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COVID-19 rehabilitation delivered via a telehealth pulmonary rehabilitation model: a case series

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Abstract

International statements have suggested the pulmonary rehabilitation (PR) model as an appropriate rehabilitation option for people recovering from coronavirus disease 2019 (COVID-19). In this case series, we present our COVID-19 telehealth rehabilitation programme, delivered within a PR setting, and discuss the management of our first three cases. All patients were male, with a median age of 73 years. Following hospital discharge, the patients presented with persistent limitations and/or symptoms (e.g. breathlessness, fatigue, and reduced exercise capacity) which warranted community-based rehabilitation. Patients were assessed and provided with an initial six-week rehabilitation programme supported via telehealth using a treatable traits approach. Patients demonstrated improvements in exercise capacity and breathlessness; however, fatigue levels worsened in two cases and this was attributed to the difficulties of managing returning to work and/or carer responsibilities whilst trying to recover from a severe illness. We found that PR clinicians were well prepared and able to provide an individualized rehabilitation programme for people recovering from COVID-19.

Introduction

In the Australian healthcare context, it is early days in our understanding of the short and longer term rehabilitation needs of those recovering from coronavirus disease 2019 (COVID-19) (novel coronavirus SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2)). There is strong evidence for the efficacy of pulmonary rehabilitation (PR) for people with chronic respiratory disease [1] and previous literature has also demonstrated the benefits of PR in terms of improvements in exercise capacity and quality of life in survivors of adult respiratory distress syndrome and influenza A (H1N1) pneumonitis [2]. International statements have now suggested that the PR setting may be an appropriate rehabilitation pathway for patients recovering from COVID-19 who have persistent pulmonary and extra-pulmonary symptoms and functional limitations [2–5]. In Sydney, Australia, the Northern Sydney Local Health District (NSLHD) has had 550 cases of COVID-19 (as of 15 July 2020). In preparation for potential rehabilitation referrals, the NSLHD PR service set up a telehealth rehabilitation programme for patients recovering from COVID-19 who have ongoing limitations and/or symptoms that may be amendable to PR (e.g. breathlessness, fatigue, and reduced exercise capacity). As rehabilitation of COVID-19 patients in Australia is in its infancy, we present our rehabilitation model and discuss the management of our first three cases, in order to share our experiences with others who may provide rehabilitation for patients recovering from COVID-19 in the future.

Case Series

Due to pandemic-related constraints, face-to-face PR has not been available in the NSLHD and rehabilitation has

been provided via a virtual telehealth model of care [6]. Patients recovering from COVID-19 were eligible to participate in the rehabilitation programme if they were referred from acute or community providers and had access to a video conference device. There was close collaboration with the PR and acute care teams for a thorough handover at hospital discharge including outcome measures, where possible (Table 1).

The COVID-19 telehealth rehabilitation programme consisted of (1) a comprehensive initial rehabilitation assessment with a physiotherapist for identification of symptoms and physical impairments that were considered treatable (i.e. treatable traits) [7] within the PR context [8]; (2) an initial six-week rehabilitation programme, with weekly contact by a physiotherapist with multidisciplinary team (MDT) input as required; and (3) a reassessment using the same outcome measures as at initial assessment (Table 1).

Outcomes considered amenable to PR included fatigue, assessed by the Fatigue Severity Scale (FSS), dyspnoea, assessed by the modified Medical Research Council (mMRC) dyspnoea scale, and exercise capacity, assessed using the five-repetition sit-to-stand test (5STS) and the 1-min sit-to-stand test (1minSTS). Prior to the initial assessment, a pulse oximeter (Onyx Vantage Red; Fairmont Medical, Australia) was delivered to the patients' homes to monitor heart rate and oxygen saturation during exercise testing (and training). This monitoring was considered important to mitigate adverse events and to gauge physiological response to exercise. An oxygen desaturation of ≥3% was determined as the point to stop exercise and request a medical review [9]. The exercise tests (5STS and 1minSTS) were conducted via video conference with the patient in full view, seated on a chair with its back against a wall. Screens of cognitive function, using the Montreal Cognitive Assessment (MoCA) blind version, and anxiety and depression, using the Hospital Anxiety and Depression Scale (HADS), were also completed. All questionnaires were posted or emailed to the patients. Patients were also asked to complete an experience measure after six weeks of rehabilitation. The rehabilitation programme prescribed for each patient was individualized to target identified treatable traits [7,8] and consisted of symptom monitoring and management strategies (e.g. breathless management techniques, breathing exercises, and energy conservation), unsupervised home-based exercise training, advice regarding daily physical activity, and education from the MDT (e.g. nursing, physiotherapy, dietetics, psychology, and occupational therapy).

The exercise prescription of intensity, duration, frequency, type, and mode [10] aimed to return the patients to their pre-morbid fitness levels. Patients were instructed to exercise on four days per week initially and to build up to six days a week [11]. Initially, the mode of aerobic exercise training was ground-based walking training [12] with a low starting intensity, that is, a breathlessness or fatigue score of <3 ('moderate') on the modified 0–10 Borg category-ratio scale. Duration of walking training was commenced between 5 to 10 min and progressed to 30 min [11]. For patients who were experiencing excessive fatigue and breathlessness, intermittent exercise was prescribed starting with 2-min intervals with a 1-min rest [11]. A rest day in between exercise sessions was also advised, if needed. Strengthening exercises were also prescribed with a focus on large muscle groups (exercise examples: sit-to-stand, heel raises, lunges, bicep curls with hand weights, wall push ups, and tricep dips). Initially, two sets of 10 repetitions were prescribed. Progression of strength training was based on symptoms during and after exercise with weights added as tolerated [11].

A COVID-19 recovery diary was provided to all patients which included advice regarding mental and physical recovery, management of symptoms, and an exercise diary with space to record levels of effort, fatigue, heart rate, and oxygen saturation. Patient cases were reviewed in a weekly MDT meeting to ensure all patient needs were met.

Patient characteristics together with impairments identified during initial rehabilitation assessment are presented in Table 2. All patients had moderate to severe signs and symptoms related to COVID-19 on hospital admission. On commencement of rehabilitation, all patients were initially in physical isolation at home, either due to still being COVID-19 positive (Cases 1 and 3) or because of social restrictions (Case 2).

Outcome measures at hospital discharge, commencement of rehabilitation, and after six weeks of rehabilitation are presented in Table 1. Patients demonstrated improvements from commencement of rehabilitation to the six-week time-point on the 5STS and 1minSTS.

All patients scored within the normal range on the MoCA (although all had some difficulty with the memory recall question) and on the HADS at commencement; however, depression score worsened in Case 2 at the six-week time-point. Fatigue score on the FSS also worsened at the six-week time-point in Case 2 and Case 3 and, when questioned, both patients reported feeling the burden of returning to normal daily duties, work, and carer roles whilst still recovering from COVID-19 which contributed to their feelings of increased fatigue and low mood. In Case 3, quarantine adversely affected family life and caused psychological strain as social support services were unable to visit the home until the patient was COVID-19 negative. Interestingly, at commencement of PR, all patients reported feeling uncertain about what they should and should not be doing during their recovery from COVID-19 and being unsure of their long-term prognosis.

Table 1. Outcome measures from hospital discharge and PR assessments.

	Case 1			Case 2				Case 3			
	Baseline PR	After six weeks of PR	Change after PR	D/C from hospital	Baseline PR	After six weeks of PR	Change after PR	D/C from hospital	Baseline PR	After six weeks of PR	Change after PR
5STS (sec)	10.66	5.04	−5.62	14.82	11.48	8.45	−3.03	22	18	13.18	−4.82
1minSTS (reps)	26	46	26	23	27	32	5	14	18	22	4
Dyspnoea, (rest/ exertion)	0/2	0/2		0/1	0/1	0/3		N/A	0/2	0/4	
HR, bpm, (rest/ exertion)	82/103	71/105		78/102	85/110	80/129		N/A	75/83	72/85	
SpO_2, % (rest/ exertion)	96/96	98/99		97/96	97/96	99/99		N/A	97/97	98/98	
FSS	9	9	0	N/A	20	33	13	N/A	13	29	16
mMRC	0	0	0	N/A	2	1	−1	N/A	2	2	0

1minSTS, 1-min sit-to-stand test (higher reps indicate better capacity); 5STS, five-repetition sit-to-stand test (lower time indicates better capacity); bpm, beats per minute; D/C, discharge; FSS, Fatigue Severity Scale (lower score indicates less symptoms); HR, heart rate (from 1minSTS test); mMRC, modified Medical Research Council dyspnoea scale (lower score indicates less symptoms); N/A, not available; PR, pulmonary rehabilitation; reps, repetitions; SpO_2, oxygen saturation (from 1minSTS test).

Table 2. Clinical characteristics of cases and hospital admission details.

	Case 1	Case 2	Case 3
Age (years)	73	59	80
Gender	Male	Male	Male
Height (m)	1.70	1.84	1.80
Weight (kg)	68	87	97
BMI (kg/m^2)	24	26	29
Diagnostic features on hospital admission	Onset of non-productive cough and fatigue. Home quarantine initially. Worsening dyspnoea and productive cough by Day 11	One-week history of fever, non-productive cough, dyspnoea, pleuritic chest pain, and diarrhoea. Respiratory distress	Dyspnoea for five days. Dry cough especially nocturnal. Night sweats
Blood	Elevated CRP, D-dimer, and ferritin. Lymphopenia	Elevated CRP and D-dimer. Lymphopenia	Elevated CRP, procalcitonin, D-Dimer, lymphopenia
Chest X-Ray/CT	Bilateral peripheral pulmonary infiltrates	Bilateral GGO	Bilateral peripheral pulmonary GGO infiltrates
SpO_2 on room air (%)	88	93	91
Respiratory rate/min	36	28	28
Heart rate (bpm)	79	78	99
Temperature (degrees)	38.0	39.8	38.0
PCR	COVID-19 +ve	COVID-19 +ve	COVID-19 +ve
Acute admission, management	Admitted to ICU Augmentin and azithromycin Hydroxychloroquine VTE prophylaxis Supplemental oxygen. Nasal high flow	Managed on a general medical ward (no ICU on site) Augmentin and azithromycin Hydroxychloroquine VTE prophylaxis Supplemental oxygen	Admitted to ICU Augmentin and doxycycline Diuretics and fluid restriction VTE prophylaxis Supplemental oxygen. Nasal high flow
ICU length of stay (days)	3	0	1
Hospital length of stay (days)	9	12	15
Comorbidities	Diabetes Hypertension	Nil	Nil
Social history/pre-morbid function/ activity level/work status	Lives with wife High physical activity Daily strenuous walk/hike 30 min Intermittent work	Lives with wife and dependent child High physical activity Nil structured exercise Full-time work	Full-time carer for wife Moderate physical activity Structured exercise twice/week—5 km walk Retired

Table 2. Continued

	Case 1	Case 2	Case 3
Impairments identified at PR assessment	Fatigue Dyspnoea on moderate exertion Reduced exercise capacity Weight loss Altered taste Gait dysfunction	Fatigue Dyspnoea on minimal exertion Reduced endurance with ADLs Cognitive fatigue Weight loss Altered taste Chest tightness Muscle weakness Poor sleep	Fatigue Dyspnoea on minimal exertion Reduced exercise capacity Reduced endurance with ADLs Cognitive fatigue Weight loss Altered taste Chest tightness Muscle weakness Poor sleep

+ve, Positive; ADLs, activities of daily living; BMI, body mass index; bpm, beats per minute; COVID-19, coronavirus disease 2019; CRP, C-reactive protein; CT, computed tomography; GGO, ground-glass opacity; ICU, intensive care unit; PCR, polymerase chain reaction; PR, pulmonary rehabilitation; SpO_2, oxygen saturation; VTE, venous thromboembolism.

With regards to adherence and progression of exercise training, Case 1 was highly compliant, completing all sessions as instructed as he had the time to focus entirely on his rehabilitation. In contrast, Case 2 and Case 3 progressed more slowly and only completed one to two sessions for the first three weeks before increasing compliance to the four to six days as prescribed. Both patients reported higher baseline symptoms of breathlessness and fatigue and had family and work demands competing with time for rehabilitation. Of particular interest, 11 weeks after the onset of COVID-19 symptoms, Case 2 was reporting persistent dyspnoea that seemed disproportionate to his recovery and a respiratory physician consultation was arranged. A mild restrictive pulmonary defect was identified on pulmonary function testing. A computed tomography pulmonary angiogram demonstrated persisting bilateral ground-glass opacities and a small pulmonary embolism affecting a segmental artery in the right middle lobe. The patient was commenced on therapeutic anticoagulation therapy and the patient's dyspnoea subsequently improved, as did his exercise capacity. Although a higher incidence of pulmonary embolism has been reported in COVID-19 [13], it is likely that the patient's dyspnoea was predominantly related to his persisting pulmonary infiltrates.

Feedback regarding the programme from the patient experience measure was highly positive with patients reporting that they had significantly improved their confidence in what to do during their recovery. Other reported benefits that aided recovery included management of symptoms during increasing functional demands, support whilst transitioning out of quarantine and physical isolation, and having the rehabilitation programme structure along with the MDT education.

Discussion

Since the outbreak of COVID-19, reports have focused on acute patient management but there is now a shift towards the longer term recovery needs of people with COVID-19. In this case series, we have presented our telehealth COVID-19 rehabilitation model and discussed the management of our first three patients. The programme delivered by PR clinicians was feasible and acceptable to patients. We believe it is valuable to provide early support to people recovering from COVID-19 and to be aware that demands related to employment and carer roles may be challenging for patients recovering from COVID-19. When providing rehabilitation via telehealth, clinicians need to be aware of some special considerations including the inability to complete comprehensive exercise testing, the need to closely monitor patients, and to have a low threshold for requesting medical reviews. To maximize rehabilitation via telehealth,

videoconferencing is recommended as the preferred method for consultation and access to pulse oximeters was felt to be important so that some level of physiological monitoring was available when providing rehabilitation via telehealth. For patients who may not have access to technology or devices, healthcare providers should consider purchase of these in rehabilitative funding models. Our patients had moderate to severe COVID-19 with relatively short hospital stays. For patients who are recovering from longer intensive care unit (ICU) stays and who may present with post-ICU syndrome [14], more intensive face-to-face rehabilitation may be required. A recent guideline provides expert consensus around rehabilitation, including a suggested core set of outcomes for people recovering from COVID-19 and this should be referred to when planning future COVID-19 rehabilitation programmes [2]. This is a single-centre report and the number of cases is limited; however, the case series indicates that rehabilitation via telehealth for people recovering from COVID-19 is feasible and safe when provided by experienced PR clinicians.

Disclosure Statements

Appropriate written informed consent was obtained for publication of this case series.

At the time when this report was written, the authors declared that the patients in this report had not been included in any previously published report on COVID-19 that they had authored.

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