Popliteal Artery Injury
Multidisciplinary Approach

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Case 1

- 23 year old man involved in an MVA
- Sustained closed right tibial plateau fracture
- Time of presentation from MVA site to hospital 5 hours
- Referred to Vascular unit 8 hours later for right lower limb cold and pale
- Pulse ?
Case 2

- 27 year old man involved in a gun shot incidence
- Right thigh gun shot wound noted
- Proceeded with CTA
- Referred to Vascular Unit 14 hours later
- Pulse ?
Documentation of Pulse

Crucial !!!
Introduction

- **Recognized** as the most limb threatening.
- It is a true end artery with tenuous collateral supply.
- Supplies the bulk of the lower limb and foot drainage.
- This is why it is so **DANGEROUS**!

Anatomy
Epidemiology

- Popliteal artery injuries account for 19% of all extremity arterial injuries.
- 5.6 per 1000 cases of penetrating trauma
- 1.6 per 1000 cases of blunt trauma.

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<th>Year</th>
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<th>(%)</th>
<th>No. Blunt Amputations</th>
<th>(%)</th>
<th>No. Total Amputations</th>
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Penetrating (%) = (Penetrating Amputations / Total Penetrating) * 100
Blunt (%) = (Blunt Amputations / Total Blunt) * 100
Vascular Injury

“The clock starts to tick”

Irreversible damage occurs in 6 hours

- Blood loss
- Progressive ischemia
- Compartment syndrome
- Tissue necrosis
Vascular Injury

**Potentially frequent incidence**

- Proximity of vessels to bone
- Tethering of vessels at joints
- Superficial location of vessels
## Arterial injuries associated with fractures or dislocations

<table>
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<th>Injury Type</th>
<th>Artery Injured</th>
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<td>Clavicle fracture</td>
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<td>Supracondylar humerus fx</td>
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<td>Elbow dislocation</td>
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<td>Pelvic fracture</td>
<td>gluteal arteries</td>
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<td>Femoral shaft fx</td>
<td>femoral artery</td>
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<td>Distal femur fracture</td>
<td>popliteal artery</td>
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<tr>
<td>Knee dislocation</td>
<td>popliteal artery</td>
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<tr>
<td>Tibial plateau fracture</td>
<td>popliteal artery</td>
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</table>
Mechanism of injury

- Penetrating trauma
  - GSW
  - Stab

- Blunt trauma
  - High energy
  - Low energy

- iatrogenic
Types of Vascular Injury

- Spasm
- Intimal flaps
- Subintimal hematoma
- Laceration
- Transection
- A-V fistula
Prognostic Factors

- Level and type of vascular injury
- Collateral circulation
- Shock/hypotension
- Tissue damage (crush injury)
- Warm ischemia time
- Patient factors/medical conditions
Speed is crucial

**Protocol Is Essential!**

- Rapid resuscitation
- Complete, rapid evaluation
- Urgent surgical treatment
Diagnosis
Physical exam
Doppler ultrasound
Duplex scanning
Imaging
Exploration

Careful physical exam and high index of suspicion are most important!
Hard Signs

- Major hemorrhage/hypotension
- Arterial bleeding
- Expanding hematoma
- Altered/absent distal pulses
- Temperature differential between extremities
- Injury to anatomically-related nerve
- Distal Ischemia (The 5 P’s)

<table>
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<th>Author</th>
<th>No. KD</th>
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<th>Hard Signs Absent</th>
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<td>437</td>
<td>81 (18)</td>
<td>58 (72)</td>
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Extremity Blunt Trauma Vascular Injury Algorithm

Hard Signs of Vascular Injury
• Expanding/Pulsatile Hematoma
• Pulseless, pallor, paresthesia, pain, paralysis, poikilothermia
• Bruit/Thrill
• Absent Doppler Signals
• API (< 0.9)

+ Hard Signs of Possible Vascular Injury

Fracture

Yes

Fracture Reduced

Yes

Normal Pulses

Yes

API Normal (≥.90)

No

Reduce Fracture

+/-/ Pulses

API Normal (≥.90)

Serial Exam

Vascular Surgery Consult

Yes

ORB vs. CTA vs. Angiogram

No

Serial Pulse Exam

Pulse Exam Changes

API ≥ .90

No

Serial API Examinations
Penetrating Extremity Vascular Injury

- Active Hemorrhage
  - Direct Pressure
    - Emergent Vascular Consult
      - OR vs. CTA vs. Angio
  - No Active Hemorrhage
    - Emergent Vascular Consult
      - CTA vs. Angio vs. OR

Hard Signs of Vascular Injury
- Expanding/Pulsatile Hematoma
- Pulseless, pallor, paresthesia, pain, paralysis, poikilothenmia
- Bruit/Thrill
- Absent Doppler Signals
- Arterial Pressure Index, API, (< 0.9)
Asymmetric pulses warrant doppler examination.

Absent pulses warrant emergent vascular consultation/surgical exploration.
### Rutherford Classification

<table>
<thead>
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<th>Category</th>
<th>Description</th>
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Most limb-threatening complications of delayed diagnosis of popliteal vascular injury are the result of overlooking hard signs, rather than an absence of signs, on initial presentation.

Doppler ultrasound

- Determine presence/absence of arterial supply
- Assess adequacy of flow

Presence of signal does not exclude arterial injury!
Doppler ultrasound

- Does not define extent or level of injury
- Abnormal values warrant further evaluation

Mills, et al. J. Trauma 2004
Duplex scanning

- Noninvasive
- Safe
- Rapid
- Reliable for
  - Injury to arteries and veins
  - A-V fistulas
  - Pseudoaneurysms
TOTAL (n=100)
No Significant Difference

DUPLEx SCANNING
Sensitivity = 90%
Specificity = 68%

ARTERIOGRAPHY
Sensitivity = 80%
Specificity = 95%

Panetta et al, J. Trauma 1992
Angiography

- Locates site of injury
- Characterizes injury
- Defines status of vessels proximal and distal
- May afford therapeutic intervention
- Multiple long bone fractures
Angiography

- Expensive
- Time-consuming
- Difficult to monitor/treat patient
- Procedural risks
  - Renal burden from dye
  - Possibility of anaphylaxis
  - Injury to proximal vessels
Operative angiography

- Single view in operating room
- Rapid
- Excellent for detecting site of injury
- Reduces wastage of time
Missed Injuries: Case of Trauma
Hide and Seek

- Incidence 2 % till 50%
- Leads to increased morbidity and mortality
WHY?

- Instability of patients
- Level of conscience
- Inexperienced of health care provider
- Radiology errors
- Technician errors
- Admission to an inappropriate service
- Inadequate exploration
- Inadequate index of suspicion in the presence of injuries
Management
Surgical exploration

Immediate exploration is indicated for:

- Obvious arterial injury on exam
- No doppler signal
- Site of injury is apparent
- Prolonged warm ischemia time
Reduce, stabilize, resuscitate

- **No pulses**
  - Injury obvious
  - Angiography or duplex
  - Surgery

- **Asymmetric pulses**
  - Multilevel injury?
  - Doppler
    - Absent
      - Angiography or duplex
    - Present
      - Observation

- **Normal exam**

*Modified from Brandyk, CORR 1005*
Conclusions

- Time is crucial
- Most important for diagnosis
  - High index of suspicion
  - Thorough physical exam
- Have a defined protocol/relationship
Thank You