Traumatic Extremity Vascular Injury

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Epidemiology

- **2012 Civilian Incidence in NTDB**
  - 278,100 LE injuries
  - 223,650 UE injuries
- **Estimated 3,700 amputations annually result**
- **Associated vascular injuries occur in <1% of all civilian fractures**
  - 5% in severe fractures
  - 6.6% in penetrating extremity injuries
Etiology

- Penetrating Injury
  - Industrial
  - Violent
  - Iatrogenic

- Blunt Injury
  - MVA
  - Falls
  - Assaults
  - Crush

- Broken Long Bones/Dislocated Joints
Pathophysiology

- **Natural Protection from Stretching and Bending**
  - Smooth muscle of arterial media
  - Arterial vasospasm upon transection

- Thus penetrating > blunt injury
Hard Signs of Vascular Injury

- Observed pulsatile bleeding
- Arterial thrill
- Bruit over or near the artery on auscultation
- Signs of distal ischemia (pain, pallor, paralysis, cool)
- Absent distal pulses
- Visibly expanding hematoma

These are absolute indications for further Dx studies:
- Arteriogram if stable
- Exploration/direct visualization in OR if unstable
- Nearly 100% predictive of need for surgical repair of penetrating trauma
Soft Signs of Vascular Injury

- Significant hemorrhage on history
- Decreased pulse compared to CL extremity
  - Doppler, IEI
- Bony injury or proximity penetrating wound
- Neurologic abnormality

- These should be closely monitored
  - IEI >0.9 → monitor without immediately vascular imaging
  - IEI <0.9 → further diagnostic studies
Workup

- Labs – CBC w/ plt, BMP, BUN/Cr, type/cross, INR
- Imaging – XR, Arteriography, Duplex, IEI
- MESS (Mangled Extremity Severity Score)
  - Objective criterion for amputation prediction
  - Score ranges 2-14, <7 predicts amputation AVOIDANCE
  - Components
    - Severity of skeletal and/or soft tissue injury
    - Severity and duration of limb ischemia (6hrs)
    - Severity of shock
    - Patient Age
• Open Fracture Grading (Gustillo-Anderson system)
  ○ Type I – wound <1cm, minimal contamination/comminution/soft tissue damage
  ○ Type II – wound >1cm, moderate soft tissue damage, minimal periosteal stripping
  ○ Type IIIA – severe soft tissue damage and contamination, soft tissue coverage adequate
  ○ Type IIIB – severe soft tissue damage and contamination, soft tissue coverage inadequate
  ○ Type IIIC – open fracture with an associated arterial injury requiring repair
Workup

- Risk factors for loss of limb
  - Delay in revascularization
  - Blunt trauma or high velocity penetrating trauma
  - LE > UE (especially popliteal artery)
  - Associated injuries
  - Older age/poor baseline health
  - Shock and obvious limb ischemia
Lower Extremity Trauma and Associated Vascular Injury

- **Midshaft Femur Fracture**
  - Generally high impact trauma (MVC, etc)
  - Arterial injury in <2%
    - Penetrating injury to medial thigh is #1 cause
    - Distal pulses may still be palpable due to collaterals
    - Occurs in injury at the adductor hiatus
    - Especially dangerous if paired w/ ligamentous knee injury
Lower Extremity Trauma and Associated Vascular Injury

- **Tibial Plateau Fractures**
  - Direct trauma, knee hyperextension injuries
  - Schatzker Class IV – medial plateau
    - Loss of ACL $\rightarrow$ anterior tibial shift $\rightarrow$ tethering of popliteal A
  - Schatzker Class VI – separation of diaphysis from metaphysis
    - Again tethering of popliteal A, usually at level of trifurcation
Lower Extremity Trauma and Associated Vascular Injury

- Tibial spine avulsion associated with popliteal injury
  - Hyperextension injury → tibial shaft posteriorly displaces
  - Common in skeletally immature
- Knee Dislocation
  - Anterior → intimal injury (stretch)
    - May not be clinically recognizable for days
  - Posterior → transection
- Tibial Shaft Fractures
  - Can be associated with infrapopliteal injury
Upper Extremity Trauma and Associated Vascular Injury

- **Humeral Fracture**
  - Surgical neck – posterior circumflex humeral artery
  - Proximal with medial displacement – axillary artery
  - Midshaft humeral fracture – deep brachial artery
  - Supracondylar humeral fracture – brachial artery
  - Posterior dislocation of elbow - brachial artery injury
Upper Extremity Trauma and Associated Vascular Injury

- Radial artery
  - Injury at anatomic snuffbox (scaphoid fracture)
- Ulnar artery
  - Pisiform injury, injury to ulnar styloid
- Ant/post interosseous arteries
  - Colles fracture, distal radial fracture