

For which thoracic operation is U-VATS superior?

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Abstract: In this special issue, I review the types of thoracic surgery that uniportal video-assisted thoracic surgery (U-VATS) is most suited to.

Keywords: Uniportal video-assisted thoracic surgery (U-VATS); multiport VATS (M-VATS); minimally invasive surgery

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Introduction

The use of uniportal video-assisted thoracic surgery (U-VATS) has spread rapidly, especially in some Asian countries. Since the first U-VATS lobectomy for early stage lung cancer was carried out in 2010 (1), its beneficial effects have been reported by several institutions around the world (2-6). U-VATS has been used to treat various respiratory diseases, such as lung cancer, mediastinal tumors, metastatic lung tumors, pneumothorax, pulmonary sequestration, hyperhidrosis, and pleural lesions (7,8). Generally, the intercostal approach is employed for U-VATS, but many institutions adopt the subxiphoid approach, especially for anterior mediastinal disease (9,10). On the other hand, until recently multiport VATS (M-VATS) was the least minimally invasive thoracic surgical procedure. Whether U-VATS is superior to M-VATS in terms of its postoperative outcomes, especially its ability to reduce wound pain, remains controversial. In this chapter, I review the types of thoracic surgery that U-VATS is most suited to.

Intercostal and subxiphoid approaches in U-VATS

U-VATS can be performed via two main approaches. For the treatment of anterior mediastinal tumors, the subxiphoid approach provides a good view of the anterior mediastinum and bilateral phrenic nerves. The subxiphoid

approach is the standard approach for U-VATS, and it has beneficial effects for patients, e.g., it reduces wound pain after surgery. In terms of major lung resection, when the subxiphoid approach is employed, U-VATS can be used to treat right-sided pulmonary lesions, but its application to left-sided pulmonary lesions can be difficult depending on the extent of any cardiac hypertrophy, which is disadvantageous. In addition, regardless of the locations of pulmonary lesions, the subxiphoid approach results in less marked delays in the treatment of air leakage or unexpected hemorrhaging and less difficulty in securing the visual field due to problems associated with collapsed lungs in patients with emphysema compared with the intercostal approach. Considering its postoperative pain-reducing effects, the subxiphoid approach might be superior, but it limits the surgical procedure. Therefore, U-VATS-based major lung resection performed via the intercostal approach will become the standard surgical treatment for pulmonary lesions in the future.

What are the advantages of U-VATS?

Firstly, in U-VATS for pulmonary lesions that require anatomical major lung resection the intercostal approach is advantageous because the processing of blood vessels and interlobar separation can be performed comparatively

easily, possibly due to the fact that anatomical lung resection through the 4th and 5th intercostal spaces can be carried out based on the same image that is utilized for thoracotomy (11). Once surgeons have acquired the skills required for the U-VATS procedure, U-VATS allows blood vessels and bronchi to be dealt with faster and easier compared with conventional M-VATS in patients with favorable lobation. Actually, it has been reported that the time required for lobectomy was shorter and that for lymphadenectomy was longer in U-VATS compared with M-VATS (12). Regarding lymphadenectomy, it is necessary to devise techniques for right- and left-sided subcarinal lymph node dissection, and this may take time. In addition, as performing U-VATS via the intercostal space facilitates interlobar treatment, thoracic surgeons with the skills required for U-VATS might agree that U-VATS makes it easier to approach and treat unexpected intraoperative hemorrhaging and air leakage around the pulmonary artery compared with M-VATS (13).

Patients' physical conditions and the surgical indications for U-VATS

U-VATS results in less chest wall invasiveness; i.e., less intercostal nerve damage, than M-VATS, and the acquisition of the skills required for the U-VATS procedure, which is less costly than the equivalent process for M-VATS, has beneficial effects for patients. Actually, many studies have reported that U-VATS has pain-reducing effects (13,14). However, we often encounter patients with narrow intercostal spaces, which increases the difficulty of U-VATS procedures performed via the intercostal approach. There are interindividual variations in intercostal width and flexibility. In general, the size of the port for U-VATS is determined by the length of the incision made in the intercostal muscle parallel to the ribs subjected to spreading and the vertical width of the relevant intercostal space. In addition, the flexibility of the intercostal muscles around the wound also affects the size of the port. During surgery, intercostal width influences the handling of the forceps, scissors, and automatic suture instruments, and it might also be associated with intercostal nerve damage. The surgical outcomes of U-VATS in patients with narrow intercostal spaces, especially the operative time and wound pain, should be investigated in future. Conversely, patients with relatively wide intercostal spaces can get significant benefits from U-VATS. In patients with wide intercostal spaces and good pulmonary lobation, U-VATS is a minimally invasive

and effective method for major lung resection.

According to my experience, in cases in which a tumor is located in the anterior diaphragm near to the chest wall U-VATS is difficult. In cases involving tumors located around the diaphragm, it is tough to secure a good surgical view and to manipulate the surgical instruments. Even if the tumor has invaded extensive regions of the chest wall or the great vessels, such as the superior vena cava or aorta, U-VATS is inappropriate in such cases. Obviously, if the tumor is large (more than 5 cm in diameter) or fragile due to necrotic changes, the surgeon need not be particular about the U-VATS approach. On the other hand, Dr. Gonzaletz *et al.* have described the use of U-VATS for bronchovascular and carinal sleeve resection for advanced lung cancer (15). U-VATS is considered to be suitable for treating small tumors and early stage lung cancer, and it might also be useful for treating advanced malignant tumors.

Is U-VATS a promising operative procedure?

The history of U-VATS is short compared with that of M-VATS, and U-VATS might become simpler with the development of surgical instruments and improvements in medical scopes. U-VATS has been performed in numerous cases, including for tumor extirpation and thymectomy for benign mediastinal lesions, the partial resection of metastatic lung tumors, bullectomy for spontaneous pneumothorax, biopsy examinations of pleural lesions, and pericardial fenestration, and it was found to be very useful, suggesting that it will remain a viable surgical option. However, some clinicians think that its use for advanced lung cancer is premature because the surgical quality of U-VATS for malignant tumors has not been determined yet. To confirm U-VATS as a minimally invasive surgical procedure for early stage lung cancer, it will be necessary to perform a prospective multicenter randomized controlled clinical trial comparing M-VATS with U-VATS.

Conclusions

Many U-VATS surgeons have stated that this procedure is mainly applicable to particular respiratory diseases (2-6). However, as U-VATS is a type of minimally invasive surgery it involves a restricted ability to manipulate surgical instruments; thus, whether it is feasible depends on the tumor characteristics and patient's physical condition. Careful consideration of the surgical indications for U-VATS should be performed in each case. Although the

short-term outcomes of U-VATS are good, the oncological validity of U-VATS remains unclear, even for early stage lung cancer. Nevertheless, after the accumulation of large amounts of data derived from a number of registries, it is possible that U-VATS will spread and become more popular among thoracic surgeons in the future.

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Footnote

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

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