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Open Thoracotomy versus Video-Assisted Thoracic Surgery for Bullectomy in Primary Spontaneous Pneumothorax

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ABSTRACT

Background: Spontaneous pneumothorax (SP) remains a significant health problem because of the high recurrence rate during thoracic drainage and conservative treatments. SP can appear under two forms: primary SP occurs in otherwise healthy patients, most commonly in tall, young, lean men, and particularly in those who smoke. Secondary SP occurs as a complication of an underlying lung disease, which most often is chronic obstructive pulmonary disease.

Objective: The aim of the study was to compare outcome in patient who undergo thoracoscope and patients who undergo thoracotomy in primary spontaneous pneumothorax.

Patients and Methods: This randomized clinical trial study was conducted at Cardiothoracic Surgery Department, Zagazig University Hospitals. We included 30 patients with primary spontaneous pneumothorax in a randomly selected (allocation sealed envelope). Patients were randomly divided into two groups; Group A: 15 cases were subjected to video-assisted thoracic surgery (VATS) Bullectomy in primary spontaneous pneumothorax. Group B: 15 cases were subjected to open thoracotomy in primary spontaneous pneumothorax.

Results: This study showed that there was significant difference between both groups regarding to intraoperative blood loss, chest tube duration and hospital stay that was higher in thoracotomy group than VATS group. The complications were higher in open thoracotomy than VATS group but it did not reach significant difference. Also, there was no significant difference regarding to recurrence. **Conclusion:** VATS is associated with shorter length of hospital stay and less blood loss with no difference of recurrence, and postoperative outcome compared to open thoracotomy in primary spontaneous pneumothorax patients.

Keywords: Spontaneous pneumothorax, VATS, Thoracoscope, Thoracotomy.

INTRODUCTION

Pneumothorax is defined as air or gas accumulated in the pleural cavity. A pneumothorax can occur spontaneously or after trauma to the lung or chest wall. Pneumothorax can also be divided into tension and non-tension [(1)]. A tension pneumothorax can be a medical emergency due to rising intrathoracic pressure from progressive air accumulation in the pleural space. Circulatory or respiratory failure might be developed from subsequent lung or mediastinal compression[(2,3)].

Primary spontaneous pneumothorax (PSP), which is defined as a pneumothorax without underlying lung disease, predominantly occurs in young, thin males. It is usually caused by ruptured pleural blebs or bullae[(4,5)].

The thoracoscopic surgery (video-assisted thoracoscopic surgery**)** for primary spontaneous pneumothorax has been proposed and studied by a lot of clinicians as the main treatment for recurrent or persistent spontaneous pneumothorax [(6,7)]. Surgical treatment is more invasive and has a lower recurrence rate than the conservative treatment but increases patient discomfort, which has restricted the application of open thoracotomy. This technique has been used not only for prolonged air leak or recurrence but also in patients at the first episode of pneumothorax, when blebs or bullae are identified with CT scan [(8)].

Open thoracotomy is an incision into the pleural space of the chest, and it has been the classic surgical treatment of PSP. Surgery is indicated when there is a recurrence of an initial episode of PSP, which produces persistent air leaks, or collapsed lung after placement of pleural drainage. The advantages of this procedure over thoracoscopic techniques are the ability to perform extensive mechanical pleurodesis and the resection of blebs[(8)]. The aim of this study was to compare outcome in patient who undergo thoracoscope and patients who undergo thoracotomy in primary spontaneous pneumothorax.

PATIENTS AND METHODS

This randomized clinical trial study was conducted at Cardiothoracic Surgery Department in Zagazig University Hospitals after fulfilling Ethical Committee requirements and having written informed consent of the patients or their surrogate. The study was carried out on 30 patients with primary spontaneous pneumothorax in a randomly selected (allocation sealed envelope) fashion.

All patients were divided into two groups; Group A: 15 cases were subjected to VATS Bullectomy in primary spontaneous pneumothorax and **Group B:** 15 cases were subjected to open thoracotomy in primary spontaneous pneumothorax.

Inclusion criteria were: Age (18-60) years. First episode with (prolonged air leak after 2 weak, No re-expansion of the lung after 2weak of insertion of intercostal tube, bi-laterality). Secondary episode, and contralateral recurrence after primary pneumothorax.

Exclusion criteria were: Age < 18 years > 60 years. Secondary spontaneous pneumothorax. Traumatic pneumothorax, and severe chest wall deformity.

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All included patients were subjected to history taking including age, gender, occupational history and past medical or surgical history, smoking, comorbidities (hypertension, diabetes, tuberculosis, COPD, asthma) and history of previous primary spontaneous pneumothorax, Clinical examination. Routine laboratory investigations including CBC. Coagulation profile including bleeding time, prothrombin time and activity, aPTT, INR and platelet count and blood grouping. Liver function test, kidney function test, and lipid profile.

Radiological evaluation including plain chest x-ray posteroanterior view and lateral view in some cases with plan metric assessment of the size of the bullae. Computed tomography with or without contrast of the chest when needed to assess size, site and complications. Electrocardiogram (ECG) in order to exclude recent myocardial infarction or significant arrhythmia.

Surgical procedure:

Group (A):

VATS was performed under general anesthesia with double lumen intubation. At the beginning and end of the operation, 0.9% isotonic solution was fulfilled to the thorax, and the lung was inflated and carefully inspected for possible air leaks, blebs, and bullae. All patients underwent apical wedge resection and mechanical abrasion and apical pleurectomy with uniportal VATS or two portal VATS (if pleural adhesion was detected) by the same surgical team. Endoscopic staplers with green cartridges (Endo GIA 60 4.8 mm, Covidien Endo GIA Universal Roticulator, Minneapolis, MN, USA) were used for wedge resection, and the upper parietal pleura was mechanically abraded by medical sandpaper or apical pleurectomy. During VATS, pleural adhesions were dissected using electrocautery or blunt dissection, if necessary. All patients were extubated in the operating theater and were followed up in the special care section of our service during the first 16 h. Chest physiotherapy was applied in the early postoperative period. Portable chest X-ray was performed after surgery within hours. Chest tube of the cases with no air leak for 48 h and fully expanded on chest X-ray was removed. Patients were discharged on the next day if their expanded lung in PA roentgenogram after the chest tube was removed. All patients were routinely followed up. Recurrent pneumothorax was defined as a pneumothorax diagnosed by chest X-ray or chest tomography within10 days after the removal of the chest tube.

Group (B):

Standard posterolateral thoracotomy is an incision used to access the pleural space of thorax in most of cases.

Outcomes:

Patients were followed up in the outpatient clinics for a period ranging from 4 – 6 months, the wound was followed up with necessary radiological investigation and clinical examination.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version 20 (IBM, USA). The parametric data expressed as mean ± SD (Range) or number (%) for categorical data. Comparisons for parametric data were carried out using independent student t-test. Fischer exact test and Chi square test were used for categorical data. P value < 0.05 was considered significant.

RESULTS

Table **(1)** showed there was no significant difference between both groups regarding to demographic data.

Table (1): Demographic data of the studied groups

	VATS (N=15)	Thoracotomy (N=15)	Statistical Analysis	P value
Age	29.2 ± 2.6 (18-56)	29.4 ± 2.4 (19-52)	t=-0.7	0.94
Sex: Female Male	3 (20%) 12 (80%)	2 (13%) 13 (87%)	X^2 =0.24	0.62
BMI	24.6 ± 0.7 (20.6-30.3)	26.2 ± 0.64 (23.3-31.2)	t=-1.7	P=0.09
Hypertension	2 (13%)	1 (7%)	X^2 =0.37	0.54
Diabetes	1 (7%)	2 (13%)	X^2 =37	0.54
Smoking	6 (40%)	8 (53%)	X^2 =53	0.46

Data are represented as mean ± SD or Number (%). Data are analyzed using independent student t test or chi square test.

Table (**2**) showed that there was significant difference between both groups regarding to operative time that was longer in thoracotomy group than VATS group, also there was significant difference between both groups regarding to intraoperative blood loss that was higher in thoracotomy group than VATS group.

Table (2): Intra-operative data of the studied groups

	VATS (N=15)	Thoracotomy (N=15)	Statistical Analysis	P value
Operative time (min)	67.6 ± 2.2 (55-85)	98 ± 1.8 (85-110)	t=-10.4	<0.001*
Inta-operative blood loss	94.3 ± 3.1 (75-110)	173 ± 4.2 (150-200)	t=-14.8	<0.001*

Data are represented as mean ± SD. Data are analyzed using independent student t test.

Table (**3**) showed that there was no significant difference between both groups regarding to bullae data.

Table (3): Bullae data of the studied groups

	VATS (N=15)	Thoracotomy (N=15)	Statistical Analysis	P value
Number of bullae				
• One bullae	6 (40%)	7 (46%)	X^2 =0.13	0.71
• 2bullae or more	9 (60%)	8 (54%)		
Site of bullae				
• Apical	7 (46%)	8 (53%)		
• Basal	4 (27%)	3 (20%)	X^2 =0.74	0.86
• Mediastinal	1 (7%)	2 (13.5%)		
• Other Site	3 (20%)	2 (13.5%)		
Size of bullae				
• 1 cm	4 (27%)	5 (33%)		
• 1-3 cm	7 (46%)	6 (40%)	X^2 =0.18	0.91
• More than 3 cm	4(27%)	4 (27%)		

Data are represented as Number (%). Data are analyzed using chi square test.

Table (**4**) showed that there was significant difference between both groups regarding to chest tube duration and hospital stay that was longer in thoracotomy group than VATS group.

Table (4): Post-Operative data of the studied groups

	VATS (N=15)	Thoracotomy (N=15)	Statistical Analysis	P value
Post-operative chest tube duration	2.7 ± 0.6 (2-4)	4.1 ± 0.91 (3-7)	t=-4.2	<0.001*
Post-operative hospital stay	5.06 ± 0.24 (4-7)	7.06 ± 0.38 (5-10)	t=-4.3	<0.001*

Data are represented as mean ± SD. Data are analyzed using independent student t test or chi square test/ Fischer exact.

Table (**5**) showed that complications were higher in open thoracotomy than VATS group but it did not reach significant difference also, there was no significant difference regarding to recurrence.

Table (5): Complications of the studied groups

	VATS (N=15)	Thoracotomy (N=15)	Statistical Analysis	P value
Complications				
• None	14 (93%)	11 (73%)		
• Re-exploration for bleeding	0 (0%)	2 (13%)	Fisher exact	0.4
• Prolonged air leak	1 (7%)	2 (13%)		
• Wound infection	0 (0%)	4 (27%)		
Follow-up recurrence	2 (13%)	0	Fischer exact	0.48

Data are represented as Number (%). Data are analyzed using Fischer exact.

DISCUSSION

Pneumothorax is defined as air or gas accumulated in the pleural cavity. A pneumothorax can occur spontaneously or after trauma to the lung or chest wall. Pneumothorax can also be divided into tension and non-tension [(1)].

The thoracoscopic surgery (video-assisted thoracoscopic surgery) for primary spontaneous pneumothorax has been proposed and studied by a lot of clinicians as the main treatment for recurrent or persistent spontaneous pneumothorax [(7)].

Our results demonstrated that there was no significant difference between both groups regarding to demographic data. Patients were predominantly men.

This agree with **Laohathai**[(9)] who found that there was no difference in term of gender and age.

Tschopp *et al.*[(10)] and **Daemen *et al.***[(11)] reported that patients were predominantly men, which is in accordance with the our results, because the incidence of primary spontaneous pneumothorax in men exceeds that in women.

In the current study, there was no significant difference between both groups regarding to indication of surgery. This agree with **Laohathai**[(9)] who reported that there was no significant difference regarding to indication of surgery between the two groups.

We revealed that there was significant difference between both groups regarding to operative time that was longer in thoracotomy group than VATS group, also there was significant difference between both groups regarding to intraoperative blood loss that was higher in thoracotomy group than VATS group. This agree with **Laohathai**[(9)] who reported that the operative time was longer and more blood loss in OT groups compared to VATS groups (180 minutes versus 70 minutes, $p<0.001$ and 100 mL versus 30 mL, $p<0.001$). In addition, **Vohra *et al.***[(12)] and **Lin *et al.***[(1)] have demonstrated that VATS results in a shorter operation time and less intraoperative blood loss than open surgery.

Regarding bullae data there was no significant difference between both groups regarding to bullae data. **Abogamila**[(13)] reported that there was no significant differences between studied groups regarding number, site, and size of bullae ($P>0.05$).

We demonstrated that there was significant difference between both groups regarding to chest tube duration and hospital stay that was longer in thoracotomy group than VATS group. This came in agreement with **Laohathai**[(9)] who reported that there was significant difference between both groups regarding to length of hospital stay that was shorter in VATS groups (9.5 days versus 15 days, $p=0.006$). Also, **Vohra *et al.***[(12)] and **Lin *et al.***[(1)] have demonstrated that VATS results in a shorter hospital stays and post-operative chest tube duration. In addition, **Ben-Nun *et al.***[(14)] demonstrated that VATS approach has the benefits of less postoperative pain, better wound cosmetics, shorter hospital stay and duration of drainage, better functional recovery, better short and long term patient satisfaction, and equivalent cost-effectiveness to the open approach. Furthermore, **Janssen and Cardillo**[(15)] concluded VATS was significantly superior to open thoracotomy measuring length of operation, bleeding volume, and length of hospital stay. In terms of morbidity, low invasive and cosmetic issue VATS is superior to open thoracotomy.

In the current study, complications including hemothorax, prolonged air leak and wound infection were higher in open thoracotomy (27%) than VATS group (7%) so there's significant difference. **Freixinet**[(16)] investigated complications rates for 46 patients undergoing VATS and 44 undergoing an open approach for primary SP. They did not find any significant difference between the two groups.

In the present study, the recurrence rate was 2 cases in VATS group while none in open thoracotomy had recurrent PSP and there was no significant difference regarding to recurrence. In agreement with our study, **Pagès *et al.***[(7)] showed a higher recurrence rate of pneumothorax after management by VATS: 3.8% of patients in VATS group vs 1.8% in thoracotomy group. Also, **Barker *et al.***[(17)] reported that a four-fold increase in the recurrence of pneumothorax following VATS as compared to open surgery has been reported in a meta-analysis with 4 randomized and 25 non-randomized studies, although a second meta-analysis of only the randomized trials did not show this difference. Further, **Vallejo *et al.***[(8)] reported that after the surgical treatment, the next step is to prevent the recurrence of spontaneous pneumothorax, which is estimated from 23 to 50% of all the patients. The highest risk occurs in the first 30 days, and, during this time, patients must avoid activities which involve acute variation of the pressure in the lungs, like flying or diving; these activities increase the risk of recurrent spontaneous pneumothorax.

CONCLUSION

In conclusion VATS is associated with shorter length of hospital stay and less blood loss with no difference of recurrence, and postoperative outcome compared to open thoracotomy in primary spontaneous pneumothorax patients.

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