Impact of a 12 weeks supervised exercise training program on pulmonary functions of patients with exercise induced asthma

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Abstract Background: Exercise induced bronchoconstriction typically develops within 5–15 min after completing exercise. Patients develop typical asthma symptoms or sometimes troublesome cough, which usually resolve spontaneously within 30–45 min. Previous studies tried to find the best way for these subjects aiming to improve exercise performance, respiratory symptoms and quality of life without provoking this type of asthma.

Objective: To investigate the effect of supervised exercise training on spirometry measures of patients with exercise induced bronchospasm (EIB) and to guess its benefit as an adjuvant to pharmacological treatment.

Subjects and methods: We studied fifty subjects with EIB; their age ranged 25–35 years. They underwent spirometry (FVC%, FEV1%, FEV1/FVC% and FEF25–75%) before and after supervised exercise training program guided by the calculated maximum work rate (MWR) of each participant throughout the 3 months period of the exercise training program.

Results: Pre and post-training FEV1% pred. and calculated FEV1% decline were compared over the 12-week supervised training program time using one way ANOVA test and revealed significant improvement throughout the training sessions. MWR was measured pre and post supervised training program and were compared using the paired-t test which revealed a significant improvement.

Abbreviations: ANOVA, analysis of variance; FEV1% pred, Forced expiratory volume in first second% predicted; EIB, exercise induced bronchospasm; FVC, forced vital capacity; MWR, maximum work rate

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Introduction

Although many asthmatic subjects up to 90% [1] find exercise-induced asthma (EIA) a problem, young adults suffer most from its effects because they are engaged more often in physical activities and sports. Exercise induced bronchoconstriction typically develops within 5–15 min after completing exercise. Patients develop typical asthma symptoms or sometimes troublesome cough, together with a decrease of 15% in forced expiratory volume in one second (FEV1), with spontaneous resolution to pre-exercise level in 30–45 min. International asthma management guidelines often recommend inhaled short-acting β2 agonist therapy (as required) for this condition, since inhaled bronchodilators taken immediately prior to exercise effectively prevent the exercise-induced bronchoconstriction [2]. However, this treatment does not influence the underlying airway hyperresponsiveness. Furthermore, patients often do not know when they are going to exercise therefore, forget their medication which is taken as needed, or even sometimes they daily do physical effort in accordance to their jobs thus they frequently use their rescue medications. Continuous treatment with inhaled corticosteroids (ICS) also offers good protection against exercise-induced bronchoconstriction [3] but unfortunately, compliance to asthma treatment remains very poor [4] due to economic and reluctance causes. Pulmonary rehabilitation is a well-recognized treatment option in different pulmonary diseases improving exercise performance, respiratory symptoms, quality of life and spirometry measures [5]. The aim of this study was to determine whether a 12-week supervised exercise program leads to improvements in asthma control and Spirometry measures, and to guess its benefit as an adjuvant therapy to pharmacological treatment.

Materials and methods

Patients

Fifty subjects, 20 females and 30 males with an age range between 20 and 35 years, all of them were within the normal body mass index which ranged between 19 and 25 kg/m² with a history of exercise-induced bronchoconstriction were recruited from the outpatient clinic department of October 6 university hospital.

Evaluation session (I)

In order to be included in the study, all subjects were physically inactive not participating in any sport activity, non smokers and they were free from other comorbidities except the exercise-induced bronchospasm.

Assessment of asthma control during the previous 4 weeks and the 3 months duration of the supervised exercise program were done according to Asthma Control Test (ACT) the score of each patient was above 19.

Conclusion: It was concluded that a 12-week supervised exercise training program enhanced the performance of subjects with EIB, led to improvements in asthma control.

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multiple comparisons with the Benferroni method. Analysis was performed using the statistical software (SPSS version 17; SPSS, Inc., Chicago, IL). $p < 0.05$ was considered significant.

**Results**

A total of 63 participants were assessed in the supervised exercise training test, 3 of them stopped training after one week, 9 participants trained following irregular schedule and one patient developed acute exacerbation and became uncontrolled, so these 13 were excluded from the study remaining only 50 regular participants included in our study. They were 30 males and 20 females; their age ranged from 20 to 35 years; mean age was (27.48 ± 3.4); the participants were all non-smokers. The characteristics of age, sex, anthropometric measures are summarized in Table 1.

Spirometry was done for all patients before each supervised training session. The measured FEV1% pred. were compared throughout the 12-week program using the one way analysis of variance (one way ANOVA) test followed by multiple comparison POST-HOC Benferroni method. There was a significant difference between all sessions regarding the pre-training FEV1% pred. being increasing sequentially from the first to the last training week ($F = 19.211, p = 0.000$). The change of FEV1% pred. over the 12-week program time is presented in Fig. 1.

Spirometry was done also for all patients 10 min after each supervised training session. The measured post-training FEV1% pred. were compared throughout the 12-week program using the one way ANOVA test followed by multiple comparison POST-HOC Benferroni method. There was a significant difference between all sessions regarding the post-training FEV1% pred. being increasing sequentially from the first to the last training week ($F = 72.554, p = 0.000$). The change of FEV1% pred. over the 12-week program time is presented in Fig. 2.

The decline from the pre-training FEV1% to the post-training FEV1% was calculated in each training session. The calculated declines of FEV1% were compared throughout the 12-week program using the one way ANOVA test followed by multiple comparisons POST-HOC Benferroni method. There was a significant difference between all sessions regarding the calculated declines of FEV1% being decreasing sequentially from the first to the last training week ($F = 31.424$,

**Table 1** Patients characteristics.

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<thead>
<tr>
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<th>Mean ± SD</th>
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<tbody>
<tr>
<td>Age (year)</td>
<td>27.48 ± 3.4</td>
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<tr>
<td>Sex</td>
<td></td>
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<tr>
<td>Males</td>
<td>30 (60%)</td>
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<tr>
<td>Females</td>
<td>20 (40%)</td>
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<tr>
<td>Anthropometric measures</td>
<td></td>
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<tr>
<td>Weight (Kg)</td>
<td>62.83 ± 2.4</td>
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<tr>
<td>Height (cm)</td>
<td>165.3 ± 4.5</td>
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<tr>
<td>BMI (kg/m²)</td>
<td>22.99 ± 1.1</td>
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</tbody>
</table>

Values are presented as mean ± standard deviation for quantitative data or as frequency (percentage) for qualitative data. BMI, body mass index.

**Figure 1** Change of FEV1% pred. Over the 12-week program time.

**Figure 2** The change of post-training FEV1% pred. Over the 12-week program time.

**Figure 3** The change of the calculated postexercise declines of FEV1% over the 12-week program time.

**Figure 4** The mean values of MWR pre and post the exercise training program.
The change of the calculated declines of FEV1% over the 12-week program time is presented in Fig. 3. Maximum work rate (MWR) was measured for all participants before the first and the last supervised training session. The measured MWR were compared using the paired-t test. There was a significant improvement regarding the pre-training MWR and the MWR 12 weeks later at the end of the training program being \( t = 10.43, p = 0.000 \). The difference of MWR between the pre and post exercise training program is presented in Fig. 4.

Discussion

Physical activity is an important cause of asthma and for some, it is the only cause in exercise induced asthma. Since there is no known cure for asthma [2] although, pharmacological intervention has been shown to significantly improve symptoms [9]. Therefore researchers studied the possible effective role of pulmonary rehabilitation treatment as an additive option in improving exercise performance, respiratory symptoms, spirometry measurement and quality of life [10] and therefore achieve a better control of exercise induced asthma.

The main finding of this study proved that after 12-week supervised exercise training the post-training FEV1% pred. increased sequentially from the first to the last training week.

Moreover, the results of this study proved a significant improvement of the of FEV1% post exercise decline so a 12 weeks supervised exercise training could gradually abolish triggering exercise induced bronchoconstriction of these participants especially with exercise maintenance.

The study also proved that there was a significant improvement regarding the pre-training MWR and the MWR 12 weeks later at the end of the training program which could be due to the increase in the strength of respiratory muscles, the decrease in airway resistance and the improvement of the aerobic fitness as it was documented in previous studies [4,11,12]. The results of this research showed the significant improvement of the pre exercise FEV1% of the participants and pointed to the objective improvement of their airway obstruction providing sustained improvement of their pulmonary functions and reducing health care utilization.

Our analysis was also fused a validated asthma control Test questionnaire (ACT) and perceived asthma control for each participant, the results revealed asthma control (score above 19) throughout the exercise training program.

Few studies agreed with ours and had highlighted the importance of encouraging supervised exercise training in this population with exercise induced asthma and proved a significant improvement in asthma control level [13–16]. Together with the improvement of lung function and progression for stepping down of asthma medication [10], as some study proved improvements in airway inflammation [17].

On the other hand, other research reported that the physical activity limitation component, is the most powerful contributor to asthma control [7].

In conclusion, this study found that a 12-week supervised exercise training program enhanced the performance of subjects with EIB and led to improvements in their asthma control. Proper selection of exercise program can permit subjects with EIB to accomplish high level in sports activity [6]. Therefore, EIB should not be a reason to exclude individuals from employment in jobs with heavy physical demands [5,7].

Additionally, it is suggested that supervised exercise should be followed by a period of self-administered exercise to maintain the improved asthma control levels and the improvement in aerobic fitness and maximum work rate. Especially that self-administered exercise may be a more cost-effective and readily available therapy for the general population of patients with exercise induced asthma.

It is advised to inform and convince patients with exercise induced asthmatic about the feasibility of including exercise programs as an essential adjunct to asthma management programs.

References


