VATS vs. Robotic Pulmonary Resection

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MSTCVS
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Barnes-Jewish Hospital
BJC HealthCare
Washington University in St. Louis
Physicians
NATIONAL LEADERS IN MEDICINE

A Debate Amongst Friends

- Rishindra M. Reddy, MD
- Once a junior resident, always a junior resident
- Recently seen wearing an Ohio State football jersey

Objectives

- VATS pulmonary resection has lower morbidity and mortality than thoracotomy
- VATS and Robotic procedures appear to have similar outcomes
- VATS pulmonary resection is less expensive than robotic surgery

GENERAL THORACIC

The Society of Thoracic Surgeons Lung Cancer Resection Risk Model: Higher Quality Data and Superior Outcomes

Felix G. Fernandez, MD, MS, Andrzej S. Kosinski, PhD, William Burfeind, MD, Bernard Park, MD, Malcolm M. DeCamp, MD, Christopher Seder, MD, Blair Marshall, MD, Mitchell J. Magee, MD, Cameron D. Wright, MD, and Benjamin D. Kozower, MD, MPH

Emory University, Atlanta, Georgia; Duke Clinical Research Institute, Durham, North Carolina; St. Luke's Health Network, Allentown, Pennsylvania; Memorial Sloan Kettering Cancer Center, New York, New York; Northwestern University, Chicago, Illinois; Rush University, Chicago, Illinois; Georgetown University, Washington, DC; Medical City Hospital, Dallas, Texas; Massachusetts General Hospital, Boston, Massachusetts; and University of Virginia, Charlottesville, Virginia

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Table 1. Patient Baseline Characteristics

Variable	Values
Total	27,844 (100)
Age, years	67.2 ± 10.1
Male	12,647 (45.4)
Race	
White	24,099 (87.0)
Black	2,369 (8.6)
Other	1,217 (4.4)
Body mass index, kg/m^2[a]	27.6 ± 6.2
Coronary artery disease	6,196 (22.3)
Diabetes mellitus	5,158 (18.5)
Renal dysfunction	504 (1.8)
Induction chemotherapy or radiation	1,801 (6.5)
Cigarette smoking	
Never	3,895 (14.0)
Past (stopped more than 1 month)	17,368 (62.4)
Current	6,581 (23.6)
Segmentectomy	1,685 (6.1)
Lobectomy	19,836 (71.2)
Sleeve lobectomy	412 (1.5)
Bilobectomy	980 (3.5)
Pneumonectomy	1,116 (4.0)

Minimally invasive	17,153 (61.6)
Thoracotomy	10,691 (38.4)

Table 4. Predictors of Mortality, Major Morbidity, and Composite Mortality and Major Morbidity[a]

Variable	Mortality Model OR (95% CI)	*p* Value	Major Morbidity Model OR (95% CI)	*p* Value
Age, 10-year increase	1.64 (1.44–1.87)	<0.001	1.13 (1.08–1.19)	<0.001
Male	1.54 (1.23–1.92)	<0.001	1.39 (1.28–1.52)	<0.001
Body mass index, kg/m^2		0.006		<0.001
≥18.5 to <25	1.00		1.00	
≥6.0 to <18.5	1.44 (0.85–2.44)		1.33 (1.07–1.65)	
≥25.0 to <30.0	0.96 (0.75–1.22)		0.83 (0.75–0.91)	
≥30.0 to <35.0	0.61 (0.43–0.85)		0.72 (0.64–0.82)	
≥35.0 to ≤99.9	1.17 (0.82–1.67)		0.81 (0.69–0.96)	
Hypertension	0.93 (0.73–1.17)	0.51	1.08 (0.98–1.19)	0.12
Steroids	1.72 (1.14–2.60)	0.01	1.28 (1.05–1.57)	0.017
Congestive heart failure	1.51 (1.01–2.25)	0.046	1.17 (0.95–1.44)	0.15
Coronary artery disease	1.32 (1.05–1.67)	0.019	1.13 (1.02–1.25)	0.022
Peripheral vascular disease	1.49 (1.13–1.96)	0.005	1.43 (1.26–1.62)	<0.001
Reoperation	1.38 (1.00–1.94)	0.052	1.35 (1.16–1.58)	<0.001
Cerebrovascular disease	1.42 (1.05–1.90)	0.021	1.08 (0.94–1.24)	0.29
Diabetes mellitus	1.08 (0.85–1.39)	0.53	1.01 (0.90–1.12)	0.93
% FEV_1, 10% decrease	1.07 (1.01–1.12)	0.02	1.13 (1.10–1.15)	<0.001
Induction therapy	1.51 (1.09–2.10)	0.014	1.20 (1.02–1.40)	0.024
Renal dysfunction	1.74 (1.06–2.86)	0.029	1.07 (0.81–1.42)	0.64
Cigarette smoking		0.14		<0.001
Never	1.00		1.00	
Past smoker	1.54 (1.00–2.38)		1.20 (1.02–1.41)	
Current smoker	1.54 (0.96–2.49)		1.64 (1.38–1.94)	
Zubrod score		<0.001		<0.001
4 or 5	2.26 (1.34–3.80)		1.72 (1.42–2.09)	
Approach		<0.001		<0.001
Minimally invasive	1.00		1.00	
Thoracotomy	1.87 (1.49–2.36)		1.49 (1.35–1.64)	

Approach <0.001 <0.001
Minimally invasive 1.00 1.00
Thoracotomy 1.87 (1.49–2.36) 1.49 (1.35–1.64)

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

Robert J. McKenna, Jr, MD, Ward Houck, MD, and Clark Beeman Fuller, MD
Cedars Sinai Medical Center, Los Angeles, California

- 1100 consecutive pts 1992-2004
- 54.1% female
- Mean age 71.2 years
- Diagnoses
  - Primary NSCLC (1015)
  - Benign disease (53)
  - Metastases (27)

Ann Thorac Surg 2006;81:421

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

Robert J. McKenna, Jr, MD, Ward Houck, MD, and Clark Beeman Fuller, MD
Cedars Sinai Medical Center, Los Angeles, California

- Results
  - 0.8% mortality
  - 15% complication rate (air leak, atrial fibrillation, readmission)
  - 2.5% conversion to open
  - Median LOS 3 days

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

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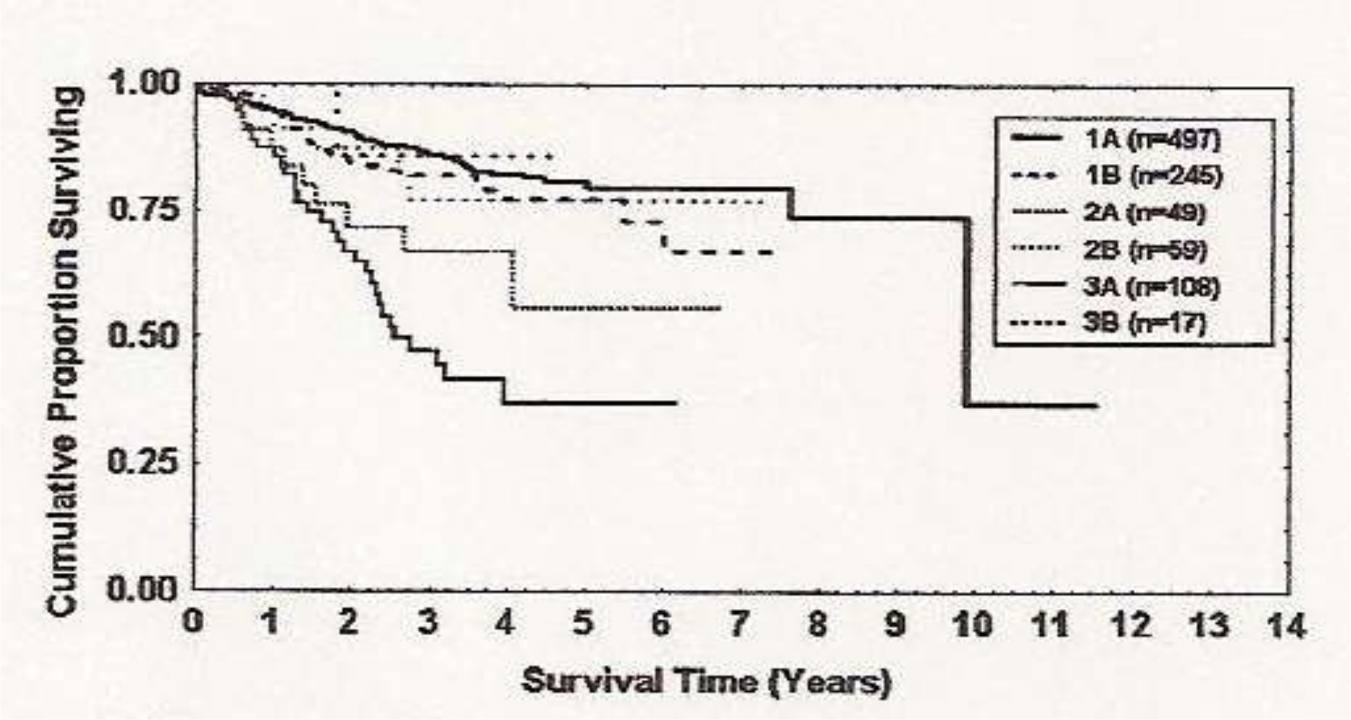


Ann Thorac Surg 2006;81:421

RICHARD E. CLARK AWARD

The Society of Thoracic Surgeons Composite Score for Rating Program Performance for Lobectomy for Lung Cancer

Benjamin D. Kozower, MD, MPH, Sean M. O'Brien, PhD, Andrzej S. Kosinski, PhD, Mitchell J. Magee, MD, Rachel Dokholyan, MPH, Jeffery P. Jacobs, MD, David M. Shahian, MD, Cameron D. Wright, MD, and Felix G. Fernandez, MD

(Ann Thorac Surg 2016;101:1379–87)

Composite Outcomes

Operative mortality	1.5%
Major complications	9.6%
Pneumonia	4.3%
Unexpected return to OR	3.9%
Reintubation	3.4%
Pulmonary embolus	0.5%
Initial Vent Support >48 Hours	0.5%
Bronchopleural fistula	0.4%
Tracheostomy	1.0%
ARDS	0.7%
Myocardial infarction	0.4%
Length of stay (median)	4 days, IQR (3,7)

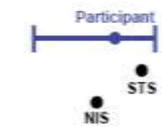
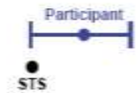
Risk Unadjusted Outcomes

STS General Thoracic Surgery Database
Participant Performance for Lobectomy Compared to STS and NIS Databases

Participant 40129
STS Period Ending 06/30/2016

Duke Clinical Research Institute

Table 6: Participant Performance for Lobectomy Compared to STS and NIS Databases[1]

	Participant Last 3 Years Jul 2013 - Jun 2016	**STS** Last 3 Years Jul 2013 - Jun 2016	**Nationwide Inpatient Sample (NIS)** Most Recently Available Year Jan 2012 - Dec 2012
Discharge Mortality	n=359 **Percent (95% CI)** 5/359=1.4% (0.5 , 3.2)	n=24,603 **Percent** 203/24603=0.8%	n=26,015 **Percent** 460/26015=1.8%
			
Postoperative Length of Stay (Days)[2]	n=359 **Median (Q1 , Q3)** 3.0 (2.0 , 5.0)	n=24,587 **Median** 4.0	n=26,015 **Median** 5.3
			
Minimally Invasive Lobectomy for Clinical Stage I Lung Cancer	n=232 **Percent (95% CI)** 179/232=77.2% (71.2 , 82.4)	n=17,515 **Percent** 12502/17515=71.4%	
			

[1] Refer to the Report Overview for the Lobectomy Population inclusion details
[2] Computed time between the surgery date and discharge date

Use and Outcomes of Minimally Invasive Lobectomy for Stage I Non-Small Cell Lung Cancer in the National Cancer Data Base

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Department of Surgery, Division of Cardiovascular and Thoracic Surgery, Duke University Medical Center, Durham, North Carolina; Department of Cardiothoracic Surgery, Stanford University Medical Center, Stanford, California; and Department of Cell Biology and Molecular Medicine, New Jersey Medical School, Newark, New Jersey

Background. Previous studies have raised concerns that video-assisted thoracoscopic (VATS) lobectomy may compromise nodal evaluation. The advantages or limitations of robotic lobectomy have not been thoroughly evaluated.

Methods. Perioperative outcomes and survival of patients who underwent open versus minimally-invasive surgery (MIS [VATS and robotic]) lobectomy and VATS versus robotic lobectomy for clinical T1-2, N0 non-small cell lung cancer from 2010 to 2012 in the National Cancer Data Base were evaluated using propensity score matching.

Results. Of 30,040 lobectomies, 7,824 were VATS and 2,025 were robotic. After propensity score matching, when compared with the open approach (n = 9,390), MIS (n = 9,390) was found to have increased 30-day readmission rates (5% versus 4%, $p < 0.01$), shorter median hospital length of stay (5 versus 6 days, $p < 0.01$), and improved 2-year survival (87% versus 86%, $p = 0.04$). There were no significant differences in nodal upstaging and 30-day mortality between the two groups. After propensity score matching, when compared with the robotic group (n = 1,938), VATS (n = 1,938) was not significantly different from robotics with regard to nodal upstaging, 30-day mortality, and 2-year survival.

Conclusions. In this population-based analysis, MIS (VATS and robotic) lobectomy was used in the minority of patients for stage I non-small cell lung cancer. MIS lobectomy was associated with shorter length of hospital stay and was not associated with increased perioperative mortality, compromised nodal evaluation, or reduced short-term survival when compared with the open approach. These results suggest the need for broader implementation of MIS techniques.

(Ann Thorac Surg 2016;101:1037–42)

Table 4. Propensity-Matched Analysis of Video-Assisted Thoracoscopic Versus Robotic Lobectomy: Perioperative and Postoperative Data

Perioperative and Postoperative Data	VATS (n = 1,938)	Robotic (n = 1,938)	p Value
Treatment specifics			
Days to definitive surgery	27 (0–48)	31 (6–53)	<0.01
Adjuvant therapy			
Radiotherapy	42 (2.2)	60 (3.1)	0.09
Chemotherapy	221 (11.6)	251 (13.1)	0.17
Chemoradiation	23 (1.2)	38 (2)	0.07
Surgical endpoints			
Conversion to open	340 (17.5)	200 (10.3)	<0.01
Nodes removed	9 (5–14)	8 (5–13)	0.01
Surgical margins			0.32
Negative	1,881 (97.6)	1,888 (97.6)	
Positive margin-microscopic	29 (1.5)	35 (1.8)	
Positive margin-macroscopic	18 (0.9)	11 (0.6)	
Short-term outcomes			
Thirty-day mortality	17 (1.5)	12 (1.3)	0.96
Thirty-day readmission	103 (5.3)	89 (4.6)	0.34
Hospital length of stay, days	5 (3–7)	5 (3–7)	0.34
Tumor characteristics			
Pathologic tumor size, cm	2.6 ± 1.4	2.7 ± 2.3	0.16
Pathologic T status[a]			0.39
T0 (in situ)	5 (0.3)	3 (0.2)	
T1	1,143 (61.0)	1,112 (59.5)	
T2	625 (33.4)	665 (35.6)	
T3	87 (4.6)	82 (4.4)	
T4	13 (0.7)	7 (0.4)	

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

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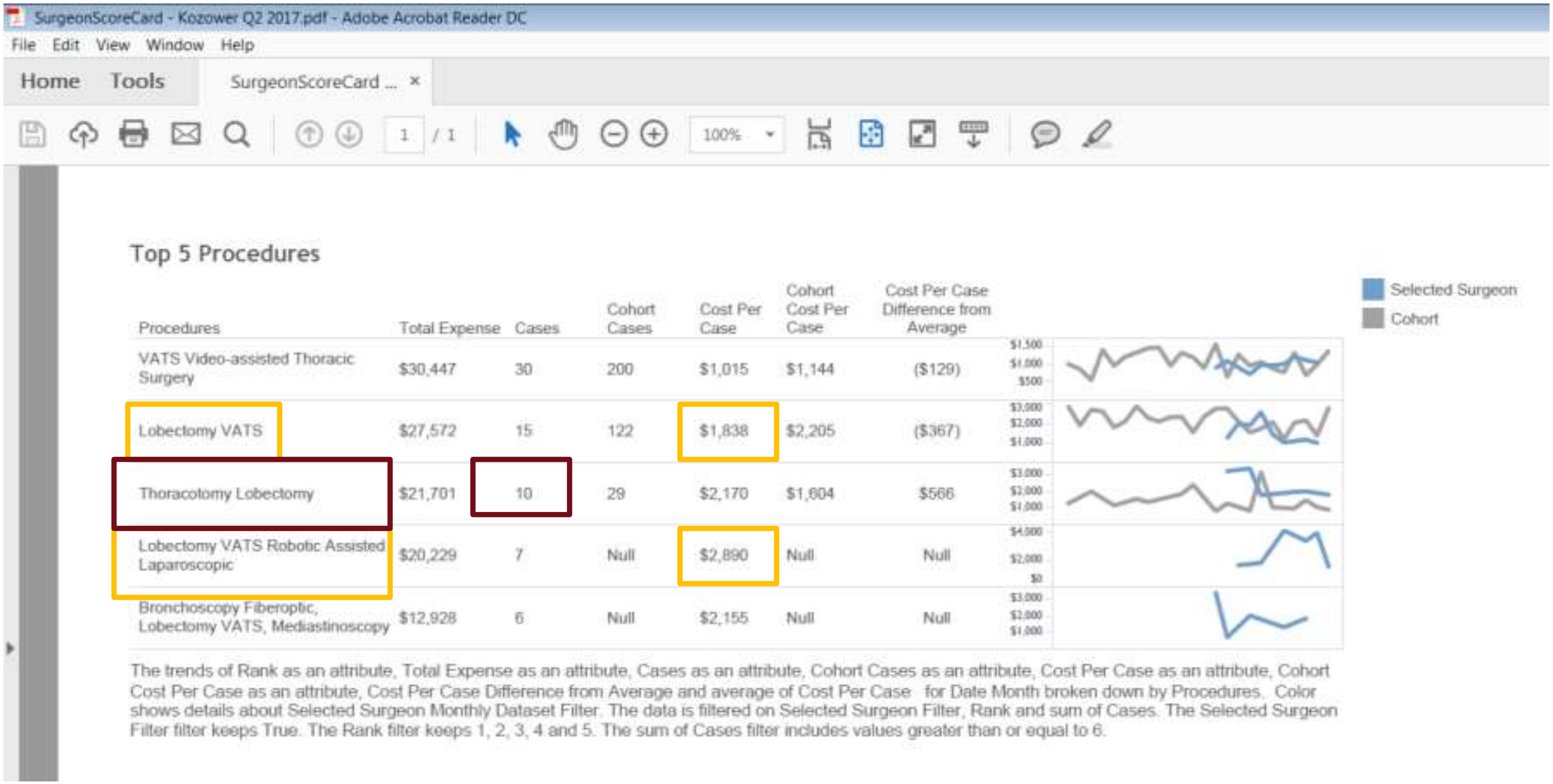
Table 3. Postoperative Morbidity

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.

Robotic Surgery is Expensive: Real life data, does not include capital or service contract costs at BJH



Top 5 Procedures

Procedures	Total Expense	Cases	Cohort Cases	Cost Per Case	Cohort Cost Per Case	Cost Per Case Difference from Average
VATS Video-assisted Thoracic Surgery	$30,447	30	200	$1,015	$1,144	($129)
Lobectomy VATS	$27,572	15	122	$1,838	$2,205	($367)
Thoracotomy Lobectomy	$21,701	10	29	$2,170	$1,604	$566
Lobectomy VATS Robotic Assisted Laparoscopic	$20,229	7	Null	$2,890	Null	Null
Bronchoscopy Fiberoptic, Lobectomy VATS, Mediastinoscopy	$12,928	6	Null	$2,155	Null	Null

The trends of Rank as an attribute, Total Expense as an attribute, Cases as an attribute, Cohort Cases as an attribute, Cost Per Case as an attribute, Cohort Cost Per Case as an attribute, Cost Per Case Difference from Average and average of Cost Per Case for Date Month broken down by Procedures. Color shows details about Selected Surgeon Monthly Dataset Filter. The data is filtered on Selected Surgeon Filter, Rank and sum of Cases. The Selected Surgeon Filter filter keeps True. The Rank filter keeps 1, 2, 3, 4 and 5. The sum of Cases filter includes values greater than or equal to 6.

Conclusions

- Minimally invasive pulmonary resection has lower morbidity and mortality than thoracotomy
- VATS and Robotic procedures appear to have similar outcomes
- VATS pulmonary resection is less expensive than robotic surgery
- Rishi – I didn't even show the U of M data showing that VATS and robotic have similar outcomes at your center

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