Abstract

Objective: In selected patients with giant bullous emphysema GBE and in those with specific complications, surgery may be the treatment of choice. Methods: In the period January 1993–February 1996 we performed 34 VATS treatments in 29 patients affected by GBE. There were 22 (76%) males and 7 (24%) females, with a mean age of 54 years (range 24–74). In 23 cases, a pneumothorax (PNX) was present at admission, while 6 patients were treated by choice. Altogether, we performed 23 resections of sessile bullae (type 2 of Reid) by using a linear endoscopic stapling device (Endo-path 35 and 45 mm) and 11 ligatures of pedicled bullae (type 1 of Reid) by loop (Endo-loop ‘PDS’). The mean number of charges for every treatment was 8 (range 4–21). The largest bullae were perforated and deprived of incarcerated air. They were then twisted on the axis perpendicular to the base in order to improve the manoeuvrability of the lesion and favour the correct placement of the Endo-path or Endo-loop. GBE was bilateral in 7 cases; one of these was treated bilaterally in the same surgical stage, other 4 were treated by staged operations.

Results: We experienced two conversions to open thoracotomy (one sessile giant bulla inside the fissura; 1 case of strong tuberculous pleural adhesions). Two patients, underwent a second operation by open thoracotomy because of a prolonged air leak. We have two peri-operative deaths, both to respiratory failure. Altogether, in 23 out of 29 (79%) cases VATS was effective and the mean hospital stay was 6 days (range 3–16). At a mean follow up of 16 months (range 1–36) no recurrence of PNX was observed.

Conclusions: VATS may be considered as a suitable surgical technique to approach GBE and, in most cases, it is effective. © 1998 Elsevier Science B.V.

Keywords: VATS; Thoracoscopy; Giant bullous emphysema; Endoscopic stapling device; Surgical treatment

1. Introduction

There is general agreement that, with proper selection of patients with giant bullous emphysema (GBE), it is possible, using surgical methods, to improve lung function and consequently the quality of life [1–4]. Other patients may, sometimes, benefit from surgery in the management of specific complications such as pneumothorax (PNX) or infection [5].

A wide variety of surgical procedures has been applied for the treatment of emphysematous bullae. Before the era of stapler, patients with GBE were treated by ligation and excision, or by ‘capitonage’ [6]. Later on, the introduction of the linear stapler permitted the resection of giant bullae easier and more safely [5]. The recent ‘rediscovery’ of thoracoscopy, involving advanced video technology, widened its application to thoracic clinical problems. One of them is the treatment of patients with GBE, with video-assisted thoracic surgical (VATS) technique, which is less invasive than the usual thoracotomy.

This study was undertaken to assess the safety and efficacy of a VATS approach for GBE.
Table 1

Sub-division of GBE complicated with PNX or bilateral according to Witz and Roeslin’s classifications and postoperative complications

<table>
<thead>
<tr>
<th>Witz and Roeslin No.</th>
<th>PNX (%)</th>
<th>Bilateral GBE (%)</th>
<th>Conversions (%)</th>
<th>Reoperations (%)</th>
<th>Deaths (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>11</td>
<td>5 (45)</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Group 2</td>
<td>17</td>
<td>17 (100)</td>
<td>7 (24)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Group 3</td>
<td>1</td>
<td>1 (100)</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>23</td>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

2. Materials and methods

From January 1976 to February 1996, we treated 148 patients with GBE, 119 (80.4%) by thoracotomy until 1992, while, since 1993, all the remaining 29 patients (19.6%) were approached by VATS. All the patients treated by VATS were divided according to Witz and Roeslin’s classification: group 1 patients are those with giant bullae well demarcated and almost normal underlying pulmonary parenchyma; group 2 patients present bullae associated with diffuse emphysema; and group 3 patients are those with a complete loss of parenchyma (‘vanishing lung’) (Table 1) [7]. Among the 29 patients treated by VATS (22 males and 7 females; mean age 54 years, range 24–74), 23 presented with a spontaneous PNX; which was persistent in 5 cases (21.7%), with a mean drainage period of 16.5 days (range 7–40) before surgery, hypertensive in 5 cases (21.7%) and associated with hemothorax in 1 case (4.3%). The remaining 6 patients (all in the group 1 by Witz and Roeslin’s classification) were treated by choice, as they presented disabling dyspnea and they underwent a preoperative and postoperative (6 months after VATS) functional investigation included static and dynamic lung volume measurements (FVC, FEV1, FEV1/VC, VC, RV, TLC), arterial blood gas analyses (\(pO_2\), \(pCO_2\), \(sO_2\)%, pH) and perfusion and ventilation lung scans. There were 7 patients, 24.1% of total, who presented bilateral GBE; 6 patients underwent VATS in emergency, 5 (83.3%) because of hypertensive PNX associated with displacement of mediastinum into the contralateral hemithorax and 1 (16.7%) because of severe hemo-PNX (> 2000 cc).

The operative technique was similar to that used in open thoracotomy. With the patient in the lateral position, and under general anesthesia by using double-lumen endobronchial intubation, three mini-incision sites are marked in the axillary triangle between the 6th and 9th intercostal space to allow the introduction of thoracic instruments.

We performed 23 resections of broad based bullae (type 2 of Reid), with a linear stapling device (Endopath 35 and 45 mm) and 11 ligatures of narrow based bullae (type 1 of Reid) by loop (Endo-loop ‘PDS’) [8].

The mean charge used for every treatment was 8 (range 4–21). The largest bullae were perforated and deflated, then twisted on the axis perpendicular to the base, in order to improve the operator’s access to the lesion and favour the correct placement of the Endopath or Endo-loop (Figs. 1 and 2).

In elderly patients (more than 65 years of age) we performed a partial pleurectomy. The pleurectomy was begun by marking the limits of pleural removal using a diathermic grasp or hook, generally from the 2nd to the 8th rib anteriorly, laterally and posteriorly. A mini-thoracotomy was never used in the VATS procedures.

On completion of the procedure, the lung was inflated, tested under water for further air leakage and two chest tube drainages were placed through the incisions. On average, chest tubes were removed after 5 days (range 3–14) and the post-operative hospitalisation time was 6 days (range 3–16). Overall peri-operative mortality was 2 patients (6.9%).

3. Results

There was no surgical morbidity, nor untoward incidents related to anesthesia. No patients required blood products. There were no intra-operative complications and mortality.

Two conversions to open thoracotomy (6.9%) were performed a few minutes after the beginning of VATS procedure, when the exploration of the pleural space

![Fig. 1. Ligation by endo-loop of a twisted narrow-based bulla.](image-url)
Of the 23 patients with spontaneous PNX treated without preoperative pulmonary function testing, 15 patients (65%) referred to a history of a chronic and disabling dyspnea, which regularly improved in all of them.

Histologic examination was performed in all cases and usually showed enlarged air spaces, fibrosis and occasionally some infiltration of inflammatory cells. Malignancy was not found, but one case of tuberculoma was revealed.

4. Discussion

Bullous disorder of the lung is primarily a medical problem, although surgical intervention in GBE is beneficial in reducing chronic and disabling dyspnea and in the management of specific complications such as PNX, infection, hemoptysis or chest pain [1,3,10,11].

Preventive surgery in asymptomatic patients is controversial; most authors agree that preventive surgery is legitimate when the bulla occupies half or more of the hemithorax, compresses the normal lung, or has enlarged over a period of years [5,10].

Gaesler and colleagues (1986) noted that bullous emphysema predisposes to PNX (occurring in 79.3% of our series), sometimes leading to prolonged air leakage which is often less responsive to chest tube thoracostomy [12].

Since the 1930s, numerous surgical procedures have been proposed for the treatment of GBE. The use of plication [1,16], local excision [14], segmental resection [17], lobectomy [13] and even lung transplantation [18] have been reported, with variable results [1,13–18]. The resection of giant bullae might be viewed as a special case of lung volume reduction in severe emphysema; in both instances the principle is to reduce lung volume by resecting the worst functioning lung tissue. The early functional changes after surgery for bullous disease are qualitatively similar to those in preliminary reports of reduction of lung volume for non-bullous emphysema [19].

The development of thoracoscopic surgical technique for the treatment of bullous lesions of the lung has significantly changed the timing and indications for surgical intervention for these diseases [20]. From 1976 to 1993 our standard approach was a thoracotomy. Our experience in the treatment by videothoracoscopy of spontaneous PNX influenced our attitude about GBE, either complicated by PNX or selected by choice, and since 1993 all patients have been approached by VATS. This is probably the reason for which, while group 1 patients by Witz and Roeslin’s classification are those generally thought to be eligible for surgical therapy [20], in our study 17 patients (58.6%) belonged to group 2 and all subjects presented PNX requiring surgical treatment.
Table 2
Pre- and post-operative FVC, FEV1 and dyspnea grade, according to Fletcher’s scale (which ranges from 1 to 5 grades), in the 6 patients (Pt) treated by choice

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>FVC</th>
<th>FEV1</th>
<th>Dyspnea</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pre- (%)</td>
<td>Post- (%)</td>
<td>Pre- (%)</td>
</tr>
<tr>
<td>1</td>
<td>30</td>
<td>M</td>
<td>5.41</td>
<td>5.63</td>
<td>4.69</td>
</tr>
<tr>
<td>2</td>
<td>33</td>
<td>M</td>
<td>3.76</td>
<td>3.50</td>
<td>2.96</td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>M</td>
<td>5.04</td>
<td>6.05</td>
<td>3.64</td>
</tr>
<tr>
<td>4</td>
<td>48</td>
<td>F</td>
<td>1.81</td>
<td>2.46</td>
<td>1.45</td>
</tr>
<tr>
<td>5</td>
<td>48</td>
<td>F</td>
<td>3.12</td>
<td>3.53</td>
<td>2.58</td>
</tr>
<tr>
<td>6</td>
<td>49</td>
<td>M</td>
<td>3.74</td>
<td>4.70</td>
<td>2.94</td>
</tr>
</tbody>
</table>

In agreement with other authors, we believe that one important post-surgical complication is persistent air leaking from the lung [5,20]. JD Cooper recommends the use of pericardial strips to prevent a persistent air leaking, in the case of lung volume reduction for severe emphysema [21,22]. On the other hand, W Weder stresses that the use of pericardial strips is not essential if endo-staplers are used [23]. In our experience, the good results about drainage time did not induce us to take into account the opportunity to utilise pericardial or PTFE strips. We have also to consider that, in the case of a giant bulla, the underlying lung parenchyma, in which the surgeon puts the endo-stapler, is often normal.

Other authors suggested to associate a pleurectomy with the bullectomy in order to achieve a better pleurodesis and reduce air leaking [5,23,24]. In agreement with them, a partial pleurectomy was performed only in elderly patients, since it would make a further thoracotomy, which might be required in younger patients, exceedingly difficult.

Our experience documents that a VATS approach is safe. In this series the conversion rate to open thoracotomy was 6.9% and only 2 patients (6.9%) had a prolonged air leakage that required a second procedure by open thoracotomy: these results may be considered satisfactory, even if not directly comparable because of different patient populations [7,10,19,25,26].

Table 3
Mean values of dynamic and static lung volumes, pre- and post-surgery, in the 6 patients treated by choice

<table>
<thead>
<tr>
<th></th>
<th>Mean ± S.D.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>87.67 ± 11.08</td>
<td>89.5 ± 21.63</td>
</tr>
<tr>
<td>FEV1</td>
<td>86 ± 19.37</td>
<td>95.3 ± 17.41</td>
</tr>
<tr>
<td>FEV1/VC</td>
<td>74.5 ± 4.68</td>
<td>78.8 ± 7.86</td>
</tr>
<tr>
<td>VC</td>
<td>89.83 ± 20.61</td>
<td>99.33 ± 20.42</td>
</tr>
<tr>
<td>RV</td>
<td>128.5 ± 66.25</td>
<td>113.17 ± 54.54</td>
</tr>
<tr>
<td>TLC</td>
<td>107.5 ± 18.84</td>
<td>108.67 ± 22.22</td>
</tr>
</tbody>
</table>

Statistical analysis was performed by paired t-test.

The postoperative death rate was 6.9% (2 patients) which is in accordance to other series of patients surgically treated for GBE. Witz and Roeslin reported a mortality rate of 1.5% in 151 patients with relatively normal lung, but the mortality rate rose to 11% in patients with diffuse emphysema [7]. In our series all deaths occurred in patients belonging to group 2 by Witz and Roeslin’s classification, with a rate of 11.8%.

The results obtained by VATS, if compared with that obtained in our previous experience by open surgery [11], are generally good. Above all, VATS has allowed the reduction of the mean post-operative hospital stay from 8 to 6 days and, as a consequence, the hospitalisation costs. So, they approximately balanced the higher financial premium for this surgical procedure.

It is concluded that the VATS approach in GBE can be performed safely and offers significant clinical improvement. Our experience, in agreement with that of other authors [10,25,26], suggests that VATS is a suitable alternative for the treatment of GBE with the possibility to reduce hospitalisation and the consequences related to a larger thoracotomic incision.

References


Appendix A. Conference discussion

Dr Weder (Zurich, Switzerland): In the very early period of the VATS management of pneumothorax, we also used the Endo-loop; but we completely abandoned this technique because we had many failures. You don’t think that in time of availability of staple devices we should abandon the technique with the loops?

Dr Ambrogi: We have not had failure by positioning the loop in the narrow-based bullae, so we use the Endo-loops that are less expensive.

Dr Klepetko (Vienna, Austria): If you are presenting us with a 7% mortality for treatment of an otherwise benign disease, I think we have to assume that a couple of your patients have been, speaking in functional terms, very poor patients. So what we would really like to hear from you is what was the average FEV1 of those patients and how many of them were showing with hypercapnia. On the other hand, I would like to raise the question, what were the indications for your operations? Were the indications purely based on the size of the bulla? Were they based on any complications of the bulla, like pneumothorax at the time of presentation of the patients, like bleeding or infection? Or were they based on functional grounds by severe compression of surrounding tissue?

Dr Ambrogi: We chose the 23 patients who underwent surgical treatment because they had pneumothorax. In most of these cases the pneumothorax underwent the first pleural drainage and because of prolonged air leak we decided to have the patient undergo the VATS technique. The 6 patients treated by choice had a giant bulla more than one-third of the hemithorax who, with the CT-scan, had compressed underlying parenchyma. Also functional tests suggested how to treat the patient.

