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EDITORIAL

Detecting Lung Cancer Early: The Clinical Imperative of Navigational Bronchoscopy

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Introduction

The late presentation of symptomatic lung cancer at an advanced stage unfortunately precludes curative treatment options, and as a result, lung cancer is associated with poor survival. Consequently, lung cancer is the most lethal cancer type worldwide, with a mortality rate greater than breast, colorectal and prostate cancer combined (Filho et al, 2025). Improvement in lung cancer mortality is predicated on early detection when radical treatment options are available, such as surgery or radical radiotherapy. Screening for lung cancer in high-risk individuals has been shown to improve mortality by approximately 20% (de Koning et al, 2020; National Lung Screening Trial Research Team, 2011) due to an associated stage shift to earlier, more treatable disease. Early-stage disease (Stage I) has a 5-year survival of 65% compared with survival in advanced disease (Stage IV) of 5% (NHS England, 2023).

In 2022, the UK National Screening Committee recommended that targeted lung cancer screening with low-dose computed tomography (CT) for high-risk individuals aged 55–74 be implemented across the four nations of the United Kingdom (UK NSC, 2022), and efforts have begun with significant geographical variation in application. As screening becomes commonplace, the volume of early-stage lung cancers being identified will increase. In addition to screening for identified lung cancer, liberal use of CT scanning is leading to increasing numbers of incidental indeterminate lung nodules suspicious for early cancer (Hendrix et al, 2023). Whilst identifying these lesions early is essential in providing more curative treatment, the small isolated lung lesion does present a significant diagnostic challenge. Best practice dictates that a tissue biopsy should be attempted prior to treatment of a lung cancer (NICE guideline NG122, 2024), and these small peripheral lesions are often not accessible by conventional biopsy means (namely, flexible bronchoscopy, endobronchial ultrasound or image-guided percutaneous biopsy). The use of navigational bronchoscopy has expanded over the past decade for such indications, and the field is rapidly evolving to become a key component of the lung cancer diagnostic pathway in the UK.

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Getting to the Lesion

The bronchial tree is complex in its organisation, and localising small lesions at the lung extremities is challenging without some form of guidance. "Navigational bronchoscopy" is an umbrella term describing a variety of bronchoscopic techniques used to access lung lesions not accessible by conventional flexible bronchoscopy. Virtual bronchoscopic navigation (VBN), often used in conjunction with slim or ultraslim bronchoscopes (UTB), utilises computer-generated 3D reconstructions of the airways to plot a bronchial route to the lesion of interest. The bronchoscopist can view this virtual map with the bronchoscopic image side by side, allowing navigation deep in the airways. Whilst VBN offers a lower cost alternative to other navigational bronchoscopy methods, patients require an additional dedicated CT scan with software specifications for planning. This approach can allow direct visualisation of peripheral lesions prior to biopsy. In addition, imaging adjuncts such as radial endobronchial ultrasound (rEBUS) and fluoroscopy are usually used to confirm position and lesion engagement. A drawback of VBN using UTB is the smaller working channel of the UTB. This limits the size of the biopsy tool that can be used to sample the lesion. With the advent of targeted therapies, adequate tissue to allow molecular testing is often required, and the use of UTB may limit this capability.

Electromagnetic navigational bronchoscopy (ENB) is a technique whereby a flexible, curved catheter with a locatable magnetic tip is passed down the working channel of a large-calibre bronchoscope. An electromagnetic field is projected over the patient's chest, and the location of the catheter tip is tracked within this field and superimposed onto a reconstructed image of the patient's bronchial tree. This route map is generated from a prior CT scan of the chest, and like VBN, a pathway can be preplanned to the lesion of interest. Once the lesion is reached, this catheter is used as a guide sheath to allow confirmation of the lesion using rEBUS and through which samples are obtained. These catheters have the same internal diameter as a standard bronchoscope working channel, allowing the use of larger tools than UTB. Yield can also be improved by adopting a multimodal approach with advanced imaging technologies, such as using a 2D fluoroscopy C-arm to allow for digital tomosynthesis. Navigational bronchoscopy has a diagnostic yield of approximately 70% (Folch et al, 2022; Kops et al, 2023) with a significantly lower rate of pneumothoraces than is reported for percutaneous biopsy (<5% vs. 26%). Meta-analysis data show no significant difference in diagnostic yield between VBN and ENB (Kops et al, 2023; Nadig et al, 2023). There is significant variability in the reported yield of navigational bronchoscopy, partly due to the inconsistent definitions of diagnostic yield used in the literature (Leonard et al, 2024) but also due to operator variability and experience. With the adoption of a new technique, there is often a learning curve, and yield is associated with experience and case throughput (Folch et al, 2022).

Robotic Assisted Bronchoscopy (RAB) is emerging as another means to navigate to small peripheral lung lesions. RAB systems utilise a precisely controlled robotic bronchoscope to navigate the airway in conjunction with side-by-side 3D mapping, much like that used in VBN. Shape sensing technology used in some RAB platforms allows far more precise targeting of nodules and prevents deflection of the catheter by sampling tools, as is often seen in ENB. Sampling nodules using RAB is not constrained by the airways, and nodules that were previously deemed not reachable by VBN/ENB are reachable. This approach also necessitates a general anaesthetic and is often used in conjunction with imaging adjuncts such as rEBUS and cone beam CT. It is considerably more expensive than other navigational bronchoscopy techniques but is expected to significantly improve diagnostic yield; however, data confirming this are not yet available. A single-centre randomised trial comparing RAB with ENB has shown comparable diagnostic yields with these two techniques (Paez et al, 2025), but this study is awaiting full publication.

The Future

There are currently approximately 10 centres in the UK that perform navigational bronchoscopy. Most of these sites accept external referrals, but there are still areas of the UK that do not have regular access. A recent trial has shown that navigational bronchoscopy is non-inferior to image-guided percutaneous biopsy for the diagnosis of indeterminate pulmonary lesions (Lentz et al, 2025). The wholesale replacement of percutaneous biopsy with advanced bronchoscopic sampling methods is neither anticipated nor appropriate. Bronchoscopic sampling is attractive in terms of lower complication rates and the ability to perform complementary procedures in the same sitting, such as mediastinal staging with endobronchial ultrasound (EBUS). Percutaneous biopsy remains a high-yield procedure (Han et al, 2018), which is widely available across the nation and in many cases will remain the primary investigation of choice. Navigational bronchoscopy should instead be considered a complementary tool in the armamentarium of the respiratory physician in the investigation of suspected lung cancer. Presently, its use is best suited to cases where concurrent mediastinal staging is required, infection is a possible differential diagnosis (as microbial samples are easily obtainable during bronchoscopy) and where percutaneous approaches are not possible due to lesion location or patient co-morbidities (for example, severe emphysema). With the ongoing roll-out of lung cancer screening, the demand for navigational bronchoscopy will increase, and any plans for lung cancer screening must be resourced with tissue diagnostics in mind. Development of specialised centres offering a suite of navigation options to be deployed depending on lesion and patient-specific characteristics will be needed as case throughput of navigation bronchoscopy is associated with improved yield (Folch et al, 2022). As demand increases nationally, it is conceivable that more established navigation techniques (VBN or ENB) will become more widespread and more advanced techniques (RAB) remain in specialised centres targeting smaller and harder to reach lesions. Clinical trials to assess the efficacy of these techniques are required to assess diagnostic yield, cost-effectiveness, and the impact these techniques have on the lung cancer pathway and overall mortality. Only then will we be able to accurately resource our services accordingly.

Conclusion

Navigational bronchoscopy has already become an integral component of the lung cancer diagnostic pathway in areas of the UK which have access to it, unfortunately this access is variable. Lung cancer screening will undoubtedly increase demand and navigational bronchoscopy needs to be included in the costing and planning of any screening service. Advanced biopsy techniques such as navigational bronchoscopy are an essential adjunct to lung cancer screening to allow early diagnosis and improve the poor mortality rate of lung cancer.

Key Points

- Lung cancer screening improves lung cancer mortality due to early detection.
- Obtaining a tissue biopsy from early-stage lung cancer can be challenging with established conventional methods (flexible bronchoscopy, EBUS and percutaneous biopsy).
- Navigational bronchoscopy is an umbrella term describing several different methods to access lung lesions not reachable by conventional flexible bronchoscopy.
- Navigational bronchoscopy has become an integral component of the lung cancer diagnostic pathway in the UK, although access is currently not equitable.
- Lung cancer diagnostics (including navigational bronchoscopy) must be resourced appropriately as part of any lung cancer screening programme.

Availability of Data and Materials

Not applicable.

Author Contributions

FRM and ADLM designed the work. FRM drafted the manuscript. Both authors contributed to the important editorial changes in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

Fraser Russell Millar is serving as one of the Editorial Board Members of this journal. We declare that Fraser Russell Millar had no involvement in the review of this article and has no access to information regarding its review. The other author declared no conflict of interest.

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