5º Simpósio Internacional Grupo ONCOCLÍNICAS

2017

Minimally Invasive Thoracic Surgery: From VATS to Robotics
A Critical View

5° Simpósio Internacional Grupo ONCOCLÍNICAS

The University of Tennessee WEST Cancer Center Methodist Healthcare Family

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Financial Disclosures:

Proctor for Intuitive Surgery

Video-Assisted Thoracic Surgery Lobectomy: Experience With 1,100 Cases

Robert J. McKenna, Jr, MD, Ward Houck, MD, and Clark Beeman Fuller, MD

(Ann Thorac Surg 2006;81:421–6)

Thoracoscopic Lobectomy Is a Safe and Versatile Procedure

Experience With 500 Consecutive Patients

Mark W. Onaitis, MD, Rebecca P. Petersen, MD, MSc, Stafford S. Balderson, PA-C, Eric Toloza, MD, PhD, William R. Burfeind, MD, David H. Harpole, Jr., MD, and Thomas A. D'Amico, MD

(*Ann Surg* 2006;244: 420–425)

Definition of Minimally Invasive Lobectomy

- Anatomic resection of an entire lobe using video camera
- No rib spreading
- Individual ligation of hilar structures
- Complete node dissection

MIS Advantages Over Open Surgery

- Less postoperative pain
- Faster return to normal activities
- Shorter length of stay
- Preservation of pulmonary function
- Consistent delivery of adjuvant therapy
- Suitable in many patients previously considered inoperable
- Lower hospital costs

Why Robotic?

- Surgeon's comfort
- Stable camera
- 3 dimensional magnified view
- Instruments with 7 degrees of freedom
- Dual console – easier to teach???
- Easier transition from open to MIS ?? Easier to teach surgeons – More patients benefit from MIS
- Easier to teach trainees

Robotic Surgery is More Expensive.

Prometeus 2012

The Andromeda Strain 1971

Mediastinal Surgery

Surg Endosc (2012) 26:261–266
DOI 10.1007/s00464-011-1879-7

Robot-assisted thymectomy is superior to transsternal thymectomy

Benny Weksler · Jonathan Tavares · Timothy E. Newhook · Christopher E. Greenleaf · James T. Diehl

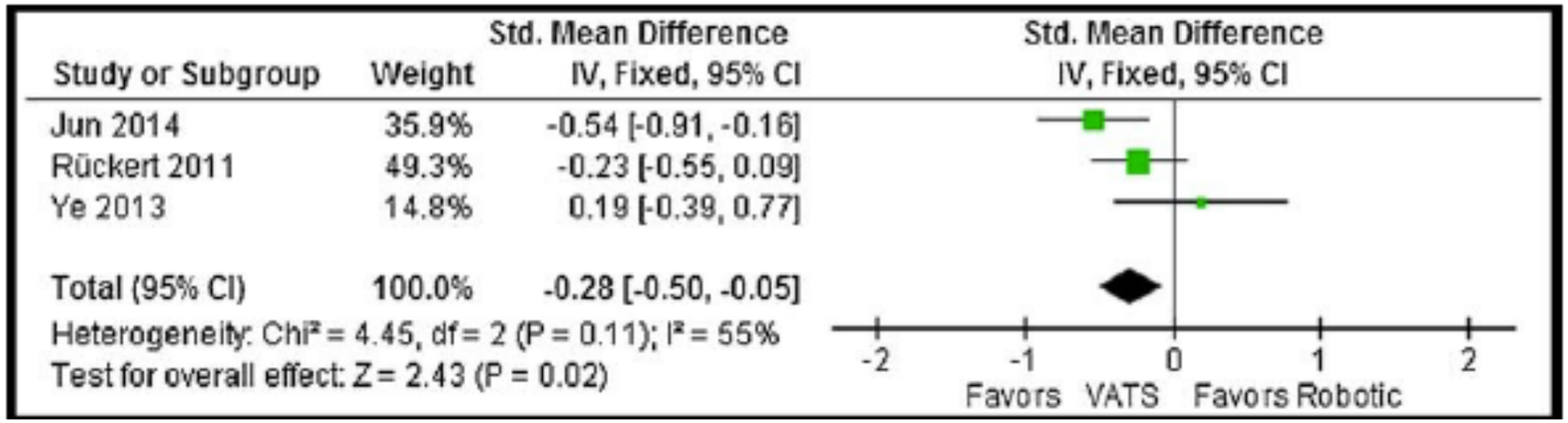
Video-Assisted Thoracoscopic Versus Robotic-Assisted Thoracoscopic Thymectomy

Systematic Review and Meta-analysis

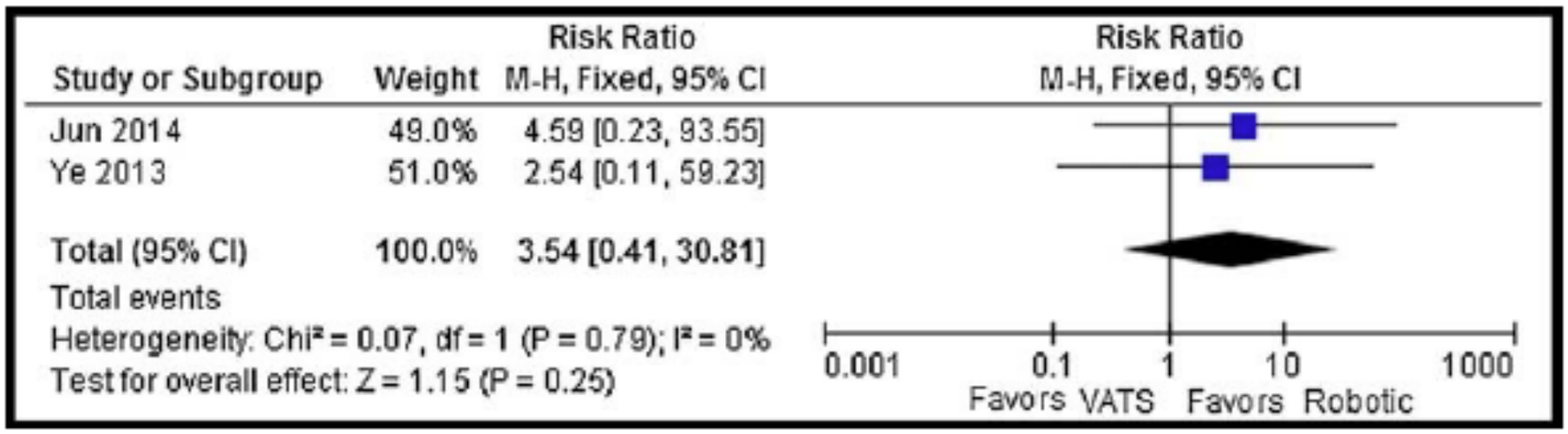
Matthew Fok, MSc, Mohamad Bashir, MD, PhD,† Amer Harky, MRCS,† David Sladden, MD,† Mariano DiMartino, MBBS,† Hazim Elsyed, BSc,* Callum Howard, BSc,* Maxwell Knipe, BSc,* and Michael J. Shackcloth, FRCS‡*

(*Innovations* 2017;12:259–264)

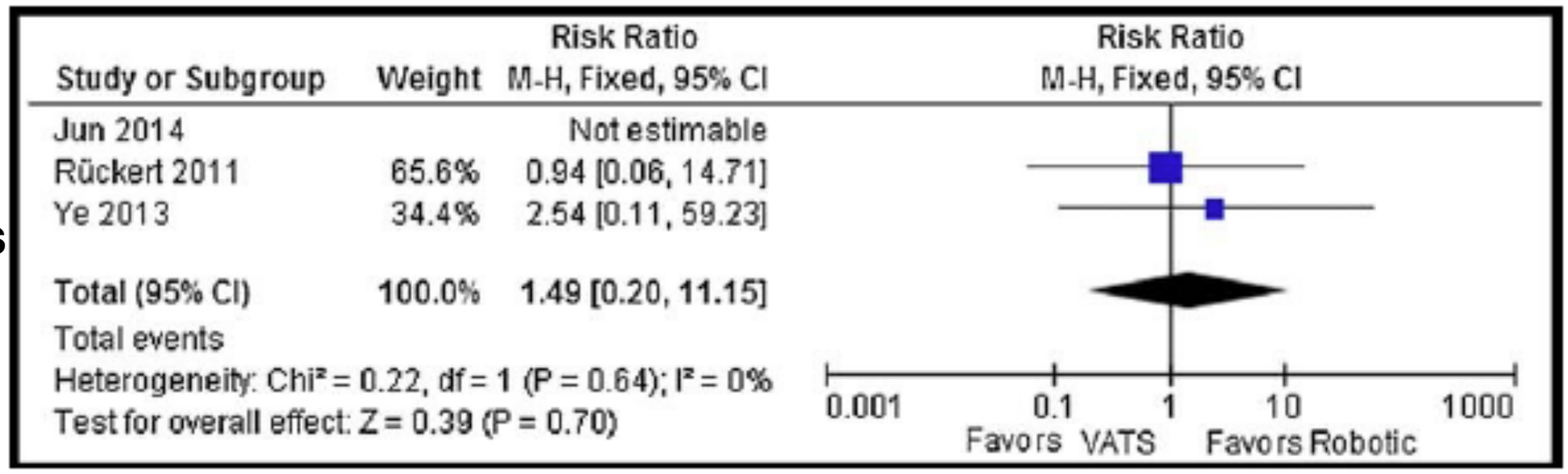
Op time



Post op pneumonia



Conversions



Esophagus

Diseases of the Esophagus (2012) **25**, 403–409
DOI: 10.1111/j.1442-2050.2011.01246.x

DISEASES OF THE ESOPHAGUS

Original article

Robot-assisted minimally invasive esophagectomy is equivalent to thoracoscopic minimally invasive esophagectomy

B. Weksler,[1,2] P. Sharma,[2] N. Moudgill,[2] K. A. Chojnacki,[2] E. L. Rosato[2]

[1]*Department of Cardiothoracic Surgery, University of Pittsburgh Medical Center, Pittsburgh, and* [2]*Divisions of Thoracic Surgery and General and Minimally Invasive Surgery, Department of Surgery, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA*

	RA MIE n (%) (median, range)	MIE (n=26) n (%) (median, range)	p
Operative time (minutes)	439±70 (445, 306-536)	484 ±76.5 (510, 345-669)	0.105
Pyloroplasty/jejunostomy	11 (100%)	24 (100%)	1.0
EBL (ml)	200±150 (150, 50-600)	226±372 (150, 50-2000)	0.819
Number of resected nodes	23±10 (19, 10-47)	23±10 (20.5, 13-53)	0.950
Stapled anastomosis	11 (100%)	23 (88.5%)	0.540

	RA MIE (n=11) (median, range)	MIE (n=26) (median, range)	P
LOS (days)	8.7±3.4 (7, 5-16)	10.0±7.7 (8.5, 1-45)	0.59
ICU LOS (days)	3.5±2.3 (4, 1-9)	2.9±1.8 (2, 1-9)	0.40
Mechanical Ventilations (days)	1.27 (1, 0-5)	0.96 (1, 0-3)	0.97
Complications	4 patients (36.4%)	10 patients (41.7%)	0.77
Death	0	2 (7.6%)	1.000

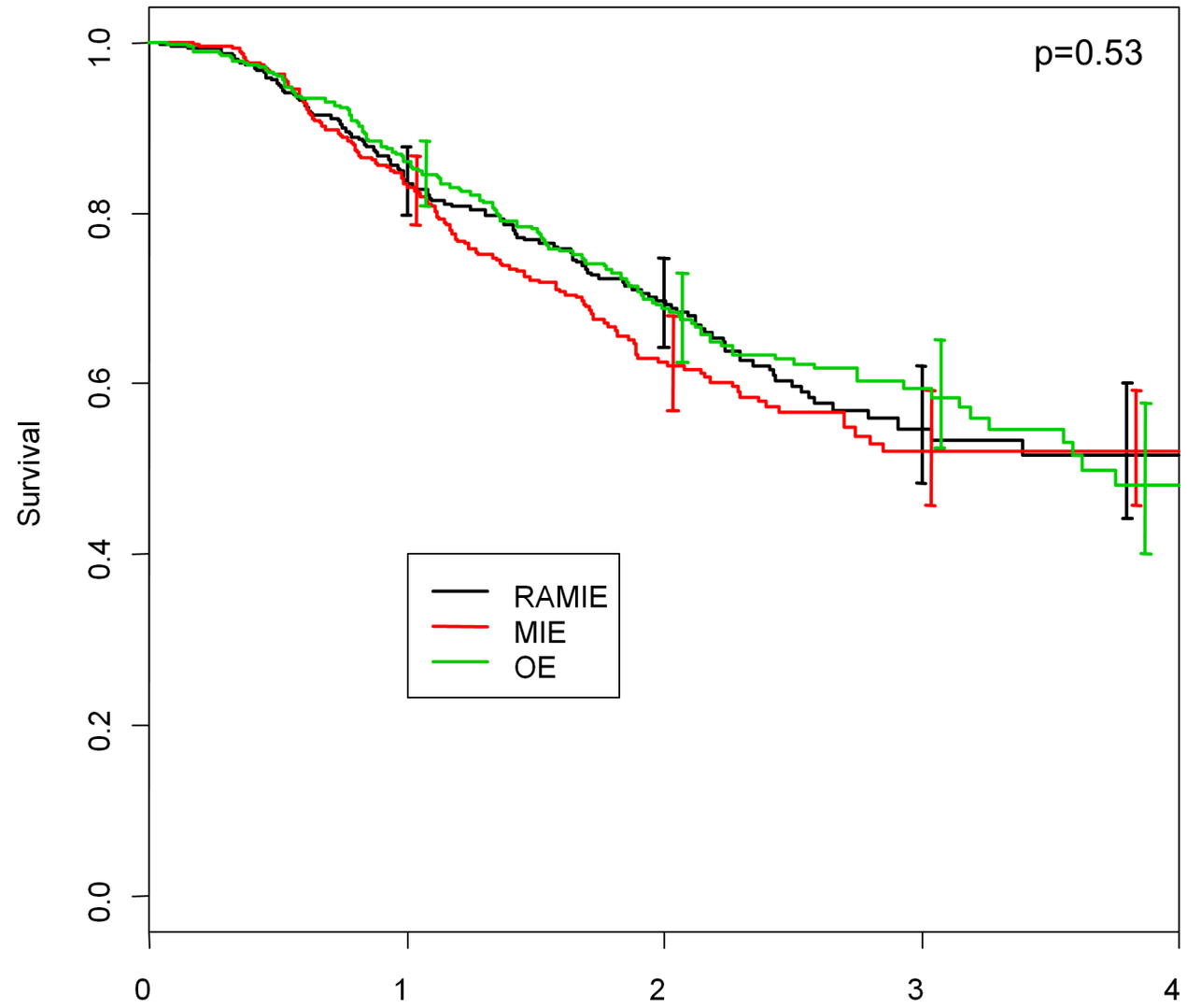
Survival After Esophagectomy: A Propensity-Matched Study of Different Surgical Approaches

Benny Weksler, MD, and Jennifer L. Sullivan, MD

Division of Thoracic Surgery, University of Tennessee Health Science Center, Memphis, Tennessee

(Ann Thorac Surg 2017;104:1138–46)

Variable	Outcome	Obs.
Nodes harvested	No differecnces	
Positive nodes	No differences	
Path stage	No differences	
R0 resection	No differences	
30-day mortality	Trend	Favors MIE and Open
90-day mortality	No differences	
30-day readmission	No differences	



Patients at risk

OE	369	293	169	62	15
RAMIE	369	264	157	44	9
MIE	369	276	139	46	7

Lung

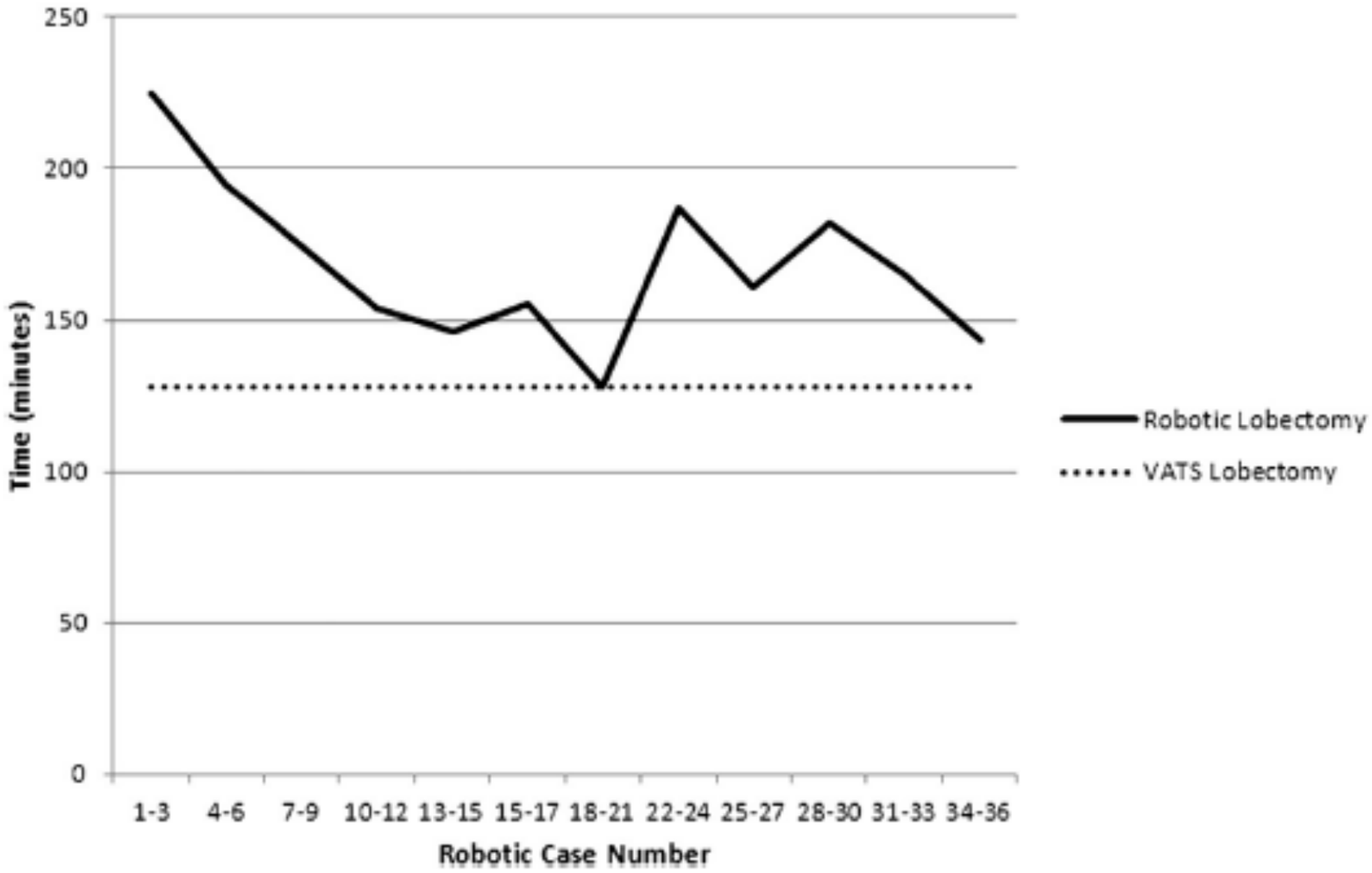
Transitioning from video-assisted thoracic surgical lobectomy to robotics for lung cancer: Are there outcomes advantages?

Benjamin E. Lee, MD,[a,b] Robert J. Korst, MD,[a,b] Elaine Kletsman, PA,[a,b] and John R. Rutledge, MAS[a]

(J Thorac Cardiovasc Surg 2014;147:724-9)

	VATS (n = 34)	Robotic (n = 35)	*P* value
Overall operative time, median minutes (range)	128 (71-237)	161 (104-272)	<.001
Upper lobectomy, median minutes (range)	134 (92-222)	172 (118-240)	
Lower lobectomy, median minutes (range)	123 (71-237)	140 (104-272)	
Stapler loads, median no. (range)	9 (5-23)	9.5 (5-13)	.74
Lymph nodes removed, median no. (range)	16 (2-44)	18 (4-77)	.42
Lymph node stations dissected, median no. (range)	2 (1-3)	3 (2-4)	.14
Length of stay, median days (IQR)	3 (2-4)	3 (2-6)	.67
Morbidity, no. (%)	6 (18)	4 (11)	.46
Mortality, no. (%)	1 (3)	0 (0)	.49
Pathologic stage, no. (%)			
IA	16 (47)	22 (63)	.64
IB	6 (18)	5 (14)	
IIA	6 (18)	2 (6)	
IIB	3 (9)	2 (6)	
IIIA	2 (6)	3 (8)	
IVB	1 (3)	1 (3)	

VATS, Video-assisted thoracoscopic surgery; *IQR*, interquartile range.


250
200
150
100
50
0
Time (minutes)
1-3
4-6
7-9
10-12
13-15
15-17
18-21
22-24
25-27
28-30
31-33
34-36
Robotic Case Number
Robotic Lobectomy
VATS Lobectomy

Comparing robot-assisted thoracic surgical lobectomy with conventional video-assisted thoracic surgical lobectomy and wedge resection: Results from a multihospital database (Premier)

Scott J. Swanson, MD,[a] Daniel L. Miller, MD,[b] Robert Joseph McKenna, Jr, MD,[c] John Howington, MD,[d] M. Blair Marshall, MD,[e] Andrew C. Yoo, MD,[f] Matthew Moore, MHA,[g] Candace L. Gunnarsson, EdD,[h] and Bryan F. Meyers, MD[i]

(J Thorac Cardiovasc Surg 2014;147:929-37)

TABLE 5. Length of stay, hospital costs, and surgery time after matching

	Lobectomy		
	RATS	**VATS**	***P* value**
Length of stay (d)			
Median	4	4	
Mean	6.07	5.83	.6131
SD	6.44	5.03	
Total hospital costs ($)			
Median	21,833.34	18,080.11	
Mean	25,040.70	20,476.58	<.0001
SD	13,164.01	10,977.67	
Operating room time (h)			
Median	4.25	4	
Mean	4.49	4.23	.0959
SD	1.98	1.73	

RATS, Robot-assisted thoracic surgery; *VATS*, video-assisted thoracic surgery; *SD*, standard deviation.

Nodal Upstaging in Robotic and Video Assisted Thoracic Surgery Lobectomy for Clinical N0 Lung Cancer

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(Ann Thorac Surg 2015;100:229–34)

Table 3. Nodal Upstaging in Video-Assisted Thoracic Surgery Versus Robotic Lobectomy (N = 211)

Procedure	T stage	No.	pN0 No. (%)	pN1 No. (%)	pN2 No. (%)	Total (pN1+pN2) No. (%)	*p* Value
VATS	cT1	119	104 (87.4)	8 (6.7)	7 (5.9)	15 (12.6)	0.72
	cT2	36	27 (75)	5 (13.9)	4 (11.1)	9 (25)	
	cT3	3	3 (100)	0	0	0	
Robotics	cT1	40	35 (87.5)	3 (7.5)	2 (5)	5 (12.5)	
	cT2	10	8 (80)	2 (20)	0	2 (20)	
	cT3	3	3 (100)	0	0	0	

VATS = video-assisted thoracic surgery.

Interactive CardioVascular and Thoracic Surgery 21 (2015) 409–414
doi:10.1093/icvts/ivv155 Advance Access publication 27 June 2015

ORIGINAL ARTICLE – THORACIC

Cite this article as: Ye X, Xie L, Chen G, Tang J-M, Ben X-S. Robotic thoracic surgery versus video-assisted thoracic surgery for lung cancer: a meta-analysis. Interact CardioVasc Thorac Surg 2015;21:409–14.

Robotic thoracic surgery versus video-assisted thoracic surgery for lung cancer: a meta-analysis

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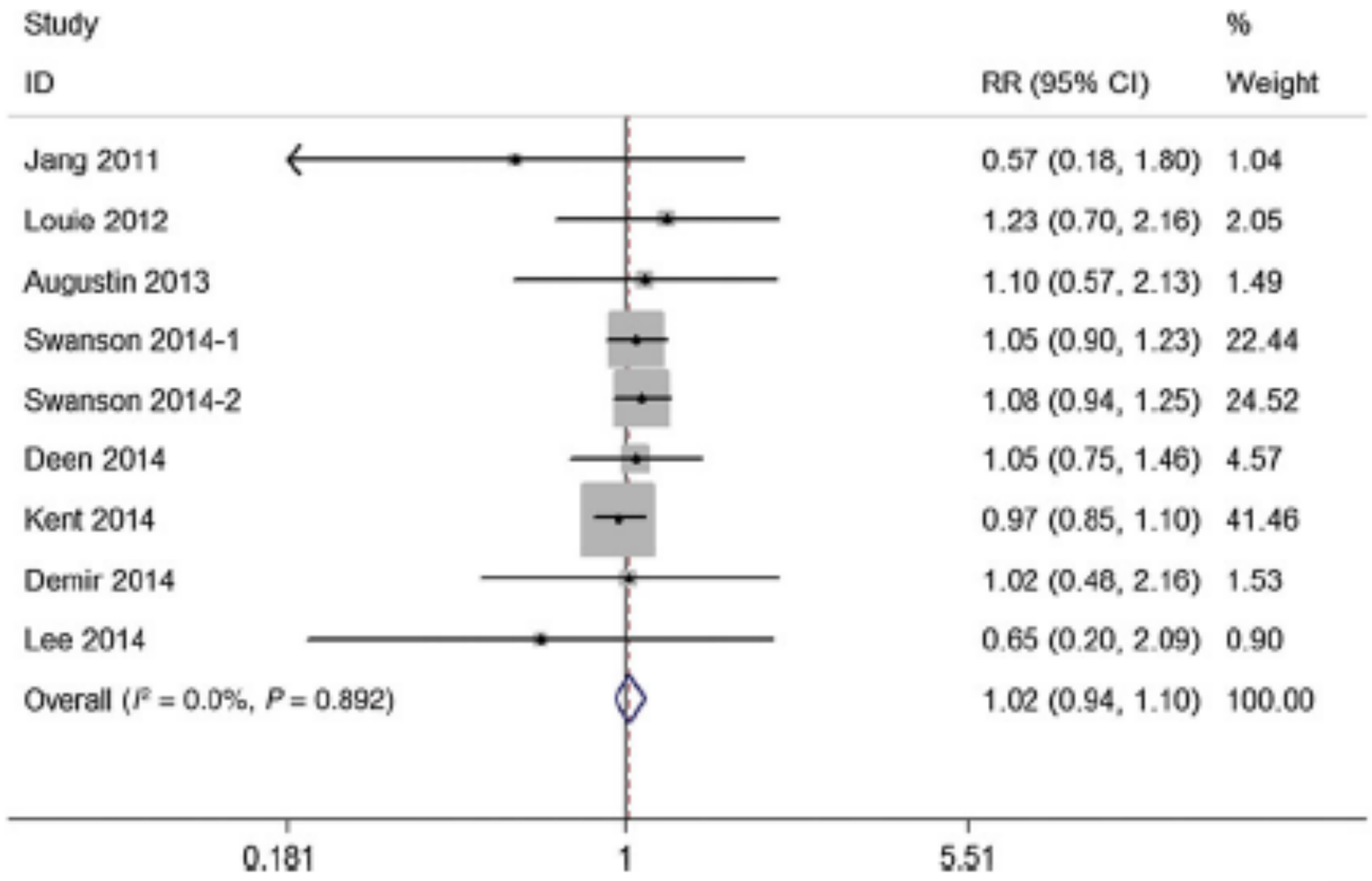
Received 6 March 2015; received in revised form 4 May 2015; accepted 18 May 2015


Study
ID
RR (95% CI)
%
Weight
Jang 2011
0.57 (0.18, 1.80)
1.04
Louie 2012
1.23 (0.70, 2.16)
2.05
Augustin 2013
1.10 (0.57, 2.13)
1.49
Swanson 2014-1
1.05 (0.90, 1.23)
22.44
Swanson 2014-2
1.08 (0.94, 1.25)
24.52
Deen 2014
1.05 (0.75, 1.46)
4.57
Kent 2014
0.97 (0.85, 1.10)
41.46
Demir 2014
1.02 (0.48, 2.16)
1.53
Lee 2014
0.65 (0.20, 2.09)
0.90
Overall (I^2 = 0.0%, P = 0.892)
1.02 (0.94, 1.10)
100.00
0.181
1
5.51

Open, Video-Assisted Thoracic Surgery, and Robotic Lobectomy: Review of a National Database

Michael Kent, MD,* Thomas Wang, PhD,* Richard Whyte, MD, Thomas Curran, MD, Raja Flores, MD, and Sidhu Gangadharan, MD

Division of Thoracic Surgery and Interventional Pulmonology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston Massachusetts; Department of Economics, Harvard University, Cambridge, Massachusetts; and Division of Thoracic Surgery, Mount Sinai Medical Center, New York, New York

(Ann Thorac Surg 2014;97:236–44)

Table 4. Propensity-Matched Analysis of Patients Undergoing Open, Video-Assisted Thoracic Surgery (VATS) or Robotic Pulmonary Resection

Outcome	Open (n = 1,233)	VATS (n = 1,233)	Robotic (n = 411)	*p* Value[a]	*p* Value[b]
Mortality	25 (2.0%)	14 (1.1%)	1 (0.2%)	0.122	0.016
LOS (mean)	8.2	6.3	5.9	0.454	<0.0001
Routine discharge	734 (59.5%)	795 (64.5%)	262 (63.7%)	0.828	0.214
Prolonged LOS	118 (9.6%)	85 (6.9%)	18 (4.4%)	0.118	0.003
Any complication	667 (54.1%)	558 (45.3%)	180 (43.8%)	0.674	0.003
Bleeding complication	24 (1.9%)	16 (1.3%)	7 (1.7%)	0.633	0.795

[a] Between robot and VATS resections. [b] Between robot and open resections.

LOS = length of stay; VATS = video-assisted thoracic surgery.

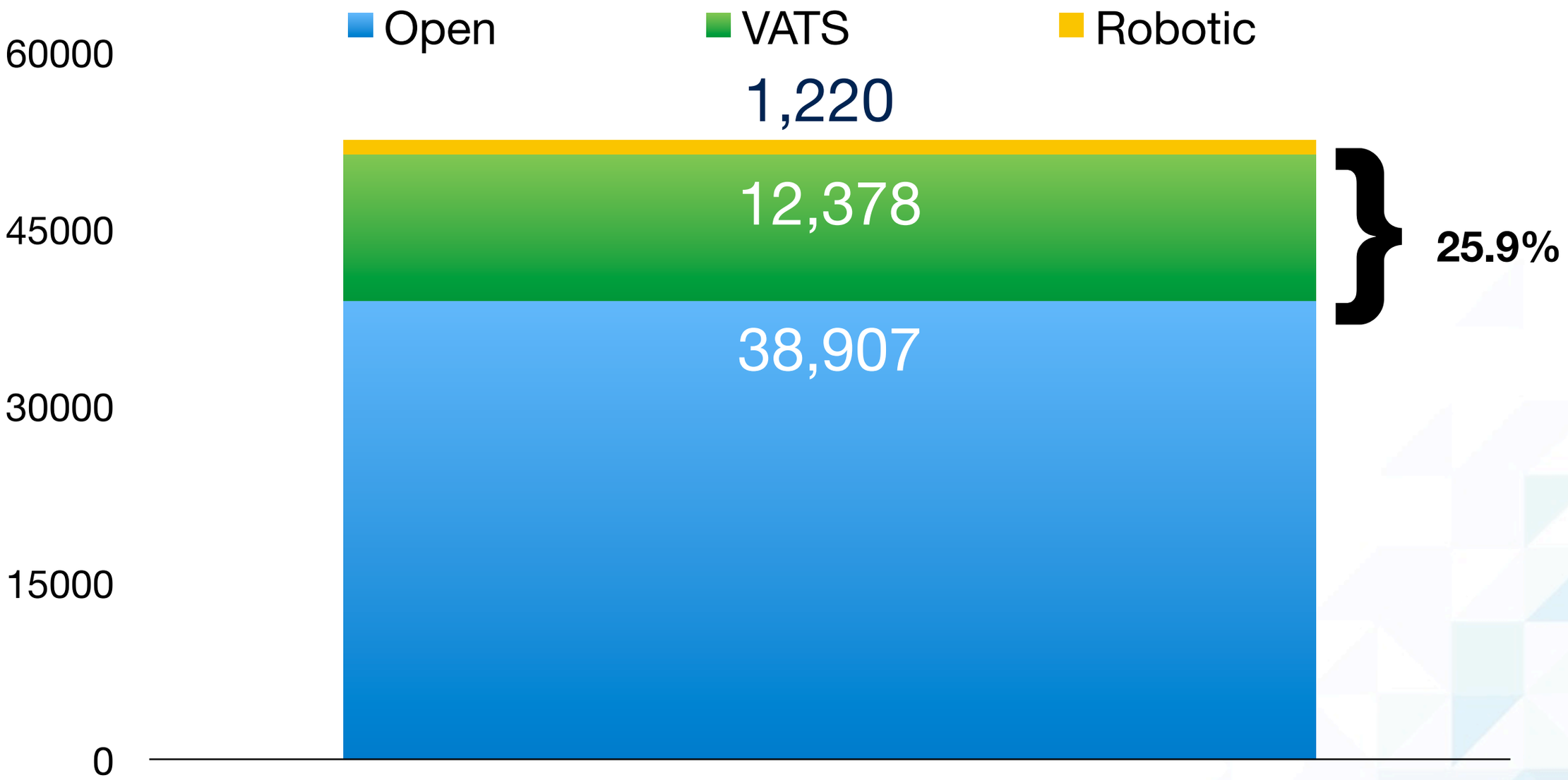
Comparison of Video-Assisted Thoracoscopic Surgery and Robotic Approaches for Clinical Stage I and Stage II Non-Small Cell Lung Cancer Using The Society of Thoracic Surgeons Database

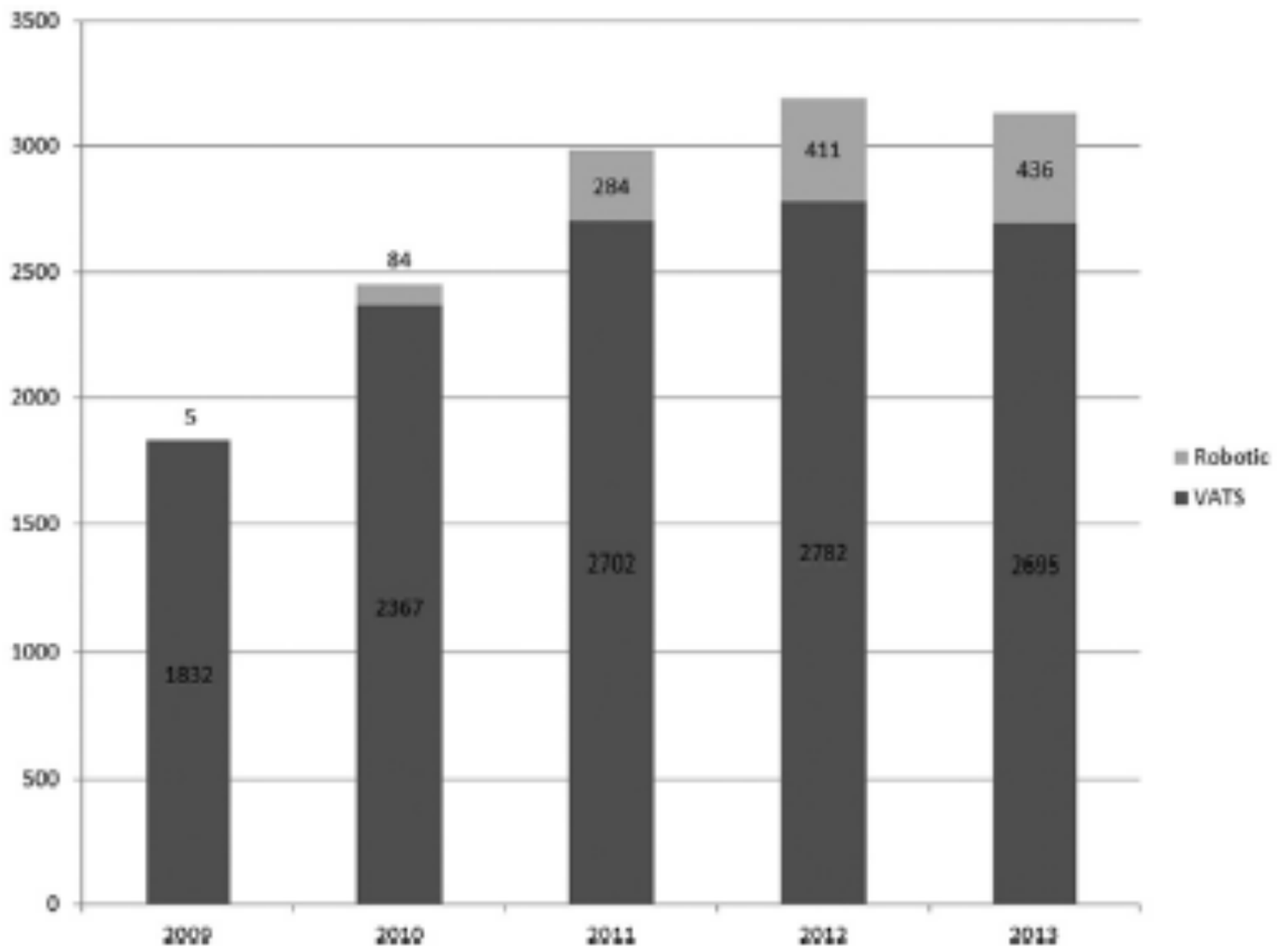
Brian E. Louie, MD, Jennifer L. Wilson, MD, Sunghee Kim, PhD, Robert J. Cerfolio, MD, Bernard J. Park, MD, Alexander S. Farivar, MD, Eric Vallières, MD, Ralph W. Aye, MD, William R. Burfeind, Jr, MD, and Mark I. Block, MD

Division of Thoracic Surgery, Swedish Cancer Institute, Seattle, Washington; Division of Thoracic Surgery, Beth Israel Deaconess Medical Center, Boston, Massachusetts; Duke Clinical Research Institute, Duke University Medical Center, Durham, North Carolina; Department of Cardiothoracic Surgery, University of Alabama at Birmingham, Birmingham, Alabama; Division of Thoracic Surgery, Memorial Sloan-Kettering Cancer Center, New York, New York; Division of Thoracic Surgery, St. Luke's University Health Network, Bethlehem, Pennsylvania; and Division of Thoracic Surgery, Memorial Healthcare System, Hollywood, Florida

(Ann Thorac Surg 2016;■:■–■)

STS Database 2009-2013




3500
3000
2500
2000
1500
1000
500
0
5
1832
84
2367
284
2702
411
2782
436
2695
2009
2010
2011
2012
2013
Robotic
VATS

Operative Time

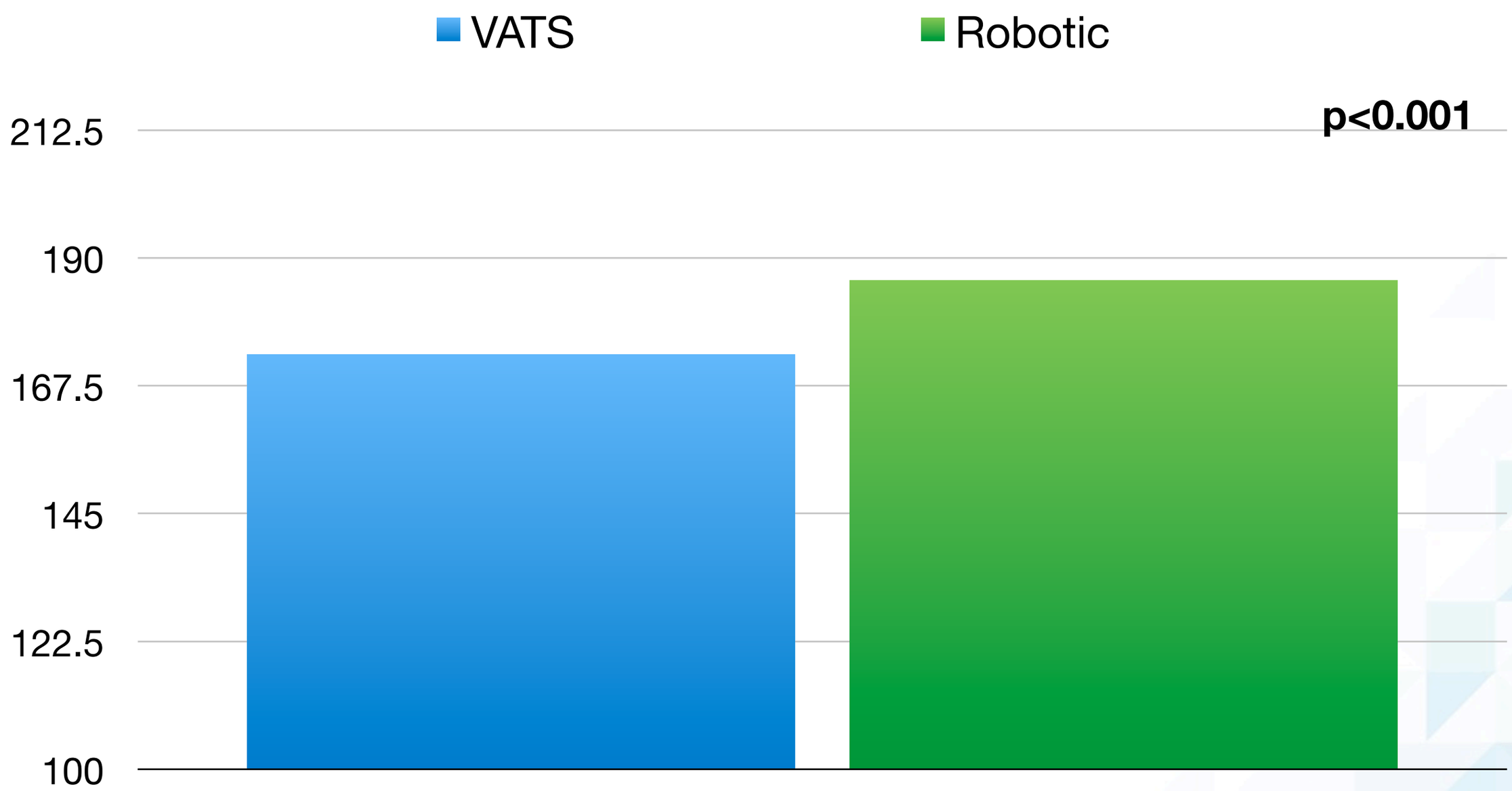


Table 3. Postoperative Morbidity

Variable	Overall N = 13,598	Robotic N = 1,220	VATS N = 12,378	*p* Value
Air leak >5 days	1,334 (9.8%)	122 (10.0%)	1,212 (9.8%)	0.8135
Atelectasis requiring bronchoscopy	391 (2.9%)	31 (2.5%)	360 (2.9%)	0.4625
Pneumonia	442 (3.3%)	33 (2.7%)	409 (3.3%)	0.2596
Adult respiratory distress syndrome	61 (0.4%)	2 (0.2%)	59 (0.5%)	0.1187
Respiratory failure	119 (1.9%)	16 (1.9%)	103 (1.9%)	0.9971
Bronchopleural fistula	42 (0.3%)	7 (0.6%)	35 (0.3%)	0.0808
Pulmonary embolus	62 (0.5%)	4 (0.3%)	58 (0.5%)	0.4858
Pneumothorax requiring CT reinsertion	474 (3.5%)	51 (4.2%)	423 (3.4%)	0.1697
Initial ventilatory support >48 hours	50 (0.4%)	6 (0.5%)	44 (0.4%)	0.4535
Reintubation	308 (2.3%)	25 (2.0%)	283 (2.3%)	0.5928
Tracheostomy	99 (0.7%)	9 (0.7%)	90 (0.7%)	0.9688
Atrial arrhythmia requiring treatment	1,346 (9.9%)	125 (10.2%)	1,221 (9.9%)	0.6840
Deep venous thrombosis	52 (0.4%)	5 (0.4%)	47 (0.4%)	0.8722
Empyema requiring treatment	50 (0.4%)	6 (0.5%)	44 (0.4%)	0.4546
Chylothorax requiring medical intervention	64 (0.5%)	4 (0.3%)	60 (0.5%)	0.4435
Unexpected admission to intensive care unit	452 (3.3%)	36 (3.0%)	416 (3.4%)	0.4547
Myocardial infarction	42 (0.3%)	5 (0.4%)	37 (0.3%)	0.5069
Recurrent laryngeal nerve Paresis/paralysis	26 (0.2%)	2 (0.2%)	24 (0.2%)	0.8177
Required reoperation for bleeding	65 (0.9%)	3 (0.8%)	62 (0.9%)	0.8449

CT = chest tube; VATS = video-assisted thoracoscopic surgery.

Table 4. Pathologic Nodal Upstaging Overall and Stratified by Clinical Staging

Clinical Stage	Proportion of Cases Upstaged to pN1 (Number Upstaged/Total Cases [%])			*p* Value
	Overall	Robotic Treatment	VATS	
cT1aN0	322/5,412 (5.95)	29/471 (6.16)	293/4,941 (5.93)	0.8422
cT1bN0	257/3,008 (8.54)	19/293 (6.48)	238/2,715 (8.77)	0.1844
cT2aN0	254/2,307 (11.01)	34/244 (13.93)	220/2,063 (10.66)	0.1228
cT2bN0	69/546 (12.64)	7/47 (14.89)	62/499 (12.42)	0.6263
Total	902/11,273 (8.00)	89/1,055 (8.44)	813/10,218 (7.96)	0.5847

VATS = video-assisted thoracoscopic surgery.

ORIGINAL ARTICLE

Long-term Survival Based on the Surgical Approach to Lobectomy For Clinical Stage I Nonsmall Cell Lung Cancer

Comparison of Robotic, Video-assisted Thoracic Surgery, and Thoracotomy Lobectomy

Hao-Xian Yang, MD,† Kaitlin M. Woo, MS,‡ Camelia S. Sima, MD, MS,‡ Manjit S. Bains, MD,*§ Prasad S. Adusumilli, MD,*§ James Huang, MD, MS,*§ David J. Finley, MD,*§ Nabil P. Rizk, MD, MS,*§ Valerie W. R[illegible] Park, MD*§*

Annals of Surgery • Volume XX, Number X, Month 2016

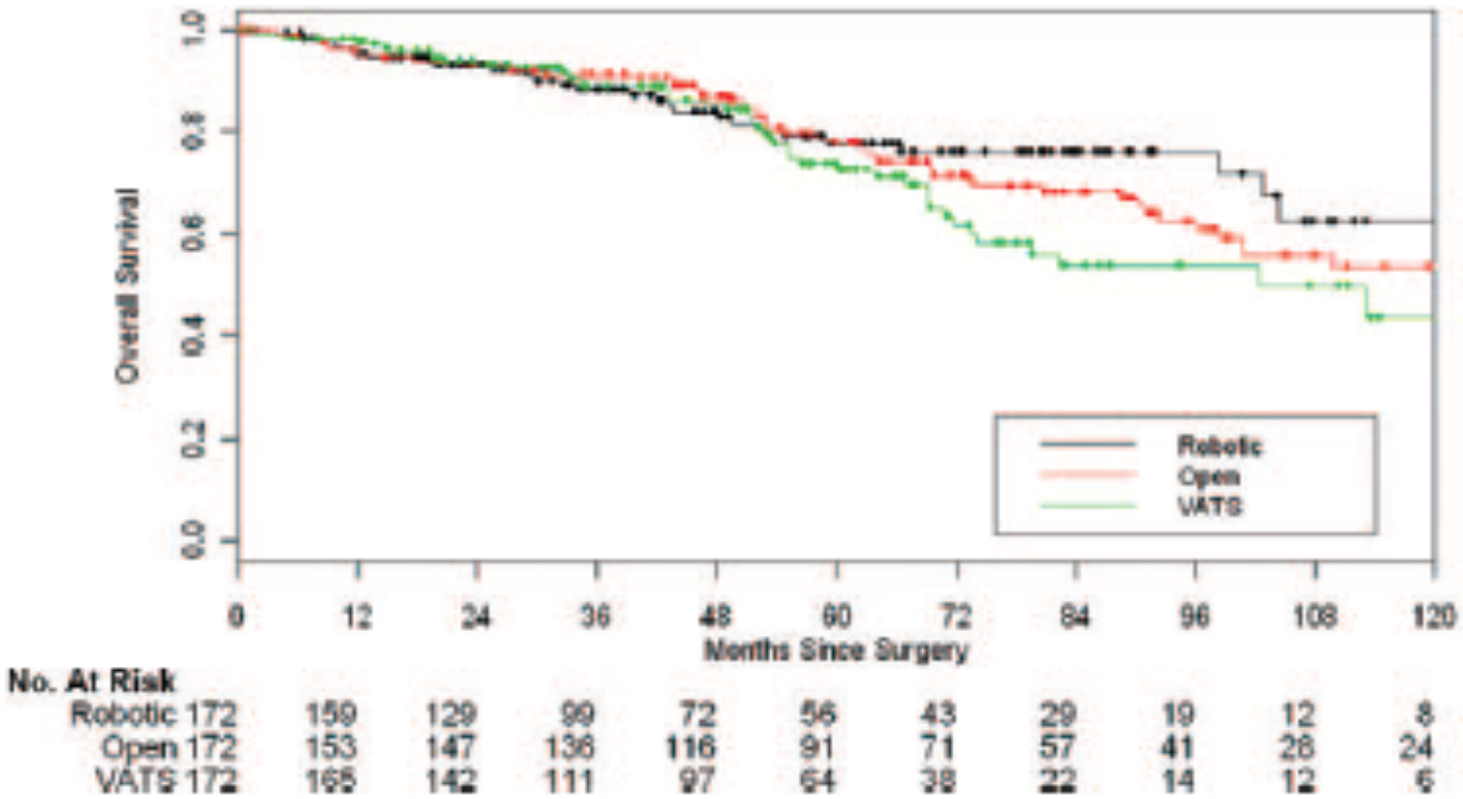

Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
Robotic
Open
VATS
0
12
24
36
48
60
72
84
96
108
120
Months Since Surgery
No. At Risk
Robotic 172 159 129 99 72 56 43 29 19 12 8
Open 172 153 147 136 116 91 71 57 41 28 24
VATS 172 165 142 111 97 64 38 22 14 12 6

TABLE 4. Surgery-related and Postoperative Outcomes of the Propensity Score-matched Groups (N = 470)

Characteristics	Approach			P
	Robotic (n = 172)	VATS (n = 141)	Open (n = 157)	
Mortality	0	1 (1)	0	0.30
LOS, d, median (range)	4 (1–32)	4 (2–50)	5 (2–29)	<0.001
Conversion to open	16 (9)	8 (6)	—	0.32
Conversion for bleeding	3	0	—	
Conversion for other reasons	13*	8†	—	
Sampled LN stations, median (range)	5 (0–8)	3 (0–7)	4 (1–8)	<0.001
Cases with complications	51 (29.7)	35 (24.8)	47 (29.9)	0.55
Resection completeness				0.99
R0	170 (99)	141 (100)	157 (100)	
R1	2 (1)	0	0	
Pathologic type				0.82
Adenocarcinoma	19 (11)	23 (16)	22 (14)	
Squamous cell carcinoma	91 (53)	69 (49)	73 (46)	
Carcinoid	39 (23)	30 (21)	40 (25)	
Other	23 (13)	19 (13)	22 (14)	
Pathologic N category				0.64
N0	145 (84)	121 (86)	137 (87)	
N1	20 (12)	14 (10)	11 (7)	
N2	7 (4)	6 (4)	9 (6)	
Pathologic stage				0.13
0-I‡	133 (77)	114 (81)	135 (86)	
II	29 (17)	21 (15)	12 (8)	
III/IV§	10 (6)	6 (4)	10 (6)	

Conclusions

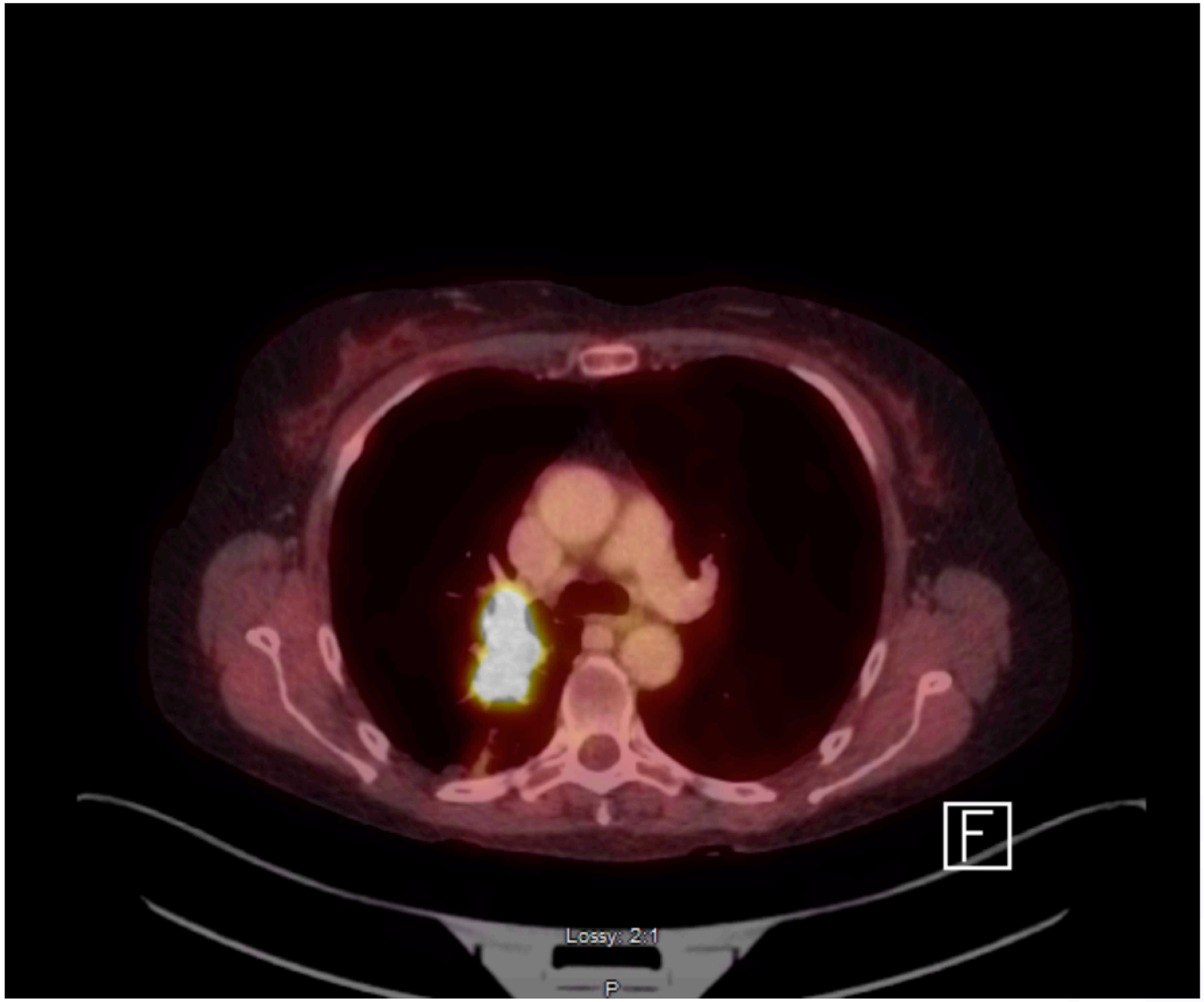
- Robotic lung surgery is equivalent to VATS in LOS, survival, nodal upstaging, and complications.

- It may allow open surgeons to convert from open surgery to MIS more easily

- It is an easier platform to teach

- Cost is a significant drawback

- There is no compelling reason for a competent VATS surgeon to switch to robotic surgery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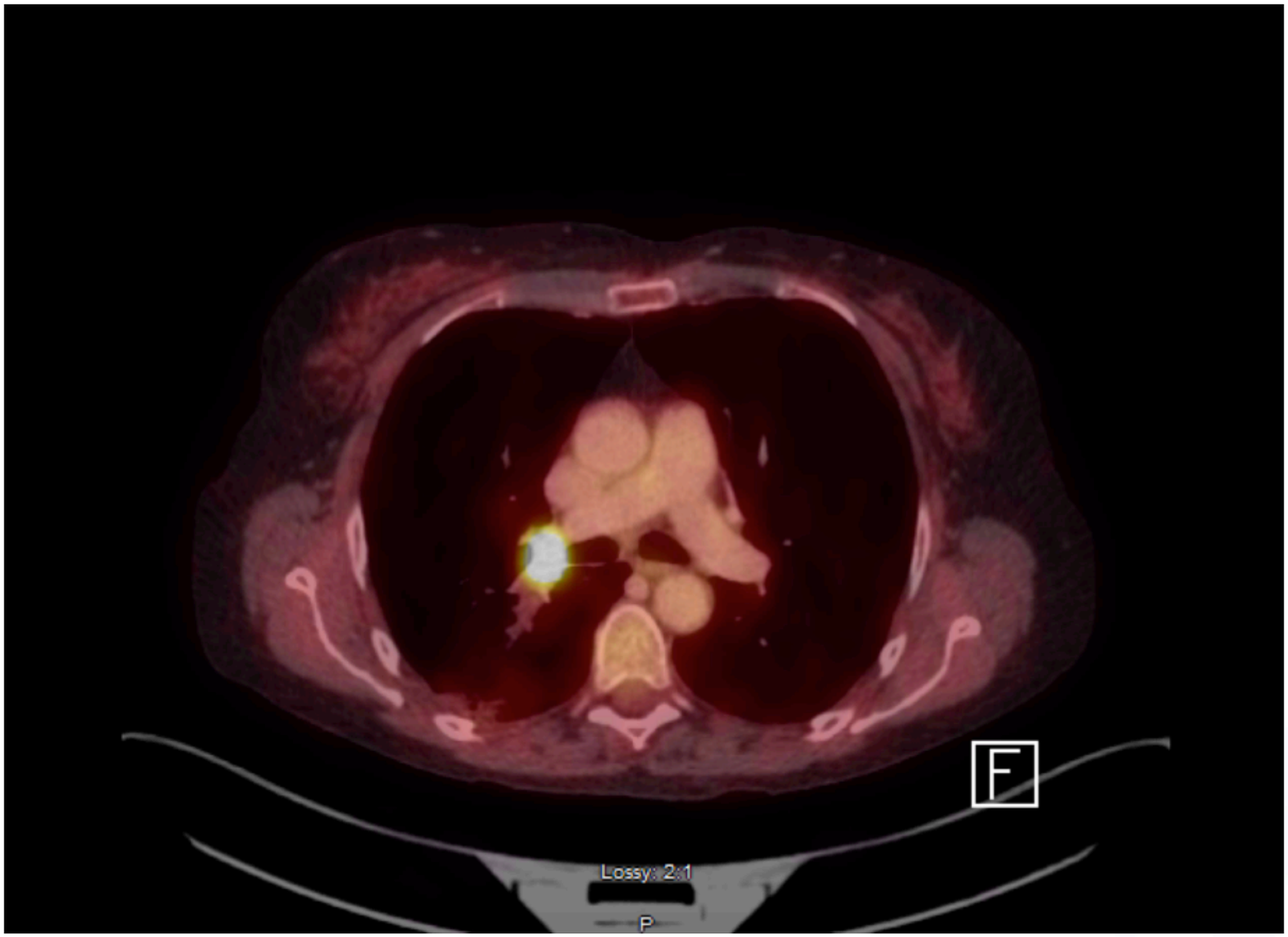
P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Lossy: 2:1
P

5º Simpósio Internacional Grupo ONCOCLÍNICAS