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Research Article

Serum adenosine deaminase as oxidative stress marker in type 2 diabetes mellitus

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ABSTRACT

Background: Oxidative stress markers are increased in type 2 diabetes mellitus and its estimation helps in predicting the long term complications. In present study comparison and correlation of the levels of serum adenosine deaminase, serum malondialdehyde, and serum total antioxidant capacity in type 2 diabetes mellitus and in age and sex matched healthy controls.
Methods: Study group consisted of 100 individuals between the age group of 35-65 years of age. Of which 50 individuals with type 2 diabetes mellitus were considered as cases. The control group consisted of 50 age and sex matched healthy individuals. Study was approved by institutional ethical committee. By aseptic precautions 2 ml of venous blood was collected in a plain vacutainer tube, after 8-12 hours of fasting. Serum adenosine deaminase, serum malondialdehyde, and serum total antioxidant capacity were estimated in all groups.
Results: The study observed an increased level of serum adenosine deaminase, malondialdehyde and decreased levels of total antioxidant capacity in type 2 diabetes mellitus compared to controls. Serum adenosine deaminase levels in type 2 diabetics were 50.77 ± 6.95 and in controls was 17.86 ± 4.04. Serum Malondialdehyde levels in type 2 diabetics was 512.13 ± 70.15 and in controls was 239.32 ± 23.97. Serum total antioxidant levels in type 2 diabetics was 0.39±0.15 and in controls was 1.66±0.25. Positive correlation was seen between serum adenosine deaminase and malondialdehyde and it was statistically significant. Statistically significant negative correlation was seen between serum adenosine deaminase and total antioxidant capacity.
Conclusion: Adenosine deaminase can be used as oxidative stress marker. Their increased levels indicate oxidative stress in type 2 diabetes mellitus. Therefore, estimation of serum adenosine deaminase levels help in early prediction and prevention of long term complications occurring due to oxidative stress in diabetics, thereby decreasing the mortality and morbidity in them.

Keywords: Serum adenosine deaminase, Type 2 diabetes mellitus, MDA

INTRODUCTION

Diabetes Mellitus (DM) is a disorder of multiple aetiologies, where alteration is characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both. Diabetes mellitus affects more than 230 million people worldwide and this number is expected to reach 350 million by 2025. Type-2 diabetes mellitus is the most common form of diabetes accounting for 90% of the cases. The chronic hyperglycemia of diabetes is associated with significant long-term squeal, particularly damage and/or dysfunction and failure of various organs, especially the kidneys, eyes, nerves, heart and blood vessels.[1]

Oxidative stress is the condition that occurs when the steady-state balance of pro-oxidants to antioxidants is shifted in the direction of the pro-oxidants, creating the potential for organic damage. "Oxidative stress" occurs when the formation of bioactive oxidation products greatly overwhelms the capacity of endogenous cellular antioxidant defence system. The resulting damage to cells and organs may activate and/or accelerate disease processes.[2]

Adenosine deaminase (EC 3.5.4.4) an enzyme involved in the metabolism of purine nucleoside, catalyses the irreversible hydrolytic deamination of adenosine and 2'-deoxyadenosine to inosine and 2'-deoxyadenosine, respectively. Further metabolism of these deaminated nucleosides leads to hypoxanthine, which can be either transformed into uric acid by xanthine oxidase or salvaged into mononucleotides by the action of hypoxanthine-guaninephosphoribosyl-transferase. The enzyme is widely distributed in vertebrate tissues and plays a critical role in a number of physiological systems.[3]

Adenosine deaminase has been shown to impair the insulin sensitivity for glucose transport and antilipolysis by inactivating extracellular adenosine, which adipocytes release spontaneously.[4] Adenosine deaminase activates lipolysis and markedly potentiates the increase in cyclic AMP accumulation due to norepinephrine.[5] Dysregulated fat metabolism and consequent elevation of free fatty acids leads to subsequent development of type 2 diabetes mellitus. Serum adenosine deaminase levels are increased in type 2 diabetes mellitus. It is also found increased levels of ADA are one of the factors which lead to increased production of oxidative stress by generation of reactive oxygen species.

The aim of the present study was, to evaluate the serum adenosine deaminase levels in type-2 diabetics and to compare and correlate adenosine deaminase with malondialdehyde and total antioxidant levels.

METHODS

Study group consisted of 100 individuals between the age group of 35-65 years of age. Of which 50 individuals with type 2 diabetes mellitus were considered as cases. The control group consisted of 50 age and sex matched healthy individuals. Subjects with tuberculosis, leprosy, acute lymphadenitis, infectious mononucleosis, enteric fever, hepatitis A and B, chicken pox, hematopoietic malignancies like Hodgkin's lymphoma and drug induced lymphadenitis were excluded from the study group. Study was approved by institutional ethical committee.

After taking the informed consent, patient details were obtained. By aseptic precautions 2 ml of venous blood was collected in a plain vacutainer tube, after 8-12 hours of fasting. Blood collected in plain vacutainer is processed immediately to obtain serum and following parameters are estimated: Serum adenosine deaminase, serum malondialdehyde, and serum total antioxidant capacity. Serum adenosine deaminase estimations were done by using commercial kit by colorimetric method of Giusti and Galanti.[6] Serum malondialdehyde measured by thiobarbituric acid method[7] and total antioxidant capacity by FRAP (ferric reducing ability of plasma) assay.[8]

RESULTS

Serum adenosine deaminase and malondialdehyde were increased in type 2 diabetes mellitus when compared to controls and total antioxidant capacity was decreased in type 2 diabetes mellitus when compared to controls which were statistically significant (Table 1/Figure 1, 2 and 3).

Table 1: Comparison of serum adenosine deaminase, malondialdehyde, and total antioxidant capacity between study groups.

Study groups	Serum adenosine deaminase	Malondialdehyde	Total antioxidant capacity
Type 2 diabetes mellitus	50.77 ± 6.95	512.13 ± 70.15	0.39 ± 0.15
Controls	17.86 ± 4.04	239.32 ± 23.97	1.66 ± 0.25
P value	<0.001	<0.001	<0.001

P value <0.005 - significant

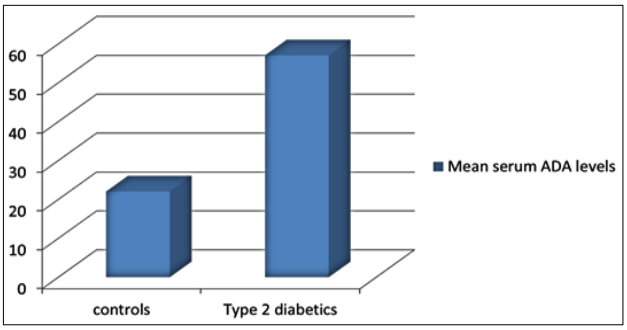

Figure 1: Comparison of ADA (mg/dl) between cases and controls.

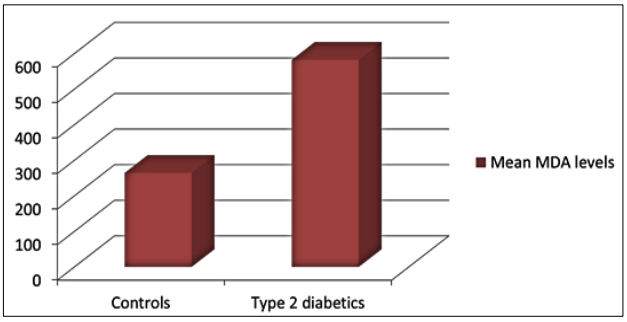

Figure 2: Comparison of MDA (nm/100 ml) between cases and controls.

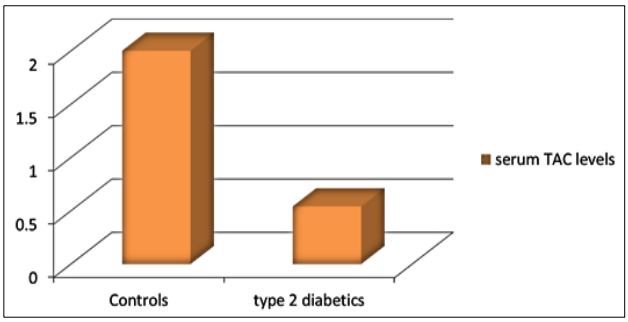

Figure 3: Comparison of serum TAC levels between cases and type 2 diabetics.

Serum adenosine deaminase had shown a statistically significant positive correlation with malondialdehyde and negative correlation with total antioxidant capacity which was statistically significant (Table 2/Figureig 4).

Table 2: Correlation between serum adenosine deaminase, malondialdehyde and total antioxidant capacity in type 2 diabetics.

Parameters correlated	r value	P value
Serum adenosine deaminase and malondialdehyde	0.973	<0.001
Serum adenosine deaminase and total antioxidant capacity	-0.964	<0.001

P value <0.005 - significant

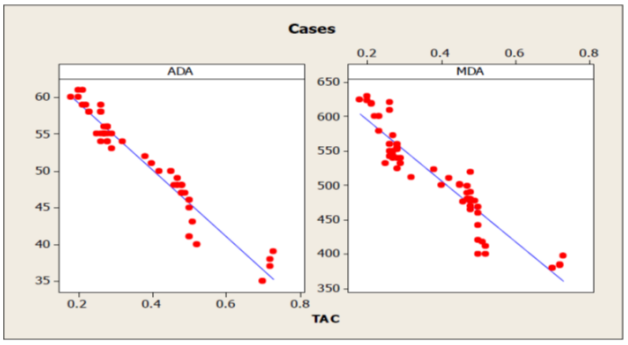

Figure 4: Correlation between ADA, MDA and TAC.

DISCUSSION

Present study was conducted to evaluate serum adenosine deaminase levels in type 2 diabetes mellitus. We observed statistically significant increase in serum adenosine deaminase levels in type 2 diabetics when compared to controls these findings were in accordance to the study of Siddiqui S et al.[9] which showed that ADA was increased in type 2 diabetics when compared to controls and decreased after antioxidant therapy. ADA can be regarded as a strong indicator of reactive oxygen species production leading to oxidative stress in type 2 diabetics and its level can be modulated by antioxidants.

The present study showed that serum MDA levels were increased in type 2 diabetics when compared to controls, which was statistically significant. These findings were in accordance to the study of Slatter et al.[10] The inter-molecular cross-linking of collagen through MDA is important in the late complications of diabetes mellitus. It contributes to the stiffening of the cardiovascular tissue. In addition it could be a link between glycation and further lipid peroxidation.

In the present study, serum TAC was significantly lower in type 2 diabetes mellitus when compared with controls, this was in accordance with Rani JA et al.,[11] which showed that there is significant decrease in total antioxidant activity in diabetic patients and hyperglycemia leads to oxidative stress.

Serum ADA levels were positively related to MDA which is in accordance with Gitanjali G et al.,[12] they had shown that ADA , MDA and FFA were significantly increased in type 2 diabetes mellitus.

Serum ADA showed negative correlation with total antioxidant capacity, which indicates serum ADA levels increases as antioxidant capacity decreases.

Oxidative stress is one of the major factor, responsible for complications in type 2 diabetes mellitus. Our study showed positive correlation of ADA with MDA. MDA is known to be an oxidative stress marker. If it is increased, patients are prone for cardiovascular complications. Serum ADA levels showed negative correlation with TAC indicating imbalance in plasma oxidant and antioxidant status.

CONCLUSION

Adenosine deaminase can be used as oxidative stress marker. Therefore, estimation of serum adenosine deaminase levels may help in early prediction and prevention of complications occurring due to type-2 diabetes mellitus, thereby decreasing the mortality and morbidity.

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Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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