

# Subxiphoid mediastinal lymphadenectomy

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**Abstract:** Video-assisted thoracoscopic surgery (VATS) has experienced an exponential growth in lung anatomic resections. Since its beginnings in early 90s with the conventional multiport VATS to the more recent uniportal approach, a continuous search for a less invasive procedure has fueled the development of minimally invasive thoracic surgery. In this sense, subxiphoid uniportal VATS has emerged as a uniportal option that avoids damage to the intercostal nerve created in a transthoracic approach. In order for this technique to become an acceptable choice for lung cancer, oncologic principles must be respected, including a feasible and safe mediastinal lymphadenectomy. Although technically more difficult than other VATS approaches, a complete lymphadenectomy is possible in the hands of expert VATS surgeons through a subxiphoid approach.

**Keywords:** Uniportal video-assisted thoracoscopic surgery (VATS); lymph node dissection; lymphadenectomy; minimally invasive; subxiphoid; novel procedure

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## Introduction

The surgical treatment of lung cancer has evolved considerably in the last two decades and video-assisted thoracic surgery has played a key role in this development. The first video-assisted thoracoscopic surgery (VATS) lobectomy was performed in the early 90s (1) starting the trend of VATS for the curative treatment of lung cancer. Initially the surgery was typically performed with three small incisions without rib spreading (2) and large case series were reported with good results last decade (3). Variations of the approach were made in the quest for a less invasive surgery and needlescopic and 2-port VATS were also performed successfully for anatomic lung resections. By 2010, the first uniportal VATS lobectomy was achieved by the team led by Dr. Gonzalez (4), which started the era of uniportal VATS lobectomies. Since then large series with this approach has been reported by different groups around the world, establishing the safety and feasibility of

the technique (5-7). As an alternative single port approach, a variety of thoracic procedures were performed through a subxiphoid incision, avoiding a transthoracic approach and preventing intercostal nerve damage. In 2016, the team from Shanghai Pulmonary Hospital published their results with more than 100 cases performed through a single port subxiphoid approach (8).

Some studies have suggested that avoiding a transthoracic approach could prevent nerve damage, resulting in less postoperative pain and neuralgia (9).

The consolidation of uniportal VATS surgery has been achieved since the oncologic principles of an anatomic lung resection are not compromised using this approach, and mediastinal lymph node dissection can be performed as efficient and safe as in other VATS approaches or open surgery. Mediastinal lymph node dissection in uniportal subxiphoid VATS is more demanding and technically difficult, so a lot of training and experience is necessary before attempting a lobectomy or segmentectomy for lung cancer (10).

## Patient selection and workup

Uniportal subxiphoid VATS lobectomy is a novel technique, few cases are reported in the literature, and the experience performing these cases is limited to few groups (8-11). It is very important to select proper cases for this approach. Subxiphoid surgery is technically more difficult compared to intercostal VATS and has some limitations that are related to the site of the incision. Patients with obesity should not be selected for a subxiphoid approach since increased mediastinal and subcutaneous fatty tissue would increase the difficulty of the operation due to a larger tunnel and compromise exposure. A highly located diaphragm due to abdominal pressure in obese patients would obstruct maneuvering and also compromise adequate exposure for dissection, especially station 7.

Patients with cardiac comorbidities should also be avoided since heart compression and retraction is frequent during the surgery, especially in the left side and this can even be persistent when dissecting stations 2R, 4R, 5 and 6. Patients with suspected N2 disease should also be discarded for this approach since the complexity and extension of the dissection could be very difficult to complete successfully with a subxiphoid approach, compromising oncologic results. In this stage of the evolution of the technique, complex cases such as an advanced or centrally located tumors, patients with prior ipsilateral thoracic surgeries or severe adhesions should not be selected for a uniportal subxiphoid lobectomy.

Proper staging and preoperative workup is very important to select the correct candidate for this approach. The chest CT has to be examined carefully to detect enlarged interlobar or mediastinum lymphadenopathy. When documented in the preoperative CT a transthoracic approach should be preferred.

## Equipment preference card

Special equipment is not mandatory but it does facilitate the procedure since there are some special considerations regarding the instruments. Since the distance from the incision to the thoracic cavity is longer and the ribs are not there to prevent the collapse of the tunnel, a wound retractor should be used to keep the incision tunnel open, prevent smearing of the camera and facilitate the introduction of the instruments. Instruments must be longer, thin and better angled (8). A 30 degree 10 mm

camera provides a good visualization of the operative field, and is critical when performing station 7 dissection, since changing the angle of the lens can provide a good visualization in a very narrow field. Energy devices such as Ligasure or Harmonic Scalpel can help maintaining hemostasis during lymph node dissection, although sometimes, since they are not angled, the correct plane of dissection is difficult to achieve.

## Procedure

Under general anesthesia, with double lumen endotracheal intubation, the patient is placed in 60–70 degree lateral decubitus position, elevating the side in which the surgery is going to be performed.

The monitor is usually placed at the head of the patient; the surgeon is located in front of the patient and the assistant holding the camera, in the opposite side. The role of the assistant is of key importance, it should have prior experience assisting in uniportal subxiphoid VATS and the surgeon should not attempt anatomic lung resections unless this is the case. Achieving the correct view of the surgical field is very difficult and more challenging in subxiphoid VATS than in any other VATS procedure. Constant communication and coordination between both is critical.

A 4–5 cm subxiphoid incision is made; the incision can be made in different ways according to the preference of the surgeon. It can be a vertical midline incision or a horizontal incision below the sternocostal triangle. A one sided, oblique incision from the xiphoid process and alongside the costal arch can be used also, and it diminishes compression to the heart (8) and facilitates the access to station 7 during lymph node dissection.

After completing the lobectomy, mediastinal lymph node dissection or sampling should be undertaken according to the case.

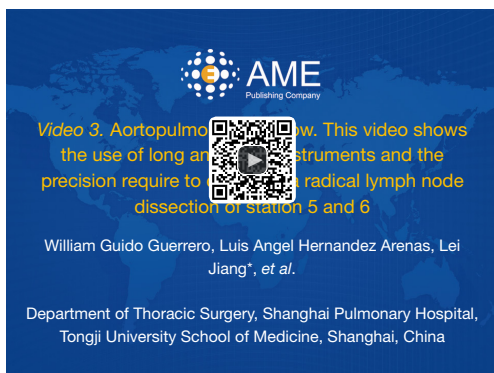
In the right side station 2 and 4 are dissected with the help of longer and more curve instruments that facilitates de exposure. Bimanual instrumentation and proper retraction of the lung facilitates exposure and visualization (*Figure 1*). When exposure is not ideal and dissection is technically difficult, the azygous vein can be transected with a stapler or separated with a silk. This would improve visualization of the operative field and can prevent bleeding from rupture of the azygous vein during dissection, since is in the path of the instruments in order to gain access to the paratracheal



**Figure 1** Right paratracheal lymphadenectomy. The video shows a radical lymph node dissection, which is possible thanks to proper lung retraction and bimanual instrumentation (12). Available online: <http://www.asvide.com/articles/1002>



**Figure 2** Subcarinal lymph node dissection. This video shows the difficulty and complexity of station 7 lymph node dissection, exposure and instrumentation is complicated by the diaphragm and heart (13). Available online: <http://www.asvide.com/articles/1003>



**Figure 3** Aortopulmonary window. This video shows the use of long and curve instruments and the precision require to complete a radical lymph node dissection of station 5 and 6 (14). Available online: <http://www.asvide.com/articles/1004>

space. The next step is to remove the pulmonary ligament (in upper lobectomies) in order to expose the subcarinal space, the lower lobe must be retracted upwards and medially and the diaphragm pushed away with another instrument to facilitate exposure and visualization. After liberating the ligament, the lung must be retracted medially and the subcarinal space cleared. This is the most complex and difficult step of the lymph node dissection in both sides, because the access, instrumentation and dissection are very challenging. Radical lymph node dissection of station 7 should only be attempted by expert surgeon with experience in subxiphoid lobectomies in order to reduce the incidence of complications (*Figure 2*). A unilateral oblique incision can reduce heart compression and facilitate the access to the subcarinal space, making the dissection easier.

In the left side, retraction of the lung downwards and putting the patient in anti-Trendelenburg position improve the exposure of station 5 and 6. Care should be taken to avoid injury to the recurrent laryngeal nerve (*Figure 3*). The heart is in the path of the instruments in the left side, so care should be taken to avoid injury or minimized compression during dissection of station 5 and 6. As in the right side, the lower pulmonary ligament is divided in order to facilitate exposure of station 7 and 8. The subcarinal space is even more complicated in the left side, since the heart beating and compression becomes troublesome for the surgeon.

Only after acquiring considerable experience a surgeon is able to complete a mediastinal lymph node dissection in a uniportal subxiphoid lobectomy, the learning curve is very steep and caution is advice to avoid complications.

### Role of team members

When performing a uniportal VATS subxiphoid lymph node dissection, it is important that every team member has previous experience in single port VATS, since it will smooth the learning process and technical challenges inherent to subxiphoid VATS (10).

The anesthesiologist should provide a good lung collapse and take care to avoid diaphragm movement, because in case the diaphragm starts to contract, the surgery through a subxiphoid approach, and specially the lymph node dissection would be impossible to perform.

The assistant has to keep a very good coordination and communication with the surgeon and be very focused in using the proper angulation of the camera to show clearly

the structures the surgeon is dissecting. The assistant can also provide aid with retraction of the lung with another instrument, so that the surgeon can use both of his instruments in the dissection process.

The surgeon must be the leader of the procedure, addressing to the other team members about the steps ahead and letting the assistant know what is the vision angle needed and proper retraction in order to facilitate the step being performed in any moment of the surgery.

### Post-operative management

The postoperative management should not differ from other VATS procedures. One 28F chest tube is placed in the thoracic cavity for unilateral resections and bilateral drainage is carried out, inserting both chest tubes through the same subxiphoid incision. Pain medication requirements may be lower, since less postoperative pain is expected as suggested by some studies (11), but more studies and randomized trials are needed to confirm this.

### Tips, tricks and pitfalls

- Previous experience with transthoracic uniportal VATS is required, and only expert VATS surgeons should attempt uniportal subxiphoid VATS lymph node dissection;
- Placement of a wound retractor helps to maintain the subxiphoid surgical tunnel patent, simplifying instrument introduction and instrumentation during surgery;
- In paratracheal right side dissection, looping or dividing the azygous vein is needed in some cases for better exposure and retraction while removing lymph nodes;
- Lymph node dissection in station 7 is the most difficult step, and should only be performed by expert surgeons in subxiphoid VATS lobectomies;
- Proper traction of the lung and changes in bed positioning are required to access the subcarinal space.

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### Footnote

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

### References

1. Roviato G, Rebuffat C, Varoli F, et al. Videoendoscopic pulmonary lobectomy for cancer. *Surg Laparosc Endosc* 1992;2:244-7.
2. Sihoe AD. The evolution of minimally invasive thoracic surgery: implications for the practice of uniportal thoracoscopic surgery. *J Thorac Dis* 2014;6:S604-17.
3. McKenna RJ Jr, Houck W, Fuller CB. Video-assisted thoracic surgery lobectomy: experience with 1,100 cases. *Ann Thorac Surg* 2006;81:421-5; discussion 425-6.
4. Gonzalez D, Paradela M, Garcia J, et al. Single-port video-assisted thoracoscopic lobectomy. *Interact Cardiovasc Thorac Surg* 2011;12:514-5.
5. Gonzalez-Rivas D, Paradela M, Fernandez R, et al. Uniportal video-assisted thoracoscopic lobectomy: two years of experience. *Ann Thorac Surg* 2013;95:426-32.
6. Shen Y, Liu Y, Feng M, et al. Uniportal video-assisted thoracoscopic lobectomy: Zhongshan experience. *J Vis Surg* 2015;1:5.
7. Aragón J, Pérez Méndez I. From open surgery to uniportal VATS: asturias experience. *J Thorac Dis* 2014;6:S644-9.
8. Song N, Zhao DP, Jiang L, et al. Subxiphoid uniportal video-assisted thoracoscopic surgery (VATS) for lobectomy: a report of 105 cases. *J Thorac Dis* 2016;8:S251-7.
9. Liu CC, Wang BY, Shih CS, et al. Subxiphoid single-incision thoracoscopic left upper lobectomy. *J Thorac Cardiovasc Surg* 2014;148:3250-1.
10. Gonzalez-Rivas D, Yang Y, Lei J, et al. Subxiphoid uniportal video-assisted thoracoscopic middle lobectomy and anterior anatomic segmentectomy (S3). *J Thorac Dis* 2016;8:540-3.
11. Nan YY, Chu Y, Wu YC, et al. Subxiphoid video-assisted thoracoscopic surgery versus standard video-assisted thoracoscopic surgery for anatomic pulmonary lobectomy. *J Surg Res* 2016;200:324-31.
12. Guido Guerrero W, Hernandez Arenas LA, Jiang L, et al. Right paratracheal lymphadenectomy. The video shows a radical lymph node dissection, which is possible thanks to proper lung retraction and bimanual instrumentation. *Asvide* 2016;3:243. Available online: <http://www.asvide.com/articles/1002>
13. Guido Guerrero W, Hernandez Arenas LA, Jiang L, et al. Subcarinal lymph node dissection. This video shows the difficulty and complexity of station 7 lymph node

- dissection, exposure and instrumentation is complicated by the diaphragm and heart. *Asvide* 2016;3:244. Available online: <http://www.asvide.com/articles/1003>
14. Guido Guerrero W, Hernandez Arenas LA, Jiang L, et al. Aortopulmonary window. This video shows the use of

long and curve instruments and the precision require to complete a radical lymph node dissection of station 5 and 6. *Asvide* 2016;3:245. Available online: <http://www.asvide.com/articles/1004>

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