Wedge Resection for Small Peripheral Lung Cancer is Appropriate

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Disclosures

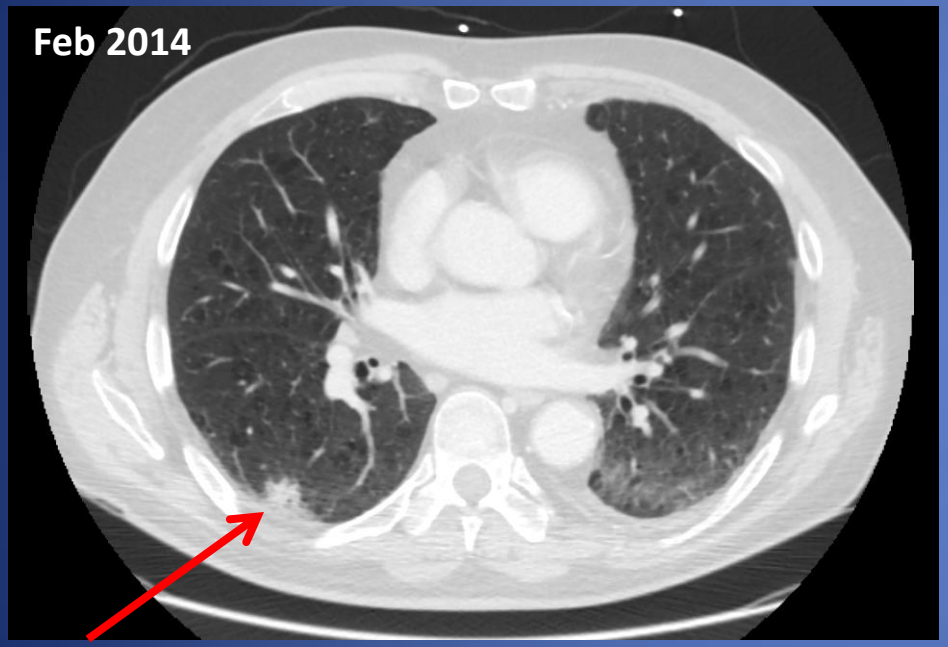
No financial disclosures

Vice-Chair NCCN Non-Small Cell Lung Cancer Guidelines Panel

Chair NCCN Lung Cancer Screening Panel

Lung Cancer Case

- 75 yo man 2 years s/p LLL lobectomy for stage IIB NSCLC, s/p adjuvant therapy
- Previous smoker, 40 pk/yr
- Slow growing RLL lung nodule
- Good performance status
- Minimal comorbidity
- FEV1 65% DLCO 54%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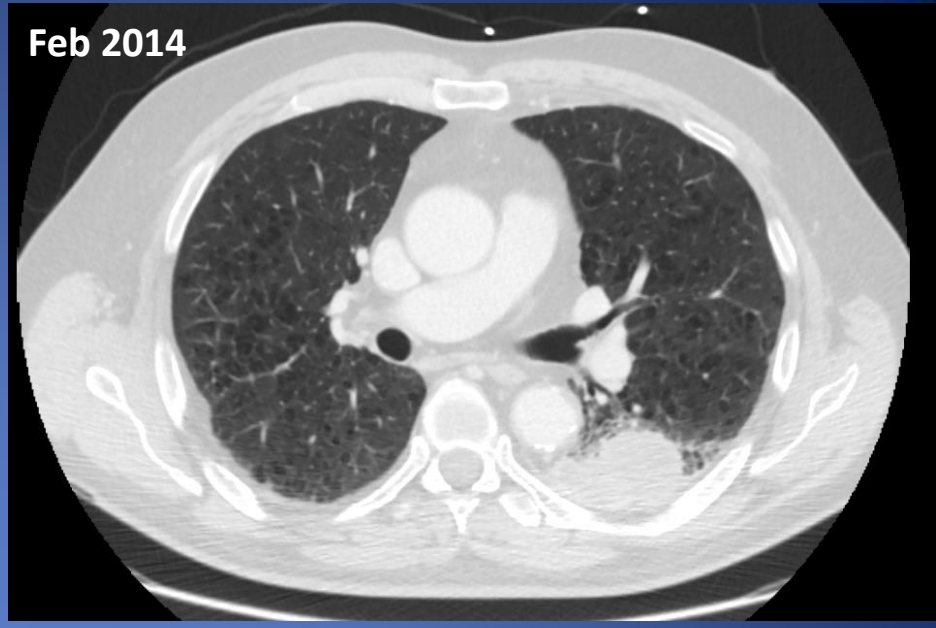
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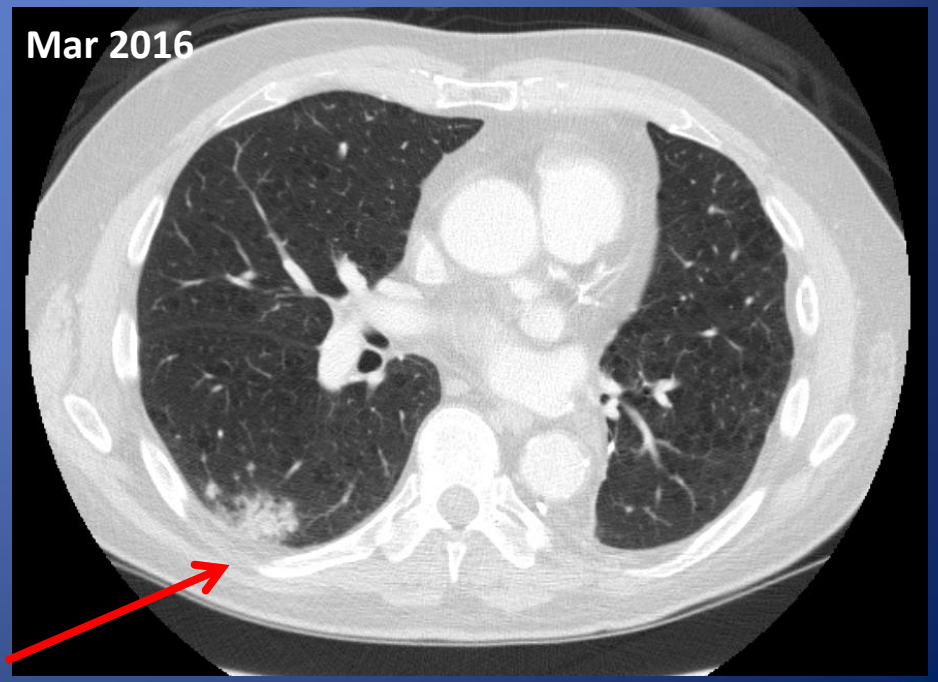
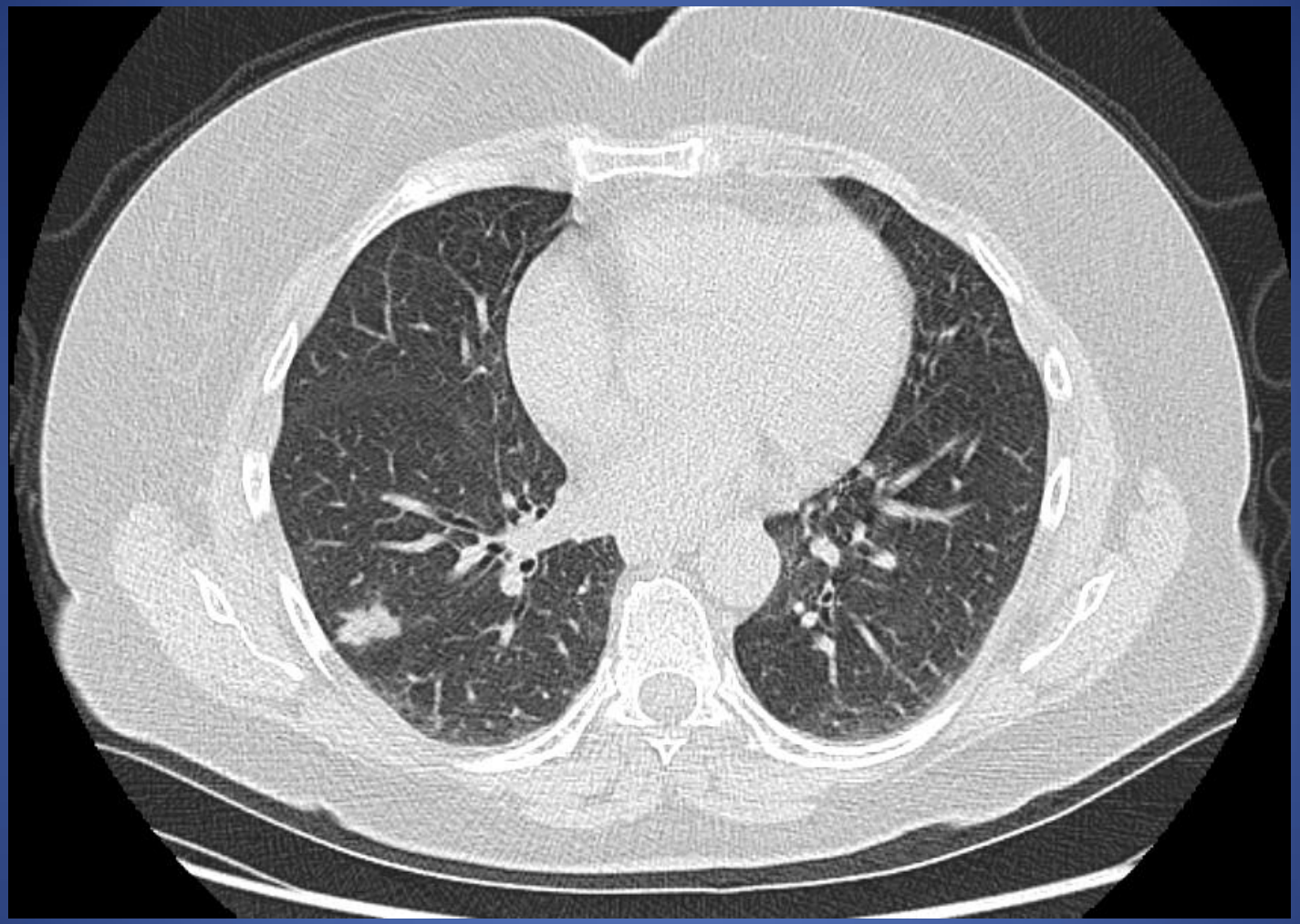

Mar 2016

Lung Cancer Case

A. Lobectomy
B. Superior segmentectomy
C. Wedge resection
D. SBRT
E. Radiologic observation

Lung Cancer Case

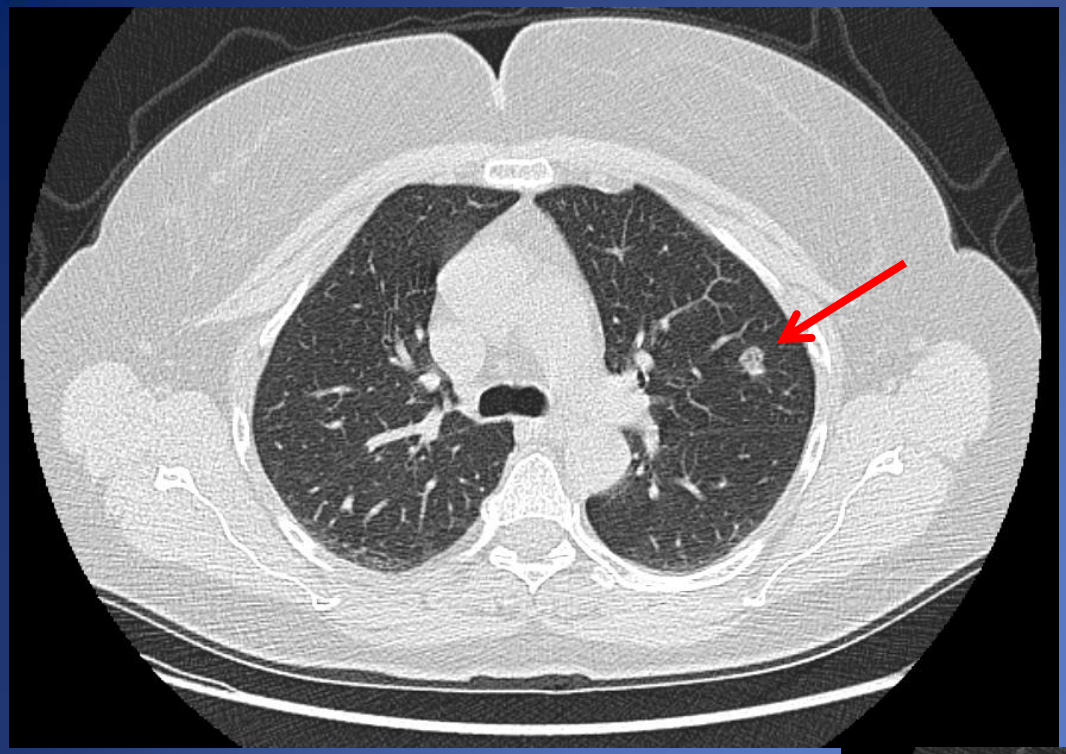
- 59 healthy woman, nonsmoker
- Incidental chest CT findings
- No comorbidity
- Excellent functional status
- Normal PFTs

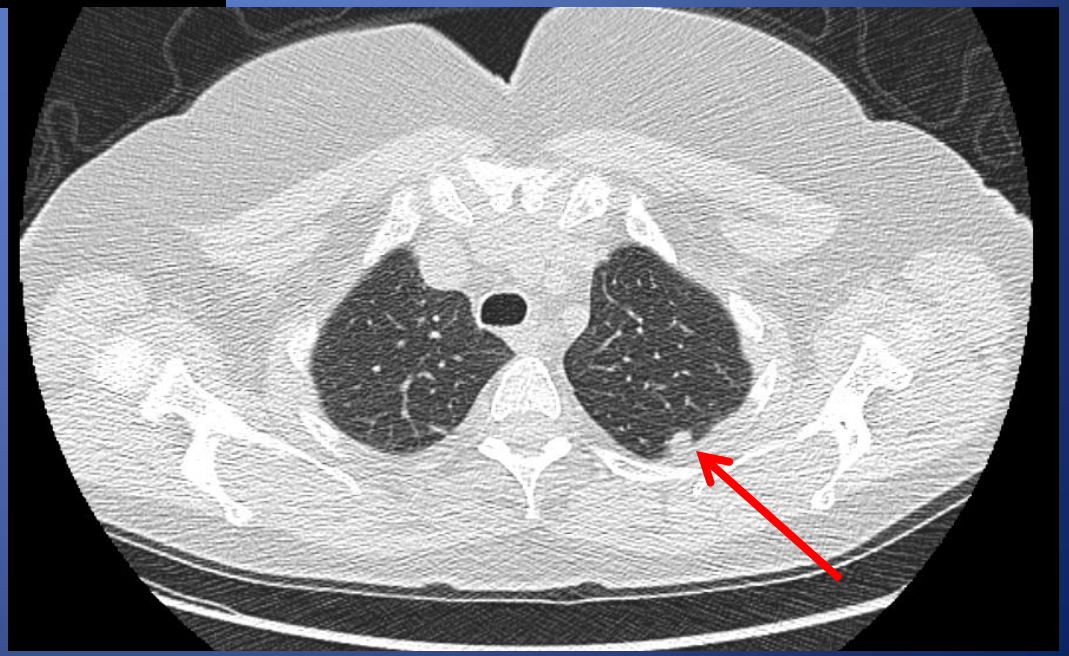


Biopsy → adenocarcinoma

Lung Cancer Case

A. Lobectomy
B. Superior segmentectomy
C. Wedge resection
D. SBRT
E. Radiologic observation





Lung Cancer Case

A. Lobectomy
B. Superior segmentectomy
C. Wedge resection
D. SBRT
E. Radiologic observation

Sublobar Resection for Lung Cancer

- Current standard of lobectomy predominantly established by LCSG in 1995 (20 years ago)
- Benefits of lobectomy
  - Decreased local recurrence – statistically significant
  - Improved survival – not statistically significant (p=.08)
  - Better lymphatic clearance and sampling
  - Better parenchymal margins
- Benefits of wedge resection
  - Preservation of lung parenchyma
    - Poor pulmonary reserve
    - Minimize impact of long-term pulmonary function
    - Consideration of additional future resections
  - Decrease morbidity and mortality

Sublobar Resection for Lung Cancer

Current standard of lobectomy predominantly established by LCSG in 1995 (20 years ago)

Has anything evolved in the past 20 years?

It’s not the 1980’s anymore….

Sublobar Resection for Lung Cancer What has changed in the past 20 years?

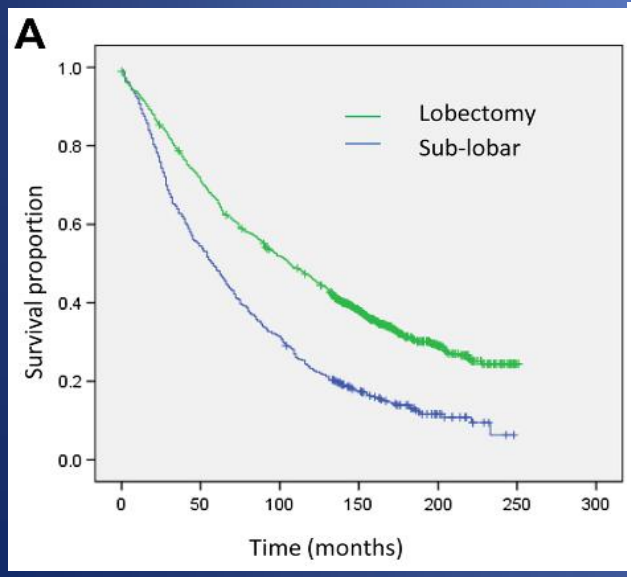
Wider use of CT scans	→	More small lung nodules
Higher resolution scans	→	More non-solid nodules
Lung cancer screening	→	Higher expectation of "doing no harm"
PET/EBUS/Med	→	Better clinical staging
More advanced age/comorbidity	→	Ablative therapies
Higher proportion of thoracic surgeons	→	Better decisions about extent of resection
	→	Better outcomes

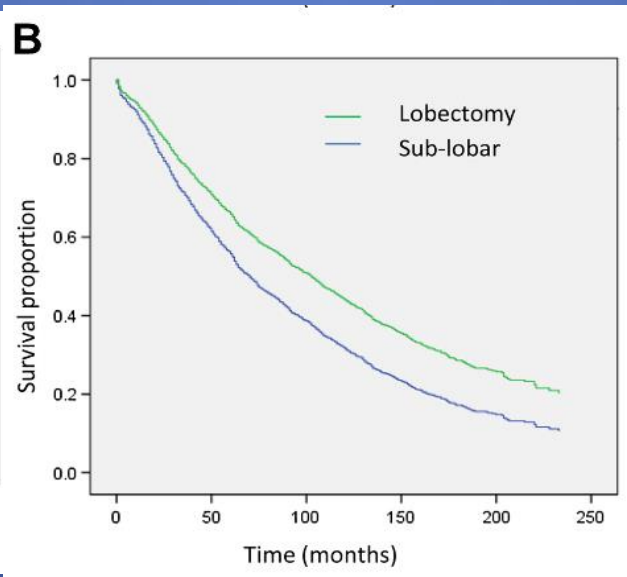
Temporal trends in outcomes following sublobar and lobar resections for small (≤2 cm) non–small cell lung cancers—a Surveillance Epidemiology End Results database analysis

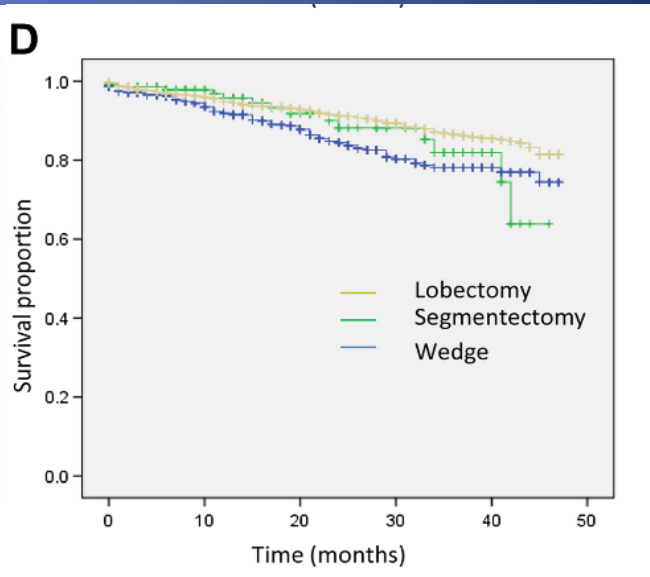
Sai Yendamuri, MD, FACS,[a,b,] Rohit Sharma, MD,[a] Michael Demmy, BS,[a] Adrienne Groman, MS,[c] Mark Hennon, MD,[a] Elisabeth Dexter, MD,[a,b] Chukwumere Nwogu, MD,[a,b] Austin Miller, PhD,[c] and Todd Demmy, MD[a,b]*

JOURNAL OF SURGICAL RESEARCH 183 (2013) 27–32

N = 8797 lobectomy = 6636 sublobar = 2161







1987-1997 **1998-2004** **2005-2008**

Pro and Con for Lob & Sub-Lob Resection for T1N0 NCLC

Table 6. Summary of Studies Comparing Sublobar With Lobar Resection for Stage I Non–Small Cell Lung Cancer

	Sublobar Resection			Lobar Resection		
Study	N	5-year Survival (%)	Local Recurrence (%)	N	5-year Survival (%)	Local Recurrence (%)
Pro lobar resection						
LCSG [15]	122	44	17.2[a]	125	65[a]	6.4
Warren [22]	66	43	22.7[a]	103	67[a]	4.9
Miller [23]	25	33	7	75	71[a]	11
Martini [24]	62	59	50[a]	511	77[a]	24
Pro sublobar resection						
Errett [25]	100	69	NA	97	75	NA
Pastorino [26]	61	55	36	411	49	38
Read [27]	113	84	4.4	131	74	11.5
Landreneau [28]	102	62	19[a]	117	70	9
Okada [17]	130	91	NA	132	78	NA
Kodama [29]	46	93	2.2	77	88	1.3
Koike [30]	74	89	2.7	159	90	1.3

[a] Statistically significant.

LCSG = Lung Cancer Study Group; NA = not available.

El-Sherif et al. Ann Thorac Surg 2006; 82: 408-16

Problems with Retrospective Database Review

- Selection bias
  - Sublobar with more comorbidity
  - Sublobar with lower pulmonary function
  - Sublobar more likely understaged
  - Lobectomy with larger tumors
  - Lobectomy with more central tumors
- Treatment bias
  - Wedge performed more commonly by non-specialists
  - Wedge with variable adequacy of margin
  - Wedge with less complete LN assessment/dissection

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Systematic Review

ANNALS OF CARDIOTHORACIC SURGERY

Meta-analysis of intentional sublobar resections versus lobectomy for early stage non-small cell lung cancer

Christopher Cao[1,2], Sunil Gupta[1], David Chandrakumar[1], David H. Tian[1], Deborah Black[3], Tristan D. Yan[1,4]

- compare OS and DFS of sublobar resections eligible for lobectomy with lobectomy
- 12 studies, 1,078 sublobar and 1,667 lobectomies
- no significant difference in OS [HR 0.91; 95% CI 0.64-1.29] or DFS (HR 0.82; 95% CI 0.60-1.12) between the two treatment arms
- sublobar resection after intentional selection rather than ineligibility achieved similar long-term survival outcomes as lobectomy

Ann Cardiothorac Surg. 2014; 3:134–141

Systematic Review

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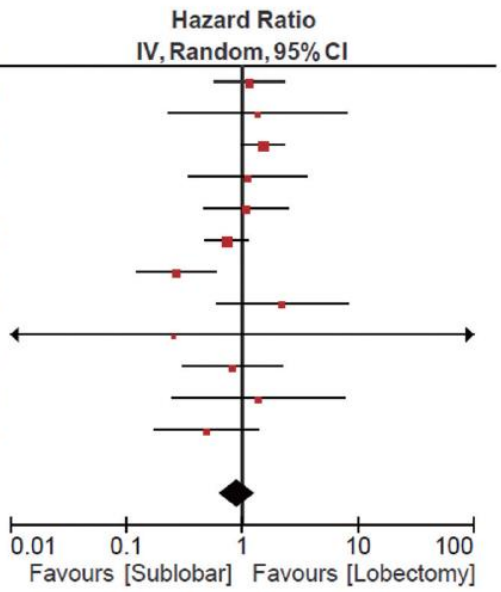
Christopher Cao[1,2], Sunil Gupta[1], David Chandrakumar[1], David H. Tian[1], Deborah Black[3], Tristan D. Yan[1,4]

Study or Subgroup	log[Hazard Ratio]	SE	Sublobar Total	Lobectomy Total	Weight	Hazard Ratio IV, Random, 95% CI	Year
Read	0.14	0.36	113	131	11.8%	1.15 [0.57, 2.33]	1990
Warren	0.3	0.91	38	34	3.3%	1.35 [0.23, 8.03]	1994
Ginsberg	0.42	0.22	122	125	17.1%	1.52 [0.99, 2.34]	1995
Kodama 1997	0.11	0.6	46	77	6.3%	1.12 [0.34, 3.62]	1997
Koike	0.08	0.43	74	159	9.8%	1.08 [0.47, 2.52]	2003
Okada	−0.31	0.22	305	262	17.1%	0.73 [0.48, 1.13]	2006
Kodama 2008	−1.31	0.41	58	80	10.3%	0.27 [0.12, 0.60]	2008
Sugi	0.79	0.67	33	111	5.4%	2.20 [0.59, 8.19]	2010
Ichiki	−1.37	294.88	35	104	0.0%	0.25 [0.00, 2.555E250]	2011
Yamashita	-0.2	0.51	90	124	7.9%	0.82 [0.30, 2.22]	2012
Hamatake	0.32	0.88	66	77	3.5%	1.38 [0.25, 7.73]	2012
Tsutani	−0.71	0.53	98	383	7.5%	0.49 [0.17, 1.39]	2013
Total (95% CI)			**1078**	**1667**	**100.0%**	**0.91 [0.64, 1.29]**	

Heterogeneity: Tau² =0.14; Chi² =19.37, df =11 (P=0.05); I²=43%
Test for overall effect: Z=0.52 (P=0.61)



re 2 Overall survival: sublobar *vs*. lobectomy. CI, confidence interval.

Ann Cardiothorac Surg. 2014; 3:134–141

Systematic Review

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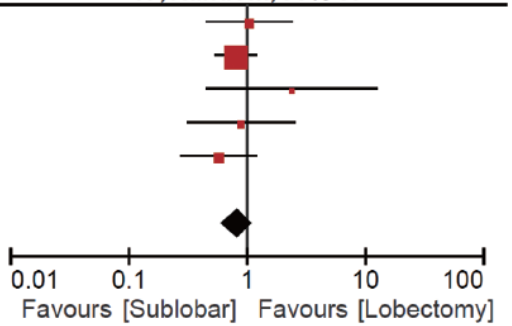
Study or Subgroup	log[Hazard Ratio]	SE	Sublobar Total	Lobectomy Total	Weight	Hazard Ratio IV, Random, 95% CI	Year
Koike	0.04	0.43	74	159	13.6%	1.04 [0.45, 2.42]	2003
Okada	−0.22	0.21	305	262	56.9%	0.80 [0.53, 1.21]	2006
Sugi	0.86	0.85	33	111	3.5%	2.36 [0.45, 12.50]	2010
Yamashita	−0.12	0.54	90	124	8.6%	0.89 [0.31, 2.56]	2012
Tsutani	−0.56	0.38	98	383	17.4%	0.57 [0.27, 1.20]	2013
Total (95% CI)			**600**	**1039**	**100.0%**	**0.82 [0.60, 1.12]**	

Heterogeneity: Tau² =0.00; Chi² =2.79, df =4 (P=0.59); I² =0%
Test for overall effect: Z=1.25 (P=0.21)

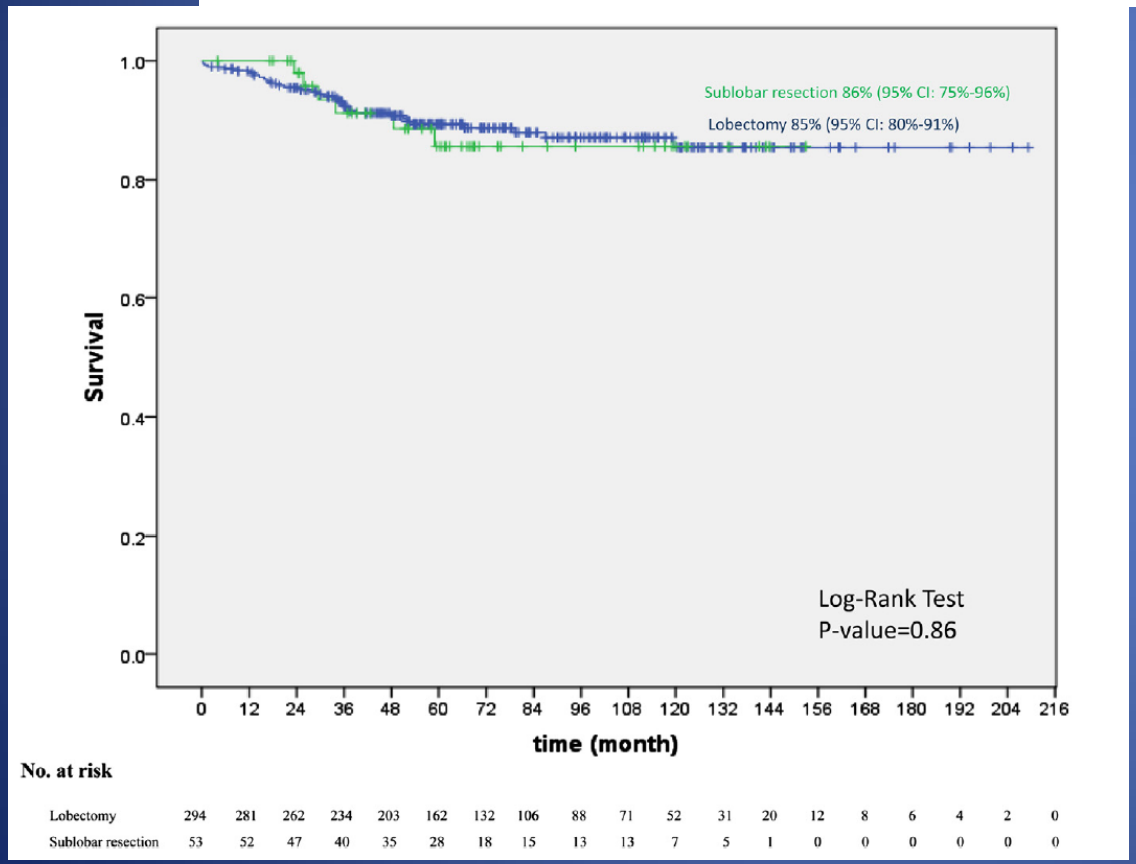


3 Disease-free survival: sublobar *vs.* lobectomy. CI, confidence interval.

Ann Cardiothorac Surg. 2014; 3:134–141

Sublobar resection is equivalent to lobectomy for clinical stage 1A lung cancer in solid nodules

Nasser K. Altorki, MD,[a] Rowena Yip, MPH,[b] Takaomi Hanaoka, MD,[c] Thomas Bauer, MD,[d] Ralph Aye, MD,[e] Leslie Kohman, MD,[f] Barry Sheppard, MD,[g] Richard Thurer, MD,[h] Shahriyour Andaz, MD,[i] Michael Smith, MD,[j] William Mayfield, MD,[k] Fred Grannis, MD,[l] Robert Korst, MD,[m] Harvey Pass, MD,[n] Michaela Straznicka, MD,[o] Raja Flores, MD,[b] and Claudia I. Henschke, PhD, MD,[b] for the I-ELCAP Investigators



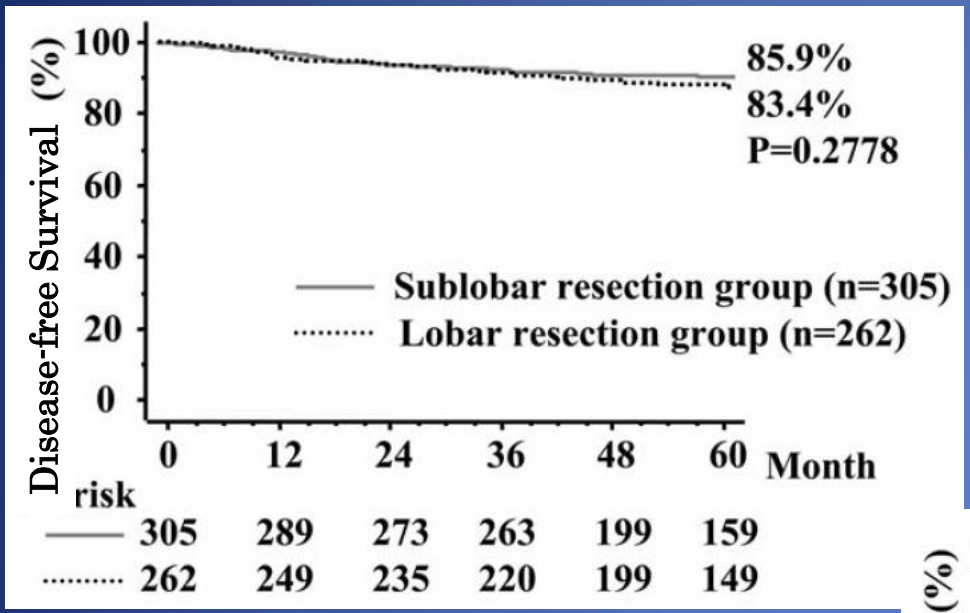
I-ELCAP 1993-2011
347 stage IA lung cancers
(only solid nodules included)
- **294 lobectomies**
- **53 sublobar resections**
- **(37 wedge resections)**

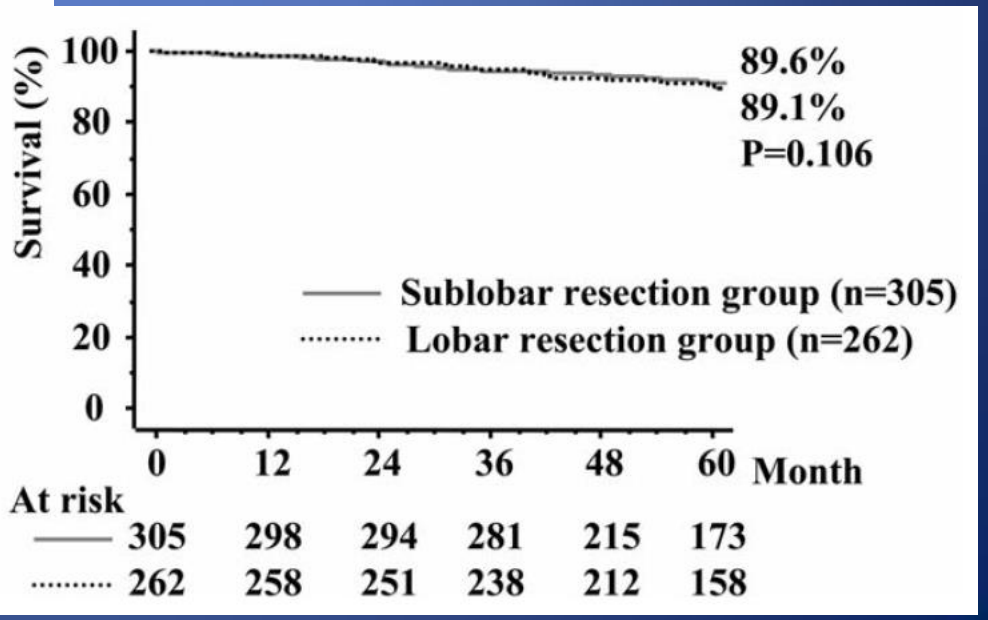
No difference in:
- **Pathologic upstaging**
- **Cancer death**
- **All-cause death**
- **Local recurrence**

J Thorac Cardiovasc Surgery 2014; 147:754-64

Radical sublobar resection for small-sized non–small cell lung cancer: A multicenter study

Morihito Okada, MD, PhD,[a] Teruaki Koike, MD, PhD,[b] Masahiko Higashiyama, MD, PhD,[c] Yasushi Yamato, MD, PhD,[b] Ken Kodama, MD, PhD,[c] and Noriaki Tsubota, MD, PhD[a]





CHEST

Original Research

LUNG CANCER

Appropriate Sublobar Resection Choice for Ground Glass Opacity-Dominant Clinical Stage IA Lung Adenocarcinoma

Wedge Resection or Segmentectomy

Yasuhiro Tsutani, MD, PhD; Yoshihiro Miyata, MD, PhD; Haruhiko Nakayama, MD, PhD; Sakae Okumura, MD, PhD; Shuji Adachi, MD, PhD; Masahiro Yoshimura, MD, PhD; and Morihito Okada, MD, PhD

CHEST 2014; 145(1):66–71

Methods: **We evaluated 610 consecutive patients with clinical stage IA lung adenocarcinoma who underwent complete resection after preoperative high-resolution CT scanning and ^{18}F-fluorodeoxyglucose PET/CT scanning and revealed 239 (39.2%) that had a >50% GGO component.**

CHEST

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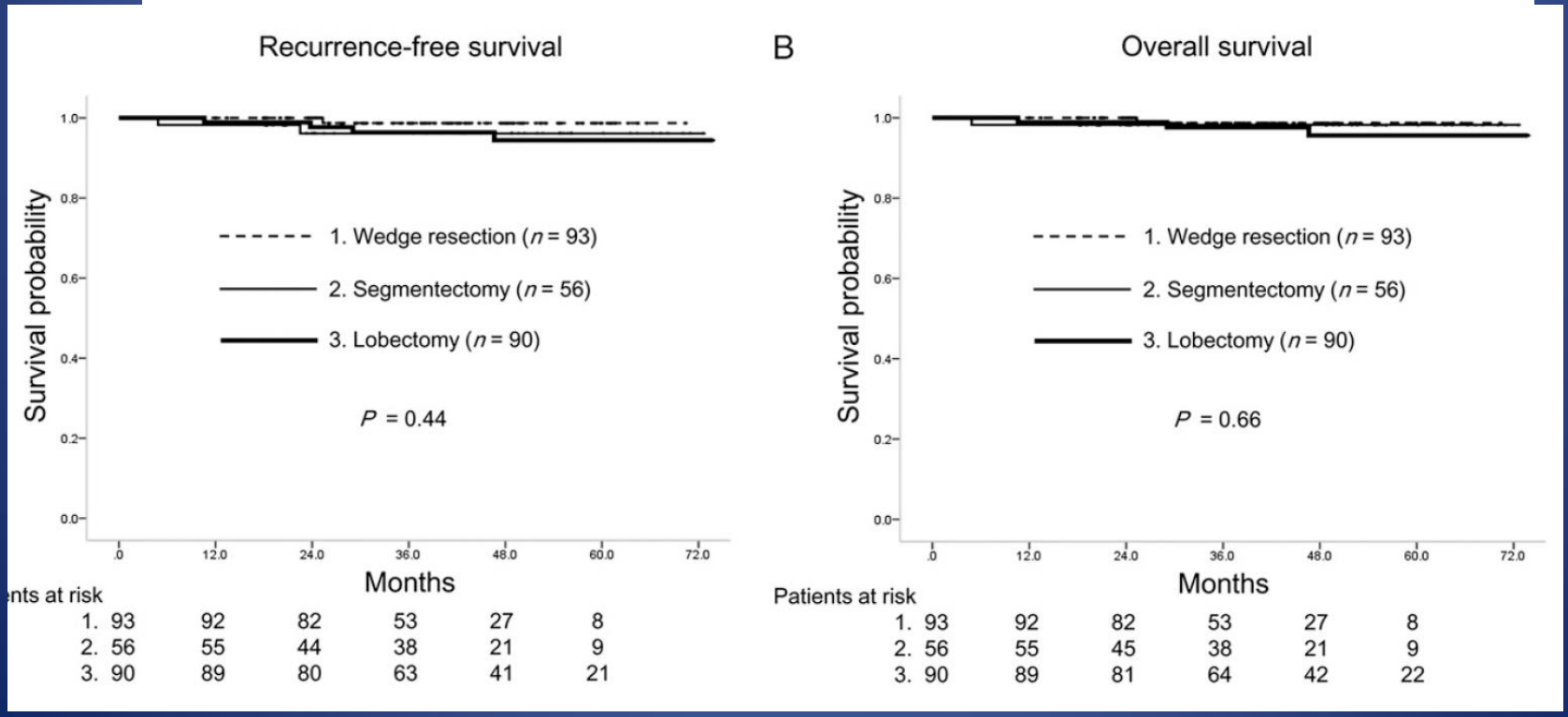
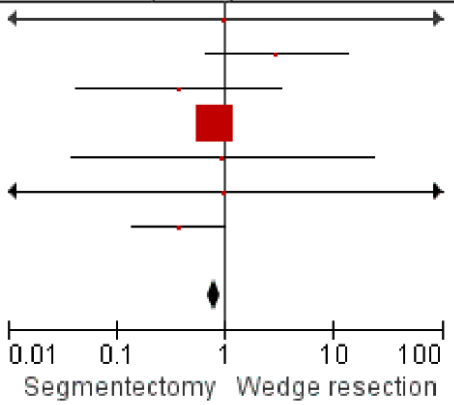


Segmentectomy versus Wedge Resection for the Treatment of High-Risk Operable Patients with Stage I Non–Small Cell Lung Cancer: a Meta-Analysis

Bing Hou[a], Xu-Feng Deng[a], Dong Zhou[a], Quan-Xing Liu[a]* and Ji-Gang Dai[a]*

Study or Subgroup	log[Hazard Ratio]	SE	Segmentectomy Total	Wedge resection Total	Weight	Hazard Ratio IV, Fixed, 95% CI
Hamatake D 2012	0	3.12	32	34	0.1%	1.00 [0.00, 452.64]
Nakamura H 2011	1.08	0.77	38	84	1.0%	2.94 [0.65, 13.32]
Okada M 2006	-0.98	1.11	214	30	0.5%	0.38 [0.04, 3.31]
Smith C. B 2013	-0.22	0.08	378	1568	95.7%	0.80 [0.69, 0.94]
Sugi K 2010	-0.05	1.63	33	15	0.2%	0.95 [0.04, 23.21]
Tsutani Y 2014	0	3.1	56	93	0.1%	1.00 [0.00, 435.24]
Yamato Y 2008	-0.97	0.5	153	93	2.4%	0.38 [0.14, 1.01]
Total (95% CI)			**904**	**1917**	**100.0%**	**0.80 [0.68, 0.93]**

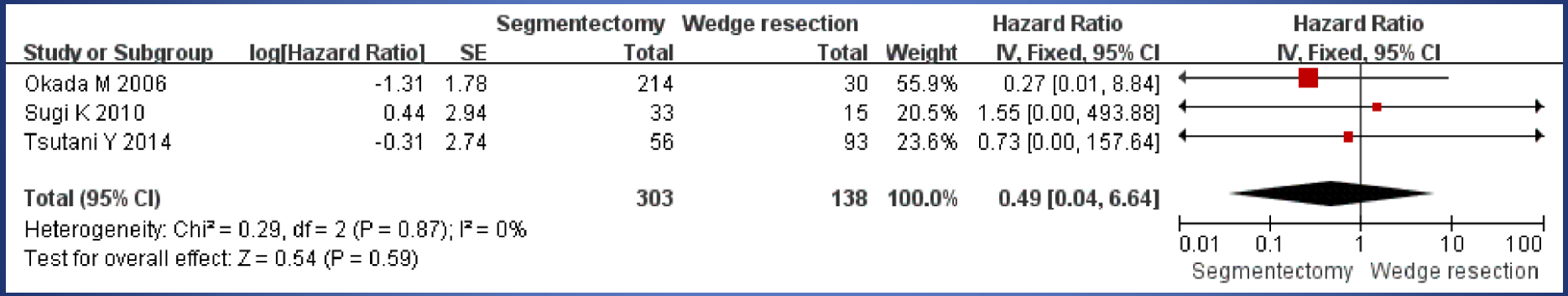
Heterogeneity: Chi² = 5.58, df = 6 (P = 0.47); I² = 0%
Test for overall effect: Z = 2.91 (P = 0.004)



Overall survival of segmentectomy versus wedge resection for stage I NSCLC patients

Segmentectomy versus Wedge Resection for the Treatment of High-Risk Operable Patients with Stage I Non–Small Cell Lung Cancer: a Meta-Analysis

Bing Hou[a], Xu-Feng Deng[a], Dong Zhou[a], Quan-Xing Liu[a]* and Ji-Gang Dai[a]*



Disease free survival of segmentectomy versus wedge resection for stage Ia NSCLC patients

Segmentectomy versus Wedge Resection for the Treatment of High-Risk Operable Patients with Stage I Non–Small Cell Lung Cancer: a Meta-Analysis

Bing Hou[a], Xu-Feng Deng[a], Dong Zhou[a], Quan-Xing Liu[a]* and Ji-Gang Dai[a]*

Stage I OS and CSS – segmentectomy better
Stage IA OS and CSS – segmentectomy better
Stage IA DFS – segmentectomy and wedge equivalent
T1a OS and CSS – segmentectomy and wedge equivalent

PRINCIPLES OF SURGICAL THERAPY (1 of 4)

Evaluation

- Determination of resectability, surgical staging, and pulmonary resection should be performed by board-certified thoracic surgeons who perform lung cancer surgery as a prominent part of their practice.
- CT and PET used for staging should be within 60 days before proceeding with surgical evaluation.
- Resection is the preferred local treatment modality (other modalities include radiofrequency ablation, cryotherapy, and SABR). 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 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

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
- Sublobar resection should also sample appropriate N1 and N2 lymph node stations unless not technically fea increasing the surgical risk.
- Segmentectomy (preferred) or wedge resection is appropriate in selected patients for the following reasons:

  - Segmentectomy (preferred) or wedge resection is appropriate in selected patients for
    - Poor pulmonary reserve or other major comorbidity that contraindicates lobectomy
    - Peripheral nodule[1] ≤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)

- 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)

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

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

Stereotactic ablative radiotherapy versus lobectomy for operable stage I non-small-cell lung cancer: a pooled analysis of two randomised trials

***Lancet Oncol* 2015; 16: 630–37**

Joe Y Chang, Suresh Senan*, Marinus A Paul, Reza J Mehran, Alexander V Louie, Peter Balter, Harry J M Groen, Stephen E McRae, Joachim Widder, Lei Feng, Ben E E M van den Borne, Mark F Munsell, Coen Hurkmans, Donald A Berry, Erik van Werkhoven, John J Kresl, Anne-Marie Dingemans, Omar Dawood, Cornelis J A Haasbeek, Larry S Carpenter, Katrien De Jaeger, Ritsuko Komaki, Ben J Slotman, Egbert F Smit†, Jack A Roth†*

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Focused radiation treatment targets lung cancer

New form of focused radiation treatment shows promise eradicating tumors

By Markian Hawryluk Published 11:21 am, Wednesday, June 24, 2015

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HEALTH

Non-invasive radiation treatment as effective for lung cancer as surgery, study finds

By Nicole Kwan Published July 14, 2015 FoxNews.com

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- Merging of 2 randomised trials
- STARS – recruitment goal 420 patients
  - 28 sites in USA, China, and France (7 enrolled patients)
  - 36 patients enrolled 2008-2013
- ROSEL – 375 patients eligible per year
  - 10 centers in Netherlands (4 enrolled patients)
  - 22 patients randomized
- Merged data produces 58 randomized patients
  - 27 patients at 3 years

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Conclusions: SABR with superior overall survival, equivalent disease-free survival, and equivalent recurrence profile

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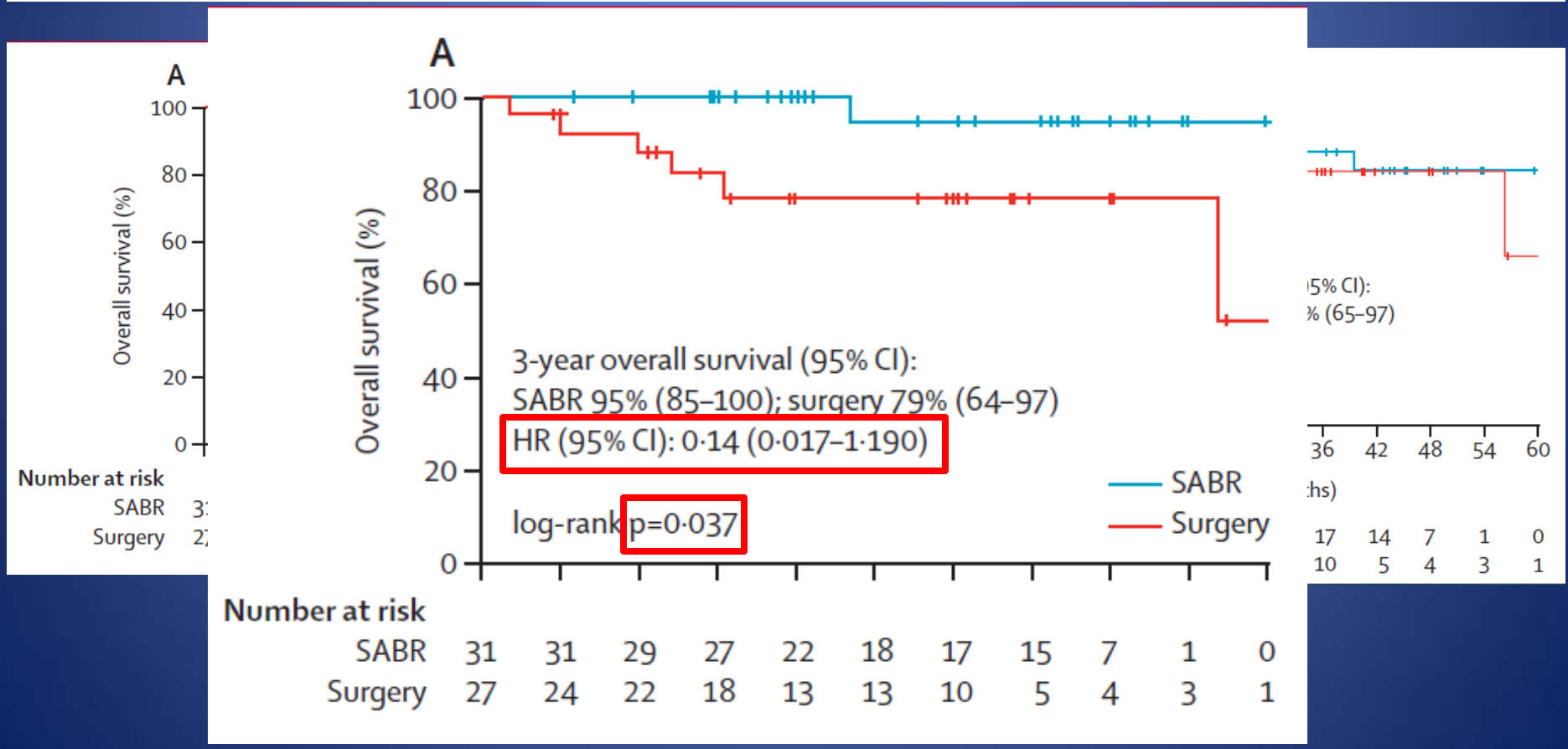

Stereotactic ablative radiotherapy versus lobectomy for operable stage I non-small-cell lung cancer: a pooled analysis of two randomised trials

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"Recurrence-free survival at 3 years was 86% (95% CI 74–100) in the SABR group (five events) compared with 80% (95% CI 65–97) in the surgery group (HR 0 · 69 [95% CI 0 · 21–2 · 29]; six events; log-rank p=0 · 54)."

	Local	Regional	Distant	Total
SABR	1	4	1	6
Surgery	0	1	2	3

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Two failed trials
Inadequate numbers
Incorrect analysis
Dangerously incorrect conclusions and popular press

Lobectomy versus Stereotactic Body Radiotherapy in Healthy Patients with Stage I Lung Cancer

Joshua E. Rosen, BASc,[1] Michelle C. Salazar, MD,[1] Zuoheng Wang, PhD,[2]

James B. Yu, MD MHS,[3] Roy H. Decker, MD PhD,[3] Anthony W. Kim, MD,[1] Frank C. Detterbeck, MD,[1] Daniel J. Boffa, MD[1]

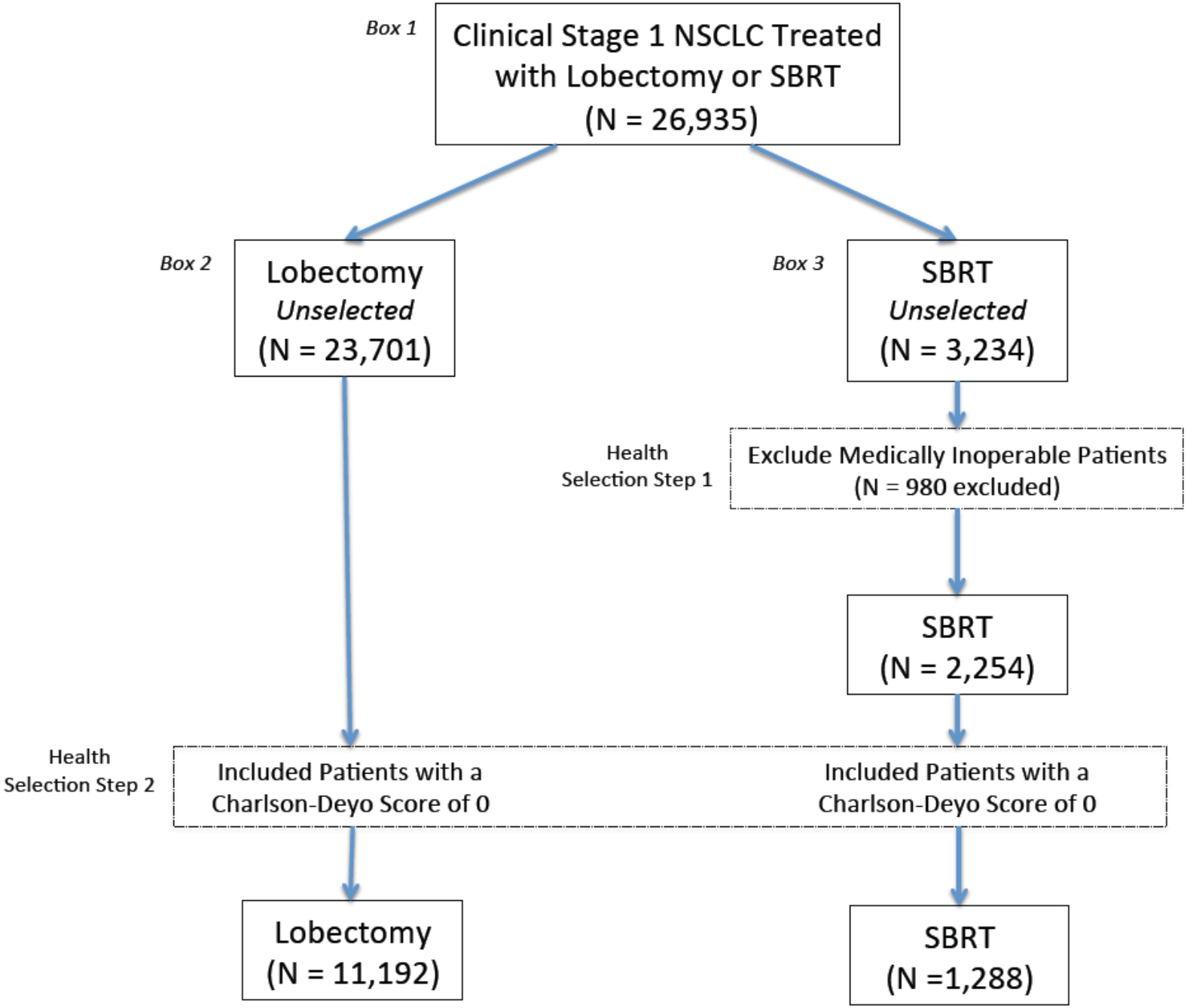
Objective: To determine whether SBRT and anatomic surgical resection (lobectomy) offer equivalent survival in otherwise healthy patients with stage I NSCLC.

Design: Retrospective cohort study using data from 2008-2011 in the National Cancer Database (NCDB).

Setting: Large national database capturing 70% of incident cancer cases in the United States.

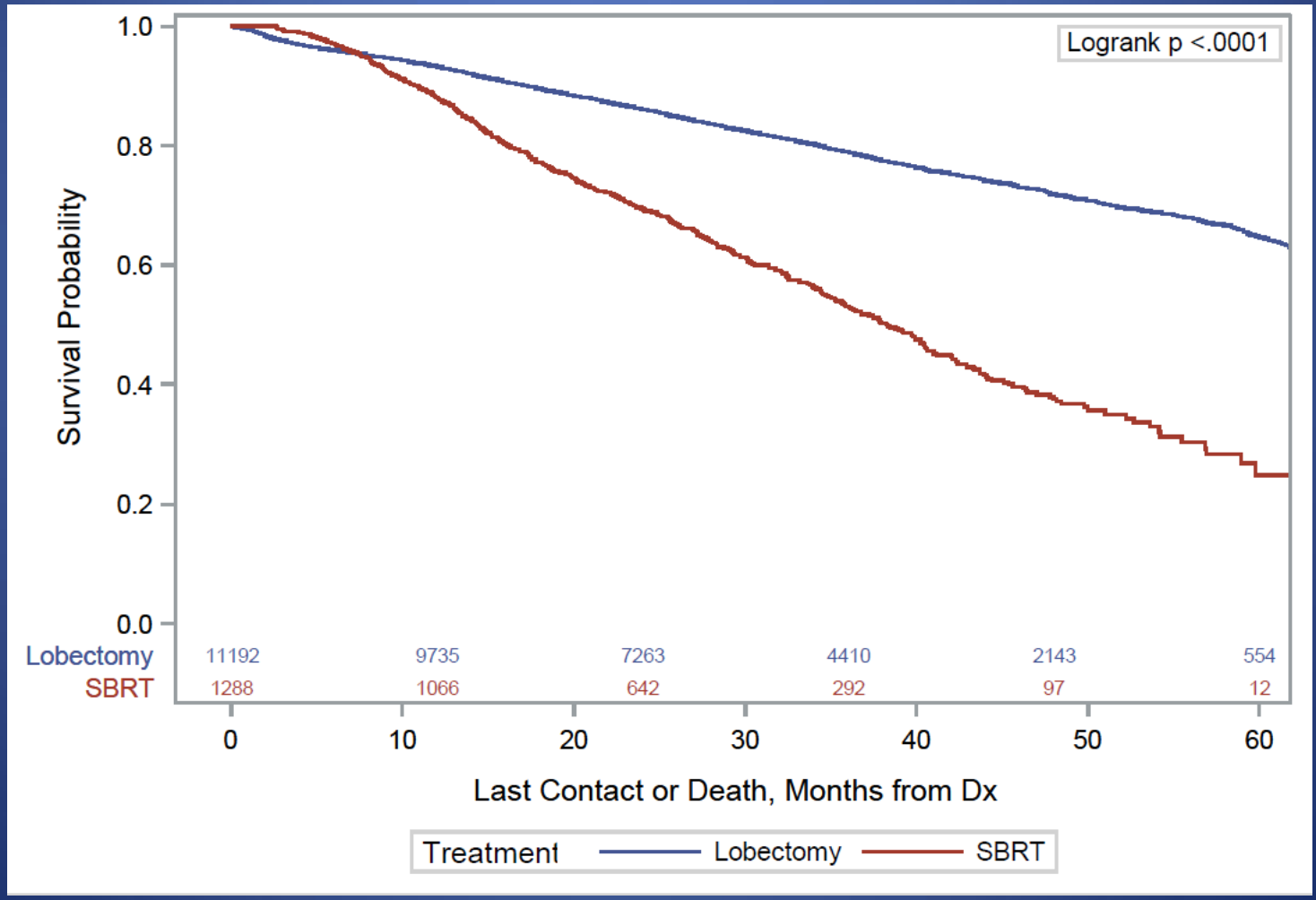
Participants: Treatment naïve patients who underwent either lobectomy or SBRT for clinical stage I NSCLC in the NCDB between 2008 and 2011. To select healthy patients, SBRT patients not offered surgery because of health-related reasons were excluded. Furthermore, only patients documented to be free of comorbidities were included. A secondary analysis of all lobectomy patients (regardless of comorbid status) vs. SBRT patients who were offered surgery but refused was also performed.

Main Outcome Measures: Overall survival from the time of diagnosis


Box 1
Clinical Stage 1 NSCLC Treated with Lobectomy or SBRT (N = 26,935)
Box 2
Lobectomy Unselected (N = 23,701)
Box 3
SBRT Unselected (N = 3,234)
Health Selection Step 1
Exclude Medically Inoperable Patients (N = 980 excluded)
SBRT (N = 2,254)
Health Selection Step 2
Included Patients with a Charlson-Deyo Score of 0
Included Patients with a Charlson-Deyo Score of 0
Lobectomy (N = 11,192)
SBRT (N =1,288)

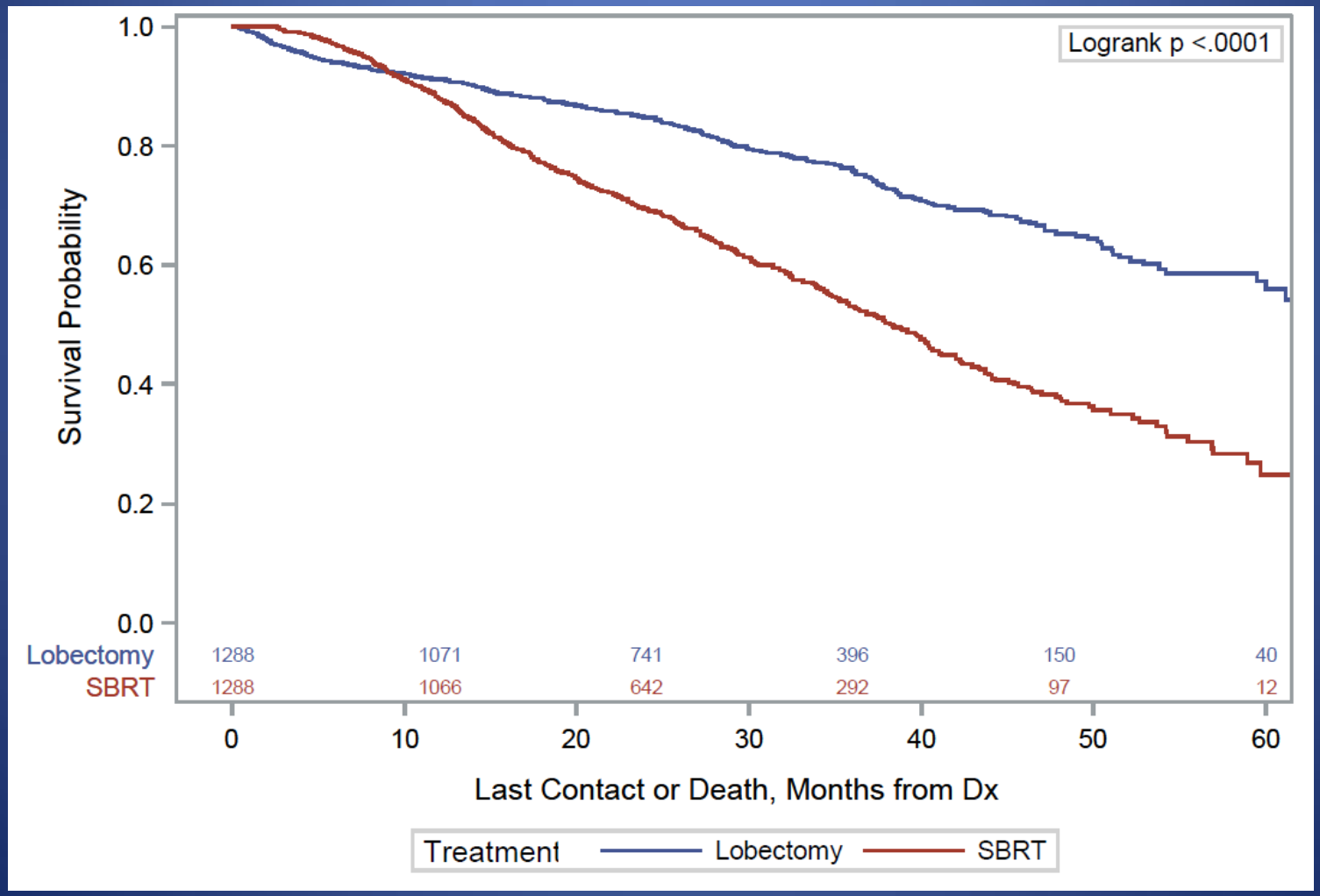
Lobectomy versus Stereotactic Body Radiotherapy in Healthy Patients with Stage I Lung Cancer

The un-matched population



Lobectomy versus Stereotactic Body Radiotherapy in Healthy Patients with Stage I Lung Cancer

The propensity-matched population



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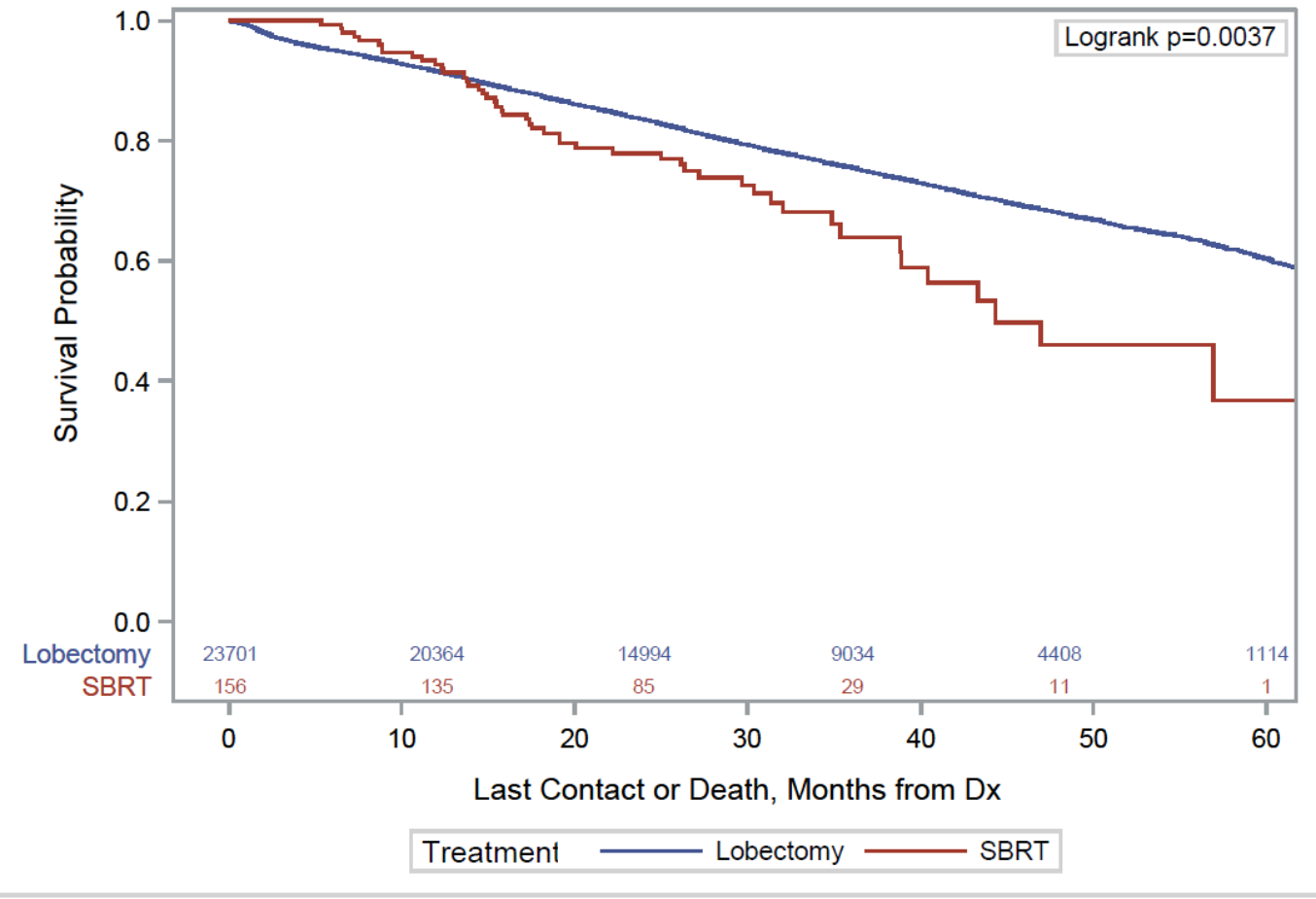
The cohort of SBRT patients who were recommended to have surgery, but refused.



Sublobar Resection for Lung Cancer Advantages Over SBRT

- Histologic confirmation
- Assessment of margins
- Nodal staging
- Easier interpretation of follow-up imaging
- Better cancer outcomes

PRINCIPLES OF SURGICAL THERAPY (1 of 4)

- **Resection is the preferred local treatment modality (other m**
  surgical oncology consultation should be part of the evalua
  SABR is considered for high-risk patients, a multidisciplinar
  - Thoracic surgeons should actively participate in multidisciplinary discussions and meetings regarding lung cancer patients (eg,

Resection

- Anatomic pulmonary resection is preferred for the majority of patients with NSCLC.
- Sublobar resection - Segmentectomy and wedge resection should achieve parenchymal resection margin
- Sublobar resection should also sample appropriate N1 and N2 lymph node stations unless not technically increasing the surgical risk.
- Segmentectomy (preferred) or wedge resection is appropriate in selected patients for the following reaso
  - Poor pulmonary reserve or other major comorbidity that contraindicates lobectomy
  - Peripheral nodule[1] ≤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)

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.

Case presentation

67 yo non-smoker male

University Chancellor

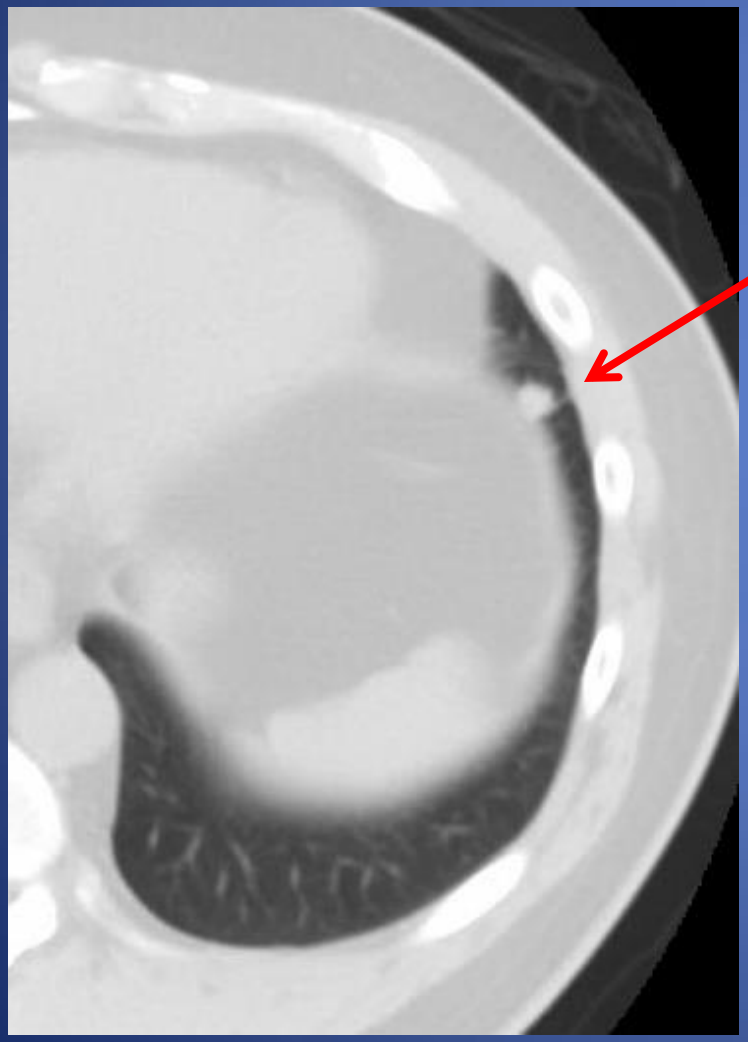
Healthy

2012 - CT → 8mm LLL nodule

2014 – CT chest → 13 mm LLL nodule

Biopsy → adenocarcinoma

Case presentation



Case Presentation

A. Radiologic observation
B. Wedge resection
C. Segmentectomy
D. Lobectomy
E. SBRT