A 69 Year-Old Woman with Abdominal Pain

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Patient Presentation

• HPI: 69 year-old woman with two months (3/05-5/05) of increasing fatigue and acute-on-chronic lower abdominal pain that radiated to her back
• PMH: Hypertension, Osteoporosis
• PE:
  – T 97.3-100F, HR 85, BP 132/80, RR 18, O2 Sat 97%
  – Mild diffuse abdominal tenderness, Non-distended, No guarding, No organomegaly or masses
• Labs:
  – WBC: 11.6 K/uL, Neutrophils 80%, No bands
  – HCT: 30.5%
  – Plt: 588 K/uL
  – ESR: 125 mm/hr
Initial Imaging Findings: Axial MRI

1. Soft tissue mass surrounding distal thoracic and proximal abdominal aorta:
   T2W bright soft tissue mass measuring approximately 1.3 cm in maximal axial thickness
2. Left Adrenal Lesion:
   A left adrenal mass measuring approximately 1.6cm is seen
Evaluation of Periaortic Mass

• Differential Diagnosis: Retroperitoneal Fibrosis v. Malignancy (Metastasis or Sarcoma)

• CT-guided biopsy X2: Non-diagnostic

• Discharged with plan for open biopsy electively for tissue diagnosis
Evaluation of Adrenal Incidentaloma

• Definition: mass lesion greater than 1 cm in diameter found on radiologic examination

• Prevalence:
  – Adrenal masses are present in up to 5% of abdominal CT scans
  – Prevalence increases with age
    • <1% for patients under 30
    • 7% for patients >70

Reviewed in Green and Woodward, 2005
Evaluation of Adrenal Incidentaloma

Two important questions:

1. Is it malignant?
2. Is it functioning?
Adenoma v. Malignancy

• Adenoma CT Findings
  – Most contain large amount of lipid
  – Most enhance after IV contrast but tend to lose contrast quickly

• Metastasis CT Findings
  – Small lesion are often homogenous
  – Large lesions are often heterogeneous due to necrosis or hemorrhage

• Adrenal Carcinoma CT Findings
  – Large mass with central necrosis
  – 20-30% have calcification
CT Findings Indicative of Adenoma

Non-Contrast Abdominal CT
- 10 Hounsfield Unit Cutoff: 40.5% sensitive and 100% specific for adenoma
- 20 Hounsfield Unit Cutoff: 58.2% sensitive and 96.9% specific for adenoma

Lipid-rich adenoma:
Unenhanced CT shows attenuation value of –4 HU, allowing confidence that this is a benign lesion

Hamrahian et. al, 2005
Dunnick and Korobkin, 2002
CT Findings Indicative of Adenoma

• Measuring Contrast Washout
  
  – Principle:
    • Most adenomas lose contrast quickly while metastases do not
    • Lipid poor adenomas (>10 HU) have enhancement features nearly identical to lipid-rich adenomas
  
  – Method:
    • Give IV bolus → Image at 60 seconds → Image at 15 minutes
CT Findings Indicative of Adenoma

• Measuring Contrast Washout

  – Percentage of Relative Washout = [(E-D)/(E)] X 100
    • E: Enhanced attenuation value at 60 seconds
    • D: Delayed attenuation value at 15 minutes

  – In one department, >40% washout is 96% sensitive and 100% specific for an adrenal adenoma (University of Michigan)

  – At BIDMC, we use >50% washout as indicative of adenoma

Dunnick and Korobkin, 2002
MR Findings Indicative of Adenoma

• Chemical Shift
  – Principle: Takes advantage of different resonant frequency peaks for hydrogen atoms in water and in lipid molecules
    • “In-phase”: Protons of water and lipid are aligned
    • “Out-of-phase”: Protons of water and lipid are opposite
  – Adenomas contain approximately equal amounts of lipid and water
    • Signal intensity loss on opposed phase images compared with in-phase images is often present in adenomas
MR Findings Indicative of Adenoma

Quantitative values use adrenal-spleen ratio
- Adrenal-spleen ratio = \[\frac{(\text{SI}_\text{o\text{-Adrenal}}/\text{SI}_\text{o\text{-Spleen}})/(\text{SI}_\text{i\text{-Adrenal}}/\text{SI}_\text{i\text{-Spleen}}) - 1}{1} \times 100\]
  - SI\text{o}: signal intensity on out-of-phase images
  - SI\text{i}: signal intensity on in-phase images
- With -25 as a threshold, 100% sensitivity and 82% specificity for identifying metastases (Mass General Hospital)

Mayo-Smith et al, 1995
Is Adrenal Incidentaloma Functional?

• Screen all adrenal incidentalomas for subclinical Cushing’s and Pheochromocytoma unless characteristic appearance of cyst or myolipoma

• If hypertensive, measure serum potassium and ALDO/Renin ratio

Grumbach et. al, 2003
Back to Our Patient: CT without Contrast

Size: 1.8cm
Attenuation: 17.8 +/- 13.0 HU

Mass does not meet cutoff for adenoma of <10 HU (Hamrahian et. al, 2005)
Back to Our Patient: CT Washout Study

Enhanced Attenuation Value
60 seconds after contrast:
75.1 +/- 15.6 HU
15 Minute CT Washout Study

Delayed Enhancement Attenuation Value 15 minutes after contrast: 59 +/- 13.4 HU
CT Washout Study

- Percentage of Relative Washout = \( [(E-D)/E] \times 100 \)

- \( [(75.1-59.0)/79.1] \times 100 = 21.4\% \)

- Patient does not meet criteria for adenoma based on relative washout value of >40%
MR Chemical Shift

Signal Intensity in-phase adrenal: 646.3 +/- 29

Signal Intensity in-phase spleen: 594.7 +/- 48.3
MR Chemical Shift

Signal Intensity out-of-phase adrenal: 480 +/- 34.8
Signal Intensity out-of-phase spleen: 486 +/- 45.7

PACS, BIDMC 20
MR Chemical Shift

- Adrenal-spleen ratio = \[
\frac{(SioAdrenal/SioSpleen)}{(SiiAdrenal/SiSpleen)} - 1\] \times 100

- \[
\frac{(480/486)}{(646/594)} - 1\] \times 100 = -9.2

- Patient does not meet criteria for adenoma based on value of < -25

Mayo-Smith et. al, 1995
Evaluation of Function

- Dexamethasone Suppression Test: Equivocal but considered consistent with stressed state

- Plasma and urine metanephrines with normal limits
Evaluation of Adrenal Incidentaloma

Myelolipoma or Cyst

- Stop

* Myelolipomas and cyst have characteristic radiographic appearances.

1. 25% of lesions >6cm are adrenal carcinomas (Grumbach et al, 2003).

F Functional tumors should be removed.

**The 10 HU cutoff on non-contrast abdominal CT should also consider the standard deviation of the attenuation value.

!! MR chemical shift should be used if there is a contraindication to contrast.

- Remove

>4 cm - 6 cm

- Dex Suppression Test
- Plasma and/or Urine Metanephrines
- ALDO and Renin if hypertensive

<10 HU

- No h/o malignancy
- Low clinical suspicion

>10 HU or high clinical suspicion or history of malignancy

Washout CT MR Chemical Shift

Stop

Adenoma FNA Biopsy Adenoma
Back to Our Patient

• Discharged on 5/26 with plan for elective open biopsy of aortic soft tissue mass and left adrenal

• Presented to ED on 5/27 with severe abdominal pain
  – Discharged with prescription for more oxycodone

• Spoke with Hospitalist staff for direct admission for continued abdominal pain on 6/01

• Repeat CTA of abdomen on 6/03
Reconstructions of Abdominal CTAs

5/18/05

- New aneurysmal dilatation and penetrating ulceration within distal thoracic and proximal abdominal aorta
  - 5/18: 3.1 cm transverse and 2.9 cm anterior-posterior
  - 6/3: 4.1 cm transverse and 3.4 cm anterior-posterior

6/3/05

PACS, BIDMC
Patient Hospital Course

- 6/3: Radiographic differential is aortitis and/or inflammatory aneurysm
- 6/4: ID consult feels aneurysm is unlikely to be infectious
  - Do not recommend starting antibiotics
- 6/7: Addendum to radiology report
  - Mycotic aneurysm is added to differential
- 6/7: Vascular surgery recommends LN biopsy by thoracic surgery
- 6/9: Peri-aortic biopsy by thoracic surgery
  - Pathology shows fibrovascular tissue with acute and chronic inflammation
Patient Hospital Course

- **6/13**: Open thoracoabdominal aneurysm repair with re-implantation of SMA, celiac, and left renal artery
  - Tissue gram stain shows gram-positive cocci
  - Tissue culture grows *Streptococcus pneumoniae*
- **6/27**: CTA of abdomen indicates that aneurysm has spread into celiac trunk, SMA, and left renal artery
  - Complete infarction of the left kidney, the spleen, multiple areas in both lobes of the liver as well as loops of small bowel
- **6/28**: Splenectomy, cholecystectomy, and left lateral segmentectomy of liver
- **7/7**: Resection of left kidney, left adrenal gland, and resection of infected aortic graft
- **7/13**: Made CMO and expired shortly thereafter
  - Post-mortem was declined
Mycotic Aneurysms

• Definition: localized, irreversible dilatation of an artery to at least one and one-half times its normal diameter due to destruction of a vessel wall by infection

• Infected aortic aneurysms are rare: 0.7% of all aneurysms

• Clinical diagnosis is difficult:
  – PE: Painful abdomen and non-specific systemic features of infection
  – Labs: Increased ESR, WBC, and anemia. Only 50% of blood cultures are positive

• Imaging findings: Saccular aneurysms with rapid expansion, stranding, and/or fluid in an unusual location

Oderich et. al, 2001
Macedo et. al, 2004
Summary

• Adrenal Incidentalomas are common
  – Can be evaluated with Washout CT or Chemical Shift MR

• Mycotic aneurysm are rare
  – Diagnosis you do not want to miss
  – Clinical findings are non-specific but imaging can help especially if an expanding aneurysm is seen
References

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