Reasons for conversion during VATS lobectomy: what happens with increased experience

Dario Amore, Davide Di Natale, Roberto Scaramuzzi, Carlo Curcio

Division of Thoracic Surgery, Monaldi Hospital, Naples, Italy

Contributions: (I) Conception and design: D Amore; (II) Administrative support: D Amore, C Curcio; (III) Provision of study materials or patients: C Curcio; (IV) Collection and assembly of data: D Amore, D Di Natale, R Scaramuzzi; (V) Data analysis and interpretation: D Amore, R Scaramuzzi, D Di Nalale; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Dario Amore. Division of Thoracic Surgery, Monaldi Hospital, Leonardo Bianchi Street, 1, 80131 Naples, Italy.
Email: dario.amore@alice.it.

Abstract: Although controlled studies have demonstrated the benefits of a minimally invasive approach for pulmonary lobectomy over thoracotomy, reports have also documented that significant complications can occur during thoracoscopic lobectomy and sometimes require planned or emergent conversion to open surgery. Several authors have identified and reported causes and implications of intraoperative conversion to thoracotomy using different types of classification. The aim of this single centre retrospective review is to evaluate how the reasons for conversion change with increased experience, dividing patients who were converted to thoracotomy during video-assisted thoracic surgery (VATS) lobectomy, between 2011 and 2017, in two groups: those treated during learning curve (LC group) and those treated after learning curve (ALC group). Our research suggests that the conversion rate, with increased skills, decreases but a variety of reasons for conversion persist. Of these, calcified, benign or malignant hilar adenopathy is the most frequent and represents the leading cause of conversion to open surgery due to complicated vascular dissection or vessel injury. It's strongly recommended, with increased confidence in performing VATS lobectomies, also to develop management strategies and techniques to prevent and control possible intraoperative adverse events.

Keywords: Video-assisted thoracic surgery (VATS) lobectomy; conversion; vessel injury

Received: 15 February 2018; Accepted: 02 March 2018; Published: 15 March 2018.
doi: 10.21037/jovs.2018.03.02
View this article at: http://dx.doi.org/10.21037/jovs.2018.03.02

Introduction

Although an increasing number of studies in literature have found that video-assisted thoracic surgery (VATS) lobectomy appears to be superior to conventional open lobectomy for perioperative outcomes (1-3), extreme caution must be exercised during major pulmonary resections through thoracoscopic approach because the procedure is not without risks. Several authors, in fact, have reported conversion rates to open surgery during VATS lobectomy for a variety of intraoperative reasons: in the range below 3% up to 23% (4,5). Calling in the question the issue of the intraoperative complications during lobectomy via VATS incisions, some researchers have carefully reviewed and classified the reasons for the conversion to thoracotomy in order to make the minimally invasive approach for pulmonary lobectomy a safer procedure (6,7).

Methods

At our institution, between 2011 and 2017, 573 patients underwent VATS lobectomy for known or suspected lung cancer. The VATS approach was converted to open thoracotomy in 40 (6.9%) of 573 patients for a variety of reasons. The length of our learning curve (LC), as also suggested by several authors (8,9), consisted of 50 VATS lobectomies. Patients undergoing conversion to open surgery were divided into two groups: those treated during LC (LC group) and those treated after LC (ALC

Table 1 Characteristics of LC group patients

Sex	Age (years)	Type of histology	Resected lobe	Pathologic stage	Reason for conversion
M	77	Adeno carcinoma	RLL	T2aN0M0	Absent fissure and benign mediastinal adenopathy
F	66	Benign tumor	LLL	–	Benign hilar adenopathy
M	65	Adeno carcinoma	ML	T1aN0M0	Incomplete fissures
F	63	Adeno carcinoma	LLL	T1bN2M0	Vessel injury
M	65	Squamous carcinoma	RLL	T2bN0M0	Incomplete fissure and benign mediastinal adenopathy
F	64	Squamous carcinoma	RLL	T1bN0M0	Incomplete fissure and benign hilar adenopathy
F	80	Atypical carcinoid	LLL	T2aN0M0	Absent fissure and benign hilar adenopathy
M	68	Adeno carcinoma	RLL	T1bN0M0	Incomplete fissure
M	67	Adeno carcinoma	RLL	T1aN0M0	Incomplete fissure and pleural symphysis

RLL, right lower lobe; LLL, left lower lobe; ML, middle lobe.

group). In all cases VATS lobectomy was performed using a three-port anterior approach, with individual dissection of bronchovascular structures and lymph node dissection or sampling without ribs spreading and self-expanding instruments applied to open the wound. All patients underwent single lung ventilation with a double-lumen endotracheal tube.

Results

In the LC group the conversion rate was: 18% (9 out of 50). The patients' characteristics are listed in *Table 1*. The most frequent reasons for conversion were absent or incomplete fissure (seven patients), followed by benign hilar or mediastinal adenopathy, vessel injury and pleural symphysis. In all cases a planned conversion to open thoracotomy was performed by extending the utility incision to a standard lateral thoracotomy. The only vascular lesion reported was an iatrogenic injury of a bronchial artery during mediastinal lymph node dissection in patient undergoing left lower lobectomy for treatment of adenocarcinoma. Postoperative complication observed was prolonged air leak (>5 days) in one patient. In the ALC group the conversion rate was: 5.9% (31 out of 523). The patients' characteristics are listed in *Table 2*. The most frequent reasons for conversion were vessel injury (thirteen patients), followed by benign hilar adenopathy, calcified hilar adenopathy, vascular adventitial fibrosis, malignant hilar adenopathy, incomplete fissure and vascular anomaly. In four cases, due to vascular injury, surgical team decided to perform an emergent conversion to open thoracotomy. As far as vascular conversion, 77% of the vascular injuries were pulmonary artery injuries, 8% were bronchial artery injuries and 15% were pulmonary venous injuries. Pulmonary arterial bleeding was caused by calcified hilar adenopathy and benign or malignant hilar adenopathy that complicated vascular dissection. Other reasons for conversion, due to pulmonary arterial bleeding, were: accidental movement of instrument around the vessel, forced dissection of a dense vascular structure in patient who received induction therapy, mechanical failure of the stapler (*Figure 1*) and inadvertent thermal injury to adjacent vascular structure using vessel sealing device (*Figure 2*). Left and right upper lobectomies were the most frequently associated with conversion to thoracotomy for vessel injury (10/13, 77%). As far as pathological N stage, in the ALC group 26% of the patients (8 out of 31) had postoperative histological diagnosis of N1 or N2 disease. Postoperative complications were observed in eight patients, consisting of atrial fibrillation in five patients, prolonged air leak (>5 days) in two patients and acute respiratory distress syndrome (ARDS) in one patient that led to prolonged intensive care unit (ICU) stay and subsequently to death.

Discussion

In the literature there is a surprising number of papers written with the objective to study causes of intraoperative conversion to thoracotomy during VATS lobectomy using classification systems too (1,6,12). This single centre retrospective review investigates instead how the reasons for conversion to thoracotomy during VATS lobectomy change with increased experience. At the beginning of

Table 2 Characteristics of ALC group patients

Sex	Age (years)	Type of histology	Resected lobe	Pathologic stage	Reason for conversion
M	70	Adeno carcinoma	RLL	T2aN0M0	Incomplete fissure
M	68	Squamous carcinoma	RLL	T2aN0M0	Benign hilar adenopathy
F	59	Adeno carcinoma	LLL	T1bN0M0	Vessel injury
M	71	Adeno carcinoma	LUL	T1bN0M0	Benign hilar adenopathy
F	69	Adeno carcinoma	RLL	T2aN0M0	Vessel injury
F	73	Adeno carcinoma	RLL	T1bN1M0	Benign hilar adenopathy
M	70	Adeno carcinoma	RUL	T1bN0M0	Vessel injury
M	71	Squamous carcinoma	LUL	T2aN0M0	Calcified hilar adenopathy
M	77	Adeno carcinoma	RUL	T1bN1M0	Vessel injury
F	66	Squamous carcinoma	LUL	T1aN2M0	Vessel injury
F	65	Adeno carcinoma	LLL	T2aN2M0	Vascular adventitial fibrosis
M	63	Large cell neuroendocrine carcinoma	LLL	T2aN2M0	Malignant hilar adenopathy
F	74	Adeno carcinoma	LUL	T2aN1M0	Calcified hilar adenopathy
M	78	Squamous carcinoma	RUL	T2bN0M0	Vessel injury
M	73	Adeno carcinoma	RUL	T1bN2M0	Vessel injury
M	71	Squamous carcinoma	RLL	T1aN0M0	Calcified hilar adenopathy
F	62	Inflammatory lesion	LLL	-	Benign hilar adenopathy
F	62	Adeno carcinoma	LUL	T1bN0M0	Vessel injury
M	62	Adeno carcinoma	LUL	T1bN0M0	Vessel injury
F	28	Typical carcinoid	RLL	T1bN0M0	Benign hilar adenopathy
M	62	Adeno carcinoma	LUL	T1aN0M0	Vessel injury
M	74	Squamous carcinoma	LLL	T2bN0M0	Vessel injury
M	79	Squamous carcinoma	LUL	T1aN0M0	Benign hilar adenopathy
M	68	Adeno carcinoma	RUL	T2aN0M0	Vascular anomaly
M	70	Squamous carcinoma	LLL	T1aN0M0	Calcified hilar adenopathy
M	58	Adeno carcinoma	LLL	T1aN0M0	Vascular adventitial fibrosis
M	69	Adeno carcinoma	RUL	T1aN0M0	Vessel injury
M	73	Adeno carcinoma	LUL	T1bN1M0	Vessel injury
F	61	Adeno carcinoma	ML	T1bN0M0	Calcified hilar adenopathy
M	73	Squamous carcinoma	LLL	T2aN0M0	Benign hilar adenopathy
M	65	Adeno carcinoma	RUL	T1aN0M0	Calcified hilar adenopathy

RLL, right lower lobe; LLL, left lower lobe; LUL, left upper lobe; RUL, right upper lobe; ML, middle lobe.

Figure 1 Vessel injury during VATS right lower lobectomy (10). The video shows a single segmental artery that supplies the superior segment of the right lower lobe, exposed, after fissure dissection, and encircled with a vessel loop. When the artery is stapled, a sudden rush of blood appears unexpectedly: the force of retraction during firing of stapler in this case probably isn't well adjusted and an excessive traction on the vessel causes hemorrhage. A tampon is quickly positioned through the utility incision to control the bleeding but because the hemorrhagia comes from the back wall of the artery and it isn't easy to manage, surgical team proceeds with conversion to lateral thoracotomy.
Available online: http://www.asvide.com/article/view/23401

Figure 2 Bleeding complications during VATS right upper lobectomy (11). The video shows anomalous pulmonary vein, draining into the superior vena cava, that is encircled by a dissector and then sealed and cut with a tissue-sealing device. An unexpected bleeding occurs due to a heat injury to the descending interlobar artery. Because the gauze packing is unable to stop the bleeding, the procedure is converted to open surgery.
Available online: http://www.asvide.com/article/view/23402

our training for major lung resections by VATS, the most frequent cause of conversion to open surgery was absent or incomplete fissure. After an initial learning-curve period, calcified, benign or malignant hilar adenopathy was the leading cause of conversion to thoracotomy due to complicated vascular dissection or vessel injury. This means that, with increased experience, surgeons tend to extend the application of VATS to more advanced disease or more challenging cases. Some authors assert that, regardless of the skills acquired, there is a patient population in which VATS lobectomy is difficult to perform (6); this explains why published intraoperative conversion rates to open thoracotomy range however from 2% to 20% (4,13). In our retrospective review the conversion rate was 18% during the LC but, with increased unit experience, it decreased to 5.9%. In according to other authors, we believe that the reasons for conversion during VATS lobectomy can decline with experience and number of cases for year but don't disappear altogether (1,6,8). In this study upper lobectomies were the most frequently associated with conversion due to vessel injury (10/13, 77%): our findings would seem to show that vascular lesions can occur more frequently during the upper lobectomies. Among the causes of vessel injury we report a case of stapling failure, during a right lower lobectomy, occurring after the LC: this adverse event suggests that, as the number of VATS lobectomies increases, it is likely that similar intraoperative complications will occur in the future. In our retrospective review, two patients required expeditious conversion to open thoracotomy due to heat injury to adjacent vascular structure using vessel-sealing device: our findings suggest that these instruments require extreme caution during dissection of the hilar structures and the surgical equipment should know the spatial temperature distribution caused by different devices with regard to application time and power setting.

Conclusions

With increased confidence in performing VATS lobectomies, the conversion rate to thoracotomy tend to decrease but, extending minimally invasive surgery to more advanced disease or more complex cases, the risk of intraoperative complications persists. This review proves, moreover, that the reasons for conversion to open surgery change with increased experience and that hilar adenopathy can make thoracoscopic dissection of the hilum technically challenging, increasing the risk of vessel

injury. We wish to highlight that thoracoscopic surgeons should always identify the preoperative risk factors to reduce unexpected conversion to thoracotomy and we strongly recommend to follow always rigorous training programs for management strategies in case of severe intraoperative complications.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.
Informed Consent: Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

References

1. Puri V, Patel A, Majumder K, et al. Intraoperative conversion from video-assisted thoracoscopic surgery lobectomy to open thoracotomy: a study of causes and implications. J Thorac Cardiovasc Surg 2015;149:55-61, 62.e1.
2. Nwogu CE, D'Cunha J, Pang H, et al. VATS lobectomy has better perioperative outcomes than open lobectomy: CALGB 31001, an ancillary analysis of CALGB 140202 (Alliance). Ann Thorac Surg 2015;99:399-405.
3. Ceppa DP, Kosinski AS, Berry MF, et al. Thoracoscopic lobectomy has increasing benefit in patients with poor pulmonary function: a Society of Thoracic Surgeons Database analysis. Ann Surg 2012;256:487-93.
4. McKenna RJ Jr, Houck W, Fuller CB. Video-assisted thoracic surgery lobectomy: experience with 1,100 cases. Ann Thorac Surg 2006;81:421-5; discussion 425-6.
5. Nomori H, Horio H, Naruke T, et al. What is the advantage of a thoracoscopic lobectomy over a limited thoracotomy procedure for lung cancer surgery? Ann Thorac Surg 2001;72:879-84.
6. Sawada S, Komori E, Yamashita M. Evaluation of video-assisted thoracoscopic surgery lobectomy requiring emergency conversion to thoracotomy. Eur J Cardiothorac Surg 2009;36:487-90.
7. Park JS, Kim HK, Choi YS, et al. Unplanned conversion to thoracotomy during video-assisted thoracic surgery lobectomy does not compromise the surgical outcome. World J Surg 2011;35:590-5.
8. Petersen RH, Hansen HJ. Learning curve associated with VATS lobectomy. Ann Cardiothorac Surg 2012;1:47-50.
9. McKenna RJ Jr. Complications and learning curves for video-assisted thoracic surgery lobectomy. Thorac Surg Clin 2008;18:275-80.
10. Amore D, Di Natale D, Scaramuzzi R, et al. Vessel injury during VATS right lower lobectomy. Asvide 2018;5:127. Available online: http://www.asvide.com/article/view/23401
11. Amore D, Di Natale D, Scaramuzzi R, et al. Bleeding complication during VATS right upper lobectomy. Asvide 2018;5:128. Available online: http://www.asvide.com/article/view/23402
12. Watanabe A, Osawa H, Watanabe T, et al. Complications of major lung resections by video-assisted thoracoscopic surgery. Kyobu Geka 2003;56:943-8.
13. Gazala S, Hunt I, Valji A, et al. A method of assessing reasons for conversion during video-assisted thoracoscopic lobectomy. Interact Cardiovasc Thorac Surg 2011;12:962-4.

doi: 10.21037/jovs.2018.03.02
Cite this article as: Amore D, Di Natale D, Scaramuzzi R, Curcio C. Reasons for conversion during VATS lobectomy: what happens with increased experience. J Vis Surg 2018;4:53.

