

Vascular Trauma

Dr. Pouya Tayebi

Assistant Professor of Vascular Surgery

Babol University of Medical Sciences

Trauma Algorithm

- **A**irway
- **B**reathing
- **C**irculation

Signs of Arterial Injury

Hard Signs (Operation Mandatory)	Soft Signs (Further Evaluation Desirable)
Pulsatile hemorrhage	Proximity
Significant hemorrhage	Minor hemorrhage
Thrill or bruit	Small hematoma
Acute ischemia	Associated nerve injury

Injury patterns

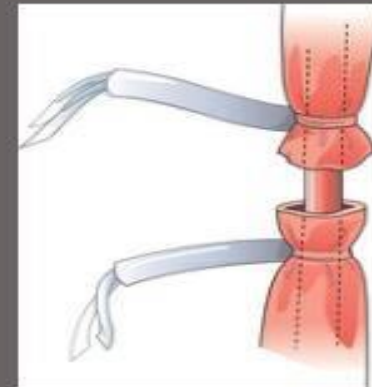
- Penetrating
 - Fully transected vs partially transected vessel
- Blunt
 - Small intimal flap vs transmural damage
- Free vs contained bleed (pseudoaneurysm)
- Arteriovenous fistula
- Iatrogenic injury

General

- Definitive therapy vs damage control
 - Control hemorrhage
 - Maintain distal perfusion
- Open vs endovascular
- Trauma patients tend to be healthier and younger than most vascular patients

What are your options?

- Observation
- Ligation
 - Ok to ligate external carotid, celiac axis, internal iliac
 - Maintain one major vessel to extremity
- Lateral suture
- End-to-end anastomosis
- Interposition grafts
 - Vein
 - Artery
 - PTFE
 - Dacron
- Extra-anatomic bypass
- Interventional radiology

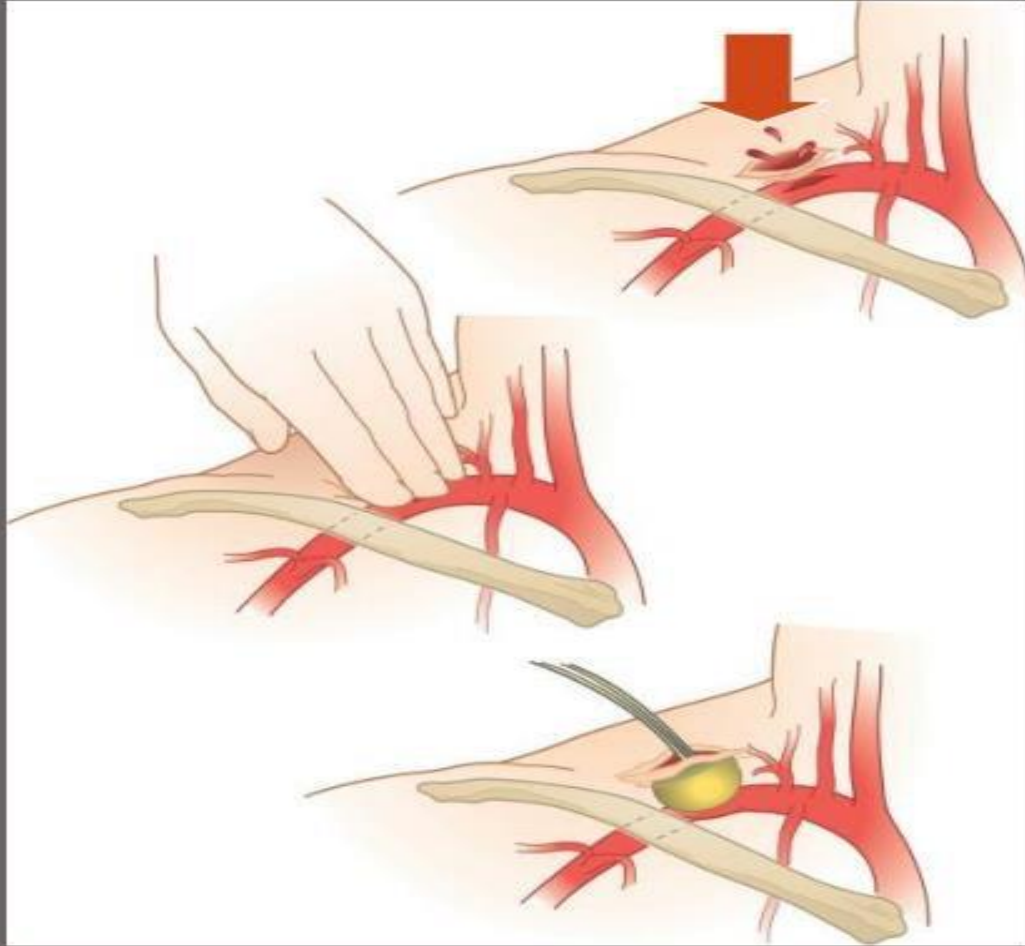


Endovascular management

- Can be considered in *hemodynamically stable* patient with no active bleeding
- Examples:
 - Access to vertebral artery
 - Repair renal artery injury
 - Repair subclavian artery injury
 - Repair of blunt injury to descending thoracic aorta



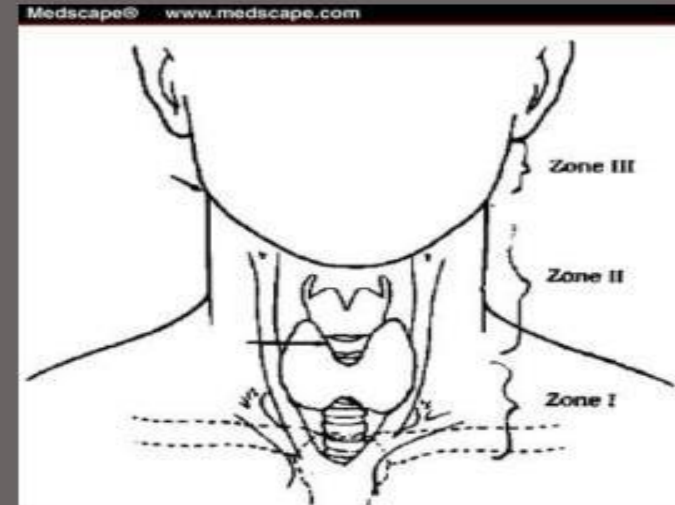
Operative Principles



- Obtain proximal and, if possible, distal control

Neck Injuries

- Major vascular injury occurs in 1 of every 4 patients with penetrating cervical injury
- Airway, airway, airway



- Asymptomatic patients with penetrating injury to zones 1 + 3 require 4 vessel angiography
- Asymptomatic patients with zone 2 injuries may get angiography or immediate surgical exploration

Blunt Cerebrovascular Injuries

- Incidence of clinically significant injuries to carotid/vertebral arteries is 1-3 per 1000 patients admitted to trauma center
- With increased screening protocols, incidence of injury is 1%
- Usually an intimal tear
- Most patients are treated with systemic anticoagulation

Thoracic Vascular Injuries

- Choice of incision
 - If unsure about location of injury, anterolateral thoractomy



Thoracic vascular injury – choice of incision

- Median sternotomy
 - Ascending aorta
 - Innominate artery
 - Proximal R subclavian artery
 - Innominate vein
 - Proximal L common carotid
- Left thoracotomy
 - L subclavian artery
 - Descending aorta
- Distal R subclavian artery – midclavicular incision

Management of specific thoracic injuries

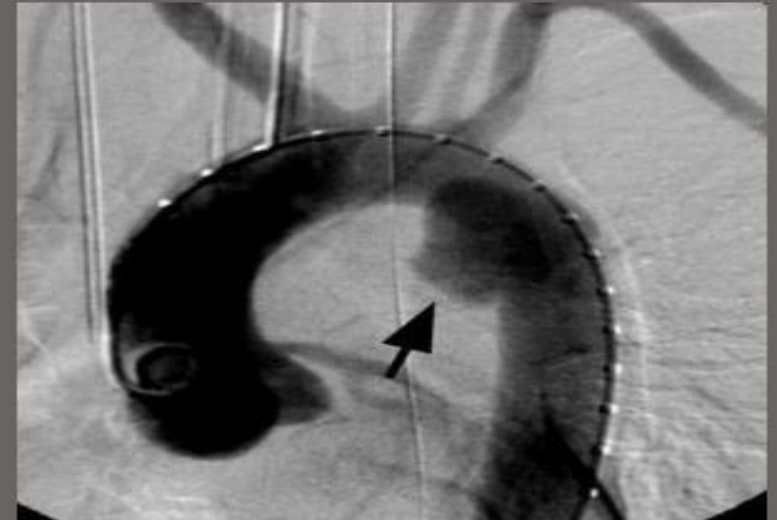
- Pulmonary hilar injuries
 - Mortality is 70%
 - Usually pneumonectomy with linear stapler is indicated

Blunt Thoracic Aortic Injury

- Cause of 10-15% of motor vehicle deaths
- Most commonly seen injury to proximal descending thoracic aorta
- Patients invariably have associated injuries:
 - 50% head
 - 46% rib fxs
 - 38% lung contusions
 - 20-35% orthopedic injuries

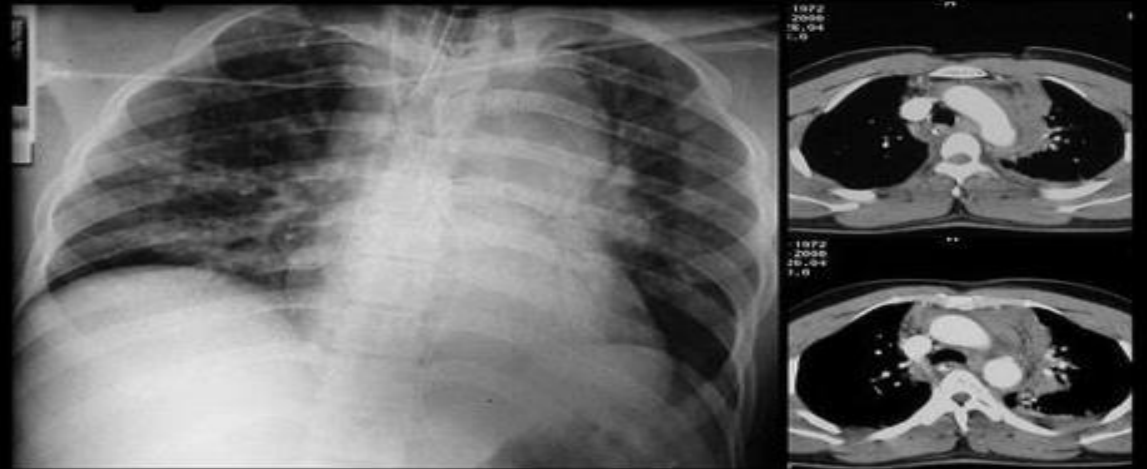
Blunt thoracic aortic injuries

- Mechanism is commonly sudden deceleration with shear force between mobile and fixed portion of the thoracic aorta
- A contained injury is almost NEVER the cause of hemodynamic instability – look elsewhere!



CXR findings

- Widened mediastinum ($>8\text{cm}$)
- Obscured or indistinct aortic knob
- Deviation of L mainstem bronchus
- Obliteration of aortopulmonary window



Operative management of blunt thoracic aortic injury

- Traditional therapy has always been prompt operative repair
- Consider non operative therapy with severe head injury or multi organ trauma
- Estimated risk for free rupture is 1%/hour
- Control BP and afterload reduction
- Remember follow up imaging when necessary

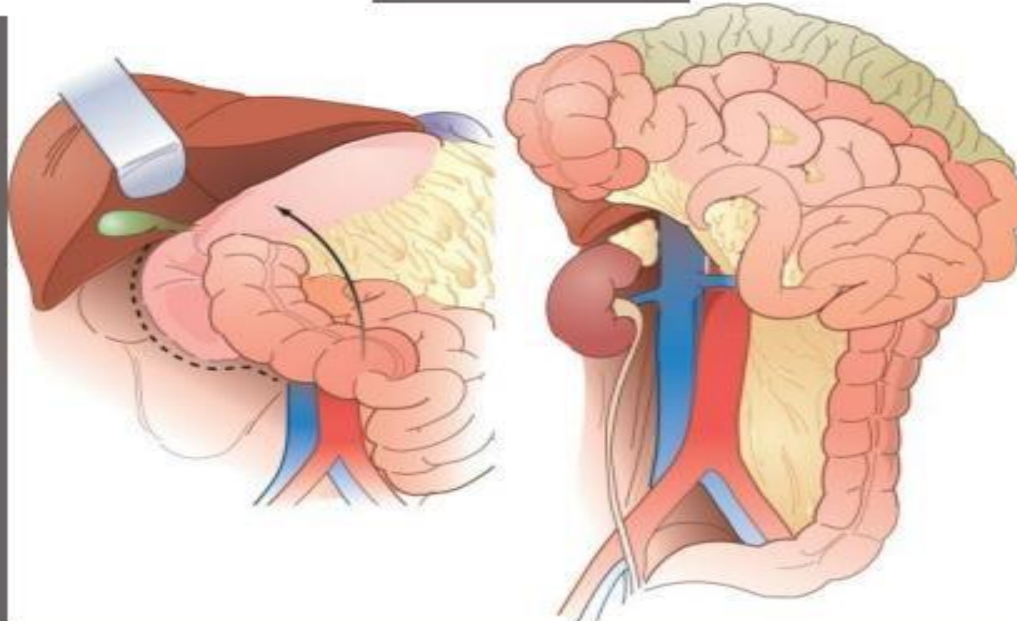
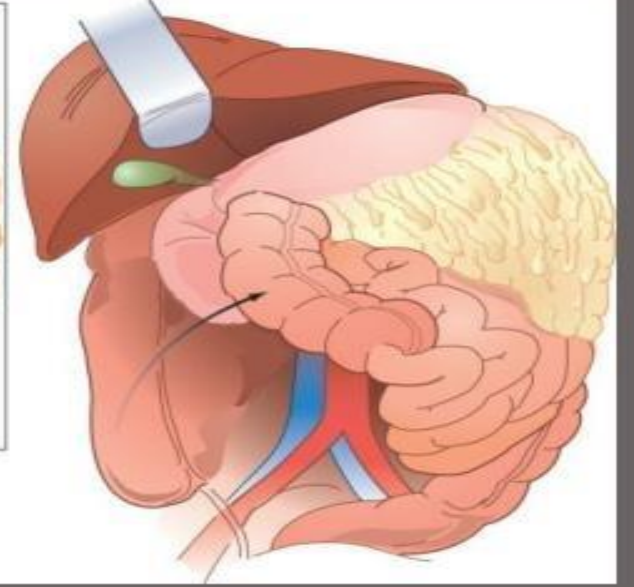
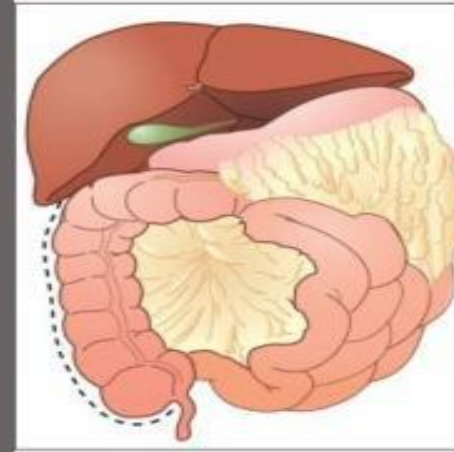
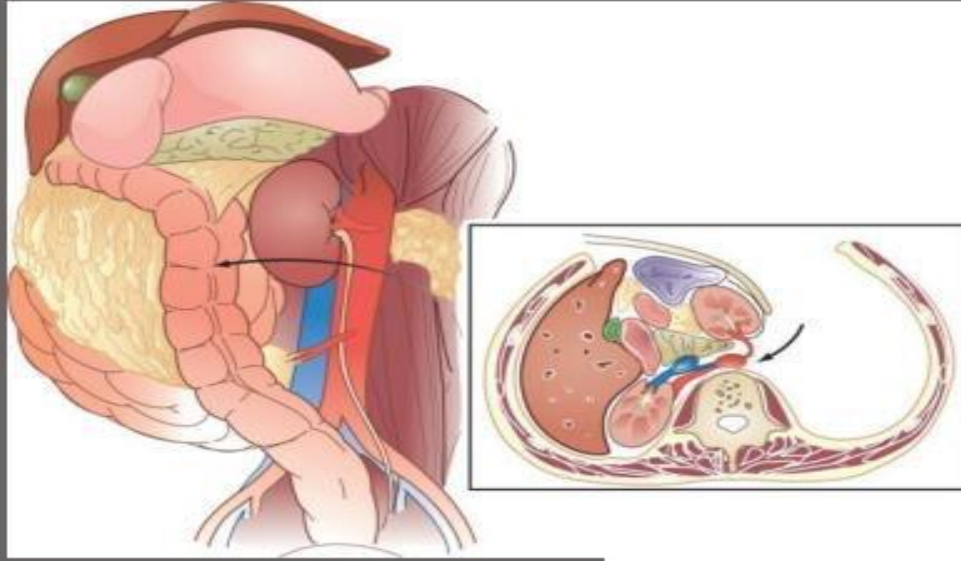
Endovascular repair

- Increasingly being used despite poor clinical data
- Open repair
 - Mortality 13% (0-55%)
 - Paraplegia 10% (0-20%)
- Endovascular repair
 - Mortality 3.8%
 - Paraplegia <1%
- Technical Obstacles
 - Size of graft vs aorta
 - Angulation of aorta

Abdominal Vascular Injuries

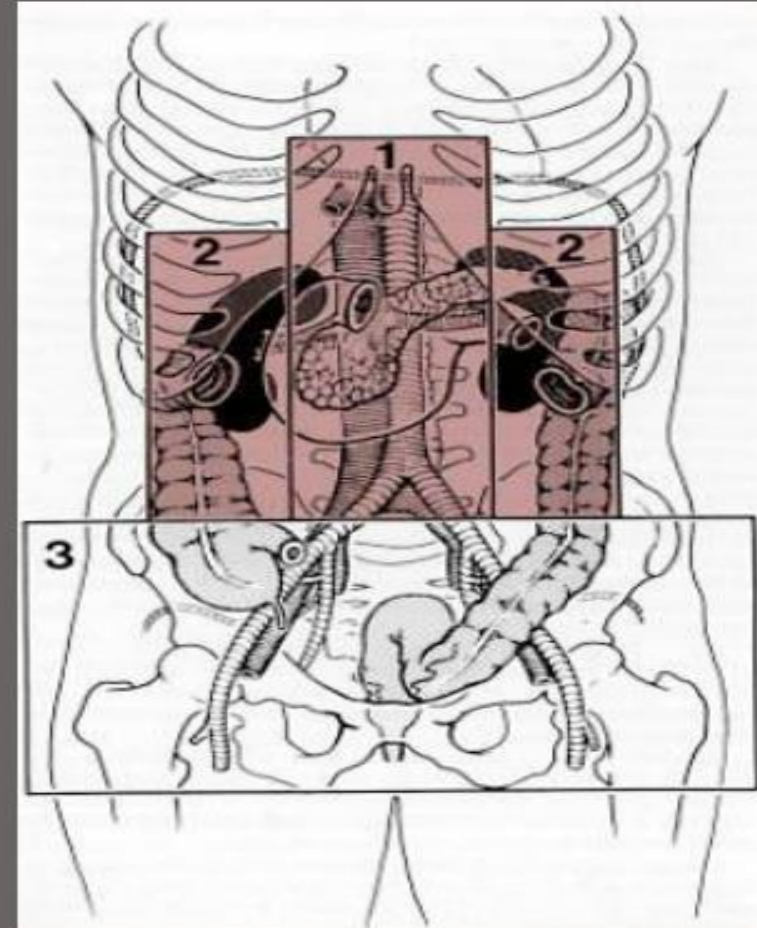
- Definitive repair vs damage control
- Aortic cross clamping (easiest is supraceliac aorta)

Retroperitoneal exposure



Retroperitoneal hematomas

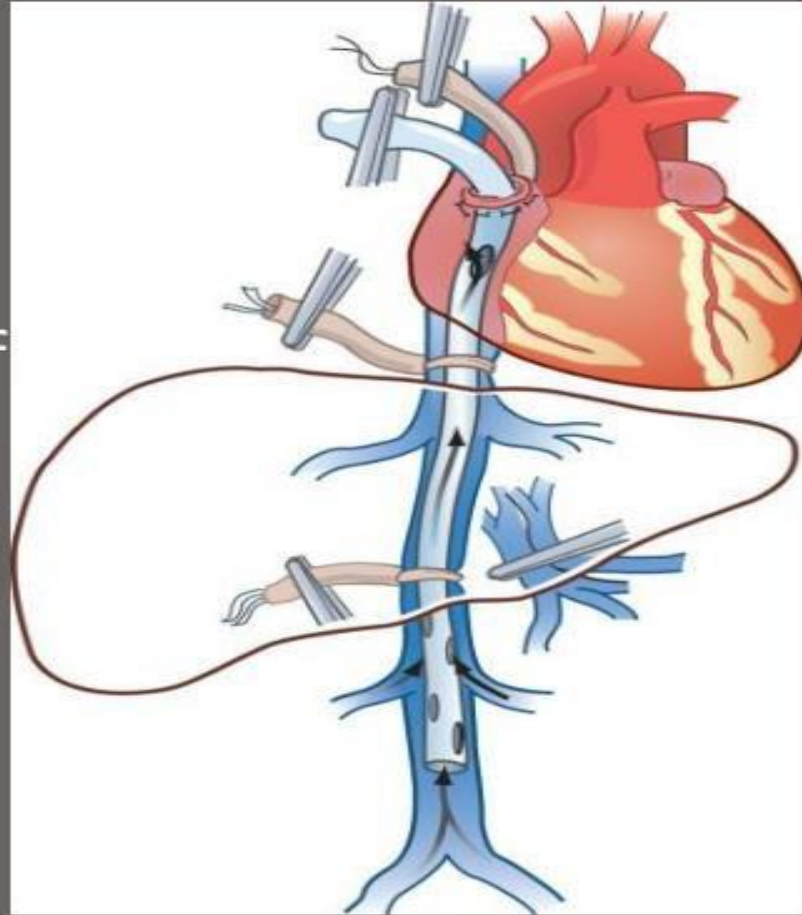
- Zone 1 injury
 - Mandates exploration for both blunt and penetrating injury
- Zone 2 injury
 - Exploration for penetrating
 - Observation for stable blunt trauma
- Zone 3 injury
 - Same as zone 2



Retrohepatic IVC injuries

Atrio-caval, or
Schrock, shunt

Mortality in excess of
80%



Peripheral Vascular Trauma

- Assess neurologic status of affected extremity
- Look for signs of compartment syndrome
- Traditional window of opportunity ≤ 6 hours
- Hand held Doppler
- Arteriography indicated for any >10 mm Hg difference between extremities

Role of Arteriography

- No use in actively bleeding patient
- Questionable use in patient with proximity injury but normal PE
- Helpful for identification of area of injury prior to going to OR
- Remember soft signs of arterial injury

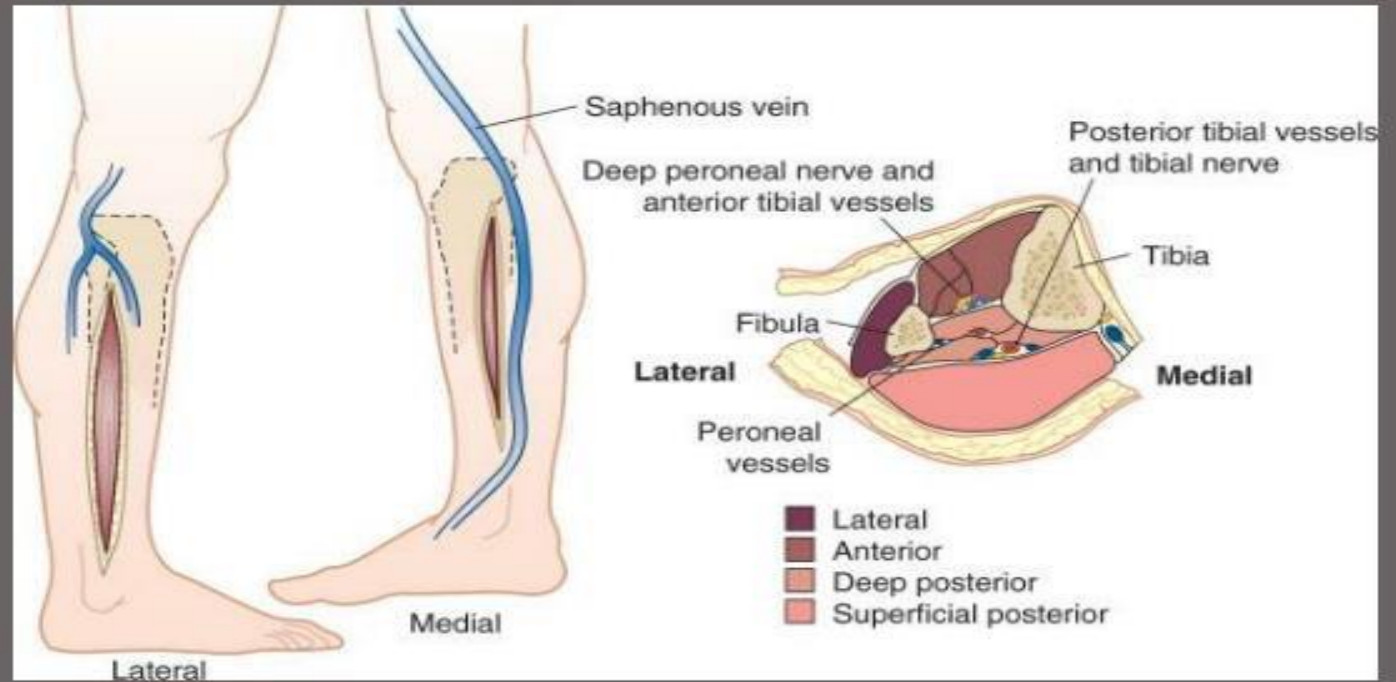
Operative Repair

- Usually bony injuries are repaired first
 - Consider temporary shunt if needed
- Small arteries of arm and below the knee usually preclude use of synthetic graft
- PTFE may be ok in contaminated field
- Principles include soft tissue coverage

Fasciotomy

- Why elevated compartment pressures?
 - Direct muscular trauma
 - Hypotension
 - Reperfusion of ischemic extremity
 - Ligation of injured veins
- Difficult to diagnose

Fasciotomy



The anterior and lateral compartments are approached through a lateral longitudinal incision following the anterior margin of the fibula. The superficial and deep posterior compartments are decompressed through a medial incision slightly posterior to the edge of the tibia.

Iatrogenic Injury

- Hemorrhage/hematoma from puncture site
 - Usually related to inadequate compression following puncture or removal of catheter
- Pseudoaneurysm
 - US guided compression effective 80-90%
- Arterial thrombosis

Peripheral vascular injuries

- Popliteal injuries have highest rate of limb loss (20%)
 - Posterior dislocation of knee
- Brachial artery most commonly injured peripheral artery (20-30% of cases)

Vascular Trauma Review

- Always remember ABC's
- Compression, control hemorrhage
- Imaging if indicated and patient stable
- Try to think about operative approach/incision ahead of time
- Follow up imaging when indicated

Thanks for your attention