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Original Article

The Gains Related to Pulmonary Rehabilitation will Continue in the First Month Following Rehabilitation or not?

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ABSTRACT

Objective: Patients with chronic obstructive pulmonary disease (COPD) admitted to the pulmonary rehabilitation (PR) program may lose their post-PR gains over time. In this study, we aimed to investigate whether the gains after PR continued in the first month following PR.

Methods: Patients with COPD who completed the PR program were evaluated retrospectively. The incremental shuttle walking test (ISWT) was used to measure the exercise capacity. In PR, patients were trained in strengthening exercises, cycling, walking band, and respiratory exercises in the presence of physiotherapist 2 days a week for a total of 8 weeks. After PR, patients were asked to record their exercise status each day into an exercise log.

Results: A total of 35 patients with COPD (mean age 64±8 years) participated in the study. There was a significant increase in the exercise capacity at the ISWT before and after PR (0.001) and the first month after the PR (p=0.001). In the St. George's Respiratory Questionnaire, a significant improvement was observed before and after PR and at the first-month follow-up (p<0.05).

Conclusion: An increased exercise capacity and the quality of life provided by PR in COPD patients continue in the early post-PR period, when patients continue to exert with behavioral changes in their daily lives.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is the most widespread respiratory disease in the world. It is expected to become the fifth cause of disability in 2020. In addition to the medical therapy burden and an increasing number of hospital applications, COPD also has a social and economic dimension.[1,2] Pulmonary rehabilitation (PR) is an interdisciplinary program for patients who have restricted daily activities and high dyspnea as a result of the disease. The target of PR is to reach patients' ideal functional capacity and improve dyspnea, thus reducing social isolation and improving the quality of life. In addition to medical therapy, PR is also recommended in patients with COPD.[2–4]

PR is designed as patient tailored programs, depending on each patient's deprivation and needs, including exercises, psychological and social support, and if necessary, nutritional support as well. PR is indicated in cases of chronic respiratory diseases, including COPD, interstitial lung disease, bronchiectasis, and kyphoscoliosis.[5,6] It is important to retain the behavioral changes obtained due to PR, as the benefits may decline over time.[5,6]

In this study, we aimed to investigate whether the gains after PR continued in the first month.

MATERIAL AND METHODS

This retrospective cohort study was conducted in the PR unit of a tertiary training hospital for chest diseases and thoracic surgery between May 2014 and December 2015. The study was in compliance with the Helsinki Declaration and authorized by the ethics committee (protocol code, 046; 05/17/2018). Patients' written consent was obtained.

The COPD diagnosis was established in accordance with the Global Initiative Chronic Obstructive Pulmonary Disease (GOLD) assessment scheme. All patients with COPD were older than 40 years of age and had a smoking

history. In spirometry, the forced expiratory volume in the first minute (FEV_1) was <80% of the estimated value in patients with COPD, and the FEV_1-to-forced vital capacity ratio (FEV_1/FVC) was ≤0.7.[7]

Cardiological evaluation was conducted in all patients before PR.

The PR inclusion criteria were patients with COPD who completed the 8-week PR program and had a month of PR control data recorded.

The PR exclusion criteria were the following: patients with unstable cardiac diseases, cognitive disorders, neurological or orthopedic disorders; patients with other chronic respiratory diseases; patients who did not complete PR or had a short-term PR program prior to thoracic surgery; lung transplantation candidates; patients who could not complete the walking test; and patients whose 1-month control data were missing.

The exercise capacity was evaluated with a field test. The incremental shuttle walking test (ISWT), which is used to measure the sub-maximal exercise capability, was performed in all patients prior and at the end of the PR program.

The ISWT was conducted in accordance with the European Respiratory Society/American Thoracic Society guidelines.[8,9] The test was performed in a corridor, and patients were guided to walk between two cones (the space between the two cones was 10 m) with voice signals that increased at 1-minute periods. The test was terminated if the patient described dyspnea that prevented the walking test to continue, or when the patient was unable to walk between the two cones within the allowed time.[9,10] During the walking test, the heart rate and oxygen saturation were also monitored by two pulse oximeters.

A pulmonary function test (PFT) was performed with ZAN 300 before and after PR.[11,12] Body mass index was calculated with a bioelectrical impedance analyzer (Tanita Body Composition Analyzer, Model TBF-300).

The modified Medical Research Council (mMRC) scale was used to evaluate dyspnea.[13] The COPD assessment test (CAT) was also applied to all patients.[14] The quality of life was assessed by the St. George's Respiratory Questionnaire (SGRQ) that has a total score range from 0 (no impairment) to 100 (maximum impairment).[15,16] Anxiety and depression were evaluated by the Hospital Anxiety and Depression Questionnaire (HADS) score. This questionnaire has 14 items and a total score range 0–21 for either anxiety or depression.[17,18]

The PR was applied 2 days/week by three outpatient physiotherapists. The PR sessions included cycling and treadmill training for 30 minutes, and breathing exercises and upper- and lower-limb strengthening exercises of the extremities.[5,6] Patients received supplementary O_2 if SpO_2 fell under 90%, and patients who were already receiving long-term oxygen therapy (LTOT) at home also received O_2 during the sessions. In addition to the exercise training, the PR also involved energy conservation methods and bronchial clearance techniques. Inhaler medication techniques were controlled for all patients, and their relatives/care givers were informed during the disease-related educational sessions.

After an 8-week PR program, a written home-exercise program diary with exercise figures was given to all patients, and they were invited for the PR follow-up at the end of the first month.

Data collection

Each patient had a PR file that included patients' demographics, comorbidities, clinical and anthropometric data, and the PFTs, ISWT, SGRQ, and HADS that were recorded prior and after PR.

Statistical analysis

The SPSS portable 20.0 package program (IBM Corporation, Armonk, NY, USA) was used for the analysis. The median with an interquartile range was employed for nonparametric continuous variables, and the mean±standard deviation was used for parametric continuous variables. The parametric changes within the groups were analyzed through a t-test. The number and percentage were used where applicable. A p-value <0.05 was accepted as statistically significant.

RESULTS

A total of 35 patients with COPD were included in the study after the exclusion criteria evaluation. There were 29 (83%) men and 6 (17%) women with the mean age 64±8 years. Seven (20%) patients were receiving LTOT, and 4 (11%) noninvasive mechanical ventilation (NIMV). The mean FEV_1% was 49±18. The patients' demographics are shown in Table 1.

The CAT score and the mMRC score significantly improved after the PR program (p=0.001, p=0.001, respectively), and 1 month after PR (p=0.001). The FEV_1% signif-

Table 1. Demographics of patients who underwent pulmonary rehabilitation

	n=35
Age (mean±SD)	64±8
Gender, n (%)	
Female	6 (17)
Male	29 (83)
Smoking (packs/year), median (IQR)	40 (30–62)
Long-term oxygen therapy, n (%)	7 (20)
Noninvasive mechanical ventilation, n (%)	4 (11)
Body mass index (kg/m^2), mean±SD	27±6
FEV_1%, mean±SD	49±18

IQR: Interquartile range; FEV: Forced expiratory volume; SD: Standard deviation.

Table 2. Exercise capacity and quality of life of patients before and after PR

	Before PR	After PR	p[1]	1. month control	p[2]
	Mean±SD	Mean±SD		Mean±SD	
Modified Medical Research Council	2±1	1±1	0.001	1±1	0.001
CAT	18±9	12±8	0.001	11±7	0.001
Incremental shuttle walking test (m)	356±120	433±125	0.001	457±124	0.001
St. George's Respiratory Questionnaire score					
Symptom	56.3±21.3	49±19	0.009	44±21.4	0.003
Activity	63.9±20.6	48.4±24.5	0.001	51±20.6	0.001
Impact	45.7±25.5	30.2±22.7	0.001	30.0±22	0.003
Total	53.0±21.8	39.3±22.7	0.001	38.6±18	0.001
Hospital Anxiety and Depression Questionnaire					
Anxiety	8±5	6±5	0.15	5±3	0.004
Depresssion	8±4	6±3	0.030	5±4	0.004
FEV_1%	49±18	52±19	0.024	56±21	0.030

PR: Pulmonary rehabilitation; CAT: COPD assessment test; FEV: Forced expiratory volume; SD: Standard deviation.
p^1: P-value between the before and after PR; p^2: P-value between the before PR and the 1-month follow-up.

icantly rose after the PR program (p=0.024) and 1 month after PR (p=0.030).

Table 2 shows the exercise capacity and the QOL and HAD scores before and after the PR program.

Exercise capacity

In ISWT, a significant increase was obtained before and after PR (p=0.001) and before PR and in the first month control after the PR program (p=0.001). There is also a significant increase obtained after PR and the first-month follow-up (p=0.003).

Quality of life

The patients showed a significant improvement in SGRQ (p<0.05) after a PR program and after the first-month follow-up (p=0.05). The anxiety score improved after PR, but this was not significantly significant (p=0.15), and in the first month, the anxiety score significantly improved (p=0.004).

DISCUSSION

Our study shows that the PR gains continue in the first month following the PR program. PR leads to achievements in the exercise capacity and QOL, and these achievements continue in the first month after PR.

In recent years, there has been an increased awareness with regard to comorbidities and multisystem symptoms in COPD. Thus, PR is considered to be at the center of chronic patient care.[1,2] Despite an appropriate medical therapy in patients with COPD, a restriction of daily activities, social isolation, depression, and consequently, a decline in the quality of life may occur.[6,18] The GOLD recommends PR, which is a combination of different activities aimed at increasing of the physical capacities and patient psychological states.[7] Smoking, nutritional depletion, hypoxia, and hypercapnia, and frequent exacerbation may be some of the physical activity restrictions.[4,19,20]

Decreased airflow as a characteristic of COPD becomes more pronounced during maximal effort. An increased respiratory frequency consequently reduces the period of expiration and boosts hyperinflation. This situation can even manifest itself in everyday activities such as walking.[3,21,22] To evaluate this, we used the CAT and the mMRC scores, and we observed a significant improvement in these scores after PR (p=0.001, p=0.001, respectively), and even 1 month after PR (p=0.001) in this study.

Exercise training provides a significant progression in the exercise capacity even in patients with the mild to severe reduction in respiratory functions.[5,6,23] As a result of improved muscle strength and oxidative capacity, a decrease in the ventilator workload, increased motivation, diminished mood impairment, and enhanced cardiovascular functions lead to an improvement in dyspnea and hyperinflation.[6,18,23] In this study, an improvement in the walking distance (exercise capacity) measured by the ISWT after PR and in the first month was significant (p=0.001).

The gains achieved with the PR are not indefinite; thus, during the follow-up, if necessary, patients can be reintroduced to the PR program.[24,25] Actually, PR is aimed at developing a behavioral change in patients.[6,23,26] The benefits of PR may decline with time (12–18 months).[5,25] In this study, we showed that the PR program achieved a behavioral change that we noticed in an early period following PR.

Inhaler medications, O_2, and NIMV devices make patients home dependent and generally immobile. In this study, 20% of the patients were using LTOT, and the patients were trained to use it. Long O_2 cannulas were suggested to give patients more freedom and make them comfortable and mobile at home.

The mean FEV_1% was increased after PR (p=0.024) and continued to improve even after the PR program (p=0.030). Even though PR mainly improves the exercise capacity rather than pulmonary functions, we can connect this to the educational sessions for the disease and inhaler medication techniques.[3–5] All of the patients and their caregivers underwent educational sessions about inhaler medication techniques by an education nurse in the beginning of PR and repeated these techniques during the sessions. A written exercise program was also a part of the PR to encourage patients to exercise at home in addition to the session days at the hospital.

Lan et al.[27] also recommended PR for patients with COPD with a normal exercise capacity. They reported significant improvements in exertional dyspnea after PR. In present study, we observed significant improvements in QOL (p<0.01) and in anxiety and depression, which was compatible with other studies.[27,28] The short-term benefits of PR may diminish with time, and this time period is reported as 6–12 months in patients with COPD.[5,28] However, the exacerbations, inadequate care support, and mood disorders may affect the adherence to maintain the benefits after a PR program. Li et al.[29] described a maintenance strategy after PR by implementing home visit and making phone calls to maintain the exercise capacity CAT, mMRC, and even for exacerbations.

Our study had some limitations. It is a single center, retrospective study with a small sample size, so some data could be missing, and there can be a limited data generalization. However, the strength of this study is in its conformation of the importance of PR in COPD and increasing the PR awareness.

In conclusion, the benefits of PR in the exercise capacity and QOL in patients with COPD continue in the early post-PR period when patients incorporate and retain their behavioral changes in their daily lives.

Ethics Committee Approval

Approved by the local ethics committee (date: 05/17/2018, no: 046).

Informed Consent

Retrospective study.

Peer-review

Internally peer-reviewed.

Authorship Contributions

Concept: İ.Ö., E.Y., M.Ö.; Design: İ.Ö., E.Y., R.A., M.Ö.; Data collection &/or processing: İ.Ö., E.Y., R.A., M.K., M.Ö.; Analysis and/or interpretation: İ.Ö., E.Y., M.Ö., M.K.; Literature search: İ.Ö., E.Y., M.Ö., R.A., M.K.; Writing: İ.Ö., E.Y., M.Ö., R.A.; Critical review: İ.Ö., E.Y., M.K.

Conflict of Interest

None declared.

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Pulmoner Rehabilitasyona Bağlı Kazanımlar İlk Ayda da Devam Eder Mi?

Amaç: Pulmoner rehabilitasyon (PR) programına kabul edilen kronik obstrüktik akciğer hastaları (KOAH) PR sonrası kazanımlarını zamanla kaybedebilirler. Bu çalışmada, PR sonrası kazanımların PR sonrası ilk ayda devam edip etmediğini araştırmayı amaçladık.

Gereç ve Yöntem: PR programını tamamlayan ve birinci ay takip kontrollerine katılan KOAH hastaları retrospektif olarak değerlendirildi. Egzersiz kapasitesini ölçmek için artan hızda mekik yürüme testi (AHMYT) kullanıldı. Sekiz haftalık PR programında haftada 2 gün fizyoterapist eşliğinde güçlendirme egzersizleri, bisiklet, yürüme bandı ve solunum egzersiz eğitimi verildi. PR sonrası hastaların egzersiz durumlarını bir egzersiz günlüğüne kaydetmeleri istendi.

Bulgular: Toplam 35 KOAH hastası (ortalama yaş 644) çalışmaya alındı. PR sonrası (p=0.001) ve PR'dan 1 ay sonraki AHMYT'de egzersiz kapasitesinde anlamlı artış saptandı (p=0.001). PR sonrası ve 1. ay kontrolünde St. George solunum anketinde de anlamlı düzelme izlendi (p<0.05).

Sonuç: KOAH hastalarında PR tarafından sağlanan egzersiz kapasitesi ve yaşam kalitesindeki kazanımlar, PR sonrası dönemde, hastaların günlük yaşamlarında davranış değişiklikleri ile devam ettirdikleri zaman devam etmektedir.

Anahtar Sözcükler: Egzersiz kapasitesi; kronik obstrüktif akciğer hastalığı; pulmoner rehabilitasyon; yaşam kalitesi.