

Clinical Applications for Dual Energy CT in Vascular Imaging

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Vascular Imaging

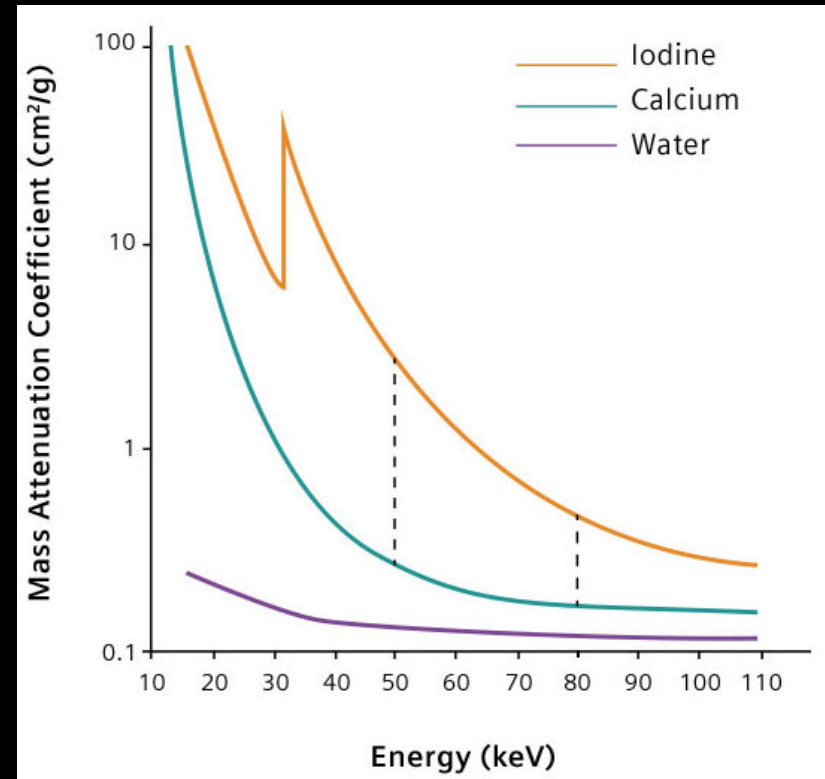
- Traditional approach involves obtaining a non-contrast phase, arterial phase, and sometimes a delayed phase
 - Involves 3 separate scans
 - Radiation dose
 - Clinical question may still be uncertain in some circumstances
 - Poor vessel opacification/contrast bolus
 - Metallic artifact
 - Dense atherosclerotic calcifications

Commonly encountered clinical dilemmas

- Trauma/Post surgical
 - Active extravasation versus high attenuation hematoma
- Gastrointestinal bleeding
 - Active bleed versus hyperdense intraluminal contents
- Poor contrast enhancement of vessels
- CT angiography
 - Dense atherosclerotic calcifications with beam hardening artifact
- Metallic artifact

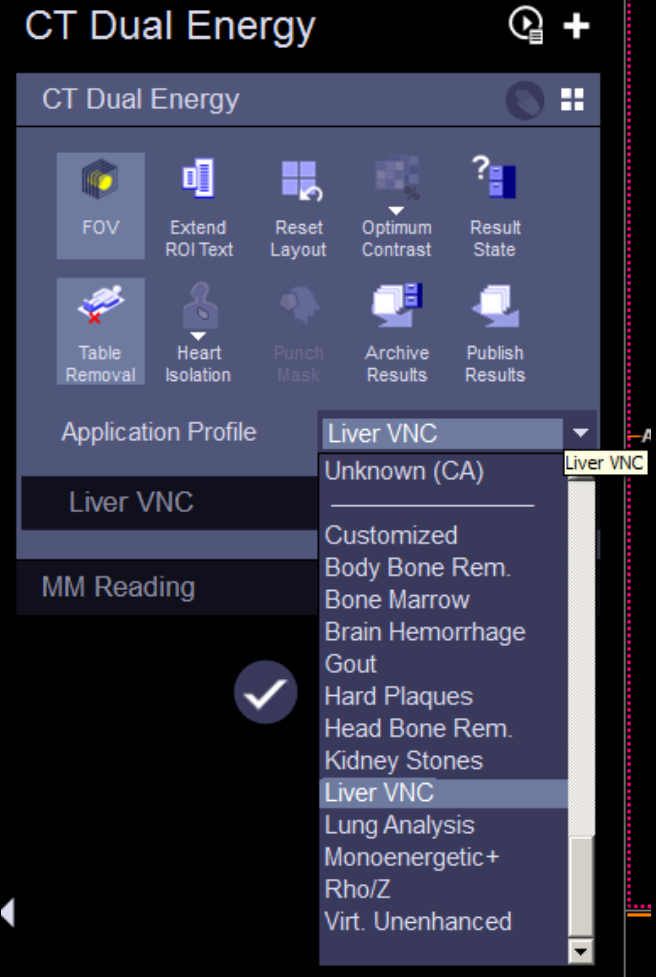
How Can Dual Energy CT Help?

- DECT can better differentiate between various materials such as iodine (contrast) and calcium and offers better soft tissue characterization
- Acquisition of low energy monoenergetic images improves vessel contrast

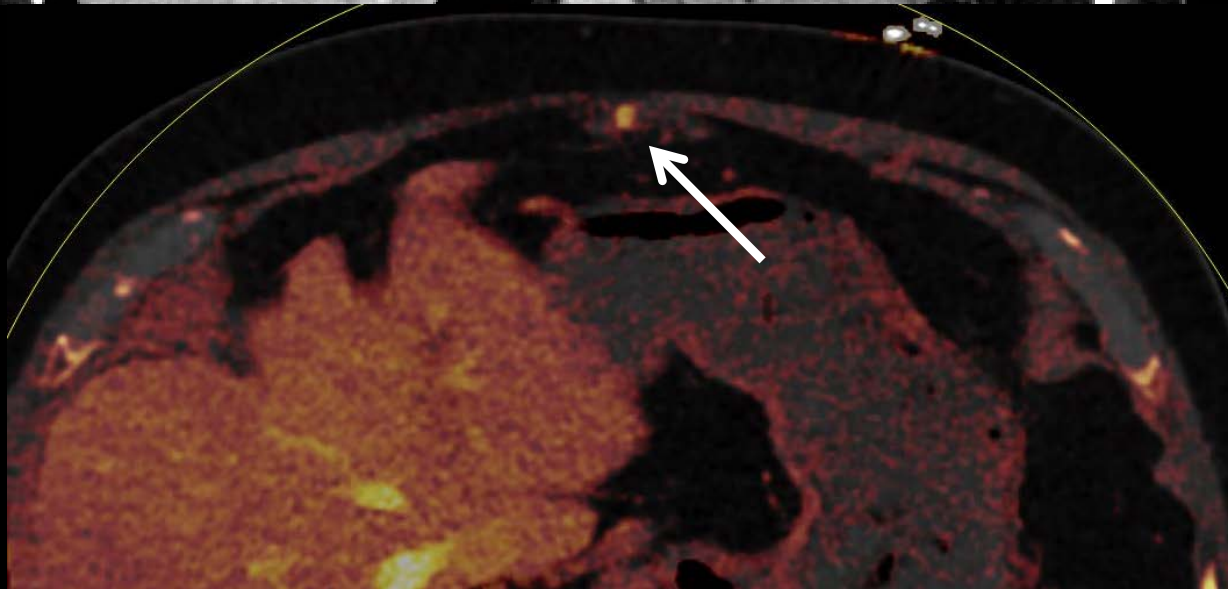
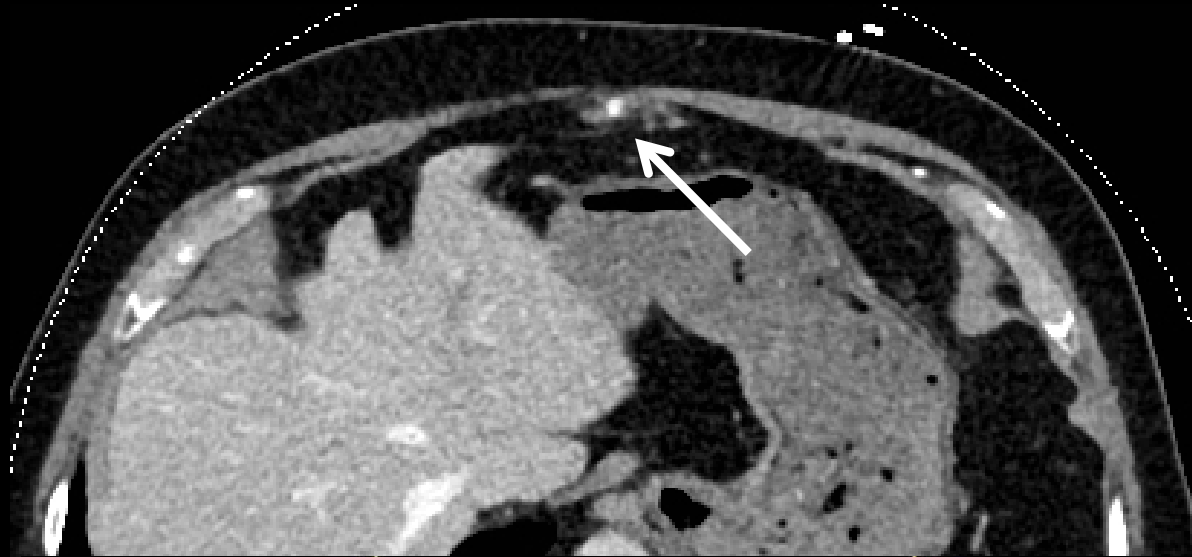


Dual Energy Specifics

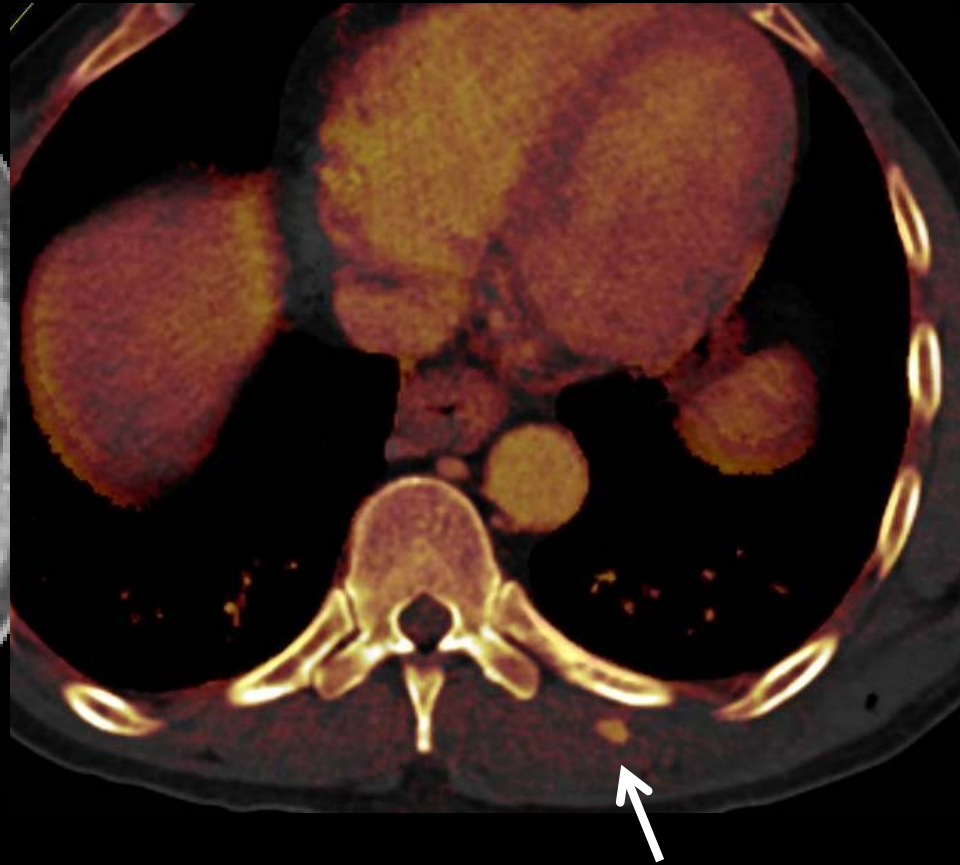
- Virtual non-contrast
- Iodine map
- Subtraction of vessel calcification
- Acquisition at low energy for improved image contrast
- Reconstruction of virtual monoenergetic images
- Subtraction of metallic artifact



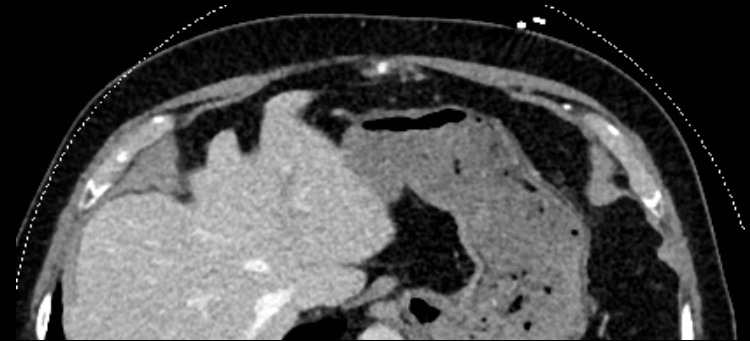
Trauma



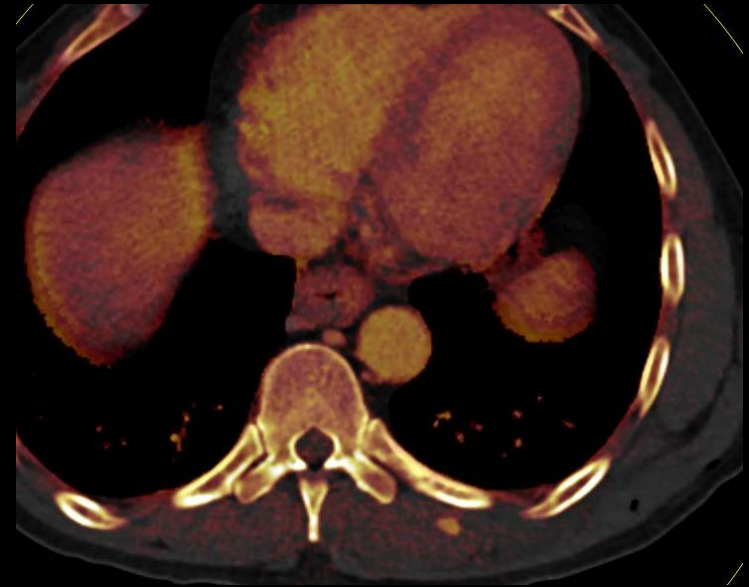
Trauma with left sided rib fractures



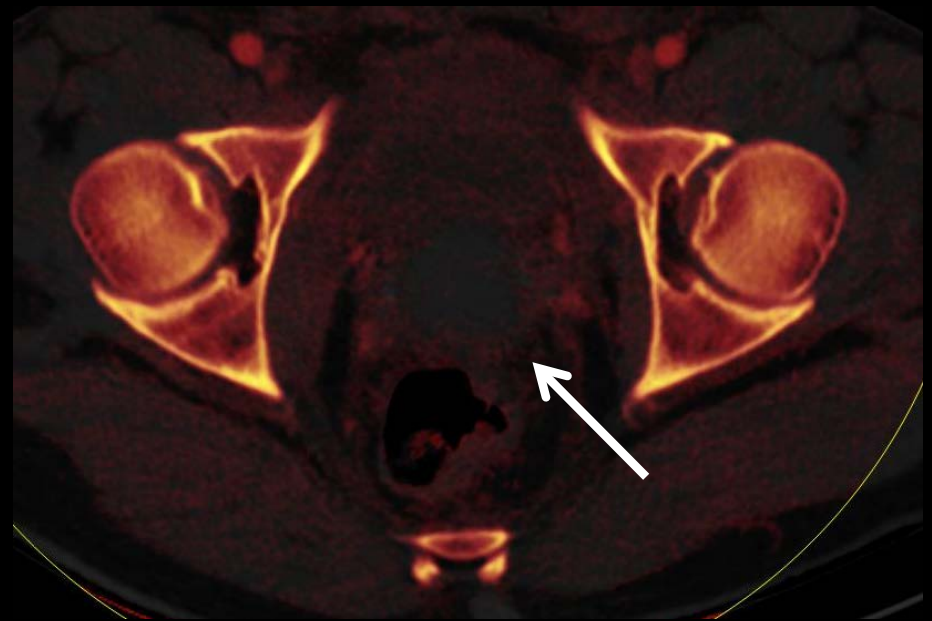
- The first case demonstrated a focal hyperdensity within the anterior abdomen. The second case demonstrated a hyperdense hematoma within the back soft tissues.



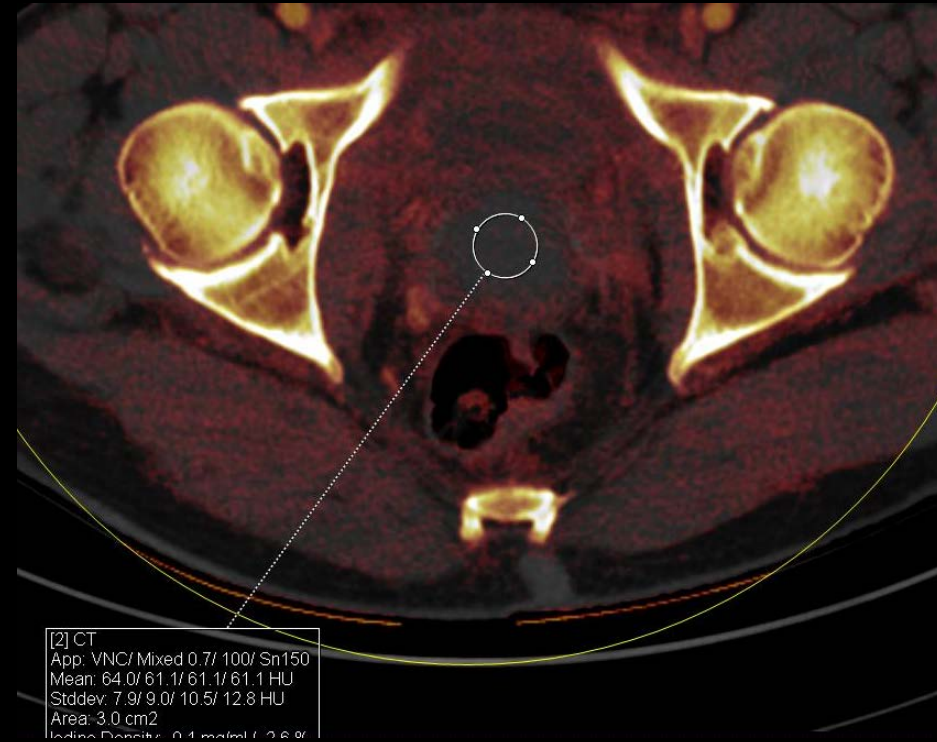
- Iodine maps overlaid on the CT images confirmed the presence of iodine, consistent with active contrast extravasations in both cases.



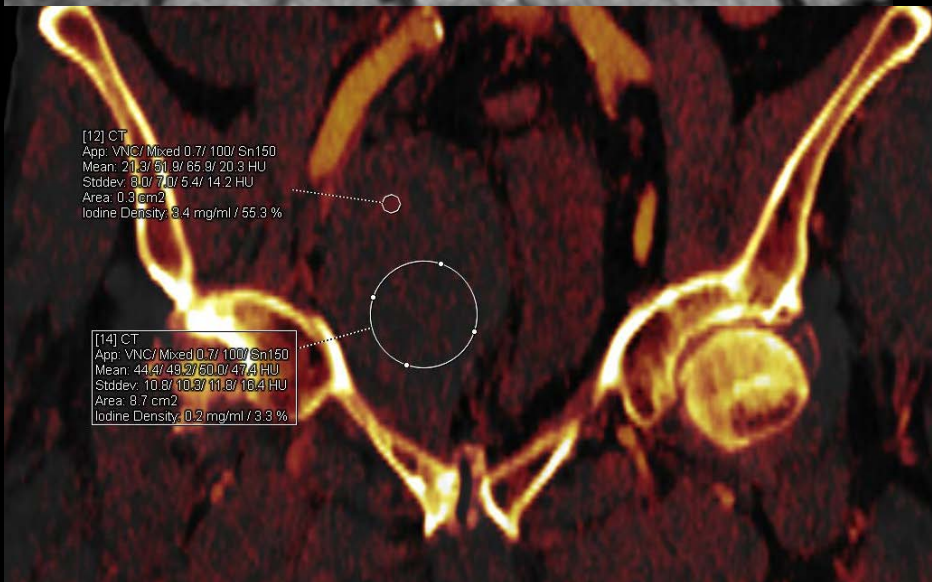
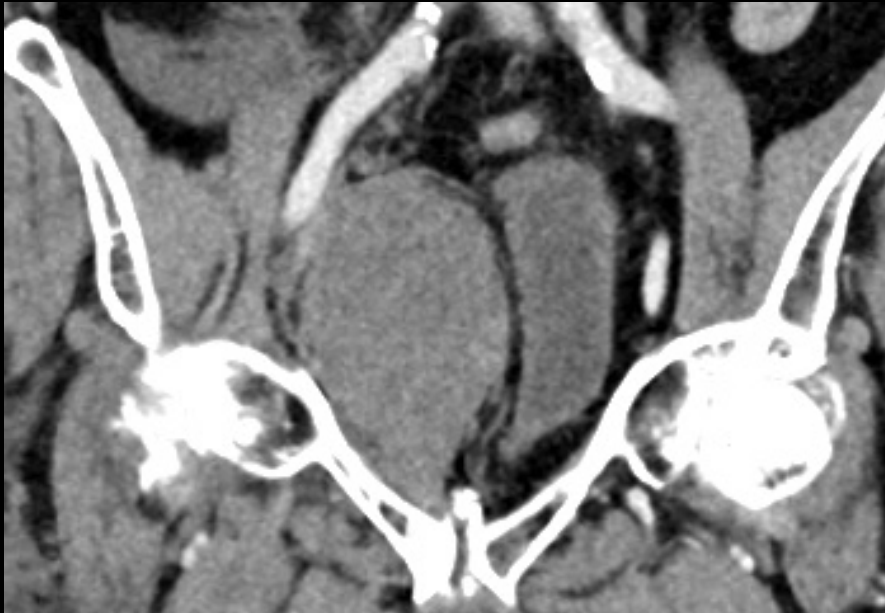
Recent prostatectomy with concern for hemorrhage in the surgical bed



- CT demonstrates a high attenuating hematoma within the prostatectomy bed.
- Iodine map shows no significant amount of iodine within the hematoma, which is consistent with a postoperative hematoma without active bleeding.



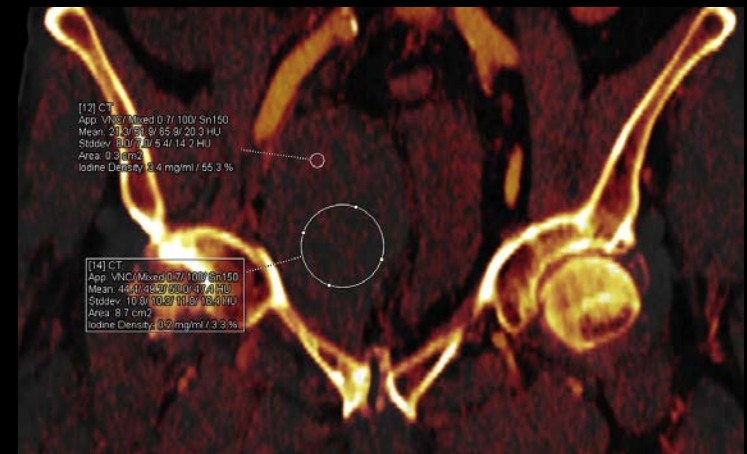
Trauma with pelvic fractures



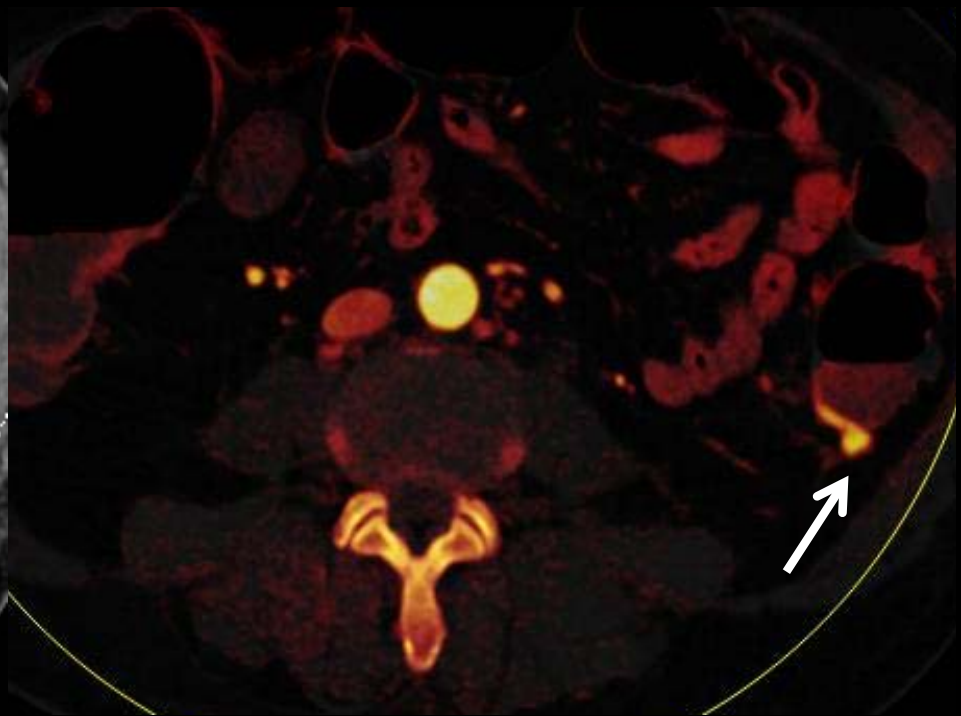
- Contrast enhanced CT demonstrates a hyperdense hematoma without any clear evidence of active contrast extravasation.

- Iodine map shows areas of high iodine concentration within the superior portion of the hematoma, suspicious for contrast extravasation.

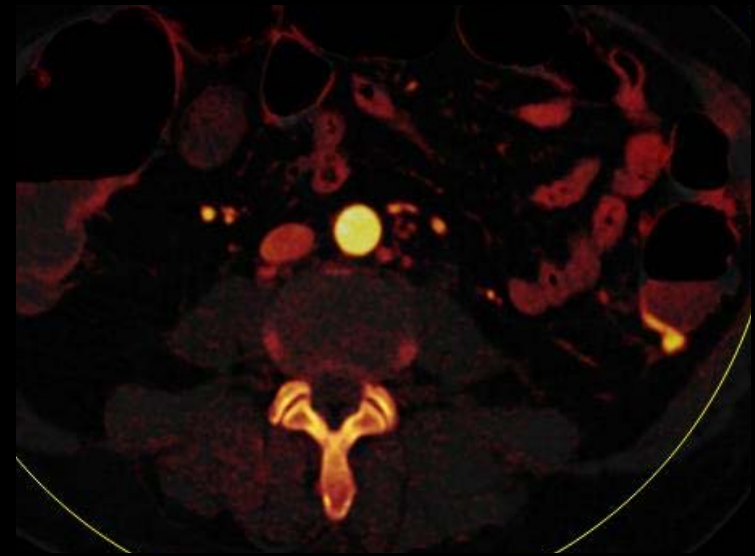
- Angiography demonstrates contrast blush within the hematoma arising from an internal iliac branch.



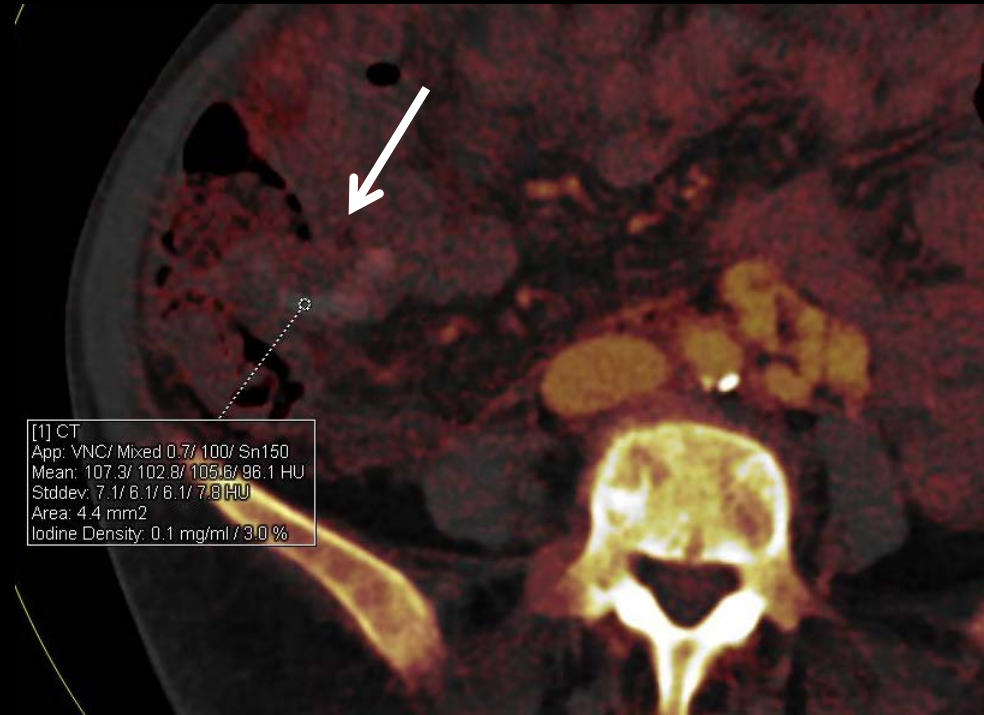
GI bleed, unknown source



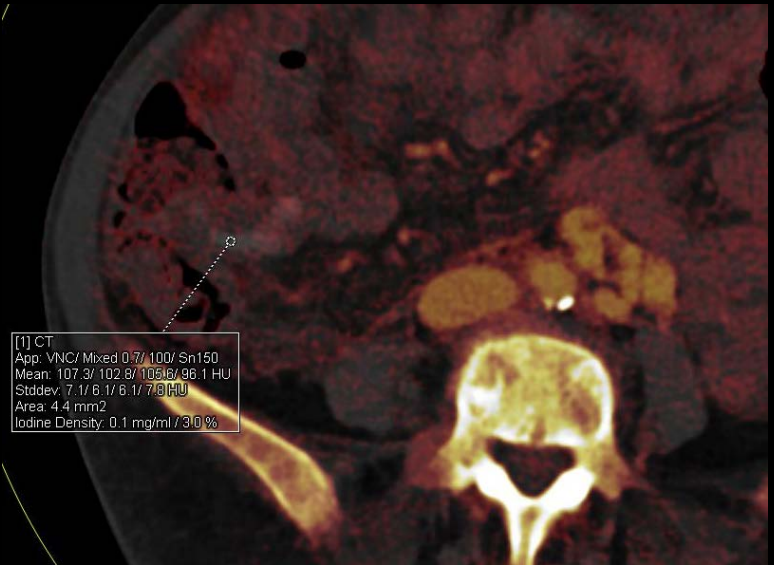
- Contrast enhanced CT demonstrates hyperdense material layering within a colonic diverticula.
- Iodine map confirms the presence of iodine, indicating an active diverticular hemorrhage.



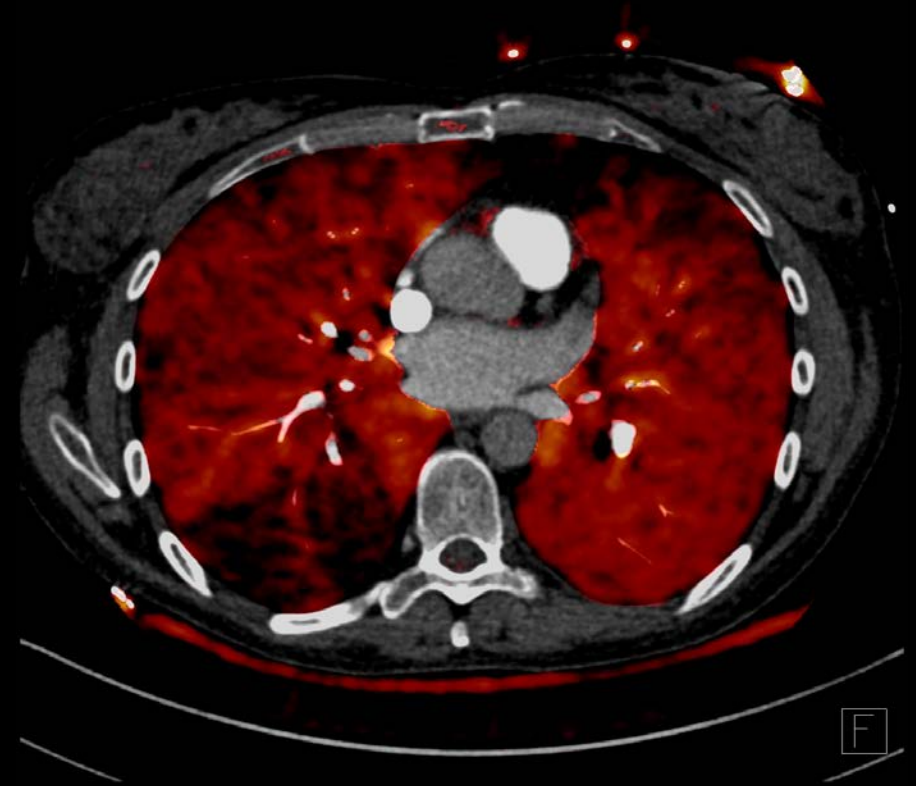
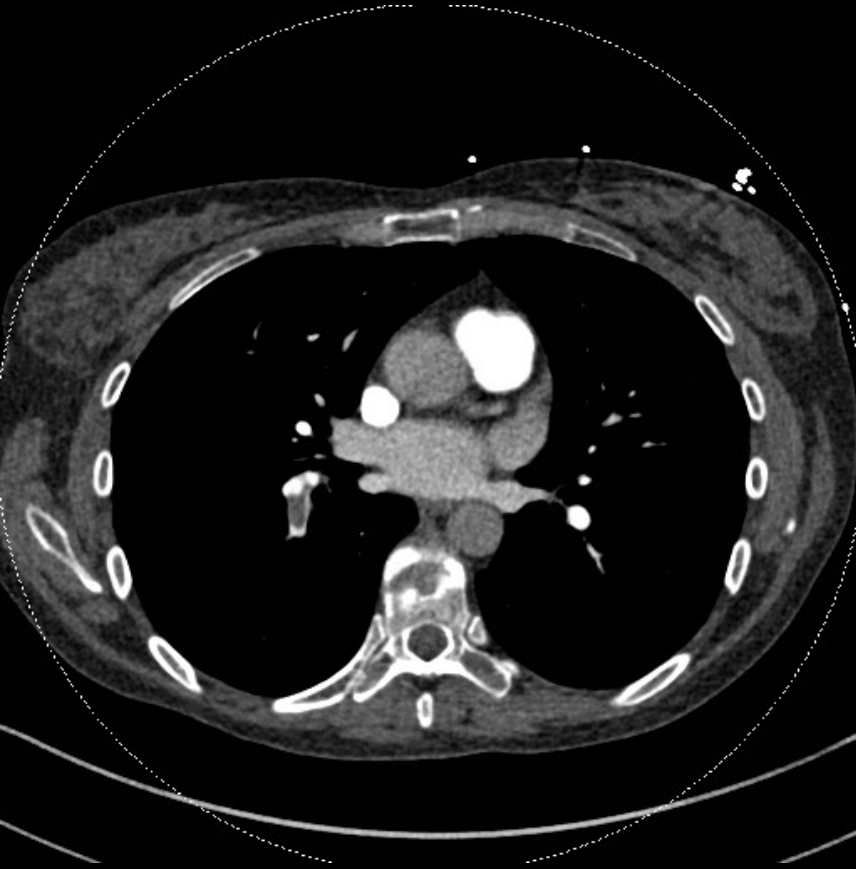
Suspected upper GI bleeding



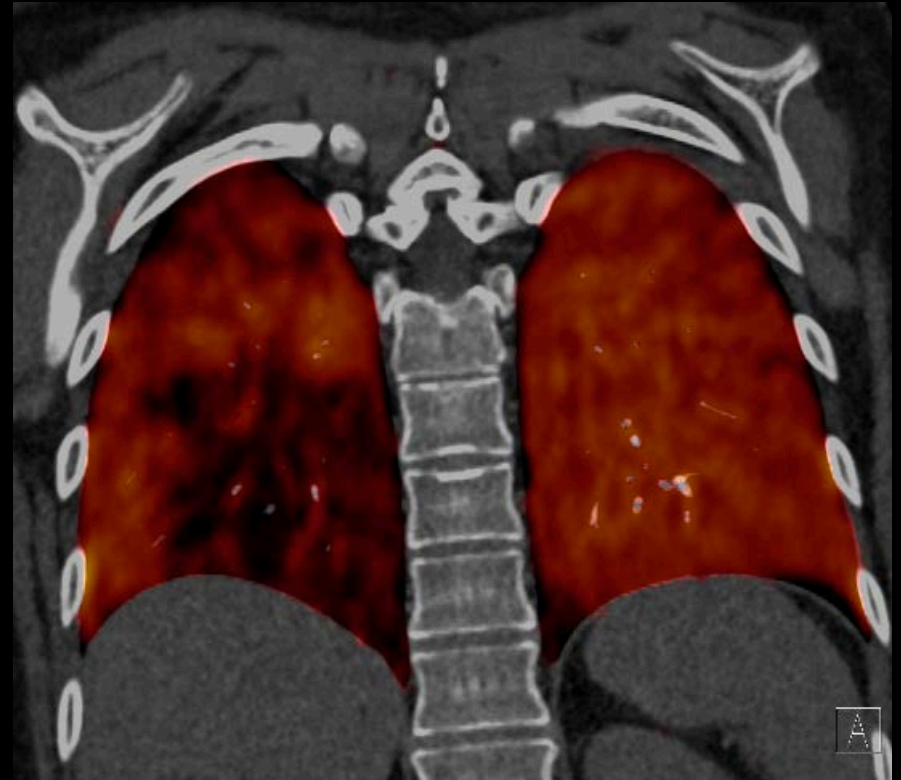
- CT demonstrated hyperdense material filling the terminal ileum, raising the possibility of a gastrointestinal bleed.
- Iodine map shows that there is no iodine present within the hyperdense material when overlayed on the CT, indicating that there is no hemorrhage.



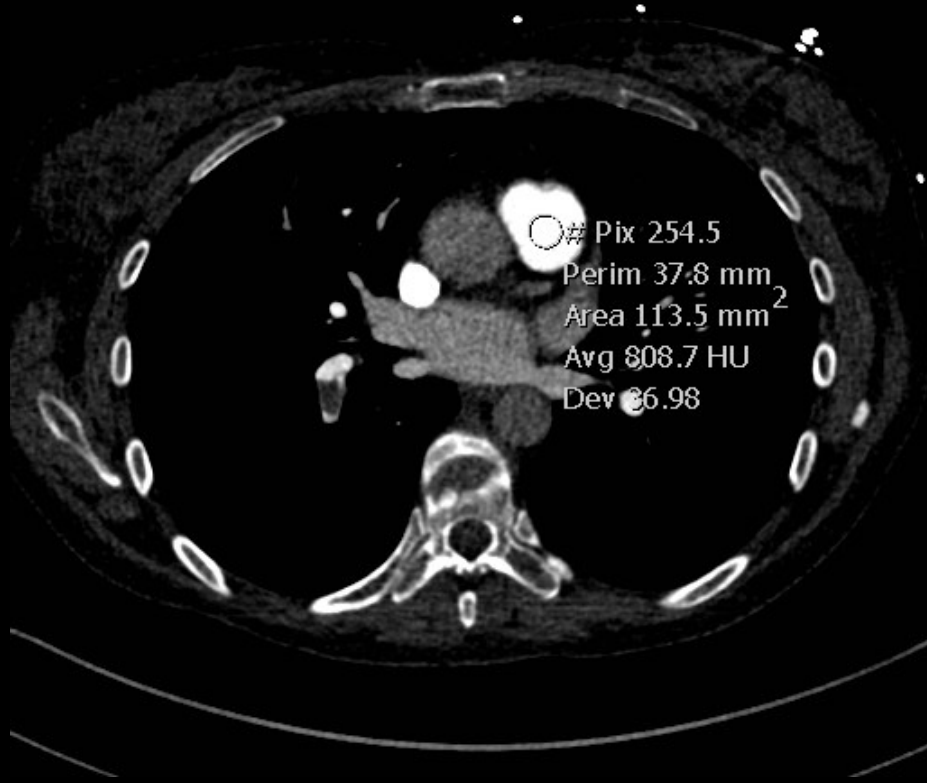
Tachycardia, shortness of breath, concern for pulmonary embolism



- Iodine map demonstrates a wedge shaped defect in the right lower lobe.
- Contrast enhanced CT image confirms right lower lobe segmental pulmonary embolus.



Low kV versus high kV

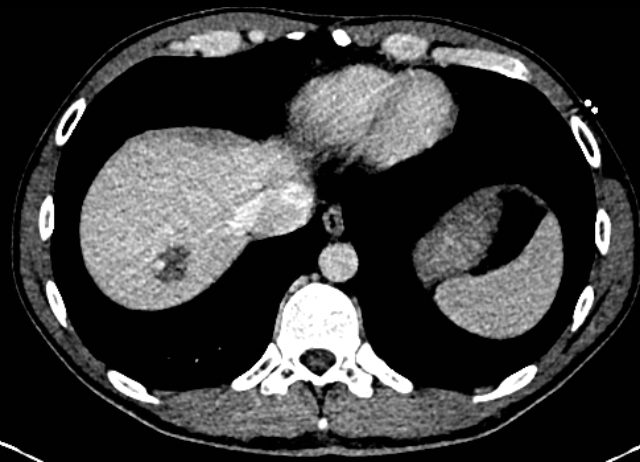


90 kV

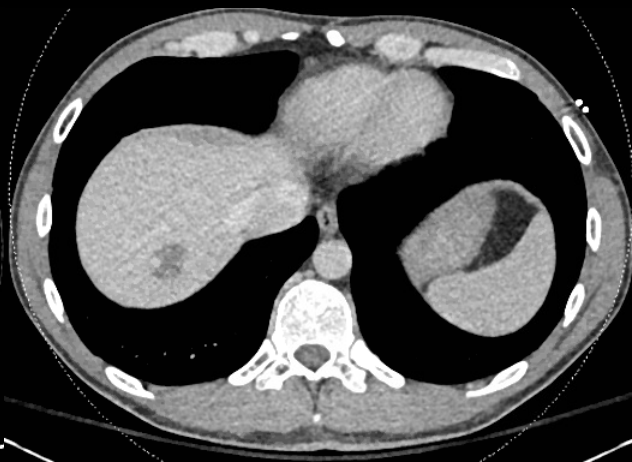


150 kV

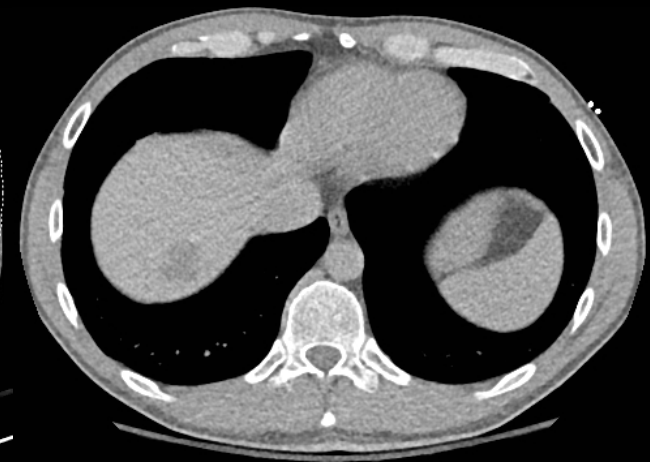
Poor contrast bolus,
incidental liver finding



100 kV



0.7 LB (120 kV)



150 kV

-Increased contrast (at low kV) clearly demonstrates the hepatic lesion is a hemangioma

References

- Dual-Energy CT: Vascular Applications. Ioannis Vlahos, Raymond Chung, Arjun Nair, and Robert Morgan. American Journal of Roentgenology 2012 199:5_supplement, S87-S97.
- Dual-Energy Spectral CT: Various Clinical Vascular Applications. Haruhiko Machida, Isao Tanaka, Rika Fukui, Yun Shen, Takuya Ishikawa, Etsuko Tate, and Eiko Ueno. RadioGraphics 2016 36:4, 1215-1232