



Evaluating Pulmonary Nodules

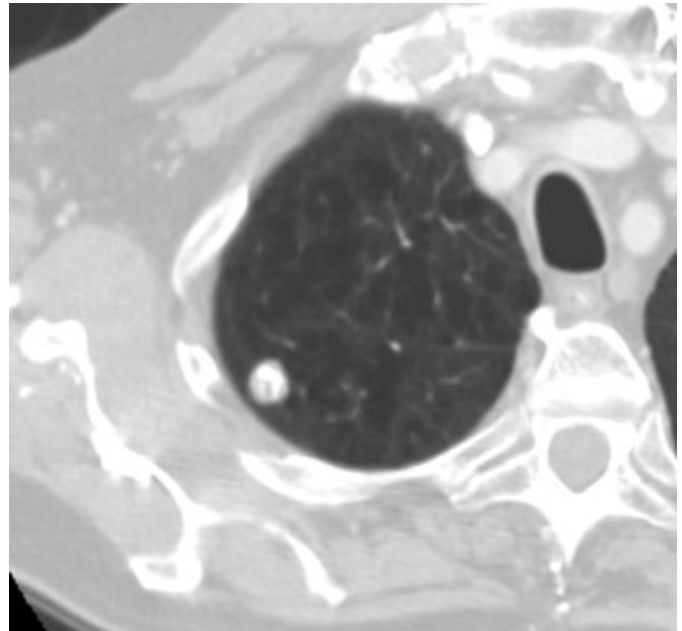
- **Pulmonary nodules smaller than 4 mm have a very low risk (<1%) of being cancerous; follow up CT scans are recommended per algorithm below.**
- **Pulmonary nodules between 4-8 mm have intermediate risk (about 6%); follow up CT scans recommended unless patient is high risk then consider PET or diagnostic intervention.**
- **Pulmonary nodules greater than 8 mm are suspicious for cancer and fine needle aspiration (FNA) biopsy is recommended or, in some cases a PET scan or VATS may be considered.**

Solitary pulmonary nodules are common incidental findings in chest x-ray or CT images, with around 150,000 new nodules found each year in the United States. They are defined as approximately round lesions less than 3 cm in diameter, surrounded by normal lung parenchyma. Anything larger than that is defined as a mass and is likely to be cancerous.

Once a nodule is found, the first step in the evaluation is to compare it to previous images to establish if it is a new finding or, if it is not, whether it is stable or increasing in size. The vast majority of nodules that have been shown to be stable for greater than two years are benign. If there are no previous studies and the nodule was detected on a chest radiograph, the next step is to evaluate it with CT. In some cases, CT can definitively show that the nodule is benign from the pattern of calcification that may be found in granulomas and hamartomas or from the presence of fat that may be present in hamartomas. If the diagnosis is not definitively benign, follow up is dependent on the size of the nodule and risk factors, such as an underlying history of malignancy or heavy smoking.

If the nodule is smaller than 4 mm, it is too small to biopsy percutaneously or to evaluate with a PET scan. As more than 99% of incidentally detected, non-calcified nodules <4mm are benign, the best option is to watch and wait, with follow up CT scans 12 and 24 months after the initial scan. If no growth has been detected after two years, the nodule can be assumed to be benign. If the patient has a history of malignancy, follow-up CT scans are recommended at 3, 6, 12, and 24 months after the scan, unless there is growth. If there is no growth, CT follow-up will continue as per clinical protocol.

Incidentally detected non-calcified nodules between 4 and 8 mm are in the intermediate risk category for malignancy. In patients without any history of cancer,



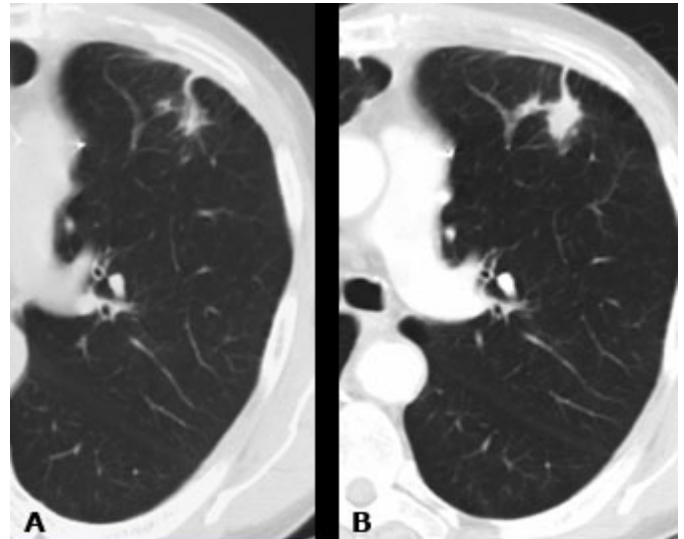
A 12 mm pulmonary nodule in right upper lung with a calcification pattern indicating that this is a benign hamartoma or granuloma.

approximately 94% of nodules of this size are benign. Risk factors, such as age, history of cigarette smoking or significant second hand smoke exposure, and the clinical situation play a role in deciding the next steps for these patients. In most cases, it is best to watch and wait, with follow-up CT scans obtained at 3, 6, 12, and 24 months. In selected cases in which clinical risk factors of cancer are high or in which nodule characteristics such as spiculation suggest a much higher likelihood of malignancy, FNA biopsy or a PET scan should be considered.

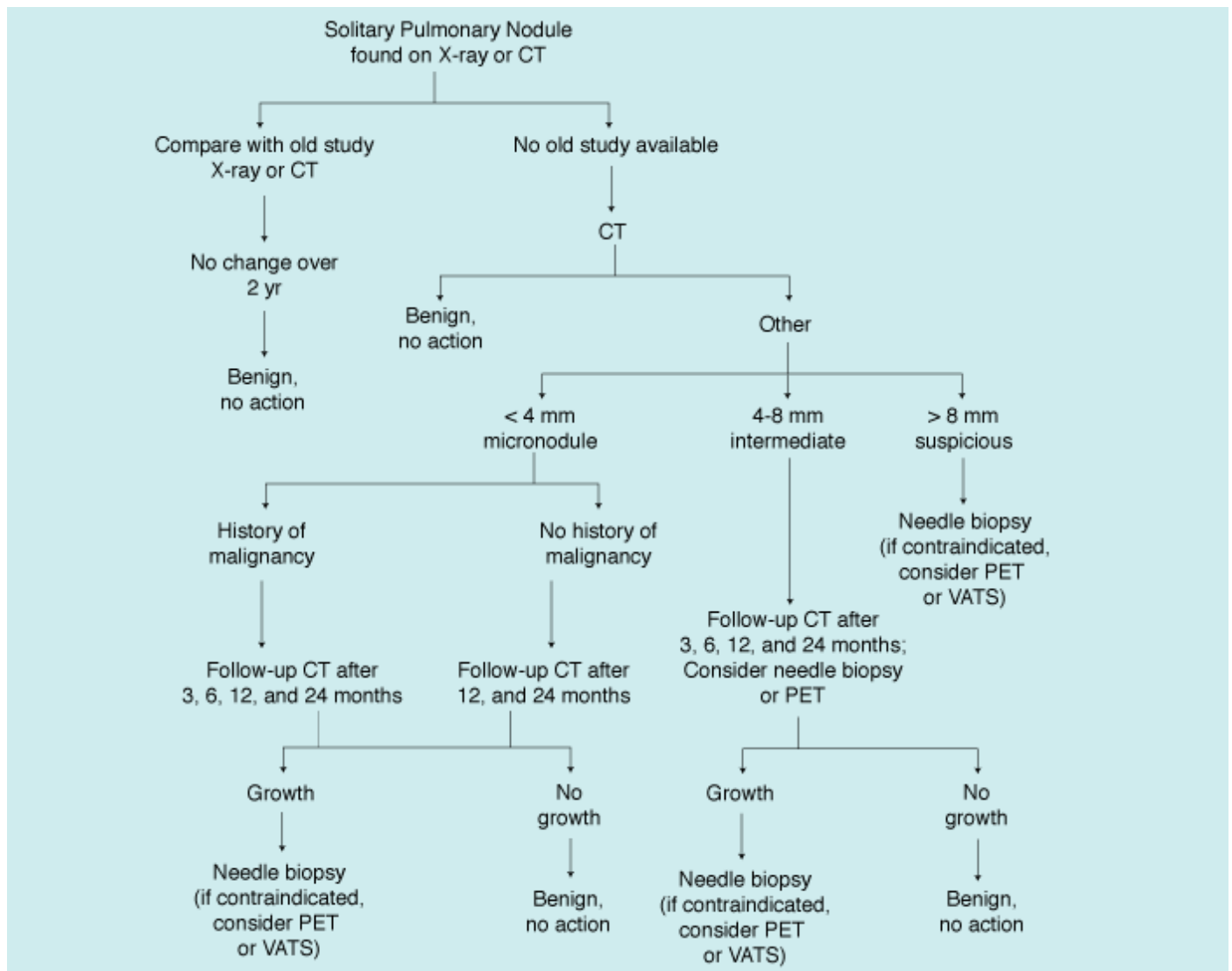
Nodules larger than 8 mm are regarded as suspicious for malignancy, because approximately 50% of incidentally detected nodules of this size are malignant.

Unless biopsy is contraindicated, it is recommended that percutaneous CT guided FNA biopsy be performed, which will provide a definitive diagnosis with an accuracy of about 90% for malignant lesions and 60-80% for specific benign lesions. In some cases, where the lesion is close to a central bronchus, bronchoscopy with transbronchial biopsy can be considered. Relative contraindications for FNA biopsy include patients who are ventilated, have severe emphysema, have had a pneumonectomy, are on anti-coagulant therapy, or have pulmonary arterial hypertension. If it is not possible to perform FNA biopsy, the choices are to perform a PET scan or surgically remove the nodule, using video assisted thoracoscopic surgery (VATS).

In any case in which a nodule is increasing in size, no matter what the initial size, it should be considered suspicious for malignancy and intervention considered. In cases in which characteristics of any size nodule suggest an inflammatory process, a short-term follow-up CT is recommended after 4-6 weeks to assess for resolution or progression.



A & B Sequential images of the same patient showing pulmonary nodule changes that are suspicious for malignancy.

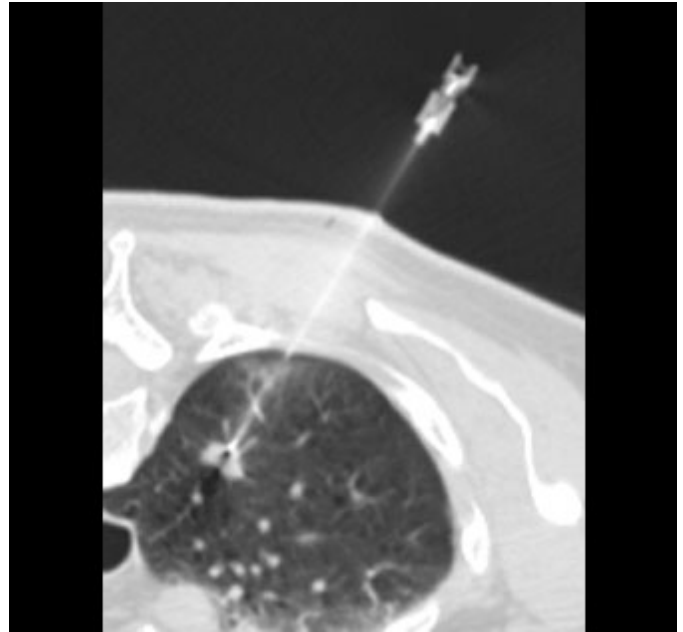


Advantages and Disadvantages of Biopsy and PET

Both PET and FNA biopsy are not as reliable for diagnosis of lesions smaller than 8 mm as they are for larger nodules. Tumors smaller than 8 mm and those with a low metabolic rate may not be detected by PET. In addition, inflammatory lesions, such as granulomatous lesions can also appear in PET scans, resulting in false positive findings for cancer. Histological examination of the cells withdrawn by FNA biopsy can differentiate between malignant and infectious lesions, such as TB and fungal infections, which may need medical treatment. In addition, the type of malignancy can be identified, which can help in determining which patients are candidates for surgery or chemotherapy.

FNA biopsy is associated with a significant number of minor complications. As many as 20% will have a small pneumothorax and 1-2% will have a pneumothorax large enough to require a chest tube. In addition, some patients will experience minor hemoptysis.

Although PET is more expensive than FNA, it does have the advantage of acquiring whole body images in cases of suspected lung cancer, which makes it possible to discover distant metastases outside of the lung. It is, therefore, a valuable tool for staging cancer.



Fine needle aspiration (FNA) biopsy of a suspicious pulmonary nodule.

	Advantages	Disadvantages
Fine Needle Biopsy	Histological diagnosis	Cannot be performed on lesions < 8 mm Minor pneumothorax, 20% Significant pneumothorax, requiring chest tube, 1-2% Minor hemoptysis, 2-5%
PET	Whole body image detects extra-pulmonary tumors Can stage known lung cancer	Cannot detect lesions < 8 mm False positives from inflammation False negatives from tumors with low metabolic rate
VATS	Definitive histological diagnosis	General anesthesia Hospitalization, 1-3 days (longer in cases of prolonged air leak in 35%) Arrhythmia, 3-4% Bleeding, 4%

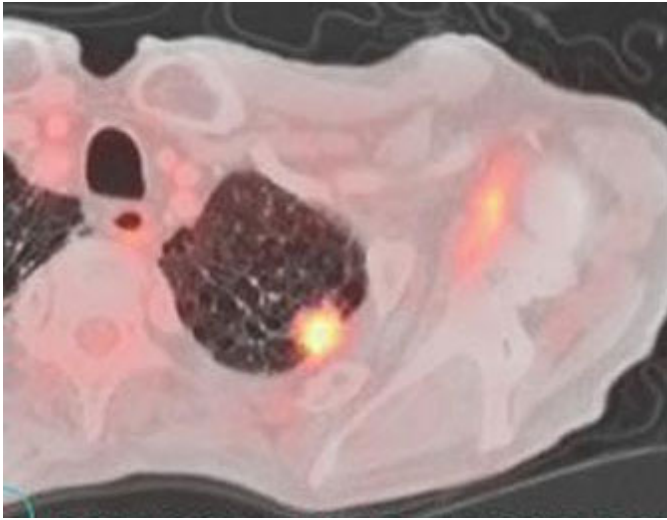
Patient Preparation and Procedures

No specific patient preparation is necessary for CT. For details about preparation for PET, see [May 2004 newsletter](#).

Patients should not eat any solid food for 6 hours prior to FNA biopsy. They may drink clear liquids up to 3 hours before the procedure. Diabetics taking insulin should take half their normal 24 hour dose in the morning and those on oral diabetic medication should not take it the night before or the morning of the procedure. Patients must have normal coagulation.

Anticoagulant medication, including aspirin, should be discontinued for 7 days prior to a FNA.

Patients will receive light conscious sedation during the FNA biopsy. After the procedure, patients will need to lie quietly for 3-4 hours in the radiology recovery area. Prior to discharge, chest x-rays will be performed to check for complications such as pneumothorax and bleeding. Biopsy results will usually be ready within 3-4 days.



PET/CT scan showing high metabolic activity in pulmonary nodule, indicative of cancer or inflammation.

Further Information

For further questions on pulmonary nodules, please contact Dr. Jo-Anne Shepard, jsheward@partners.org Director of Thoracic Radiology (617-726-4256) or Dr. Michael Lanuti, mlanuti@partners.org, Assistant in Thoracic Surgery (617-726-6751).

Scheduling

Both PET and CT examinations may be scheduled online through Radiology Order Entry (ROE) or by calling 617-724-XRAY (617-724-9729). A consultation for FNA biopsy of the lung can be requested by calling 617-724-4254 or by faxing a [Thoracic Biopsy Approval form](#) available on the MGH Radiology Department website.

References

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