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Validity and Challenges of sublobar resection

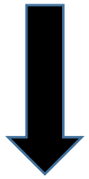
은평성모병원 심장혈관흉부외과

문영규

Background

Since 1995

Stage I Lung cancer



Standard treatment

Anatomical Lobectomy

Randomized Trial of Lobectomy Versus Limited Resection for T1 N0 Non–Small Cell Lung Cancer

Lung Cancer Study Group (Prepared by Robert J. Ginsberg, MD, and Lawrence V. Rubinstein, PhD)

Background. It has been reported that limited resection (segment or wedge) is equivalent to lobectomy in the management of early stage (T1–2 N0) non–small cell lung cancer.

Methods. A prospective, multiinstitutional randomized trial was instituted comparing limited resection with lobectomy for patients with peripheral T1 N0 non–small cell lung cancer documented at operation. Analysis included locoregional and distant recurrence rates, 5-year survival rates, perioperative morbidity and mortality, and late pulmonary function assessment.

Results. There were 276 patients randomized, with 247 patients eligible for analysis. There were no significant differences for all stratification variables, selected prognostic factors, perioperative morbidity, mortality, or late pulmonary function. In patients undergoing limited resection, there was an observed 75% increase in recurrence rates ($p = 0.02$, one-sided) attributable to an observed tripling of the local recurrence rate ($p = 0.008$ two-sided), an observed 30% increase in overall death rate ($p = 0.08$, one-sided), and an observed 50% increase in death with cancer rate ($p = 0.09$, one-sided) compared to patients undergoing lobectomy ($p = 0.10$, one-sided was the predefined threshold for statistical significance for this equivalency study).

Conclusions. Compared with lobectomy, limited pulmonary resection does not confer improved perioperative morbidity, mortality, or late postoperative pulmonary function. Because of the higher death rate and locoregional recurrence rate associated with limited resection, lobectomy still must be considered the surgical procedure of choice for patients with peripheral T1 N0 non–small cell lung cancer.

(Ann Thorac Surg 1995;60:615–23)

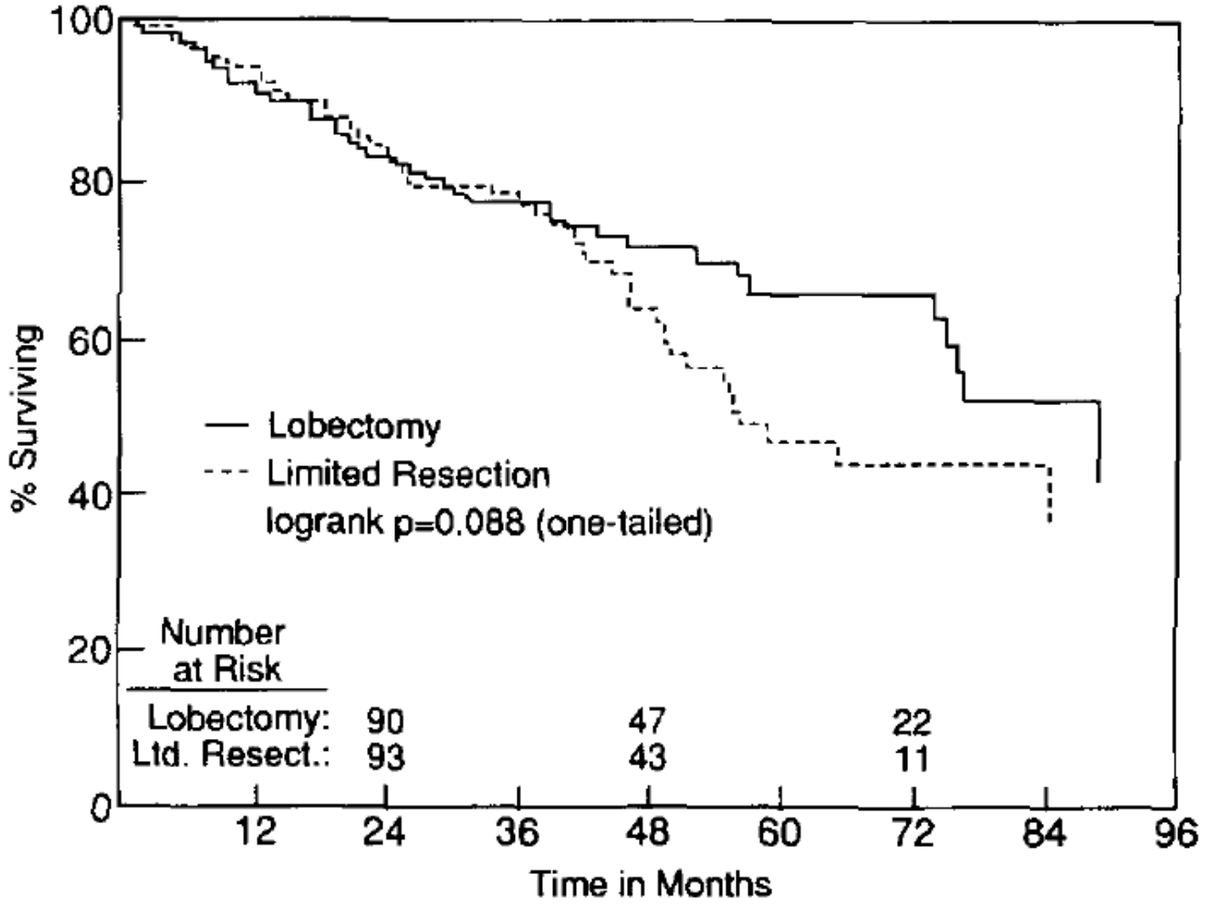


Fig 1. Time to death (from any cause) by treatment for 247 eligible patients.

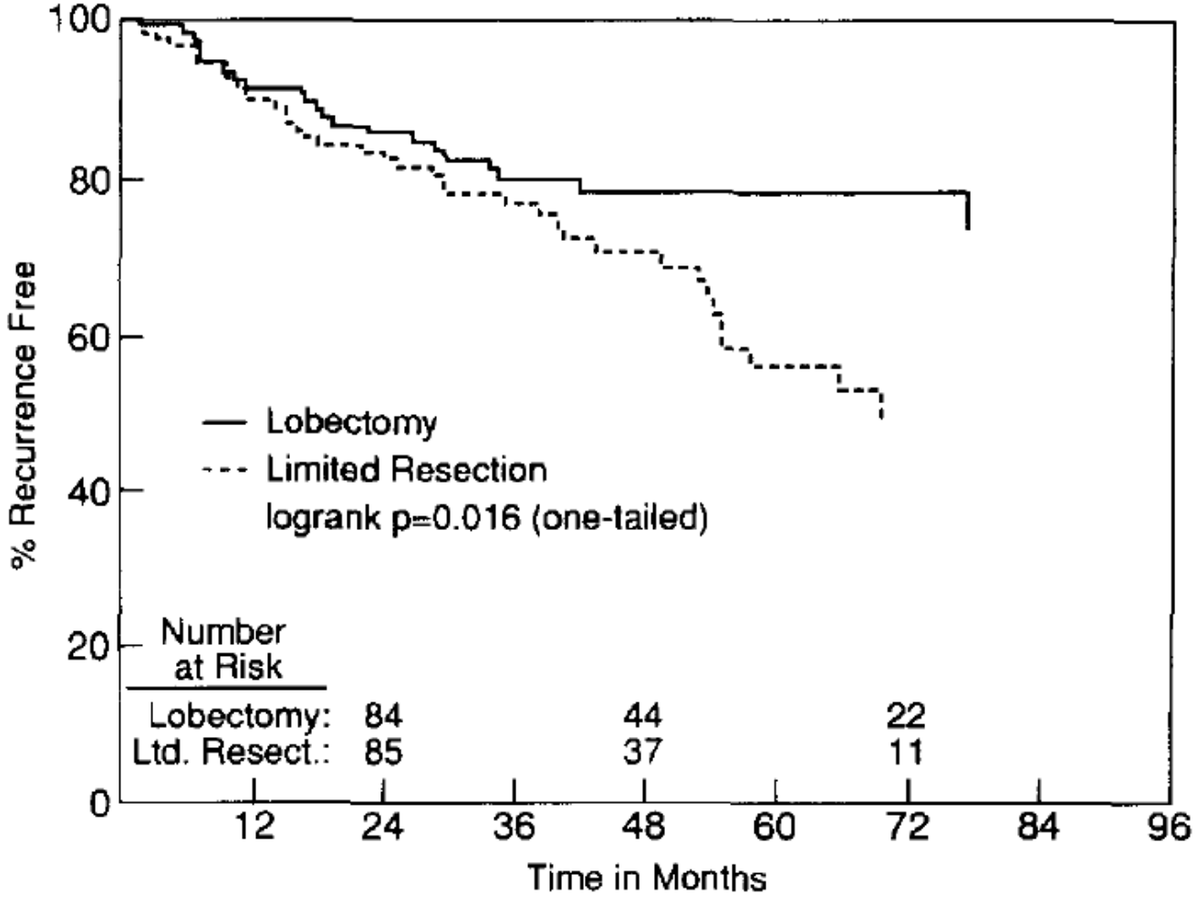
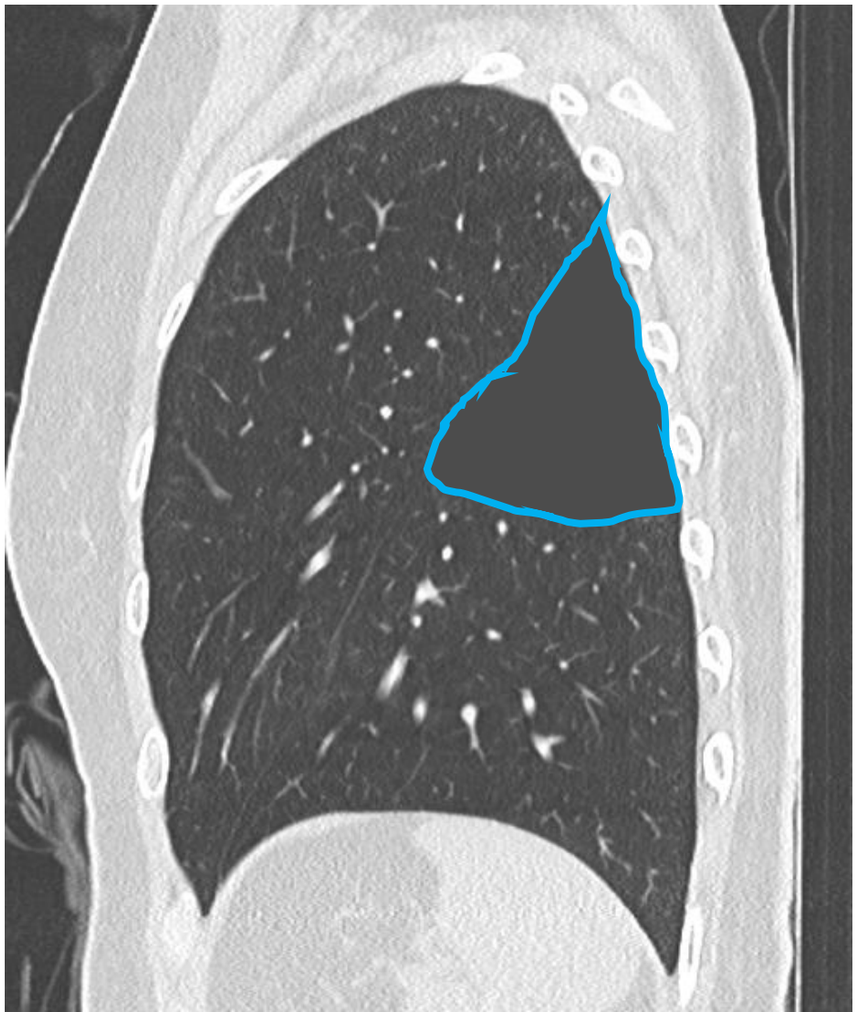


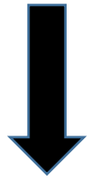
Fig 2. Time to recurrence (excluding second primaries) by treatment for 247 eligible patients.

- Early detection of lung cancer
- GGN = non invasive or minimally invasive adenocarcinoma



GGN lung cancer

Small-sized lung cancer



Minimally invasive surgery

Sublobar resection

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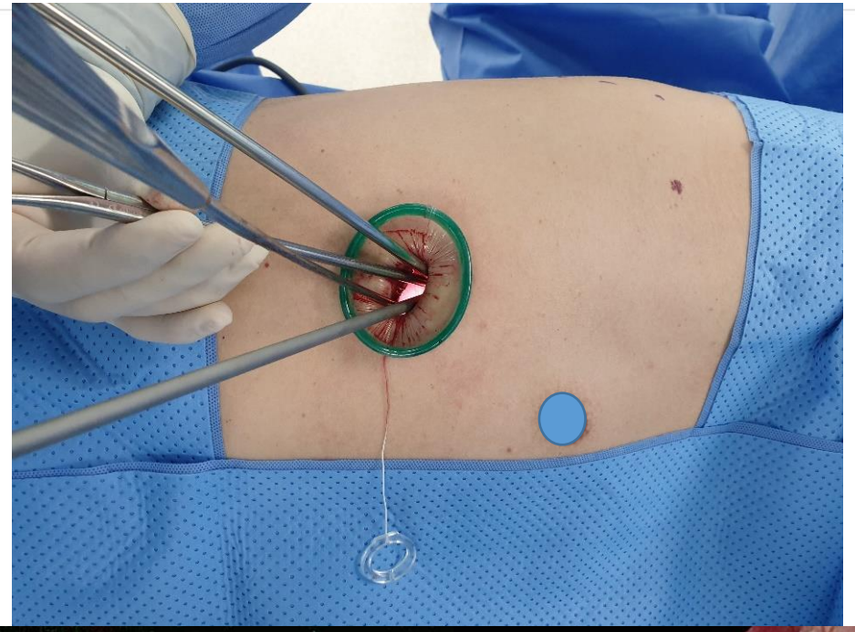
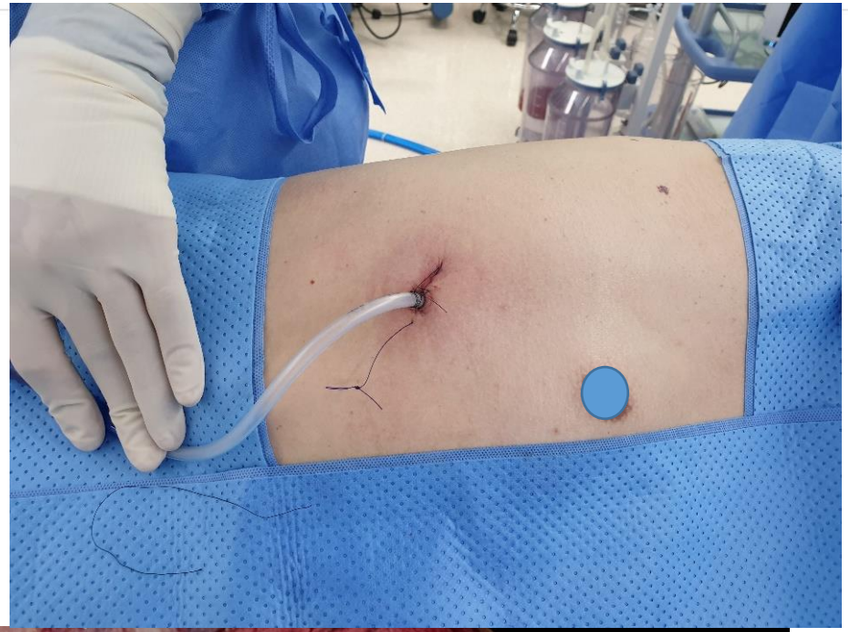
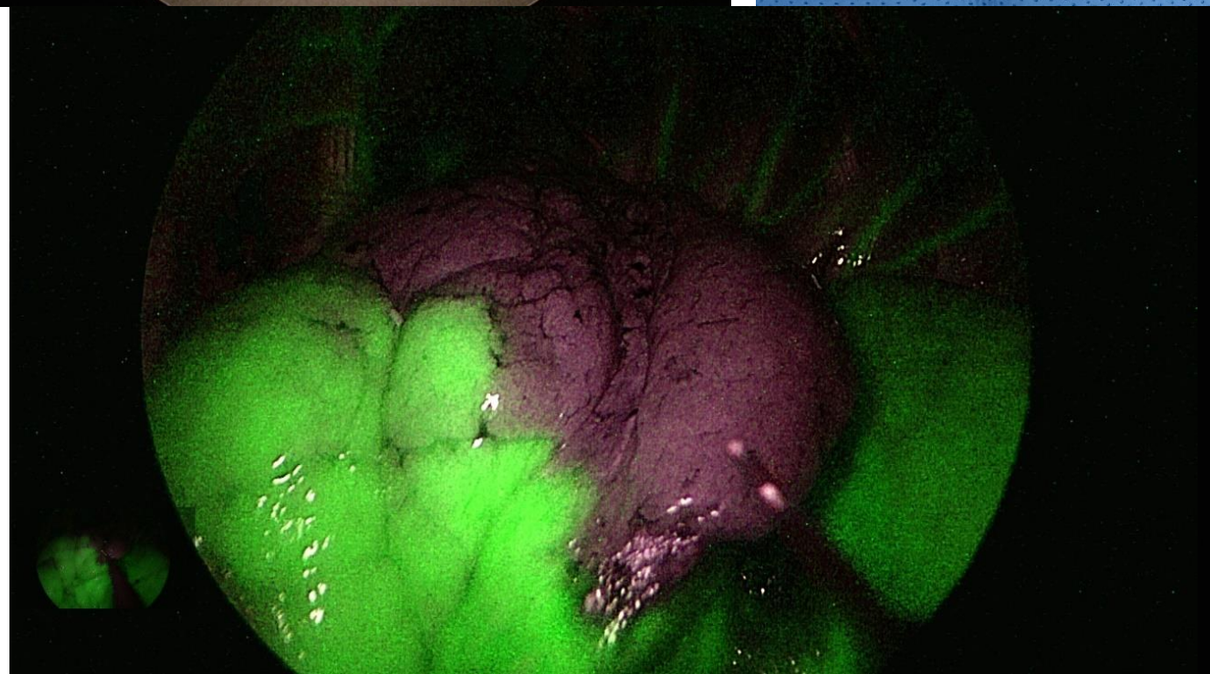
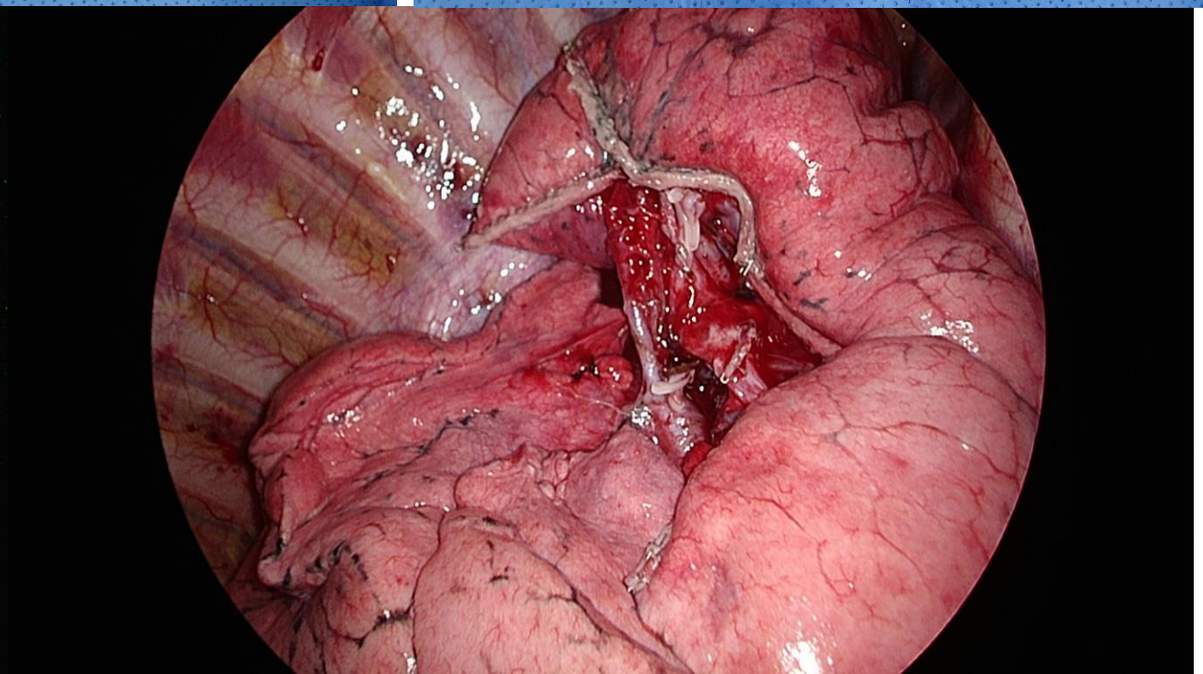
Uniportal VATS



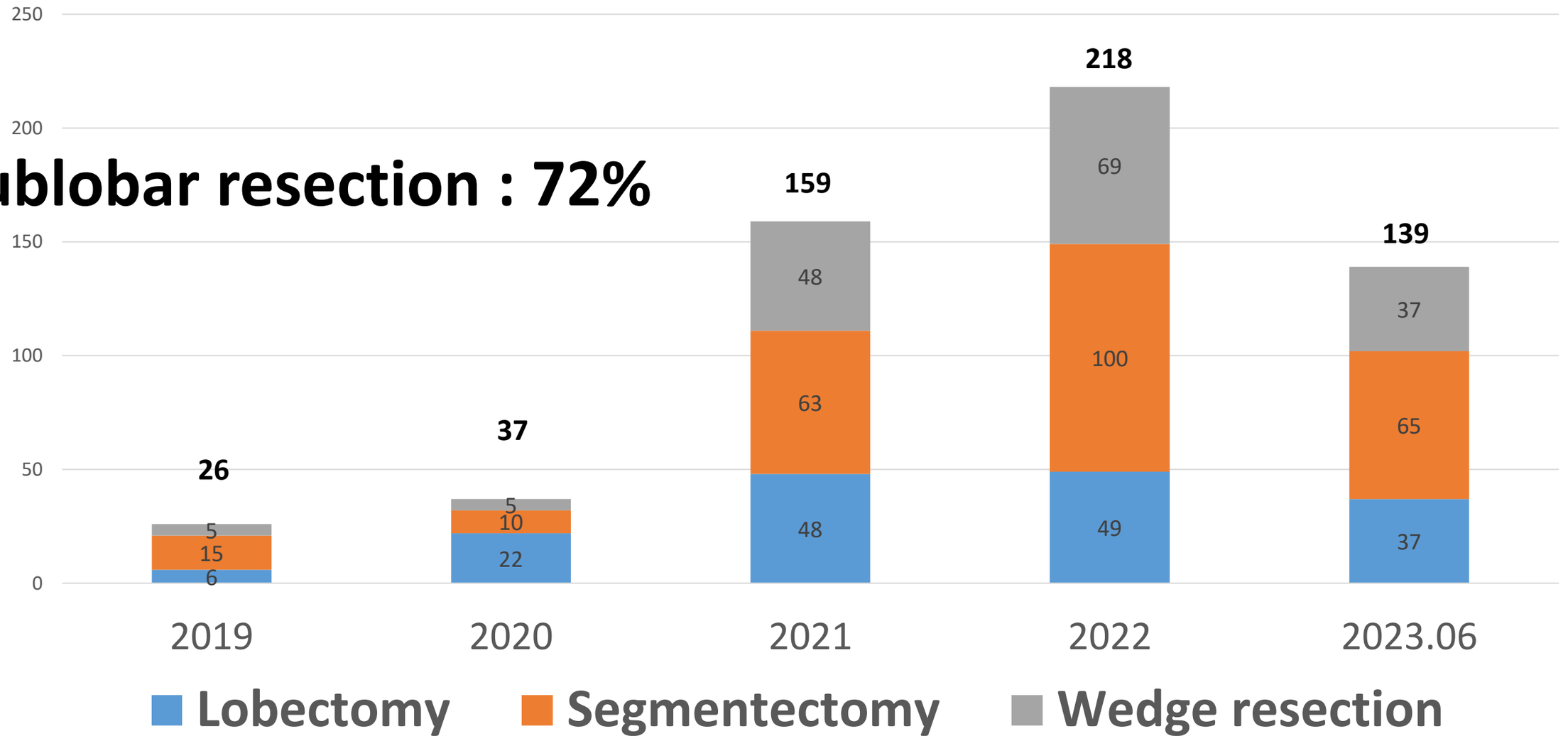






Lung cancer operation (Y Moon.)
(Eunpyeong St. Mary's Hospital, 2019.4~2023.6)

Sublobar resection : 72%



Contents

1. Sublobar resection?
2. Surgical Indication
3. Case

1. Sublobar resection?

Sublobar resection?

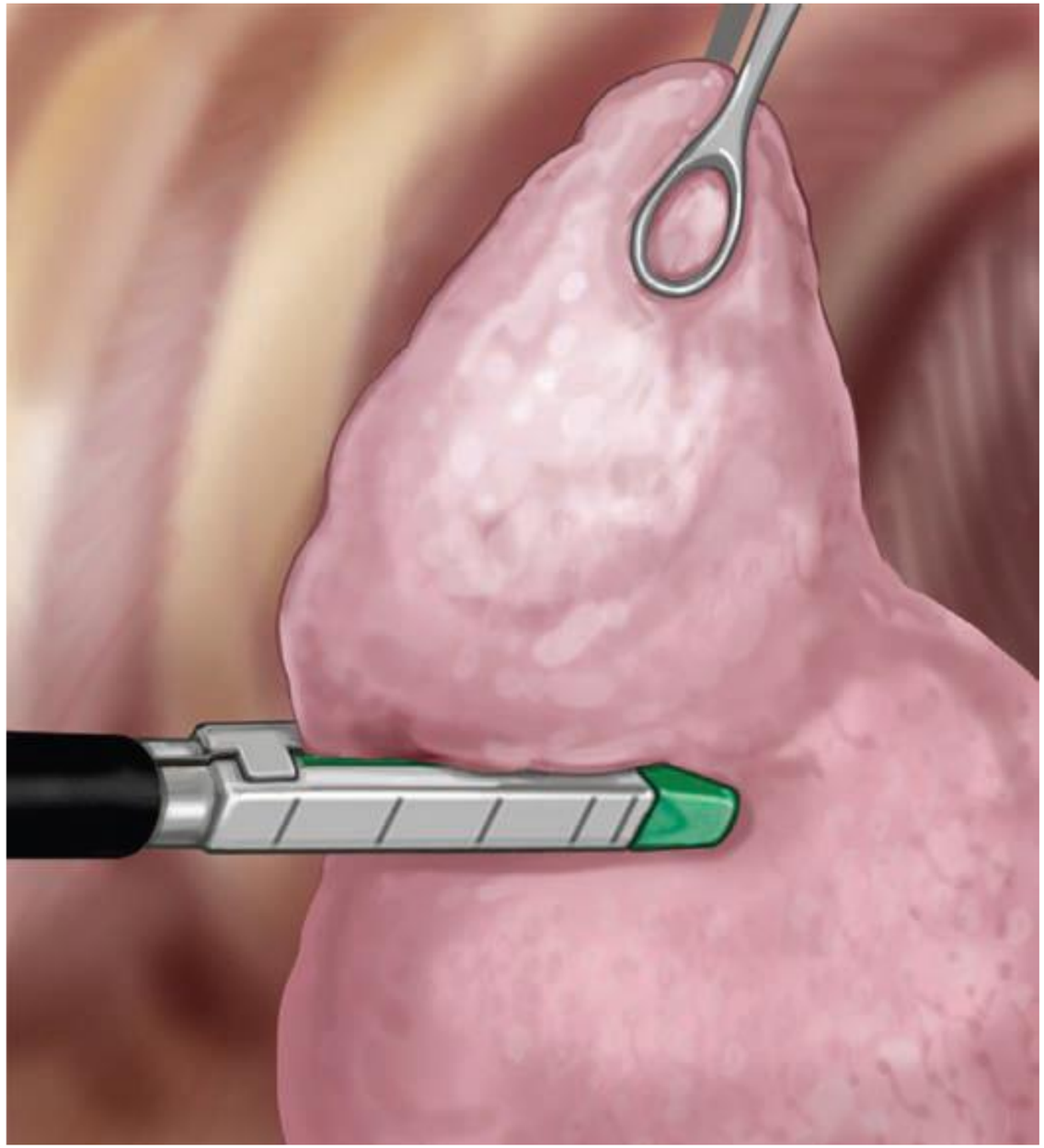
- Wedge resection = 폐 쐐기 절제술
- Segmentectomy = 폐 구역 절제술

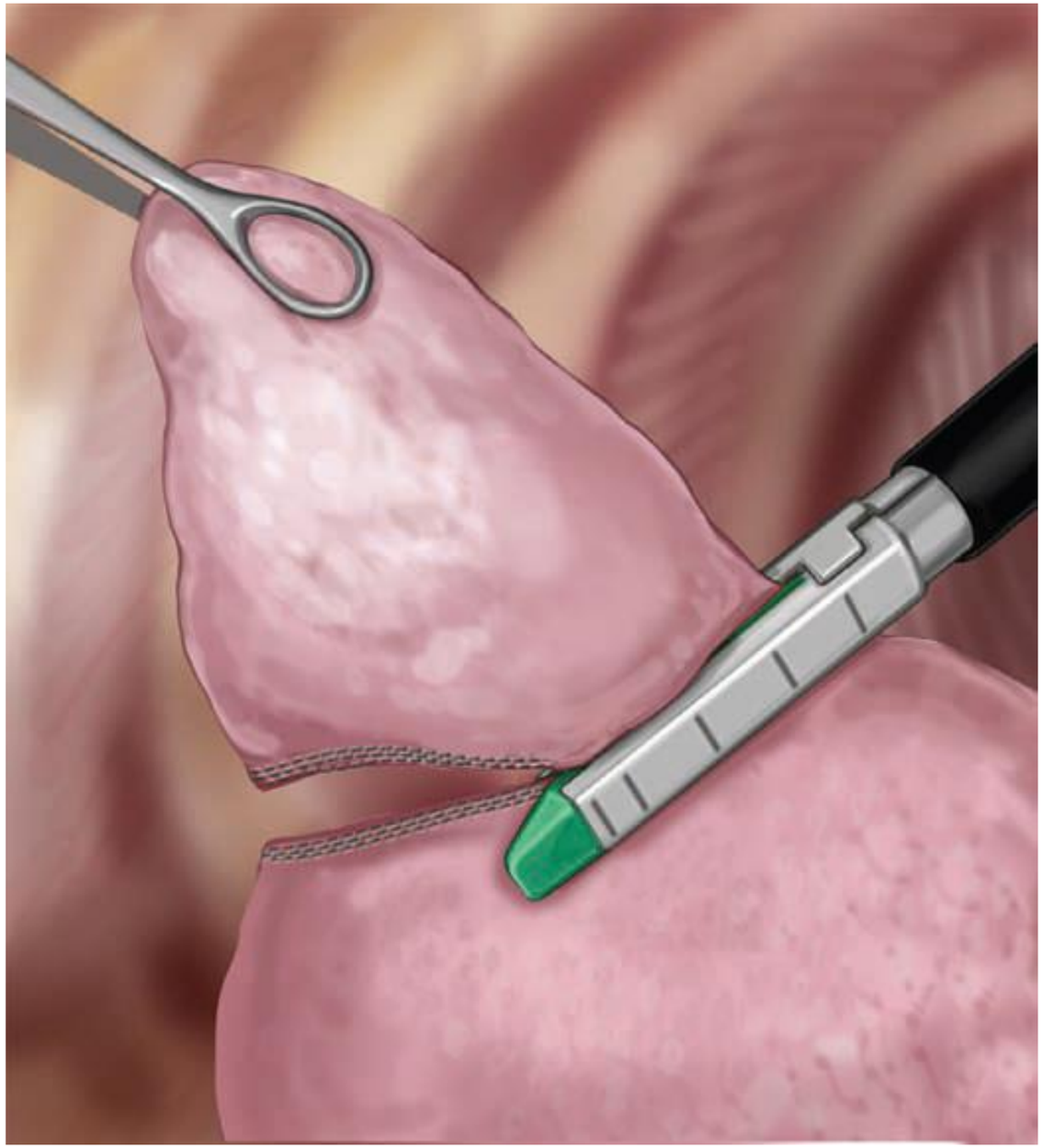
Sublobar resection?

- Wedge resection = 폐 쐐기 절제술 : **Non – anatomical**
- Segmentectomy = 폐 구역 절제술 : **Anatomical**

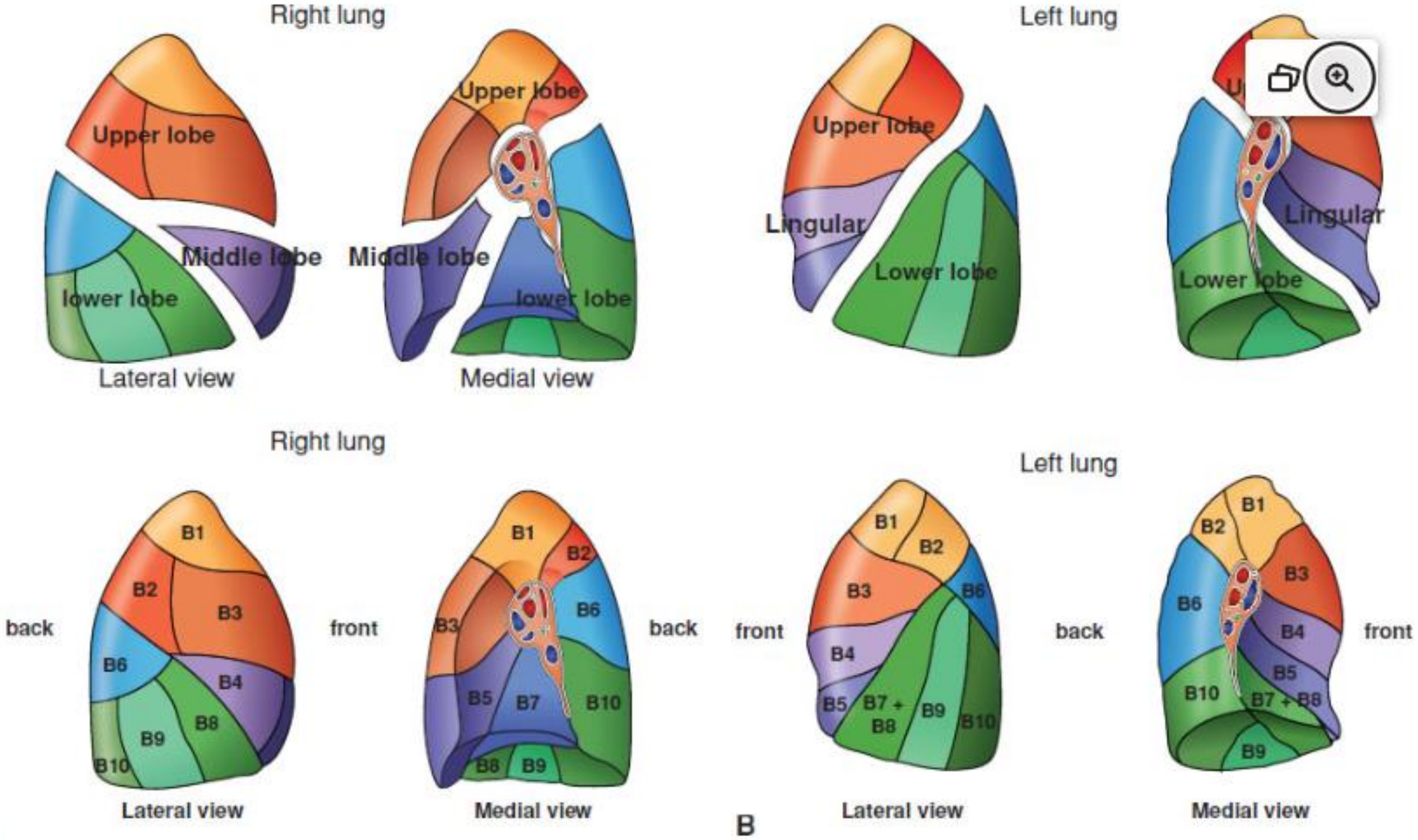
Wedge resection

(Adult chest surgery, 2nd edition)



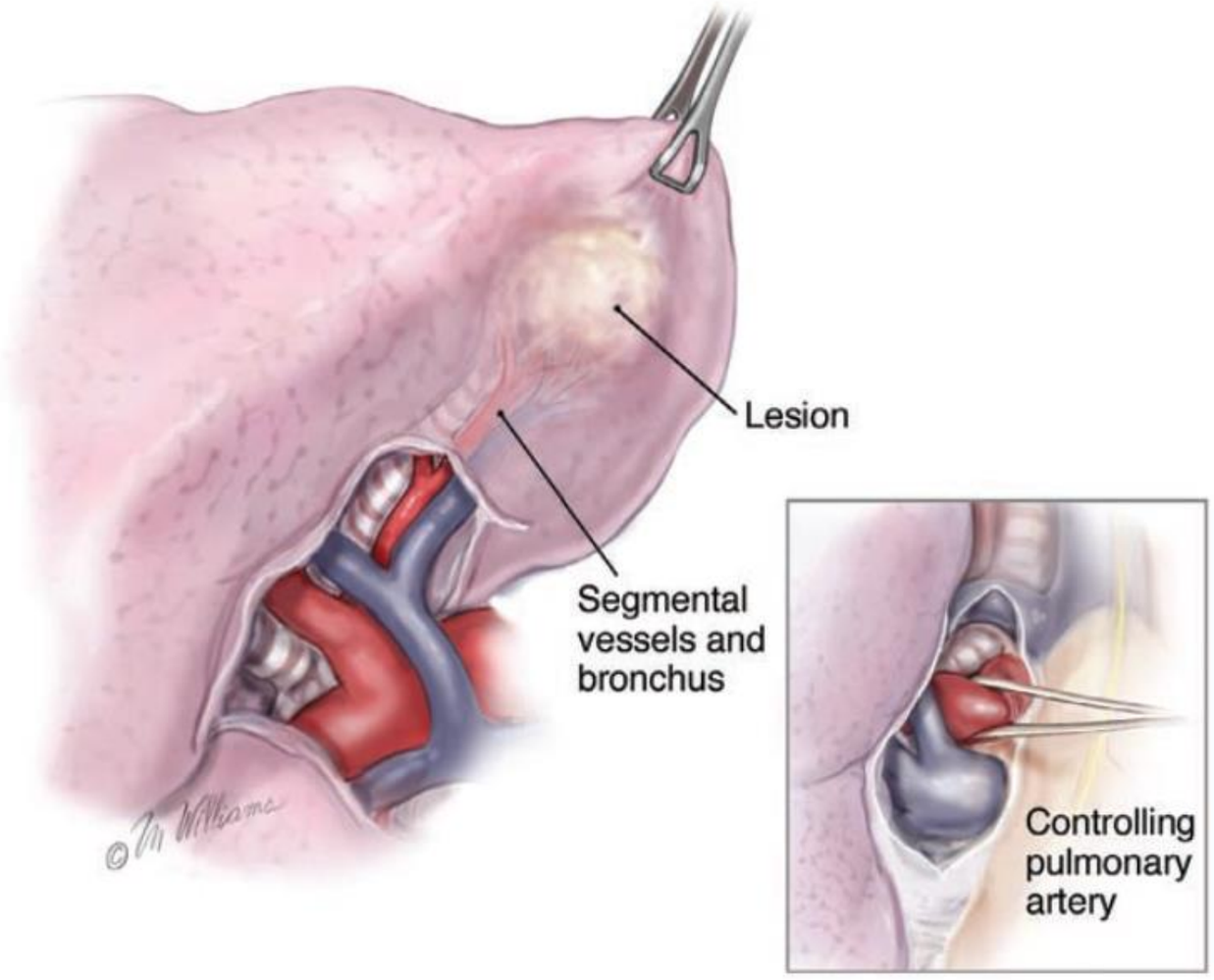


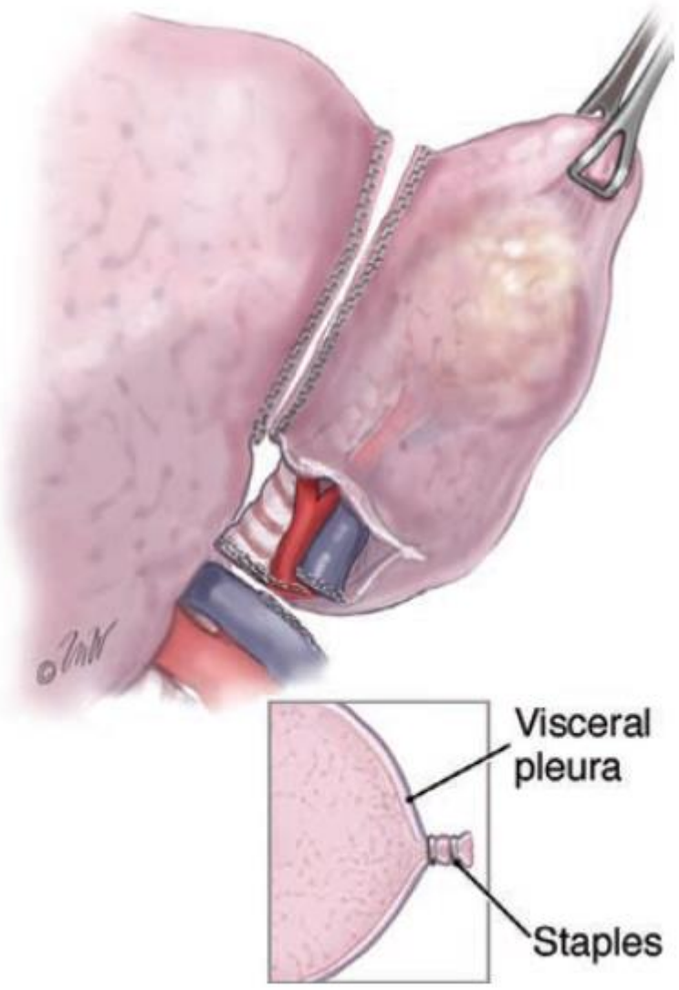
(Adult chest surgery, 2nd edition)



Segmentectomy

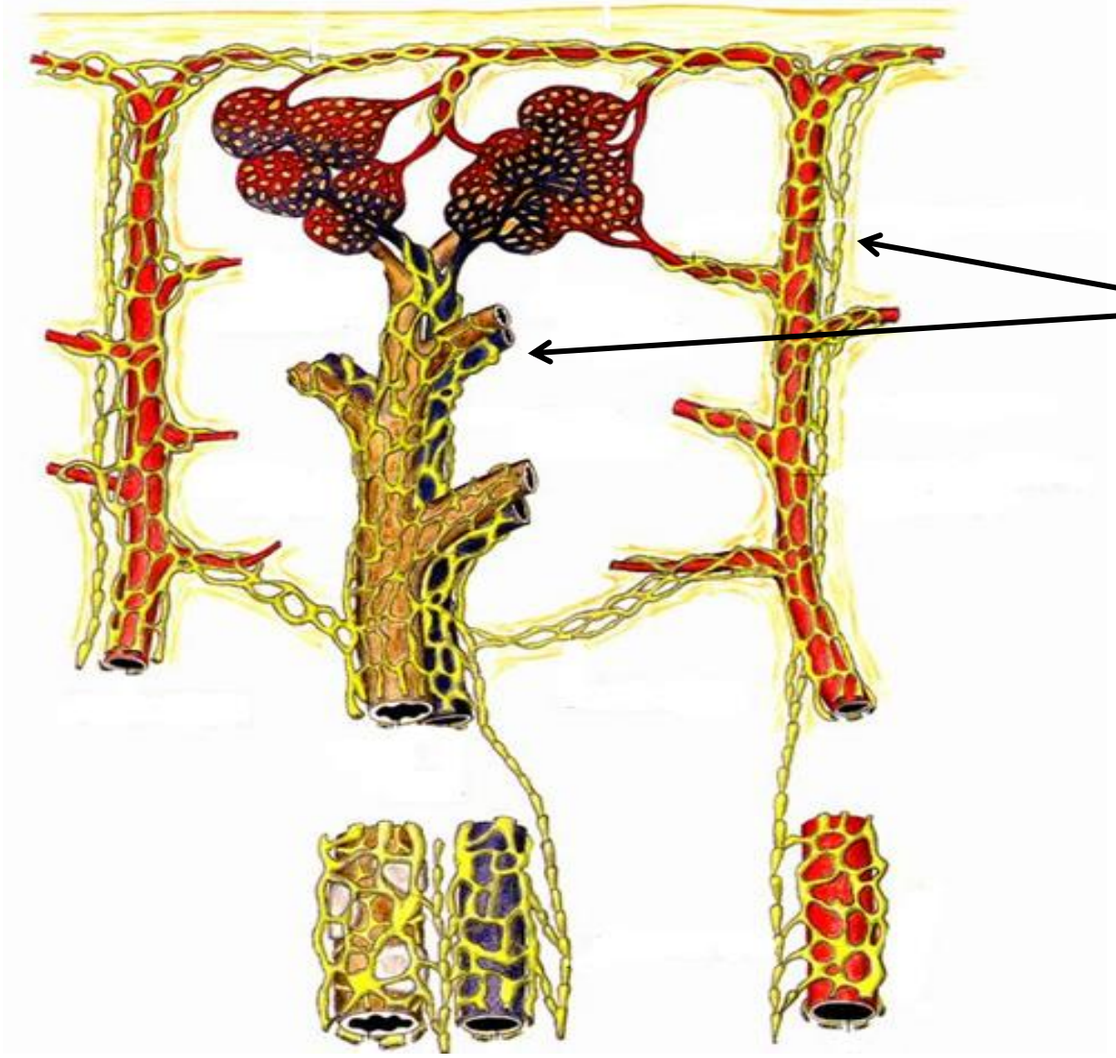
(Adult chest surgery, 2nd edition)





Shun-ichi Watanabe, MD
National Cancer Center Hospital, JAPAN
Japan Clinical Oncology Group (JCOG)

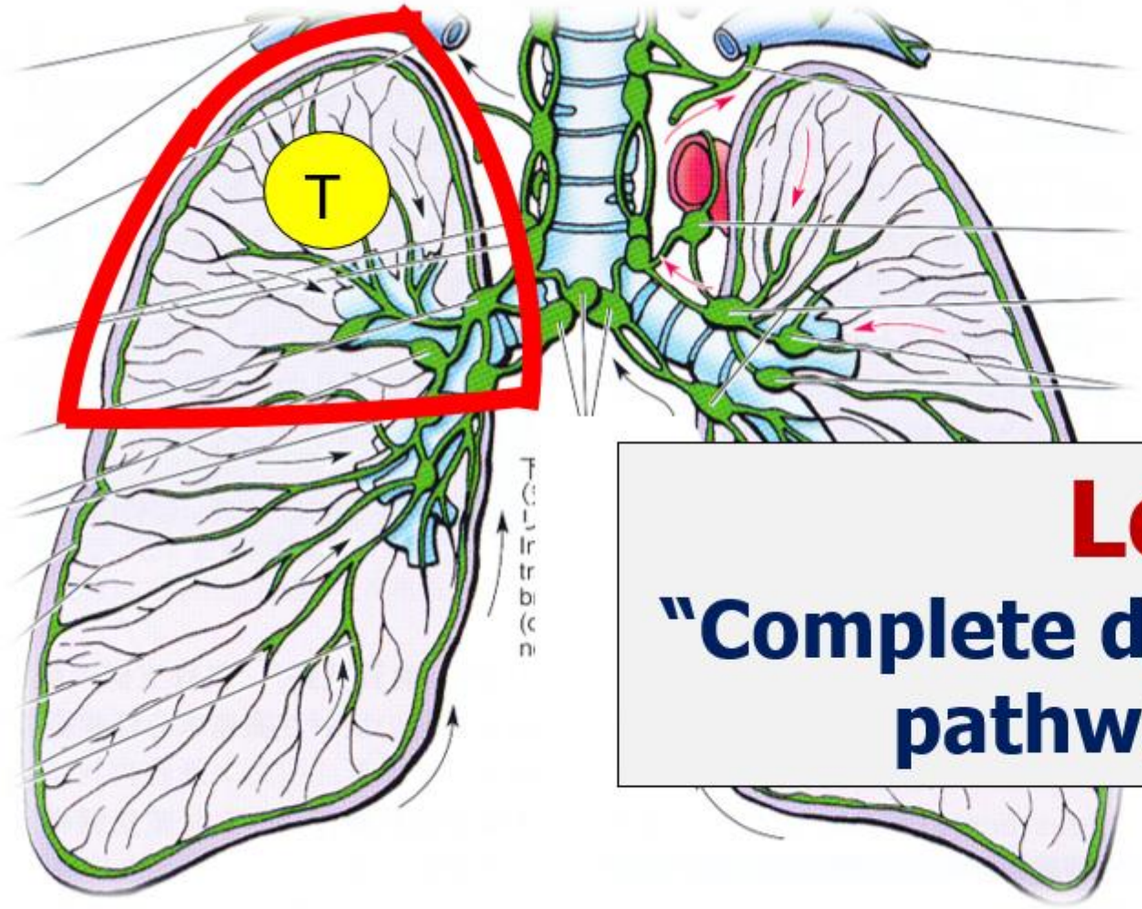
Network of lymphatics within the peripheral lung



Numerous lymphatic vessels along the PA, PV and Br

Shun-ichi Watanabe, MD

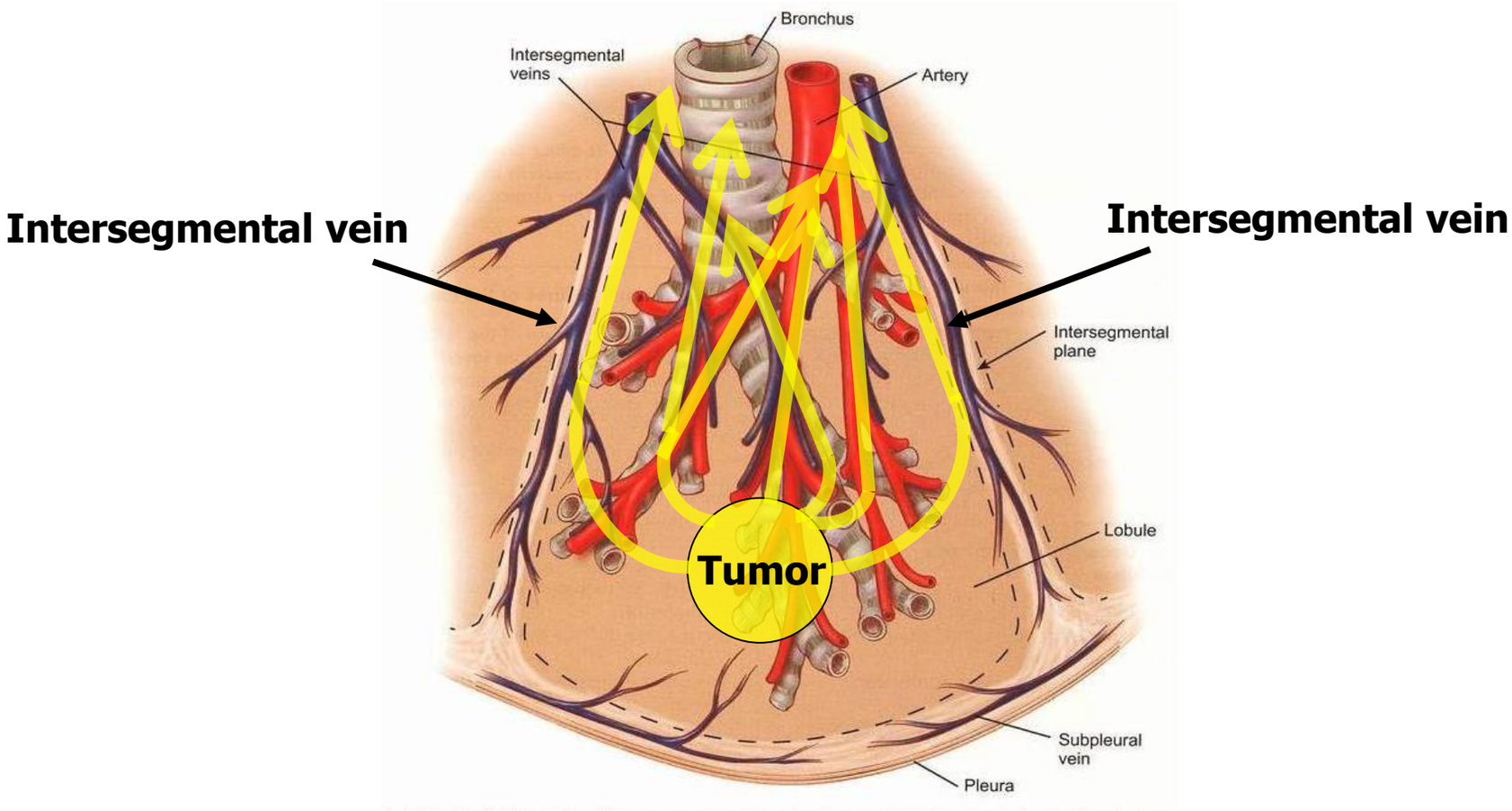
National Cancer Center Hospital, JAPAN
Japan Clinical Oncology Group (JCOG)



Lobectomy =

"Complete dissection of the lymphatic pathways within the lobe"

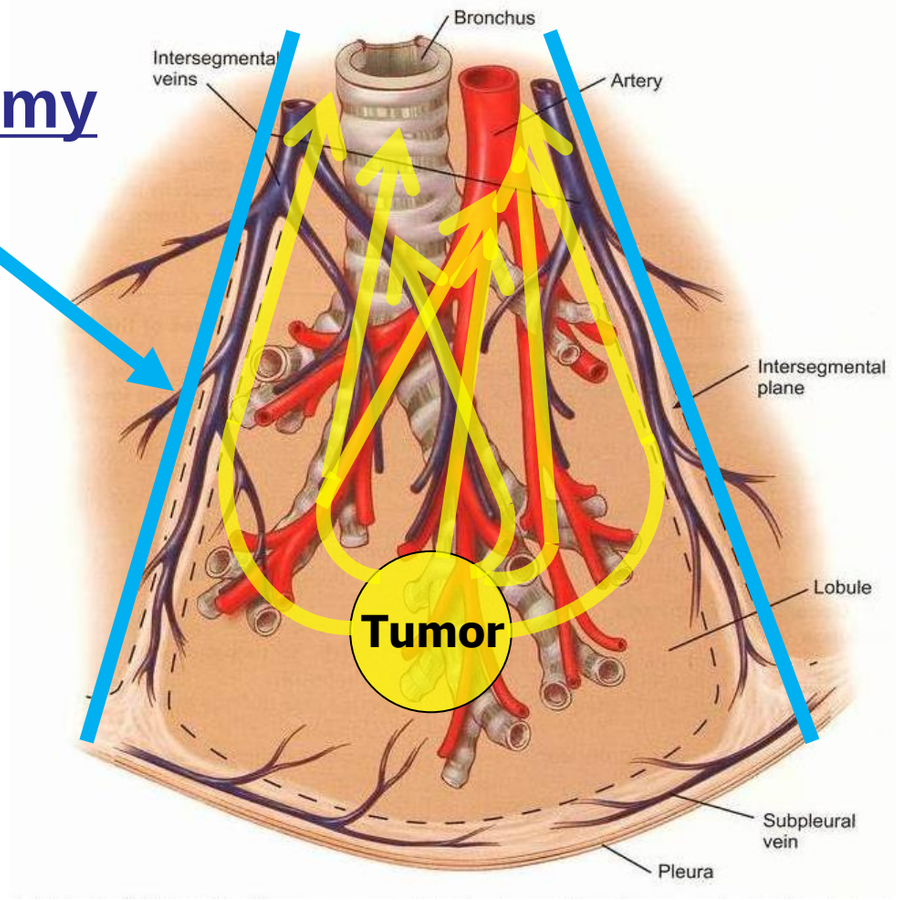
Shun-ichi Watanabe, MD
National Cancer Center Hospital, JAPAN
Japan Clinical Oncology Group (JCOG)



Tumor cells would spread along the vessels and bronchus within the intersegmental planes

Shun-ichi Watanabe, MD
National Cancer Center Hospital, JAPAN
Japan Clinical Oncology Group (JCOG)

Segmentectomy

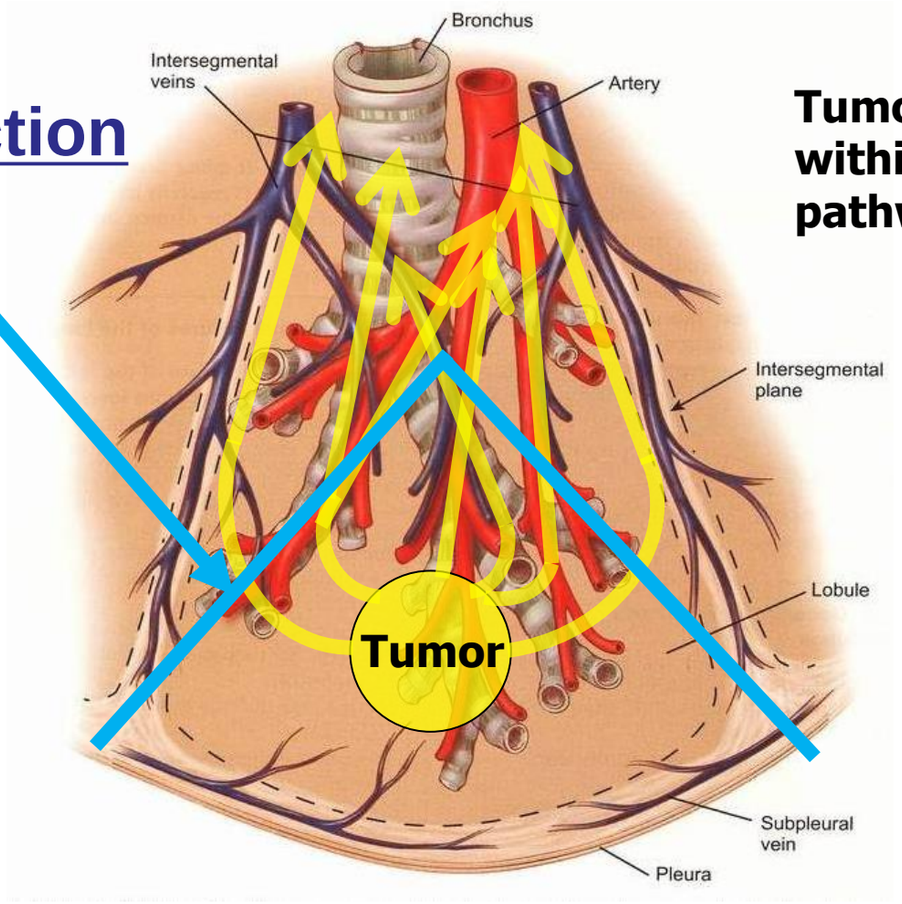


We can remove the regional lymphatic pathways around the tumor

Anatomic segmentectomy could be applied even for invasive tumor.

Shun-ichi Watanabe, MD
National Cancer Center Hospital, JAPAN
Japan Clinical Oncology Group (JCOG)

Wedge resection



Tumor cells may persist within the lymphatic pathways

Non-anatomic wedge resection should be applied only for non-invasive tumor

Sublobar resection?

- Wedge resection → Non-Invasive tumor
- Segmentectomy → Invasive tumor

2. Surgical indication

PRINCIPLES OF SURGICAL THERAPY

Evaluation

- Determination of resectability, surgical staging, and ***pulmonary resection should be performed by thoracic surgeons who perform lung cancer surgery as a prominent part of their practice***.
- CT and PET/CT used for staging should be within 60 days before proceeding with surgical evaluation.
- For medically operable disease, resection is the preferred local treatment modality (other modalities include SABR, thermal ablation such as radiofrequency ablation, and cryotherapy). Thoracic surgical oncology consultation should be part of the evaluation of any patient being considered for curative local therapy. In cases where SABR is considered for high-risk or borderline operable patients, a multidisciplinary evaluation including a radiation oncologist is recommended.
- The overall plan of treatment as well as needed imaging studies should be determined before any non-emergency treatment is initiated.
- Thoracic surgeons should actively participate in multidisciplinary discussions and meetings regarding patients with lung cancer (eg, multidisciplinary clinic and/or tumor board).
- Patients who actively smoke should be provided counseling and smoking cessation support (NCCN Guidelines for Smoking Cessation). While patients who actively smoke have a mildly increased incidence of postoperative pulmonary complications, these should not be considered a prohibitive risk for surgery. Surgeons should not deny surgery to patients solely due to smoking status, as surgery provides the predominant therapy for patients with early-stage lung cancer.

Resection

- Anatomic pulmonary resection is preferred for the majority of patients with NSCLC.
- Sublobar resection - Segmentectomy and wedge resection should achieve parenchymal resection margins ≥2 cm or ≥ the size of the nodule.
- Sublobar resection should also sample appropriate N1 and N2 lymph node stations unless not technically feasible without substantially increasing the surgical risk.
- Segmentectomy (preferred) or wedge resection is appropriate in selected patients for the following reasons:
  - Poor pulmonary reserve or other major comorbidity that contraindicates lobectomy
  - Peripheral nodule[a] ≤2 cm with at least one of the following:
    - Pure AIS histology
    - Nodule has ≥50% ground-glass appearance on CT
    - Radiologic surveillance confirms a long doubling time (≥400 days)
- VATS or minimally invasive surgery (including robotic-assisted approaches) should be strongly considered for patients with no anatomic or surgical contraindications, as long as there is no compromise of standard oncologic and dissection principles of thoracic surgery.
- In high-volume centers with significant VATS experience, VATS lobectomy in selected patients results in improved early outcomes (ie, decreased pain, reduced hospital length of stay, more rapid return to function, fewer complications) without compromise of cancer outcomes.
- Lung-sparing anatomic resection (sleeve lobectomy) is preferred over pneumonectomy, if anatomically appropriate and margin-negative resection is achieved.
- T3 (invasion) and T4 local extension tumors require en-bloc resection of the involved structure with negative margins. If a surgeon or center is uncertain about potential complete resection, consider obtaining an additional surgical opinion from a high-volume specialized center.

Margins and Nodal Assessment (see NSCL-B 2 of 4)

The Role of Surgery in Patients with Stage IIIA (N2) NSCLC (see NSCL-B 2 of 4 through NSCL-B 4 of 4)

[a] Peripheral is defined as the outer one third of the lung parenchyma.

Note: All recommendations are category 2A unless otherwise indicated.
Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

- Segmentectomy (preferred) or wedge resection is appropriate in selected patients for the following reasons:
  - Poor pulmonary reserve or other major comorbidity that contraindicates lobectomy
  - Peripheral nodule[a] ≤2 cm with at least one of the following:
    - Pure AIS histology
    - Nodule has ≥50% ground-glass appearance on CT
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Four prospective multicenter trials

- JCOG 0804/WJOG4507L (J Thorac Cardiovasc Surg 2022;163:289-301)
- JCOG 0802/WJOG4607L (Lancet 2022;399:1607-1617)
- JCOG1211 (Lancet Respir Med 2023;11:540-549)

- CALGB140503 (N Engl J Med 2023;388:489-498)

- JCOG 0804/WJOG4507L (J Thorac Cardiovasc Surg 2022;163:289-301)
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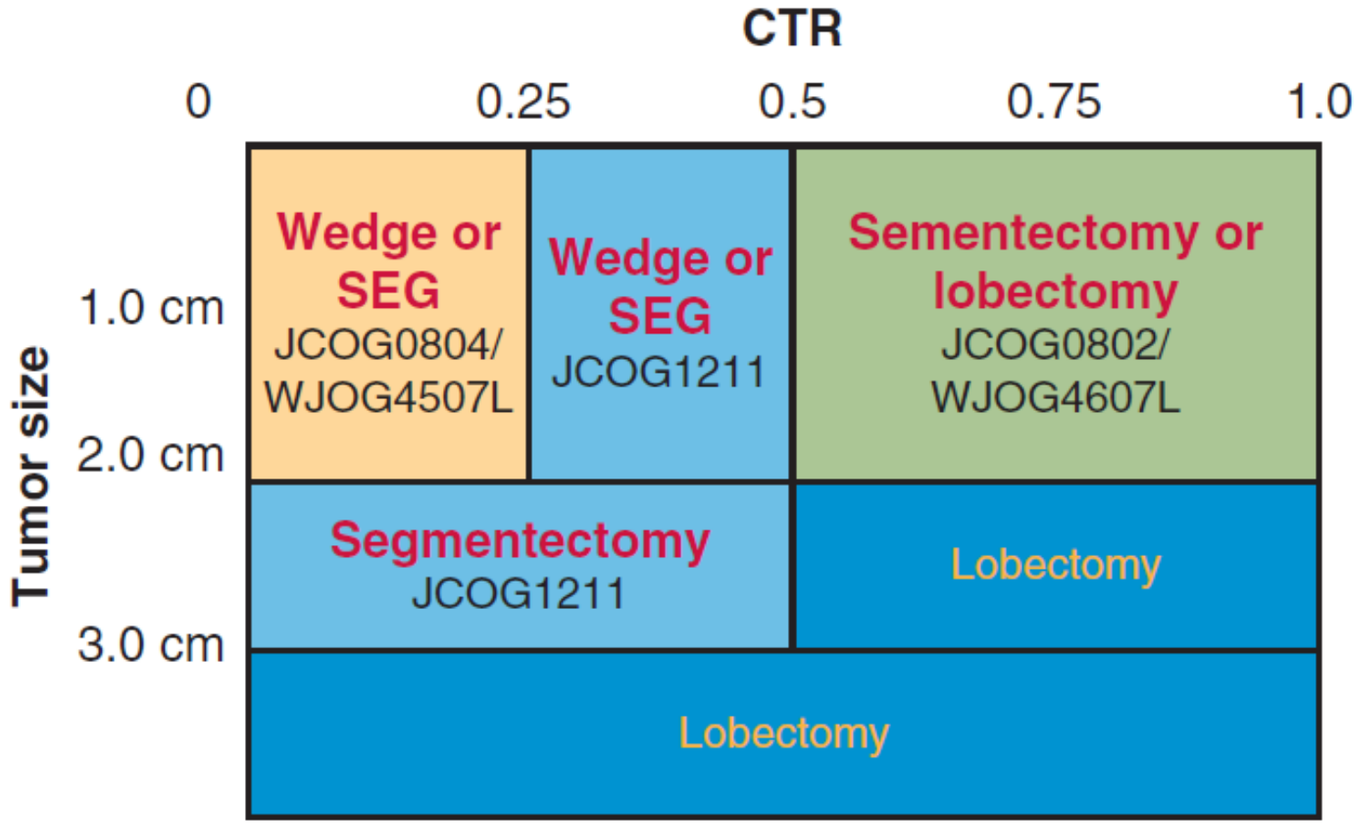
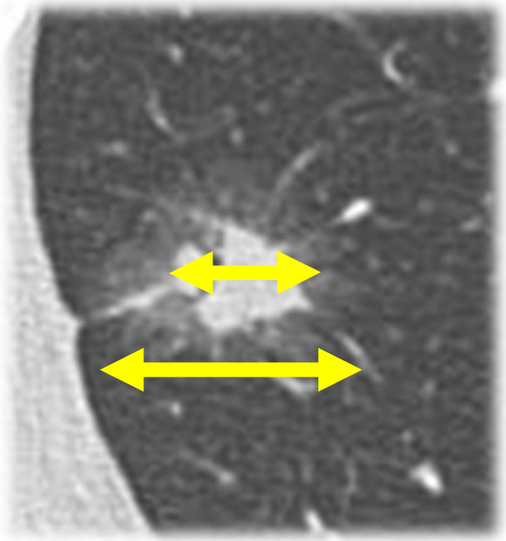


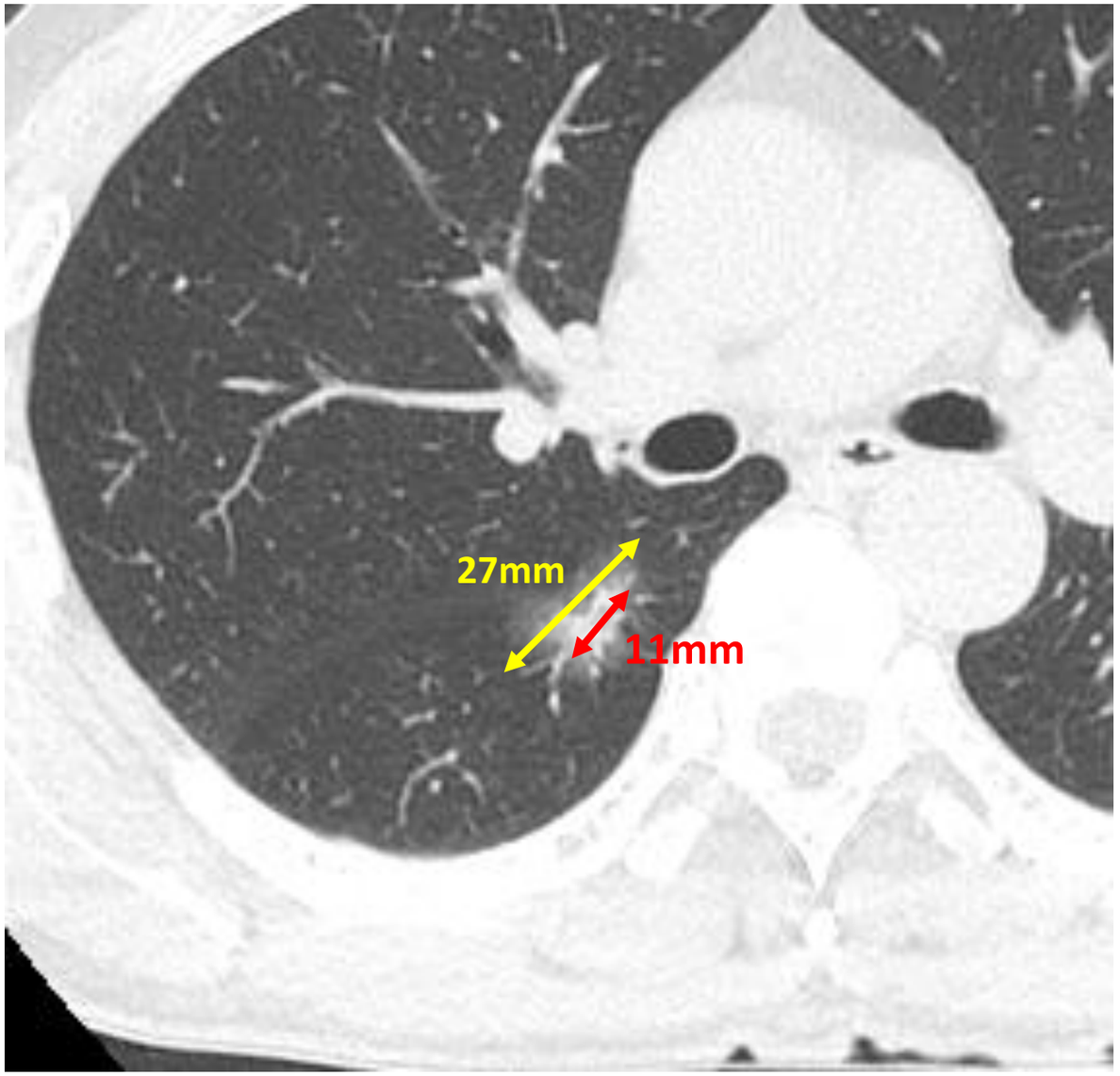
CTR = consolidation/tumor ratio

The type of surgery is selected based on tumor size and C/T ratio



C/T ratio =
Max. consolidation diameter / max. tumor diameter

Solid	Part solid	Pure GGN
1	↔	0



Tumor size = 27mm

Consolidation size = 11mm

C/T ratio= 11/27 = 0.407…

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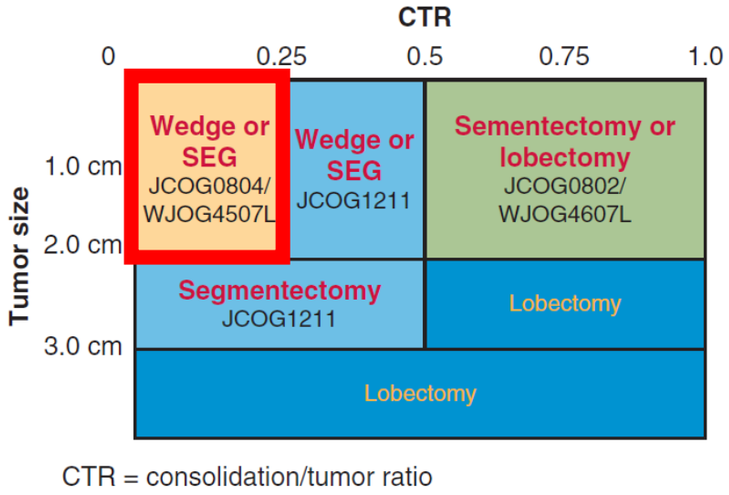


CTR = consolidation/tumor ratio

THORACIC: LUNG CANCER: CLINICAL TRIAL

A single-arm study of sublobar resection for ground-glass opacity dominant peripheral lung cancer

Kenji Suzuki, MD,[a] Shun-ichi Watanabe, MD,[b] Masashi Wakabayashi, MD,[c] Hisashi Saji, MD, PhD,[d] Keiju Aokage, MD,[e] Yasumitsu Moriya, MD,[f] Ichiro Yoshino, MD,[g] Masahiro Tsuboi, MD,[e] Shinichiro Nakamura, ME,[h] Kenichi Nakamura, MD,[c] Tetsuya Mitsudomi, MD,[i] and Hisao Asamura, MD,[j] on behalf of the West Japan Oncology Group and Japan Clinical Oncology Group

(Journal of Thoracic and Cardiovascular Surgery 2022;163:289-301)

Peripheral lesion (3 or fewer nodules)

C/T ratio ≤ 0.25

Tumor size ≤ 2cm

Wedge resection 258, Segmentectomy 56

Node dissection : not mandatory

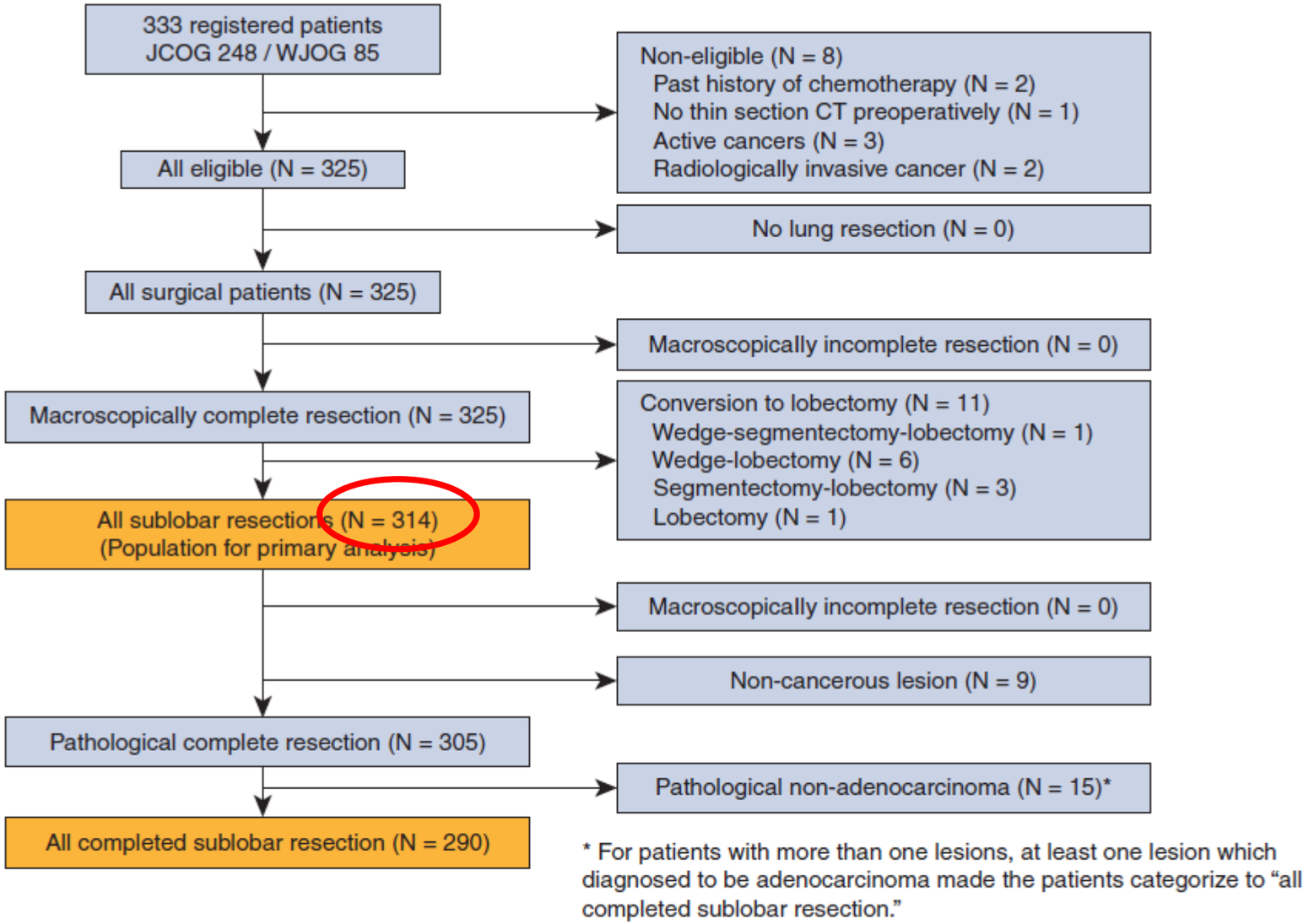
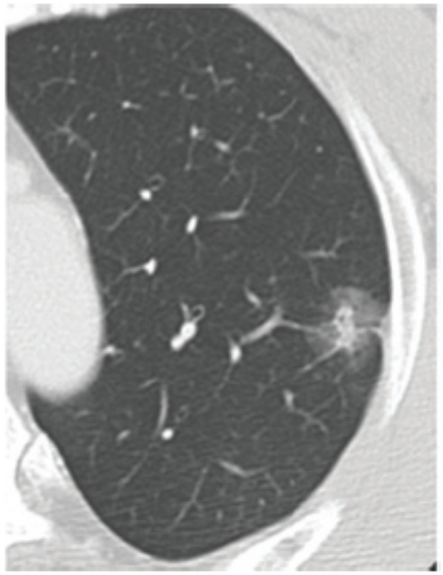


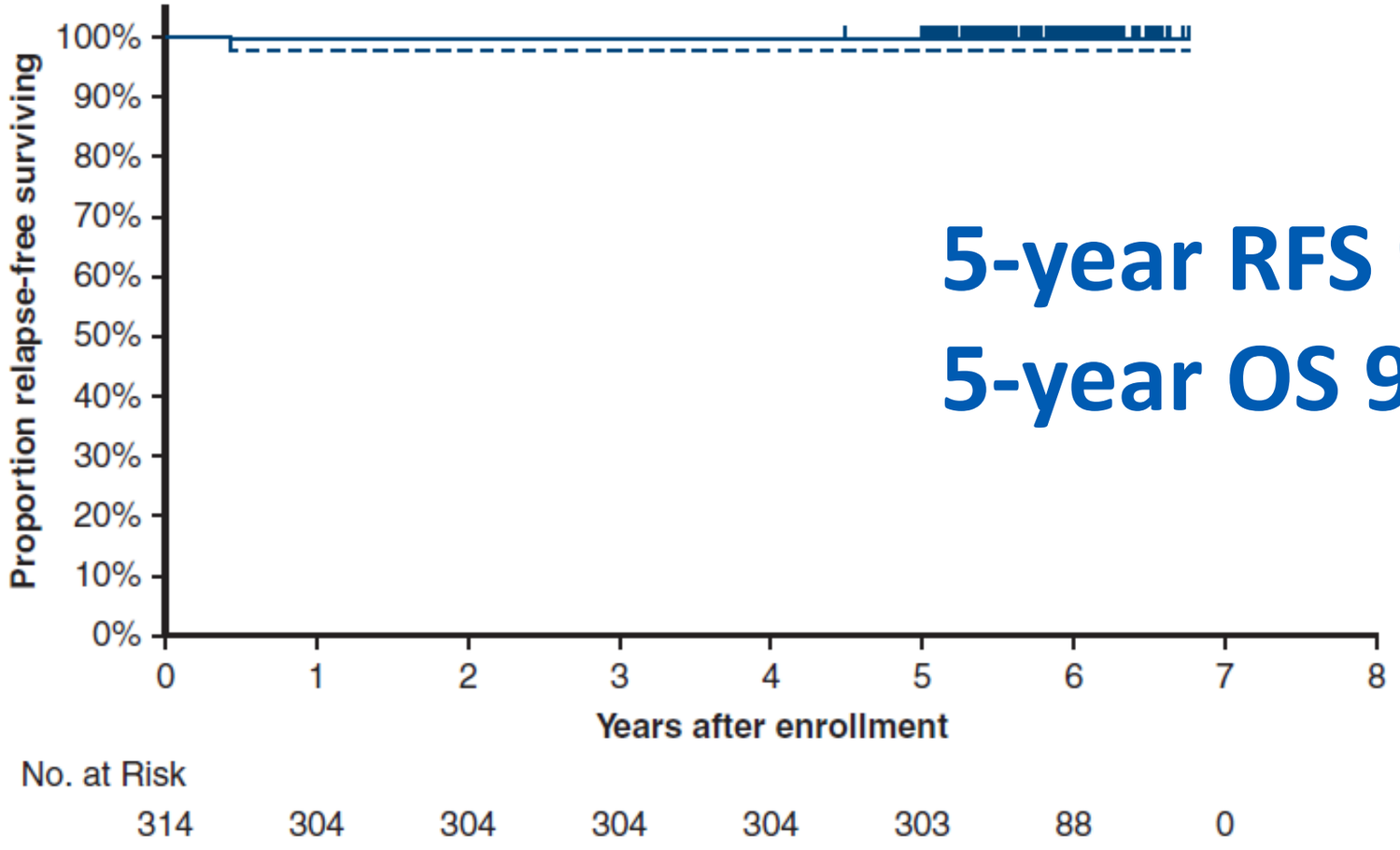
FIGURE 1. Consort diagram of JCOG0804/WJOG4507L study. JCOG0804/WJOG4607L is a 1-arm study with wide wedge resection for GGO-dominant lung cancer based on the criteria of JCOG0201, which defined radiologic noninvasive lung cancer as tumor 2.0 cm or less in size with CTR 0.25 or less. After wedge resection, factors related to ineligibility for sublobar resections should be investigated, and surgical procedures according to the study protocol is terminated if an unresectable factor is found intraoperatively. *JCOG*, Japan Clinical Oncology Group; *WJOG*, West Japan Oncology Group; *CT*, computed tomography.

JCOG0804/WJOG4507L Study showed excellent survival after sublobar resection for peripherally located Ground Glass dominant lung tumor



N = 314
0% < CTR < 25%

Sublobar resection



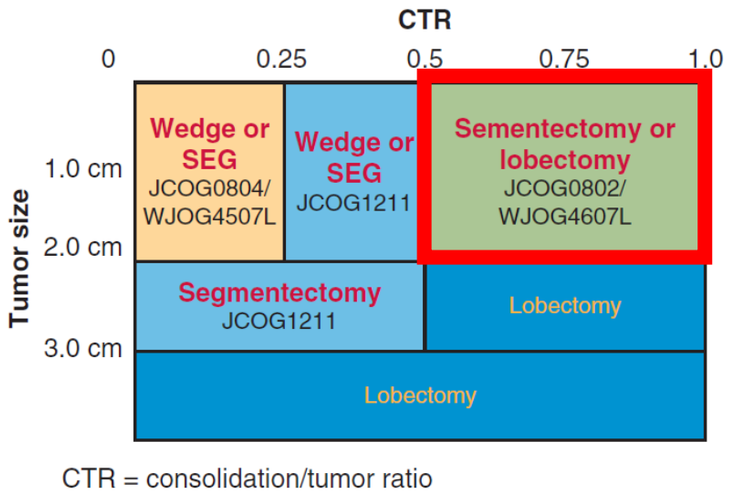
5-year RFS 99.7%

5-year OS 99.4%

Sublobar resection is enough for Ground Glass dominant peripherally located lung cancer

FIGURE 2. The 5-year relapse free survival for all patients except benign lesions and atypical adenomatous hyperplasia with sublobar resection was 99.7% (90% CI, 97.6-99.9). *CTR*, Consolidation tumor ratio.

- **Sublobar resection (wedge resection)** with a enough resection margin offered sufficient local control and relapse-free survival for lung cancer clinically resectable N0 staged by computed tomography with 3 or fewer peripheral lesions **2.0cm or less** amenable to sublobar resection and with a **consolidation tumor ratio of 0.25 or less**.



Segmentectomy versus lobectomy in small-sized peripheral non-small-cell lung cancer (JCOG0802/WJOG4607L): a multicentre, open-label, phase 3, randomised, controlled, non-inferiority trial

*Hisashi Saji, Morihito Okada, Masahiro Tsuboi, Ryu Nakajima, Kenji Suzuki, Keiju Aokage, Tadashi Aoki, Jiro Okami, Ichiro Yoshino, Hiroyuki Ito, Norihito Okumura, Masafumi Yamaguchi, Norihiko Ikeda, Masashi Wakabayashi, Kenichi Nakamura, Haruhiko Fukuda, Shinichiro Nakamura, Tetsuya Mitsudomi, Shun-Ichi Watanabe, Hisao Asamura, on behalf of the West Japan Oncology Group and Japan Clinical Oncology Group**

(Lancet 2022;399:1607-1617)

Clinical stage IA NSCLC

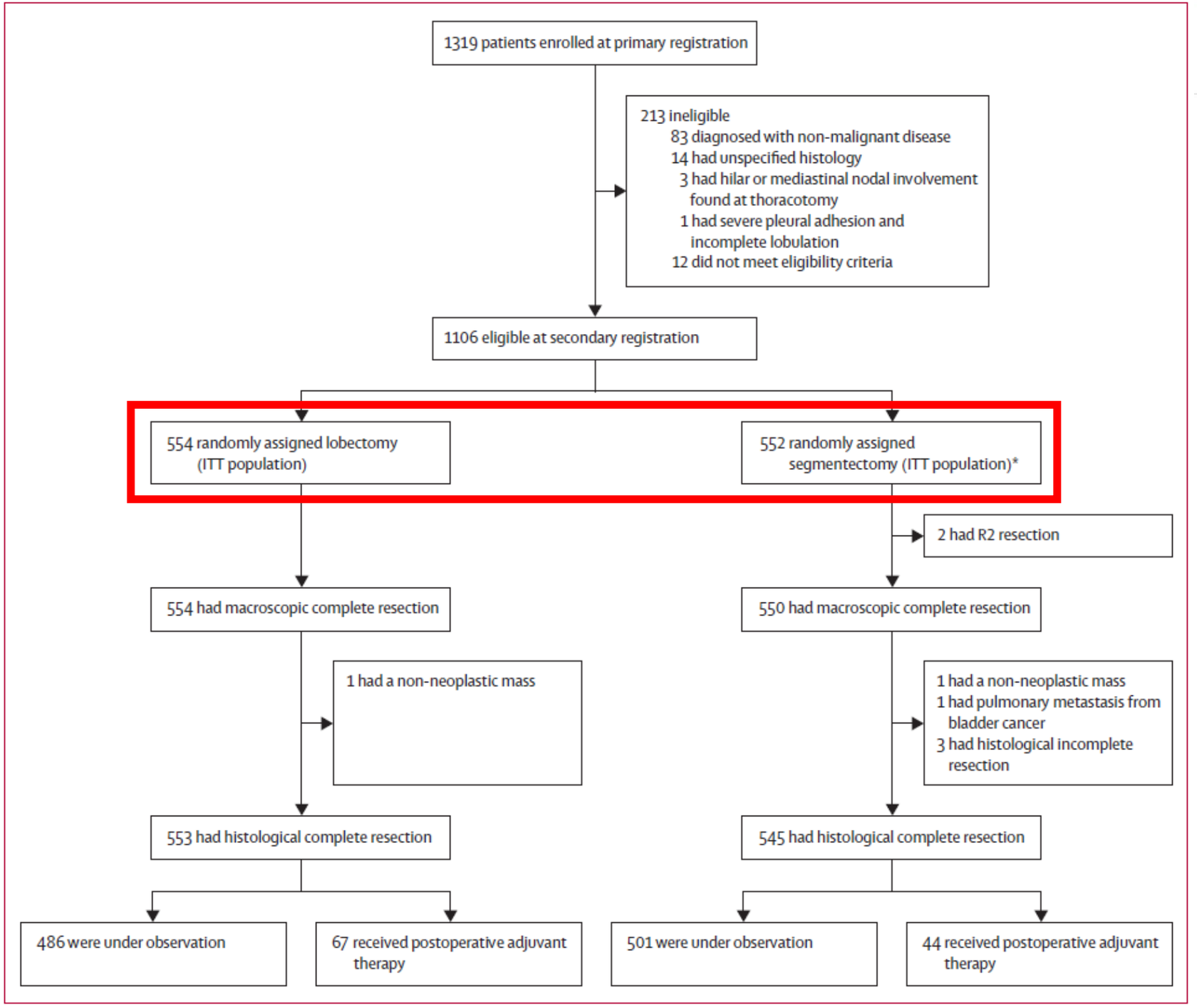
Peripheral location (outer third of lung)

C/T ratio > 0.5

Tumor size ≤ 2cm

Segmentectomy vs Lobectomy

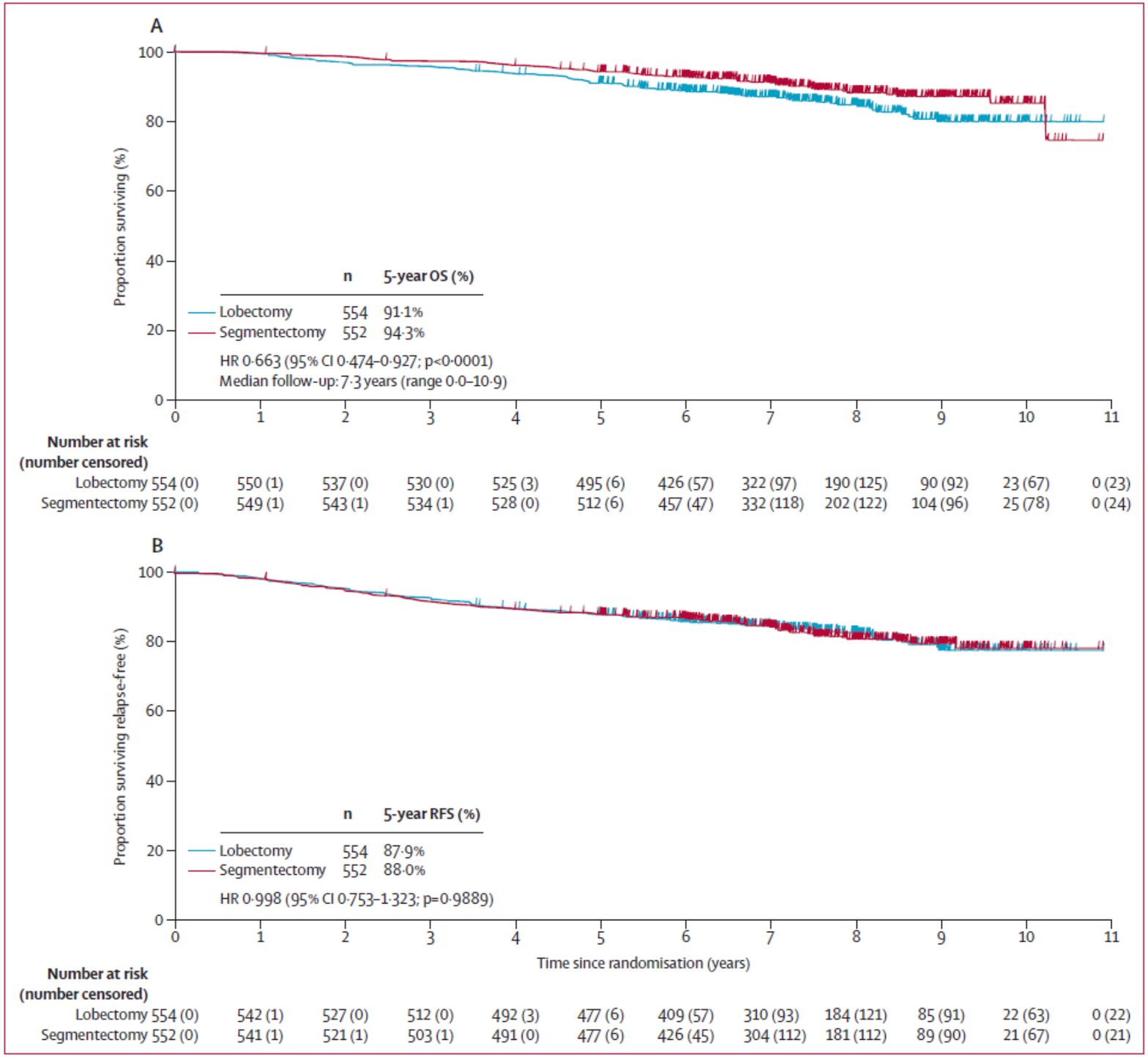
Systematic nodal dissection or selective nodal dissection


1319 patients enrolled at primary registration
213 ineligible
83 diagnosed with non-malignant disease
14 had unspecified histology
3 had hilar or mediastinal nodal involvement found at thoracotomy
1 had severe pleural adhesion and incomplete lobulation
12 did not meet eligibility criteria
1106 eligible at secondary registration
554 randomly assigned lobectomy (ITT population)
552 randomly assigned segmentectomy (ITT population)*
2 had R2 resection
554 had macroscopic complete resection
550 had macroscopic complete resection
1 had a non-neoplastic mass
1 had a non-neoplastic mass
1 had pulmonary metastasis from bladder cancer
3 had histological incomplete resection
553 had histological complete resection
545 had histological complete resection
486 were under observation
67 received postoperative adjuvant therapy
501 were under observation
44 received postoperative adjuvant therapy

	Lobectomy group (n=554)	Segmentectomy group (n=552)*
Age, years	67 (35–85)	67 (32–83)
Sex		
Female	261 (47·1%)	262 (47·5%)
Male	293 (52·9%)	290 (52·5%)
ECOG performance status		
0	541 (97·7%)	542 (98·2%)
1	13 (2·3%)	10 (1·8%)
Smoking history		
Yes	308 (55·6%)	308 (55·8%)
No	246 (44·4%)	244 (44·2%)
Pack years		
≥20	239 (77·6%)	251 (81·5%)
<20	67 (21·8%)	55 (17·9%)
Unknown	2 (0·6%)	2 (0·6%)
CTR		
0 to ≤0·25	1 (0·2%)	0 (0%)
0·25 to ≤0·5	62 (11·2%)	73 (13·2%)
0·5 to <1	208 (37·6%)	194 (35·1%)
1	283 (51·1%)	285 (51·6%)
FEV1, mL	2260 (1110–4760)	2280 (1010–4900)
FVC, mL	3050 (1370–5990)	3095 (1590–5940)
Pathological type		
Adenocarcinoma	501 (90·4%)	502 (90·9%)
Squamous cell carcinoma	38 (6·9%)	37 (6·7%)
Others	15 (2·7%)	13 (2·4%)

(Table 1 continues in next column)

	Lobectomy group (n=554)	Segmentectomy group (n=552)*
(Continued from previous column)		
TNM classification (7th edition)		
pT1a/pT1b	427 (77·1%)/ 51 (9·2%)	453 (82·1%)/ 35 (6·3%)
pT2a/pT2b/pT3	71 (12·8%)/ 0 (0%)/4 (0·7%)	59 (10·7%)/ 1 (0·2%)/2 (0·4%)
Unknown pT status	1 (0·2%)	2 (0·4%)
pN0/pN1/pN2	522 (94·2%)/ 16 (2·9%)/15 (2·7%)	516 (93·5%)/ 17 (3·1%)/17 (3·1%)
Unknown pN status	1 (0·2%)	2 (0·4%)
pM0/pM1a/pM1b	553 (99·8%)/ 0 (0%)/0 (0%)	549 (99·5%)/ 0 (0%)/1 (0·2%)
Unknown pM status	1 (0·2%)	2 (0·4%)
pIA/pIB	455 (82·1%)/ 64 (9·2%)	468 (84·8%)/ 46 (8·3%)
pIIA/pIIB	15 (2·7%)/ 3 (0·5%)	18 (3·3%)/ 1 (0·2%)
pIIIA/pIV	16 (2·9%)/0 (0%)	18 (3·1%)/1 (0·2%)
Unknown p stage	1 (0·2%)	2 (0·4%)
Nodal dissection		
No dissection	0 (0%)	1 (0·2%)
Hilar	9 (1·6%)	17 (3·1%)
Mediastinal, systematic	221 (39·9%)	182 (33·0%)
Mediastinal, selective	324 (58·5%)	352 (63·8%)
Video-assisted thoracic surgery		
Yes	491 (88·7%)	495 (89·7%)
No	63 (21·3%)	57 (20·3%)



5-year OS
Segmentectomy 94.3%
Lobectomy 91.1%

5-year RFS
Segmentectomy 88.0%
Lobectomy 87.9%

Supplementary Table S1. Relapse pattern and site of the first relapse

	Lobectomy (n = 554)	Segmentectomy (n = 552)*
Relapse	n = 44 (7·9%)	n = 67 (12·1%)
Proportion of local relapse**	30/554 (5·4%)	58/552 (10·5%)
Relapse pattern		
Locoregional	17 (3·1%)	38 (6·9%)
Distant	14 (2·5%)	7 (1·3%)
Both	13 (2·3%)	20 (3·6%)
Unknown	0	2 (0·2%)

Supplementary Table S4. Postoperative respiratory function

	Lobectomy (n = 554)	Segmentectomy (n = 552)*	*P* value	Differences
Proportions of decrease on 6 months				
FEV1·0, %	n = 454	n = 492		
Median	−13·1	−10·4	< 0·0001	2·7
IQR	−20·5–−0·7	−16·6–−4·7		
Range	−63·8–53·5	−48·6–27·9		
FVC, %	n = 454	n = 492		
Median	−13·5	−9·9	< 0·0001	3·6
IQR	−20·9–−6·6	−16·4–−3·2		
Range	−70·2–30·8	−48·0–23·0		
Proportions of decrease in 1 year				
FEV1·0, %	n = 526	n = 528		
Median	−12·0	−8·5	< 0·0001	3·5
IQR	−18·8–−5·6	−14·8–−3·5		

- JCOG0802/WJOG4607L is the first randomized trial to show the **superiority of segmentectomy over lobectomy in overall survival** for early-stage lung cancer. These results indicate that segmentectomy should be the standard surgical procedure for patients with small-sized peripheral NSCLC.

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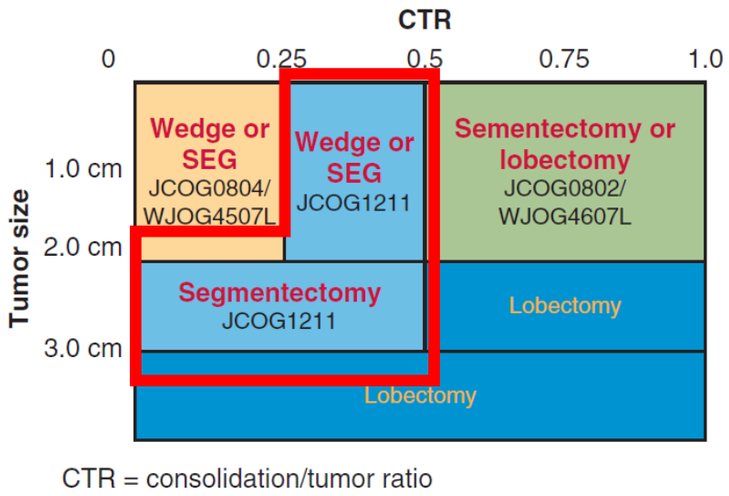


CTR = consolidation/tumor ratio

Segmentectomy for ground-glass-dominant lung cancer with a tumour diameter of 3 cm or less including ground-glass opacity (JCOG1211): a multicentre, single-arm, confirmatory, phase 3 trial

Keiju Aokage, Kenji Suzuki, Hisashi Saji, Masashi Wakabayashi, Tomoko Kataoka, Yuta Sekino, Haruhiko Fukuda, Makoto Endo, Aritoshi Hattori, Takahiro Mimae, Tomohiro Miyoshi, Mitsuhiro Isaka, Hiroshige Yoshioka, Ryu Nakajima, Kazuo Nakagawa, Jiro Okami, Hiroyuki Ito, Hiroaki Kuroda, Masahiro Tsuboi, Norihito Okumura, Makoto Takahama, Yasuhisa Ohde, Tadashi Aoki, Yasuhiro Tsutani, Morihito Okada, Shun-ichi Watanabe, on behalf of the Japan Clinical Oncology Group

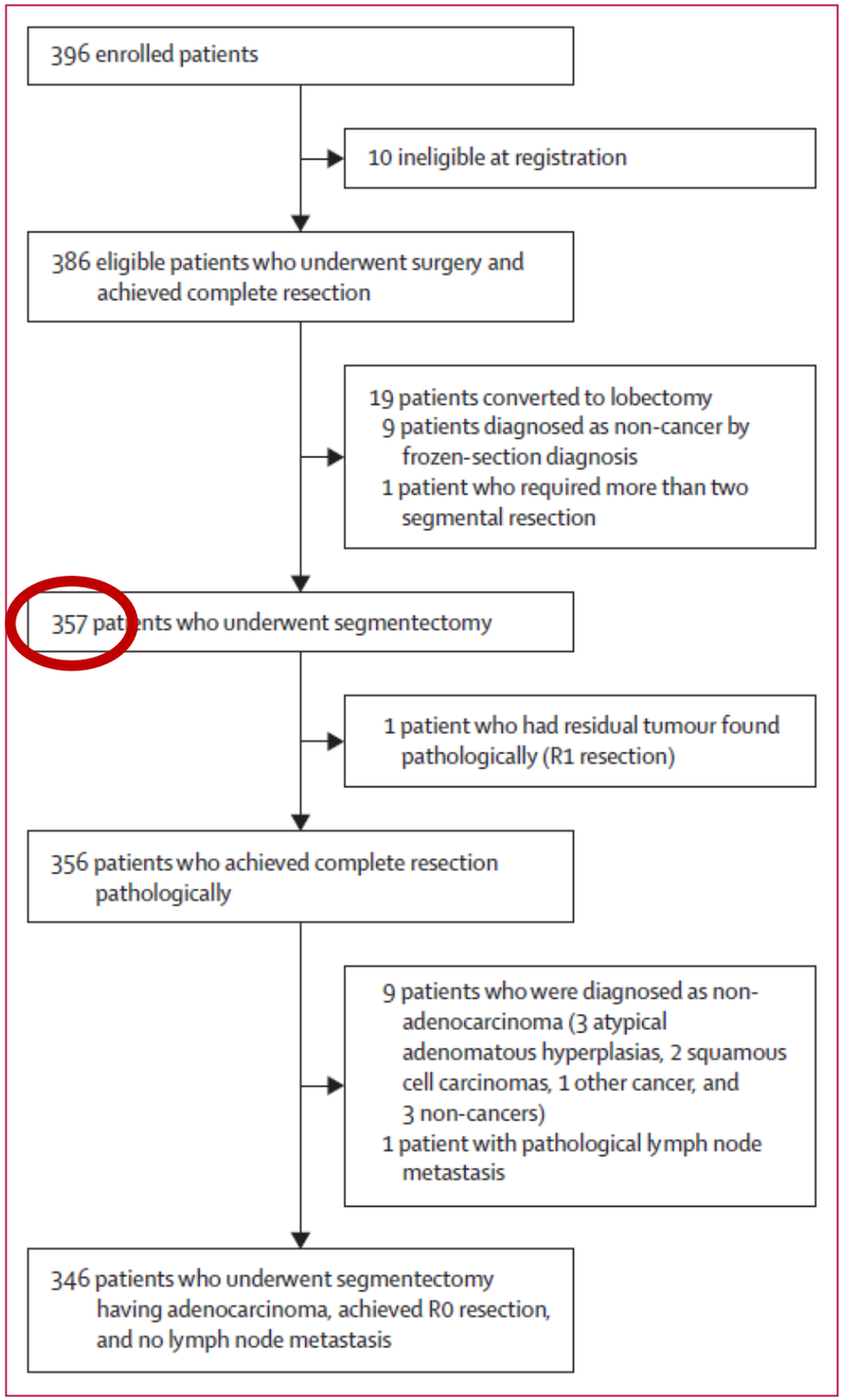
(Lancet Respiratory Medicine 2023;11:540-549)

NSCLC

C/T ratio ≤ 0.5

Tumor size ≤ 3cm

Segmentectomy



	All enrolled patients (n=396)	All patients who underwent segmentectomy (n=357)
(Continued from previous column)		
Comorbidity		
Yes	205 (52%)	186 (52%)
No	191 (48%)	171 (48%)
Median tumour diameter including ground-glass opacity* (IQR)	19·0 (14·0–23·0)	19·0 (14·0–22·8)
Median tumour diameter† (IQR)	6·0 (3·1–8·0)	6·0 (3·3–8·0)
CTR		
>0 to ≤0·25	115 (29%)	98 (27%)
>0·25 to ≤0·50	280 (71%)	259 (73%)
>0·50 to ≤1·00	1 (<1%)	0
Median FEV_1, mL (IQR)	2240 (1885–2700)	2230 (1890–2700)
Median forced volume capacity, mL (IQR)	2875 (2420–3635)	2860 (2420–3630)
Clinical T stage*		
T1a	222 (56%)	203 (57%)
T1b	174 (44%)	154 (43%)
Clinical T stage†		
Tis	65 (16%)	57 (16%)
T1mi	115 (29%)	102 (29%)
T1a	185 (47%)	171 (48%)
T1b	31 (8%)	27 (8%)
Tumour location		
Right upper lobe	104 (26%)	91 (25%)
Right lower lobe	91 (23%)	86 (24%)
Left upper lobe	140 (35%)	124 (35%)
Left lower lobe	61 (15%)	56 (16%)
Target group		
Tumour size >2 cm to ≤3 cm, CTR ≤0·5	173 (44%)	154 (43%)
Tumour size ≤2 cm, CTR >0·25 to ≤0·5	176 (44%)	163 (46%)
Tumour size ≤2 cm, CTR ≤0·25, non-peripheral tumour	44 (11%)	40 (11%)

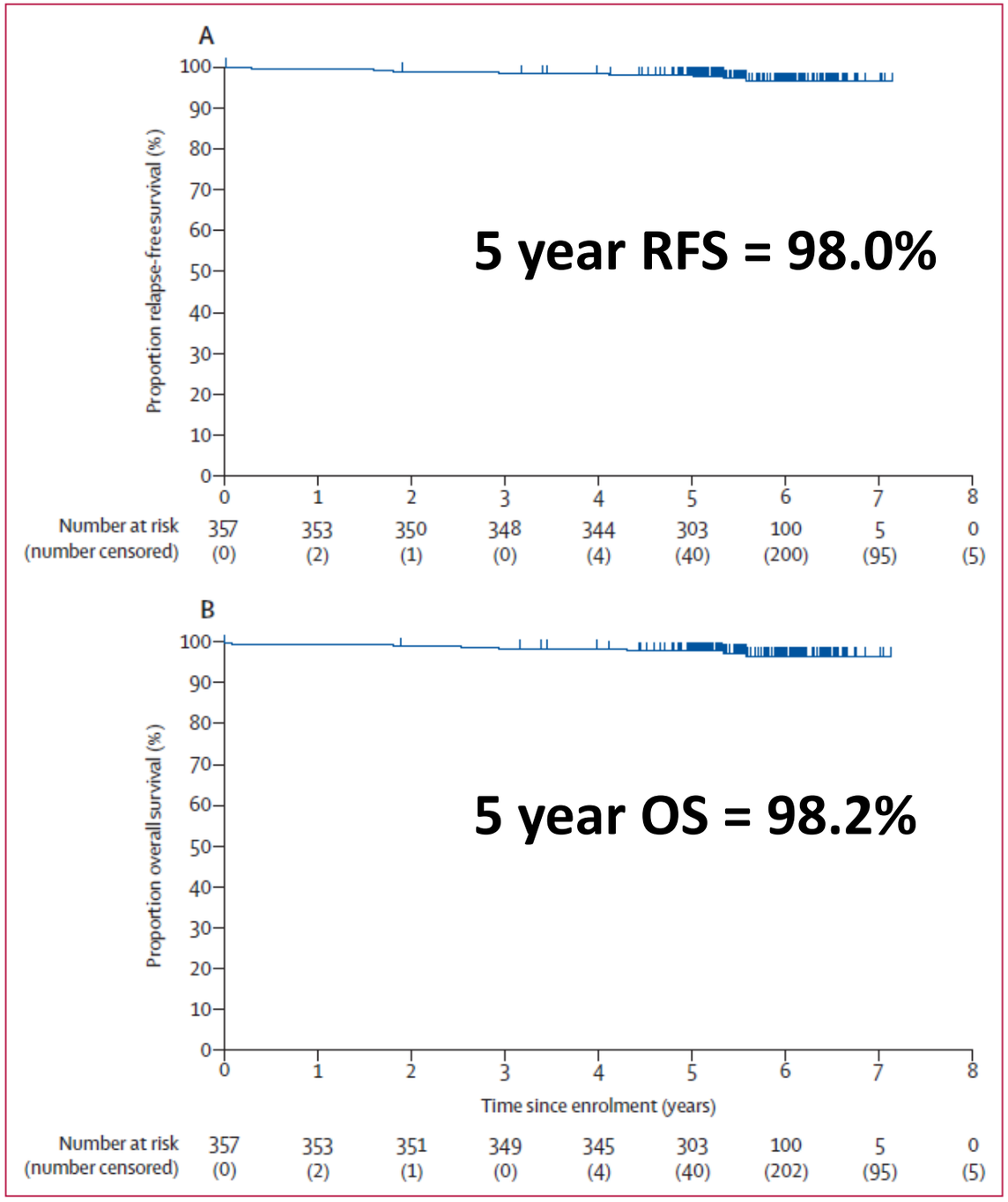


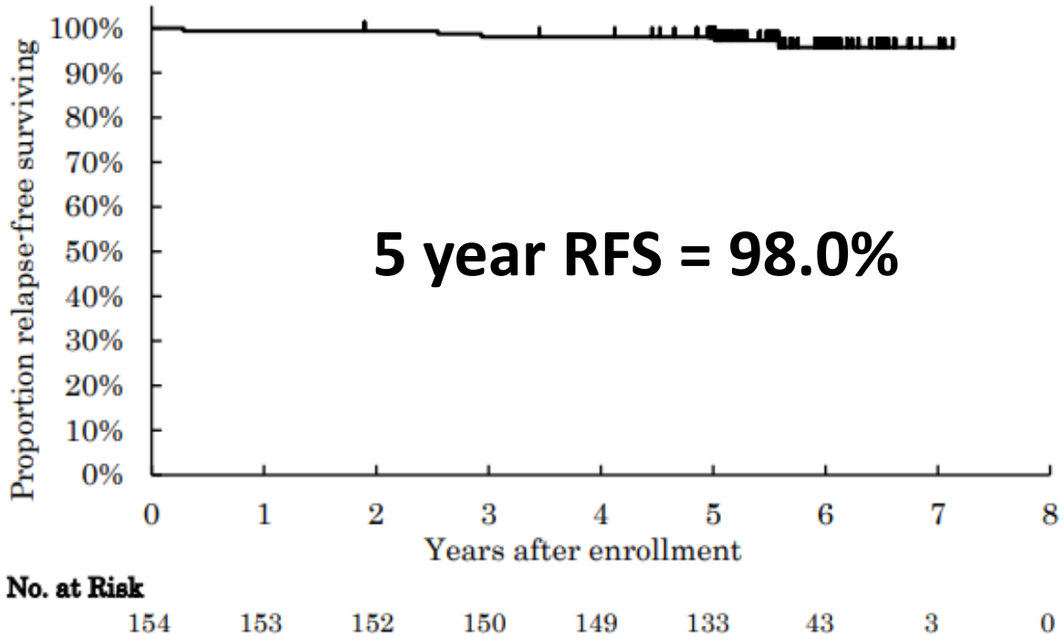
Figure 2: **Kaplan–Meier estimates for all 357 patients who underwent segmentectomy**
(A) Relapse-free survival. (B) Overall survival.

	All enrolled patients (n=396)	All patients who underwent segmentectomy (n=357)
Total death	9 (2%)	9 (3%)
Lung cancer death	1 (<1%)	1 (<1%)
Other death	7 (1%)	7 (2%)
Other cancer including secondary lung cancer	5 (1%)	5 (1%)
Non-malignant disease	2 (1%)	2 (1%)
Respiratory disease	0	0
Cerebrovascular disease	0	0
Cardiovascular disease	0	0
Other diseases	2 (1%)	2 (1%)
Unknown	1 (<1%)	1 (<1%)
Relapse	2 (1%)	2 (1%)
Locoregional recurrence	1 (<1%)	1 (<1%)
Ipsilateral hilar and mediastinal lymph node	1 (<1%)	1 (<1%)
Distant recurrence	1 (<1%)	1 (<1%)
Bone	1 (<1%)	1 (<1%)
Both	0	0 (<1%)

Table 3: **Summary of causes of death and relapse site**

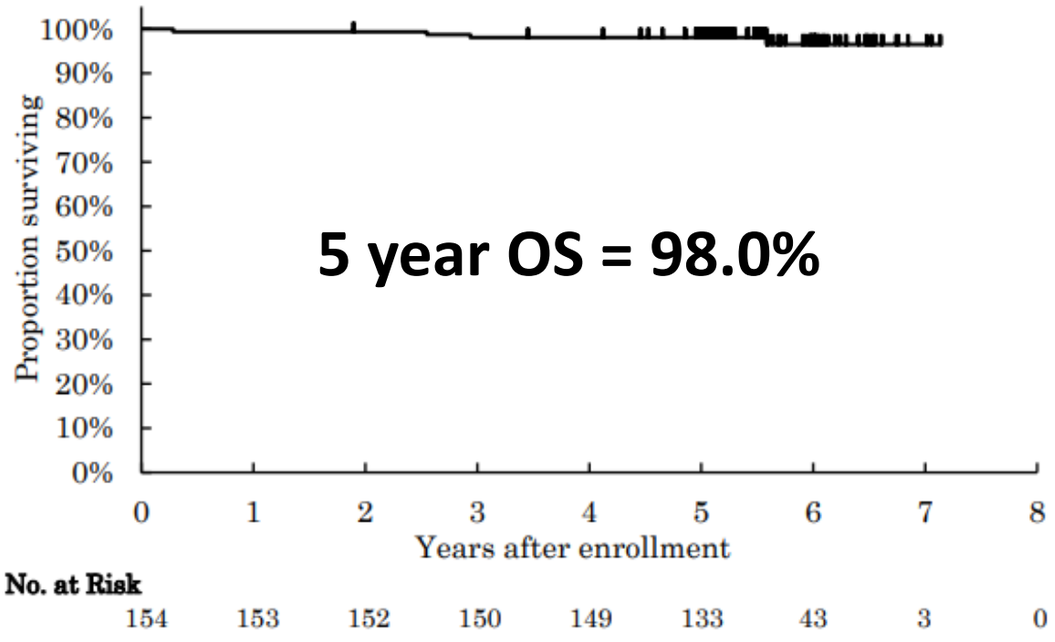
154 patients, Tumor size : 2-3cm, C/T ratio ≤ 0.5

C



5 year RFS = 98.0%

D



5 year OS = 98.0%

- **Segmentectomy** should be considered as part of **standard treatment** for patients with predominantly GGO NSCLC with a tumor size of 3cm or less in diameter, including **GGO even if it exceeds 2cm**.

- CALGB140503 (N Engl J Med 2023;388:489-498)

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 FEBRUARY 9, 2023 VOL. 388 NO. 6

Lobar or Sublobar Resection for Peripheral Stage IA Non–Small-Cell Lung Cancer

Nasser Altorki, M.D., Xiaofei Wang, Ph.D, David Kozono, M.D., Ph.D., Colleen Watt, B.S., Rodney Landrenau, M.D., Dennis Wigle, M.D., Ph.D., Jeffrey Port, M.D., David R. Jones, M.D., Massimo Conti, M.D., Ahmad S. Ashrafi, M.D., Moishe Liberman, M.D., Ph.D., Kazuhiro Yasufuku, M.D., Ph.D., Stephen Yang, M.D., John D. Mitchell, M.D., Harvey Pass, M.D., Robert Keenan, M.D., Thomas Bauer, M.D., Daniel Miller, M.D., Leslie J. Kohman, M.D., Thomas E. Stinchcombe, M.D., and Everett Vokes, M.D.

- Multicenter, noninferiority, phase 3 trial
- NSCLC, cT1N0M0 (**Tumor size ≤ 2cm**)
- Peripheral location (outer third of the lung)
- **Sublobar resection vs Lobectomy**
  - Wedge resection (201, 59.1%)
  - Segmentectomy (129, 37.9%)
- **LN dissection (Hilar node + mediastinal node)**

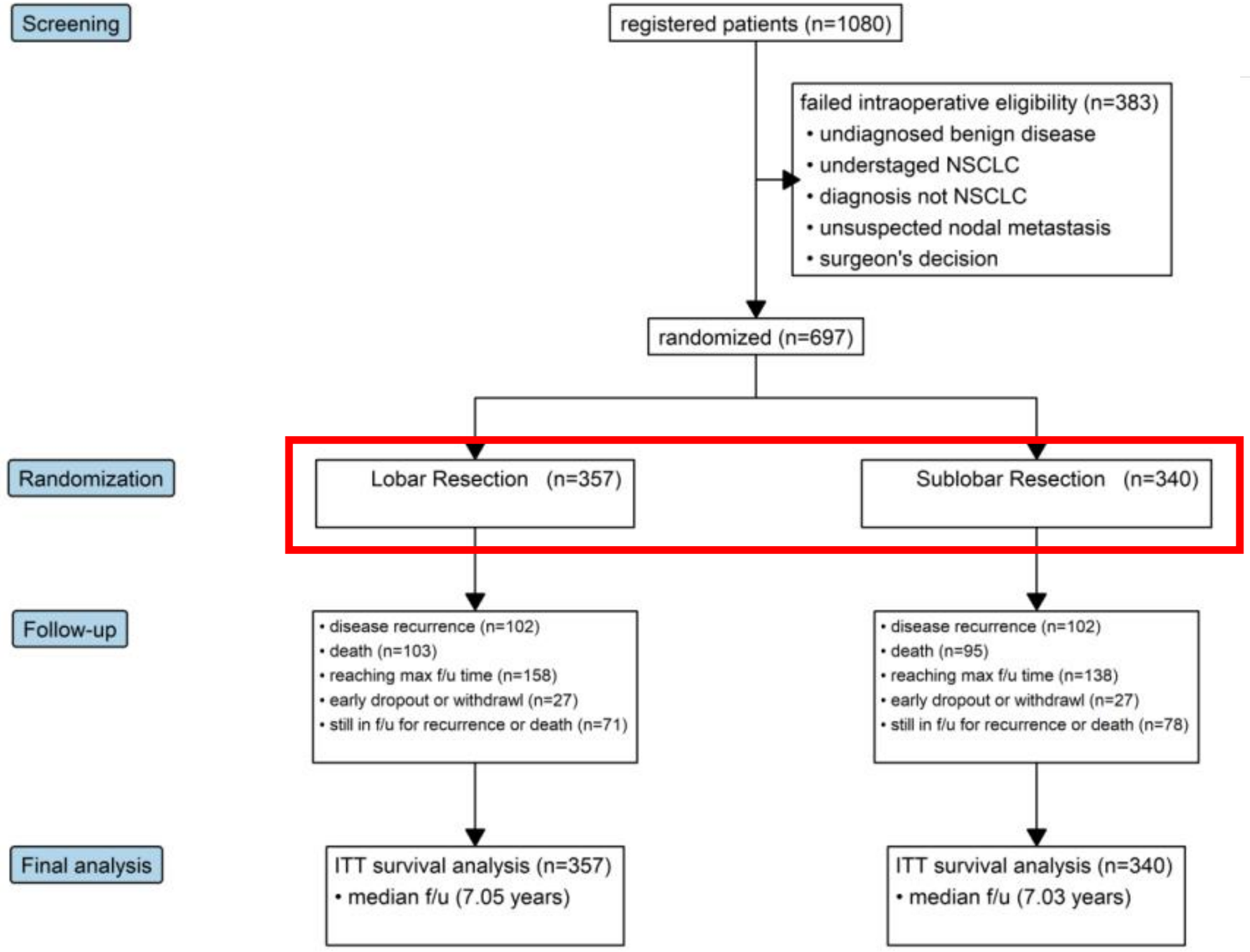
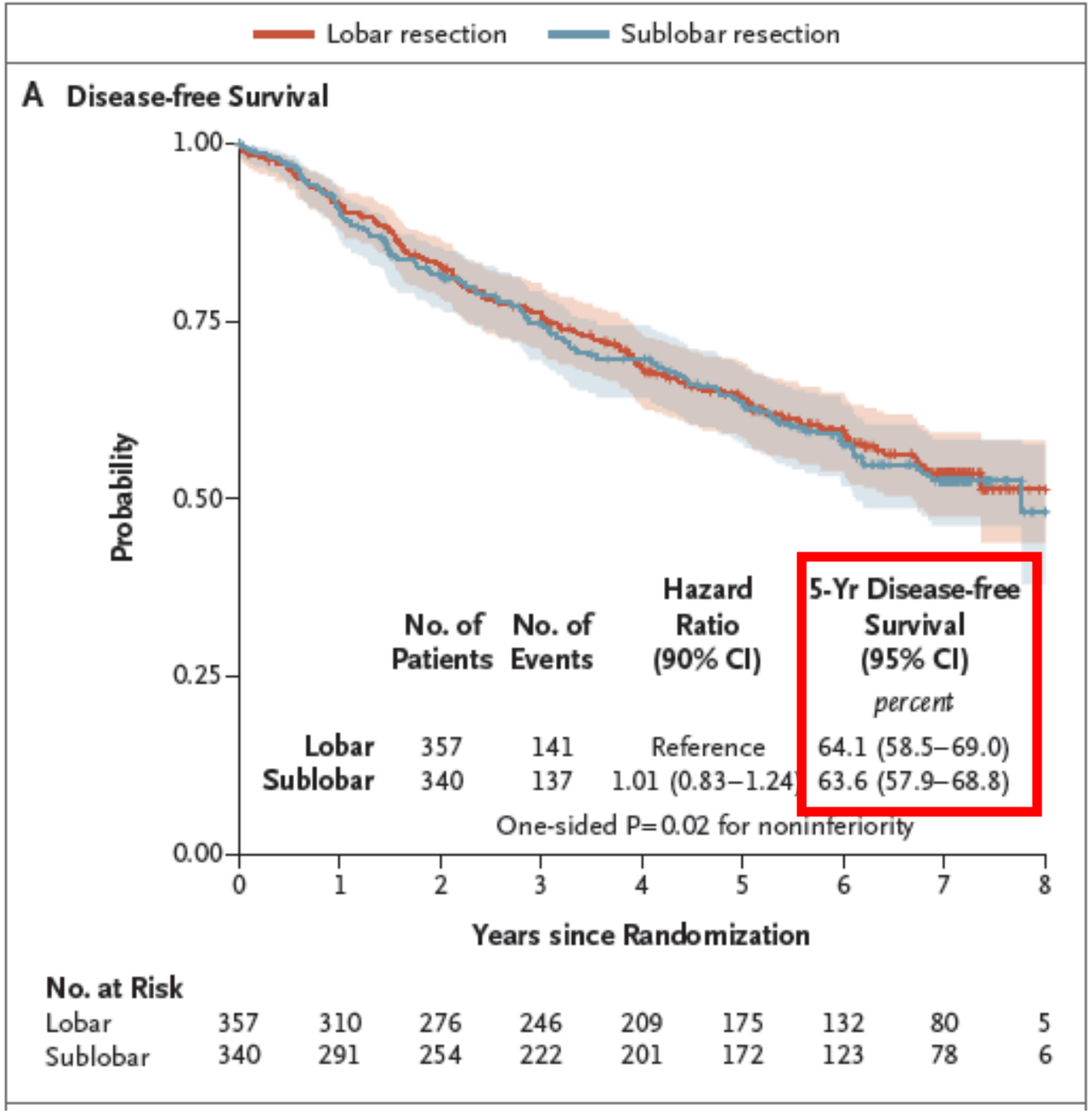

Screening
registered patients (n=1080)
failed intraoperative eligibility (n=383)
• undiagnosed benign disease
• understaged NSCLC
• diagnosis not NSCLC
• unsuspected nodal metastasis
• surgeon's decision
randomized (n=697)
Randomization
Lobar Resection (n=357)
Sublobar Resection (n=340)
Follow-up
• disease recurrence (n=102)
• death (n=103)
• reaching max f/u time (n=158)
• early dropout or withdrawl (n=27)
• still in f/u for recurrence or death (n=71)
• disease recurrence (n=102)
• death (n=95)
• reaching max f/u time (n=138)
• early dropout or withdrawl (n=27)
• still in f/u for recurrence or death (n=78)
Final analysis
ITT survival analysis (n=357)
• median f/u (7.05 years)
ITT survival analysis (n=340)
• median f/u (7.03 years)

Table 1. Demographic and Clinical Characteristics of the Patients at Baseline.*

Characteristic	Sublobar Resection (N=340)	Lobar Resection (N=357)	Total (N=697)
Age — yr			
Median	68.3	67.6	67.9
Range	37.8–89.7	43.2–88.9	37.8–89.7
Race — no. (%)†			
White	314 (92.4)	313 (87.7)	627 (90.0)
Black	16 (4.7)	29 (8.1)	45 (6.5)
Asian	2 (0.6)	4 (1.1)	6 (0.9)
Other	8 (2.4)	11 (3.1)	19 (2.7)
Sex — no. (%)			
Male	150 (44.1)	147 (41.2)	297 (42.6)
Female	190 (55.9)	210 (58.8)	400 (57.4)
ECOG performance-status score — no. (%)‡			
0	263 (77.4)	250 (70.0)	513 (73.6)
1	72 (21.2)	102 (28.6)	174 (25.0)
2	5 (1.5)	5 (1.4)	10 (1.4)
Smoking status — no. (%)			
Never	28 (8.2)	35 (9.8)	63 (9.0)
Former	172 (50.6)	177 (49.6)	349 (50.1)
Current	140 (41.2)	145 (40.6)	285 (40.9)
Tumor size — no. (%)			
<1.0 cm	28 (8.2)	30 (8.4)	58 (8.3)
1.0–1.5 cm	174 (51.2)	180 (50.4)	354 (50.8)
>1.5–2.0 cm	138 (40.6)	147 (41.2)	285 (40.9)
Histologic type — no. (%)			
Adenocarcinoma	218 (64.1)	226 (63.3)	444 (63.7)
Squamous-cell carcinoma	45 (13.2)	53 (14.8)	98 (14.1)
Other	77 (22.6)	78 (21.8)	155 (22.2)


Lobar resection
Sublobar resection
A Disease-free Survival
Probability
1.00
0.75
0.50
0.25
0.00
0 1 2 3 4 5 6 7 8
Years since Randomization
No. of Patients
No. of Events
Hazard Ratio (90% CI)
5-Yr Disease-free Survival (95% CI)
percent
Lobar 357 141 Reference 64.1 (58.5–69.0)
Sublobar 340 137 1.01 (0.83–1.24) 63.6 (57.9–68.8)
One-sided P=0.02 for noninferiority
No. at Risk
Lobar 357 310 276 246 209 175 132 80 5
Sublobar 340 291 254 222 201 172 123 78 6

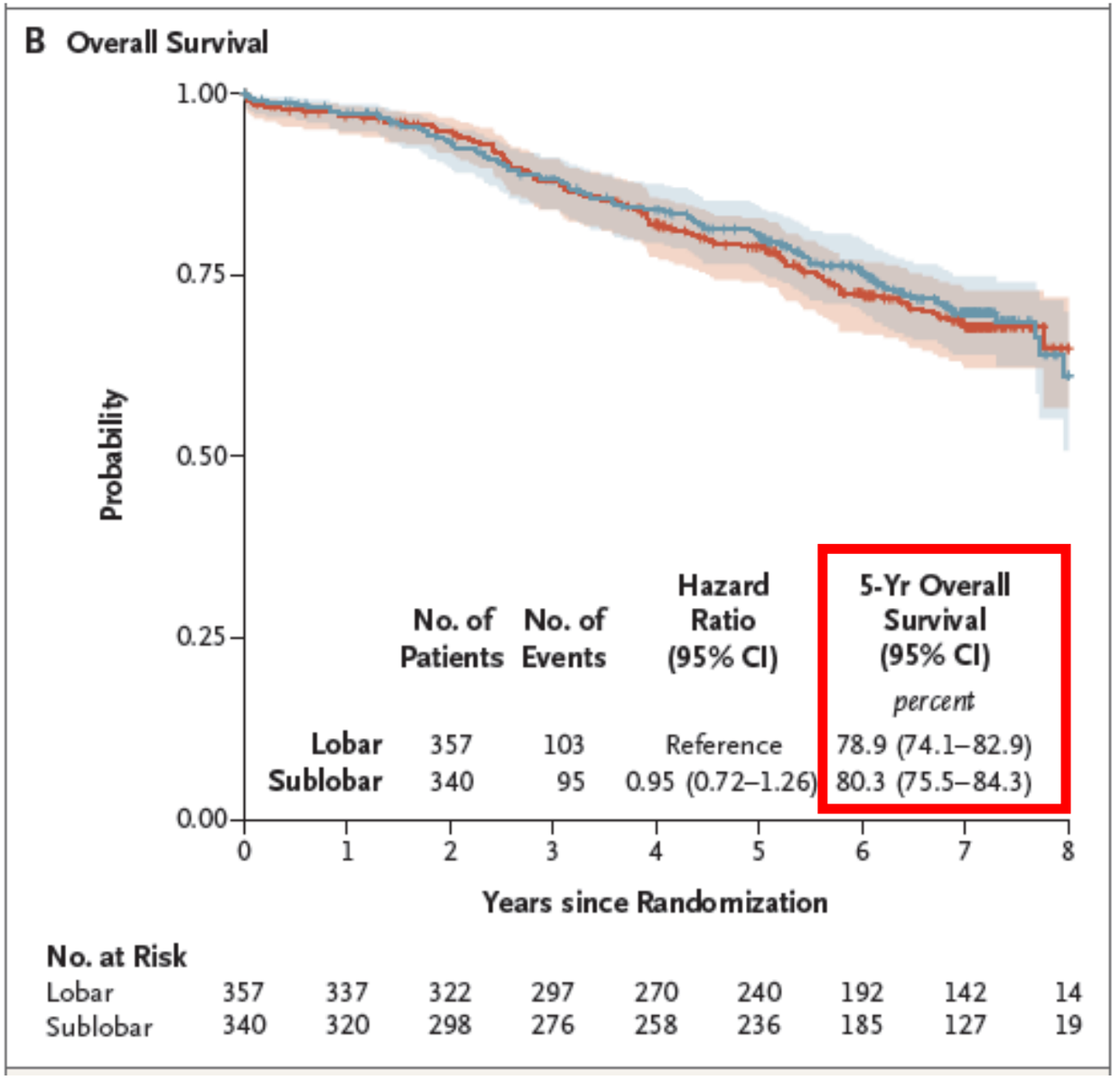

B Overall Survival
Probability
1.00
0.75
0.50
0.25
0.00
0 1 2 3 4 5 6 7 8
Years since Randomization
No. of Patients
No. of Events
Hazard Ratio (95% CI)
5-Yr Overall Survival (95% CI)
percent
Lobar 357 103 Reference 78.9 (74.1–82.9)
Sublobar 340 95 0.95 (0.72–1.26) 80.3 (75.5–84.3)
No. at Risk
Lobar 357 337 322 297 270 240 192 142 14
Sublobar 340 320 298 276 258 236 185 127 19

Table 2. Patterns of Recurrence.

Type of Recurrence	Sublobar Resection (N=336)	Lobar Resection (N=351)	Difference (95% CI)*
	number (percent)		*percentage points*
Overall	102 (30.4)	103 (29.3)	1.0 (–5.8 to 7.9)
Locoregional recurrence	45 (13.4)	35 (10.0)	3.4 (1.0 to 8.3)
Regional recurrence only	6 (1.8)	9 (2.6)	–0.8 (–3.2 to 1.6)
Any distant recurrence	51 (15.2)	59 (16.8)	–1.6 (–7.1 to 3.9)
New primary lung cancer	60 (17.9)	52 (14.8)	3.0 (–2.5 to 8.6)

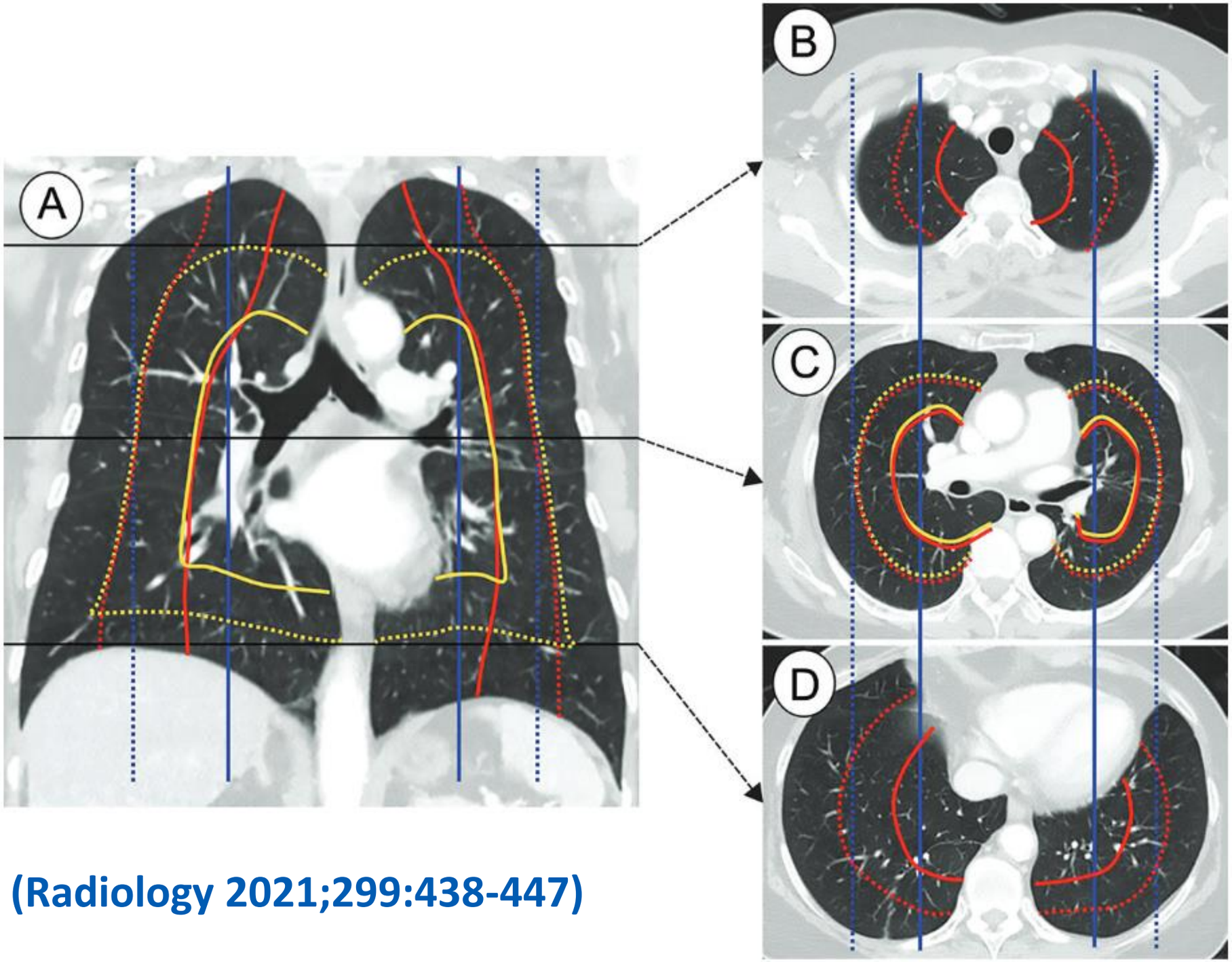
* The widths of the confidence intervals have not been adjusted for multiplicity and may not be used in place of hypothesis testing.

- In patients with **peripheral NSCLC with a tumor size of 2 cm or less** and pathologically confirmed node-negative disease in the hilar and mediastinal lymph nodes, **sublobar resection was not inferior to lobectomy** with respect to disease-free survival. Overall survival was similar with the two procedures.

Summary of 4 trials

- **In patients with peripheral NSCLC (Tumor ≤2cm, N0), sublobar resection is noninferior to lobectomy with respect to oncological outcomes.**

- Peripheral NSCLC (outer third of the lung)
- Tumor size
- C/T ratio
- Resection margin length
- LN metastasis



(Radiology 2021;299:438-447)

- Peripheral lung cancer (outer third of the lung)
- Tumor size ≤ 2cm
  or 2cm < Tumor size ≤ 3cm (and C/T ratio <0.5)
- LN metastasis (-)
- Sufficient surgical margin (≥2cm or ≥ tumor size)

→ **Segmentectomy**

- Peripheral lung cancer (outer third of the lung)
- Tumor size ≤ 2cm (C/T ratio <0.25)
- Sufficient surgical margin (≥5mm)

→ **Wedge resection**

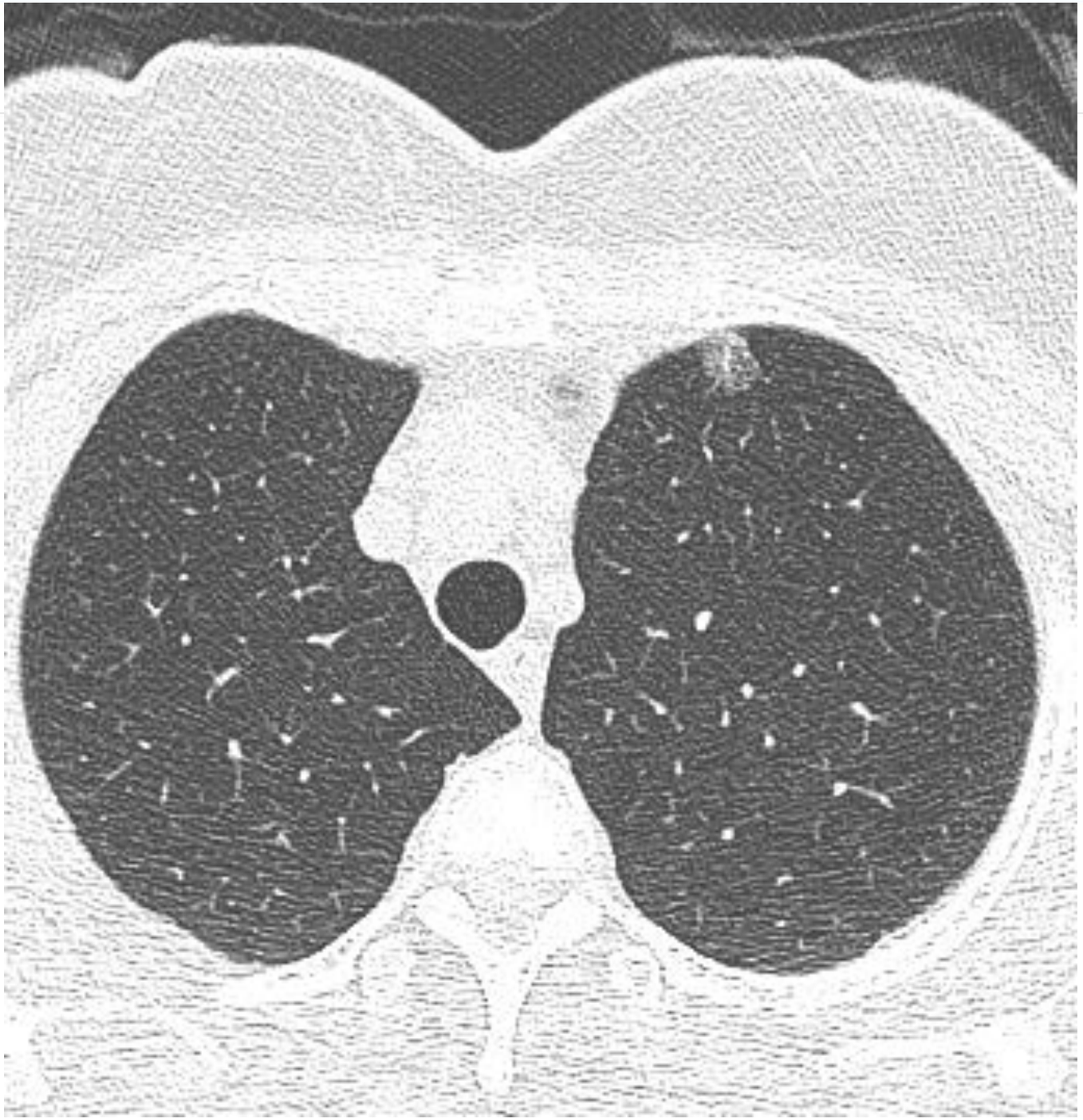
- Non-peripheral lung cancer
- Tumor size ≤ 2cm (C/T ratio <0.25)
- Sufficient surgical margin

→ **Segmentectomy**

3. Case

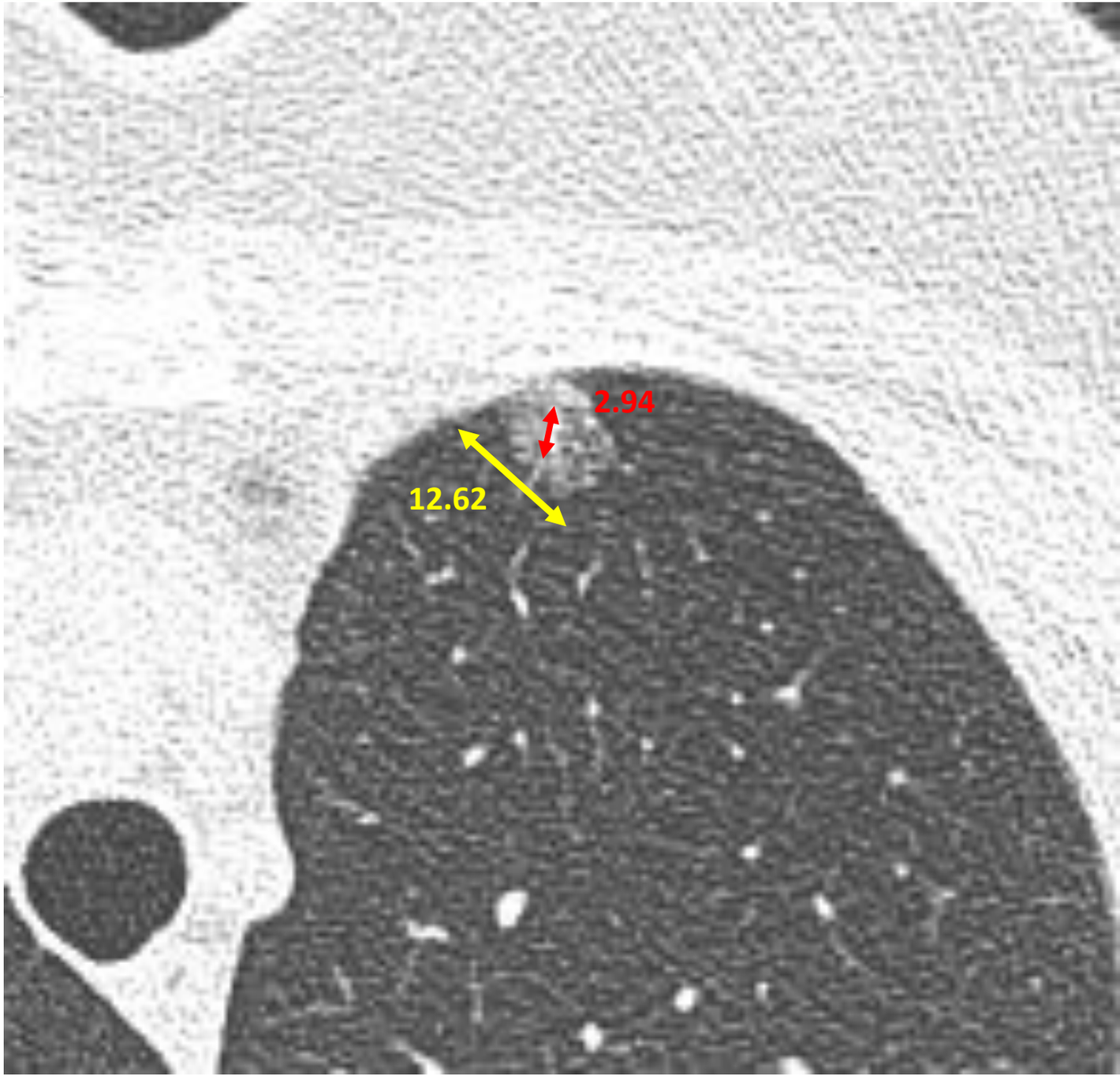
Case 1.

- 62/F, growing GGN



- Tumor size = 12.62mm
- Consolidation size = 2.94mm
- **C/T ratio = 0.23**

Wedge resection



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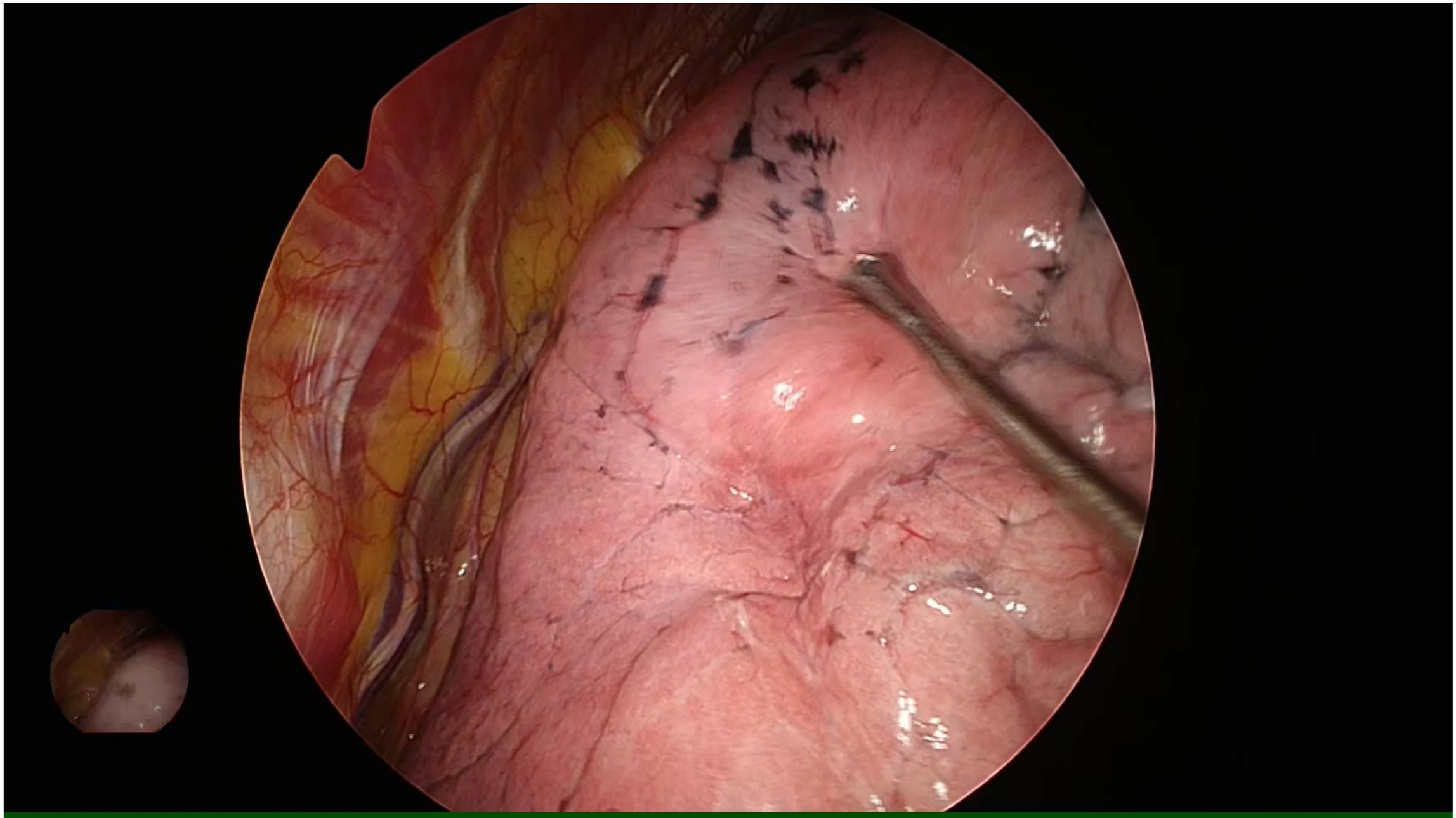
Uniportal VATS LUL wedge resection (no chest drainage)



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Ahn and Moon
Journal of Cardiothoracic Surgery (2022) 17:317
https://doi.org/10.1186/s13019-022-02053-9

Journal of Cardiothoracic Surgery

RESEARCH Open Access

Uniportal video-assisted thoracoscopic surgery without drainage-tube placement for pulmonary wedge resection: a single-center retrospective study

Seha Ahn and Youngkyu Moon*

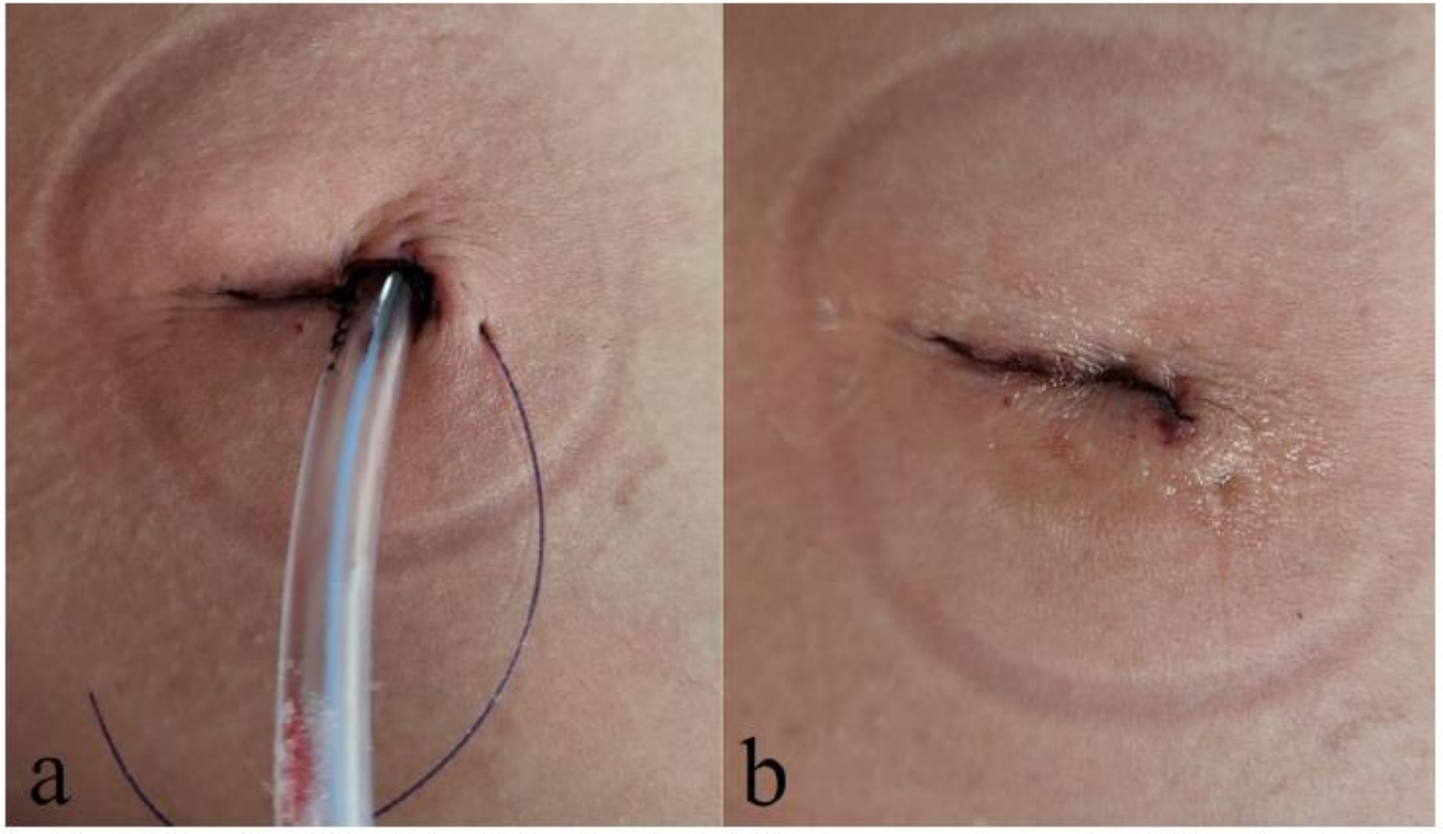
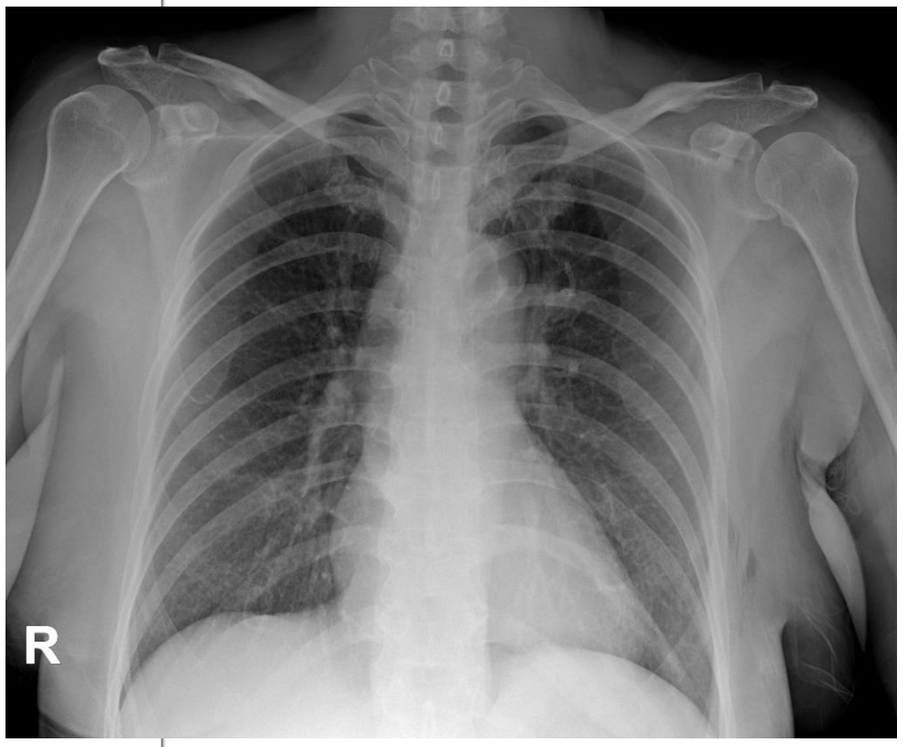


Fig. 1 Closed working incision with a 20-French chest tube after uniportal VATS pulmonary wedge resection (**a**). Closed working incision was covered with topical tissue adhesive after cutting the remainder of secured thread (**b**)



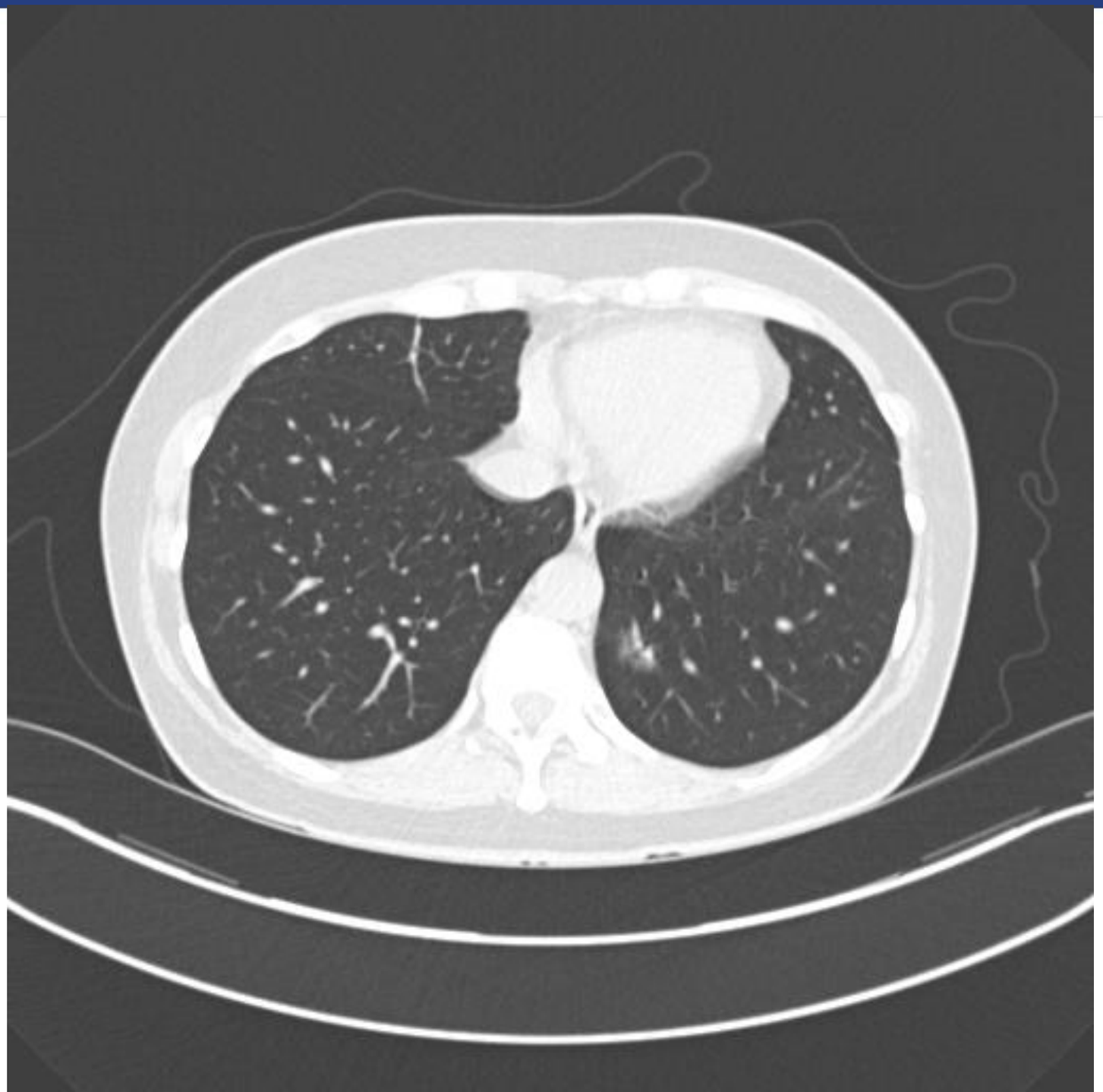
Pathological diagnosis

- Tumor size 0.8cm, invasive part size 0.3cm
- Adenocarcinoma (Acinar 15%, Lepidic 85%)
- Resection margin : 1cm

pT1a(mi)N0M0 = Minimally invasive adenocarcinoma

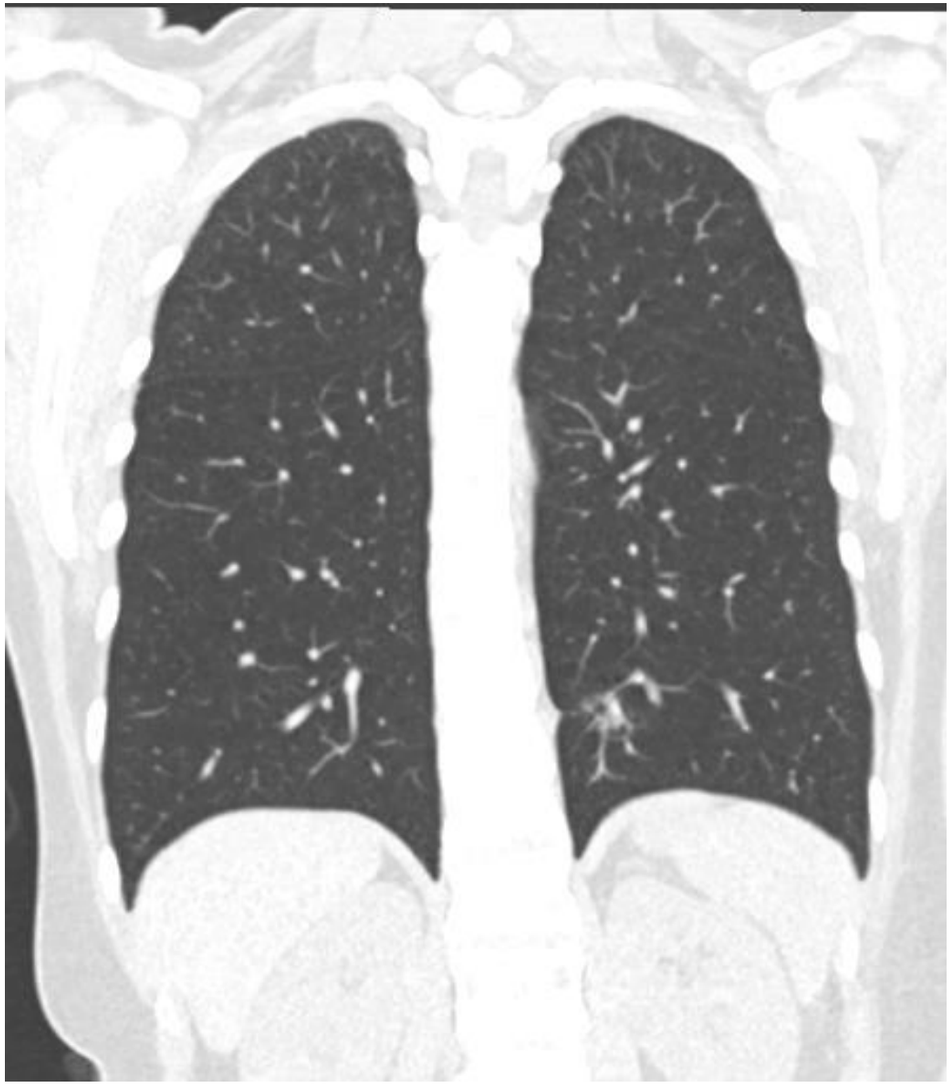
Case 2.

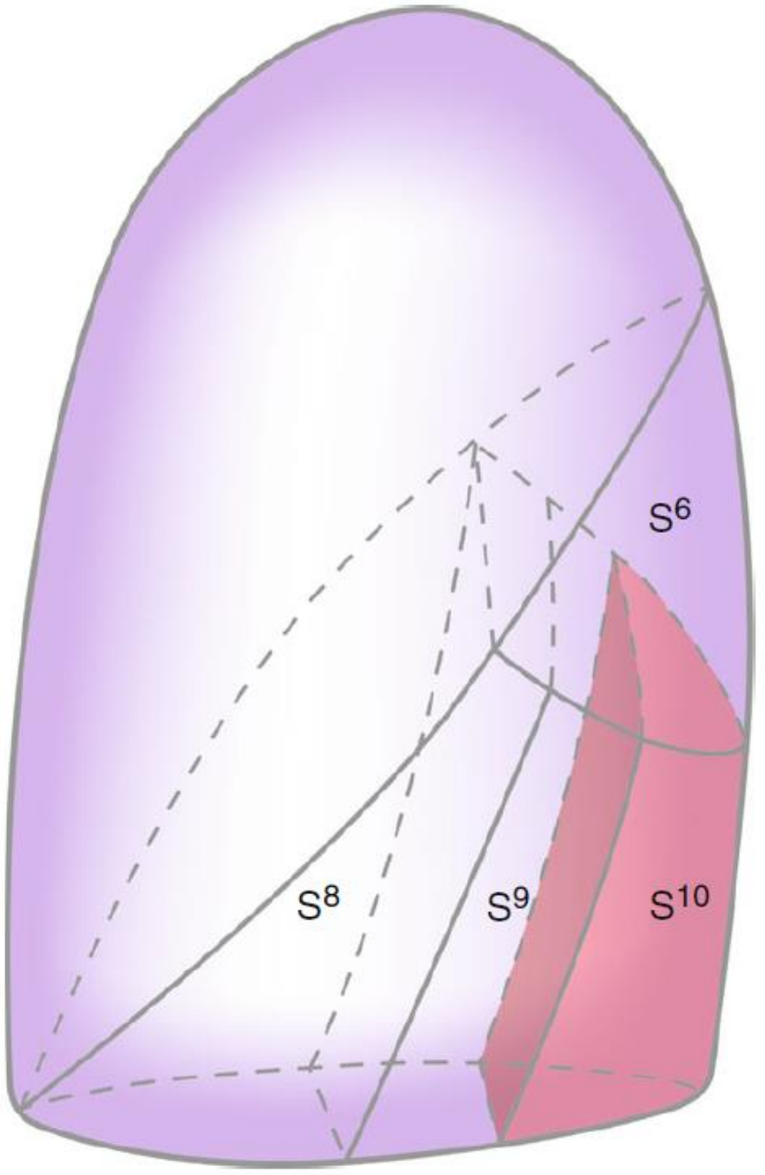
- 44/F, Part solid GGN
- Smoking : 8 pack years



- Tumor size = 17.4mm
- Consolidation size = 9.46mm
- **C/T ratio = 0.54…**

Segmentectomy




S6
S8
S9
S10

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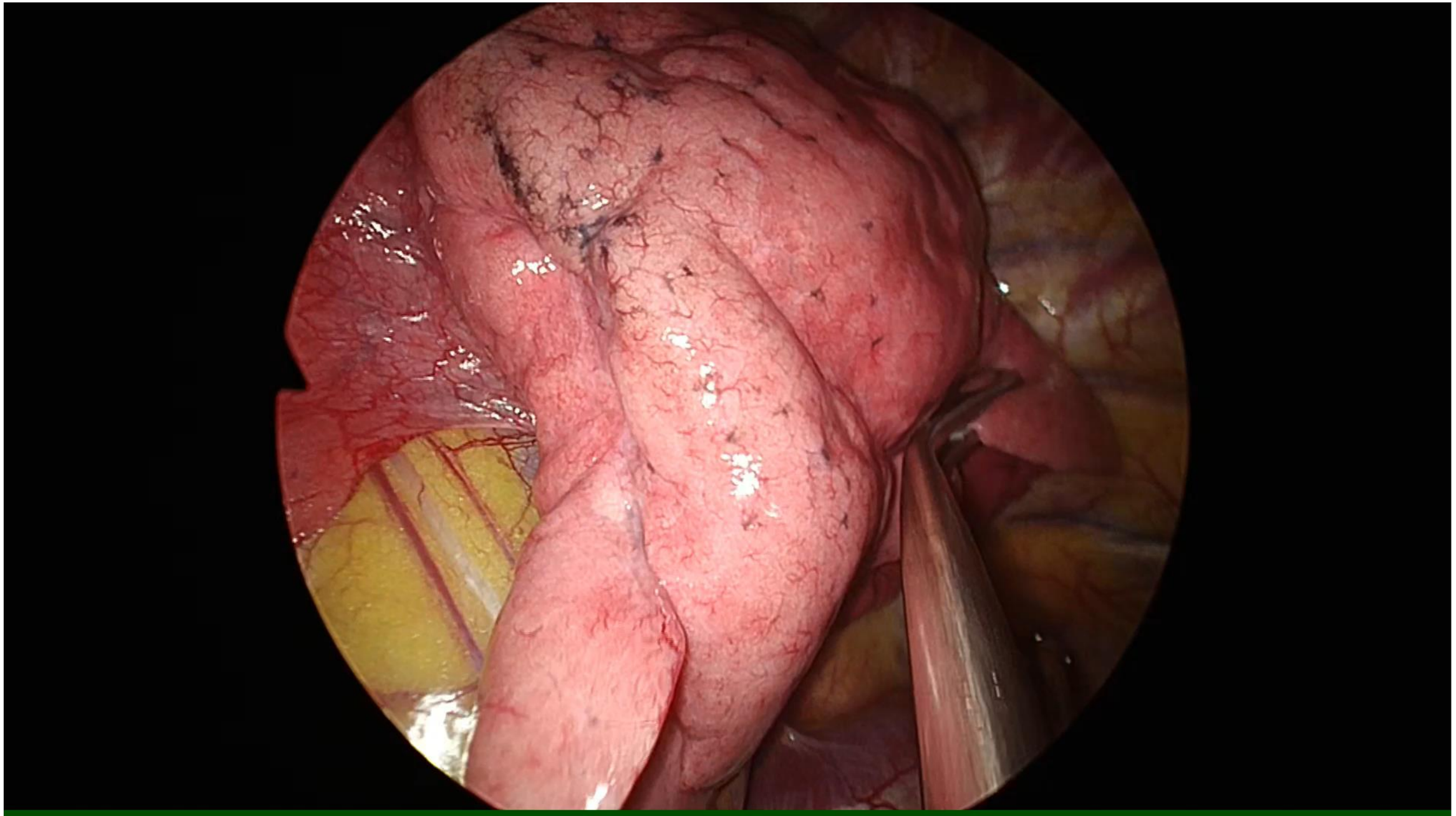
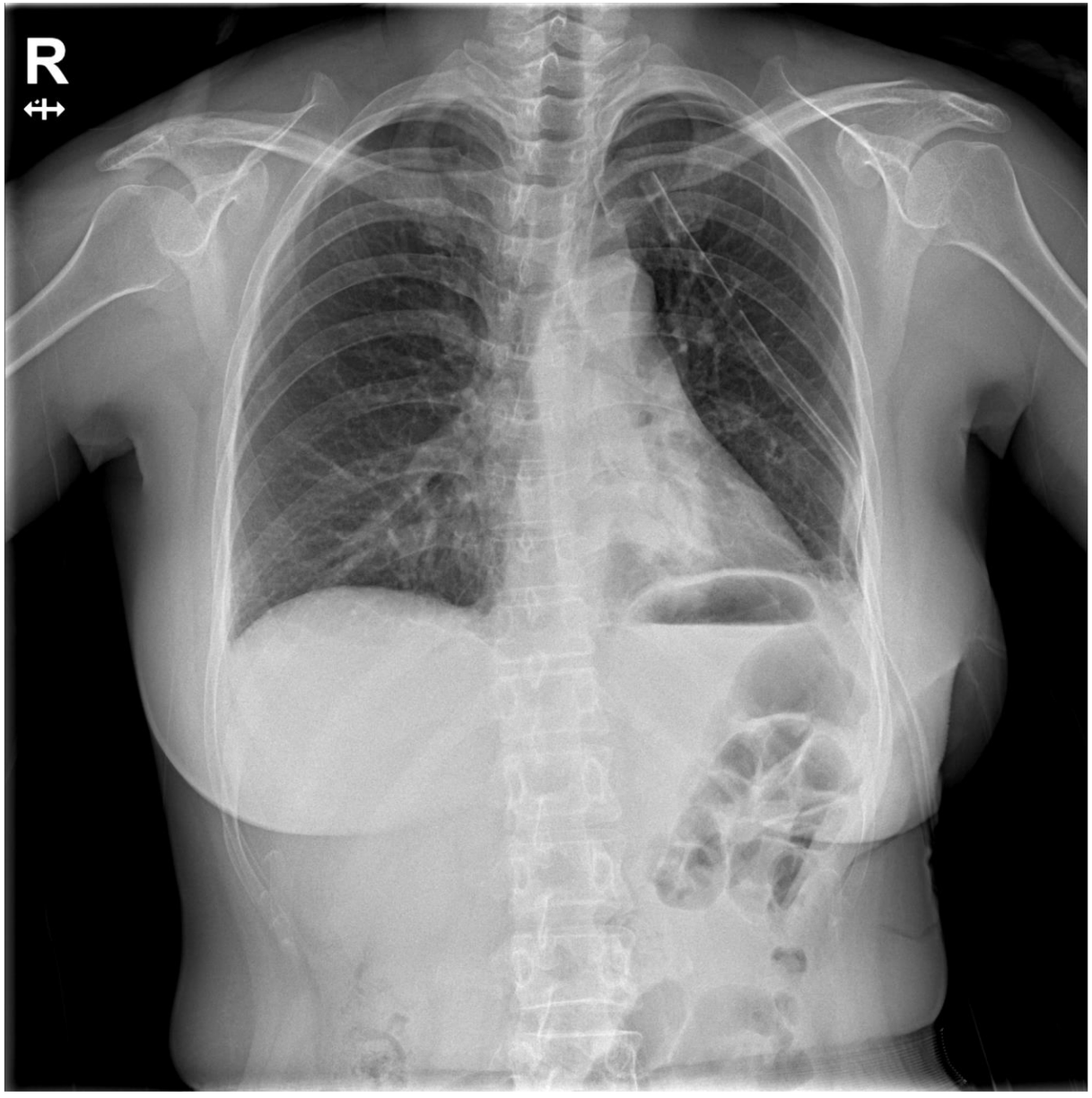
Uniportal VATS LLL posterobasal (S10) segmentectomy





POD # 1 chest tube removal

POD # 3 D/C

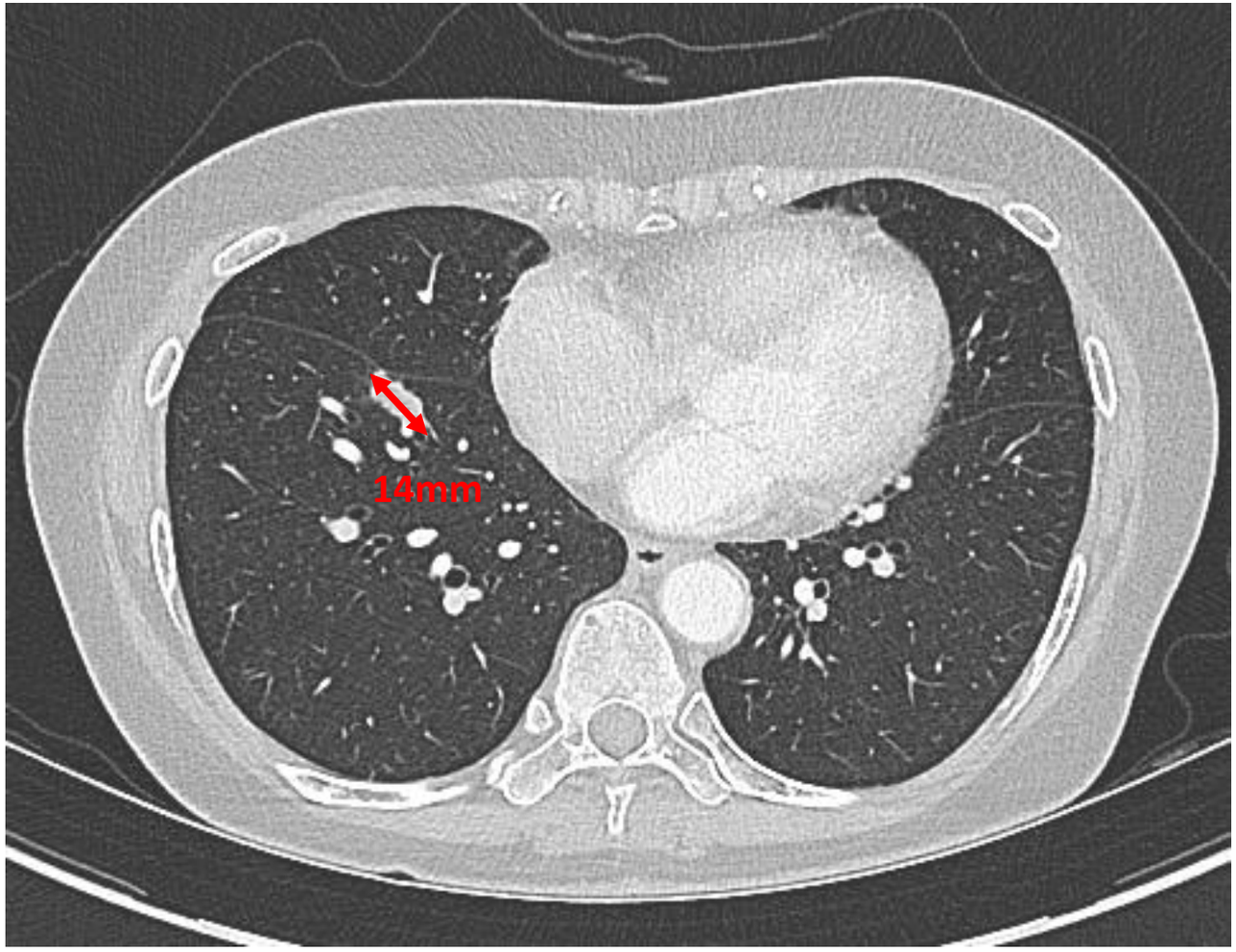
Pathological diagnosis

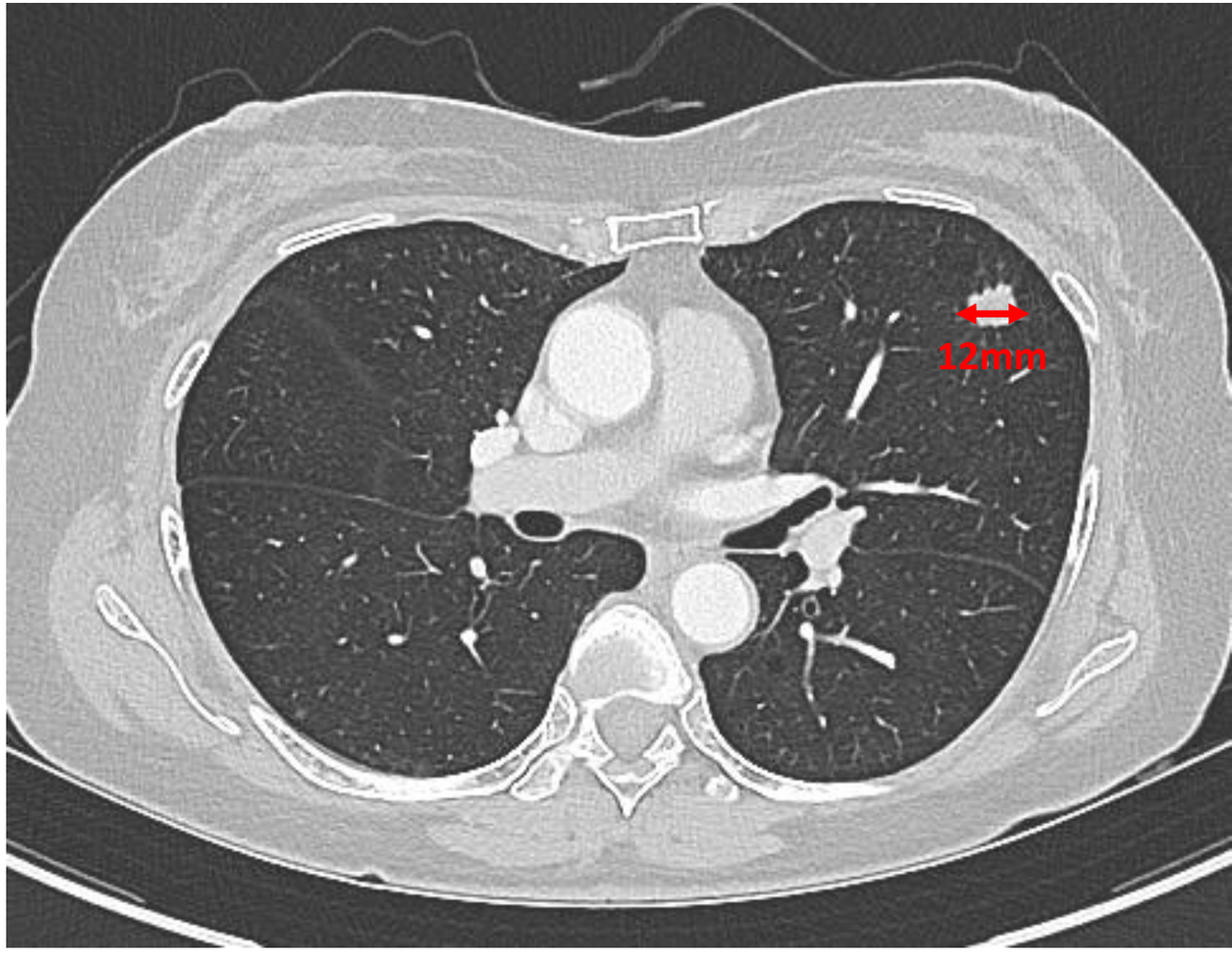
- Tumor size 1.7cm, invasive part size 0.9cm
- Adenocarcinoma (Acinar 75%, Lepidic 25%)
- Resection margin : 1.5cm

pT1aN0M0

Case 3.

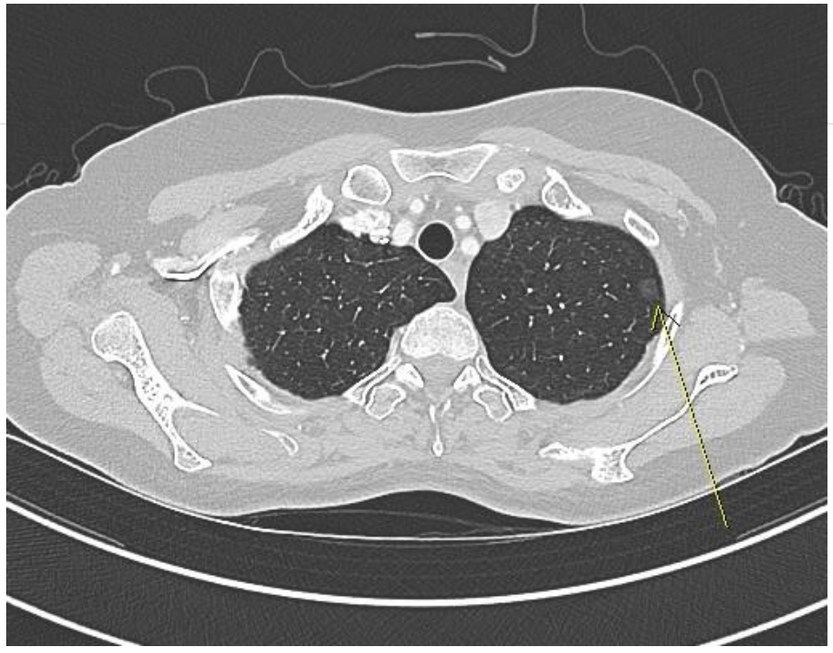
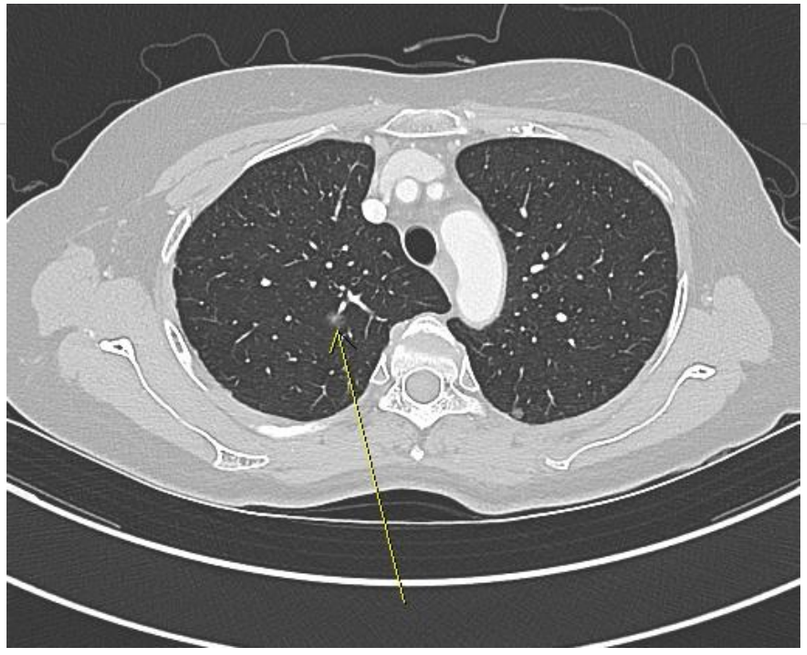
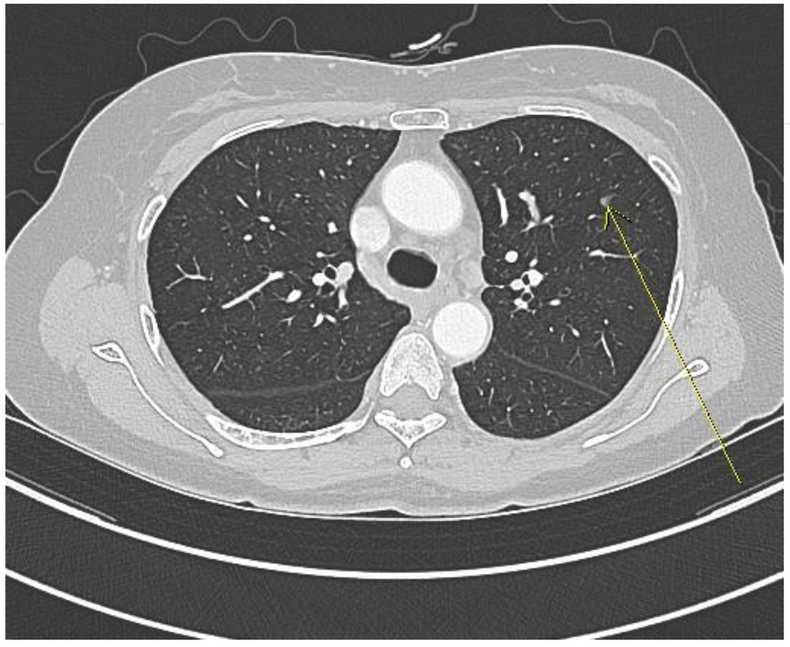
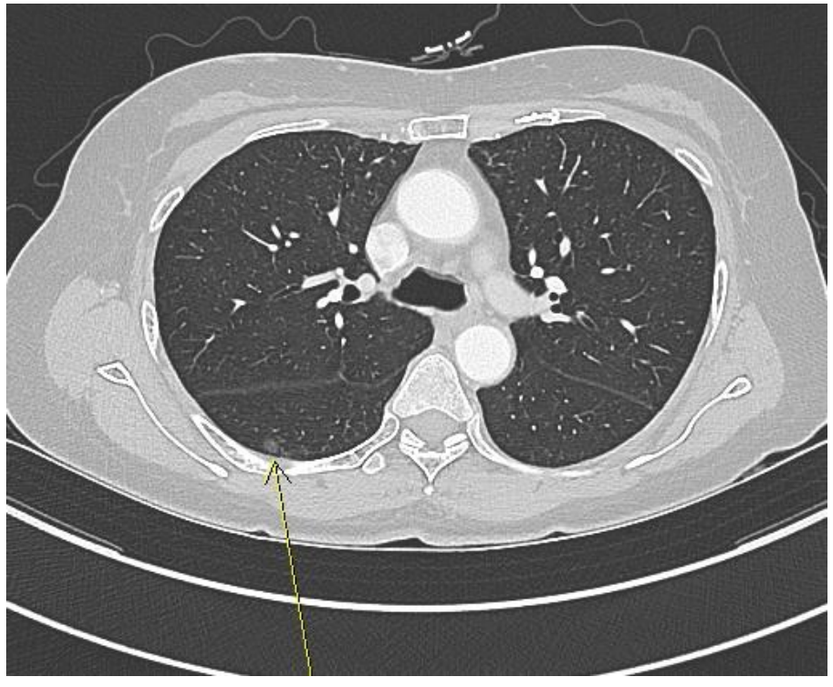
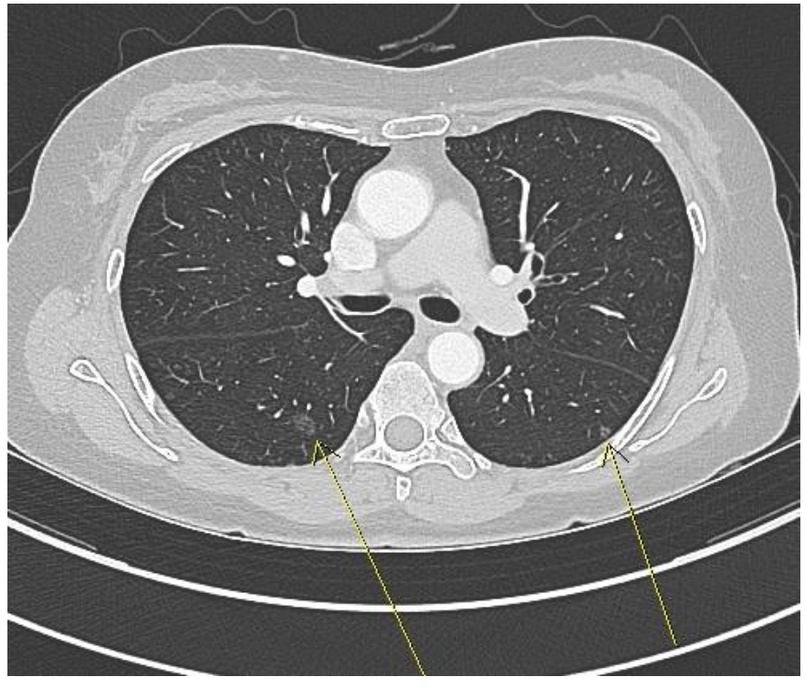
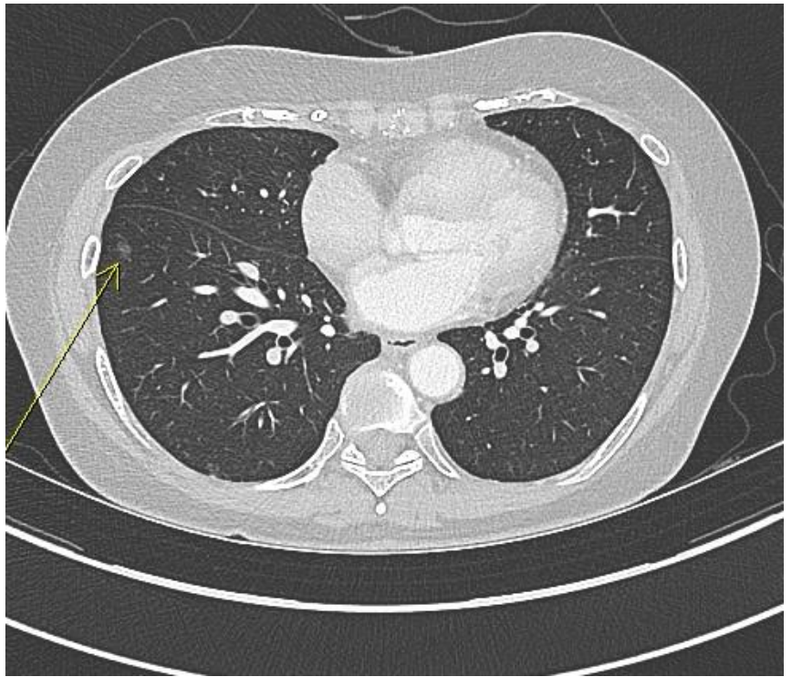
- 44/F
- Solid nodules, RLL, LUL
- Mutiple GGNs (<1cm), RUL, RLL, LUL, LLL

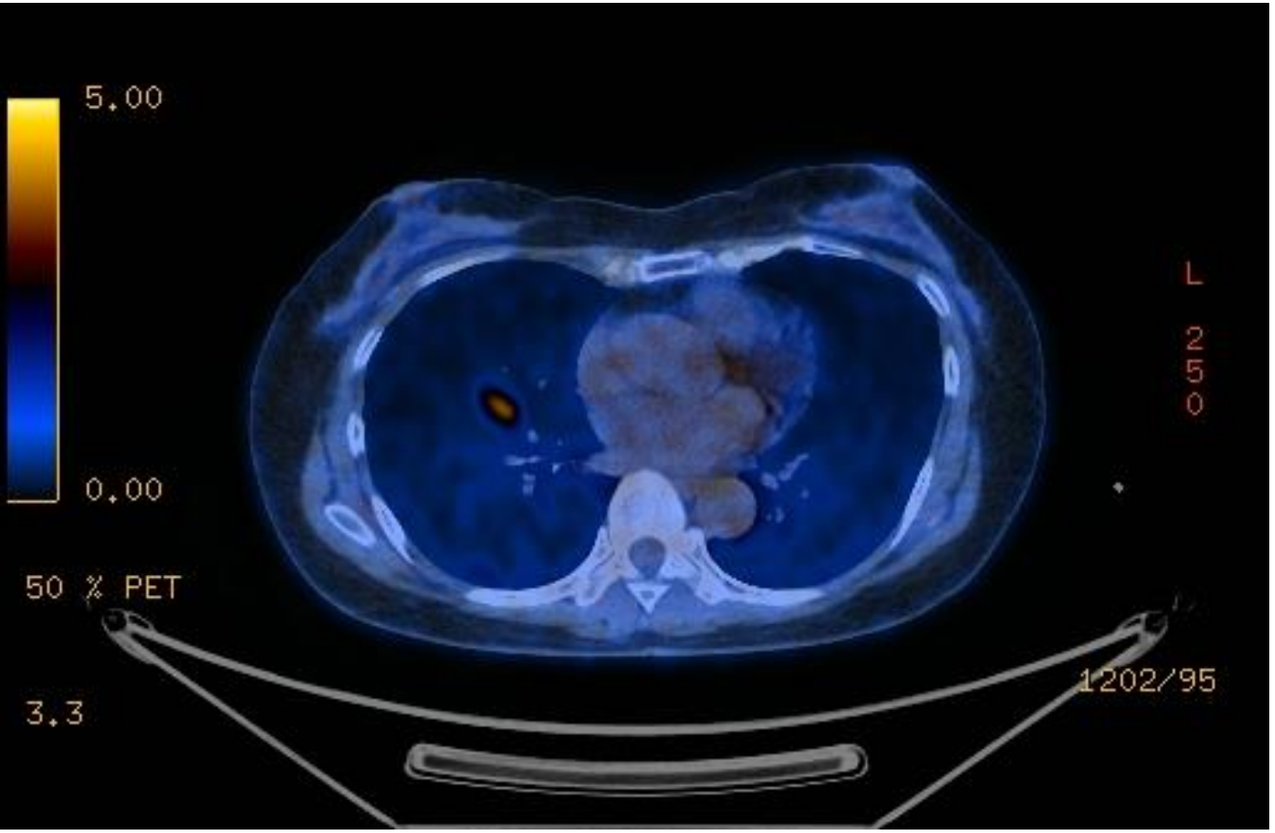


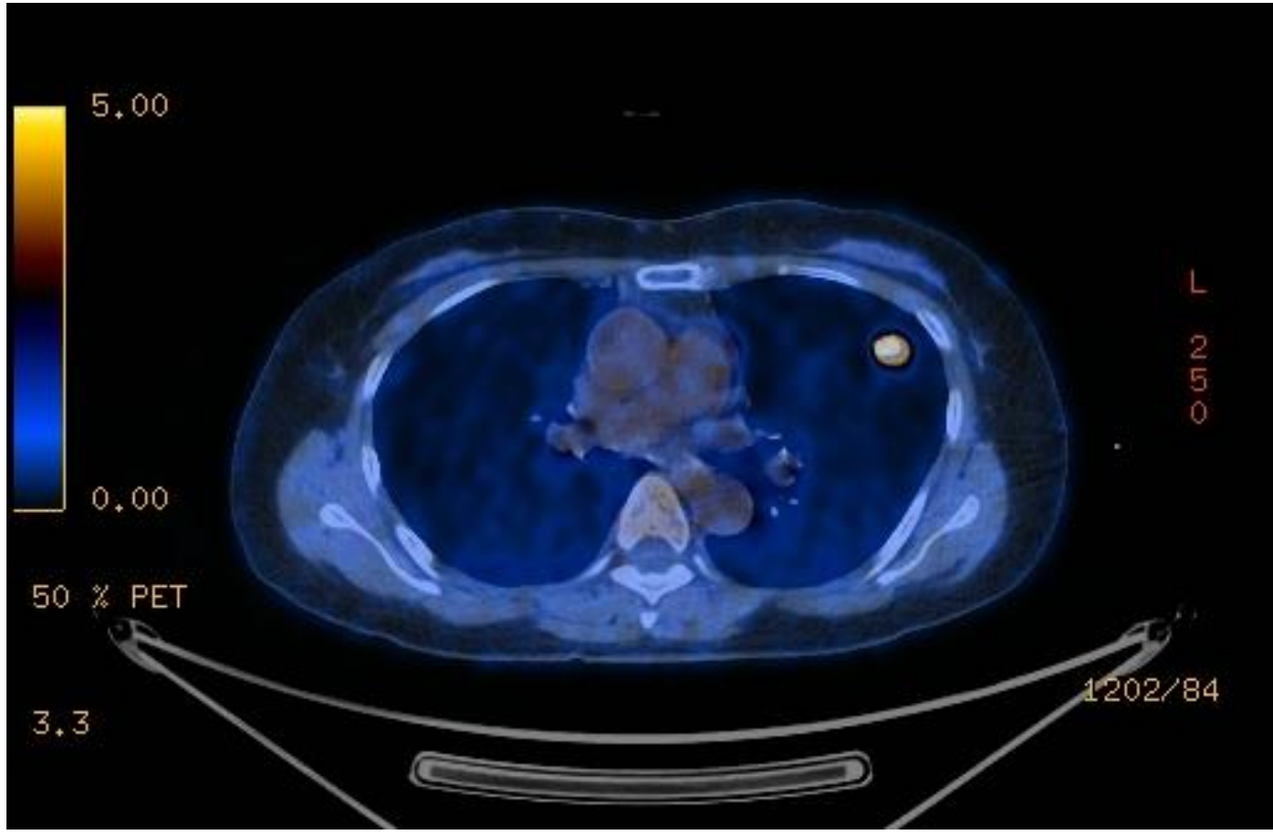


Size 14mm, C/T ratio = 1

Size 12mm, C/T ratio = 1

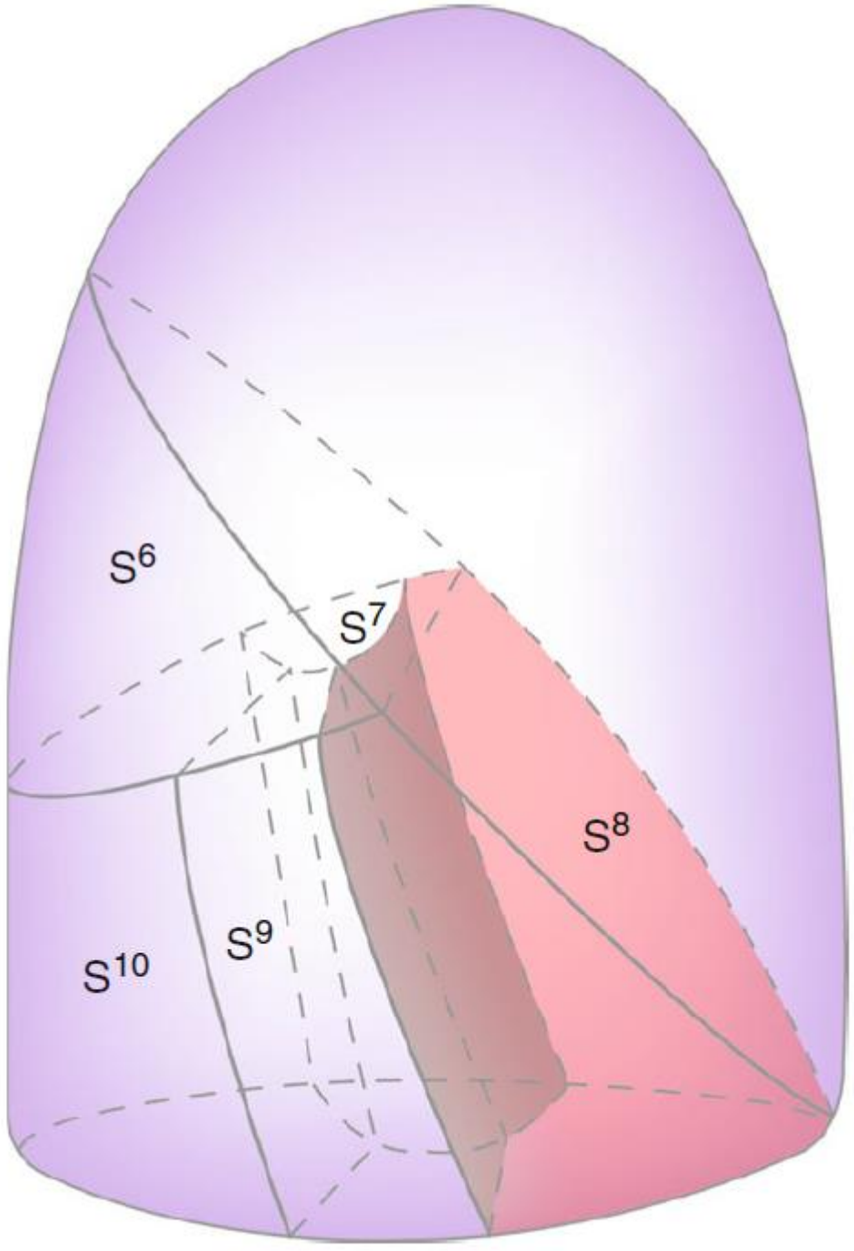







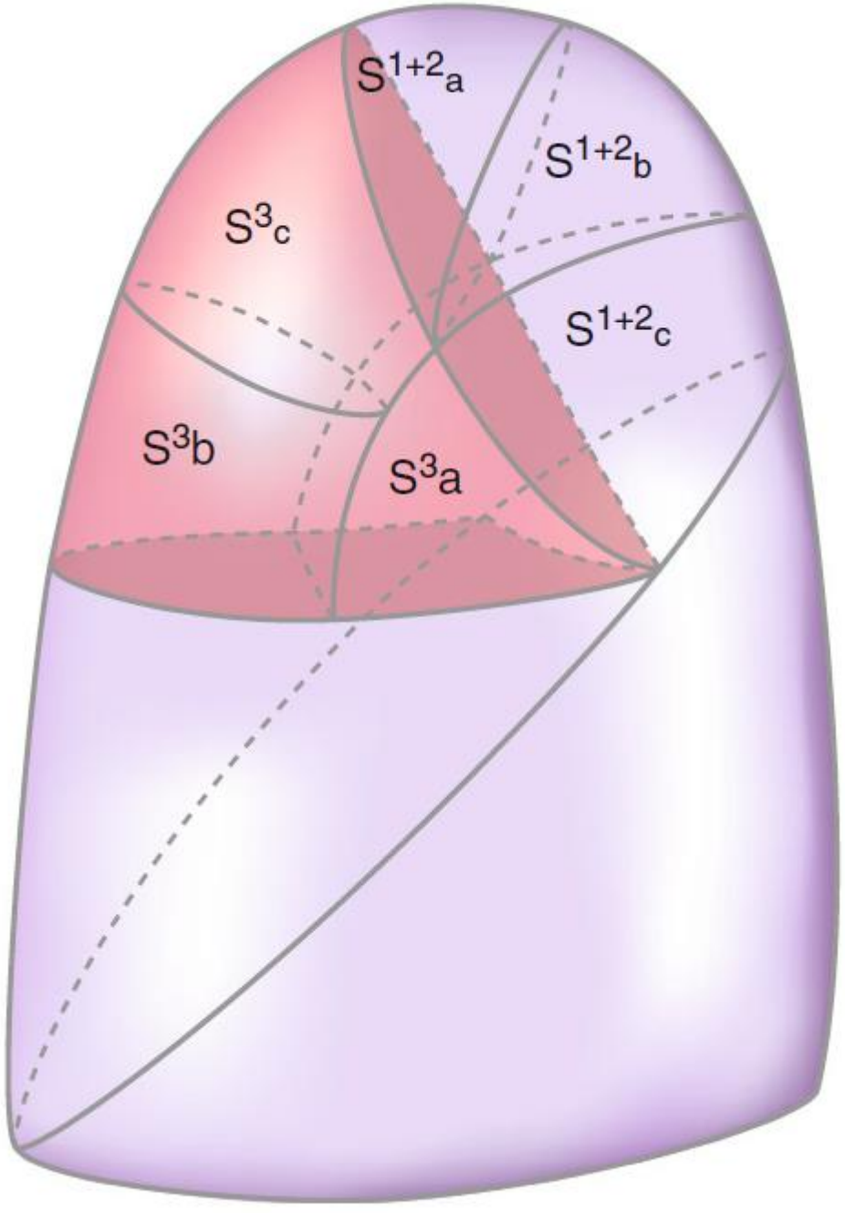




Segmentectomy

Segmentectomy


S6
S7
S8
S9
S10


S1+2a
S1+2b
S3c
S1+2c
S3b
S3a

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Uniportal VATS RLL anterobasal (S8) segmentectomy

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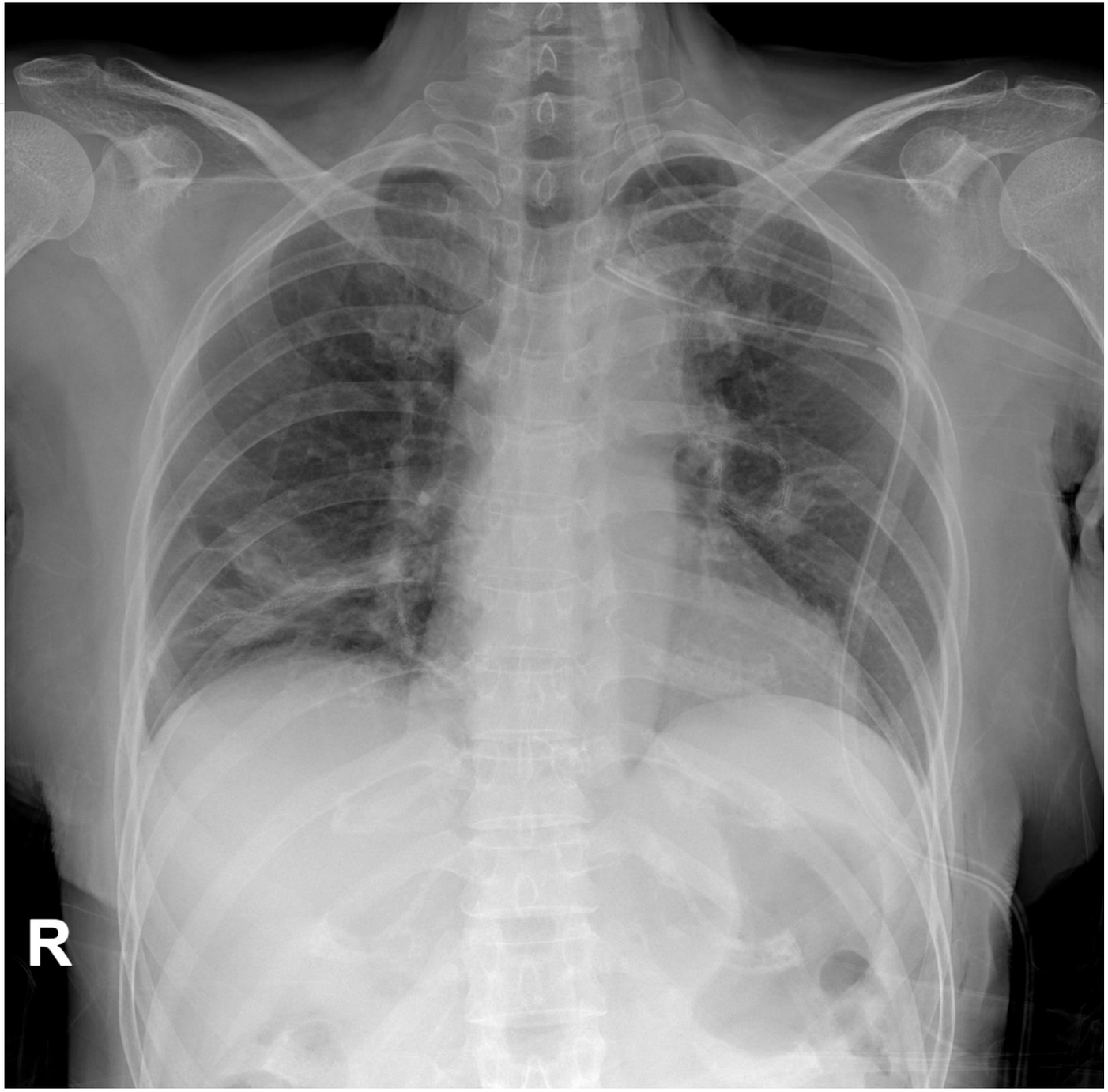
Uniportal VATS LUL anterior (S3) segmentectomy



POD # 1 chest tube removal

POD # 4 D/C

Pathological diagnosis

- RLL : Chronic inflammation with abscess formation

- LUL
  - Tumor size 1.3cm
  - Adenocarcinoma (acinar 75%, solid 20%, micropapillary 5%)
  - Resection margin 3.5cm

pT1bN0M0

Thank you for your attention