Dr D'Amico. So based on that complete complex analysis, can you better predict conversions now? Are there any cases that should not be even started thoracoscopically?

Dr Puri. At this point in time, all patients in our practice who have central tumors who would either require a pulmonary arterial or a complex bronchoscopic closure are not attempted thoracoscopically. Tumors >8 cm in size or tumors that have an infiltrating bronchioloalveolar carcinoma type pattern are not attempted thoracoscopically simply because of difficulty in manipulating the lobe, and the vast majority of tumors converted in this analysis for size reasons were larger than 7 to 8 cm. Also patients with prior pleurodesis are not attempted thoracoscopically at this point in time.

Dr D'Amico. Did you record and analyze the frequency of transfusions? It is known that patients undergoing VATS have

fewer transfusions than patients undergoing planned thoracotomies, but what about transfusions for open versus conversions or emergent versus nonemergent conversions?

Dr Puri. The incidence of intraoperative transfusion in our planned open thoracotomy group was just shy of 10%. It was 1.3% in patients who had their operations completed thoracoscopically and it was 16% in patients who had conversions. The 16% rate of transfusions intraoperatively was almost entirely related to vascular injuries, and two-thirds of vascular injuries required intraoperative transfusions, and all of these numbers were statistically significant.

Dr D'Amico. So those cases should have been converted 5 minutes earlier?

Dr Puri. I agree with you. I guess the take-home message is: Avoid emergent vascular conversions.

EDITORIAL COMMENTARY

Are we looking at a surgical black box in the future?

J. Matthew Reinersman, MD, and Shanda H. Blackmon, MD, MPH

See related article on pages 55-62.

During the past 20 years, thoracoscopic lobectomy or video-assisted thoracoscopic surgical (VATS) lobectomy has been established as a feasible and oncologically sound alternative to traditional open lobectomy, and it may be the new criterion standard. Despite current evidence, however, queries of many large national databases continue to demonstrate low overall rates of thoracoscopic lobectomy. Many arguments remain as to why there has not been more widespread adoption of VATS lobectomy. One hurdle may be the perceived risk of catastrophic intraoperative complications and emergency conversions to thoracotomy. Catastrophic complications during VATS lobectomy, are rare, according to Flores and associates.¹ In their article in this issue of the *Journal*, Puri and colleagues have now tackled the area of unplanned conversions nicely by examining their institution's experience in the course of 8 years

and more than 1200 operations with thoracoscopic lobectomy and conversions to open thoracotomy. Only a small percentage (7%) of their VATS lobectomies required conversion to open thoracotomy.

Puri and colleagues performed a root cause analysis according to a previously published classification system, the VALT system. According to this analysis, 25% of conversions were related to vascular causes, 64% related to anatomic considerations, 9% related to lymph nodes, and 1% related to technical failure of equipment. The majority of these conversions were nonemergency in nature, and after conversion, patients had similar outcomes to those of planned open lobectomy. Even operations requiring emergency conversion had no worse outcomes other than a higher rate of transfusion. The transfusion rates were greater overall for conversions, but this mostly was related to emergency conversions.

Puri and colleagues found no predictors of conversions. Patients requiring conversion did have a higher clinical T stage. It does make sense that bulky central tumors are not always approachable through thoracoscopic lobectomy, especially when a larger tumor cannot be removed without spreading the ribs.

A second important finding of this study is the decrease in conversions as experience increased. In this study, during a 3-year period, the conversion rate fell from 28% to 11% as the use of VATS lobectomy increased from 16% of operations to 76%. Thus with increasing experience a greater proportion of lobectomies can safely be completed by

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means of VATS, if this trend applies to each surgeon in the same fashion.

The detailed examination of the root cause of each conversion makes this article particularly useful. Because this was a single-institution study, with its inherent weakness and bias, Puri and colleagues may want to validate or explore their analysis further by means of large multi-institutional or national databases. Unfortunately, operative detail is missing from most large databases, making such a study difficult without a multi-institutional approach. Perhaps a surgical “black box” should exist when catastrophic complications happen, not necessarily conversions.

Puri and colleagues should be applauded for focusing on complications, conversions to open lobectomy, and potential judgment mistakes. Because the majority of conversions were for nonemergency causes, this likely reflects increasing good judgment rather than failure as VATS experience increased and surgeons began to practice beyond their learning curve. The tendency to label a conversion to open surgery as a complication or technical failure is a mistake. Some circumstances mandate conversion. From this study, no preoperative variables reliably predicted conversions. The risk of conversion should not dissuade one from adopting VATS lobectomy.

As our colleagues in general surgery have done during a similar period with laparoscopic cholecystectomy, analysis of root causes of conversions is an important step in certifying the safety of the technique. The moral of the

story is that converting is not a failure or complication. Converting affords no additional morbidity or mortality than does a planned traditional open lobectomy. Conversion may mean more time in the operating room and may increase expense. With this knowledge, it is to be hoped that we can encourage our colleagues to continue to work toward a better way of predicting conversions or avoiding them entirely. The VALT system—vascular, anatomic, lymph nodes, and technical—is a simple model for categorizing conversions. Three of the four are clearly variables surgeons can better analyze and attempt to predict how they will alter the operation. We encourage further research into the root cause analysis, or surgical “black box,” so that we can continue to improve outcomes regardless of approach for the sake of our patients. In the future, we should formalize our teaching to become more sophisticated, as our airline industry colleagues have done, integrating validated visual heuristics and simulation into our training models. With the practice of recording our own cases, 3-dimensional modeling, and openness to self-critique, we could potentially improve outcomes further by practicing approaches to unusual anatomy and avoiding problems on the basis of visual cues and planning.

Reference

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