What's New in Renal Mass Evaluation: How to Manage Renal Masses Detected at Non-Contrast CT

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Disclosures

Lippincott, Williams, and Wilkins
Philadelphia, PA
– Book Royalties
Incidental Renal Masses

- are almost always benign
- their evaluation may lead to unnecessary costly tests and potentially morbid treatments.

However...
Incidental Renal Masses

- Most RCC is diagnosed via an incidental finding
- RCC is curable only when locally-confined

Hence, the challenge...
Cancer Incidence

http://www.seer.cancer.gov

Age-Adjusted SEER Incidence Rates
By Cancer Site
All Ages, All Races, Both Sexes
1992-2012 (SEER 13)

Kidney and renal pelvis
Radiologist’s Goals

Diagnosis + Recommendations = Management
At the conclusion of this lecture, participants will be able to:

- Diagnose and manage incidental renal masses detected at non-contrast CT, and in a way that is both conservative and medically appropriate.
Conservative approach

- Conservative approaches include those that do less, i.e., observation strategies, now known as ‘active surveillance’, or simply ignoring the findings altogether.
Outline

• The case for being conservative and a review of the basics…
• Two renal mass presentations
• Incompletely characterized masses
• Summary and ‘take-home’ message
Why be Conservative?

1) Most renal masses are benign; many solid ones are benign.
2) Many small RCCs are indolent.
3) Treatments are costly, morbid, and may not affect disease–specific survival.
4) RCC is a rare cause of overall mortality.
5) Active surveillance appears to be safe.

Management of the Incidental Renal Mass

Despite substantial advances in the imaging-based diagnosis of renal masses, the increased detection of incidental renal masses with cross-sectional imaging poses problems to the radiologist and referring physician. Most incidental renal masses can be diagnosed with confidence and either...

Silverman SG et al, Radiology 2008
<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Management 1</th>
<th>Management 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Simple, benign</td>
<td>Ignore</td>
<td>Ignore</td>
</tr>
<tr>
<td>II</td>
<td>Complic, benign</td>
<td>Ignore</td>
<td>Ignore</td>
</tr>
<tr>
<td>IIIF</td>
<td>Probably benign</td>
<td>Observe</td>
<td>Obs/Ign</td>
</tr>
<tr>
<td>III</td>
<td>Indeterminate</td>
<td>Surgery</td>
<td>Surg/Obs</td>
</tr>
<tr>
<td>IV</td>
<td>Malignant</td>
<td>Surgery</td>
<td>Surg/Obs</td>
</tr>
</tbody>
</table>

Surveillance often appropriate in patients with co-morbid disease.

Silverman SG et al, Radiology 2008
Managing Incidental Findings on Abdominal CT: White Paper of the ACR Incidental Findings Committee

Lincoln L. Berland, MD\textsuperscript{a}, Stuart G. Silverman, MD\textsuperscript{b}, Richard M. Gore, MD\textsuperscript{c}, William W. Mayo-Smith, MD\textsuperscript{d}, Alec J. Megibow, MD, MPH\textsuperscript{e}, Judy Yee, MD\textsuperscript{f}, James A. Brink, MD\textsuperscript{g}, Mark E. Baker, MD\textsuperscript{h}, Michael P. Federle, MD\textsuperscript{i}, W. Dennis Foley, MD\textsuperscript{j}, Isaac R. Francis, MD\textsuperscript{k}, Brian R. Herts, MD\textsuperscript{l}, Gary M. Israel, MD\textsuperscript{m}, Glenn Krinsky, MD\textsuperscript{n}, Joel F. Platt, MD\textsuperscript{k}, William P. Shuman, MD\textsuperscript{m}, Andrew J. Taylor, MD\textsuperscript{n}

Berland LL et al, JACR 2010
Management flowchart...

Incidental Cystic Renal Mass ¹
Detected on CT

Bosniak I or II
- Benign no further follow-up ²

Bosniak IIIF
- General population
- Limited life expectancy or co-morbidities ⁷

Bosniak III or IV
- General population
- Limited life expectancy or co-morbidities ⁷

CT or MRI at 6 and 12 mo, then yearly for 5 yrs. ³,⁴
- No morphologic change
  - Benign no further follow-up

If follow-up appropriate, CT or MRI at 6 and 12 mo, then yearly for 5 yrs. ³,⁸
- Morphologic change ⁵
  - Surgery ⁶

Surgery, follow-up or no further follow-up based on life expectancy and co-morbidities

Further action based on change, life expectancy and co-morbidities

JACR 2010
**Management - Solid Renal Mass**

<table>
<thead>
<tr>
<th>Size</th>
<th>Diagnosis (Dx)</th>
<th>Recommended Action</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large (&gt;3cm)</td>
<td>RCC</td>
<td>Surgery</td>
<td>Rarely benign</td>
</tr>
<tr>
<td>Small (1-3cm)</td>
<td>RCC</td>
<td>Surgery</td>
<td>MRI/Biopsy if hyperdense</td>
</tr>
<tr>
<td>Very small (&lt;1cm)</td>
<td>RCC, AML, Oncocytoma</td>
<td>Observe until 1 cm</td>
<td>Use thin sections</td>
</tr>
</tbody>
</table>

*Provided there is no detectable fat by CT/MR!*

Active surveillance has been suggested

Silverman SG et al, Radiology 2008
Management flowchart...
Two renal mass ‘presentations’

‘Completely Characterized’ Renal Mass
• Imaging features are diagnostic e.g., classic AML on CT or MRI, simple cyst on US, CECT, CEMRI.
• Imaging features allow full probabilistic assessment based on current evidence e.g., Bosniak Cysts, and solid masses.

‘Incompletely Characterized’ Renal Mass
• Too small to diagnose, even after renal mass protocol CT or MRI.
• Imaging features do not allow full probabilistic assessment based on current evidence e.g., ‘complex’ renal masses on US, non-fat containing renal masses on non-contrast CT or MRI, and some masses on enhanced CT.
Classic Angiomyolipoma

- ≤ - 10 HU is virtually diagnostic of fat cells
- Must be lesion ROI
- Must be non-calcified (Fat plus Ca^{2+} could be RCC)

...with imageable fat

-56 HU
What is known?

- Guidelines on how to manage renal masses that are fully characterized with renal mass protocol CT or MRI examinations.
- Most renal masses are either too small, or detected on examinations not designed to evaluate them fully.
- Such masses are considered ‘incompletely characterized’.
What is new and helpful?

• Guidelines on how to manage renal masses that are ‘incompletely characterized’.

• Although diagnosing renal cancer at an organ-confined stage is the first priority, a ‘conservative approach’ (reduced healthcare costs and radiation exposure) is now evidenced-based.

Silverman SG et al, Radiology 2015
Incompletely Characterized Incidental Renal Masses: Emerging Data Support Conservative Management

With imaging, most incidental renal masses can be diagnosed promptly and with confidence as being either benign or malignant. For those that cannot, management recommendations can be devised on the basis of a thorough evaluation.

Silverman SG et al, Radiology 2015
Incompletely characterized

• Renal mass that is ‘too small to characterize’
• Renal mass detected on non-renal mass protocol
  – ‘Complex’ renal mass on US; non-contrast MRI
  – Non-fat containing renal mass on non-contrast CT
    » Hyperdense (hyperattenuating) renal mass
    » Simple cyst-appearing renal mass
### BWH Renal Mass CT Protocol

**64 Channel MDCT with 3 phases**

Contrast Material (80cc)

<table>
<thead>
<tr>
<th>Unenhanced</th>
<th>Nephrographic</th>
<th>Excretory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>Kidneys</td>
<td>Kidneys</td>
</tr>
<tr>
<td><strong>Delay</strong></td>
<td>--</td>
<td>100 s</td>
</tr>
<tr>
<td><strong>Collimation</strong></td>
<td>1.2 mm</td>
<td>1.2 mm</td>
</tr>
<tr>
<td><strong>Axial Recon/Incr</strong></td>
<td>3/1.5</td>
<td>3/1.5</td>
</tr>
<tr>
<td><strong>Post Processing</strong></td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

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Iodinated contrast material (370 mgI/ml); 0.5 s rotation time

Quality reference mAs - 200, 120 kVp
What is ‘too small to characterize’? TSTC Definition relates to technique!

Lesion diameter $<$ $2 \times$ section thickness

Section thickness $\leq \frac{1}{2}$ lesion diameter

Section thickness $> \frac{1}{2}$ lesion diameter
Three cystic masses, the largest 2 are cysts...

The 3 mm lesion is < 2x section thickness...

How do we report this finding?

Jinzaki et al, AJR 2004
"3 mm cystic renal mass that is too small to diagnose definitively; it is statistically likely a benign simple cyst."

Bosniak and Rofsky, Radiology 1996
Silverman SG et al, Radiology 2008
Volume-averaged cyst?

Solid!

Probably malignant!

3 years later

Courtesy Alec Megibow, NYU
Volume-averaged cyst vs solid mass?

- Relate CT protocol’s section thickness to mass size and attenuation…
- If 3 mm sections (particularly with 1.5 mm increments) 5-6 mm or larger cysts should be \( \leq 20 \). If not, the lesion may be solid.
- If 5 mm sections, 10 mm or greater cysts should be \( \leq 20 \). If not, the lesion may be solid.
‘Complex’ on US

• Use US to diagnose simple cysts

• If not simple, often ‘complex’

• Renal mass protocol CT/MRI

• Use of Doppler and FDA-approved contrast agents may allow more cystic masses to be completely characterized.

Barr RG et al, Radiology 2014
Noncontrast MR Findings

- Paucity of data
- Diagnose AML w/ fat-sensitive sequences
- Homogeneous T2-hyperintense (SI CSF comparable to CSF) and no other features), are probably simple cysts
- Ignore apparent Bosniak II cysts?
- More research is needed…
Hyperdense on NCCT

- ‘Hyperdense’ = ‘hyperattenuating’
- Original definition: hyperdense to renal parenchyma
- Current definition: hyperdense to ‘simple fluid’, or > 20HU
Hyperdense on NCCT

- Masses with homogeneous CT attenuation $\geq 70$ HU were benign cysts in 99.9% of cases (Jonisch et al Radiology 2007)

- Of 3001 CTC exams followed for 4 yrs, none of the homogeneous $> 70$HU masses was cancer (O’Connor et al AJR 2011)

- Of 193 RCCS, none was homogeneous and $> 70$ HU (Pooler AJR 2012)
Hyperdense at NCCT

OK to ignore if...

1) $\geq 70$ HU
2) Homogeneous

...Probably does not need to be small ($\leq 3$cm)!

Otherwise, evaluate for solid mass...

1) Renal mass protocol CT or MRI
2) Percutaneous biopsy
How do we report them?

Hyperdense mass on noncontrast CT

So long as the mass is homogeneously hyperdense, and ≥ 70 HU...

Radiology Report...

“Homogeneously hyperdense renal mass statistically likely benign proteinaceous cyst”
How do we report them?

Heterogeneous mass on non-contrast CT

or any area measuring between > 20 and <70 HU

Radiology Report...

“Heterogeneously hyperdense mass that could represent a RCC, or a hemorrhagic or benign complicated cyst. Renal mass protocol CT or MRI recommended.”
Hypodense at NCCT

Can we ignore these masses?

What is the chance that a simple cyst-appearing renal mass is a renal cancer?

‘Simple cyst appearing renal mass’ ‘SCARMs’
Of 3001 CTC exams followed for 4 yrs, none of the homogeneous $\leq 20$HU masses was cancer (O’Connor et al AJR 2011)

Of 193 RCCs, none was homogeneous and $\leq 20$ HU (Pooler AJR 2012)

Of 15,695 pts examined with unenhanced CT, all 2,669 masses with homogeneous attenuation $\leq 20$ HU were benign (O’Connor et al Radiology 2013)
How do we report them?

Simple cyst-appearing renal mass on noncontrast CT

“Simple cyst-appearing renal mass statistically likely benign”

Radiology Report...

O’Connor et al Radiology 2013
Unenhanced CT Findings

No need for further evaluation...

- < Contain fat (≤ -10 HU) but no Ca^{2+} >
- Homogeneous and ≥ 70HU
- Simple cyst-appearing (≤ 20 HU; no septa, wall thickening, or Ca^{2+})

likely can be ignored...
Unenhanced CT Findings

- Contain fat and Ca^{2+}
- Measure > 20 and < 70 HU in any part
- Appear heterogeneous
- Non-simple cyst-appearing (septa, thick wall, Ca^{2+})

Need for further evaluation...

All could be RCC...

which need evaluating...