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Old Dog with New Tricks: 99mTc-sestamibi SPECT-CT for Renal Mass Differentiation

Zachary Beswick
Henry Ford Health System

Ishani Dalal
Henry Ford Health System

An Old Dog with New Tricks: ^{99m}Tc-sestamibi SPECT-CT for Differentiation of Renal Masses

Zachary Beswick, M.D.

Ishani Dalal, M.D.

Henry Ford Hospital – Detroit, Michigan

RENAL CELL CARCINOMA (RCC)

- 80-85% of primary renal malignancies
- Relatively more common in North America
- Men > Women
- Risk factors include smoking, obesity, and hypertension
- Subtypes
  - Clear cell (75-85%)
  - Papillary (10-15%)
  - Chromophobe (5-10%)

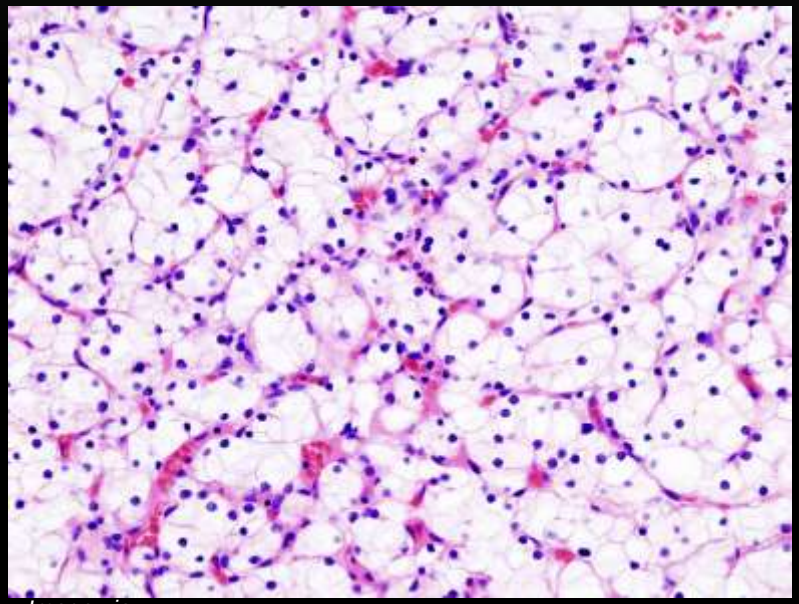


Image via https://ru.wikipedia.org/wiki/%D0%A4%D0%B0%D0%B9%D0%BB:Renal_clear_cell_ca_(1)_Nephrectomy.jpg

BENIGN RENAL TUMORS

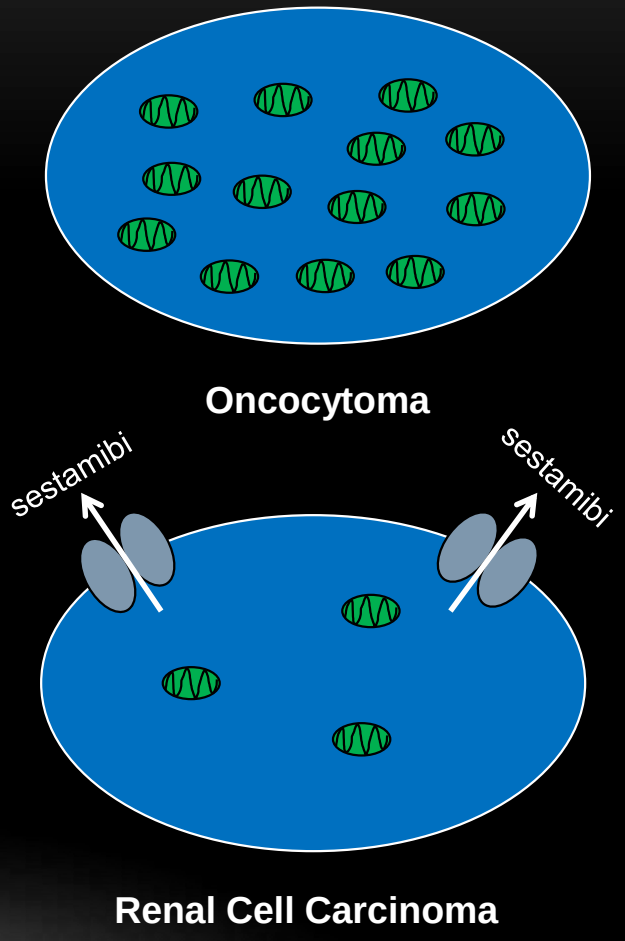
- Risk of malignancy decreases with smaller tumor size
- In one study, of the benign resected tumors, 75% were oncocytomas and 11% were angiomyolipomas
- Oncocytoma
  - Well differentiated neoplastic cells which behave benignly
  - Difficult to distinguish from RCC histologically
  - Homogenous solid mass, which may have a central scar
- Angiomyolipoma
  - Enhancing mass with macroscopic fat and without calcification

DIFFERENTIATION CHALLENGES OF RENAL MASSES

- Limited ability to distinguish malignant and benign solid renal masses on cross-sectional imaging
- Limitations of percutaneous renal biopsy:
  - Poor negative predictive value
  - Tumors incapable of being biopsied
  - Invasive procedure

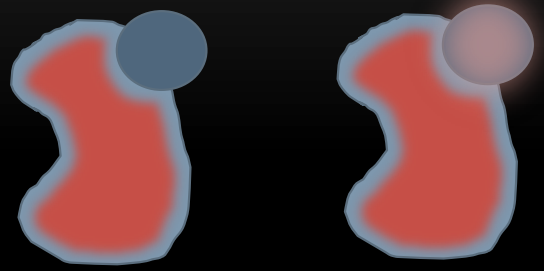
MECHANISM OF ACTION

- ^{99m}Tc-sestamibi is a lipophilic cation which localizes to cells based on mitochondrial content
- Renal oncocytomas have large numbers of mitochondria, especially in comparison to renal cell carcinoma (RCC) which have a relative paucity of mitochondria
- RCCs also often possess drug pumps that move ^{99m}Tc-sestamibi out of the cells
- As a result, renal oncocytomas demonstrate significant radiotracer uptake, while RCCs demonstrate limited uptake

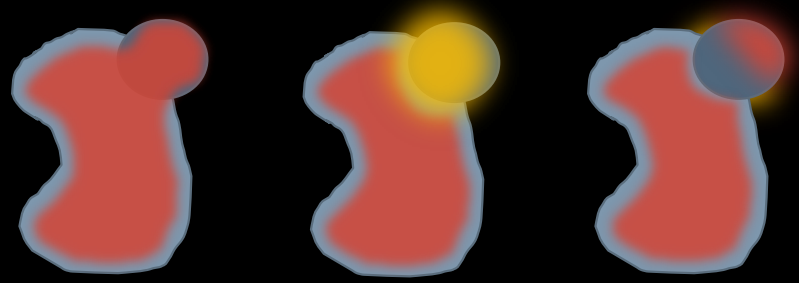


INTERPRETATION

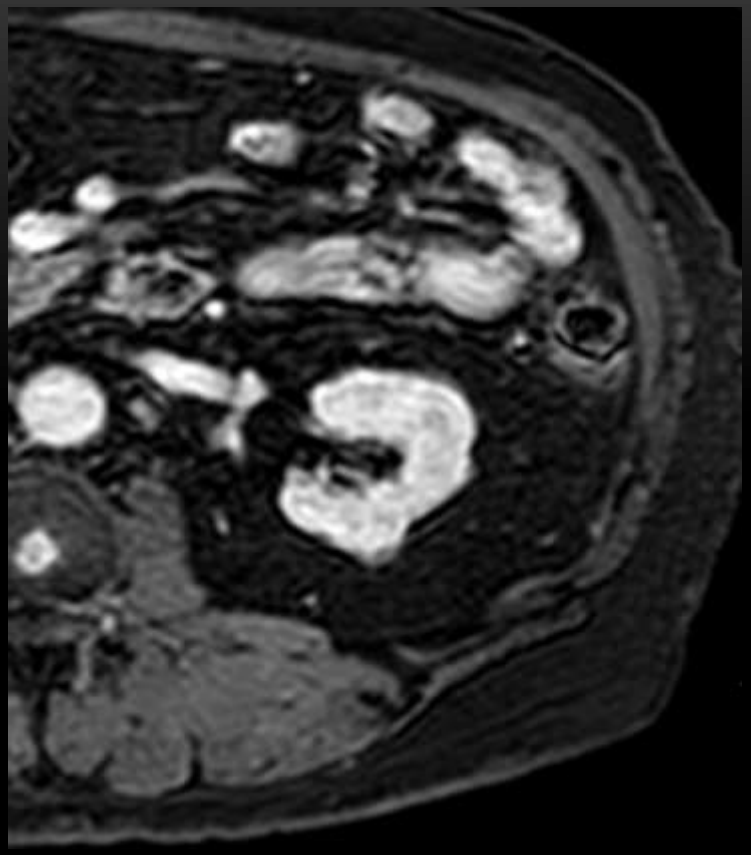
- Renal parenchyma displays high uptake of ^{99m}Tc-sestamibi
- RCCs generally show a distinct decrease in radiotracer uptake relative to surrounding normal parenchyma
- In contrast, oncocytomas display uptake that is usually increased or similar to that of renal parenchyma
- Masses displaying variable uptake are likely to be benign if any portion displays a moderate to high amount of uptake



RCC patterns



Benign patterns



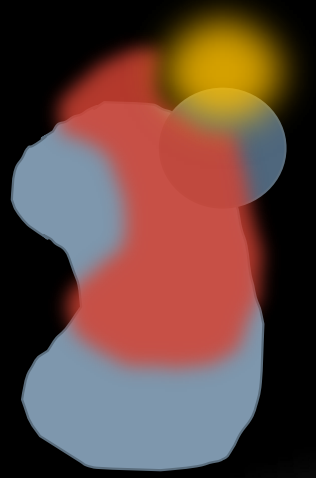
Post contrast T1 fat-saturated MR image shows a 1.6 cm T1 mildly hyperintense posterior renal mass concerning for RCC, prompting ^{99m}Tc-sestamibi SPECT-CT

^{99m}Tc-sestamibi uptake within the mass is of similar intensity to surrounding renal parenchyma, a pattern consistent with a benign renal mass and inconsistent with RCC

A photopenic defect is seen over the posteromedial renal mass, this lack of any discernable radiotracer uptake indicates that this lesion is unlikely to be benign and more likely represents RCC

PITFALLS

- Uptake misrepresentation due to respiratory motion
- Inability to distinguish radiotracer uptake or lack of uptake when evaluating smaller lesions



MANAGEMENT ROLE

- Potential to be used instead of or in concert with renal biopsy for risk stratification of small renal masses
- Major benefit in preventing kidney resections due to benign masses misclassified as malignant
- Opportunity for decreased morbidity from renal biopsies