



Review Article

Summary of respiratory rehabilitation and physical therapy guidelines for patients with COVID-19 based on recommendations of World Confederation for Physical Therapy and National Association of Physical Therapy

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Abstract. [Purpose] To summarize the existing official guidelines issued by the World Confederation for Physical Therapy and Associations of Physical Therapy in various countries and to clarify the recommended methods of respiratory rehabilitation and physiotherapy for patients in different stages of the coronavirus disease of 2019 (COVID-19). [Methods] An introductory literature search was conducted using the keywords “COVID-19”, “respiratory rehabilitation”, “physical therapy”, and others in the database of the Association of Physical Therapy. [Results] Using 12 coronavirus disease-2019 rehabilitation-related articles, we summarized data on physical therapy (PT) evaluation; treatment; indications; contraindications; and termination indicators for patients in acute, stable, and post-discharge stages. [Conclusion] PT for COVID-19 patients with coronavirus disease 2019 should be formulated according to the stage of the disease and condition of the patients.

Key words: COVID-19, Respiratory rehabilitation, Physical therapy

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INTRODUCTION

A new coronavirus (SARS-CoV-2) outbreak occurred in December 2019, which caused various clinical symptoms leading to a syndrome called “Corona virus disease of 2019 “ (“COVID-19”) ¹⁾. COVID-19 can lead to the occurrence of symptoms such as fever, cough, increased airway secretions, dyspnea and others. Patients incur weakness, sarcopenia, and decreased exercise tolerance due to long-term bed rest in isolation or treatment in the ICU. The method to safely rehabilitate COVID-19 patients is an issue that has led to concerns among physiotherapists at present. This paper summarizes the existing guidelines issued by the World Confederation for Physical Therapy (WCPT) and other authorities including the Association of Physical Therapy as of April 16, 2020, and describes the recommended methods of respiratory rehabilitation and physical therapy for COVID-19 patients in all stages of the disease.

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METHODS

The aim was to study and summarize the findings in the articles on physical therapy for COVID-19 patients among adults (over 18 years old). The following inclusion criteria were considered: (i) Articles written in English; (ii) The full-text versions of the articles that could be retrieved and read completely. Articles were excluded based on the following criteria: (i) Articles outside the field of rehabilitation or physical therapy. (ii) Non-patient articles (such as viral studies or animal experiments). Searches were conducted in databases including Medline (PubMed), Cochrane library, Ovid, Embase, WCPT and the official website of the Associations of Physical Therapy in Europe and America. Databases were searched using the following keyword combinations: “COVID-19”, “Coronavirus pneumonia” “Pulmonary Rehabilitation”, “Physical Therapy”, “Respiratory physiotherapy”, “Physiotherapy”, and “Respiratory Rehabilitation”. The logical operators “and”/“or” were used in each combination. During the study selection process, two blinded independent researchers analyzed the results. The last search date was April 16, 2020.

RESULTS

Physical Therapy for COVID-19 Patients in Acute Stage (ICU, Critical Stage): Patients who had been admitted in the ICU had experienced impairments in all three domains of the international classification of functioning, disability and health (ICF) classification (including body functions and structures, activity limitations, and participation restrictions). These impairments included decreased pulmonary function, reduced 6-minute test distance walk, reduced strength of the respiratory and limb muscles, decreased ability to perform activities of daily living²). COVID-19 mainly damages the respiratory system, importing great significance to respiratory rehabilitation and physical therapy interventions. The main goal of respiratory physiotherapy is to reduce the symptoms of dyspnea, improve lung capacity, counteract the complications resulting from respiratory failure and immobilization, decrease the level of anxiety and counteract depression³).

Assessment: Before starting physiotherapy in severely and critically patients, a comprehensive assessment of the patients should be carried out; in particular the state of consciousness, respiratory system, cardiovascular system and musculoskeletal system. Patients meeting the physiotherapy inclusion criteria should be started on treatment as soon as possible. Main evaluation included: (1) basic vital signs: respiratory rate, heart rate, blood pressure, temperature, blood oxygen saturation; (2) Joint range of motion (passive and active); (3) degree of dyspnea.

Treatment: The treatment strategies included the following. (1) Position change: Position change can reduce the occurrence of bedsores, promote sputum excretion, and reduce the degree of dyspnea. Avoidance of bad posture is important. Half-seated (45 to 60 degrees) or seated postures are promoted whenever possible. If unable to sit, the bed angle is raised between 30 and 45 degrees. Postural intervention should be performed 3 times/day for at least 20 min/time. (2) Prone position ventilation: Many severe COVID-19 patients are ideal for prone position ventilation. Prone position ventilation can have a positive impact on oxygen binding and pulmonary dynamics. Prone ventilation is recommended as a routine strategy for patients with PaO₂/FiO₂ less than 150 mmHg. They should be ventilated for at least 16 hours per day and stopped when the Oxygenation Index (PaO₂/FiO₂) is greater than 150 mmHg, the positive end-expiratory pressure (PEEP) is less than or equal to 10 cm or the fraction of oxygen concentration in the inhaled air (FiO₂) is less than or equal to 60%. (3) Respiratory control: It is performed in a sitting or semi-recumbent position, and the patient's accessory muscles of inspiration are relaxed (especially in the upper limbs and neck), by inhaling through the nose (making the air warm and moist), and taking slow, prolonged breaths and exhaling. A shallow, slow, calm breathing pattern is established. Expiration could be pursed-lip breathing. The model could be adopted during rest or exercise. The exact frequency and utilization are controlled by the patients themselves to avoid worsening effort of breathing caused by the training. (4) Passive joint motion. (5) Muscle stretching. (6) Neuromuscular electrical stimulation. (7) Bedside standing training (in patients with lower limb muscle strength greater than grade 3). (8) Walking exercises (standing up independently with less help). (9) Maintaining physical strength and exercise endurance. When the patient's autonomous consciousness is adequate and they are in a relatively stable state, a power bicycle in bed, walking, and bed to chair transfer can be established.

Precautions: Before beginning treatment, it is important to check the following. (1) The electrocardiogram (ECG), oxygen saturation (SaO₂), mean arterial pressure (MAP) and other vital signs must be monitored throughout the course of physical therapy⁴). (2) SpO₂ is maintained at 95–100% level of oxygen, but in patients at risk of hypercapnia (i.e. in patients with coexisting chronic obstructive pulmonary disease, COPD), oxygen saturation is kept at 88–89%³). It is important to be careful not to disconnect the lines attached to the patient, including catheters with urine collection bags, cardiac monitoring devices, central catheters, gastric tubes or gastrostomy (percutaneous, endoscopic gastrostomy, PEG) tubes, etc. (4) In order to avoid the exacerbation of respiratory load caused by some PT treatments, it is recommended not to carry out excessive intensive respiratory training (such as respiratory endurance training, thoracic traction, tracheobronchial clearance, excessive intensive training of respiratory muscle strength, and resistance muscle strength training) as the patients' respiratory function is unstable during this period.

Initiation Criteria: It is necessary to ensure compliance with the following factors before commencement of therapy in the acute stage including: FiO₂ ≤60%; SpO₂ ≥93%; respiratory rate ≤30 breaths/min; PEEP ≤10 cm f; systolic pressure

≥90 mmHg and ≤180 mmHg; MAP ≥65 mmHg and ≤110 mmHg; Heart rate ≥40 beats per minute (BPM) and ≤120 BPM; Temperature <38.5°; No new arrhythmias or myocardial ischemia; No new unstable deep vein thrombosis and pulmonary embolism; No aortic stenosis; No severe hepatorenal disease or new, progressive impairment of liver and kidney function.

Contraindications: The contraindications to therapy include: Temperature >38°; severe dyspnea; resting heart rate >120 BPM; X-ray manifestations: progression of thoracic infiltration >50% within 24–48 hours; SpO₂ <95%; blood pressure <90/60 mmHg or >140/90 mmHg.

Termination Indicators: The indication to terminate therapy include: SpO₂: <93% or >4% decrease from baseline; respiratory rate >30 breaths/min; systolic blood pressure <90 mmHg or >180 mmHg; MAP <65 mmHg or >110 mmHg, or more than 20% change from baseline; arrhythmia or myocardial ischemia; anxiety; fatigue and physical activity intolerance.

Physical Therapy for COVID-19 Patients in Stable Period (General Admission, Isolation Period): Isolation is an effective way to prevent the spread of the virus, but it limits the patient's living space and reduces their natural activity. It may lead to decreasing muscle strength, reduced efficiency of expectoration, intolerance to physical activity and mental problems⁵.

Assessment: The following evaluations are recommended before therapy in this phase. (1) Basic vital signs: respiratory rate, heart rate, blood pressure, body temperature, oxygen saturation; (2) Muscle strength: grip strength, isometric muscle strength test; (3) Joint range of motion (passive and active); (4) Ability to balance (especially in patients who have been in bed for a long time); (5) Physical strength and exercise endurance (6-minute walking test); (6) Presence of anxiety or depression.

Treatment⁶: The advocated treatment strategies in this phase encompasses the following. (1) Respiratory training and respiratory muscle training: On the basis of the treatment results of respiratory control in the acute stage, moderate respiratory muscle strength training should be carried out according to the respiratory function of patients; (2) Airway secretion clearance: sputum can be expelled by hand; postural drainage (to avoid head drop); active cycle of breathing techniques (ACBT); induced or assisted cough and other techniques; (3) Abdominal breathing and diaphragm training⁷. (4) Exercise therapy: mild exercise training (maintaining a Borg score of 3–4 or visual analog scale (VAS) score 5–6), 1–2 times a day, 30 minutes each time is carried out. Trying to walk, bedside bicycling and other exercises with intensity less than 3 Mets; (5) Resistance training: Using progressive resistance training, three groups per day, 10 times per group, with a 1 repetition maximum of 50–70%; (6) Sitting and standing balance training; (7) Psychological support.

Termination Indicators: The exercises were terminated if the patient's (1) SpO₂ decreased by 4 percentage points; or (2) the patient had perspiration, nausea and vomiting, dizziness, blurred vision, etc. (3) severe sudden dyspnea; (4) chest compression or pain; (5) rapid heart rate or arrhythmia; (6) was unable to maintain balance.

Initiation criteria, contraindications and precautions for physiotherapy are the same as those in the acute phase.

Physical Therapy for COVID-19 Patients in Recovery Period (Discharge, Home Isolation, Suspected): Prolonged hospital admission or isolation greatly reduced the amount of exercise in this stage, resulting in muscle weakness, low exercise endurance, weakness or fatigue. Long periods of absence from social and family activities can also make patients feel isolated. Prolonged isolation may also lead to negative psychological effects (depression, anxiety) and including PTSD⁸. The purpose of PT of discharged patients was to enable patients to return to society, restore their organic functions and prevent psychological disorders. PT at home mainly uses remote guidance, psychological support, social education and other means to let patients understand the importance of PT, through brochures or videos to make patients understand respiratory rehabilitation, adopt a healthy lifestyle, and to promote their return to the family and society.

Assessment: The appraisal of the patient's condition included the following in this phase. (1) General clinical evaluation: physical examination, laboratory microbiological examination, pulmonary function test, nutritional evaluation; (2) Symptomatic examination: dyspnea, fatigue test, anxiety and depression scale; (3) Muscle strength: general muscle and respiratory muscle strength examination; (4) Active and passive joint range of motion examination; (5) Functional examination: Timed Up and Go test (TUGT), 6-minute walking test. (6) Balance function evaluation. (7) Endurance and physical strength evaluation; (8) Activity of daily living evaluation.

Treatment: The treatments proposed in this phase comprised of the following. (1) Aerobic exercise: walking up and downstairs, walking at home, dancing. The intervention should last for at least 6 weeks, five times a week, 30–60 min/day, and start with low-intensity exercise. The intensity is increased by 10% every week. A limit of 70% of the maximum heart rate is set. (2) Resistance training: Squatting is permitted or medium weight items can be carried. Progressive resistance training method is used, in groups of 1–3/day, intensity 8–12 repetition maximum, with 8–12 exercises in each group, for at least 6 weeks, 2–3 times/week; (3) balance training: cross obstacles; (4) breathing training: normal breathing mode is used for breathing training; abdominal breathing; pursed-lip breathing; thoracic expansion exercise are other exercises suggested. (It is imperative to be careful while treating not to cause respiratory muscle fatigue and respiratory system problems); (5) Keeping airway clear; (6) ADL training: guide transfer, bathing, toilet, daily hygiene maintenance, etc. can be encouraged in this phase.

Contraindications: The following signs are contraindications to therapy. (1) resting heart rate >120 BPM; (2) blood pressure ≥140/90 mmHg or ≤90/60 mmHg; (3) SpO₂ ≤95%; (4) other coexisting diseases that are not suitable for exercise.

Termination Indicators: Therapy should be terminated if the following occur. (1) Temperature >38.2 degrees; (2) difficulty or shortness of breath with no relief after resting; (3) chest pain, chest tightness, dyspnea, aggravated cough, dizziness, headache, blurred vision, palpitation, night sweat, unable to maintain balance, etc.

The initiation criteria and precautions of physiotherapy are the same as above.

DISCUSSION

This is the first introductory article on respiratory rehabilitation and physiotherapy in patients with COVID-19 in Japan. Currently, the epidemiological situation of COVID-19 is a great challenge for all medical practitioners. This article aims to advocate the possibility of providing physical therapy in the COVID-19 patient population. For patients, rehabilitation at all stages is necessary. It can effectively improve the respiratory function of patients, their exercise endurance and physical strength, inhibit the occurrence of various complications or disuse syndromes. Preventing patients from various physical and psychological disorders, can facilitate patients' return to family, work, and society as soon as possible, and improve their quality of life.

However, it is more important to ensure the safety and health of rehabilitation practitioners. At present, remote training or technical video guides are new approaches to rehabilitation based on the premise that it protects physiotherapists as well. This approach can be utilized not only in hospitals, but also as family guidance and follow-up after discharge.

COVID-19 has had a great impact on the global economy. The anticipated economic losses for patients themselves and their families will be greater. In the United States, the total cost of admission for COVID-19 patients is \$72,000. On the other hand, if a patient dies due to illness, it will result in a loss of social gains averaging at least \$350,000⁹⁾. Some scholars estimate that COVID-19 is expected to bring about \$1 trillion in economic losses to the world in 2020, which greatly exceeds the financial crisis of 2008¹⁰⁾. Therefore, reducing the mortality rate of patients, reducing the ICU and admission time of patients, maintaining the potential of patients similar to that before illness, and prompting them to return to society and work as soon as possible will not only reduce additional medical resources and expenditures, but also reduce the negative impact on society, the country and the world economy. It has been documented that respiratory function in patients' had a negative correlation with mortality during admission, and the treatment period in ICU was shortened from an average of 20.4 days to 12.8 days after an improvement in respiratory function¹¹⁾. Moreover, rehabilitation interventions could shorten the admission time by 20% and reduce the total medical expenses¹²⁾.

As of April 19, the total number of patients in Japan is 10,437, including 8,348 hospitalized patients. The utilization rate of available beds in Japan has reached 112%. Among them, the number of patients with COVID-19 in Tokyo has reached 261% compared with that of dedicated beds¹³⁾. The Tokyo government said on April 3 that Tokyo was on the verge of a "medical collapse". Once medical collapse occurs, not only the health care system, but also national economy, politics and infrastructure in the country will face serious challenges. One of the measures to mitigate the emergence of medical collapse is to allocate medical resources reasonably and suppress the patient's condition as soon as possible¹⁴⁾. In summary, PT will directly affect the physical function of patients, especially the respiratory function. PT intervention during ICU stay can help in earlier transfer of patients to the general wards¹⁵⁾. ADL and exercise endurance training will also allow discharged patients to return to social work. It indirectly reduces the probability of medical collapse and could help maintain national and social stability.

In conclusion, the physical therapy of COVID-19 patients will not only reduce the mortality rate of patients, hospital admission time and medical expenses, but also save medical resources, reduce personal and national economic losses, and the probability of adverse social stability events such as medical collapse. Therefore, physical therapy should be introduced into the mainstream treatment of COVID-19 patients as early as possible.

Conflict of interest

The authors declare that they have no conflicts of interest related to this work.

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