폐결절/폐암 진단적 접근:
-내시경적 진단-

2024.4

울산의대 울산대병원
호흡기내과 이태훈

순서

- 폐결절/폐암 **진단적 접근**
- 내시경적 진단

폐결절(<3cm)/폐종괴(>=3cm)_“주소” 최초방문

- 무증상 1-2기
  - **폐암고위험군: (30py(15y-quit) 55-75y):** 폐암검진CT (LDCT)
  - 수술 전 검사, 건강검진 등에서 우연히 발견 (**폐암고위험군 & 폐암비고위험군**)

- 유증상 3-4기
  - 호흡곤란 (locally advanced)
  - 허리통증 (bone(spine mets))
  - 마비 (brain mets)

폐결절(<3cm) 폐종괴(>=3cm)

- The discovery of a lung nodule/mass prompts a decision regarding
  - observation,
  - direct surgery, or
  - tissue biopsy

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Solid<15mm, or Subsolid:solid portion<8mm: Observation

-Solid (or Subsolid전체크기)<6: no risk: no fu
-Solid (or Subsolid전체크기)<6: high risk* (sm): 12mCT
-Solid 6-8: 6mCT
-Solid 8-15: 3mCT

-Subsolid:solid 0 (pGGO)<30: 12mCT
-Subsolid:solid 0 (pGGO)>=30: 6mCT
-Subsolid:solid<6: 6mCT
-Subsolid:solid 6-8: 3mCT

주요참고:
NCCN2024, Fleischner2017, LungRADS한글2020

*high risk (NCCN2024)
-smoking,
-폐암가족력(FDR: 부모,형제,자식)
-직업(석면, 라돈-광산, 우라늄-원자력발전소)

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  - **direct surgery**, or
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f/u CT: Growing, or

Solid15-30, or **Subsolid:solid≥8**

(if 1st CT for a new lesion, 1mCT to r/o infl.lesion after ABX)
(if subsolid, add CBC/eos/IgE to r/o PIE[parasite])

→ **Upfront surgery** (Wedge resection) with frozen biopsy

Most cost-effective unless a distant or nodal metastasis is suspected

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(if subsolid, add CBC/eos/IgE to r/o PIE/parasite)

Nodule (tumor) is > 30 mm, Central lesion, or Multiple lesions,
LN mets or Distant mets
Possibility of benign disease that can be treated medically
-Satellite lesions, acute-onset resp or systemic sx (fever)

주요참고:
NCCN2024, Fleischner2017, LungRADS한글2020

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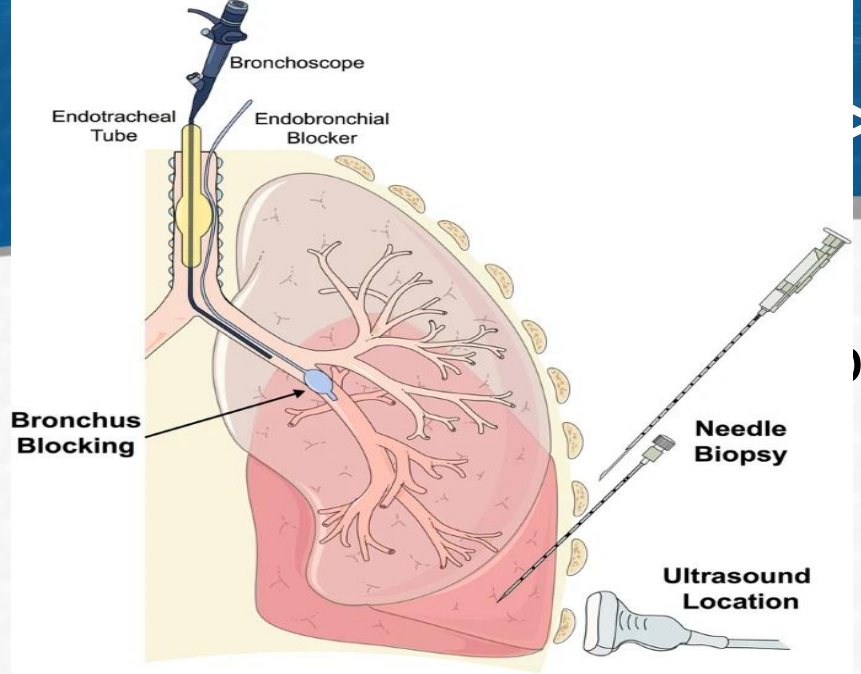
>=3cm)



Needle biopsy was carried out at bedside under ultrasound guidance. To prevent tension pneumo-thorax and massive intrabronchial hemorrhage, an endobronchial blocker was placed at lobar bronchus by a bronchoscope.

odule/mass prompts a decision regarding

- **tissue biopsy**
  - Percutaneous biopsy
    - Fluoroscopy-guided biopsy
    - CT-guided biopsy
  - Thoracoscopic biopsy
  - Bronchoscopic biopsy
    - Flexible bronchoscopy
      - Conventional bronchoscopy (외경:5mm이상)
      - Radial EBUS using thing bronchoscope (외경:3-4mm)
      - Convex EBUS
      - ENB, Robot bronchoscopy
    - Rigid bronchoscopy

내시경적 진단
(호흡기내과/흉부외과)

Tissue biopsy

- Things to consider when deciding on a tissue biopsy method.
  - ***i) Simultaneous histopathologic diagnosis and disease staging*** *(Metastatic sites are preferred over primary sites)*
  - ***ii) Ease of access & Safety (bleeding, pneumothorax)***
  - ***iii) Diagnostic yield (↑) of the procedure***
  - ***iv) Cost (↓) of the procedure***
  - ***v) Institution's experience and facilities***

cEBUS = convex EBUS, FB = flexible bronchoscopy, rEBUS = radial EBUS

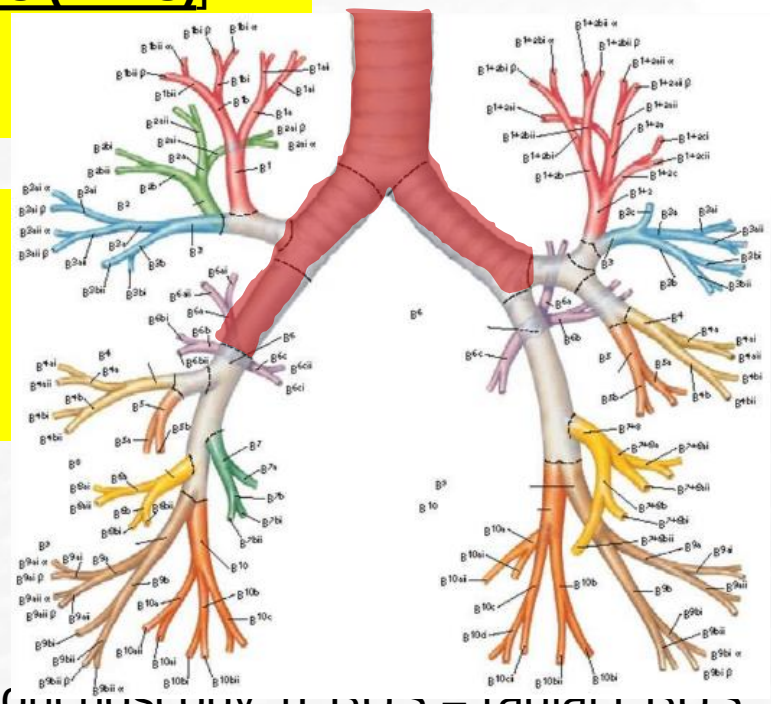
UUH: The current tissue biopsy strategy

- First priority modalities
  - Cancer-suspicious **lung lesion(s) with Pleural Effusion**: Thorachoscopic biopsy (**medical thoracoscopy**)
  - Cancer-suspicious **lung lesion(s) in central lung airway** (**up to the segmental bronchial openings**): **Conventional FB**
  - Cancer-suspicious **lung lesion(s) with mediastinal LAP or central lung airway-abutting mass**: **cEBUS**

- If **1st prioriy modalities are impossible** [usually for the **peripheral lung lesions (PLLs)**]
  - Percutanous biopsy (**CT-guided biopsy**) vs **rEBUS**

- Special situation
  - Cancer-suspicious **lung lesion(s) with**
    1) **significant "central airway obstruction"**
    2) **significant "bleeding"**

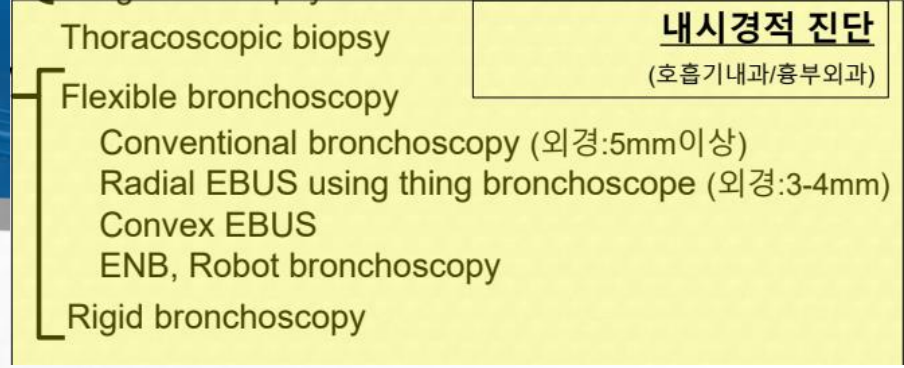
RB



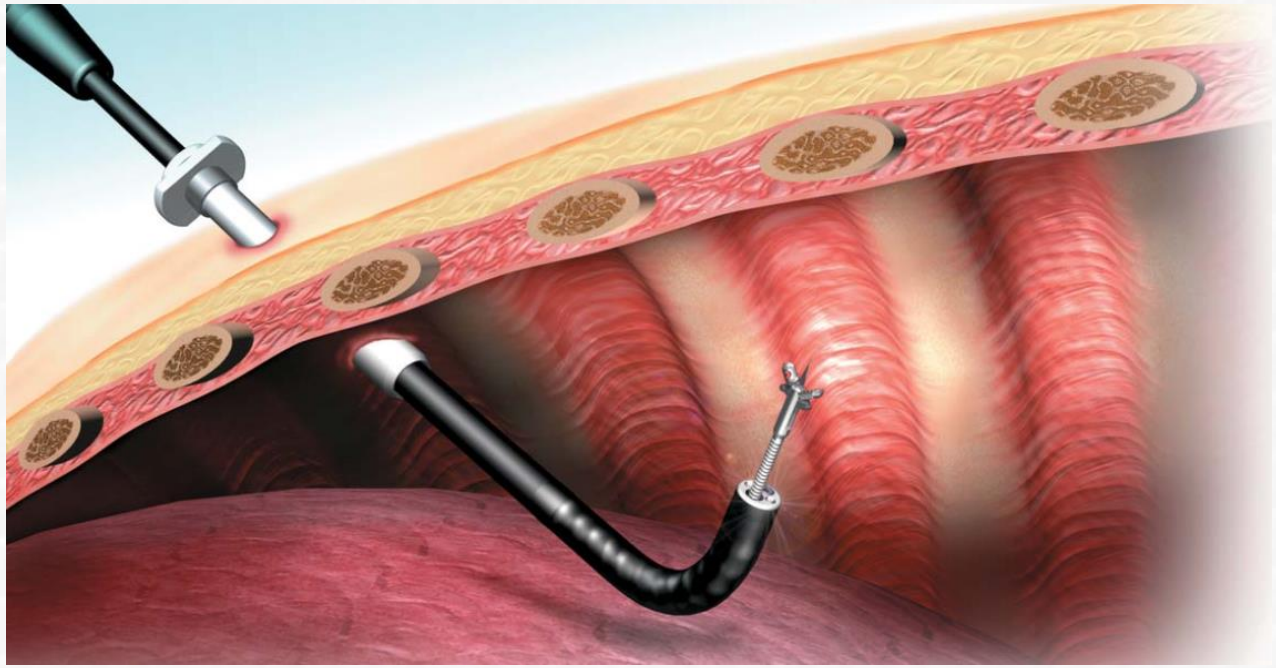
cEBUS = convex EBUS, FB = flexible bronchoscopy, RB = rigid bronchoscopy, rEBUS = radial EBUS

순서

- 폐결절/폐암 진단적 접근
- **내시경적진단**



Medical thoracoscopy (MT)



내시경적 진단
(호흡기내과/흉부외과)

- Thoracoscopic biopsy
- Flexible bronchoscopy
  - Conventional bronchoscopy (외경:5mm이상)
  - Radial EBUS using thing bronchoscope (외경:3-4mm)
  - Convex EBUS
  - ENB, Robot bronchoscopy
- Rigid bronchoscopy

Tissue biopsy: Good candidate for MT

: Cancer-suspicious **lung lesion(s) with Pleural Effusion**

Thoracoscopic biopsy

내시경적 진단

주소: 호흡곤란

SO: 발열이나 흉통 없음.
CRP 1mg/dL

Tissue biopsy: Good candidate for MT

: Cancer-suspicious **lung lesion(s) with Pleural Effusion**

Thoracoscopic biopsy

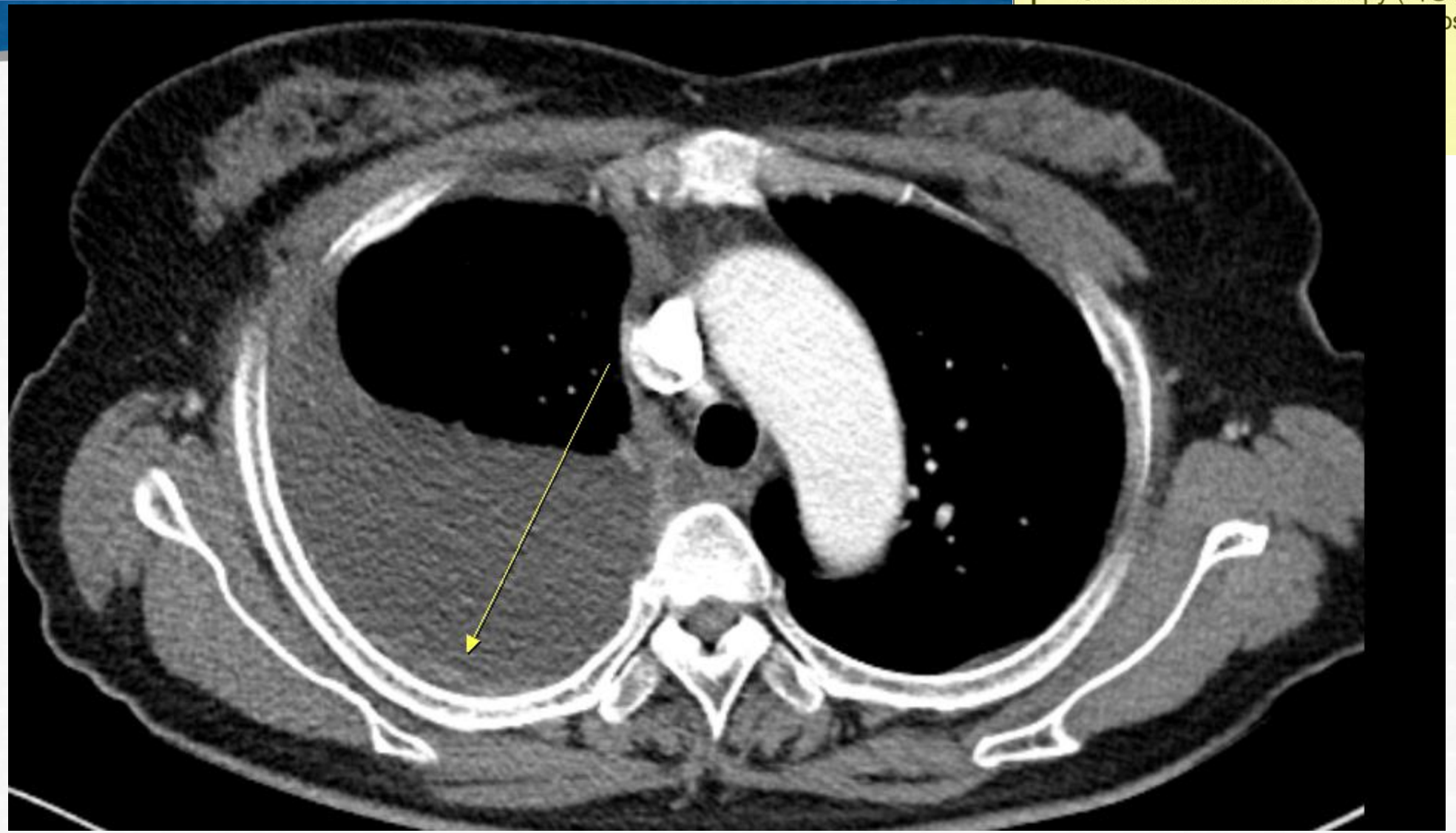
Flexible bronchoscopy

Conventional bronchoscopy (외경:5mm이상)

oscope (외경:3-4mm)

내시경적 진단

(호흡기내과/흉부외과)



Medical thoracoscopy (MT)

Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

Flexible bronchoscopy
- Conventional bronchoscopy (외경:5mm이상)
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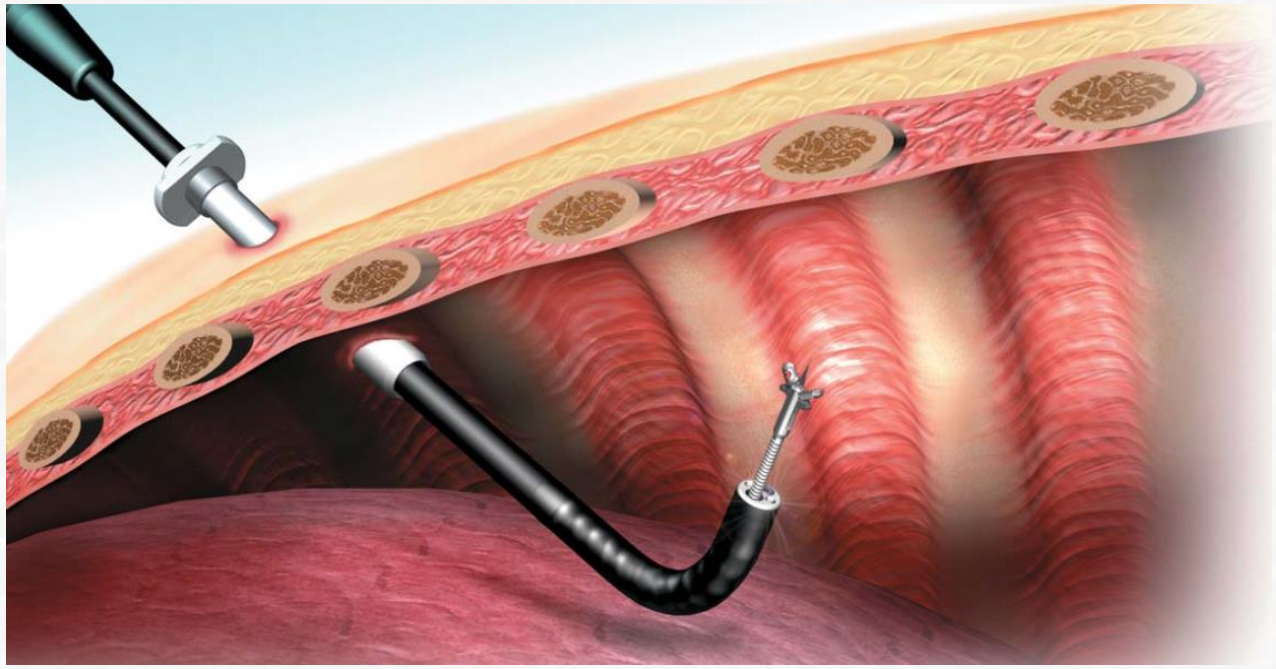
Rigid bronchoscopy



Medical thoracoscopy
= Pleuroscopy
= Local anesthetic thoracoscopy

- MT의 정의: **내과의사 (physician)에 의해 전신마취가 아닌 상태 (의식하 진정+국소마취)**에서 시행되는 **흉강경(thoracoscopy)**
  - 외과의사 (surgeon)에 의해 전신마취하에 이루어지는 흉강경(thoracoscopy) [VATS, video-assisted thoracoscopic surgery]에 비해 **제한적 적응증 (Drain/Bx(parietal)/Desis) 만 가지고 있음.**

2020_utd_Medical thoracoscopy (pleuroscopy)_Equipment, procedure, and complications

MT scope의 종류

- Thoracoscopic biopsy
- Flexible bronchoscopy
  - Conventional bronchoscopy (외경:5mm이상)
  - Radial EBUS using thing bronchoscope (외경:3-4mm)
  - Convex EBUS
  - ENB, Robot bronchoscopy
- Rigid bronchoscopy

내시경적 진단
(호흡기내과/흉부외과)

▪Rigid Mini-Thoracoscope

A bit difficult at first (requires another monitor)
Cheaper
잔고장이 없음.

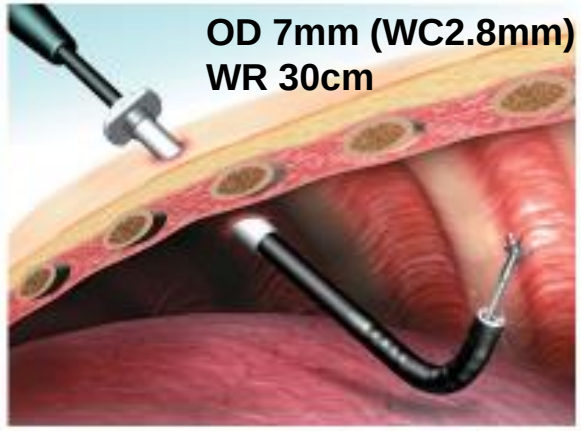
- ✓ Diagnostic
- ✓ Therapeutic (pleurodesis, adhesiolysis)
- ✓ 1 or 2 ports of entry
- ✓ Metallic trocar

Cantó A, et al. Thorax. 1977;32(5):550-4.
Oldenburg FA Jr, et al. Chest. 1979;75(1):45-50.

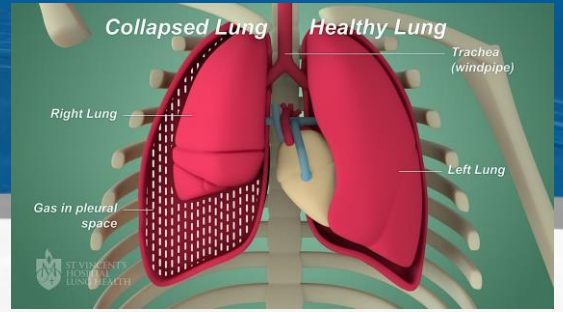
▪Semirigid Thoracoscope

Convenient (can utilize existing Olympus center system)
Expensive
Fragile

- ✓ Diagnostic ± Therapeutic (pleurodesis)
- ✓ 1 port of entry
- ✓ Flexible trocar



McLean AN, et al. Chest. 1998;114(1):150-3.



내시경적 진단
(호흡기내과/흉부외과)

- Thoracoscopic biopsy
- Flexible bronchoscopy
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  - ENB, Robot bronchoscopy
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	MT	VATS
Who	**Pulmonologist**	**Thoracic surgeon**
Where	**Endoscopy suite**	**Operating room**
How	**LA with Conscious sedation**	**GA**
	Spontaneous respiration	**Double lumen intubation**
		Single lung ventilation

Somewhat moving

Partial lung collapse

Complete immobility

Complete lung collapse

MT

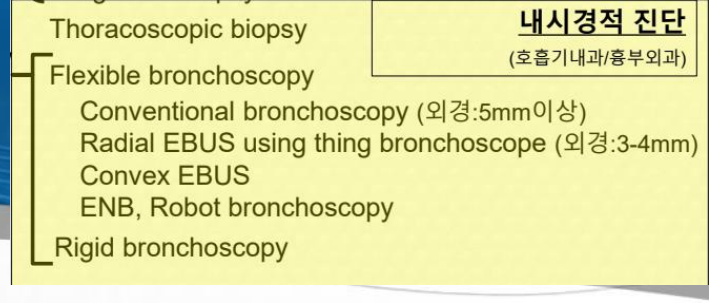
-narrower pleural space
-1 port
-simple procedure
-simple instruments (just a scope and the forceps)

VATS

-wider pleural space
-2 or(<) 3 ports
-complex procedure
-multiple instruments

Procedures that are **too complex, time consuming**, or have **frequent complications should be done with VATS rather than MT.**

Loddenkemper et al. Medical thoracoscopy/pleuroscopy: manual and atlas (2011 Thieme)
Curr Opin Pulm Med 2016, 22:297–308



- MT의 금기
  - 절대적 금기
    - **Lack of pleural space (pleural adhesion)**
    - Unstable hemodynamic status
    - Severe hypoxemia despite O_2 supply
    - Uncooperative patient
    - Lack of informed consent
  - 상대적 금기
    - Trapped lung
    - Bleeding tendency
    - Very severe obesity
    - Refractory cough

Pleural adhesion

-suspected from

Patient's history:

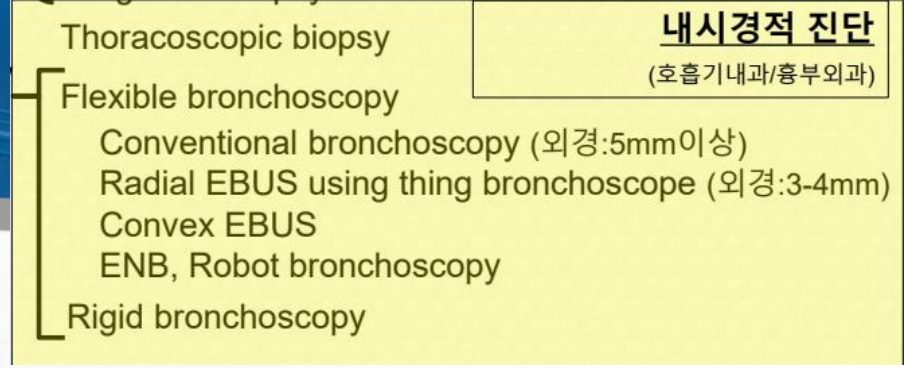
- previous pleurisy, *or*
- thoracic surgery

Imaging study:

- CT: pleural thickening w/o effusion, *or*
- Ultrasound: no lung sliding

Loddenkemper R, et al. Medical thoracoscopy/pleuroscopy. 2011 p79

FB (flexible bronchoscopy)



- OD
  - **6.9mm (6.6mm)**
    - cEBUS

- **5~6mm**
  - Conventional bronchoscope

Lung lesion(s) at central lung airway

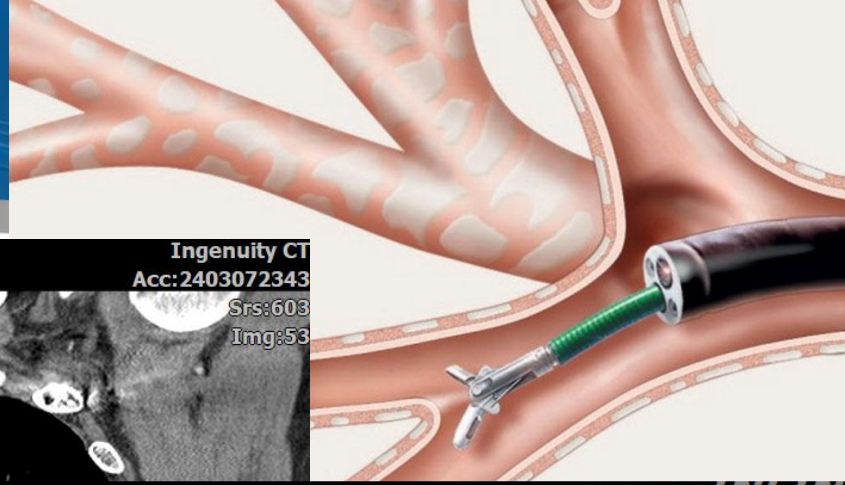
- **4mm**
  - Thin bronchoscope
- **3mm**
  - Ultrathin bronchoscope

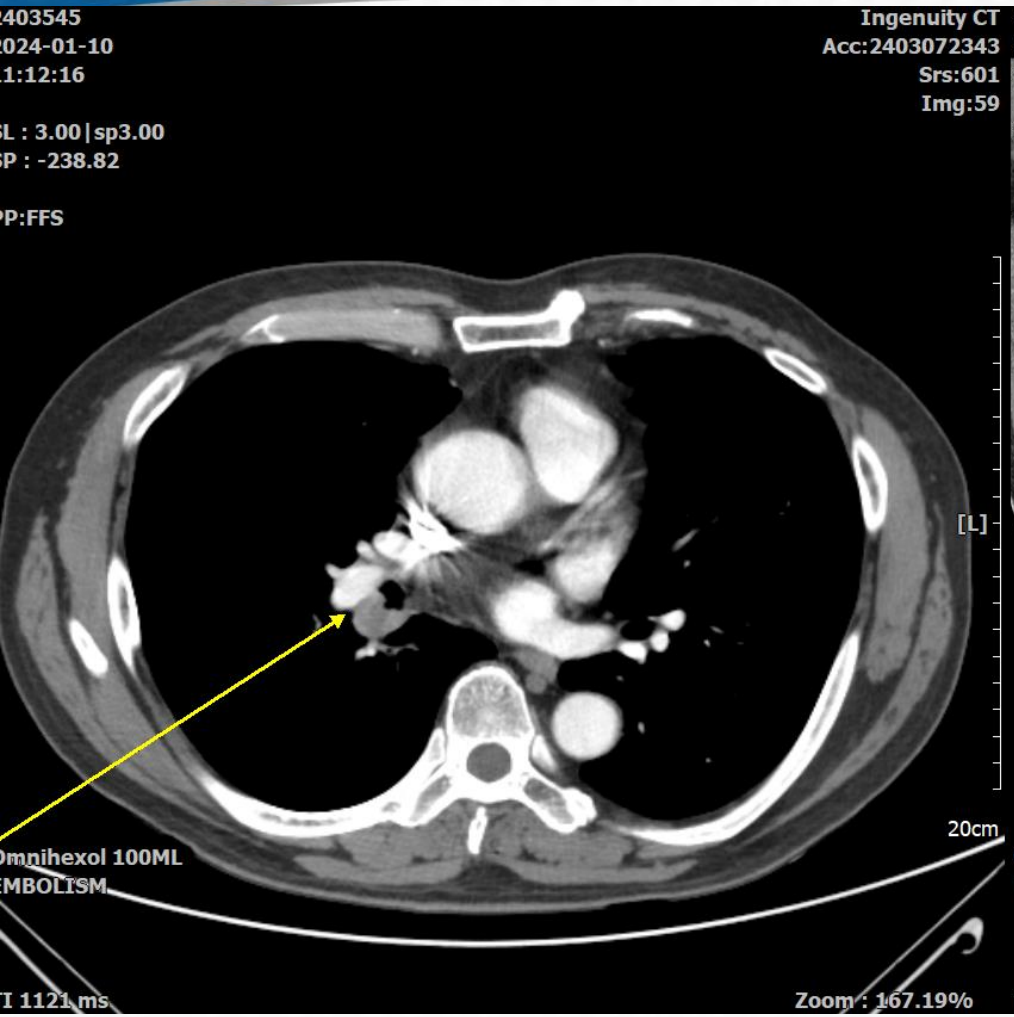
rEBUS Bx
For PLLs

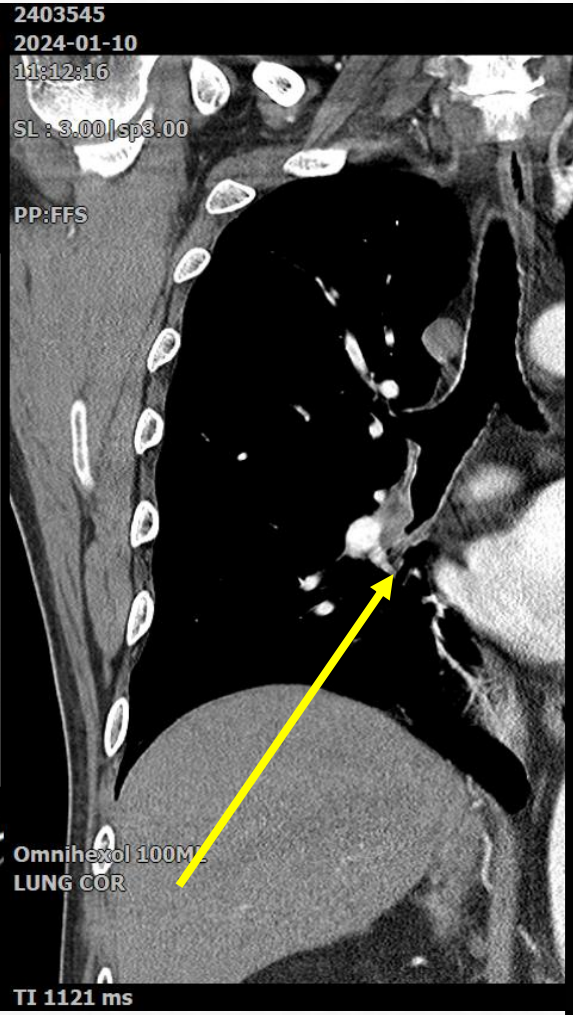
Bx = biopsy, cEBUS = convex EBUS, FB = flexible bronchoscopy, PLLs = peripheral lung lesions, rEBUS = radial EBUS

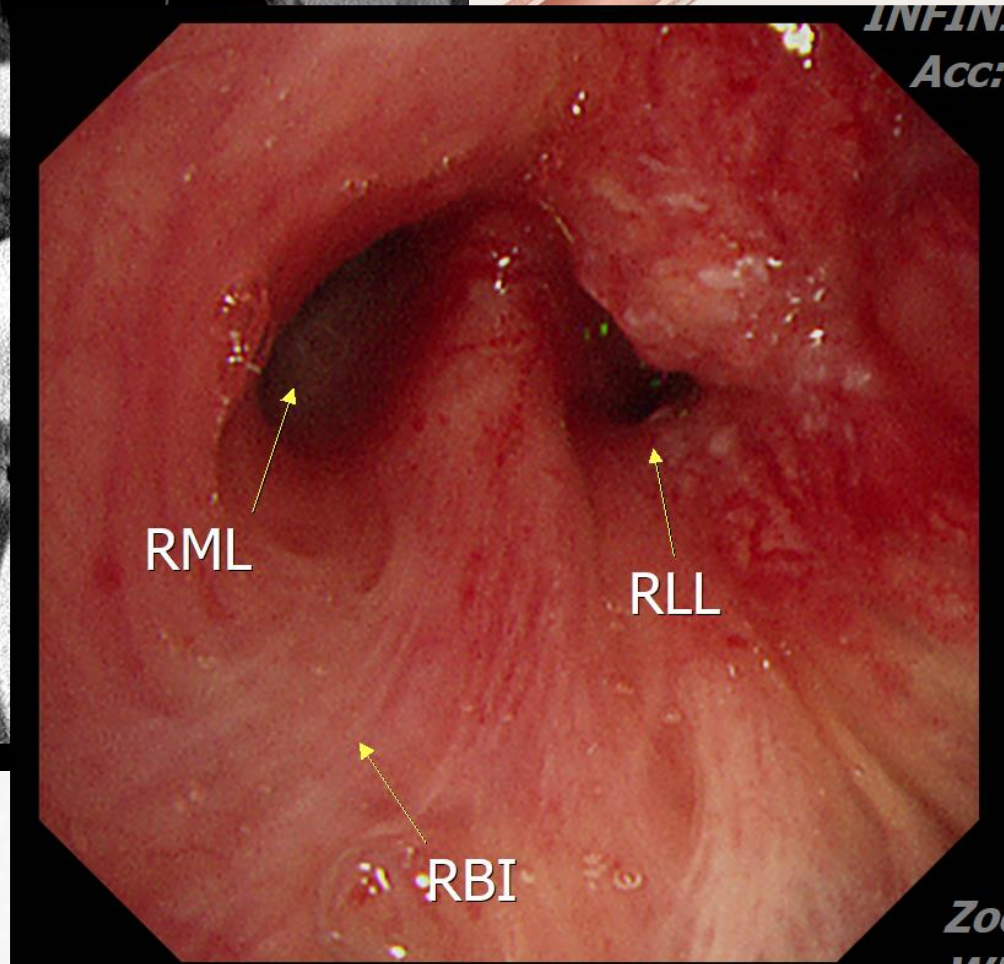
Tissue biopsy: Good candidate for Conventional FB (OD5-6mm)

: Lung lesion(s) in central lung airway (up to a segmental bronchus opening)



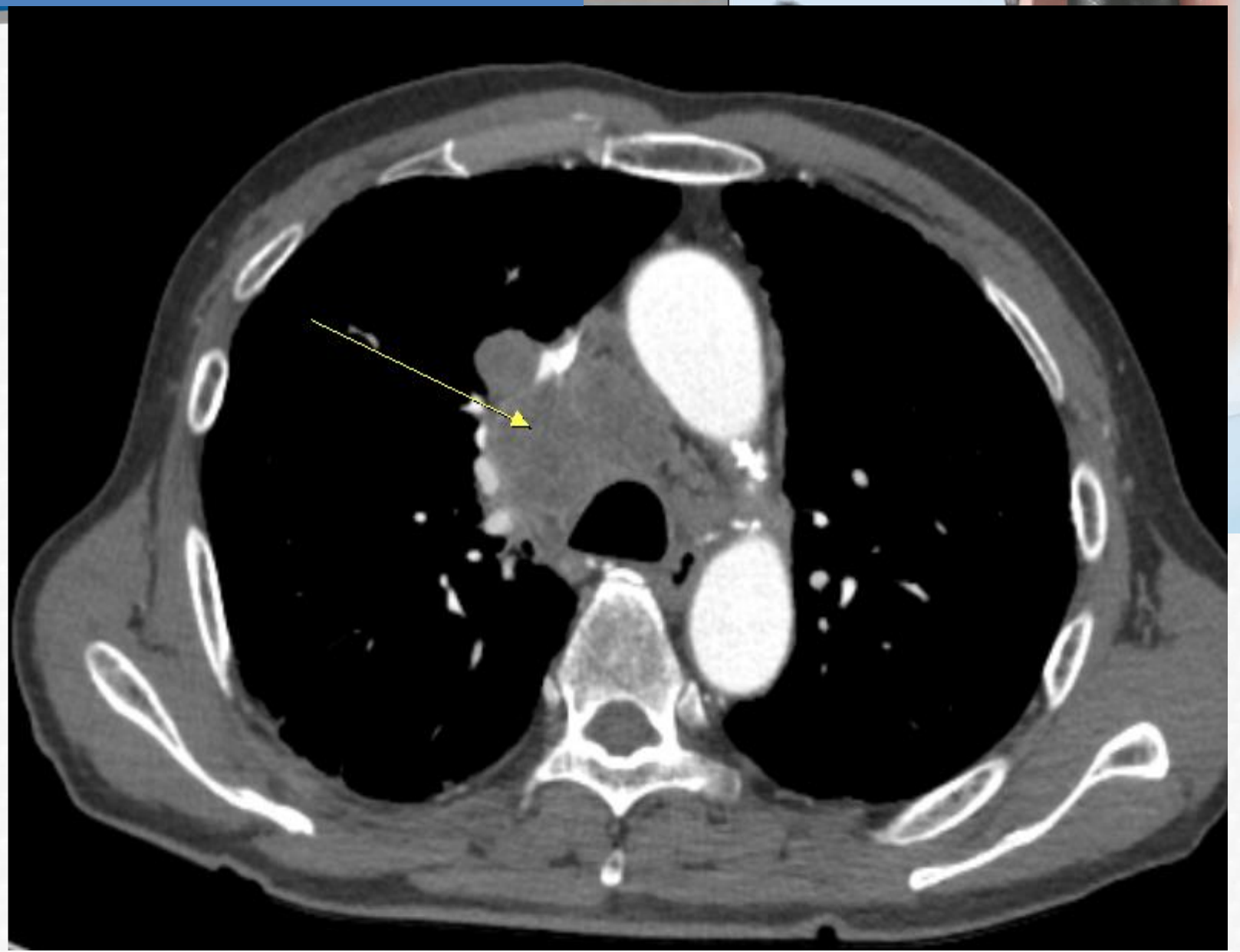


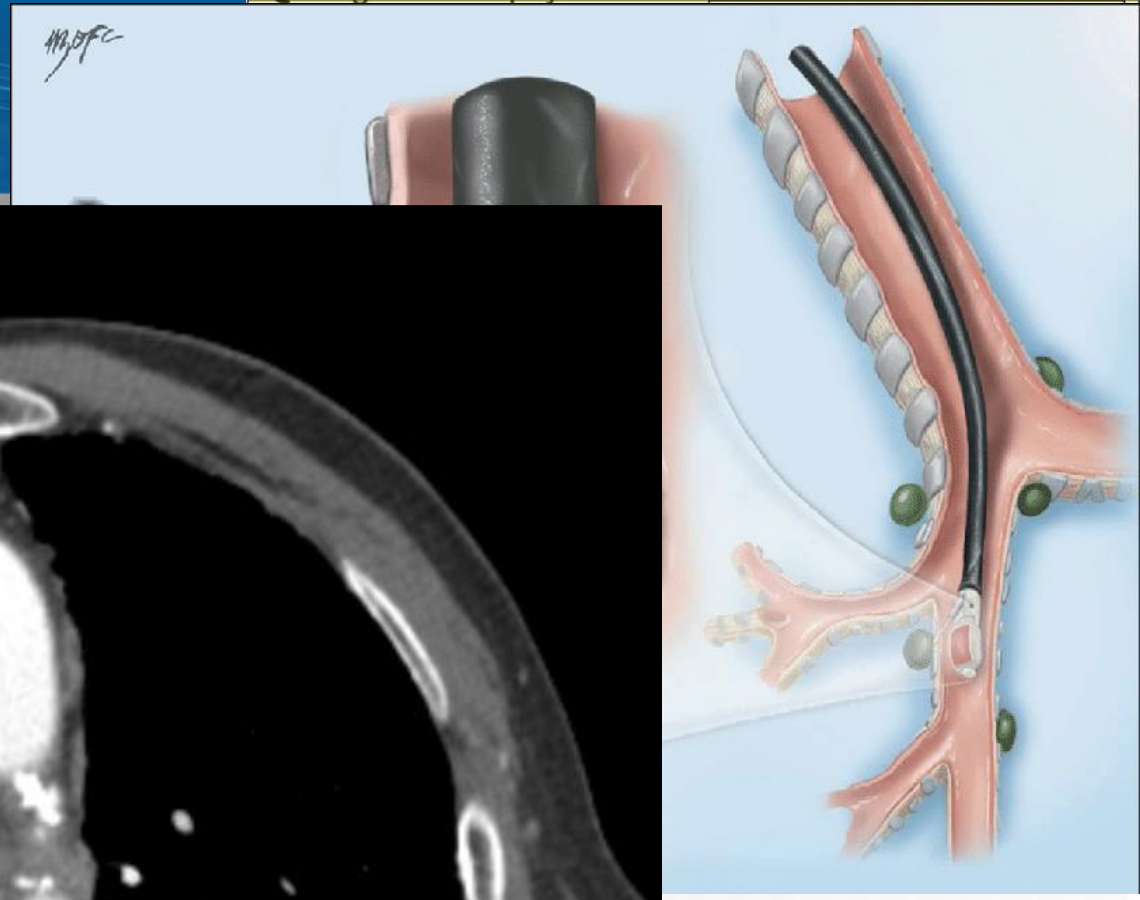




Tissue biopsy: Good candidate for cEBUS

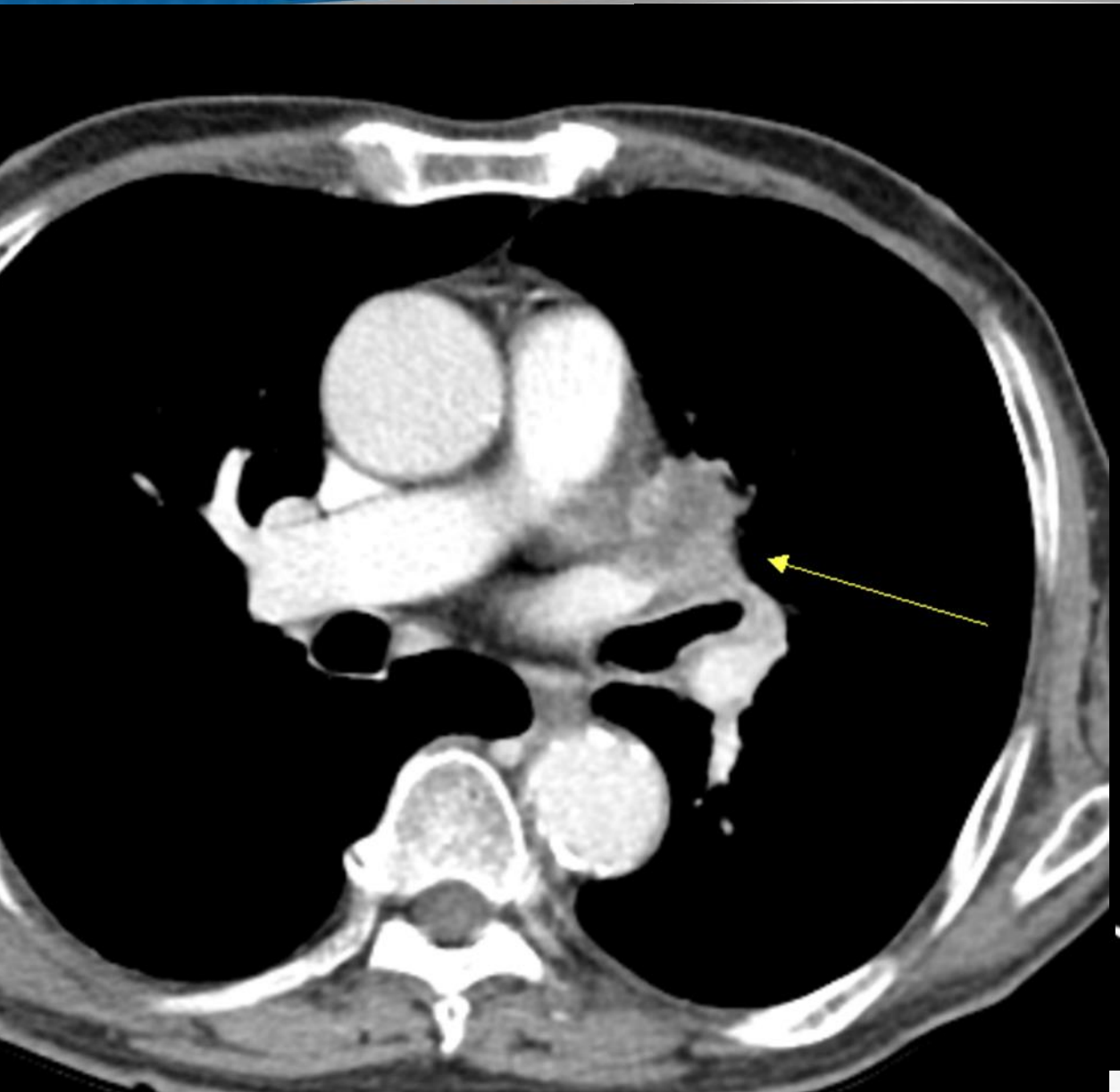
: Lung lesion(s) with mediastinal LAP or central lung airway-adjacent mass

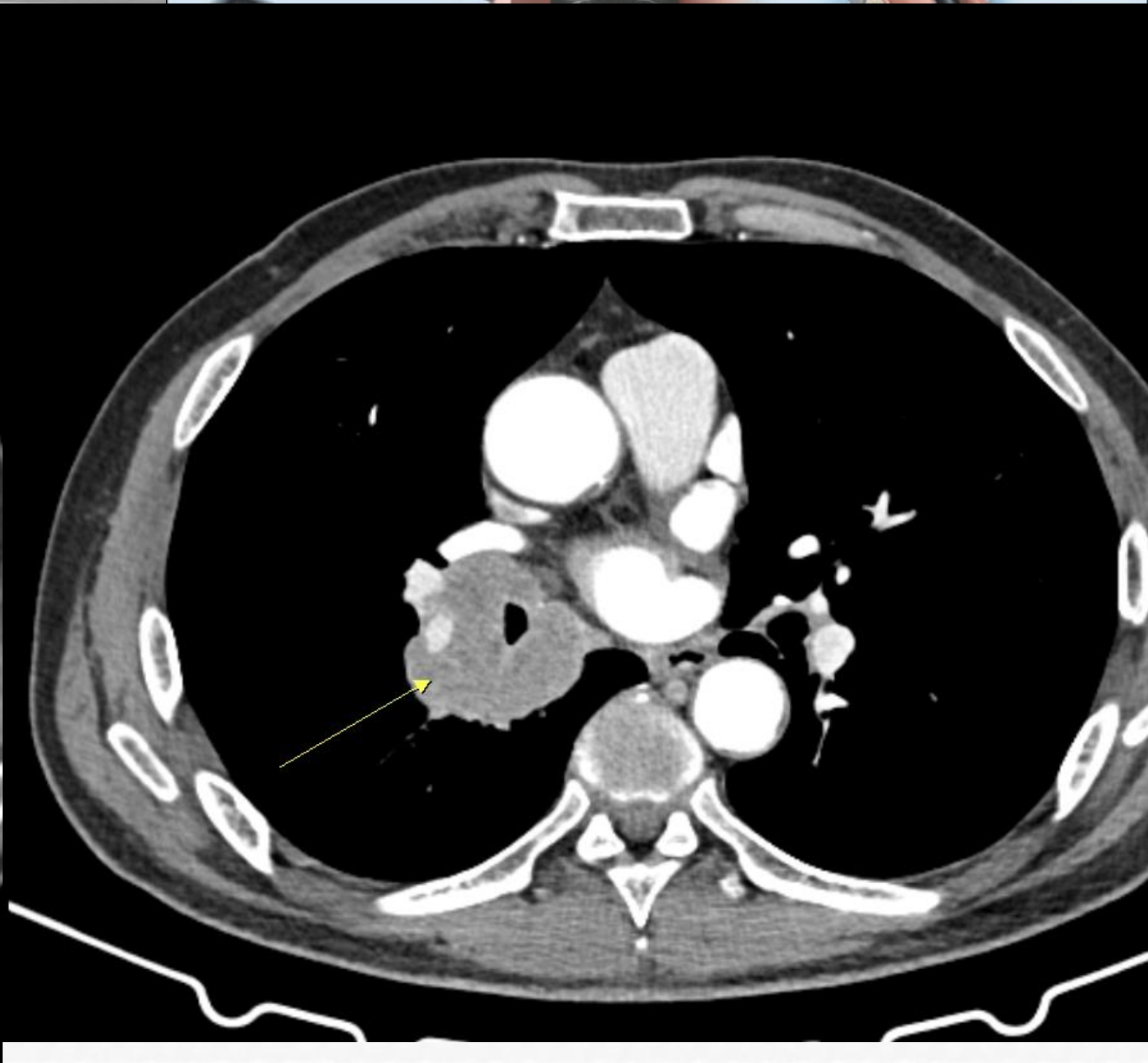




Tissue biopsy: Good candidate for cEBUS

: Lung lesion(s) with mediastinal LAP or
central lung airway-abutting mass/nodule





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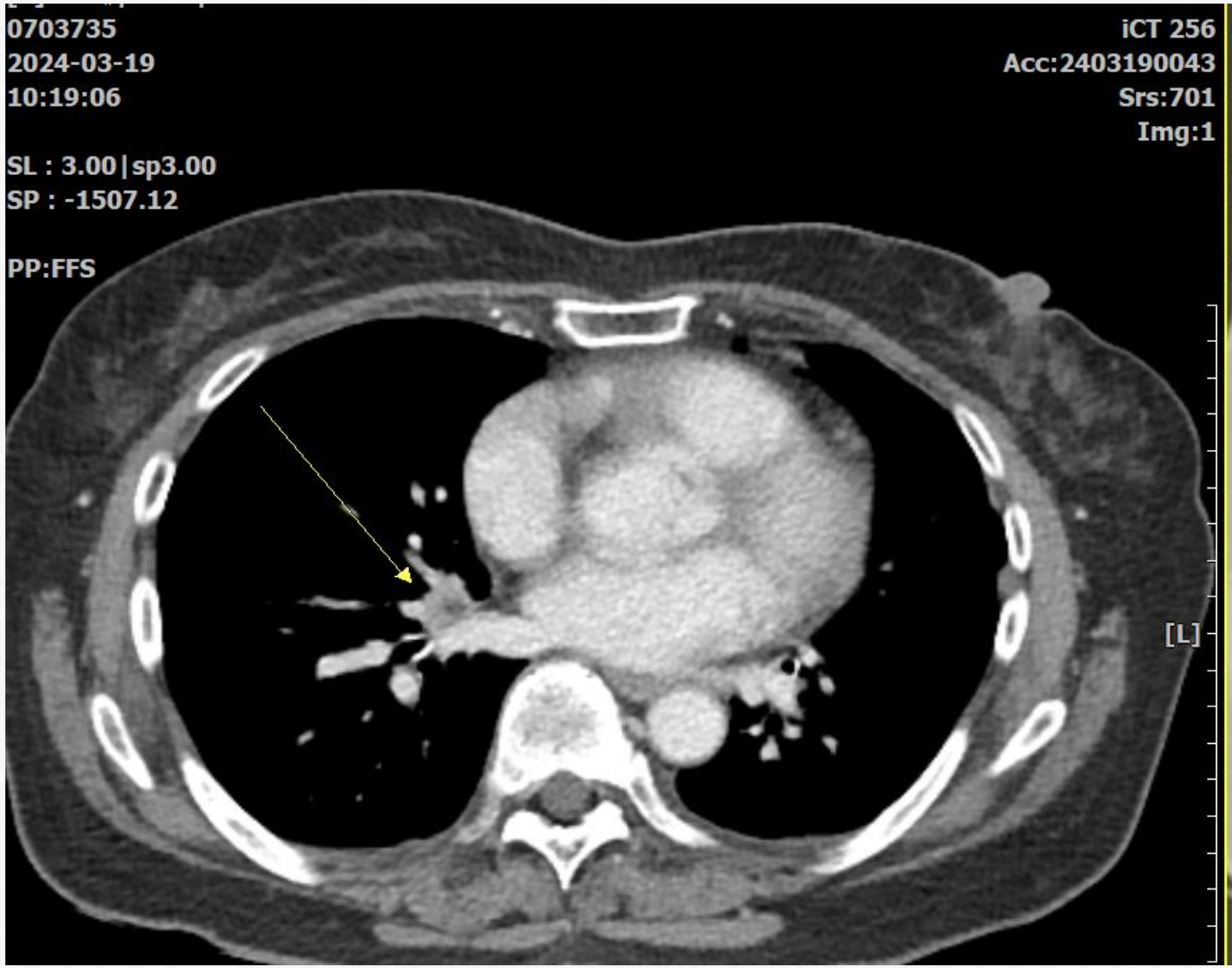
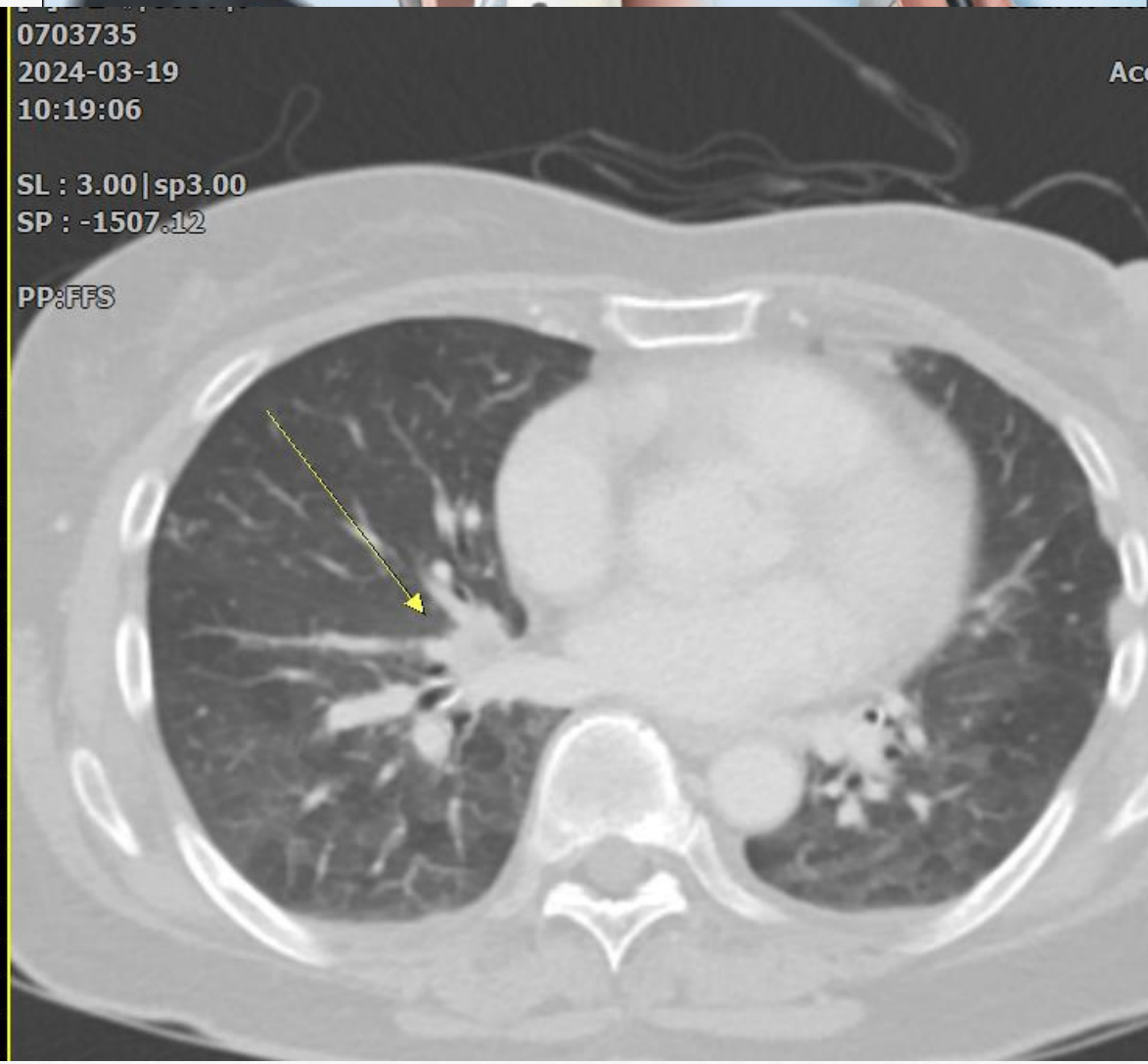




cEBUS scope으로 central lung airway 어디까지 접근가능한가?

ORIGINAL INVESTIGATION

The Usefulness of Endobronchial Ultrasonography–guided Transbronchial Needle Aspiration at the Lobar, Segmental, or Subsegmental Bronchus Smaller Than a Convex-type Bronchoscope

Noriaki Kurimoto, MD, PhD, FCCP, Takeo Inoue, MD, PhD,† Teruomi Miyazawa, MD, PhD, FCCP,† Katsuhiko Morita, MD, PhD,‡ Shin Matsuoka, MD, PhD,§ and Haruhiko Nakamura, MD, PhD**

J Bronchology Interv Pulmonol. 2014 Jan;21(1):6

직경 **4.5mm**의 기관지까지 가능

Tlee)직경 **4.5mm** 의 기관지 인접 병변 中

cEBUS-TBNA 가능할 수 있는 병변 위치

- RLL/LLL basal (대부분 가능)
- RLL/LLL sup (일부가능 [입구부(inlet)병변만])
- RML (일부가능-probe at RML or RLL basal)
- LUL Lingula (일부가능- probe at lingula)
- RUL ant/post (일부가능 [입구부(inlet)병변만])

cEBUS-TBNA 불가능 병변

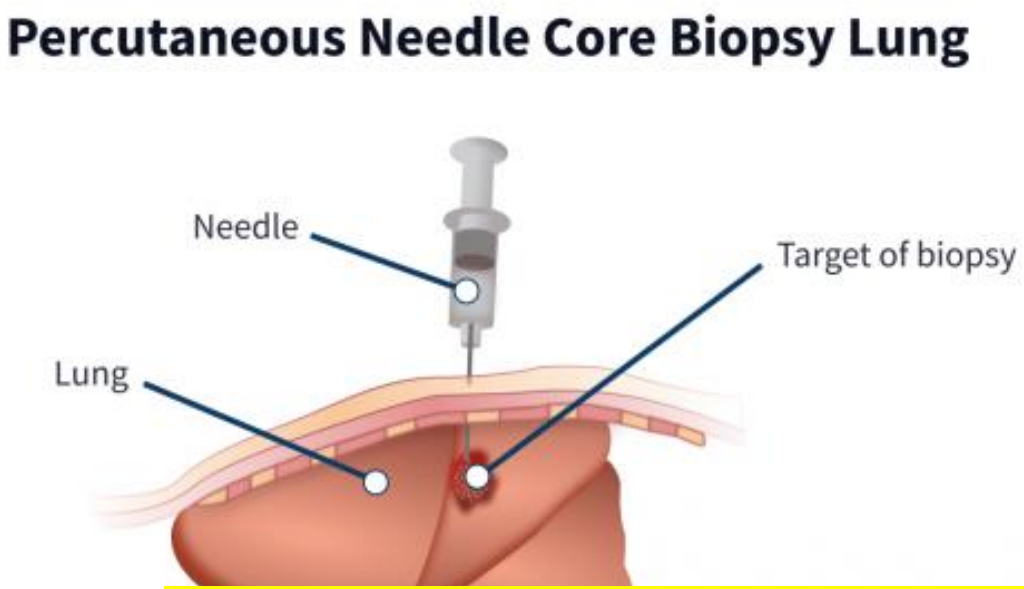
- LUL upper*
- RUL apical*

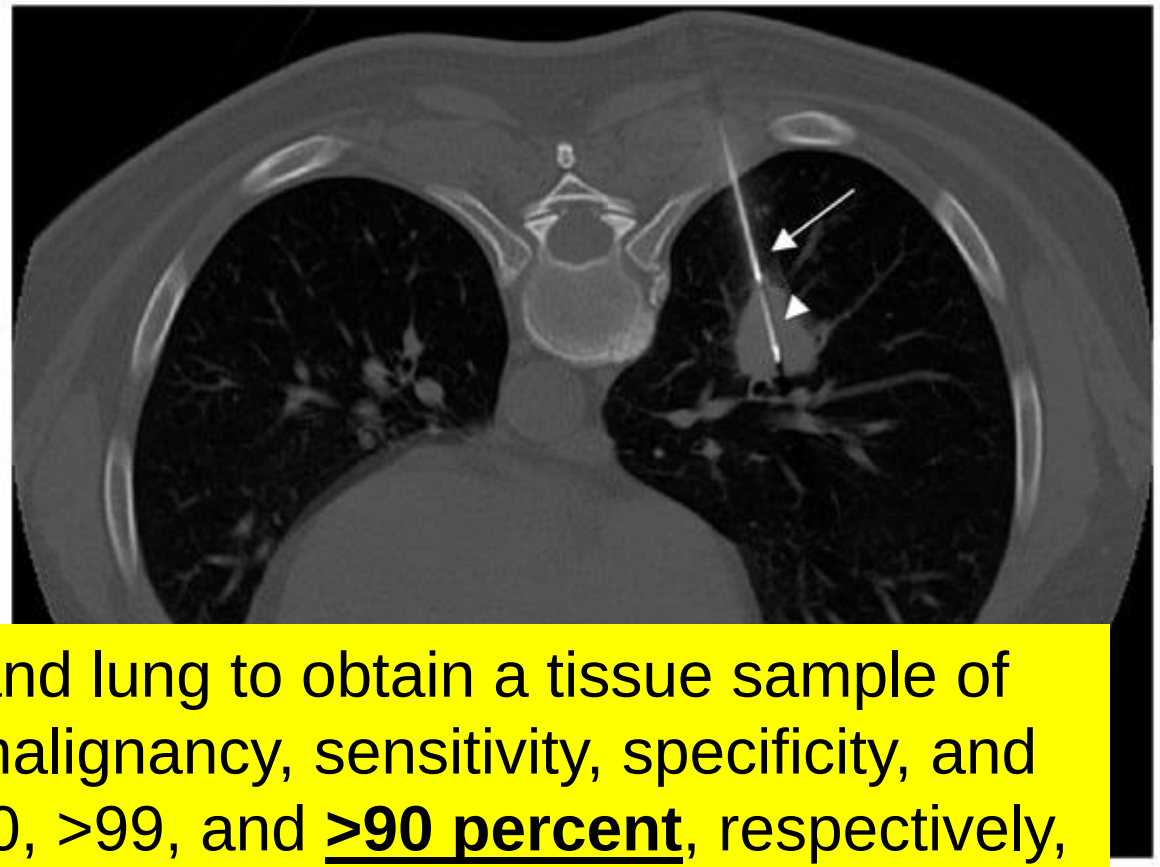
*입구부(inlet) 병변이더라도 probe 의 굴곡각이 나오지 않아 불가능

Peripheral lung lesions (PLLs)

- Percutanous biopsy (CT-guided biopsy)
- rEBUS (radial EBUS)
- ENB (electromagnetic navigation bronchoscopy)
- Robotic bronchoscopy

Percutanous biopsy (CT-guided biopsy) =PCNB (percutaneous needle biopsy)





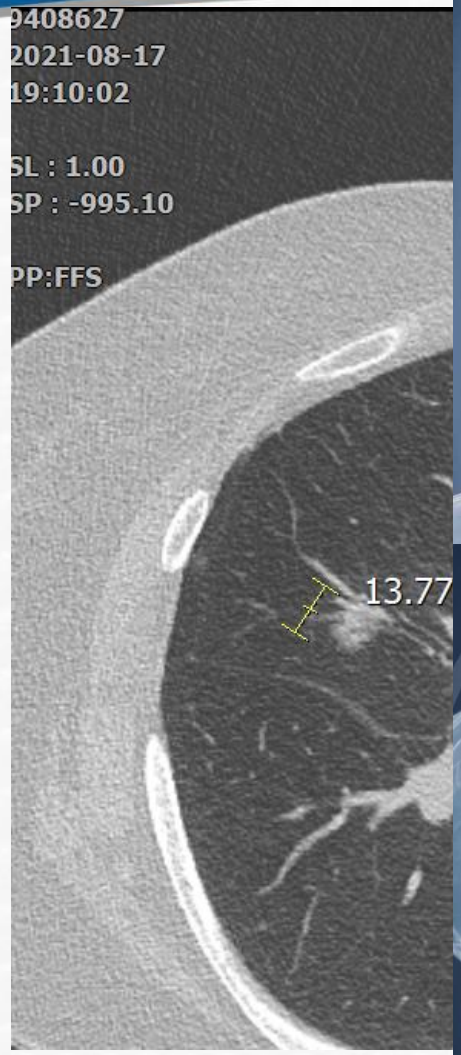
The needle traverses pleura and lung to obtain a tissue sample of the nodule. For diagnosis of malignancy, sensitivity, specificity, and **yield of TTNB are** usually >90, >99, and **>90 percent**, respectively, **even for nodules measuring <1 cm**

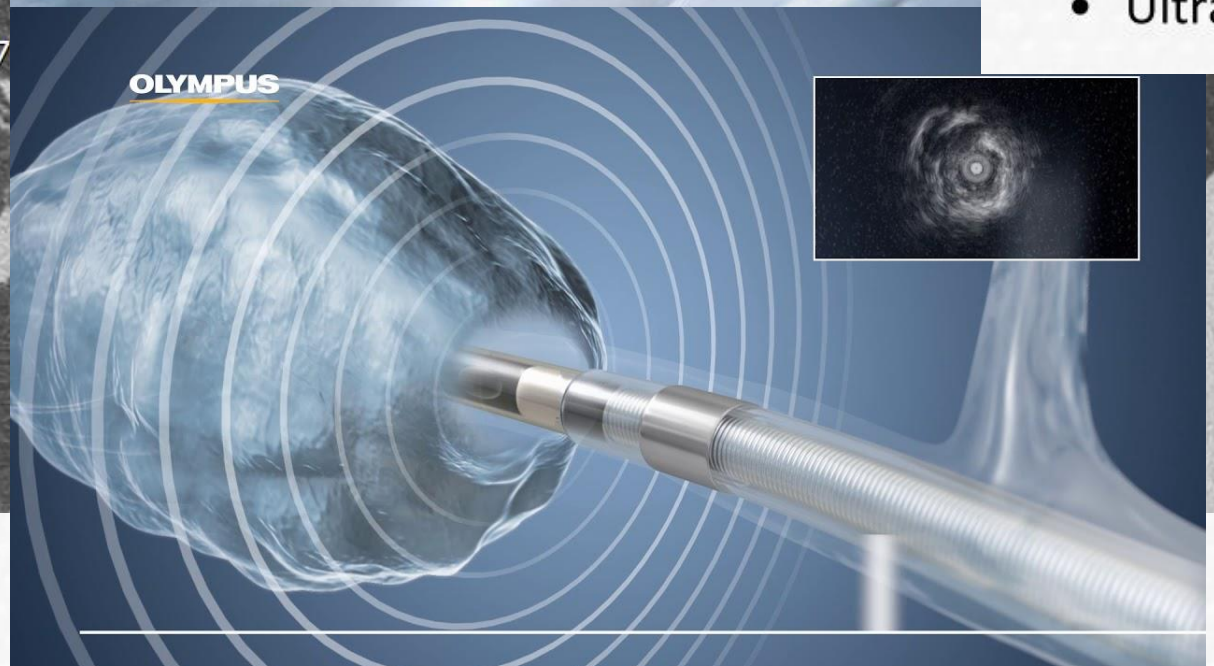
rEBUS (radial EBUS)

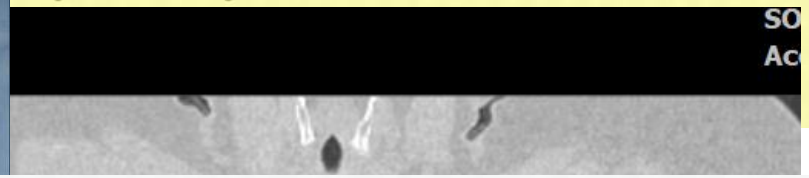
Thoracoscopic biopsy

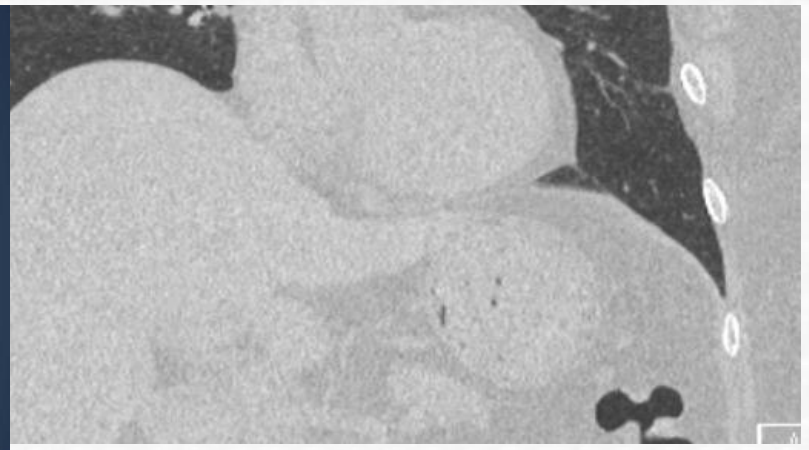
내시경적 진단
(호흡기내과/흉부외과)

Flexible bronchoscopy
- Conventional bronchoscopy (외경:5mm이상)
- Radial EBUS using thing bronchoscope (외경:3-4mm)
- Convex EBUS









- **4mm**
  - Thin bronchoscope
- **3mm**
  - Ultrathin bronchoscope

} rEBUS Bx For PLLs

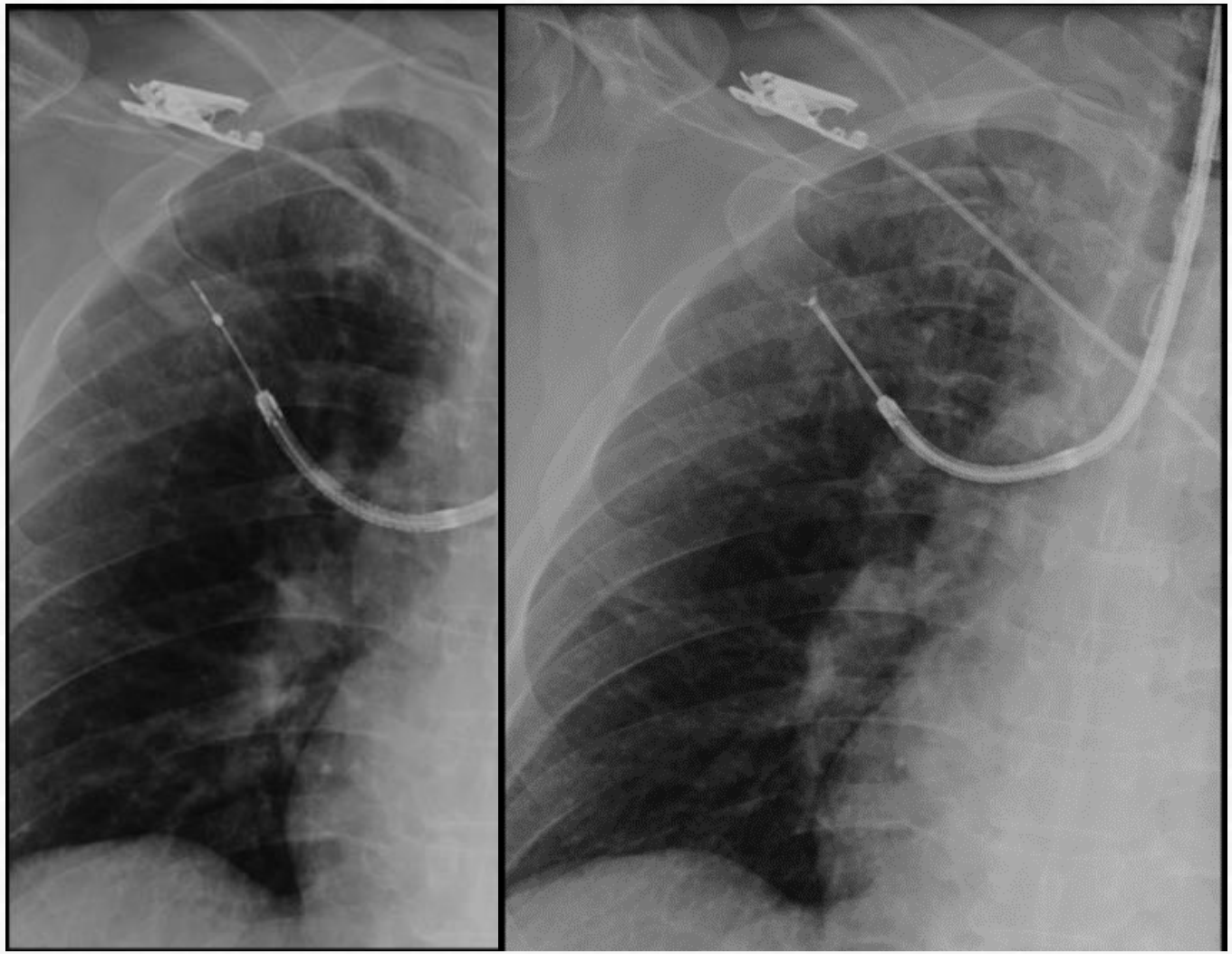
rEBUS (radial EBUS)

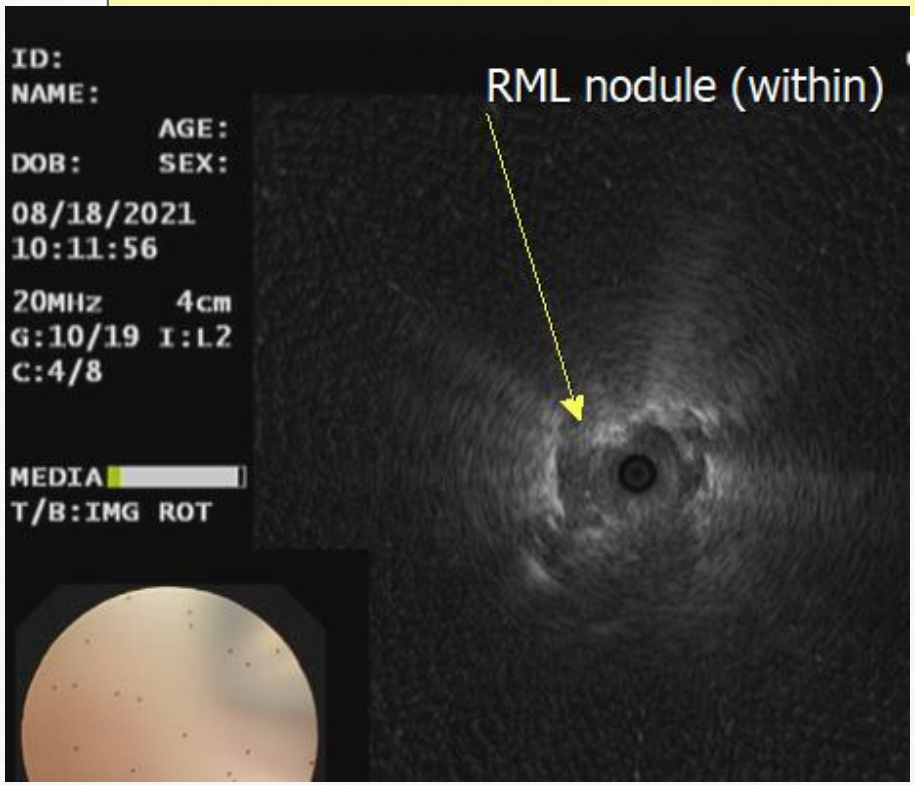
Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

Flexible bronchoscopy
- Conventional bronchoscopy (외경:5mm이상)
- Radial EBUS using thing bronchoscope (외경:3-4mm)
- Convex EBUS
- ENB, Robot bronchoscopy

Rigid bronchoscopy



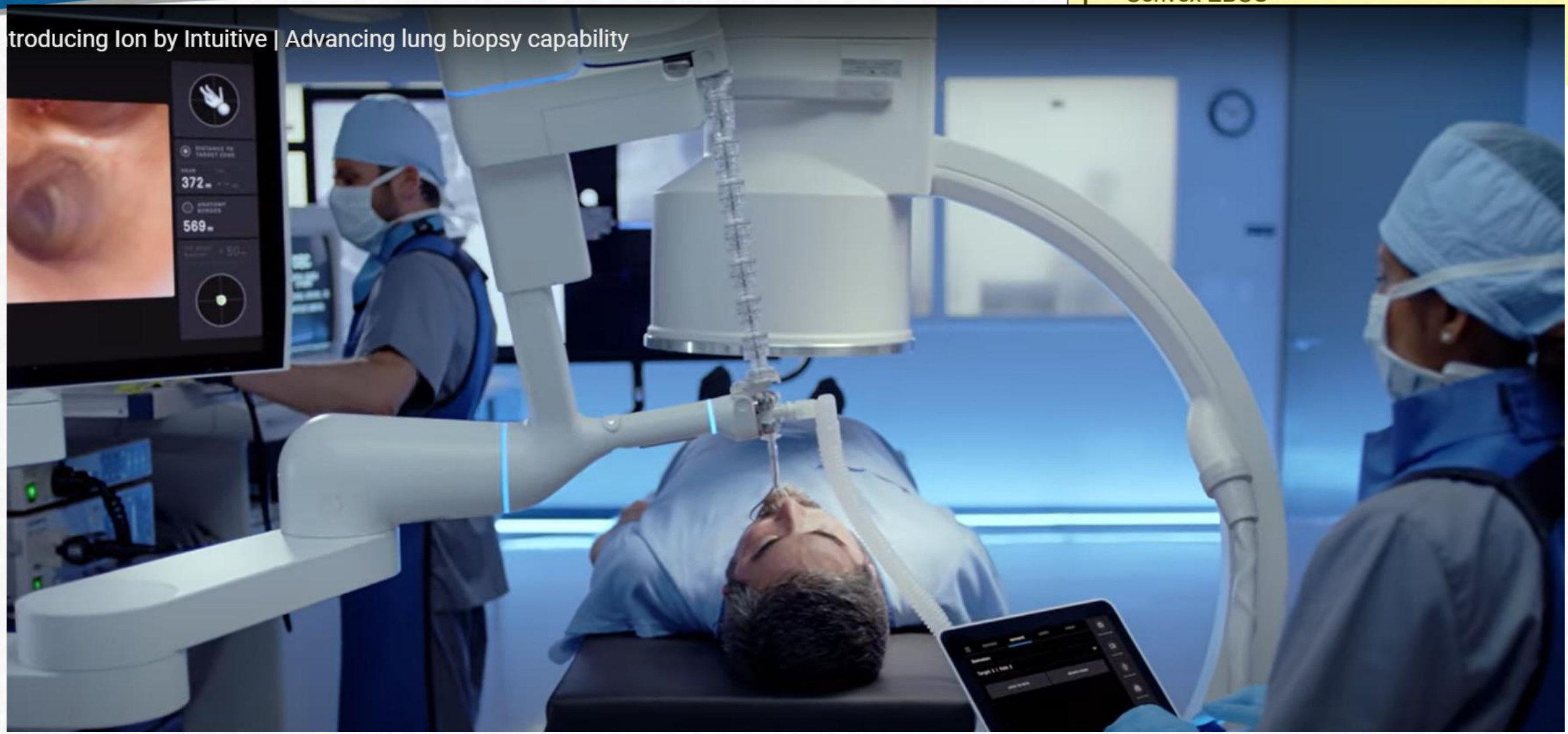


Robotic bronchoscopy

Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

Flexible bronchoscopy
- Conventional bronchoscopy (외경:5mm이상)
- Radial EBUS using thing bronchoscope (외경:3-4mm)
- Convex EBUS



https://www.youtube.com/watch?v=0ZaobUiJhCQ&t=39s

Robotic bronchoscopy

Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

Flexible bronchoscopy
- Conventional bronchoscopy (외경:5mm이상)
- Radial EBUS using thing bronchoscope (외경:3-4mm)
- Convex EBUS

	Monarch Robotic Bronchoscopy System (Auris Health, Inc., Redwood City, CA, USA)	Ion Robotic Bronchoscopy System (Intuitive Surgical©, Sunnyvale, CA, USA)	The Galaxy System (Noah Medical, San Carlos, CA, USA)
Navigation Technology	Electromagnetic Navigation	Shape Sensing	Electromagnetic with digital tomosynthesis TiLT+ Technology™
Catheter Outer Diameter	Outer Sheath: 6 mm Inner Scope: 4.2 mm	3.5 mm	4.0 mm
Working Channel Diameter	2.1 mm	2.1 mm	2.1 mm
Vision during Biopsy	Yes	No	Yes
Scope Reprocessing	Yes	Yes	No, disposable
Compatibility with Cone Beam or Advanced Fluoroscopy	Yes	Yes	Yes
Therapeutic tools	Under Investigation	Under Investigation	Unclear
FDA Approval	Yes	Yes	Pending

Not yet in KOR

Life (Basel). 2023 Jan 28;13(2):354

Robotic bronchoscopy *(not yet in KOR)*

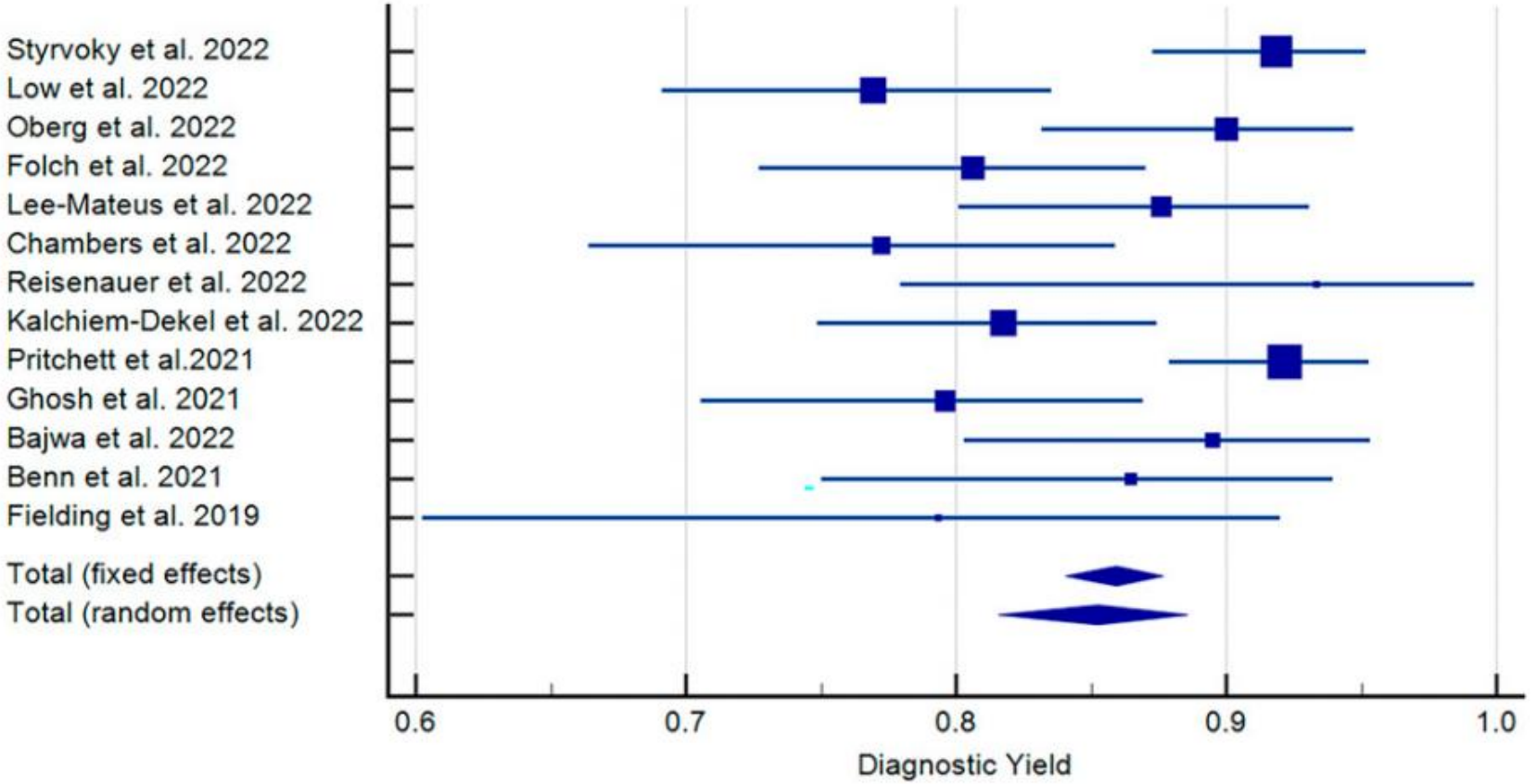
Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

mm이상)
cope (외경:3-4mm)

Convex EBUS
ENB, Robot bronchoscopy

Rigid bronchoscopy



The pooled

diagnostic yield

of RAB (20 studies, 1,779 lesions) was **84.3%** (95% CI, 81.1–87.2%).

Ann Am Thorac Soc. 2023 Dec;20(12):1801

Thoracoscopic biopsy

내시경적 진단

흡기내과/흉부외과)

이상)

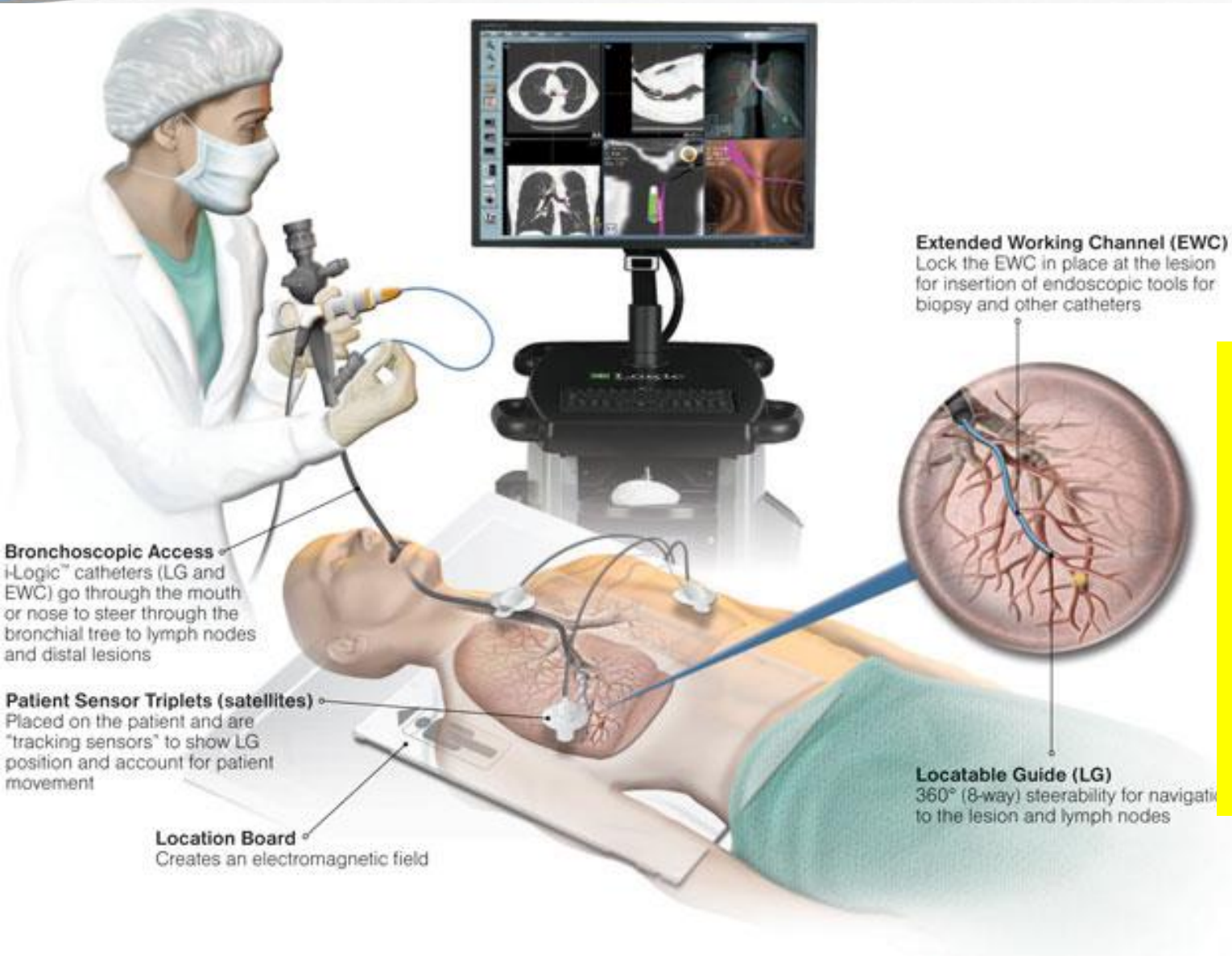
e (외경:3-4mm)

Convex EBUS

ENB, Robot bronchoscopy

Rigid bronchoscopy

ENB (electromagnetic navigation bronchoscopy)



전자기장을 이용해서

실시간으로 만들어지는

Virtual Bronchoscopic Navigation

(VBN) map을 보면서, locatable guide

를 이동시키면서 병변을 찾아서

조직검사를 시행

Two widely used ENB

Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

Flexible bronchoscopy
- Conventional bronchoscopy (외경:5mm이상)
- Radial EBUS using thing bronchoscope (외경:3-4mm)
- Convex EBUS
- ENB, Robot bronchoscopy

Rigid bronchoscopy

- **superDimension** (Medtronics, USA)
- Spin (**Veran**, USA)

ENB (electromagnetic navigation bronchoscopy)

Thoracoscopic biopsy

내시경적 진단
흡기내과/흉부외과)

이상)
e (외경:3-4mm)

Convex EBUS
ENB, Robot bronchoscopy

Rigid bronchoscopy

홈 > 병원·개원가 > 의대병원 > 단신

[redacted]병원, 차세대 경피적 폐결절 내비게이션 도입

박선혜 기자 | 입력 2021.05.26 11:34 | 댓글 0

병변 위치 정확히 찾아주는 전자기 유도방식 활용
환자 고통 줄이고 폐암 수술 정확성 높여

ENB (electromagnetic navigation bronchoscopy)

Thoracoscopic biopsy

내시경적 진단

흉기내과/흉부외과)

이상)

e (외경:3-4mm)

ex EBUS

Robot bronchoscopy

ronchoscopy

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Class 2 Device Recall SPiN Thoracic Navigation System

FDA Home › Medical Devices › Databases

Date Initiated by Firm May 15, 2023

Date Posted July 28, 2023

Recalling Firm/ Manufacturer	Olympus Corporation of the Americas 3500 Corporate Pkwy Center Valley PA 18034-8229
For Additional Information Contact	SAME 484-896-5000
Manufacturer Reason for Recall	Electromagnetic (EM) sensor tracking malfunction impacts the use of navigation functionality during endobronchial procedures and prompts the system to report a coil break warning message. This could result in a potential procedural delay

https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfres/res.cfm?id=200659

Peripheral lung lesions (PLLs)

Percutanous biopsy (CT-guided biopsy)

rEBUS (radial EBUS)

~~ENB (electromagnetic navigation bronchoscopy)~~

~~Robotic bronchoscopy (*not yet in KOR*)~~

Peripheral lung lesions (PLLs)

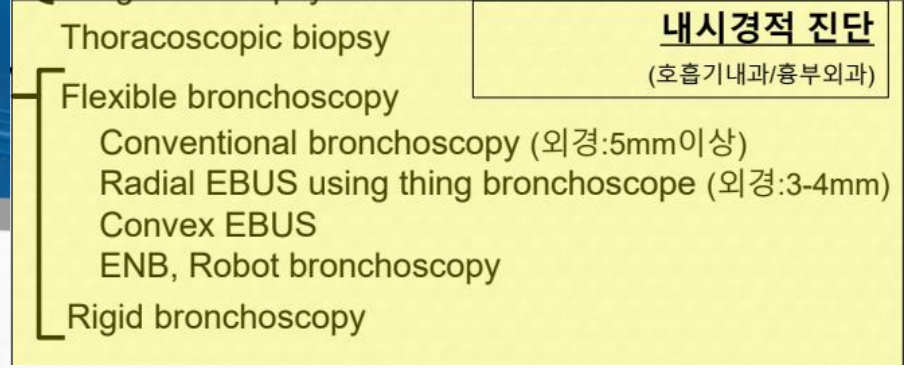
	DxYD	Cx		Cost	Author's experience
		PNX	Bleeding		
PCNB	>90% (even <1cm)	10-20% (tube 5%)	1-5%	Low	Not our area
ENB	50-70%	<1%	<1%	High	A little bit difficult
rEBUS	50-70%	<1%	<1%	Moderate	Slightly more difficult than ENB

- **PCNB vs rEBUS**
  - 기관의 경험과 시설을 고려하여 더 잘할 수 있는 것을 선택!
  - PCNA-favored case와 rEBUS-favored case: 상호보완적 선택!

PCNB = percutaneous needle biopsy

Selection of rEBUS-Bx-compatible case

- CT-bronchus sign (within or adjacent)
- Size 15(-20)mm이상



Selection of rEBUS-Bx-compatible case

Thoracoscopic biopsy

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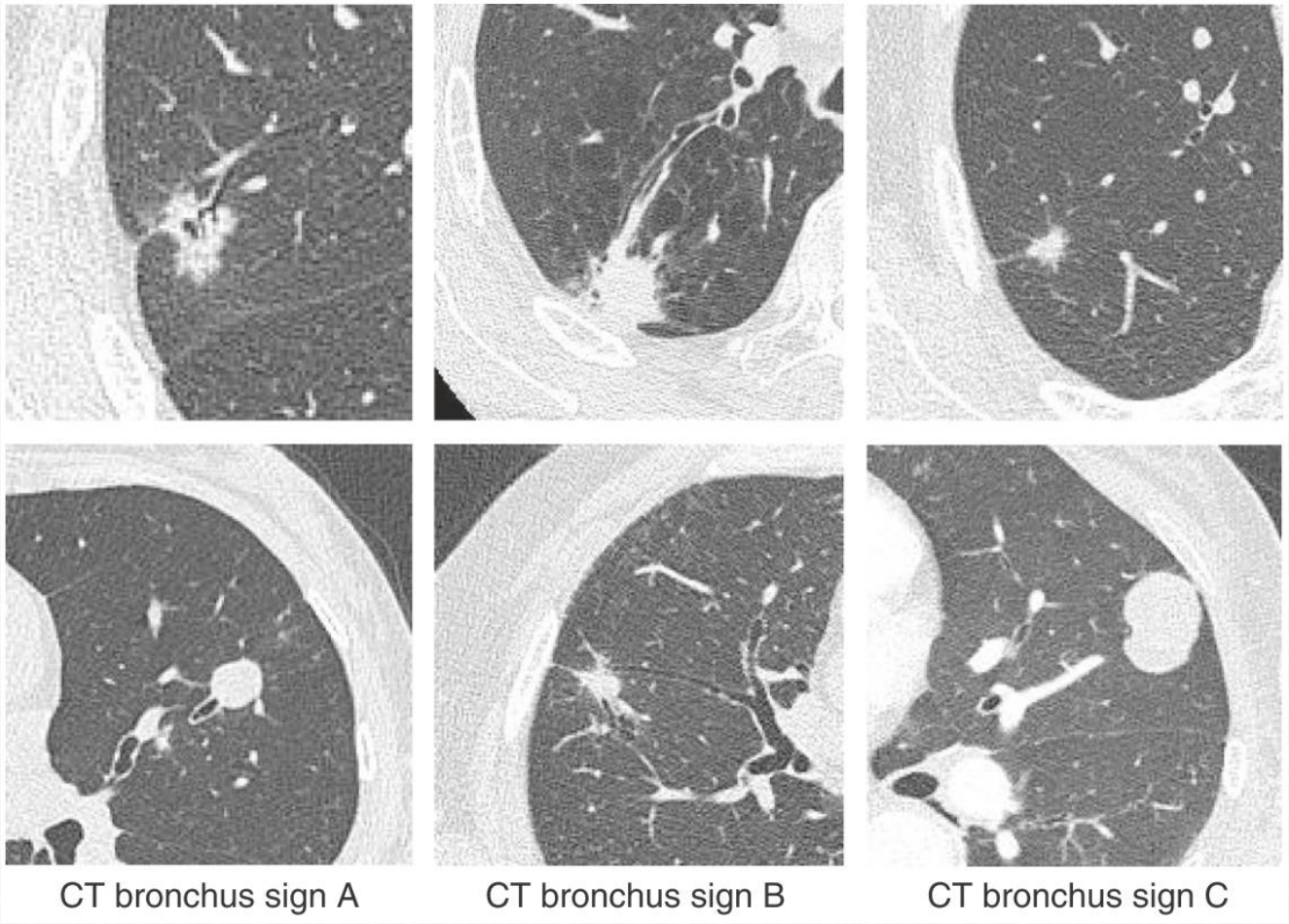
- Convex EBUS
- ENB, Robot bronchoscopy

Rigid bronchoscopy

- CT-bronchus sign (within or adjacent to)



CT bronchus sign A | CT bronchus sign B | CT bronchus sign C

CT상 bronchus가 within lesion or adjacent to lesion인 병변을 선택해야 함.

Minezawa et al. BMC Medical Imaging (2015) 15:21

Selection of rEBUS-Bx-compatible case

Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

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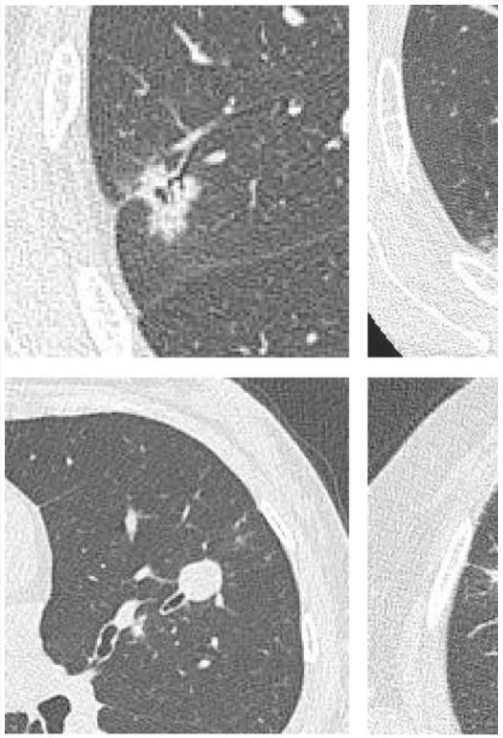
Rigid bronchoscopy

- CT-bronchus sign (within or adjacent to)



CT bronchus sign A CT bro

Table 4 Contribution of clinical factors available before bronchoscopy to diagnostic yield (all cases)

Variables		Diagnostic yield	*p* value
Lesion diameter	<20 mm	51/80 (63.8 %)	0.01*
	≥20 mm	57/69 (82.6 %)	
Lesion location	Upper lobe or sup segment of lower lobe	40/56 (71.4 %)	0.82
	Middle or lower lobe [a]	68/93 (73.1 %)	
Feature of the lesion	GGO	12/18 (66.7 %)	0.24
	Solid	96/131 (73.2 %)	
Visibility of the lesion on Chest X-ray	Clearly visible	59/72 (81.9 %)	0.01*
	Vague or invisible	49/77 (63.6 %)	
Number of bronchial branch to reach the lesion	≥5	35/50 (70.0 %)	0.63
	≤4	73/99 (73.7 %)	
Operator's experience (years)	≥7	34/52 (65.4 %)	0.16
	≤6	74/97 (76.3 %)	
CT bronchus sign[b]	A	72/86 (83.7 %)	0.001*
	B	32/49 (65.3 %)	
	C	4/14 (28.6 %)	

* significant difference, [a] except for superior segment of the lower lobe, [b] See Methods

Minezawa et al. BMC Medical Imaging (2015) 15:21

Selection of rEBUS-Bx-compatible case

Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

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- Convex EBUS
- ENB, Robot bronchoscopy

Rigid bronchoscopy

- Size 15(-20)mm이상
  - Eom & Mok et al. BMC Pulmonary Medicine (2018) 18:137

Table 3 Diagnostic yield by EBUS-GS according to lesion size

Mean diameter, mm	No./Total (%)
< 20	22/47 (46.8)
20–30	59/73 (80.8)
> 30	65/80 (81.3)
Total	146/200 (73.0)

Diagnostic yields were significantly different among patients with lesions < 20 mm, 20–30 mm, and > 30 mm in mean diameter ($P < 0.001$)

Selection of rEBUS-Bx-compatible case

Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

Flexible bronchoscopy
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- Convex EBUS
- ENB, Robot bronchoscopy

Rigid bronchoscopy

- Size 15(-20)mm이상
  - 15mm기준 연구. Yamada et al. CHEST 2007; 132:603–608

Table 2—*Features Associated With Diagnostic Yield of TBB Using EBUS-GS*

Variables	Lesions Diagnosed by EBUS, No./Total Lesions, No. (%)	p Value*
Underlying disease		
Benign	16/30 (53)	0.075
Malignant	90/128 (70)	
Lesion diameter, mm		
≤ 15	16/40 (40)	< 0.001
> 15 and ≤ 20	25/34 (74)	
> 20 and ≤ 25	26/36 (72)	
> 25 and ≤ 30	39/48 (81)	
Location		
Right upper lobe	24/40 (60)	0.66
Right middle lobe	8/12 (67)	

Selection of rEBUS-Bx-compatible case

Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

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- Convex EBUS
- ENB, Robot bronchoscopy

Rigid bronchoscopy

- Size 15(-20)mm이상
  - Bae & Lee et al. Medicine 2020;99:17(e19870)

Table 4

Diagnostic yields*: VBN group versus NVBN group.

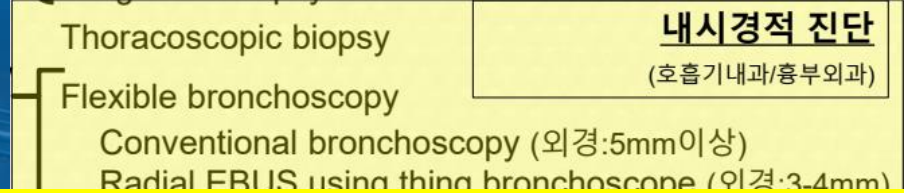
Variables	Total (n = 118)	VBN (n = 57)	NVBN (n = 61)	*P*-value
Overall yield, result/total (%)	90/118 (76)	41/57 (72)	49/61 (80)	.284
	74/118 (63)†	*34/57 (60)*†	*40/61 (66)*†	*0.506*†
Yield for diagnosis, result/total (%)				
Benign	34/38 (90)	15/16 (94)	19/22 (86)	.464
	18/22 (82)†	*8/9 (89)*†	*10/13 (77)*†	*0.474*†
Malignant	56/80 (70)	26/41 (63)	30/39 (77)	.188
	56/96 (58)†	*26/48 (54)*†	*30/48 (63)*†	*0.408*†
Yield for size, result/total (%)				
>20 mm	67/83 (81)	30/40 (75)	37/43 (86)	.202
	59/83 (71)†	*27/40 (68)*†	*32/43 (74)*†	*0.487*†
≤20 mm	23/35 (66)	11/17 (65)	12/18 (67)	.903
	15/35 (43)†	*7/17 (41)*†	*8/18 (44)*†	*0.845*†

NVBN = non-VBN, VBN = virtual bronchoscopic navigation.

* Diagnostic yield: the fraction of people whose final diagnosis has been confirmed by EBUS GS TBLB.

† Assuming 16 cases whose EBUS TBLB results are non-specific chronic inflammation and without size increase on 12-month follow-up CT scan were false negative (i.e., malignant).

Selection of rEBUS-Bx-compatible case



- CT-bronchus sign (within or adjacent)
- Size 15(-20)mm이상

CT-bronchus sign: within → 진단률 80% 이상

CT-bronchus sign: adjacent to → 진단률 60% 이상

CT-bronchus sign: absent → 진단률 30% 미만

Size 15mm이상 → 진단률 70% 이상

Size 15mm미만 → 진단률 40% 미만

Selection of PCNB-compatible case

- The most common complication of PCNB is **pneumothorax (10 to 17 %).**
  - 7 % of PCNB procedures result in a pneumothorax requiring chest tube drainage.
  - Risk is increased in patients with **emphysema**, **greater distance between pleural surface and lesion**, and when the **needle crosses a fissure**, and when the biopsy needle traverses greater than two pleural surfaces.
- **Hemoptysis** occurs less commonly **(1 to 9.5 %)** and hemorrhage requiring intervention is very rare.
  - The risk of complications appears to be greatest **longer pleura-to-target distance, ground-glass nodules**, and **open bronchus sign**

2024_utd_Diagnostic evaluation of the incidental pulmonary nodule
Korean J Radiol 2018;19(5):880

Open bronchus sign (CT-bronchus sign과 유사)

Hemoptysis risk

PCNB needle이 bronchus를 traverse할 가능성

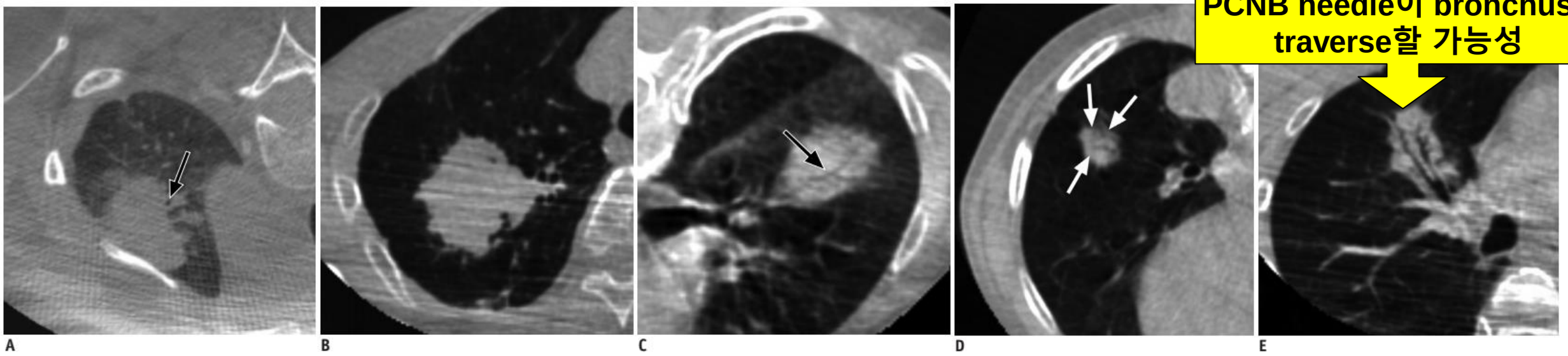


Fig. 1. OBU index.

A. 1 (none): single open bronchus (arrow) in tumor periphery. **B.** 2 (low): multiple open bronchi in tumor periphery with adequate room to advance cutting needle into tumor. **C.** 3 (possible): centrally (arrow) and peripherally located open bronchi in tumor with space to advance cutting needle into tumor while evading open bronchi. **D.** 4 (probable): it is possible that open bronchi (arrows) in tumor are injured or penetrated by cutting needle. **E.** 5 (high): it is highly likely that open bronchi in tumor are penetrated by cutting needle. OBU = open bronchus unavoidability

OBU = open bronchus unavoidability

Korean J Radiol 2018;19(5):880

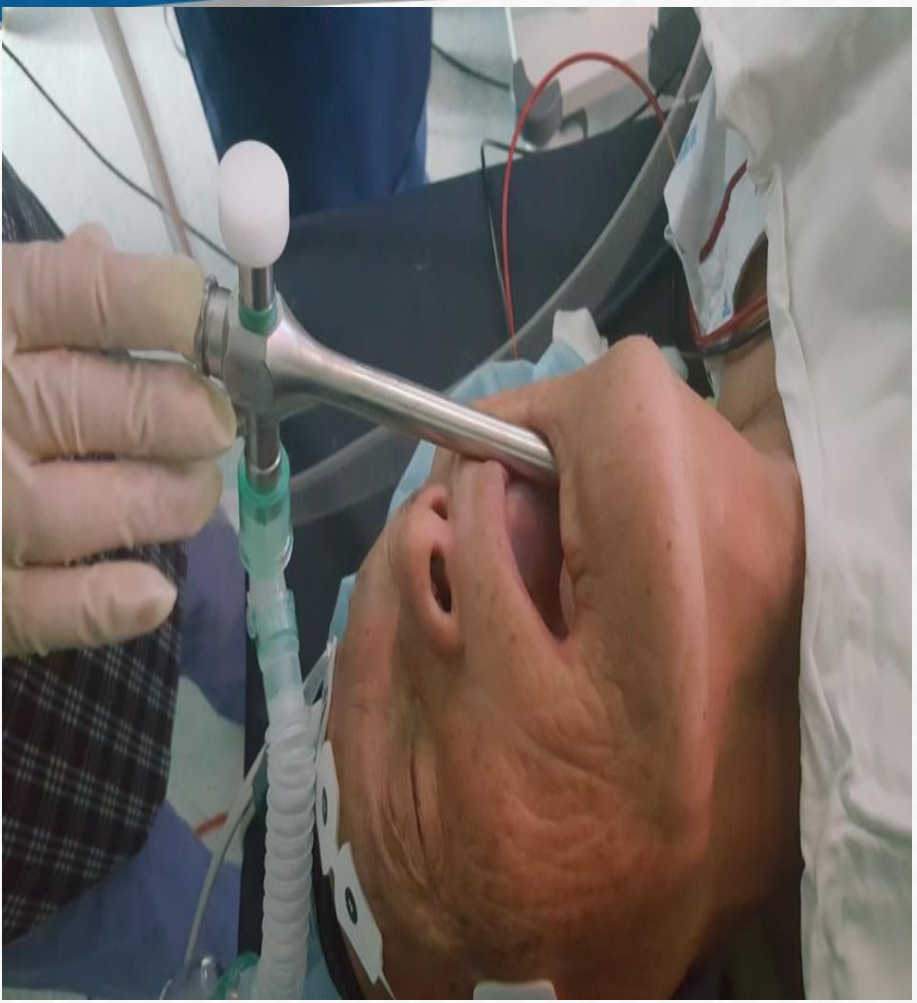
Peripheral lung lesions (PLLs)

	DxYD	Cx		Cost	Author's experience
		PNX	Bleeding		
PCNB	>90% (even <1cm)	10-20% (tube 5%)	1-5%	Low	Not our area
ENB	50-70%	<1%	<1%	High	A little bit difficult
rEBUS	50-70%	<1%	<1%	Moderate	Slightly more difficult than ENB

- **PCNB vs rEBUS**
  - 기관의 경험과 시설을 고려하여 더 잘할 수 있는 것을 선택!
  - PCNA-favored case와 rEBUS-favored case: 상호보완적 선택!
    - **PCNB favor:** **15(-20)mm 미만 결절 (rEBUS로 잘 안나옴)**
    - **rEBUS favor:** **a large bronchus sign on CT (PCNB needle이 bronchus를 traverse할 가능성 있을때)**

PCNB = percutaneous needle biopsy

Rigid bronchoscopy (RB)



Thoracoscopic biopsy

내시경적 진단
(호흡기내과/흉부외과)

- Flexible bronchoscopy
  - Conventional bronchoscopy (외경:5mm이상)
  - Radial EBUS using thing bronchoscope (외경:3-4mm)
  - Convex EBUS
  - ENB, Robot bronchoscopy
- Rigid bronchoscopy

Rigid bronchoscopy (RB)

Under General Anesthesia

Ventilator

Large airway lumen (FB in RB가능)
Good suction capacity
Bleeding control capacity (tamponade, coagulation)
→FB로 하기 어려운 시술을 가능케 함

Deep sedation and high-flow oxygenation
(without ventilaor)
(in the bronshcoscopy suite

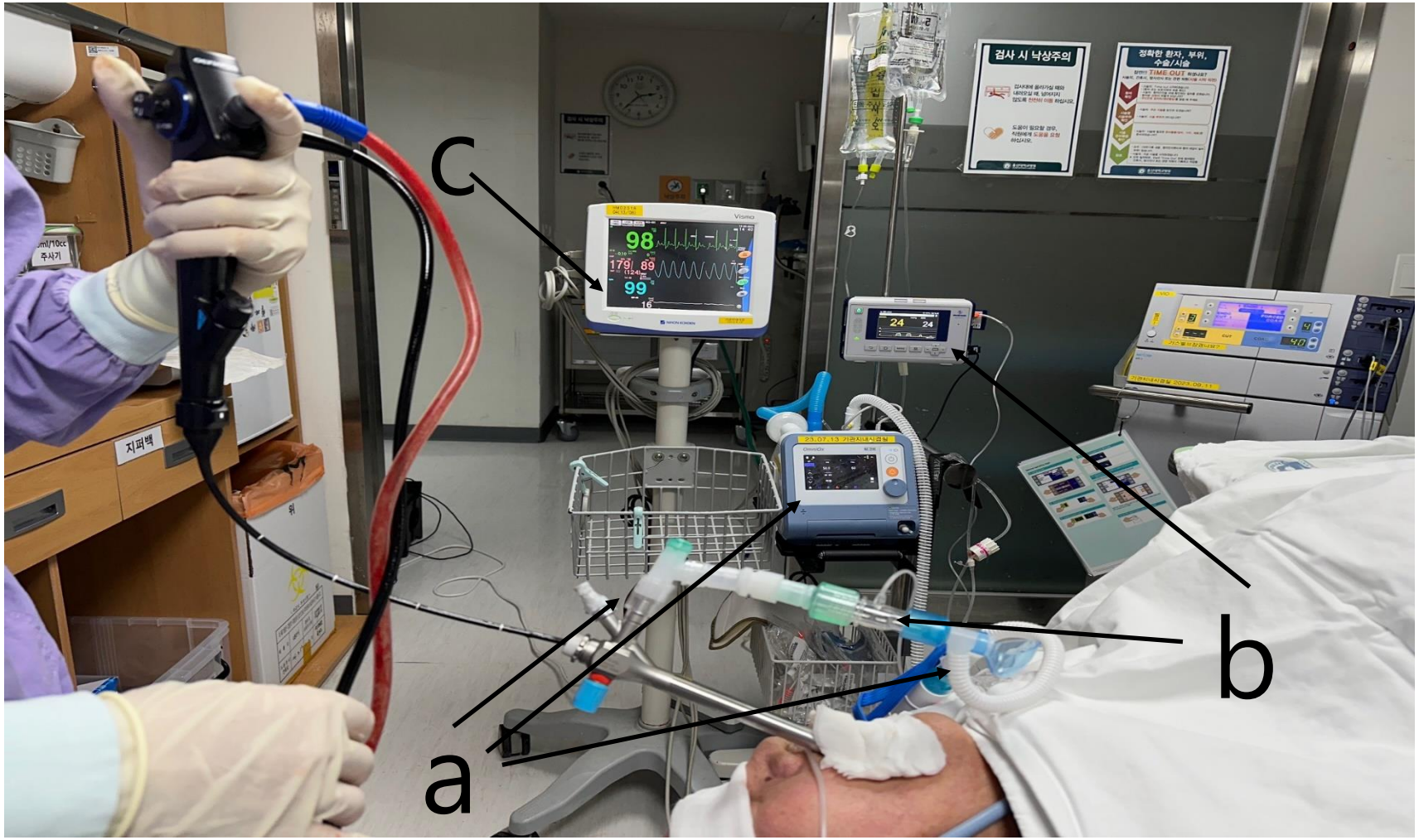


Figure. Conducting advanced bronchoscopic procedures with endotracheal intubation and high-flow oxygenation. A, High flow oxygenation via uncuffed endotracheal tube (HF-ETT): High flow oxygenation was administered to the ETT through a side adapter (a). End-tidal CO2 (EtCO2) (b), vital signs (V/S), and pulse O2 saturation (SpO2) (c) were monitored. B, High flow oxygenation via rigid bronchoscope (HF-rigid): High flow oxygenation was administered to the rigid bronchoscope through the ventilation side port (a). EtCO2 (b), V/S, and SpO2 (c) were monitored.

Bronchoscopy의 적응증

BOX 1.1 Indications for bronchoscopy

- Investigations of symptoms
  - haemoptysis
  - persistent cough
  - recurrent infection
- Suspected neoplasia
  - unexplained paralysis of vocal cords
  - stridor
  - localized monophonic wheeze
  - segmental or lobar collapse
  - assessment of nodules or masses identified on radiology
  - ed right hemi-diaphragm
-
  - on
  - mycobacterial infection
-
  - transbronchial lung biopsy
- Therapeutic
  - clearance of airway secretions
  - recurrent mucous plugging causing lobar collapse and atelectasis in patients on mechanical ventilators
  - foreign body removal
  - palliation of neoplasm
  - endobronchial ablation of tumour (cryotherapy, electrocautery, laser)
  - insertion of airway stents
  - insertion of brachytherapy catheters
  - insertion of fiducial markers for the gamma/cyberknife
  - bronchoscopic lung volume reduction
  - bronchial thermoplasty for asthma
  - treatment of bronchopleural fistula

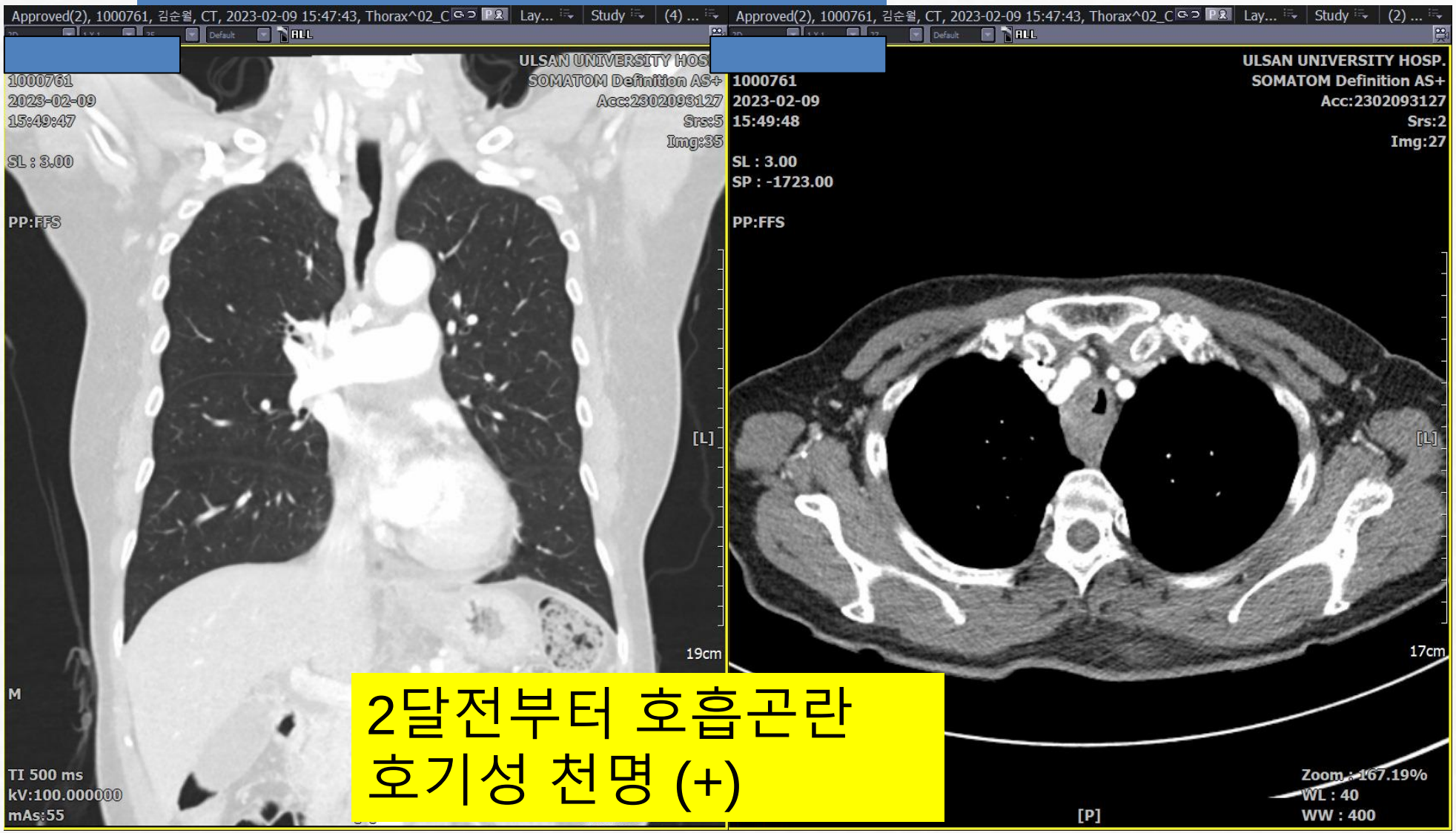
Rigid bronchoscopy

- **진단내시경**
  - **-균검사(oragnism identification)**
  - **-조직검사 (pathology)**
    - **>세포병리검사(cytopathology[cytology])**
    - **>조직병리검사(histopathology[biopsy])**
- **치료내시경**
  - **-Mass Excision or Tumor Ablation**
  - **-Stent or Balloon**

2012_Shah_Atlas of Flexible Bronchoscopy

Tissue biopsy: Good candidate for RB

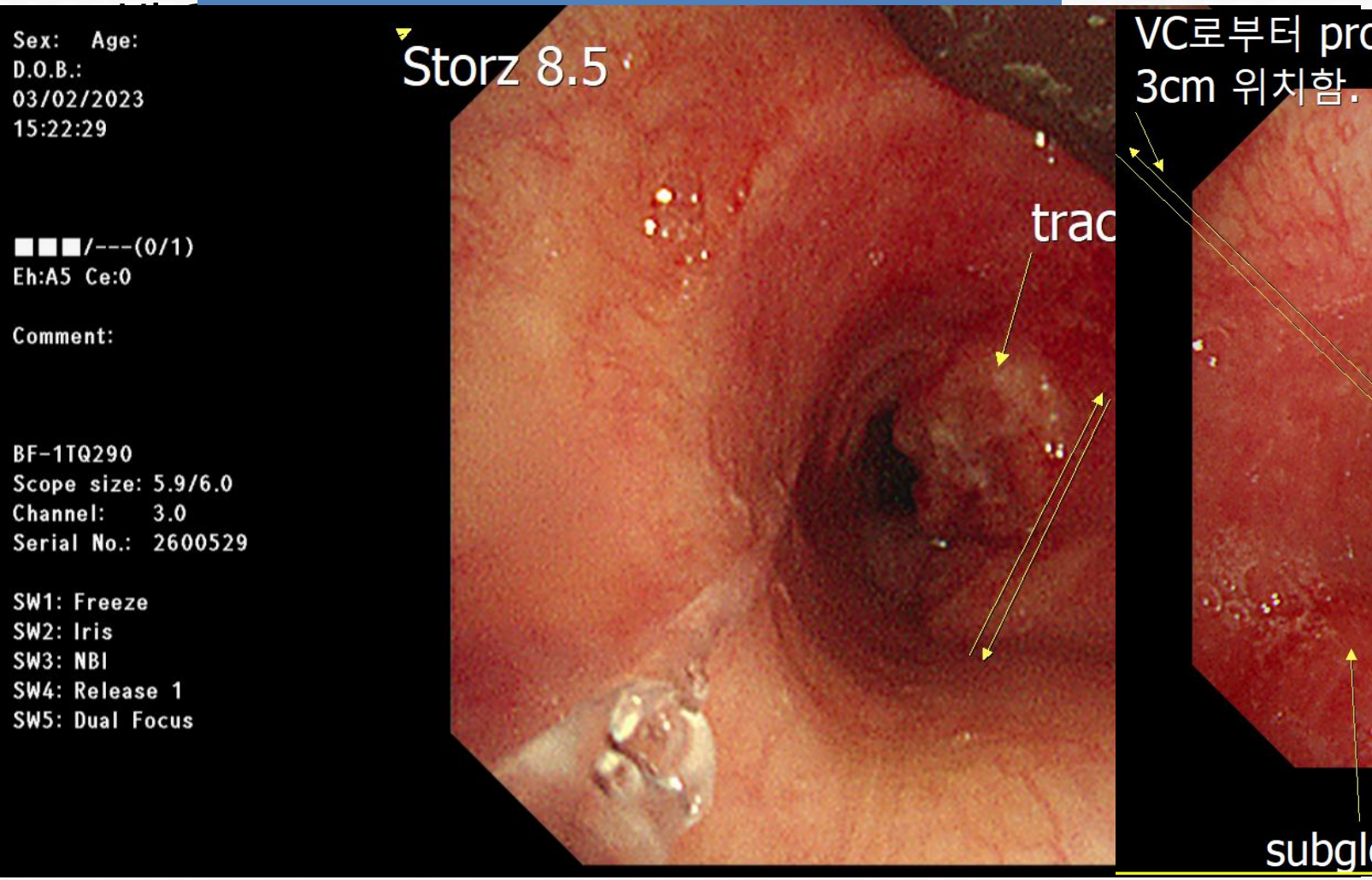
: Cancer-suspicious lung lesion(s) with
significant “central airway obstruction”
significant “bleeding”

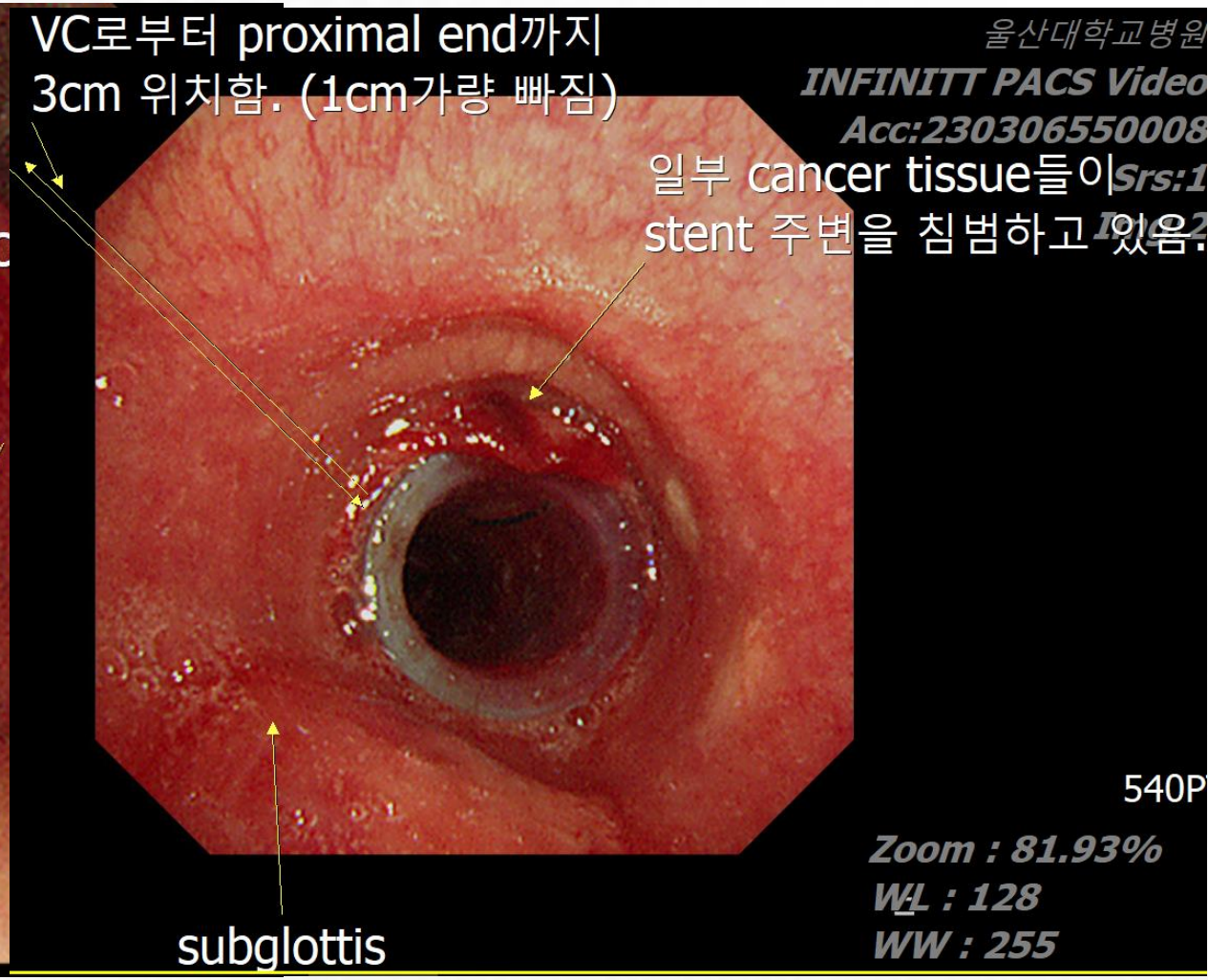


2달전부터 호흡곤란
호기성 천명 (+)

Tissue biopsy: Good candidate for RB

: **Cancer-suspicious lung lesion(s)** with
significant "central airway obstruction"
significant "bleeding"





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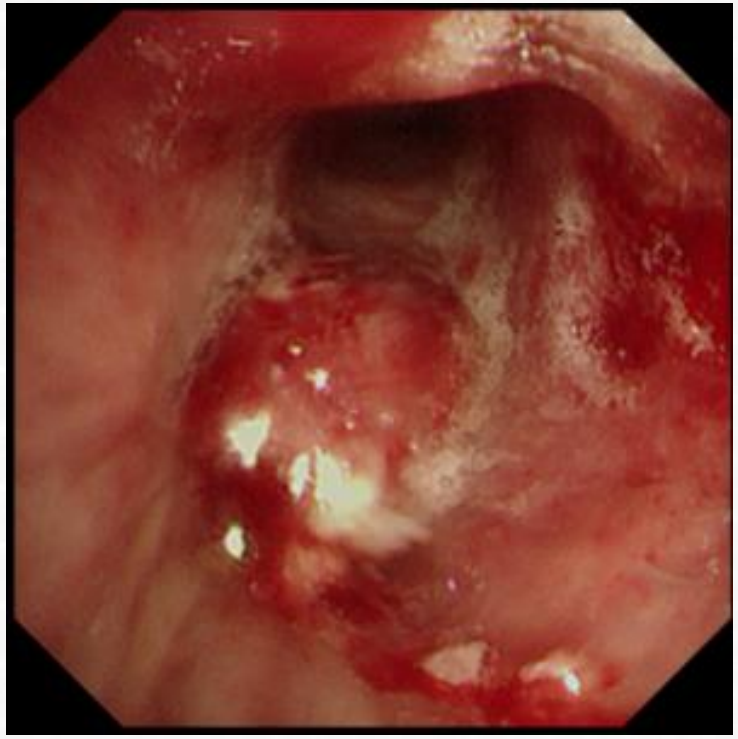
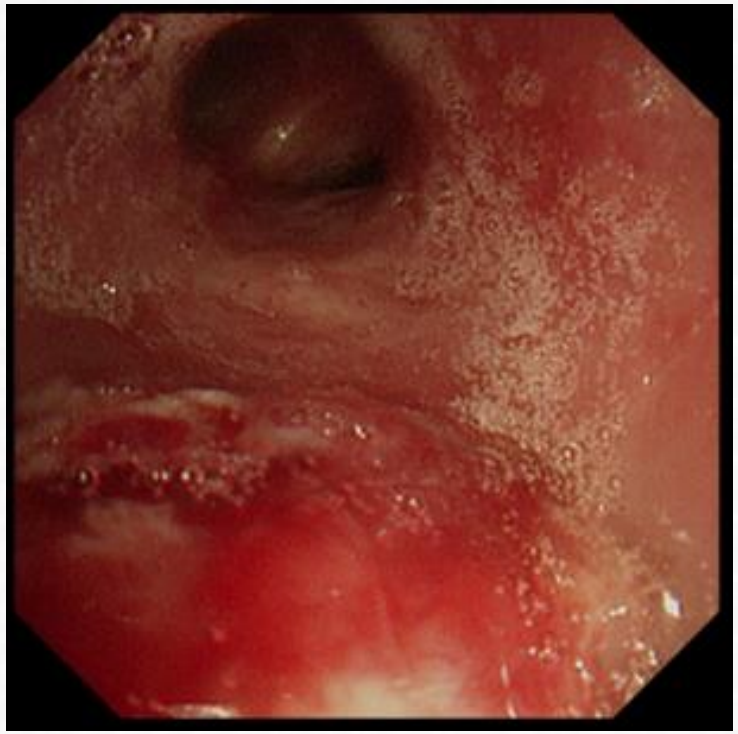
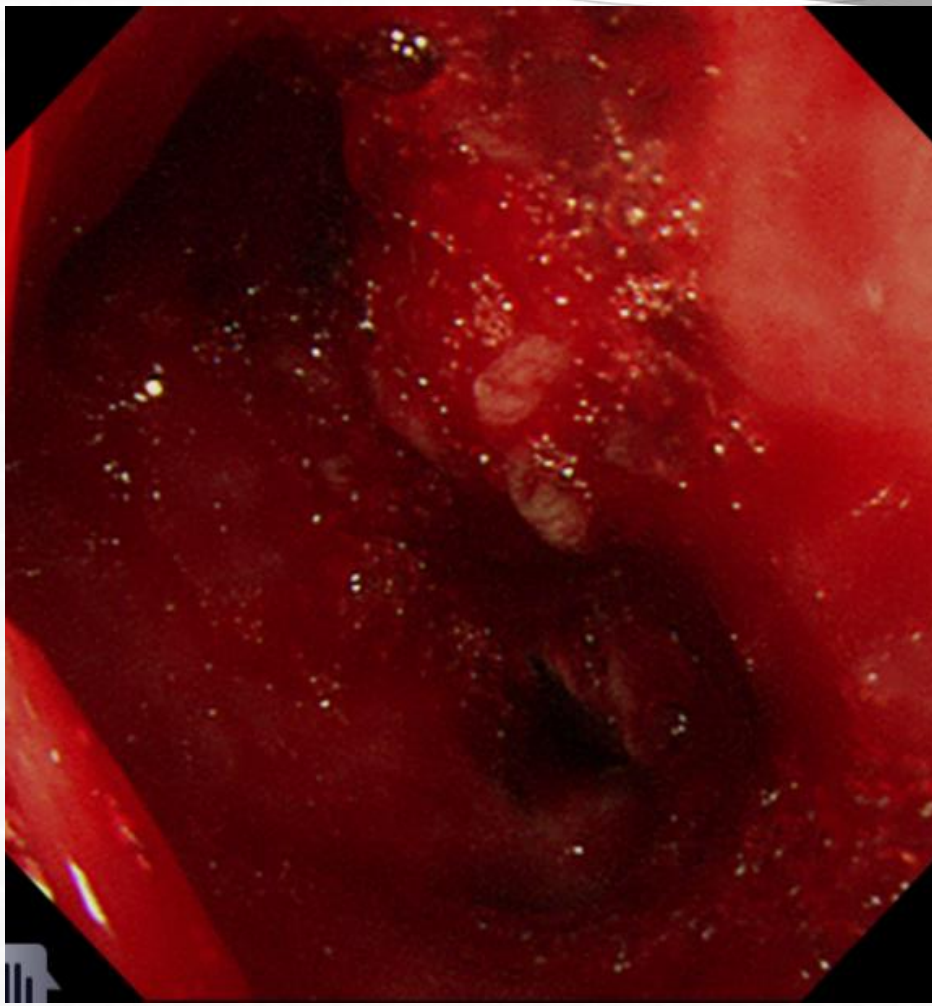






요약

요약

- The discovery of a lung nodule/mass prompts a decision regarding
  - observation,
  - direct surgery, or
  - tissue biopsy

Solid<15mm, or **Subsolid:solid portion<8**mm: Observation

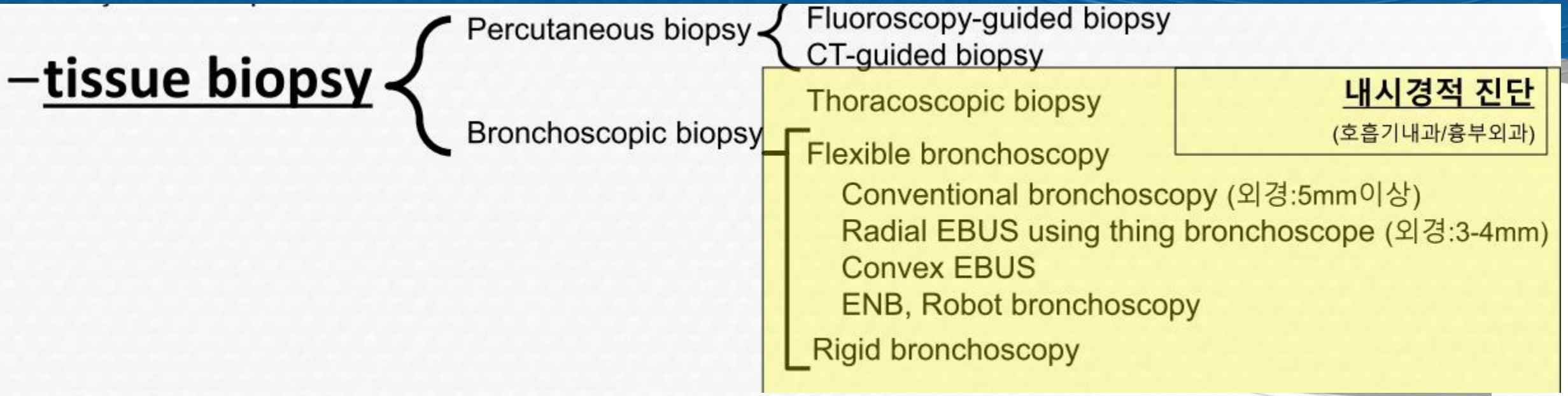
f/u CT: Growing, or

Solid15-30, or Subsolid:solid≥8
(if 1st CT for a new lesion, 1mCT to r/o infl.lesion after ABX)
(if subsolid, add CBC/eos/IgE to r/o PIE/parasite)

Nodule (tumor) is > 30 mm, Central lesion, or Multiple lesions,
LN mets or Distant mets
Possibility of benign disease that can be treated medically
-Satellite lesions, acute-onset resp or systemic sx (fever)

주요참고:
NCCN2024, Fleischner2017, LungRADS한글2020

*high risk (NCCN2024)
-smoking,
-폐암가족력(FDR: 부모,형제,자식)
-직업(석면, 라돈-광산, 우라늄-원자력발전소)



- Things to consider when deciding on a tissue biopsy method.
  - ***i) Simultaneous histopathologic diagnosis and disease staging*** ***(Metastatic sites are preferred over primary sites)***
  - ***ii) Ease of access & Safety (bleeding, pneumothorax)***
  - ***iii) Diagnostic yield (↑) of the procedure***
  - ***iv) Cost (↓) of the procedure***
  - ***v) Institution's experience and facilities***

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Thank you!

Q & A

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