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# Can Serum MDA: SOD Ratio Predict Risk of Retinopathy in Type 2 Diabetes Mellitus?

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## ABSTRACT

**Background-**Free radicals may play a role in diabetic retinopathy. Aims and objectives- Serum malondialdehyde and superoxide dismutase can be measured to assess the levels of free radicals and antioxidants respectively. In the present study we tried to find out any correlation between the ratio of serum malondialdehyde: superoxide dismutase and diabetic retinopathy.
**Materials and methods-** Serum malondialdehyde and superoxide dismutase were measured in 67 diabetic retinopathy cases and 61 diabetic patients without retinopathy.
**Results-** In cases superoxide dismutase levels were decreased significantly and malondialdehyde levels were increased highly significantly with respect to controls. The ratio superoxide dismutase: malondialdehyde in cases was decreased significantly with respect to controls.
**Conclusion-**A cutoff value of 0.144 for the ratio malondialdehyde: superoxide dismutase in serum of diabetic patients may be an indicator of retinopathy. Further research should be carried out to confirm these findings.

***Keywords-*** malondialdehyde, superoxide dismutase, diabetic retinopathy

## INTRODUCTION

Diabetic retinopathy (DR), a major microvascular complication of type 2 diabetes mellitus, has a significant impact on the world's health systems. Despite growing evidence documenting the effectiveness of routine DR screening and early treatment, DR frequently leads to poor visual functioning and represents the leading cause of blindness in working-age populations. [1] Among individuals with diabetes, the overall prevalence of any DR has been estimated to be about 34.6%. [2]

Increasing evidence in both experimental and clinical studies suggests that oxidative stress plays a major role in the pathogenesis of both types of diabetes mellitus. Free radicals are formed disproportionately in diabetes by glucose oxidation, nonenzymatic glycation of proteins, and the subsequent oxidative degradation of glycated proteins. [3] Since antioxidants prevent free radical induced damage or destroy free radicals, it seems plausible that a sufficient intake of antioxidants may play an important role in protection against diabetes. [4]

Significant increases in free radical production can be indirectly measured by the presence of lipid peroxidation products, primarily malondialdehyde (MDA). [5] On the other hand, superoxide dismutase (SOD) levels can be used as a measure of antioxidant activity against free radicals. [6]

In the present study we tried to find out any correlation between the ratio of serum MDA: SOD and DR.

## MATERIALS AND METHODS

In this case control study 67 DR patients were recruited as cases from the ophthalmology outpatient department of a tertiary care medical college and hospital. 61 age and sex matched diabetic patients

who did not have any diabetic complications were selected as controls. Duration of the present study was 1 year and 3 months. All patients who were eligible for participation in the study were appropriately screened and enrolled after obtaining informed consent. Exclusion criteria included participants who were smokers, suffering from acute or chronic diseases, hepatic or renal impairment, taking antioxidant supplements, unusual dietary habits, hemodialysis and cancer chemotherapy.

Blood was collected from all subjects after overnight fasting and estimation of serum parameters done in the department of Biochemistry.

Serum MDA was estimated by the method of Esterbauer and Cheeseman. [7] Serum SOD was assayed by the method of Paoletti and Mocali. [8] To avoid the possible dispersion of serum MDA and SOD level results, all the samples were processed at the same time, at the end of the recruitment process.

Statistical analysis of data was performed using SPSS software, and inferences were drawn. p values of <0.05 and <0.001were considered to be statistically significant and highly significant respectively .

## RESULTS

**Table 1. Serum levels (mean ± SD) of SOD (mU/ml) and MDA (nmol/ml) in cases and controls.**

| Parameter | Cases | Controls |
|---|---|---|
| SOD | 0.59±0.18 | 0.67±0.21 |
| MDA | 4.1±0.8 | 3.7±0.6 |
| SOD:MDA | 0.144±0.079 | 0.181±0.093 |

Following are the results for t test-

For SOD:

p value is 0.022, which is statistically significant.

The difference of mean of cases and controls is -0.0800.

95% confidence interval of this difference: From -0.4182 to -0.0118.

t = 2.3198, degree of freedom = 126, standard error of difference = 0.034,

SEMof cases and controls are respectively 0.22 and 0.269.

For MDA:

p value is 0.0019, which is statistically highly significant.

The difference of mean of cases and controls is 0.400.

95% confidence interval of this difference: From 0.151 to 0.649.

t = 3.1754, degree of freedom = 126, standard error of difference = 0.126

SEMof cases and controls are respectively .098and.077.

For SOD:MDA:

p value is 0.0164, which is statistically significant.

The difference of mean of cases and controls is -0.03700.

95% confidence interval of this difference: From -0.06710 to -0.00690.

t = 2.4325, degree of freedom = 126, standard error of difference = 0.015

SEM of cases and controls are respectively.00965 and .01191.

## DISCUSSION

Free radicals are generated in vivo as by products of normal metabolism. [9] Free radicals like superoxide, nitric oxide, and hydroxyl radicals, and other reactive species such as hydrogen peroxide, peroxynitrite, and hypochlorous acid, are produced in the body, primarily as a result of aerobic metabolism. [10] In general, free radicals are reactive chemically, some (e.g. HO•) being extremely reactive. [11] These reactive radicals and oxidants may injure cells and tissue directly via oxidative degradation of essential cellular components as well as injure cells indirectly. [12] Hydroxyl radical and peroxynitrite in excess can damage cell membranes and lipoproteins by a process called lipid peroxidation. This reaction leads to the formation of MDA. [13] The determination of MDA has attracted widespread interest, because it appears to offer a facile means of assessing lipid peroxidation in biological materials. [14] So, in the present study we assessed MDA as a

measure of the amount of damage caused by free radicals.

Diabetes can be produced in animals by the drugs alloxan and streptozotocin; the mechanism of action of these two drugs is different, but both result in the production of active oxygen species. Scavengers of oxygen radicals are effective in preventing diabetes in these animal models. Not only are oxygen radicals involved in the cause of diabetes, they also appear to play a role in some of the complications seen in long-term treatment of diabetes. [15] Thus, in our study also, highly significantly increased MDA levels, in cases with respect to controls, point towards a role of free radicals in causation of diabetic complications like retinopathy (table 1).

Aerobic organisms have integrated antioxidant systems, which include enzymatic and non-enzymatic antioxidants that are usually effective in blocking harmful effects of ROS. [16] SODs are metal-containing enzymes that catalyze the dismutation of superoxide radicals to oxygen and hydrogen peroxide and are found in all aerobic organisms examined where it plays a major role in the defense against toxic-reduced oxygen species. [17] To assess the defense against free radicals, we estimated SOD, which was found to be decreased in cases significantly with respect to controls (table 1).

But more importantly, the ratio 0.144 between mean levels of SOD:MDA in cases was decreased significantly with respect to the corresponding ratio 0.181 in controls. Even with prolonged and detailed search of worldwide literature, we could not locate any previous research with respect to any cutoff value for SOD:MDA ratio in DR. But, though we obtained a value of 0.144 for the ratio of MDA: SOD in serum, the present study has drawbacks, for example, the number of subjects might be inadequate; also, the study population might not be truly reflective of the actual general population. So, further research with more patients and in a more diverse population is required for establishing our findings.

## CONCLUSION

We think that a cutoff value of 0.144 for the ratio of SOD:MDA in serum of diabetic patients may be an early indicator or marker of retinopathy in diabetic patients. In addition, further studies should be done to confirm our findings and to help in this line of research.

Conflict of interest-nil
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