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Original Research

INTERVENTIONAL PULMONOLOGY

Factors Related to Diagnostic Yield of Transbronchial Biopsy Using Endobronchial Ultrasonography With a Guide Sheath in Small Peripheral Pulmonary Lesions*

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Study objectives: **To evaluate factors predicting the diagnostic yield of transbronchial biopsy (TBB) using endobronchial ultrasonography with a guide sheath (EBUS-GS) in small peripheral pulmonary lesions (PPLs) ≤ 30 mm in mean diameter.**

Design: **Retrospective analysis.**

Patients and methods: **One hundred fifty-five consecutive patients with 158 small PPLs underwent TBB using EBUS-GS.**

Results: **A definitive diagnosis was established by TBB using EBUS-GS in 106 PPLs (67%). The diagnostic yield of PPLs ≤ 15 mm in mean diameter (40%) was significantly lower than that of PPLs > 15 mm and ≤ 30 mm in mean diameter (76%; $p < 0.001$). PPLs in which the probe was positioned within the PPL on the endobronchial ultrasonography (EBUS) image had a higher diagnostic yield (83%) than PPLs in which the probe was positioned adjacent to the PPL (61%) or outside the PPL (4%; $p < 0.001$). There were no significant differences in diagnostic yield for underlying disease, location, CT scan bronchus sign, operator, or type of EBUS probe. In the multivariate analysis, only the position of the probe (within or adjacent to the PPL when judged against outside the PPL) was determined to be a significant factor predicting diagnostic yield. On the other hand, a pathologic diagnosis was established with the first, second, third, fourth, and fifth biopsy specimens in 65%, 80%, 87%, 91%, and 97% of PPLs, respectively.**

Conclusions: **The position of the probe (*ie*, within or adjacent to the PPL) is a significant factor in predicting the diagnostic yield of TBB using EBUS-GS for small PPLs; the optimum number of biopsy specimens is at least five.** ***(CHEST 2007; 132:603–608)***

Key words: endobronchial ultrasonography with a guide sheath; peripheral pulmonary lesions; transbronchial biopsy

Abbreviations: EBUS = endobronchial ultrasonography; EBUS-GS = endobronchial ultrasonography with guide sheath; PPL = peripheral pulmonary lesion; TBB = transbronchial biopsy; VB = virtual bronchoscopy

Various procedures have been developed to diagnose peripheral pulmonary lesions (PPLs). The transbronchial biopsy (TBB) procedure, which uses a bronchoscope under fluoroscopic guidance, has been performed since the 1970s, with 36 to 86% diagnostic accuracy.[1–5] Diagnostic accuracy is influenced by lesion size; Schreiber and McCrory[1] have reported in a systematic review that the diagnostic accuracy of lesions < 20 mm in mean diameter was 33%. Other studies[2–5] have found the diagnostic accuracy of benign lesions to be 35 to 50%, which is lower than that of malignant lesions.

These days, small-caliber, radial-type ultrasound probes can be used for the clinical application of ultrasonography to tracheal-bronchial lesions, and PPLs. Endobronchial ultrasonography (EBUS) has been used for imaging guidance in the TBB of PPLs.[6,7] Furthermore, Kurimoto et al,[8] Kikuchi et

al,[9] and our preliminary study have shown the feasibility and effectiveness of TBB using EBUS with a guide sheath (EBUS-GS), and several reports[10,11] have since demonstrated the safety and efficacy of TBB using EBUS-GS. Nevertheless, the diagnostic yield of TBB using EBUS-GS in PPLs ranges from 58 to 77%,[8–11] which is not even close to 100%. Accordingly, we have attempted to determine by multivariate analysis the characteristics of PPLs that cannot be reached by forceps or a bronchial brush by TBB using EBUS-GS. Moreover, as the guide sheath is left in the lesion in performing the EBUS-GS technique, multiple biopsy specimens can be obtained repeatedly and easily. Therefore, it is important to determine the optimum number of biopsy specimens required to increase the diagnostic yield. In the present study, we evaluated factors predicting the diagnostic yield of TBB using EBUS-GS in small PPLs, and evaluated the number of biopsy specimens required for successful TBB using EBUS-GS, by analyzing the cumulative diagnostic yield of successive biopsy specimens.

Materials and Methods

Patients

The medical records of 155 consecutive patients with 158 small PPLs (≤ 30 mm in mean diameter) who underwent TBB using EBUS-GS between August 2003 and March 2006 at Hokkaido University Hospital were retrospectively reviewed. In the same period, no patients with small PPLs underwent conventional TBB. PPLs were defined as lesions that were surrounded by pulmonary parenchyma and were endoscopically invisible (*ie*, no evidence of endobronchial lesion, extrinsic compression, submucosal tumor, narrowing, inflammation, or bleeding of the bronchus). All chest CT scans were reviewed, and the mean diameters of the PPLs was recorded. Because this study was a retrospective analysis, we did not submit any documents related with this study to the internal review board at our institute. However, all patients then gave written informed consent to undergo the procedures described below.

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TBB Using EBUS-GS

TBB using EBUS-GS was performed as described previously.[8,9] A 20-MHz mechanical radial-type probe (XUM-S20–17R; Olympus; Tokyo, Japan) with an external diameter of 1.4 mm (*ie*, 1.4-mm probe) was used most often, and a 20-MHz mechanical radial-type probe (UM-S20–20R; Olympus) with an external diameter of 1.7 mm (*ie*, 1.7-mm probe) was used for PPLs assumed to be easily reached before bronchoscopy. The probe was connected to an endoscopic ultrasound system (EU-M30S; Olympus). A flexible fiberoptic bronchoscope with a 2.0-mm diameter working channel (BF-P-260F; Olympus) and a guide sheath with an external diameter of 1.9 mm (XB01–836-12; Olympus) were used for the 1.4-mm probe, and a flexible fiberoptic bronchoscope with a ≥ 2.8-mm diameter working channel (BF-1T-30 and BF-1T260; Olympus) and a guide sheath with an external diameter of 2.7 mm (XB01–836-13; Olympus) were used for the 1.7-mm probe. After the bronchoscope was inserted under local anesthesia as deeply as possible into the target bronchus under direct vision, an EBUS probe was inserted into the guide sheath, and the guide sheath-covered probe was then inserted through the bronchoscope working channel into the bronchi leading to the area suspected of containing the PPL. EBUS imaging and radiograph fluoroscopy were used to confirm that the probe and guide sheath had reached the PPL. If an EBUS image of the PPL could not be obtained, the probe was removed from the guide sheath and a double-hinged curette was inserted into the guide sheath; the appropriate bronchus was selected by manipulating the curette under fluoroscopic guidance. Once the bronchus was determined, the curette was removed from the guide sheath and again the probe was inserted into the guide sheath to obtain an EBUS image of the PPL. After locating the PPL on the EBUS image, the probe was removed from the guide sheath, and the guide sheath was left in the PPL. Biopsy forceps and bronchial brushes were introduced via the guide sheath, and pathologic and cytologic specimens were obtained under fluoroscopic guidance. Biopsy specimens were numbered sequentially and reported separately. Bronchoscopy procedures were performed by eight pulmonary fellows, each with > 4 years of training and experience in bronchoscopy.

When evaluating the position of the probe against the PPL on the EBUS image, the positions of the probe were divided into the following three patterns as previously reported[8,10]: (1) within (the probe was located in the bronchus inside the PPL); (2) adjacent to (the probe was located in the bronchus adjacent to the PPL); and (3) outside (the probe was located in the bronchus outside the PPL) [Fig 1].

If a definitive diagnosis was not obtained by EBUS-GS, the patient underwent other procedures (*eg*, video-assisted thoracoscopy or percutaneous needle biopsy) or clinical and radiologic follow-up to confirm the diagnosis of the PPL. We also reviewed images of 59 PPLs from 58 patients who had undergone high-resolution CT scanning and determined whether the PPLs contained the CT scan bronchus sign[12–15] (*ie*, the finding on a high-resolution CT scan of a bronchus leading directly to a PPL).

Statistical Analysis

Data were analyzed using Pearson χ^2 test. Multivariate analysis was used to identify the factors affecting diagnostic yield. All variables reaching a significant level of 5% in univariate analysis were tested in a logistic regression analysis. Statistical software (SPSS, version 11.0.1; SPSS; Chicago, IL) was used for all analyses. Statistical significance was established at the $p < 0.05$ level, and all analyses were two-sided.