Endobronchial Ultrasonography in Bronchoscopic Occult Pulmonary Lesions

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**Introduction:** The diagnostic yield of flexible bronchoscopy for peripheral pulmonary lesions is variable and often limited. Endobronchial ultrasonography (EBUS) has been reported to help localize a bronchoscopic occult pulmonary lesion and thereby improve the diagnostic yield of transbronchial biopsy (TBB).

**Methods:** We evaluated the yield of EBUS-guided TBB in 50 consecutive patients with a bronchoscopic occult pulmonary lesion.

**Results:** The mean diameter of the lesions was 36.6 mm (SD = 19.7 mm). We could visualize 74% of the bronchoscopic occult lesions with EBUS, and in these patients, a histologic diagnosis on TBB was obtained in 84%. However, the diagnostic yield was very poor for lesions <20 mm.

**Conclusion:** EBUS-guided TBB is effective for localizing and diagnosing bronchoscopic occult pulmonary masses ≥20 mm, but its yield remains unsatisfactory for lesions <20 mm.

**Key Words:** Bronchoscopy, Endobronchial ultrasonography, Pulmonary lesion, Transbronchial biopsy.

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Flexible bronchoscopy has a variable and often poor diagnostic yield for pulmonary lesions in cases of a normal endobronchial examination on bronchoscopy. The sensitivity of bronchoscopy for detecting malignancy in a solitary pulmonary nodule depends on the size of the nodule, the proximity to the bronchial tree, and the prevalence of cancer in the study population. For nodules that are 20 to 30 mm in diameter, the sensitivity is 40% to 60%. The diagnostic yield is mostly achieved with the auxiliary use of radiographic fluoroscopic guidance, but lesions <20 mm in diameter remain difficult to detect, with a diagnostic yield of <30%. In the absence of radiographic fluoroscopic guidance, it can often be difficult to identify the correct distance and bronchial access to a peripheral pulmonary lesion >20 mm.

Endobronchial ultrasonography (EBUS) using a miniprobe has been reported to be useful in confirming the accurate bronchial route and obtaining a histologic diagnosis of peripheral pulmonary lesions.

In this study, the diagnostic efficacy of EBUS-guided transbronchial biopsy (TBB), in the absence of radiographic fluoroscopic guidance, was evaluated in a series of consecutive patients with a pulmonary mass and normal bronchoscopic inspection.

**Patients and Methods**

From January 1 to May 31, 2005, we prospectively studied the use of EBUS-guided TBBs in patients referred to the endoscopy unit with a pulmonary nodule or solid mass. During this period, EBUS was added in 50 consecutive patients having normal endoluminal findings on routine diagnostic bronchoscopy. A pulmonary nodule or solid mass was defined as a lesion surrounded by pulmonary parenchyma on computed tomography (CT). Spiral chest CT was reviewed before the procedure, and the largest diameter of the lesion was measured on the soft-tissue windows. Patients with a spiral CT showing a pulmonary infiltrate (with the presence of an air bronchogram in the lesion and thus a high likelihood of a benign infectious lesion) or a subpleural lesion lying entirely within 10 mm from the pleura (as an EBUS miniprobe performs only radial scanning at 10 mm from its distal tip) were excluded from this study. After informed consent, bronchoscopy using local anesthesia was performed with a flexible bronchoscope (BF-1T160; Olympus). All patients received oxygen 2 liters/min via a nasal cannula, and blood oxygenation was monitored with continuous pulse oximetry. Fluoroscopy was not used during the procedure because it is not available in our endoscopy unit.

The EBUS system (processor EU-M20 and driving unit MH-240; Olympus), equipped with a 20-MHz mechanical radial miniprobe (UM-BS20-26R; Olympus) with a balloon sheath (MAJ-643R; Olympus), has been used by one staff member of the respiratory endoscopy unit. After localization of the lesion, the bronchoscope was kept in place at the nearest visible subsegmental carina, and the miniprobe was removed while measuring the distance to the lesion. We did not use a catheter sheath because it renders the procedure...
RESULTS

A total of 50 patients (34 males and 16 females) with an average age of 69 years were examined. The mean diameter of the lesions on CT was 36.6 ± 19.7 mm (range, 8–90 mm). The location of the lesions was variously distributed: 14 in the right upper lobe, five in the right middle lobe, eight in the right lower lobe, 15 in the left upper lobe, and eight in the left lower lobe.

In 34 patients, a pathologic (histology + cytology) diagnosis could be established: primary lung cancer in 28 patients (adenocarcinoma, n = 7; squamous cell carcinoma, n = 5; large cell carcinoma, n = 13; and small cell lung carcinoma, n = 3). A benign lesion could be documented in six patients (bronchiolitis obliterans in two patients and postransplantation lymphoma, mucor mycosis infection, antracosisis that proved to be stable at follow-up, and Mycobacterium tuberculosis infection in one patient each) (Table 1). The bronchoscopic occult lesion could be visualized with EBUS in 37 of 50 patients (74%), and a histologic diagnosis could be established in 31 of these 37 (84%).

In 16 patients, no diagnosis was obtained during bronchoscopy (Table 1). These undiagnosed lesions were homogeneously spread: 34% (10 of 34 lesions) in the upper lobe segments, 29% (six of 21 lesions) in the lower/middle lobe segments. In 13 patients, the lesion could not be found with EBUS, although access was considered feasible based on the CT scan, leading to 11 nondiagnostic bronchoscopies, as additional cytologic examination of the lavage fluid was diagnostic in two of these (non-small cell lung cancer and Mycobacterium tuberculosis one each). A bronchoscopic diagnosis was also lacking in five patients in whom the lesion was visible on EBUS. In two of these, with visualization on a tangential EBUS image, the diagnosis ultimately proved to be non-small cell lung cancer (B2r, 37 mm) and metastasis of a colorectal carcinoma (B3r, 11 mm) in one each. Three patients, with visualization on circular EBUS, ultimately proved to have a lymphoma (B5l, 43 mm) and two had an unknown but stable lesion at follow-up (B11, 23 mm and B1r, 40 mm).

Moderate bleeding requiring only bronchoscopic hemostasis was noted in one patient. No significant adverse effects (pneumothorax, respiratory distress, or urgent surgery) occurred.

An overall pathologic diagnostic yield of 68% was obtained (Table 2). For lesions <20 mm in the greatest diameter, the pathologic diagnostic yield decreased to 18%, whereas 82% was reached for lesions ≥20 mm. In the overall group, the average diameter of the diagnosed lesions (41 mm; range, 15–90) was significantly higher than the average diameter of the undiagnosed lesions (27 mm; range, 8–87, p = 0.013). However, when considering only lesions ≥20 mm, there was no difference between the average diameter of the diagnosed lesions (42 mm; range, 20–90) and the average diameter of the undiagnosed lesions (43 mm; range, 23–87, p = 0.977). Because size does not discriminate between diagnosed and undiagnosed lesions for the subgroup ≥20 mm, we hypothesized that other factors did, such as a tangential visualization (e.g., hematogenous metastasis) or an inaccessible target bronchus (e.g., occlusion of the bronchus leading toward the lesion).

DISCUSSION

EBUS can guide TBB by revealing the optimal bronchial access and measure the distance to a pulmonary lesion. The reflection of adjacent zones of normal aerated lung tissue generally defines a peripheral lesion as a clear hypoechoic texture on EBUS (Figure 1). Most of the published studies (Table 3) used radiographic fluoroscopy, with radiation exposure for both the patient and medical staff.4–6 Only Herth et al.3 reported on the feasibility of EBUS-guided TBB without the use of fluoroscopy in lesions >20 mm.

In the present study, the use of EBUS led to visualization of 90% of the bronchoscopic occult lesions ≥20 mm and to a pathologic diagnostic yield of 82% (Table 2). This result is in line with the study by Herth et al., including only peripheral pulmonary lesions >20 mm and reporting a diagnostic yield of 87% for EBUS-guided TBB without the need for radiographic equipment or radiation exposure (Table 3).

For lesions <20 mm, our yield of EBUS-guided detection and pathologic diagnosis decreased to 18%. In contrast, Japa-
nese groups have reported diagnostic yields of 53% and 72%, respectively, for lesions \( \leq 20 \) mm using EBUS-guided TBB with a catheter sheath and under radiographic fluoroscopy.\(^5,6\) More recently, one of these Japanese groups performed EBUS-guided TBB using virtual bronchoscopic navigation and detected 67% of lesions \( \leq 20 \) mm on EBUS, resulting in a diagnostic yield of 44%.\(^7\) A higher diagnostic yield of 63% has been reported for CT-guided TBB, but this method is less desirable because of excessive radiation exposure from CT and lengthy occupation of the CT room.\(^8\) CT-guided percutaneous transthoracic fine-needle aspiration biopsy may be considered in very small, easily accessible peripheral lesions. Its sensitivity for detecting malignancy in lesions \( \leq 20 \) mm in diameter has been reported to be \( \geq 60\% \).\(^9,10\) Electromagnetic navigation in bronchoscopy is a novel method of assessing the localization of peripheral pulmonary lesions and may be of further help to improve the diagnostic yield of bronchoscopy in very small peripheral pulmonary nodules.\(^11,12\)

In summary, in the daily experience of clinicians, EBUS-guided TBB is effective for detecting and diagnosing peripheral pulmonary nodules or masses \( \geq 20 \) mm, but its yield remains unsatisfactory for lesions \( < 20 \) mm. Based on these findings, increased use of the technique, both in standard pulmonary practice and in prospective multicenter studies, is warranted. The advantage of using an EBUS miniprobe in the detection and diagnosis of bronchoscopic occult pulmonary lesions \( \geq 20 \) mm is that use of radiographic fluoroscopy can be abandoned. Careful positioning and measurement of the distance to the lesion remain essential. Studies with new navigation techniques such as virtual bronchoscopy and electromagnetic navigation may improve the diagnostic yield of lesions \( < 20 \) mm, but EBUS will be useful as well in these cases to confirm accurate insertion into the lesion.

**REFERENCES**

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