Review Article on Thoracic Surgery

Converting uniportal video-assisted thoracic surgery: multiport or open?

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Abstract: Uniportal video-assisted thoracic surgery (U-VATS) has recently been increasing in some countries. The basis of its surgical procedure is, of course, multiport VATS (M-VATS) and thoracotomy. To safely perform U-VATS and establish this surgical procedure, it is essential to investigate convert cases. Referring to the history of the spread of M-VATS and literature on the investigation of convert cases, conversion of U- VATS was reviewed based on the experience of our department.

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

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Introduction

In 2010, about 2 years and 6 months after Diego Gonzalez Rivas reported video-assisted thoracic surgery (VATS) lobectomy for lung cancer (1), our institution performed the first case of minimally invasive anatomical lung resection in Japan. Since then, we have reported the surgical outcomes in Japan for about 6 years until now (2,3). The pursuit of minimally invasive surgery is a proposition for surgeons. Among existing surgical treatments, the accuracy of the procedure of this surgery has been improved when it is simply considered with regard to chest wall invasion. If prevention of intercostal nerve injury can be demonstrated, it may be an ultimate minimally invasive surgery. Although this is thoracoscopic surgery, technically, it contains many elements of thoracotomy compared with the procedure of 2- or 3-port VATS. We experienced cases in which uniportal VATS (U-VATS) was inevitably converted. In this review, the cause of conversion of U-VATS is discussed.

Cause of conversion

Before discussing conversion of U-VATS, the cause of conversion of Multiport VATS (M-VATS) to open thoracotomy is discussed based on the literature (4-16). The rate of conversion of M-VATS is shown in *Table 1* (4-16). Their mean rates were approximately 8.5%, and hemorrhage and adhesion due to vascular injury, tumor size, anatomical problems, such as fissureless lung, firm fixation of lymph nodes to the pulmonary artery and bronchus, and technical problems, such as the use of an automatic suture device and differential lung ventilation failure in anesthesia, were presented as the causes in several reports. In contrast, reported cases of lobectomy for lung cancer in which U-VATS was converted to open thoracotomy are presented in *Table 2* (17-22). On meta-analysis, the mean conversion rate was 3.6%, being not significantly different from that of M-VATS, and on comparison of the overall mortality in the same report, it was significantly lower in patients treated

Table 1 Conversion rates to open thoracotomy during VATS procedure

Authors	Year of publication	Number of cases	Conversion rate (%)
Sugi *et al.* (4)	2000	95	4.2
Saloaini *et al.* (5)	2001	105	5.7
Walker *et al.* (6)	2003	159	11.2
Roviaro *et al.* (7)	2004	171	5.3
Ohtsuka *et al.* (8)	2004	106	10
McKenna *et al.* (9)	2006	1100	2.5
Shiraishi *et al.* (10)	2006	100	14.7
Swanson *et al.* (11)	2007	128	13
Jones *et al.* (12)	2008	286	10.5
Li *et al.* (13)	2012	306	8.8
Puri *et al.* (14)	2015	604	6.9
Chun *et al.* (15)	2015	1110	6.2
Vallance *et al.* (16)	2017	684	10.9

VATS, video-assisted thoracic surgery.

with U-VATS than M-VATS (17). Furthermore, the rates of conversion of U-VATS and M-VATS to thoracotomy were 1.0% and 1.6%, respectively, in propensity-matched patient cohorts, showing no significant difference in both procedures (17).

The cause of conversion of U-VATS was analyzed using data of detailed reports from 3 institutions (3,18,23) including patients of our institution. Strictly speaking, there are 2 patterns of conversion of U-VATS: (I) conversion to open thoracotomy; and (II) conversion to 2- or 3-port M-VATS. Cases are shown by the cause in *Tables 3,4*. Although further verification is necessary because the number of cases analyzed was small, no technical problem, such as the use of an automatic suture device or differential lung ventilation failure in anesthesia, was noted, being a characteristic, in cases with conversion to open thoracotomy, and hemorrhage was the cause in 0.7 and 1.7% in the data from 2 institutions (3,23), respectively, being within the acceptable range. Anatomical problems were the causes of conversion to M-VATS in relatively many cases in the 3 institutions, being characteristic. Cases with

Table 2 Summary of conversion rate and morbidity comparing uniportal multiportal VATS lobectomy for lung cancer

Paper	Conversion to thoracotomy (%)		Overall morbidity (%)	
	Uniportal	Multiportal	Uniportal	Multiportal
Chung (17)	10/90 (11%)	9/60 (15%)	18/90 (20%)	17/60 (28%)
Hirai (3)	1/60 (2%)	0/20 (0%)	10/60 (17%)	5/20 (25%)
Mu (18)	2/58 (3%)	8/347 (2%)	6/58 (10%)	33/347 (10%)
Shen (19)	1/100 (1%)	2/100 (2%)	4/100 (4%)	7/100 (7%)
Wang (20)	0/50 (0%)	1/183 (1%)	5/50 (10%)	25/183 (14%)
Zu (21)	0/33 (0%)	0/49 (0%)	3/33 (9%)	5/49 (10%)

VATS, video-assisted thoracic surgery.

Table 3 Conversions from U-VATS to open thoracotomy

Cause	Calvin	Hirai	Chung
Bleeding	1/8 (12.5%)	2/10 (20%)	0/32 (0%)
Lymph node related	1/8 (12.5%)	1/10 (10%)	0/32 (0%)
Anatomy (adhesion, tumor size, fissure)	0/8 (0%)	0/10 (0%)	9/32 (28.1%)
Technical (stapler, anesthesia etc.)	0/8 (0%)	0/10 (0%)	0/32 (0%)
%(within conversion cases)	2/8 (25%)	3/10 (30%)	9/32 (28.1%)
%(among total cases)	2/150 (1.3%)	3/180 (1.7%)	9/90 (10%)

U-VATS, uniportal video-assisted thoracic surgery.

Table 4 Conversions from U-VATS to 2-port or 3-port VATS

Cause/paper	Calvin	Hirai	Chung
Bleeding	2/8 (25%)	1/10 (10%)	2/32 (6.3%)
Lymph node related	1/8 (12.5%)	1/10 (10%)	5/32 (15.6%)
Anatomy (adhesion, tumor size, fissure)	3/8 (37.5%)	5/10 (50%)	13/32 (31.3%)
Technical (stapler, anesthesia)	0/8 (0%)	0/10 (0%)	3/32 (9.4%)
%(among conversion cases)	6/8 (75%)	7/10 (70%)	23/32 (71.9%)
%(among total cases)	6/150 (4.0%)	7/180 (3.9%)	23/90 (25.6%)

U-VATS, uniportal video-assisted thoracic surgery.

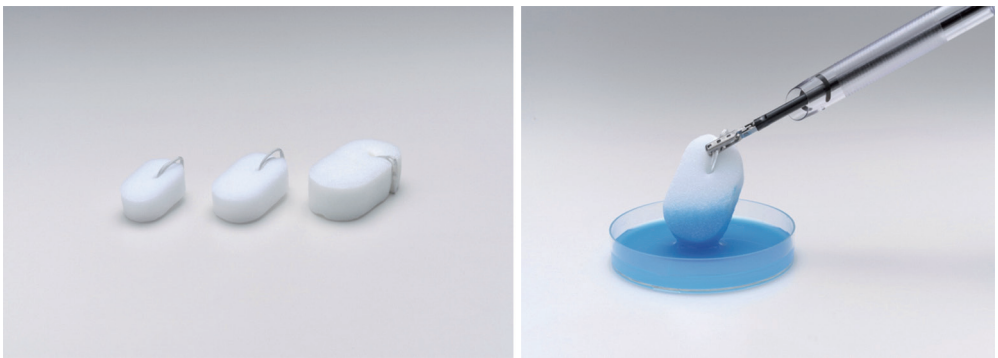

Figure 1 Secrea (Hogy TM).

Figure 2 Hemostasis using the Secrea to it. A6 bleeding (24). Available online: http://www.asvide.com/article/view/30351

conversion to M-VATS accounted for more than 70% of all cases in all 3 institutions, suggesting that if the operator learned the M-VATS procedure and is familiar with the U-VATS technique to some extent, most cases can be dealt with by M-VATS before conversion to open thoracotomy in the future.

Conversion during U-VATS, especially for dealing with hemorrhage

All surgeons have difficulty in carefully preparing a visual field at the beginning of the use of U-VATS and they have similar feeling to that when they learned M-VATS from thoracotomy. Scopists also require some techniques because they have to secure a visual field from the same direction as that of surgical instruments. The surgical procedure proceeds while devising avoidance of interference with the scope by forceps and scissors mainly by the operator. When unexpected hemorrhage and anatomical problems occur during the procedure, these have to be dealt with by calmly making a judgment as in M-VATS. Since intraoperative hemorrhage may lead to endanger the life of the patient, it is necessary to always pay attention during surgery applied through a small wound, such as U-VATS, more closely than that in M-VATS. In our institution, a polyurethane sponge, Secrea (HOGY TM), is always prepared for hemorrhage, and the hemorrhagic point is carefully pressed (*Figures 1,2*) (24,25). In U-VATS applied through an about 3–4-cm sized

Table 5 Criteria for conversion in our institute

More than 4 hours of operation time in uniportal VATS procedure
More than 500 mL of blood loss
Severe adhesion to diaphragm, SVC and aorta
Tumor invading to main bronchus, main PA, SVC and aorta

U-VATS, uniportal video-assisted thoracic surgery; SVC, superior vena cava.

small wound, depressors, such as Securea, can be easily inserted and placed on the hemostasis point compared with inserting and placing it in M-VATS, especially in surgery using only cylindrical trocar, so that hemorrhage can be dealt with by calmly making judgment and conversion to open thoracotomy and M-VATS as needed. Of course, simulation of hemorrhagic cases is sufficiently performed with nursing staff regularly to promote communication.

Judgement criteria for conversion

Conversion is an event that operators want to avoid, but strong a feeling of the operator to provide minimally invasive surgery to the patient and excessively sticking to U-VATS may lead to disadvantages for the patient, such as prolongation of the operative time (more than 4 hours) and unexpected massive hemorrhage (more than 500 mL). Generally, in cases that the lung is firmly adhered to diaphragm, aorta and superior vena cava (SVC), the operator should convert to M-VATS or thoracotomy. Furthermore, tumor invading main bronchus, main PA, SVC and aorta is also a contraindication of U-VATS. Considering my experience of M-VATS, it is desirable to prepare the criteria to indicate conversion in each institution, perform surgery following it, and convert the procedure to M-VATS and open thoracotomy as needed. In our department, U-VATS was indicated only for curative surgery for stage I lung cancer early after its introduction, but original indication criteria of conversion were prepared and surgery is routinely performed following it (*Table 5*).

Conclusions

Although U-VATS is complex and difficult compared with that of M-VATS at present, when it is performed by a thoracic surgeon familiar with M-VATS, the frequency of conversion may be almost the same as that of M-VATS (17). In the literature, the mortality rate of patients treated with U-VATS is still 0%, but serious complications may be reported with spread of this surgical procedure in the future, as it occurred in M-VATS, for which further evaluation of the surgical outcomes and investigation of problems are essential. Close investigation of cases with conversion of U-VATS is especially important.

The task concerning conversion of U-VATS, which is the theme of this report, is improvement of the technical aspects of the surgical procedure by U-VATS surgeons so as to avoid open thoracotomy as much as possible and convert the procedure to multiport VATS even in the worst cases. In addition, acquisition of the ability to smoothly convert the procedure from U-VATS to M-VATS, from U-VATS to open thoracotomy, or from U-VATS to open thoracotomy through M-VATS may be a task for U-VATS surgeons in the future.

The history of U-VATS is still short and the, the surgical procedure performed by U-VATS surgeons has been improving steadily and new surgical instruments may be developed in the future. The analysis of conversion cases from U-VATS to M-VATS or thoracotomy is essential to do U-VATS safer. Eventually, devising to reduce U-VATS conversion rate is still the key to the development and spread of this surgical procedure.

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Footnote

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appropriately investigated and resolved.

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