Pleurectomy versus pleural abrasion in patients with spontaneous pneumothorax: a randomized controlled trial

Abdelfatah E.M. Salaheldin Abugabal, Mostafa A. ElDewer, Ahmed Mostafa, Ahmed El Nori

Department of Cardiothoracic Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Abdelfatah E.M. Salaheldin Abugabal, MBBCH, MSc, Department of Cardiothoracic Surgery, Faculty of Medicine, Ain Shams University, Cairo 11351, Egypt. E-mail: abdelfatah_abugabal@med.asu.edu.eg

Received: 10 October 2023
Revised: 20 October 2023
Accepted: 23 October 2023
Published: 31 January 2024

The Egyptian Journal of Surgery 2024, 43:205–213

Background
A prevalent clinical issue that can affect people of any age is pneumothorax. Depending on the degree of cardiorespiratory impairment, the severity of the symptoms, and the size of the pneumothorax, the course of treatment might range from conservative to surgical. In this study, we examined the risks of pneumothorax recurrence in individuals with spontaneous pneumothorax using the pleural abrasion and pleurectomy procedures.

Patients and methods
We did a randomized controlled trial involving 80 patients with spontaneous pneumothorax. Patients were randomly allocated to undergo video-assisted thoracoscopic surgery bullectomy with mechanical pleurodesis; pleural abrasion, or pleurectomy. We compared the incidence of recurrence of spontaneous pneumothorax as a primary outcome, postoperative drainage amount, hospital stay, and mortality as our secondary outcome in both groups. This trial is listed on ClinicalTrials.gov as NCT05407974.

Results
There were two cases of recurrence of pneumothorax in the pleurectomy group and no recurrence in the pleural abrasion group with *P* value of 0.152. The drainage amount was higher in the pleurectomy group with mean 230.00±75.79 ml than the abrasion group with mean 192.50±65.58 ml (*P*=0.020). There was no statistically significant difference between the two groups as regards hospital stay (*P*=0.556), there were no cases with hospital mortality in both groups.

Conclusion
Mechanical pleurodesis performed with bullectomy as a technique to reduce the recurrence of spontaneous pneumothorax has proven its efficiency in our study. Despite pleurectomy group showed increase in the drainage amount postoperatively compared with pleural abrasion. There was no difference in the recurrence rates, hospital stay, and in hospital mortality in both groups. Our conclusion does support the adoption of mechanical pleurodesis in patients undergoing bullectomy for spontaneous pneumothorax whether by pleurectomy or pleural abrasion.

Keywords:
pleural abrasion, pleurectomy, pneumothorax, video-assisted thoracoscopy

Egyptian J Surgery 43:205–213

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Abbreviations: PSP, primary spontaneous pneumothorax; SSP, secondary spontaneous pneumothorax.

Introduction

A somewhat frequent clinical issue that can affect people of any age is pneumothorax. The severity of cardiorespiratory impairment, the severity of symptoms, and the size of the pneumothorax all have a role in initial care, regardless of the cause (primary and secondary to lung illnesses or injury) [1].

The symptoms of a pneumothorax can range from mild pleuritic chest pain and shortness of breath to a serious medical emergency needing rapid treatment due to cardiorespiratory collapse [2–4]. Reduced breath sounds, decreased ipsilateral chest expansion, and an excessively resonant percussion tone are typical symptoms. Tension pneumothorax is characterized by mediastinal shift away from the afflicted side, tachycardia, tachypnea, and hypotension [5].

According to its cause, spontaneous pneumothorax can be classified as primary, secondary, or traumatic. On rare occasions, people may experience concurrent hemothorax due to bleeding brought on by the

shearing of nearby subpleural arteries during lung collapse [1].

The majority of people who develop primary spontaneous pneumothoraxes (PSP) are young, skinny males without a history of underlying long illness. The precise etiology of PSP is still unclear, despite the fact that it is mostly related to the rupture of a subpleural bleb or bulla [6]. In addition, there is a nine-fold increase in risk of PSP with current cigarette smoking [7].

Primary lung conditions such chronic obstructive pulmonary disease, interstitial pneumonia, and pulmonary fibrosis disease commonly co-occur with secondary spontaneous pneumothorax (SSP) [8].

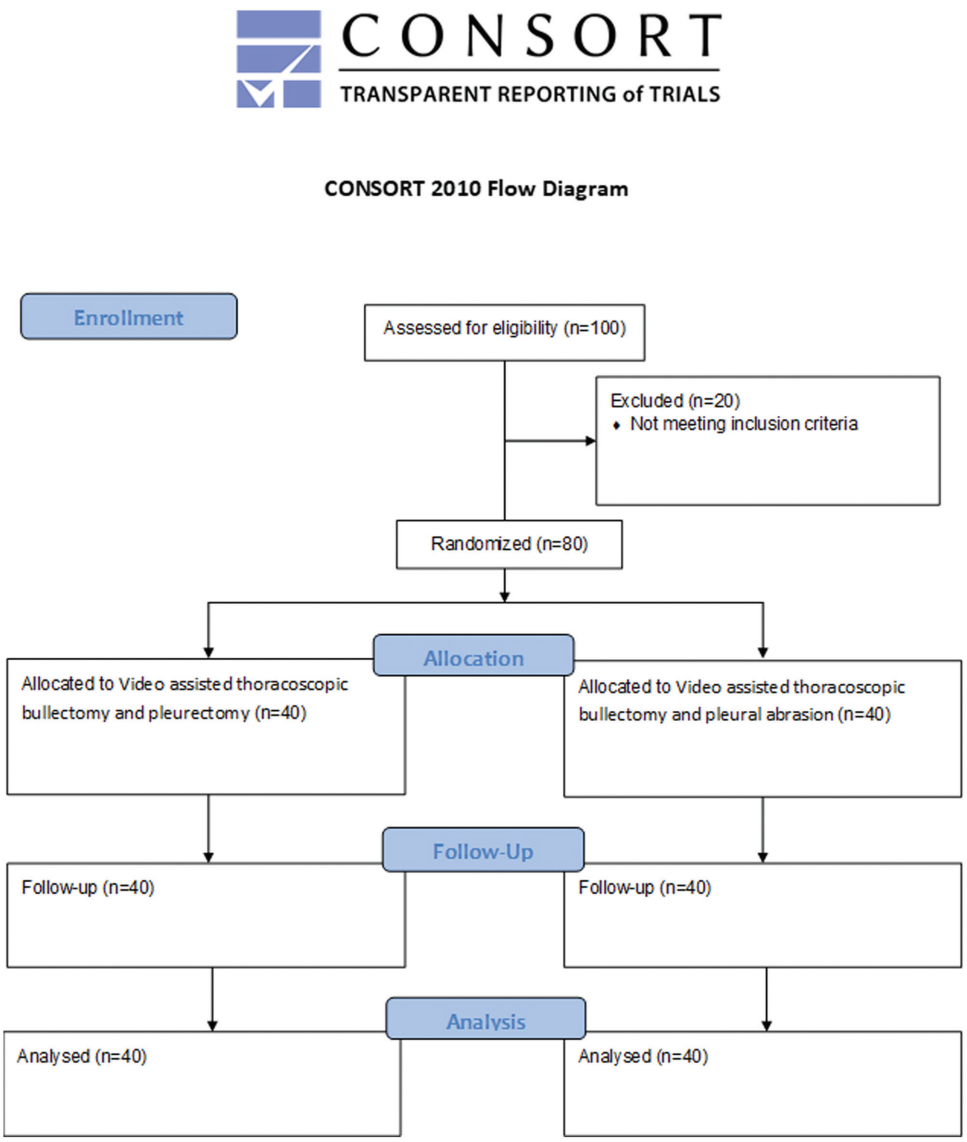
Depending on the patient's health, treatment options for spontaneous pneumothorax might range from conservative measures like drainage and pleurodesis to surgical intervention [8].

Surgery is used to cure bullous lesions that are causing air leakage and to prevent them from coming back. Different pleurodesis treatments, such as chemical pleurodesis or mechanical pleurodesis by pleural abrasion or pleurectomy, are utilized to lower the recurrence rate after surgery without further pleurodesis [6].

Objectives

The primary objective was to measure the postoperative recurrence rate of pneumothorax. The secondary

Figure 1



Participants flow chart.

objectives were to measure drainage amount, length of hospital stay, and mortality.

Patients and methods

Trial design

A randomized controlled study was carried out between October 2021 and June 2023. For surgical intervention, we enlisted 80 patients with spontaneous pneumothorax who were sent to Ain Shams University Hospitals.

The CONSORT statement [9] for reporting randomized controlled trials served as our guide when we published our experiment. On 04/05/2022, ClinicalTrials.gov registered this randomized clinical trial with the identifier NCT05407974.

The study was approved by the institutional review board, and on September 22, 2021, the Ain Shams University Ethics Committee issued its permission under IRB number FWA 00017585.

Participants

In the current investigation, 100 people were investigated; 20 patients did not meet the requirements for inclusion. Our final study comprised of 80 patients (40 in each group) (Fig. 1). All patients gave their written informed permission to participate in the trial before any surgical intervention.

Patients were assigned at random in accordance with a planned operation schedule; for example, the first patient to arrive was placed in group A (the abrasion group), the second patient to arrive was placed in group B (the pleurectomy group), and so on. For each patient enrolled, we obtained a baseline computed tomography chest without contrast [10]. A follow-up following surgery, a chest radiograph was taken, and each patient was subsequently monitored for recurrence for 6 months (Table 1).

Interventions

Patients were operated on under general anesthesia with a double lumen endotracheal tube and were placed in the lateral decubitus position (Fig. 2).

Pleural abrasion group (A): the parietal pleura was mechanically abraded by being rubbed with gauze or a cleaning pad (Fig. 3).

Pleurectomy group (B): pleurectomy was carried out using a grasper and a little piece of gauze. The purpose of a pleurectomy was to remove the parietal pleural, particularly above the blebs or bullae-containing regions.

In both groups, every patient had blebs removed along with a pleurectomy or pleural abrasion.

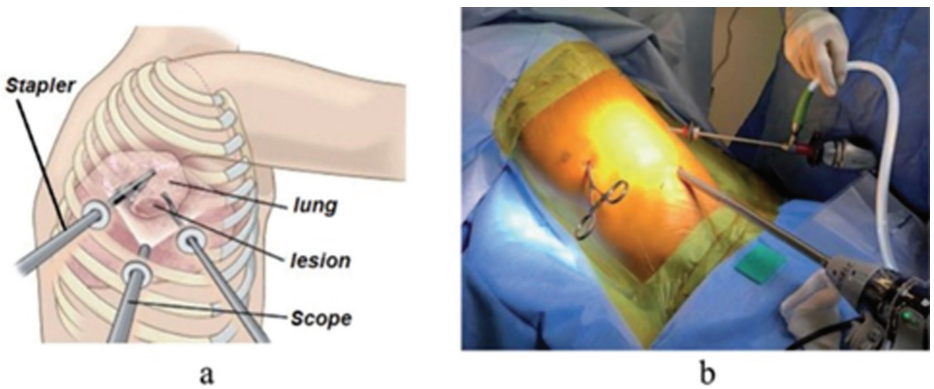
Depending on the kind of pneumothorax and the surgeons' desire, a chest tube was placed in the pleural cavity, some of which were connected to

Table 1 Inclusion criteria and exclusion criteria

Inclusion criteria	Exclusion criteria
(1) All age groups were included	(1) Refusal of procedure or participation in the study
(2) Patients presented with spontaneous pneumothorax; primary or secondary	(2) Patients with acquired pneumothorax (e.g. traumatic)
*=(3) Approach: VATS	(3) Approach: any open thoracotomy approach or switching from VATS to open thoracotomy
	(4) Patients with history of previous thoracic surgery on the same side of chest

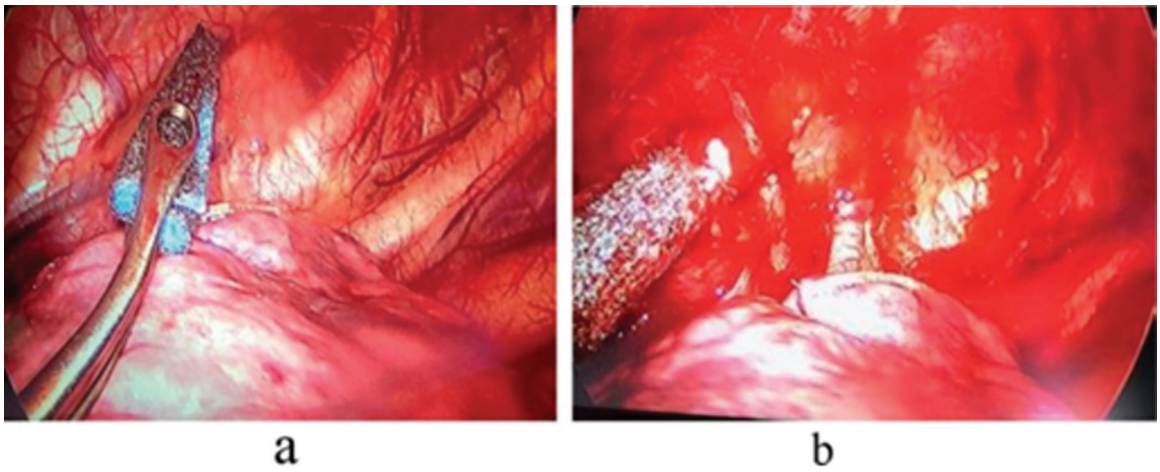
VATS, video-assisted thoracoscopic surgery.

Figure 2



Port placements for the classical three-port video-assisted thoracoscopic surgery in the lateral decubitus position. Different configurations, change according to the visual and staple requirements: (a) camera through central port and (b) camera through posterior port.

Figure 3



Pleural abrasion using electrocautery scratch pad (a) before and (b) after.

low-grade suction for the first 24 h. After that, the suction was cut off.

Outcomes

Postoperative both groups were compared regarding the postoperative drainage amount, length of hospital stay, mortality, and risk of recurrence.

Follow up chest radiograph was done immediately postoperatively, and then each patient was followed up after 6 months.

Sample size

Sample size: 80 patients (40 in each group).

By using PASS 11 (version 23.0. Armonk, NY: IBM Corp) program for sample size calculation, setting confidence level at 90%, margin of error ±0.15.

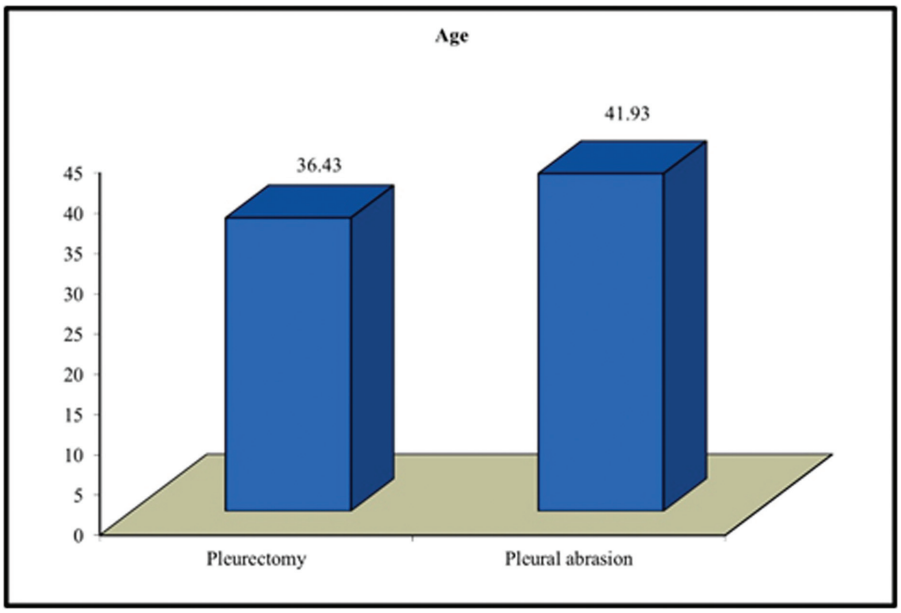
Randomization

Patients were randomized according to a designed operation schedule, that is, first patient to present was assigned to group A (abrasion group), and second patient to present was assigned to group B (pleurectomy group) and so on.

Blinding

Patients were not told of their placement in a research group. To maintain the study group's anonymity

Figure 4



Bar chart showing the mean age in both groups.

during the evaluation, the recorded data were not orally communicated.

Statistical analysis

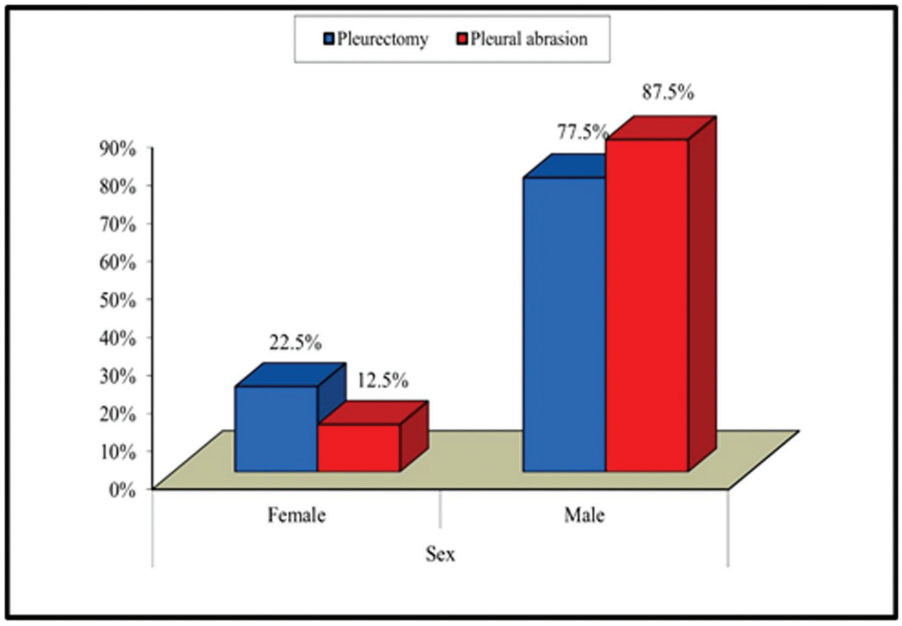
Data were statistically examined using SPSS software. Means and SDs for continuous variables, percentages, and frequencies for categorical variables were all part of the descriptive statistics. For statistical analysis, we assumed normality and homoscedasticity. For quantitative data analysis, hypothesis Student's t tests were used, while qualitative data (ordinal, categorical) was evaluated using the χ^2 test. For all statistical comparisons, a P value of 0.05 is considered significant, while a P value of 0.01 is considered extremely significant.

Results

Baseline data

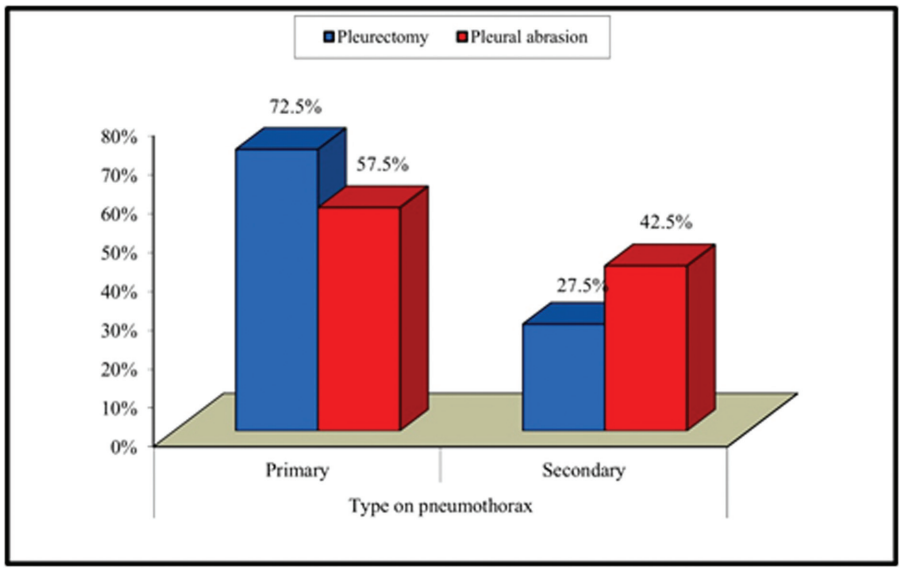
This controlled clinical trial was conducted on 80 patients that were classified into two groups, 40 patients each.

Figure 5



Bar chart showing the sex of patients in each group in our study.

Figure 6



Bar chart comparing the percentage of type of spontaneous pneumothorax patients in both groups.

The trial included 66 (82.5%) males and 14 (17.5%) females in both groups with mean age±SD 39.18 ±13.43 years.

There was no significant difference between the two groups regarding the demographic data where for the age in the pleurectomy group patients had mean age group of 36.43±12.43 while it was 41.93±13.97 for the pleural abrasion with *P* value of 0.067 (Fig. 4).

There was no significant difference between both groups as regards the sex where in pleurectomy group there was nine females and 31 males and in the abrasion group there was five females and 35 males with *P* value of 0.239 (Fig. 5).

According to the type of spontaneous pneumothorax present in each group of patients; 29 patients with PSP underwent pleurectomy while 23 patients had pleural abrasion, on the other hand 11 patients with SSP had pleurectomy and 17 SSP patients underwent pleural abrasion with no significant difference among them with *P* value of 0.160 (Fig. 6 and Table 2).

Outcomes and estimation

Postoperative data

As regard the postoperative drainage amount there was a statistically significant difference between both groups, where it was higher in the pleurectomy group with mean±SD 230.00±75.79 ml and for the pleural abrasion group it was 192.50±65.58 ml with *P* value of 0.020 (Fig. 7).

As regards postoperative hospital stay there was no significant difference between both groups, where the mean±SD hospital stay for pleurectomy group and pleural abrasion group was 3.28±0.64 and 3.35±0.48 days, respectively, with *P* value of 0.556, in which the longest hospital stay was in the pleurectomy group with 5 days for only two (5%) patients, but the majority of pleurectomy group; 27 (67.5%) patients had hospital stay of 3 days, 26 (65%) patients in pleural abrasion group had 3 days of hospital stay (Figs 8 and 9).

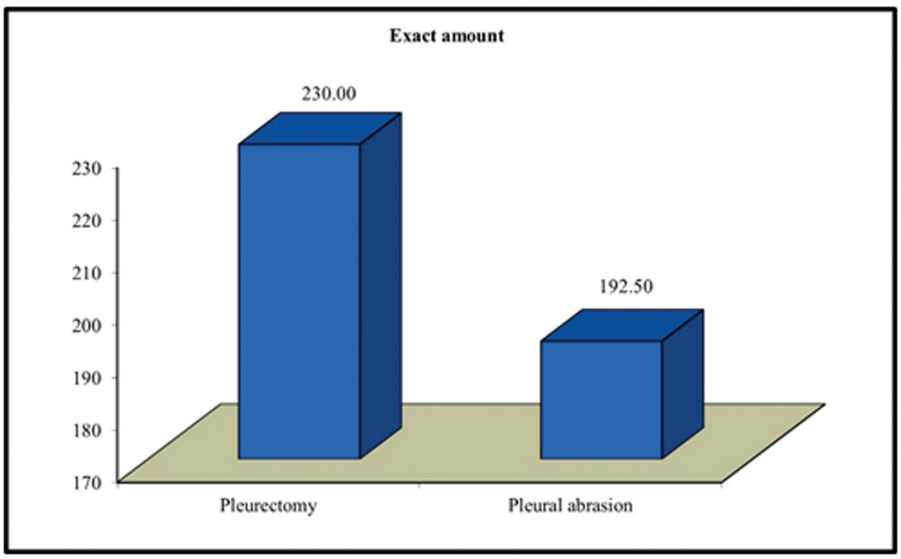
As regards the recurrence rate of pneumothorax postoperatively there was no significant difference between both groups where there were two cases of

Table 2 The difference between the pleurectomy and pleural abrasion group in demographics and preprocedural status

	Pleurectomy (*N*=40)	Pleural abrasion (*N*=40)	*P* value
Age (years)	36.43±12.43	41.93±13.97	NS
Sex [*n* (%)]			
Male	31 (77.5)	35 (87.5)	NS
Type of pneumothorax [*n* (%)]			
Primary	29 (72.5)	23 (57.5)	NS
Secondary	11 (27.5)	17 (42.5)	NS

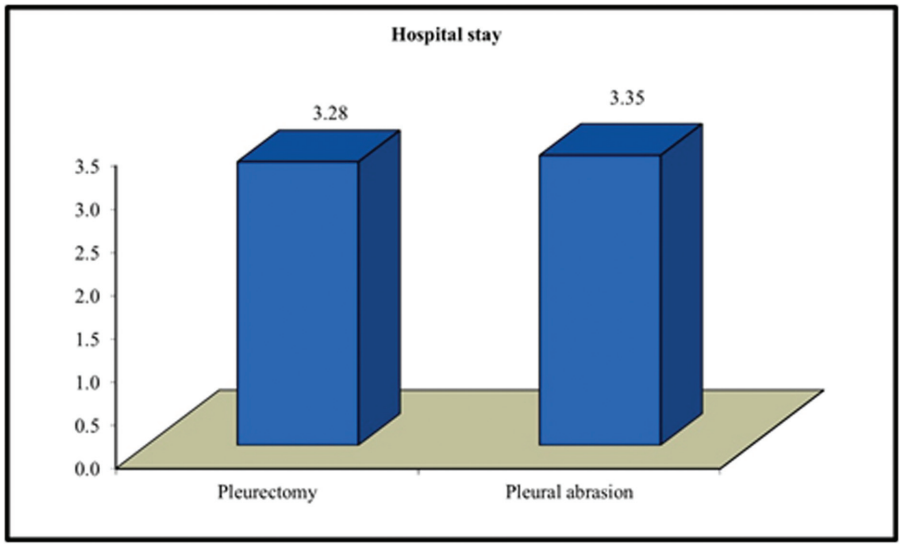
NS, not significant.

Figure 7



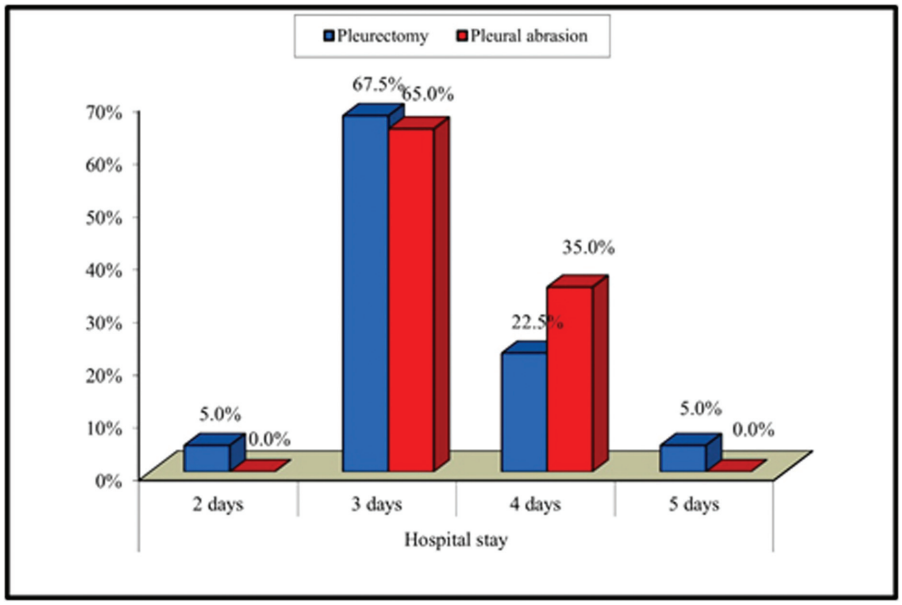
Bar chart comparing the mean postoperative drained amount among both groups.

Figure 8



Bar chart comparing the mean postoperative hospital stay among both groups.

Figure 9



Bar chart showing the percentage of patients with postoperative hospital stay in days among both groups.

recurrence in the pleurectomy group and no cases in the pleural abrasion group with *P* value of 0.152, and there were no cases of hospital mortality in both groups (Fig. 10 and Table 3).

Harms

No harm or unintended effects happened to any patient in both groups.

Discussion

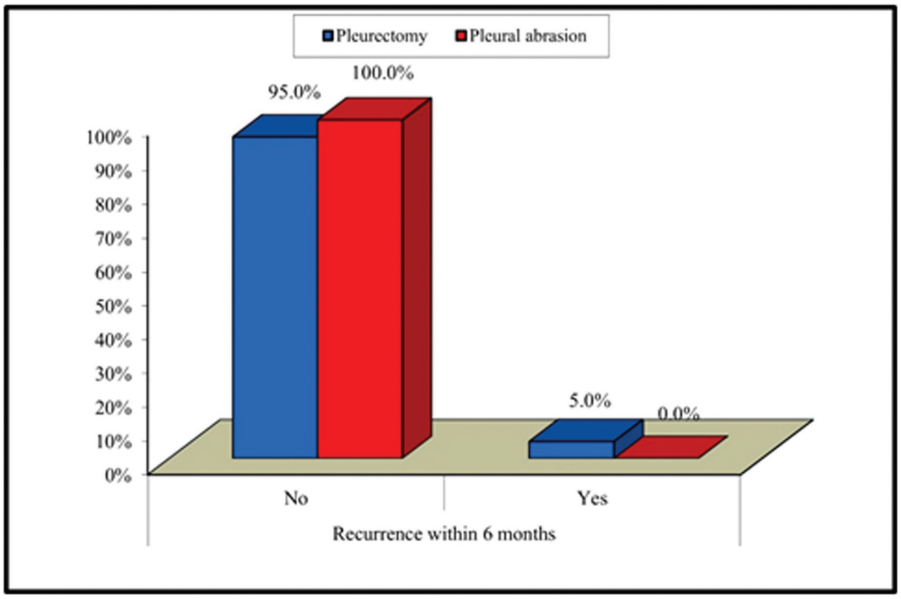
Interpretation

While the majority of studies on surgical treatment of spontaneous pneumothorax were based on a comparison of thoracotomy and video-assisted thoracoscopic surgery, they did not primarily focus on different surgical pleurodesis procedures and their outcomes [11].

In our study we aimed to compare both mechanical pleurodesis techniques (pleurectomy and abrasion) in terms of recurrence of pneumothorax, postoperative drainage amount, length of hospital stay, and mortality.

This controlled clinical trial included 40 patients that underwent pleurectomy with nine (22.5%) females and 31 (77.5%) males with mean age±SD of 36.43±12.43,

Figure 10



Bar chart comparing the postoperative recurrence of pneumothorax within 6 months in both groups.

Table 3 The difference between the pleurectomy and pleural abrasion group in postprocedural status

	Pleurectomy(*N*=40)	Pleural abrasion (*N*=40)	*P* value
Postoperative drainage amount (ml)	230.00±75.79	192.50±65.58	0.020
Hospital stay	3.28±0.64	3.35±0.48	0.556
Recurrence of pneumothorax within 6 months [*n* (%)]			
No	38 (95)	40 (100)	0.152
Yes	2 (5)	0	
In hospital mortality	0	0	NA

and 40 patients that underwent pleural abrasion with five (12.5%) females and 35 (87.5%) males with mean age±SD of 41.93±13.97.

While 23 patients with PSP and 17 patients with SSP received pleural abrasion, 29 patients with PSP and 11 patients with SSP got pleurectomy. Each patient was monitored for the recurrence of spontaneous pneumothorax for 6 months after surgery.

Our study found that postoperative drainage amount in the pleurectomy group was slightly higher than that of the pleural abrasion group with significant difference of *P* value of 0.020, which agreed with multiple studies as Ocakcioglu and Kupeli [6] found that the postoperative drainage amount was less in the abrasion group. Also Ling *et al.* [12] found that the pleurectomy group had larger postoperative drainage.

In agreement with our study, Ng *et al.* [11] found the length of hospital stay was median 6 (3–11) days versus 5 (2–13) days in the pleurectomy and pleural abrasion group, respectively, with no significant difference between the two groups (*P*=0.755), which matched our results where there was no significant difference between both groups as regard the hospital stay where the mean±SD hospital stay for pleurectomy group and pleural abrasion group was 3.28±0.64 and 3.35±0.48, respectively, with *P* value of 0.556. On the other hand, Ocakcioglu and Kupeli [6] pointed out that the duration of the hospital stay was significantly shorter in the pleural abrasion group compared with the pleurectomy group (3.25±0.75 vs. 3.98±1.56 d, respectively; *P*=0.006).

In agreement with our study, Ng *et al.* [11] stated that there was no in-hospital mortality following any of the procedures. Also according to Ocakcioglu and Kupeli [6] there was no postoperative mortality observed in either group.

In our study there were two cases of recurrence in the pleurectomy group within 6 months and no cases in the pleural abrasion group with *P* value of 0.152.

Ocakcioglu and Kupeli [6] found the same recurrence rate on comparing both groups. While Joharifard *et al.* [13] found significantly lower rate of postoperative recurrence when patients were treated with pleurectomy rather than pleural abrasion.

Generalizability

Pleural abrasion and pleurectomy are both reliable methods of mechanical pleurodesis to be performed along with bullectomy for patients with spontaneous pneumothorax as a technique to decrease the recurrence rate of pneumothorax.

Despite the fact that the pleural abrasion group experienced considerably greater postoperative drainage than the pleurectomy group did, there was no discernible difference between the two groups in terms of postoperative mortality or hospital stay.

In addition, there was no discernible difference between the pleurectomy and pleural abrasion groups in terms of the postoperative recurrence rate within 6 months.

Limitations

We could not put into comparison the number of ports used in the video-assisted thoracoscopic surgery procedure.

Recommendations

Mechanical pleurodesis is recommended to be done along with bullectomy in patients with spontaneous pneumothorax. The choice of the type of mechanical pleurodesis will not affect the outcome as regards the recurrence of pneumothorax.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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