Surgical Technique

Uniportal video-assisted thoracoscopic right upper lobectomy with systematic lymphadenectomy

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Abstract: Over the past decade, uniportal video-assisted thoracic surgery (VATS) has been reported to be a promising, less invasive alternative with potentially better cosmesis and less postoperative pain and paraesthesia. Although uniportal VATS has now evolved into a sophisticated technique capable of performing some of the most complex thoracic procedures, this approach to lobectomy is not standardized, and the surgical procedure still varies between surgeons. Here, we describe our uniportal VATS procedure during right upper lobectomy in a patient with a nodule in the right upper lobe. Subsequent mediastinal lymphadenectomy was performed to remove lymph nodes from the 2nd, 3rd, 4th, 7th, 8th, and 9th groups. Although there are some details that are different compared to the conventional VATS approach, as experience with uniportal VATS has grown, this approach is a viable alternative approach for lobectomy in selected patients.

Keywords: Video-assisted thoracic surgery (VATS); right upper lobectomy; lymph node excision; uniportal surgery; lung neoplasms

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Introduction

Traditional video-assisted thoracic surgery (VATS) lobectomy, usually performed through two to four incisions, allows multiple different angles of approach to the hilar structures and lymphatic tissues during VATS lobectomy (1). Over the past decade, the double- or multiple-port VATS lobectomy has become the first choice for early stage non small-cell lung carcinoma. However, lobectomy also can be accomplished with a single incision (uniportal), with potentially better cosmesis and reduced access trauma (2). Uniportal access was initially described by Rocco and colleagues for minor thoracic and pulmonary procedures (3,4). It has now become an increasingly popular approach to manage thoracic surgical diseases. Moreover, uniportal VATS has evolved into a sophisticated technique capable of performing some of the most complex thoracic procedures, such as anatomic segmentectomy, sleeve lobectomies, and pulmonary artery reconstructions (5-7). However, the uniportal VATS approach to lobectomy is not standardized, and the surgical procedure still varies between surgeons during lobectomy. This article presents our surgical experience with right upper lobectomy with systematic lymphadenectomy using uniportal VATS.

Clinical data

A 58-year-old woman presented with a finding of a right upper lobe lesion during incidental computed tomography (CT) screening. The patient had bronchoscopy with no significant positive findings, but refused the CT-guided biopsy. Chest CT imaging revealed a 12 mm × 15 mm solitary part-solid nodule in the right upper lobe (*Figure 1*). The patient had existing comorbidities with hypertension and hepatitis B, but denied any other medical history. She was also assessed preoperatively with a positron emission tomography and computerized tomography scan to evaluate the positive regional node and to ensure that there was no evidence of metastatic disease. Lung function was evaluated

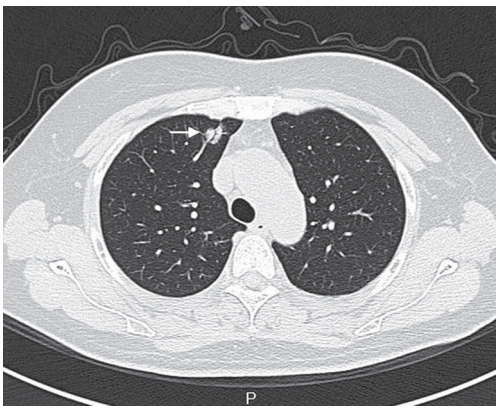

Figure 1 Computed tomography scan shows a 12 mm × 15 mm solitary part-solid nodule in the right upper lobe (arrow).

Figure 2 Uniportal video-assisted thoracoscopic right upper lobectomy with systematic lymphadenectomy (8).
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via formal spirometry with a FEV_1 of 2.08 L (96.8% predicted), a FVC of 2.08 L (97% predicted) and a FEV_1/FVC ratio of 84.79%.

Operative techniques

This describes our approach to uniportal VATS wedge pulmonary resection for the current case. A frozen section examination confirmed lung adenocarcinoma, and then right upper lobectomy with systematic lymphadenectomy was performed. The surgical procedure is described below (*Figure 2*).

Anesthesia and positioning

The patient was placed in the left lateral decubitus position with the arms extended to 90° (*Figure 1*). To protect the intercostal neurovascular bundles, the table was flexed to maximize the intercostal spaces. General anesthesia was induced and intubation was achieved via a double lumen endobronchial tube.

The surgeon and the assistant stood in front of the patient to maintain the same thoracoscopic vision during all steps of the procedure and experience more coordinated movements. When dissecting the inferior hilar structures, the surgeon stood caudally, while the assistant stood cranially; in contrast, when dissecting the superior hilar structures, the surgeon stood cranially, while the assistant stood caudally (*Figure 3*). Usually, the surgeon held the suction tool in the left hand and the harmonic scalpel in the right hand. The assistant held the thoracoscope in one hand and the endoscopic grasper in the other hand.

Ports

The incision, about 4–5 cm long, was performed in the 5th intercostal space in the anterior position. A 3.5-cm plastic wound protector kept the utility wound open and prevented the lung from expanding when suction was applied. For most of the surgical steps, a 30°, high-definition, 10-mm thoracoscope was usually placed at the posterior part of the utility incision with the working instruments in the anterior part.

Right upper lobectomy (Figure 2)

In this case, since it was not clear whether the lobe was malignant prior to surgery, wedge pulmonary resection was performed first. Due to a minor incomplete horizontal fissure between the upper and middle lobe, the fissure was first dissected using a harmonic scalpel. Nodule identification was performed under camera view. After isolation in the horizontal fissure, the nodule in the right segmental ventrale was resected at least 2 cm from the nodule edge using a staple (Covidien Inc., Mansfield, MA, USA). The nodule was removed in a protective bag. Lung adenocarcinoma was confirmed via frozen section examination, and then right upper lobectomy was performed.

To expose the posterior segmental artery, we continued to divide and staple the incomplete oblique fissure using the stapler, pulling the parenchyma anteriorly to ensure that the middle lobe artery was to the left side of the stapler (*Figure 4A*). The subsequent dissection sequence was as follows: posterior segmental artery, right upper vein, anterior,

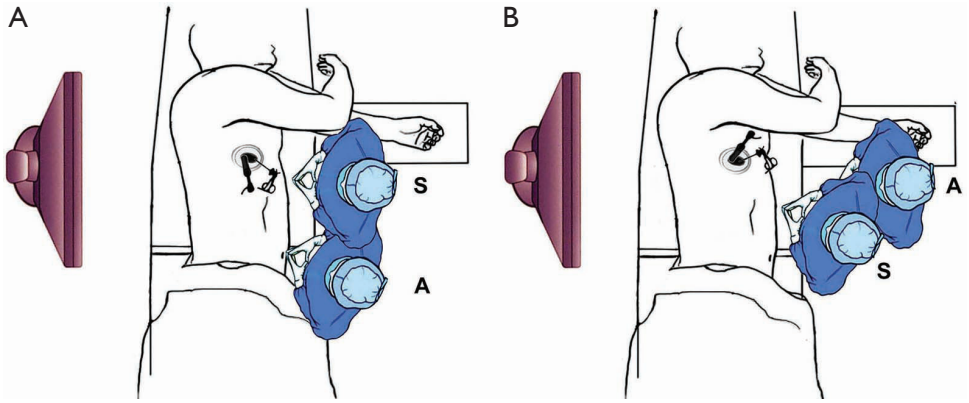

Figure 3 The surgeon and assistant positioned in front of the patient watching the same monitor. (A) When dissecting the inferior hilar structures, the surgeon stood caudally, while the assistant stood cranially; (B) when dissecting the superior hilar structures, the surgeon stood cranially, while the assistant stood caudally. S, surgery; A, assistant.

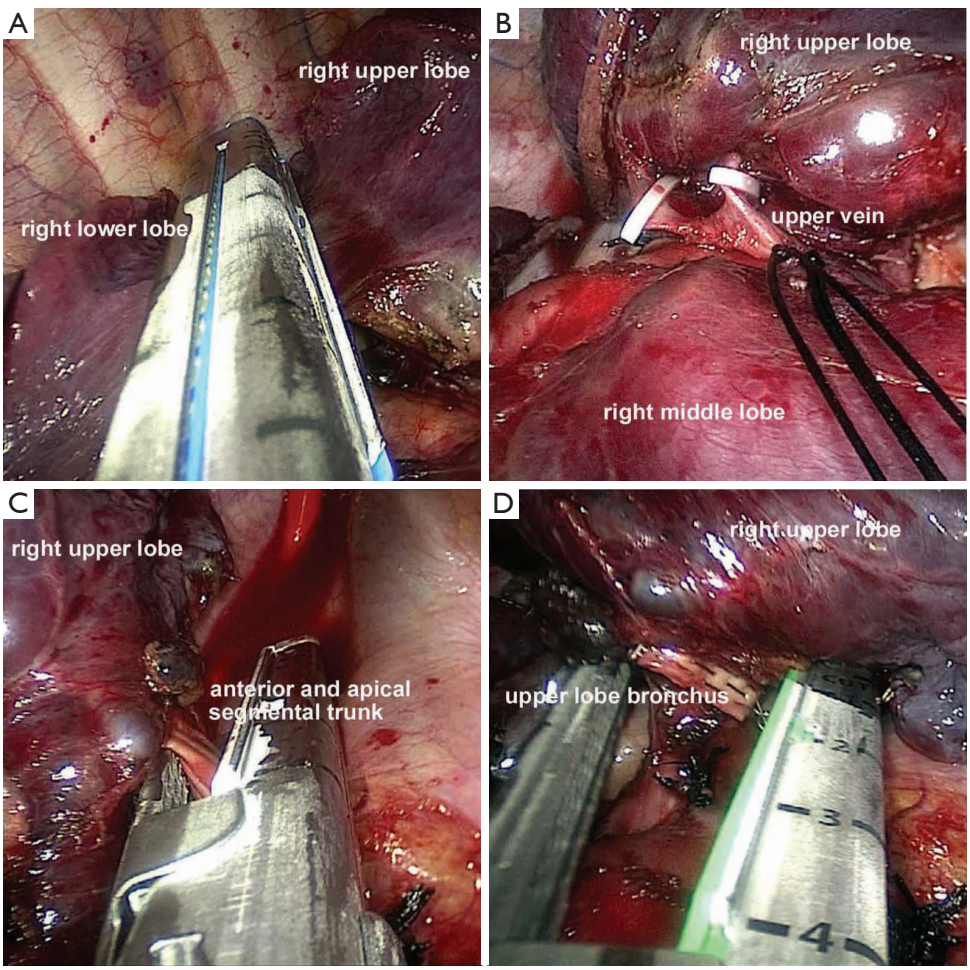

Figure 4 The uniportal VATS right upper lobectomy procedures. (A) The incomplete oblique fissure was stapled as the first step; (B) the upper vein was cut by placing hemoclips and using ligation; (C) the anterior and apical segmental trunk was stapled with the guidance of a 16-F-urinary catheter; (D) the upper lobe bronchus was stapled. VATS, video-assisted thoracic surgery.

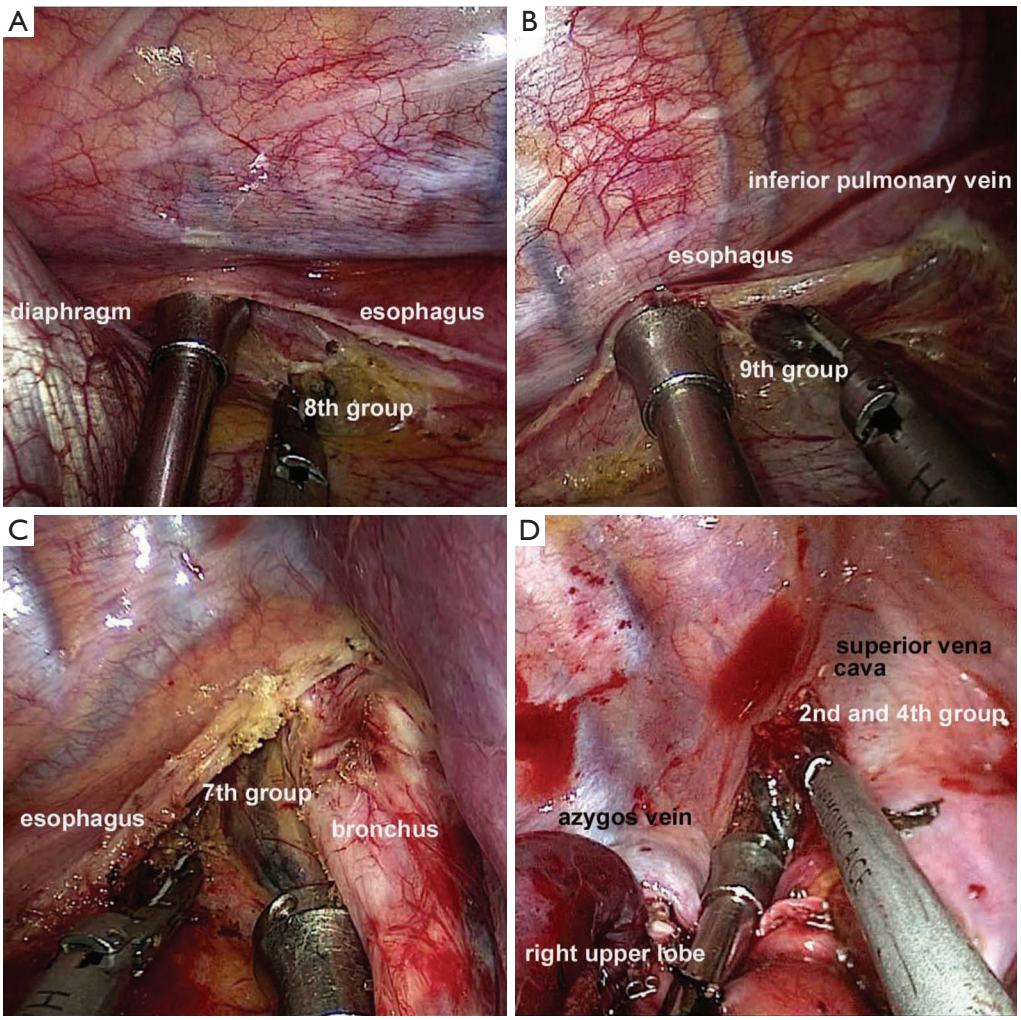

Figure 5 Radical mediastinal lymph node dissection. (A) The 8th group; (B) the 9th group; (C) the 7th group; (D) the 2nd and 4th group.

apical segmental trunk and upper bronchus. The posterior segmental artery was firstly exposed, dissected, and ligated. To obtain a better angle for the insertion of the staples to the artery, the upper vein was then dissected free and divided. However, in this case, there was no angle for staple insertion at the upper vein from the incision; in such cases, we doubly ligate the proximal vein, using clips for distal vascular control (*Figure 4B*). Usually, once this vein is stapled, the anterior and apical segmental trunk are easily exposed when the right upper lobe is pushed down and then stapled with the guidance of a 16F-urinary catheter (*Figure 4C*). After stapling the anterior and apical segmental trunk, the upper lobe bronchus was exposed. We recommend removal of the interbronchial lymph nodes (12th group) to better define the anatomy. The upper lobe bronchus was stapled (*Figure 4D*), and we ensured that the vascular stumps were away from the stapler's jaws. When the lobectomy was completed, the lobe was removed in a protective bag through the utility incision.

Radical mediastinal lymphadenectomy

After the lung was removed, a radical mediastinal lymph node dissection was performed. The lung was pushed downwards by the assistant. Upon retracting the lobe with a long-curved grasper, the inferior pulmonary ligament was mobilized, and the 8th and 9th group lymph nodes were dissected (*Figure 5A,B*). Then, the lung was pushed forwards by the assistant. The posterior mediastinal pleura was opened in front of the right vagus nerve, from the right inferior pulmonary vein to the azygos vein. After the esophagus and the intermediate bronchus were separated to facilitate the procedure, the right subcarinal lymph node (7th

Figure 6 Incision on the right side. A chest tube was placed in the posterior part of the incision.

group) was dissected en bloc (*Figure 5C*). After opening the pleura inferiorly to the azygos vein, lifting the azygos vein, and retracting the superior vena cava to the right side, the paratracheal lymph node (2nd and 4th group) were dissected en bloc (*Figure 5D*). The 3rd group was also dissected. Finally, the lung was re-expanded for air leakage testing for the bronchial stump and pulmonary resection margin. A single 24F chest tube was placed in the posterior part of the incision up to the tip of the thoracic cavity prior to closure of the port site (*Figure 6*). No additional incisions were made for the chest tube placement.

Postoperative management

The operative time was 142 min. The time of right upper lobectomy was 50 min, and the lymph node dissection time was 45 min. The number of lymph nodes dissected was 24. Patient bleeding was 100 cc. This patient was observed one day in the ICU, and postoperative drainage continued for three days. The chest tube was removed postoperatively when the daily chest tube drainage was <100 cc with no air leakage and sufficient lung expansion on chest radiographs. Postoperative hospitalization time was five days. There was no complication. Final pathology revealed a T1N0M0 lung invasive adenocarcinoma.

Comments

At present, uniportal VATS is not only indicated for initial stages or easy cases, but has evolved into a sophisticated technique capable of performing some of the most complex thoracic procedures in the same manner as a double- or multiple-port approach (9,10). However, there are still some detailed changes for the surgical procedure in comparison to the classical multiple-port approach.

In comparison, we feel that conventional multiple ports create an optical plane that requires a torsional angle and that single ports provide a direct view to the target tissue, which mimics the internal maneuvers performed during open surgery (1,11). Therefore, there are some differences in the processing sequence to the lung fissure, blood vessels, and bronchus. For the right upper lobectomy such as in this case, we recommend first dividing the fissure to provide a much better field of the relationship with the hilar structure. The normal sequence of the subsequent dissection is as follows: upper vein, posterior segmental artery, anterior and apical segmental trunk, and upper bronchus. However, when there is no angle for staple insertion for the upper vein from the incision, we strongly recommend placing hemoclips and using ligation.

Compared to traditional VATS, uniportal VATS has more demands for the cameraman (12). Optimal exposure of the lung is vital to facilitate dissection of the structures and to avoid instrument interference. Under such conditions, the cameraman is required to raise his or her arm to hold the thoracoscope. Moreover, with different anatomical locations, the relative position of the surgeon and assistant need to change.

In our experience, based upon the evolution from multiple-port to single-port VATS, we have applied the single-port technique mostly for pulmonary resections. We expect further development of new technologies such as double-jointed forceps and wireless cameras, which may allow the uniportal approach to become an easy and standardized approach for even the most complex thoracic procedures at centers with consistent experience with multiple-port VATS.

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Footnote

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

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