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Video-assisted thoracoscopic surgery versus thoracotomy for recurrent spontaneous pneumothorax

A comparison of results and costs

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Abstract *Objective.* Video-assisted thoracoscopic surgery (VATS) represents at present the most suitable treatment of recurrent spontaneous pneumothorax. After three years we consider this interesting to draw up a trial balance of our VATS experience in comparison with the cases treated before 1991 with the classic thoracotomic approach.
Methods. We have considered retrospectively the results obtained in a series of 30 consecutive patients with recurrent spontaneous pneumothorax treated with VATS between November 1991 and August 1994 in comparison with those obtained in a group of 30 patients previously treated with a traditional thoracotomy. The groups have been selected in such a way that surgical indications, sex ratio, age and number of episodes were homogeneous. The parameters we have compared were the postoperative complications, the duration of chest drainage and hospitalization, the operating times and the relapses. Besides these technical parameters we considered the economic data too.
Results. On average drains removal occurred one day before in VATS-Group: the time spent in the Hospital was significantly shorter in VATS-Group, being on average 1 week. Short term complications may be considered similar in the two Groups. Prolonged air leaks occurred in 13% and 16% respectively. Emothorax requesting reoperation occurred in 1 case for each Group. One death occurred in thoracotomy-Group in an old patient presenting a severe cronic respiratory insufficience with exacerbation in postoperative time. We have registered 2 relapses after VATS and none after thoracotomy.
Conclusions. The study has demonstrated the therapeutic efficacy of VATS and in the same time that in VATS the total economic cost is lower (22.7%) in comparison with traditional thoracotomy.
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Key words Pneumothorax · Video-assisted thoracoscopic surgery · Pleurectomy · Thoracotomy · Pleural abrasion

Introduction

Spontaneous pneumothorax (SP) occurs in more than 7 in 100,000 men, and in more than 1 in 100,000 women, per year. It may be subdivided into primary SP, resulting from the rupture of a subpleural bleb when the underlying lung is otherwise normal, or secondary SP, in which the air leak is related to the presence of an underlying lung disease, usually bullous emphysema. The aims of treatment are to effect full re-expansion of the lung and to prevent recurrence. Intercostal tube drainage of the pleural space is the accepted method of treatment in patients when the degree of lung collapse exceeds 25% (70% of all cases of SP). Failure of the lung to re-expand after intercostal drainage may be as high as 35%, and recurrent pneumothorax may

occur in 40%. In a randomized trial, talc pleurodesis was shown to result in a significantly lower recurrence rate than did simple drainage alone. However, further treatment for recurrent pneumothorax may be hindered by the presence of patchy but dense adhesions [3].

The accepted indications for surgical intervention are, at present, persistent air leak, recurrent SP, contralateral SP, and first SP occurring in people in certain high-risk occupations (e.g. aviators). The recent development of endoscopic video equipment has made possible superior thoracoscopic visualization and has facilitated the performance of minimally invasive procedures. Thoracoscopy, on the other hand, allows access to the thoracic cavity and produces less tissue trauma, including that caused by intercostal nerve damage and rib spreading. In principle, video-assisted thoracoscopic surgery (VATS) does not represent a new surgery, but it should be considered a new technical solution. The indications for VATS in cases of SP are practically the same as we have just mentioned for thoracotomy.

Our VATS experience in the treatment of SP started at the end of 1991 and since then we have applied this method in 30 patients with recurrent SP. After 3 years we consider it interesting to draw up a trial balance of this experience in comparison with 30 cases treated before 1991 with the classic thoracotomy approach. Furthermore, comparing one method to another we have considered both the clinical-therapeutic features and the economic implications [11].

Patients and methods

We analyzed two groups of patients with recurrent SP. Group 1 was treated with VATS and group 2 with classic thoracotomy. The groups may be considered homogeneous with regard both to the numerical composition and to the statistical data (Table 1). In both groups the indication for surgical treatment was the same and the differences in the severity of disease as well as the primary/secondary pneumothorax ratio between the two groups were not statistically significant.

Group 1

This group consisted of 30 patients, 25 males and 5 females, with an average age of 32.5 years (range 15–81 years). They all presented a recurrent SP at the 2nd or 3rd episode (mean recurrence value: 2.06). There were 14 left and 16 right SPs.

Group 2

This group also consisted of 30 patients, 27 males and 3 females, with an average age of 38.6 years (range 18–77 years). The mean recurrence value in this group was 2.13. There were 9 left and 21 right SPs.

All the patients included in this study had recurrent SP, which alone represented an indication for surgical treatment without preventive intercostal tube drainage. Besides standard chest radiograph, the patients underwent computed tomography (CT) of the thorax.

Table 1 Statistical analysis of two groups of SP

	VATS	Thoracotomy
No. of cases	30	30
Age range	32.5 (15–81)	38.6 (18–77)
Male-to-female ratio	5:1	9:1
No. of episodes	2.06	2.13
Left Right	14 16	9 21

Table 2 Operative procedures on thoracotomy

Bullectomy and apical pleurectomy	25
Apical pleurectomy alone	3
Bullectomy and abrasion	1
Abrasion alone	1

Table 3 Operative procedures on VATS

Bullectomy and partial pleurectomy	18
Bullectomy and abrasion	3
Abrasion alone	3
Partial pleurectomy alone	3
Bullectomy and chemical pleurodesis	2
Bullectomy alone	1

The aim of CT was mainly to point out the presence of a centrolobular emphysema, in the light of the fact that we have verified that it is often very difficult to prove the presence of bullae.

Surgical procedures performed with the two approaches were not uniform because often they were guided by intraoperative conditions. Nevertheless, as shown in Tables 2 and 3, there were some common procedures, such as bullectomy associated with apical pleurectomy among the thoracotomy operations and bullectomy associated with partial pleurectomy in the VATS cases. The surgical techniques are more precisely described in the following paragraph.

Thoracotomy

With the patient under general anesthesia using single-lung ventilation, a limited lateral thoracotomy is made through the fifth intercostal space, sparing the serratus anterior. Once the pleural cavity is opened, excision of apical bullae is performed using TA30 stapling devices, this procedures usually requires two stapler applications. An apical pleurectomy is carried out. Two drains are inserted through two separate incisions and placed on suction.

Video-assisted thoracoscopy

With the patient under general anesthesia, ventilation is commenced with double-lumen intubation. The patient is prepared as for thoracotomy. The initial 1.5 cm incision is made and the first trocar for the video-thoracoscope is inserted through the sixth intercostal space. Two further trocars are inserted, upon topographic location of the bullae. The bulla is grasped with an Endograsp and excised with the EndoGia 30. In this approach a second application is necessary to complete resection. Then, with a coagulant Endodissect, a partial ra-

Table 4 Clinical data of two groups of SP

	VATS	Thoracotomy
Primary SP	22	18
Secondary SP	8	12
Operating time (min)	51.5	93.6
Conversions	0	
Chest drainage (days)	6.24	7.4
range	(1–12)	(5–17)
Postop stay (days)	6.9	12.1
range	(2–15)	(8–21)

Table 5 Complications of two groups of SP

	VATS		Thoracotomy	
	No.	%	No.	%
Air leaks	4	13.3	5	16.6
Hemothorax	1	3.3	1	3.3
Death	0	0	1	3.3
Recurrent pneumothorax	2	6.6	0	0

dial pleurectomy is carried out. In this technique, defined as "spotty leopard" pleurectomy, the apical parietalis pleura is dissected and coagulated along the circumferential bone axis of the ribs (at least five or six). The different methods of pleurodesis we report represent only the expression of a normal training curve linked to acquisition of experience, to results analysis and to the evolution of operative instruments. Currently partial apical pleurectomy is our routine method, which has given us excellent results, similar to those obtained in open surgery, with no relapses. We never utilized a minithoracotomy in the VATS procedures. Two intercostal drains are inserted through the anterior and lateral incisions and placed on continuous high-volume suction.

Concerning intraoperative features, primary and secondary SPs were identified (Table 4). Primary SPs were slightly more frequent in group 1 than in group 2; the difference may be mainly related to the age of patients.

Results

According to the aims of the present report, the following data were analyzed: 1) Intraoperative data, 2) short-term postoperative data, 3) long-term postoperative data and 4) costs.

1. Intraoperative data

Operating times were carefully analyzed and quantified in minutes. As stressed in Table 4, the operating time was, on average, less than 1 h for VATS and more than 1½ h with the thoracotomy approach. Video-assisted thoracoscopic surgery never needed to be converted to thoracotomy.

Table 6 Costs in VATS (US$)

	$
Endograsp	163
Endodissect	157
EndoGIA 30	275
EndoGIA 30 recharge	125
Trocar 5+11.5	25

Table 7 Costs in thoracotomy (US$)

	$
TA 30	175
TA 30 recharge	107

2. Short-term postoperative data

The immediate postoperative time was analyzed with attention, because it may represented the most significant difference between the two methods. The mean time needed to remove the chest drains was measured (Table 4). Obviously the drain removal coincided with full lung expansion with no residual air leak. On average, drain removal occurred 1 day earlier in group 1. The time spent in the hospital was significantly shorter for group 1 than group 2, being an average of 1 week. The prolonged hospital stay in the thoracotomy group was mainly linked to the major postoperative pain experienced by patients in this group, which resulted in delayed social recovery.

Short-term complications may be considered similar in the two groups (Table 5). Prolonged air leaks occurred in 13% and 16%, respectively. Hemothorax requiring reoperation occurred in one case of each group. One death occurred in group 2, in an old patient presenting severe chronic respiratory insufficiency with prolonged postoperative time. For reasons linked to our service organization, we cannot evaluate the analgesics used for each group in this retrospective study.

3. Long-term postoperative data

In this section we really only had to consider one aspect: recurrence of SP. These data are decisive in defining the therapeutic efficacy of the procedures performed. As listed in Table 5, we registered two relapses after VATS and none after thoracotomy.

4. Costs

We also tried to estimate the economic costs of the two procedures as accurately as possible. This evaluation principally depended on calculating suture material costs and

Table 8 Total costs of two treatments of SP (US$)

	VATS	Thoracotomy
Endotracheal tube	22	22
Hardware	745	282
Suture materials	3	36
Drains	77	77
Hospital stay	1.815	3.182
Additional cost due to relapse	120	
Total	2.782	3.599

hospital stay. It was not possible, in our experience, to evaluate the social and working recovery of the patients. The cost of 1 day hospital stay was the same for the two groups, and in our service this was equivalent to 263 US$.

The evaluation also considered the costs of instruments and materials which were usually used in the two methods. In Tables 6 and 7 these costs are listed for group 1 (VATS) and group 2 (thoracotomy). They concern the hardware required plus the costs of endotracheal tubes, drains and suture materials. The anesthesia cost was the same. The VATS video equipment was already available and is more utilized for diagnostic thoracoscopy, so that its use and the relative costs cannot be considered as specific to VATS. All the operative instruments utilized in thoracoscopic surgery are disposable and their cost is therefore greater when calculating the overall cost of VATS. It is to be expected that the overall cost of a VATS procedure will certainly be lower when multi-use instruments become available.

Nevertheless, the total costs are highly affected by postoperative hospital stay expenses, finally depending on the postoperative course. As clearly shown in Table 8, the postoperative mean period of hospital stay was definitely shorter for group 1, so that the total costs for this group are considerably less in comparison to those of group 2 (US$).

With regard to the two relapses occurring in the VATS group: in the first one, consisting of a very small apical lung collapse, full re-expansion was achieved with conservative treatment utilizing ventilation therapy and respiratory kinesitherapy. The another one was treated with thoracotomy, the cost of which was taken into account in the overall cost of a single VATS procedure. The costs related to the two cases of hemothoraces were not considerd because one occurred in each group.

Discussion

Spontaneous pneumothorax represents one of the most common elective applications of VATS. At present many reports, with remarkable consistency, exist in the literature [1, 5, 6, 8, 9]. Nevertheless, some authors have recently expressed doubts about the real therapeutic efficacy of this technique in the treatment of SP. The combination of bullectomy and parietal pleurectomy through a thoracotomy access is an extremely effective method for preventing relapses, which do not exceed 0.5%. However, parietal pleurectomy is currently criticized, especially as a treatment of SP in the young patient. Such a procedure, in fact, might greatly complicate any future need of lung transplant or of re-opening the pleural cavity for any reason. Today alternative procedures of pleurodesis are also preferred in open operations, such as partial pleurectomy or pleural abrasion [4, 10]. In fact, VATS operates in the same way: associating bullectomy with a partial pleurectomy.

In group 2 there was a predominance of apical parietal pleurectomies, but it should be taken into account that most of these cases consisted of thoracotomies performed before 1990 in old patients with secondary SP, for whom this method is still accepted. However, secondary SP in the old patient often presents therapeutic problems linked to the presence of extended adhesions and multiple large bullae, so that treatment with VATS may prove very difficult [7, 12].

After some years of experience with VATS, another point to be mentioned is the timing of the removal of tube drains postoperatively. In the first instance, according to Boutin who re-evaluated diagnostic thoracoscopy [2], tube drains were used only with the aim of achieving lung re-expansion and were removed within 9–10 h after operation. Currently, these parameters have been partially reviewed and, before removing the tubes, we prefer to achieve sure lung re-expansion without evident air leaks, so as to minimize the risk of having to drain the pleural cavity again.

From the clinical and therapeutic point of view, our study confirms the efficacy of VATS, which registered only two relapses (6.6%), a result which may be considered satisfactory, especially as no classic parietal pleurectomy was performed. Furthermore, the operating times were greatly reduced by VATS application. These results highlight the importance of VATS in the treatment of recurrent SP.

This report also analyzes the economic data in the comparison between VATS and classic thoracotomy in the treatment of SP. This aspect appears to be very important in the present Italian health organization and worthy of consideration. The equipment used in minimally invasive videoendoscopic surgery is doubtlessly very expensive, so that if we consider this element alone VATS should be considered uneconomical. Nevertheless, VATS guarantees a shortened postoperative hospitalization because of reduced operative stress without thoracotomy incision, while maintaining good therapeutic efficacy. Considering the high cost of hospital stay in Italy, this means a saving of money and a reduction in costs which we have quantified as equal to 22.7%.

In conclusion our experience has confirmed the therapeutic efficacy of VATS in the treatment of recurrent SP and has also demonstrated its economic advantage. The latter seems to be related solely to shorter hospitalization (Table 8) without which one may expect an almost identical level of costs.

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