

THE ROLES OF CHEST PHYSIOTHERAPY IN THE MANAGEMENT OF PATIENTS WITH COVID-19

ROLURILE FIZIOTERAPIEI RESPIRATORII ÎN MANAGEMENTUL PACIENTULUI CU COVID-19

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Abstract

Background: The high rate of mortality among critically ill patients with COVID-19 mainly due to complications associated with acute respiratory failure urgently calls for effective therapeutic strategies to improve ventilation and alleviate the condition. While chest physiotherapy management techniques improve ventilation and help to keep the blood-oxygen saturation high enough to prevent acute respiratory failure and death, there are limited reports on their utilization in the management of patients with COVID-19.

Objective: To highlight the roles of chest physiotherapy in the management of patients with COVID-19.

Review: A review of COVID-19 pneumonia and the roles of some chest physiotherapy techniques for the alleviation of its clinical manifestations was done.

Conclusion: The clinical manifestations of COVID-19 which are largely respiratory have solutions rooted in very many of the techniques that Cardiopulmonary physiotherapists use in managing respiratory conditions. Therefore, chest physiotherapy is an important adjunct therapy in the management of patients with COVID-19.

Key words: *COVID-19, chest physiotherapy, patients*

Rezumat

Introducere: Rata crescută a mortalității printre pacienții în stare critică cu COVID-19, în principal din cauza complicațiilor asociate cu insuficiența respiratorie acută, necesită urgent strategii terapeutice eficiente pentru ameliorarea disfuncției ventilatorii și atenuarea afecțiunii. În timp ce tehnicile de management a fizioterapiei respiratorii îmbunătățesc ventilația și ajută la menținerea saturației de oxigen în sânge suficient de mare pentru a preveni insuficiența respiratorie acută și decesul, există limitări privind utilizarea lor în managementul pacienților cu COVID-19.

Obiectiv: Evidențierea rolurilor fizioterapiei respiratorii în managementul pacienților cu COVID-19

Acceptat pentru publicare în 09.06.2020; Publicat pentru prima dată online în 10.06.2020

Pentru citare: Aweto, H.A., Adedoyin, R.A. (2020). The roles of chest physiotherapy in the management of patients with COVID-19, *Revista Română de Kinetoterapie*, 26(44), 11-18

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Recenzie: S-a efectuat o trecere în revistă a pneumoniei COVID-19 și a rolurilor unor tehnici de fizioterapie respiratorie pentru ameliorarea manifestărilor sale clinice

Concluzie: Manifestările clinice ale COVID-19, care sunt respiratorii în mare măsură, au soluții înrădăcinate în foarte multe dintre tehnicile utilizate de fizioterapeuți cardiopulmonari în managementul/gestionarea afecțiunilor respiratorii. Astfel, fizioterapia respiratorie este o terapie complementară importantă în managementul pacienților cu COVID-19

Cuvinte cheie: *COVID-19, fizioterapie respiratorie, pacienți*

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the virus that causes COVID-19 and was first identified in samples of bronchoalveolar lavage fluid from a patient in Wuhan, China [1]. COVID-19 affects different people in different ways. This means that symptoms vary from person to person. Most infected people will develop mild to moderate symptoms while a few others may not have symptoms at all [2, 3]. Children especially have mild or no symptoms after being infected with SARS-CoV-2 [2]. The level of severity of the disease depends on a person's level of immunity prior to infection [3]. This is why those at higher risk of developing acute respiratory distress syndrome (ARDS) and death are older adults especially males and those with other health conditions that compromise their immune system [3, 4]. This group of patients may develop dyspnoea and hypoxemia due to pneumonia within one week after onset of the disease which may quickly progress to ARDS or end-organ failure [4]. Unfortunately, antibiotics will not kill the infecting organisms in cases of viral pneumonia so treating the symptoms helps to alleviate the impact of the disease on the patient [5].

In general, the respiratory system is usually compromised in patients with COVID-19. Common clinical manifestations in patients include fever, nonproductive cough, dyspnoea, fatigue, radiographic evidence of pneumonia, anxiety and depression [6]. Other symptoms include nasal congestion, runny nose, sore throat, sneezing, myalgia as well as gastrointestinal problems such as diarrhoea and vomiting. In the presence of acute respiratory failure in critical conditions, there is a reduction of lung compliance, increased work of breathing and alteration of blood oxygenation (hypoxemia), leading to a rapid and shallow respiratory pattern (hyperventilation). Thomas *et al* [7] reported that physiotherapy may be beneficial in the respiratory treatment and physical rehabilitation of patients with COVID-19. Since chest physiotherapy improves ventilation and relieves respiratory symptoms in respiratory diseases, it is highly indicated in the management of patients with COVID-19 to alleviate the symptoms of the disease, slow down the progression of the disease severity and reduce the mortality rate of the disease.

How Pneumonia occurs and the body's response in human coronavirus infection

In response to the coronavirus infection of the airways and lungs, the body's defence mechanism fights back by deploying inflammatory cells, chemicals and fluid in the blood through the vascular circulation to the lungs. The pathogenesis of human coronavirus is not fully understood, but in Middle East respiratory syndrome (MERS), it was observed that the severity of lung damage is correlated with extensive pulmonary infiltration of neutrophils and macrophages and higher numbers of these cells in the peripheral blood [8-10]. Neutrophils are the main source of chemokines and cytokines and when cytokine storm is generated, it can lead to ARDS, which is a

leading cause of death in patients with severe acute respiratory syndrome (SARS) and MERS [8, 11]. Wu *et al* [3] observed that patients with COVID-19 pneumonia who had developed ARDS had significantly higher neutrophil counts than did those without ARDS. During this process, the alveoli sacs in the lungs which are normally filled with air become inflamed and are filled with inflammatory cells and fluid through a process known as Consolidation [5]. The alveoli sacs are the part of the lungs where gaseous exchange between the blood capillaries and takes place. The carbon dioxide in the carbon dioxide-rich blood from the heart is exchanged with oxygen from the oxygen-rich air in the lungs via a pressure gradient through a process known as diffusion. When these alveoli sacs are filled with inflammatory cells and fluid instead of air, there is little or no room for gaseous exchange at these sites. There is also the narrowing of the airways which limits air passage from the atmosphere into the lungs. These cause the level of oxygen in the blood to continue to reduce (hypoxaemia) resulting in organ failure and even death depending on the severity. In very severe cases the oxy-haemoglobin saturation (SpO₂) can go below 75. Hypoxemia is defined as blood oxygen saturation of less than 90% [12]. Ideally, a healthy person's blood oxygen saturation should be 100% when measured with a pulse oxymeter. In response to the hypoxaemia, the body tries to get in more oxygen into the blood by triggering off hyperventilation- a situation where the rate of breathing increases.

The roles of Chest physiotherapy in the management of patients with COVID-19

Physiotherapy management of patients with COVID-19 should start as soon as an infected person notices the first symptom. At this early stage, treatment can be self-administered. Early chest physiotherapy management will ensure improved ventilation which helps to keep the blood-oxygen saturation high enough to prevent multiple organ failure and death while the viral infection runs and completes its course. In essence starting early to manage patients with chest physiotherapy slows down the progression of the severity of the disease and ensures a fast recovery.

The aims of Physiotherapy management are to:

1. Improve ventilation by reducing breathlessness and the work of breathing
2. Improve diaphragmatic excursion and breathing control
3. Clear excess secretions if there is any [7]
4. Teach effective coughing techniques [7]
5. Improve lung function
6. Maintain sufficient mobility to prevent circulatory complications and restricted thoracic, shoulder girdle and arm movements
7. Help the patient back to a good posture and pain free movements
8. Improve general wellbeing of the patient and return the patient to a life as full and as independent as possible

The Chest physiotherapy management modalities are as follows:

- A. **Breathing Exercises:** These exercises have value as an add-on therapy to medication and other standard treatments in respiratory conditions [13]. They involve;
 - i. Exercises that aim at manipulating the pattern of breathing (**Breathing Retraining**);

- ii. Exercises that aim at increasing the strength and/or endurance of the respiratory muscles (**Respiratory Muscle Strengthening**);

Breathing Retraining

The major goals in breathing retraining are:

1. Reducing respiratory rate by decreasing the number of breaths taken per time
2. Encouraging deep breathing (Diaphragmatic breathing) through the use of the abdominal muscles and lower thoracic chest.
3. Encouraging breathing through the nose (Nasal Breathing)
4. Encouraging relaxation to decrease anxiety through relaxed, controlled breathing
5. Decreasing expiratory flow through pursed lip breathing

Examples of breathing retraining exercises are as follows:

- a. **Diaphragmatic Breathing** – This technique involves breathing through the nose and holding the breath as long as possible while ensuring that the diaphragm moves maximally to help slow down the breathing rate and decrease the body's need for oxygen. It can be done in sitting or standing positions.
- b. **Pursed Lip Breathing**– This is a breathing technique that consists of exhaling through tightly pressed (pursed) lips and inhaling through the nose with the mouth closed [14]. It results in slower and deeper breaths with a shift in respiratory muscle recruitment from the diaphragm to the accessory muscles of breathing, leading to decreased breathlessness and improved oxygenation on exercise. With regular practice, it can help strengthen the lungs and make them work more efficiently.
- c. **Buteyko breathing**- This technique was developed in the 1950s by a Russian doctor named Konstantin Buteyko. He developed it to control hyperventilation and anxiety which leads to shortness of breath in patients with asthma [15]. It uses series of exercises to teach patients to breathe less deeply and less rapidly. Although it does not improve lung function, it helps reduce breathlessness. The patient breathes normally through the nose for 2-3 minutes and then breathes out normally. He/she is then instructed to close the nose with the fingers, and hold. The length of time that the patient can hold his/her breath is noted after which the patient releases the nose and returns to nasal breathing. The patient then waits for 3 minutes before repeating the whole process and holding the breath for as long as possible [15].

Respiratory Muscle Strengthening

These are specific trainings for the respiratory muscles using inspiratory muscle training equipment such as incentive spirometer to increase the capacity of the inspiratory muscles [16, 17]. These exercises increase the strength and endurance of the diaphragm and accessory muscles of respiration [18]. The patient is asked to sit upright in a chair and breathe in through a mouth piece of this external device as slowly and as deeply as possible, to enable the piston in the device to move up to the level indicated by the marker. The patient is then asked to hold their breath for as long as possible and then exhale slowly and watch the piston fall back into the

bottom of the column. This way, the respiratory muscles are forced to work harder, increasing their strength, leading to easier diaphragmatic breathing and a reduction in lung hyperinflation.

B. Active Cycle of Breathing Techniques (ACBT)

This is an active breathing technique performed by the patient and can be used to mobilise and clear excess pulmonary secretions and to generally improve lung function [19]. It is a flexible method of treatment which can be used in conjunction with positioning and adapted for use with most patients.

It consists of three phases: **Breathing Control, Deep Breathing Exercises, and Huffing or Forced Expiratory Technique (FET)**. It is used to achieve the following aims;

1. Loosen and clear secretions from the lungs.
2. Improve ventilation in the lungs.
3. Improve the effectiveness of a cough

Breathing Control and Deep Breathing Exercises are achieved through breathing retraining exercises while **Huffing or FET** is exhaling forcefully through an open mouth and throat instead of coughing. It is performed by forcefully breathing out with an open throat, as if trying to clear the throat of a bony obstruction, while using the abdominal muscles to help to gently squeeze the air out. Huffing helps to move secretions from the small airways to the larger airways, from where they are then removed by coughing as coughing alone cannot remove secretions from small airways.

C. Chest Percussion

Chest Percussion is one of the interventions for airway clearance which augments the mobilization of secretions in one or more lung segments to the central airways [20]. It is performed with cupped hands which strikes the patient's chest wall in an alternating rhythmic manner over the lung segments being drained of excess secretions. The technique is applied over a towel to ensure it does not feel uncomfortable. When short periods of percussions (<30 sec) are combined with three or four thoracic expansion exercises via diaphragmatic breathing, no fall in oxygen saturation is seen.

D. Heat Therapy

Heat is used by physiotherapists to alleviate pain and induce the release of endorphins, powerful opiate-like chemicals which block pain transmission. Heat can be employed in different forms to relieve the symptom of chest pain, especially musculoskeletal chest pain. An example of heat therapy modality used by Physiotherapists for this purpose is **Infrared therapy** [21].

Another **heat therapy** that has proven to be effective in loosening mucous secretions from the airways and lungs of these patients as well as to improve ventilation is **breathing in hot water vapours**. This therapy is particularly very helpful for these patients since the SARS-CoV-2 virus does not thrive in hot and very humid environment. The patient sits on a chair with a bucket of very hot water at his/her feet; he/she places a big towel over his/her head and covers the bucket as well with the same towel placed on the head. He/she breaths in deeply the rising vapour for about 15 minutes. This procedure is repeated several times a day. Physiologically, heat therapy causes increase in cutaneous vasodilatation which brings about a redistribution of blood supply from the

central towards the periphery. This means increased blood supply to skin and reduced blood supply to the internal organs including the lungs. This may be particularly important in resolving the pneumonia as there will be less supply of the inflammatory cells, chemicals and fluid brought by the blood to the lungs in response to the viral infection. This will in turn improve the gaseous exchange between the alveoli sacs in the lungs and blood capillaries supplying the lungs. This will lead to improved oxygenation of the blood and decreased mortality caused by hypoxaemia.

It is important to **drink lots of water** not only to replace the increased loss of body fluids through increased sweating during the heat therapy but also to increase the hydration of the body for metabolic purposes as well as loosen mucous secretions for easy expectoration.

E. Pulmonary Rehabilitation

Although pulmonary rehabilitation is a multidisciplinary and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic, its major component is exercise training [22, 23]. A baseline exercise capacity testing using the six minute walk test is essential in formulating the exercise training prescription and in evaluating for hypoxaemia during exercise [12]. Pulmonary rehabilitation optimizes the patient's ability to function independently, relieves fatigue, improves physical abilities and exercise tolerance, reduces anxiety and depression (brought about by an increased release of endorphins during exercise), increases muscle strength, improves breathlessness, improves quality of life, reduces complications and progression of the disease, and it also causes gross reduction in mortality [24]. The patient should wear a pulse oxymeter on one of the fingers during exercise training to monitor the oxygen saturation of the blood. Supplemental oxygen should be kept handy while the patient exercises in case the oxygen saturation drops to a dangerous low.

Conclusion

The clinical manifestations of COVID-19 which are largely respiratory have solutions rooted in many of the techniques that Pulmonary physiotherapists use in managing respiratory conditions. Therefore, chest physiotherapy is an important adjunct therapy in the management of patients with COVID-19.

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