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Cone-Beam CT–Guided Thin Linear EBUS Bronchoscopic Biopsy of a Non- Peripheral Lung Nodule: Highlighting the Effect of Bronchoscopic Tools on CT-to-Body Divergence: A Case Report

Tajalli Saghaie[1]

tajalli.saghaie@mqhealth.org.au

Macquarie University

Lewis Holmes[1]

Macquarie University

Nathan Mortimer[1]

Macquarie University

Jonathan P. Williamson[1]

Macquarie University

Case Report

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Abstract

Background: Accurate bronchoscopic biopsy of non-peripheral pulmonary nodules adjacent to proximal segmental airways remains challenging. Such lesions lie beyond the reach of standard endobronchial ultrasound transbronchial needle aspiration (EBUS-TBNA) and resist accurate bronchoscope angulation in proximal, less flexible bronchi.

Case presentation: A 43-year-old non-smoking male was referred for biopsy of an incidentally found 16-mm solid right upper lobe nodule located adjacent to the second subsegmental branch (RB3b). The procedure was performed under general anaesthesia using cone-beam computed tomography (CBCT)–guided thin linear EBUS bronchoscopy (UCP190F, Olympus; 5.9-mm distal diameter). Intraprocedural CBCT acquisition enabled nodule segmentation and biopsy pathway planning overlaid on augmented fluoroscopy. Real-time ultrasound confirmed lesion localisation. During close-range bronchoscope manipulation, articulation of the bronchoscope tip caused reproducible displacement of the lesion relative to the augmented fluoroscopic target — a phenomenon we term bronchoscope- or tool-induced divergence, distinct from the established concept of CT-to-body divergence. Fine-needle aspiration under simultaneous ultrasound and augmented fluoroscopic guidance, with rapid on-site cytology, confirmed lesional material. Three cryobiopsies were then obtained using a 1.1-mm cryoprobe (Erbe, Tübingen) via the working channel in a wedged, stabilised position. The patient was discharged the same day; histopathology confirmed a typical carcinoid tumour.

Conclusions: CBCT-guided bronchoscopy using a thin linear EBUS bronchoscope is feasible for non-peripheral lung nodules in anatomically challenging locations. Awareness of bronchoscope- and tool-induced divergence is clinically relevant and should be considered alongside CT-to-body divergence when targeting accuracy is suboptimal, particularly in proximal airways.

Background

Despite recent advances in bronchoscopic sampling of pulmonary nodules, small non-peripheral lesions beyond the reach of standard Endobronchial Ultrasound TransBronchial Needle Aspiration (EBUS-TBNA) pose a unique challenge [1]. Their proximal location adjacent to larger, less flexible, and thicker early generation bronchi can make bronchoscope angulation and accurate trans-bronchial puncture difficult. By combining cone-beam CT (CBCT) guidance with a thin linear EBUS bronchoscope to successfully diagnose a typical carcinoid tumour, we report a case that highlights novel procedural insights.

Case presentation

A 43-year-old male non-smoker without significant comorbidity was referred for biopsy of an incidentally found 16-mm solid, round right upper lobe pulmonary nodule, located in the anterior segment adjacent to the second subsegmental branch (RB3b) [Figure 1].

The procedure was performed under general anaesthesia with muscle paralysis. A CBCT acquisition (Azurion, Philips, Netherlands) was obtained during a breath hold. The nodule was segmented, and a pathway to the biopsy point was planned and overlaid on augmented fluoroscopy [Figure 1].

Simplified bronchial branch tracing supported navigation to the target in RB3b [2]. A thin linear EBUS bronchoscope with 5.9-mm distal end diameter (UCP190F, Olympus, Japan) was advanced to the target airway. Real-time ultrasound identified the lesion, which corresponded with the marked target on augmented fluoroscopy. It was noted that manipulations of the bronchoscope tip resulted in significant divergence between the augmented target and the lesion, which remained visible both on ultrasound and standard fluoroscopy [Figure 2]. A 25-gauge needle (ViziShot 2, Olympus, Japan) was used for fine-needle aspiration under simultaneous ultrasound and augmented fluoroscopic guidance, with rapid on-site cytology confirming lesional material.

Subsequently, a 1.1-mm cryoprobe (Erbe, Tubingen, Germany) was introduced through the bronchoscope working channel. Three cryobiopsies were performed by withdrawing the probe through the working channel. The patient was discharged the same day. Pathology confirmed a typical carcinoid tumour.

Discussion and conclusions

Beyond demonstrating a novel approach by combining CBCT guidance with a thin linear EBUS bronchoscope for targeting non-peripheral lung nodules, this case also provides technical insights. CBCT with augmented fluoroscopy has been established as a real-time intraoperative imaging platform that supports bronchoscopic navigation and biopsy pathway confirmation [4],[5].

We introduce the concept of bronchoscope- or tool-induced divergence. While CT-to-body divergence is well described [3], this case illustrates how biopsy tools or the bronchoscope itself can accentuate divergence. When close to the target, any articulation of the bronchoscope inevitably displaces the target as well. Awareness of this phenomenon is particularly important when working in more proximal airways and with larger bronchoscopes or tools. In scenarios where tool-in-lesion confirmation is not achieved, if the bronchoscopist is unaware of tool-induced divergence when adjusting their approach in close proximity to the target, this may reduce accuracy and cause frustration.

Furthermore, this case demonstrates the feasibility of performing cryobiopsy through the working channel of a thin linear EBUS bronchoscope in a wedged and stabilised position. The compatibility of the UCP190F with a 1.1-mm cryoprobe allowed repeated sampling without loss of scope position, allowing the cryoprobe to find the needle tract without difficulty, and combining the benefits of real-time ultrasound guidance with high-quality tissue acquisition. The use of an ultrathin 1.1-mm cryoprobe through the working channel of a bronchoscope for peripheral lesion biopsy has previously been shown to be feasible and diagnostically effective [6],[7]; this case extends that approach to a thin linear EBUS platform under simultaneous real-time ultrasound and CBCT guidance.

CBCT-guided bronchoscopy using a thin linear EBUS bronchoscope can offer unique advantages for selected non-peripheral lung nodules. Recognition of airway-based anatomy, tool-induced divergence, and expanded biopsy capabilities may improve diagnostic confidence and outcomes.

Abbreviations

CBCT: Cone-beam computed tomography

EBUS: Endobronchial ultrasound

EBUS-TBNA: Endobronchial ultrasound transbronchial needle aspiration

RUL: Right upper lobe

RB3b: Second subsegmental branch of the anterior segment of the right upper lobe

Declarations

Ethics approval and consent to participate

The authors declare that written informed consent was obtained for the publication of this manuscript and accompanying images and attest that the form used to obtain consent from the patient complies with journal requirements as outlined in the author guidelines. Formal ethics committee approval was not required for this single case report at our institution.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

Competing interests

The authors declare no conflicts of interest relevant to this submission.

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Authors' contributions

LH, TS and NM were involved in patient care. TS and NM were involved in the procedure. TS and JPW were involved in the concept. All authors have read and contributed to the final manuscript.

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Figures

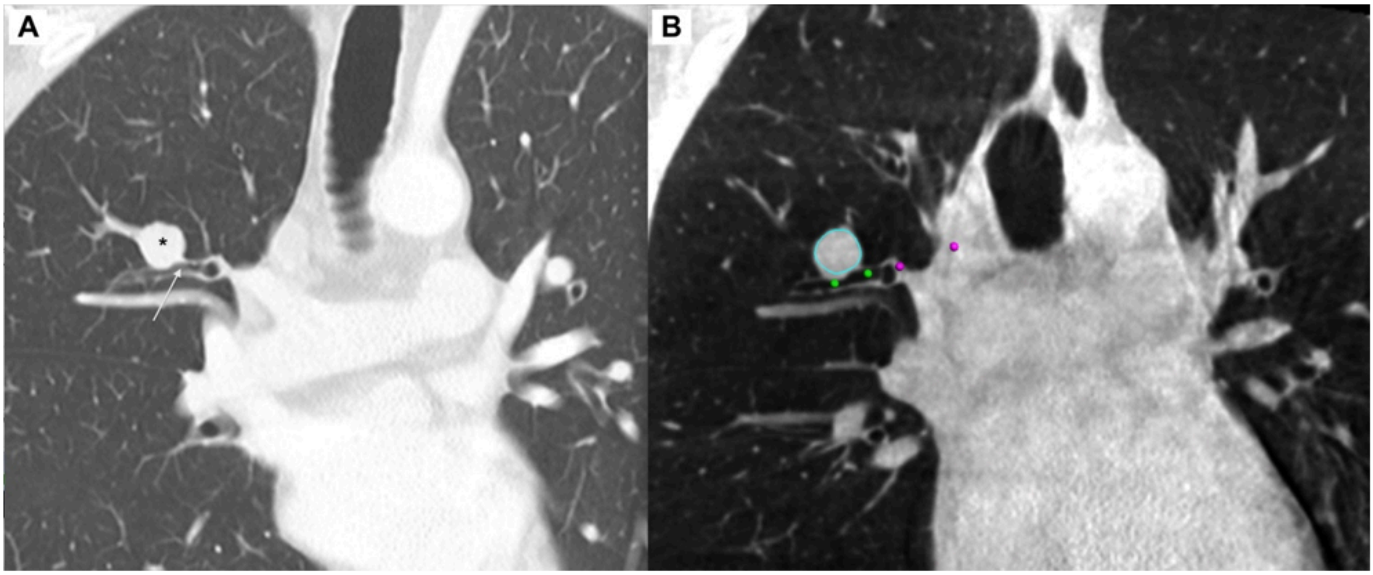


Figure 1

A. Preprocedural coronal CT scan images showing a solid round 16-mm nodule (asterisk) located in the anterior segment of the right upper lobe (RUL) with the closest airway branch RB3b (arrow). B. Segmentation (blue) of the lesion and planning dots (green and purple dots) on the intraprocedural CBCT acquisition.

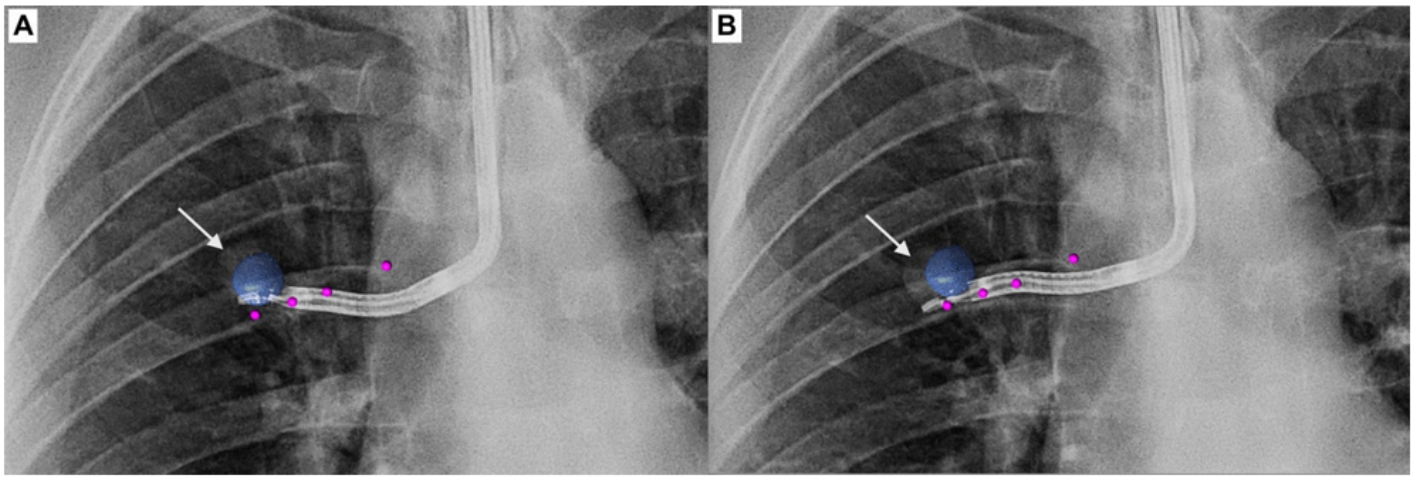


Figure 2

Tool-induced divergence. Intraprocedural augmented fluoroscopy demonstrating the divergence between the segmented target (blue) and the radio-opaque lesion (arrow) when the EBUS scope is close and how this divergence changes with upward flexion (A) and downward flexion (B) of the scope.

Supplementary Files

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