Rehabilitation of a Post–Intensive Care Unit Patient After Severe COVID-19 Pneumonia

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Abstract: The recent novel severe acute respiratory syndrome coronavirus 2 infection resulted in a coronavirus disease 2019 pandemic that significantly strained healthcare systems globally. The early wave of patients in Singapore with severe pneumonia requiring intensive care units are gradually being referred for post–critical illness management with our inpatient medical rehabilitation unit. There is growing information regarding the actual rehabilitation process for patients severely affected by coronavirus disease 2019. This case report shares experiences and challenges faced during rehabilitation of severe coronavirus disease 2019 pneumonia and post–intensive care syndrome. It also describes the post–discharge rehabilitation program in a setting of strict nationwide safe distancing and stay-home policies.

Key Words: Rehabilitation, COVID-19, Pneumonia, Intensive Care Units

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Coronavirus disease 2019 (COVID-19) was first reported in Wuhan, China, in December 2019,[1] swept across the world rapidly, and declared a pandemic by the World Health Organization on March 11, 2020.[2] Singapore had its first confirmed case on January 23, 2020, and although initial numbers were small, this increased exponentially with 10,000 cases on April 22, 2020, doubling 2 wks later to more than 20,000 cases.[3]

In Singapore, most COVID-19 cases are managed by public hospitals under the Ministry of Health. There were a total of 1004 cases as of May 20, 2020, with 22 deaths and 10 patients classified as critically ill.[3] Previous publications indicated that 5%–12% of patients become critically ill, require intensive care unit (ICU) admission, and possibly mechanical ventilation.[4,5] However, the vast majority of our cases were young, only needing monitoring and care at work dormitories or community quarantine facilities with medical teams stationed.

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Singapore General Hospital (SGH), the largest tertiary academic healthcare institution under the Ministry of Health, takes many cases, especially those requiring specialized support such as Extra Corporeal Membrane Oxygenation. The Department of Rehabilitation Medicine at SGH has almost 50 postacute rehabilitation beds for complicated patients including with brain injury, spinal cord injury, and cancer.

There are publications on COVID-19 complications including neurological (dizziness, headache, impaired consciousness, acute cerebrovascular disease, ataxia, seizure, taste, smell and visual impairment, nerve pain) and cardiovascular (pulmonary embolism, deep-vein thrombosis, ischemic stroke, myocardial infarction, systemic arterial embolism), as well as critical illness neuropathy, myopathy, and general deconditioning.[6–8]

However, details regarding the actual rehabilitative process and ensuring continuum of rehabilitation care have been relatively limited. It is important to have adequate facilities, healthcare provider protection, triage process, patient management and therapy protocols, and discharge planning accounting for national infection prevention policies.[9]

PATIENT BACKGROUND

This study conforms to CAse REports (CARE) guidelines/requirements (Supplemental Checklist, Supplemental Digital Content 1, http://links.lww.com/PHM/B142), and patient had given written informed consent. The patient, a 64-yr-old man with no significant medical history, presented at SGH on February 6, 2020 with falling, lethargy, generalized weakness, and without localizing neurological deficits. His reverse-transcription polymerase chain reaction was positive for SARS-CoV-2 RNA, possibly acquired occupationally as a taxi driver having sustained contact with foreign tourists. He was promptly isolated and started on intravenous antibiotics coverage and oral combination lopinavir/ritonavir. Unfortunately, he continued to deteriorate and 2 days later, required intubation and ICU transfer for type I respiratory failure with acute respiratory distress syndrome. A tracheostomy was placed, and he was successfully transferred out after 12 days. Seven days later, however, he was readmitted to ICU with respiratory difficulty and recurrent pneumonia for another 15 days.

His step-down isolation-ward team was headed by a rehabilitation physician (physiatrist/physical and rehabilitation medicine physician) deployed for acute care services who quickly initiated a rehabilitation program. The tracheostomy was ultimately decannulated on April 6, and he was sent to the inpatient rehabilitation unit on April 8.

THE REHABILITATION UNIT

The rehabilitation problem list included the following: (1) proximal myopathy; (2) postcritical illness musculoskeletal

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deconditioning; (3) bilateral hand tremors from weakness; (4) pulmonary deconditioning; (5) poor endurance and effort tolerance; (6) moderate oropharyngeal dysphagia; and (7) psychoemotional issues, fatigue, and poor appetite.

He was able to walk 60 m supervised but had poor effort tolerance requiring frequent rest intervals. His initial 6-min walk test, bilateral hand-grip strength, and psychoemotional measures are detailed in Table 1. He was on nasogastric tube feeding but was also taking honey-thick consistency food orally. He had a persistent low mood and was unmotivated for therapy.

Personal protective equipment (PPE) used during inpatient rehabilitation followed hospital guidelines for COVID-19–cleared patients in nonisolation general wards. This included only surgical mask for healthcare providers (physicians, nurses, therapists, porters), while patients used a surgical mask or reusable face covering unless eating or drinking. The mask was compulsory during transportation to gyms but could be removed during actual therapy sessions. Patient numbers in the rehabilitation gyms were restricted to allow safety distancing of 2 m. Rehabilitation equipment was cleaned with 70% isopropyl alcohol wipes after each use. Procedures that generated aerosolized particles, eg, chest physiotherapy with coughing, suctioning, intubation, or tracheostomy care, required N95 mask, eye protection goggles or face shield, gown, and gloves. Nebulizers were discouraged and spacer devices used for drug delivery. If powered air-purifying respirator was used as alternative to N95 mask, PPE would then comprise powered air-purifying respirator, surgical mask, gown, and gloves.

TABLE 1. Outcome measures: Rehabilitation unit admission versus discharge

Outcome Measures	Admission	Discharge
6-MWT, m	194	272
Grip strength, kg		
Right	16.0	26.7
Left	24.6	32.0
PHQ-9	3	1
Functional Independence Measure		
Eating	1	6
Grooming	6	6
Bathing	4	5
Dressing upper body	5	5
Dressing lower body	5	5
Toileting	5	5
Bladder management	5	6
Bowel management	5	6
Transfers (bed–chair)	5	5
Transfers (toileting)	4	5
Transfers (shower)	4	5
Locomotion	5	6
Equipment + distance, m	60 m with supervision	140 m with modified independence
Stairs	1	1
Comprehension	7	7
Expression	7	7
Social interaction	7	7
Problem solving	7	7
Memory	7	7
Total FIM score	95	101

6MWT, 6-min walk test; FIM, Functional Independence Measure; PHQ-9, Patient Health Questionnaire 9.

The rehabilitation program addressed physical impairments as well as psychoemotional needs. His respiratory condition had improved and was not requiring supplementary oxygen or chest physiotherapy. He was instructed and reminded on use of incentive spirometer at least 15 mins thrice daily, with tidal volume goal of greater than 400–600 mL per breath, 10–20 breaths per minute. Physiotherapy included standing balance, tolerance training with weights, progressive resistance, progressive ambulation with decreasing interval resting, and circuit training with half-squats.

He did not require extensive occupational therapy as self-care ability recovered quickly. However, a virtual home assessment was done using smartphone photographs, also discussions, and advice on safety issues with family. Speech therapy followed the McNeill Dysphagia Therapy Program, and he was taught maximal-effort hard swallows to improve feeding safety. Nasogastric tube supplementary feeding stopped on April 15, once oral feeding was deemed safe and adequate.

Psychoemotional issues received frequent support and encouragement from the physiatrists, therapists, and medical social worker. He needed meal delivery arrangements as he lived alone and family was reluctant for his discharge fearing him being still contagious.

DISCHARGE PROGRAM

The patient did well (discharge outcomes: Table 1) and was discharged on April 18, 2020, amid nationwide restrictions including stay-home rules except for essential activities. Leaving home for exercise was allowed but only with masking and only around the immediate neighborhood. Outpatient and home-based rehabilitation therapies were banned except for patients with special needs, an exemption for which he did not qualify.

His post–hospital discharge rehabilitation program was customized. It included printed materials on independent home exercises: (1) calisthenics, walking, and stair climbing; (2) range-of-motion exercises; (3) limb-strengthening exercises; (4) energy conservation including body mechanics, pacing, advanced planning, and activity prioritization; (5) diaphragmatic breathing exercises; (6) assistive walking devices; and (7) emergency contacts.

The program was monitored, reinforced, and with reviews on psychosocial emotional state using his smartphone. We ensured that he was able to use video conferencing Apps (he had WeChat and WhatsApp) and prearranged for telephone or online connection 2–3 times weekly with our rehabilitation team. Initial follow-up sessions were voice calls while awaiting time slot bookings for videoconferencing on a corporate Zoom account. SingHealth has an App "Health Buddy," which allows patients to view appointments and payments. It provides resources including online home therapy exercise instructions and videos, and he was taught how to access these.

DISCUSSION

During our previous encounter with SARS-CoV in 2003, physiatrists were first deployed for general medicine work. Where

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possible, patients with stroke, amputation, and other rehabilitation diagnoses were preferentially sent to medical units covered by physiatrists. Other rehabilitation consultations and reviews were performed over telephone.[10]

With SARS-CoV-2, physiatrists are again deployed to cover COVID-19 wards but also continue to run inpatient medical rehabilitation units. It has been suggested that there might be increased transfer pressure from acute services to allow room for COVID-19 patients, and indeed our rehabilitation unit has been full.[11] However, physiatrists deployed to acute care and isolation facilities also allow early functional assessment and quick addressing of rehabilitation needs.

Our infection prevention protocols for post–COVID-19 patients are similar to South Korea and elsewhere, including hand washing, equipment disinfection, frequent symptom checking, mask wearing, and staff safe distancing.[12,13] Patients then required two negative reverse-transcription polymerase chain reaction swab tests, absence of fever, and respiratory symptoms before transfer to rehabilitation units.

Patients with more severe complicated COVID-19 disease requiring ICU care have impairments and disabilities better managed by specialist medical rehabilitation units as summarized by the British Society of Rehabilitation Medicine.[14] An additional consideration is the drastic curtailment of outpatient, home-based, and community day rehabilitation services as has been reported in Italy.[11] We have several experiences applicable in other countries.

Comfort Level

Healthcare provider fear of infection and transmission to families is very real. Our rehabilitation care staff, however, did not have significant concerns with COVID-19 patients based on informal discussions, observations, and interactions. Possible reasons included constant communications and updates, ready availability of PPE, faith in the medical system, established protocols and procedures, and past encounters with SARS in 2003 and H1N1 influenza in 2009.[10] Veterans from these outbreaks working alongside were probably reassuring for younger staff.

Delayed Rehabilitation

Early rehabilitation in survivors of critical illness has been shown to be safe, with earlier hospital discharge, improved functional recovery, and cost-savings.[15] Before transfer of COVID-19 patients, however, a protocol is needed for infectivity risk, appropriate PPE, referral, and triage of patients for the rehabilitation unit. There was delay from out of ICU until rehabilitation unit including awaiting COVID-19 test results but this was mitigated by our physiatrists deployed to acute care units initiating early rehabilitation assessment and management.

A recent position statement reported that active viral replication dropped quickly after the first week of symptom onset and viable virus not found after second week of illness.[16] This suggests possibility of earlier admission for rehabilitation.

Outcome Measures

The quality of evidence for exercise rehabilitation efficacy after ICU discharge on functional exercise capacity and health-related quality of life is very low.[17] Although our patient showed Functional Independence Measure gains from admission to discharge (Table 1), most items only showed 1-point improvement, and Patient Health Questionnaire 9 did not prove very useful. He did, however, show significant improvement with bilateral hand grip strength and 6-min walk test. For patients with mainly pulmonary deconditioning, grip strength and 6-min walk test may be easy and appropriate outcome measures rather than formal pulmonary function tests and may also be useful for monitoring subsequent outpatient progress.

Psychosocial Emotional

The patient quickly improved physically, but psychosocial emotional issues required more attention.[18] His Patient Health Questionanaire 9 results (Table 1) were not diagnostic for depression and improved from 3 to 1. Nonetheless, he had significant daily complaints suggesting guilt and depression, although not suicidal and not requiring antidepressant drugs. He responded well to frequent reassurance, encouragement, and "bedside psychotherapy" intervention.

There were unique psychoemotional issues, namely, social isolation and stigmatization due to fear of contagion. His family and friends had to be reassured repeatedly that he was clear of SARS-CoV-2 virus. Even so, we discovered that they minimized contact with him after discharge. Our therapists and social services provider screened for any worsening psycho-emotional issues and ensured that he had adequate daily necessities during telecommunication sessions. Anxiety was addressed with breathing techniques and heightened surveillance for mood issues.

Telerehabilitation

Telemedicine has been applied to help deal with disruption of rehabilitation services in Italy.[19] With restrictions in ability to provide outpatient, home, and community-based outpatient follow-up sessions, we had to customize a posthospital telerehabilitation program. Hard copies of a home exercise routine were printed and provided, and we created a rehabilitation plan using smartphone for telemonitoring and telesupport. Predischarge arrangements were made to communicate online, check-in, and be available for questions. Our healthcare organization's App with prerecorded exercises videos was helpful.

CONCLUSIONS

The COVID-19 patients with severe respiratory complications and deconditioning after prolonged ICU immobility benefit from comprehensive rehabilitation and physiatrists deployed to acute care can initiate early rehabilitation. There may be significant psychosocial emotional issues relating to posttraumatic stress, survivor guilt, family concern, and fear that the patient might infect them. A protocol for safe, effective, continuum of rehabilitation includes early triage and intervention, appropriate PPE, applicable functional outcome measures, and discharge planning. In an environment with service limitations, telerehabilitation using smartphones is effective.

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