ORIGINAL ARTICLE

Video-Assisted Thoracic Surgery Through a Single Skin Incision

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Objective: To develop a minimally invasive video-assisted thoracic surgery technique.

Design: Case series.

Setting: University referral center.

Patients: Six consecutive patients with a pneumothorax who underwent video-assisted thoracic surgery through a single skin incision.

Interventions: A flexible digital bronchoscope was placed in a scope guide. A single 2.0-cm skin incision was made in the midaxillary line. The entire lung was carefully explored. An endoscopic stapling device was then inserted, and the lung resection was performed through a single skin incision.

Primary Outcome Measures: Operative time, estimated amount of blood loss, operative complications, and postoperative air leakage were recorded.

Results: The video-assisted thoracic surgery procedure through a single incision was successful in all 6 patients. There were no associated complications at 1-year follow-up.

Conclusions: We were able to perform the video-assisted thoracic surgery procedure through a single skin incision using a scope guide and a flexible scope that enables visualization of the entire pleural cavity, providing even laser ablation. This new technique can be used to treat patients with pneumothoraces without the need for additional skin incisions.

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VIDEO-ASSISTED thoracic surgery (VATS) has gained popularity because it is minimally invasive. The standard technique for VATS uses more than 3 separate skin incisions.[1-3] Many minimalistic surgical interventions, including laser ablation and looping of blebs, have been designed for the treatment of patients with pneumothoraces. We report a variation of the VATS technique that uses only a single skin incision.

RESULTS

All 6 patients were men (**Table**). One patient sustained a traumatic pneumothorax from a thoracic stab wound with 2 needles. The other 5 patients had a spontaneous pneumothorax. For 3 of these patients, this was the first presentation with a pneumothorax. After diagnosis, thoracostomy tubes were inserted through the fifth intercostal space in the midaxillary line in 3 patients, the seventh intercostal space in the anterior axillary line in 1 patient, and the eighth intercostal space in the midaxillary line in 1 patient.

The surgical procedure was performed without difficulty through the same skin incision. In 4 patients, no obvious lung pathologic lesions were detected with preoperative chest radiography and chest computed tomography. In 1 patient, a 1.8-cm bulla was noted preoperatively in the apex. Intraoperatively, however, bullae and blebs were found in the apex of all patients with a spontaneous pneumothorax (**Figure 4** and **Figure 5**). Partial lung resection of the apex was carried out in all patients with a spontaneous pneumothorax. Removal of foreign bodies using this technique was performed in the patient who sustained a traumatic pneumothorax. The mean operating time was 81.5 minutes, and all patients were extubated in the operating room. The operative bleeding was less than 5 mL. Postoperatively, there were no air leaks in the chest tube, and the tube was removed by postoperative day 3. Postoperative pain was minimal. There were no complications at 1-year follow-up.

PATIENTS, MATERIALS, AND METHODS

Six patients with a pneumothorax who were evaluated for the VATS procedure from October to December 1996 were acceptable candidates for this procedure. All patients underwent preoperative evaluation with chest radiography and thin-slice chest computed tomography.

The equipment consisted of flexible digital bronchoscopes (models BF-200 and BF 1T-200, Olympus, Tokyo, Japan), 2 scope guides (curved spiral pipes, 8.0 and 6.5 mm in external diameter, fitted to the bronchoscopes) (**Figure 1**), a high-resolution video monitor, a digital monitoring system (models CV 200, CLV-U20D, and EVIP-230, Olympus), endoscopic instruments, and an endoscopic stapler.

All patients were given general anesthesia through a double-lumen endotracheal tube and were placed in the left lateral decubitus position. A single skin incision (approximately 1.8 cm long in 5 patients and 2.5 cm long in 1 patient) was made in the fifth intercostal space of the midaxillary line. When a chest tube was placed preoperatively, we used the skin incision for insertion of a 20F catheter chest tube at the completion of the procedure. At this site, the scope guide was inserted slightly ahead of the bronchoscope to prevent smudging of the lens. Since the head of the bronchoscope is controllable, an extended view was obtained by adjusting the handle. When the lung was inflated, intratracheal bronchial suction through the double-lumen endotracheal tube reduced the lung volumes. There was no need for an airtight valve for a positive-pressure pneumothorax. The tip of the bronchoscope was directed posteriorly with a 180° angulation of the head. The instrument was placed with the guidance of the bronchoscope to avoid injuries. The entire lung was carefully explored using retraction instruments. The bronchoscope allows for close-up visualization (**Figure 2**). There were essentially no blind spots using this technique. After exploration with the BF-200 bronchoscope, the BF lT-200 bronchoscope and the scope guide were used. The skin wound was extended to 2.0 cm, and an endoscopic stapling device was inserted in a similar fashion. The endoscopic grasper and stapler were inserted beside the scope guide, and a blebectomy was then performed (**Figure 3**).

Once the absence of air leaks and bleeding was confirmed, a 20F catheter thoracostomy tube was placed through the same incision, and the wound was closed in multiple layers.

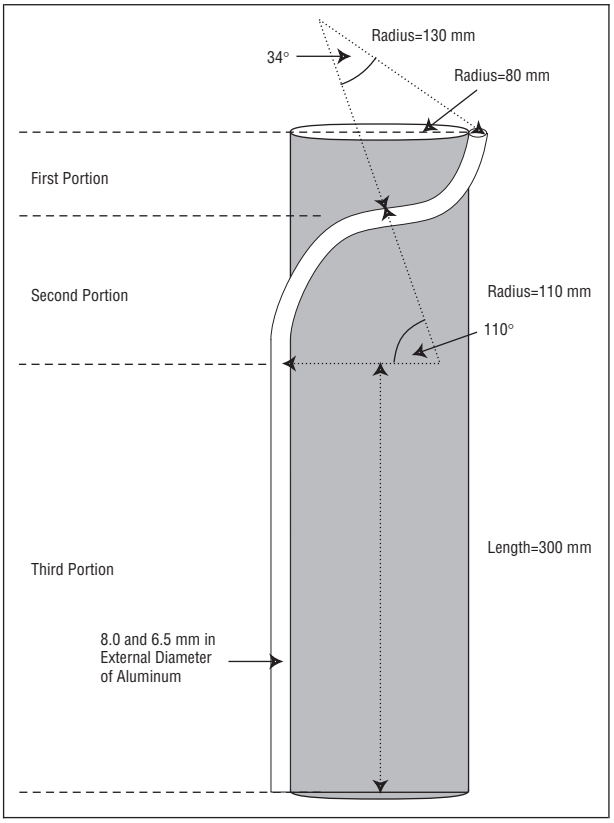

Figure 1. *Design of the scope guide. The scope guide is made of aluminum, which enables some clearance of the bronchoscope. The angulation and length of the second and third portions are adjusted to allow for greater thoracic size, as necessary.*

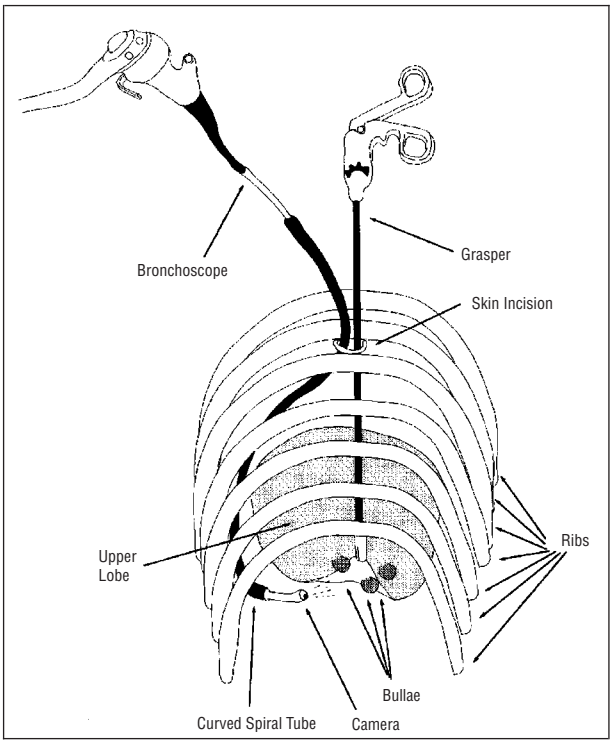

Figure 2. *Schematic view and positioning of the scope guide. The spiral scope guide can be positioned in close proximity to the chest wall. This enables one to maintain distance between the camera and the lesion, especially in the apex where there is a narrow space.*

COMMENT

The VATS procedure performed through a single skin incision previously has been difficult. We resolved this problem using a scope guide and a flexible scope that enables visualization of the entire pleural cavity. In addition, the flexible scope provides sufficient visualization for laser ablation.

Patients with pneumothoraces are usually treated conservatively with chest tube drainage. The incidence

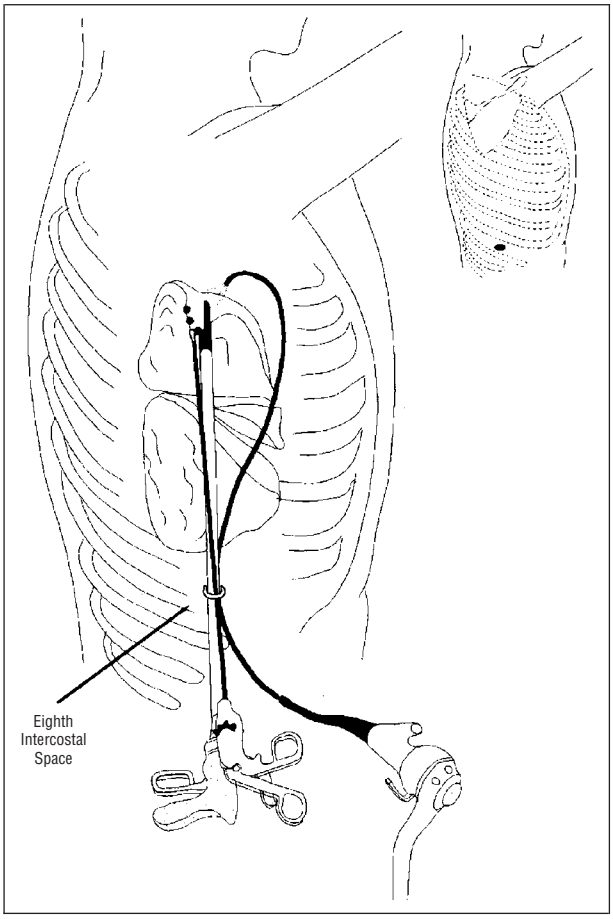

Figure 3. *Schematic view of bleb stapling. There is no difficulty manipulating the specimen. When the lesion is held by the grasper, the direction of the lesion is recognized by the angulation of the grasper. The stapler can be applied easily by directing the stapler parallel to the grasper.*

Patient Characteristics*

Age, y	Indication	Surgery	Approach
43	Stabbing	Removal of needles	Fifth ICS in the MAL
33	SP	Blebectomy	Fifth ICS in the MAL
21	SP	Blebectomy	Eighth ICS in the MAL
24	SP	Blebectomy	Fifth ICS in the MAL
24	SP	Blebectomy	Fifth ICS in the MAL
28	SP	Blebectomy	Seventh ICS in the AAL

**SP indicates spontaneous pneumothorax; ICS, intercostal space; MAL, midaxillary line; and AAL, anterior axillary line.*

of recurrence, however, is 50%. This new technique can be used to treat patients with pneumothoraces without additional skin incisions when a chest tube is initially inserted. The previous skin incision can be used with no need for additional skin incisions. It is difficult to resect apical blebs using a rigid thoracoscope through the eighth intercostal space because the staple line is not easily seen anteriorly. This is not a problem using the flexible bronchoscope with a controlled head and the scope guide (Figure 3). The advantage of this technique is that the skin incision can be made where it will later be covered by clothing. Adding an incision makes it more difficult to cover completely.

Figure 4. *Photograph of the specimen. All patients with a spontaneous pneumothorax had small blebs, even if no lung pathologic lesions were detected by chest radiography or chest computed tomography.*

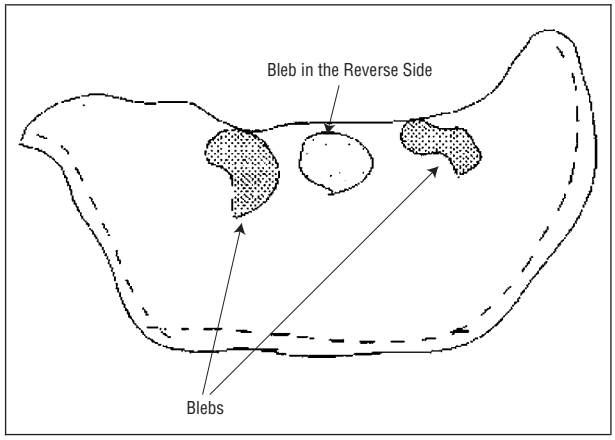

Figure 5. *An adequate apical specimen with a trapezoid shape was resected through the eighth intercostal space.*

The curvature of the guide is extremely important in obtaining adequate positioning and visualization. The curvature is also designed to prevent nerve injury. Perhaps the greatest benefit of the scope guide is the prevention of thoracic injury.

This technique can be used to perform a biopsy of the pleural lesions, for laser ablation of blebs and bullae, for the extraction of foreign bodies, and for wedge resection of blebs or small peripheral tumors. We demonstrated the usefulness of this technique in the resection of the lung segments in the anterior, posterior, mediastinal, and diaphragmatic locations in pigs. The contraindications of this procedure include adhesions, large tumors (>2.0 cm in diameter), and multiple bullae.

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