

Electro-navigational bronchoscopy for bilateral peripheral lung lesions: A case report

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SUMMARY

Electromagnetic navigational bronchoscopy (ENB), one of the methods of navigational bronchoscopy is an advanced diagnostic tool allowing tissue sampling at the lung peripheries which were previously accessible only by computed tomography (CT) guidance or video-assisted thoracoscopic surgery (VATS). We report a 53-year-old man who presented with a cough and dyspnea with constitutional symptoms for one month. CT thorax revealed multiple bilateral peripheral lung nodules and there were no endobronchial lesions on flexible bronchoscopy. ENB was performed using a loan machine from Veran navigational technology. Biopsy successfully revealed small cell carcinoma of the lung thus preventing him from undergoing a more invasive diagnostic procedure. This case highlights the utility of ENB in the evaluation of peripheral lung nodules that were inaccessible by conventional bronchoscopy. This is one of the first few successful applications of Veran ENB in Asia.

KEY WORDS:

Electromagnetic navigational bronchoscopy, peripheral lung nodules

INTRODUCTION

Bronchoscopy was first performed in 1897 and there have been many advances since. ENB is among the latest technology in bronchoscopy which allows navigation to distal regions of the lungs rendering biopsy possible. Based on the inspiratory and expiratory 1 millimetre (mm) CT images, a software is used to construct a three-dimensional image of the patient's lungs, with anatomical landmarks identified. These virtual images are then transferred to the computer system to correlate with the actual image from the video-bronchoscope. Compared with CT guided biopsy, ENB biopsy results in fewer pneumothoraces, significant haemorrhage episodes and respiratory failure.¹ This new diagnostic tool is safe, accurate and it may prevent more invasive procedures such as VATS.

CASE REPORT

A 53-year-old man presented to our centre with unresolved fever and cough back in 2015. He was initially admitted in a private centre and was treated as community-acquired pneumonia in which he received intravenous ceftriaxone for 3 days and subsequently discharged with oral ciprofloxacin

based on the susceptibility of *Klebsiella pneumoniae* isolated from the sputum culture.

As he was still unwell upon completion of the antimicrobial, he sought further treatment in our centre. He gave a history of a chronic cough for 1 month since discharged from the hospital with intermittent fever, and shortness of breath on exertion. There was also loss of weight of 5 kilograms in 1 month and loss of appetite. He was an active smoker of 30 packed years. His past medical history included diabetes mellitus which was well controlled with a single oral hypoglycaemic agent.

Chest radiograph (Figure 1A) revealed interstitial opacities in the right lower zone. On CT thorax (Figure 1B), there were multiple peripheral lung nodules, with the largest in the anterior segment of left lower lobe (LLL) measuring 3.2 x 2.2 cm and the right middle lobe measuring 1.8 x 1.9 cm. There were also multiple bilateral mediastinal lymphadenopathies and multiple ill-defined hypodense lesions in the liver suggestive of liver metastases.

Inspiratory and expiratory CT images were then transferred to a software to construct a virtual airway leading to these peripheral lesions. In view of the presence of an airway leading to the lesion, the patient was subjected to ENB. Flexible bronchoscopy was performed initially under conscious sedation (fentanyl and midazolam) which did not reveal any endobronchial lesion. Transbronchial lung biopsy under the guidance of Veran ENB was performed via bronchoscopy with working channel 2.8 (Figure 2). Biopsies were taken from the medial segment of the right middle lobe (RB5) and anterior segment of left lower lobe (LB7). There were no complications post procedure. Both biopsies revealed small cell carcinoma with immunohistochemical studies positive for TTF-1 and CD56. A final diagnosis of extensive stage small cell lung cancer was established.

He was referred to the oncology team and had completed 4 cycles of cisplatin and etoposide. He has been on regular follow-up since then.

DISCUSSION

Navigational bronchoscopy is an emerging interventional pulmonology tool for the diagnosis of peripheral lung nodules. There are 2 forms of navigational bronchoscopy; i.e ENB and virtual bronchoscopic navigation (VBN); in which

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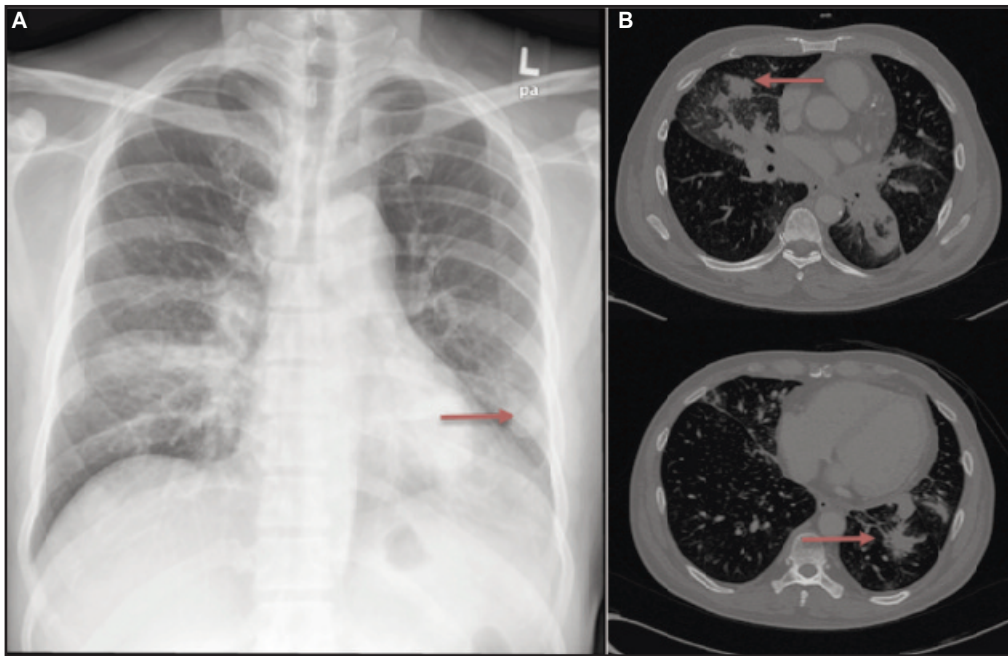


Fig. 1: Chest X-ray (1A) showed left lower lobe lung nodule. CT scan (1B) showed multiple lung nodules with no endobronchial involvement.

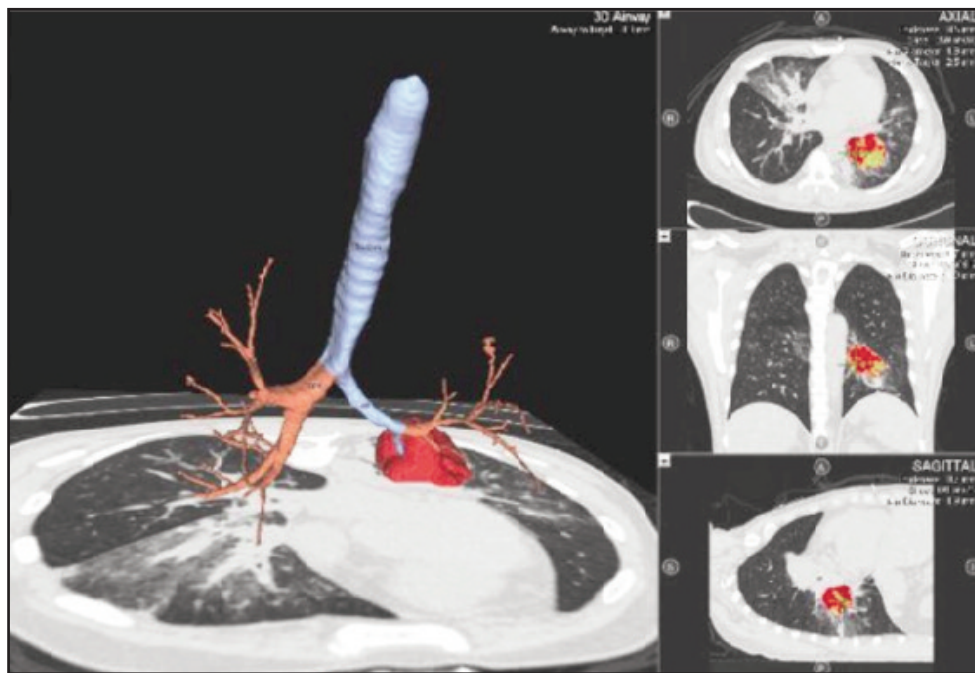


Fig. 2: Veran Electromagnetic Navigational Bronchoscopy leading to the lesion.

both can be performed under conscious sedation. Technically, it is not difficult under experienced bronchoscopist's hands as the initial steps of airway assessment are similar to normal bronchoscopy. However, the cost of the navigational system and biopsy needle may be a limiting factor in most hospitals.

ENB has 3 stages; 1) Planning 2) Navigational 3) Biopsy. During the planning stage, a 3-dimensional route to the lesion is created once the CT images are transferred to the

software. Navigational phase to the lesion begins after linking the virtual fiducial registration point; i.e the main carini to the actual position by a sensor probe. A bronchoscope is wedged to the targeted lobe and navigation is continued using the transbronchial needle biopsy until it reaches the target lesion. At present, there are 2 different ENB using slightly different protocol i.e Veran medical and Super dimension ENB.

Meanwhile, VBN is another form of navigational bronchoscopy that displays 3-dimensional images of the tracheal and bronchial lumens prepared from the continuous volume data of helical CT.² Based on virtual images that are matched with actual images, bronchoscope are then advanced to the target lesion.

Other techniques for biopsy of peripheral lesions include under CT guidance, ultrathin bronchoscopy or radial endobronchial ultrasound (EBUS).^{2,3} Each tool has its own advantages and disadvantages. The CT-guided biopsy requires an accessible window for needle biopsy insertion and has an increased risk of pneumothorax, significant haemorrhages and respiratory failure.¹ On the other hand, ultrathin bronchoscopy is a bronchoscope with an outer diameter of 3 mm that can reach up to 8 generation bronchi. However, it is not widely available in most centres and requires a steep-learning skill of the operator as the bronchoscope is difficult to control during manoeuvring. Radial EBUS is a probe, covered with guide sheath and inserted via a working bronchoscope channel which is advanced to the target lesion producing a well-characterised image suggestive of the nodule. It may precisely locate peripheral lung nodules that are not visible by fluoroscopy and can also access internal structure of the nodules.² However in certain peripheral nodules, lesions can't be reached without a navigational system.

There are published studies demonstrating the effectiveness of combination therapy of radial EBUS with either EMN or VBN that increase the yield of biopsy. Eberhardt et.al reported in a randomised study that the combination of ENB with EBUS was greater (88%) than EBUS (69%) or ENB alone (59%; $p=0.02$).³ Meanwhile, the Virtual Navigation in Japan (V-NINJA) trial group reported that the diagnostic yield for small peripheral pulmonary lesions is increased when virtual bronchoscopy is combined with EBUS compared with EBUS alone (80.4% vs 67.0%; $p=0.032$).²

Although the technology is expensive and not widely available in Malaysia, the value of ENB should not be underestimated. Solitary pulmonary nodules (SPN) have become more prevalent and have resulted in diagnostic challenges in clinical practice, especially due to the

increasing reports of peripheral lung adenocarcinoma.⁴ National lung cancer screening using low-dose CT is a plausible prospect in the near future.⁴ This emphasizes the need for early detection which could create the opportunity for most patients to undergo curative surgery. With an average diagnostic yield of over 75% and up to almost 100% in some lobes such as the right middle lobe, ENB is a useful and complimentary tool to diagnose solitary or peripheral nodules.^{1,3} The pneumothorax incidence rate is less than 2% compared to the 15-35% risk pneumothorax in CT-guided transthoracic needle aspiration. In the near future, ENB technology has the potential to improve targeted treatment of lung cancers including the placement of fiducial markers for CyberKnife Radiosurgery, or local chemotherapy, high-dose brachytherapy or local radiotherapy directed at the target site under ENB guidance.⁵

To our knowledge, this is the first published case of a successful navigational bronchoscopy in Malaysia. Indeed, back in 2015, our centre was the first few in Asia to successfully attempted the Veran navigational system. Navigational bronchoscopy is potentially a useful device for early diagnosis of lung cancer as an alternative to other diagnostic modalities.

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