

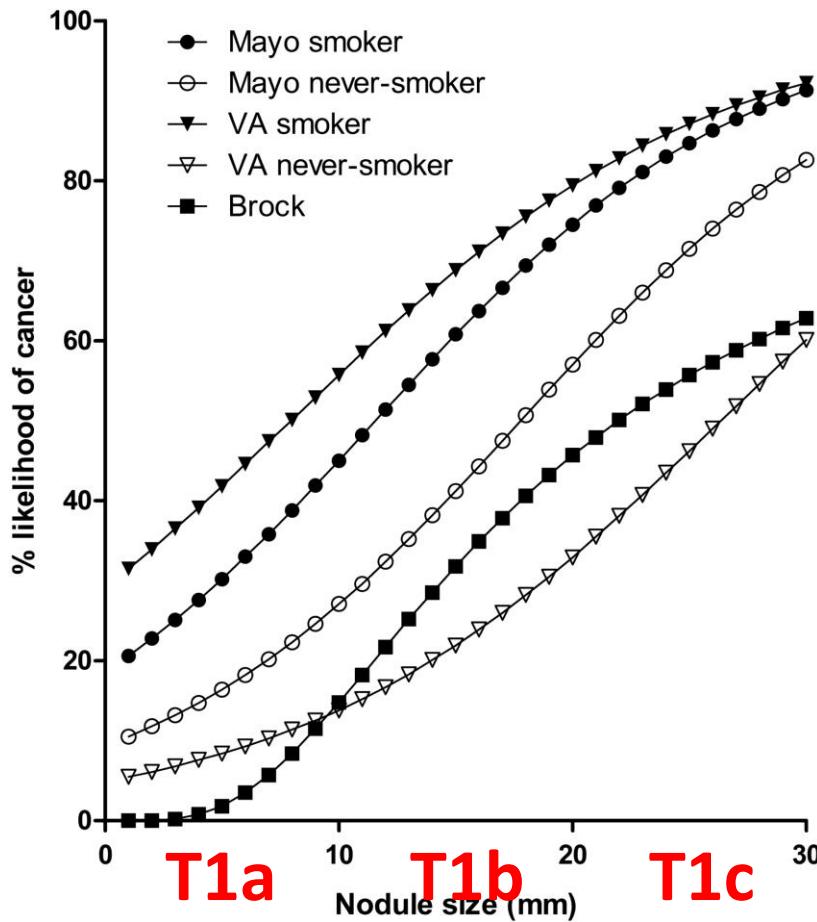
台灣胸腔外科醫學會 2019冬季會

Percutaneous Localization of Small Lung Nodules: NTUH experience

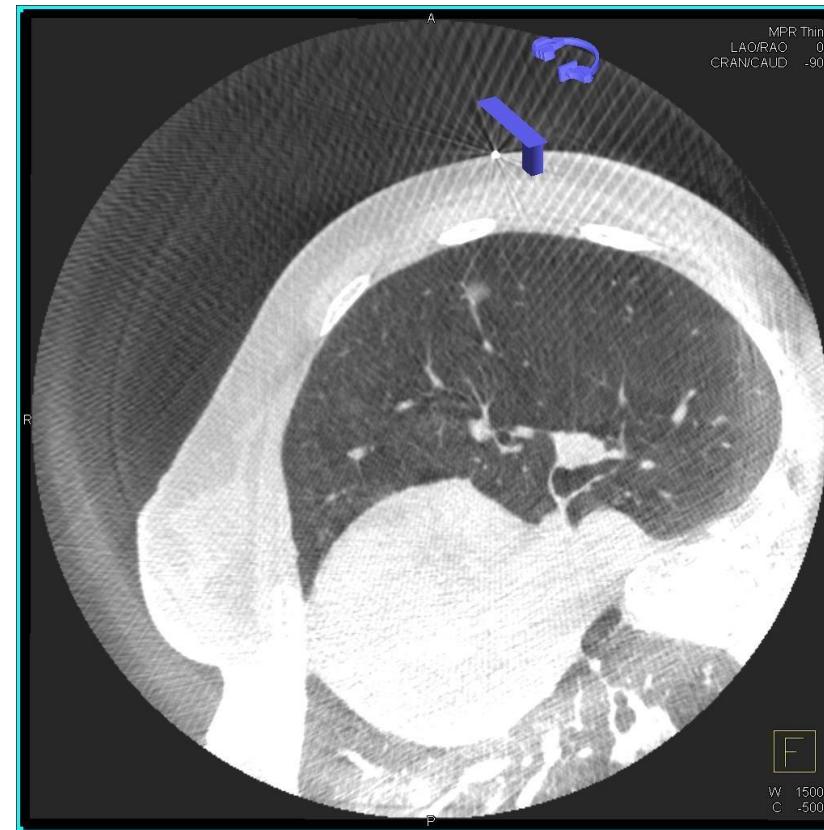


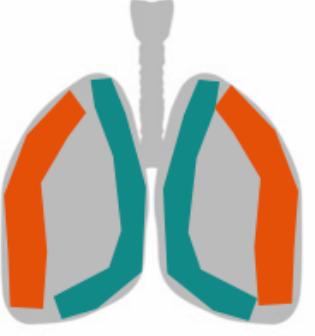
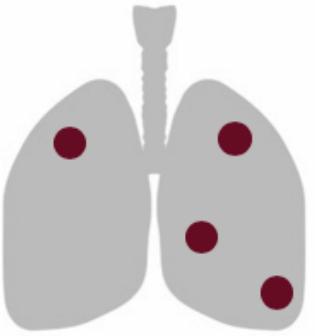
早期肺癌治療的趨勢：影像導引定位手術

Prediction Model of cancer and nodular size

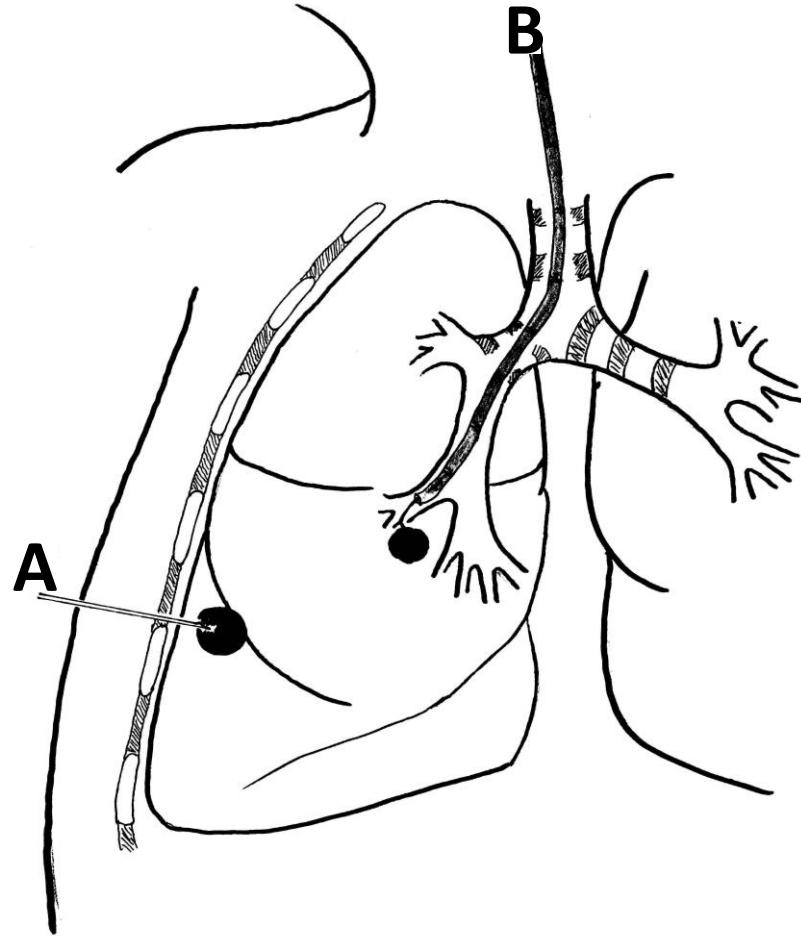


Callister ME, et al. British Thoracic Society guidelines for the investigation and management of pulmonary nodules. Thorax. 2015 Aug;70



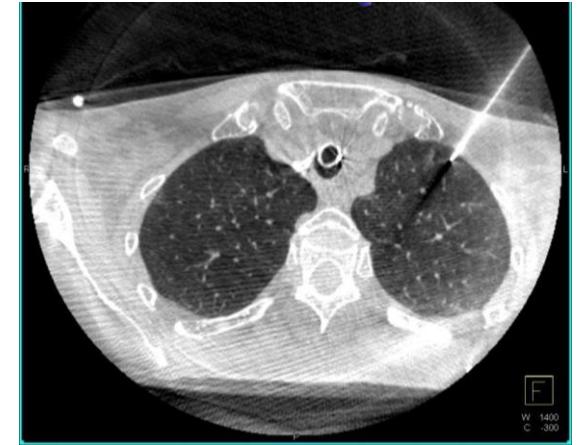
<u>Nodule characteristics</u>	<u>Plan + Navigation</u>	<u>Localization</u>	<u>Confirmation</u>	<u>Treatment</u>
<p>position</p> 	<p>Pre-operative CT</p> <p>Intra-operative CT</p> <p>Augmented Fluoroscopy</p> <p>Navigation</p> <p>Robotic</p>	<p>Percutaneous pathway</p> <p>Endobronchial pathway</p>	<p>Pre-OP CT</p> <p>Intra-OP CT</p> <p>EBUS</p>	<p>VATS</p> <p>microwave</p> <p>RFA</p> <p>Laser</p> <p>Cryo</p> <p>Thermo Vapor</p> <p>Photodynamic</p> <p>Photothermal</p> <p>Direct Tumor Injection</p>
<p>single/multiple</p> 				

肺部腫瘤或病變的精準診斷及治療



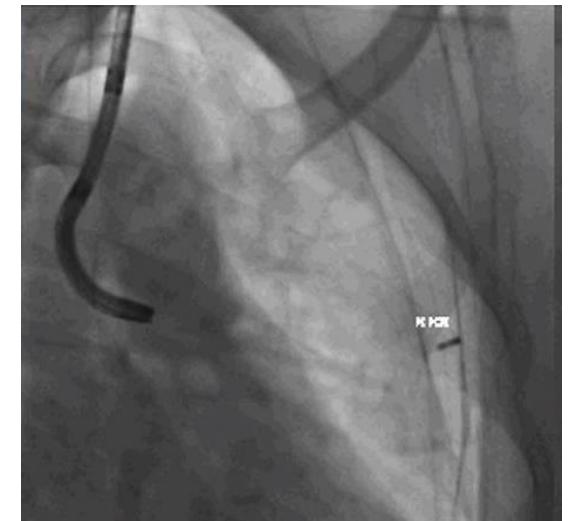
A 周邊型病變 (70%)

使用電腦斷層等導引，
經胸壁穿刺定位。

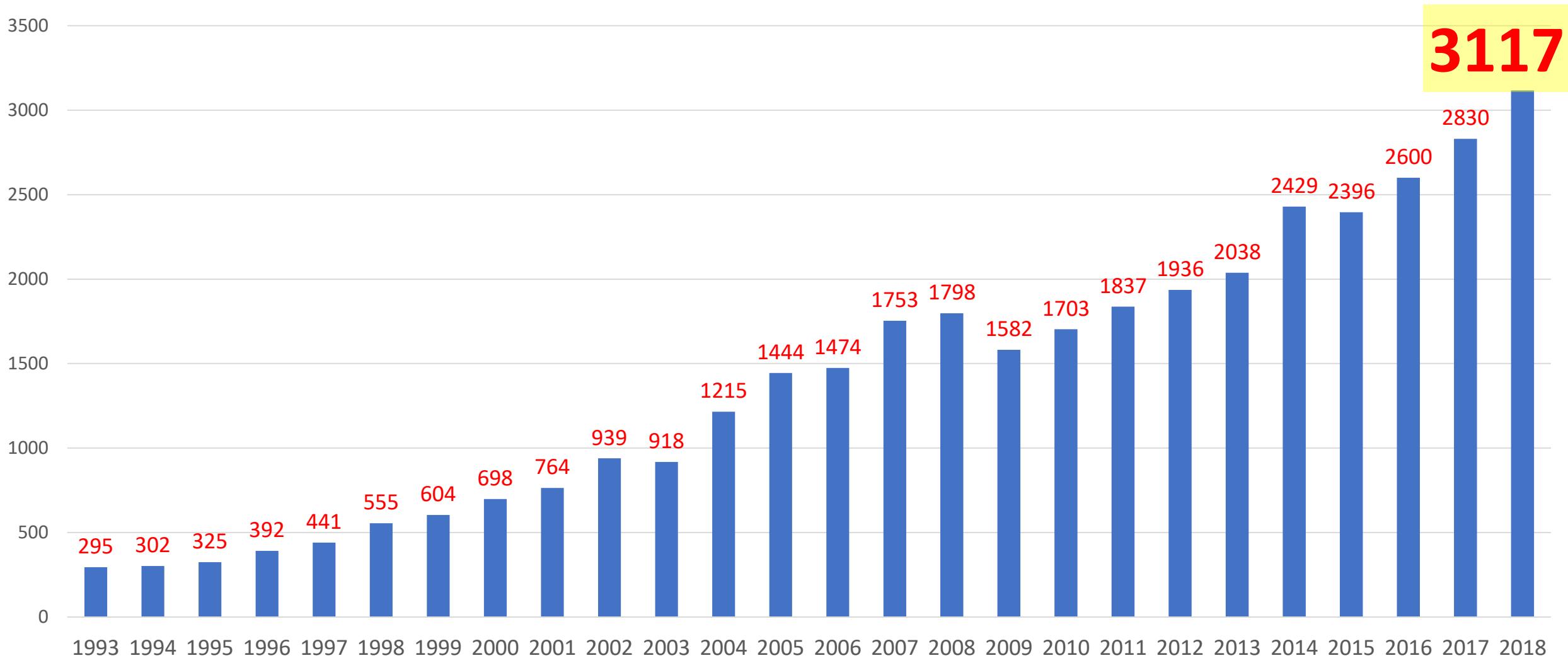


B 中央型病變 (30%)

使用支氣管鏡導引，
經呼吸道定位。

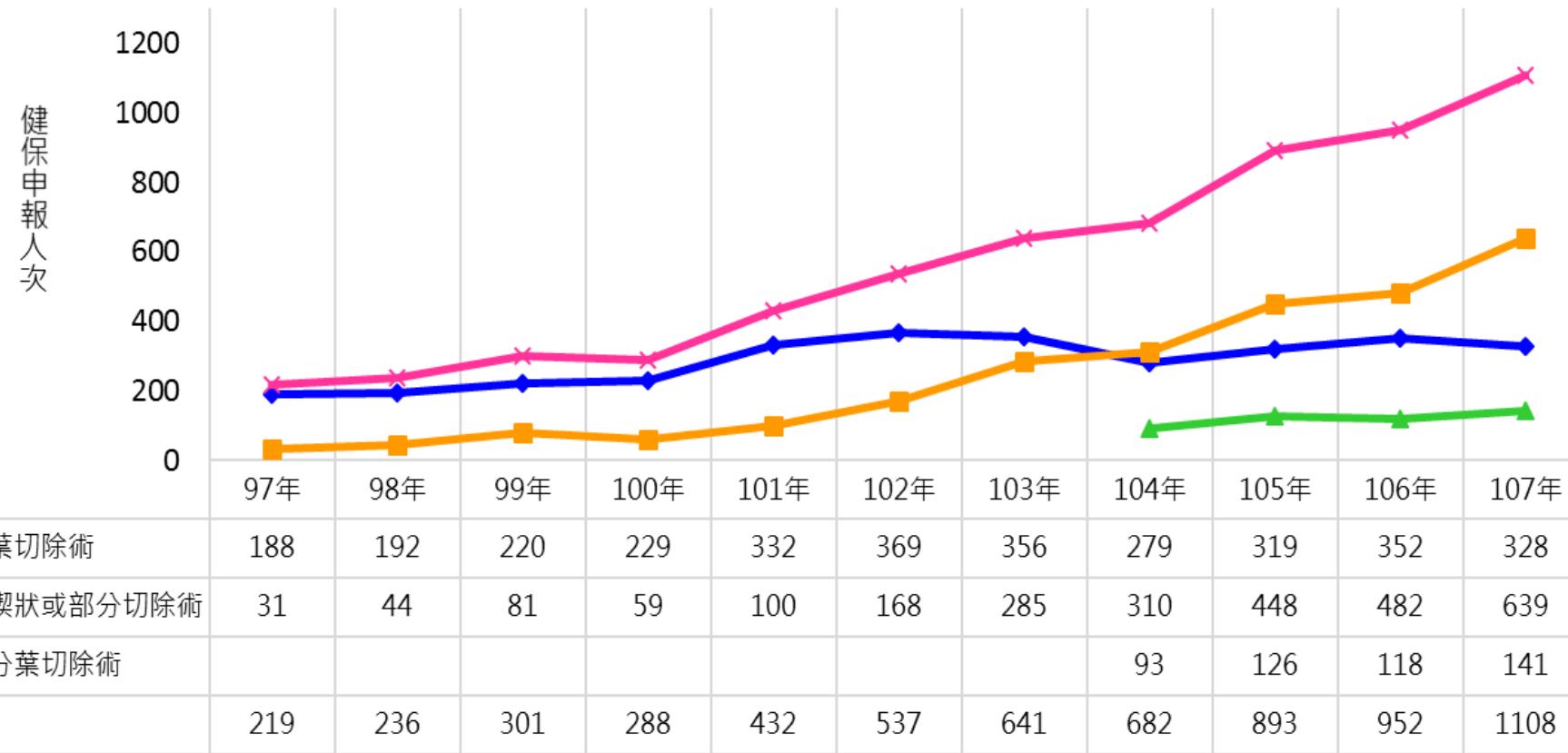


台大總院胸外歷年手術量：2018年突破3000台



台大總院歷年肺癌手術量（胸腔鏡手術）

台大胸外肺癌歷年手術人次：10年成長5倍



不插管

單孔

定位

台大胸腔外科近十年肺癌手術的發展

Anesthesia (2009)

Intubation -> Non-intubation

VATS techniques (2013)

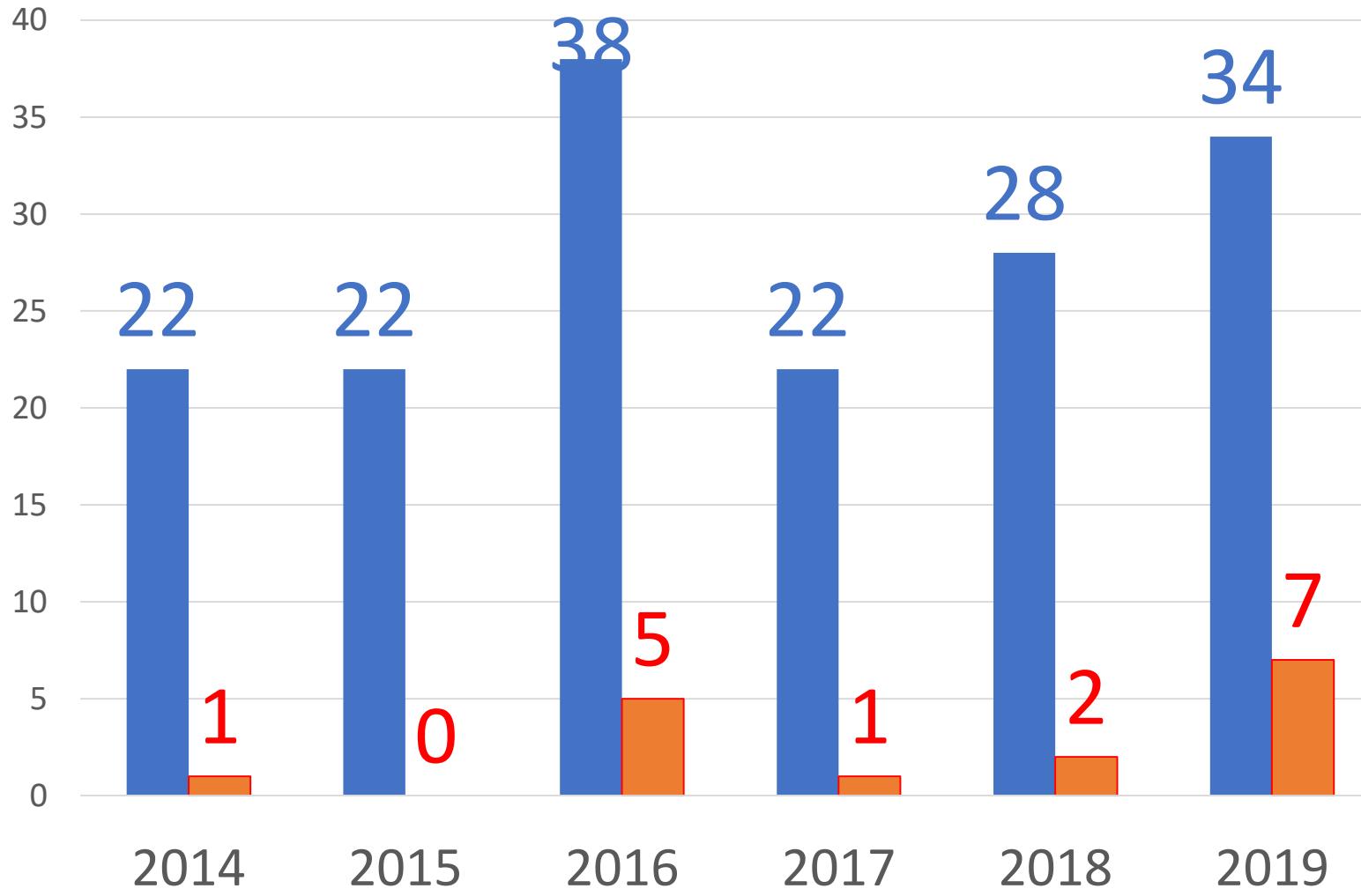
Three ports -> Uniportal VATS

Localization (2013)

Hook-wire -> Dye



台大總院-胸腔外科 SCI論文 (2014-2019)

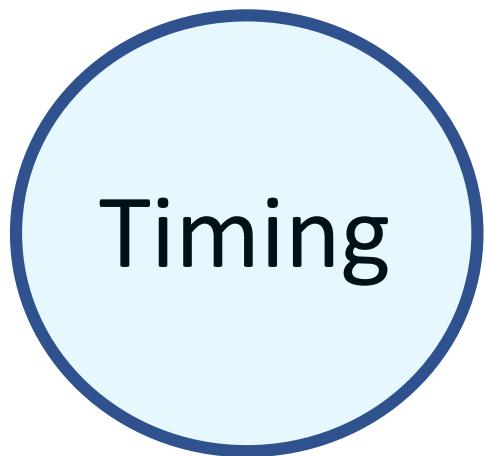


SCI論文總數

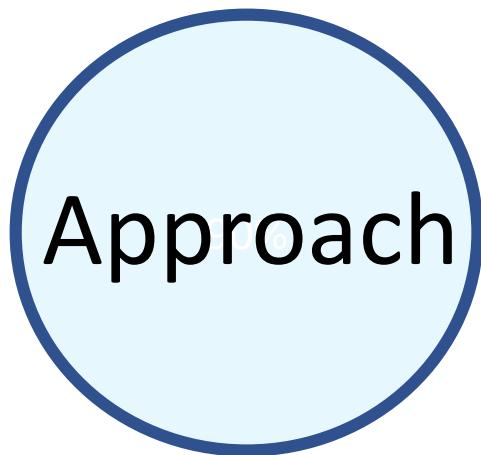
定位手術論文

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3. Kuo SW, Tseng YF, Dai KY, Chang YC, Chen KC, Lee JM. Electromagnetic Navigation Bronchoscopy Localization Versus Percutaneous CT-Guided Localization for Lung Resection via Video-Assisted Thoracoscopic Surgery: A Propensity-Matched Study. *J Clin Med.* 2019 Mar 18;8(3).
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8. Chen PH, Hsu HH, Yang SM, Tsai TM, Tsou KC, Liao HC, Lin MW, Chen JS. Preoperative Dye Localization for Thoracoscopic Lung Surgery: Hybrid Versus Computed Tomography Room. *Ann Thorac Surg.* 2018 Dec;106(6):1661-1667.
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11. Lin MW, Chen JS. Image-guided techniques for localizing pulmonary nodules in thoracoscopic surgery. *J Thorac Dis.* 2016 Oct;8(Suppl 9):S749-S755.
12. Yang SM, Ko WC, Lin MW, Hsu HH, Chan CY, Wu IH, Chang YC, Chen JS. Image-guided thoracoscopic surgery with dye localization in a hybrid operating room. *J Thorac Dis.* 2016 Oct;8(Suppl 9):S681-S689.
13. Tseng YH, Lee YF, Hsieh MS, Chien N, Ko WC, Chen JY, Lee JM, Huang PM, Lin MW, Chen JS, Chang YC. Preoperative computed tomography-guided dye injection to localize multiple lung nodules for video-assisted thoracoscopic surgery. *J Thorac Dis.* 2016 Oct;8(Suppl 9):S666-S671.
14. Lin MW, Tseng YH, Lee YF, Hsieh MS, Ko WC, Chen JY, Hsu HH, Chang YC, Chen JS. Computed tomography-guided patent blue vital dye localization of pulmonary nodules in uniportal thoracoscopy. *J Thorac Cardiovasc Surg.* 2016 Aug;152(2):535-544.e2.
15. Hung WT, Hsu HH, Hung MH, Hsieh PY, Cheng YJ, Chen JS. Nonintubated uniportal thoracoscopic surgery for resection of lung lesions. *J Thorac Dis.* 2016 Mar;8(Suppl 3):S242-50.
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Image-guided Percutaneous Localization



Pre-operative
Intra-operative



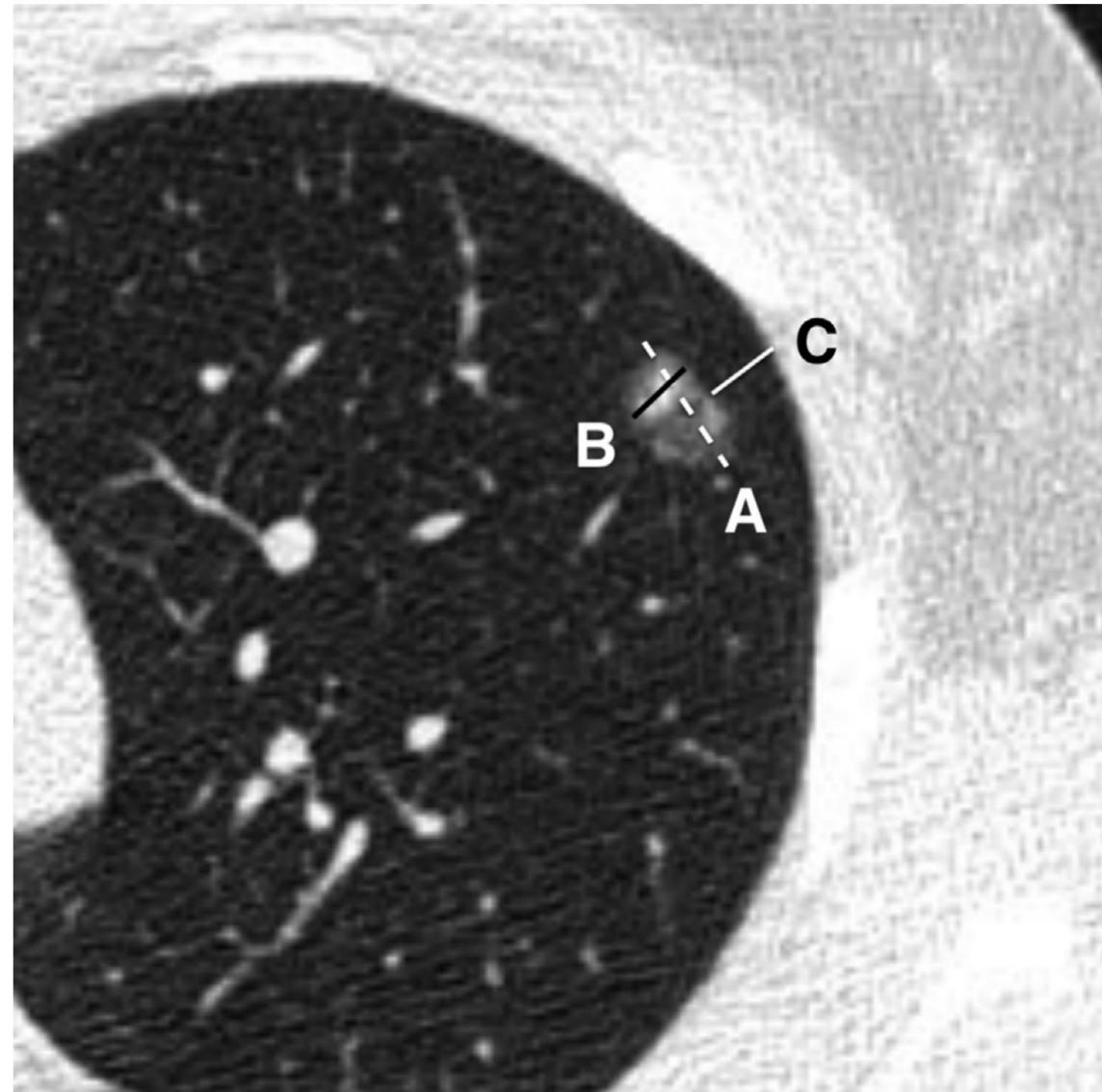
Sliding CT
Cone-beam CT
Electromagnetic Navigation
Sonography



Hook-wire
Micro-coil
Methylene Blue dye
Patent Blue V dye
ICG
Lipiodol

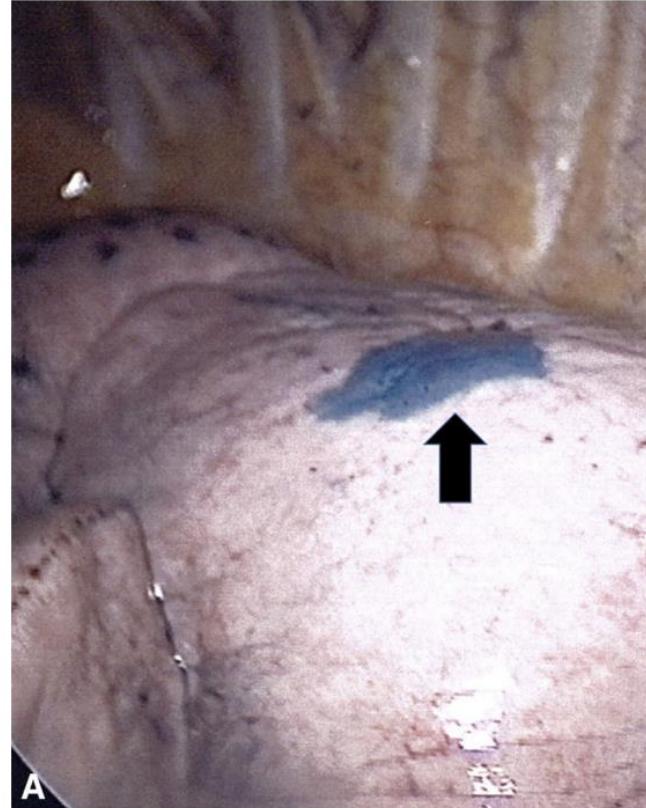
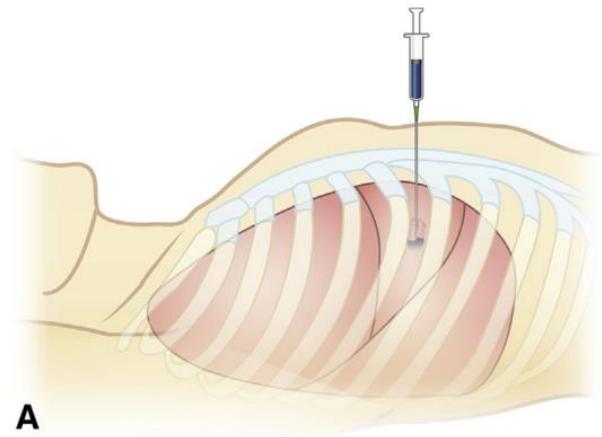
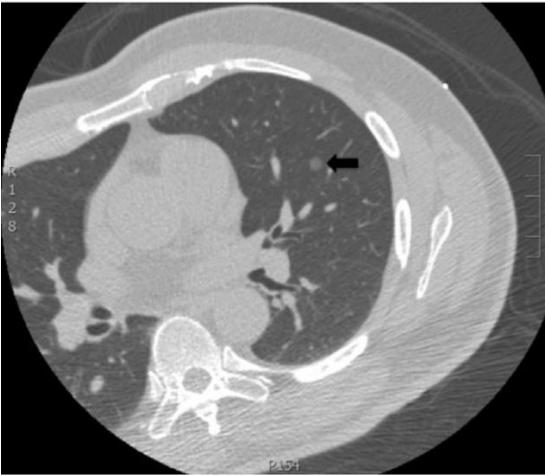
定位手術適應症

- A. **Pure** ground-glass nodules
- B. Nodules of **Solid part $\leq 1 \text{ cm}$**
- C. **Deeply-seated** nodules with a distance from nodule to the pleural surface of $> 2 \text{ cm}$.



1

Preoperative Sliding CT-guided PBV dye



A

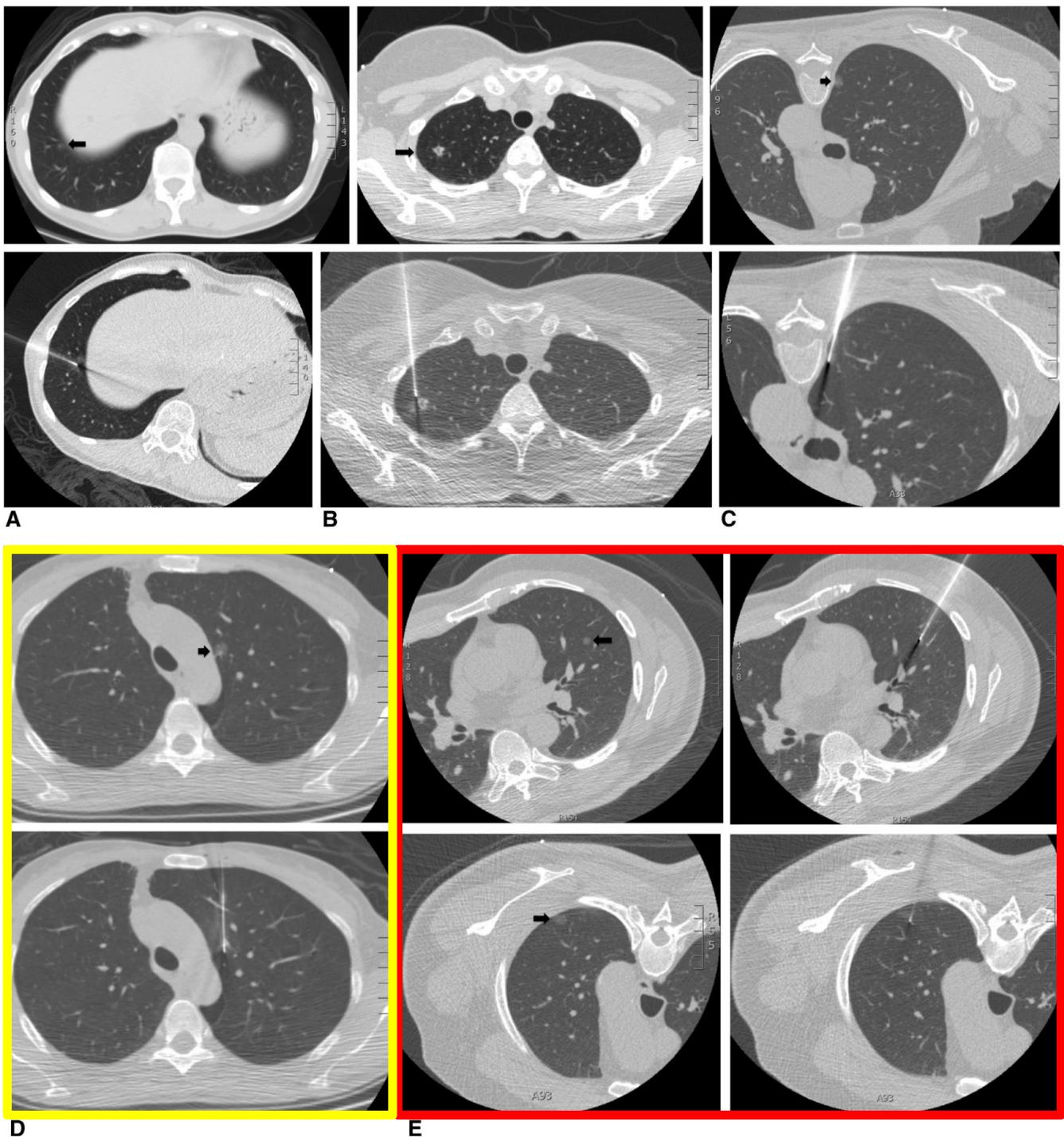


B

Preoperative Sliding CT-guided PBV dye

- 1) 高成功率
- 2) 使用傳統滑軌式電腦斷層掃描器即可施行
- 3) 醫療人員不會曝露在輻射環境
- 4) 耗時短，手術安全性高
- 5) 可同時定位多顆腫瘤，深層腫瘤

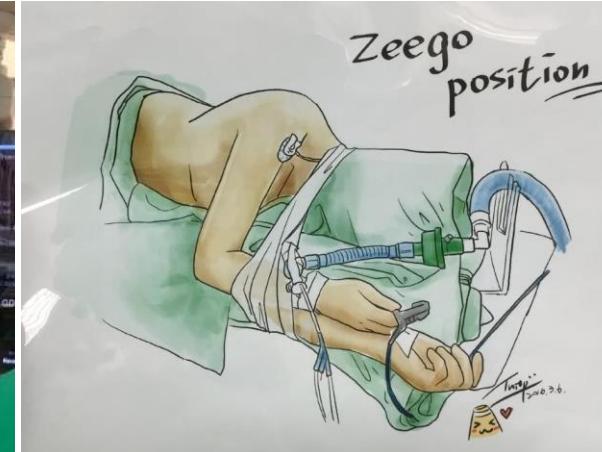
Lin MW, et al. Computed tomography-guided patent blue vital dye localization of pulmonary nodules in uniportal thoracoscopy. J Thorac Cardiovasc Surg. 2016 Aug;152(2):535-544

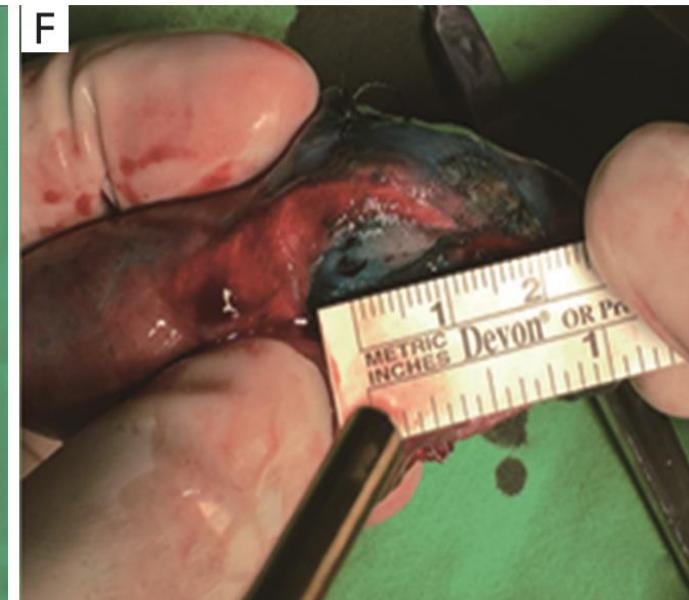
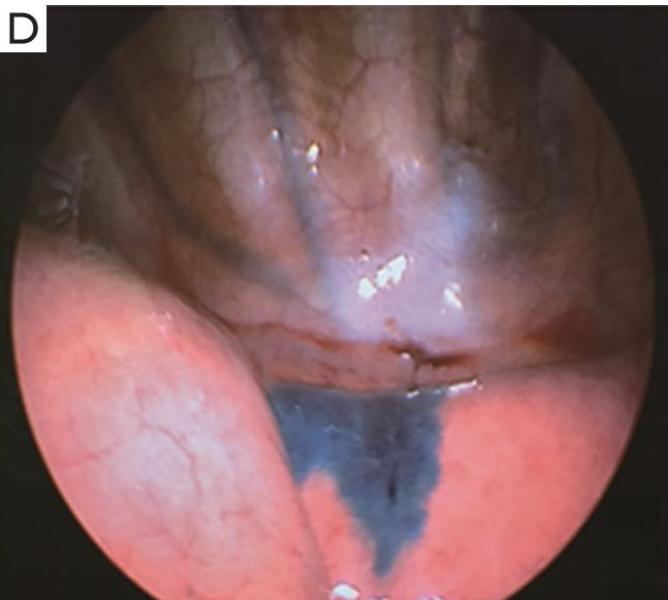
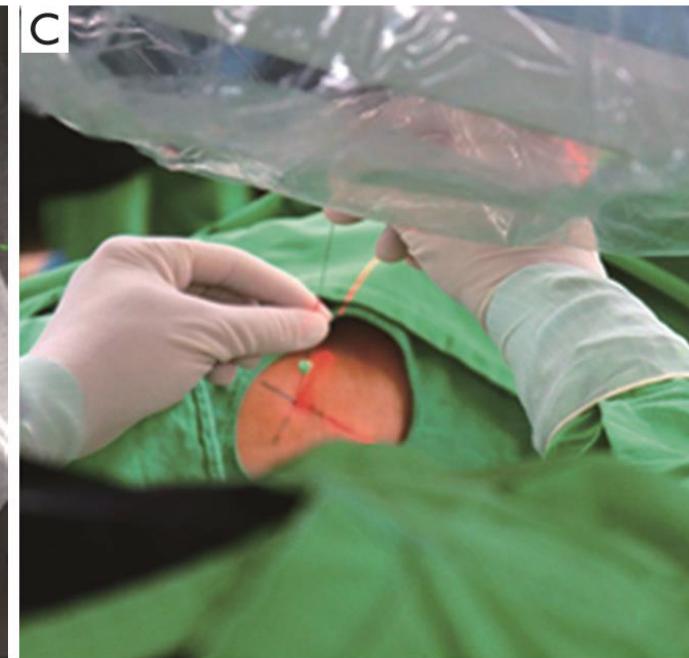
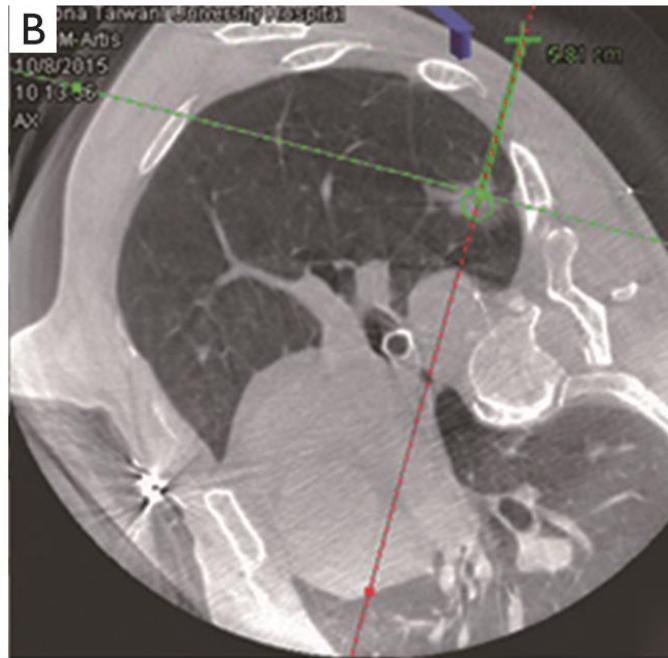


定位手術，可以
實行在困難位置，
深層腫瘤，多顆
腫瘤。

2

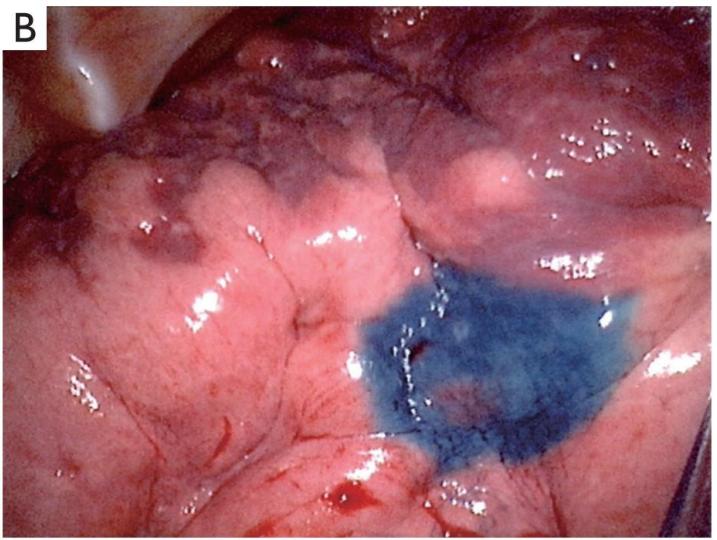
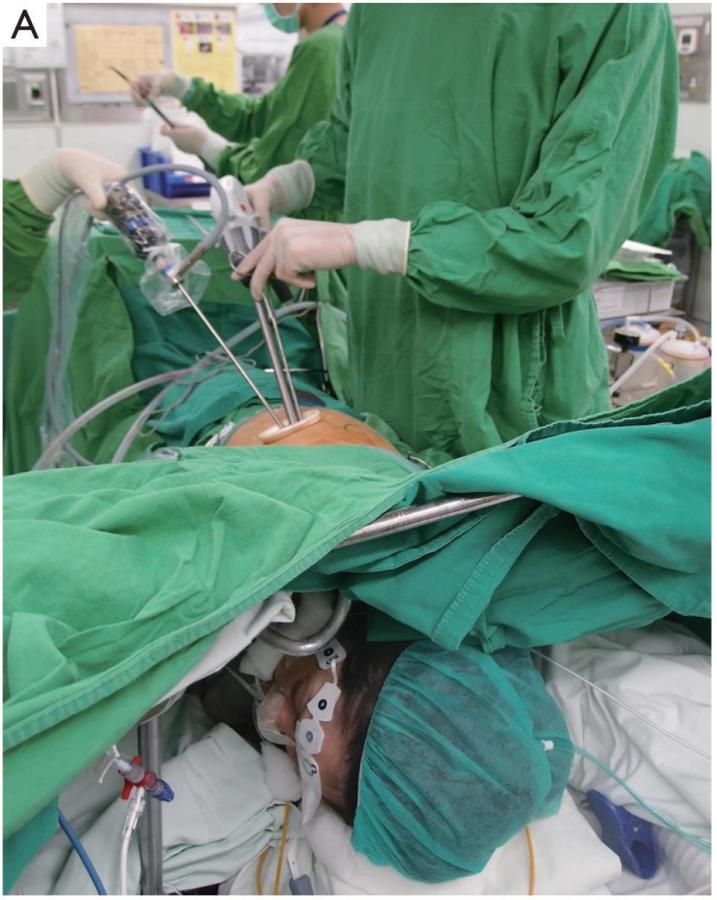
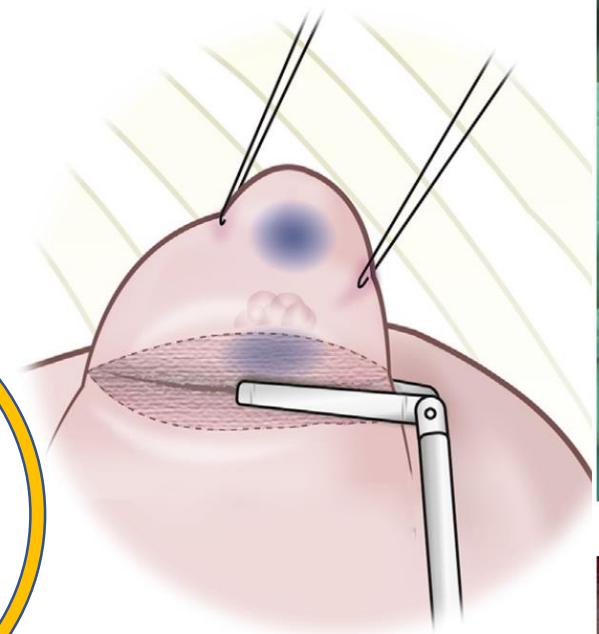
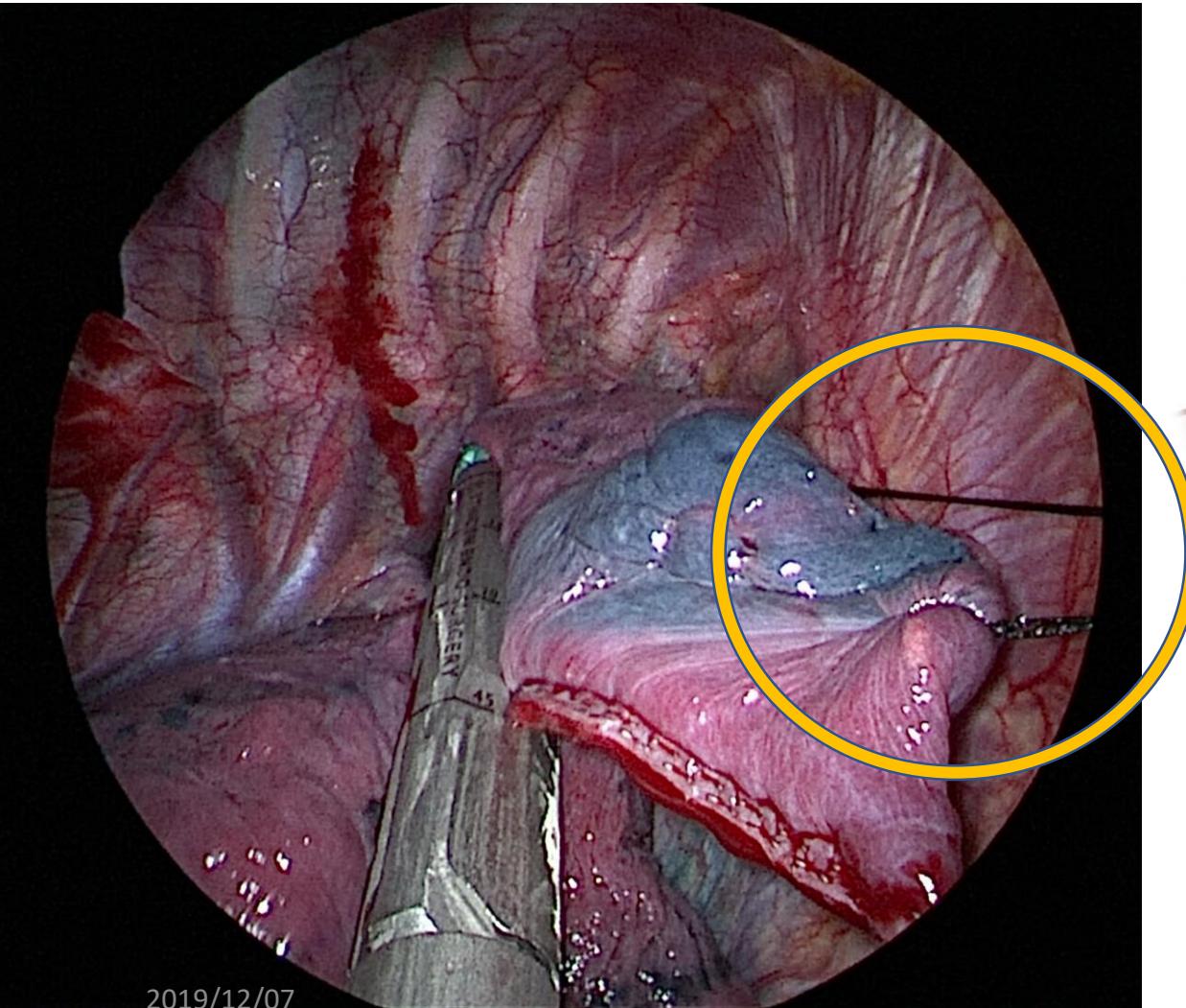
Hybrid OR – Cone Beam CT (CBCT)





Step 1:
DynaCT to
find lesions

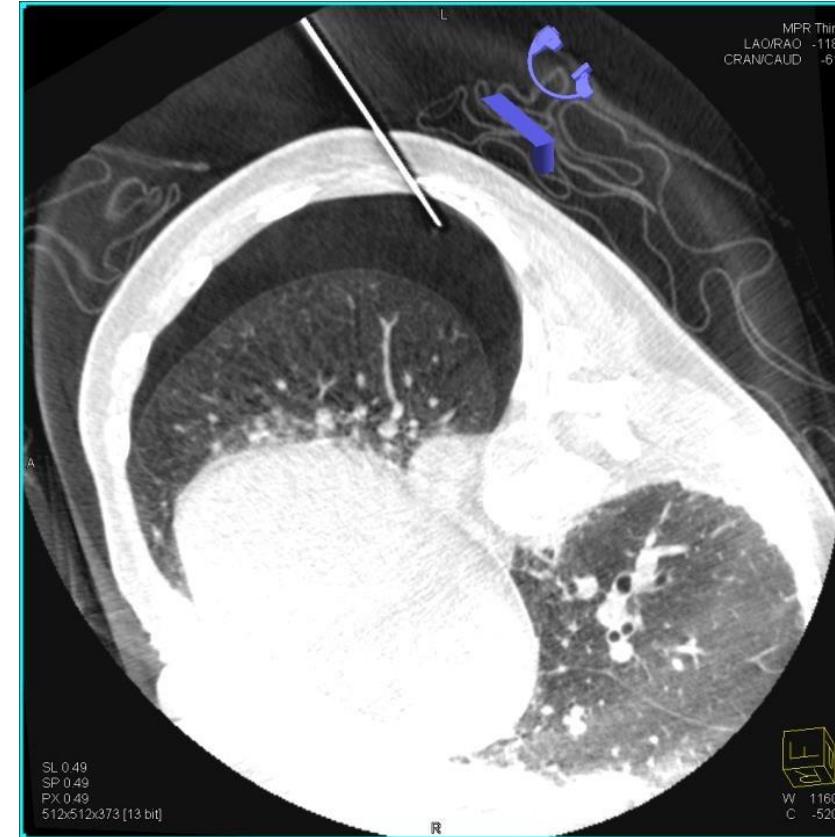
定位 + 不插管麻醉 + 單孔胸腔鏡



定位手術安全性



出血，咳血



氣胸

過敏

Air embolism

定位 + 單孔手術

Lin et al

Thoracic

Computed tomography-guided patent blue vital dye localization of pulmonary nodules in uniportal thoracoscopy

Mong-Wei Lin, MD, PhD,^a Yao-Hui Tseng, MD,^b Yee-Fan Lee, MD,^b Min-Shu Hsieh, MD,^c Wei-Chun Ko, MD,^b Jo-Yu Chen, MD,^b Hsao-Hsun Hsu, MD, PhD,^a Yeun-Chung Chang, MD, PhD,^b and Jin-Shing Chen, MD, PhD^a

ABSTRACT

Objective: Due to the limitations of the small single incision, an ideal preoperative localization technique is essential for surgical resection of small pulmonary nodules by uniportal video-assisted thoracoscopic surgery (VATS). The aim of this study is to evaluate the usefulness and safety of preoperative computed tomography (CT)-guided patent blue vital (PBV) dye localization in patients with small indeterminate pulmonary nodules who have undergone uniportal VATS for lung resection.

Methods: In this retrospective study, 177 consecutive patients (196 pulmonary nodules) who underwent preoperative CT-guided PBV dye localization and uniportal VATS from January 2013 to September 2015 were enrolled.

Results: The CT-dye localization procedure was performed successfully and correctly for 99.5% (195/196) of the nodules within a mean procedure time of 30 minutes. The mean size of the nodules was 7.8 mm, and their mean depth from the pleural surface was 18.3 mm. Most of the nodules (78.6%, 154/196)



Thoracoscopic view of the indeterminate lung nodule localized by CT-guided PBV dye.

Central Message

CT-guided PBV dye localization for uniportal VATS is safe and feasible, and results in a short hospital stay and low morbidity rate.

Safe & Feasible

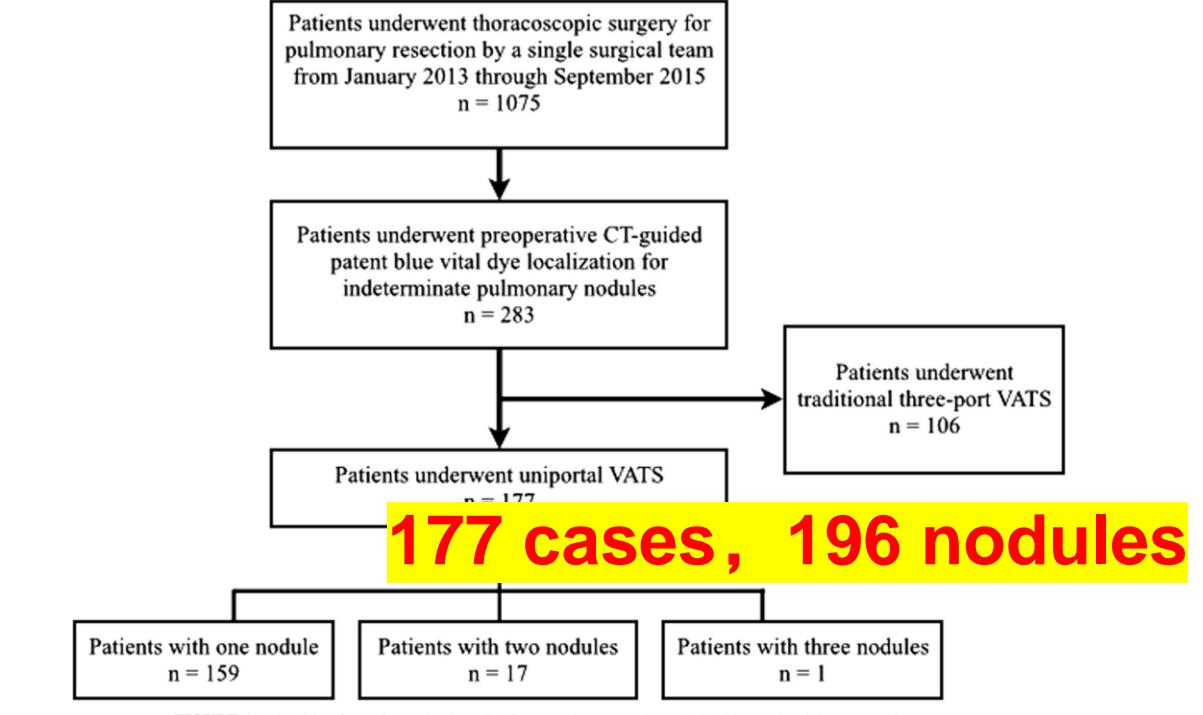


FIGURE 1. Algorithm for patient selection. CT, Computed tomography; VATS, video-assisted thoracoscopic surgery.

Localization-related complications

Intrapulmonary focal hemorrhage

Pneumothorax

Small

Large†

Hemoptysis

Hemothorax

Allergic reaction

Complications need invasive management

Failed localization

96 (54.2)

52 (29.4)

49

3

1 (0.5)

0 (0)

0 (0)

0 (0)

1 (0.5)

Preoperative computed tomography-guided dye injection to localize multiple lung nodules for video-assisted thoracoscopic surgery

Yao-Hui Tseng^{1,2}, Yee-Fan Lee¹, Min-Shu Hsieh³, Ning Chien¹, Wei-Chun Ko¹, Jo-Yu Chen¹, Jang-Ming Lee⁴, Pei-Ming Huang⁴, Mong-Wei Lin⁴, Jin-Shing Chen⁴, Yeun-Chung Chang¹

¹Department of Medical Imaging, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan;

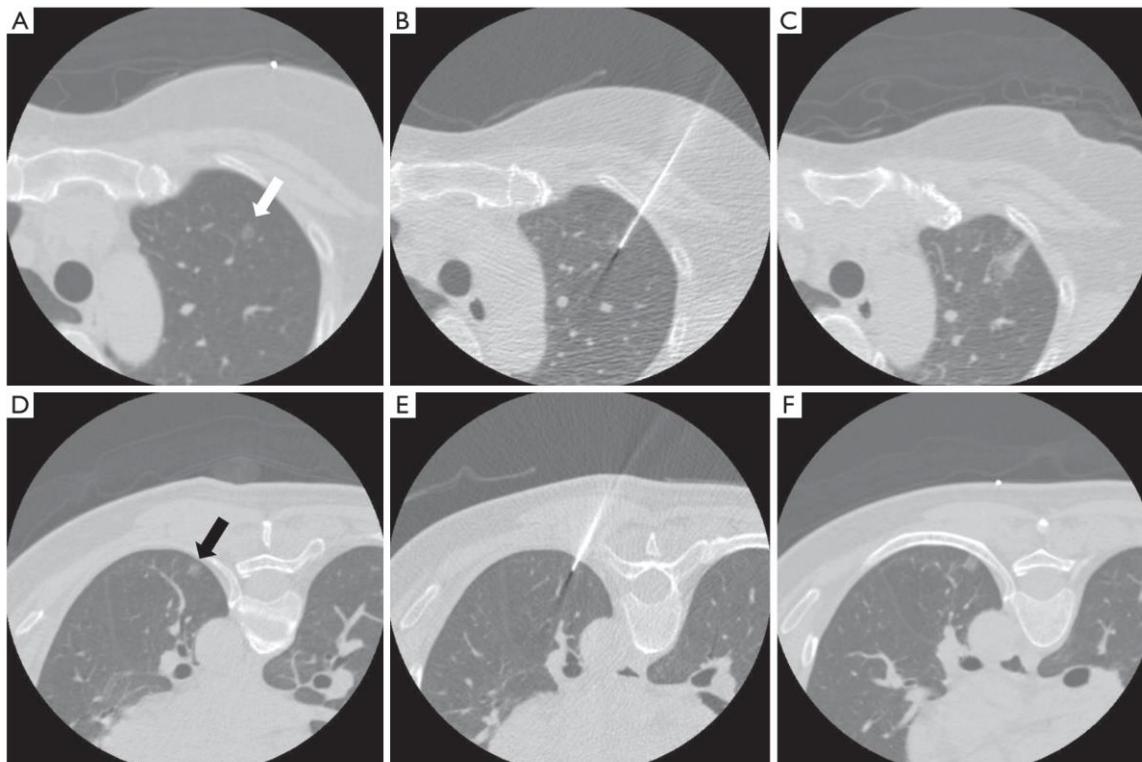
²Department of Medical Imaging, National Taiwan University Hospital Yun-Lin Branch, Taipei, Taiwan; ³Department of Pathology, ⁴Department of

多顆結節定位

Nodules	Patients (N=100)
2	85
3	13
4	2
Total Nodules = 217	
Size (cm)	0.8±0.4 (range, 0.3–2.2)
Success rate (per nodule) (%)	99
Failed reasons	
Poor dye visualization	1
Progressive pneumothorax	1
Complications (patient number) [%]	
Mild hemorrhage	24 [24]
Pneumothorax (cm)	
Mild (<1)	31 [31]
Moderate (1–2)	7 [7]
Large (>2)	2 [2]
Anaphylaxis	1 [1] 21

A safe, feasible, and accurate method with high success rate

Correspondence to: Yeun-Chung Chang, MD, PhD. Department of Medical Imaging, National Taiwan University Hospital, No. 7, Chung-Shan South Road, Taipei 10002, Taiwan. Email: ycc5566@ntu.edu.tw.



Nonintubated uniportal thoracoscopic surgery for resection of lung lesions

Localization + Nonintubated + Uniportal

¹Division of Thoracic Surgery, Department of Surgery, ²Department of Anesthesiology, ³Department of Thoracic Surgery, Department of Surgery

Table 2 Anesthetic and operative procedures

Variable ^a	No. [%] (N=116)
Preoperative CT-guided dye localization	77 [66]
Anesthetic induction duration, min	10 [4–29], 11±4.7
Operation procedure	
Wedge resection only	30 [26]
Wedge resection + lymphadenectomy	77 [66]
Segmentectomy + lymphadenectomy	7 [6]
Lobectomy + lymphadenectomy	2 [1.7]
Surgical duration, min	83 [32–165], 86±27.7
Wedge resection only, min	63 [32–165], 68±27.8
Wedge resection + lymphadenectomy, min	88 [49–152], 91±22.9
Segmentectomy + lymphadenectomy, min	100 [59–144], 100±35.4
Lobectomy + lymphadenectomy, min	164±14 [N=2]
Conversion to	
Multiport VATS	5 [4.3]
Tracheal intubation	1 [0.9]
Thoracotomy	0 [0]

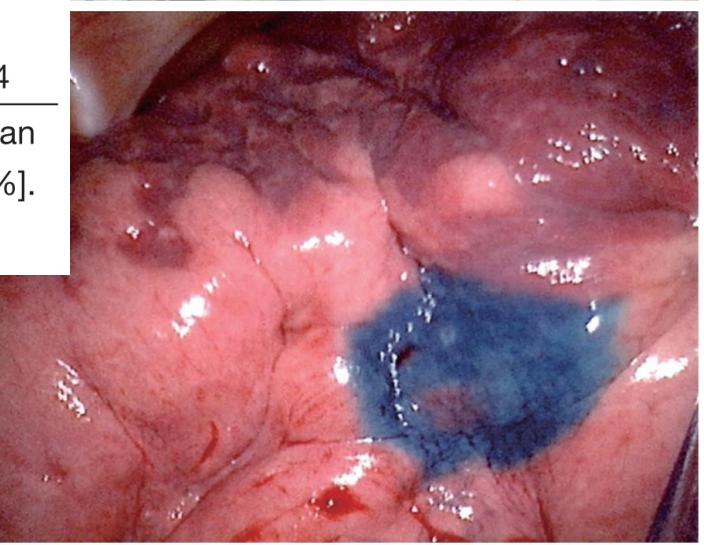
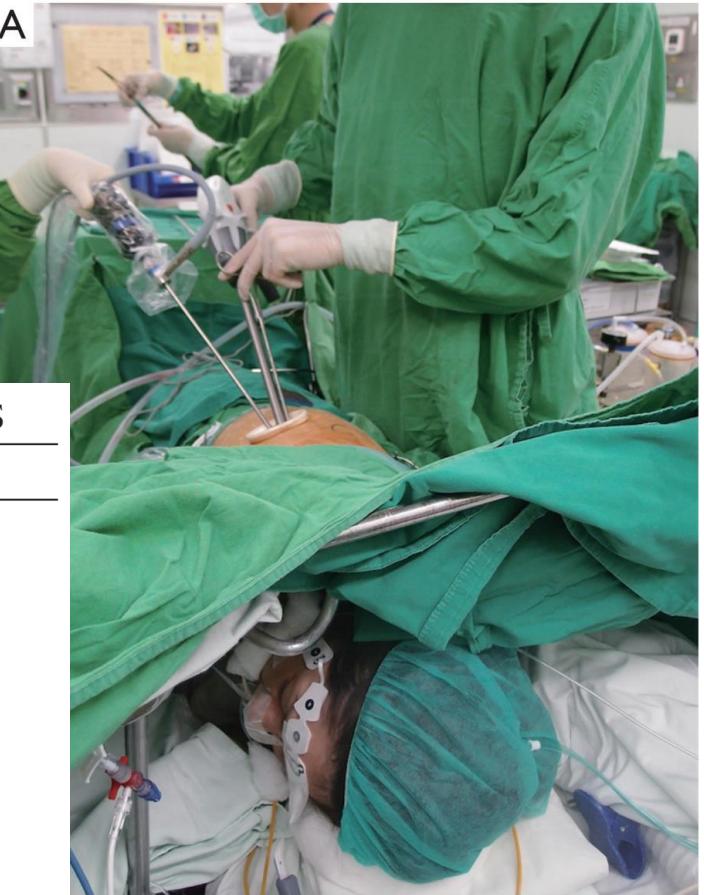
Table 3 Treatment outcome of nonintubated uniportal VATS

Variable ^a	N=116
Operation complications	
Air leaks >3 days	2 [1.7]
Bleeding	1 [0.9]
Pneumonia	1 [0.9]
Post-op pain intensity on numeric rating scale	
Day 1	2 [0–5], 1.9±1.1
Day 2	1 [0–4], 1.4±0.9
Chest tube drainage, day	
Day 1	1 [0–7], 1.5±1.1
Hospital stay after operation, days	
Median [range], 3.3±1.4	

^a, continuous data are shown as median [range] and mean

± standard deviation, and categorical data as number [%].

VATS, video-assisted thoracoscopic surgery.



深層結節定位

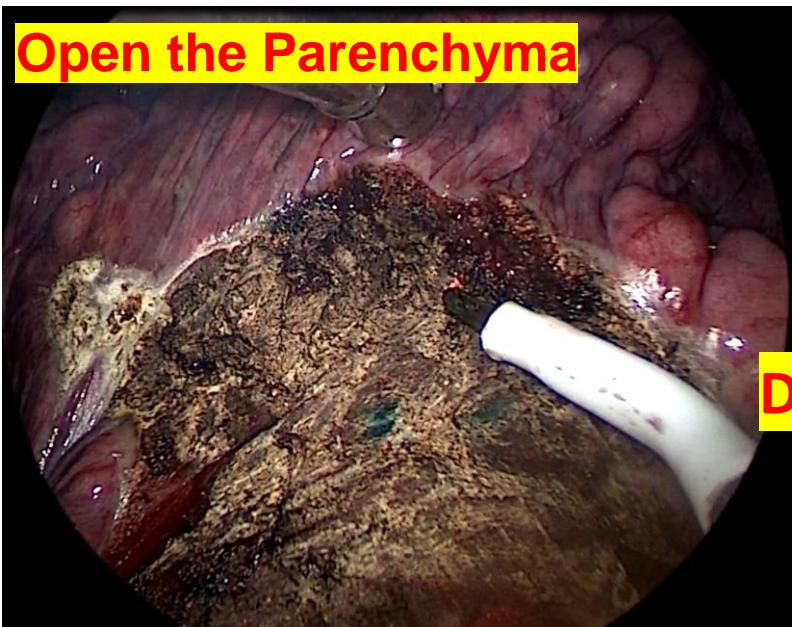
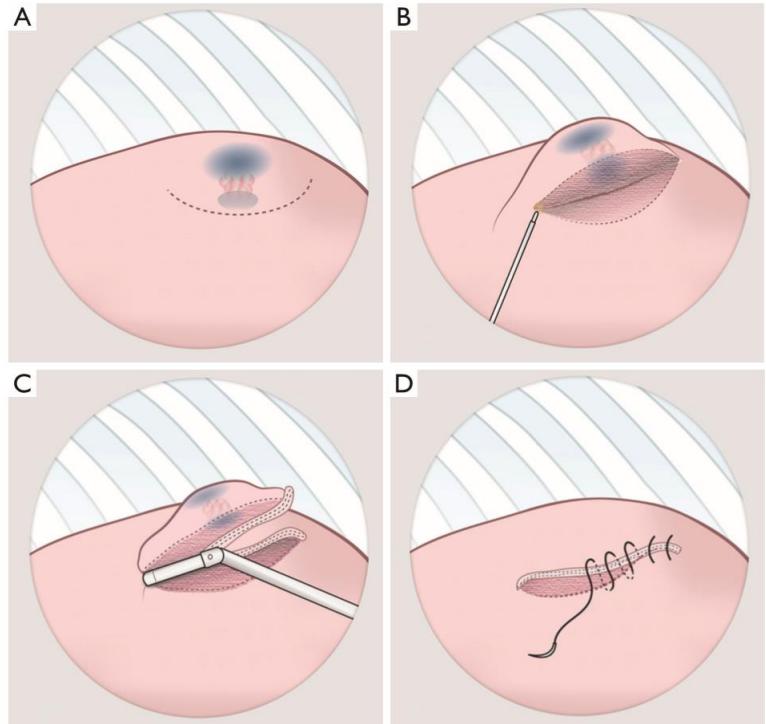
Computed tomography-guided dye localization for deeply situated pulmonary nodules in thoracoscopic surgery

Tung-Ming Tsai¹, Xu-Heng Chiang¹, Hsien-Chi Liao², Kuan-Chuan Tsou³, Mong-Wei Lin¹, Ke-Cheng Chen¹, Hsao-Hsun Hsu¹, Jin-Shing Chen¹

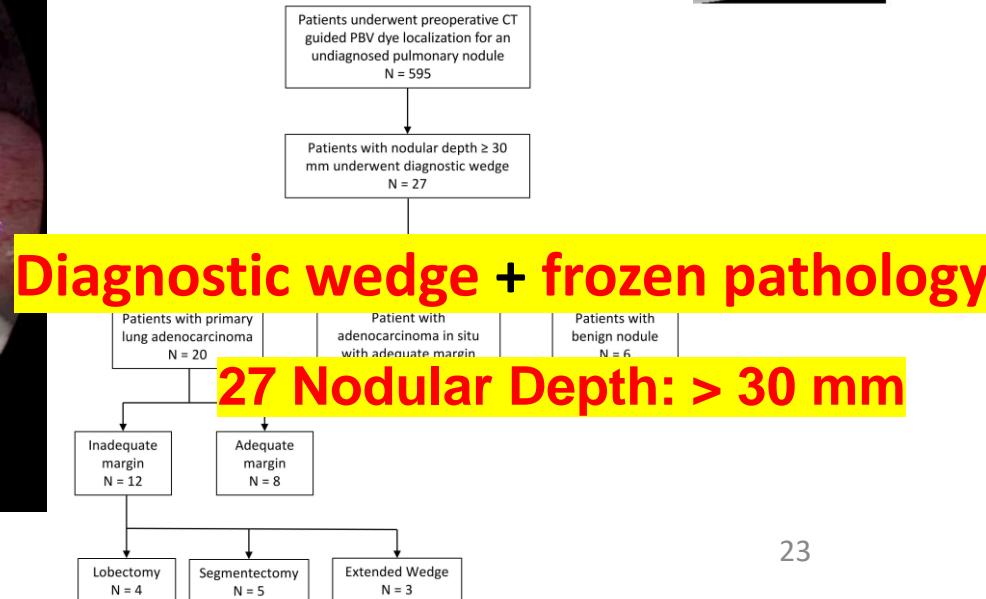
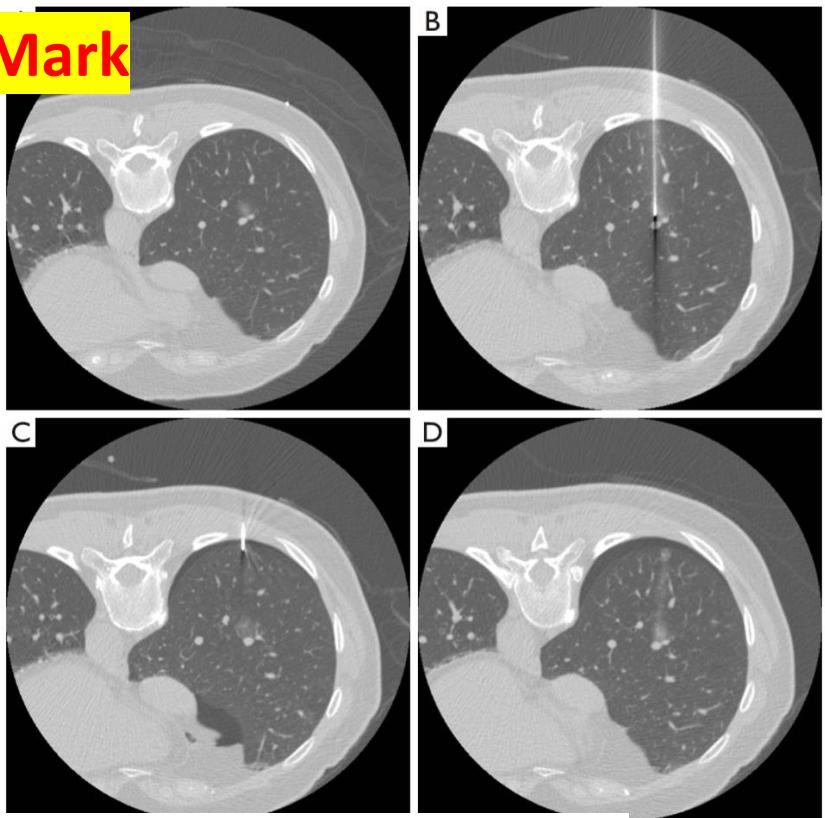
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Contributions: (I) Conception and design: TM Tsai, KC Chen, JS Chen; (II) Administrative support: MW Lin, HH Hsu, JS Chen; (III) Provision of study materials or patients: MW Lin, HH Hsu, JS Chen; (IV) Collection and assembly of data: TM Tsai, XH Chiang, HC Liao, KC Tsou; (V) Data analysis and interpretation: TM Tsai, MW Lin, KC Chen; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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Dual Mark



定位手術：降低單孔手術變多孔的Conversion Rate

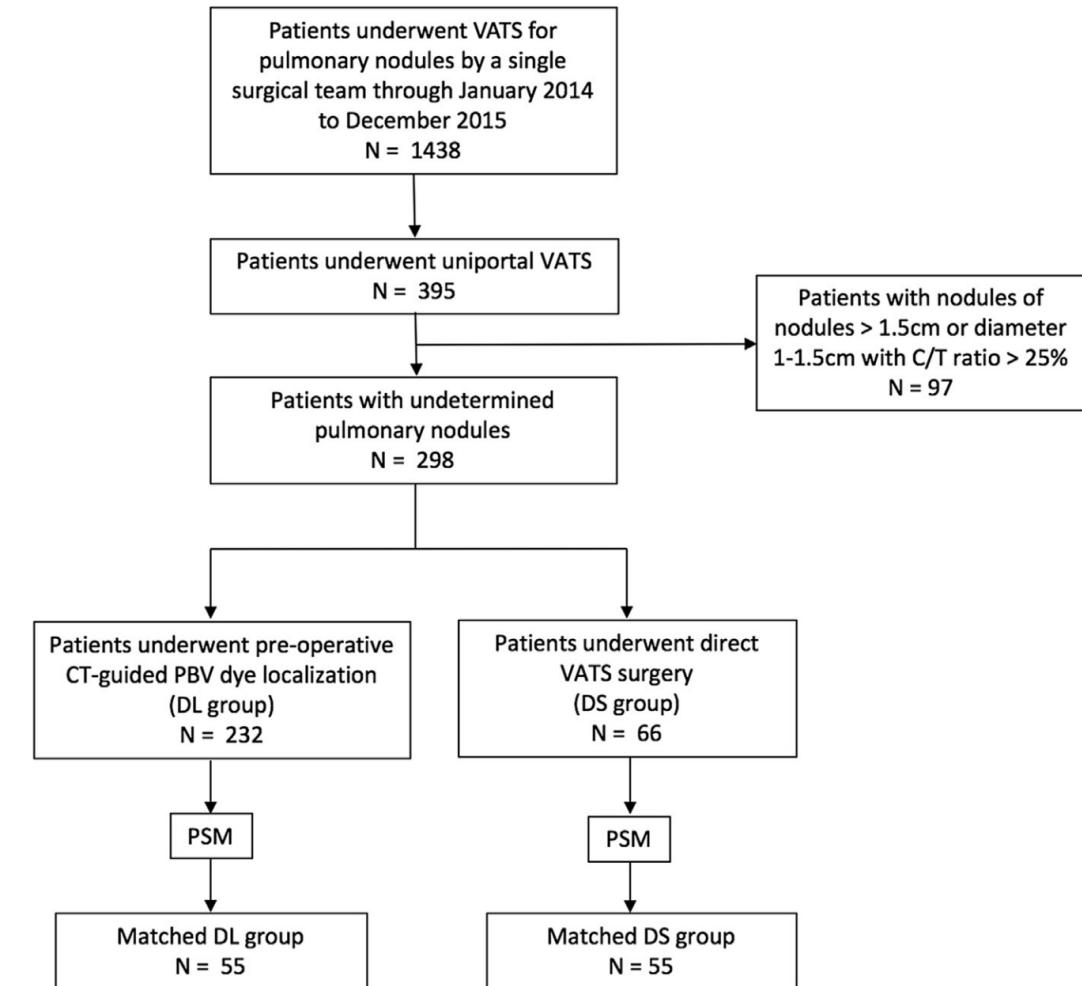
Original Article

Computed tomography-guided dye localization prior to uniportal thoracoscopic surgery for lung nodules: A propensity score matching analysis

Tung-Ming Tsai, Wan-Tir Jin-Shing Chen*

Table 2 Perioperative outcome of propensity-matched patients.

Variables	DL (N = 55)	DS (N = 55)	P-value
Operative Methods			0.801 ^c
Wedge resection	49 (89.1)	49 (89.1)	
Segmentectomy	5 (9.1)	4 (7.3)	
Lobectomy	1 (1.8)	2 (3.6)	
Non-intubated VATS (N, %)	28 (50.9)	29 (52.7)	1.000 ^b
Operative duration (min)	85 (63–112)	76 (60–106)	0.280 ^a
Blood loss (mL)	20 (9–30)	23.5 (11–40)	0.140 ^a
Conversion to multi- ports VATS	1 (1.8)	7 (12.7)	0.030 ^b
Thoracic drainage (days)	1 (1–1)	1 (1–1)	0.892 ^a
Hospital stay (days)	3 (2–4)	3 (2–3)	0.104 ^a
Morbidity	2 (3.6)	1 (1.8)	1.000 ^b
Mortality	0	0	
Pathological nodule size (cm)	0.80 (0.6–0.9)	0.90 (0.7–1.2)	0.032 ^a
Histology			0.008 ^c
Primary NSCLC	46 (83.6)	31 (56.4)	
Metastatic cancer	3 (5.5)	7 (12.7)	
Benign nodule	6 (10.9)	17 (30.9)	



Sliding \leftrightarrow Cone-Beam CT

Preoperative Dye Localization for Thoracoscopic Lung Surgery: Hybrid Versus Computed Tomography Room

 Check for updates

Pei-Hsing Chen, MD, Hsiao-Hsun Hsu, MD, PhD, Shun-Mao Yang, MD, Tung-Ming Tsai, MD, Kuan-Chuan Tsou, MD, Hsien-Chi Liao, MD, Mong-Wei Lin, MD, PhD, and Jin-Shing Chen, MD, PhD

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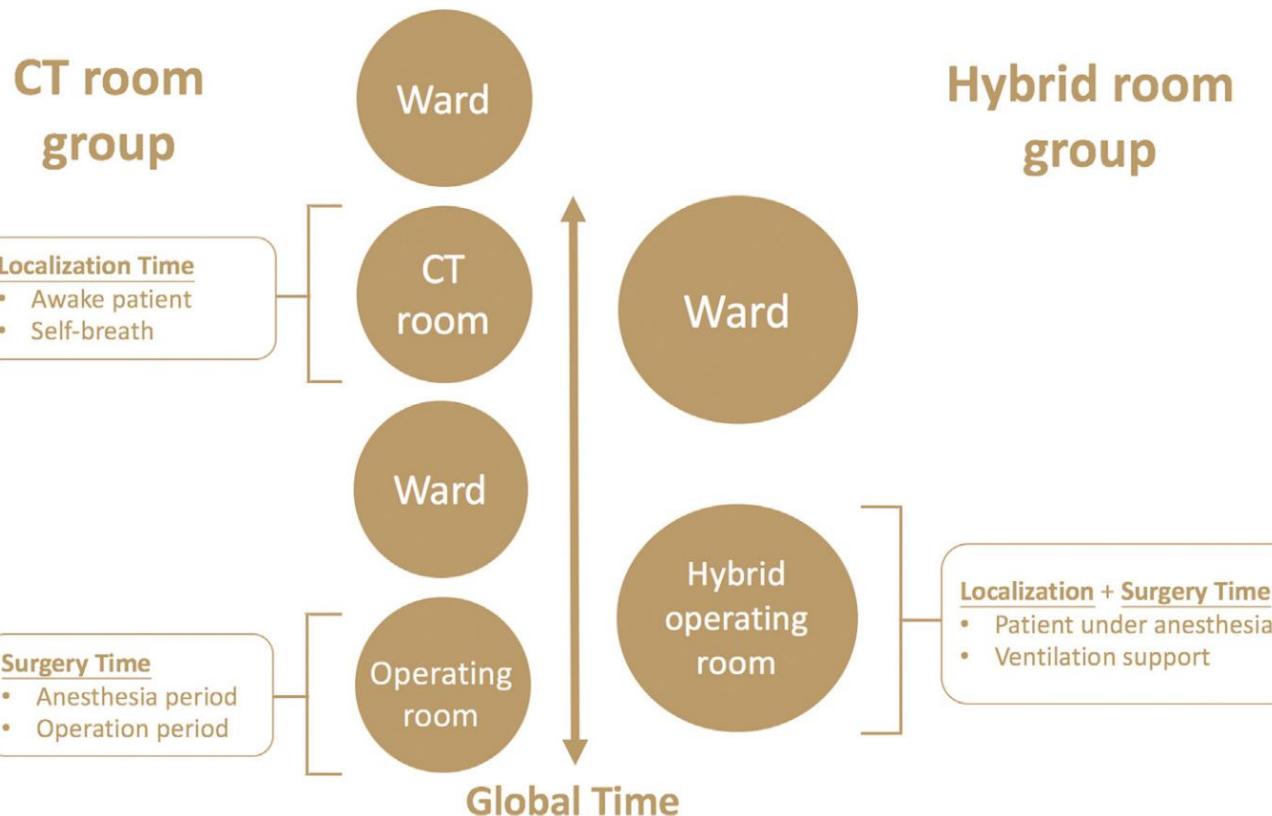
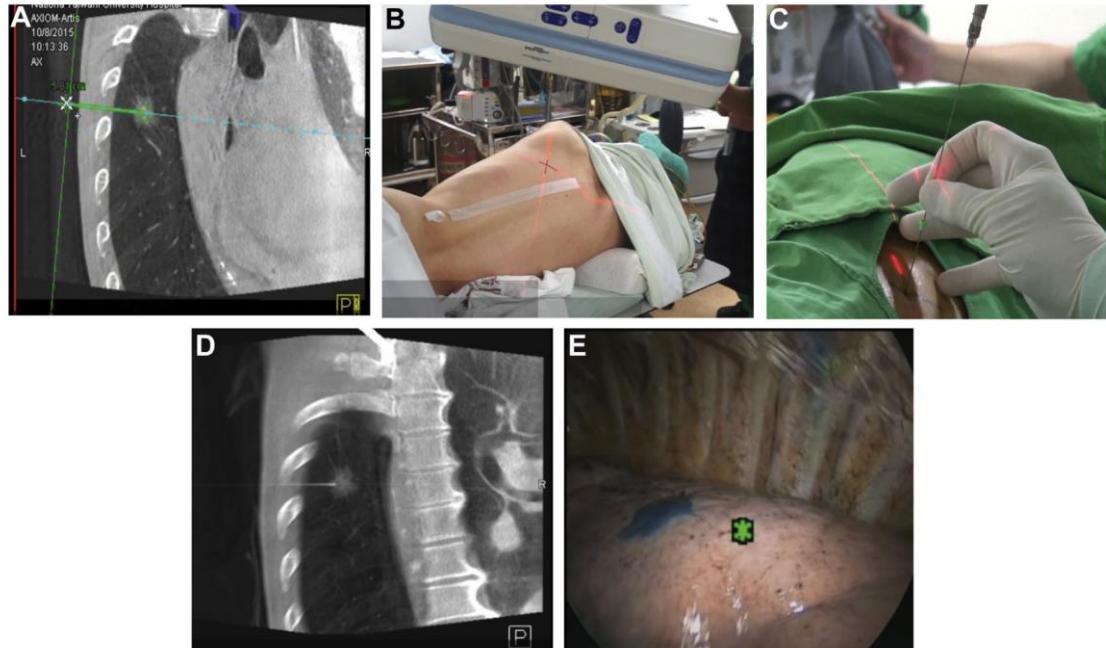
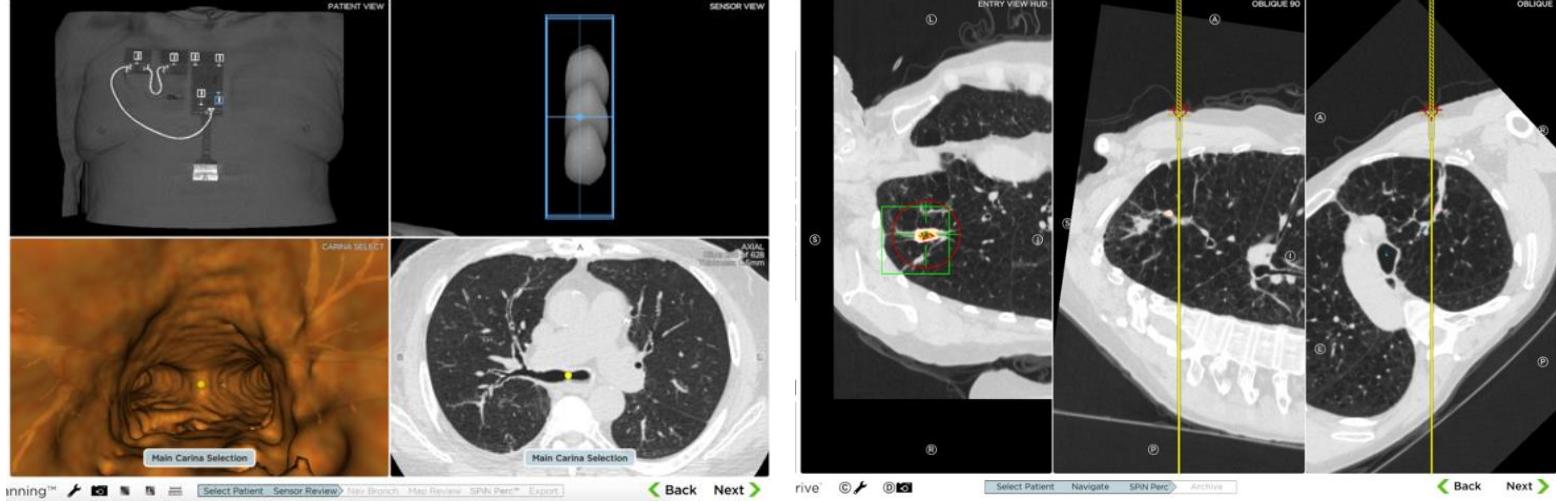


Table 3. Localization and Surgery Results

Variable	Hybrid Room Group	CT Room Group	p Value
Total number of patients	25	50	>0.999
Operation method			
Wedge	24 (96)	48 (96)	
Segmentectomy	1 (4)	2 (4)	
Global time, minutes	192.6 \pm 44.2 (123–300)	244.1 \pm 101.8 (102–552)	0.003
Localization time, minutes	33.1 \pm 8.0 (21–58)	22.3 \pm 10.7 (8–73)	<0.001
Surgery time, minutes	107.2 \pm 42.5 (31–185)	89.0 \pm 27.1 (50–163)	0.060
Radiation exposure			0.002
Dose length product, mGy*cm	953.5 \pm 725.4 (291.0–3150.5)	317.2 \pm 183.7 (61.2–671.9)	
Chest tube drainage, days	1 \pm 0.4 (0–2)	1.5 \pm 0.8 (1–4)	0.001
Postoperative hospital stay, days	3.0 \pm 1.2 (2–8)	3.4 \pm 1.1 (2–7)	0.161
Localization-related complications			
Pneumothorax ^a			
Small	NA	19 (38)	
Large	1 (4)	0 (0)	
Intrapulmonary focal hemorrhage	NA	29 (58)	
Diaphragm injury	1 (4)	0 (0)	
Failed to localization	2 (4)	0 (0)	

Electromagnetic Navigation



Percutaneous Localization in NTUH

- 1) Preoperative Sliding CT-guided dye localization
- 2) Hybrid OR : intra-operative CBCT
- 3) Electromagnetic navigation

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