Factors Affecting Selection of Operative Approach and Subsequent Short-Term Outcomes after Anatomic Resection for Lung Cancer

Joseph D Phillips, MD, Ryan P Merkow, MD, Karen L Sherman, MD, Malcolm M DeCamp, MD, FACS, David J Bentrem, MD, MS, FACS, Karl Y Bilimoria, MD, MS

BACKGROUND: Previous studies evaluating video-assisted thoracoscopic surgery (VATS) for lung cancer are single-institution series, suffer from small sample size, or use administrative or self-reported databases. Using a multi-institutional, standardized, and audited surgical outcomes database, our objectives were to examine preoperative factors associated with undergoing VATS vs open resection and assess subsequent perioperative outcomes.

STUDY DESIGN: The American College of Surgeons National Surgical Quality Improvement Program Participant Use File was used to identify patients who underwent anatomic resection (eg, segmentectomy, lobectomy, and bi-lobectomy) for primary lung cancer (2005 to 2010). Multiple logistic regression models, including propensity scores, were developed to assess preoperative factors associated with undergoing VATS and the risk-adjusted association between operative approach and 30-day outcomes.

RESULTS: Of 2,353 patients undergoing resection, 74% underwent open thoracotomy (OT) and 26% underwent VATS. After regression for confounders, factors associated with undergoing a VATS were patient age older than 75 years (odds ratio [OR] = 1.41; 95% CI, 1.05–1.90), Hispanic ethnicity (OR = 2.52; 95% CI, 1.69–3.77), and cardiothoracic surgery training (OR = 1.68; 95% CI, 1.37–2.07). Patients undergoing OT had a higher likelihood of any adverse event developing (24% vs 14%; OR = 1.76; 95% CI, 1.35–2.29), specifically pneumonia and sepsis/septic shock. Median length of stay was significantly longer in the OT group (7 vs 4 days; $p < 0.001$). Mortality was not significantly different for VATS vs OT after regression for confounders.

CONCLUSIONS: In addition to patient factors, surgeon training can play a role in determining the operative approach offered to patients. Patients selected for VATS had a lower 30-day morbidity and shorter length of stay compared with OT anatomic resection for primary lung cancer. (J Am Coll Surg 2012;215:206–215. © 2012 by the American College of Surgeons)

Lung cancer is the most commonly diagnosed malignancy and the leading cause of cancer mortality worldwide.[1] In the United States, >200,000 cases of non-small cell lung cancer are diagnosed, with nearly 159,000 deaths each year.[2] Surgical therapy is the curative mainstay for resectable disease, and video-assisted thoracoscopic surgery (VATS) is being used more frequently.[3,4] The oncologic equivalency of VATS compared with open thoracotomy (OT) resections has been demonstrated recently.[5-11] Despite the acceptance of VATS at large academic institutions, the majority of pulmonary procedures in the United States

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From the Department of Surgery and Surgical Outcomes and Quality Improvement Center, Feinberg School of Medicine, Northwestern University (Phillips, Merkow, Sherman, DeCamp, Bentrem, Bilimoria), Jesse Brown VA Medical Center (Bentrem), Chicago, IL, and Department of Surgery, University of Colorado School of Medicine, Aurora, CO (Merkow).
Correspondence address: Karl Y Bilimoria MD, MS, Department of Surgery, Northwestern University, Feinberg School of Medicine, 676 N St Clair Ave, Suite 6-650, Chicago, IL 60611. email: kbilimoria@nmff.org

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Abbreviations and Acronyms

ACS NSQIP = American College of Surgeons National Surgical Quality Improvement Program
ASA = American Society of Anesthesiologists
CPT = Current Procedural Terminology
LOS = length of stay
OR = odds ratio
OT = open thoracotomy
VATS = video-assisted thoracoscopic surgery

are performed by nonthoracic surgeons,[12] with only approximately 30% of resections (20% of lobectomies) being done via VATS.[3]

Previous studies documenting improved morbidity and shorter length of stay (LOS) for VATS vs OT anatomic resections for cancer are limited by their small samples size,[13] single-institution design,[5-7,14-18] or use of administrative[19] or self-reported databases.[4] No large randomized controlled trials have been done or are likely to be performed to directly compare these 2 approaches. Consequently, the objectives of this study were to evaluate potential preoperative factors that might influence selection of operative approach and to compare 30-day morbidity and mortality of anatomic resection for primary lung cancer between VATS and OT using a multi-institutional validated, standardized, and audited surgical outcomes database.

METHODS

Data source

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) is a prospective, multi-institutional, risk-adjusted 30-day outcomes program that provides participating hospitals with comparative data for internal quality-improvement efforts.[20] The details of the ACS NSQIP sampling strategy, data abstraction, variables collected, and outcomes monitored have been described previously.[20-24] Briefly, the program collects standardized and reliable preoperative, intraoperative, and postoperative clinical data. Data abstraction at each site is overseen by surgical clinical reviewers who undergo an initial intensive training process, followed by continuing education and training to ensure reliable and standardized high-quality data across institutions. Data consistency and reliability are continually verified through software checks and built-in prompts, as well as on-site inter-rater reliability audits.[25]

Patients

Using the ACS NSQIP Participant Use File from 2005 to 2010, patients who underwent an anatomic lung resection (ie, segmentectomy, lobectomy, or bi-lobectomy) were identified using Current Procedural Terminology (CPT) codes.[26] The dataset contains multiple CPT codes for each patient, facilitating the ability to determine the full extent of the surgical procedure (eg, wedge resection alone vs wedge resection followed by lobectomy). Patients were included if ICD-9 postoperative diagnosis codes were consistent with malignant neoplasm of the lung.[27] Patients were excluded if they underwent pneumonectomy (n = 132) or wedge resection alone (n = 590), had a postoperative diagnosis of malignancy of the trachea or main bronchus (n = 14), or no recorded American Society of Anesthesiologists (ASA) class (n = 4).

Variables

Potential independent variables included patient demographics, lifestyle factors (smoking status and alcohol intake), comorbidities, ASA class, functional status, and attending surgeon specialty (ie, training; cardiothoracic vs general/vascular). Elements of pre-existing coronary artery, peripheral vascular, and neurologic diseases are listed in Table 1. Standard definitions for these variables have been described previously.[22] Surgical specialty (cardiac, thoracic, general surgery, vascular) is designated by the surgeon and is ascertained by the surgical clinical reviewer at each site. Surgical approach was dichotomized based on the most invasive CPT code listed. For example, a case with both thoracoscopic wedge and open lobectomy codes was evaluated in the OT group. Tumor location was based on ICD-9 coding. Highest-level resident was categorized based on recorded postgraduate year (ie, none, junior [PGY1 to 3], senior [PGY4 to 5], or fellow [PGY6 to 9]).

Outcomes

All ACS NSQIP outcomes have been defined previously.[22] Patients were followed for 30 days after their index procedure, both in-hospital and as outpatients, irrespective of whether readmitted to the same or an outside facility. The 30-day outcomes evaluated included infectious, wound, pulmonary, renal, cardiac, and neurologic complications, as well as return to the operating room and 30-day mortality. Length of stay after the index procedure was dichotomized based on the median of the entire cohort (6 days). Patients with preoperative ventilator dependence, pneumonia, urinary tract infections, or wound infections were precluded from having the associated postoperative complication.

Statistical analysis

Continuous variables were compared using *t*-tests, and medians were compared with the Wilcoxon rank sum test. Categorical variables were compared using chi-