

ROLE OF SPECIAL BREATHING TECHNIQUES IN CURRENT PHYSIOTHERAPY PRACTICE FOR CHRONIC OBSTRUCTIVE PULMONARY DISEASES

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Abstract

The article determines the role of special breathing techniques in current physiotherapy practice for chronic obstructive pulmonary disease (COPD) taking into account scientific sources. The research is based on the scientific sources selected from electronic databases of the Vernadsky National Library of Ukraine, the Russian Scientific Electronic Library "eLibrary", Web of Science, PubMed, PEDro over the recent 10 years.

Special breathing techniques include exercises for respiratory muscles (respiratory gymnastics) and airway clearance techniques (lung clearance: manual percussion and vibration, postural drainage, controlled coughing, autogenic drainage, and active cycle of breathing techniques). Most physiotherapists prescribe physical exercises (169/189, 89 %), forced expiratory technique (153/189, 81 %) and active cycle of breathing techniques (149/189, 79 %).

There is currently no convincing evidence of the clinical and rehabilitation efficiency of the use of special breathing techniques. Further scientific research should be undertaken to identify the evidence of the role of special breathing techniques in physiotherapy practice for COPD.

Key words: chronic obstructive pulmonary disease (COPD), physiotherapy, rehabilitation, special breathing techniques.

Introduction

Chronic obstructive pulmonary disease (COPD) is a widespread disease of the respiratory system and is an important health problem that significantly affects the quality of patients' life [1, 2]. Today, rehabilitation as well as medication treatment is one of the main ways of COPD patients' recovery and their health improvement [2, 3, 4]. The main goals of pulmonary rehabilitation for patients with COPD are to reduce COPD symptoms, to improve the quality of life and to increase physical and emotional performance in everyday life [1, 2, 3]. The main principle of pulmonary rehabilitation [3, 4, 35] is an individual assessment of the patient's state and selection a special programme for each patient according to his needs.

The key component of pulmonary rehabilitation is physiotherapy with its service: numerous exercises, mechanotherapy, occupational therapy, and therapeutic massage [3, 5, 6]. These means of physical therapy, which affect the organs of movement during their performance, are applied separately or together with modern apparatus methods and have not lost their clinical significance yet. At present, the following results of pulmonary rehabilitation of patients with COPD have been confirmed [1, 2, 7]:

- improvement in the ability to physical activity (level of evidence A);
- decrease in perception of shortness of breath (level of evidence A);
- improvement in the quality of life caused by health (level of evidence A);
- decrease in number and duration of hospitalization (level of evidence A);
- decrease in anxiety and depression associated with COPD (level of evidence A);
- training in strength and endurance of the upper group of muscles that improves hands and arms movement (level of evidence B);
- keeping continuous positive effect after the training course (level of evidence B);
- improvement to survival skills (level of evidence B);
- benefit of respiratory muscles training combined with general muscle training (level of evidence C);
- improvement of recovery after hospitalization from significant aggravation (level of evidence A);
- increase in effectiveness of long-term bronchodilators (level of evidence B).

Among the numerous and various physical exercises in the rehabilitation of patients with COPD, special breathing techniques are mostly used. However, there is no convincing

evidence supporting the significant *clinical efficacy and the advisability* of the use of these techniques.

The aim of the study

The purpose of the study is to determine the role of special breathing techniques in modern physiotherapy for COPD based on scientific sources.

Materials and methods of research

Research is based on the scientific sources selected from electronic databases of the Vernadsky National Library of Ukraine, the Russian Scientific Electronic Library "eLibrary", Web of Science, PubMed, PEDro over the recent 10 years.

Results and Discussion

It is known that the use of physiotherapy for COPD has its own characteristics, which are described in detail in the main rehabilitation guidelines [1, 2, 3, 8, 9, etc.] and numerous review articles [4, 10–19, etc.]. The physiotherapy techniques for patients with COPD should be aimed at:

- decrease in the effects of skeletal muscle dysfunction;
- development of correct breathing pattern;
- elimination of the pressure of the respiratory muscles, their training to increase strength and endurance;
- increase in chest and diaphragm mobility;
- prevention of expiratory airway collapse;
- improvement of drainage function of bronchi and bronchial patency.

Special breathing techniques should be applied to solve these rehabilitation tasks. Exercises for respiratory muscles (respiratory gymnastics) and airway clearance (pulmonary clearance) which directly affect the pathophysiological mechanisms of COPD are among such breathing exercises [5, 6, 20, 21, 22, etc.].

Exercises for respiratory muscles (respiratory gymnastics)

Respiratory exercises are an important part of rehabilitation programmes for patients with COPD. The use of respiratory exercises is commonly referred to respiratory gymnastics or respiratory training. In the countries of the former Soviet Union (Russia, Ukraine, Belarus), the peculiarities of the use of respiratory gymnastics for obstructive pulmonary diseases were described in the 80–90s of the last century [23, 24, 25, etc.].

At the end of the last century, many researchers proved that the use of breath optimization techniques by the patients with COPD reduces the subjective perception of

shortness of breath and increases physical endurance. Gosselink R. (2004) believes that the main goals of respiratory gymnastics are the following [26]:

- decrease in symptoms and attenuation of adverse physiological effects caused by lowering the strength and endurance of respiratory muscles;
- control of the pattern of thoracoabdominal movements;
- reduction in dynamic hyperinflation and improvement of gas exchange.

Ponomarenko G. M. et al (2016) [6] suggests the following therapeutic effects of special respiratory exercises:

- 1) strengthen the respiratory muscles;
- 2) increase the mobility of the chest and diaphragm;
- 3) contribute to the expansion of pleural adhesions;
- 4) reduce stagnant phenomena in the respiratory system;
- 5) facilitate the withdrawal of sputum;
- 6) improve the breathing mechanism and coordination of breathing and movement.

Today, the most popular breathing techniques are the following:

- persed-lip breathing;
- breathing with sound pronunciation;
- diaphragmatic breathing;
- relaxing breathing;
- applying devices that create additional air pressure.

P e r s e d - l i p b r e a t h i n g

In physical therapy, persed-lip breathing is the best way to control shortness of breath [27]. This is a quick and easy way to slow pace of breathing making each breath more effective. It is believed that this breathing technique improves pulmonary ventilation, eliminates trapped air in the lungs, keeps the airways open longer and facilitates respiration, prolongs exhalation to slow the breathing rate, improves breathing patterns by moving old air out of the lungs and allowing for new air to enter the lungs.

While performing persed-lip breathing exercises, the patient should relax his neck and shoulder muscles, and take a slow normal breath through his nose counting to two and keeping his mouth closed. It is better for him to purse his lips like a “tube” as if he is whistling or blowing out a candle. The patient should breathe out slowly and gently through his pursed lips while counting to four.

Patients are advised to use this breathing technique during the difficult part of any activity, such as bending, lifting or stairs climbing. Practicing this technique 4–5 times a day makes the patient's breathing pattern correct [5, 11, 12, 27, 28].

Relaxing Breathing Technique

Relaxing breathing exercises are recommended to patients with hyperventilation, with dry, abdominal cough and after physical activity. Relaxation of the respiratory muscles facilitates breathing and can remove the phenomena of bronchial obstruction.

While performing relaxing breathing exercises, the patient should take a comfortable position, completely relax the chest, shoulders, hands, facial muscles, and tongue. The depth of breathing should be minimal: the patient should breathe in as slowly as possible, and breathe out as free as possible. Optimal breathing should be 8-10 breaths per minute. Repetitive relaxation exercises should be performed 4 times a day for 10–15 minutes. Such exercises should be done best while lying on the back, or while sitting or standing [5, 29].

Breathing with sound pronunciation ("sound gymnastics")

Breathing exercises with sound pronunciation ("sound gymnastics") are aimed at the development of duration of phases in inhalation and exhalation of 1:2. With a slow, gentle inhalation with a pause after it, the most complete gas exchange in the alveoli and mixing of inhaled air with alveolar one occurs. Then, for a longer exhalation, the sounds or their combinations (for example, "mmm", "pff", "brakh", "brokh", "brukh", etc) are pronounced. Finally, vibration of vocal cords arising from pronunciation of the sound "rrr" (growling) is transmitted to the lungs, the trachea and from them to the chest, contributing to the relaxation of bronchial smooth muscle spasm ("the principle of vibro massage") [11, 22, 23, 24, etc.].

Over the recent 10-year period, no additional information on the use of pursed-lips breathing, sound gymnastics, diaphragmatic breathing and relaxing breathing techniques in the COPD rehabilitation has been given in scientific sources.

Airway clearance techniques

Airway clearance techniques have been known for a long time. They include the following [3]:

- manual percussion and vibration;
- postural (positioning) drainage;
- controlled coughing;
- autogenic drainage (AD);
- active cycle of breathing techniques.

Manual percussion and vibration

The following manual techniques as percussion and vibration are widely used in foreign specialists' practice. In 1999 Pryor J. A. evaluated their beneficial effect on reducing sputum viscosity and improving *mucociliary clearance* [30]. The validity of the use of manual therapy in the pulmonology practice depends on connection between the parts of the body that are combined as segments. Bronchial obstruction, hypoventilation, *respiratory muscle* fatigue, decrease in diaphragmatic excursion lead to the formation of functional blocks of vertebral joints, ribs and regional muscle imbalance. In turn, the disturbance of the biomechanics of the spine and thoracic cells through vertebral visceral and vertebral motor segments causes increased respiratory failure, generalized deterioration of the functional state of respiratory muscles. Manipulation acts to improve the activity of the respiratory muscles, in particular, increase in the mobility of the chest, decrease in thoracic pain, and also contribute to increase in bronchial patency and pulmonary *compliance* [11, 12, 13, 23, 24, 25, etc.].

The purpose of manual percussion and vibration is to enhance mucociliary clearance from both central and peripheral airways. The optimal vibration frequency, which increases the transport of the sputum, is 12–17 Hz. With manual percussion, it reaches 3–5 Hz. Vibration should be carried out after tapping and only during exhalation, the duration of vibration should be about a minute in every position. Tapping is performed by clapping with a capped hand, or half-open fists on the chest. Tapping should be carried out in each position for at least one minute and only on the ribs, but not on the spine, chest or soft tissues. The optimal position of the patient is sitting, at an angle of 45°. During the procedure, it is important to perform correct breathing: inhalation – through the nose, exhalation – through a slightly open mouth. While tapping, the sputum, "tearing off" from the bronchial wall, must move upward with the flow of air. On average, the procedure takes 10–15 minutes. The performance of these techniques should not be accompanied by a feeling of pain or discomfort. Patients with extremely severe forms of the disease as well as patients who are prone to bronchospasm, are better tolerated with a low percussion frequency. Old age, prolonged use of glucocorticosteroids, osteoporosis are contraindications for percussion and vibration chest physiotherapy [5, 11, 30, 31, 32]. In recent years, it is suggested that vibration of chest wall inspiratory muscles during inspiration (in-phase) reduces breathlessness in patients with chronic obstructive pulmonary disease (COPD) [31].

There are different opinions about the influence of manual techniques on the patients with COPD. Thus, Cross J. L. et al (2012) assessed the effectiveness of manual chest physiotherapy techniques on the quality of life over six-months period after exacerbation of

COPD. The authors did not find out the advantages in the quality of life of COPD patients, who used manual methods of exposure to the chest, compared with patients who did not use these methods [33].

P o s t u r a l (p o s i t i o n i n g) d r a i n a g e

Postural drainage is the most well-known technique for improving evaporation of sputum. Postural drainage is recommended in cases when the amount of sputum is more than 30 ml per day in the presence of COPD in combination with bronchiectasis and proximal bronchitis. The technique of passive drainage involves the effect of gravity to move sputum from the respiratory tract towards the large bronchi, which facilitates its expectoration.

Before the beginning of postural drainage, a patient should take expectorants, and a patient with airway obstruction should inhale bronchodilators 30 minutes before the procedure. The patient takes a drainage position in which the chest should lay at an angle of about 20–30° from the horizontal level. A number of technical techniques can be used such as raising the foot end of the bed (Trendelenburg position), adjusting wooden shield on the bed at an angle 90°, using sofa pillows. While the procedure it is important to have relaxation skills, control diaphragmatic breathing. Postural drainage can be combined with active breathing technique and forced loud exhalation "huffing" (forced exhalation with an open vocal cleft). While a passive drainage procedure, the patient randomly takes different positions (on his side, on his stomach, etc) and empirically selects the optimal position for clearing sputum. Each position of the drainage should be generally held for 5–15 minutes. It is better to perform bronchial drainage once or twice a day, taking into account the nature and volume of sputum. For patients with exacerbations of chronic obstructive pulmonary disease, these procedures should be increased by four times a day [5, 6, 23, 24, 25, etc].

No new information on the use of postural drainage for COPD treatment has been found during the last 10 years.

C o n t r o l l e d c o u g h i n g

Airway sputum hypersecretion and development of mucociliary dysfunction are manifested by coughing and sputum production. With obstructive disorders at the level of small bronchi, the cough becomes obstructive and unproductive, causes increased shortness of breath and may contribute to the development of tracheobronchial dyskinesia. COPD patients should be explained the need to control cough movements and note that spontaneous cough is less effective [34].

Controlled coughing involves a slow, deep breath, holding the breath for a few seconds, and the next 2–3 cough movements. The patient should know the phases of controlled coughing [5]:

- phase 1 – after a calm exhalation through pursed lips, the patient takes a slow, deep breath;
- phase 2 – holding the breath for 2–4 seconds;
- phase 3 – two sharp coughing movements with an open mouth (the first coughing movement separates the sputum from the walls of the bronchi, and the second one pushes it toward the exit in the mouth);
- phase 4 – holding the breath for 2–4 seconds;
- phase 5 – calm, shallow inhalation.

After coughing, a patient should relax and have a rest.

No new information on the use of controlled coughing for COPD treatment has been found during the last 10 years.

A u t o g e n o u s d r a i n a g e

Autogenic drainage is quite complicated for the patient to perceive breathing technique. It includes three stages [5]:

Stage 1 – separating sputum from the airway *walls* ("unsticking"). At this stage, it is suggested to alternate the usual breath with breath in reduced volumes and with holding the breath for 1–3 seconds.

Stage 2 – collecting sputum in the large and middle airways ("collecting"). A slow breath with exhalation from 1/3 to 1/2 of inspiratory reserve volume is performed. When the patient feels like wheezing, he should proceed to the next stage.

Stage 3 – evacuating sputum ("evacuating"). The sputum is removed by increased volumes of airflow combined with short coughing movements and "huffing".

Each stage usually takes 2–3 minutes, and the whole procedure takes 6–9 minutes.

No new information on the use of autogenous drainage for COPD treatment has been found during the last 10 years.

A c t i v e c y c l e o f b r e a t h i n g t e c h n i q u e s

To improve chest clearance, it is necessary to use the active cycle of breathing techniques, which includes forced expiratory technique ("huff" technique), controlled coughing, relaxation and breathing control. Forced expiratory technique ("huffing") and controlled coughing aimed at increasing the expiration rate, form the basis of the chest cleaning technique.

The English term "huffing", as one of the important components of forced expiratory technique, denotes noisy exhalation ("H-u-uff"). Huffing and controlled coughing play an important role in improving the sputum clearance from the central and intermediate lung zones. It is shown that the use of these exercises ("techniques") contributes to the improvement of the drainage function of the lungs (improvement of the removal of sputum from the airways) [5, 30].

Airway clearance techniques for COPD are still popular abroad. Osadnik C. R. et al (2013) find that the most of physiotherapists (123/189, 65 %) consider necessary to apply airway clearance techniques while exacerbation of COPD. Physiotherapists quite often prescribe physical exercises (169/189, 89 %), forced expiratory technique (153/189, 81 %) and active cycle of breathing techniques (149/189, 79 %) [36].

The results of the scientific sources show that most of the special breathing techniques were developed and applied in the last century. These techniques are still used in current physiotherapy for COPD. Special breathing techniques are taught, their applying is described, their indications and contraindications are given in the most popular guidelines on medical and physical rehabilitation, and physiotherapy nowadays.

Despite the fact that special breathing techniques are popular among rehabilitation and physical therapists, however, over the past 10 years, no scientific work has been found to highlight the issue of the effectiveness of the use of these techniques and their role in the physiotherapy for COPD. While studying scientific sources there was no evidence of advantages or disadvantages of the use of special breathing techniques for COPD. Consequently, judging the clinical importance of special breathing techniques for COPD is impossible due to the absence of evidence-based studies.

Conclusions

In current physiotherapy for COPD special breathing techniques (exercises for respiratory muscles – respiratory gymnastics, airway clearance techniques – lung clearance) are applied to improve positive clinical outcomes, respiratory function, and the quality of patients' life. Most physiotherapists prescribe physical exercises (169/189, 89 %), forced expiratory technique (153/189, 81 %) and active cycle of breathing techniques (149/189, 79 %).

In studies carried out in the last century, we can find data on the clinical effectiveness of special breathing techniques. However, there is currently no convincing evidence of the benefits of the use of these techniques due to the lack of evidence-based research.

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