Should surgical pleurectomy for spontaneous pneumothorax be always thoracoscopic?*

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Abstract

Fifty-seven patients were studied over a period of three years to analyse the efficacy of surgical pleurectomy for spontaneous pneumothorax. Thirty-one and 26 patients underwent open and video-assisted thoracoscopic surgery (VATS) pleurectomy, respectively. VATS was the main modality used for primary spontaneous pneumothorax (PSP) (21 vs. 8). However, secondary spontaneous pneumothorax (SSP) was mainly managed with open pleurectomy (23 vs. 5). The median operating time was significantly longer in open group (72.4 vs. 55 min; P=0.005). The amount of analgesia required in the first five days was significantly more in open group (108 mg vs. 46.9 mg; P=0.02). Chest drainage was significantly more in open group (1027.1 ml vs. 652.8 ml; P=0.04). However, chest drain duration and hospital stay had no significant difference. VATS emerged as a cost-effective modality (£1770 vs. £3226). The ability to return to work was significantly earlier in VATS group in PSP patients (6 weeks vs. 10 weeks; P=0.007). There were 3 (5.27%) recurrences in VATS group for patients with SSP. This experience suggests that VATS pleurectomy is an appropriate modality for PSP. However, open pleurectomy is a viable alternative to treat SSP.

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1. Introduction

Spontaneous pneumothorax (SP) is divided into primary and secondary pneumothorax.

Primary spontaneous pneumothorax (PSP) occurs after the rupture of a subpleural bleb in otherwise normal lungs.

Secondary spontaneous pneumothorax (SSP) occurs in the presence of underlying lung disease, usually emphysematous bullae.

The indications for surgical treatment in PSP are well defined [1]. Surgical intervention in the setting of SSP is associated with a much higher morbidity than it is in the setting of PSP [2] and has been conventionally considered only as a last resort [3].

In 1956, Gaensler [4] reported the first series of patients with recurrent spontaneous pneumothorax, in whom parietal pleurectomy was performed as a major therapeutic measure.

The technique of VATS ligation of pleural bullae and parietal pleurectomy for the treatment of spontaneous pneumothorax was first described in 1991 [5].

Since then VATS pleurectomy has attracted enormous enthusiasm among thoracic surgeons treating spontaneous pneumothorax.

We report our experience regarding efficacy of VATS and open pleurectomy as a therapeutic modality for spontaneous pneumothorax.

2. Patients and methods

From 2004 to 2006, fifty-seven patients requiring pleurectomy by open or VATS due to recurrent spontaneous pneumothoraces were included in this prospective study conducted at Walsgrave Hospital Coventry, UK.

The patients with giant bullae and/or unfit for general anaesthesia were excluded.

The surgery was performed by one surgeon and each patient received an explanation by the surgeon about the differences between the VATS and open pleurectomy to make a choice for himself or herself.

Preoperative investigations included pulmonary function tests, chest radiograph and a computed tomographic scan of the thorax in selected patients with emphysema.

3. Operative procedures and management

3.1. Video-assisted thoracoscopic (VATS) pleurectomy

With the patient under general anaesthesia, ventilation was commenced with double-lumen intubation. The patient...
was prepared for thoracotomy. Contralateral single lung ventilation was begun before the initial 2-cm incision was made below the tip of scapula in the 6th intercostals space. A 10 mm video-thoracoscope (mainly 0° telescope) was inserted via 10.5 mm thoraco-port, and the thoracic cavity inspected. If a single large bulla was identified, thoracotomy was performed through two further 2-cm incisions anterior and posterior to the borders of the latissimus dorsi in the fourth intercostals space. The bulla was grasped with an endograss or an endobabcock and excised with the 30 mm endo GIA stapling device.

Apical pleurectomy was then performed by blunt dissection to the level of fifth rib using a curved artery forceps. The ribs were spread only enough to allow a parietal pleurectomy to be performed from the level of the fifth rib, together with stapled excision of apical bullae, if present, using the TA 30 or TA 55 stapling devices. The incision was closed in layers using absorbable material, including the pericostal sutures. Two drains were inserted through two separate incisions and placed on continuous suction to 2–5 kPa.

3.2. Open pleurectomy

With the patient under general anaesthesia using single lung ventilation, a limited postero-lateral thoracotomy was made through the 5th intercostals space, sparing the serratus anterior and the rhomboid muscles.

The ribs were spread only enough to allow a parietal pleurectomy to be performed from the level of the fifth rib, together with stapled excision of apical bullae, if present, using the TA 30 or TA 55 stapling devices. The incision was closed in layers using absorbable material, including the pericostal sutures. Two drains were inserted through two separate incisions and placed on suction at 2–5 kPa.

3.3. Analgesia

A postoperative paravertebral regional nerve block between T4 and T8 using 10 ml of 0.5% bupivacaine was performed in all patients. After the operation, patients were extubated in the operating room and transferred to the high dependency unit, where they were started on a patient-controlled analgesia (PCA) system using bolus doses (1 mg) of morphine with a lockout time of 5 min and no background infusion. This was continued until oral analgesia was commenced on as and when needed basis.

3.4. Postoperative

Intercostal drains were removed when the underlying lung was fully expanded with no residual air leak. Patients were discharged from the hospital when they were fully mobile and when their pain was controlled by oral analgesia.

3.5. Follow-up

On follow-up examination as an outpatient at 6–8 weeks after operation, the following details were recorded.

- The evidence of recurrent pneumothorax (as assessed by chest radiograph).
- The findings from the subjective assessment of wound pain.
- The results of the assessment of wound healing.

Information regarding complications or recurrent pneumothorax after discharge from outpatient follow-up was obtained from the respective referring physicians.

3.6. Statistical analysis

Continuous variables are shown as median with 25th and 75th centile and categorical variables are shown as a percentage with 95% confidence interval (CI). Comparisons were made with Kruskal–Wallis tests and χ²-test as appropriate. Standard statistical tests were used to calculate odds ratios and 95% CI.

Logistic regression was used to examine the effects of VATS/open procedure in in-hospital morbidity, while adjusting for differences in patient characteristics. In all cases, P-value of <0.05 was considered significant.

4. Results

4.1. Patient characteristics

In all, 57 patients were studied in this prospective review. Thirty-one patients underwent open pleurectomy while VATS pleurectomy was carried out on 26 patients.

The summary of details of all the cases is given in Table 1.

Recurrent spontaneous pneumothorax was the indication for treatment in 23 (74.19%) patients of the open pleurectomy group and 20 (76.92%) patients of the VATS pleurectomy group.

4.2. Operative details

All patients underwent apical pleurectomy. Bullectomy was performed in 23 (74.19%) patients of open and 17 (65.38%) patients of VATS pleurectomy group using a median of two staple cartridges per patient range of 1–4.

The median operating time was significantly longer for patients in open pleurectomy group than those in VATS pleurectomy group 75.34 vs. 54.09 min (P = 0.005). There was no significant difference in the operative blood loss between the two groups, however, there was a considerable difference in consumables used in operating theatre costing

<table>
<thead>
<tr>
<th>Table 1 Patient characteristics</th>
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</thead>
<tbody>
<tr>
<td>Characteristics</td>
</tr>
<tr>
<td>No. of patients</td>
</tr>
<tr>
<td>Sex (M/F)</td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Primary SP</td>
</tr>
<tr>
<td>Secondary SP</td>
</tr>
<tr>
<td>Associated bullae</td>
</tr>
<tr>
<td>Respiratory function tests (1)</td>
</tr>
<tr>
<td>FEV₁</td>
</tr>
<tr>
<td>FVC</td>
</tr>
<tr>
<td>Time of operation (min)</td>
</tr>
<tr>
<td>Morphone (mg)</td>
</tr>
<tr>
<td>Cost (excluding staff)</td>
</tr>
<tr>
<td>Chest tube drainage (ml)</td>
</tr>
<tr>
<td>Chest tube duration (days)</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
</tr>
<tr>
<td>Return to work (weeks)</td>
</tr>
</tbody>
</table>
£67.88 in open pleurectomy as compared to £25.32 in VATS pleurectomy.

4.3. Postoperative details

The median postoperative analgesic requirement as reflected by morphine consumption in the first five days after operation was significantly more i.e. 150.5 mg (10–300 mg) in open pleurectomy vs. 55 mg (10–120 mg) in VATS pleurectomy ($P=0.02$).

The median postoperative intercostals drainage, mainly in the first five days, was significantly more in open pleurectomy group i.e. 1027.35 ml (185–5300 ml) in open pleurectomy vs. 643.8 ml (150–3050 ml) in VATS pleurectomy ($P=0.04$).

In patients with PSP, the median inability to work was reduced significantly in VATS group by six weeks as compared to ten weeks in open pleurectomy ($P=0.007$).

In contrast to this, the patients with SSP had no significant difference.

There was no significant difference in the duration of intercostals drainage for the two groups statistically, as the drains were removed at a median of six days with the range of 2–25 days after operation.

The median postoperative hospital stay for both groups was eight days with the range of 2–28 days which was not statistically significant. However, two patients in each group had postoperative hospital stay exceeding 20 days as they required multidisciplinary review regarding concurrent problems. In one patient, initial VATS pleurectomy for SSP was abandoned in favour of open pleurectomy because of poor visualisation caused by pleural adhesions.

One elderly patient with SSP who had undergone open pleurectomy died due to respiratory failure in hospital after the operation.

One patient in each group required revision thoracotomy for haemostasis, while one patient with SSP developed surgical emphysema in VATS pleurectomy group which prolonged his hospital stay.

During subsequent follow-up, recurrent pneumothorax developed in 3 (5.27%) patients in VATS pleurectomy group and none in open pleurectomy patients.

In recurrent SP patients, one was initially operated for endometriosis related SSP and two for recurrent SSP due to diffuse cystic lung disease. They were successfully managed with re-do open pleurectomy with no further recurrence.

The summary of post-op morbidity and mortality is given in Table 2.

<table>
<thead>
<tr>
<th>Complications</th>
<th>VATS n = 26</th>
<th>Open n = 31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apical haematoma</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Haemothorax</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Empyema</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Collapse</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Surgical emphysema</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Recurrence</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Mortality</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

5. Discussion

Successful pneumothorax management should regard cause and extent of the air leak and must be directed towards elimination of the causative lesion, rapid and full expansion of the lung, minimal risk of recurrence, low or no morbidity and mortality, low cost and short hospital stay [6].

In our experience, the application of thoroscopic technique met most of these requirements, especially in patients with PSP. However, the benefits were less clear in patients with SSP.

In patients with diffuse bullous lung disease associated with SSP, technical difficulties were posed by the presence of patchy pleural adhesions (a sequel of prolonged intercostals drainage) and multiple blebs.

The analysis of the pattern of recurrence in 3 (5.27%) patients with SSP in VATS group showed residual blebs which were missed. VATS was also more time consuming in this group due to these technical limitations, multiple bullae required greater use of the endoscopic stapling device. As a result, the trocar introduction incisions have to be large enough (10 mm) to allow insertion of a camera to perform complete exploration of the pleural cavity under different angles.

In this study, open approach emerged as appropriate modality for diffuse bullous lung disease associated with SP as relapse is anticipated in <5% [7] and in these high-risk patients, one gets only one chance to get it right.

We agree with Waller et al. [8] that VATS can be an option in a selected group of patients with SSP (elderly emphysematous) who are at high risk for suffering from complications of thoracotomy and offers an alternative to prolonged intercostals tube drainage with its risks of immobility and an alternative to the inconvenience of a Heimlich valve apparatus. In this analysis, they also demonstrated an important benefit of VATS over thoracotomy is the reduced postoperative respiratory dysfunction.

We differ with Cardillo et al. [9] who suggested talc poudrage as a preferred option for pleurodesis, because talc pleurodesis along with its added risks, especially in young patients, also causes restriction of basal lung segments which are important for ventilation. Although extra-pleural layer remains intact following chemical pleurodesis, which makes subsequent lung operations more feasible than pleurectomy, however, this drawback is compensated by the limited extent of pleural resection (apico-lateral pleurectomy).

We believe that stapling wedge resection of apical blebs is an appropriate option than bulla ligation [10]. However, we are not in agreement with Naunheim and associates [11] who suggested blind apical stapling in patients with no evidence of bulla because we consider that an isolated apico-lateral pleurectomy is the right choice in this group of patients.

We choose to use a posterolateral rather than axillary thoracotomy as suggested by Kim et al. [12] in diffuse bullous disease because of reservation about the access offered and chronic wound pain by the latter approach. Furthermore, in a prospective, randomised comparison, Hazelrigg and associates [13] found no reduction in the
postoperative respiratory dysfunction when a muscle sparing rather than the standard postero-lateral thoracotomy was used.

The major criticism to VATS surgery was the expenditure of equipment but with an established settings, the added benefits cannot be denied. In this study, there is an overall saving of £1455 in VATS cases, further savings may be made in this group with a reduced need for convalescence, early return to work and treatment of post-thoracotomy pain.

We believe Vanderschueren’s 4-stage system [14] is a useful tool to classify and stratify different treatment options for SP. It would help to standardise future clinical practice to prevent treatment failure.

We agree that preoperative CT-scan in fine cuts may help the detection of underlying bullous disease and in choosing the appropriate surgical procedure [15].

Certain relevant issues in optimising the surgical management for SP like role of CT-scan in every case of SP, justification of talc pleurodesis in PSP, surgery following first episode of SP and multi-centric randomised trial based on therapies stratified as per Vanderschueren 4-stage system will require more clinical studies in future to achieve desired evidence.

In conclusion, the findings from this study suggest that VATS pleurectomy is a cost-effective, patient friendly modality for PSP. However, its efficacy for SSP is still to be determined. Open pleurectomy is a viable alternative to treat re-do cases and complicated SSP.

References