Tumor Doubling Time of Pulmonary Carcinoid Tumors Measured by CT

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Tumor Doubling Time of Pulmonary Carcinoid Tumor Measured by CT

Douglas H Russ, BS, Julie A Barta, MD, Nathaniel R Evans, MD, Robert T Stapp, DO, Gregory C. Kane, MD*
Background

- Pulmonary Carcinoid Tumor (PCT) is a neuroendocrine neoplasm
- 1-2% of all lung cancers
- Typical (low grade) and atypical (intermediate grade) subtypes
- Metastatic, but indolent
  - Clinically known to grow slowly, but limited literature on growth rates
- Often identified as solitary nodules on incidental radiography (e.g. CXR, Chest CT)
What to do once incidental nodule is identified?

If PCT is truly slow-growing, is a 2-year follow up timeframe long enough to detect tumor growth on CT?

<table>
<thead>
<tr>
<th>Fleischner Society 2017 Guidelines for Management of Incidentally Detected Pulmonary Nodules in Adults</th>
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</thead>
<tbody>
<tr>
<td><strong>A: Solid Nodules</strong></td>
</tr>
<tr>
<td><strong>Size</strong></td>
</tr>
<tr>
<td><strong>Nodule Type</strong></td>
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<tr>
<td><strong>Single</strong></td>
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<tr>
<td>Low risk¹</td>
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</tbody>
</table>
MR, 78 y.o. male

- Chest CT for Hx of bronchiectasis → incidental 5 mm peripheral nodule visible
- Repeat CT → nodule now 6 mm
- Percutaneous needle biopsy of nodule now measuring 10 mm

Timeline:
- 01-2009
- 11-2007
- 09-2017
Objectives & Hypothesis

• Research Question
  – What is the true growth rate of PCT as measured on CT?

• Hypothesis
  – We hypothesized that PCT would demonstrate a prolonged tumor doubling time compared to other lung neoplasms.
Approach

• Retrospective medical chart review

• Medical charts (EPIC) & radiographic scans (PACS)

• PCT nodule dimensions measured manually or retrieved from radiology reports

• **Inclusion criteria**
  – Pathologic diagnosis of PCT
  – ≥ 2 years of radiographic follow up by CT prior to biopsy/resection
  – Tumor demonstrated definitive growth*

• 14/89 patients with pathologically-confirmed PCT met all criteria

• 11 typical carcinoids, 3 atypical carcinoids

*defined as an increase in average nodule diameter ≥ 2 mm¹
Results: Tumor Doubling Time

Volume Doubling Time\(^1\) = \[\frac{\ln(2) \times \Delta T}{\ln \left( \frac{V_2}{V_1} \right)} = \frac{\Delta T}{\log_2 \left( \frac{V_2}{V_1} \right)}\]

Patient MR → **171 weeks**

11 typical PCTs demonstrated definitive growth

Median DT = 140 weeks  
Mean DT = 161 ± 105

SCLC\(^2\) → 6 weeks  
SCC\(^2\) → 13 weeks  
Adenocarcinoma\(^2\) → 20 weeks (solid), 36 weeks (subsolid)
Conclusions

• The median doubling time of typical PCT was 141 weeks, or almost three years.

• It is conceivable that typical PCTs detected early with small diameter may be mistaken for benign non-growing lesions when followed for less than two years in low-risk patients.

• The frequency of atypical carcinoids was too small to form any conclusion about growth rates.
Future Directions

- Analysis of larger, prospective cohorts could identify the frequency of PCT and other tumors with prolonged doubling time compared with non-neoplastic lung nodules.
Acknowledgements

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