Probability of lung cancer in patients with incidentally detected pulmonary nodules

THE CLINICAL QUESTION

Does nodule size and smoking history predict incidence of cancer in patients with incidental pulmonary nodules? How accurate are two widely used models for identifying cancer in these patients?

TAKE HOME MESSAGE

The authors proposed a so-called rule of 10s for current smokers.
The expected frequency of cancer is approximately 10%, 20%, and 30% for smokers with nodules measuring > 8 to 15 mm,
> 15 to 20 mm, and > 20 to 30 mm, respectively.
A corresponding rule of 3s can be used to remember the estimated frequency of lung cancer in never smokers with nodules measuring > 8 to 15 mm (3%), > 15 to 20 mm (6%), and > 20 to 30 mm (12%)

STUDY CONCLUSION

Almost 10% of patients with an incidental pulmonary nodule measuring > 8 mm in diameter will receive a lung cancer diagnosis. Existing prediction models have acceptable accuracy but overestimate the probability of cancer.

STUDY BACKGROUND

- Nodule identification has been increasing over time, the frequency of lung cancer diagnosis after incidental nodule detection is not well defined

- Large, population-based studies of the characteristics of incidental nodules and the corresponding likelihood of cancer are lacking
- Smaller studies from the VA were published but cannot be applied to general population.

CURRENT PRACTICE

- According to clinical practice guidelines from the ACCP, a key step in the management of patients with nodules > 8 mm in diameter is to estimate the probability of cancer, using either clinical intuition or a validated prediction model

- Widely used models include the Mayo Clinic model for incidental nodules and the Brock model for nodules detected by screening

- The Mayo Clinic model was developed in a sample of smokers and non-smokers with nodules detected incidentally on chest radiography, and the Brock model was developed in a population of current and former smokers with nodules identified on a screening low-dose CT scan.

STUDY DESIGN

Type of trial: Retrospective observational study

N: Final Cohort: 23,789. No lung cancer: 21,433 (90.1%) and Lung cancer: 2,356 (9.9%)

Study groups: All patients with incidental pulmonary nodules

Setting: Kaiser Permanente Southern California

Enrollment: January 1 2006 and December 31 2016

Follow up: lung cancer identification within 27 months (2 year follow up and three additional months for diagnostic evaluation)

Primary outcome: Lung cancer diagnosis within 27 months of nodule identification.
1. A new incident cancer in the KPSC Cancer Registry or
2. The presence of two ICD 9 or 10, diagnosis codes for lung cancer within 60 days

Nodule characteristics were categorized by size (9-15 mm, > 15-20 mm, and > 20-30 mm), Attenuation (solid, part solid, nonsolid, and not specified), Edge (smooth, lobulated, irregular, spiculated, and not specified).

Compared the accuracy and discrimination of the Mayo Clinic model and the parsimonious Brock model to identify lung cancer among patients with nodules measuring > 8 mm in diameter.

Estimated the probability of cancer by applying the published regression equations to each patient in the sample

POPULATION

Inclusion criteria:
- All adults (age>= 18 years) who at any time between January 1 2006 and December 31 2016 underwent at least one CT chest were included

Exclusion criteria:
- CT scans performed for lung cancer screening (CPT G0297) or nodule follow-up (CPT 73680) were not included.
- Patients with prior history of cancer were excluded

Baseline Characteristics:
- Sample size: 23,789
- Female proportion: 53.1%
- Median age: 65
- Smoking status
  - Current: 10.8%
  - Former: 35.2%
  - Never: 37.1%
  - Unknown: 16.3%

INTERVENTIONS

- Records reviewed from Kaiser Permanente Southern California (KPSC) EHR
- Natural language processing algorithm was used to scan text from radiology reports (nodule characteristics – size, lobe, attenuation, and edge)
- For each patient with an identified nodule, they estimated the probability of cancer using the Mayo Clinic model and the Brock model

OUTCOMES

- Lung cancer was diagnosed in 5.4% of never smokers, 12.2% of former smokers, and 17.7% of current smokers (P < .001).

- The frequency of lung cancer increased from 5.7% for nodules measuring 9 to 15 mm in diameter, to 12.1% for nodules measuring > 15 to 20 mm in diameter, and to 18.4% for nodules measuring > 20 to 30 mm in size

- Among never smokers, the frequency of lung cancer increased from 2.8% to 6.2% to 11.2% across the three size categories.

- Among current smokers, the frequency of lung cancer increased from 10.9% to 20.3% to 30.0% across size categories.

- Lung cancer was frequent among patients with upper lobe (12.8%), lobulated (16.3%), and spiculated (32.8%) nodules

- For the full sample of patients with a nodule of > 8 mm in diameter, the Mayo Clinic model was more accurate than the parsimonious Brock model

- When restricted to current or former smokers, the Mayo Clinic model was still more accurate than the parsimonious Brock model, although the difference between the two was smaller
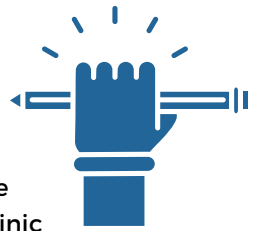
FUNDING

STUDY STRENGTHS

This was the first study that used a large population-based cohort to compare nodule characteristics to incidence of lung cancer diagnosis. Authors also made a commendable effort to compare the accuracy of the Mayo clinic and Brock models.

Prevalence of cancer in this study sample corresponds roughly to the lower limits of cancer prevalence ranges cited by the Lung Imaging Reporting and Data System for nodules detected by screening, so the authors propose its potential applicability to nodules detected incidentally as well.

STUDY LIMITATIONS & POTENTIAL FOR BIAS

Prevalence of cancer in this sample was lower (9.9%) than other studies. The entire study population was from Southern California, results may not be generalizable to other geographies. A multi-center cohort is necessary.

Results cannot be extended to patients with incidental nodules < 8mm

ARTICLE CITATION

Vachani A, Zheng C, Amy Liu IL, Huang BZ, Osuji TA, Gould MK. The Probability of Lung Cancer in Patients With Incidentally Detected Pulmonary Nodules: Clinical Characteristics and Accuracy of Prediction Models. Chest. 2022 Feb;161(2):562-571. doi: 10.1016/j.chest.2021.07.2168. Epub 2021 Aug 6. PMID: 34364866.

SUGGESTED READING

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3. MacMahon H, Naidich DP, Goo JM, et al. Guidelines for management of incidental pulmonary nodules detected on CT images: from the Fleischner Society 2017. Radiology. 2017;284(1):228-243.

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