INFLUENCE OF OBESITY ON SPIROMETRIC PARAMETERS IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Harmful air particles emissions (heavy industry, thermal and nuclear power plants, vehicles that burn fissile fuel, professional exposure in factories and mines, consumption of cigarettes), greatly disturb the function of the respiratory system. Obesity is associated with chronic low-grade inflammation and increased numbers of activated macrophages in adipose tissue. Adipose tissue provides an abundance of inflammatory mediators, suggesting a possible link between obesity and immunological developments in COPD.

The aim of the paper was to determine whether obesity has a significant effect on spirometric parameters in patients with COPD, and to determine whether weight loss caused by reduction of adipose tissue has a positive effect on improvement of spirometric parameters in patients with COPD.

The study included 190 examinees aged 35 to 65 years, of both sexes, divided into four groups: the first group recruited 40 examinees with different degrees of obesity and without verified COPD, 20 persons (group 1a) with obesity from I (BMI 30-35) to III (BMI>40) and 20 subjects (group 1b) with pre-obesity (BMI 25-30); the second group included 50 examinees who had normal nutritional status and COPD with different duration; the third group consisted of 50 examinees, who had I degree obesity (BMI 30-35) and COPD; the fourth group consisted of 50 examinees, who had II degree obesity (BMI of 35-40) and COPD with different duration.

The research lasted three years, covering the period from 2007 to 2010. The subjects were being examineed for 180 days, and all the changes related to spirometry parameters and body mass index (BMI) were followed up.

Comparing the average measures and standard deviations in FEV1/ FVC between groups 4 (66,71±4,53), 2 (69,1±5,98) and 3 (70,69±5,81), there were no significant statistical differences. The values of spirometric parameters between two groups of patients with COPD were compared. The first group of patients involved subjects who in the period of 180 days had weight loss greater than 10% and second (2) group in which subjects had no significant weight loss. It was found that respondents from the first group had a statistically significant increase in the observed values of all spirometric parameters compared to another group. FVC: 4.33(1) 0.99(2); p<0, 01. FEV1: 7.38(1) 2.67(2); p<0.01. FEV1/FVC: 4,27(1) 2,14(2); p<0,05.

Obesity has no significant effect on spirometric parameters in patients with COPD. Losing weight in favor of adipose tissue reducing has a significant effect on improving the spirometric parameters in patients with COPD. Acta Medica Medianae 2011; 50(4): 11-16.

Key words: obesity, influence, chronic obstructive pulmonary disease (COPD), spirometric parameters, Body Mass Index (BMI)

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Introduction

Harmful air particles emissions (heavy industry, thermal and nuclear power plants, vehicles that burn fissile fuel, professional exposure in factories and mines, consumption of cigarettes), greatly disturb the function of the respiratory system. It simply gives any individual the right to ask whether there is a relationship between obesity and quality of breathing. We know that in some patients who have body mass index-BMI over 40, almost half of their body weight belongs to the adipose tissue (1). Two principal mechanical effects of obesity on respiratory lung function have been identified: an adipose tissue and muscle weakness. Analyzing the fat thickness (expressed in length), the visualization and measurement of which were enabled by applying this method, we found out that higher values of thickness are correlated with a higher degree of reduction in amplitude of the oscillation frequency and acceleration during the respiratory cycle in identical conditions. It was observed that especially
higher values of abdominal fat have a significant effect on the above relationship (2).

The weakness of respiratory muscles in obese individuals is attributed to muscle inefficiency. It is the result of reduced ability of the chest wall muscles (during the process of muscle contractions), which are surrounded by a layer of adipose tissue, reduced diaphragm movements, the primary muscle involved in the breathing action. On the other hand, the necessary circulation which delivers oxygen and nutrients for normal muscle functioning is compromised to some extent by different redistribution in obese people, causing all the muscles in general to suffer. This is supported by the fact that breathing exercises are used to enhance the lung capacity which is often weakened (of reduced intensity) in obese patients compared to examinees with normal body weight (3).

Obesity is associated with chronic low-grade inflammation and increased number of active macrophages in the adipose tissue. Adipose tissue provides an abundance of inflammatory mediators, suggesting a possible link between obesity and immunological developments in COPD. This hypothesis is explained by histological preparations of adipose tissue on more than 10,000 samples, where the immune cytological analysis evidenced high number of macrophages in the connective tissue between the adipocytes. The presence of increased concentrations of C-reactive protein, tumor necrosis factor alpha (TNF-α) and interleukin-6 in the serum of the obese population has been undoubtedly proved (4).

TNF-α is a proinflammatory cytokine which is mainly secreted by macrophages. It plays a role in the regulation of a wide range of biological processes, including cell proliferation, differentiation and apoptosis, which have physiological basis, particularly in modulation of mucous tissues in the respiratory tract, which is the main pathological feature of COPD.

Reduction diets (reduced food intake) are definitely the optimal health strategies for the obese patients with chronic respiratory disease. Several studies have shown that therapeutic approaches, principles and maintaining of weight loss included food reduction, increase in physical activity and medical care (absorption of fats from digestive tract), whereby, in short time, a moderate degree of reduction in weight or fat tissue has been achieved. However, long-term investigation studies’ results have shown the opposite, because the majority of patients have succeeded to regain some or most of their weight (5).

There are no specific recommendations about weight loss, or appropriate strategies on regulation of body weight in patients with chronic respiratory diseases. This poses a problem, because patients with chronic respiratory diseases are often inactive, and therefore are often not able to comply with the recommendations related to the level of physical activity.

**Aim**
- To determine whether obesity has a significant effect on spirometric parameters in patients with COPD.
- To determine whether weight loss caused by reduction of adipose tissue has a positive effect on improvement of spirometric parameters in patients with COPD.

**Patients and methods**

The study included 190 examinees aged from 35 to 65 years old, of both sexes, divided into four groups.

1. The first group (1a) consisted of 40 examinees with different degrees of obesity and without verified COPD, 20 individuals (group 1a) with obesity degree I (BMI 30-35) to III (BMI> 40) and 20 individuals (group 1b) with pre-obesity (BMI 25-30).

2. The second group consisted of 50 examinees of different age structure, both sexes, who have normal nutritional status and COPD with different duration.

3. The third group consisted of 50 examinees of different age structure, both sexes, who had obesity degree (BMI 30-35) and COPD with different duration and degree severity.

4. The fourth group consisted of 50 examinees of different age structure, both sexes, who had II degree of obesity (BMI 35-40) and COPD of different duration and severity degree.

The research period lasted three years, from 2007 to 2010. Patients who fulfilled basic conditions for participation in the study underwent the clinical examination which included the important measurements of body weight, body height and calculation of BMI using the formula BMI=TT/TV2, as well as the waist measurements, on the basis of which the examinees were selected in groups according to degree obesity and obesity classification (WHO, 1997). The subjects were followed up for 180 days and spent 15 days both at the beginning and end of the study in the home institution Special Hospital "Sokobanja" in Sokobanja, where besides diagnostic procedures (such as spirometry that is as a ratio between two parameters' FEV1/FVC named as FVC - forced vital capacity and FEV1 - forced expiratory volume per 1 second), passed through the educational program and treatment of respiratory rehabilitation (that included the diet with limited food calorie intake in the range from 1200 to 1800 kcal, physical activity twice a day with mat exercises, breathing exercises, extended breathing exercises, aqua fitness program and walking tracks).

Survey results were analyzed using a software program for statistical analysis of data (SPSS). We used standard statistical parameters: arithmetic mean (Xsr.), standard deviation (SD), Fisher and Hiz-test, Student’s t-test, linear correlation, multivariate linear regression, whereby the results are presented in tables and graphs.
Graph 1. Mean values and standard deviations of FEV1/FVC in the examined groups at the beginning (F=619,259; p<0,001) and end of 180 days (F=685,548; p<0,001) (ANOVA test, t-test for repeated measures).

**Table 1.** Lung capacity in patients with reduced body weight by more than 10% and in those without body weight reduction - in patients with COPD (Mann-Whitney U test).

**Table 2.** Parameters of body mass indexes of patients presented by groups (ANOVA comparison test) A (1a vs 1b), B (1a vs 2), C (1a vs 3), D (1a vs 4), E (1b vs 2), F (2 vs 3), G (2 vs 4), H (1b vs 3), I (3 vs 4)

**Results**

Graph 1 presents mean values and standard deviations of FEV1/FVC in the examined groups at the beginning (F=619,259; p<0,001) and end of 180 days (F=685,548; p<0,001) (ANOVA test, t-test for repeated measures). Comparing the values at the beginning FEV1/ FVC and after a period of 180 days, statistically significant differences in the values of the analyzed groups were observed.

The lowest values at the beginning of testing were reported in group 4 (66,71±4,53), which were significantly lower compared to the groups 1a (96, 87±3,45) and 1b (98, 10±3,77) but without significant difference compared to the values in group 2 (69,1±5,98). Statistically significant increase in the value at the end of the test occurred first in the group 2 (72,6±6,12) t=3,969; p<0,01, then in the group 3 (70,69±5,81) t=2,403; p=0,020 and in the group 4 (68,43±5,25) t=2,175; p=0,034, which...
Obesity significantly influences the life quality of COPD patients, affects the frequency of dyspnea, reduces physical fatigue threshold, affects the occurrence of frequent exacerbations, but its direct influence on the values of spirometric parameters has not been proved yet. This fact has initiated the investigations into the relationship between obesity and spirometric parameters. Furthermore, it helped introducing significant methodological parameters important for the management of COPD (6).

Influence of weight reduction on dyspnea, tolerance exercises and quality of life in overweight and obese patients with COPD has not yet been significantly described in the literature. There are studies showing that weight loss leads to improved lung function and symptoms, regardless of the degree of obstructive changes in the respiratory system (7, 8).
Given results have shown that the length of obesity with tendency to increase in the reported period is a significant negative predictor for lung function of the observed performance (p>0.001), (the ratio of FEV1/FVC (p>0.001) and diffusion capacity (p>0.001) (9).

By analyzing the spirometric parameters of FEV1 values, it has been observed that the obese examinees had better results which amounted to 50.0%, i.e. 20.4% of predicted amount, compared to normal patient whose FEV 1 was on average 44.2%, i.e. 19.4% of predicted amount (10).

Conclusions

1. Obesity has no significant effect on spirometric parameters in patients with COPD.
2. Losing weight in favor of adipose tissue reducing has a significant effect on improving the spirometric parameters in patients with COPD.

References

UTICAJ GOJAZNOSTI NA SPIROMETRIJSKE PARAMETRE KOD BOLESNIKA SA HRONIČNOM OPSTROKTVNOM BOLEŠĆU PLUĆA

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Emisija štetnih aero čestica (teštka industrija, termo i nuklearne elektrane, prevoznog sredstva koja sagorevaju fosilna goriva, profesionalno eksponiranje u fabrikama i rudnicima, konzumacija cigareta...), u mnogome remeti funkciju respiratornog sistema. Gojaznost je udružena sa hroničnom inflamacijom niskog stepena i povećanim brojem aktiviranih makrofaga u masnom tkivu. Masno tkivo daje obilje inflamatornih medijatora, što sugeriše moguću povezanost gojaznosti sa imunološkim desavanjima u HOBP-u.

Cilj rada bio je utvrditi da li gojaznost ima značajan uticaj na spirometrijske parametre kod bolesnika sa HOBP-om i da li smanjenje telesne težine na račun smanjenja adipoznog tkiva ima pozitivan efekat na poboljšanje spirometrijskih parametara kod bolesnika sa HOBP-om.

Ispitivanjem je obuhvaćeno 190 ispitanika starosti od 35 do 65 godina oba pola, podeljenih u četiri grupe. Prvu grupu činilo je 40 ispitanika različitog stepena gojaznosti bez verifikovane HOBP i to (1a) sa prisutnom gojaznošću od I (ITM 30-35) do III (ITM >40) i (1b) sa prisutnom pred-gojaznošću (ITM 25-30). Drugu grupu (2) činilo je 50 ispitanika, koji imaju normalnu uhranjenost i verifikovanu HOBP različite dužine trajanja. Treća grupa (3) od 50 ispitanika imala je gojaznost I stepena (ITM od 30-35) i verifikovanu HOBP i četvrta grupa (4) od 50 ispitanika oba pola imala je gojaznost II stepena (ITM od 35-40) i verifikovanu HOBP.

Vremenski interval u kome su trijažirani bolesnici za dato istraživanje iznosio je tri godine i odnosi se na period od 2007. do 2010. godine. Ispitanici su praćeni 180 dana, zajedno sa svim promenama vezanim za spirometrijske parametre i indeks telesne mase (ITM).

Poređenjem srednjih vrednosti i standardnih devijacija za FEV1/FVC odnos između: grupa 4 (66,71 ± 4,53), 2 (69,1 ± 5,98) i 3 (70,69 ± 5,81), nije uočena značajna statistička razlika. Upoređujući vrednosti spirometrijskih parametara između dve grupe bolesnika sa HOBP-om. Prve (1) u kojoj su bili ispitanici koji su u periodu od 180 dana imali gubitak telesne mase veći od 10% i druge (2) u kojoj su bili ispitanici bez značajnog gubitka u telesnoj masi. Ustanovljeno je da su ispitanici iz prve grupe imali statistički značajno povećanje vrednosti svih posmatranih spirometrijskih parametara u odnosu na drugu grupu: FVC: 4.33(1) 0.99(2); p<0,01. FEV1: 7.38(1) 2.67(2); p<0.01. FEV1/FVC: 4,27(1) 2,14(2); p<0,05.

Gojaznost nema značajan efekat na spirometrijske parametre u bolesnika sa HOBP. Redukcija telesne težine i količine masnog tiva ima značajan efekat na popravljanje spirometrijskih pokazatelja sa HOBP. Acta Medica Medianae 2011;50(4):11-16.

Ključne reči: gojaznost, odnos, hronična respiratorna bolest pluća (HOBP), spirometrijski parametri, indeks telesne mase (ITM)