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Impact of Pulmonary Rehabilitation on Recuperation of Patients from Moderate to Severe COVID-19 Illness in Western India

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Abstract

Background: COVID-19 virus has caused widespread acute respiratory disease globally since 2020. Patients with evidence of lower respiratory illness either clinically or radiologically had moderate to severe illness. COVID respiratory and non-respiratory symptoms (psychological, cognitive etc.) noticed after 4-8 weeks of primary disease were called long COVID syndrome. Survivors of moderate to severe disease had a poor quality of life. The main objective of this retrospective study was to assess the role of outpatient Pulmonary Rehabilitation (PR) done in moderate severe COVID-19 survivors who had symptoms after 4-8 weeks at Shaivam lung rehabilitation centre, Ahmedabad.

Method: We analyzed the impact of PR on 30 patient's post COVID-19 who were willing to participate during the ongoing pandemic. It was an out-patient 6-8 weeks of programme designed to target respiratory and general muscle training, relaxation technique, nutritional counselling, occupational and psychological support. Patients were tested with of combination of self-assessment quality of life scale (adaptedfrom short form 36 questionnaire (SF 36), muscle training, dyspnoea scale and physical assessment. Standard objective assessment included oxygenation index (SpO_2/FiO_2 ratio), 6 Minutes Walk Distance (6 MWD), Modified Medical Research Council (MMRC) score, Manual Muscle Testing (MMT) along with Pulmonary Function testing (PFT). All these subjective and objective variables were tested pre and post-PR programme to assess the impact on defined parameters.

Results: From Dec 2020 to March 2022, we studied the impact of PR on 30 out of 55 patients fitting into the inclusion criteria. Significant benefit was noted in subjective (SLRQ score) and objective (6 MWD, MMRC, oxygenation, MMT) quality of life post-PR programme ($p<.001$). Improvement in spirometry was not statistically significant, indicating structural chronicity of COVID pulmonary fibrosis.

Conclusion: Pulmonary rehabilitation is safe, effective and feasible on an outpatient basis in COVID-19 survivors of illness with poor quality of life. Further research is required to prove its widespread benefit in such patients.

Keywords: Pulmonary rehabilitation; Cognitive; Respiratory disease; Parameters; Retrospective

Introduction

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) a novel Beta Coronavirus was responsible for the global outbreak of acute respiratory illness known as Coronavirus Disease 2019 (COVID-19). Manifestations of COVID can be mild to moderate in 80% cases, 15% have severe disease, and 5% have a critical illness [1,2]. Those needing oxygen therapy or in need of critical care services have guarded outcomes. The disease causes major alveolar damage, severe inflammation and vascular insult resulting in hypoxemic acute respiratory failure. Moderate to severe cases require oxygen therapy or mechanical ventilation. Long COVID syndrome exists in patients who manifest symptoms even after 4-8 weeks of primary disease [3]. Physical, psychological and cognitive impairment is seen in such patients after recovery [4]. ICU survivors have a poor quality of activity of daily living due to the high prevalence of muscle weakness and physical performance impairment [5].

COVID pulmonary fibrosis is a sequela of severe COVID-19 lung disease [6]. In the perspective of functional medicine, it reduces both the motility and mobility of organ and locomotion respectively. In such patients, therapeutic dilemma hounds around the treating physician and no proven benefits have been seen with existing medications.

Pulmonary Rehabilitation (PR) is defined as a comprehensive intervention based on a thorough patient assessment followed by patient tailored therapies that include, but are not limited to, exercise training, education and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long term adherence to health enhancing behaviors. This non-pharmacological intervention is known to decrease symptoms (dyspnea and fatigue), improve exercise tolerance and quality of life, reduce healthcare utilization, as well as increase physical activity among such patients.

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PR has been the main therapeutic intervention in lung diseases like COPD, ILD, pulmonary hypertension and advanced asthma. Extrapolating its benefit on quality of life it has been recommended in acute and subacute lung disease. Along with reducing dyspnoea and fatigue, PR improves exercise endurance and many areas of health related quality of life. Such personalized treatment plan can reduce complications, enhance endurance, social participation, and reduce medical budget [7-11].

PR has been proposed by national/international guidelines and recommendations for [12,13]. Our study aimed to report the safety, functional outcome and preserve lung function with pulmonary rehabilitation in subjects suffering from COVID-19 sequelae.

Materials and Methods

Study design

This retrospective observational study screened patients of post COVID-19 undergoing outpatient PR at Shaivam Lung Rehabilitation Centre, Ahmedabad from Dec 2020 to March 2022. Patients from both the waves of COVID-19 were included to study the impact of structural and functional impact of different strains. Chest specialist and pulmonary rehabilitation specialist manage this centre. Ethics committee clearance was taken (AHD/ACD-018/09-20).

Inclusion criteria for rehabilitation were based on the following criteria:

- Willingness to undergo outpatient PR during the pandemic.
- 4-8 weeks post COVID disease (no active illness).
- Oxygen requirement less than 2 LPM.
- Age between 18 to 70 years.
- No on-going indoor treatment.
- Hemodynamically stable.
- No active cardiac, neurological or nephrology disease.
- Mental stability to undergo a rehabilitation programme.

Exclusion criteria:

- Non-cooperative and mentally unfit.
- Right heart failure.
- Those who couldn't complete the rehabilitation session due to personal or epidemic related travel restriction.
- Persistent reverse transcriptase polymerase chain reaction positive.
- Lung transplant candidate.
- Medically deemed unstable due to active cardiorespiratory, nephrology or neurological disease.
- Poor anticipated quality of life due to associated comorbidities.

Intervention

Retrospective data of all patients who underwent rehabilitation was studied. Data was collected in regard to past medical disease, on-going therapeutics and detailed rehabilitation programme impact. Those who could complete 6 weeks of PR programme were enrolled finally for study. Data was entered and analyzed using Microsoft Excel. Paired t-test was used to assess statistical significance. Subjects were free to withdraw consent during the participation period for any personal or pandemic related lock down reasons. Post COVID physical limitation was assessed by 6 MWD, chest expansion and symptoms on exertion. Baseline quality of life was judged by SF-36 questionnaire which assesses eight health concepts based on physical functioning, physical role, pain, general health, vitality, social function, emotional role and mental health [14,15].

Our pulmonary rehabilitation program was according to the Italian position paper. Type, intensity, timing and modality of intervention were tailored to individual patients as disease, tolerance and oxygen requirement. Only patients with RT-PCR test for SARS-CoV-2 were included in our study. Infection control practices were strictly followed during the entire rehabilitation programme. Patients were free to withdraw consent due to pandemic or personal reasons.

Manual Muscle Testing (MMT) was used to determine the extent and degree of muscular strength/weakness resulting from disease, injury or disuse [16]. Subjective breathlessness was assessed by MMRC score [17]. Need of oxygen was assessed along with the dose of oxygen (in litres per minute) pre and post rehabilitation. We looked for nature and quality of cough along with breathing pattern. Chest expansion was studied by taking the measurement at deep inspiration and expiration by measure tape at the level of intermammary line. Normal range of motion is about 2.5" which is limited in restrictive lung diseases. Chest mobility was assessed as per the American Thoracic Society (ATS)/European respiratory society task force statement [18]. Pulmonary function testing like 6 MWD, PFT were tested in all patients pre and post PR. Apart from this standard post COVID radiology, routine labs and Echo were reviewed as and when required. Baseline and follow up CT chest and Diffusion capacity of Carbon monoxide (DLCO) were not available in all patients hence were not studied in our study.

Core pulmonary rehabilitation included endurance training, strength training, respiratory physiotherapy, relaxation technique, occupational therapy, psychological and nutritional support. After completion of PR therapy, they were guided for home based further programmes.

Results

Of 55 patients screened, 30 were taken for this retrospective observational study. 60% of them were males and 40% females. Patient age distribution is given in Table 1. 86 percent patients had associated comorbidities along with COVID-19 lung disease.

	Male	Female	Total
20-40	1	1	2
41-60	9	4	13
61-75	6	5	11

Above 75	2	2	4

Table 1: Age wise distribution across genders among studied participants.

Among 30 patients, 6 had mild, 14 had moderate and 10 had severe COVID-19 disease. 20 patients (66%) were having oxygen therapy at the time of enrolment (Table 2).

Particular	Mean value at pre-rehabilitation	Mean value at post-rehabilitation
Oxygen need (FiO_2)	0.24	0.21
Oxygen need*	1.4 LPM*	0.65 LPM*
SpO_2/FiO_2 ratio	390.05	457.56
SF 36 score	32.87	50.67
MMT	3.20	4.26
MMRC	2.70	1.33
6 MWD	198.6	296.9
Note: *n is 20 and n is 10.		

Table 2: Basic profile of participants compared with pre-post intervention.

Parameters	Pre-rehab (Mean ± SD)	Post-rehab (Mean ± SD)
Oxygenation improvement (SPO_2/FiO_2) ratio	390.05 ± 54.03	457.57 ± 15.22
SF-36 score	32.87 ± 9.03	50.67 ± 8.66
Improvement in muscle strength (MMT)	3.20 ± 0.89	4.27 ± 0.58
Effect on dyspnea scale (MMRC)	2.77 ± 1.04	1.33 ± 0.96
Patient 6 MWD score	198.6 ± 137.7	296.9 ± 108.1
PFT improvement (FVC%)	68.25 ± 20.58	69.71 ± 23.42
PFT improvement (PEF%)	85 ± 25.19	84.94 ± 29.07

Table 3: Comparison of pulmonary function indicators pre-post intervention.

Discussion

Those who survive COVID-19 illness can still have symptoms and signs due to significant structural and functional limitation in terms of dry cough, variable grades of dyspnea, chest pain and poor appetite along with lack of ability to perform day to day activity. Long COVID syndrome is now a defined entity. COVID-19 fibrosis is well known to affect quality parameters in survivors.

In our study, improvement was seen in SF score with pulmonary rehabilitation. Statistically significant benefit was seen in the pre *vs.* post rehabilitation score of all patients. The quality of life as adjudged by SF 36 was better in post rehabilitation phase indicating a value added intervention in such patients who are left to nature and some experimental therapies to improve after such nasty viral insult. This correlates well with findings published in the indoor rehabilitation work published by Gloeckl R, et al., among 50 patients studied. The mean score improved from 32.87 to 50.67 with a p value of <0.0001. The improvement seen with outpatient PR programme in post COVID-19 disease correlated well with their objective and subjective quality of breathing, respiratory mechanics and activity of daily living.

The 6 MWD, measurable parameter of lung function also showed statistical significance from 198.6 m to 296.9 m (p, 0.0001). 6 MWD has been a gold standard of testing in various chronic lung disease patients for benefits of PR [19,20]. Even the ATS and ERS coordinated international task force for COVID-19 have recommended testing for hypoxia at rest and exertion on discharge. Similar testing is recommended at end of 6-8 weeks of PR programme. The significant improvement in 6 MWD is a robust boost to experience the physical and mental strength.

Modified medical research council dyspnea score has been studied extensively in COPD patients. MMRC has been an integral part of our questionnaire which showed statistically significant impact in post PR patients (2.77 to 1.33). This along with 6 MWD makes the effectiveness of our rehabilitation programme significant. Oxygenation improvement noted in our study is a significant findings highlighting the importance of chest wall and diaphragm wall contribution to respiratory physiological improvement. 10 patients (33%) were weaned from oxygen post rehabilitation.

MMT score a surrogate for muscle strength also showed improvement with robust PR programme. Strengthening exercises used were with aid of theraband, hand and leg cycle along with IT band mobilization.

Health related quality of life can be defined as "the gap between our expectations of health and our experience of it". A primary aim of the treatment of lung diseases is to enhance quality of life by reducing the impact of the disease. However, the relationship between symptoms and exercise capacity or functional limitation and quality of life, is neither simple nor direct. Apart from SF 36, other questionnaires which have been used in lung disease assessment are Chronic Respiratory disease Questionnaire-CRQ, St George's respiratory questionnaires and EXACT-Respiratory Symptoms tool (E-RS). SF 36 also assesses impact on non-respiratory organs which is not uncommon to COVID-19; our positive impact can be generalised.

Kunoor, et al., has documented function and psychological benefits post COVID-19 pulmonary rehabilitation from their single centre experience. Short term effects of out-patient PR were documented in a systemic review for COVID-19 by Cochrane group.

We couldn't demonstrate statistical significance in PFT parameters studied (PEFR and FVC). DLCO was not studied as more than 70% percent of patients enrolled didn't have baseline test available or couldn't perform the procedure physically. The lack of improvement noted in spirometry is explained due to time needed to regress or reverse the structural changes in post COVID pulmonary fibrosis patients. Reversal of COVID-19 fibrosis is unpredictable and time to achieve normal lung function has not been studied so far. Due to cost constraints, follow up CT chests were not studied. The findings in our study emphasis on careful monitoring of Lung function on subsequent follow up of such patients.

Mariya P Jiandani, et al., have already published evidence based Indian consensus in 2020 for acute therapy in COVID-19 patients. In general, we have demonstrated that outpatient PR programme for moderate to severe COVID-19 survivors having poor quality of activity of daily living decreases dyspnea, improves exercise capacity and measurable parameters of quality of life. A study by Wang et al., concluded that given the possibility of long term disability, outpatient post-hospitalization pulmonary rehabilitation may be considered in all patients hospitalized with COVID-19.

Conclusion

A Barman, et al., have highlighted the dire need of studies for clinicians to choose the best type of rehabilitation programme and its effect. Respiratory rehabilitation can improve exercise capacity and PFT parameters in patients recovering from SARS infection. Our study has shown the impact of pulmonary rehabilitation, its effectiveness in patients recovering from moderate to severe COVID-19 infection, including those requiring assisted living or oxygen therapy. Literature is widely available for positive effect of rehabilitation in different lung diseases.

We have shown that targeted pulmonary rehabilitation is safe and effective in patients post COVID-19 illness to improve the physical and functional recovery. It will act as a guide to build a robust rehabilitation programme in survivors of COVID-19 and similar disabling diseases of lung. The results are in sync with existing literature for COVID-19 rehabilitation effect across the globe and chronic lung disease. Such positive impact of PR in moderate to severe COVID-19 survivors should be cumulatively assessed and standardized protocols formulated to update the existing therapeutic guidelines.

Limitations of the study

Due to outpatient nature of assessment, we couldn't take immediate survivors post COVID who were bed ridden. Sample size during the ongoing COVID pandemic was small limiting the statistical validity across the spectrum of illness. We couldn't do a prospective study due to COVID-19 pandemic. Underlying comorbidity was not studied as a confounding factor due to small sample. Radiological inclusion criteria were not taken due to lack of evidence in post COVID-19 for disability. Due to resource limitations, follow up CT scans are not available comparison of disease sequelae. We only assessed short term effects (6-8 weeks) of pulmonary rehabilitation. Given the heterogeneity of treatment in post-COVID survivors, we haven't studied the impact of pharmacological agents on recovery.

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Conflict of Interest

None.

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