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Video Assisted Thoracic Surgery (VATS) Experience in Management of Primary Spontaneous Pneumothorax: Early Results

Mohamed Elkhouly*[1], Mohamed Hagagg[2]
[1]Department of Cardiothoracic Surgery, Faculty of Medicine, Cairo University, Cairo, Egypt
[2]Department of Cardiothoracic Surgery, Faculty of Medicine, Menoufia University, Menoufia, Egypt
***Corresponding authors:** Mohamed Elkhouly**, Mobile:** (+20) 01115551412, **E-mail:** elkhoulymohamed98@gmail.com

ABSTRACT

Background: Pneumothorax without underlying lung disease is the definition of primary spontaneous pneumothorax (PSP). When an interventional technique is required for its treatment, Video Assisted Thoracic Surgery (VATS) is the procedure of choice. It is associated with a marked reduction in operation time, post-operative pain atelectasis, and shorter hospital stay with an accepted recurrence rate of around 3%.

Objective: We aimed to evaluate cases with PSP who were treated by VATS at Cairo and Minoufia Universities

Methods: This retrospective study was carried out on 19 successive cases with a mean age of 44 years old, both sex who underwent VATS procedure for PSP. Under general anesthesia & double lumen intubation, VATS was conducted. The same surgical team conducted apical pleurectomy or mechanical abrasion and bullectomy on 19 of the patients who had VATS.

Results: Regarding the postoperative results, hospital stay ranged from 2-7 days with a mean (±SD) value of 27.05±6.75 years. No case needed ICU admission. Regarding the postoperative complications, ICT removal ranged from 1-3days with a mean (±SD) value of 1.15 ± 0.27 days. Air leaks occurred in 2 (10.53%), Wound infection did not occur in any case.

Conclusions: VATS is superior to open thoracotomy as regards cosmetics short operation timeless pain less atelectasis and shorter hospital stay

Keywords: VATS, Primary Spontaneous Pneumothorax, PSP.

INTRODUCTION

Primary spontaneous pneumothorax (PSP) is a pneumothorax without underlying lung illness, that occurs most frequently in young, thin males. The annual incidence of PSP is 9 per 100,000. Males aged 22 to 26 years old are the most susceptible. It affects < 1/5 of females[1].

It is typically the result of ruptured pleural bullae or blebs. PSP is accompanied by hyper-resonance (tympanic) on percussion, lower chest wall movement on inspection, lower breath sounds on auscultation, and diminished tactile fremitus on palpation of the chest [2]. Patients with extensive pneumothorax are more likely to exhibit these findings (free air occupies > 15 -20 % area of hemithorax). In response to a respiratory or circulatory impairment or discomfort, reflex tachycardia occurs in the majority of patients[2].

The emergence of video-assisted thoracic surgery (VATS) was preceded by technological breakthroughs in digital technologies, lenses, micro-cameras, monitors, and also the use of general anesthesia to provide one-lung ventilation[3]. VATS is the approach of choice when an interventional technique is deemed required for the treatment of pneumothorax, and it is accompanied by a significant reduction in recurrence to approximately 3%[4]. Additionally, VATS enables the effective and safe utilization of treatments such as pleurectomy, bullectomy, and mechanical pleurodesis that are required for pneumothorax treatment[5].

Conservative care of SP (monitoring, needle aspiration, chest tube, etc.) has shown a significant recurrence rate (16-52%). The recurrence rate increases considerably as the number of SP events increases[6]. Accepted surgical indications for pneumothorax with the lower morbidity of VATS involve; radiologically demonstrated large bullae, recurrence, incomplete expansion of the lung, tension pneumothorax, persistent air leak, spontaneous hemopneumothorax, bilateral involvement, SP in a high-risk occupation, and suspicion of malignancy[7].

A meta-analysis combining randomized and non-randomized data suggests that VATS is associated with a greater recurrence rate than open thoracotomy[8]. However, a comprehensive analysis comprising solely randomized studies indicated that VATS was superior to thoracotomy in terms of hospital stay duration, atelectasis, and pain alleviation after the treatment[9]. Therefore, we established this research to evaluate the cases with PSP who were treated by VATS.

PATIENTS AND METHODS

This retrospective research was carried out on 19 successive cases with a mean age of 27 years old, both sex who underwent VATS procedure for PSP in the Cardiac Surgery unit of Elkasr Elaini Medical Centre, Cardiothoracic Surgery Department in Cairo University, and Minoufia University Cairo, Egypt.

Ethical consent:

Informed written consent was obtained from the patient or relatives of the patients. The study was done after approval from the Ethical Committee in the Cardiac Surgery Unit of Elkasr Elaini Medical Centre, Cardiothoracic Surgery Department in

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Cairo University and Minoufia University, Cairo, Egypt, between 2019 and 2021. The study was conducted according to the Declaration of Helsinki.

Exclusion criteria: All patients who had secondary SP, traumatic, catamenial pneumothorax (related to menstruation), and iatrogenic pneumothorax; treated conservatively or with awake non-intubated procedures; <18 years old, and with missing data.

Under general anesthesia and double-lumen intubation, VATS was conducted. The same surgical team performed bullectomy and mechanical abrasion or apical pleurectomy on 19 of the patients who underwent VATS.

Pneumothorax confirmed by CT scan or chest radiography that happened 30 days or more after removal of the chest tube was the definition of postoperative recurrent pneumothorax.

VATS Technique:

All patients were put in the supine position. The anesthesiologist starts with the insertion of two wide-pore intravenous cannulas. Basic monitoring was started using a non-invasive blood pressure cuff, finger pulse oximetry, and chest electrocardiographic electrodes. Induction of anesthesia was given followed by tracheal intubation using a double-lumen endotracheal tube under fibro-optic bronchoscopic guidance for proper positioning of the bronchial part. The patient was turned to lateral decubitus with the disease side being the upside one. The anesthesiologist gave an ultrasound-guided percutaneous paravertebral block. We ask the anesthesiologist to start single lung ventilation and we remove the already inserted chest intercostal tube.

The first step usually is sterilization and draping with special care for proper sterilizing of the chest tube tract. The next step is enlarging the chest tube's opening to 2cm if it is smaller than that.

The introduction of a 10 mm camera with 30 degrees lens is started to evaluate the lung for any blebs, bulla, fistula, and lung adhesions. We usually start with the release of any lung adhesions using an endoscopic electrocautery spatula at 40-degree energy of dissecting mode. Resection of the blebs either apical, mediastinal or fissural using endoscopic staplers of 3.6 mm thickness was done. Repair of the bronchopleural fistula was done using 3/0 Vicryl stitches. Test for air leak was done by filling the thoracic cavity with warm saline and asking the anesthesiologist to inflate the collapsed lung with gradual positive sustained pressure till ensuring good lung inflation without any leaking point or localizing remaining air-leaking points to be controlled.

Afterward, apical pleurectomy was done by direct dissection from the chest wall to allow pleurodesis and prevent relapse of the pneumothorax. Good hemostasis was performed and then inserting apical chest intercostal tube of 30 or 32 sizes under thoracoscopic vision with ensuring good lung expansion. Then, the tube is fixed to the skin using one silk stitch, and remaining of the opening is closed with simple silk stitches.

The patient is reversed from anesthesia, extubated, and transferred to the recovery room and later on to his inpatient room after ensuring stable hemodynamics and respiration. A chest x-ray was done the next day. The chest tube was removed when there was no air leak for 24 hours, drainage was less than 100 ml/24 hours of serous fluid, Lung is fully expanded in the chest x-ray. The patient was discharged the next day after chest tube removal. Follow-up was performed after 10 days at the outpatient clinic for stitch removal and to ensure good lung expansion on a new chest x-ray.

Figure (1): Excised bullae from 2 different pts using VATS.

Statistical analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD). Qualitative variables were presented as frequency and percentage (%).

RESULTS

In our study, age ranged from 18- 43 years with a mean (±SD) value of 27.05±6.75 years. Our study

included 17 (89.47%) males and 2 (10.53%) females. 8 (42.11%) were smokers. The Operative time ranged from 95-155 min with a mean (±SD) value of 125.79±15.66. Regarding the affected side, it was right in 14 (73.68%) patients and left in 5 (26.32%) patients. 5 (26.32%) patients had 1st attack and 14 (73.68%) had 2nd attack. 7 (36.84%) of patients had collapsed lungs, and 12 (63.16%) of patients had inflated lungs. In all cases, the mean amount of blood lost was < 100 ml. In 19 (100%) cases, macroscopic blebs or bullae were discovered. All cases had subpleural blebs or bullae (emphysema-like alterations) as definitive pathology (**Table 1**).

Table (1): Baseline characteristics of the studied group:

		N=19
Age (years)	**Mean ± SD**	27.05±6.75
	Range	18-43
Sex	**Male**	17 (89.47%)
	Female	2 (10.53%)
Smoking	**No**	11(57.89%)
	Yes	8 (42.11%)
Operative time (min)	**Mean ± SD**	125.79±15.66
	Range	95-155
Affected Side	**Right**	14 (73.68%)
	Left	5 (26.32%)
Attack	**1st**	5 (26.32%)
	2nd	14 (73.68%)
Lung	**Collapsed**	7 (36.84%)
	Inflated	12 (63.16%)

Data are presented as mean ± SD or frequency (%)

Hospital stay ranged from 2-7 days with a mean (±SD) value of 4.05±1.0 years (**Table 2**).

Table (2): Postoperative results of the studied group

ICU stay	**No**	19 (100.0%)
	Yes	0 (0.0%)
Hospital stay (days)	**Mean ± SD**	4.05±1.0
	Range	2-7

Data are presented as mean ± SD or frequency (%), ICU: Intensive care unit

ICT removal ranged from 1-3days with a mean (±SD) value of 1.15 ± 0.27 days. Air leaks occurred in 2 (10.53%), and wound infection did not occur in any case (**Table 3**).

Table (3): Postoperative complications of the studied group

Removal of ICT (days)	**Range**	1-3
Air leak	**No**	17 (89.47%)
	Mild	2 (10.53%)
Wound infection	**No**	19 (100%)
	Yes	0 (0.0%)

Data are presented as mean ± SD or frequency (%), ICT: intrapleural chest tube.

DISCUSSION

A variety of clinical techniques and therapy strategies have been found for pneumothorax, an illness recognized since antiquity. Additionally, PSP is one of the most prevalent issues a thoracic surgeon confronts regularly. PSP, which has been recognized since antiquity, remains one of the most common diseases encountered by thoracic surgeons [10]. VATS, regardless of whether uniportal or multiportal, remains the treatment of choice and a safe approach for PSP treatment in terms of recurrence, hospital stay, postoperative paraesthesia, minor complications, and recovery time[11]. VATS is becoming an increasingly prevalent treatment for persistent or recurrent PSP. Surgical procedures typically entail diffuse treatment of the pleura and possible localized treatment of bullous illness. Rates of postoperative recurrence range from 6 - 27.9 % following bullectomy alone although VATS is the most successful treatment for PSP[12].

The possible function of VATS after an initial episode of PSP is not suggested by guidelines, however, its usage may in the future be promoted for certain subpopulations[13]. More recent research utilizing VATS as a primary treatment for pneumothorax indicated life quality improvement and cost savings compared to chest drain therapy[14]. These trials have not yet resulted in a change in clinical practice or an expansion of VATS indications. In our study, we only used VATS in 1st attack pnx if persistent air leak or lung collapse was present.

In our research, there were 89.47% males and 42.1% smokers. All cases had subpleural blebs or bullae identified as the definitive pathology. 2 (10.53 %) cases developed air leaks.

Either apical pleurectomy or mechanical abrasion can be conducted with comparable success rates. As a result of continuing smoking, the creation of new bullae-blebs is viewed as the primary cause of late-period recurrences[15].

It is unclear how blebs and bullae contribute to the etiology of air leakage in pneumothorax. A study employing fluorescein-enhanced autofluorescence thoracoscopy suggests the existence of air leaks in places distinct from visibly diseased lungs, supporting the theory that pneumothorax is caused by diffuse air leaks [16]. The fact that pleurodesis in conjunction with bullectomy lowers recurrence relative to bullectomy alone further indicates the need for dispersed treatment in conjunction with more focused therapy. The bullous

disease has been treated with many surgical procedures, although it is unknown whether these strategies affect recurrence rates. The primary objective of surgical treatment is to avoid recurrence by removing bullae and blebs and performing apical pleurodesis[17]. **Orki *et al.*[18]** described their retrospective analysis of VATS bulla ablation using electrocoagulation and concluded that apical pleurectomy is a safe approach for PSP recurrence with a comparable recurrence rate of 4.76 %.

Our results revealed that Hospital stay ranged from 2-7 days with a mean (±SD) value of 27.05±6.75 years and no patient needed to ICU stay

This was consistent with the findings of **Merino *et al.*[19]** who conducted a retrospective review of 787 patients with PSP treated with abrasion and bullectomy and revealed a reduced surgical time, hospital stay, and complication rate with VATS. The frequency of recurrence following VATS pleurectomy or mechanical abrasion appears to be significantly higher than that described in previous research, based on available data[20]. In a major randomized controlled trial involving patients with PSP, the frequency of recurrence following VATS was 14.2% in the group treated with mechanical abrasion and bullectomy (n=657)[21].

Also, **Akyil *et al.* [22]** examined the relationship between climatic conditions and pneumothorax in 1097 patients with PSP. They found that in October (n=131; 12 %) and in the fall (n=330; 30 %), the peak time of admission to the hospital. In their setting, 67 % of cases experienced their 1st pneumothorax incident in the spring and fall (September: n=10; 17.8 %). Barker *et al*. observed a recurrence rate of 5.4% for cases performed VATS for PSP, the VATS majority of whom received pleurectomy or mechanical abrasion.

Following **Jung *et al.*[23]** 175 cases who performed VATS for PSP had a median age of 20 years (IQR, 15–40) and were predominantly male (97.1%). The incidence rate of PSP did not differ between the left and right sides. The median interval from the initial PSP procedure for ipsilateral recurrent pneumothorax was 6 months (IQR: 2–8) and for contralateral pneumothorax was 13 months (IQR: 10–18). The median operating time was 20 min (IQR: 15–30), and the median chest drainage indwelling period was 2 days (IQR: 2–4). There was no postoperative atelectasis, arrhythmias, pneumonia, wound infection, or bleeding.

In addition, **Cardillo *et al.*[20]** conducted a prospective observational cohort analysis of 1415 cases requiring VATS for PSP and received VATS. The range of postoperative stays was 4 - 12 days, with a mean of 5.4 days (95 % CI: 5.4 to 5.5). By the 4th postoperative day, 1282 patients (90.6 %) had their drains removed. 92 patients (6.5 %) had their drains removed on day 5, 29 patients (2.0 %) on day 6, and 12 patients (0.8 %) after ≥7 days. There were complications in 29 patients (2.0 %). In the vast major of cases (n=24), these complications consisted of a protracted air leak (1.7% of the total); 3 cases had a localized pleural effusion without infection indications, 1 case had had postoperative empyema, 1 case, and substantial postoperative bleeding. Numerous studies have demonstrated the superiority of VATS in terms of shorter surgery time and hospital stays, less postoperative pain, less immune system impact, and less recovery time[24, 25].

We had some limitations in our research. First, it is retrospective research comprised of consecutive cases, which is susceptible to selection bias. Second, no direct comparisons with conservative therapy or alternative VATS procedures are made. Third relatively small sample size and single center study. Our research lacked a control group. Nonetheless, the strength of our research lies in the fact that we performed a normal VATS procedure on all cases and PSP was assessed from many perspectives.

Finally, further studies with larger cohorts are needed with longer duration of follow-up to investigate long-term outcomes need longer observation to confirm this result

CONCLUSION

VATS is superior to mechanical pleurodesis or pleurectomy for PSP treatment in cases with the bullous disease.

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