ADRENAL INCIDENTALOMA

BLAKE TYRRELL MD
MARCH 2016
Case

- 74 yo ♀ noted to have an incidental right adrenal mass 4/2007
  - on CT for pyelonephritis

- 4.4 cm, low density (5 HU on noncontrast CT)

- In retrospect, a similarly sized lesion was also noted in 2000

- “These findings suggest a benign adenoma”
ADRENAL INCIDENTALOMA (AIO)

QUESTIONS

• Definition
• Prevalence?
• Age-related prevalence?
• Is the lesion malignant?
• Is the lesion functional?
• Indications for surgery
AIO: ABREVIATIONS

- Pheo-pheochromocytoma
- ACC-adrenocortical carcinoma
- CS/SCS-Cushing’s syndrome/subclinical Cushing’s syndrome
- APA-aldosterone-producing adenoma
- NF-non-functional
- PAC-plasma aldosterone concentration
- PRA-plasma renin activity
- DST-dexamethasone suppression test
- CRH-corticotropin-releasing hormone

AIO*

- Definition
  - Adrenal mass ≥1cm in diameter
- Prevalence Percent
  - In 87,065 Autopsies 5.9%
  - In 79,915 CT scans (1980’s) 0.9%
- Age-related prevalence
  - 20-29 years 0.2%
  - >70 years 6.9%

*Endo Metab Clin NA 29:159,2000
AIO

- Prevalence with more recent CT scans
  - Herrera et al, 1991-2066/61,054=3.4%
  - Bovio et al, 2006—23/520=4.4% **

*Surgery 110:1014,1991,
** J Endocrinol Invest 29:298,2006

<table>
<thead>
<tr>
<th></th>
<th>Functional</th>
<th>Non functional</th>
<th>Others</th>
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<tbody>
<tr>
<td><strong>Benign</strong></td>
<td>Adenoma Cortisol</td>
<td>Adenoma</td>
<td>Adrenal Ca</td>
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<tr>
<td></td>
<td>Cortisol</td>
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<td>Adrenal Ca</td>
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<tr>
<td></td>
<td>Aldosterone</td>
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<td>Granuloma</td>
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<td>Adenoma</td>
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<td>Sarcoidosis</td>
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<td></td>
<td>Pheo</td>
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<td>Adrenal Ca</td>
<td>Adrenal Ca</td>
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<tr>
<td></td>
<td>Adrenal Ca</td>
<td>Mets/Lymphema</td>
<td>Malignant Adrenal Ca</td>
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<td></td>
<td>Adrenal Ca</td>
<td>Neuroblastoma</td>
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<tr>
<td></td>
<td>Adrenal Ca</td>
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<td>Malignant Adrenal Ca</td>
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</table>

*From C Liu MD
AIO:TUMOR TYPES*

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pheo</td>
<td>5.1</td>
</tr>
<tr>
<td>ACC</td>
<td>4.7</td>
</tr>
<tr>
<td>CS/SCS</td>
<td>5.3</td>
</tr>
<tr>
<td>APA</td>
<td>1.0</td>
</tr>
<tr>
<td>Mets</td>
<td>2.5</td>
</tr>
<tr>
<td>Presumed NF adenoma</td>
<td>82.4</td>
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*Endo Metab CI NA 29:159,2000-review of 13 studies, 2005 pts

AIO:ATYPICAL SERIES

<table>
<thead>
<tr>
<th>Study</th>
<th>N*</th>
<th>Percent</th>
</tr>
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<tbody>
<tr>
<td>Barzon et al**</td>
<td>65/202</td>
<td>32</td>
</tr>
<tr>
<td>Kasperlik-Zaluska et al***</td>
<td>62/208</td>
<td>30</td>
</tr>
</tbody>
</table>

*Pts with clinically significant lesions (Pheo, ACC, CS/SCS, APA, Mets)

**JCEM 83:55, 1998

***Clin Endocrinol 46:29, 1997
AIO: TUMOR TYPES(%)  

<table>
<thead>
<tr>
<th>REVIEW*</th>
<th>MAYO**</th>
<th>SWEDEN***</th>
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<tbody>
<tr>
<td>Pheo</td>
<td>3.1</td>
<td>1.5</td>
</tr>
<tr>
<td>ACC</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>CS/SCS</td>
<td>6.4</td>
<td>0.6</td>
</tr>
<tr>
<td>APA</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Mets</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Presumed NF</td>
<td>89.9</td>
<td>96.5</td>
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</tbody>
</table>


AIO: IMAGING PHENOTYPE*  

** BENIGN**  
- Round to oval & <3cm  
- Smooth margins  
- Homogeneous  
- NECT density <10 HU  
- MRI: isointense vs liver  

** SUSPICIOUS**  
- Irregular & >4cm  
- Indistinct margins  
- Heterogeneous with necrosis, hemorrhage or calcification  
- NECT density > 10 HU and especially if >40 HU  
- MRI: hyperintense vs liver  

* Adapted from EndoMetab Cl NA 29:159,2000

**For Pheo, ACC or Mets**
Imaging Phenotype:
CT Characterization of Adrenal Masses*

**HU (Hounsfield Unit)**

- **Density measurement by CT**
  - Water 0 HU; Fat -100HU, Air -1000HU

- **Adenomas:**
  - higher intracytoplasmic fat = lower HU
  - *AJR 171:201,1998*

CT Characterization of Adrenal Masses
HU (Hounsfield Unit)*

- **On non-enhanced CT: cutoff \(<\ 10\ HU\)** differentiates adenomas from non-adenomas
  - Sensitivity 71%
  - Specificity 98%
  - *AJR 171:201,1998*
Normal adrenal glands

- Fixed relationship to vessels:
  - Right lies posterior to the IVC
  - Left lies posterior to the splenic vessels

- No strict criteria for mass/enlargement:
  - Contour deformity
  - Limb thickening greater than 7-10 mm
CT Characterization of Adrenal Masses
HU (Hounsfield Unit)*

- On non-enhanced CT: cutoff $< 10$ HU differentiates adenomas from non-adenomas
  - Sensitivity 71%
  - Specificity 98%

*AJR 171:201,1998
CT Characterization of Adrenal Masses
Washout On Enhanced CT *

- Lesions > 10HU on unenhanced CT
  - 10-40% are ‘lipid poor’ adenomas

- > 50% washout at 10 min delayed imaging is C/W a lipid poor adenoma

*Radiology 234:479,2005

CT characterization of adenomas

Non-enhanced
Contrast-enhanced
Delayed

10 HU
65 HU
25 HU

< 18 HU
85% sens
100% spec

< 52 HU at 10 min
92% sens
95% spec

AJR 1998; 170: 747-752
AJR 1996; 166: 531-536
Radiology 1998; 207: 369-375

Distinguishable by density in non-enhanced and delayed phases
Pheochromocytomas can washout

- Two series of 31 and 9 PHEO'S:
  - Mean NECT density = 41 HU (range, 19-58)
  - Washout > 60% in 14 (45%)
  - Mean NECT density = 34 HU (range, 9-42; 1 < 18)
  - DECT done in 4; washout > 60% in 1 (25%)

- Two series of 11 and 7 ACCs:
  - None mimicked adenoma at NECT or DECT


MRI characterization of adenomas

- Clear signal loss on out of phase gradient echo MRI:
  - MICROSCOPIC fat sensitive sequence
  - Visual assessment is sufficient

AJR 1995; 165: 91-5
Radiology 1995; 197: 421-5
Three different patients
Variable appearance – clinical correlation is critical

“Light bulb” bright on T2 - sometimes!
Internal hemorrhage and cyst formation - common
Hyperintense on T2 image
Adrenocortical carcinoma

- 1 per million per year

- Imaging findings:
  - large (> 5 cm), irregular
  - Venous invasion common
  - +/- Necrosis, calcification

- Frequently metastatic at diagnosis

CT of adrenal metastasis

NECT  CECT

50 HU
### PET of adrenal metastasis

<table>
<thead>
<tr>
<th>Description</th>
<th>Sens</th>
<th>Spec</th>
<th>Acc</th>
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</thead>
<tbody>
<tr>
<td>PET of 113 adrenal masses in 94 lung cancer patients</td>
<td>93%</td>
<td>90%</td>
<td>92%</td>
</tr>
<tr>
<td>PET/CT of 41 adrenal masses in 38 patients with known or suspected cancer</td>
<td>100%</td>
<td>94%</td>
<td>95%</td>
</tr>
</tbody>
</table>

- Misleading results rare but possible:
  - False -ve: Small, hemorrhagic, or necrotic mets
  - False +ve: Adenoma and myelolipoma

*UPenn - J Nucl Med 2004; 45: 2058-62
MGH - Radiology 2006; 238: 970-7*

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### Unsuspected pheochromocytoma

*64 year old man – staging PET and CT for lung cancer showing presumed adrenal metastasis
Adrenalectomy demonstrated Pheo!
76% (22/29) of PCCs are FDG avid
Radiology 1999; 212: 35-41*
Cyst mimicking adenoma

NECT

Density = 11 HU

Cyst mimicking adenoma

CECT

Density = 12 HU
Adrenal myelolipoma

- Fat and bone marrow ("myelo") elements
- 1-2 per 1000 autopsies
- Sporadic, idiopathic, and benign
- **MACROSCOPIC** fat is virtually diagnostic:
  - Case reports in adenoma and carcinoma
Adrenal myelolipoma

- Fat and bone marrow ("myelo") elements
- 1-2 per 1000 autopsies
- Sporadic, idiopathic, and benign
- **MACROSCOPIC** fat is virtually diagnostic
  - Case reports in adenoma and carcinoma

Adrenal cyst

*Simple: Benign endothelial cyst*

*Complex: Hemorrhagic pseudocyst*
Hemorrhagic adrenal pseudocyst

AIO: QUESTIONS

- Is the lesion malignant?
- Is the lesion functional?
AIO: PREDICTORS OF MALIGNANCY

- Size >4cm ~25% malignant, however, if lesion 4-6cm <10% malignant*
- Imaging phenotype—if suspicious consider Pheo, ACC or mets
- Prior/current malignancy—chance of metastasis is ~50%** (Range 32-70%---if lesion >3cm, chance of metastasis is 43-100%***)
- Chance that AIO is a metastasis from an occult primary cancer---4/1639=0.2%****(all lesions>6cm and bilateral in 3)

*JCEM 85:637,2000,**Surgery 130:1060,2001,

AIO: PRIOR MALIGNANCY STRATEGY

- R/O Pheo
- Procedure
  - Disseminated disease - None
  - Solitary adrenal lesion - Consider FNA*
  - Bilateral adrenal lesions - R/O Addison’s

*R/O Pheo. This is the only role for FNA
**If staging otherwise negative
AIO: QUESTIONS
NO PRIOR MALIGNANCY

• Is the lesion functional?
• Evaluate for
  • Pheo
  • CS/SCS
  • APA (if hypertensive)

PHEO STRATEGY

• Do not measure VMA, plasma catechols or spot urines
• Use specific methods—interference is assay specific.
  EG—for metanenephines LCMSMS*<RIA
  <HPLC<spectrophotometry

*Acetominophen, desipramine, ephedrine and catechols do not interfere
PHEO
RECOMMENDED TESTS

• 24 HR urine for fractionated catechols* and metanephrines** in the same collection
  OR
• Fractionated plasma metanephrines**

*LC-ECD @UCSF
**LCMSMS@UCSF
# PHEO:DX

## URINE ASSAYS*

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<tr>
<th>Year</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>1978-1996</td>
<td>98%</td>
<td>98%</td>
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<tr>
<td>2003-2004</td>
<td>90-92%</td>
<td>98%</td>
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</tbody>
</table>

- Mets (LCMSMS)
  - 2007: 97% 91%

Clin Endo 66:703,2007

## NIH*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sensitivity</th>
<th>Specificity</th>
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</thead>
<tbody>
<tr>
<td>Plasma mets**</td>
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<td>89 (82-96)</td>
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<tr>
<td>Urine mets**</td>
<td>97</td>
<td>69</td>
</tr>
<tr>
<td>Urine catechols**</td>
<td>86</td>
<td>88</td>
</tr>
<tr>
<td>Plasma catechols**</td>
<td>84</td>
<td>81</td>
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<tr>
<td>U total mets***</td>
<td>77</td>
<td>93</td>
</tr>
<tr>
<td>VMA***</td>
<td>64</td>
<td>95</td>
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</table>

*JAMA 287:1427,2002—(N=858, PHEO=214, Fasting, IV, Supine)
** LC-ECD  ***Spectrophotometry
**PHEO:DX**

- **PLASMA METS***
  - NIH **
    - SENS 99% SPEC 89%(82-96)
  - Mayo Clinic***
    - All ages 96-98% 84-85%
    - Age adjusted 100% 97%

*By LC-ECD  **JAMA 287:1427,2002
*** JCEM 88:553,2003 / 89:2859,2004
BMC Endo Disorders 4:2,2004 / 5:1,2005

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**PHEO DX**

**PLASMA METS**

- **LC-ECD***
  - SENS 98%(391/399) SPEC 96%(2286/2456)
  - Range 95-100% 85-100%

- **LCMSMS***
  - SENS 100% SPEC 96%

*Adapted from JCEM 99:1915,2014(7studies)
**Clin Chemica Acta 411:546,2010
(N=151,PHEO 38, Fasting, Sitting)
### PHEO:DX STRATEGY

- **PLASMA METS**
  - Measure in AM, fasting and sitting for 15 min: supine with IV for 30 min is not practical
  - LCMSMS appears to be the best assay
  - If using LC-ECD-- D/C OTC (especially acetaminophen and decongestants) and unnecessary meds and use in pts < age 60
  - A normal result effectively rules out PHEO*

- **URINE METS/CATECHOLS**
  - D/C OTC meds, tricyclic antidepressants
  - A normal result makes Pheo very unlikely

*J Hypertension 25:1427,2007 (N=1260,Sens 100%,Spec 96.7%, Negative predictive value 100%)

### PRIMARY HYPERALDOSTERONISM

- Hypertensive population
  - 5-8% of all hypertensives have primary hyperaldo (60-70% hyperplasia, 30-40% APA)
  - Most are not hypokalemic

- AIO
  - 0-1%
  - Most are not hypokalemic
APA EVALUATION*

- Evaluate if hypertensive
- D/C spironolactone and eplerenone
- Measure PAC (ng/ml) by LCMSMS
- Measure PRA by IRMA or ICMA assay with a lower limit of detection of 0.1 ng/ml/hr
- Calculate ARR (aldo/renin ratio)
- CRITERIA--PAC>15-18
  --PRA subnormal to suppressed
  --ARR>20-30

*JCEM 93:3266,2008

APA:
Your lab can misinterpret the results for you

- PAC-8ng/ml
- PRA-0.2ng/ml/hr
- ARR-40
APA CONFIRMATION*

• Oral NaCl 2gm tid for 3d: measure 24-hr aldosterone and sodium on 3rd day
  Positive result--Urine aldosterone > 10-12mcg/24hr with urine NA >200meq
OR

• IV NS at 500ml/hr x 4hr: measure PAC at end of 4hr
  Positive result—PAC >10 ng/ml
  *JCEM 93:3266, 2008

SCS

Greetings Ms Smith,

• The good news is that the CT scan did not reveal a reason for your abdominal pain, nausea and diarrhea.
• However, the bad news is that we found a golf ball sized tumor in your left adrenal gland.
• We will now proceed to measure some stress responsive adrenal hormones and refer you to a surgeon.
SCS

• Definition
  – Autonomous cortisol secretion in a pt with an AIO

• Prevalence
  – Overt CS in <1% of AIO
  – SCS reported in 0.6 –>25% of AIO*

• Features
  – Not cushingoid
  – Obesity, HTN and DM in 25-75%
  – Adenomas usually >3 cm

• Risk
  – Potential complications of obesity, HTN, DM and osteoporosis
  – Post-op adrenal crises

*Clin Endocrinol 48:627,1998 –in this study 31/57(54%) had abnormal responses to a DST

SCS

ENDOCRINE ABNORMALITIES

• Abnormal DST-1MG vs 3MG vs 8mg vs 2-day LDDST: normal response of cortisol defined as <1.8, <2.5, <3 or <5 mcg/dL--???

• 24 hr urine cortisol normal to elevated*

• Abnormal DV with elevated midnight cortisol or late night salivary cortisol*

• Low or suppressed plasma ACTH (IRMA or ICMA assay)

• Subnormal DHEA-S level

• Subnormal ACTH response to CRH

• BEST 2 OUT OF THREE???

*These may be abnormal with stress ie “Pseudocushings”
SCS: ADRENAL INSUFFICIENCY (AI) AFTER UNILATERAL ADRENALECTOMY*

- **Evaluation**
  - DST 1,3 or 4mg doses. Criteria for normal response – N=8

- **Results**
  - 91.3% of pts with abnormal DST plus 2 other abnormal tests had post-op AI (Best tests appear to be low ACTH and elevated midnight serum cortisol).
  - However, only 12% (23/197) met these criteria


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SCS EVALUATION

- No clearly defined guidelines or criteria for evaluation or surgery
- **POSSIBLE STRATEGY**
  - Baseline 8 AM cortisol and ACTH (IRMA OR ICMA assay)
  - Overnight 1mg DST

- **Interpretation**
  - If post DST cortisol < 1.8mcg/dl and ACTH > 5pg/ml – no further W/U required
  - If post DST cortisol > 5mcg/dl and ACTH < 5pg/ml – DX is established. Confirm with urine cortisol or late night salivary cortisol
  - Multiple other possible results – evaluate further or follow?
AIO
MORE QUESTIONS

- Indications for surgery
- How to F/U non-surgical pts
  - Risk of developing malignancy or hyperfunction

AIO:INDICATIONS FOR SURGERY

- Clearly proven function
- Size >4cm if not clearly an adenoma or other benign lesion eg myelolipoma
- Suspicious imaging phenotype
- (Prior malignancy ??-if staging otherwise negative??)
Incidentaloma – guidelines for F/U

<table>
<thead>
<tr>
<th>Publication</th>
<th>Hormonal tests</th>
<th>Frequency</th>
<th>Duration (years)</th>
<th>Imaging</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIH Consensus statement 2002</td>
<td>1 mg DXT, plasma-free metanephrines, K and renin/aldo in those with hypertension</td>
<td>Annual</td>
<td>4</td>
<td>Monitor those &lt; 4 cm, use additional criteria in those 4-6 cm</td>
<td>Two CTS, at least 6 months apart, no data to support continued imaging if no increase in size CT at 6, 12 and 24 months</td>
</tr>
<tr>
<td>Young, NEJM 2007 (2)</td>
<td>1 mg DXT, urinary metanephrines and catecholamines, K and renin/aldo in those with hypertension</td>
<td>Annual</td>
<td>4</td>
<td>Monitor those &lt; 4 cm</td>
<td>CT at 6, 12 and 24 months</td>
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<tr>
<td>UpToDate, Feb 2008 (3)</td>
<td>1 mg DXT, urinary metanephrines and catecholamines, K and renin/aldo in those with hypertension</td>
<td>Annual</td>
<td>4</td>
<td>CT at 6, 12 and 24 months</td>
<td></td>
</tr>
</tbody>
</table>


AIO:RISK OF MALIGNANCY OR HYPERFUNCTION WITH F/U*

- Became malignant-1/1081=0.1%
  -1 lymphoma, no ACC
- Became functional-20/1147=1.7%
  -13 SCS(1.1%), 6 CS(0.5%), 1 Pheo(0.09%)
  -therefore overt fx in 7/1147=0.6%

Review of 18 studies
**AIO: RISK OF MALIGNANCY OR HYPERFUNCTION WITH F/U**

- Became malignant-0.2%: 1 RCC met, 1 lymphoma, no ACC
- Became functional-0.9%: Pheo, CS or SCS

Review of 16 studies, N=1410, mean age 60.8 yrs, mean tumor size 2.5cm, mean F/U 3.2 yrs

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**AIO: RISK OF MALIGNANCY OR HYPERFUNCTION WITH F/U**

- 209 Indeterminate adrenal masses(>10 HU)*
- No prior malignancy and no suspicious imaging features
- Became malignant-none
- Became functional-1.0% (2 Pheo)

*AJR 189:1119,2007
AIO:F/U OF APPARENTLY BENIGN LESIONS

• No evidence based guidelines
  – CT in 3-6 mos and then prn, OR in 1-2 yrs, OR in 6,12 and 24 mos
  – Endocrine evaluation in 1-2 yrs OR yearly for 4 yrs

  – OR “-the default position after initial evaluation should be to either excise the lesion or discharge from follow-up)*

* Cawgood et al Eur J Endocrinol 161:513,2009
74 yo with a 4.4 cm “benign” adenoma

**PMH**
- HTN of recent onset
  - 6-8 months

**MED**
- Atenolol 50mg/d
- Amlodipine 5mg/d

**ROS**
- Gradual weight gain, 25 lbs over 6-7 years
- Maybe ↑ bruising
- Recent HAs and anxiety
- No palpitations, no sweating, no spells
- No known hypokalemia

**Physical Exam**
- BP 170/80, HR 64, Wt 140 lbs
- Not cushingoid although some ↑ dorso-cervical fat & right supraclavicular fat
- Scattered bruises on LE
- Mild skin thinning
- No striae, no hirsutism, no peripheral edema

---

74 yo with a 4.4 cm adrenal mass, 5HU on CT new HTN, gradual weight gain, abnl fat deposition

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
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<tbody>
<tr>
<td>AM Cortisol</td>
<td>26ug/dL</td>
</tr>
<tr>
<td>ACTH</td>
<td>&lt; 5pg/ml</td>
</tr>
<tr>
<td>24hr Urine Cortisol</td>
<td>141ug/24 hr(&lt;50)</td>
</tr>
<tr>
<td>K</td>
<td>Normal</td>
</tr>
<tr>
<td>Aldosterone</td>
<td>7ng/dL</td>
</tr>
<tr>
<td>Plasma renin act</td>
<td>0.2 ng/mL/hr</td>
</tr>
<tr>
<td>ARR</td>
<td>35</td>
</tr>
<tr>
<td>Urine metanephrines</td>
<td>Normal</td>
</tr>
<tr>
<td>catecholamines</td>
<td></td>
</tr>
<tr>
<td>Plasma metanephrines</td>
<td>Normal</td>
</tr>
</tbody>
</table>

**Diagnosis?**
- ACTH Independent Adrenal Cushing’s syndrome
74 yo with a 4.4 cm adrenal mass- cortisol hypersecretion

Course

• Laparoscopic adrenalectomy 1/2008
• Adrenal Insufficiency, post op
  – On HC, gradually tapered off
• Cortisol normal 2/2009

THE END
74 yo with a 4.4 cm adrenal mass, 5HU on CT new HTN, gradual weight gain, abnl fat deposition

Urine free cortisol 141 ug/24 h (< 50)

ACTH < 5
Cortisol 26ug/dL

K Normal
Aldosterone 7ng/dL
Plasma renin act 0.2 ng/mL/hr
ARR 35

Urine metanephrines, catecholamines Normal

Plasma metanephrines Normal

Diagnosis?

ACTH Independent Adrenal Cushing’s syndrome

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<td>Monitor those &lt; 4 cm, use additional criteria in those 4-6 cm</td>
<td>Two CTs, at least 6 months apart, no data to support continued imaging if no increase in size CT at 6, 12 and 24 months</td>
</tr>
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<td>Young, NEJM 2007</td>
<td>1 mg DXT, urinary metanephrines and catecholamines, K and renin/aido in those with hypertension</td>
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Incidentaloma – guidelines for F/U

<table>
<thead>
<tr>
<th>Publication</th>
<th>Hormonal tests</th>
<th>Frequency</th>
<th>Duration (years)</th>
<th>Imaging</th>
<th>Frequency</th>
</tr>
</thead>
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<tr>
<td>NIH Consensus statement 2002</td>
<td>1 mg DXT, plasma-free metanephrines, K and renin/ald in those with hypertension</td>
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Current guidelines questioned

Recommended evaluation of adrenal incidentalomas is costly, has high false-positive rates and confers a risk of fatal cancer that is similar to the risk of the adrenal lesion becoming malignant; time for a rethink?

T J Cawood, P J Hunt, D O'Shea*, D Cole and S Soole
Department of Endocrinology, Christie North Hospital, Princes Way and St John's, Christie North and 10 Department of Endocrinology, St Thomas's University Hospital, Dublin, Ireland

◆ Observations:
  – False:true positive ratios for recommended tests ≈ 50:1
  – CT cancer induction risk ≈ chance of cancer detection

◆ Conclusions:
  – Basic clinical evaluation for malignancy or functionality
  – One imaging follow-up in 3-6/12 if 4–6 cm or otherwise suspicious

Eur J Endocrinol 2009; 161: 513-27
Unsuspected pheochromocytoma

- **Risk of iodinated contrast:**
  - No increase in serum levels (10 unblocked cases)
  - Alpha blockade still prudent if PCC a possibility

- **Risk of biopsy:**
  - Italian series of 4 completely unsuspected PCCs
  - Full blown crisis in 1 after biopsy

- **Risk of surgery:**
  - UCSF series of 4 completely unsuspected PCCs
  - Catecholamine crisis in 2 (and one with MI)