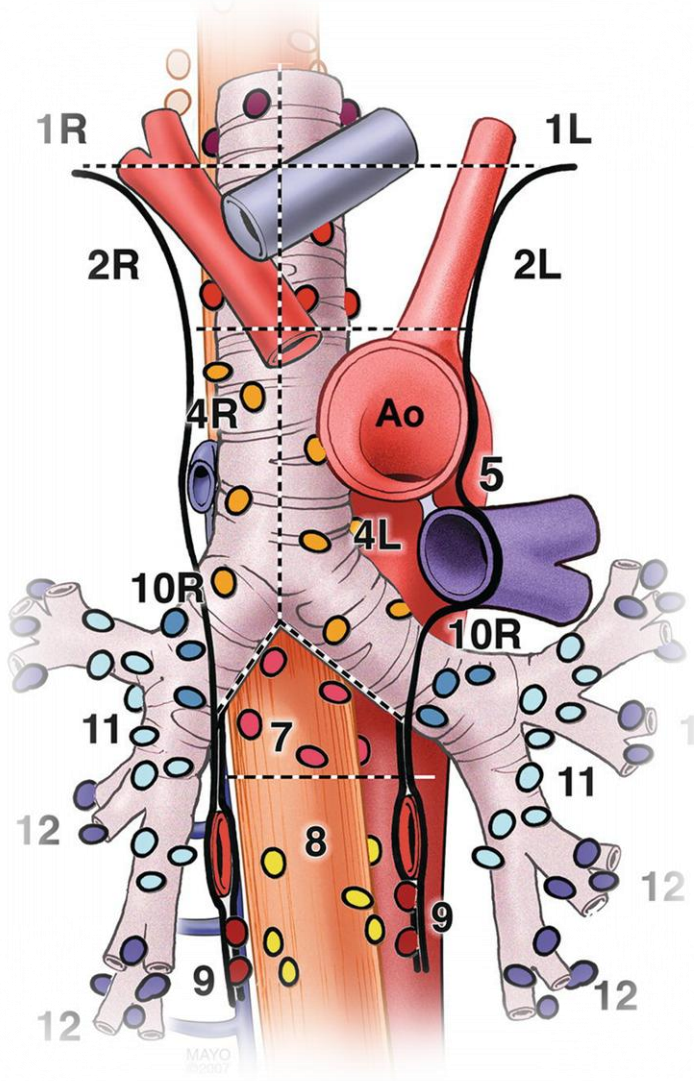
2025年支氣管內視鏡超音波推廣及實體操作課程
Hand-on Seminar of Endobronchial Ultrasonography
EBUS-TBNA 操作介紹

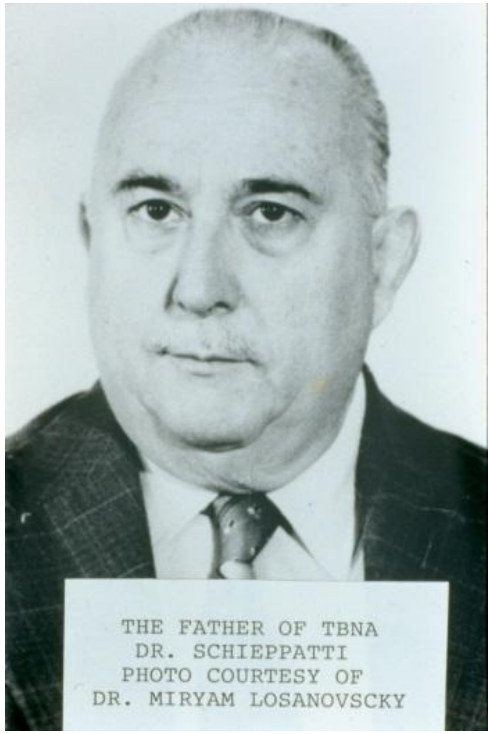
高雄長庚紀念醫院胸腔內科
張晃智醫師　2025-11-15

Method of Diagnosing Mediastinal Lymphadenopathy

- Non-invasive
  - CT
  - PET/CT
- Invasive
  - Mediastinoscopy
  - VATS/Thoracotomy
- Minimally invasive
  - Conventional transbronchial needle aspiration, cTBNA
  - Endobronchial ultrasound guided transbronchial needle aspiration, EBUS-TBNA
  - Endoscopic ultrasound guided fine needle aspiration, EUS-FNA

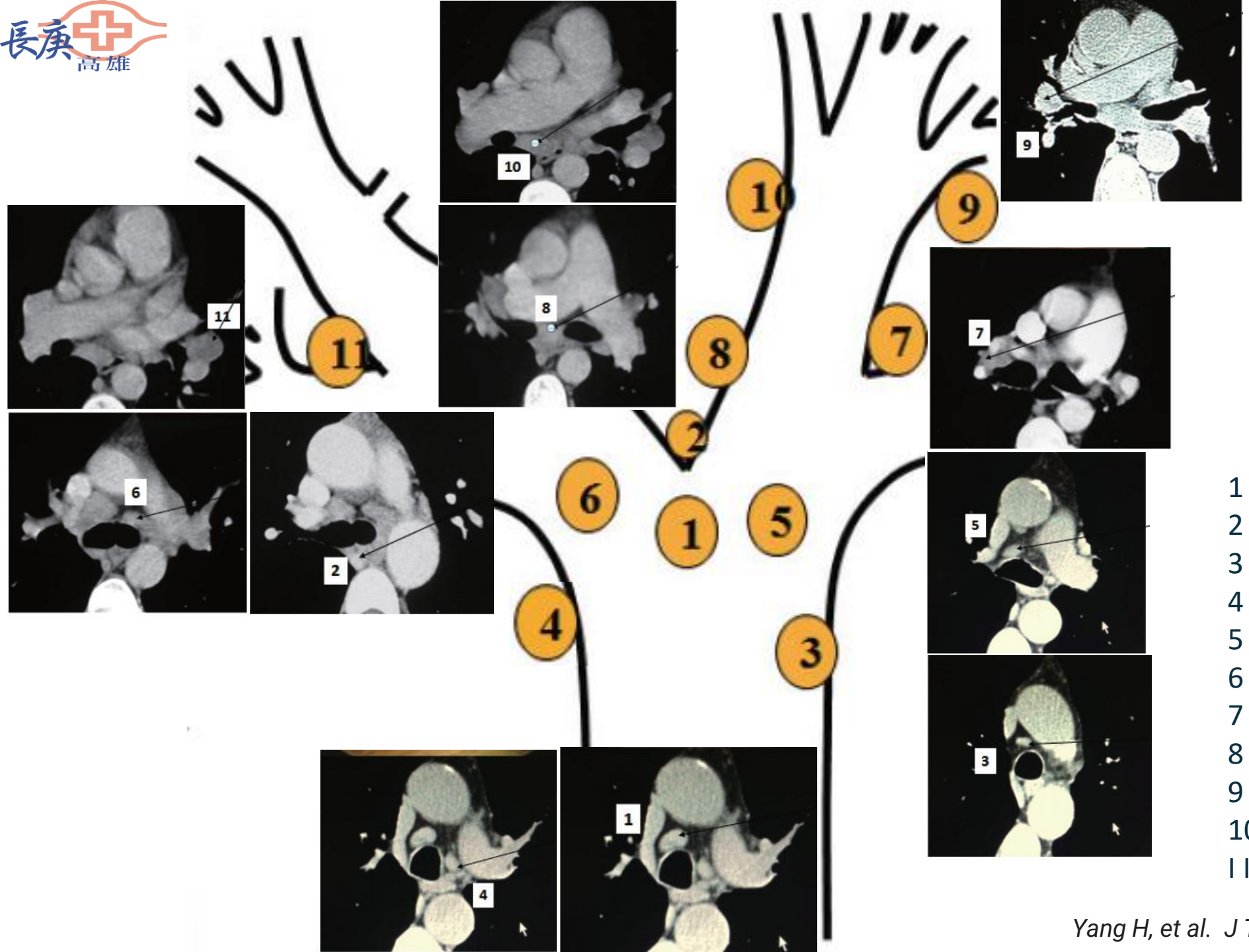


- Transbronchial needle aspiration (TBNA) was first developed in 1949 for use with the rigid bronchoscope by Dr. **Schieppati** from Argentine.
- **Wang** et al. designed a prototype needle for flexible bronchoscope in 1978.
- "**Wang Map**" was developed in 1994



Yang H, et al. J Thorac Dis. 2015 Dec;7(Suppl 4):S279-86.

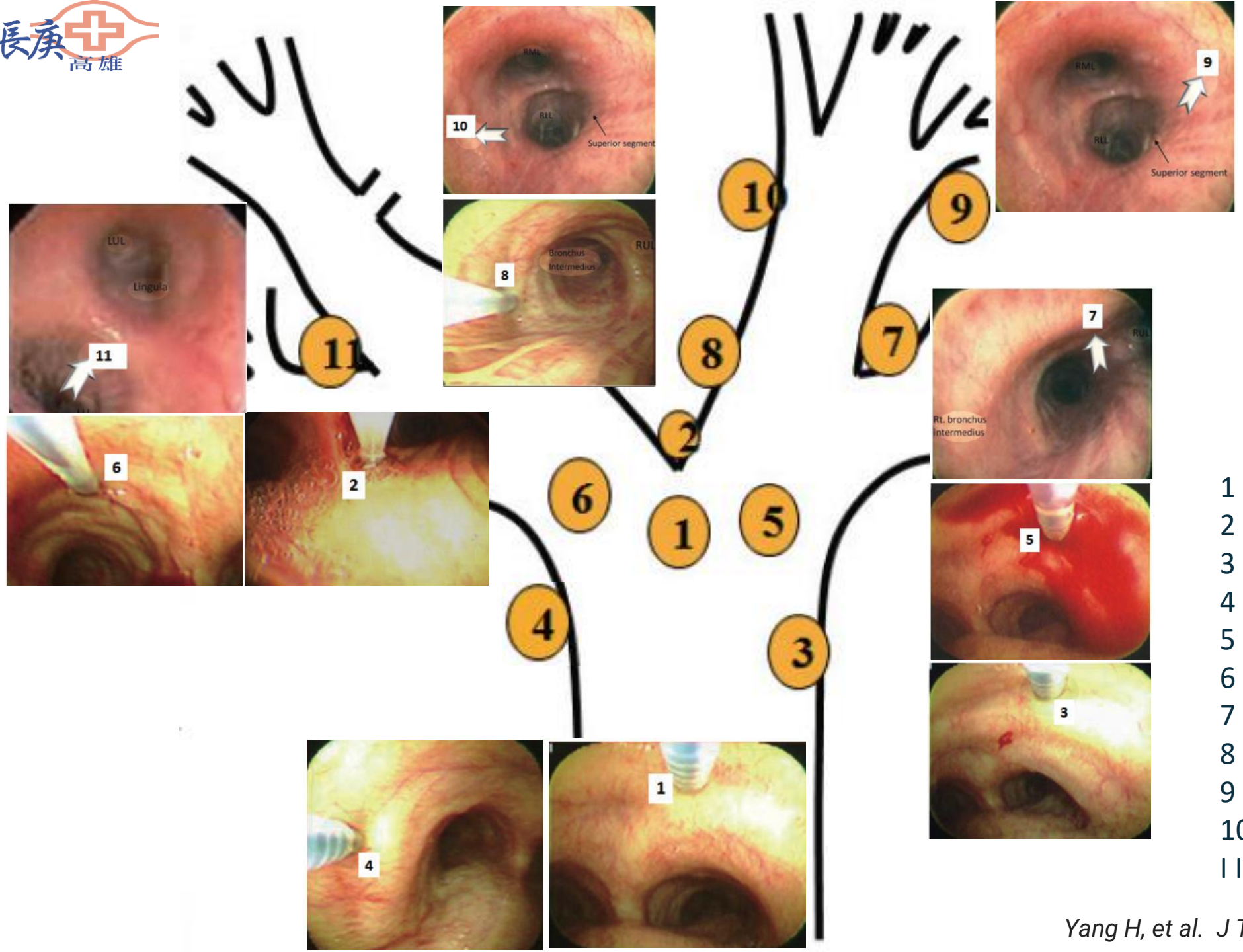
“Wang Map”



1 Ant.Car ina LN
2 Past. Carina LN
3 Rt. Paratrac hea LN
4 Lt. Paratrachea (A-Pwindaw
5 Rt. Main Bronchus LN
6 Lt. Main Bronchus LN
7 Rt. Upper Hilar LN
8 Sub Carina LN
9 Rt. Lower Hi lar
10 Sub - Sub Carina LN
I I Lt. Hi lar LN

Yang H, et al. J Thorac Dis. 2015 Dec;7(Suppl 4):S279-86.

“Wang Map”



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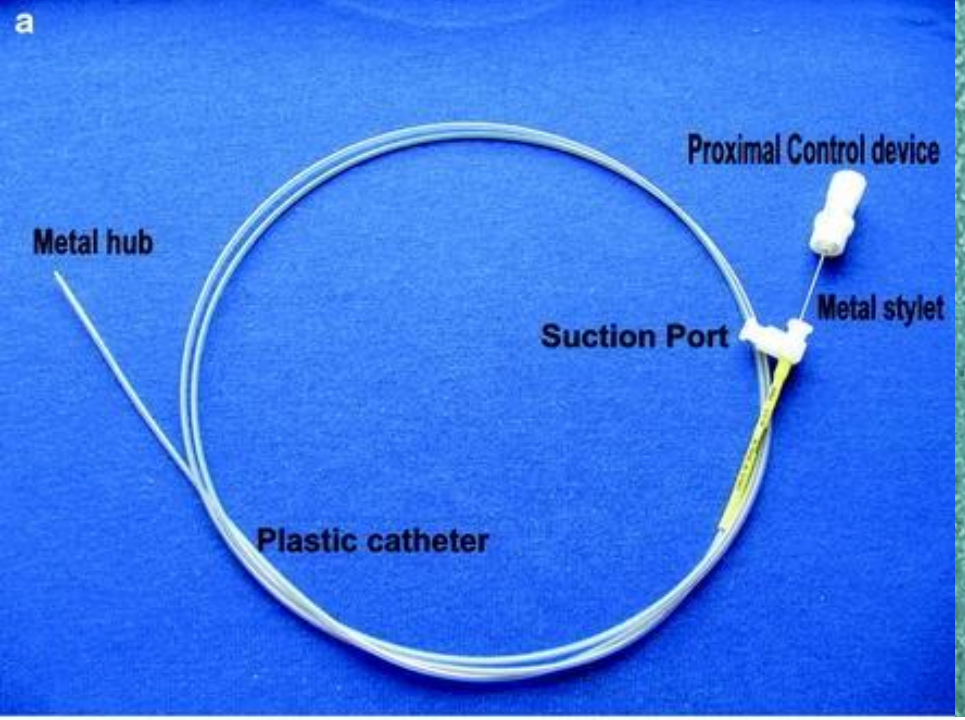
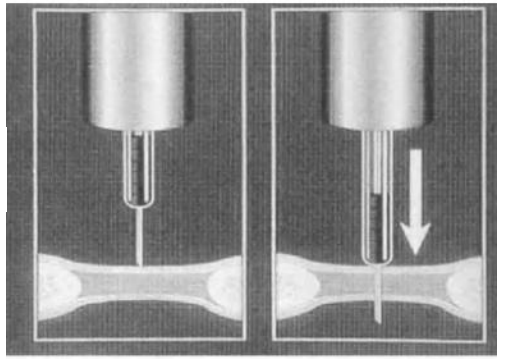
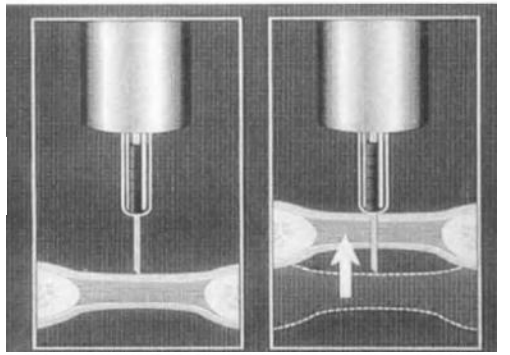
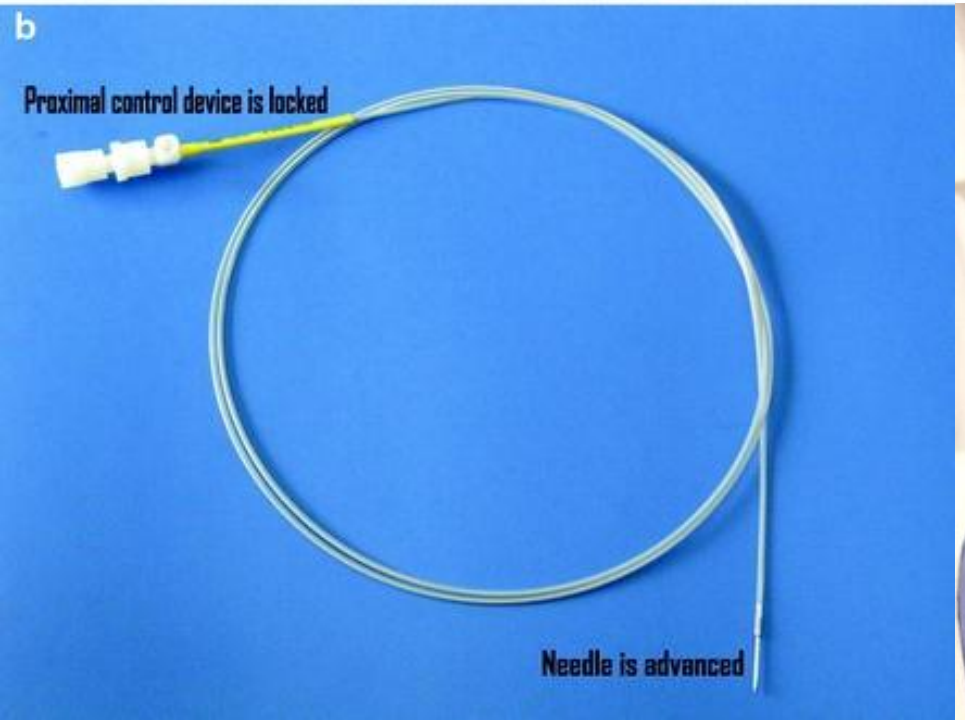


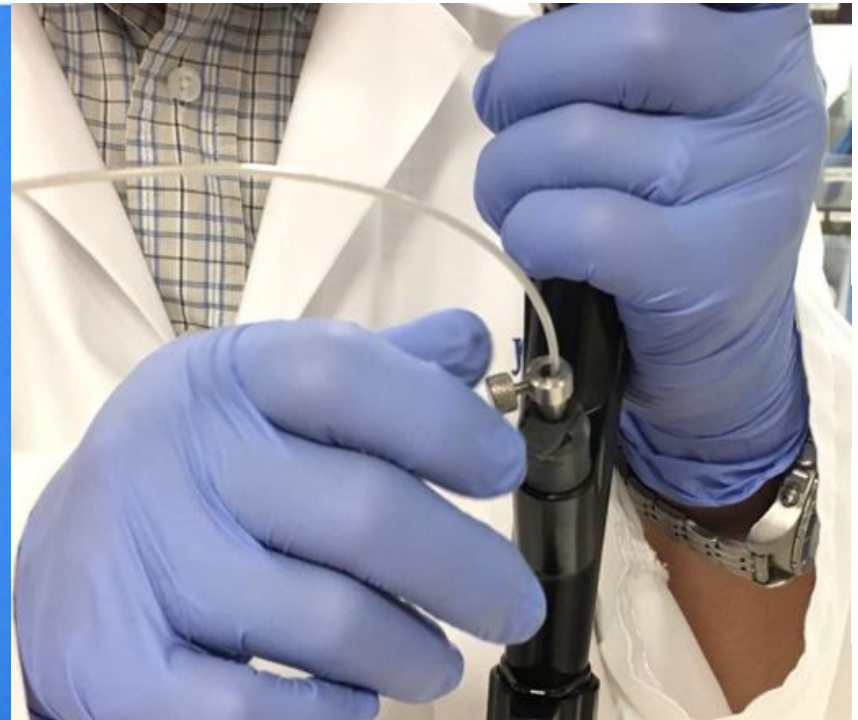
Jabbing



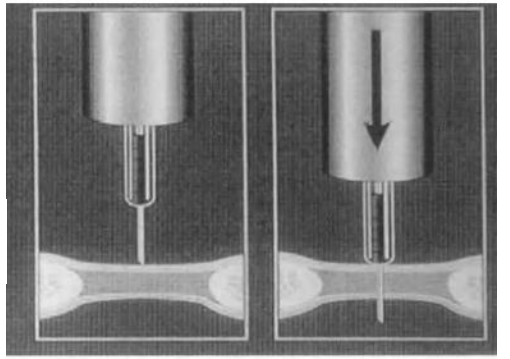
Coughing



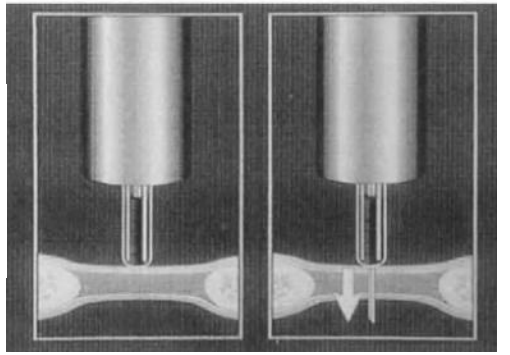




Pushing



Hub against the wall



cTBNA for nodal staging by Wang map

- **Patients with mediastinal lymphadenopathy underwent conventional TBNA by Wang's LN map**

	N	No. of tissue obtained	Ability
Patients	73	67	91.8 (67/73)
Lymph nodes	166	118	**71.1** (118/166)
≤1cm	89	49	55.1 (49/89)
≤0.5cm	30	11	36.9 (11/30)
0.6-1cm	59	38	64.4 (38/59)
>1cm	77	67	**87.0** (67/77)
1.1-2cm	51	45	**88.2** (45/51)
>2cm	26	22	**84.6** (22/26)

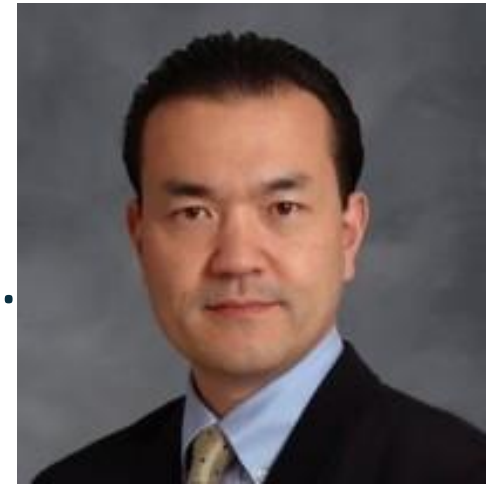
KoPeng Wang, Report at 2004 World Congress for Bronchology

Conventional Transbronchial Needle Aspiration (cTBNA)

- Advantage
  - Can be completed by regular bronchoscope
  - Relatively comfortable
  - Less cost
- Limitation
  - Steep learning curve
  - Less sensitive in detecting small lesion

Yang H, et al. J Thorac Dis. 2015 Dec;7(Suppl 4):S279-86.

Convex-probe Endobronchial Ultrasound (CP-EBUS)



- CP-EBUS was developed in 2002.
- First been used in lung cancer staging in 2005 by Yasufuku, et al.
- Accepted by clinicians for diagnosing mediastinal and hilar LAPs after 2007.
- Current application:
  - Determination of position and the shape of peribronchial structures, particularly lymph node (LN).
  - Determination of the depth of tumor invasion of the tracheal/bronchial wall.
  - **Peribronchial LN or lesion sampling**

Yang H, et al. J Thorac Dis. 2015 Dec;7(Suppl 4):S279-86.
Herth F.J.F. (2018) Interventions in Pulmonary Medicine. Springer, Cham.

EBUS-TBNA vs Mediastinoscopy

- EBUS-TBNA was superior to mediastinoscopy in terms of its diagnostic performance for mediastinal staging of cN1–3 NSCLC.

TABLE 3. Diagnostic Performance of EBUS-TBNA and Mediastinoscopy on a Per-Person Basis (n = 127)

	EBUS-TBNA	Mediastinoscopy	*p* Value
Sensitivity	66/75 (88.0) [80.6–95.4]	61/75 (81.3) [72.5–90.2]	0.0039
Specificity	52/52 (100) [100–100]	52/52 (100) [100–100]	NA
Accuracy	118/127 (92.9) [88.5–97.4]	113/127 (89.0) [83.5–94.4]	0.0001
PPV	66/66 (100) [100–100]	61/61 (100) [100–100]	NA
NPV	52/61 (85.2) [76.3–94.1]	52/66 (78.8) [68.9–88.7]	0.0018

Data are presented as numbers/total numbers (%) [with 95% confidence intervals].
EBUS-TBNA, endobronchial ultrasound-guided transbronchial needle aspiration; NA, not applicable; NPV, negative predictive value; PPV, positive predictive value.

Um SW, et al., J Thorac Oncol. 2015 Feb;10(2):331-7.

Mediastinoscopy vs Endosonography for Mediastinal Nodal Staging of Lung Cancer
A Randomized Trial

JAMA®

- potentially **resectable** NSCLC
- mediastinal nodes with short axis ≥ 10 mm
- **PET-positive** mediastinal or hilar nodes
- Nodal invasion : **N2/N3**

Table 2. Diagnostic Performance[a]

Nodal Invasion, N2/N3	No./Total No. (%) [95% Confidence Interval] Surgical Staging (n = 118)	Endosonography and Surgical Staging (n = 123)	*P* Value
Sensitivity	41/52 (79) [66-88]	62/66 (94) [85-98]	.02
Negative predictive value	66/77 (86) [76-92]	57/61 (93) [84-97]	.18

[a] Patient numbers and results are based on a multiple imputation procedure assigning values to missing data for mediastinal nodal status (n=8 for the surgical staging group and n=3 for the endosonography group), resulting in 1 additional patient with a nodal metastasis in the surgical staging group.

EBUS-TBNA staging

- Sensitivity: **94%**
- NPV: **93%**

Mediastinoscopy staging

- Sensitivity: **79%**
- NPV: **86%**

Annema T, van Meerbeeck J, Rintoul R et al. JAMA 2010; 304(20):2245-2252

Comparison of Endobronchial Ultrasound, Positron Emission Tomography, and CT for Lymph Node Staging of Lung Cancer*

Kazuhiro Yasufuku, MD, FCCP; Takahiro Nakajima, MD; Ken Motoori, MD; Yasuo Sekine, MD; Kiyoshi Shibuya, MD; Kenzo Hiroshima, MD; and Takehiko Fujisawa, MD

Chest 2006;130;710-718

EBUS-TBNA for the Clarification of PET Positive Intra-Thoracic Lymph Nodes—an International Multi-Centre Experience

Robert C. Rintoul, FRCP, PhD,* Kurt G. Tournoy, MD, PhD,† Hesham El Daly, MD,‡ ...las R. Carroll, FRCP, FRCR,* Robert C. Buttery, MRCP, PhD,* Klaas van Kralingen, MD,§ P. van Meerbeeck, MD, PhD,† Klaus F. Rabe, MD, PhD,§ and Jouke T. Annema, MD, PhD§

J Thorac Oncol 2009;4:44-48

Application of Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration Following Integrated PET/CT in Mediastinal Staging of Potentially Operable Non-small Cell Lung Cancer*

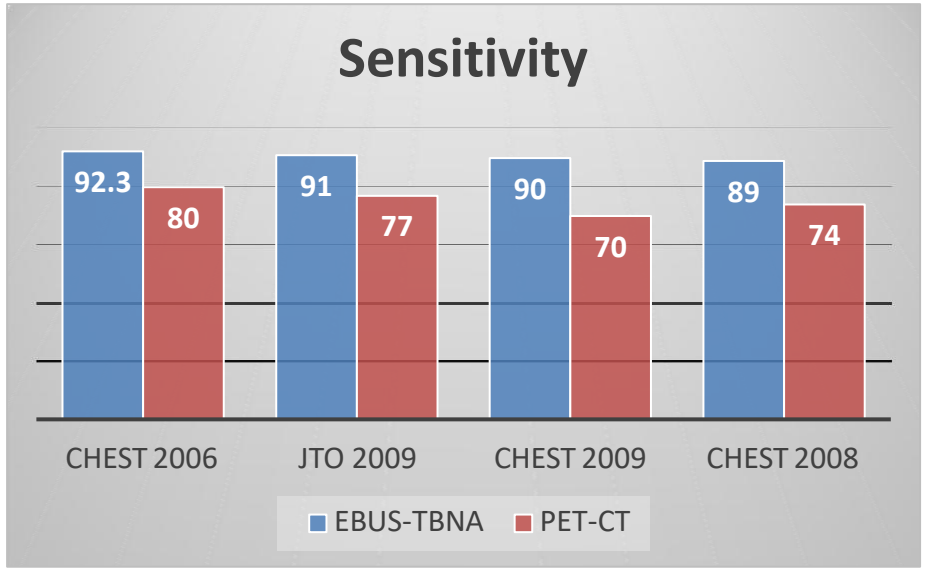
Bin Hwangbo, MD; Seok Ki Kim, MD, PhD; Hee-Seok Lee, MD; Hyun Sung Lee, MD, PhD; Moon Soo Kim, MD; Jong Mog Lee, MD; Hyae-Young Kim, MD, PhD; Geon-Kook Lee, MD, PhD; Byung-Ho Nam, PhD; and Jae Ill Zo, MD, PhD

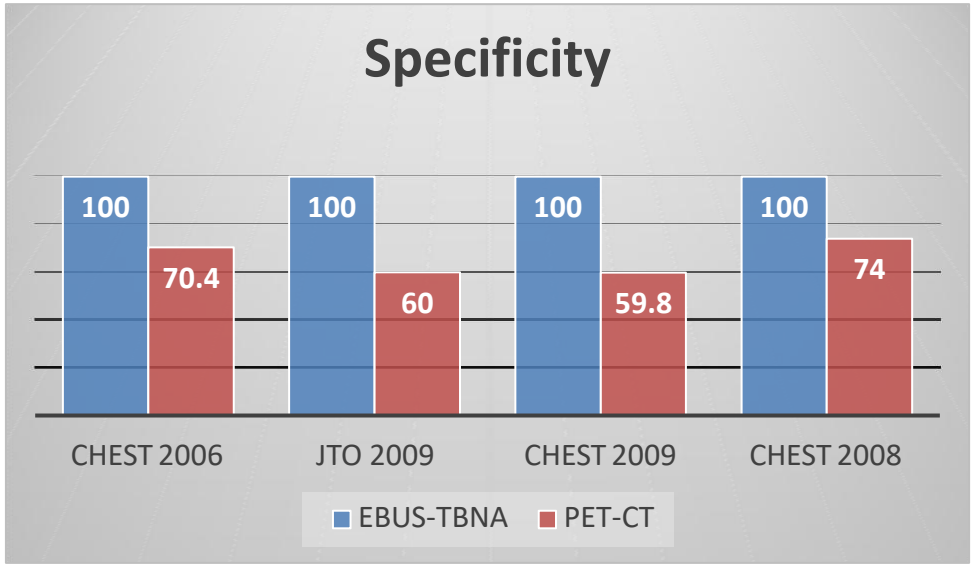
Chest 2009;135;1280-1287

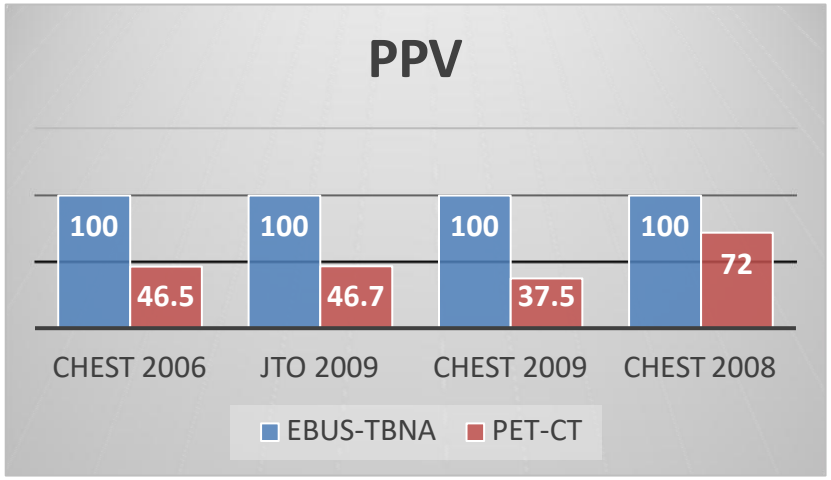
Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration of Lymph Nodes in the Radiologically and Positron Emission Tomography-Normal Mediastinum in Patients With Lung Cancer*

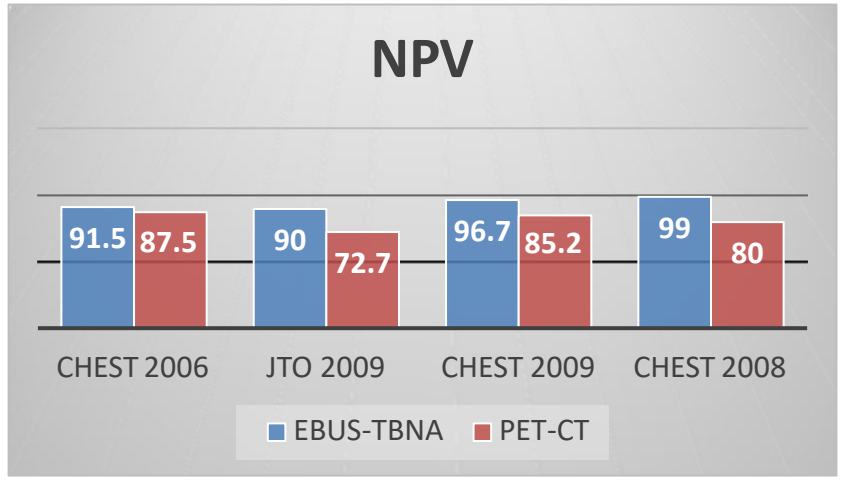
Felix J. F. Herth, MD, FCCP; Ralf Eberhardt, MD; Mark Krasnik, MD; and Armin Ernst, MD, FCCP

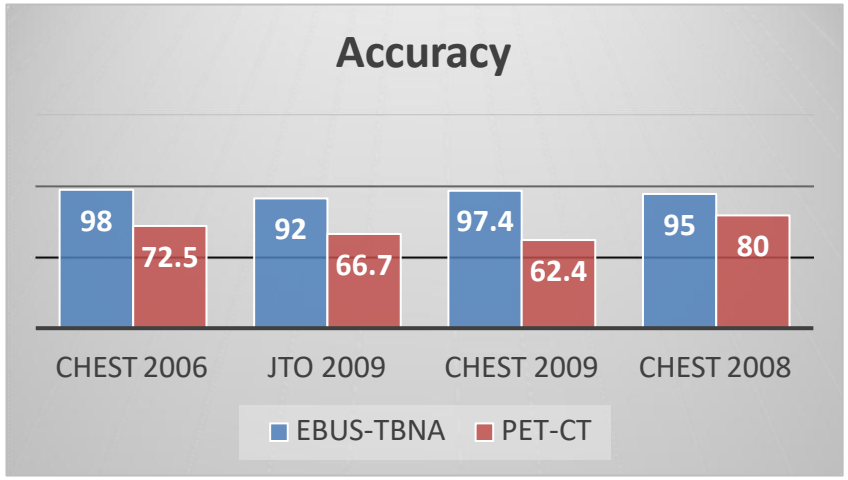
Chest 2008;133;887-891











Relationship between endobronchial ultrasound-guided (EBUS)-transbronchial needle aspiration utility and computed tomography staging, node size at EBUS, and positron emission tomography scan node standard uptake values: A retrospective analysis

Clare Marchand & Andrew R.L. Medford

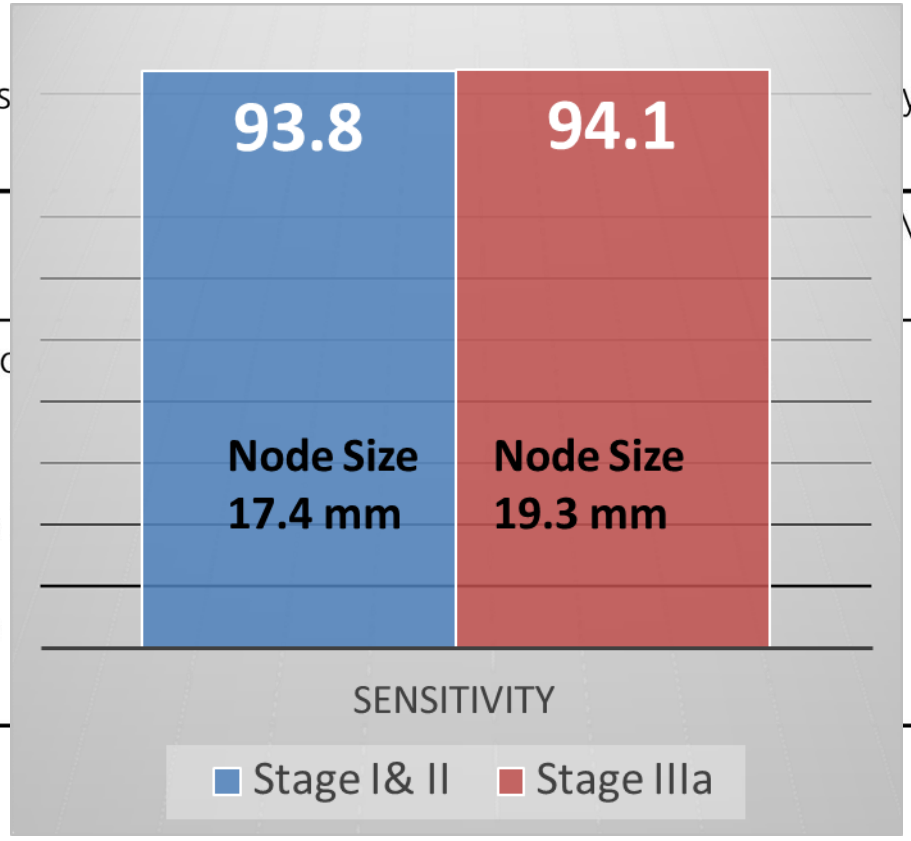


Table 3 Diagnos y cohort (extrathoracic cancers and all lung cancers), all NSCLC cases and stages

Cohort	Mean EBUS node size (mm)	Sensitivity (%)	Accuracy (%)	NPV (%)	Prevalence (%)
Whole study coho	21.2	95.7	96.5	83.3	82.4
NSCLC only (combined)	20.3	94.3	95.7	85.5	74.8
NSCLC Stage I &	17.4	93.8	96.4	92.3	57.1
NSCLC Stage IIIa	19.3	94.1	95.4	82.4	78.5
NSCLC Stage IIIb	22.0	96.8	97	66.7	93.9
NSCLC Stage IV	20.9	93.2	94.6	79.0	79.7

Thoracic Cancer (2017) doi: 10.1111/1759-7714.12438

Relationship between endobronchial ultrasound-guided (EBUS)-transbronchial needle aspiration utility and computed tomography staging, node size at EBUS, and positron emission tomography scan node standard uptake values: A retrospective analysis

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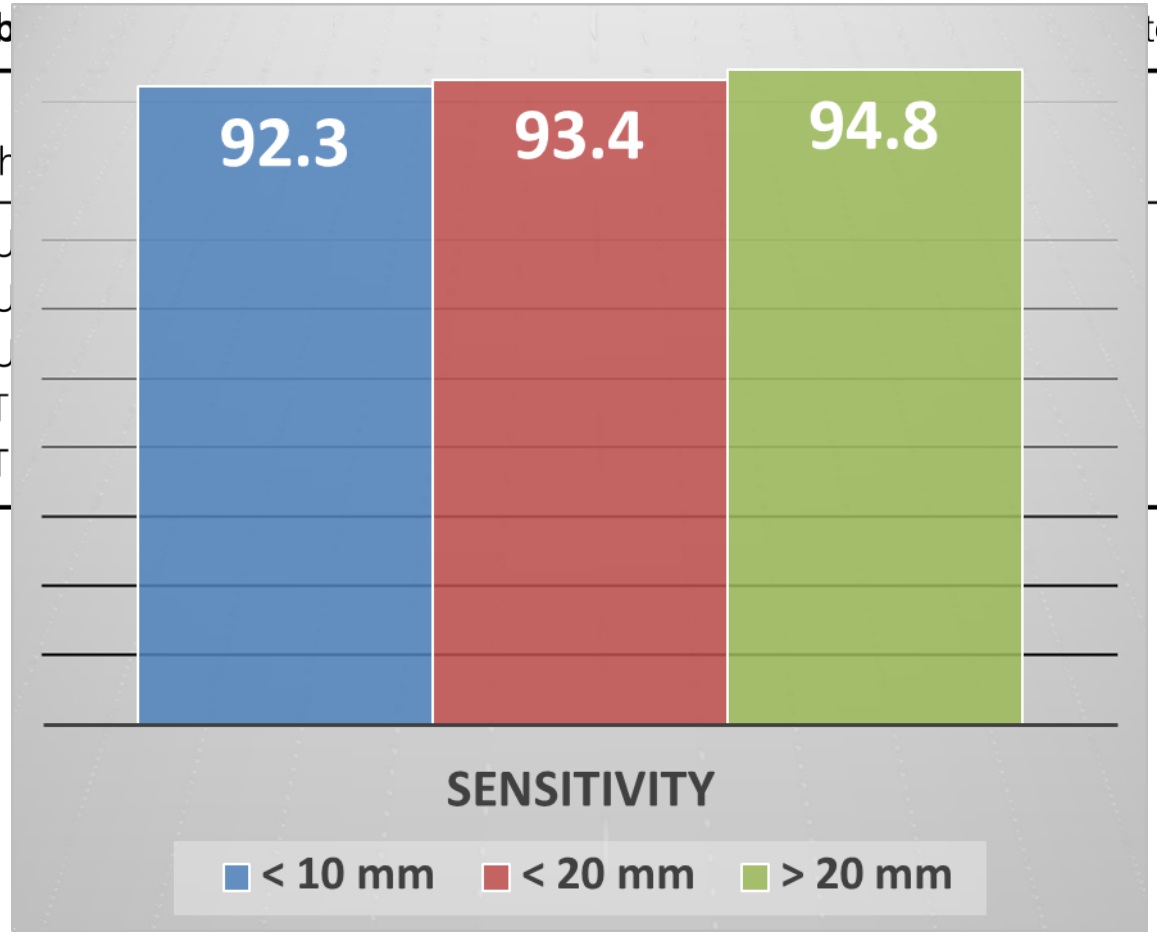
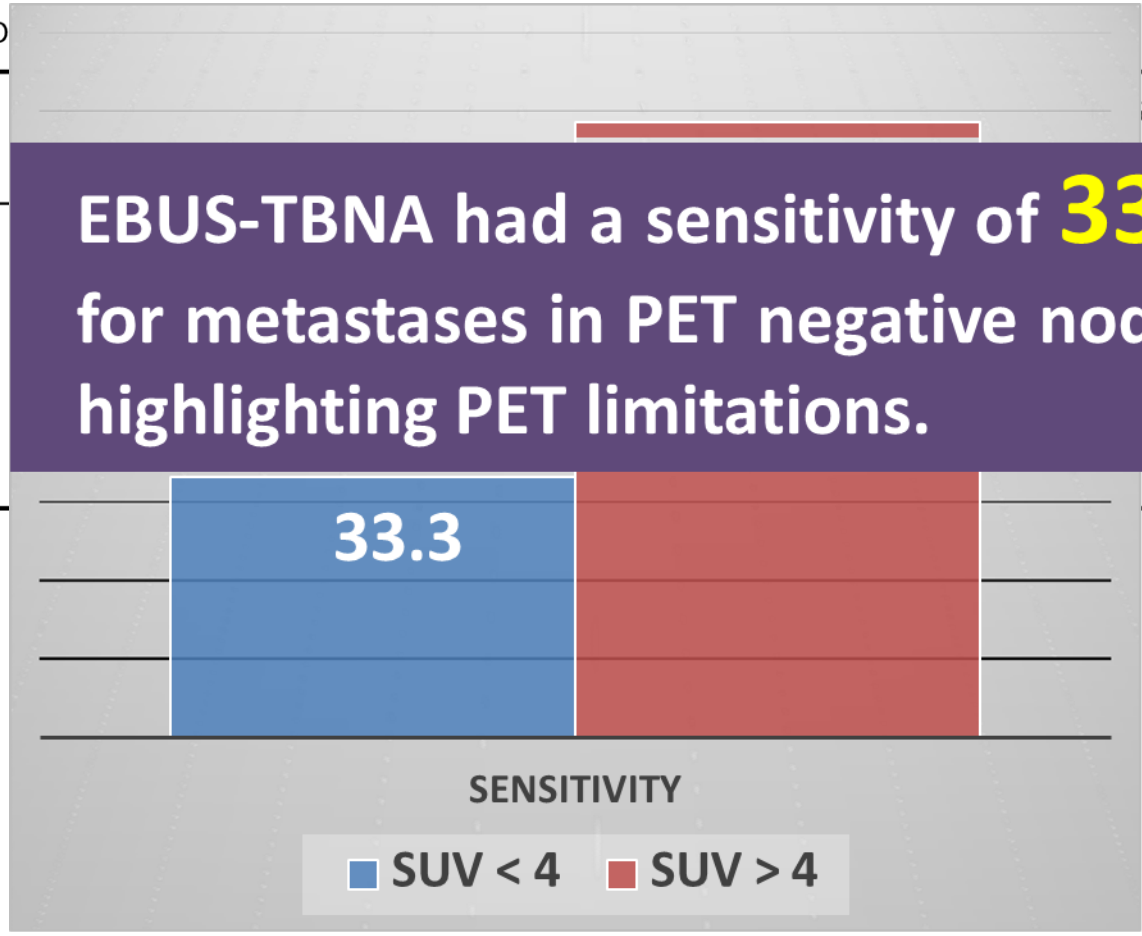


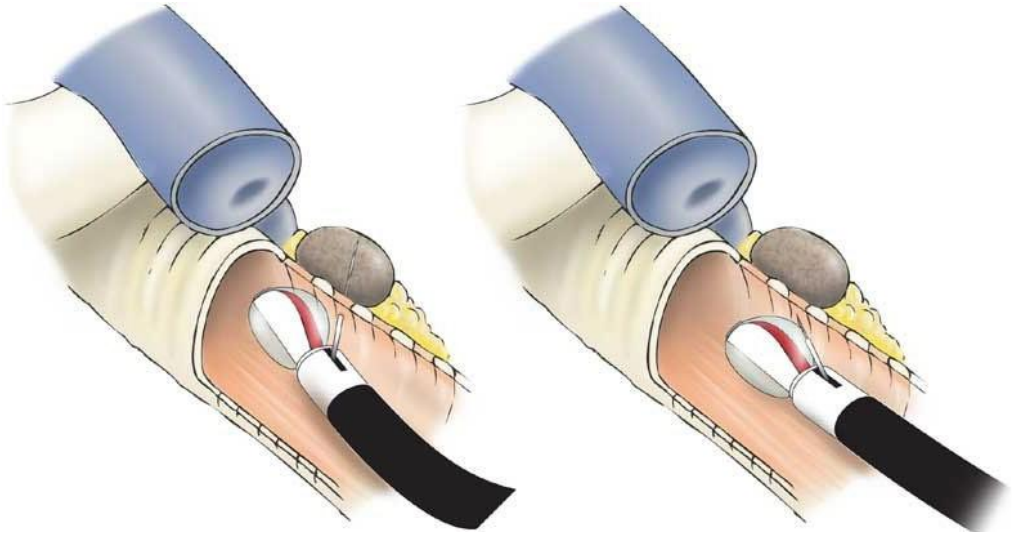


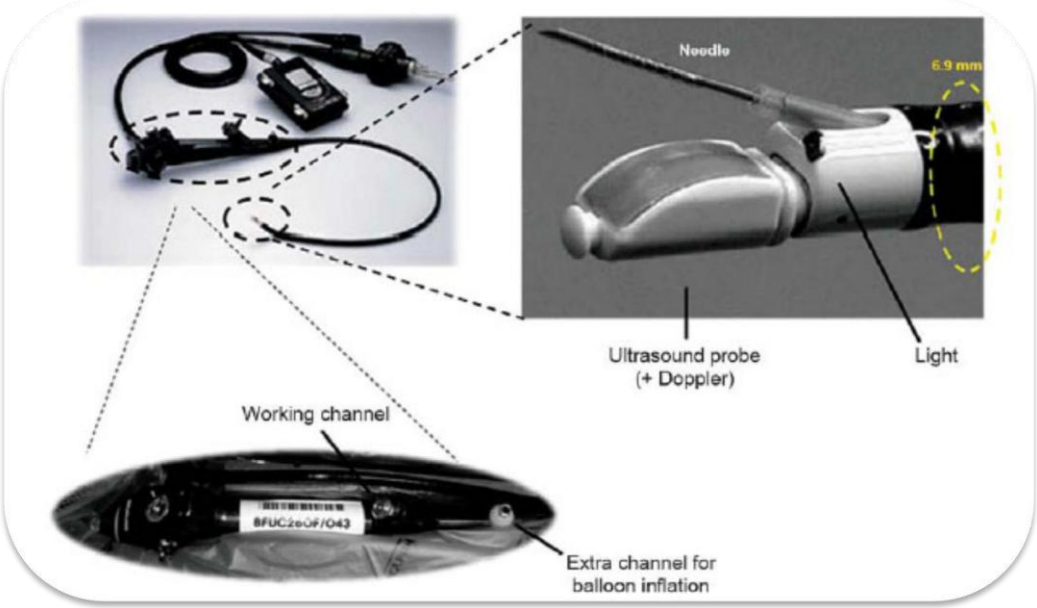
Thoracic Cancer (2017) doi: 10.1111/1759-7714.12438

Convex Probe Endobronchial Ultrasound

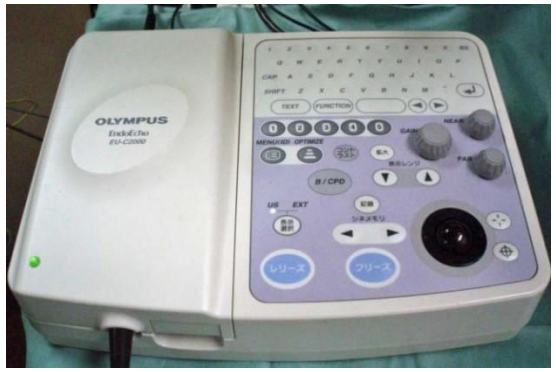
- Ultrasonic bronchoscope with convex probe
  - Olympus BF-UC190F
  - Pentax EB-1970UK
  - Fujifilm EB-530US
- Ultrasound processor

EBUS BF-UC180F





Ultrasound processor



EU-C60
2001

- 1st generation
- With color Doppler mode

EU-ME1
2009

- With EBUS and EBUS-TBNA
- With Doppler, THI, power mode

EU-ME2
2013

- With elastography
- Pulse Wave Doppler B mode

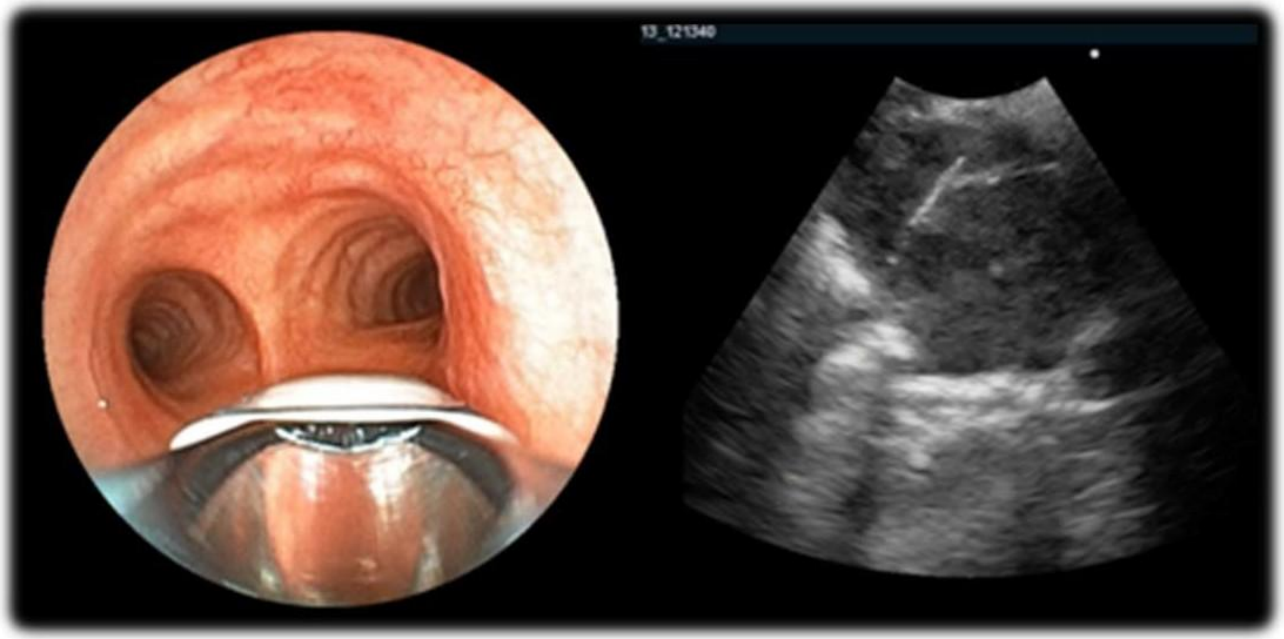
EU-ME3 2022

EBUS - EB1970UK

- 6.3mm Insertion Tube
- 2mm working channel
- Color CCD video images
  - 45º Forward Oblique
- Hitachi 5500 scanner
  - 75º Forward Oblique
- 5, 6.5, 7.5, 9, 10 MHz options

EBUS scope – EB-530US

- 10°forward oblique view
- Wide Field of View: 120°

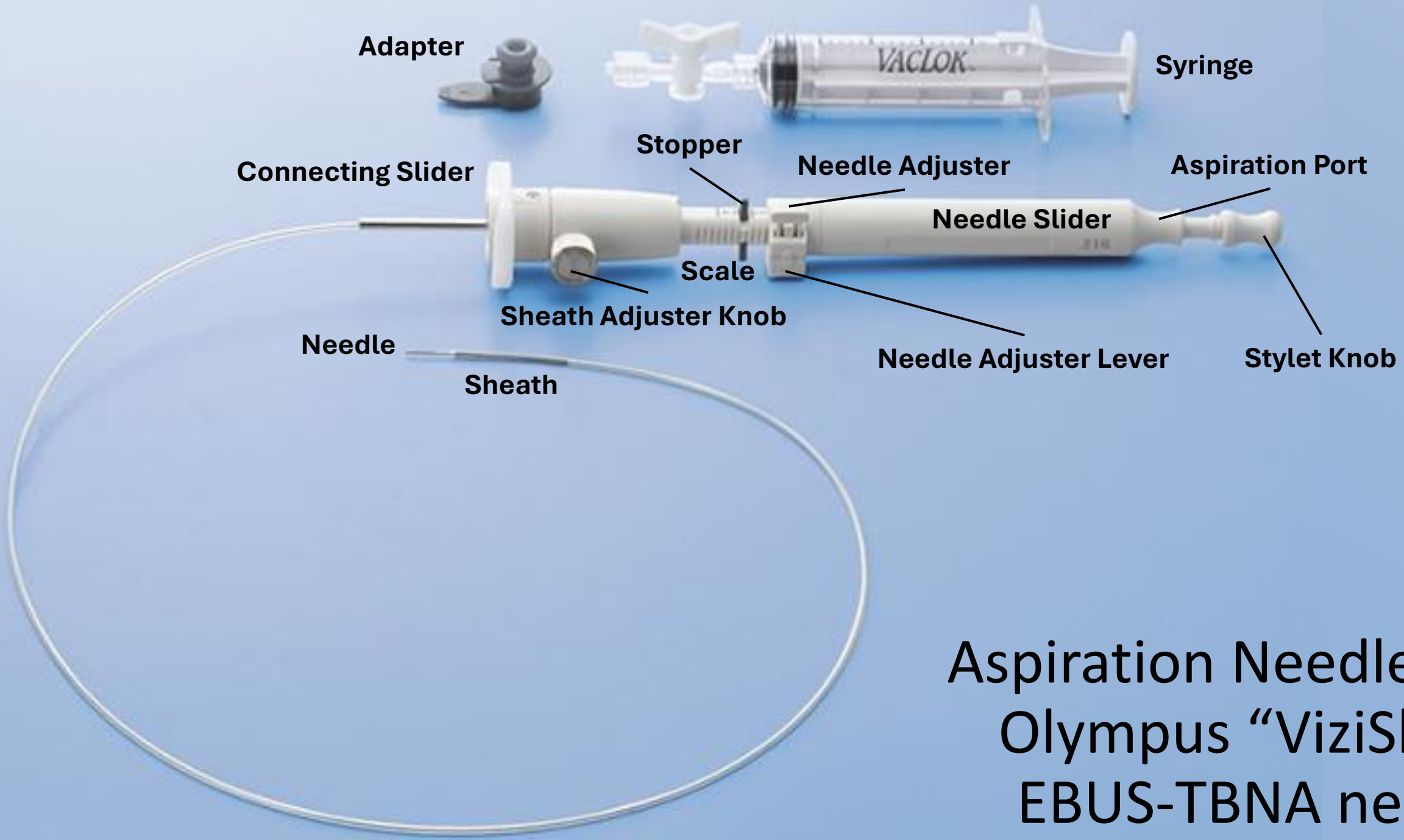


FUJIFILM

長庚 高雄

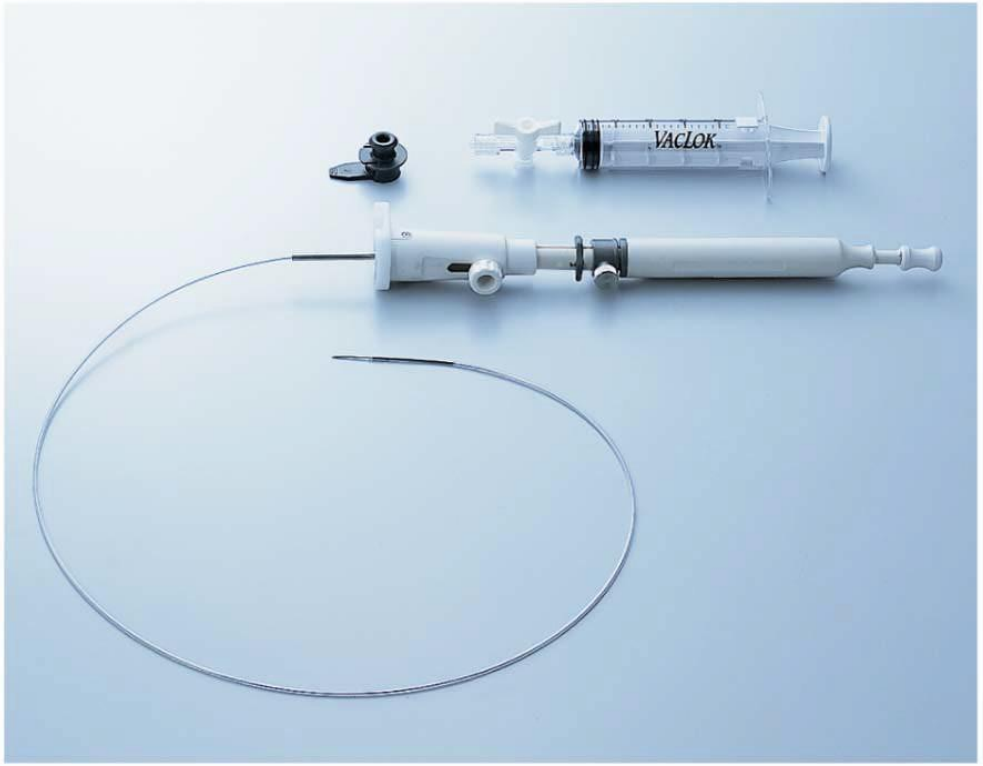
OLYMPUS PENTAX MEDICAL FUJIFILM

廠牌	OLYMPUS	PENTAX	FUJIFILM
視野	80°	100°	120°
視野方向	35°向前斜視	45°向前斜視	10°向前斜視
先端部外徑	Φ 6.9 mm	Φ 7.4 mm	Φ 6.7 mm
插入部外徑	Φ 6.3 mm	Φ 6.2 mm	Φ 6.3 mm
有效長度	600 mm	600 mm	610 mm
管道內徑	Φ 2.2 mm	Φ 2.0 mm	Φ 2.0 mm
角度範圍	向上：120° 向下：90°	向上：120° 向下：90°	向上：130° 向下：90°
掃瞄頻率	5MHz, 6MHz, 7.5MHz, 10MHz, 12MHz	5MHz, 6.5 MHz, 7.5MHz, 9MHz, 10MHz, 12MHz	5MHz, 7.5MHz, 10MHz, 12MHz



Aspiration Needle Set
Olympus “ViziShot”
EBUS-TBNA needle

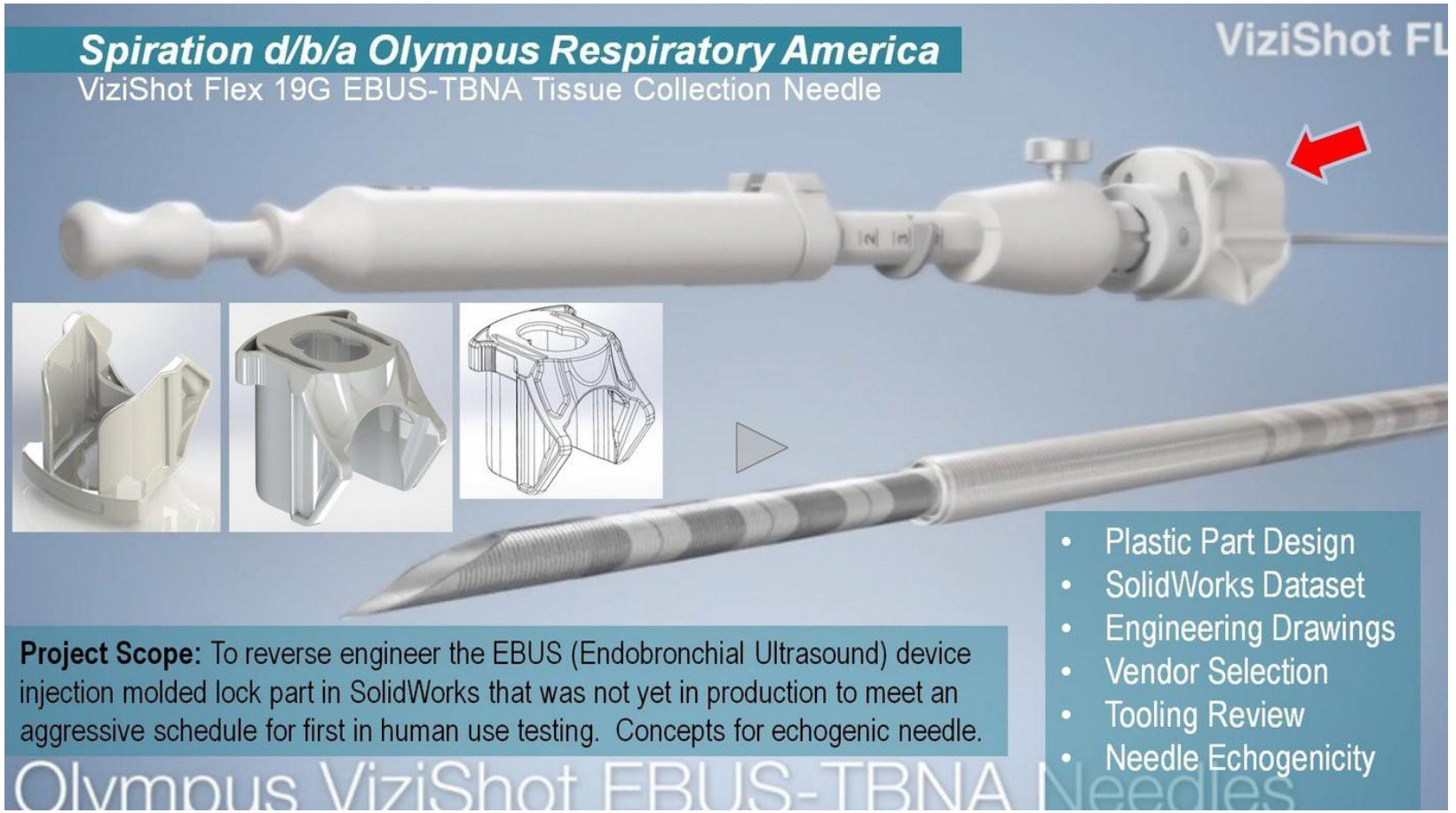
NA-201SX-4022, 4021



19G, 21G, 22G

ViziShot 2 21, 22, and 25 gauge needles

OLYMPUS



OLYMPUS

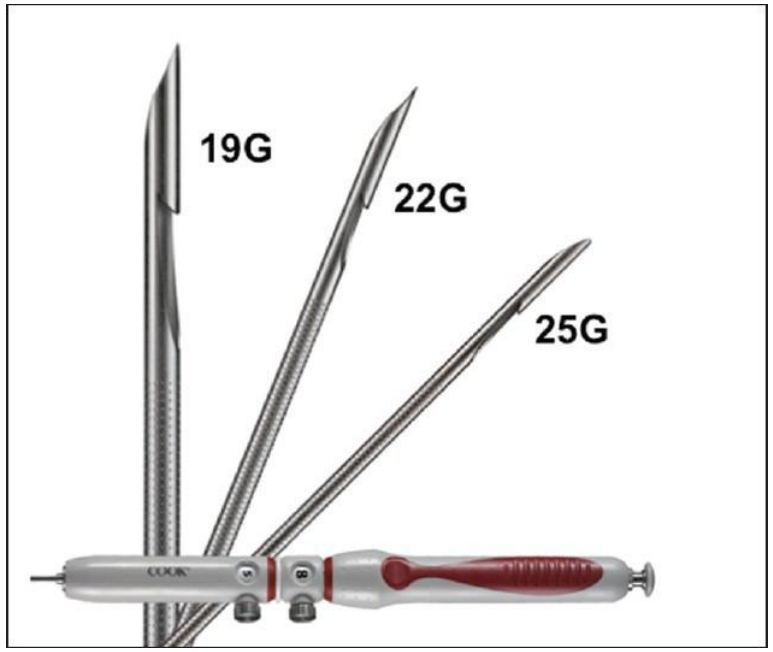
SonoTip EBUS Pro Flex

SonoTip® EBUS Pro

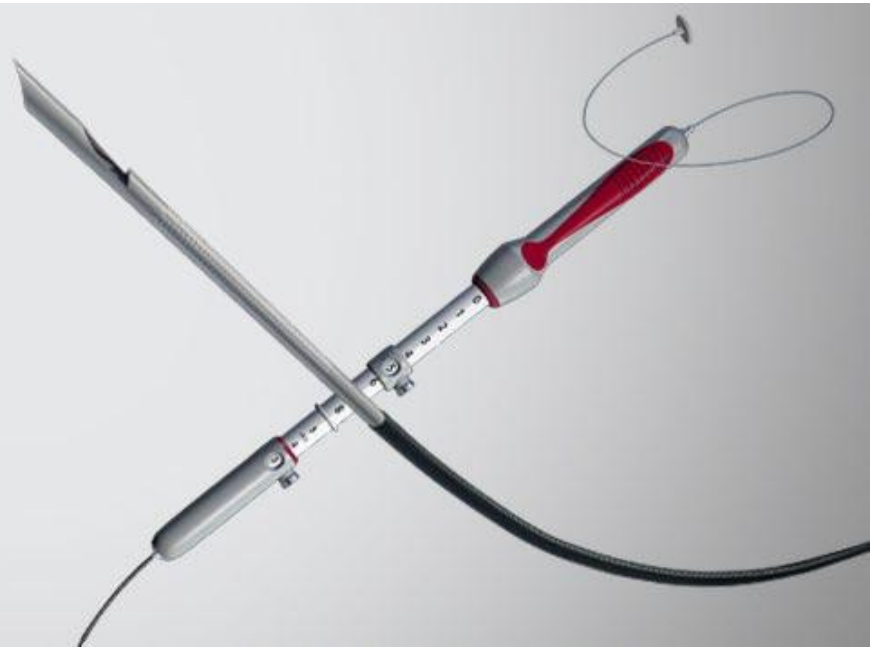
- Dimensionally Stable Nitinol Needle
  Eliminates needle deformation ("Banana-Effect") after initial puncture for precise needle positioning in repeated passes
- Twist-Lock Technology for Sheath & Needle Length Adjustment
  Single hand operation

  Needle length adjustment (0 - 4 cm)
- Blue Colored Plastic Sheath
  Creates a high contrast image under endoscopic visualization providing clear identification of the outer sheath and the respiratory tract for precise needle guidance
- Luer-locking Needle and Stylet
  Provides exact needle and stylet tip positioning

EchoTip ProCore EBUS Needles



- Core trap design to obtain tissue
- 19G, 22G and 25G

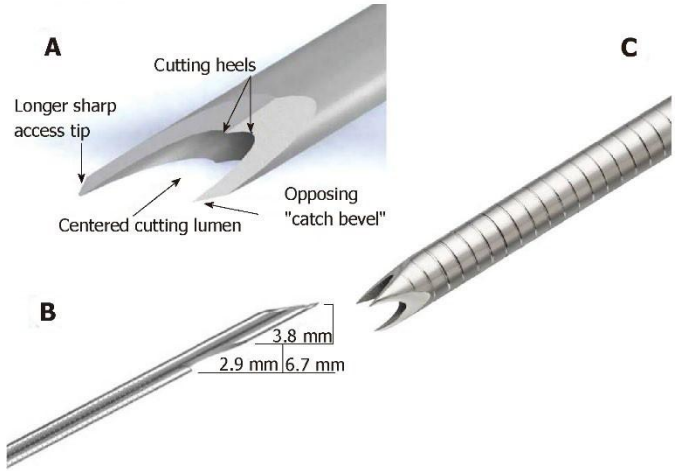


Endobronchial ultrasound bronchoscopy Franseen fine needle biopsy tool versus standard fine needle aspiration needle: Impact on diagnosis and tissue adequacy

Matthew C. Aboudara [a,*], Timothy Saettele [a], Ossama Tawfik [b]

Needle type	FNA	FNB	FNB	FNB	FNB	FNB
Needle tip	Menghini	Reverse-bevel Westcott	Forward-bevel Westcott	Franseen	Fork-tip	Franseen
Commercial name	Many different available	ProCore®	ProCore®	Acquire™	SharkCore™	TopGain®
Available sizes	19–25G	19, 22, 25G	20G	22, 25G	19, 22, 25G	19, 22, 25G

Variable	Standard Needle (n = 31)	Franseen Needle (n = 31)	P value
Diagnosis, n (%)	30 (96)	29 (93)	1.0
Adequate for Molecular Testing, n (%)	14 (48)	24 (86)	0.01
Adequate for NGS, n (%)	12 (47)	22 (76)	0.02
Median Tumor Surface Area, mm^2, (IQR)	9 (1–45)	80 (25–121)	0.002
Tumor cellularity, (%)			
<20%	16 (53)	4 [13]	<0.001
21–49%	1 [3]	5 [16]	
>50%	13 (42)	20 (64)	



Respiratory Medicine 208 (2023) 107131

EBUS: 21g vs 22g needle

TABLE 2. Classification of Histologic Specimens Obtained by EBUS-TBNA

Category of Histologic Specimens	Needle Size for EBUS-TBNA	
	21-gauge	22-gauge
I. Diagnostic	35 (58)	34 (57)
II. Nondiagnostic, adequate	8 (13)	13 (22)
III. Nondiagnostic, inadequate	15 (25)	7 (12)
IV. No specimens	2 (3)	6 (10)

Data are presented as n (%). Using the χ^2 test, $P = 0.40$ across the sampling yield of adequate histologic specimens (I and II) in the needle sizes.
EBUS-TBNA indicates endobronchial ultrasound-guided transbronchial needle aspiration.

使用21號針，拿到 specimen 的機會比較高，但會出現blood contamination 機會也會增加許多

Table 1 Results of evaluated factors of each needle

Evaluated factors ($n = 45$)	22G > 21G	22G = 21G	22G < 21G	*P*-value
Cytology				
Number of tumour cells (n =)	11	12	22	$P = 0.0256$
Blood contamination (n =)	3	9	33	$P < 0.0001$
Histology				
Quantity of tissue (n =)	14	16	15	$P = 0.9661$

Oki M, MD, Saka H, Kitagawa C et al. *J Bronchol Intervent Pulmonol* 2011;18:306-310
Nakajima T, Yasufuku, Takahashi R et al. *Respirology* 2011; 16:90-94

Mediastinal Lymph Node Map

Supraclavicular zone

1 Low cervical, supraclavicular, and sternal notch nodes

SUPERIOR MEDIASTINAL NODES

Upper zone

2R Upper Paratracheal (right)

2L Upper Paratracheal (left)

3a Prevascular

3p Retrotracheal

4R Lower Paratracheal (right)

4L Lower Paratracheal (left)

AORTIC NODES

AP zone

5 Subaortic

6 Para-aortic (ascending aorta or phrenic)

INFERIOR MEDIASTINAL NODES

Subcarinal zone

7 Subcarinal

Lower zone

8 Paraesophageal (below carina)

9 Pulmonary ligament

N1 NODES

Hilar/Interlobar zone

10 Hilar

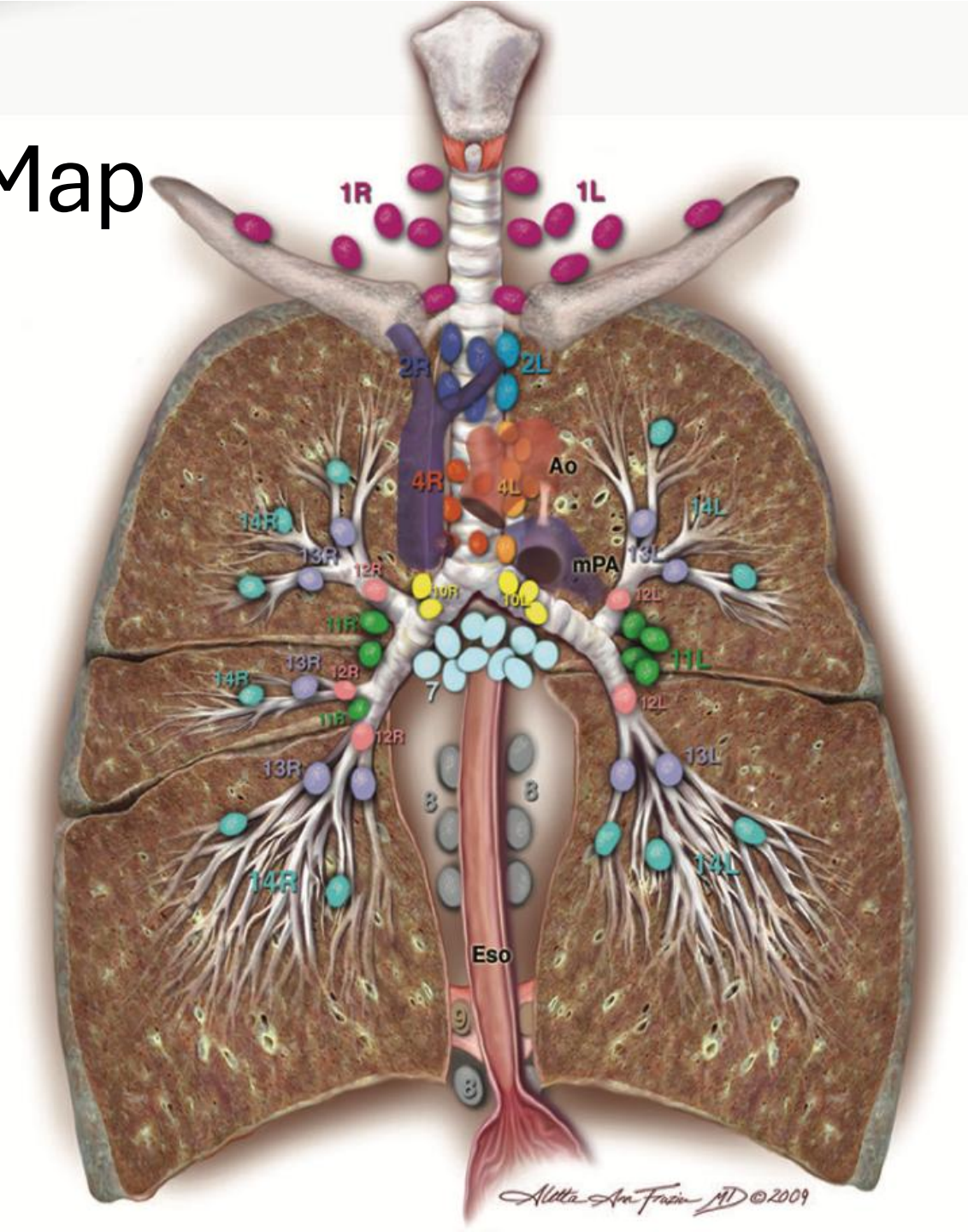
11 Interlobar

Peripheral zone

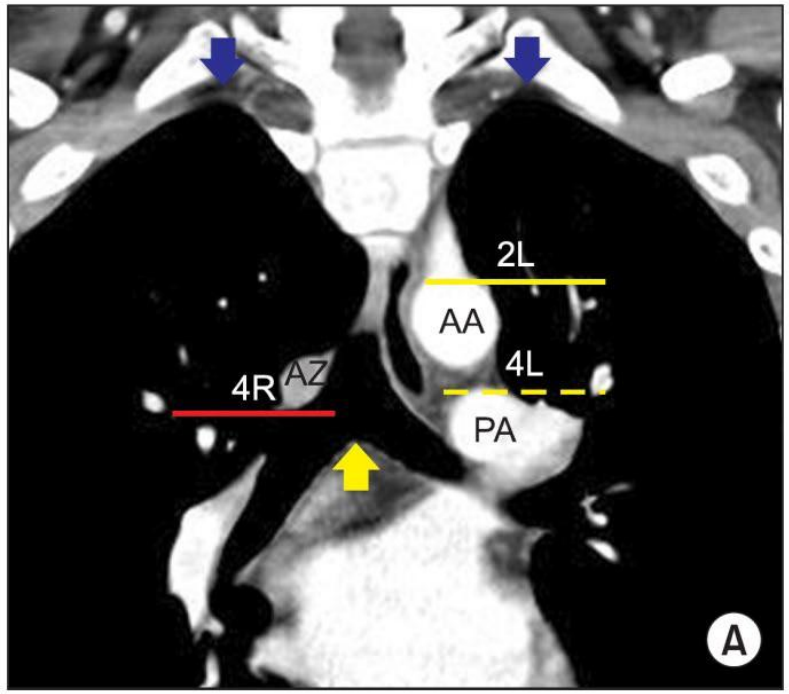
12 Lobar

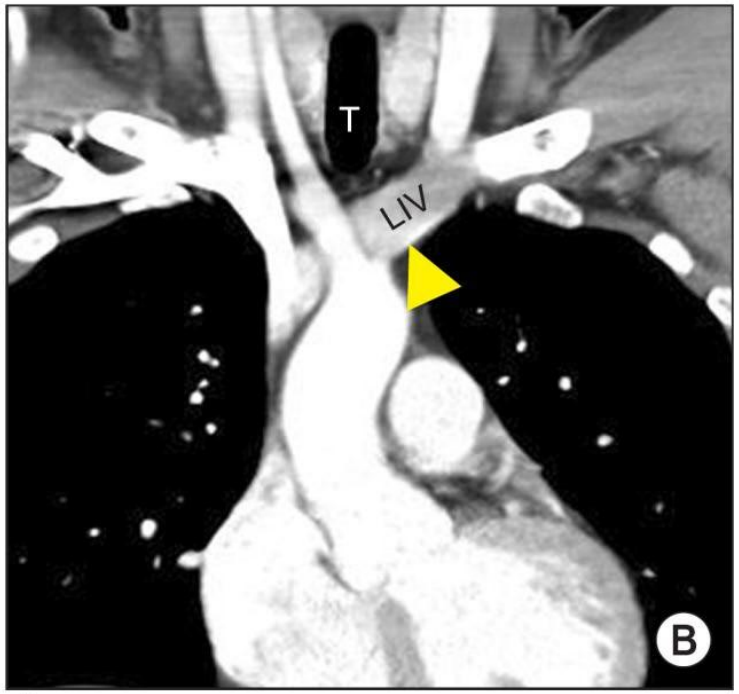
13 Segmental

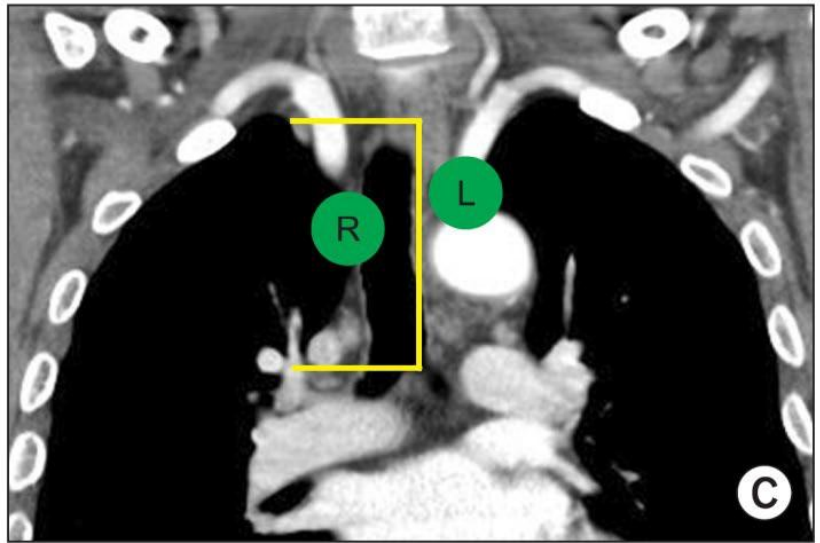
14 Subsegmental

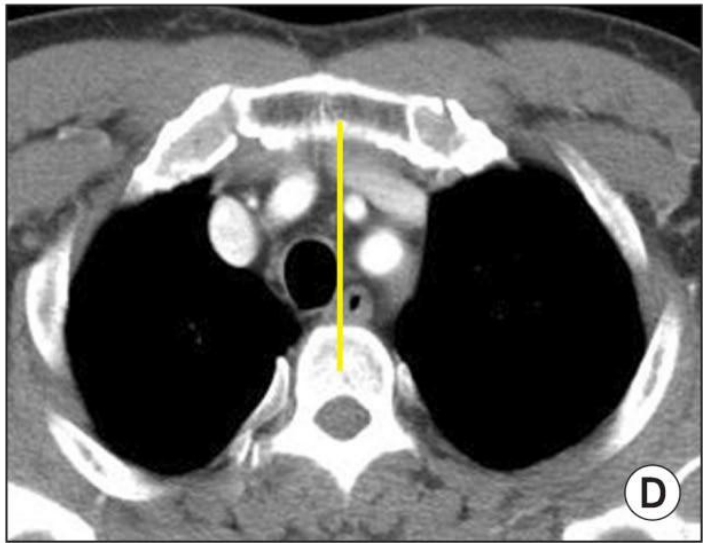


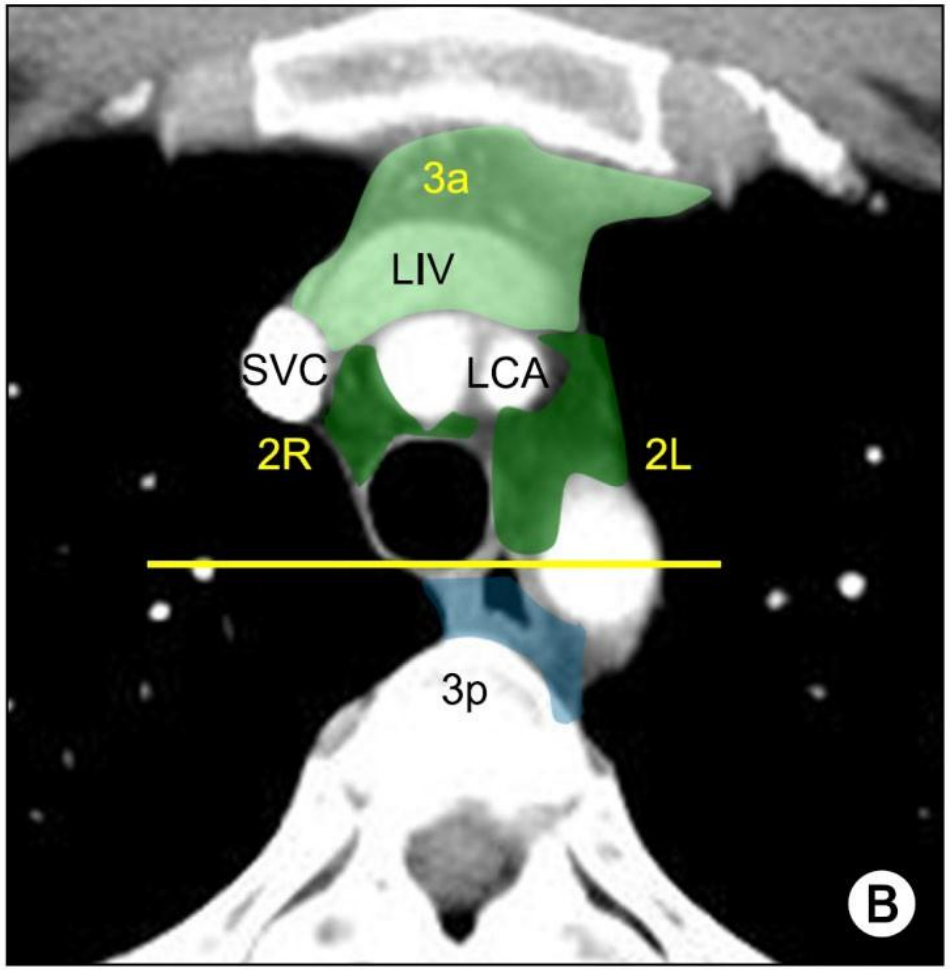
Group 2 Upper Paratrachea



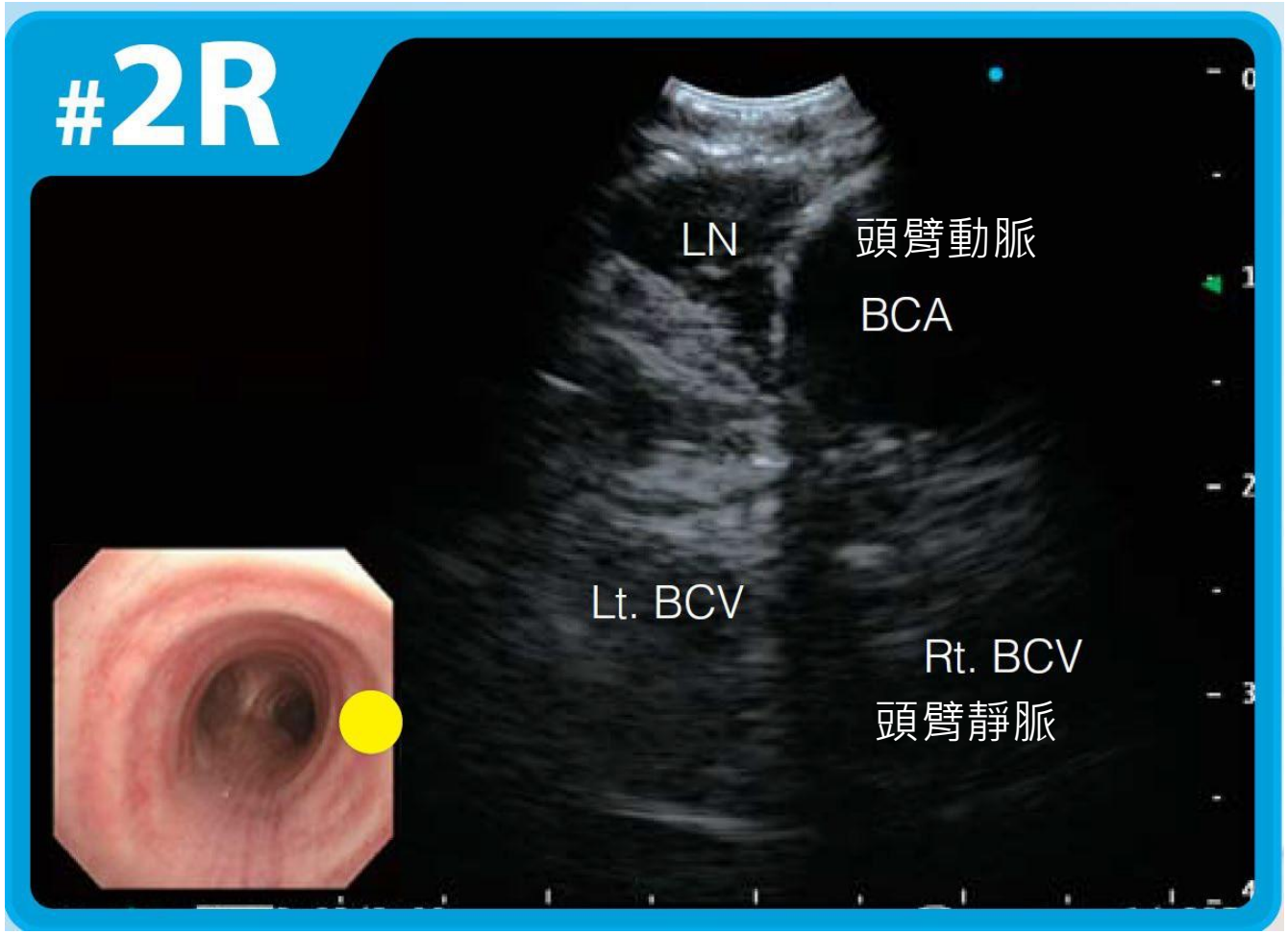


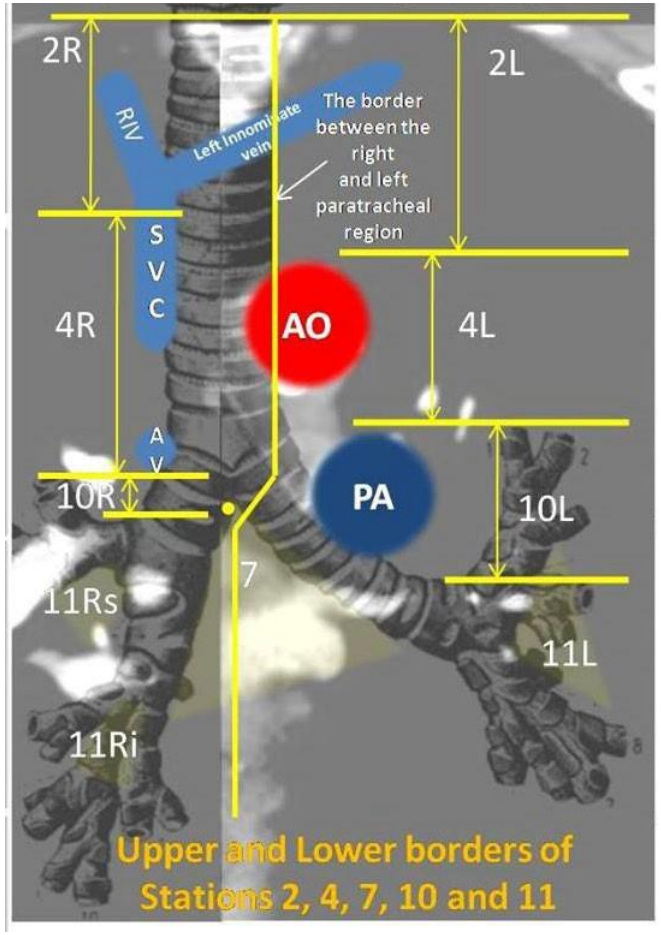






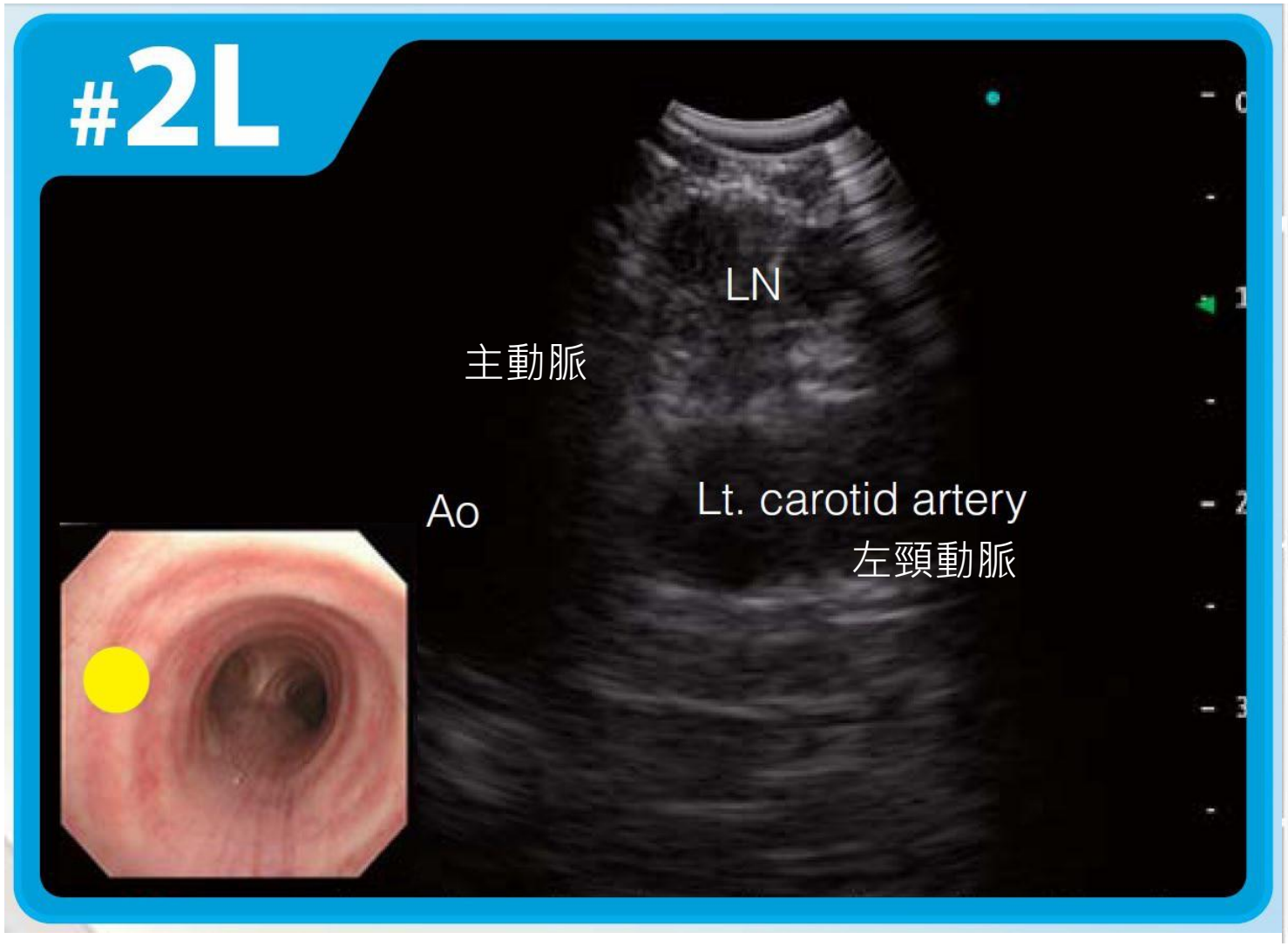
Group 2R

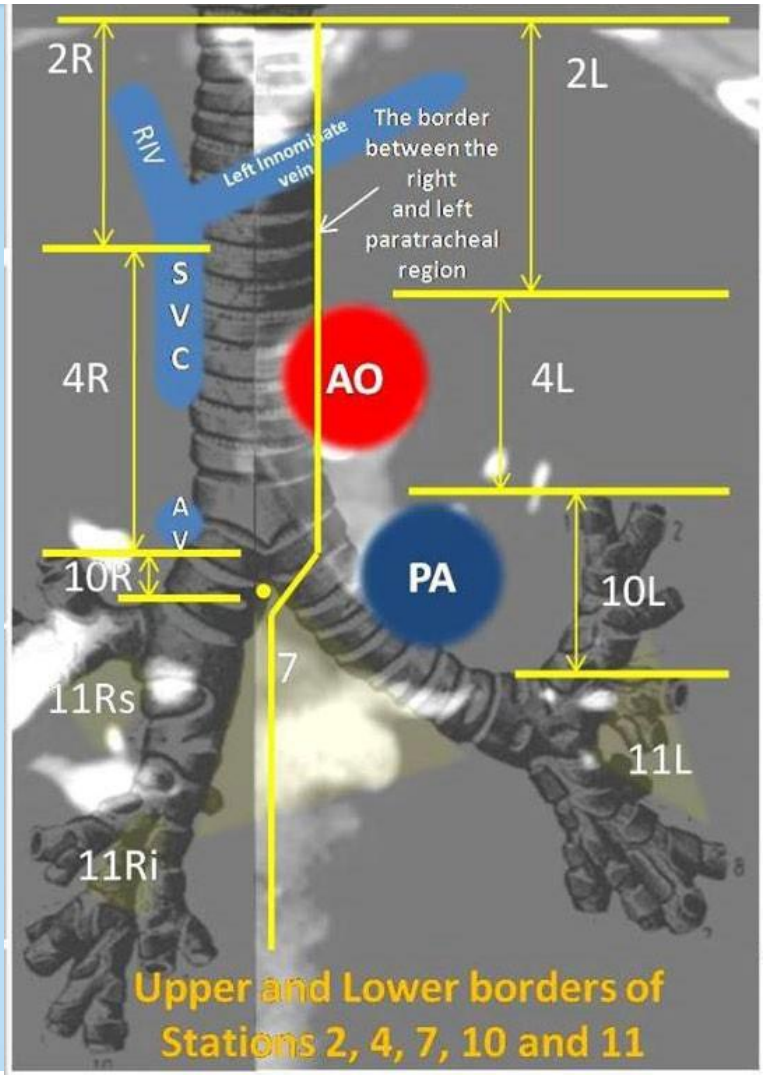




While visualizing the SVC on the ultrasound image, withdraw the bronchoscope maintaining contact with the trachea at the two to three o'clock position. The SVC will bifurcate to the left and right bracheocephalic veins. Any lymph node distal to the bifurcation along the right side of the trachea is station #2R.

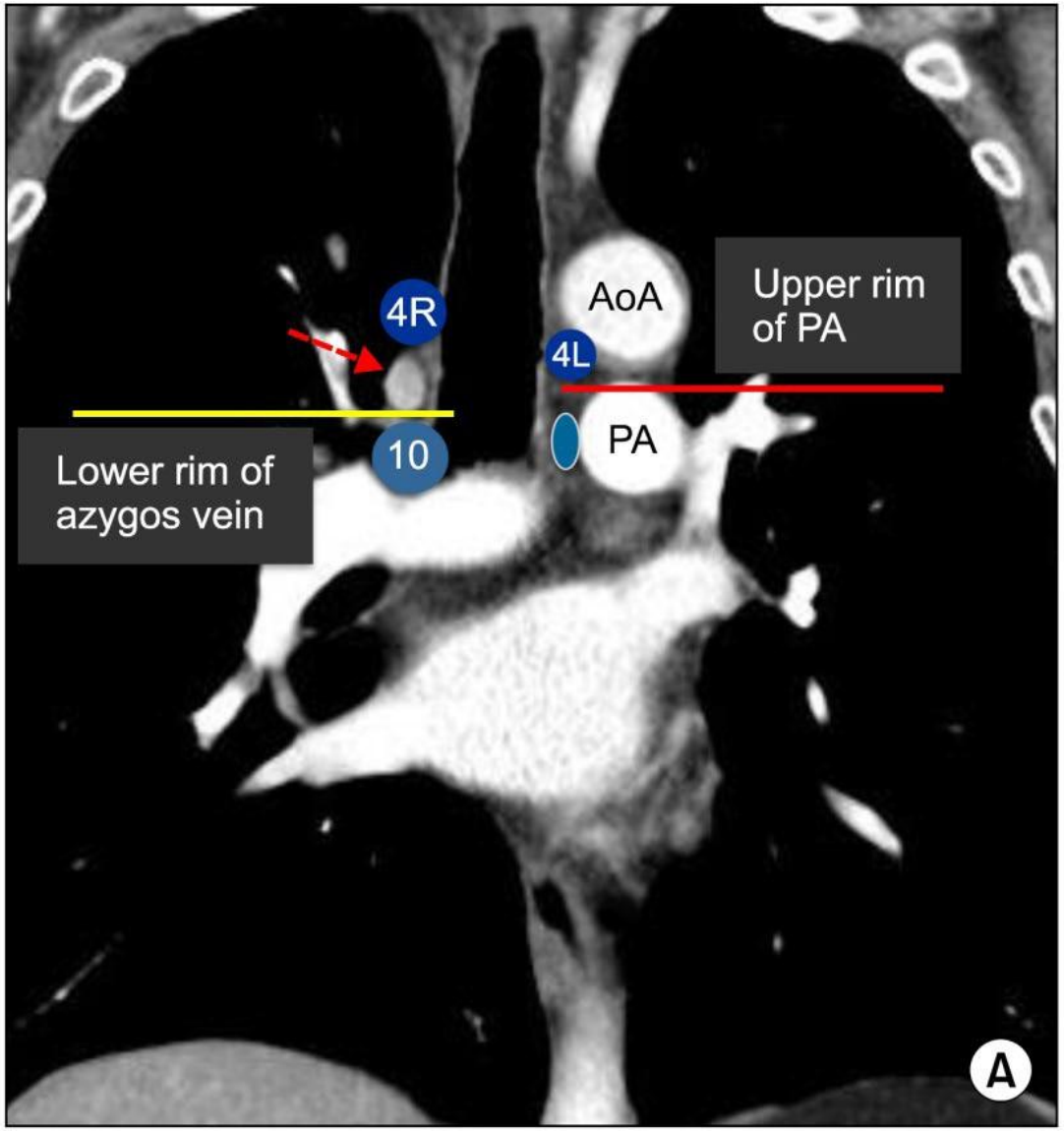
Group 2L

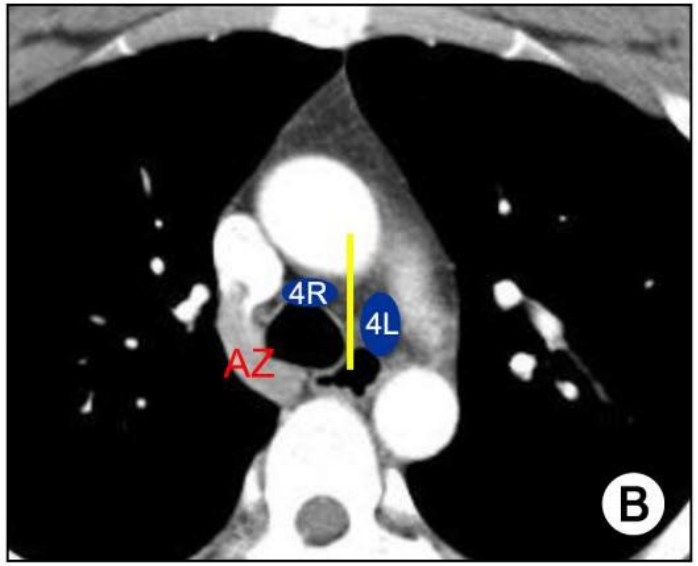


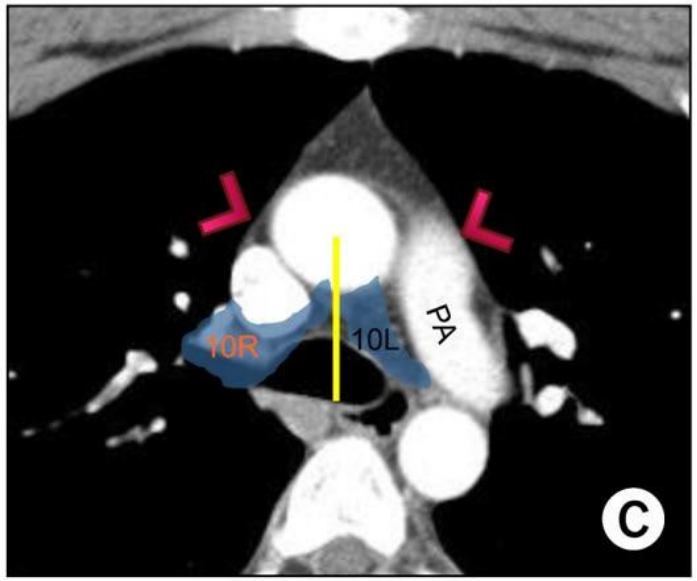


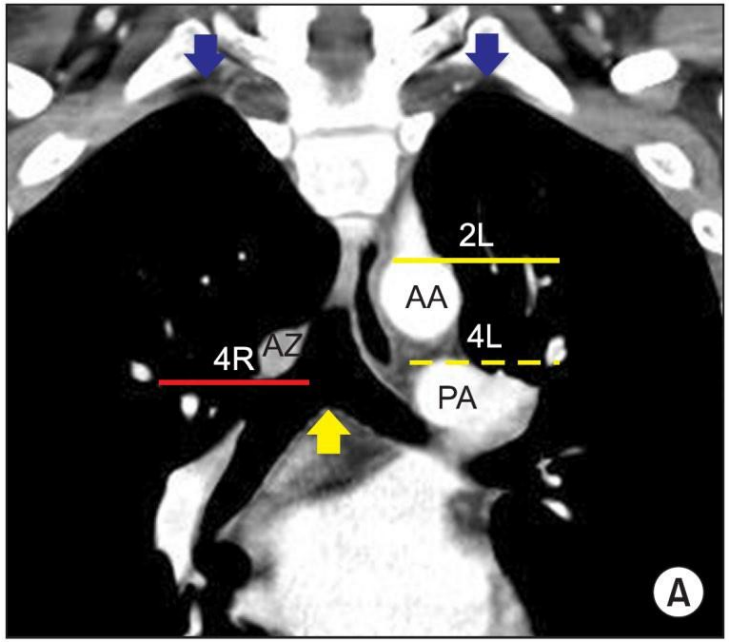
The aortic arch is the vascular landmark for differentiating station #2L and #4L. Lymph node present on the left side of the trachea above the aortic arch is station #2L.

Group 4 Lower Paratrachea

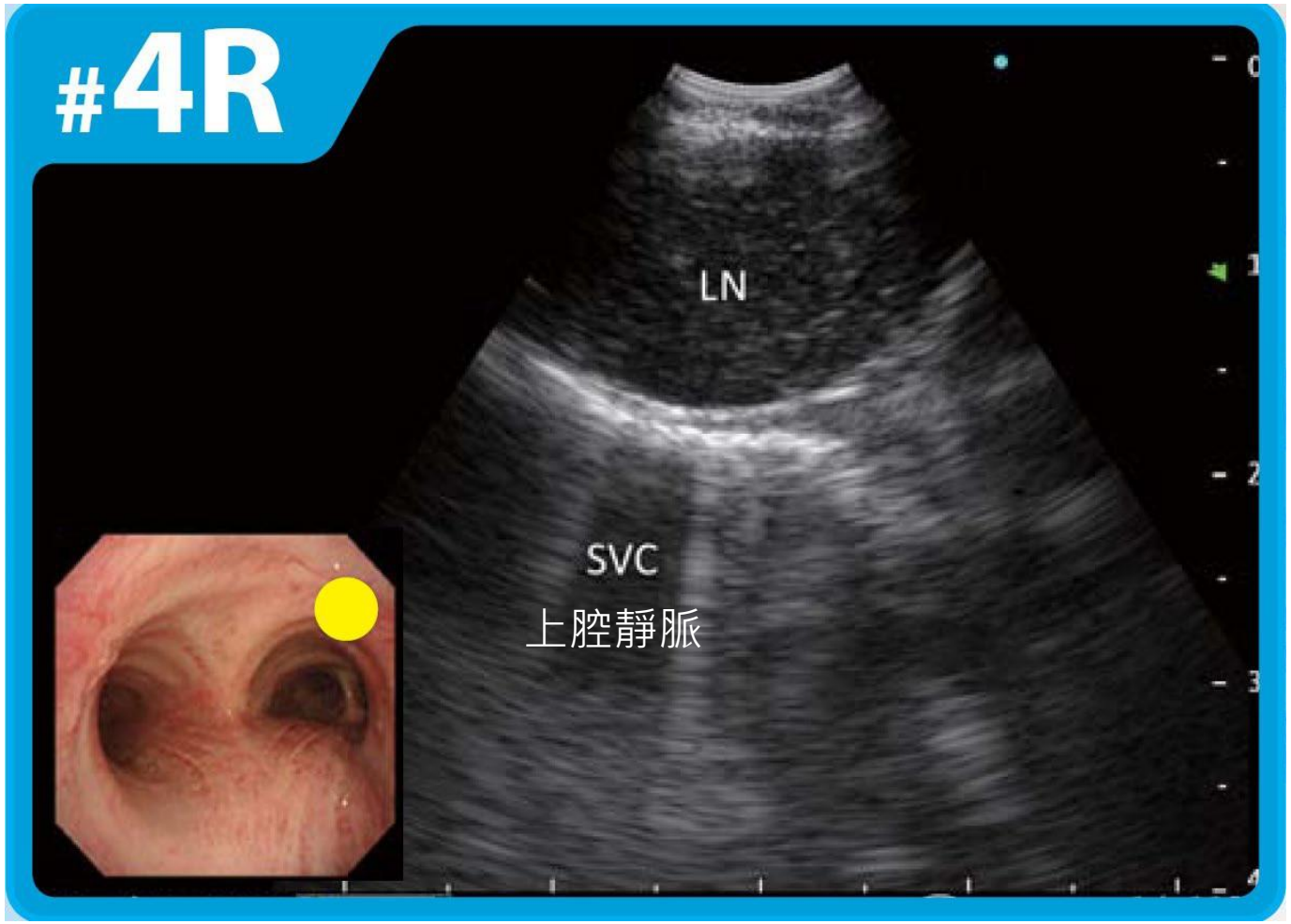


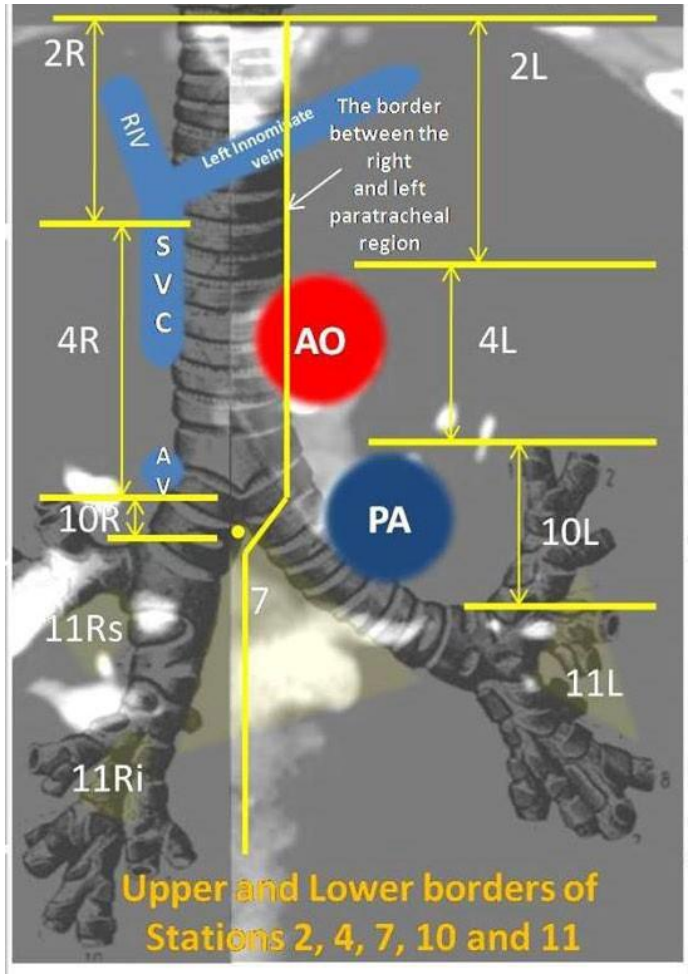






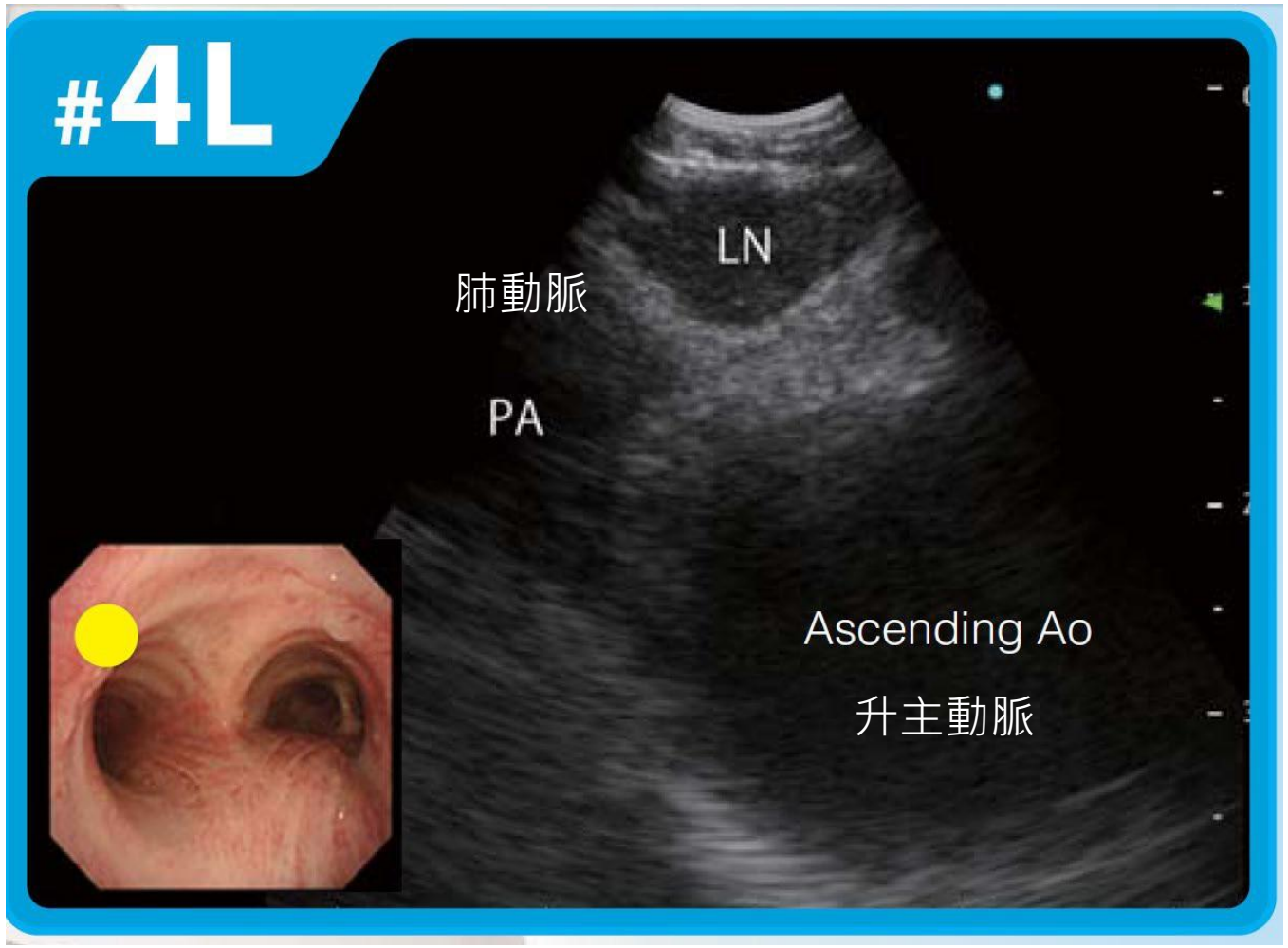
Group 4R

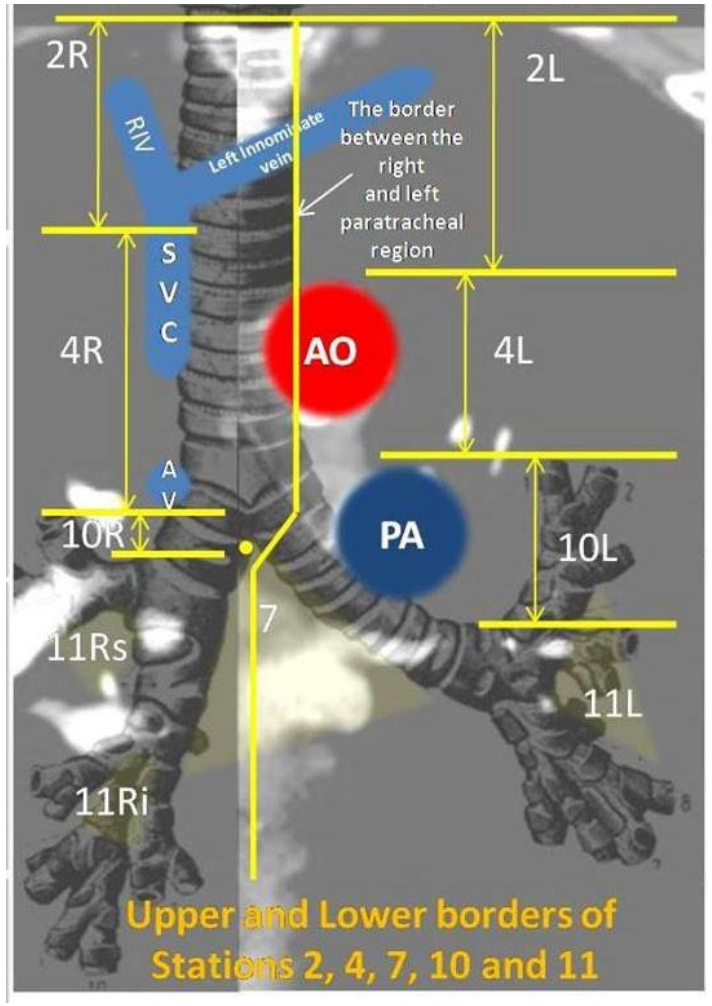




Withdraw the bronchoscope to the trachea looking straight towards the main carina. Turn to the two o'clock position and press the tip just proximal to the main carina. Look for the SVC and the azygos vein branching from the SVC. Station #4R is close to the SVC and the azygos vein.

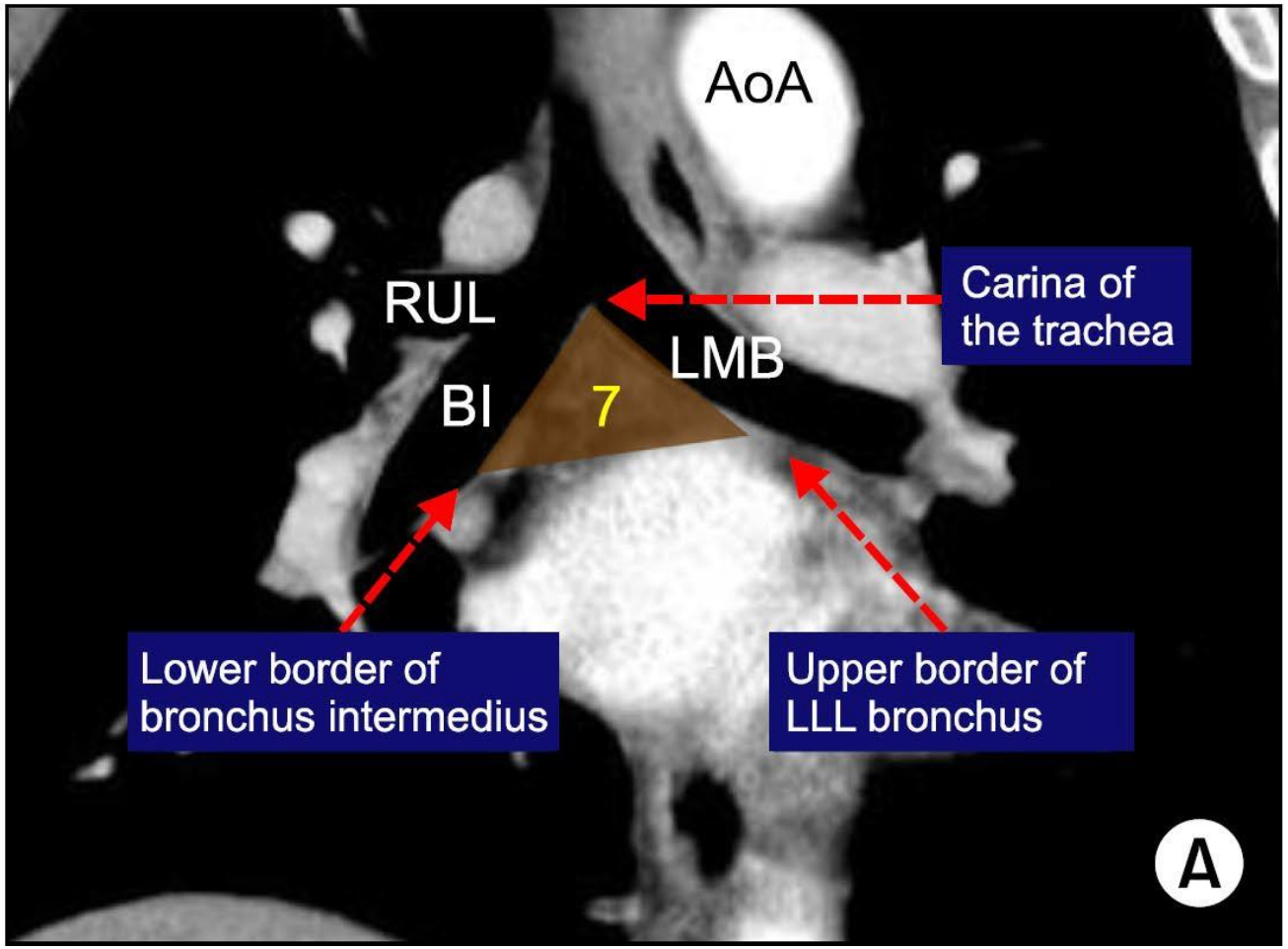
Group 4L

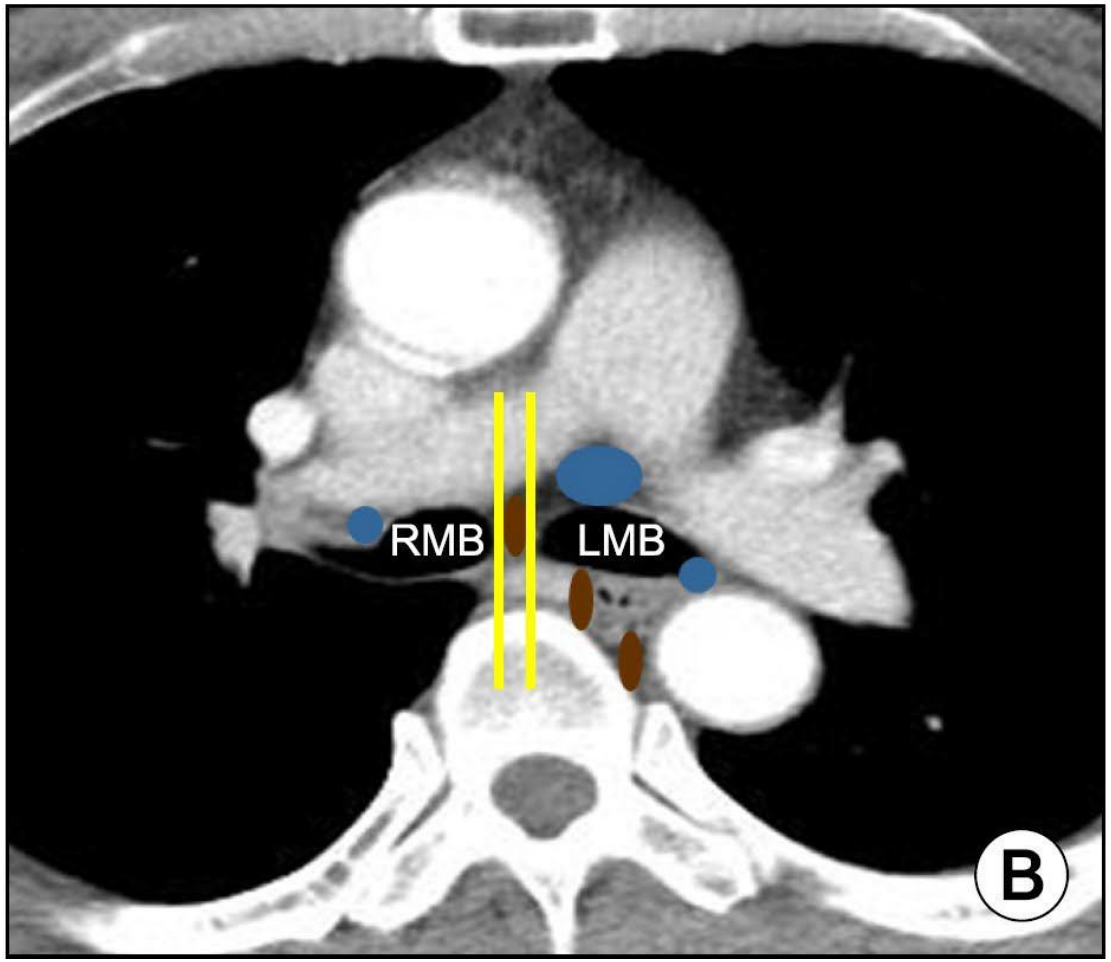




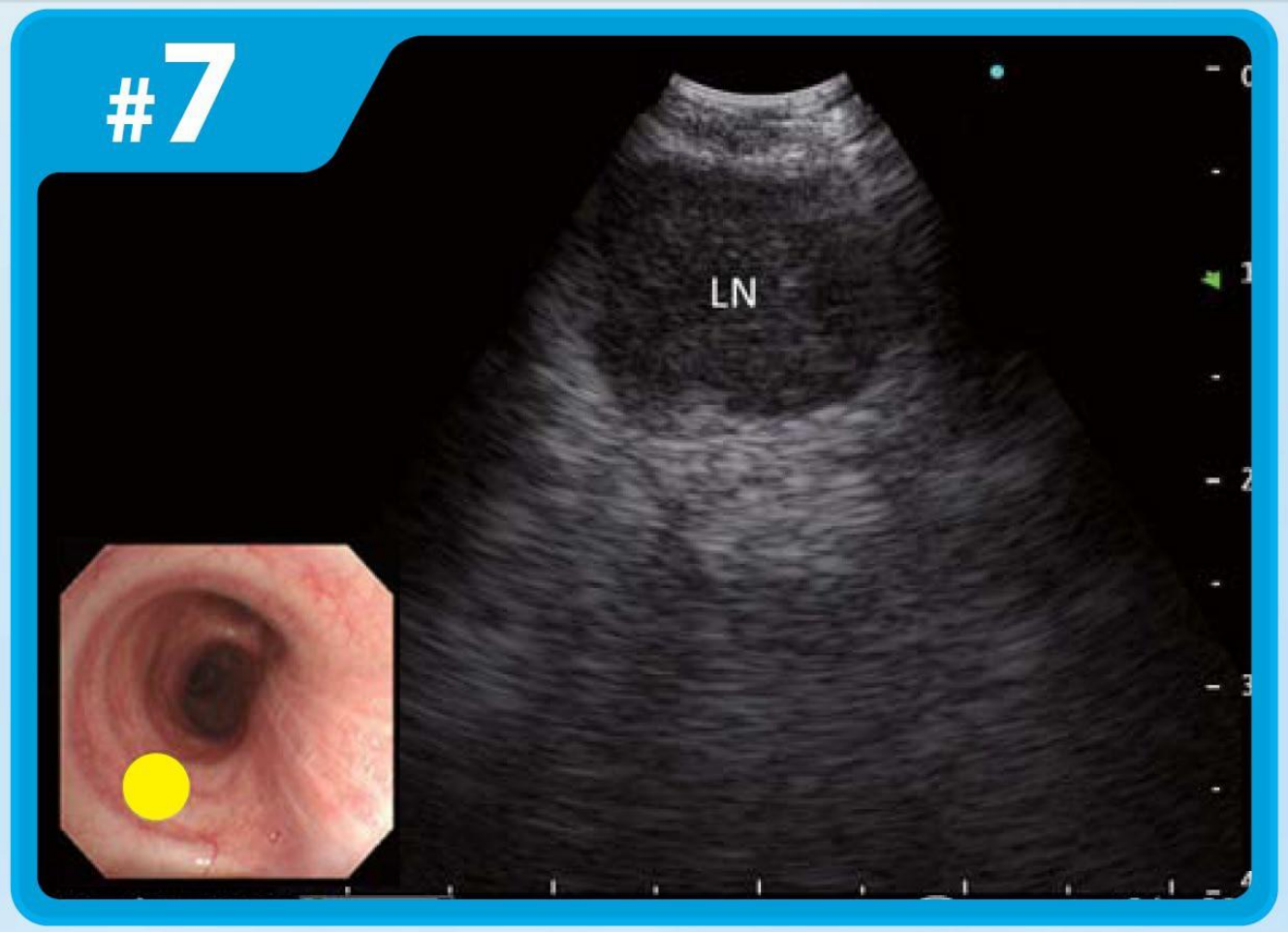
Facing the main carina, turn the bronchoscope to the 10 o'clock position and press the tip just proximal to the main carina and scan the area for station #4L. The aortic arch can be followed to the aorto-pulmonary window. The aortic arch is proximal and the left main pulmonary artery is distal.

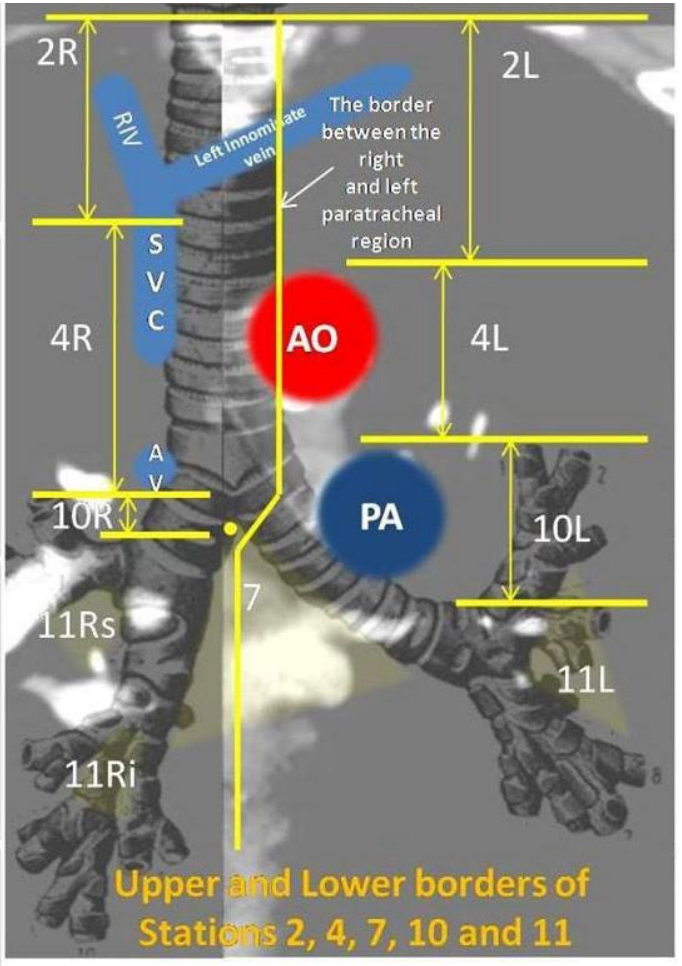
Group 7 Subcarina





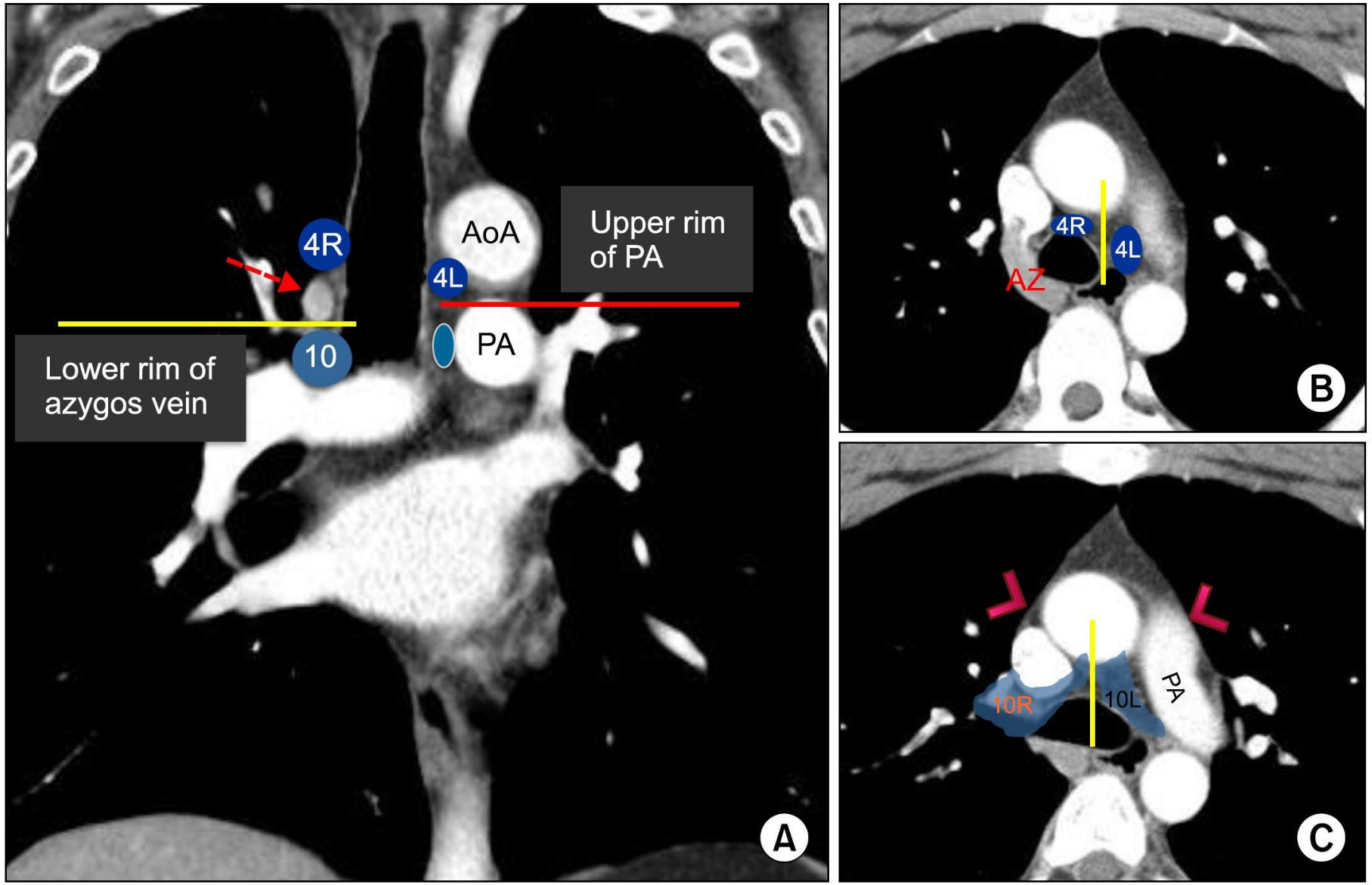
Group 7



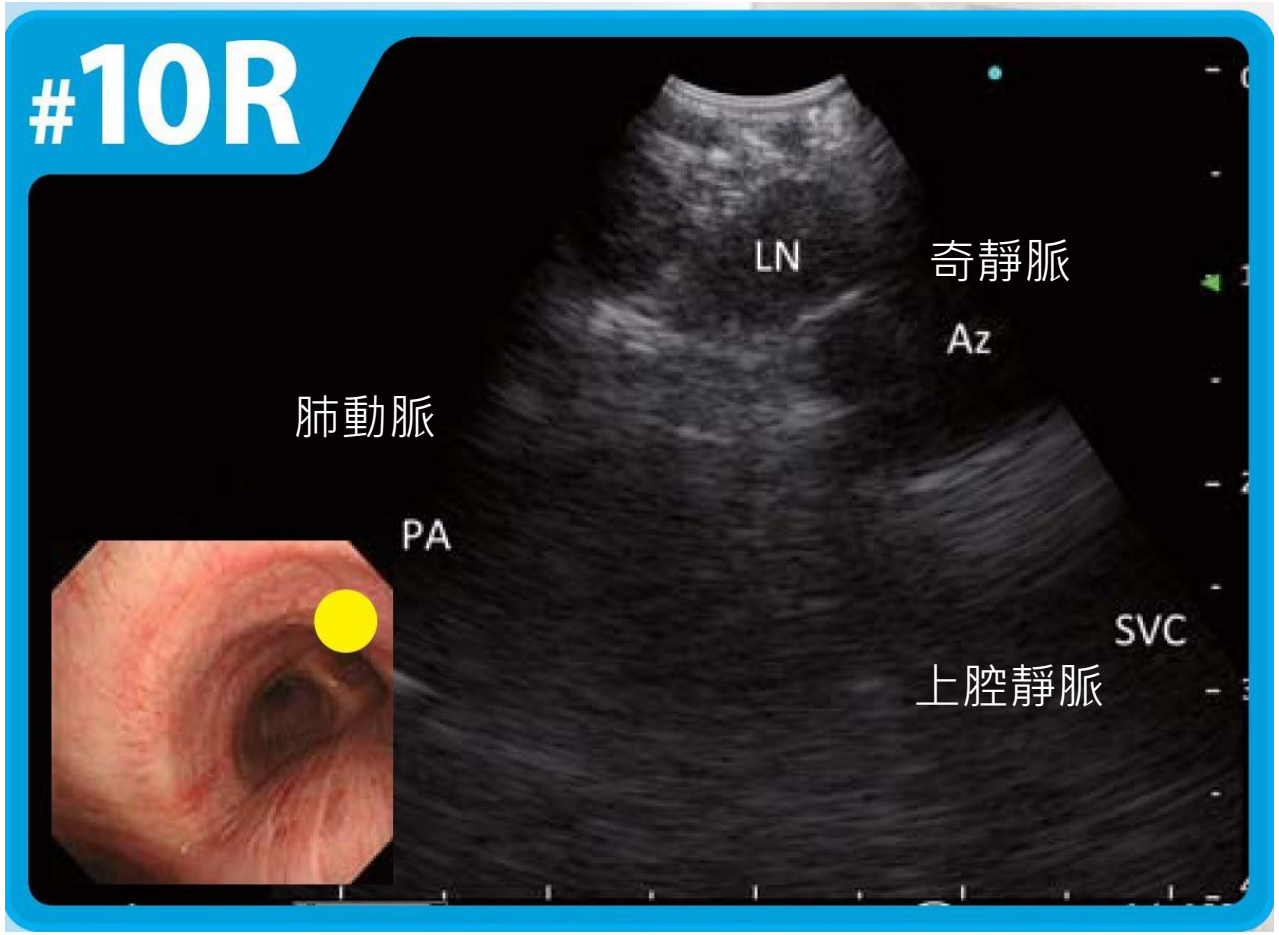


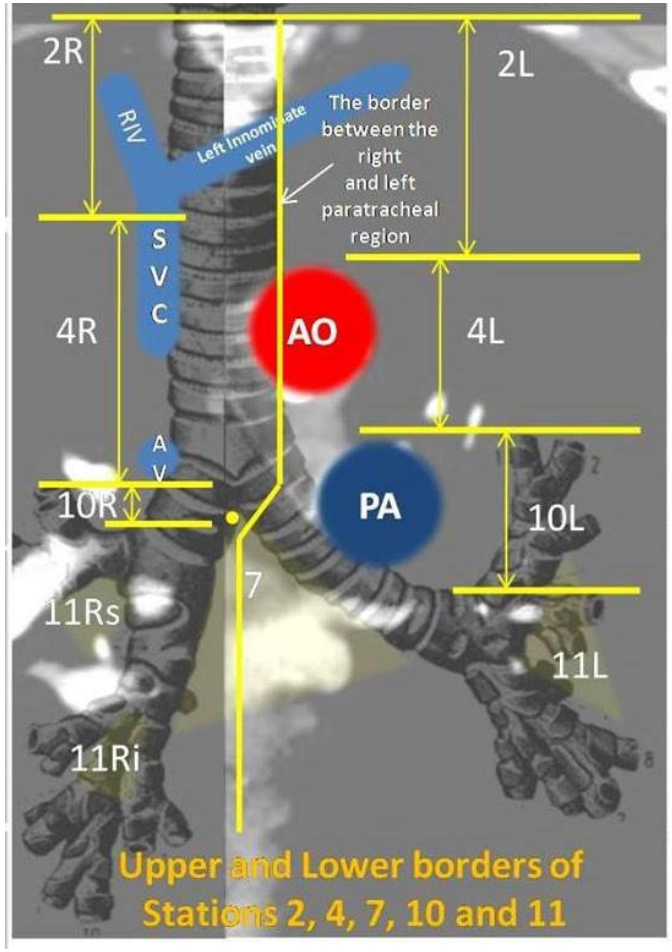
Station #7 can be visualized from either the right or the left main bronchus. On the right side, turn to the 12 o'clock position and press the tip against the right main bronchus where the main stem of the pulmonary artery is visualized. After confirmation with the Doppler mode, turn the tip to the nine o'clock position to visualize station #7. Lymph node distal to station #7 along the main bronchus is station #10R.

Group 10 Hilar nodes



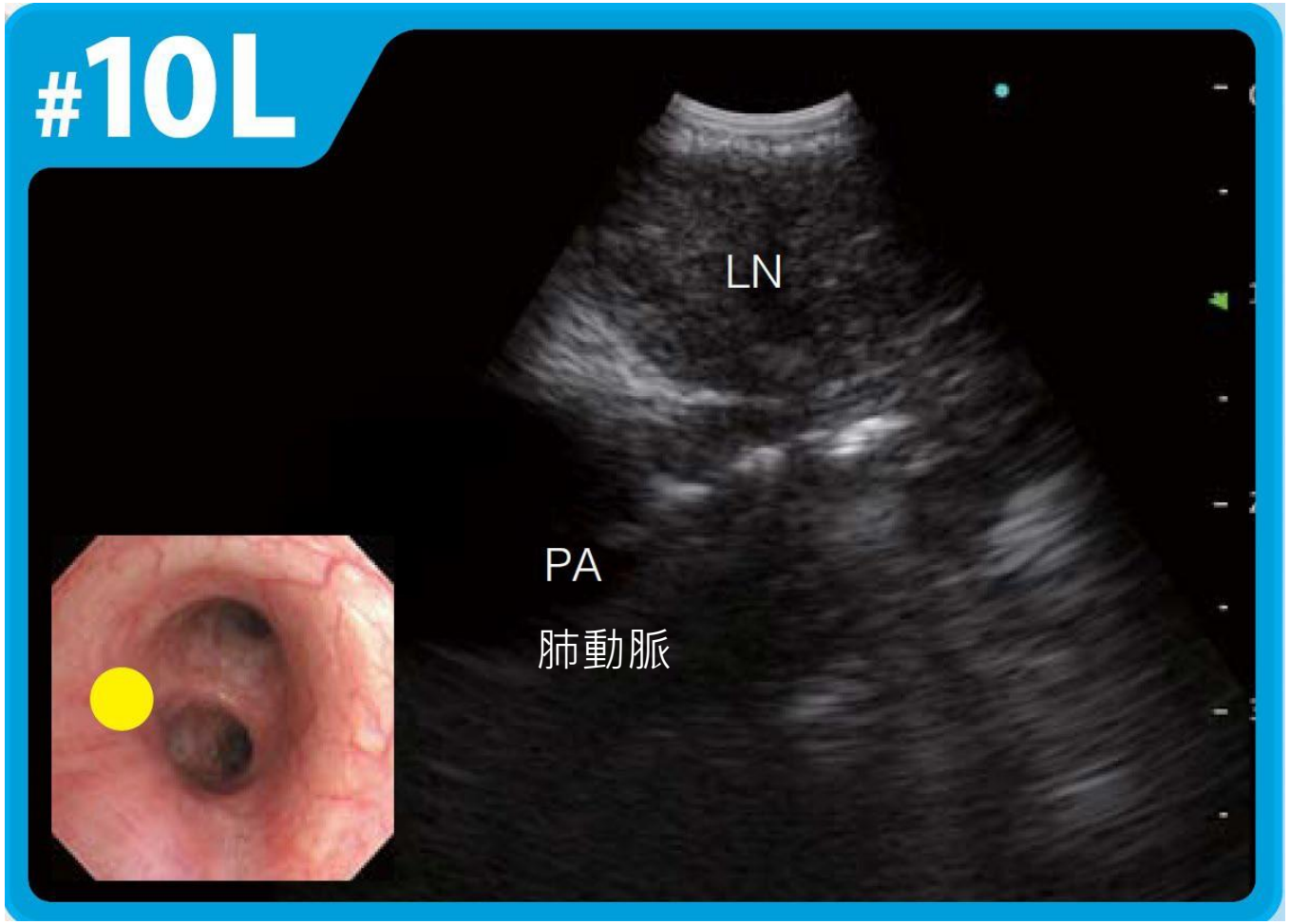
Group 10R

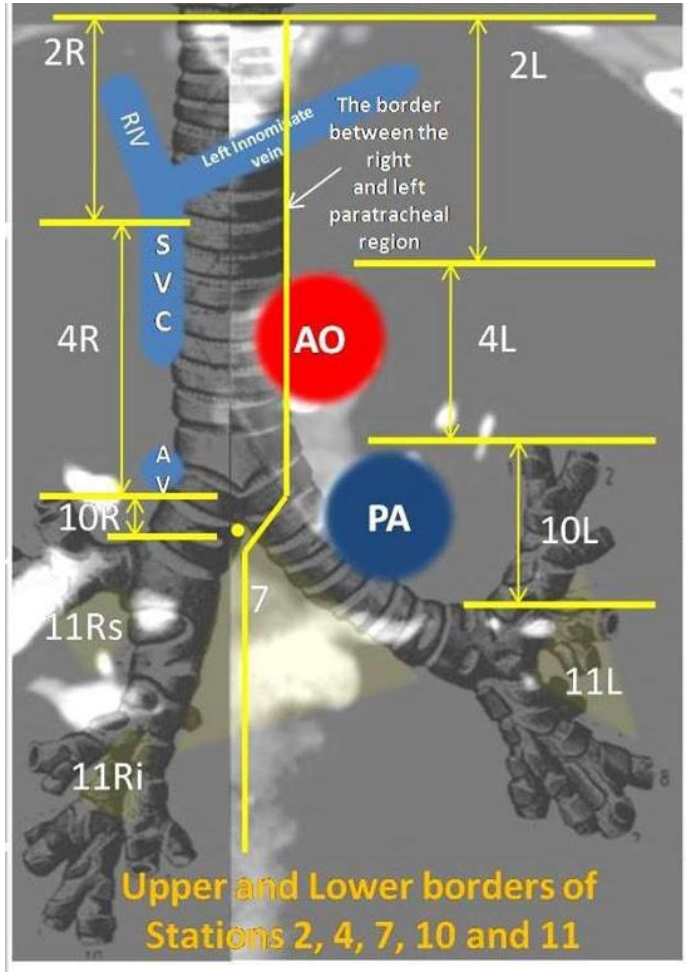




Withdraw the bronchoscope to the right main bronchus. Turn the tip to the three o'clock position and press the tip to visualize station #10R. Station #10R also lies just distal to station #7 along the right main bronchus. This part is visualized after identifying station #7 at the nine o'clock position at the right main bronchus.

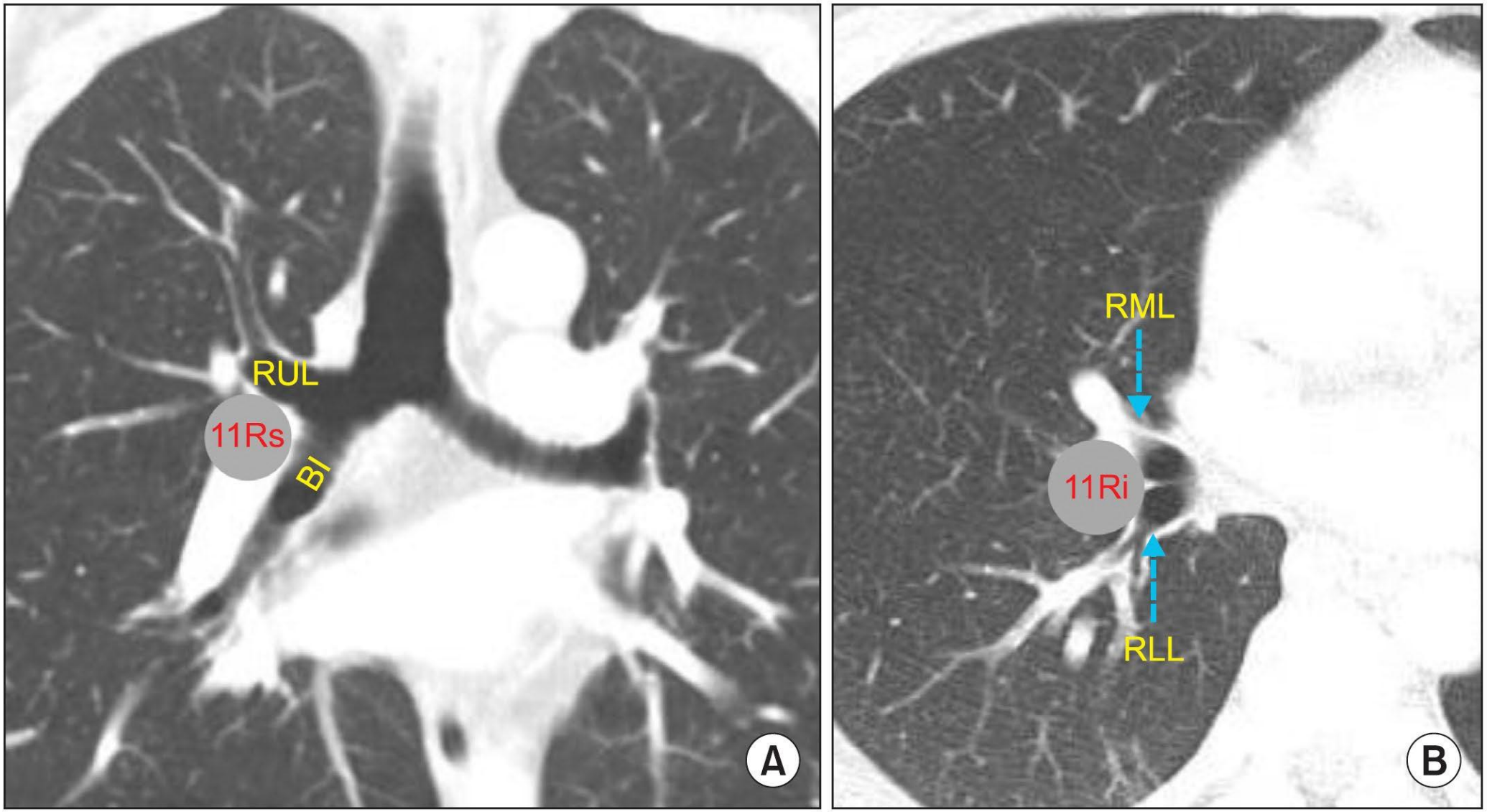
Group 10



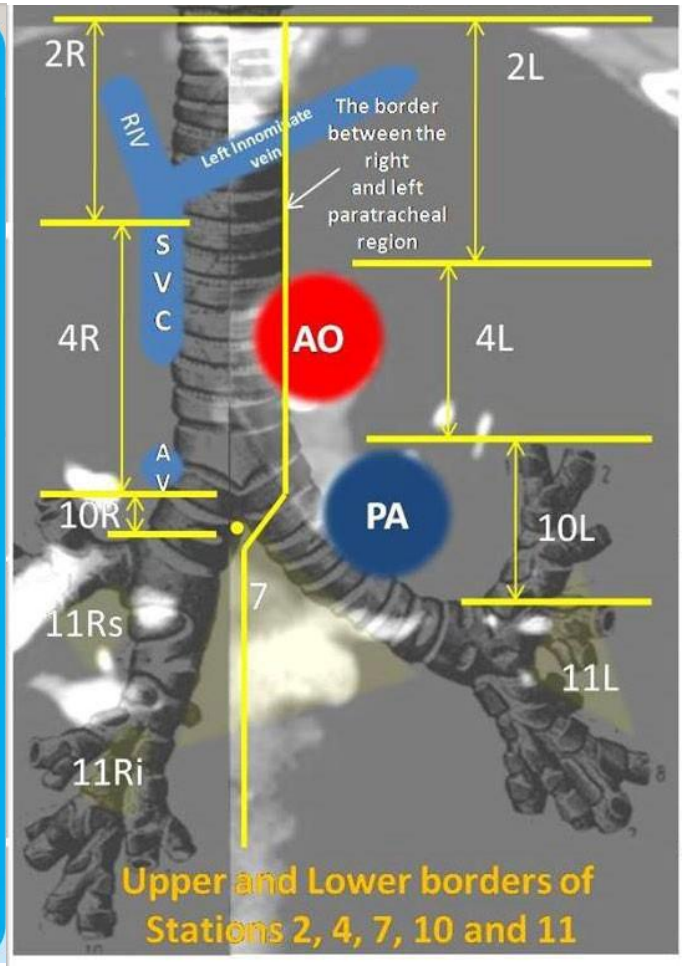


Advance the bronchoscope into the left main bronchus at the 10 o'clock position by following the left pulmonary artery on ultrasound image. This is the area of station #10L. Similar to station #10R, #10L can be visualized distal to station #7 at the three o'clock position on the left main bronchus.

Group 11 Interlobar node

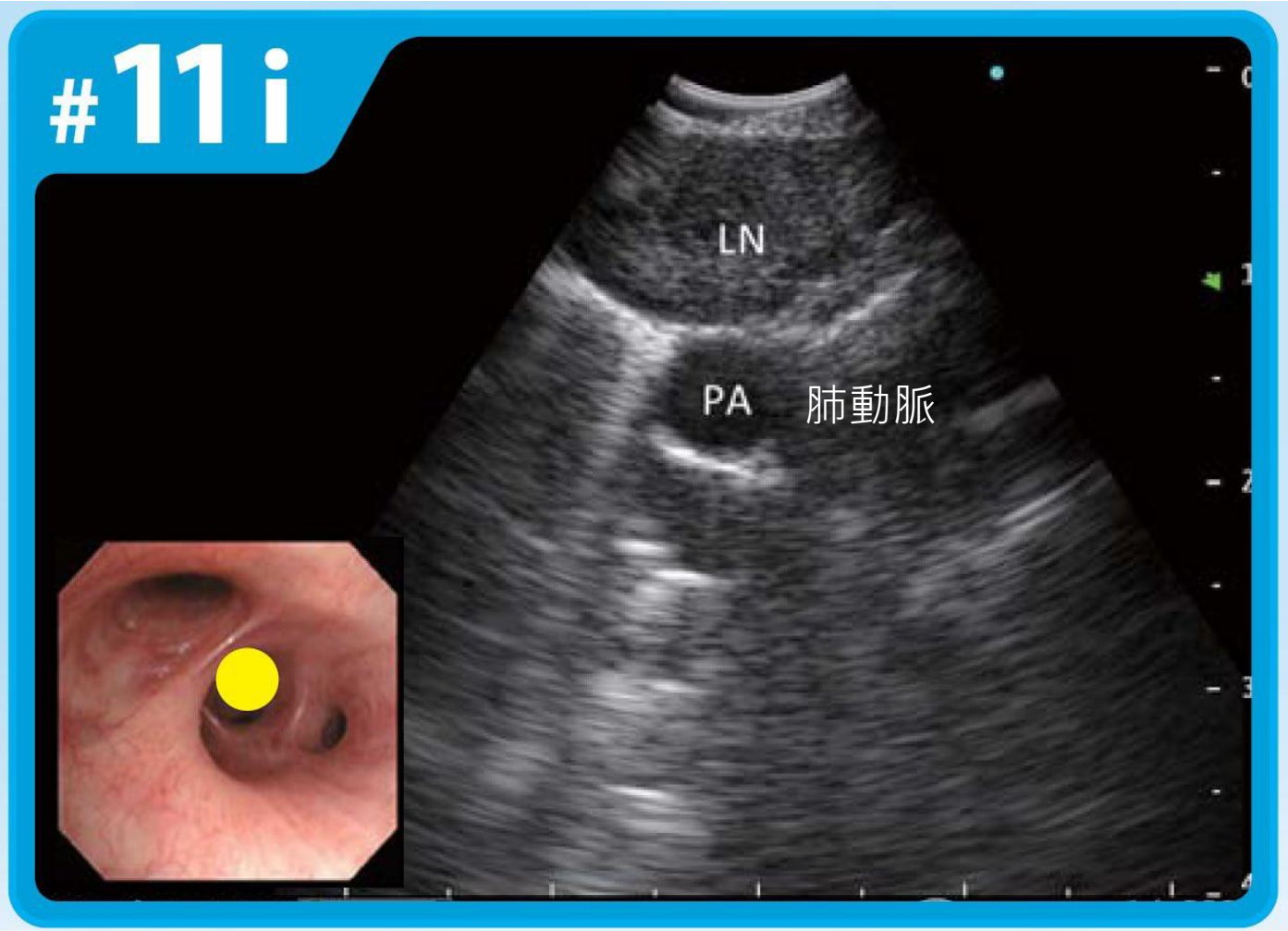


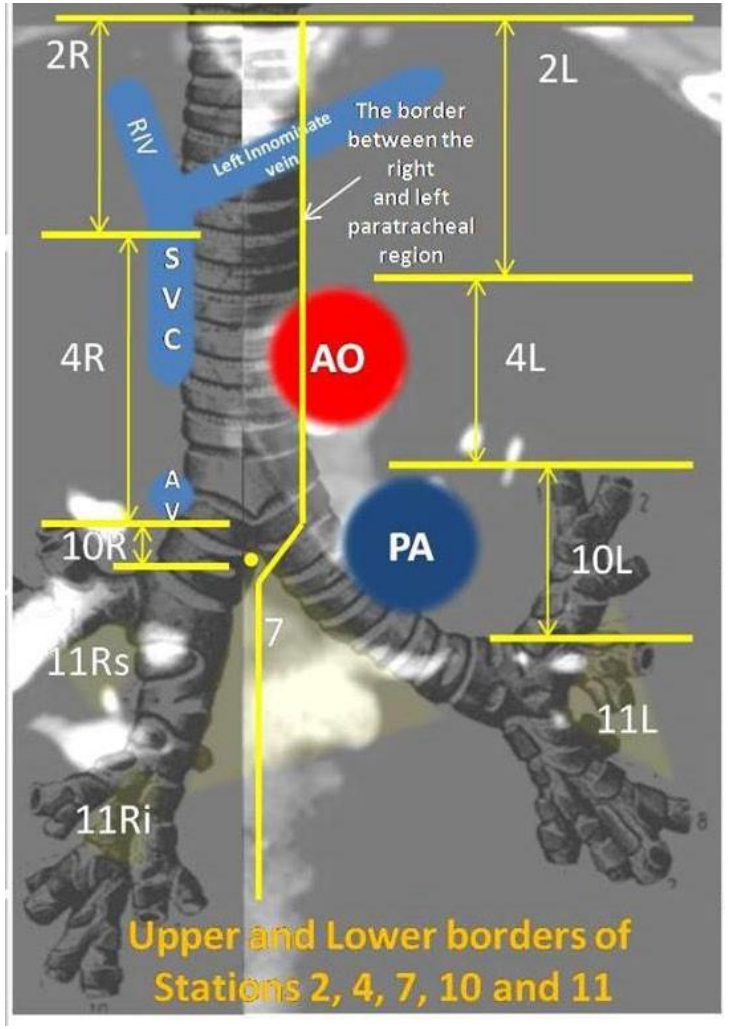
Group 11Rs



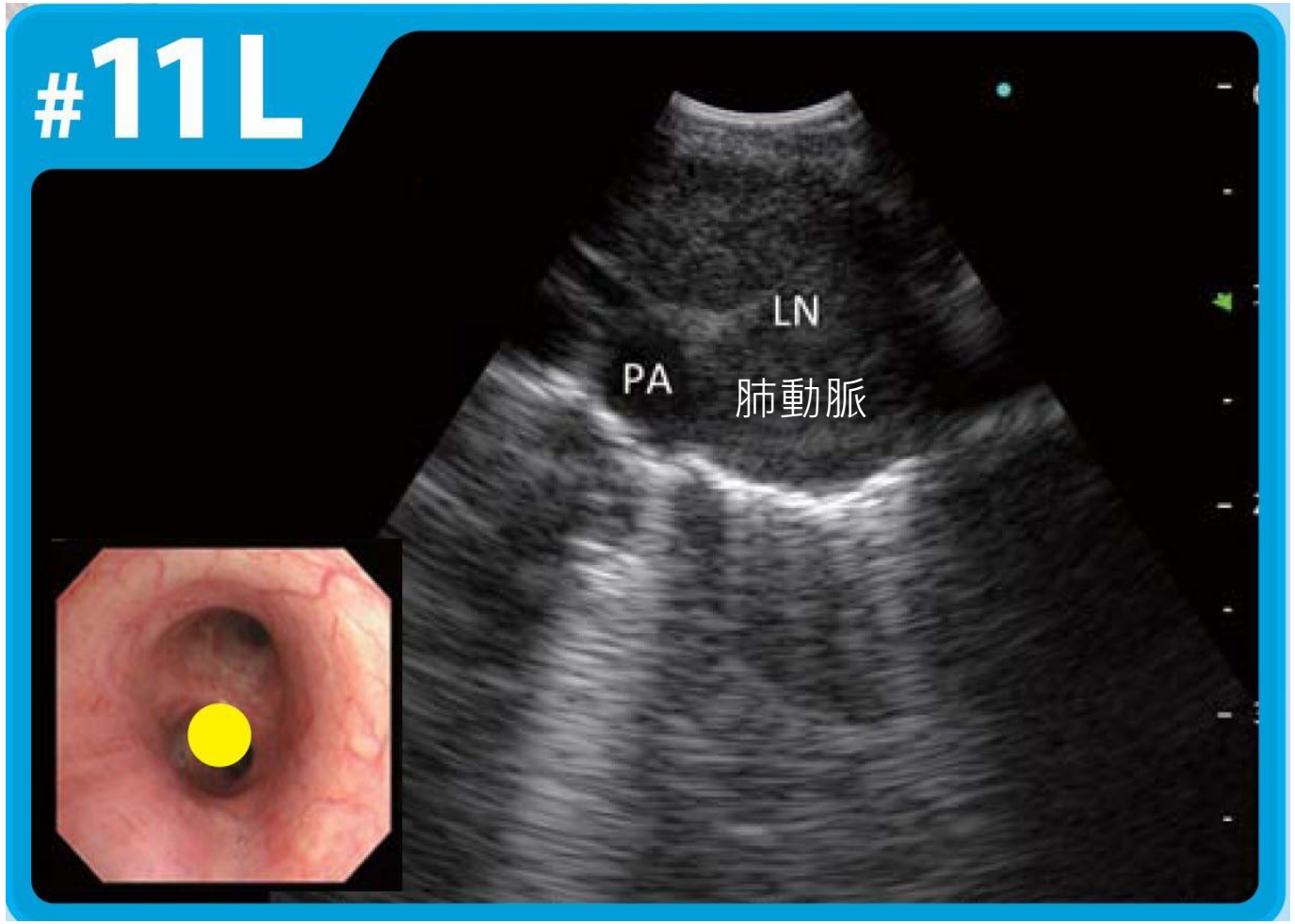
Straighten and withdraw the bronchoscope to the intermediate bronchus. Turn to the two o'clock position and press the tip just distal the entrance of the right upper lobe bronchus. Station #11R can be visualized with the interlobar pulmonary artery running distal to the lymph node.

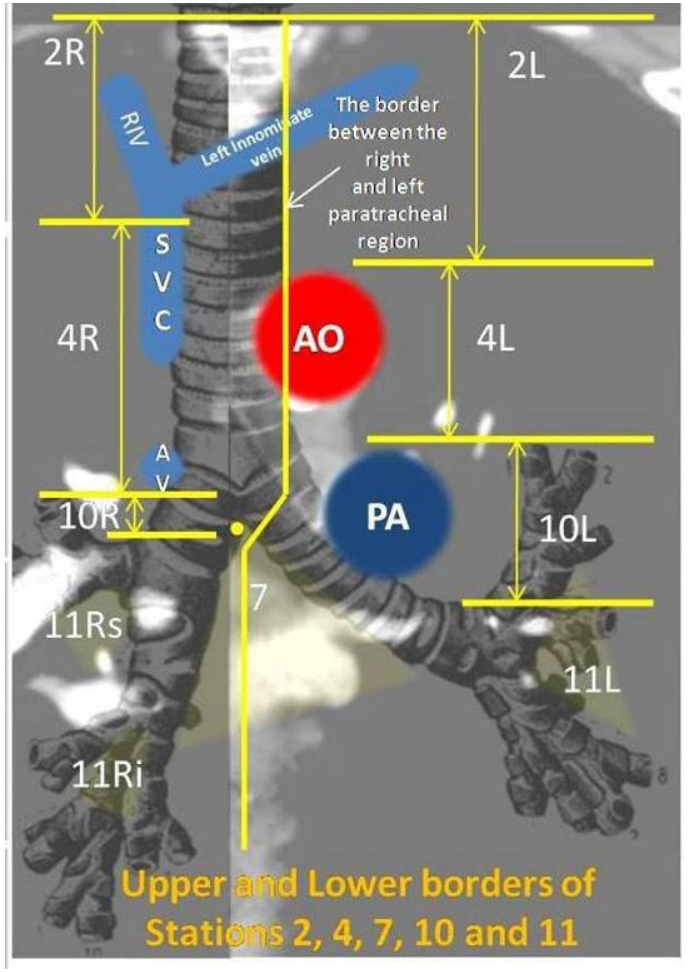
Group 11Ri


#11 i
LN
PA
肺動脈

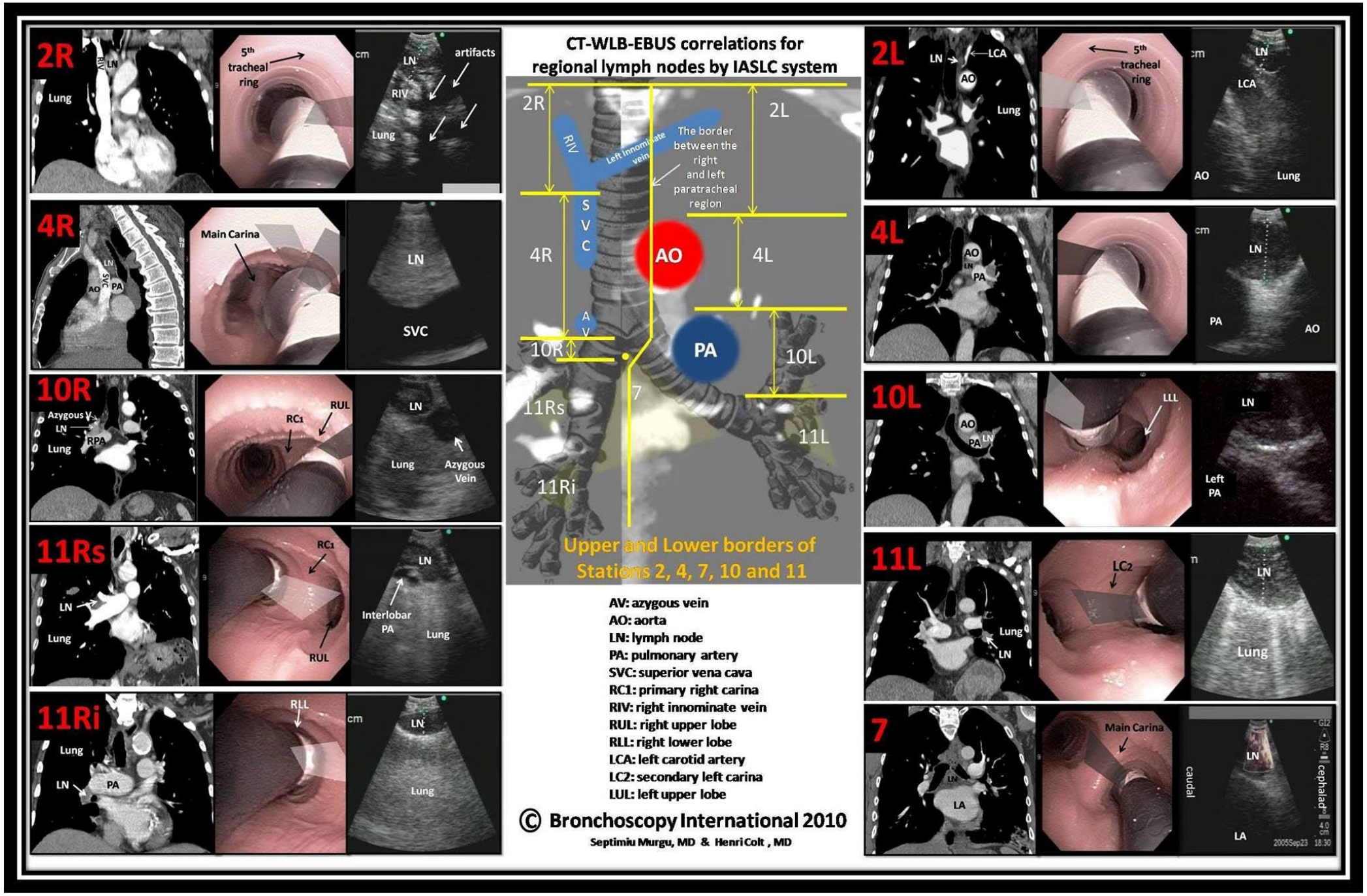

2R
2L
RIV
Left Innominate vein
The border between the right and left paratracheal region
SVC
4R
AO
4L
AV
10R
PA
10L
7
11Rs
11L
11Ri
Upper and Lower borders of Stations 2, 4, 7, 10 and 11

Group 11L





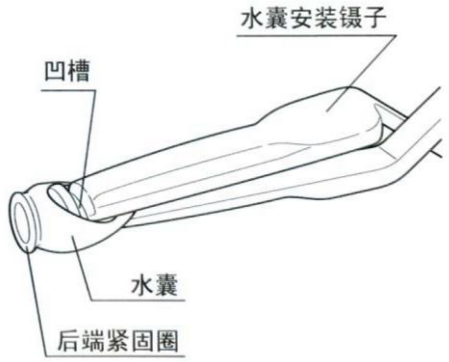
Further advancing the bronchoscope into the left lower lobe bronchus, press the tip at the two o'clock position in the carina of the upper and lower lobe bronchus. Station #11L is visualized adjacent to the interlobar pulmonary artery.


CT-WLB-EBUS correlations for regional lymph nodes by IASLC system
2R
Lung
LN
RIV
5th tracheal ring
cm
artifacts
4R
Main Carina
SVC
AO
PA
10R
Azygous V
RPA
RC1
RUL
Azygous Vein
11Rs
Interlobar PA
11Ri
RLL
2L
LCA
4L
10L
LLL
Left PA
11L
LC2
7
LA
The border between the right and left paratracheal region
Left Innominate vein
11Rs
11Ri
Upper and Lower borders of Stations 2, 4, 7, 10 and 11
AV: azygous vein
AO: aorta
LN: lymph node
PA: pulmonary artery
SVC: superior vena cava
RC1: primary right carina
RIV: right innominate vein
RUL: right upper lobe
RLL: right lower lobe
LCA: left carotid artery
LC2: secondary left carina
LUL: left upper lobe
© Bronchoscopy International 2010
Septimiu Murgu, MD & Henri Colt, MD

Balloon preparation

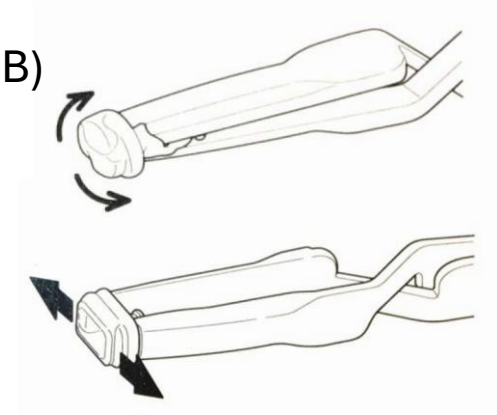
Balloon sheath
Balloon sheath applicator
Three-way stopcock
Distilled water, 10ml
Syringe, 10ml

(A)



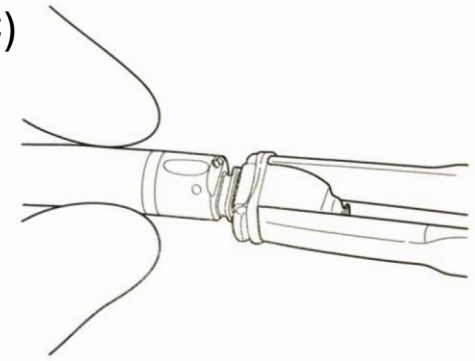
夾住水球(約夾滿 2/3)

(B)



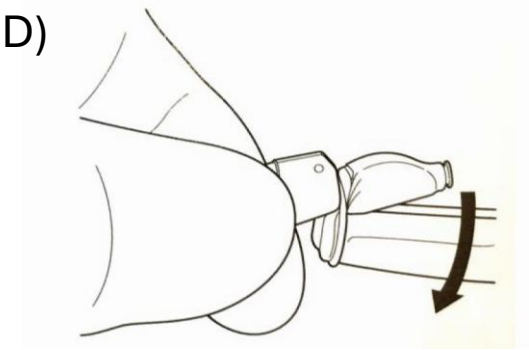
將水球往回翻，蓋住夾子尖端，輕輕撐開水球至超音波探頭的寬度

(C)



由兩側將水球套在探頭上

(D)

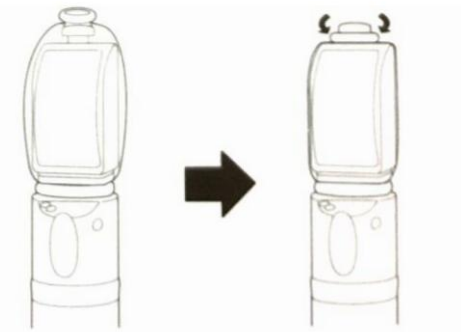


套入後由下方將夾子移出（小心易破）

(E)

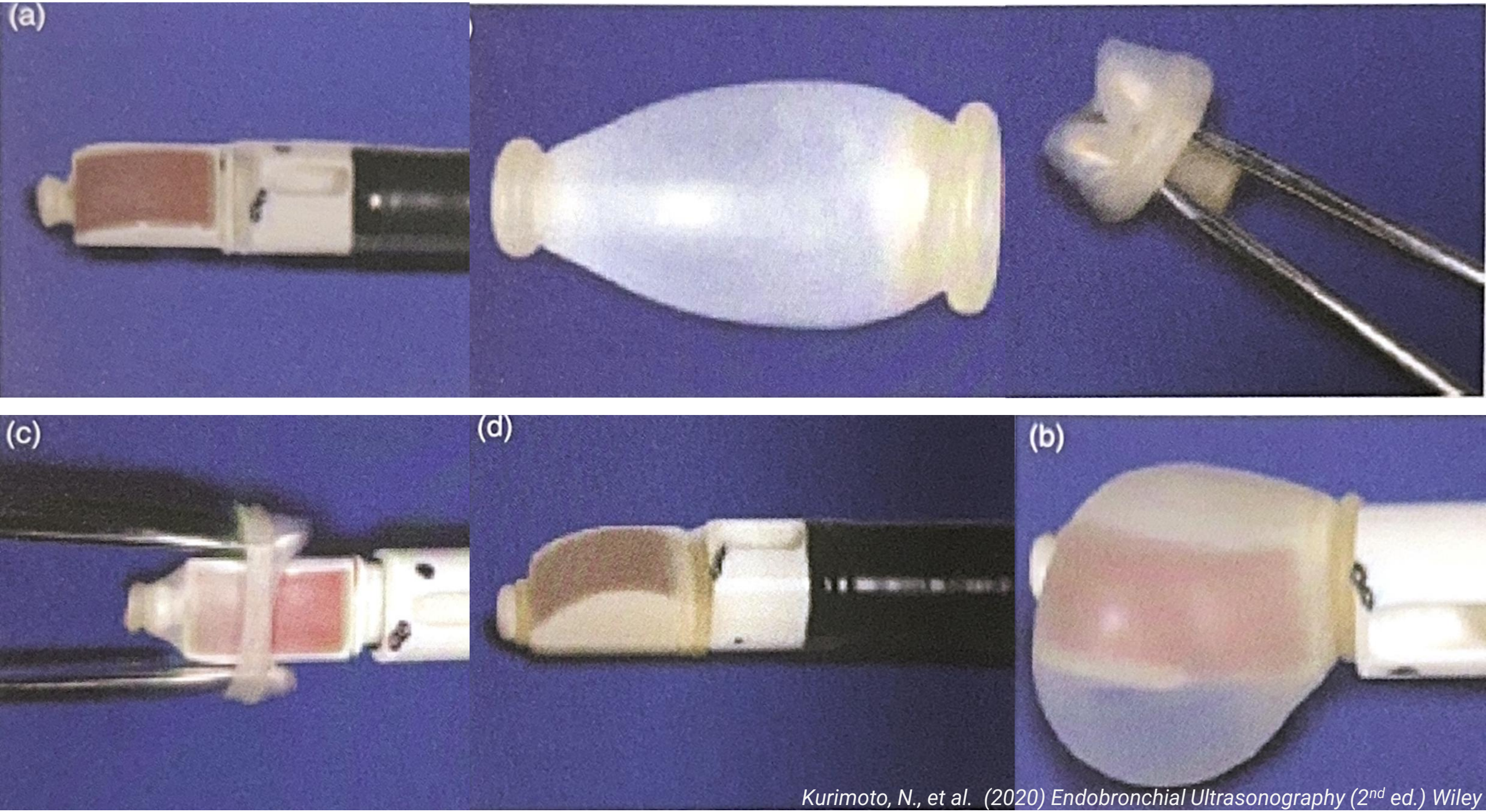
打入水後將氣泡排出

(F)



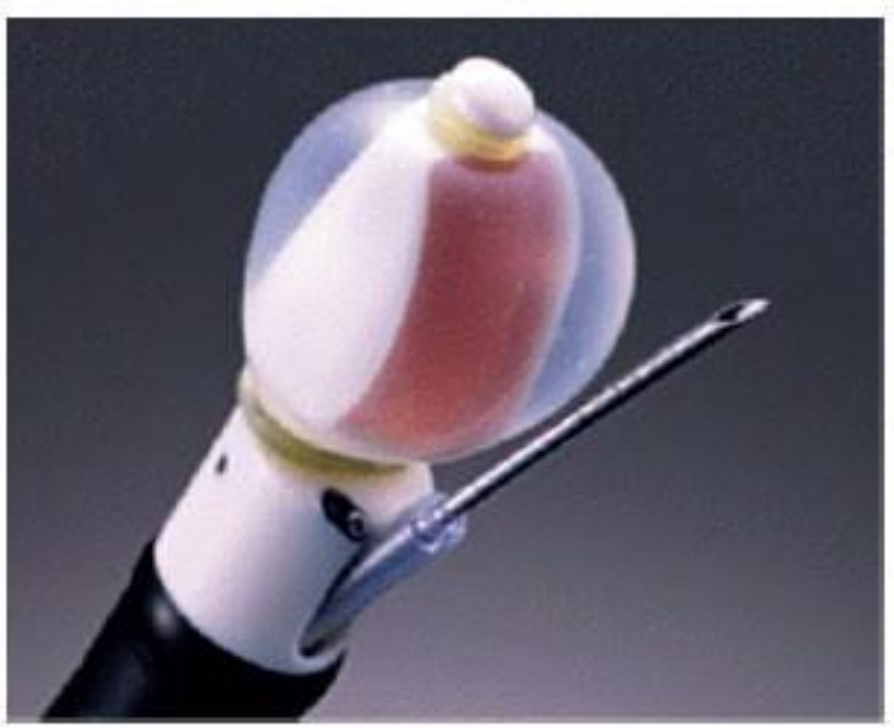
將水球末端下翻，打水測試是否漏水

Courtesy of Olympus & 臺大金山分院 林書永醫師



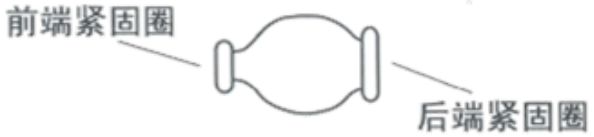
Kurimoto, N., et al. (2020) Endobronchial Ultrasonography (2nd ed.) Wiley

Balloon



〈术语〉

- 水囊(MAJ-1351)

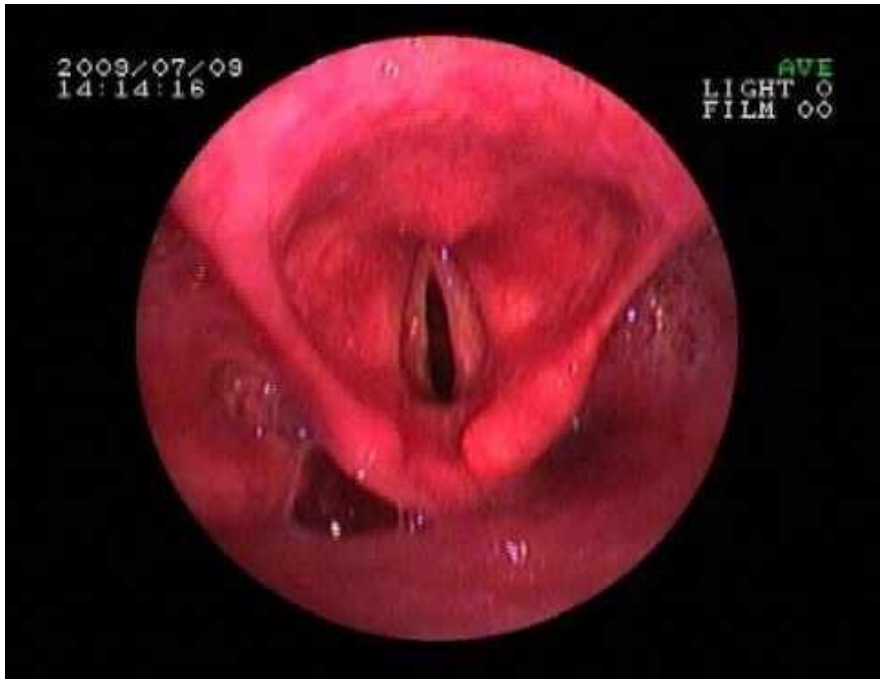


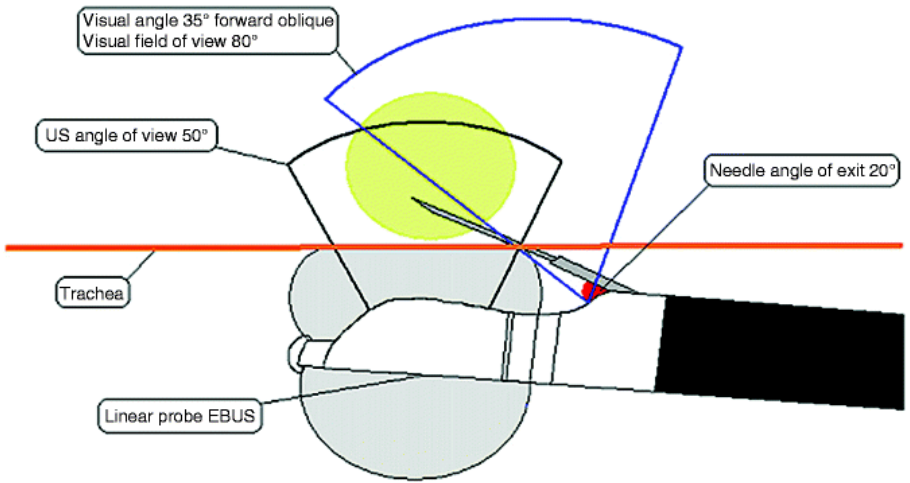
- 水囊安装镊子(MAJ-1352)

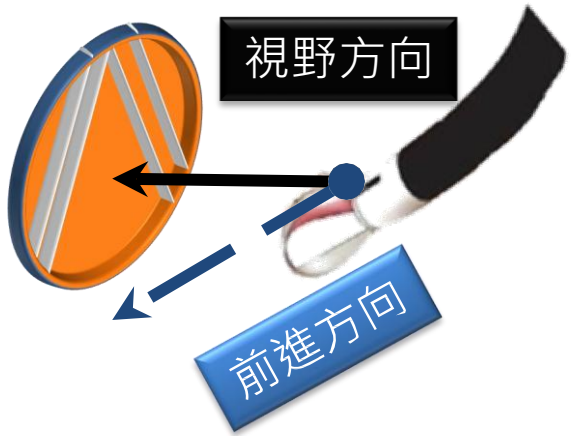
- 超音波探頭與呼吸道之間如果存在空氣，將不能獲得良好的超音波圖像，因此需要靠水來當作介質。
- 為防止形成假影，應移除水囊內所有氣泡，也必須預防水自水囊內漏出。

Insert the bronchoscope

- White light bronchoscopy
  - Trachea, main bronchus
  - 30°-35° of oblique visual angle
- Sonography examination with inflated balloon
  - Prevent over-inflation

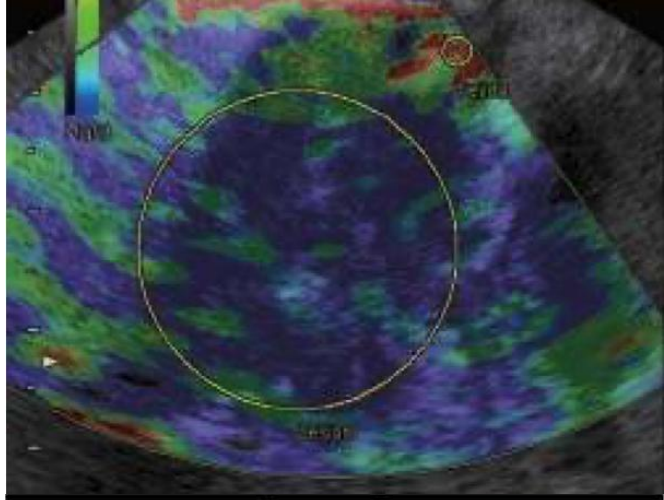






Convex-Probe EBUS mode

- B-mode
- Doppler
  - Color Doppler
  - Power Doppler
- Tissue Harmonic Echo, THI
  - Reduce artifacts from side lobes,
- Elastography
  - Visualizing and assessing the elasticity
  - Superimposed on the B-mode



CHEST

Original Research

INTERVENTIONAL PULMONOLOGY

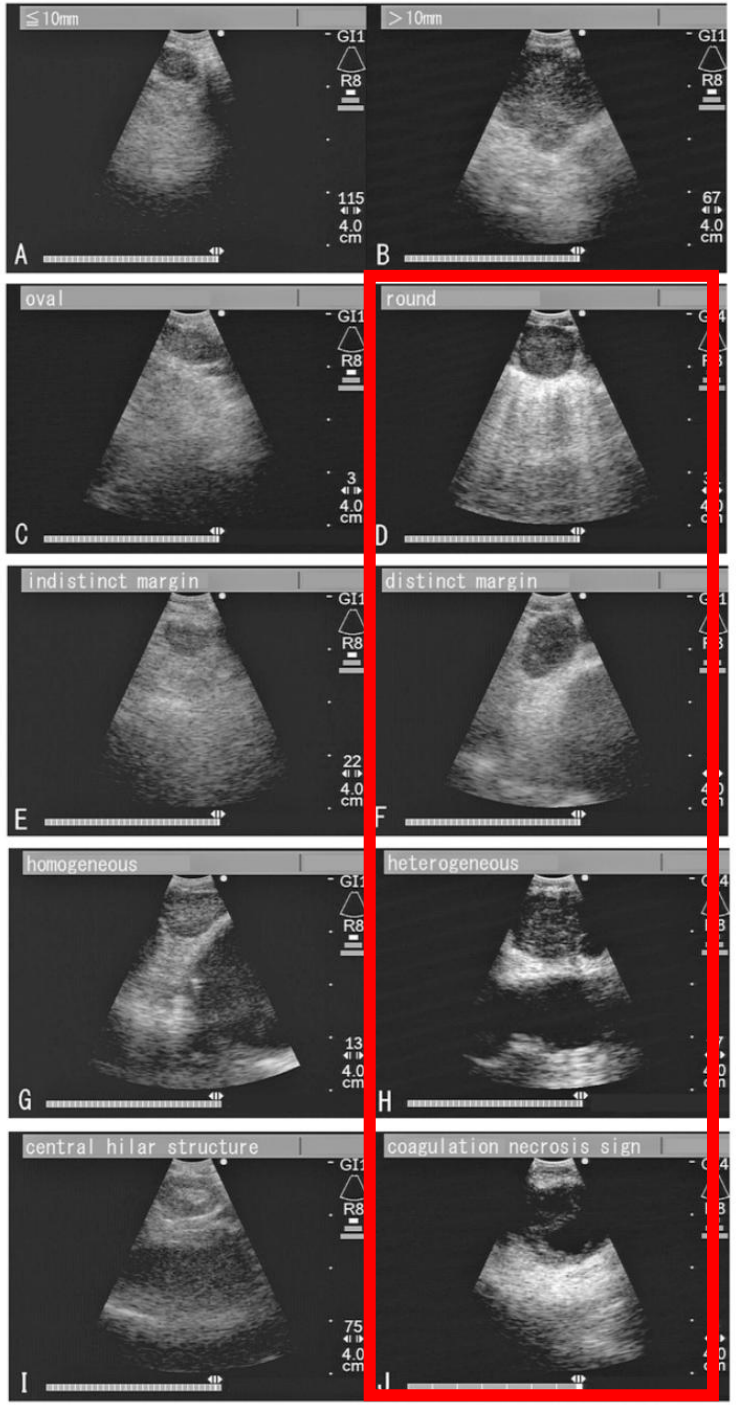
The Utility of Sonographic Features During Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration for Lymph Node Staging in Patients With Lung Cancer

A Standard Endobronchial Ultrasound Image Classification System

Taiki Fujiwara, MD; Kazuhiro Yasufuku, MD, PhD, FCCP; Takahiro Nakajima, MD, PhD; Masako Chiyo, MD, PhD; Shigetoshi Yoshida, MD, PhD; Makoto Suzuki, MD, PhD; Kiyoshi Shibuya, MD, PhD; Kenzo Hiroshima, MD, PhD; Yukio Nakatani, MD, PhD; and Ichiro Yoshino, MD, PhD

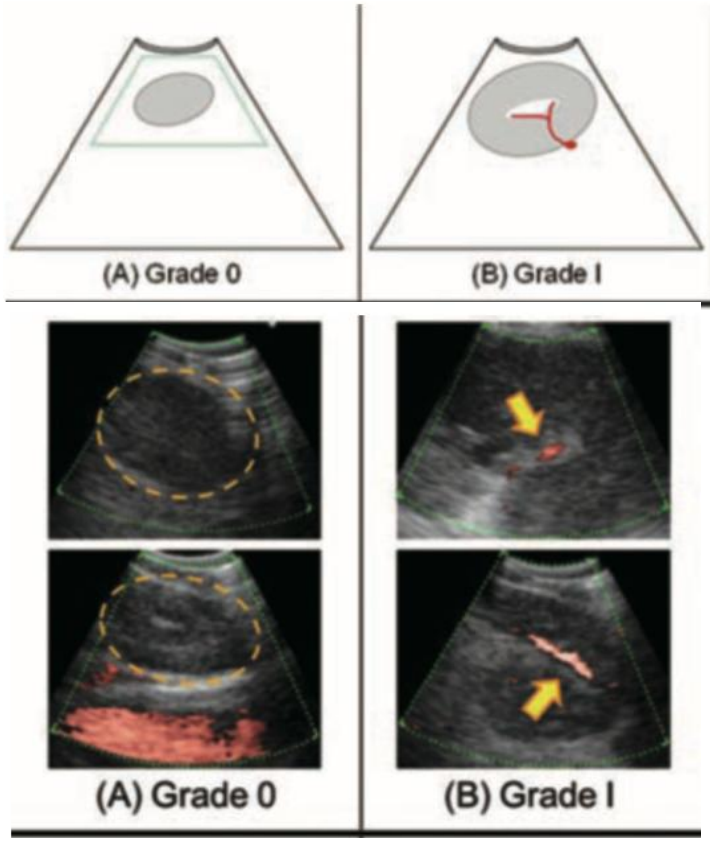
Size	Shape	Margin	Ecogenecity	Central Hilar Structure	Coagulation Necrosis Sign
(a) ≦ 1cm	(c) oval	(e) indistinct	(g) homogeneous	(i) present	(k) present
(b) >1cm	(d) round	(f) distinct	(h) heterogeneous	(j) absent	(l) absent

- Independent predictive factors
  - **Round shape**
  - **Distinct margin**
  - **Heterogeneous echogenicity**
  - **Coagulation necrosis sign**
- Accuracy:
  - **63.8% to 86.0%**

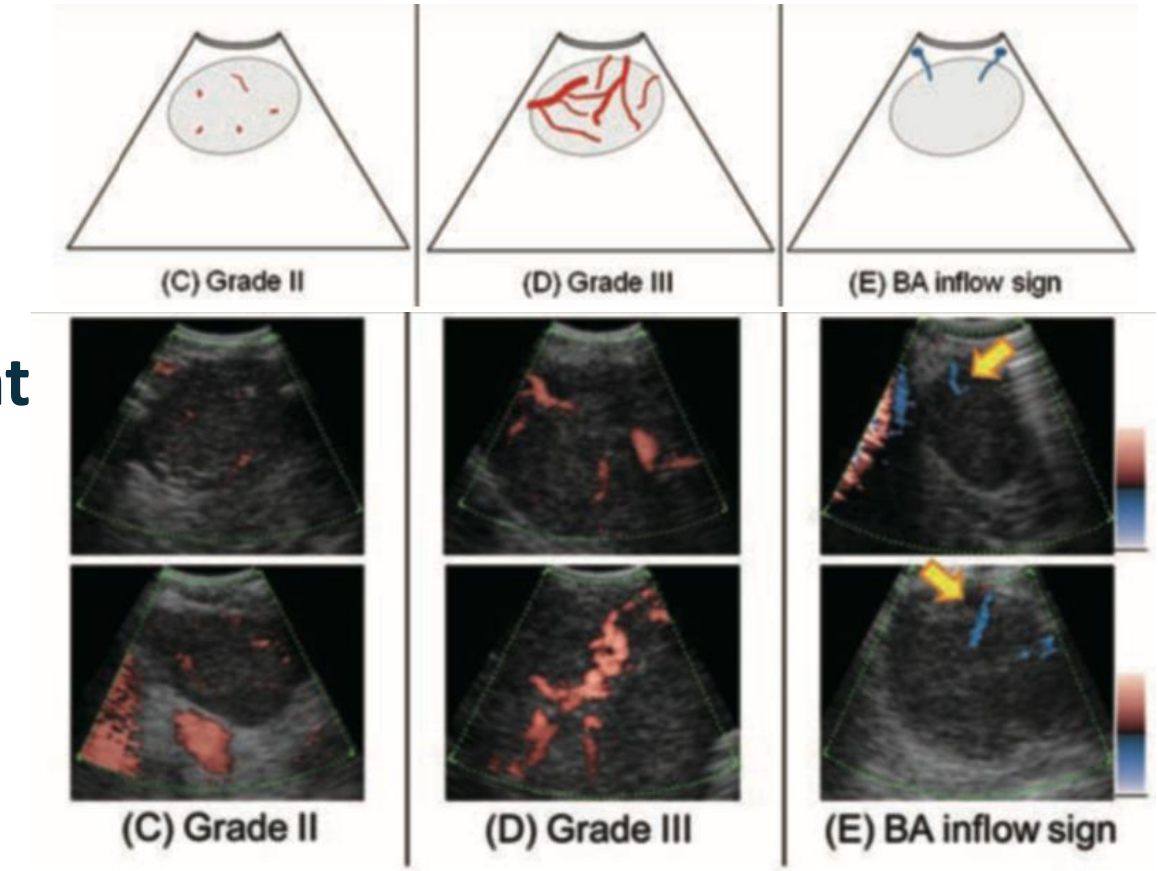


The Utility of Vascular Image Patterns in Predicting Metastasis During EBUS-TBNA for LN Staging

Benign



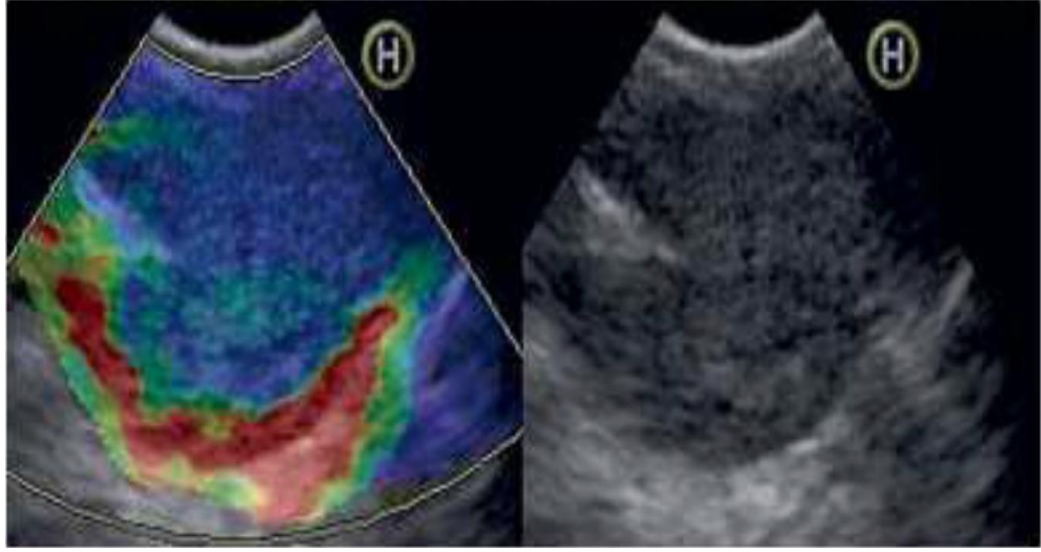
Malignant



- As vessel involvement increased in the node to rich flow with **> 4 vessels** (grades 2 and 3), the nodes were considered **malignant**, Sensitivity : 87.7%, Specificity: 69.6%,
- Diagnostic Accuracy: 78.0%-80.3%

Nakajima T, et al, J Thorac Oncol. 2012;7: 1009–1014

Elastography



- Non-invasive adjunct to characterize nodes base on their degree of stiffness.
- The electronic measurement of different degree of strain can be represented in red, green, and blue color format: blue represents the greatest strain and most likely malignant tissue.
- Izumo score
  - Predominantly nonblue (type 1), partially blue (type 2) and predominantly blue (type 3); **type 3 LN suggest malignant involvement**.
- Nakajima et al.
  - Mean stiff area ratios :
  - **Malignant LNs (0.478, harder)** v.s. Benign LNs (0.216, softer), p = 0.002
  - Cutoff value of 0.311, Sensitivity:81%, Specificity:85%

The Utility of Sonographic Features During Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration for Lymph Node Staging in Patients With Lung Cancer

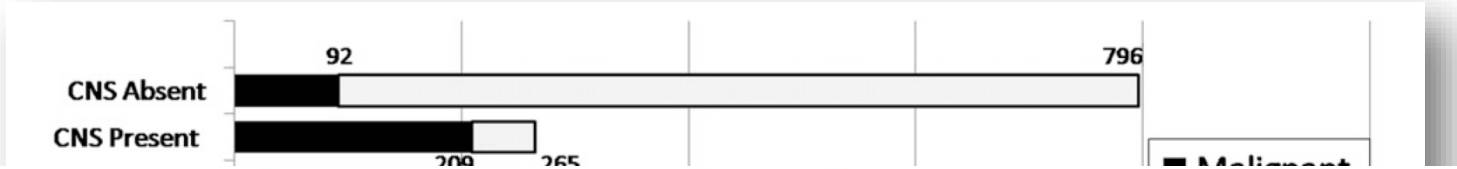
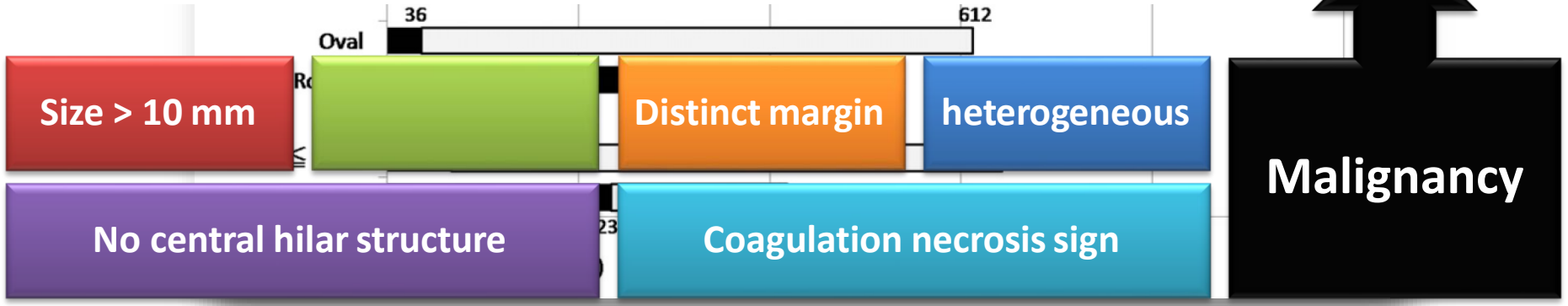


Table 3—*Diagnostic Yield of Each Endobronchial Ultrasound Image Category for Metastatic Lymph Node*

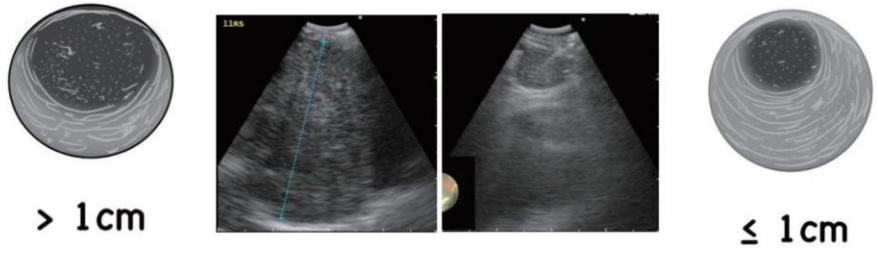
Morphologic Category	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Diagnosis Accuracy
Size: > 10 mm	77.9	75.8	55.9	89.7	76.4
Shape: round	88.0	75.8	59.0	94.1	79.3
Margin: distinct	94.4	54.3	45.5	96.0	65.7
Echogenicity: heterogeneous	77.3	86.6	69.5	90.6	83.9
Central hilar structure: absence	89.7	53.5	43.3	92.9	63.8
Coagulation necrosis sign: presence	69.4	92.6	78.9	88.4	86.0



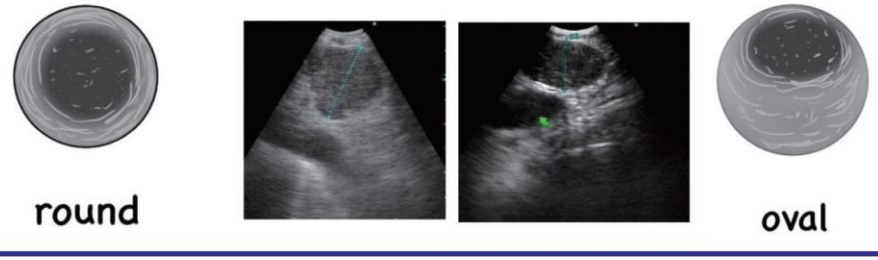
CHEST 2010; 138(3):641–647

偏向惡性 偏向良性

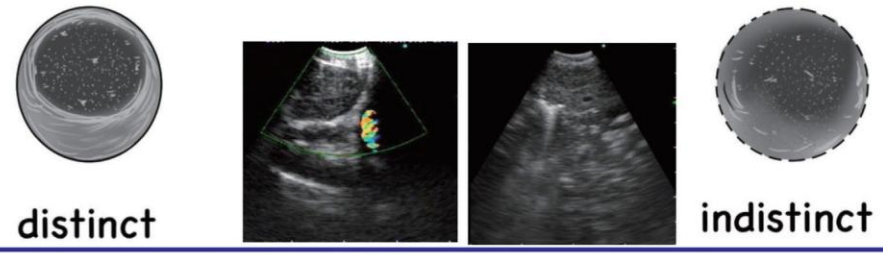
Size 5.39X



Shape 5.36X

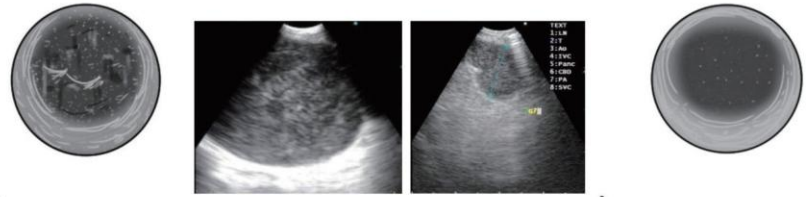


Margin 2.21X

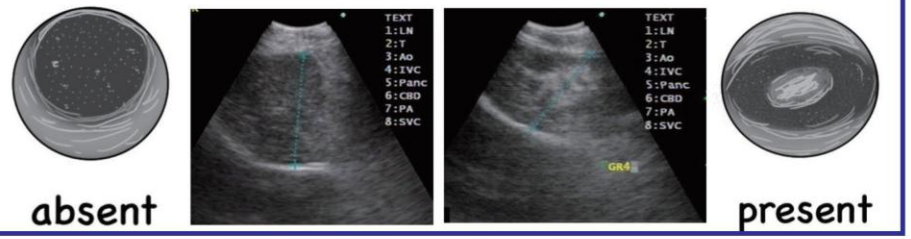


偏向惡性 偏向良性

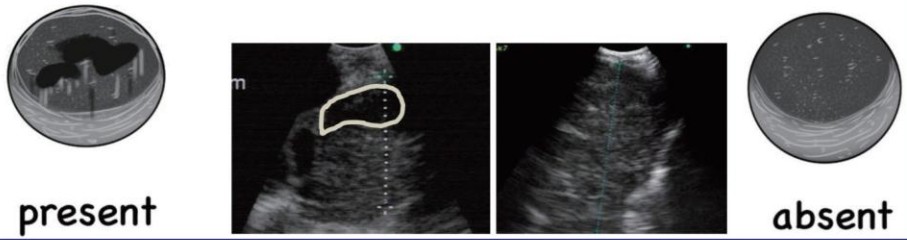
Ecogenecity 6.04X



Central Hilar Structure 7.73X



Coagulation Necrosis Sign 9.23X



Respir Med. 2020 Aug 1;171:106097.

Sonographic Features of Endobronchial Ultrasonography Predict Intrathoracic Lymph Node Metastasis in Lung Cancer Patients

Lei Wang, MD, Weihua Wu, MD, Yunqian Hu, MD, Jiajun Teng, MD, Runbo Zhong, MD, Baohui Han, MD, PhD, and Jiayuan Sun, MD, PhD

Departments of Ultrasound, Pulmonary Medicine, and Endoscopy and Pulmonary Medicine, Shanghai Chest Hospital, Shanghai Jiaotong University; and Department of Respiration, Shanghai East Hospital, Shanghai Tongji University, Shanghai, China

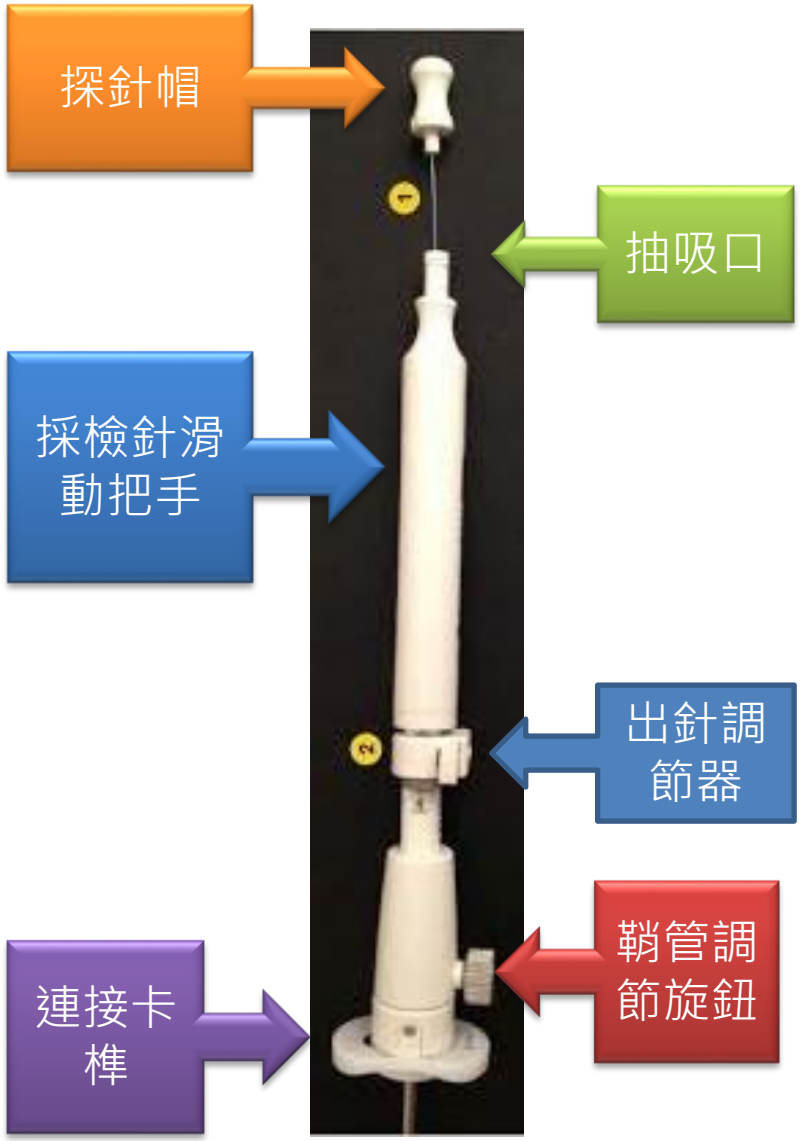
Table 4. Diagnostic Test Parameters and Exact 95% Confidence Intervals for Score System to Predict Lymph Node Metastasis Based on Odds Ratio

EBUS Characteristics	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
Shape: round	86.06%	21.02%	73.97%	36.63%	68.03%
Matting: presence	35.08%	96.59%	96.41%	36.32%	52.13%
CHS: absence	91.72%	60.80%	85.92%	73.79%	83.15%
Nonhilar perfusion	81.70%	74.43%	89.29%	60.93%	79.69%
Sonographic features[a]					
0	1.53%	84.66%	20.59%	24.79%	24.57%
1+	98.47%	15.34%	75.21%	79.41%	75.43%
2+	93.03%	55.68%	84.55%	75.38%	82.68%
3+	76.69%	84.66%	92.88%	58.20%	78.90%
4	26.36%	97.16%	96.03%	33.60%	45.98%

[a] Sonographic features satisfy none (0) or at least one (1+), two (2+), three (3+), or four (4) of the four categories (round shape, presence of matting, absence of central hilar structure [CHS], nonhilar perfusion) based on the odds ratio.

CHS = central hilar structure; NPV = negative predictive value; PPV = positive predictive value.

Connect to needle



15 steps of EBUS-TBNA

- Advance needle through the working channel
- Secure the needle housing by sliding the flange, recheck the sampling site
- Release the sheath screw, advance the sheath to the bronchial wall and locked
- Measure and adjust depth secure
- Retract a little of stylet, for checking the needle head is sharpened
- Advance the needle using “jab” technique
- Move the stylet in and out to dislodge bronchial wall debris
- Remove the stylet
- Attach syringe and apply suction
- Move the needle back and forth inside the node 10-15 times
- Release the suction and remove the syringe
- Keep sampling several times
- Retract needle and depth secure, unlock and retract sheath, and remove needle

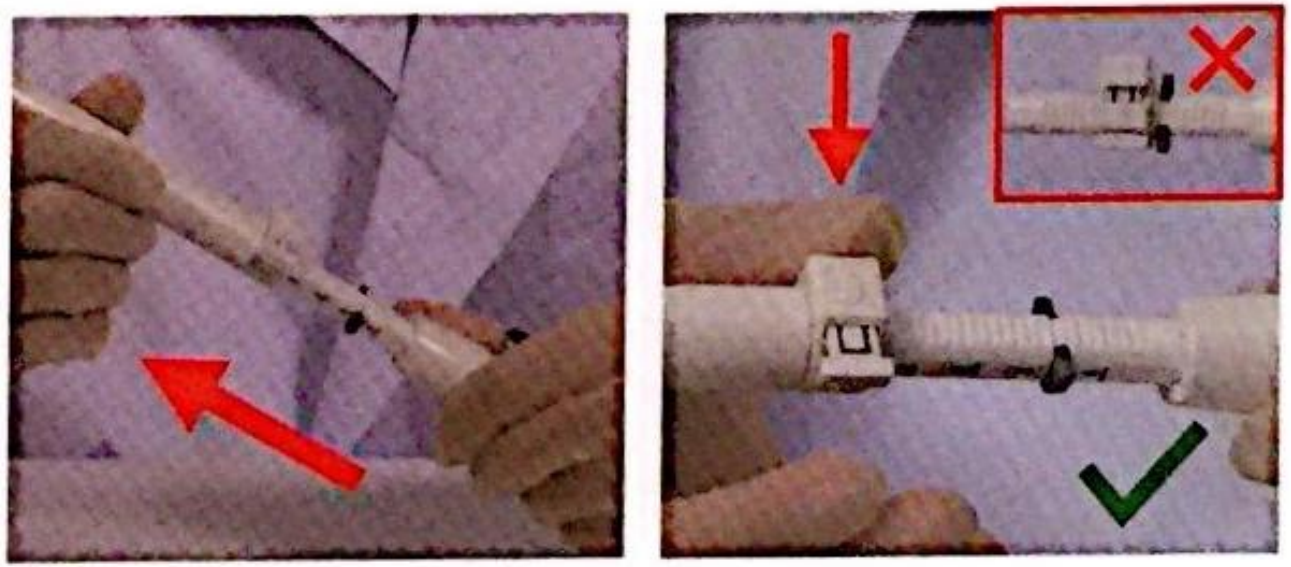
Ref: http://bronchoscopy.org; *https://www.youtube.com/watch?v=Z9FdgVx_xrM&t=3s*

Preparation before using the ViziShot EBUS-TBNA needle

【1】

Ensure that the sheath adjuster is fully retracted and the knob is tightened.

【2】



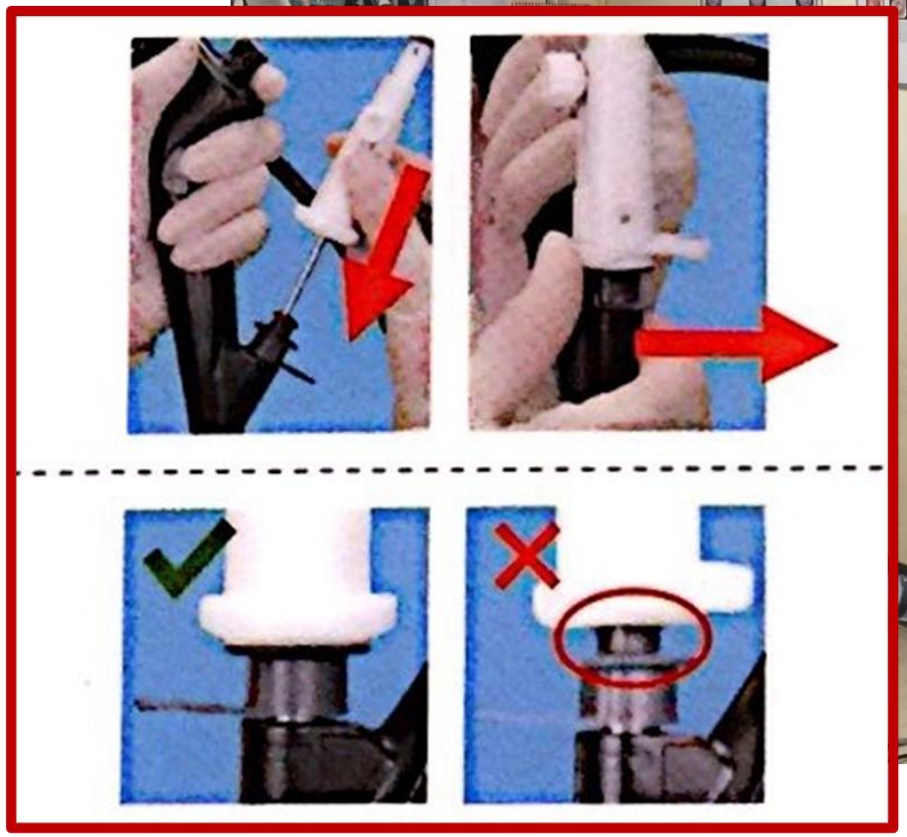
Confirm that the needle slider is fully pulled up until it clicks and the needle adjuster is locked. Failure to do so may result in damage to the endoscope.

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 1 :
The biopsy needle is passed through the working channel

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 2:
The housing is secured to the bronchoscope by a flange



蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

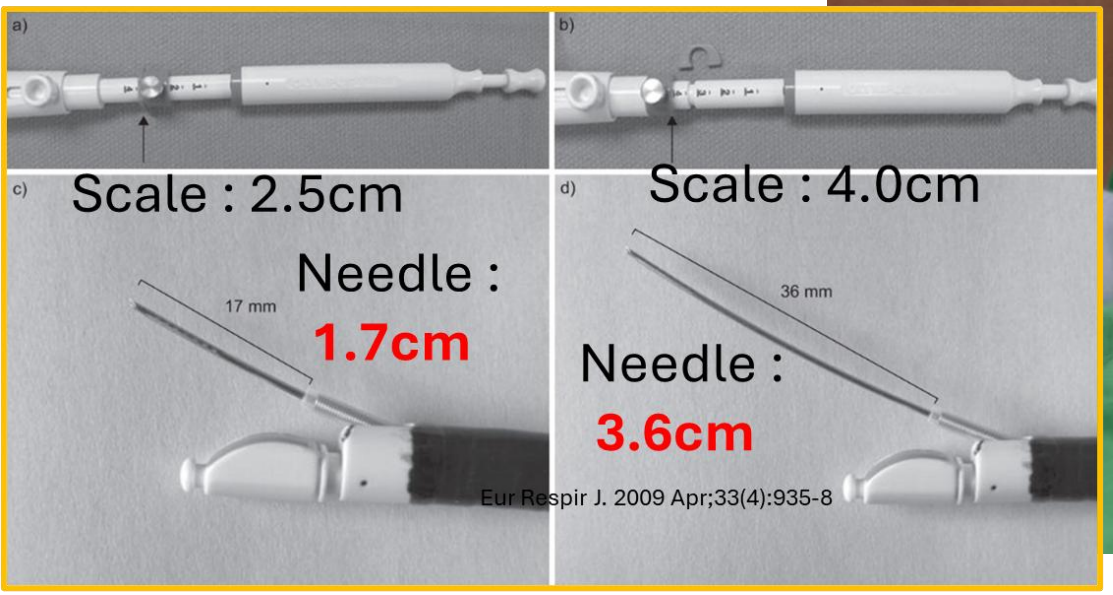
Step 3:
The sheath is released by twisting the inferior screw

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 4:

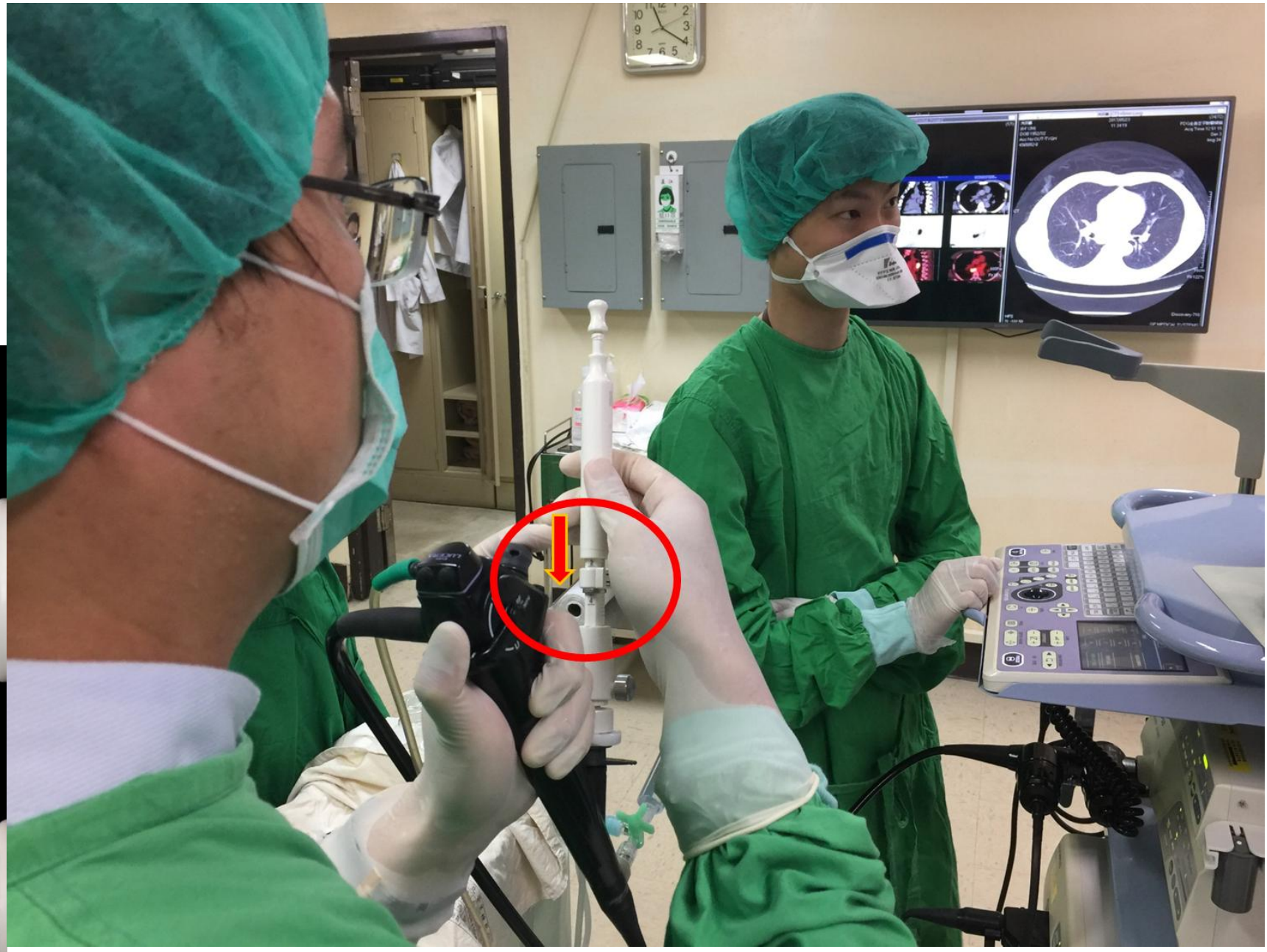
With the node visualized by ultrasound, the sheath is advanced out of the end of the scope until it slightly touches the airway wall. It is therefore safe to advance the needle

Step 5 :
The needle screw, located superiorly, is then released.
(scale : 0-4cm)



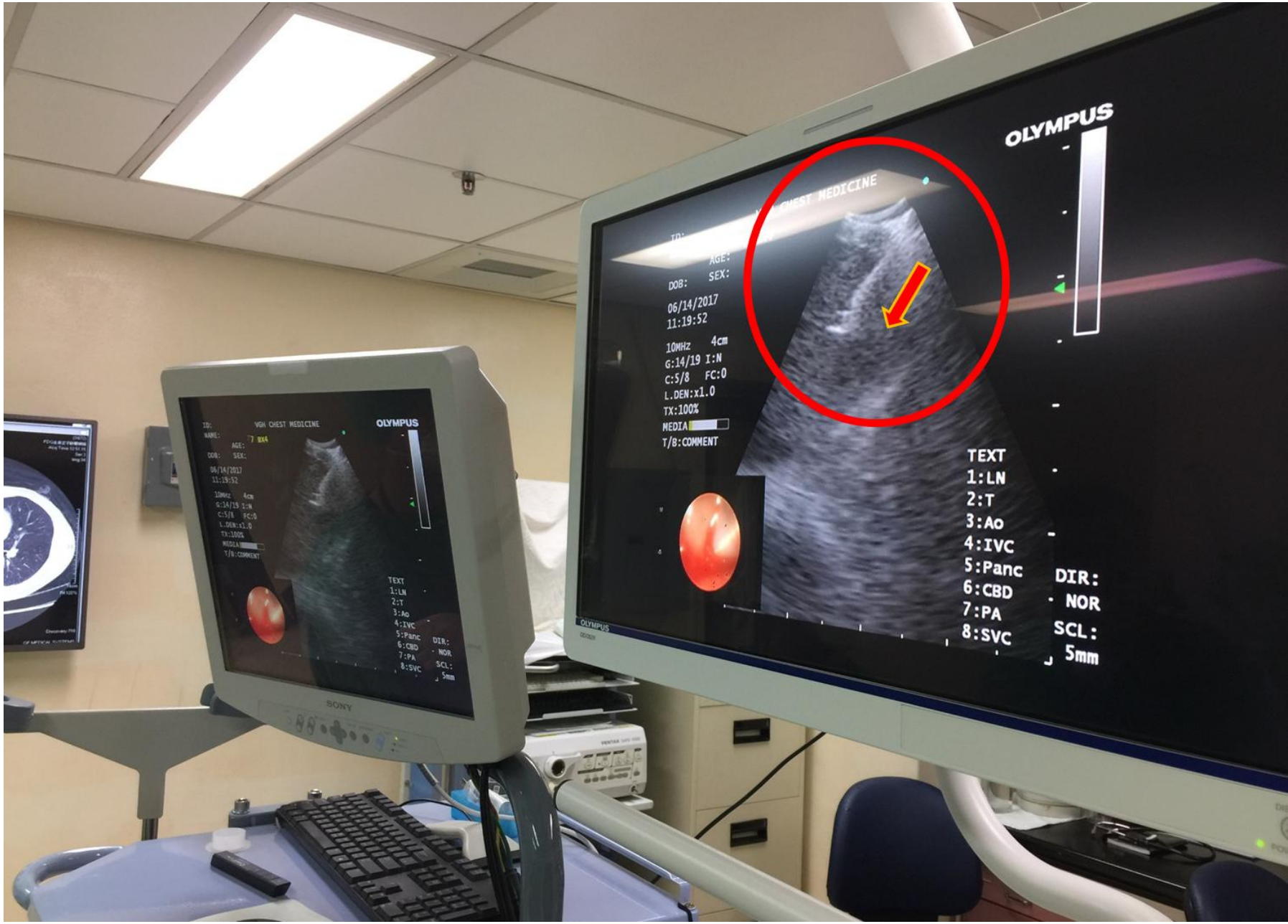
蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 6 :
The needle is advanced into LN using a quick jab



蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 7:
Visualized the needle entering the target node



蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 8:
Move the stylet in and out a few times to dislodge bronchial wall debris

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 9:
Remove the stylet

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 10:
The syringe is applied to the biopsy needle

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

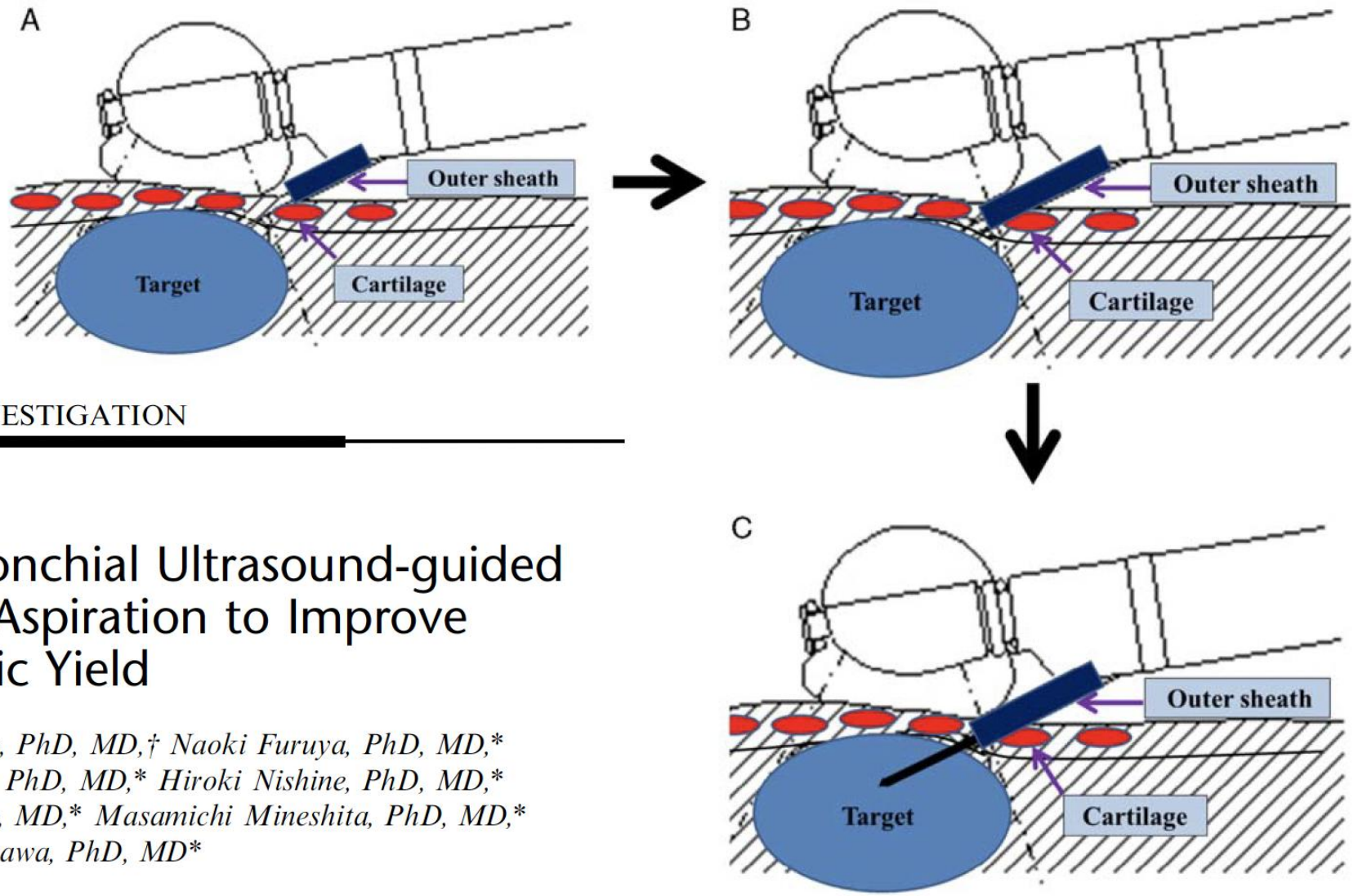
Step 11 :
Suction is applied at usually -20mL of air

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 12 :
Pass the needle in and out of the node 10-15 times

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Outer Sheath Method



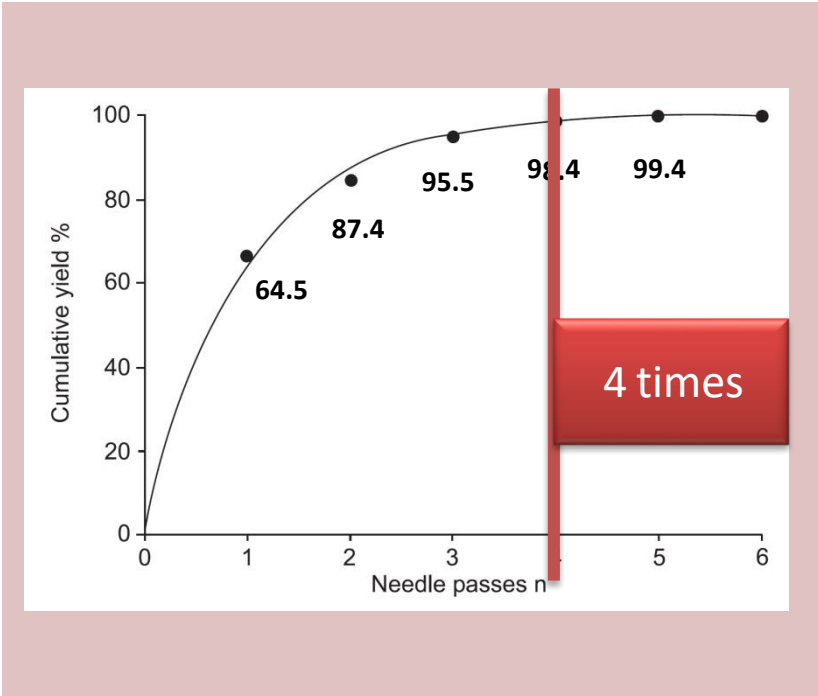
ORIGINAL INVESTIGATION

New Technique for Endobronchial Ultrasound-guided Transbronchial Needle Aspiration to Improve Diagnostic Yield

Takeo Inoue, PhD, MD, Noriaki Kurimoto, PhD, MD,† Naoki Furuya, PhD, MD,* Hiroshi Handa, PhD, MD,* Hirotaka Kida, PhD, MD,* Hiroki Nishine, PhD, MD,* Atsuko Ishida, PhD, MD,* Seiichi Nobuyama, MD,* Masamichi Mineshita, PhD, MD,* and Teruomi Miyazawa, PhD, MD**

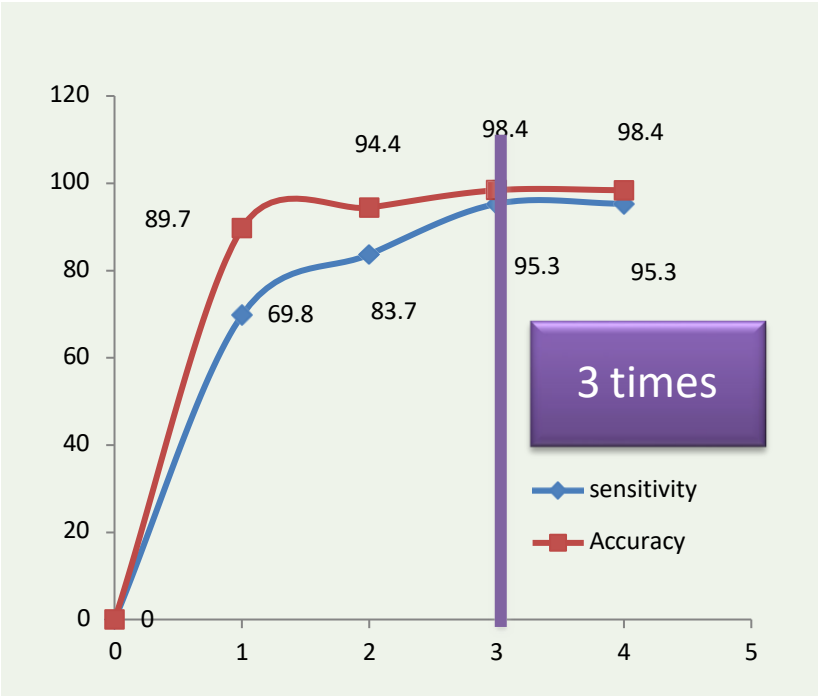
FIGURE 1. A, The convex probe is moved from side to side perpendicularly to the long axis of the bronchus to confirm the maximal cross-sectional area of the target lymph node and its puncture site. B, Puncture site between rings of cartilage is selected using the OSM to avoid puncturing tracheal or bronchial cartilage. The OSM involves pressing the outer sheath of the puncture needle gently against the bronchial wall immediately before puncture. C, Then moving the entire bronchoscope back up the wall and performing the puncture when the tip of the outer sheath of the puncture needle is caught in a concavity between 2 rings of cartilage. Once the outer sheath of the puncture needle is firmly held between 2 rings of tracheal and/or bronchial cartilage, the puncture needle is extruded. OSM indicates outer sheath method.

TBNA: How many passes per target site?



Eur Respir J 2007; 29: 112–116

Transbronchial needle aspirates: how many passes per target site?



CHEST 2008; 134:368–374

Real-time Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration in Mediastinal Staging of Non-Small Cell Lung Cancer*

How Many Aspirations Per Target Lymph Node Station?

How many back and forth movement of the need passes per lymph node?

EBUS-TBNA: Are Two Needle Revolutions (Back and Forth Movement of the Needle Inside the Lymph Node) Adequate for Diagnosis of Lung Cancer?

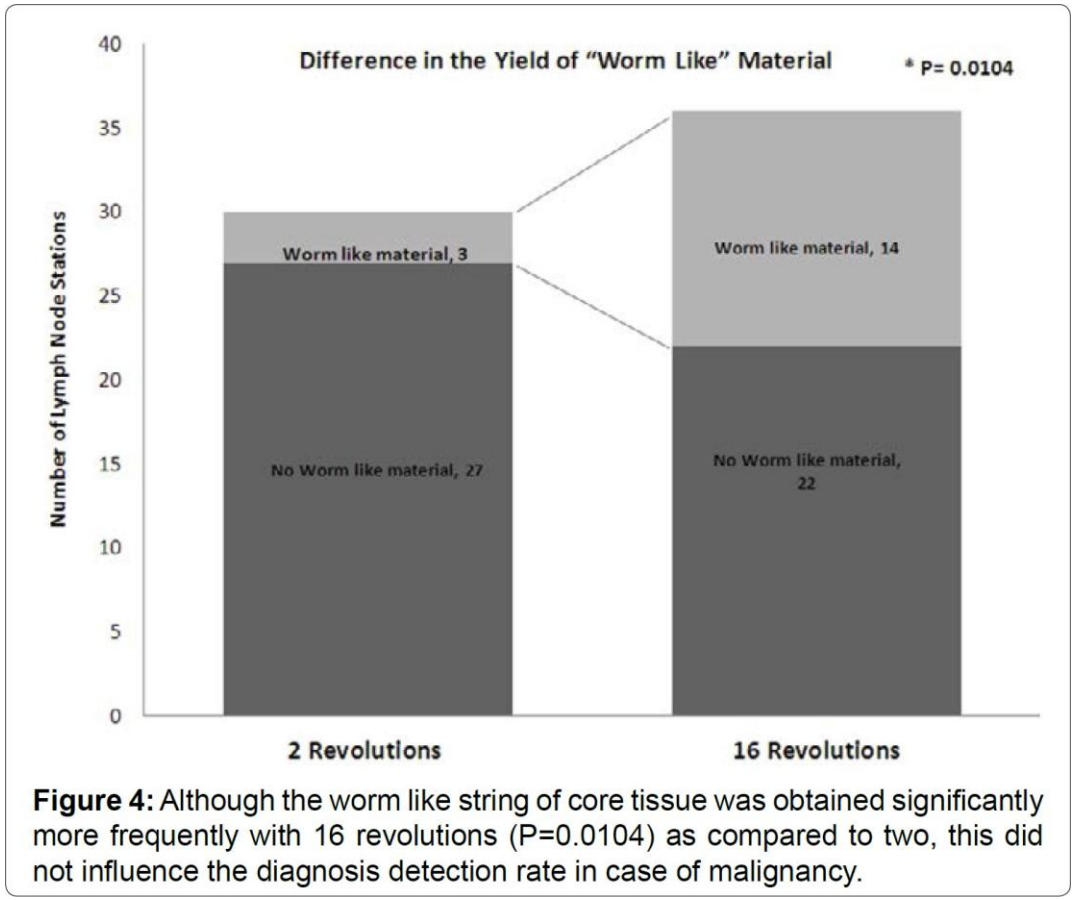


Figure 4: Although the worm like string of core tissue was obtained significantly more frequently with 16 revolutions (P=0.0104) as compared to two, this did not influence the diagnosis detection rate in case of malignancy.

- **Standard procedure：建議插10-20次**
- 當進針至Lymph node時，插2次與插16次，診斷率相近
- 插16次可以取得worm-like specimen的機會比較高
- 需要比較多的組織，或是benign的病灶，建議插15-20次
- 只要staging的病人，可以插2次

Verma et al., J Pulm Respir Med 2014, 5:1

Observational Study

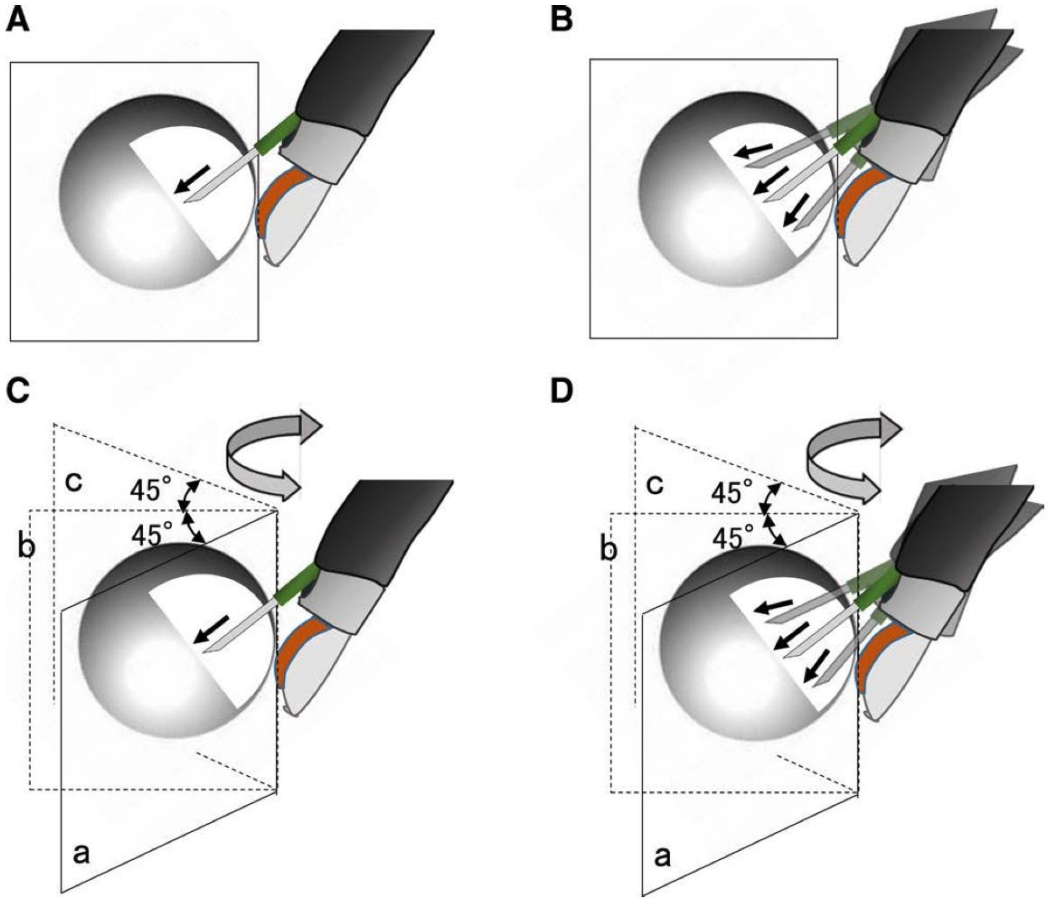
Medicine

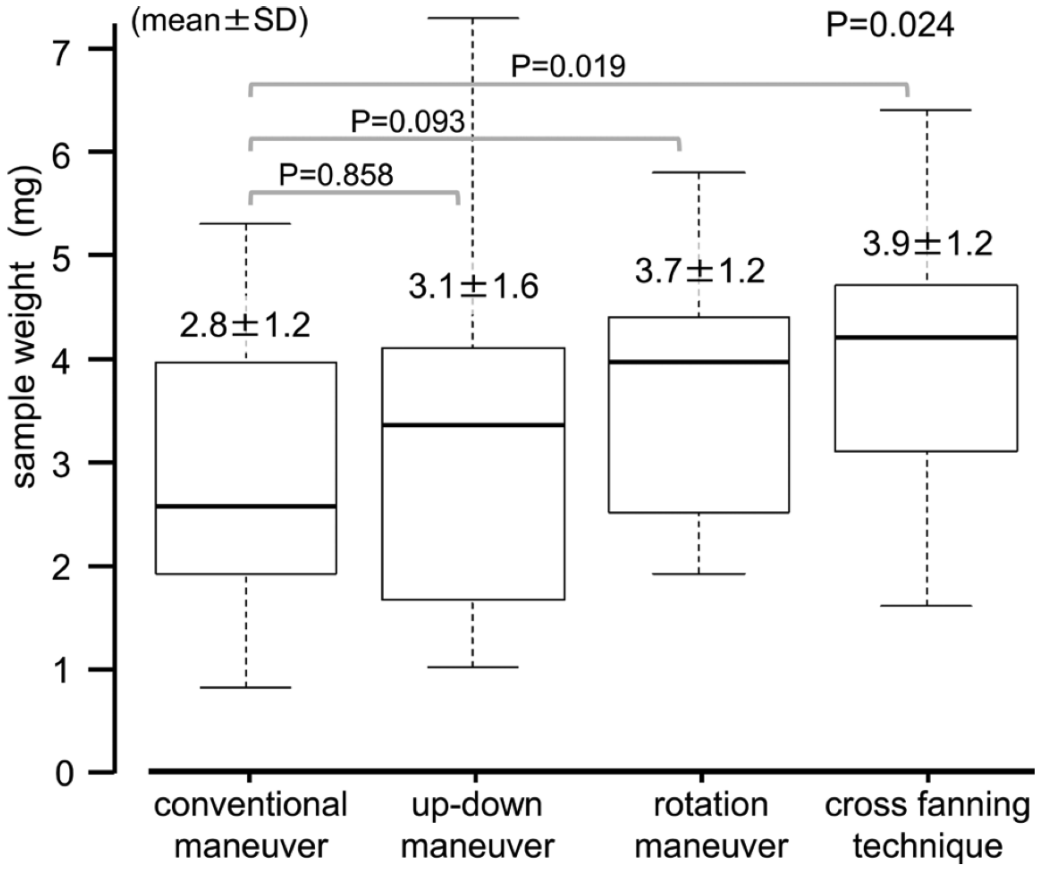
OPEN

Cross-Fanning Technique

Comparison of the harvest volume between maneuvers of endobronchial ultrasound-guided transbronchial needle aspiration including the "cross-fanning technique"

Yasuyuki Mizumori, MD[a,*], Yoshihiro Seri, MD[a], Katsuya Hirano, MD[a], Nobuya Hirata, MD[a], Masaki Takenouchi, MD[a], Shin Sasaki, MD[a], Yasuharu Nakahara, MD[a], Tetsuji Kawamura, MD[a]





TBNA: with and without aspiration?

Randomized Clinical Trial of Endobronchial Ultrasound Needle Biopsy With and Without Aspiration

Conclusions: **Regardless of LN size, no differences in adequacy, diagnosis, or quality were found between samples obtained using EBUS-TBNA and those obtained using EBUS-TBNCS. There is no evidence of any benefit derived from the practice of applying suction to EBUS-guided biopsies.**

- 有沒有使用negative suction對診斷沒有影響
- 有使用negative suction可能可以得到較大的組織
- 但使用negative suction可能會增加血液的contamination，使診斷困難度提高
- 血流量較高的組織，若要使用negative suction，建議negative pressure可以改為5或 10ml，使得抽吸到的血液減少。

CHEST 2012; 142(3):568–573

Contents lists available at ScienceDirect

Lung Cancer

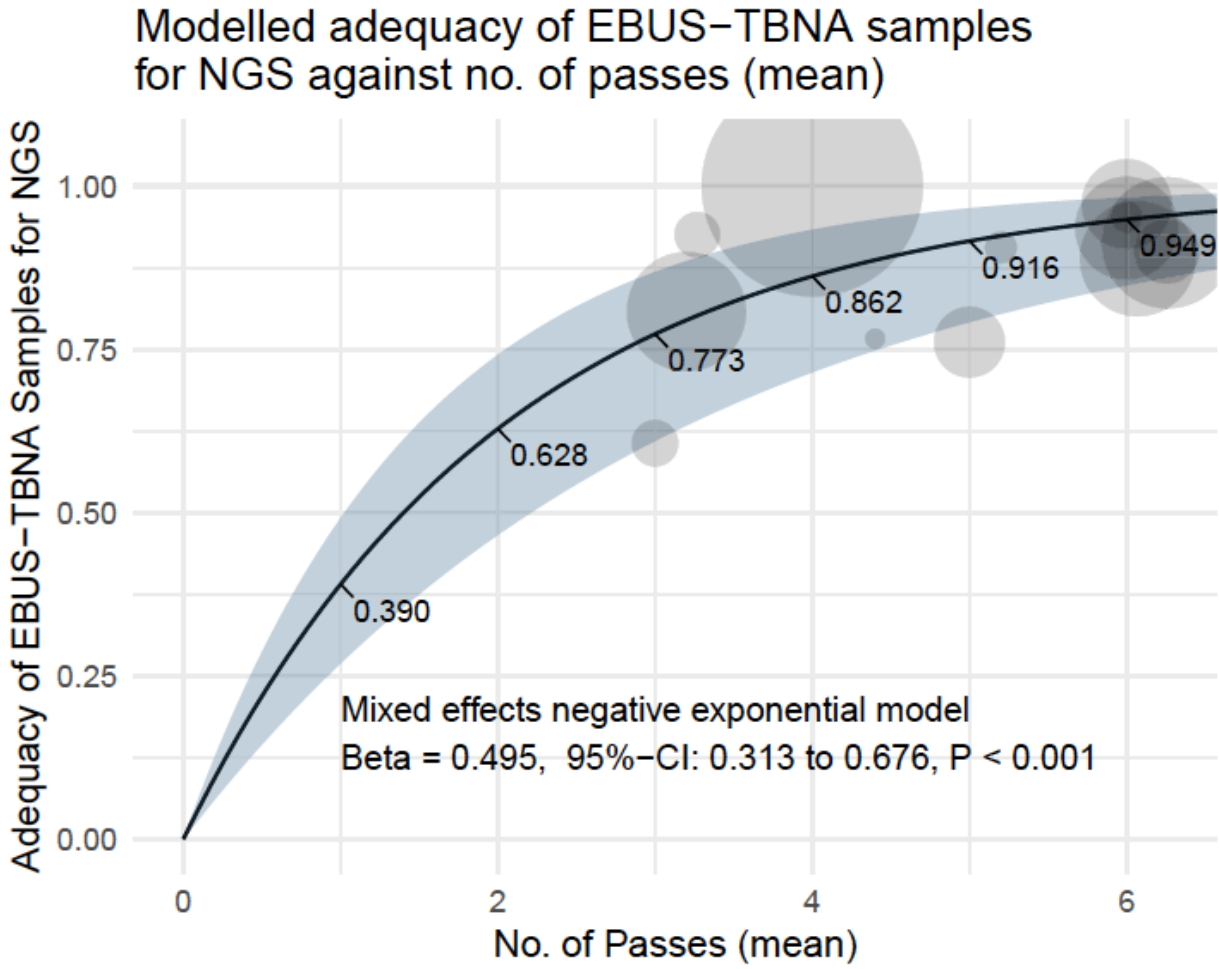
journal homepage: www.elsevier.com/locate/lungcan

A systematic review and *meta*-analysis of the adequacy of endobronchial ultrasound transbronchial needle aspiration for next-generation sequencing in patients with non-small cell lung cancer

Joseph J Zhao [a], Hiang Ping Chan [b], Yu Yang Soon [c], Yiqing Huang [d], Ross A Soo [d], Adrian C L Kee [a,b,e,*]

[a] Yong Loo Lin School of Medicine, National University of Singapore, Singapore
[b] Division of Respiratory & Critical Care Medicine, Department of Medicine, National University Hospital, Singapore
[c] Department of Radiation Oncology, National University Cancer Institute, Singapore
[d] Department of Haematology-Oncology, National University Cancer Institute, Singapore, Singapore
[e] National University Cancer Institute, Singapore

- 21 studies comprising 1175 patients were included.
- Proportion of adequate EBUS-TBNA samples for **NGS** increases as mean number of passes increases.
- Modelled yield rates were 77.3%, 86.2%, 91.6% and 94.9% at mean passes of 3, 4, 5 & 6 respectively.
- EBUS-TBNA based samples are suitable for NGS and the success of EBUS-TBNA sampling appears to be proportionate to the number of passes.



Zhao JJ, et al., Lung Cancer. 2022 Apr;166:17-26.

Needle Size

- No difference in diagnostic yield between 22G and 21G needle, however, 21G needle shows superior characterization in benign lesion or NSCLC

Jeyabalan A, et al., Respirology. 2014 Jul;19(5):735-9.

- No difference in diagnostic yield between 21G and 19G needle, however, 19G needles showed higher smear cellularity and ROSE evaluation adequacy.

Elmufdi FS, et al., J Bronchology Interv Pulmonol. 2021 Jan 1;28(1):29-33.

- No difference in diagnostic yield between 22G and 19G needle

Manley CJ, et al., J Am Soc Cytopathol. 2022 Mar-Apr;11(2):114-121.

- RCT with propensity score matching: no difference in diagnostic yield between 21/22G and 19G needle.

Romatowski NPJ, et al., Chest. 2022 Sep;162(3):712-720.

Suction Utilization

- No difference in specimen adequacy, diagnosis rate, or specimen quality regardless of node size

Casal RF, Chest. 2012;142(3):568-573.

- Utilization of high-pressure suction (40kPa) did not impact the diagnostic yield; however, high-pressure suction was associated with bigger samples (11.2 vs. 9.1 mm3, p = 0.036) and fewer additional procedures (3.8% vs. 17.5%, p = 0.042), when compared to standard vacuum syringe suction.

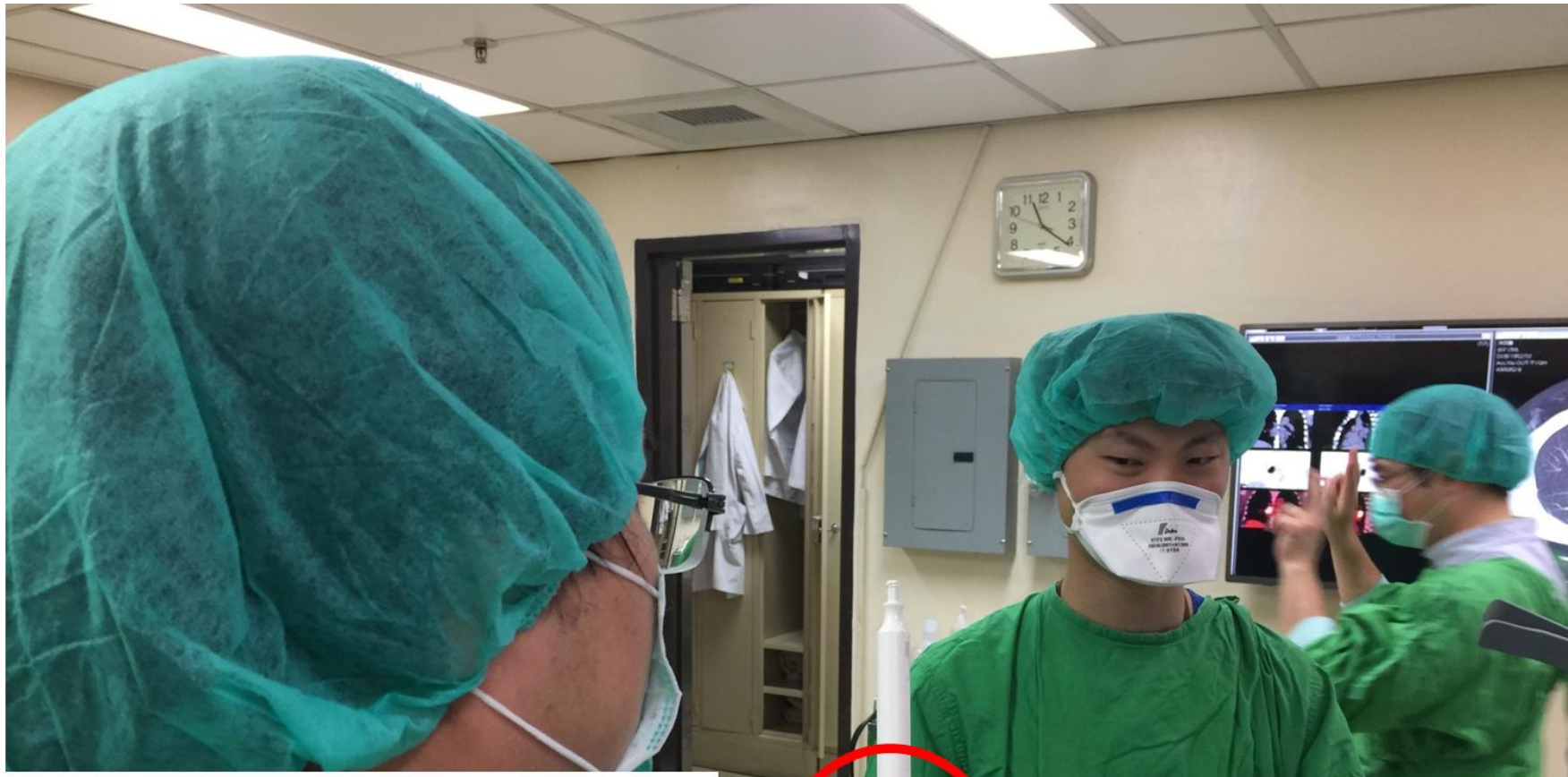
Tsaknis G, et al., J Bronchology Interv Pulmonol. 2022 Apr 1;29(2):115-124.

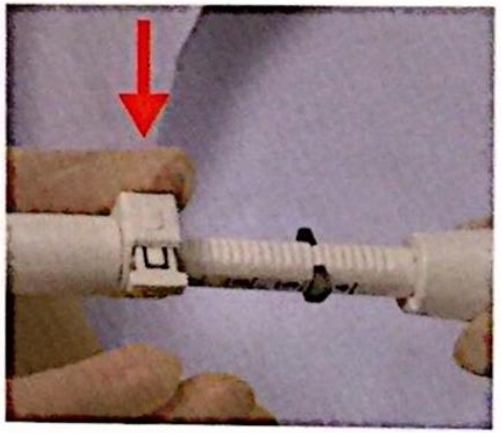
Step 13 : Suction is then released

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

長庚 高雄

Step 14 : Retract the needle into the sheath





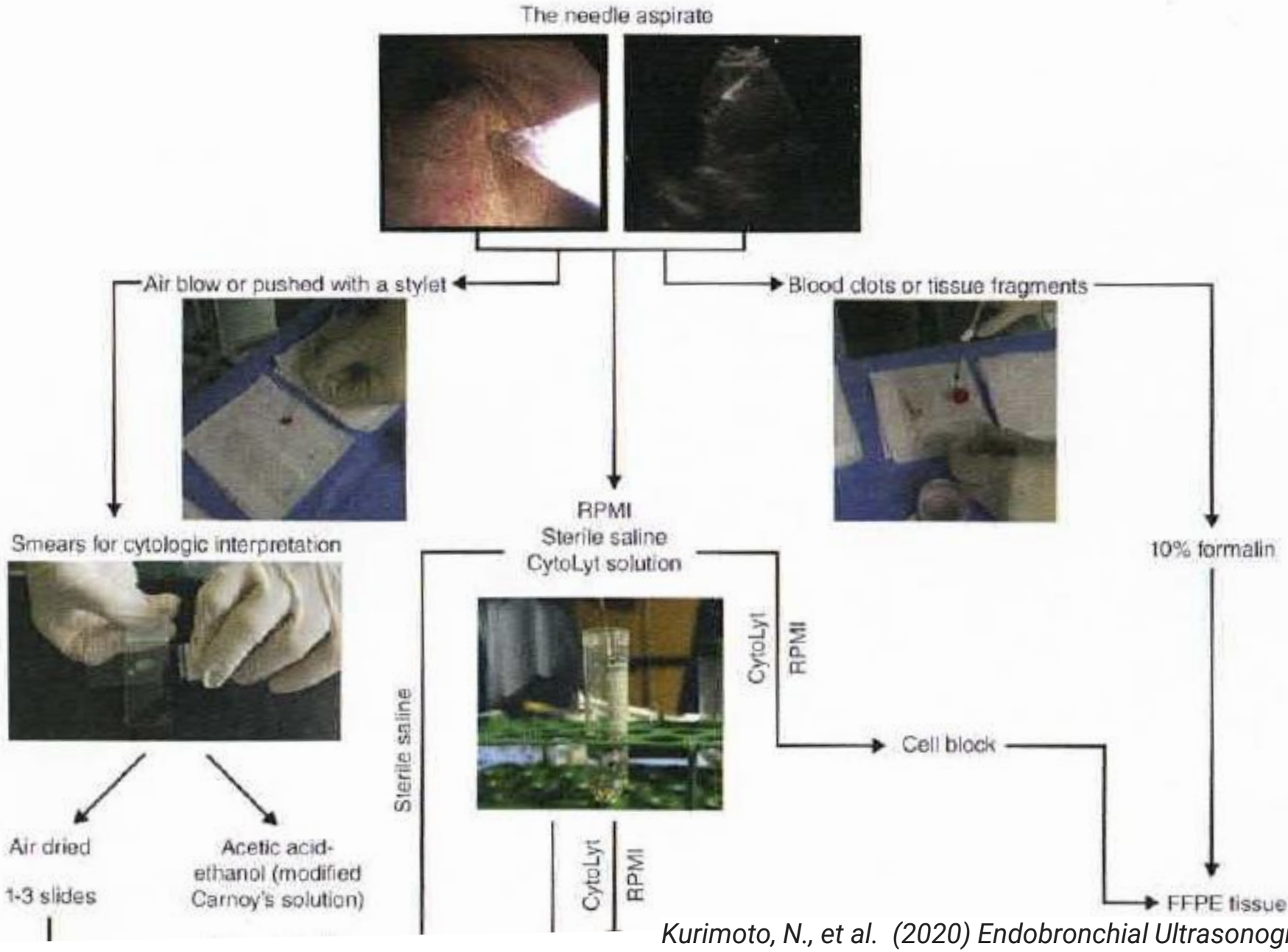
蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Step 15 :The needle housing is unlocked, and the needle and the sheath are removed together

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Specimen collection

- Microbiology
- Tissue
- Cytology
- Cell block



Kurimoto, N., et al. (2020) Endobronchial Ultrasonography (2nd ed.) Wiley

出針至 1-2cm，

將針尖置於載玻片上，

慢慢放入stylet探針 ，

將標本推送至載玻片上

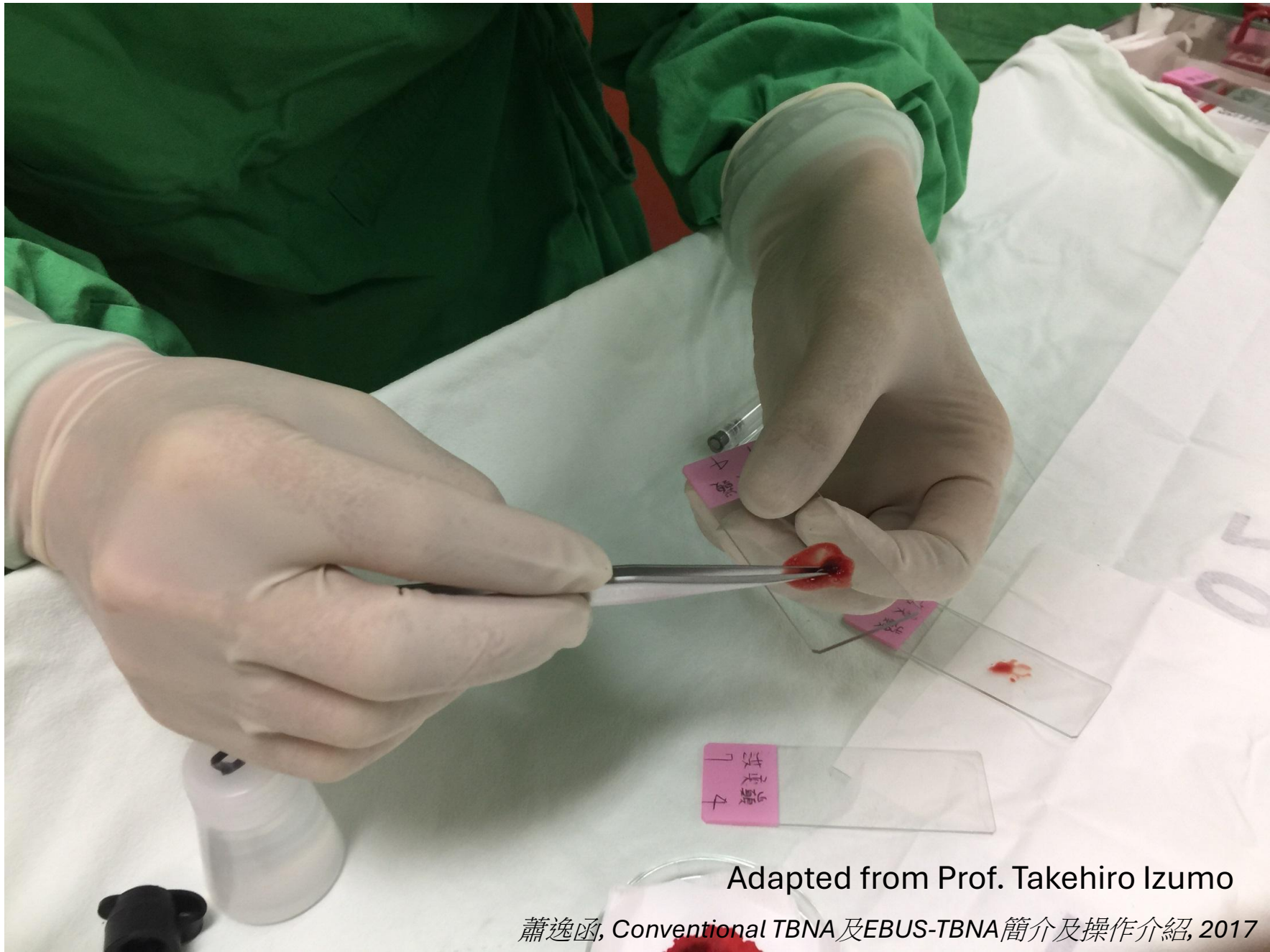
Adapted from
Prof. Takehiro Izumo

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

利用鑷子拿起組織標本，

放置在濾紙上，

在福馬林中固定



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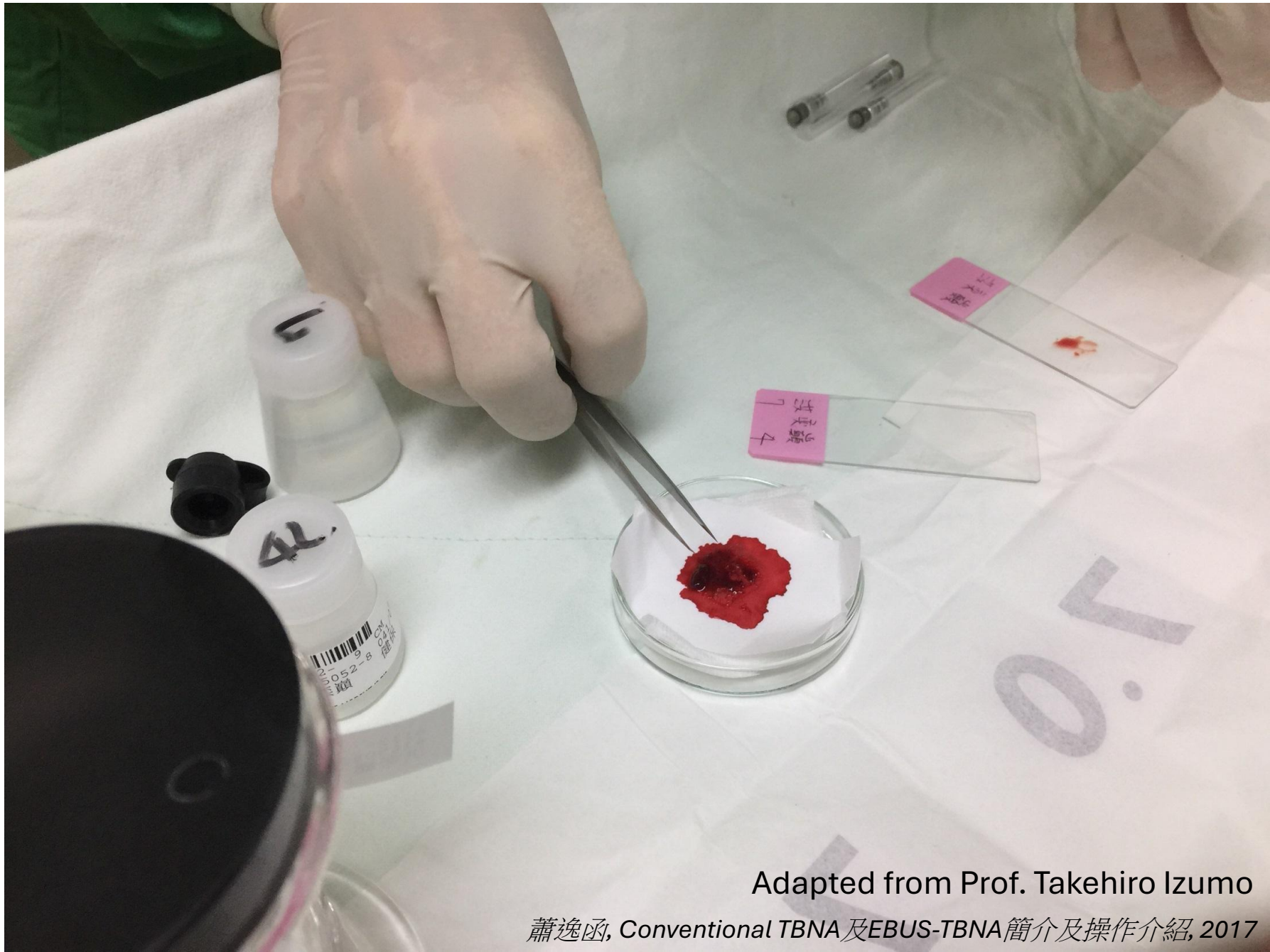

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蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

用10c.c.空針抽空氣，
用力迅速將針桶內殘留的
組織推到另一載玻片上

Adapted from
Prof. Takehiro Izumo

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

與另一片載玻片對抹，
其中一片用 95%酒精濕法固定
(for Papanicolaou stain)，
另一片可在現場以Liu stain做
on-site 細胞學檢查 (ROSE)22

Adapted from Prof. Takehiro Izumo

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

利用2-3mL生理食鹽水
沖洗穿刺針針腔以製備
液基細胞學檢查及
細菌培養標本

Adapted from
Prof. Takehiro Izumo

蕭逸函, Conventional TBNA及EBUS-TBNA簡介及操作介紹, 2017

Rapid On-Site Evaluation, ROSE

- Jain et al. reported ROSE dose not adversely affect aspiration number, procedure time, or complication rate.

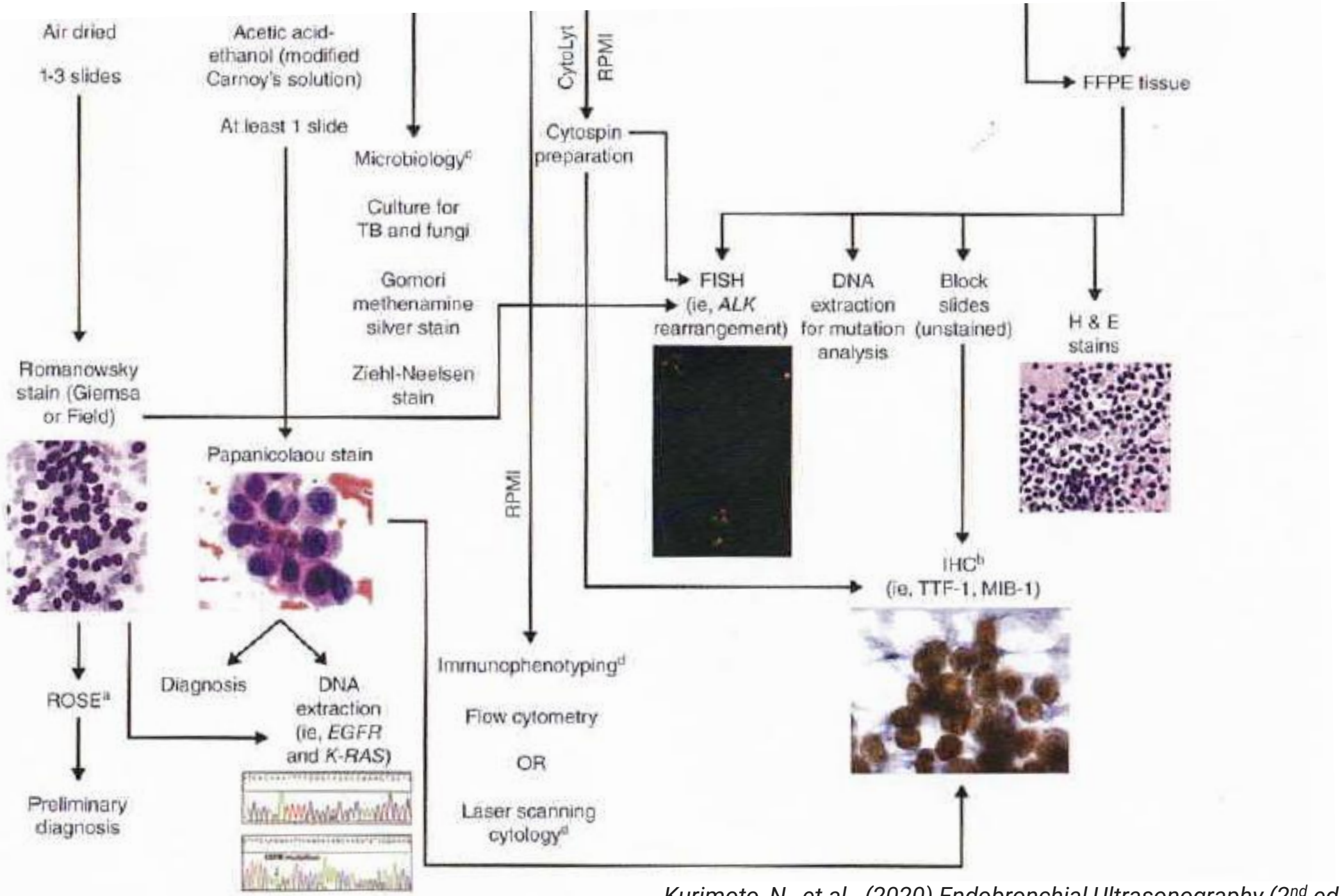
Jain D, et al., Arch Pathol Lab Med. 2018 Feb;142(2):253-262.

- ROSE significantly reduced the requiring of needle passes to make diagnosis.

Oki M, et al., Respiration. 2013;85(6):486-92.

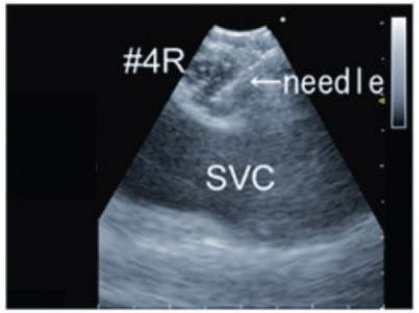
- ROSE reduced the need for repeat diagnostic procedures to obtain additional material for genetic testing.

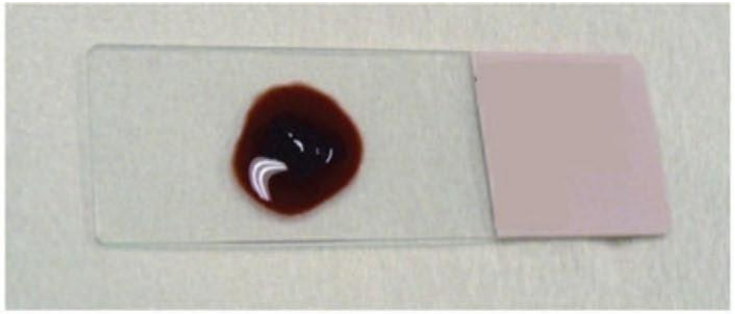
Trisolini R, et al., Chest. 2015 Dec;148(6):1430-1437.



Kurimoto, N., et al. (2020) Endobronchial Ultrasonography (2nd ed.) Wiley

Specimen management





air-dry

- Diff-Quick®
- Giemsa

95% ethanol

- Papanicolaou

saline

- Microbiology
- Cell block
- Flow cytometry
- DNA/RNA

10% formalin

- Histology
- IHC
- FISH
- DNA/RNA

storage in -80°C

- DNA/RNA
- Protein

EBUS-TBNA with Genetics Testing

- One meta-analysis reported the adequacy of EBUS-TBNA to evaluate EGFR and ALK mutations was feasible in 94.5% (28 studies, n = 2497 patients) and 95% of the patients (12 studies, n = 607), respectively

Labarca G, et al., Ann Am Thorac Soc. 2018 Oct;15(10):1205-1216.

- PD-L1 testing on EBUS-TBNA or other tissue specimens may provide differing results, as shown by the concordance rates ranging between 69.8% and 91.3%

Jug, R., et al., J. Am. Soc. Cytopathol. 2020, 9, 485-493
Toshimura, K., et al., Lung Cancer 2019, 134, 202-209
Sakata, K.K., et al., Chest 2018, 154, 827-837

Compare Deep and Moderate Sedation

- No significant difference in diagnostic rate, complication rate, patient comfort and satisfaction.
- Cough is more common in moderate sedation and deep sedation require more vasopressor for medication-induced hypotension

Aswanetmanee, P., et al., Endoscopic Ultrasound 5: 300-306

Complication

- Major bleeding
- Pneumothorax
- Mediastinal abscess
- Mediastinitis
- Esophageal rupture

THANK YOU FOR YOUR ATTENTION