



Effects of preoperative physiotherapy education on hospital stay and postoperative pulmonary complications in patients undergoing thoracic surgery

Toraks cerrahisi yapılan hastalarda ameliyat öncesi fizyoterapi eğitiminin hastanede yatış ve ameliyat sonrası akciğer komplikasyonları üzerine etkileri

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ABSTRACT

Background: This study aims to investigate the effects of preoperative physiotherapy education on hospital stay and postoperative complications in patients undergoing thoracic surgery.

Methods: This retrospective study included a total of 96 patients who underwent lobectomy or pneumonectomy for a bronchial carcinoma or metastatic lung disease (84 males, 12 females; median age 60 years; interquartile range 55-67 years) between September 2012 and September 2013. A novel preoperative physiotherapy education protocol was developed by the pulmonary rehabilitation unit and thoracic surgery department of our hospital for patients undergoing thoracic surgery. Of the patients, 49 were applied preoperative physiotherapy education and 47 were not applied. Outcomes of patients who were applied or not preoperative physiotherapy education protocol during a six-month period were compared.

Results: The length of hospital stay and postoperative complication rates were similar between the groups ($p>0.05$). In preoperative physiotherapy education group, the number of days between the date of education and operation was found to be negatively correlated with the length of hospital stay and the postoperative complication rates ($p<0.05$).

Conclusion: Our study results suggest that physiotherapy education should start as early as possible before lung surgery and this protocol is associated with shorter hospital stay and lower postoperative complication rate.

Keywords: Postoperative pulmonary complications; preoperative physiotherapy education; thoracic surgery.

ÖZ

Amaç: Bu çalışmada, toraks cerrahisi uygulanan hastalarda ameliyat öncesi fizyoterapi eğitiminin hastanede yatış ve ameliyat sonrası komplikasyonlar üzerine etkileri incelendi.

Çalışma planı: Bu retrospektif çalışmaya Eylül 2012 - Eylül 2013 tarihleri arasında bronşiyal karsinom veya metastatik akciğer hastalığı nedeni ile lobektomi veya pnömonektomi yapılan toplam 96 hasta (84 erkek, 12 kadın; medyan yaş 60 yıl; çeyrekler arası aralık 55-67 yıl) alındı. Hastanemizin pulmoner rehabilitasyon birimi ve göğüs cerrahisi bölümü tarafından toraks cerrahisi yapılacak hastalar için yeni bir ameliyat öncesi fizyoterapi eğitim protokolü geliştirildi. Hastaların 49'una ameliyat öncesi fizyoterapi eğitimi uygulanır iken, 47'sine uygulanmadı. Ameliyat öncesi fizyoterapi eğitimi protokolü uygulanan ve uygulanmayan hastaların sonuçları altı aylık dönemde karşılaştırıldı.

Bulgular: Hastanede yatış süresi ve ameliyat sonrası komplikasyon oranları gruplar arasında benzer idi ($p>0.05$). Ameliyat öncesi fizyoterapi eğitimi verilen grupta, eğitim tarihi ve ameliyat arasında geçen gün sayısı, hastanede yatış süresi ve ameliyat sonrası komplikasyon oranları ile negatif ilişkili bulundu ($p<0.05$).

Sonuç: Çalışma sonuçlarımız, fizyoterapi eğitiminin akciğer cerrahisinden mümkün olan en erken dönemde başlaması gerektiğini ve bu protokolün hastanede daha kısa yatış süresi ve daha az ameliyat sonrası komplikasyon oranı ile ilişkili olduğunu göstermektedir.

Anahtar sözcükler: Ameliyat sonrası akciğer komplikasyonları; ameliyat öncesi fizyoterapi eğitimi; toraks cerrahisi.

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Thoracic surgery impairs respiratory function, resulting in a high risk of postoperative pulmonary complications which are the major causes of morbidity and mortality.^[1,2] The incidence of postoperative pulmonary complications has been reported to vary between 5 and 80%, accounting for the majority of the expected 3 to 4% mortality rate.^[3,4] Postoperative pulmonary complications following thoracic surgery are related to impaired diaphragm, decreased chest wall motility, pain, ineffective cough, and immobilization.^[5-7]

In clinical practice, the majority of patients are initiated physiotherapy on their first postoperative day with common treatments, such as breathing techniques, cough/huff, and walking exercises.^[8] However, it is difficult for these patients to effectively concentrate on such treatments due to pain and the sedatives taken during the early postoperative period.^[9] Preoperative education is, thus, considered to be beneficial to improve compliance during the postoperative period and to avoid postoperative complications, although there is a limited number of studies in this subject in the literature.^[10-12]

In the present study, we aimed to investigate the effects of preoperative physiotherapy education on hospital stay and postoperative complications in patients undergoing thoracic surgery.

PATIENTS AND METHODS

This retrospective, cohort study was conducted at Dr. Suat Seren Chest Diseases and Chest Surgery Training and Research Hospital, Izmir, Turkey. The study was conducted in accordance with the principles of the Declaration of Helsinki.

A novel protocol was developed by the pulmonary rehabilitation unit and the thoracic surgery department. Before the protocol was developed, a physiotherapist visited the patients and performed the physiotherapy techniques on their first postoperative day on the ward and on subsequent days, if necessary; however, this was not routinely done in the intensive care unit.

After the protocol was developed, the thoracic surgery department referred all patients to the pulmonary rehabilitation unit, after the surgical council decision. During the first session in the pulmonary rehabilitation unit, the physiotherapist educated all patients and their families regarding the importance of early physiotherapy and exercise treatment before surgery, informing about the potential postoperative complications. The physiotherapist also instructed the patients breathing exercises, limb exercises, coughing,

huffing, the active cycle of breathing techniques, and incentive spirometry exercises. She asked each patient to perform all of these activities at least once in the rehabilitation unit to ensure that he/she learned the exercises. The patients were, then, asked to perform the exercises three times daily on the ward, until the date of operation and to continue after surgery, starting as early as possible, particularly in the intensive care unit. Additionally, she provided an illustrated brochure to increase the patients' compliance with the physiotherapy program. On the first postoperative day, the physiotherapist visited the patients and applied treatments to meet the needs of each individual.

Six months after the protocol was initiated, we collected the data from the preoperative physiotherapy education protocol group (group 1) and compared them with group 2 which was consisted of patients in whom no preoperative education was given. We recorded demographic information, diagnosis, type of operation, length of hospital stay, postoperative complications, and the number of days between the date of education and operation.

Statistical analysis

Statistical analysis was performed using the PASW version 17.0 software program (SPSS Inc., Chicago, IL, USA). Descriptive statistics were expressed as median (interquartile range) or percentage (%). The normality of the data was evaluated using the Shapiro-Wilk test. The Mann-Whitney U test and chi-square tests were used to compare baseline characteristics and outcomes of two groups. The correlation analysis was done using the Spearman's correlation analysis. A *p* value of <0.05 was considered statistically significant.

RESULTS

Of a total of 96 patients, 84 (87.5%) were men and 12 (12.5%) were women with a male-to-female ratio of 7:1. The groups were similar in terms of age, gender and type of operation ($p=0.736$, $p=0.076$, and $p=0.106$, respectively) (Table 1). The number of patients with metastatic lung cancer was significantly higher in the preoperative physiotherapy education group ($p=0.031$) (Table 1). Although shorter hospital stays with lower postoperative complications were found in the preoperative physiotherapy education group, the differences were not significant ($p=0.236$, $p=0.227$, and $p=0.721$, respectively) (Table 2). The postoperative complications among the patients are shown in Figure 1. There was no significant differences in the types of complications between the groups ($p>0.05$) (Table 2).

Table 1. Demographic and clinical features of patients

	Group 1 (n=49)				Group 2 (n=47)				p*
	n	%	Median	IQR	n	%	Median	IQR	
Age (year)			60	55-67			60	55-66	0.736
Gender									0.076
Male	40	81.6			44	93.6			
Female	9	18.4			3	6.4			
Diagnosis									0.031
Bronchial carcinoma	42	85.7			46	97.9			
Metastatic lung	7	14.3			1	2.1			
Operation									0.106
Lobectomy	25	51			26	55.3			
Pneumonectomy	12	24.5			13	27.6			
VATS lobectomy	2	4.1			6	12.8			
Wedge resection	8	16.3			2	4.3			
Wedge resection with VATS	2	4.1			0	0			

IQR: Interquartile range; * Mann-Whitney U test, Pearson Chi-square test, p<0.05, VATS: Video-assisted thoracoscopic surgery.

The median number of days between the date of education and operation was 4 (3-6.5) days in the preoperative physiotherapy education group (range 1 to 24) days. In this group, the number of days between the date of education and operation was negatively correlated with the length of hospital stay and postoperative complication rates (r=-0.547, r=-348) (Table 3).

DISCUSSION

In our study, we investigated the effects of a preoperative physiotherapy education protocol in patients undergoing lung surgery, and we found no significant decreases in the length of hospital stay or postoperative complications. However, there was a negative relationship between the number of days between the date of education and operation and the

length of hospital stay and postoperative complication rates. Therefore, we found this conclusion to be interesting, as it indicates that the time of preoperative physiotherapy education is of utmost importance before lung surgery.

To the best of our knowledge, this is the first study to evaluate the relationship between the number of days between the date of education and operation and the length of hospital stay and postoperative complications. Sekine et al.^[13] investigated prophylactic preoperative chest physiotherapy in lung cancer patients with chronic obstructive pulmonary disease, and found significantly shorter hospital stays. In the aforementioned study, the duration of preoperative physiotherapy was two weeks. However, in our study, the time before surgery was 4 (range 3 to 6.5) days, and the distribution had a wide range (1 to 24) days. This finding suggests that the

Table 2. Hospital stay and postoperative complication rates

	Group 1 (n=49)				Group 2 (n=47)				p*
	n	%	Median	IQR	n	%	Median	IQR	
Length of hospital stay (day)			7	4-8			7	6-10	0.227
Postoperative complication									0.721
Yes	9/49	18.4			10/47	21.3			
No	40/49	81.6			37/47	78.7			
Types of postoperative complication									
Atelectasis	1/49	2.0			4/47	8.5			0.199
Subcutaneous emphysema	4/49	8.2			2/47	4.3			0.678
Infection	1/49	2.0			1/47	2.1			1.000
Hemorrhage	-	-			3/47	6.4			0.113
Chylothorax	1/49	2.0			-	-			1.000
Prolonged air leak	2/49	4.1			-	-			0.495

IQR: Interquartile range; * Mann-Whitney U test, Chi square test, * p<0.05.

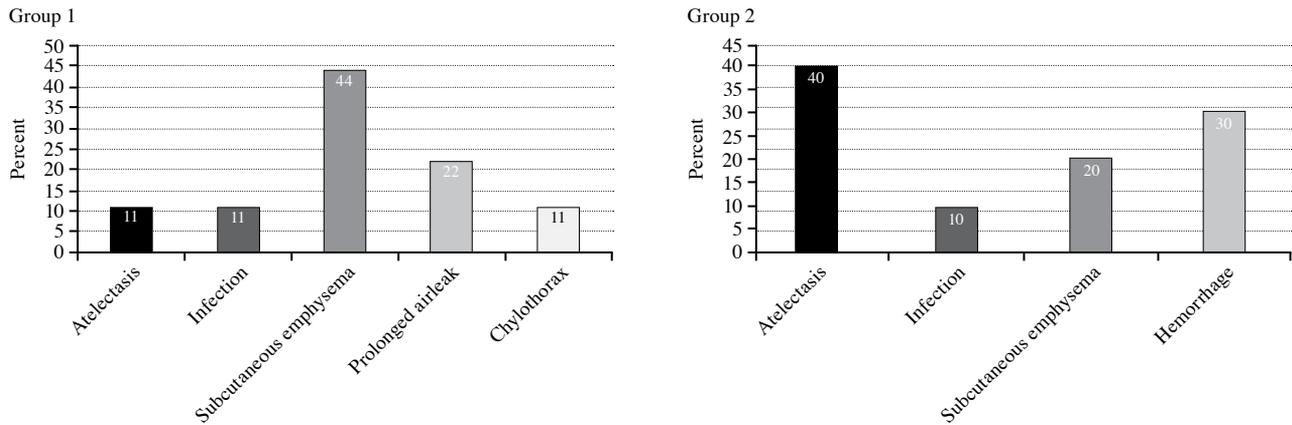


Figure 1. Postoperative complications.

gains would be better, if the duration before surgery is longer.

In recent studies on preoperative rehabilitation, supervised training exercises were performed for 4 to 6 weeks, and these patients showed improved exercise capacity, fewer postoperative complications, shorter hospital stays, and improved quality of life.^[14-20] Additionally, operations may be possible after pulmonary rehabilitation in patients who were inoperable due to the limited exercise capacity.^[21]

Despite the growing awareness of the importance of exercise training in the preoperative period, it is not realistic to include all patients in an exercise training in the clinical setting. Physiotherapists in the thoracic surgery department should, therefore, develop exercise prescriptions which are simple and cost-effective, and which are arranged according to the needs of the individuals considering its clinical benefits. In our study, before the protocol was developed, it was not possible to apply postoperative interventions to all patients for various reasons in our department of thoracic surgery. When patients were referred to other departments for screening, the physiotherapist was unable to visit them in the wards or practice any techniques. In addition, some patients were unwilling to do any exercises, in particular due to pain, on the first postoperative day. Therefore,

this type of preoperative protocol may have several advantages for thoracic surgery departments with many patients and that do not have a physiotherapist on staff all day.

Consistent with the literature, the postoperative pulmonary complication rates were 9% and 10% in the protocol and control groups, respectively in our study. The most common postoperative complications following thoracic surgery are atelectasis, pneumonia, prolonged air leak, pleural effusion, hemothorax, and requirement for prolonged mechanical ventilation.^[23-25] Although pneumonia is one of the most common postoperative complications after lung surgery, none of our patients experienced pneumonia.

On the other hand, the evidence for implementing physiotherapy treatment for patients prior to thoracic surgery is limited. The optimal exercise prescription for patients undergoing lung surgery has not been clearly established, yet.^[25] Pursed-lip breathing, diaphragmatic breathing, ambulation, progressive shoulder and thoracic cage mobility programs, walking exercises, incentive spirometry, coughing, and huffing are common physiotherapy techniques.^[8,13] In the present study, we prescribed our protocol compatible with the literature, emphasizing the educational content about the reduction of shoulder range of motion and coughing due to the incisional pain following surgery,

Table 3. Correlation analysis results

	Length of hospital stay	Postoperative complication rate
The number of days between the date of education and operation	-0.547**	-0.348*

Spearman's Correlation Analysis, * p<0.05; ** p<0.01.

as well as the importance of early mobilization and extremity exercises in bed to prevent thromboembolic events and to improve functional recovery.

Nonetheless, this retrospective study has some limitations. First, we were unable to evaluate the lung function, pain, exercise capacity, shoulder range motion, or the quality of life and long-term outcomes of our patients. To provide group homogeneity, we chose lobectomy and pneumonectomy operations, which cause more lung impairment and postoperative complications. Second, we were unable to perform a subgroup analysis of the video-assisted thoracoscopic surgery operations due to our small sample size. Finally, we calculated the number of days between the date of education and operation rather than asking the patients' own exercise diaries. It is likely that the patients did not practice their exercises every day before surgery.

Although we educated all patients with high and low risks for postoperative pulmonary complications with the same protocol, we believe that certain patients with low exercise capacity and high risk of postoperative complications may need supervised exercise programs consisting of aerobic and progressive resistance training for 4 to 6 weeks, and they should be directed to a rehabilitation unit before the surgery. According to our clinical observations, this protocol increased our patients' motivation, courage, understanding, and compliance with the postoperative treatment. All started to their exercises, until we visited them on the ward following surgery.

In conclusion, based on our study results, preoperative physiotherapy education should begin as early as possible before surgery in patients undergoing lung surgery to reduce the length of hospital stay and to prevent postoperative complications.

Declaration of conflicting interests

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REFERENCES

1. García-Miguel FJ, Serrano-Aguilar PG, López-Bastida J. Preoperative assessment. *Lancet* 2003;362:1749-57.
2. Lawrence VA, Cornell JE, Smetana GW. Strategies to reduce postoperative pulmonary complications after noncardiothoracic surgery: systematic review for the American College of Physicians. *Ann Intern Med* 2006;144:596-608.
3. Fisher BW, Majumdar SR, McAlister FA. Predicting pulmonary complications after nonthoracic surgery: a systematic review of blinded studies. *Am J Med* 2002;112:219-25.
4. Nakahara K, Ohno K, Hashimoto J, Miyoshi S, Maeda H, Matsumura A, et al. Prediction of postoperative respiratory failure in patients undergoing lung resection for lung cancer. *Ann Thorac Surg* 1988;46:549-52.
5. Massard G, Wihlm JM. Postoperative atelectasis. *Chest Surg Clin N Am* 1998;8:503-28.
6. Varela G, Brunelli A, Rocco G, Novoa N, Refai M, Jiménez MF, et al. Measured FEV1 in the first postoperative day, and not ppoFEV1, is the best predictor of cardio-respiratory morbidity after lung resection. *Eur J Cardiothorac Surg* 2007;31:518-21.
7. Hough A. *Physiotherapy in respiratory care*. 3th ed. Salisburn: Nelson Thornes; 2001.
8. Cavalheri V, Jenkins S, Hill K. Physiotherapy practice patterns for patients undergoing surgery for lung cancer: a survey of hospitals in Australia and New Zealand. *Intern Med J* 2013;43:394-401.
9. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *Br J Anaesth* 1997;78:606-17.
10. Kisner C, Colby LA. *Therapeutic exercise*. 5th ed. Philadelphia: F.A. Davis; 2007.
11. Brunelli A, Charloux A, Bolliger CT, Rocco G, Sculier JP, Varela G, et al. ERS/ESTS clinical guidelines on fitness for radical therapy in lung cancer patients (surgery and chemo-radiotherapy). *Eur Respir J* 2009;34:17-41.
12. Denehy L. Physiotherapy and thoracic surgery: thinking beyond usual practice. *Physiother Res Int* 2008;13:69-74.
13. Sekine Y, Chiyo M, Iwata T, Yasufuku K, Furukawa S, Amada Y, et al. Perioperative rehabilitation and physiotherapy for lung cancer patients with chronic obstructive pulmonary disease. *J Thorac Cardiovasc Surg* 2005;53:237-43.
14. Morano MT, Araújo AS, Nascimento FB, da Silva GF, Mesquita R, Pinto JS, et al. Preoperative pulmonary rehabilitation versus chest physical therapy in patients undergoing lung cancer resection: a pilot randomized controlled trial. *Arch Phys Med Rehabil* 2013;94:53-8.
15. Morano MT, Mesquita R, Da Silva GP, Araújo AS, Pinto JM, Neto AG, et al. Comparison of the effects of pulmonary rehabilitation with chest physical therapy on the levels of fibrinogen and albumin in patients with lung cancer awaiting lung resection: a randomized clinical trial. *BMC Pulm Med* 2014;14:121.
16. Mujovic N, Mujovic N, Subotic D, Marinkovic M, Milovanovic A, Stojic J, et al. Preoperative pulmonary rehabilitation in patients with non-small cell lung cancer and chronic obstructive pulmonary disease. *Arch Med Sci* 2014;10:68-75.
17. Benzo R, Wigle D, Novotny P, Wetzstein M, Nichols F, Shen RK, et al. Preoperative pulmonary rehabilitation before lung cancer resection: results from two randomized studies. *Lung Cancer* 2011;74:441-5.
18. Bobbio A, Chetta A, Ampollini L, Primomo GL, Internullo E, Carbognani P, et al. Preoperative pulmonary rehabilitation in patients undergoing lung resection for non-small cell lung cancer. *Eur J Cardiothorac Surg* 2008;33:95-8.

19. Cesario A, Ferri L, Galetta D, Cardaci V, Biscione G, Pasqua F, et al. Pre-operative pulmonary rehabilitation and surgery for lung cancer. *Lung Cancer* 2007;57:118-9.
20. Myrdal G, Lambe M, Hillerdal G, Lamberg K, Agustsson T, Ståhle E. Effect of delays on prognosis in patients with non-small cell lung cancer. *Thorax* 2004;59:45-9.
21. Divisi D, Di Francesco C, Di Leonardo G, Crisci R. Preoperative pulmonary rehabilitation in patients with lung cancer and chronic obstructive pulmonary disease. *Eur J Cardiothorac Surg* 2013;43:293-6.
22. Ercegovic M, Subotic D, Zugic V, Jakovic R, Moskovljevic D, Bascarevic S, et al. Postoperative complications do not influence the pattern of early lung function recovery after lung resection for lung cancer in patients at risk. *J Cardiothorac Surg* 2014;9:92.
23. Imamoglu OU, Dogusoy I, Okay T, Yıldırım M, Yasaroglu M, Aydemir B. Noncardiac complications after thoracotomy. *Turk Gogus Kalp Dama* 2000;8:785-8.
24. Stéphan F, Boucheseiche S, Hollande J, Flahault A, Cheffi A, Bazelly B, et al. Pulmonary complications following lung resection: a comprehensive analysis of incidence and possible risk factors. *Chest* 2000;118:1263-70.
25. Ambrosino N, Gabbrielli L. Physiotherapy in the perioperative period. *Best Pract Res Clin Anaesthesiol* 2010;24:283-9.