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Review Article

Breathing Exercises in Chronic Respiratory System Diseases

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Abstract

Breathing exercises are among the most frequently used approaches for chronic respiratory system diseases.The most preferred methods among breathing exercises are pursed-lip breathing, diaphragmatic breathing, slow-deep breathing, and positioning. These exercises aim to reduce dyspnoea and provide effective ventilation with respiratory control. Pranayama, or yogic breathing, a respiratory technique generally used in chronic respiratory system diseases, is a practice that aims to manipulate the breathing pattern based on the principle of re-teaching breathing. Human respiration is the only physiological system that is under both involuntary and voluntary control. Therefore, these breathing exercises and techniques raise the awareness of individuals about their breathing, establish a self-control technique, and help regulate biochemical and metabolic activities in the body by affecting neurocognitive, autonomic, and pulmonary functions.

Keywords: Chronic; respiratory system; disease; breathing exercises; nursing

Introduction

Respiration involves gas exchange by the organism to continue living. The respiratory system consists of two components, the lung parenchyma and the respiratory muscles responsible for gas exchange, and its main functions are to provide alveolar ventilation and maintain acid-base balance with partial pressure of oxygen (pO2) and carbon dioxide (pCO2) [1]. When this balance is disturbed, various acute and chronic respiratory system diseases may develop. The World Health Organisation (WHO) defines chronic respiratory system diseases as diseases with serious morbidity and mortality in its global report on non-communicable diseases. Also, it was reported that 36 million (63%) of the 57 million deaths in the world were due to non-communicable diseases, of which 4.2 million (11.7%) were due to respiratory system diseases [2]. The report published by the Global Burden of Disease in 2017 showed that 544.9 million people in the world suffered from chronic respiratory diseases, corresponding to an increase of 39.8% compared to 1990. Also, chronic respiratory diseases, the third leading cause of death after cardiovascular and neoplastic diseases, have become a major public health concern, accounting for 7% of all deaths worldwide with 3.91 million deaths [3].

Major chronic respiratory diseases include chronic obstructive pulmonary disease (COPD), asthma, respiratory allergies and chronic infections, occupational lung diseases, obstructive sleep apnoea syndrome, and pulmonary hypertension [4]. These health concerns have a prevalence that is specific to age, gender, and geographical characteristics, and it has been reported that the diagnosis rate is equal for men and women who live in high-income regions and lower in Africa and South Asia [3]. Similarly, risk factors of COPD and asthma include demographic and economic characteristics, smoking, environmental and occupational exposures, metabolic factors, and genetic characteristics. Also, the rapidly rising rate of the elderly population in the last 30 years has

increased the incidence of chronic respiratory diseases [5] and mortality by 4–8% [2, 6]. However, many chronic diseases can be diagnosed and treated early with the developing technology today [7].

Breathing Exercises Used in the Management of Respiratory System Diseases

Respiratory system diseases are mostly health disorders that can be prevented when risk factors are eliminated. However, when exposure to risk factors cannot be prevented, problems such as cough, secretion, dyspnoea, and loss of pulmonary function are commonly experienced [8]. The management of these problems is primarily aimed at relieving the patient's breathing and providing adequate tissue perfusion. Therefore, smoking cessation, reduction of exposure to harmful gas particles, use of devices that ensure airway patency, long-term oxygen therapy, and breathing exercises are employed today as well as medical treatments [4,7]. Breathing exercises are based on improving respiratory muscle functions, minimising shortness of breath, and increasing exercise tolerance [9]. These methods alleviate the right heart burden due to hypoxaemia and pulmonary hypertension induced by chronic respiratory diseases while increasing the survival rate and improving the quality of life. They also shorten the duration of hospitalisation and reduce the related cost [4,7]. The most preferred methods among breathing exercises include pursed-lip breathing, diaphragmatic breathing, and slow-deep breathing and positioning [9]. Additionally, pranayama or yogic breathing is used especially in chronic respiratory diseases [10]. These exercises aim to reduce dyspnoea, provide more effective ventilation by controlling respiration [9] and contribute to the manipulation of respiration type by re-teaching respiration [10].

Pursed lip breathing

Pursed-lip breathing is a technique that allows the control of oxygenation and ventilation. The technique requires a person to inspire through the nose and exhale through the mouth at a slow controlled flow. The expiratory phase of respiration is going to prolong when compared to inspiration to expiration ratio in normal breathing. This technique creates a back pressure producing a small amount of positive end-expiratory pressure. The positive pressure created opposes the forces exerted on the airways from the flow of exhalation. As a result, pursed-lip breathing helps support breathing by the opening of the airways during exhalation and increasing excretion of volatile acids in the form of carbon dioxide preventing or relieving hypercapnia. Through purse-lip breathing, people can have relief of shortness of breath, decrease the work of breathing, and improve gas exchange. They also regain a sense of control over their breathing while simultaneously increasing their relaxation [11]. This breathing technique—generally used to relieve dyspnoea in diseases such as COPD, congestive heart failure, and panic attacks—also helps reduce the need for non-invasive mechanical ventilation [11]. During the pursed lip breathing exercise—a-controlled breathing technique—first, the mouth is closed and the person is instructed to breathe through the nose by counting to three. Then, the inhaled breath is exhaled through the mouth again with the lips pursed by counting to seven [12]. However, a good coordination and a prolonged expiration are required for the pursed-lip breathing exercise to be effective. This is because prolonged duration of the technique causes the fatigue of the respiratory muscles on one hand, and potentially induces syncope caused by an excessive drop in pCO2 in arterial blood.

Therefore, it is sufficient to limit the pursed-lip breathing exercise to three to five breaths [11]. In a study conducted with COPD patients it was found that there was a significant increase in tidal volume and after pursed-lip breathing exercise compared to normal breathing [13]. Ceyhan et al., reported that breathing exercises and inhaler drug use training in patients with COPD alleviated the severity of dyspnoea and enhanced the quality of life [14]. Ubolnuar et al., concluded that pursed-lip breathing exercises applied in COPD patients with moderate and severe stages improved lung capacity [11]. Another study conducted with COPD and healthy individuals revealed that positive changes were observed indicated that the pursed-lip breathing manoeuvre in comparison to normal breathing has an improving effect on the level of oxygenation [15]. Jansang et al., found that the pursed lip breathing exercise, applied three times a week for 12 weeks in individuals aged 60–75 years, was an effective method to improve pulmonary function and respiratory muscle strength shortness of breath, 6-minute walk distance (6MWD), lung function, and respiratory muscle strength were measured at pre- and post-test [16]. It was found that diaphragmatic and pursed-lip breathing exercises, which were applied together for 15 minutes five days a week for four weeks in patients with stroke, improved respiratory muscle strength [17]. Pursed-lip breathing exercises applied in patients with lung cancer improved the management of dyspnoea as well as worry and anxiety [18]. Based on these results, it is considered crucial that the pursed lip breathing exercise, which is a quite easy-to-apply, inexpensive, effective, and non-invasive method, be extended, especially for clinical use, when its effect on physiological and psychological parameters in many chronic diseases is taken into consideration.

Diaphragmatic breathing

The diaphragm is a dome-shaped musculo-tendinous structure that separates the thoracic and abdominal cavity. Also, this skeletal muscle, can change its width and increase the depth of breathing by altering muscle activity and contractile force [1]. However, the efficiency of the diaphragm muscle is increased in diaphragmatic breathing since the accessory expiratory abdominal muscles push the diaphragm upwards during exhalation so that the respiratory burden is reduced by utilising the diaphragm muscle instead of the accessory muscles. This improves respiration by increasing the ventilation rate of the lungs [19]. During the application of the diaphragmatic breathing exercise, the person first places one hand on the abdomen and the other on the thorax under the clavicle. As the patient inhales deeply through the nose, he/she feels how the hand on the abdomen moves and inflates the abdomen outwards while keeping the hand on the thorax in minimal movement. On expiration, she/he should feel inward movement of the hand on the abdomen and the abdominal muscles and the breath should be exhaled slowly through the pursed-lip [20].

The diaphragm muscle, which has additional physiological roles besides from inducing breathing, can contribute significantly to speaking, swallowing, and respiration. For example, the phrenic nerve, which innervates diaphragm functions, is connected with the vagus nerve and can affect all systems. Also, diaphragm movement during breathing cycle, directly and indirectly, affects the sympathetic and parasympathetic nervous systems and supports motor activity. It also affects postural stability, defecation, urination, and labour by modulating intra-abdominal pressure [21]. In a systematic review, it was found that diaphragmatic breathing exercise had positive effects on cardiorespiratory fitness capacity and pulmonary function in patients with COPD and was effective in alleviating stress in individuals with asthma [21]. Fernandes et al., applied diaphragmatic breathing exercises in patients with moderate and severe COPD for four weeks and found that the respiratory frequency of the patients lowered and the tidal volume increased [22]. Likewise, no significant difference was found between the pulmonary function tests before and after diaphragmatic and pursed-lip breathing exercises applied together in patients with COPD, but significant improvements were found in arterial blood oxygen saturation and dyspnoea severity in the patients [23]. In a study conducted by Ong et al., in patients with supragastric belching and gastroesophageal reflux resistant to proton pump inhibitors, they found that diaphragmatic breathing exercises relieved symptoms and enhanced the quality of life [24]. It was reported that diaphragmatic breathing exercises applied on athletes lowered the oxidative stress level, which was correlated with simultaneous fall in blood cortisol level and a rise in melatonin [25]. These results clearly indicate that diaphragmatic breathing exercise, which can be applied in different fields, has a therapeutic effect on respiratory parameters in particular.

Slow-Deep Breathing

The slow-deep breathing exercise, an integrative body-mind-based practice, especially for psychosomatic problems, supports raising awareness in the muscles relaxation as well as inhalation and exhalation. During this exercise, which can be applied while sitting or in the bed, the person breathes at maximum power and feels the abdominal muscles contracting. Thus, pressure is applied on the abdomen. Then, the patient is asked to exhale again and repeat this breathing exercise for short periods, several times a day [26]. Stimulation of the sympathetic nervous system, especially due to stress, can cause physical fatigue and sleeplessness. Therefore, slow-deep breathing exercises help reduce sympathetic activity and increase parasympathetic activity by providing relaxation in the person [27]. In a systematic review, it was found that slow-deep breathing exercise improved physical and mental health due to its positive effects on the parasympathetic nervous system [28]. Westerdahl et al., found that patients who underwent coronary artery bypass grafting had smaller atelectatic areas in the lung and better pulmonary function after deep breathing exercises for four days after surgery [29]. Another study revealed that slow i-nspiratory muscle training given to elderly individuals with systolic hypertension reduced blood pressure and increased inspiratory muscle strength and lung capacity [30]. Manandhar et al., also determined that slow-deep breathing exercises applied in individuals with hypertension for five minutes lowered arterial blood pressure [31]. It was concluded that slow-deep breathing exercises applied in addition to opioid administration during removal of chest tube were effective in relieving pain [32]. Gholamrezaei et al., reported that controlled breathing modulated respiratory rate and cardiovascular responses, but did not relieve pain [33].

Positioning

Positioning a specific treatment technique, is used for physiological purposes such as optimisation of O2 transport, increase of tidal volume, and decrease of respiratory muscles and cardiac workload. In patients with acute respiratory distress syndrome (ARDS), prone positioning has been reported to increase tidal volume and functional residual capacity. It was reported that positioning the affected area facing upwards in unilateral lung problems and acute lobar atelectasis improved ventilation and facilitated excretion from the airways [26]. In a study, it was found that prone positioning in patients with moderate and severe ARDS reduced mortality and could improve the arterial oxygen [34]. Tuğba et al., found that the positioning of intensive care patients negatively affected ventilation-perfusion match, increased oxygenation, and shortened the length of stay in the intensive care unit by reducing the infection caused by atelectasis [35]. Karaali et al., also found that the positioning technique they used in patients with atelectasis improved oxygenation and regressed atelectasis findings [36]. However, inappropriate positioning may lead to an impaired ventilation-perfusion ratio, reduced cardiac output, decreased cerebral perfusion, and/or elevated oxygen consumption. Also, inappropriate positioning in vital conditions such as head trauma may lead to elevated intracranial pressure [35]. Therefore, although positioning, an important step of chest physiotherapy, is used in many respiratory system problems to increase oxygenation, it is highly important to follow the patients carefully, as it may pose different risks if the appropriate disease-specific position is not provided.

Pranayama (Yogic breathing)

Yoga is one of the complementary and supportive practices with a history of 3000 years. In the modern world, this approach is emphasised to have two main aspects, “asana” (physical postures) and “pranayama” (breathing exercises), especially for balancing physical, mental, emotional, and spiritual health [37]. Pranayama is a combination of “prana,” denoting life (breath/life) energy, and “ayama,” denoting expansion/regulation/control in Sanskrit [38]. Based on the principle of re-teaching breathing, pranayama is often used to manipulate the breathing pattern, correct posture, provide flexibility of chest cage, and improve the strength and endurance of respiratory muscles. It contributes to the regulation of metabolic activities in the body by affecting neurocognitive, autonomic, and pulmonary functions by raising the individual’s awareness of breathing and establishing a simple control technique [39]. Erdoğan and Taşçı found that pranayama breathing technique applied on patients with asthma positively affected some parameters such as pulmonary function tests, bronchodilator use, quality of life, IgE, and eosinophil count [39]. Yoga and pranayama, especially applied

for asthma, aim primarily to take breathing under control and reduce hyperventilation. This helps to support the immune system and auxiliary respiratory muscles by lowering the stress level [40]. Pranayama can improve pulmonary functions by strengthening expiratory and inspiratory muscle strength [41]. Kaminsky et al., found that pranayama applied in patients with COPD improved inspiratory capacity, albeit at a low level [42]. After pranayama was applied in patients with pleural effusion for 20 days, they found that there was an improvement in lung capacity and pulmonary function test (spirometry) [43]. Sarwal et al., also stated that pranayama applied during COVID-19 strengthened the immune system, thus reducing the incidence of infection [44]. A randomised controlled study by Thokchom et al., in which they applied asana, pranayama, and meditation together revealed cellular and molecular markers of oxidative stress, alleviation of inflammation, and improvement in quality of life, and pulmonary functions (FEV1, FEV1/FVC) [45].

Conclusion

In conclusion, it appears that of respiratory exercises are that can be used safely, especially in the management of symptoms related to chronic respiratory diseases that can be used safely, especially in the management of symptoms related to chronic respiratory diseases. However, smoking, the severity of dyspnoea, anxiety, depression, frequency of hospitalisation, and inappropriate duration and time of the program may negatively affect the participation rate in breathing exercises. For this reason, it is recommended that patients and healthy person breathing exercises.

Conflict of Interest

The authors declare no conflict of interest.

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