

A 2-cm single-incision thoracoscopic left upper division segmentectomy

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Contributions: (I) Conception and design: HK Kim; (II) Administrative support: HK Kim, YH Choi; (III) Provision of study materials or patients: HK Kim, HJ Lee; (IV) Collection and assembly of data: HK Kim, HJ Lee, KN Han; (V) Data analysis and interpretation: HK Kim, KN Han; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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Background: A video-assisted thoracic surgery (VATS) sublobar resection for early lung malignancy has been applied recently in selected patients with the improvement in surgical technique.

Methods: From 2012, we began VATS segmentectomy with 2-cm single incision in early lung cancer (T1a, tumor size <2 cm) and no lymph node metastasis with preoperative dual localization for lung lesion.

Results: In the video clip, we performed a 2-cm single-incisional VATS segmentectomy for early lung cancer at left upper lobe upper divisional segment and lymph node dissection using a 5-mm thoracoscope, articulating or curved endoscopic devices. Dual localization for lung lesion could help to identify the specific location of lung lesion. The potential benefits of single-incisional VATS segmentectomy include less intercostal pain, better postoperative outcomes more over than less incisional scar.

Conclusions: A single-incision VATS segmentectomy might be a feasible option for the treatment of early lung cancer in selected patients.

Keywords: Segmentectomy; minimally invasive thoracic surgery; single-incisional thoracoscopic surgery; video-assisted thoracic surgery (VATS)

Received: 20 August 2015; Accepted: 21 August 2015; Published: 24 September 2015.

doi: 10.3978/j.issn.2221-2965.2015.07.06

View this article at: <http://dx.doi.org/10.3978/j.issn.2221-2965.2015.07.06>

Single-incision thoracoscopic segmentectomy with ultra-small (2 cm) incision could be a feasible option for treatment in early lung cancer.

Video-assisted thoracic surgery (VATS) is an approach for performing thoracic procedures, and usually performed through three or four access ports with minimal incisions and no rib spreading (1). This approach is associated with not only less postoperative pain and low morbidity and mortality in the immediate postoperative period (2), but also with a shorter hospitalization time and lower medical costs (3).

Recently, there has been renewed interest in a single-incision thoracoscopic surgery. Most thoracic procedures using conventional multi-port VATS could be performed through a single, minimal incision (3-5 cm), with acceptable outcomes in treating lung malignancy (4). It has been

reported that single-incision VATS is feasible even in complex VATS procedures, such as sleeve resection, segmentectomy, and vascular reconstruction (5-7). However, the potential advantages of this variant of VATS still remain controversial.

It has generally been accepted that sublobar resections, specifically segmentectomy and wedge resection, should be considered for patients in whom lobectomy is contraindicated because of insufficient lung reserve and comorbidity. Sublobar resection is still not a standard treatment for early lung cancer. However, it could be an alternative, low-risk option for cT1N0 or smaller cancers in selected patients because of the better postoperative courses relative to lobectomy. With the increased detection of early, and therefore smaller, lung lesions, lobectomy may



Figure 1 A 2-cm single-incision thoracoscopic left upper division segmentectomy (13).

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no longer be the most appropriate standard procedure for the removal of small lesions because smaller tumors have a better prognosis and a lower chance of local recurrence or systemic metastasis. Segmentectomy could promise better postoperative outcomes and quality of life, with lower surgical risks, in patients with poor lung function (8).

There have been a few reports of single-incision VATS segmentectomy with surgeons using their own methods and instruments (9). At our center, we began using single-incision VATS in 2009 in patients with pneumothorax or in those who required a simple wedge resection. We have performed more than 100 surgical cases of anatomic resection since 2010. We began using single-incision VATS segmentectomy in 2012 and then minimized the incision length to 2 cm by using the 3-mm thoracoscope in 2014. Our rationale for this ultra-minimal incision is based on our surgical experiences, which have shown the feasibility of applying segmentectomy to early lung cancer without compromising surgical outcomes (10).

In addition, preoperative localization with hookwire, lipiodol, or radioisotope (^{99m}Tc) has been routinely employed in our center for patients who were indicated for lung segmentectomy and who had no contraindications (11,12). Preoperative localization helps to identify the specific location of small lung lesions during VATS and prevents inappropriate division of the intersegmental plane. In addition, double localization with lipiodol or occasionally with a radioisotope, could lower the likelihood of missing deep lung lesions during the procedure. Intraoperative real-time fluoroscopy was used to detect lesions injected with lipiodol and a thoracoscopic gamma probe was used to

detect deep lesions injected with radioisotope.

In this video (*Figure 1*), we performed a 2-cm single-incision VATS segmentectomy and complete lymph node dissection in a patient with a ground glass lesion at the left upper divisional segment, and suspected the presence of cT1aN0 lung cancer. During the operation, along with a 5-mm thoracoscope, we used an articulating device, a curved endoscopic instrument, and specially designed graspers with a shorter shaft length. An energy device was used for tissue dissection and endostaplers were used for vascular and fissural division. We used vascular clips for small segmental vascular branches, wherein the surgical angles made the use of staplers difficult. Whether to dissect lymph node in all station in early lung cancer is controversial. We sampled the aortic and subcarinal lymph nodes. There was no difficulty in removing the resected segment through the 2-cm incision because the volume of the lung segment was not large and could be removed through the small incision.

Considering our smaller incision (2 cm), complex, single-incision VATS might be still difficult for VATS beginners, and even for experts. The potential advantages of single-incision VATS include less postoperative pain and shorter hospital stays, compared to multiport VATS. However, it is still unclear whether using a smaller incision during single-incision VATS is superior to conventional VATS and this should be addressed in future studies. VATS has evolved from using three or four incisions, 2-5 cm in length, to a single, 3-5 cm incision, with an aim towards a more minimally invasive approach. Further attempts, such as the use of a 2-cm incision in the present study, could promote the future development of related instruments and high definition cameras with smaller diameters. The recent introduction of a robotic surgical system for single port surgery reflects the current trends for developing minimally invasive surgical approaches.

In summary, single-incision VATS segmentectomy could be performed safely and without difficulty, even though a 2-cm incision, by using an appropriate combination of conventional instruments and a thoracoscope with a small diameter, as well as a high definition system.

Acknowledgements

None.

Footnote

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

Ethical Statement: Institutional Review Board in our center waived the approval process and the informed consent of case video for single patient if it contains surgical procedures or techniques with no individual identifier and intended risk for individual patient.

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doi: 10.3978/j.issn.2221-2965.2015.07.06

Cite this article as: Han KN, Kim HK, Lee HJ, Choi YH. A 2-cm single-incision thoracoscopic left upper division segmentectomy. *J Vis Surg* 2015;1:11.