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CORRESPONDENCE

Is tomosynthesis an ingenious scheme for bronchoscopic diagnosis of lung nodules?

To the Editors:

Bronchoscopic diagnosis of small peripheral nodules is still unsatisfactory, requiring improvements in technology and systems.[1] In a recent publication in *Respirology*, Aboudara *et al.* have reported a new method of fluoroscopic electromagnetic navigation bronchoscopy (F-ENB) and compared its efficacy and safety with standard ENB (s-ENB).[2] They have shown that F-ENB may increase the diagnostic yield of ENB for small peripheral nodules (s-ENB: 54.4%, F-ENB: 79.1%, P = 0.0019) with a low complication rate (s-ENB: 5.9%, F-ENB: 3.0%).[2]

Tomosynthesis-assisted navigational bronchoscopy using conventional fluoroscopic C-arm is a novel scheme that can correct subtle divergence between the catheter tip and the nodule in a two-dimensional image and achieve correct alignment. The authors obtained an additional oblique image by an easier method and verified the efficacy (diagnostic yield) and safety (low complication rate) of F-ENB by comparing it to s-ENB.[2] F-ENB, which employs the fluoroscopic C-arm frequently used in the clinic, appears to be a simple and promising method directly applicable to clinical practice. However, verification of its invasiveness and other improvements is necessary to establish it as a standard diagnostic method.

Because a breath-hold manoeuvre is required to capture the tomosynthesis image, the F-ENB uses a neuromuscular blockade, which is associated with the risk of asphyxia. Alternative methods requiring voluntary breath hold by patients should, therefore, be explored in the future. For example, can tomosynthesis images be obtained with patients breathing spontaneously under local anaesthesia and oxygen inhalation, holding their breath for a maximum of 30 s? As for physical invasiveness, the total procedural duration and radiation exposure dose for F-ENB need to be examined further. In addition, I would recommend that the authors perform a questionnaire-based survey of the patients to assess the invasiveness of F-ENB directly.

Recently, computed tomography (CT)-guided biopsies have often been used instead of bronchoscopy for histological diagnosis of lung tumours. However, it is associated with severe complications, such as air embolism and cancer dissemination.[3] Thus, improvement in bronchoscopic techniques is essential for a better diagnosis of lung tumours. New technologies including ultrathin fibrescope, navigation system and endobronchial ultrasound; analytical techniques such as DNA analysis of bronchial wash fluid; and new testing systems (ROSE: rapid onsite cytology) have all been developed and improved in the last 20 years.[4] Besides, many minor innovative modifications of tests used in clinical practice have contributed to better diagnostic yield.[1] By improving the diagnostic yield by about 25%, the F-ENB represents a significant evolution in the innovative modifications associated with bronchoscopy. I expect bronchoscopy to achieve a diagnostic yield comparable to that of CT-guided biopsy. It may be a game-changer in lung cancer diagnosis, allowing a diagnostic yield comparable to that seen in other cancers (gastric and colorectal).

This study is a retrospective comparative study with historical control. To reduce biases, a multi-institutional prospective comparative study and randomized controlled trials based on the data from this study should be carried out. Large-scale trials should be conducted soon to validate the clinical utility of F-ENB and establish it as a new diagnostic standard.

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Reply

From the Authors:

We appreciate the comments by Dr Goto in response to our study detailing our experience with digital

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tomosynthesis-assisted navigational bronchoscopy, otherwise known as fluoroscopic navigation (F-NAV). We agree that F-NAV is an exciting innovation that has significant potential to improve diagnostic outcomes for peripheral pulmonary nodules (PPN) with a lower complication rate than computed tomography-guided transthoracic needle aspiration (CT-TTNA).

There are two main deficiencies of existing navigation software platforms. First, 40% of nodules are invisible under C-arm fluoroscopy.[1] The bronchoscopist must rely upon the navigation software or knowledge of the airway anatomy to reach the nodule and then confirm with radial endobronchial ultrasound (REBUS). However, even with 97% localization with REBUS, diagnostic yield remains poor.[2] This is a factor of (i) relation of biopsy tools to nodule (proximal, distal and tangential), (ii) ineffective biopsy tools, (iii) deflection of the bronchoscope or catheter or (iv) a false-positive REBUS image (atelectasis or bleeding).

Second, these techniques are based upon a pre-procedure CT scan that is used to plan the pathway to the nodule, resulting in intra-procedural CT-body divergence. This divergence was not subtle in our study. With a median size of 1.5 cm and a median divergence of 1.5 cm in most lobes, it is not surprising that the diagnostic yield in the standard electromagnetic navigation arm was 55%. By correcting for divergence, diagnostic yield increased by 25%.

Importantly, the presence of a bronchus sign was seen in 22% of F-NAV patients. The absence of a bronchus sign is associated with a diagnostic yield of 49% and its absence has been proposed as a reason to avoid bronchoscopy.[3] Our yield of 79% challenges this assumption and supports the use of adjunct imaging and needle biopsy tools.

All of the patients underwent general anaesthesia (GA) with endotracheal intubation. As such, neuromuscular blockade (NB) was safe and there was no asphyxiation. At the end of the procedure, sugammadex was used to reverse paralysis and there was no prolonged awakening. We agree with Dr Goto that the use of neuromuscular blockade under moderate sedation with no secure airway for ventilation is contraindicated.

We do not see this procedure as more invasive than traditional bronchoscopy with biopsy of PPN under moderate sedation. The risk of complications is identical. Previous data comparing linear EBUS under either moderate sedation or GA reported no differences in complications or patient desire to repeat the procedure.[4] It is then probably unlikely that the patients in our study would perceive GA with NB as invasive.

An important understanding of digital tomosynthesis is that a static image of the nodule obtained during the procedure is necessary to accurately locate and update its position in relation to the catheter. Without this breath-hold manoeuvre, true nodule location is confounded. While we are aware of bronchoscopists performing F-NAV under moderate sedation with spontaneous respirations, it is unknown how accurate this approach is compared to a breath hold under GA with NB. Further studies would be needed and, until then, we cannot recommend this approach.

Finally, we agree with Dr Goto that prospective, comparative studies are needed to verify the diagnostic utility of F-NAV. A randomized control, non-inferiority trial comparing F-NAV versus CT-TTNA is currently enrolling (NCT04250194).

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