



Subxiphoid uniportal video-assisted thoracoscopic surgery in lung cancer resection

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Exponential advances in surgical technology have enabled moving to less invasive technique. Achievement of radical resection whatever the chosen approach is the fundamental integral part of oncological surgical principles. In 2014, Liu *et al.* (1) described the first uniportal video-assisted thoracoscopic surgery (VATS) lobectomy through subxiphoid incision harnessing that to decrease pain score by avoidance a traumatic insult to the intercostal nerve. Subxiphoid access is a novel approach for unilateral or bilateral lung tumor resection. The subxiphoid approach is safe, oncological achievable, it can alleviate postoperative pain and reduce hospital stay (2). Furthermore, it allows patients to resume physical activity quicker, which makes this approach preferable in selected patients.

The indications of subxiphoid approach included the presence of early stage lung cancer (2), without suspicious mediastinal lymph nodes metastasis, and thymectomy. Then, it is considered a worthwhile tool for bilateral lung lesions resection, both lung metastasectomies (3), bilateral lung blebs resection in bilateral pneumothorax and pericardial window, or even pneumonectomy in specific circumstances (4).

Meticulous selection of those who are candidates for this approach including patients having a tumor, or ground glass opacity (GGO) within 2 cm in maximum dimension, lacking mediastinal lymph nodes involvement. But the drawbacks of subxiphoid approach are obvious, such as: hilar centrally located tumor, tumor abutting chest wall, obesity with body mass index (BMI) $>30 \text{ kg/m}^2$ (5), adhesions related to previous surgery, cardiomegaly, cardiac comorbidities, and highly probable mediastinal lymph nodes metastasis (5) are relative contraindication.

The incidence of postoperative chronic pain and chest wall numbness can reach up to 45% (6). Chronic pain affects the long-term quality of life after surgery (7).

Subxiphoid incision is associated with less postoperative pain and neuralgia after 6 months comparable with transthoracic access (1), therefore, subxiphoid has been promoted to clinical practice (3). Moreover, faster recovery may allow patients to begin adjuvant therapy earlier. Also, enhances early physical activities such as: coughing, sputum expelling and starting ambulation earlier. In this regards, subxiphoid access is considered a worthwhile tool due to minify health-care cost by earlier patient pain-free recovery with less morbidities.

The pros of this approach for lung lesion resection are the tremendous reduction of estimated blood loss and the patient maintains the same posture on the operation table, which may shorten the operation time especially when the patient gets both lung lesions on the same spot.

Subxiphoid incision is a real thoracic cage wound; located exactly above the diaphragm and below the sternocostal triangle; therefore, possibility of incisional hernia is absolutely negligible. We suggest a midline incision when the subxiphoid angle is acute, whereas transverse incisions for wider angle. To expand the subxiphoid tunnel, we recommend excision of pericardial fat and xiphoid process giving enough room for the instruments passing through.

The mean BMI was reported for the subxiphoid technique (22.0 ± 0.83) (8), however, Al Sawalhi *et al.* (9) described a feasibility of subxiphoid technique in an obese patient.

To overcome heart compression on the left side caused by instruments which may elicit cardiac arrhythmia, the

surgeon sometimes used a sternal elevator retractor.

The most technical challenging point of uniportal subxiphoid access is the instrument-fighting problem which could be more harder than the intercostal approach. Furthermore, carbon dioxide insufflation may help providing more space in the chest cavity.

The crucial point for the surgeon to practice subxiphoid uniportal VATS is the previous extensive experience in uniportal VATS lobectomy accompanied with skilled assistant. The length of learning curve based on the previous experience in major VATS procedures and learning in high volume center. Furthermore, we recommend starting operation on minor cases on the right side, especially upper and middle lobe with complete fissures. The conversion rate decrease from 13% to 8% after performing the first 100 subxiphoid VATS procedures (5). The cons of this technique that once the bleeding happens, it's advisable to tamponade the bleeding spot and definitively to control the bleeding by exploring the chest through intercostal thoracotomy. Furthermore, we encourage using long, articulated stapler, curved electrical hook, oval forceps, and DeBakey forceps. The anesthesiologist plays a crucial integral part with meticulous monitoring especially using one lung ventilation with a contralateral iatrogenic pneumothorax and intra-operative arrhythmia on the left side.

Although, an achievement of proper lung cancer staging mandates three N2 mediastinal lymph nodes, however, Moon *et al.* (10) reported that mediastinal lymph nodes clearance is not essential for early stage lung cancer (clinical N0), non-small lung cancer, smaller than 3 cm in size, or GGO-predominant.

It was reported that mediastinal lymph nodes dissection through subxiphoid incision was challenging and should be carried out by an expert surgeon (1); however, Song *et al.* (2) concluded in his study that mediastinal lymph nodes dissection either choosing subxiphoid approach or transthoracic one was the same.

There are tips, tricks, and recommendations for mediastinal lymph nodes dissection:

- (I) For better exposure of subcarinal space. Using 30° thoroscopic articulated lens is advisable. Furthermore, fruitful traction of the lung anteriorly and medially will make subcarinal lymph nodes dissection easier;
- (II) Energy devices like Ligasure (Medtronic, NC, USA), Harmonic Scalpel (Ethicon, Inc.) are preferable for lymph nodes dissection as well as control bleeding on spot;

(III) Subcarinal lymph nodes dissection can be approachable after releasing the inferior pulmonary ligament;

(IV) We recommend to loop the azygos vein or retracted using suction for dissection paratracheal lymph nodes.

In summary, either unilateral or bilateral lung lesions resection using one stage subxiphoid uniportal VATS approach is safe and oncological achievable.

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