Managing Incidental Findings on Abdominal MDCT

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Scourge of Incidental Findings

- More CTs (26M in 1998, 61M in 2006)
- If CTC reimbursed: 3.5M/yr at 10 years
- CTC brings problems of whole-body screening, with benefits of polyp detection
- ECFs helping to keep CTC from reimbursement
Cascade Effect

- William Casarella, MD, Former Chair, Emory Radiology:
  - Negative Virtual colonoscopy
  - Renal, hepatic and lung masses detected
    - Additional CT scans
    - PET scan
    - Liver biopsy
    - Video-aided thoracoscopy with wedge resection
  - Excruciating post-operative pain, 5 weeks of recuperation, over $50,000 in charges
  - All findings benign
Frequency of Incidentalomas
## Extracolonic Findings on CTC

<table>
<thead>
<tr>
<th>Article</th>
<th>Patients</th>
<th>Patients with Missed Findings</th>
<th>Patients Getting Surgery, Bx</th>
<th>Patients Malignant, Serious Dx</th>
<th>Cost of Workup/Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xiong, 2005</td>
<td>3280</td>
<td>2.7%</td>
<td>0.8%</td>
<td>3.7%</td>
<td>--</td>
</tr>
<tr>
<td>Yee, 2005</td>
<td>500</td>
<td>1.6%</td>
<td>1%</td>
<td>2.6%</td>
<td>$28.12</td>
</tr>
<tr>
<td>Xiong, 2006</td>
<td>225</td>
<td>--</td>
<td>0.4%</td>
<td>--</td>
<td>$297</td>
</tr>
<tr>
<td>Kim, 2007</td>
<td>3120</td>
<td>--</td>
<td>--</td>
<td>0.3%</td>
<td>--</td>
</tr>
<tr>
<td>Tolan et al, AJR 2007</td>
<td>400</td>
<td>--</td>
<td>--</td>
<td>12.3%</td>
<td>$66.59</td>
</tr>
</tbody>
</table>
Summary - ECFs on CTC

- Important incidental findings
  - ~10% if average risk
  - ~30% if high risk or symptomatic
- Patients getting additional tests ~5-15%
- Patients getting additional tests with benign result ~2.5%
- Patients getting surgery or biopsy ~0.5-1%
Incidental Findings on CTC

- Hassan, et al:
  - 100,000 patients - Monte Carlo simulation
  - Cost: $162/patient
  - 2292 life years gained, mostly from AAA
    - Only 298/2292 from cancer
    - $7,063/life-year saved
  - Cancer: 4.6 life-years gained/200 pts
Frequency of Recommendations - Incidentalomas

Work-up, Cost Implications

- Hanson, et al. study: U Wisconsin, RSNA 2006
- Patients followed after Virtual Colonoscopy
  - 2,195 patients
  - Work-up done in 6.1%
  - 22 surgeries, 18 invasive procedures
  - $138 average added to cost of each procedure
  - Much concentrated in a few major operations, e.g. nephrectomies
Scourge of Incidentalomas

- Renal
- Liver
- Adrenal
- Pancreas
- Other, including:
  - Adenopathy
  - Ovarian
  - AAA, other vascular
  - GI
Radiologist’s Problems

- Identified inconsistently
- Categories inconsistent
- High, moderate or low?, Potentially important? Clinically important vs. unimportant
- No established guidelines for work-up or follow-up
- Medicolegal risk
Pilot - Total Body Screening

- 50 patients - 25 screened
- Followed 2 years
- Clinically important findings in abd/pelvis
  - 7/25 (28%)
- 2 abdominal radiologists
Pilot - Total Body Screening

- Chest, abdomen and pelvis findings:
  - Non-contrast, low dose (high noise), lower specificity
  - 36% different recommendations
  - Kappa 0.52 - moderate agreement
  - 2 cases
    - Both radiologists reported, 1 called actionable
  - 10 cases
    - 1 reported actionable, 9 didn’t report at all
ACR, SCBT-MR, SGR, SUR to the Rescue
ACR Involvement in Incidentaloma Problem

- Incidental Findings Committee, under Body Imaging Commission
- Also working with SCBT-MR and SGR-SUR
- Commission: Reed Dunnick, then James Brink, Chair: Lincoln Berland
- Four subcommittees established
  - Renal – Stuart Silverman
  - Liver – Richard Gore
  - Adrenal – William Mayo-Smith
  - Pancreas – Alec Megibow
- Decided to defer other (vascular, ovarian, etc.)
- Plans to submit white paper Fall, 2009
Objectives of ACR Project

- Describe imaging features for identifying incidentalomas
- Differentiate low-dose non-contrast from enhanced
- Create useable format, standard lexicon (RadLex)
- Classify
- What is unnecessary to report?
- When to:
  - Ignore
  - Follow-up
  - Evaluate (further testing)
  - Intervene
Objectives of ACR Project

- Communicate
- Develop educational plan
- Ongoing guideline development, refinement
- Solicit clinical specialty input
- Propose, support research
Benefits

- Reduce risk to patient
- Limit costs
- Improve consistency, quality
- Medicolegal protection
- Lead to evidence-based approach
Challenges

- Setting guidelines with consensus, given limited scientific evidence
- Determining whether to report some findings
- Agreeing on terminology for reports
- Creating differing criteria based on comorbidities and life expectancy
- Setting reasonable certainty of diagnosis (conservativeness)
- Decrease, not increase work-up of incidentalomas
Algorithm for Incidentals

- Identify
- Characterize
- Categorize by recommendation:
  - Ignore
  - Follow-up
  - Evaluate further
  - Intervene (e.g. biopsy, surgery)
Renal Incidentalomas

Note: Tables for managing renal incidental findings are work-in-progress and updates will be displayed at the presentation.
## Managing Incidental Renal Cystic Mass

<table>
<thead>
<tr>
<th>Bocniak Category</th>
<th>Imaging Features (5)</th>
<th>General Population</th>
<th>Co-morbidities or Limited Life Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>I*</td>
<td>Hairline-thin wall; no septa, calcifications, or solid components; water attenuation; no enhancement</td>
<td>Ignore</td>
<td>Ignore</td>
</tr>
<tr>
<td>II</td>
<td>Few hairline-thin septa with or without perceived (not measurable) enhancement; fine calcification or a short segment of slightly thickened calcification in the wall or septa; homogeneously high-attenuating masses (≤3 cm) that are sharply marginated and do not enhance</td>
<td>Ignore</td>
<td>Ignore</td>
</tr>
<tr>
<td>IIIF</td>
<td>Multiple hairline-thin septa with or without perceived (not measurable) enhancement, minimal smooth thickening of wall or septa that may show perceived (not measurable) enhancement, calcification may be thick and nodular but no measurable enhancement present; no enhancing soft-tissue components; intrarenal nonenhancing high-attenuation renal masses (&gt;3 cm)</td>
<td>Observe$^\dagger$</td>
<td>Observe$^\dagger$ or ignore$^\ddagger$</td>
</tr>
<tr>
<td>III</td>
<td>Thickened irregular or smooth walls or septa, with measurable enhancement</td>
<td>Surgery$^\ddagger$</td>
<td>Surgery$^\ddagger$ or observe$^\ddagger$</td>
</tr>
<tr>
<td>IV</td>
<td>Criteria of category III, but also containing enhancing soft-tissue components adjacent to or separate from the wall or septa</td>
<td>Surgery$^\ddagger$</td>
<td>Surgery$^\ddagger$ or observe$^\ddagger$</td>
</tr>
</tbody>
</table>
## Managing Renal Cystic Mass for General Population

<table>
<thead>
<tr>
<th>Mass Size</th>
<th>Probable Diagnosis</th>
<th>Recommendation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large (&gt;3 cm)</td>
<td>Renal cell carcinoma *</td>
<td>Surgery¹</td>
<td>Angiomyolipoma with minimal fat, oncocytoma, and other benign neoplasms may be found at surgery</td>
</tr>
<tr>
<td>Small (1–3 cm)</td>
<td>Renal cell carcinoma *</td>
<td>Surgery¹</td>
<td>If hyperattenuating and homogenously enhancing, consider MR and percutaneous biopsy to diagnose angiomyolipoma with minimal fat</td>
</tr>
<tr>
<td>Very small (&lt;1 cm)</td>
<td>Renal cell carcinoma, oncocytoma, angiomyolipoma²</td>
<td>Observe until 1 cm⁵</td>
<td>Thin (≤3 mm) sections help confirm enhancement</td>
</tr>
</tbody>
</table>
Managing Renal Cystic Mass in Limited Life Expectancy

<table>
<thead>
<tr>
<th>Mass Size</th>
<th>Probable Diagnosis</th>
<th>Recommendation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large (&gt;3 cm)</td>
<td>Renal cell carcinoma*</td>
<td>Surgery(^1) or observe</td>
<td>Angiomyolipoma with minimal fat, oncocytoma, other benign neoplasms may be found at surgery; Biopsy can be utilized preoperatively to confirm renal cell carcinoma</td>
</tr>
<tr>
<td>Small (1–3 cm)</td>
<td>Renal cell carcinoma*</td>
<td>Surgery(^1) or observe</td>
<td>If hyperattenuating and homogenously enhancing, consider MR and percutaneous biopsy to diagnose angiomyolipoma with minimal fat</td>
</tr>
<tr>
<td>Very small (&lt;1 cm)</td>
<td>Renal cell carcinoma, oncocytoma, angiomyolipoma(^4)</td>
<td>Observe until 1.5 cm(^5)</td>
<td>Thin (≤3 mm) sections help confirm enhancement</td>
</tr>
</tbody>
</table>
Incidental Renal Cysts
Bosniak II Cysts

- Since initial categorization, more often recognized, studied, followed
- Progression to RCC rare
- Further imaging, follow-up probably not cost-effective
Incidental Renal Masses
Renal Cell Carcinoma – Risk

![Graph showing number of deaths/yr for various causes including CVD, Lung cancer, Colon cancer, Breast cancer, and Renal cancer. The graph indicates significantly higher number of deaths for CVD compared to the others.]
Renal Cell Carcinoma: Overdiagnosis

- Rate of increased detection three-fold higher than increase in mortality rate – 61% cases incidental
- RCC – 0.5% deaths, 2% autopsies
- Perhaps only 20% or fewer RCCs discovered at screening may be potentially fatal
Hepatic Incidentalomas

Note: Tables for managing hepatic incidental findings are work-in-progress and updates will be displayed at the presentation.
## Managing Incidental Liver Nodules \( \leq 1.5 \text{ cm} \)

### Nodule <0.5 cm

<table>
<thead>
<tr>
<th>Attenuation</th>
<th>Ignore</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low attenuation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average risk patient</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>High risk patient</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

### Nodule 0.5 - 1.5 cm

<table>
<thead>
<tr>
<th>Attenuation</th>
<th>Ignore</th>
<th>Follow up</th>
<th>Evaluate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flash Filling (Robustly Enhancing)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average risk patient</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk patient</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Low Attenuation, benign imaging features</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average risk patient</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk patient</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low Attenuation, suspicious imaging features</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average risk patient</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>High risk patient</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
## Managing Incidental Liver Nodules >1.5 cm

<table>
<thead>
<tr>
<th>Nodule &gt;1.5 cm</th>
<th>Ignore</th>
<th>Follow up</th>
<th>Evaluate</th>
<th>Biopsy/FNA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flash Filling (Robustly Enhancing)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benign diagnostic imaging features</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imaging features not diagnostic for benign</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Low attenuation, benign imaging features</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low attenuation, suspicious imaging features</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low risk patient</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average risk patient</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>High risk patient</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Trend in Detecting Incidentalomas

- Northwestern University Experience
  - Dr. Gore: 200 ER cases
    - Renal 63%
    - Liver 42%
    - Adrenal 8%
    - Pancreas 3%
TSTC Liver Lesions
What are These Hepatic Incidentalomas?

- Cysts
- Non-calcified granulomas
- Especially if numerous:
  - von Meyenburg complexes (multiple bile duct hamartomas)
Liver Hemangioma

- Becomes isodense to vessels in equilibrium
Approach to Questionable Hemangiomas

- If small (≤2 cm), almost diagnostic or highly unlikely to be malignant:
  - Report as benign

- If want to pursue
  - ONE more test
    - Suggest NOT repeating CT, probably not MRI
    - Labeled red cell, Ultrasound, US contrast
  - If still uncertain: **Stop or Follow-up or Biopsy**
Diagnosing and Managing Small Liver Lesions with Comorbidities
Liver Incidental Findings – Two Studies

- 262/1454 no primary, no malignancy in any small lesion
- If no malignancy – probably <<1% chance small lesions significant
“Incidentaloma” – Known Cancer

- Sino-nasal cancer
- Examinations several months apart
Hepatic Incidentalomas in Breast Cancer

- 1012 women, 941 without known liver mets
- 277 with TSTCs, 191 got follow-up imaging
- 3/277 (1.1%) with confirmed breast liver mets

Liver Lesions in Cirrhosis – UAB Study

- Hepatic lesions in 27% of 57 patients with cirrhosis on screening for HCC
- 33% were indeterminate
- 98% of indeterminate lesions were insignificant
- Single HCC – detected biochemically anyway
Adrenal Incidentalomas

Note: Flowchart for managing adrenal incidental findings is work-in-progress and update will be displayed at the presentation.
Managing Adrenal Incidental Nodules

Incidental Adrenal Mass (≥1 cm)
Discovered on CT (with or without contrast)

- Imaging Features are Diagnostic (Myelolipoma, Ca++)
  - Benign, No follow-up

- Imaging Features Not Diagnostic
  - < 4cm
    - Prior Imaging
      - Stable ≥ 1 Year
        - Benign*
      - Lesion Enlarging
        - Concerning for Malignancy
          - Consider biopsy/resection**
  - ≥ 4cm
    - No Prior Imaging
      - HU ≤ 10 or pixel mapping > 10% ≤ 0HU
        - Benign*
      - HU > 10
        - No hx cancer, consider resection**
Managing Adrenal Incidental Nodules

- No History of Malignancy
  - Benign Imaging Features, Presume Benign*
    - Consider 1 year follow-up CT/MR
  - Concerning Imaging Features
    - HU ≤ 10 or pixel mapping > 10% ≤ 0HU
      - Benign*
    - Enhanced CT
      - No Enhancement = Cyst or Hemorrhage
        - Benign, No follow-up
      - APW/RPW ≥ 60/40%
        - Benign*
      - APW/RPW < 60/40%
        - Biopsy if Appropriate**
          - Consider CSI MR or PET
  - History of Malignancy
    - Unenhanced CT
      - HU > 10
        - Enhanced CT
Pancreatic Incidentalomas

Note: Flowchart for managing pancreatic incidental findings is work-in-progress and update will be displayed at the presentation.
Pancreatic Cystic Nodules

- Asymptomatic patient
- < 3 cm: observe by imaging unless:
  - Solid elements, mural nodule
  - Dilatation CBD
    - >8 mm w/o cholecystectomy
    - >14 mm with cholecystectomy
  - Dilatation (MPD)
    - > 5 mm
  - Patient demand
Pancreatic Cystic Nodules

- < 3cm if surgery considered
  - Cyst aspiration by EUS for mucin, amylase, CEA
    - If mucin: attempt to determine if “gut mucin”
    - Amylase > 250 U: diagnostic of pseudocyst
    - CEA > 200 ng/ml: diagnostic of mucinous pancreatic neoplasm (+/- malignancy)
Pancreatic Cystic Nodules

- Surgery not routinely indicated
  - If classic findings of Serous Cystadenoma present and < 4 cm
  - If asymptomatic pseudocyst
  - If cystic metastasis (known from patient history)
Pancreatic Cystic Nodules

- Cystic mass should NOT be diagnosed as IPMN unless communication with MPD
  - 3-D MRCP recommended
  - Secretin enhanced MRCP may help detect communication
  - O/w careful 3-D MDCT

- Main duct and combined (main and branch duct) IPMNs are treated as malignant
Pancreatic SPEN, MCT

- Solid and pseudopapillary epithelial neoplasms (SPEN) should be removed
- Cystic mass (particularly tail) in middle-age woman
  - HIGH likelihood of Mucinous Cystic Tumor:
  - EUS aspiration recommended
  - If mucin: resect
Follow-up: Modality

- <70: Limited MR (non GD, T2 weighted)
- >70 MDCT or MR unless not an option
Follow-up: Timing

- No established follow-up regimen. Options:
  - Verona:
    - Image q 6mos x 2 year
    - Then q 1 year x 2 year
    - Then stop
  - Sendai:
    - < 1cm: MR or MDCT q 1 year
    - 1-3 cm: EUS or MR for suspicious features
    - Follow with MR or CT q 6 months
    - > 3 cm: resect
Follow-up: Age, Co-morbidities

- In elderly, frail patients, esp. hospitalized:
  - Cysts < 2.5 cm report but do not recommend follow-up or further characterization if asymptomatic.
Summary

- Early incidental detection may not lead to longer survival.
- Detecting and following incidentalomas provides no benefit for many conditions.
- Incidental findings, false positives and overdiagnosis lead to healthy people getting extra tests.
- Aggressively pursuing findings probably does more harm than good.
- A consistent approach may minimize the economic implications and optimize the health effects of incidentalomas.
Incidentalomas – What Should We Do?

- Appreciate the insignificance of the overwhelming majority of incidentalsomas
- Limit reporting of incidentalsomas to those that could herald diseases in which the course of disease may be altered
- Strive to definitively characterize incidentalsomas, but balance with risk and cost of additional studies
- If reporting an incidentalsoma, quantify the probability of its importance
- Help direct referring clinicians to the most cost-effective approach to managing the few incidentalsomas that must be pursued