CASE STUDY

A Brief Program of Pulmonary Rehabilitation is Effective for Intensive Care Unit Survivor with Post-Covid-19 Infection

Suriah Ahmad[1], Nur Ayub Md Ali[2], Katijjahbe Md Ali[1,3]

[1] Physiotherapy Unit, Universiti Kebangsaan Malaysia Medical Centre, Malaysia
[2] Cardiothoracic Unit, Heart and Lung Centre, Universiti Kebangsaan Malaysia Medical Centre, Malaysia
[3] Physiotherapy Department of Nursing and Allied Health, School of Health Sciences, Swinburne University of Technology, Australia

ABSTRACT

This case study described a successful pulmonary rehabilitation program (PRP) for an 18-year old female of intensive care unit (ICU) survivor. This patient had a history of COVID-19 infection and ventilated for 14 days with a total six weeks hospitalization. The patient presented with post COVID-19 syndrome and with sensorimotor axonal polyneuropathy on discharged from ICU. Her comorbidity includes epilepsy and newly diagnosed diabetes mellitus. She was referred to our outpatient clinic with reported physical limitation and dyspnea. She has marked reduction in grip and ankle strength, reduced exercise tolerance and was wheelchair-bound. She underwent five sessions of PRP which consists of aerobic conditioning, strengthening, balance, stretching and walking exercise. Following the completion of PRP, the patient regained walking ability without foot drop, increased gait speed, had good balance and coordination, better hands grip, and exercise tolerance. PRP plays an important role for optimal recovery of patient with post COVID-19 syndrome.

Keywords: COVID-19, ICU survivor, polyneuropathy, pulmonary rehabilitation

Corresponding Author:
Nur Ayub Md Ali
Email: drnurayub@gmail.com
Tel: 03 – 91454866

INTRODUCTION

COVID-19 is a highly infectious respiratory disease which has infected more than 199 million people worldwide and resulted in 4.2 million deaths so far (WHO 2021). Scientific evidence shows that patients who undergo invasive ventilation in intensive care unit (ICU) have a 50% of prevalence developing respiratory and limb muscle weakness (Medrinal et al. 2020). It is therefore reasonable to expect that a large proportion of COVID-19 ICU survivors will develop such weakness.

Tankisi et al. (2020) reported critical illness myopathy and polyneuropathy as the consequences of COVID-19 infection, with symptoms of foot drop due to weakness of ankle dorsiflexors muscles. Acute unilateral foot drop is a common presentation, however bilateral foot drop is rare, as there are limited number of data been reported. The compression of deep peroneal nerve, common peroneal nerve, or sciatic nerve are the most common aetiology of unilateral foot drop (Stewart 2008). Unilateral compression neuropathy for lower extremity is commonly presented, caused by peroneal nerve palsy. Peroneal nerve entrapment is often caused by external compression commonly following anaesthetic drugs, prolonged hospitalization, limb casting, tight bracer, compression wrapping, and pneumatic compression device usage (Poage et al. 2016).

Guidelines from an international team of expert physiotherapy researchers and clinicians recommended early physiotherapy in the ICU to prevent ICU-acquired weakness (Thomas et al. 2020). Based on the individual deficits in COVID-19 patients, various international expert groups suggested comprehensive multidisciplinary rehabilitation such as pulmonary rehabilitation to improve respiratory, physical and psychological impairments (Spruit et al. 2021; Polastri et al. 2020; Vitacca et al. 2020). Pulmonary rehabilitation was a feasible, safe, and effective therapeutic option for COVID-19 patients independent of the disease severity (Gloeckl et al. 2021). PRP for ICU survivor with post-COVID-19 infection results in improvements of patient reported outcomes, namely dyspnoea, limbs strength and exercise capacity (Thomas et al 2020; Vitacca et al.2020; Parker et al. 2021). To date there have been limited reports i.e., a few case studies and series internationally but none in Malaysia on recovery and rehabilitation in COVID-19 patients using PRP (Parker et al. 2021; Negrini et al. 2020; Gloeckl et al. 2021). Therefore, in this paper, we report our findings for a COVID-19 ICU survivor of patient recovery and rehabilitation following PRP.

CASE STUDY

An 18-year-old post COVID-19 female patient with a background history of epilepsy was referred to us on 7th May 2021 for PRP. The patient presented to Emergency Department (ED) with history of unresponsiveness in addition to urinary incontinence, fever, and headache for two days with shortness of breath. She was then tested positive with COVID-19 and newly diagnosed with diabetes at ED ward with blood glucose 36 mmol/L. She was treated as diabetic ketoacidosis (DKA) with hyperosmolar hyperglycaemic state (HHS) secondary to sepsis. She was intubated for airway protection for 14 days and subsequently developed foot drop during ICU hospitalization. During her ICU stay, she developed ICU-acquired weakness with MRC scale less than 48. The Nerve Conduction test (NCS) was used to evaluate neuromuscular integrity with results showed sensorimotor axonal polyneuropathy.

The patient was hospitalized in the ICU for a total of 23 days, and transferred out to medical ward for eight days before being discharged home. She was referred for PRP as an outpatient at four days after discharge. She was accompanied by a caregiver, wheelchair-bound when attending our PRP. Initial examination using the Manual Muscle Testing (MMT) showed her bilateral shoulder flexion, elbow flexion, and wrist extension power were at 3/5; while the power of hip flexion, knee flexion, and ankle dorsiflexion were 2/5, 3/5 and 1/5 respectively with MRC scale less than 48. Modified Dyspnoea Borg's scale was 7 in resting position. Patient was not able to perform 6-minute walking test (6 MWT), with marked desaturation (to 90%) during 6-minute walk test.

During the first session, an electrical muscle stimulation was administered to her ankle dorsiflexor bilaterally (parameter setting: pulse rate 150hz, pulse width 300ms, output intensity 45mA). We started a structured PRP of 60 minutes duration consist of upper limbs (UL) and lower limbs (LL) strengthening, aerobic, balance, and stretching exercises. Functional gait training was facilitate using a walker. Additionally, the patients were given a home exercise booklet that include strengthening, endurance and balance exercises, and re-education on functional training walking for home exercise. On her second visit, she was able to walk independently with a high stepping gait accompanied by a caregiver. She was compliance to her home exercise booklets as instructed daily. She showed progress on her UL and LL with her MMT measurement. Prior to physiotherapy treatment, her MMT for bilateral UL with shoulder flexion was 4/5, elbow flexion was 4/5, and wrist extension was 5/5. Similarly, for her LL MMT with hip flexion 4/5, knee flexion 4/5, and ankle dorsiflexion was 2/5 with MRC total score less than 48. Modified Dyspnoea Borg's score was 0 in the resting position. She completed the 6MWT and achieved 180m distance but with high stepping gait. Therefore, we stopped electrical stimulation and continue with functional exercise for the PRP second session. We added endurance type exercise training with moderate intensity targeted Borg Rating of Perceived Exertion (RPE) between 12 to 14. Patient was instructed to rate her exertion on the scale during exercise activities. The mode of exercise includes cycling (15 minutes), walking (10 minutes), stepping on 1-inch step board (10 minutes) and strengthening exercise of bilateral UL and LL for a total duration of 60 minutes. Exercises intensity was progressed for 5 – 10% weekly for both UL and LL from the previous exercise prescription. Each muscles group were prescribed with 8 – 12 repetitions (2 – 4 sets), two minutes rest, with frequency of two to three sessions weekly. We advised the patient to increase walking for 20 – 30 minutes daily as tolerated.

After the ninth week (3rd session), she was able to walk with normal gait independently and completed 6MWT with 350m walking distance. Her MMT for bilateral shoulder flexions, elbow flexions, wrist extensions, hip flexions, knee flexions, and ankle dorsiflexion restored power of 5/5 with MRC score of 60. Modified Dyspnoea Borg's score was 0 at resting position. Similarly, with previous prescription, the patient was instructed to rate her exertion on the scale during exercise activities with targeted RPE between 12 to 14. The mode of exercises was progressed with cycling (15 minutes), walking (20 minutes), stepping on 1-inch step board (10 minutes) and strengthening exercise of UL and LL (15 minutes) for total duration of for 60 minutes with frequency of three sessions weekly.

After four months (5th session) of brief PRP, she had restored her pre-COVID-19 functional status. Her 6MWT completed with distance achieved at 534m. She achieved normal grip strength measured using JAMMAR with 30kg for right hand and 28kg left hand in comparison with a healthy population reference range of similar for her age and sex (Massy-Westropp et al. 2011). She has resumed her study and able to travel around independently without any residual symptoms. We continued her exercises prescription with targeted RPE between 12 to 14. The mode of exercises prescribed maintained with cycling (15 minutes), walking (20 minutes), stepping on 1-inch step board (10 minutes) and strengthening exercise of UL and LL (15 minutes) for total duration of for 60 minutes with frequency three sessions weekly. Table 1 shows the outcomes at week 1, 3, 6, and 16.

DISCUSSION

Our findings offer first insight into the recovery of post COVID-19 ICU survivor in Malaysia. This is the first case of post Covid-19 syndrome presented with sensorimotor axonal polyneuropathy that underwent a brief PRP. Anecdotally, our experience in treating ICU COVID-19 survivor with brief PRP has indicated a recovery from acute post COVID-19 symptoms. Our report shows that

Table I: Results of outcome measures used at week 1, week 3, week 9 and week 16

Week Post Hospital Discharged	Ambulation status	Medical Research Council (MRC)	MMRC Dyspnea score	Borg's score at rest	6MWD	Hand grip	
						Right	Left
Week 1	Wheelchair	30	4	0.5	Unable to perform	15kg	14kg
Week 2	Walk independently with close supervision (high stepping gait)	46	2	0	180m	-	-
Week 9	Walk independently	60	1	0	350m	-	-
Week 16	Walk independently	60	0	0	534m	30kg	28kg

PRP is feasible (despite low adherence rate of pulmonary rehabilitation sessions), is safe with no adverse events, and beneficial to improve exercise performance and quality of life for post COVID-19 ICU survivor. To the best of our knowledge, this is the first case study investigating the effects of a pulmonary rehabilitation in ICU survivor post COVID-19 patient in Malaysia.

In a recent systematic review, Negrini et al. (2020) reported the level of evidence of PRP in COVID-19 patients to be low. However, our case study indicates that recovery of exercise performance can be accelerated when COVID-19 patients was referred to pulmonary rehabilitation after the acute phase of the disease. This result is consistent with other study based on 6MWD, suggesting of improvement by a minimal important difference of 30m in patients with respiratory diseases (Gloeckl et al. 2021).

A significant proportion of ICU COVID-19 survivors require physiotherapy as part of their recovery. Healthy patients with mild symptoms of COVID-19 might need a few sessions, while more severely ill patients might need a few months of rehabilitation similar to our case study which is tailored to her needs. We believed that a PRP that consists of a structured exercise program incorporated with progressive aerobic, balance, and strengthening exercises improved patient's reported limited physical limitation, dyspnoea, UL and LL strength as well as quality of life for ICU survivor post COVID-19.

Our exercises prescription and very early rehabilitation in outpatient setting (within four days after discharge from the hospital) enable her to resume her studies. Furthermore, the patient was very compliant to her home exercise prescription with five times frequency weekly without supervision. Her adherence toward PRP at the hospital and home program reflected in her excellent recovery following COVID-19 despite our limitation during the movement control order (MCO) period with 70% reduction of face-to-face appointment. However, the five sessions of supervised physiotherapy session within four months and five sessions of unsupervised weekly at her own time had improved her condition beyond expectation.

We assessed muscle strength using both the MRC scale and handgrip dynamometry. These tools have been recommended as standard tools for diagnosis of ICU-acquired weakness and the associated post-intensive care syndrome (Van Aerde et al. 2021; Jaffri A & Jaffri UA. 2020; Ulutaş et al. 2021). The MRC was assessed in 12 muscle groups and then individual scores are combined into a sum-score, which result in an overall estimation of motor function. Summed scores below 48 out of 60 and below 36 out of 60 indicate significant and severe weakness, respectively (Van Aerde et al. 2021; Jaffri A& Jaffri UA. 2020; Ulutaş et al. 2021). Similarly, hand-held dynamometry is a reliable and objective measure of global strength in physical impaired subjects and can be used to assess and monitor strength recovery in the longitudinal follow- up time (Ulutaş et al. 2021). Hand-held dynamometry was reported as a reliable tool in critically ill patients who had powerful enough strength to overcome gravity (MRC ≥3) in lower and upper muscles (Van Aerde et al. 2021; Vanpe et al. 2011).

We have observed significant physical weakness based on the MRC and handgrip dynamometry measurement in critically ill patient recovering from COVID-19, highlighting the need for ongoing physical rehabilitation in COVID-19 ICU survivors. Detailed analysis of both ICU care and early follow-up of COVID-19 patients may allow identification of the most favourable management strategies of patients with severe COVID-19 (Parker et al. 2021). A limitation of this study is that it is a single case study and therefore, our findings may not reflect the general outcomes of PRP in ICU survivors.

CONCLUSION

Our case study shows that a brief PRP is effective, feasible, and safe for post COVID-19 ICU survivor. PRP is an important component in helping patients to return to their optimum level of independent activities of daily living.

ACKNOWLEDGEMENTS

The authors would like to thank Zamsuril Lok, Nurdiyana Ismail, and Aimi Munirah Abdul Rahman for their support and contribution to the trial. We also wish to thank the cardiorespiratiory staff at the Physiotherapy Unit and Heart & Lung Centre, Hospital Canselor Tuanku Muhriz, Kuala Lumpur.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

FUNDING

This study did not receive any funding.

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