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Case Report

Rehabilitation of mechanically ventilated elderly patient with COVID-19 of a dedicated COVID tertiary hospital: a case report

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ABSTRACT

Corona virus disease 2019 (COVID-19), a highly communicable disease caused by severe acute respiratory syndrome-corona virus 2 (SARS-CoV2) which originated in Wuhan, China has affected 213 countries worldwide and has caused an economic crisis. As of August 10, 2020, India's recovery rate is 63%. Most of the critical cases requiring intensive care unit (ICU) management are elderly patients with co-morbidities. The case report is of an elderly, comorbid patient who was intubated and put on a mechanical ventilator. At a time when critical patients on mechanical ventilator hardly survived, this patient survived and was successfully weaned from the ventilator and extubated. The case report emphasizes physical therapy management along with medical management for an elderly SARS CoV2 survivor with co-morbidities, and his journey from the onset of symptoms to being mechanically ventilated to performing his daily activities with minimal discomfort.

Keywords: COVID-19, SARS-CoV-2, Mechanical ventilation, Physical therapy, Early mobilization, Pulmonary rehabilitation

INTRODUCTION

COVID-19 is a highly contagious disease, spread by human to human transmission (approximately 2-10 days prior to the individual becoming symptomatic) by means of droplets while coughing or sneezing without covering the nose and mouth, during aerosol generating procedures like nebulization, intubation, open suctioning or through fomites.[1]

The virus binds to the angiotensin-converting enzyme 2 (ACE2) receptors present in the epithelial lining of the respiratory system.[2] Fever, dry cough, myalgia or fatigue, and headache are the symptoms of COVID-19 commonly observed in patients.[3] Sore throat, loss of smell/taste, hemoptysis and diarrhoea are also recorded in few patients. The symptoms may range from mild illness (80%) to moderate and severe illness (14%). In mild cases, the non-respiratory symptoms are predominant while in moderate and severe illness or severe acute respiratory illness (SARI), pneumonia and/or acute respiratory distress syndrome (ARDS) is associated with severe hypoxia and type 1 respiratory failure. Only 5% develop critical illness and need ICU care. Severe affection and poor clinical outcomes (fatality rate of 8%) are seen in patients who are elderly or with underlying cardiac, renal or metabolic (obesity and diabetes mellitus) risk factors.[2-5]

Medical management of COVID-19 patients is symptomatic with supplemental oxygen and high flow nasal oxygen therapy (HFNO) to correct the hypoxia, antimicrobials to treat all likely pathogens causing SARI, zinc, vitamin C and vitamin D supplements for boosting the immune system and immunomodulators like tocilizumab. Patients who are unable to maintain oxygen saturation with oxygen therapy are initially observed with pressure support non-invasive ventilation i.e. bilevel

positive airway pressure (BiPAP) or continuous positive airway pressure (CPAP) and later progressed to invasive ventilation like mechanical ventilation in case of further deterioration. The understanding of outcomes in COVID-19 patients on mechanical ventilator in ICU is poor. Wang in his study had reported up to 100% mortality in mechanically ventilated patients and have speculated that COVID-19 does not result into a classic ARDS. This in turn has led to uncertainty about the treatment.[6] Mortality rate for mechanically ventilated patients in New York city was found to be 88% and in the United Kingdom was 65%.[7] However, recent studies reported a mortality rate of 35.7 % in mechanically ventilated patients and out of the total patients in ICU, 60% of the patients survived to hospital discharge. Cardiac injury was seen to be associated with high risk of mortality.[8] Nevertheless the cause of death in the mechanically ventilated patients is unclear.

Physical therapy in ICU aims at reducing the consequences of immobilization, any superadded respiratory infection and complications of mechanical ventilation. It reduces the risk of mortality and length of hospitalization and promotes early recovery of patients. Critical patients are prone to develop ICU acquired muscle weakness and hence early mobilization is recommended as prevention.[9,10]

COVID-19 being a novel disease, with an unclear pathophysiology, physical therapy intervention is limited to the patient's clinical presentation and expertise of the physical therapist. This case study focuses on the rehabilitation of an elderly man with co-morbidities who was successfully weaned from mechanical ventilation and is now functionally independent in his activities of daily living (ADLs).

CASE REPORT

A written consent was obtained from the patient. He is a 65-year old man with a history of type 2 diabetes mellitus for 17 years and hypertension since 10 years, managed with oral hypoglycemics and antihypertensive medications. His body mass index (BMI) on admission was 35.44 kg/m^2 (obesity class 2).[11] Patient initially complained of headache, fever and dry cough which was subsequently followed by fatigue, myalgia and loss of appetite. He consulted a physician who prescribed symptomatic treatment with mild relief in symptoms. On day 12 of onset of symptoms, he experienced breathlessness on walking in the house (modified medical research council [mMRC] scale, grade 3).[12]

As the symptoms progressed to breathlessness at rest (mMRC grade 4), the patient was brought to a dedicated COVID tertiary hospital. At the time of admission, on general examination, patient was restless, afebrile with respiratory rate of 32 breaths/min, pulse rate of 116 beats/min and oxygen saturation (SpO_2)-60% on room air. On physical examination, an increased work of breathing was observed with the use of accessory muscles. A throat swab was collected for COVID-19 testing. He was directly admitted to the respiratory ICU, where he was immediately attended by the team of chest physicians.

Investigations on admission showed: positive real time-polymerase chain reaction (RT-PCR) test for COVID-19; chest x-rays showed bilateral opacities throughout the lung field, predominantly in the lower lobes; arterial blood gas analysis showed type 1 respiratory failure; raised interleukin 6 (IL-6); raised D-dimer; and electrocardiography (ECG)-sinus tachycardia.

The patient was on medical management as prescribed by the chest physician which comprised of non-invasive ventilation (NIV) with BiPAP, broad spectrum antibiotics (injection meropenem, injection levoflox and tablet azee), methylprednisolone, anti-hypertensives, insulin, multi minerals and vitamins. As D-dimer and IL-6 levels were raised, low molecular weight heparin-LMWH (anti-coagulant) and tocilizumab (IL-6 inhibitor) were also administered. The course of his symptoms, functional activity and oxygen (O_2) requirements is outlined in Figure 1.

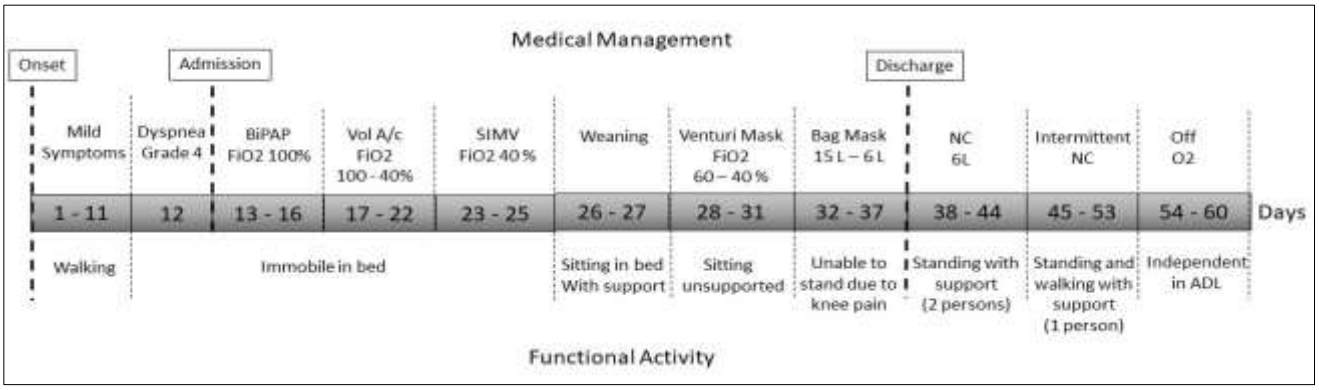

Figure 1: Timeline of O_2 requirements and functional activity of a COVID-19 patient.

Vol A/C: volume assist/control; SIMV: synchronized intermittent mandatory ventilation; VM: venturi mask; BMV: bag and mask ventilation; NC: nasal cannula; ADL: activity of daily living

The patient was unable to maintain oxygen saturation with NIV-BiPAP and was in severe ARDS (ratio of arterial oxygen partial pressure to fractional inspired oxygen i.e. PaO_2/FiO_2 ratio <100). He was immediately intubated and put on volume assist-control (A/C) mode on mechanical ventilator and was sedated. X-ray on the day of intubation is shown in Figure 2a. Sedation, obesity and general malaise contributed to reduced mobility and development of bed sores on sacral region and spine of scapula. Physical therapy treatment was commenced from day 25 of onset of symptoms after a referral from the treating chest physician. On day 25 (first day of physical therapy management), patient was conscious, oriented on synchronized intermittent mandatory ventilation (SIMV) mode (FiO_2-40%) with SpO_2- 92%, pulse rate (PR)-110 beats/minute and respiratory rate (RR)- 26 breaths/minute. He was tachypneic and apprehensive, unwilling to move, fearing breathlessness. He was counselled and explained the benefits of positioning by the treating doctor and physical therapist. X-ray post extubation is shown in Figure 2b.

The primary goal of physical therapist was to relieve breathlessness, early mobilization to prevent the consequences of immobilization and promote independence in performing ADL's. Description of physical therapy management with alterations in vitals is shown in Table 1.

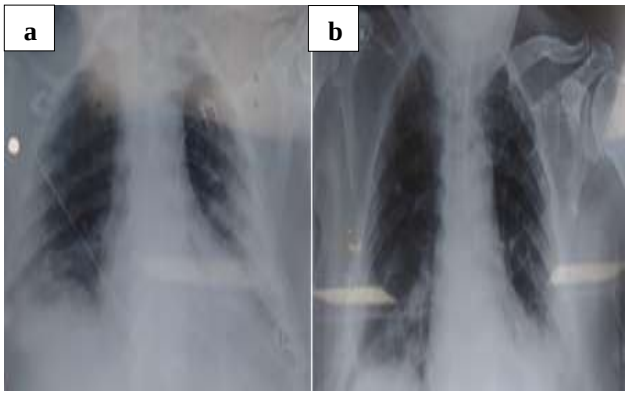

Figure 2: Chest x-ray (a) on day 17: pre-intubation - bilateral fluffy shadows seen all over the lung (left > right) with obliteration in the costophrenic angle bilaterally and (b) on day 26: post-extubation - fluffy shadows seen in bilateral lower lobes (left > right) with obliteration in the costophrenic angle on the left, an improvement is observed as compared to the previous X-Ray.

Table 1: Physical therapy management from day 25 to day 35.

Days		Day 25	Day 27	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34	Day 35
Mode of delivery of O_2 (FiO_2%/O_2 in L)		**SIMV (40% FiO_2)**	**BiPAP (40% FiO_2)**	**Venturi mask (60%)**	**Venturi mask (60%)**	**Venturi mask (31%)**	**BMV (15 L)**	**BMV (12 L)**	**BMV (10 L)**	**BMV (6 L)**
Increase in O_2 during exercise		No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PR (beats/min) pre		110	103	106	101	96	97	94	89	91
PR (beats/min) post		114	105	100	97	90	93	91	91	88
RR (breaths/min) pre		26	26	26	28	26	22	24	22	21
RR (breaths/min) post		26	26	23	25	22	18	23	20	18
SPO_2 (%) pre		92	95	92	95	94	91	93	95	96
SPO_2 (%) post	Immediate	94	97	89	92	99	89	97	98	97
	2 minutes	94	97	96	97	99	95	96	99	98
RPE pre		-	1	1	1	1	1	0.5	0.5	0.5
RPE post		-	2	1	0.5	0.5	0.5	0.5	0.5	0.5
Positioning - side lying, high side lying, propped up		✓	✓	✓	✓	✓	✓	✓	✓	✓
Breathing exercise										
Breathing control		×	×	✓	✓	✓	✓	✓	✓	✓
Thoracic expansion exercise		×	×	×	×	×	×	✓	✓	✓
In bed exercise		×	✓	✓	✓	✓	✓	✓	✓	✓
Sitting in bed with back support		×	×	×	×	✓	✓	✓	✓	✓
Sitting unsupported on edge of bed		×	×	×	×	×	×	✓	✓	✓

Continued.

Days	Day 25	Day 27	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34	Day 35
Upper limb mobility exercise	×	×	×	×	✓	✓	✓	✓	✓
Reach outs in sitting	×	×	×	×	×	×	✓	✓	✓
Lower limb mobility exercise	×	×	×	×	×	×	✓	✓	✓

PR: pulse rate; RR: respiratory rate; SpO_2: oxygen saturation; RPE: rate of perceived exertion; SIMV: synchronized intermittent mechanical ventilation; BMV: bag and mask ventilation.

DISCUSSION

In Mumbai, as quoted by the state COVID-19 task force, "Probably one-third of the COVID deaths in the city are due to delayed diagnosis of symptomatic cases or late admission, which delays treatment and reduces the chances of survival".[13] As there was no history of travel or contact with a COVID-19 positive individual, the initial symptoms of fever, dry cough and headache in our patient were treated with anti-pyretic and hence a delay was caused in testing for COVID-19. This delay in his testing and medical management may have contributed to the severe presentation of the disease requiring ICU care.

In a study done by Wu, approximately 59.5% of patients who presented with dyspnea developed ARDS.[14] The overactive inflammatory response to COVID-19 viral infection in the lungs causes' pulmonary vasoconstriction and microthrombi, intrapulmonary shunt, and ARDS. This results in ventilation perfusion mismatch causing severe hypoxia and type 1 respiratory failure. Evidence shows that men are at a higher predisposition to develop severe ARDS because of androgen hormones which are seen to have higher plasma levels in men as compared to women, that help drive the transcription of transmembrane protease serine 2 (TMPRSS2).[15] It is observed that comorbidities such as hypertension (27.4%) and diabetes (19.0%) increase the chances of developing ARDS and its progression from ARDS to death is furthermore increased due to older age beyond 60 years.[14] Due to the chronic hyperglycemic state seen in type 2 diabetes mellitus and chronic inflammatory state owing to excessive adipose tissue in obese patients, a delayed and depressed immune response and impaired immune memory is observed with increased risk of mortality due to COVID-19.[16] Our patient being obese, diabetic and hypertensive elderly male, he was predisposed to develop severe COVID-19 illness. Prolonged stay in ICU along with use of sedatives results in longer period of immobilization. This causes ICU acquired weakness which profoundly impacts the functioning of the patient.[17] Early mobilization of patients in ICU improves functional outcomes like independence in daily activities and early discharge.[18]

Physical therapy services to COVID-19 patients at our health care setup were commenced from 13 May 2020. The initial period went in understanding the impairments and formulating treatment protocols for patients and training of physical therapists for the same. Patient was admitted during this period and physical therapy was hence started on day 25 of onset of symptoms. The patient was attended by a physical therapist on one to one basis with level A personal protective gear.[10,19,22,23] Heart rate, respiratory rate RPE and SPO_2 were monitored throughout the sessions. Physical therapy was discontinued if oxygen saturation dropped more than 3% or if the heart rate increased by more than 20 beats/min.[10]

During the mechanical ventilation phase, dyspnea relieving position of high side lying and passive exercises to prevent circulatory stasis and maintain range of motion of joints were given.[10,20] Studies have shown that positioning improved oxygen saturation in patients with ARDS by homogeneous distribution of transpulmonary pressure.[21] As per guidelines, prone positioning was attempted. As patient was obese, he was uncomfortable in prone causing desaturation of more than 3%. Hence prone positioning was discontinued.[22] COVID-19 awake repositioning protocol (CARP) has shown promising results in patients with ARDS by improving the ventilation-perfusion mismatch thus countering hypoxaemia. Frequent change in positions from left lateral (side lying) to propped up, to right lateral for 30 minutes each was given to improve oxygenation and reduce respiratory effort.[10,20,22,23] Positioning also helped relieving pressure on the bed sores thus promoting their healing.[24] After weaning off trials, on day 27, patient was extubated and put on BiPAP. As it was difficult to explain breathing control to the patient using verbal commands, it was then taught to him through proprioceptive feedback by therapist's hand on patient's upper abdomen. Patient was instructed to breathe out when pressure on the abdomen was increased by therapist's hand for a count of 6 and to breathe in when the pressure was released for a count of 3. Precautions were taken to prevent elicitation of cough. Breathing control helped in reducing pulse rate and respiratory rate and improving oxygen saturation.[22,25] Cough etiquettes were taught.[10]

On day 29, as the patient's condition improved, he was progressed to Venturi mask. During this time simple in-bed exercises were given. Patient's oxygen saturation dropped below 90 and the session was discontinued. From then onwards, oxygenation was increased prior to sessions and continued till the recovery phase to prevent exercise related fall in oxygen saturation.[23] Patient was progressed from supine-lying exercises to supported sitting in bed followed by unsupported sitting at edge of the bed. Evidence shows that upright sitting improves the oxygenation of the lungs and builds confidence in the patient.[26] Thoracic expansion exercises with lateral stretches were administered once he was confident in

sitting unsupported. Reaching out exercises in sitting to encourage lateral weight shifting within the patient's base of support were commenced. Upper limb and lower limb active exercises in sitting were included. Progression to standing was attempted for the patient. However, patient had difficulty in standing due to pain in the right knee (numeric rating scale [NRS] 7/10). On palpation, tenderness was present over the medial joint line of right knee (grade 3) with mild swelling. Static quadriceps exercises and application of ice packs was advised to reduce the swelling and pain at the knee.

On day 37, patient tested negative for COVID-19. An improvement was noted clinically as well as radiologically. Patient was stable maintaining oxygen saturation on nasal canulae (5 L/min). Considering his age, presence of bedsores, reduced functional status, patient needed specialized nursing care and attention which otherwise was difficult in the hospital because of the pandemic situation. Discharge was planned after a discussion of the treating doctor, physical therapist, the patient and his relatives. An oxygen concentrator was made available for use at home. Patient and his relative were counselled about the importance of being compliant to medical care and physical therapy exercises. The relative was taught how to care for the bedsore and physical therapy exercises were explained.

Post discharge, insulin and low-molecular-weight heparin (LMWH) were tapered and stopped. In the first week post discharge, patient continued with application of ice packs and static quadriceps exercises for knee pain and general exercises with supplemental oxygen (5 l/min) twice in a day that were taught in the hospital. By the end of first week post-discharge, knee pain was reduced (NRS 2/10) and patient was able to stand with the support of two persons. By end of 2nd week post discharge, he was able to stand up and walk in the house with the support. He was advised to stand up from sitting as many times as he could perform with support of person and with supplemental oxygen (2-3 l/min) twice a day. He was able to perform five times at the time. Gradually his O_2 requirements reduced to oxygenation on SOS (if occasion required) eventually weaning off of O_2 support. By day 60, he was able to maintain an oxygen saturation of 95% on room air and he was able to stand and walk with minimal support.

CONCLUSION

Health is one of the most essential pillars for the development of a country. COVID-19 pandemic has increased healthcare as well as economic burden. Hence like other diseases, a multidisciplinary approach to management of COVID-19 patient improves functional mobility and early return to their daily routine activities post disease. Early diagnosis and treatment can prevent severe complications. This case report expresses a ray of hope that patients on mechanical ventilation can survive and become independent.

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REFERENCES

1. WHO. Modes of transmission of virus causing COVID-19: Implications for IPC precaution recommendations. 2020. Available at: https://www.who.int/news-room/commentaries/ detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations. Accessed on 09 August 2020.
2. Nanda A, Vura NV, Gravenstein S. COVID-19 in older adults. Aging Clin Exp Res. 2020;10:1-4.
3. Wan S, Xiang Y, Fang W, Zheng Y, Li B, Hu Y, et al. Clinical features and treatment of COVID-19 patients in northeast Chongqing. J Med Virol. 2020;92(7):797-806.
4. Guan WJ, Liang WH, Zhao Y, Liang HR, Chen ZS, Li YM, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: A Nationwide Analysis. Eur Respir J. 2020;55(5):2000547.
5. Li B, Yang J, Zhao F, Zhi L, Wang X, Liu L, et al. Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China. Clin Res Cardiol. 2020;109(5):531-8.
6. Wang Y, Lu X, Li Y, Chen H, Chen T, Su N, et al. Clinical course and outcomes of 344 intensive care patients with COVID-19. Am J Respir Crit Care Med. 2020;201(11):1430-4.
7. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. JAMA. 2020;323(20):2052-9.
8. Shi S, Qin M, Shen B, Cai Y, Liu T, Yang F, et al. Association of cardiac injury with mortality in hospitalized patients with COVID-19 in Wuhan, China. JAMA Cardiol. 2020;5(7):802-10.
9. Castro AA, Calil SR, Freitas SA, Oliveira AB, Porto EF. Chest physiotherapy effectiveness to reduce hospitalization and mechanical ventilation length of stay, pulmonary infection rate and mortality in ICU patients. Respir Med. 2013;107(1):68-74.

10. Thomas P, Baldwin C, Bissett B, Boden I, Gosselink R, Granger CL, et al. Physiotherapy management for COVID-19 in the acute hospital setting: Recommendations to guide clinical practice. J Physiother. 2020;66(2):73-82.
11. Barba C, Cavalli-Sforza T, Cutter J, Darnton-Hill I, Deurenberg P, Deurenberg-Yap M, et al. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;363(9403):157-63.
12. Munari AB, Gulart AA, Dos Santos K, Venâncio RS, Karloh M, Mayer AF. Modified Medical Research Council dyspnea scale in GOLD classification better reflects physical activities of daily living. Respir Care. 2018;63(1):77-85.
13. Hindustan Times. One-third of Covid deaths a result of delay in admission or reporting: Maharashtra task force. 2020. Available at: https://www.hindustantimes.com/mumbai-news/one-third-of-covid-deaths-a-result-of-delay-in-admission-or-reporting-maharashtra-task-force/story-YfsA3NDVIz93znvghUtkmN.html. Accessed on: 10 August 2020.
14. Wu C, Chen X, Cai Y, Zhou X, Xu S, Huang H, et al. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. JAMA Intern Med. 2020;180(7):934-43.
15. Voinsky I, Baristaite G, Gurwitz D. Effects of age and sex on recovery from COVID-19: analysis of 5769 Israeli patients. J Infect. 2020;81(2):102-3.
16. Costa FF, Rosário WR, Farias AC, de Souza RG, Gondim RS, Barroso WA. Metabolic syndrome and COVID-19: An update on the associated comorbidities and proposed therapies. Diabetes Metab Syndr. 2020;14(5):809-14.
17. Shehabi Y, Bellomo R, Reade MC, Bailey M, Bass F, Howe B, et al. Early intensive care sedation predicts long-term mortality in ventilated critically ill patients. Am J Respir Crit Care Med. 2012;186(8):724-31.
18. Zhang L, Hu W, Cai Z, Liu J, Wu J, Deng Y, et al. Early mobilization of critically ill patients in the intensive care unit: A systematic review and meta-analysis. PloS one. 2019;14(10):e0223185.
19. Public Health England. Guidance COVID-19: personal protective equipment use for aerosol generating procedures. 2020. Available at: https://www.gov.uk/government/publications/covid-19-personal-protective-equipment-use-for-aerosol-generating-procedures. Accessed on 10 August 2020.
20. Berney S, Haines K, Denehy L. Physiotherapy in critical care in Australia. Cardiopulm Phys Ther J. 2012;23(1):19.
21. Pelosi P, Brazzi L, Gattinoni L. Prone position in acute respiratory distress syndrome. Eur Respir J. 2002;20(4):1017-28.
22. Verma CV, Arora RD, Shetye JV, Karnik ND, Patil PC, Mistry HM, et al. Guidelines of physiotherapy management in acute care of COVID-19 at dedicated COVID-19 centre in Mumbai. Physiother-J Indian Assoc Physiother. 2020;14:55-60.
23. Guidelines for Chest Physiotherapy management of COVID-19 in Indian Set-up – MS OTPT Council (2020). 2020. Available at: www.msotptcouncil.org. Accessed on: 10 August 2020.
24. Burk RS, Grap MJ. Backrest position in prevention of pressure ulcers and ventilator-associated pneumonia: conflicting recommendations. Heart Lung. 2012;41(6):536-45.
25. Radaelli A, Raco R, Perfetti P, Viola A, Azzellino A, Signorini MG, et al. Effects of slow, controlled breathing on baroreceptor control of heart rate and blood pressure in healthy men. J Hypertens. 2004;22(7):1361-70.
26. Katz S, Arish N, Rokach A, Zaltzman Y, Marcus EL. The effect of body position on pulmonary function: a systematic review. BMC Pulm Med. 2018;18(1):1-6.

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