Video-assisted thoracic surgery complications

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Abstract

Video-assisted thoracic surgery (VATS) is a miniinvasive technique commonly applied worldwide. Indications for VATS are very broad and include the diagnosis of mediastinal, lung and pleural diseases, as well as large resection procedures such as pneumonectomy. The most frequent complication is prolonged postoperative air leak. The other significant complications are bleeding, infections, postoperative pain and recurrence at the port site. Different complications of VATS procedures can occur with variable frequency in various diseases. Despite the large number of their types, such complications are rare and can be avoided through the proper selection of patients and an appropriate surgical technique.

Key words: *complications, treatment, videothoracoscopy.*

Introduction

The term "thoracoscopy" means endoscopy of the interior of the chest. Jacobeus is considered its father; in 1910, he used a modified cytoscope to cut adhesions in the pleural cavity in order to collapse the lung affected by tuberculosis. In subsequent decades, the technique of treatment performance was improved thanks to two important breakthroughs. The first one was the introduction of separate lung ventilation (the 1960s), which allowed procedures to be conducted with a non-ventilated lung. The second one was the introduction of video camera techniques to the surgical optics, allowing the image to be transferred to a TV screen and enlarged. It was then that the abbreviation video-assisted thoracic surgery (VATS) started to be used in thoracic surgery [1, 2].

Indications for video-assisted thoracic surgery

Over the decades, indications for thoracoscopy, and then VATS, were expanded. Two periods are noteworthy: the period between 1992 and 2002, when indications for VATS mainly included diagnostic procedures and small thoracic surgical procedures; and the period from 2002 to the present, when the VATS technique has been used to perform large thoracic surgical procedures such as the resection of the oesophagus or the whole lung (Table I).

Complications, general characteristics

According to the Clavien-Dindo classification, complications can be divided into 5 categories (Table II). The first two categories include minor complications, not requiring treatment and prolonged hospital stay, or complications requiring treatment with drugs, parenteral nutrition or transfusion. In the third category, patients require hospital stay, diagnostic endoscopic procedures or reoperation. The fourth category includes serious life-threatening complications and the fifth is the death of the patient [3]. Complications after VATS can occur intra-operatively and are usually connected with the primary disease,

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Table I. Indications for VATS

1992–2002	2003–2013
Main diagnostic investigations: • Pleuroscopy • Mediastinoscopy • Lung biopsy • Pleural biopsy • Mediastinal biopsy Small thorac. procedures: • Sympathectomy • Pneumothorax surgery • Splanchnicectomy • Nuss surgery	Large thorac. procedures: • Lobectomy • Pneumonectomy • Sleeve resection • Oesophagectomy • Thymectomy

while complications in the post-operative period are most often associated with the method itself [4].

In 1993, the first papers on complications after VATS were published. In one of them, Kaiser and Bavaria presented their first experiences of using a videothoracoscope in a group of 266 patients. He noted complications in 10% of the patients [5]. Three subsequent large publications appeared in 1996. In the reports of the authors, the percentage of complications was in the range of 3.7–4.3% [6–8]. The first multicentre study on complications after VATS was published in 1998 (55 surgeons from 40 centres). In his analysis, Downey reported a 10% complication rate. No intra-operative complications were observed. The general post-operative mortality was 2% [9]. In 2008 Imperatori *et al.* published data on their own experience of VATS and observed complications, among which prolonged air leak was the most common (4.7%) [10]. The most important complications of the VATS technique include prolonged air leak, bleeding, post-operative wound infections, post-operative pain, and recurrence at the port site. Table III presents the most common complications observed by various authors.

Table II. Classification of surgical complications by Clavien-Dindo

Grade I	Non-life-threatening, not requiring use of drugs, treated only with bedside intervention and does not lengthen hospital stay longer than twice the median
Grade II	Potentially life-threatening, requiring only drug therapy, total parenteral nutrition or transfusion
Grade III	Life-threatening, requiring therapeutic imaging or endoscopic procedure or reoperation
Grade IV	Complication with residual or lasting disability or objective signs of life-threatening diseases
Grade V	Death

Table III. Complications after VATS according to various authors

Authors [ref.]	Year/number of patients	Prolonged air leak [%]	Bleeding [%]	Wound infection [%]	Mortality [%]
Kaiser and Bavaria [5]	1993/266	3.8	1.9	1.9	ND
Jancovici *et al.* [6]	1996/937	6.7	1.9	ND	0.5
Yim and Liu [7]	1996/1337	1.6	0.4	0.9	0.07
Krasna *et al.* [8]	1996/348	0.9	0.9	ND	Null
Dawney [9]	1998/1358	3.2	1.2	0.4	2.0
Hazelringg *et al.* [11]	1998/1820	3.2	1.6	1.6	Null
Imperatori *et al.* [10]	2008/721	4.7	1.5	0.9	Null

ND – not determined

Prolonged air leak

Prolonged air leak is the most common complication after VATS [2]. Emphysema, experienced pneumothorax, age over 70 years, male sex and forced expiratory volume in 1 s (FEV_1) < 70% should be considered the most important risk factors [12]. This complication is most often observed with the coagulation of the bullae in the treatment of pneumothorax, stapler failure and the sidle of an endoloop [13, 14]. Air leak is also observed from the line of a mechanical stitch or in its direct surroundings. The use of staplers with pads while removing the bullae reduces the risk of post-operative air leak from the line of stitches [12].

The treatment is based on the use of chemical pleurodesis (doxycycline, talc) and suction with permanent negative pressure [15, 16].

Bleeding

Bleeding after VATS occurs with the incidence of 0.5–1.9%. This complication is most often the result of sub-bleeding from adhesions which were not sufficiently coagulated or from the site of a previously placed trocar [10, 17]. After the treatment of spontaneous pneumothorax with the VATS technique, bleeding may also occur from the wall of the chest after performed pleurectomy. Precise coagulation and preparation usually allow one to limit the severity of the bleeding [13, 14]. During the VATS treatment, bleeding can be stopped using coagulation, clips or staplers [10]. Massive bleeding from the vessels of the lung or subclavian artery occurs occasionally; it requires the application of timely pressure and urgent conversion to thoracotomy [18].

Infections

Infections after VATS procedures appear with the incidence of approx. 6.3%, and the most frequently mentioned ones include pneumonia (3%), empyema (1.4%) and infection of the surgical wound (1.7%). The study by Rover *et al.* showed an increased risk of infections after VATS procedures in patients with chronic obstructive pulmonary disease (COPD) and FEV_1 < 70% [10]. In another study from 2011, Nan *et al.* reported a similar percentage of complications (6%). Risk factors included the presence of a tumour, immunosuppression, the presence of infection before VATS treatment, prolonged hospital stay before the surgery and the presence of a central catheter [19]. The prophylactic use of antibiotics is controversial. Studies have only shown a reduction in the risk of infections near wounds with no influence on the incidence of pneumonia and pleural empyema while using antibiotic prophylaxis in VATS procedures [20].

Post-operative pain

Post-operative pain is mentioned by Solaini *et al.* as the most important complication after VATS procedures [17]. The study performed by Landreneau *et al.* showed a statistically significant increase in pain sensation ($p = 0.001$) and statistically increased ($p = 0.05$) demand for painkillers in patients after thoracotomy in comparison to the VATS procedures [21]. In another publication, the same author examined the patients 1 year after thoracotomy and the VATS treatment. The study did not show any significant statistical differences between both types of procedures in the intensity of shoulder pain and demand for narcotic painkillers [22]. Post-operative ailments can be limited using the one port or micro-ports technique [23, 24].

Recurrence at the port site

Recurrence at the port site is a complication strictly connected with the surgical technique. Its incidence is estimated at 0.26–0.5%. In the resection of the lung tissue with the VATS technique on 410 patients, Parekh *et al.* noted only one case of port site recurrence [25]. The risk of that complication may increase in the treatment of mesothelioma, metastases of sarcoma or melanoma and malignant pleural effusion in VATS. Special aggressiveness is exhibited by mesothelioma and malignant pleural effusions, where the presence of cancer cells was established at the needle and pleural drain sites [6, 10]. Recurrences do not only concern malignant tumours. In the literature, there are reports on the recurrence of benign tumours such as schwannoma [26]. The use of bags and coagulation of the port wound are procedures which reduce the risk of the complication [6, 10, 25].

Complications characteristic of specific VATS procedures

Lung biopsy and wedge resection

The most serious complication of lung biopsy or wedge resection with the VATS technique is bleeding.

The main site of bleeding is the intercostal vessels and lung parenchyma. If the bleeding cannot be stopped using coagulation, stapler or clips, the treatment of choice is conversion to thoracotomy [10]. According to various authors, it may take place in 8–12% of cases [6, 8]. The most common complication after biopsy/wedge resection of the lung with the VATS technique is air leak. According to various authors, air leak lasting more than 7 days occurs in less than 5% of cases [5–7, 9]. Infectious complications, such as empyema, lung inflammation and post-surgical wound infections, occur with an incidence similar to that for other procedures with the VATS technique [10].

Particularly noteworthy is the evaluation of the location of tumours in the lung during VATS procedures. Difficulties with finding a tumour may result in its omission or incomplete resection [10, 27]. If the inspection of the pleural cavity using a thoracoscope does not allow one to localize a tumour, mid-surgical ultrasound, injection with methylene or lipiodol, or palpation can be used. Ninety-four percent efficacy of palpation in the localization of tumours within the lung was shown [10].

Anatomical resections of the lung

Major procedures performed with the VATS technique include segmentectomy, lobectomy, pneumonectomy and cuffed resection [27–29]. The main aims of using VATS in these procedures are the reduction of surgical trauma, shorter hospital stay and fast recovery of the patient. Complications are recorded in 8–15% of cases, while conversion is necessary in 0–23%. The main reasons for conversion are bleeding, massive adhesions, advanced stage of the tumour and mid-surgical cardio-pulmonary complications [10, 30]. The most dangerous life-threatening complication is bleeding from vessels during surgery (8.2% of cases), which is the reason for 30% of decisions to convert to thoracotomy [30, 31]. The bleeding can result from carelessness in preparation or the failure of a vascular stapler. Prevention includes good qualifications and experience of operating with the VATS technique [27, 32]. Mortality after anatomical resections of the lung with the VATS technique does not exceed 2% [10, 27, 28].

Procedures in the mediastinum

The VATS in mediastinal pathologies most often concerns neurogenic tumours, lymph nodes and tumours of the anterior mediastinum. Diagnostic procedures usually take place when other diagnostic methods (e.g. thin needle biopsy) are negative. Complications after those procedures are rare. Noteworthy is lymphorrhoea, which occurs in 1% of cases after VATS procedures in the mediastinum. About 50% of cases of lymphorrhoea can be stopped by applying conservative treatment: drainage of the pleural cavity and use of a diet low in triglycerides [10]. If such treatment is ineffective, the management of choice is the ligation of the thoracic duct through the right pleura. The treatment is feasible using the VATS technique [33].

Pleural biopsies

The VATS complications during procedures of the pleura are rare. Observed complications occur with an incidence similar to that for other VATS procedures. In the literature, attention is paid to the risk of recurrence at the port site in the case of pleural mesothelioma and malignant pleural effusion [10].

Treatment of spontaneous pneumothorax and emphysema

In the VATS treatment of spontaneous pneumothorax, we remove the emphysematously changed fragment of the lung tissue and perform pleurectomy. The most commonly observed complication is prolonged air leak, which may take place in as many as 20% of patients [10]. Pleurectomy performed during VATS may be the cause of bleeding, whose frequency may reach as high as 3.6%, while in other VATS procedures the frequency is 1.9% [6, 10, 18]. Pleurectomy can also result in chronic pain, whose frequency may reach as high as 21% [18, 34]. Among complications connected with pleurectomy, the Horner syndrome is also described [35]. Recurrence after the treatment of spontaneous pneumothorax using the VATS technique of pleurectomy is estimated at 5% [10, 18].

Sympathectomy and splanchnicectomy

The percentage of complications after sympathectomy and splanchnicectomy is 15–16%. In the case of sympathectomy, the most commonly observed complication is hyperhidrosis and a feeling of hot hands which result from the procedure itself (approx. 10%). The frequency of neurological disorders involving the upper limbs and Horner's syndrome

are estimated as 2.1% and 0.9% respectively. Bleeding is observed in 0.5% of patients and conversion is necessary in approx. 1.5–2% of cases [36–39].

Oesophagus operative procedures

Complications of VATS oesophagus procedures are estimated as high as 43% of treated patients. Mortality is appraised as 2% of patients. The most frequent are pulmonary complications (12–23%). Pneumonia and atelectasis are the most important of them. A less frequent but significant complication is paralysis of the recurrent laryngeal nerve, which is observed in 3–9% of patients [40–42]. Another complication – leak in the anastomosis (6–9%) – is associated with the technique of making the anastomosis and does not fall within the subject scope of this article [41].

Summary

Complications of VATS procedures are rare and the frequency is estimated as 3–4% of treated patients. The most frequent complication is prolonged postoperative air leak. The other significant complications are bleeding, infections, postoperative pain and recurrence at the port site. Different complications of VATS procedures can occur with variable frequency in various diseases. We maintain that many complications can be avoided by ensuring better selection of patients and proper operative technique.

References

1. Deslauriers J, Sirois C. Thoracoscopy for diagnosis and staging. Pearson's thoracic & esophageal surgery. Churchill Livingstone, Philadelfia 2002; 103-15.
2. Brodsky JB, Cohen E. Video-assisted thoracic surgery. Curr Opin Anaesthesiol 2000; 13: 41-5.
3. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004; 240: 205-13.
4. LoCicero J. 3rd credentialing issues and complications of video-assisted thoracic surgery. Semin Thorac Cardiovasc Surg 1993; 5: 303-4.
5. Kaiser LR, Bavaria JE. Complication of thoracoscopy. Ann Thorac Surg 1993; 56: 796-8.
6. Jancovici R, Lang-Lazdunski L, Pons F, et al. Complication of video-assisted thoracic surgery. Ann Thorac Surg 1996; 61: 553-7.
7. Yim APC, Liu HP. Complications and failures of video-assisted thoracic surgery: experience from two centers in Asia. Ann Thorac Surg 1996; 61: 538-41.
8. Krasna MJ, Deshmukh S, McLaughlin JS. Complication of thoracoscopy. Ann Thorac Surg 1996; 61: 1066-9.
9. Dawney RJ. Complications after video-assisted thoracic surgery. Chest Surg Clin N Am 1998; 8: 907-15.
10. Imperatori A, Rotolo N, Gatti M, et al. Peri-operative complications of video-assisted thoracoscopic surgery. Int J Surg 2008; 6 suppl 1: S78-81.
11. Hazelringg SR, Magee MJ, Cettindag IB. Video-assisted thoracic surgery of diagnosis of the solitary lung nodule. Chest Surg Clin N Am 1998; 8: 763-74.
12. Brunelli A, Monteverde M, Borri A, et al. Predictors of prolonged air leak after pulmonary lobectomy. Ann Thorac Surg 2004; 77: 1205-10.
13. Liu HP, Yim APC, Izzat MB, et al. Thoracoscopic surgery for spontaneous pneumothorax. World J Surg 1999; 23: 1133-6.
14. Yim APC, Liu HP. Complications and failures of video-assisted thoracic surgery: experience from two centres in Asia. Ann Thorac Surg 1996; 61: 538-41.
15. Chen JS, Hsu HH, Chen RJ, et al. Additional minocycline pleurodesis after thoracoscopic surgery for primary spontaneous pneumothorax. Am J Respir Crit Care Med 2006; 173: 548-54.
16. Rathinam S, Bradley A, Cantlin T, Rajesh PB. Thopaz sortable suction systems in thoracic surgery: an end user assessment and feedback in a tertiary unit. J Cardiothorac Surg 2011; 6: 5-9.
17. Solaini L, Prusciano F, Bagioni P, et al. Video-assisted thoracic surgery (VATS) of the lung: analysis of intraoperative and postoperative complications over 15 years and review of the literature. Surg Endosc 2008; 22: 298-310.
18. Gómez-Caro A, Moradiellos FJ, Larrú E, et al. Effectiveness and complications of video-assisted surgery for primary spontaneous pneumothorax. Arch Bronconeumol 2006; 42: 57-61.
19. Nan DN, Fernández-Ayala M, Fariñas-Álvarez C, et al. Nosocomial infection following video-assisted thoracoscopic surgery. Rev Esp Quimioter 2011; 24: 217-22.
20. Bernard A, Pillet M, Goudet P, Viard H. Antibiotic prophylaxis in pulmonary surgery. J Thorac Cardiovasc Surg 1994; 107: 896-900.
21. Landreneau RJ, Hazelrigg SR, Mack MJ, et al. Postoperative pain-related morbidity: video-assisted thoracic surgery versus thoracotomy. Ann Thorac Surg 1993; 56: 1285-9.
22. Landreneau RJ, Mack MJ, Hazelrigg SR, et al. Prevalence of chronic pain after pulmonary resection by thoracotomy or video-assisted thoracic surgery. J Thorac Cardiovasc Surg 1994; 107: 1079-85.
23. Tamura M, Shimizu Y, Hashizume Y. Pain following thoracoscopic surgery: retrospective analysis between single-incision and three-port video-assisted thoracoscopic surgery. J Cardiothorac Surg 2013; 8: 153-7.
24. Chou SH, Li HP, Lee JY, et al. Needlescopic video-assisted thoracic surgery for primary spontaneous pneumothorax. Minim Invasive Ther Allied Technol 2009; 18: 221-4.
25. Parekh K, Rusch V, Bains M, et al. VATS port site recurrence: a technique dependent problem. Ann Surg Oncol 2001; 8: 175-8.
26. Anraku M, Nakahara R, Matsuguma H, Yokoi K. Port site recurrence after video-assisted thoracoscopic resection of chest wall schwannoma. Interact Cardiovasc Thorac Surg 2003; 2: 483-5.
27. Piwkowski C, Gabryel P, Kasprzyk M, Dyszkiewicz W. Video-assisted thoracic surgery pneumonectomy: the first case report in Poland. Videosurgery Miniinv 2012; 7: 197-201.

28. Agasthian T. Initial experience with video-assisted thoracoscopic bronchoplasty. Eur J Cardiothorac Surg 2013; 44: 616-23.
29. Traibi A, Grigoroiu M, Boulitrop C, et al. Predictive factors for complications of anatomical pulmonary segmentectomies. Interact Cardiovasc Thorac Surg 2013; 17: 838-44.
30. 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.
31. Kawachi R, Tsukada H, Nakazato Y, et al. Morbidity in video-assisted thoracoscopic lobectomy for clinical stage I non-small cell lung cancer: is VATS lobectomy really safe? Thorac Cardiovasc Surg 2009; 57: 156-9.
32. Craig SR, Walker WS. Potential complications of vascular stapling in thoracoscopic pulmonary resection. Ann Thorac Surg 1995; 59: 736-7.
33. Watanabe A, Koyanagi T, Nakashima S, Higami T. Supradiaphragmatic thoracic duct clipping for chylothorax through left-sided video-assisted thoracoscopic surgery. Eur J Cardiothorac Surg 2007; 31: 313-4.
34. Passlick B, Born C, Sienel W, Thetter O. Incidence of chronic pain after minimal-invasive surgery for spontaneous pneumothorax. Eur J Cardiothorac Surg 2001; 19: 355-8.
35. Cardillo G, Carleo F, Giunti R, et al. Videothoracoscopic talc poudrage in primary spontaneous pneumothorax: a single-institution experience in 861 cases. J Thorac Cardiovasc Surg 2006; 131: 322-8.
36. Oncel M, Sadi Sunam G, Erdem E, et al. Bilateral thoracoscopic sympathectomy for primary hyperhydrosis: a review of 335 cases. Cardiovasc J Afr 2013; 24: 137-40.
37. Baghdadi S, Abbas MH, Albouz F, Ammori BJ. Systematic review of the role of thoracoscopic splanchnicectomy in palliating the pain of patients with chronic pancreatitis. Surg Endosc 2008; 22: 580-8.
38. Stefaniak T, Pirski MI, Osęka T, et al. Original article Simultaneous bilateral transthoracic sympathectomy through posterior access in Lin-Telaranta modification for primary hyperhidrosis. Videosurgery Miniinv 2009; 4: 47-52.
39. de Andrade Filho LO, Kuzniec S, Wolosker N, et al. Technical difficulties and complications of sympathectomy in the treatment of hyperhidrosis: an analysis of 1731 cases. Ann Vasc Surg 2013; 27: 447-53.
40. Neoral Ć, Aujeský R, Škarada J, et al. Thoracoscopic treatment of benign esophageal tumors. Videosurgery Miniinv 2012; 7: 294-8.
41. Decker G, Cossemans W, De Leyn P, et al. Minimally invasive esophagectomy for cancer. Eur J Cardiothorac Surg 2009; 35: 13-21.
42. Kawakubo H, Takeuchi H, Kitagawa Y. Current status and future perspectives on minimally invasive esophagectomy. Korean J Thorac Cardiovasc Surg 2013; 46: 241-8.

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