Upper Extremity Arterial Disease
Objectives

Upper extremity anatomy

Overview of diseases affecting large, medium and small size arteries.

Overview of treatments
Subclavian Artery

- Left arises from aorta, right is branch of brachiocephalic artery.
- From origin to lateral margin 1st rib.
- Major branches: Vertebral, Internal Mammary, Thyrocervical Artery, Costocervical Trunk, Dorsal Scapular.
Axillary Artery

Begins at lateral margin of 1st rib.

Major Branches
- Superior Thoracic Artery.
- Thoracoacromial Artery.
- Lateral Thoracic Artery.
- Subscapular Artery.
- Anterior and Posterior Humeral Circumflex.
Brachial Artery

Arises at the anatomic neck of the humerus, at inferior margin of Teres Major.

**Major Branches**
- Profunda Brachial, Superior and Inferior Ulnar collateral arteries.
- Terminates in the Radial and Ulnar Arteries, with Ulnar giving rise to Interosseous Variations
- High origin of Radial Artery:
Two palmar arches

Dual supply provides collateral flow

Radial artery terminates in deep palmar arch, which is complete in 95% of patients (the proximal arch.)

Ulnar artery terminates in superficial palmar arch, which is complete in 80% of patients (distal arch)
Pathophysiology

Atherosclerosis
Thromboembolism
Iatrogenic
Trauma
Buerger’s Disease
Occupational Injury
Vasospastic disorder
Inflammatory Arteriopathies
Thoracic outlet
Ergotamine abuse
Connective Tissue disorders
Clinical Manifestations

Symptoms

- Arm claudication
- Hand or finger pain
- Raynaud's phenomenon
- Decreased in pulse (subclavian, axillary brachial, ulnar, radial)

Signs

- Aneurysm
- Abnormal Allen’s test
- Digital ulcer
- Gangrene
Atherosclerosis
Arteritis; Takayasu’s, Giant cell
Thoracic outlet
Radiation induced vasculitis
Iatrogenic injury
Trauma

Stenosis, occlusion, embolization
Stenosis, Occlusion, embolization
Initimal damage, aneurysm formation and embolization
Stenosis, occlusion
Occlusion, embolization, stenosis
Occlusion, hemorrhage
## Small vessel disease

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Chest x-ray should be performed in patients with thromboembolic small artery occlusion and larger artery obstruction to detect bony abnormalities (TOS).

Hand x-ray useful to detect soft tissue calcifications in small artery obstructive disease: CREST syndrome, Esophageal motility disorder, Scleroderma, Mix connective tissue disorder.

Arteriography or CTA performed when diagnosis is unclear.
Evaluation of Upper extremity arterial disease

Vascular lab
Segmental pressure measurements,
Finger pressures
Pulse volume recording
Duplex ultrasound evaluation.
Qualitative and quantitative, locates stenosis and occlusions.

All major arteries of the upper extremity are interrogated.

Subclavian artery is evaluated except where it courses behind the clavicle.
Cuffs at brachial, upper elbow and wrist, pressure measured at each level, compared to other arm at that level.

Difference between limbs seldom exceeds 5-7mmHg.

Pressure decreases proceeding distally.

Wrist/brachial or forearm/brachial index usually less than 1.0.

Ratios below 0.7 are abnormal.
Finger Pressure

Finger ipsilateral brachial index averages 0.97 (range 0.8-1.2)

FIBI<0.70 is abnormal
Most common etiology of upper extremity disease. Producing occlusion, high grade stenosis and ulcerated plaques.

Most common location:
- Subclavian 61%
- Innominate 20%
- Brachial 12%
- Radial/ulnar 2%

Proximal occlusion well tolerated (extensive collaterals)

Bypass
Endarterectomy

Percutaneous angioplasty and stenting for isolated short segment lesions (innominate, subclavian)
Most common cause of acute UE ischemia.

Accounts for 15-30% of all peripheral cases.

Cardiac source, A. fib 50%, Recent MI in 33%.

Usually in large vessels
   Brachial 55%
   Subclavian 18%
   Axillary 25%
   Forearm <2%
Pathophysiology

Typical locations for occlusion
Area just proximal to deep brachial origin.
Origin of brachial bifurcation

Symptoms: pain, pallor, paresthesias, pulselessness.

Sudden onset of arterial insufficiency

Open surgical thromboembolectomy

Thrombolytic therapy
Cardiac cath most common 0.9-4%

Long segment thrombosis-results in acute symptoms.

Short segment thrombosis-may present with chronic ischemic signs and symptoms

Axillary injury can result from:
- Transaxillary arteriography
- Performance of an axillary block

Incidence of thrombosis is 0.8%

Presentation maybe ischemia with or without neurologic symptoms as a result of axillary sheath hematoma.

Surgical treatment:
- Bypass, interposition
- Thrombectomy, embolectomy
- +/- Evacuation of hematoma
Penetrating and Blunt trauma are significant source of upper extremity ischemia.

- axillary 4-10%
- brachial 30%
- radial/ulnar 6-21%

Physical findings
Hard/Soft signs

Brachial plexus injury can occur concomitantly with arterial injury.
Treatment

Surgical treatment
Bypass
Interposition
Evacuation of hematoma

Endovascular: Covered stent (innominate, subclavian)
Inflammatory Arteriopathies

Takayasu’s arteritis is the common vasculitis producing symptoms (claudication or ischemia) in the upper extremity.

Frequently affects aorta and its major branches in young Asian women. Bimodal age distribution (<40 yr. old).

In addition to ischemic symptoms: headaches, malaise, fever, joint pain, high ESR, anemia.

Angio shows long segments of smooth stenoses.
Giant cell arteritis. Same disease with bimodal distribution (>60 yrs. old) affects older caucasian females.

Carotid branches mostly affected but affects all arch vessels like Takayasu's’s.

Visual impairment in 50%
Immunosuppressive agents

Corticosteroids during active phase beneficial.

Antiplatelet therapy beneficial
Thoracic outlet syndrome

Arterial 1-2%

Young individuals

Etiology can be due to anatomic, congenital and traumatic factors.

Post-stenotic dilatation of subclavian

Stretch injury to axillary artery can occur especially in extreme rotations of athletes.

Symptoms and signs can include pain, cool, weakness, claudication, distal ulceration or gangrene.
Thoracic outlet syndrome

Physical exam
Pulsatile mass, subclavian artery bruit, atrophic skin changes, ulceration or gangrene of the finger tips.
Decrease pulse in affected limb.

Diagnostic studies
CXR
US examination of subclavian maybe useful
CT angiogram
Angiogram with positional views
Thoracic outlet syndrome

Management of the ischemia

Decompression

Repair of the arterial lesion (>2CM)

Angioplasty without rib removal is not beneficial
Connective tissue disorders

Usually involves small vessels

Scleroderma and CREST: common cause of finger ischemia in women.

Presentation: range from Raynaud’s syndrome to gangrene of the digits.

Arteriography: extensive small artery occlusion involving the palmar arch and the digital arteries.

Angio of patient with CREST
Connective tissue disorders

No good therapy exist for small vessel disease secondary to scleroderma and CREST.

Initial therapy with calcium channel blockers and antiplatelet therapy.

Cilostazol may help to heal ischemic digital ulcerations in patients with these disorders. (Dean; Vasc. Med 2001; 6: 245-8.)
Buerger’s disease

**Thromboangiitis obliterans**

Usually involves medium to small size vessels characterized by occurrence of segmental thrombotic occlusions.

Digital ischemia and ulceration occur.

**Diagnostic criteria:**
- Males less than 45 yrs. old.
- Directly linked to tobacco use
- Exclusion of other diseases
- Normal proximal vessels
- Vascular lab testing

Similar clinical findings with use of cannabis and cocaine use.
Buerger’s disease
Thromboangiitis obliterans

Pathological lesion acute stage – neutrophilic inflammation (preservation of the internal elastic lamina). Atherosclerotic lesions and immune arteritides have disruption of this layer.

Late lesions: by intense perivascular fibrosis.

Life expectancy is not affected
Buerger’s disease
Thromboangiitis obliterans

Supportive measures
Avoiding cold temperatures and mechanical trauma
Smoking cessation is key.
Small vessel injury.

Characteristic blanching and numbness of the hands after use of a vibratory tool.

Result of repeated trauma induced vasospasm followed by thrombosis and occlusion.

A single digit can be involved causing the vibratory white finger.

Removal from occupation source.

Revascularization in selected patients
Small vessel injury usually the ulnar artery.

Repetitive injury by manual laborers

The vessel maybe thrombosed or hypothenar portion aneurysmal with microembolization.

More severe in those with tobacco use

Present with pale, cool, ulcerated and painful fingers on the ulnar side of the hand.

Allen’s test can help to confirm suspicion
Conservative treatment
Cessation of smoking
Avoidance of extreme cold
Vasodilator therapy

Workup with non invasive vascular testing.

If FIBI < 0.7 arteriography can be used to obtain detailed assessment of outflow to the hand and digits.

Corkscrew appearance of ulnar indicates alternating fibrosis and dilatation – early ulnar thrombosis

Recent thrombosis – thrombolytic therapy.

Surgical revascularization
Vasospastic Disorder

Definition: reversible vasoconstriction in the distal extremities in response to cold or emotional stimuli.
Episodic, exaggerated vascular response to cold or emotional stimuli.

Classic triphasic color change.
2/3 of patients have the classic change.

Prevalence in colder climates = 15-20%
Prevalence warmer climates = 2-3%
Raynaud’s Syndrome

Raynaud’s Disease: patients with primary vasospastic disease. Vasospastic symptoms without underlying secondary systemic disease or occlusive disease.

Raynaud’s Phenomenon: Patients with vasospastic disease with underlying collagen vascular disease. With occlusive disease, non reversible structural arterial issue.
Raynaud’s Disease

Rarely develop ulceration or digit threatening ischemia

Woman comprise the majority of these patients (80%)

Condition can be inherited

Onset second and third decades

Condition must be present for 2 years without appearance of an underlying systemic condition to be termed primary vasospasm or Raynaud’s disease.

Usually bilateral.

Non invasive lab testing
Raynaud’s Disease

Minimize cold exposure, avoiding medications

Long acting nifedipine 30mg 1 to 3 times per day

Surgical sympathectomy at the digital level
Raynaud’s Phenomenon

Associated with many disorders

Unilateral involvement: thoracic outlet syndrome

Investigation of the arterial system from the great vessels to the digital vessels.

Vascular lab

Angiography diagnostic and therapeutic

Digital Sympathectomy
Associated Diseases

- Scleroderma
- Systemic Lupus Erythematosus
- Rheumatoid arthritis
- Sjogren’s Syndrome
- Buerger’s Disease
- Vibration Arterial injury
- Hypersentivity Angiitis
- Fibromuscular Disease
- Frostbite