

Novel Imaging: Radiographic Biopsy

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JOHNS HOPKINS
MEDICINE

Disclosures

- None

Serious Gaps in Knowledge Exist

Increase in BENIGN Renal Masses Being Removed: CURRENT DIAGNOSTICS NOT GOOD ENOUGH!

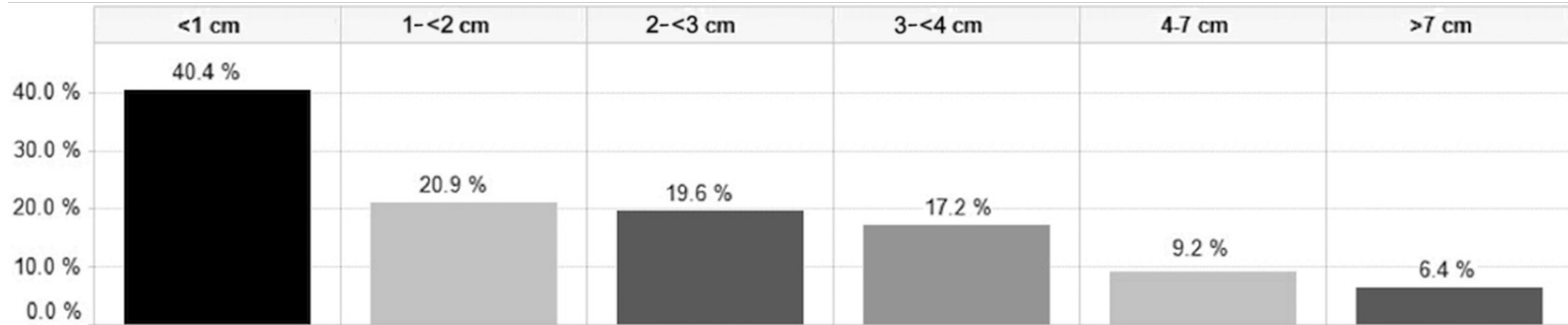


Figure 1. Estimated proportion of resected lesions with benign histology in American studies by 1 cm size strata (primary analysis).

*The estimated number of surgically resected benign renal masses in the United States from 2000 to 2009 increased by **82%** from 3,098 to **5,624**.*



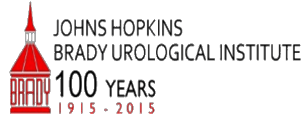
Johnson, et al. The Journal of Urology, Volume 193, Issue 1, 2015, 30–35

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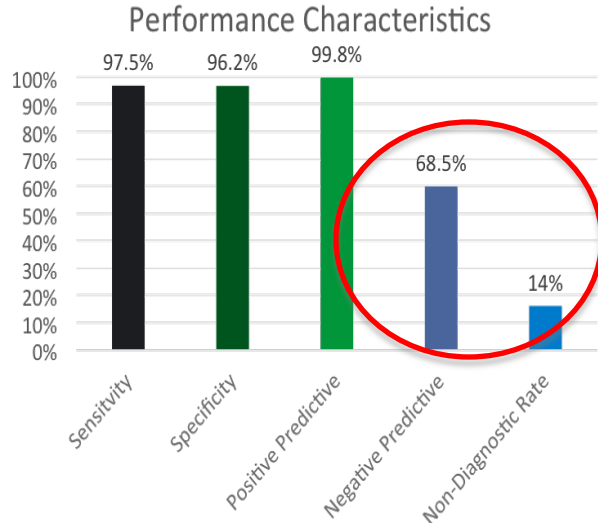




Oncology: Adrenal/Renal/Upper Tract/Bladder

Diagnostic Accuracy and Risks of Biopsy in the Diagnosis of a Renal Mass Suspicious for Localized Renal Cell Carcinoma: Systematic Review of the Literature

Hiten D. Patel,* Michael H. Johnson, Phillip M. Pierorazio, Stephen M. Sozio, Ritu Sharma, Emmanuel Iyoha, Eric B. Bass and Mohamad E. Allaf



- Hematoma 4.9%
- Pain 1.2%
- Gross hematuria 1.0%
- Pneumothorax 0.6%
- Hemorrhage 0.4%

Not all masses
can be biopsied

FLAWED Literature:
Non-consecutive cases

Lack of Accurate Imaging for Metastatic / Recurrent Disease

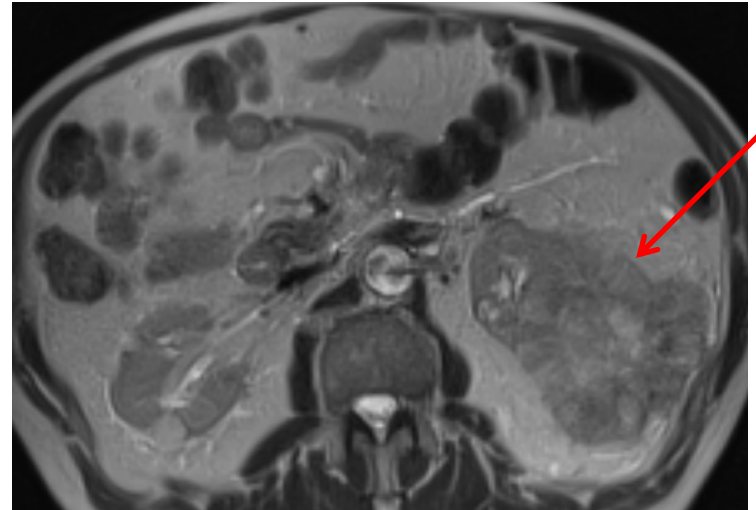
- FDG-PET has limited sensitivity for accurate staging and diagnosis
- Inability to predict early response to an ever increasing array of (non-conventional) systemic therapies

But...Radiographic Biopsy is Already Possible!

- Localized Disease:
 - Multiphasic CT Scan
 - Sestamibi SPECT/CT
 - Carbonic Anhydrase-9
- Regional / Metastatic Disease:
 - PSMA PET/CT
 - Carbonic Anhydrase-9

Case 1

- 79yo male with eGFR=45 presents with a 9cm incidental renal mass
- PMH: Mitral valve replacement
- Meds: Coumadin
- Lobulated **avidly enhancing** renal mass, central hypodensity





Johns Hopkins Workup

- Tc 99m **Sestamibi** SPECT/ CT
 - Standard at JH
 - Mitochondrial Imaging Agent

Facility List Search -

SESTAMIBI Search Browse (F4) Preference List (F5) Facility List (F6) Database Lookup (F7)

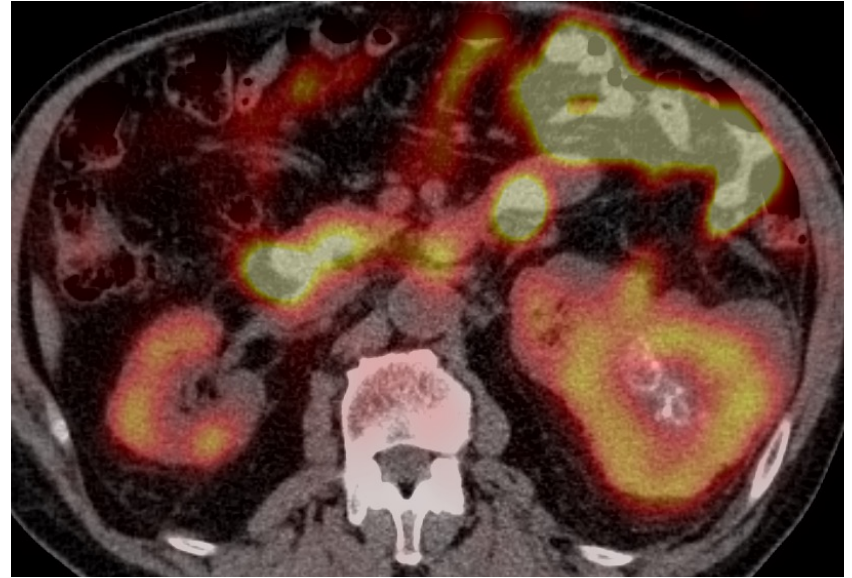
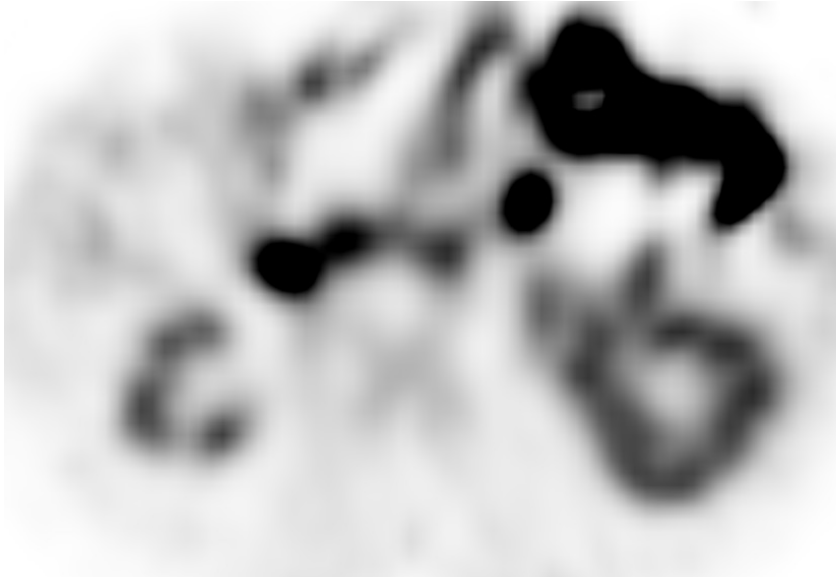
☒ Medications ☒ Procedures ☒ Order Panels ☐ Split

Name	Dose	Frequ	JH	BV	LC	QC	SM	HC	SH	Type	Code	Formulary	Copay	Coverage	Type
NM RENAL SESTAMIBI SCAN										Imagin	IMG542				

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HOT TUMOR ON SESTAMIBI IMAGING



3 Year Follow-up on Surveillance: Now 82yo, avid golfer

Oncocytomas

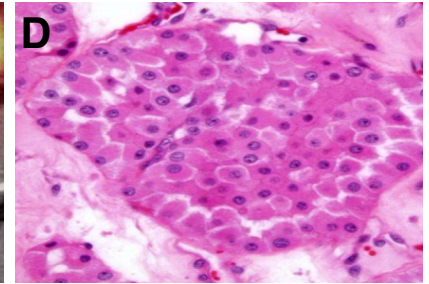
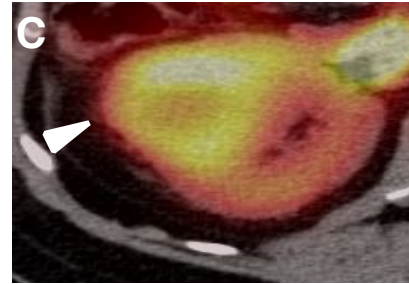
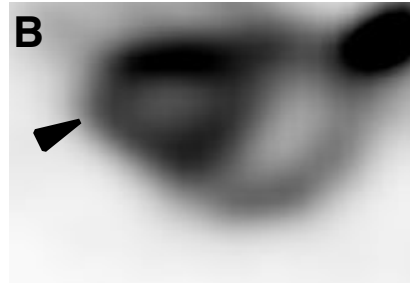
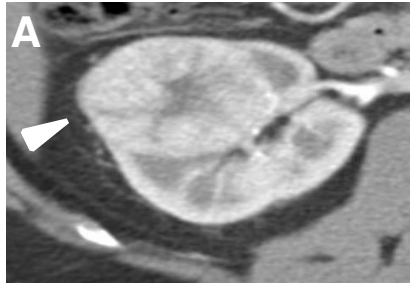
Standard CT/MRI

SPECT

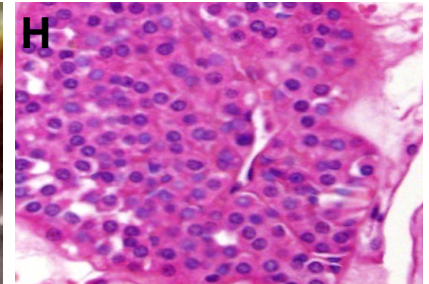
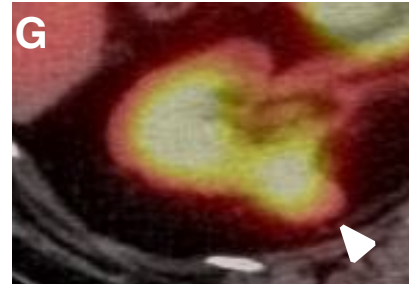
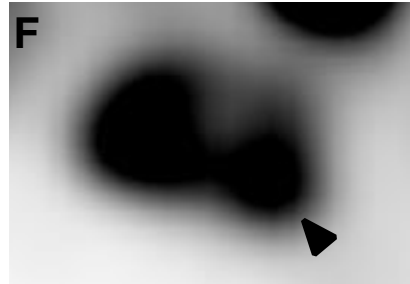
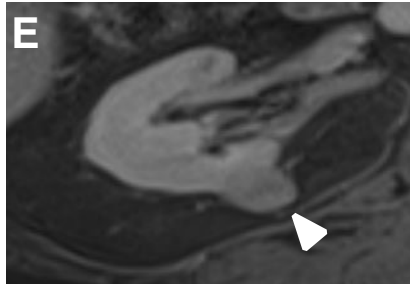
SPECT/CT

Histology

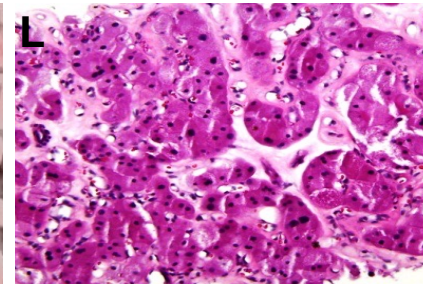
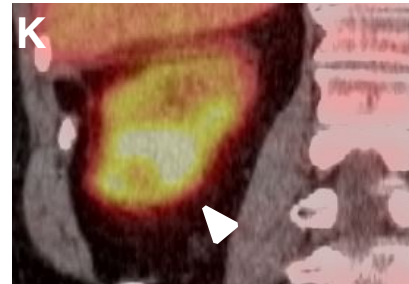
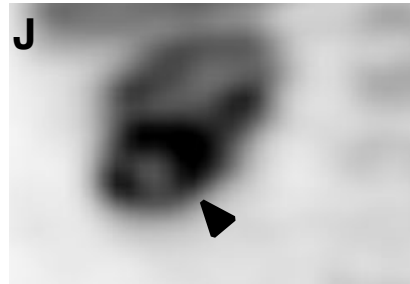
Patient 1



Patient 2



Patient 3



Resected RCCs

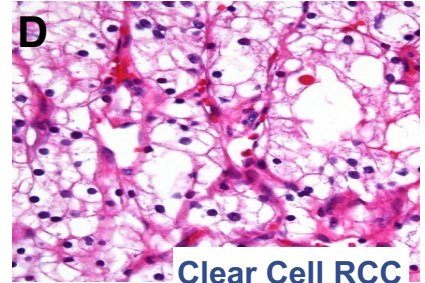
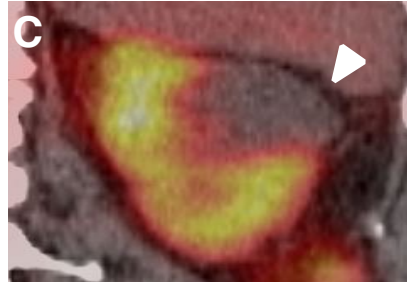
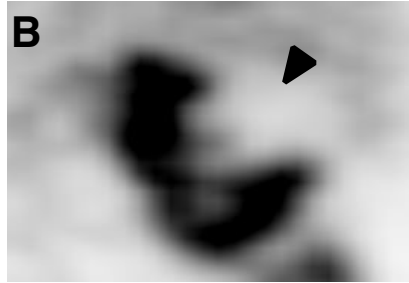
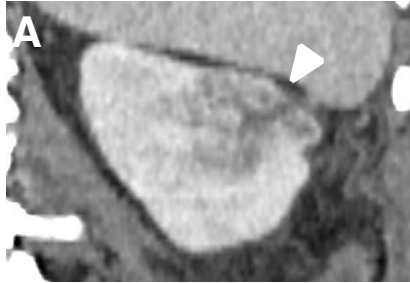
Standard CT/MRI

SPECT

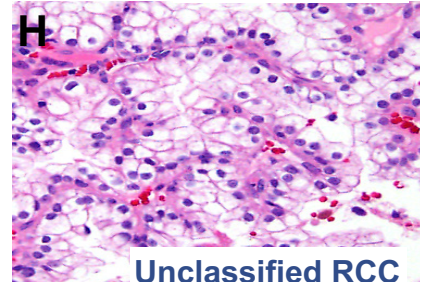
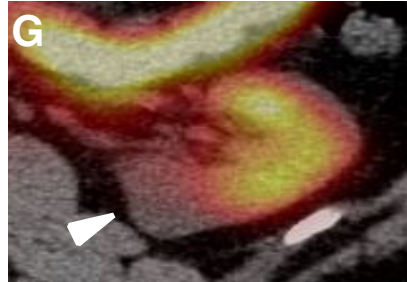
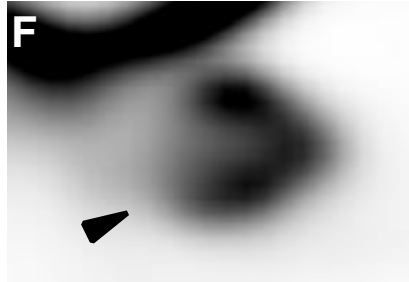
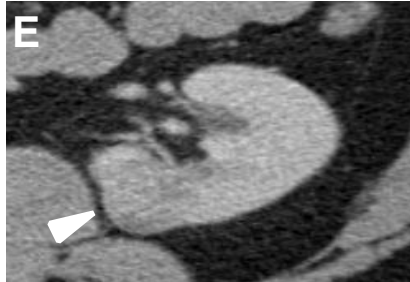
SPECT/CT

Histology

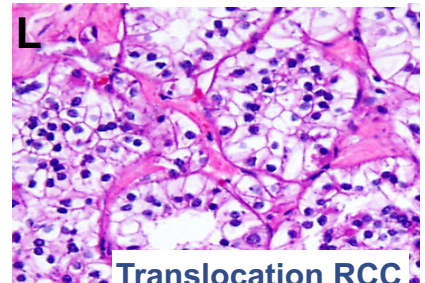
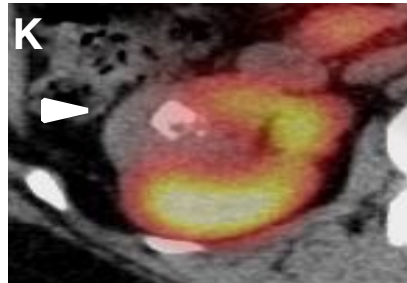
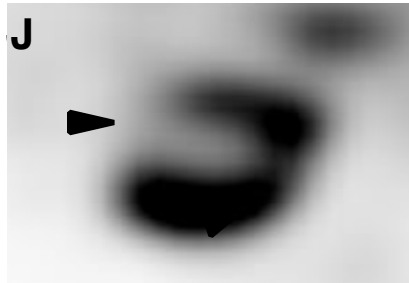
Patient 4



Patient 5



Patient 1



Oncocytoma

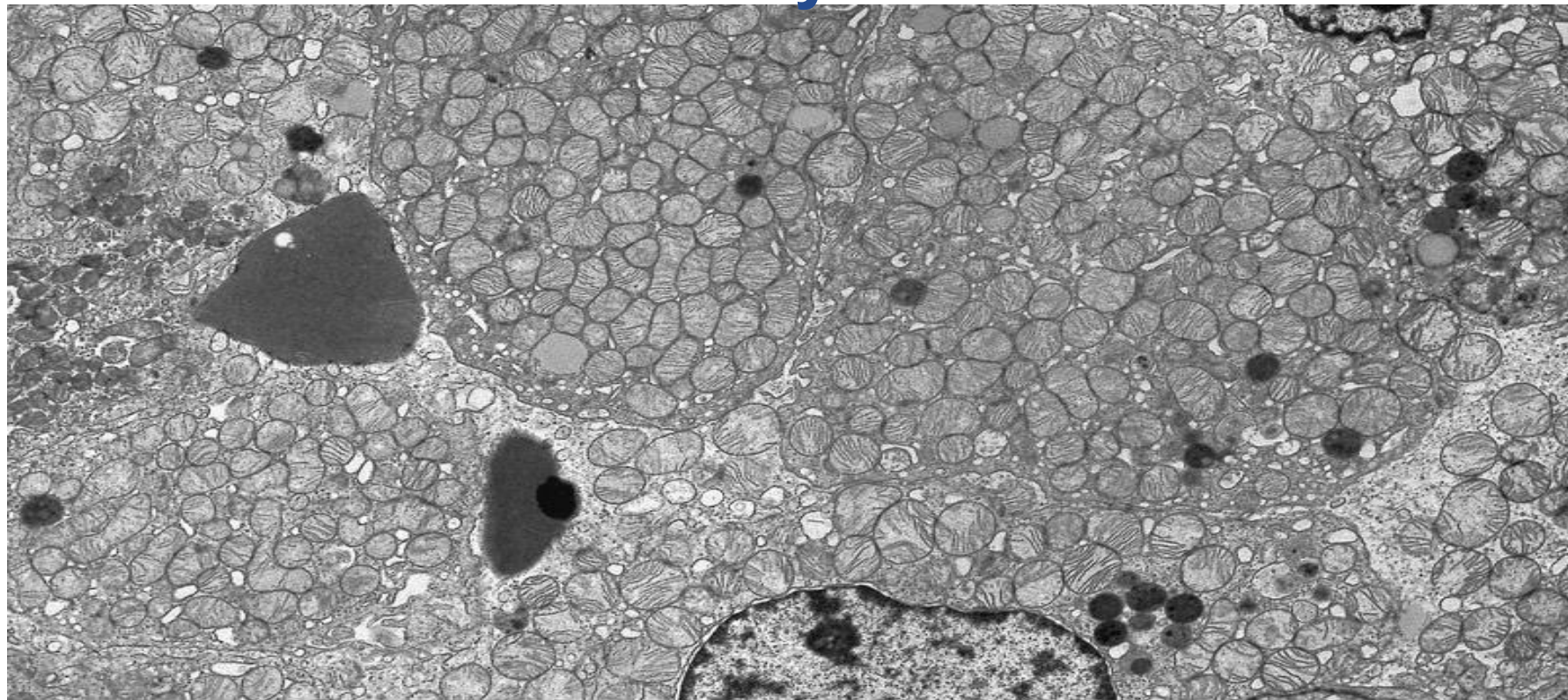
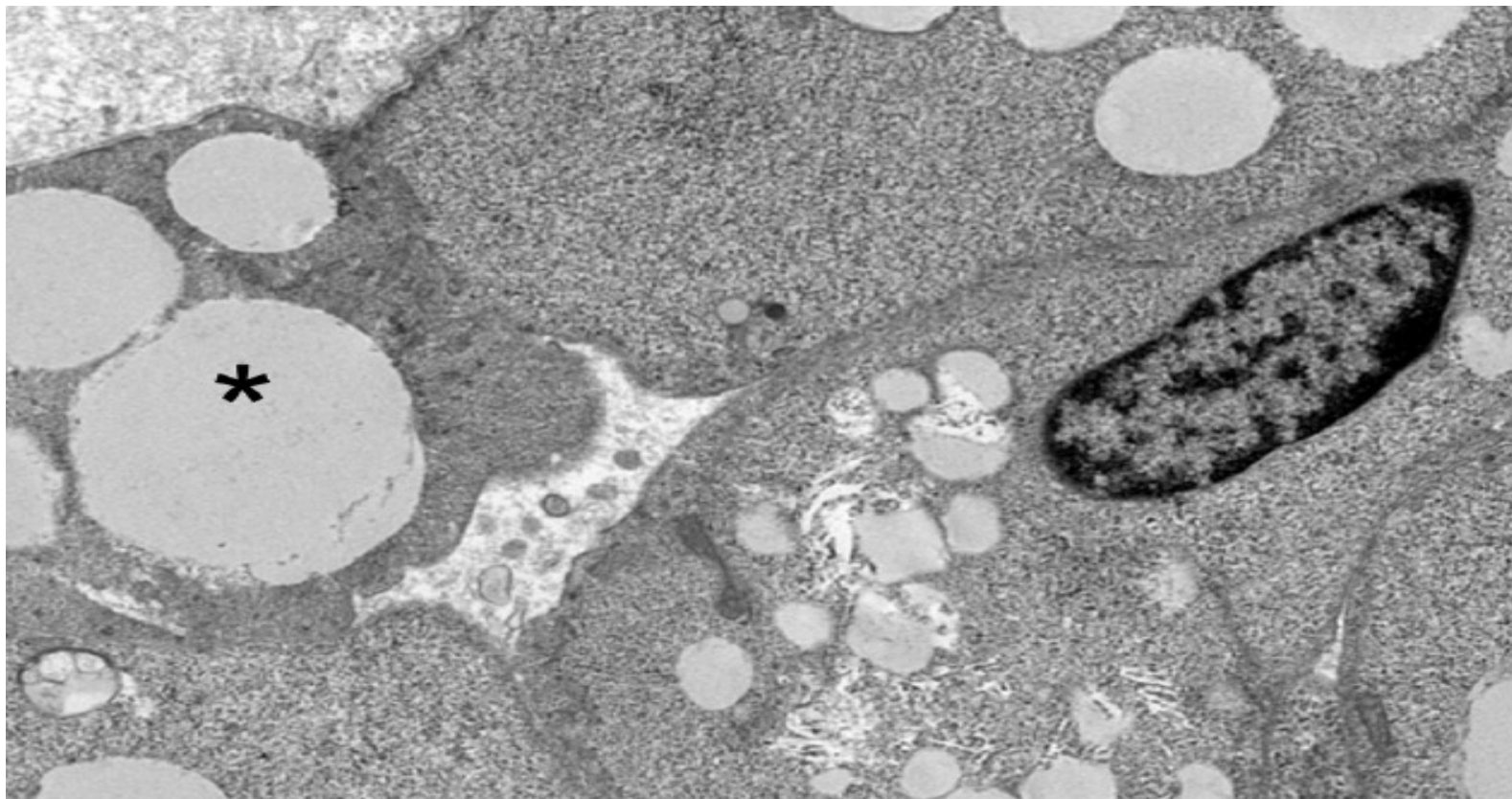


Fig. 1-220 AFIP 3rd Series, Vol. 11

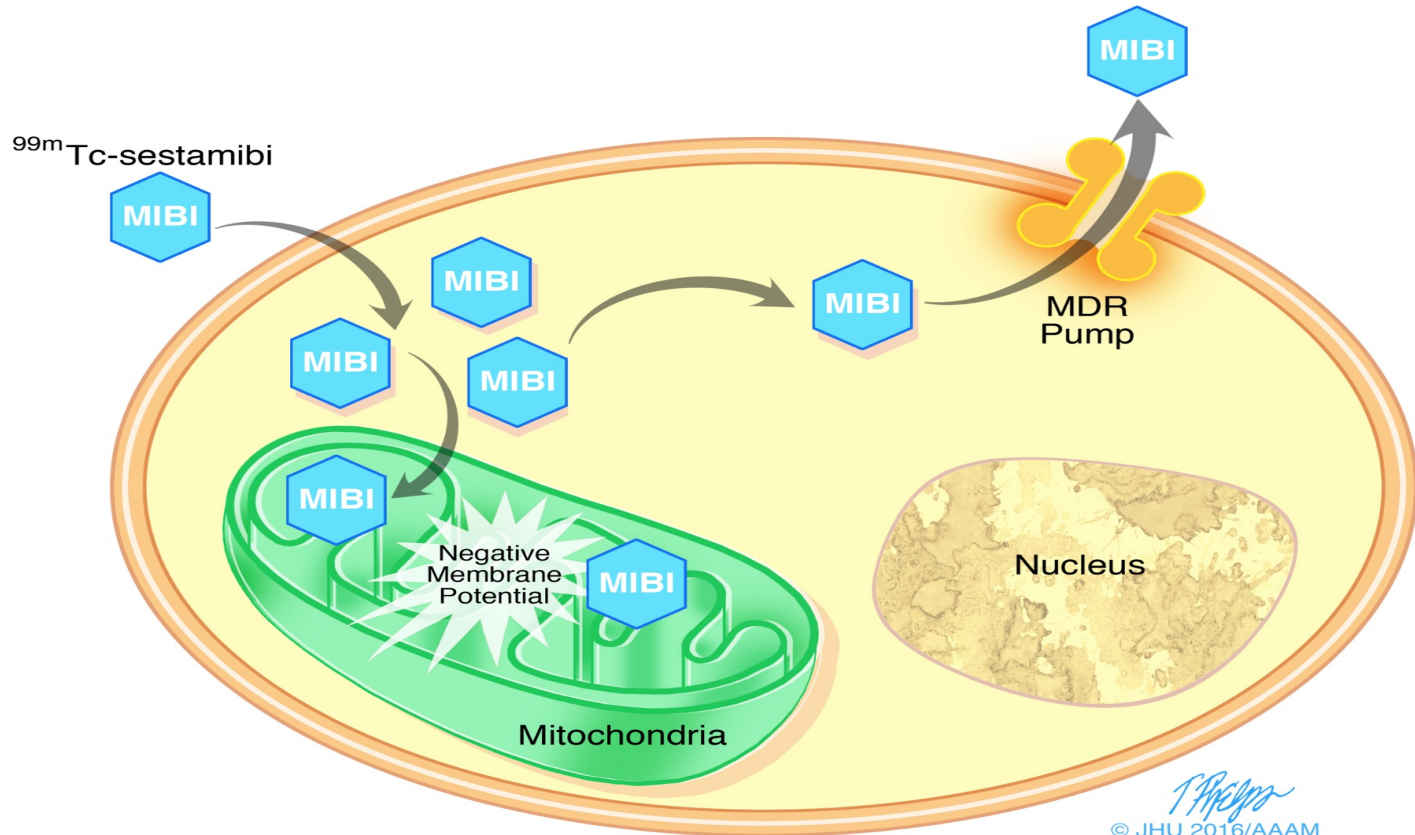
RENAL ONCOCYTOMA

The cytoplasm of the oncocyte is packed with large mitochondria ($\times 3000$).

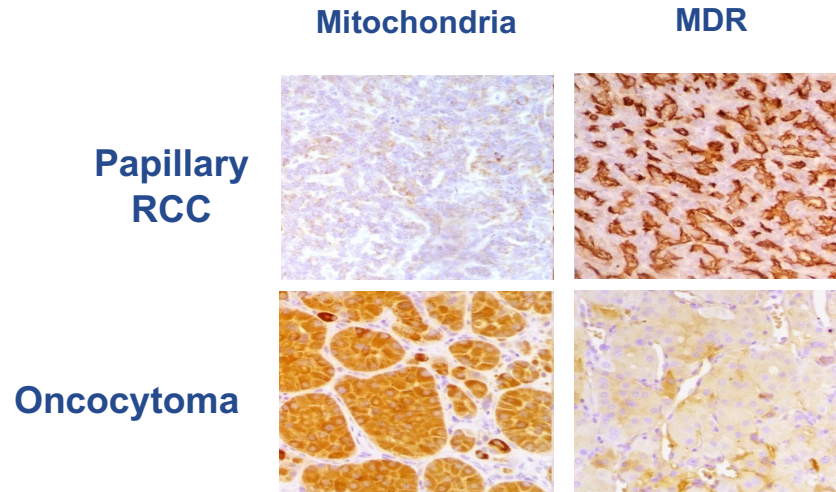
Clear Cell RCC



Sestamibi Mechanism of Action



^{99m}Tc -sestamibi Mechanism of Action (Immunohistochemistry)



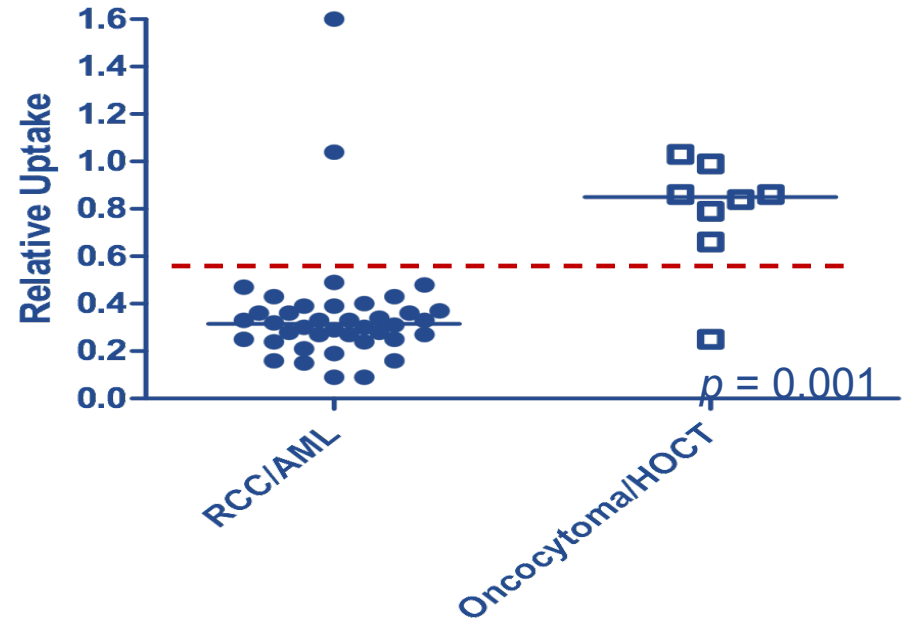
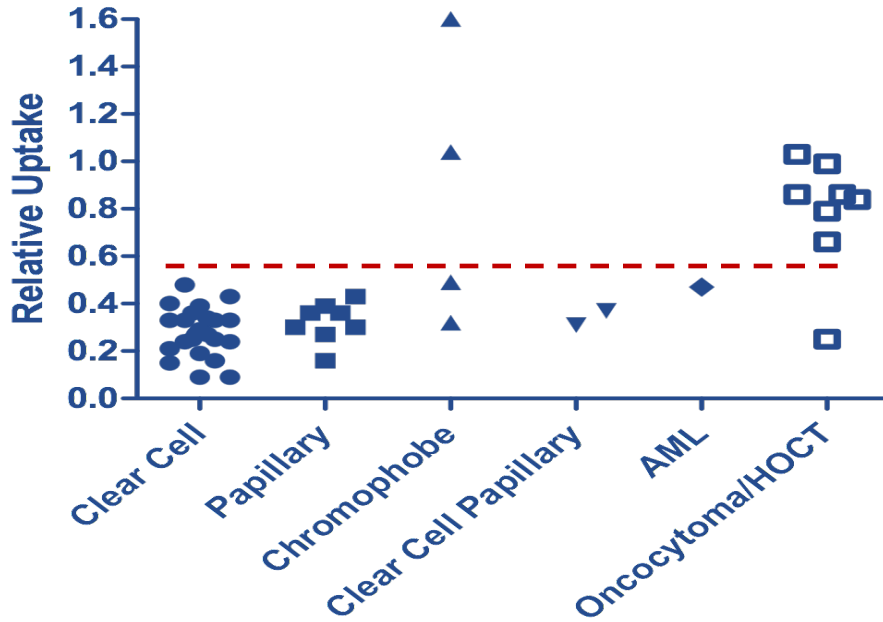
Prospective Diagnostic Trial

Prospective Evaluation of Technetium Tc 99m–Sestamibi SPECT/CT for the Diagnosis of Renal Oncocytomas and Hybrid Oncocytic/Chromophobe Tumors

¹Michael A. Gorin^a, Steven P. Rowe^b, Alex Baras^c, Lilja Solnes^b, Mark W. Ball^a, Phillip M. Pierorazio^a, Christian P. Pavlovich^a, Jonathan I. Epstein^{a,c}, Mehrbod S. Javadi^b, Mohamad E. Allaf^{a,*}

Gorin et al., European Urology, Sep 2015

Results



Sensitivity and Specificity

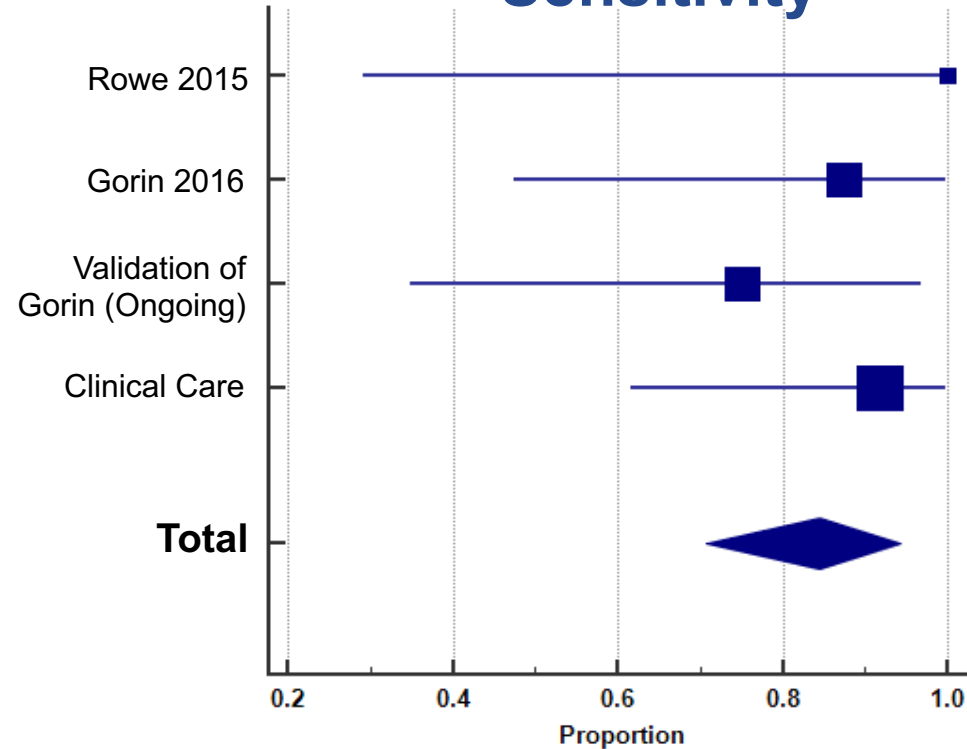
		Oncocytoma/HOCT	
		+	-
SPECT/CT	+	7	2
	-	1	40

Sensitivity = 87.5% (95% CI 52.9–97.9%)

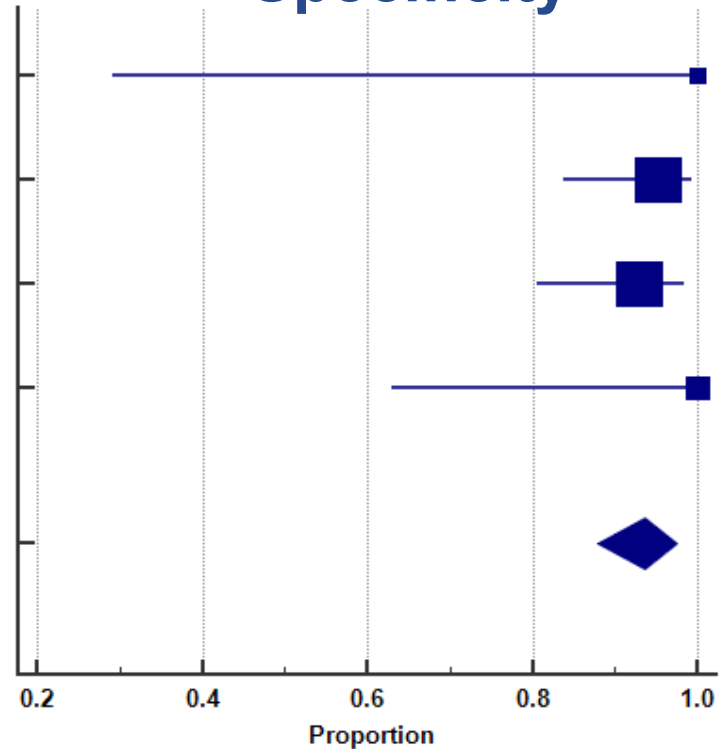
Specificity = 95.2% (95% CI 84.2–98.7%)

Updated Results (n=126)

Sensitivity



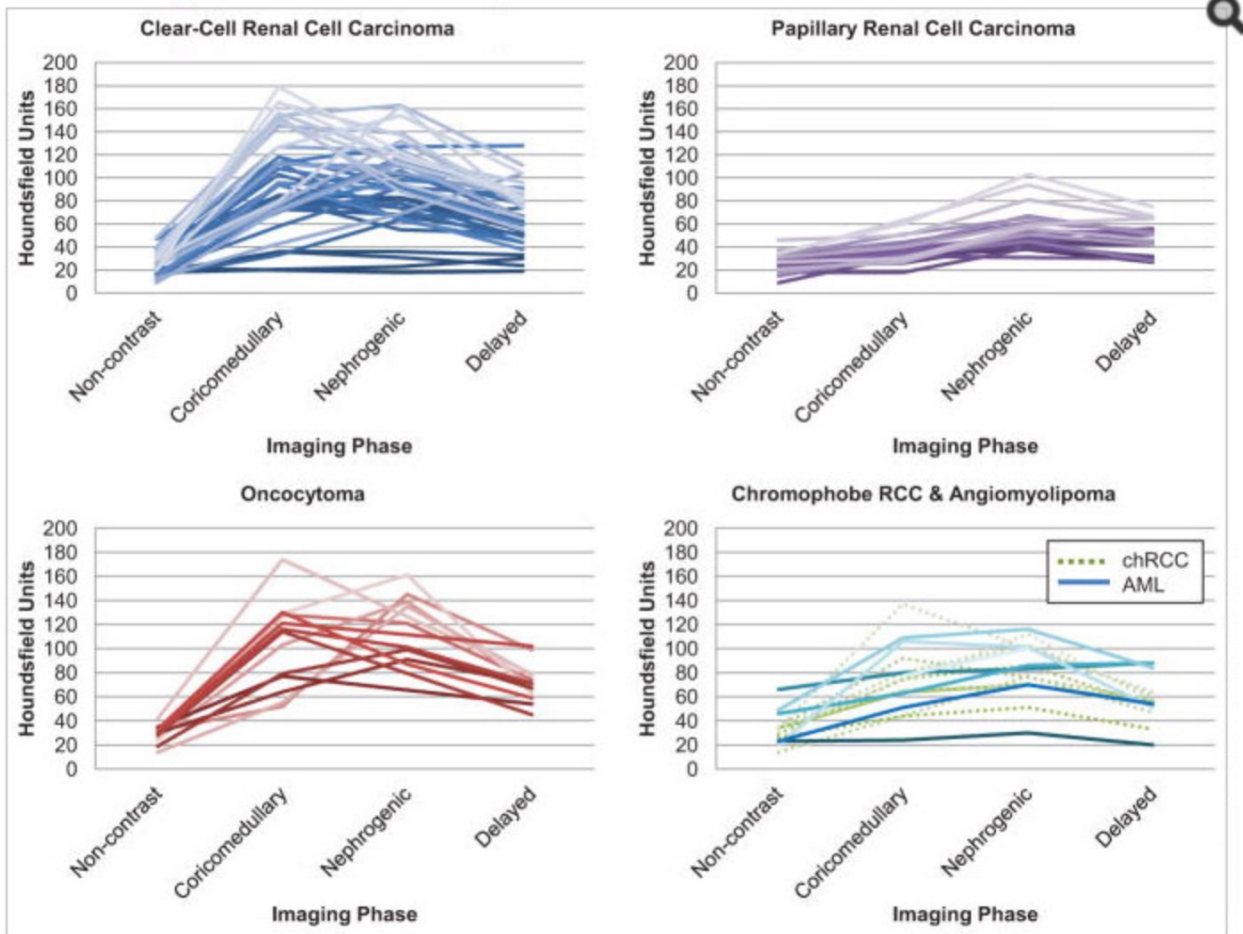
Specificity



Multiphasic Enhancement Patterns of Small Renal Masses (≤ 4 cm) on Preoperative Computed Tomography: Utility for Distinguishing Subtypes of Renal Cell Carcinoma, Angiomyolipoma, and Oncocytoma

Phillip M. Pierorazio, Elias S. Hyams, Salina Tsai, Zhaoyong Feng, Bruce J. Trock, Jeffrey K. Mullins, Pamela T. Johnson, Elliot K. Fishman, and Mohamad E. Allaf

- Avid enhancement: Clear Cell RCC & Oncocytoma
- “Hypoenhancing”: Papillary RCC
- Variable: Chromophobe RCC



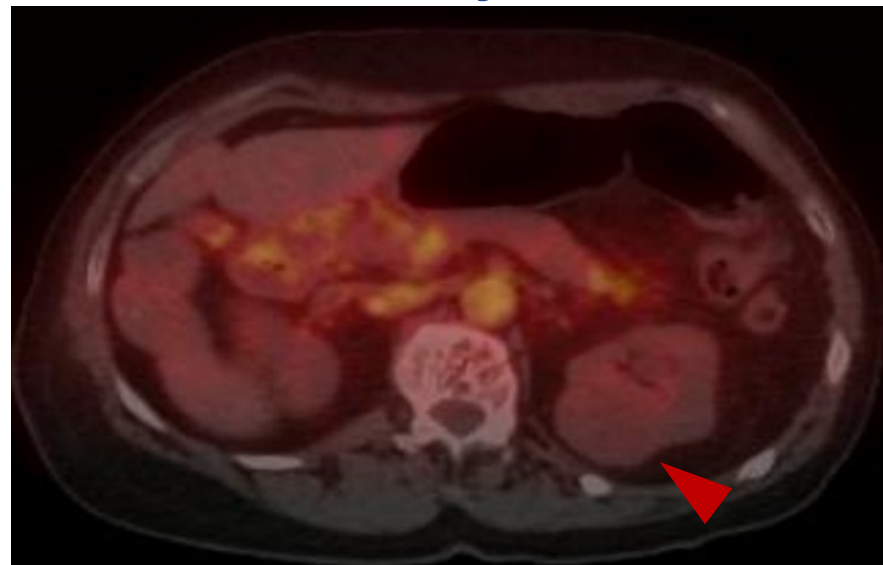
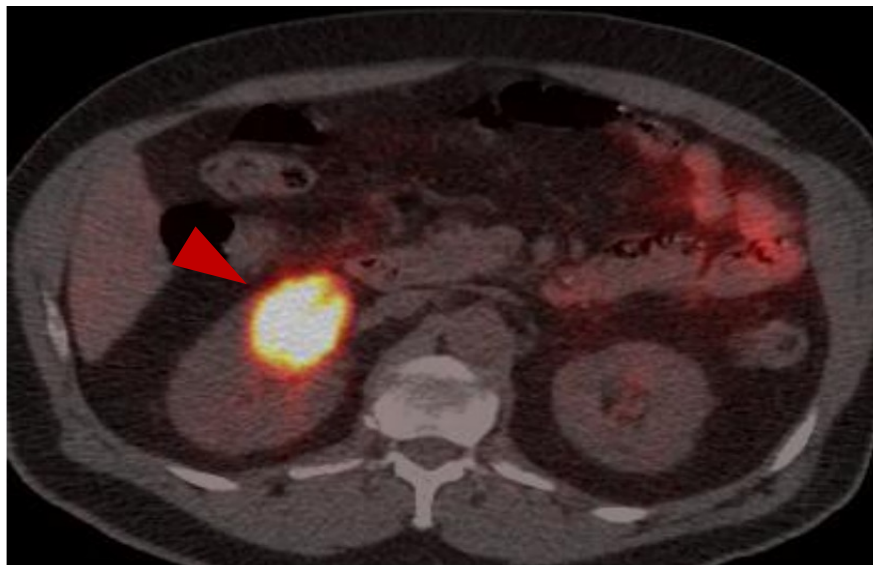
New Paradigm?

- Avid Enhancement + HOT Sestamibi= Oncocytoma
- Avid Enhancement + Cold Sestamibi= Clear cell RCC
- Hypoenhancement + Cold Sestamibi= Papillary RCC

Positron Emission Tomography/Computed Tomography Identification of Clear Cell Renal Cell Carcinoma: Results From the REDECT Trial

Chaitanya R. Divgi, Robert G. Uzzo, Constantine Gatsonis, Roman Bartz, Silke Treutner, Jian Qin Yu, David Chen, Jorge A. Carrasquillo, Steven Larson, Paul Bevan, and Paul Russo

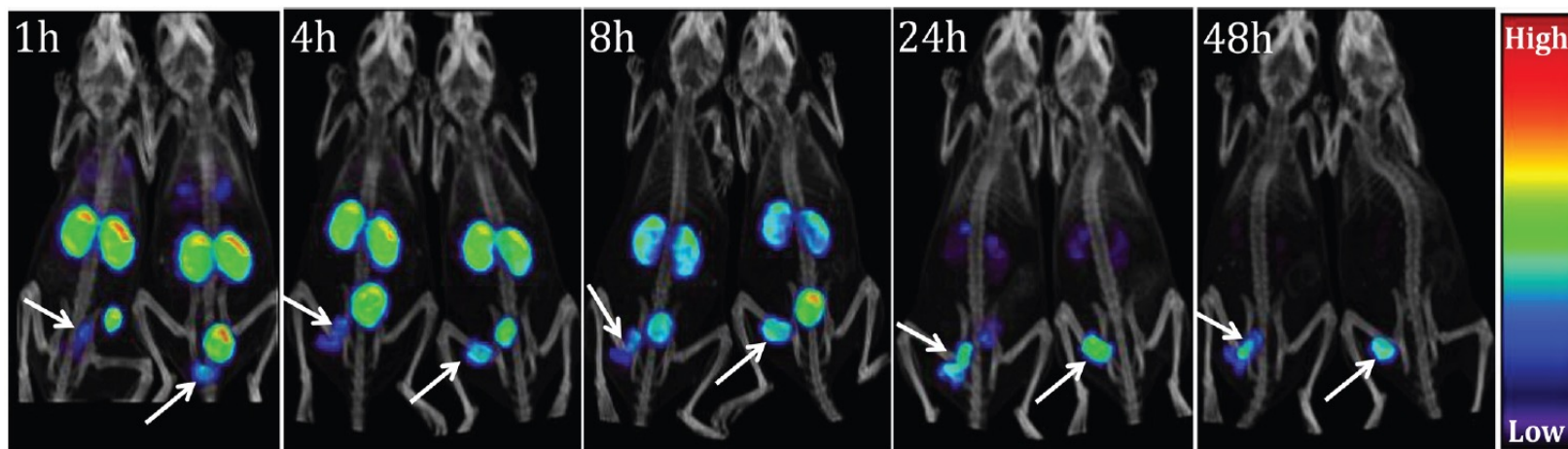
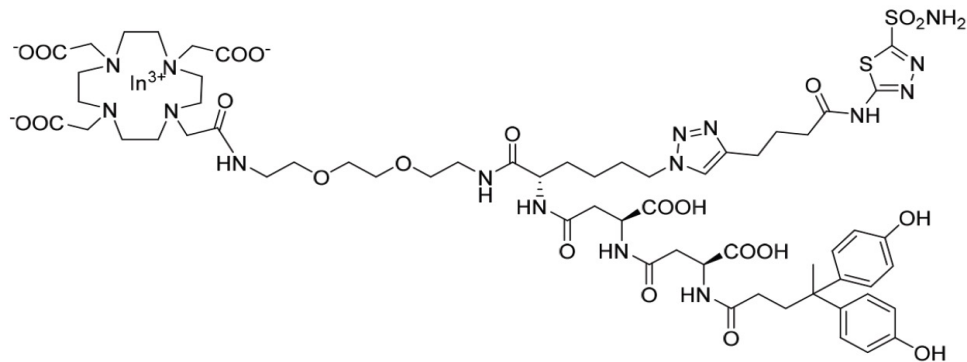
^{124}I -girentuximab Immuno-PET/CT Clear Cell RCC Oncocytoma



ZIRCON Trial (PET antibody agent)

- T1 renal mass undergoing surgery
- Injection then 5 +/- 2d imaging then surgery
- 300 patients
- Sensitivity 86%, Specificity 87%
- Safe, well tolerated, and accurate

CAIX Imaging with Novel Small Molecules



Case 2

- 53yo male
 - eGFR <60
 - Solitary kidney (Nx 10yrs ago for RCC)
 - Negative FDG-PET

Is Kidney Tumor Cancer?
Is Adrenal Tumor a Metastasis?

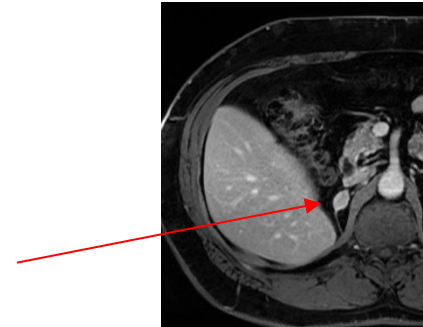
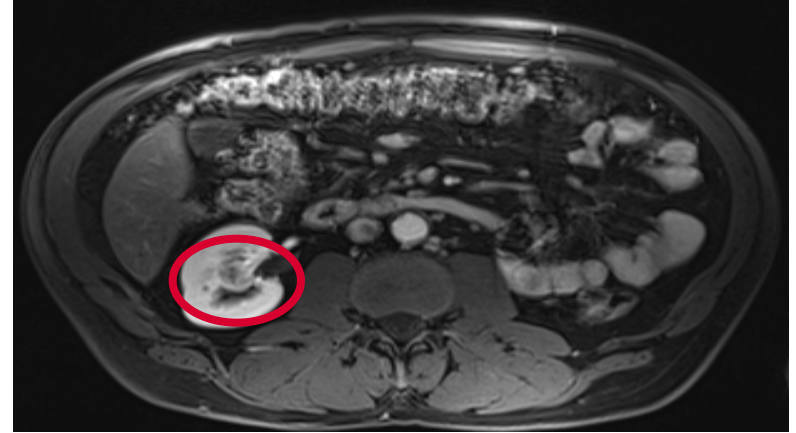
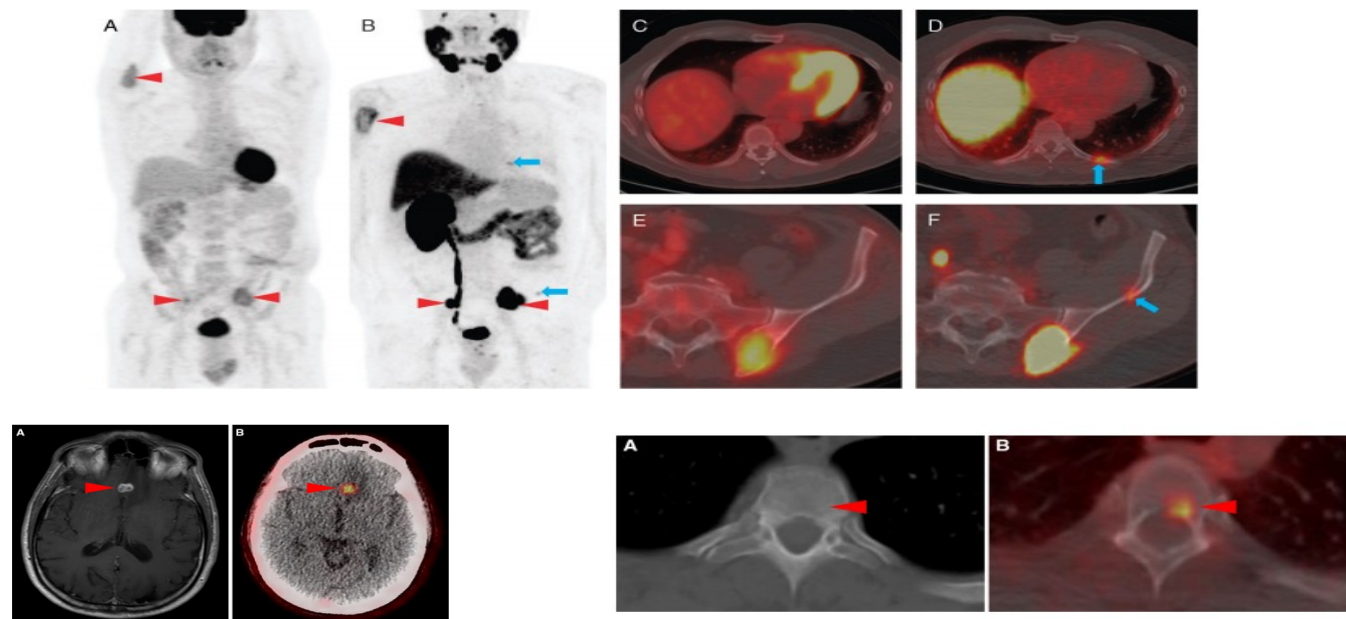


Table 1 *Results of PSMA immunohistochemistry in tumor cells and tumor-associated neovasculature*

PSMA EXPRESSION IN CANCER	No. of positive tumors/total no. of tumors studied	
	Tumor cells	Neovasculature
Conventional renal cell carcinoma	0/11	11/11
Transitional cell carcinoma	0/6	6/6
Testicular embryonal carcinoma	0/1	1/1
Colonic adenocarcinoma	0/5	5/5
Neuroendocrine carcinoma	0/5	5/5
Glioblastoma multiforme	0/1	1/1
Malignant melanoma	0/5	5/5
Pancreatic duct carcinoma	0/4	4/4
Non-small cell lung carcinoma	0/5	5/5
Soft tissue sarcoma	0/6	5/6
Breast carcinoma	0/6	5/6
Hemangioma	0/3	0/3
Hemangioendothelioma	0/1	0/1
Angiosarcoma	0/1	0/1
Angiolipoma	0/1	0/1
Angiomyolipoma	0/2	0/2
Prostatic adenocarcinoma	12/12	2/12

Imaging of metastatic clear cell renal cell carcinoma with PSMA-targeted ^{18}F -DCFPyL PET/CT

Steven P. Rowe¹ · Michael A. Gorin² · Hans J. Hammers³ · M. Som Javadi¹ · Hazem Hawasli¹ · Zsolt Szabo¹ · Steve Y. Cho⁴ · Martin G. Pomper^{1,3} · Mohamad E. Allaf²

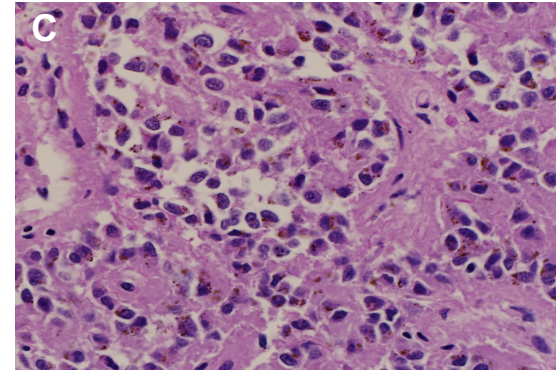
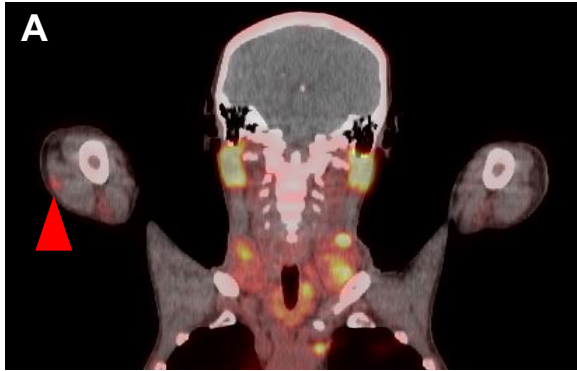


PSMA-Targeted ^{18}F -DCFPyL PET/CT Imaging of Clear Cell Renal Cell Carcinoma: Results from a Rapid Autopsy

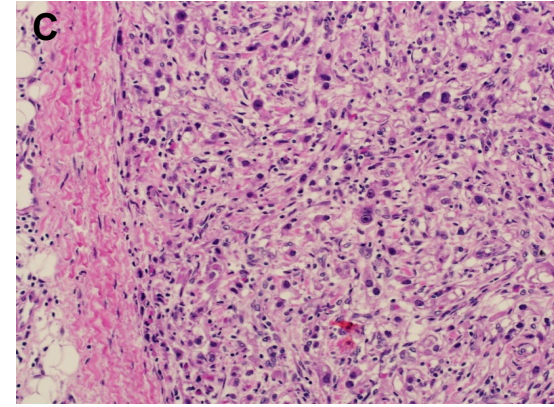
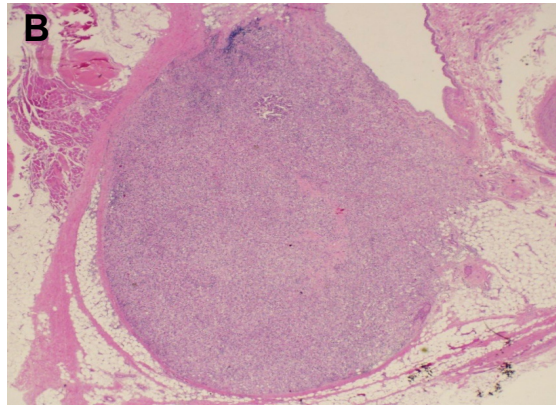
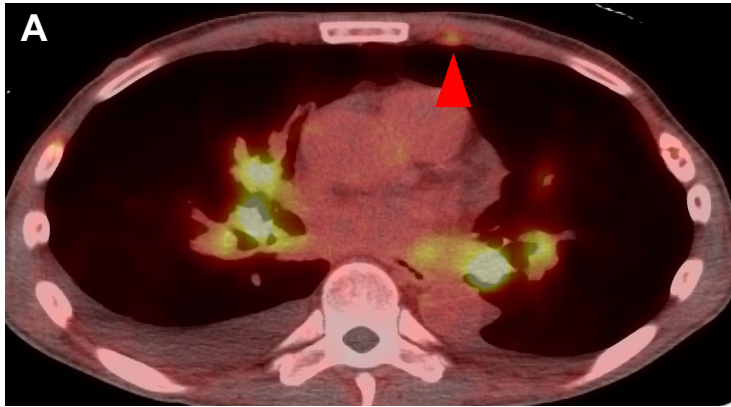
Michael A. Gorin^{a,*}, Steven P. Rowe^b, Jody E. Hooper^c, Max Kates^a, Hans-Joerg Hammers^d, Zsolt Szabo^b, Martin G. Pomper^b, Mohamad E. Allaf^a

- To evaluate the specificity of ^{18}F -DCFPyL PET/CT, a seventh patient with progressive ccRCC was imaged prior to death and a rapid autopsy was performed.
- On conventional imaging, 54 sites of disease were identified.
- With the exception of 1 lesion (left inguinal lymph node), all sites of disease had corresponding radiotracer uptake.
- In addition, 12 sites of disease were identified on ^{18}F -DCFPyL but not conventional imaging.
- Of these occult lesions, 8 were readily accessible at the time of rapid autopsy and 7 were confirmed to be metastatic ccRCC.

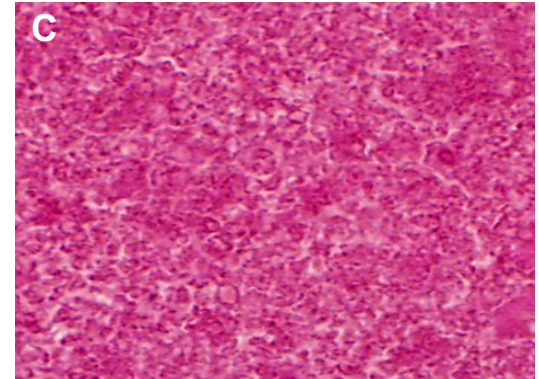
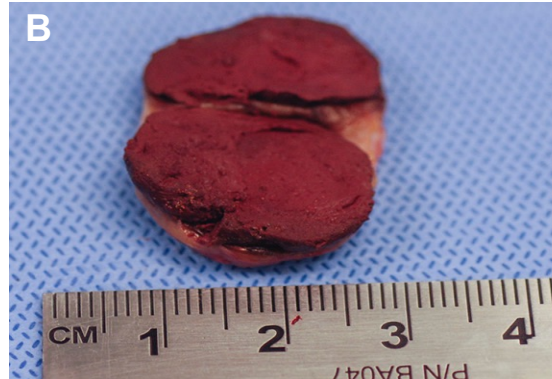
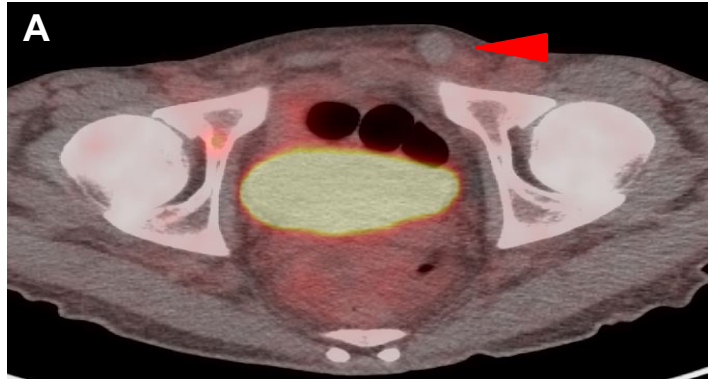
Rapid Autopsy Study



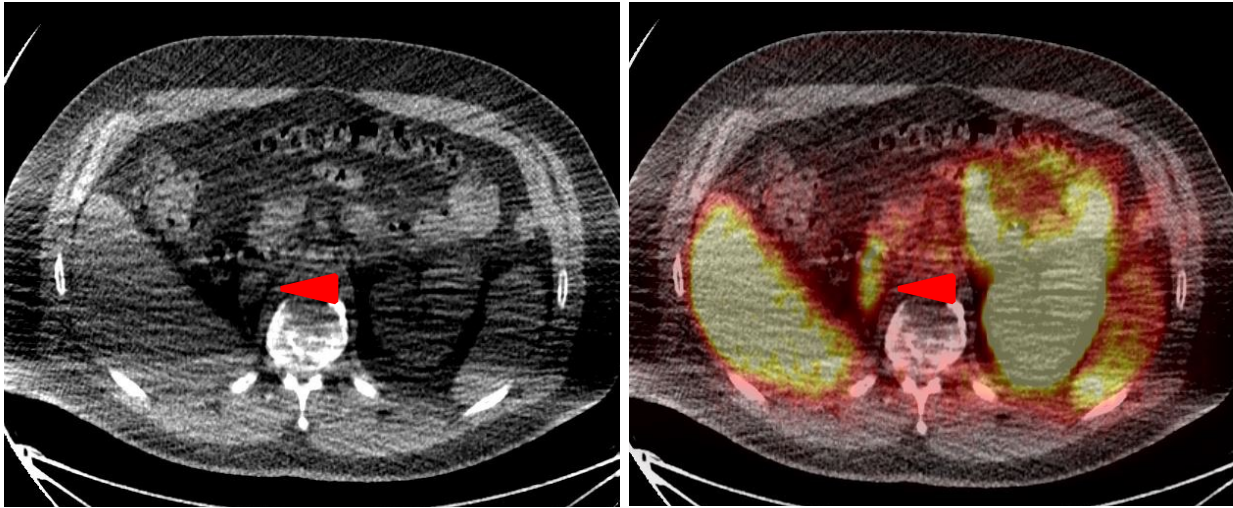
Rapid Autopsy Study



Rapid Autopsy Study

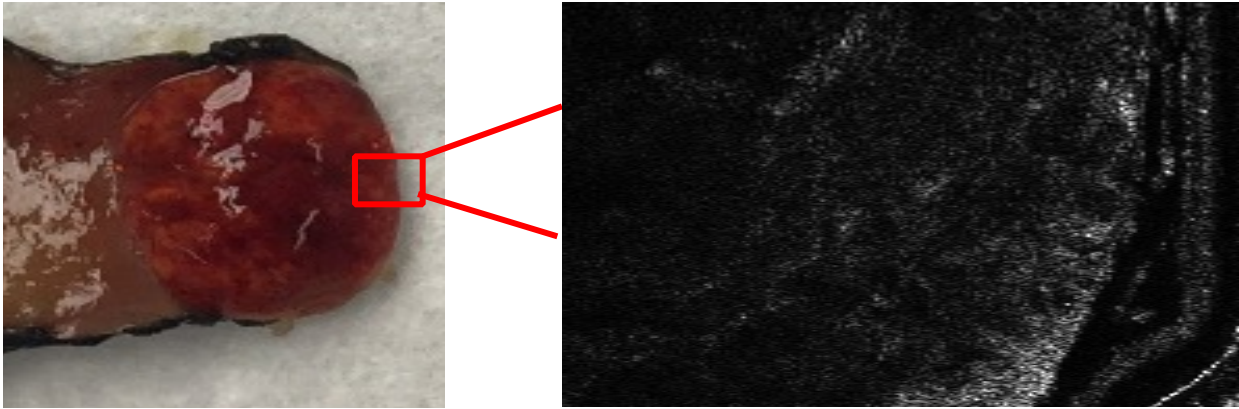


- Adrenal Lesion was FDG-PET negative BUT...
HOT ON PSMA PET



- Adrenal Tumor Resected: Clear-cell RCC, -SM

Renal Tumor was Sestamibi COLD



- Partial nephrectomy was performed
- Margin confirmed by OCT (a story for another day!)
- Final Pathology: ccRCC, ISUP2, R0

Our patient:

- Sestamibi cold renal tumor, PSMA hot adrenal lesion
- Final pathology: Clear cell ISUP 2 RCC, -SM (kidney), Clear cell RCC –SM (adrenal tumor).
- Cr=1.3 postop

Conclusions

- ^{99m}Tc -sestamibi SPECT/CT and CAIX based imaging are promising imaging modalities for renal tumors.
- PSMA based imaging is encouraging for comprehensive staging of advanced RCC.
- We do not need to biopsy the majority of tumors because radiographic biopsy is here!