Considerations for post-acute rehabilitation for survivors of COVID-19

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Abstract

Background: Coronavirus disease of 2019 (COVID-19), the infection caused by severe acute respiratory syndrome coronavirus 2, was first reported on December 31, 2019. Because it has only been studied for just over three months, there is still an incomplete understanding of the disease, in particular its sequelae and long-term outcomes. As well, very little has been written about the rehabilitation needs for patients with COVID-19 after discharge from acute care.

Objective: The objective of this report was to answer the question “What rehabilitation do survivors of COVID-19 require?”. The question was stated within the context of a sub-acute hospital delivering geriatric inpatient and outpatient rehabilitation services.

Methods: Literature on COVID-19 and rehabilitation was accessed from April 6 to April 14, 2020. Research papers were accessed through Medline and through websites searched using the terms “COVID-19” or “novel coronavirus”, +/- “rehabilitation”. The terms “critical illness”, “severe acute respiratory syndrome” and “Middle East respiratory syndrome coronavirus”, +/- “rehabilitation” were also searched.

Results: Three areas relevant to rehabilitation after COVID-19 were identified. First, details of how patients might present have been summarized: comorbidities, complications from an intensive care unit stay +/- intubation, and the effects of the virus on multiple body systems, including cardiac, neurological, cognition, and mental health. Second, suggested procedures regarding design of an inpatient rehabilitation unit for COVID-19 survivors, staffing issues, and considerations for outpatient rehabilitation have been made. Third, guidelines for rehabilitation (physiotherapy, occupational therapy, speech-language pathology) following COVID-19 have been made, with respect to recovery of the respiratory system as well as mobility and function.

Conclusions: A thorough assessment and individualized, progressive treatment plan which focuses on function, disability, and return to participation in society will help each patient to maximize their function and quality of life. Careful consideration of the rehabilitation environment will ensure that all patients have the most complete recovery possible.

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Original Manuscript

Viewpoint

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Keywords: COVID-19; rehabilitation; subacute care; inpatient rehabilitation

Introduction

Coronavirus disease of 2019 (COVID-19), the infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first reported on December 31, 2019. Because it has only been studied for just over three months, there is still an incomplete understanding of the disease, in particular its sequelae and long-term outcomes. Knowledge about the disease, its presentation and treatment are changing very rapidly, and guidelines are quickly being created and updated. Therefore, it is important to remain current by engaging in frequent reviews of new research.

The objective of this report was to answer the question “What rehabilitation do survivors of COVID-19 require?”. The question was stated within the context of a subacute hospital delivering geriatric inpatient and outpatient rehabilitation services. Very little has been written about the rehabilitation needs or outcomes for patients with COVID-19 after discharge from acute care. Much of what has been published has been based on expert opinion but not direct observation of the actual trajectories

of COVID-19 patients. Many of the early position papers come from China and Italy, locations which have had the earliest experience with COVID-19, and potentially have insight into the longer-term outcomes and ongoing patient needs. Organizations like the World Health Organization (WHO) and physiotherapy organizations [including the Canadian Physiotherapy Association] have also written acute-care clinical practice guidelines for patients with COVID-19. Some authors have extrapolated on the post-acute patient presentations and rehabilitation needs from patients with similar conditions, such as severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), and sepsis, and from those requiring intensive care unit (ICU) care and assisted mechanical ventilation for other reasons. These suggestions have been included here, and research on these conditions has informed the following regarding patient presentation and rehabilitation. However, the physical presentations of SARS and MERS are different than that of COVID-19, and their patient experiences are not necessarily the same as that of COVID-19 patients. These differences must be kept in mind and notes to this effect have been included below.

As for any patient admitted for rehabilitation after illness, a thorough intake exam performed by the healthcare staff (physicians, nursing, and allied health) is the best way to inform the care given, and to estimate discharge date and destination.

Methods

Literature on COVID-19 and rehabilitation was accessed from April 6 to April 14, 2020. Research papers were accessed through Medline and through websites searched using the terms “COVID-19” or “novel coronavirus”, +/- “rehabilitation”. Papers regarding the sequelae of ICU admission, SARS, and MERS were searched for in the same way, using “critical illness”, “severe acute respiratory syndrome” and “Middle East respiratory syndrome coronavirus”, and “rehabilitation”. All papers relevant to the topic were considered, including those accepted and published online ahead of print. Position papers and statements found through web searches were considered; statements and data taken from these sources were verified through the source documents.

Results

Patient Presentation For COVID-19 Survivors in the Rehabilitation Unit

Comorbidities, direct lung damage from COVID-19, and concurrent injuries to other organs and systems due to COVID-19 are all important to consider when creating a rehabilitation treatment plan for patients recovering from COVID-19.

Comorbidities

The leading comorbid conditions which patients with COVID-19 have are hypertension (55%), coronary artery disease and stroke (32%), and diabetes (31%). [1] COVID-19 patients are less likely to have the following chronic illnesses: liver diseases (9%), chronic obstructive pulmonary disease (7%), malignancy (6%), chronic renal failure (4%), gastrointestinal diseases (3%), central nervous system diseases (<1%), and immunodeficiency (1%). Therefore, survivors requiring prolonged rehab are more likely to be older and to have pre-existing cardiovascular and cerebrovascular disease, which may influence their rehabilitation and outcomes.

Complications From Severe COVID-19

The most likely early complications are acute respiratory distress syndrome (ARDS) and sepsis/septic shock, multi-organ failure, acute kidney injury, and cardiac injury. [1-3] These complications contribute to the need for ICU admissions. [1]

Critical illness polyneuropathy (CIP) is a mixed sensorimotor neuropathy leading to axonal degeneration, which may occur after COVID-19. [4-7] In one study of patients hospitalized in the ICU with ARDS, up to 46% of patients presented with CIP. CIP causes difficulty weaning from mechanical ventilation, generalized and symmetrical weakness (distal greater than proximal, but including diaphragmatic weakness), distal sensory loss, atrophy, and decreased or absent deep tendon reflexes. Associated are pain, loss of range of motion, fatigue, incontinence, dysphagia, anxiety, depression, post-traumatic stress disorder (PTSD), and cognitive loss. Muscle biopsies and electromyographic testing can be diagnostic, but it is unclear how often these are done in the acute care setting after COVID-19.

Critical illness myopathy (CIM), presenting in 48%-96% of ICU patients with ARDS, is a non-necrotizing diffuse myopathy with fatty degeneration, fiber atrophy, and fibrosis. [5-7] It is associated with exposure to corticosteroids, paralytics, and sepsis. The clinical presentation is similar to CIP, but with more proximal than distal weakness, and sensory preservation. For both CIP and CIM, the cranial nerves and facial muscles are preserved. Myopathy recovers more completely and quickly than polyneuropathy; however, for both, weakness, loss of function and quality of life, and poor endurance may persist for up to 2 years, or even longer. These prolonged changes are out-of-proportion with any residual loss of pulmonary function. Research studies on the effect of post-acute care rehabilitation are inconclusive but suggest that comprehensive integrated inpatient rehabilitation is required.

Post ICU syndrome is described separate from CIP and CIM, and is associated with reduced pulmonary function (restrictive pattern), reduced inspiratory muscle strength, and poor knee extensor, upper extremity and grip strength, and low functional capacity. [8] Improvement occurs over a year or more.

SARS-CoV-2 Virus may Persist

COVID-19 patients who have physically recovered and have tested negative twice are deemed to be cured and noninfectious. However, there are reports of patients subsequently testing positive 5-13 days later, using a different manufacturer’s test kit. [9] The virus may also persist in a patient’s oropharyngeal cavity and stools for up to 15 days after they are declared cured of COVID-19 (no fever, no respiratory symptoms, 2 negative swab tests). [10] This is of particular concern for patients intending to be discharged to rehabilitation facilities or long-term care, because they may still be able to transmit disease, potentially infecting other patients/residents. Because of this, an extra 14 days in quarantine, or discharge to a dedicated COVID-19 step-down unit has been recommended. [9,11]

Cardiac Sequelae

In one study [2], 20% of hospitalized patients in China with COVID-19 had associated cardiac injury. These patients were more likely to have comorbidities, require mechanical ventilation, and have other complications (eg, ARDS 59%, acute kidney injury 9%, electrolyte disturbances 16%, hypoproteinemia 13% and coagulation disorders 7%). They also had a much higher mortality (51% vs 5%). The mechanism of cardiac injury is uncertain. Presentations can include arrhythmia, cardiac insufficiency, ejection fraction decline, troponin I elevation, and severe myocarditis with reduced systolic function. [12,13] One brief report profiled a woman with acute myopericarditis/heart failure post-COVID-19. [14] As the research investigating cardiac injury included either cross-sectional studies or cohort studies with short-term follow-up (4 weeks), long-term outcomes are unknown. [12,15] Persistent tachycardia was common after SARS, but tended to resolve itself and was not associated with increased risk of death. The presence of cardiac injury and accompanying comorbidities must be taken into consideration for patients entering rehabilitation.

Neurological Sequelae

Acutely, 36.4% of patients with COVID-19 develop neurological symptoms, including headaches, disturbed consciousness, seizures, absence of smell and taste, and paresthesia. [6,15] Posterior reversible encephalopathy syndrome, causing headache, confusion, seizures and visual loss, is a potential complication of COVID-19. [6] Viral encephalitis has been reported to be caused by COVID-19, and brain tissue edema and partial neuronal degeneration have been found in deceased patients. [16,17] It is hypothesized that COVID-19 could increase one's risk for acute cerebrovascular events. At least one person has had Guillain-Barré syndrome associated with COVID-19; however no causal relationship was determined. [18]

SARS could induce neurological diseases such as polyneuropathy, viral encephalitis, and aortic ischemic stroke. [19] In MERS, almost one-fifth of patients showed neurological symptoms (altered consciousness, paralysis, ischemic stroke, Guillain-Barré syndrome, infectious neuropathy or seizures). [20,21]

Other Body Systems

Those severely affected by COVID-19 are more likely to have acute kidney injury as well as secondary infection. [1,13] Survivors of ARDS with mechanical ventilation have reported complications such as tracheal stenosis, heterotopic ossification, contractures, adhesive capsulitis, decubitus ulcers, hoarseness, tooth loss, sensorineural hearing loss, tinnitus, brachial plexus injuries, and entrapment neuropathies (peroneal & ulnar). [5,22] They also had concerns regarding scaring and changes in appearance due to a variety of causes.

Osteoporosis and avascular necrosis have been reported as sequelae from SARS. [23] These may have been due to the use of corticosteroids, which are not a suggested treatment for COVID-19. [1] It is unknown how prevalent the use of corticosteroids is for COVID-19 in different cities/countries.

Cognitive Sequelae

In one study, after ICU admission (91% were mechanically ventilated), median global cognition scores (measured by the Repeatable Battery for the Assessment of Neuropsychological Status) were on average 1.5 SD below the age-adjusted population mean, and similar to those with mild cognitive impairment. [24] Twenty-six percent had scores 2 SD below the population mean, similar to scores for patients with mild Alzheimer's disease. Repeat testing at 12 months did not show much change. The trend was the same for patients regardless of their age. Cognitive impairment can persist. [5] While 70%-100% may have cognitive impairment at discharge, 46%-80% still have it one year later, and 20% at 5 years. All components of cognition can be affected: attention, visual-spatial abilities, memory, executive function, and working memory. There is a great deal of variation, however.

Psychological Sequelae

From research into ICU admissions for ARDS, adverse psychological impacts have been reported. [5] Even after 2 years, post-traumatic stress disorder PTSD (22%-24%), depression (26%-33%) and general anxiety (38%-44%) are prevalent. These have been reported as concerns post-COVID-19 as well, accompanied by a severe reduction in quality of life and function. [22] One of the greatest risk factors for post-ARDS mood disturbances is premorbid psychiatric illness. Other risks include younger age, female sex, unemployment, alcohol use, and greater use of opioid sedation. Family members, too, may suffer from PTSD, anxiety, and depression, and difficulty managing their new role of caregiver. [5]

Suggested Procedures for Post-COVID-19 Rehabilitation

After discharge from acute care, some patients who have recovered from the acute respiratory effects of COVID-19 will need further rehabilitation. How many may need post-acute care? In one study, thirty percent of patients hospitalized with sepsis (which has a similar mortality rate to COVID-19) required facility-based care; another 20% required home health care [25].

Design and Procedures for an Inpatient Rehabilitation Unit

These suggestions regarding the design of an inpatient rehabilitation unit in this time of COVID-19, and procedures to be followed, have come from the experiences of China and Italy, who are ahead of Canada on the COVID-19 trajectory. [6,15,26,27] Experience during the SARS epidemic has also informed these suggestions on the provision of rehabilitative care (these are presented in the past tense). [28] Each suggestion needs to be evaluated based on the unique circumstances of each rehabilitation unit, and the needs of the patients and the greater health care community.

- A separate unit or area is suggested for the rehabilitation of patients post-COVID-19, and other patients arriving on the unit.
- Depending on the need it has been suggested that dedicated facilities be used to treat those post-COVID-19, for example in underutilized rural hospitals or by retrofitting unused buildings such as university dormitories. [25]
- There may be a need to take patients earlier from acute care than generally done, in order to reduce the burden on the acute care hospitals.
- Patients stayed in their rooms (SARS).
- Group therapy and therapy done in rehabilitation gyms should be prohibited; therapy should be provided one-on-one in patients' rooms.
- Discharges to home were done sooner than usual (as soon as the family was able to take care of the patient), in order to free up space (SARS).
- It was difficult to discharge some patients because long-term care facilities and retirement homes were not accepting new residents (SARS).
- Shared equipment must be decontaminated between patients; use single-use equipment where possible (eg, Theraband rather than hand weights). Pay particular attention to electrode sponges, hydrocollator heat packs, gel, topical lotions, items for training manual dexterity etc.
- Plan therapeutic activities to minimize the number of personnel involved when possible (eg, one therapist with a gait aid rather than a therapist and an assistant).
- Minimize the number of personnel entering a patient's room. [29] Have a single staff member do most (if not all) of the care and duties with a particular patient (eg, deliver food trays, make bed, give meds, help with am care). This suggestion was made for the acute care of COVID-19 patients, but might be helpful in some rehabilitation situations as well.
- Walking practice should be done in parts of the hospital that are not commonly used.
- Surgical masks should be worn by the patients and the therapists.
- Patients should be kept at least 2 m apart. Avoid talking or eating while facing each other.

Personnel Considerations [6,15,26,27]

- Health checks for personnel should be done frequently.
- There may be personnel shortages due to staff illness, staff on isolation, or redeployment.
- There may be changes in staff/patient ratios, due to more one-on-one treatments (due to patients not being seen in the rehabilitation gyms).
- Continuous staff training will be required due to changing protocols/guidelines.

- Take time to train and retrain personnel in the use of personal protective equipment (PPE).
- Physiotherapists and speech-language pathologists (S-LP) should wear higher levels of PPE if they may be exposed to aerosols from post-COVID-19 patients (eg, Chest physiotherapy and swallowing assessments).
- It is important to seek ongoing input from front-line staff, to inform others. One group of rehabilitation professionals in Italy has been holding weekly webinars to stay up-to-date with the changing needs of rehabilitation during this time. [27] These are available for an international audience.
- Cancel all nonrequired therapies and services or use telecommunication to deliver them.
- The time taken to don PPE and do infection control measures may decrease work efficiency.
- Rehabilitation allied health professionals wore scrubs and a t-shirt at work, and had a shower and changed into street clothes before going home (SARS).
- Rehabilitation staff were divided into 2 ‘teams’, who worked independently of each other. If several members of one team became ill, the other team could take over (SARS).

- Meetings should be held virtually, when possible.

Home-based Rehabilitation

If patients can be managed at home, this might be a good option, even for patients who might have been admitted to inpatient rehabilitation in the past. [25,28] Isolation is easier at home, and the burden would be lessened on inpatient services. However, for this to be a viable choice, enhanced homecare services and/or outpatient rehabilitation must be available, including “home first” level of care on par with inpatient rehabilitation. This mode of delivery might be difficult to institute, if homecare staff are restricted from entering patients’ homes. [30] However, given the right precautions, home-based care may be safer for patients who have recovered from COVID-19 and for other patients in a rehabilitation unit. Home-based therapy may be provided via telerehabilitation [28], provided that systems are in place to ensure that patients and therapists are able to use this method successfully, given the rehabilitation needs of the individual patient. One or more in-person visits might be required as well. Telerehabilitation might also be a good choice for those being discharged from inpatient rehabilitation, in order to continue their treatment and promote further recovery. [7,15,26]

Rehabilitation Guidelines After COVID-19

The importance of rehabilitation after COVID-19 has been emphasized, following the framework of the International classification of Functioning, Disability and Health [31,32]. The WHO does not have rehabilitation guidelines for post-COVID-19 patients. [3] Each patient should be fully assessed by all rehabilitation professionals, and a suitable treatment plan created, in conjunction with the patient and the team, and considering the patient’s wishes and goals. The direct impact of COVID-19 (eg, on the respiratory system and other systems), it’s sequelae (eg, ICU stay, mechanical ventilation), and comorbidities (eg, hypertension, diabetes) will inform the treatment plan. [33] Discharge destination and functional needs will also impact the plan. What follows are some guidelines suggested by health care professionals in China, Italy and other areas, based on their experiences and expert opinions. [33,34] The guidelines are influenced by the prevailing rehabilitation of the regions; however there is very little actual research on the impact of rehabilitation after COVID-19, with only one randomized controlled trial published so far. [35]

Respiratory Rehabilitation

Recommendations from both China and Italy recommend not to begin respiratory rehabilitation too early, to avoid aggravating respiratory distress or dispersing the virus unnecessarily. [33,36,37] In the

acute phase, diaphragmatic breathing, pursed lip breathing, bronchial hygiene, lung expansion techniques (positive expiratory pressure), incentive spirometry, manual mobilization of the rib cage, respiratory muscle training, and aerobic exercise are not recommended. [37] Secretions are not commonly a problem after COVID-19, however, comorbid conditions like bronchiectasis, secondary pneumonia, or aspiration may increase secretions. [22] Postural drainage and standing (gradually increasing the time) are suggested for secretion management. [38]

Once in inpatient rehabilitation, respiratory assessment should include dyspnea, thoracic activity, diaphragmatic activity and amplitude, respiratory muscle strength (maximal inspiratory and expiratory pressures), respiratory pattern, and frequency. [38] Cardiac status should also be assessed. [38]

In the post-acute phase, inspiratory muscle training should be included if inspiratory muscles are weak. Deep, slow breathing, thoracic expansion (with shoulder elevation), diaphragmatic breathing, mobilization of respiratory muscles, airway clearance techniques (as needed), and positive expiratory pressure devices can be added based on assessed needs. Care must be taken to avoid overloading the respiratory system and causing distress. [22] One randomized controlled trial showed a significant improvement in respiratory function, endurance, quality of life, and depression from 2 sessions of 10 minutes of respiratory rehabilitation a week for 6 weeks following discharge from acute care. [35] Rehabilitation included respiratory muscle training with a positive expiratory pressure device, cough exercises, diaphragmatic training (using 1 to 3 kg of weight on the abdomen in supine), chest stretching, and pursed-lip breathing. Patients should be monitored closely for shortness of breath, decreased SaO_2 (<95%), blood pressure <90/60 or >140/90, heart rate >100, temperature >37.2, excessive fatigue, chest pain, severe cough, blurred vision, dizziness, heart palpitations, sweating, loss of balance, and headache. [33,36]

Mobility and Functional Rehabilitation

Functional assessment should include muscle joint range of motion, strength testing, and balance (Berg Balance Scale suggested). [22,33,36] Exercise capacity can be assessed with the 6-minute walk test (with continuous oxygen saturation monitoring) and cardiopulmonary exercise testing. Function and disability can be measured with the International Physical Activity Questionnaire, Physical Activity Scale for the Elderly, and the Barthel Index [(to measure activities of daily living (ADL)].

Physiotherapy should begin while in the acute inpatient setting and continue after transfer to inpatient rehabilitation. [33,36] Early mobilization should include frequent posture changes, bed mobility, sit-to-stand, simple bed exercises, and ADL, respecting the patient's respiratory and hemodynamic states. [22,39] Active limb exercises should be accompanied by progressive muscle strengthening (suggested program: 8 to 12 repetition maximum load, for 8 to 12 repetitions, 1 to 3 sets with 2 minutes rest between sets, 3 sessions a week for 6 weeks). [33,36] Neuromuscular electrical stimulation may be used to assist with strengthening. Aerobic reconditioning can be accomplished with overland walking, or cycle or arm ergometry, or a NuStep cross-trainer. [22] Initially aerobic activity should be kept to less than 3 metabolic equivalents of task. Later, progressive aerobic exercise should increase up to 20 to 30 minutes, 3 to 5 times a week. Balance work should be incorporated. Studies on the effectiveness of exercise interventions after SARS showed benefits on endurance, VO_2max and strength. [40]

Occupational therapy (OT) should focus on ADL and instrumental ADL guidance and targeted interventions to facilitate functional independence and prepare for discharge. [41] SL-P should assess and treat dysphagia and voice impairments resulting from prolonged intubation and may also address

respiratory strength and coordination. [41] OT should also address cognitive changes while SL-P should address communication issues. [41] Chinese medicine techniques like Tai Chi, Qigong 6-character mnemonic, guided breathing, and Baduanjin qigong have been suggested by the Chinese. [33,36] Education on the importance of a healthy lifestyle, and participation in family and social activities should be included. Psychological interventions, delivered by OT, social work or rehabilitation psychology may be required for depression, anxiety, or PTSD. [41]

Conclusions

Rehabilitation after COVID-19 is similar to that provided for many patients in geriatric rehabilitation units who have been affected by illness or injury. Some may present with a variety of sequelae associated with the viral illness and with a prolonged stay in the ICU, possibly including mechanical ventilation. Many will have pre-existing comorbidities. A thorough assessment and individualized, progressive treatment plan which focusses on function, disability, and return to participation in society will help each patient to maximize their function and quality of life.

Acknowledgements

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Conflicts of Interest

None declared.

Abbreviations

ADL: activities of daily living
ARDS: acute respiratory distress syndrome
CIM : critical illness myopathy
CIP: critical illness polyneuropathy
COVID-19: coronavirus disease of 2019
ICU: intensive care unit
MERS: Middle East respiratory syndrome
OT: occupational therapy
PPE: personal protective equipment
PTSD: post-traumatic stress disorder
SARS: severe acute respiratory syndrome
SARS-CoV-2: severe acute respiratory syndrome coronavirus 2
S-LP: speech-language pathologists
WHO: World Health Organization

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