

Oxidative Stress and Lipid Profile in COPD Patients: Beneficial Role of Exercise and Scope for Improvement.

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Abstract

Smoking is a major risk factor in COPD [Chronic Obstructive Pulmonary Disease]. It contributes to inflammation and oxidative stress which are implicated in hyperlipidemia and lung function decline. Exercise may result in anti-inflammatory effects which limit smoking induced changes in COPD. The aim of the present study was to evaluate the oxidant anti-oxidant imbalance and lipid profile in exercising and non-exercising COPD groups and included 50 patients in each group. The results indicated that the lung functions were significantly reduced in those not doing exercise. The serum levels of antioxidant enzymes (SOD, Catalase and GPX) were significantly lower in non exercising group as compared to exercising group ($p < 0.001$) while the levels of MDA (Malondialdehyde) were significantly higher in the same group ($p < 0.001$). The levels of HDL ($p < 0.001$) were significantly higher and VLDL ($p = 0.03$) were significantly lower in exercising group as compared to non exercising group. The present study indicates that exercise has beneficial role in COPD and reduces Oxidant Anti Oxidant imbalance and improves lipid profile and it may be due to anti-inflammatory effects of exercise.

Keywords: COPD, exercising, non-exercising, smokers, Oxidant Anti-Oxidant, lung functions, lipid profile, inflammation.

Accepted November 03 2012

Introduction

WHO recognizes that chronic obstructive pulmonary disease (COPD), carries much importance in matters of public health [1]. Smoking is a major risk factor and smoking is known to have hyperlipidemic effects [2,3]. Oxidative stress is implicated in COPD which initiate inflammatory responses in the lungs [4]. COPD results in reduction in physical activity and poor quality of life. Exercise training increases aerobic power, increase lactate threshold, improves acid buffering and improves quality of life and provides a feeling of self belief and wellbeing in COPD patients. Exercise is included in pulmonary rehabilitation in COPD [5, 6]. Various researches worldwide have suggested that symptom limited interval training and strength training increases exercise capacity for COPD patients, moreover exercise in moderation is shown to improve lipid profile and antioxidant defenses in smokers [7] thus present study was undertaken to evaluate Oxidant Anti-Oxidant imbalance and lipid profile in those COPD patients following self-exercise regime.

Materials and Methods

The present study was undertaken in the Departments of Physiology, Biochemistry and TB and Respiratory Diseases and included 100 newly diagnosed patients of COPD selected from OPD of TB and Respiratory Diseases, JNMC, AMU, Aligarh. The study period was between January to April 2010. Institutional Ethical Committee clearance was obtained. Subjects were then divided into two groups of fifty each (those doing exercise and those who don't do any type of exercise) on the basis of history of at least thirty minutes exercise per day regularly for at least past three months. Subjects doing any type of exercise prescribed or recommended by a Physician were excluded i.e. exercising group included strictly those who were following their self regime of exercise like walking or jogging etc.

Inclusion and Exclusion Criteria: Only newly diagnosed cases of COPD (selected from among those attending TB and Respiratory Diseases OPD) having history of smoking and willingness to participate were included in the present study. Subjects suffering from Hypertension, Bronchial Asthma, Diabetes or any illness other than COPD in which Oxidant Anti Oxidant imbalance is im-

plicated in the cause were excluded. Those taking Anti - Oxidants and Anti-Hyperlipidemic medications were excluded from the study.

The lung functions were done using Mir Spirolab II spirometer and the patients with COPD were selected according to the guidelines of GOLD [8]. With prior consent and aseptic precautions 8 ml of venous blood was drawn from peripheral vein of the subjects after overnight fasting. Estimation of antioxidant enzymes namely Catalase (units/mgm of serum proteins) was done by the method of Aebi[9], Glutathione Peroxidase (nmol NADPH oxidized/min/mgm of serum proteins) by the method of Paglia and Valentine[10], Superoxide Dismutase (units/mgm of Serum Proteins) by method of McCord and Fridovich [11] respectively. MDA (nmol/ml) an indirect measure of free radical activity was estimated according to the method of Philpot[12]. Protein was estimated using Lowry method[13]. Lipid profile namely Total cholesterol (TC), Triglycerides (TG) and HDL (high density lipoprotein) were estimated using commercially available kits; LDL (low density lipoprotein) was estimated applying Friedwald formula[14]. VLDL (very low density lipoprotein) cholesterol was estimated by formula Triglycerides/5.

Statistical analysis: The data obtained was statistically analyzed using SPSS 17.0 (Statistical Package for Social Sciences). The comparison of lung functions, oxidant anti-oxidants and lipid profile parameters between exercising and non exercising COPD group was done using student's t test. P value of less than 0.05 was taken to be statistically significant.

Results and Observations: 100 male Subjects having COPD with history of smoking were selected and grouped into exercising and non-exercising groups. The mean age of former group was 39.78 ± 7.65 while that of latter group was 40.19 ± 9.50 years [Table 1]. The spirometric values namely FVC, FEV1, FEV1/FVC % and FEV1 % Predicted were significantly lower in non exercising group in comparison with those doing exercise ($P < 0.001$ for all) [Table 2]. The estimated values of GPX (glutathione peroxidase), SOD (superoxide dismutase) and Catalase were significantly lower ($p < 0.001$ for all) in non exercising group but the levels of MDA were higher ($p < 0.001$) in the same as compared to exercising group [Table 3]. The levels of HDL (< 0.001) were significantly higher and VLDL ($p = 0.03$) were significantly lower in exercising group as compared to non exercising group [Table 4].

Table 1. Anthropometry (* $p < 0.05$ is significant)

Parameters	Exercising COPD Group (n=50)	Non -Exercising COPD Group (n=50)	P value
Age (years)	39.78 ± 7.65	40.19 ± 9.50	NS
Height (cms)	174.10 ± 7.65	172.73 ± 6.52	NS
Weight (Kg)	57 ± 3.27	55.04 ± 8.32	NS

Table 2. Pulmonary Functions in COPD Patients (* $p < 0.05$ is significant)

Parameters	Exercising COPD Group	Non Exercising COPD Group	P value
FVC (Litres)	3.92 ± 0.76	3.05 ± 0.69	$< 0.001^*$
FEV1 (Litres)	2.67 ± 0.57	1.99 ± 0.46	$< 0.001^*$
FEV1/FVC (%)	68.80 ± 2.25	61.09 ± 3.78	$< 0.001^*$
FEV1 % Predicted	72.62 ± 5.64	66.29 ± 6.47	$< 0.001^*$

Table 3. Oxidant Anti-Oxidant Status in COPD Patients (* $p < 0.05$ is significant)

Parameters	Exercising COPD Group	Non Exercising COPD Group	P value
SOD (units/mgm of Serum Proteins)	9.51 ± 0.05	8.87 ± 0.06	$< 0.001^*$
Catalase (units/mgm of Serum Proteins)	9.86 ± 0.04	8.88 ± 0.07	$< 0.001^*$
GPX (nmol NADPH oxidized/min/mgm of Serum Proteins)	55.56 ± 0.42	52.78 ± 0.29	$< 0.001^*$
MDA (nmol/ml)	1.32 ± 0.04	1.98 ± 0.02	$< 0.001^*$

Table 4. Lipid Profile in COPD Patients(**p*<0.05 is significant)

Parameters	Exercising COPD Group	Non Exercising COPD Group	P value
TC(mgm/dl)	241.08± 79.76	255.73± 129.88	NS
TG(mgm/dl)	132.65± 39.67	150.78± 60.78	NS
LDL(mgm/dl)	159.49± 80.21	173.44± 126.22	NS
VLDL(mgm/dl)	24.6±4.87	26.94± 4.19	0.03*
HDL(mgm/dl)	51.50± 2.74	43.66± 2.08	<0.001*

Discussion

In the present study the levels of HDL and VLDL were improved in smoker COPD group doing exercise which can be attributed to beneficial effects of exercise on lipid status [7]. Improvement in lipid profile has been shown in unsupervised jogging and prolonged aerobic exercises [15, 16]. In our study smokers not doing any sort of exercise had deranged lipid profile which can be explained on the basis of effects of smoking on lipid profile [3].

In present study the levels of anti oxidant enzymes were reduced and MDA which is an indirect measure of free radical activity was increased in non exercising COPD group in comparison to exercising COPD group. Oxidative stress is implicated in pathogenesis of COPD and contribute to inflammatory processes and proteolytic activity[17] which is thus expected to be present in both study groups though inflammatory markers have not been evaluated in the present study. In recent years the role of inflammatory cytokines has been demonstrated in oxidative stress [18]. The possible explanation for lower oxidant anti-oxidant imbalance in exercising COPD group in our study can be due to recent findings which suggest that exercise have potent anti inflammatory effect and enhance antioxidant defenses[19,20,21].Inflammatory cytokines like IL 6 decrease the activity of lipoprotein lipase which in turn elevates triglyceride levels[22].The study done by Panagiotakos etal [23] demonstrated lower levels of inflammatory markers in physically active persons compared to those following sedentary lifestyles. In our study improved lipid profile in exercising COPD group can be attributed to anti-inflammatory effects of exercise [24].

All the subjects included in our study belonged to moderate COPD group as per GOLD classification [8]. Lung functions were reduced in both groups though statistically reduction was less in those who were following self regime of exercise and thus were more physically active in comparison to other group and are expected to have lesser pro inflammatory cytokines (though we have not measured them) thus limiting inflammation and lung function decline. Inflammation is known to effect lung functions in COPD [25, 26] and physical inactivity is linked to

COPD[27]. Exercise has anti-inflammatory effects and also provides symptomatic improvement [28]. Thus possible explanations for our findings could be low levels of inflammation and lesser physical inactivity.

In conclusion on the basis of study the Oxidant Anti-Oxidant imbalance, lipid profile derangement and lung function decline is less in exercising COPD group as compared to those who were not exercising.

Limitation of the present study is that the subjects included were newly diagnosed cases not following any recommended or supervised exercises but were doing self-exercise regime. Thus a follow up study before and after enrolling subjects to pulmonary rehabilitation is required along with evaluation of pro and anti inflammatory cytokines.

Acknowledgement: Authors are thankful to participants of the study and also to the supporting staff.

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