



January 2006

A Multi-modal Approach to the Adrenal “Incidentaloma”

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What is an “adrenal incidentaloma”?

- Mass lesion in the adrenal gland serendipitously discovered by radiologic exam.
- Very common: 1-5% of all abdominal CT scans
- In patients with no known primary cancer: almost always benign adenomas.
- The adrenal gland is the 4th most common site of metastasis-- implications for oncology patients



Radiologic imaging plays a critical role in characterizing adrenal masses as benign or malignant.



Patient #1: JG

- Patient JG is a 57 year old woman with an adrenal mass incidentally found on non-contrast CT imaging for abdominal pain.



JG: Abdominal CT w/o Contrast

- 2.5 x 2.5cm mass in left adrenal gland
- Homogeneous attenuation
- Round and well circumscribed

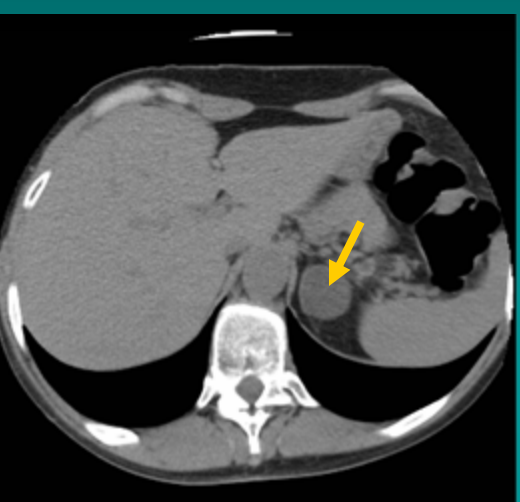


PACS, BIDMC



Differential Diagnosis

- Adrenal Adenoma
- Adrenal Metastasis
- Adrenal Carcinoma
- Pheochromocytoma
- Adrenal Cyst
- Infection (TB, Meningococci)
- Adrenal Myelolipoma



Patient JG: PACS, BIDMC



Step #1: Evaluating adrenal masses

Non-contrast CT:
Check Hounsfield Units

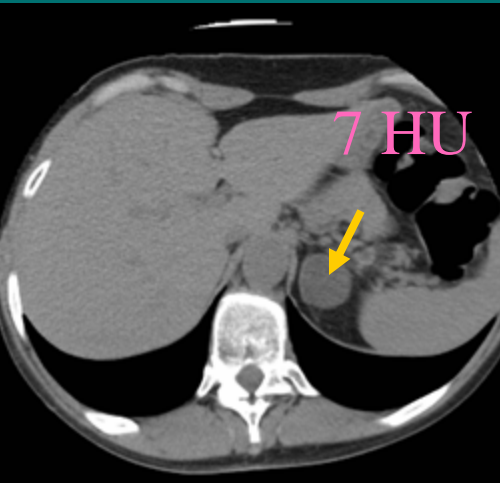
Less than
10 HU

BENIGN
ADENOMA



Greater than
10 HU

NEEDS FURTHER
WORKUP



Patient JG: PACS, BIDMC



Adrenal Adenomas

- Very common: 2-10% of autopsies involve a cortical adrenal adenoma
- Benign, with no malignant potential
- If non-functional, no need for intervention
- Typical radiographic characteristics:
 - Round and homogenous density
 - Well circumscribed
 - Diameter usually $< 4\text{cm}$
 - 70% have low ($<10\text{ HU}$) attenuation values

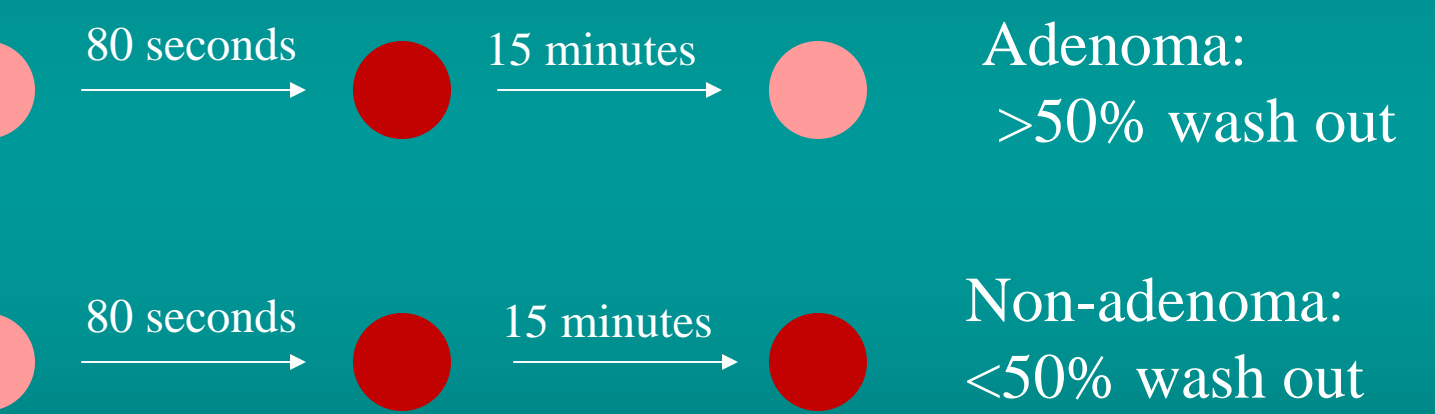


Does $>10\text{HU}$ = Malignant?

- Not necessarily!
- Up to 30% of adenomas do not contain sufficient lipid to have low attenuation at CT.
- Adrenal masses with $>10\text{HU}$ attenuation require further workup
- This can be done via two modalities:
 - Contrast “washout” on CT
 - Chemical Shift on MRI



Contrast-Enhanced CT with washout



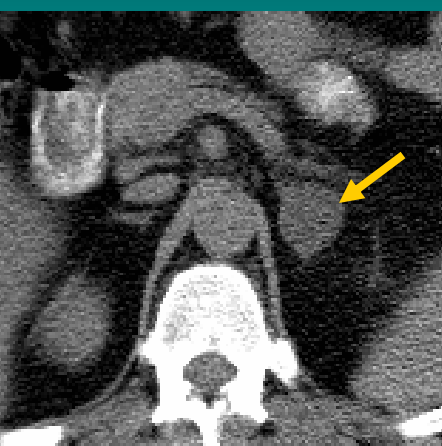


Patient #2: RS

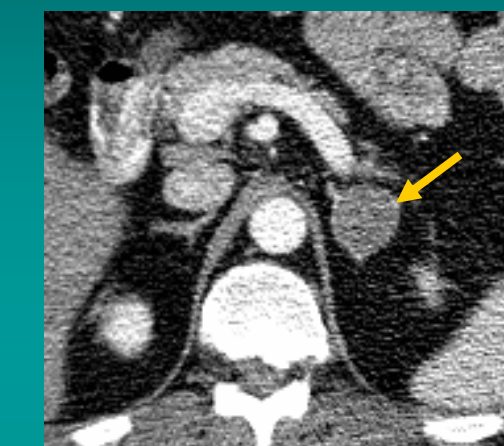
- 52 year old man with history of chronic abdominal pain
- Has history of “left adrenal mass, probably benign adenoma”



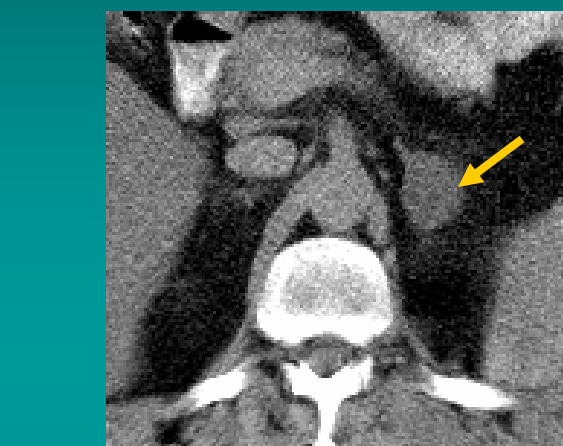
Percentage of washout: benign



Pre-contrast
7.4 HU



t=65sec
72 HU



t=15 min
20 HU

>50% washout = adenoma

Images from PACS, BIDMC

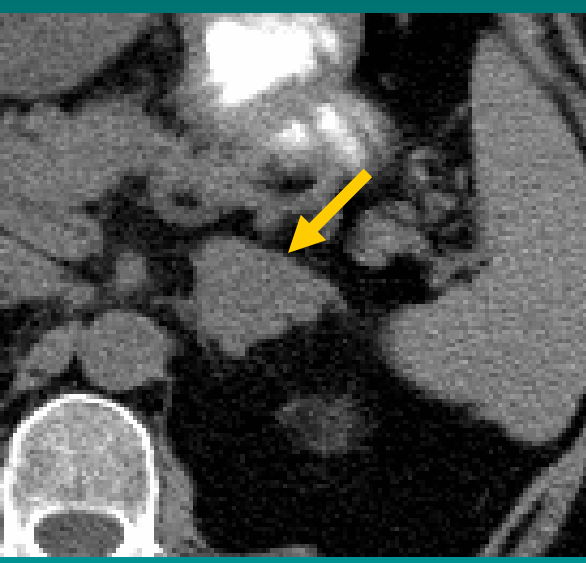


Patient #3: JI

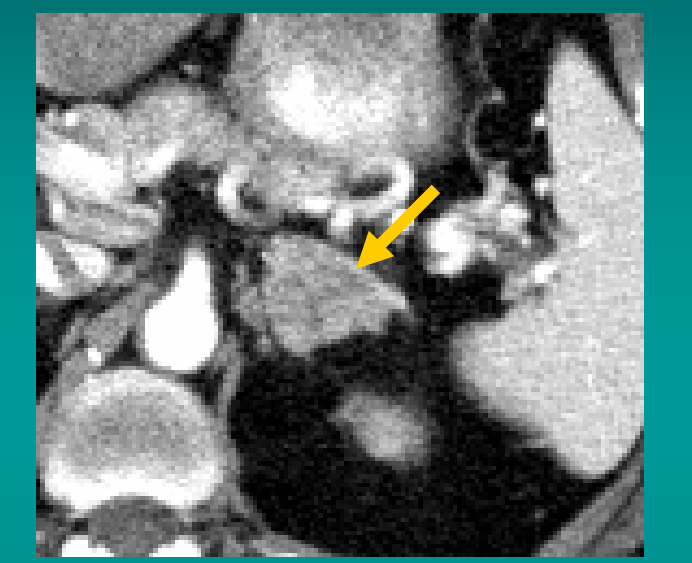
- 68 year-old woman with history of bilateral breast cancer
- Did well until 2004 when routine blood-work showed a rise in CEA
- Metastatic workup with CT was ordered



Percentage of washout: malignant



Pre-contrast



t=60 sec



t=15 minutes

<50% washout warranted biopsy, which revealed metastatic breast cancer.

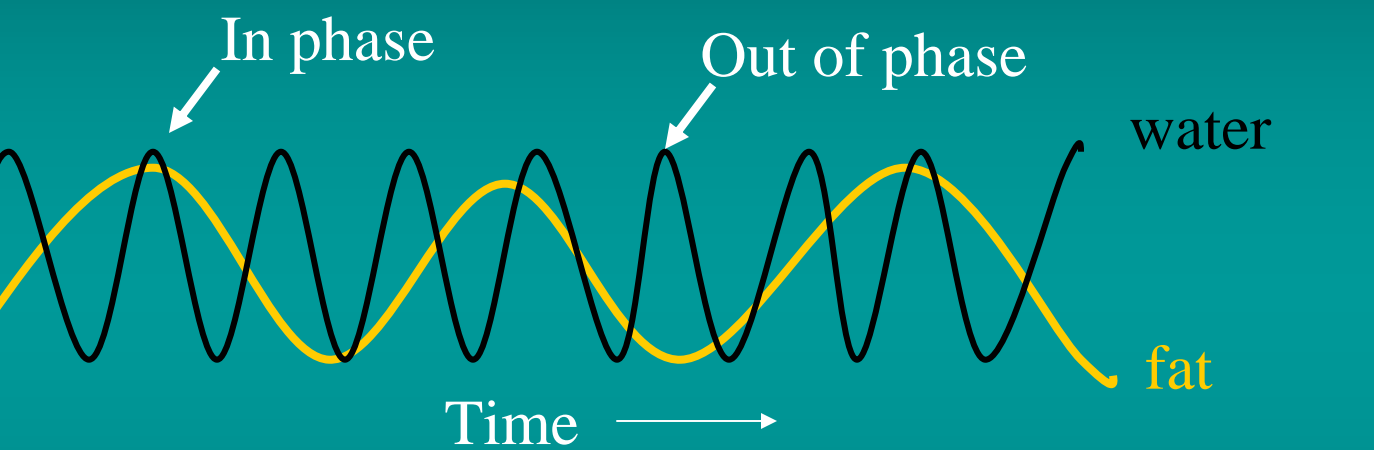


If CT is non-conclusive...

- **Chemical Shift Imaging**- an MR technique
- Relies on different resonance frequency rates of protons in fat and water molecules
- Most sensitive method for differentiating adenomas from metastases



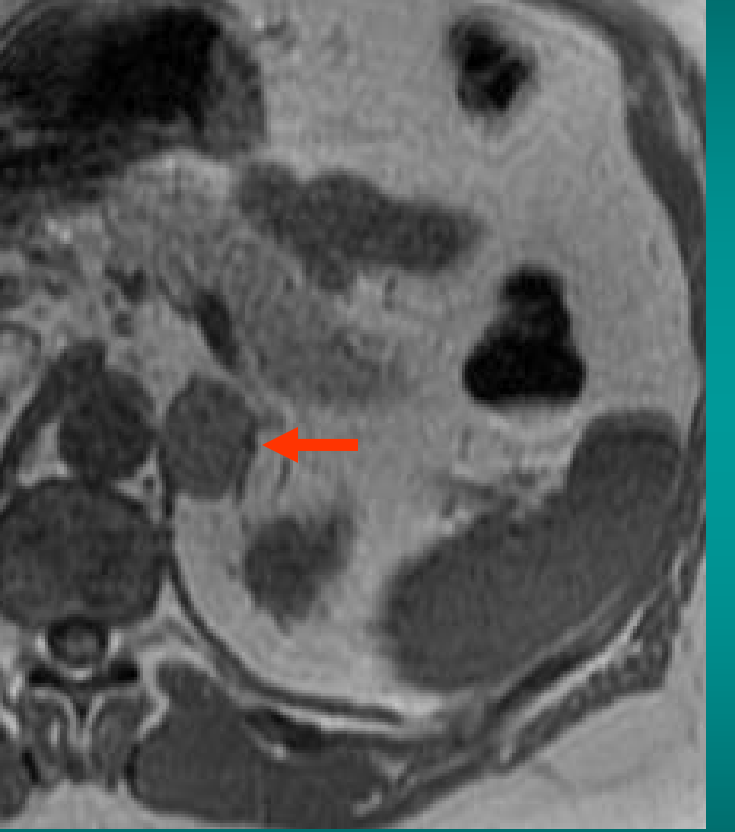
Chemical Shift Imaging



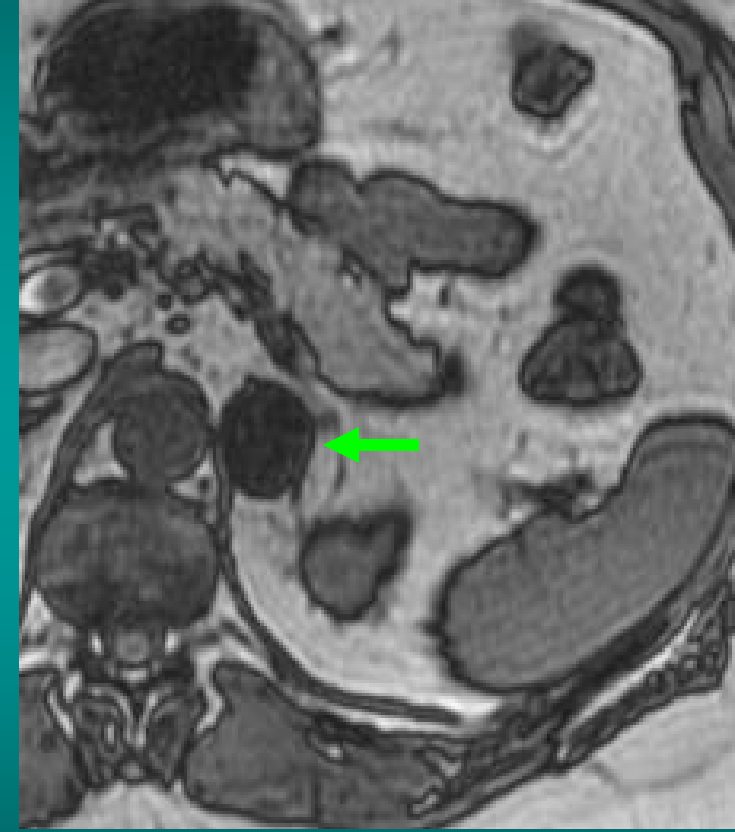
Tissue containing lipid and water have signal loss (appear darker) on out of phase images.



Adrenal adenoma



In-phase



Opposed-phase

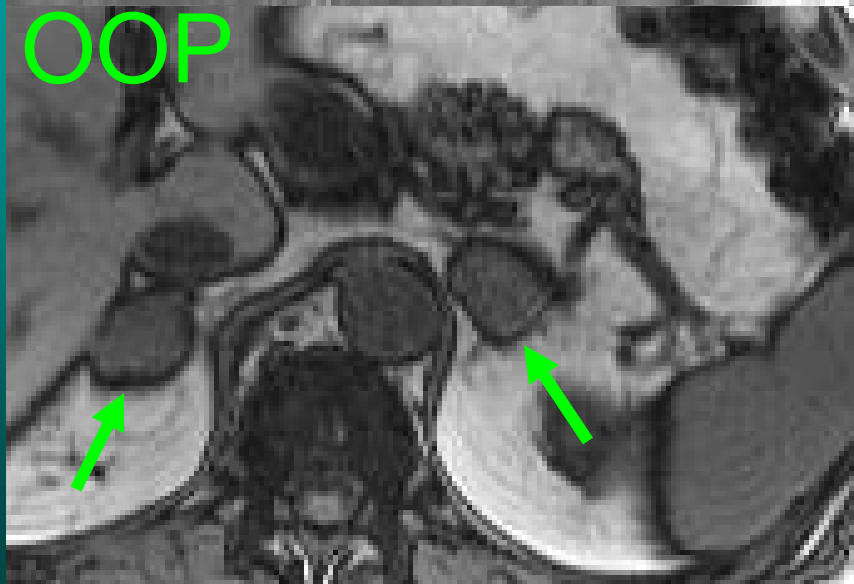


Patient#4: RR

- 74 year old man w/ history of esophageal carcinoma.
- Recent CABG complicated by sternal wound infection
- CT with contrast incidentally revealed prominence of both adrenal glands
- MRI for further evaluation



RR: Workup w/ chemical shift

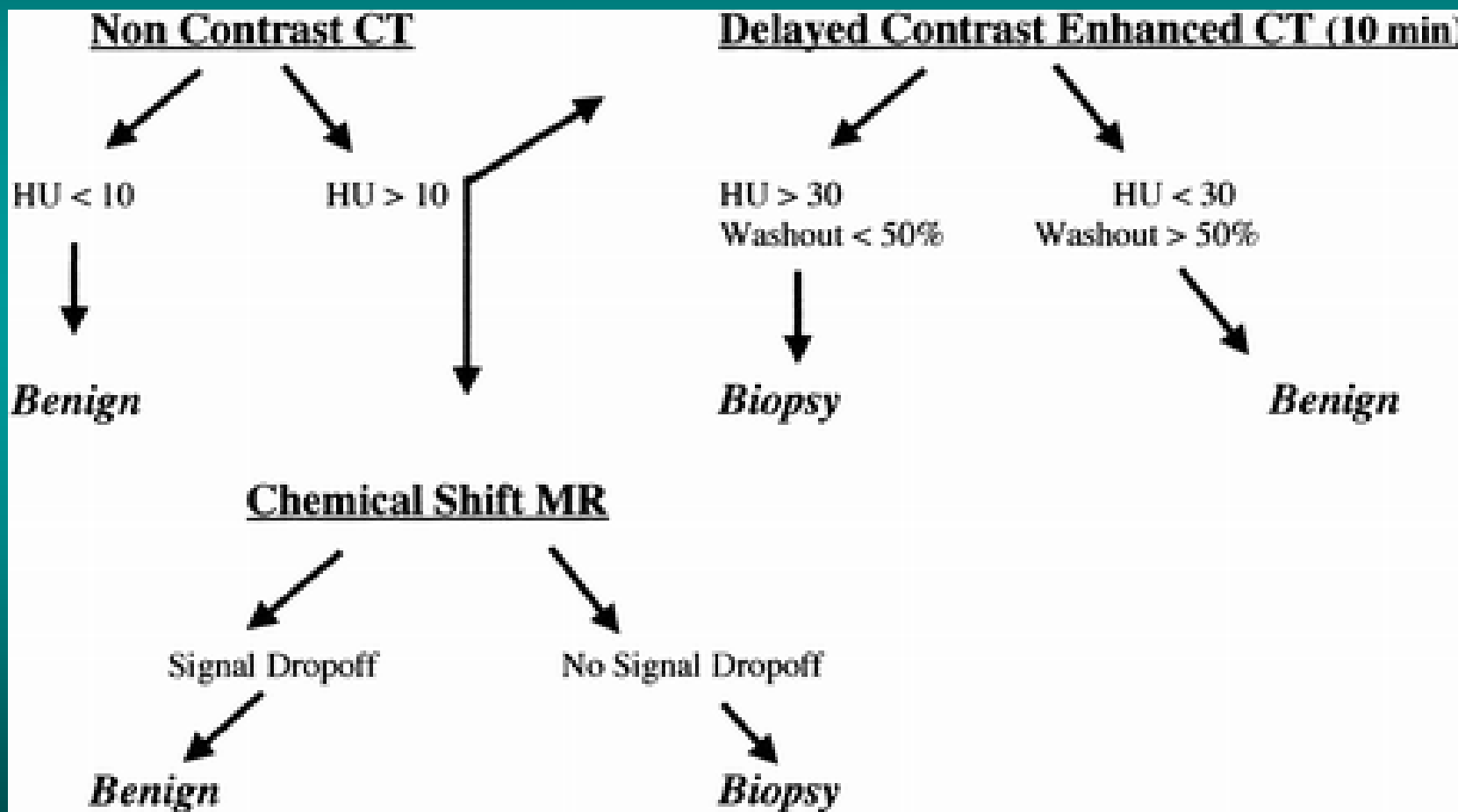


-Little signal drop-off
on out-of-phase image

-Adrenal biopsy revealed
esophageal adenocarcinoma

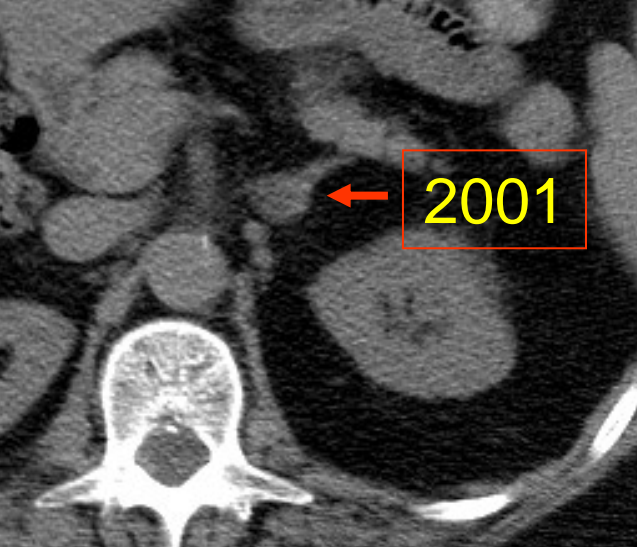


Algorithm for differentiating benign from “concerning” adrenal masses

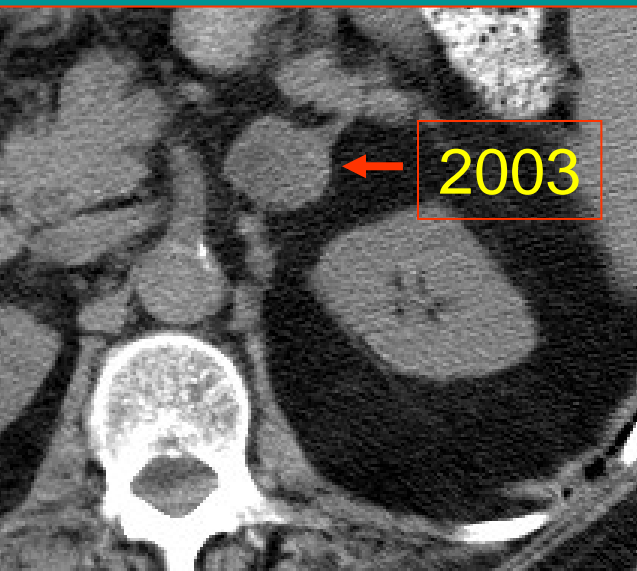




Limitations of the Algorithm



-MR is a 60 year old man with history of “adrenal adenoma” in 2001.



2003 lesion = 9HU

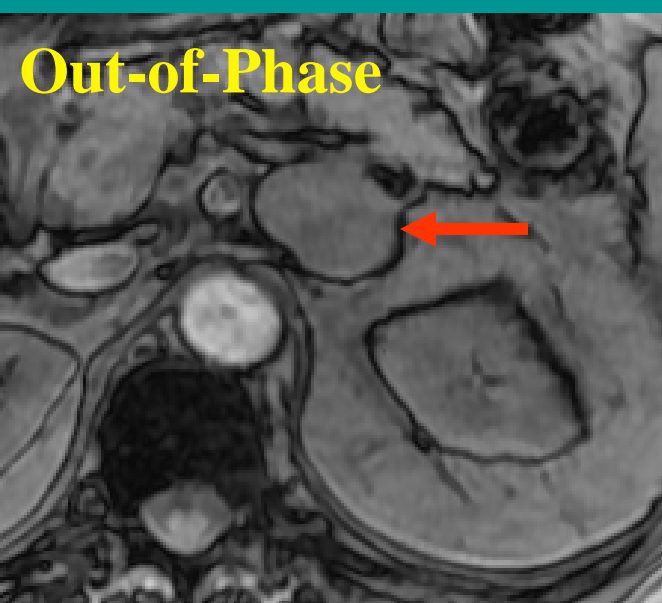
This was consistent with a benign lesion, but radiologist nonetheless recommended further characterization with MR given lesion’s rapid growth rate over 2 years



Adrenal Carcinoma



No signal drop-off on out-of-phase image



Biopsy revealed adrenal carcinoma

Lesson: algorithm must be complemented by good clinical judgment! Lesions with suspicious characteristics always warrant further work-up.



Pheochromocytoma

- Most pheos are not “incidental” findings...
- ...but some are: Mayo Clinic study of 150 patients diagnosed with pheo-- 15 were discovered incidentally on radiologic exam



Pheochromocytoma



Non-enhanced CT

- large tumors (often >3cm)
- heterogeneous attenuation
- +/-necrosis/hemorrhage



T2 weighted MRI

- highly intense on T2



Summary

- Adrenal masses are common incidental findings on abdominal CT
- Radiologist's key task is to assess whether an adrenal mass is benign or concerning for malignancy-- especially crucial in the oncology patient
- Algorithm for workup involves **contrast washout patterns on CT and chemical shift MR imaging**
- Algorithm should be used in conjunction with clinical judgment
- Pheochromocytomas may be incidental findings!



References

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Acknowledgments

- Darren Brennan, MD
- Ivan Pedrosa, MD
- Vassilios Raptopoulos, MD
- Jason Handwerker, MD
- Gillian Lieberman, MD
- Pamela Lepkowski
- Larry Barbaras, Webmaster