Editorial

Technical aspects of video-assisted and robotic-assisted thoracoscopic segmentectomy

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Introduction

Li and co-authors very nicely presented their technique of robot-assisted thoracic surgery (RATS) S6-segmentectomy illustrated by high quality figures (1). They presumably base their approach on the excellent book of Nomori and Okada (2), one of the most important references for open segmentectomy of the lung.

It is not the main goal of this editorial to simply expand on the advantages and drawbacks of the robotic approach, but rather to discuss the technical aspects of minimally invasive segmentectomy in general. In the presented case, the surgical procedure was performed with the assistance of the da Vinci Surgical System (Intuitive Surgical Inc., Sunnyvale, CA, USA). The integrated 3D vision, the ergonomics for the operating surgeon and the 7 degrees of freedom of the EndoWrist instrument (3) make the robotic approach a good tool to pass from an open to a minimally invasive technique. If safety concerns about bleedings have been reported for RATS anatomical resections compared to video-assisted thoracic surgery (VATS) with more need for conversion to thoracotomy (4), the use of appropriate measures can prevent such bleedings, or at least manage them once occurred (5). While superior costs of RATS compared to VATS are well established (6), this was not a disadvantage for gaining the most relative market share increase (+200%) for anatomical resections of lung cancer between 2010 and 2012 in the United States (7). Comparisons of the different approaches showed no perioperative or oncological benefit of RATS compared to VATS (8). Finally, in recent years the uniportal approach has become increasingly popular and is without question challenging the multiportal VATS approach, and with that it could also become the new challenger of robotic surgery (9).

Background

While VATS lobectomy, including sublobar anatomical resections, have a history of 25 years of development, RATS lobectomy started more than10 years later (10). Distinct VATS approaches have been used, leading to the apparitions of different surgical schools. Some advocate VATS lobectomy through a posterior approach (11) with the first step being the dissection of the artery in the fissure. Others recommend the anterior approach with a pragmatic sequence of section of hilar structures from anterior to posterior as they are encountered during the dissection (12). Most of these techniques use either four or three ports including a utility port, not last for security issues. This utility port has also been questioned with "closed chest" VATS anatomical resections (13) or, on the other hand, expanded at the costs of the standard ports resulting in the so called "uniportal approach" (14). Finally, the question of air leakage has been addressed specifically for the "fissureless" patient. The development of the "fissure last" technique (15), or the thoracoscopic tunnel technique allowing a "fissure first, hilum last" approach (16) are both strategies to overcome this frequent postoperative problem.

Technical considerations for robotic segmentectomy

What can we learn from the VATS experience and implement into RATS segmentectomy techniques?

In order to answer this question, we focused on three particular points, which are of crucial importance when defining a specific surgical technique.

Vein or artery first?

There are mainly three concerns about the sequence of vessel ligation during segmentectomy: the feasibility of the resection, bleeding and oncological considerations. Regarding the access to the segmental hilum, the primary dissection of the artery in the fissure can help identifying the basic anatomy (17). For VATS lobectomies, Li *et al.* showed that there was significantly less bleeding when the artery was ligated first (105 *vs.* 148 mL) (18). However, this difference did not have any clinical impact on short term patient outcomes. Somewhat more important seems to be the finding of Kurusu and colleagues, that more circulating tumor cells were seen in patients in whom the artery was ligated before the vein during lobectomy (19). So far, no clinical impact of the sequence of vessel ligation on tumor recurrence (20) or long-term survival was demonstrated (18). Since any additional manipulation of the lung during surgery could possibly result in an increase in tumor recurrence, a pragmatic sequence of vessel ligation should be chosen (20).

Sparing of the V6b+c subsegmental veins and intersegmental plane issues

The classic open segmentectomy method illustrated by Nomori and Okada (2) uses the intersegmental veins as an orientation for the plane of dissection while tearing apart the parenchyma along this anatomical structure. This manoeuver inevitably results in a wounded surface necessitating sealing of small bleeders and air leaks with sutures and/or biologic sealant products. Furthermore, this proceeding is difficult to apply in a minimally invasive setting and therefore most surgeons use stapling devices for this step. The volume loss in the remaining segments due to the shrinkage induced by the technique of stapling however does not result in a decreased postoperative pulmonary function (21) and has only minimal clinical and radiological consequences (22). One could hypothesize that preserving the intersegmental veins could improve the venous drainage of the adjacent lung segments, but this problem is probably more/only of clinical relevance when performing for example a lingula-sparing lobectomy rather than a simple segmentectomy of the lower lobe. On the other hand, section of the intersegmental veins can give the surgeon a better access for the subsequent positioning of the stapling device near the segmental hilum. Since in RATS segmentectomies the section of the parenchyma is usually performed by the surgeon at the operating table with usual endoscopic staplers, one will be able to translate every evolution in the VATS technique for managing the intersegmental plane to robotic procedures as well.

Lymphatic drainage

The lymphatic drainage is well known to follow the bronchial tree (23). There is a suspected tendency to perform a less thorough lymphadenectomy during segmentectomy than during lobectomy. This could be one of the reasons for the currently observable trend towards a higher incidence of local recurrence after segmentectomy compared to lobectomy. Wolf *et al.* (24) for example showed that when more lymph nodes are sampled, the local recurrence rate seems to be similar to that encountered after lobectomy. For this reason, some groups even advocate a routine of frozen section of intersegmental lymph nodes during segmentectomy with the consequence of an extended resection, mainly lobectomy.

Closing remarks

As long as the costs won't stop the broadened use of robotics as an alternative to VATS sublobar resections (6), its usage will continue to develop. It will be interesting with the growing experience gained over the years, if the advantages of RATS will be as worthy for relatively trivial segmentectomies like S6, as for more complex partial basilar segmentectomies. The integrated features of the da Vinci surgical system already allows a better visualization of the intersegmental plane with the use of indocyanine green (25). We can imagine that augmented reality—when ripe for clinical usage—will be first implemented in RATS systems, opening new possibilities for complex segmentectomies.

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None.

Footnote

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

References

1. Li Ch, Yang S, Guo W, et al. Ruijin robotic thoracic surgery: right S6 segmentectomy. AME Med J 2017;2:23.
2. Nomori H, Okada M. Illustrated Anatomical Segmentectomy for Lung Cancer. Tokyo: Springer, 2011.
3. Park BJ, Flores RM, Rusch VW. Robotic assistance for video-assisted thoracic surgical lobectomy: technique and initial results. J Thorac Cardiovasc Surg 2006;131:54-9.
4. Augustin F, Bodner J, Maier H, et al. Robotic-assisted minimally invasive vs. thoracoscopic lung lobectomy: comparison of perioperative results in a Learning curve setting. Langenbecks Arch Surg 2013;398:895-901.
5. Kocher GJ, Schmid RA, Melfi FMA. Robotic lobectomy: tips, pitfalls and troubleshooting. Eur J Cardiothorac Surg 2014;46:e136-8.
6. Bao F, Zhang Ch, Yang Y, et al. Comparison of robotic and video-assisted thoracic surgery for lung cancer: a propensity-matched analysis. J Thorac Dis 2016;8:1798-803.
7. Rajaram R, Mohanty S, Bentrem DJ, et al. Nationwide Assessment of Robotic Lobectomy for Non-Small Cell Lung Cancer. Ann Thorac Surg 2017;103:1092-100.
8. Cao C, Manganas C, Ang SC, et al. A systematic review and meta-analysis on pulmonary resections by robotic video-assisted thoracic surgery. Ann Cardiothorac Surg 2012;1:3-10.
9. Harris CG, James RS, Tian DH, et al. Systematic review and meta-analysis of uniportal versus multiportal video-assisted thoracoscopic lobectomy for lung cancer. Ann Cardiothorac Surg 2016;5:76-84.
10. Melfi FM, Fanucchi O, Davini F, et al. Robotic lobectomy for lung cancer: evolution in technique and technology. Eur J Cardiothorac Surg 2014;46:626-30; discussion 630-1.
11. Richards JM, Dunning J, Oparka J, et al. Video-assisted thoracoscopic lobectomy: the Edinburgh posterior approach. Ann Cardiothorac Surg 2012;1:61-9.
12. Hansen HJ, Petersen RH. Video-assisted thoracoscopic lobectomy using a standardized three-port anterior approach – The Copenhagen experience. Ann Cardiothorac Surg 2012;1:70-6.
13. Gossot D. Technical tricks to facilitate totally endoscopic major pulmonary resections. Ann Thorac Surg 2008;86:323-6.
14. Gonzalez-Rivas D. VATS Lobectomy: Surgical Evolution from Conventional VATS to Uniportal Approach. ScientificWorldJournal 2012;2012:780842.
15. Mitchell JD. Techniques of VATS lobectomy. J Thorac Dis 2013;5:S177-81.
16. Decaluwe H, Sokolow Y, Deryck F, et al. Thoracoscopic tunnel technique for anatomical lung resections: a "fissure first, hilum last" approach with staplers in the fissureless patient. Interact Cardiovasc Thorac Surg 2015;21:2-7.
17. Yan TD. Surgical atlas of thoracoscopic lobectomy and segmentectomy. Ann Cardiothorac Surg 2014;3:183-91.
18. Li F, Jiang G, Chen Y, et al. Curative Effects of Different Sequences of Vessel Interruption During the Completely Thoracoscopic Lobectomy on Early Stage Non-Small Cell Lung Cancer. Ann Thorac Cardiovasc Surg 2015;21:536-43.
19. Kurusu Y, Yamashita J, Hasashi N, et al. The sequence of vessel ligation affects tumor release into the circulation. J Thorac Cardiovasc Surg 1998;116:107-13.
20. Refaely Y, Sadetzki S, Chetrit A, et al. The sequence of vessel interruption during lobectomy for non-small cell lung cancer: Is it indeed important? J Thorac Cardiovasc Surg 2003;125:1313-20.
21. Tao H, Tanaka T, Hayashi T, et al. Influence of stapling the intersegmental planes on lung volume and function after segmentectomy. Interact CardioVasc Thorac Surg 2016;23:548-52.
22. Ojanguren A, Gossot D, Seguin-Givelet A. Division of the intersegmental plane during thoracoscopic segmentectomy: is stapling an issue? J Thorac Dis 2016;8:2158-64.
23. Nohl-Oser HC. An investigation of the anatomy of the lymphatic drainage of the lungs. Ann R Coll Surg Engl 1972;51:157-76.
24. Wolf AS, Richards WG, Jaklitsch MT, et al. Lobectomy versus sublobar resection for small (2cm or less) non-small cell lung cancers. Ann Thorac Surg 2011;92:1819-23.
25. Pardolesi A, Veronesi G, Solli P, et al. Use of indocyanine green to facilitate intersegmental plane identification during robotic anatomic segmentectomy. J Thorac Cardiovasc Surg 2014;148:737-8.

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