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Tele-pulmonary rehabilitation and remote assessment of exercise capacity

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Abstract:

Tele-pulmonary rehabilitation (PR) is a good option for patients who underwent lung transplantation or on the waiting list during the COVID-19 pandemic; in addition, optimum content, duration, and optimum remote assessment tests have not been defined for tele-PR. We reported our tele-PR model and two cases of exercise capacity, which were assessed remotely. Tele-PR can be effective in improving the exercise capacity in patients who underwent lung transplantation and in those who have advanced lung disorders and are on the waiting list for transplantation. Furthermore, shuttle tests can be practical and convenient to use for remote assessment.

Keywords:

Exercise test, lung transplantation, telemedicine, telerehabilitation

Introduction

Pulmonary rehabilitation (PR) is an effective intervention in symptomatic chronic respiratory patients. Since the COVID-19 pandemic, telehealth systems have been used more all around the world. One of the telehealth applications is tele-PR. Tele-PR is a good option for patients who underwent lung transplantation and for those who are on the waiting list during the COVID-19 pandemic. In addition, optimum content, duration, and remote assessment tests have not been defined for

tele-PR. The field tests are simple, require little equipment, and are commonly used for assessing PR. The incremental shuttle walk test (ISWT) and the endurance shuttle walk test (ESWT), the field tests, have been shown to be valid, repeatable, and used to evaluate changes in exercise capacity after a management approach in chronic respiratory diseases.^[1-3]

We aimed to present our tele-PR model: the effectiveness of tele-PR in improving the exercise capacity using shuttle walk tests in two patients (one who underwent

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lung transplantation and the other who was on the waiting list for transplantation).

Case Report 1

History

A 28-year-old female was diagnosed with cystic fibrosis (CF) with genetic confirmation and a history of recurrent pneumonia. She was referred by a lung transplantation (LTX) center. She lost 10 kg and needed long-term oxygen therapy in the previous year. On examination, she looked cachectic, and bilateral diffuse crackles were heard.

Investigations and treatment

She was using long-acting beta-agonists (inhaled corticosteroid). Chest X-ray is shown in Figure 1a. Initial assessments were performed in our PR center (Table 1). Exercise capacity was assessed under 2 L/min nasal oxygen. She was prescribed oral nutritional supplement treatment. She had a pulse oximeter, sphygmomanometer, dumbbells, 10-m nasal cannula at home. After the approval was taken, she underwent a synchronous video-conferencing tele-PR program twice a week for 18 weeks. Similar to conventional the program, the teleprogram consisted of exercise training, nutritional and psychosocial evaluation, support, and education. Educational sessions consisted of information about the disease, self-management, exercise training, breathing retraining, airway clearance techniques, energy conservation, dietary advice, psychological issues, and lung transplantation issues.^[4] Exercise training program covered warm-up, stretching, cool-down, resistance, and endurance train-

ing.^[5] For resistance training, the initial weight was 0.5 kg, which was increased to 1 kg for upper extremity muscles, and the 1-kg load was increased to 2 kg for lower extremity muscles. Increases were arranged according to the patient's tolerance.^[4] For endurance training, she walked initially 75% of the patient's VO₂peak as calculated from ISWT and gradually increased every 3–5 sessions, when dyspnea: modified Borg <3 and leg fatigue Borg <13.^[4] During exercise, oxygen saturation, blood pressure, walk distance, and pause times were recorded intermittently.^[5] After the program was completed, ISWT and ESWT were performed remotely via the Internet. ISWT distance increased from 240 to 350 m, and the endurance time increased from 7 to 20 min (Table 2).

Case Report 2

History

A 44-year-old female was diagnosed with pulmonary hemosiderosis and underwent bilateral LTX. Diagnosis of pulmonary hemosiderosis was confirmed by pathology through explantation of the lung. She was referred to our PR center 3 months after LTX. She had a complaint of fatigue. On examination, breath sounds diminished in the basal of the left lung.

Investigations and treatment

She was under immunosuppressive treatment. Chest X-ray is shown in Figure 1b. Initial assessments were performed in our center (Table 1). She had a pulse oximeter, sphygmomanometer, elastic exercise bands, dumbbells, and treadmill at home. After approval was taken, she

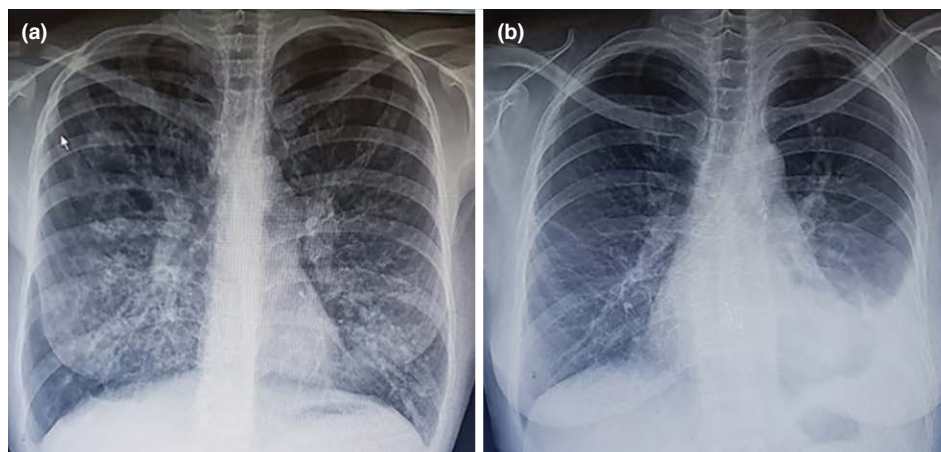


Figure 1: Chest X-ray of (a) Case 1, demonstrating reticular and cystic opacities in the bilateral middle and lower zones, and (b) Case 2, demonstrating blunting of the left costophrenic angle

Table 1: Initial assessments of cases

Parameters	Before PR	
	Case 1	Case 2
FEV ₁ of predicted %	37	71
FVC of predicted %	55	70
FEV ₁ /FVC	53	90
BMI (kg/m ²)	16.4	22.3
FFMI (kg/m ²)	14.6	15.5
mMRC	3	0
SGRQ total	68.60	31.03
CRQ	57	106
Anxiety score	9	8
Depression score	10	7

Anxiety and depression scores were measured using the Hospital Anxiety and Depression Scale. PR: Pulmonary rehabilitation, BMI: Body mass index, FFMI: Fat-free mass index, mMRC: Modified Medical Research Council, SGRQ: St. George's Respiratory Questionnaire, CRQ: Chronic respiratory questionnaire

Table 2: Values of shuttle walk tests before and after tele-PR

Parameters	Case 1		Case 2	
	Before tele-PR	After tele-PR	Before tele-PR	After tele-PR
ISWT (m)	240	350	340	420
ESWT (min)	7	20	12	20

Tele-PR: Tele-pulmonary rehabilitation, ISWT: Incremental shuttle walk test, ESWT: Endurance shuttle walk test

underwent a synchronous videoconferencing tele-PR program twice a week for 18 weeks. The content of the program was similar to the other patient except for the resistance exercise. For resistance exercise, the weight was 1 kg for both upper and lower extremity muscles as the patient could not tolerate more weight. Exercises were performed with initially 70% of the patient's VO₂-peak (3.5 km/h) as calculated from the ISWT for the treadmill and increased gradually up to 90% (4.5 km/h). After the program was completed, ISWT and ESWT were performed remotely via the Internet. ISWT distance increased from 340 to 420 m, and the endurance time increased from 12 to 20 min (Table 2).

Discussion

PR as a cornerstone of integrated care and an evidenced-based effective approach is recommended not only for advanced chronic lung disease but also for LTX recipients; therefore it should take place in a perioperative period of LTX. Despite its benefits, tele-PR has been underutilized. It was recommended as an alternative

approach to PR in an attempt to increase the enrolment, adherence, and completion of PR.^[6] Additionally, due to the increased number of patients, suspended face-to-face programs, and high contagious nature of COVID-19 infection, tele-PR programs have come to the front line.

Tele-PR has been found to be as effective as face-to-face programs in terms of improvement in exercise capacity in COPD patients.^[7,8] One of our patients was CF on the LTX waiting list, and the other was an LTX recipient. Both of the patients had improvements in exercise capacity. Although the optimal content was not defined, it was shown that tele-PR programs, consisting of essential components of multidisciplinary PR such as exercise training, education, and support were successful.^[8] Our tele-PR model consisted of all the components of conventional PR programs. We suggested that the evident improvement in exercise capacity could be due to multicomponent.

Since the COVID-19 pandemic, PR remote evaluation has been recommended.^[9] The validity of the remote assessment of exercise capacity has not been shown in patients with chronic respiratory disease, but the reliability and the validity of the 6-minute walk test (6MWT) were studied in 17 patients with chronic heart failure.^[10] Although there was no clear recommendation, it is important to comply with the standards of the applied test. For 6MWT, a 30-m space at patients' homes can be challenging. A 10-m space and giving no encouragement are advantages in the remote assessment for shuttle tests. We used ISWT and ESWT in accordance with the standards.^[2] The CD of shuttle tests was played at the hospital; the patients were advised to follow the instructions and were monitored closely via the Internet.

Consequently, tele-PR can be effective in improving the exercise capacity in patients who underwent LTX and in those who have advanced lung disorders and are on the waiting list. Furthermore, shuttle tests can be practical and more convenient to use for remote assessment of exercise capacity.

Informed Consent

Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

Conflicts of interest

There are no conflicts of interest.

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Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept – İ.C., P.E.; Design – İ.C., P.E.; Supervision – İ.C., N.D., F.T.; Funding – İ.C.; Materials – İ.C., P.E.; Data collection &/or processing – N.D., F.T.; Analysis and/or interpretation – İ.C., P.E., N.D., F.T.; Literature search – İ.C., N.D., F.T.; Writing – İ.C., P.E.; Critical review – İ.C., P.E., N.D., F.T.

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