Resource Mindful Evaluation and Imaging of Vascular Disease

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Disclaimer

RPVI (Registered Physician in Vascular Interpretation
Vascular lab interpretation:
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Screening AAA Ultrasound

Impression:
1. 4.5 cm infrarenal aortic aneurysm with thrombus
2. CT angiography recommended for additional anatomic detail
Goals

1. Evaluation of arterial and venous disease
2. Monitoring of arterial and venous disease
3. Efficiency
4. Safety
5. Economic impact
Nature of Problems

1. Aneurysms: Thoracic, abdominal aortic; visceral; peripheral
2. Arterial occlusive disease - stenosis, thrombosis, embolism
3. Venous thrombosis
4. Edema and chronic venous insufficiency
Goal of Diagnostic Imaging

1. Existence of pathology
2. Severity of pathology
3. Need for intervention
4. Planning for intervention
Anatomy or Physiology

1. Aneurysms - presence, size (anatomy)
2. Ischemia - presence, physiologic impact
3. Venous thrombosis - presence, acuity
4. Edema, ulcers, varicose veins (venous insufficiency) - presence, severity, anatomy
Question

What asymptomatic peripheral vascular diseases have been demonstrated to be worthy of screening?
Answers(?)

1. Abdominal aortic aneurysms
2. Carotid stenosis
Abdominal aortic aneurysms
2. Carotid stenosis
3. Lower extremity arterial occlusive disease
Answers(?)

1. Abdominal aortic aneurysms
2. Carotid stenosis (modest reduction in rate of stroke; NNT=10-15, NNH=100)
   a. Bruits
   b. Peripheral arterial disease
   c. Coronary artery disease
3. Lower extremity arterial occlusive disease: as a marker for systemic atherosclerosis
Diagnostic Tools

1. History
2. Physical examination
3. Physiologic tools: ABI, segmental pressures, photoplethysmography, digital pressures, TCPO2
4. Ultrasound (B-mode) - anatomic tool
   a. Aorto-iliac, visceral, peripheral arterial aneurysms
Diagnostic Tools

1. Duplex (combination of technologies)
   a. B-mode ultrasound
   b. Pulsed Doppler
   c. Character of flow (presence, direction, turbulence)
   d. Velocity of flow

2. Angiography
Angiography Anatomy

1. Duplex (noninvasive, cheap = $)
2. Magnetic resonance (noninvasive, $$)
3. CT angiography (contrast, radiation, $$)
4. Catheter angiography (invasive, contrast, $$$, physiologic assessment, allows conversion to immediate intervention)
1. Carotid disease - embolic >> thrombotic
2. Duplex - acceptable accuracy
   a. Carotid bifurcation stenosis ~ plaque burden
   b. Demonstrated efficacy of interventions
   c. Indirect evidence of disease proximal or distal to bifurcation
   d. Turbulence: not normal
   e. Velocity criteria for different categories of stenosis (<50%, 50-75%, >75%)
Question

Patient with TIA (half-hour of slurred speech), or amaurosis fugax, or parietal cortical infarct

Duplex: <50% left ICA stenosis versus Duplex shows >50% internal carotid stenosis versus Duplex shows >75% internal carotid stenosis

Further evaluation needed? MRA, CTA, catheter
Vertebral Basilar Insufficiency

Symptoms

?
Vertebrobasilar Insufficiency Symptoms

1. Vertigo (+/- “dizziness, loss of balance”)
2. Diplopia, tunnel vision
3. Drop attacks
4. Syncope or presyncope
Vertebrobasilar Insufficiency
Anatomy
?
Vertebrobasilar Insufficiency

1. Physical examination
Vertebrobasilar Insufficiency

1. Physical examination
   a. Pulse examination
   b. Blood pressures in both arms
   c. Subclavian steal
Vertebrobasilar Insufficiency

1. Physical examination
   a. Pulse examination
   b. Blood pressures in both arms
   c. Subclavian steal

2. Carotid duplex
   a. Comparison of arm blood pressures
   b. Vertebral artery
      i. Direction of flow
      ii. Character of flow
   c. Carotid and subclavian artery duplex
Vertebrobasilar Insufficiency

1. Physical examination
   a. Pulse examination
   b. Blood pressures in both arms
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2. Carotid duplex
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Vertebrobasilar Insufficiency

1. Subclavian artery stenosis or occlusion ("Subclavian steal syndrome")
2. Bilateral vertebral artery occlusive disease
3. Basilar artery occlusive disease

Next decision?
Vertebrobasilar Insufficiency

1. Subclavian artery stenosis or occlusion ("Subclavian steal syndrome")
2. Bilateral vertebral artery occlusive disease
3. Basilar artery occlusive disease

Next decision?

Better imaging - Angiography
Vertebrobasilar Insufficiency

1. Subclavian steal
   a. Subclavian artery angioplasty/stent
   b. Carotid to subclavian bypass
   c. Subclavian transposition to carotid

2. Vertebral artery revascularization
   a. Transposition of vertebral artery to carotid artery
   b. Vertebral artery bypass
   c. Vertebral artery angioplasty/stent

3. Carotid revascularization
Lower Extremity Arterial Occlusive Disease

1. Clinical problems
   a. Exertional pain
   b. Foot pain
   c. Ulcers
   d. Large artery embolism
   e. Digital artery embolism
Lower Extremity Arterial Occlusive Disease

1. Clinical problems
   a. Exertional pain - ischemia?
   b. Foot pain - ischemic rest pain?
   c. Ulcers - ischemia playing a role?
   d. Large artery embolism - site?
   e. Digital artery embolism - source?
1. Clinical problems
   a. Exertional pain - ischemia? ABI
   b. Foot pain - ischemic rest pain? ABI
   c. Ulcers - ischemia playing a role? ABI
   d. Large artery embolism - site? Duplex
   e. Digital artery embolism - source?
      i. ABI/TBI
      ii. Duplex
Lower Extremity Arterial Occlusive Disease

Vascular lab protocols

Rest pain or ulceration:
If ABI normal, stop
If ABI abnormal, duplex

Claudication:
If ABI normal, treadmill
If ABI or treadmill abnormal, duplex
Question

65 year-old male smoker
Right calf claudication at two blocks
Palpable femoral pulses, no popliteal or pedal pulses, bilaterally

Next step?
Answer

ABI (office or vascular lab) to confirm diagnosis

Modify atherosclerotic risk factors
Antiplatelet agent
HMG co-reductase inhibitor

No mechanical intervention
65 year-old male former smoker
Right calf claudication at 50 feet
No femoral or more distal pulses on right.
Normal femoral, popliteal, and pedal pulses, bilaterally

Next step?
Answer

ABI/duplex to confirm diagnosis and anatomy

Modify atherosclerotic risk factors
Antiplatelet agent
HMG co-reductase inhibitor

Offer possible mechanical intervention
CT angiography or directly to catheter angiography with possible intervention
Lower Extremity Arterial Occlusive Disease

1. Iliac artery occlusive disease
   a. Most likely to be treated endovascularly
      i. Stenoses and short occlusion effective and relatively durable
   b. Claudication least likely to improve with supervised exercise

2. Common femoral - surgical

3. Infrainguinal - surgical or endovascular
   a. All interventions less durable
   b. Endovascular less durable than surgical
   c. Morbidity: surgical > endovascular
Question

65 year-old male smoker
Weeks of pain in the right foot
Dependent rubor, pallor on elevation
Only femoral pulses palpable bilaterally
Inaudible Doppler signals

Next step?
Answer

ABI/duplex to confirm diagnosis and anatomy?

Modify atherosclerotic risk factors
Antiplatelet agent
HMG co-reductase inhibitor

Directly to catheter angiography with possible intervention, and/or plan surgical revascularization
Abdominal Aortic Aneurysms

1. Screening - ultrasound (>3.0-3.5 cm)
2. Monitoring - ultrasound
   a. 3-4 cm: every two years
   b. 4-5 cm: yearly
   c. 5.0-5.5 cm: every six months
3. CT without contrast if US ineffective
4. CT angiography only for planning of repair
Thoracic Aortic Aneurysms

1. Diagnosis - CT or MR (> 4cm)
2. Screening - not established
3. Monitoring - low-dose CT
   a. 4-5 cm: yearly
4. Referral for >5 cm
   a. Repair selectively
   b. Somewhat based on BSA
5. CT angiography only for planning of repair
Thoracic aortic dissections

1. Early morbidity - malperfusion or rupture
2. Ascending aortic dissections
   a. Coronary or great vessel malperfusion
   b. Acute valvular insufficiency
   c. Acute pericardial tamponade
   d. Rupture
3. Descending thoracic aortic dissections
   a. Early - malperfusion or rupture
   b. Late - pseudoaneurysm formation
Thoracic aortic dissections

1. Monitoring -
   a. Early - CT angiography if concerned about malfperfusion
   b. Later - CT without contrast
      i. Evaluating caliber of pseudoaneurysm
      ii. Consider low-dose CT

2. Referral for
   a. >5 cm
   b. Early repair selectively for “high-risk”
   c. CT angiography for planning of repair
1. Chest radiograph - 0.1 mSv (10 days background)
2. CT abdomen/pelvis: 10 mSv (3.5 years)
3. CT angiography abdomen/pelvis, with and without intravenous contrast: 20 mSv (7 years)
4. Three-phase CTA abdomen/pelvis: 30 mSv
5. PET-CT: 25 mSv
Renal Artery Stenosis

1. RCT’s of renal angioplasty/stenting disappointing
2. Limit to truly resistant hypertension, flash pulmonary edema, or rapid deterioration of renal function (nephrologist’s purview)
3. Renal artery duplex - 80% accurate
4. CTA better, unless heavily calcified
5. Catheter angiography with manometry is definitive
6. Intervention based on indications, not presence of stenosis (“oculo-stenotic-balloon reflex”)
Mesenteric Artery Stenosis

1. Duplex- 80-90% accurate
2. Celiac and mesenteric arteries
3. CT or catheter angiography both definitive
4. Intervention based on indications (e.g. mesenteric angina, not presence of stenosis (“oculo-stenotic-balloon reflex”))
Venous Thrombosis

1. Compression ultrasound: determines whether segment examined is patent
2. Venous duplex:
   a. Presence and character of spontaneous flow and flow with augmentation
   b. Character of occlusion
      i. Dilated, mobile, poorly attached, or echolucent implies acute
      ii. Echogenic - subacute or chronic
      iii. Atretic - chronic
Venous Thrombosis
Repeat duplex?

1. Distinction between acute and subacute
2. Duration of therapy?
   a. Expert opinion (mine) supports > 3 months for provoked DVT with poor recanalization
   b. Risk is recurrent thrombosis
3. Exclusion of propagation:
   a. Of deep calf vein thrombosis not anticoagulated
   b. Of superficial venous thrombosis (for which anticoagulation might be initiated)
4. Establishing new “baseline” for later comparison
Venous duplex for Insufficiency

1. “Venous insufficiency”: occlusion, valve incompetence, or both; deep or superficial

2. Patency assessed like venous duplex for DVT

3. Valve incompetency
   a. Cuff-deflation reflux time
   b. >0.5 seconds is abnormal
Figure 3. Venous duplex ultrasound demonstrating reflux in the
Venous duplex for Insufficiency

1. Generally available in vascular labs
2. Not usually available in radiology
3. Uses:
   a. Varicose vein evaluation
   b. Edema evaluation - to exclude venous insufficiency as cause of edema
   c. Venous edema - does not involve foot or toes
   d. Lymphedema or Na overload - foot edema
   e. Venous ulcer treatment
Venous duplex for Insufficiency for Varicose Veins

1. Great and small saphenous vein incompetence
   a. Now usually treated with catheter thermal ablation
   b. Stimulated explosion of “vein clinics”
2. Painful varicose veins is a clinical, not imaging diagnosis
3. Initial treatment is compression/elevation
4. Imaging is to determine cause, in order to direct specific therapy