Disclosures:

I have no disclosures.
Objectives

• The what and the why:
  – Overview of upper extremity arterial pathophysiology
    • Review Anatomy

• The how:
  – Basic technique for physiological assessment
  – Technique for TOS, digits, Raynaud’s, Allen’s test
  – Basic technique for duplex evaluation of conduit arteries
Anatomy

• We are not symmetrical
Anatomy

• We are not symmetrical

• Look for anomalous high bifurcation of brachial artery
Anatomy

• Where does the axillary artery start?
• Technically the lower border of the 1\textsuperscript{st} rib
• Practically, the distal edge of the clavicle
Anatomy

• Where does the axillary artery start?
• Technically the lower border of the 1\textsuperscript{st} rib
• Practically, the distal edge of the clavicle
  – Has three parts in relation to pectoralis minor muscle
    • 1\textsuperscript{st} part is proximal (medial) to pectoralis minor
    • 2\textsuperscript{nd} part is deep to muscle
    • 3\textsuperscript{rd} part is distal (lateral) to muscle
• Becomes brachial artery at lower border of teres major
Anatomy
Clinical Manifestations of Arterial Compromise in the upper extremity

• Classic signs/symptoms of peripheral vascular disease:
  – Symptoms with use (claudication)
  – Symptoms at rest
  – Tissue loss/gangrene

• Signs of embolic phenomena

• Signs of Nonvascular etiology (compression, vasospastic)
Duplex Examination of UE Arteries

• Same criteria as for LE
  – 2 X PSV step up = 50-99% stenosis
  – 3X PSV step up = 75-99% stenosis

• Post stenotic turbulence

• Change in waveform profile

• Upper extremity arteries more “multiphasic”
Other Indications for Duplex of UE

- Acute ischemia (time line permitting)
- Abnormal vertebral waveform/Subclavian bruit
- Arm pressure asymmetry right vs left >20mmHg
- PSA or bruit S/P arterial access
  - Common access for cardiac and peripheral angiography
- Evaluate inflow for dialysis access
Thoracic Outlet Syndrome

• Caused by compression of brachial nerve plexus/subclavian artery/subclavian vein
  – Symptoms can be variable

• Thoracic outlet may become smaller:
  – Growth, Posture, Slack joints (pregnancy)
  – Muscular hypertrophy (athletes)
  – Change in routine habits (new job requiring repetitive motion)

• 1st rib often contributes to problem (can be congenital spare)
Extra First Rib
Thoracic Outlet

- Arterial TOS is uncommon (~1% of cases of TOS)
- The subclavian artery is least effected by compression
  - High transmural pressure withstands extrinsic force better than vein or nerve
- Chronic compression leads to injury/aneurysm
- Presenting symptoms more likely to be embolic in nature
- If arterial study is ordered **LOOK AT VEINS** also
Testing for TOS

• Duplex serves to evaluate for chronic changes
  – Aneurysm
  – Post stenotic dilation
  – Chronic embolization of distal arteries
• Duplex not useful in evaluating hemodynamic changes caused by provocative maneuvers
• PPG more sensitive than duplex
  – Less prone to movement artifacts
  – Looking for the abnormal flow in the symptomatic position
Testing for TOS

• Apply PPG to finger and tape cable to avoid motion
• Perform provocative maneuvers
  – Rest
    • Head left and right
  – Arms adducted
    • Head left and right
  – Adson’s* maneuver
    • Head left and right
  – Symptomatic position
Adson’s* Test: A cynic’s def^n

• The contorting of the upper extremity in an unnatural position in order to elicit a desired result.

• Specific but not sensitive
Obstructive Disease:
Atherosclerosis & Arteritis

- Atherosclerosis occurs at branch points
  - Looks heterogeneous
- Arteritis can occur anywhere
  - Looks hypoechoic and homogeneous
  - Axillary artery can be involved in GCA
  - Very easy to see – add it to your protocol for superficial temporal arteries
  - $?
Arteritis
Arteritis
Arterial emboli
Upper Extremity PVR/Segmental Pressures

Exam Date: 07/06/2012 10:36

SEGMENTAL PRESSURE STUDY

RIGHT Upper Arm
PVR 65mmHg 166cc Gain: 1mmHg/20mm Speed:25
PVR 61mmHg 119cc Gain: 1mmHg/20mm Speed:25

LEFT Upper Arm
PVR 66mmHg 202cc Gain: 1mmHg/20mm Speed:25
PVR 63mmHg 121cc Gain: 1mmHg/20mm Speed:25
Findings on duplex eval\textsuperscript{n} of hand

- Trauma of arteries
- Repetitive (hypothenar hammer syndrome)
- Aneurysm
- Penetration wound
- Crush
- Cardiac emboli
- Incidental or nonvascular: fibroma
# Upper Extremity PVR/Segmental Pressures

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![Graph showing PVR/Segmental Pressures](image)
Reynaud’s Phenomenon

• Primary vs Secondary (RD vs RP old terminology)
  – Primary = unknown etiology
  – Secondary = other associated disease (autoimmune, chemical,…)

• The patriotic disease
  - white -> blue -> red
The role of the vascular lab in diagnosis of Reynaud’s Phenomenon:

Differentiate fixed disease vs vasospastic phenomena
Raynaud’s Phenom has characteristic PPG waveform

From Strandness and Sumner 1975
Perform PPG at room temperature

If waveforms normal then physician will rely on clinical evaluation

If abnormal warm hands

If waveforms remain abnl: \(\rightarrow\) fixed dz

If waveforms normalize:

• Cannot rule out underlying vasospastic disorder
Fixed distal disease of upper extremity

• Thromboangiitis obliterans (Buerger’s disease)
  – Inflammation of palmer arch and/or digital arteries
  – Common in male smokers

• Thromboemboli
Allen’s Test

• Manual compression of supply to palmar arch
  – Compress both then release one
  – Compress both then release other

• Which is dominant?
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