Lung cancer R0 resection– Robot, VATS or muscle sparing thoracotomy?

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Eric Vallières MD FRCSC
Thoracic Surgery
Swedish Cancer Institute

Open vs. VATS vs. Robot lung resection

The MIS approaches
<u>are less "chest wall" morbid</u>
than the open approach,
everything else should probably be the same…

Chest wall morbidity may lead to other complications early after surgery (pneumonia, a fib, less ambulation) and MIS may be particularly advantageous in the elderly, frail individual

Open vs. MIS lung resection

Thoracotomy pain is not related to the length of the incision but rather to the rib spreading

In-hospital stay is driven mainly by drainage of chest tubes and air leaks … possibly by time to obtain satisfactory oral pain control… not by the incision!!!

Open vs. MIS lung resection

- Whatever the approach, lung cancer resection should follow the established principles of lung cancer surgery:
  - Do not cut across cancer
  - Anatomical resection of the involved lobe/ segment
  - Individual ligature of vessels/ bronchus
  - R0 resection
  - Adequate lymph node resection: "*my fears of the "fissureless" stapling technique with station 11 LNs…"*

Robot, VATS vs. open lung resection

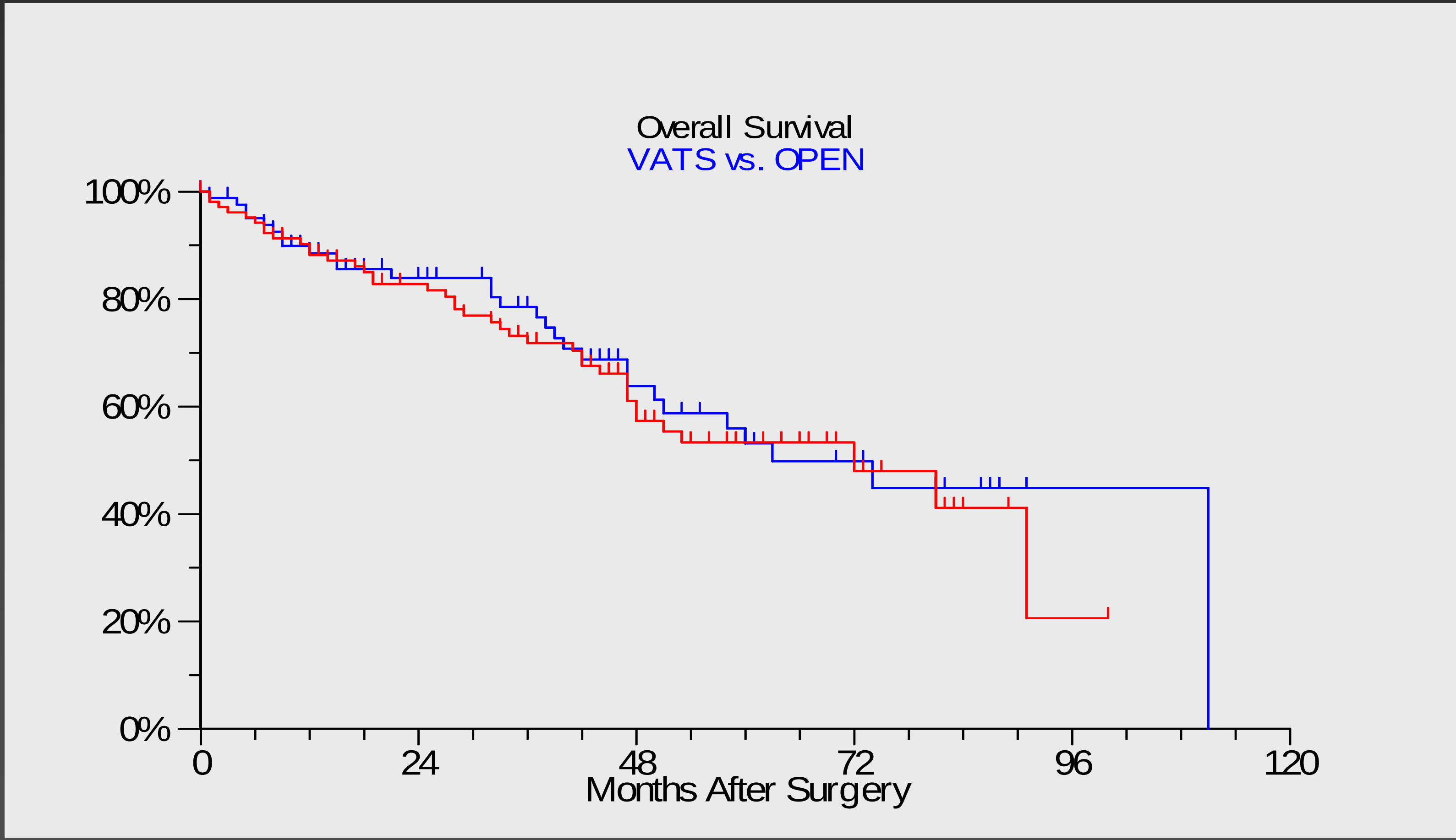
Comparative series and administrative data sets have suggested a superiority of the MIS platforms with less morbidity, faster recovery, shorter hospitals stays and even better cancer survival for stage I disease…

Patient selection?

And beware, this literature is dominated by clinical stage I disease…

Overall 5 year survival

VATS = 53%; Open 53%

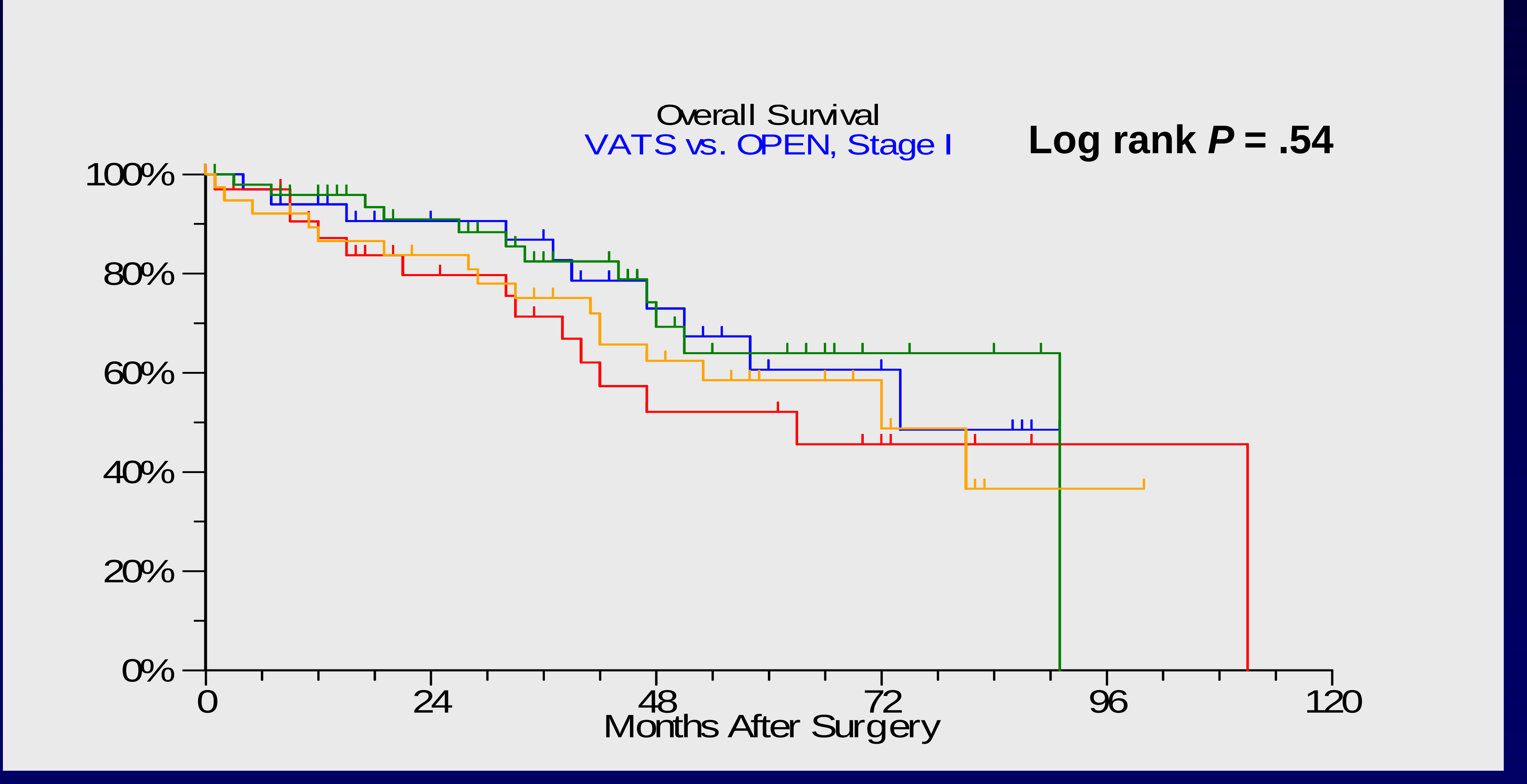


Log rank p = 0.66

Louie B, et al. *Ann Thorac Surg.* 2008;26(May 20 Suppl): Abstract 7526.

5-Year Survival—pStage 1 (Swedish Series)

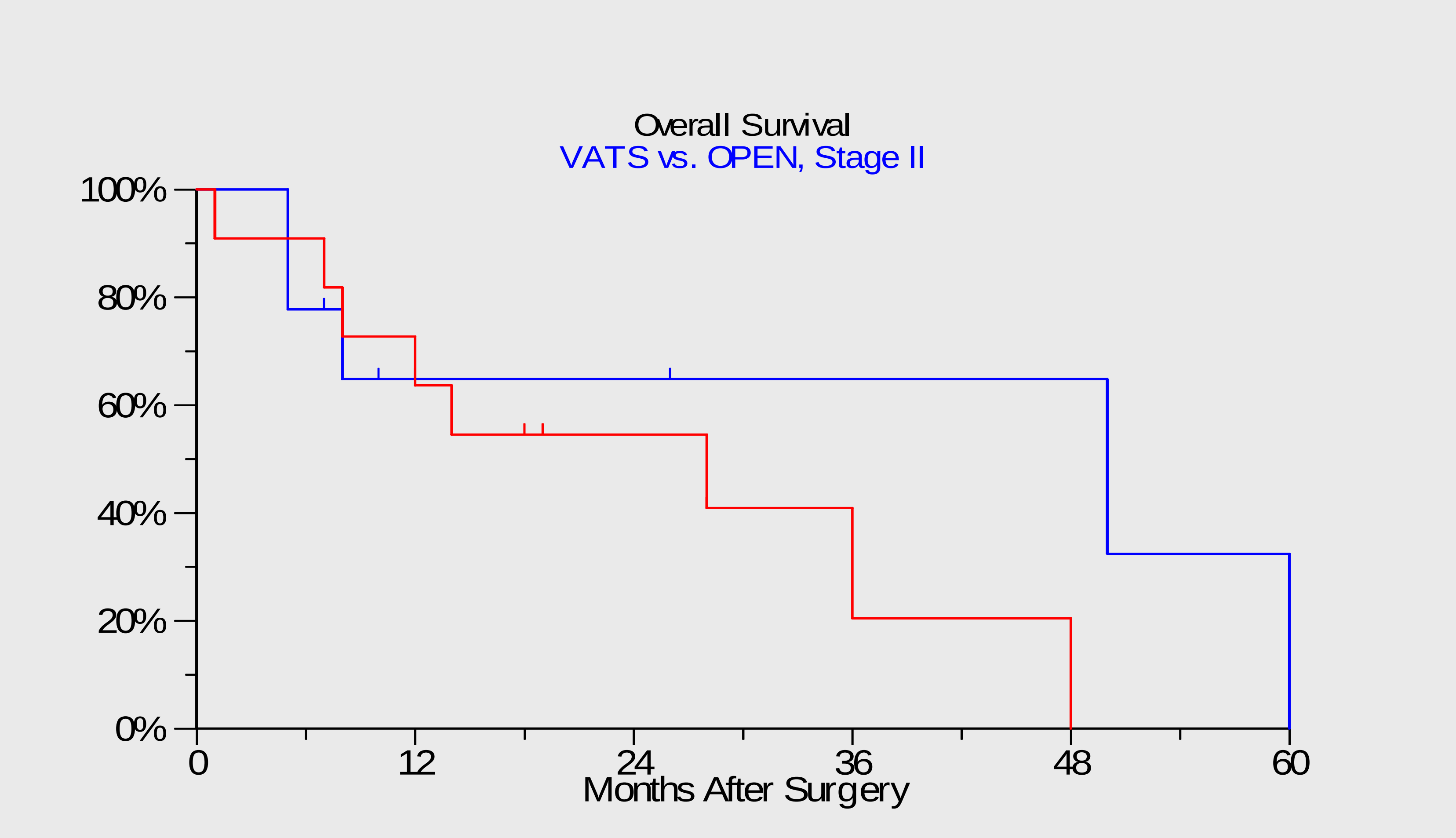
Open 1A = 61%; VATS 1A = 64%; Open 1B = 52%; VATS 1B = 59%



Louie B, et al. *Ann Thorac Surg.* 2008;26(May 20 Suppl): Abstract 7526.

5 year survival – pStage II

Open (10) = 32%; VATS (11) = 21%



Log rank p = 0.27

Systematic Review and Meta-Analysis of Randomized and Nonrandomized Trials on Safety and Efficacy of Video-Assisted Thoracic Surgery Lobectomy for Early-Stage Non–Small-Cell Lung Cancer

Tristan D. Yan, Deborah Black, Paul G. Bannon, and Brian C. McCaughan

- Purpose: **Assess the safety and efficacy of VATS lobectomy**
- Methods: **Meta-analysis, randomized and nonrandomized comparative studies, *all studies compared both operations***
  - **Morbidity**
  - **Mortality**
  - **Recurrence**
  - **5 year survival**
- Studies Excluded
  - **VATS wedge resection or segmentectomy**
    - *Those which did not include a comparative group that contained surgery as a form of intervention*

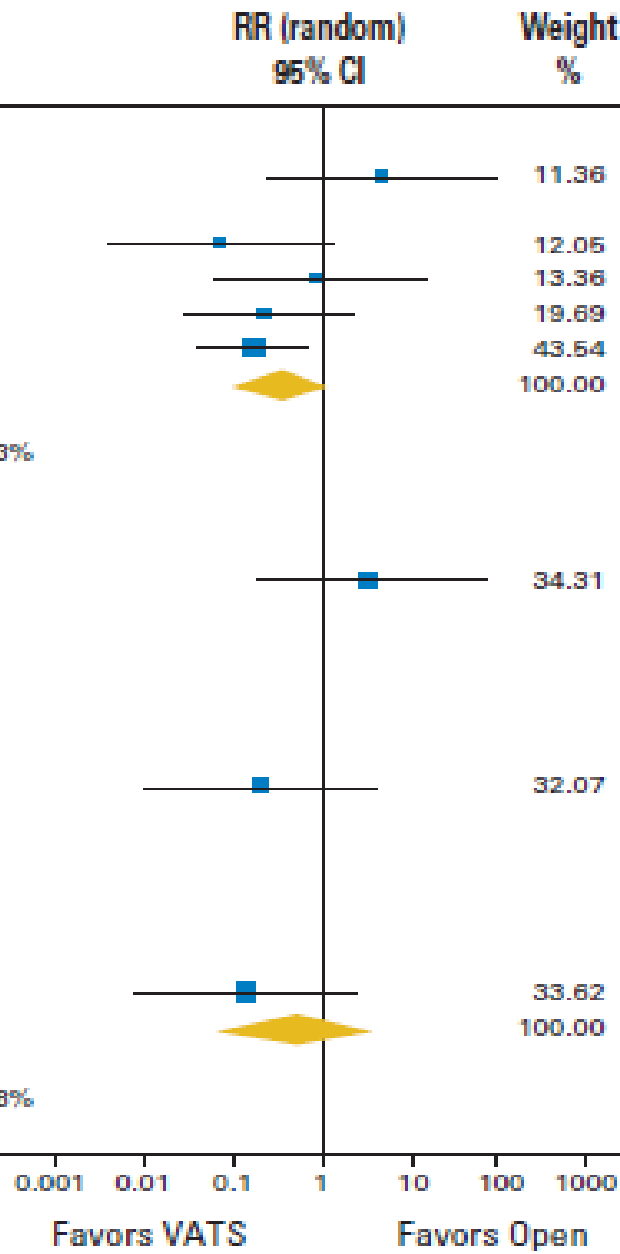
J Clin Oncol 2009: 27:2553-2562.

Table 1. Summary of the 21 Trials Included in the Present Systematic Review

Study	Design	Quality Assessment Score	No. of Patients	Clinical Stage		Procedure	
				Stage	No.	Stage	No. of Patients
Kirby (1995)[1]	RCT	19	61	cIA + B	61	No rib spreader, access ≤ 8 cm	PLT
Sugi (2000)[2]	RCT	18	100	cIA	100	No rib spreader, access ≤ 8 cm	PLT
Giudicelli (1994)[3]	OC	13	67	cIA + B	67	Rib spreader, access ≤ 10 cm	PLT
Ohbuchi (1998)[4]	OC	9	70	cIA	70	No rib spreader, access ≤ 7 cm	PLT
Sugiura (1999)[5]	OC	16	44	cIA cIB	36 8	No rib spreader, access ≤ 6 cm	PLT
Inada (2000)[6]	OC	12	54	cIA + B	54	No rib spreader, access ≤ 7 cm	Not specified
Yim (2000)[7]	OC	13	36	cIA + B	36	No rib spreader, access length not specified	PLT
Nomori (2001)[8]	OC	17	66	cIA + B	66	Rib spreader, access ≤ 6 cm	ALT
Nagahiro (2001)[9]	OC	14	22	cIA + B	22	No rib spreader, access ≤ 7 cm	PLT
Koizumi (2002)[10]	OC	14	87	cIA + B	87	No rib spreader, access ≤ 10 cm	PLT
Tatsumi (2003)[11]	OC	13	239	pIA	145 94	Rib spreader, access ≤ 7 cm	PLT
Tashima (2005)[12]	OC	12	240	cIA cIB	160 80	No rib spreader, access ≤ 8 cm	PLT
Muraoka (2006)[13]	OC	14	85	cIA	85	No rib spreader, access ≤ 8 cm	PLT
Shigemura (2006)[14]	OC	14	105	cIA	145	No rib spreader (n = 50), rib spreader (n = 31)	Not specified
Shiraishi (2006)[15]	OC	17	160	cIA	160	No rib spreader, access ≤ 7 cm	PLT
Sawada (2007)[16]	OC	15	288	cIA + B	194 94	No rib spreader, access ≤ 8 cm	PLT
Sakuraba (2007)[17]	OC	14	140	cIA	140	No rib spreader, access ≤ 5 cm	PLT
Petersen (2007)[18]	OC	15	100	pI pII	40 24	No rib spreader, access ≤ 5 cm	PLT
Whitson (2007)[19]	OC	14	147	cIA + B	147	No rib spreader, access ≤ 6 cm	PLT
Tajiri (2007)[20]	OC	13	292	cIA + B	292	No rib spreader (n = 168), rib spreader (n = 63)	PLT
Park (2007)[21]	OC	17	244	cIA + B	244	No rib spreader, access ≤ 4 cm	PLT

Abbreviations: RCT, randomized controlled trial; OC, observational cohort; PLT, posterolateral thoracotomy; ALT, anterior limited thoracotomy.

Study or subcategory	VATS n/N	Open n/N	Weight %	RR (random)	95% CI
03 Pneumonia					
Sugiura et al[5]	2/22	0/22	11.36	5.00	(0.25 to 98.52)
Nomori et al[8]	0/33	0/33			Not estimable
Koizumi et al[10]	0/52	4/35	12.05	0.08	(0.00 to 1.36)
Muraoka et al[12]	1/43	1/42	13.36	0.98	(0.06 to 15.11)
Petersen et al[18]	1/57	3/43	19.69	0.25	(0.03 to 2.33)
Whitson et al[19]	2/59	17/88	43.54	0.18	(0.04 to 0.73)
Subtotal (95% CI)	266	263	100.00	0.34	(0.10 to 1.16)
Total events: 6 (VATS), 25 (Open)					
Test for heterogeneity: $\chi^2_4 = 5.58$, $P = .23$, $I^2 = 28.3\%$					
Test for overall effect: $z = 1.72$, $P = .09$					
04 Mortality					
Giudicelli et al[3]	3/44	0/23	34.31	3.73	(0.20 to 69.32)
Kirby et al[1]	0/25	0/30			Not estimable
Sugiura et al[5]	0/22	0/22			Not estimable
Yim et al[7]	0/18	0/18			Not estimable
Nomori et al[8]	0/33	0/33			Not estimable
Koizumi et al[10]	0/52	0/35			Not estimable
Tatsumi et al[11]	0/118	2/121	32.07	0.21	(0.01 to 4.23)
Muraoka et al[12]	0/43	0/42			Not estimable
Shigemura et al[14]	0/50	0/55			Not estimable
Shiraishi et al[15]	0/81	0/79			Not estimable
Sakuraba et al[17]	0/84	0/56			Not estimable
Petersen et al[18]	0/57	0/43			Not estimable
Park et al[21]	0/122	3/122	33.62	0.14	(0.01 to 2.74)
Subtotal (95% CI)	749	679	100.00	0.49	(0.06 to 3.76)
Total events: 3 (VATS), 5 (Open)					
Test for heterogeneity: $\chi^2_2 = 2.85$, $P = .24$, $I^2 = 29.8\%$					
Test for overall effect: $z = 0.69$, $P = .49$					



Selection Bias??? Non-balanced Risks??? Smaller tumors??

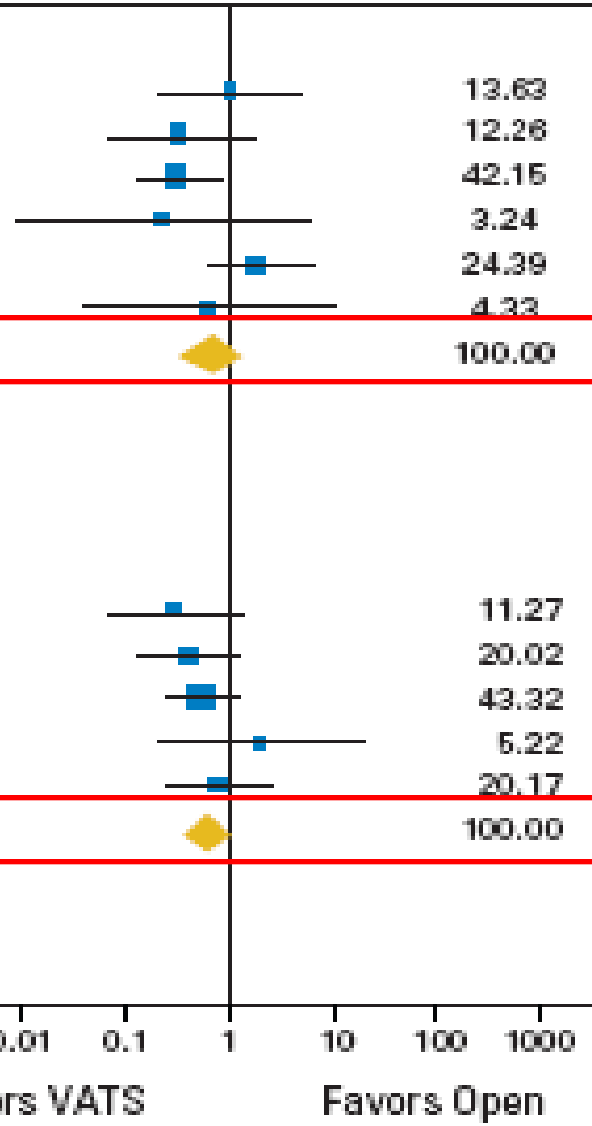
Table 2. Perioperative Outcomes of the 21 Trials Included in the Present Systematic Review

Study	Conversion Rate (%)	Surgery Time (hours)		Blood Loss (ml)		Chest Drain (days)		Hospital Stay (days)	
		VATS	Open	VATS	Open	VATS	Open	VATS	Open
Kirby (1995)[1]	10	2.7	2.9	NR	NR	4.6	6.5	7.1	8.3
Sugi (2000)[2]	4	NR	NR	NR	NR	NR	NR	NR	NR
Giudicelli 1994[3]	10.2	2.2	1.8	84	112	8.0	10.0	12.0	15.0
Ohbuchi 1998[4]	0	3.6	3.3	82	126	5.3	7.6	15.4	24.0
Sugiura 1999[5]	12	3.8	3.3	150	300	NR	NR	23	22
Inada (2000)[6]	NR	4.7	3.7	201	244	6.5	5.7	15.4	12.2
Yim (2000)[7]	0	1.3	1.4	NR	NR	3.2	4.1	4.1	5.3
Nomori (2001)[8]	13.1	4.7	4.5	176	250	1.2	1.5	7.3	7.9
Nagahiro (2001)[9]	NR	4.2	3.1	187	216	3.8	3.6	NR	NR
Koizumi (2002)[10]	NR	4.7	4.5	253	443	NR	NR	NR	NR
Tatsumi (2003)[11]	5.6	3.7	3.8	129	253	NR	NR	19.5	24.9
Tashima (2005)[12]	6.9	2.9	3.1	110	165	NR	NR	13.3	14.5
Muraoka (2006)[13]	8.5	4.8	4.9	151	362	3.0	3.9	NR	NR
Shigemura (2006)[14]	NR	3.6	2.7	107	163	NR	NR	13.1	17.9
Shiraishi (2006)[15]	14.7	3.8	3.7	142	204	NR	NR	NR	NR
Sawada (2007)[16]	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sakuraba (2007)[17]	7.6	NR	NR	NR	NR	NR	NR	NR	NR
Petersen (2007)[18]	5	NR	NR	NR	NR	3.1	4.7	4.2	5.3
Whitson (2007)[19]	15.7	3.8	3.5	251	255	5.0	6.1	6.4	7.7
Tajiri (2007)[20]	NR	4.3	4.2	72	226	4.9	7.1	NR	NR
Park (2007)[21]	NR	3.7	3.0	NR	NR	NR	NR	4.9	7.2
Minimum	0	1.3	1.4	72	82	1.2	1.5	4.1	5.3
Maximum	15.7	4.8	4.9	253	443	8.0	10.0	24.0	24.9
Median	8.1	3.7	3.6	146	235	4.6	5.3	12.0	12.2

Abbreviations: VATS, video-assisted thoracic surgery; NR, not reported.

J Clin Oncol 2009: 27:2553-2562.

Study or subcategory	VATS n/N	Open n/N	RR (random) 95% CI	Weight %	RR (random)	95% CI
01 Local Recurrence						
Sugi et al[2]	3/48	3/52		13.63	1.08	(0.23 to 5.11)
Koizumi et al[10]	2/45	4/32		12.26	0.36	(0.07 to 1.83)
Tatsumi et al[11]	6/118	19/121		42.15	0.32	(0.13 to 0.78)
Shigemura et al[14]	0/81	1/55		3.24	0.23	(0.01 to 5.49)
Shiraishi et al[15]	8/81	4/79		24.39	1.95	(0.61 to 6.22)
Sakuraba et al[17]	1/94	1/56		4.33	0.67	(0.04 to 10.44)
Subtotal (95% CI)	457	395		100.00	0.64	(0.30 to 1.35)
Total events: 20 (VATS), 32 (Open)						
Test for heterogeneity: $\chi^2_5 = 7.16$, $P = .21$, $I^2 = 30.2\%$						
Test for overall effect: $z = 1.17$, $P = .24$						
02 Systemic Recurrence						
Sugi et al[2]	2/48	7/52		11.27	0.31	(0.07 to 1.42)
Koizumi et al[10]	4/45	7/32		20.02	0.41	(0.13 to 1.27)
Tatsumi et al[11]	9/118	16/121		43.32	0.58	(0.27 to 1.25)
Shigemura et al[14]	3/81	1/55		5.22	2.04	(0.22 to 19.08)
Sakuraba et al[17]	6/94	5/56		20.17	0.80	(0.26 to 2.50)
Subtotal (95% CI)	376	316		100.00	0.57	(0.34 to 0.95)
Total events: 24 (VATS), 36 (Open)						
Test for heterogeneity: $\chi^2_4 = 2.54$, $P = .64$, $I^2 = 0\%$						
Test for overall effect: $z = 2.14$, $P = .03$						



Smaller Tumors???

J Clin Oncol 2009: 27:2553-2562.

Lymph Node Evaluation by Open or Video-Assisted Approaches in 11,500 Anatomic Lung Cancer Resections

Daniel J. Boffa, MD, Andrzej S. Kosinski, PhD, Subroto Paul, MD, John D. Mitchell, MD, and Mark Onaitis, MD

In contrast, lower rates of N1 upstaging in the VATS group may indicate variability in the completeness of the peribronchial and hilar lymph node evaluation. Systematic hilar dissection is encouraged, particularly as more surgeons adopt the VATS approach.

(Ann Thorac Surg 2012;94:347–53)

A paradox? Reported survival rates appear similar or better w VATS???

What about the robot?

- The data is even weaker…

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

Conclusions. Case volume for robotic pulmonary resections has increased significantly during the study period, and thoracic surgeons have been able to adopt the robotic approach safely. Robotic resection appears to be an appropriate alternative to VATS and is associated with improved outcomes compared with open thoracotomy.

(Ann Thorac Surg 2014;97:236–44)

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]

Conclusions: RATS lobectomy and wedge resection seem to have higher hospital costs and longer operating times, without any differences in adverse events. (J Thorac Cardiovasc Surg 2014;147:929-37)

Early Experience With Robotic Lung Resection Results in Similar Operative Outcomes and Morbidity When Compared With Matched Video-Assisted Thoracoscopic Surgery Cases

Brian E. Louie, MD, Alexander S. Farivar, MD, Ralph W. Aye, MD, and Eric Vallières, MD
Division of Thoracic Surgery, Swedish Cancer Institute, Seattle, Washington

(Ann Thorac Surg 2012;93:1598–1605)

Characteristic*	Robotic	VATS
Tumor/Lesion Size (cm)	2.8 (0.9 – 7.2)	2.3 (0.9 – 4.9)
Operative Time (min) Incision to close	213	207
Length of Stay (median)	4.0 (2 - 21)	4.5 (2 - 22)
ICU Days	.92	.64
EBL (mL)	153	134

Morbidity and Mortality

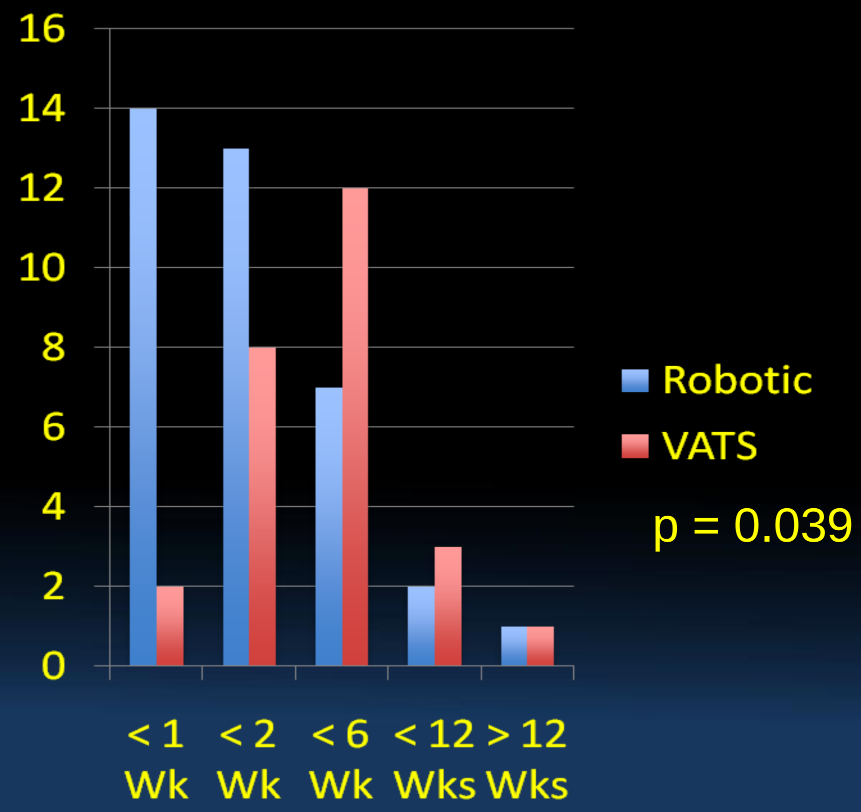
Grade	Complication	Robotic	VATS
Major		8 (17%)	5 (15%)
Grade IVa	Acute renal failure	0	1
	Respiratory failure	1	0
Grade IIIb	Post op hemorrhage	2	0
	Pleural effusion	1	0
	Bronchopleural fistula	1	0
	Bimalleolar ankle #	1	0
Grade IIIa	Prolonged air leak (> 5 days)	2	4
Minor		12 (26%)	7 (21%)
Grade II	Prolonged air leak (3-5 days)	4	2
	Atrial fibrillation	3	2
	Pneumonia	2	1
	Ileus	1	2
	UTI	1	0
Grade I	Lobar collapse	1	0

Seely et al. Classification of M & M After Thoracic Surgery
Annals of Thoracic Surgery, 2010;90:936-42

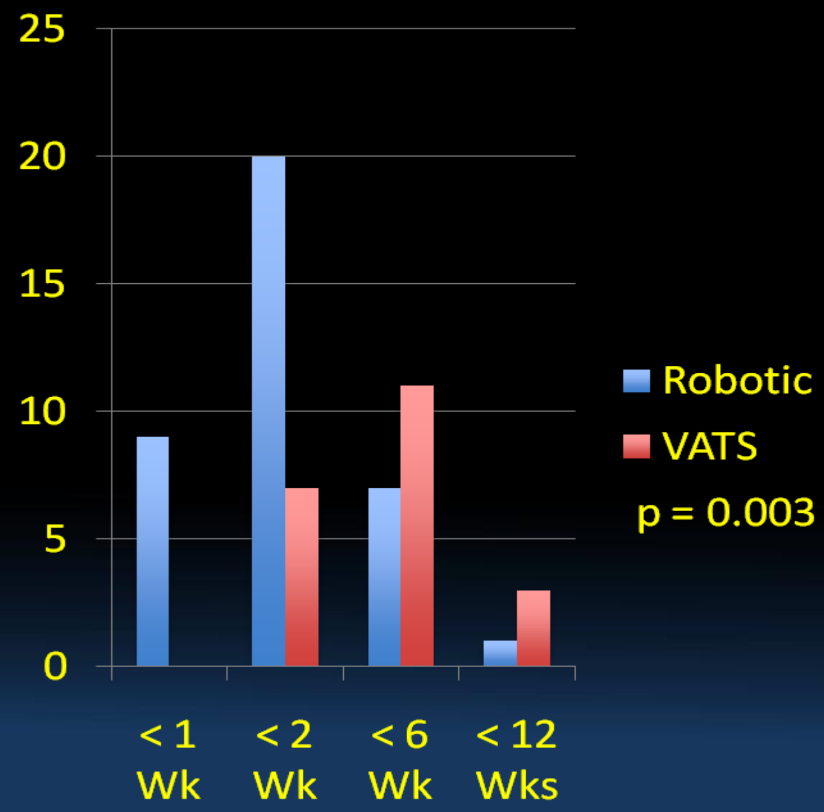
p = NS

Narcotic Use and Return to Usual Activities

Duration of Narcotic Use



Return to Usual Activities



Defining the Cost of Care for Lobectomy and Segmentectomy: A Comparison of Open, Video-Assisted Thoracoscopic, and Robotic Approaches

Shaun A. Deen, MD, Jennifer L. Wilson, MD, Candice L. Wilshire, MD, Eric Vallières, MD, Alexander S. Farivar, MD, Ralph W. Aye, MD, Robson E. Ely, MBA, and Brian E. Louie, MD

Division of Thoracic Surgery and Clinical Transformation Department, Swedish Medical Center and Cancer Institute, Seattle, Washington

Conclusions. VATS is the least expensive surgical approach. Robotic cases must be shorter in operative time or reduce supply costs, or both, to be competitive. Lessening operating time, eradicating unnecessary laboratory work, and minimizing intensive care unit stays will help decrease direct hospital costs.

(Ann Thorac Surg 2013;■:■–■)

Annals of Thoracic Surgery 97(3): 1000-7, Mar 2014

Table 3. Comparison of Key Clinical Outcomes

Clinical Outcome	Open	Robot	VATS	Open vs Robot p Value	Open vs VATS p Value	Robot vs VATS p Value
Inpatient stay, days	5.47	4.62	4.75	0.054	0.11	0.777
Complication rate, %	30	32	31	0.890	0.942	0.950
OR time, minutes	180	223	202	<0.001	0.02	0.045
Additional procedures, %	41	42	28	0.863	0.125	0.102

OR = operating room; VATS = video-assisted thoracoscopic.

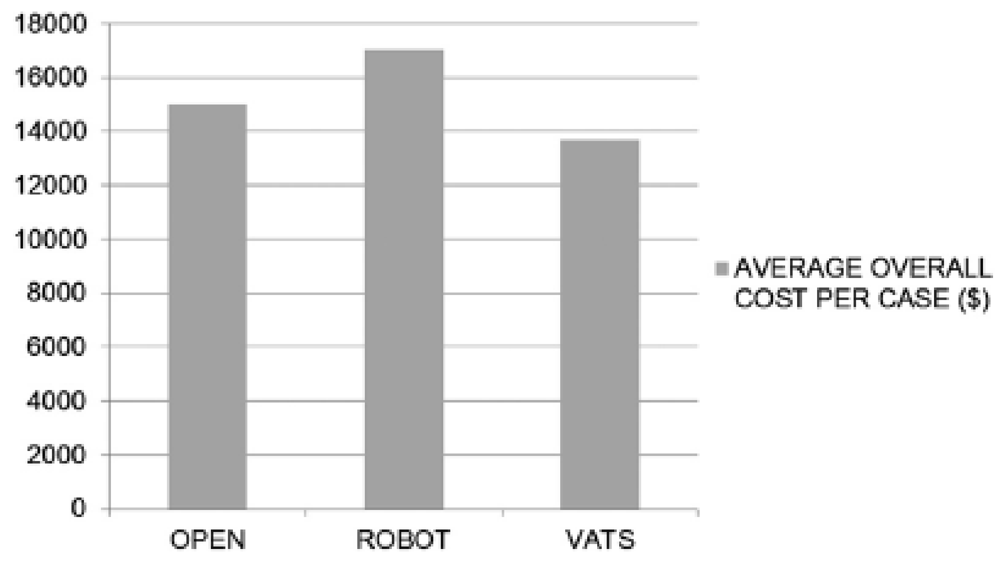


Fig 2. Overall cost per case comparison: open versus robot ($p = 0.058$), open versus video-assisted thoracoscopic (VATS [$p = 0.227$]), and robot versus VATS ($p < 0.001$).

Conclusions

- There is no randomized data, beware of the zealots!!!
- All 3 platforms are an option, though at this time, the robotic approach seems to be more costly, and the VATS approach the least expensive
- One should not compromise a good cancer operation for “technology”

Conclusions

- Modern day thoracotomies: muscle sparing, minimal rib spreading, use of endostaplers, intracostal sutures at closure are still a valid option for the appropriate patient/ cancer.
- Evaluating your own results may allow you to improve your "results" whatever the platform you prefer.