Video-Assisted Thoracoscopic Surgery for Spontaneous Pneumothorax in Emphysematous Patients

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Objectives. Video-assisted thoracoscopic surgery (VATS) is a useful modality for the management of spontaneous pneumothorax (SP). We report our experience using VATS for SP in emphysematous patients with regards to efficacy, morbidity, and mortality.

Methods. We retrospectively studied 25 emphysematous patients with SP who were treated primarily by VATS. This series included 23 male and 2 female patients with a median age of 75 years (range, 62 to 86 years). All 25 patients presented with persistent pneumothorax (air leakage for more than 4 days), and 15 (60%) of them had recurrent ipsilateral pneumothorax (first ipsilateral recurrence in 13, and second in 2). The mean preoperative chest drainage was 8 days (range, 4 to 14 days). Preoperatively, ventilator support was mandatory for three patients with respiratory failure. A limited thoracotomy was necessary for three patients because of massive adhesion, and for one patient because of persistent postoperative air leak. Routine bullectomy with staple cartridges and strip reinforcement of suture line, subsequent mechenical pleurodesis with scouring pads, and talc powder instillation were performed for all 25 patients.

Results. One patient died of pneumonia two months after operation. Postoperative complications with prolonged air leak (> 7 days) occurred in 3 patients. At a mean follow-up of 12 months (range, 6 to 43 months), no pneumothorax had recurred in 23 patients. In comparison with our experience using this technique to treat primary SP in 72 patients, there was no significant difference in the operating time, number of staples used, 24-hour postoperative blood loss, or 24-hour postoperative morphine dosages; however, the duration of both preoperative and postoperative chest drainage was longer, and there were more primary treatment failures with prolonged air leak (> 7 days).

Conclusions. As a minimally invasive method, VATS is an adequate initial treatment procedure for emphysematous patients with SP. **(Mid Taiwan J Med 2003;8:78-84)**

Key words

emphysematous lung, spontaneous pneumothorax, video-assisted thoracoscopic surgery

INTRODUCTION

While primary spontaneous pneumothorax (SP) commonly occurs in young, tall, thin patients without apparent underlying lung disease, secondary SP, which makes up about 70% of cases, occurs in elderly patients with emphysematous lung disease [1]. The mechanism of secondary SP is dynamic bronchiolar obstruction which results in check-valve hyperinflation of the distal airways and

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subsequent alveolar rupture [2,3]. SP occurring in elderly patients with emphysematous lung disease may exaggerate the existing poor pulmonary function of the patient, and sometimes, may lead to respiratory failure. The standard treatments of SP are bed rest and observation, and tube thoracostomy. However, as many as 20% of patients with SP may eventually require surgical treatment because of recurrent pneumothorax, persistent bronchopleural fistula, or failure of the lungs to expand fully [4-6].

Video-assisted thoracoscopic surgery (VATS) is a useful modality for the management of SP. VATS causes less tissue trauma and postoperative pain, which leads to shorter hospital stays and improvement in pulmonary function. Although VATS has several benefits in the management of SP [7-12], few reports have discussed the surgical benefits in the management of emphysematous patients with secondary SP, especially in comparison with patients with primary SP. Therefore, this retrospective study will describe these surgical results.

MATERIALS AND METHODS

Patient Selection

From November 1997 to December 2001, 25 emphysematous patients with SP were treated by VATS in the Division of Chest Surgery of the China Medical College Hospital because they had either failed to respond to chest tube drainage for SP or suffered recurrent episodes. Patients with SP related to trauma or iatrogenic causes were excluded. All patients had typical chest radiographic manifestations of emphysematous change, flattened diaphragm, and increased posterior-anterior chest wall diameter.

Anesthetic Technique

With the patient under general anesthesia, ventilation commenced with double-lumen intubation. Intermittent positive-pressure ventilation of the nonoperative lung was undertaken if oxygen desaturation of the patient occurred.

Video-Assisted Thoracoscopic Surgery

The patient was placed in a posterolateral thoracotomy position. An initial 2.0 cm incision was made and the first 11 mm trocar for the video-thoracoscopy was inserted either through the previous chest thoracostomy wound or the seventh intercostal space near the midaxillary line. Two stab wounds (2 cm) were made in the topographic location of the bullae to allow for the introduction of conventional instruments into the chest. These procedures were usually carried out with three incisions in a triangular configuration on the chest. The entire surface of the lung was carefully explored and the lung was manipulated with clamps. Adhesions which made bullectomy difficult were lysed using a combination of blunt dissection and electrocautery through the stab wound. We avoided unnecessary dissection which might have created additional air leaks. The ruptured bullae of all 25 patients were located on the apex of the lung, and were identified by VATS during the operation. Each bulla was then grasped and excised with an endoscopic linear stapler (Endo-GIA 30, Auto Suture Company Division, United States Surgical Corporation, Norwalk, Conn.). Following the bullectomy, mechanical pleurodesis was stimulated by pleural abrasion which was performed by rubbing the pleural surface with scouring pads attached to the tip of standard curved forceps. All the parietal pleurae were abraded by inserting forceps directly through either the various incision wounds or port sites. Two additional procedures were performed for the emphysematous patient with SP; 1) the staple cartridges were incorporated with Teflon strips (Meadox, Boevres, France) for buttressing the staple line; 2) subsequent chemical pleurodesis was performed under thoracoscopic vision with three grams of sterile, asbestos-free talc which was evenly insufflated by a disposable single-use spray canister over the entire pleural space. A 28-Fr chest tube was placed through the seventh intercostal port site. The lung was then reinflated and the other two incision sites were closed in two layers. The tube was connected to an aspiration system and negative suction of 15 cm H_2O was applied.

Limited thoracotomy was performed if hemorrhage, massive adhesions, or uncontrolled

Table 1. Patient characteristics

Characteristics	Primary SP (n = 72)	Emphysematous patients (n = 25)	*p*
Male-to-female ratio	55:17	23:2	_
Age (yr)	21 (range, 15-44)	75 (range, 62-86)	< 0.001
Preoperative chest drainage (d)	3 (range, 1-8)	8 (range, 4-14)	0.02
Recurrent pneumothorax	50 (69%)	15 (60%)	0.86

SP = spontaneous pneumothorax.

air leaks were encountered during the VATS procedure.

Postoperative Care

The patients were extubated when they were awakened. Prophylactic antibiotics were administered to all patients. The chest tube was left in place for a minimum for 5 days, and was removed if there was no air leak. The patients received intravenous morphine through a patient-controlled analgesia system.

Statistical Analysis

The results of the perioperative variables evaluated in patients with either primary SP or emphysematous lung were compared by unpaired Student's *t* test.

RESULTS

Patient Characteristics

Table 1 shows comparative data between 72 patients with primary SP and 25 emphysematous patients with SP who were treated by VATS. Twenty-five emphysematous patients (23 men, 2 women) with a median age of 75 years (range, 62 to 86 years) presented with secondary SP, while 72 patients (55 men, 17 women) with a median age of 21 years (range, 15 to 44 years) presented with primary SP ($p < 0.05$). The mean preoperative chest drainage of emphysematous patients and primary SP patients was 3 days (range, 1 to 8 days) and 8 days (range, 4 to 14 days), respectively ($p < 0.05$). Regarding the surgical indications for VATS, all 25 patients presented with persistent pneumothorax (air leakage for more than 4 days). Among them, there were 15 (60%) patients with recurrent ipsilateral pneumothorax (first ipsilateral recurrence in 13, and second in 2), which was not significant in comparison with 50 patients who had recurrent (69%) primary SP.

Surgical Results

Preoperatively, ventilator support was mandatory for three emphysematous patients with respiratory failure. In comparison with our previous experience using this technique to treat primary SP, there was no difference in the operating time, number of staples used, 24-hour postoperative blood loss, or 24-hour postoperative morphine usage; however, the duration of both preoperative and postoperative chest drainage was longer in emphysematous patients, and there were more cases of primary treatment failure with prolonged air leak (> 7 days). A limited thoracotomy was necessary in three patients because of massive adhesion, and in one patient because of a persistent postoperative air leak after operation. In comparison, all primary SP patients were successfully treated by VATS in our previous series (Table 2).

In the current study, a complication developed in four emphysematous patients (Table 3). One patient died of pneumonia two months after operation. Postoperative air leaks (> 7 days) occurred in three patients; one patient required a second operation by limited thoracotomy for suture ligation of the leakage site, one patient's air leak was controlled after 30 days of chest drainage, and one patient developed a localized bronchopleural fistula. At a mean follow-up of 12 months (range, 6 to 43 months), no pneumothorax had recurred in 23 of the 25 patients.

Table 2. Surgical results

Variable	Primary SP (n = 72)	Emphysematous patients (n = 25)	*p*
Operative time (min)	86 (45-130)	102 (65-180)	0.67
Number of staples used	2.4 (1-5)	3.2 (2-6)	0.82
24-hour postoperative blood loss (mL)	292 (85-850)	310 (110-650)	0.66
24-hour postoperative morphine usage (mg)	34 (28-41)	30 (21-36)	0.51
Prolonged air leak (> 7 days)	0	3	0.03
Postoperative chest drainage (d)	3.9 (3-7)	8.6 (5-30)	0.03
Revisional thoracotomy	0 (0%)	4 (20%)	0.01

SP = spontaneous pneumothorax.

Table 3. Complications after VATS for emphysematous patients with spontaneous pneumothorax

Patients	Age (yr)	Sex	Complication	Outcome
1	67	Male	Persistent air leak	Doing well
2	78	Male	Unstapled bullae with persistent air leak	Revisional thoracotomy
3	75	Male	Bronchopleural fistula	Open drainage
4	86	Male	Bronchopneumonia	Died 2 mo after operation

VATS = video-assisted thoracoscopic surgery.

DISCUSSION

The surgical indications, which are the same for patients with primary SP and emphysematous patients with SP, include recurrent pneumothorax, persistent bronchopleural fistula, or failure of the lungs to expand fully. VATS was first used to manage pneumothorax in 1990 by Levi et al [13]. Subsequently revised techniques regarding pleurectomy, pleural abrasion, endoscopic staples which permit bullectomy with satisfactory control of air leaks, hemostasis of tissue margins, and even suture-line buttressing with strips for reinforcement have been reported in the literature [7,8,11-14]. VATS now causes less tissue trauma and postoperative pain than before. It also leads to early mobilization, a short hospital stay, minimal blood loss, reduced postoperative morbidity, early return to occupational activity, and excellent cosmetic results [7-12,15].

In this study, three patients required preoperative ventilatory support. After operation, one of them died of pneumonia and the other two patients recovered uneventfully. We suggest that preoperative ventilatory support is not a contraindication to operation.

Although patients with primary SP or emphysema combined with SP can be treated by VATS, there is a learning curve in the management of the patients who have emphysema and SP for three reasons.

First, unruptured, tiny blebs can be identified in around 80% of patients with primary SP during operation [16]. In our experience, the blebs were resected by EndoGIA prophylactically to prevent recurrence. As the ruptured bleb which caused the pneumothorax may cause fibrotic scarring, it should also be resected. However, ruptured bullae due to paraseptal emphysema were identified in all of the 25 emphysematous patients with SP, and intentional resections were performed to cease the persistent air leaks.

Second, adhesions which make bullectomy difficult can be encountered more frequently in emphysematous patients with SP compared with patients with primary SP; therefore, we avoided

unnecessary dissection that might have created additional air leaks, which would have made limited thoracotomy necessary as it was for 3 patients in this study.

Third, only subsequent mechanical pleurodesis following bullectomy was performed for patients with primary SP by rubbing the pleural surface with scouring pads; however, two additional procedures were performed for the emphysematous patients with SP. One involved stapler cartridges incorporated with Teflon strips (Meadox, Boevres, France) for buttressing the staple line. The other procedure involved subsequent chemical pleurodesis performed under thoracoscopic vision with three grams of sterile, asbestos-free talc sprinkled over the entire pleural space as evenly as possible. This procedure provided a dense pleurodesis to prevent recurrence in these high-risk elderly patients with poor pulmonary function. To date, we have not encountered pleural exudates or foreign body reactions following talc instillation in our patients as was reported in the literature [17,18].

In this study, we found that emphysematous patients with SP had prolonged air leaks (> 7 days), longer duration of both preoperative and postoperative chest drainage, and more primary treatment failures (16%) than the patients in our previous study using VATS to treat primary SP. Mouroux et al reported that morbidity was higher after VATS for secondary SP than that for primary SP, 28% and 7%, respectively [12]. Tanaka et al also reported a morbidity of 37% and a mortality of 4% [19]. Our favorable results may be attributable to our experience with VATS.

In conclusion, VATS is a valid method for treating emphysematous patients with SP. The technique is simple, and the postoperative results are satisfactory. In the long term, as more and more surgeons gain experience, favorable results with an acceptable percentage of morbidity and mortality will be obtained.

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視訊輔助胸腔鏡手術對肺氣腫病人併自發性氣胸的處理

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背景 視訊輔助胸腔鏡手術已成爲治療自發性氣胸有效方法，本研究針對原發性和肺氣腫病人自發性氣胸，探討視訊輔助胸腔鏡手術的效果。

方法 本回溯性研究，係針對25例肺氣腫病患併自發性氣胸，使用視訊輔助胸腔鏡手術。包括23例男性，2例女性，平均年齡75歲(範圍：62至86歲)。所有25例病患都有持續性氣胸(氣漏超過4天)。25例中，有15例(60%)病患爲同側氣胸復發(其中13例爲同側第一次復發，2例爲第二次復發)。術前胸管引流平均天數爲8天(範圍：4到14天)。有3例病例，術前因呼吸衰竭須使用人工呼吸器。25例病例中，有3例因術中肋膜腔廣泛沾黏，1例因術後持續氣漏，都須進行侷限性開胸術。所有25例病例做氣泡切除皆使用自動縫合器及以鐵氟龍(Teflon)條布加強縫線吻合，並以刮除塊做機械性肋膜沾黏術，再加上煤渣粉末噴灑於肋膜腔。

結果 有1病例手術後二個月死於肺炎。術後併發症爲持續性氣胸超過7天者有3例。平均追蹤12個月(範圍：6到43個月)，23例皆無復發氣胸。比較72例原發性自發性氣胸，同樣使用此技術的結果，發現在手術時間，使用自動縫合器數目，術後24小時失血量和術後24小時使用嗎啡劑量，皆無顯著差異。然而，肺氣腫病例併自發性氣胸，術前和術後胸管引流天數都較長，術後產生大於7天的持續性氣漏的病例也較多。

結論 我們認爲視訊輔助胸腔鏡手術是一最少傷害手術，可以做爲肺氣腫病例併自發性氣胸最先考慮的治療方法。(中台灣醫誌 **2003;8:78-84**)

關鍵詞

肺氣腫，自發性氣胸，視訊輔助胸腔鏡手術

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