The Impact of Thoracoscopic Surgery on Payment and Health Care Utilization After Lung Resection

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Background. **Lung resection by video-assisted thoracoscopic surgery (VATS) is associated with multiple clinical benefits compared with resection by thoracotomy (OPEN). Less is known about reimbursements, costs, and resource use with each approach. This study used a commercial insurance claims database to examine differences between VATS and OPEN lung resections in payment, health care utilization, and estimated days off work for health care visits.**

Methods. **All adult inpatient discharges for patients undergoing VATS or OPEN lung resection in 2010 were identified from the Truven MarketScan Database (Ann Arbor, MI).**

Results. **A total of 2,611 patients underwent lobectomy (VATS, 270; OPEN, 669) or wedge resection (VATS, 1,332; OPEN, 340). After adjustment, OPEN lobectomies had a longer length of stay (mean difference, 1.79 days) and higher payment to hospitals (mean difference, $3,497) and physicians (mean difference, $433) compared with VATS. Similar findings were noted after wedge resections. OPEN lobectomies had 1.28-times and 1.14-times more health care utilization days within 90 days and 365 days, respectively, after the operation compared with VATS, translating into increased expenditures of $3,260 at 90 days and $822 at 365 days for OPEN procedures. No significant differences in utilization were noted between OPEN and VATS wedge resections, except for fewer outpatient visits within 90 days in the OPEN group.**

Conclusions. **Compared with an OPEN approach, lobectomy and wedge resection by VATS were associated with lower hospital and physician payments. In addition, lobectomy by VATS was associated with less health care utilization in the early postoperative period and during the first year after the operation. These payment and utilization reductions are important in an era of value-based purchasing in health care.**

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The popularization of minimally invasive surgery (MIS) techniques during the past 2 decades or more has dramatically altered the manner in which many surgical procedures, including pulmonary resections, are performed. Video-assisted thoracoscopic surgery (VATS) has been increasingly used for pulmonary operations, with the advantages of decreased pain, improved cosmesis, faster resumption of activities, and quicker return to work compared with operations performed by thoracotomy (OPEN) [1–3]. In addition, lung resections performed by VATS are associated with lower complication rates and decreased length of stay (LOS) compared with OPEN operations [4, 5]. When lung resection is undertaken for primary lung carcinoma, oncologic efficacy, as assessed by long-term survival, appears equivalent between VATS and OPEN approaches [1, 2, 6]. Finally, VATS lung resections may be less costly to the hospital than OPEN operations, likely due to shorter LOS and fewer perioperative complications [5].

The costs associated with any surgical intervention can be difficult to define and determine. Costs can be categorized into those borne by the patient, the provider (ie, the health care facility), or the payer (ie, the employer-sponsored, private health insurance company, or governmental agency). Most studies assessing the financial aspects of lung resection have focused on perioperative costs to the health care facility; few reports have assessed costs to the patient or the payer. With the evolving health care reform laws in the United States (U.S.) and the concomitant economic pressures on the U.S. health care delivery system to contain costs, an increasing emphasis has been placed on value-based care or pay for performance. Patients and their payers are seeking improved value for their health care expenditures, with value being defined as quality divided by cost.

Given the recognized clinical benefits of VATS, a thorough analysis of the cost side of the equation assumes

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Abbreviations and Acronyms

CCI = Charlson Comorbidity Index
CI = confidence interval
DRG = diagnosis-related group
ER = emergency room
LOS = length of stay
MIS = minimally invasive surgery
OPEN = open thoracotomy
RVU = relative value unit
U.S. = United States
VATS = video-assisted thoracoscopic surgery

importance. This study used a large, commercial insurance claims database to assess differences between VATS and OPEN lung resections in payments to hospitals and physicians, health care utilization, and estimated patient days off work for health care visits.

Patients and Methods

Data Source

Data for this study were obtained from the Truven Health Analytics MarketScan Commercial Claims and Encounters Database (Ann Arbor, MI). This database contains the enrollment and health care (medical and drug) claims of millions of employees and their dependents that are covered annually under a variety of health plans offered by medium- or large-sized firms. Included are inpatient admissions, outpatient and emergency department visits, as well as outpatient prescription drug claims, linked by a unique patient identifier. The data conformed to the Health Insurance Portability and Accountability Act of 1996 confidentiality requirements, so neither informed consent nor Institutional Review Board approval was required for this study.

Study Population

All adults between the ages of 18 and 64 undergoing lung operations, as assessed by the appropriate International Classification of Diseases, Ninth Revision-Clinical Modification procedure codes at an inpatient setting for VATS (lobectomy, 32.41; wedge, 32.20) or OPEN (lobectomy, 32.49; wedge, 32.29) lung resection, in the calendar year 2010 were selected. If a patient underwent more than one thoracic resection, then the first operation was considered the index procedure. To be eligible for data analysis, patients were required to have a minimum of 2 years of continuous enrollment (1 year before and 1 year after the index operation date).

Discharges with total payments of less than $1,000 or more than $150,000 were the top and bottom 1% of cases and were excluded to improve homogeneity and create more comparable groups. Separate analyses for lobectomy and wedge resection cases were conducted. Patients who underwent conversion from VATS to OPEN, or who underwent a robotic operation, were excluded.

Main Outcome Measures

Our study assessed three main outcome measures within 90 and 365 days after the index procedure: (1) health care utilization, including office, hospital outpatient, and emergency department visits; (2) payments (gross covered payments minus copayments, coinsurance, and coordination of benefits); and (3) estimated days off work due to health care utilization. If a patient had a claim for an office visit or a laboratory test, we estimated a half-day of utilization. If a patient had a claim for an outpatient visit or visit to an emergency department, urgent care facility, or ambulatory surgery center, we estimated a full day of utilization. For inpatient service claims, the LOS was converted directly to days of utilization.

Statistical Analysis

A difference-in-difference approach was used to adjust patients' prior health care utilization. Outcomes were modeled with a generalized linear model. Within-individual correlation was adjusted using a generalized estimating equation. Office and outpatient visits and days of health care utilization were modeled with a negative binomial distribution. Expenditures were estimated with a gamma distribution. Emergency department visits and inpatient services were modeled only in the postoperative period using multivariate logistic regression analysis. Independent variables in the regression model included age, gender, region, procedure type, Charlson Comorbidity Index (CCI), primary diagnosis, and index hospital LOS.

Results

A total of 6,797 patients underwent thoracic inpatient operations in 2010. After applying the inclusion and exclusion criteria, 939 patients remained in the lobectomy group and 1,672 in the wedge resection group (Fig 1). VATS was used to perform 270 of the 939 lobectomy procedures (29%) and 1,332 of the 1,672 wedge resection procedures (80%).

Patient demographics and clinical characteristics for VATS and OPEN cases for lobectomies and wedge resections are listed in Table 1. For patients undergoing lobectomy, age and CCI scores were similar between VATS and OPEN groups. The average age was 55 years ($p = 0.23$) for both lobectomy groups, and the average CCI was 4.5 for the VATS and 4.7 for the OPEN lobectomy groups ($p = 0.27$). Patients undergoing OPEN lobectomy had a higher prevalence of chronic obstructive pulmonary disease (62.0% vs 52.2%, $p = 0.01$) and hypertension (56.1% vs 49.3%, $p = 0.06$) compared with those undergoing VATS. Primary lung cancer in the upper lobe was the leading primary diagnosis for lobectomy (43.7% for VATS and 42.0% for OPEN resections), followed by lung cancer in the lower lobe (19.3% for VATS and 20.5% for OPEN resections).

For patients undergoing wedge resection, the OPEN group was older (52.2 vs 49.6 years, $p < 0.0001$) and had higher CCI scores (4.5 vs 3.3, $p < 0.0001$) compared with the VATS group. The two leading primary diagnoses for