Does Thoracoscopic Surgery Decrease the Morbidity of Combined Lung and Chest Wall Resection?

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Background. **Because the traditional open lung approach with en bloc chest wall resection carries substantial risk for complications and death, we studied our thoracoscopic approach for this operation.**

Methods. **From 2007 to 2013, all consecutive video-assisted thoracoscopic (VATS) and open chest wall resections at a comprehensive cancer center were tabulated retrospectively. Data were analyzed by approach, type, and cause of early major morbidity and mortality. Lung cancer cases (the largest subset, T3) were analyzed separately. Statistical tests included the Kruskal-Wallis test for continuous variables and the χ^2 for categoric variables. Survival data were analyzed by the Kaplan-Meier method and log-rank tests.**

Results. **Of 47 chest wall resections performed, 17 (36%) were performed by VATS with no conversions. Resections were performed for primary non-small cell lung cancer (15 VATS and 16 thoracotomy), sarcoma (11), metastatic disease from a separate primary (2), and benign conditions (3). Patients undergoing a VATS approach were older (76 vs 56 years, $p = 0.003$), and the operative times, blood loss, and ribs resected were similar between groups. Patients undergoing VATS had shorter intensive care unit and hospital lengths of stay, but both groups had high hospital morbidity and mortality, largely resulting from postoperative pneumonia or respiratory systemic inflammatory response syndrome (n = 5), stroke (n = 2), and postoperative colon ischemia (n = 1). Groups had a 90-day mortality of 26.7% and 25% respectively. Stage-matched survival curves for both approaches were superimposable ($p = 0.88$).**

Conclusions. **Thoracoscopic chest wall resection was feasible, expanded our case selection, and reduced prosthetic reconstruction. It did not, however, protect frail, elderly patients reliably. Briefer, less traumatic operations may be needed for this cohort.**

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Approximately 5% of lung resections performed for primary non-small cell lung cancer (NSCLC) involve en bloc chest wall resection for locally advanced disease [1]. The optimal treatment of these patients is challenging, and it is controversial, especially regarding the timing and effectiveness of neoadjuvant treatments, adjuvant treatments, or both; patient selection criteria; and extent of resection (extrapleural vs en bloc rib resection) [2–4]. Arguably, complete surgical resection remains the best alternative for long-term survival, especially without lymph node metastases or other evidence of advanced disease [5].

In 2007 we performed our initial VATS lobectomy with en bloc chest wall resection for locally advanced NSCLC. Since then, additional cases in patients with suitable anatomy have been performed thoracoscopically. We sought to investigate whether performing en bloc chest wall resection using a completely thoracoscopic approach would offer any benefit over traditional open approaches, with attention toward the older high-risk frail patient population.

Patients and Methods

After local Institutional Review Board approval, EDR 207311, the cases of patients from January 2007 (the year of our first thoracoscopic en bloc chest wall resection) to December 2013 who underwent chest wall resection at a National Cancer Institute—designated comprehensive cancer institute (Roswell Park Cancer Institute) were reviewed retrospectively. Perioperative outcomes were performed for patients undergoing resection for primary NSCLC involving the chest wall. Medical records focusing on preoperative evaluation, operative reports, and pathology reports were reviewed in detail. Pathologic

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staging was based on the seventh edition of the AJCC Cancer Staging Manual, with focus on patients with T3 tumors.

Patients who underwent surgical resection for primary NSCLC were divided into two groups. Group 1 included patients who underwent standard thoracotomy (open approach), and group 2 included patients who underwent a thoracoscopic (VATS) approach. Outcomes analyzed included perioperative mortality and major morbidity, operative time (min), estimated blood loss (mL), hospital length of stay (days), intensive care unit (ICU) length of stay (days), number of ribs resected, mode of chest wall reconstruction, and mode(s) of neoadjuvant therapy. Operative deaths were defined as deaths that occurred within 90 days after the operation, or those that occurred during the same hospitalization. Morbidity was defined as the occurrence of at least one postoperative adverse event as defined by the Society of Thoracic Surgeons General Thoracic Surgery Database.

Patients underwent standard evaluation involving complete history and physical examination, pulmonary function testing for risk stratification, radiographic assessment with computed tomography (CT), and positron emission tomography/CT scanning for clinical staging. For patients found to be high risk for postoperative respiratory complications based on pulmonary function tests, additional testing (quantitative lung perfusion scanning and cardiopulmonary exercise examination) was performed. Surgical staging involved mediastinoscopy or transcervical extended mediastinal lymphadenectomy.

Data were analyzed by approach type, and the largest subset (T3 lung cancers) was analyzed separately. Special attention was given to the attributed causes of early major morbidity and mortality. Statistical analysis methods included the Kruskal-Wallis test for continuous variables, the χ^2 test for categoric analysis, and the Kaplan-Meier method and log-rank test for survival comparisons between both groups. Statistical analyses were performed with Minitab 17 (Minitab Inc., State College, PA).

Results

There were 47 total chest wall resections performed during the defined period: 64% by standard thoracotomy and 36% by VATS with no conversions. Thirty-one resections were performed for primary NSCLC, 15 by a VATS approach and 16 by thoracotomy. In the total cohort, three cases were performed for benign conditions and 11 for sarcoma pathology. Two were for isolated metastatic disease from a separate primary. Twenty-one patients underwent some form of neoadjuvant treatment: 7 patients underwent induction chemotherapy, and 14 underwent concurrent chemotherapy with radiation.

Demographic features, baseline characteristics, comorbid conditions, and baseline pulmonary function details are listed in Table 1. Pathologic results, staging, and operative details for patients with NSCLC are listed in Table 2. Patients in both groups were largely similar in terms of baseline characteristics, with the exception of the VATS group having an older mean/median age.

Table 1. Patient Preoperative and Operative Characteristics

Characteristic	VATS (n = 17)	Open (n = 30)	*p* Value
Gender			
Male (%)	8 (47%)	20 (67%)	0.188
Female (%)	9 (53%)	10 (33%)	
Age (median, y)	73	56	0.001
Comorbidities			
Current smoker	3 (18%)	13 (43%)	0.074
Former smoker	13 (76%)	9 (30%)	0.002
Never smoker	1 (6%)	6 (20%)	0.191
HTN	8 (47%)	11 (37%)	
Diabetes	3 (18%)	2 (7%)	
CHF	1 (6%)	1 (3%)	
CAD	6 (35%)	4 (13%)	
COPD	8 (47%)	14 (48%)	
PFTs (mean)			
FEV_1 (% predicted)	83.8	78.3	0.409
DLCO (% predicted)	77.6	76.3	0.870

CAD = coronary artery disease; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DLCO = diffusing capacity of lung for carbon monoxide; FEV_1 = forced expiratory volume in 1 second; HTN = hypertension; PFTs = pulmonary function tests; VATS = video-assisted thoracoscopic surgery.

Perioperative outcomes for patients treated for NSCLC are listed in Table 3. Operative time, blood loss, and total number of ribs resected were similar between groups. The patients undergoing VATS had shorter ICU and hospital lengths of stay, but both groups experienced high hospital morbidity and mortality largely from postoperative pneumonia or respiratory systemic

Table 2. Operative Characteristics of Patients With NSCLC

Characteristic	VATS (n = 15)	Open (n = 16)
Histologic classification		
Adenocarcinoma	5	9
SCC	5	4
Adenosquamous	1	1
NSCLC, sarcomatoid	1	2
NSCLC, NOS	3	0
Operation		
Lobectomy	14	15
Pneumonectomy	1	1
Pathologic stage (NSCLC)		
IB	1	1
IIB	10	10
IIIA	2	4
IIIB	2	0
IV	0	1

NOS = not otherwise specified; NSCLC = non-small cell lung carcinoma; SCC = squamous cell carcinoma; VATS = video-assisted thoracoscopic surgery.