Editorial

Augmented fluoroscopy and cone beam CT-guided needle biopsy using a steerable guiding sheath: a promising approach for peripheral pulmonary lesions

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Opportunities to examine patients with small peripheral pulmonary lesions have increased with the evolution of radiological technologies and the increasing availability of computed tomography (CT) screening for lung cancer. An accurate diagnosis is indispensable for decisions regarding optimal management. For patients who require pathological diagnosis to determine appropriate management, non-surgical biopsy is often performed (1). For non-surgical biopsy procedures, clinicians can use either of two major approaches: image-guided transthoracic biopsies (e.g., CT-guided biopsy and ultrasound-guided biopsy) and transbronchial biopsies (e.g., guided bronchoscopy and robotic bronchoscopy). Image-guided transthoracic biopsy provides a higher diagnostic yield than does transbronchial biopsy; however, it is associated with greater frequencies of complications, such as pneumothorax and hemorrhage (1,2). Bronchoscopy has been widely used as a less invasive procedure for the diagnosis of peripheral pulmonary lesions, although the diagnostic sensitivity of conventional bronchoscopy (using a standard-size bronchoscope under fluoroscopic guidance) for peripheral lung cancer smaller than 20 mm is reportedly only 34% (1). Because of this low diagnostic sensitivity, previous lung cancer management guidelines did not recommend using bronchoscopy for the diagnosis of peripheral lung cancer (3). However, over the past two decades, the accuracy of bronchoscopy has dramatically increased with instrumental and technical improvements (2). In more recent lung cancer management guidelines (1), guided bronchoscopy methods [e.g., radial probe endobronchial ultrasound (rEBUS) guidance and navigation device guidance] are suggested for the diagnosis of peripheral pulmonary lesions.

Recent bronchoscopy modifications have facilitated greater diagnostic accuracy by overcoming several limitations of conventional bronchoscopy. The first improvement was confirmation that the biopsy instrument had reached the lesion. Traditionally, biopsy instrument contact with the target lesion during conventional bronchoscopy was confirmed by fluoroscopy alone; however, the spatial relationship between the biopsy instrument and the target lesion cannot be accurately determined by two-dimensional fluoroscopy images. In addition, some lesions (e.g., ground glass nodules and lesions hidden by mediastinal structures) cannot be identified by fluoroscopy (4), and the diagnosis for fluoroscopically invisible lesions is reportedly challenging (5). The development of rEBUS has overcome this limitation; thus, it has dramatically enhanced the diagnostic yield of bronchoscopy (1,2,4,6,7). rEBUS has enabled localization of the target lesion, as well as prediction of biopsy success

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on the basis of the spatial relationship between the lesion and the rEBUS probe (6). Furthermore, rEBUS-guided bronchoscopy is useful for the diagnosis of ground glass nodules (8). Cone beam CT (CBCT) is another technique that can confirm the positions of the biopsy instrument and the target lesion (9,10). It can be used together with rEBUS or as an alternative to rEBUS during bronchoscopy; the diagnostic value of CBCT for peripheral pulmonary lesions has also been reported (9,10). The second improvement was confirmation of the bronchial route leading to the target lesion. Two main navigation systems—electromagnetic navigation bronchoscopy (ENB) and virtual bronchoscopic navigation—are currently available for clinical practice, and the value of navigational bronchoscopy for diagnosing small peripheral pulmonary lesions is well-established (11-14). Augmented fluoroscopy (AF) is a new navigation technology that demonstrates the correct bronchial route to the target lesion on fluoroscopy images in real-time (15,16). Furthermore, CBCT is useful during navigation: it provides real-time feedback regarding the bronchoscope position and the instrument position. The third improvement comprised bronchoscope accessibility and catheter guidance to the peripheral pulmonary lesions. Although the correct bronchial pathway is indicated by the navigation system, bronchoscopy may be unsuccessful when the bronchoscope or biopsy instrument cannot be advanced through the intended pathway. The development of reduced diameter bronchoscopes or catheter alternatives to bronchoscopes (e.g., robotic bronchoscopes and steerable extended working channels), which permit good accessibility through the small bronchus to the peripheral lung, has enhanced the diagnostic yield of bronchoscopy (14,17-21). Recently, a 3.0 mm ultrathin bronchoscope with a 1.7 mm working channel was developed; this allows the use of rEBUS and has enabled the implementation of multimodal bronchoscopy (17-19). The fourth improvement was the development of instruments with better sampling ability and better maneuverability. Stiff instruments restrict the flexion range of the bronchoscope and may result in diagnostic failure; thus, increasingly flexible instruments have been developed (14,22). In addition, instruments have been developed to enable the acquisition of larger samples (e.g., cryoprobes) (22,23); these instruments may enhance the diagnostic yield of bronchoscopy. Multimodal bronchoscopy using combinations of some of these improved modalities has improved diagnostic accuracy for small peripheral pulmonary lesions (17).

In a study in the recent issue, de Ruiter *et al.* evaluated the instrument deliverability of several guiding sheaths (GSs) for performing transbronchial needle aspiration (TBNA) without bronchoscopy under AF and CBCT image guidance (24). The study was conducted in three phases: a bench model, an *ex vivo* swine lung model, and an *in vivo* swine model. It compared the instrument delivery accuracies of four precurved GSs (45, 90, 180, and 180 EWC, Medtronic) that are commonly used during ENB, as well as two steerable endovascular GSs (Destino Twist, Oscor Inc.; Morph AccessPro, BioCardia), through the insertion of ENB instruments (e.g., 21-gauge, 19-gauge, and transbronchial access tool needles) and a marker coil. The study showed that the needle delivery errors of steerable GSs, particularly the error of the Destino Twist GS, were smaller than the needle delivery errors of precurved GSs; thus, the use of steerable endovascular GSs might enhance procedural accuracy. In addition, this study in a swine model demonstrated the feasibility of TBNA and fiducial marker delivery using an endovascular steerable GS for small peripheral lung lesions without bronchoscopy under AF and CBCT image guidance. The findings suggest that the procedure might be useful for clinical diagnosis and treatment. Indeed, the authors described a patient in whom TBNA was successfully performed using the indicated procedure.

This preclinical study has provided some useful information for current clinical practice, because the results appear applicable to bronchoscopic procedures. The use of a steerable endovascular GS in place of a precurved GS may help to increase the diagnostic accuracy of TBNA during ENB or CBCT/AF-guided bronchoscopy. In addition, the use of a steerable endovascular GS may contribute to accurate localization of peripheral lung cancer via ENB (25). As the authors note, steerable GSs have smaller outer diameters and larger inner diameters, compared to ultrathin bronchoscopes; thus, the procedure may provide good accessibility to the small peripheral airway and enable the use of larger biopsy instruments. However, this procedure lacks direct visualization, which may compromise bleeding-related safety.

Modifications of techniques and instruments based on such strong investigations should improve the diagnostic yield for small peripheral lung cancer. We hope the authors plan to conduct a clinical trial regarding the efficacy and

safety of this promising procedure.

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