A comparison of quality and cost indicators by surgical specialty for lobectomy of the lung

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Objectives: This investigation compared patients undergoing lobectomy for non–small cell lung cancer by either a general surgeon or a cardiothoracic surgeon across a geographically diverse system of hospitals to see whether a significant difference in quality or cost was present.

Methods: The Premiere administrative database and tumor registry data of a single health system's hospitals was used to compare adherence to national treatment guidelines, patient outcomes, and charges for patients undergoing lobectomy for non–small cell lung cancer in a 5-year period. Surgeons performing lobectomy were designated as a general surgeon or cardiothoracic surgeon according to their national provider number and board certification status. Excluded from analysis were centers that performed fewer than 50 lobectomies during the study period.

Results: During the study period, 2823 lobectomies were performed by 46 general surgeons and 3653 lobectomies were performed by 29 cardiothoracic surgeons in 54 hospitals in a single health care system. Significant differences were found between general and cardiothoracic surgeons with respect to adherence to national guidelines in staging and treatment, mean length of stay, significant morbidity, and operative mortality. Mean charges for lobectomy of the lung were also found to differ significantly between general and cardiothoracic surgeons.

Conclusions: This review found that currently measurable indicators for quality of care were significantly superior and overall charges were significantly reduced when a lobectomy for non–small cell lung cancer was performed by a cardiothoracic surgeon rather than by a general surgeon. (J Thorac Cardiovasc Surg 2013;145:68-74)

According to some estimates, the majority of lung resections in the United States continue to be performed by general surgeons.[1] Other surgical specialties have found that surgeons with additional formal training after general surgery residency achieve superior outcomes in more complex surgical procedures relative to general surgeons.[2,3] Several investigations have assessed the issue of whether a similar variation in results exists between residency-trained cardiothoracic surgeons and general surgeons.[1,4-6] Although these authors have been able to show variation in such things as preoperative and intraoperative staging, long-term survival, and operative mortality, these analyses are limited because of the use of a combination of claims or nonconsecutive sampling databases, case mix designation of surgeon specialty rather than board certification, or the inclusion of a mixture of surgical procedures for analysis. Furthermore, no attempt at comparing the costs of care between the two surgical specialties has been made. The purpose of this investigation was to compare the adherence to nationally accepted treatment guidelines, outcomes, and associated costs for lobectomy of the lung for non–small cell lung cancer (NSCLC) between general surgeons and thoracic surgeons within a diverse health care system.

MATERIALS AND METHODS

This study was designed as a retrospective cohort analysis. Institutional review board approval was obtained at St Vincent Hospital (Indianapolis, Ind) and individual patient consent was not required with the condition of patient anonymity outside the initial data-gathering phase of the study. By interrogating the Premier inpatient database (Premier Inc, Charlotte, NC), hospitals performing at least 50 lobectomies (cumulative; *Current Procedural Terminology* [*CPT*] code 32480) for NSCLC (*International Classification of Diseases, Ninth Revision* [*ICD-9*] diagnosis codes 162.2, 162.3, 162.4, 162.5, 162) during the calendar years 2005 through 2009 within the Ascension Health system were identified. Lobectomy procedures were then attributed to individual surgeons within these facilities. Surgeons were identified as either a general surgeon or a thoracic surgeon on the basis their national provider numbers and their board certification status. No attempt was made to differentiate thoracic surgeons who practiced cardiac and thoracic surgery from those that limited their practice to noncardiac thoracic surgery.

Patient demographic data; adherence to National Comprehensive Cancer Network (NCCN) guideline[7]; and information related to the lobectomy procedure, including charges, postoperative stay, operative morbidities, and operative mortality were abstracted for each patient from the Premier database or the local hospital's American College of Surgeons tumor

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Abbreviations and Acronyms
NCCN = National Comprehensive Cancer Network
NSCLC = non–small cell lung cancer

registry data (Table 1). Also calculated were Charlson comorbidity index scores for each patient, as determined from secondary *ICD-9* disease codes.[8,9] Excluded from analysis were patients undergoing a bilobectomy (*CPT* 32482), lobectomy for a superior sulcus tumor or pulmonary metastasis (*ICD-9* 197), lobectomy with a bronchoplastic procedure (*CPT* 32486), video-assisted thoracoscopic lobectomy, or lobectomy in the setting of stage IV NSCLC, such as a patient with an isolated brain metastasis. Also excluded were patients undergoing lobectomy with a primary *ICD-9* code denoting an endobronchial (162.9) or tracheal (162) tumor component, NSCLC involving multiple lobes of the lung (162.8) or the chest wall (198.89, 171.4), or a pleura-based neoplasm (163).

Postoperative stay was calculated as the number of days from the day of surgery until death or discharge. Patients who died after lobectomy did not have the opportunity for readmission and so were removed from that portion of the analysis. Postoperative morbidities were attributed in a binary fashion by patient, so that a patient who had more than 1 event was only counted once; however the tabulations of specific categories of complications include every occurrence. Operative mortality was defined as patient death after surgery before discharge from the hospital or within 30 days of surgery.

Hospital charges represent the total gross charges before any contractual adjustments and include all postings from the day of surgery through discharge or death. Professional fees were excluded. Parity of hospital charges was tested by examining each facility's charge per discharge index; a comparison of inpatient charges indexed to discharge diagnoses.[10] This is a method of determining whether different facilities have similar levels of charges used by the private insurers and the Centers for Medicare and Medicaid Services.[11] Patients transferred between facilities during their lobectomy hospitalization were excluded from eligibility from this study because of the artifactual change in charges and hospital stay that resulted. A readmission was attributed to patients designated in either cohort who required readmission to the hospital within 30 days of discharge from the lobectomy admission; however, charges incurred during the readmission were not included in the hospital charge calculation for that patient.

The unit of analysis for this study was a patient undergoing lobectomy for NSCLC. Surgeon specialty was identified as the exposure variable. Discharge versus operative mortality was the primary outcome for the analysis. Multiple logistic regression analysis was used to study relationships between patient variables and the identified outcome measures. Regression models were adjusted for clustering or nesting at the hospital level by the construction of 2-level hierarchic analysis models with the assumption of normative distribution of variables.[11,12] Group mean centering for each cohort was used within the analyses. Adjustments within the regression analysis were made for patient age and Charlson comorbidity index score and reported as adjusted odds ratios. Hospital and surgeon volume were then individually adjusted by including a continuous variable representing each in the regression model and the effect on the primary outcomes observed.

Bivariate analysis of data was performed with GraphPad Prism software (version 4.02; GraphPad Software, Inc, San Diego, Calif) for Windows (Microsoft, Redmond Wash). Differences between categoric variables were evaluated by the Fisher's exact test. Differences between continuous variables were measured by the 2-tailed Student *t* test or the Mann-Whitney test for nonnormally distributed data. Multivariate analysis was performed with Stata software (version 11; StataCorp, College Station, Tex).

For the purposes of this investigation, adherence to NCCN guidelines (Table 2) was defined according to whether pulmonary function testing, computed tomographic imaging of the chest, and staging of the mediastinum occurred before surgery. Mediastinal lymph node sampling or dissection at the time of lobectomy was also required.

RESULTS

During the 5-year study period, 2823 lobectomies that were performed by 46 general surgeons and 3653 lobectomies that were performed by 29 thoracic surgeons at 54 hospitals in 31 states met the entrance criteria for this investigation (Table 3). This resulted in mean numbers of lobectomies for general surgeons and thoracic surgeons of 61 and 126, respectively, during the 5-year period. Mean age and mean Charlson comorbidity index score varied significantly between the two patient cohorts. Sex distribution did not.

The frequencies of patients with pathologic stage I and II NSCLC were similar between the 2 patient groups; however, significantly more patients with stage IIIA disease underwent surgery by a thoracic surgeon, whereas significantly more patients with stage IIIB disease underwent surgery in the general surgeon cohort. It was also significantly more common for patients with stage III NSCLC to receive neoadjuvant therapy if their care involved a thoracic surgeon.

Patients operated on by a thoracic surgeon also had a significantly higher rate of fulfilling the study's NCCN criteria. This finding was true for each of the 4 criteria examined as well as for the overall category. Similarly significant was the difference in the number of patients found not to have a malignancy in the lobectomy specimen in the general surgeon group relative to the thoracic surgeon cohort.

Mean hospital stay was significantly longer in the general surgeon cohort than in the thoracic surgeon cohort. In addition, the number of patients with a prolonged stay, defined by Kozower and colleagues[11] as longer than 14 days, was significantly greater in the general surgeon patient cohort. No significant difference in readmission rates between the 2 groups was found. The difference in stay in the general surgeon cohort could not be explained solely on the basis of the differences in operative morbidity and mortality.

The frequency of postoperative morbidities was found to be significantly higher in the general surgeon patient cohort than in the thoracic surgeon patient cohort (Table 4). When individual postoperative events were compared, prolonged air leak and return to the operating room for bleeding were found to differ significantly between the 2 patient groups, with a higher frequency of occurrence in the general surgeon patient cohort. Operative mortality was also significantly more frequent in the general surgeon patient cohort. No variables examined other than surgeon specialty were found to be predictors for morbidity or mortality after lobectomy for NSCLC.

After adjustment for the confounding variables of age and Charlson comorbidity index score, multiple logistic