Surgical Technique

Application of uniportal video-assisted thoracic surgery (VATS) in pulmonary tumors

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Introduction

At present, lung cancer resection can be done by different approaches and methods, such as traditional thoracotomy, small incision thoracotomy, thoracoscopic surgery and robot surgery. Video-assisted thoracic surgery (VATS) lung cancer resection greatly reduces the trauma of traditional thoracotomy, and has obvious advantages in terms of hospital stay, complication rate, survival time and so on (1,2). However, with the development of the minimally invasive technique, the operation method has gradually developed from 4 ports, to 3 ports, to double-port and finally, to the uniportal approach, which can further reduce the trauma of patients. Since Rocco *et al.* reported the experience of uniportal VATS wedge resection for the first time in 2004 (3), the indications of uniportal VATS in the diagnosis and treatment of pulmonary diseases have been continuously expanded. For the first time in 2011, Gonzalez *et al.* reported a uniportal VATS lobectomy. A single thoracoscopic minimally invasive operation was performed with only a small incision of about 3 cm in length. All surgical equipment, including for thoracoscopy, passed through this small hole during the operation of lung cancer (4). Subsequently, Gonzalez has reported on more difficult types of uniportal VATS lung cancer resection, such as segmental resection (5), total pneumonectomy (6), lobectomy (7), bronchial sleeve lobectomy (8), and bronchial and pulmonary double sleeve lobectomy (9). So far, the uniportal VATS has basically covered all kinds of major resection of lung cancer. The technique has the advantages of less surgical trauma, less postoperative pain, faster recovery and less surgical scarring (10). The aim of this video is to show the operative points and postoperative rehabilitation of uniportal lung cancer minimally invasive surgery (*Figure 1*).

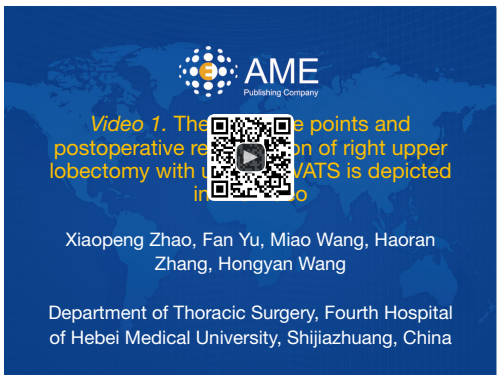

Figure 1 The operative points and postoperative rehabilitation of right upper lobectomy with uniportal VATS is depicted in this video (11). VATS, video-assisted thoracic surgery.
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Operative techniques

The patients were treated with double lumen endotracheal intubation, 90-degree decubitus on the contralateral side, intravenous inhalation combined anesthesia, and contralateral pulmonary ventilation. The operator stood on the ventral side of the patient and the assistant who held the camera on the dorsal side of the patient. The incision of right superior lobectomy is usually chosen as the 4th

intercostal anterior axillary intercostal, and the length is about 3.5 cm. Here, the chest wall has less muscle layers, wider intercostal space, and is a more suitable distance from the hilus of the lung. We conventionally use the incision cover. The 10-mm, 30-degree camera should be close to the edge of the incision and occupy as little space as possible. The depth of the camera should be adjusted to the target area by rotating the button to adjust the angle of the lens. It is important to avoid wide swinging of the mirror body which might occupy the field operation space of the operator. In the surgery presented, the operator held an elbow attractor in one hand, an ultrasonic knife or an electric coagulation hook in the other, and operated from the ventral side of the chest. The hilar lung was dissected layer by layer, the lymph node was pressed with an aspirator during lymph node dissection, the lymph node was disconnected with an electric coagulation hook or ultrasonic knife, and the entire lymph node was removed without the need for additional instruments to participate in the exposure. If the dissection of lymph nodes in group 7 is poorly exposed, it is suggested that the operation bed should be rotated 30 degrees to the prone position of the patient, and the patient's posture be changed so that the lymph nodes can be fully exposed by pulling the right main bronchus with the aspirator. The pulmonary blood vessels and trachea should be freed as long as possible, and surrounding lymph nodes and connective tissue that may block the passage of the suture should be removed. Using a curved stapler platform, the bronchus or blood vessel should be drawn with a silk thread, if necessary, to allow the suture to pass through. The upper lobe arteriovenous of the right lung were cut off by white staples, the trachea of upper lobe of the right lung was cut off in green staple, and the interlobar fissure was treated with gold staples. ECHELON TM stapler platform (sc45) was used in the operation. The sterile glove No. 8 was inserted into the chest cavity by incision, and the excised lung lobe specimen was placed into the glove, which was removed through the incision. After the operation, 20F thoracic drainage was placed through the incision, with the head placed on the top of the pleura. The muscle tissue, subcutaneous tissue and skin were sutured. Forty-eight hours after operation, bedside X-ray films of the chest were taken to understand the recruitment of the lobes, and patients were encouraged to exercise early after the operation. The drainage tube can be removed after a thoracic drainage of less than 100 mL/day.

Comments

Conventional thoracotomy, traditional double- or triple-port VATS and uniportal VATS are three important stages in the history of thoracic surgery. In the early stage, the traditional VATS was operated by straight endoscope instruments on the operating surface through different operating ports. The number, position and spacing of the operating ports determined the success of the operation. The innovation of both the endoscope stapler platform with curved head and the of aspirator device, effectively avoids the problem of interference between instruments in single port surgery. With the progression of this technology, uniportal VATS has seen a wide range of developments. Concerning the angle of vision, in traditional VATS, the camera and instruments enter the chest through different incisions, which can lead to visual errors. Meanwhile, in uniportal VATS, instruments and camera enter the chest through the same incision, which is similar to the open operation under the same straight perspective. The visual error is minimal and the visual field is direct to the target tissue. This may also be the theoretical basis for the direct transition from open operation to uniportal VATS operation.

For the operators transitioning from traditional VATS to uniportal VATS, the visual perception and geometric characteristics of the endoscope are different. The uniportal thoracoscopic camera and all the operating instruments come in and out of the same port. The instruments may interfere with each other during the operation. It is difficult to fully expose the surgical field, and the instruments repeatedly enter and exit or exchange, thus prolonging the operation time and increasing the difficulty of the operation. We suggest that in the early stage of the learning curve for the uniportal VATS technique, the patients with small lesions, peripheral type, well-developed pulmonary fissure and easily exposed vessels should be selected for operation. If serious pleural adhesions or accidents occur during the operation, they should be changed to traditional VATS or open surgery as soon as possible. Generally, after a period of learning, there is no difference between the uniportal and the traditional VATS operation.

The main advantage of uniportal VATS is to reduce

postoperative pain and sensory abnormalities. The incision is located from the front of axillary to the midaxillary line. This part is mostly intercostal muscle, and the muscle layer of chest wall is small, easy to stop bleeding and has high elasticity, so it will not cause great damage to the body, and can alleviate the short-term pain and long-term sensory abnormality of patients after operation. There was also less effect on patients' exercise. At the same time, in ergonomics, the uniportal VATS operator and assistant face the display with minimal neck flexion and torsional motion, which can effectively improve the subjective comfort of the operator after operation.

In uniportal thoracoscopic surgery, we usually choose the anterior axillary 4th intercostal as the surgical incision to upper lobectomy, and the 5th intercostal for the middle and lower lobectomy. The patient's lobes are automatically tilted forward or backward by adjusting the operating bed angle to expose the hilar and carinal lymph nodes. In order to increase the range of operation in the chest, special uniport surgical instruments such as elbow aspirator and double joint oval forceps were used in the operation. The use of a curved stapler platform for the treatment of pulmonary vessels, lung fissure and bronchi can increase the mobility of the instrument and reduce the difficulty of operation. The order in which blood vessels, fissure and bronchi are handled should not be confined to a fixed, single procedure, but rather proceed according to the different conditions encountered during the operation. For example, when it is difficult to deal with the superior pulmonary vein, it is suggested that the pulmonary artery branch should be treated first, and then the vein should be treated.

Since the development of the uniportal thoracoscopic lobectomy and systemic lymph node dissection, we have found that the surgical procedure is less invasive, more elegant, more effective, safer and more feasible. Through reasonable accumulation of surgical experience, we can quickly master the technique of thoracoscopic lobectomy. With the development of camera technology, the camera body has become thinner and thinner, reducing the length of the incision and subsequent interference with other instruments. The future wireless camera system may not be involved in the surgical incision at all. With its ability to avoid interference with other devices and provide multiple visual angles, the minimally invasive advantage of uniportal VATS has become increasingly apparent.

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None.

Footnote

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

Informed Consent: Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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