Journal of Iranian Medical Council, Volume 4, Issue no. 3
http://dx.doi.org/10.18502/jimc.v4i3.7218

Original Article

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The Effect of Telerehabilitation on Quality of Life, Exercise Capacity, and Spirometry Indexes in Patients with Chronic Obstructive Pulmonary Disease in Masih Daneshvari Hospital

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Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) leads to limited activity and reduced quality of life. Treatment of this disease is a long-term process that requires the cooperation of patients in monitoring and treatment.

Methods: In the present study which was conducted from April 2019 to March 2021 in Masih Daneshvari Hospital, Tehran, Iran, 75 patients were randomly divided into telerehabilitation and control groups. Patients in the control group received pulmonary rehabilitation including respiratory, isometric, and aerobic exercises for 8 weeks, three times per week. In the second group, patients were given a lung rehabilitation booklet and asked to repeat the exercises three times a week for four weeks according to a specific schedule. In addition, patients installed Behzee care application on the mobile phone that recorded various indicators such as heart rate, SpO2, dyspnea, fatigue, and daily activities. This application reminded the patient of the program every day and at a specific time.

Finally, the patients' conditions were compared in the two groups after 8 weeks using CAT and mMRC questionnaires and 6-Minute Walk (6MW) exercise indices as well as spirometry tests.

Results: In all four indicators (6MW, CAT, and mMRC questionnaires as well as spirometry), patients showed improvement after rehabilitation ($p<0.001$). This improvement was significantly higher in the telemedicine group compared to the other group ($p<0.01$).

Conclusion: The use of telerehabilitation in COPD patients is effective in improving spirometry indices, quality of life, as well as activity and sports indices.

Keywords: Chronic Obstructive Pulmonary Disease (COPD), Telerehabilitation, Pulmonary rehabilitation, Spirometry

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Received: Mar 12 2021
Accepted: May 20 2021

Citation to this article:

Ghadimi S, Fakharian A, Abedi M, Zahiri R, Norouz Afjeh M and Mirenayat MS.The Effect of Telerehabilitation on Quality of Life, Exercise Capacity, and Spirometry Indexes in Patients with Chronic Obstructive Pulmonary Disease in Masih Daneshvari Hospital. *J Iran Med Counc*. 2021;4(3):159-64.

Introduction

The World Health Organization estimates that Chronic Obstructive Pulmonary Disease (COPD) will be the third leading cause of death in the world by 2030 (1). The disease causes an irreversible airway obstruction which results in severe inflammatory responses in response to toxic and allergenic stimuli such as cigarette smoke. Systemic inflammation and dysfunction of peripheral and respiratory muscles in COPD lead to decreased muscle strength, osteoporosis, heart disease, and chronic shortness of breath, which negatively affect the quality of life of these individuals. All of these lead to decreased exercise tolerance, social isolation, and ultimately depression and weakness (2).

The use of physical methods and pulmonary rehabilitation are among the non-pharmacological therapies to improve and control symptoms in patients with COPD (3). Pulmonary rehabilitation uses a combination of methods including training to influence activity levels, symptoms, and reduce complaints in patients with COPD. Pulmonary rehabilitation minimizes complaints and increases the tolerance of patients in performing activities (4). However, rehabilitation programs and their follow-up by the patient are severely restricted for various reasons including high costs of rehabilitation, dispersion of these centers, accessibility of centers, and limited mobility of patients. Therefore, the development of a model of home-based or telerehabilitation is a necessity as an effective solution in providing these services (5). According to a systematic review, home-based rehabilitation programs including sports programs are superior to center-based programs for the elderly (6). Studies also showed a positive effect of home-based pulmonary rehabilitation on increasing exercise tolerance in people with chronic lung disease. A telerehabilitation program is a non-invasive intervention with several benefits including easy establishment, low cost, and optimal efficiency for improving daily activities and patients' quality of life in the first line of treatment (7).

Considering the importance and benefits of telerehabilitation services in improving the signs and symptoms of Chronic Obstructive Pulmonary Disease (COPD), in this study, an attempt was made to investigate the effect of telerehabilitation on quality of life, exercise capacity, and spirometric parameters in patients with COPD in Masih Daneshvari Hospital, Tehran, Iran.

Materials and Methods

The present study, which was designed as a case-control study, was approved by the Ethics Committee in Biomedical Research Center of Masih Daneshvari Hospital affiliated to Shahid Beheshti University of Medical Sciences with the ethics code of IR.SBMU.NRITLD.REC.1398.066. Patients first received a full explanation of how the work would be done and completed an informed consent form to participate in the study. Then, the patient information questionnaire, Saint George's Respiratory Questionnaire (SGRQ), and the COPD Assessment Test (CAT) were filled in by the patients and a six-minute walking test was taken. Using a simple randomization method with the help of file numbers, patients were divided into two groups. Patients with even codes were placed in the control group and patients with odd codes were in the experimental group.

In the control group, 38 patients were studied who received a pulmonary rehabilitation program through training by a professional physiotherapist and the pulmonary rehabilitation group of Masih Daneshvari Hospital in Tehran, Iran. Also, a booklet of lung rehabilitation guides for patients with chronic lung diseases written by this center was given to the patients. The duration of the rehabilitation program, which included breathing exercises, isometric limb exercises, and aerobic exercises, was 8 weeks, three times per week, and each session lasted about one hour.

In the experimental group, 37 patients were included who, like the control group, received a pulmonary rehabilitation program through a booklet and training by a professional physiotherapist and a pulmonary rehabilitation group for eight weeks, three times per week. In addition, Behzee care application was installed on the mobile phones of these patients, and indicators such as heart rate, oxygen saturation, fatigue, and shortness of breath as well as daily activity (by recording the number of steps in each training session) were recorded. Through this application, patients' training program was set for each treatment session and they were reminded at a specific time and day.

Indicators including FEV1/FVC, distance traveled in

the 6-Minute Walk Test (6-MWT), CAT score, and mMRC were measured and compared in both groups before the start of the pulmonary rehabilitation program and then at the end of 8 weeks. Data analysis was performed in the form of descriptive and analytical statistics using SPSS v23 software (IBM,USA). Mean and standard de*via*tion were used to describe quantitative variables and relative frequency and frequency to describe qualitative variables. In the tests used in this study, p-value for type 1 error was considered 0.05. The normality of the variables was assessed using the Kolmogorov-Smirnov test.

Results

Based on the results in table 1, out of a total of 75 COPD patients participating in this study, 37 were included in the experimental group (receiving telerehabilitation) and 38 patients in the control group (not receiving telerehabilitation). Among them, 48 patients (64%) were men and 27 patients (36%) were women. The mean age of patients was 66.16 years and the control group with a mean age of 66.56 years was older than the experimental group with a mean age of 65.76 years.

Comparison of the results obtained from the study of the two groups showed that the mean FEV1/FVC in the group of patients using telerehabilitation had a significant increase compared to the control group (p=0.006). Also, telerehabilitation was significantly effective in the 6-minute walk test (6MWT) index (0.013). In addition, the findings of the present study indicated that the use of telemedicine led to a significant decrease in the score of the CAT questionnaire in patients in the intervention group compared to the control group (p=0.002). Also, comparison of the scores of the mMRC questionnaire in the two groups showed that the use of telemedicine significantly improved the score of this questionnaire in the intervention group (p=0.013) (Table 2).

Discussion

In the present study, two groups of patients with COPD were treated with classical methods and also using telerehabilitation, and the clinical results related to spirometry tests, exercise capacity, and their clinical condition were compared with each other. In this study, spirometry tests and FEV1/FVC evaluation were used to check the respiratory condition of patients.

Based on the findings of this study, in the group using telerehabilitation and in the control group, after treatment and rehabilitation in the study period, FEV1/FVC parameter improved in patients (p<0.001). In other studies, it was found that the improvement rate of FEV1/FVC in the group of patients using telemedicine was higher than the control group and was statistically significant (p=0.006). In the control group, the rate of FEV1/FVC parameter after receiving classical treatments has improved by an average of about 10 which turned out to be 15 in the telerehabilitation group. Therefore, the difference between the two groups can be related to continuous monitoring and use of telemedicine facilities in the telerehabilitation group. Bairapareddy *et al* in 2018 and Bernocchi *et al* in 2017 reached similar results in patients with chronic heart and lung failure, and the findings of this part of the study are in line with the findings of these two researchers (5,8).

The clinical condition and the severity of the symptoms of the disease for patients in this study were assessed using two questionnaires, CAT and mMRC. In both questionnaires, higher obtained score

Table 1. Demographic information of patients in two groups

Indexes		Control (Mean±SD)	Cases (Mean±SD)	Total (Mean)	p-value
Age(Year)		66.65±7.12	65.76±6.84	66.16	0.541
Gender N(%)	Males	25(65%)	23(62%)	48(64%)	0.235
	Females	13(35%)	15(38%)	27(36%)	0.212
BMI		25.53	24.01	24.77	0.081

BMI-Body Mass Index

Table 2. Comparison of the mean differences of the measured indicators in the two groups

Indexes	Control group (M±SD)	Telerehabilitation group (M±SD)	p-value
FEV1/FVC	10.59±3.14	15.78±9.00	0.006
6MW	43.08±9.54	67.17±10.52	0.013
CAT	6.61±2.03	2.05±080	0.002
mMRC	0.54±0.69	1.13±0.67	0.013

by the patients (40 points in CAT and 4 points in mMRC) indicates the worse condition of the patient. Moreover, in both groups, the scores obtained by patients were significantly reduced *via* performing treatment and rehabilitation measures. The control group had an average of 2 improvement scores in CAT questionnaire after receiving treatment, while the improvement rate in the telemedicine group was 6 points on average. Changes in both groups were statistically significant ($p<0.001$). It was further found that the rate of change in the telemedicine group was significantly higher than the control group which conveys that the observed difference was related to use of telemedicine. In another study, Maltais *et al* found similar results regarding the effectiveness of telemedicine (9). Similar results were obtained in the mMRC questionnaire. In both groups, improvement in scores was observed, but the rate of improvement in scores was higher in the telemedicine group and the telemedicine group was significantly different from the control group at the end of the study ($p<0.001$). Considering the relationship between the scores of this questionnaire and patients' quality of life, it can be claimed that the use of telemedicine can be effective in improving the quality of life of patients with COPD as confirmed by Jung *et al* in a parallel study. Almojaibel examined the possibility of providing telemedicine services to patients with COPD (10); the study showed that performing telemedicine in the clinic requires further investigation and the provision of treatment and monitoring protocols and standards is a gross problem. This concern is significant due to low participation of individuals in the case study. In this study, obtaining information about the close scrutiny and proper follow-up of patients during training created difficulties for the researchers especially due to old age and patients' lack of familiarity with technology. Therefore, the development of strategies and standardizing and organizing actions should be the main target of future studies as described and confirmed by Almojaibel as well (10).

The 6-minute walk test was used to measure patients' activity and sports skills. In this study, it was found that in both groups of patients, namely the control group and the telemedicine group, treatment and rehabilitation measures led to an improvement of 6MWT. The changes observed in both groups were statistically significant ($p<0.001$) but the rate of these changes was higher in the telemedicine group. According to the present study, the telemedicine group improved more in the index compared to the control group. Therefore, telemedicine can be considered an effective strategy in improving the activity and sports indices of patients with COPD

as consistently confirmed by Baireparedy *et al* (5). Jokar *et al* in a study of patients at Masih Daneshvari Hospital, Tehran, Iran, examined the prevalence of fatigue in patients with COPD and its relationship with telemedicine. In this study, telemedicine was found to have a statistically significant relationship with improving fatigue in patients with COPD (11). The findings of this study also reinforce the improvement of patients' activity status using telemedicine. One of the problems facing current studies is the provision of a standard set of care as well as guidelines for providing telemedicine services to patients with COPD as Almojaibel indicated in his systematic review (10).

Conclusion

The capacity of telemedicine in monitoring and educating patients with COPD is significantly effective in improving quality of life, clinical symptoms, individuals' activity, and limitations of exercise performance, as well as spirometric indices. The use of telemedicine along with the main therapies can improve the status of these indicators. Moreover, establishing a set of standardized care and interventions which can be implemented through telemedicine as well as educating and training patients in using the technology should be the focus of investigation in future studies for improving clinical practice.

Acknowledgements

The authors would like to appreciate the support of staff at Shahid Beheshti University of Medical Sciences and Health Services and all people who helped us in conducting this research.

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