

# Segmentectomy and Limited Resection for NSCLC



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# Disclosures

- Speakers' Bureau, Integra Life Sciences (spouse)
- Consultant, Tissium (spouse)
- No discussion of off-label product use

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# Objectives

- Rationale for segmentectomy and sublobar resection in NSCLC
- Current trends in segmentectomy among general thoracic surgeons
- Segmentectomy vs. Lobectomy: surgical and oncologic outcomes
- Operative considerations and decision making for patients

## 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)

 Lobectomy is the current standard for management of early stage disease



- "Limited resection" group
  - 33% wedge resections
  - remaining 67% had segmentectomy (up to 2 adjacent)

Ann Thor Surg 1995; 60:615-23

## Also in 1995....27 years ago













# Advances in GTS and Lung Cancer Care

- Technology
  - Imaging modalities (CT, PET)
  - Minimally invasive techniques



- ICG/visualization of intersegmental planes





# Advances in GTS and Lung Cancer Care

- Technology
  - Imaging techniques (CT, PET)
  - Minimally invasive techniques
  - ICG/visualization of intersegmental planes
- Implementation of LDCT screening has increased the relative proportion of Stage I lesions
  - Lesions are small; many are ground glass or part-solid



## Lung Cancer Stage at Diagnosis



http://seer.cancer.gov/statfacts/html/lungb.html

#### Lung and Bronchus

Recent Trends in SEER Age-Adjusted Incidence Rates, 2004-2018 Observed SEER Incidence Rate By Stage at Diagnosis, Both Sexes, All Races (includes Hispanic), All Ages



# NLST and NELSON Results



	* * * * * * * * * * * * * * * * *	
	<b>NLST</b> n = 53,456	<b>NELSON</b> n = 15,792
Eligibility	55 – 74 years <u>&gt;</u> 30 PYH	50 – 74 years > 10 cig/d for > 30 yrs > 15 cig/d for > 25 yrs
	Current smoker or quit < 15 yrs	Smoking cessation < 10 yrs
Proportion women	41%	16%
Comparator/control	CXR	Usual care
Screening modality	LDCT Nodule mean diameter	LDCT Nodule volume, VDT
Screening interval	Annual x 3 years	1, 2, 4, 6.5 yrs
Positive threshold	> 4 mm	VDT 400 – 600 days
Proportion of Stage I among NSCLC diagnosed (screen arm)	50%	55%

#### JAMA | US Preventive Services Task Force | RECOMMENDATION STATEMENT

# 2021 Update

#### Screening for Lung Cancer US Preventive Services Task Force Recommendation Statement

What does the USPSTF recommend?	<ul> <li>Adults aged 50 to 80 years who have a 20 pack-year smoking history and currently smoke or have quit within the past 15 years:</li> <li>Screen for lung cancer with low-dose computed tomography (CT) every year.</li> <li>Stop screening once a person has not smoked for 15 years or has a health problem that limits life expectancy or the ability to have lung surgery.</li> <li>Grade: B</li> </ul>
To whom does this recommendation apply?	Adults aged 50 to 80 years who have a 20 pack-year smoking history and currently smoke or have quit within the past 15 years. (See below for definition of pack-year.)
What's new?	The USPSTF has revised the recommended ages and pack-years for lung cancer screening. It expanded the age range to 50 to 80 years (previously 55 to 80 years) and reduced the pack-year history to 20 pack-years of smoking (previously 30 pack-years).
How to implement this recommendation?	<ol> <li>Assess risk based on age and pack-year smoking history: Is the person aged 50 to 80 years and have they accumulated 20 pack-years or more of smoking?         <ul> <li>A pack-year is a way of calculating how much a person has smoked in their lifetime. One pack-year is the equivalent of smoking an average of 20 cigarettes—1 pack—per day for a year.</li> </ul> </li> <li>Screen: If the person is aged 50 to 80 years and has a 20 pack-year or more smoking history, engage in shared decision-making about screening.         <ul> <li>The decision to undertake screening should involve a discussion of its potential benefits, limitations, and harms.</li> <li>If a person decides to be screened, refer them for lung cancer screening with low-dose CT, ideally to a center with experience and expertise in lung cancer screening.</li> <li>If the person currently smokes, they should receive smoking cessation interventions.</li> </ul> </li> </ol>
How often?	<ul> <li>Screen every year with low-dose CT.</li> <li>Stop screening once a person has not smoked for 15 years or has a health problem that limits life expectancy or the ability to have lung surgery.</li> </ul>

## Is Lobectomy Justified?



May 2018 8 mm part-solid nodule

#### May 2021 1.4 cm part-solid nodule



#### National Trends and Outcomes of Segmentectomy in the Society of Thoracic Surgery Database

Peter J. Kneuertz, MD, Jing Zhao, PhD, Desmond M. D'Souza, MD, Mahmoud Abdel-Rasoul, MS, MPH, and Robert E. Merritt, MD



https://doi.org/10.1016/j.athoracsur.2021.07.056





# Indication for surgery relatively constant over time



PRESS

RICHARD E. CLARK MEMORIAL PAPER FOR GENERAL THORACIC SURGERY

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# Decreasing use of thoracotomy $\rightarrow$ increasing MITS approaches

# Decreasing incidence of major complications over time



ARTICLE IN PRESS

#### Lobectomy vs. Segmentectomy



# The Battle for Oncologic Supremacy



Choice of Surgical Procedure for Patients With Non–Small-Cell Lung Cancer  $\leq 1 \text{ cm or} > 1 \text{ to } 2 \text{ cm}$ Among Lobectomy, Segmentectomy, and Wedge Resection: A Population-Based Study

Chenyang Dai, Jianfei Shen, Yijiu Ren, Shengyi Zhong, Hui Zheng, Jiaxi He, Dong Xie, Ke Fei, Wenhua Liang, Gening Jiang, Ping Yang, Rene Horsleben Petersen, Calvin S.H. Ng, Chia-Chuan Liu, Gaetano Rocco, Alessandro Brunelli, Yaxing Shen, Chang Chen, and Jianxing He

- SEER database study (1/2000 12/2012)
- 15,760 patients with T1abN0M0 NSCLC
- Subgroup analysis for tumors >1 to 2 cm



Choice of Surgical Procedure for Patients With Non–Small-Cell Lung Cancer  $\leq 1 \text{ cm or} > 1 \text{ to } 2 \text{ cm}$ Among Lobectomy, Segmentectomy, and Wedge Resection: A Population-Based Study

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Lobectomy better than sublobar resection Segmentectomy better than wedge resection



J Clin Oncol 34:3175-3182.



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#### JCOG

# But wait...



#### Randomized Trial of Segmentectomy Compared to Lobectomy in Small-Sized Peripheral Non-Small Cell Lung Cancer (JCOG0802/WJOG4607L)

Hisao Asamura<sup>1</sup>, Morihito Okada<sup>2</sup>, Hisashi Saji<sup>3</sup>, Masahiro Tsuboi<sup>4</sup>, Ryu Nakajima<sup>5</sup>, Kenji Suzuki<sup>6</sup>, Keiju Aokage<sup>4</sup>, Masashi Wakabayashi<sup>7</sup>, Kenichi Nakamura<sup>7</sup>, Haruhiko Fukuda<sup>7</sup>, Shinichiro Nakamura<sup>8</sup>, Tetsuya Mitsudomi<sup>9</sup>, Shun-ichi Watanabe<sup>10</sup>

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On behalf of the Japan Clinical Oncology Group (JCOG) and West Japan Oncology Group (WJOG)





### Study scheme of JCOG0802/WJOG4607L



# JCOG 0802



#### Patient characteristics at final registration

Characteristics	Arm A: Lobectomy (N=554)	Arm B: Segmentectomy (N=552)	
Median age, years (range)	67 (35-85)	67 (32-83)	
Male / Female (%)	293 (52.9%) / 261 (47.1%)	290 (52.5%) / 262 (47.5%)	
ECOG performance status: 0 / 1 (%)	541 (97.7%) / 13 (2.3%)	542 (98.2%) / 10 (1.8%)	
Smoking history: Yes / No (%)	246 (44.4%) / 308 (55.6%)	244 (44.2%) / 308 (55.8%)	
Median max. tumor diameter, cm (range)	1.60 (0.6-2.0)	1.59 (0.6-2.0)	
Consolidation / tumor ratio (CTR) (%)			
0≤ CTR ≤0.25	1 (0.2%)	0 (0%)	
0.25< CTR ≤0.5	62 (11-2%)	73 (13.2%)	
0.5< CTR <1.0	208 (37.6%)	194 (35.1%)	
CTR = 1.0	283 (51.1%)	285 (51.6%)	
Median FEV1.0, mL (range)	2260 (1110-4760)	2280 (1010-4900)	
Median FVC, mL (range)	3050 (1370-5990)	3095 (1590-5940)	
Histological type			
Adenocarcinoma	501 (90.4%)	502 (90.9%)	
Squamous cell carcinoma	38 (6.9%)	37 (6.7%)	
Others	15 (2.7%)	13 (2.4%)	
Pathological stage (7 <sup>th</sup> TNM)			
pIA/pIB/pIIA/pIIIA/pIIB/pIV/unknown	455 (82.1%)/64/15/3/16/0/1	468 (84.8%)/46/18/1/17/1/2	



### Result 1. Overall survival (primary endpoint)



# JCOG 0802

0%

No. at Risk Lobectomy 554

Segmentectomy 552

Years after randomization







#### **Result 5. Recurrence pattern**

 Proportion of local recurrence = loco-regional +/- distant recurrence among all enrolled patients.

Recurrence location	Arm A: Lobectomy (N=554)	Arm B: Segmentectomy (N=552)	P value*
Total	44 (7.9%)	67 (12.1%)	0.0214
Loco-regional	17 (3.1%)	38 (6.9%) Re-	resection?
Distant	14 (2.5%)	7 (1.3%)	
Loco-regional + distant	13 (2.3%)	20 (3.6%)	1
Unclassified	0	2	
Proportion of local recurrence	30 (5.4%)	58 (10.5%)	0.0018
			Fisher's exact test

# JCOG 0802



## Conclusions

 JCOG0802/WJOG4607L is the first phase 3 trial to demonstrate the benefit of segmentectomy with significant differences in OS.

 These results indicate that segmentectomy should be the standard surgical procedure instead of lobectomy for patients with smallsized (≤2 cm, CTR >0.5) peripheral c-stage IA NSCLC.





Perioperative mortality and Morbidity after Lobar versus Sublobar Resection for early stage lung cancer: A post-hoc analysis of an international randomized phase III trial (CALGB/ Alliance 140503)

Nasser K. Altorki, M.D.<sup>1</sup>, Xiaofei Wang, PhD<sup>2,4</sup>, Dennis Wigle, M.D.<sup>3</sup>, Lin Gu<sup>4</sup>, Gail Darling, M.D.<sup>5</sup>, Ahmad S Ashrafi, M.D.<sup>6</sup>, Rodney Landrenau, M.D.<sup>7</sup>, Daniel Miller, M.D.<sup>8</sup>, Moishe Liberman, M.D.<sup>9</sup>, David R Jones, M.D.<sup>10</sup>, Robert Keenan, M.D.<sup>11</sup>, Massimo Conti, M.D.<sup>12</sup>, Gavin Wright, M.D.<sup>13</sup>, Linda J Veit, MPH<sup>14</sup>, Suresh S. Ramalingam, M.D.<sup>15</sup>, Mohamed Kamel, M.D.<sup>1</sup>, Harvey I. Pass, M.D.<sup>16</sup>, John D. Mitchell, M.D.<sup>17</sup>, Thomas Stinchcombe, M.D.<sup>18</sup>, Everett Vokes, M.D.<sup>19</sup>, and Leslie J Kohman, M.D.<sup>14</sup>





Lancet Respir Med. 2018 December ; 6(12): 915–924. doi:10.1016/S2213-2600(18)30411-9.



# Indications for Segmentectomy

- Able to achieve adequate margin
- Lesion features: size, ground glass, indolent behavior
- Need/desire to spare parenchyma
  - Poor pulmonary function or h/o prior lung resection
- cN0
- Patient will tolerate an operation

National NCCN Cancer Network<sup>®</sup>

#### 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 lung cancer patients (eg. multidisciplinary clinic and/or tumor board).
- Patients who are active smokers should be provided counseling and smoking cessation support (NCCN Guidelines for Smoking Cessation). While active smokers 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 prodominant 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<sup>a</sup> ≤2 cm with at least one of the following:

Or 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 o 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

<sup>a</sup> Peripheral is defined as the outer one third of the lung parenchyma.

(see NSCL-B 2 of 4 through NSCL-B 4 of 4)

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.

NSCL-B 1 OF 4

## Location: Adequate Margins Achievable?





53F, Chinese American h/o thyroid cancer, rectal carcinoid LLL GGN stable since 2019

## Location: Adequate Margins Achievable?





53F, Chinese American h/o thyroid cancer, rectal carcinoid LLL GGN stable since 2019

#### 1/2022: increased size of LUL GGN

Surgery vs. observation?

If surgery, wedge vs. segment?



## **Sparing the Lung Parenchyma**

![](_page_31_Picture_1.jpeg)

![](_page_31_Picture_2.jpeg)

67M, longtime h/o cigarette smoking Enlarging PET-avid RLL nodule Upper lobe predominant emphysema

4/2021: FEV1 61% predicted DLCO 39% predicted

Stheking tessation Pulmonary renaegmentectomy?

7/2021: FEV1 68% predicted DLCO 51% predicted

<u>R VATS S9-10, MLNS</u> Path: 1.4 cm SCCA Stations 4R, 7, 8, 9, 11 negative pT1bN0M0

![](_page_31_Picture_8.jpeg)

# Nodule Features

![](_page_32_Picture_1.jpeg)

![](_page_32_Picture_2.jpeg)

- 54 yo male, previously healthy
- Smoking status: non-smoker
- CT chest: 1.0 x 1.0 cm GGO
- Wedge resection "not feasible" *If surgery, what operation?*

**Observation?** SBRT? Surgery?

Thoracic Cancer ISSN 1759-7706

#### CASE REPORT

# Uniportal video-assisted thoracoscopic left S4 anatomical segmentectomy

Nan Song<sup>1</sup>, Liang Duan<sup>1</sup>, Zhiyong Fang<sup>2</sup> & Gening Jiang<sup>1</sup>

![](_page_33_Picture_7.jpeg)

![](_page_33_Picture_8.jpeg)

Final pathology: T1a(mi) N0 M0

### The Biology/Histology Effect

![](_page_34_Figure_1.jpeg)

#### Outcomes for Surgery in Large Cell Lung Neuroendocrine Cancer

![](_page_34_Figure_3.jpeg)

10

20

Tumor size (m

30

40

![](_page_35_Picture_0.jpeg)

![](_page_35_Picture_1.jpeg)

![](_page_35_Picture_2.jpeg)

#### Lung Parenchyma

71M, longtime cigarette smoker Enlarging LUL nodule on serial LDCT scans

#### Segmentectomy vs. Lobectomy?

![](_page_35_Picture_6.jpeg)

![](_page_36_Picture_0.jpeg)

![](_page_36_Picture_1.jpeg)

#### When is a Wedge Acceptable?

![](_page_36_Picture_3.jpeg)

70M, longtime h/o cigarette smoking h/o CAD, COPD FEV<sub>1</sub> 42% pred; DLCO 47% pred

TTNA: NSCLC; complicated by postprocedure ptx; complicated by RRT,  $\Delta$  MS  $\rightarrow$  urgent pigtail

Ongoing rolling air leak x 10 days, unable to tolerate water seal PET, brain MRI: no distant dz

OR: Left VATS WR x 3, pleurodesis Path: 2.5 cm SCCA, pT1bN0M0 Stations 5, 7, 8, 9, 10 negative d/c'd home POD #4

### Last But Not Least: Lymph Nodes

![](_page_37_Picture_1.jpeg)

# Effect of the number of lymph nodes examined on the survival of patients with stage I non–small cell lung cancer who undergo sublobar resection

Sai Yendamuri, MD, FACS,<sup>a,b</sup> Samjot Singh Dhillon, MD,<sup>c</sup> Adrienne Groman, MS,<sup>d</sup> Grace Dy, MD,<sup>c</sup> Elisabeth Dexter, MD,<sup>a,b</sup> Anthony Picone, MD,<sup>a,b</sup> Chukwumere Nwogu, MD,<sup>a,b</sup> Todd Demmy, MD,<sup>a,b</sup> and Mark Hennon, MD<sup>a,b</sup>

- SEER Database analysis (2004-2015)
- Sublobar resection of NSCLC < 2 cm
- 3916 patients eligible

	Wedge Resection 3201 (82%)	Segmentectomy 715 (18%)
<u>At least one</u> LN examined at time of surgery	50.5%	<b>76.5%</b>

# Effect of the number of lymph nodes examined on the survival of patients with stage I non–small cell lung cancer who undergo sublobar resection

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![](_page_38_Figure_2.jpeg)

Survival improves with exam of  $\geq$ 1 LN

No survival difference seg vs. wedge when  $\geq$ 1 LN is examined

JTCVS 2018; 156:394-402

Check for updates

# Effect of the number of lymph nodes examined on the survival of patients with stage I non–small cell lung cancer who undergo sublobar resection

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![](_page_39_Figure_2.jpeg)

Check for updates

![](_page_40_Picture_0.jpeg)

# Summary

- Implementation of LDCT screening → more small, subcentimeter and part-solid lung nodules
- Use of segmentectomy is increasing....
   and safe
- JCOG0802 suggests that segmentectomy is *at least* as oncologically effective as lobectomy (if not superior)
- Decision for sublobar resection is nuanced but should always include LNs

# Thank you

![](_page_41_Picture_1.jpeg)