Editorial Commentary

# Is a complicated VATS lung resection better than no VATS at all?—converting our stance on intraoperative conversions

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Since its introduction in the early 1990s, video-assisted thoracoscopic surgery (VATS) has been the focus of several technological advances, improvements in technique, and increased utilization (1,2). Compared to open thoracotomy, VATS lung resections are associated with improved outcomes of reduced postoperative morbidity and length-of-stay without evidence of inferior long-term survival or disease recurrence (3-5). However, one potential barrier to increased adoption of VATS into routine practice is the concern for requiring an intraoperative conversion. In their article "Intraoperative Conversion During Video-assisted Thoracoscopy Does Not Constitute a Treatment Failure", Fourdrain and colleagues challenged the stigma surrounding intraoperative conversions for patients undergoing VATS anatomic lung resection (6). They concluded that major morbidity and mortality in patients who experienced conversions were no different than patients who underwent a planned thoracotomy, and thus the possibility of conversion should not deter thoracic surgeons from pursuing minimally invasive approaches.

The conclusion brought forth by this study is important, especially as overall experience with VATS grows and the indications for use continue to expand. VATS lobectomy conversion rates range from 2–23%, and have often been viewed as a negative outcome (1,7,8). One potential reason why intraoperative conversions have been associated with treatment failure is the way in which several previous studies investigating conversions have been designed. The majority of retrospective studies on this topic have compared VATS conversions directly to successfully completed VATS lung resections (1,6,9). In these studies, patients who experienced conversions have been documented to experience increased morbidity and length-of-stay. Puri and colleagues published a similar retrospective review of their institution's experience with VATS lobectomy conversions for lung cancer (10). They examined 1,227 patients, of which 517 (42%) underwent full VATS, 87 (7%) experienced a conversion to thoracotomy, and 623 patients (51%) underwent planned thoracotomy. They compared conversions to both completed VATS and to planned thoracotomy. Compared to the successful VATS cohort, patients who experienced a conversion had a higher incidence of postoperative complications, including atelectasis, pneumonia, arrhythmias, and respiratory failure. Additionally, length-of-stay was longer for VATS patients who underwent conversion. These differences were no longer observed when comparing conversions to planned thoracotomy, however. Fourdrain observed a similar pattern; converted patients had longer length-of-stay and a higher incidence of complications including pneumonia and arrhythmia compared to completed VATS (6). However, similar morbidity and length-of-stay were observed when the comparator group was planned thoracotomy. These studies demonstrate how treatment failure is relative. It is perhaps more appropriate to compare conversions to the would-be alternative: planned thoracotomy. This follows logical clinical decision making, as the real choice that surgeons must face during the operative planning phase is the choice to start off with a thoracotomy or pursue VATS with a variable risk of unplanned conversion. Based on the conclusions by Fourdrain, we can assume that the risk of conversion will

likely not lead to worse clinical outcomes and should not preclude selection of VATS if the operating surgeon feels sufficiently comfortable and experienced to do so (6).

Perhaps one of the most interesting findings described by Fourdrain and colleagues is the relationship between surgeon experience and conversions. The authors documented a relatively high conversion rate at the beginning of the study period, when VATS techniques were first being implemented at their institution (6). Over time, with presumably greater surgeon experience, the utilization of VATS increased dramatically and was associated with a significant decline in intraoperative conversions. This phenomenon has also been described by previous studies. Puri *et al.* documented the conversions over an 8-year interval [2004–2012] and found that the conversion rate dropped significantly from 28% to 11% (10). While Fourdrain *et al.* observed a possible "learning curve" effect, the relationship between experience and outcomes is not further explored in the study via an evaluation of case volume or time.

Few studies have accurately captured the impact of experience on conversions. Amore and colleagues reviewed 573 VATS cases over an 8-year study period [2011–2017] to assess the impact of the VATS learning curve on risk of conversion (11). They defined the length of the learning curve as 50 VATS lobectomies. They studied conversions in operations performed by surgeons during the learning curve phase (<50 lobectomies) and after the learning curve phase (≥50 lobectomies). They observed a significant difference in conversion rate, with surgeons operating during the learning-curve phase having significantly more conversions (18% *vs.* 5.9%). Interestingly, they noted that the indications for conversions also changed with increased experience. In the learning curve phase, the majority of conversions were performed for absent/incomplete fissure. In the post-learning curve phase, the majority of conversions were performed primarily for vessel injury, presence of calcified hilar lymph nodes or hilar lymphadenopathy. The authors suggested that increased experience and comfort with advanced VATS techniques might result in surgeons pursuing technically challenging cases involving more central, and advanced tumors than previously.

However, the relationship between experience and conversions is likely more nuanced (1). Experience likely leads to greater confidence in case selection, but also greater technical capability and skill to handle some intraoperative emergencies thoracoscopically. Several case reports and institutional reviews from centers that perform a large volume of VATS lung resections have described the use of intracorporeal suturing, thermal energy devices, and sealants to handle intraoperative hemorrhage (12). Additionally, with increased experience comes better preoperative planning. Perhaps the most important strategy to prevent intraoperative complications is improved patient selection. One potentially useful feature of institutional reviews like Fourdrain's study is the ability to examine granular preoperative data to identify patients at risk for an intraoperative complication necessitating conversion.

Ideally, a risk prediction model that accounts for patient comorbidities, disease pathology characteristics, imaging findings, and surgeon experience could be developed for the identification of VATS conversion. However, risk prediction in this population has been notoriously challenging, with only a few studies able to identify risk factors for conversion (1,10). Byun and colleagues reviewed 1,110 patients who underwent VATS lobectomy to identify independent risk factors for conversion (9). They identified 69 individuals (6.2%) who underwent conversion, and performed 3:1 matching to non-converted patients based on date of operation, extent of operation (lobectomy, bilobectomy, or sleeve lobectomy), and pathologic stage. Accounting for patient comorbidities, pulmonary function, tumor characteristics, and lymph node characteristics, the authors identified advanced age (>65 years), reduced forced expiratory volume in one second (<1.8 L), and presence of calcified lymph nodes as independent risk factors for experiencing a conversion. Using institutional data from a histoplasmosis-endemic region, Samson and colleagues characterized the degree of calcifications in hilar lymph node stations on computed-tomography scans into a "calcification score" and assessed risk for intraoperative VATS conversion (13). Accounting for patient age, pulmonary function status, tumor characteristics, and surgeon experience, Samson found that calcification score was the only variable significantly associated with intraoperative conversion. One limitation of the study performed by Fourdrain is their lack of inclusion of radiographic features and history of prior thoracic infections/procedures in their analysis of conversions (6).

Fourdrain and colleagues used 90-day mortality as the primary endpoint for analysis. With excellent outcomes, the very limited number of events makes it challenging to perform and interpret risk-adjusted logistic regression without over-fitting the models. Given the low 90-day mortality, a focus on more common and meaningful outcomes including prolonged length-of-stay, need for transfusion, need for ICU admission,

 

and prolonged air leak might have been equally interesting and more statistically valid.

This study should be lauded for being one of the larger institutional reviews of conversions to be published. Study of conversions can be challenging, as it is important to understand the indication and the planned *vs.* unplanned nature behind each conversion. Often, these are not adequately captured or described by large administrative or clinical databases, and prospective study is challenging given the relatively few events that occur. Thus, studies like Fourdrain and colleagues' publication are critical for providing the granular detail for truly understanding the intraoperative decision-making leading to conversion. Future study into the characterization of conversions will be necessary, especially as experience grows and newer minimally invasive technologies are adopted. With the introduction of robotic-assisted thoracic surgery over the past decade, it will be interesting to see whether this new technology is associated with fewer conversions, and how the change in learning curve will impact conversion rate over time.

Importantly, the take home message from Fourdrain's study is one we entirely agree with. Thoracic surgeons should not view safe conversions as a barrier to adoption of new technologies. Rather, the focus should be on appropriate patient selection for minimally invasive techniques while still employing conversion-to-thoracotomy when it provides the safest solution.

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## Footnote

*Conflicts of Interest*: The authors have no conflicts of interest to declare.

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