Evaluation of Incidental Lesions Discovered at Imaging

Radiology Associates of Indianapolis

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Indeterminate Lesions

Current Discussion

- Thyroid nodule
- Adrenal nodule

Future Discussion

- Pulmonary Nodule
- Renal Mass
- Hepatic Mass
- Ovarian Mass
Perspective on Incidentalomas

- Common
- Occasional clinical significance
- Ambiguity of results creates patient anxiety
- Inconsistent interpretations and recommendations frustrate referring physicians and patients
- Imaging overutilization = unnecessary cost & conflict of interest for imagers
Goals

• *Optimize* patient safety and cost effectiveness
• *Determine* which lesions require further imaging
• *Select* a study with the highest probability of identifying the lesion
• *Utilize* a standard protocol with a clear endpoint
Thyroid Incidentalomas

- Often discovered on CT or MRI of neck or chest, or on carotid US
- Present in 50% of adult population at ultrasound
- Equal malignant potential for palpable and non-palpable nodules
- Less than 7% of nodules are malignant
- Require evaluation with high resolution US
US Features of Benign Thyroid Nodules

**Diagnostic:**
- Pure Cyst = benign
- Solid nodule with absent internal flow = benign

**Suggestive:**
- Cystic component
- Peripheral Halo (thin and uniform) around nodule
- Colloid crystals
Figure 1b. Punctate echogenicities in thyroid nodules

Malignant Thyroid Nodules

- No clear evidence that treatment of thyroid cancers of < 1 cm alters life expectancy
- Most thyroid cancers: papillary or follicular histology with excellent prognosis
- Risk of malignancy greater for patients < 20 years and > 60 years of age
- Higher risk with previous radiation exposure
- Cancer risk of 10 - 13% whether thyroid contains solitary or multiple nodules
Frequency of Occurrence of Thyroid Malignancies

**Carcinoma**
- Papillary 75%
- Follicular 10%
- Medullary 5%
- Anaplastic <5%

**Sarcoma** rare

**Lymphoma** <5%
**Metastases**
- lung, breast, renal
US Features of Malignant Thyroid Nodules

- Microcalcifications
- Taller than wide
- Marked hypoechogenicity (less than adjacent strap muscles)
- Coarse internal calcifications

- Microlobulations
- Irregular margins
- Internal blood flow
- Solid composition
Malignant Thyroid Nodule
Nodule Selection for FNA

- Imaging features suggest neoplasm
- Substantial growth since prior examination
- Abnormal lymph nodes: direct node biopsy and biopsy of ipsilateral thyroid nodule
- Nodule size = Poor predictor of malignancy: one third of thyroid cancer occurs in a nondominant nodule
### Consensus Statement Society of Radiologists in Ultrasound RSNA 2005

<table>
<thead>
<tr>
<th>US Feature</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solitary nodule</td>
<td></td>
</tr>
<tr>
<td>Microcalcifications</td>
<td>Strongly consider US-guided FNA if ≥1 cm</td>
</tr>
<tr>
<td>Solid (or almost entirely solid) or coarse</td>
<td>Strongly consider US-guided FNA if ≥1.5 cm</td>
</tr>
<tr>
<td>calcifications</td>
<td></td>
</tr>
<tr>
<td>Mixed solid and cystic or almost entirely</td>
<td>Consider US-guided FNA if ≥2 cm</td>
</tr>
<tr>
<td>cystic with solid mural component</td>
<td></td>
</tr>
<tr>
<td>None of the above but substantial growth</td>
<td>Consider US-guided FNA</td>
</tr>
<tr>
<td>since prior US examination</td>
<td></td>
</tr>
<tr>
<td>Almost entirely cystic and none of the above</td>
<td>US-guided FNA probably unnecessary</td>
</tr>
<tr>
<td>and no substantial growth (or no prior US)</td>
<td></td>
</tr>
<tr>
<td>Multiple nodules</td>
<td>Consider US-guided FNA of one or more nodules, with</td>
</tr>
<tr>
<td></td>
<td>selection prioritized on basis of criteria (in order</td>
</tr>
<tr>
<td></td>
<td>listed) for solitary nodule*</td>
</tr>
</tbody>
</table>

**Note.**—FNA is likely unnecessary in diffusively enlarged gland with multiple nodules of similar US appearance without intervening parenchyma. Presence of abnormal lymph nodes overrides US features of thyroid nodule(s) and should prompt US-guided FNA or biopsy of lymph node and/or ipsilateral nodule.

* Panel had two opinions regarding selection of nodules for FNA. The majority opinion is stated here.*
Thyroid Nodule Evaluation

- **Ultrasound** identifies suspicious lesions requiring US guided FNA
- **FNA** confirms lesions as malignant, benign, or nondiagnostic
- **Repeat FNA** for nondiagnostic histology (15 - 20%)
- $^{123}$I *Radionuclide Scan* for selected cases with persistent nondiagnostic FNA
  - or
- **Surgical Excision**
Nondiagnostic FNA

- 15 - 20% of thyroid FNA nondiagnostic
- Rebiopsy with US guidance: target solid components, foci with increased flow, microcalcifications
- Consider $^{123}$I radionuclide scan for persistent nondiagnostic FNA: “hot” nodule = benign
- Surgical excision for “cold” nodule with persistent nondiagnostic FNA
Thyroid Nodule Workup

Sonographic Findings

Positive
- FNA (Cytology)
  - Malignant
    - Surgery
  - Nondiagnostic
    - Repeat (US Guided) Biopsy
      - Malignant/Nondiagnostic
        - Surgery
        - Radionuclide Scan
          - Cold Nodule
          - Hot Nodule
  - Benign
    - Observation

Negative
- Observation
Summary

- Evaluate incidental (nonpalpable) thyroid nodules with high resolution ultrasound
- Consideration for biopsy rests on clinical & ultrasound features of each nodule
- Persistent nondiagnostic FNA requires radionuclide scan or excision
Indeterminate Adrenal Nodules

“Incidentalomas”
Incidentally Discovered Adrenal Lesions

- Asymptomatic adult
- No history of malignancy
- Unilateral or bilateral
Adrenal Adenomas

- Vast majority of “incidentalomas”
- Benign
- Discovered on CT, US, or MRI
- > 99% nonfunctioning

- 1 - 9% of population
- Increased incidence: with ageing, DM, HTN
- < 1% (benign) hyperfunctioning
Imaging Features of Adrenal Adenomas

- Smoothly marginated, homogeneous
- Unilateral or bilateral
- Can be visibly low attenuating on CT
- Range from a few millimeters to 10 cm
- Stable or enlarge slowly
--Lipid-rich adenoma in 74-year-old woman

Adrenal Lesion Size
Asymptomatic Adult without History of Malignancy

- < 3 cm very rarely malignant
- 3 cm to 5 cm rarely malignant
- > 5 cm increasing incidence of malignancy
Diagnosis of Adrenal “Incidentaloma”

- Positive diagnosis on imaging
- Imaging stability over 1 year
- Clinically asymptomatic over 2 years
• 321 incidentally discovered adrenal masses in 291 patients.
• All lesions with CT numbers >10 HU
• Smoothly marginated, homogeneous lesions with average size of 2.1 cm (range 0.5 - 6.0 cm)
• Stable for one year on imaging followup or two years of clinical stability.
Song, et al

- No malignancies
- 3 benign Subclinical Hyperfunctioning Adenomas (SHA): 2 pheochromocytomas & 1 cortisol producing adenoma
- All SHA identifiable biochemically
- Each SHA abnormal on adrenal CT & chemical shift MRI
ACR Imaging Recommendations

• Standard Noncontrasted CT (NCCT)
• NCCT with Histogram Analysis
• Contrasted CT with relative percentage washout
• MRI with Chemical Shift Imaging (CSI)
### ACR Appropriateness Criteria 2006

Asymptomatic Patient (no malignancy)

Adrenal Nodule < 3 cm in diameter

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Appropriateness Rating</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCCT</td>
<td>8</td>
<td>No previous NCCT</td>
</tr>
<tr>
<td>Adrenal CT Protocol</td>
<td>8</td>
<td>&gt; 10 HU on NCCT</td>
</tr>
<tr>
<td>MRI with CSI</td>
<td>8</td>
<td>When NCCT is equivocal</td>
</tr>
</tbody>
</table>

Appropriateness Criteria Scale 1 = least appropriate
9 = most appropriate
## ACR Appropriateness Criteria 2006

**Asymptomatic Patient (no malignancy)**

**Adrenal Nodule 3 -5 cm in diameter, Remove Larger Lesions**

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<tr>
<td>Adrenal CT Protocol</td>
<td>8</td>
<td>&gt; 10 HU on NCCT or adrenal nodule discovered on nonadrenal protocol CCT</td>
</tr>
<tr>
<td>MRI with CSI</td>
<td>8</td>
<td>If identified only on early CCT or discovered incidentally on MRI. If lesion is indeterminate on NCCT, CSI is unlikely to be helpful</td>
</tr>
</tbody>
</table>

**Appropriateness Criteria Scale:**

1 = least appropriate

9 = most appropriate
Adrenal Imaging: Physicochemical Basis

Fat

- Nonfunctioning adenomas composed of lipid rich, hyperplastic adrenal cortex
- Diminished attenuation (fat density) on NCCT: < 10 HU
- Signal drop out on out-of-phase MRI sequences (CSI): signal cancellation in fat and water containing lesion
Nonfunctioning adenomas enhance & washout rapidly
Malignancies enhance rapidly & washout slowly
CCT with relative percentage washout: > 50% washout diagnostic for benign adenoma
Figure 15a. Indeterminate right adrenal mass found at CT in a 45-year-old woman with breast cancer
Figure 15b. Indeterminate right adrenal mass found at CT in a 45-year-old woman with breast cancer

Mayo-Smith, W. W. et al. Radiographics 2001;21:995-1012
Positive Diagnosis of Benign Adrenal Nodule (Adenoma)

• NCCT: average HU <10
• NCCT with Histogram Analysis: > 5 % of pixels with HU <0
• CCT with relative percentage washout: > 50% washout at 15 minutes
• MRI with CSI: signal drop out on out of phase imaging
Hyperfunctioning Adrenal Adenomas

- Benign
- Asymptomatic (Subclinical): laboratory testing diagnostic, consider for all lesions > 4 cm
- Symptomatic: clinical diagnosis
  - HTN (pheochromocytoma)
  - Cushing’s syndrome (cortisol)
  - Conn’s syndrome (hyperaldosterone)
- Imaging: may mimic nonfunctioning adenoma
Other Benign Adrenal Lesions

- Adrenal cyst
- Myelolipoma
- Hemorrhage
- Chronic granulomatous disease
Adrenal Pseudocyst

- Thin, smooth wall < 3 mm thickness
- Homogeneous, near water density
- Nonenhancing
- Usually diagnosed on initial imaging examination - no further evaluation
Adrenal pseudocyst in 35-year-old woman

Myelolipoma

- Benign
- Composed of bone marrow elements
- Smoothly marginated
- Pathognomonic finding: grossly visible fat
- Usually diagnosed on initial imaging examination - no further workup
Figure 26. Bilateral myelolipomas in a 79-year-old man

Mayo-Smith, W. W. et al. Radiographics 2001;21:995-1012
Chronic Inflammatory Disease

- Usually histoplasmosis or tuberculosis
- Bilateral or rarely unilateral
- Diffuse adrenal enlargement
- Preservation of adreniform morphology
- May require further evaluation - including biopsy - to establish diagnosis
--Histoplasmosis in 68-year-old man

Adrenal Hemorrhage

- Hyperintense lesion on CT
- Clinical setting - trauma or anticoagulation therapy - aids in establishing diagnosis
- May require followup imaging to exclude other entities
--Adrenal hematoma in 75-year-old woman

“Incidentaloma” Workup

Categorize Lesions
- Benign
- Potentially malignant

Stratify Risk of Malignancy
- Low risk
- Intermediate & high risk
Benign Adrenal Lesions

- Pathognomonic findings of a benign lesion

  Or

- Smoothly marginated, homogeneous, < 3 cm lesion in asymptomatic patient with no history of malignancy
Indeterminate Adrenal Lesions

**Low Risk**
- Asymptomatic
- No history of malignancy
- Benign morphology
- Lesion size between 3 - 5 cm

**Intermediate Risk**
- Benign morphology
- Lesion size > 5 cm

**High Risk**
- Symptomatic or
- History of malignancy or
- Abnormal morphology or
- Size > 6 cm
“Incidentaloma” Evaluation

- Benign lesion: no further workup
- Low risk: 6 month followup NCCT
- Intermediate risk & high risk: pursue imaging algorithm to establish diagnosis
Workup of Adrenal Incidentaloma

- Asymptomatic
- No History of Malignancy
- Smooth, homogeneous nodule

< 3 cm Nodule

NCCT @ 6 months

> 10 HU

Observe

< 10 HU

NCCT

> 5 cm Nodule

Advanced Imaging

3 ≤ 5 cm Nodule

Observe?

NCCT

> 10 HU

Observe

< 10 HU

Stable

Abnormal

Observe > 10 HU

> 50% washout

Observe

< 50% washout

Signal dropoff

Observe

No signal dropoff

Advanced Imaging: PET/CT, Radionuclide Studies, Biopsy
Advanced Adrenal Imaging

- **PET/CT:** diagnose adrenal metastases & other malignancies
- $^{1^{31}}$ MIBG & $^{1^{111}}$ octreotide: localize and identify pheochromocytomas
- Adrenal Biopsy: gold standard but indeterminate results in about 15% of cases
**Adrenal Metastases**

- Patients with known history of malignancy
- Unilateral or bilateral
- Often irregularly marginated, hyperattenuating & nonhomogeneous
- May demonstrate necrosis & dystrophic calcification
--Metastases from adenocarcinoma of lung in 34-year-old woman

Adrenal Carcinoma

- Rare: 2 cases/million/year
- Present Clinically: abdominal pain, palpable mass, or endocrinologic syndrome
- Hormonally active: >50% endocrinologically active - Cushing’s Syndrome, Conn's syndrome, virilization or feminization
Imaging Features of Adrenal Carcinoma

- Most > 6 cm in size
- Inhomogeneous, irregular margins, central necrosis, calcification in 20 - 30%
- May invade IVC and adrenal veins
- Irregular enhancement with slow washout
Figure 25. Adrenal carcinoma in a patient who presented with left flank pain

Mayo-Smith, W. W. et al. Radiographics 2001;21:995-1012
Summary

Adrenal Incidentaloma

- Common lesion
- Usually benign
- Workup algorithms evolving
- Can use more cost effective imaging
- Clear endpoint for most patients
www.rai-imaging.com

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