Araştırma Makalesi
Research Article

Impact of respiratory rehabilitation on anxiety and depression in post-operative lung cancer patients

POSTOPERATİF AKCİĞER KANSERLİ HASTALARDA SOLUNUM REHABİLİTASYONUNUN ANKSİYETE VE DEPRESYON ÜZERİNE ETKİLERİ

Hakan ÇELİKHİSAR[1], GÜLAY İLKHAN DAŞDEMİR[2]

[1]İBB Eşrefpaşa Hastanesi, Göğüs Hastalıkları, İzmir,
[2]Tire Devlet Hastanesi, Göğüs Hastalıkları, Izmir,

ABSTRACT

Introduction: Whether respiratory rehabilitation is beneficial for patients, who have undergone lung resection due to cancer, is still under debate. We investigated the impact of respiratory rehabilitation on the quality of life, and anxiety and depression levels of patients.

Method: Patients, to whom respiratory rehabilitation was recommended after lung resection, were assessed with the 6-minute Walk Test (6MWT), Visual Analog Pain Scale (VAS), Quality of Life Questionnaire (EORTC QLQ C30) and Hospital Anxiety and Depression Scale (HADS) on date of first admission and date of discharge. These questionnaires were repeated 6 months after respiratory rehabilitation ended.

Results: 186 patients applying to the physiotherapy unit after lung resection were included in the study. 78 (42%) of these patients received respiratory rehabilitation services and the assessment questionnaires were repeated with these patients 6 months after discharge. During respiratory rehabilitation the average quality of life score increased from 55.4 to 67.9 ($p<0.05$), the average anxiety score dropped from 5 to 3 and the average depression score from 3.5 to 2.5 ($p<0.05$). 6 months after discharge, the average quality of life score remained stable at 66.9 ($p=0.8$), the average anxiety score increased to 5.5 ($p<0.05$) and the average depression score to 5 ($p<0.05$).

Conclusion: This observational study carried out during respiratory rehabilitation has shown that after treatment there is an improvement in the quality of life, and anxiety and depression levels of patients. It was observed that after discharge, the quality of life score of patients remained stable, whereas anxiety and depression levels deteriorated.

Keywords: Lung cancer, pulmonary resection, respiratory rehabilitation, quality of life

Hakan ÇELİKHİSAR
İBB Eşrefpaşa Hastanesi, Göğüs Hastalıkları, İzmir, Türkiye
E-posta: hcelikhisar@gmail.com
https://orcid.org/0000-0002-0109-3208

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ÖZ

Amaç: Kanser nedeniyle akciğer rezeksiyonu uygulanan hastalar için solunum rehabilitasyonunun faydalı olup olmadığı tartışmalı bir konudur. Solunum rehabilitasyonunun hastaların yaşam kalitesi ile anksiyete ve depresyon düzeyi üzerindeki etkilerini araştırdık.

Gereç ve Yöntem: 2017 ve 2019 yılları arasında akciğer rezeksiyonu sonrası solunum rehabilitasyonu önerilen hastalara, hastaneye ilk girişleri ve taburcu oldukları zaman dilimlerinde, 6 dakika yürüme testi (6DYT), Görsel Analog Ağrı Ölçeği (VAS), Yaşam Kalitesi Anketi (EORTC QLQ C30) ve Anksiyete ve Depresyon Ölçeği (HAD) ile değerlendirildi. Bu anketler, solunum rehabilitasyonunun bitiminden 6 ay sonra tekrarlandı.

Bulgular: Akciğer rezeksiyonu uygulanıp fizik tedavi ünitesine başvuran 186 hasta çalışmaya dahil edildi. Bu hastalardan 78'i (%42) solunum rehabilitasyonu hizmeti aldı ve bu hastalara taburcu olduktan 6 ay sonra değerlendirme anketleri tekrar yapıldı. Solunum rehabilitasyonu sırasında, ortalama yaşam kalitesi skoru 55,4'ten 67,9'a ($p < 0,05$) yükselirken, ortalama anksiyete skoru 5'ten 3'e ($p < 0,05$) ve ortalama depresyon skoru ise 3,5'ten 2,5'e düştü ($p < 0.05$). Taburcu edildiklerinden 6 ay sonra ise, ortalama yaşam kalitesi skoru 66.9'da stabil kalırken ($p = 0.8$), ortalama anksiyete skoru yeniden yükselerek 5,5'e çıktı ($p < 0.05$) ve ortalama depresyon skoru ise 5'e yükseldi ($p < 0.05$).

Sonuç: Solunum rehabilitasyonu sırasında yapılan bu gözlemsel çalışma, tedavi sonunda hastaların yaşam kalitesi ile anksiyete ve depresyon düzeylerinde iyileşme olduğunu göstermiştir. Hastaların, taburcu olup eve döndükten sonra yaşam kalitesi skoru stabil kalırken, anksiyete ve depresyon düzeylerinde kötüleşme olduğu saptanmıştır.

Anahtar Kelimeler: Akciğer kanseri, pulmoner rezeksiyon, solunum rehabilitasyonu, yaşam kalitesi

Lung cancer is on the rise due to the increase in smoking, environmental pollution brought about by industrialization and the aging of the world population (1). In women, it is the fifth most common type of cancer after breast, thyroid, colorectal and uterine malignancies, and ranks first with 19.4% of cancer-related deaths in the world (2-3). Surgical resection is the most radical treatment at the appropriate stage in the treatment of lung cancer, but chemotherapy and radiotherapy appear as treatment options in advanced stages of the disease (4). In cases where the general performances of the patients are not suitable for these treatment methods, the methods that come to the fore and become popular in recent years are respiratory physiotherapy and palliative care (5).

Pulmonary resection, when applicable, is a preferred treatment for thoracic tumours. Additionally, this surgical procedure is related to thoracic trauma, which has significant impact on the respiratory function (4-5). Although surgical resection results in higher survival rates, it is correlated to significant morbidity, functional restrictions and low quality of life (3). All of these factors cause a significant decrease in the quality of life, which has serious effects on wellbeing. (4-6). The pulmonary rehabilitation program was created by evaluating the patient in detail; not limited to exercise, education and life change; It is a comprehensive treatment approach that aims to improve the physical and emotional state of patients with chronic diseases and to ensure the continuation of gains in the long term. It has been proven that pulmonary rehabilitation improves the quality of life exercise capacity and dyspnea perception and it is recommended as one of the non-pharmacological treatment methods (6-7). The aim of respiratory rehabilitation is to reduce symptoms, preserve long-term respiratory functions and prevent decline in lung function, increase exercise capacity, reduce

complications, and maintain and improve quality of life. There are very contradictory views on the use of post-operative respiratory rehabilitation in patients, who have undergone lung resections due to cancer. Although its efficiency on physical parameters is proven, its impact on the quality of life is not yet clearly determined (8-11). There are different opinions about the effectiveness of respiratory rehabilitation in patients who have undergone lung resection surgery. Studies that increase pulmonary functions and capacity are scientifically supported, but the effect of respiratory rehabilitation on quality of life is controversial. (12-13). The purpose of our study is to assess the quality of life, as well as, levels of anxiety and depression during and after RR.

METHODS

We have carried out a prospective observational study on patients admitted to the chest diseases Department of Okmeydanı Training and Research Hospital and Esrefpasa Metropolitan Municipality Hospital between January 2017 and December 2019. Demographic, clinical and surgical data were collected prospectively and a surgical approach was offered to all patients (thoracotomy or videothoracoscopy). Perioperative pain management includes the administration of epidural anaesthesia (naropein), mostly in combination with paracetamol, tramadol and morphine. It was ensured that level I (paracetamol) and level II (tramadol) analgesics as defined by the World Health Organization, which are partly associated with a specific neuropathic pain treatment (gabapentin or pregabalin) were administrated orally.

All patients included in the study signed informed consent forms. Six months after being discharged from our institution, for each patient, Quality of Life Questionnaire and Hospital Anxiety and Depression Scale (HADS) were repeated by phone/mail. During the first 2 weeks, a basic spirometry test, capillary arterial blood gas analysis and 6-minute walk test were performed on all patients, and the patients completed the quality of life questionnaire and the HAD scale assessing their levels of anxiety and depression (14). Before exercise, the patients underwent an incremental functional exercising test on the cycle-ergometer. On the last week of treatment, spirometry test, capillary arterial blood gas analysis and 6-minute walk test were performed once more, and the patients were again asked to complete the quality of life questionnaire and the HAD scale. Six months after being discharged, Quality of Life Questionnaire and Hospital Anxiety and Depression Scale were repeated by phone/mail.

In this patient group, the methodology recommended for the assessment of pulmonary function included the 6-minute walk test and functional exercising test (15-17). The team providing the respiratory rehabilitation (RR) in question, consisted of a pulmonologist, physiotherapists, nurses, dieticians and a psychologist. Respiratory rehabilitation schedule, consisted of an exercise schedule (cycle-ergometer or treadmill), relaxation sessions, respiratory physiotherapy, massaging the scapulohumeral region operated, strengthening the upper muscles and gymnastic sessions. Nutrition recommendations were given after medical consultation. Exercise sessions were planned in accordance with the doctor's opinion, at an intensity corresponding to the ventilation threshold, 5 to 7 times a week -if that is not feasible - in a manner that will correspond to 50% of the maximum load observed during functional exercise. Sessions were carried out under the provision of a physiotherapist and lasted 20-40 minutes, depending on the patient. The program load (Watt) was re-evaluated each week based on heart frequency. Exercise sessions generally started two weeks later and continued for the 3-week portion of the 4-week process. The 2-week time limit was a pragmatic approach based on the clinical reflections on tissue healing, allowing safety while putting pressure on the surgery wound during exercise.

Regarding pain, Visual Analog Pain Scale (VAS) was carried out every day for the first 3 days, one week later every other day and after that twice a week until discharge. It was ensured that the attending physician of the patient was involved when any value is equal to or greater than 4/10. Quality of life was assessed using a specific 30-item questionnaire, EORTC QLQ-C30 (version 3.0) (18). EORTC QLQ-C30 included five functional scales (physical capacity, role capacity, cognitive state, emotional state and social functionality), three multiple-symptom scales (fatigue, pain, nausea-vomiting) and a single simple scale for

assessing overall wellbeing and quality of life. Other questions were related to the symptoms commonly reported by cancer patients (shortness of breath, lack of appetite, insomnia, constipation and diarrhoea), and the financial impact of the disease. The answer categories for the majority of the questions provided four levels ranging from "not at all" and "very much". The answer categories for overall wellbeing and quality of life provided seven levels ranging from the option "very poor" to "excellent". Specific module questionnaire (EORTC QLQ-LC13) is designed especially for lung cancer patients, and the side effects of chemotherapy and radiotherapy.

HAD scale is a questionnaire used for screening anxiety and depressive disorders and includes 14 questions rated between 0 and 3 (19). Seven questions are related to anxiety (total A) and the other seven questions are about the depressive dimension (total D); providing two different scores. (Maximum points for each score = 21). The following interpretation may be suggested for each score (A and D), in order to screen the anxiety-related and depressive symptoms. 7 or less = no symptoms, 8 to 10 = symptoms suspected, 11 or more = definite symptoms. The study has been reviewed and approved by a certified Ethical Committee, including the number of the approval document and the date of the approval. The registration number (Bezmialem University): 2011- KAEK-25 2020/01-02-1965.

Statistical analysis

Firstly, a definitive analysis was performed on the study population and the parameters studied. The comparison of demographic characteristics between the group of patients completing the questionnaire and the patients not completing the questionnaire was carried out with the Chi-Square Test, and the Non-Small-Cell Lung Carcinoma (NSCLC) stages were compared using the Fisher's Exact Probability Test. The parameters related to the period before RR, after RR and 6 months after RR were compared in accordance with the Wilcoxon matched pairs (Wilcoxon Signed Rank Test) using a common non-parametric comparison test. The relation between the dichotomous variables- namely anxiety and depression - and chemotherapy, was studied using the Fisher's exact probability test. The comparison of HAD score grades (<8, 8-10,> 10) at different periods of time was carried out with the Bhapkar test. All tests were bilateral with a significance level of 5%. Statistical analysis was carried out with the software Statistical Package for Social Sciences version 11.0 (SPSS, Carry, USA).

Results

198 patients, on whom thoracotomy or videothoracoscopy was performed because of lobectomy, pneumectomy or bilobectomy operations due to tumour resection between January 2017 to December 2019, were evaluated for the study. 186 of the patients agreed to take part in the study. 6-month assessment questionnaires were received from 78 (42%) of these patients. The comparison of lung cancer demographic data and TNM classification between patients completing the questionnaire and the patients who discontinued the study during the follow-up phase, did not reveal any differences. (Table 1).

Table 1. Characteristics of the Patients.

Number of patients (n:178)	**Patients Discontinued During Follow-up (n: 108)**	**Patients Followed-up (n: 78)**	**p**
Demographic characteristics			
Sex Ratio	2.4 (77 M/31F)	1.7 (50M/28F)	
Age (years)	64 (58-74)	66 (60-72)	NS
Body Mass Index (kg/m2)	22 (20-27)	23 (21-26)	
Hospital stay (average number of days)	27 (18-31)	26 (22-28)	NS
FEV1 Pre-op (expected %)	87 (74-104)	83 (72-100)	
***TNM classification	n (%)	n (%)	NS
Stage I	44/97 (46)	40/70 (58)	
Stage II	23/97 (23)	13/70 (18)	
Stage IIIA	18/97 (19)	14/70 (20)	
Stage IIIB	7/97 (7)	3/70 (4)	
Stage IV	5/97 (5)	0	
Histology	n (%)	n (%)	NS
**NSCLC	97 (89)	70 (89)	
***Others	11 (11)	8 (11)	

NS: not statistically significant; M: Male, F: Female.
*T: tumour; N: node=lymph node; M: metastasis, TNM classification 2017.
** Non-Small-Cell Lung Carcinoma.
*** Others: metastases (count = 17), small cell carcinoma (count = 2).

The average time between the day these 78 patients had undergone a surgical intervention and the date they applied to our institution is 9±3.7 days. 72 patients underwent thoracotomy and 6 videothoracoscopy. All patients were offered respiratory rehabilitation (RR). (Fundamental characteristics of these 78 patients are provided in Table 1). 73 patients underwent a functional exercising test and the remaining 5 underwent an exercise electrocardiogram. Functional exercising averages and the standard deviations are as follows: at 1 2.1, (± 2.3) VO2 peak (mL / kg / minute), maximum load supported at 60.6 watt (± 25.2).

Average hospital stay duration of the patients was 26±3.8 days. The average for the completed sessions was recorded as 14±6.8. Significant improvements were observed with regard to the levels of pain, pulmonary function and the 6-minute walk test from admission to discharge. (Table 2).

Table 2. The change in functional parameters between the start and end of the respiratory rehabilitation provided by the institution

	Start	**End**	**p**
Pain (n:75)			
*VAS (millimetres)	3 (2-4)	1 (1-2)	< 0.0001
Spirometry (n:70)			
FVC (expected%)	70 (62-79)	78 (72-91)	< 0.0001
FEV1 (expected%)	62 (51-68)	67 (57-76)	< 0.0001
6MWT (n:71)			
Distance (meters)	374 (303-438)	472 (432-532)	< 0.0001
Arterial Blood Gas (ABG) (n:70)			
PO2 (mmHg)	68 (65-76)	73 (66-79)	NS
PCO2 (mmHg)	37 (34-38)	35 (32-38)	NS

*VAS: Visual Analog Pain Scale; FVC: Forced vital capacity; FEV1: Forced Expiration Volume per second; 6MWT: 6-minute walk test: ABG: arterial blood gas NS: not statistically significant

70 patients completed the questionnaires, QLQ-C30 (version 3.0) and QLQ-LC13 at the start, end and 6-months after discharge. Overall wellbeing, all functional scales and several symptom scales (fatigue, pain, lack of appetite, cough) have shown improvement between the

start and end of RR. Overall wellbeing remained stable from the end of RR to the date corresponding to 6-months after discharge, however, a deterioration in the emotional state, and shortness of breath, diarrhoea, pain (outside the region of operation) and peripheral neuropathy were noted. (Table 3).

Table 3 a. Quality of life: The changes observed between the start and end of respiratory rehabilitation and from the date rehabilitation ended to the date corresponding to 6 months after discharge

n:70 **QUALITY OF LIFE QUESTIONNAIRE**	**Start Average (standard deviation)**	**End Average (standard deviation)**	**P1**	**6 months later Average (standard deviation)**	**P2**
Overall Wellbeing	55.4 (±21)	67.9 (± 16)	< 0.0001	66.9 (± 22)	NS
Functional scales					
Physical capacity	71.8 (± 23)	81.3 (± 18)	0.0031	81.5 (± 19)	NS
Role capacity	65.9 (±31)	77.4 (± 23)	0.0005	79.6 (± 22)	NS
Emotional State	77.2 (± 24)	84.9 (± 21)	< 0.0001	76.8 (± 27)	< 0.0001
Cognitive State	82.6 (± 21)	87.3 (± 18)	< 0.0001	83.3 (± 22)	NS
Social functionality	73.8 (±30)	86.8 (± 20)	0.0006	83.3 (± 27)	NS
Symptom Scales					
Fatigue	45.8 (±31)	29.7 (± 24)	< 0.0001	33.6 (± 26)	NS
Nausea	10.9 (±20)	5.9 (± 19)	NS	5.1 (± 12)	NS
Pain	36.1 (± 31)	20.4 (± 18)	< 0.0001	21.5 (± 22)	NS
Shortness of Breath	39.8 (±32)	31.8 (± 23)	NS	41.2 (± 31)	0.031
Insomnia	32.3 (± 34)	26.6 (± 28)	NS	33.4 (± 32)	NS
Lack of Appetite	31.8 (± 36)	24.1 (± 33)	0.041	19.2 (± 31)	NS
Constipation	31.8 (± 34)	20.9 (± 32)	0.040	16.7 (± 25)	NS
Diarrhoea	7.5 (± 21)	1.8 (± 11)	NS	9.3 (± 18)	0.023
Financial Challenges	9.7 (±21)	6.7 (± 14)	NS	8.1 (± 16)	NS

Table 3 b. (continued)

Symptom Scales	Start Average (standarddeviation)	End Average (standarddeviation)	P1	6 months later Average (standard deviation)	P2
Shortness of breath at rest	15.3 (± 22)	9.1 (± 17)	0.007	12.9 (± 20)	NS
Shortness of breath during exercise	28.6 (± 25)	26.9 (± 22)	NS	33.2 (± 26)	0.01
Cough	31.1 (± 23)	21.9 (± 25)	< 0.05	23.8 (± 26)	NS
Haemoptysis	1.8 (± 11)	0.5 (± 6)	NS	0.0 (± 0)	NS
Dry mouth	1.9 (± 7)	1.8 (± 10)	NS	4.7 (± 15)	NS
Dysphagia	8.3 (± 17)	3.2 (± 12)	NS	7.0 (± 16)	NS
Peripheral neuropathy	3.7 (± 14)	4.3 (± 12)	NS	16.9 (± 26)	0.0005
Alopecia	3.7 (± 16)	3.8 (± 15)	NS	8.9 (± 21)	NS
Chest pain	22.6 (± 28)	16.1 (± 21)	< 0.04	15.1 (± 16)	NS
Arm or shoulder pain	20.7 (±24)	20.1 (± 27)	NS	22.7 (± 31)	NS
Pain at other regions	13.1 (± 26)	14.2 (± 22)	NS	22.1 (± 32)	0.03

p1: difference between the start and end of rehabilitation; p2: difference between the end of rehabilitation and 6 months after discharge; NS: not statistically significant; QOL: quality of life. For various scales, scores are between 0 to 100. An overall wellbeing quality of life score closer to 100 indicates an excellent level of quality of life. Likewise, a functional scale score closer to 100 indicates a close-to-excellent level of functioning. In contrary, a score closer to 100 on a symptom scale points to a critical problem or symptom.

68 patients completed the HAD (anxiety and depression scale) questionnaire at the beginning and end of RR, and 6 months after discharge. The average anxiety and depression levels significantly decreased at the start and end of SR; however, they showed an increase within the 6-month period following discharge (Table 4). The increase in the anxiety and depression scores of the patients 6 months after discharge was not related to chemotherapy: a deterioration was observed in the anxiety scores of 75% of the patients receiving chemotherapy, and 70% of the patients not receiving chemotherapy. Additionally, a deterioration was observed in the depression scores of 68% of the patients receiving chemotherapy, and 63% of the patients not receiving chemotherapy. ($p = 0.35$)

The number of patients with an anxiety or depression score below 8 did not show any changes between the start and end of treatment, however, this number decreased significantly 6 months after discharge. (Table 4).

Table 4. Anxiety and depression level: The changes observed between the start and end of respiratory rehabilitation and from the date rehabilitation ended to the date corresponding to 6 months after discharge

Number of patients (n:68)	Start	End	p1	6 months	p2
HADS Anxiety score (A)					
A<8	54	56	NS	48	0.012
A > 8 and < 10	4	7		8	
A>10	10	5		12	
Depression Score (D)					
Number of patients					
D<8	58	61	NS	50	0.012
D> 8 and < 10	4	2		7	
D>10	6	5		11	
Average Anxiety	5.0 (2-7)	3.0 (1-7)	0.0041	5.5 (3-9)	< 0.0001
Average depression	3.5 (1-5)	2.5 (1-4)	0.011	5.0 (2-8)	< 0.0001
Patients with both A and D < 8	52	56		44	

p1: difference between the start and end of rehabilitation; p2: difference between the end of rehabilitation and 6 months after discharge; HADS: Hospital Anxiety and Depression Scale; NS: Not statistically significant; HAD Score: If the score is lower than 8, no symptoms; if the score is between 8-10 Suspected Anxiety or Depression Symptoms; if the score is above 10, definite anxiety or depression symptom.

DISCUSSION

This observational study carried out during respiratory rehabilitation has shown that an improvement is observed in the quality of life, and anxiety and depression levels of patients at the end of treatment.

Thoracotomy has a great influence on both pulmonary function and quality of life (1). Right after surgical intervention, FEV1 and vital capacity decrease immediately and these are automatically recovered 1 month after thoracotomy (pulmonary resection) (1,2).

The improvement observed in our investigations on FEV1 and vital capacity, definitely resulted from this automatic recovery. Furthermore, two other studies carried out right after surgery (less than 2 weeks after surgery) had the same finding (9,10). However, in contrary, all studies on respiratory rehabilitation (RR) programs offered after surgical intervention (3 weeks to 3 months later) did not cause any improvement in the respiratory function (11).In two randomized trials (comparison between two groups with and without RR), the improvement in the 6-minute walk test is very significant (11,12). In the study carried out by Stigt, as a decrease was observed in the distance travelled by the control group, this improvement is even more significant (13).

This improvement determined with the walk test has allowed us to differentiate studies providing a real respiratory rehabilitation programs from other studies suggesting an indefinite increase in exercise. Thus, in Arbane study, where no differences were observed between the muscle strengthening group and the group without muscle strengthening, no effort tests were carried out, the use of cycle-ergometer was not made clear and the number of total exercise sessions were unknown (14). Undergoing lung resection due to cancer causes a significant deterioration on the quality of life of the patients operated (14,17). Right after surgical intervention, the quality of life decreases, and although it is not possible to recover it to the value pre-operation, it shows incremental increase from 6 months to one year (13,14). It is debated whether respiratory rehabilitation (RR) program has an effect on this increase in the quality of life. A previous randomized study carried out on only 15 patients has shown that the benefits are observed on quality of life in

just 3 months in the group with RR (14). However, in the randomized study carried out by Stigt on 57 patients did not show any differences between the group with RR and without RR within the 12-month period, in terms of quality of life (15).

With this study, we can confirm that RR significantly increases the quality of life of patients receiving RR. It is remarkable that this improvement was achieved in only 1 month, dissimilar to the studies, where improvement is obtained at months 3 to 6. In our study, it was shown that six months after discharge, generally, the quality of life is maintained. In this period, wellbeing, physical capacity, role capacity, cognitive state and social functionality were maintained without any deterioration.

Among functional scales, only "emotional state" deteriorated significantly. Regarding symptoms, after 6 months chemotherapy-related symptoms (peripheral neuropathy and diarrhoea) were observed, in addition to shortness of breath and intensified pain that are unrelated to the surgical scar were observed. This was also reported in previous studies. In the study carried out by Handy, it was noted that shortness of breath deteriorated 6 months following surgery (17). In the studies of Sarna and Schulte, same was observed after 2 to 5 years (18,19). The shortness of breath problem in question starts abruptly and is persistent. The most common factor known is concomitant chronic obstructive pulmonary disease (COPD) (20-22).

Even if shortness of breath is moderate before surgery, it will undoubtedly worsen with major lung resection. Diffusion Capacity (DLCO) being lower than 45% is correlated to shortness of breath after surgery in a more specific context (22). It can be said that the increase in the level of pain intensity outside the region of surgery is caused by potential chemotherapy. As pain has a multi-dimensional characteristic, cancer's heavy and dominant nature lowers the pain detection threshold of these patients. Unlike Stigt's study, we did not observe any deterioration in pain during RR, on the contrary, both the assessment performed with Visual Analog Pain Scale (VAS) and the quality of life questionnaire, we identified significant improvement in pain levels (13).

Finally, during RR and 6 months after discharge, we examined the anxiety and depression levels of our patients with the hospital anxiety and depression (HAD) scale. It was surprising to see that the change in these two levels (anxiety and depression) was not parallel with the level of "overall wellbeing" portion of the quality of life score. However, the change in these anxiety and depression levels followed the same trend with "emotional state" portion of the quality of life score. Therefore, we noticed that these two levels improved during RR but significantly deteriorated 6 months after discharge. The most significant change was the deterioration of the levels of anxiety and depression within the 6-month period following discharge. Indeed, the number of patients with an anxiety or depression score over 7 increased significantly.

However, the anxiety and depression scores assessed with the HAD scale were surprisingly low in this population, without regard to how and when these were assessed. In our study, the average score for anxiety varies from 3 to 5.5 and for depression from 2.5 to 5. This finding was previously noted. For example; in Myrdal's study, on average, HAD test was performed 23 months after the lung cancer surgery. The average anxiety score was 4.96 and depression score was 4.02 (21). We were actually expecting higher scores, and accordingly, higher levels of anxiety and depression. Myrdal argued that the patients not responding to the questionnaires sent by mail in their study were the ones who were most affected and who experienced the most complications. (21). In our study, this did not seem to be the case, as the patients not responding to the questionnaires were not significantly different than the ones completing the questionnaires in terms of non-small-cell lung carcinoma (NSCLC) classification. In the meantime, we analysed whether the deterioration in anxiety and depression levels were related to chemotherapy in the 6-month period following discharge, however no such effect was observed. This increase in the scores of depression and anxiety was observed in almost all of the patients. The low effect of the first chemotherapy sessions on the quality of life were already shown (22). The temporary improvement during RR could have been caused by the psychological management of our institution. As a matter of fact, the majority of patients receiving cancer treatment, after receiving consent, benefit from the psychological consultancy services provided, if deemed necessary by the psychologist. Additionally, it is for the benefit of the

patients in many aspects that they are receiving respiratory rehabilitation under the supervision of an institution. First of all, they no longer need to deal with their daily responsibilities. Additionally, as it is not allowed for the relatives to accompany the patient at all times, the patient is provided with an environment that will allow them to focus on themselves. This significant deterioration in their emotional state makes it necessary for us to provide specialized care to our unstable patients, also after discharge.

In this observational study, 42% of the relative patients completed their 6-month questionnaire. Additionally, it should be noted that these patients are probably the most motivated ones. In fact, it cannot be said that our study is based on the broadest data that can be obtained. For example, we did not have any functional respiration data, and again, we also did not have any information on the level of anxiety, depression, and the quality of life before surgery. Similarly, we had not reviewed the psychotropic medicine use of our patients, and we cannot tell whether psychological management decreases the use of medication. Most importantly, our study was not randomized, meaning, we cannot officially conclude that RR is superior to conventional treatment.

Thoracotomy, a procedure performed for major pulmonary resection, is an important cause of morbidity and mortality. (23). It is interesting that peri-operative respiratory rehabilitation decreases this rate. RR provided prior to surgery is directed at mitigating complications that may be observed after the surgery, especially in fragile patients. The purpose of post-operative respiratory rehabilitation is to accelerate recovery and to make the patient autonomous as quickly as possible. (23).

Finally, the increasing use of videothoracoscopy in major pulmonary resections constitutes real progress, as it mitigates the post-operative complications and most importantly, pain. (24). In conclusion, RR provided right after surgery makes it possible to improve the quality of life rapidly and sustainably. However, the improvement in the emotional state, more precisely anxiety and depression, is temporary. Nevertheless, it will be possible to identify the unstable patients with the in-patient treatment to be provided at the hospital, thus it may be possible to consider providing care to these patients at their homes after discharge. The physicians of the relative fields should consider directing the patients with to an exercise program following lung resection. More research is required for verifying the effectiveness of exercise in post-operative lung cancer patients and whether the effects will be maintained after the period of active intervention.

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Author contributions

CH: Literature search and analysis, design and concept of the article, case collection, data gathering and workflow planning, forming the general lines and framework of the study, regulation of the presentation of the information and data in the article. DGI: Processing, preparation and writing of the collected information, critically and intellectually evaluating the content of the article, analysis of the content of the article, evaluating the accuracy of the data, Statistical evaluation of the article data and the arrangement and interpretation of these data.

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