

5-2019

# Old Dog with New Tricks: $^{99m}\text{Tc}$ -sestamibi SPECT-CT for Renal Mass Differentiation

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## Recommended Citation

Beswick, Zachary and Dalal, Ishani, "Old Dog with New Tricks:  $^{99m}\text{Tc}$ -sestamibi SPECT-CT for Renal Mass Differentiation" (2019). *Teaching and Education*. 4.  
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# An Old Dog with New Tricks: $^{99m}\text{Tc}$ - sestamibi SPECT-CT for Differentiation of Renal Masses

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# 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%)

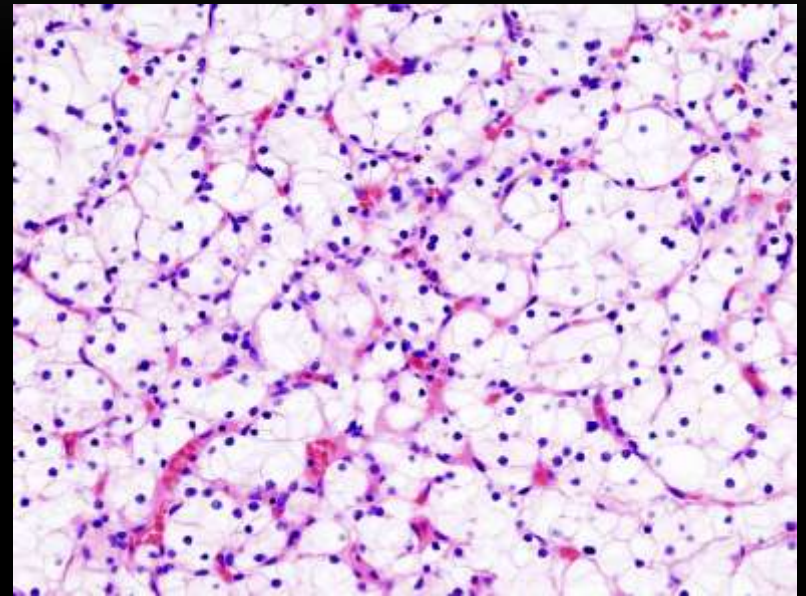


Image via  
[https://ru.wikipedia.org/wiki/%D0%A4%D0%B0%D0%B9%D0%BB:Renal\\_clear\\_cell\\_ca\\_\(1\)\\_Nephrectomy.jpg](https://ru.wikipedia.org/wiki/%D0%A4%D0%B0%D0%B9%D0%BB:Renal_clear_cell_ca_(1)_Nephrectomy.jpg)

# BENIGN RENAL TUMORS

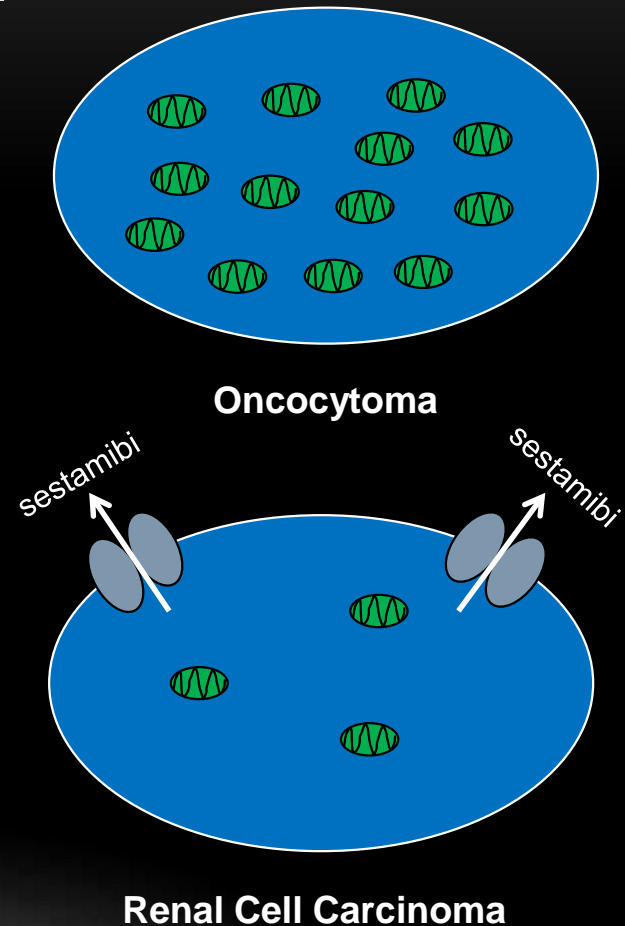
- Risk of malignancy decreases with smaller tumor size
- In one study, of the benign resected tumors, 75% were oncocytomas and 11% were angiomyolipomas
- Oncocytoma
  - Well differentiated neoplastic cells which behave benignly
  - Difficult to distinguish from RCC histologically
  - Homogenous solid 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

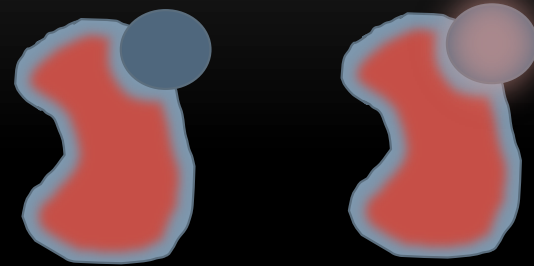
# MECHANISM OF ACTION

- $^{99m}\text{Tc}$ -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  $^{99m}\text{Tc}$ -sestamibi out of the cells
- As a result, renal oncocytomas demonstrate significant radiotracer uptake, while RCCs demonstrate limited uptake

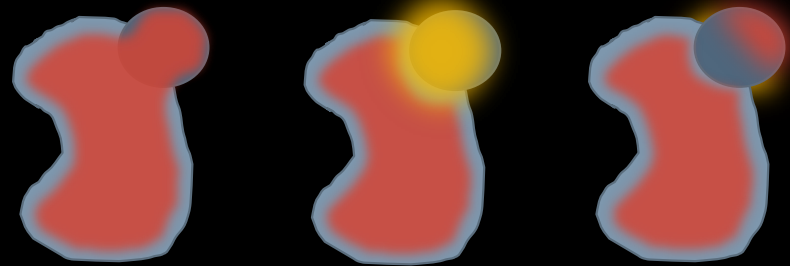


# INTERPRETATION

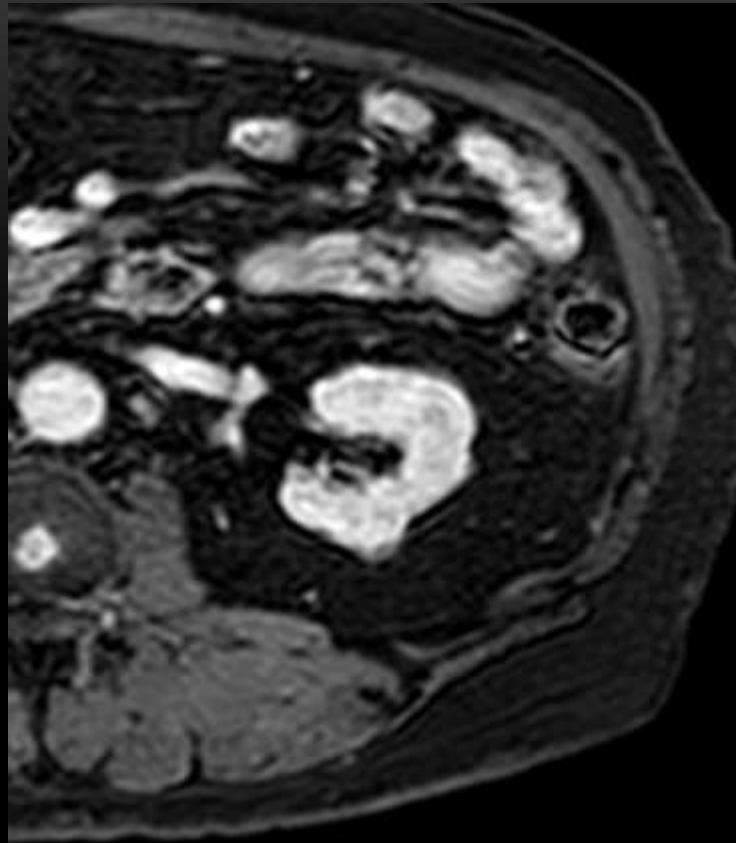
- Renal parenchyma displays high uptake of  $^{99m}\text{Tc}$ -sestamibi
- RCCs generally show a distinct decrease in radiotracer uptake relative to surrounding normal parenchyma
- In contrast, oncocytomas display uptake that is usually increased or similar to that of renal parenchyma
- Masses displaying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



RCC patterns



Benign patterns

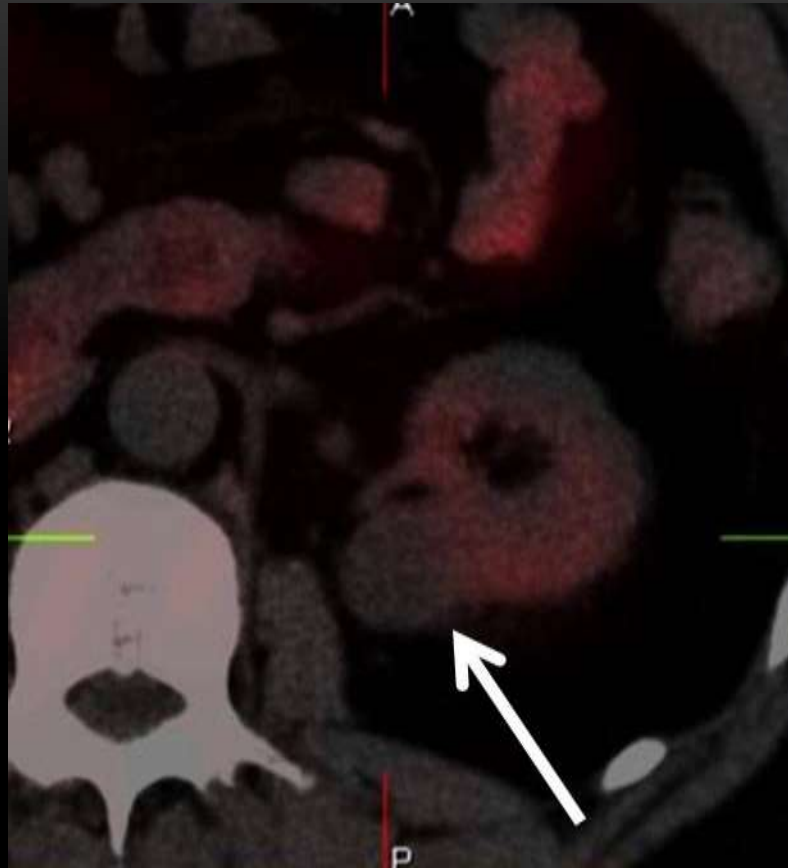


Post contrast T1 fat-saturated MR image shows a 1.6 cm T1 mildly hyperintense posterior renal mass concerning for RCC, prompting  $^{99m}\text{Tc}$ -sestamibi SPECT-CT





$^{99m}\text{Tc}$ -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