

IV. 新型コロナウイルス感染症に関する論文等

IV. 2 Early Intensive Physiotherapy for Critically Ill Patients with Coronavirus Disease who require Mechanical Ventilation

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ABSTRACT

Purpose : Caring for critically ill patients with significant post-discharge disability, as well as reduced activities of daily living and quality of life is challenging owing to the rapid increase in the number of patients with coronavirus disease 2019 (COVID-19). Although prevention of mortality is important, post-acute care physiotherapy also warrants attention. We report our early experiences with acute physiotherapy for patients with COVID-19, who underwent intubation and provide recommendations to ensure procedural safety during the pandemic.

Material and Methods

This retrospective single-center study included patients with “critical” COVID-19 infection that necessitated mechanical ventilation between March 20, 2020 and March 27, 2020.

Results : Physiotherapy interventions were delayed in the first 3 cases primarily because of time spent in preparation for infection control, healthcare provider apprehension, and lack of knowledge; these patients showed intensive care unit-acquired weakness and ventilator-associated pneumonia. Early initiation of physiotherapy in the latest 3 patients was associated with uneventful recovery from acute respiratory distress syndrome and fewer respiratory complications or delirium. Delayed initiation of physiotherapy may significantly negatively affect recovery, as well as patients’ functional abilities.

Conclusion : Implementation of carefully planned procedures with use of adequate personal protective equipment can enable safe and effective initiation of intensive physiotherapy in critically ill patients with COVID-19.

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INTRODUCTION

The ongoing coronavirus disease 2019 (COVID-19) pandemic caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) represents an unprecedented challenge for the medical community^{1,2)}. Approximately 5–10% of patients require intensive care unit (ICU) admission and mechanical ventilation³⁾. Caring for critically ill patients who may show marked post-discharge disability and impairments is challenging owing to the increasing number of COVID-19 cases^{2,4-6)}. At the time of our physical therapy, it was initially difficult to provide the same level of intervention as for patients with other severe diseases because of the need for infection protection and a large amount of manpower for patients with severe COVID-19. Although prevention of mortality is a priority, post-acute care physiotherapy is important to maintain activities of daily living and quality of life. Acute respiratory distress syndrome (ARDS) is a life-threatening form of respiratory failure regardless of COVID-19 positivity⁷⁾, and appropriate supportive intensive care at the acute stage, including physiotherapy, is essential for favorable post-discharge outcomes. Effective physiotherapy and lung recruitment maneuvers in a safe and efficient medical environment are necessary to prevent complications during the COVID-19 outbreak. We report our early experiences with initiation of acute physiotherapy in patients with COVID-19, who underwent tracheal intubation. We have additionally highlighted a few recommendations regarding procedural safety during the ongoing pandemic.

I . CASES

This retrospective single-center study included patients diagnosed with “critical” COVID-19 that necessitated mechanical ventilation. Between March 20, 2020 and March 27, 2020, six patients with COVID-19 received mechanical ventilation at our hospital. Of the physical therapists, only 6 out of a total of 82 actually intervened in the treatment of patients with severe COVID-19. The age range of the physical therapists consisted of those in their 20s to early 40s. Physical therapy interventions lasted 20 or 40 minutes per patient. All staff members who attended to these patients received adequate education

and training regarding the use of personal protective equipment (PPE). We focused on prevention of ventilator-associated pneumonia (VAP) and intensive care unit-acquired weakness (ICU-AW). Figure 1 shows a representative case of intensive physiotherapy administered to a critically ill patient with COVID-19, who required mechanical ventilation.

Table 1 shows the baseline characteristics and clinical course of the patients included in this study. Case 1 (Age: 72 years, Male, 169 cm, 71 kg) underwent intubation for severe ARDS and received deep sedation (Richmond Agitation-Sedation Scale [RASS] score -5), as well as continuous renal replacement therapy for acute kidney injury and multi-organ failure. Physiotherapy was performed using manual drainage with the patient placed in the right side-lying position. We observed a slight post-intervention improvement in airway passage, increase in oxygenation levels, and decrease in the fraction of inspired oxygen (FiO₂) from 0.95 to 0.85. However, the patient’s respiratory condition worsened the following day; the FiO₂ remained at 1.0, and an arrhythmia-induced episode of hypotension required discontinuation of physiotherapy.

Case 2 (Age: 75 years, Male, 175cm, - kg) presented with hyperactive delirium and VAP at the time of intervention. We performed physiotherapy for 80 min twice daily, with an out-of-bed schedule during the day, together with sitting on the edge of the bed and assisted sit-to-stand exercises. The patient gradually became able to maintain a seated position with proximal stabilization, and we observed improved strength in all extremities.

Case 3 (Age: 78 years, Female, 144cm, 51.9kg) presented with ICU-AW at the time of physiotherapy intervention, 7 days after admission. Two physical therapists implemented postural drainage (in a side-lying position) in this patient with excessive sputum production. The patient initially had an Intensive Care Delirium Screening Checklist (ICDSC) score of 6, which indicated delirium. However, the patient recovered from delirium and could stand independently and walk with assistance post-intervention.

Case 4 (Age: 75 years, Female, 150cm, 46kg) was moderately frail prior to admission and developed de-

lirium (ICDSC score 5) complicated by VAP before initiation of physiotherapy on day 14. The patient (RASS score -5) was placed in the partially prone left side-lying and left side-lying positions to aid sputum expectoration and positional respiration. We continued administration of physiotherapy for 40 min twice daily, focused on the side-lying position and range-of-motion exercises to prevent deconditioning.

Case 5 (Age: 76 years, Male, 155cm, 45kg) was transferred from another hospital, 4 days after diagnosis of COVID-19 and could walk at the time of admission. However, intubation and respiratory care were required 3 days later, and physiotherapy was introduced. The patient (RASS score -5) was placed in the partially prone left side-lying position for postural respiratory therapy. Delirium, VAP, other respiratory complications, and ICU-AW were not observed.

Case 6 (Age: 66 years, Male, 168cm, 78kg) received physiotherapy intervention immediately after admission. Prone positioning was initiated with the assistance of five medical staff members. The patient received deep sedation with respiratory management, and postural respiration therapy was administered. Although prone positioning required significant manpower to ensure a safe procedure, this approach was effective, and the patient's oxygenation saturation tended to improve. The ratio of the arterial oxygen partial pressure to FiO_2 (P/F ratio) markedly increased from 109 to 240 on day 13.

II . DISCUSSION

This report is one of the rare articles on the clinical outcomes of physical therapy for critically ill COVID-19 patients in ICU in Japan.

We analyzed the data of six critically ill patients with COVID-19, who underwent mechanical ventilation at our institution. Based on real-world experience in ICU settings during the COVID-19 outbreak, we observed that early initiation of intensive physiotherapy could lower the rate of respiratory complications and ICU-AW.

COVID-19 is often complicated by ARDS, which is associated with significant morbidity and mortality. Early introduction of intensive physiotherapy is currently recommended and considered effective in pa-

tients with ARDS^{8,9)}. Therefore, the same approach is expected to be useful in patients with COVID-19, who require mechanical ventilation. For example, prone positioning appears to benefit patients with ARDS because it facilitates recruitment and decreases heterogeneity of respiratory compliance, leading to improved oxygenation and reduced injurious ventilation^{8,10)}. Although prevention of mortality is the cardinal treatment goal, post-acute care physiotherapy is also important to improve patients' post-discharge activities of daily living and quality of life.

Delayed initiation of physiotherapy may significantly negatively affect recovery, particularly in those at a high risk of deterioration and may contribute to a decline in functional abilities. Factors that cause delayed physiotherapy include restrictions and apprehensions among healthcare providers who aim to prevent the spread of infection. In our study, the first few physiotherapy interventions were delayed owing to the time spent in preparation for COVID-19 infection control, healthcare provider apprehension, and lack of knowledge. Therefore, we observed several cases of ICU-AW and VAP that affected medical treatment. However, early physiotherapy led to relatively uneventful recovery from ARDS with lower rates of respiratory complications or delirium.

Physical therapists who come into close contact with patients during physiotherapy are particularly at risk of infection secondary to aerosol and droplet contamination. The risk of infection among healthcare providers should be minimized to enable delivery of high levels of uninterrupted patient care. Although it is important that all physiotherapy units establish clear protocols and standard operating procedures to avoid complications, early introduction of intensive physiotherapy should be encouraged to ensure favorable prognosis in critically ill patients with COVID-19.

The physical therapy team for COVID-19 patients should be composed of physical therapists with extensive experience in respiratory and circulatory disorders, ICU, and early rehabilitation. The physical therapist should have the ability to perform physical assessments in order to modify physical therapy interventions according to COVID-19 advanced status.

In addition, our hospital has formulated standards

for physical therapy intervention (Table 2) , and based on these standards, physical therapy is conducted through multidisciplinary discussions. We have also created a flow chart that summarizes the types and timing of interventions according to the severity of the disease (Figure 2) .

CONCLUSIONS

Carefully planned procedures with adequate PPEs can ensure early administration of safe and effective intensive physiotherapy to critically ill patients with COVID-19.

ABBREVIATIONS

P/ F ratio; PaO₂/ FiO₂ ratio, CCI; Charlson Comorbidity index, CFS; Clinical frailty scale, ICU-MS; Intensive care unit mobilization score, FSS-ICU; Functional status score for the intensive care unit, GNRI; Geriatric nutritional risk index, ICU-AW; Intensive care unit acquired weakness, VAP; Ventilator-associated pneumonia, ICDSC; Intensive care delirium screening checklist, ROM; Range of motion, EOB; Edge of bed.

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Table 1. Baseline characteristics, physiotherapy program, and clinical course of each COVID-19 patient

	Severity of ARDS (P/F ratio)	Comorbidity, baseline ADL, nutrition status.	Days from intubation to first physiotherapy	Physiotherapy program	Clinical course and outcome measures
CASE 1 Age: 72 years Male 169 cm / 71 kg	Severe (P/F ratio: 60)	CCI: 0 Katz index: 6 CFS: 3 ICU-MS: 0 FSS-ICU: 1 GNRI: 86.8	10	80 min x 2 visits Right side-lying position, manual chest wall mobilization (percussion, vibration), and ROM exercises	ICU-AW: – VAP: – ICDSC: – Continued bed rest and on respirator at day 36
CASE 2 Age: 75 years Male 175 cm / -	Moderate (P/F ratio: 136)	CCI: 0 Katz index: 6 CFS: 5 ICU-MS: 4 FSS-ICU: 1 GNRI: -	15	80 min x 2 visits Sitting EOB, sit to stand exercises, manual chest wall mobilization (percussion, vibration), and ROM exercises	ICU-AW: – VAP: + ICDSC: 5 Extubated at day 16, able to stand with minimal assistance
CASE 3 Age: 78 years Female 144 cm / 51.9 kg	Severe (P/F ratio: 87)	CCI: 0 Katz index: 4 CFS: 7 ICU-MS: 4 FSS-ICU: 5 GNRI: 67.5	6	80 min x 2 visits Side-lying postural drainage, manual chest wall mobilization (percussion, vibration), and ROM exercises	ICU-AW: + VAP: – ICDSC: 6 Extubated at day 10, able to transfer with minimal assistance and use wheel chair
CASE 4 Age: 75 years Female 150 cm / 46 kg	Moderate (P/F ratio: 122)	CCI: 2 Katz index: 6 CFS: 6 ICU-MS: 0 FSS-ICU: 1 GNRI: 59.2	9	40 min x 2 visits Prone left side-lying postural drainage, secretion removal, manual chest wall mobilization (percussion, vibration), and ROM exercises	ICU-AW: + VAP: + ICDSC: 5 Extubated at day 25, bed rest and sitting EOB with maximal assistance
CASE 5 Age: 76 years Male 155 cm / 45 kg	Moderate (P/F ratio: 180)	CCI: 0 Katz index: 6 CFS: 5 ICU-MS: 0 FSS-ICU: 1 GNRI: 57.2	0	20 min x 1 visit Partial prone left side-lying, manual chest wall mobilization (percussion, vibration), and ROM exercises	ICU-AW: – VAP: – ICDSC: 3 Extubated at day 3, able to walk under supervision
CASE 6 Age: 66 years Male 168 cm / 78 kg	Moderate (P/F ratio: 109)	CCI: 1 Katz index: 6 CFS: 2 ICU-MS: 0 FSS-ICU: 1 GNRI: 88.4	1	20 min x 1 visit Prone side-lying with postural respiration therapy, manual chest wall mobilization (percussion, vibration), and ROM exercises	ICU-AW: – VAP: – ICDSC: – Still on respirator at day 14, bed rest and sitting EOB with maximal assistance

Table 2. Criteria for Physical Therapy Intervention in Patients with COVID-19

<ul style="list-style-type: none"> ● Criteria for early initiation of physical therapy <ol style="list-style-type: none"> 1) Ventilator management has been in place for more than 24 hours 2) Elderly patients over 65 years old whose ADLs have declined due to severe frailty, multiple disabilities, or dyspnea 3) Patients under 65 years of age whose ADLs have decreased due to dyspnea ● Criteria for not actively providing physical therapy <ol style="list-style-type: none"> 1) Within 24 hours after endotracheal intubation 2) Endotracheal intubation is scheduled on the day of intervention 3) Immediately after extubation
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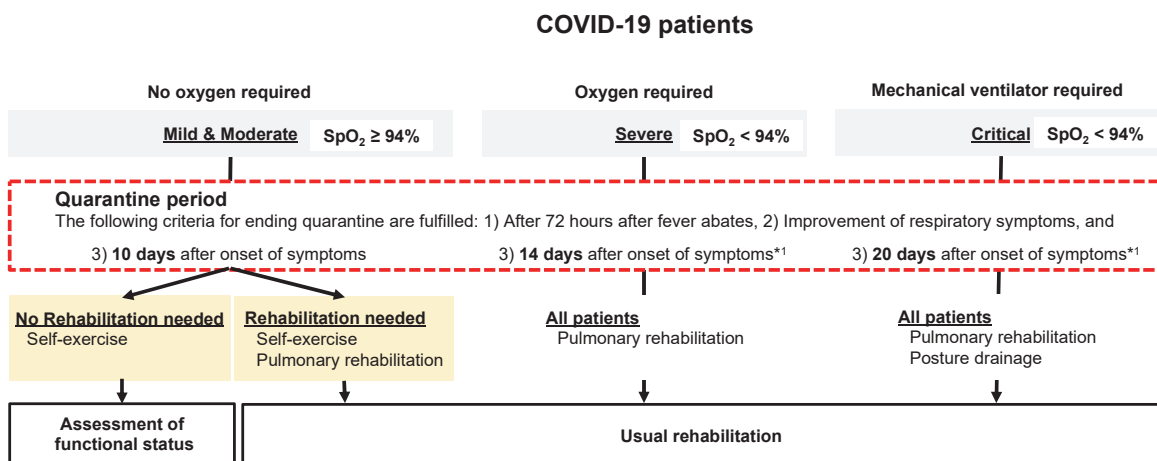
Figure 1. Intensive physiotherapy administered to a critically ill patient with COVID-19, who required mechanical ventilation



Severe COVID-19 patients on ventilators in the intensive care unit required at least two physical therapists and at least one nurse due to the amount of care and prevention of infection.

A · B : Postural drainage, C : Sitting edge of bed D: Standing

Figure 2. Flow of Physical Therapy Interventions by Severity for Patients with COVID-19



*1 Patients with oxygen required at 21 days after the onset of symptoms must meet the following criteria; *2 Two consecutive negative SARS-CoV-2 RT-PCR tests in a 24-hour interval