

Potential Prophylactic and Therapeutic Effects of Respiratory Physiotherapy for COVID-19

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Abstract. New coronavirus disease 2019 (COVID-19) has succeeded in surprising the world with infecting more than 12 million people and claiming 560,000 lives in only six months. COVID-19 is associated with a spectrum of respiratory symptoms, especially dyspnea. Patients who progress to severe or critical condition display peripheral and posterior lung lesions bilaterally. These patients require admission to the intensive care unit (ICU); therefore, they are prone to ICU-related complications during disease and after recovery. Respiratory physiotherapy techniques, in particular, active techniques, might help the improvement of airway clearance and lung capacity in addition to the reduction of breathing effort during the active disease. In parallel, it might lead to the prevention of disabilities, resulting from infection and extended hospitalization in patients who recovered from COVID-19. This supports physiotherapy both as a prophylactic and therapeutic strategy for COVID-19. (www.actabiomedica.it)

Keywords: COVID-19; physiotherapy; prophylactic; recurrence; respiratory physiotherapy; respiratory therapy; therapeutic

Introduction

Novel coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first identified in 2019 in Wuhan, the capital of China's Hubei province (1). Now, it has spread worldwide with more than 5.5 million cases affected, and 350,000 lives claimed (May 25th, 2020). The virus not only can spread person-to-person within six feet through respiratory droplets

produced when an infected person coughs or sneezes, but also can be transferred to a person by touching a contaminated surface or object (1,2). Fever, cough, and shortness of breath are the most common symptoms of COVID-19. However, some patients may also experience myalgia, sputum production, diarrhea, sore throat, loss of smell, and abdominal pain (3). The virus primarily attaches to upper respiratory tracts. However, the involvement of the lower respiratory tract is more common than that of the upper respiratory tracts.

Respiratory dysfunction in COVID-19

Pathologic findings show features of diffuse alveolar damage and mild thickening in alveolar walls in COVID-19 patients (4,5). The study by Luo *et al.* (5), ascertained the massive pulmonary interstitial fibrosis and, to a lesser extent, hyaline degeneration as the main changes in lung tissue, especially in late-stages of COVID-19. Computed tomography (CT) demonstrates the distribution of consolidation and ground-glass opacity over the peripheral and posterior lung fields (6,7) with about 80% involvement of both lungs (6).

Respiratory physiotherapy: mechanism of action

Chest physiotherapy, including clearance techniques and positioning in prone mainly, assists oxygenation in patients who are in the intensive care unit (ICU) (8). In particular, techniques such as percussion and vibration are useful for moving the aggregate airway secretions (9). Active cycle of breathing techniques (ACBT) that are accomplished by patients independently can also help the clearance of pulmonary secretions, improvement of lung function, and amelioration of effective cough in these patients. Three components defined for this technique are: 1) breathing control, 2) deep breathing or thoracic expansion exercises, and 3) forced expiratory techniques like huff and cough (10).

Respiratory physiotherapy: implications for viral infections

Respiratory physiotherapy is considered as one of the therapeutic options for symptom alleviation in various respiratory viral infections (11–13). In particular, studies support the benefits of prone positioning on airway clearance and oxygenation in patients with influenza (14). Breathing exercises, combined with other interventions, could enhance the total lung capacity in the patients suffering from influenza-related acute respiratory distress syndrome (ARDS) (13). In infants with respiratory syncytial virus bronchitis, chest physiotherapy techniques consisted of prolonged slow expiration have shown to improve respiratory parameters transiently, but no changes in the duration of admission were reported (12). Several

randomized control trials investigated the effect of respiratory therapy on children admitted with acute viral bronchiolitis (15–17). An enhancement on SpO₂, respiratory rate, and chest retraction was demonstrated in addition to the reduction in wheezing.

Respiratory physiotherapy: lessons learned from SARS

Severe acute respiratory syndrome coronavirus 1 (SARS-CoV-1) is an earlier discovered strain of human coronaviruses. It was firstly reported in China in 2003 (18). SARS-CoV-2 has shown a remarkable identity with SARS-CoV-1 in structure (5). Also, both SARS-CoV-1 and SARS-CoV-2 can bind to the same receptor that is the angiotensin-converting enzyme 2 (ACE2), a receptor expressed by alveolar membrane cell. This explains the high similarities in respiratory symptoms produced by these two viruses.

Respiratory physiotherapy for COVID-19

Less is understood about the effect of physiotherapy on patients with COVID-19. On theoretical considerations, active techniques of the respiratory physiotherapy such as ACBT would satisfy the needs of patients with COVID-19 in acute stages as well as after recovery (9,11), while keeping patients away from physiotherapists and maintaining the disease transmission at the low-risk (9).

Potential therapeutic effects during disease

Some cases progress to severe respiratory conditions like pneumonia and multi-organ failure, requiring admission to ICU. Patients admitted to ICU are susceptible to ICU acquired weakness (19). Generally, early physiotherapy interventions, including exercise and mobilization, help decrease the severity of ICU-associated complications, and functional recovery is thereby facilitated after the acute phase of ARDS (20). Particularly speaking, Lau *et al.* showed that exercise improves muscle performance and cardiorespiratory function in those recovered from SARS-CoV-1 (21). Lower tract respiratory infections (LTRI) are common to both SARS-CoV-1 and SARS-CoV-2. Respiratory

therapy for LTRI, which mainly consists of breathing techniques, exercise training, and education (18,22), can improve SpO₂ level, lung capacity, and activity limitation resulting from dyspnea associated with LRTI (18).

Potential prophylactic effects after recovery

The relapse risk of COVID-19 is established in some patients after recovery (23). Based on the result of recent studies, a few patients show fever, a positive nucleic acid for the SARS-CoV2, and the virus in oropharyngeal swab after becoming afebrile and recovery from respiratory syndrome (24,25). Even, there has been one reported case, who tested positive after two consecutive discharges (26). In such cases, virus eradication is not successfully achieved, while the clinical symptoms disappear (26). Patients with comorbidities, including cardiovascular disease (CVD) and diabetes mellitus, as well as the elderly, seem to be more prone to recurrence because of staying more extended periods at the hospital (23). Chest physiotherapy techniques focused on breathing work reduction and promotion of alveolar recruitment (27) might help to alleviate the frequency and severity of pulmonary complications (28,29), and thereby reducing the risk of recurrence following COVID-19 (30).

Conclusions

In conclusion, because of the disabling effects of COVID-19, physiotherapy would be the inseparable part of the treatment. One prospective study based on radiologic findings indicated the pulmonary fibrosis in 62% of discharged patients with SARS-CoV-1 (31). The similarity of SARS-CoV-2 and SARS-CoV-1 supports the possibility of fibrosis development in patients with COVID-19 after the acute stage, so physiotherapy interventions could be beneficial to decrease the development of lung problems. In addition, previous studies have shown the preventive role of pulmonary rehabilitation on symptoms exacerbation in various respiratory diseases (32). Further investigations are warranted to study the role of chest physiotherapy in the prevention of severe involvement

of the respiratory system in COVID-19 after a relapse of disease. Altogether, physiotherapy interventions, including mobilization, chest physiotherapy, and exercise training, could be considered as both prophylactic and therapeutic strategies for all patients after recovery.

Conflicts of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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