

支氣管鏡及EBUS概論

臺北榮民總醫院 胸腔部

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2026/08/29



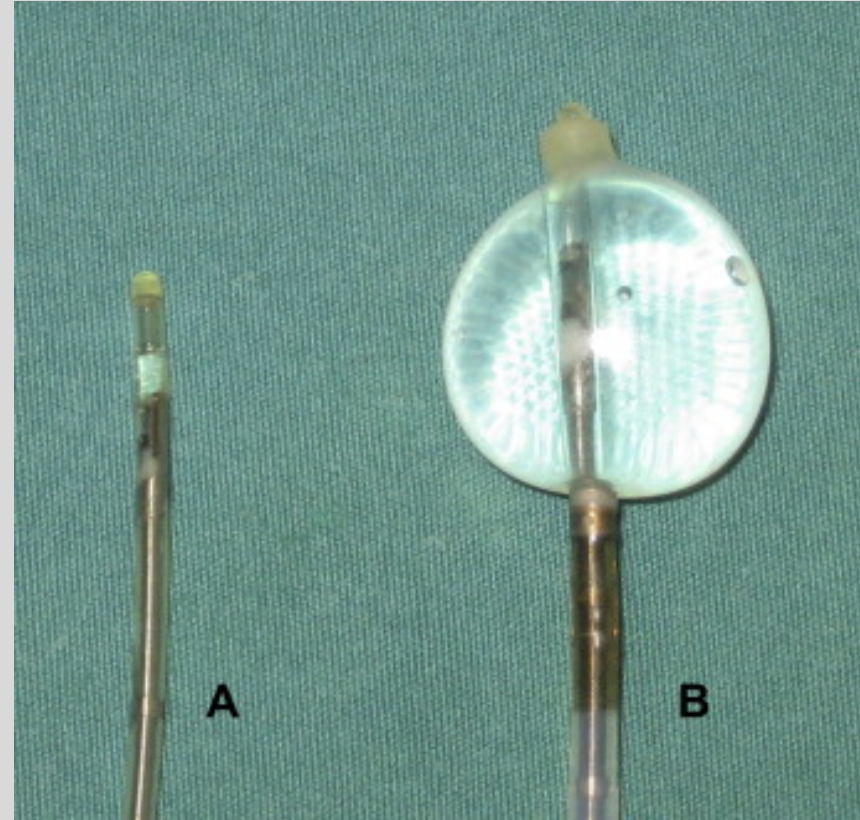
Outline

- Background introduction : Rp-EBUS and Cp-EBUS
- Procedure details of Rp-EBUS
- Procedure details of Cp-EBUS-TBNA



Introduction

- EBUS is available in 2 types of transducers: radial EBUS and convex EBUS–TBNA.
- First introduced in 1992
- Diagnostic tool for lung cancer and staging



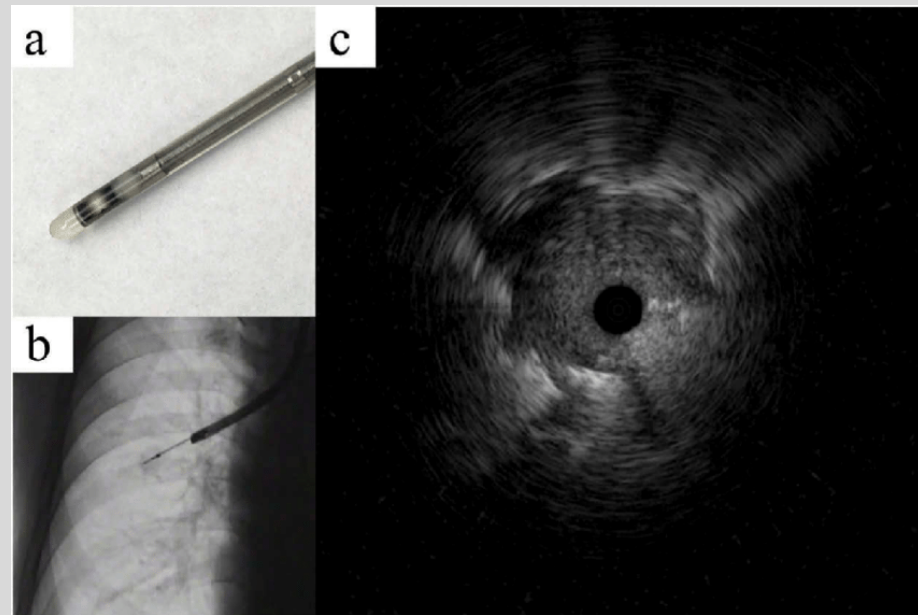
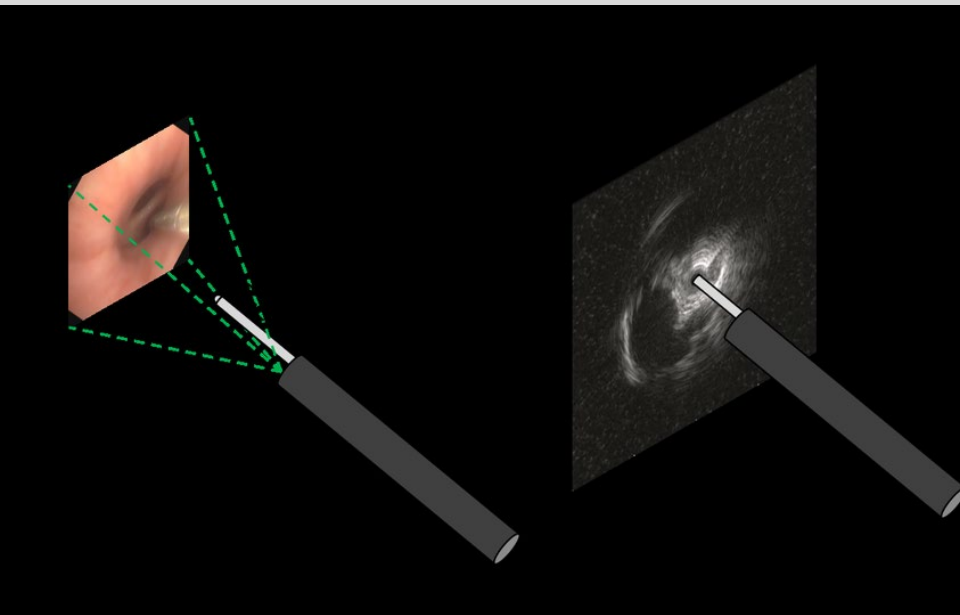
A: 'Peripheral' probe that utilizes guide sheaths without balloons to locate peripheral lung lesions.

B: 'Central' probe that employs balloon sheaths to assess airway walls and identify lymph nodes.



Two types of Endobronchial Ultrasonography (EBUS)

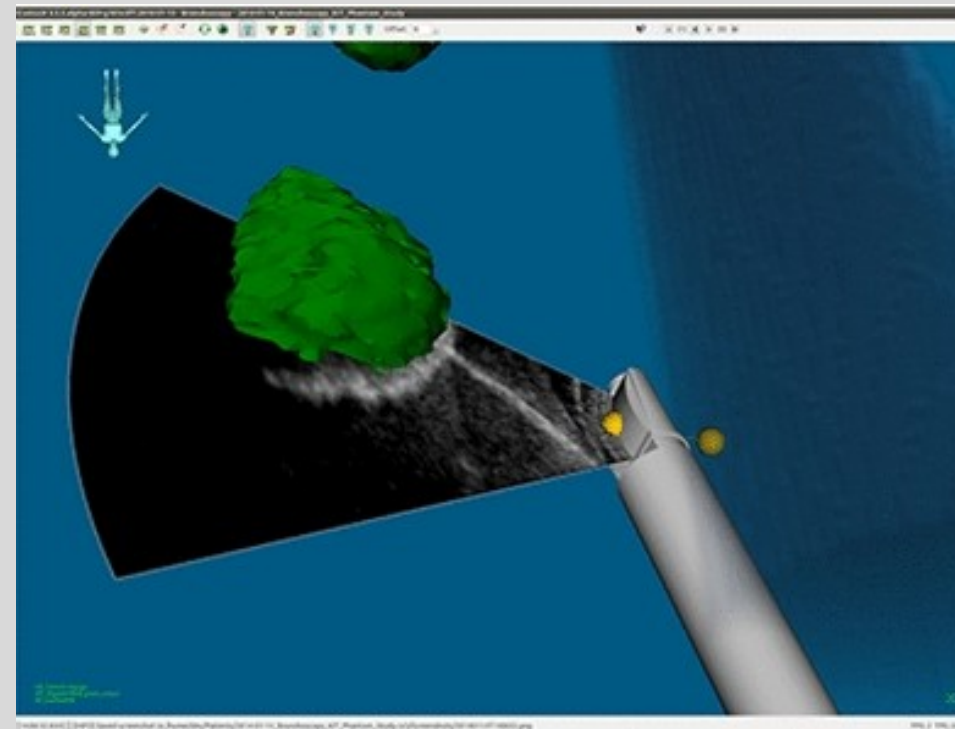
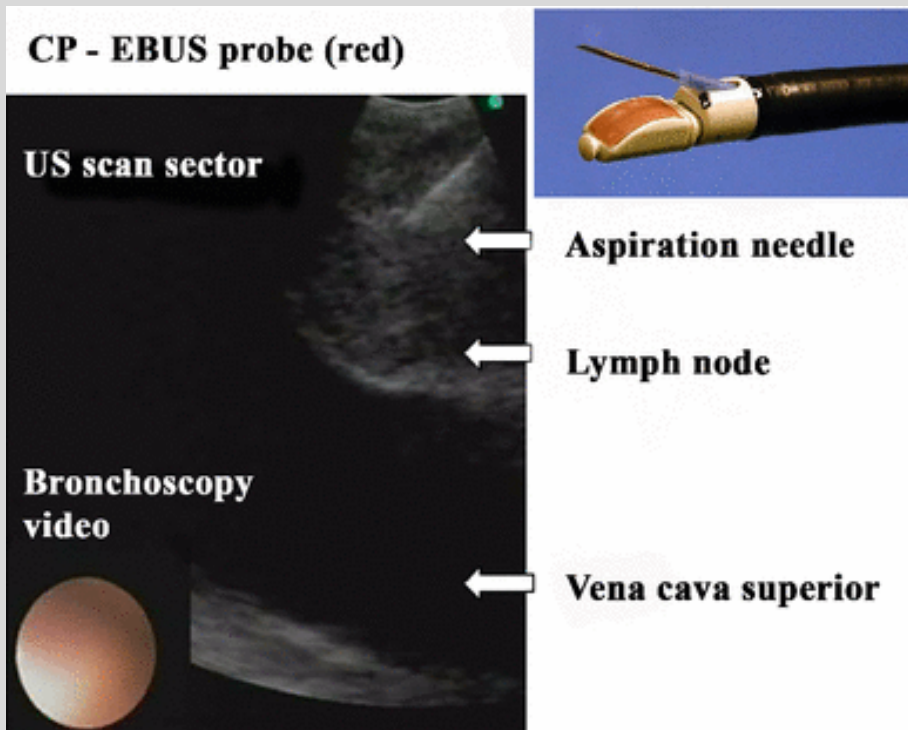
- Radial probe (RP-EBUS)
 - 20MHz
 - Provides a tissue cross-section image with a radius of about 2-3 cm





Two types of Endobronchial Ultrasonography (EBUS)

- Convex probe (CP-EBUS)



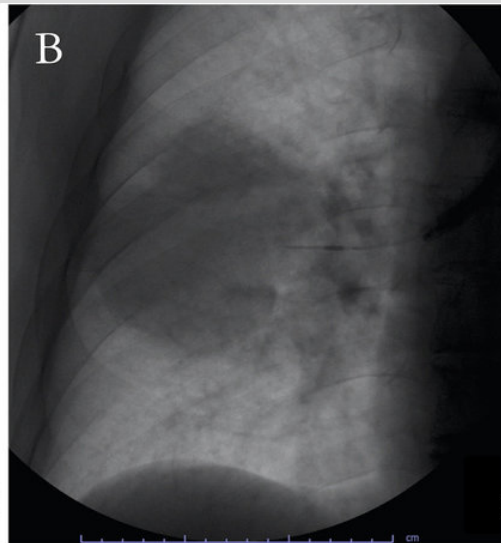
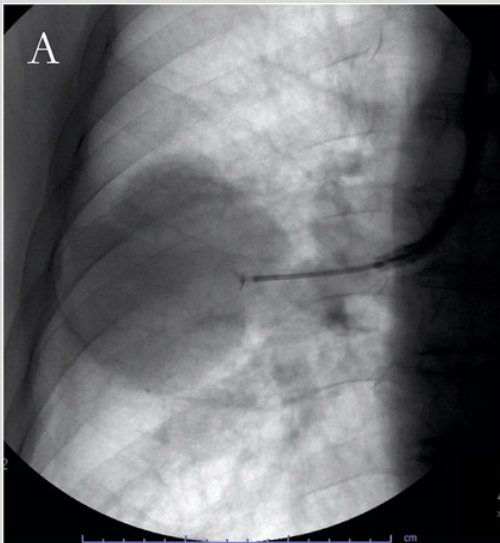
Radial Probe of EBUS





Peripheral intrapulmonary lesions

- Transbronchial biopsy often performed for peripheral intrapulmonary lesions
- Percutaneous needle biopsy:
 - pneumothorax, air embolism, tumor seeding



Chest 2000;118;1630-1638
Pulmonology, 28(6), 461-471
Diagnostics 2022, 12, 359.



EBUS-TBB vs. TBB

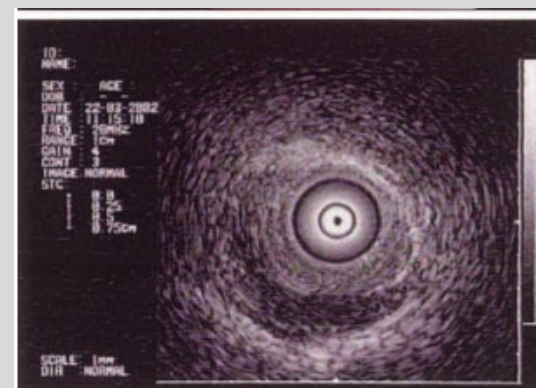
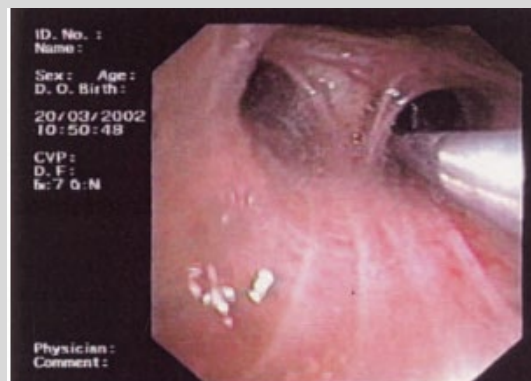
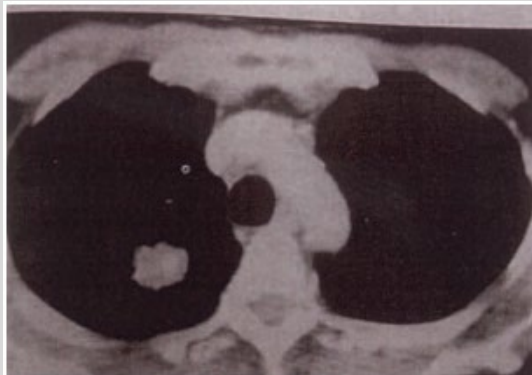
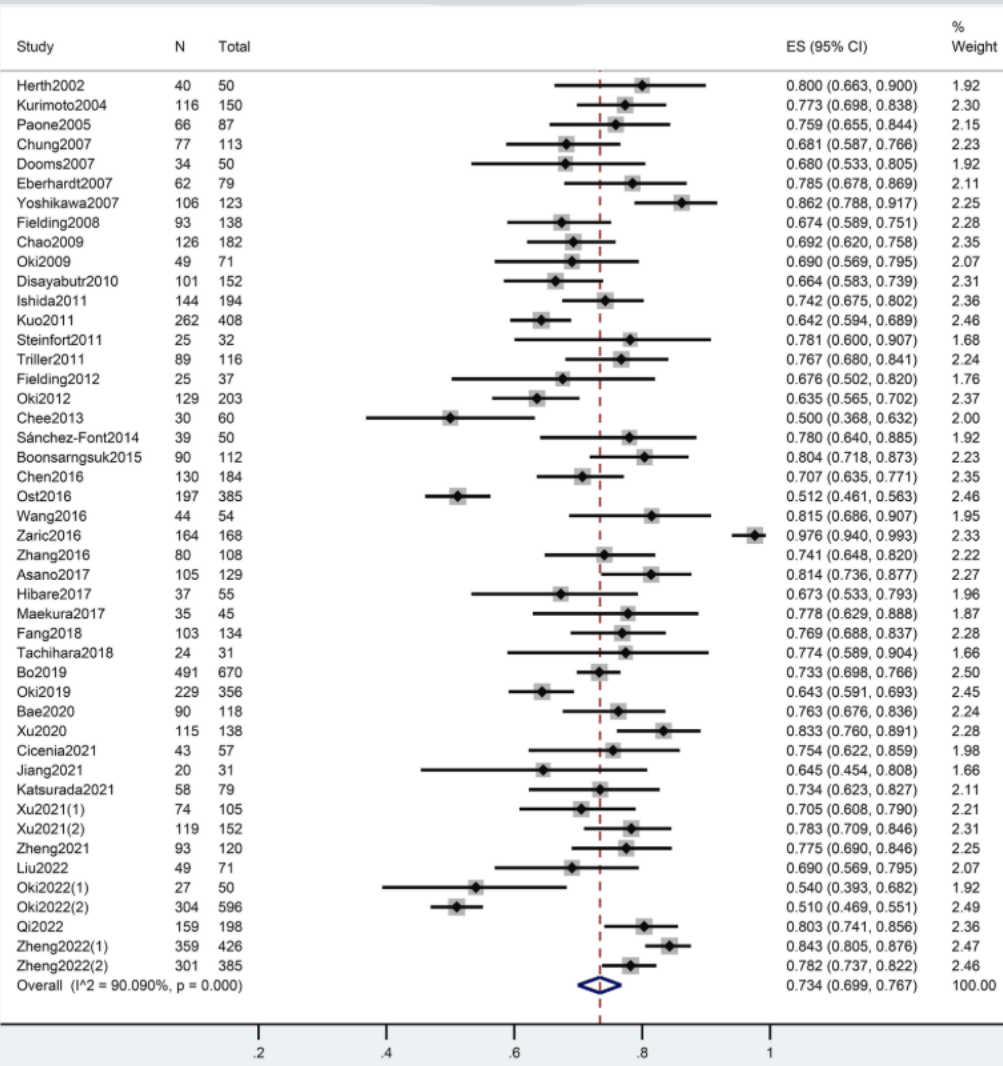


Table 5—Comparison Between Sensitivity, Specificity, Predictive Values, and Accuracy Observed in a Subset of Study and Control Groups: Patients With Lesions ≤ 2 Cm in Diameter*

Variables	EBUS-TBB (n = 25)	TBB (n = 31)	p Value
Sensitivity	71 (47–95)	23 (3–43)	< 0.001
Specificity	100	100	NS
NPV	73 (46–100)	52 (3–100)	0.18
PPV	100	100	NS
Accuracy	84 (12–65)	58 (40–75)	0.07



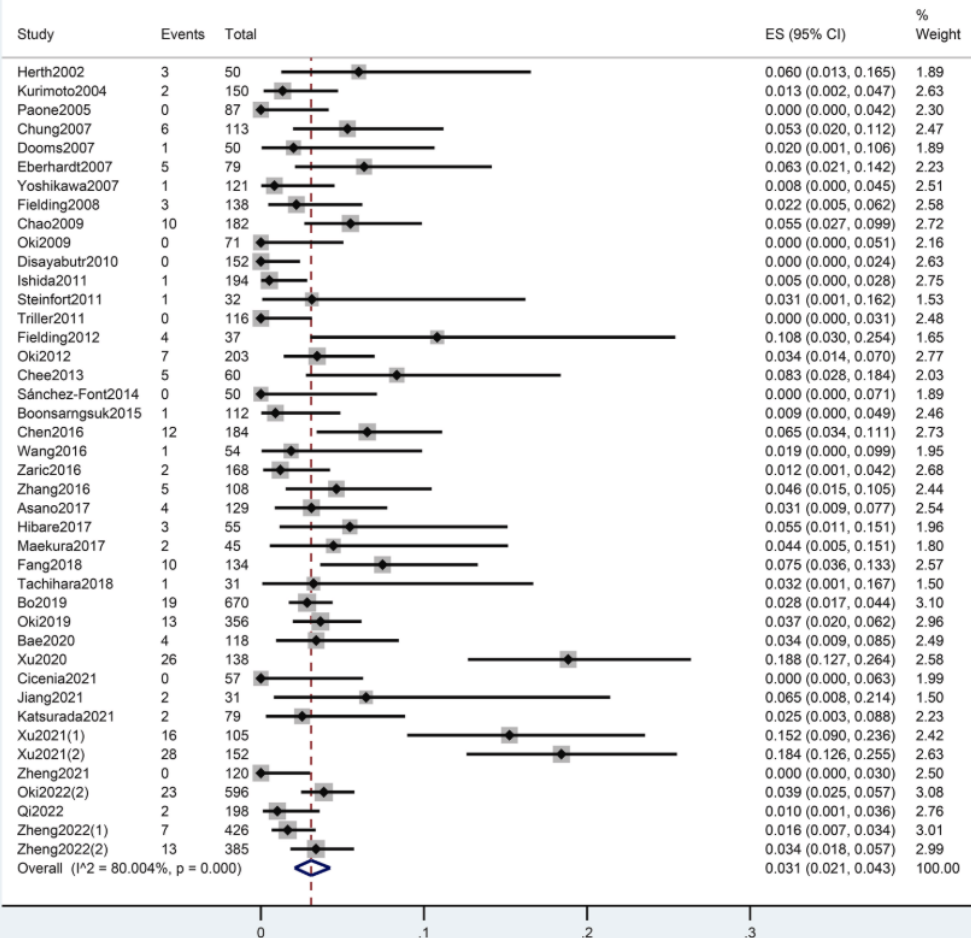
Peripheral intrapulmonary lesions



A pooled (46 selected studies) diagnostic yield of 73.4 % (95 % CI: 69.9%–76.7 %), with significant heterogeneity detected among studies ($I^2 = 90 \%$, $P < 0.001$).



Peripheral intrapulmonary lesions



A total of 314 complications in 6407 procedures were reported in 43 studies.

The pooled complication rate was 4.2 % (95 % CI: 2.4%–6.5 %).

PTX: pooled incidence rate was 0.4 % (95 % CI: 0.1%–0.7 %)

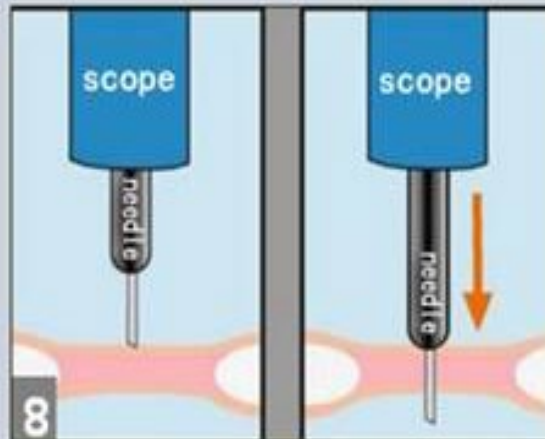
Moderate and severe bleeding, the incidence rate was 1.1 % (95 % CI: 0.5%–2.0 %)



RP-EBUS Protocol

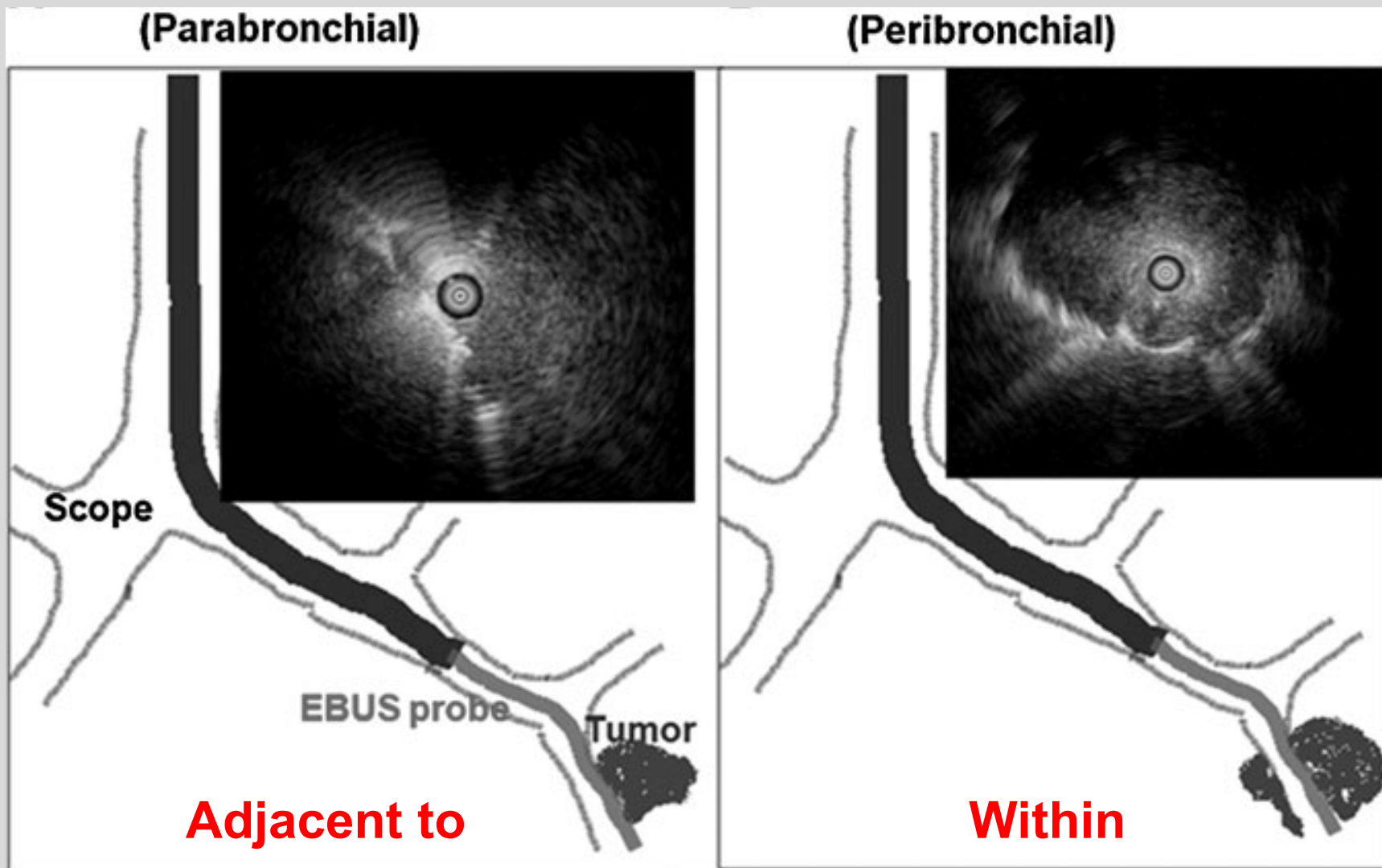
- CT bronchogram
- 將 **EBUS** 探頭推進至操作者感覺到阻力的位置。
- 一邊回拉探頭一邊掃描，以取得 **EBUS** 影像。
- 紀錄自支氣管開口至周邊肺病灶的探頭插入距離，作為後續TBB forceps插入距離的參考。

Step 3 Puncture





The Location of the Probe



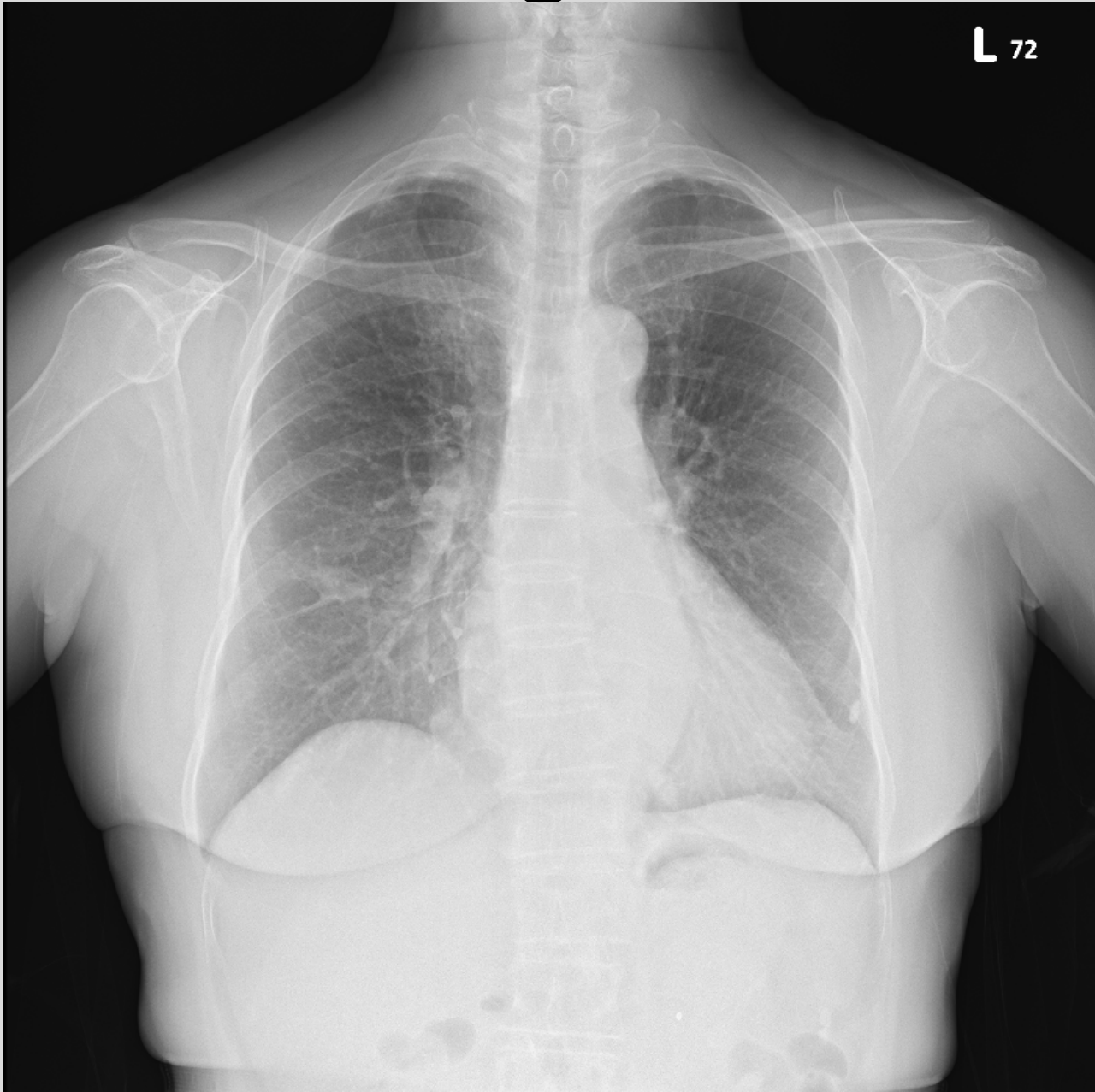


Case Sharing

- 74/F
- PHx:
 - Primary open angle glaucoma OU s/p Trabeculectomy + MMC soaking OD on 20140904, s/p MMC bleb knife revision OD on 20180301
- CC: Admitted for abnormal CXR and chest CT
- Non-smoker

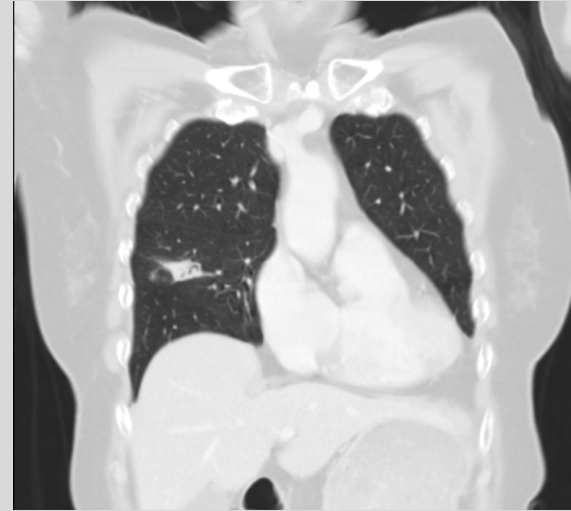
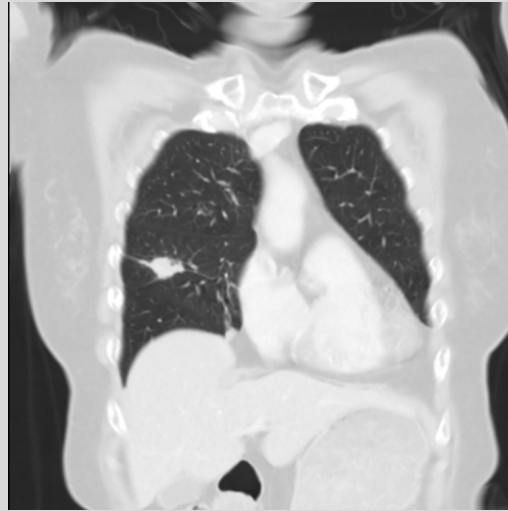
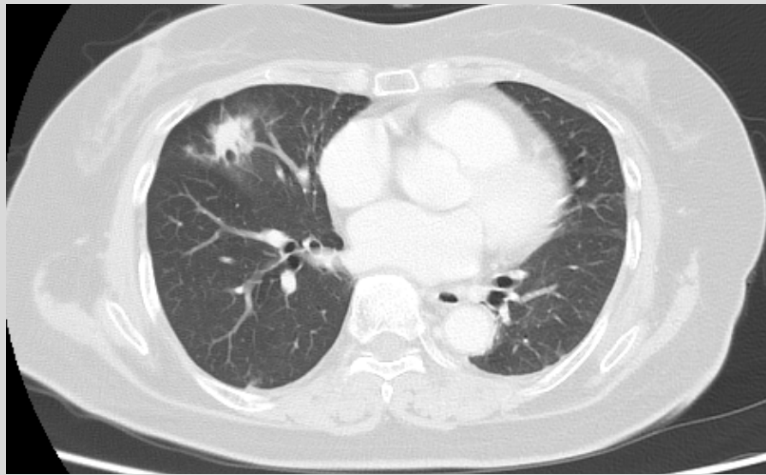
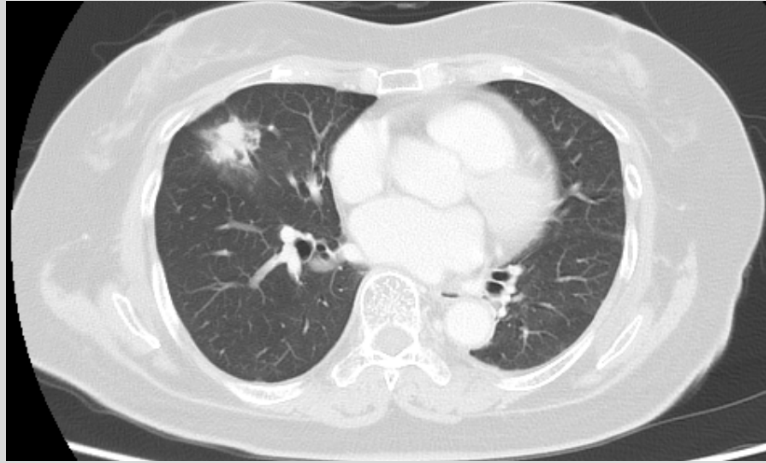


Case Sharing



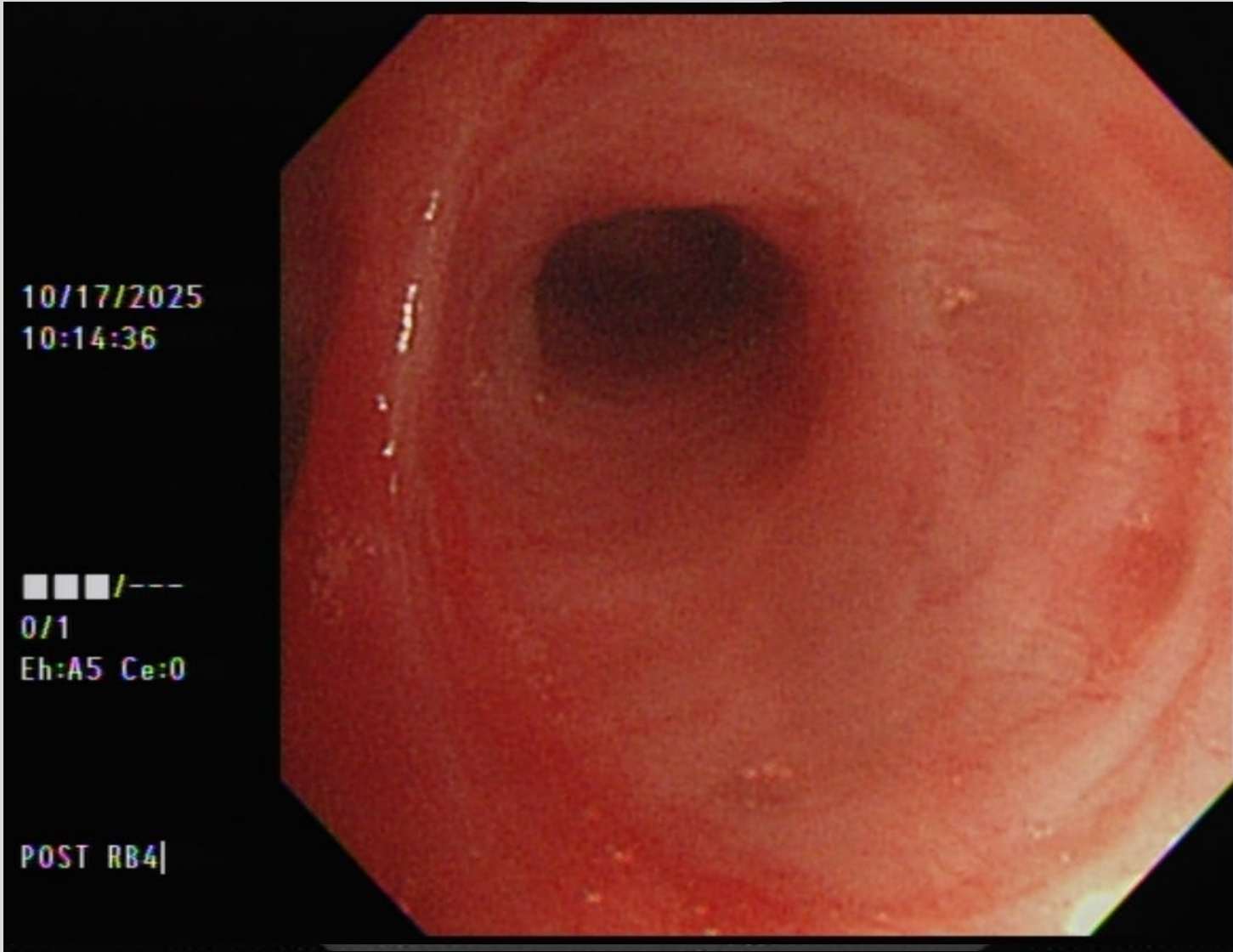


Case Sharing





Case Sharing





Case Sharing

檢體 :

(Specimen type)

Imprint(Bronchia (RB4)

醫囑名稱 :

(Medical order)

IMPRINT CYTOLOGY

Adenocarcinoma

BRONCHIAL. IMPRINT , RML B4

PATHOLOGICAL DIAGNOSIS:

Lung, RB4, bronchoscopic biopsy

--- Adenocarcinoma

GROSS FINDING:

1. Fixation: formalin

2. Specimen number: 7 pieces

3. Specimen size:

--- In total: 0.9 x 0.2 x 0.1 cm

--- The largest: 0.3 x 0.2 x 0.1 cm

4. Specimen appearance: tan, soft

The entire specimen is embedded in one block. (SCW)

Immunostain for TTF-1 is done on block A.

MICROSCOPIC FINDING:

Sections show lung tissue with non-mucinous adenocarcinoma cells in acinar and micropapillary growth patterns.

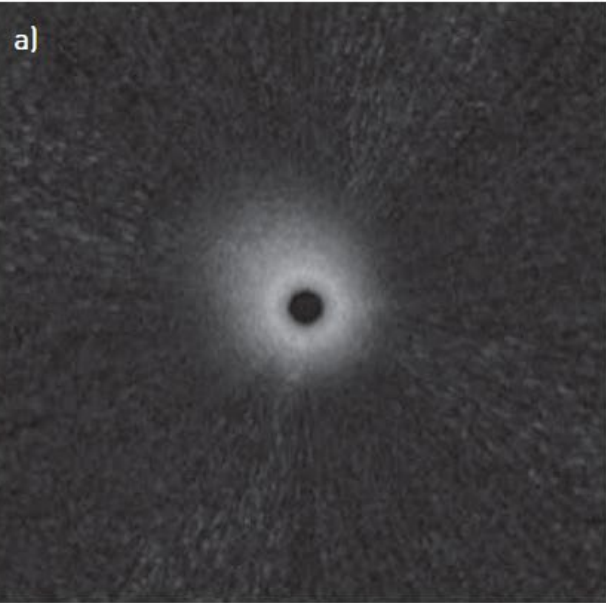
The tumor cells are positive for TTF-1.

Based on the pathological findings, the tumor is compatible with adenocarcinoma of lung origin.

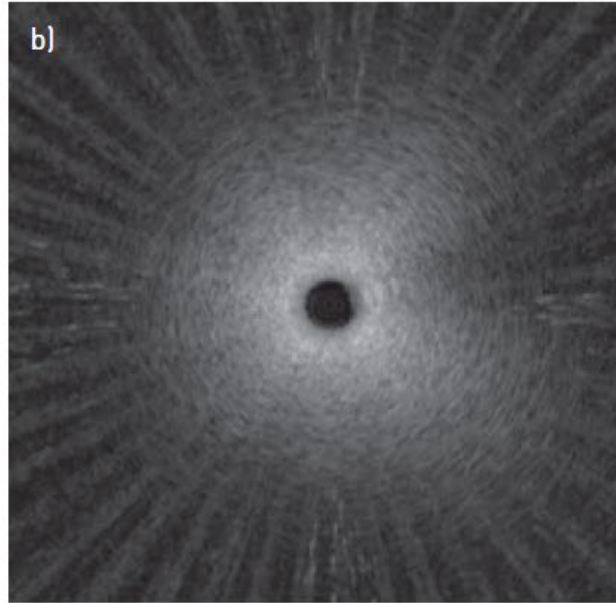
Other Applications of RP-EBUS



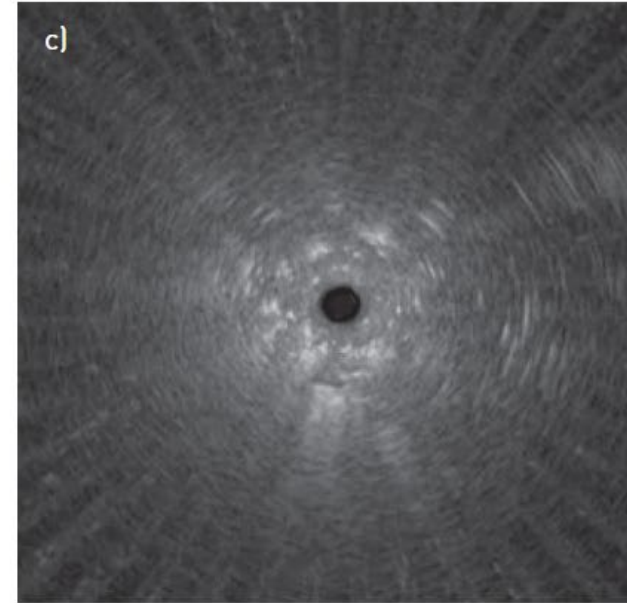
RP-EBUS for GGO lesions



Normal lung



Blizzard sign

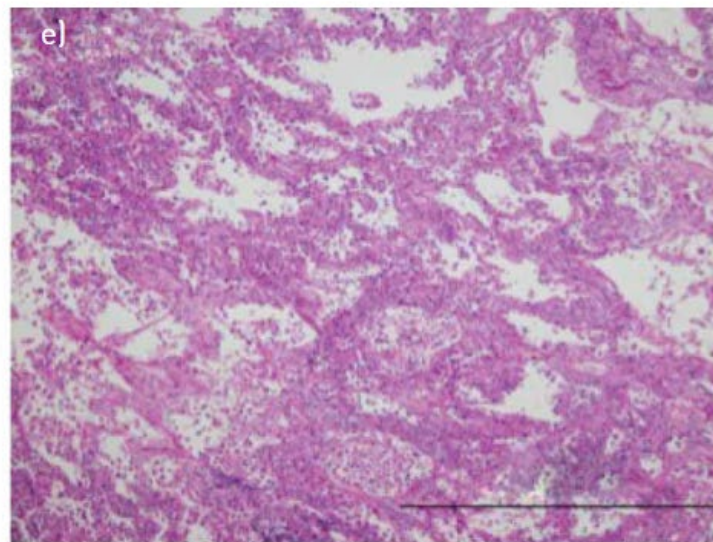
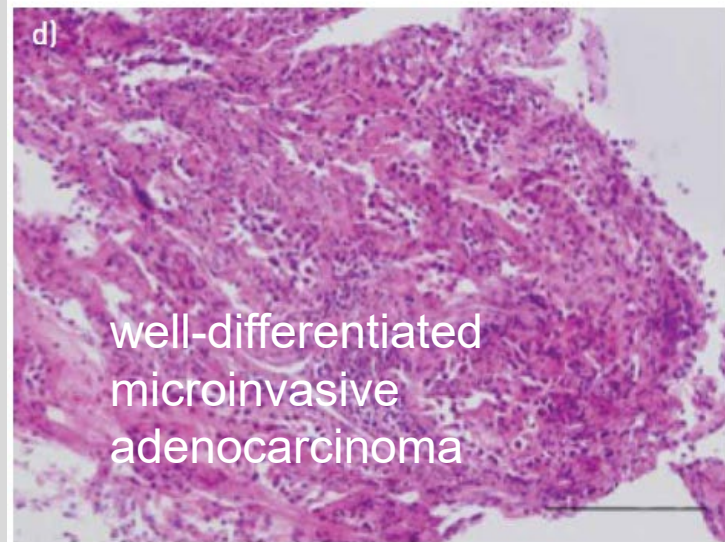
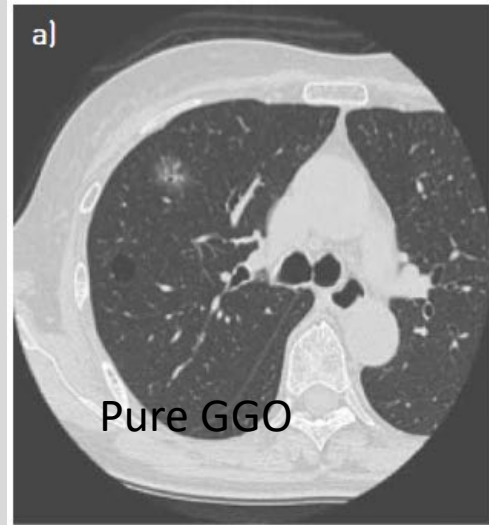


Mixed blizzard sign

Mixed blizzard sign:

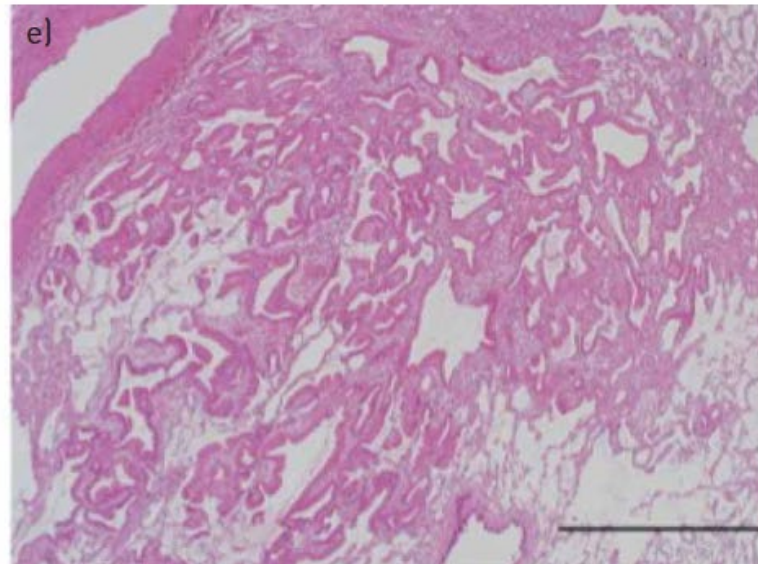
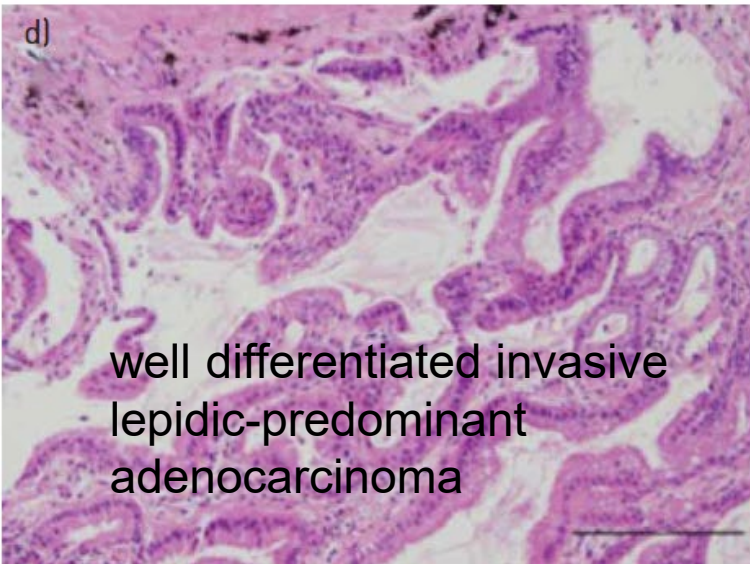
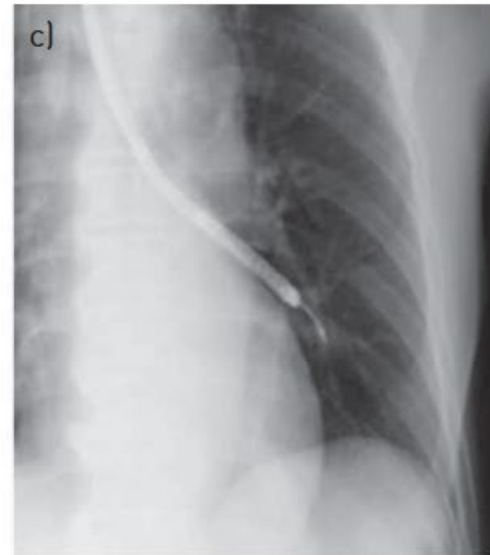
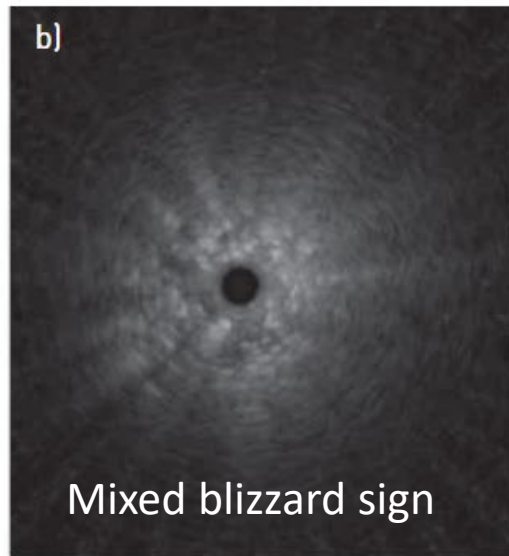
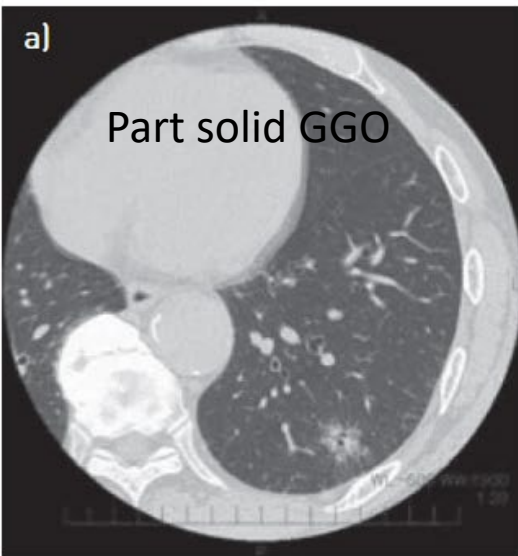
Diffusely heterogenous acoustic shadow(with some hyperechoic dots, linear arcs and vessels) that is distributed irregularly within a blizzard.

RP-EBUS for GGO lesions





RP-EBUS for GGO lesions





RP-EBUS for GGO lesions

	Thin-section CT findings				
	Pure GGO	Part-solid (>75% GGO)	Part-solid (>50–75% GGO)	Part-solid (25–50% GGO)	Part-solid (<25% GGO)
Subjects n	9	7	29	35	36
EBUS types					
Blizzard [#]	100 (9/9)	85.7 (6/7)	51.7 (15/29)	31.4 (11/35)	8.3 (3/36)
Mixed blizzard [¶]	0 (0/9)	14.3 (1/7)	48.3 (14/29)	68.6 (24/35)	91.7 (33/36)

Data are presented as % (n/N), unless otherwise stated. Total n=116. CT: computed tomography; EBUS: endobronchial ultrasound; GGO: ground-glass opacity; EBUS-GS: EBUS with a guide sheath. [#]: n=44; [¶]: n=72.

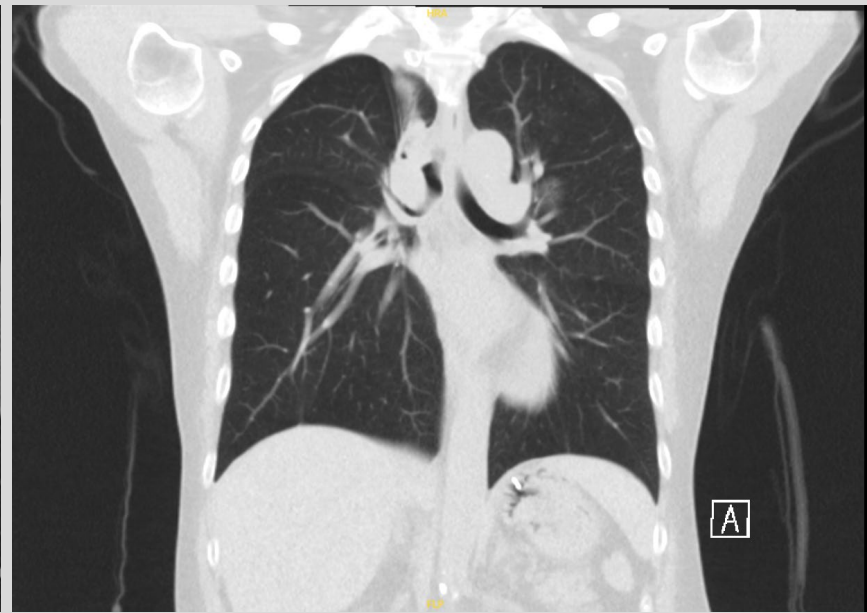
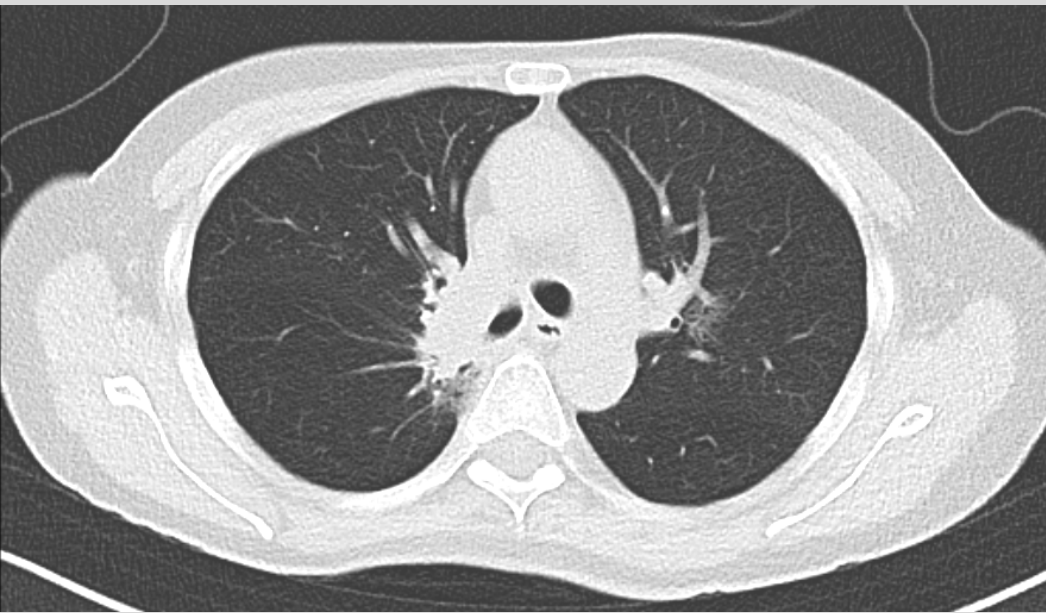


Case Sharing

- 54/F
- PHx:
 - Poorly differentiated squamous cell ca, RUL, with bulky pN2, inoperable, in March 2006, s/p CCRT and Taxol+carbo.
- CC: Admitted for abnormal CXR and chest CT
- Non-smoker

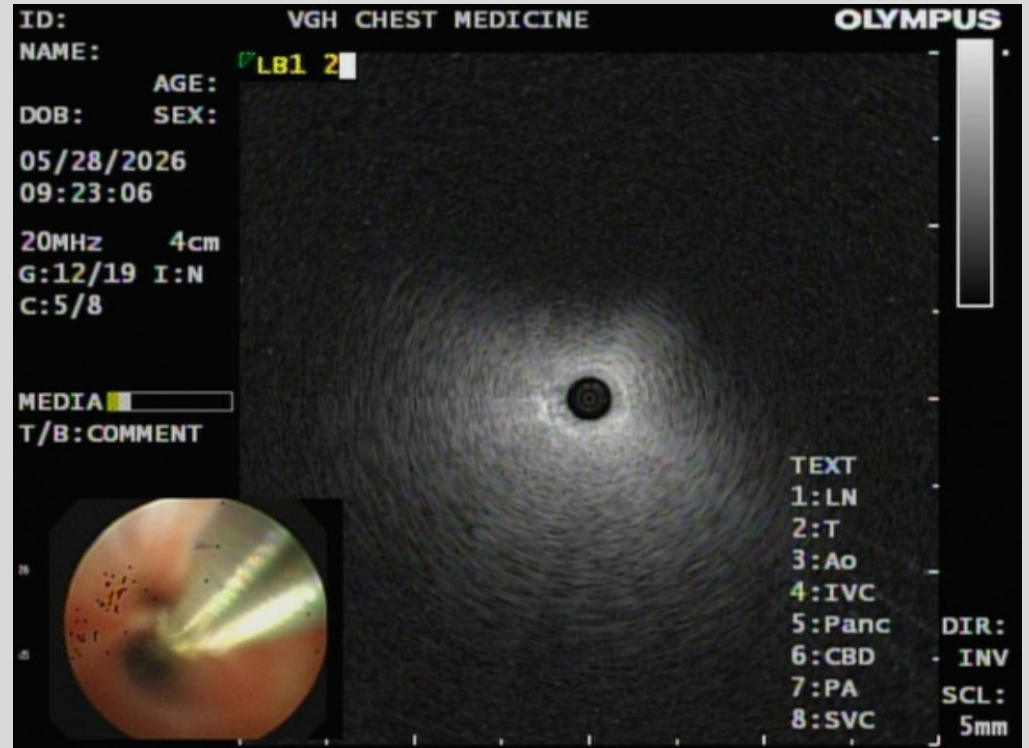
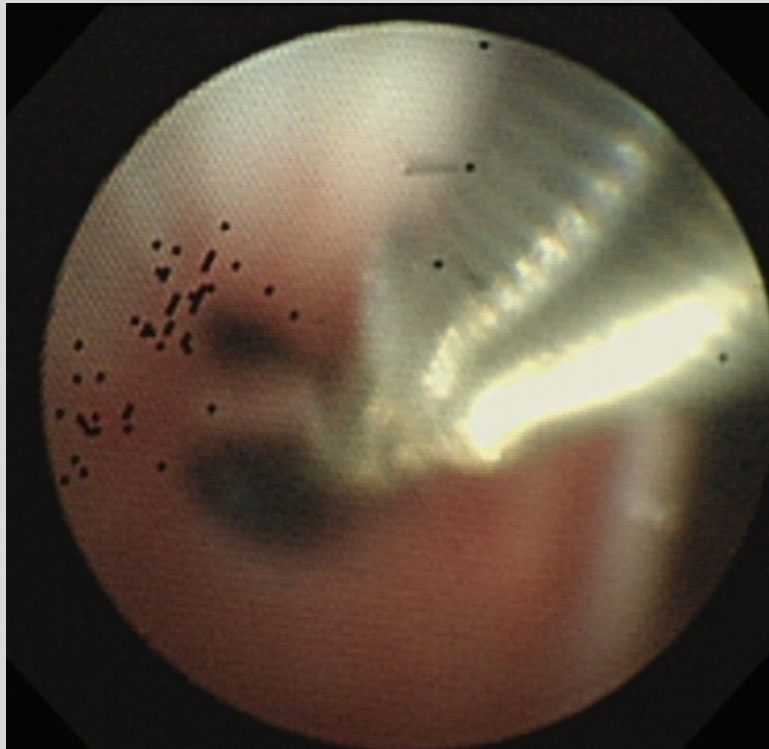


Case Sharing



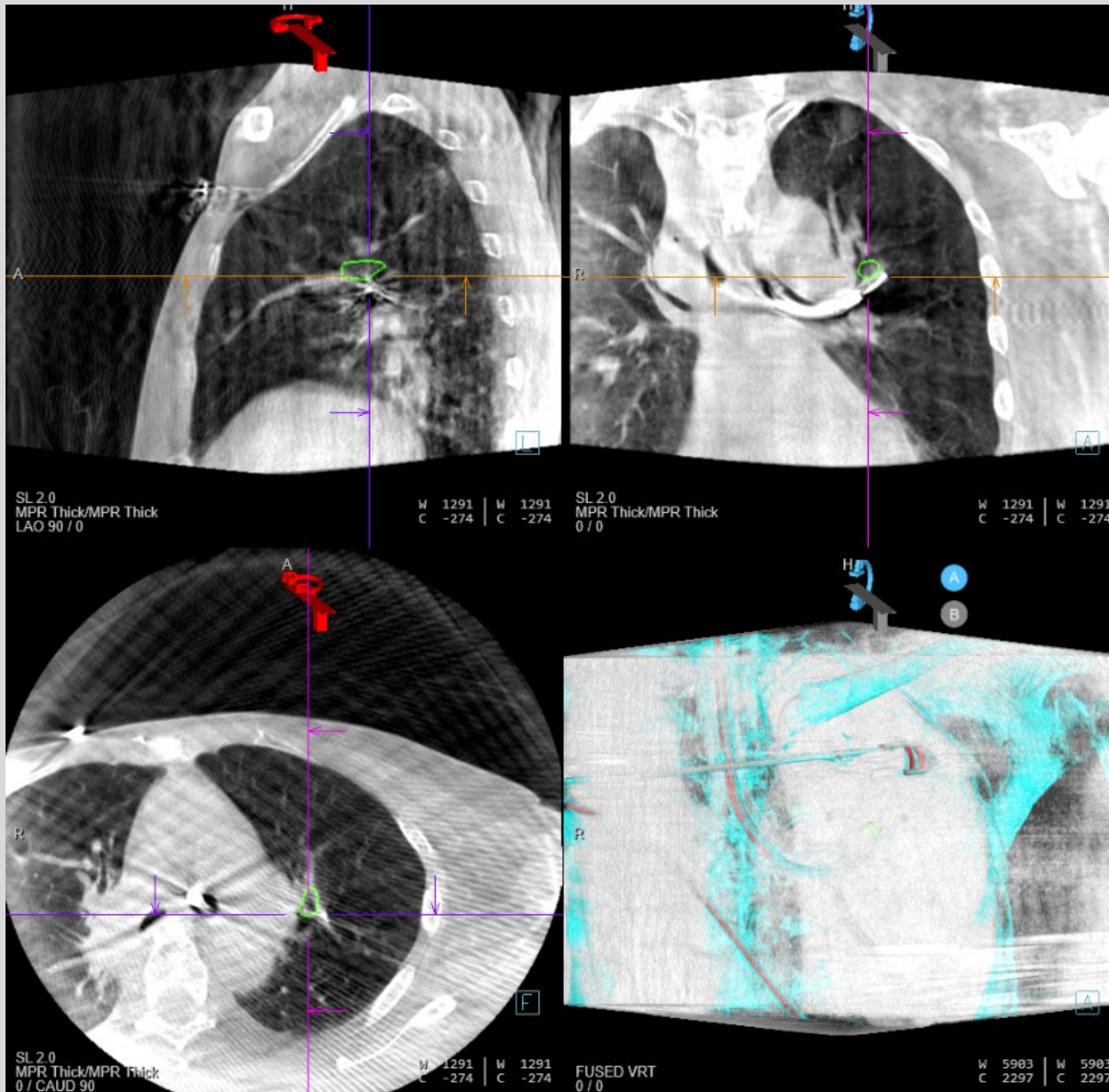


Case Sharing





Case Sharing



CBCT-augmented fluoroscopy with cryobiopsy

病理號: S115-21973

PATHOLOGICAL DIAGNOSIS:

Lung, LB1+2, CBCT-EBUS biopsy

--- Adenocarcinoma

GROSS FINDING:

1. Fixation: formalin
2. Specimen number: 2 pieces
3. Specimen size:
--- 0.8 x 0.6 x 0.4 cm and 0.6 x 0.5 x 0.4 cm
4. Specimen appearance: tan, soft
Entire specimen is embedded in one block. (WYC)

MICROSCOPIC FINDING:

Sections show lung tissue with non-mucinous adenocarcinoma cells in lepidic growth pattern. Based on the pathological findings, the tumor is compatible with adenocarcinoma of lung origin.

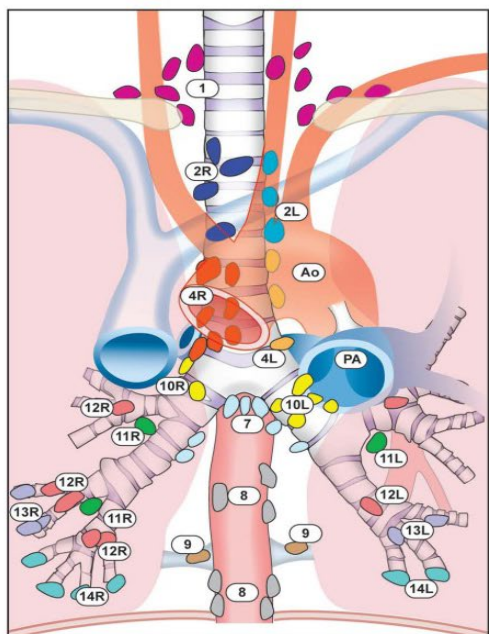
Problem of EBUS Radial Probe

Not Real Time !!

Convex Probe of EBUS



Mediastinal staging of lung cancer



Supraclavicular zone

- 1 Low cervical, supraclavicular, and sternal notch nodes

Superior Mediastinal Nodes

Upper zone

- 2R Upper Paratracheal (right)
- 2L Upper Paratracheal (left)
- 3a Pre-vascular
- 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

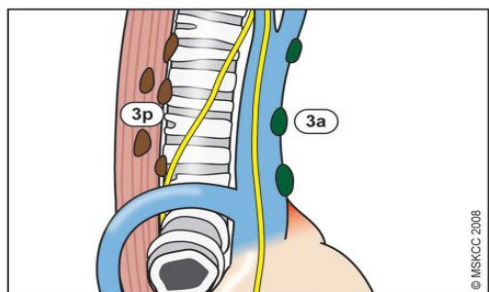
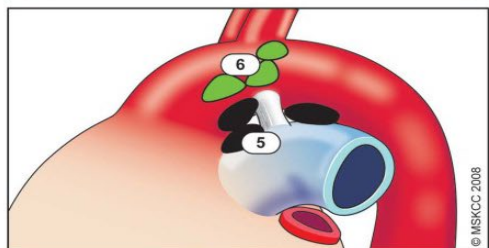
- 10 Hilar
- 11 Interlobar

Peripheral zone

- 12 Lobar
- 13 Segmental
- 14 Subsegmental

Regional Lymph Nodes (N)

- NX** Regional lymph nodes cannot be assessed
- N0** No regional lymph node metastases
- N1** Metastasis in ipsilateral peribronchial and/or ipsilateral hilar lymph nodes and intrapulmonary nodes, including involvement by direct extension
- N2** Metastasis in ipsilateral mediastinal and/or subcarinal lymph node(s)
- N3** Metastasis in contralateral mediastinal, contralateral hilar, ipsilateral or contralateral scalene, or supraclavicular lymph node(s)



ILLUSTRATION

The IASLC lymph node map shown with the proposed amalgamation of lymph into zones.

(© Memorial Sloan-Kettering Cancer Center, 2009.)

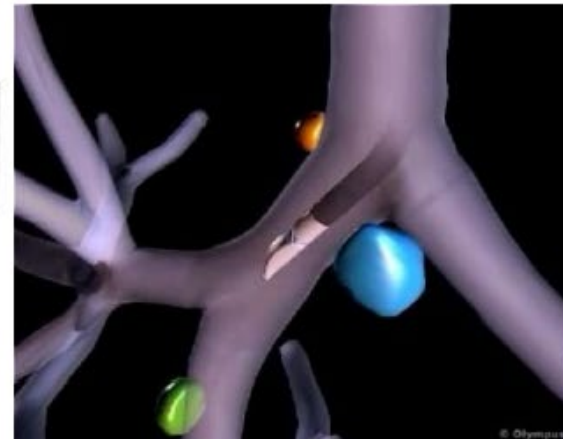
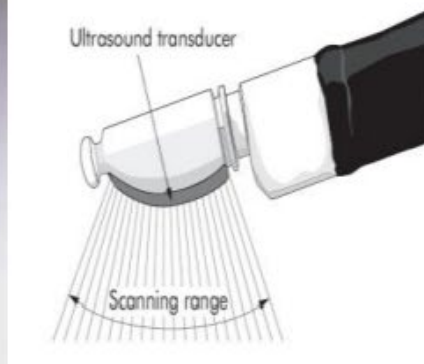
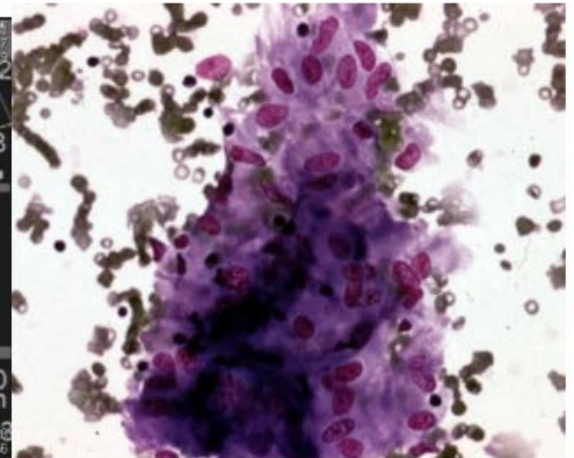
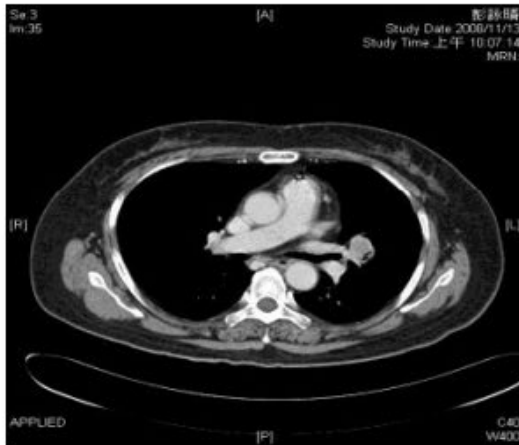


Diagnosing mediastinal lymphadenopathy

- **Non-invasive**
 - CT/PET
- **Invasive**
 - Mediastinoscopy
 - VATS/thoracotomy
- **Minimally invasive**
 - Conventional TBNA
 - **EBUS-guided TBNA**
 - EUS-guided FNA
 - Combine EBUS and EUS FNA

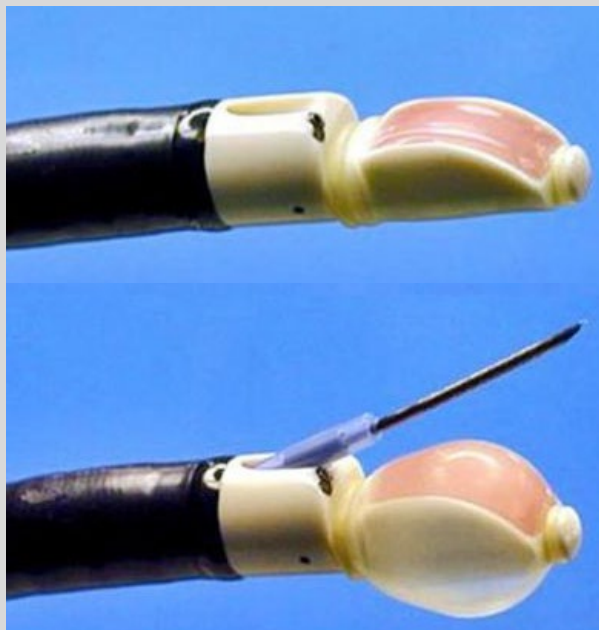


Convex Probe EBUS (CP-EBUS)

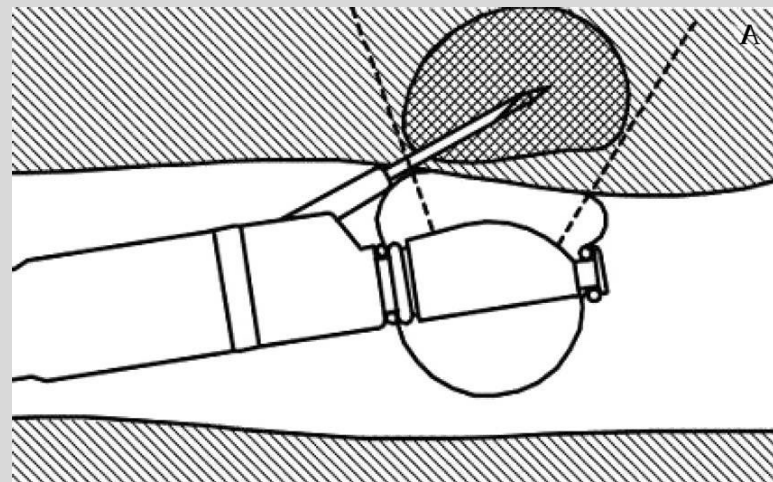




Convex Probe EBUS (CP-EBUS)



Scanning range : 50 degrees



- Outer diameter : **6.9mm**
- Working channel : **2.2mm**
- Direction of view :
10-30 degree forward oblique
- Ultrasound frequency : 5-12MHz
- Ultrasound penetration : **5cm**
- **Doppler** available to identify vascular, solid and cystic structure





EBUS-TBNA versus mediastinoscopy for mediastinal lymph node staging of lung cancer

TABLE 2. Lymph node stations biopsied by endobronchial ultrasound-guided transbronchial needle aspiration and mediastinoscopy

LN station	Total	Malignant	Benign	Inadequate
LN stations biopsied by EBUS-TBNA				
2R	30	12	12	6
4R	137	25	74 (5)	38
2L	2	1	0	1
4L	108	15	39 (1)	54
7	149	25	101 (2)	23
Total	426	78	226 (8)	122
LN stations biopsied by mediastinoscopy				
2R	115	16	97 (2)	2
4R	151	26	124 (4)	1
2L	26	1	23	2
4L	132	12	118 (4)	2
7	149	24	122 (4)	3
Total	573	79	484 (14)	10

Number of false-negative LN stations in parentheses. *LN*, Lymph node; *EBUS-TBNA*, endobronchial ultrasound-guided transbronchial needle aspiration.

TABLE 3. Lymph node staging based on different modalities

N Stage	CT	EBUS-TBNA	Mediastinoscopy	Final pathology
0	90 (59%)	107 (70%)	109 (71%)	90 (59%)
1	7 (5%)	3 (2%)	N/A	10 (7%)
2	51 (33%)	33 (22%)	35 (23%)	42 (27%)
3	5 (3%)	10 (7%)	9 (6%)	11 (7%)

CT, Computed tomography; *EBUS-TBNA*, endobronchial ultrasound-guided transbronchial needle aspiration.

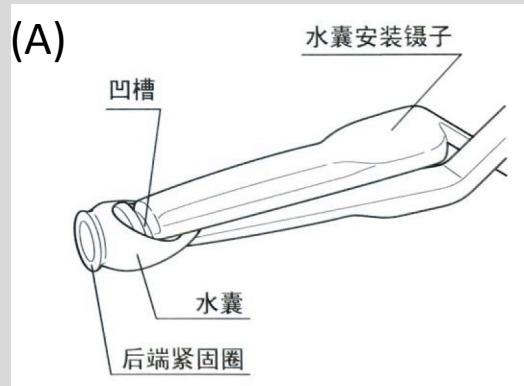
EBUS-TBNA and mediastinoscopy achieve **similar results** for the mediastinal staging of lung cancer



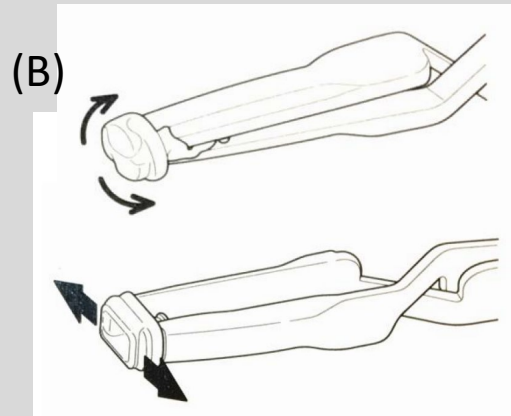
Procedure details of EBUS-TBNA

- Balloon preparation
- Regional LN mapping under CP-EBUS
- EBUS-TBNA Technique in a Step-by-Step Approach
- Specimen collection

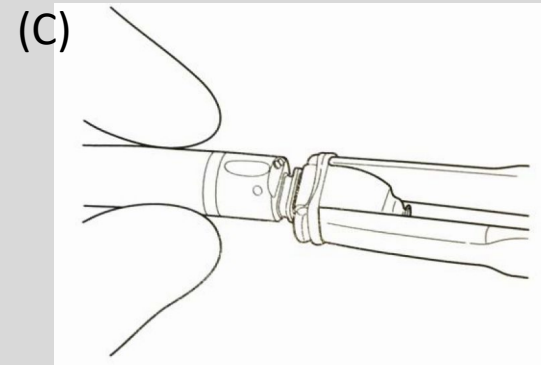
Balloon preparation



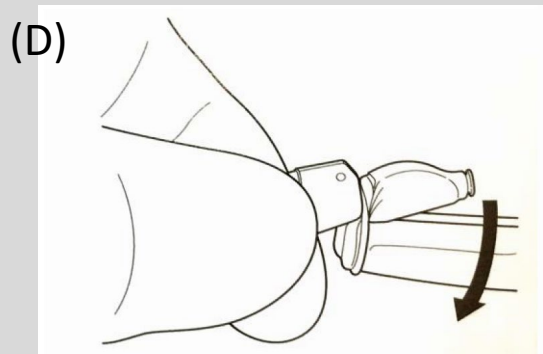
夾住水球(約夾滿 2/3)



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



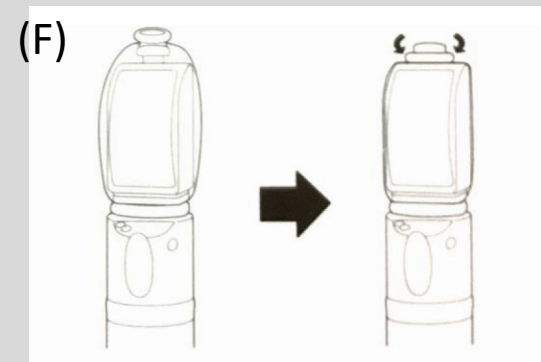
由兩側將水球套在探頭上



套入後由下方將夾子移出 (小心易破)

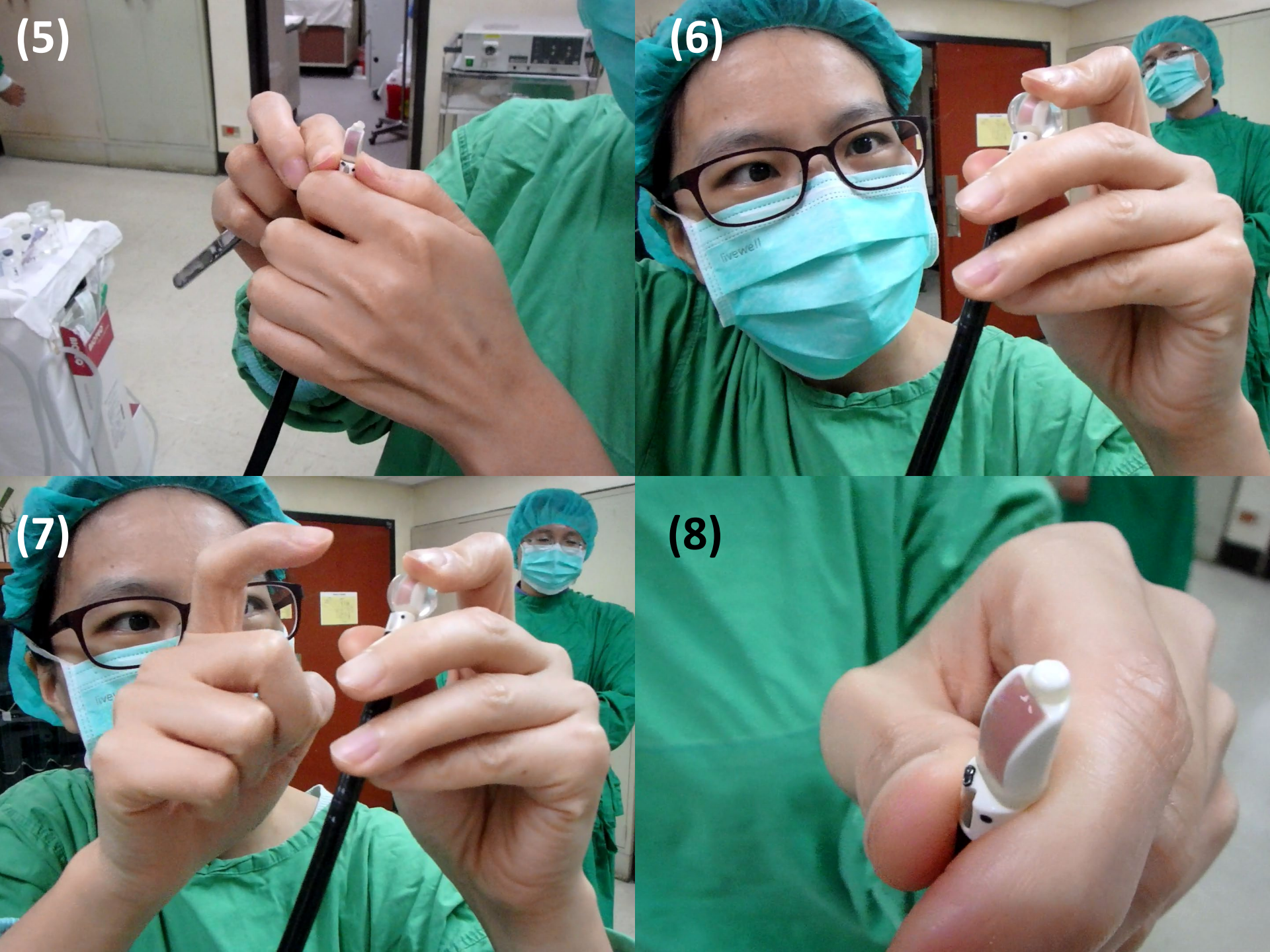


打入水後將氣泡排出

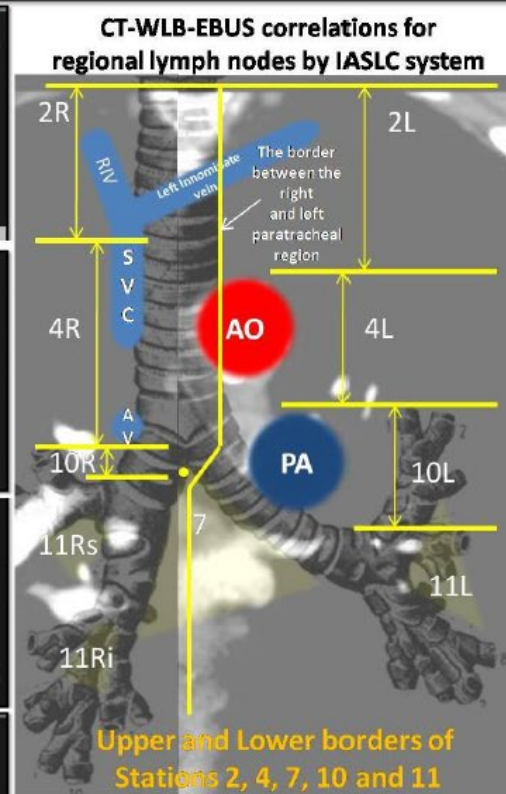
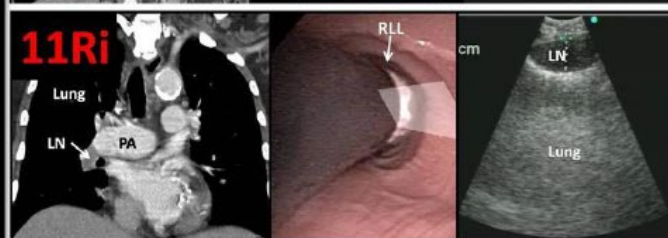
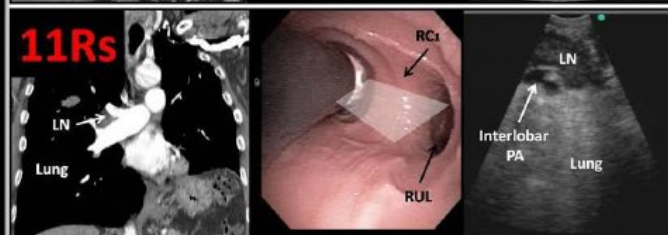
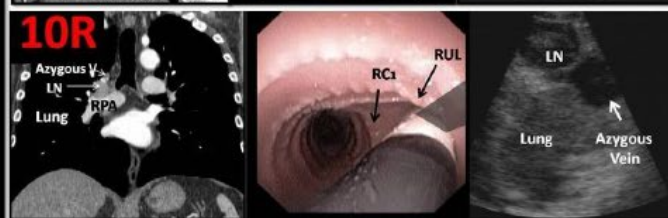
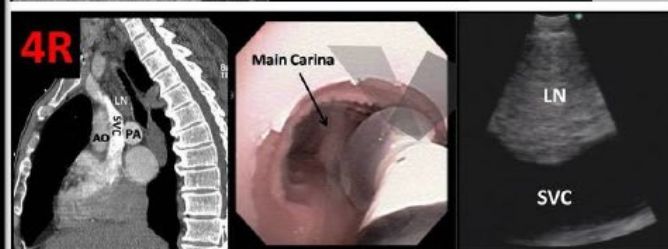
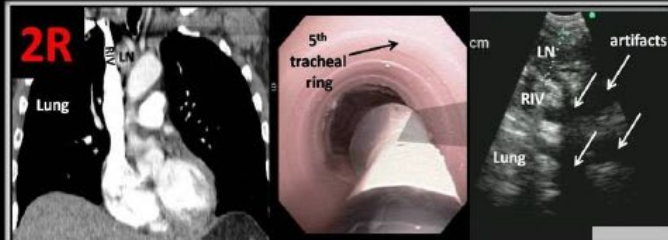


將水球末端下翻，打水測試是否漏水





Regional LN mapping under CP-EBUS

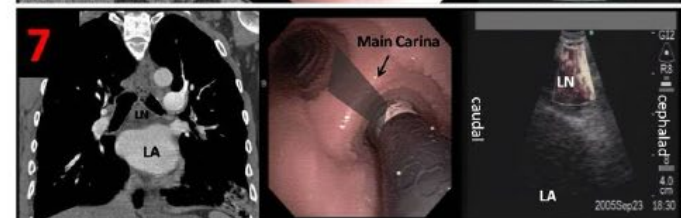
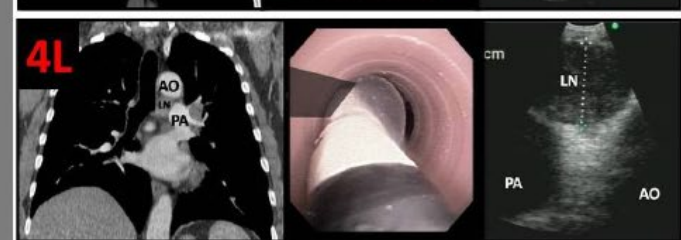
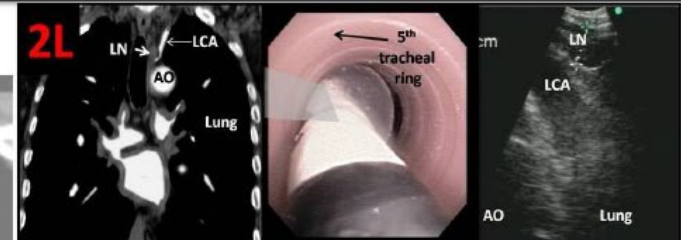


Upper and Lower borders of Stations 2, 4, 7, 10 and 11

AV: azygos 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

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Septimiu Murgu, MD & Henri Colt, MD



#4 Lower Paratracheal Nodes

4R:

includes right **paratracheal nodes**, and **pretracheal nodes** extending to the left lateral border of trachea

Upper border:

intersection of caudal margin of innominate vein with the trachea

Lower border:

lower border of **azygos vein**

4L:

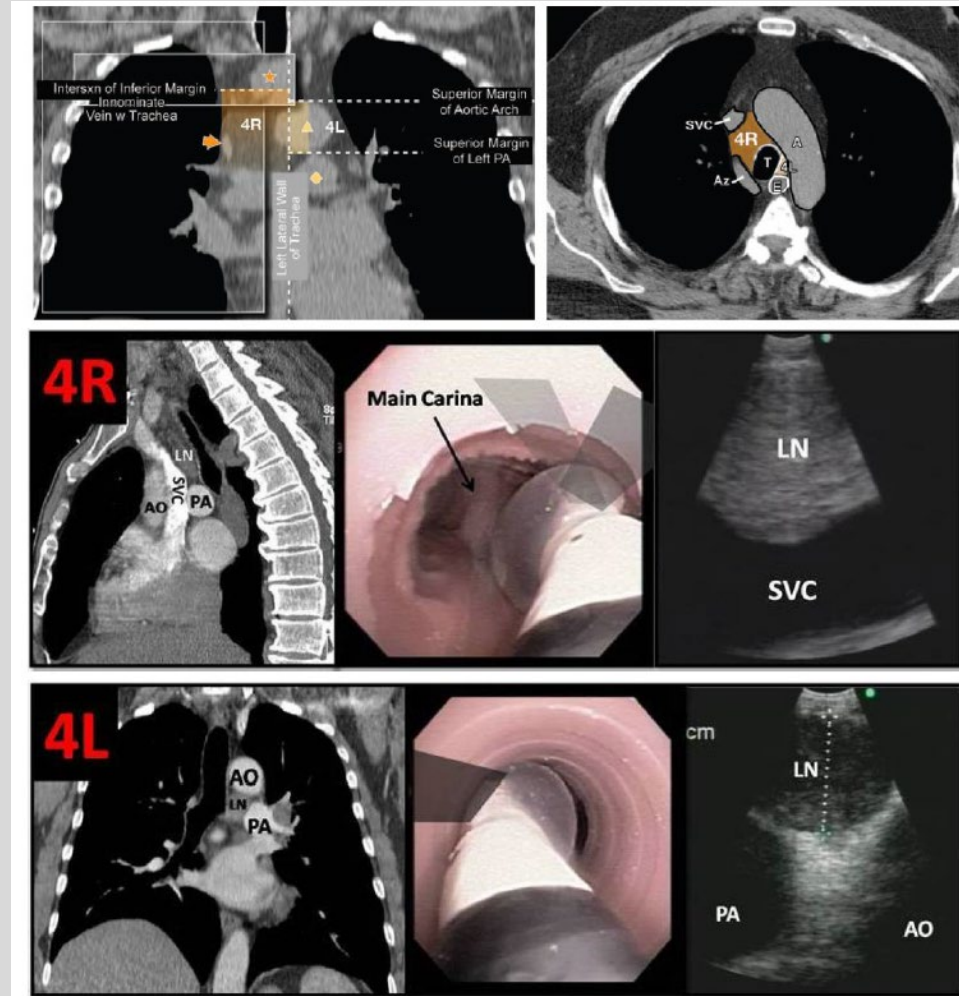
includes nodes to the left of the left lateral border of the trachea, medial to the ligamentum arteriosum

Upper border:

upper margin of the **aortic arch**

Lower border:

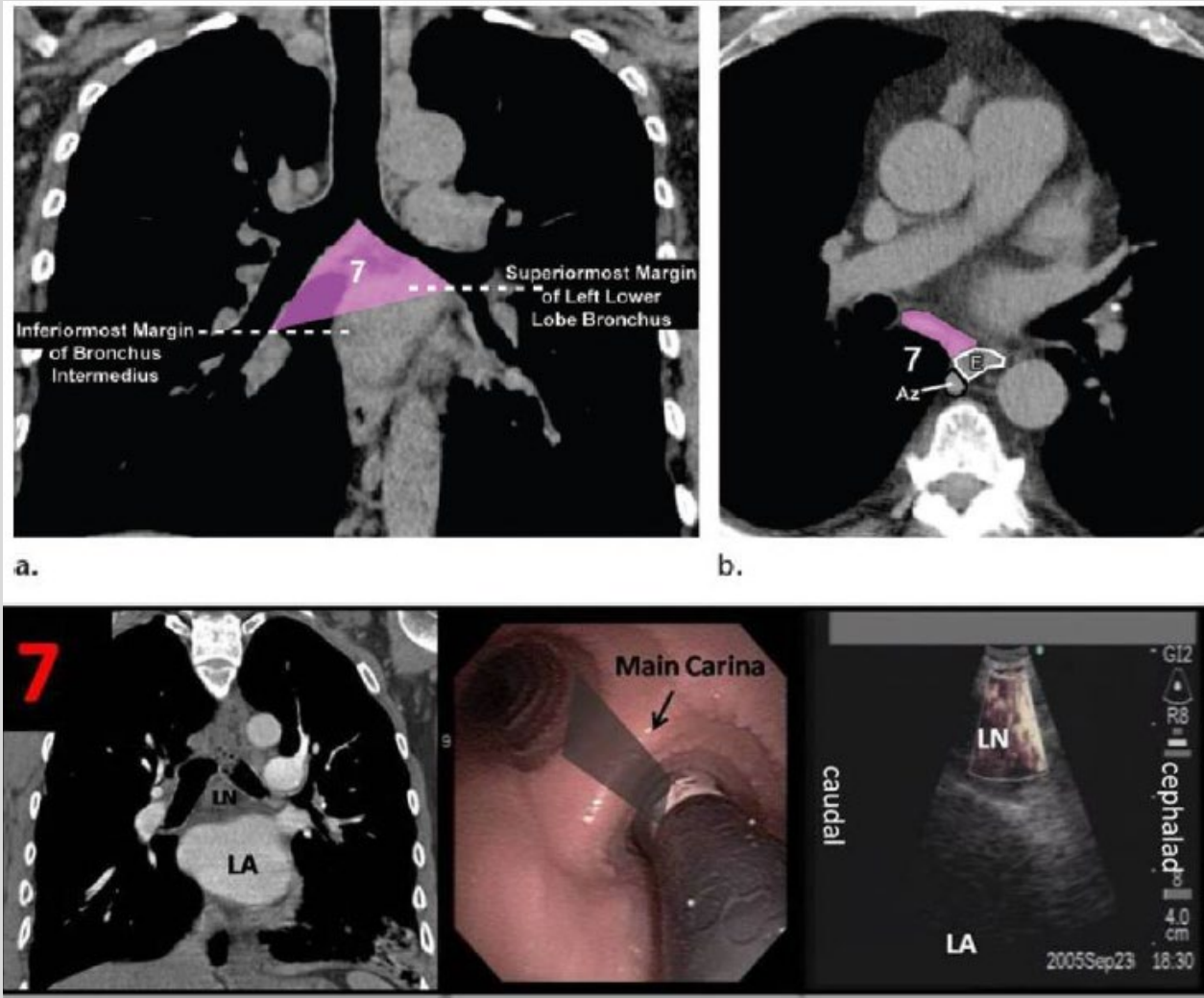
upper rim of the **left main pulmonary artery**



#7 Subcarinal Nodes

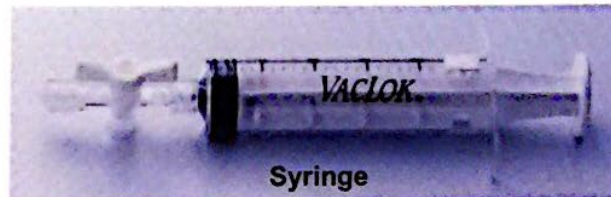
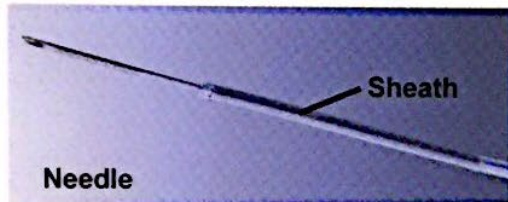
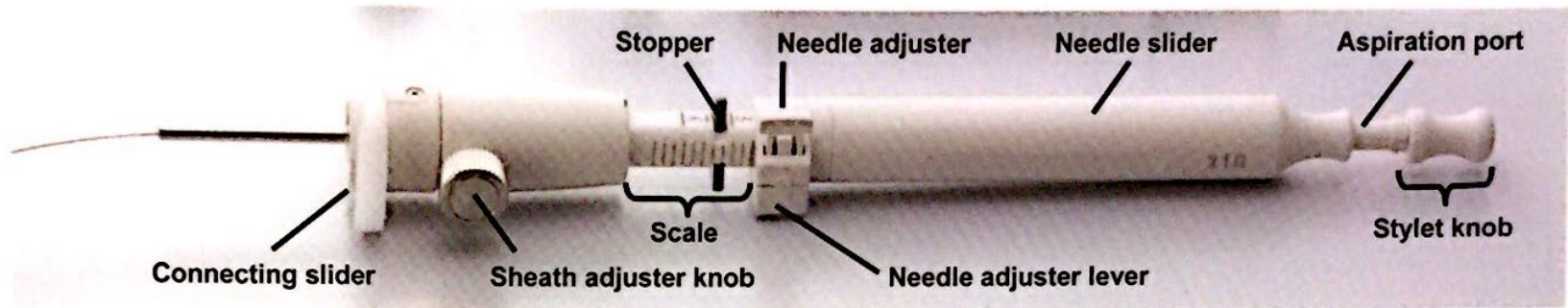
Upper border: the carina of the trachea

Lower border: the **upper** border of the **lower lobe bronchus on the left**;
the **lower** border of the **bronchus intermedius on the right**



EBUS-TBNA Technique in a Step-by-Step Approach

ViziShot EBUS-TBNA needle



**Single use adapter
biopsy valve
(MAJ-1414)**

This adapter should be attached to the instrument channel port of the Endoscope, before the needle is inserted.

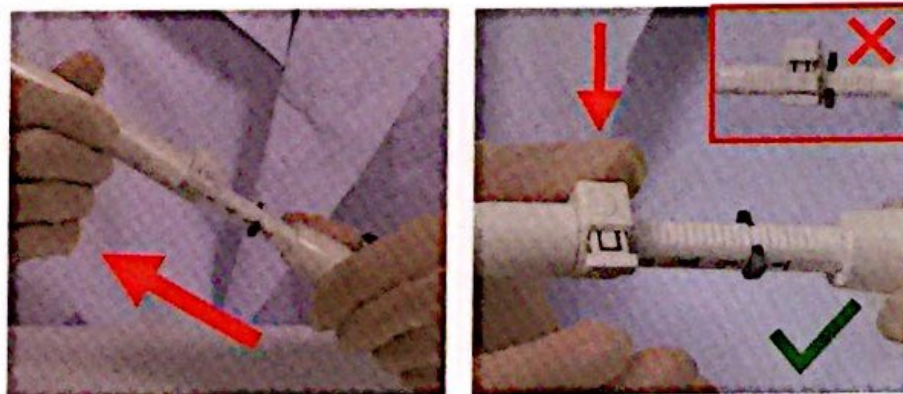
Preparation before using the ViziShot EBUS-TBNA needle

【1】



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

【2】



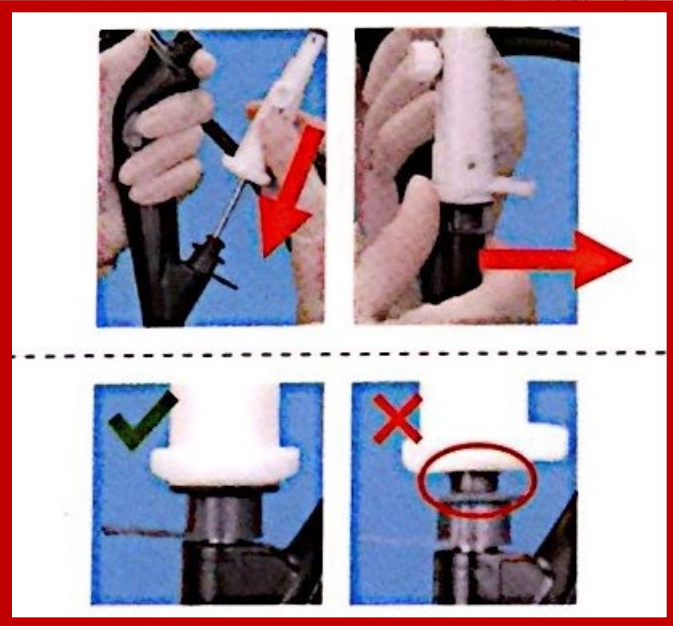
Confirm that the needle slider is fully pulled up until it clicks and the needle adjuster is locked. Failure to do so may result in damage to the endoscope.

OLYMPUS[®]

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

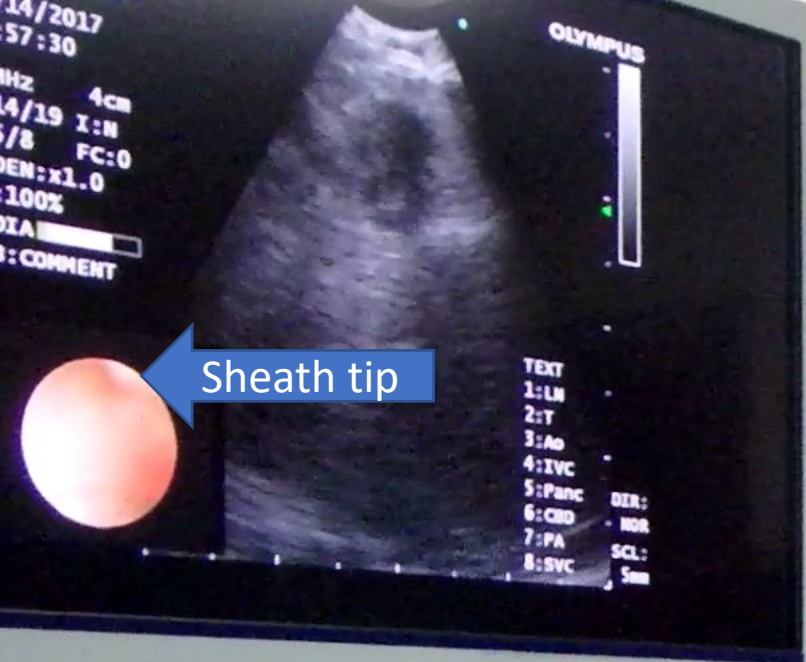


Step 2: The housing is secured to the bronchoscope by a flange



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



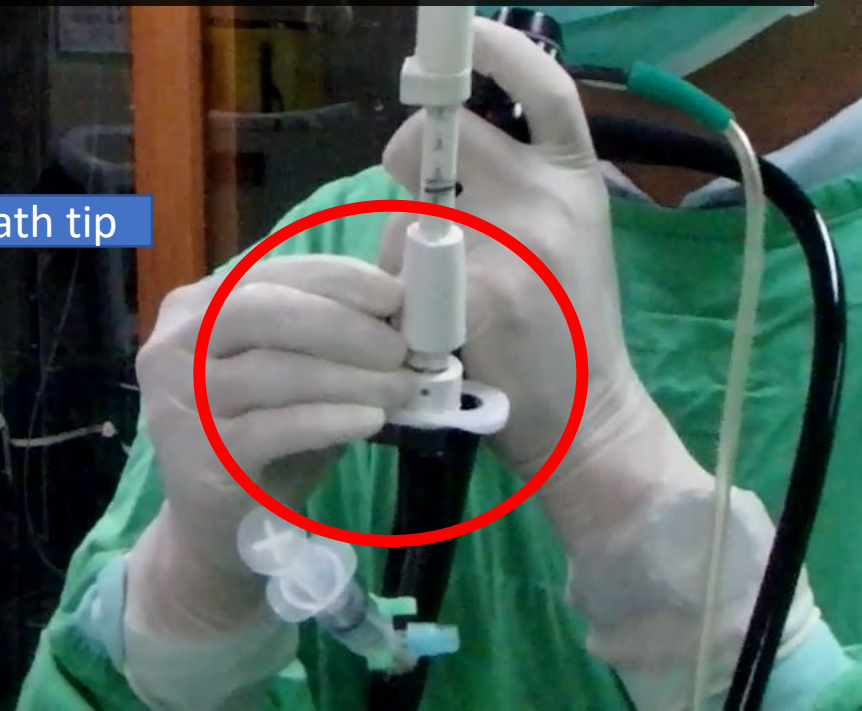


Sheath tip

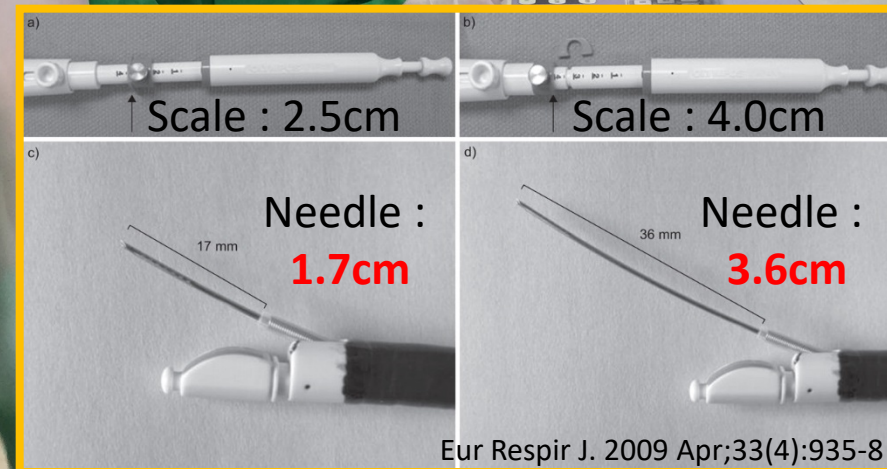
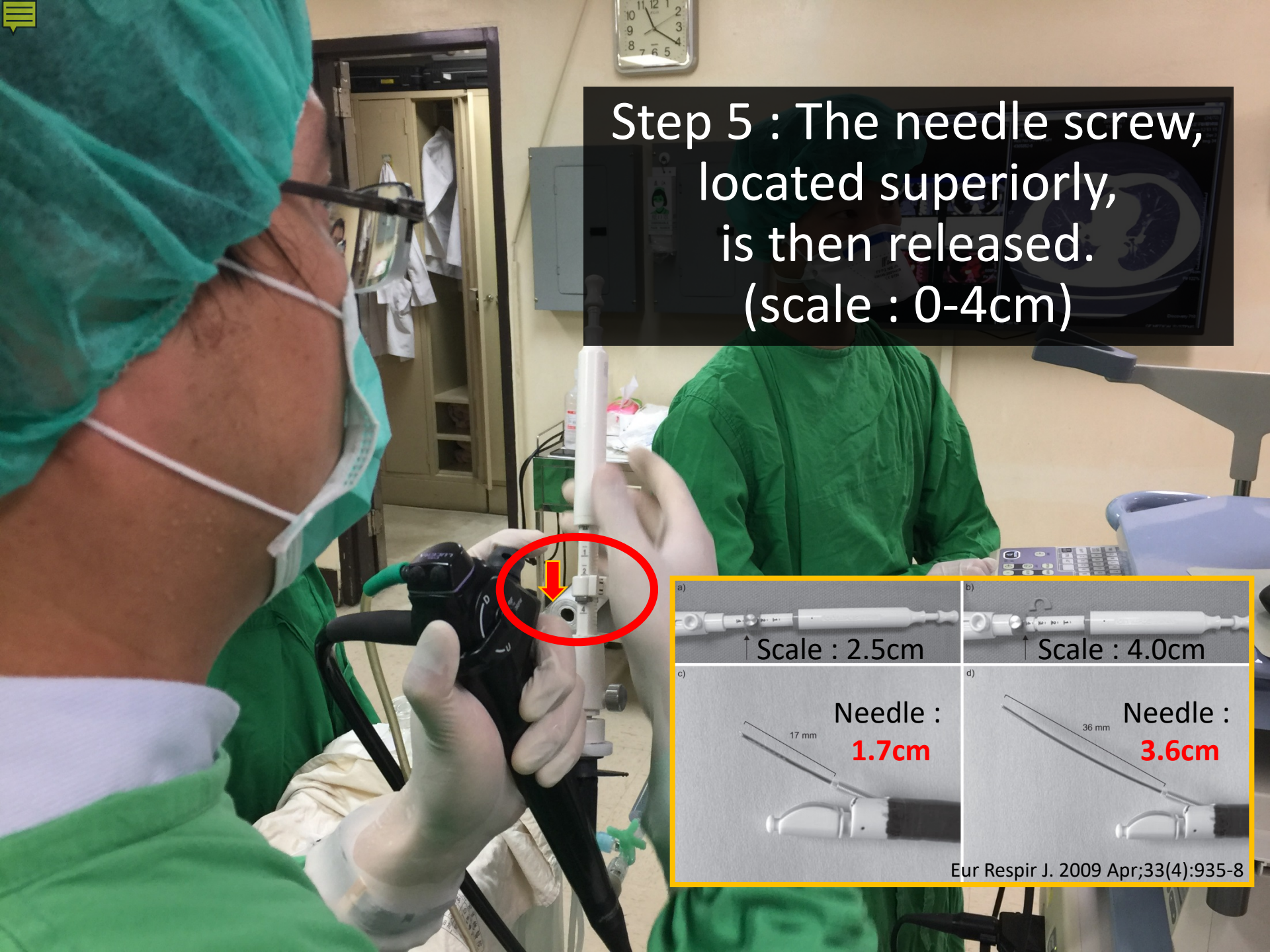
Step 4: With the node visualized by ultrasound, the sheath is advanced out of the end of the scope until it **slightly touches the airway wall**. It is therefore safe to advance the needle



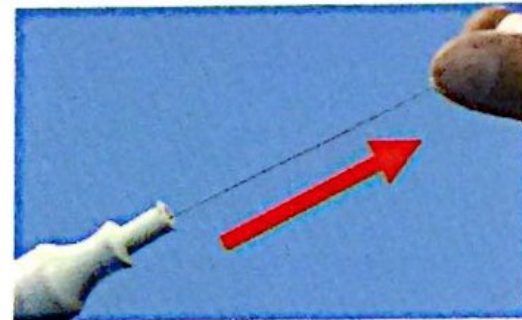
Sheath tip



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

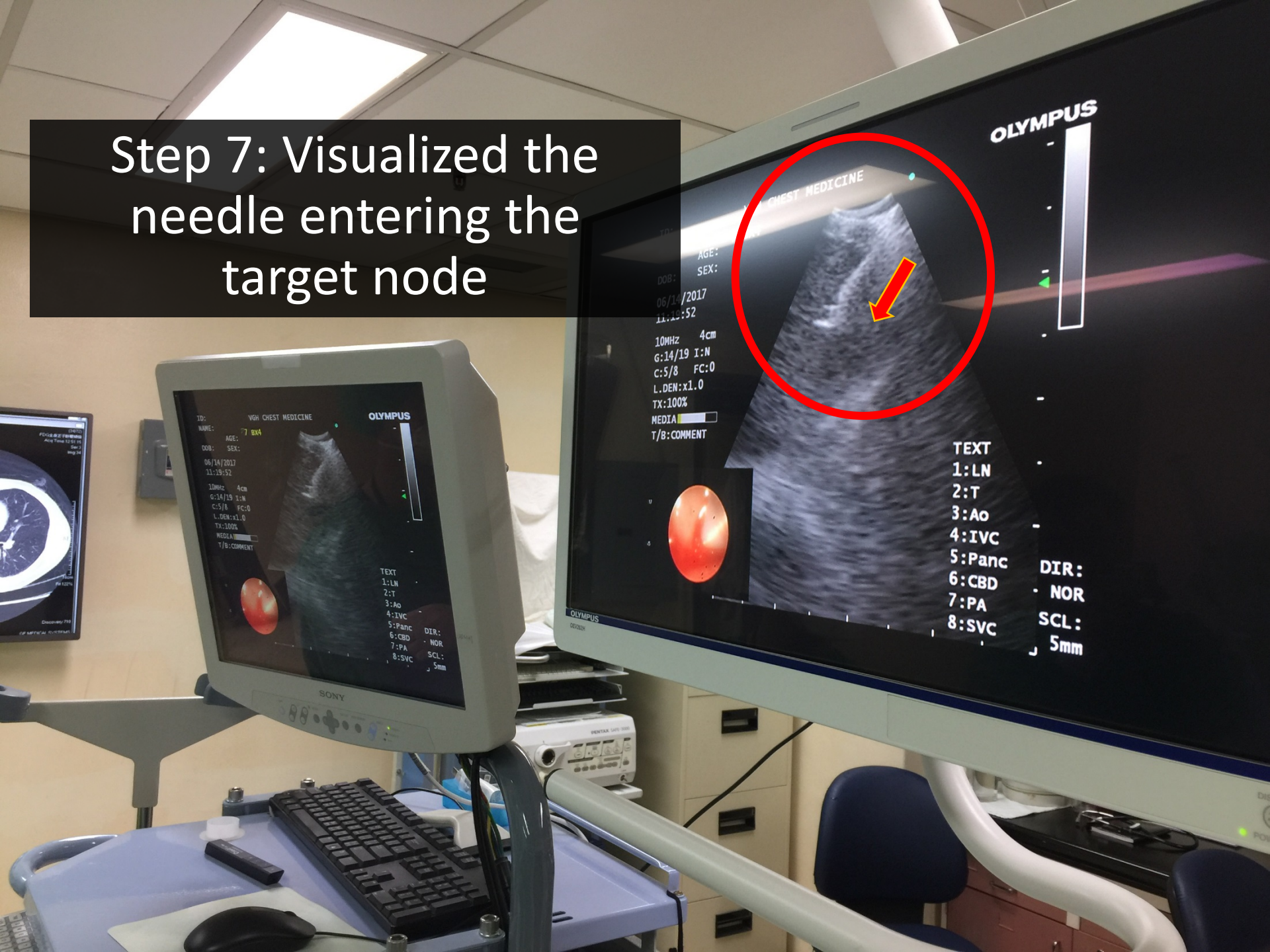


Step 6 : The needle is advanced into LN using a quick jab



Pull the stylet knob out approximately 50mm. This sharpens the needle for easier penetration into the target site.

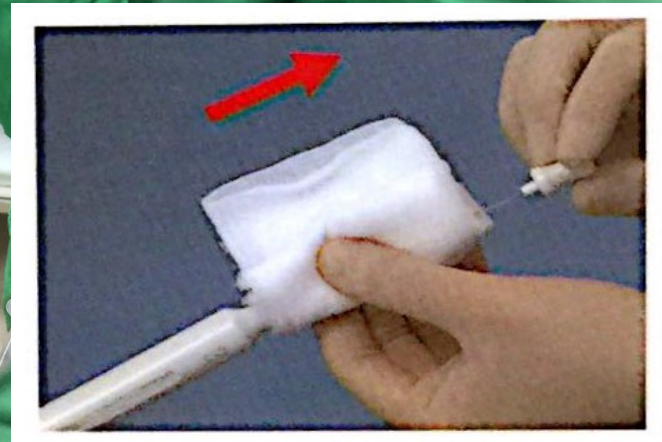
Step 7: Visualized the
needle entering the
target node



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



Step 9: Remove the stylet





Step 10: The **syringe** is applied to the biopsy needle



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

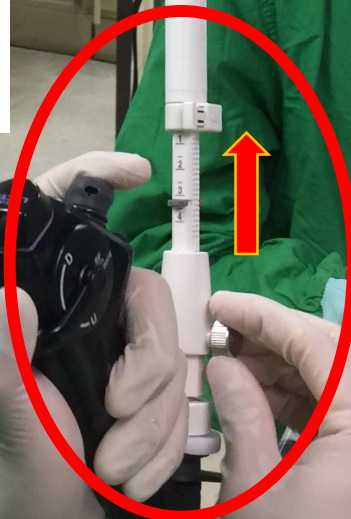
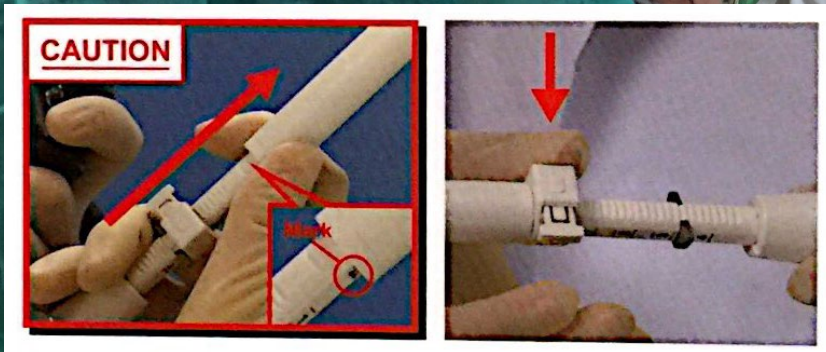
Step 12 : Pass the
needle in and out of
the node **10-15 times**





Step 13 : Suction is then released

Step 14 : Retract the
needle into the sheath





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

Specimens collection

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

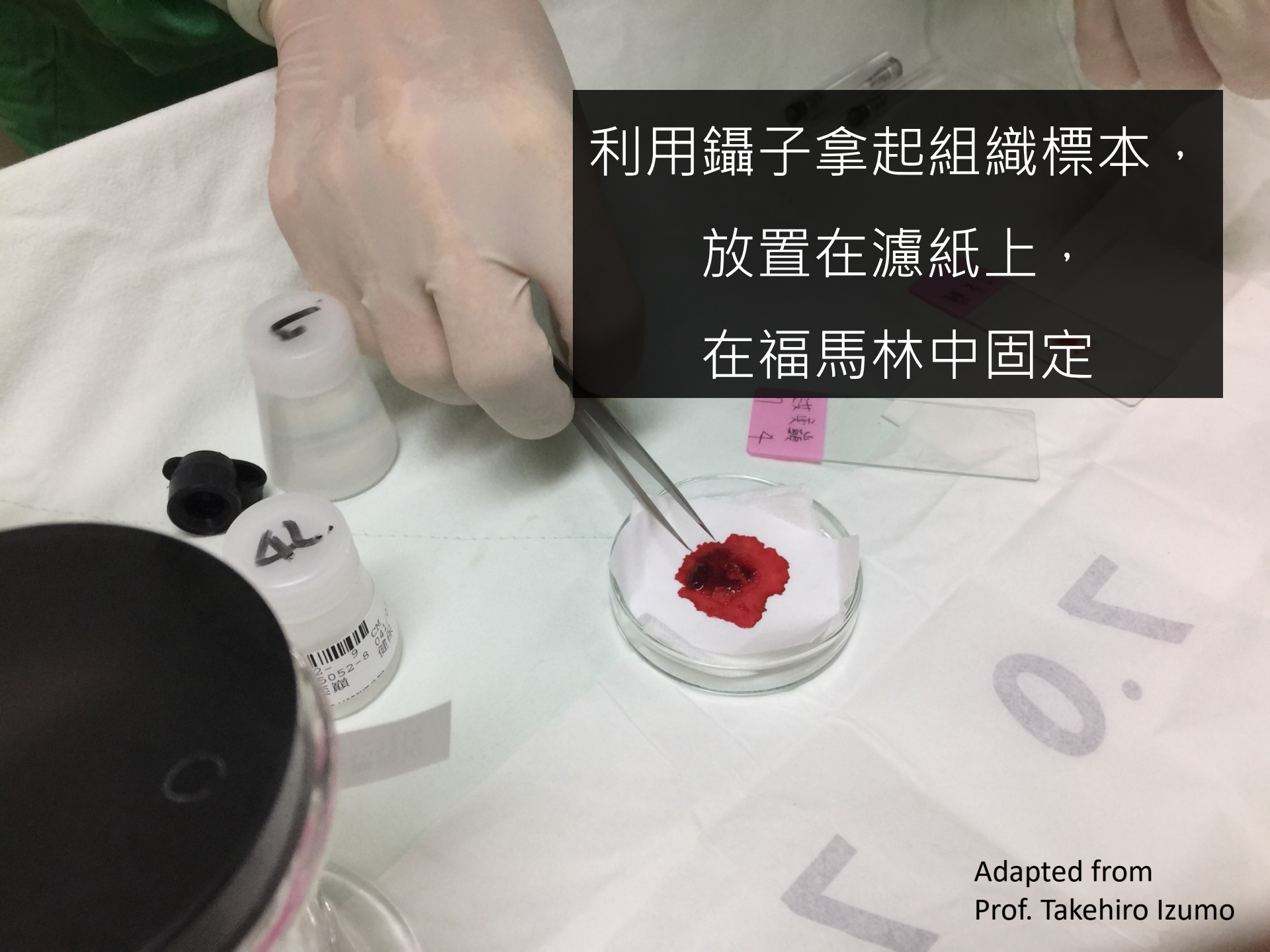
Adapted from
Prof. Takehiro Izumo



利用鑷子拿起組織標本，
放置在濾紙上，
在福馬林中固定



Adapted from
Prof. Takehiro Izumo



利用鑷子拿起組織標本，
放置在濾紙上，
在福馬林中固定

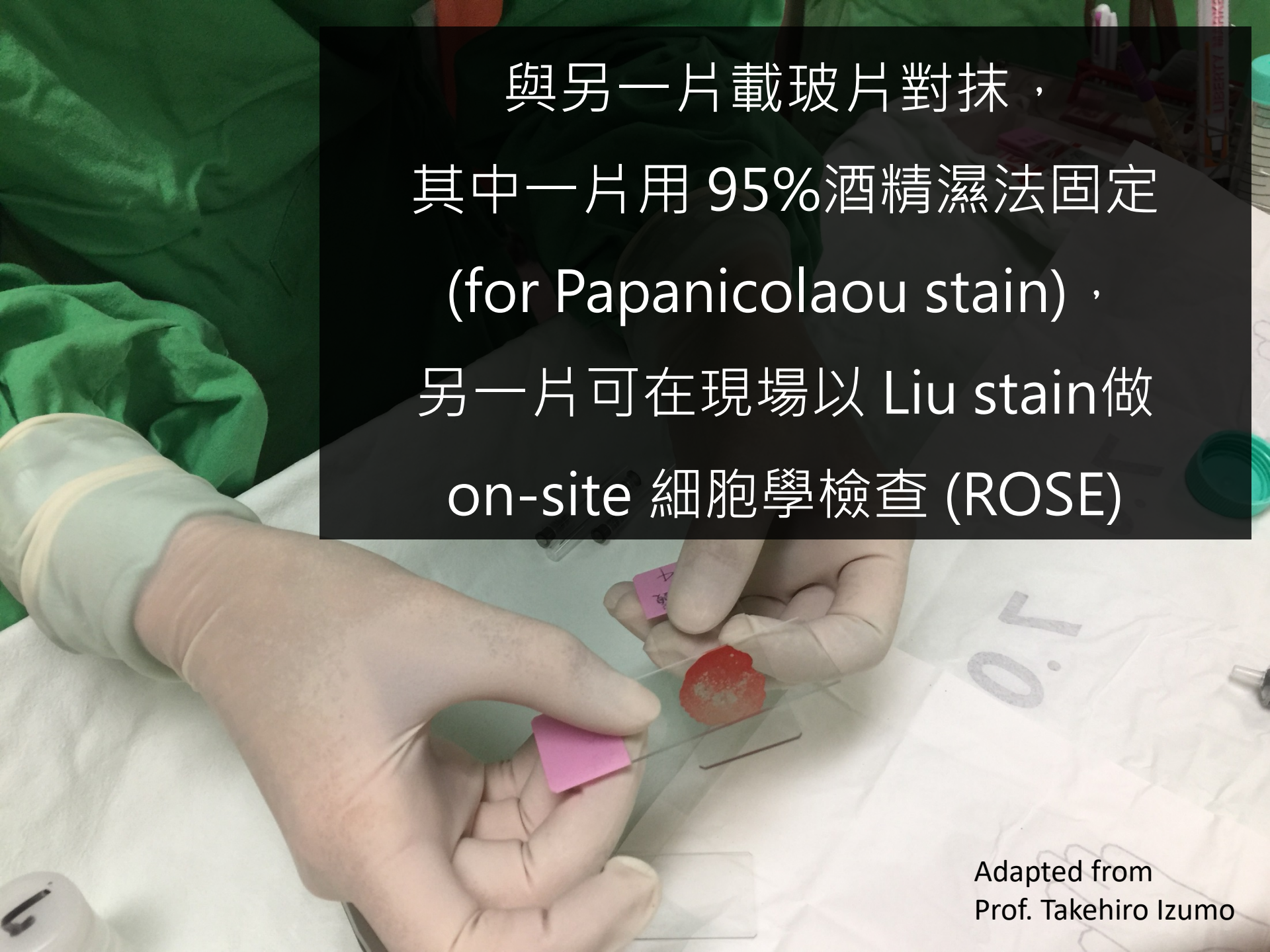
Adapted from
Prof. Takehiro Izumo

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

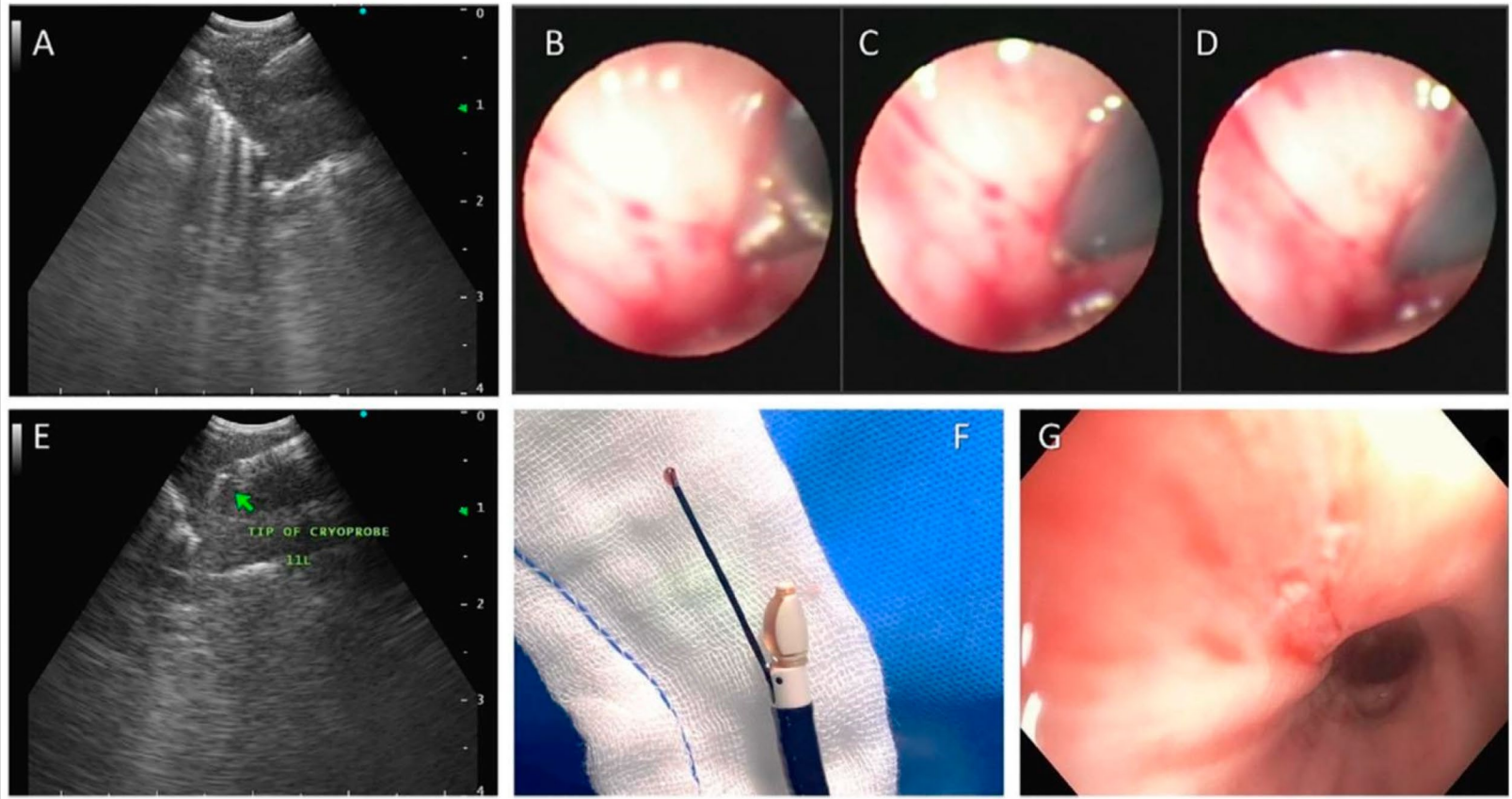
與另一片載玻片對抹，
其中一片用 95%酒精濕法固定
(for Papanicolaou stain)，
另一片可在現場以 Liu stain 做
on-site 細胞學檢查 (ROSE)



Adapted from
Prof. Takehiro Izumo



EBUS-Intranodal cryobiopsy





EBUS-Intranodal cryobiopsy

Diagnostic Yield	EBUS TBCB+TBNA (1)	EBUS TBNA	<i>p</i> Value
Overall	93–94 (%)	80–81 (%)	0.001 and 0.0039
Common lung cancer	94.1 (%)	95.6 (%)	NS
Uncommon mediastinal malignancies	91.7 (%)	25 (%)	0.001
	76 (%)	59 (%)	NS
Benign mediastinal lesions	94 (%)	67 (%)	0.0009
Mediastinal nodal metastases	99 (%)	99 (%)	NS
Lymphoma	87.5 (%)	12.5 (%)	NA
Genomic testing	93–97 (%)	73.5–79 (%)	0.001



Case Sharing

- 56/M
- PHx: Denied
- Smoking: Denied



Case Sharing



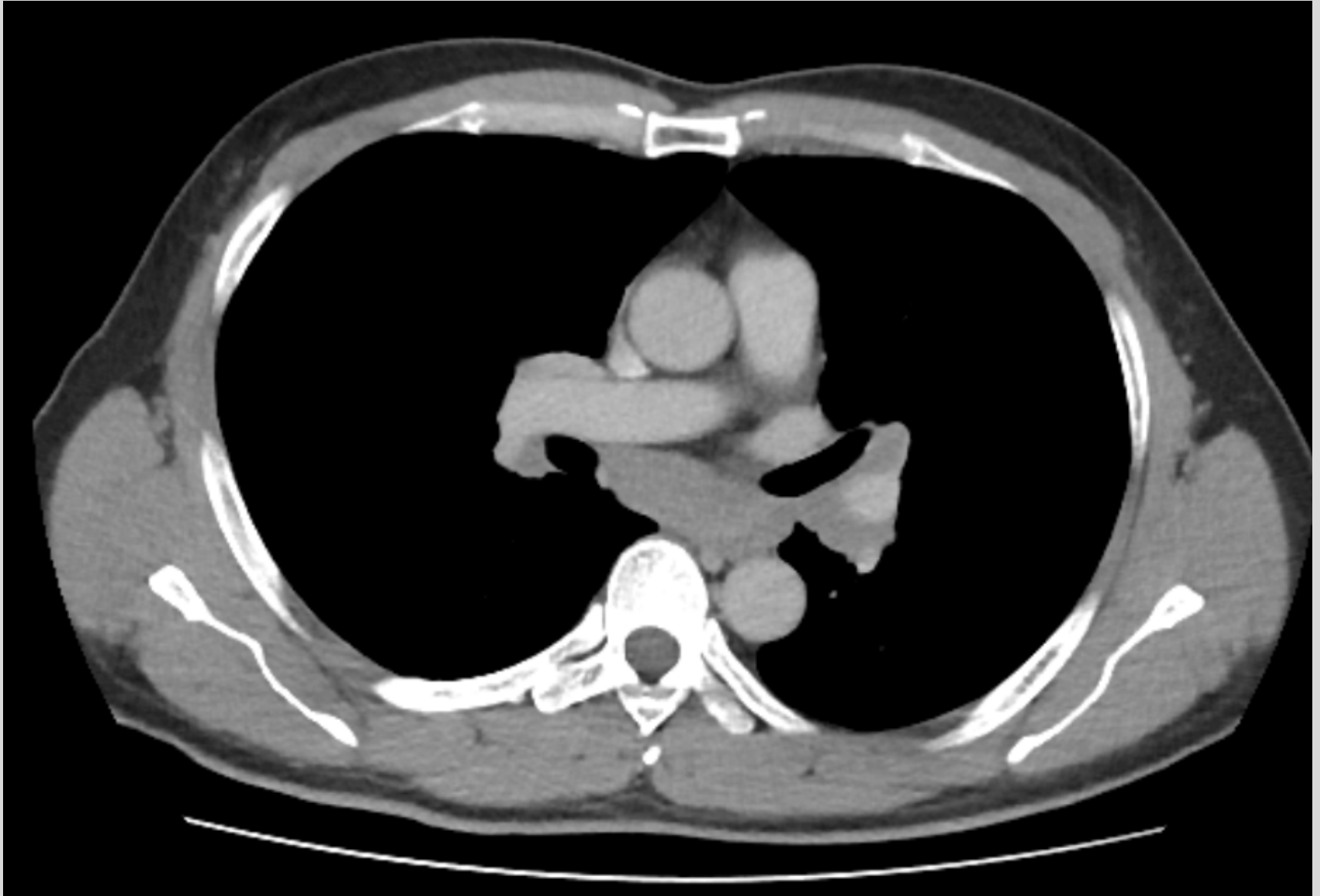


Case Sharing





Case Sharing





Case Sharing



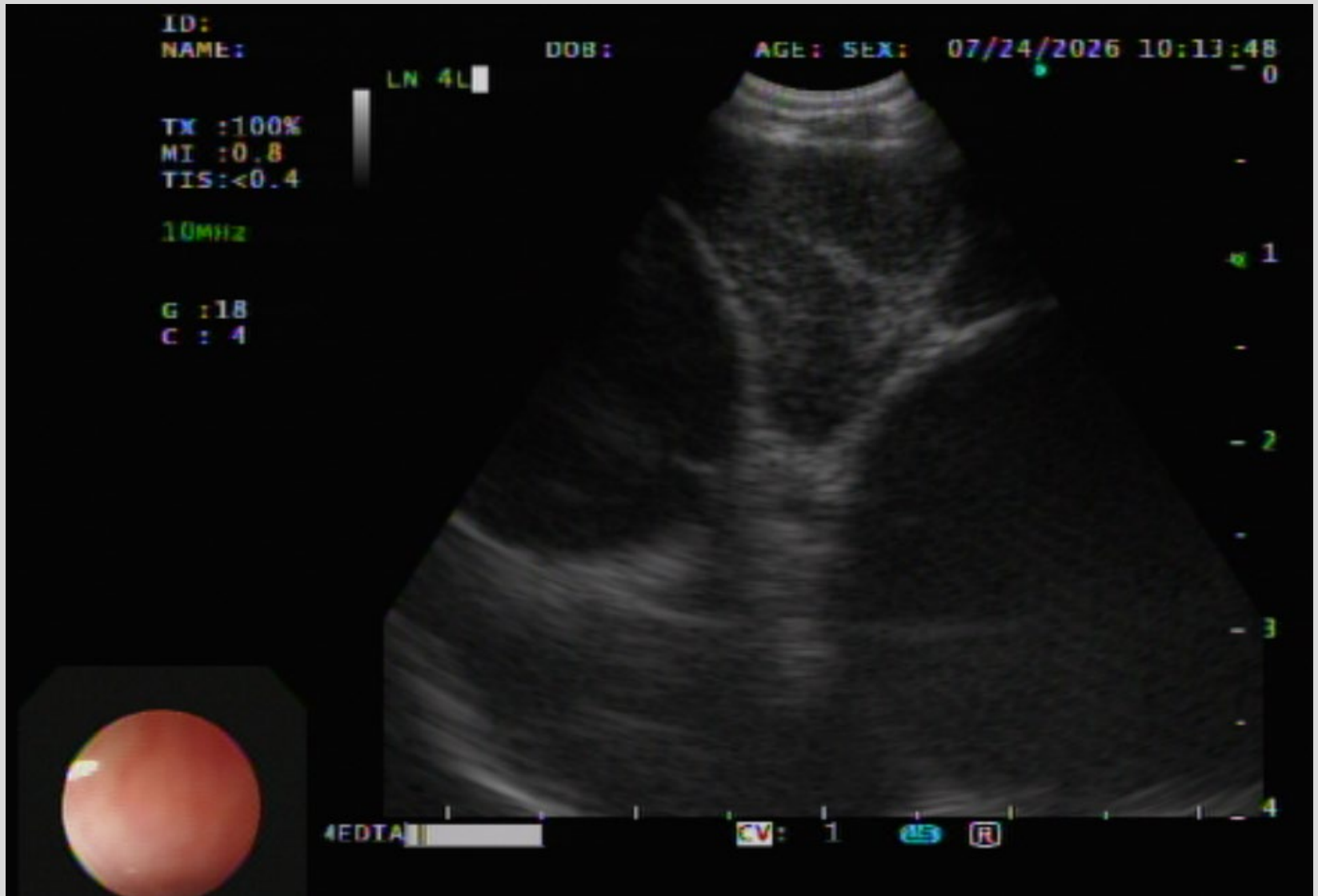


Case Sharing



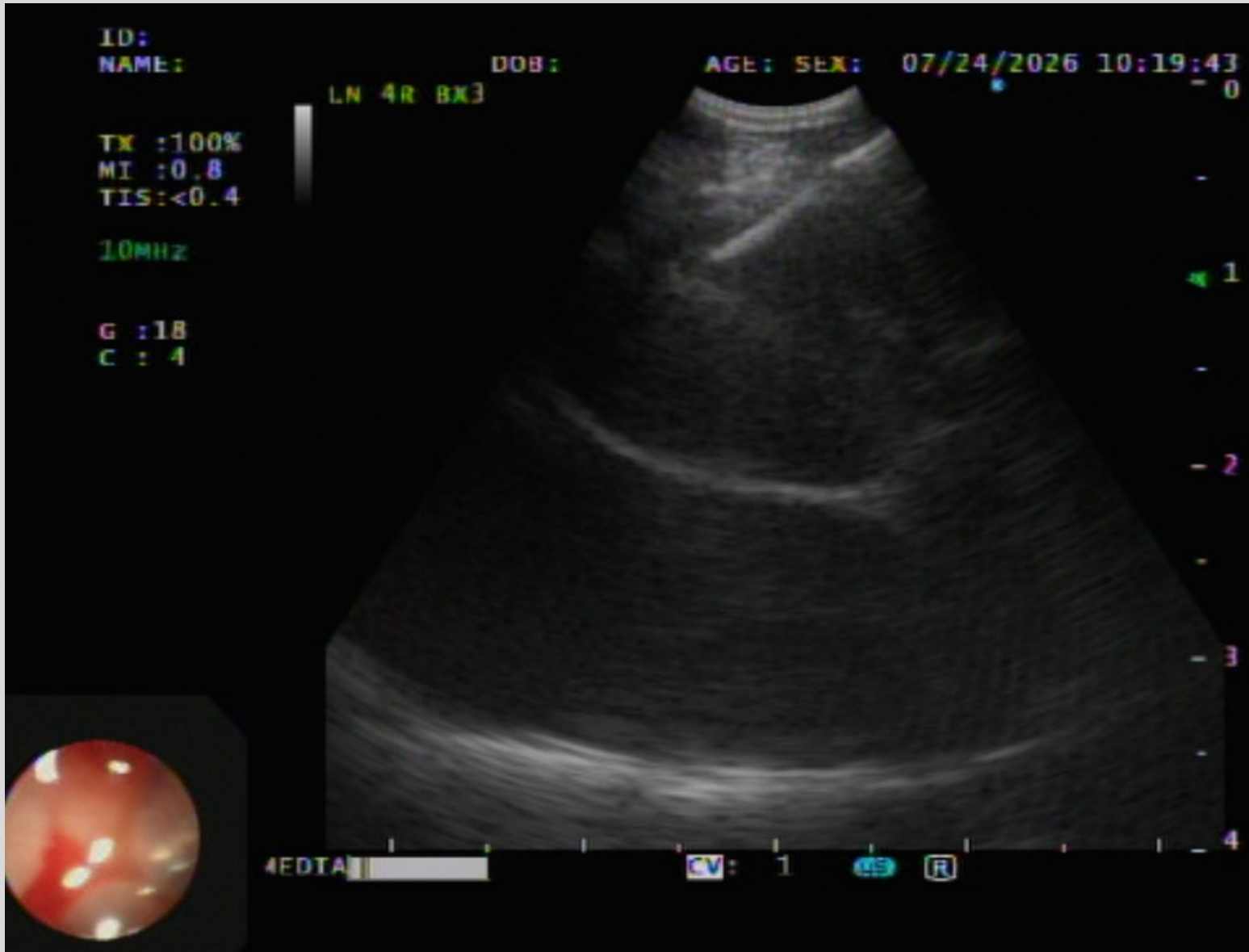


Case Sharing





Case Sharing





Case Sharing





Case Sharing



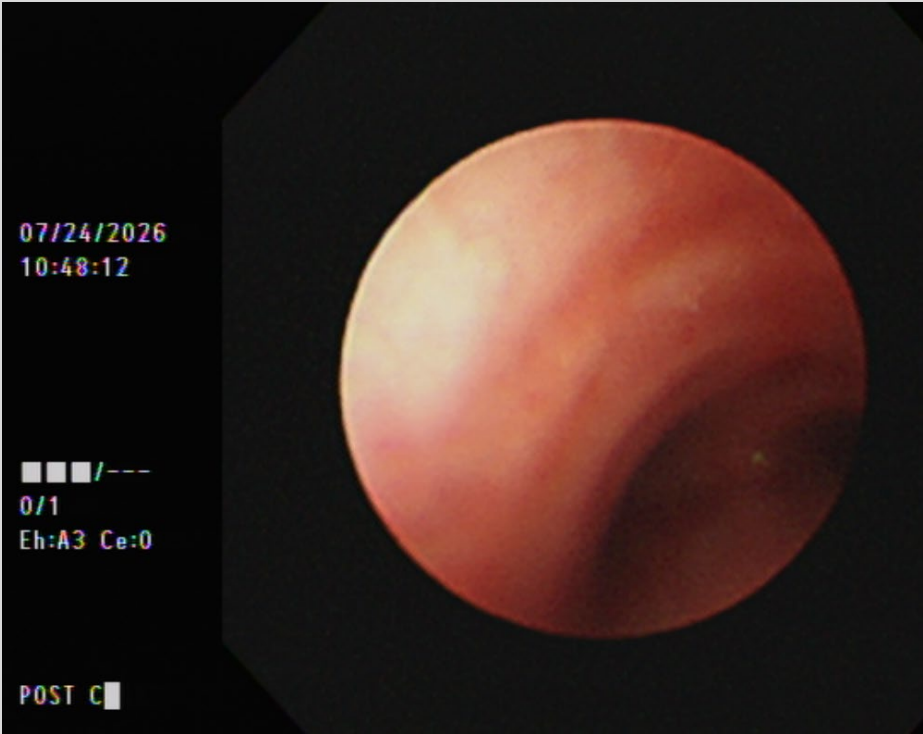
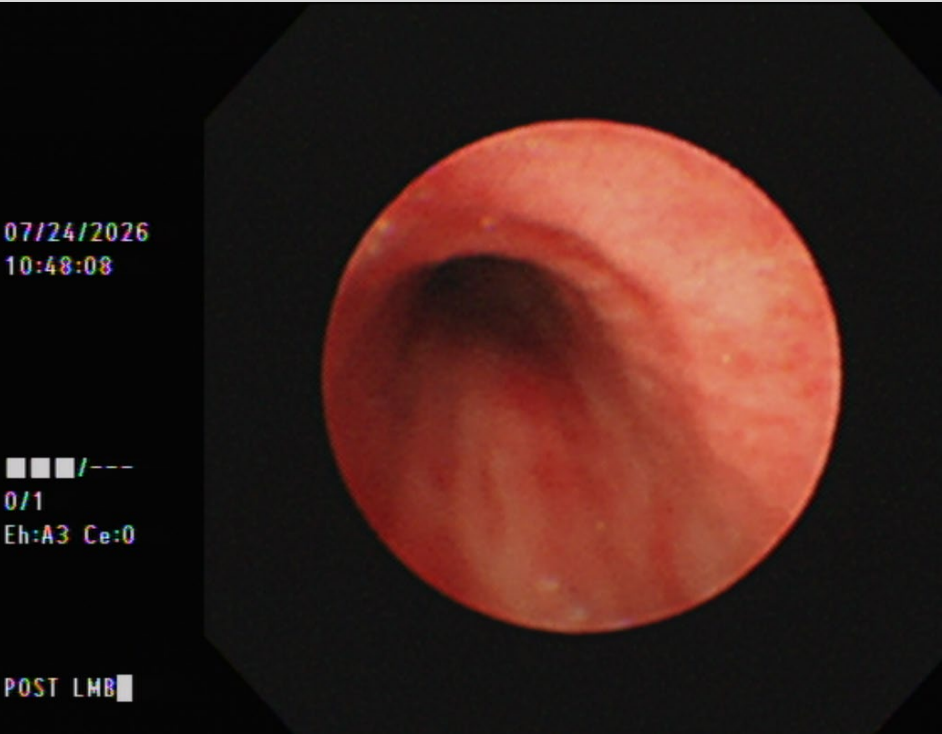


Case Sharing





Case Sharing





Case Sharing

病理號: S115-31288

PATHOLOGICAL DIAGNOSIS:

Lymph node, station 7, EBUS-TBNA

--- Chronic granulomatous inflammation

GROSS FINDING:

Received in formalin consists of 2 fragments of gray tan soft tissue, measuring 0.2 x 0.1 x 0.1 cm and 0.2 x 0.1 x 0.1 cm. Entire specimen is embedded in 1 block. GMS and acid-fast stains are performed.

MICROSCOPIC FINDING:

Sections show blood clots and lymphoid tissue with chronic granulomatous inflammation. Multinucleated giant cells is also noted. No microorganism is demonstrated with GMS and acid-fast stain. No cells diagnostic of malignancy are seen. PCR for Mycobacterium tuberculosis will be performed and the result will be issued in another report.

病理號: S115-31286

PATHOLOGICAL DIAGNOSIS:

Lymph node, station 4R, EBUS-TBNA

--- Presence of epithelioid histiocytes

GROSS FINDING:

Received in formalin consists of one fragment of gray tan soft tissue, measuring 0.3 x 0.2 x 0.1 cm. Entire specimen is embedded in 1 block. GMS and acid-fast stains are performed.

MICROSCOPIC FINDING:

Sections show blood clots and lymphoid tissue with few epithelioid histiocytes. No cells diagnostic of malignancy are seen.



Take Home Messages

- RP-EBUS guided TBB provided better diagnostic rate in peripheral lung lesion compared to TBB alone.
- RP-EBUS cannot provide real-time sampling
- CP-EBUS-TBNA can provide similar diagnostic yield compared to mediastinoscopy.
- CP-EBUS can perform under real time sampling for mediastinal nodal staging.

Thanks for your attention!!