



Vascular Injuries in Extremity Trauma

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TRAUMA & EMERGENCY RADIOLOGY

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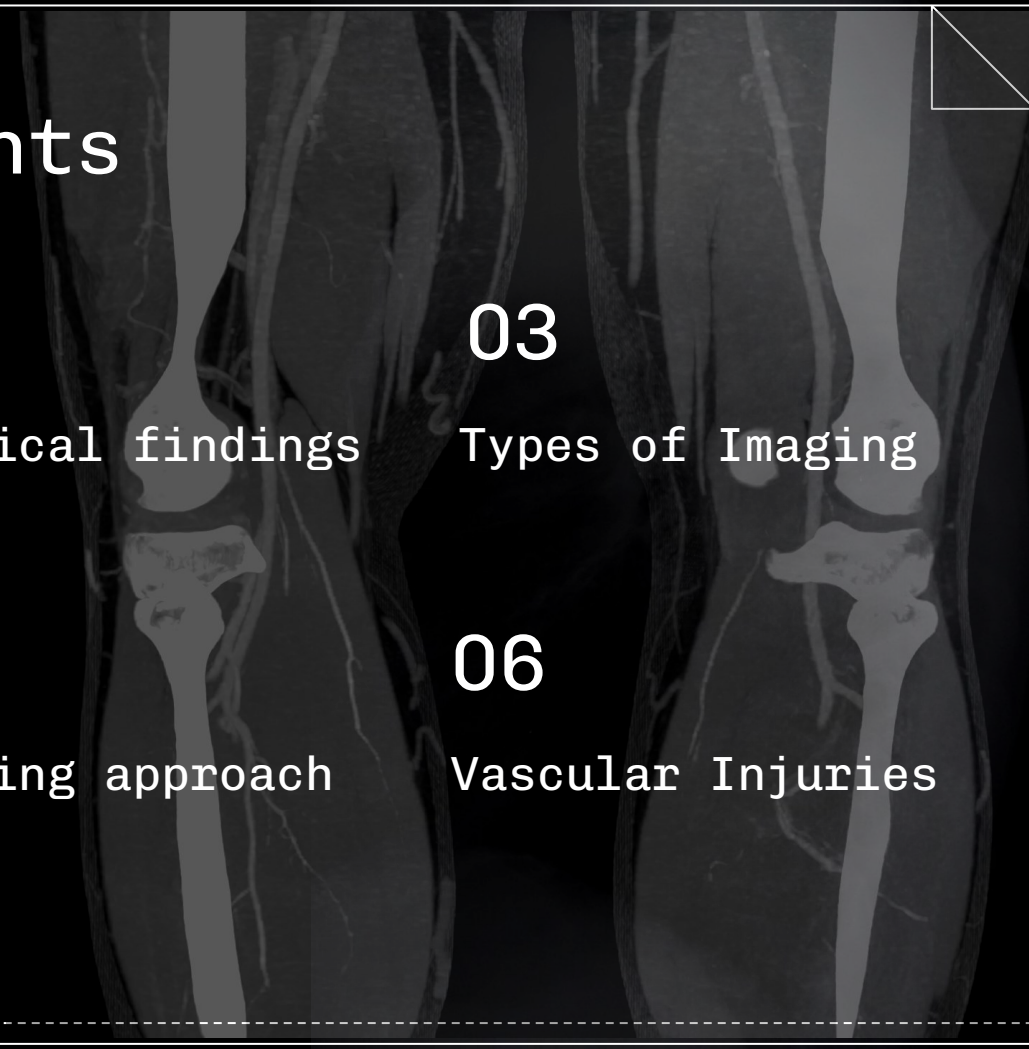
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Vascular Injuries



Background: Extremity Trauma

- **Between 1-2% of all civilian trauma have vascular injuries**
Account for > 20% of all trauma-related deaths

2/3 lower extremity – femoral or popliteal

9/10 male
- **Penetrating vs Blunt 3:1**
 - **Penetrating**
Gunshot wounds > Stab wounds
 - **Blunt**
Crush injury, tissue tearing > Fractures or dislocations

Assessing Vascular Injury

- Physical examination is key
- Hard signs: strong correlation to arterial injury
- Soft signs: 3-25% arterial injury
- Minority of injuries with hard signs, some are clinically occult.

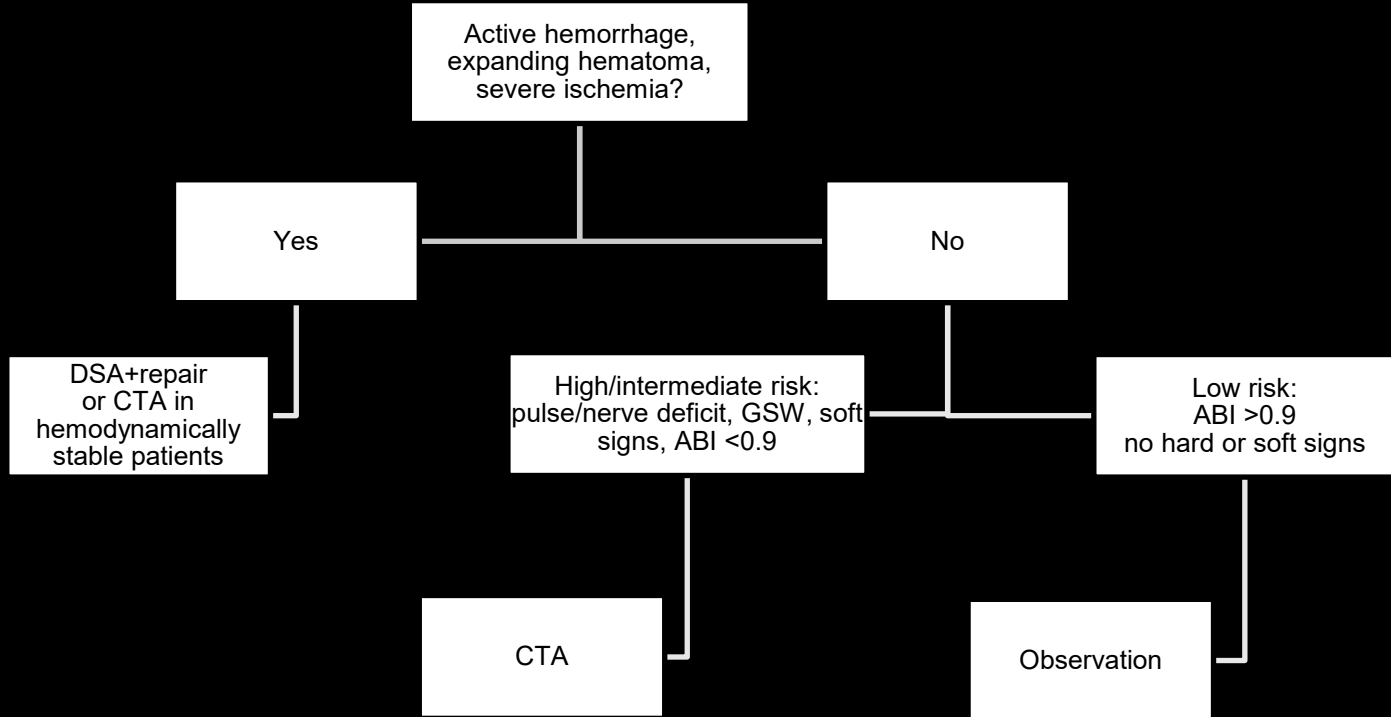
Hard Signs	Soft Signs
Pulsatile bleeding	Nonpulsatile bleeding
Expanding/pulsating hematoma	Nonexpanding/nonpulsatile hematoma
Loss of distal pulses	Diminished pulse
Bruit/thrill	History of arterial (massive) bleeding/hypotension
	Previously applied tourniquet
	Neurologic deficit
	Wound in proximity to named vessel

Undiagnosed Injury?

- Thrombosis
- Rupture with hemorrhage
- AV-fistula / Pseudoaneurysm formation
- Most feared complication: **Compartment syndrome** >>
Permanent muscle and nerve injuries >> **Amputation**

Management Algorithm

Based on EAST management guidelines



Imaging in Vascular Trauma

- In the acute setting
 - Digital Subtraction Angiography (DSA)
 - CTA

Digital Subtraction Angiography (DSA)

Traditionally was the reference standard

Advantages:

- Classify vascular injuries
- Not obscured by metal artifact
- Endovascular repair

Disadvantages:

- Cost
- Endovascular team
- Time consuming
- Potential delay of diagnosis
- Invasive >> might lead to complications



Occlusion of SFA b/c of intimal injury

CT Angiography (CTA)

- Primary diagnostic according to EAST
- Workhorse in diagnosing extremity trauma
- Fast, non-invasive
- 24/7 availability
- Detect and characterize non-vascular injuries
- High sensitivity and specificity

Dissection of posterior tibial and peroneal artery +
comminuted tibial fracture

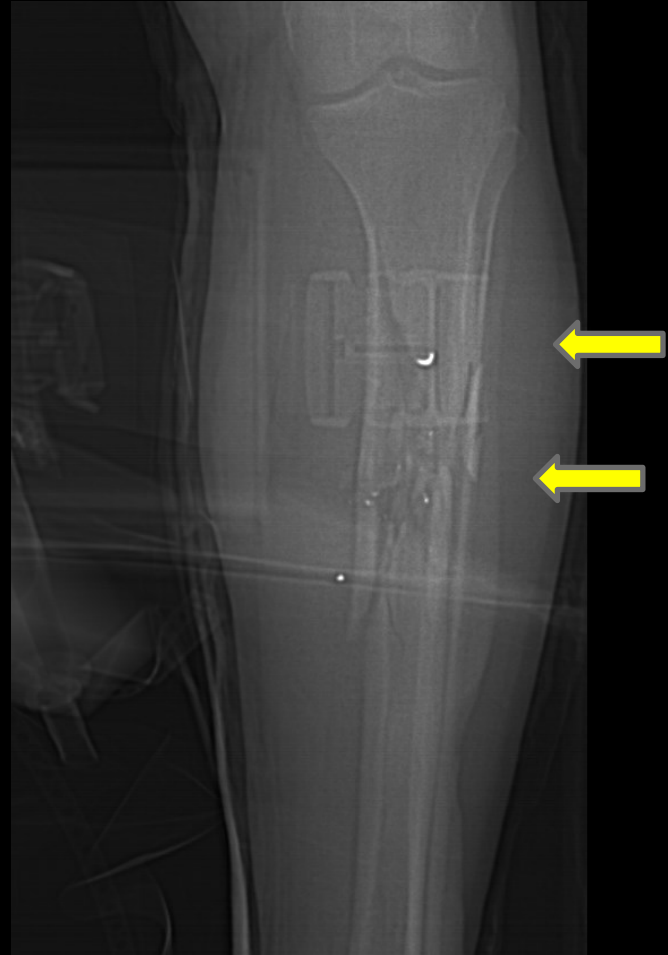
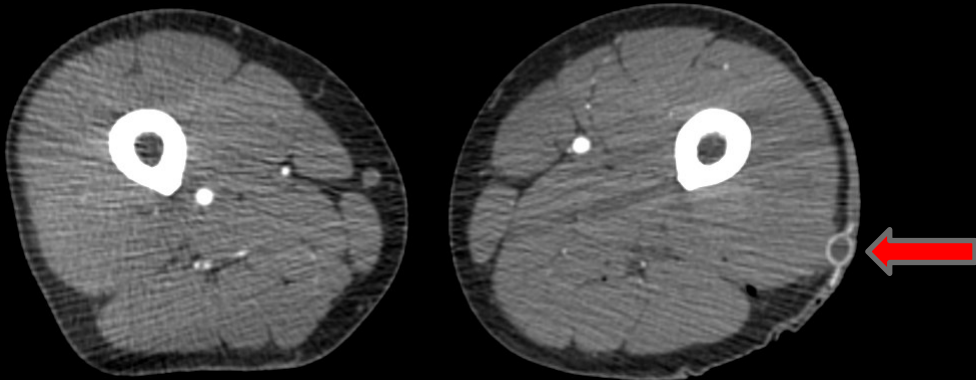


CTA: What do we need?

- Peripheral IV-line
- High contrast injection rate (>4mL/s)
- Bolus tracking, ROI:
 - Aortic arch for the upper extremity runoff
 - Infrarenal abdominal aorta for a lower extremity runoff
 - Added as run-off to WBCT
- Arterial phase acquisition always
- Selected cases: venous phase
- Contrast load consideration? Renal status? > Not an issue in the acute setting

Approach to CTA

- Mark wounds with vitamin E-capsule
- Check the scout!
 - Bullet fragments
 - Foreign objects
 - Fractures



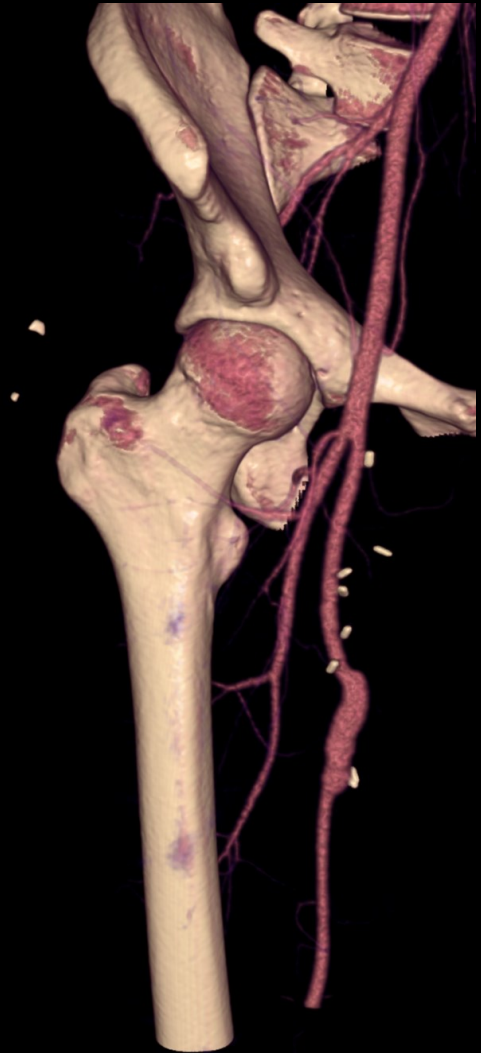
Approach to CTA

- Thin axial slices <0.6 mm
- MPR
- Play with windowing:
discriminate between bone fragments /
bullets / vessels / extravasation



Approach to CTA

- Coronal MIP is your friend!
- 3D volume for easy overview



Vascular Injuries

- Extravasation
- Vessel irregularity
- Occlusion
- Pseudoaneurysm
- Traumatic arteriovenous (AV) fistula

Extravasation

- Contrast media outside the vessel lumen.

Arterial extravasation represents active bleeding.

- Irregular morphology, "blush".
- Hematoma either iso- or hyperattenuating.
- Venous phase: the attenuation rises, and hematoma increases in size.

Case: Extravasation

33-year-old male, multiple gunshot wounds in right leg

Active bleeding distally in femoral artery

Iso-attenuating hematoma with irregular border



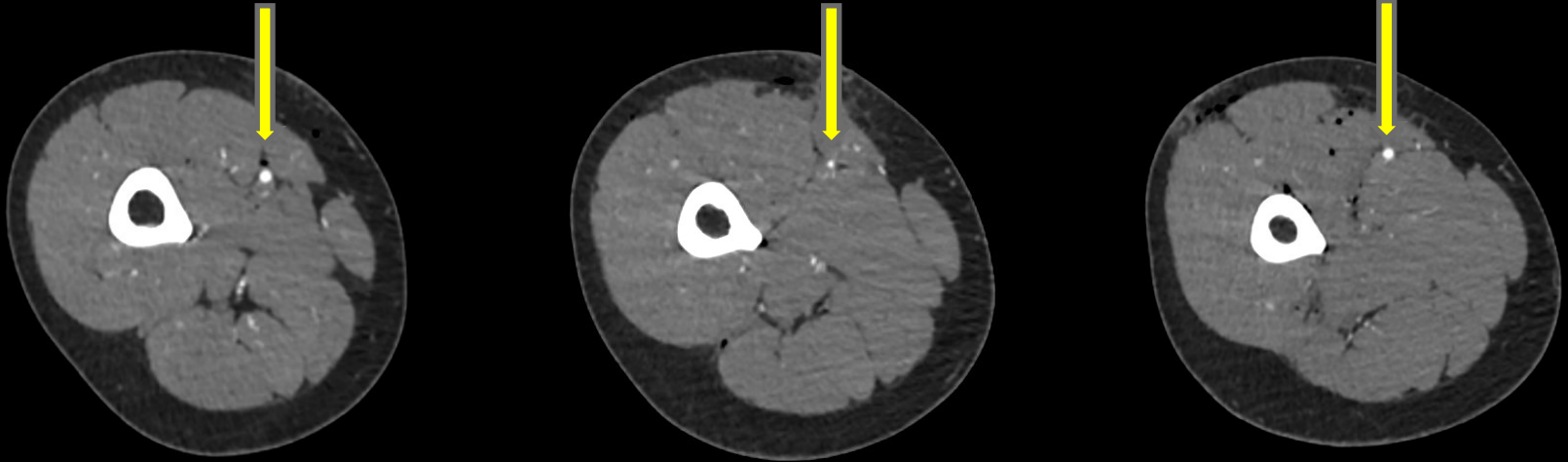
Vessel Irregularity

- Diffuse narrowing of the lumen, "flickering star"
- Secondary to either vasospasm or dissection
- Similar appearance of the opacified lumen
- Vasospasm benign protective mechanism
- Note the finding, as dissection can potentially lead to thrombus>>occlusion>>bleed>>compartment syndrome

Case: Vasospasm

20-year-old male, gunshot wound to the right thigh

Diffuse narrowing and normalization of the lumen of SFA in the axial plane, like a "flickering star"

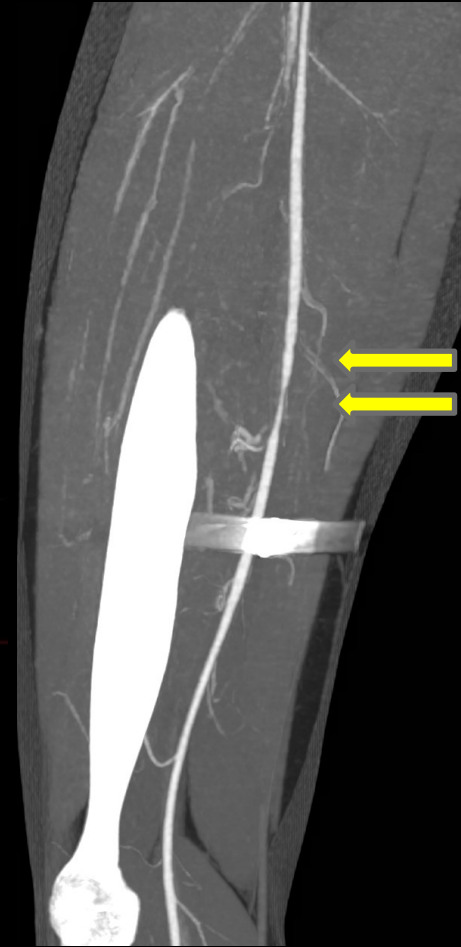
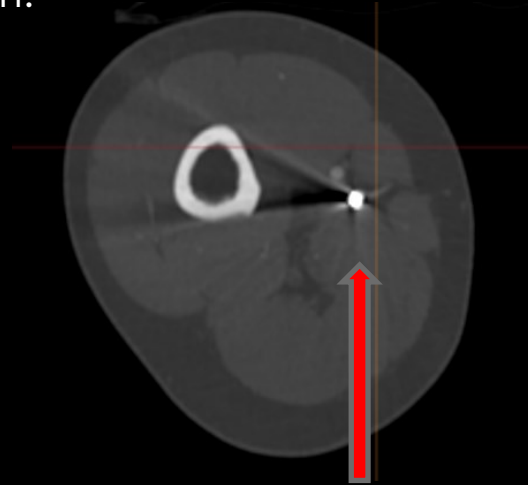


Case: Vasospasm

Sagittal MIP show lumen irregularity

No extravasation

Bullet is adjacent to the SFA approx. 1 cm.



Occlusion

- Interrupted contrast flow in an artery
 - With or without distal constitution

- Secondary to:
 - Thrombosis
 - Transection
 - Dissection / Intimal injury

Case: Occlusion

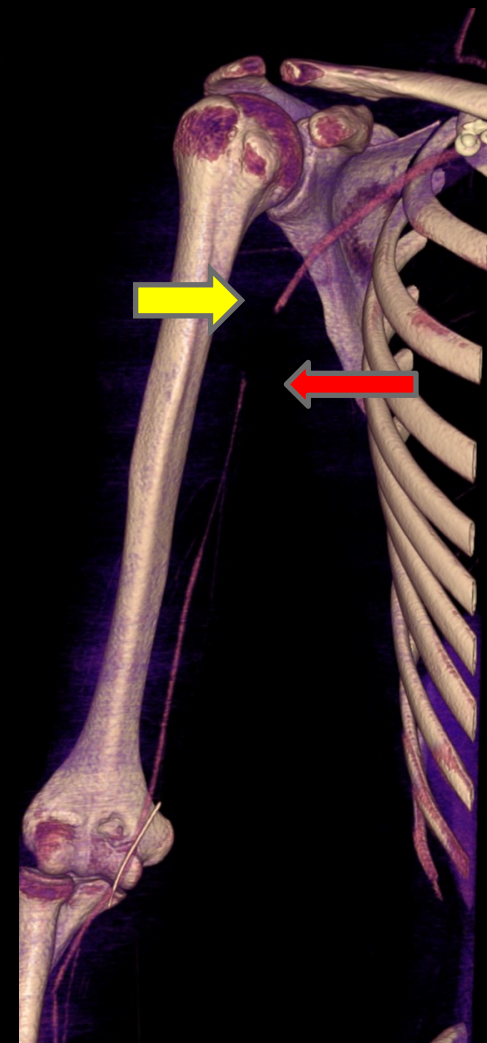
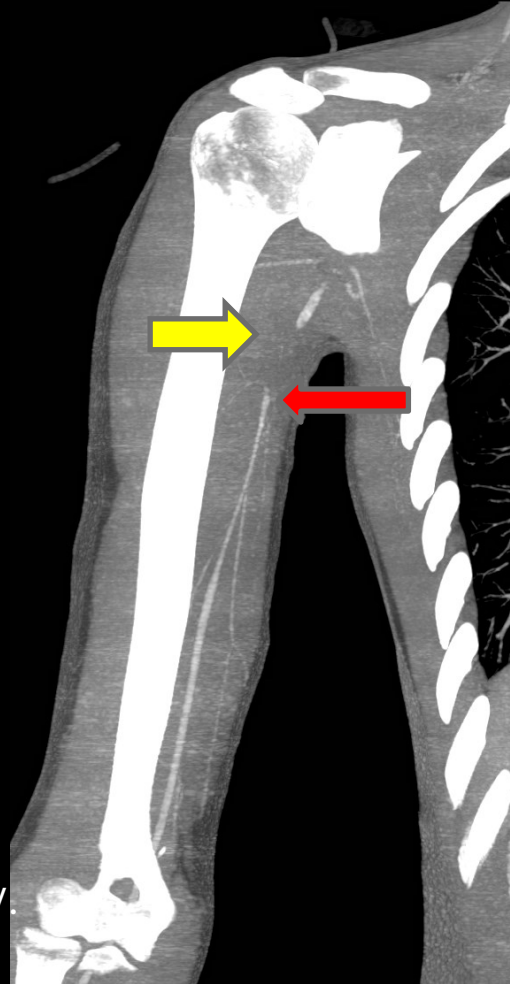
23-year old male, penetrating trauma
Fall through glass window

Occlusion of the brachial artery
with thrombosis.

Distal reconstitution.

No active bleed.

Transection confirmed during surgery



Pseudoaneurysm

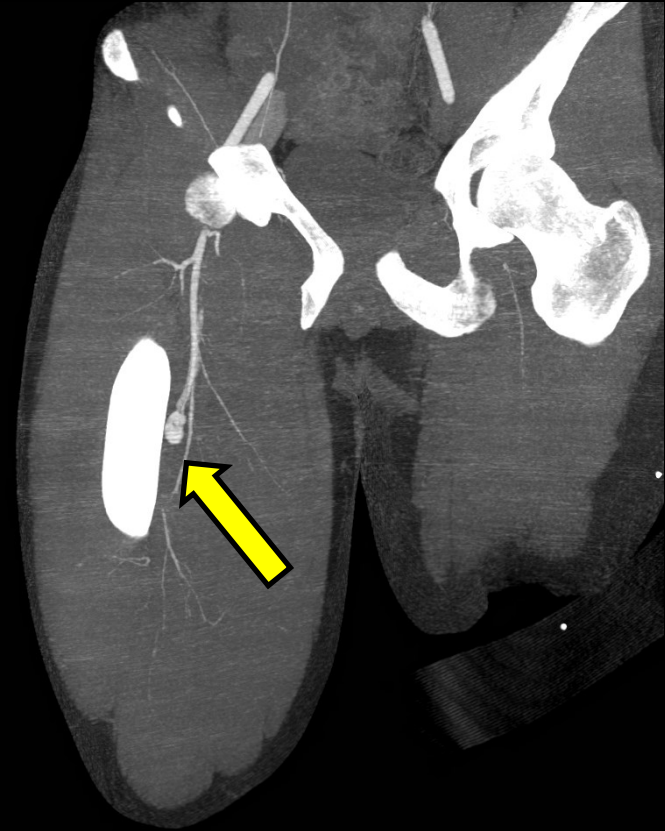
- Round, well-defined, outpouching of arterial wall
- Damage of the inner layers with an intact tunica adventitia.
- Differentiate from extravasation:
 - Round well-defined morphology, not blush-like
 - Does not enlarge in venous phase

Case: Pseudoaneurysm

25-year-old male, stabbing wound in right thigh

Pseudoaneurysm, branch from deep femoral artery

No active bleed



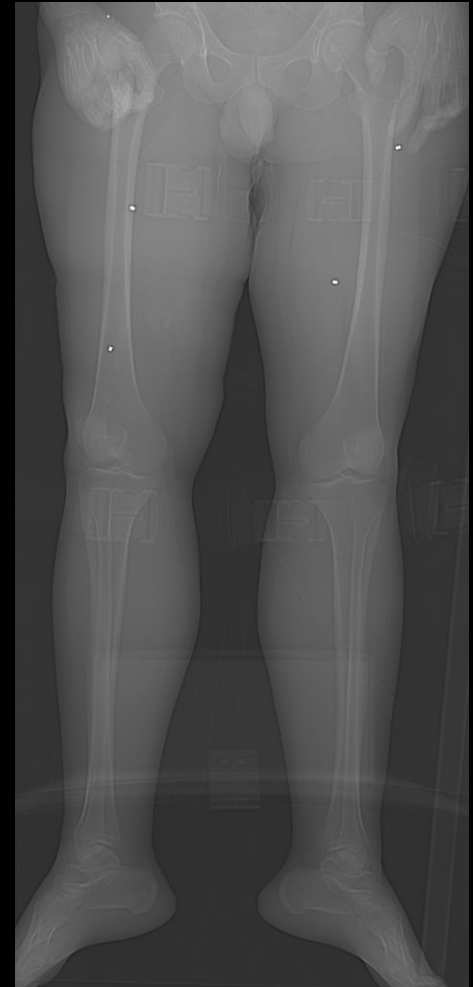
AV-fistula

- Tear in the vessel wall in adjacent artery and vein
- Often because of penetrating trauma
- High pressure arterial blood flows into the lower pressure vein
- Early or equal contrast enhancement in the vein in the arterial phase
- Pitfall: hyperemia with venous congestion

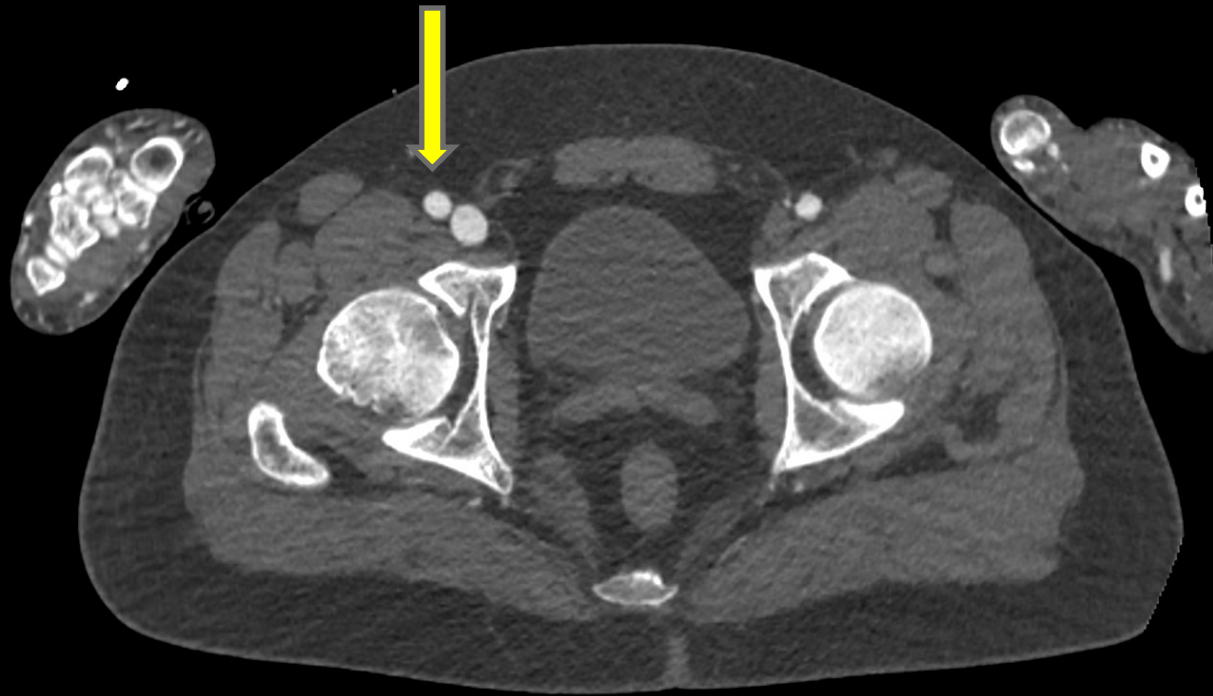
Case: Stabbing wound

40-year-old male, played with knives, no previous medical history.

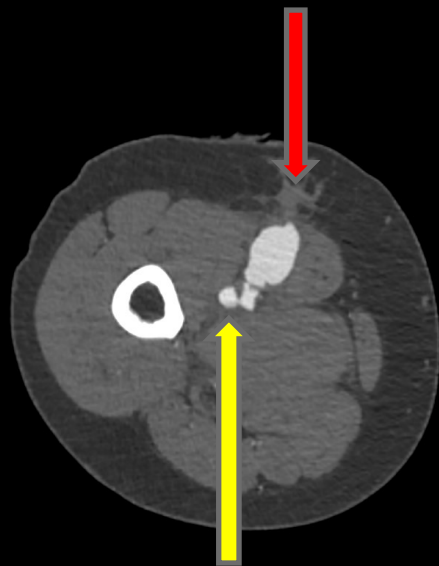
Active bleeding on site, arrives with tourniquet right upper thigh.



Case: Stabbing wound



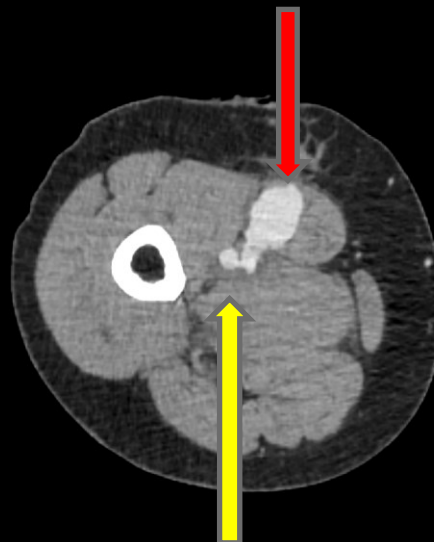
Case: Stabbing wound



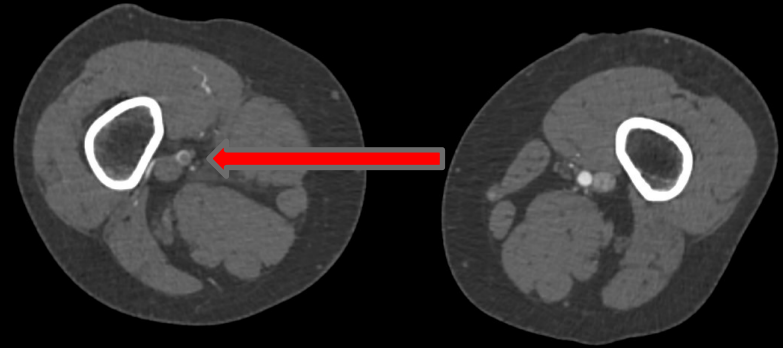
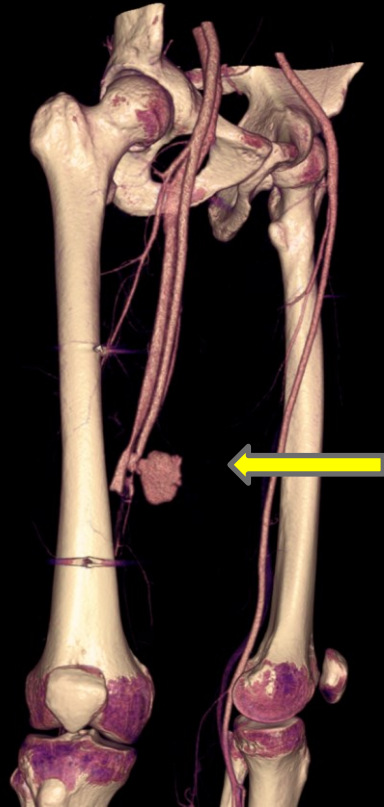
Arterial Phase



Venous Phase



AV-fistula Pseudoaneurysm Thrombosis





Thank You for listening!

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