

REVIEWS

ARTICOLE DE SINTEZĂ

The role of singing therapy in pulmonary rehabilitation Rolul terapiei prin cântat în reabilitarea pulmonară

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Abstract

Pulmonary rehabilitation is a multidisciplinary therapeutic intervention intended for patients with chronic respiratory diseases, which may include singing therapy as a method for improving physical and psychosocial status. This study aims to evidence the benefits of singing therapy for pulmonary patients and thus, to highlight the role of this therapy as part of respiratory rehabilitation.

There are literature data that suggest singing as an adjuvant therapy in respiratory diseases.

Regarding symptomatology, studies demonstrated that singing therapy reduced dyspnea and facilitated cough and expectoration. Objectively, pulmonary function improved through a reduction of lung hyperinflation, with the increase of arterial blood oxygen saturation. The questionnaires applied to subjects showed an increase of exercise capacity and the ability to control symptoms by breathing techniques acquired during the singing lessons. The majority of the patients reported an improvement of psycho-emotional status, with the reduction of anxiety associated with the sensation of suffocation, and an increased desire to socialize. The quality of life was significantly improved in these studies.

Singing therapy as a pulmonary rehabilitation method remains an area open to research. The benefits of this therapy for patients with chronic respiratory diseases vary from one individual to another, but its positive effects on the patients' mental state and quality of life are a certainty.

Keywords: pulmonary rehabilitation, singing.

Rezumat

Reabilitarea pulmonară reprezintă o intervenție terapeutică multidisciplinară destinată pacienților cu boli respiratorii cronice, ce poate include și terapia prin cântat ca mijloc de îmbunătățire a stării fizice și a statusului psihosocial. Prezentul studiu își propune să evidențieze beneficiile pe care terapia prin cântat le aduce bolnavilor pulmonari, și astfel să accentueze rolul acestei terapii în cadrul reabilitării respiratorii.

În literatura de specialitate există date care sugerează ca terapie adjuvantă în bolile respiratorii cronice, cântatul.

În privința simptomatologiei, unele studii au demonstrat că terapia prin cântat a redus dispneea și a facilitat tusea și expectorația. Obiectiv, funcția pulmonară s-a ameliorat prin scăderea hiperinflației pulmonare cu creșterea saturației în oxigen a sângelui arterial. Chestionarele aplicate subiecților au relevat creșterea capacității de efort, și abilitatea de controlare a simptomelor prin tehnici de respirație însușite în cadrul lecțiilor de cântat. Majoritatea pacienților au raportat o îmbunătățire a statusului psiho-emoțional, cu reducerea anxietății asociată senzației de sufocare, și cu creșterea dorinței de socializare. Calitatea vieții s-a demonstrat a fi important ameliorată în toate studiile urmărite.

Terapia prin cântat ca mijloc de reabilitare pulmonară rămâne un domeniu deschis cercetării. Beneficiile pe care acest tip de terapie le aduce pacienților cu boli respiratorii cronice variază de la un individ la altul, însă efectele pozitive asupra stării psihice și a calității vieții pacienților sunt o certitudine.

Cuvinte cheie: reabilitare pulmonară, cântat.

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Introduction

Respiratory diseases are a major public health problem particularly in industrialized countries, having an increasing incidence and a strong economic and social impact. Epidemiologists estimate that by 2020, chronic obstructive pulmonary disease will become the fourth most frequent cause of death worldwide (Croitoru & Miron, 2014).

The most important diagnostic and treatment guidelines currently used in pneumology recognize the place of rehabilitation in the modern therapy of respiratory diseases (Croitoru & Miron, 2014), with the recommendation of its application as early as possible in order to obtain optimal results (1).

The effectiveness of pulmonary rehabilitation is continuously reinforced by international research and clinical experience (1).

Definition of pulmonary rehabilitation

According to the most recent definition of the American Thoracic Society / European Respiratory Society in 2013, *"pulmonary rehabilitation is a comprehensive intervention based on a thorough patient assessment, followed by patient-tailored therapies which include, but are not limited to: exercise training, education and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors"* (Spruit et al., 2013).

In other words, pulmonary rehabilitation is focused on the patient, not on the disease, the challenge consisting of the need to act simultaneously on several parameters – symptomatology, quality of life, exercise tolerance. Finally, for the chronic pulmonary patient, compliance with a correctly applied quality pulmonary rehabilitation program can allow an improvement of lifestyle, with benefits for health status (Croitoru & Miron, 2014).

Objectives of pulmonary rehabilitation

The major objectives of pulmonary rehabilitation can be formulated from three perspectives. Patients wish through their participation in pulmonary rehabilitation programs to obtain a diminution of dyspnea and fatigue, an improvement of skeletal muscle strength and an amelioration of respiratory capacity with the increase of exercise tolerance, an improvement of emotional status and the quality of life. The therapist aims to educate the patient to acquire breathing strategies allowing an optimal control of symptoms, as well as to preserve residual pulmonary function and prevent pulmonary disease complications; the challenge for the therapist is to increase the degree of independence for these patients. From the perspective of society, respiratory rehabilitation programs are designed to obtain the active participation of patients in work and activities of daily life with an increased effectiveness and implicitly, with the reduction of costs associated with the management of the disease – reduction of the number and duration of hospitalizations, reduction of pharmacological requirements (2).

Indications of pulmonary rehabilitation

Candidates for respiratory rehabilitation are patients with signs and symptoms of respiratory system disorder, for whom standard pharmacological treatment has proved to be partially effective, and who are capable of understanding the role of physical therapy as an addition to the basic treatment (Matcovschi et al., 2011). The disorders benefiting from pulmonary rehabilitation are: obstructive pulmonary diseases (bronchial asthma, bronchiectasis, chronic bronchitis, chronic obstructive pulmonary disease (COPD), cystic fibrosis, sarcoidosis), restrictive pulmonary diseases (interstitial diseases, thoracic wall diseases, neuromuscular diseases, post-poliomyelitis and post-tuberculosis syndromes, thoracic cage abnormalities), bronchopulmonary cancer. For lung transplantation or any thoracic or abdominal surgery, pulmonary rehabilitation is an integrated part of pre- and postoperative treatment (1). There are many literature studies that focus on the benefits obtained by pulmonary rehabilitation programs in the main respiratory diseases.

Chronic obstructive pulmonary disease

In COPD, according to GOLD guidelines published in 2013, pulmonary rehabilitation applied in the periods in which the disease is compensated is beneficial for the increase of exercise capacity, the reduction in the intensity of the sensation of suffocation, the improvement of the quality of life, the reduction of the number of hospitalizations for disease exacerbations, the amelioration of anxiety and depression secondary to the disease, the enhancement of the effect of long-acting bronchodilators, and the increase of survival (3). A review published in 2015 systematized the effects of pulmonary rehabilitation in patients with moderate COPD, analyzing randomized clinical trials available in the literature. It was found that adherence to pulmonary rehabilitation programs results in a significant improvement in the quality of life and a less spectacular but obvious increase of exercise tolerance (Rugbjerg, 2015). Nikolettou published in 2015 a study conducted over a 7-week period, including 68 patients with moderate/severe COPD who attended an inspiratory muscle training program at home. An improvement of maximum inspiratory pressure and an amelioration of the patients' perception of their health status were found at the end of the training period (Nikolettou et al., 2015). Recently, Pothirat et al. analyzed the role of physical training as an integrated part of pulmonary rehabilitation in hospitalized patients. 30 patients diagnosed with advanced COPD performed exercises for the increase of strength and endurance during an 8-week period. The parameters indicating respiratory function, the strength of muscles involved in training, dyspnea and the quality of life were continuously monitored. A significant improvement in the strength of limb and thoracic cage muscles, with a decrease of dyspnea, an increase of exercise tolerance and an amelioration of the quality of life were demonstrated. The authors suggest that such a pulmonary rehabilitation program which involves low costs and is easy to use brings important benefits for patients with advanced chronic obstructive pulmonary disease (Pothirat et al., 2015).

Lung neoplasms

Regarding the benefits of pulmonary rehabilitation for patients with lung neoplasms, recent literature data indicate positive effects and open an optimistic perspective for this non-pharmacological therapy. Jastrzebski published in 2015 the results of a study evaluating the effects of pulmonary rehabilitation in patients with advanced lung neoplasms, under chemotherapy. A definite improvement of exercise tolerance and dyspnea, with the increase of lung volumes, and an improvement of the quality of life were obtained following participation in pulmonary rehabilitation programs with a duration of 8 weeks (Jastrzebski et al., 2015). Another study on former smokers with operated lung neoplasms under chemotherapy monitored the effects of pulmonary rehabilitation initiated simultaneously with chemotherapy. Respiratory exercises improved lung volumes and capacities, with more important benefits in patients with respiratory failure (Tarumi et al., 2015). Recently, Maeda et al. published the results of a study that assessed the effects of pulmonary rehabilitation programs in patients undergoing pulmonary resection for neoplasms. The study demonstrated an improvement of exercise tolerance in general, even in geriatric patients, which did not exceed the physical exercise capacity existing prior to surgery (Maeda, 2015).

Bronchial asthma

In January 2013, a meta-analysis was published which studied the effects of physical exercise on the quality of life, bronchial reactivity, exercise-induced bronchoconstriction, pulmonary function and exercise tolerance in asthmatic patients who attended different physical training programs. 17 studies including 599 asthmatic patients were analyzed, and it was shown that physical training induced an improvement of respiratory symptoms, a decrease in the number of days without symptoms, an increase of exercise tolerance, and a significant improvement in the quality of life of these patients (Eichenberger et al., 2013). In 2014, Evaristo et al., proposed for the amelioration of respiratory function in asthmatic patients a program combining aerobic exercises and breathing reeducation techniques (Evaristo et al., 2014). The World Allergy Organization conducted a study on patients with bronchial asthma and allergic disorders. 280 clinicians were questioned, and their opinions, as well as their experience and confidence in physical training as a therapy for allergic respiratory tract disorders were assessed. The results of the study indicated the advanced level of knowledge of the interviewed doctors regarding the benefits of physical activity in asthma and the confidence of these specialists in this adjuvant therapy. It was concluded that a wide-scale promotion of physical training as a complementary treatment in bronchial asthma was required (Moreira et al., 2014).

Sport and pulmonary rehabilitation programs are extremely important in patients with bronchial asthma and COPD, in the context in which these patients tend to avoid physical activity, with the consecutive decrease of exercise tolerance and the development of dyspnea on increasingly smaller efforts. These patients should be made aware that a sedentary lifestyle exposes them to the risk of aggravation of symptoms, and they should be encouraged to practice sport at the limit of tolerance and attend pulmonary

rehabilitation programs, in order to prevent the reduction of exercise capacity and muscle strength, to avoid muscle atrophy, and to improve their quality of life (Rohrer & Schmidt-Trucksäss, 2014).

The mentioned studies reported no adverse effects of physical training programs in pulmonary patients. However, this does not mean that pulmonary rehabilitation is indicated in any pulmonary condition.

Contraindications of pulmonary rehabilitation

Contraindications of pulmonary rehabilitation include: severe cognitive dysfunctions or psychiatric disorders that reduce treatment compliance; organic diseases in a decompensated stage (unstable angina pectoris, decompensated congestive heart failure; severe hepatic dysfunction; advanced stage/metastatic neoplasms, renal failure); exacerbations and complications of bronchopulmonary diseases (exacerbation of COPD, severe exercise-induced hypoxemia that cannot be corrected by additional oxygen administration, acute cor pulmonale, severe pulmonary hypertension); absence of physical exercise ability (Matcovschi et al., 2011).

Singing therapy in pulmonary rehabilitation

Singing, the act of producing musical sounds by using the vocal cords, is a very natural human act, with origins that go beyond the age of articulate speech (Bonilha et al., 2009). It involves the acquisition of specific posturing and breathing techniques, which for professional singers become essential in modulating and controlling the generated sounds (Bonilha et al., 2009; Thomasson & Sundberg 1999).

It has been observed that patients with chronic pulmonary diseases tend to involuntarily use "breathing strategies" – active expiration with protruded lips, use of the abdominal wall or specific body postures during breathing, thus obtaining an improvement of dyspnea and physical performance (Matcovschi et al., 2011).

There is a very high similarity between these behaviors and those of a singer who sings a piece of music. Singing requires an adequate posture to facilitate effective breathing control; secondarily to correct posturing, the singer executes a short, deep inspiration using the contraction of the diaphragm muscle, followed by an active and prolonged expiration supported by the contraction of respiratory muscles, with the exsufflation of an air column through the half-closed vocal cords. Thus, respiratory muscle training and at the same time, effective lung ventilation occur (Bonilha et al., 2009).

If these techniques used by singers were transferred to the daily life of the pulmonary patient as respiratory hygiene rules, benefits for the control of symptoms, with the improvement of the quality of life would be obtained (Bonilha et al., 2009). Thus, singing might become an adjuvant therapy in pulmonary rehabilitation through the breathing exercises involved (Lord et al., 2012).

Effects of singing on the respiratory system

Singing acts by three major factors that contribute to an increased effectiveness of the respiratory act: *posture, mechanics of ventilation, and contractile capacity of respiratory muscles.*

Posture

The ideal posture for singing and, at the same time, adequate for effective breathing involves the positioning of the singer/pulmonary patient in orthostatism, with the head elevated, in slight extension, with a straight spine, retracted abdomen, relaxed shoulders, and a slightly increased support polygon. The benefits of this posture for the singer as well as for the respiratory patient have been proved by specialized studies. Some studies have evidenced the role of the correct positioning of the spine in improving thoracic cage expansion, with a beneficial effect on ventilation and vocal parameters (Jang et al., 2015; Staes et al., 2010). A diminished vocal quality in the absence of adequate head and cervical spine positioning during singing in opera singers has been demonstrated (Jonson & Skinner, 2009). It has also been shown that thoracic muscles, particularly the pectoralis major muscle, play an important role in thoracic positioning as well as in improving the efficiency of respiratory effort, with an impact on respiratory capacity and vocal quality in singers (Pettersen, 2006). Through the same correct posturing, both the singer and the respiratory patient make a first step towards a more effective respiration.

Mechanics of ventilation

Correct singing involves deep inspiration with the obligatory involvement of the diaphragm. Diaphragmatic respiration facilitates a uniform distribution of ventilation, mobilizes large air volumes and allows *complete lung aeration* with a low energy cost (Matcovschi et al., 2011). Professional singers are trained to use their diaphragm during singing for a better vocal quality. Pulmonary patients are encouraged by therapists to use the same type of respiration to improve dyspnea. Studies have demonstrated that the involvement of the diaphragm muscle during singing is beneficial for the capacity to modulate sounds, contributing to vocal cord *stabilization*, with an impact on phonation (Leanderson et al., 1987). In patients with lung neoplasms, and in pulmonary patients with reduced function in general, diaphragmatic respiration has proved to be a good instrument for diminishing anxiety caused by dyspnea (Yates et al., 2013).

Once complete inspiration has been performed, the singer executes a prolonged active expiration, which coincides with the generation of musical sounds. In obstructive pulmonary diseases, the airways tend to close before expiration has been completed (Matcovschi et al., 2011); thus, air trapping occurs – the unexpired air remains trapped in the lungs along with the reserve residual volume, so that at the next inspiration, there will be a lower alveolar capacity to receive oxygenated air; in this way, the gas exchange will also be diminished, and arterial blood will be less oxygenated. When the singer executes the active expiration, airway collapse no longer occurs. Transposed to the situation of a pulmonary patient, singing means avoiding the air trapping phenomenon, with the increase of current volume at the next inspiration and the improvement of arterial blood oxygenation. These phenomena lead to a reduction of dyspnea, with the consecutive decrease of respiratory rate and a lower energy consumption by respiratory muscles (Matcovschi et al., 2011; Yates et al., 2013).

Contractile capacity of respiratory muscles

During singing, the vocal cords are mobilized in adduction, with the reduction of the diameter of the larynx. For the generation of musical sounds, the singer executes a prolonged active expiration with the release of an air column through the half-closed vocal cords (Bonilha et al., 2009). Thus, an active expiration results, concomitantly with the increase of air flow resistance, which allows the training of expiratory muscles and at the same time, effective lung ventilation by the prevention of airway collapse and lung hyperinflation (Matcovschi et al., 2011; Bonilha et al., 2009; Lord et al., 2012; Yates et al., 2013).

In conclusion, active expiration with protruded lips that pulmonary patients are trained to perform has an even greater impact on the respiratory system if paralleled by the generation of a musical sound. Thus, singing becomes a natural act, which combines various motor activities that have the potential to improve pulmonary ventilation, gas exchange, respiratory muscle function, dyspnea and exercise tolerance, facilitating in this way the act of respiration and increasing the quality of life.

In experimental models, hypercapnia is associated in the long term with the reduction of output in the phrenic nerve (Baker et al., 2001), involving the reduction of contractile activity in respiratory muscles (Hopkinson et al., 2004; Hopkinson et al., 2012). Singing can increase the participation of the diaphragm in the act of respiration, through a reduction in the degree of hypercapnia and an improvement of excitability in the corticospinal tract, with an increase in the conduction velocity of nerve impulses. In other words, singing allows a higher effectiveness of the diaphragm muscle, compared to the situation in which diaphragmatic breathing would apply in the absence of singing. This effect, added to the effects that result from *respiratory hygiene* required by singing – adequate posturing, breathing techniques for the prevention of lung hyperinflation, training of respiratory muscles, will definitely lead to an improvement of respiratory symptoms.

Singing as a therapeutic method in pulmonary rehabilitation – clinical studies

Over the past years, the interest of researchers in the field of respiratory rehabilitation has focused on non-pharmacological therapies, with the study of their benefits on symptomatology, respiratory function, psycho-emotional status and, not least, on the quality of life in patients with chronic pulmonary diseases. Among these non-pharmacological therapies, singing therapy has been the object of studies carried out both in USA and Europe. Despite the small number of studies, the results are promising and open new perspectives in pulmonary rehabilitation.

A study performed in Brazil in 2009 by Bonilha assessed the effects of weekly singing lessons on respiratory parameters and on the quality of life in patients with moderate or severe COPD, in a compensated stage. For 24 weeks, the subjects of the experimental group attended weekly singing lessons with the duration of one hour, coordinated by a voice teacher and a kinesiotherapist. The therapy program comprised the relaxation of neck and

upper limb muscles for 5 minutes; breathing exercises – rapid and deep inspiration, followed by prolonged complete or interrupted expiration, with the training of using the diaphragm in respiration, for another 10 minutes; vocal exercises under the guidance of the voice teacher for 15 minutes, continued by effective singing – Brazilian folk songs for 30 minutes. The subjects were encouraged to practice singing at home for 30 minutes a day, at least 2 days a week. In parallel, the subjects of the control group attended manual workshops, with the same duration and periodicity. The most important objective result of this study was a significantly higher expiratory output in the experimental group compared to the control group. Spirometric and arterial blood gas measurements indicated a reduction of lung hyperinflation during singing, with an important increase of oxygen saturation (SaO₂). There was also a marked reduction of dyspnea, according to the Borg scale. In patients with bronchial secretions, the singing lessons stimulated cough and expectoration of a significant amount of sputum (Bonilha et al., 2009).

Another randomized clinical trial carried out in a university hospital in Victoria, Australia, and published by Tamplin (2012), focused on the potential benefits of singing in improving respiratory function, vocal intensity and emotional state in tetraplegic patients. The study included 24 tetraplegic patients, who were divided into two groups: an experimental group and a control group. The subjects of the experimental group attended singing lessons 3 times a week, for 12 weeks, while the subjects of the control group participated in music relaxation sessions for the same time period. The patients were clinically evaluated at the beginning of the study, at the middle of the study period, immediately after the end of the 12 weeks, and 6 months after the intervention. The tests involved the evaluation of respiratory function, the contraction force of accessory respiratory muscles, measurements for the quantification of vocal quality and intensity, as well as questionnaires assessing the quality of life. The results obtained showed an increase in the vocal intensity and phonation time of patients in the group attending singing lessons. Also, this group had a tendency to improved pulmonary function and respiratory muscle strength. In both groups there was an improvement of the emotional state.

The authors concluded that music therapy in tetraplegic patients can have positive effects on both physical and mental status, improving the patients' emotional state. These positive effects are amplified when music therapy is associated with therapeutic singing (Tamplin, 2012).

A review published in June 2014 (Irons et al., 2014) assessed the role of singing therapy as an adjuvant treatment method in patients with cystic fibrosis. Randomized clinical trials were selected in which the effects of singing on the quality of life, disease evolution, respiratory muscle strength and pulmonary function of patients with cystic fibrosis were evidenced.

Following the application of inclusion and exclusion criteria, only one study proved to be eligible and was finally analyzed. This was a randomized trial carried out in two pediatric hospitals in Australia, which evaluated the effects of singing programs on the quality of life and respiratory muscle strength in children diagnosed with cystic fibrosis.

The study included 51 subjects divided into two groups: the experimental group, attending 8 singing lessons, and the control group, attending recreational therapy programs.

At the end of the experimental period, an improvement in the quality of life according to the Cystic Fibrosis Questionnaire-Revised was demonstrated in both groups. In the experimental group, there was an increase of maximum expiratory volume 6-8 weeks after the intervention. No significant differences in the other respiratory parameters were found between the two groups.

The authors of this review established that at the time when this meta-analysis was attempted, data supporting the potential of singing therapy in the treatment of cystic fibrosis were insufficient. However, the authors conclude in an optimistic note, considering that the increasing interest in the non-pharmacological treatment of this disease might generate new studies on the effects of singing therapy on the respiratory function and psycho-emotional state of patients with cystic fibrosis (Irons et al., 2014).

Studies performed in UK (Lord et al., 2010) showed that improving the pulmonary function can fail if singing breathing exercises are not practiced for a sufficiently long time period to be correctly acquired and executed or when the individual exercise capacity is not taken into consideration. Starting from this finding and based on previous studies reporting beneficial effects of singing on health status in chronic patients in general, Lord et al. resumed research, adopting a more elaborate protocol. They included in their study patients with COPD diagnosed according to GOLD guidelines, who learned breathing control strategies and subsequently participated in singing lessons two times a week, for 8 weeks. The lessons consisted of relaxation techniques, posturing and vocal exercises. The subjects were encouraged to practice these techniques at home daily, being monitored for exercise tolerance. Patients gained a better breathing control and reported an improvement of mental status, with the amelioration of dysthymia and an increase of the desire to socialize. Understanding the importance of singing as a breathing training method, the patients accepted to include this activity in their daily lives as a method for the self-management of respiratory symptoms (Lord et al., 2012).

Conclusions

1. Pulmonary rehabilitation involves the training of the patient with respiratory disease for correct posturing, driving the air flow into the airways, preventing air trapping, using the diaphragm muscle in the act of respiration and increasing respiratory muscle strength.
2. Singing educates the patient for correct posture, deep inspiration and prolonged expiration, preventing the air trapping phenomenon and improving pulmonary ventilation.
3. Singing increases the participation of the diaphragm muscle and the contraction force of respiratory muscles during respiration, with the improvement of current volumes.
4. Singing improves the quality of life and can be a self-management method in the case of patients with chronic pulmonary diseases.

Conflicts of interest

Nothing to declare

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