The Solitary Pulmonary Nodule

Maria Said, Harvard Medical School Year III
Gillian Lieberman, MD

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Objectives

I. Present a Patient: discuss normal lung anatomy and pathology noted

II. Differential Diagnosis for Small Pulmonary Nodules (SPNs) with some examples from the BIDMC

III. Assessing SPNs and the role of additional imaging or tests
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Ms. GB

HPI: 72 yr old woman with history of recurrent breast cancer presented with a cough

PMH: Breast cancer s/p mastectomy 1981
  Recurrence chest in wall 1988
  Hysterectomy
  Cholestezystectomy

Meds: Tamoxifen, Prevacid, Lipitor, Mylanta

Allergies: codeine
Mrs. GB’s Chest X-Ray

Airway
Bones
Cardiac
Diaphragm
Everything else
Fields
Gastric Bubble
Hilum
A CT helps us answer three big questions unanswered by CXR

a) Is it solitary?
b) What does it really look like?
c) Are there abnormal lymph nodes?
Small Pulmonary Nodules

- Single radiologically visible lesion that is less than 3cm and surrounded by lung parenchyma.
- 150,000 new solitary pulmonary nodules are discovered every year.
- 1 in 500 chest radiographs will reveal an SPN.
- Approximately 50% of these will be malignant.
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The Differential

- Vascular
- Infectious
- Trauma
- Autoimmune, Inflammatory
- Metabolic
- Iatrogenic, drugs
- Neoplastic
- Congenital, cardiac
The Differential

- V: Arteriovenous malformation, Infarct, Hematoma
- I: Tuberculosis, Fungal, Round Pneumonia, Abscess, Dog Heartworm (Dirofilaria immitis)
- T: --
- A: Rheumatoid arthritis, Wegener granulomatosis
- M: --
- I: --
- N: Malignant (Primary pulmonary carcinoma, Primary pulmonary lymphoma, Primary pulmonary carcinoid tumor, Solitary Metastasis and Benign (Hamartoma, Chondroma)
- C: Bronchial atresia, Sequestration
- Other: External object, Pseudotumor (fluid in fissure), Atelectasis
Patient 1: TB
Patient 2: Round Pneumonia
Patient 3: Multiple nodules on CT
cause unknown
Patient 4: Pulmonary sequestration

PACS, BIDMC
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Assessing Likelihood of Malignancy

1. Age
2. History, underlying risk factors
3. Size of lesion
4. Border characteristics
5. Calcification of lesion
6. Cavitation of lesion
7. Presence of fat in lesion
8. Growth rate of lesion
1. Age

In one series, the percentage of solitary nodules due to malignancy was:
- 3% in patients between 35-39
- 15% between ages 40 and 49
- 43% between ages 50 and 59
- 50% or higher at age 60 or above

2. History

- Smoking
- Asbestos
- Previously diagnosed malignancy
- Fever

45 year old woman with bladder cancer, nodule was metastasis

3. Size of lesion

The smaller the nodule, the more likely it is to be benign.

Caveat: 80% of benign nodules are less than 2 cm, but 15% of malignant nodules are less than 1 cm.
4. Border Characteristics

Benign lesions tend to be smooth and discrete. Malignant lesions have irregular, lobulated, or spiculated borders.

Caveat: 21% malignant nodules have well defined margins.

Non-small cell cancer in a 63 year-old woman

5. Calcification of Lesion

Benign:
- Diffuse, homogeneous calcification
- Central calcification (granuloma)
- Laminated (concentric) calcification (granuloma)
- “Popcorn” calcification (hamartoma)

Malignant:
- Eccentric
- Amorphous

Caveat: 38%-63% benign nodules are not calcified
5. Calcification

Chondrohamartoma (popcorn)

Non-small cell cancer (amorphous)

6. Cavitation

Benign cavitary nodules have smooth, thin walls (<4mm).

Malignant nodules have thick, irregular walls (>16 mm)

Caveat: There is a great deal of overlap.
6. Cavitation

Aspergillus infection in a 48 yr old man with leukemia (thin wall)
Non-small cell lung cancer in a 61 yr old woman (thick wall)

7. Presence of Fat

The presence of fat (easily assessed on CT by measuring HU units) is a reliable indicator of a hamartoma.

8. Growth Rate

Malignant lesions have roughly a doubling time between approximately a month and a year. Benign lesions generally have a doubling time less than a month and greater than a year.

Pitfalls

- Difficult measuring small lesions
- Doubling refers to volume, not to diameter
- Broncholalveolar carcinomas and carcinoid tumors can have DT greater than a year.
The upper and lower nodules are growing at the same rate. Because the human eye judges diameter, not volume, the bottom nodule appears to be growing faster.

Further Testing

Radiographic Testing
- CT Densitometry
- Contrast-Enhanced CT (sens: 95-100%, spec: 70-93%)
- Bronchoscopy (sens: 20-80%)
- PET (lesions with low FDG uptake are typically benign)
  (sens: 96.8%, spec: 77.8%)

Invasive Testing
- Fine needle aspiration (sens 80-95%, spec 50-88%)
- Thorascopy (video assisted thoracic surgery, or VATS):
  can be used for diagnosis and excision
- Thoracotomy
How to Proceed

Decision Analysis Model can be used to assess the risk that a nodule is malignant

If probability cancer:

<12% : radiographic follow-up
12-69%: CT and PET scanning
>69 to 90%: CT followed by either biopsy or surgery
>90%: surgery
Mrs. GB's Pet Scan

Courtesy of J. Anthony Parker, MD, PhD
Ms. GB’s Pet Scan

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I. Presented Patient Ms. GB – nodule found on CXR, followed up by CT and PET

II. Explored differential diagnoses include infection and other benign causes as well as malignancy

III. Discussed assessment of SPNs using nodule characteristics and additional radiographic techniques


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