THE UPPER EXTREMITY ARTERIAL EXAMINATION

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- History / Physical examination
- Duplex ultrasound
- Physiologic (non-imaging) testing: CW Doppler, Plethysmography, Temperature

- History
- When
- Type of onset
**THE UPPER EXTREMITY ARTERIAL EXAMINATION**

- Physical examination - Acute
  - Pain
  - Pallor / Temperature
  - Pulses
  - Sensory / Motor Loss
  - Arm pressure difference

- Physical examination - Chronic
  - Pulses
  - Weakness
  - Arm pressure difference (> 20mmHg)

- History - Chronic
  - Pain with exertion (claudication)

- Atherosclerotic disease (ASO)
- Non-atherosclerotic disease
- No disease
THE UPPER EXTREMITY ARTERIAL EXAMINATION

- Atherosclerotic disease (ASO)
- Duplex ultrasound

Innominate Artery
Rt Subclavian Artery
Lt Subclavian Artery
Axillary Artery
THE UPPER EXTREMITY
ARTERIAL EXAMINATION

- Subclavian / Axillary artery:
  - Normal hemodynamics
  - Multiphasic
  - High resistance

BTW: What is this vessel?
THE UPPER EXTREMITY ARTERIAL EXAMINATION

- Atherosclerotic disease:
  - Characteristics of a stenosis
  - Focal elevation in velocity
  - Post-stenotic turbulence
  - Damped* flow signals distally

* Monophasic, or the so-called “tardus parvus” waveform
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Bilateral subclavian artery stenosis

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Proximal disease

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Proximal disease

Right – Left Communication
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Subclavian steal

Evolution of subclavian steal

Subclavian / Axillary artery:

BTW #2
THE UPPER EXTREMITY ARTERIAL EXAMINATION

- Atherosclerotic disease (ASO)
- Non-atherosclerotic disease
- No disease

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Large vessel disease
  - Intraluminal obstruction
  - Structural (wall) integrity defects
  - Extraluminal factors
  - Small vessel disease

Each study type will have a slightly different testing protocol

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Large vessel disease — Duplex ultrasound
- Intraluminal obstruction
- Structural (wall) integrity defects
- Extraluminal factors
- Small vessel disease
- Physiologic testing
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Large vessel intraluminal obstruction
- Thromboembolism
- Vasculitis / Arteritis
  (Inflammatory diseases)
- Fibromuscular dysplasia

THE UPPER EXTREMITY ARTERIAL EXAMINATION

- Vasculitis

  Inflammatory disease
  Immunologic disorders

  (Inflammatory bowel disease/
   Crohn’s disease)
THE UPPER EXTREMITY ARTERIAL EXAMINATION

- Giant cell arteritis
- Temporal arteritis
- Takayasu’s arteritis
- Molecular imaging (18FDG PET)

THE UPPER EXTREMITY ARTERIAL EXAMINATION

- Takayasu’s arteritis

THE UPPER EXTREMITY ARTERIAL EXAMINATION

- Non-atherosclerotic disease
  - Fibromuscular dysplasia
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Fibromuscular dysplasia
  - Rare “orphan” disease
  - < 1 per 2,000 prevalence
  - www.orpha.net

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Fibromuscular dysplasia
  - ~ 10% familial
  - ~ 90% female
  - 30-50 years of age
  - (Has been seen as young as 14 years)

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Fibromuscular dysplasia
  - Renal artery ~ 70%
    (Bilateral ~ 35%)
  - Carotid artery ~ 30%
  - Multiple vessels ~ 30%
  - Subclavian / Brachial Rare (< 3%)
  - Exact frequency unknown
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease
- Structural (wall) integrity defects
  - Dissection
  - Aneurysm
  - Pseudoaneurysm

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease
- Dissection
  - Spontaneous
  - Traumatic / iatrogenic
  - Associated with an underlying disease

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease
- Dissection
  - Associated conditions -
    - Marfan syndrome
    - Ehlers-Danlos syndrome (Type IV)
    - Penetrating atherosclerotic ulcer
    - Fibromuscular dysplasia
    - Cystic medial necrosis
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Dissection
  - Thoracic aorta
  - Involvement of arch vessels
    - Common carotid artery
    - Subclavian artery

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Dissection

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- True Aneurysm (Uncommon)
- Subclavian / Axillary Artery
  
  CRT*  100% in most published series
  (Nehler et al  Arch Surg 1997)

  JR Richard; Jeremy Bonderman; ...
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- True Aneurysm (Uncommon)
- Subclavian / Axillary Artery
  CRT 100% in most published series
- Distal to Axillary Artery
  Blunt trauma (All age groups)
  Mayo Clinic: 12 in 20 years

- Pseudoaneurysm (Increasingly common)
Non-atherosclerotic disease

- Pseudoaneurysm (Increasingly common)

Extraluminal factors

- Compartment syndrome (Blunt trauma)
- Compression syndromes

Thoracic outlet syndrome

- Symptoms typically neurogenic
- Etiology – Skeletal abnormalities
- Etiology – Soft tissue abnormalities
- Etiology – Postural factors
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Thoracic outlet syndrome
  - Etiology – Skeletal abnormalities
Non-atherosclerotic disease

- Thoracic outlet syndrome
- Etiology – Soft tissue abnormalities

Physiologic testing

Small vessel disease
- Vasospastic disorders (Raynaud’s syndrome)
- Thromboangiitis obliterans (Buerger’s disease)
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Raynaud’s syndrome  (Maurice Raynaud – 1862)
- Triggered by stressor (frequently cold exposure)
- Functional defect (not structural)
- Tricolor changes:
  - White – Ischemia
  - Blue – Cyanosis
  - Red - Reperfusion

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Raynaud’s syndrome
THE UPPER EXTREMITY ARTERIAL EXAMINATION
Non-atherosclerotic disease
 Raynaud’s syndrome
Physiologic testing:
Digit waveforms pre- and post-cold exposure
Digit pressures pre- and post-cold exposure
Temperature recovery post-cold exposure
THE UPPER EXTREMITY ARTERIAL EXAMINATION
Non-atherosclerotic disease

- Raynaud’s syndrome
  Physiologic testing – Temperature response

- Buerger’s disease (Leo Buerger – 1908)
  - Inflammatory disease affecting smaller arteries
  - Cellular / inflammatory thrombosis
  - Predominantly in males, 4th-5th decade
  - Smoking cessation is key to treatment
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Buerger’s disease
  - Amputation in 25% of patients
  - Role of therapeutic angiogenesis ??

- Physiologic testing
  - Doppler waveforms
  - Radial, Ulnar, Palmar arteries
  - Digit PPG waveforms / Pressures
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Non-atherosclerotic disease

- Buerger’s disease
  - Physiologic testing – Doppler

Non-atherosclerotic disease

- Atherosclerotic disease (ASO)
- No disease
  - (Pre-operative evaluations)
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Pre-operative evaluation

- CRF ➔ Dialysis
- CAD ➔ CABG

Successful dialysis access:

Arterial inflow > 2.0mm

Principles and Practice of Surgery: ACS

Arterial - Luminal diameter
Central obstruction
Palmar arch
THE UPPER EXTREMITY ARTERIAL EXAMINATION

Pre-operative evaluation

Successful dialysis access:
Arterial inflow > 2.0mm

Radial artery for CABG:
Radial Artery > 2.5mm

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Pre-operative evaluation

Radial artery for CABG:
Radial Artery > 2.5mm

Radial Artery
Ulnar Artery

THE UPPER EXTREMITY ARTERIAL EXAMINATION

Pre-operative evaluation

Radial artery for CABG:
Radial Artery > 2.5mm