Diagnostic impact of visualized lesion extent by radial endobronchial ultrasound on forceps biopsy for peripheral pulmonary lesions

Hideaki Furuse[1], Yuji Matsumoto[1, 2], Keigo Uchimura[1], Tatsuya Imabayashi[1], Takaaki Tsuchida[1]

1 Department of Endoscopy, Respiratory Endoscopy Division, National Cancer Center Hospital, Tokyo, Japan

2 Department of Thoracic Oncology, National Cancer Center Hospital, Tokyo, Japan

Disclosures - Nil

The presenter has advised that the following presentation will NOT include discussion on any commercial products or service.

Introduction

- It is essential to visualize target peripheral pulmonary lesions (PPLs) sufficiently by radial endobronchial ultrasound (R-EBUS) in diagnostic bronchoscopy using forceps.[1,2]

- Otherwise, transbronchial needle aspiration (TBNA) and cryobiopsy have been reported effective for improving the diagnostic outcomes, [3–5] but the appropriate boundary of the decision is unclear. Therefore, we aimed to identify the boundary based on R-EBUS images.

1. Kurimoto N, et al. *Chest*. 2004;126(3):959–965.
2. Ali MS, et al. *Respirology*. 2017;22(3):443–453.
3. Ost DE, et al. *Am J Respir Crit Care Med*. 2016;193(1):68–77.
4. Kho SS, et al. *ERJ Open Res*. 2019;5(4):00135–2019.
5. Matsumoto Y, et al. *Chest*. 2021;160(5):1890–1901.

Methods

- Consecutive patients who underwent forceps biopsy for PPLs using R-EBUS between June 2015 and May 2017 were retrospectively reviewed.

- Cases in which R-EBUS showed "invisible" or blizzard sign[6] and those who underwent TBNA or cryobiopsy were excluded.

- The angle where the lesion covered the R-EBUS probe was defined as "contact angle", and it was measured using an ImageJ based on captured R-EBUS images.

- Factors affecting the diagnostic yield were statistically analyzed, including the contact angle.

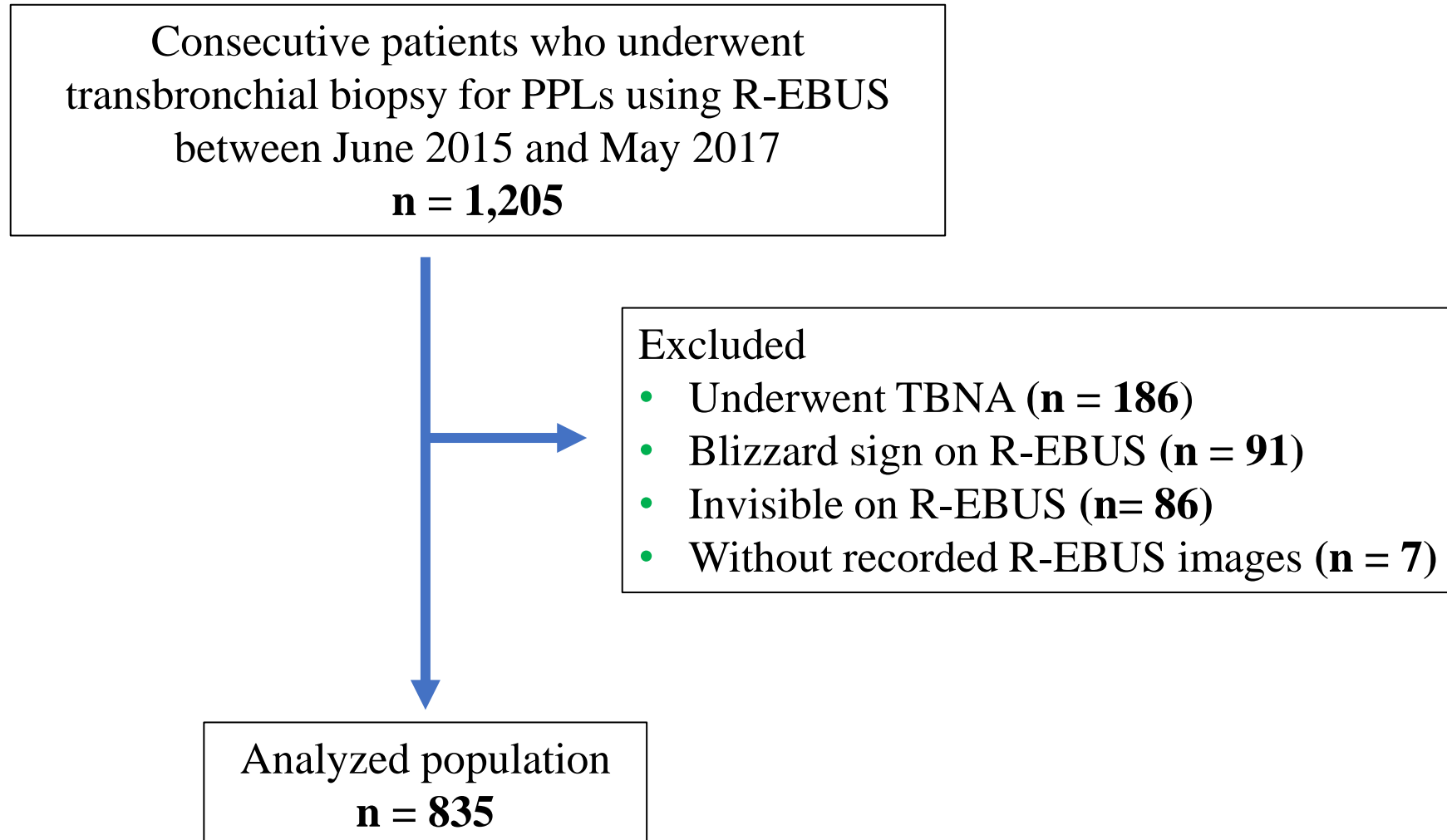6. Izumo T, et al. *Eur Respir J*. 2015;45(6):1661–1668.

Contact angle
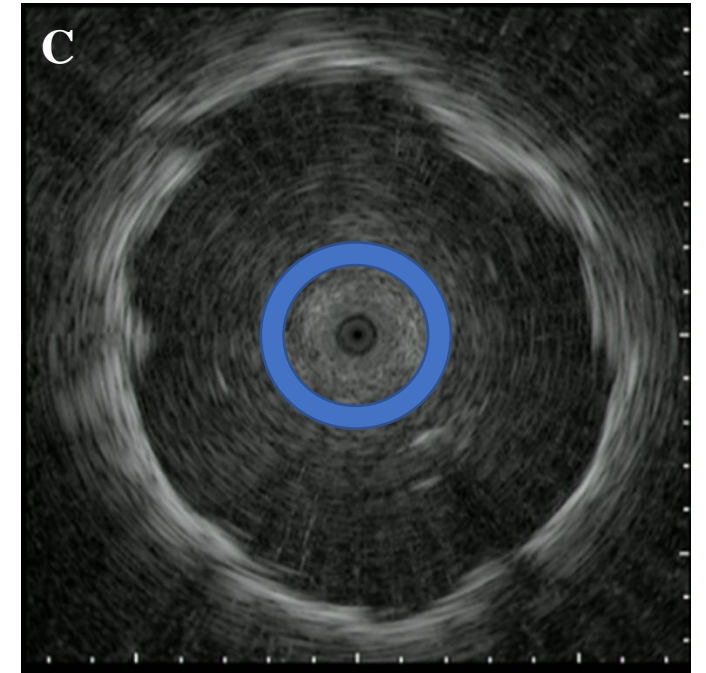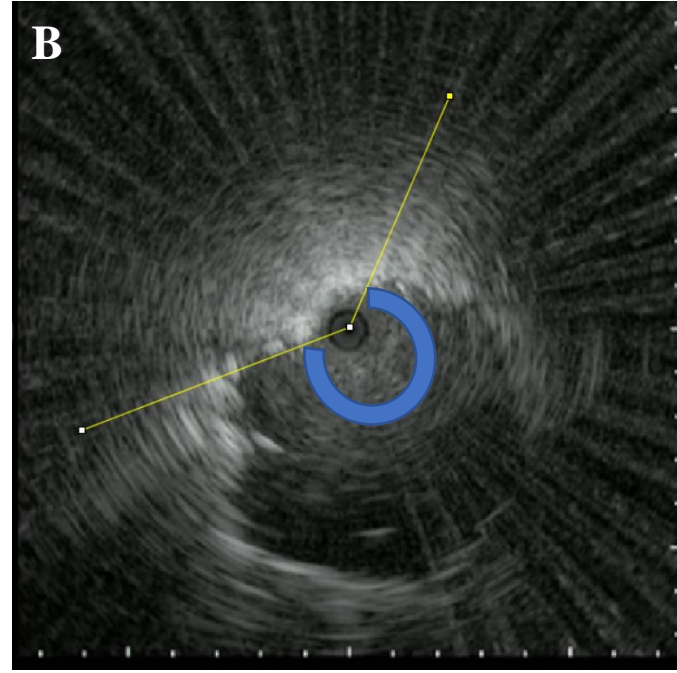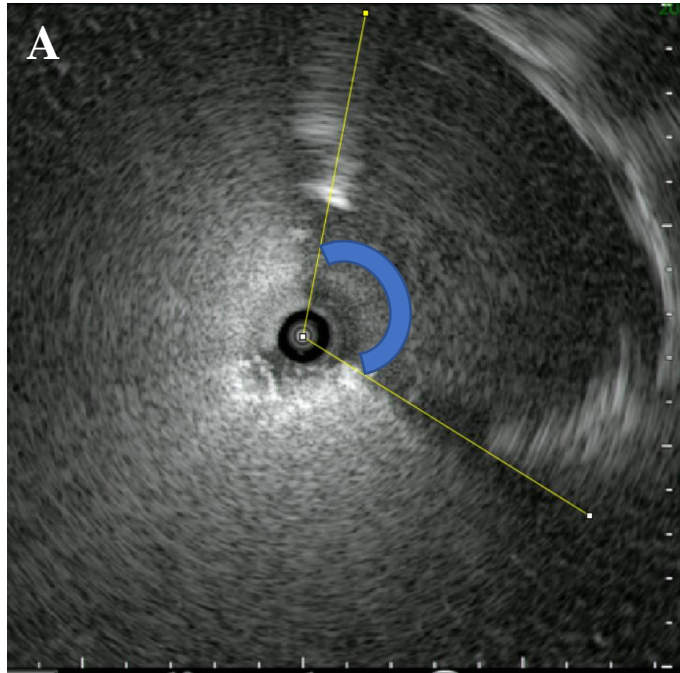
The angle where the lesion covered the R-EBUS probe was defined as "contact angle".
Several examples of measurements of contact angle are shown as follows:

A) Contact angle: 110 degrees; **B)** Contact angle: 230 degrees;
C) Contact angle: 360 degrees (i.e., entirely circumferential finding)

Results

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│ Consecutive patients who underwent          │
│ transbronchial biopsy for PPLs using R-EBUS │
│ between June 2015 and May 2017              │
│ n = 1,205                                   │
└─────────────────────────────────────────────┘
                    │
                    │        ┌──────────────────────────────────────────────┐
                    │        │ Excluded                                     │
                    ├───────▶│ • Underwent TBNA (n = 186)                   │
                    │        │ • Blizzard sign on R-EBUS (n = 91)           │
                    │        │ • Invisible on R-EBUS (n= 86)                │
                    │        │ • Without recorded R-EBUS images (n = 7)     │
                    │        └──────────────────────────────────────────────┘
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          │ Analyzed population      │
          │ n = 835                  │
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PPL, peripheral pulmonary lesion; R-EBUS, radial endobronchial ultrasound; TBNA, transbronchial needle aspiration

Characteristics

Variable	n = 835
Age, years	69 (17–90)
≤ 70	407 (48.4)
> 70	428 (51.6)
Sex	
Male	495 (59.3)
Female	340 (40.7)
Size, mm	26.8 (7.1–121.0)
≤ 20	231 (27.7)
> 20	604 (72.3)
Morphology	
Solid	704 (84.3)
Part-solid	131 (15.7)
Lobe	
RUL/LUS	396 (47.4)
RML/lingula	112 (13.4)
RLL/LLL	327 (39.2)

(continued)	
Location	
Inner 2/3	270 (32.3)
Outer 1/3	565 (67.7)
Distance from the costal pleura, mm	8.0 (0–62.5)
≤ 10	467 (55.9)
> 10	368 (44.1)
Bronchus sign	
Positive	728 (87.2)
Negative	107 (12.8)
Visibility on chest radiography	
Visible	726 (86.9)
Invisible	109 (13.1)
Contact angle, degrees	
360	471 (56.4)
< 360	364 (43.6)

LLL, left lower lobe; LUS, left upper segment; RLL, right lower lobe; RML, right middle lobe; RUS, right upper lobe
Values are given as medians (ranges) or numbers (%).

Diagnostic yield according to the contact angle

	Diagnostic	Nondiagnostic	*p* value
Overall	654 (78.3)	181 (21.7)	
Contact angle, degrees			< 0.001
360	434 (92.1)	37 (7.9)	
< 360	220 (60.4)	144 (39.6)	

Values are given as numbers (%).

Clinical factors associated with successful diagnosis

Variable	Reference	Univariable			Multivariable		
		odds ratio	95% CI	*p* value	odds ratio	95% CI	*p* value
Age, years	(continuous, 1 year change)	1.00	0.99–1.01	0.912	1.00	0.99–1.02	0.584
Male	Female	1.10	0.79–1.54	0.573	0.95	0.64–1.39	0.775
Size, mm	(continuous, 10 mm change)	1.27	1.14–1.40	< 0.001	0.99	0.98–1.01	0.434
Lesion in RUL/LUS	Lesion in RML/lingula	1.05	0.63–1.77	0.844	1.18	0.66–2.12	0.582
Lesion in RUL/LUS	Lesion in RLL/LLL	1.32	0.93–1.88	0.123	1.38	0.92–2.08	0.119
Outer 1/3 location	Inner 2/3 location	0.75	0.52–1.08	0.127	0.96	0.59–1.58	0.886
Distance from the costal pleura, mm	(continuous, 1 mm change)	1.00	0.99–1.01	0.980	1.01	0.99–1.02	0.591
Positive bronchus sign	Negative bronchus sign	3.01	1.96–4.62	< 0.001	1.51	0.91–2.50	0.108
Visible on chest radiography	Invisible on chest radiography	3.20	2.09–4.88	< 0.001	1.63	0.99–2.70	0.057
Contact angle	(continuous, 10 degrees change)	1.10	1.08–1.11	< 0.001	1.10	1.08–1.11	< 0.001

CI, confidence interval; LLL, left lower lobe; LUS, left upper segment; RLL, right lower lobe; RML, right middle lobe; RUS, right upper lobe
The multivariable-adjusted model was adjusted for age, sex, size, lobe, location, distance from the costal pleura, bronchus sign, visibility on chest radiography, and contact angle.

ROC curve analysis of the contact angle to the diagnostic yield

310 degrees
(specificity: 0.790, sensitivity: 0.667)

AUC = 0.770

ROC, receiver operating characteristic; AUC; area under the curve
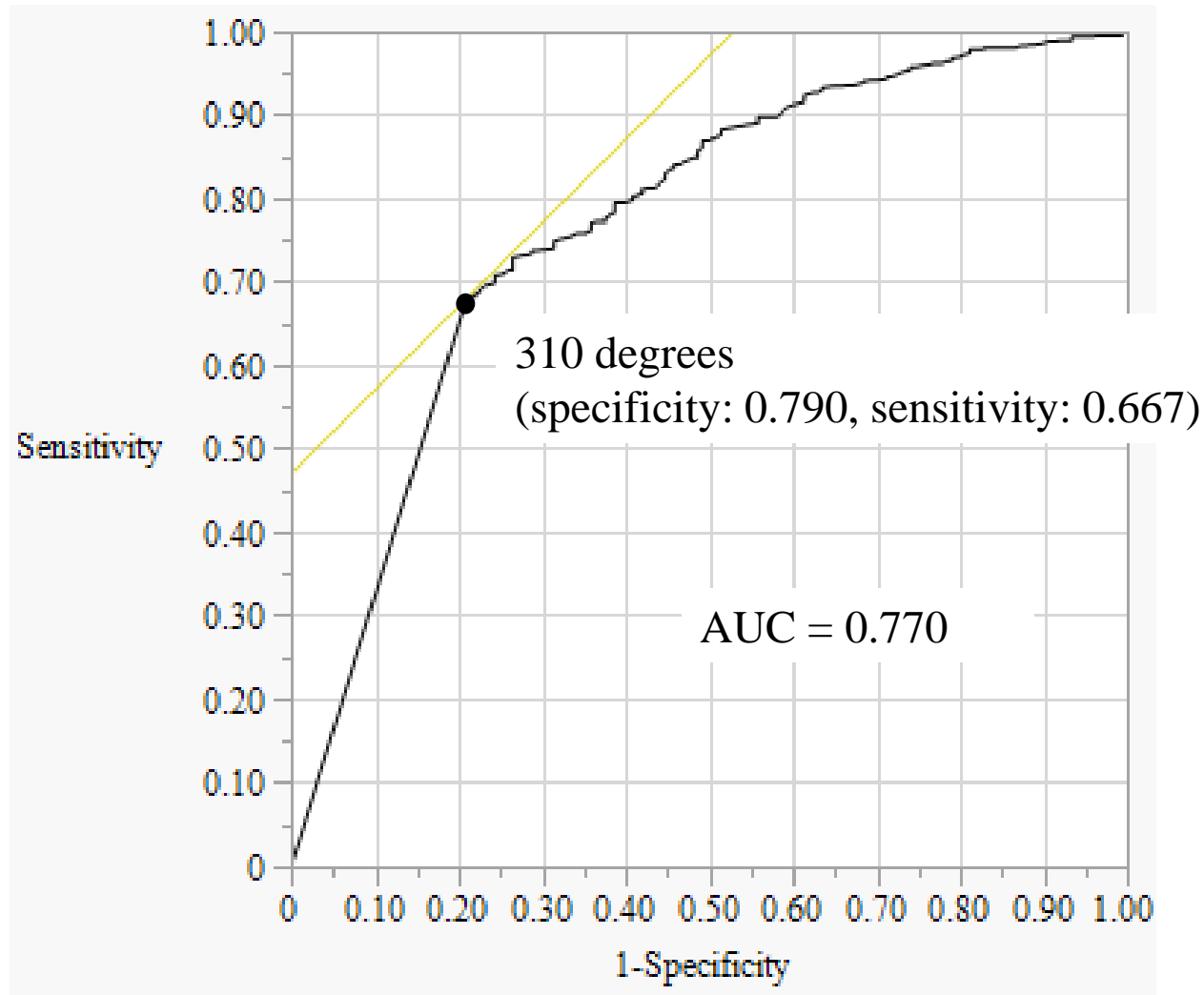
Discussion

- It is well known that biopsy forceps are less effective for the lateral sampling, which results in inadequate diagnostic performance for PPLs that show "adjacent to" on R-EBUS.[1,2]

- We demonstrated that the increased contact angle was significantly associated with successful diagnosis by transbronchial forceps biopsy. In addition, the optimal cut-off value was 310 degrees by receiver operating characteristic curve analysis.
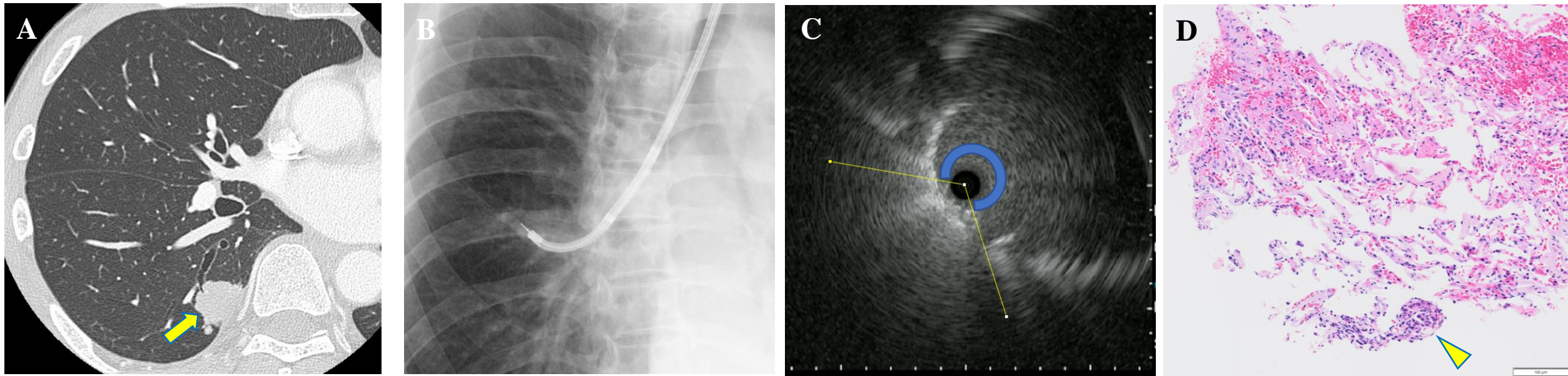
A representative case of 61-year-old male who failed to diagnose by transbronchial forceps biopsy.

A) High-resolution CT shows a 26.0-mm solid nodule (arrow) in the right lower lobe with a positive bronchus sign.

B, C) R-EBUS detected the lesion with the contact angle of 240 degrees. Then, five forceps biopsies were performed.

D) Although a few atypical cells (arrowhead) were observed in the biopsy specimen, it did not lead a definite diagnosis. Subsequently, a surgical resection specimen led to the diagnosis of lung adenocarcinoma.

Discussion

- TBNA and cryobiopsy have been reported to be effective for PPLs that show "adjacent to" on R-EBUS.[3–5]

- The cryoprobe allows for biopsies of the entire circumference of the contacted area,[7] and our previous study demonstrated that cryobiopsy showed a 14.9% improvement in the diagnostic yield when added to conventional biopsies for lesions "adjacent to" on R-EBUS.[5]

- Therefore, such biopsy methods are expected to improve the diagnostic outcomes in cases with a contact angle of less than 310 degrees.

7. Hetzel J, et al. *Respiration*. 2008;76(2):193–197.

Conclusions

- The contact angle by R-EBUS was significantly associated with the diagnostic yield for PPLs using forceps.

- If the contact angle is less than 310 degrees, the diagnostic ability of forceps is limited and TBNA or cryobiopsy would be better to apply.