Annals of the Royal College of Surgeons of England (1993) *vol.* 75, 237–240

Videothoracoscopy in the treatment of spontaneous pneumothorax: an initial experience

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Key words: Videothoracoscopy; Spontaneous pneumothorax; Pleurectomy

We report an initial experience with the new and potentially advantageous technique of videothoracoscopy in the treatment of pneumothorax. A series of 18 consecutive patients (14 male, 4 female) presenting with spontaneous pneumothorax over a 4-month period underwent surgical treatment by this method. The indication for surgery was recurrent pneumothorax in nine patients and persistent air leak in the remainder (median duration 15 days, range 5–28 days). Stapled apical bullectomy with apical parietal pleurectomy was performed in 14 patients, bullectomy alone was performed in one patient and pleurectomy alone in three patients. Additional talc pleurodesis was carried out in three of these patients. Median duration of operation was 53.5 min (range 35–120 min). The median postoperative drainage was 300 ml in 24 h (range 50–580 ml). The median duration of intercostal drainage was 48 h (range 24–384 h) and of postoperative hospital stay 4 days (range 3–18 days). The mean postoperative analgesic requirement was 1.3 mg morphine/h. Three complications required reoperation. In two patients a large air leak persisted after operation; one proceeded to thoracotomy for suturing of the air leak and in the other this was accomplished by videothoracoscopy. A further patient re-presented at 2 weeks with recurrent pneumothorax which was treated at thoracotomy.

At a median follow-up of 68.5 days (range 10–124 days) this is the only recurrence. These complications were caused by errors in surgical technique early in our series.

This initial experience of videothoracoscopic pleurectomy suggests it is an effective, well-tolerated treatment of spontaneous pneumothorax.

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Spontaneous pneumothorax is a common clinical problem for both thoracic physicians and surgeons for which there is as yet no universally accepted treatment protocol. The incidence in patients without underlying lung disease is over 7/100 000 per year in males (but about six times less in females) *(1)* and the incidence of recurrent pneumothorax is over 4/100 000 patients per year *(2)*.

Active management with intercostal tube drainage is indicated in over 70% of patients in whom >25% lung collapse has occurred *(3,4)*. Surgery is indicated for persistent air leak (although the timing of intervention is debated); ipsilateral recurrence; bilateral simultaneous pneumothorax or after a single episode in high-risk groups, ie aviators or deep-sea divers. The principles of surgical intervention are: 1, to identify and close the source of air leak, and 2, to obliterate the pleural space to prevent lung collapse. Traditionally, these objectives have been achieved by thoracotomy and in 1990 over 1000 such procedures were performed in the United Kingdom *(5)*. However, recent advances in endoscopic video equipment have enabled many of these procedures to be performed via a minimally invasive approach using a conventional thoracoscope *(2,6)*.

The potential advantages of this method include reduction in postoperative pain and pulmonary dysfunction and, consequently, hospital stay *(2)*. Conversely, the procedures are time-consuming and relatively expensive.

We report our initial experience with videothoracoscopic techniques in the treatment of recurrent and persistent spontaneous pneumothorax. Complications of the technique and implications for patient selection and future treatment are discussed.

Patients and methods

Patients were referred from chest physicians throughout the Northern Region with either recurrent or persistent spontaneous pneumothorax.

Surgical procedure

All procedures were carried out under general anaesthesia with an additional paravertebral nerve block between levels T4 and T8 with 0.25% bupivacaine with adrenaline. In two cases high-frequency jet ventilation was used in patients assessed to be at excessive risk from single-lung anaesthesia. Standard double-lumen intubation was employed in the remainder. In each case the patient was positioned and prepared for thoracotomy. The lung to be operated on was collapsed and single-lung anaesthesia commenced before surgery. Initially, two incisions were made: one 2 cm incision at the anterior border of the latissimus dorsi in the 4th intercostal space and another similar incision at the posterior border of this muscle. The pleura was breached by digital palpation and air introduced into the chest. A 12 mm Surgiport® (AutoSuture®) was inserted through the incision. A forward-viewing thoracoscope attached to a video camera was then inserted via the Surgiport using the posterior incision. A thorough inspection of the lung and chest wall was facilitated by gentle manipulation of the lung with a Roberts forceps introduced through the anterior incision.

Apical bullectomy

If a source of air leak could be identified, a third incision was made in the mid-axillary line in the 5th intercostal space and again a Surgiport was inserted. Using the three ports of access the apical bulla was mobilised from any adhesions to the chest wall and secured with an Endograsp® (AutoSuture®) and a stapled bullectomy was performed with an Endo-GIA® (AutoSuture®) device under videothoracoscopic control. Up to three staple cartridges were required.

Pleurectomy

Pleurectomy was begun by inserting a Roberts forceps through the anterior incision under videothoracoscopic control. The tips of the forceps were carefully guided into the extrapleural plane and were then advanced towards the apex, stripping off the parietal pleura with a sweeping motion. In two patients the pleural strip was accomplished by insufflating carbon dioxide via a blunt cannula under the parietal pleura. Care was taken to keep the pleural sheet intact until it had been stripped up to the apex when it was removed by grasping it with the Roberts forceps and withdrawing it through the anterior incision with a twisting motion. The apical pleurectomy was then completed by repeating the process through the posterior incision with the thoracoscope inserted anteriorly. A complete parietal pleurectomy extending from the level of the 5th rib to the apex was thus performed in two stages. Any blood which had collected in the paravertebral gutter was aspirated and two intercostal drains were inserted, one to the apex and one to the base under the video control.

Postoperative care

Patients were started on an intravenous patient-controlled analgesia system (administering morphine) on extubation at the end of the operation. This was continued for 16–24 h during the patient's stay on a high dependency unit. Intercostal drains were maintained on a negative pressure of 50 mmHg.

Chest radiographs were performed 4 h after operation and then daily. Drains were removed when drainage was minimal, when no air leak was present and when the lung was fully expanded. Patients were discharged from hospital when apyrexial, mobile and pain free with oral analgesia.

Results

Patient details (Table I)

In all, 18 patients were referred to our unit for further treatment of spontaneous pneumothorax over a 4-month period. There was wide variation in age from 16 to 83 years (median 41 years) with a male predominance (14:4). Nine patients had suffered more than one pneumothorax, and in the remainder surgery was indicated for a persistent air leak (median duration 15 days, range 5–28 days). In this group of patients there were four who, after assessment by thoracic anaesthetists, were thought to be at high risk of respiratory failure after thoracotomy because of poor respiratory reserve.

Operative procedures (Table II)

Apical parietal pleurectomy was performed in 17 patients and in 13 of these an apical bulla was identified and excised by endoscopic stapling. Additional talc pleurodesis was performed in two of these patients. In the remaining patient (one of the earlier cases) apical bullectomy was combined with talc pleurodesis, but pleurectomy was not performed. Operating time ranged from 35 to 120 min (median 53.5 min) and total serosanguinous drainage in the first 24 h ranged from 50 to 580 ml (median 300 ml).

Table I. Patient details

Number of patients: 18 (14 male, 4 female)	
Age: Median 41 years (range 16–83 years)	
Presentation:	recurrent pneumothorax 9
	persistent pneumothorax 9
Preoperative drainage: median 15 days (range 5–28 days)	

Table II. Operative details

Procedure	*Number*
Apical pleurectomy/bullectomy	11
Apical pleurectomy/bullectomy/talc pleurodesis	2
Apical pleurectomy	4
Apical bullectomy/talc pleurodesis	1
Total	18
Operating time: median 53.5 min (range 35–120 min)	

Postoperative course (Table III)

The mean postoperative morphine requirement was 15.7 ± 9.5 mg in the first 12 h after operation.

Patients mobilised on the first postoperative day with little restriction of movement. The median duration of postoperative intercostal tube drainage was 48 h (range 24–384 h). Seven patients were discharged on the 3rd postoperative day, three on the 4th and one each on the 5th and 7th days. Two patients with persistent air leak were discharged on the 14th postoperative day, and one who underwent further surgery on the 18th day. One of the referred patients required treatment of a spontaneous pneumothorax before contralateral pneumonectomy for bronchogenic carcinoma and was not discharged between operations.

Complications (Table IV)

Immediate thoracotomy due to vascular or lung damage during videothoracoscopic procedures was not necessary.

Table III. Postoperative course

Analgesic requirement
Morphine (12 h postop): Mean (s.e.) 15.7 (9.5) mg
Drainage
Total (24 h postop): Median 300 ml (range 50–580 ml)
Duration: Median 48 h (range 24–384 h)
Postoperative hospital stay: Median 4 days (range 3–18 days)
Postoperative follow-up: Median 68.5 days (range 10–124 days)

Table IV. Complications

Operative	
Immediate thoracotomy	0
Parenchymal lung damage	1
Missed apical bulla	1
Postoperative	
Recurrent pneumothorax	1
Death	1
Total	4

There was one postoperative death in a 79-year-old male who suffered a perioperative myocardial infarction after successful treatment of spontaneous pneumothorax.

There were three treatment failures. The causes were parenchymal lung damage due to traumatic cannula insertion in two cases and failure to identify an apical bulla due to incomplete apical mobilisation in the presence of adhesions in another. These complications were managed by thoracotomy in the first two patients and by repeat videothoracoscopy and stapled bullectomy in the other. All these complications occurred in the first month of our experience.

At a median follow-up of 68.5 days (range 10–124 days) there has been one case of recurrent pneumothorax which occurred 2 weeks after operation.

Discussion

We have found videothoracoscopic pleurectomy and bullectomy to be an effective treatment for persistent or recurrent spontaneous pneumothorax. The technique described includes several variations from the original description by Nathanson *et al. (2)*. We have not found it necessary to insufflate carbon dioxide to obtain lung collapse; with double-lumen endotracheal intubation, which we have found to be invaluable, the required lung can be isolated and air introduced via the first incision allows the lung to collapse. To simplify the procedure and reduce cost, we perform pleurectomy with blunt dissection using conventional instruments. We have attempted successfully to strip the pleura by insufflating carbon dioxide beneath it under pressure. However, the overall operating time was not reduced. Stapled bullectomy has been a quick and effective method of sealing any air leak and ligation of the bulla has not been attempted. Laser coagulation has been advocated as a technique for dealing with bullous air leak but requires additional expensive equipment and is often complicated by parenchymal air leakage *(7,8)*.

A major technical difficulty associated with videothoracoscopic surgery is obtaining optimal visualisation. Pleural adhesions, formed due to prolonged intercostal drainage or attempted chemical or talc pleurodesis, often hinder access. Division of these adhesions with endoscopic shears or electrocoagulation is necessary as they may conceal the leaking bulla. In patients with poor respiratory reserve high-frequency jet ventilation has been used and it is imperative that inflation pressures are as low as possible to facilitate endoscopic instrumentation.

Analysis of treatment failures in this series (Table IV) has revealed parenchymal lung damage and failure to identify the source of air leak as the important causes. We now perform intrathoracic digital palpation before introducing instruments to prevent parenchymal lung damage and we utilise computed tomography to locate apical bullae preoperatively.

The operative strategy of parietal pleurectomy in preference to pleural abrasion *(9)* or chemical pleurodesis

is based on its reported lower rate of recurrence *(10)*. We performed only apical rather than total pleurectomy or basal pleurodesis since in all our cases the air leak was at the apex of the lung. This procedure allows future thoracotomy to be performed away from an area of adhesions should it be required for other pathology *(11)*.

Thoracoscopy has been used for many years since the original description by Jacobaeus in 1915 *(12)*. The additional use of video equipment has widened its diagnostic and therapeutic applications. Conventional thoracoscopy may miss up to 9% of emphysematous bullae *(13)*, but videothoracoscopy provides a wider field of vision and increased illumination. Image magnification is a further advantage which facilitates careful haemostasis.

Video assisted thoracoscopy holds many advantages over open thoracotomy for conditions such as spontaneous pneumothorax, where the incision may contribute most of the postoperative morbidity. Pain is the most important factor responsible for ineffective ventilation and coughing leading to atelectasis and postoperative chest infection. Pleurectomy via a standard thoracotomy may cause a greater than 60% reduction in peak expiratory flow, forced expiratory volume and forced vital capacity in the first 24 h after operation *(14)*, and a reduction in vital capacity of up to 16% may persist even after 8 weeks *(10)*. The use of small incisions which do not require spreading of the ribs to admit instruments reduces postoperative pain, and subsequently pulmonary dysfunction, enabling patients to leave hospital earlier. The postoperative stay in this learning series is shorter than the mean of 8.5 days reported in another large series after apical pleurectomy via thoracotomy *(11)*.

The clinical implications of a minimally invasive treatment for spontaneous pneumothorax are extremely important. Surgery can be considered in patients with respiratory impairment in whom thoracotomy would not be tolerated and earlier in otherwise fit patients receiving treatment by intercostal drainage. A recent report which suggests that maximal healing of an air leak is obtained by 48 h of intercostal tube drainage and no significant benefit is obtained by further delay supports the concept of earlier surgical intervention *(15)*. Videothoracoscopy also offers a technique that enables closure of the air leak, considered sufficient treatment of the condition *(16)*, without prejudicing future thoracotomy.

Our initial experience with videothoracoscopic pleurectomy has been favourable and we envisage its increasing future use. A prospective randomised trial is being undertaken to compare its merits with standard pleurectomy via thoracotomy.

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Received 20 October 1992