

Testing Considerations, Patient History, Mechanisms of Disease, and Physical Examination

CHAPTER 3



Appropriate Indications for Testing

- **MUST** obtain appropriate indications for testing prior to performing a study
 - www.svunet.org
 - www.cms.gov
- Pertinent clinical history and documentation of relevant physical examination findings
- Important lab results should be included
- Identification of risk factors and knowledge of differentials

Testing Environment

- **Maintain a warm environment for the patient**
 - **Promotes overall comfort**
 - **Diminishes effects of peripheral vasoconstriction**

- **Warm gel and blankets are key**

Patient Signs and Symptoms

Chronic Occlusive Disease

- Indication of inadequate arterial blood supply to contracting muscles
- You are trying to determine if the patient has this disease by the following symptoms:
 - Claudication
 - Rest Pain
 - Tissue Loss

Claudication

- Those symptoms that occur with exercise and are relieved by rest
- The result of inadequate blood flow to a muscle or group of muscles during exercise
- Claudication is a symptom – not a diagnosis
- Claudication is always reproducible

Claudication

- Most common sites:
 - Calf
 - Hip
 - Thigh
 - Buttock

*****The site of arterial involvement responsible for the patient's symptoms is always proximal to the muscle group*****

Claudication

- Often describe as *intermittent* during exercise and predictably occurs with the same amount of activity
- True claudication results from inadequate blood supply to the exercising muscle resulting from:
 - Arterial spasm
 - Atherosclerosis
 - Arteriosclerosis
 - Occlusion

Claudication

- Differential diagnosis of neurogenic and MSK causes must be ruled out
 - These are not predictable
- “How many city blocks can you walk before experiencing the pain?”

Ischemic Rest Pain

- Indication of advanced arterial occlusive disease
- Pain is located in the foot (heel, toes, etc) and not the calf
- Patient finds relief by hanging their feet over the edge of the bed (creating dependency)
 - Walking may also provide relief by increasing the blood supply to the feet

Necrosis

- Tissue loss or death represents the most severe form of arterial insufficiency
- Generally seen at the dorsum of the foot and toes



Arterial Disease Progression

- Arterial disease develops with a typical progression:
 - 1. Claudication
 - 2. Rest pain
 - 3. Non-healing ulceration
 - 4. Gangrene
- As the disease worsens, the patient will walk shorter distances before experiencing claudication and the time required for symptoms to subside will increase

Acute Arterial Occlusion

- Initial pain is characterized by the sudden onset of symptoms
- Commonly known as the **5 P's**
 - Pain
 - Pallor
 - Pulselessness
 - Paresthesia
 - Paralysis
- Emergency situation as the abrupt onset of occlusion has not provided time for collaterals to develop

2 Additional P's:
Polar (cold)
Purplish (cyanosis)

Cold Sensitivity

- **Symptoms:**
 - **Changes in skin color**
 - **Pallor (paleness or white)**
 - **Cyanosis (bluish)**
 - **Rubor (dark red)**
 - **Trophic changes**
- **Raynaud's Phenomenon:**
 - **Digital vasospasm that is precipitated by exposure to cold**
 - **Primarily affects women**

Risk Factors and Contributing Diseases

Diabetes

- **Diabetes mellitus – most common**
- **Chronic systemic disease**
 - **Disorders of metabolism of insulin, carbohydrate, fat and protein**
- **Atherosclerosis is more common**
 - **Occurs at a younger age**
- **Higher incidence of occlusive disease of the lower extremities**
- **Higher incidence of gangrenous changes**
 - **Leading to amputations**
- **Controllable risk factor**

Hypertension

- Unclear if HBP causes or enhances the development of atherosclerosis
- Increases the risk of embolization due to:
 - Increased flow
 - Turbulence
- Systemic hypertension is associated with:
 - Greater incidence of coronary atherosclerosis
 - Increase in peripheral and cerebrovascular involvement
- **Controllable risk factor**

Hyperlipidemia

- Excessive amount of plasma lipids associated with development of atherosclerosis
- Frequent cause:
 - Diet high in fats
 - Metabolic problems associated with heredity
- **Controllable risk factor**

Smoking

- Chemicals in cigarettes irritate the endothelial lining of the arteries
- Harmful effects include:
 - Vasoconstriction of the arteries
 - Increased blood pressure
 - Increased myocardial oxygen demand
 - Increased cholesterol levels
- **Controllable risk factor**

Other Risk Factors

- Controllable:
 - Obesity
 - Sedentary lifestyle
- Uncontrollable:
 - Age
 - Family History
 - Male Gender



Mechanisms of Disease

Atherosclerosis

- Most common arterial pathology
- Includes thickening, hardening, and loss of elasticity of the walls of the arteries
 - Affects the intima and media layers
- Typically occurs at the sites of bifurcations and origins of vessel branches (i.e. carotid bifurcation, visceral vessels)
- Leriche syndrome:
 - Obstruction of the terminal aorta in males causing lower extremity fatigue, impotence, and pallor/coldness of LE

Embolism

- **Obstruction of a blood vessel by a foreign substance or blood clot**
 - Most frequent cause is plaque breaking loose and travelling distally until it lodges in small vessels
- **Blue Toe Syndrome:**
 - Tissue ischemia as a result of embolization of cholesterol crystals resulting in cyanosis of tissues in the digits
 - Commonly attributed to peripheral vascular procedures such as angiography



Aneurysm

- **Types include:**
 - **True aneurysm**
 - **Dissecting aneurysm**
 - **Pseudoaneurysm**

True Aneurysm

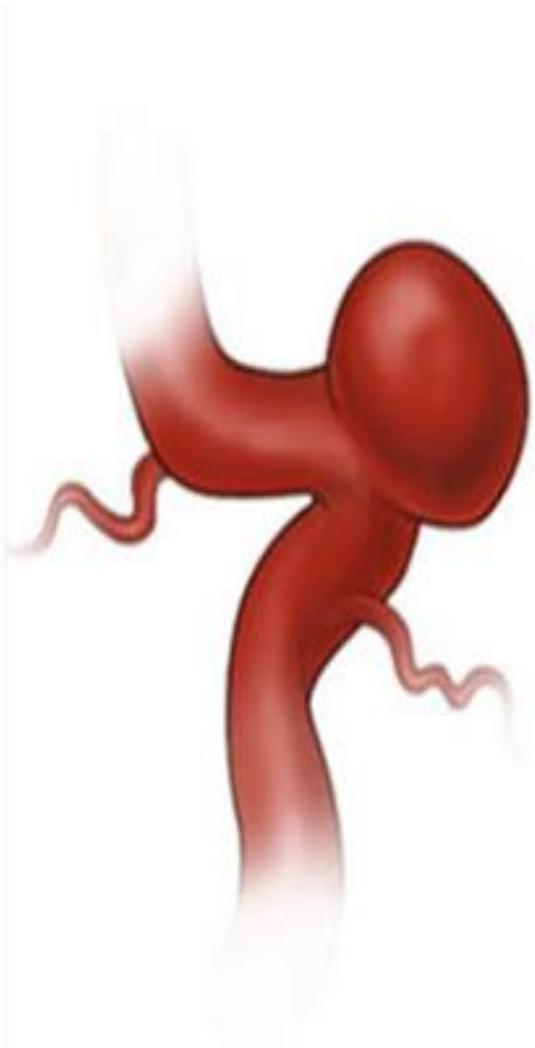
- **Dilatation of all three layers of the arterial wall**
- **Most common location is in the infrarenal aorta, but can occur anywhere**
- **Patients with one aneurysm typically have a second aneurysm (common femoral and popliteal artery common sites)**
- **Complications include rupture, distal embolization, thrombus formation**

Dissecting Aneurysm

- Small tear of the intima allows blood to form a cavity between two wall layers creating a *false lumen*
- Two conditions must occur for this to happen:
 - Weakening of the media wall
 - Intimal tear through which blood can leak into the media
- Most dissections occur within the thoracic aorta

Pseudoaneurysm

- **“Pulsating hematoma”**
 - A hole in the wall of the artery permits blood to escape into adjacent tissue
 - If the hematoma is surrounded by tissue and has continuous blood flow, a pseudoaneurysm forms
- Results from damage to the artery caused by insertion of a catheter (angiography, endovascular procedure, etc)
- Must identify the “neck” or communicating channel from the main artery to the pulsatile pseudoaneurysm



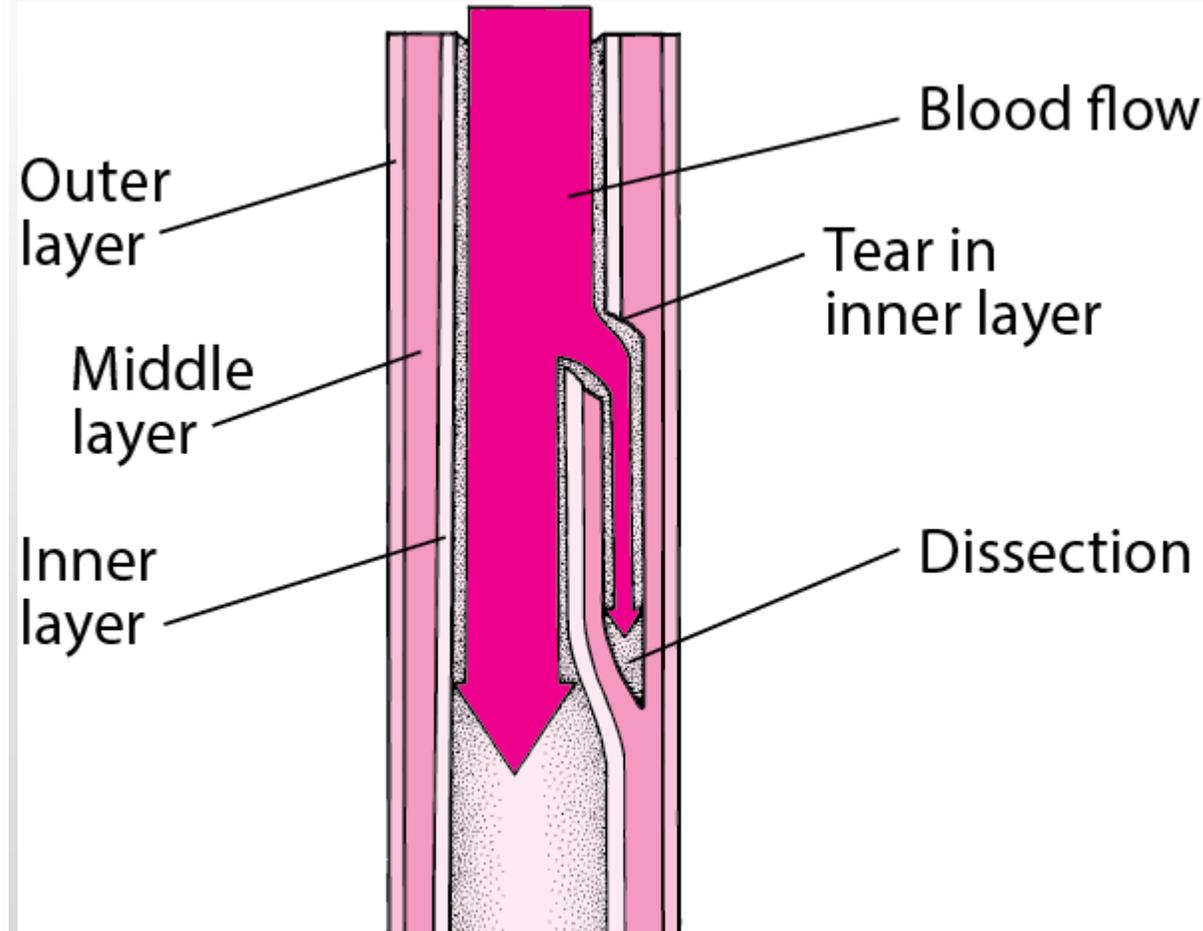
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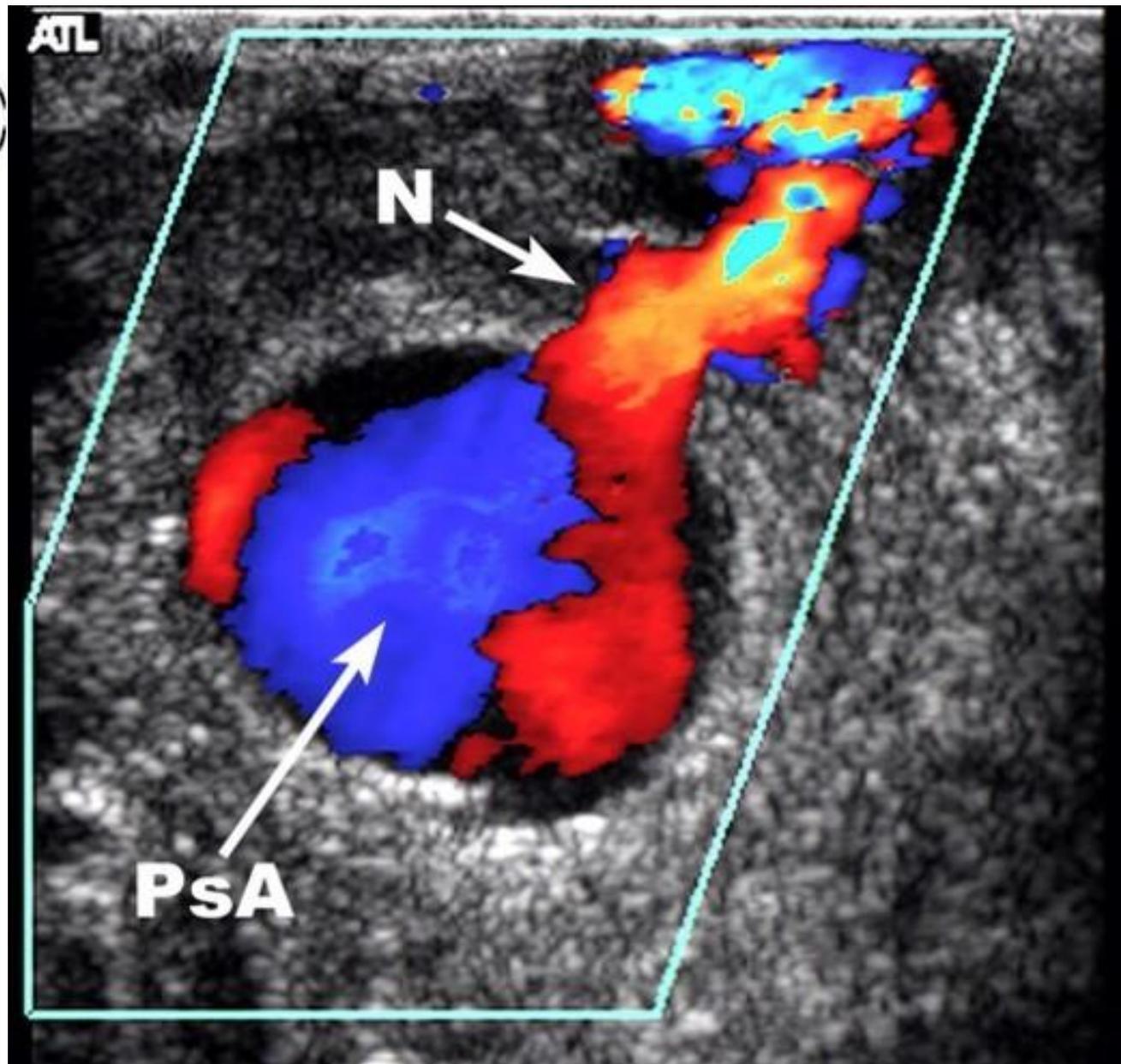
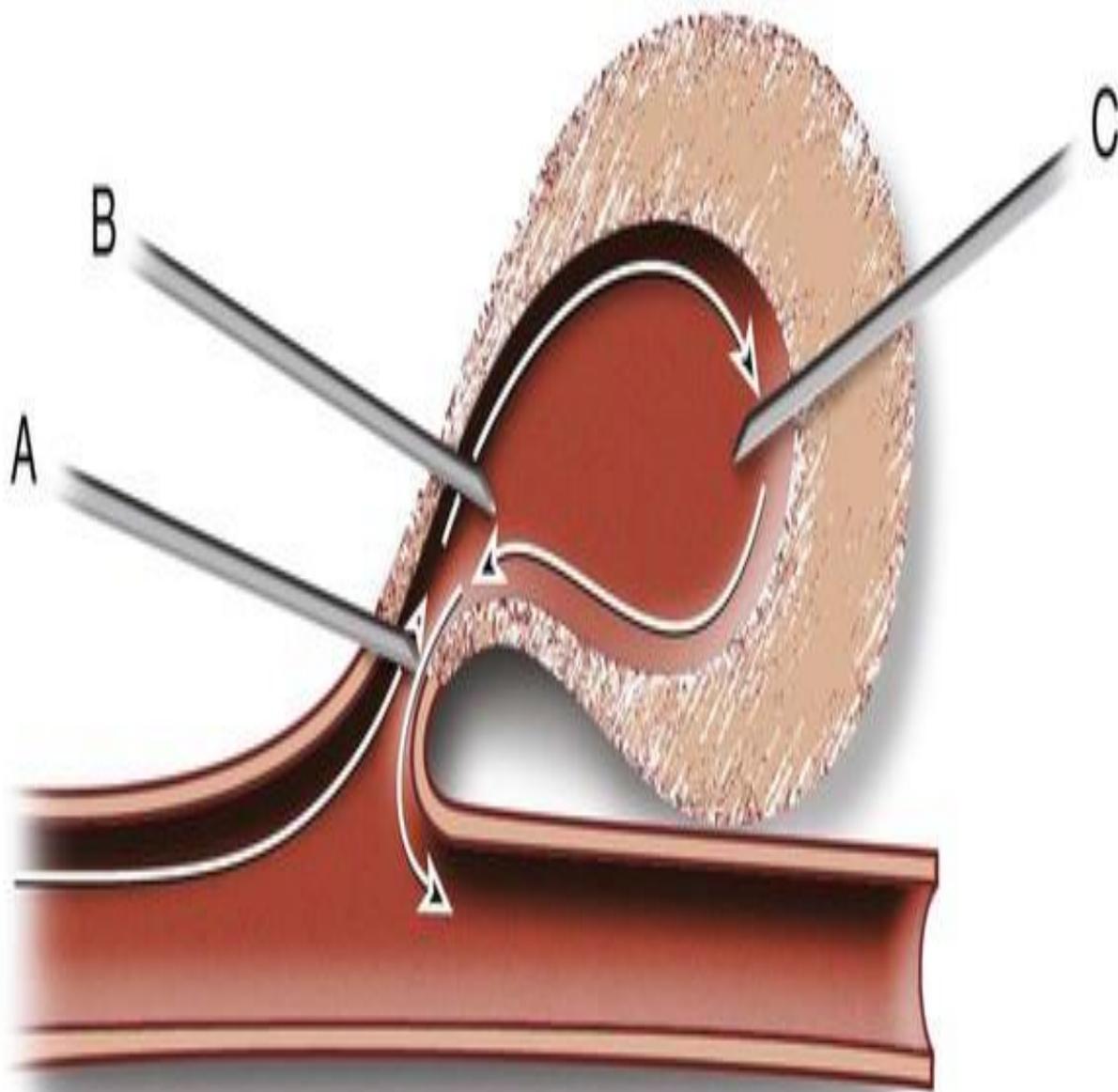


Fusiform



Dissecting





Arteritis

- Inflammation of the arterial wall
- Often causes thrombosis the vessel
- Many forms: Takayasu's, temporal arteritis, polyarteritis disease
- Most common form is Buerger's disease (*thromboangitis obliterans*)

Buerger's Disease

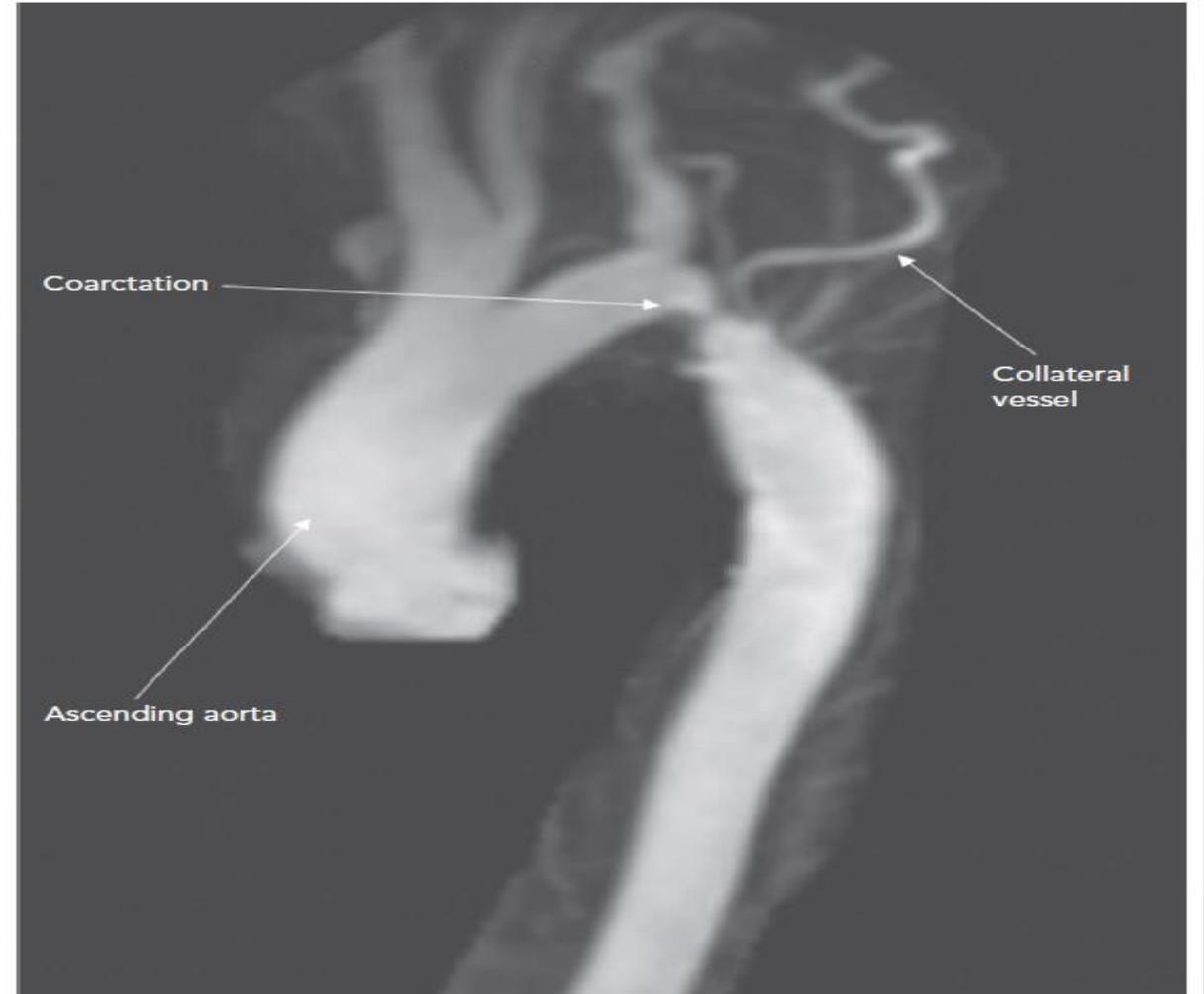
- Associated with heavy smoking
- Men younger than 40 yo
- Patients have occlusions of the distal arteries
- Rest pain and ischemic ulceration
- Patchy areas of ulceration and gangrene



Coarctation of the Aorta

- Congenital narrowing of the thoracic aorta
- Leads to hypertension due to decreased kidney perfusion, decreased lower extremity pulses

Figure 1: Coarctation Magnetic Resonance Image



Cardiac MRI of a 53-year-old patient with severe coarctation and evidence of collateral flow.

Vasospastic Disorders

- **Symptoms include changes in skin color:**
 - Pallor
 - Cyanosis
 - Rubor
- Patient also experiences paresthesia and pain

Raynaud's

PRIMARY RAYNAUD'S

- Idiopathic
- Also called “Spastic Raynaud's Syndrome” or “Raynaud's Disease”
- Criteria for the diagnosis:
 - Vasospasm precipitated by cold or emotional stress
 - Usually bilateral
 - Absence of gangrene
 - Absence of underlying disease accounting for symptoms
 - Presentation of symptom greater than 2 years
 - Condition is benign and has excellent prognosis

Raynaud's

SECONDARY RAYNAUD'S

- Fixed arterial obstruction leading to vasoconstriction of arterioles
- Also called "Obstructive Raynaud's Syndrome"
- Associated with:
 - Connective tissue disorders
 - Arterial occlusive disease
 - Thoracic outlet syndrome
 - Trauma
 - Neurologic disorders
 - Drugs/Toxins

**Ischemia is
constantly
present**

Primary or Spastic Raynaud's



Secondary or Obstructive Raynaud's



Miscellaneous Pathologies

- **Collagen vascular disorder**
 - Temporal arteritis
 - Scleroderma
- Ehlers-Danlos syndrome
- Livedo reticularis
- Necrobiosis lipoidica
- Vasculitis

Physical Examination

Physical Examination

- **Before a physical examination is performed, the patient should be resting supine for several minutes**
 - **Allows the patient's heart rate and blood pressure to return to its resting state**
 - **A thorough history can be taken while the patient is resting and this can occupy the time**
- **Keep the patient warm and relaxed**
 - **Cool temperatures results in vasoconstriction of the arteries**

Physical Examination

- **Observation of the distal leg and feet for any of the following features of chronic arterial occlusive disease:**
 - **Color Changes**
 - **Temperature Changes**
 - **Ulcerations**
 - **Trophic Changes**
 - **Elevation/Dependency Changes**

Color Changes

- **Pallor** – the result of deficient blood supply
 - Arterial system cannot pump adequate blood into the capillary system against gravity due to arterial blockages
- **Rubor** – suggests damaged, dilated vessels or vessels dilated due to reactive hyperemia
 - Dependent rubor – a deep red color occurs due to blood pooling in the arterioles
- **Cyanosis** – concentration of deoxygenated hemoglobin
- **Livedo reticularis** – purplish patches on the dorsum of the foot due to dilated capillary and venule filling; not arterial obstruction

Temperature

- **Patient's skin should be warm**
 - **Touch the patient's skin to determine warm/cold**
- **If skin is cool, check for:**
 - **Symmetrical coolness**
 - **Vasoconstriction**
 - **Asymmetrical coolness**
 - **Arterial insufficiency**

Ulcerations

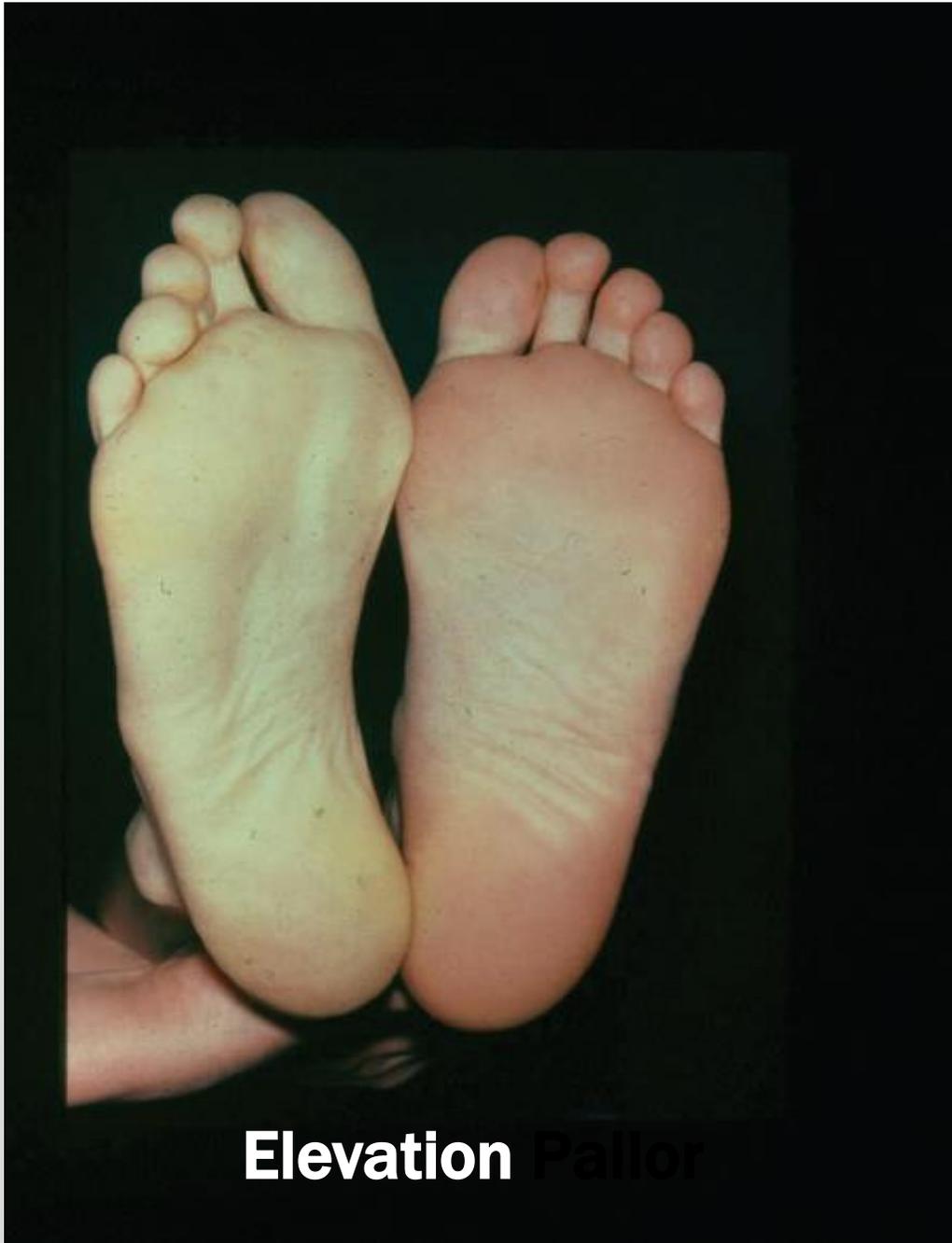
- **Ulcerations due to arterial insufficiency are:**
 - **Located tibial area, foot, and toes**
 - **Usually deep and irregular in shape**
 - **Painful compared to venous ulcers**
 - **Important to know the duration of the present ulcers**
- **Gangrene is the death of tissue, usually due to deficient or absent blood supply**

Trophic Changes

- **Loss of hair on the extremity may reflect a poor nutritional state caused by decreased circulation**
 - **Hair loss alone is a poor indicator of peripheral vascular occlusive disease**
- **Skin becomes shiny and scaly**
- **Toenails are often thickened and brittle**

Elevation/Dependency Changes

- **Elevation – leg becomes pale because of poor arterial perfusion (Pallor Elevation)**
 - **Only minimal arterial blood can make its way distally through blockages without hydrostatic pressure to help assist the flow**
- **Dependency – leg becomes red because of the large amount of blood flowing into the small vasodilated superficial arteries**
 - **Hydrostatic pressure assists in increasing flow to the dependent leg**



Palpation

- **Rhythmic throbbing of an artery in time with the heartbeat**
Evaluate for pulses and aneurysms
 - **Aneurysms – strong bounding pulsation and easily palpable**
- **Evaluate for the presence, strength, and regularity of the pulsation**
 - **Fistula, Dialysis Graft – have a palpable “thrill”**
- **Always perform a bilateral evaluation for comparison**
- **Do not use your thumb to feel for pulses!**

Palpation

- Palpable pulses include:
 - Aorta
 - Femoral
 - Popliteal
 - Dorsalis pedis
 - Posterior tibial
 - Carotid
 - Axillary
 - Brachial
 - Radial
 - Ulnar



Peroneal artery
CANNOT be
palpated!!!

Auscultation

- **Listening through a stethoscope**
 - **Normal – “lub dub” sound corresponding to the heart**
 - **Abnormal – “Bruit,” low-frequency sound**
- **Bruit auscultation is more frequently checked with carotid examinations**
- **Auscultation sites:**
 - **Aorta**
 - **Femoral**
 - **Popliteal**
 - **Carotid**