

## Video-assisted thoracoscopic surgery in the treatment of pneumothorax: 107 consecutive procedures

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The aim of this prospective study was to evaluate video-assisted thoracoscopic surgery (VATS) in primary and secondary spontaneous pneumothoraces. Over a 37-month period, 107 videothoracoscopic interventions were performed to treat spontaneous pneumothorax in 105 patients, 78 men and 27 women, whose average age was 28 years.

Indications for surgery included recurrent ipsilateral pneumothorax (47 cases), persistent air leak (23 cases), hypertensive pneumothorax (14 cases), history of contralateral pneumothorax (13 cases), and elective surgery (10 cases).

All of these patients were treated by endoscopic resection of the bullae (or apical zone in cases where the suspected abnormalities, or bullae, could not be visualized) plus physical pleurodesis. There were no perioperative deaths.

Complications occurred in 6% of the cases of primary spontaneous pneumothorax and in 45% of the cases of secondary spontaneous pneumothorax. The complications among the secondary pneumothorax patients ranged widely from postoperative subcutaneous emphysema (resolved through simple, unassisted observation) to the need for an accessory minithoracotomy. Two patients (1.8%) suffered a recurrence of pneumothorax 4 and 8 months, respectively, after VATS treatment.

**Key words:** *Pneumothorax. Video-assisted thoracoscopic surgery. VATS. Surgical treatment.*

Cirugía videotoracoscópica en el tratamiento de los neumotórax: consideraciones sobre 107 procedimientos consecutivos

El objetivo del trabajo es valorar la cirugía videotoracoscópica en los neumotórax primarios y secundarios. Para ello se ha realizado un estudio prospectivo a lo largo de 37 meses, durante los cuales se practicaron 107 intervenciones videotoracoscópicas para el tratamiento de los neumotórax espontáneos en un total de 105 pacientes.

Se incluyó a 78 varones y 27 mujeres con una edad media de 28 años. Las indicaciones quirúrgicas fueron: neumotórax recurrente ipsilateral en 47 casos; fuga aérea persistente en 23 casos; neumotórax hipertensivo en 14 ocasiones; cuadro de neumotórax contralateral antiguo en 13 casos, y cirugía electiva en 10 casos.

Todos los pacientes fueron tratados con resección endoscópica de zona bullosa (o zona apical en caso de no visualizar la zona sospechosa) más pleurodesis física. No hubo mortalidad perioperatoria.

Las complicaciones fueron del 6% en los casos de neumotórax espontáneos primarios y del 45% en los casos de neumotórax espontáneos secundarios, incluyendo éstas una amplia gama, desde el enfisema subcutáneo posquirúrgico resuelto con simple observación hasta la necesidad de minitoracotomía accesoria. Dos pacientes (1,8%) sufrieron recidiva del neumotórax a los 4 y 8 meses de la videocirugía, respectivamente.

**Palabras clave:** *Neumotórax. Videotoracoscopia. Tratamiento quirúrgico.*

### Introduction

Video-assisted thoracoscopic surgery (VATS), dating from the early 1990s, has revolutionized the treatment of several thoracic diseases and conditions<sup>1</sup>. Pneumothorax

is among those that have benefited most from the gradually increasing use of VATS, which provides a less invasive means to resolve a condition that is benign but of high prevalence among young patients<sup>2</sup>. Pneumothorax has become one of the most accepted indications for VATS<sup>3</sup>.

The standard initial treatment for spontaneous pneumothorax is thoracic drainage. However, if the problem is not resolved (persistent pneumothorax) or there is recurrence, surgical treatment should be considered<sup>4,5</sup>. The surgical techniques (standard thoraco-

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tomy, axillary thoracotomy and VATS) enable closure of the air leaks that cause the pneumothorax, wedge resection of the affected zone and/or pleurectomy<sup>6</sup>.

Spontaneous pneumothorax can be classified as primary (due to rupture of a subpleural bleb in a normal pulmonary parenchyma) or secondary (when the air leak occurs in a diseased lung)<sup>7</sup>. In both forms, an important causal role is played by blebs and bullae, which are present in a high percentage of patients and which can be detected during surgery<sup>8</sup>. VATS is therefore an ideal procedure for detecting such macroscopic lesions, and their resection by endoscopic linear cutter has become the treatment of choice<sup>9</sup>.

The present paper describes the indications for VATS in our hospital and the technique applied, as well as the complications and results observed over a three-year period.

## Material and methods

### Patients

A prospective study was carried out on 238 VATS interventions taking place over a period of 37 months. In 107 interventions (44%) the indication for surgery was primary or secondary pneumothorax.

Surgery was performed on 105 patients (78 men and 27 women) with a mean age of 28.78±13.96 years (range: 15–78 years).

Indications for surgery were the following: recurrent ipsilateral pneumothorax (47 cases); persistent air leak for more than five days even after checking correct placement of and active drainage from the chest tube<sup>10</sup> (23 cases); hypertensive pneumothorax (14 cases); a history of contralateral pneumothorax (13 cases); and elective surgery (10 cases). See Table 1.

### Surgical technique

All procedures were performed with general anesthesia and selective intubation. The patient was in lateral decubitus position, resting on the side opposite the pneumothorax. After selective blocking of the affected lung, the surgeon made a first incision at the sixth or seventh intercostal space on the medial axillary line and a 10 mm trocar was inserted followed by a 0-degree optic. With video-assisted guidance two more trocars (diameters: 10 mm and 12 mm) were inserted into the chest cavity at the fourth intercostal space on the anterior axillary line and at the fifth intercostal space on the posterior axillary line, respectively. In no case was carbon dioxide used to aid in the formation of a thoracic space. After triangulation from the trocars, we explored the lung with an Endoscopic Blunt Dissector (BCD 10, Ethicon Endo-Surgery Inc., Cincinnati, Ohio, U.S.A.) to detect blebs or bullae causing air leaks. If adhesions were found, they were removed by electrocoagulation and scissors. An Endoscopic Articulating Linear Cutter (ETS – Flex 45, Ethicon Endo-Surgery Inc., Cincinnati, Ohio, U.S.A.) was used whenever lesions were found, but if none were visualized, a small portion of the pulmonary apex was biopsied for histopathologic study. The mean number of firing strokes was 2.7 per patient (range: 1-7).

TABLE 1  
Indications for surgery in the pneumothorax patients studied

Indication for surgery	No. of cases	Percentage
Recurrent ipsilateral	47	43
Persistent	23	21
Hypertensive	14	13
History of contralateral pneumothorax	13	12
Elective	10	11

TABLE 2  
Perioperative complications of video-assisted thoracoscopic surgery

Complication	PSP (5/83)	SSP (11/24)	Total (16/107)
Persistent air leak (>7 days)	0	2	2
Hemorrhage	1	1	2
Subcutaneous emphysema (observation)	1	1	2
Insertion of new chest tube	1	3	4
Conversion to thoracotomy	1	2	3
Repeat video-assisted thoracoscopy required	1	2	3
Total	5	11	16

PSP: primary spontaneous pneumothorax; SSP: secondary spontaneous pneumothorax.

The cavity was then washed with physiological saline solution to check for the continued presence of air leaks. Finally physical pleurodesis was performed by abrasion. Talc insufflation was never performed.

In all cases a chest tube (24 F) was inserted through the trocar situated on the medial axillary line and was connected to an aspirator of –20 cm H<sub>2</sub>O. In the cases of conversion to thoracotomy, two chest tubes were inserted.

The patients receiving VATS treatment were taken to the recovery room where they remained for a mean duration of 120 minutes (range: 60-180) before being taken to the ward. No patient required transfer to the postoperative intensive care unit.

## Results

Of the 107 VATS interventions, 83 (77.6%) involved primary pneumothorax and 24 (22.4%) involved secondary pneumothorax.

There were no perioperative deaths. Conversion to posterolateral thoracotomy took place in three cases: one due to inadequate pulmonary blocking and two due to large pleuropulmonary adhesions detected on the mediastinal zone. These latter two cases were men with secondary pneumothoraces, in one of whom the pneumothorax was a recurrence.

Perioperative complications developed in 16 cases. (See Table 2.) In 13 of these cases the complications were resolved through unassisted observation or by replacing the chest drainage tube. A second intervention was necessary in four cases (3.7%).

In two cases, an immediate postoperative intervention was performed due to hemorrhaging 6 and 18 hours, respectively, after the VATS. In one of these cases a

transfusion of one unit of packed red blood cells was required. Both patients had undergone VATS for large mediastinal adhesions and in both cases the hemorrhage was located in an arteriole in the mediastinal region. The two other VATS-treated cases required re-intervention on the seventh and eighth day, respectively, to correct persistent air leak. In all four cases a posterolateral thoracotomy was performed.

During 93 interventions (86.91%) lung disease was identified as the cause or the presumed cause of the pneumothorax; thus resection was performed.

Chest tubes were removed a mean  $1.96 \pm 1.01$  days after surgery (range: 1-8 days). The mean postoperative hospital stay was 3.64 days (range: 3-12).

Two patients experienced a postoperative recurrence (ipsilateral pneumothorax <10%) following removal of the chest tube. They required no more than routine monitoring during out-patient appointments.

In the cases of two other patients, postoperative recurrences during the follow-up period were diagnosed when the patients came to our emergency room. These patients required more radical treatment. One woman with secondary pneumothorax suffered two episodes of partial basal ipsilateral pneumothorax eight and twelve months, respectively, after surgery. These two recurrences were successfully treated by chest drainage. The other patient, although young and presenting no risk factors, suffered a recurrence of 25% pneumothorax four months after surgery and required a thoracotomy.

## Discussion

Spontaneous primary pneumothorax, traditionally treated by axillary thoracotomy, has become one of the most accepted indications for VATS<sup>2,9</sup>. In the case of secondary pneumothorax, VATS is gradually becoming a more accepted treatment<sup>11</sup>, although the presence of lung disease is a source of higher rate of complications<sup>12</sup>.

The cause of lesions in primary pneumothorax is not entirely understood. They may be the result of a break in the alveolar wall, causing air to leak into the pulmonary interstitial spaces and pleural viscera, forming small subpleural vesiculae<sup>13</sup>. In secondary pneumothorax, a demonstrated pulmonary disease would be the cause of the clinical picture. In the 24 cases of secondary pneumothorax in our study, the underlying pulmonary diseases were the following: chronic obstructive pulmonary disease/bullous emphysema (18 cases); infection in immunodepressed patients (4 cases); Langerhans cell histiocytosis (2 cases). There was a higher percentage of complications among secondary pneumothorax patients, as reflected in Table 2.

Spontaneous pneumothorax recurs after chest drainage treatment of a first episode in 20 to 25%<sup>14,15</sup> of

patients. In our study, the rate of recurrence after VATS treatment was 1.8%: two patients who suffered an ipsilateral pneumothorax. Only one of these patients received surgical treatment in a follow-up period limited to 14 months. In the series studied, the mean period of postoperative follow-up was 14.4 months (range: 2-36 months).

Some patients, for work-related or personal reasons, requested surgery at the first episode (elective surgery). This surgery was performed in 10 cases with no postoperative complications or recurrences. All 10 patients were operated on within a few days of the first episode and postoperative chest tubes were inserted.

The surgical technique used was insertion of three trocars (for proper triangulation) and resection by endoscopic stapler of the diseased zones (bullae or blebs), generally on the superior lobe. After checking for absence of air leaks, physical pleurodesis was performed. We performed neither talc insufflation (recurrence 1.79%) nor apical pleurectomy (recurrence 9.15%), although some authors report recurrence rates of postoperative pneumothorax above and below ours (7%). In some cases in our study, no chest tubes and/or thoracotomies were required. In our opinion talc, an adhesive agent of tested effectiveness, should be used only in patients with malignant pleural effusions. We did not use biological sealants, as we consider their high cost and debatable effectiveness for treating spontaneous pneumothorax<sup>16</sup> does not make them a viable option.

In patients in whom no lung disease was evident (14 cases), a biopsy of the most apical part was performed by one or two firing strokes followed by physical pleurodesis. Sometimes subpleural blebs are difficult to see and a thorough inspection of the lung is needed. For such an exploration we use a blunt dissector which permits us to turn the surface of the parenchyma back, thus avoiding unnecessary traction which may lead to postoperative air leaks. This technique requires manual reexpansion of the lung by the anesthetist to provide a view of lesions which may be hidden by the atelectasis. One among those patients suffered a recurrence of pneumothorax (<10%) which only required out-patient management.

The mean duration of the postoperative hospital stay was 3.64 days. In the cases of pneumothorax treated by thoracotomy (axillary or posterolateral), the mean postoperative stay was 5.67 days, with 38% also requiring admission to a postoperative intensive care unit.

In conclusion, we consider that inserting a chest tube for drainage is the first measure to take on diagnosing spontaneous pneumothorax. In cases of contralateral or hypertensive pneumothorax, we opt for surgery, with VATS being our preferred technique. VATS is also the first technique we consider for treating persistent

pneumothorax.

A thorough VATS exploration of the pulmonary parenchyma identifies lesions in a high percentage of patients because an endoscopic video camera offers a better view of the site than can be obtained by axillary thoracotomy.

The low rate of complications and the good long range results, in terms of short hospital stays and rapid functional recovery, make VATS our technique of choice in the treatment of both primary and secondary spontaneous pneumothoraces.

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