

Updates and Future Direction of Bronchoscopy for Peripheral Lung Lesions

부산대병원

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엄정섭

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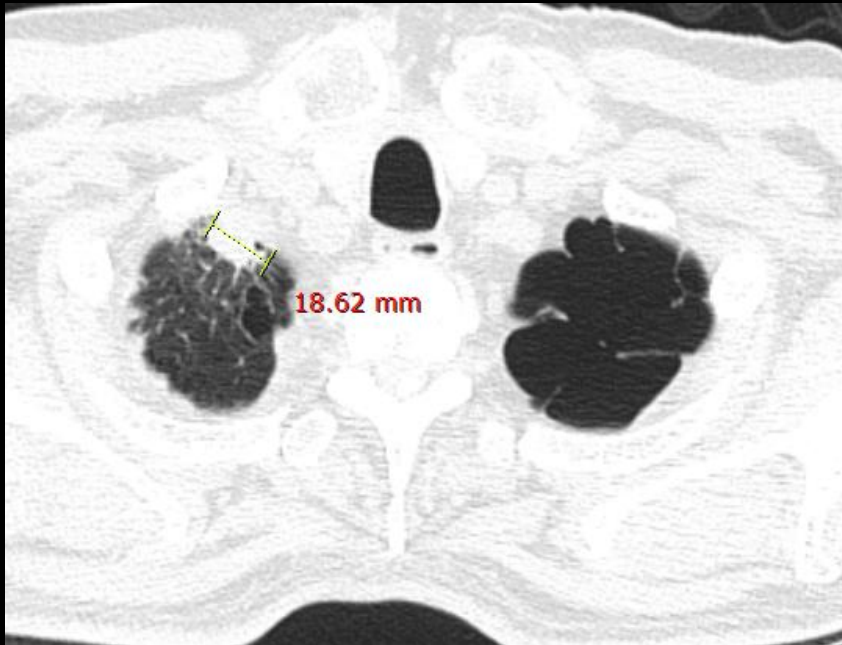
- 1 Representative cases
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- 4 Marking for VATS
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Representative cases

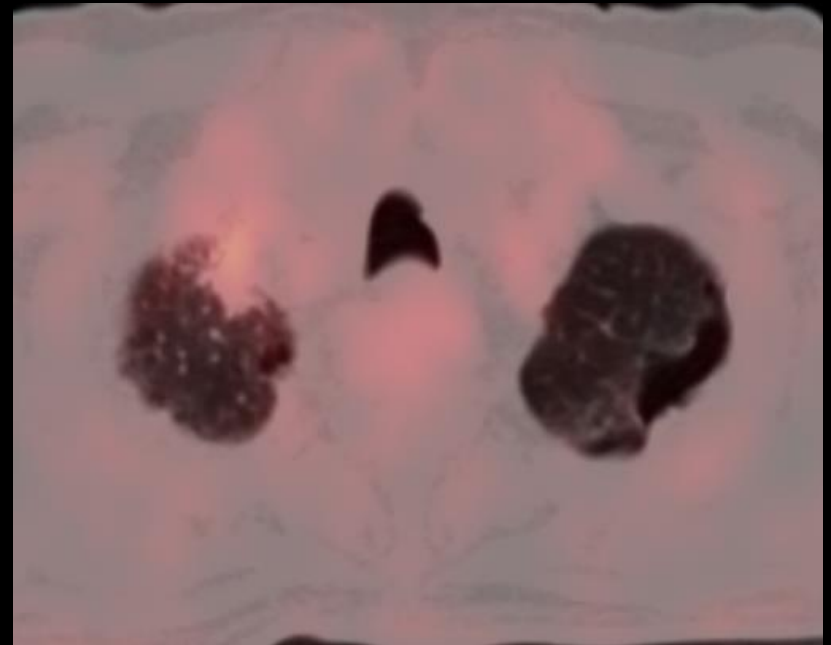
Case I



Case I



Chest CT



PET

CONCLUSION

1. Suspicious for lung cancer, RUL
2. Suspicious for bone metastases, right pelvic bone and sacrum
3. Left renal cyst
4. Right pleural effusion

Case I

육안소견

Submitted are 4 parts.

1. Right, upper lobe, apical segment #1~2: fragments of brown white soft tissue, 0.1x0.1cm in size(the largest). Blocked in toto in A.
2. Right, upper lobe, apical segment #3~4: a fragment of brown white soft tissue, 0.2x0.1cm in size. Blocked in toto in B.
3. Right, upper lobe, apical segment #5~6: a fragment of brown white soft tissue, 0.2x0.1cm in size. Blocked in toto in C.
4. Right, upper lobe, apical segment #7~8: 2 fragments of brown white soft tissue, 0.1x0.1cm in size(the larger one). Blocked in toto in D.

PA 박수현 육안검사의 이창훈 전사자 김동경 저장

폐병리 적절성 보고 적합검체 부적합 검체 SMS전송

진단

Lung, upper lobe, apical segment #1~2, right, EBUS-TBLB :
Adenocarcinoma, suggestive of primary in the lung.

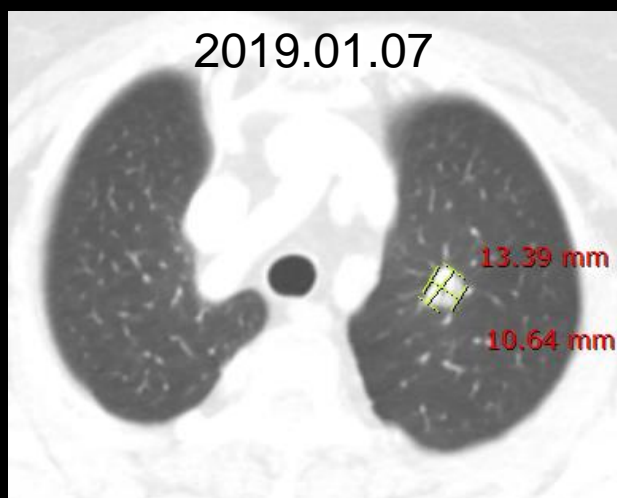
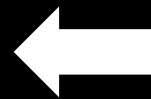
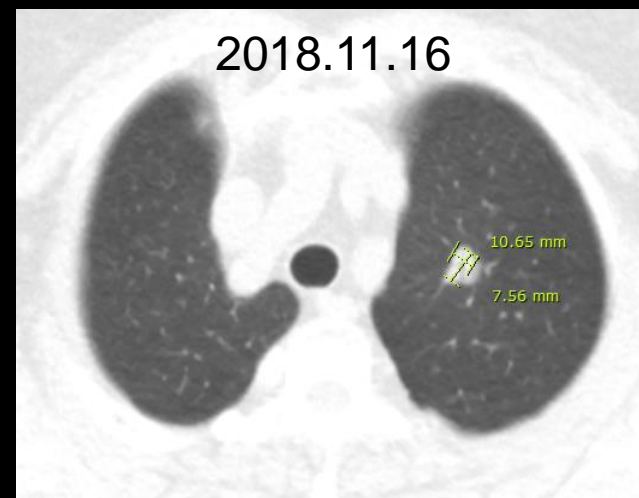
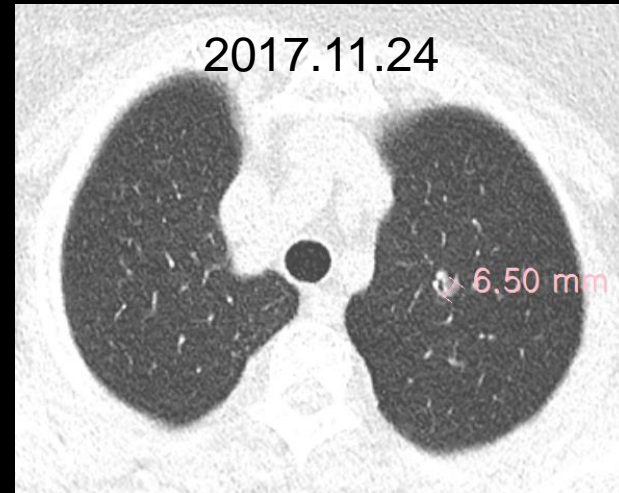
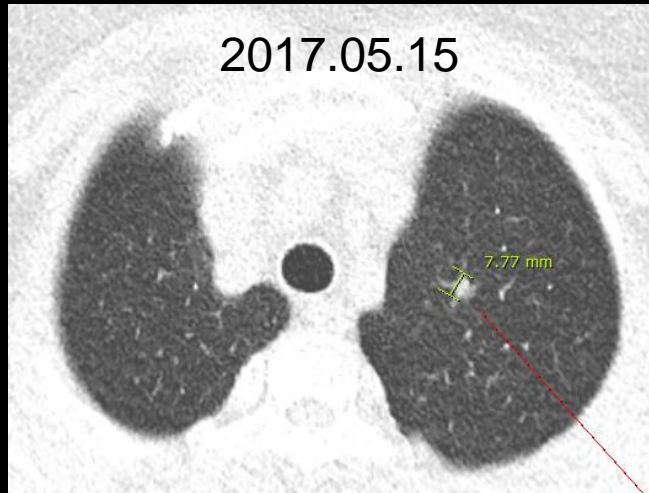
Lung, upper lobe, apical segment #3~4, right, EBUS-TBLB :
Adenocarcinoma, suggestive of primary in the lung.

Lung, upper lobe, apical segment #5~6, right, EBUS-TBLB :
Adenocarcinoma, suggestive of primary in the lung.

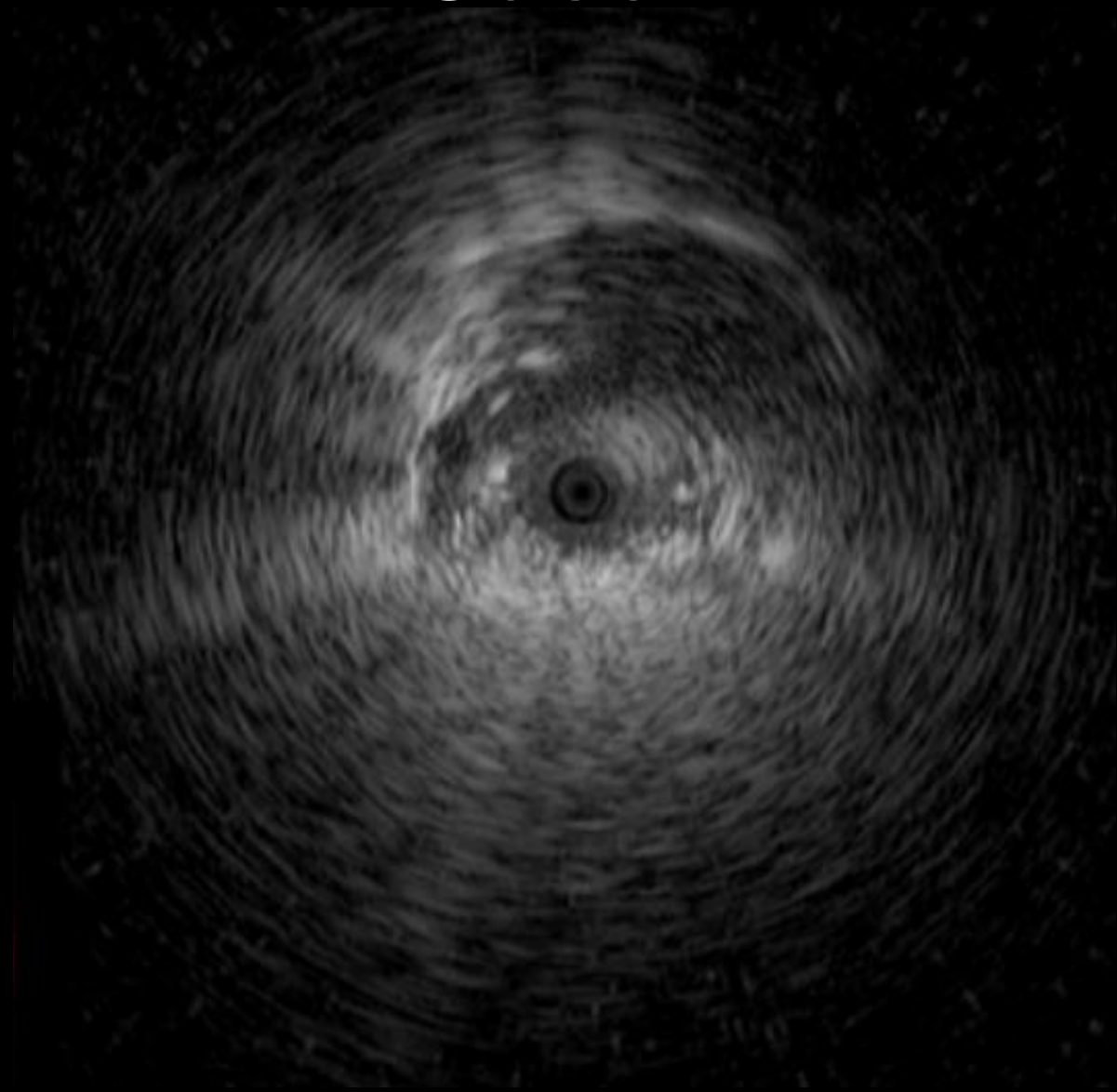
Lung, upper lobe, apical segment #7~8, right, EBUS-TBLB :
Adenocarcinoma, suggestive of primary in the lung.

NOTE: The result of EGFR mutation and ALK gene studies (section B) will be followed.

Case II



Case II



Case II

육안소견

Submitted are 3 parts.

1. Left, upper lobe, upper division, apicoposterior segment #1~2
: a fragment of brown white soft tissue, 0.2x0.2cm in size.
Blocked in toto in A.
2. Left, upper lobe, upper division, apicoposterior segment #3~4
: a fragment of brown white soft tissue, 0.2x0.1cm in size.
Blocked in toto in B.
3. Left, upper lobe, upper division, apicoposterior segment #5~7
: fragments of brown white soft tissue, 0.2x0.1cm in size(the largest).
Blocked in toto in C.

PA

박수현

육안검사의

이창훈

전사자

김동겸

저장

폐병리 적절성 보고

적합검체

부적합 검체

SMS전송

진단

Lung, upper lobe, upper division, apicoposterior segment, #1~2, left, EBUS-TBLB :
Adenocarcinoma, suggestive of primary in the lung.

Lung, upper lobe, upper division, apicoposterior segment, #3~4, left, EBUS-TBLB :
Adenocarcinoma, suggestive of primary in the lung.

Lung, upper lobe, upper division, apicoposterior segment, #5~7, left, EBUS-TBLB :
Adenocarcinoma, suggestive of primary in the lung.

Immunohistochemistry (section A)

: TTF-1 - positive

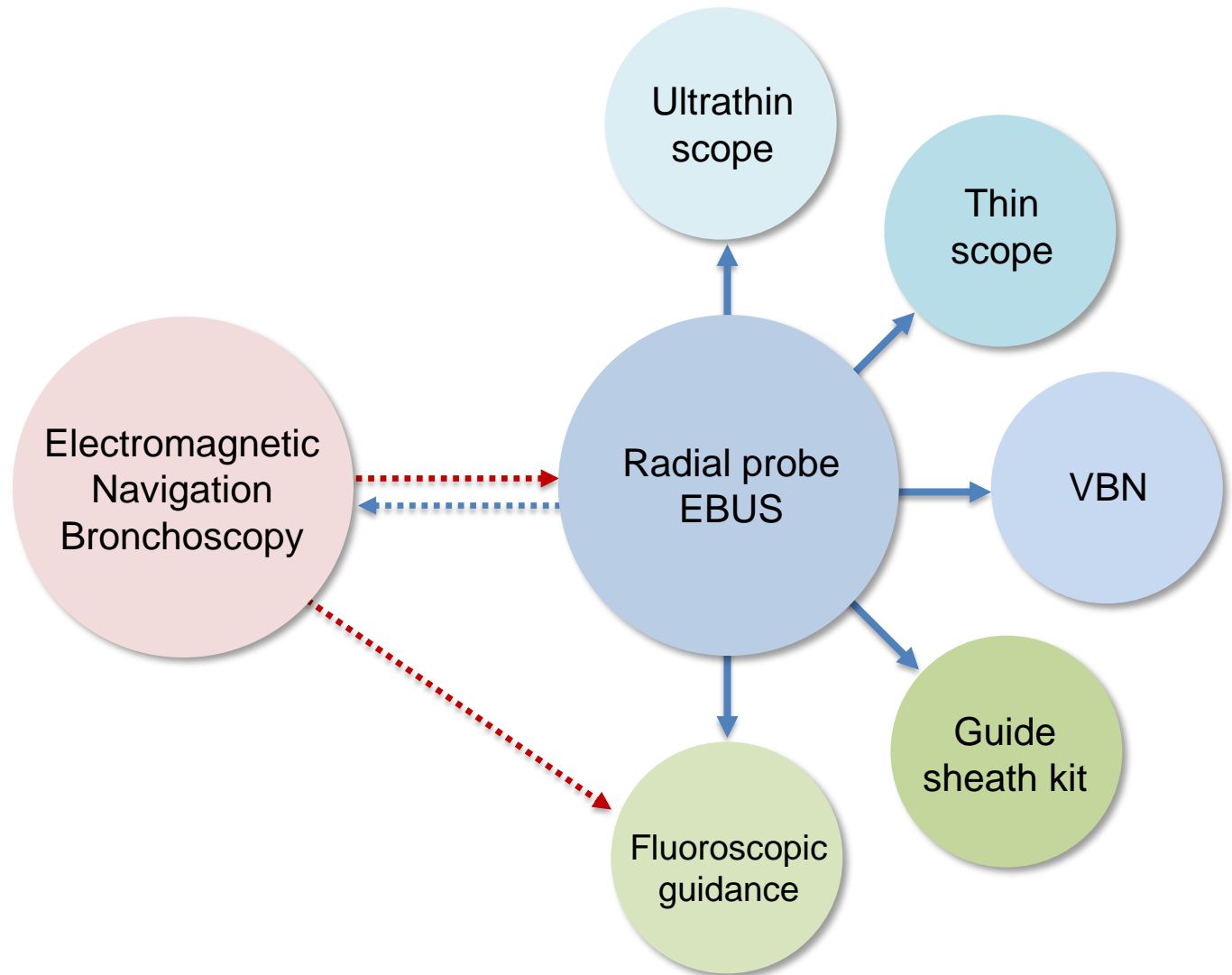
PD-L1 SP263 (Ventana) Tumor Expression: 0%

PD-L1 SP142 (Ventana) - Tumor Expression: 0%

- Tumor Infiltrating Immune Cell Expression: 0%

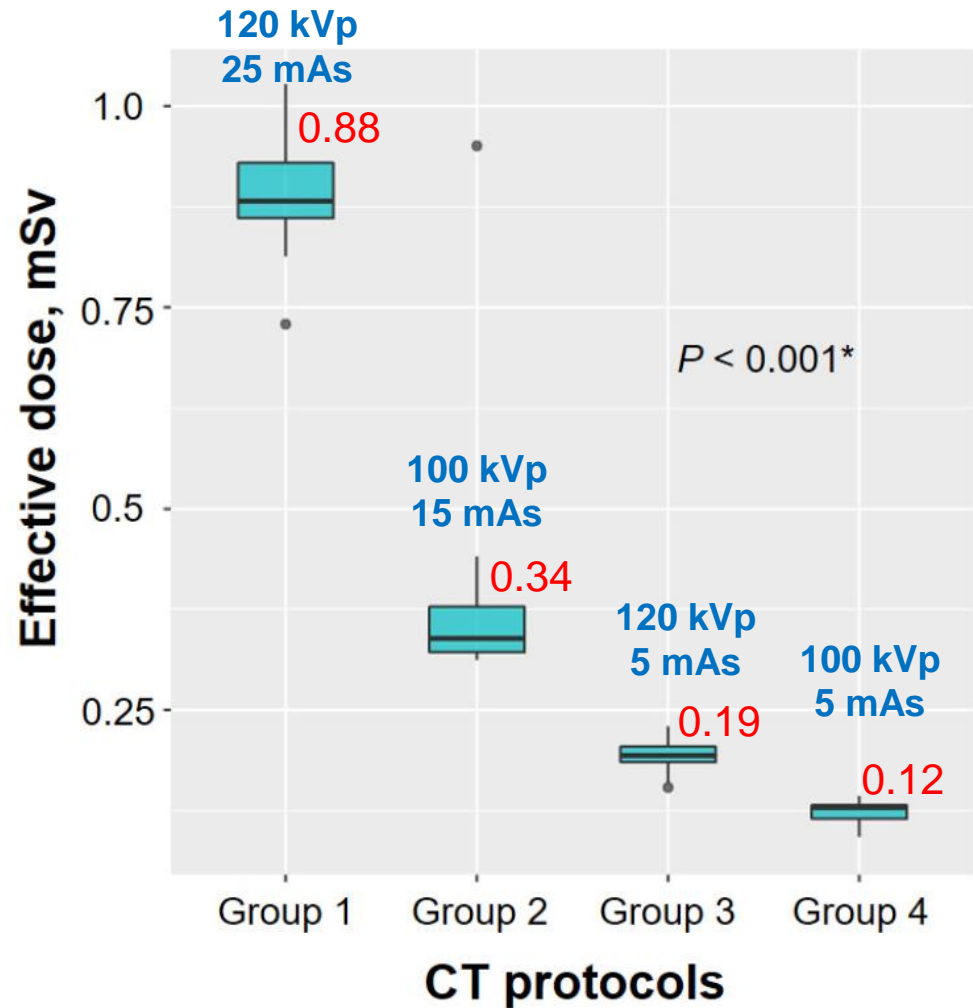
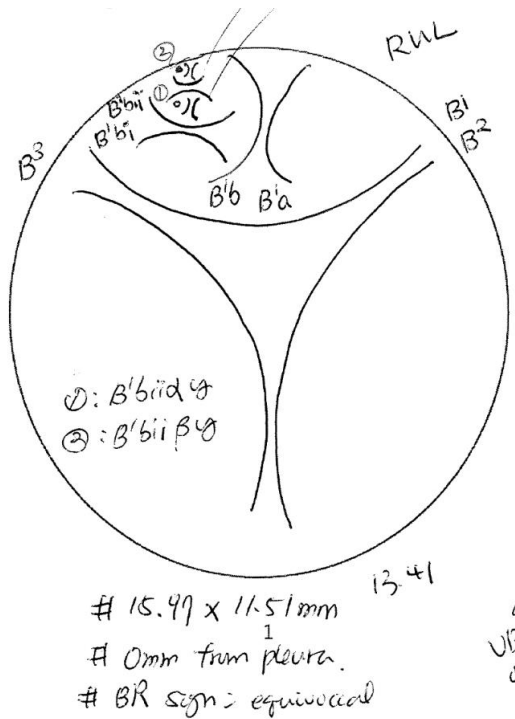
NOTE: The result of EGFR mutation and ALK gene studies (section B) will be followed.

Recent updates

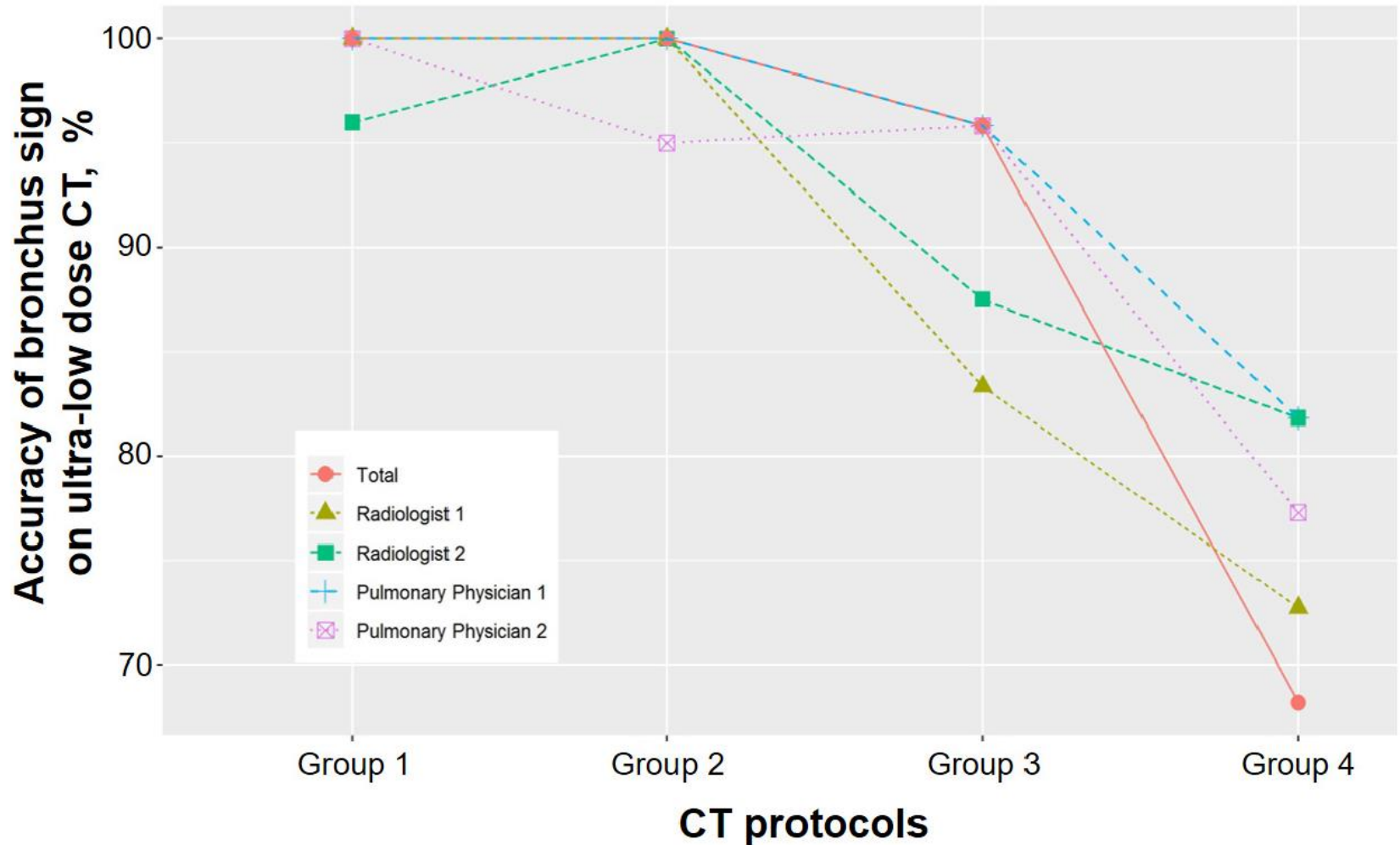


EBUS= endobronchial ultrasound
VBN = virtual bronchoscopy navigation

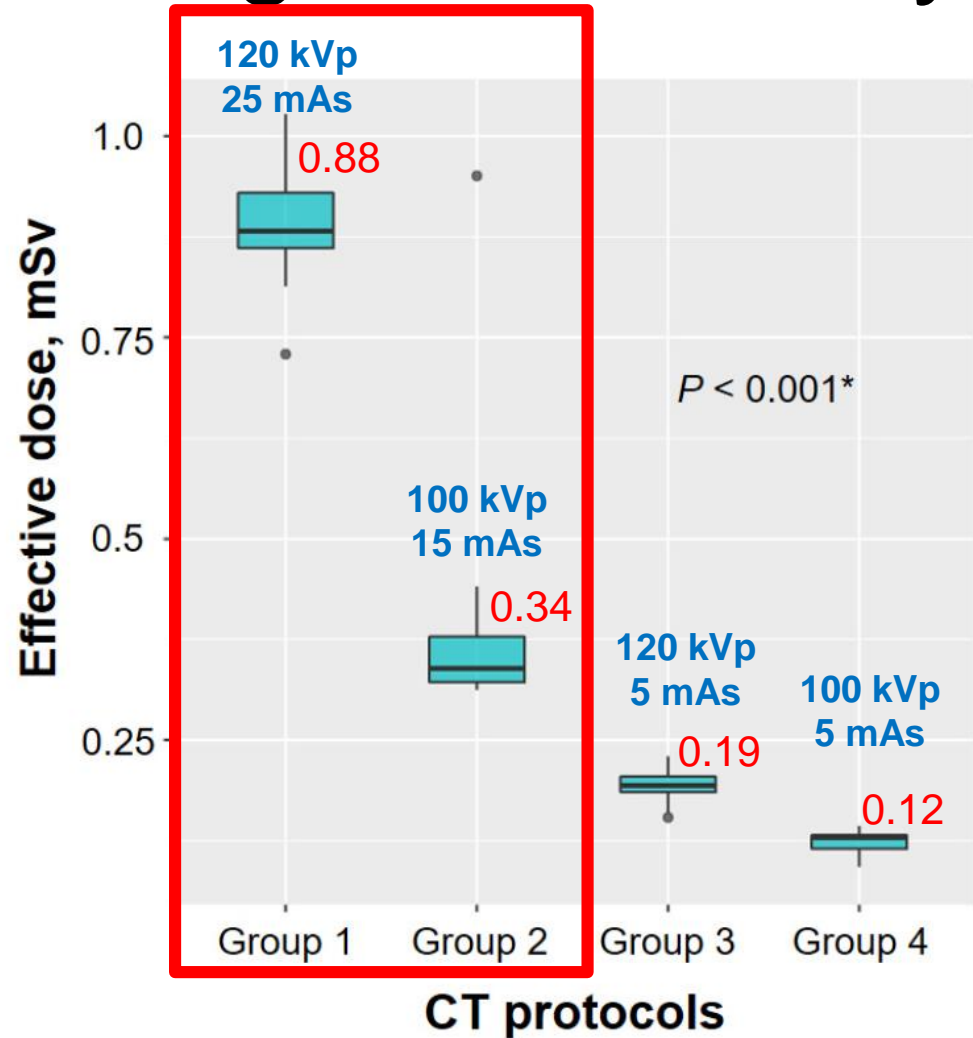
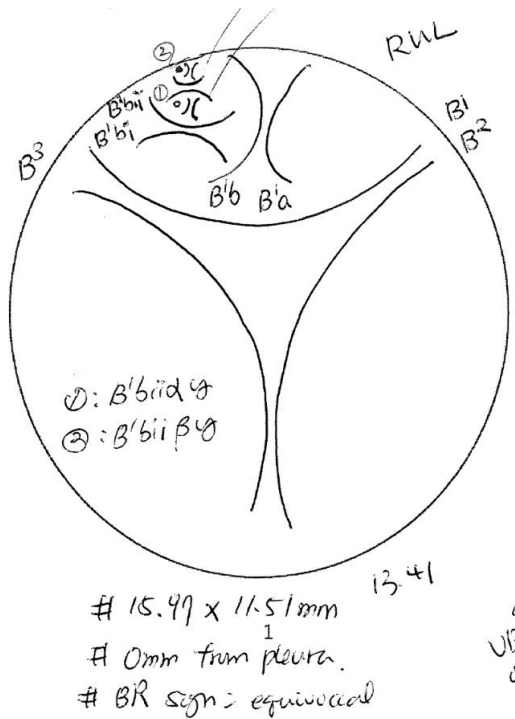
LDCT for reading CT anatomy



LDCT for reading CT anatomy



LDCT for reading CT anatomy

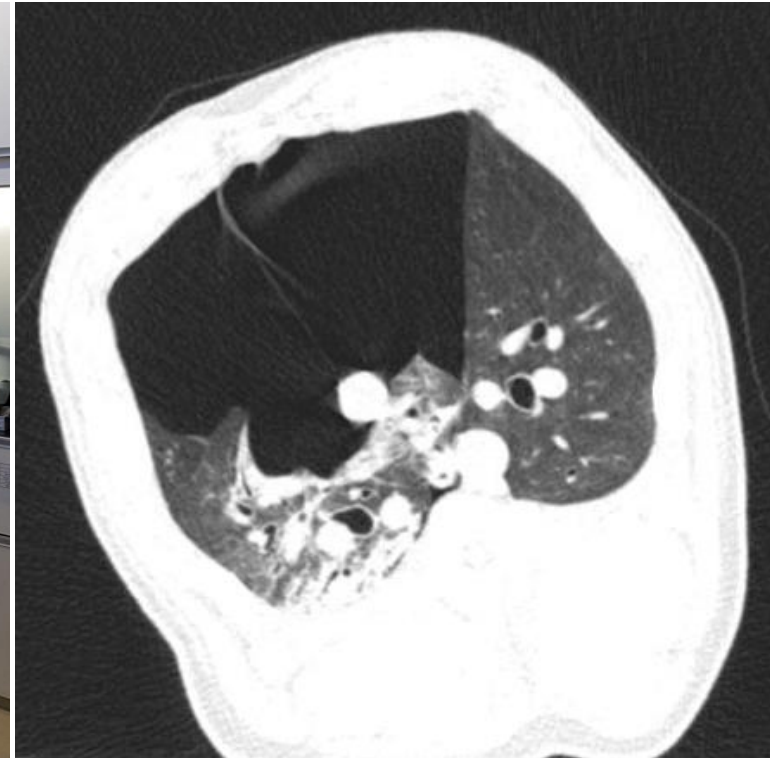


LDCT for VBN – Animal study



CT scan under general anesthesia

LDCT for VBN – Animal study



CT scan under general anesthesia +
Ambu bag with peep valve

LDCT for VBN – Animal study

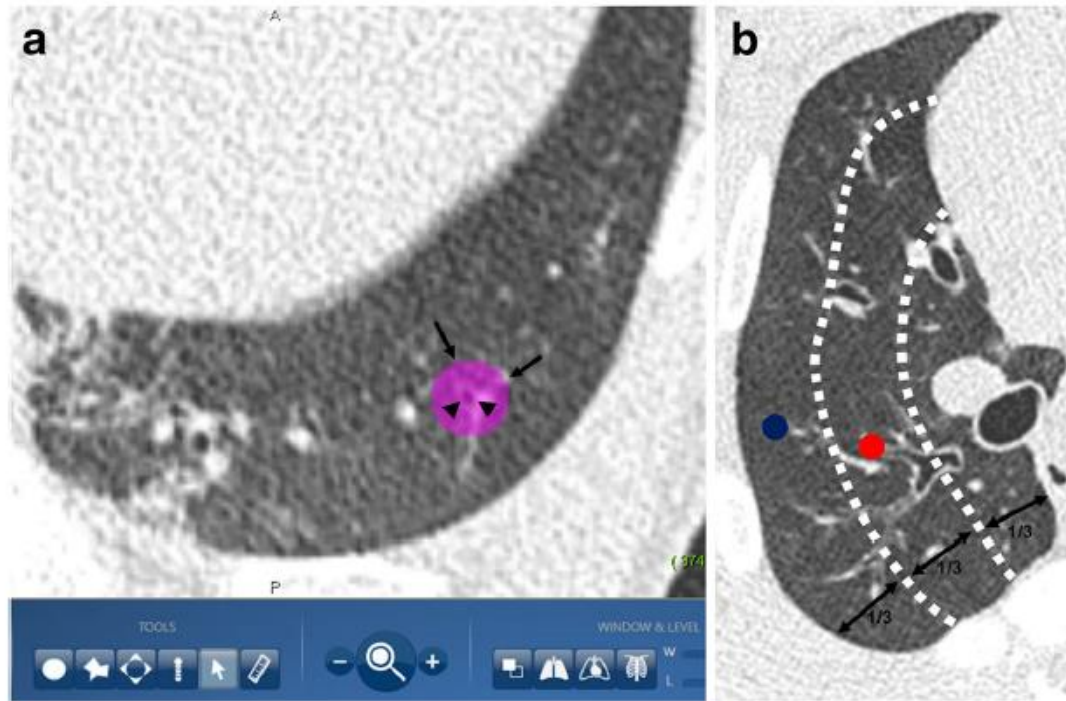
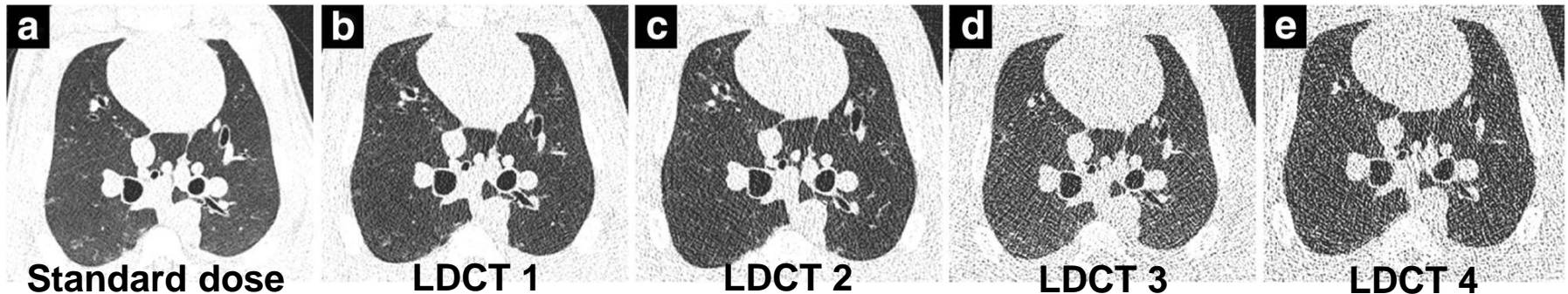


Fig. 2 Virtual targets for the virtual bronchoscopy navigation. **a** Creation of a three-dimensional virtual target (arrow) located on the peripheral bronchus (arrowhead) using LungPoint software. **b** Central (red circle) and peripheral (blue circle) virtual targets created in the middle and outer one-third of the lung parenchyma, respectively

LDCT for VBN – Animal study

- CT protocols for porcine models

	Standard dose CT	LDCT protocol 1	LDCT protocol 2	LDCT protocol 3	LDCT protocol 4
Peak kilovoltage	120 kVp	120 kVp	120 kVp	100 kVp	100 kVp
Milliamperes	50 mAs	15 mAs	8 mAs	7 mAs	4 mAs
Mean effective dose	1.68 mSv	0.51 mSv	0.28 mSv	0.15 mSv	0.09 mSv



LDCT for VBN – Human study

- CT protocols for human study

	Group 1	Group 2	Group 3
Peak kilovoltage	120 kVp	120 kVp	100 kVp
Milliamperes	15 mAs	8 mAs	7 mAs

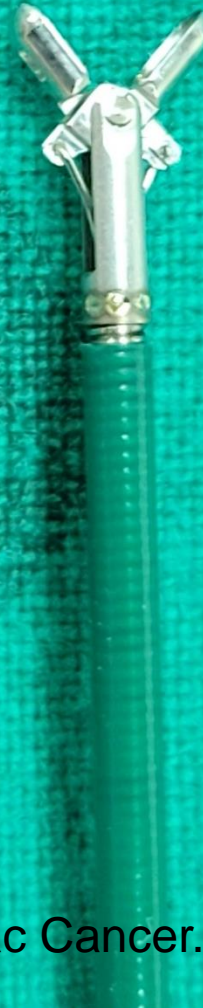
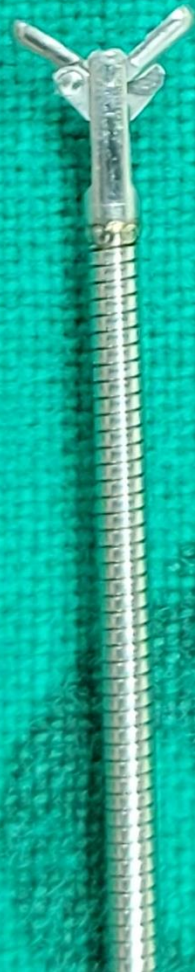
Human study의
결과를 어떻게 나올까?



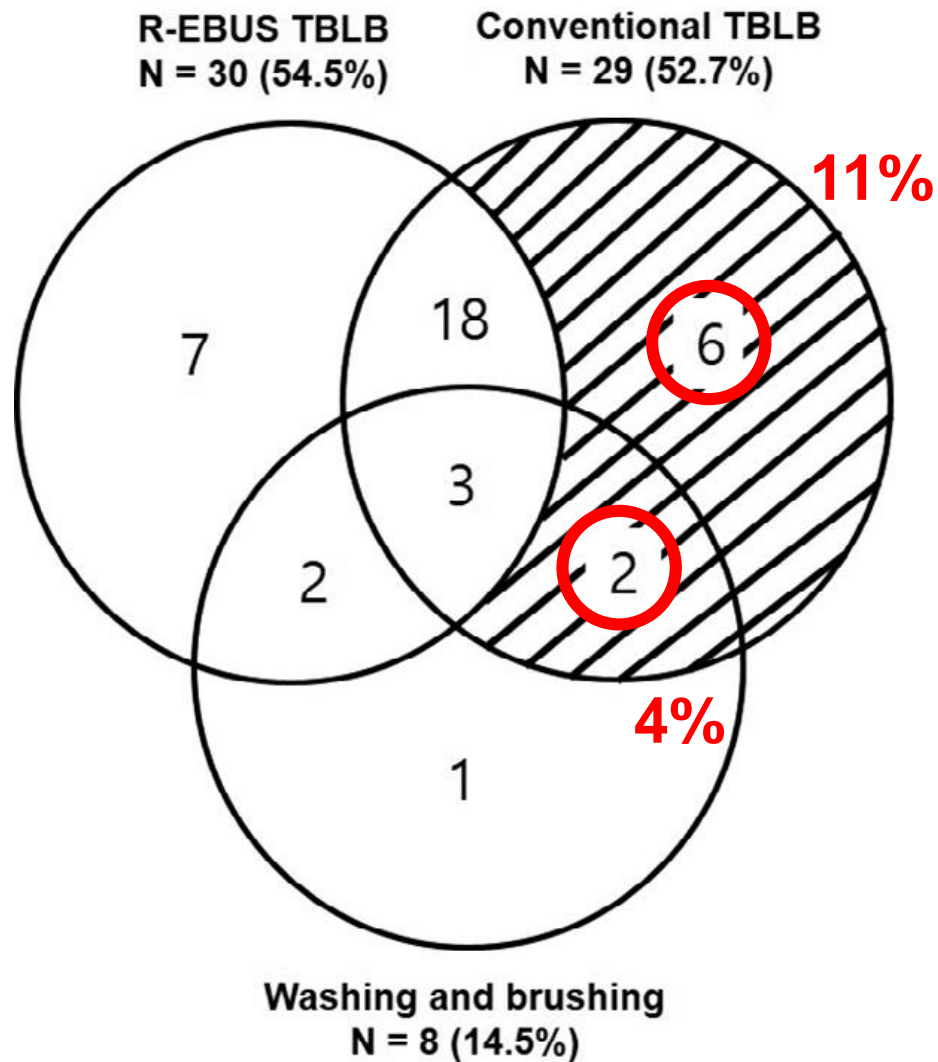
Forceps size

Outer diameter: 1.5 mm
Cup opening size: 4.0 mm

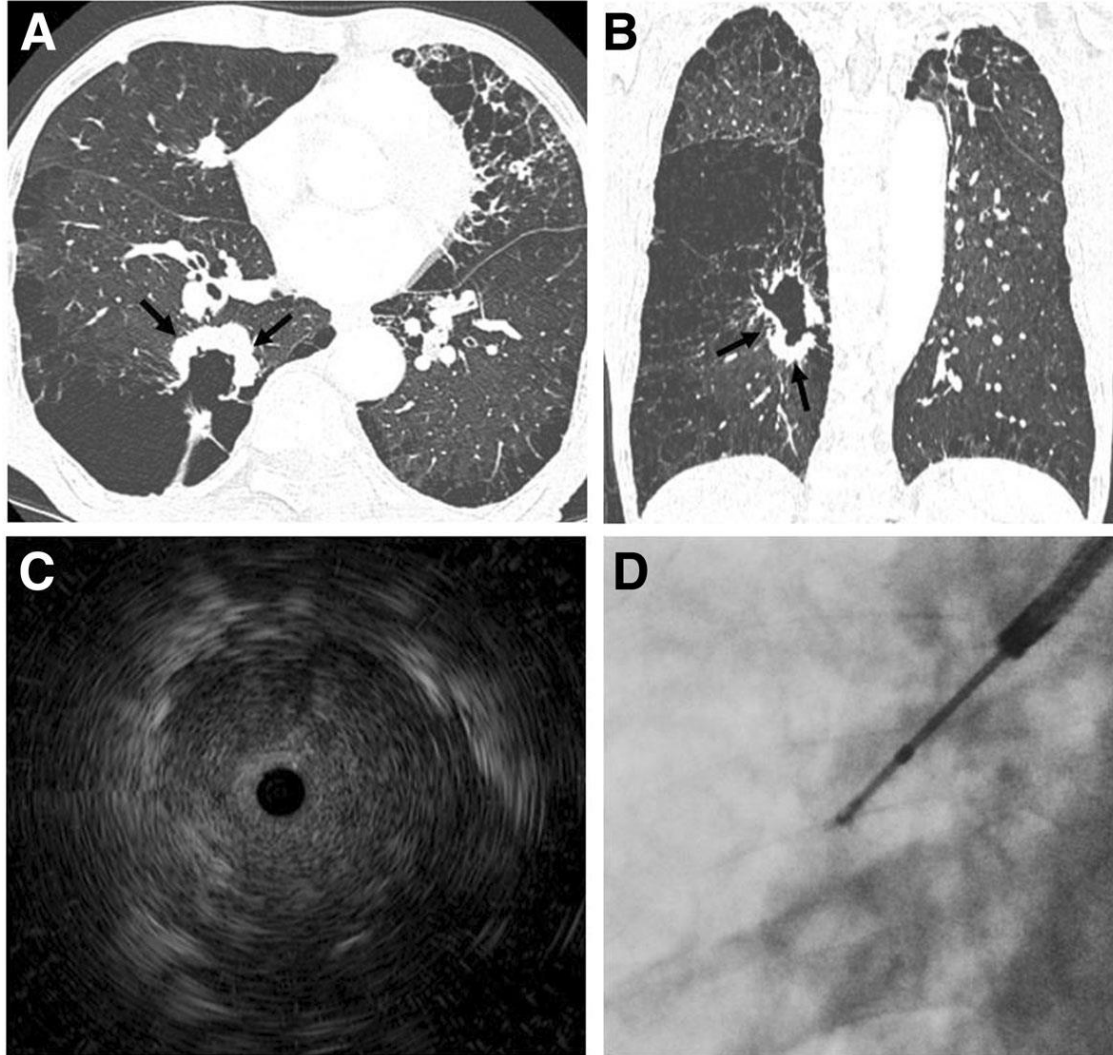
Outer diameter: 2.0 mm
Cup opening size: 5.0 mm



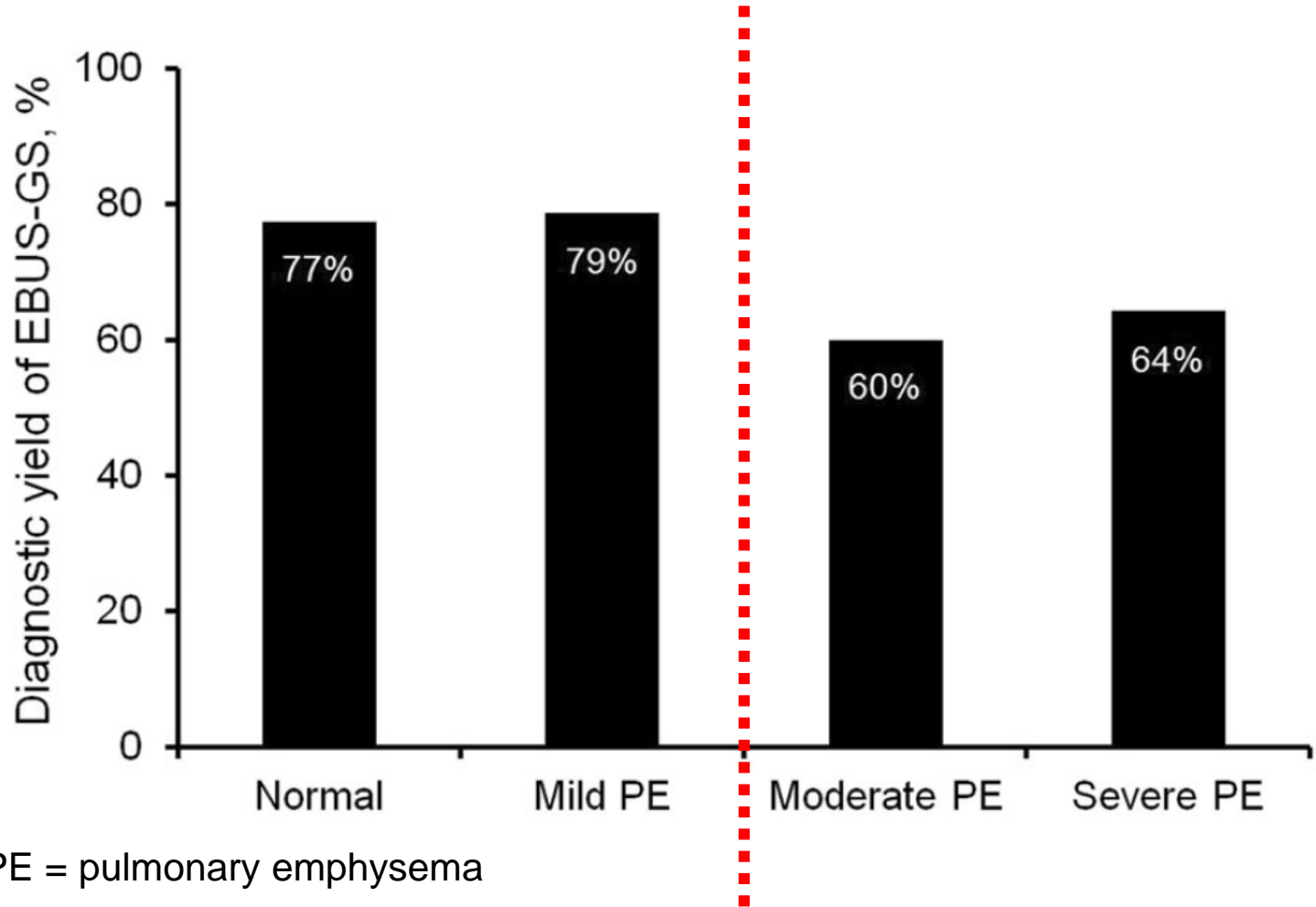
- N = 55
- Bronchus sign (+) = 64%
- EBUS finding
 - : Within 58%
 - : Adjacent 38%
 - : Invisible 4%
- Successful diagnosis = 39/55 (71%)



TBLB in emphysema patients



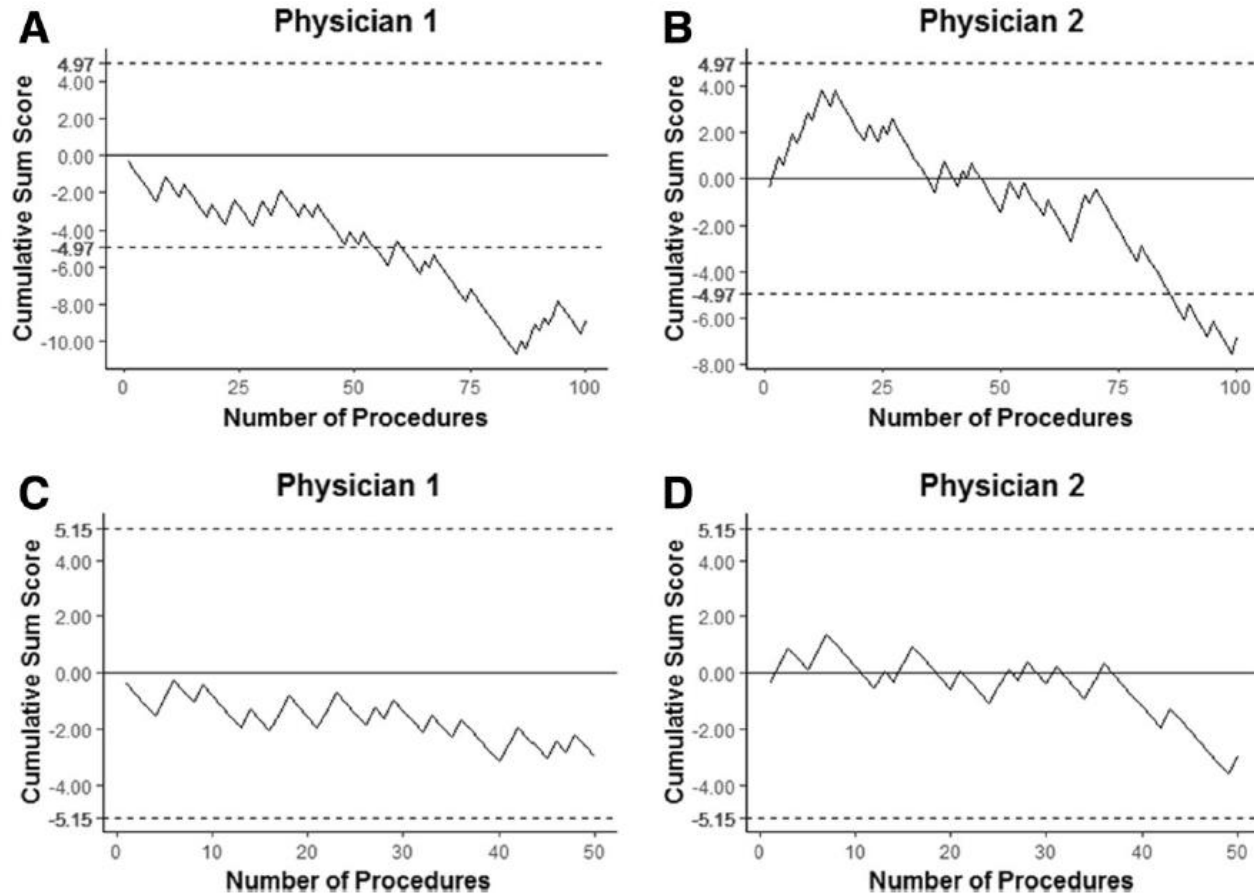
TBLB in emphysema patients



TBLB in IPF patients

	With IPF	Without IPF	P-value
Diagnostic yield	67%	76%	0.129
Complication rate	2%	1%	0.454

Learning curve



Novel techniques

Case III

Report

FINDING

Right lower lobe에서 관찰되는 1.5cm크기의 well defined nodule은 저명한 enhancement가 있고 subtle wash out을 보이고 있음.(90sec0이미지에서 스캔되지 않아서 평가에 제한이 있음).

이 병변은 2017.11.8외부병원 CT에서 0.9cm으로 관찰되었음.

Lung cancer 가능성을 배제할 수 없으며 그 밖에, sclerosing hemangioma, carcinoid tumor을 고려할 수 있음.

CONCLUSION

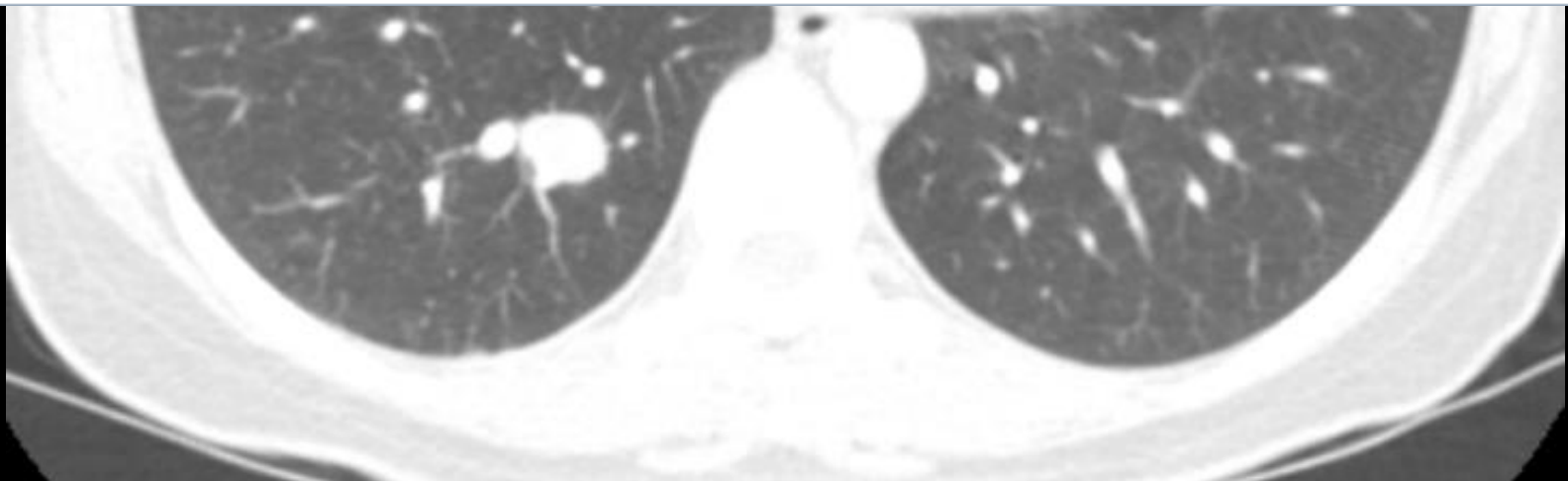
1.5cm sized indeterminate nodule in right lower lobe posterobasal segment. (0.9cm →1.5cm)

→ DDx1) lung cancer cannot be excluded.

2) sclerosing hemangioma.

3) carcinoid tumor

r/o Subinvolved thymus.



Case III

육안소견

Submitted are 3 parts.

1. Right, lower lobe, posterobasal segment #1~2: 2 fragments of yellow white soft tissue, 0.2x0.2cm in size(the larger one). Blocked in toto in A.
2. Right, lower lobe, posterobasal segment #3~4: a fragment of yellow white soft tissue, 0.2x0.1cm in size. Blocked in toto in B.
3. Right, lower lobe, posterobasal segment #5~9: fragments of brown white soft tissue, 0.3x0.2cm in size(the largest). Blocked in toto in C.

PA

이슬지

육안검사의

이창훈

전사자

저장

폐병리 적절성 보고

적합검체

부적합 검체

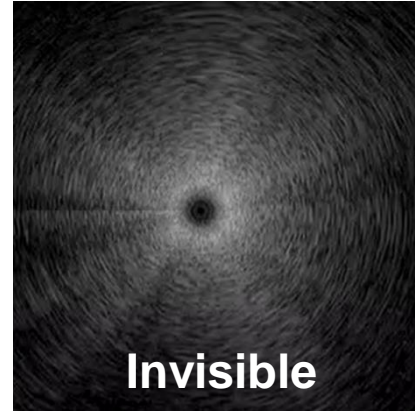
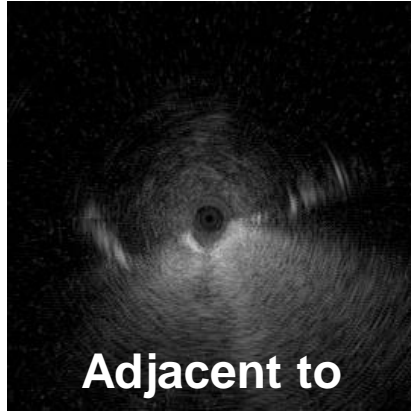
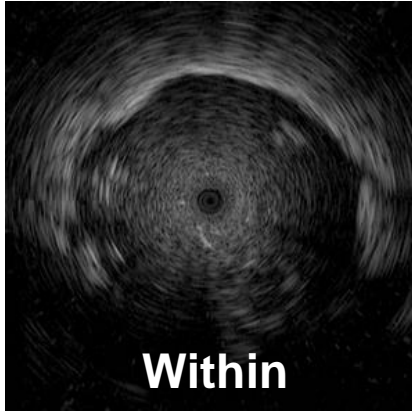
SMS전송

진단

Lung, lower lobe, posterobasal segment, #1~2, right, EBUS-TBLB :
Chronic inflammation.

Lung, lower lobe, posterobasal segment, #3~4, right, EBUS-TBLB :
Chronic inflammation.

Lung, lower lobe, posterobasal segment, #5~9, right, EBUS-TBLB :
Chronic inflammation.

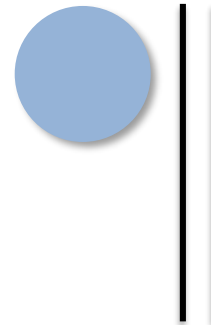
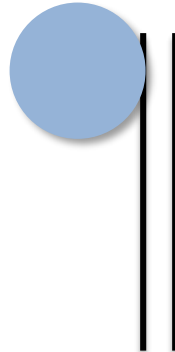
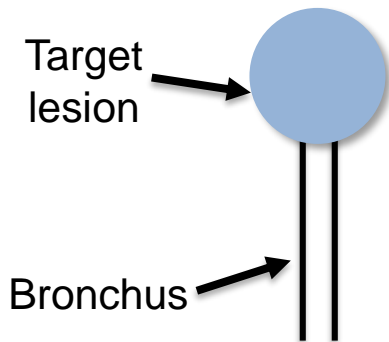


**Diagnostic
yield**

87%

42%

< 1%



Needle for peripheral lesions

Olympus PeriView FLEX TBNA Needle Brings New Capabilities to Early Diagnosis of Lung Disease

The First TBNA Needle Designed for Peripheral Bronchoscopy Featuring Increased Flexibility and Smaller Outer Diameter, Brings the Periphery Within Reach

CENTER VALLEY, Pa., (January 15, 2018) – Olympus, a global technology leader in designing and delivering innovative solutions for medical and surgical procedures, among other core businesses, announced today the availability of the PeriView FLEX needle that will enable improved access to peripheral pulmonary lesions during transbronchial needle aspiration (TBNA) procedures that are conducted in the diagnosis of lung diseases.

The device features Olympus' FLEX-cut technology, an innovation leveraging a spiral pattern of laser cuts on the needle, for unprecedented flexibility. The flexibility of the needle is a major advantage as it does not limit articulation of the bronchoscope making it difficult to reach certain target locations. Furthermore, the PeriView FLEX TBNA needle is the only TBNA needle that can be used with the Olympus 2.0 mm guide sheath. This smaller guide sheath provides an extension of the bronchoscope's working channel, which creates an extended reach and when combined with the PeriView FLEX, enables better access when compared to other TBNA needles on the market.



Olympus announced today the availability of a new needle that will enable improved access to peripheral pulmonary lesions during transbronchial needle aspiration (TBNA) procedures that are conducted in the diagnosis of lung diseases. **The PeriView FLEX TBNA needle features FLEX-cut technology for unprecedented flexibility and is the only TBNA needle that can be used with the Olympus 2.0 mm guide sheath** which extends the working channel for improved reach and better access when compared to other TBNA needles on the market.

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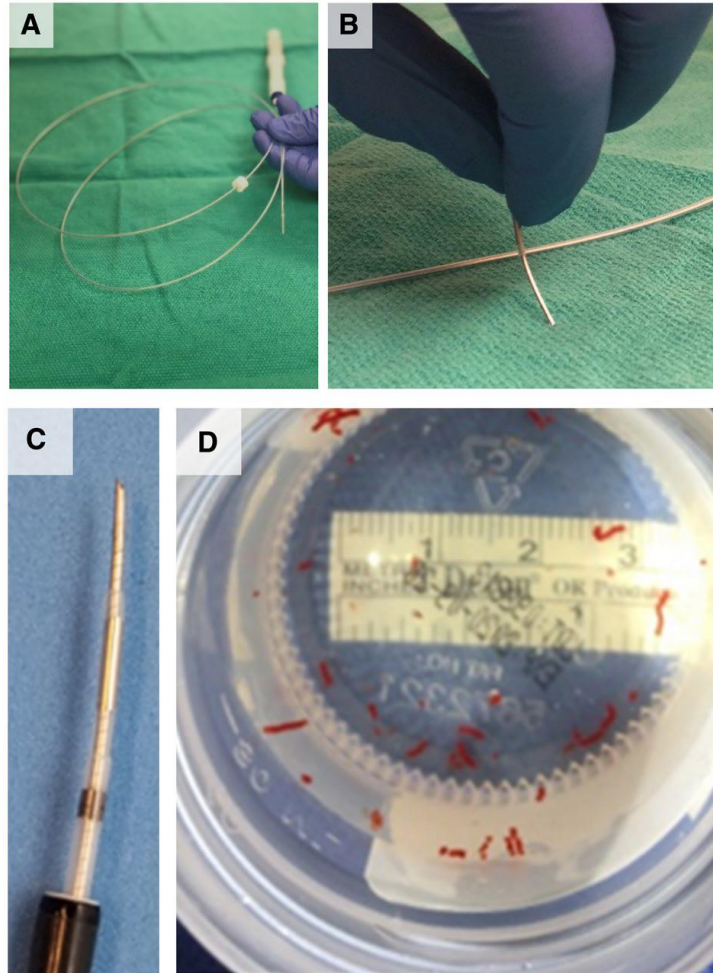


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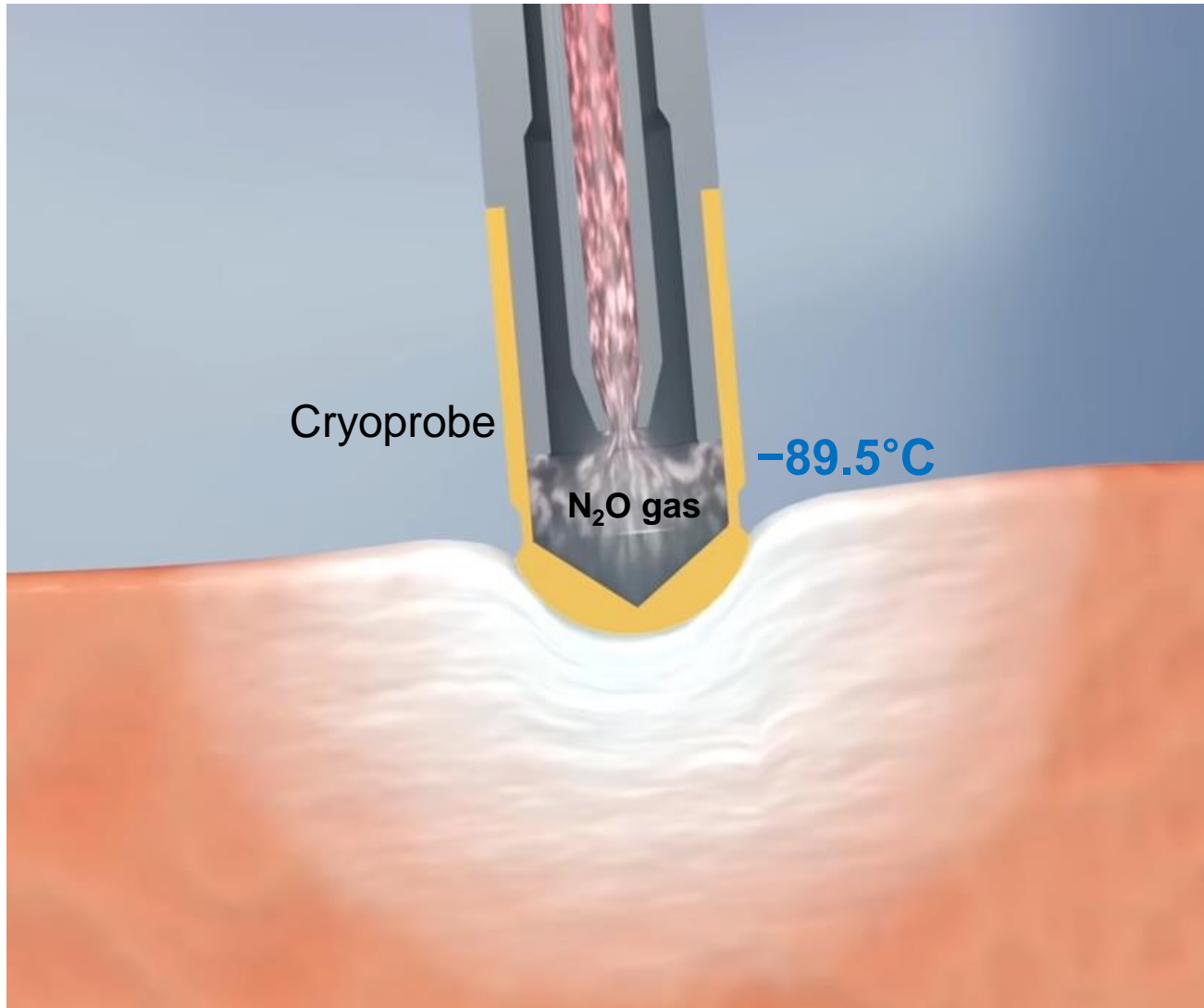
Needle for peripheral lesions



Needle for peripheral lesions

Diagnosis yield	With FLEX needle	Without FLEX needle
Malignancy	(76/92) 83%	(72/92) 78%
Overall	(87/111) 78%	(80/111) 72%

CryoTBLB





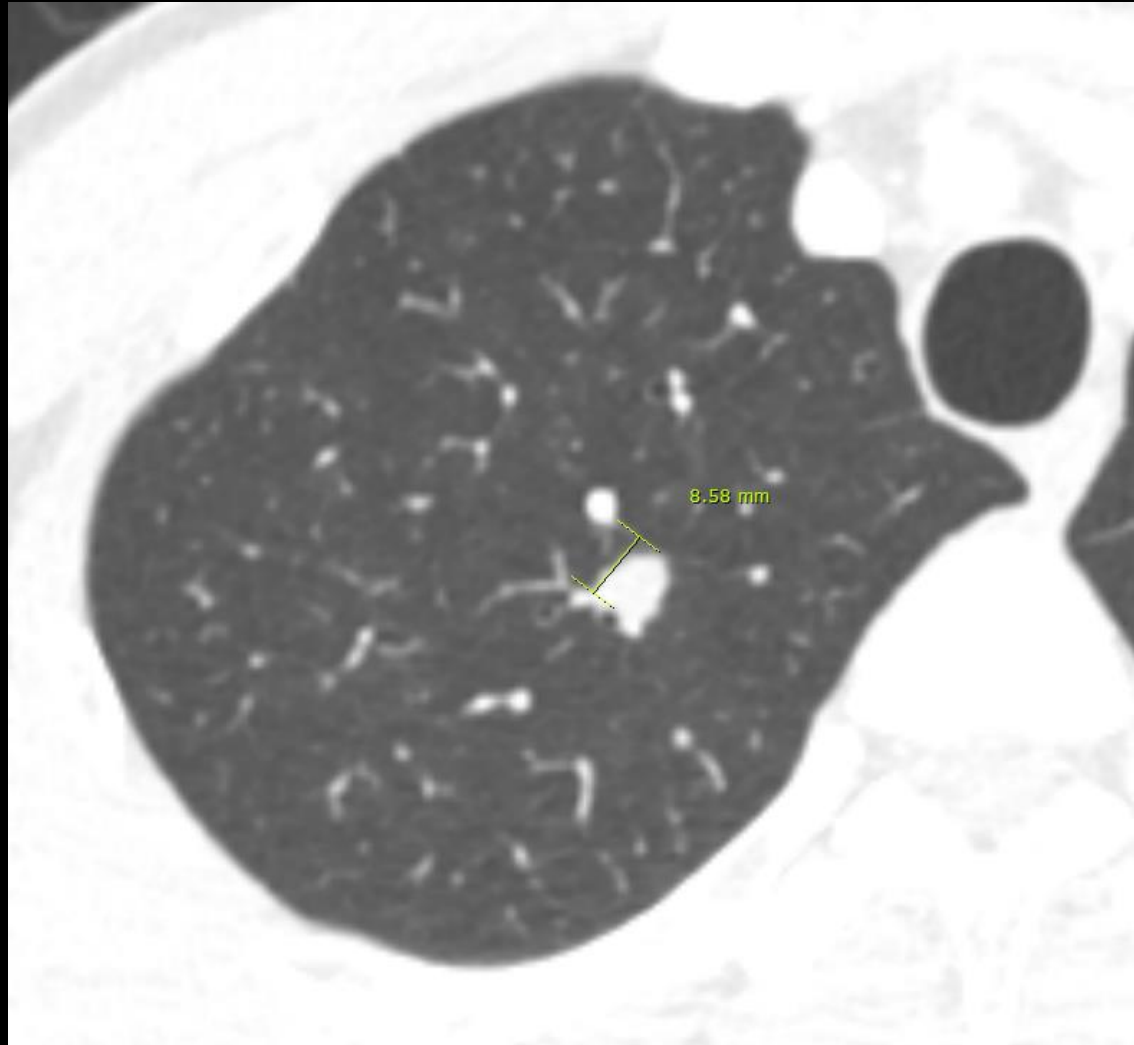
1.9 mm cryoprobe

2 mm channel

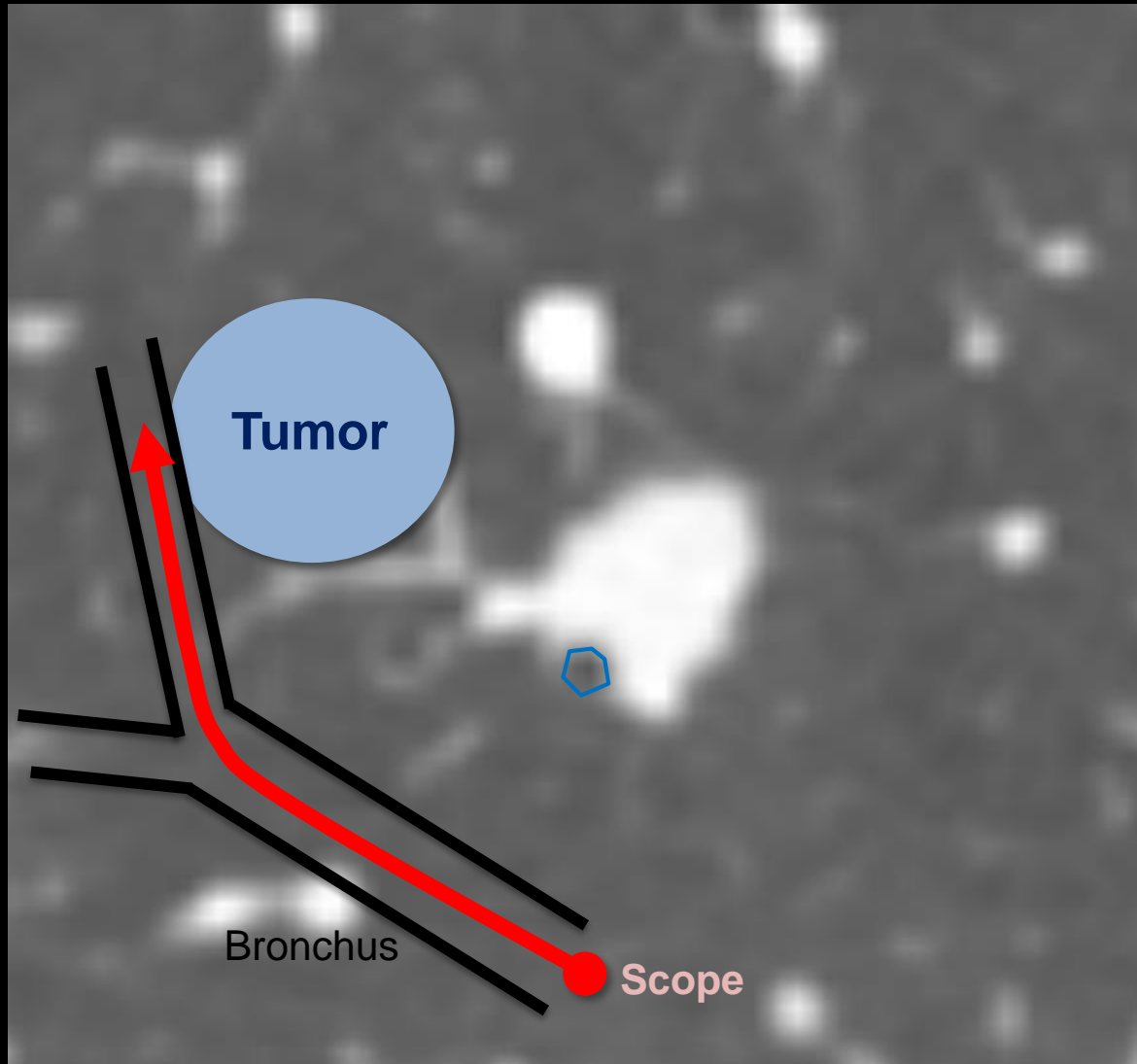
4mm thin
bronchoscope



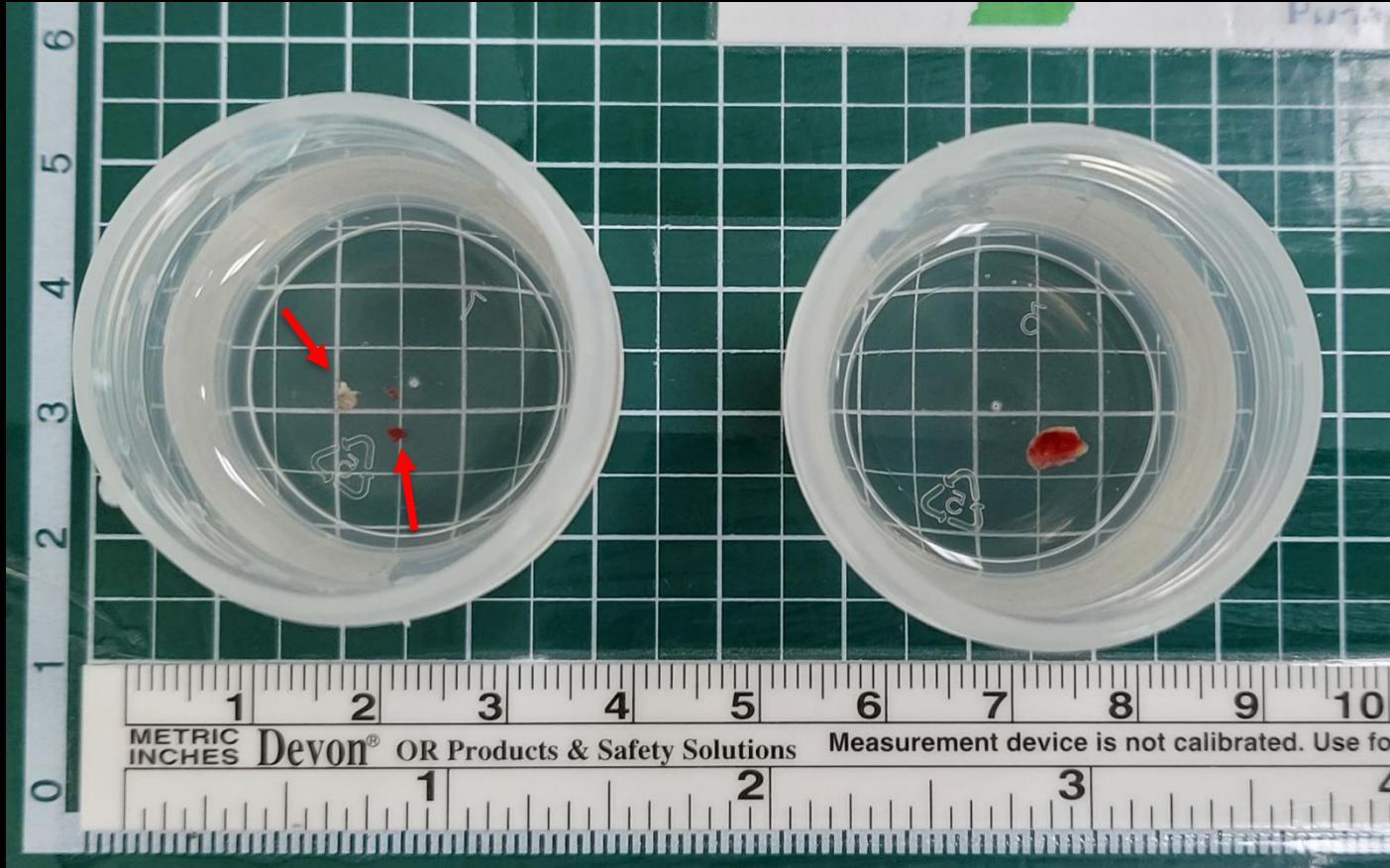
Case IV



Case IV



Case IV



EBUS-GS 3회

CryoTBLB 1회

Case IV

육안소견

Submitted are 2 parts.

1. Right, upper lobe, apical segment #1~3: 2 fragments of brownish white soft tissue, 0.3x0.2cm in the largest size. Blocked in toto, Slide A.
2. Right, upper lobe, apical segment #4: a fragment of brownish white soft tissue, 0.6x0.4cm in size. Blocked in toto, Slide B.

PA

박수현

육안검사의

김아롱

전사자

강지혜

저장

진단

Lung, upper lobe, apical segment #1~3, right, EBUS-TBLB :
Acute and chronic inflammation with necrosis.

← EBUS-GS 3회

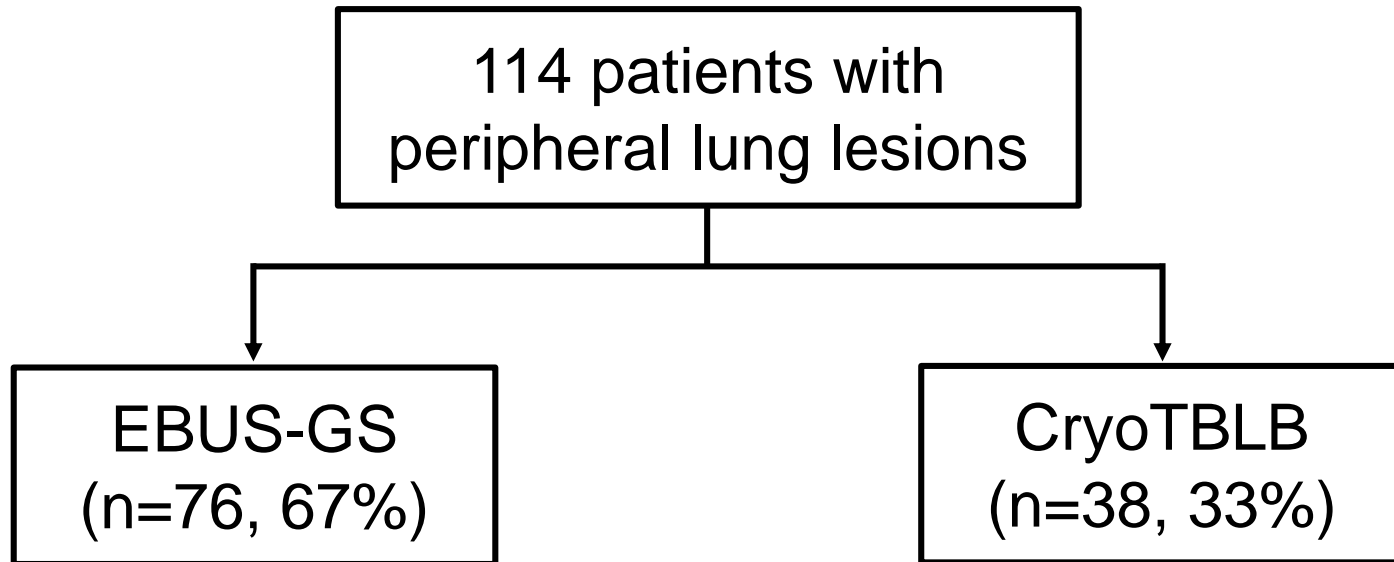
Lung, upper lobe, apical segment #4, right, EBUS-TBLB :
Chronic granulomatous inflammation with necrosis.

← CryoTBLB 1회

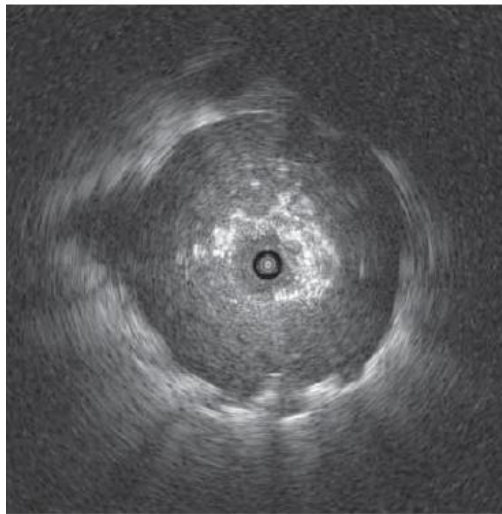
Tissue TB-PCR positive

EBUS-GS vs. CryoTBLB

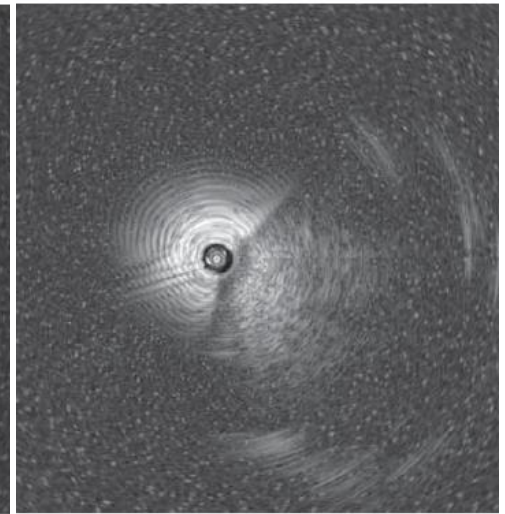
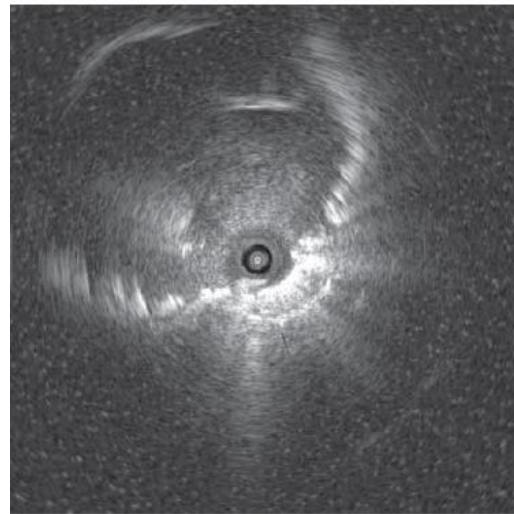
- Single center, retrospective study
- N=144



EBUS-GS vs. CryoTBLB



vs.



Concentric

43%

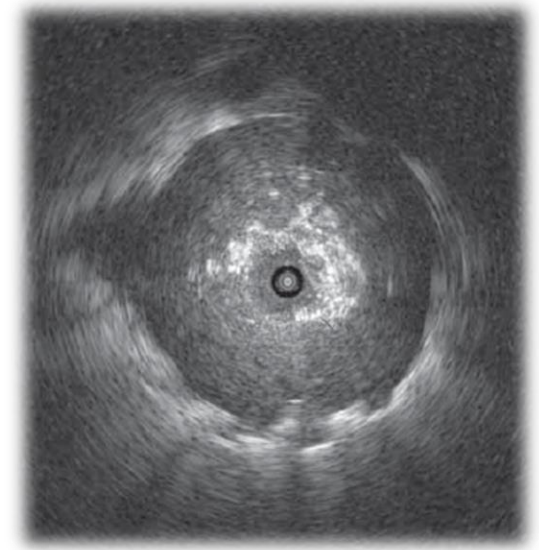
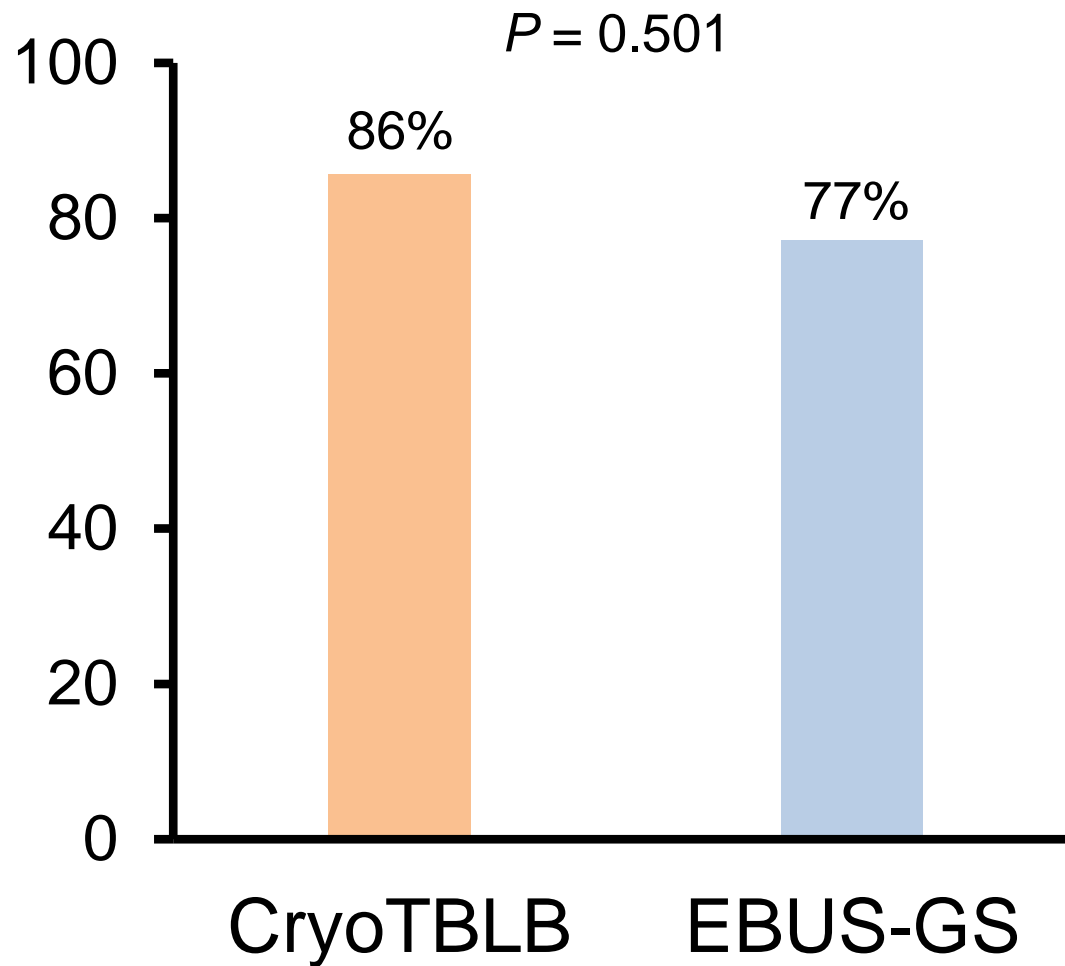
Eccentric

41%

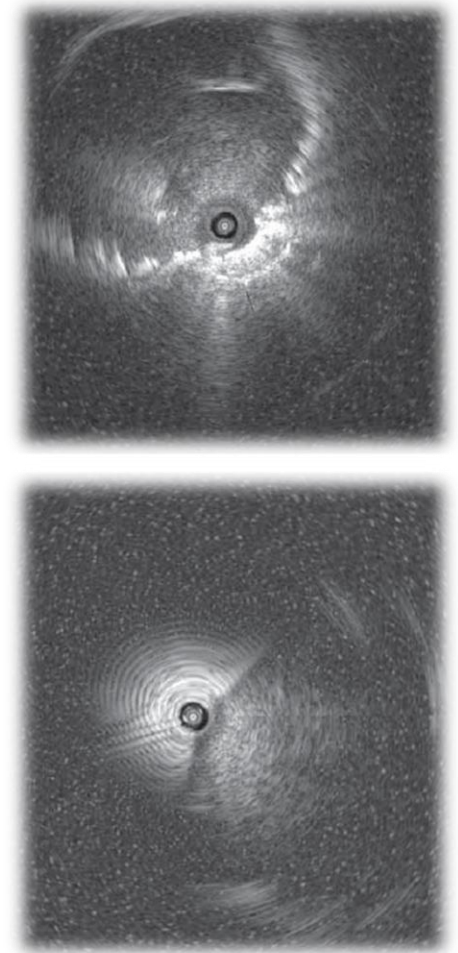
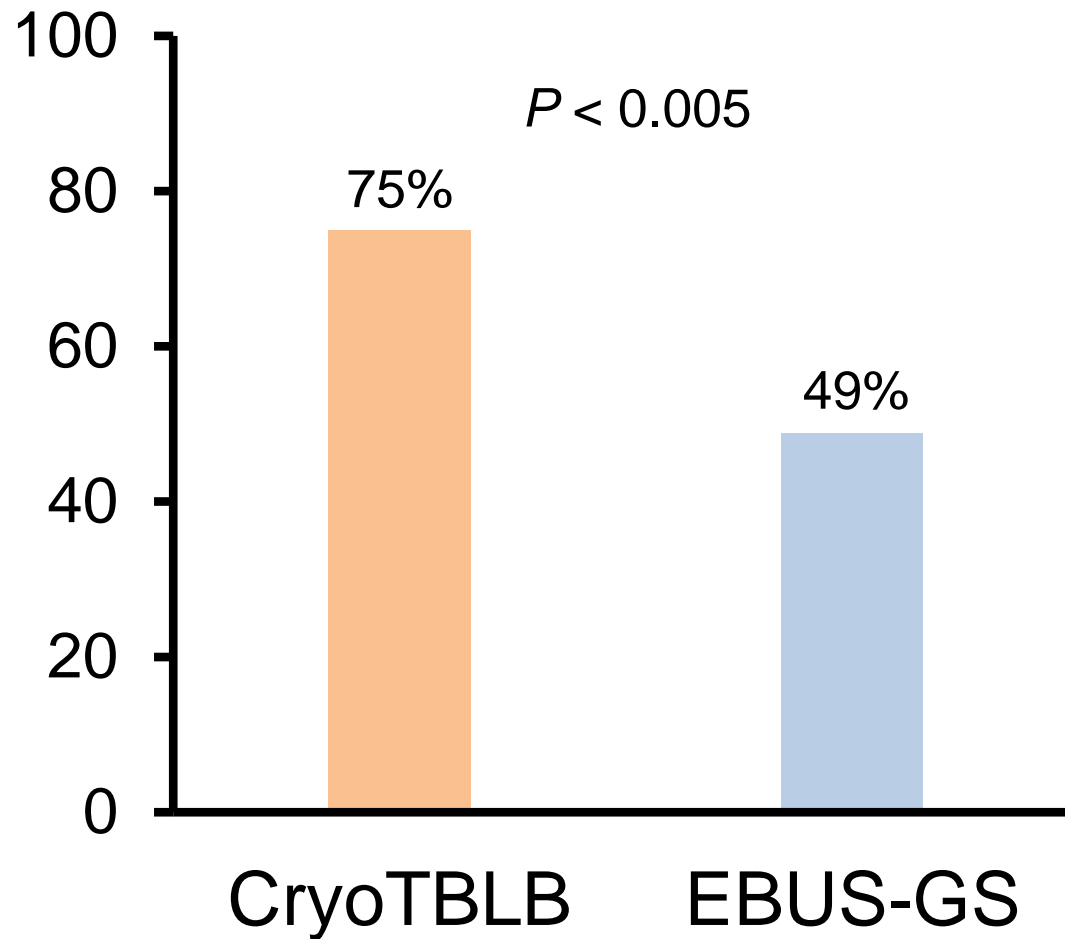
Adjacent

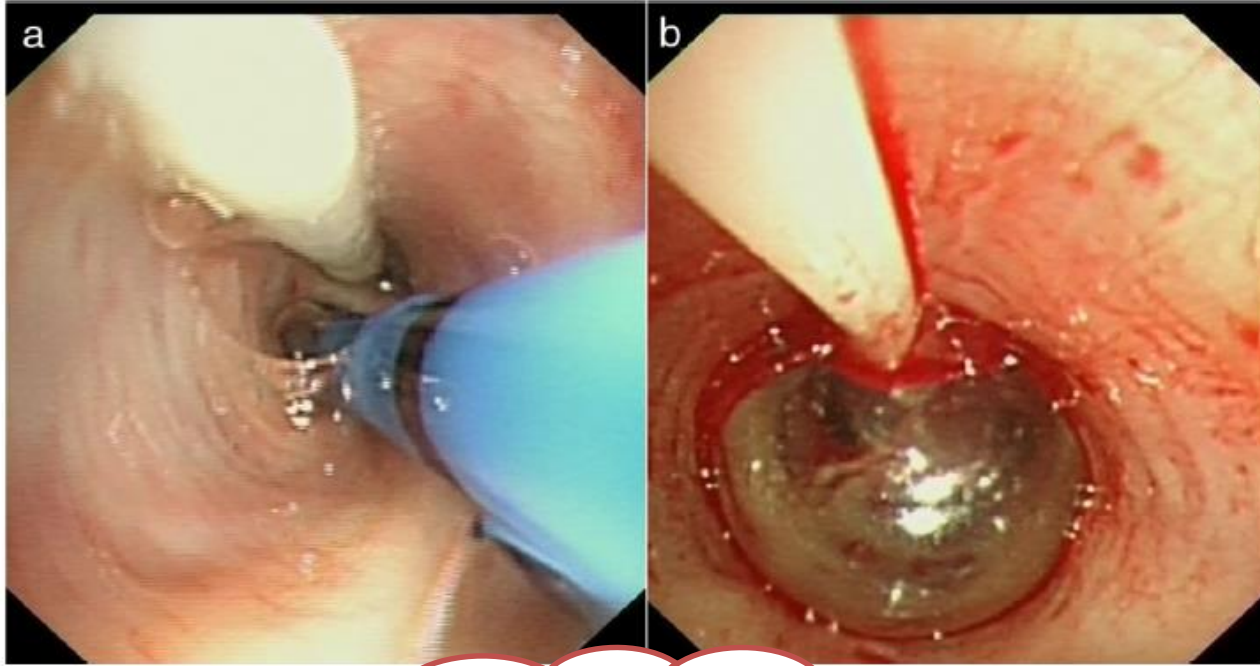
16%

Concentric on radial EBUS



Eccentric or Adjacent on EBUS





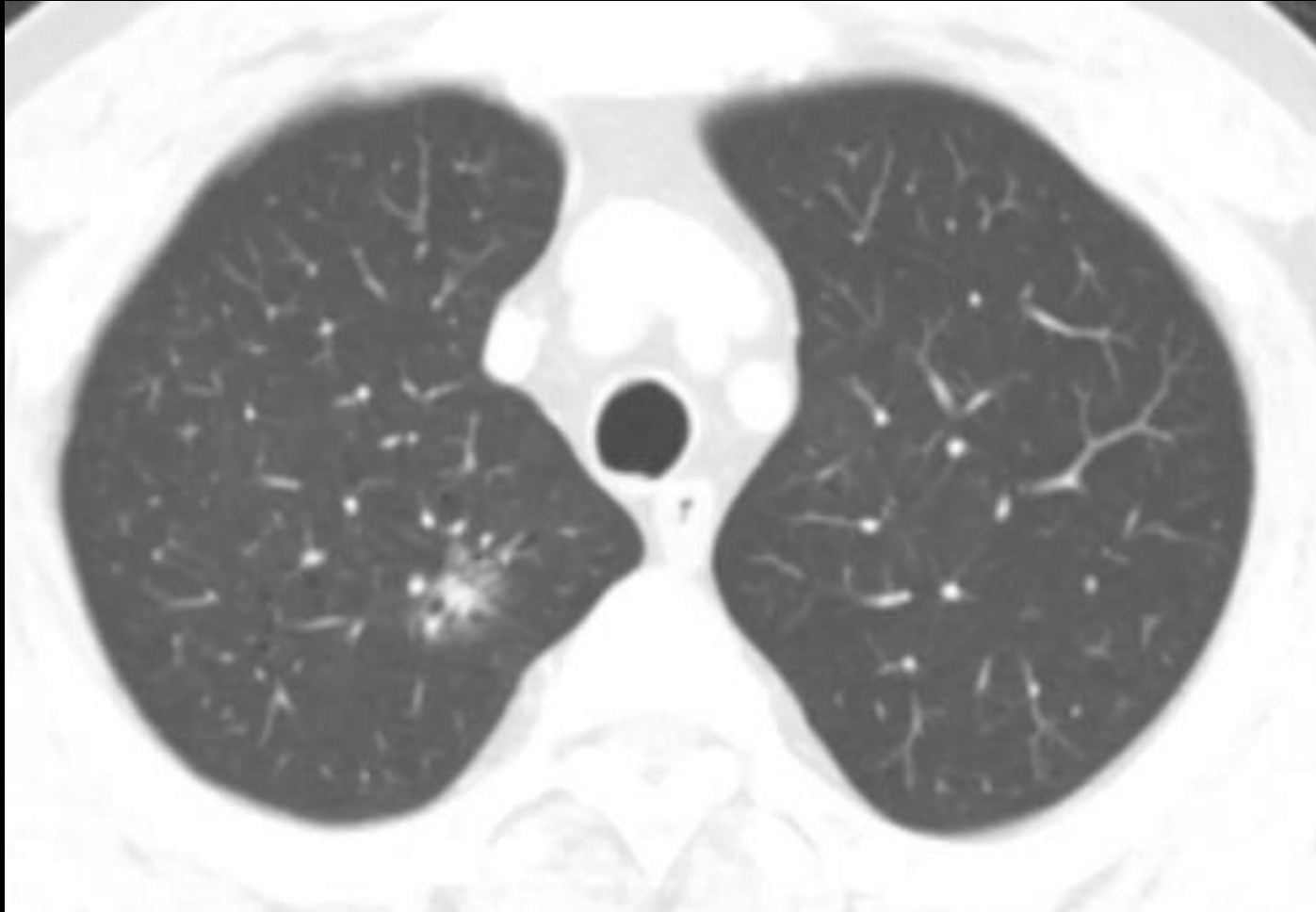
출혈이 많으면 어떡하지?



Pajares Ruiz V, et al. Arch Bronconeumol. 2014;50:309-10.



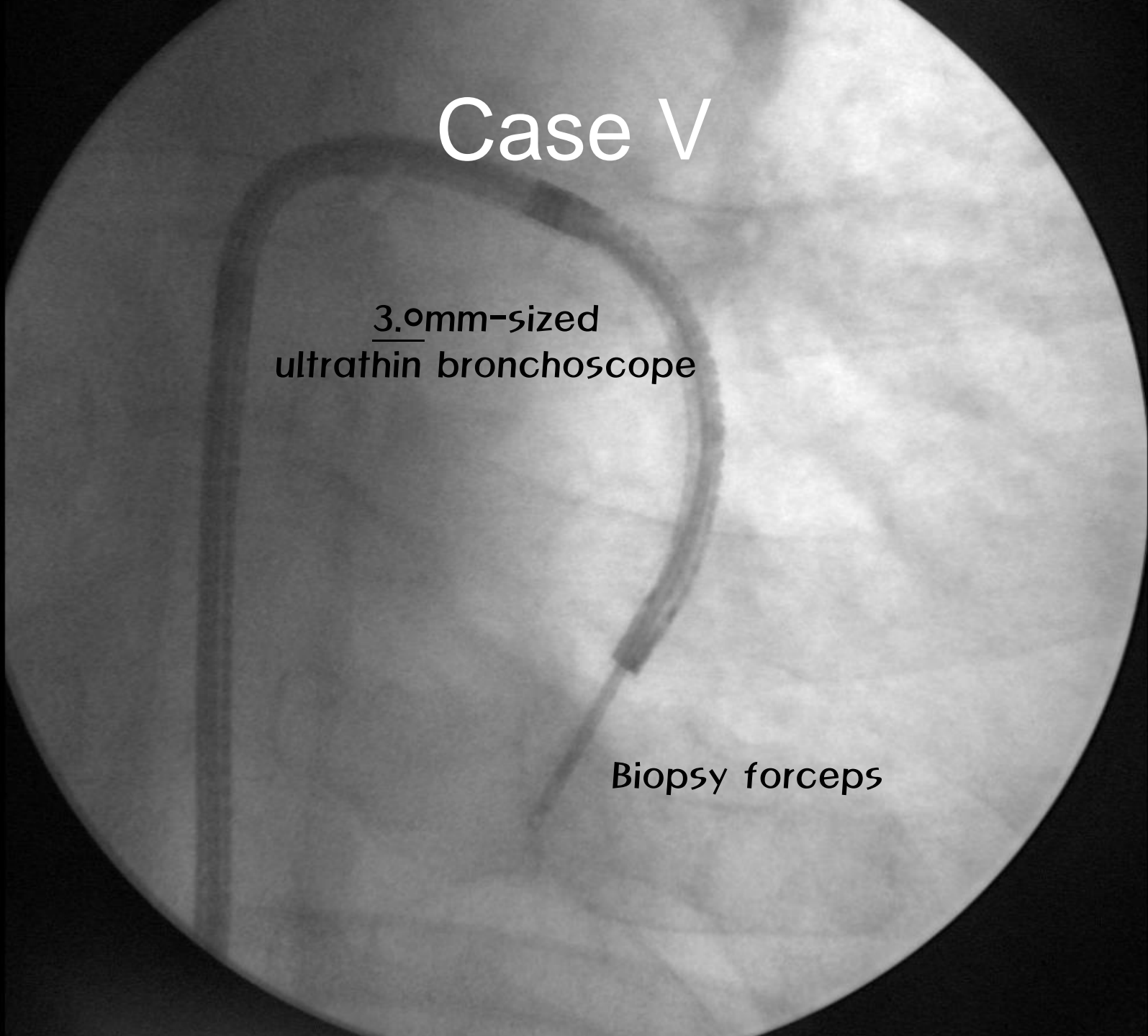
Case V



Case V

3.0mm-sized
ultrathin bronchoscope

Biopsy forceps



Case V

진단

Lung, upper lobe, apical segment #1~3, right, EBUS-TBLB :
No tumor.

Lung, upper lobe, apical segment #4~8, right, EBUS-TBLB :
Non-small cell carcinoma, consistent with adenocarcinoma.

Immunohistochemistry in section
TTF-1(+)

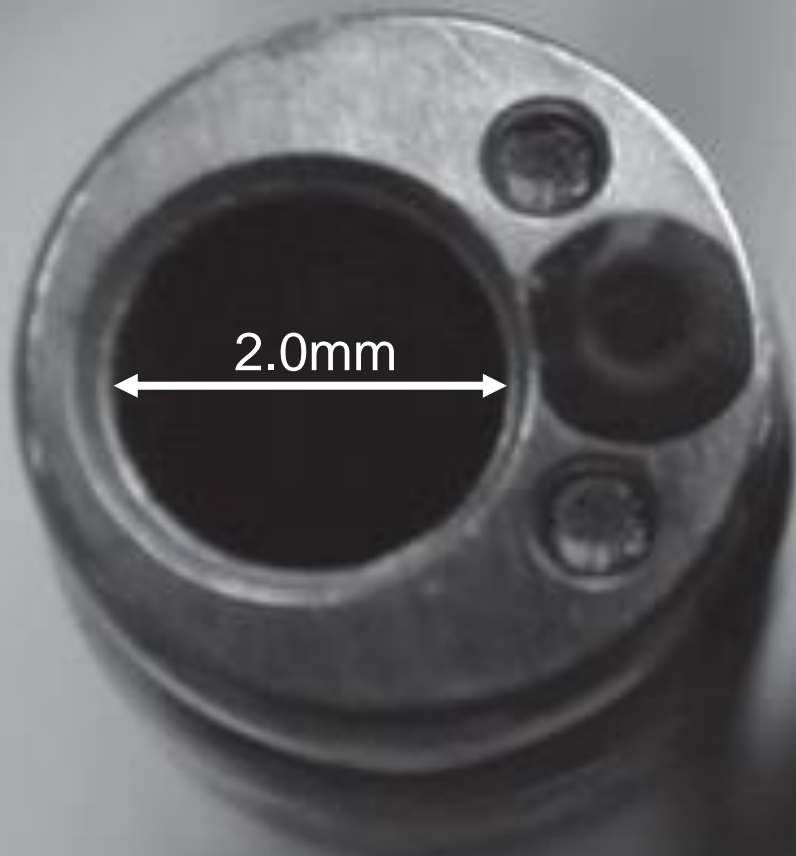
ALK (D5F3 CDx Ventana): negative
PD-L1 SP263 (Ventana) Tumor Expression: <5%

PD-L1 22C3 (Dako, 녹십자, 031-260-9600) Tumor Proportion Score: 0%(2019.12.24)

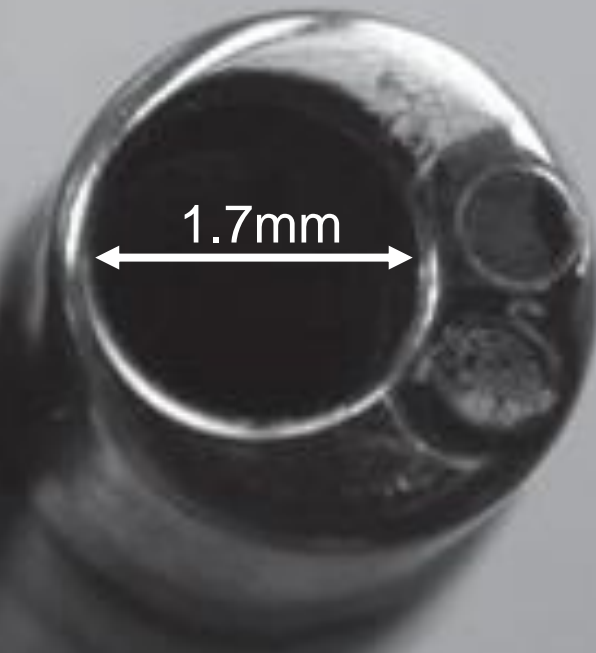
진단

Lung, upper lobe, right, VATS lobectomy with mediastinal node dissection:

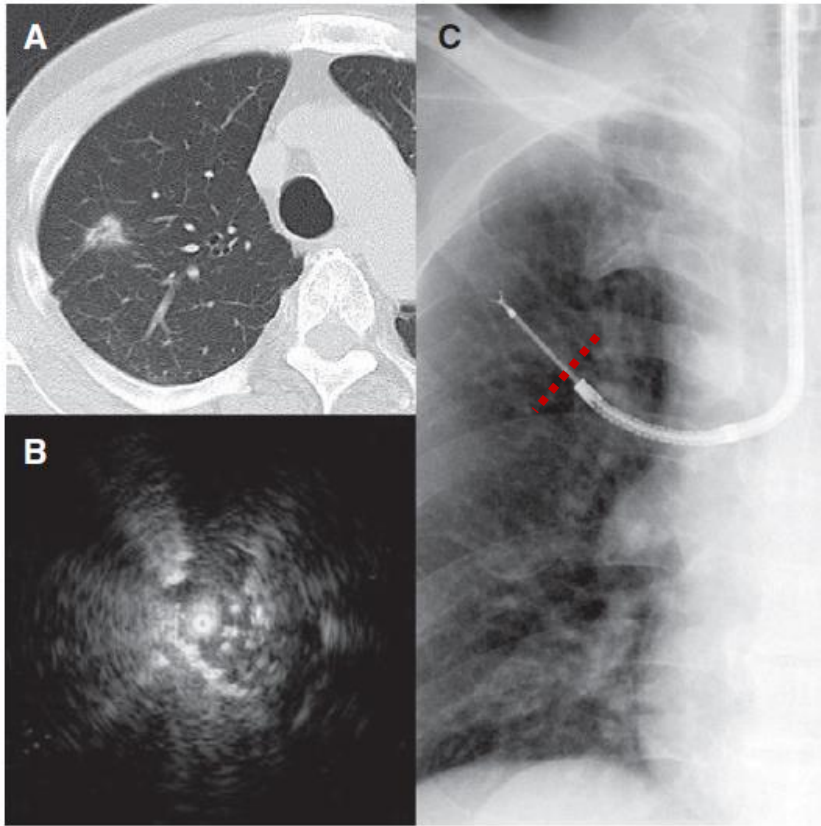
1. Histologic type: Adenocarcinoma, moderately differentiated;
predominantly acinar growth pattern (60%), papillary growth pattern (15%)
and lepidic growth pattern (25%)
2. Location: right upper lobe
3. Dimensions: 2.1x2.0x1.0cm
4. Confined to lung parenchyma and no involvement of visceral pleura
5. Growth pattern: infiltrative growth pattern
6. Lymphovascular perineural invasion: not identified
7. Lymph node status: no metastasis in 2 peribronchial lymph nodes
8. Status of resection margins
 - Bronchial margin: free from carcinoma (safety distance, 17 mm)
 - Parenchymal margin, peribronchial : free from carcinoma (safety distance, 26 mm)
 - Vascular margin: free from carcinoma
 - Chest wall margin: free from carcinoma
9. Partial pathologic TNM stage: pT1b pN0
10. Adjacent lung parenchyma



4.0mm-sized
thin bronchoscope

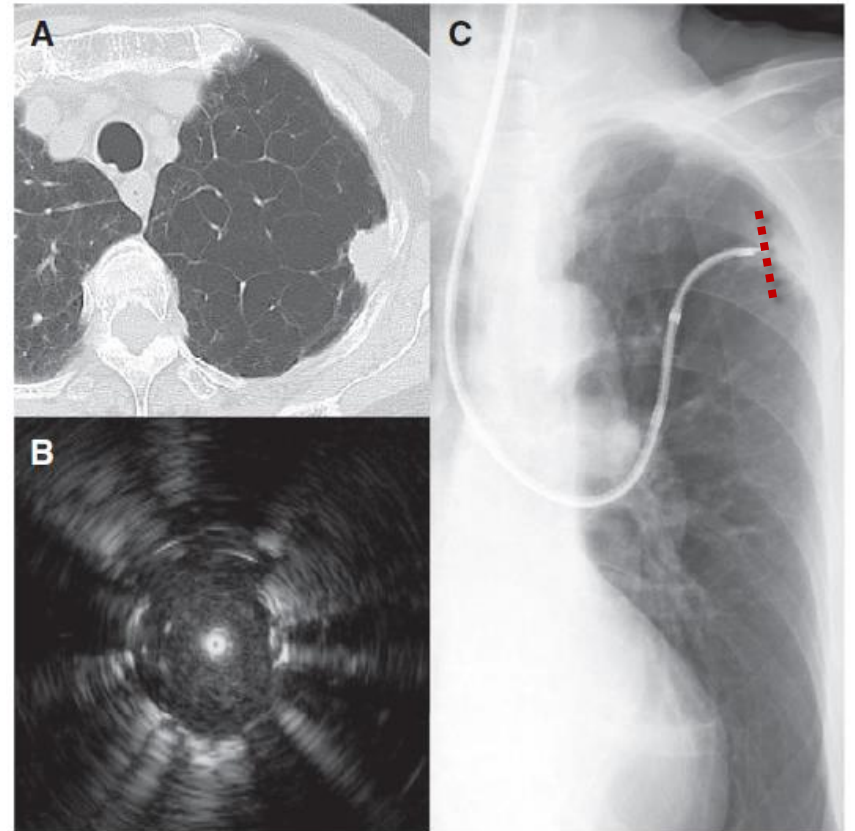


3.0mm-sized
ultrathin bronchoscope



Thin bronchoscope

Versus



Ultrathin bronchoscope

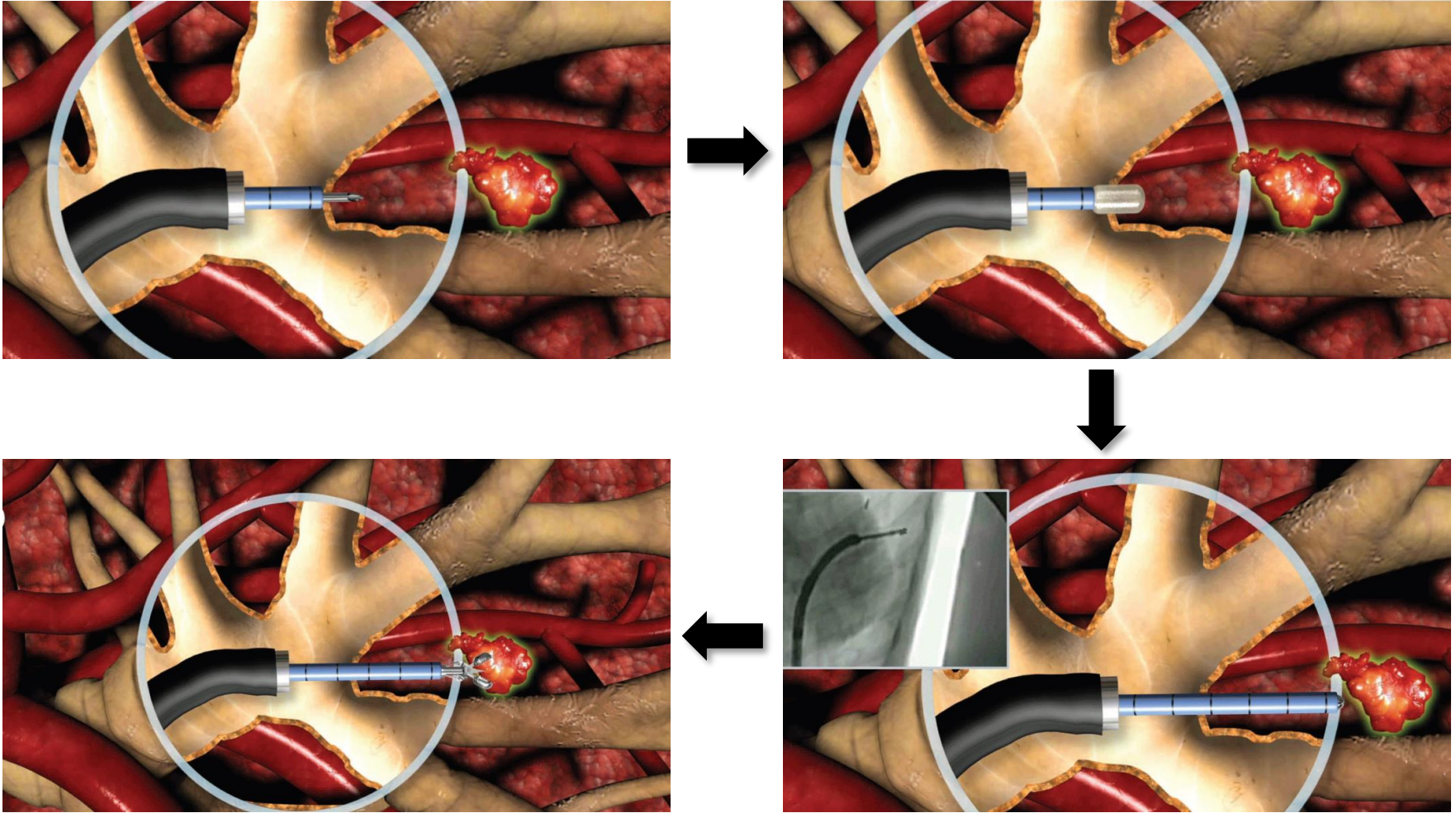
Diagnostic yield

Lesion size, mm	UTB	EBUS-GS	<i>P</i> -value
≤ 20	65%	49%	0.037
20~30	84%	71%	0.061
Total	74%	59%	0.044

UBT = ultrathin bronchoscopy

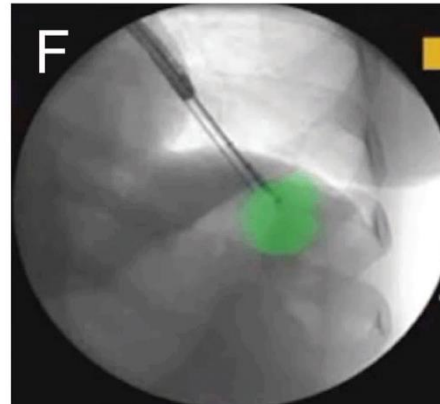
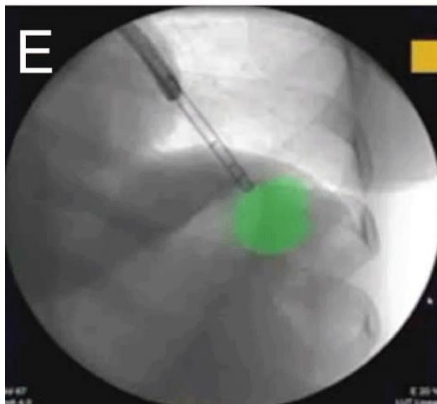
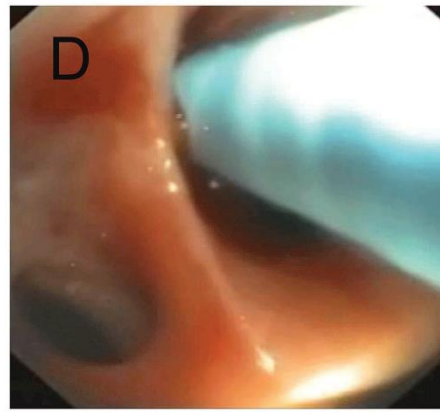
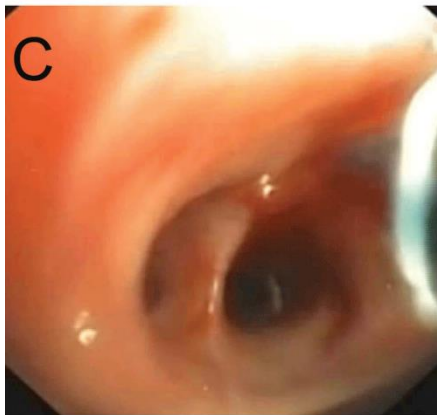
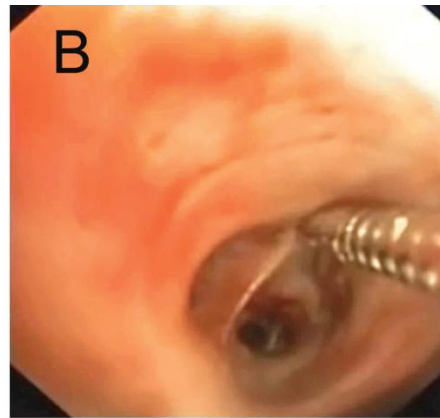
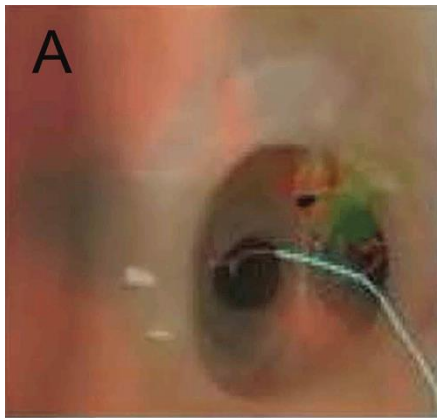
EBUS-GS = endobronchial ultrasound using guide sheath

BTPNA



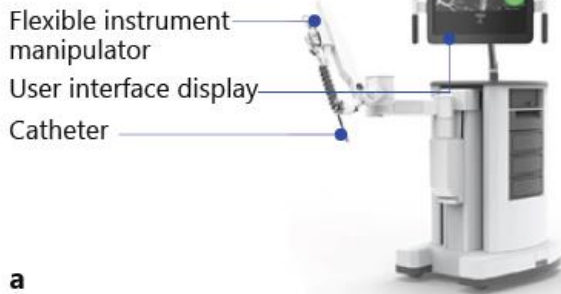
BTPNA = bronchoscopic transparenchymal nodule access

Herth FJ, et al. Thorax. 2015;70(4):326-32.

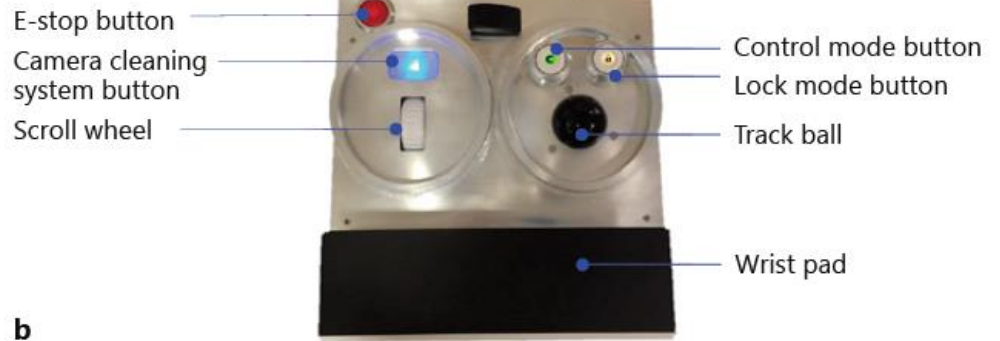


Robot-assisted bronchoscopy

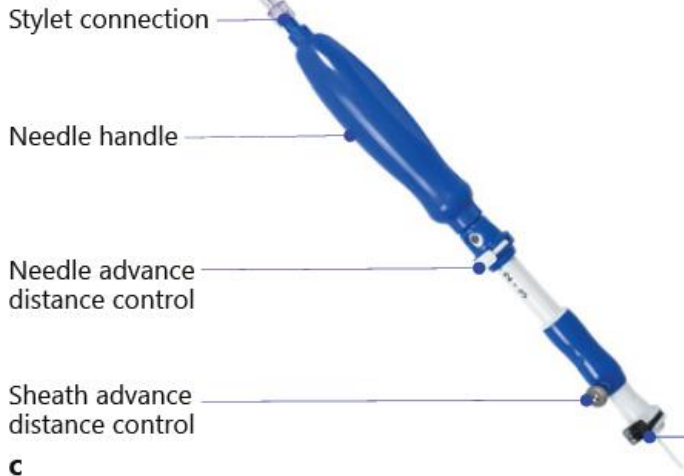
System cart



Master control console



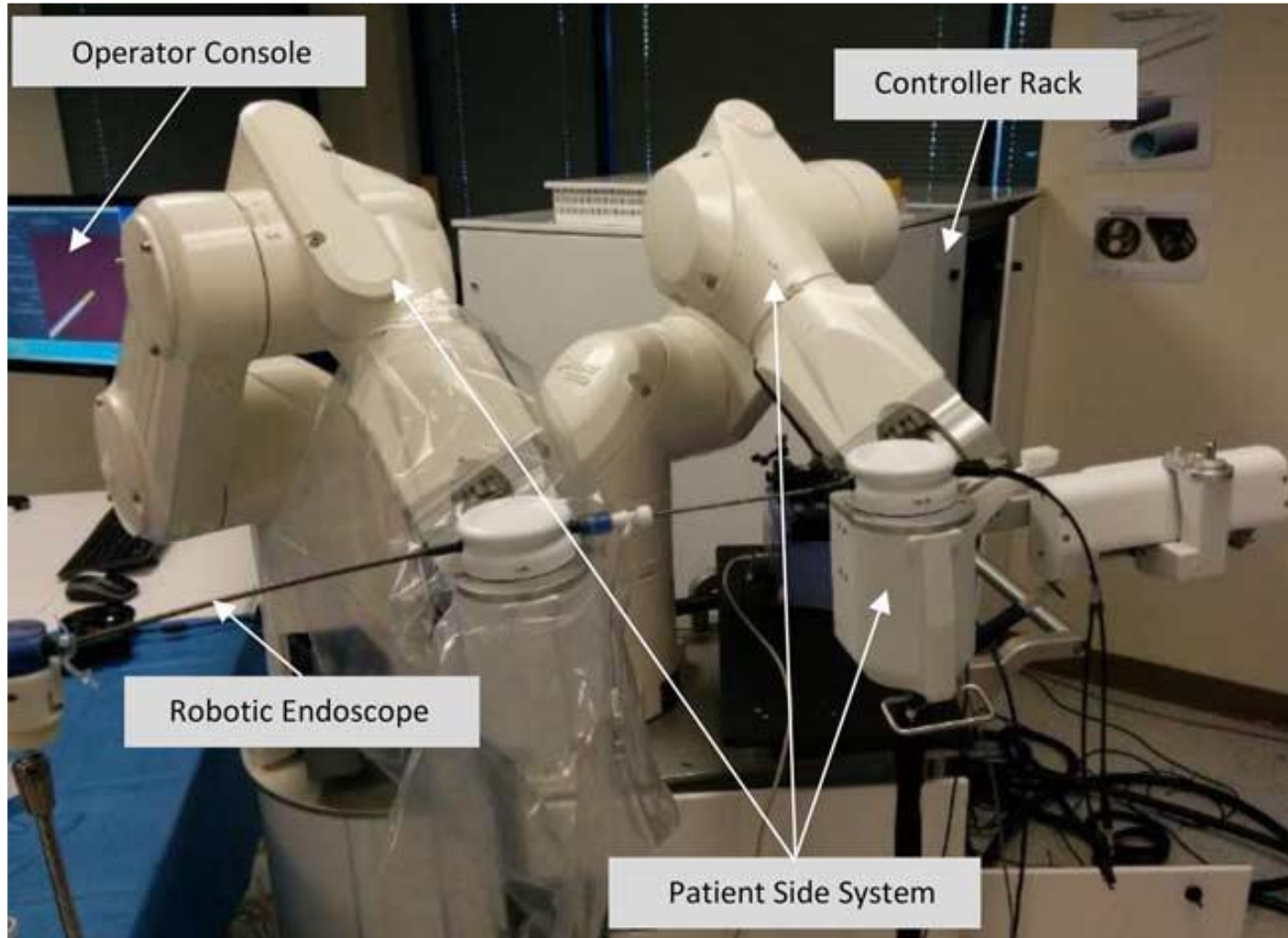
Biopsy needle



Catheter instrument and vision probe



Robot-assisted bronchoscopy



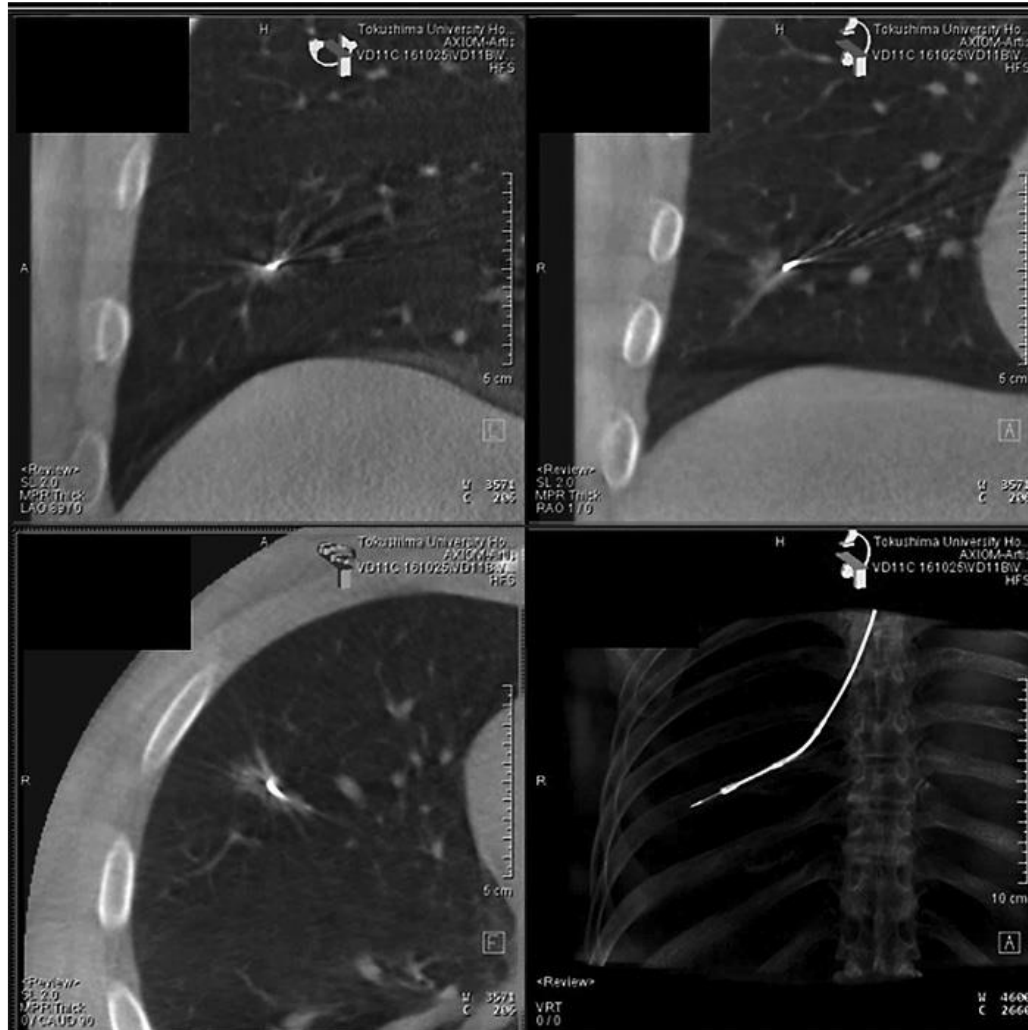
Rojas-Solano JR, et al. J Bronchology Interv Pulmonol. 2018;25(3):168-175.

Cone beam CT

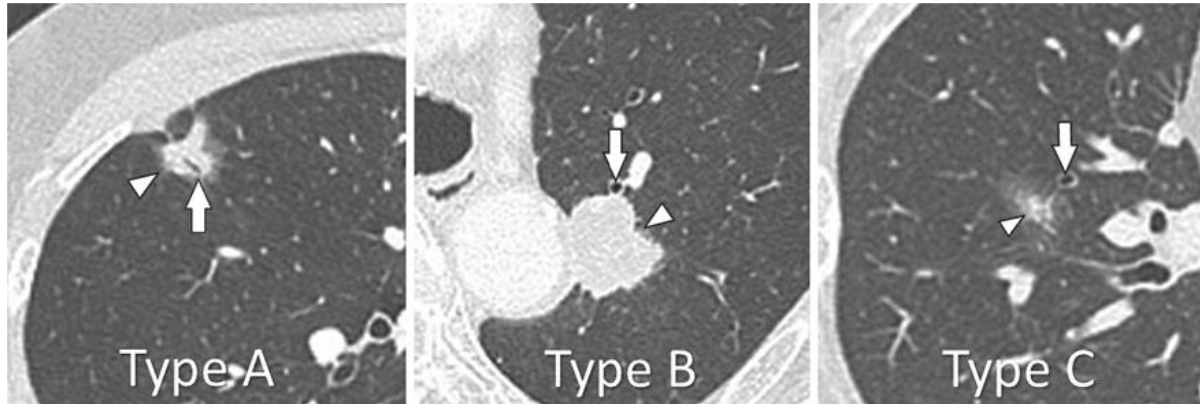


Rouzé S, et al. Interact Cardiovasc Thorac Surg. 2016;22:705-11.

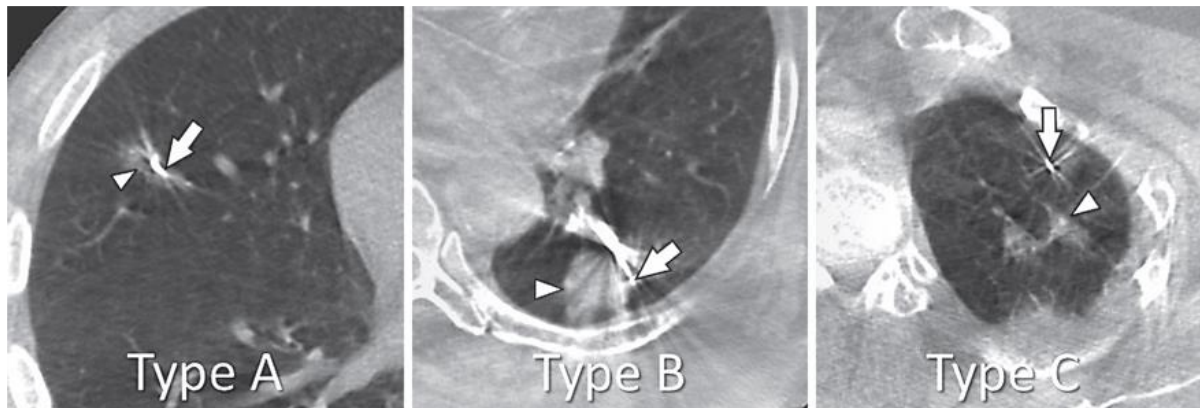
Cone beam CT



Cone beam CT



Conventional CT before procedure



Cone beam CT during procedure

Bronchoscopic treatment

Table 1 Available animal and human data on bronchoscopic ablation of peripheral tumors

Subject type	Ablative technique	Number of ablations/subjects	Authors
Animal (sheep)	RFA	12/6	Tsushima <i>et al.</i> (23)
Animal (swine)	MWA	12/3	Ferguson <i>et al.</i> (24)
Animal (swine)	TVA	84/7	Henne <i>et al.</i> (25)
Animal (canine)	PDT	3/3	Musani <i>et al.</i> (26)
Animal (swine)	BLITT	10/5	Casal <i>et al.</i> (27)
Human	RFA	10/10	Tanabe <i>et al.</i> (28)
Human	RFA	28/20	Koizumi <i>et al.</i> (29)

RFA, radiofrequency ablation; MWA, microwave ablation; TVA, thermal vapor ablation; PDT, photodynamic therapy; BLITT, bronchoscopic thermal interstitial therapy.

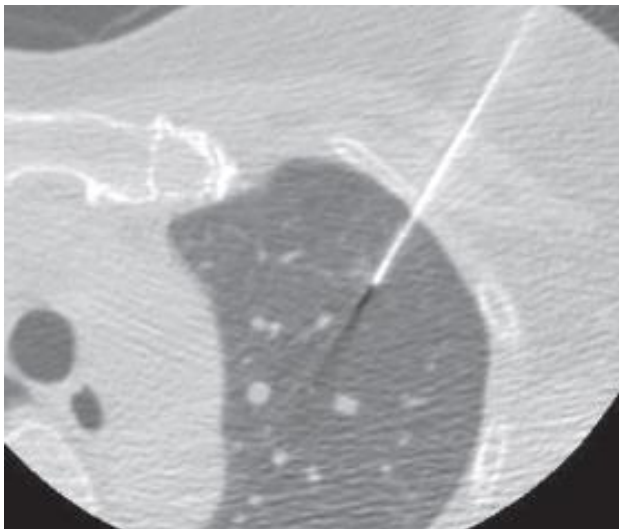
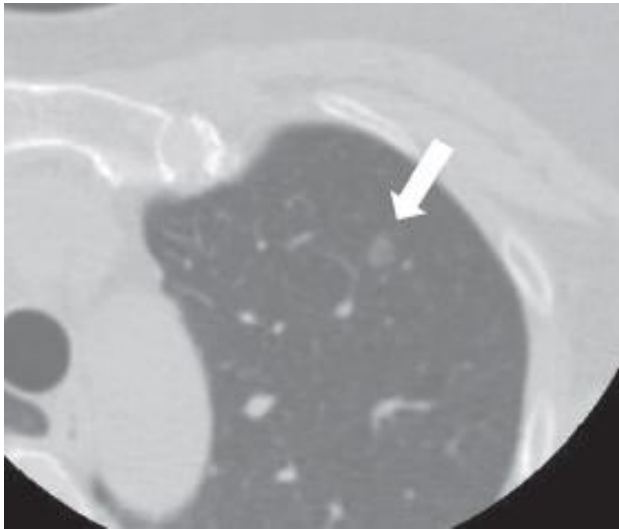
Bronchoscopic treatment

Table 2 Available human trials of bronchoscopic ablation of peripheral tumors registered in ClinicalTrials.gov

Ablative technique	Ablation followed by surgical resection	Region	ClinicalTrials.gov identifier
PDT	No	United States, Canada	NCT02916745
PDT	Yes	United States	NCT03344861
PDT	No	Taiwan	NCT03211078
TVA	Yes	Australia	NCT03198468
TVA	No	Austria, Italy	NCT03514329
BLITT	Yes	United States	NCT03707925
RFA	No	China	NCT03009630
RFA	Yes	China	NCT03272971
RFA/MWA	No	China	NCT02972177
MWA	No	United States	NCT03713099
MWA	No	United Kingdom	NCT03569111

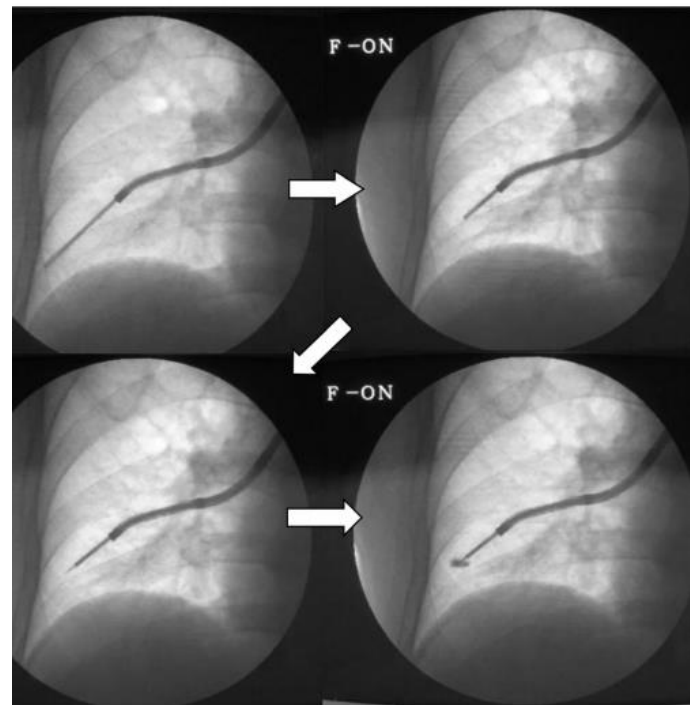
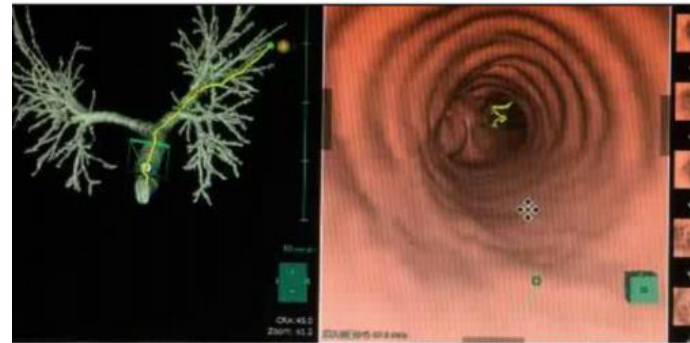
RFA, radiofrequency ablation; MWA, microwave ablation; TVA, thermal vapor ablation; PDT, photodynamic therapy; BLITT, bronchoscopic thermal interstitial therapy.

Marking for VATS



Percutaneous approach

VS.



Bronchoscopic approach

Anayama T, et al. J Cardiothorac Surg. 2018;13:5.
Tseng YH, et al. J Thorac Dis. 2016;8:S666-S671.

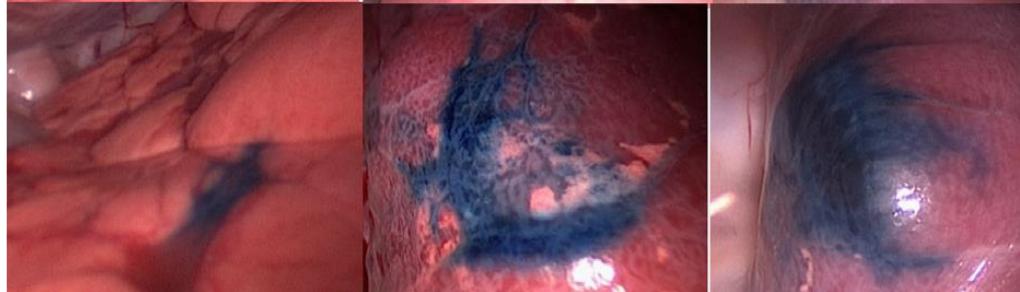
Transbronchial dye injection

- Animal experiments with porcine models

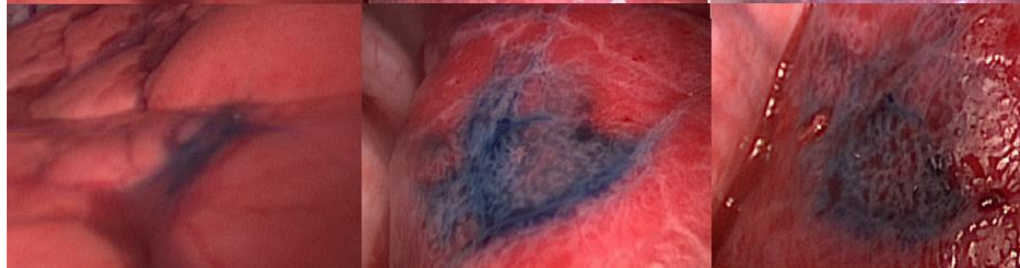
Detection



Peak



Wash-out



Transbronchial dye injection

	Amount of indigo carmine injected		
	0.6 mL (n=3)	0.8 mL (n=3)	1 mL (n=3)
Detection time	4.5 min	2.7 min	2.2 min
Peak time	28.1 min	34.1 min	43.0 min
Wash-out time	117.2 min	134.1 min	134.7 min

Bronchoscopy room



Operating room

Localization

4mm scope

Thin-section
CT image

Indigo carmine
+
Lipiodol

Virtual
bronchoscopy
navigation

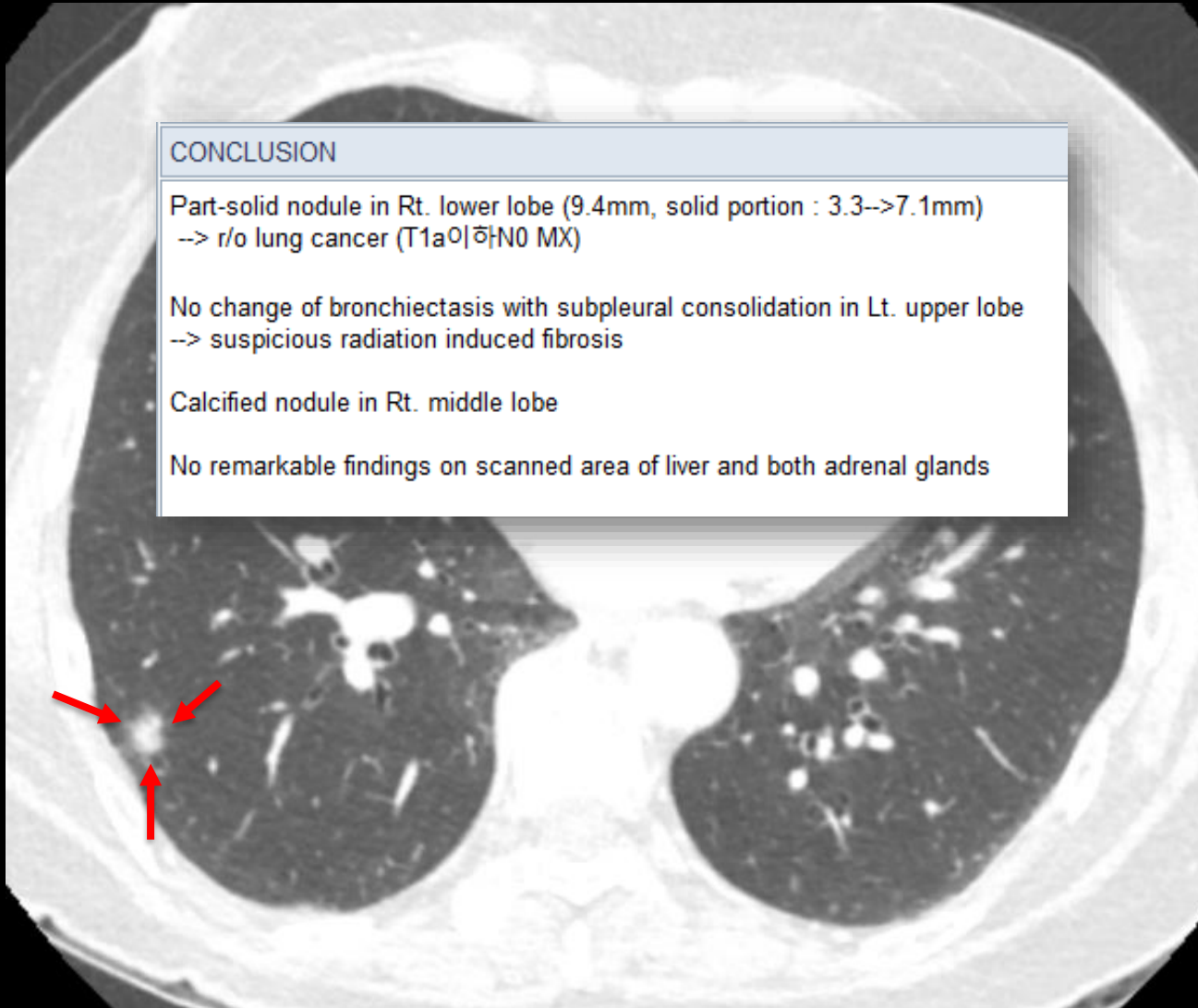
Guide sheath
or spray catheter

Fluoroscopy

Immediate identification & Resection



Case VI



CONCLUSION

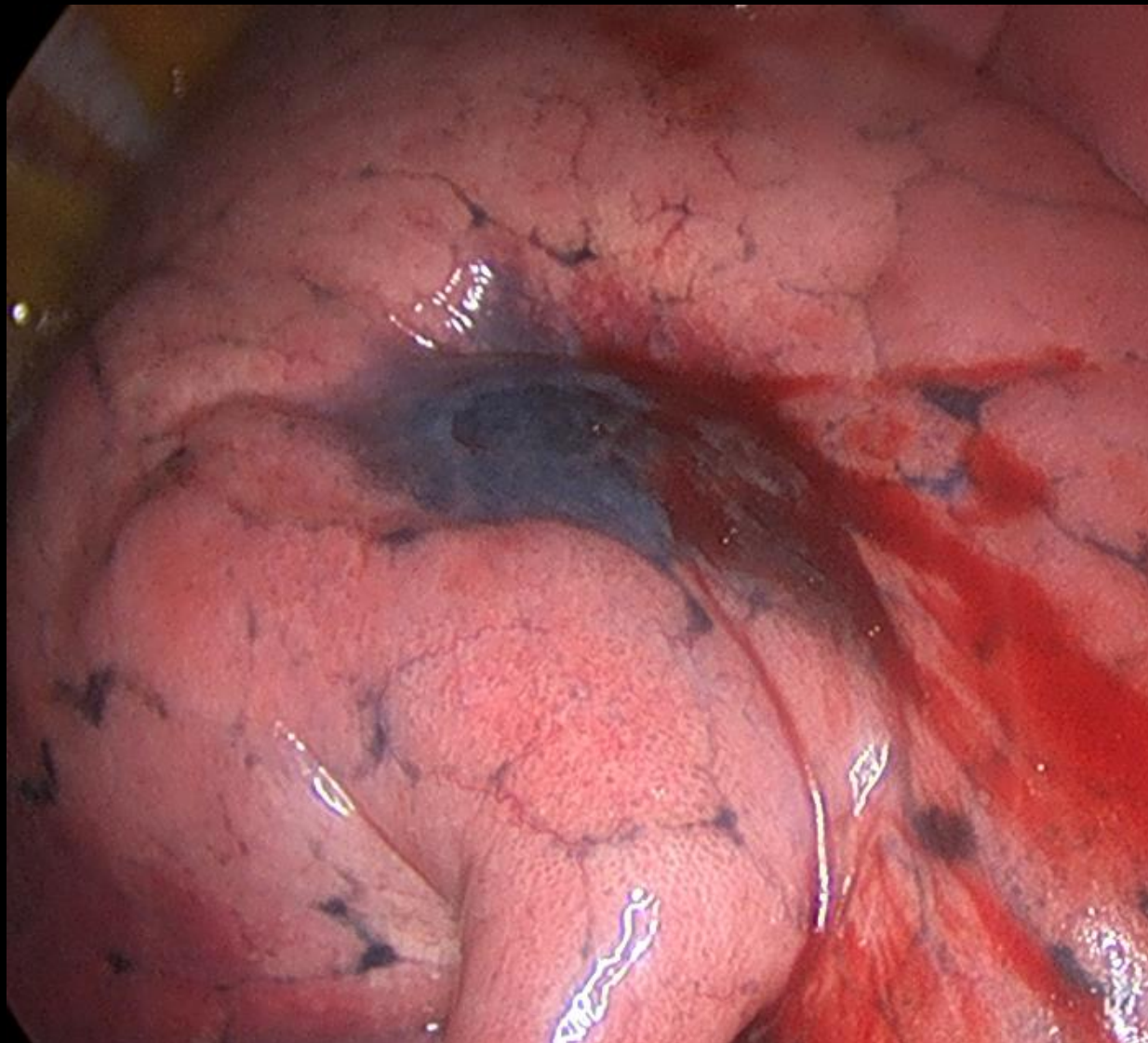
Part-solid nodule in Rt. lower lobe (9.4mm, solid portion : 3.3-->7.1mm)
--> r/o lung cancer (T1a이하N0 MX)

No change of bronchiectasis with subpleural consolidation in Lt. upper lobe
--> suspicious radiation induced fibrosis

Calcified nodule in Rt. middle lobe

No remarkable findings on scanned area of liver and both adrenal glands

Case VI



Case VI

진단

Lung, lower lobe as wedge, right, VATS wedge resection :

1. Histologic type: Adenocarcinoma, well to moderately differentiated; predominantly acinar growth pattern(60%) and lepidic growth pattern (about 40%)
2. Location: right lower lobe
3. Dimensions: 1.0x0.5x0.5cm
4. Confined to lung parenchyma and no involvement of visceral pleura
5. Growth pattern: infiltrative growth pattern
6. Lymphovascular and perineural invasion: not identified
7. Lymph node status: no attached peribronchial lymph nodes
8. Status of resection margins: free from carcinoma (safety distance, about 2 mm)
9. Partial pathologic TNM stage: pT1a pN0
10. Adjacent lung parenchyma
 - anthracotic pigmentation around bronchovascular bundles and in subpleural areas
 - patchy atelectasis, emphysema.

Lung, lower lobe, right, lobectomy with mediastinal node dissection:

No residual tumor (R0), with

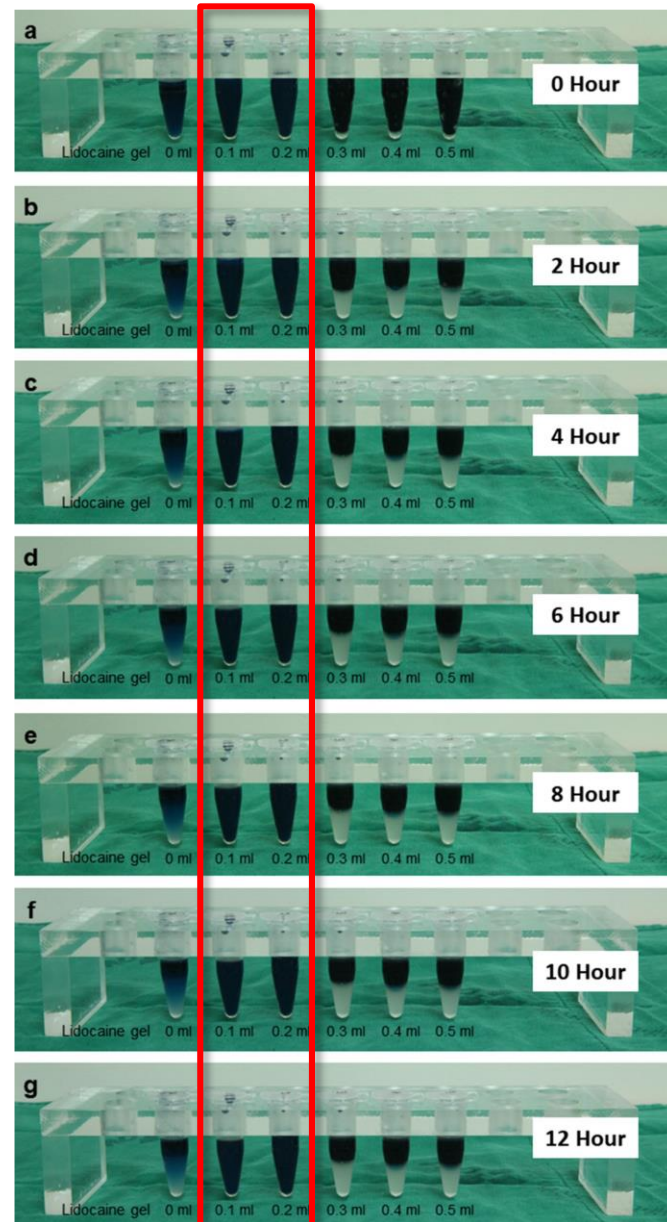
1. Lymph node status: no metastasis in peribronchial lymph nodes(0/11, with anthracosis)
2. Adjacent lung parenchyma
 - anthracotic pigmentation around bronchovascular bundles and in subpleural areas
 - patchy atelectasis, emphysema.

Lymph node, 4R, dissection : No tumor (0/15, with anthracosis).

Lymph node, #7, dissection : No tumor (0/5, reactive hyperplasia with anthracosis in a node).

Lymph node, #9, dissection : No tumor (0/3, with anthracosis).

Lipiodol 0.5 ml
+
Lidocaine gel ??
+
Indigo carmine 0.5 ml



Summary

Conventional TBLB

1960'

Radial probe
EBUS

1980'

Virtual bronchoscopy
navigation (VBN)

1990'

Evolution of Technology

2000'

Electromagnetic
navigation
bronchoscopy
(ENB)

2010'

Ultrathin
bronchoscope

Bronchoscopic
transparenchymal
nodule access
(BTPNA)



우리 병원에서는 어떠한 조합으로
조직검사를 할 수 있을까?





감사합니다!