

Pleural abrasion versus pleurectomy in primary spontaneous pneumothorax surgery

Primer spontan pnömotoraks cerrahisinde plevral abrazyon ile plevrektominin karşılaştırılması

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Background: In this study, we aimed to compare the success of pleural adhesion procedures (pleural abrasion versus a pleurectomy) in preventing recurrence after the surgical treatment of primary spontaneous pneumothorax (PSP).

Methods: Between January 2006 and December 2008, the results of 208 operations performed on 190 patients with PSP were examined. As pleural adhesion procedures, 87 pleural abrasions (group A) [20 via video-assisted thoracic surgery (VATS); 67 via axillary thoracotomy (AT)] and 121 apical parietal pleurectomies (group P) (34 via VATS; 87 via AT) were performed. The patients in groups A and P were followed up for a median of 46 (range 28-63) and 41 (range 28-63) months, respectively. They were monitored for recurrence, and, if present, the factors affecting the recurrence were then analyzed.

Results: No differences between the groups were found with respect to age, pneumothorax side, surgical indications, surgical approach, duration of surgery, or complication development. The chest tube duration and hospitalization time were significantly shorter in group P ($p=0.0001$ and $p=0.002$, respectively). Recurrence developed in six patients (6.8%) in group A and one patient (0.8%) in group P ($p=0.02$). In the univariate analysis, no relationship was found between the rate of recurrence and the surgical approach, age, gender, pneumothorax side, or surgical indication. In the logistic regression analysis, the surgical approach and pleural adhesion procedure were independent predictors of recurrence ($p=0.048$ and $p=0.034$, respectively).

Conclusion: A pleurectomy is more effective than abrasion at preventing postoperative recurrence in PSP surgery. Additionally, it has advantages in terms of chest tube duration and hospitalization time.

Key words: Pleural abrasion; pleurectomy; recurrence; spontaneous pneumothorax; surgery.

Amaç: Bu çalışmada, primer spontan pnömotoraks (PSP) cerrahi tedavisinde, nüksü önlemek için yapılan plevral adezyon işlemlerinin (plevral abrazyon ve plevrektomi), başarısı karşılaştırıldı.

Çalışma planı: Ocak 2006 - Aralık 2008 tarihleri arasında, 190 PSP'li olguya uygulanan 208 cerrahi girişimin sonuçları incelendi. Plevral adezyon işlemi olarak; 87 plevral abrazyonu (grup A) [20 olguda video yardımcı torasik cerrahi (VYTC), 67 olguda aksiller torakotomi (AT) yaklaşımı ile], 121 apikal parietal plevrektomi (grup P) (34 olguda VATS, 87 olguda AT yaklaşımı ile) uygulandı. Grup A hastaları ortanca 46 (dağılım 28-63) ay, grup P hastaları ise 41 (dağılım 28-63) ay takip edildi. Hastalar nüks açısından izlendi ve eğer varsa nüksü etkileyen faktörler analiz edildi.

Bulgular: Gruplar arasında yaş, pnömotoraks tarafı, ameliyat endikasyonu, ameliyat yaklaşımı, ameliyat süresi ve komplikasyon gelişimi açılarından fark yok idi. Göğüs tüpü kalış süreleri ve hastanede yatış süreleri grup P'de anlamlı olarak daha kısa idi (sırasıyla $p=0.0001$ ve $p=0.002$). Grup A olgularının altısında (%6.8), grup P olgularının ise birinde (%0.8) nüks gelişti ($p=0.02$). Tek değişkenli analizde nüks oranı ile ameliyata yaklaşım biçimi, yaş, cinsiyet, pnömotoraks tarafı ve ameliyat endikasyonu arasında ilişki bulunamadı. Logistic regresyon analizinde ameliyata yaklaşım biçimi ve plevral adezyon işlemi nüksü bağımsız olarak etkileyen faktörler olarak bulundu (sırasıyla $p=0.048$ ve $p=0.034$).

Sonuç: PSP cerrahisinde plevrektomi, ameliyat sonrası nüksün önlenmesi açısından abrazyondan daha etkindir. Buna ek olarak, plevrektomi, göğüs tüpü kalış süresi ve hastanede kalış süreleri açılarından daha avantajlıdır.

Anahtar sözcükler: Plevral abrazyon; plevrektomi; nüks; spontan pnömotoraks; cerrahi.



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Spontaneous pneumothorax that occurs in patients with no underlying lung disease is called primary spontaneous pneumothorax (PSP),^[1,2] and it usually occurs as a result of a rupture of a subpleural bleb in the lung apex. It typically occurs in young, asthenic, adult males.^[1] Primary spontaneous pneumothorax occurs at an annual age-adjusted frequency of 7.4-18 cases per 100.000 in men and 1.2-6 cases per 100.000 in women.^[1-3]

Patients who developed PSP are usually treated with a tube thoracostomy. Indications for surgical treatment for first-episode pneumothorax patients include prolonged air leak (PAL), incomplete lung reexpansion, a background of a high-risk occupational group, recurrence, and sequential or synchronous bilateral pneumothorax.^[2,4]

The purpose of the surgical treatment of PSP is to resect the apical bulla and bleb areas. In addition, various pleural adhesion procedures are recommended to prevent recurrence. To this end, the pleura can be abraded using mechanical, chemical (talc), or physical (laser, electrocautery, or diathermy) methods, or a pleurectomy can be performed.^[5-11]

This study compared the efficiency of pleural abrasion and pleurectomy methods in reducing recurrence in patients undergoing a wedge resection of the lung due to PSP.

PATIENTS AND METHODS

Records of the patients with PSP treated surgically between January 2006 and December 2008 were obtained from our clinic database. Patients were excluded if they had undergone surgery for spontaneous hemopneumothorax, if they had not undergone a lung resection, if a stapler had not been used for the lung resection, or if a pleural adhesion procedure had not been added. This was done in order to form homogeneous patient groups. Additionally, patients younger than 15 years of age or older than 45 years of age were also excluded due to the increase of secondary pneumothorax for these age groups. The results of 208 surgical procedures performed on 190 PSP patients were evaluated retrospectively. It was decided that 18 patients with PSP who underwent bilateral procedures would also not be included in our study, leaving 190 cases which were evaluated retrospectively. This study was conducted in compliance with the Declaration of Helsinki, and the institutional review board (IRB) was obtained before the commencing the study.

The indications for surgery were recurrent pneumothorax (n=103), sequential bilateral pneumo-

thorax (n=62), and prolonged air leak (PAL) (n=43). A pneumothorax was deemed "recurrent" when it occurred on the same side where one had previously been detected and was "sequential bilateral" when it developed in the opposite hemithorax from where a pneumothorax had been seen before. In the patients with PSP who were treated with a tube thoracostomy, persistent air leakage from the drain for at least five days was defined as PAL.

Fifty-four operations were performed with video-assisted thoracic surgery (VATS), and 154 with an axillary thoracotomy approach. The VATS operations were done using double-lumen intubation. Three 11.5-mm-diameter ports were used. One was inserted in the seventh intercostal space in the mid-axillary line for the endocamera, and the other two ports were inserted at the anterior and posterior axillary folds in the fourth or fifth intercostal space for the endoscopic instruments. A zero-degree video thoracoscope (Karl Storz; Tuttlingen, Germany) was used as a standard, with a 30-degree video thoracoscope on standby if needed. The axillary thoracotomies were performed with a standard approach using an approximately 8 cm incision over the axillary area with double-lumen intubation. The thorax was entered through the third or fourth intercostal space. All of the operations were completed successfully with no intraoperative complications, and it was not necessary to enlarge the incision in the axillary thoracotomy or to convert the VATS to an open thoracotomy.

In all patients, the areas in the upper lobes with bullae/blebs were identified, and these areas were resected (wedge resection) using a stapler (Endo-GIA or GIA stapler, Covidien, Mansfield, Massachusetts, USA). Tissue adhesive was not used with any patient. The pleural adhesion procedure used was pleural abrasion in 87 patients (group A) and parietal pleurectomy in 121 patients (group P).

The extent of the removed parietal pleura was varied, but the maximum area where the pleurectomy was from the fourth intercostal space to the apical area and to the internal mammary artery anteriorly and the sympathetic chain posteriorly. The surgeons who performed the pleurectomy held the pleura with a clamp, dissected it from the endothoracic fascia, and removed the incised pleura. In the patients for whom abrasion was performed, surgical gauze attached over a clamp was used to produce vigorous pleural abrasion that caused uniform oozing from the pleura. There was no patient pleurectomy and pleural abrasion were performed together. In both approaches, a thorax tube was inserted at the end of

the operation, and all patients were extubated in the operating room.

Suction (-10 cm H₂O) was applied to all chest tubes for the first 24 postoperative hours, and the chest tube was removed 24 hours after full expansion had been achieved and the leak had resolved. Any complications that developed postoperatively, the resulting treatment, and the total durations of the chest tube insertion and hospitalization were recorded.

After discharge, all patients were routinely followed up on days seven and 30 with a physical examination and chest X-ray. In addition, all patients were called by phone asked to report any signs of recurrence or complications.

The data was analyzed using the Statistical Package for the Social Sciences (SPSS, Inc., Chicago, Illinois, USA). Student's t-test was used to compare the averages, the Mann-Whitney U-test was used to compare medians, and a chi-square test or Fisher's exact test was used to compare the frequencies. Variables that differed at the $p \leq 0.1$ level were included in the multivariate analysis, and $p < 0.05$ was considered significant.

RESULTS

No difference between the 87 patients in group A and the 121 patients in group P was found with regard to age, pneumothorax side, surgical indications, surgical approach, or duration of surgery (Table 1). Group P had more males ($n=116$) than group A ($n=75$) ($p=0.019$).

The median duration of chest tube insertion was four (range 2-12) and two (range 2-14) days for the patients in groups A and P, respectively ($p=0.0001$).

No mortality occurred in either group. Complications developed in 14 patients (16%) from group A and 18 patients (14.8%) from group P ($p=0.85$). In group A, the most frequent complications were prolonged air leak (PAL) ($n=9$) and wound infection ($n=2$). Repeat surgery was required in one patient who developed PAL and in one patient who developed empyema (2.2%). In group P, the most frequent complications were PAL ($n=12$) and hematoma ($n=4$). Repeat surgery was required in three patients who developed PAL and three patients who developed hematoma (4.9%). The groups showed no statistical difference in the rate of complications which required another operation ($p=0.85$). The rate of postoperative pleural hematoma development was slightly higher in group P than in group A (3.3% versus 1.1%), but this difference was not significant ($p=0.4$).

The patients in group A were hospitalized for a median of four (range 2-22) days versus a median of three (range 2-24) days in group P ($p=0.002$).

The patients in group A were followed for a median of 46 (range 28-63) months versus 41 (range 28-63) months for group P. During the follow-up period, pneumothoraces recurred in seven patients. No relationship was found between recurrence and age ($p=0.6$), pneumothorax side ($p=0.97$), or surgical indication ($p=0.33$). The rate of recurrence in the patients undergoing VATS and an axillary thoracotomy

Table 1. General characteristics and variables related to surgery of the patients performed pleural abrasion (group A) and pleurectomy (group P)

	Group A (n=87)		Group P (n=121)		<i>p</i>
	n	Range	n	Range	
Mean age	26	16-45	27.5	16-45	0.23*
Sex					
Male	75		116		0.019**
Female	12		5		
Pneumothorax side					
Right	45		70		0.49**
Left	42		51		
Operation indication					
Recurrent pneumothorax	40		63		0.68**
Sequential bilateral pneumothorax	28		34		
Prolonged air leak	19		24		
Operative approach					
Video-assisted thoracic surgery	20		34		0.42**
Axillary thoracotomy	67		87		
Duration of operation (min)	96.7	50-150	110	45-180	0.07*

* Student's t-test; ** Chi-square test.

was 7.4% (4/54) and 1.9% (3/154), respectively ($p=0.07$). Six of the patients who developed recurrence were in group A (6.8% of the patients in this group), and only one group P patient developed recurrence (0.8% of the patients in this group). The low recurrence rate in group P compared with that in group A was statistically significant ($p=0.02$). Factors that affected recurrence development were analyzed using multivariate analysis. The gender, surgical approach, and pleural adhesion method were included in the logistic regression analysis. The effect of gender was not significant ($p=0.2$), whereas the surgical approach ($p=0.048$) and pleural adhesion procedure (VATS over axillary thoracotomy) ($p=0.034$) were independent predictors of recurrence.

DISCUSSION

Patients with PSP require surgical treatment for various indications, and one of the main purposes is to prevent recurrence. Nevertheless, recurrent pneumothorax can develop in some patients despite surgery. Various factors can increase the risk of recurrence after PSP surgery, with one being the effect of the pleural adhesion procedure performed during the surgery. Although it has been suggested that these procedures increase the risk of intraoperative bleeding, postoperative pleural hematoma, and infection and can also lead to difficulty if a future thoracotomy is needed,^[5] the presence of these adverse effects has not been demonstrated. In contrast, it has been shown that pleural adhesion procedures along with wedge resection of the lung area containing bullae/blebs decrease the risk of recurrence.^[2,5,10,12] Because of this, pleural abrasion is usually preferred. In addition, the American College of Chest Physicians (ACCP) Delphi consensus statement^[2] stated that pleural abrasion should be performed in order to prevent recurrence, that it can be applied in the upper half of the thorax, and that some surgeons recommend a pleurectomy. However, limited, inconsistent evidence is available with regard to whether a pleurectomy or abrasion is the more effective procedure. Two factors affect this decision: the recurrence rate and the morbidity rate. Pleurectomies are usually avoided, possibly due to the risk of morbidity. Regarding the recurrence rates, although some studies report a satisfactory low recurrence rate with abrasion,^[5,7] Rena et al.^[7] stated that the risk of recurrence is lower with pleurectomies than with abrasion. We also found that pleurectomies were superior to abrasion in preventing recurrence. In addition, this method does not increase the surgery duration or morbidity compared with abrasion.

Early postoperative results were another factor in our study in favor of pleurectomies. In group P, both the durations of the chest tube and hospitalization were

shorter than in group A. This was an unexpected finding because pleural abrasion is a less invasive procedure than a pleurectomy, and more fluid-blood drainage can usually be expected after a pleurectomy. However we found that hemorrhagic complications were slightly more frequent after a pleurectomy. Air leak resolved quickly after the pleurectomy procedure, probably due to either the occurrence of stronger inflammation when compared with pleural abrasion or the covering of the parenchymal resection line by a blood clot. This led to early chest tube removal and an early discharge.

According to our results, our conclusion is that both early (chest tube duration and hospitalization time) and late (recurrence) results of pleurectomies are superior to those of abrasion in PSP surgery.

We also found that the recurrence risk was higher in patients operated on with the VATS approach and that type of surgical approach can affect the recurrence rate after PSP surgery. Many studies have indicated that there is a high recurrence rate with the VATS approach is used.^[13-15] One of the factors leading to this difference may be that VATS is usually more limited and that abrasion is the preferred pleural adhesion method. Nevertheless, in our series, similar numbers of patients underwent abrasion and pleurectomy in the VATS and thoracotomy groups, and the negative effect of the VATS approach on the recurrence rate persisted in the multivariate analysis. Therefore, the increased recurrence rate in the patients treated with VATS was a direct result of the limitations of VATS and did not arise from the avoidance of a pleurectomy.

In conclusion, we believe that a pleurectomy is the preferred pleural adhesion method in the surgical treatment of PSP.

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