

# Clinical stage of lung cancer revised by accidental pneumothorax and positron emission tomography

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**Abstract** Clinical lung cancer staging is an important basis for choosing treatment modalities and prognosing outcomes. However, it is not always accurate. We reported an interesting process of clinically staging in a case with lung cancer. According to admission computer tomography findings, he was preliminarily diagnosed as stage IV with nonprimary-tumor lobe metastasis and chest wall invasion. Computer tomography findings after accidental pneumothorax resulting from percutaneous puncture biopsy and positron emission tomography findings denied the chest wall invasion and nonprimary-tumor lobe metastasis. His diagnosis was revised as stage IIa that was confirmed subsequently by histological staging after surgery and follow-up. Our experiences indicate computer tomography scanning after artificial pneumothorax is a useful tool for identifying whether or not chest wall is invaded directly by an adjacent tumor, and positron emission tomography scanning needs to be considered for accurately evaluating the nature of concurrent pulmonary nodules in patients with lung cancer.

**Keywords** Lung cancer · Clinical stage · Pneumothorax · Computer tomography · Positron emission tomography

## Introduction

Clinical stage of lung cancer based on TNM system is an important basis for choosing the treatment modalities and prognosing outcomes [1]. Computer tomography (CT) is a

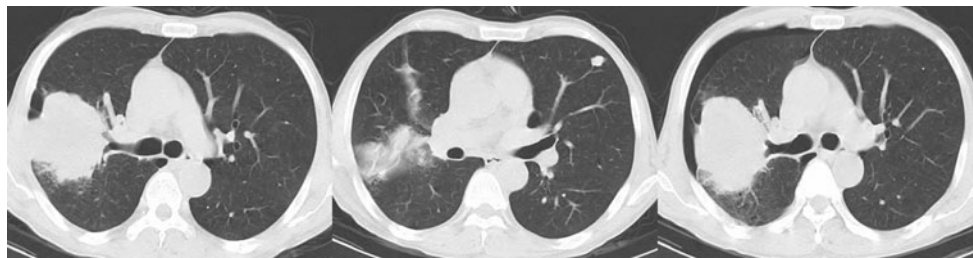
commonly used tool for clinically staging lung cancer and can provide accurate clinical stage in most patients with lung cancer. However, clinical stage of lung cancer based on CT images is not always accurate under some conditions, for example when a tumor closes to chest wall or a nodular lesion presents concurrently in other lung field. We reported here a process of revising clinical stage of such a case with lung cancer whose radiological findings on admission revealed not only a mass closing to chest wall but also a nodule in other lung field.

## Case report

A 60-year-old man was admitted to the hospital because of productive cough for 1 month and low-grade fever for half a month. There was no hemoptysis, wheezing, hoarseness, dyspnea or chest pain, and antibiotic treatments were inefficacious. Physical examination on admission revealed unremarkable except for diminished breath sound on right upper chest auscultation. Tumor markers' tests revealed squamous cell carcinoma antigen and cytokeratin fragment21-1 increase, 2.3 µg/l and 18.21 ng/l, respectively. Admission chest CT findings (Fig. 1) revealed a mass (5 × 7 cm) in right upper lobe closing to chest wall, a noncalcified nodule in left lingual lobe, and no lymphadenectasis signs. The findings of abdominal ultrasonography, brain magnetic resonance imaging, and radionuclide bone scanning did not detect metastatic lesion. Based on the above-mentioned, he was preliminarily diagnosed as lung cancer with stage IV and with nonprimary-tumor lobe metastasis and direct chest wall invasion.

Subsequently, percutaneous puncture biopsy was performed and histological changes revealed squamous cell carcinoma. After percutaneous puncture biopsy, the patient

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**Fig. 1** Admission CT findings revealed a mass in right upper lobe closing to chest wall (*the left*) and a noncalcified nodule in left lingular lobe (*the middle*). CT findings after percutaneous puncture biopsy

presented slight shortness of breath. The complication of pneumothorax resulting from percutaneous puncture biopsy was suspected and chest CT scanning was performed again. While confirming slight right pneumothorax, CT findings revealed the mass in right upper lobe was pushed away from chest wall by gases inside pleural cavity (Fig. 1). This sign did not support the direct chest wall invasion. On the basis of the histological diagnosis, CT findings, and results of other screening examinations, we speculated the nodule in left lung might be benign and the patient could benefit from surgery. To demonstrate the speculation, chest positron emission tomography (PET) scanning was performed. PET findings (Fig. 2) revealed no hypermetabolism signs within the nodule in left lung, chest wall, lung hilum, and mediastinum.

On the basis of the revised clinical stage, surgery of right upper lobectomy and regional and mediastinal lymphadenectomy was performed. Biopsy after surgery confirmed there were no visceral pleura invasion and no regional and mediastinal lymph nodes metastasis. During 12 months of follow-up after surgery, the nodule in left lung did not present any change on CT images.

## Discussion

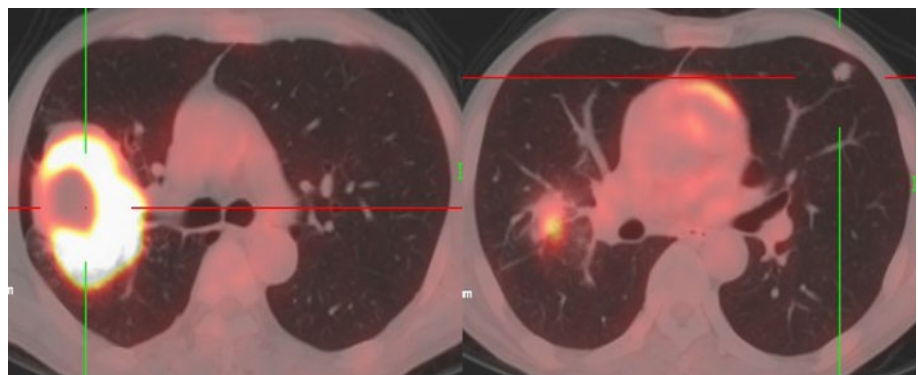
Detailed chest anatomical images provided usually by CT scanning are an important basis for clinically staging lung

revealed slight right pneumothorax, and the mass in right upper lobe was pushed away from chest wall by gases inside pleural cavity (*the right*)

cancer and choosing surgery modality [2, 3]. However, it is difficult to distinguish whether or not chest wall is directly invaded by an adjacent tumor on CT images [4, 5]. In this case, because the tumor closed to chest wall, it was necessary to suspect chest wall invaded directly. CT findings after accidental pneumothorax resulting from percutaneous puncture biopsy revealed the tumor was pushed away from chest wall by gases inside pleural cavity. Based on this sign, the stage T2b was defined. And this clinical T staging was confirmed by histological staging after surgery. This process of defining clinical T staging was accidental. However, it indicates that artificial pneumothorax is a useful tool for identifying whether or not chest wall is invaded directly by an adjacent tumor, consistent with previous studies that reported that CT scanning after artificial pneumothorax could improve the accurate rate of diagnosis of chest wall invasion [6, 7].

With technological advances, noncalcified nodule measured up to 3 cm in diameter is becoming frequent incidental findings on CT images. It is estimated that, influenced by the different scanning technique used, population enrolled and definition of nodule, the prevalence of pulmonary nodules is about 5–60% and the prevalence of malignancy in patients with pulmonary nodules is about 1.1–12% [8, 9]. However, it is nearly impossible to define the nature of pulmonary nodules based on a single CT scanning. In this case, because of a tumor and a noncalcified nodule presenting concurrently in different lung field, it was easy to be diagnosed as lung cancer with

**Fig. 2** PET findings revealed hypermetabolism signs within the mass in right upper lobe, not within the nodule in left lung, chest wall, lung hilum, and mediastinum



nonprimary-tumor lobe metastasis. Defining the nature of this nodule was important because it would directly impact on management and prognosis. Based on the histological diagnosis, no lymphadenectasis detected on CT images and no distant metastasis detected by other screenage examinations, we speculated that this nodule might be benign and had nothing to do with metastasis. Subsequent PET findings revealed no hypermetabolism signs within this nodule. PET scanning is much more accurate than CT scanning in defining the nature of pulmonary nodule and is estimated that accuracy of defining malignancy is average 94% [10, 11]. Thus, we defined there was no nonprimary-tumor lobe metastasis and this nodule in left lung was benign in this case. After the surgery of right upper lobectomy, this nodule presented no change on CT images during 12 months of follow-up. This further confirmed this nodule was benign. Our experiences indicate, when a patient with lung cancer presents concurrently nodules in other lobe, it is hastily to diagnose nonprimary-tumor lobe metastasis based on CT images, and PET scanning need to be considered for accurately evaluating the nature of concurrent pulmonary nodules.

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