Review Article on Thoracic Surgery

Uniportal video-assisted thoracic surgery for complicated pulmonary resections

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Abstract: In the past 20 years, video-assisted thoracic surgery has made a great progress, from 4-ports to 2-ports, and eventually to this revolutionary approach—uniportal video-assisted thoracic surgery (VATS). It can share the same instruments, the same surgical principles, the same strategies of trouble-shooting and the same postoperative short-term outcomes with conventional VATS via the improvement of instruments and surgical skills. And it has already been safe to adopt uniportal VATS in complicated pulmonary resections. In this study, we shared five video clips about uniportal VATS for complicated pulmonary resections: sleeve resection, segmentectomy, pneumonectomy and angioplasty. We hope these video clips can be instrumental for young surgeons.

Keywords: Uniportal; video-assisted thoracic surgery (VATS); pulmonary

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Introduction

With the prevalent of the concept of minimal invasive surgery, thoracic surgeons also have spared no effort to minimize the operative trauma in the past about 20 years since video-assisted thoracic surgery (VATS) was first adopted in a pulmonary lobectomy (1), and the long-term outcomes of VATS for early stage lung cancer have been proved to be similar with thoracotomy (2,3). Nowadays, uniportal VATS has been already applied in pulmonary surgeries as a revolutionary approach with more less trauma (4), it can share the same instruments, the same surgical principles, the same strategies of trouble-shooting and the same postoperative short-term outcomes (5) with conventional VATS via the improvement of instruments and surgical skills, which also facilitates the feasibility and safety of uniportal VATS. For experienced surgeons, it has already been safe to adopt uniportal VATS in complicated pulmonary resections such as sleeve resection, segmentectomy and so on (6-8). But for young surgeons, it is still considerable to take more practice of conventional VATS before starting uniportal VATS. Here we demonstrated five cases of complicated pulmonary resections including sleeve resection, segmentectomy, pneumonectomy and angioplasty by using uniportal VATS approach.

Patient selection and workup

There were 5 patients underwent uniportal VATS in this study: (I) case No. 1: right upper lobe apical segmentectomy; (II) case No. 2: right upper sleeve lobectomy; (III) case No. 3: left pneumonectomy; (IV) case No. 4: left upper lobectomy and vascular reconstruction; (V) case No. 5: left lower lobe S7+S8 segmentectomy.

Patient No. 1 (54-year-old, female) had a history of a small nodule in her right upper lobe for 1 year; the latest CT scan suggested that the nodule (1.5 cm in diameter) in the apical segment of right upper lobe enlarged. No other metastasis sign was found.

Patient No. 2 (44-year-old, male) had a history of continuous cough for 2 months, A central mass (2 cm in

diameter) was found in his right lung by CT scan, and the result of bronchoscope showed the mass located in right upper lobar bronchus invading right principal bronchus. Pathological biopsy confirmed the diagnosis of squamous carcinoma.

Patient No. 3 (63-year-old, male) was hospitalized because chronic hemoptysis for 6 months. Bronchoscope showed the left principal bronchus was obstructed by a neoplasm at 2 cm away from carina. Pathological biopsy confirmed the diagnosis of squamous carcinoma. PET-CT showed no distant metastasis sign.

Patient No. 4 (45-year-old, male) had a 3-month history of left lung shadow in X-ray, CT scan revealed a solid nodule (2.5 cm in diameter) in left upper lobe (LUL) with mild invasion of left pulmonary artery. PET-CT suggested the nodule was hypermetabolic with no distant metastasis.

Patient No. 5 (52-year-old, male) had a history of small nodule (1.5 cm in diameter) in left lower lobe. After 8 months of follow up, the CT showed no significant changes. PET-CT suggested potential risk of early stage of lung cancer and revealed no metastatic lymph nodes in mediastinum.

Pre-operative preparation

All the patients received routine blood biochemistry, cardiovascular and pulmonary function test, brain MRI, ECT and/or PET-CT to exclude surgical contraindication. All the smoker patients had to stop smoking at least for 2 weeks before admission, and they would receive preoperative respiratory preparation such as aerosol inhalation.

All the patients and their caregiver were detailedly informed about the advantage and disadvantage of uniportal VATS, and the importance of postoperative expectoration as well as early ambulation.

Equipment preference card

High-definition endoscopic system with a 30° camera was applied in our uniportal VATS. A lap-protector was used to avoid contamination. Unipolar electrocoagulation and harmonic scalpel were used for dissection. Linear staplers were used to cut vessels and bronchus. A long scissor was usually used to dissect the vessels and bronchus. A protective bag was applied in removing the specimen.

Procedure

Case No. 1: after dividing the mediastinal pleura to expose the hilum, the apical-anterior branch of the pulmonary artery (A1 & A3) was dissected, then the A1 was cut by a stapler. The bronchus of apical segment was dissected by a long scissor, followed by being transected by a stapler. Subsequently, dissection of the branches of superior pulmonary vein to expose and cut the vein of apical segment (*Figure 1*).

Case No. 2: after dissection of the lymph nodes around hilum, the apical-anterior branch of the pulmonary artery was detached and cut by a stapler. The vein superior pulmonary vein was detached by a long scissor and transected by a stapler. The fissure was divided to expose the intermediate bronchus, which was cut up by a long scissor. The right principal bronchus was also cut up beneath the transected azygos vein arch. After dissection of the level 7 lymph nodes, the bronchus was reconstructed and closed by interrupted sutures (*Figure 2*).

Case No. 3: after dissection of the mediastinal pleura and lymph nodes, the left pulmonary artery trunk was detached and transected by a stapler. The superior and inferior pulmonary vein was transected respectively. After dissection of the lymph nodes, the left principal bronchus was well exposed and cut up by a long knife. The stump of left principal bronchus was closed by interrupted sutures after the specimen was removed (*Figure 3*).

Case No. 4: after dissection of the mediastinal pleura and lymph nodes, the main pulmonary vessels of LUL were well detached to have adequate proximal and distal vascular control. The pulmonary vein trunk of LUL was ligated by silk sutures, and the branches of the vein were ligated and cut by scissor. The main pulmonary artery of LUL was closed by a vascular clamp and transected laterally by a stapler; the bronchus of LUL was cut up by scissor. After removing the specimen, the cut margin of the main pulmonary artery was reinforced by continuous sutures, and the bronchus was closed by interrupted sutures (*Figure 4*).

Case No. 5: after dividing the fissure, the branches of pulmonary artery of left lower lobe (LLL) were well exposed. Using a clamp to detach the artery of segment 7 & 8 (A7+A8). After ligating and cutting the A7+A8, the bronchus of segment 7 & 8 (S7+S8) was exposed and transected by scissor. The vein of segment 7 & 8 (V7+V8) was ligated subsequently (*Figure 5*).

Role of team members

Our team members included one chief surgeon, two assistants, one chief nurse, an anesthesia team, a pathological

Figure 1 Uniportal video-assisted thoracic surgery (VATS) right upper lobe apical segmentectomy (9).
Available online: http://www.asvide.com/articles/1123

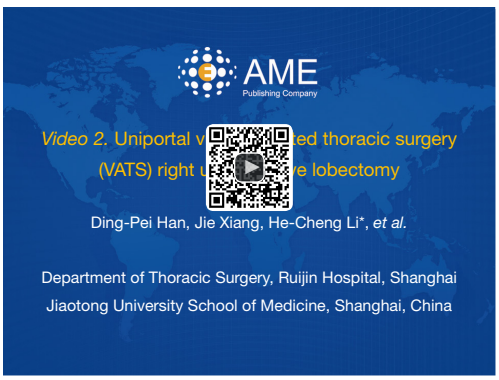

Figure 2 Uniportal video-assisted thoracic surgery (VATS) right upper sleeve lobectomy (10).
Available online: http://www.asvide.com/articles/1124

Figure 3 Uniportal video-assisted thoracic surgery (VATS) left pneumonectomy (11).
Available online: http://www.asvide.com/articles/1125

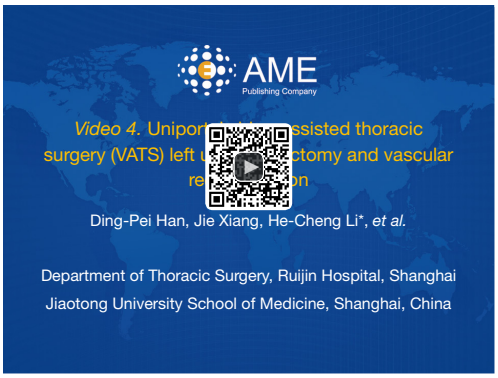

Figure 4 Uniportal video-assisted thoracic surgery (VATS) left upper lobectomy and vascular reconstruction (12).
Available online: http://www.asvide.com/articles/1126

Figure 5 Uniportal video-assisted thoracic surgery (VATS) left lower lobe S7+S8 segmentectomy (13).
Available online: http://www.asvide.com/articles/1127

team and a rehabilitative team.

All the uniportal VATS were performed by the chief surgeon, the assistants were in charge of holding camera and assistant traction. Double-lumen endotracheal intubation and intraoperative airway management were carried out by the anesthesia team. Preoperative publicizing and education were conducted by a nursing team lead by the chief nurse, so were the postoperative cares (such as nursing and pain management). The job of the rehabilitative team was to help the patients undergoing early function training of involved upper extremities and early ambulation. The intraoperative frozen section diagnosis and pathological diagnosis were reported by the pathological team.

Post-operative management

All patients in this study returned to ICU from operative room and stayed for 1 day. Rehabilitation physician helped the patients undergoing early function training of involved upper extremities and early ambulation at the 1st day postoperatively. All the patients received prophylactic antibiotics, expectorant aerosol inhalation and other symptomatic treatments. The chest tubes were removed at 2nd and 3rd day postoperatively. The five patients discharged at 1 day after the removing of the chest tubes.

Tips, tricks and pitfalls

- Experiences of open surgery and conventional VATS were essential for young surgeons before approaching complicated pulmonary uniportal VATS. The adept skills of troubleshooting are the assurance of safety;
- In uniportal VATS, the camera lens is entered into the patient's body from the incision. It is a big challenge for the camera assistant to ensure the quality of image and keep the camera stable simultaneously. We fix the shank of the camera on the margin of the incision with 7# suture to give the camera a fulcrum, the camera assistant can use singe hand to hold the camera, which decreases the level of fatigue and helps to stay in focus;
- During the whole procedure, the camera assistant should use "ipsilateral and single-hand" position as often as possible. And then, it will give the surgeon more operating space, reduce the collision of instruments and limbs and increases the degree of comfort and concentration. The fluency and accuracy of the surgery can also be guaranteed;
- To adjust the camera lens in a proper distance, the camera assistant should be well acquainted with the surgical procedures, understand the intention and habits of the surgeons, stay in focus and be adaptable in any condition;
- In uniportal VATS, the endoscope is often fixed among incision protector and silk suture, which increases the resistance of movement. We can use paraffin to lubricate the endoscope to reduce the resistance, which improves control of the camera lens;
- Four perspectives of observation: (I) from anterior to posterior: it's often used in the dissection of anterior mediastinum and the front of pulmonary hilum, such as the anterior hilum and the group 2 or 4 lymph node dissection, etc.; (II) from posterior to anterior: it's often used in the dissection of posterior mediastinum and the back of pulmonary hilum, such as the posterior hilum and the group 7, 8 or 9 lymph node dissection; (III) from top to bottom: it's often used in the dissection of the top of the hilum, such as free of the first branch of pulmonary artery and the group 5 or 6 lymph node dissection; (IV) from bottom to top: it's often used in hemostasis of thoracic wall and release of pleural adhesions;
- The importance of perioperative interdisciplinary cooperation for these complicated pulmonary surgeries.

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Footnote

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

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