Frequently Asked Questions in the Interpretation of Preoperative and Postoperative Chest CT Scans Related to Lung Cancer Imaging

성균관의대 삼성서울병원 진단방사선과
이 경 수

Kyung Soo Lee, MD

Department of Radiology, Samsung Medical Center,
Sungkyunkwan University School of Medicine

Abstract

With the advent of multidetector-row CT, lung cancer imaging is much more promising than before. However, the effectiveness of multidetector-row CT in making an initial diagnosis, staging, and evaluating post-treatment changes of lung cancer still remains to be proved. Fast imaging along with volumetric data set and attendant multi-planar imaging provide much more details on the anatomic changes and pathology associated with lung cancer. However, with images showing anatomic and pathologic changes only, radiologists confront with several questions the answers of which may help evaluate lung cancer more thoroughly. The frequent questions that I have in daily practice of chest CT interpretation are as follows.
(Korean J Nucl Med 2002;36;25-27)

In Preoperative CT Imaging Interpretations

Evaluation of Solitary Pulmonary Nodule (SPN)

Most malignant tumors are characterized by increased glucose metabolism. The sensitivity of FDG PET in imaging a SPN is 83-100% and specificity is 63% to 90% [1]. Standard uptake value (SUV) of > 2.5 is considered indicative of malignancy.

When pulmonary nodules present with surrounding satellite nodules, little enhancement with administration of contrast (< 15HU), or with calcification of laminated, diffuse, popcorn-like, and nodular types, CT suggests benign granulomatous disease such as TB, histoplasmosis, cryptococcus, sarcoid, and rheumatoid nodule and organizing pneumonia [2,3]. In these circumstances, does PET enable to differentiate between benign and malignant nodules?

Small nodules less than 10 mm in diameter are frequently noticed on thoracic CT in patients with or without thoracic or extrathoracic malignancy. In patients with lung cancer, presence of malignant satellite nodules in the same primary lobe makes T4 disease, whereas presence of them in the non-primary lobe makes M1 disease. In both the conditions, the diseases are unresectable. With CT images only, differentiation of benign and malignant satellite nodules is difficult even though not feasible, especially when they are small and less than 10 mm in diameter [4]. Does PET help differentiate between

Corresponding author: Kyung Soo Lee, MD
Department of Radiology, Samsung Medical Center
Seoul 135-710, Korea.

malignant and benign nodules when the nodules are less than 10 mm in diameter?

Nodular bronchioloalveolar carcinoma (BAC) and adenocarcinoma with BAC component appear with nodule of ground-glass opacity or nodule containing large proportion of ground-glass opacity. In these conditions, the doubling time of these nodules is very long and may be more than 2 years. Furthermore, mediastinal nodal or extrathoracic metastases are much less than nodules with higher attenuation (dense nodules) [5,6]. What are the SUVs in these tumors (nodular BAC or adenocarcinoma with BAC component)? Low SUV in solitary nodular lung cancer suggests low metabolic activity and the less likelihood of mediastinal nodal or extrathoracic metastasis?

Evaluation of Lung Cancer Staging

PET is more accurate than CT in demonstrating nodal metastases from non-small cell lung cancer. Wahl et al [7] demonstrated a sensitivity of 82% and a specificity of 81% for PET compared with a sensitivity of 64% and a specificity of 44% for CT in the staging of mediastinal nodal disease. The overall diagnostic accuracy of PET was 92% and 75% for CT.

Although showing superiority in tumor staging, does PET alone provide such a sufficient resolution to help determine the extent of tumor and involvement of individual lymph node group that further CT study is unnecessary?

Central tumor and resultant atelectasis or a lobe or a segment on CT or MR makes classify the tumor into being T2 disease. Does PET can help differentiate between post-obstructive atelectasis or post-obstructive pneumonia and tumor per se? Does PET provide reliability on the extent of tumor (especially chest wall invasion and mediastinal extent)?

PET may be used to evaluate adrenal masses, with sensitivity and specificity of 100% and 80%, respectively [8]. PET also detects bony metastatic lesions not found on conventional studies. The accuracy, sensitivity, and specificity of PET for bone metastases have been reported to be above 90% [9]. How about brain metastases? Brain is the most frequent site of extrathoracic metastases in patient with lung cancer. It is the frequent site of metastases even in patients with stage I lung cancer [10]? Can whole body PET be replaced brain MR in the detection of brain metastases? Reported sensitivity in detecting brain metastases is around 60%.

In Postoperative CT Imaging Interpretations

FDG PET is useful in measuring response to chemotherapy and radiation and also in the detection of recurrent disease. PET has been reported to have a sensitivity of 97% to 100% and a specificity of 62% and 100% in the detection of recurrent tumors [11,12].

In the interpretation of postoperative or post-radiation/post-chemotherapy CT scans, differentiation between fibrotic mass and recurrence is sometimes difficult. When (how many months after completion of therapy) PET scans are reliable?

By noticing SUV of primary tumor after therapy, PET can help differentiate between sterilized primary tumor and still dormant tumor with decreased activity?

References

1. Gupta NC, Maloof J. Gunel E. Probability of malignancy in solitary pulmonary nodules using fluorine-18-FDG and PET. J Nucl Med 1996; 37:943-948.
2. Kim H, Kang SJ, Suh GY, Chung MP, Kwon OJ, Rhee CH, Jung KJ, Kim TS, Lee KS. Predictors for benign solitary pulmonary nodule in

tuberculosis-endemic area. Korean J Intern Med 200; 16:236-241.

3. Yang PS, Lee KS, Han J, Kim EA, Kim TS, Choo IW. Focal organizing pneumonia: CT and pathologic findings. J Korean Med Sci 2001; 16:573-578.
4. Kim YH, Lee KS, Primack SL, et al. Small pulmonary nodules on CT accompanying surgically resectable lung cancer: likelihood of malignancy. J Thorac Imaging. 2002; 17:40-46.
5. Kim EA, Johkoh T, Lee KS, et al. Quantification of ground-glass opacity on high-resolution CT of small peripheral adenocarcinoma of the lung: pathologic and prognostic implications. AJR 2001; 177:1417-1422.
6. Kim BT, Kim Y, Lee KS, et al. Localized form of bronchioloalveolar carcinoma: FDG PET findings. AJR 1998; 170:935-939.
7. Wahl RL, Quint LE, Greenough RL, Meyer CR, White RI, Orringer MB. Staging of mediastinal non-small cell lung cancer with FDG PET, CT, and fusion images: preliminary prospective evaluation. Radiology 1994; 191:371-377.
8. Erasmus JJ, Patz EF, McAdams HR, et al. Evaluation of adrenal masses in patients with bronchogenic carcinoma by using 18F fluorodeoxyglucose positron emission tomography. AJR 1997; 168:1357-1360.
9. Bury T, Barreto A, Daenen F, Barthelemy N, Ghaye B, Rigo P. Flurine-18 deoxyglucose positron emission tomography for the detection of bone metastases in patients with non-small lung cancer. Eur J Nucl Med 1998; 25:1244-1247.
10. Jung KJ, Lee KS, Kim H, et al. T1 lung cancer on CT: frequency of extrathoracic metastases. J Comput Assist Tomogr. 2000; 24:711-718.
11. Patz EF, Lowe VJ, Hoffman JM, Paine SS, Harris LK, Goodman PC. Persistent or recurrent bronchogenic carcinoma: detection with PET and 2-[F-18]-2-Deoxy-D-glucose. Radiology 1994; 191:379-382.
12. Patz EF, Connolly J, Herndon J. Prognostic value of thoracic FDG PET imaging after treatment for non-small cell lung cancer. AJR 2000; 174:769-774.