Research Article

Assessment of Level of Serum Uric Acid and Oxidative Stress Along with HBA1C in Patients with Type II Diabetes Mellitus

Pravinkumar L. Sonawane*[1], Sarguru Datchanamurthi[2], Abhay P. Jagtap[1]
1. Assistant Professor, Department of Biochemistry, DVVPF'S Medical College, Ahmednagar, India.
2. Prof. and Head, Department of Biochemistry, B.J. G.M.C. Medical College and Sasoon General Hospital, Pune, India.
***Corresponding author's E-mail:** pravinsonawane32@gmail.com

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ABSTRACT

Type II diabetes formerly known as adult-onset diabetes, is a type of diabetes that is characterized by high blood sugar, insulin resistance, and relative lack of insulin due to obesity, lack of exercise or genetically determined. HbA1c in diabetic patients provides valuable information about the changes occurring in the blood glucose level over last three months. Oxidative stress can be served as good marker of degree of diabetes in addition is HbA1c. SOD is considered as a first line defense against ROS, as it is present in almost all cells and it deals with the most hazardous radicals i.e. Superoxide ($O2^-$). The High level of uric acid or hyperuricemia makes oxidative stress by inducing the production of reactive oxygen species (ROS) which interferes the insulin signaling pathway, creates inflammatory state that reduced the insulin sensitivity, blood glucose uptake and metabolism, also reducing the insulin production from pancreatic islet cells. Keeping these facts in mind the present study was designed to assess the level of Uric acid and oxidative stress along with HbA1c in type II D.M.

Keywords: Type II Diabetes Mellitus, Serum Uric acid (SUA), HbA1c, Superoxide Dismutase (SOD).

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INTRODUCTION

Glucose molecule in the blood normally binds to the haemoglobin molecule –known as glycated haemoglobin (HbA_{1c}) or glycation. Its level is increased in diabetes mellitus and thus monitoring the levels of HbA_{1c} in diabetic patients provides valuable information about the changes occurring in the blood glucose level over the period of three months. Diabetes is a metabolic disorder and is generally accompanied by increased levels of free radicals and decreased activity of antioxidants and various studies suggests that increased oxidative stress in diabetes mellitus may be due to increased formation of Glycated Haemoglobin (HbA1c). This increased glycation is thus involved in progression of diabetes and its complications.[1,2]

Oxidative stress produced is characterized by production of different free radicals. One of this free radical is superoxide (O_2^-) which causes cellular damage[6]. Increased oxidative stress is widely accepted participants in the development and progression of diabetes and its complications[7]. SOD is considered a first line of defense against ROS, as it is present in almost all cells and it deals with the most hazardous radicals i.e. superoxide (O_2^-).[8]

Uric acid is a diprotic acid which is catabolic end product of purine bases. Normal reference of uric acid in human blood is 1.5-6 mg/dl in women and 2.5-7 mg/dl in men. Several evidences from epidemiological studies that serum uric acid level is an independent risk factor and predicts a 17% increment in the risk of T2DM. Insulin can stimulate the urate-anion exchanger in the brush border membranes of renal proximal tubules and raise the renal urate reabsorption. This process makes the serum uric acid levels increased along with increased level of blood glucose levels reflected on the glycated haemoglobin levels (HbA1C) less than 7% but then decreased with further increment of HbA1C level more than 7%, and it makes a bell-shape relation. [3-4]

Aims and Objectives:

1) To estimate the level of HbA1c and serum uric acid in type 2 DM patients and in age and sex matched healthy controls.

2) To find the correlation between these parameters if any.

MATERIALS AND METHODS

The present study comprised of 50 known diabetic patients (with blood glucose > 180mg/dl) and 50 healthy controls (age and sex matched). This study was conducted in collaboration with tertiary care hospital in north Maharashtra from March 2022 to July 2022.

Inclusion Criteria

OPD and IPD patients diagnosed as type-II DM are included in present study.

Exclusion Criteria

Patients having type-I Diabetes Mellitus, Gestational Diabetes Mellitus.

Sample Collection and Processing

5ml blood was collected by venipuncture under aseptic condition and transferred 2ml in EDTA tube for the estimation of HbA1c, 1ml in fluoride bulb for estimation of blood glucose and 1ml in plain bulb for uric acid estimation, with prior well-informed written consent.

The blood samples collected were processed immediately for estimation of fasting and post prandial blood glucose by GOD-POD method, Glycated Haemoglobin (HbA1c) by Ion Exchange Resin method[5] and the estimation of Serum Uric acid had been done by Caraway's method in digital colorimeter (Systronic) method**.**

Statistical Analysis

All the biochemical parameters measured in study group subjects were statistically compared with those estimated in controls. Results were presented as **Mean ± SD**. Student paired 't' test and SPSS Version 2022 used for statistical analysis between controls and cases for numerical variables.

Correlation between HbA1c and serum uric acid was calculated by using Karl Pearson's Coefficient.

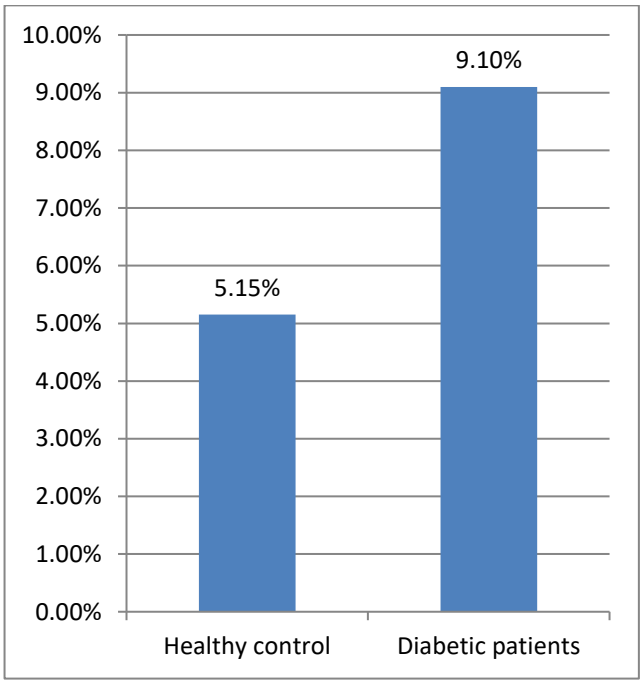
RESULTS AND OBSERVATIONS

Table 1: Statistical Analysis of the Parameters of Glycaemic Index in Healthy Controls and Type 2 D.M.

Parameters	Healthy Controls n = 50 (Mean ± SD)	Type-II D.M. n = 50 (Mean ± SD)	'p' value	'r' value
Glycated Hb %	5.15 ± 0.6	9.10 ± 0.63	0.0001	0.286
Sr. Uric acid (mg/dl)	4.6 ± 0.3	7.9 ± 0.3	0.0001	
SOD Level	4.98 ± 0.58	2.82 ± 0.58	0.0001	-0.153

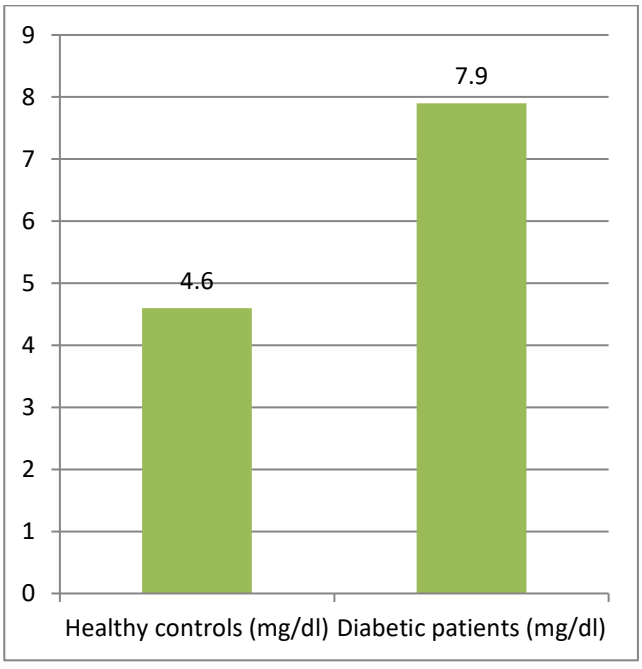
(n= number of cases, p< 0.05 Significant value, p< 0.001 highly significant)

Figure 1: Concentration of Glycated Haemoglobin (%) in Healthy Controls and Type II DM.



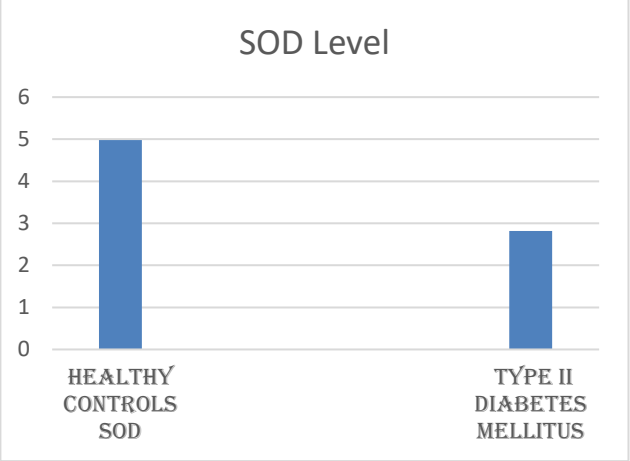
(P<0.001- Highly significant)

Figure 2: Level of Sr. Uric acid by Caraway's method in Healthy Controls and Type II DM.



(P < 0.001- Highly Significant.)

Figure 3: Level of SOD in Healthy Controls and Type II DM.



DISCUSSION

Oxidative stress is one of the important factors playing pathological role in diabetic complications and is a status in which disturbance in the balance between oxidants and natural antioxidants are seen. There are many possible explanations for increased oxidative stress observed in patients with D.M., one of them could be higher rate of glycation. Proposals have been made suggesting that increased glycation itself can lead to the production of free radicals**.** HbA1c can provide accurate and reliable method to assess routinely the relative level of glycemic control[9].

In the present study Table no.1 and Fig. 1, 2 and 3 shows levels of Glycated haemoglobin, uric acid and SOD level in healthy controls and type II diabetic patients.

In diabetic patients, the mean HbA1C was increased as compared to control, this difference was statistically significant ($p<0.001$) when compared between study cases and healthy control subjects.

Superoxide Dismutase (SOD) is one of the defenses against oxidative stress which can be a good marker for diagnosis as well as prognosis of the disease. It catalyzes the dismutation of superoxide radicals to oxygen and hydrogen peroxide (H_2O_2). SOD is thought to be one of the major enzymes that protect cells from ROS[10]. In the present study (Fig. No. 3 and table no.1) shows that erythrocyte SOD activity was significantly decreased in type 2 diabetic patients as compared to healthy controls ($P< 0.001$).

Hyperglycemia seen in DM activates many reactions such as glucose autoxidation, non-enzymatic glycation of proteins, activation of protein Kinase C. This results in overproduction of Superoxide, Hydroxyl radicals and Hydrogen peroxide. So, there is a possibility that while quenching superoxide, SOD may be utilized or SOD is inhibited by these oxidants and this causes reduction in the SOD activity. Palanduz S, Ademoglu E et al observed that the SOD activity significantly decreased in diabetes mellitus patients. They suggested that there seems to be an imbalance between plasma oxidant and antioxidant systems in patients with type II DM[9]**.**

Abdolijalal Marjani et al also found decreased erythrocyte SOD enzyme activity with type II DM as compared to controls**.** Recent studies have introduced serum uric acid as a potential risk factor for hypertension[12], stroke[11], and cardiovascular diseases[13]. Our findings suggest that type 2 diabetes is another consequence of hyperuricemia.

These results led us to think if there is a relation among the level of HbA1c, uric acid and SOD. This is the reason; we have correlated these parameters by using Karl Pearson's Coefficient. In the present study we observed a non significant inverse correlation ('r' value = -0.153). As the levels of HbA1c increases, there is a decrease in SOD levels. It indicates that there is an influence of glycemic control on antioxidant levels in diabetic subjects.

Where we observed a significant correlation ('r' value = 0.128) between the level of SOD and Uric acid in the patients having type II DM.

CONCLUSION

From the present study we conclude that oxidative stress is in the foreground of diabetes. HbA1c being the marker of glycemic control was compared with the oxidative stress marker SOD. There is an inverse correlation observed between these two markers. This indicates that as the degree of severity of diabetes increases, there is decrease in SOD activity which leads to oxidative stress. It suggests that a good glycemic control can reduce the oxidative stress in type II Diabetes Mellitus.

Our findings suggest that type 2 DM is an another consequence of hyperuricemia. Moreover, xanthine oxidase inhibitors, which are currently used to decrease serum uric acid levels, are safe and inexpensive. In conclusion, our findings, together with those from previous literature, indicates that lowering uric acid may be a novel treatment target for preventing type II DM and justify a prospective clinical trial on the possible benefits of the measurement and lowering of serum uric acid on multiple chronic diseases.

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