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Original Article

Effect of Sympathetic Stimulation on Airway Resistance

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ABSTRACT

Introduction: Sympathetic stimulation causes bronchodilation. Exercise is a physiological variation that brings the body systems in sympathetic domain. In the present study we tried to assess the effect of sympathetic stimulation (through moderate exercise) on alteration of airway resistance.

Methods: Young healthy volunteers (n=35, age=19-25 yrs) participated in the study. Just before the exercise FVC, FEV_1, PEFR and $FEF_{25-75\%}$ were measured by using Spirometer (SpiroExcel, Medicaid). Then the volunteers were asked to perform the Harvard Step Test for 3 minutes and again the aforesaid parameters were measured. Data was analysed by using Student's t-test.

Results: The study recorded significantly increased values of FVC, FEV_1, PEFR and $FEF_{25-75\%}$ immediately following the exercise. ($p<0.05$)

Conclusions: Increased FVC immediately following the exercise denoted better performance of respiratory muscles due to better perfusion in them as a result of sympathetic stimulation. Increased values of FEV_1, PEFR and $FEF_{25-75\%}$ following exercise indicated effect of sympathetic stimulation on smooth muscles of respiratory airways. Increment of $FEF_{25-75\%}$ indicates specially the increased caliber of terminal bronchioles, made up of smooth muscles only, which was dilated by sympathetic stimulation through β_2 receptor, resulting better alveolar ventilation.

KEYWORDS: Sympathetic stimulation, FVC, FEV_1, PEFR and $FEF_{25-75\%}$

INTRODUCTION

Reports support the effectiveness of moderate aerobic exercise training in reduction of resting heart rate[1] and in enhancement of cardio-respiratory efficiency.[2] Moderate intensity aerobic exercise training (30 min/day, 4 days/ week, for 12 weeks) was found to increase aerobic capacity even in the older adults (>60 years).[3] Exercise training for 6 months in type II diabetics (age 39-54years) improved VO_2 max in them by 1.73 ml O_2/kg/min.[4] Even in chronic heart failure patients, mild exercise (exercise for a minute or less followed by rest of 2 minutes) training increased VO_2 max.[5] The immediate effect of moderate isotonic aerobic exercise on blood pressure and heart rate has also been studied.[6] Nevertheless, data about the effect of it on pulmonary functions is scanty. This study was undertaken to assess the immediate effect of moderate aerobic exercise on pulmonary function test parameters in young adult volunteers.

MATERIALS AND METHODS

Young healthy volunteers (n=35, age=19-25 yrs) participated in the study. Their height and weight were recorded. BMI of volunteers were calculated by the formula BMI=weight in kg / (height in meter^2).[7] Just before the exercise FVC, FEV_1, PEFR and $FEF_{25-75\%}$ were measured by using spirometer (SpiroExcel, Medicaid) following the guidelines of American Thoracic Society.[8] Then the volunteers were asked to perform the Harvard Step Test for 3 minutes. They were asked to place one foot on a 10 inch high stool, step up, place both feet on the platform, straighten the legs and back, and immediately step down again, bringing down the same foot he/she first raised. This stepping up and down was continued at the rate of 20 steps per minute, following the rhythm of a metronome, for 3 minutes.[6,9] Immediately, after exercise the participant sat quietly on a chair and again the aforesaid parameters were measured. Data was then analyzed by using Student's t-test.

RESULTS

All the volunteers of our study were eutropic (BMI within 18-23 kg/m^2).[7] The study recorded significantly increased FVC, FEV_1, PEFR and $FEF_{25-75\%}$ immediately following the exercise. ($p<0.05$) The result has been presented in the table 1.

Table1: Comparison of pulmonary function parameters before and after exercise (n=35)

Parameters	Before exercise (Mean±SD)	After exercise (Mean±SD)	P value	Remarks
FVC (L)	3.17 ± 0.83	3.50 ± 0.81	$p < 0.05$	**Significant**
FEV1 (L)	2.78 ± 0.74	3.11± 0.73	$p < 0.05$	**Significant**
FEV_1/FVC (%)	86.84 ± 9.35	89.76 ± 7.9	$p > 0.05$	Insignificant
PEFR (L/S)	7.32 ± 1.81	8.55 ± 2.56	$p < 0.05$	**Significant**
$FEF_{25-75\%}$ (L/S)	4.45 ± 1.45	5.49 ± 1.41	$p < 0.05$	**Significant**

DISCUSSION

Previous study noted lower values of MVV, FVC, FEV_1 and ERV in obese adolescent males, compared to their eutropic counterparts before and after exercise.[10] In the present study all the volunteers were eutropic, none was obese [BMI within 18-23].

$FEF_{25-75\%}$ is an indicator of patency of smaller airways.[11] Earlier studies indicated reduced $FEF_{25-75\%}$ as an indication of airflow obstruction.[12] Present study recorded increase in $FEF_{25-75\%}$ value following exercise. Recent study of kegel exercise training among the young females [3 times/day for 4 weeks] also noted increased FVC, FEV_1, PEFR, IC and MVV along with marked improvement in $FEF_{25-75\%}$.[13] Chistopher et al. (2015) noticed better PFT results following an 8 weeks exercise training in obese Malaysian individuals.[14] Exercise in all the cases used to increase sympathetic activity. In our study also, we noted significantly increased value of FVC, FEV_1, PEFR and $FEF_{25-75\%}$ following exercise indicating effect of sympathetic stimulation on bronchial smooth muscles.

Increment of $FEF_{25-75\%}$ indicates the increased caliber of terminal bronchioles, made up of smooth muscles only, which was dilated by sympathetic stimulation through β_2 receptor, resulting better alveolar ventilation.[15,16] Furthermore, physical exercise caused hyperdynamic circulation that caused shear force to the endothelium of pulmonary vessels; NO was formed, diffused to vascular smooth muscle cells preventing the vasoconstriction.[15] [Usually, sympathetic stimulation causes constriction of vessels of viscera through alpha receptor stimulation.] Naturally, moderate isotonic exercise induced reduction of smaller airway resistance that facilitates alveolar ventilation is beneficial as it increases cardio-respiratory efficiency.

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