

Management of Incidental Pulmonary Nodules Detected on Computed Tomography Images

- The Fleischner Society recently updated its guidelines for the management of incidentally detected pulmonary nodules in adults ≥ 35 years of age.
- The updated guidelines intend to minimize the number of follow-ups and provide clinicians and patients with greater choice in management decisions.
- The updated guidelines address both solid and subsolid (*i.e.*, nodules with a ground-glass component) pulmonary nodules.
- The updated guidelines do *not* apply to pulmonary nodules detected during lung cancer screening, pulmonary nodules in patients with a known cancer, or pulmonary nodules in patients suspected of having an infection.

Pulmonary nodules are often incidentally detected on imaging studies. In particular, improvements in computed tomography (CT) technology have resulted in the detection of smaller and clinically less significant pulmonary nodules, which led the Fleischner Society to publish recommendations for the management of incidentally detected solid pulmonary nodules in 2005. Guidelines for incidentally detected subsolid nodules (*i.e.*, nodules with a ground-glass component) were released by the Fleischner Society in 2013.

In early 2017, the Fleischner Society updated its guidelines for the management of incidentally detected solid and subsolid pulmonary nodules (**Table 1**) to reflect current thinking on nodule management (see **Figure 1** for examples of both types of lung nodules). The update differs from prior versions in two important aspects. First, it reflects an effort to minimize the number of follow-up exams, primarily by boosting the minimum threshold size requiring follow-up in solid nodules and by extending the recommended period of time between follow-up for subsolid nodules. Second, it allows for greater discretion in management decisions by recognizing that patient co-morbidities and various risk factors may incline patients and clinicians to choose a more aggressive or more conservative approach. Accordingly, timing for follow-ups is now presented in a range instead of at a specific point.

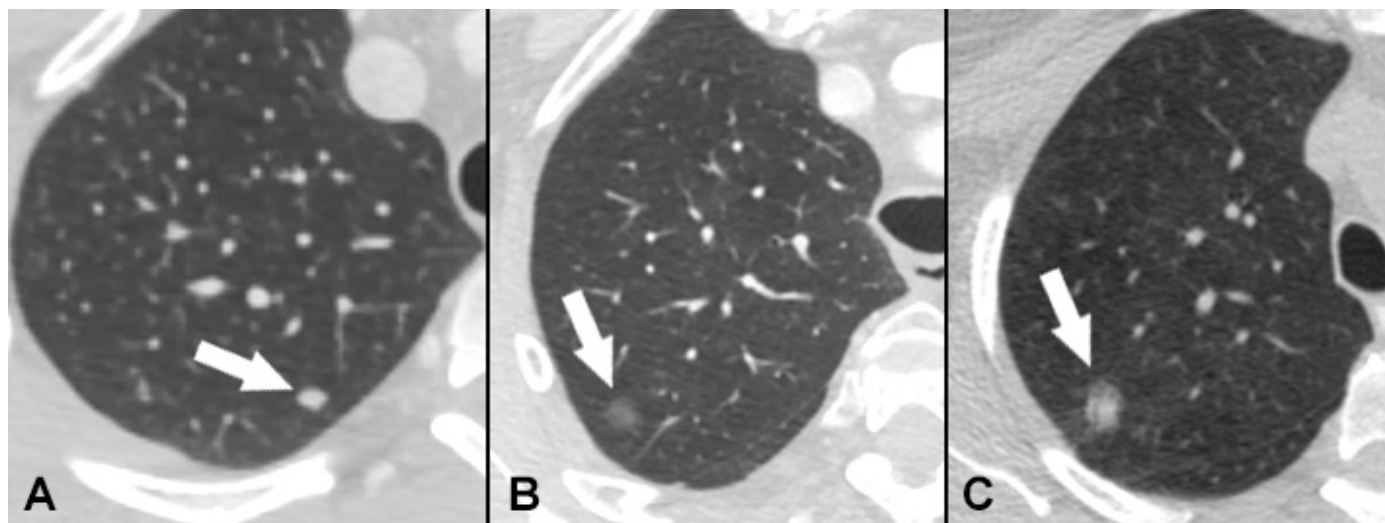


Figure 1. Axial CT images demonstrating solid (**A**) and subsolid (**B, C**) pulmonary nodules. Whereas all subsolid pulmonary nodules contain a ground-glass component, some are pure ground glass (**B**) while other also contain a solid component (**C**).

The updated guidelines retain an emphasis on low-radiation CT techniques. CT examinations of the thorax performed to follow incidentally detected lung nodules should use a low-dose technique to minimize radiation exposure. Also unchanged is the patient population to which Fleischner Society guidelines are applicable: adults ≥ 35 years of age with incidentally detected pulmonary nodules. The guidelines do *not* apply to pulmonary nodules detected during lung cancer screening, which are managed by the Lung CT Screening Reporting and Data System (Lung-RADS™) to account for the high-risk patient population eligible for lung screening. In addition, the guidelines do *not* apply to patients with a known malignancy or patients suspected of having an infection. Nodules detected in these patients cannot be considered incidental and need to be followed more closely (Figure 2). Lastly, because lung cancer is rare in young adults and children, incidental pulmonary nodules in patients under 35 years of age should be managed on a case-by-case basis and not by the Fleischner Society guidelines.

Summary of Updated Fleischner Society Recommendations

Single Solid Nodules

The updated Fleischner Society guidelines stratify single solid nodules into three groups: less than 6 mm in size, 6-8 mm in size, and greater than 8 mm in size. For single solid nodules less than 6 mm, the recommended follow-up depends on whether the patient is at low or high risk of lung cancer. While the 2005 guidelines recommended follow-up at 12 months for nodules 4-6 mm, the size threshold has been increased because several screening trials have shown the risk of cancer is considerably lower than 1% in nodules less than 6 mm, even in high-risk patients. As a result, no routine follow-up is suggested for low-risk patients with a solid nodule measuring less than 6 mm. For high-risk patients, follow-up may be conducted at 12 months, depending on nodule morphology and/or location.

For single solid nodules 6-8 mm in size, follow-up is now recommended at 6-12 months for low-risk patients; the precise time can vary depending on the size and morphology of the nodule and on patient preference. In many cases, one follow-up low-dose CT is sufficient. For high-risk patients, the updated guidelines suggest an initial follow-up low-dose CT at 6-12 months and another low-dose CT at 18-24 months. This recommendation is informed by screening studies that have shown an average risk of malignancy of approximately 0.5-2.0% for nodules this size. As is the case with low-risk patients, the times can vary based on individual risk factors and patient preference.

In cases of single solid nodules larger than 8 mm, clinicians and patients should consider follow-up at 3 months with CT alone, CT combined with positron emission tomography (PET), tissue sampling, or some combination of these options. Determination may depend on size, morphology, co-morbidities, and/or other factors and is best made in collaboration with a thoracic surgeon or a pulmonologist. While the average risk of cancer is approximately 3% in single solid nodules 8 mm in size, the individual risk can be substantially higher in certain patients.

Multiple Solid Nodules

The updated guidelines recommend no routine follow-up for multiple solid nodules smaller than 6 mm in patients without a history of cancer or suspected infection. While such nodules are often incidentally detected with CT, they are usually benign—typically either granulomas, the result of an earlier infection, or intrapulmonary lymph nodes. Patients at high risk for lung cancer may consider follow-up low-dose CT at 12 months. In cases in which at least one of the nodules is 6 mm or larger, a follow-up low-dose CT should be performed at 3-6 months. Depending on the risk level, clinicians and patients should consider a second low-dose CT at 18-24 months.

The updated guidelines note that for all cases of multiple solid nodules, the dominant nodule (*i.e.*, the most suspicious, as opposed to the largest) should serve as a guide in making management decisions.

Single Subsolid Nodules

Routine follow-up is not recommended for pure ground-glass nodules smaller than 6 mm, although follow-up may be warranted in cases of nodules with suspicious morphology close to 6 mm. The updated guidelines also suggest 2- and 4-year follow-up low-dose CT in patients at high risk. For nodules 6 mm or larger, follow-up with low-dose CT should be conducted at 6-12 months and then every 2 years until 5 years after the original finding. The 2005 guidelines had suggested follow-up at 3 months, but this concept was abandoned after studies showed that earlier follow-up is not likely to have any bearing on the outcome of these nodules.

Single part-solid nodules smaller than 6 mm should, in practice, be treated similarly to pure ground-glass nodules, especially because discrete solid components are not always discernible at this size. Therefore, no routine follow-up is recommended. For single part-solid nodules 6 mm or larger, the updated guidelines suggest follow-up at 3-6 months to confirm persistence. In cases with unchanged solid components less than 6 mm, follow-up should be performed annually for at least 5 years. Studies have shown that solid components this size usually suggest either adenocarcinoma *in situ* or minimally invasive adenocarcinoma. In cases with solid components 6 mm or larger, biopsy or resection should be considered after consultation with a thoracic surgeon.

Multiple Subsolid Nodules

Infection may be responsible in cases of multiple subsolid nodules smaller than 6 mm in size. If the nodules are still present at a 3-6 month follow-up, the updated guidelines recommend further follow-up at approximately 2 and 4 years. In cases of multiple subsolid nodules in which at least one nodule is 6 mm or larger, clinicians should make management decisions based on the most suspicious nodule.

Scheduling

Multidisciplinary evaluation of pulmonary nodules is performed on the main campus of Massachusetts General Hospital in Boston, MA in the [Pulmonary Nodule Clinic](#). Appointments can be made through Epic (inside the Partners network) or [Physician Gateway](#) (outside the Partners network) or by calling 617-643-4723.

Further Information

For further information on the evaluation of patients with pulmonary nodules, please contact [Florian Johannes Fintelmann, MD](#), Thoracic Imaging and Intervention Division, Department of Radiology, Massachusetts General Hospital, at 617-724-4254.

Information about lung screening at Massachusetts General Hospital is available at www.massgeneralimaging.org/lungscreening. Please contact the MGH Lung Screening Program manager, MaryAnn Tateosian, at 617-726-3517 with any questions.

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Management of Incidentally Detected Pulmonary Nodules

(Fleischner Society 2017 Recommendations)

These recommendations do not apply to Lung Cancer Screening

SOLID NODULES				
		Size (average of long- and short-axis diameters)		
		<6 mm (<100 mm ³)	6–8 mm (100–250 mm ³)	>8 mm (>250 mm ³)
Single				
	Low risk [†]	No routine follow-up [‡]	LDCT at 6–12 mos, then consider LDCT at 18–24 mos	Consider CT, PET/CT, or tissue sampling at 3 mos
	High risk [†]	Optional LDCT at 12 mos [‡]	LDCT at 6–12 mos, then LDCT at 18–24 mos	Consider CT, PET/CT, or tissue sampling at 3 mos
Multiple*				
	Low risk [†]	No routine follow-up	LDCT at 3–6 mos, then consider LDCT at 18–24 mos	LDCT at 3–6 mos, then consider LDCT at 18–24 mos
	High risk [†]	Optional LDCT at 12 mos	LDCT at 3–6 mos, then LDCT at 18–24 mos	LDCT at 3–6 mos, then LDCT at 18–24 mos

[†] Consider all relevant risk factors.
[‡] Nodules <6 mm do not require routine follow-up, but certain patients at high risk with suspicious nodule morphology, upper lobe location, or both may warrant 12-month follow-up.
 * Use most suspicious nodule as guide to management. Follow-up intervals may vary according to size and risk.
 LDCT = Low Dose CT

Table 1. Current management recommendations for incidentally detected pulmonary nodules based on the 2017 Fleischner Society guidelines (solid nodules).

Management of Incidentally Detected Pulmonary Nodules

(Fleischner Society 2017 Recommendations)

These recommendations do not apply to Lung Cancer Screening

SUBSOLID NODULES

Size (average of long- and short-axis diameters)

<6 mm (<100 mm³)

≥6 mm (>100 mm³)

Single

Ground glass

No routine follow-up[‡]

LDCT at 6–12 mos to confirm persistence, then LDCT every 2 yrs until 5 yrs

If Growth, consider biopsy or resection

Part solid*

No routine follow-up[‡]

LDCT at 3–6 mos to confirm persistence. If unchanged and solid component remains <6 mm, annual LDCT should be performed for 5 yrs.

If Growth, consider biopsy or resection

Multiple[†]

LDCT at 3–6 mos. If stable, consider LDCT at 2 and 4 yrs.

LDCT at 3–6 mos. Subsequent management based on the most suspicious nodule(s).

If Growth, consider biopsy or resection

* In practice, part-solid nodules cannot be defined as such until ≥6 mm, and nodules <6 mm do not usually require follow-up. Persistent part-solid nodules with solid components ≥6 mm should be considered highly suspicious.

† Multiple <6 mm pure ground-glass nodules are usually benign, but consider follow-up in selected patients at high risk at 2 and 4 years.

‡ In certain suspicious nodules <6 mm, consider follow-up at 2 and 4 years. If solid component(s) or growth develops, consider resection.
LDCT = Low Dose CT

Table 1. Current management recommendations for incidentally detected pulmonary nodules based on the 2017 Fleischner Society guidelines (subsoliid nodules).

Management of Pulmonary Nodules in the Setting of Infection or Known Malignancy

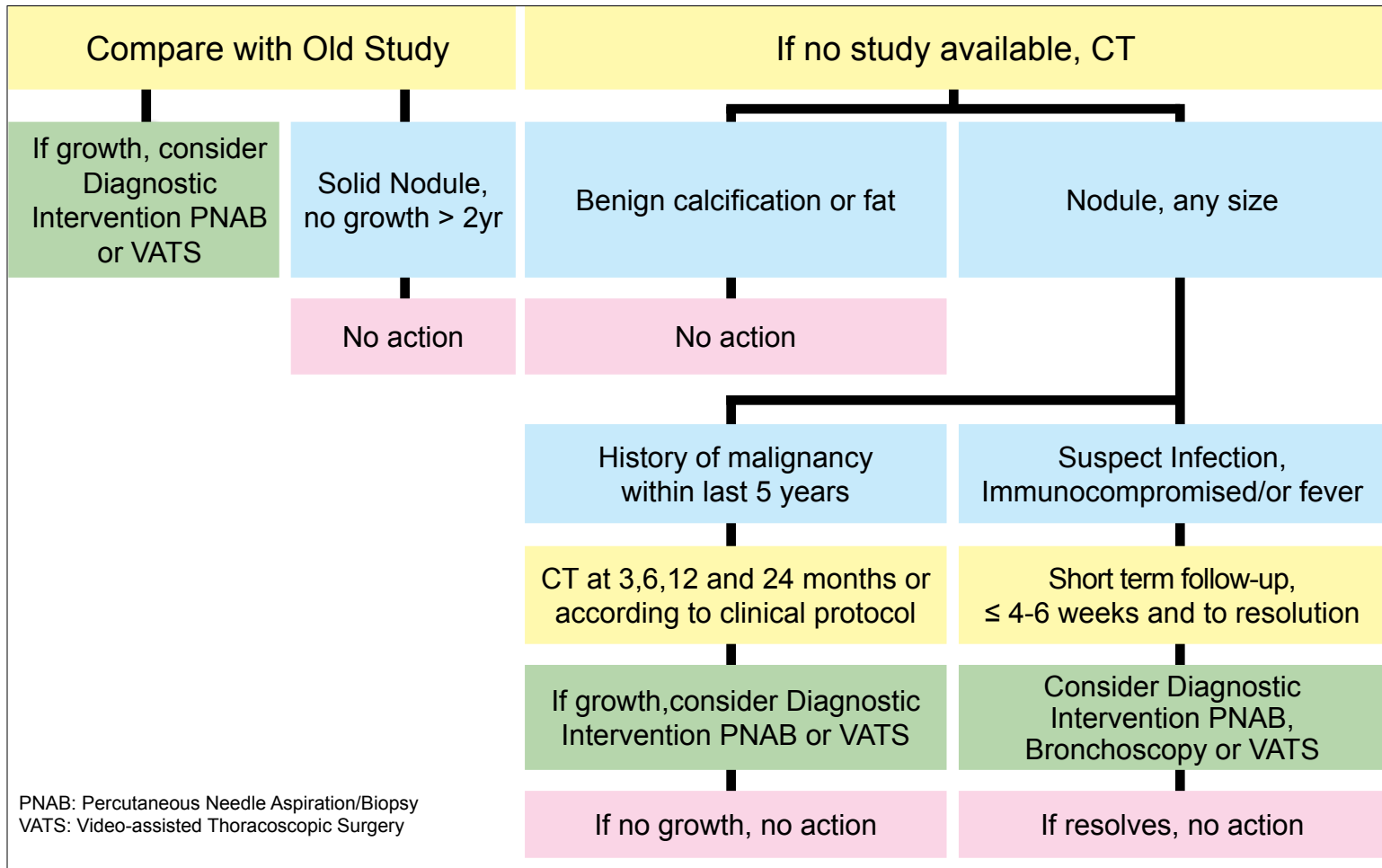


Figure 2. Recommended follow-up algorithms for pulmonary nodules in patients with suspected infection or known malignancy.