Early Outcomes of video-assisted thoracoscopic management of secondary spontaneous pneumothorax

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Abstract

Background: Secondary spontaneous pneumothorax (SSP) is a presence of air in the pleural cavity due to underlying lung disease. Thoracotomy was the typical surgical technique for managing pneumothorax. However, video-assisted thoracoscopic surgery (VATS) became a standard for spontaneous pneumothorax treatment.

Objectives: Assessment of VATS effectiveness and safety in the management of secondary spontaneous pneumothorax.

Patients and methods: 96 patients with secondary pneumothorax underwent video-assisted thoracoscopic surgery for persistent air leak for more than 7 days or having a recurrent pneumothorax on the same side. A retrospective analysis of the patient's clinical characteristic data, perioperative outcome, and recurrence was performed.

Results: 96 patients, the mean age was 61.1±11.7 years. 33 (32.3%) patients had a single attack and 63 (67.7%) patients had recurrent attacks of SPP. All patients had 3 ports of VATS surgery which included bullectomy and talc pleurodesis. Post-operative complications occurred in 37.5% of the patients. 31.3% experienced persistent air leak for more than 7 days after the surgery and 3.1 % had empyema due to prolonged air leak. Post-operative long hospital stay was significantly correlated with BMI (p=0.003), ASA grade (p=0.017), current smoking (p=0.016), and post-operative complication (p=0.001) in univariate analysis. In multivariate analysis, postoperative complication (p=0.001) and body mass index (BMI) was the only significant risk factors for a long hospital stay.

Conclusion: Patients who had thoracoscopic surgery for the management of secondary spontaneous pneumothorax had a shorter length of hospitalization and a lower incidence of recurrence. High BMI and post-operative complications are risk factors for prolonged hospital stay.

Keywords: Outcome; Secondary spontaneous pneumothorax; Video assisted thoracoscopy.

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Introduction

The presence of air in the pleural cavity without trauma is known as Spontaneous Pneumothorax (SP) **(Schnell et al., 2019)**. Primary spontaneous pneumothorax (PSP) affects patients without underlying lung conditions **(Sahn and Heffner, 2000)**. If it affects those patients with an underlying lung disease like chronic obstructive pulmonary disease (COPD), it is known as Secondary Spontaneous Pneumothorax (SSP) **(Schnell et al., 2019)**.

SPS occurs due to many diffuse lung diseases, such as interstitial pneumonia/pulmonary fibrosis (IP/IPF), endometrial disorders, neoplastic disorders, and congenital disorders **(Nakajima et al.,2009)**. PSP affects males more than females, with about 7.4 to 18 patients per 100,000 population per year between males and 1.2 to 6 patients per 100,000 population per year among females. It usually affects males between 10 and 30 years, and it is not common beyond 40 years **(Primrose, 1984)**. SSP is more prevalent above 45 years with predominance in females more than males **(Noppen, 2003; Cardillo et al., 2000)**. Lateral and axillary thoracotomy incisions were the standard surgical approach for operating pneumothorax. But now, video-assisted thoracoscopic surgery (VATS) has become the most used technique for surgical intervention and is now considered the standard for pneumothorax surgery **(Chen et al., 2012; Tschopp et al., 2006)**.

We studied the effectiveness and safety of video-assisted thoracoscopy in management of primary and secondary spontaneous pneumothorax.

Patient and Methods

A retrospective analysis for a prospectively collected data, observational and single arm study for 96 patients with a secondary pneumothorax who underwent video-assisted thoracoscopic surgery for persistent air leak more than 7 days or having a recurrent pneumothorax on the same side. Patients with a history of trauma or iatrogenic pneumothorax, or previous surgery on the chest were excluded and we excluded patients with the poor general condition who were unlikely to tolerate general anaesthesia.

We, retrospectively, collected the data for age, gender, pre-operative data, surgical details, as well as postoperative morbidity and mortality, and pneumothorax recurrence. Thoracoscopy was used as the surgical approach, with the patient under general anesthesia and one-lung ventilation. three ports access were utilized. Inspection of the chest cavity for another pathology and confirmation of the bulleas position and numbers. The air leakage sites were confirmed using the water test. Excision of the bulla using staplers as a standard approach. If there are multiple bulleas, the one showing the air leak is one which is usually excised. After that talc pleurodesis was done to all patients. A chest tube was inserted, and continuous suction was through the chest tube at an H_2O pressure of -15 to 20 CC until removal of the chest tube.

The primary end point is hospital mortality, and the secondary endpoint is perioperative morbidity which included prolonged air leak for more than 7 days, pneumonia, empyema, cardiac problem, stroke, and recurrence within 6 months after surgery. The study has been approved by the institutional review board under number 4/2023 CARS11. No patient consent was needed as it is a retrospective data study.

Statistical analysis

This study utilized numbers with percentages to describe categorical variables and means with standard deviations for continuous variables. The chi-squared test was used for categorical variables and Welch's t-test for continuous variables. SPSS 26 (IBM Corp., Armonk, NY, US) was used for statistical analysis, with a P value less than 0.05 considered statistically.

Results

96 patients (66 male and 30 female), the mean age was 61.1±11.7 years. 33 (32.3%) patients had a single attack and 63 (67.7%) patients had recurrent attacks of SPP. Pre-operative data is presented in (**Table.1**).

Table 1.Clinical characteristics of the patients

Factor	Value
Age (years)	61.1±11.7
Male: Female	66 (68.8%):30 (31.2%)
Body Mass Index (kg/ m2)	23.5±5.9
Diabetes Mellitus	9 (9.8%)
Hypertension (n, %)	18 (17.8%)
Ex-smoker	66 (68.8%)
Smoker	30 (31.2%)
ASA Grade I (n,%) Grade II (n, %) Grade III (n, %)	21 (21.8%) 54 (56.3%) 21 (21.9%)
Single: Recurrent SSP (n, %)	63 (65.6%): 33 (34.4%)

SSP: secondary spontaneous pneumothorax

All patients were operated on through 3 ports VATS surgery which included bullectomy and talc pleurodesis. No allergy was detected to Talc powder. Post-operative complications were in 37.5% of the patients. 31.3% experienced persistent air leak for more than 7 days after the surgery and 3.1 % had empyema due to prolonged air leak. No major complications happened after surgery regarding respiratory failure, stroke, and peri perioperative mortality. Post-operative data is presented in (**Table 2**).

Table 2. Complications

Complication (n, %) Persistent air leak (n, %) Empyem (n, %) Pneumonia and chest infection (n, %)	36 (37.5%) 30 (31.3%) 3 (3.1%) 3 (3.1%)
Post operative Hospital stay (M±SD) days	7.1±3.7
In hospital Mortality	zero
Stroke	zero
30 days mortality	zero
Recurrence within 6 months	6 (5.5%)

Post-operative long hospital stay was significantly correlated with high BMI (p=0.003), ASA grade (p=0.017), current smoking (p=0.016), and post-operative complication (p=0.001). Univariate analysis for factors affecting hospital stay is presented in (**Table.3**). Multivariate analysis for factors affecting post-operative hospital stay were presented in (**Table. 4**).

Table 3. Univariate analysis for long hospital stay

Factor	Hazard ratio	95%CI	P value
Sex	1.31	-2.6-5.28	0.5
Age	0.04	-0.2-1.02	0.55
BMI*	0.42	-0.7.0-0.15	0.003
ASA Grade	3.1	0.59-5.6	0.017
Single or recurrent attack	0.41	-3.48-4.31	0.28
Current smoking	4.5	0.89-8.14	0.016
Post operative complication	0.67	3.9-9.6	0.0001

*BMI: body mass index

Table 4Multivariate analysis for long hospital stay.

Factor	Hazard ratio	95%CI	P value
BMI*	-0.27	-0.48- -0.05	0.015
ASA Grade	1.10	-0.85 - 3.06	0.258
Current smoking	2.35	0.33– 5.04	0.083
Post operative complication	5.07	2.37 – 7.77	0.001

*BMI: body mass index

Discussion

Our study aimed to investigate the clinical characteristics and perioperative outcomes of patients who underwent surgical intervention for SSP. Although SSP patients presented with diverse risk factors, surgical procedures were effective in eliminating thoracic drains and facilitating hospital discharge.

Many underlying lung conditions can cause SSP. Most patients with these diseases have a small respiratory reserve, causing serious respiratory distress at the onset of the pneumothorax **(Tschopp et al., 2006).**

In our study, the male sex was prominent, and all of the cases had an underlying history of COPD, all of our patients had a history of smoking. Most of these diffuse lung diseases were COPD, which is likely to affect older men who are heavy smokers. In these patients, spontaneous pneumothorax has significantly higher complication and mortality rates **(Videm et al., 1987; Igai et al., 2016)**. The second most commonly occurring ailment was interstitial pneumonitis or pulmonary fibrosis, a result consistent with Ichinose et al.'s report on surgical interventions utilized among Japanese SSP patients **(Isaka et al., 2013)**.

SSP can be a complex condition to be managed as patients may suffer from additional health issues besides respiratory problems caused by underlying pulmonary disease. This can make SSP a serious and potentially life-threatening illness. Although surgical intervention has been shown to be effective in treating SSP in some cases, it is important to note that the mortality rate associated with such procedures is around 3% **(Hence et al., 2015; Kanda et al.,2015)**. As a result, surgical intervention should be carefully considered considering the risks it poses to compromised SSP patients. It is worth noting that alternative treatments for SSP other than surgery have also been mentioned in other studies **(Hence et al., 2015; Kanda et al.,2015; Zhang et al., 2009)**.

In our study, postoperative complications occurred in 37.5% of the patients. The most serious complication was persistent air leak for more than 7 days for 31.3% of patients. Another study reported that the median hospital stay after operation was 7 days (range, 3-75) **(Joen et al., 2017)**. In our study, postoperative complications occurred in 38 patients (24.52%), and postoperative recurrence was shown to have occurred in 8 patients (5.16%). Another study reported that postoperative complications developed in 21 patients (24%) and hospital mortality/prolonged length of stay occurred in 6 patients (7%) **(Kawai et al., 2021)**.

In our study, prolonged hospital stay was significantly correlated with high BMI (p=0.003), ASA grade (p=0.017), current smoking (p=0.016), and postoperative complication (p=0.0001) in univariate analysis, However, in multivariate model high BMI (p=0.015) and post operative complication (p=0.001) were the only significant factors. Some reports discussed that Bulla and low serum albumin negatively associated with prolonged air leak and prolonged hospital stay **(Yap at al., 2020)**. Hospital stay was significantly lower in VATS group 10.6±5.8 days versus conventional surgery group of 14.2±14.2 days 9 **(Kim et al., 2011)**.

Isaka et al, reported that post-operative morbidity was 20.6% and mortality was 4.1%. The recurrence rate was 9.3%. In multivariate analysis, a Goddard score in COPD ≥7 and repairing the bulla without the use of staplers were significant risk factors for morbidity **(Isaka et al., 2013)**.

In our study all patients have talc pleurodesis after bullectomy with a recurrence rate in 2 patients (5.5%), no mortality was recorded.

While another single-center retrospective study found a low post-surgical pleurodesis recurrence rate of 4.8% in 104 elderly patients (aged >70 years). A systematic review reported that the rates of recurrence following surgical treatment were 5.4% for VATS and 1.1% for open surgery **(Isaka et al., 2013)**. Conversely, a retrospective study conducted in a single center found that the recurrence rate of post-surgical pleurodesis was exceedingly low at 4.8% out of 104 cases **(Nagata et al., 2020)**.

Limitations to our study included that it is a retrospective study, the sample size is very limited as it is a single-center study, and short-term follow-up as long-term follow-up is not easy to manage.

Conclusion

For patients who have secondary spontaneous pneumothorax and experience continuous air leakage or insufficient

expansion of the lungs, thoracoscopic surgery that involves talc-induced pleurodesis is associated with reduced morbidity and mortality and post-operative hospital stay in comparison to other treatment options.

List of abbreviations

BMI: Body mass index

COPD: Chronic obstructive pulmonary disease

PSP: Primary spontaneous pneumothorax

SP: Spontaneous pneumothorax

VATS: Video assisted thoracoscope

Authors' contributions: Hesham Hassan Ahmed: Design, Writing, data collection, discussion, and statistics; Amr Ashry: Revised the manuscript and approved the final draft; Mohammed El-Hag-Aly: Designed the work revised the manuscript.

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