The results of wedge resection and partial pleurectomy in the surgical treatment of primary spontaneous pneumothorax: videothoracoscopy or axillary thoracotomy?

Primer spontan pnömotoraksın cerrahi tedavisinde kama rezeksiyon ve parsiyel plevrektominin sonuçları: Videotorakoskopi mi aksiller torakotomi mi?

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Background: In this study we compared the results of wedge resection and partial pleurectomy in primary spontaneous pneumothorax (PSP) patients treated using video-assisted thoracoscopic surgery (VATS) and axillary thoracotomy approaches.

Methods: Four-hundred and seventy-eight patients were treated in our clinic for PSP between January 2007 and December 2008. We performed 110 apical wedge resections with a stapler and a partial pleurectomy in 101 patients. Forty-five of the procedures were performed with VATS (group V) and 65 with axillary thoracotomy (group T) approaches. The two groups were compared with respect to the duration of the procedure, number of stapler reload units used, duration of chest tube, requirement for postoperative narcotic analgesics, postoperative complications, need for reoperation, and recurrence rate. Student's t-test, the chi-square test, and Fisher's exact test were used for the statistical analysis.

Results: There were no significant differences between groups V and T in terms of age, gender, smoking habits, pneumothorax side, surgical indications, duration of surgery, postoperative duration of chest tube, postoperative complication rate, reoperation rate, or recurrence rate. Narcotic analgesics were needed in five cases in group V and 20 cases in group T (p=0.02). The mean number of stapler reload units used during the operation was 2.7 in group V and 1.43 in group T (p<0.0001).

Conclusion: Both methods can be safely used in PSP surgery. Video-assisted thoracoscopic surgery procedures are less painful, but require more stapler reload units than axillary thoracotomy.

Key words: Pain; spontaneous pneumothorax; thoracotomy; video-assisted thoracoscopic surgery.

Amaç: Bu çalışmada primer spontan pnömotoraks (PSP) hastalarında video yardımlı torakoskopik cerrahi (VATS) ve aksiller torakotomi yaklaşımlarıyla yapılan kama rezeksiyon ve parsiyel plevrektominin sonuçları karşılaştırıldı.

Çalışma planı: Ocak 2007 - Aralık 2008 tarihleri arasında kliniğimizde PSP nedeniyle 478 hasta tedavi edildi. Bu hastaların 101'ine stapler yardımıyla, 110 apikal kama rezeksiyonu ve apikal plevrektomi işlemi uygulandı. Bu işlemlerin 45'i VATS (grup V), 65'i aksiller torakotomi (grup T) yaklaşımıyla yapıldı. İki grup, işlem süresi, kullanılan stapler yükleme ünitesi sayısı, göğüs tüpü kalma süresi, ameliyat sonrası narkotik analjezik gereksinimi, ameliyat sonrası komplikasyonlar, tekrar ameliyat gereksinimi ve rekürens oranları açısından karşılaştırıldı. İstatistiksel analiz için Student t-testi, ki-kare testi ve Fisher kesinlik testi kullanıldı.

Bulgular: Grup V ve grup T arasında yaş, cinsiyet, sigara alışkanlığı, pnömotoraks tarafı ve cerrahi endikasyonlar, ameliyat süresi, ameliyat sonrası göğüs tüpü kalma süresi, ameliyat sonrası komplikasyon oranı, tekrar ameliyat gereksinimi ve rekürens oranları açısından gruplar arasında anlamlı fark bulunmadı. Grup V'de beş hastada, grup T'de ise 20 hastada narkotik analjezik kullanma gereksinimi oluştu (p=0.02). Ameliyat sırasında kullanılan ortalama stapler yükleme ünitesi sayısı grup V'de 2.7, grup T'de ise 1.43 idi (p<0.0001).

Sonuç: Her iki yöntem de PSP cerrahisinde güvenli şekilde kullanılabilir. Video yardımlı torakoskopik cerrahi uygulaması daha az ağrılı olmakla birlikte, aksiller torakotomiye göre daha fazla stapler yükleme ünitesi kullanımı gerektirir.

Anahtar sözcükler: Ağrı; spontan pnömotorax; torakotomi; video yardımlı torakoskopik cerrahi.

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Primary spontaneous pneumothorax (PSP) should be treated surgically when indicated by recurrence, synchronous or metachronous bilateral pneumothoraces, prolonged air leak, incomplete lung re-expansion, or a patient with a high-risk occupation.[1-3]

The literature contains numerous reports comparing video-assisted thoracic surgery (VATS) and axillary thoracotomy for the surgical treatment of PSP.[4-8] However, the results are contradictory and inconclusive as to which method is superior. This study contributes to the existing research by comparing the outcomes of VATS and axillary thoracotomy performed for the same surgical procedure.

PATIENTS AND METHODS

This retrospective study analyzed 478 patients who were hospitalized for primary spontaneous pneumothorax between January 2007 and December 2008. Of the 478 patients who were admitted with PSP, surgical intervention was indicated in 120 cases. Three of these patients refused surgery and were excluded from this study. Additionally, 16 cases that a wedge resection or pleurectomy was not done or a wedge resection performed without using a stapler were also excluded. The remaining 101 cases formed the study group. One hundred and ten surgical procedures involving VATS or axillary thoracotomy were performed on these 101 patients.

The institutional review board approved this retrospective study. The patients gave informed consent for their treatment.

A chest radiograph from each patient and chest computed tomography (CT) was taken from 62 of 101 patients (61.4%). Patients who had previously been treated for ipsilateral pneumothorax were classified as patients with "recurrent pneumothorax." Repeat pneumothorax on the opposite side was defined as "contralateral pneumothorax." Prolonged air leak was defined as air leakage lasting more than five days.

Twenty-seven cases underwent surgery without a tube thoracostomy (TT). The surgical indications in these cases were recurrent pneumothorax or contralateral disease. These patients were able to tolerate the pneumothorax (no hypoxia or hypotension developed) and were given nasal oxygen preoperatively. The surgical indications in the other 74 patients who were operated on after a TT were prolonged air leakage, incomplete lung re-expansion, and recurrent or contralateral disease (Table 1). The 101 patients required 110 surgical interventions. Of the procedures, 65 (59.1%) involved an axillary thoracotomy (group T) and 45 (40.9%) involved VATS (group V). Apical wedge resection was performed and an apical partial pleurectomy was added to all procedures. The same surgical group performed the operations over a two-year period using VATS when the videothoracoscopic instrumentation was available in our hospital (group V); otherwise an axillary thoracotomy was performed (group T).

The VATS procedure was performed under general anesthesia, with double-lumen endotracheal intubation. A 1- to 1.5 cm incision in the 8th intercostal space on the mid-axillary line was performed and the lung was visualized using a 0° telescope (Karl Storz, Tuttlingen, Germany). When no bulla or bleb was detected using the 0° videothoracoscopic telescope, exploration was performed with a 30° videothoracoscopic telescope. In six (13.3%) patients, we found bullae or blebs that were not identified during the 0° videothoracoscopic examination. For videothoracoscopic instrumentation, two entrances on the 4th or 5th intercostal spaces and on the anterior and posterior axillary line were created. Bulla or blebs were grasped and resected with endostapling device (Endo-GIA Universal stapler, 45-4.8 mm; Covidien, Mansfield, MA, USA). No conversion to thoracotomy was necessary in group V.

The axillary thoracotomy was performed through a standard axillary muscle-sparing, about 10 cm. incision under general anesthesia with single-lumen endotracheal intubation. A small finochietto rib spreader was used. After visualization of the bulla or bleb area, a wedge resection with a stapler (GIA 60/80, 4.8 mm linear stapler; Covidien, ABD) was performed.

Table 1. Operative indications

Operation indication	Number	VATS (n=45)		Axillary thoracotomy (n=65)		*p*
		n	%	n	%	
Recurrent pneumothorax	56	22	48.9	34	52.3	
Prolonged air leak	28	10	22.2	18	27.7	
Bilateral pneumothorax	24	13	28.9	11	16.9	0.32
Incomplete re-expansion	2	–	–	2	3.1	
Total	110	45	100	65	100	

VATS: Video-assisted thoracoscopic surgery.

In patients in whom neither bullae nor blebs were identified, an apical wedge resection was also performed. A single chest tube was inserted after all the procedures. All patients were extubated in the operating room postoperatively. The wedge resection and pleural specimens of all patients were examined histopathologically.

Postoperatively, the chest tubes were placed under –10 cmH_2O suction. Three 1 g doses of cefuroxime sodium were used as infection prophylaxis; the first dose was given one hour preoperatively. The chest tubes were removed when drainage was less than 150 mL in 24 hours and no air leakage was evident. The postoperative analgesia protocol included a single 20 mg dose of tenoxicam given intravenously in the first postoperative hour. Intravenous tramadol hydrochloride 50 mg was given twice daily during the first 24 postoperative hours. After the first day, 1500 mg/day paracetamol and 150 mg/day diclofenac sodium (in three doses) were given orally. For patients with pain despite this standard analgesic protocol, pethidine 50 mg intramuscular (i.m) was given when needed. To compare the level of pain, the need for additional pethidine by each patient was recorded.

All cases were followed 3, 7, and 30 days after discharge from the hospital. A physical examination was performed and a chest X-ray was taken. The patients were followed up for a median of 21 (range 12-35) months.

Data are reported as the mean ± standard error of the mean or as percentages. Student's t-test, the chi square test, or Fisher's exact test was used for qualitative variables. A *p* value of less than 0.05 was considered significant.

RESULTS

No significant difference existed between the two groups in terms of age, sex, smoking habits, or pneumothorax side (Table 2). The mean operating time was 73.4±30.6 min in group V and 54.1±25.9 min in group T; the difference was not significant (p=0.7). The mean duration of chest tube was 3.1±2.4 days in group V versus 3.0±2.3 days in group T (p=0.3).

Complications occurred in eight cases in group V (17.7%). In three cases, the postoperative complications required reoperation (6.6%): videothoracoscopic hematoma evacuation was performed in two patients, while the other patient was reoperated on to treat a massive air leak and a wedge resection was done via a thoracotomy. The complication was prolonged air leakage in the five other patients.

Seven patients had at least one complication in group T (10.7%). Four patients had prolonged air leak, one had a wound infection, and two cases required reoperation (3.1%): one for a postoperative hematoma (videothoracoscopic evacuation) and one for a massive, prolonged air leak (re-thoracotomy and repeat wedge resection). In terms of complications, no significant difference was found between the two groups (p=0.39).

In the postoperative period, five patients from group V (11.0%) and 20 patients from group T (30.7%) required pethidine chloride in addition to the standard postoperative analgesia protocol. The difference was significant (p=0.02).

The mean number of stapler reload units used was 2.7±1.7 in group V and 1.4±0.8 in group T (p<0.0001).

No recurrence took place in group T. An ipsilateral recurrence occurred in two patients in group V (1 and 3 months after the initial pneumothorax; 4.4%) and these cases were reoperated on via an axillary thoracotomy. However, the difference was not significant (p=0.16).

DISCUSSION

The surgical treatment of PSP varies. Studies have proposed that PSP can be treated directly with VATS during the first episode.[9-11] We do not advocate the use of surgery during the first episode because of a 20-25% chance of recurrence after the first episode in a PSP patient, and in our series, no patient was operated

Table 2. Demographic parameters of patients

Type of operation (n=110)	VATS (n=45)			Axillary thoracotomy (n=65)			*p*
	n	%	Mean±SD	n	%	Mean±SD	
Mean age			29.0±9.7			27.4± 9.5	0.7
Gender							
Male	42			64			0.3
Female	3			1			
Side of pneumothorax (R/L)	29/16			39/26			0.69
Smoking history	24	53.3		31	47.6		0.69

VATS: Video-assisted thoracoscopic surgery; SD: Standard deviation.

on during the first episode. We recommend surgical treatment in patients with recurrent ipsilateral PSP, contralateral pneumothorax, bilateral pneumothorax, prolonged air leakage, or incomplete lung re-expansion after primary treatment, or in patients with high-risk occupations.[1-3] In our study, the most common surgical indications were ipsilateral recurrence of PSP and prolonged air leakage.

The three goals of PSP surgery are to excise the bullae or blebs that caused the air leak, maintain full re-expansion of the lung, and prevent ipsilateral recurrence. Pleurectomy is used to maintain pleural adhesion and prevent recurrence.

Many reports hold that VATS should be the first choice in PSP because of its superior comfort, better cosmetic result, short hospitalization time, reduced analgesic requirement in the postoperative period, reduced physiological trauma, and improved postoperative pulmonary function.[12,13] Nevertheless, some studies found no significant difference in terms of outcome and pain between thoracoscopic and axillary thoracotomy approaches.[5,6] In their review, Sedrakyan et al.[4] concluded that VATS is associated with better outcomes and has a complication profile comparable to thoracotomy for the treatment of pneumothorax. Baumann and Noppen[2] concluded that the treatment of PSP should involve a thoracoscopic method. In contrast, we found that the outcomes with the two approaches were similar.

Studies have repeatedly reported that when no bleb or bulla is seen during the surgery, the recurrence rate is increased.[10-12,14-16] Naunheim et al.[16] found that the only independent predictor of recurrence was the failure to identify and ablate a bleb at operation; this resulted in a 23% recurrence rate versus a 1.8% rate in those with ablated blebs. During the operation, blebs may not be discovered for many reasons: inadequate evaluation, lack of experience, and blebs too small to be seen macroscopically. We explore the lung with a 30° telescope if no bulla or bleb is seen during the VATS examination performed with a 0° telescope. This makes it possible to examine the mediastinal and posterior areas of the upper lobe. With this method, we were able to identify bullae or blebs in six patients. Nevertheless, despite this additional effort, no bullae or bleb was seen in four patients. An apical wedge resection and pleurectomy was also performed in these patients.

Combining a wedge resection with a pleural adhesive procedure decreases the recurrence ratio.[3] With this goal, pleurectomy or pleural abrasion (mechanical or the application of talc powder) can be used.[8,12,14] However, the optimal intervention remains unknown and no consensus exists regarding the optimal method. Publications have reported that pleurectomy is superior to abrasion[8,17] and that it can be performed apically,[3] but the amount of pleura that should be removed is not clear. We performed a partial pleurectomy in all patients. Further studies should investigate the effect of the pleurectomy method on outcome. A pleurectomy can cause postoperative hemorrhage.[12] In our study, three patients (2.7%) were reoperated on to treat postoperative hematomas, which were likely unwanted complications of the pleurectomy.

In our study, the operating time was longer in group V, although the difference was not significant. This might have occurred because the exploration with VATS takes longer. Waller[18] reported similar results. In addition, increased experience with VATS can shorten the time, increase the efficiency of the treatment, and reduce the recurrence rate.[10,18]

In our series, no significant difference was observed between groups V and T in terms of chest tube duration and complications. A prolonged air leak was the most common complication after VATS in PSP surgery.[15,16,19] A prolonged postoperative air leak can result from air leaking from the stapler line or unseen bullae or blebs. Using sealants after stapling could have prevented some of these air leaks, but because no such agents were used in our study, their efficacies were not compared.

Many researchers have reported less pain after VATS compared to thoracotomy.[4,13] In our study, the use of pethidine chloride was significantly lower in group V ($p=0.02$). Less pain may be experienced after VATS because no intercostal retractor is used and the incision is smaller. Jutley et al.[20] found that uniportal VATS was tolerable, safe, and efficient for treating spontaneous pneumothorax in their series. Moreover, they reported that the incidence postoperative pain and paresthesia was lower than with three-port VATS.[20]

No consensus exists in the literature in terms of the cost of VATS and axillary thoracotomy for PSP.[21] We could not calculate the total costs in our study, although the cost of VATS is probably higher than that of the axillary thoracotomy approach because more stapler reload units were used in the former procedure.

Several papers have reported that ipsilateral recurrence is higher after VATS.[11,15] They speculated that this could be due to the difference in the pleurectomy or pleural abrasion method used.[6,14] Massard et al.[15] reported that the recurrence rate after open surgery is less than 3%. In their review, Barker et al.[22] found that the recurrence of pneumothorax was four times greater with a video-assisted approach compared to an open approach when a similar pleurodesis procedure was performed. However, Vohra et al.[23] criticized the review by

Barker et al.[22] because most of the studies reviewed were not randomized, so the fourfold increase of recurrence after VATS may be spurious. In our study, recurrences took place in two patients (1.8%) and both cases were in group V. Nevertheless, the difference between groups V and T was not significant (p=0.16) despite the fact that more parietal pleura was resected in group T.

As limitations of our study, we could not calculate the total costs. In addition, we did not assess the visual-analog scale (VAS) score as a reliable method of evaluating pain.

In the surgical treatment of PSP, no significant difference was found between VATS and axillary thoracotomy in terms of operation duration, duration of chest tube, complication rate, and recurrence. VATS is probably more expensive than axillary thoracotomy because more stapler reload units are used, but VATS also has advantages, such as less pain in the early postoperative period and less narcotic analgesic usage. Both methods can be effective in PSP surgery.

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REFERENCES

1. Fry WA, Paape K. Pneumothorax. In: Shields TW, editor. General thoracic surgery. 6th ed. Philadelphia: Willams and Wilkins; 2005. p. 794-805.
2. Baumann MH, Noppen M. Pneumothorax. Respirology 2004;9:157-64.
3. Baumann MH, Strange C, Heffner JE, Light R, Kirby TJ, Klein J et al. Management of spontaneous pneumothorax: an American College of Chest Physicians Delphi consensus statement. Chest 2001;119:590-602.
4. Sedrakyan A, van der Meulen J, Lewsey J, Treasure T. Video assisted thoracic surgery for treatment of pneumothorax and lung resections: systematic review of randomised clinical trials. BMJ 2004;329:1008.
5. Freixinet JL, Canalís E, Juliá G, Rodriguez P, Santana N, Rodriguez de Castro F. Axillary thoracotomy versus videothoracoscopy for the treatment of primary spontaneous pneumothorax. Ann Thorac Surg 2004;78:417-20.
6. Kim KH, Kim HK, Han JY, Kim JT, Won YS, Choi SS. Transaxillary minithoracotomy versus video-assisted thoracic surgery for spontaneous pneumothorax. Ann Thorac Surg 1996;61:1510-2.
7. Noppen M. Management of primary spontaneous pneumothorax. Curr Opin Pulm Med 2003;9:272-5.
8. Ayed AK, Al-Din HJ. The results of thoracoscopic surgery for primary spontaneous pneumothorax. Chest 2000;118:235-8.
9. Torresini G, Vaccarili M, Divisi D, Crisci R. Is video-assisted thoracic surgery justified at first spontaneous pneumothorax? Eur J Cardiothorac Surg 2001;20:42-5.
10. Haraguchi S, Koizumi K, Hioki M, Orii K, Kinoshita H, Endo N, et al. Postoperative recurrences of pneumothorax in video-assisted thoracoscopic surgery for primary spontaneous pneumothorax in young patients. J Nippon Med Sch 2008;75:91-5.
11. Morimoto T, Fukui T, Koyama H, Noguchi Y, Shimbo T. Optimal strategy for the first episode of primary spontaneous pneumothorax in young men. A decision analysis. J Gen Intern Med 2002;17:193-202.
12. Gossot D, Galetta D, Stern JB, Debrosse D, Caliandro R, Girard P, et al. Results of thoracoscopic pleural abrasion for primary spontaneous pneumothorax. Surg Endosc 2004; 18:466-71.
13. Ben-Nun A, Soudack M, Best LA. Video-assisted thoracoscopic surgery for recurrent spontaneous pneumothorax: the long-term benefit. World J Surg 2006;30:285-90.
14. Rena O, Massera F, Papalia E, Della Pona C, Robustellini M, Casadio C. Surgical pleurodesis for Vanderschueren's stage III primary spontaneous pneumothorax. Eur Respir J 2008;31:837-41.
15. Massard G, Thomas P, Wihlm JM. Minimally invasive management for first and recurrent pneumothorax. Ann Thorac Surg 1998;66:592-9.
16. Naunheim KS, Mack MJ, Hazelrigg SR, Ferguson MK, Ferson PF, Boley TM, et al. Safety and efficacy of video-assisted thoracic surgical techniques for the treatment of spontaneous pneumothorax. J Thorac Cardiovasc Surg 1995;109:1198-203.
17. Maggi G, Ardissone F, Oliaro A, Ruffini E, Cianci R. Pleural abrasion in the treatment of recurrent or persistent spontaneous pneumothorax. Results of 94 consecutive cases. Int Surg 1992;77:99-101.
18. Waller DA. Video-assisted thoracoscopic surgery for spontaneous pneumothorax-a 7-year learning experience. Ann R Coll Surg Engl 1999;81:387-92.
19. Waller DA, Forty J, Morritt GN. Video-assisted thoracoscopic surgery versus thoracotomy for spontaneous pneumothorax. Ann Thorac Surg 1994;58:372-6.
20. Jutley RS, Khalil MW, Rocco G. Uniportal vs standard three-port VATS technique for spontaneous pneumothorax: comparison of post-operative pain and residual paraesthesia. Eur J Cardiothorac Surg 2005;28:43-6.
21. Van Schil P. Cost analysis of video-assisted thoracic surgery versus thoracotomy: critical review. Eur Respir J 2003; 22:735-8.
22. Barker A, Maratos EC, Edmonds L, Lim E. Recurrence rates of video-assisted thoracoscopic versus open surgery in the prevention of recurrent pneumothoraces: a systematic review of randomised and non-randomised trials. Lancet 2007; 370:329-35.
23. Vohra HA, Adamson L, Weeden DF. Does video-assisted thoracoscopic pleurectomy result in better outcomes than open pleurectomy for primary spontaneous pneumothorax? Interact Cardiovasc Thorac Surg 2008;7:673-7.