



Posterior fissure first approach in single port video-assisted thoracoscopic surgery

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Abstract: More than 20 years have passed since thoracoscopic surgery became common as a low-invasive surgery. Thoracic surgeons have since aimed for further low-invasive surgical treatments and progress in this concept has resulted in an increase in reduced port surgery and new procedures such as robot-assisted surgery. Single-port video-assisted thoracic surgery (SPVATS) has already become common in some countries. It is an ultimate form of reduced port surgery and can be applied for the surgical treatment of most surgically-treated diseases including lung cancer. Regarding the approach to the interlobular regions in surgical procedures, it has been discussed which of the anterior fissure first and posterior fissure first is appropriate for multi-port VATS (M-VATS). In this report, the propriety of the posterior fissure first approach to the interlobular region in SPVATS lobectomy for early lung cancer is reviewed.

Keywords: Single-port video-assisted thoracic surgery (SPVATS); posterior fissure; multi-port video-assisted thoracic surgery (M-VATS); minimally invasive surgery

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Introduction

For surgeons, the surgical procedure of single-port video-assisted thoracic surgery (SPVATS) is slightly complex compared with that of multi-port VATS (M-VATS). Surgeons have to proceed the operation while avoiding interference among instruments because a scope, forceps, and scissors are simultaneously inserted through a small 3–4 cm thoracotomy wound. In our department, problems with interference among instruments are prevented using a combination of forceps and scissors with different lengths. Regarding the small thoracotomy site, most SPVATS surgeons have been reported as preparing small thoracotomy on the 4th or 5th intercostal anterior or midaxillary line in anatomical lung resection in past reports on SPVATS (1-4). From this region, the anterior approach is naturally easier for operation

of the interlobular region. Normally, in the procedure of interlobular exposure of the pulmonary artery, the starting point of dissection is decided based on the state of lobulation, i.e., a region easy to expose the pulmonary artery, and it is advanced toward the direction easier to process (*Table 1*, Grade II) (5). On the other hand, in the posterior approach to the interlobular region through this small thoracotomy, when the lung segment adjacent to S⁶ shows incomplete lobulation, operation may be firstly applied to the interlobular region even though it is somewhat difficult due to the addition of mobilization of the lung. In addition, the posterior approach to the interlobular region is advantageous for right or left lower lobectomy because processing of A⁶ is easier, regardless of the interlobular condition. In M-VATS, preparation of ports on the posterior axillary line or around the auscultatory triangle to secure the visual field of the scope through it and

Table 1 The Royal inflammatory anatomical classification of the pulmonary fissures (5)

Grade I: the PA is readily visualized without dissection
Grade II: the PA is revealed following minimal dissection
Grade III: a shallow fissural cleft whereby a large amount of dissection is required to identify the PA
Grade IV: there is no discernable fissural cleft at all on initial inspiration

PA, pulmonary artery.

apply the posterior fissure first from the dorsal side of the patient has recently been occasionally reported (6). Similarly, the posterior fissure first by preparing small thoracotomy in the auscultatory triangle was recommended for SPVATS in a study (6). In this report, advantages and disadvantages of the anterior and posterior fissure first approaches to the interlobular region as a surgical procedure of SPVATS are discussed.

Discussion on which of the anterior or posterior fissure first approach is appropriate for M-VATS lobectomy

It has been discussed also for M-VATS which of the anterior and posterior interlobular approaches should be applied first for interlobular operation. Superiority of processing through the anterior interlobular approach in operation including that for incomplete fissure lung has recently been occasionally reported (7-9). In my opinion, for right upper and middle lobectomies, the surgical procedure of hilum first and fissures last through the anterior interlobular approach may be easier to do because the operation can proceed to the upper and middle lobes regardless of the interlobular condition by processing the pulmonary vein then the pulmonary artery through the anterior approach, followed by identifying the bronchus, exposing the interlobular pulmonary artery, transecting the pulmonary artery entering the pulmonary lobe and then the bronchus, and finally transecting the interlobular region. In right lower pulmonary lobectomy, the inferior pulmonary vein is exposed first then the pulmonary artery is exposed through the anterior interlobular approach because dissection is easy and the presence of incomplete lobulation is relatively rare between the middle and lower lobes. The common basal artery or A⁶ is cut next and the upper-lower interlobular region is cut using a stapler or ultrasonic scissors, then the

inferior pulmonary vein is processed, and finally the lower lobe bronchus is cut.

In left upper lobectomy, excluding cases with incomplete fissure lung (Table 1, Grade III, IV) (5), generally, the operation is applied in the clockwise direction with respect to the hilum. The superior pulmonary vein is easy to process from the anterior side. After exposure, dissection, and transection, A³ and A¹⁺²a+b are transected in this order. When lobulation between the upper and lower lobes is incomplete, the upper lobe bronchus is identified after processing the superior pulmonary vein, and after identification of the lingular segment bronchus and B⁸, the interlobular region between the lingular segment and S⁸ is transected using an autosuture device to set the interlobular transection line from the anterior interlobular region to prepare the interlobular region. In left lower lobectomy, similarly, the interlobular region between S⁶ and S¹⁺²c is transected using an ultrasonic scalpel or autosuture device after transection of the left inferior pulmonary vein from the posterior fissure direction, the interlobular pulmonary artery is identified and exposed, the vascular sheath is incised, and tunneling is applied inside the sheath to prepare the interlobular region separating the lingular segment.

Posterior fissure first is a surgical procedure in which interlobular transection between S²a and S⁶ is applied in right upper and lower lobectomies and interlobular transection between S¹⁺²c and S⁶ is applied in left upper and lower lobectomies using an ultrasonic scalpel or stapler to expose the middle pulmonary artery trunk and basal segmental artery. Preparation of the camera port around the auscultatory triangle is advantageous in that a visual field from the posterior side can be easily secured and the upper lobe bronchus can be processed in advance, being useful for M-VATS. In left lobectomy, the pulmonary artery, especially A¹⁺²c and A⁶, can be easily processed because the visual field is approached from the dorsal side.

The point of interlobular approach of M-VATS, completely different from that in SPVATS is flexibility: After preparation of the first port and passing a thoracoscope through the port, the camera operation hole can be changed during surgery depending on the intrathoracic condition. Specifically, it is possible to judge which of the anterior fissure first or posterior fissure first approach is better based on the intraoperative findings through the first port and adjustment can be made to make either approach easier according to the conditions, being a defining difference from SPVATS.

Anterior fissure first approach or posterior fissure first approach in SPVATS lobectomy?

The position of the small thoracotomy wound for SPVATS is on the 4th or 5th anterior axillary line or midaxillary line in most cases, as described above. In our facility, basically, the operator stands on the patient's dorsal side, the camera assistant stands on the patient's ventral side, and surgery is performed using face-to-face 2 inverted monitors. In addition to the ease of processing of the hilar blood vessels, the advantage of this surgical procedure through a small thoracotomy wound is that unexpected bleeding from the interlobular region can be rapidly treated. In right upper and middle lobectomies from this small thoracotomy wound, the pulmonary vein is processed, then the pulmonary artery and bronchus are transected in this order, and the interlobular region is finally transected using a stapler in many cases, even when the region between the upper and middle lobes is fissureless. In interlobular preparation, an interlobular line is prepared using an autosuture device from the anterior site, i.e., the anterior fissure first approach, setting the index to the origin of the middle. In left upper lobectomy, when the region between the upper and lower lobes is fissureless, the superior pulmonary vein is processed and then A^3 and A^{1+2} are transected in this order, followed by exposure of the upper lobe bronchus, and the lingular segment bronchus and B^8 are identified and a transection line between the lingular segment and S^8 is decided. Then, the interlobular region is prepared by dissecting the vascular sheath of the interlobular pulmonary artery and identifying the lingular segment pulmonary artery. In left lower lobectomy, firstly, the inferior pulmonary vein is transected using an autosuture device when it is possible, and then an interlobular transection line between the lingular segment and B^8 is decided in many cases, which is the anterior fissure first approach described above.

However, for left upper or lower lobectomy, when the lingular segment is large and exposure of the visual field is anatomically difficult or cardiac dilatation is present, posterior fissure first is employed. Securing a visual field by camera and exposure of the surgical field are slightly difficult because it is approached from the anterior side, but after the dorsal-side pulmonary artery is exposed, the interlobular line between S^{1+2c} and S^6 is judged based on the pulmonary anatomy, and transection is advanced using an autosuture device or ultrasonic scalpel to firstly identify the A^6 bifurcation and the interlobular pulmonary artery is exposed based on the positional relationship with the A^{1+2c} branch on the central side. The subsequent procedure is the

same as that of multi-port VATS described above.

The characteristic of SPVATS is that the operation can be performed using the orientation of thoracotomy because basically, the visual field of the camera and surgical instruments are inserted from the same direction. From my experience, shortening of the operative time can be expected when the surgeon acquires the skill of the procedure compared with that of multi-port VATS. However, it is less flexible in responding to the interlobular region compared with that of M-VATS because of the approach through a single hole. When a small thoracotomy wound is made on the anterior axillary line, camera operation may be difficult due to mobilization of the lung from the ventral side during the posterior fissure first procedure. When a small thoracotomy wound is made on the posterior axillary line in SPVATS, processing of the segments contacting to S^6 is easy and a visual field can be easily secured even in the posterior fissure first procedure, suggesting that posterior fissure first is superior in processing the region between the right upper and lower lobes and between the left upper and lower lobes in cases with incomplete lung fissure. It has recently been reported that surgery can be safely performed in a visual field from the dorsal side preparing a small thoracotomy wound for SPVATS on the posterior axillary line (6). On the other hand, the posterior intercostal space is generally narrower than the anterior intercostal space and the following concerns have been pointed out: (I) Operability of the stapler decreases and (II) the incidence of postoperative air leak may be high compared with that after the fissureless technique from the anterior side (6). From our experience, lobectomy including incomplete lung fissure through the anterior fissure first approach preparing a small thoracotomy wound on the anterior axillary line was mostly safely applicable. The reason why we basically make a small incision on the anterior axillary line and select the anterior fissure first for the interlobular region is largely due to operability of surgical instruments and autosuture devices. It is also easy to clamp the pulmonary artery on the central side when unexpected bleeding from the pulmonary artery occurs during interlobular processing and this is another advantage. As described above, posterior fissure first may be a beneficial interlobular approach when it is applied to left upper and lower lobectomies in cases with incomplete fissure (*Table 1*, Grade III, IV) (5), but the interlobular fissure is present in most cases and at present, it may be safer to expose the interlobular pulmonary artery through the anterior fissure first as an interlobular approach in SPVATS.

Conclusions

The operability of anterior fissure first and posterior fissure first is determined by selecting which of the anterior, midaxillary, or posterior axillary line on which a small thoracotomy wound is made, and this is the characteristic of SPVATS. This surgical procedure, anterior fissure first making a small incision on the anterior axillary line, is easy for operators skilled in SPVATS, and from our experience of SPVATS lobectomy for early lung cancer, processing was possible employing anterior fissure first in most cases. However, lobulation varies among individuals and flexibility to apply pulmonary artery dissection and interlobular preparation in regions with favorable interlobular condition may be necessary regardless of anterior or posterior fissure first. Posterior fissure first is beneficial for some difficult cases with interlobular fissureless lung between bilateral upper and lower lobes (*Table 1*, Grade III, IV). Surgeons should acquire the thoracoscope operative skills to perform the surgical procedure and secure a visual field via both anterior and posterior fissure approaches so as to be applicable to all kinds of cases.

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