Intraoperative costs of video-assisted thoracoscopic lobectomy can be dramatically reduced without compromising outcomes

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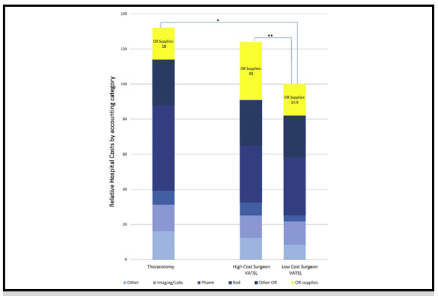
ABSTRACT

Objective: To determine whether surgeon selection of instrumentation and other supplies during video-assisted thoracoscopic lobectomy (VATSL) can safely reduce intraoperative costs.

Methods: In this retrospective, cost-focused review of all video-assisted thoracoscopic surgery anatomic lung resections performed by 2 surgeons at a single institution between 2010 and 2014, we compared VATSL hospital costs and perioperative outcomes between the surgeons, as well as costs of VATSL compared with thoracotomy lobectomy (THORL).

Results: A total of 100 VATSLs were performed by surgeon A, and 70 were performed by surgeon B. The preoperative risk factors did not differ significantly between the 2 groups of surgeries. Mean VATSL total hospital costs per case were 24% percent greater for surgeon A compared with surgeon B ($P = .0026$). Intraoperative supply costs accounted for most of this cost difference and were 85% greater for surgeon A compared with surgeon B ($P < .0001$). The use of nonstapler supplies, including energy devices, sealants, and disposables, drove intraoperative costs, accounting for 55% of the difference in intraoperative supply costs between the surgeons. Operative time was 25% longer for surgeon A compared with surgeon B ($P < .0001$), but this accounted for only 11% of the difference in total cost. Surgeon A's overall VATSL costs per case were similar to those of THORLs (n = 100) performed over the same time period, whereas surgeon B's VATSL costs per case were 24% less than those of THORLs. On adjusted analysis, there was no difference in VATSL perioperative outcomes between the 2 surgeons.

Conclusions: The costs of VATSL differ substantially among surgeons and are heavily influenced by the use of disposable equipment/devices. Surgeons can substantially reduce the costs of VATSL to far lower than those of THORL without compromising surgical outcomes through prudent use of costly instruments and technologies. (J Thorac Cardiovasc Surg 2017;■:1-11)



VATSL hospital costs are safely reduced by the selective use of expensive intraoperative supplies. *$P < .05$; **$P < .01$.

Central Message

VATSL costs vary widely by surgeon and are influenced by disposable equipment use. Cost-effective instrumentation selection can decrease the cost of VATSL by 19% with equivalent outcomes.

Perspective

In several studies, the greater intraoperative costs of VATSL counterbalance the cost savings achieved from the reduced length of stay compared with thoracotomy. Our findings demonstrate that surgeons can safely reduce intraoperative VATSL costs by eliminating use of unproven, expensive surgical adjuncts/disposables, thereby lowering total hospitalization costs to below those of thoracotomy.

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THOR

Pulmonary lobectomy performed via video-assisted thoracoscopy lobectomy (VATSL) has been consistently documented to be associated with shorter length of hospital

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Abbreviations and Acronyms
OR = operating room
STS = Society of Thoracic Surgeons
THORL = thoracotomy lobectomy
VATSL = video-assisted thoracoscopic lobectomy

stay[1-6] and slightly lower complication rates compared with thoracotomy lobectomy (THORL).[1-3,6-10] Economic analyses have determined that postdischarge costs are lower after VATSL than after THORL,[11,12] but have been inconsistent in finding an in-hospital cost benefit for VATSL.[11-15] Several studies have suggested that the greater intraoperative costs of VATSL compared with THORL is why overall hospital costs have not been lower for VATSL.[14,16,17]

Given the strong shift toward value-based health care, we sought to determine whether the higher intraoperative costs of VATSL compared with THORL[14,16,17] can be favorably impacted by surgeons' intraoperative choices and, if so, whether these more cost-effective choices can be made without adversely affecting outcomes. We further hypothesized that a cost-effective surgeon could perform VATSL with equal or reduced intraoperative and total in-hospital costs compared with THORL. We addressed these questions by studying overall hospital and intraoperative costs of VATSLs and THORLs performed by 2 surgeons, one who tended to consider costs in his choice of devices/instruments and the other who was less focused on cost savings and tended to be an earlier adopter of novel devices.

METHODS

Study Population and Clinical Data Collection

We retrospectively reviewed prospectively collected data on all patients who underwent VATSL, video-assisted thoracoscopy segmentectomy, or video-assisted thoracoscopy bilobectomy by 2 surgeons at Stanford University Hospital in fiscal years 2010 to 2014 (September 2009 to August 2013). We also collected data for all 100 THORLs performed by these 2 surgeons during the same period. Sleeve lobectomies were excluded. Approval for this study was obtained from the Institutional Review Board of Stanford University, which exempted the study from the typical requirement for informed consent given the nature of the study. Although our analysis is performed from a hospital cost perspective, in a setting of limited societal resources, the hospital perspective clearly has implications for society as a whole.

We used the Society of Thoracic Surgeons (STS) General Thoracic Database entries for our patients (with additional custom fields that we added) to collect demographic information and data on staging (American Joint Committee on Cancer Staging Manual, 7th edition), preoperative comorbidities, pulmonary function tests, operative variables, and postoperative outcomes. The only comorbidity defined differently from the STS database definition was our use of creatinine concentration $\geq$1.2 mg/dL as a comorbidity. When required data were unavailable in the STS database fields, we retrospectively queried the electronic medical record.

VATSLs that were converted to THORLs were included in the VATSL group (intention-to-treat analysis). One patient (out of 270) was excluded in the outcomes analysis because of unavailable data. VATSLs were performed using a 3-incision or 3-port technique, except in rare instances where a fourth was added. Postoperative management was provided at the discretion of the individual surgeon.

Operating room (OR) time was defined as time from anesthesia induction to extubation and thus included time for bronchoscopy, positioning, and mediastinoscopy when performed. The use of glues, gels, and adjuncts, such as the LigaSure device (Medtronic, Minneapolis, Minn) or a harmonic scalpel was recorded, as were intraoperative blood loss and blood transfusion. When blood loss was recorded as "minimal," we used a value of 25 mL. Intraoperative complications were defined as surgeries requiring blood transfusions and those requiring conversion to thoracotomy due to bleeding.

Major postoperative complications collected included acute respiratory distress syndrome, atelectasis requiring bronchoscopy, bronchopleural fistula, chylothorax requiring intervention, delirium, empyema, new central neurologic event, other events requiring use of the operating room (OR) with general anesthesia, other neurologic events, pneumonia, respiratory failure requiring reintubation, unexpected admission to the intensive care unit, and unexpected return to the OR. The duration of chest tube insertion and air leak, as well as the incidence of prolonged air leak (>5 days), were recorded as well.

Financial Data Collection

In-hospital costs for the index hospitalization during which surgery (VATSL or THORL) was performed were collected by Stanford Health Care Finance Department personnel. The hospital agreed to provide the research team with relative (but not absolute) direct technical cost data for each patient and surgeon. The data were separated into intraoperative and postoperative costs and then into several different categories within each of these subdivisions. Intraoperative costs were broken down into OR supplies and other OR costs (with the latter essentially determined by OR time). Postoperative costs were broken down into bed costs, pharmacy costs, supply costs, imaging/laboratory test costs, and other costs. Costs were compared between the 2 surgeons, and the data were analyzed to identify the main drivers of any cost differences identified.

Stanford Hospital uses a complicated internal method of coding for specific devices used in the OR. Using this coding system plus the surgeons' operative reports, we were able to identify nearly all of the specific devices used in the various procedures; however, approximately 5% of device codes could not be successfully affiliated with a specific device, which was an insufficient percentage to alter our results in any substantial way.

Data Analysis

Differences in all outcomes between surgeon A and surgeon B were first assessed in bivariate analyses, without adjusting for patient demographic data or tumor stage. Differences in patient and tumor characteristics were also assessed between surgeon A's VATSL patients and surgeon B's VATSL patients, as well as between all VATSL patients and all THORL patients, to determine whether the surgeons were operating on a similar patient population and to explore how the VATSL and THORL patients differed. Finally, differences in all outcomes between the 2 surgeons were analyzed in multivariable regression models, adjusting for differences in the 2 surgeons' patient populations. All clinically relevant patient characteristics (including stage) that differed between the 2 surgeons at a threshold of $P < .20$ were included as covariates in the adjusted analyses. A linear regression model was used for continuous data, and a logistic regression was used for binary variables.

Separate statistical analyses of cost data were performed by the Stanford Health Care Finance Department, with close guidance from the clinical research team. This was necessary because the clinical team was blinded to the crude financial data.

A P value $< .05$ was considered to indicate statistical significance. All analyses were conducted in Excel (Microsoft, Redmond, Wash), GraphPad