

ASSESSMENT OF THE REHABILITATION EFFICIENCY FOR SKELETAL AND RESPIRATORY MUSCLE DYSFUNCTION IN COPD PATIENTS

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ABSTRACT

Introduction. COPD (Chronic obstructive pulmonary disease) results, as the latest expanded definition of the disease indicates, among others, in reduced exercise tolerance in patients caused, inter alia, by skeletal and respiratory muscle dysfunction.

Aim. The aim of the study is to describe changes that take place in the muscles as a result of the disease, as well as to assess the impact of weight and endurance training on the composition of body mass and exercise capacity in the patients with COPD.

Material and methods. The surveyed group involved 12 patients diagnosed with COPD on the basis of spirometry and associated pulmonary symptoms. Most of the patients were males. All patients were subjected to a 21 day ongoing rehabilitation program. Before and after the given period, each patient was examined in the direction of body mass composition. The study determined the mass of adipose tissue, muscle mass and total body water content.

Results and conclusions. In the process of the study we obtained results that showed positive effects of the applied rehabilitation. Although the results of the study had shown no statistically significant differences, the results obtained, leading to the expected changes (increase in the case of fat-free mass and water content, and a decrease for the fat mass measurements) show that the rehabilitation program used in the investigated group can be recommended for use in the course of rehabilitation program for these patients, following further complementary studies.

Key words: COPD, skeletal and pulmonary muscles, rehabilitation

Introduction

According to WHO 2004 data, there are approximately 2 million Polish people between the age of 41 and 72 suffering from COPD. The data indicate that this disease is the 6th leading cause of death in the world; moreover, some estimations show that by 2030 it may reach third place in the category [1]. Despite the more and more increasing sophistication of medicine, successful methods delaying the effects of COPD have been still earnestly sought for.

COPD results, among others, in reduced exercise tolerance in patients caused, inter alia, by skeletal and respiratory muscle dysfunction.

Dysfunction of skeletal muscles in COPD patients

Decrease in exercise tolerance is caused, inter alia, by reduced oxidative metabolism of muscles. It leads to reduction in exercise tolerance for several reasons. The first one to be mentioned is severity of lactic acidosis frequently observed in COPD after a given exercise load, which increases oxygen demand [2].

Another important mechanism that occurs in the muscles of patients with COPD, which may reduce patient's willingness to undertake any physical effort, is their premature acidification, and increased susceptibility to contractile fatigue. These changes are caused by the decrease in oxidative enzyme capacity, and increased cytochrome oxidase activity.

Muscle weakness in chronic obstructive pulmonary disease is therefore a consequence of mus-

cle failure due to loss of physical activity, weight loss, general weakness and inflammation present in the whole body.

Dysfunction of respiratory muscles in COPD patients

Skeletal muscle weakness is not the only problem related to the musculoskeletal system in patients with COPD. Due to limitations in air flow, the respiratory tract is affected by gasometrical alternations. This results in inspiratory chest setting. The chest expands anterior-posteriorly, becomes excessively arched, which results in expansion of the intercostal space. Ribs are set at an approximately straight angle, thus differing from their normal setting [3]. This pathology forces a noticeable need for the use of auxiliary inspiratory muscles, which are to compensate the increase in the mobility of upper ribs pathologically engaged in resting breathing.

An additional burden for the auxiliary respiratory muscles is the need to overcome the developing process of the disease duration of the pathological endobronchial “intrinsic” positive end-expiratory pressure, called PEEPi. Its occurrence is associated with high energy expenditure, which, as the disease is developing, becomes more and more significant burden and forces the patient to engage auxiliary muscles in breathing once again, which in turn causes further pathologies, resulting from the increase in muscle tone, and leading to disturbances in the statics of the spine and the shoulder girdle.

Respiratory muscles show earlier adaptation to changing conditions than discussed earlier skeletal muscles. Unfortunately, despite all the adaptation changes, the respiratory muscles and diaphragm of COPD patients have a reduced strength and endurance than in healthy subjects [2].

Rehabilitation methods in COPD

The key element of COPD patient's care is education. It should be based on the patient's and his/her family's knowledge how to cope with everyday situations, and convincing patients about involving physical exercises in their daily routine. Exercises shall be introduced in groups or individually and adjusted to the condition of patients and include: strength training, endurance training on cycloergometer and special breathing exercises. Additionally, this should be accompanied by physiotherapy programs aimed at facilitating the expulsion of the retained secretion from the bronchial tree, relaxation of stiff muscles and improvement of patient's

well-being. Psychological care shall be also included in any comprehensive rehabilitation program.

Supplementation in pulmonary rehabilitation in COPD patients

Pharmacotherapy also plays important part in the rehabilitation of patients with COPD as it slows down progression of the disease and supports capabilities of the body. Besides pharmaceutical drugs, using supplements to increase fitness and muscle strength is considered for COPD patients. Statistics show that creatine supplementation has a beneficial effect on certain parameters which are improving in case of its use in athletes. Recent studies show satisfactory results and prove the effectiveness of applying this supplementation in patients with COPD. Creatine, due to its role in the metabolism of physical exercise, improves not only muscle mass parameters, but also exercise capacity of patients. Based on studies, patients using creatine supplementation show greater increase in muscle mass and improvement of physical performance in comparison to the others who have not received such supplementation [3].

Aim

The aim of this study is to assess the impact of weight and endurance training on the composition of body mass and exercise capacity in patients with COPD. After the studies we want to obtain answers to the following assumptions:

1. Does rehabilitation program reduce fat mass content in the body mass of the patients subject to the study?
2. Do applied exercises increase fat-free mass content of the patients?
3. How does the water content in body composition of patients in the study group change after rehabilitation?

Material and methods

The surveyed group involved 12 patients diagnosed with COPD on the basis of spirometry and associated symptoms. Ten of the patients were males, the other two were women. Patients were subjected to an ongoing rehab program lasting 21 days, during which they attended classes included in the program.

Before and after this period of 21 days, each patient was examined in the direction of the body

mass composition. The study determined the following parameters: the mass of adipose tissue, muscle mass and total body water content. The study was using Bodystat 1500 apparatus to measure body composition and was performed in line with the manual of the unit.

Statistical methods

Statistica StatSoft 10.0 software was used for statistical analysis. Results of quantitative variables are presented using descriptive statistics measures: arithmetic mean, standard deviation and minimum and maximum values. Qualitative data are presented in numbers and percentages. Distribution of quantitative variables was tested using Kolmogorov-Smirnov test. Because these distributions do not differ significantly from the normal distribution, the parametric t-test (Student) for dependent samples was applied to test hypotheses concerning the impact of rehabilitation. Assumed significance level was $\alpha=0.05$.

Results

The results are presented in tables and graphs below.

Table I. Characteristics of the investigated group.

Patient's ref. number	Weight (kg)	BMI	Age (years)	Height (cm)
1.	96.4	41.7	54	152
2.	75	27.5	57	165
3.	108	33.3	62	180
4.	88.0	28.7	56	175
5.	67.0	24.6	60	165
6.	84.0	27.7	55	174
7.	105.0	35.5	54	172
8.	92.0	29.7	62	176
9.	69.0	21.5	61	179
10.	84.0	29.1	57	169
11.	92	31.1	55	171
12.	77.0	24.3	68	178
Mean value	86.5	29.6	58.4	171.3
Minimum	67	21.5	54	152
Maximum	108	41.7	68	180
Standard deviation	13.1	5.4	4.3	7.9

Table II. Assay of fat mass content before and after rehabilitation.

Variable	MV	SD	N	Difference	t	df	p
Fat mass (measurement before rehabilitation)	28.1	10.5	12	1.85	1.2	11	0.2500
Fat mass (measurement after rehabilitation)	26.3	12.8					

Table III. Assay on fat-free mass in COPD patients.

Variable	MV	SD	N	Difference	t	df	p
Fat-free mass (measurement before rehabilitation)	58.3	7.9	12	-0.9	-0.6	11	0.5878
Fat-free mass (measurement after rehabilitation)	59.2	6.7					

Table IV. Assay on TBW content variations before and after rehabilitation.

Variable	MV	SD	N	Difference	t	df	p
Water (measurement before rehabilitation)	42.4	4.0	12	-1.8	-1.0	11	0.3402
Water (measurement after rehabilitation)	44.2	6.2					

Discussion

Studies currently carried out in the world try to determine the most effective rehabilitation program that to the greatest extent would minimize symptoms of chronic obstructive pulmonary disease. However, too few researches are aimed at the verification of effects of specific forms of rehabilitation used in patients suffering from this disease.

Worldwide studies show beneficial impact of pulmonary rehabilitation on cardiovascular and ventilation parameters in patients with COPD. Although there are also studies conducted to verify the impact of the duration of rehabilitation on applied programs, their results are not clear enough to draw any constructive conclusions.

Most effective program resulting in the improvement of patients with COPD is still being sought for. Differences in the use of specific forms of rehabilitation do not allow drawing any meaningful conclusions.

The survey carried out show the effectiveness of the applied rehabilitation program. Although the differences observed in the results are not statistically significant, the observed trends (upward – in the case of fat-free mass and water content measurements; and downward for fat mass measurements) indicate that rehabilitation was successful. It is possible that after longer implementation, the examined differences would be statistically significant. The rehabilitation program used in the investigated group of patients and creatine supplementation led to expected changes confirmed by the above study carried out on patients with COPD and can be recommended for use in the course of rehab programs for those patients, following further complementary studies.

Conclusions

In the process of this study over muscle and fat mass of patients subject to 21-day rehabilitation program, we obtained results showing positive results of the applied rehabilitation.

1. Fat mass of patients before the rehabilitation is greater, and it is reduced during the rehabilitation period. The observed difference is not statistically significant.
2. The result for fat-free mass is also statistically insignificant. The increasing trend of the parameter has been observed.
3. The study on total body water content in the composition of body weight of the patients shows an upward trend; however again, the differences are not statistically significant.

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