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Original articles

Endoscopy assisted microthoracotomy: initial experience

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Abstract

Background **Although thoracoscopy has been used for diagnostic and minor therapeutic procedures for many years, there have been few reports of its use in performing major intrathoracic procedures, which have traditionally required formal thoracotomy.**

Methods **Twenty one patients (M:F 1·2:1; mean (SD) age 47·1 (18·8), range 17–75 years) underwent endoscopic intrathoracic surgery. Eight had unidentified peripheral masses on the chest radiograph, eight required lung biopsy, and five had recurrent or persisting pneumothoraces. Under general anaesthesia a laparoscope attached to a video monitor was introduced into the chest. One or two additional stab incisions were made as needed for the introduction of standard surgical or endoscopic intruments and staplers.**

Results **There were no complications or deaths, though one patient developed a second pneumothorax seven days after endoscopic pleurectomy, necessitating open pleurodesis. All patients were discharged home from two to six days after surgery (mean (SD) 3·7 (1·2) days).**

Conclusion **Endoscopic thoracic surgery is a safe and useful technique for certain cases. It merits further investigation and assessment.**

The use of endoscopes is part of the standard practice of many medical specialties. In recent years some surgical procedures that have traditionally been performed via a laparotomy incision are now carried out with laparoscopic techniques. A good example of this is the operation of endoscopic cholecystectomy.[1 2]

Although thoracoscopy has been performed by thoracic surgeons for over 70 years,[3] there are only isolated reports of its use in the execution of major surgical procedures within the thorax. We present our preliminary experience of 21 patients undergoing intrathoracic procedures using the technique of endoscopy assisted microthoracotomy.

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Methods

The first endoscopy assisted wedge resection of a primary lung carcinoma was carried out in this unit on 2 April 1991. The patient was a 75 year old woman, who had a forced expiratory volume in one second (FEV_1) of 0·85 litre (47% of the predicted value). Since then 20 other patients have had 21 endoscopic microthoracotomies by means of the techniques to be described. In total, there were 11 men and 10 women with ages ranging from 17 to 75 (mean (SD) 47·1 (18·8) years. Four patients had pre-existing chronic cardiac or respiratory disabilities; three had severely limited respiratory reserve with an FEV_1 of 0·9 l or less. In contrast, one of the patients who underwent staged bilateral pleurectomy was a potential Olympic athlete.

OPERATIVE TECHNIQUE

All procedures were carried out under general anaesthesia with a double lumen endotracheal tube. Patients were positioned and draped as for a standard posterolateral thoracotomy. After the lung had been allowed to collapse, a laparoscope with camera attached (GU Manufacturing, London) was introduced into the pleural cavity via a 1 cm stab incision through the sixth intercostal space in the posterior axillary line, so that the entire thoracic cavity could be inspected; it was sometimes necessary to divide pleural adhesions so that this could be achieved. With the laparoscope as opposed to the smaller thoracoscope, the width and quality of the field of view is similar if not superior to that obtained with formal thoracotomy. Depending on the site of the lesion and the planned procedure, one or sometimes two further 1 cm stab incisions were made to allow the introduction of surgical instruments into the chest.

With an assistant holding the laparoscope, the surgeon watches the video monitor, with both hands free to manipulate the instruments within the chest. Currently, stapling instruments specifically designed for endoscopic surgery are used, such as the ENDO-scissors and ENDO-GIA linear cutting stapler (Autosuture UK, Ascot). The latter instrument can be inserted through an 12 mm trocar and, when applied, inserts and cuts between two parallel rows of staples over a distance of 3 cm. Before the ENDO-GIA stapler became available we used the RLH30 stapler (Ethicon, Edinburgh), which could be inserted via a 2·5 cm incision, or, in one patient, the Ethicon PLC75 stapler, which required a slightly larger opening.

Of the 16 patients having resection of lung tissue, either for lung biopsy or for removal of a solid pulmonary mass, the first seven had the resection performed with one of the "non-endoscopic" staplers. These patients required a single 2–3 cm incision for introduction of the stapler, in addition to one or two 1 cm stab incisions. With the availability of the ENDO-GIA stapler, 1 cm incisions only are required for introduction of instruments. Depending on the size of the resected specimen, one of these incisions may need to be enlarged slightly to prevent compression of the tissue during its withdrawal from the chest.

At the end of the procedure, one or two intercostal drains are inserted through the incisions already made. Any remaining wounds are closed with 1/0 Vicryl for the muscle layer and 2/0 nylon for the skin.

Specific details of technique for the different procedures are as follows.

Lung biopsy

After introduction of the laparoscope and inspection of the thorax, the most suitable portion of lung to be resected for the biopsy is grasped with the ENDO-forceps, which is inserted alongside the laparoscope. Via a second, more anteriorly placed incision, an ENDO-GIA staper is inserted (applied across the edge of the lung) and fired. This may need to be repeated, depending on the size of the specimen to be removed. The specimen is withdrawn with the ENDO-forceps, along with the laparoscope and trocar.

Wedge excision of pulmonary mass

After insertion of the laparoscope the mass is located by inspection and palpated with forceps for confirmation of its size and consistency. The rest of the thorax is inspected to exclude other abnormalities. The mass is grasped with a small Duval tissue forceps, inserted through a second port. Through a third port, usually placed more anteriorly, several applications of the ENDO-GIA are made, to effect a wedge excision of the lung tissue containing the mass. The specimen is withdrawn through the most appropriate opening.

Pleurectomy

The laparoscope is inserted through the sixth intercostal space in the posterior axillary line. The lung and pleural cavity are inspected for evidence of pulmonary blebs. Through a second incision made anteriorly in the same space the process of stripping the pleura from the inside of the chest wall is begun, Roberts artery forceps being used. This instrument is introduced via a stab incision without a trocar and the tip inserted to an increasing depth into the extrapleural plane, without breaching the parietal pleura. One further incision is made between the previous two, so that access is available for the insertion of forceps to grasp the pleura and apply countertraction. All three ports are interchangeable so far as instruments and the laparoscope are concerned. In this way the parietal pleura is removed from the whole of the inside of the chest wall, including the apex and costodiaphragmatic recess. Haemostasis is carried out as needed by diathermy, which can often be applied more precisely under laparoscopic vision than when the chest is formally opened, especially in the apical regions.

Any apical blebs are grasped with tissue forceps and excised by one or two applications of the ENDO-GIA stapler. After pleurectomy both apical and basal drains are inserted.

In one patient, who had cystic fibrosis, a persistent air leak was causing a pneumothorax, which failed to respond to conventional intercostal drainage. Pleurectomy was not carried out, as this would have excluded her from consideration for transplantation surgery in the future. The air leak was located endoscopically and closed with a single figure of eight 3/0 Vicryl suture. This was inserted through a separate 2 cm incision by means of a long needle holder and forceps. The knot was tied externally and secured with the aid of a Negus knot pusher. The three drains that had been inserted preoperatively were left in situ. The small residual air leak stopped within two days of surgery, having been present for 13 weeks before operation.

POSTOPERATIVE CARE

All patients were extubated immediately after surgery, and nursed in a general thoracic surgical ward. Intramuscular opiate analgesia was given for the first 24 hours, oral paracetamol being used thereafter. Single drains were removed on the first postoperative day, though when two drains had been inserted, as in pleurectomy, they were removed sequentially on days 1 and 2. The patients were mobilised as soon as possible and discharged home when independent.

Results

Tables 1–3 summarise the characteristics of all

Table 1 Endoscopic procedures for pneumothorax

Patient No	Age (y)	Sex	Medical history	Diagnosis	FEV_1 l	FEV_1 % pred	Procedure	Complications	Day of discharge
1	18	M	None	Recurrent pneumothorax	3·6	86	Pleurectomy	Further pneumothorax	3
2	20	F	None	Recurrent pneumothorax	4·15	119	(1) Left pleurectomy	None	6
							(2) Right pleurectomy	None	4
3	21	F	Cystic fibrosis	Persistent pneumothorax	1·47	46	Suturing of air leak	None	6
4	18	M	None	Recurrent pneumothorax	4·48	91	Pleurectomy	None	4
5	17	M	None	Recurrent pneumothorax	3·9	90	Pleurectomy	None	4

Table 2 Endoscopic procedures for a solid pulmonary mass

Patient No	Age (y)	Sex	Medical history	Diagnosis	FEV_1 l	FEV_1 % pred	Procedure	Complications	Size of specimen (cm)	Day of discharge
1	75	F	None	Adenocarcinoma	0·85	47	Wedge excision	None	2	4
2	66	F	Hypertension	Adenocarcinoma	0·9	48	Wedge excision	None	1	4
3	75	F	Angina hypertension	Adenocarcinoma	0·8	46	Wedge excision	None	2	5
4	45	M	None	Metastatic adenocarcinoma	3·75	86	Wedge excision	None	1	4
5	45	F	None	Wegner's granuloma	3·65	80	Wedge excision	None	2	3
6	65	M	None	Adenocarcinoma	2·66	87	Wedge excision	None	2	4
7	44	M	Testicular seminoma	Metastatic seminoma	3·49	114	Wedge excision (×2)	None	3 +0·75	4
8	58	M	None	Adenocarcinoma	3·1	78	Wedge excision	None	1·5	4

patients in the series. With regard to the solid pulmonary masses, five patients had wedge resections for primary adenocarcinoma of the lung; one had resection of a metastatic adenocarcinoma from an occult primary; one had resection of two metastatic lesions related to a primary testicular seminoma; and the remaining patient had a wedge excision of a Wegener's granuloma. All tumours appeared completely resected on macroscopic and histological examination. There was no evidence of lymphadenopathy from computed tomography or endoscopic inspection of the mediastinum.

Histological examination of the lung biopsy specimens showed cryptogenic fibrosing alveolitis (four patients), sarcoidosis (three), and malignant non-Hodgkins lymphoma (one).

Of the four patients having pleurectomy, one required staged bilateral procedures separated by six weeks.

These techniques were successfully used in 21 patients, but had to be abandoned on four other occasions. Dense pleural adhesions prevented an endoscopic lung biopsy in one patient and cardiomyotomy for achalasia in another. In two patients with peripheral lung masses, one mass (measuring 0·5 cm) was not visualised endoscopically, and even after thoracotomy could be detected only by palpation; the other was adjacent to a poorly formed oblique fissure, which required formal dissection via a limited thoracotomy for wedge resection to be carried out safely.

No complications occurred in hospital, and the patients were discharged home two to six days after surgery (mean (SD) 3·4 (1·2)). The first patient to have an endoscopic pleurectomy, however, who was discharged on postoperative day 3, developed a further pneumothorax on the same side three days after leaving hospital; a standard thoracotomy, iodine pleurodesis, and pleural drainage were then performed. Exploration showed most of the lung to be adhering to the chest wall, except for one area anteriorly. The whole of the parietal pleura appeared to have been completely removed at the time of the first procedure. Three days after removal of drains following this open procedure the lung again collapsed, necessitating further intercostal drainage. The patient went on to make an uneventful recovery. In retrospect it seemed that the single drain that had been inserted at the time of the endoscopic pleurectomy was removed too early, on the first postoperative day. Despite this, the problems experienced after formal thoracotomy and pleurodesis testify to the difficulty encountered in this particular patient in getting the lung to adhere to the chest wall. Since we have used apical and basal drains for all patients undergoing endoscopic pleurectomy no further problems of this nature have been encountered.

Discussion

Laparoscopy has been used for diagnostic and therapeutic purposes for many years, especially in gynaecology, where it is a standard tool for the diagnosis and treatment of many conditions, such as infertility, endometriosis, and polcystic ovaries.[4,5] Only recently have more extensive procedures gained in popularity, particularly in general surgical practice. Laparoscopic cholecystectomy was first performed in 1987[6-8] but is now a standard procedure in many centres.[1,9]

Thoracoscopy was first described as a therapeutic procedure in "collapse" treatment for patients suffering from pulmonary tuberculosis,[3] when it was used for the division of intrapleural adhesions (apical pneumolysis). More recently, with the decline of tuberculosis, it has been used principally for viewing and taking small biopsy specimens of the pleura,

Table 3 Endoscopic lung biopsies

Patient No	Age (y)	Sex	Medical history	Diagnosis	FEV_1 l	FEV_1 % pred	Procedure	Complications	Day of discharge
1	68	M	None	Pulmonary fibrosis	2·86	95	Lung biopsy	None	2
2	36	M	None	Sarcoidosis	2·77	94	Lung biopsy	None	2
3	60	F	Cardiac failure	Pulmonary fibrosis	1·4	60	Lung biopsy	None	3
4	51	M	None	Sarcoidosis	2·65	76	Lung biopsy	None	2
5	44	M	None	Pulmonary fibrosis	2·21	55	Lung biopsy	None	2
6	35	M	None	Sarcoidosis	2·0	55	Lung biopsy	None	2
7	52	M	None	Pulmonary fibrosis	2·38	76	Lung biopsy	None	3
8	67	M	None	Lymphoma	1·66	51	Lung biopsy	None	2

lung, and mediastinum.[10] Nevertheless, other procedures have been described, such as pleurodesis,[11 12] the sealing of air leaks[13] and bronchopleural fistulas,[14] and removal of foreign bodies from the chest.[15] More extensive procedures, however, traditionally performed via a formal thoracotomy incision, have only recently been reported.[16–18]

Current techniques used in endoscopic surgery within the abdomen can easily be adapted to the pleural cavity. With the use of the double lumen endotracheal tube the lung can be completely collapsed and an excellent view of the thoracic cavity obtained. This method of ventilation obviates the need for an airtight seal and gas insufflation, as required in laparoscopy and suggested by Nathanson *et al* in their report of two patients having endoscopic pleurectomy; ventilation in these cases was via a single lumen endotracheal tube.[16] The complete collapse of the ipsilateral lung provided by the double lumen tube makes lung resections easier and safer, whether for lung biopsy or for removal of tumours. We would strongly recommend the use of selective lung ventilation during endoscopic surgery within the thorax.

The use of the larger diameter laparoscope with camera attachment and video monitor provides a better view than that achieved with standard thoracoscopy. While the assistant holds the laparoscope, the surgeon is free to use both hands for the manipulation of instruments while he observes his or her actions on the screen. Although we have found standard thoracotomy instruments to be useful, the specially designed laparoscopic instruments (of which the ENDO-GIA stapler is particularly advantageous) allow procedures to be carried out through smaller incisions.

A formal thoracotomy incision is a major procedure causing substantial postoperative pain and entailing a lengthy hospital stay and recovery. In contrast, we have observed that the patients in the present series appeared to recover much faster, with less pain and earlier mobilisation, and being discharged from hospital sooner after surgery than the patients undergoing standard thoracotomy. We may reasonably assume that the incidence of cardiorespiratory complications would be less frequent with a smaller incision. Nathanson *et al* have postulated that the catabolic response to trauma that occurs after major surgery is diminished with the use of endoscopic techniques; the "trauma of access" is reduced or absent, without compromising exposure of the operating field.[9] This would obviously explain why patients recover much more quickly after endoscopic as opposed to conventional cholecystectomy.[19] Although our group of patients was small, none developed any complications despite the fact that several were at high risk from a standard thoracotomy because of pre-existing medical problems and in some cases very poor pulmonary reserve. We would expect that the advantages of endoscopic surgery in the abdomen[1 2 9 19] could be mirrored in the chest and certainly the mean time in hospital of 3·4 days, is encouraging in this regard.

With regard to thoracoscopic resection of solid pulmonary masses, we would recommend that only small peripheral lesions should be removed by these techniques. This particularly applies to primary lung tumours, where inadequate resection may compromise a definitive cure. If the tumour cannot be completely and safely removed by wedge resection, then at present we would proceed to formal thoracotomy and more radical resection.

The technique is relatively straightforward and easy to learn and has already been used by surgical trainees. As in the abdomen, however, there is a risk of complications occurring during endoscopic surgery within the chest, which would require formal thoracotomy. We would thus recommend that the procedures are carried out only by surgeons who already have expertise in both thoracoscopy and general thoracic surgery. We would agree with Cuschieri that caution and conservatism are necessary in the exploration of any new surgical technique.[20] Nevertheless, we are confident that endoscopic surgery within the thorax is destined to become part of the armamentarium of all general thoracic surgeons in the near future.

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