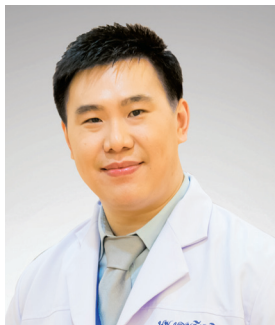


# Electromagnetic Navigation Bronchoscopy with Two Points Dye Marking for Surgical Biopsy in Small Peripheral Intersegmental Pulmonary Nodule: A Case Report

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## Abstract

In lung cancer screening programs, small peripheral pulmonary nodules are detected more frequently. We reported a case in which electromagnetic navigation bronchoscopy (ENB) with biopsy failed to give a diagnosis of intersegmental pulmonary nodule so ENB with dye marking combined with minimally invasive surgical biopsy was used for the diagnosis for the first time in Thailand.

**Keywords:** ENB, navigation bronchoscopy, pulmonary nodule localization, tattoo, dye marking, intersegmental pulmonary nodule

In the present day, small solitary pulmonary cancer is detected to a great extent from lung cancer screening programs using low dose computed tomography (CT) scans. The smaller the nodules are, the more challenging tissue biopsies are. Non-subpleural, peripheral pulmonary nodules are the most difficult areas to obtain a tissue biopsy. In patients who failed CT Guided biopsy or Electromagnetic Navigation Bronchoscopy (ENB) with biopsy, Video Assisted Thoracic Surgery (VATS) with biopsy under dye marking can be performed to make a definite diagnosis. We report a case where we performed navigation bronchoscopy with dye marking for the first time in Thailand as a diagnosis option to offer this group of patients.

## Case report

In November 2017, a 61-year-old male Asian with a current history of 35 pack a year smoking presented with a 6-mm speculated solid right upper lobe nodule found on CT chest (Figure 1) after an episode of pneumonia. Serial chest CT at 3 months' interval revealed a persistent nodule without significant change. ENB (superDimension) was utilized for needle biopsy and fine needle aspiration (FNA) which found normal pulmonary tissue. After detailed discussion with the patient, he elected to proceed with a surgical biopsy. Chest CT was carefully reviewed and a right upper lobe nodule was found on the intersegmental plane (between apical segment and posterior segment) 2 cm away from pleural surface, without a direct line of bronchus into the lesion (bronchus sign). Given its location and size, we believe the nodule was unlikely to be found on thoracoscopic visualization or palpation via thoracoscopy or even thoracotomy. ENB was elected to inject dye to localize the lesion preoperatively. We planned for a thoracoscopic wedge resection, frozen section, possibly proceeding to lobectomy if a primary lung cancer was found.

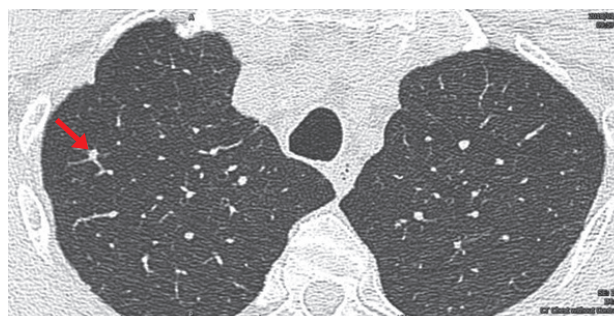


Figure 1: CT chest demonstrated right upper nodule.

The patient was placed supine under single lumen endotracheal tube No.8.5. A magnetic board and sensors were positioned on the patient. Routine preoperative planning and virtual bronchoscopy were performed. The nodule was located in the intersegmental plane between apical segment and posterior segment as we reviewed on chest CT. Therapeutic bronchoscopy with 2.8 mm working channel was used. Locatable guide was inserted through Extended Working Channel (EWC) then registration was completed. We started to navigate from posterior segment of right upper lobe bronchus and reached 1 cm away from center of target then the locatable guide was removed from the extended working channel (Figure 3B). The 25 G injection needle (InjectorForce Max 1650 mm, minimum channel size 2.0mm) was then inserted through extended working channel and advanced to subpleural area under fluoroscopy then 0.3 ml of methylene blue was injected followed by advancing Locatable guide back to Extended Working Channel to completely flush the methylene

blue into the targeted area. Then, we navigated into the apical segment of the right upper lobe bronchus and reached 2.2 cm away from the center of target (Figure 3C). Dye marking was performed in the same fashion as the first location. A bronchial blocker was used to isolate the right lung, then the patient was placed on left lateral decubitus, prepped and draped. Thoracoscope was used to visualize in the thoracic area. Two spots of Methylene blue were found (Figure 3B). Time of final injection to thoracoscope exploration was 20 minutes. Wedge resection by EndoGIA was performed to include both markings. Size of specimen was 4.8 x 4 x 11 cm. We attempted to palpate the specimen but we failed to identify it so it was opened sharply and we finally were able to identify the lesion. It was marked by suture material, sent for frozen section and it was found to have 0.4 x 0.3 firm scar at targeted area so the operation was concluded. After 6 months, Postoperative CT chest demonstrated absence of right upper lobe nodule (Figure 4).

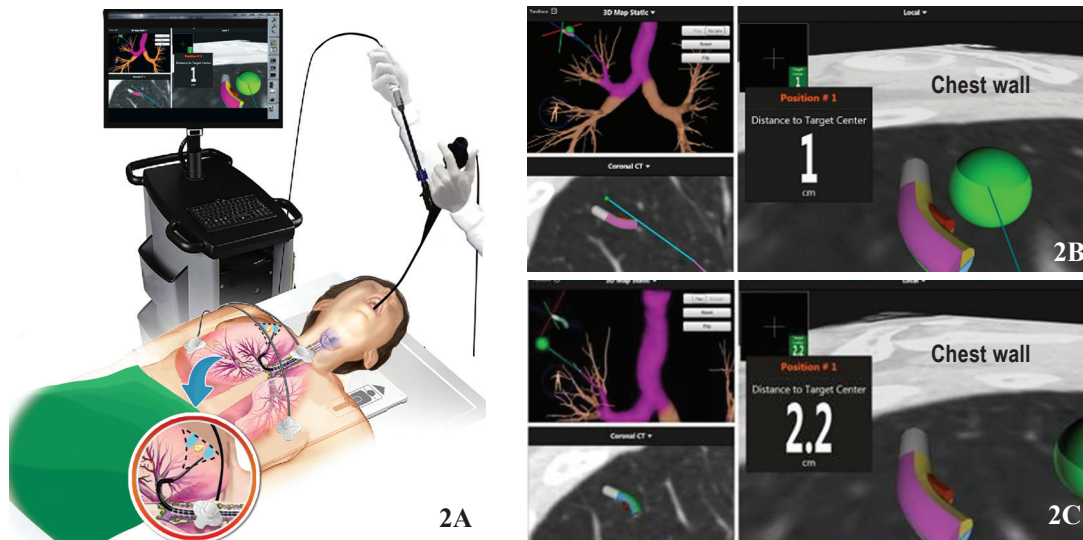


Figure 2A-C

- 2A: Electromagnetic navigation bronchoscopy by superDimension in supine position.
- 2B: Distance of locatable guide (grey rod) to target center (green spot) was 1 cm in coronal plane, white area showed chest wall. Left upper box showed the pathway from posterior segment of right upper lobe bronchus on inferior end.
- 2C: Right box showed distance of locatable guide (grey rod) to target center (green spot) at 2.2 cm in coronal plane on superior end.

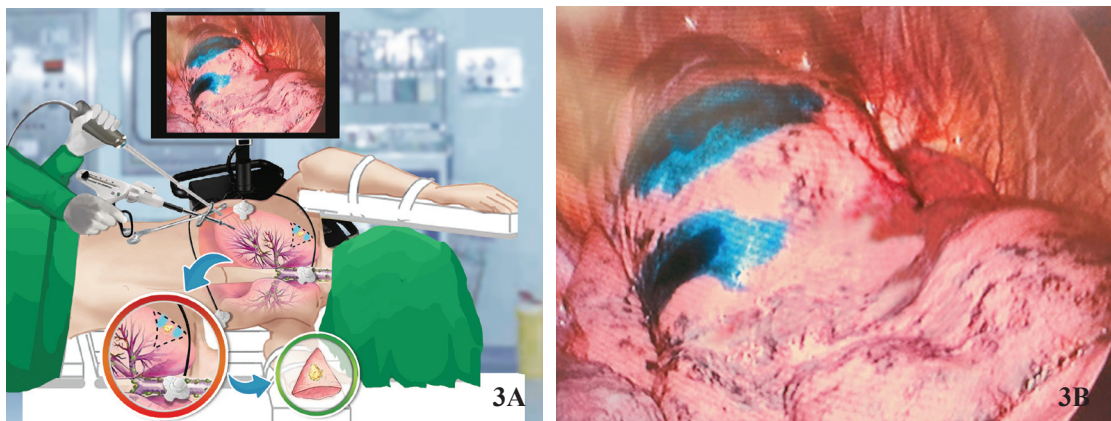


Figure 3A-B

- 3A: Dye marking to thoracoscopic visualization time: 20 minutes.
- 3B: Two points of Methylene blue from thoracoscopic view.



Figure 4: 6 months postoperative Chest CT showed absence of right upper lobe nodule.

## Discussion

Electromagnetic Navigation bronchoscopy (ENB) with biopsy is an effective tool to make a diagnosis for small peripheral lung nodules. Meta-analysis from Zhang et al<sup>1</sup> found pooled sensitivity, specificity, positive likelihood ratios (PLRs), negative likelihood ratios (NLRs), and diagnostic odds ratios (DORs) of ENB was 82%, 100%, 19.36, 0.23, and 97.62, respectively. Despite this, non-diagnostic biopsy from ENB can still be found in very small pulmonary nodules, especially those measuring less than 1 cm. In a minimally invasive thoracic surgery era, a sub centimeter pulmonary nodule is challenging to identify intraoperatively. Suzuki et al<sup>2</sup> showed that preoperative markings for small indeterminate pulmonary nodules should be considered when the distance to

the nearest pleural surface is more than 5 mm in cases of lung nodules of less than 10 mm ( $p < 0.05$ ). With the use of ENB, immediate preoperative localization with dye marking can facilitate surgery, shorten transit time and reduce cost compared to localization in a radiology suite with high accuracy as high as 97-100%.<sup>3-5</sup> Even though ENB diagnostic yield is highly dependent on the presence of a bronchus sign on CT imaging,<sup>6</sup> thoroscopic wedge resection with two-point marking can eliminate this limitation by marking between two subsegmental bronchus as we demonstrated in this case. Up to now, we have performed 4 cases of dye marking for sub centimeter pulmonary nodule as shown in Table 1 below.

Table 1: ENB with dye marking experiences at Bangkok hospital

Location	Bronchus sign	Number(s) of dye marking	Nodule size	SUVmax	Nodule characteristics	Pathology
Right upper lobe	No	2	6 mm	N/A	Solid	Old scar
Right lower lobe	Yes	1	8 mm	8.9	GGO	Organizing pneumonitis
Right middle lobe	Yes	1	3 mm	Non avid	GGO	Adenocarcinoma in situ
Left lower lobe	No	1	8 mm	1.9	Solid	Adenocarcinoma, lepidic

## Conclusion

ENB with dye marking is an effective tool to diagnose small pulmonary nodules when the distance to the nearest pleural surface is more than 5 mm in a case of lung nodules of less than 10 mm in size. A small peripheral intersegmental pulmonary nodule can also be identified by using the two-point dye marking.

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