Biosciences, Biotechnology Research Asia Vol. **4**(1), 221-223 (2007)

Serum antioxidant enzyme levels and lipid peroxidation rate in type-II diabetes

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(Received: February 16, 2007; Accepted: April 05, 2007)

ABSTRACT

Oxidative stress induced by reactive oxygen species (ROS), which are generated due to hyperglycemia may involve in the development of complications in Diabetes. So the aim of this study is evaluate the levels of serum antioxidant enzymes and lipid peroxidation rate in Type-II Diabetes. In this study we observed significantly higher lipid peroxidation ($p < 0.001$) in comparison to normal control and at the same time significantly lower activity of serum antioxidant enzymes were observed in diabetic group ($p<0.001$) when compared to control group.

Key words: Free radicals, oxidative stress, antioxidant enzymes, type-II Diabetes.

INTRODUCTION

Diabetes is a major worldwide health problem predisposing to markedly increased cardiovascular mortality and serious morbidity[1]. Due to increasing obesity and altered dietary habits in both western and developing countries, the prevalence of type-II diabetes is growing at an exponential rate[2]. In 2004 according to World Health Organization (WHO) more than 150 million people worldwide suffer from diabetes. The WHO has predicted that the major burden will occur in the developing countries. The countries with the largest number of diabetic people will be India, china and USA by the year 2025.

Oxidative stress induced by reactive oxygen species (ROS), which are generated due to hyperglycemia, is one of the major foci of recent research related to diabetes[3]. Many complications of diabetes mellitus are associated with increased activity of free radical induced lipid peroxidation and accumulation of lipid peroxidation products[4, 5]. Lipid peroxidation is a free radical related process, which is potentially harmful because its uncontrolled, self-enhancing process causes disruption of membranes, lipids and other cell components.

Abnormally high levels of lipid peroxidation and the simultaneous decline in the activity of blood antioxidant enzyme like Superoxide dismutase (SOD), Glutathione peroxidase (GSH-Px), Glutathione Reductase (GR) and Glutathione (GSH) can leads to damage of cellular organelles and oxidative stress. Though many reports were available with regard to oxidative stress and antioxidant status of type II diabetes[6, 7] very few studies were carried out in India in type II diabetic patients on the levels of lipid peroxidation rate and serum antioxidant enzyme activity. In the present study, the relationship between the levels of serum antioxidant enzymes like SOD, GSH-Px, GR, GSH

and serum lipid peroxidation product Malondialdehyde (MDA) an oxidant in type-II diabetic patients were investigated against healthy non diabetic volunteers as controls.

MATERIALS AND METHODS

Fifty healthy subjects of age group between 35 to 55 years irrespective of sex who were non-smokers with no history of any chronic systemic illness were selected and treated as normal control group. 40 type II diabetic patients of age group between 35 to 55 years irrespective of sex who were non-smokers with no history of diabetic complication like neuropathy, retinopathy, nephropathy and vascular symptom were selected from out patient department (OPD) medicine. In both control and diabetic group the oxidative stress biomarkers namely SOD, GSH–Px, GR, and reduced GSH were estimated[8-11]. Lipid peroxidation rate was determined by estimating thiobarbituric acid reactive substances (TBARS) (12) to study the prevalence of oxidative stress in type-II diabetes. All the results were expressed as Mean $\pm$SD. Student t test was used to assess statistical significance of the results between control and diabetic group. And the p values<0.001 were considered as highly significant, p value < 0.01 as significant and p value <0.1 as insignificant.

RESULTS AND DISCUSSION

The levels of oxidative stress biomarkers namely Superoxide dismutase (SOD), Glutathione peroxidase (GSH-Px), Glutathione reductase (GR), reduced Glutathione (GSH) Lipid peroxidation rate (by estimating malondialdehyde MDA) in diabetic group were compared with normal age matched control group (Table-1).

Significantly higher levels of lipid peroxidation rate ($p < 0.001$), and very low levels of serum enzymes involved in antioxidant activities in diabetes were observed when compared with control ($p < 0.001$).

Table - 1: showing the levels of serum enzymes involved in antioxidant activities, lipid peroxidation rate in type-II diabetes in comparison with normal control group.

Parameters	Group-1Normal control	Group-2Diabetic patients
Malondialdehyde (MDA) nmol/h	1.037 ± 0.213	2.365*** ± 0.403
Super oxide dismutase (SOD) U/g. Hb	1095.59 ± 140.71	417.79*** ± 56.91
Glutathione peroxidase (GSH-Px) U/g. Hb	82.04 ± 3.85	26.06*** ± 9.54
Glutathione reductase (GR) U/L	63.052 ± 4.37	25.12*** ± 4.41
Reduced Glutathione (GSH) µmol/L	211.04 ± 15.27	93.49*** ± 14.63

*** $p < 0.001$

Increasing evidence in both experimental and clinical studies suggests that oxidative stress plays a major role in the pathogenesis of diabetes. Free radicals are formed disproportionately in diabetes by glucose degradation, non-enzymatic glycation of proteins, and the subsequent oxidative degradation, which may play an important role in the development of complications in diabetic patients. The generation of free radicals may leads to lipid peroxidation and formation of severe damage in diabetes. In the present study we observed increased levels of serum MDA irrespective of sex in diabetic group (table-1), which clearly indicates the exposure of increased oxidative stress in diabetes. In this study lower levels of serum antioxidant enzymes like SOD, GSH-Px and GR which plays an important role in scavenging free radicals were observed in diabetic group when

compared with age matched normal control, which straightaway indicates the increased oxidative stress in diabetes, causing the imbalance between oxidants and antioxidants, which is normally maintained in healthy conditions, a key factor for diabetic complications. Other researchers were observed the same changes[13, 14]. In this study we observed lower levels of reduced Glutathione, the most important antioxidant metabolite that plays an important role in maintaining good levels of Glutathione peroxidase activity which is the main enzyme involved in removing the H_2O_2 generated from dismutation of Superoxide anions by Super Oxide Dismutase. GSH is also the co-factor of several reducing enzymes such as dehydroascorbate reductase and endoperoxide isomerase[15]. The results suggests that the increase in lipid peroxidation and decline in antioxidant enzyme activity may appear early in type-II diabetes, before the development of secondary complications.

REFERENCES

1. Zimmet, P.Z., Mccarty, D.J., and De Couten, M.P. The global Epidemiology of non insulin dependent diabetes mellitus and the metabolic syndrome. *Journal of diabetes and its complications.* **11:** 60-68 (1997).
2. Zimmet, P.Z., and Lefebvre, P. The global NIDDM epidemic. Diabetology. **39:** 1247-1248 (1996).
3. J.R.Pfaffly. Review on Diabetic complications. *Free radicals in biology and medicine*, 77: 222 (2001).
4. Baynes JW. Role of oxidative stress in development of complications in diabetes. *Diabetes.* **40:** 405-411 (1991).
5. Palanduz S, Ademoglu E, Gokkusu C, et al. Plasma antioxidants and type-II diabetes mellitus. *Res. Commun. Mol. Pathol. Pharmacol.* **109:** 309-18 (2001).
6. Giugliano D, Ceriello A, Paolisso G. Diabetes mellitus, Hypertension and Cardiovascular diseases: which role of oxidative stress? *Metabolism* **44:** 363-368 (1995).
7. Dhalla NS, Temsah RM, Netticadan T. role of oxidative stress in cardiovascular diseases. *J Hypertens,* **18:** 655-73. (2000).
8. McCord J.M. and Fridovich I. Super oxide dismutase: *Journal of Biological Chemistry.* **244:** 6049-6055 (1969).
9. Pagila D.M and Valentine W.N. Studies on the quantitative and characterization of erythrocyte Glutathione peroxidase. *Journal of Laboratory and Clinical Medicine.* **20:** 150-168 (1986).
10. Goldberg D.M and Spooner R.J. Methods of enzymatic analysis. Bergmeyer H.V. 3rd edn.Volume 3 p258-265 (1983).
11. Butler E., Duron O. and Kelly B.M. Improved methods for determination of blood Glutathione. *Journal of Laboratory and Clinical Medicine*. **61:** 882- 890 (1963).
12. Satoh K. Serum lipid peroxide in cerebrovascular disorders determined by a new colorimetric method. *Clinical Chemistry Acta.* **90:** 37- 43 (1978).
13. Subhash C Bose K and Agrawal B.K. effect of lycopene from cooked tomatoes on serum antioxidant enzymes, lipid peroxidation rate, lipid profile and Glycated hemoglobin in type II diabetes. *The Ind. J. Nutr. Dietet.,* **43** (4): 153-60 (2006).
14. Sundaram RK, Bhaskar A, Vijayalingam S, et al. Antioxidant status and lipid peroxidation in type-II diabetes mellitus with and with out complications. *Clin. Sci* (lond) **90:** 255-60 (1996).
15. Lenzi A., Picardo M., Gandini L., Lombardo F., Terminali O. Glutathione treatment of dyspermia: effect on lipoperoxidation process. *Human Reproduction.* **9**(11): 2044-2050 (1994).