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Original Research Article

A Study on Antioxidants status in Type 2 Diabetes Mellitus Patients

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Abstract

Background: Diabetes mellitus is an endocrinal disorder. Over production of reactive oxygen and nitrogen species thought to be involved in the initiation and development of vascular complications in diabetes. Increased levels of MDA, Vitamin E and Ceruloplasmin are the markers for oxidative stress in type 2 diabetes mellitus. The aim of the present study is to study the Antioxidant status in Type 2 Diabetes patients.
Materials & Methods: This, case control study was conducted on 40 subjects. Among them 20 were controls, 20 were known Type 2 Diabetes patients. Patients with T2DM with other endocrinal disorders, patients on antioxidants, minerals and multivitamins as supplement form are excluded from the study. A laboratory investigations consisting of glucose, total cholesterol, triglycerides, HDLC, LDLC Vitamin E, MDA and Ceruloplasmin were carried out on fasting blood sample of subjects selected for this study.
Results: In the present study, FBS, PPBS, MDA, Ceruloplasmin, total cholesterol and LDLC were significantly increased in T2DM cases and HDLC, Vitamin E was significantly decreased in cases when compared to controls. (p value <0.05).
Conclusion: The findings of this study is in accordance to earlier studies, that there is an increased oxidative stress in diabetics compared to controls; and the oxidative stress further increases as diabetes to cardiovascular diseases. This study emphasizes the importance of assessing the antioxidant status in diabetes in addition to the markers of oxidative stress and lipid profile to formulate the specific therapies for early therapeutic intervention and better treatment of diabetes mellitus.
Keywords: Type 2 diabetes mellitus, MDA, Vitamin E, Lipid Profile

1. Introduction

India leads the world with largest number of individuals with diabetes mellitus earning the dubious distinction of being termed the "diabetes capital of the world". It has been estimated that the global burden of type 2 diabetes mellitus (T2DM) will increase to 438 million in 2030. Similarly, for India this increase is estimated to be 58%, from 51 million people in 2010 to 87 million in 2030 [1,2].

Diabetes mellitus is an endocrinal disorder; it involves progressive development of insulin resistance and a relative deficiency in insulin secretion due to β-celldysfunction, causing hyperglycemia. It is a complex disorder which has an aberrant metabolism of fats, carbohydrates and proteins. This results in rise in blood sugar, glycosuria, keto-acidosis and ketonuria [3]. In view of wide prevalence of diabetes irrespective of the sex or race in populations and the significant morbidity and mortality associated with the disease.

Long standing metabolic derangement is frequently associated with permanent and irreversible functional and structural changes in the cells of the body, mainly the vascular system leading to well defined clinical entities affecting eye, kidney and the nervous system. The commonest cause is atherosclerotic or cholesterol plaques that is accelerated in type 2 diabetes [4, 5]. This results in loss of endothelial integrity one of the Virchow's triad and enhances vascular blocks and the resulting sequel. There is hypothesis that genetic factors or the environmental factors or both make an individual susceptible to type 2 diabetes and atherosclerosis [6].

There are various experimental studies suggesting the over production of reactive oxygen and nitrogen species to be involved in the initiation and development of vascular complications in diabetes [7]. Free radicals are very reactive chemical species, can cause oxidative injury by attacking the macromolecules like lipids, carbohydrates, proteins and nucleic acids. Under normal circumstances there is a critical

balance in generation of oxygen free radicals and antioxidant defense mechanism to protect them from free radical toxicity [8]. Breech in this balance leads to oxidative stress. Oxidative stress is known to be a component of molecular and cellular tissue mechanism in a wide spectrum of human disease [9, 10]. The aim of the present study is to study the Antioxidant status in Type 2 Diabetes patients.

2. Materials & Methods

This study is a cross sectional case-control study, conducted in the Department of Biochemistry in association with Department of Medicine in Sri Venkata Sai Medical College, Yenugonda, Mahabubnagar, Telangana. The study was conducted on 40 subjects. Among them 20 were controls, 20 were known Type 2 Diabetes patients. Patients with Type 2 DM with other endocrinal disorders, patients on antioxidants, minerals and multivitamins as supplement form are excluded from the study. A fasting (12 hours) venous blood sample (5ml) was drawn from the patients and controls into a sterile disposable syringe which was transferred into centrifuge tubes and was allowed to clot for 30 minutes. The sample was centrifuged at 3000 rpm for 10 minutes and the separated serum was used for the estimation of glucose (GOD-POD method), total cholesterol (CHOD-PAP method), triglycerides (TGL) (GOP-PAP method), high density lipoprotein (HDLC) (CHOD-PAP method), low density lipoprotein (LDLC) (Enzymatic Colorimetric Assay), vitamin E (Baker's and Frank's method), Malondialdehyde (MDA) (Thiobarbituric acid) and Ceruloplasmin (copper oxide activity method). Well designed proforma was prepared and patient's history was taken.

2.1 Statistical Analysis

Data were expressed as mean ±SD. *P* value <0.05 is considered as statistically significant. Statistical analysis was performed using Graph pad calculator software.

3. Results

In the present study, total of 40 subjects were included. 20 were known type 2 diabetes mellitus patients, among them 10 were males (50%) and 10 were females (50%) age ranging between 35 to 70 years. 20 age & sex matched healthy subjects were taken as controls. In this study, antioxidant parameters MDA, Ceruloplasmin were significantly increased in T2DM cases. The mean value of total cholesterol was significantly increased in cases. Vitamin E and HDL cholesterol was significantly decreased and LDL cholesterol was significantly increased in cases, as illustrated in table 1.

Table 1: Comparison of various biochemical parameters between T2DM patients & healthy controls

Parameters	Controls (n=20) Mean ± SD	Cases(n= 20) Mean ± SD	P-value
FBS (mg/dl)	88.6±6.51	220.60±92.69	0.0001*
PPBS (mg/dl)	126.75±11.19	284.70±104.06	0.0001*
Total Cholesterol (mg/dl)	164.5±6.84	207.25±60.96	0.0035
Triglycerides (mg/dl)	134.80±12.22	153.20±74.24	0.2936
HDLC (mg/dl)	46.75±4.2	36.05±8.65	0.0001*
LDLC (mg/dl)	90.80±8.08	136.45±43.03	0.0001*
VLDLC (mg/dl)	26.95±2.50	40.60±21.32	0.0071
MDA (nmol/L)	250.40±16.68	438.85±86.74	0.0001*
Vitamin E (mg/dl)	1.400±0.241	0.595±0.393	0.0001*
Ceruloplasmin (mg/dl)	31.05±4.33	37.35±7.86	0.0033

* Statistically significant

4. Discussion

Diabetes mellitus is a complex and multifactorial disease, indulging severe insulin dysfunction in conjugation with gross abnormalities in glucose homeostasis, lipid and protein metabolism. It contributes for macrovascular and microvascular complications in diabetes [11]. Prolonged exposure to hyperglycemia leads to increased oxidative stress. Oxidative stress plays an important role in chronic complications of diabetes and is postulated to be associated with increased lipid peroxidation. Insulin secretion is also closely associated with lipoxygenase derived protein [12]. Low levels of lipooxygenase peroxides stimulate the secretion of insulin but when concentration of endogenous peroxides increases, it may initiate uncontrolled lipid peroxidation leading to cellular infiltration and islet cell damage. Antioxidants constitute foremost defence system that limit the toxicity associated with free radicals. Levels of defence mechanisms are altered in diabetes and therefore, the ineffective scavenging system of the free radicals play an important role in determining the tissue injury [13].

In the present study, MDA levels are significantly increased in cases when compared to controls. Our results are in accordance with previous studies [14-17]. Increased oxidative stress and free radical generation may be the cause of increase in MDA level which is the marker for lipid peroxidation.

In the present study, ceruloplasmin levels are significantly increased in T2DM cases when compared to

controls. The liver is a major source of ceruloplasmin in adults. Proinflammatory agonist of acute phase reaction such as certain cytokines, TNF- α are known to express the gene expression of ceruloplasmin in hepatocytes. As ceruloplasmin is a free radical scavenger as well as a late acute phage reactant protein it might have been increased in T2DM due to inflammation as well as oxidative stress.

In the present study, vitamin E levels were significantly decreased in T2DM cases when compared to controls. In diabetes mellitus, oxidants play a major role for the development of inflammation and oxidative stress. Vitamin E levels are increased in the serum for scavenging these oxidants. As a physiologically important compensatory mechanism, antioxidant and membrane stabilizer vitamin E interrupts the chain reaction of lipid peroxidation by interacting with lipid peroxy radicals and protects the cell against damage from oxidants and in turn as vitamin E utilized to the larger extent which might be the cause of its decrease in these cases [18].

5. Conclusion

The findings of this study is in accordance to earlier studies, that there is an increased oxidative stress in diabetics compared to non diabetics; and the oxidative stress further increases as diabetes to cardiovascular diseases. This study emphasizes the importance of assessing the antioxidant status in diabetes in addition to the markers of oxidative stress and lipid profile to formulate the specific therapies for early therapeutic intervention and better treatment of diabetes mellitus. Future large prospective studies are recommended. Limitation of the study is small sample size.

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