

Respiratory physiotherapy in chronic obstructive pulmonary disease

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Abstract

World Health Organization state that obstructive pulmonary diseases exhibit a high rate of mortality due to changes in ventilatory arising out of this disease. The loss of functionality is demonstrated in the reduction of physical activities that have an impact on activities of daily living, as well as on hospitalizations by worsening respiratory symptoms. Pulmonary physical therapy has been well established and increasingly recommended in patients with chronic obstructive pulmonary disease (COPD). The key elements to the treatment include a multidisciplinary approach. In general, patients seek physical therapy care when have respiratory symptoms. Respiratory physical therapy intervention must be early, as it will minimize the deleterious effects of bronchial obstruction, promoting improvement of pulmonary ventilation and patient's functionality, improving their quality of life. In COPD patients, physical therapy programs are crucial, such as: pulmonary rehabilitation duration, orientations of

maintenance therapy, management of exacerbations, training intensity of aerobic exercise, the inspiratory muscle training, behavioral guidelines and psychological support are part of a set of necessary attention to the therapeutic success. On the basis of the literature review, the aim of this article was to demonstrate the intervention of respiratory physiotherapy in pathological changes of bronchial obstruction and the beneficial results on pulmonary function.

Keywords: *Pulmonary disease, chronic obstructive; Physical therapy modalities; Pulmonary ventilation.*

Introduction

Obstructive pulmonary disease may be acute or chronic. When treated, acute obstructive disease does not develop deleterious aspects, and patients can return to full functionality without effects on their quality of life. According to the World Health Organization (WHO) however, chronic obstructive pulmonary disease (COPD)

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can lead to death over time.¹ The WHO describes that air body channels are changed by COPD and when such changes reach a critical level this reduces physical activity, interferes with daily life activities, and increases risk of hospitalization as a result of worsening symptoms.²

According to a study by Lokke, COPD is prevalent in both men and women; however, it is less common in women. While it does not have any significant relationship with sex, COPD is greatly related to age and smoking. Furthermore, COPD expands across the pulmonary system with organic repercussions, and is thus considered as a systemic pathology.² Thereby, respiratory physical therapy assistance (i.e., prescription and accompaniment) is important to decrease the impact of its systemic repercussions.^{1,3}

In COPD, chronic respiratory flow limitation is usually related to symptoms such as increased mucus production, dyspnea, and cough; it is important to evaluate the state and severity of the disease in order to choose the best treatment. Concerning the symptoms of COPD, a cohort study⁴ was published by the Portuguese Journal of Pulmonology in 2011, in which 298 patients answered a questionnaire about the symptoms that led them to seek medical attention; among these, dyspnea was the most common reason, followed by cough and then expectoration. The diagnosis and severity of COPD are defined according to the parameters of lung function, following the guidelines of the Global Initiative of Chronic Obstructive Lung Disease (GOLD); in spite of its clinical characterization being established, more knowledge regarding the various stages of this disease is still needed.³⁻⁵

Acute and chronic obstructive diseases exhibit pathological changes that prevent/limit airflow in a mild, moderate, or severe way. These changes may be related to (a) airway narrowing by bronchospasm (contraction of smooth muscle), mucosal edema, or inflammation (bronchitis); (b) the presence of intrabronchial secretions, tumors, or foreign bodies; or (c) extrinsic compression (tumors) altering the lung

function of the patient.⁶

In order to define the pathological changes of the respiratory system, it is worth mentioning its physiological functions. The respiratory tract, when healthy, has important defense mechanisms, which are crucial for the maintenance of its functionality. These defenses are divided into immunological (natural and acquired) and mechanical processes, and are related to lung structure. Appropriate lung structure maintains the right conditions for gas exchange, aerodynamic filtration (which is related to the size of the inhaled material contributing to its deposition onto the mucous membrane), and mucociliary transport (responsible for the elimination of mucus towards the oropharynx).^{6,7} In obstructive disease, these defense mechanisms may be severely compromised, resulting in respiratory infections, worsening of the disease, and deterioration of already compromised pulmonary function.

Prevention and control of obstructive disease progression via the abolition of risk factors followed by a comprehensive treatment program, including respiratory physical therapy, can have a positive impact on quality of life, according to several authors such as Bellamy et al, Gulini, and Kunikoshita.⁸⁻¹⁰ The aims of this study were to discuss the respiratory physical therapy techniques used to treat the pathological changes caused by bronchial obstruction and to highlight their consequent optimization of pulmonary ventilation.

Development

Respiratory physical therapy

Respiratory physical therapy is recommended based on the history and severity of the disease, the patient's comorbidities, and the frequency and duration of treatment. However, it should be taken into account that when initiated immediately after the diagnosis of obstructive disease and performed regularly by the patient, physical therapy minimizes the deleterious effects of obstruction.¹¹

In COPD, obstructed areas are not ventilated and display impaired gas exchange, causing infections and hypoxemia due to the growth of microorganisms. The resulting complications include systemic musculoskeletal changes and a fall in endurance, impairing the quality of life of patients with COPD.¹⁰⁻¹³ Respiratory physical therapy for obstructive disease aims to improve patient lung function through cleansing via stimulation of bronchial secretion elimination, relaxation of the bronchial muscles, optimization of ventilation, and improvement of cardiopulmonary fitness.¹⁴⁻¹⁶

The assessment methods used in physical therapy evaluate the parameters of disease progression and include anamnesis, auscultation, ectoscopy, palpation, oximetry, cardiopulmonary fitness analysis, pulmonary function tests, blood gas analysis, and chest radiography. Subjective data such as the perception of dyspnea, fatigue, and pain are assessed by the Borg and Visual Analogue scales and are important for qualitative evaluation.¹⁷⁻¹⁹ Exercise tests such as the six-minute walk test and the 6-min step test are also important evaluations used to determine the cardiopulmonary fitness of patients.^{17,20}

Interventional physiotherapeutic techniques

With regards to interventional techniques, aerosol therapy with diluents such as water and saline solutions is indicated when the secretion present is hyperviscous and hyperadherent, in order to facilitate its removal with the lowest energy expenditure.^{21,22} Aerosol therapy, which is indicated by assistant physicians, acts on the processes of inflammation and bronchospasm. Patients are instructed to perform breathing exercises to reduce both inspiratory flow rate, which optimizes the deposition of particles from the conveyed substances, and expiratory flow rate, which minimizes the output speed of the inhaled particles, with the goal of keeping the particles in the bronchial duct for longer. Thus, aerodynamic filtration is used during aerosol treatment.²¹

Bronchial clearance is another major goal of physical therapy intervention for COPD. Currently, the techniques for clearance are divided into conventional and current methods.

Conventional clearance techniques

Conventional techniques for physical therapy include postural drainage, percussion, forced expiration, and cough techniques (explosive cough and huffing).

Postural Drainage and Percussion

Postural drainage may be associated with percussion. Drainage through postural changes in the patient optimizes the airways structure in relation to dependent and independent ventilation by subjecting it to the action of gravity and facilitating drainage.²³⁻²⁷

The postural positions involving decubitus at an angle other than 0° are the Fowler position, in which the patient is placed with the chest elevated above 0° and up to 45°, and the Trendelenburg position, which places the patient's chest at an angle of less than 0° and up to a maximum of -30°. This technique requires constant monitoring at all levels because it leads to abnormal ventilation due to the action of gravity on blood pressure and the cardiopulmonary system. It may also cause the displacement of mucus, which can be gathered in a large quantity in a given region, promoting dyspnea as a result of a momentary blockage in airflow.

The postural position indicated is relative to the structural area of the bronchial tree to be treated. Contraindications to the technique are pulmonary edema, congestive heart failure, pulmonary embolism, active hemoptysis, an intracranial pressure above 20 mmHg, active bleeding, hemodynamic instability, myocardial infarction, massive pleural effusion, spinal cord injuries, and recent surgeries. Postural drainage in the case of COPD should be indicated according to the severity of the disease; moderate and severe cases have limitations in the use of this technique.

Manual percussion is the most widely used pulmonary percussion technique, and generates intrapulmonary vibrations that detach secretions and mobilize them through expiratory flow towards the trachea; when in contact with receptors, these secretions stimulate the cough reflex, resulting in their consequent elimination. Hand vibration and tapping have the same goal, and both should be performed at the expiration stage to optimize expectoration.

Maneuvers executed on the outer surface of the chest, and tapping in particular, have contraindications such as lung injuries, rib fractures, osteoporosis, active hemoptysis, edema, tumors, lung metastases, and bronchospasms.^{23,26} Hand vibration should be used in COPD patients under auscultatory monitoring, and tapping in emphysema should be avoided because it can stimulate the bronchial muscles and cause bronchospasms.

Forced expiration

This technique can be accomplished with little, moderate, or a lot of effort, depending on the strength of the respiratory muscles used to exhale a certain lung volume at a determined flow velocity. It is also known as huff and aims to shift bronchial secretions towards the oropharynx in order to achieve expectoration with the slightest change in pleural pressure and reduced energy expenditure. In the case of COPD, this technique should be recommended to patients because it reduces flow velocity, thus minimizing the stimulation of bronchospasms.^{10,27,28}

Cough techniques (explosive cough and huff)

Explosive coughing involves a lot of energy expenditure, increasing dyspnea and the subjective perception of fatigue, and is therefore detrimental to COPD patients. To minimize the deleterious effects of explosive coughing, the patient should be instructed to perform coughing only after learning its phases and use techniques such as huff (forced expiratory technique) to reduce flow velocity; this type of controlled

coughing minimizes its negative effects.^{14,27,29}

Current clearance techniques

Current clearance techniques include autogenic drainage, active cycle of breathing, expiratory flow acceleration (EFA), and associated devices such as positive expiratory pressure (PEP) systems and the Flutter or Shaker (which uses oscillatory positive pressure). However, in patients with COPD and emphysema, some techniques such as EFA are contraindicated because they stimulate bronchial smooth muscles and cause bronchospasms.^{12,14,23,25,27,28}

Autogenic drainage

Autogenic drainage is conducted in 3 phases and aims to remove mucus from the bronchial walls through the stages of “take off,” collection, and clearance by breathing with different lung volumes. For diseases with the risk of developing bronchospasms, the flow rate should be controlled (including coughing).

Active cycle of breathing

This technique is also carried out in 3 phases, with repeated respiratory cycles performed through predominantly diaphragmatic breaths, followed by deep breaths and slow flow velocity upon both inspiration and expiration and then the removal of secretions through huff, thus optimizing mucociliary transport. The active cycle of breathing method is suitable for patients with COPD, who may develop bronchospasm.

Expiratory flow acceleration

This technique aims to increase the speed of expiratory flow, optimizing the movement of mucus in the bronchial duct. This is accomplished through the maneuver of chest compression associated with expiratory flow. It is contraindicated for patients with COPD because it may cause bronchospasms by stimulating the bronchial muscles.

Positive expiratory pressure

This technique is indicated to reduce air

trapping, reverse atelectasis, and mobilize secretions through resistance to airflow. Presumably, it prevents airway collapse and moves secretions towards larger bronchi, facilitating their elimination. According to its indications, it may be used for COPD patients.

Flutter[®] or Shaker[®]

This instrument combines the physiology of PEP with high-frequency oscillations and has the same goal as PEP. The velocity of expiratory flow can be controlled by the patient and it is also indicated for COPD.

Muscle relaxation

Patients with respiratory effort caused by acute exacerbation of chronic disease or the moderate to severe stage of disease can present functional incursion of the respiratory muscles because of exacerbated use and may develop a hypertrophic state with retraction. These changes decrease chest movement, hindering pulmonary ventilation.^{27,30}

Patients who do not present a barrel chest with structured muscle changes fully benefit from stretching and muscle relaxation exercises aimed at improving muscle elasticity, allowing the functional incursion of respiratory muscles. Thus, thoracic movements are optimized, allowing better expansion of the chest.

Patients who show moderate or severe illness do not benefit significantly from this technique, but it does improve their subjective effort perception.

Respiratory exercises

The current respiration standards aim to educate patients regarding thoracoabdominal breathing movements, improve the movement of the chest cavity, optimize the functionality of the respiratory muscles, and promote improved ventilation and consequent oxygenation. Respiratory exercises improve muscle performance as well as stimulating endurance, providing improved cardiopulmonary conditioning.^{27,30}

Conclusion

Respiratory physical therapy intervention for obstructive pulmonary diseases, especially COPD, promotes clear benefits on pulmonary ventilation. Despite the absence of randomized studies and controlled trials, and the fact that data is still only available in small quantities, relevant tests have shown that some of the clearance techniques used in physical therapy provide a greater amount of secretion elimination, improving perfusion and lung function. The fact remains that after intervention involving airway clearance physiotherapy, muscle relaxation, and breathing exercises, there is an improvement in blood gas values, pulmonary auscultation, chest radiography, pulmonary function tests, and the subjective perception of dyspnea; this can be considered relevant in the treatment of patients with obstructive diseases, despite little apparent evidence for therapeutic effects. Therefore, it is recommended that randomized trials be conducted and clinical evidence be collected in order to provide a scientific grounding to the techniques used by respiratory physical therapy.

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