

Uniportal Video-Assisted Thoracoscopic Surgery Segmentectomy



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KEYWORDS

- Uniportal VATS • Single-port VATS • Non-small cell lung cancer • Sublobar resection
- Segmentectomy

KEY POINTS

- A uniportal approach to video-assisted thoracoscopic surgery (VATS) segmentectomy may be feasible, with minimal trauma owing to a minimal incision, regardless of the location of the lesion.
- Specific techniques for lesion localization and identification of intersegmental plane are essential to achieve the best operative results during VATS segmentectomy.
- Long-term outcomes using this alternative VATS technique for early stage lung cancer should be monitored.

INTRODUCTION

Since the introduction of lung segmentectomy for benign lesions in 1939, technical advances in thoracic surgery have changed the treatment of early stage non-small cell lung cancer (NSCLC).^{1–3} The indications for segmentectomy include solitary pulmonary nodules,⁴ infectious lung diseases with limited involvement,⁵ and early stage lung malignancy.^{6,7} Patients with poor cardiopulmonary reserve, insufficient for lobectomy, are also candidates for segmentectomy, to preserve normal lung parenchyma and reduce postoperative morbidity.⁶ In addition, with the use of computed tomography (CT) for lung cancer screening, the detection of small tumors without nodal involvement is increasing. Moreover, lobectomy may be contraindicated in high-risk elderly patients.^{8,9}

A randomized surgical trial for NSCLC (<3 cm), reported by the Lung Cancer Study Group in 1995, found an increased rate of locoregional

recurrence with limited resection compared with lobectomy (8.6% vs 2.2%, respectively),¹⁰ and concluded that lobectomy should be the standard for patients with stage IA lung cancer. However, recent trials have shown that anatomic sublobar resection (segmentectomy and wedge resection) can achieve outcomes equivalent to lobectomy in selected patients with stage IA NSCLC.^{11–13}

Video-assisted thoracoscopic surgery (VATS) has become the standard approach for thoracic procedures,¹⁴ and is usually performed through 3 or 4 access ports, with minimal incisions and no rib spreading. This approach is associated with not only less postoperative pain and low morbidity and mortality in the immediate postoperative period, but also shorter duration of hospitalization and lower medical costs. In addition, VATS segmentectomy has been shown to yield equivalent oncologic results compared with lobectomy using open or VATS technique.^{15,16} More recently, there has been renewed interest in a uniportal approach, which was introduced by some pioneers.^{17,18} Most

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thoracic procedures using conventional multiport VATS can be performed through a single, minimal incision (3–5 cm), with acceptable outcomes in treating lung malignancies.^{19,20} It has been reported that uniportal VATS is safe and feasible, even for complex procedures, such as sleeve resection,^{21,22} segmentectomy,^{23–25} and vascular reconstruction.^{26,27} Studies on the uniportal VATS approach are ongoing, with many surgeons using their own methods and instruments for various thoracic diseases.^{28,29} The potential benefits are reduced intercostal pain and better cosmetic results; moreover, some patients make preferential requests for VATS. However, despite being the least invasive approach for early lung cancer, few studies have reported the outcomes of uniportal VATS segmentectomy, and the evidence is still unclear. As surgical experience increases, the supporting evidence will address the potential benefits of this innovative method for early stage lung cancer.

Improved techniques for localization of small lung lesions during VATS could help to prevent inappropriate division of the intersegmental plane.^{30–32} In this section, we report our clinical experiences and introduce the technical details of uniportal VATS segmentectomy, including preoperative localization techniques. In addition, we performed a literature review of the obstacles and potential complications associated with this minimally invasive procedure.

PATIENT SELECTION

The usual indications for lung segmentectomy include a tumor less than 2 cm in diameter without thoracic lymph node involvement, a small (<1 cm) ground glass opacity (<50%), or a benign lung disease with poor or even with normal pulmonary reserve, in which the goal is to preserve normal lung parenchyma.^{12,33,34} There are no absolute exclusion criteria for uniportal VATS, although conventional multiport VATS might be more appropriate in selected patients with extensive adhesions. Theoretically, limited pulmonary wedge resection and segmentectomy seem to be well-matched to a limited incision approach such as uniportal VATS. Furthermore, the use of uniportal VATS with a small incision (2–3 cm) may be justified, because the resected specimen can be removed through the incision. Our indications for pulmonary segmentectomy include a solitary peripheral pulmonary nodule measuring 2 cm or less in the targeted segment, suspected cT1N0M0 lung cancer, and small (<1 cm) ground-glass opacities on chest CT (**Fig. 1**). Other indications include a metastatic or benign pulmonary tumor that cannot be accessed by wedge

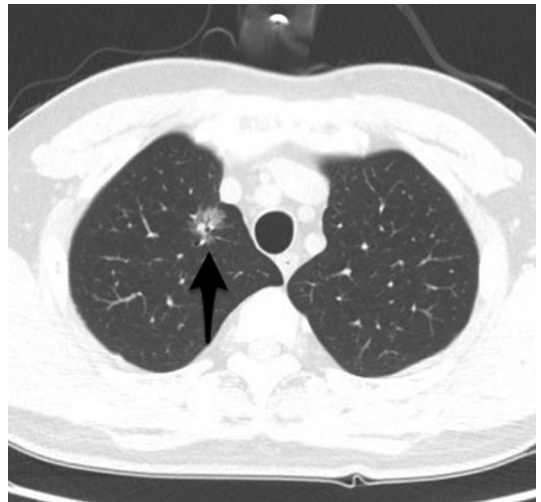


Fig. 1. Partly solid nodule in right upper lobe (arrow). Clinical T1aN0 non-small cell lung cancer.

resection, or inflammatory disease that is resectable through segmentectomy instead of lobectomy, thereby preserving lung parenchyma in patients with poor pulmonary reserve.

TECHNIQUE

Preoperative Localization

Chest CT with 3-dimensional reconstruction can be helpful in planning surgery. The possibility of a fused fissure and the anatomy of the segmental branches of the pulmonary artery and vein should be evaluated for a safe operation. In addition, preoperative localization with a radiotracer, coil, radiopaque marker, or a hook-wire may be indicated for small, nonpalpable nodules that are difficult to localize using a minimally invasive approach.^{35–37} We routinely perform preoperative CT-guided localization of pulmonary tumors with the dual use of a hook-wire and lipiodol or a radioisotope to identify the intersegmental plane for a sufficient resection margin (>2 cm from the lesion) in candidates for pulmonary segmentectomy (**Fig. 2**).

However, if a pneumothorax or hemothorax had been caused by a previous percutaneous needle lung biopsy, or if there is sufficient resection distance from the intersegmental plane on CT, we do not perform localization. The advantage of dual localization is a higher lesion detection rate, even when a hook-wire is dislodged.³⁰ The localization technique is also used to identify the proper resection margin in deeper lesions. These procedures were performed 1 to 2 hours before surgery, and were guided by CT fluoroscopy. Intraoperative C-arm fluoroscopy was used to detect the lipiodol, and a gamma probe was used to detect radio-tracer marking before segmental division (**Fig. 3**).

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