

## The value of chest tomosynthesis in locating a ground glass nodule (GGN) during endobronchial ultrasonography with a guide sheath: a case report

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### ABSTRACT

A 74-year-old man was referred to our department for work-up of a pure ground glass nodule (GGN) on computed tomography (CT). He was suspected to have lung cancer by CT scan, but no lesion was visible on chest X-ray. Chest tomosynthesis was performed before bronchoscopy, showing a clear GGN. We could not detect a tumor signal on endobronchial ultrasonography so we relied on the chest tomosynthesis image as a guide during transbronchial biopsy. The diagnosis of adenocarcinoma was confirmed on histopathology. In this case, transbronchial biopsy under the guidance of chest tomosynthesis was useful for the diagnosis of GGN.

### KEY WORDS

Chest tomosynthesis; ground glass nodule; endobronchial ultrasonography with a guide sheath; guide sheath sampling

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### Introduction

The frequency of discovering small nodules and ground glass nodules (GGNs) has increased with the widespread use of chest computed tomography (CT) (1). For many years, transbronchial biopsy (TBB) had been performed for these abnormal chest shadows. Recently, endobronchial ultrasonography with a guide sheath (EBUS-GS) has advanced the diagnostic yield of TBB for peripheral pulmonary lesions (PPLs) (2-4). However, the diagnosis of a GGN is very challenging even if EBUS-GS and X-ray fluoroscopy are utilized. One of the reasons is the difficulty in identifying the optimal site for biopsy.

Chest tomosynthesis (the SONIALVISION safire radiography/fluoroscopy system, Shimadzu, Japan) is a term coined from "tomography" and "synthesis". It is a device that permits

reconstruction of several slices of the thorax in the coronal plane at a desired depth in a single session of photography. Currently, it is used mainly in the field of orthopedics but there has been a recent report that it is excellent in visualizing chest nodules (5). However, there have been only a few reports on GGNs.

We report a case of a pure GGN that was not seen on routine chest radiography or X-ray fluoroscopy but was pinpointed on chest tomosynthesis done prior to bronchoscopy; a diagnosis of adenocarcinoma was made by transbronchial biopsy.

### Case report

A 74-year-old man was referred to our department for work-up of a pure GGN measuring 1.8 cm, located in the left S<sup>1+2</sup>a, as seen on chest CT done on June 2012 (Figure 1A). The patient had a smoking history of 20-pack years, which he quit 20 years ago. Chest X-ray did not show any abnormal shadow on the left upper lung field (Figure 1B). Likewise, F-18-fluorodeoxyglucose positron emission tomography (FDG-PET) did not show abnormal accumulation in the GGN or in any other site (Figure 1C).

On the other hand, chest tomosynthesis done before bronchoscopic examination clearly revealed a lesion on the left upper lung field (Figure 2A). EBUS-GS was performed under X-ray fluoroscopy, but a GGN or a clear tumor signal on EBUS

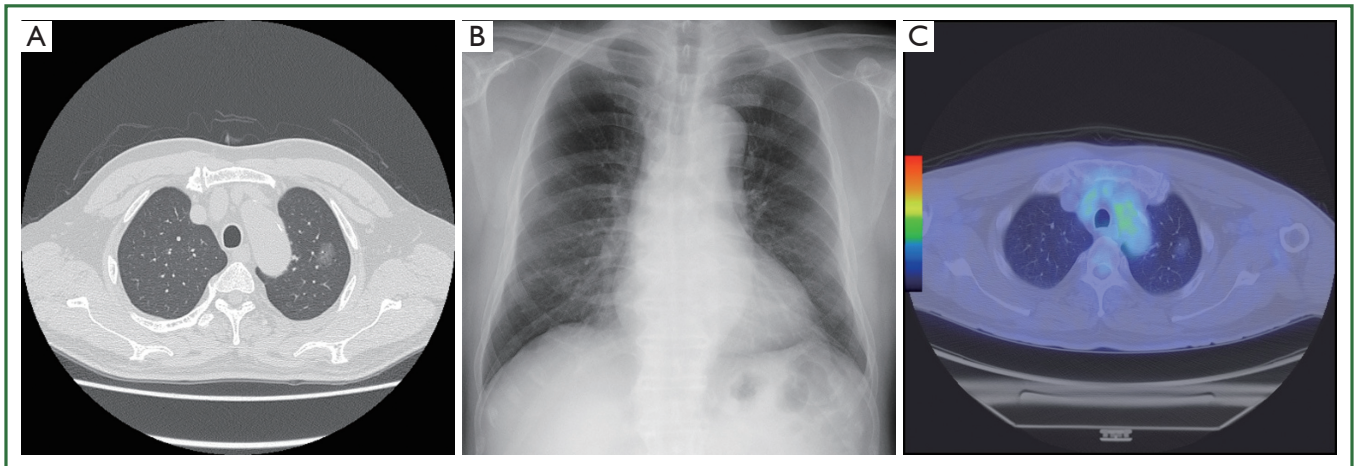
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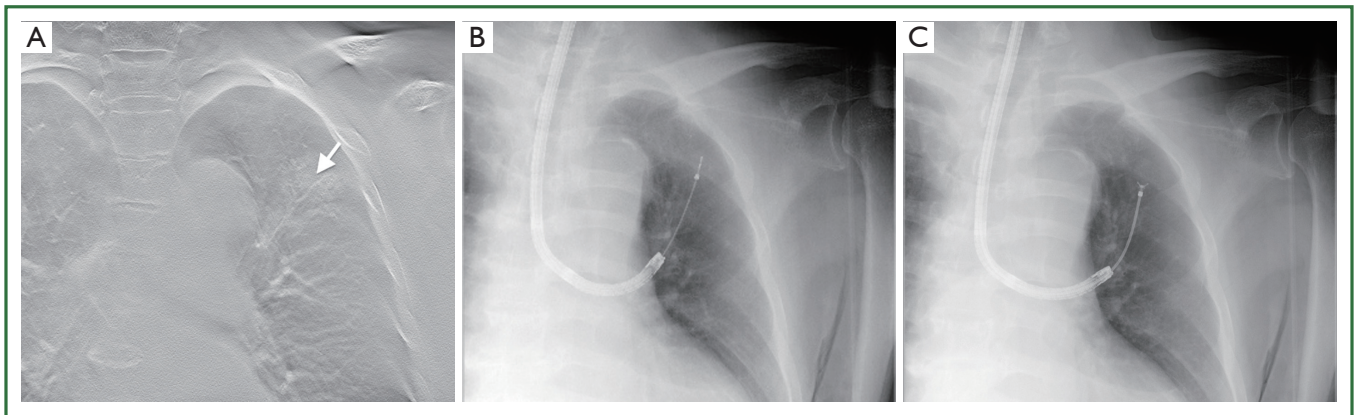
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**Figure 1.** A. A pure ground glass nodule, 1.8 cm in size, can be seen on the left S<sup>1+2</sup>a by chest CT; B. No abnormal shadow on chest X-ray; C. No abnormal accumulation in the ground glass nodule in the left S<sup>1+2</sup>a by FDG-PET.



**Figure 2.** A. Chest tomosynthesis can visualize a ground glass nodule on the left upper lung field very clearly (arrow); B. Insert the endobronchial ultrasound probe into the working channel of the bronchoscope under X-ray fluoroscopy; C. Insert biopsy forceps into the guide sheath to perform a biopsy repeatedly under X-ray fluoroscopy (guide sheath sampling).

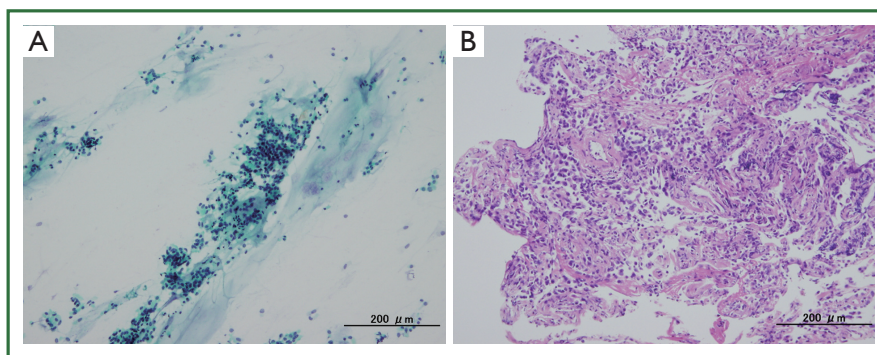
could not be visualized (Figure 2B). We inserted a guide sheath (K-203, Olympus, Japan) through the working channel of the bronchoscope up to the area corresponding to the location of the GGN on the chest tomosynthesis coronal image. Guide sheath sampling was done on this site, obtaining cytology samples by brushing two times and nine TBB specimens (Figure 2C). Although the brush cytology turned out to be negative (Figure 3A), histopathology demonstrated that the proliferated atypical cells had nuclear inclusion bodies with prominent nucleoli (Figure 3B). The resected specimen was diagnosed as well differentiated microinvasive adenocarcinoma at our hospital.

## Discussion

To our knowledge, this is the first case report to describe that chest tomosynthesis is effective in pinpointing the location of a GGN during bronchoscopy guide sheath sampling. Although the detection rate of a GGN has increased along with the widespread

use of chest CT, pathological diagnosis through procedures less invasive than surgical biopsy remains to be an issue (1). The diagnostic yield of bronchoscopy for lung cancer has improved with the advent of EBUS-GS (2) and the capability of this imaging modality to characterize a solid nodule or a consolidation has been established. However, this does not hold true for a GGN (6,7). Up until now, it has long been thought that bronchoscopic diagnosis of a GGN suspicious for an early-stage lung cancer would be impossible because of the difficulty in identifying the exact site for sampling.

Chest tomosynthesis is a tomography device that can reconstruct coronal plane images of the thorax at a desired depth by one session of photography. Recently, there has been a report that it is excellent in visualizing a chest nodule (5). Chest tomosynthesis easily determines the anterior-posterior position between the lesion and bronchi and can capture images while a patient is in the bronchoscopic position, i.e., supine with both hands at the side. In addition, it enables visualization of the



**Figure 3.** A. Papanicolaou staining of brushing specimen did not show any malignant cells ( $\times 100$ ); B. Hematoxylin and Eosin staining of biopsy specimen shows that the proliferated atypical cells had nuclear inclusion bodies with prominent nucleoli ( $\times 100$ ).

location of a pure GGN in the coronal plane.

Currently, chest tomosynthesis takes 2.5 seconds for a single scan and about seven minutes for the reconstruction of images, making it unfeasible to simultaneously perform TBB. Technological improvement would be needed to make the image processing faster (8).

Since GGN, especially the pure type, exhibits extremely weak cytological atypia, precise histopathologic diagnosis becomes a challenge and a larger number of tissue samples are needed. Furthermore, the wall of the bronchus encompassing a GGN is often thick compared to a normal bronchial wall. This makes it difficult for a small biopsy forceps to reach the lesion beyond the wall of the involved bronchus. In order to solve these problems and to make a proper diagnosis, it is necessary to use a guide sheath in the lesion and perform biopsy several times using large biopsy forceps to collect sufficient quantity and size of tissue.

Diagnostic bronchoscopy for GGNs is expected to increase in the future and the development of fluoroscopy technology to confirm a lesion site is very important. Although chest tomosynthesis is very useful for its capability of visualizing a GGN, there are some concerns about the increase in radiation exposure due to the use of X-ray. At our institution, the measured dose of one time chest tomosynthesis is 1.39 mGy compared those of plain chest X-ray and chest CT which are 0.2 mGy and 8.0 mGy, respectively. This translates to a measured dose of chest tomosynthesis seven times higher than that of chest X-ray but only one-sixth of the dose from chest CT. Prudence would dictate that further decreasing the amount of radiation exposure is necessary.

In conclusion, chest tomosynthesis is useful for the identification of the site of a GGN when performing diagnostic bronchoscopy (brushing, TBB) by guide sheath sampling. The potential for a more accurate bronchoscopic examination is promising; especially when in the near future, guide sheath sampling can be done concurrently with real-time chest tomosynthesis.

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**Disclosure:** The authors declare no conflict of Interest.

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