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Comparative study between using a stapler and hand sewing in bullectomy

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Abstract

Introduction: Spontaneous pneumothorax is a life-threatening thoracic condition that could be either primary spontaneous pneumothorax (PSP) in the absence of an underlying lung disease or secondary spontaneous pneumothorax (SSP) in the presence of an underlying lung disease. In the case of recurrent, contralateral spontaneous pneumothorax or persistent air leak with a chest drain, surgery with bullectomy associated with pleurectomy or pleurodesis is the gold standard management.

Aim: To compare two different techniques for bullectomy, either by using staplers or by hand sewing.

Material and methods: Retrospective review of all patients with spontaneous pneumothorax who underwent bullectomy and pleurectomy by thoracotomy. Group A (30 patients) had repair by using staplers and group B (30 patients) had repair using the hand sewing technique.

Results: The mean operative cost was 4400 ±433.4 Egyptian pounds (EGP) versus EGP 2733.3 ±253.7 in group A and group B respectively (p = 0.001). Mean post-operative cost was 1000 ±100 EGP in group A compared to EGP 2060 ±154.4 in group B (p = 0.0001). Duration of air leak was 1.8 ±1.095 and 9.1 ±3.2 days in group A and group B, respectively (p = 0.0001). Re-exploration occurred in 1 patient in group A (3.3%) and 2 patients in group B (6.6%) (p = 0.5).

Conclusions: The operative cost was significantly higher in the stapler group compared to the hand sewing technique group. However, the duration of post-operative air leak, post-operative hospital stay and post-operative cost were significantly lower in the stapler group. There was no significant difference between the 2 groups in the re-exploration rate after surgery.

Key words: pneumothorax, bullectomy, stapler, hand-sewing.

Introduction

Pneumothorax occurs when air enters the pleural space [1]. Pneumothoraces can be classified into spontaneous (subclassified into primary and secondary) or acquired (subcategorized as traumatic and iatrogenic). Primary spontaneous pneumothorax (PSP) occurs due to the rupture of blebs or bullae in the absence of underlying lung disease [1]. It represents a significant global health concern prevalent in the young with annual incidence rates of PSP known to be 18–28 per 100,000 in men and 1.2–6 per 100,000 in women, respectively [2].

Secondary spontaneous pneumothorax (SSP) occurs due to an underlying lung disease, mainly chronic obstructive pulmonary disease (COPD), in addition to other diseases such as sarcoidosis, tuberculosis, cystic fibrosis, malignancy and idiopathic pulmonary fibrosis.

Conservative management includes observation, aspiration, and chest tube drainage, which is widely utilized to treat the first episode of PSP or SSP [3]. However, the incidence of recurrence remains highly variable with conservative management, ranging from 14% to 50% within 1–5 years in these patients [4]. Surgical intervention is a cornerstone for the definitive treatment of PSP, allowing resolution of the acute episode and prevention of recurrence.

It is indicated in cases with persistent air leak, hemopneumothorax, bilateral pneumothorax, contralateral pneumothorax, people with at-risk occupations such as pilots and divers, and recurrent pneumothoraces [5].

The gold standard surgical management to treat PSP or SSP consists of surgery with bullectomy associated with pleurectomy or talc pleurodesis. Access for surgical bullectomy with pleurectomy/pleurodesis can be obtained through video-assisted thoracoscopic surgery (VATS), axillary mini-thoracotomy, anterolateral or posterolateral thoracotomy [5]. Bullectomy can be performed using multiple methods such as stapling, which is known to reduce post-operative air leakage; however, this method is expensive compared to others such as hand sewing [6].

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Table I. Pre-operative data

Parameter	Group A	Group B	*P*-value
Age	47.7 ±8.3	43.4 ±7.4	0.05
Sex (M/F)	19/11	21/9	0.7
Smoking (*N*/%)	24/80%	26/86.7%	0.36
COPD (*N*/%)	10/33.3%	14/46.7%	0.21

Aim

This retrospective study aims to compare two different techniques for bullectomy, either by using staplers or by hand sewing, with regards to postoperative hospital stay, mortality, cost, and air leak duration.

Material and methods

Study design and patient population

All patients who underwent thoracotomy for bullectomy and pleurectomy for spontaneous pneumothorax, either PSP or SSP, at Assiut University Hospital, Egypt, between 2012 and 2015 were included for retrospective data collection. Patients < 18 years of age, patients with incomplete data, and cases of traumatic or iatrogenic pneumothorax were excluded.

A retrospective review of the patients' charts including pre-operative, operative, and post-operative notes were reviewed to collect the studied variables. All the patients underwent bullectomy and pleurectomy by thoracotomy. Sixty patients with spontaneous pneumothorax, either PSP or SSP, who underwent surgical repair, including bullectomy and pleurectomy, were divided into 2 groups: group A comprising patients who had repair using staplers, which included 30 patients, and group B comprising patients who underwent repair using hand sewing technique, which also included 30 patients.

Endpoints

The primary endpoints of this study were duration of post-operative air leak, post-operative hospital stay, and operative and post-operative cost.

Statistical analysis

Categorical data are reported as frequencies and proportions. Mean and standard deviation were used to express continuous variables. The level of significance was set at a *p*-value < 0.05. Data analyses were conducted using IBM SPSS Statistics version 26.0 for Windows [7].

Results

The mean age was 47.7 ±8.3 and 43.4 ±7.4 years in groups A and B ($p = 0.05$), respectively, with 19 (63.3%) males in group A and 21 (70%) males in group B ($p = 0.7$). Smoking history was noted in 80% ($N = 24$) in group A, compared to 86.7% ($N = 26$) in group B ($p = 0.36$). COPD was observed in 10 (33.3%) patients and 14 (46.7%) patients in groups A and B, respectively ($p = 0.21$). Table I shows the pre-operative data.

The operative time was 2.4 ±0.5 hours and 3.7 ±0.47 hours in groups A and B, respectively ($p = 0.001$). Air leak was noted in 23 cases in group A (76.7%) and 30 cases in group B (100%) ($p = 0.001$). The duration of air leak in days was significantly lower in group A ($p = 0.0001$), as the mean duration of air leak was 1.8 ±1.095 in group A compared to 9.1 ±3.2 in group B. All the 30 (100%) patients in group A underwent drain removal in hospital, compared to 17 (43.3%) patients only in group B, while the remaining 13 (56.7%) patients were discharged home with the drain *in-situ* ($p = 0.0001$).

However, there was no significant difference regarding the rate of re-exploration due to air leak between the groups ($p = 0.5$) as re-exploration occurred in 1 patient in group A (3.3%) and 2 patients in group B (6.6%).

The total hospital stay was 3.27 ±0.78 days in group A, compared to 7.3 ±1.2 days in group B ($p = 0.0001$). Post-operative outcomes are illustrated in Table II.

The operative cost was significantly higher ($p = 0.0001$) in the stapler group (A) compared to group B, as it was EGP 4400 ±433.4 versus EGP 2733.3 ±253.7 in groups A and B, respectively; however, the post-operative cost was significantly lower in group A ($p = 0.0001$) as it was EGP 1000 ±100 in group A, compared to EGP 2060 ±154.4 in group B.

Table II. Post-operative outcome

Parameter	Group A	Group B	*P*-value
Duration of air leak	1.8 ±1.095	9.1 ±3.2	0.001
Presence of air leak post-operative (*N*/%)	23/76.7%	30/100%	0.001
In-hospital removal of chest drain (*N*/%)	30/100%	17/43.3%	0.0001
Discharge with a drain (*N*/%)	Zero	13/56.7%	0.0001
Hospital stay [days]	3.27 ±0.78	7.3 ±1.2	0.0001
Re-exploration (*N*/%)	1/3.3%	2/6.6%	0.5

Table III. Cost

Parameter	Group A	Group B	*P*-value
Duration of surgery	2.4 ±0.5	3.7 ±0.47	0.001
Operative cost [EGP]	4400 ±443.3	2733.3 ±253.7	0.0001
Post-operative cost [EGP]	1000 ±100	2060 ±154.4	0.0001
Total cost [EGP]	6400 ±443.34	5793 ±311.7	0.001

The total operative and post-operative cost was significantly higher in group A, as it was EGP 6400 ±443.34, compared to EGP 5793 ±311.7 in group B (p = 0.001). Table III shows the cost in the 2 groups.

Discussion

During the COVID-19 pandemic, there were significant shortages, increased prices, and delayed delivery of essential health commodities. Similar disruptions are likely in future crises that impact supply chains, emphasizing the need for robust preparedness measures. Staplers, among other medical supplies, were notably affected during this period [8].

This study objective was to compare the outcomes of using staplers versus hand sewing in bullectomy procedures, highlighting the differences between group A (stapler) and group B (hand sewing). Regarding demographic and pre-operative characteristics, the mean age in group A was 47.7 ±8.3 years, compared to 43.4 ±7.4 years in group B (p = 0.05), indicating a borderline significant age difference. Gender distribution was similar, with 63.3% males in group A and 70% in group B (p = 0.7). Smoking history and COPD prevalence were comparable, with 80% smokers in group A and 86.7% in group B (p = 0.36), and COPD was noted in 33.3% of the patients in group A and 46.7% of group B patients (p = 0.21), suggesting well-matched baseline characteristics. This demographic consistency is in line with previous studies, which also found no significant demographic differences between groups undergoing different bullectomy techniques [5].

Regarding the operative time, group A had a significantly shorter operative time (2.4 ±0.5 hours) compared to group B (3.7 ±0.47 hours). The marked reduction in operative time for group A underscores the efficiency of using staplers in surgical procedures. This efficiency is well supported by existing literature. Subotic *et al.* [9] concluded that increased stapler usage was mostly responsible for the significantly decreased operative time and improved surgical outcomes. That study closely parallels the efficiency observed in our bullectomy research.

Regarding air leakage, stapler usage in group A was associated with fewer postoperative air leaks (76.7%) compared to group B (hand-sewn), which had a 100% occurrence rate (p = 0.001). Additionally, the duration of air leak was significantly shorter in group A (1.8 ±1.095 days) versus group B (9.1 ±3.2 days) (p = 0.0001). These findings suggest that staplers provide a more secure closure, reducing the post-surgery incidence and duration of air leaks. This observation is supported by the study conducted by Subotic *et al*. [9], which showed that staplers, due to their mechanical precision, offer better sealing of tissues, thereby minimizing postoperative air leaks. Drain management also differed significantly between the groups. All patients in group A had their drains removed during their hospital stay, whereas only 43.3% of patients in group B had their drains removed before discharge (p = 0.0001). This indicates a quicker recovery for patients in group A, as evidenced by earlier drain removal. The quicker drain removal in the stapler group aligns with findings from Brunelli *et al*. [10], which showed that efficient air leak management and quicker drain removal are associated with shorter hospital stays and faster recovery times [10]. Re-exploration rates due to air leaks were low and statistically similar between the two groups, with 3.3% in group A (stapler) and 6.6% in group B (hand-sewn) (p = 0.5). This similarity indicates that both techniques had comparable needs for further surgical intervention. The comparable re-exploration rates suggest that the initial choice of surgical method did not significantly impact the likelihood of requiring additional surgery. This observation is supported by a study conducted by Yazawa *et al.* [11], which compared re-exploration rates in thoracic surgery using staplers and hand-sewn techniques. The study found no significant difference in re-exploration rates between the two methods, highlighting that both techniques are effective and reliable for thoracic procedures.

Group A had a significantly shorter hospital stay (3.27 ±0.78 days) compared to group B (7.3 ±1.2 days) (p = 0.0001). This reduction indicates improved recovery times and better resource utilization for patients in the stapler group. These findings are consistent with Brunelli *et al*. [10], who reported that the use of staplers in lung surgery was associated with shorter hospital stays due to fewer complications and faster postoperative recovery. Additionally, Brunelli *et al*. [10] highlighted that efficient management of postoperative complications, such as air leaks, can significantly reduce the length of hospital stays.

The cost analysis revealed that operative costs were higher in group A (EGP 4400 ±433.4) compared to group B (EGP 2733.3 ±253.7) (p = 0.0001). However, post-operative costs were significantly lower in group A (EGP 1000 ±100) versus group B (EGP 2060 ±154.4) (p = 0.0001). Despite the higher initial operative cost, the post-operative cost was significantly lower in group A, while the overall costs were higher in group A (EGP 6400 ±443.34) compared to group B (EGP 5793 ±311.7) (p = 0.001). This indicates that, while stapler use incurs higher upfront costs, it offers savings in post-operative care, likely due to shorter hospital stays and fewer postoperative complications. The increased operative costs with stapler use stem from the price of stapling devices and cartridges. However, these are offset by savings in post-operative care. Van Schil P [12] found that staplers in thoracic surgery significantly reduced hospital stays and complications compared to hand-sewn techniques, leading to lower overall costs despite higher initial expenses.

Conclusions

The stapler method in bullectomy offers significant advantages in operative efficiency, reduced post-operative air leak duration, and shorter hospital stays, potentially improving patient outcomes and resource utilization. However, these benefits come with increased total costs. Decision-making should balance clinical benefits against financial implications.

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Ethical approval

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Disclosures

The authors report no conflict of interest.

References

1. Gilday C, Odunayo A, Hespel AM. Spontaneous pneumothorax: pathophysiology, clinical presentation and diagnosis. Top Companion Anim Med 2021; 45: 100563.
2. Lesur O, Delorme N, Fromaget JM, Bernadac P, Polu JM. Computed tomography in the etiologic assessment of idiopathic spontaneous pneumothorax. Chest 1990; 98: 341-347.
3. Schopp JM, Bintcliffe O, Astoul P, Canalis E, Driesen P, Janssen J, Krasnik M, Maskell N, Van Schil P, Tonia T, Waller DA, Marquette CH, Cardillo G. ERS task force statement: diagnosis and treatment of primary spontaneous pneumothorax. Eur Respir J 2015; 46: 321-335.
4. Cardillo G, Bintcliffe OJ, Carleo F, Carbone L, Di Martino M, Kahan BC, Maskell NA. Primary spontaneous pneumothorax: a cohort study of VATS with talc poudrage. Thorax 2016; 71: 847-853.
5. Nachira D, Meacci E, Congedo MT, Pogliani L, Chiappetta M, Vita ML, Margaritora S. Surgical treatment of primary spontaneous pneumothorax: what is better to do? J Thorac Dis 2020; 12: 1274-1276.
6. Tantraworasin A, Seateang S, Bunchungmongkol N. Staplers versus handsewing for pulmonary lobectomy: randomized controlled trial. Asian Cardiovasc Thorac Ann 2014; 22: 309-314.
7. IBM Corp. IBM SPSS Statistics for Windows, Version 26.0. IBM Corp, Armonk, NY, 2019.
8. Pagala P, Mlugu EM, Mwakalukwa R, Kagashe GA. Impact of COVID-19 on the supply chain of essential health commodities: a mixed method study, in Dar es Salaam, Tanzania. J Pharm Policy Pract 2023; 16: 103.
9. Subotic D, Hojski A, Wiese M, Lardinois D. Use of staplers and adverse events in thoracic surgery. J Thorac Dis 2019; 11 (Suppl 9): S1216-S1221.
10. Brunelli A, Cassivi SD, Halgren L. Risk factors for prolonged air leak after pulmonary resection. Thorac Surg Clin 2010; 20: 359-364.
11. Yazawa T, Igai H, Numajiri K, Ohsawa F, Matsuura N, Kamiyoshihara M. Comparison of stapler and electrocautery for division of the intersegmental plane in lung segmentectomy. J Thorac Dis 2021; 13: 6331-6342.
12. Van Schil P. Cost analysis of video-assisted thoracic surgery versus thoracotomy: critical review. Eur Respir J 2003; 22: 735-738.