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Video-Assisted Thoracoscopy Versus Open Thoracotomy for Spontaneous Pneumothorax

This retrospective study was designed to compare the contribution of the video-assisted thoracoscopic surgery (VATS) and open thoracotomy in the management of spontaneous pneumothorax (SP). The medical records of 100 patients with recurring or persisting (SP) treated were reviewed. The patients were divided into two groups: group I treated by thoracotomy while in group II (VATS) was used. There were 96 men and 6 women aged from 16 to 75 years. Indications for operation and sex distribution were comparable. The mean age for group I was 35 years and for group II was 45 years. Hospital stay was identical in both groups. The amount of narcotic requirements was lesser in group II than in group I as well as the postoperative respiratory dysfunction. There have been no recurrence to date (mean follow-up 6 years for the group I and 3 years for the group II). VATS have been shown to produce results comparable to those obtained following open thoracotomy with reduction of postoperative pain, respiratory dysfunction, catabolic response to trauma and decrease in wound related complications. VATS is a valid alternative to open thoracotomy for primary (SP) but it should be used with caution for the management of secondary pneumothorax.

Key Words : *Thoracoscopy; Thoracotomy; Thoracic surgical procedures; Pneumothorax*

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INTRODUCTION

Primary spontaneous pneumothorax (SP) is a potentially dangerous condition which often affects young and otherwise healthy people. It is a relatively uncommon problem with a reported incidence of 5 to 10 per 100,000, a male to-female ratio of 6:1 and a peak prevalence in the 16-24-year-old age group (1). The incidence of secondary pneumothorax is 6.3 per 100,000 per year for males and 2.0 per 100,000 for females (2). Primary spontaneous pneumothorax results most commonly from rupture of sub-pleural emphysematous blebs while secondary type has many associated causes. The goals of therapy is to obtain rapid restoration of lung expansion and to avoid recurrence. Regardless of type, surgical intervention is indicated in patients with a persistent air leak more than 7 days, following recurrent ipsilateral or contralateral pneumothoraces, and in cases of bilateral pneumothoraces.

Although VATS techniques may be useful, in many instances it may be more expeditious and therefore safer to carry out a formal transaxillary thoracotomy (TAT) to ensure the condition is dealt with effectively.

The objective of this study was to review our experience in the management of spontaneous pneumothorax and evaluate the efficacy and safety of each technique in terms of complications, recurrence rate and postoperative subjective complaint.

PATIENTS AND METHODS

This retrospective controlled clinical study comprises 100 patients with recurrent or persistent (more than 7 days) spontaneous pneumothorax treated in our unit from April 1986 to April 1995. There were 94 men and 6 women ranging in age from 16 to 75 years. During phase 1, from 1986 to 1990, 50 patients underwent transaxillary thoracotomy (TAT) while during phase 2, from 1991 to 1995, 50 patients were treated by VATS. The open technique complied closely with the endoscopic procedure for apical pleurectomy, abrasion of the visceral pleura and electrocoagulation of the blebs. Preoperative investigations included a chest roengenogram and a computed tomographic scan of the thorax in patients with suspected underlying pathology. Blood gas analysis and pulmonary function tests including measurement of the forced expiratotory volume in 1 second.

Surgical indications

Surgery was performed on 46 patients during the course of the second episode. Bilaterality was the indications in 3 patients, one of whom had simultaneous pneumothoraces. Forty-three patients had the operation because of persistent air leak beyond 7 days and 8 because the lung failed to reexpand despite adequate tube suction drainage.

Transaxillary thoracotomy

All patients received general anesthesia by inhalation. The patient was ventilated through a single endotracheal tube.

Placement of a double-lumen endotracheal tube was left to the discretion of the anesthesiologist. The patient was placed in the lateral decubitus position.

The entire chest wall was prepared and draped in the standard manner. A limited axillary thoracotomy was made through the fourth intercostal space, sparing the serratus anterior and rhomboid muscles. The ribs were spread enough to allow the introduction of the operator's hand and allowing use of standard stapling instruments in order to perform apical pleurectomy and excision of the apical blebs using stapling devices. Apical blebs were identified and a thorough search for other blebs in the superior segment of the lower lobe was carried out before performing therapeutic resection. The apical pleurectomy was started at the incision where the pleura is stripped from the endothoracic fascia until the apex was reached. Bleeding was controlled with electrocautery. The rest of the parietal pleura was abraded with a dry gauze sponge. The incision was closed in layers using absorbable materials. Through separate incisions, two chest tubes were left in place until full expansion of the lung and cessation of air leaks.

Thoracoscopy

Thoracoscopy was done under general anesthesia with the patient in a lateral decubitus position. To allow the lung to collapse, the operation table was placed in anti-Trendelenburg position. A double lumen tube was inserted to allow deflation of one lung. The thoracoscope was introduced through a 1-cm additional ports located at the axilla, third intercostal space and the second in the midclavicular line, fifth intercostal space respectively. The latter entry sites are used for the introduction of grasping and coagulation instruments. After inspection of the whole thoracic cavity with the Valsalva maneuver including the apices of the upper lobes, apical pleural adhesions, if present, were cut with endoscopic scissors. A biopsy was taken from the pleura and the lung as indicated.

Then, the blebs which are generally located at apices of the upper and lower lobes were elecrocoagulated. If apical blebs could not be visualized, routine coagulation of the apices was done. The apical pleura strips begins by marking the posterior, anterior and inferior limits of the dissection with scissors. The grasping forceps is used to lift and steady the pleura while it is bluntly stripped off the inner chest wall with a pledget introduced through the 11-mm cannula within a reducing a tube.

The visceral pleura is scratched from the apex to the diaphragm. The entire parietal surface is abraded by inserting the dissector directly through the various port sites. At conclusion of the procedure, two chest tubes were inserted through the entry sites. After full recovery, all patients were transferred to the floor. Chest tubes were removed when the lungs were completely expanded, absence of air leakage for 24 hours and drainage was minimal, and the patients were dismissed the following day.

Analgesia

All patients were extubated in the operative table and transferred to the ward after full recovery. Routine postoperative analgesia using Pethedine at the dose of 50 mg every 4 to 6 hours was administered and adapted to the individual requirements for 24 hours after which an oral analgesia was started on an as-needed basis. No epidural analgesia was used in either group.

Post procedural assessment

The total amount of analgesic requirements administered in the first postoperative 12 hours, total volume of intercostal drainage in the first postoperative 24 hours, duration of chest drainage in days, duration of the procedure in minutes, and pulmonary function test results (forced expiratory volume in 1 second; FEV1) obtained on the third postoperative day, and length of postoperative stay were recorded for both groups of patients.

All patients received a follow-up physical examination and a plain chest radiograph at 1, and 3 months and 1 year postoperatively. Subsequent follow-up was based on physical examination only. The following information were recorded: 1) presence of pneumothorax 2) the quality of wound healing and its related complications 3) residual postoperative pain. Data analysis: values were expressed as the mean ± standard deviation. Data were analyzed by the unpaired t test. Disease variables were analyzed by x^2 test or, when appropriate, Fisher's exact test. A p value less than

0.05 was considered significant.

RESULTS

Patients characteristics

Table 1 shows comparative data on patients who were treated by TAT and VATS. There were no differences in sex ratio among the two groups; however the patient group treated by VATS was significantly younger (35±17 years, p=0.04). In both groups, the mean hospital stay was 5 days.

Operative and postoperative details: There were no episodes of hemorrhage, and no patient required a blood transfusion. There were no episodes of pneumonia and no infection of the pleural cavity was observed in this study. No patient died as a direct result of treatment and all were discharged from the hospital. In both groups, an apical parietal pleurectomy and electrocogulation or stapling of blebs were performed.

The median operating time was significantly longer for patients treated by TAT than for those treated by means of VATS (44 versus 38 minutes; p<0.05).

There was no significant difference in the operative blood loss nor in the duration of chest drainage between the two groups (Tables 2, 3). The mean post operative analgesia requirement in the first 12-hour after operation was lower in the group treated by means of VATS rather than for those treated by thoracotomy, but this did not reach statistical significance. The postoperative hospital stay was identical in both groups. The operation resulted in a significant decrease from the preoperative values for the forced expiratory volume in one second and forced vital capacity by the third post operative day. These decreases were significantly less in the group treated by means of VATS than those treated by thoracotomy.

Spontaneous pneumothorax was primary in 50 patients with a mean age of 22 (14-45) years (Tables 2 and 3). The causes of secondary spontaneous pneumothorax in the remaining 50 patients included emphysema (n=18), tuberculosis (n=3), Marfan syndrome (n=2), asthma (n=2) and lymphangiomatosis (n=1). There were 5 conversions to open thoracotomy, for an overall conversion rate of 10% and

Table 1. Summary of all cases of spontaneous pneumothorax

Characteristics	VATS	Thoracotomy
No. of patients	50	50
Male-to-female ratio	48:2	46:4
Age (years)	35 (15-60)	45 (25-65)
Operating time (min)	40 (30-90)	42 (35-85)
12-hour postop pethedine use (mg)	180 (120-240)	240 (180-300)
72-hour decrease in FEV1 (%)	27 (5-40)	40 (20-60)
Chest drainage (days)	3 (2-12)	3 (2-10)
Post-op stay (days)	5 (4-13)	5 (4-11)
Postoperative blood loss (mL)	190 (150-170)	230 (150-400)
Follow-up (years)	3 (1-6)	6 (3-10)
Operative death	0	0
Recurrent pneumothorax	0	0

Table 2. Summary of cases of primary spontaneous pneumothorax

Characteristics	VATS	Thoracotomy
No. of patients	25	25
Male-to-female ratio	23:2	24:1
Age (years)	21 (14-35)	23 (15-45)
Operating time (min)	39 (25-90)	35 (25-65)
12-hour postop pethedine use (mg)	175 (125-225)	225 (175-300)
72-hour decrease in FEV1 (%)	29 (5-55)	45 (15-75)
Chest drainage (days)	3 (2-12)	3 (2-10)
Post-op stay (days)	5 (3-14)	5 (4-13)
Postoperative blood loss (mL)	150 (100-180)	210 (140-350)
Follow-up (years)	3 (1-6)	6 (3-10)
Operative death	0	0
Recurrent pneumothorax	0	0

Table 3. Summary of cases of secondary spontaneous pneumothorax

Characteristics	VATS	Thoracotomy
No. of patients	25	25
Male-to-female ratio	24:1	23:2
Age (years)	62 (48-65)	64 (58-78)
Operating time (min)	45 (35-90)	40 (30-65)
12-hour postop pethedine use (mg)	150 (100-200)	200 (150-300)
72-hour decrease in FEV1 (%)	35 (10-60)	48 (16-75)
Chest drainage (days)	3 (2-13)	3 (2-9)
Post-op stay (days)	5 (4-14)	5 (4-12)
Postoperative blood loss (mL)	160 (110-190)	220 (150-350)
Follow-up (years)	3 (1-6)	6 (3-10)
Operative death	0	0
Recurrent pneumothorax	0	0

both of them were secondary pneumothorax. Three conversions were in men (age 55, 60 and 65 years) due to severe adhesions between the visceral pleura and the inner chest wall. The remaining two conversion were done in patients with large and lobulated bullae. Subsequent follow-up showed no occurrence of pleural effusion nor recurrence of pneumothorax was observed in any group.

DISCUSSION

Regardless of its type, a first episode of pneumothorax is traditionally managed by closed tube thoracostomy which is considered the main therapeutic approach in the majority of patients, However this method is usually ineffective in preventing recurrences and successful reexpansion, resulted in cure in approximately 80% of cases (3). The natural progressive sequences of non operative therapies of recurring spontaneous pneumothorax have varied from rest and observation, needle aspiration, and chemical pleurodesis with tetracycline or talc poudrage. Rates of recurrence after rest and needle aspiration was around 40%; after suction drainage 22% and after thoracotomy, the rate was 1.06% (4).

Currently, the gold standard for operative therapy is a two-part procedure: resection or spotty coagulation of blebs and pleurodesis. The rationale for this approach is to eliminate the cause of the recurrent pneumothoraces, namely the bleb-containing area of the lung, and to prevent future lung collapse by a thorough pleurodesis.

Transaxillary thoracotomy (TAT) and VATS have proved to be useful methods in the management of spontaneous pneumothorax (5, 6). Surgical management of pneumothorax by TAT and VATS are aimed at treating parenchymal lesions and achieving pleurodesis by abrasions and/or pleurectomy. In 1956 Gaensler and colleagues (7) reported the first series of patients with recurrent spontaneous pneumothorax

Table 4. Results of surgical treatment of pneumothorax

Reference	Year	No. of patients	Morbidity (%)	Mortality (%)	Recurrence (%)	Follow-up months	Access
Linder	1993	94	8.5	NS	1.1	NS	VATS
Hazelrigg	1993	26	0	0	0	8	VATS
	1993	20	0	0	NS	NS	TAT
Waller	1994	30	NS	6.7	6.7	NS	VATS
	1994	30	NS	13.3	3.3	NS	TTY
Yim	1995	100	8	NS	3	17 (8-24)	VATS
Naunheim	1995	113	8	NS	4.1	13.1(1-34)	VATS
Liu	1995	82	7.3	0	0	22	TTY
Cole	1995	30	7	NS	17	NS	VATS
		43	NS	NS	3	NS	TTY
Mouroux	1996	100	10	0	3	30 (7-49)	VATS
Al-Qudah	1998	50	0	0	0	6 (3-10)	TAT
		50	0	0	0	3 (1-6)	VATS

VATS: Video- assisted thoracotomy, TAT: transaxillary thoracotomy, TTY: Formal thoracotomy, NS:Not stated.

in whom parietal pleurectomy was performed as a major therapeutic measure. Two and half decades later, Deslauriers and colleagues (8) described a modified form of open pleurectomy with the use of a transaxillary approach with the aim to reduce postoperative morbidity significantly and to achieve prompt restoration of working capacity.

The use of electrocautery through a thoracoscope in treating spontaneous pneumothorax has been reported by Wakabayashi (9). Electrocautery was effective in sealing rupture blebs but failed to control air leaks from ruptured large bullae. In 1990 Levi and associates (10) were the first to treat pneumothorax by VATS who performed pleurectomy through a 2 to 3 cm posterior incision. During the last 10 years, VATS has tremendously evolved from a well established diagnostic procedure of viewing and biopsying from the pleura and mediastinum to a world wide accepted therapeutic tool for the management of the pleuropulmonary and esophageal diseases. On the other hand, among the VATS indications in managing intrathoracic problems, treatment of pneumothorax is regarded as the procedure of choice, with excisions of the responsible bullae and blebs and partial parietal pleurectomy or spotty pleural coagulation (11, 12). However, despite the widespread practice of using minimal invasive techniques in the thoracic cavity, to the best of our knowledge few authors have tried, in a prospective means, to compare such a technique with the open thoracotomy for the treatment of spontaneous pneumothorax (13-15). The principal advantage of VATS procedures over the traditional TAT is the size of the incision. During a traditional TAT, the skin and the intercostal muscles are cut over a distance of 15 to 20 cm where in VATS 3 incisions of 2 cm each are sufficient for exploring the thoracic cavity. Small incisions generally reduce trauma access and consequently result in reduction of postoperative pain, postoperative pulmonary dysfunction, catabolic response to trauma and decreased wound related complications (16). Moreover, patients treated with VATS do not generally need admission to intensive care unit postoperatively as was the case in the present study.

In addition, although VATS does not allow palpation of the lung, it seems to be superior to TAT as it permits unrestricted excellent visualization of the entire pleural cavity, and allowing an accurate assessment of the lung, comprising extent of air leak and staging of lung pathology (17). Regarding the postoperative status of the pulmonary functions, there are few scientific trials in which VATS has been compared with conventional surgical approaches. A comparison between VATS and limited formal thoracotomy (without epidural anesthesia) for pneumothorax showed better results in the VATS group on the third postoperative day [mean percentage decrease in forced expiratory volume in one second compared with preoperative value was 29% in the VATS group and 43% in the thoracotomy group] (15). An important benefit of VATS over TAT, which this study clearly demonstrated, is the significant reduction in postoperative pulmonary dysfunction.

In our experience to date, the use of VATS has not resulted in reduction in the hospital stay (mean: 5 days) nor in the operating time. This may be partially attributed to our learning curve in handling VATS' equipment and the relatively small number in this series. Our results have also confirmed those of Hazelrigg (11) and associates who reported a mean hospital stay of 4.5 days after axillary thoracotomy. With regard to analgesia, we do not use a continuous thoracic epidural anesthesia, because in our institution that would require an intensive care bed and such patients are generally placed in the general ward after the operation.

We did not observe any recurrent pneumothoraces in both groups at a mean follow-up of 3 years for the VATS group and 6 years for the TAT group. Despite the decreased requirements of the postoperative narcotics on the VATS group but they do not reach a statistical difference and such results have also been reported by Landerneau and Harzerligg (14, 18).

In contrast, the reduction of girdle disability in the immediate postoperative period is markedly obvious in patients treated by VATS.

In terms of treatment of primary spontaneous pneumothorax some authors have demonstrated that VATS is more advantageous than a partial muscle-sparing posterolateral thoracotomy (15). Conversely, our results have clearly demonstrated no significant difference in the analgesia requirements, and the chest tube drainage time and hospital stay. Like others (12, 19), there were no intraoperative or postoperative deaths (Table 4). The most frequent postoperative complication (prolonged air leak lasting more than 7 days) was similar to those require an intensive care bed, and these patients are placed in the general ward after observed after conventional technique and more frequently observed in patients with secondary pneumothorax. The cost of intensive care for patients treated by TAT is counterbalanced by the cost of the double lumen tube used in patients treated by VATS. Based on the results of our study, we conclude with others (17, 19) that for the treatment of recurrent primary pneumothorax, thoracoscopic pleurectomy combines the effectiveness of open pleurectomy with the advantages of thoracoscopy. In some circumstances, especially when access is poor or when unexpected problems arise, conversion to thoracotomy may be necessary. A high conversion rate is necessary to reduce morbidity and should not be viewed as a failure (20-22).

The indication of VATS in the treatment of secondary spontaneous pneumothorax should be considered with caution and surgery via a limited transaxillary thoracotomy is found to be as safe and effective as VATS.

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