Editorial

The importance of antiadhesion treatment for the successful video-assisted thoracic surgery

Akiko Uemura[1,2], **Ryou Tanaka**[1]

[1]Faculty of Veterinary Medicine, Department of Veterinary Surgery, Tokyo University of Agriculture and Technology, Tokyo, Japan; [2]Faculty of Life & Environmental Sciences, Department of Animal Sciences, Teikyo University of Science, Tokyo, Japan

Correspondence to: Ryou Tanaka. Faculty of Veterinary Medicine, Department of Veterinary Surgery, Tokyo University of Agriculture and Technology, Tokyo 183-8509, Japan. Email: ryo@vet.ne.jp.

Comment on: Lin F, Wei S, Liu C, *et al*. The technique of cutting open the bronchus during VATS left upper lobectomy with complicated hilar anatomy. J Thorac Dis 2018;10:6269-70.

Submitted Dec 28, 2018. Accepted for publication Jan 02, 2019.
doi: 10.21037/jtd.2019.01.03
View this article at: http://dx.doi.org/10.21037/jtd.2019.01.03

Video-assisted thoracic surgery (VATS) lobectomy has been the most common procedure for malignant and benign pulmonary diseases. However, in many cases with complicated hilar anatomies, the incidence of massive bleeding interferes with continuation of VATS and often forces a conversion to thoracotomy.

Various techniques have been introduced to troubleshoot this situation to reduce the incidence of massive bleeding. If adhesions are found during pulmonary lobectomy with VATS, proposed solutions include the new pulmonary vessel clamping method (1) and the novel ligation method for the pulmonary artery for avoiding complications, such as severe bleeding (2).

Professor Lunxu Liu's team from the Department of Thoracic Surgery, West China Hospital, Chengdu, China reported a technique that involves cutting open the bronchus during a VATS left upper lobectomy to manage unexpected, severe hilar adhesions. This technique was very effective in this patient; however, adhesions are always an obstacle during VATS, especially in cases involving re-operative pulmonary resections. Professor Lunxu Liu's team found that directly dissecting or indirectly treating the surrounding tissue was a useful strategy to address existing adhesions within the limited visual and operative fields. However, as an alternative for managing already-existing adhesions, we believe that the best approach is to prevent adhesions in the first place, thus expanding potential VATS indications.

Few reports exist that describe re-operative pulmonary resection. Dissection of adhesions prolongs the duration of surgery and can cause problems such as pulmonary vascular injuries and increased surgical invasiveness; therefore, successful adhesion management often leads to successful surgery.

Endoscopy has long been used as an examination method. Recently, it has become the central pillar of minimally-invasive surgery. Even for diseases where open surgery is conventionally recommended, there are published reports of successful video-assisted thoracoscopic surgery, and the indications for VATS have dramatically expanded. VATS is now a widely-chosen technique because of its association with less postoperative pain and fewer postoperative complications, particularly when compared to thoracotomy (3). Pulmonary lobectomy by VATS also produces better long-term prognosis than that associated with open surgery (4); further, VATS has become the preferred means of treating early-stage lung cancer (5).

Although the advantages of VATS are well-recognized, its disadvantages include limited access to the operative field, prolonged surgical duration, difficulties managing bleeding, a unidirectional line of site, and a limited visual field. Adhesions exacerbate these disadvantages, and appropriate control of adhesions is therefore a critical issue if we are to expand the applications of VATS.

Adhesions post a greater obstacle during VATS, compared to thoracotomy. As mentioned by Professor Lunxu Liu's team, adhesions can prevent tool passage, thereby worsening the operative and visual fields.

Procedural conversion from VATS to open surgery due to uncontrollable adhesions often increases the risk of surgical complications (6). In order to obtain the maximum effect, given the limited space of VATS, adhesions are the most significant problem to address if we are to expand the indications for minimally-invasive surgery.

Unlike serosal adhesions in the abdomen that are commonly accompanied by clinical symptoms like pain and ileus (7), pleural adhesions rarely cause notable problems like organ impairment. However, patients with pleural adhesions have an increased incidence of adverse surgical outcomes and higher pleural morbidity. Pleural adhesions can contribute to prolonged surgical duration, hemorrhage, a poor visual field, and pulmonary vascular injury (8). Products designed to prevent adhesions after abdominal surgery are readily available in clinic. However, there are no commercially-available products for the prevention of pleural adhesions.

Many studies have focused on preventing postoperative pleural adhesions. Initially, non-absorbable materials are used as agents to prevent pleural adhesion. These materials act as a physical barrier and stop the formation of adhesions caused by fibroblast proliferation in the pleural space. Most of these materials used in recent studies are biodegradable (9,10) and include polyethylene glycol (11), hyaluronate (12), TachoComb (13), and so forth.

A carboxymethyl cellulose-based membrane has been frequently used to prevent postoperative abdominal adhesions, and a trial on its application to pleural adhesions was reported (14). Noishiki *et al.* developed a glycerin-based adhesion-preventive agent using surface water induction technology, and obtained a higher adhesion-preventive effect following pleural surgery than that obtained with carboxymethyl cellulose used during thoracotomy in dogs (15). We used hyaluronic acid, which is safer than glycerin. We additional used the surface water induction technology, as described by Noishiki *et al.*, and found that hyaluronic acid had a high adhesion-prevention effect after thoracotomy in dogs (16). After pleural surgery using insoluble hyaluronic acid creates a physical barrier, preventing adhesions from forming during the postoperative period (17). Insoluble hyaluronic acid causes few short-term (16,18) and mid-term (19) intrapleural inflammatory responses. This is likely attributable to the excellent ability of insoluble hyaluronic acid to act as a physical barrier. Furthermore, insoluble hyaluronic acid is a high molecular weight and is unlikely to cause inflammatory reactions in vivo. Therefore, these results might have been obtained because hyaluronic acid does not cause unnecessary immune responses.

Other membranous and powdered formulations of pleural adhesion-prevention agents have been reported (20). Many studies have examined pleural adhesions following conventional thoracotomy; however, we examined the potential use of adhesion-preventive agents during VATS, based on agent operability (18). Additional studies that use VATS, and minimally invasive thoracic surgery [including a recent report of robot-assisted thoracoscopic surgery (RATS)] (21) are needed. This is because examination of various perspectives are important for determining the most effective adhesion-prevention agent formulation.

Currently, we cannot say that our emphasis on preventing pleural adhesions will become increasingly popular in general clinical practice. However, postoperative pleural adhesions can reduce the risk of air leaks after pulmonary lobectomy (22). Some clinicians believe that postoperative pleural adhesions are necessary. In addition, pleural adhesion-preventive agents are still at the animal testing stage and are not commercially available.

In spite of this, thoracotomy, with its broad operative and visual fields, is becoming a thing of the past. VATS is now routinely used during multiple surgeries, like for second primary lung cancer (23), surgical removal of pulmonary abscess (24), and multiple pulmonary lobectomies for metastatic tumors (25). VATS is an important treatment option for patients who seek a less-invasive surgery, including elderly patients (21), and we expect that the importance of preventing adhesions will be increasingly recognized within the field of pulmonary medicine.

Acknowledgements

None.

Footnote

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

References

1. Kamiyoshihara M, Nagashima T, Ibe T, et al. A tip for controlling the main pulmonary artery during video-assisted thoracic major pulmonary resection: the outside-field vascular clamping technique. Interact Cardiovasc Thorac Surg 2010;11:693-5.

2. Watanabe A, Koyanagi T, Nakashima S, et al. How to clamp the main pulmonary artery during video-assisted thoracoscopic surgery lobectomy. Eur J Cardiothorac Surg 2007;31:129-31.
3. Fang HY, Chen CY, Wang YC, et al. Consistently lower narcotics consumption after video-assisted thoracoscopic surgery for early stage non-small cell lung cancer when compared to open surgery: a one-year follow-up study. Eur J Cardiothorac Surg 2013;43:783-6.
4. Al-Ameri M, Bergman P, Franco-Cereceda A, et al. Video-assisted thoracoscopic versus open thoracotomy lobectomy: a Swedish nationwide cohort study. J Thorac Dis 2018;10:3499-506.
5. Berfield KKS, Farjah F, Mulligan MS. Video Assisted Thoracoscopic Lobectomy for Lung Cancer. Ann Thorac Surg 2018. [Epub ahead of print].
6. Li SJ, Zhou K, Wu YM, et al. Presence of pleural adhesions can predict conversion to thoracotomy and postoperative surgical complications in patients undergoing video-assisted thoracoscopic lung cancer lobectomy. J Thorac Dis 2018;10:416-31.
7. ten Broek RP, Issa Y, van Santbrink EJ, et al. Burden of adhesions in abdominal and pelvic surgery: systematic review and met-analysis. BMJ 2013;347:f5588.
8. Getman V, Devyatko E, Wolner E, et al. Fleece bound sealing prevents pleural adhesions. Interact Cardiovasc Thorac Surg 2006;5:243-6.
9. Hamaji M, Kojima F, Komatsu T, et al. A synthetic bioabsorbable sheet may prevent postoperative intrapleural adhesions following thoracotomy: a canine model. Interact Cardiovasc Thorac Surg 2014;19:914-20.
10. Akerberg D, Posaric-Bauden M, Isaksson K, et al. Prevention of pleural adhesions by bioactive polypeptides - a pilot study. Int J Med Sci 2013;10:1720-6.
11. Karacam V, Onen A, Sanli A, et al. Prevention of pleural adhesions using a membrane containing polyethylene glycol in rats. Int J Med Sci 2011;8:380-6.
12. Tanaka A, Abe T, Matsuura A. Prevention of postoperative intrapleural adhesion of the thoracotomy incision by a bioresorbable membrane in the rat adhesion model. Ann Thorac Cardiovasc Surg 2000;6:151-60.
13. Komatsu K, Fujii A, Higami T. Haemostatic fleece (TachoComb) to prevent intrapleural adhesions after thoracotomy: a rat model. Thorac Cardiovasc Surg 2007;55:385-90.
14. Lefort B, El Arid JM, Bouquiaux AL, et al. Is Seprafilm valuable in infant cardiac redo procedures? J Cardiothorac Surg 2015;10:47.
15. Noishiki Y, Shintani N. Anti-adhesive membrane for pleural cavity. Artif Organs 2010;34:224-9.
16. Uemura A, Nakata M, Goya S, et al. Effective new membrane for preventing postthoracotomy pleural adhesion by surface water induction technology. PLoS One 2017;12:e0179815.
17. Uemura A, Takiguchi M, Funakoshi K, et al. Assessment of the subcutaneous degradation process of insoluble hyaluronic acid in rats. Biochem Biophys Res Commun 2018;505:511-5.
18. Uemura A, Fukayama, T, Tanaka, T, Baba, YH, Shibutani, M, Tanaka, R. Development of an Anti-Adhesive Membrane for Use in Video-Assisted Thoracic Surgery. Int J Med Sci 2018;15:689-95.
19. Uemura A, Tanaka, T, Chantawong, P, Kitpipatkun, P, Tanaka, R. Development of an Insoluble Hyaluronic Acid Membrane as an Effective Material for the Prevention of Post-thoracotomy Pleural Adhesions in Dogs. Thai J Vet Med 2018;48:493-8.
20. Hamaji M, Burt BM, Date H, et al. Basic experiments of bioabsorbable materials in prevention of postoperative intrapleural adhesions following thoracotomy. Gen Thorac Cardiovasc Surg 2016;64:82-6.
21. Upham TC, Onaitis MW. Video-assisted thoracoscopic surgery versus robot-assisted thoracoscopic surgery versus thoracotomy for early-stage lung cancer. J Thorac Cardiovasc Surg 2018;156:365-8.
22. Rivera C, Bernard A, Falcoz PE, et al. Characterization and prediction of prolonged air leak after pulmonary resection: a nationwide study setting up the index of prolonged air leak. Ann Thorac Surg 2011;92:1062-8; discussion 1068.
23. Muranishi Y, Sonobe M, Hamaji M, et al. Surgery for metachronous second primary lung cancer versus surgery for primary lung cancer: a propensity score-matched comparison of postoperative complications and survival outcomes. Interact Cardiovasc Thorac Surg 2018;26:631-7.
24. Galetta D, Spaggiari L. Video-Thoracoscopic Management of Postpneumonectomy Empyema. Thorac Cardiovasc Surg 2018;66:701-6.
25. Capov I, Dolezel J, Vlcek P, et al. Repeated resection for recurrent pulmonary metastases. Rozhl Chir 2013;92:694-8.

Cite this article as: Uemura A, Tanaka R. The importance of antiadhesion treatment for the successful video-assisted thoracic surgery. J Thorac Dis 2019;11(1):59-61. doi: 10.21037/jtd.2019.01.03

