Surgical Technique

Uniportal video-assisted thoracoscopic surgery left upper lobe trisegmentectomy using flexible tip 3D video scope

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Abstract: A 69-year-old male patient with a history of melanoma and prostate cancer was found to have a 2.6 cm PET-avid, slowly enlarging, left upper lobe lung nodule that was suspicious for either metastasis or primary lung cancer. Due to the deep location of the nodule, a wedge resection was not recommended. A diagnostic and therapeutic uniportal video-assisted thoracoscopic surgery (U-VATS) left upper lobe trisegmentectomy was performed uneventfully. Final pathology confirmed the presence of metastasis from prostate cancer without lymph node involvement. His recovery was uneventful and he was discharged two days after surgery. In this video, we demonstrate our technique for left upper lobe lingula-sparing lobectomy (trisegmentectomy). More importantly, the video demonstrates that a thorough lymphadenectomy can be effectively performed during U-VATS lung resections.

Keywords: Uniportal; segmentectomy; lung resections; minimally invasive lung surgery

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Introduction

Uniportal video-assisted thoracoscopic surgery (U-VATS) has gained acceptance across the world as a safe and effective technique. Nevertheless, arguments against UVATS include undetermined oncologic equivalency to established open and minimally invasive thoracic surgery. Another concern raised has been inadequate lymph node dissection since most current U-VATS videos are limited to the pulmonary resection without showing the lymphadenectomy portion. In our video, we demonstrate a left upper trisegmentectomy (apico-posterior and anterior), sparing the lingula, along with extensive mediastinal node dissection.

Case presentation

The patient is a 69-year-old male with a history of prostate cancer and Stage 3 melanoma, resected 7 and 12 years before, respectively. He was found to have a 2.6 cm, slowly enlarging, left upper lobe mass that was PET-avid. An oligometastatic lesion from either one of the previous cancers was suspected but a primary lung cancer was not ruled out. We recommended a U-VATS lingula-sparing upper lobectomy (upper trisegmentectomy) for both diagnostic and therapeutic purpose.

A U-VATS upper trisegmentectomy was performed uneventfully. The lesion was confirmed to be consistent with metastasis from prostate cancer. All lymph nodes were negative for metastases. He had an uneventful recovery and the chest tube was removed on post-operative day 2, following which he was discharged home with minimal pain medications. Two weeks later he was off all pain medications and returned to normal activities without restrictions.

Surgical technique

Equipments and instruments

We have evolved towards the use of technologies that enhance ergonomics and improve visibility during U-VATS.

Our routine operating equipment includes a 10 mm 3D camera that has a flexible tip (ENDOEYE FLEX 3D™, Olympus, USA). The advantages of this camera scope include the ability to visualize around tight corners and

to keep the camera at the lower corner of the uniportal incision, which reduces arm and shoulder fatigue for the assistant. In addition, the absence of a perpendicular light source attachment in the ENDOEYE (in contrast to the traditional thoracoscope) significantly reduces the clashes between the surgeon's instruments and the light cable. Unfortunately, the high definition 3D view cannot be transferred to video recordings.

As demonstrated in our video, we use an energy device such as the ultrasonic Harmonic Scalpel™ (Ethicon, USA) or the bipolar Ligasure™ with curved tip (Covidien, USA) to perform dissection and in some instances to seal and divide pulmonary vessels less than 7 mm in width. Another important instrument in our armamentarium is an articulating automated stapler (iDrive™, Covidien, USA) but even more critical is the availability of curved tip stapler loads (Endo GIA™ Curved Tip with Tristaple™ technology, Covidien, USA) to divide either the pulmonary vessels or the bronchus.

We use a soft tissue wound protector such as the Alexis™ wound protector (Applied Medical, USA) to prevent smudging of the camera scope.

Patient position and incision

General anesthesia with a double lumen endotracheal tube is used in all our U-VATS. The patient is positioned in the lateral decubitus thoracotomy position with the lower arm on a padded side board and the upper arm supported on a pillow roll placed between both arms.

The incision routinely measures between 2.5 to 4 cm and is made in the 5th intercostal space between the anterior and mid-axillary lines for either upper or lower lobe resections. In patients with long torsos, the incision may be made in the 6th intercostal space for lower lobectomy.

Operative technique for left upper lobe trisegmentectomy

During a planned segmentectomy for cancer, we perform the lymphadenectomy first and send the nodes for frozen section. If nodal metastasis is reported, we perform a formal lobectomy.

Step 1: hilar exposure

The pulmonary hilum is first exposed by incising the pleura along the anterior aspect of the hilum and any anterior hilar lymph nodes are removed as shown in the video. This dissection is then continued along the aorto-pulmonary window and proceeding posteriorly along the curve of the aorta, exposing the posterior aspect of the hilum and lymph nodes in these areas. Care should be taken to stay close to the pulmonary vessels to prevent injury to the recurrent laryngeal or phrenic nerve. The use of an energy vessel-sealing device also reduces the risk of electric or thermal injury to these nerves.

Step 2: lymphadenectomy

Once the hilum is exposed we proceed with thorough aortopulmonary (station 5), prevascular (station 6) and hilar lymphadenectomy (station 10).

Step 3: pulmonary vessel exposure and division

The anatomy of the left upper lobe pulmonary vasculature is the most variable among all the lobes, with virtually no normal pattern described (1). It is important to keep this variability in mind since one or more extra vascular branches to the upper trisegments may be present. Hence, we dissect and expose all upper trisegment vessels prior to dividing them. Posteriorly, one must be careful not to divide the superior segmental (part of the lower lobe) arterial branch, which may travel close to the posterior segmental artery. Removal of the segmental lymph nodes helps with visualization of the arteries.

The pulmonary veins to the upper trisegment are exposed and circumferentially dissected as the next step. The lingular vein is easily identified in most patients and spared. We find the use of either a blunt suction instrument or the Gonzalez-Rivas dissector (Scanlan International, USA) useful to dissect around the veins and the arteries (*Figure 1*).

We routinely do not divide the pulmonary veins before the arteries for three reasons: (I) in our experience, dividing majority of the arterial branches before the vein reduces vascular engorgement and allows the lung to empty, making it easier to remove through the small incision; (II) it is typically easier to divide the upper lobe vein after dividing the arterial branches; (III) it reduces the risk of injuring the artery during passage of the stapler, as shown in the video.

Step 4: upper trisegmental bronchial division

After the upper trisegmental vessels are divided, the trisegmental bronchus is exposed by removing the peribronchial lymph nodes or sweeping them towards the specimen side. One can easily palpate the bronchus to the lingula more anteriorly with the suction instrument during dissection and we do not typically expose this bronchus to avoid devascularizing it. Moreover, once the trisegmental

Figure 1 Left upper trisegmentectomy (2).
Available online: http://www.asvide.com/articles/1731

bronchus is clamped with the stapler, intraoperative bronchoscopy is performed to confirm that the bronchus to the lingula has not been compromised. Alternatively, the lung can be re-inflated and inflation of the lingula visualized, but we prefer bronchoscopic confirmation. We have found that occasionally the segment to be removed gets re-inflated as well and may not adequately deflate, making its removal through a small incision difficult. After confirming proper stapler placement, the bronchus is divided.

Step 5: parenchymal division

Next, the lung is inflated to identify the plane to divide the upper segments from the lingula. This line is marked with cautery and a medium thickness stapler is then used to divide the parenchyma.

Steps 6 and 7: specimen removal and subcarinal lymphadenectomy

After the specimen is removed using a specimen retrieval bag, further dissection of the interlobar (station 11L) and subcarinal (station 7) nodes is performed. The inferior pulmonary ligament is also divided and station 9L nodes are removed.

Step 8: chest tube placement

We routinely use a 19 Fr soft channel drain for all our U-VATS operations. The drain is placed through a separate stab incision in the skin inferiorly and sub-muscularly tunneled to the initial intercostal incision. We have found that this reduces the risk of air-leak around the incision and also is cosmetically superior to placing the chest tube within the U-VATS incision.

Comments

As with any new surgical technique or technology, it is important to demonstrate that sound surgical principles are followed and that oncologic principles are not compromised in U-VATS. It is imperative for U-VATS experts to include their techniques for mediastinal node dissection in their videos, especially on social media sites such as YouTube. This will increase adoption by many surgeons who remain skeptical of U-VATS.

Our video demonstrates that in addition to being able to perform a well-defined left upper lobe trisegmentectomy, lymph node dissection is not compromised during U-VATS procedures.

As more surgeons perform U-VATS, modifications are bound to happen which will help overcome current challenges, improve ergonomics and make it easier to teach. Most importantly, these refinements in techniques will hopefully improve patient outcomes and prove U-VATS to be a true advancement in surgery.

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Footnote

Conflicts of Interest: The author has 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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