Goals

Identify vascular injuries

Confidently and accurately evaluate vascular injury

Coordinate treatment
A Rare Injury

1-3% of all extremity trauma

Occurs more with penetrating trauma
GSW 46%
Blunt 19%
Stabbing 12%

Hafez et al J Vas Surg 2001
Pathology of Injury

Spasm
Intimal flap
External compression
  Compartment syndrome
  Hematoma
Thrombus
Laceration/transsection
  External projectiles
  Bone fragments
Successful diagnosis and management of extremity vascular injuries requires:

* Thorough history and physical
  * High index of suspicion
  * Rapid administration of care
Mechanism of injury heightens the surgeon’s awareness of potential vascular insult

Considerations:
* Fracture Personality
* Presence of dislocation
* Blunt trauma vs penetrating trauma
High Risk Fractures

Open fractures

Segmental diaphyseal fractures

Floating limbs

Associated crush injuries
Fracture Specific Vascular Injuries

Clavicle
Supracondylar humerus
Pelvic ring
Distal femur
Tibia plateau
Tibia shaft

Subclavian
Brachial
Gluteal, Iliac, Obturator
Popliteal
Popliteal tibial
Dislocations Associated with Vascular Injury

Scapulothoracic dissociation
64-100%

Knee dislocation
16%

Flanagan et al OCNA 2013, Miranda et al JTrauma 2002
Blunt Trauma

Stretching or shearing of vessels

Intimal damage/dissection, thrombus

Subtle clinical findings

27% amputation rate
Penetrating Injury

Direct injury to vessel:
Laceration/transsection

Exam findings: May not always be obvious

Delayed pseudo-aneursym and AVF

9% amputation rate
Physical Exam

**Hard Signs**
- Pulsatile bleeding
- Expanding hematoma
- Thrill at injury site
- Pulseless limb

**Soft Signs**
- Asymmetric limb temperature
- Asymmetric pulses
- Injury to anatomically-related nerve
- History of bleeding immediately after injury

Hafez et al J Vas Surg 2001
Important

Vascular injuries are dynamic injuries!

Repeat examinations
Emergency Department Management

Control Bleeding
  Compressive dressing
  Judicious tourniquet

Fluid resuscitation

Reduce & splint fractures

Re-evaluate
Ankle Brachial Index

Indications
- Asymmetric pulses
- Soft exam findings
- High energy tibia plateau fractures
- All knee dislocations

Vascular consult and advanced imaging for ABI <0.9

ABI does not define extent or level of injury

Ankle Brachial Index

Benefits
- Cheap
- Easy
- Negative predictive value between 96% and 100%

Limited diagnosis
- Venous injuries
- False positive with arterial spasm
- Injuries can preclude cuff placement

Duplex Scan

- Technician dependent
- Time intensive
- Steep learning curve
- Limited indication in acute trauma patients
Angiography

Historical Gold Standard

Localizes the lesion

Defines type and extent of lesion
  Active hemorrhage vs occlusion

Allows treatment planning
  embolization vs bypass
Angiography Disadvantages

Patient risks
  Renal insult
  Anaphylaxis
  Iatrogenic vessel injury

Expensive

Difficult to resuscitate patients

Delays operative intervention
Multi-Detector CT Angiography (MDCTA)

Replacing angiography as standard of care

95% sensitivity and 87% specificity

Decreased contrast load

Fast

Effective costwise

MDCTA Disadvantages

Cannot exclude all arterial dissections
- May still require angiography

Limited resolution in presence of
- Foreign bodies
- Vascular calcifications
Surgical Exploration

Indications:

Frank vascular injury

Vascular injury not amenable to endovascular repair

Expanding/pulsatile hematoma

Thrill at injury site

Pulseless limb
Evaluation Algorithm

PHYSICAL EXAMINATION

Normal

Observation

NO CHANGE
Physical Examination

CHANGE
Physical Examination

WEAK SIGNS
Vascular Injury

STRONG SIGNS
Vascular Injury

SURGICAL INTERVENTION

ABI > 0.90

Observation

YES

Advanced Imaging
(i.e., CT Arteriography)

NOT Normal

Normal

Observation

CHANGE
Physical Examination

SURGICAL INTERVENTION
Sequence of Surgical Treatment

Who goes first? Vascular or Orthopaedics
Who Goes First?

Meta-analysis shows sequence of fixation (vascular vs orthopaedic) does not affect amputation rate.

Traction upon vascular repair is not shown to lead to vascular compromise.
Treatment

Have a protocol in place

Consider each patient individually

Restore blood flow

Debride devitalized tissue

Stabilize fractures
Indications for Fasciotomy

Diagnosis of acute compartment syndrome

Arterial injury requiring repair

Combined arterial venous injury

Warm ischemia > 6hr

Cold ischemia > 12hr
Prognostic Factors

Soft tissue injury (crush)
Level of vascular injury
Collateral circulation
Ischemia time
Patient factors
Complications of Vascular Injury

- Blood Loss
- Compartment syndrome
- Tissue necrosis
- Infection
- Amputation
- Death
Case Example

30 yr old presents with elbow dislocation and report of bleeding at the scene

Arterial bleeding is observed in ED

Vascular is consulted

Patient to OR within 3 hours of injury
Direct arterial repair of brachial artery
Ligament repair of elbow
Case Example

29 yr old MVC with bilateral open lower extremity injuries

Cold feet bilateral mangled RLE

No pulses
No pulse with traction
Foot perfusion improves
CT angiogram ordered/vascular consult
Normal LLE
Patient taken to OR for I&D ex-fix left and guillotine amputation right
Pulse returns LLE
Q2 hour vascular checks
12 hours post op patient loses pulse

Taken to OR emergently by vascular for on-table angio and endovascular bypass of intimal flap

Infection develops HD #4, sepsis, and AKA is performed
Vascular Injuries: Summary

Maintain high index of suspicion
* Recognize common injury patterns
* Thorough, repeated examination

Rapid recognition and treatment is paramount

Have a protocol for evaluation and treatment


• For questions or comments, please send to ota@ota.org