A Multi-modal Approach to the Adrenal “Incidentaloma”

Heather Morris, Harvard Medical School Year III
Gillian Lieberman, MD
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 < 4cm
  - 70% have low (<10 HU) attenuation values
Does >10HU = Malignant?

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

**Adenoma:**
- >50% wash out

**Non-adenoma:**
- <50% wash out
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.

Images from PACS, BIDMC
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  

Images courtesy of Dr. Pedrosa
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

Images courtesy of Dr. Pedrosa
Algorithm for differentiating benign from “concerning” adrenal masses

Non Contrast CT

- HU < 10
  - Benign

- HU > 10
  - Delayed Contrast Enhanced CT (10 min)
    - HU > 30
      - Washout < 50%
        - Biopsy
      - Washout > 50%
        - Benign
    - HU < 30
      - Benign

Delayed Contrast Enhanced CT (10 min)

- HU > 30
  - Washout < 50%
    - Biopsy
  - Washout > 50%
    - Benign

Chemical Shift MR

- Signal Dropoff
  - Benign
- No Signal Dropoff
  - Biopsy

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

In-Phase

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

Out-of-Phase

Biopsy revealed adrenal carcinoma

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

Images courtesy of Dr. Pedrosa
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

Source: Up-To-Date
Pheochromocytoma

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

T2 weighted MRI
- highly intense on T2

Images from Krishnan A, Shirkoda A.
http://www.emedicine.com/radio/topic552.htm
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


• Young WF, Kaplan NM. The Adrenal Incidentaloma. *Up-To-Date online* 2006.
Acknowledgments

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