Incidental Findings on Chest CT

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I have no conflicts of interest to report
Incidentaloma

Pulmonary Nodule
Mediastinal Lymph Node
Coronary Artery
Incidental Nodule

• How big is the problem?
• Jacobs 2008
  – Retrospective review of 11 publications: CAC (7) and lung cancer screening (4)
  – Clinically significant findings (required F/U) – 3% to 41%
  – 7.7% of CAD and 14.2% of Lung Cancer Screening studies required F/U
• Hall 2009 - 589 pulmonary CTAs from ED at UNC
  – Pulmonary embolism – 9%
  – 24% incidental finding other than pe
  – 13% pulmonary nodule (of which as per guidelines 96% needed follow-up)
  – 9% - adenopathy
• Swensen – Mayo Lung Cancer Screening
  – 69% - 1 or more positive findings in chest or abdomen after 3 years

Classically Benign
Perifissural lymph node

- Lung CA screen population
- 28% NCN adjacent to fissure
- 0% - became CA

Ahn et al. Radiology. 2010
Incidental Findings

Touch!

Suspicious/Malignant
Worrisome Calcifications
Edge Characteristics
Lung Cancer/ TB?
Incidental Findings

Touch?

Indeterminate
## What Now? Follow-up

### Solitary

<table>
<thead>
<tr>
<th>Size</th>
<th>Risk</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6mm (&lt;100 mm³)</td>
<td>Low</td>
<td>No follow up</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Optional at 12 months</td>
</tr>
<tr>
<td>6 - 8 mm (100 - 250 mm³)</td>
<td>Low</td>
<td>CT at 6 - 12 months, then consider CT at 18 - 24</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>CT at 6 - 12 months, then CT at 18 - 24 months</td>
</tr>
<tr>
<td>&gt; 8 mm (&gt;250 mm³)</td>
<td>Low/High</td>
<td>Consider CT at 3 months, PET/CT or Biopsy</td>
</tr>
</tbody>
</table>

MacMahon et al, Radiology 2017
## What Now? Follow-up
### Multiple

<table>
<thead>
<tr>
<th>Size</th>
<th>Risk</th>
<th>Recommendation</th>
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</thead>
<tbody>
<tr>
<td>&lt; 6 mm (&lt;100 mm$^3$)</td>
<td>Low</td>
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<td>Low</td>
<td>CT at 3 - 6 months, then consider CT at 18 – 24</td>
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<td>High</td>
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<td>High</td>
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</tr>
</tbody>
</table>

MacMahon et al, Radiology 2017
What next?

PET/CT OR 8 weeks
Fleischner
NOT for Oncology Patients
<table>
<thead>
<tr>
<th>Category</th>
<th>Category Descriptor</th>
<th>Findings</th>
<th>Fleischner (High Risk)</th>
<th>Management</th>
<th>Probability of Malignancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>No nodules and definitely benign nodules</td>
<td>No lung nodules</td>
<td>≤ 6 mm Optional CT</td>
<td>Continue annual screening with LDCT in 12 months</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nodule(s) with specific calcifications: complete, central, popcorn,</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>concentric rings and fat containing nodules</td>
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<td></td>
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</tr>
<tr>
<td>Benign</td>
<td>Nodules with a very low likelihood of becoming a</td>
<td>Solid nodule(s):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td>clinically active cancer due to lack of size or growth</td>
<td>&lt; 6 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>New &lt; 4 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Category 3 or 4 nodules unchanged for ≥ 3 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benign</td>
<td>Probably benign finding(s) – short term follow up</td>
<td>Solid nodule(s):</td>
<td>≥ 6 mm to &lt; 8 mm at</td>
<td>6 mm – 8 mm CT 6-12 months</td>
<td>1-2%</td>
</tr>
<tr>
<td>Appearance or</td>
<td>suggested; includes nodules with a low likelihood of</td>
<td></td>
<td>baseline OR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavior</td>
<td>becoming a clinically active cancer</td>
<td></td>
<td>new 4 mm to &lt; 6 mm</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Non solid nodule(s) (GGN) ≥ 20 mm on baseline CT or new</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspicious</td>
<td>Findings for which additional diagnostic testing and/or</td>
<td>Solid nodule(s):</td>
<td>&gt; 8 mm to</td>
<td>Chest CT with or without contrast; PET/CT and/or tissue sampling</td>
<td>&gt; 15%</td>
</tr>
<tr>
<td></td>
<td>tissue sampling is recommended</td>
<td>≥ 8 to &lt; 15 mm at baseline OR</td>
<td>growing &lt; 8 mm OR</td>
<td>depending on the probability of malignancy and comorbidities; PET/CT may</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>new 6 to &lt; 8 mm</td>
<td>be used when there is a ≥ 8 mm solid component.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solid nodule(s):</td>
<td>≥ 15 mm OR</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>new or growing, and ≥ 8 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspicious</td>
<td></td>
<td>Category 3 or 4 nodules with additional features or imaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>findings that increases the suspicion of malignancy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* PET/CT may be used when there is a ≥ 8 mm solid component.
Incidental Solid Nodule

What next?
Incidental Solid Nodule
Incidental Non Solid Nodule

What now?
## What Now? Follow-up

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground glass</td>
<td>&lt; 6mm (&lt;100 mm³)</td>
<td>No follow up</td>
</tr>
<tr>
<td></td>
<td>≥ 6 mm (&gt; 100 mm³)</td>
<td>CT 6 - 12 months to confirm, then CT every 2 years until 5 years</td>
</tr>
<tr>
<td>Part Solid</td>
<td>&lt; 6mm</td>
<td>No follow up</td>
</tr>
<tr>
<td></td>
<td>≥ 6 mm</td>
<td>CT 3 - 6 months to confirm, if stable and solid &lt; 6 mm, then annual for 5 years</td>
</tr>
<tr>
<td>Multiple</td>
<td>&lt; 6 mm</td>
<td>CT 3 - 6 months, if stable then consider CT at 2 and 4 years</td>
</tr>
<tr>
<td></td>
<td>≥ 6 mm</td>
<td>CT 3 - 6 months, then management based on most suspicious nodule</td>
</tr>
</tbody>
</table>

MacMahon et al, Radiology 2017
# ACR LungRADS® - Non Solid

<table>
<thead>
<tr>
<th>Category</th>
<th>Category Descriptor</th>
<th>Category</th>
<th>Findings</th>
<th>[Fleischner] High Risk</th>
<th>Management</th>
<th>Probability of Malignancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benign Appearance or Behavior</td>
<td>Nodules with a very low likelihood of becoming a clinically active cancer due to lack of size or growth</td>
<td>2</td>
<td>Part solid nodule(s):</td>
<td>&lt; 6 mm total diameter on baseline screening</td>
<td>&lt; 6 mm No follow up</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non solid nodules(s) (GGN):</td>
<td>&lt; 20 mm OR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≥ 20 mm and unchanged or slowly growing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably benign finding(s) – short term follow up suggested; includes nodules with a low likelihood of becoming a clinically active cancer</td>
<td>3</td>
<td>Part solid nodule(s):</td>
<td>≥ 6 mm total diameter with solid component &lt; 6mm OR new &lt; 6mm total diameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non solid nodule(s) (GGN) ≥ 20 mm on baseline CT or new</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspicious</td>
<td>Findings for which additional diagnostic testing and/or tissue sampling is recommended</td>
<td>4A</td>
<td>Part-solid nodule(s):</td>
<td>≥ 6 mm with solid component ≥ 6 mm to &lt; 8 mm OR with a new or growing &lt; 4 mm solid component</td>
<td>3 month LDCT; PET/CT may be used when there is a ≥ 8 mm solid component 6 month LDCT</td>
<td>5-15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Part solid nodule(s) with a solid component ≥ 8 mm OR</td>
<td>Chest CT with or without contrast; PET/CT and/or tissue sampling depending on the *probability of malignancy and comorbidities;</td>
<td>&gt; 15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a new or growing ≥ 4 mm solid component</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pulmonary Nodule: Subsolid

Category: 2 (GGN < 20mm) 4B (PSN Solid > 8mm)
Pulmonary Nodule: Subsolid
Incidental Nodule

- Review 1000 CTA chest CTs: Intermountain Health Care
- Rate of incidental nodule = 9.9% requiring follow-up
- Rate of appropriate follow-up when nodule noted
  - 29% underwent recommended follow-up; 0% when mentioned in findings of report only
- Affect of radiology report:
  - 68% reports had nodule follow-up recommendation
  - 20% in impression; 12% in findings only
    - When in impression with specific recommendations – 29% adherence
    - When in findings – 0% adherence

Blagev. JACR, 2014
Incidental Nodule: Conclusion

• Incidental Nodules are not rare
• Management
  – Most important - compare to prior studies
  – Recommendations in the Impression
• For non-oncology patients
  – Fleischner - solid nodule
  – Fleischner - GGO
  – ACR Incidental Chest White Paper - in development
• Oncology patients
  – 3 month short term follow-up
• Lung Cancer Screening
  – ACR LungRADS®
Incidental Mediastinal Lymphadenopathy

• How big is the problem?
  • Reported: 0.15 – 3%
    – Variety of CAC and lung CA screening CTs
  • Jacobs, 2008
    – Retrospective review of 11 CAD (7) and lung cancer screening (4) published studies
    – Lymphadenopathy: 1 – 6% of studies
  • Hall, 2009
    – 589 CTAs for pulmonary embolus
    – Positive = > 1cm node not associated with pneumonia; any > 3cm node; multiple nodes
    – Mediastinal – 29%; hilar – 7%
    – New adenopathy – 9% of cases
• Thymoma – SEER data = incidence 0.15 cases in 100,000
  – 0.6% of all thymic neoplasms; 0.2% of all malignancies

Marom ;Engles., Int J Cancer 2003
Incidental Mediastinal Lymphadenopathy

- Stigt, 2011
  - Patients with at least one incidental ≥ 10 mm lymph node
  - N = 83; 10mm - > 30mm; EUS or EBUS
  - Results:
    - 64 – also hilar nodes
    - Lymphocytes – 55; sarcoid – 18; granuloma – 1; cyst – 1; mets – 1; inadequate - 7
  - Multiplicity, small size, coexistence with hilar lymphadenopathy
  - Incidental lymph nodes – mainly manifestation of reactive inflammation

Stigt et al. JTO, 2011
Mediastinal Lymph Nodes
Mediastinal Lymph Nodes
Staging - Lymph Nodes

Accuracy:

- CT 62 - 88%
- MR 50 - 82%
- PET 81 - 96%

# NSCLC - Lymph Nodes

## PET/CT (CT)

<table>
<thead>
<tr>
<th>Author</th>
<th>Journal</th>
<th>Year</th>
<th>Sens</th>
<th>Spec</th>
<th>Accur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yi</td>
<td>AJR</td>
<td>2007</td>
<td>56 (65)</td>
<td>100 (89)</td>
<td>90 (83)</td>
</tr>
<tr>
<td>Kim</td>
<td>Rad</td>
<td>2006</td>
<td>61</td>
<td>96</td>
<td>86</td>
</tr>
<tr>
<td>Antoch</td>
<td>Rad</td>
<td>2003</td>
<td>89 (70)</td>
<td>94 (59)</td>
<td>93 (63)</td>
</tr>
<tr>
<td>Birim</td>
<td>ATS</td>
<td>2005</td>
<td>90 (70)</td>
<td>90 (70)</td>
<td></td>
</tr>
</tbody>
</table>
Lymph Nodes: PET/CT
Incidental Mediastinal Lymphadenopathy

Conclusions:

• Size criteria: Not ideal, but the only reference
• In oncology patients
  – Consider the malignancy
    • Lung, esophageal, mesothelioma, lymphoma
    • Testicular, Renal
    • Breast, Melanoma
• In screening
  – Not uncommon - reactive nodes
• In non-oncological patients
  – Majority can be ignored - size > 10 cm
Incidental Coronary Artery Calcification

- **How big is the problem?**
- **1965 - Fluoroscopy**\(^1\) (for cardiac investigations) - 31%
- **1997 - UK**\(^2\)
  - 450 chest CTs - 26% of males, 15.6% of females; none in patients < 40 yrs old
- **Prospective Army Coronary Calcium (PACC)**\(^3\)
  - 40 - 45 year old: prevalence – 17.3%
- **2009 – Turkey**\(^4\)
  - 113 thoracic CT, (31-92 yrs old; 72 male, 41 female)
  - CAC = 33%
- **2010**\(^5\) - 100 Consecutive CTAs
  - CAC detected on 46%

Incidental Coronary Artery Calcification

NLST:

- NLST (from 3856 death certificates)
  - Cardiovascular disease – 956 deaths [486 in CT group, 470 CXR group]
  - Lung cancer - 930 deaths [427 in CT group, 503 in CXR group]

- NLST – CAC study
  - Agatston 1 – 100, HR 1.27; mild HR 2.09
  - Agatston 101-1,000, HR 3.57, moderate HR 3.86
  - Agatston > 1000, HR 6.63, heavy HR 6.95

Aberle & NLST Team, NEJM; Chiles. Radiology, In press
CAC Moderate
CAC Heavy
Conclusions:

• Numerous studies indicate CAC should be reported
• NLST
  – Report at least visual score – mild, moderate, heavy
Thoracic Incidentaloma

Thank You