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Research Paper

A single institution experience using the LigaSure vessel sealing system in video-assisted thoracoscopic surgery for primary spontaneous pneumothorax

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Abstract

This study sought to report our 6-year experience with the LigaSure vessel sealing system (LVSS) in video-assisted thoracoscopic surgery (VATS) for primary spontaneous pneumothorax. A series of 180 consecutive patients with primary spontaneous pneumothorax were operated on in our institution from May 2005 to December 2010. Intraoperatively, large lesions (bullae or blebs) with a diameter more than 2 cm were resected by staplers, and the residual lesions were treated by LVSS. LVSS was also used to ablate the apical area when no lesions were found. Conventional apical pleural abrasion was done in all cases. All patients were successfully treated using VATS with minimal perioperative bleeding. The mean operating time was 76 minutes (range, 43–160 minutes) for single-side procedures and 169 minutes (range, 135–195 minutes) for bilateral procedures, the mean number of applied staples was 1.93 per patient (range, 0–8 days), the duration of drainage was 3.8 days (range, 2–15 days), and the duration of hospital stay was 5.8 days (range, 3–16 days). Postoperative complications included persistent air leak ($>$ 5 days) in 11 cases (6.1%) and residual pneumothorax in 6 (3.3%). None required reoperation. The mean duration of follow-up was 57 months (range, 24–105 months). Recurrence was seen in three cases (1.7%), and all underwent another operation thereafter. None of the lesions in the relapse cases received ablation with LVSS in the first operation. LVSS can optimize VATS for primary spontaneous pneumothorax and reduces the use of single-use staples. The method is safe, easy to use, and cost-effective and produces satisfactory results.

Keywords: LigaSure vessel sealing system, video-assisted thoracoscopic surgery (VATS), primary spontaneous pneumothorax

INTRODUCTION

Automatic stapler device has been applied as a first-line method for thoracoscopic bulla resection in patients with primary spontaneous pneumothorax[1,2]. It is easy to carry out and is reliable in reducing the incidence of postoperative air leak[3]; however, this procedure may have anatomic and quantitative limitations.

Efforts were made in the last decade for safe lung parenchyma cutting alternative to the use of stapler. Electrocautery and lasers have been reported to coagulate blebs and bullae, but with poor results, probably due to charring and burning of the bulla's wall, which may lead to prolonged air leaks[4–6].

The LigaSure vessel sealing system (LVSS) (Valleylab, Boulder, CO., USA) is a new bipolar system for vascular

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sealing, which allows coagulation and connection of tissues without overheating and 'burning through', while having a feedback from the tissue being welded. It has already been used as a daily routine in abdominal surgery[7–9], but scant literature is available on its use in thoracic surgery. Few surgeons have examined this device for wedge resection of lung parenchyma[10–12]. Herein, we describe our experience using LVSS in video-assisted thoracoscopic surgery (VATS) for primary spontaneous pneumothorax.

PAITENTS AND METHODS

Patients

Between January 2005 and December 2010, 180 consecutive patients with primary spontaneous pneumothorax underwent thoracoscopic surgery at our institution. Of these, 144 were men, 36 were women, and the average age was 23 years (ranging, 14–54 years). A left-side procedure was done in 103 cases, a right-side procedure in 61 cases and a bilateral procedure in 16 cases. The reasons for intervention were recurrent ipsilateral pneumothorax, bilateral pneumothorax, and first episode with occupational risk or persistent air leak more than 5 days, or prior contralateral occurrence. The study protocol was approved by the local ethics committee at the authors′ affiliated institution. Patient consent was not required because of the retrospective nature of the study.

Surgical procedures

All 180 consecutive patients were operated on via three-port VATS under general anesthesia using a double-lumen endotracheal tube in the lateral decubitus position. The first port was opened in the fifth or sixth intercostal space at the mid-axillary line, and a 10.5-mm trocar was inserted. When a chest tube was inserted preoperatively, a 10.5-mm trocar was inserted into that site and a 10-mm thoracoscope was introduced via the trocar. The pleural cavity was examined initially for existing adhesions or effusion, and the locations of the lesions (blebs or bullae) were sought, especially in the apex. Then, the other two ports were created with optical observation in the forth anterior and the fifth middle intercostal space (near the tip of the scapula) for thoracoscopic instruments, and the location and size of the lesions were examined repeatedly in the apex, hilum and diaphragmatic faces.

After exploration, large lesions (2 cm or more in diameter) were resected by stapler and the residual lesions were treated with LVSS. If a normal visceral pleural was found, ablation of a small portion of the apical upper lobe with LVSS was performed. Conventional apical pleural abrasion was carried out in all cases. Following a careful bleeding and leakage control, a chest tube was inserted, and the operation was concluded.

RESULTS

Patient demographic and baseline data are shown in ***Table 1***. All patients were successfully treated using VATS by the same team. Forty-nine patients (27%) underwent only stapled resection of the lesions, and 44 patients (24%) underwent only ablation of the lesions with LVSS. The remaining 87 patients (49%) received both ablation and stapled resection of the lesions. There were no complications during surgery. The blood loss was negligible (levels too low for measurement). Operating time depended on the presence of adhesions, on the number of blebs or bullae and their extension over the lung′s surface. The mean operating time was 76 minutes (range, 43–160 minutes) for single-side procedures and 169 minutes (range, 135–195) for bilateral procedures, the mean number of applied staples was 1.93 per patient (range, 0–8), the duration of drainage was 3.8 (range, 2–15 days), and the duration of hospital stay was 5.8 (range, 3–16 days).

No related deaths occurred but some postoperative complications developed in 20 cases (9.4%), which was due to persistent air leak (> 5 days) in 11 cases (6.1%), and residual pneumothorax in 6 (3.3%), need to insert a new pleural drain in 3 (1.7%). None required reoperation.

All the patients were followed up to December 2012, with an average duration of follow-up for 57 months (range, 24–105 months). There were no cases of chronic pain requiring analgesia. Three cases of recurrence (1.7%) were seen. All underwent another operation thereafter. The leaking area was found in all cases. Two lesions were at the stapled line and the other was newly developed blebs which were different from ablated lesions. Adhesion was observed in all three cases but the grade was trivial.

Table 1 **Patient characteristics**

Characteristics	Value
Age	23 (range, 14–54 years)
Gender	
Male	144 (80%)
Female	36 (20%)
Side of operation	
Left	103 (57.2%)
Right	61 (33.9%)
Both	16 (8.9%)
Approach	
Staple	49 (27%)
LVSS	44 (24%)
Staple and LVSS	87 (49%)

Table 2 **Operative and postoperative variables**

Parameters	Value
Operating time	76 (range, 43–160 minutes)
Single-sided	169 (range, 135–195 minutes)
Bilateral	
Number of stapler	1.9 per patient (range, 0–8),
Drainage duration	3.8 (range, 2–15 days)
Postoperative hospital stay	5.8 (range, 3–16 days)
Major complications	
Prolonged air leak	11 (6.1%)
Residual pneumothorax	6 (3.3%)
Relapse	3 (1.7%)

DISCUSSION

Stapler resection of blebs or bullae is widely performed during VATS for primary spontaneous pneumothorax[1,2]. Its disadvantages are foreign bodies left in the suture, and high costs. When used for large or multiple lesions, staple cassettes are too expensive to use in large numbers. Besides, because of the endostapler′s head size, the repeated insertion of the device through the intercostal space produces a significant trauma and, as a consequence, postoperative chest pain. Moreover, an increase in the volume of the normal lung near the lesions resected may result in postoperative respiratory hypofunction.

LVSS utilizes a new bipolar technology for vascular sealing with a higher current and lower voltage as compared to conventional electrocautery. The system has the ability to regulate output based on the particular kind of tissue and stop automatically in order to minimize the effect on surrounding tissue[13,14]. Transmission of heat to the surrounding tissue occurs within a distance of 1.0 to 1.5 mm[13]. Its use has already been authorized by the US Food and Drugs Administration for all general surgery and urological operations as well as most gynecological procedures[7–9]. Nevertheless, the experience with the device is limited in thoracic surgery. Kovács and colleagues employed LVSS in lung wedge resection, and the results were found to be acceptable; however, the rate of persistent air leak was higher than that of patient who underwent stapler resection[10]. Shigemura et al. found LVSS was not optimal for bullae with a broad base when used for thoracoscopic bullectomy[12]. We also found that LVSS was particularly time-consuming when used for large lesions.

There are reports of other sealing techniques for pulmonary resection that do not rely on the use of a stapler[4–6]. Sawabata and colleagues found that stapler resection was better than the M-tip (an electroablation technique) for resecting a pneumocyst of > 2 cm. The reason is thought to be that when a large pneumocyst is shrunk by heat, there still remains a downsized bullae that may have the potential to cause pneumothorax[2]. Yim *et al.* also consider that their new sealing technique is not a replacement for the speedy, reliable, and convenient gold standard of staplers, but rather as coexisting to provide new choices for pulmonary resection[15].

Based on the results of the previous studies, our group used LVSS following stapled resection of large lesions (2 cm or more in diameter) during VATS for primary spontaneous pneumothorax from May 2005 to December 2010. The procedure was found to be safe in the present series of patients. The mean number of applied staples was 1.93 per patient (range, 0–8). The results in terms of the operation time, the duration of drainage, the postoperative hospital stay, and postoperative complications are comparable with those reported in the literature[2,5,16]. Furthermore, this procedure seems particularly suitable for difficultly situated lesions, located over the mediastinum, surface of the lung or in the interlober fissure. In addition, the ratio of relapse in our study was lower than that of patients who received conventional stapled resection procedure (5%)[17,18]. What′s more, the lesions in cases of relapse were not in the areas where ablation had been carried out.

In conclusion we have reported the utility of LVSS technique following stapled resection of large lesions during VATS for primary spontaneous pneumothorax. The procedure produces results equal to or better than those typically obtained by institutions using conventional mechanical staples and wedge resection procedures. While larger multi-center studies should be considered to further examine the use of this technique, We believe that this safe, easy, and cost effective method is feasible for the treatment of primary spontaneous pneumothorax.

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