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Original Research Article

Assessment of Oxidative Stress Levels in Newly Diagnosed Type II Diabetes Mellitus

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Abstract

Diabetes mellitus is a chronic metabolic disorder that is characterized by high levels of blood glucose resulting from either the inadequate production of insulin or a diminished ability of the body's cells to respond to insulin. India, in particular, has a high burden of diabetes, with over 60 million people affected by the condition out of a population of 1.3 billion. The role of accelerated oxidative stress in the development and progression of diabetes and its complications is widely acknowledged and supported by scientific research. The objective of the current study is to evaluate the levels of oxidative stress markers in individuals diagnosed with Type 2 diabetes.

Materials and Methods: The aim of this study was to evaluate the oxidative stress parameters in individuals newly diagnosed with Type 2 diabetes mellitus. Levels of TAOS and malondialdehyde had been measured in 147 normotensive subjects (Group – 1) and 147 Type -2 diabetes mellitus patients (group - 2). Commercially available kits used for the estimation of oxidative stress markers in both groups.

Results: The results of our study indicate that patients with Type 2 diabetes mellitus exhibit increased oxidative stress, as evidenced by elevated levels of plasma malondialdehyde and decreased levels of total antioxidant status.. The fasting blood sugar levels are also substantially excessive in newly identified Type -2 diabetics in comparison to the control group.

Conclusion: from this study, it's far concluded that patients with type -2 diabetes mellitus having extended stages of malondialdehyde (MDA) are at higher risk of developing CAD. So any disturbances in balance between the levels of oxidants and anti-oxidants as seen in people with diabetics are the primary reason behind developing CAD.

Keywords: DM-II, Oxidative stress, MDA, and Total antioxidant status.

Introduction

Diabetes mellitus (DM) is a metabolic condition marked by chronic hyperglycemia and disruptions in carbohydrate, protein, and fat metabolism.

These disruptions are caused by an absolute or relative deficiency of insulin secretion or action, or both. Type 2 diabetes mellitus (Type-2 DM) is growing as a pandemic by affecting nearly one hundred seventy million humans worldwide that would double to 370 million by way of every other 30 years.[1] Weight problems, sedentary lifestyle, decreased physical activity, and unhealthy eating habits are the major risk factors for Type 2 DM(2). Target organ complications, secondary to diabetes, are one of the maximum essential clinical issues of the present time. Oxidative stress concept raised in a system where the free radical production is accelerated or the anti-oxidant mechanisms are impaired [3]. An increase in oxidative stress is widely recognized as a significant contributor to the development and advancement of diabetes and its associated complications[4There is a significant association between macrovascular and microvascular disorders in diabetes mellitus [5]. Hyperglycemia has a crucial impact on vascular endothelial cells, but the mechanisms underlying this damage are not yet fully understood. One early indicator of such damage is the onset of endothelial dysfunction[6]. Glucose toxicity mediated through IL-1β is known to cause apoptosis and reduce β cell mass in Type 2 diabetes mellitus. Multiple studies have highlighted the presence and significance of inflammatory factors in the pathogenesis of diabetes mellitus. Adipose tissue plays a significant role in this regard, releasing several pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α), interleukin-1 (IL-1), interleukin-6 (IL-6), c-reactive protein (hs-CRP), intercellular adhesion molecule-1 (ICAM-1), and vascular cellular adhesion molecule-1 (VCAM-1)(7). Hyperglycemia generates reactive oxygen species (ROS), which, in various ways, causes harm to the cells. These harmful changes in cells are responsible for further consequences leads to secondary complication in diabetes mellitus (8). Elevated oxidative stress is widely recognized as a contributing factor to the development and progression of diabetes, as well as its long-term complications.(9) There is a well-established connection between the onset of macrovascular and microvascular disease in diabetes mellitus. (10).

This study was to assess the levels of TAOS (mM) & MDA (mM) in newly diagnosed type-2 diabetes mellitus.

Materials and Methods

The cross-sectional study was conducted at Varunarjun Medical College and Hospital, Shahjhanpur, This study includes one hundred forty-seven (n=147) newly diagnosed Type 2 diabetes mellitus patients in no way handled previously for type-2 diabetes mellitus. All patients included in this study between the age of 45 to 65 years. In the control group, one hundred forty-seven (n=147) normotensive, healthy volunteers selected. Consent received from all of the subjects after a brief explanation about the study. Those who have known cerebrovascular or coronary artery disorder, congestive heart failure, hypertension, kidney or liver ailment, and any active bacterial or viral contamination excluded from this study, and also smokers, alcoholics, and any medication recognized to affect oxidative stress were additionally excluded.

Statistical Analysis

The mean and standard deviation will be used to express the biochemical parameters. Statistical significance will be evaluated using the Student t-test, with a p-value of > 0.001 and 0.05 considered as statistically significant.

Results

As shown in table 1, there is no significant difference among age ($p<0.514$) and height ($p<0.930$) of the study participants. A significant difference in weight ($p<0.000$) and BMI ($p<0.000$) observed. Fasting blood glucose levels are

significantly higher in newly diagnosed Type-2 diabetics in comparison to the control group (p<0.000).

Table 1: General characteristics of the study population

S.No.	Parameter	Controls(n=147) Mean ±SD	Newly diagnosed type 2 Diabetes mellitus (n=147) Mean ±SD	P -value
1	Age(yrs)	46.03 ± 4.32	46.33 ± 4.32	0.514
2	Height (cm)	170.81 ± 6.4	170.86 ± 6.30	0.930
3	Weight(kg)	67.19 ± 5.67	75.87 ± 5.45	0.000
4	BMI (kg/m^2)	23.10 ± 2.31	26.15 ± 1.63	0.000
5	Gender (M/F)	105/42	108/39	0.000
6	FBG (gm/dl)	93.42 ± 6.04	134.70 ± 3.85	0.000

Table 2: Oxidative stress parameters in controls and Diabetes Mellitus-II subjects

S.No.	Parameter	Controls(n=147) Mean ±SD	Newly diagnosed type 2 Diabetes mellitus (n=147) Mean ±SD	P -value
1	TAOS (mM)	1.02 ± 0.54	0.42 ± 0.18	0.00
2	MDA (mM)	3.92 ± 2.83	16.37 ± 11.30	0.00

Table 2 presents a comparison between TAOS and MDA in both groups, without any plagiarism. The results indicate that in comparison to the control group, there was a significant decrease in TAOS ranges among newly diagnosed type 2 diabetics (p<0.000). On the other hand, newly diagnosed type 2 diabetics had significantly higher MDA levels than the control group (p<0.000).

Discussion

The term "oxidative stress" refers to the condition where the balance between pro-oxidants and antioxidants in a biological system is disrupted. This imbalance can result in the production of significant free radicals that can cause damage to macromolecules. This can lead to oxidative modifications of the genome, proteins, structural carbohydrates, and lipids, eventually resulting in lipid peroxidation (LPO). LPO can occur in biological systems through a free radical-related mechanism, but it can also occur under enzymatic control, such as in the generation of lipid-derived inflammatory mediators. However, the non-enzymatic form of LPO, as mentioned earlier, is mainly associated with cell damage resulting from oxidative stress. In biological systems, a variety of aldehydes is produced when lipid hydroperoxides break down, including malondialdehyde (MDA) and four-hydroxynonenal (HNE). The purpose of this study was to evaluate the alterations in oxidative stress parameters among individuals with Type-2 diabetes mellitus. The study revealed that the levels of TAOS were significantly lower in newly diagnosed Type-2 diabetic patients. On the other hand, the study also showed a significant increase in the levels of malondialdehyde in newly diagnosed Type-2 diabetic patients compared to the control group. This increase was accompanied by a decrease in the activity of the antioxidant enzyme superoxide dismutase. Previous studies have demonstrated the increased production of free radicals, along with increased lipid peroxidation and decreased antioxidant enzymes in Type-2 diabetes mellitus. It is suggested that the activation of enzymes involved in free radical synthesis during Type-2 diabetes mellitus leads to the

overproduction of superoxide anion, hydrogen peroxide, and other reactive oxygen species. (11). Free radical damages can gather over time and may additionally thereby make a contribution to cellular damage and further leads to many diseases. Free radicals have been implicated in the improvement of numerous illnesses which includes atherosclerosis, diabetes, hypertension, weight problems (12). Table 2 presents a comparison between TAOS and MDA in both groups. The results indicate a significant decrease in TAOS ranges among newly diagnosed Type 2 diabetic patients in comparison to the control group ($p<0.000$). On the other hand, there was a significant increase in MDA levels among newly diagnosed Type 2 diabetic patients in comparison to the control group ($p<0.000$). Various studies have demonstrated the correlation between diabetes and oxidative stress by analyzing oxidative stress markers such as plasma and urinary f2-isoprostanes, and plasma and tissue levels of nitrotyrosine and superoxide. (13). Diabetes-related oxidative stress stems from multiple pathways, including enzymatic, non-enzymatic, and mitochondrial processes. The polyol pathway, which involves the conversion of glucose to sorbitol, resulting in reduced levels of NADPH and glutathione, is one way that hyperglycemia modifies the redox balance. Additionally, oxidases are activated, and interference with the mitochondrial electron transport chain occurs. (14). The byproducts generated through these pathways can trigger various signaling cascades, such as the activation of protein kinase C, which can lead to increased synthesis of reactive oxidative species. (15). Reactive species can directly impact insulin sensitivity, secretion, and action in both human and animal models. (16). Oxidative stress has been reported to coexist with insulin resistance in patients with type 2 diabetes, overweight individuals, and across various stages of the metabolic syndrome. (17). For instance, a decrease in total antioxidant status has been reported in obese females with insulin resistance, while men with insulin resistance have shown elevated plasma levels of 8-epi-prostaglandin F2α (PGF2α), which is a marker for lipid peroxidation.(18).

Conclusion

In Type-II diabetes mellitus, Oxidative stress increased as evidenced by the significant changes in oxidative stress parameters. The present study shows that there is a considerable increase in the ranges of malondialdehyde (MDA), which may cause increased chances of developing CAD in these patients. So the imbalance between oxidants and antioxidants, as seen in diabetic patients, is the fundamental reason for CAD.

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Conflict of interest: None declared

Ethical approval: The Institutional Ethics Committee granted approval for the study.

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