Technical & Safety Performance of CT-guided Percutaneous Microwave Ablation for Metastatic & Primary Lung Tumors

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Objectives
The primary objective of this study was to demonstrate technical performance of a CT-guided percutaneous microwave ablation (MWA) system in subjects with primary or secondary lung tumors by measuring dose response.
Methods
This was a prospective, non-randomized, single-arm, multicenter study. Evaluation of the ablated zone created in subjects already scheduled for surgical resection of metastatic or primary lung disease per standard practice was performed. Dose response was assessed by comparing actual versus predicted ablation zone size and volume and was measured for each ablation zone using CT imaging immediately post ablation and prior to the surgical resection. Tumor ablation immediately post-procedure was assessed with histologic analysis. Complete ablation was defined as 100% non-viable tumor cells based on NADH staining.
Results: A total of 15 subjects (mean age 58.9 years) were enrolled in the study. Five subjects (5/15, 33.3%) had a history of thoracic surgery; 73% (11/15) had metastatic tumors and 27% (4/15) had primary tumors. All 15 subjects underwent ablation and resection. Complete ablation was detected in 54.4% (6/11), incomplete ablation in 36.4% (4/11), and delayed necrosis in 9.1% (1/11). There were no device-related AEs reported.
Conclusions
Histologic complete ablation can be achieved with microwave ablation, but CT scanning less than an hour after microwave ablation is not the ideal time point to measure dose response. While smaller ablation zones were expected based on previous reports, delayed imaging may represent a more realistic view of ablation baseline imaging and should be considered in future studies when evaluating the accuracy of pre-procedure planning.

Table 1: Percentage change from the predicted outcome to the actual outcome based on immediate post-ablation CT scan measurements.

Variable	**Mean ± SD (N)** **[Median] (Min, Max)**
% Change Ablation Zone Width (X)	-43.6 ± 18.8 (12) [-44.7] (-77.4, -11.2)
% Change Ablation Zone Height (Y)	-15.1 ± 31.7 (12) [-11.5] (-77.4, 45.2)
% Change Ablation Zone Depth (Z)	-32.8 ± 26.0 (11) [-26.1] (-74.1, 15.6)
% Change Ablation Zone Volume (Actual volume vs predicted volume)	-63.5 ± 26.3 (11) [-67.3] (-94.9, -5.5)
% Change Ablation Zone Volume (Actual calculated volume vs predicted volume)	-57.7 ± 31.8 (11) [-59.3] (-96.9, 7.5)

Time To Treatment And Patient Survival In Non-Small Cell Lung Cancer

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Objective: Associations between timeliness of treatment in non-small cell lung cancer (NSCLC) and patient cure rate are still under debate. We hypothesized that delays in surgical resection would increase mortality in adult NSCLC patients. **Methods:** We retrospectively reviewed the medical records of patients who underwent surgical resection between November 1, 2006 and December 24, 2012 for NSCLC. Delays in treatment (time between documentation of concern for cancer and date of surgery) were analyzed. We identified associated factors and assessed survival using univariate and multivariate Cox regression and Kaplan-Meier estimates. **Results:** We compiled data from 100 patients; the mean age at surgery was 71 years (range 50 – 89), 59 (59%) were female, and 98 (98%) were Caucasian. The stage distribution was stage I: 71, stage II: 14, and stage III/IV: 15. 66 patients had government or no insurance. The mean delay from date of concern to date of surgery was 30.6 days (range 3 – 109). We observed no relationship between time to treatment and survival. In both univariate and multivariate analyses, age at surgery and stage were associated with survival (hazard ratio: 1.064, $p = 0.003$; hazard ratio: 1.065, $p = 0.003$, respectively). Having commercial health insurance had a univariate hazard ratio of 0.453 ($p < 0.049$) for survival but became nonsignificant in multivariate analyses. **Conclusions:** We found no significant difference between a shorter time to treatment and survival in this small sample. We did find that advanced age and higher stage were negative predictive factors for survival.

Reasons for Extended Length of Stay (ELOS) Following Chest Tube Removal in Fast-Track General Thoracic Surgical Patients

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Objectives:
Many patients undergoing general thoracic surgery can be discharged on the same day as chest tube removal, but some are not, leading to increased resource utilization. This study assesses the frequency and duration of extended length of stay (ELOS) after tube removal and identifies risk factors for ELOS.

Methods:
We reviewed all adult patients undergoing general thoracic surgery at a tertiary referral medical center captured in the Society of Thoracic Surgeons General Thoracic Surgery Database and obtained detailed clinical data on chest tube management using the electronic medical record from August 2013 to March 2017. Pre-operative demographics, procedures, diagnoses, comorbidities, hospital service category, and laboratory values were examined to identify risk factors associated with ELOS after chest tube removal using multivariable generalized linear regression models.

Results:
1470 patients had ≥1 chest tubes placed at the time of operation and discharged after chest tube removal: anatomic lung resection (500, 34%), wedge resection (426, 29%), decortication (235, 16%), and other (309, 21%). 51% (750) of these patients were male, (265, 18%) were black, and the mean age was 59 years (SD:15). One-third of patients had prior cardiothoracic operations. Common comorbidities were hypertension (838, 57%), CAD (250, 17%), COPD (382, 26%), and steroid use (147, 10%). 23% of these patients had ELOS, defined as discharge ≥ 1 calendar day after chest tube removal (mean 2.7 days; SD: 18.6). A multivariable regression model identified risk factors for ELOS (Table).

Conclusion:
Patients with obesity, more severe disability, or actively smoking were more likely to have ELOS, as were patients who underwent decortication. Patients admitted to transplant and oncology services were more likely to experience ELOS. These factors should be considered when identifying appropriate patient groups for fast-track algorithms.

Table. Predictors (by multivariable linear regression) of ELOS after chest tube removal among fast-track thoracic surgery patients

Risk Factor	Coefficient*	P value
Service transplantation	7.88	<.0001
Service oncology	2.10	0.015
Greater disability (Zubrod>=2)	1.42	<.0001
Decortication Procedure	1.31	0.0004
Current Smoker	1.05	0.0001
Lower Hemoglobin (unit: 1 g/dl)	0.41	<.0001
BMI (unit: 5 kg/m^2)	0.31	0.001

*Number of additional days of extended length of stay associated with presence of risk factor.

Lung Cancer Screening at an Urban Safety Net Hospital: Age, Race, and Income Are Associated with Lower Screening Rates Thoracic Surgical Patients

Boston Medical Center

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*These authors contributed equally.

OBJECTIVE: While lung cancer screening has been shown to improve cancer-specific mortality and is now formally recommended, implementation is not well studied. We sought to determine the screening rate at an urban safety net hospital and identify socioeconomic barriers to screening.

METHOD: Using an institutional clinical data repository, we identified 8,932 smokers ages 55-80 years evaluated by a primary care physician between 1/1/2015 and 1/31/2017. We randomly selected one-third of these to review for lung cancer screening eligibility and determined the number of eligible patients. We collected demographic information including race, primary language, education status, and median income (estimated using zip code), and used statistical analysis to determine their associations with screening.

RESULTS: In total, 685/2,235 (30.7%) patients meeting screening criteria underwent a screening CT whereas 1,550/2,235 (69.4%) potentially eligible patients were not screened. The median ages of unscreened to screened patients were 66 and 63 years, respectively ($p<0.001$). Thirty-nine percent (268/685) of the screened sample was African American versus 48% (245/516) of the unscreened population ($p=0.001$). In addition, unscreened patients had a lower annual household income (Table). Education level and insurance type were not significantly associated with screening status.

Demographic	Screened n=685	Unscreened n=516	p-value
Age (years)	63 (60-68)	66 (61-73)	<0.0001
Age			<0.0001
<65	395 (57.7%)	230 (44.6%)	
≥65	290 (42.3%)	286 (55.4%)	
Race			0.001
White	312 (45.8%)	202 (39.2%)	
Black/African-American	268 (39.3%)	245 (47.5%)	
Asian	20 (2.9%)	3 (0.6%)	
Unknown	82 (12.0%)	66 (12.8%)	
Median household income			0.002
<$30,000	104 (15.2%)	116 (22.5%)	
$30,000 - $39,999	82 (12.0%)	67 (13.0%)	
$40,000 - $49,999	80 (11.7%)	69 (13.4%)	
$50,000+	419 (61.2%)	264 (51.2%)	

Influence of Technical Difficulty on Patient Outcomes After Thoracoscopic Lobectomy

East Carolina University

Elizabeth Marshall, Dante Dali, Carlos Anciano, Aundrea Oliver, Mark Iannettoni, James Speicher

Objective:

It has frequently been presumed that factors leading to more complicated surgical dissection result in inferior outcomes for patients undergoing lung resection for cancer. While some studies have demonstrated both open and thoracoscopic lobectomy to be safe and effective in complicated patients, other studies continue to show conflicting results with respect to morbidity and mortality. Our study aim was to determine if patient outcomes are affected by the technical difficulty of thoracoscopic lobectomy and, if so, which outcomes are affected and which aspects of technical difficulty contribute to the difference in outcome.

Methods:

Patients who underwent thoracoscopic lobectomy over a two year period at as single institution were included for IRB-approved retrospective chart review. Patients were categorized as either "routine" or "complicated" based on objective data in operative notes. A two tailed T test of unequal variance was performed to determine significance of results.

Results:

There were 66 patients included in the study: 41 were classified as "routine" and 25 as "complicated". When comparing the following variables, none were found to be significantly different: length of hospital stay, length of ICU stay, chest tube duration, duration of air leak, readmission rate and postoperative complication rate ($P>0.05$). There were no mortalities in the "complicated" patient group and 1 mortality in the "routine" patient group.

Conclusions:

No statistical difference in postoperative course or outcome was found when comparing patients whose resection was technically difficult versus those classified as routine. The data suggests that technically difficult thoracoscopic lobectomy is not predictive of a challenging postoperative course.

	Routine	Complicated	p Value
Length of Stay (Days)	5.3	4.2	0.09
Length of ICU Stay (Days)	0.6	0.1	0.13
Chest Tube Duration (Days)	5.9	4.3	0.20
Air Leak Duration (Days)	2.8	2.4	0.72
Readmission Rate (%)	12.2	12.0	0.98
Overall Postoperative Complication Rate (%)	26.8	16.0	0.38

Table 1: Comparison of postoperative outcomes data of patients classified as "routine" and "complicated" based on objective technical data.

Endobronchial Valves In The Management Of Prolonged Air Leaks In Patients With Chronic Lung Disease

East Carolina University

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Objectives.

Prolonged air leak is a challenging problem in patients with spontaneous pneumothorax and chronic lung disease who are poor surgical candidates. Conventional management consists of long term chest tube placement, however in some cases patients are unable to leave the hospital due to the need for continuous negative pressure to the tube. We report our investigational application of endobronchial valves in the management of patients with air leak arising from chronic lung disease in whom surgical intervention was contraindicated.

Methods.

With Institutional Review Board-approval, endobronchial valves were placed in patients with persistent air leaks arising from non-operative causes. Successful outcomes were defined as complete resolution of air leak and removal of chest tube.

Results.

Six patients with persistent air leak requiring negative pressure suction were treated with 2 to 4 valves per patient. Persistent air leak was secondary to bullous emphysema, sarcoidosis, lung cancer, or necrotizing infection. Overall successful outcome rate was 67%. Average length of stay before and after valve placement was 21 ± 16 days and 13 ± 7 days, respectively. Furthermore, average length of stay post valve placement was 9 ± 4 days in the success group compared to 21 ± 4 days in the failure group. Only one adverse event was recorded, of a bronchial valve migration with no adverse outcome.

Conclusions.

Endobronchial valves are a valid alternative to surgical intervention for high-risk patients who have failed conventional management of persistent air leak arising from non-operative causes. They appear to be associated with shorter length of stay when successful.

Outcomes After Resection Of Thymic Neoplasms With Pleural Metastases

The University of Texas MD Anderson Cancer Center

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Objective

In the management of Masaoka Stage IVA thymic neoplasms (TN), it is unclear if specific treatment of pleural metastases (PM) confers any survival benefit. We reviewed our experience with thymoma and thymic carcinoma (TC) with concurrent isolated PM to identify factors which may influence outcomes.

Methods

Records of patients evaluated for thymoma or TC with PM from 2000 to 2018 were assessed. We excluded patients with previously treated or resected TN, and those with only local pleural invasion but without spatially separate PM.

Results

Forty-nine patients met inclusion criteria (Table). Median survival and progression-free survival (MPFS) were 123 and 24 months, respectively. MPFS for thymoma versus TC were 27 and 19 months (p=0.044), respectively. MPFS following resection versus never-resected were 32 and 12 months (p=0.007), respectively (Figure). While there was a trend towards poorer survival for TC (hazard ratio 6.86; p=0.071) in multivariate analysis, no differences in clinicopathologic factors were identified which predicted survival or recurrence between thymoma versus TC, or following resection.

After resection of thymoma, the first site of failure was pleural in 70% (14/20), with distant recurrence less common (4/20). However, failure after resection of TC was pleural in 57% (4/7), followed by chest wall (2/7).

Conclusions

TN with pleural dissemination represent a treatment challenge, with TC conferring worse prognosis. While multimodal therapy should be undertaken, surgery is paramount to locoregional control. Though disease characteristics could not be identified to guide prognostication, TN represent an indolent process, and interventions should be aimed at limiting disease progression.

Table:

Baseline demographics and disease characteristics

	n (%)
Male sex	20 (41)
Median age, years (IQR)	55.8 (47-64.5)
Metastatic disease location[1]	
Pleural	42 (86)
Diaphragmatic	19 (39)
Pericardial	7 (14)
Pathology	
Thymoma	38 (78)
Thymic carcinoma	11 (22)
Primary tumor size on imaging, cm, mean (SD)	7.8 (2.8)
Treatment strategy[2]	
Chemotherapy and/or radiation therapy only	13 (27)
Neoadjuvant chemotherapy + surgery	2 (4)
Surgery + adjuvant therapy	9 (18)
Neoadjuvant chemotherapy + surgery + adjuvant therapy	24 (49)
Primary tumor response to upfront chemoradiation therapy[3]	
Increased	2 (6)
Stable	12 (36)
Decreased	19 (58)
Metastatic tumor response to upfront chemoradiation therapy[3]	
Increased	5 (15)
Stable	13 (39)
Decreased	11 (33)
Complete response	4 (12)
Extent of resection	
Thymectomy only	8 (23)
Thymectomy + partial pleurectomy	23 (66)
Thymectomy + complete pleurectomy	3 (9)
Thymectomy + extrapleural pneumonectomy	1 (3)
Positive surgical margins[4]	17 (53)

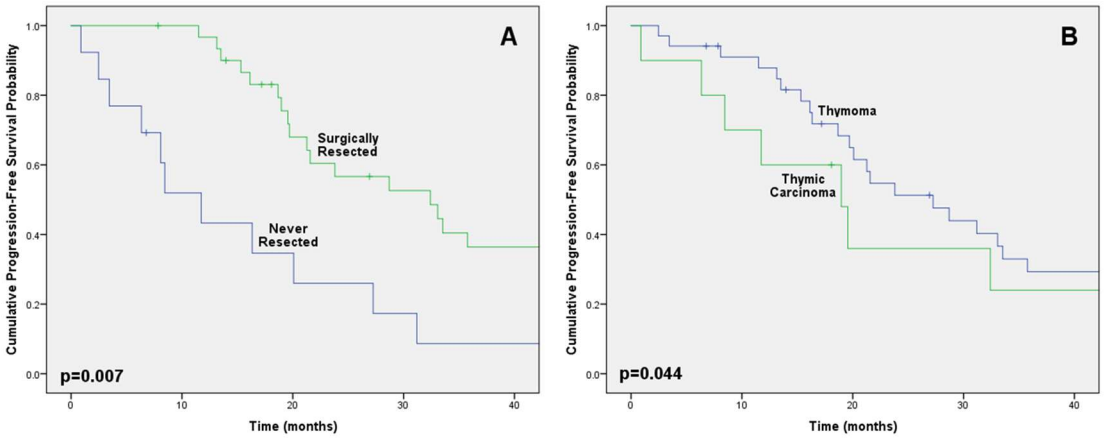
[1]17 patients had multifocal metastatic disease.

[2]1 patient declined neoadjuvant therapy.

[3]33 of 39 patients who underwent any upfront chemoradiation therapy had available imaging or reports.

[4]32 of 35 patients who underwent surgical resection had available pathologic reports.

Figure:



(A) Median progression-free survival of patients undergoing surgical resection and those who never underwent resection. (B) Median progression-free survival time of patients with thymoma versus thymic carcinoma.

Robotic Resection of a Thoracic Duct Cyst

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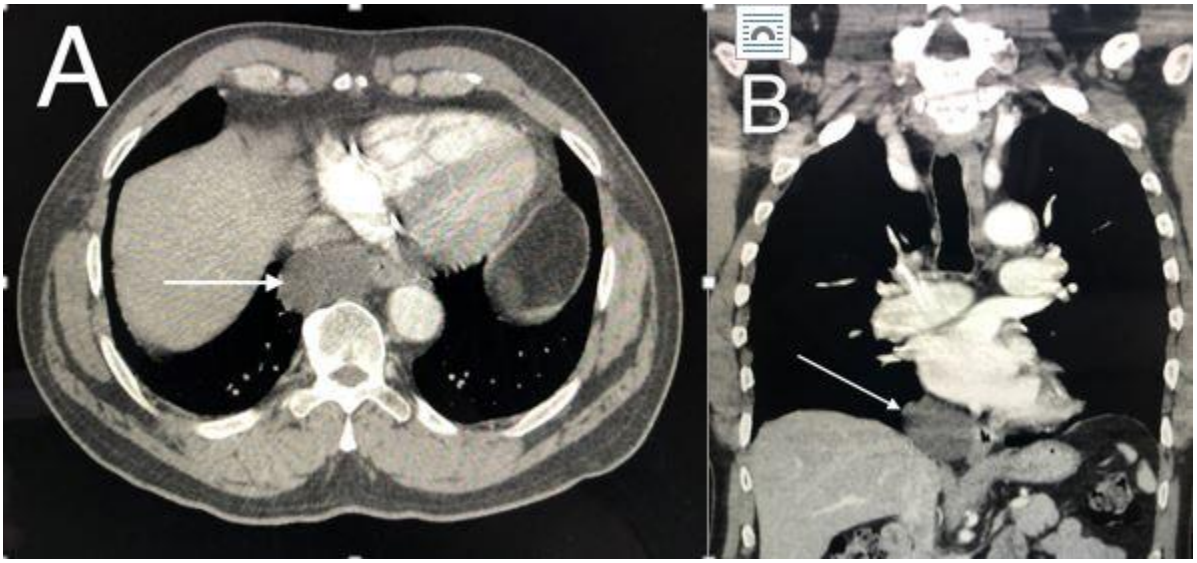
Objective: To present the case of a robotic-assisted thoracoscopic resection of a thoracic duct cyst (TDC) and to review the literature on the subject. To our knowledge, robotic resection of a TDC has not been previously described. **Methods:** Our institution's electronic health record and an intraoperative video were reviewed. A Pubmed literature search was also performed for thoracic duct cyst. Results: A 69-year-old male presented with a one year history of dyspnea and back tightness. Computed tomography revealed a 5x3 cm homogeneous, cystic right paraesophageal mass (Figure). On upper endoscopy, the esophageal mucosa was normal and there was no fistula to the mass. A right robotic-assisted thoracoscopic resection of the paraesophageal mass was performed. Final pathology revealed a thoracic duct cyst. **Conclusion:** Both open thoracotomy as well as thoracoscopic resection of TDC have been described in the literature, but a robotic approach has not. As the adoption of robotic surgery continues to evolve, we suspect that the resection of mediastinal masses such as thoracic duct cysts will become more common. Further studies comparing robotic to non-robotic thoracoscopic resection of mediastinal masses (including TDC) would be helpful to determine the preferred treatment while minimizing morbidity, length of stay, and cost.



Utilization of Low-Dose CT Scan for Lung Cancer Screening: Barriers to LDCT Utilization in the Primary Care Setting

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Objective: Low-dose CT (LDCT) scan for lung cancer screening is underutilized. Thus, identifying the barriers to utilization of LDCT is essential.

Methods: Primary care providers practicing Internal Medicine or Family Practice in 3 different healthcare settings were surveyed. Providers practiced at a university tertiary care center, a county hospital, or a community hospital. Provider and patient demographics, knowledge of lung cancer screening criteria, screening practices, and barriers to the utilization of LDCT were assessed. A Likert scale was used to assess providers' perception regarding barriers to the utilization of LDCT. Differences in responses between hospitals and provider specialties were assessed using univariable analysis.

Results: The survey was sent to 614 providers, with a 15.7% (97/614) response rate. 91.7% (88/96) of respondents were physicians and 78.7% (74/94) practiced Internal Medicine. 39.2% (38/97) were university-based, 27.8% (27/97) were county-based, and 33% (32/97) were community-based. 29.8% (29/97) of providers have never ordered a LDCT scan. Providers demonstrated variation in knowledge of CMS eligibility criteria for lung cancer screening (Figure 1a). Common barriers to utilization of LDCT scan included failure of the electronic medical record (EMR) to notify providers of eligible patients (54.7%; 52/95), patient refusal (36.9%; 34/92), perceived high false-positive rate leading to unnecessary procedures (18.9%; 18/95), time constraint (16.9%; 16/95), and lack of insurance coverage (13.7%; 13/95) (Figure 1b).

Conclusion: Provider knowledge of lung cancer screening guidelines varies, perhaps contributing to underutilization of LDCT for lung cancer screening. Lack of electronic medical record alerts for eligible patients, a modifiable factor, is perceived as the greatest barrier to utilization of LDCT lung cancer screening.

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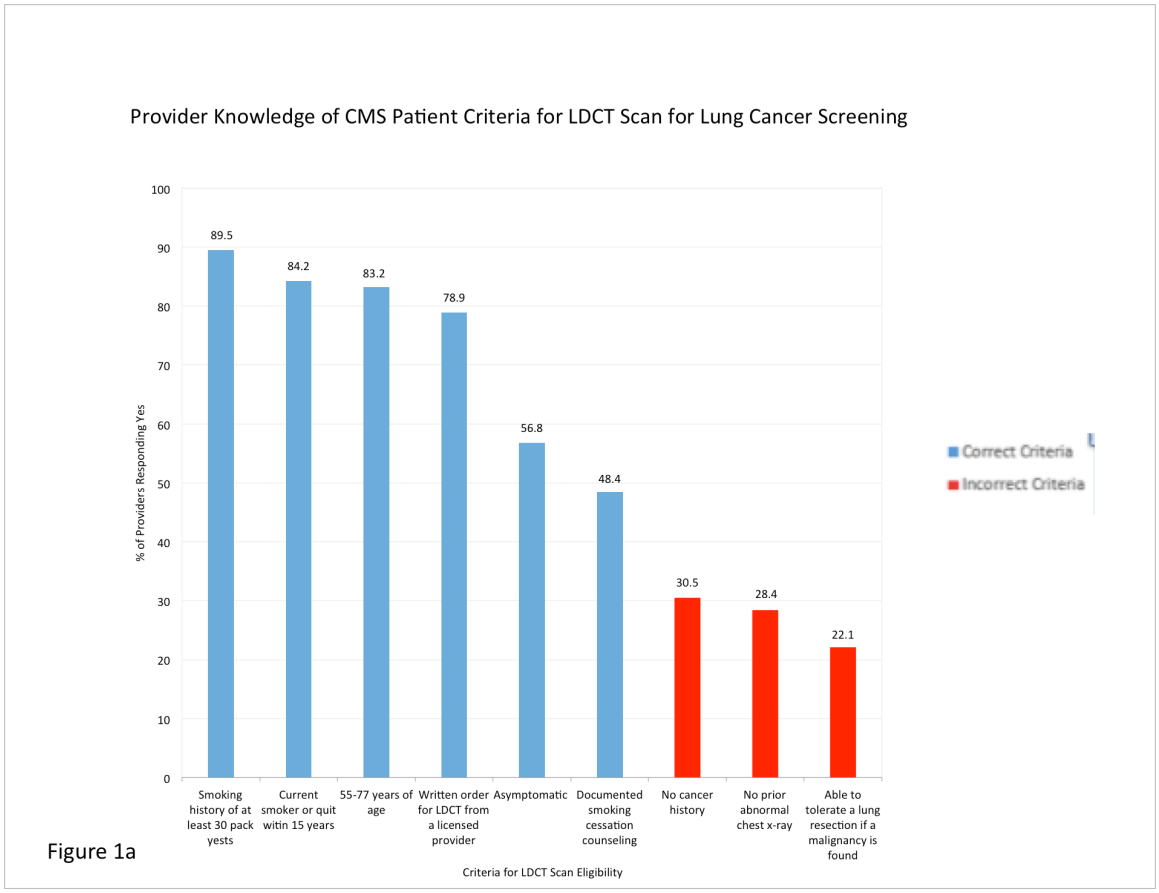

Figure 1a

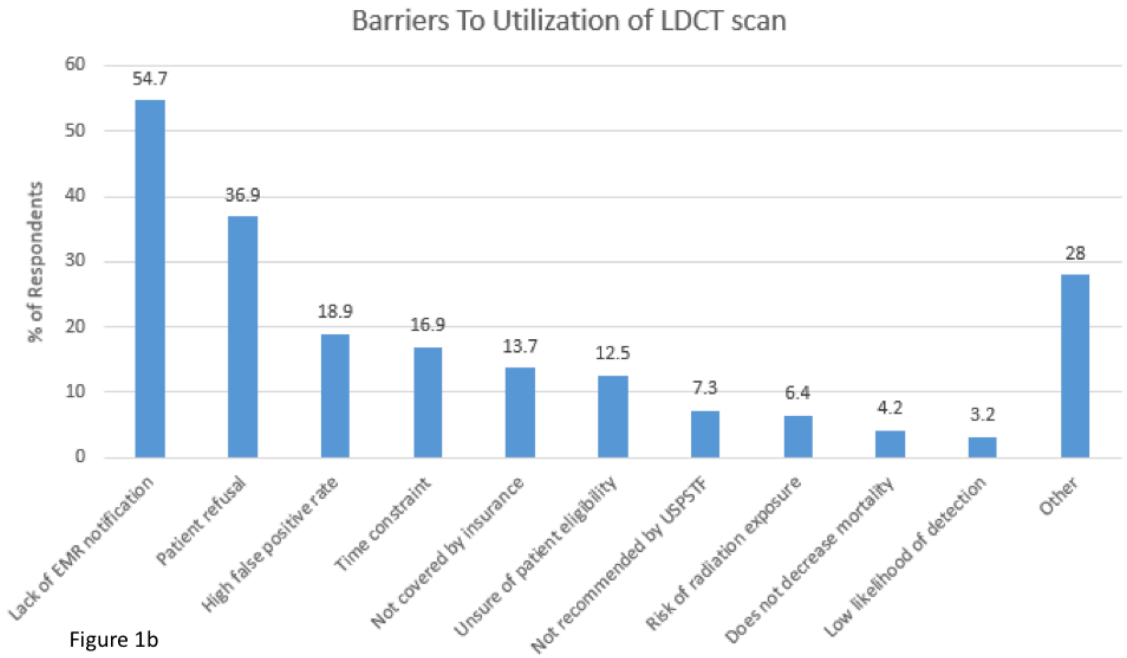

Figure 1b

Gregory R. Toci, Trevor A. Davis, and Stephen C. Yang

Title:
Nuss and Ravitch Repairs for Primary and Recurrent Adult Pectus Excavatum: Comparison of Postoperative Complication and Recurrence Rates

Objective:
Limited data exist for recurrence rates after pectus excavatum repair in the adult population. We reviewed outcomes in adult patients undergoing Ravitch or Nuss pectus excavatum repairs to determine if there was a statistical difference in postoperative complications and recurrence between primary and redo operations.

Methods:
A retrospective cohort study of patients undergoing primary and redo pectus excavatum repair between 2001-2018 was performed. Patients were excluded if they were receiving a concurrent unrelated operation, <18 years old, or had less than 1-year follow-up (for recurrence analysis). Postoperative complications were recorded based on procedure type (Ravitch/Nuss) and repair (primary/redo). Chi-square or Fisher Exact tests were performed for postoperative complications and recurrence rates between groups.

Results:
There were no significant differences between all Nuss repairs and all Ravitch repairs in postoperative complications (p=0.59) and recurrence (p=0.44). There were no significant differences between redo Nuss repairs and redo Ravitch repairs in postoperative complications (p=0.26) and recurrence (p=0.99). There were no significant differences between primary and redo Nuss or Ravitch repairs in postoperative complications (Nuss p=0.26; Ravitch p=0.99) and recurrence (Nuss p=0.10; Ravitch p=0.99). Average follow-up time was 3.9 years. The most common postoperative complications for redo Ravitch repairs were neurologic and hematologic, while for redo Nuss repairs were pulmonary and neurologic.

Conclusions:
Postoperative complication and recurrence rates were equivalent between Nuss and Ravitch procedures of all types, suggesting either procedure may have utility in recurrent pectus excavatum. Further research should look to expand sample size for comparisons.

Table 1. Postoperative complications and recurrence between Nuss and Ravitch procedures, stratified by subgroup. (%, x) denotes the percentage and absolute number of derivations.

Total			
	Nuss	Ravitch	p-value
Postoperative Complications	22 (9.3%, 237)	3 (5.7%, 53)	0.589
Recurrence	15 (7.0%, 213)	3 (11.1%, 27)	0.436
Nuss			
	Primary	Redo	p-value
Postoperative Complications	15 (8.2%, 184)	7 (13.2%, 53)	0.264
Recurrence	9 (5.4%, 167)	6 (13.0%, 46)	0.099
Ravitch			
	Primary	Redo	p-value
Postoperative Complications	2 (7.4%, 27)	1 (3.8%, 26)	0.999
Recurrence	2 (14.3%, 14)	1 (7.7%, 13)	0.999
Redo			
	Nuss	Ravitch	p-value
Postoperative Complications	7 (13.2%, 53)	1 (3.8%, 26)	0.260
Recurrence	6 (13.0%, 46)	1 (7.7%, 13)	0.999

Incidence and Risk Factors for Postoperative Urinary Retention in Patients Undergoing Fast-Track General Thoracic Surgery

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James Kirklin, MD, James Donahue, MD
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Background
One aspect of enhanced recovery after general thoracic surgery involves minimizing placement of indwelling monitoring devices such as urinary catheters. Many patients, however, suffer from postoperative urinary retention when urinary catheters are not placed. The incidence and risk factors for this problem are not well defined.

Methods
We retrospectively reviewed all adult patients undergoing major general thoracic surgery (STS major surgical procedures) between August 1st, 2013, and March 31st, 2017. We excluded patients undergoing outpatient surgery, patients on dialysis, and patients who came out of the operating room with a catheter. Preoperative demographics, comorbidities, diagnoses, lab values, clinical characteristics, and intraoperative variables were examined to identify risk factors for postoperative urinary retention using multivariable logistic regression modeling. A prognostic nomogram was developed for assisting medical decision-making.

Results
1484 patients met the criteria for our study (anatomic lung resection 32%, wedge resection 28%, decortication 12%, others 28%). Mean age was 59 years, 51% were male, and 82% were white. The incidence of postoperative urinary retention within 24 hours of operation was 19%. In a multivariable logistic regression model, risk factors for postoperative urinary retention included older age, male sex, white race, increased creatinine (per 1 g/dl increase), COPD, chest wall resection, anatomic lung resection, and pectus repair (Table 1). The nomogram for estimating the risk of postoperative urinary retention is shown in Figure 1.

Conclusions
Postoperative urinary retention occurs in almost 20% of patients who undergo major general thoracic surgery who do not have a urinary catheter in place at the end of their operation. Identification of risk factors associated with postoperative urinary retention may help practitioners target certain patients with prophylactic measures to prevent this complication.

Nomogram for predicting the probability of having post-op 24-hr urinary retention in patients who underwent general thoracic procedures, n=1484, 2013-2017

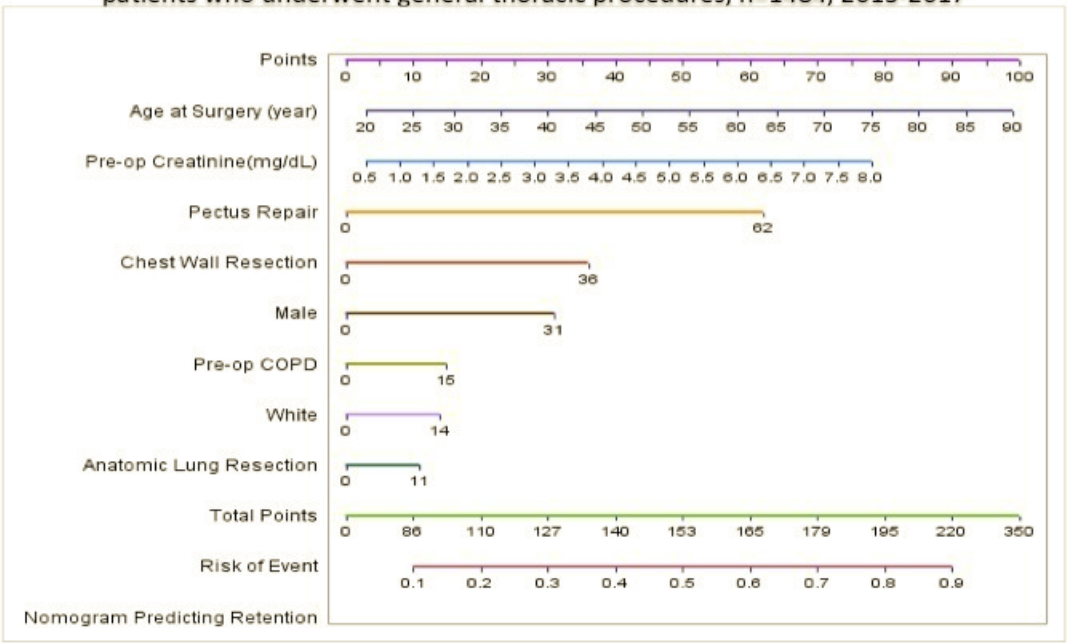

Figure. The total points of a 65-year-old white male patient, who had a pre-op creatinine as 2.5 mg/dL and with pre-op COPD and a chest wall resection, can be summed to 64 (Age) +14 (White) + 31 (Male) + 25 (Creatinine x 10) + 15 (Pre-op COPD) + 36 (chest wall resection) = 185 approximately with a predicted probability of retention (indicated by the line of Risk of Event) between 0.7 to 0.8.

Table 1. Risk factors for postoperative urinary retention after general thoracic surgery

Variable	Odds Ratio (95% CI)	P-value
Age at surgery (per 10 year increase)	1.57 (1.38-1.77)	<.0001
Pre-op Creatinine (per 1.0 mg/dL increase)	1.39 (1.06-1.82)	0.02
Pectus Repair	7.72 (2.39-24.96)	<0.01
Chest Wall Resection	3.25 (1.28-8.25)	0.01
Male	2.74 (2.04-3.69)	<.0001
Pre-op COPD	1.62 (1.2-2.19)	<0.01
White Race	1.59 (1.05-2.41)	0.03
Anatomic Lung Resection	1.45 (1.06-1.97)	0.02

Table. Predictors (by multivariable linear regression) of ELOS after chest tube removal among fast-track thoracic surgery patients

Risk Factor	Coefficient*	P value
Service transplantation	7.88	<.0001
Service oncology	2.10	0.015
Greater disability (Zubrod>=2)	1.42	<.0001
Decortication Procedure	1.31	0.0004
Current Smoker	1.05	0.0001
Lower Hemoglobin (unit: 1 g/dl)	0.41	<.0001
BMI (unit: 5 kg/m^2)	0.31	0.001

*Number of additional days of extended length of stay associated with presence of risk factor.

Analysis Of The Etiology of Postoperative Ileus After Esophagectomy

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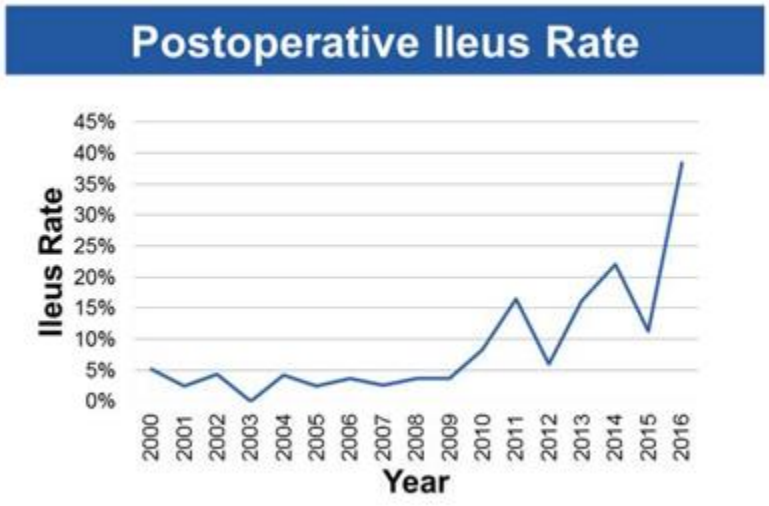
Mayo Clinic

Objective: Rates of postoperative ileus following esophagectomy seem to have increased in our practice in recent years. The aim of this study was to quantify the increase in the rate of postoperative ileus and identify possible causes and/or risk factors.
Method: A retrospective chart review of a prospectively maintained database all patients who underwent an esophagectomy from 2000-2016 was performed. There were 1,955 patients, 1567 males and 388 females. More than 100 variables on each patient were collected and analyzed including demographic data, details of induction therapy, surgical treatment and postoperative course. A multivariate analysis was performed to identify variables associated with an increase in postoperative ileus.
Results: The rate of postoperative ileus increased from a rate of <5% from 2000-2009 to a high of 36% in 2016. Multiple changes in the preoperative, intraoperative, and postoperative management of patients were identified during the study period. An increase in number of epidural catheters, early initiation of tube feedings, and a more concentrated tube feed formula were associated in multivariate analysis with a significant increase in postoperative ileus. A higher body mass index was associated with a significantly lower rate of ileus. There was also a trend toward higher intraoperative intravenous fluids given also being associated with high rates of ileus.
Conclusions: Our perception that we have a significantly increased rate of postoperative ileus is reality. Postoperative ileus is a multifaceted complication that likely has a multifaceted etiology. Most of the factors we have analyzed do not seem to be contributory to the observed increase in ileus. Changes in anesthetic technique seem to be the most significant factors identified



PREDICTORS OF PATIENT-REPORTED REFLUX AFTER ESOPHAGECTOMY

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Abstract

Background:

Patient-reported reflux is one of the most common complaints after esophagectomy. This study aimed to determine predictors of patient-reported reflux. Specifically, we aimed to determine if a preserved pylorus would protect a patient from symptomatic reflux.

Methods:

A prospective clinical trial recorded patient-reported reflux after esophagectomy from 8/17/2015 to 7/2/2018. Patients at least 6 months from creation of a posterior mediastinal gastric conduit, who completed at least one reflux questionnaire, and had the pylorus treated in either a temporary or permanent manner (Botox™, pyloromyotomy, or pyloroplasty) were included in the analysis. Multivariable linear regression was performed utilizing SAS software (Chicago, III, v9.4).

Results:

Of the 110 patients meeting inclusion criteria, 88 (80%) were men, the median age was 65 (range 24-85), and 105 (95%) had esophageal cancer. Temporary pyloric drainage with Botox™ was utilized in 15 (14%) patients, pyloromyotomy in 88 (80%), and pyloroplasty in 7 (6%). A thoracic anastomosis was performed in 78 (71%) patients. Multivariable linear regression analysis revealed patient-reported reflux was significantly worse in women (p=0.004), patients with shorter conduit lengths (p=0.02), and patients who did not receive perioperative chemoradiation (p=0.003), Table.

Conclusion:

Female gender, not receiving perioperative chemoradiation therapy, and a shorter gastric conduit emerged as significant independent predictors of patient-reported reflux after esophagectomy. Preservation of the pylorus does not appear to protect a patient from symptomatic postoperative reflux. Further objective studies with direct pH assessment and larger studies are needed to confirm these findings.

Table. Univariate and multivariable analysis of predictors of patient reported reflux.

	Univariate			Multivariable		
Variable	Parameter Estimate	Standard error	p Value	Parameter Estimate	Standard Error	p Value
Gender = Female	17.86	6.00	0.0036	17.73	5.98	0.0038
Chemoradiation = No	12.41	5.37	0.022	17.07	5.57	0.0028
Length of Conduit, per cm	-1.65	0.86	0.060	-1.96	0.83	0.020
Pyloric Drainage = No/Botox	7.97	7.23	0.27	8.87	7.22	0.22
Redundant Conduit	1.01	10.35	0.92			
Max conduit width, per cm	0.83	1.54	0.59			
Level of Anastomosis = Below azygos vein	0.50	11.08	0.96			
Location = Thoracic	1.66	5.50	0.76			
Malignant = No	10.89	11.94	0.36			
Diabetes = Yes	1.20	6.60	0.86			
BMI, per unit	0.36	0.57	0.54			

Per-Oral Plication of the Esophagus (POPE): Initial Clinical Experience

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Objectives: Patients with end-stage achalasia, a sigmoid esophagus, or a redundant esophageal conduit have few options other than esophageal replacement or a high risk remedial surgery. Per-Oral Plication of the Esophagus (POPE) is a novel, minimally invasive treatment for patients with persistent symptoms from end-stage achalasia or a redundant esophageal conduit. The objective of this study was to analyze the clinical outcomes of the POPE procedure.
Methods: Patients with end-stage achalasia, a sigmoid esophagus, or a redundant conduit from two collaborative institutions underwent the POPE procedure from 10-24-2013 to 10-5-2018 and were followed-up for patient reported outcomes. The POPE procedure includes an endoscopic exploration of the conduit with internal plication utilizing the Apollo OverStitch Endoscopic Suturing device (Apollo Endosurgery, Austin, Texas).
Results: A total of nine patients underwent the POPE procedure (44% women, age IQR=25-64.5 years, median of 49 years). Six patients had end-stage achalasia with a sump effect. Three patients had redundant conduit (two colon interposition, one jejunal interposition). None of the patients had complications from the intervention. Patients were successfully able to avoid surgical intervention with acceptable symptoms resolution after undergoing the POPE procedure 55% (5/9) of the time. Two of the redundant interposition patients sustained prolonged relief from symptoms by reducing the internal diameter and sigmoid shape of their interpositions.
Conclusions: The POPE procedure offers patients a less invasive treatment option to improve swallowing without burning a bridge for future therapy or intervention. This procedure should be offered to patients prior to a complex surgical reconstruction to attempt to avoid more invasive procedures.

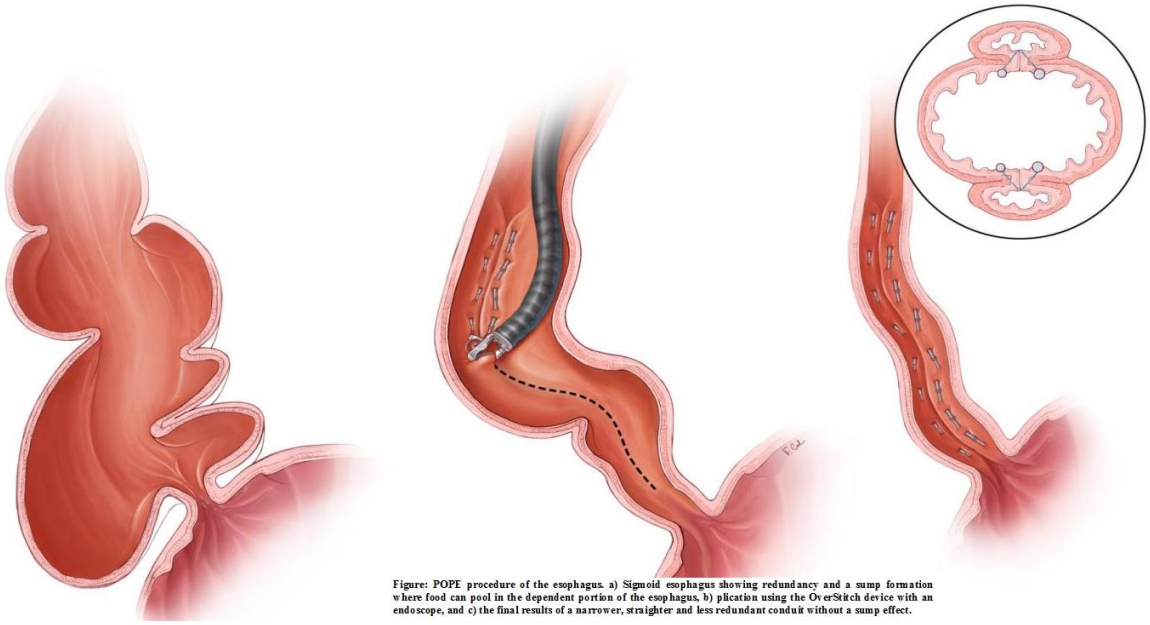

Figure: POPE procedure of the esophagus. a) Sigmoid esophagus showing redundancy and a sump formation where food can pool in the dependent portion of the esophagus, b) plication using the OverStitch device with an endoscope, and c) the final results of a narrower, straighter and less redundant conduit without a sump effect.

Sublobar Resection is Associated with Decreased Survival for Early Stage Large Cell Neuroendocrine Carcinoma of the Lung

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Objective: Sublobar resection (SLR) for early non-small cell lung carcinoma (NSCLC) has been shown to have similar survival to lobectomy. Large cell neuroendocrine carcinoma of the lung (LCNEC) although treated like a NSCLC has a poor prognosis as compared to NSCLC. We sought to determine if there are poor outcomes in patients with early stage LCNEC treated with SLR versus lobectomy.

Methods: We queried patients with pathologic stage I LCNEC ≤3 cm within the National Cancer Data Base between 2004-2014. Propensity score matching was used to compare 5-year overall survival (5YOS) between patients receiving SLR (wedge or segmentectomy) to those receiving lobectomy. Patients were matched for age, node sampling, co-morbidity score, tumor size, insurance status and other factors. Patients that received neoadjuvant therapy were excluded. Kaplan-Meier methods were used for analysis.

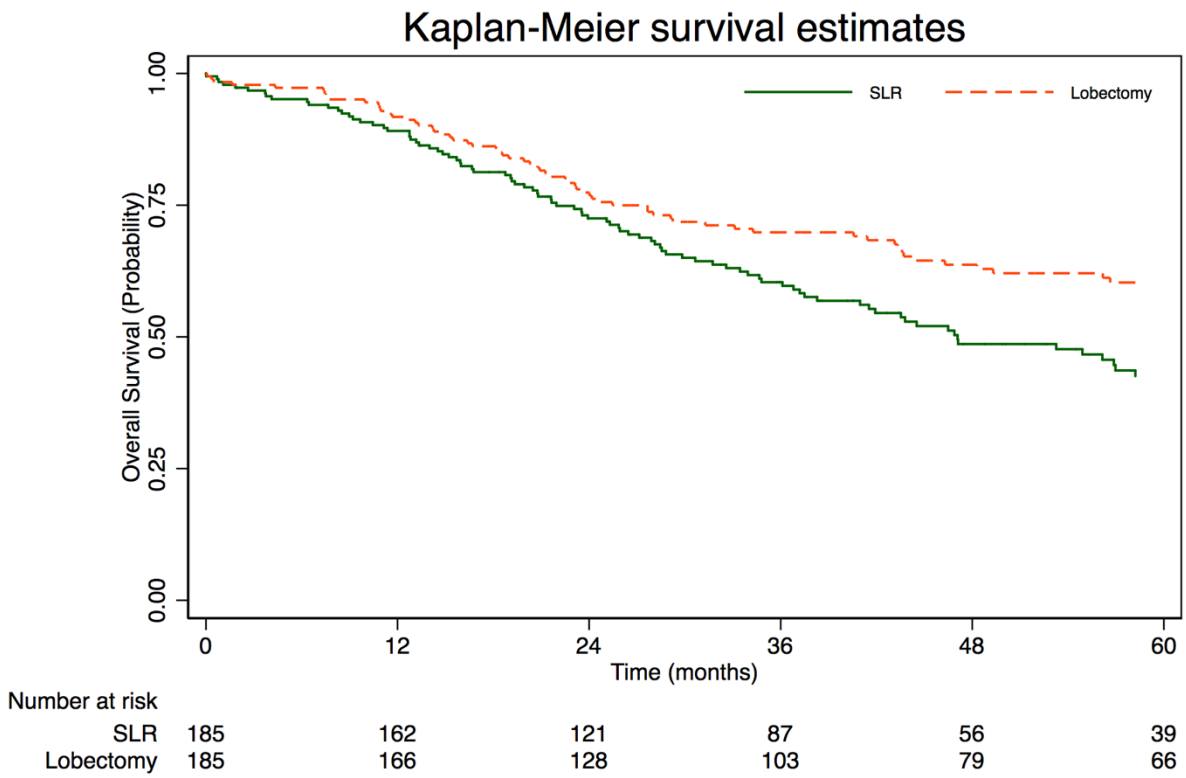
Results: There were 1,135 patients that met inclusion criteria, 264 treated with SLR (224 wedges and 40 segmentectomies) and 749 patients with lobectomy. Patients who received SLR were older, had more comorbidities, and smaller tumors. On unadjusted Kaplan-Meier analysis, SLR had decreased 5YOS compared to lobectomy (37.9% vs. 56.6%, P<0.001). Propensity score matching (1:1) across 12 demographic and tumor variables yielded 185 patients per group with 34 segmentectomies and 151 wedge resections in the SLR cohort. On Kaplan-Meier analysis of the matched cohort, SLR had worse 5YOS compared to lobectomy (41.5 % vs. 60.3%, p=0.001).

Conclusion: SLR for early stage LCNEC is associated with lower 5YOS compared to lobectomy on unadjusted and propensity matched analyses.

Table 1 – Patient Demographics: Pre-Match and Matched Cohorts

	Pre-Match			Matched		
Characteristic	**SLR**	**Lobectomy**	**P**	**SLR**	**Lobectomy**	**P**
Numbers of Patients	264 (26.1%)	749 (73.9%)		185 (50.0%)	185 (50.0%)	
Median Age (IQR)	70 (63, 76)	66 (59, 72)	**<0.001**	69 (63, 76)	69 (62, 76)	**0.959**
Year of Diagnosis			**0.295**			**0.255**
2006	23 (8.7%)	57 (7.6%)		18 (9.7%)	11 (6.0%)	
2007	18 (6.8%)	63 (8.4%)		13 (7.0%)	10 (5.4%)	
2008	26 (9.9%)	69 (9.2%)		15 (8.1%)	19 (10.3%)	
2009	17 (6.4%)	55 (7.3%)		12 (6.5%)	18 (9.7%)	
2010	23 (8.7%)	74 (9.9%)		19 (10.3%)	12 (6.5%)	
2011	19 (7.2%)	85 (11.4%)		12 (6.5%)	18 (9.7%)	
2012	21 (8.0%)	76 (10.2%)		11 (6.0%)	22 (11.9%)	
Sex			**0.802**			**1.000**
Male	121 (45.8%)	350 (46.7%)		86 (46.5%)	86 (46.5%)	
Female	143 (54.2%)	399 (53.3%)		99 (53.5%)	99 (53.5%)	
Race			**0.917**			**0.592**
White	235 (89.0%)	665 (88.8%)		163 (88.1%)	159 (86.0%)	
Black	21 (8.0%)	64 (8.5%)		16 (8.7%)	16 (8.7%)	
Other	8 (3.0%)	20 (2.7%)		6 (3.2%)	10 (5.4%)	
Median Income			**0.976**			**0.676**
<$38,000	53 (20.3%)	148 (20.1%)		39 (21.1%)	40 (21.6%)	
$38,000-$47,999	61 (23.4%)	163 (22.2%)		39 (21.1%)	46 (24.9%)	
$48,000-$62,999	73 (28.0%)	213 (28.9%)		59 (31.9%)	60 (32.4%)	
≥$63,000	74 (28.4%)	212 (28.8%)		48 (26.0%)	39 (21.1%)	
Insurance			**0.008**			**0.745**
Private	62 (23.5%)	238 (31.8%)		50 (27.0%)	56 (30.3%)	
Medicare	184 (69.7%)	441 (58.9%)		125 (67.6%)	118 (63.8%)	
None/Other	18 (6.8%)	70 (9.4%)		10 (5.4%)	11 (6.0%)	
Co-Morbidity Index			**0.001**			**0.994**
0	76 (28.8%)	314 (41.9%)		55 (29.7%)	55 (29.7%)	
1	125 (47.4%)	313 (41.8%)		91 (49.2%)	90 (48.7%)	
2	50 (18.9%)	95 (12.7%)		33 (17.8%)	33 (17.8%)	
≥3	13 (4.9%)	27 (3.6%)		6 (3.2%)	7 (3.8%)	
Facility Type			**0.219**			**0.554**
Community	14 (5.3%)	65 (8.7%)		8 (4.3%)	8 (4.3%)	
Comprehensive	126 (47.7%)	329 (44.0%)		86 (46.5%)	90 (48.7%)	
Academic	91 (34.5%)	275 (36.8%)		72 (38.9%)	61 (33.0%)	
Integrated Cancer Network	33 (12.5%)	79 (10.6%)		19 (10.3%)	26 (14.1%)	
Miles to Facility (IQR)	10.9 (4.8, 25.8)	11.2 (5.3, 28.7)	**0.303**	10.5 (4.7, 25.3)	11.8 (5.6, 31.6)	**0.156**
Tumor Size (cm) (IQR)	1.8 (1.4, 2.2)	2 (1.5, 2.5)	**<0.001**	1.7 (1.3, 2.3)	1.8 (1.3, 2.3)	**0.493**
Tumor Location			**0.228**			**0.760**
Main bronchus	1 (0.4%)	1 (0.1%)		0 (0.0%)	0 (0.0%)	
Upper right lobe	82 (31.1%)	284 (37.9%)		60 (32.4%)	58 (31.4%)	
Middle right lobe	9 (3.4%)	35 (4.7%)		7 (3.8%)	4 (2.2%)	
Lower right lobe	41 (15.5%)	119 (15.9%)		28 (15.1%)	23 (12.4%)	
Upper left lobe	89 (33.7%)	211 (28.2%)		62 (33.5%)	69 (37.3%)	
Lower left lobe	42 (15.9%)	99 (13.2%)		28 (15.1%)	31 (16.8%)	
Lymph Nodes Resection			**<0.001**			**0.586**
No	74 (28.0%)	9 (1.2%)		6 (3.2%)	8 (4.3%)	
Yes	190 (72.0%)	740 (98.8%)		179 (96.8%)	177 (95.7%)	

Figure 1 – Kaplan-Meier Survival Curves for the Matched Cohort (p<0.001)



Streamlining Pulmonary Lobectomy: Results and Pitfalls

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Hospital Universitario Fundación Favaloro

Objective: To describe the results and pitfalls of implementing a streamlining program for pulmonary lobectomy.

Methods: Patients who underwent pulmonary lobectomy were selected from a prospectively maintained database. Streamlining focused on eliminating non-value adding steps and improving outcomes. Three different periods were identified: (1) No Streamlining (NS) (2008-12); (2) Streamlining Implementation Period (SIP) (2013-14); and (3) Full Streamlining (FS) (2015-17). Major complications were defined as per the Society of Thoracic Surgeons metrics for lobectomy star rating; financial data was analyzed when available.

Results: 176 lobectomies were performed: 71, 28 and 77 patients were operated during NS, SIP and FS, respectively. Mean age was 60.27 12.28 years. 99/176 (56%) were males. Overall major complications occurred in 19/176 (10.3%). 30-day mortality rate was 5/176 (2.7%). Chest tube drainage time decreased at FS (4 vs. 4 vs. 3 days; $p=0.025$) as well as length of stay (LOS) (6 vs. 8 vs. 4 days; $p<0.001$). Major complications peaked significantly during SIP (8.4 vs. 25 vs. 7.7%; $p=0.03$). There were no differences in 30-day mortality and readmission rates between periods. Direct contribution margin improved significantly from SIP to FS (-0.03% to 9.66%; $p=0.012$).

Conclusions: Streamlining lobectomy can result in decreased LOS and improved direct contribution margin. A significant increase of major complications was observed during the SIP. Efforts should be directed to minimize the negative impact that changing prevailing standards could have.

Increased National Utilization of Minimally Invasive Thymectomy is Associated with Improved Outcomes

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Objectives
Thymic epithelial tumors (TETs) are increasingly treated with minimally invasive surgery (MIS). However, national utilization trends and outcomes remain unknown. Our objectives were (1) to describe the trend in and factors associated with utilization of minimally invasive thymectomy, and (2) to compare outcomes of open and minimally invasive thymectomy.

Methods
Patients with TETs in the National Cancer Database from 2004-2015 were identified. We assessed trends in MIS from 2010-2015. Hierarchical multivariable logistic regression was used to assess patient, tumor, and hospital factors associated with MIS, as well as 90-day mortality, readmission, R0 resection, and prolonged length of stay (>5 days). Survival was assessed with Kaplan-Meier analysis.

Results
Of 6,991 TETs, 4,488 (66.3%) underwent thymectomy. Of 2,212 cases which recorded surgical approach, 578 (26.1%) were MIS. The utilization of MIS increased from 17.0% in 2010 to 33.6% in 2015 ($p<0.01$). Factors associated with MIS were age 50-59, smaller tumors, absence of extension to surrounding structures, absence of metastatic disease, and metropolitan location. Prolonged length of stay was higher after open thymectomy (31.7% open vs. 16.3% MIS; OR 0.53, 95% CI 0.37-0.75). Ninety-day mortality, readmissions, and R0 resection rate did not differ. After excluding metastatic disease, tumors >4cm, and extension into other structures, 5-year survival was 92.6% after MIS and 87.7% after open (Figure, $p<0.01$).

Conclusions
The utilization of MIS for thymectomy approximately doubled during the study period, and was most strongly associated with favorable tumor characteristics. Length of stay and 5-year survival were improved after MIS compared to open.

Table. Patient, Tumor, and Hospital Factors Associated with Minimally Invasive Surgery for Thymic Epithelial Tumors

	OR	95% Confidence Limits	
Female sex	1.01	0.75	1.37
Age			
18 – 49	Referent		
50 – 59	2.04	1.23	3.38
60 – 69	1.42	0.84	2.41
≥ 70	1.37	0.74	2.54
Race/Ethnicity			
Non-Hispanic White	Referent		
Non-Hispanic Black	0.95	0.60	1.48
Hispanic	0.47	0.23	0.99
Asian	1.14	0.67	1.95
Other	0.63	0.09	4.21
Insurance Status			
Private	Referent		
Medicaid/other gov't	0.75	0.39	1.45
Medicare	1.42	0.94	2.15
Uninsured	0.65	0.21	1.96
Charlson-Deyo co-morbidity score ≥ 2	0.75	0.39	1.47
Tumor size			
0 – 4 cm	Referent		
5 – 9 cm	0.41	0.29	0.56
10 – 14 cm	0.20	0.11	0.35
15 – 19 cm	0.13	0.03	0.50
≥ 20 cm	0.14	0.01	1.29
WHO Classification			
Type A	Referent		
Type AB	1.23	0.72	2.11
Type B1	1.58	0.86	2.92
Type B2	1.06	0.60	1.89
Type B3	0.98	0.52	1.83
Type C	0.99	0.54	1.82
Type NOS	0.97	0.53	1.78
Tumor extension			
Confined to gland	Referent		
Adjacent connective tissue	1.26	0.88	1.79
Other structures within mediastinum	0.50	0.33	0.75
Beyond mediastinum	0.28	0.12	0.65
Metastatic disease	0.30	0.12	0.77
Academic institution	1.23	0.81	1.87
Geographic region			
New England	Referent		
Middle Atlantic	1.01	0.42	2.43
South Atlantic	0.77	0.32	1.88
East North Central	0.83	0.34	2.06
East South Central	0.87	0.28	2.74
West North Central	0.12	0.03	0.44
West South Central	0.46	0.15	1.39
Mountain	0.15	0.04	0.65
Pacific	1.09	0.43	2.75
Metropolitan area	2.23	1.30	3.82

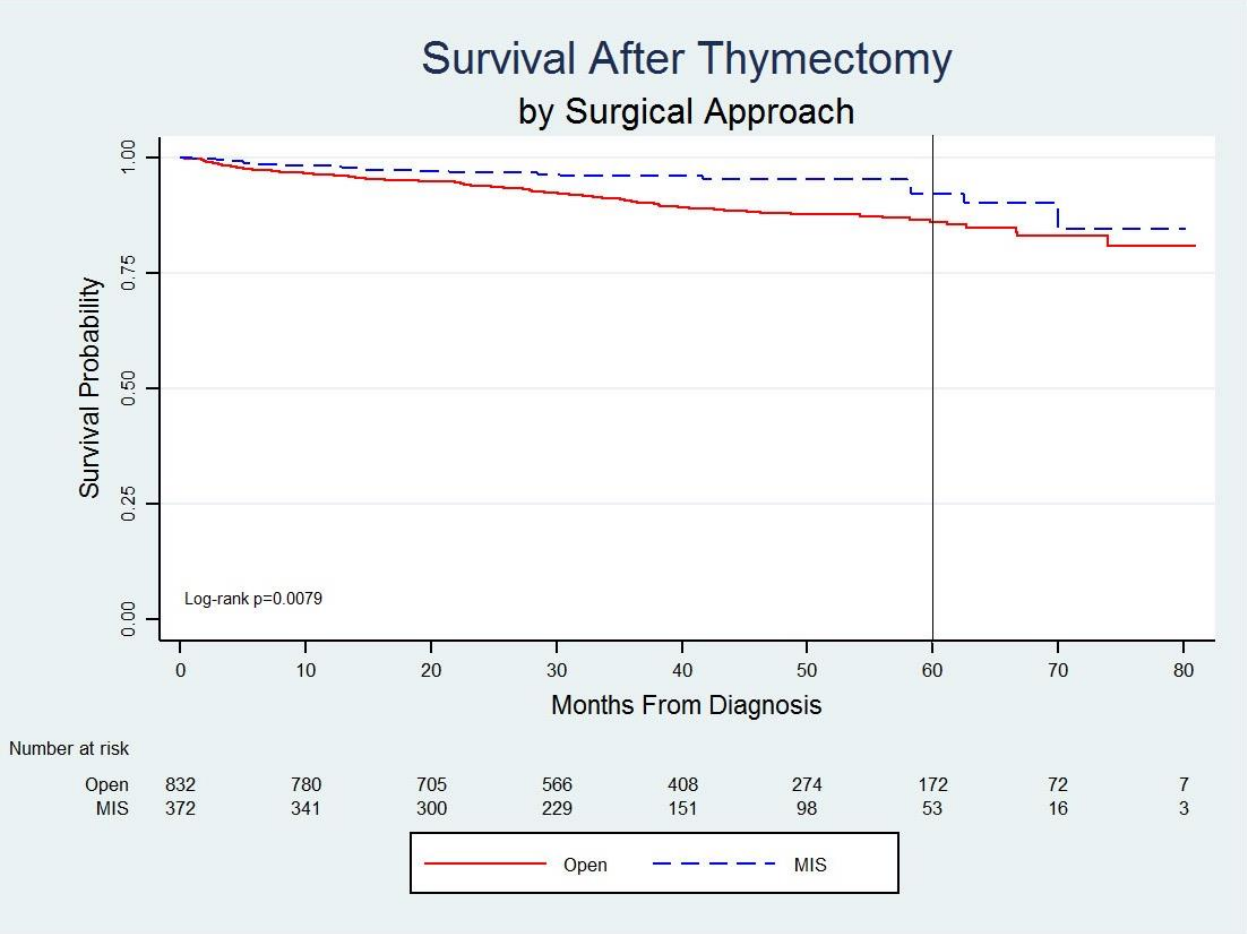

Figure. Kaplan-Meier Curves for Survival Time from Diagnosis, by Surgical Approach. Patients with metastatic disease, tumors >4cm, and tumor extension to adjacent organs/structures either within or outside mediastinum were excluded from this analysis. "Number at risk" listed below the x-axis indicates how many patients were alive and not lost to follow-up at that point in time. Vertical line represents 5-year survival mark (92.6% for MIS and 87.7% for open surgery).

Robotic Lobectomy: First Do No Harm? – An Analysis From The National Cancer Database

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Introduction. Robotic techniques have been increasingly adopted in pulmonary resections for non-small cell lung carcinoma (NSCLC). Conversion to open operations are occasionally necessary. We hypothesized that these conversions compromise perioperative and long-term outcomes compared to the gold standard of open lobectomy.

Methods. The National Cancer Database was queried for patients undergoing lobectomy for clinical T1 or T2, N0, M0 NSCLC between 2010 and 2014. Three groups were identified: Robotic (RATS), robotic converted to open (C-RATS) and open lobectomy (OPEN). Patients who had a thoracoscopic lobectomy were excluded from analysis. Demographics, staging, short-term outcomes and long-term survival were analyzed using multivariable logistic and Poisson regressions.

Results. We identified 71125 lobectomy patients of which 43974 (61.8%) cases were open, 5901 (8.3%) were RATS and 590 (0.8%) C-RATS (i.e. RATS conversion rate: 8.8%). After controlling for demographics, type of institutions, Charleson Comorbidity index, and pathologic T and N-stage, C-RATS had longer length of stay, higher readmission rates, increased 30-day and 90-day mortality and a lower rate of R0 resection when compared to both OPEN and RATS (Table). Five-year overall survival was similar in C-RATS and open cases, but inferior to the RATS group ($p<0.001$)

Conclusion. Robotic lobectomies that required conversion to open had worse perioperative outcomes when compared to open lobectomies. These findings raise concerns regarding the safety of current strategies for wider implementation of robotic lobectomy.

Table: Outcome comparison between groups

	RATS	C-RATS	Open	p-value
Length of stay in days, mean (SD)	5.6 (5.23)	8.2 (8.4)*	7.1 (6.34)	*<0.001 vs RATS, Open
Unplanned Readmission-30 days (%)	3.9	7.5*	4.1	*<0.001 vs Open
Mortality - 30 days (%)	1.36*	3.79#	2.06	*<0.001 vs Open; #<0.01 vs Open
Mortality - 90 days (%)	2.34*	6.93*	3.74	*<0.001 vs Open
Margin positivity (%)	2.3*	4.8#	2.70	*<0.01 vs C-RATS # <=0.01 vs Open

Using A Functional Lumen Imaging Probe In The Operating Room To Assess The Gastroesophageal Junction And Predict Patient Outcomes Following Fundoplication

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Objective: The purpose of this study is to evaluate the intra-operative use of a functional lumen imaging probe (FLIP) to objectively evaluate hiatal hernia repair and fundoplication. We hypothesize that these measurements correlate with long-term outcomes such as persistent reflux and gas bloat. **Methods**: This is a retrospective review of a prospectively maintained quality database. One-hundred seventy-five patients underwent laparoscopic hiatal hernia repair and fundoplication. The FLIP was used to evaluate the gastro-esophageal junction by measuring minimum diameter (D_{min}), balloon pressure and distensibility index (DI) at different times throughout the operation. Outcomes were measured up to two years after surgery and survey scores were compared to final measurements using a Spearman's rank correlation coefficient. Paired t-test was used to evaluate changes throughout the operation. **Results**: Crural closure and fundoplication resulted in a significant decrease in DI. After one year, patients with a final DI < 2.0 mm^2/mmHg reported significantly more gas-bloat than those with a final DI ≥ 2.0 mm^2/mmHg (p=0.0398). This disparity became even more dramatic at two years (p=0.0058). Additionally, patients with a final DI between 2.0-3.5 mm^2/mmHg scored significantly lower on the Reflux Severity Index at one year compared to those with a final DI < 2.0 or > 3.5 mm^2/mmHg. **Conclusion**: The FLIP can be a useful adjunct in the operating room to objectively evaluate crural closure and fundoplication. Additionally, post-operative measurements correlate with patient outcomes up to 2 years after surgery, suggesting the potential to individualize each patient's operation and reduce adverse long-term effects.

	Initial (*P*)	Post-reduction (*P)*	Final
Diameter (mm)	8.6 (0.344)	9.5 (0.614)	8.7
Pressure (mmHg)	**28.6 (0.037)**	**26.9 (0.027)**	**36.3**
Distensibility (mm^2/mmHg)	**2.6 (0.033)**	**3.0 (0.047)**	**1.9**

*P-value based on comparison with final measurements.