Pulmonary Artery Bleeding During Video-Assisted Thoracoscopic Surgery

Intraoperative Bleeding and Control

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KEYWORDS

• Thoracoscopy • VATS lobectomy • Hemorrhage • Complications

KEY POINTS

- Video-assisted thoracoscopic surgery (VATS) lobectomy has been shown to be safe and has many advantages for patients over an approach with a thoracotomy.
- With appropriate planning and operative technique, the risk of pulmonary artery injury and bleeding can be minimized; but surgeons should always ensure that they are prepared to manage this situation if it occurs.
- Pulmonary artery injuries can be repaired via VATS, but surgeons should not hesitate to use conversion to thoracotomy when needed and depending on their VATS experience.

INTRODUCTION

The use of video-assisted thoracic surgery (VATS) dates back to the 1940s when a cystoscope was used to drain a pleural effusion, but it was not until the 1990s when the use of video-assisted techniques to achieve anatomic lung resection such as lobectomy was described.[1] Both single-institution and multi-institution trials have subsequently shown VATS lobectomy to be safe and feasible.[2–4] Controlled studies have also demonstrated benefits of a minimally invasive approach over thoracotomy.[5,6] The technique is particularly beneficial for higher-risk patients, such as older patients and patients with impaired pulmonary function.[7–9] Reports have also documented that a minimally invasive VATS approach can be used in more advanced situations, such as large and central tumors with clinically positive nodal disease and after induction therapy, as well as for sleeve resections, chest wall resections, and pneumonectomy.[10–14]

Despite the advances and demonstrated benefits of minimally invasive thoracic surgery, a VATS approach for lobectomy has not been universally adopted. As recently as 2010, a VATS approach was used in the minority (45%) of lobectomies recorded in the Society of Thoracic Surgeons General Thoracic Surgery Database.[9] Several reasons may explain why a VATS approach has not been more widely used. Despite the advanced applications described earlier, some tumors may still not be technically appropriate for the use of a VATS approach. In addition, some reports have expressed concerns that the lymph node harvest achieved via VATS is inferior to that achieved during thoracotomy.[15–18] However, another significant reason that a VATS approach is not used more often could be concerns that

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Thorac Surg Clin ■ (2015) ■–■
http://dx.doi.org/10.1016/j.thorsurg.2015.04.007
1547-4127/15/$ – see front matter

the ability to safely control and dissect the hilar pulmonary vessels is limited. Some surgeons may not feel comfortable visualizing and handling these structures through a small incision and a scope while watching on a monitor.

In particular, concerns over how to control and repair any inadvertent vascular injury are likely very prominent for many surgeons. Of the pulmonary structures, pulmonary artery bleeding caused by injury during dissection and manipulation is generally the most feared because of the relatively delicate nature of the vessel and very-high-volume blood flow through this structure. Compared with the other hilar pulmonary structures, it is generally thought that the pulmonary artery is most easily injured. Importantly, attempts to repair a pulmonary artery injury can sometimes lead to more extensive tearing that could potentially progress to involve the main pulmonary artery. Major pulmonary artery injuries can result in an intraoperative patient death caused by exsanguination when the injury is not adequately controlled in a timely fashion. Perhaps not as immediately catastrophic but also potentially devastating to patients, a pulmonary artery injury could lead to the need to perform a more extensive pulmonary resection, such as pneumonectomy, rather than the planned lobectomy. The concern over pulmonary artery manipulation during minimally invasive surgery is well captured by an editor's comments about VATS pulmonary resections in a prominent cardiothoracic surgery textbook: "Should a problem occur during a video-assisted procedure when stapling a pulmonary artery branch, I would submit that there will be a significant squeeze on the surgeon's coronary circulation until such time as the chest can be opened."[19]

Reviewing the many successful case series of VATS lobectomy should not lead to an interpretation that potential pulmonary artery bleeding during VATS dissection is insignificant. In contrast, experienced VATS surgeons generally do not understate the importance of safety and careful pulmonary artery manipulation.[20,21] Rather, a more appropriate interpretation of the reported VATS lobectomy series may be that the risk of serious complications resulting from pulmonary artery injuries can be minimized with careful planning and operative technique. The purpose of this article is to review the incidence and mechanisms of pulmonary artery bleeding during VATS lobectomies. In addition, management strategies and techniques to prevent, control, and repair pulmonary artery injuries that occur during VATS procedures is described.

INCIDENCE OF PULMONARY ARTERY BLEEDING DURING VIDEO-ASSISTED THORACOSCOPIC SURGERY LOBECTOMIES

Although concerns over pulmonary artery injuries and bleeding during VATS lobectomy are certainly well founded and understood, estimating the risk and consequences of pulmonary artery injuries during VATS lobectomy is difficult. The incidence of pulmonary artery bleeding reported by large-volume, very experienced surgeons and centers is very low.[4,10,22–27] **Table 1** shows that the incidence of conversion to thoracotomy because of bleeding, which is likely from the pulmonary artery in most cases, ranges from 0.5% to 5.2%. In addition, the reports of an intraoperative catastrophe, such as death, caused by uncontrolled pulmonary artery bleeding in high-volume series are negligible.

However, the incidence of pulmonary artery injuries across the spectrum of surgical experience is likely to be higher than what is reported by higher-volume centers. Instances of pulmonary artery injuries during VATS lobectomy may be underreported in the medical literature, as intraoperative complications are generally not eagerly publicized.

Table 1
Summary of incidence of all conversions and conversions for bleeding in large VATS lobectomy series

	Number of Patients	All Conversions	Conversion for Bleeding
McKenna et al,[4] 2006	1100	28 (2.5%)	6 (0.5%)
Villamizar et al,[10] 2013	916	36 (3.9%)	21 (2.3%)
Puri et al,[23] 2015	604	87 (14.4%)	22 (3.6%)
Liang et al,[25] 2013	382	6 (1.6%)	4 (1.0%)
Roviaro et al,[22] 2004	337	78 (23.1%)	5 (1.5%)
Stephens et al,[24] 2014	307	22 (7.2%)	12 (3.9%)
Samson et al,[26] 2013	193	45 (23.3%)	10 (5.2%)
Nicastri et al,[27] 2008	153	14 (9.2%)	5 (3.3%)