Intraoperative conversion from video-assisted thoracoscopic surgery lobectomy to open thoracotomy: A study of causes and implications

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Objective: To study causes and implications of intraoperative conversion to thoracotomy during video-assisted thoracoscopic surgery (VATS) lobectomy.

Methods: We performed an institutional review of patients undergoing lobectomy for known or suspected lung cancer with root cause analysis of every conversion from VATS to open thoracotomy.

Results: Between 2004 and 2012, 1227 patients underwent lobectomy. Of these, 517 procedures (42%) were completed via VATS, 87 procedures (7%) were converted to open procedures, and 623 procedures (51%) were performed via planned thoracotomy. Patients undergoing thoracotomy were younger and had a higher incidence of prior lung cancers. Planned thoracotomy and conversion group patients had higher clinical T stage than patients in the VATS group, whereas the planned thoracotomy group had higher pathologic stage than patients in the other groups. Postoperative complications were more frequent in patients in the conversion group (46%) than in the VATS group (23%; $P < .001$), but similar to the open group (42%; $P = .56$). Validating a previous classification of causes for conversion, 22 out of 87 conversions (25%) were due to vascular causes, 56 conversions (64%) were for anatomy (eg, adhesions or tumor size), and 8 conversions (9%) were the result of lymph nodes. No specific imaging variables predicted conversion. Within the conversion groups, emergent (20 out of 87; 23%) and planned (67 out of 87; 77%) conversion groups were similar in patient and tumor characteristics and incidence of perioperative morbidity. The conversion rate for VATS lobectomy dropped from 21 out of 74 (28%), to 29 out of 194 (15%), to 37 out of 336 (11%) ($P < .001$) over 3-year intervals. Over the same periods, the proportion of operations started via VATS increased significantly.

Conclusions: With increasing experience, a higher proportion of lobectomy operations can be completed thoracoscopically. VATS should be strongly considered as the initial approach for the majority of patients undergoing lobectomy. (J Thorac Cardiovasc Surg 2015;149:55-62)

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See related commentary on pages 62-3.

Supplemental material is available online.

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Surgical resection via lobectomy and systematic mediastinal lymph node assessment is the gold standard for treatment of early stage non–small cell lung cancer (NSCLC). The feasibility, safety, and oncologic efficacy of video-assisted thoracoscopic surgery (VATS) lobectomy have been established over the past 2 decades via large institutional series[1,2] as well as multicenter trials.[3] Despite the favorable evidence, registry data as well as data from the Society of Thoracic Surgeons (STS) general thoracic database show that only 30% to 40% of anatomic lung resections are performed utilizing VATS.[4,5]

Technical barriers, including a potential higher risk of intraoperative complications and perceptions about unplanned conversions to thoracotomy, are important issues preventing more widespread acceptance of VATS lobectomy. The incidence of intraoperative conversion to an open approach ranges from 5% to 23% with nearly half the conversions being performed emergently.[6-8] Retrospective series describing conversions show conflicting evidence with some centers reporting greater perioperative morbidity compared with successful VATS

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Abbreviations and Acronyms

NSCLC = non–small cell lung cancer
STS = Society of Thoracic Surgeons
VATS = video-assisted thoracoscopic surgery

completion[6] with others showing equivalent outcomes.[9] Few reports compare unplanned conversions with planned thoracotomy for lobectomy.[6]

Preoperative patient-related variables have been studied for association with the likelihood of conversion and computed tomography scan lymph node calcification score found to be a potential predictor.[6] The role of surgeon/institutional experience in conversion, however, remains inadequately understood. Additionally, the effect of conversion on immediate and delayed outcomes is debatable.

Our objective was to study causes of intraoperative conversions to thoracotomy during VATS lobectomy using and validating an existing classification system.[8] We also assessed short- and long-term implications of conversion with respect to cases completed using VATS and those undergoing planned thoracotomy.

PATIENTS AND METHODS

With approval from the institutional review board at Washington University School of Medicine, a single-center, retrospective review of our database was performed to identify patients who had undergone lobectomy for known or suspected lung cancer between December 2004 and December 2012. We chose a start date of 2004 for the study because we initially started offering VATS lobectomy in 2004. Additionally, electronic patient records have been reliably available for review since that time. Patients who underwent a complete anatomic lobectomy with individual division of hilar bronchovascular structures were included in the study cohort. Patients undergoing wedge resection, segmentectomy, bilobectomy, or pneumonectomy were excluded, as were any patients who underwent lung transplantation.

Each patient was classified as having undergone a VATS lobectomy, open thoracotomy, or intraoperative unplanned conversion from VATS to open operation for lobectomy by an independent chart review by 2 observers (K.M. and V.P.). Cases with inconsistent classification by the 2 observers were resolved by joint review by K.M., V.P., and J.B. VATS lobectomy was defined according to Cancer and Leukemia Group B 39802 trial criteria.[3] Briefly, the technique mandated no rib spreading; a maximum incision length of 8 cm for removal of the lobectomy specimen; individual dissection of the vein, arteries, and airway; and standard lymph node sampling or dissection (identical to an open thoracotomy). Cases where a planned VATS operation was intraoperatively abandoned in favor of an open thoracotomy with rib spreading were classified as conversions. Each conversion was studied in detail by 2 observers (K.M. and V.P.) in a root cause analysis[10] and classified using the previously described VALT system as either vascular, anatomy (related), lymph node (related), or technical (equipment failure).[8]

We utilized a prospectively maintained database to glean information about patient demographics, diagnosis, preoperative workup, operation, perioperative course, and outcomes. Missing data were obtained by a review of patient charts. Perioperative events were defined per STS data collection guidelines (Table E1) Follow-up data were obtained from clinic notes and supplemented by querying the social security death index to determine survival.

Data were managed using Excel (version 2010, Microsoft Corp, Redmond, Wash) and analyzed using SPSS version 22.0 for Windows (IMB-SPSS Inc, Armonk, NY). Descriptive statistics were expressed as mean ± standard deviation unless otherwise specified. Categorical data were expressed as counts and proportions. Comparisons were done with 2-tailed t tests for means of normally distributed continuous variables. Differences among the categorical data were analyzed with either Fisher exact test or χ^2 comparison. We generated Kaplan-Meier (product limit) survival plots, and survival comparisons between groups of patients were completed using the Mantel-Haenszel log rank test. After an initial exploratory comparison between the VATS, open, and conversion groups, logistic regression models were fitted to assess the influence of preoperative variables on the likelihood of conversion. The influence of increasing institutional experience with VATS lobectomy was studied separately by dividing the population into 3-year intervals. A secondary analysis of emergent and nonemergent conversions was also carried out. Emergent conversions were defined as those dictated by significant bleeding or airway injury, whereas nonemergent conversions were related to lack of progress in the operation. For the purpose of this study, in keeping with STS definitions, conditions signifying major perioperative morbidity are summarized in Table E1.

RESULTS

Between 2004 and 2012, 1227 patients underwent lobectomy for known or suspected lung cancer at our institution. Of these, 517 procedures (42%) were completed via VATS, 87 procedures (7%) were converted to open operation, and 623 procedures (51%) were performed via planned thoracotomy. Patients undergoing thoracotomy were younger and had a higher incidence of prior lung cancers. (Table 1) Patients undergoing successful VATS lobectomy were less likely to be men, current smokers, or have undergone prior cardiothoracic surgery. Planned thoracotomy and conversion group patients had higher clinical T stage than patients in the VATS group (Table 1), whereas patients in the planned thoracotomy group had higher clinical N stage than patients in the other 2 groups. There was no difference in the prevalence of intrathoracic granulomatous disease, including lymph node calcifications, between the groups. Patients undergoing successful VATS had a somewhat higher forced expiratory volume in 1 second percent predicted that those undergoing thoracotomy. Patients in the planned thoracotomy group had higher pathologic stage than patients in the other groups (Table 1).

Postoperative STS database-defined complications were more frequent in the conversion group, (40 out of 87; 46%) than in the VATS group (119 out of 517; 23%) ($P < .001$), but similar to the open group (264 out of 623; 42%) ($P = .56$). The higher incidence of perioperative morbidity in the 2 open groups was largely related to greater incidence of atelectasis, pneumonia, arrhythmias, and respiratory failure (Table 2). The length of stay was also longer if a patient underwent a planned or unplanned thoracotomy (Table 2). Surgical mortality was similarly low across the groups (thoracotomy 5 out of 623 [0.8%], VATS 0 out of 517 [0%], and conversion 1 out of 87 [1%]; $P = .1$).