PNEUMOLOGIA 2018
Milano, 14 – 16 giugno 2018

Minimally invasive technique in lung cancer surgery

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University of Milan, Italy

Nowadays, lung cancer surgery is more minimally invasive due to the screening programs and to the early detection of lung cancer

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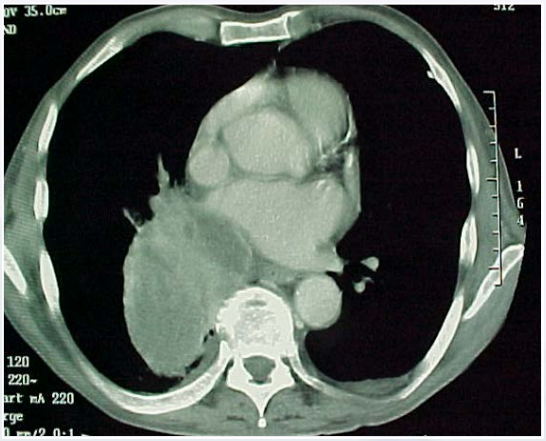
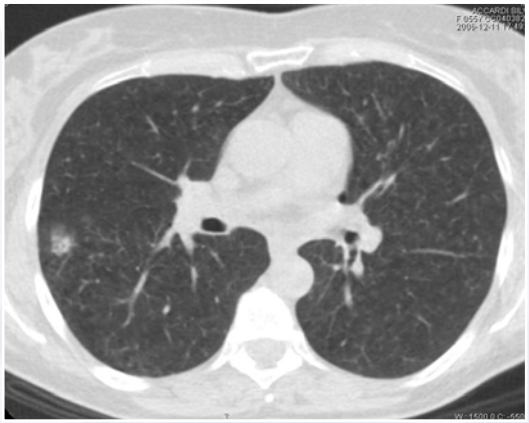
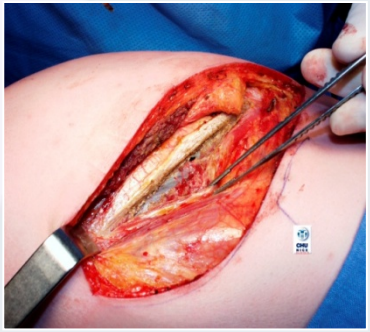
Evolution of Surgical Treatment







Posterolateral Thoracotomy

Lateral Muscle Sparing Thoracotomy

VATS Approach

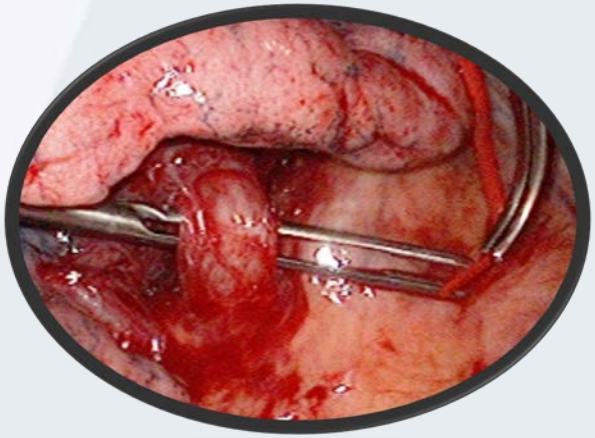
Robotic Approach

VATS pulmonary resection

"We define VATS pulmonary resection as a video assisted, minimally access approach in which the surgeon operates primarily by watching the television monitor and uses no rib spreading throughout the entire procedure"

Yim AP. Pearson, 2008

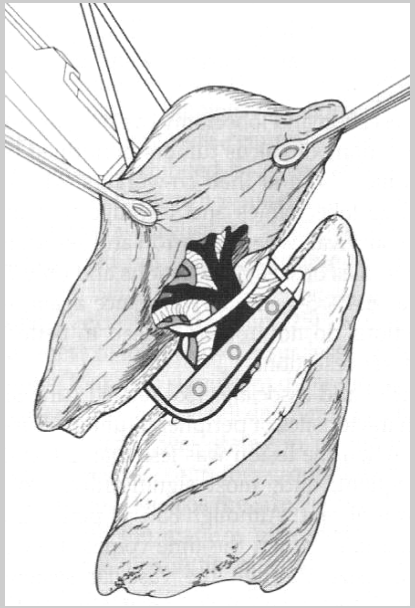
- Full Endoscopic Procedure (Monitor-based)
- Individual Dissection & Stapling of Hilar Structures
- No Rib Spreading



NON ANATOMICAL
HILAR
DISSECTION

SSL

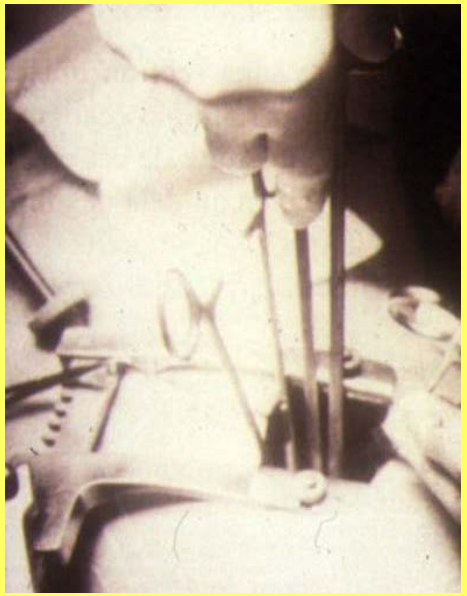
Lewis RJ. SSL- Lobectomy
Ann Thorac Surg
1993



PAST

RIB SPREADING

Hybrid VATS Lobectomy



Giudicelli R. Eur J Cardiothorac Surg 1994

J CARDIOVASC SURG 1999;40:597-601

A standard muscle-sparing utility thoracotomy for VATS procedures

L. SPAGGIARI, P. CARBOGNANI, P. SOLLI, M. RUSCA

From the Department of General Thoracic and Vascular Surgery University of Parma, Parma, Italy

Backgrounds. **Improvements in surgical equipment have rendered video-assisted thoracic surgery (VATS) an effective device for thoracic surgeons and nowadays several intrathoracic diseases can benefit from this approach. This development has expanded potential use and recently the technical feasibility of major lung resections by VATS has been demonstrated. The authors present their experience with a standard muscle-sparing utility thoracotomy (UT) utilized for all VATS procedures, including major lung resections.**

Methods. **From November 1996 to October 1997, 30 patients were operated on. There were 22 males and 8 females (medium age 58 years; range 24-78). There were 13 anatomical lung resections (*i.e.*: 11 lobectomies, 1 left pneumonectomy, 1 segmental resection), 8 wedge resections, 3 lung biopsies, 2 debridements of pleural empyema, 2 mediastinal nodes biopsies, 1 esophageal resection for leiomyoma, 1 excision of benign mediastinal cyst.**

Results. **No mortality or major morbidity were recorded, as well as no rib fractures due to the rib spreader. Two patients suffered from prolonged air-leaks after respectively left upper lobectomy and lung biopsy and required prolonged chest drainage. Concerning anatomic major lung resections the medium hospital stay was 7.9 days and medium chest tube time was 5.6 days. The utility thoracotomy through the auscultatory triangle proved to be a safe approach and confirmed the technical feasibility of various type of surgical procedures with results comparable to standard open thoracotomy. Our data shows that VATS approach did not seriously affect the duration of hospital stay, chest tube time, the overall morbidity or lung function.**

Conclusions. **As the real benefit of this approach remains controversial, the majority of the studies comparing the VATS approach to conventional muscle-sparing thoracotomy neither nor prospective nor randomized, and several parameters are difficult to evaluate in the literature further study are mandatory.**

KEY WORDS: Thoracotomy methods - Thoracics surgical, procedures - Surgical procedures, endoscopic - Thoracoscopy.

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Improvements in surgical equipment have rendered video-assisted thoracic surgery (VATS) an effective device in the hands of the thoracic surgeon and nowadays several intrathoracic diseases can benefit from this approach.

This development has expanded the potential use and recently the technical feasibility of major lung resections by VATS has been demonstrated.[1-7]

VATS operations can be performed through different approaches according to the surgeon's preference and this reflects the fact that the procedure is by no means standardized yet.

Considering the philosophy of VATS (*i.e.*: minimal invasive surgery) we have developed a standard muscle-sparing utility thoracotomy (UT) that we use to perform all VATS procedures, including major lung resections.

Materials and methods

Surgical technique

The patient is positioned in standard lateral decubitus with the operative table fixed at 30° at the level between nipples and umbilicus.

General anesthesia with selective one-lung ventilation is given.

The skin incision for the utility thoracotomy is 5-7 cm length and the chest is entered in the space between the latissimus dorsi anteriorly and the trapezius/rhom-

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DEFINITION of VATS LOBECTOMY

PRESENT

"Pure"VATS Lobectomy

INCISIONS

- number (1-5)
- lenght (4-8cm)
- placement

INSTRUMENTARIUM

INDICATIONS

LYMHNODES MANAGEMENT

Surgery for Early-Stage Non-Small Cell Lung Cancer: A Systematic Review of the Video-Assisted Thoracoscopic Surgery Versus Thoracotomy Approaches to Lobectomy

(Ann Thorac Surg 2008;86:2008–18)

Bryan A. Whitson, MD, PhD, Shawn S. Groth, MD, Susan J. Duval, PhD, Scott J. Swanson, MD, and Michael A. Maddaus, MD

Benefits of VATS:

- Reduce in postoperative pain
- Rate of postoperative complications
- Better preserved respiratory functions
- Reduction of lenght of in-hospital stay
- Fastern return to previous activity level

VATS = Standard approach for early stage lung cancer in USA

Video-Assisted Thoracoscopic Lobectomy Is Less Costly and Morbid Than Open Lobectomy: A Retrospective Multiinstitutional Database Analysis

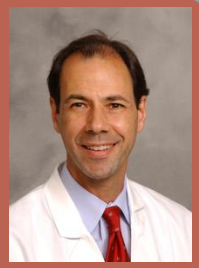
Scott J. Swanson, MD, Bryan F. Meyers, MD, Candace L. Gunnarsson, EdD, Matthew Moore, MHA, John A. Howington, MD, Michael A. Maddaus, MD, Robert J. McKenna, MD, and Daniel L. Miller, MD

(Ann Thorac Surg 2012;93:1027–32)

VATS LOBECTOMY

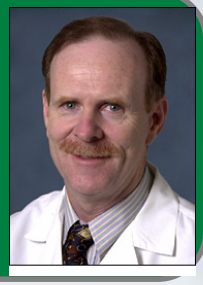
EDINBURGH
POSTERIOR APPROACH
W WALKER, UK

DUKE APPROACH
T D'AMICO, USA



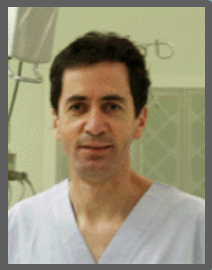
UNIPORTAL
VATS LOBECTOMY
D GONZALEZ RIVAS,
SPA

McKENNA APPROACH
R McKENNA, USA



COPENAGHEN
ANTERIOR APPROACH
H HANSEN & R PETERSEN, DEN

TOTALLY
ENDOSCOPIC APPROACH
D GOSSOT, FRA



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ROBOTIC SURGERY

To overcome vats limitations, micromechanic and robotic technology was introduced in the mid-1990.

Natural movements of the surgeon's hands are traslated into **precise instrument movements** inside the patient with tremor filtration.

Three dimensional view offers a visual magnification that compensate the absence of haptic feedback

- Robotic system can made advanced thoracoscopic surgery accessible to surgeons who do not have advanced videoendoscopic training
- Expand indications
- Advantages for patients

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ROBOTIC SURGERY

Feasible?

Acceptable learning curve?

Adequate oncological results?

VATS or Robotic resection?

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ROBOTIC LOBECTOMIES
- Literature-

Lead Author	Year	Pts	OT (min)	LOS (Days)	Compl. (%)	Mortality (%)	Conversion (%)
Melfi	2004	107	220	5	na	1	na
Park	2006	30	218	4.5	26	0	12
Gharagozloo	2009	100	216	4	21	3	13
Dylewski	2011	165 / 35*	90	3	26	0	1.5
Cerfolio	2011	106 /16*	132	2	27	0	10
IEO	2010	54	224	4.5	20	0	9.4
Park, IEO, Pisa	2012	325	210	5	25	na	8
IEO	2012	91	213	5	20	0	10
Meyer	2012	185	211	4	17	2	2
Adam	2014	120	242	4.7	na	0	3.3
Melfi	2014	68/160	222/166	4.4/3.8	na	1/0	10/6
Velez-Cubian	2015	104/104	179/172	6/4	na	3/0	7/13
IEO	2018	339	192	5	25.6	0	6.5

* segmentectomies

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ROBOTIC LOBECTOMY
- IEO tecnique -

- Lateral position
- Robot at the head posteriorly
- Four incisions including a small utility incision
- Camera arm: VII space mid axillary line
- No rib spreading
- Individual ligation of hilar elements

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Right upper lobectomy

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LYMPHADENECTOMY

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Spaggiari L. Ann Thorac Surg. 2011

ROBOTIC SURGERY

Feasible?

Acceptable learning curve?

Adequate oncological results?

VATS or Robotic resection?

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LEARNING CURVE

ROBOTIC AND VATS LOBECTOMIES

Author	Year	Operation	No. of operations
Melfi	2008	Robotic lobectomy	20
Gharagozloo	2009	Robotic lobectomy	20
Louie	2012	Robotic lobectomy	6
IEO	**2010**	**Robotic lobectomy**	**18**
IEO	**2011**	**VATS lobectomy**	**30-50**
Lee	2009	VATS lobectomy	30-50
Belgers	2010	VATS lobectomy	25-30
Petersen	2010	VATS lobectomy	50

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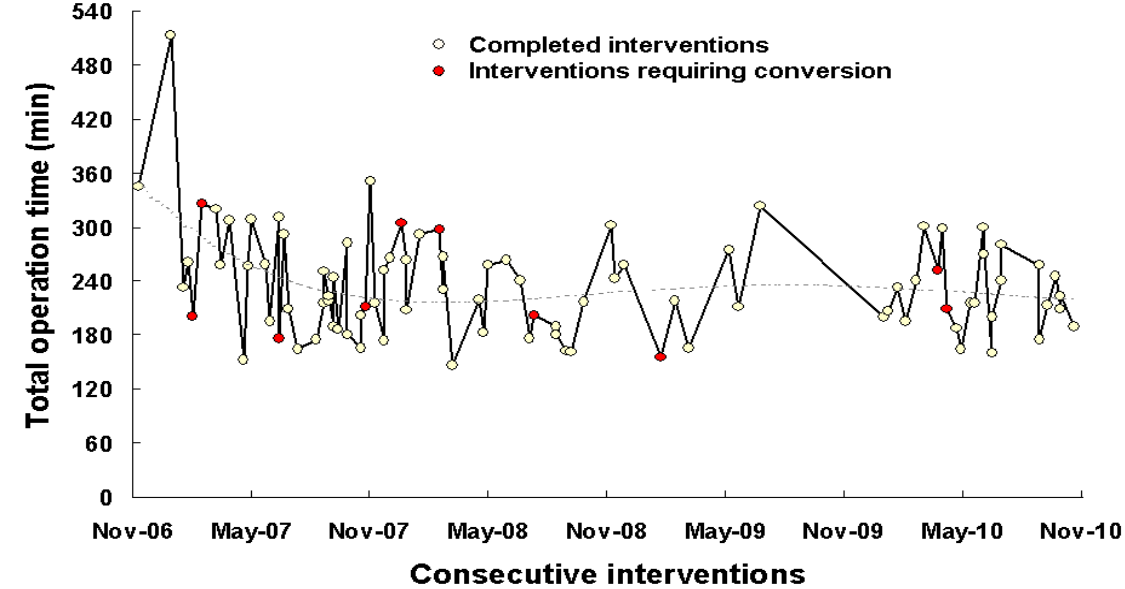
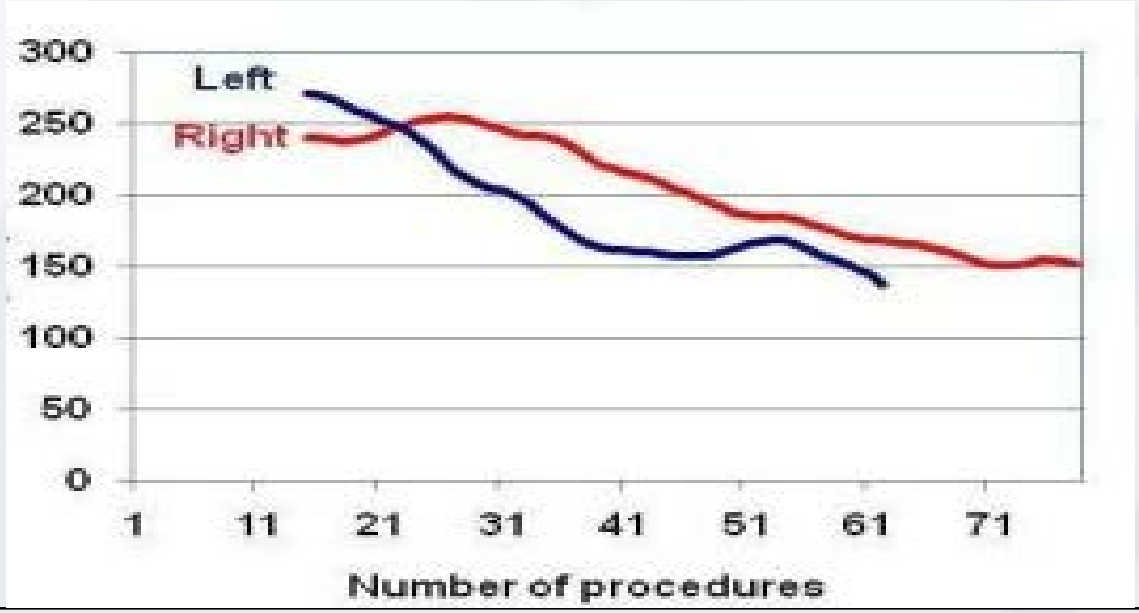


ROBOTIC LOBETCOMY
Mean duration: 220 min

Plateau reached after the first 18 cases

IEO, Innovation 2011



VATS LOBECTOMY
Mean duration: 206 min

Plateau reached after 50 cases

Lee, AATS 2009

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Four-arm robotic lobectomy for the treatment of early-stage lung cancer

Giulia Veronesi, MD,[a] Domenico Galetta, MD,[a] Patrick Maisonneuve, DipEng,[b] Franca Melfi, MD,[c] Ralph Alexander Schmid, MD,[d] Alessandro Borri, MD,[a] Fernando Vannucci, MD,[a] and Lorenzo Spaggiari, MD, PhD[a,e]

JTCVS 2010

LEARNING CURVE - SAFETY - RADICALITY

	ROBOT (54)			OPEN (54)	p value	p value
	I	II	III		I vs II+III	II+III vs Open
Complications	33%	22%	6%	19%	0.04	0.77
Operative time	260	213	235	154	0.02	<0.0001
Postop days	6 days	5 days	4 days	6 days	0.002	0.002
Median N° LN	15	17	17	18	0.24	0.72

1) Learning curve include 18 pts, complications, postoperative days and operative time declines with experience
2) Postoperative stay was SHORTEN after robotic than open procedures
3) Complications and N° lymph nodes removed were comparable in open and robotic lobectomies

ROBOTIC SURGERY

Feasible?

Acceptable learning curve?

Adequate oncological results?

VATS or Robotic resection?

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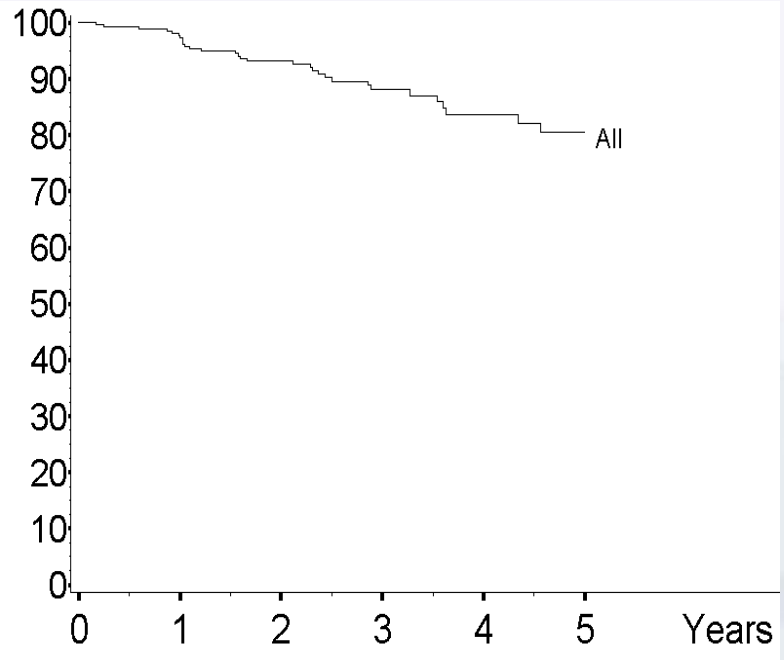
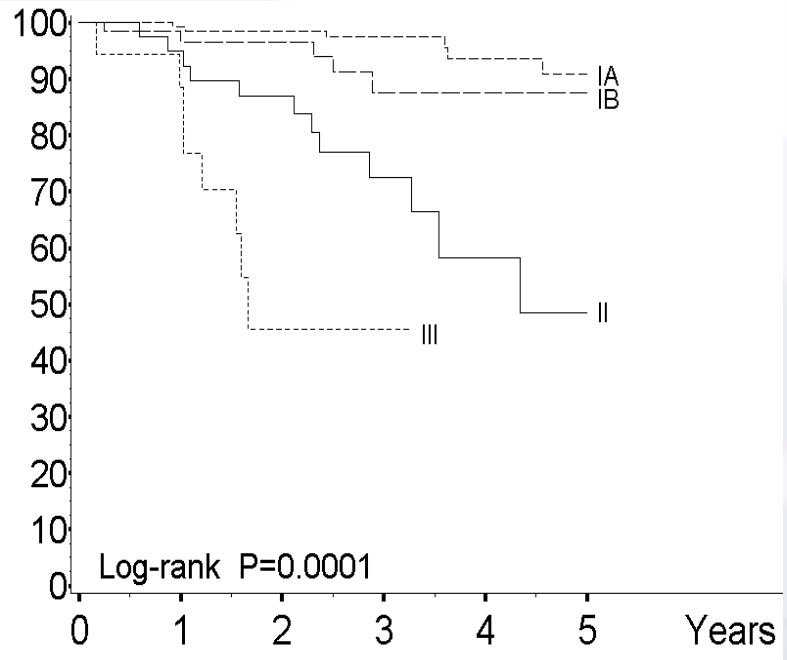
ROBOTIC LOBECTOMY FOR NON-SMALL CELL LUNG CANCER (NSCLC): LONG-TERM ONCOLOGIC RESULTS

B.J. Park, F. Melfi, P. Maisonneuve, L. Spaggiari, R Da Silva, G. Veronesi

Journal of Thoracic and Cardiovascular Surgery 2011





Pathologic stage	**325**	
IA	176	(54%)
IB	72	(22%)
IIA	41	(13%)
IIB	15	(5%)
IIIA	21	(6%)

Oncological results after 325 robotic lobectomies are comparable to open/ vats results. 90% 5 years survival in stage 1 disease

Initial consecutive experience of completely portal robotic pulmonary resection with 4 arms

Robert J. Cerfolio, MD, FACS, FCCP, Ayesha S. Bryant, MD, MSPH, Loki Skylizard, MD, and Douglas James Minnich, MD, FACS

J Thorac Cardiovasc Surg, 2011

	Robotic operation (N = 106)	Rib- and nerve-sparing thoracotomy (N = 318)	*P* value
Estimated blood loss (mL, median ± SD)	30 ± 26	90 ± 22	.03
Operative time (h, median ± SD)	2.2 ± 1.0	1.5 ± 0.8	<.001
No. of mediastinal (N2) lymph node stations removed (median)	5	5	>.999
No. of mediastinal (N2) lymph nodes removed (median)	12	11	.906
No. of N1 lymph node stations removed (median)	3	3	>.999
No. of N1 lymph node removed (median)	5	4	.89
Chest tube duration (d, median and range)	1.5 (1–6)	3.0 (1–67)	<.001
Hospital stay (d, median and range)	2.0 (1–7)	4.0 (1–67)	.01
Morbidity (no.)	28 (27%)	120 (38%)	.05
Operative mortality (no.)	0	11 (3%)	.11
Verbal pain score 3 wk postoperatively (median and range)	2.5 (0–7)	4.4 (0–8)	.04

No difference in lymph node dissection

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The long-term survival of robotic lobectomy for non–small cell lung cancer: A multi-institutional study

Robert J. Cerfolio, MD, MBA,[a] Asem F. Ghanim, MD,[a] Mark Dylewski, MD,[b] Giulia Veronesi, MD,[c,d] Lorenzo Spaggiari, MD,[d] and Bernard J. Park, MD[e]

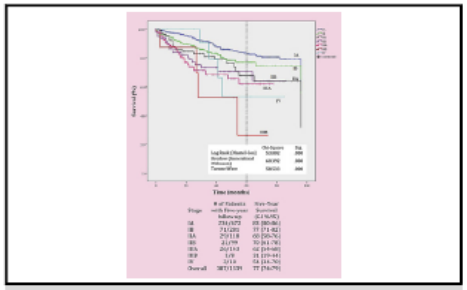
ABSTRACT

Objective: Our objective is to report the world's largest series with the longest follow-up of robotic lobectomy for non–small cell lung cancer (NSCLC).

Methods: This was a multi-institutional retrospective review of a consecutive series of patients from 4 institutions' prospective robotic databases.

Results: There were 1339 patients (men 55%, median age 68 years). The median operative time was 136 minutes, median number of lymph nodes was 13 (5 N2 stations and 1 N1), median blood loss was 50 cc, and 4 (0.005%) patients received intraoperative transfusions. Conversions occurred in 116 patients (9%) and for bleeding in 24 (2%). Median length of stay was 3 days. Major morbidity occurred in 8%. The 30-day and 90-day operative mortality was 0.2% and 0.5%, respectively. Follow-up was complete in 99% of patients with a median follow-up of 30 months (range 1-154 months). The 5-year stage-specific survival was: 83% for the 672 patients with stage IA NSCLC, 77% for the 281 patients with stage IB, 68% for the 118 patients with stage IIA, 70% for 99 patients with IIB, 62% for 143 patients with stage IIIA (122 had N2 disease, 73%), and 31% for 8 patients with stage IIIB (none had N3 disease). The cumulative incidence of metastatic NSCLC was 15% (128 patients, 95% confidence interval, 13%-18%). The cumulative incidence of local recurrence in the ipsilateral operated chest was 3% only (26 patients, 95% confidence interval, 2%-5%).

Conclusions: The oncologic results of robotic lobectomy for NSCLC are promising, especially for patients with pathologic N2 disease. However, further follow-up and studies are needed. (J Thorac Cardiovasc Surg 2018;155:778-86)



Stage-specific survival for non–small cell lung cancer after robotic lobectomy

Central Message

Our objective is to report the world's largest series with the longest follow-up of robotic lobectomy for non–small cell lung cancer.

Perspective

The mid-term oncologic results of robotic lobectomy for non–small cell lung cancer are quite promising, especially for patients with pathologic N2 disease.

See Editorial Commentary page 787.

See Editorial page 777.

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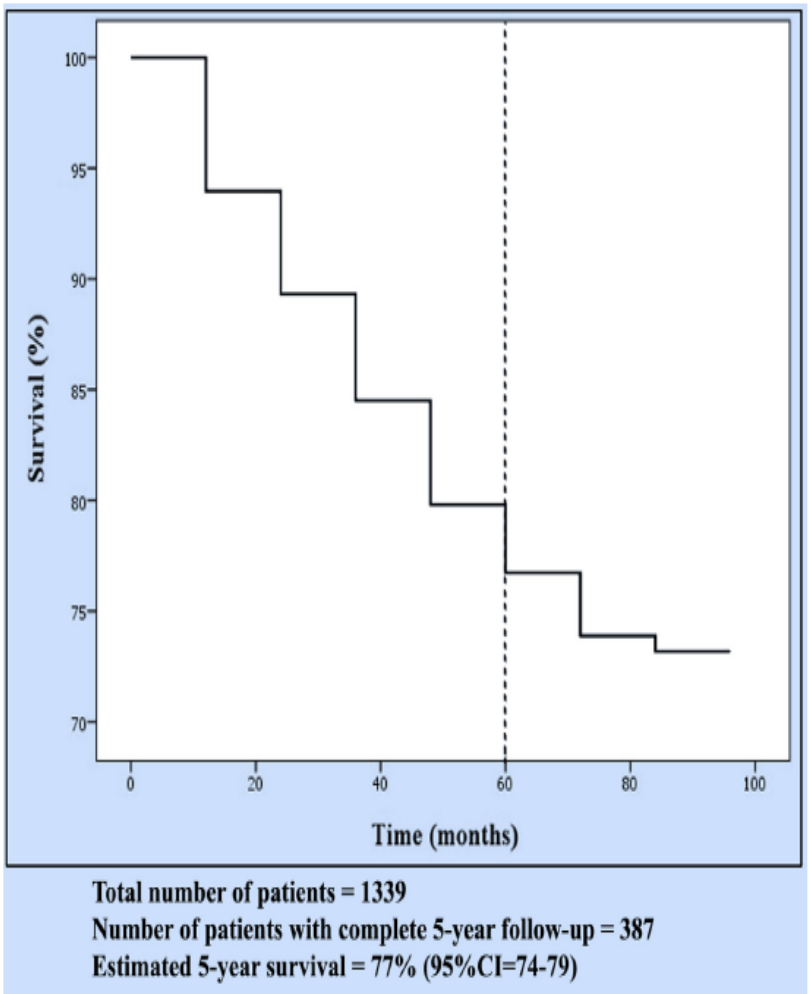
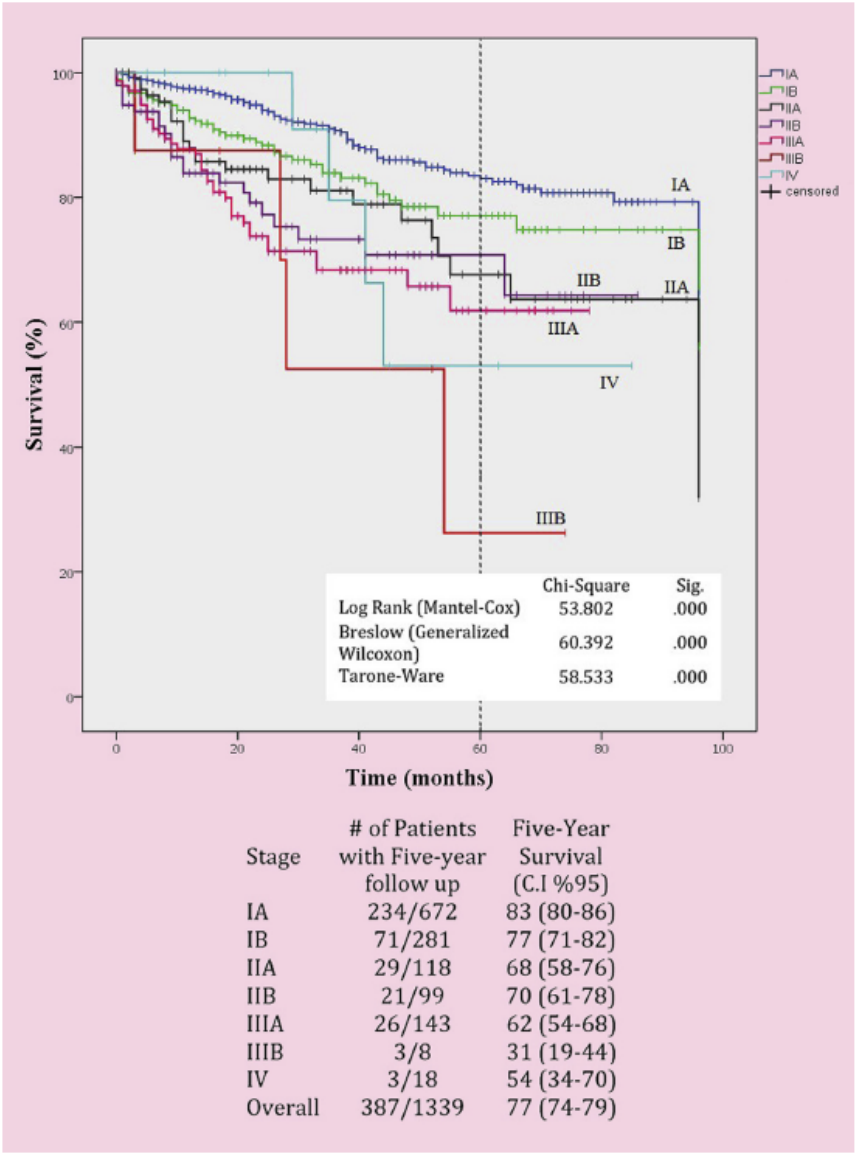


FIGURE 1. Overall survival for non–small cell lung cancer after robotic lobectomy. *CI*, Confidence interval.



Stage	# of Patients with Five-year follow up	Five-Year Survival (C.I %95)
IA	234/672	83 (80-86)
IB	71/281	77 (71-82)
IIA	29/118	68 (58-76)
IIB	21/99	70 (61-78)
IIIA	26/143	62 (54-68)
IIIB	3/8	31 (19-44)
IV	3/18	54 (34-70)
Overall	387/1339	77 (74-79)

FIGURE 2. Stage-specific survival for non–small cell lung cancer after robotic lobectomy. *CI*, Confidence interval.

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Ten years' experience in robotic thoracic surgery for early stage lung cancer: evolution and lessons learned

M. Casiraghi, D. Galetta, A. Borri, A. Tessitore, R. Romano, C. Diotti, D. Brambilla, P. Maisonneuve, L. Spaggiari

Thor Cardiovasc Surg. 2018

339 patients underwent RATS for clinical stage I (n=318) or II (n=21) NSCLC

	All N=339	Pneumonectomy N=3	Lobectomy N=307	Segmentectomy N=29
Clinical Stage				
IA	264 (77.9)	1 (33.3)	236 (76.9)	27 (93.1)
IB	54 (15.9)	1 (33.3)	51 (16.6)	2 (6.9)
IIA	17 (5.0)	1 (33.3)	16 (5.2)	-
IIB	4 (1.2)	-	4 (1.3)	-
Histology				
Adenocarcinoma	281 (82.9)	3 (100)	251 (81.8)	27 (93.1)
Squamous cell carcinoma	40 (11.8)	-	38 (12.4)	2 (6.9)
Adenosquamous	5 (1.5)	-	13 (4.2)	-
Other types	13 (3.8)	-	5 (1.6)	-
Tumor size (mm)				
Median [range]	18 [3-98]	45 [23-98]	19 [3-85]	13 [6-34]

22 conversions (6.5%):

4 (1.2%) oncological reasons
3 (0.9%) bleeding
15 (4.4%) technical issue

	Pneumonectomy N=3	Lobectomy N=286	Segmentectomy N=28
Operative time	275 (192-336)	192 (75-364)	172 (115-224)

Median length of stay was 5 days (range 2-191)

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Overall median N1+N2 station resected was 5 (range 1-8)
Overall median N1+N2 lymph nodes resected was 15 (1-55)

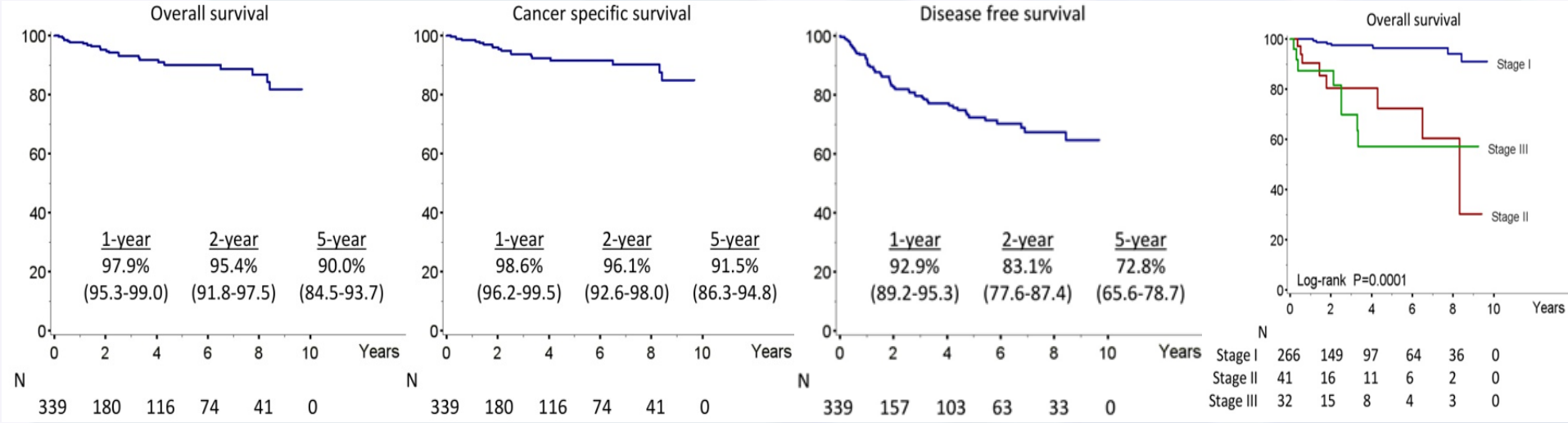
Pathological upstaged → 17.6% (56/317)

STAGE II → 76.4%

STAGE I → 96.4%

STAGE III→ 57.8%

Median follow-up of 2.4 years (0.1-9.7)



Thor Cardiovasc Surg. 2018

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ROBOTIC SURGERY

Feasible?

Acceptable learning curve?

Adequate oncological results?

VATS or Robotic resection?

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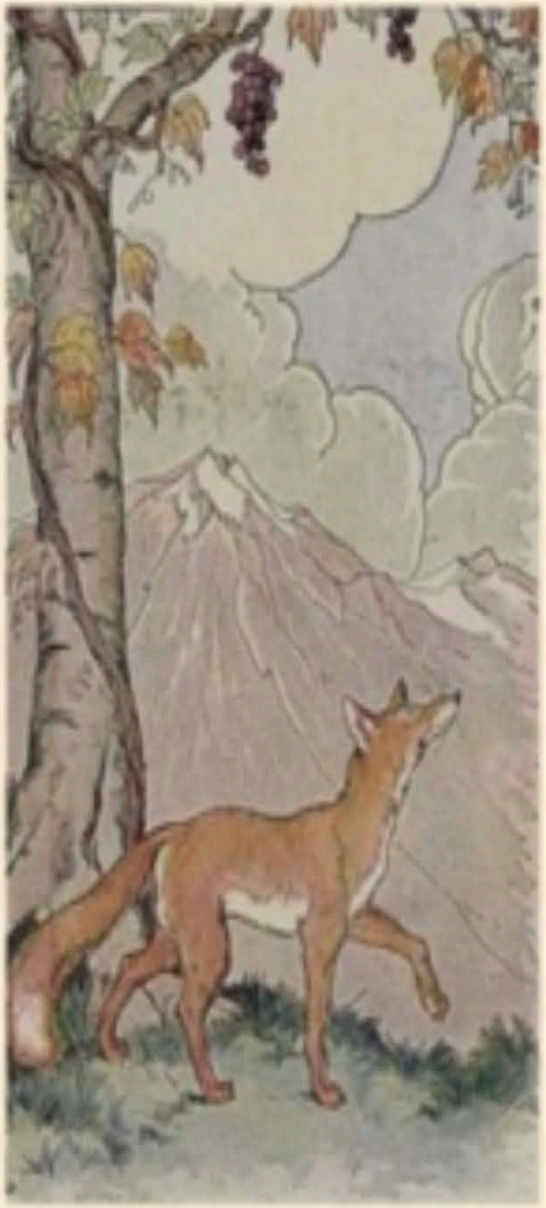
“La volpe e l’uva” di Esopo

Una volpe affamata vide dei grappoli d’uva che pendevano da un pergolato, e tentò di afferrarli. Ma non ci riuscì. "Robaccia acerba!" disse allora tra sé e sé; e se ne andò.

Così, anche fra gli uomini, c’è chi, non riuscendo per incapacità a raggiungere il suo intento, ne dà la colpa alle circostanze.



ROBOT vs VATS

ADVANTAGES

1. Intuitive movements
2. Tremor filtration
3. Increased degrees of freedom
4. Motion scaling
5. Stereoscopic vision
6. Stable camera platform
7. Equivalence between the dominant and non-dominant hands
8. Motion analysis
9. Eye-hand-target alignment
10. Possibly shorter learning curve

DISADVANTAGES

1. Costs
2. Loss of tactile feedback
3. Limited instrumentation available
4. Significant system set-up time
5. Need of at least one experienced assistant
6. Possible delayed response by the surgeon in case of catastrophic event

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Eye-hand-target alignment

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Robot-Assisted Thoracoscopic Surgery versus Video-Assisted Thoracoscopic Surgery for Lung Lobectomy: Can a Robotic Approach Improve Short-Term Outcomes and Operative Safety?

Julien Mahieu, Philippe Rinieri, Michael Bubenheim, Emile Calenda, Jean Melki, Christophe Peillon, Jean-Marc Baste

Thorac cardiovasc Surg 2015

	V Group ($n = 28$)	R Group ($n = 28$)	p-Value
Preincision time, median (min)	60	80	<0.0001
Operative time, median (min)	185	190	0.55
Length of stay, median (d)	7	6	0.40
Conversion, no. (%)	5 (17.8)	3 (10.7)	0.5
Emergency, no.	4	1	
Other reasons, no.	1	2	
Morbidity, no. (%)	12 (42.8)	14 (50)	0.9347
Grade I (Clavien–Dindo Classification)	8 (28.5%)	8 (28.5%)	
Grade ≥ III (Clavien–Dindo Classification)	4 (14%)	6 (21.4%)	
Grade IIIA	4	1	
Grade IIIB	0	2	
Grade IV	0	3	
30-day mortality, no.	0	0	
Intraoperative bleeding, median (mL)	200	100	0.1147
Drainage time, median (d)	5	5	0.7897
Drainage > 7 d, no. (%)	5 (17.8)	7 (25)	0.7458

Perioperative outcomes are similar even in the learning period but robotic approach seems to offer **more operative safety with fewer conversions** for uncontrolled bleeding.

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The Prevalence of Nodal Upstaging During Robotic Lung Resection in Early Stage Non-Small Cell Lung Cancer

Jennifer L. Wilson, MD, Brian E. Louie, MD, Robert J. Cerfolio, MD, Bernard J. Park, MD, Eric Vallières, MD, Ralph W. Aye, MD, Ahmed Abdel-Razek, MD, Ayesha Bryant, MD, Alexander S. Farivar

Ann Thorac Surg. 2014

302 patients

Pathologic nodal upstaging occurred in 33 patients (10.9%)

pN1 6.6%;

pN2 4.3%

Hilar (pN1) upstaging	Robot	Vats	Thoracotomy
cT1a	3.5	5.2	7.5
cT1b	8.6	7.1	8.8
cT2a	10.8	5.7	11.5

The rate of nodal upstaging for robotic resection appears to be superior to VATS and comparable to thoracotomy

CONCLUSIONS

Modern medicine and diffusion of screening programs require less invasive treatment for very early stage lung cancers or mediastinal diseases

Robotic lobectomy with lymph node dissection is safe and associated with significantly shorter postoperative hospitalization than open surgery

Most disadvantages of the robotics will be overcome when technological advances improves instrumentation and extended use of robotics reduces costs

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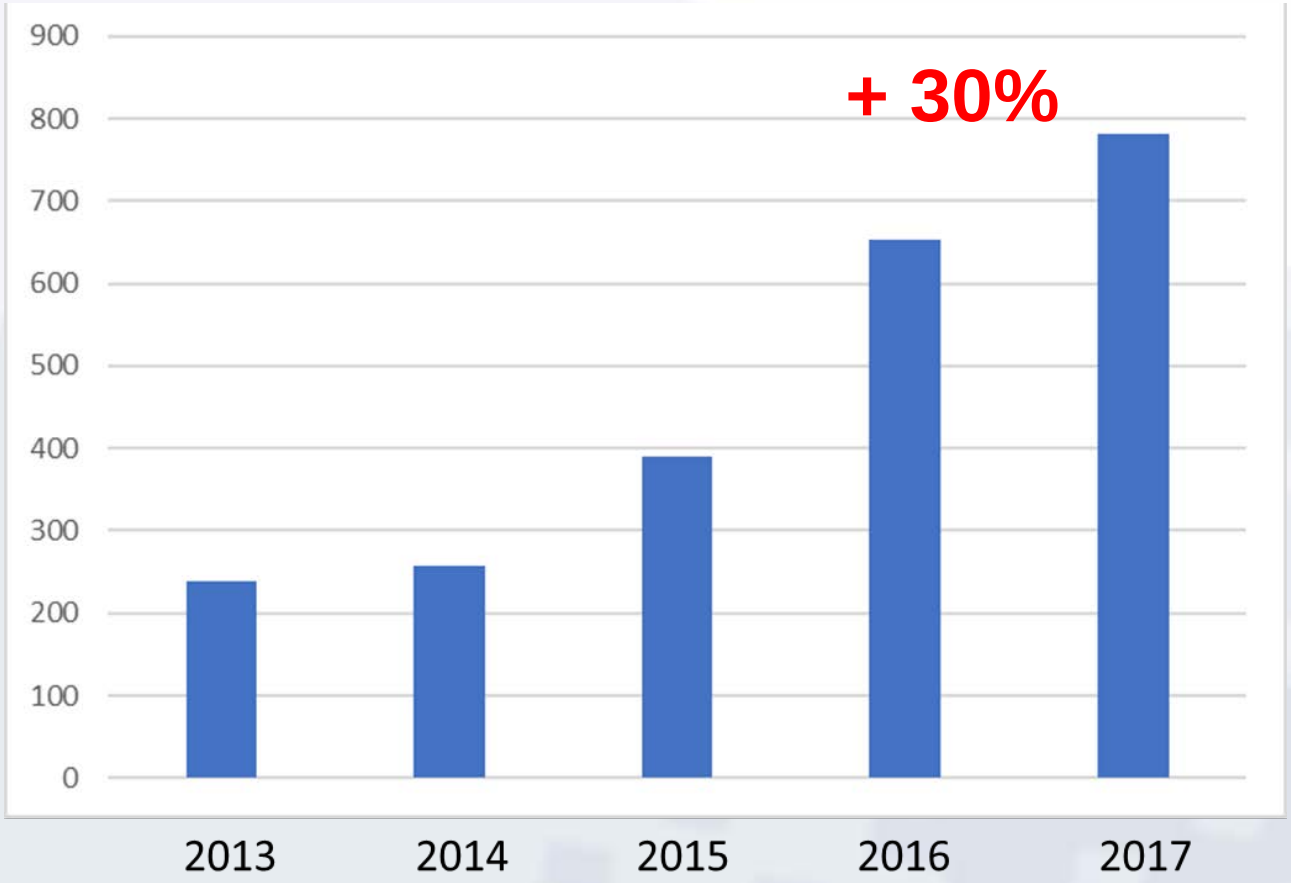
Robotic Thoracic Surgery in Italy



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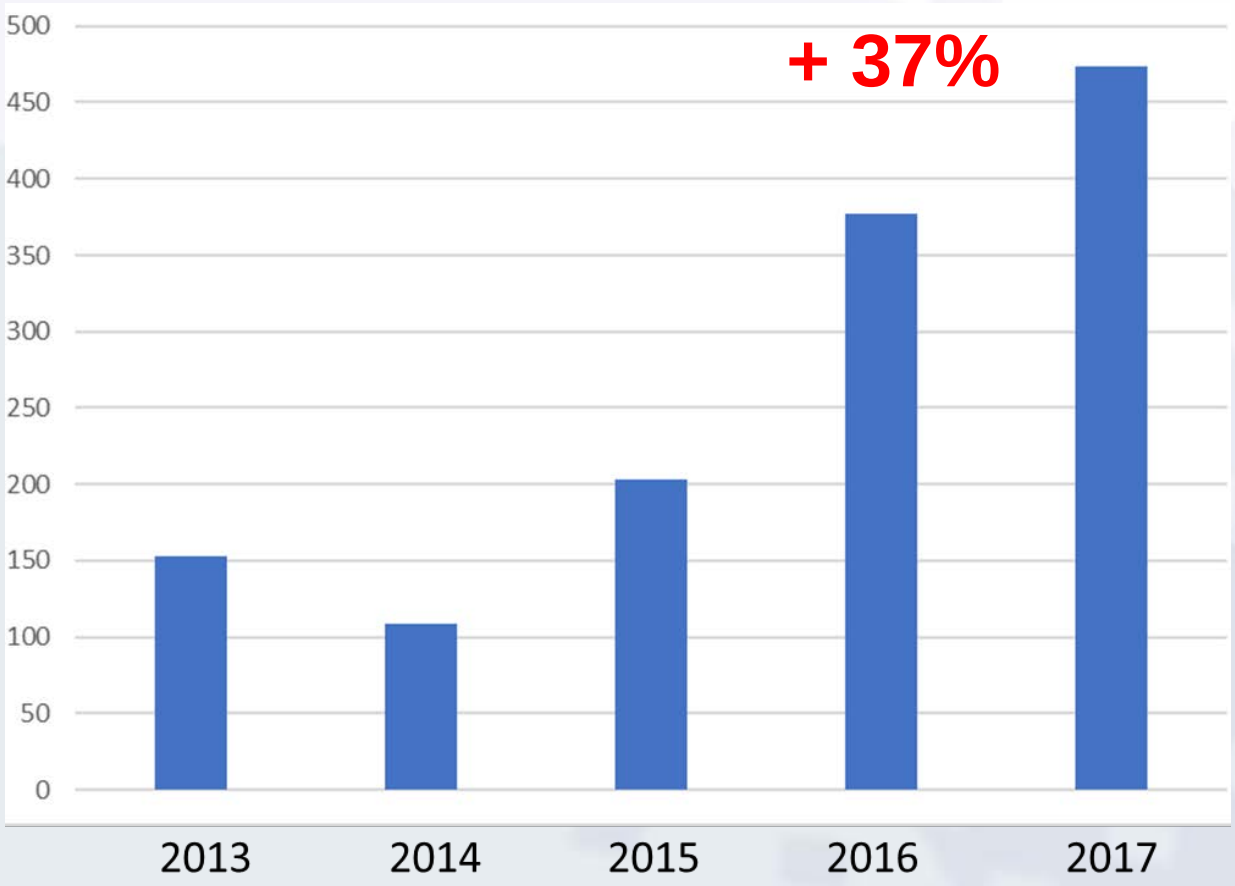
Robotic Pulmonary Lobectomy in Italy



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- ✓ Ospedale Cisanello - Pisa

- ✓ Istituto Nazionale Tumori Regina Elena - Roma

100

- ✓ Ospedale Universitario di Padova

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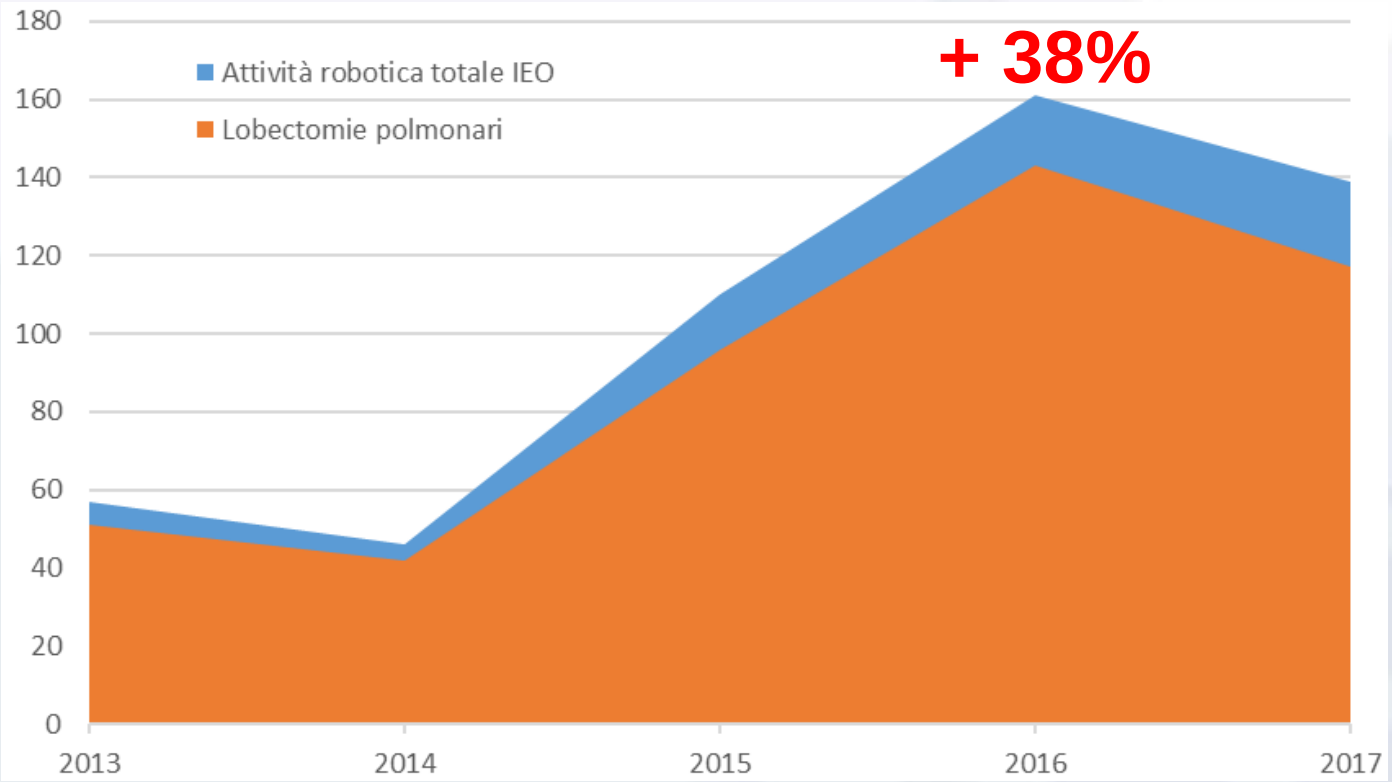
Robotic Thoracic Surgery at IEO

In our Division we performed 22% of the thoracic robotic surgery in Italy



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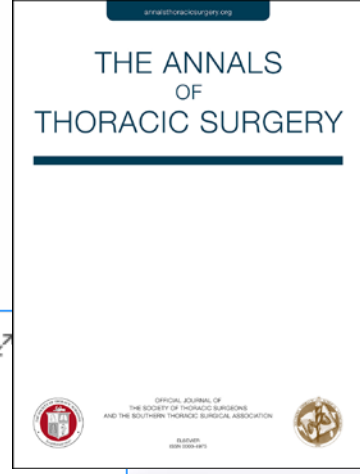
What's
NEXT



ARTICOLO FULL TEXT

Robotic Hybrid Approach for an Anterior Pancoast Tumor in a Severely Obese Patient

Articolo in stampa: Testo accettato

Alessio Vincenzo Mariolo MD, Monica Casiraghi MD, Domenico Galetta MD, PhD e Lorenzo Spaggiari MD, PhD

Abstract

Several different surgical approaches to anterior Pancoast tumors have been proposed. The transmanubrial osteomuscular sparing approach (TMA) allows optimal exposure and control of apical chest wall structures, but requires an additional thoracotomy to perform the lobectomy with radical lymph node resection. The presented technique combines TMA with robotic-assisted upper lobectomy in a severely obese patient, reducing the invasiveness of the surgical approach and the postoperative complications.

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Not available for sale…yet!

Grazie

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