Fast-track video-assisted bullectomy and pleurectomy for pneumothorax: initial experience and description of technique

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Abstract

Objective: Pleurectomy ± bullectomy by video-assisted thoracoscopic surgery (VATS) is an established surgical procedure for pneumothorax. Early ambulation and discharge should be a reasonable goal. This study explores the feasibility of day-case surgery and identifies the obstacles requiring further work to facilitate day-case pneumothorax surgery. Methods: Between June 2007 and May 2008, 16 consecutive patients underwent video-assisted thoracoscopic surgery bullectomy ± pleurectomy (under the care of a single surgeon) with immediate connection to an ambulatory drainage system in the theatre following surgery. Analgesia comprised temporary paravertebral with early conversion to oral opiate ± paracetamol. There were 13 males (81%), average age 23 (range: 17—29) years, and three females (19%), average age 35 (range: 22—46) years. Twelve patients (75%) had left-sided disease, of which nine (56%) underwent elective surgery. All patients had previously suffered at least one primary spontaneous pneumothorax. Patients with probable secondary pneumothorax were excluded from the study. Length of stay (LOS) was compared with a control group of patients conventionally treated prior to the study. Results: In 13 patients (81%), early discharge was achieved 1 (range: 1—2 days) day post-op, whilst connected to an ambulatory drainage system. In three patients, early discharge was not achieved. One of these patients had the chest drain removed prematurely and remained an inpatient for 3 days with aspiration and observation for a small pneumothorax. The two remaining patients required extended inpatient admissions due to postoperative non-surgical complications. In the 13 patients discharged immediately, the time to drain removal (in clinic) was electively 7 days (range: 2—11 days). Two patients required re-admission: one for contralateral spontaneous pneumothorax and another for an ipsilateral basal pneumothorax treated with a drain. Conclusion: We have shown early discharge with ongoing ambulatory drainage following VATS pleurectomy ± bullectomy in patients with primary pneumothorax to be feasible with paravertebral in the theatre and rapid conversion to oral analgesia. Patients managed intercostal drains at home. Limiting factors such as postoperative nausea and pain control usually can be sufficiently managed in the outpatient. Shorter stays may have a beneficial financial result. Long-term follow-up and a quantification of the patients experience is warranted.

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1. Introduction

In the last 20 years, video-assisted thoracoscopic surgery (VATS), bullectomy with associated procedures (pleurectomy, talc poudrage, pleural abrasion or a combination) has been accepted as the management option of choice in surgical treatment of recurrent pneumothoraces [1—4]. Indications for surgery include complete pneumothorax, recurrent pneumothorax and failure of conservative management. In the UK in 2005—2006, 1377 patients underwent VATS pleurectomy ± bullectomy (Society for Cardiothoracic Surgery, UK and Ireland — Thoracic Surgical Activity, 2005—2006). The safety and efficacy of VATS in the management of pneumothoraces has long been acknowledged [5] and that the benefits of VATS versus open management are in increasing early mobilisation is widely accepted. If a suitable drainage system can be found, the reduced surgical trauma to the chest wall muscles from VATS should make discharge on the day of surgery, with the drain in situ, reasonable for some patients. This will allow them to enjoy the comforts of recovering at home whilst a pleuroscopy develops. In our experience, patients previously had lengthy hospital stays postoperatively whilst waiting for the gradual weaning from epidural to oral medication and using wall suction for several days.

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A significant subset of patients with pneumothorax is young and otherwise healthy with primary pneumothorax. In other branches of surgery, young patients are often managed as day cases. Maintaining full contact between the visceral pleura and the raw surface of the chest wall is important to maximise the chance of a good pleurodesis [6]. Appropriate portable drainage allows full expansion of the lung and drainage of the pleural space. Flutter valves potentially offer superior conditions for the drainage of air from the pleural space than under-water systems [7]. In the current hospital climate, with the relentless pressure to minimise inpatient length of stay, we asked the question whether it is possible to perform VATS bullectomy and pleurectomy as a day case. We report our early experience prior to a formal trial of day-case versus inpatient surgery for pneumothoraces. We describe the anaesthetic and surgical technique involved, the outpatient follow-up necessary and the potential benefits and future potential for this technique.

2. Materials and methods

2.1. Patient selection

Sixteen consecutive patients with primary pneumothorax were operated by a single team (Table 1). Elderly patients with evidence of secondary aetiology (COAD/emphysema) were excluded from the study. Patients were counselled about pleurectomy being painful. They were asked if they would prefer to be at home with control over the timing of their medication or stay in hospital (mean time 7 days) and rely on the nurses dispensing at specific times. If they expressed an interest in being at home they were advised that they would be discharged within the first 1 or 2 days with a drain in situ and a demonstration of a portable drainage system was given. If they felt uncertain about being at home, they were advised to stay in. Those who wished to be ‘fast tracked’ were given phone numbers to a specialist nurse and direct access to the ward.

2.2. Anaesthetic technique

2.2.1. General anaesthesia

Patients are pre-medicated with midazolam and atropine in the anaesthetic room prior to intravenous induction comprising propofol and remifentanil if bronchoscopy is to be performed. If no bronchoscopy is necessary, remifentanil is substituted with fentanyl. Neuromuscular blockade is achieved with rocuronium or atracurium. Patients are then intubated with a double-lumen tube (Mallinckrodt Bronchocath, Mallinckrodt Medical, Athlone, Co. Westmeath, Ireland). Intermittent positive pressure ventilation using 7–10 ml kg\(^{-1}\) tidal volumes is performed and the anaesthesia maintained using desflurane in an oxygen/air mixture. A one-lung ventilation technique employing a lung protection protocol is used. A 3–5 ml kg\(^{-1}\) tidal volume, with application of 5–10 cm H\(_2\)O of positive end expiratory pressure (PEEP) and permissive hypercapnia (increasing respiratory rate to keep end tidal CO\(_2\) 6–7 kPa) is used. Oxygen insufflation ± continuous positive airway pressure (CPAP) is given to the non-ventilated lung. Neuromuscular blockade is reversed with neostigmine and glycopyrrolate prior to extubation in the theatre and transfer to recovery.

2.3. Analgesic technique

The main change has been to the analgesic regimen. Previously, a thoracic epidural was sited prior to the induction of general anaesthesia and maintained with a continuous infusion of 0.1% bupivacaine + 4 µg ml\(^{-1}\) fentanyl delivered for approximately 48 h. After this, a systemic opiate-based approach was initiated using patient-controlled analgesia (PCA) morphine or oral long-acting morphine (MST)/oramorph and the epidural removed. We now perform a paravertebral block once the patient is anaesthetised and in the lateral decubitus position. As much as 10–15 ml of 0.375% bupivacaine with adrenaline 1:200 000 is injected at approximately T5 and T8 level. This is supplemented by intravenous morphine and paracetamol intra-operatively and oral morphine (MST/oramorph) and regular paracetamol postoperatively.

2.4. Surgical technique

Patients are placed in the lateral decubitus position with the diseased side uppermost. Following isolation of the ipsilateral lung, a 2-cm VATS port is inserted one to two rib spaces below the tip of the scapula (bearing in mind the likely position of dome of diaphragm). The camera is introduced and the hemi-thorax inspected. A further two 2-cm ports are created under direct vision, attempting to minimise the number of intercostal spaces used. Adhesions are mobilised to facilitate full inspection of the lung. An apical resection is carried out using a suitable linear cutting staple device (Echelon™ 60 ENDOPATH® Stapler, Ethicon Endo-Surgery) to remove blebs and scars for histological evaluation. A subtotal pleurectomy is the preferred technique; the pleurectomy extends to at least the upper two-thirds of the hemi-thorax, over the subclavian vessels and down to the level of the aortic arch or azygos vein medially and down as far as possible interiorly, posteriorly and laterally. Lung re-expansion is visualised directly and air leaks are sought and stapled prior

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Patient demographics.</th>
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<tr>
<td></td>
<td>Fast-track</td>
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<tr>
<td>Number</td>
<td>16</td>
</tr>
<tr>
<td>Sex</td>
<td>Male: 13; female: 3</td>
</tr>
<tr>
<td>Primary pneumothorax</td>
<td>16 (100%)</td>
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<tr>
<td>Stapler</td>
<td>EZ45: 9; Echelon: 7</td>
</tr>
<tr>
<td>Pleurectomy/pleurodesis</td>
<td>Pleurectomy: 14 (88%); Talc: 2 (12%)</td>
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to scope removal. Following haemostasis, a single 28Fr intercostal drain is inserted through the first port site. Port sites are closed with 0 Dexon® to muscle, 2/0 Vicryl® to fat and 3/0 Monocryl® or clips to skin. The drain is placed directly on to a portable drainage system (Rocket® Ambulatory Chest Drain, Rocket Medical, Washington, New-castle, UK; Portex® Ambulatory Chest Drain, Atrium® Express Mini 500TM) and a portable chest X-ray (CXR) performed in the recovery room. If the lung is not fully inflated, the patient is encouraged to breathe deeply and cough, and a repeat CXR is performed. Failure to achieve full expansion or continuous air leak necessitated connection to under-water seal and high-volume, low-pressure suction.

2.5. Postoperative management

Patients were returned to the ward from the theatre recovery room and commenced on oral opiate analgesia. Non-steroidal anti-inflammatory analgesics were not used in any of these patients. Once recovered from anaesthetic, mobile, eating and drinking, patients were allowed home if they met some appropriate criteria, such as an adequacy of oral analgesia, a 12-h drainage of less than 75 ml, complete lung expansion and the presence of only minor air leak at most. ‘Minor’ refers to adequate drainage so that CXR confirmed full lung expansion. The patients’ understanding of who and how to contact the team for help was confirmed and they were discharged with a date to return in 1 week. Management of the ‘fast-track’ group required no special service provisions, as like most units, we accept telephone enquiries from discharged patients; arrange for community nurses to visit and check dressings, etc.; and have weekly specialist thoracic surgery nurse outpatient clinic availability to review patients with drains. No special training or new investment was required.

2.6. Patient demographics

Between June 2007 and May 2008, 16 patients with primary pneumothorax underwent VATS bullectomy ± pleurectomy (under the care of a single surgical team) with immediate connection to a portable drainage system in the theatre following surgery. Thirteen were male (81%) with average age 23 (range: 17—29) years, and three female (19%) with average age 35 (range: 22—46) years.

3. Results

Sixteen patients underwent immediate connection to a portable drainage device in the operating room at the end of the operation. Thirteen patients were discharged home with drain in situ. The mean postoperative length of stay (LOS) in this group was 1 day (seven discharged on day 1 and six on day 2; median LOS 1 day). The drain remained in situ for 7 days on average (range: 2—11 days) while the patient was at home. The drain was removed in an outpatient setting by a trained nurse practitioner. There were two re-admissions in this group: one for contralateral spontaneous pneumothorax and another for an ipsilateral basal pneumothorax.

Three patients were not allowed to go home for fast-track discharge. One patient had a drain removed accidentally on day 1. He was kept in for observation and had a small amount of residual air aspirated before being sent home without a drain in situ at 3 days. The remaining two patients (13%) had significant air leak following operation and thus were not suitable for prompt discharge home with a portable drainage system. The mean LOS for these patients was 14 days (range: 12—17 days). None were re-admitted in this group.

Retrospective comparison was made with a control group (10 patients undergoing VATS pleurectomy at this institution between 2006 and 2007 under old postoperative drainage, analgesia and discharge protocols). The LOS was significantly greater (mean of 7 vs 1 day, p < 0.05) (Table 2).

4. Discussion

The VATS approach to bullectomy/pleurectomy has advantages over the open approach. VATS is associated with a lower postoperative analgesic requirement, shorter hospital stay, less lung dysfunction and reduced post-operative use of analgesics [1—4,5,8—11]. We have not identified all the variables that confound day-case pleurectomy but believe that we have made a useful start in making this common procedure a day-case operation. Several conditions seem important and require further evaluation. They include: an experienced surgical and anaesthetic team; availability of adequately functioning portable chest drain systems; adequate postoperative pain control; early and aggressive mobilisation and adequate outpatient infrastructure for open review following discharge. Management of the ‘fast-track’ group required no special service provisions, as like most units, we accept telephone enquiries from discharged patients; arrange for community nurses to visit and check dressings; and have weekly specialist thoracic surgery nurse outpatient clinic availability to review patients with drains. No special training or new investment was required.

When patients were reviewed in the outpatient clinic, complete lung expansion and the absence of any perceivable prior air leak was confirmed before drain removal. Ongoing air leak preceded further review in the clinic 1 week later. The drain was removed by specialist thoracic nursing staff in the same clinic. No pre-removal drain clamping period was used.

In our unit, the anaesthetic and analgesic management had traditionally included epidurals and systemic opiates. Fernandez et al. have demonstrated that epidural anaesthesia adds no benefit to the management of patients post VATS bullectomy and pleurectomy [11]. Adequate pain control can be achieved with oral analgesia from the day of surgery onwards. The succeeding postoperative period is largely incident-free and can safely be spent at home.

Table 2: Comparison of fast-track with standard (control) management.

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<th>Comparison</th>
<th>Fast-track</th>
<th>Control</th>
<th>p value</th>
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<tr>
<td>Number suitable for early discharge</td>
<td>13 (81%)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Postoperative length of stay (days, mean, range)</td>
<td>1 (1—2)</td>
<td>7 (4—15)</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Duration of drainage (days, mean, range)</td>
<td>7 (2—11)</td>
<td>4 (2—12)</td>
<td>n/a</td>
</tr>
<tr>
<td>Re-admissions</td>
<td>2</td>
<td>2</td>
<td>n/a</td>
</tr>
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After lobectomy, it is the primary surgeon’s practice (EB) not to use suction as flutter valves seem to offer adequate and sometimes superior drainage [7]. Mobilisation and deep breathing are sufficient to allow for re-expansion of the lung. This leads to the idea that pleurectomy patients should also be mobilised on their return from the operating room. Provided adequate drainage systems exist, patients should be able to manage at home.

We have demonstrated that it is possible to perform day-case pleurectomy and blebectomy in the majority of patients with primary spontaneous pneumothorax. This is a marked reduction in inpatient bed days when compared to other series [8–11].

There were recurrences; however, one case of a contralateral pneumothorax cannot be attributed to this technique. The basal ipsilateral pneumothorax could have resulted from traditional management as the doctor does not perform abrasion over the diaphragm. If we accept these, then the success at early follow-up was 100% freedom from recurrence in patients fit for early discharge.

In our series, it was decided that an air leak necessitating suction to achieve full lung expansion was a significant contraindication to discharge. Newer portable drains with suction may change this requirement. These patients were observed and treated, as required, with low-pressure, high-volume suction and/or further intercostal chest drain insertion, all resulting in prolonged hospital admissions.

Retrospective comparison was made with a control group (10 patients undergoing VATS pleurectomy at this institution under old postoperative drainage, analgesia and discharge protocols between 2006 and 2007). The LOS was significantly greater (mean of 7 vs 1 day, p < 0.05). The fast-track patients could save a possible bed cost of 6 days at £250 (for hotel costs alone) per day that is £1500.

4.1. Limitations

It is interesting to note that the mean age of patients who were eventually unsuitable for fast-track discharge was 38 years, compared to a mean age of 25 years for the intervention group. Histopathological analysis and clinical history did not support a diagnosis of ‘secondary pneumothorax’, and thus, this remains an interesting observation at the moment. There may be other factors which lend a propensity to prolonged air leak post operation. Currently, this fast-tracking approach appears better suited to young patients.

Further extension of this study will need to address patient satisfaction and ultimately, the main measure of success — rates of recurrence. The intervention group had two re-admissions but we feel that possibly neither of these could be deemed a failure of the principle of fast-track discharge. We will re-visit the cohort at 1 year post-operatively at which point definitive recurrence rates will be available.

The study attempts to make a comment on financial implications of early discharge. Preparation for possible increased access to district nursing services/general practitioner during the first week may be sensible in a larger study.

In conclusion, the combination of short hospital admissions and nurse-led drain removal results in a much lower LOS without increasing complications. It is feasible and indeed desirable to approach VATS bullectomy and pleurectomy as a near ‘day-case’ management option for pneumothorax.

Acknowledgements

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References


Appendix A. Conference discussion

Dr D. Cohen (Boston, United States): It would seem to me that patients who have a peripheral wedge resection for a lung nodule could also enter this sort of fast-track approach. Do you have any answer for that?

Dr M. H. Chamberlain (Nottingham, United Kingdom): I agree with what you are saying. It would obviously increase our number of patients that we can study and see which ones are more suitable for this than those that are not. I think that’s an option.

Dr S. Elia (Rome, Italy): Did you see any difference correlating with the location of the bullae resected?

Dr Chamberlain: Most of the cases that have been included here were apical bullae. Obviously you do occasionally find patients with more widespread disease, in which case we tend to favour talc pleurectomy in those patients. There hasn’t really been any difference in those in the follow-up as to which ones have been successful and those that have not.