ORIGINAL ARTICLE

Nodal Upstaging Is More Common with Thoracotomy than with VATS During Lobectomy for Early-Stage Lung Cancer: An Analysis from the National Cancer Data Base

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ABSTRACT

Introduction: Questions remain regarding differences in nodal evaluation and upstaging between thoracotomy (open) and video-assisted thoracic surgery (VATS) approaches to lobectomy for early-stage lung cancer. Potential differences in nodal staging based on operative approach remain the final significant barrier to widespread adoption of VATS lobectomy. The current study examines differences in nodal staging between open and VATS lobectomy.

Methods: The National Cancer Data Base was queried for patients with clinical stage T2N0M0 or lower lung cancer who underwent lobectomy in 2010–2011. Propensity score matching was performed to compare the rate of nodal upstaging in VATS with that in open approaches. Additional subgroup analysis was performed to assess whether rates of upstaging differed by specific clinical setting.

Results: A total of 16,983 lobectomies were analyzed; 4935 (29.1%) were performed using VATS. Nodal upstaging was more frequent in the open group (12.8% versus 10.3%; $p < 0.001$). In 4437 matched pairs, nodal upstaging remained more common for open approaches. For a subgroup of patients who had seven lymph or more nodes examined, propensity matching revealed that nodal upstaging remained more common after an open approach than after VATS (14.0% versus 12.1%; $p = 0.03$). For patients who were treated in an academic/research facility, however, the difference in nodal upstaging between an open and VATS approach was no longer significant (12.2% versus 10.5%, $p = 0.08$).

Conclusions: For early-stage lung cancer, nodal upstaging was observed more frequently with thoracotomy than with VATS. However, nodal upstaging appears to be affected by facility type, which may be a surrogate for expertise in minimally invasive surgical procedures.

Keywords: Lung cancer surgery; Lobectomy; Staging; Video-assisted thoracic surgery (VATS)

Introduction

The surgical approach to treatment of lung cancer has traditionally been thoracotomy. Because of the increased morbidity associated with open chest surgery (especially in patients with lung cancer, who often have multiple medical comorbidities), however, minimally invasive options are

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frequently used. Over the past two decades, video-assisted thoracic surgery (VATS) has been used increasingly as a minimally invasive approach to lung cancer surgery with excellent morbidity and mortality rates.[1–4] Short-term advantages of VATS over thoracotomy are well documented: fewer complications, less pain, improved lung function, shorter recovery period, and lower acute care costs.[3,5–12] VATS is particularly beneficial in elderly patients (older than 70 years), with fewer complications and shorter hospital stays than with thoracotomy.[5]

The long-term efficacy of VATS versus thoracotomy (open) approaches to lung cancer surgery is uncertain. Survival after surgery for node-negative lung cancer is associated with the number of lymph nodes (LNs) evaluated.[13,14] Higher numbers of LNs resected provide more complete staging and reduce the likelihood of missing metastatic LNs. Research has demonstrated the existence of greater variability in LN assessment with VATS than with thoracotomy.[15] A critical study from the Society of Thoracic Surgeons (STS) General Thoracic Surgery Database (GTSD) found that an open approach resulted in identification of a greater number of occult LN metastases than did VATS.[16] Two recent studies also demonstrated superior LN staging with thoracotomy than with VATS.[17,18] Incomplete LN evaluation with VATS could compromise survival by leaving residual cancer and limiting staging data, thus affecting optimal treatment based on accurate staging.

In light of the potential differences between the completeness of nodal staging and safety of VATS and those of thoracotomy, a critical gap exists in knowledge regarding which surgical approach (open versus VATS) is optimal for treatment early-stage lung cancer from the standpoint of long-term survival. The current study was designed to examine differences in nodal staging between open and VATS lobectomy in a large national, generalizable data set.

Methods

Data Collection and Definition of Study Variables

The National Cancer Data Base (NCDB), an oncology outcomes database maintained by the American Cancer Society and the American College of Surgeons, represents approximately 70% of newly diagnosed cancer cases within the United States and comprises more than 30 million historical records collected from more than 1500 Commission on Cancer–accredited facilities. The NCDB Participant Use File 2011 was queried for patients with non–small cell lung cancer (NSCLC) in clinical stage T2N0M0 or lower who underwent lobectomy in 2010–2011.

All lung cancers were staged using the seventh edition of the American Joint Committee on Cancer lung cancer staging guidelines.[19,20] Surgical approach (VATS versus open) was defined on an intention-to-treat basis; thus, thoracoscopy cases converted to open lobectomy were classified as VATS. The facility type was determined by Commission on Cancer program accreditation level and based on the types of services provided and case volume.[21] Community cancer programs treat 100 to 500 cases of cancer per year, comprehensive community cancer programs treat more than 500 cancer cases, and academic or research programs (including National Cancer Institute–designated cancer centers) treat more than 500 cases of cancer in addition to providing postgraduate medical education.

Primary outcome variables of interest included 30-day mortality rate, number of regional LNs examined, regional LN positivity, American Joint Committee on Cancer pathologic nodal status (N stage), readmission within 30 days of surgical discharge, status of surgical margins, and length of surgical inpatient stay. Long-term survival data after 2006 are not available in the NCDB 2011 participant user files and were thus not available for inclusion in our analysis. Cases with an unknown surgical approach, concomitant cancer diagnoses, palliative care, preoperative radiation, or missing primary outcome variables were excluded from the data set. After all inclusion and exclusion criteria were met, 16,983 cases remained available for analysis (Fig. 1). Approval for the study was exempted by the Institutional Review Board of Emory University.

Data Analysis and Statistical Methods

All data are presented as mean values with standard deviations or as counts with percentages. All data are complete except where noted within the text or in footnotes to the tables. Descriptive statistics for each variable were reported. All statistical tests were two sided, with the alpha threshold of significance set at 0.05. The univariate association of each covariate with surgical approach and the categorical outcomes was assessed using the chi-square test for categorical covariates and analysis of variance for numerical covariates. The univariate association of each covariate with inpatient stay was assessed using analysis of variance for categorical covariates and Pearson correlation for numerical covariates.

To reduce the treatment selection bias, a propensity score matching method was implemented. The propensity scores were estimated with a logistic regression model that predicts surgical approach by all baseline covariates of interest in this study: facility type, sex, race, insurance, income, education, urban versus rural residence, Charlson/Deyo comorbidity score, year of diagnosis, primary site, histologic diagnosis, grade, age, and tumor size (cm). Cases from the two surgical groups were matched to each other without replacement on the basis of propensity scores by using a greedy matching algorithm.[22] The balance of covariates between the two treatment groups after matching was evaluated by calculating the standardized differences with a value less than 0.10 as the criterion of sufficient balance[23] (see Appendix 1 for propensity score