The Results of Thoracoscopic Surgery for Secondary Spontaneous Pneumothorax

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ABSTRACT

Objective: To review our experience of video-assisted thoracoscopic surgery for the treatment of secondary spontaneous pneumothorax caused by bullous emphysema

Design: Prospective study

Setting: Chest Diseases Hospital, Kuwait

Subjects: Forty-six consecutive patients who underwent thoracoscopy for secondary spontaneous pneumothorax by a single surgeon during a five year period

Intervention: Video-assisted thoracoscopic bullectomy and pleural symphysis procedure

Main Outcome Measure: Resolution of pneumothorax

Results: Mean age of patients was 49.3 years (range: 38 - 70 years), and 44 were men (96%). All patients had bullous emphysema; their mean preoperative forced expiratory volume in one second (FEV1) was 54.4% of predicted and mean forced vital capacity (FVC), 66.9% of predicted. Persistent pneumothorax was the most frequent indication for surgery, occurring in 35 patients (76%). The most common method of management was stapling of an identified bulla, which was done in all patients. Pleurodesis was achieved by gauze abrasion (n = 23) and apical pleurectomy (n = 23). Postoperative prolonged air leak occurred in seven patients (15%), six in the pleural abrasion group and one in the apical pleurectomy group (p = 0.04). The mean (± SD) postoperative hospital stay was 5.7 ± 4.5 days. Mean follow-up is 42 months (range = 36 - 54 months) for all patients. Pneumothorax recurred in three patients (6.5%) in whom pleural abrasion was done. The recurrences occurred in the first six months of follow-up.

Conclusions: Video-assisted thoracoscopic surgery is a safe procedure in the treatment of select secondary spontaneous pneumothorax caused by bullous emphysema. Apical pleurectomy is a more effective way of producing pleural symphysis.

INTRODUCTION

Spontaneous pneumothorax (SP) can be divided into primary SP resulting from rupture of subpleural blebs, and secondary SP, which is related to the presence of an underlying lung disease(e.g., bullous emphysema, tuberculosis). The indications for surgical treatment include persistent air leak, recurrent SP, contralateral SP, and SP in a high-risk occupation, such as pilot or diver[1]. The aims of surgical treatment are to close the site of the air leak, to allow full re-expansion of the lung, and to prevent future recurrence[9]. The use of video-assisted thoracoscopic surgery (VATS) has been advocated and used as an alternative to thoracotomy in the treatment of primary SP[2-4]. The standard surgical treatment for secondary SP is through a thoracotomy approach, with very low recurrence rate[10]. Surgical intervention by means of thoracotomy in the setting of secondary SP is associated with a much higher morbidity than in the setting of primary SP[9]. The role of VATS and its long-term results for patients with secondary SP is still unclear[2-7]. The aim of this study was to describe our experience in Kuwait and to report on the long-term follow-up of 46 consecutive patients with secondary SP caused by bullous emphysema.

SUBJECTS AND METHODS

The study was conducted at the Chest Diseases Hospital, which is the only center for the surgical treatment of chest disorders in Kuwait. From January 2002 to December 2005, 46 patients with persistent or recurrent secondary SP were treated by VATS; these patients comprise the study subjects. Preoperative investigations included a chest radiograph, a computed tomography of the chest, complete blood count, serum
The output and the duration of the pleural drainage of episodes of pneumothorax, and the operative time. Postoperative Assessment

chest tube. patients were discharged the day after removal of the pleural fluid drained through the tube for 24 h. All patients were fully expanded with no air leakage and < 100 ml drain was removed when the underlying lung was (acetaminophen) was given as needed. The intercostal incision in the eighth intercostal space at midaxillary line for insertion of a 0° videothoracoscope (Karl Storz; Tuttingen, Germany). Two additional ports were then inserted under direct vision: a 12-mm trocar through the fifth intercostal space on the anterior axillary line, and a 12-mm posterior trocar through the fifth intercostal space near the tip of the scapula. The bulla was identified and grasped with empty sponge stick. The excision was done by using an ENDO-GIA stapling device (Auto Suture Company; United States Surgical Corp; Northwalk, CT). Then, a parietal pleural abrasion by gauze or apical pleurectomy was performed. Pleurectomy was performed with a hook electrocautery; the longitudinal limit of the resection ran in an apical direction along the sympathetic trunk to the height of the left subclavian artery or the brachiocephalic trunk on the right side. The pleura was incised at least one cm away from the sympathetic trunk. Then it was grasped with the endograsper, raised, and divided with the dissector. Once the plane was developed pleural stripping was achieved by lifting the pleural flap with the aid of a gauze pledget. The area of pleurectomy requires precise hemostasis. None of the patients had bleeding complications. A 28 F chest tube was inserted through the inferior incision in the eighth intercostal space and connected to underwater seal suction with a negative pressure of 20 cm H\textsubscript{2}O.

Postoperative Care

All patients were extubated in the operating room and transferred to the thoracic surgery ward. Antibiotic in the form of cefoxitin was give to all patients. An analgesic, pethidine, was administered IM every 4 to 6 h according to patient request, and an oral analgesic (acetaminophen) was given as needed. The intercostal drain was removed when the underlying lung was fully expanded with no air leakage and < 100 ml pleural fluid drained through the tube for 24 h. All patients were discharged the day after removal of the chest tube.

Postoperative Assessment

Data recorded for all patients included the number of episodes of pneumothorax, and the operative time. The output and the duration of the pleural drainage after operation, the amount of analgesia given in the first 24 h after the operation, length of hospital stay, postoperative air leak, and recurrences were also recorded. The follow-up chest radiograph was done at intervals of one week, one month, and three months, and then the patients were followed up with a telephone communication for this study. The recurrence was proved by chest radiography during follow-up period.

Statistical Analysis

Data were expressed as mean ± SD. Data analyses were made using SPSS software windows version-8 package (SPSS, Chicago, IL). The cut-off level for statistical significance was a p-value of less than 0.05. The unpaired Student’s t test was used to assess the significance between means of variables in the groups. The Pearson \(\chi^2\) test was used to ascertain the significance of association between two categorical variables. The \(\chi^2\) test was replaced by Fisher’s exact test if the cell frequencies of any of the 2 \(\times\) 2 contingency tables went below five.

RESULTS

This series included 44 male and two female patients (mean age, 49.3 ± 10.3 years, range 38 to 70 years). In all cases, secondary SP was diagnosed on the basis of the existence of emphysematous bullous disease confirmed by chest radiographic appearance, computed tomography of the chest, and preoperative spirometry; the mean forced expiratory volume at one second (FEV\textsubscript{1}) was 54.4% of predicted (range, 43 - 110%); and the forced vital capacity (FVC) was 66.9% of predicted (range, 47 - 110%).

Thirty-five patients (76%) were operated upon when they had persistent air leak more than seven days. In eleven patients (24%), VATS was done because of a recurrent episode of SP. VATS was unilateral in all cases and all procedures were performed by the same surgeon, on the right side in 35 cases (76%) and on the left side in 11 cases (24%). Extension of the trocar incisions was necessary in three patients because of adhesions.

The operative time was 62.3 ± 9.8 minutes (range, 40 - 90 minutes). Pleural procedures performed included gauze abrasion in 23 cases (50%) and apical pleurectomy in 23 cases (50%). The clinical data on these procedures are shown in Table 1.

All patients were extubated at the end of the operation, and no patient required mechanical ventilation during the postoperative period.

The mean amount of postoperative analgesia in the form of pethidine was 101.9 ± 26.8 mg in the first 24 h.

The duration of chest tube drainage was 4.8 ± 4.5 days (range, 2-22 days). Seven patients (15%) had an air leak lasting more than five days. These patients
required prolonged pleural drainage for 7 to 22 days, and none required a re-operation. Air leak occurred in six patients after pleural abrasion procedures and one occurred after apical pleurectomy. The difference is statistically significant (p = 0.04). Air leak occurred in six out of 22 patients in whom multiple bullous disease was identified. Air leak occurred in one out of 24 patients with single bulla. The difference is statistically significant (p = 0.02).

The postoperative hospital stay ranged from three to 23 days (mean, 5.7 ± 4.5 days). There were no deaths in this series, and no patients required monitoring in the ICU.

All patients in this study were followed regularly (mean follow-up time, 42 months; range from 36 - 54 months). Recurrent ipsilateral pneumothorax occurred after three of the 46 procedures (6.5%). These occurred at four, 16, and 24 weeks after the original procedure. All these recurrences had occurred after pleural abrasion procedures and in patients with multiple bullous disease. Two patients underwent a re-operation by thoracotomy; excision of the air leak site and partial pleurectomy was performed. One patient who had recurrence at 24 weeks after the original procedure healed by chest drainage and chemical pleurodesis.

**DISCUSSION**

Videothoracoscopy is a rapidly developing technique that allows many surgical procedures to be performed without the need for thoracotomy. VATS allows inspection of the entire lung, identification of bullae, and resection of bullous disease. Previous reports of the use of VATS have concentrated on its use in the treatment of primary SP. VATS has become the surgical approach of choice in the management of select primary SP[14,18]. VATS bullectomy and mechanical pleurodesis carry long-term results that are comparable with those of thoracotomy[4]. For secondary SP, because patients are generally older and ill, the role of VATS approach is still unclear[7,9,10]. VATS for secondary SP has been shown to be associated with a higher morbidity[9]. Therefore, careful patient selection and improvement of the surgical technique are important factors for ensuring optimal outcome. In this series, we have successfully treated 46 patients with secondary SP caused by bullous emphysema using VATS procedure. This group represents a population with minimal co-morbidity who can tolerate selective one-lung ventilation and general anesthesia. However, problems with intraoperative desaturation were encountered. Two-lung ventilation was then necessary, but, to enable the procedure to continue, low-tidal-volume manual ventilation was employed while dissection or manipulation was performed. VATS causes less respiratory dysfunction than thoracotomy, thus improving postoperative recovery.

Short term results from this series were comparable with those reported in the literature[11-13]. The duration of postoperative chest tube drainage is determined by the presence of complete expansion of the lung and the absence of air leak. In the literature, the duration of postoperative drainage is variable. Waller et al[9] reported a mean duration of 6.3 days, Andres et al[12] reported 5.4 days, and Passlick et al[10] reported five days. We report a mean of 4.8 days (range, 2 - 21 days).

The postoperative hospital stay is determined mainly by the duration of pleural drain. Other factors of importance are postoperative pain and early mobilization. We have reported a mean hospital stay of 5.7 days (range, 3 - 23 days). The use of small incisions of VATS procedure has shown a trend toward shorter hospital stay. Passlick et al[10] have reported a mean hospital stay of 12.5 days, Andres et al reported 7.7 days, and Waller et al[9] reported nine days.

There were no intraoperative or postoperative deaths in this series. The most frequent postoperative complications was prolonged air leak lasting more than five days[10,12]. Seven patients (15%) in this series had prolonged air leak. Andres et al[12] have reported 25% incidence. Passlick and colleagues[10] found that 16.6% had prolonged air leak and all required a second intervention by lateral thoracotomy. The cause of the air leak problem is either an air leak on the raw surface of staples or missed bullous areas. Thus, the resection of the bullous area has to be done with care, and the entire lung should be inspected for other bullae. Passlick et al[10] have reported that incomplete pleurodesis without an obvious air leak is another factor for prolonged air leak. We have encountered the problem of postoperative air leak after bullectomy in emphysematous lung with patients who have multiple bullae, particularly on more than one lobe and in a position which are not easily dealt with using

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Pleural Abrasion* (n = 23)</th>
<th>Apical Pleurectomy* (n = 23)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time (min)</td>
<td>58.8 ± 9.2</td>
<td>66.7 ± 8.5</td>
<td>0.001</td>
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<tr>
<td>Postoperative pleural drainage (ml)</td>
<td>338.2 ± 106.4</td>
<td>370.4 ± 98.6</td>
<td>0.2</td>
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<tr>
<td>Analgesia requirement (mg)</td>
<td>94.3 ± 22.3</td>
<td>109.5 ± 29.1</td>
<td>0.05</td>
</tr>
<tr>
<td>Chest tube duration (days)</td>
<td>5.3 ± 5.5</td>
<td>3.8 ± 2.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>6.3 ± 5.5</td>
<td>4.7 ± 2.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Postoperative air leak:</td>
<td></td>
<td></td>
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<tr>
<td>n (%)</td>
<td>6 (26)</td>
<td>1 (4)</td>
<td>0.04</td>
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<tr>
<td>Recurrence: n (%)</td>
<td>3 (13)</td>
<td>0</td>
<td>0.07</td>
</tr>
</tbody>
</table>

* Data presented as mean ± SD or n (%)
endoscopic stapling. Many surgical techniques have been described for resecting the bullae. One way is wedge resection using an endoscopic stapler[3,14]. Other methods, such as endoscopic stapling device that does not excise the bulla[8,9], electrocoagulation, laser coagulation of bulla, or a combination of different methods, are favored by different authors[8,14]. Ogawa et al and colleagues have devised a method of spraying the staple line with aerosolized fibrin glue to seal the air leak sites[5].

Our long term recurrence rate is three out of 46 patients (6.5%). All these recurrences occurred within six months after the intervention and two required a re-operation. One reason for recurrence is failure to recognize the site of the leak in the absence of bullous disease. Unrecognized bullae or inadequate resection of the diseased portion of the lung may also contribute. Another factor is inadequate pleurodesis, especially in between the trocar sites. These failures suggest that gauze pleural abrasion is probably less effective than apical pleurectomy. Like Tanaka et al, we found that the recurrences were more frequent in patients in whom multiple bullous disease was identified[5]. It is for such patients for that apical pleurectomy may be indicated, and this will probably provide more pleural adhesion with a decreased subsequent recurrence rate. It is not time-consuming, difficult to achieve or a source of postoperative bleeding as others have suggested, and is, therefore, preferred to pleural abrasion which has been associated with a higher recurrence rate[16]. Our recurrence rate is comparable to that reported in the literature after thoracoscopy, which varies from four to 8.6%[11,12,17].

CONCLUSIONS

VATS procedure can be done safely in the treatment of selected group of patients with secondary SP who are in good general condition. The procedure is well tolerated and allows early discharge usually within five days. It is now our procedure of choice and has become the routine approach for the treatment of bullous disease of the lung. Because of its less invasiveness, reduced morbidity and shortened postoperative stay, we tend to intervene slightly earlier in patients with persistent air leaks and even during the first episode of pneumothorax. VATS wedge excision and apical pleurectomy represent a satisfactory treatment modality in patients with bullous emphysema and secondary SP.

REFERENCES