HAWLEY H. SEILER RESIDENT AWARD PAPER

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GENERAL THORACIC

Video-Assisted Thoracic Surgery Lobectomy Cost Variability: Implications for a Bundled Payment Era

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Background. In 2013, the Centers for Medicare and Medicaid Services began its Bundled Payments for Care Improvement Initiative. If payments are to be bundled, surgeons must be able to predict which patients are at risk for more costly care. We aim to identify factors driving variability in hospital costs after video-assisted thoracic surgery (VATS) lobectomy for lung cancer.

Methods. Our institutional Society of Thoracic Surgeons data were queried for patients undergoing VATS lobectomy for lung cancer during fiscal years 2010 to 2011. Clinical outcomes data were linked with hospital financial data to determine operative and postoperative costs. Linear regression models were created to identify the impact of preoperative risk factors and perioperative outcomes on cost.

Results. One hundred forty-nine VATS lobectomies for lung cancer were reviewed. The majority of patients had clinical stage IA lung cancer (67.8%). Median length of stay was 4 days, with 30-day mortality and morbidity rates of 0.7% and 37.6%, respectively. Mean operative and postoperative costs per case were $8,492.31 (± $2,238.76) and $10,145.50 (± $7,004.71), respectively, resulting in an average overall hospital cost of $18,637.81 (± $8,244.12) per patient. Patients with chronic obstructive pulmonary disease and coronary artery disease, as well as postoperative urinary tract infections and blood transfusions, were associated with statistically significant variability in cost.

Conclusions. Variability in cost associated with VATS lobectomy is driven by assorted patient and clinical variables. Awareness of such factors can help surgeons implement quality improvement initiatives and focus resource utilization. Understanding risk-adjusted clinical-financial data is critical to designing payment arrangements that include financial and performance accountability, and thus ultimately increasing the value of health care.

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The value of health care, a concept equivalent to the outcomes achieved relative to dollars spent (ie, value = outcomes/cost), is gaining momentum in the current landscape of American health care reform [1, 2]. As a result, health care reimbursement schemes will be undoubtedly changing over the next few years, and the current fee-for-service reimbursement scenario is being replaced by a bundled payment strategy for procedural-based episodes of care [3–9]. Accordingly, in January 2013 the Centers for Medicare and Medicaid Services (CMS) began its Bundled Payments for Care Improvement Initiative in efforts to deliver higher quality health care at lower cost [10].

In order to ensure that actual expenditures are properly aligned with target price for an episode of care, surgeons, policy makers, and other stakeholders must be able to predict which patients might be at greater risk for more costly care. A previous study that investigated hospital quality and cost of various inpatient surgeries concluded

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that there is a direct correlation between the rate of postoperative complications and episode-based Medicare payments [11]. An additional series investigated the economic impact of complications after lobectomy and pneumonectomy, citing a direct correlation between the number of events and overall cost [12]. While preventing postoperative complications would certainly help to reduce costs there are other relevant factors, such as patient's baseline health status and comorbid conditions, which must be considered.

In an effort to truly investigate the costs associated with video-assisted thoracic surgery (VATS) and the value it affords patients, the current study aims to identify factors driving variability in hospital costs after VATS lobectomy for lung cancer. We hypothesize that there are specific patient risk factors and postoperative outcomes that will be responsible for large variations in cost associated with VATS lobectomy. If these factors can be identified, thoracic surgeons and hospital administrators can effectively work together to focus resource utilization and quality improvement efforts to decrease costs, maintain optimal patient outcomes, and increase the value of VATS lobectomy.

Patients and Methods

Data Collection and Definition of Study Variables

A retrospective review of the Emory University Society of Thoracic Surgery General Thoracic Surgery Database (STS-GTSD) from October 1, 2009 through September 30, 2011 (fiscal years 2010 to 2011) identified 149 patients who underwent VATS lobectomy for primary lung cancer. Cases which were started thoracoscopically and converted to thoracotomy were excluded. Records were analyzed for patient demographics, preoperative comorbidities, operative variables, and postoperative outcomes. Major and minor morbidity were defined according to the STS-GTSD [13]. All lung cancers were staged using the American Joint Committee on Cancer 7th Edition of Lung Cancer Staging guidelines [14, 15].

The STS-GTSD data were subsequently linked with hospital financial data to determine operative and postoperative hospital costs for each patient. We partnered with financial analysts within our institution to obtain line-item costs associated with each patient's hospital encounter. These costs were then grouped into the following 10 major categories per our hospital's financial department: operating room [OR]; anesthesia; postanesthesia recovery unit [PACU]; floor; intensive care unit [ICU]; radiology; pathology; laboratory; pharmacy; and miscellaneous. We chose to analyze raw costs and not charges due to the likelihood of high variability in charge data throughout the country, thus potentially impacting the generalizability of our results. Approval for the study was obtained from the Institutional Review Board of Emory University.

Operative Technique, Patient Demographics, and Clinical Characteristics

All 149 cases throughout the study period were performed at 2 similar tertiary care referral centers within Emory Healthcare. Patient populations and referral patterns are similar at both hospitals. Cases were performed by 3 experienced surgeons, each having performed greater than 100 VATS lobectomies before data collection began. In all cases, a standard 3-port non-rib-spreading technique with the assistance of cameras and video monitors was used. Postoperative management was protocolized and standardized at both institutions. Patient demographics and preoperative risk factors are listed in Table 1. The majority of patients were female (57.0%) with a mean age of 67.1 ($\pm$ 9.0) years and clinical stage IA lung cancer (67.8%). Few patients had neoadjuvant chemotherapy (n = 9, 6.0%) or radiation (n = 5, 3.4%), and the most common medical comorbidities were hypertension (n = 103, 69.1%) and chronic obstructive pulmonary disease (COPD) (n = 63, 42.3%). Most patients were classified as American Society of Anesthesiologists (ASA)

Table 1. Patient Demographics and Preoperative Risk Factors

Demographics, n (%)	n = 149
Average age (years)	67.1 ($\pm$9.0)
Sex (female)	85 (57.0)
Race (Caucasian)	115 (77.2)
Preoperative risk factors, n (%)	
Average BMI, kg/m^2 (SD)	26.8 ($\pm$6.0)
Past or current smoker	129 (86.6)
Average pack years (SD)	45.4 ($\pm$30.8)
Hypertension	103 (69.1)
Chronic obstructive pulmonary disease	63 (42.3)
Coronary artery disease	32 (21.5)
Diabetes	27 (18.1)
Cerebrovascular disease	15 (10.1)
Neoadjuvant chemotherapy	9 (6.0)
Neoadjuvant radiation	5 (3.4)
$D_{LCO} \leq 50\%$ predicted[a]	29 (19.5)
$FEV_1 \leq 50\%$ predicted[a]	10 (6.7)
Clinical stage[b]	
T1a	48 (32.2)
T1b	53 (35.6)
T2a	36 (24.2)
T2b	9 (6.0)
T3	3 (2.0)
American Society of Anesthesiologists	
2	17 (11.4)
3	113 (75.8)
4	19 (12.8)
Zubrod score[c]	
0	111 (74.5)
1	35 (23.5)
2	1 (0.7)
3	2 (1.3)

[a] D_{LCO} missing for 40 patients; FEV_1 missing for 27 patients.   [b] Based on American Joint Committee on Cancer, 7th Edition.   [c] Preoperative functional status.

BMI = body mass index; D_{LCO} = diffusing capacity of lung for carbon monoxide; FEV_1 = forced expiratory volume in the first second of expiration.