



Ryder Trauma Center



The Role of Whole Body MDCT Angiography in Blunt Polytrauma

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Learning Objectives



1. Discuss indications of the whole Body MDCT
2. Describe whole body CT protocols currently in use
3. Review key injuries identified with WBCTA that require urgent intervention

D. Dreizin and F. Munera. Radiographics 2012; 32: 609-631

Trauma Epidemiology

- Trauma is the **leading cause of death** < 45
- In trauma, **“time is life”**. Outcomes greatly improved when critical interventions are provided within the **golden hour** following injury.
- WBMDCT can **decrease the LOS** ¹ in the trauma room and **increase survival** ²

¹ - Hilbert P, et al Injury 2007; 38(5): 552-558

- Wurmb TE, et al JOT 2009;66(3):658-65 & E Med J. 2011; 28(4):300-4

- Tso D, et al RSNA'11

². Huber-Wagner S, et al Lancet 2009; 373: 1455-61.

Role of MDCT in polytrauma

Help Guide management!

- Goals:
 1. Determine who has significant injuries
 2. Who needs surgical or endovascular intervention?

CT findings in polytrauma requiring surgical or percutaneous intervention:

1. Major vascular injuries
2. Active Hemorrhage
3. Unstable spinal fractures
4. Diaphragmatic rupture
5. Pancreatic injury with ductal involvement
6. Injuries of the mesentery or hollow viscera

1. Indications-When WB MDCT?

- High-velocity mechanism of injury
 - High-speed MVA or falls from heights > 3 m, Pedestrians HBC
 - Ejection from vehicle, severe car deformity, knowledge about fatalities, etc

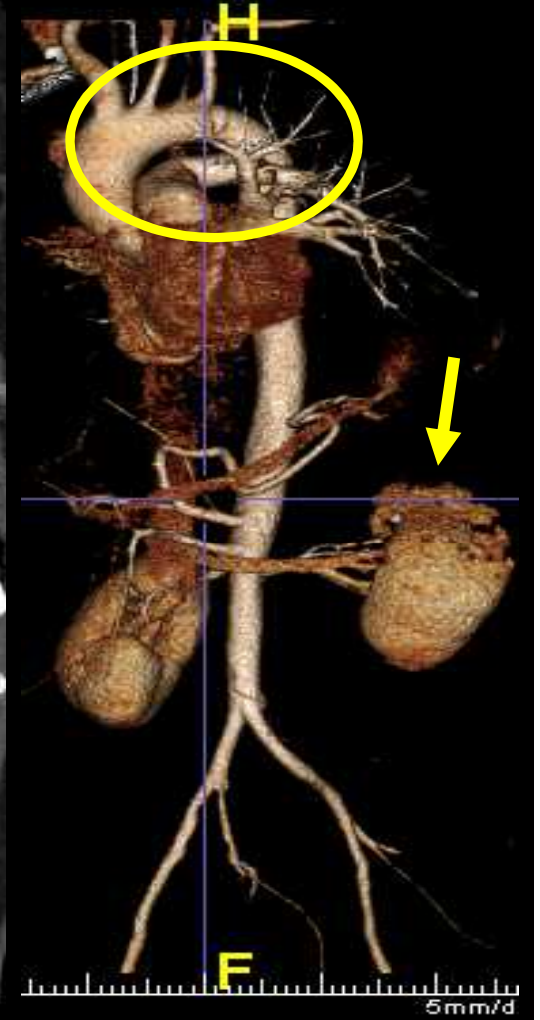
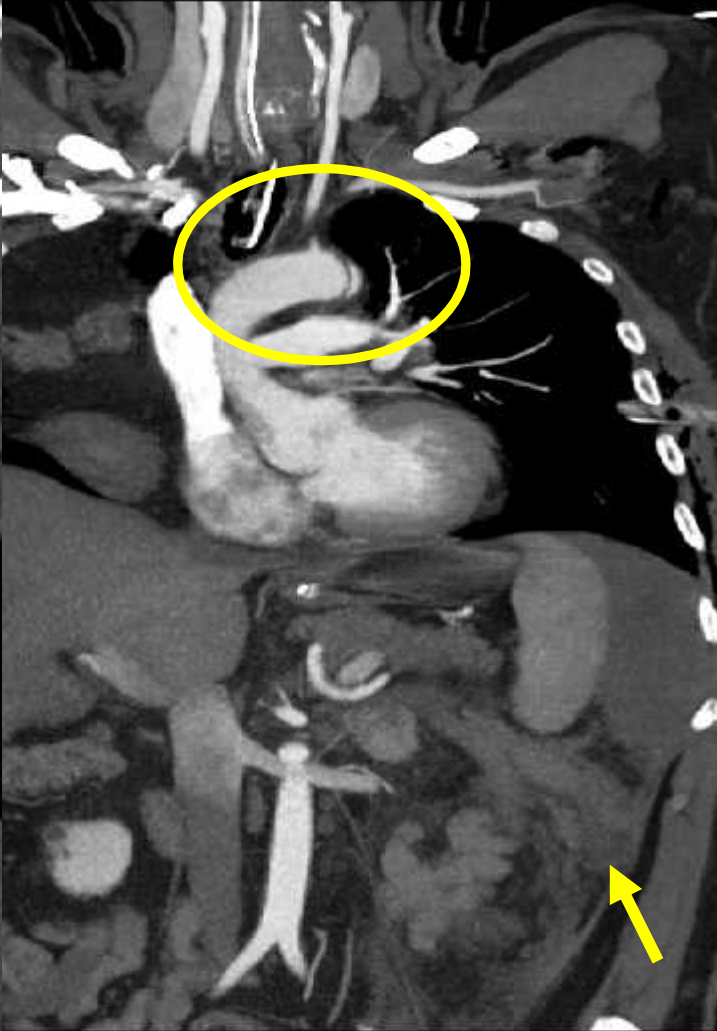
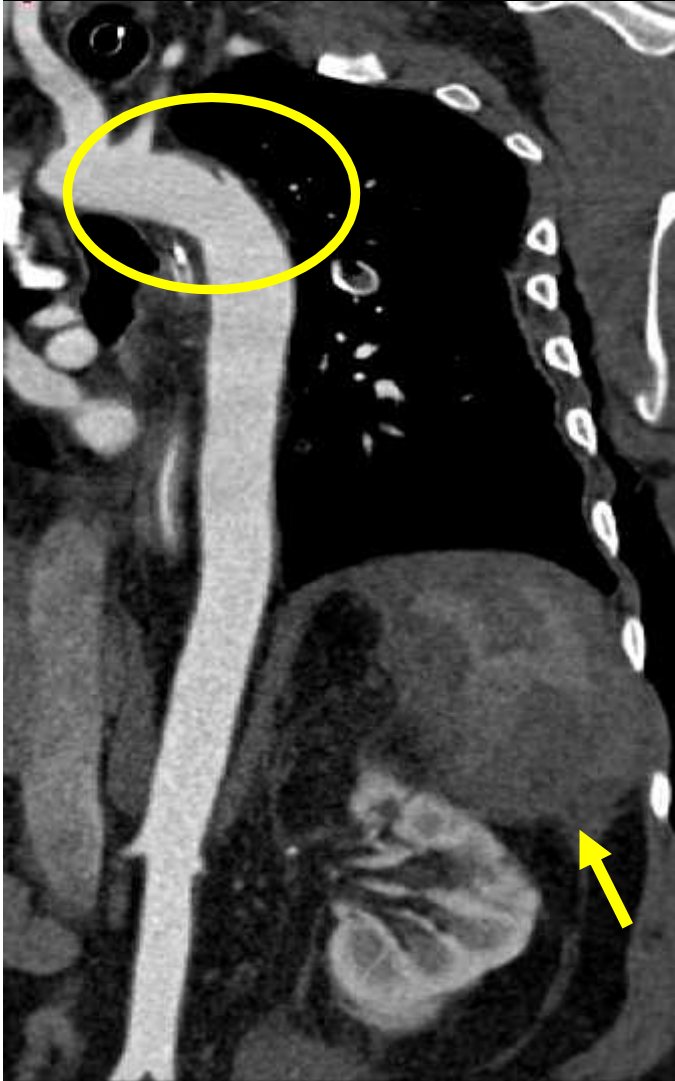
2. Trauma Whole Body CT Techniques

- **Segmented Whole body CT scan:**
 - CTA Chest
 - Portal Phase Abdomen and Pelvis.
- **Single pass whole body CT: \Rightarrow WBCTA**
 - Single pass through the neck, chest, abdomen and pelvis.

D. Dreizin and F. Munera. Radiographics 31:609-31 2012
F. Munera, Rivas LA, et al. Radiology 263:645-60 2012



RICA + Ao
Diaphragmatic
Injuries



“Whole Body” CT Angiogram

UMiami protocol severe blunt polytrauma

- Unenhanced CT of the brain
- Circle of Willis to symphysis pubis
- **Delay:** empiric 20 seconds (25 s > 55 y/o)
- No oral contrast
- Automated exposure control (reference MA 200)
- **MDCT (64 or 128):** 0.6 mm, 3.0 & 1.5 mm
- Routine sagittal and coronal reformations & 3D reconstructions generated at PACS workstation

2. WB MDCT Technique: Controversies

Arm Positioning? above head, along body, flexed over the chest, “swimmers” etc.

- “How we do it”: Arms up (unless prevented by fracture or injury) – ↓ dose* Brink et al. Radiology’10

- Karlo CA, et al. Emerg Radiol 18: 285–293 2011
- Lemos A, et al ECR’11



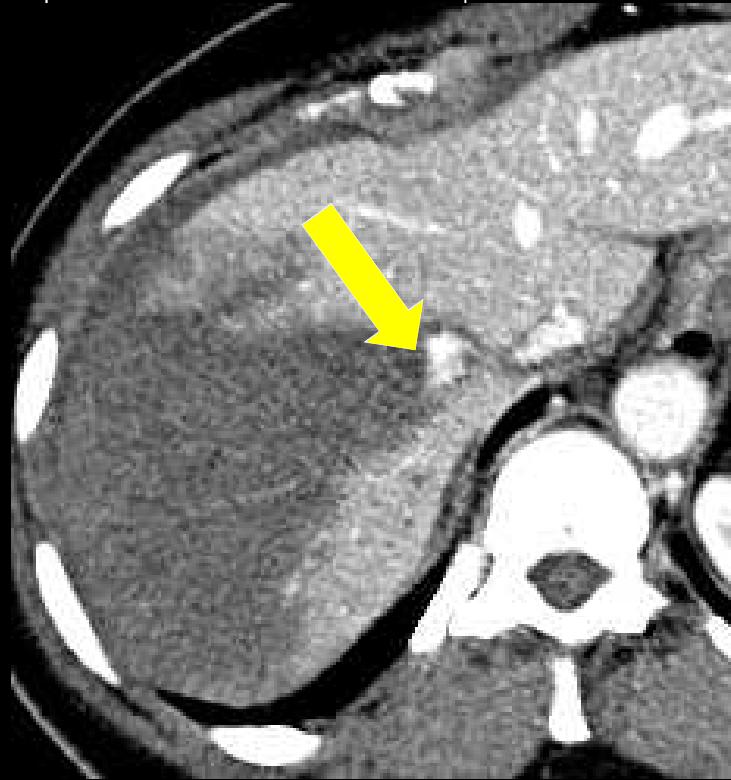
2. WBCTechnique: Controversies

- Ideal injection protocol?
 - **single bolus** 400 mg/ml: Nguyen et al AJR'09
 - **biphasic, triphasic**: Loupatatzis et al Eur Radiol'08, S. Bader RSNA'11, **split bolus** Clark T et al, Glaser-Gallion et al RSNA'11, **dual bolus** *Franklin* RSNA'12, Biphasic injection: > uniform/prolong enhancement*

“ How we do it”: 100 mL 350 mg/mL **Biphasic**: @ 4 mL/s 15 sec, then 3 mL/s followed by 40 mL saline chaser @ 4 mL/s

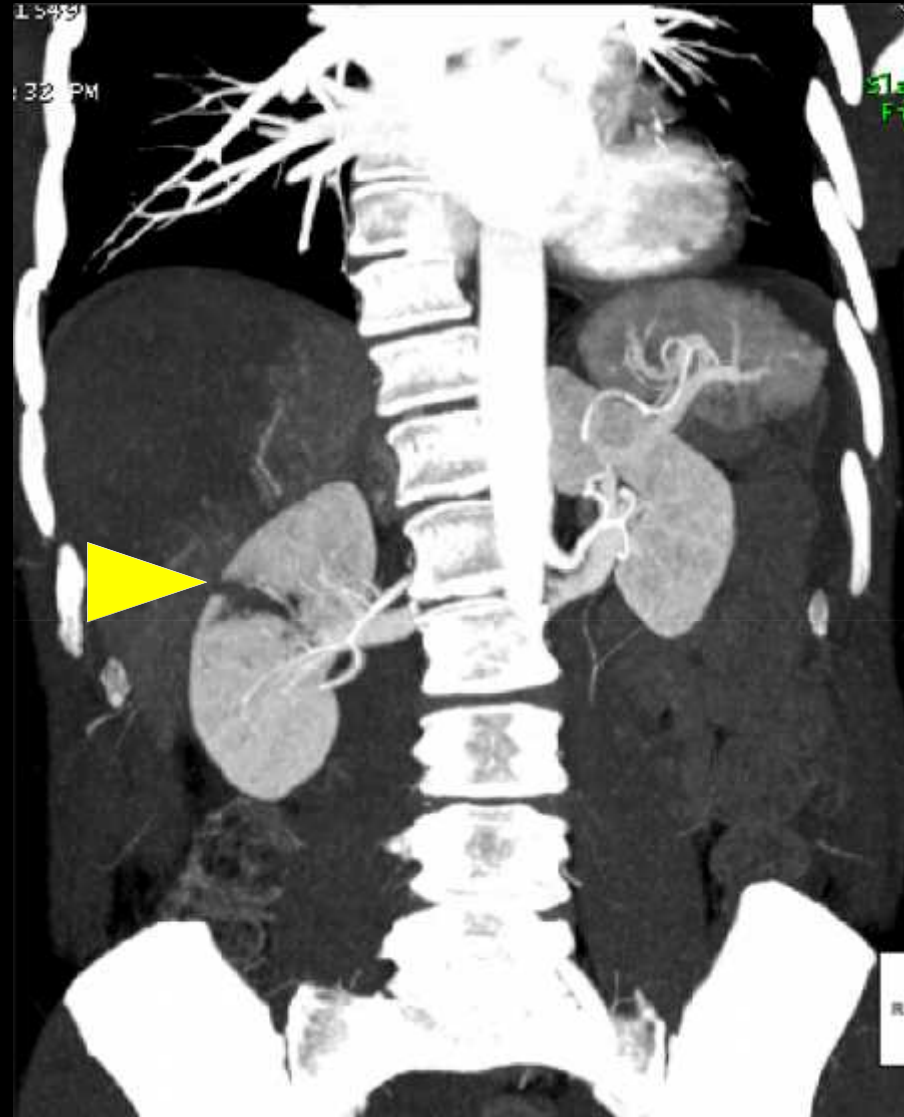
* Bae KT. Radiology. 2010;256(1):32-61.

Portal Phase



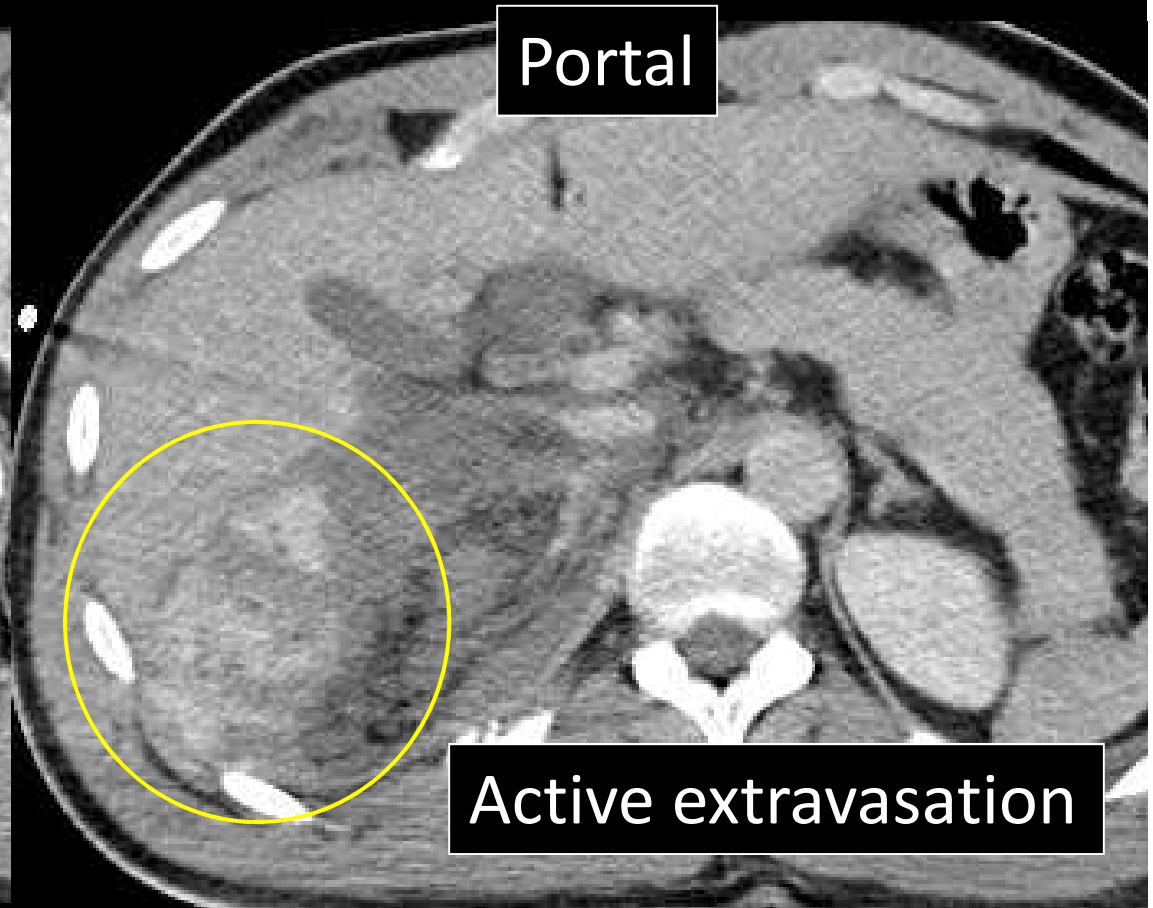
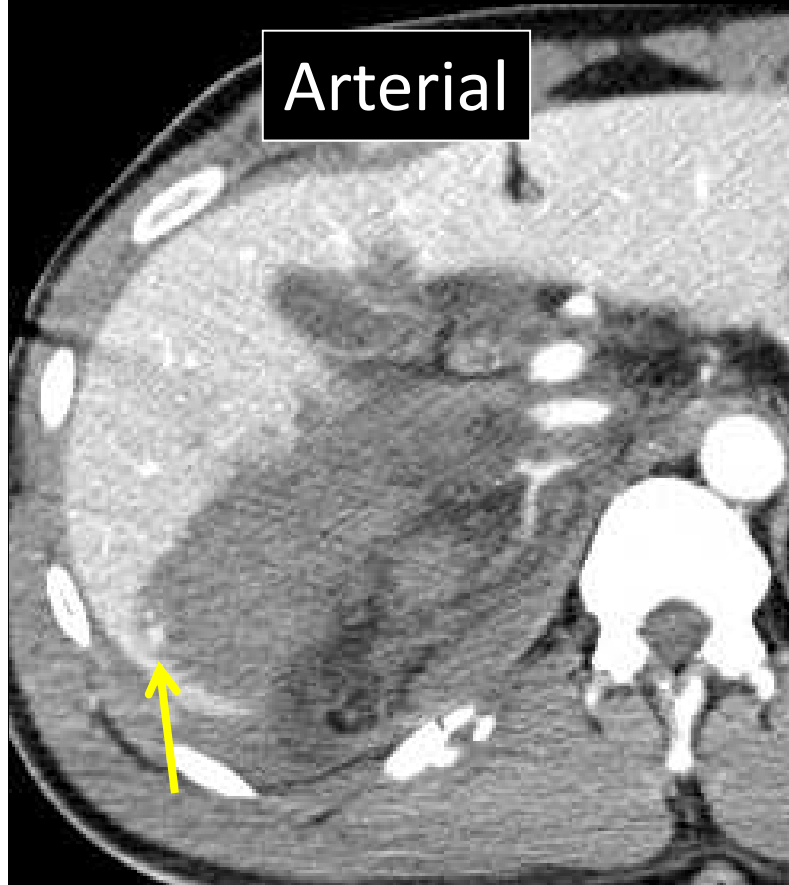
Routine Portal Phase

Extensive laceration +
venous involvement: ↑risk
concomitant arterial injury



Arterial

Portal: second point in time



Selective Acquisition Delayed images

- Hemoperitoneum
- Free fluid
- Vascular lesion
- Renal injury
- Mesenteric hematoma
- Pelvic fractures

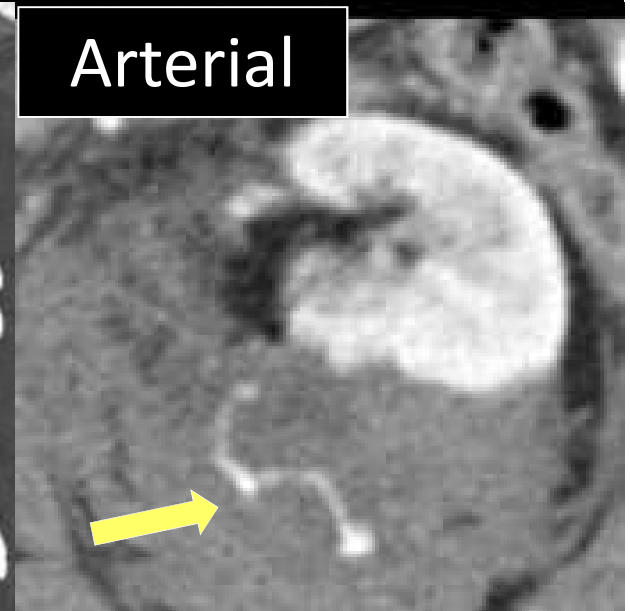
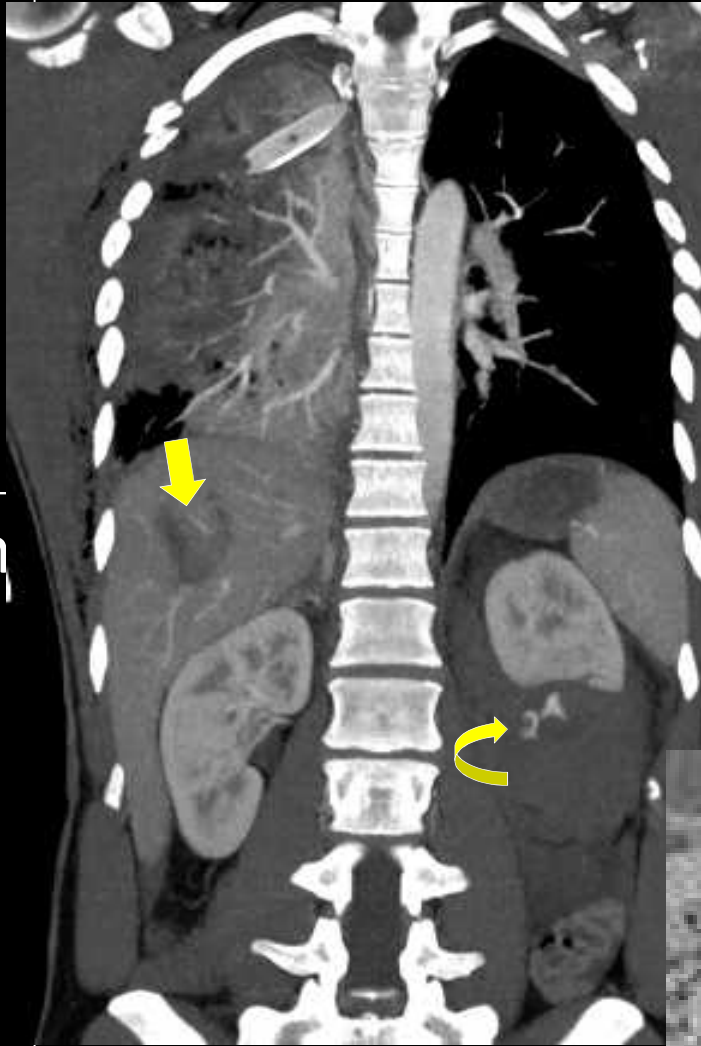




Image Interpretation

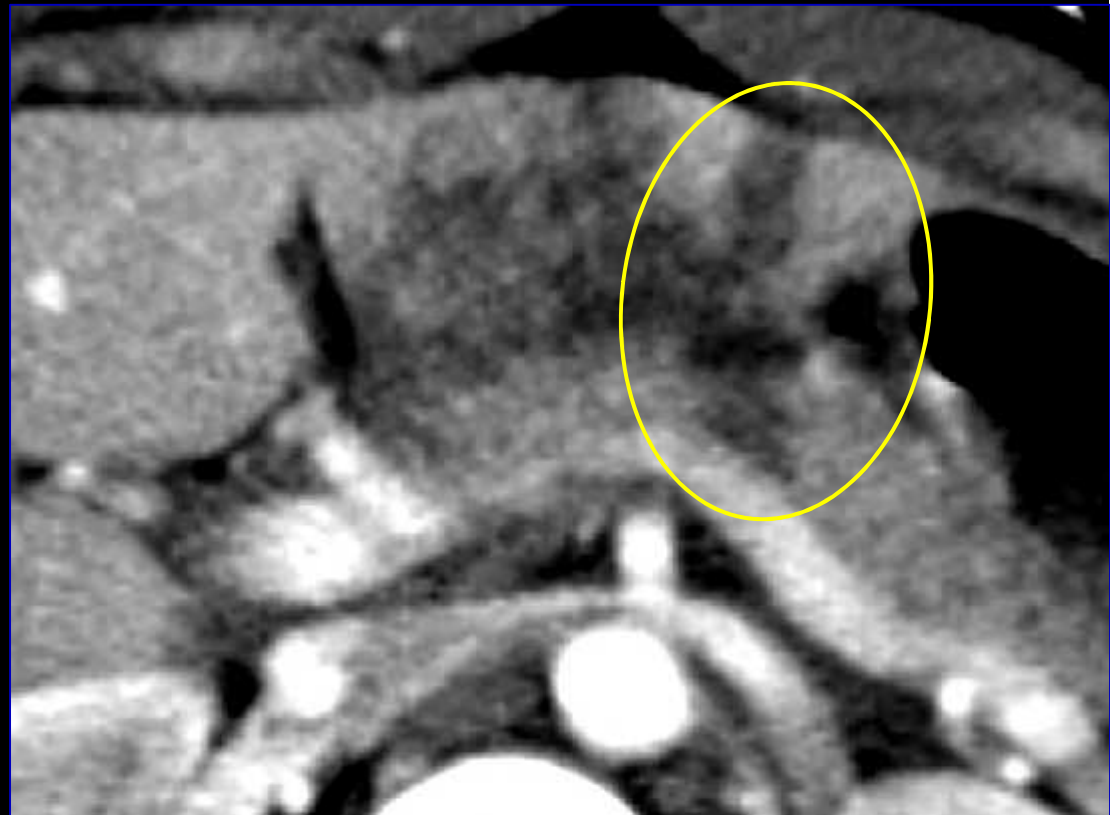
- Be Mindful of known associations

AP Compression mechanism: Midline force vector

Teaching point:

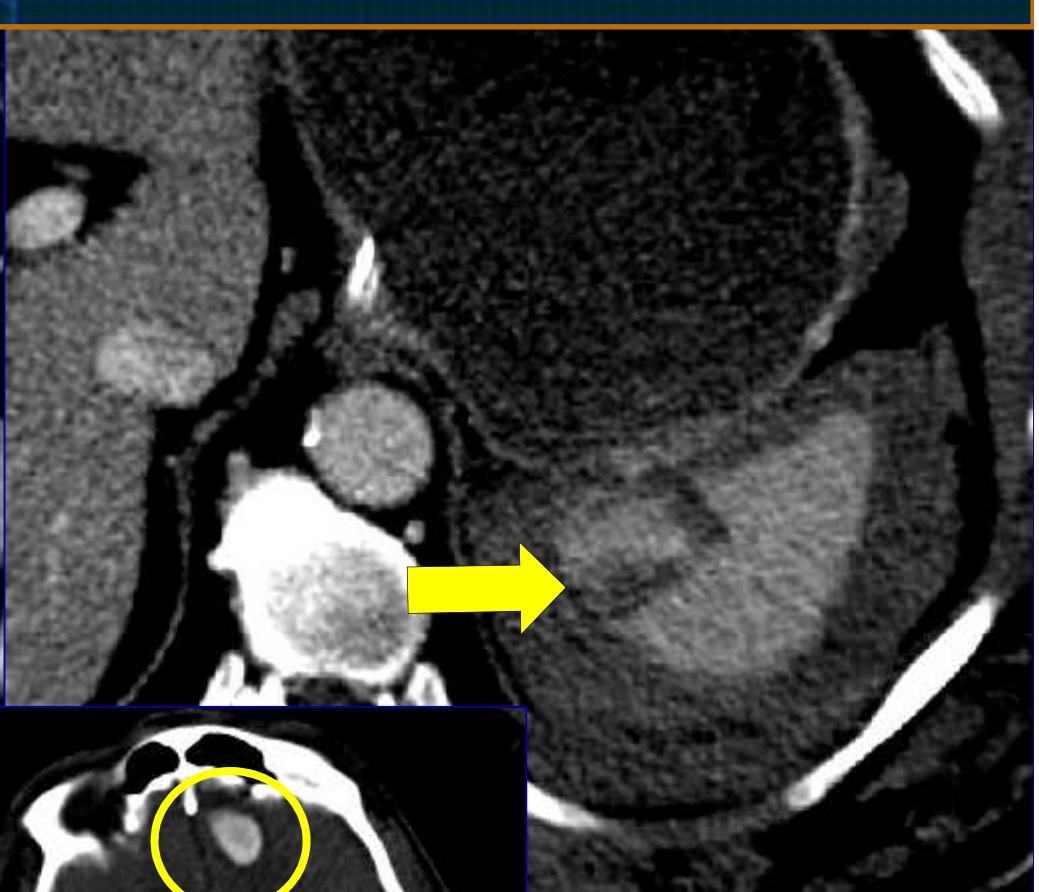
Because of the large volume of information at whole body CT, efficient search requires determining injury mechanism & force vector.

Intervention: distal pancreatectomy

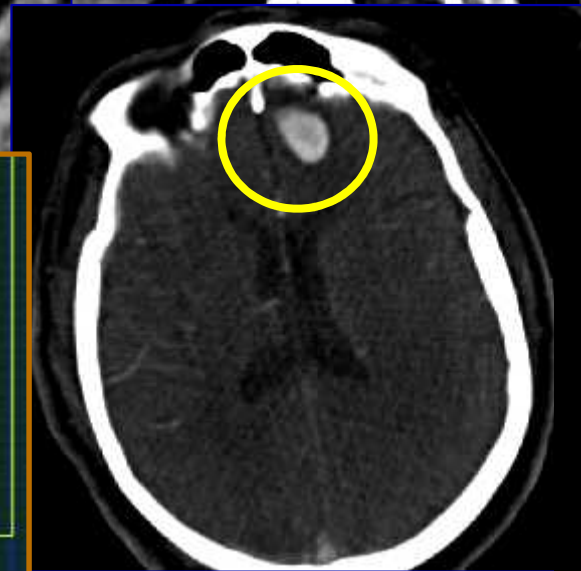


28 yo female restrained driver in a mva who collided with a parked car at high speed

Image Interpretation: Left lateral vector



68 yo male
unrestrained driver mva
wide-impact left lateral
injury pattern



Intervention:
distal
pancreatectomy
splenectomy

Image Interpretation

Targeted Evaluation: ↑ efficiency & accuracy

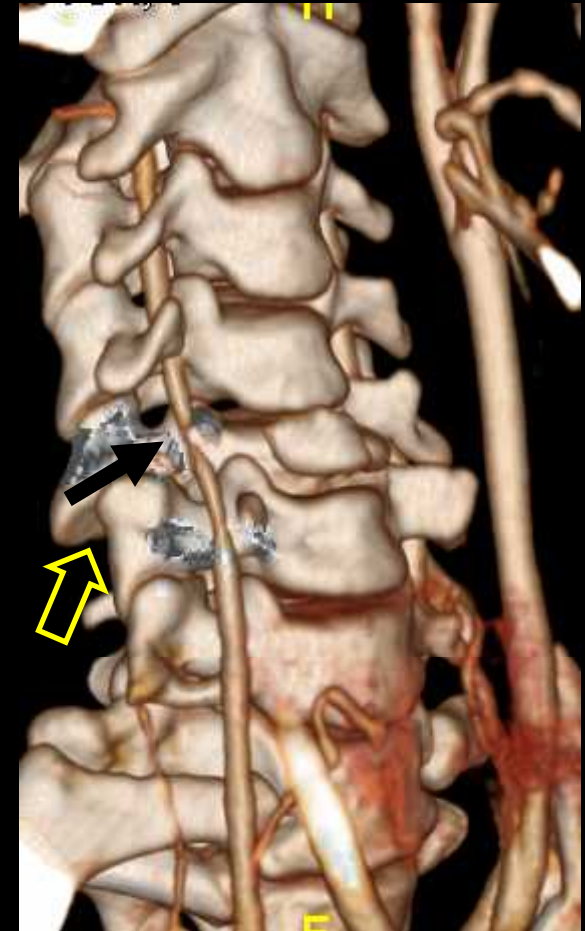


3a. Continuous Acquisition: Integration of Neck

- Indication for C-spine imaging + contrast enhanced body CT
- Neck routinely included with contrast
- Sliker, et al AJR'08 No significant differences between dedicated neck MDCTA and whole body-MDCT as part of a routine trauma protocol *

* Sliker CW, Shanmuganathan K, Mirvis SE AJR 2008; 190:790-9
• Chokshi FH, Munera F, Rivas LA, et al AJR. 2011;196 (3):W309-15
• Munera F, Foley M, Chokshi FH. RCNA 2012; 50 (1): 59-72

RVA Blunt Injury



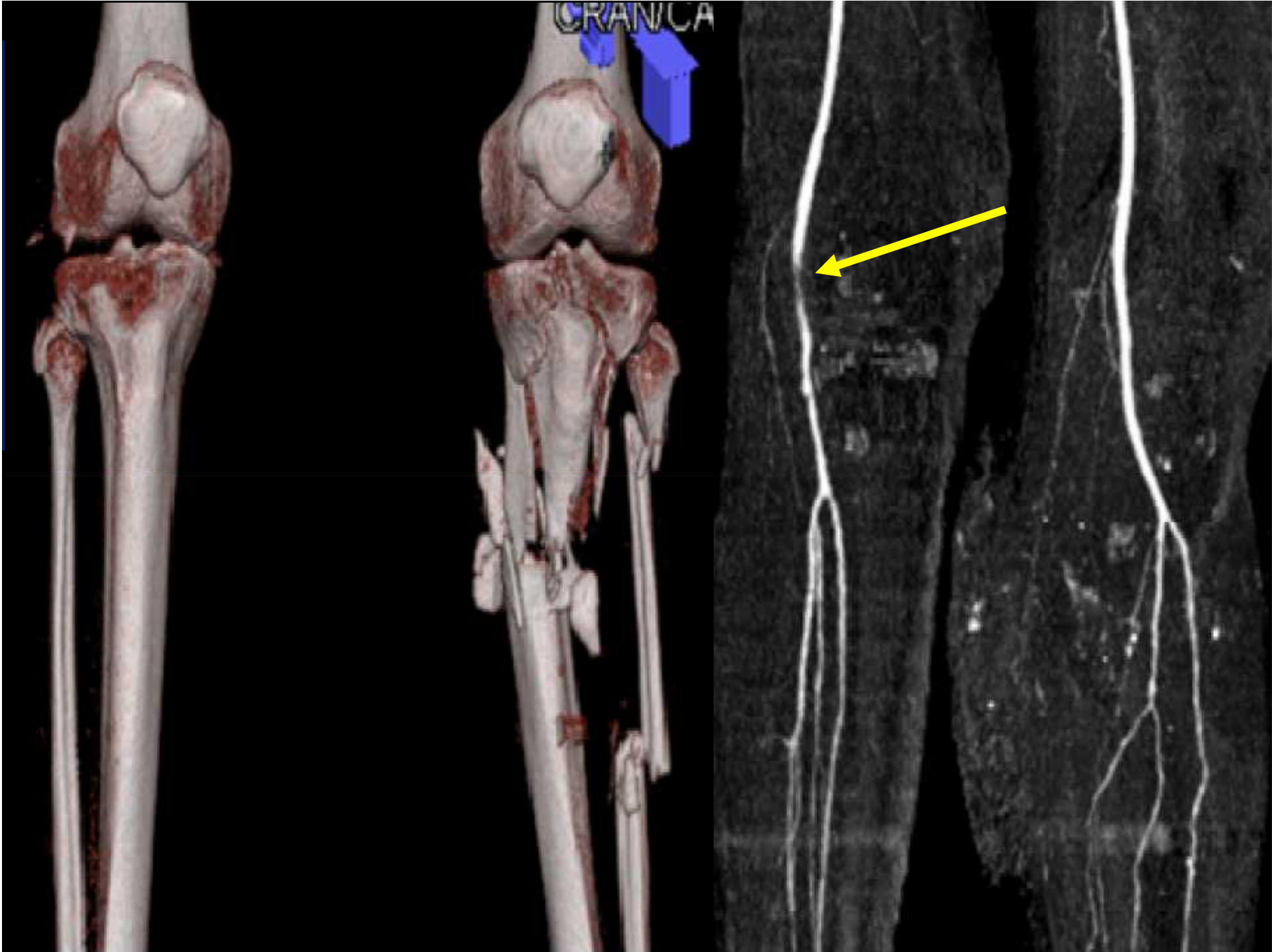
C4-C5 facet fracture-
Subluxation

3. WBMDCT Integration of Lower extremities

- Selectively in patients with clinical suspicion of arterial injuries
- Results in diagnostic image quality in the majority of patients *



* Foster BR, Anderson SW, Uyeda JW, et al. Radiology 2011; 261:787–795



4a. WBCTA in Solid Organ Injuries

- Controversies:
- Optimal timing for evaluation of solid organs?
- CTA improves visualization of Vascular Injury on late arterial phase
- Is an additional phase needed to determine, clarify or exclude injury?
Portal? Delayed?

- Boskak AR et al, K Shan, Mirvis SE, et al RSNA'11
- Uyeda, J et al ASER 11
- Foley M, Munera F, Rivas LA, et al RSNA'10
- Lemos A, et al RSNA'08 and Franklin RSNA'12

Case # 1

s/p MVA

Late Arterial
Phase



Vascular
Injury?



Portal Phase

Case # 2

Portal



Arterial

4a. WBCTA in Solid Organ Injuries

Pancreatic Injuries

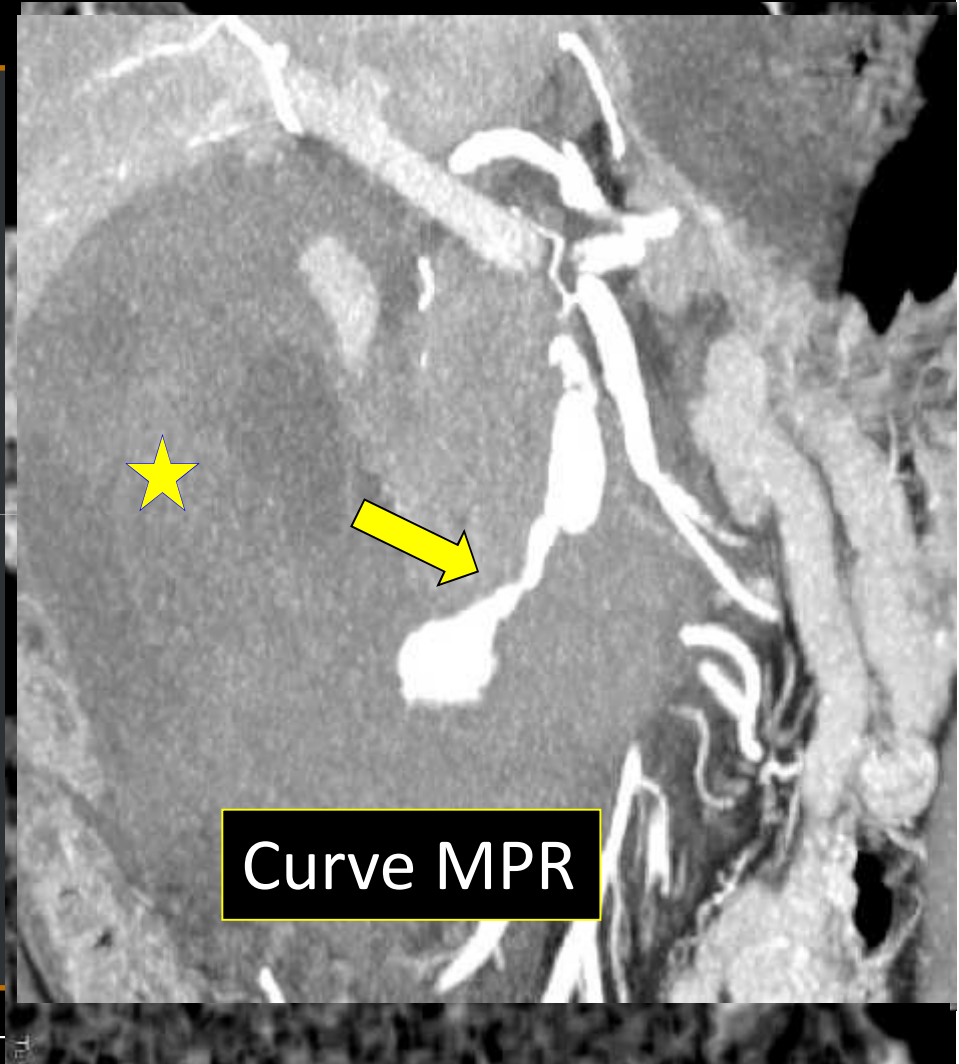
Pancreatic injuries that require
Early deaths usually due to
intervention involve the pancreatic

duct to acute hemorrhage

• Deep pancreatic lacerations >
from major vascular injury
50% pancreatic thickness:

suspicion for PD disruption →

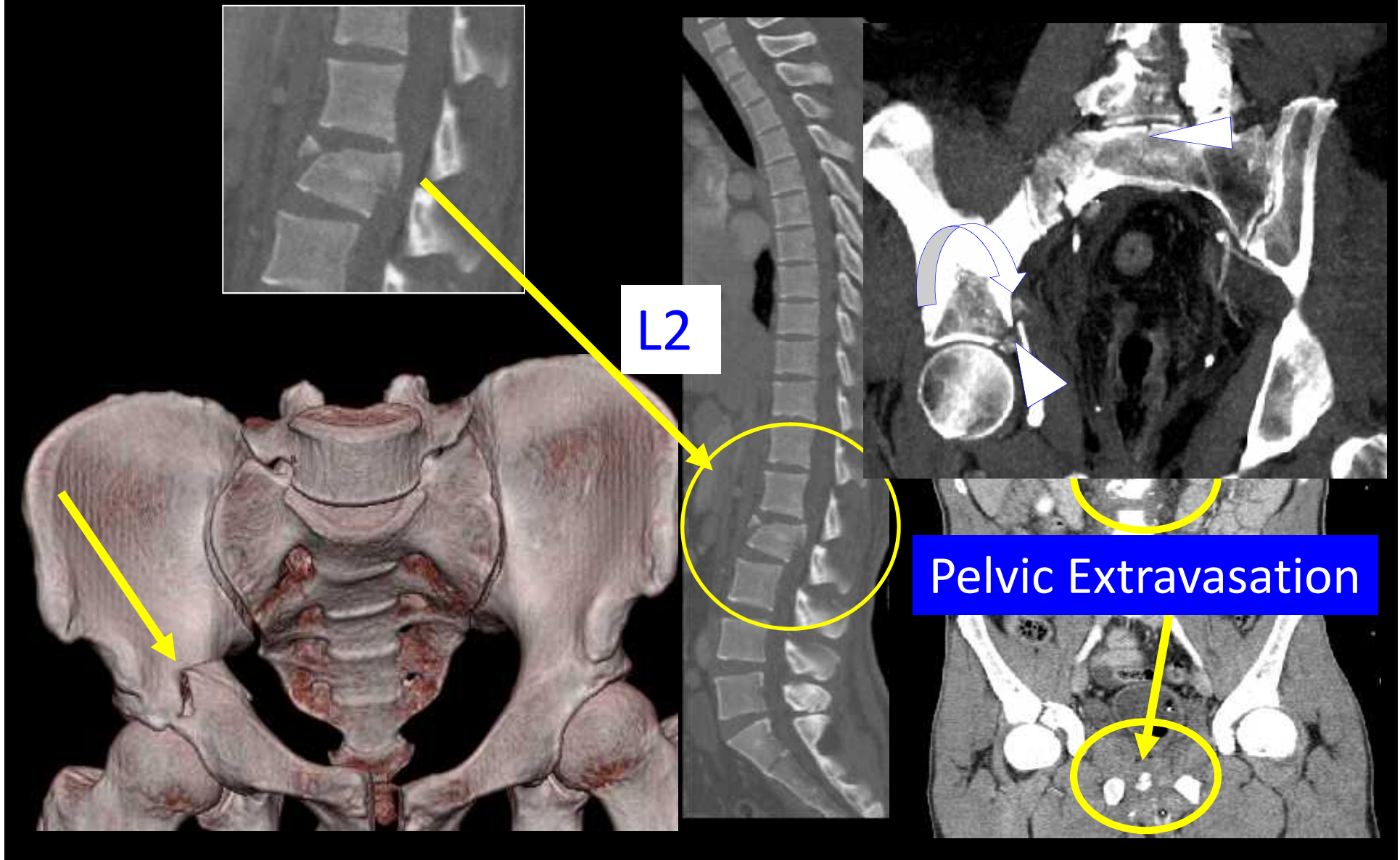
Warrant additional imaging
(MRCP or ERCP) *.



* Gupta A, et al RadioGraphics 2008; 24: 1381-1395

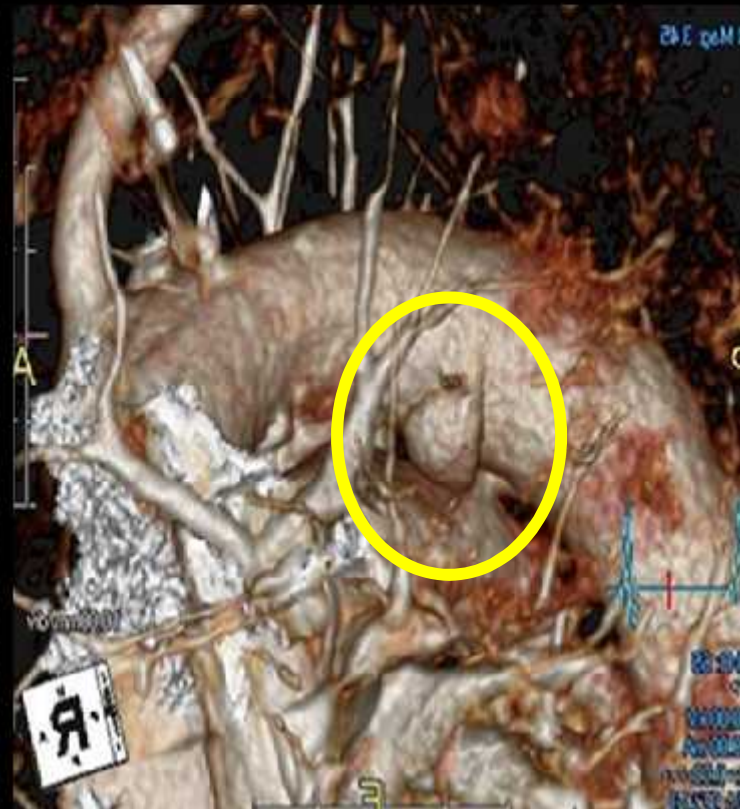
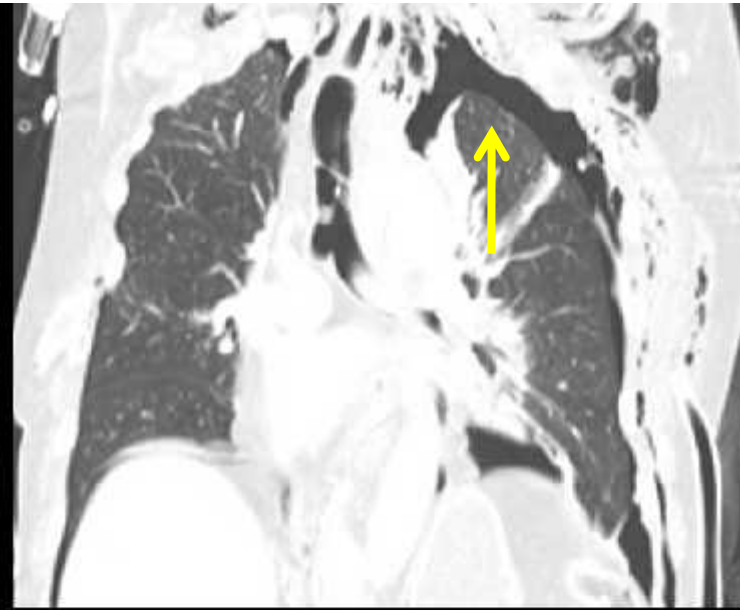
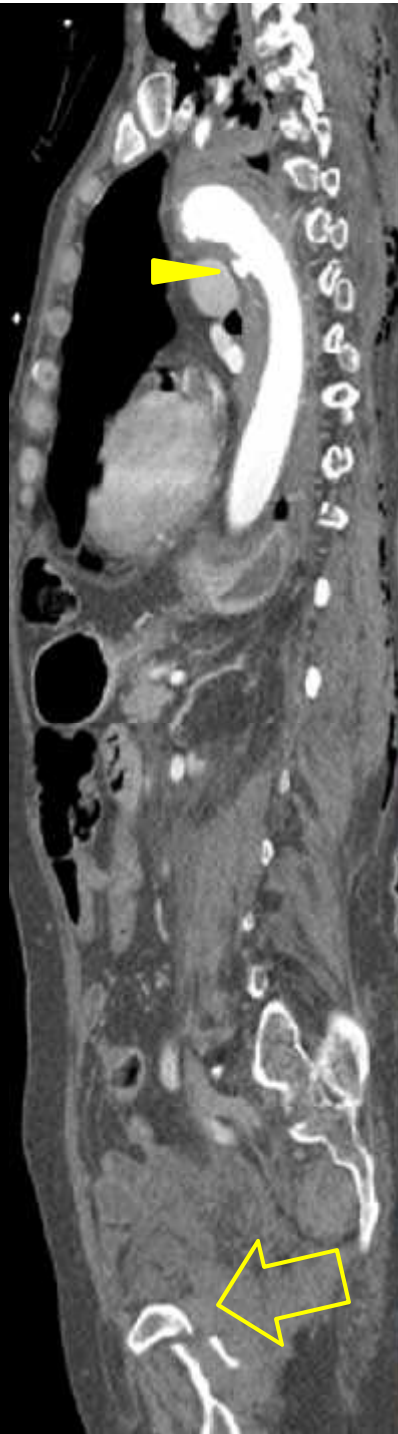
* Linsenmaier U. RadioGraphics 2008; 28:1591-1601

4b. WBCTA in Osseous Injuries

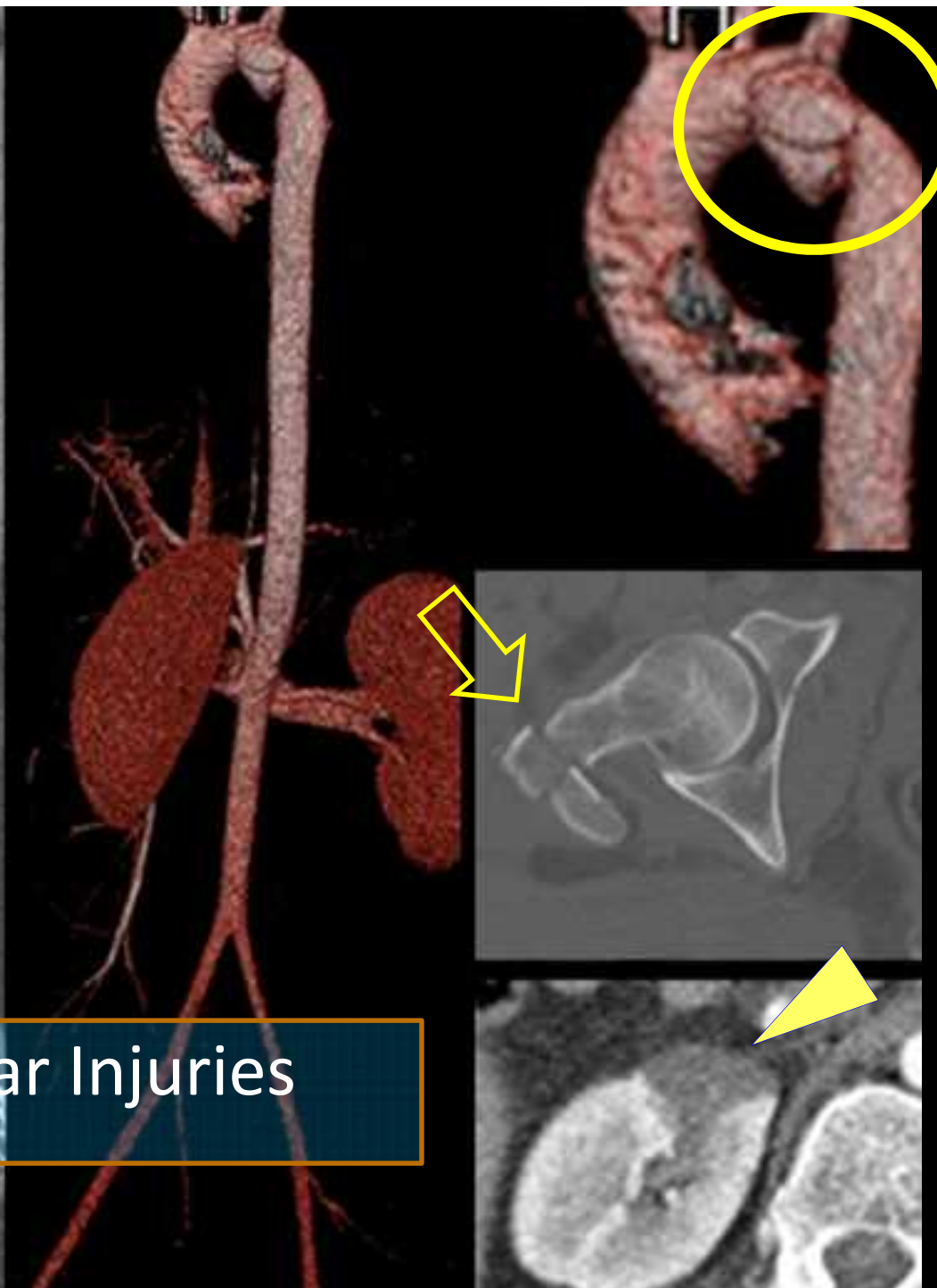
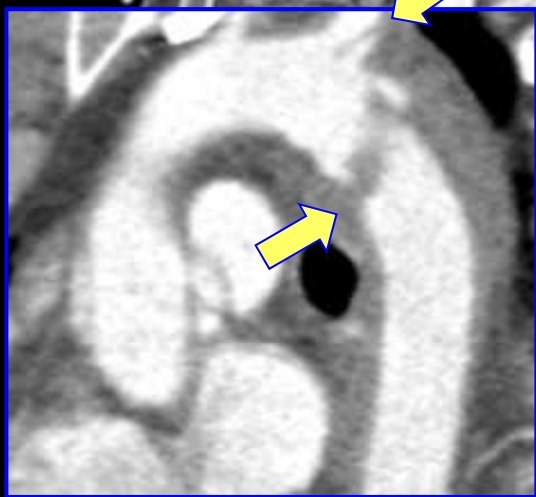


4c. WBCTA in Vascular Injuries

Aortic
Pseudoaneurysm

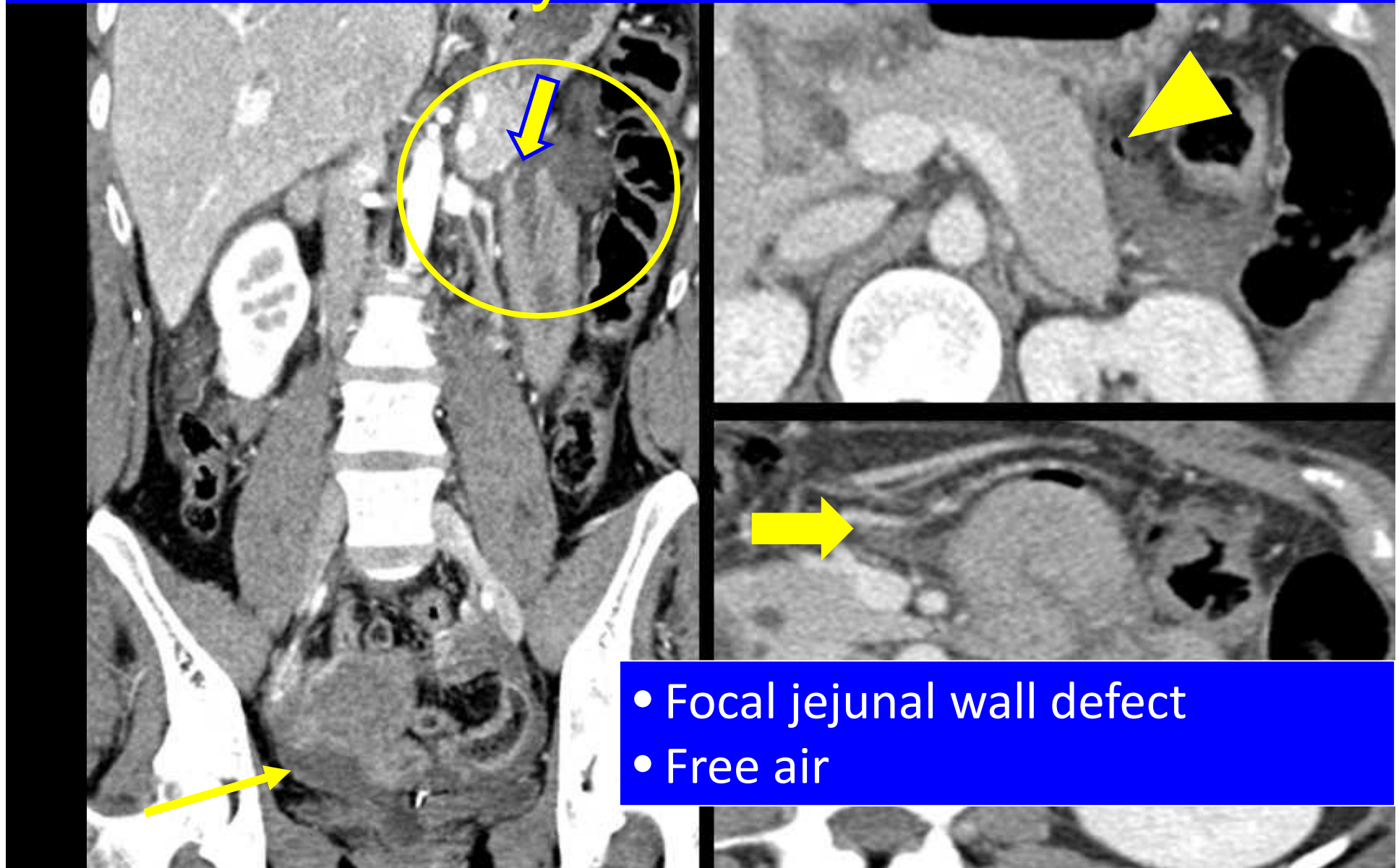


Typical

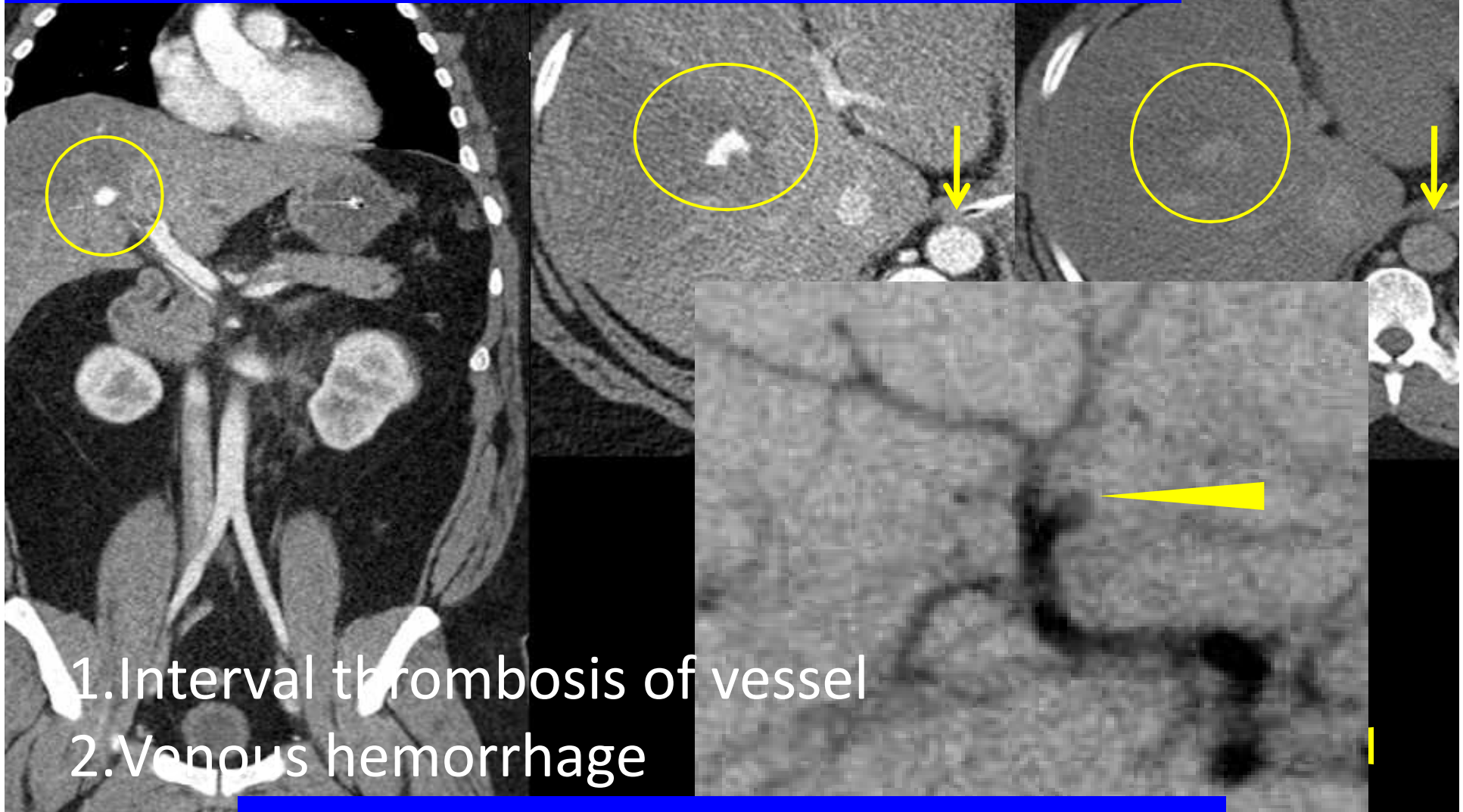


4c. WBCTA in Vascular Injuries

4d. WBCTA injuries of the Mesentery or hollow viscera



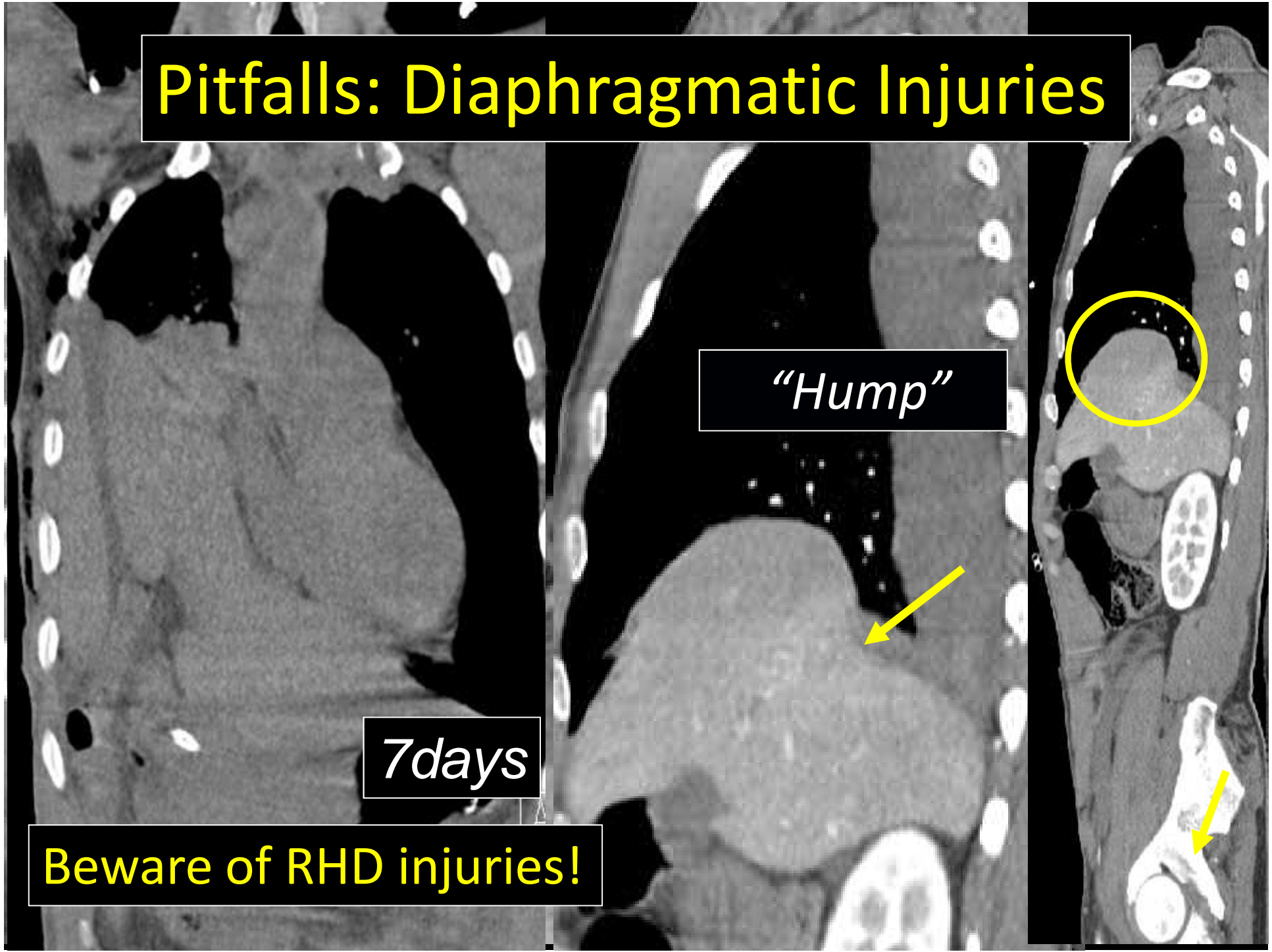
5. Pitfalls – False Positives



- 1. Interval thrombosis of vessel
- 2. Venous hemorrhage

Interval thrombosis of the artery feeding the pseudoaneurysm

Pitfalls: Diaphragmatic Injuries



7 days

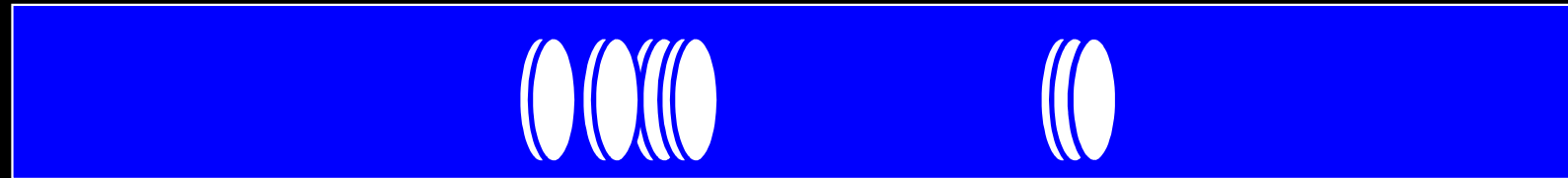
"Hump"

Beware of RHD injuries!

WB MDCT- The price to pay

- 1. Data explosion:
 - Remove unnecessary series (bone, lung algorithm recons)
- 2. Excessive radiation:
 - Avoid unnecessary studies
 - Automated exposure control/ iterative recons
 - Low dose for extremities CTA, arterial and delayed images
 - We need to get use to noisy images

Summary WB CTA Protocol

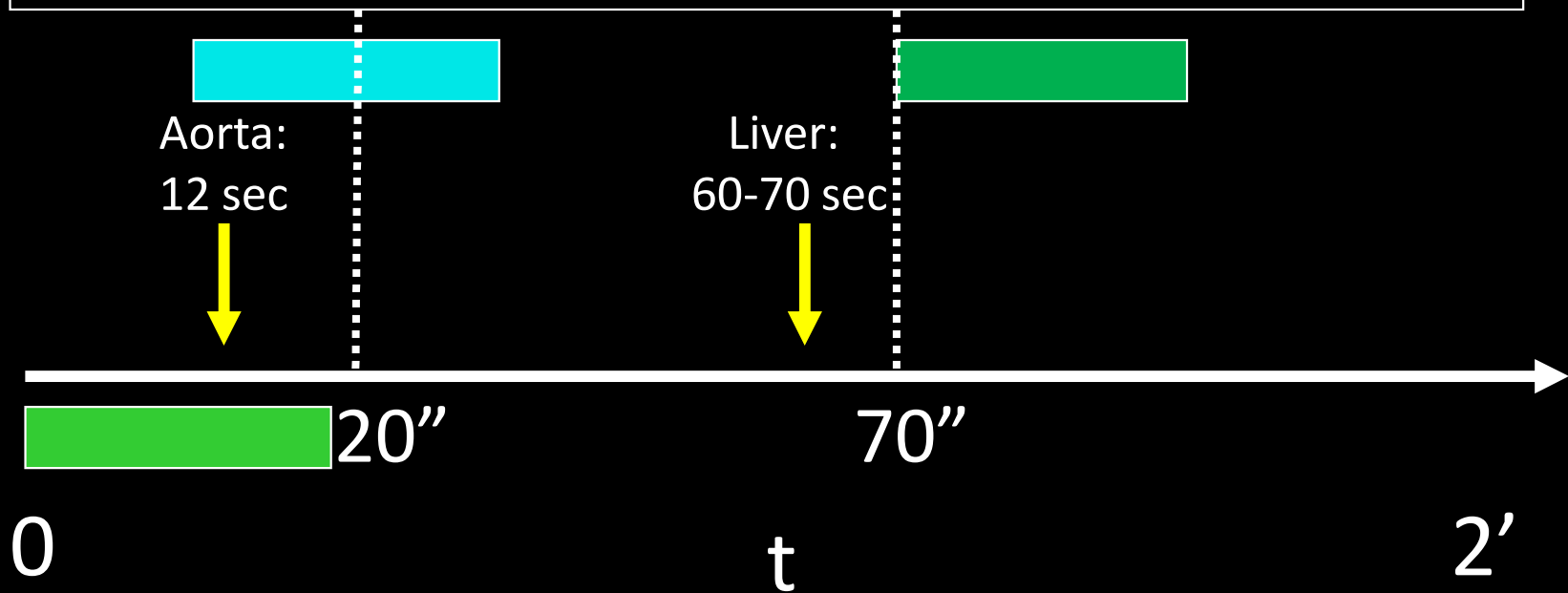


Neck/Chest/AP

Abdomen

Aorta:
12 sec

Liver:
60-70 sec



100 mL @ 4 mL/s 15 sec, then 3 mL/s

Conclusion

1. No universally accepted standard protocol
2. WBCTA identifies blunt polytrauma related injuries which require intervention
3. Consider possible pitfalls: improper technique, false + CTAs, NI variants, and artifacts
4. Indiscriminate use of Whole Body CT for patients with minor injuries is not justified



Thank you for
your attention!

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