Chapter 15
Pulmonary Physiotherapy in Patients with Bronchial Asthma

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Abstract In the present study we investigated the effectiveness of a 3-month breathing exercise program in patients with mild-to-moderate asthma, as assessed from spirometric indices. The study group consisted of 28 asthma patients (mean age of 43 years). The physiotherapy program consisted of 45-min exercise sessions, performed twice a week for 3 months. We measured the flow-volume indices (FEV_1, FVC, PEF, MEF_{50}) before and after the exercise sessions at the beginning and end of the physiotherapy program. In addition, the patients measured their personal best peak expiratory flow (PEF). We found no significant changes in spirometric indices before and after an exercise session either at the beginning or end of the physiotherapy program, although there was a tendency for lower values after the exercise sessions at both beginning and end of the physiotherapy program. There was a significant decrease in PEF after an exercise session at the beginning of the physiotherapy program; this decrease lost significance after completion of the physiotherapy program. However, PEF values were greater both before and after the exercise sessions at the end of the physiotherapy program compared with the corresponding sessions before the program. We conclude that the breathing exercise program employed in the study failed to appreciably improve lung function in asthmatic patients. However, there was no asthma exacerbations observed during the conduction of breathing exercise program, which underscores the need for pulmonary rehabilitation in asthma treatment.

Keywords Breathing exercise • Bronchial asthma • Peak expiratory flow • Pulmonary rehabilitation • Spirometry

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15.1 Introduction

Bronchial asthma is one of the most frequent chronic inflammatory disorders of airways and constitutes a major social problem, since it increases healthcare cost and limits patients' quality of life (Accordini et al. 2006; Lindberg et al. 2002). The incidence and prevalence of asthma varies even within the same country and it depends on the age of the population studied, ethnicity, financial status, and on the criteria used for diagnosis. There has been an increase in the number of atopic asthma cases over the last century. At the beginning of twentieth century less than 1% of population had allergic diseases, whereas in the 1950s that rate increased to 3–5% and in the 1960s it reached 5–10% (Rabe et al. 2000).

Bronchial asthma is characterized by increased hyperresponsiveness of airways to various stimuli, which causes relapsing episodes of shortness of breath, wheezing and coughing, mainly at night time and in the early morning hours. Bronchial tree hyperactivity is more common in winter (14.8%) than in summer (5.9%). There are risk factors facilitating asthma development, mainly coming from the environment, such as exposure to aeroallergens, air pollutants, nicotine smoke, and air conditioning, but also deficiency of vitamins, high protein diet, or diet containing inadequate amounts of omega-3 fatty acids may foster asthma. The airflow limitation observed in asthma is associated with an exacerbation of the underlying, symptom-free chronic inflammation of bronchioles, leading to remodeling of airway walls. The resulting structural changes seem to affect sensory information from nerve endings in the airways, which may constitute motor hyperactivity of bronchial smooth muscles (Bousquet et al. 2001; GINA 2002, 2010; Vilsvik et al. 2001; Yeatts et al. 2003). Consequences of bronchial narrowing and obstruction include impaired respiratory function. The disturbance in gas exchange resulting from unfavorable conditions of ventilation and its neural regulation leads to oxygen deficit, which, in turn, limits the patients' physical capacity and quality of life (Groneberg et al. 2004; Menz et al. 2007; Stanton et al. 2008).

The main aim of pulmonary rehabilitation in asthma is to improve the patients' quality of life and to lower the intensity of fear and anxiety associated with breathlessness. Pulmonary physiotherapy, along with pharmacological treatment, comprises the essential element of medical care for bronchial asthma and it helps to alleviate the intensity of symptoms and to reduce the consequences of the disease. The primary focus of physiotherapy is to teach patients effective expiration techniques, diaphragmatic breathing, and to strengthen abdominal muscles (Burianova et al. 2008; Menz et al. 2007). In the present study we set out to verify the effectiveness of a 3-month program of breathing exercise in improving lung function, assessed from spirometry, in patients with mild-to-moderate asthma.

15.2 Methods

The study was performed in accordance with the Helsinki Declaration for Human Experimentation and the protocol was approved by a local Ethics Committee. The study group consisted of 28 bronchial asthma patients (F/M-3/25; mean age of 43 years, mean body mass of 62.5 kg, mean body height of 164.2 cm, mean BMI of 23.1 kg/m^2). The patients were treated at the outpatient Regional Ambulatory of the Allergy Clinic in Katowice, Poland. The physiotherapy program consisted of 45-min exercise sessions, performed twice a week for the duration of 3 months under the supervision of a physiotherapist, with a recommendation of continual home breathing exercise. The program consisted of breathing exercises of moderate intensity, teaching of expiration techniques such as 'pursed lip breathing' and diaphragmatic breathing in various body positions with progression to walking. The exercises aimed at relaxation of accessory inspiratory muscles, enhancing the removal of air from lungs and the work of the diaphragm, increase in abdominal muscles strength, and improvement of coughing effectiveness. Special attention was paid to teaching the proper breathing rhythm (relaxed inspiration and prolonged expiration). Throughout the physiotherapy program, the patients were taking their regular medications as prescribed by physicians.

At the beginning and end of the 3-month physiotherapy program, before and after the 45-min exercise sessions, we measured the flow-volume-loop indices: FEV_1, FVC, PEF, and MEF_{50} (where FEV_1 - forced expiratory volume in 1 s, FVC-forced vital capacity, PEF-peak expiratory flow, MEF_{50} - mid expiratory flow at 50% of FVC), with the use of a Lung Test-1000 spirometer. The patients were told to perform maximal forced expiration through a mouthpiece with nose clip in place, immediately after performing maximal inspiration. The test was done in the resting sitting position. The data were in the absolute values and as the percentage of predicted values for subjects of similar anthropometric characteristics. Additionally, the patients were instructed to measure their personal best PEF, with the use of their personal peak flow meters. The PEF measurement was performed before spirometry tests to avoid intensification of airway obstruction caused by forced exhalations. For all measurements, three trials were performed and the best of the three was selected to further analysis.

Data are given as means ± SD. Normality of data distribution was checked with the Wilk-Shapiro test. A *t*-test for dependent variables was used to compare differences between the values of individual indices before and after an exercise session and at the beginning and end of the physiotherapy program. A $p<0.05$ was considered to represent statistical significance. All statistical analyses were performed using a commercial Statistica package (v. 6.0).

15.3 Results

The results of lung function indices are presented in Table 15.1. We observed no significant changes in spirometric indices recorded before and after an exercise session either at the beginning or end of the 3-month physiotherapy program, although there was a consistent tendency for lower values after the exercise sessions at both beginning and end of the physiotherapy program.

There was a significant decrease in the PEF value after an exercise session at the beginning of the physiotherapy program; the decrease became insignificant after completion of the physiotherapy program (Table 15.2). However, PEF values were greater both before and after the 45-min exercise sessions at the end of the 3-month physiotherapy program compared with the corresponding sessions before the physiotherapy program.

Table 15.1 Lung function indices in 28 asthmatic patients before and after a single 45-min breathing exercise session at the beginning and end of 3-month physiotherapy program

	Beginning 45-min exercise			End 45-min exercise	
	Before	After	% Predicted	Before	After
FEV_1 (l)	2.6 ± 0.7	2.5 ± 0.7	81.9 ± 14.9	2.6 ± 0.7	2.5 ± 0.7
FVC (l)	3.2 ± 0.7	3.1 ± 0.7	85.8 ± 13.6	3.2 ± 0.7	3.1 ± 0.6
PEF (l/s)	6.1 ± 1.8	5.9 ± 1.9	85.7 ± 14.7	6.1 ± 1.9	6.0 ± 1.7
MEF_{50} (l/s)	3.0 ± 1.5	2.9 ± 1.4	68.9 ± 26.8	3.0 ± 1.5	2.9 ± 1.4

Values are means ± SD
There were no significant differences noted

Table 15.2 Peak expiratory flow (PEF) in 28 asthmatic patients before and after a single 45-min breathing exercise session at the beginning and end of 3-month physiotherapy program

	Beginning 45-min exercise		End 45-min exercise	
	Before	After	Before	After
PEF (l/min)	355.6 ± 76.1	335.2 ± 89.6*	399.3 ± 91.6**	392.6 ± 81.2**

Values are means ± SD
*p < 0.001 for the difference before and after the 45-min exercise session; **p < 0.001 for the difference before the corresponding exercise sessions at the beginning and end of the 3-month breathing exercise program

15.4 Discussion

The present study failed to demonstrate appreciable effects on lung function, assessed from spirometric indices, of a 3-month physiotherapy program in patients suffering from asthma. Spirometry constitutes an essential tool in diagnosis, treatment, and monitoring of bronchial asthma (Petty 2001). Although the results of spirometry may be affected by the patient's attitude, the extent of airway narrowing, exposure to aeroallergens, and the severity of the disease related to daily changes and seasonal exacerbations (Bousquet et al. 2001; Burianova et al. 2008; GINA 2010), the lack of improvement in spirometric indices after the long-term breathing exercise program, overall, speaks against an essential role of such exercise in asthma treatment. That, however, does not exclude an ancillary role of breathing exercise in asthma. Breathing exercise we employed apparently led to disease stabilization, as we did not observe any exacerbations throughout the time of physiotherapy. This observation may be taken as verification of the need for physiotherapeutic approaches in asthma treatment.

The tendency for a decrease in spirometric indices we observed just after completion of a 45-min exercise session was most likely a result of the after-exercise fatigue of respiratory muscles; the phenomenon also reported in other studies (Vilsvik et al. 2001). In the longer run, however, we observed an increase in PEF values recorded before and after an exercise session after completion of physiotherapy compared with the corresponding recordings taken before physiotherapy. These increases may be a sign of benefits acquired from physiotherapy. Alternatively, these increases may reflect the comfort of the patient's use of a peak flow meter at home, with no distress stemming from repeated lung function tests always performed at a physician's office. Personal peak flow meters are a conveniently accessible means of monitoring asthma, whereas such devices are not commonly used in diagnosis of asthma (Petty 2001). Regardless of the underlying cause of PEF increase after breathing exercises, it should be underscored that pulmonary physiotherapy may only be adjunctive, and not substitutive, to pharmacological treatment in helping alleviate symptoms.

15.5 Conclusions

- Physiotherapy outcomes after the completion of a 3-month breathing exercise program were not satisfactory. On the other hand, however, we did not observe any exacerbation of asthma throughout the physiotherapy program, which positively verifies the need for physiotherapeutic interventions in asthma treatment.
- It may be assumed that effects of physiotherapy treatment in asthma are affected by the patient's attitude and the severity of the disease, as expressed by daily changes and seasonal exacerbations.

Conflicts of Interest: The authors declare no conflicts of interest in relation to this article.

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