.181.6.1811695

Takeaway: when all the carotid waveforms are similar, look at the heart

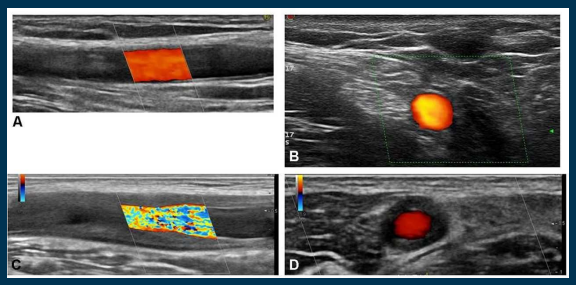
Vertebral Waveform in Subclavian Steal



https://www.sciencedirect.com/science/article/pii/S2211968X12000940
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6380121/

- Pre-steal waveforms show diminished and then reversed flow just after systolic upstroke
- Alternating flow eventually progresses to complete retrograde flow
- "Crouching bunny sign": pre-steal bisystolic vertebral artery waveform

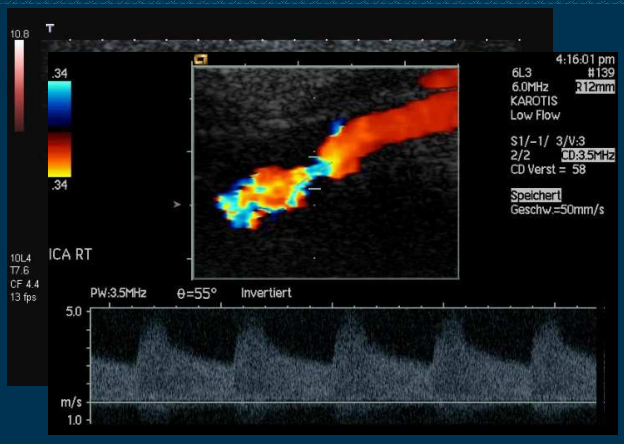
Temporal Arteritis



https://rmdopen.bmj.com/content/4/1/e000598

- "Halo sign" in transverse view: edema in the vessel wall from inflammation
- Can see associated stenosis (turbulent high-velocity flow) or occlusion

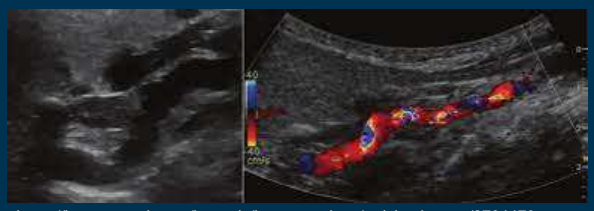
Carotid Fibromuscular Dysplasia



https://cardiovascularultrasound.biomedcentral.com/articles/10.1186/1476-7120-2-7

- "String of beads" pattern of alternating stenoses and dilatations
  - Sometimes best seen on power Doppler
- Usually localized to mid- to distal-cervical ICA
- Identified stenoses are typically not in the proximal ICA, where atherosclerotic lesions are usually found

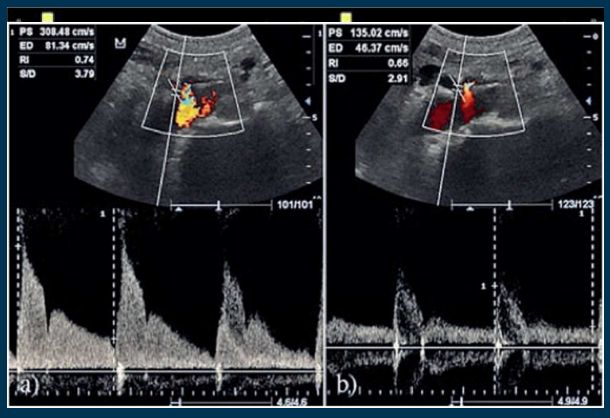
Renal Fibromuscular Dysplasia



https://jamanetwork.com/journals/jamaneurology/article-abstract/2704470

- Similar string-of-beads pattern
- Similarly localized to mid- to distal renal artery, in contrast to atherosclerotic renal artery stenosis

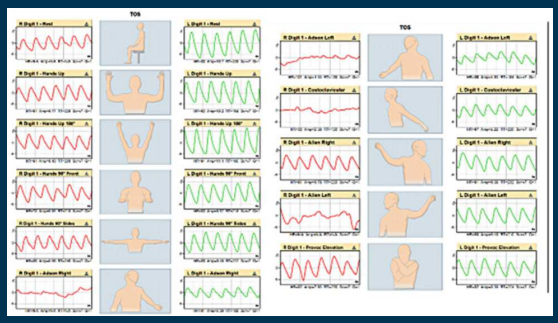
Median Arcuate Ligament Syndrome (Celiac Artery Compression Syndrome)



https://journals.sagepub.com/doi/10.1177/8756479314528753

- During inspiration: artery moves down, no compression by median arcuate ligament
- During expiration: artery moves up and becomes kinked against median arcuate ligament
- Color flow and Doppler waveforms will demonstrate increase in velocities and turbulent flow on expiration, which normalize on inspiration

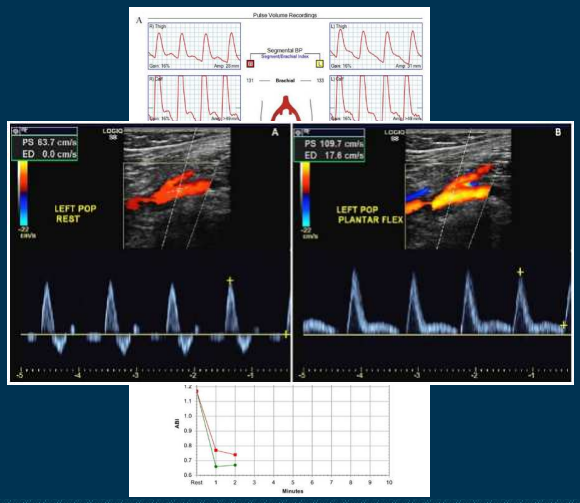
Thoracic Outlet Syndrome



AbuRahma AF, Perler BA. Noninvasive Vascular Diagnosis: A Practical Textbook for Clinicians (Fifth Edition), p637. 2022.

- Positional changes in upper extremity arterial flow, best measured by digital PPG waveforms
- Various provocative positions can be performed
- A useful adjunct to help with diagnosis of neurogenic TOS

Popliteal Entrapment Syndrome



https://journals.sagepub.com/doi/10.1177/1358863X18822750
https://journals.sagepub.com/doi/10.1177/1358863X19871343

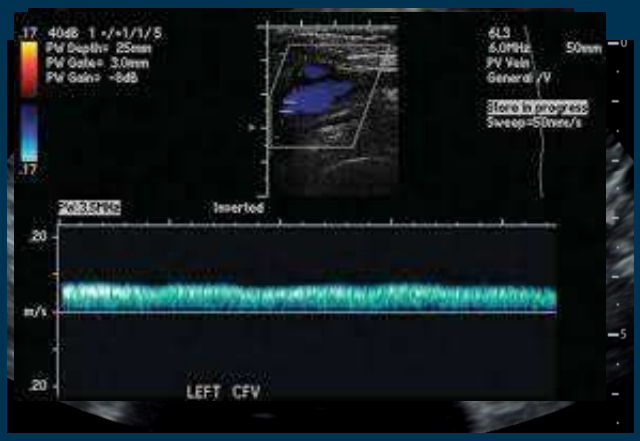
- Physiologic testing shows intermittent claudication physiology, but in younger patients without risk factors for PAD
- Duplex ultrasound of the popliteal artery shows abnormal waveforms with provocative maneuvers (active ankle plantarflexion and/or dorsiflexion)
- In later stages with artery damage, abnormal ABI, PVR waveforms, Doppler waveforms can be seen even at rest

Dialysis-Associated Steal Syndrome

- Physiologic testing: blunted/flattened finger PPG waveforms and pressures, which improve with AVF/AVG compression
- Bidirectional flow or complete reversal of flow in arteries distal to AVF/AVG

https://www.uptodate.com/contents/hemodialysis-access-induced-distal-ischemia
https://www.ajronline.org/doi/10.2214/AJR.09.2899

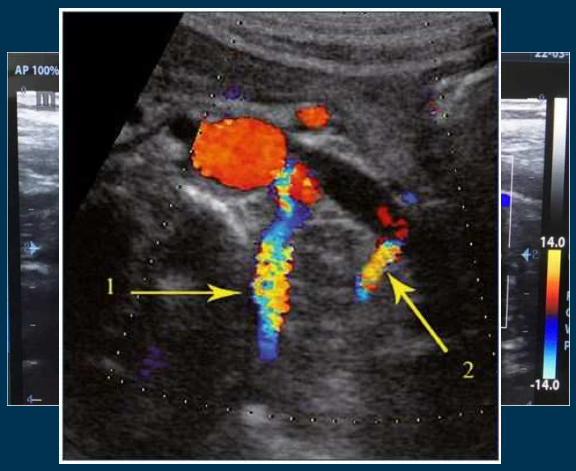
May-Thurner Syndrome (Left Iliac Vein Compression)



- Compression of left CIV between right CIA and the spine
- Narrowed flow channel, turbulent flow, increased velocities in the L CIV
- Loss of phasic waveform in L CFV distal to the stenosis

https://jetem.org/may-thurner/
https://www.ardms.org/may-thurner-syndrome-what-sonographers-should-know/
https://onlinelibrary.wiley.com/doi/abs/10.7863/jum.2007.26.7.885

Nutcracker Syndrome (Left Renal Vein Compression)

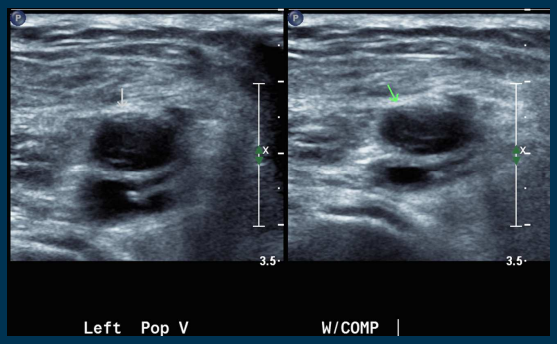


- Compression of LRV between SMA anteriorly and aorta posteriorly
  - "Bird's beak" appearance
- Increased velocities and turbulent flow in the area of compression
  - Dilated LRV to the left of this area
- Retrograde flow in L gonadal vein (can be linked to pelvic congestion syndrome) or other venous collaterals

https://bmcnephrol.biomedcentral.com/articles/10.1186/s12882-019-1508-6
https://www.phlebolymphology.org/duplex-ultrasound-investigation-in-pelvic-congestion-syndrome-technique-and-results/

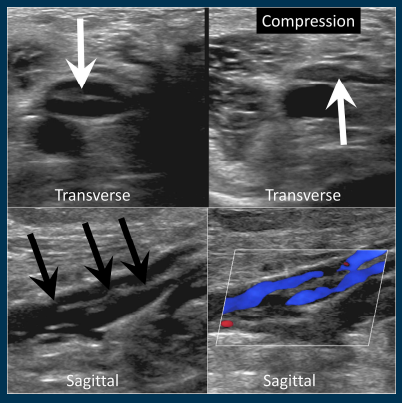
Acute vs. Chronic Deep Vein Thrombosis

Acute



https://www.acc.org/education-and-meetings/patient-case-quizzes/dvt-in-a-patient-with-a-complex-medication-regimen

Chronic



https://onlinelibrary.wiley.com/doi/abs/10.1002/jum.14776

Acute vs. Chronic Deep Vein Thrombosis

Acute	Chronic
• Hypoechoic	• Brightly echogenic
• Smooth borders	• Irregular borders
• Spongy	• Rigid
• Vein is enlarged	• Vein is small
• Collaterals are small	• Collaterals are large

Summary

- Be prepared on the RPVI exam for uncommon conditions and their appearance on vascular testing
- When in doubt, go back to basics: describe what you see in the images and think about the physiology that could cause it

Thank You