Percutaneous lung biopsy of a small metastatic nodule under CT-guidance

Tobias Gassenmaier, MD

Department of Radiology and Nuclear Medicine, Luzerner Kantonsspital, Luzern, Switzerland

History

A 61-year-old male patient, suffering from a renal cell carcinoma (RCC), underwent a CT examination for staging. A small lung nodule was detected, suspicious of a metastasis. The patient was admitted for a biopsy of the lesion under CT guidance.

Diagnosis and Intervention

A native chest CT was performed in the prone position for planning. The small lung nodule, measuring 6 × 8 mm in size, was shown in the left lower lobe, posterior basal segment (S10).

The patient was prepared under sterile conditions and local anesthesia using lidocaine. As the direct in-plane access was obstructed by a rib or the spine, due to the paravertebral location of the lesion, an angled approach from cranial was planned. A 17G coaxial needle with valve (to reduce the risk of pneumothorax or air embolism) was directed towards the pleura, using the entry point and the angle of the planned path projected by myNeedle Laser. The needle position was monitored and controlled by intermittent short sequential scans (i-sequence) and automatic multiplanar reformats (MPRs) reconstruction along the coaxial needle using automatic needle detection algorithm within myNeedle Guide 3D. This algorithm also calculated the distance between the needle tip and the lesion, guiding the advancement of the needle. Once the proper position of the coaxial needle was achieved, an 18G biopsy needle was inserted and a position check was repeated. This showed that the small round lesion was centrally captured. A punch biopsy with a 2 cm advancement was taken and the specimen was preserved in formalin. The instruments were removed with a blood patch during retraction.

In the control CT scan, immediately after the biopsy, signs of minor expected bleeding in the biopsy channel and blood in the access path after a blood patch were visible, with no evidence of a pneumothorax. The patient was asymptomatic and was transferred to the medical day ward for monitoring. Control imaging, 3 hours after intervention, using an ultra-low-dose chest CT protocol showed neither pneumothorax nor bleeding, allowing the patient to be discharged. The histological examination of the specimen confirmed a pulmonary metastasis from a renal cell carcinoma.

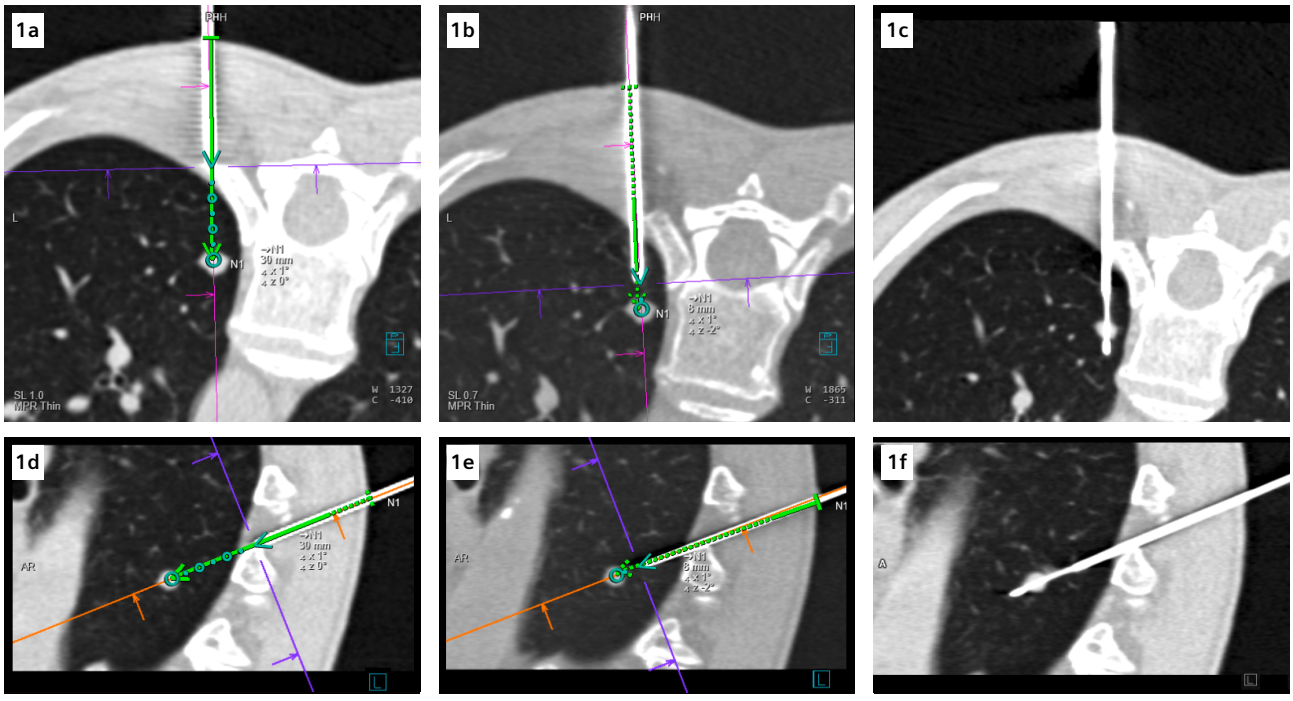
Comments

A percutaneous lung biopsy guided by CT is a minimally invasive, established technique for histologically diagnosing pulmonary lesions, particularly effective for peripherally located lesions. Despite its efficacy, the procedure carries risks such as pneumothorax and intrapulmonary hemorrhage, potentially leading to longer hospital stays and increased costs. A precise planning of the needle trajectory and careful needle positioning are crucial to mitigate these risks. In this case, the procedure was conducted using the SOMATOM X.ceed, which incorporates an integrated laser system (myNeedle Laser) and 3D guidance software (myNeedle Guide 3D) featuring the automatic needle detection algorithm (myNeedle Detection). This advanced technology facilitates precise and efficient interventions. The myNeedle Laser projects the entry point and the angle of the planned path directly onto the patient's surface, aiding accurate needle insertion. The needle trajectory is shown automatically on MPRs, supporting off-plane, angulated procedures.

Throughout the biopsy, monitoring scans are performed to verify the needle position. The system employs an AI-based needle detection algorithm* that automatically aligns the MPRs with the detected needle, scrolls to the axial image at the needle tip, and provides a projected path preview. This graphical representation allows interventionists to evaluate whether the needle is on course or if adjustments are needed.

Integrating the laser guidance system with the automated needle detection algorithm not only enhances procedural efficiency but also potentially reduces radiation exposure by minimizing the need for frequent monitoring scans. ●

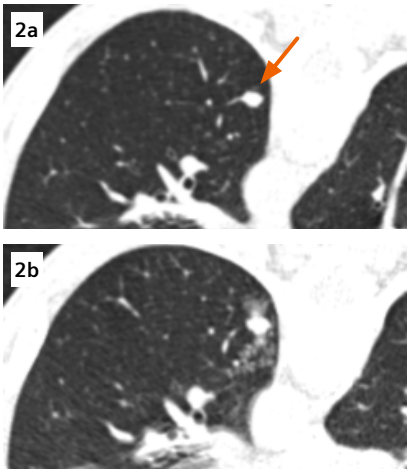
** The automatic needle detection algorithm detects the needle tip with a deviation <5mm and <5 degrees in 90% of all needles. Additional manual adjustment (fine tuning) of the needle-aligned view is always possible.*



1 MPR images, reconstructed automatically along the coaxial needle in the intermittent control scans, show a 17G coaxial needle positioned close to the pleura (Fig. 1a & 1d) and advanced to the nodule (Fig. 1b & 1e). The small nodule is centrally captured by an 18G biopsy needle (Fig. 1c & 1f). An AI-based needle detection algorithm automatically detects the position of the tip of the needle (purple line), calculates its distance to the nodule (small circles) and projects a preview of the needle trajectory in-plane (solid green line) and off-plane (dotted green line).

Examination Protocol

Scanner	SOMATOM X.ceed		
Scan area	Thorax	Mid Thorax	Thorax
Scan mode	i-spiral mode (planning)	i-sequence/i-spiral (Planning/monitoring)	i-spiral mode (control)
Scan length	344 mm	36/75.6 mm	343 mm
Scan direction	Cranio-caudal	Cranio-caudal	Cranio-caudal
Scan time	5.5 s	0.35/2 s	5.5 s
Tube voltage	120 kV	110/90 kV	90 kV
Effective mAs	106 mAs	38/95 mAs	134 mAs
Dose modulation	CARE Dose4D	CARE Dose4D	CARE Dose4D
$CTDI_{vol}$	7 mGy	2.1/2.9 mGy	4 mGy
DLP	262 mGy*cm	3/28.8 mGy*cm	144 mGy*cm
Rotation time	0.5 s	0.5 s	0.5 s
Pitch	0.8	NA/0.8	0.8
Slice collimation	128 × 0.6 mm	128 × 0.6 mm	128 × 0.6 mm
Slice width	0.6 mm	0.6 mm	0.6 mm
Reconstruction increment	0.4 mm	0.4 mm	0.4 mm
Reconstruction kernel	Br36/Br60	Br36/Br60	Br36/Br60



2 An axial image acquired in a prone position for planning (Fig. 2a) shows a small lung nodule (arrow) in the left lower lobe (S10). In the control CT scan immediately after the biopsy (Fig. 2b), dotted hyperdensities close to the nodule are visible representing minor bleeding in the biopsy channel and blood in the access path after a blood patch. No signs of pneumothorax are evident.

The products/features (mentioned herein) are not commercially available in all countries. Their future availability cannot be guaranteed.