A hybrid approach incorporating uniportal thoracoscopy for lobectomy with en bloc chest wall resection

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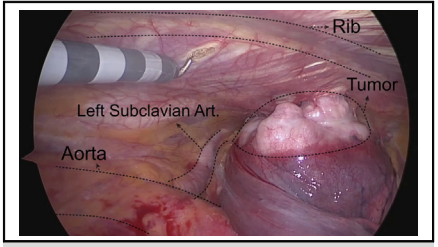


Uniportal view of a tumor with invasion of the chest wall.

CENTRAL MESSAGE

Uniportal video-assisted thoracoscopic surgery enables surgeons to perform complex procedures, such as lobectomy and en bloc chest wall resection, which is demonstrated in this report.

▶ Video clip is available online.

Lung cancer with chest wall invasion (CWI) comprises approximately 5% of operable lung neoplasms, and extended resections are performed to maximize local disease control.[1] Tumors with CWI are classified as T3 but have a higher rate of incomplete resection (25.9%) and recurrence (55.6%) than other T3 tumors due in part to the technical difficulty of resecting the portion of the tumor that has invaded the chest wall.[2,3]

Video-assisted thoracoscopic surgery (VATS) using a single port—uniportal VATS (UVATS)—has evolved and become an acceptable minimally invasive approach for thoracoscopic resection with similar oncologic outcomes as VATS using multiple ports.[4,5] UVATS offers surgeons a direct view, similar to that obtained in open surgery, and may result in less pain and decrease the risk of adverse events postoperatively.[6] UVATS reflects the instinct of thoracic surgeons to push the limits without compromising safety or oncologic quality.[7]

METHODS

UVATS resection of a tumor invading the chest wall is described in 10 distinct steps, each with an accompanying video. We use the location where the tumor invades the chest wall as a traction point, allowing visualization of the hilum and completion of the lobectomy with fewer instruments, which is important when employing UVATS. UVATS, combined with a counter incision, allowed for precise definition of the tumor margins within the chest wall and limited rib resection to the minimum needed for proper oncologic margins.

RESULTS

The hybrid approach to achieve a UVATS left upper lobectomy with chest wall resection presented here was performed in a 60-year-old woman with a left upper lobe (LUL) mass measuring 3.5 × 3.0 cm infiltrating the chest wall (Figure 1). The patient was staged with imaging tests as T3 N0 M0. After multidisciplinary tumor board discussion, upfront resection was offered as long as invasive mediastinal staging was negative. Before resection, mediastinoscopy was performed and biopsies of station 4 bilaterally and station 7 were negative. The postoperative period was uneventful, and the final pathological staging was pT3 N0 M0 with negative margins.

STEPS FOR HYBRID UVATS RESECTION OF LUNG TUMORS WITH CWI

1. Videomediastinoscopy and Mediastinal Lymph Node Dissection (Video 1)

With the patient placed supine with cervical extension, a 2-cm transverse incision is made 1 fingerbreadth above the sternal notch. Dissection is carried down sharply to the

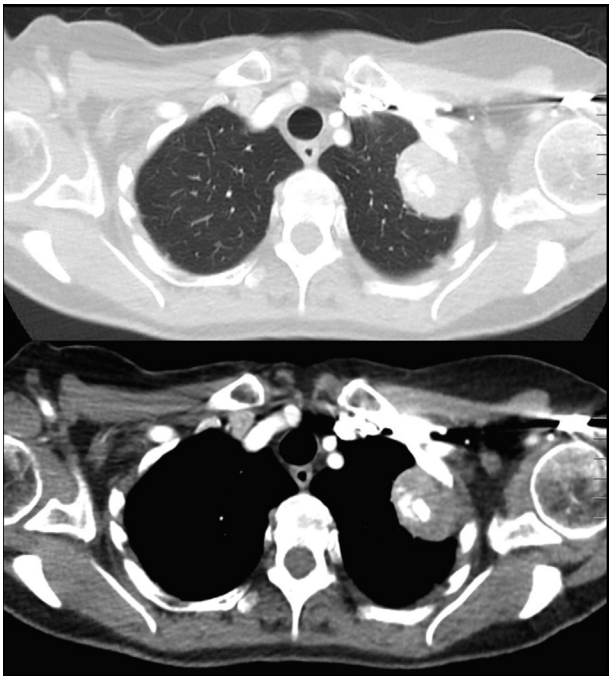
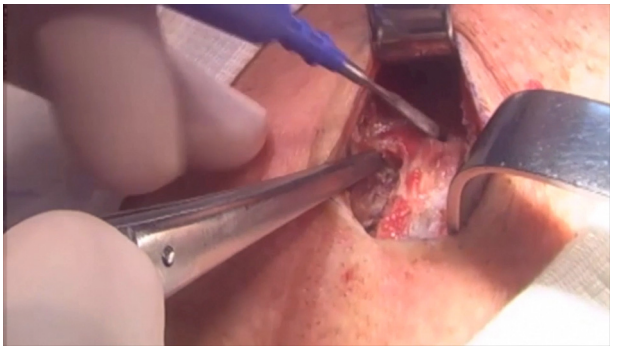


FIGURE 1. Preoperative computed tomography of left upper lobe lung cancer with chest wall invasion.

pretracheal fascia. After videomediastinoscopic inspection, lymph node (LN) stations 4R, 4L, and 7 are dissected with the tip of the sucker and an energy device and submitted for frozen section analysis. This is a reasonable approach when the surgeon opts to resect station 4L, and avoids the risks of performing this resection through VATS.

2. Patient Positioning and Port Placement (Video 2)

Under general anesthesia and single-lung ventilation with a double-lumen endotracheal tube, the patient is placed in lateral decubitus with the hips flexed. The surgery is performed through a single port placed with a 3- to 4-cm incision in the fifth intercostal space, generally at the anterior axillary line.

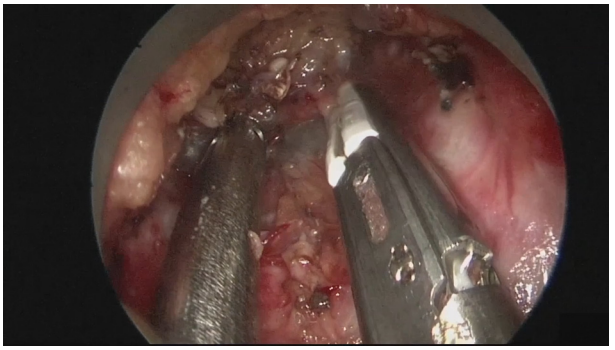


VIDEO 2. Patient positioning and port placement. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.

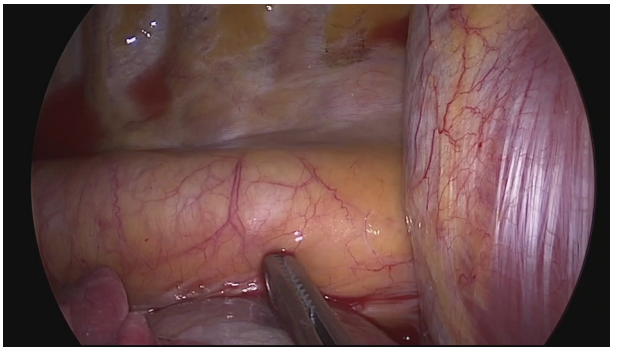
A preemptive intercostal nerve block is routinely done near the incision site in the third, fourth, and fifth intercostal spaces. After transecting the serratus anterior muscle, a tunnel is created under the serratus toward the patient's back, and the intercostal muscle is transected. This internal thoracotomy promotes better exposure, more comfort, and easier removal of the specimen. A wound protector is placed for optimal exposure and to facilitate the use of instrumentation.

3. Dissection of the Posterior Mediastinal Pleura and LN Stations 9 and 10 (Video 3)

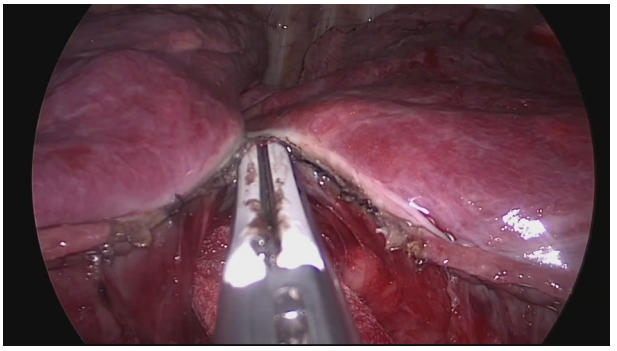
The pleural cavity is inspected using a 5-mm, 30° camera to ensure the absence of pleural implants. The lesion and CWI are identified. Traction is then placed on the left lower lobe anteriorly and cranially to expose the pulmonary ligament and posterior mediastinal pleura. After opening the pleura, which allows identification of the esophagus, pulmonary artery, and main airway, LN stations 9 and 10 (posterior) are systematically dissected.



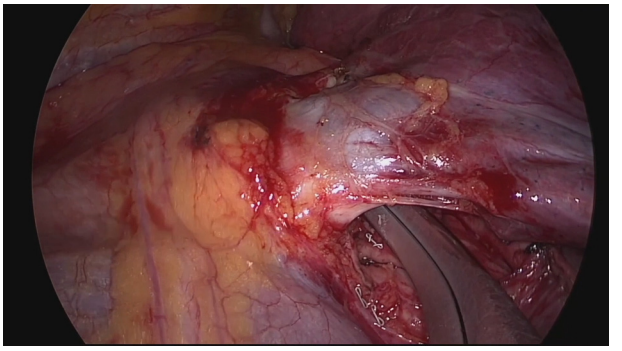
VIDEO 1. Videomediastinoscopy and mediastinal lymph node dissection. In the patient shown, frozen-section analysis of these lymph node stations was consistent with lymphoid tissue. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.



VIDEO 3. Dissection of the posterior mediastinal pleura and lymph node stations 9 and 10. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.



VIDEO 4. Anterior hilar and interlobar dissection with fissure division. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.



VIDEO 6. Pulmonary vein cerclage and stapling. *PA*, Pulmonary artery; *SPV*, left superior pulmonary vein. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.

4. Anterior Hilar and Interlobar Dissection With Fissure Division (Video 4)

Traction is placed on the LUL toward the spine, providing good exposure of the anterior portion of the hilum. The mediastinal pleura is dissected between the superior and inferior pulmonary veins, and the level 10 anterior LN station is easily identified and dissected. The dissection progresses toward the superior pulmonary vein and interlobar space, and the secondary carina can be visualized. The dissection of the fissure and the interlobar LNs (station 11) allows complete exposure of the pulmonary artery.

5. Stapling the Lingular and Apicoposterior Arterial Branches (Video 5)

The lingular (A4-5) and apical-posterior ($A1+2^{c}$) branches of the pulmonary artery are separated and divided with a vascular stapler. LN station 13 is dissected.

6. Pulmonary Vein Cerclage and Stapling (Video 6)

LN station 10, which is close to the superior pulmonary vein and located on the pulmonary artery, is identified and dissected. During this dissection, we ensure that there are not strong adhesions to the pulmonary artery. Now well exposed, the pulmonary vein is dissected and safely retracted away from the LUL bronchi with Semb forceps to allow passage of a curved tip vascular stapler, which is then applied to the vein.

7. Dissecting and Stapling the $A1+2^{a+b}$ + A3 Arterial Branches (Video 7)

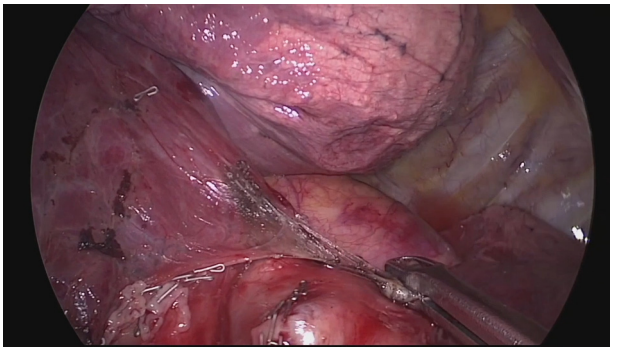
With the LUL vein transected, space is created for the dissection of the $A1+2^{a+b}$ + A3 branches of the pulmonary artery with a curved-tip vascular stapler.

8. Exposure and Stapling of the Bronchus (Video 8)

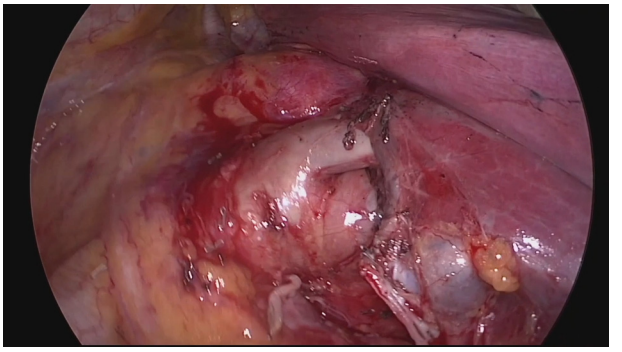
At this point, the only structure remaining of the LUL hilum is the bronchus, which is easily sectioned using a medium-thickness tissue stapler load.

9. Scoring Planned Margins and Division of Intercostal Muscles (Video 9)

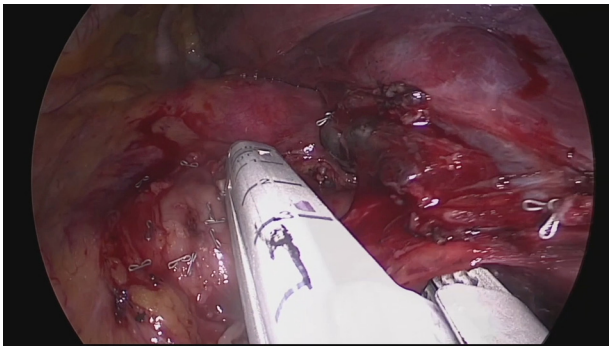
The intercostal musculature is sectioned using a hook and a bipolar energy device, and the oncological macroscopic margins are defined and scored.



VIDEO 5. Stapling the lingular and apicoposterior arterial branches. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.



VIDEO 7. Dissecting and stapling the $A1+2^{a+b}$ + A3 arterial branches. *PA*, Pulmonary artery. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.



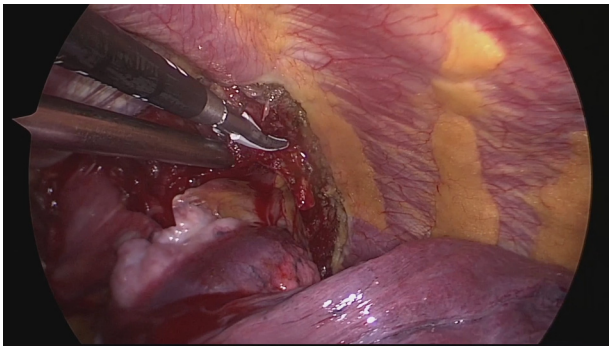
VIDEO 8. Exposure and stapling of the bronchus. *LUL*, Left upper lobe. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.

10. Counter Incision and Thoracoscopic-assisted Rib Resection (Video 10)

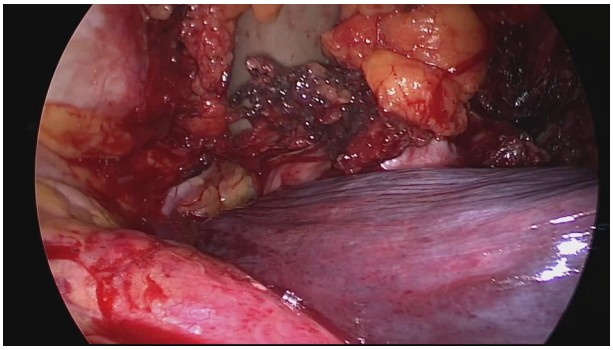
Through an axillary counter incision and with the aid of the surgeon's finger, an extrafascial space is created to collapse the lesion and define the oncologic margins. The second and third ribs are resected through the counter incision taking advantage of the hybrid approach. Hemostasis is achieved and the intercostal bundles are sealed using bipolar energy. The specimen is removed in a sterile bag. In this patient, patching of the defect was not required due to the apical location of the tumor behind the scapula and the small chest wall resection (<5 cm) that was required. However, patching should be considered in all patients who require chest wall resection.

DISCUSSION

Surgical planning for resection of lung tumors with CWI is always challenging. The promise of faster recovery, decreased use of analgesics, shorter intubation time, and lower rates of chronic pain move us to perform these procedures using increasingly less invasive techniques. Berry and colleagues[8] first demonstrated that thoracoscopic lobectomy with en bloc chest wall resection was safe and feasible. In their retrospective study of 105 resections for non–small cell lung cancer with CWI, 12 resections were performed using a hybrid thoracoscopic approach, and 93 were performed via thoracotomy. Postoperative outcomes were similar, with a shorter length of stay after the hybrid procedure.[8] In 2013, Gonzalez-Rivas and colleagues[9] reported right upper lobectomy with a precise chest wall resection performed under intrapleural visualization through an posterior incision before UVATS lobectomy through an anterior incision. Drevet and Ugalde Figueroa[10] analyzed outcomes after UVATS for both standard and complex pulmonary resections. For lung anatomic resections, UVATS required a steep learning curve; however, once proficiency was gained, the surgeons could confidently perform more complex surgeries.[10] In the procedure detailed here, the addition of a counter incision immediately above the location where the tumor invades the chest wall facilitates the chest wall resection because the steep angle for placing the rib cutter ensures proper oncologic margins. UVATS resection has proven to be a feasible approach to complex lung lesions when performed at an experienced center.



VIDEO 9. Scoring planned margins and division of intercostal muscles. A green circle highlights the location of the tumor with chest wall invasion. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.



VIDEO 10. Counter incision and thoracoscopic-assisted rib resection. A green circle highlights the location of the tumor with chest wall invasion. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00269-4/fulltext.

CONCLUSIONS

The 10 steps of the procedure outlined in this report, a hybrid coupling UVATS LUL with a counter incision to obtain appropriate margins within the chest wall, offer a safe and reliable pathway to perform resection of lung tumors with CWI. In experienced hands, the oncologic outcomes of this procedure are comparable with open surgery with added benefits characteristic of a minimally invasive approach.

Conflict of Interest Statement

Dr Ugalde discloses relationships as a consultant for AstraZeneca, Bristol, Ethicon, and Medtronic. All other authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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