

## Effects of Chemical Pleurodesis after Thoracoscopic Procedures for Primary Spontaneous Pneumothorax

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### Abstract

**Background:** Methods to achieve adhesion of the two pleural layers and thus, “obliteration of the pleural space” have included mechanical abrasion and instillation of chemical irritants. Combination of two methods after thoracoscopic bullectomy has rarely been mentioned in the literatures. The aim of this study is to evaluate the safety and efficacy of additional chemical pleurodesis after thoracoscopic treatment of primary spontaneous pneumothorax.

**Methods:** 120 patients undergone video assisted thoracoscopy (VATS) for 1ry spontaneous pneumothorax were retrospectively studied. The patients were divided into 2 equal groups (group A): without chemical pleurodesis after VATS and (group B): with chemical pleurodesis after VATS. VATS procedures included resection of the blebs and mechanical pleurodesis by scrubbing the parietal pleura.

**Results:** There was no significant difference between the two groups in terms of demographic data, operative findings, and operation time. There was significant decrease in the rate of prolonged air leaks, duration of postoperative chest drainage, hospital stay and the incidence of recurrence in group B patients.

**Conclusion:** Chemical pleurodesis is a safe and convenient procedure that may improve the outcome and reduce the rate of recurrence after thoracoscopic treatment for primary spontaneous pneumothorax.

**Keywords:** VATS; Primary Spontaneous Pneumothorax; Chemical Pleurodesis

### Background

Pneumothorax is defined as air in the pleural space that is between the lung and chest wall [1]. Spontaneous pneumothorax which occurs without trauma to the thorax is a significant problem [2,3]. Primary pneumothoraces arise in otherwise healthy people without any lung disease. Secondary pneumothoraces arise in subjects with underlying lung disease [4]. Primary spontaneous pneumothorax most commonly occurs in young tall lean male subjects [5]. The estimated recurrence rate is 23 to 50% after the first episode and increases to 80% after the third pneumothorax [6]. Despite the absence of underlying pulmonary disease in these patients subpleural blebs and bullae are likely to play a role in the pathogenesis since they are found in up to 90% of cases of primary pneumothorax at thoracoscopy or thoracotomy and in up to 80% of cases on CT scanning of the thorax [7]. Optimal management of this benign disease has been a matter of debate until recently, when some consensus of treatment guidelines were reached [8]. Traditionally, open thoracotomy has been considered the definite treatment for patients with recurrence to find the offending bleb, remove it, and do some manipulation (pleurodesis or pleurectomy) to encourage adhesion formation [9]. Physicians, however, are reluctant to refer patients for this treatment because of a

long postoperative recovery period, considerable postoperative pain and a high instance of complications [10]. Recent advances in video assisted thoracoscopic surgery VATS that combine bullectomy with pleural abrasion provide a feasible alternative for treating primary spontaneous pneumothorax [11]. Unfortunately, the recurrence rate of this procedure ranges between 4% and 7% in most series and is generally higher than open thoracotomy [12]. In addition a leading bleb may be missed or pleural abrasion may be incomplete. For the efficacy of VATS is questioned, and more aggressive procedures such as pleurectomy are sometimes performed to enhance the effects of pleural symphysis [13]. Intrapleural installation of a chemical irritant (chemical pleurodesis) is an effective way to shorten the duration of air leaks and prevent the recurrence of spontaneous pneumothorax in nonsurgical patients [14,15]. In the present study we report our experience of additional chemical pleurodesis after thoracoscopic procedures in treating patients with primary spontaneous pneumothorax. The effects of this adjuvant therapy were evaluated by comparing the outcomes of the patients who underwent thoracoscopic procedure alone with those who underwent additional chemical pleurodesis.

## Methods

In 2 tertiary centers (in Benha university hospitals, Egypt); and (King Fahad Medical City (KFMC) in Saudi Arabia); 120 patients with primary spontaneous pneumothorax undergone video assisted thoracoscopic management were retrospectively studied.

The study protocol was approved by the Local Ethical Committee. Files were included in the study irrespective of patients' outcome as regard survival.

The indications for thoracoscopic management in these patients included ipsilateral recurrence, contralateral recurrence, continuous air leaks for 3 days or presence of large blebs or bullae > 2 cm on CT scan. Patients with secondary spontaneous pneumothorax were excluded from this study.

Patients converted to transaxillary mini-thoracotomy were also excluded from this study. Conversion to thoracotomy was performed when open suturing technique was indicated, dense or massive adhesions were encountered or the site of air leaks were not detected. In this study we are comparing between two equal groups (each group 60 patients). Group A: In these patients we did excision of the blebs only and nothing was administered to the pleural cavity after operation (this was the old protocol in the hospital before 2007).

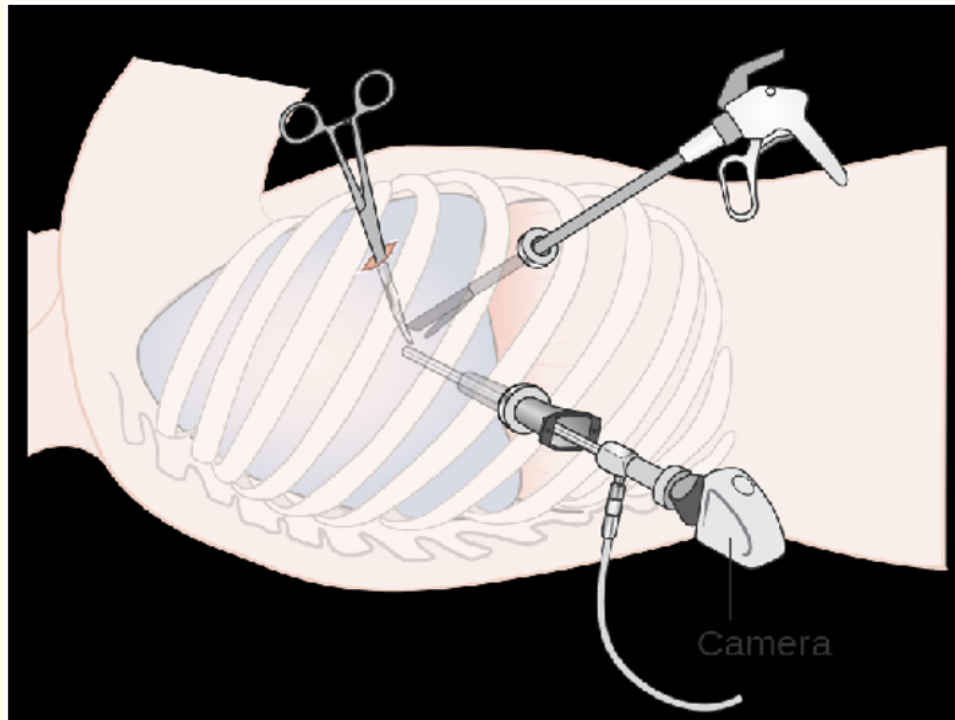
Group B: In these patients, additional chemical pleurodesis was performed for the purpose of decreasing the incidence of prolonged air leaks and ipsilateral recurrence of pneumothorax after operation (this is the new protocol since 2007).

Informed consents were obtained from the patients after thorough explanation.

## Operative techniques of VATS

The operation procedures and technique were identical in both groups.

Under general anesthesia using intubation with a single or double lumen endotracheal tube (depends on anesthetist and surgeon preference). The patients were placed in a lateral decubitus position, and the ipsilateral lung was deflated. A 10 mm telescope (Karl Storz Tuttingen, Germany) was first inserted through the previous chest tube insertion hole to examine the pleural cavity. If the chest tube wound was not available a 12 mm port was made at the sixth or seventh intercostal space (Figure 1). Two 15 mm skin incision were made at the 3<sup>rd</sup> or 4<sup>th</sup> intercostal space, anterior and posterior axillary lines. Light pleural adhesions were freed using electrocautery. When blebs were identified they were excised with endoscopic staplers. Blind apical stapling was done if no blebs could be identified. The upper half of the parietal surface was abraded by inserting the dissector with a gauze pledget or strip of a diathermy scratch pad through the port site. After postoperative lung re-inflation normal saline solution was instilled to check for air leaks. A chest tube was placed in the apex through one of the insertion wounds. The surgical specimens were routinely sent for histopathologic examination.



**Figure 1:** Recovery of hearing loss in high frequency.

### Post-operative care and chemical pleurodesis

The patients were extubated in the operating theater and observed for 1 to 2 hours in the recovery room. The chest tube was connected to a low-pressure suction system of approximately -10 to -20 cm H<sub>2</sub>O. Postoperative analgesics include routine oral non-steroid analgesics. IM pethidine 50 mg was administered if the pain becomes intolerable.

Chest radiography was performed in the next morning. The lung was fully expanded in all our patients.

After that the management was different in the two groups: In group A (without chemical pleurodesis) patients: The chest tube was removed 24 hours after stopping of air leak. The air leak was persistent for 5 days in nine patients, for whom the tube was clamped for 24 hours and chest radiography was repeated showed fully expanded lung, so the tube was removed.

In group B (with chemical pleurodesis) patients When there was no or minimal air leak, 20 ml of 1% Lidocaine hydrochloride (200 mg) followed by a solution of 20 ml of normal saline solution containing 2 grams of tetracycline (when available) or 300 mg of minocycline was instilled into the pleural cavity through the thoracostomy tube which is then clamped. Patients were repositioned every 30 minutes. Side effects and complaints of the patient were recorded. The tube was reopened and reconnected to a low suction after 6 hours later. There was no air leak in any of these patients. Chest radiography was repeated showed fully expanded lung so the tube was removed.

### Data collection and statistical analysis

The clinical data, operative findings, operation time, durations of postoperative chest drainage, length of hospital stay and complications were collected from the medical records. The requested doses of Pethidine were collected from the nursing records. Patients were followed up for 2 years during clinical visits. Freedom from recurrence was analyzed. All data were collected and the results were analyzed using SPSS statistical package for windows, Version 7.5. Comparisons were made by the log-rank test,  $P < 0.05$  was considered significant.

### Results

120 patients undergone VATS for primary spontaneous pneumothorax were retrospectively studied.

The patients were divided into 2 groups: Group A (without chemical pleurodesis after VATS) and Group B (with chemical pleurodesis after VATS). The demographic data and operative findings of these patients were nearly same without significant difference as shown in table 1.

Variables	Group A (N 60)	Group B (N 60)	P Value
Mean age (years)	26.3 +/- 9.8	25 +/- 8.4	> 0.05 (N. S)
<b>Sex</b>			
Male	45 (75)%	48 (80%)	> 0.05 (N. S)
Female	15 (25)%	12 (20%)	> 0.05 (N. S)
Mean weight (Kg)	55.8 +/- 8.1	54.7 +/- 7.8	> 0.05 (N. S)
<b>Side involved</b>			
Left	24 (40%)	33 (55%)	> 0.05 (N. S)
Right	36 (60%)	27 (45%)	> 0.05 (N. S)
Smoking	12 (20%)	15 (25%)	> 0.05 (N. S)
<b>Surgical indications</b>			
Persistent air leak	27 (45%)	24 (40%)	> 0.05 (N. S)
Ipsilateral recurrence	21 (35%)	24 (40%)	> 0.05 (N. S)
Contralateral recurrence	12 (20%)	12 (20%)	> 0.05 (N. S)
Presence of bleb	57 (95%)	54 (90%)	> 0.05 (N. S)
Presence of multiple blebs	12(20%)	15 (25%)	> 0.05 (N. S)
Time of operation (minutes)	94.2 +/- 32	94.2 +/- 29.1	> 0.05 (N. S)

**Table 1:** The demographic data and operative findings of both groups. Data are presented as mean +/- SD or number (%). N. S: Non-significant.

Blebs or bullae were identified in 111 patients (92.5%) and the most common site for blebs was the upper lobe (87%).

There were no significant statistical difference between the two groups in age, sex, weight, side involvement, smoking status, surgical indications, surgical approaches operative findings, and time of operation.

Their average age in both groups was around 25 years (range from 16 to 48 years). There were 75% males in 1<sup>st</sup> group while males constitute 80% of 2<sup>nd</sup> group. Smokers constitute 20% of 1<sup>st</sup> group and 25% of 2<sup>nd</sup> group.

Regarding surgical indications also there were insignificant differences between the two groups. Persistent air leak were 45% in group A and 40% in group B. Also the operation time was nearly same in the two groups.

The results of treatment are summarized in table 2.

Variables	Group A (N = 60)	Group B (N = 60)	P value
Pethidine ampoules (mean)	2.4 +/- 2.5	2.8 +/- 2.1	> 0.05 (N.S.)
Post-operative drainage (mean number of days)	5.3 +/- 2.8	4.1 +/- 3.1	< 0.05 (S)
Post-operative hospital stay (mean number of days)	8.6 +/- 3.4	6.1 +/- 3.5	< 0.05 (S)
Air leaks > 5 days	15 (15%)	0 (0%)	< 0.05 (S)
Recurrence (Total)	6 (10%)	0 (0%)	< 0.05 (S)

**Table 2:** The results of treatment in both groups.  
Data are presented as mean +/- S D or number (%).  
S: Significant; N.S.: Non-Significant.

There was no hypersensitivity or adverse reaction for tetracycline nor minocycline instillation. Chest pain was a common complaint after chemical pleurodesis in group B. However, the total amount of pethidine was not significantly different between the two groups. Patients treated with chemical pleurodesis (group B had significantly shorter periods of chest drainage, air leak and postoperative hospital stay (Table 1).

Drainage days were significantly higher in the 1<sup>st</sup> group than in 2<sup>nd</sup> group. Regarding total hospital stay it was more in group A than in group B with significant difference (p value < 0.05). The air leak period more than 5 days was significantly shorter in group B than in group A (p value < 0.05).

During the postoperative follow up, patients in group B had no ipsilateral recurrence while ipsilateral recurrence took place in 6 patients of group A (10%).

These 6 patients were managed by pleurectomy through mini-thoracotomy with postoperative chemical pleurodesis. These 6 patients had no recurrence during follow up (Table 2).

## Discussion

The Timing of surgical intervention for spontaneous pneumothorax has recently been challenged and remains under a lot of debate [16]. Recently, after the improvement of thoracoscopic technique and the excellent diagnostic and therapeutic results of the method, VATS became the technique of choice for many thoracic procedures because it has the advantage of better gas exchange postoperatively than axillary thoracotomy, this is because its small incisions and, the avoidance of rib spreading leading to less incision pain, no chest wall deformity nor peripheral atelectasis [15-17].

So VATS became a valid alternative to open thoracotomy for the treatment of spontaneous primary pneumothorax [18,19].

Since then several modalities in the management of blebs and pleurae have been reported with variable results. Blebs are generally removed or ligated under standardized procedures. Methods of pleural symphysis have included mechanical abrasion and instillation of chemical irritants. Each method can reduce the rate of recurrence to a certain degree [11,13,19].

However, a combination of two methods after thoracoscopic bullectomy has rarely been mentioned in the literature. In our study, additional chemical pleurodesis resulted in significant decrease in the rate of prolonged air leaks, duration of postoperative chest drainage and hospital stay. This coincide with other two studies. One of them used minocycline and the other used Acromycin as a chemical pleurodesis after VATS bullectomy [6,13].

The indications of VATS in our study were: persistent air leak, ipsilateral recurrence, contralateral recurrence of pneumothorax or the presence of large blebs or bullae > 2 cm.

This was similar to other studies [20-23].

Time of operation in our study was around 94 minutes. It was around 91 minutes for VATS and around 86 minutes for transaxillary thoracotomy in another study [24].

In our study additional chemical pleurodesis resulted in significant decrease in the incidence of recurrence (from 10% to 0%) of primary spontaneous pneumothorax than after VATS bullectomy and pleural abrasion. This is favorable as compared with series of VATS bullectomy with either mechanical abrasion (4.6% to 7%) [12,19,23] or chemical pleurodesis (4% to 9%) [13,14,25].

The beneficial effect of addition of chemical pleurodesis to VATS bullectomy and pleural abrasion may be due to combined chemical and mechanical pleurodesis that inflames the entire pleural surface more evenly and thoroughly. This effect hastens the healing of blebs that are occasionally missed during thoracoscopic procedures and prompts symphysis of pleura to prevent the recurrence of pneumothorax.

One study used minocycline pleurodesis after VATS bullectomy and pleural abrasion. This decreased the ipsilateral recurrence of primary spontaneous pneumothorax from 9.8% to 2.9%. The recurrence in minocycline group took place late after 6 months [6,20].

We did not do apical pleurectomy to our patients. Some authors concluded that apical pleurectomy is a more effective way of producing pleural symphysis and others documented a recurrence free rate of 93.8% after VATS wedge resection and pleurectomy [23-25].

We used tetracycline or minocycline for chemical pleurodesis in our patients.

Some authors concluded that recurrence rate showed significant difference between the type of pleurodesis used and documented recurrence rate 0% after talcum, 16.4% after fibrin glue, 10.2% after resection without pleurodesis, 7.9% after pleural abrasion and 4.4% after pleurectomy [25,26].

Also others concluded that, stapling of the bullae and talc poudrage by VATS represent the treatment of choice of primary spontaneous pneumothorax [21,24-26].

Chest pain was the most common problem associated with chemical pleurodesis.

While intrapleural lidocaine administration in this study led to that the total amount of pethidine requested in group B was not significantly increased.

The six patients with ipsilateral recurrence of pneumothorax in our study were managed by pleurectomy through mini-thoracotomy. Some authors documented that extensive pleurectomy through thoracotomy is superior to limited pleurectomy through VATS [23,27].

### Conclusions

Video-assisted thoracoscopic surgery is a valid alternative to thoracotomy for treatment of primary spontaneous pneumothorax with an acceptable recurrence rate and minimal postoperative complications.

Intrapleural instillation of chemical irritants (tetracycline, minocycline, or talc) after thoracoscopic management of primary spontaneous pneumothorax is a safe and convenient procedure that may be used to decrease the rate of recurrence and hasten the healing of air leaks in these patients.

Pleurectomy (thoracoscopically or through thoracotomy) is an effective way of producing pleural symphysis.

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### Disclosure

The authors declare that nothing to disclose.

### Competing Interest

The authors declare that they have no competing interests.

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