Clinical Use of Dual Energy CT Iodine Map for Renal Lesions

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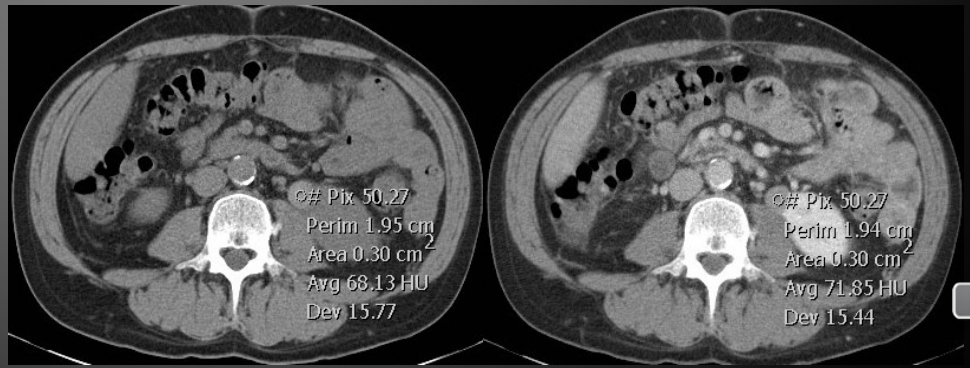
Assessment of enhancement (presence of iodine) in a renal lesion

- Traditional approach to renal lesions:
  Look for increased density (or not) from pre to post contrast images
  - Requires 2 scans
  - How much increase in HU?



Pseudo-enhancement

- The presence of iodine in the post contrast image affects the measured density of ANY lesion (probably due to beam hardening)
  - Research indicates 10 HU of increase is expected
  - Up to 20 HU or greater can occur (pseudo-enhancement)

Dual Energy CT

- Using two different energies allows for identification of specific materials
  - Iodine separation is clinically relevant
- Images showing iodine only are capable of being generated
  - No need for pre-post contrast images?

Iodine Separation

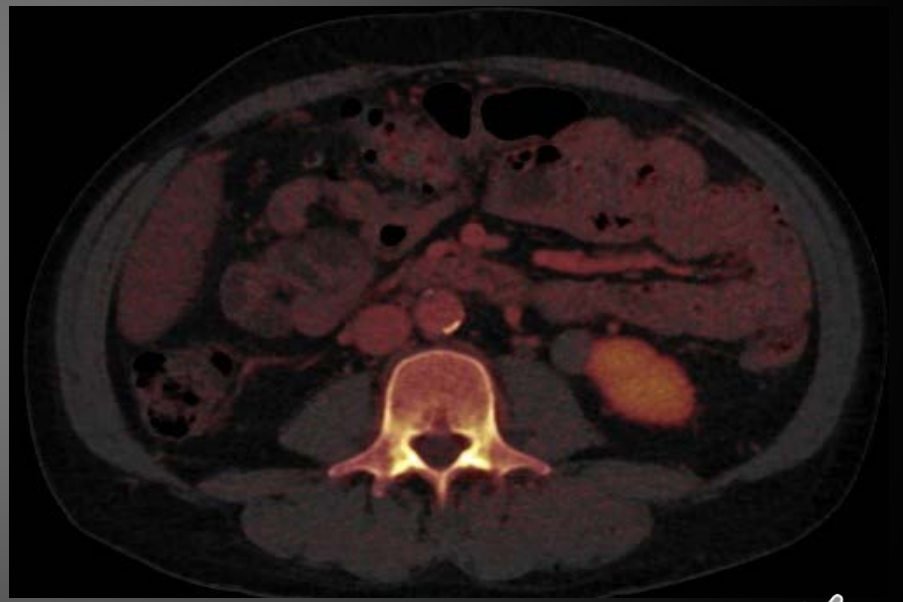
- Generation of high quality images requires good spectral separation of iodine
  - Dual Source CT can provide good separation
    - One tube at 80-90 kVp, other at 150 kVp

Iodine Map Images

- Iodine can be color coded
  - Red (like PET often is)

- Iodine “only” image overlays the traditional CT images

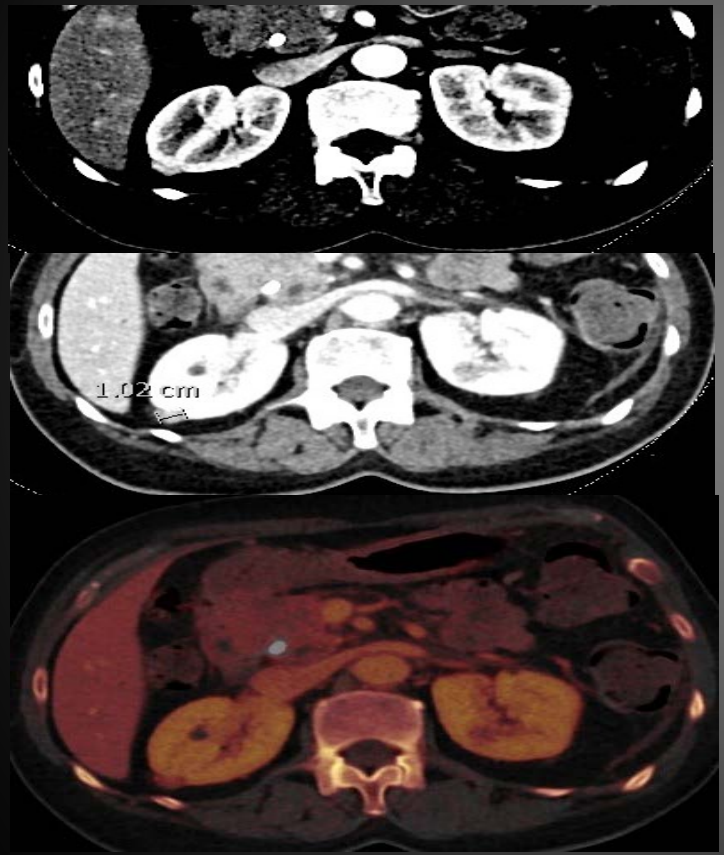
Benign Renal Cyst

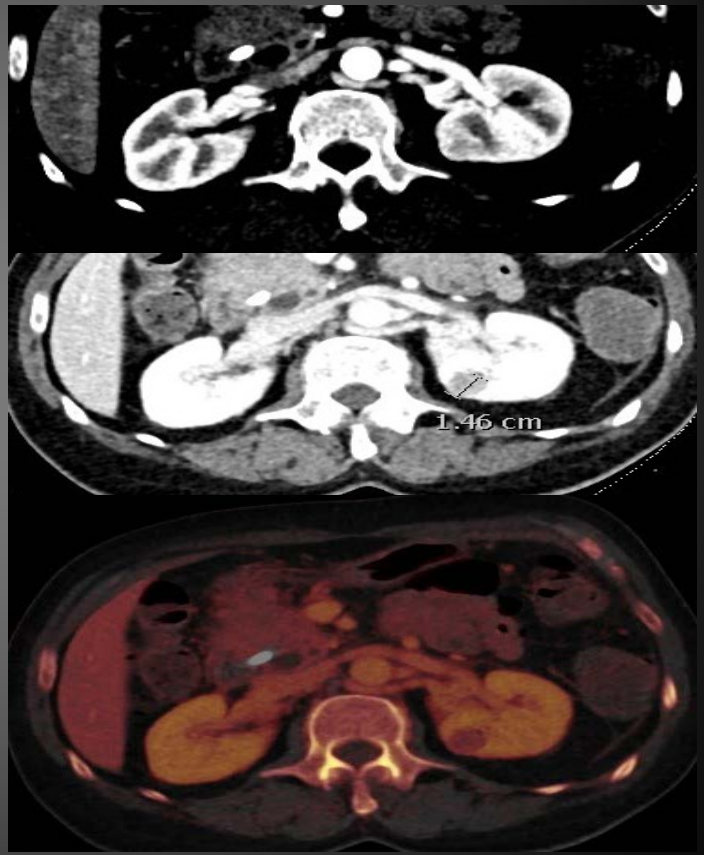


Benign Renal Cyst

- Despite the fact that the lesion measures greater than 20 HU on a single post contrast phase CT (26 HU), the iodine image shows no visible iodine present in the cyst
  - All renal neoplasm (RCC) should have iodine
  - Can feel more confidence in a benign diagnosis?

RCC (bilaterally)





Presence of iodine

- Red color visible in both renal lesions

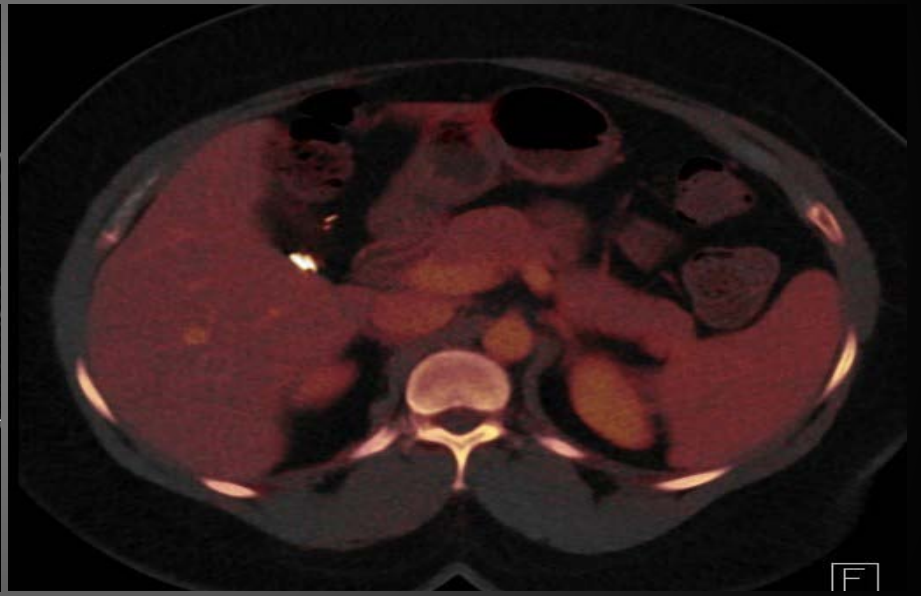
  Indicates iodine (hence enhancement)

  - ANY amount of red color indicated tumor

Artifact

- Note in prior case the “color” associated with the very dense biliary stent
  - Metallic or similar dense material may be confused for enhancement
    - Similar to PET/CT attenuation correction error

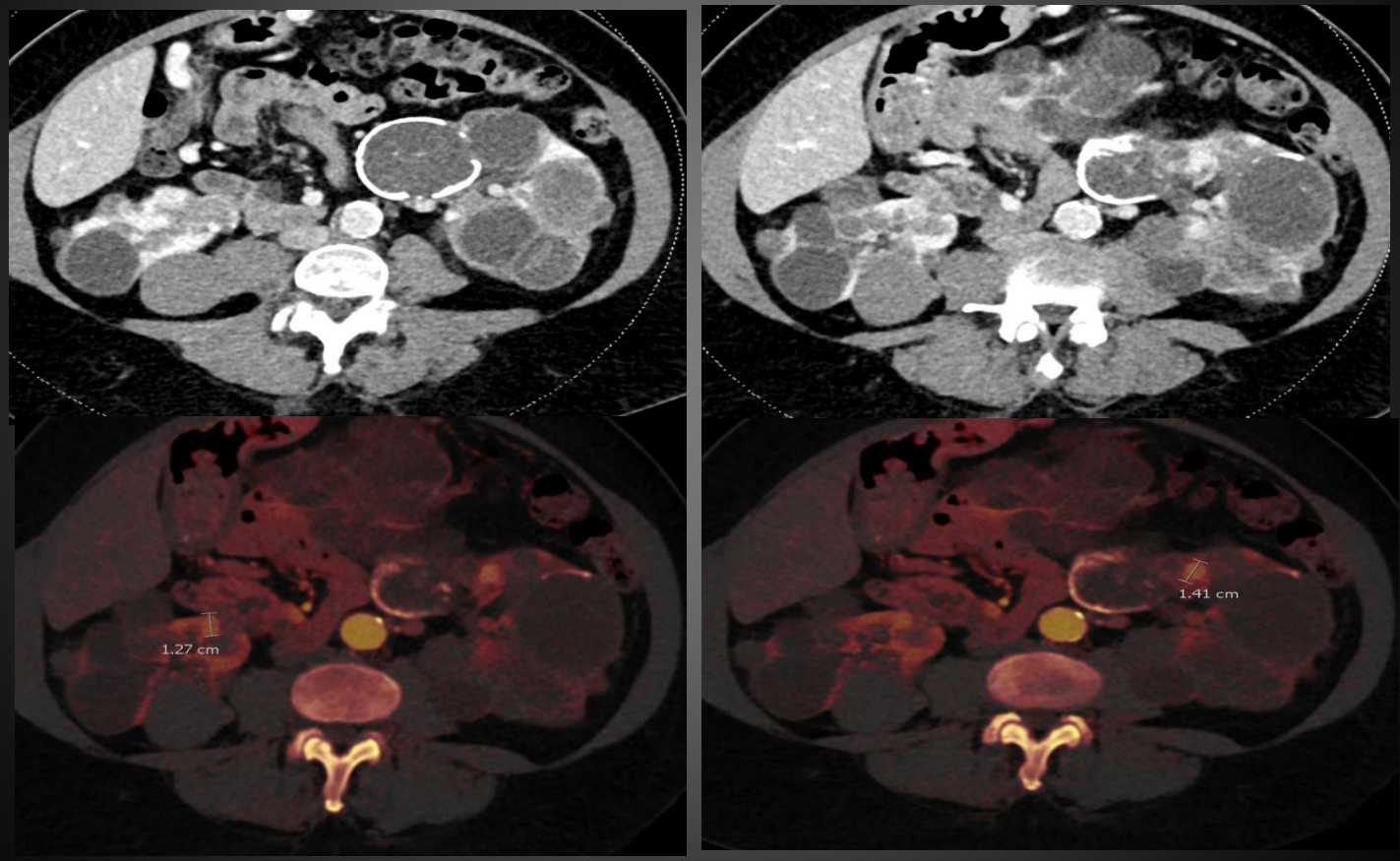
Artifact – Cholecystectomy clips



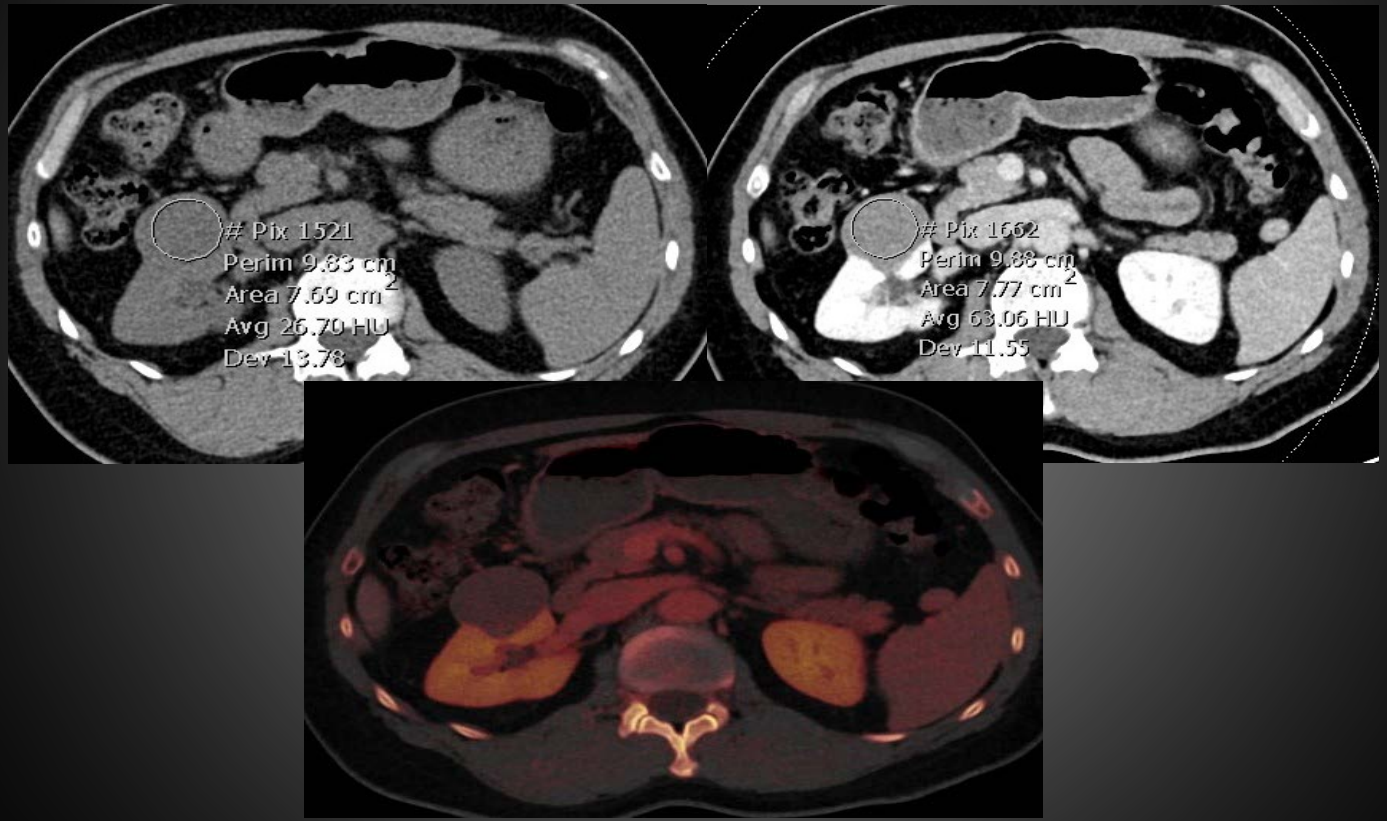
When else can it be useful?

- In cases with complex renal lesions
  - In cases with many renal lesions
    - Polycystic Renal and Von Hippel Lindau (VHL)

VHL patient



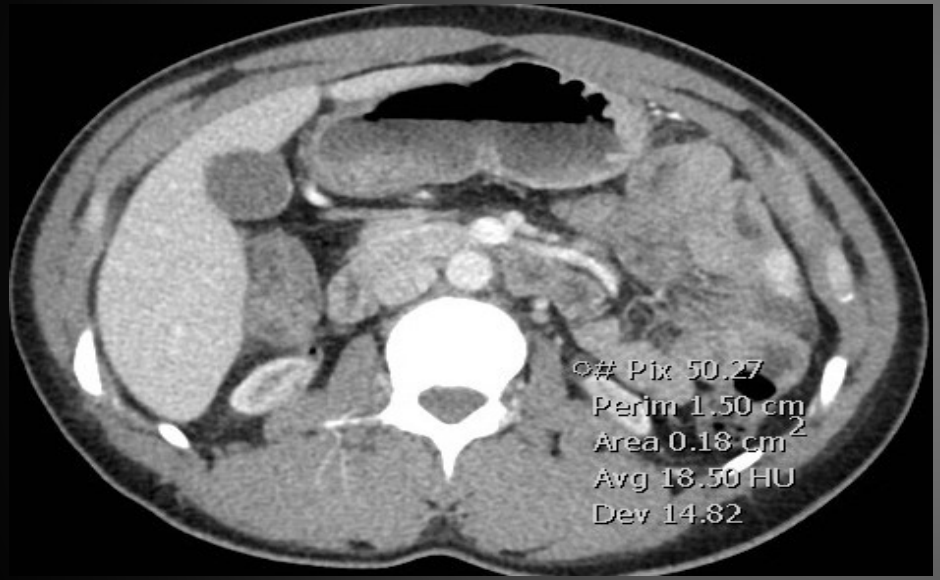
When can it be problematic?

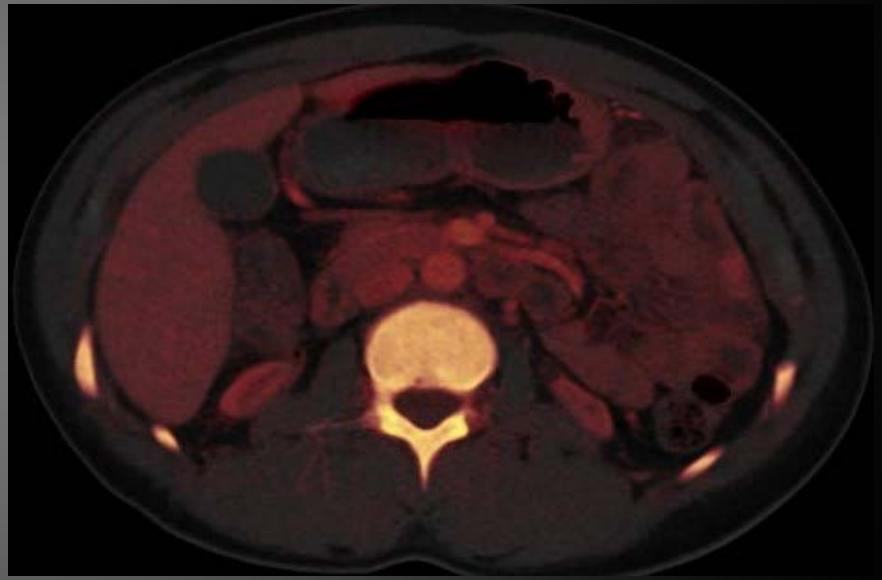


Low level of enhancement

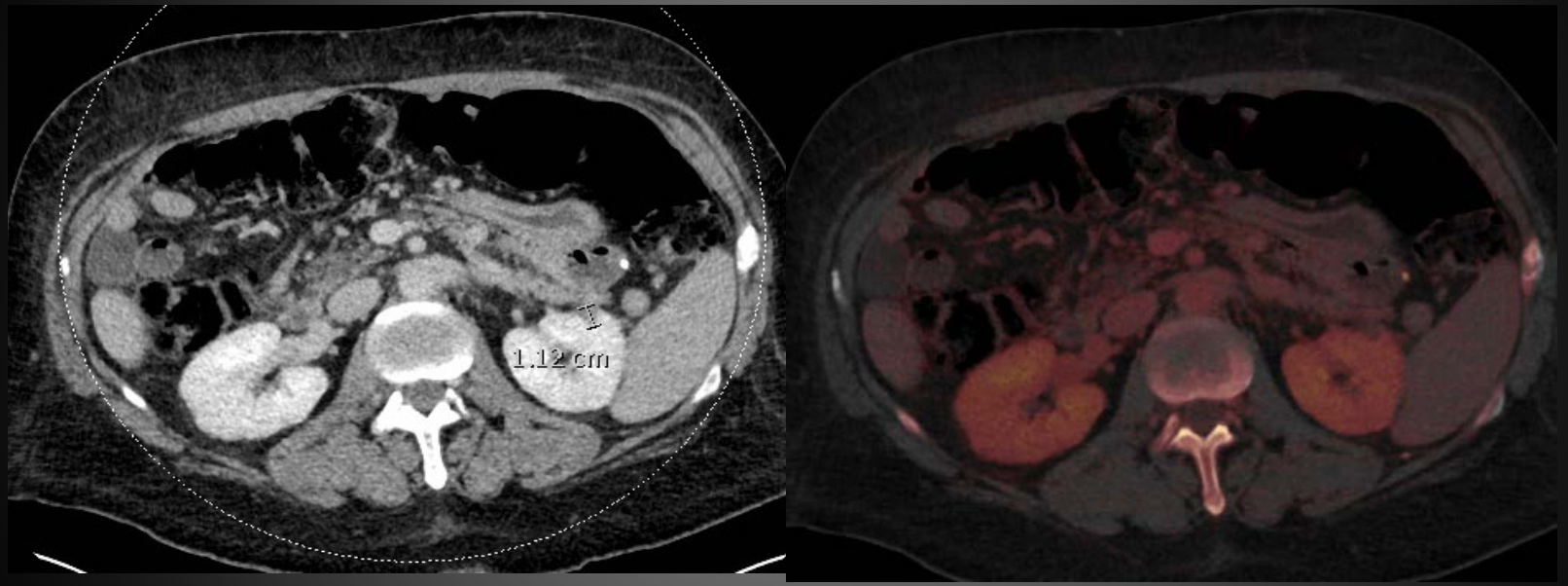
- Papillary RCC with low level enhancement
  - Especially difficult when homogeneous
- Need further defining for the lower limit of “signal” on Iodine images
  - Windowing optimization and improvements in quantification are still needed

What you might encounter in clinical routine





Another one



Size of lesion matter?

- Although size is a limiting factor in traditional CT dual phase imaging, it appears to be easier to visualize non-enhancing cysts on iodine images
  - Defining the lower limit of size is still a point of ongoing research

References

- Caruso D, De Cecco CN, Schoepf UJ, Schaefer AR, Leland PW, Johnson D, Laghi A, **Hardie AD**. **Can dual-energy computed tomography improve visualization of hypoenhancing liver lesions in portal venous phase? Assessment of advanced image-based virtual monoenergetic images.** Clin Imaging. 2017 Jan - Feb;41:118-124. doi: 10.1016/j.clinimag.2016.10.015.
- De Cecco CN, Muscogiuri G, Schoepf UJ, Caruso D, Wichmann JL, Cannaò PM, Canstein C, Fuller SR, Snider L, Varga-Szemes A, **Hardie AD**. **Virtual unenhanced imaging of the liver with third-generation dual-source dual-energy CT and advanced modeled iterative reconstruction.** Eur J Radiol. 2016 Jul;85(7):1257-64. doi: 10.1016/j.ejrad.2016.04.012.

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