Video-assisted thoracoscopic surgery (VATS) pleurodesis for pneumothorax

Calvin S.H. Ng*, Gaetano Rocco, Anthony P.C. Yim*

Division of Cardiothoracic Surgery, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, NT, Hong Kong SAR, China
Department of Cardiothoracic Surgery, Northern General Hospital, Sheffield, United Kingdom

Spontaneous pneumothorax is a common condition that impacts significantly on healthcare expenditure. Its optimal management, however, remains a subject of considerable controversy. The proven safety and efficacy of minimal access video-assisted thoracic surgery (VATS) has changed the way we manage this condition. We present VATS pleurodesis utilizing the endoscopic stapling technique for the management of spontaneous pneumothorax.

Keywords: Spontaneous pneumothorax; Thoracoscopy; Video-assisted thoracic surgery (VATS)

Introduction

Thoracoscopy, without video assistance and performed under local anesthesia has been practiced by European pulmonologists for almost a century. Sattler was credited to be the first to identify bullae in a patient with spontaneous pneumothorax using thoracoscopy and reported this in 1937 [1]. The development of solid state systems and microcameras in the 1980s preceded the advent of video-assisted thoracic surgery (VATS) in the 1990s. While thoracoscopy allows simple observation and talc poudrage, VATS permits procedures like mechanical pleurodesis, pleurectomy and bullectomy. There is excellent consensus among the surgeons that VATS (which commonly include bullectomy and either mechanical pleurodesis or partial pleurectomy) is the approach of choice when an interventional procedure is considered necessary [2]. We routinely perform blebectomy or bullectomy when it can be identified thoracoscopically (Photos 1 and 2). Furthermore, patients who underwent isolated VATS pleurodesis, without apical resection were associated with a much higher rate of recurrence compared to when the resection was performed [2]. We generally avoid pleurectomy and prefer pleurodesis, not only because bleeding is more common in the former but also because there is a chance that these patients may need lung surgery, and prior pleu-
rectomy would seriously complicate future surgical management.

With the lowered morbidity of VATS, the accepted surgical indications for pneumothorax include persistent air leak, recurrence, radiologically demonstrated huge bulla, spontaneous hemopneumothorax, incomplete expansion of the lung, tension pneumothorax, bilateral involvement and SP in a high-risk occupation, such as pilot or scuba diver [2]. Some authors have even recommended VATS for uncomplicated first time pneumothorax, which we currently do not advocate. However, there remain considerable controversies on issues such as the duration of persistent air leak and the number of recurrences before surgery is deemed appropriate. A recent consensus from the American College of Chest Physicians recommended the observation of air leaks for 4 days prior to surgical intervention [3]. Our experience supports the use of VATS when persistent air leak is present for more than 3 days, and on the second admission for SP [2].

Surgical preparation and technique

The general strategies to VATS are similar to those described in our other contribution (see Ng CSH and Yim APC. Video-assisted thoracoscopic surgery (VATS) bullectomy for emphysematous/bullous lung disease – doi: 10.1510/mmcts.2004.000265).

Surgical procedure

1. Incision and port placement

The incision and port sites are similar to those described in our other contribution (see Ng CSH and Yim APC. Video-assisted thoracoscopic surgery (VATS) bullectomy for emphysematous/bullous lung disease – doi: 10.1510/mmcts.2004.000265).

2. Exploration

The entire hemithorax should be inspected. Blunt atraumatic instruments (sponge-holding forceps) should be used for manipulation of the lung tissue. Adhesions should all be taken down to achieve a good operating field. Haemostasis is secured with diathermy for any adhesion bands. Special attention is needed for dividing apical adhesions because of the proximity of the subclavian vessels (Video 1). The presence of subpleural bullae has been reported to be present in 76 to 100% of primary spontaneous pneumothorax patients during video-assisted thoracoscopic surgery [2]. The whole lung surface, particularly at the apex and the lung edges, should be carefully searched for blebs and bullae. In a collapsed lung, a small bleb especially when ruptured (Video 2) can be difficult to identify. If left behind, these blebs could lead to recurrence.

3. Endoscopic stapled blebectomy/bullectomy

The endoscopic stapler resection line, which should be across healthy lung tissue, is marked by sponge-
Video 3. The target region with blebs or bullae is identified, and endoscopic stapled blebectomy/bullectomy is performed.

Video 4. During endoscopic stapled blebectomy/bullectomy, it is important to ensure the continuity of each staple line to prevent air leak. The resected abnormal wedge of lung is removed.

Video 5. Endoscopic Marlex mesh mechanical pleurodesis is performed to the whole pleural cavity including the diaphragmatic surface.

Video 6. Endoscopic endo-loop bulla ligation performed using a pre-tied commercial endo-loop or by a homemade polydioxanone loop. Holding forceps. Endoscopic stapled blebectomy/bullectomy is performed, ensuring that there is continuity of each staple line to prevent air leak (Video 3). Crossing of staples is to be avoided, and only gentle traction should be applied to prevent tearing of the lung. The resected lung wedge can best be retrieved through the anterior port with the wider intercostals space (Video 4). In our experience, the division of the inferior pulmonary ligament is generally not required unless a very large apical lung wedge is resected with the bleb or bulla.

4. Mechanical pleurodesis

A piece of rolled up Marlex mesh is mounted at the end of the endoscopic grasper, and mechanical pleurodesis is performed to the whole pleural cavity including the diaphragmatic surface (Video 5). Particular attention should be paid to ensure mechanical pleurodesis is thoroughly performed at the apical and lateral regions of the pleural cavity. It is important to check that the piece of mesh covers the entire tip of the endoscopic grasper to prevent injury. Furthermore, extra care is needed at the apex to avoid injury to the subclavian vessels.

5. End of the procedure

The areas of adhesiolysis and port sites are inspected for bleeding and hemostasis secured with diathermy. Through the inferior port site, a 24Fr chest drain is positioned under direct videoscopic vision to the apex and to lie antero-laterally in the pleural cavity. The lung is then reinflated under direct vision, and layered closure of the stab wounds complete the operation. We do not routinely check for airleak from the staple line.

Other techniques for managing blebs/bullae

1. Endoloop ligation

Endoscopic endoloop bulla ligation can be suitable for bulla in primary and secondary SP [4]. It is performed using a pre-tied commercial endo-loop or by a homemade polydioxanone loop (Video 6). Homemade devices are, of course, more cost effective. However, a known complication of endoloop ligation is the accidental slipping off of the loop during lung expansion or after a forceful sneeze. The problem can be minimized by the placement of a double or triple loop around each bulla [5,6]. Furthermore, a small metal clip can be applied to prevent loosening of the endoloop knot (Video 7).

2. Endoscopic suturing

Video-assisted thoracoscopic suturing of apical bullae with mechanical pleurodesis has been shown to be a
Placement of a double loop around each bulla can prevent accidental falling off of the loop. A metal clip can be applied to prevent loosening of the endo-loop knot.

Endoscopic suturing of bleb is performed using conventional surgical instruments.

The ends of the sutures are tied and bleb has been plicated.

Argon beam coagulation of multiple blebs.

Viable alternative to endoscopic stapled bulllectomy with mechanical pleurodesis [7,8]. Parenteral narcotic requirement, chest drainage duration, hospital stay and pneumothorax recurrence were similar for both techniques [7,8]. To minimize cost, the long conventional needle holder and standard monofilament polypropylene sutures used were found to be as effective as the specialized endoscopic suturing equipment for thoracoscopic suturing of bullae (Photos 3, 4 and 5). Therefore, in view of the high cost of staple-cutters, endoscopic suturing of apical bullae should be considered in selected cases of small localized bullae for PSP [7,8]. However, it must be emphasized that endoscopic suturing should be performed by surgeons adequately trained in the skill.

3. Argon beam coagulator

Argon beam coagulation (ABC) is less effective than stapled, suturing or endo-loop ligation bulllectomy in several patient series [7,8]. Patients treated with ABC had more post-operative prolonged air leaks (<10 days), as well as pneumothorax recurrences [7,8]. Therefore, the consensus is that ABC should not
Video 9. A roticulating endograsper is used to suspend the target parenchymal area cranially. Subsequently, a roticulating endostapler is positioned just caudal to the lesion to be removed.

Video 10. Endoscopic bleb/bullectomy is performed and the endograsper repositioned more distally upon each firing. Roticulating endoscissors are used to divide tissue not separated after stapling. Specimen is removed by endobag or directly by Roberts clamp.

Video 11. An electrocautery scratch-pad mounted on Roberts clamp is used for mechanical pleurodesis. This maneuver can create a tear in the parietal pleura where pleurectomy can be initiated with endo kittner.

be used as the primary treatment modality for SP (Video 8).

The uniportal VATS technique

Recently, Rocco et al. described the uniportal VATS technique for the management of spontaneous pneumothorax. Usually, an incision of 2 to 2.5 cm is made for uniportal VATS; if the chest cavity has been drained before, the same incision where the chest drain has been inserted can be used [9]. The port site is created directly anterior to the scapular line (see


After thorough inspection of the lung for any emphysematous changes, the target area is usually identified at the upper lobe apex or at the apical segment of the lower lobe (Video 9). A roticulating endograsper (Roticator Endograsp, MMCTSLink 10) is introduced parallel to the videothoracoscope in such way as to suspend the target parenchymal area cranially. Subsequently, a roticulating endostapler (Endo GIA Roticator, MMCTSLink 15) is inserted on the opposite side of the videothoracoscope through the same incision. The jaws of the endostapler are opened inside the chest and positioned just caudal to the lesion to be removed. This maneuver is facilitated by having the endograsper “present” the parenchymal area to the endostapler which can then be gently pushed into position prior to firing.

The endostapler is fired and the endograsper repositioned more distally onto the remaining lung to be resected (Video 10). Serial firings (up to three) are usually needed to remove all diseased lung tissue. Should a bridge of parenchyma remain to hold the specimen in place, a roticulating endoscissors can also be introduced. At this point the specimen can be removed either through an endobag (EndoCatch, MMCTSLink 16) or directly by using a long Roberts clamp.

A simple electrocautery scratch-pad, secured with a long stitch to facilitate its retrieval and mounted on the same Roberts clamp, is used to start the parietal pleural abrasion (Video 11). This maneuver is meant to create a tear in the parietal pleura from where a formal pleurectomy can be initiated with the aid of an endo kittner. Alternatively, a pleural abrasion can be performed throughout the chest cavity.

Technical considerations

Complication associated with the technique include air leak from the staple line, particularly when there is crossing of staple lines [5]. Furthermore, we have previously reported endoscopic staple cutter malfunctioning as a potential hazard [6]. We normally keep the chest drain on continuous 15 cmH2O suction for at least 24 h before considering removal to allow pleurodesis. Any pleural airspace in the early post-operative period should be dealt with aggressively, for example by increasing suction pressure or repositioning the drain to allow full lung expansion, because pleural apposition is the key to effective pleurodesis. Similarly, avoiding air leak into the pleural space during chest drain removal is also important. [Ng CSH, Yim APC. Insertion of Chest Drain Guidelines: Other
Table 1. VATS for spontaneous pneumothorax

<table>
<thead>
<tr>
<th>Authors</th>
<th>Case description</th>
<th>Patient No.</th>
<th>Blebs/bulla seen at VATS (%)</th>
<th>Stapled bullectomy</th>
<th>Endoloop/endo-suturing/ABC</th>
<th>Abruision pleurodesis (%)</th>
<th>Prolonged post-operative air leak (%)</th>
<th>Mean hospital stay in days (range)</th>
<th>Mean or median follow-up in months (range)</th>
<th>SP recurrence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yim [7]</td>
<td>PSP</td>
<td>483</td>
<td>87</td>
<td>196</td>
<td>261/35/6 (alone in 20 cases)</td>
<td>100/261/35/6 (alone in 20 cases)</td>
<td>0/4 (2–12 days)</td>
<td>3 (1–30)</td>
<td>20 (1–36)</td>
<td>1.7 (1997)</td>
</tr>
</tbody>
</table>

ABC, argon beam coagulation; NA, data not available; PSP, primary spontaneous pneumothorax; SSP, secondary spontaneous.

References

[1] Sattler A. Zur Behandlung der Spontanpneumothorax mit besonderer Berück-...


