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COMPARISON OF LIPID PEROXIDATION AND ANTIOXIDANT STATUS IN SMOKERS AND NONSMOKERS

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ABSTRACT

Introduction: Cigarette smoking is the single biggest avoidable cause of death and disability in developed countries. Smoking affects numerous organ systems resulting in various tobacco related diseases. Cigarette smoke increases the level of oxidative stress not only by the free radical induced lipid peroxidation but also by weakening the antioxidant defence mechanisms.

Objectives: The present study was undertaken to compare lipid peroxidation and antioxidant status in smokers and nonsmokers.

Materials and Methods: The study was conducted on 80 male subjects with age varying from 20 to 40 years. They were divided into 2 groups, Group I included 40 smokers and Group II included 40 nonsmokers. The biochemical parameters of lipid peroxidation such as Malondialdehyde (MDA) and Antioxidant status such as vitamin C & E were estimated and data was statistically analysed using paired and unpaired student's t-test.

Results: The mean plasma MDA levels were significantly higher, whereas the mean plasma Vitamin C & E levels were non-significantly lower among the study group as compared to control group.

Conclusion: It can be concluded from our study that cigarette smoking leads to significant increase in lipid peroxidation due to excessive ROS production whereas the antioxidant status was non significantly lower due to younger age group having higher endogenous antioxidant storage.

Key words: Cigarette smoking, Lipid peroxidation, Antioxidant status.

INTRODUCTION

Cigarette smoke is a complex mixture of over 4700 chemical compounds including high concentrations of oxidants and free radicals present in both the gas and tar phases of cigarette smoke.[1] Lipid peroxidation involves oxidative destruction of lipids localized mainly in cell membranes.[2] Malondialdehyde (MDA) is one of the end product of lipid peroxidation and acts as an index of lipid peroxidation.[3]

Vitamin C is a hydrophilic vitamin with well known antioxidant properties. [4] Vitamin E is widely recognized as a major lipid soluble chain breaking antioxidant in biological membranes.[2] Cigarette smoke increases the level of oxidative stress not only by the free radical induced lipid peroxidation but also by weakening the antioxidant defence mechanisms.

Hence, the present study was planned to evaluate the effects of cigarette smoking on the Malondialdehyde (MDA) which acts as a marker of lipid peroxidation and antioxidant status such as Vitamin C and E, and to compare them with nonsmokers.

OBJECTIVES

The present study was undertaken to study the effects of cigarette smoking on various biochemical parameters such as Malondialdehyde (MDA) as an index of lipid peroxidation and vitamin C and E as an index of antioxidant status in smokers and compared them with nonsmokers.

MATERIAL AND METHODS

The present study was carried out on 80 male subjects with age varying from 20 to 40 years.

Group I consisted of 40 male smokers consuming 1 pack (consisting of 10 cigarettes)/day for at least 5 years. They served as study group.

Group II consisted of 40 male nonsmokers. They served as control group.

Inclusion Criteria:-

1. Smokers who had H/O consuming 10 or more than 10 cigarettes per day for at least 5 years.
2. Nonsmokers who were not exposed to Passive smoking were included in the study.

Exclusion Criteria:-

1. Subjects who were known cases of diabetes

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mellitus, hypertension and endocrinal disorders.

2. Subjects who were on dietary supplements and antioxidants for the last four months.

Written informed consent was taken from all the subjects. They were instructed to avoid a diet rich in antioxidants during the study period.

Blood samples were collected from each subject for the analysis of biochemical parameters of lipid peroxidation such as malondialdehyde (MDA) and antioxidant status such as Vitamin C & E levels in plasma. 7 ml of blood was collected from antecubital vein and plasma was separated by centrifugation at 3000 rpm for 10 minutes and then transferred to a sterilized test tube. Estimation of MDA was done by thiobarbituric assay (TBA) method using Elico Spectrophotometer. Estimation of Vitamin C was done by titration of ascorbic acid with dye (2,6 dichlorophenolindophenol) in acidic solution. Plasma tocopherol estimation was based on the reduction of ferric to ferrous ions by tocopherols which then form a red complex with α,α -dipyridyl.

Statistical Analysis

Mean and standard deviation (SD) was computed. All the results were analysed using paired and unpaired student's t-test. P 0.05 was considered as statistically significant.

RESULTS

The Table 1 and 2 showed that with increase in duration of smoking there was a significant increase in levels of plasma MDA (P = 0.0005) and significant decrease in vitamin C (P = 0.006) and vitamin E (P = 0.04) levels among the study group.

Table 3 and Figure 1 showed that plasma MDA levels were significantly higher (P = 0.0005) among the study group as compared to controls, whereas the plasma vitamin C and E levels were non-significantly lower among the study group as compared to the control group.

Table 1: Relation of duration of smoking (5-10 years) with mean plasma MDA, Vitamin C and Vitamin E levels.

Parameters	Mean±SD	P value
Plasma MDA (µmol/L)	6.59±1.17	0.000524
Plasma Vitamin C (mg/L)	0.45±0.10	0.006736
Plasma Vitamin E (mg/L)	11.97±3.44	0.040496

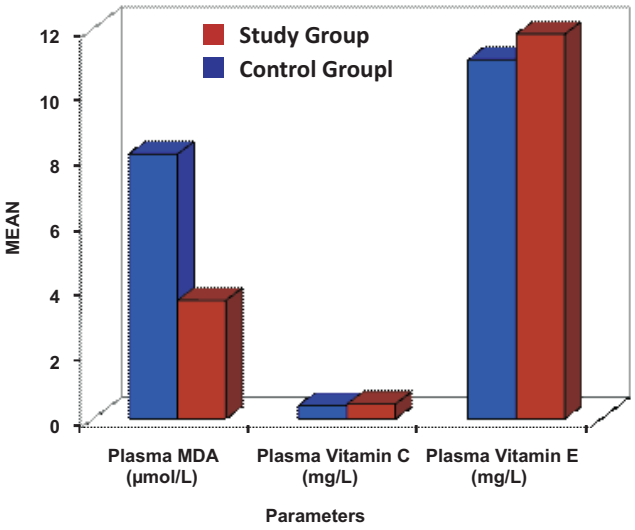
Table 2: Relation of duration of smoking (>10 years) with mean plasma MDA, Vitamin C and Vitamin E levels.

Parameters	Mean±SD	P value
Plasma MDA (µmol/L)	10.05±1.51	0.000524
Plasma Vitamin C (mg/L)	0.36±0.10	0.006736
Plasma Vitamin E (mg/L)	9.92±4.12	0.040496

Table 3: Comparison of mean Plasma MDA, Vitamin C and E levels in study and control groups (mean±SD)

Parameters	Group I (N=40)	Group II (N=40)	P-Value
Plasma MDA (µmol/L)	8.15± 2.18	3.65± 1.39	0.000545
Plasma Vitamin C (mg/L)	0.41± 0.11	0.46± 0.15	0.097059
Plasma Vitamin E (mg/L)	11.05± 3.87	11.84± 3.61	0.175532

Figure 1: Comparison of Plasma MDA, Vitamin C and E levels in various groups (mean±SD)



DISCUSSION

In our study, only adult smokers and nonsmokers in the age group of 20-40 years were selected to minimize the effect of aging on plasma vitamin C, E and MDA levels, as the antioxidant enzymes are used up in combating the increased stress when various metabolites of reactive oxygen species accumulate in the body with increasing age.

There was a significant increase in mean plasma MDA levels (p=0.006) with increase in number of cigarettes smoked per day. This is attributed to increased endogenous production of ROS due to dysfunction of

mitochondrial respiratory chain.[5] The mean plasma vitamin C (p=0.088) and vitamin E (p=0.089) levels were non-significantly decreased when the number of cigarettes smoked per day were increased above 20 cigarettes per day.[6] This non-significant decrease could also be due to lesser number of cases studied who were consuming 20 cigarettes per day. Zhou et al reported that with greater daily smoking quantity, the plasma and the erythrocyte values of lipid peroxides were elevated and even after cessation of smoking for one year, the above values were not significantly different from those in the matched nonsmoker group.[7]

The significant increase in MDA level (p=0.005) while significant decrease in vitamin C (p=0.006) and vitamin E (p=0.04) levels were found with increase in duration of smoking. The decrease in plasma vitamin E levels and elevated plasma and erythrocyte lipoprotein levels were also observed along with longer duration of smoking by Zhou et al.[7] Diken et al in his study concluded that cigarette smoking, especially long-term smoking may lead to significant changes in the enzymatic and non-enzymatic antioxidant defense systems of elderly smokers. As a result of the changed antioxidant status in long-term smokers, peroxidation reactions may be accelerated and some deleterious changes may occur in the body of smokers.[8]

On comparing various parameters among the study and control groups, it was observed that there was a significant increase in MDA (p=0.0005) level is study group as compared to control group. Kalra et al studied the oxygen free radical production activity of polymorphonuclear (PMN) leucocytes in blood and the MDA content of blood and serum in smokers and nonsmokers. They found an increase in MDA levels in smokers which was attributed to increased production of oxygen-derived free radicals.[9] There was non-significant decrease in plasma vitamin C (p=0.097) and E (p=0.175) levels in smokers when compared to nonsmokers. Smoking results in a reduced supply of circulating antioxidants in the body, which may be due to the creation of an extra demand for antioxidants through oxidative stress. The diets of smokers usually contain lower amounts of antioxidants rich foods.[10] The results are similar to the findings of some other studies on healthy young adults that found little or no differences in oxidant damage markers between nonsmokers and smokers.[11]

Thus, it is evident from our study that the smoking results in a significant increase in lipid peroxidation as evidenced by increased MDA and decrease in antioxidant status which may be the biochemical basis for increased pathogenecity associated with smoking. However, further investigations involving a large number of participants and analysis of other factors are required to confirm the extent of the free radical load generated by smoking and its effect on the antioxidant status.

CONCLUSION

It can be concluded from our study that cigarette smoking leads to significant increase in lipid peroxidation as evident by MDA due to excessive ROS production and free radical injury whereas the antioxidant status was non-significantly decreased which may be due to younger age group having higher endogenous antioxidant storage.

REFERENCES

1. Rahman I, MacNee W. Oxidant/antioxidant imbalance in smokers and chronic obstructive pulmonary disease. Thorax 1996; 51 (4): 348-50.
2. Goraca A, Skibska B. Plasma antioxidant status in healthy smoking and non- smoking men. Bratisl Lek Listy 2005; 106 (10): 301-6.
3. Haberland M, Fong D, Cheng L. Malondialdehyde-altered protein occurs in atheromas of Watanable heritable hyperlipidemic rabbits. Science 1988; 241: 215-8.
4. Naida KA. Vitamin C in Human Health and disease is still a mystery? Nutr J 2003; 2:7.
5. Miro O, Alonso JR, Jarreta D, Casademont J, Urbano-Marquez A, cardellach F. Smoking disturbs mitochondrial respiratory chain function and enhances lipid peroxidation on human circulating lymphocytes. Carcinogenesis 1999; 20 (7): 1331-6.
6. Bloomer RJ. Decreased blood antioxidant capacity and increased lipid peroxidation in young cigarette smokers compared to nonsmokers: Impact of dietary intake. J Nutr 2007; 6: 39.
7. Zhou JF, Yan XF, Guo FZ, Sun NY, Qian ZJ, Ding DY. Effect of cigarette smoking and smoking cessation on plasma constituents and enzyme activities related to oxidative stress. Biomed Environ Sci 2000; 13(1): 44-55.
8. Diken H, Kelle M, Tumer C, Deniz B, Baylan Y, Sermet A. Effects of cigarette smoking on blood antioxidant status in short-term and long-term smokers. Turk J Med Sci 2001; 31: 553-7.
9. Kalra J, Chaudhary AK, Prasad K. Increased production of oxygen free radicals in cigarette smokers. Int J Exp Pathol 1991; 72(1): 1-7.
10. Sardesai SP, Shinde NS, Patil SB, Rayate MN, Muley B. Tobacco handling by pregnant bidi workers: As hazardous as smoking during pregnancy. Indian J Obstet Gynecol 2007; 57(4): 335-8.
11. Jacob RA, Aiello GM, Stephensen CB, Blumberg JB, Milbury PE, Wallock LM et al. Moderate antioxidant supplementation has no effect on biomarkers of oxidant damage in healthy men with low fruit and vegetable intakes. J Nutr 2003; 133:740-3.