

Research Article

A study to assess serum levels of superoxide dismutase and catalase in senile cataract patients with and without diabetes mellitus at tertiary care hospital

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ABSTRACT

Background: The objective was to assess the possible relationship of serum levels of superoxide Dismutase and catalase and development of senile cataract in patients with and without diabetes mellitus.

Methods: The study was done in the Department of Ophthalmology with support of Department of Biochemistry at Geetanjali Medical College and Hospital, Geetanjali University, Udaipur, Rajasthan. The study has been conducted during the time period of October 2014 and October 2015. Blood samples of 120 senile cataract patients, i.e. 60 with diabetes and 60 without diabetes were taken and levels of superoxide dismutase and catalase were studied.

Results: Statistically significant difference in age wise occurrence of cataract was found between diabetic and non-diabetic patients i.e. cataract was found at a later age in senile non diabetic patients as compared with senile diabetic patients ($p < 0.001$). Senile diabetic patients had significantly lower serum level of SOD as compared to senile non diabetic patients ($p < 0.001$ for both). Similarly, senile diabetic patients had significantly lower serum levels of catalase as compared to senile non diabetic patients ($p < 0.001$ for both).

Conclusions: Increase in oxidative stress and decrease in anti-oxidant enzyme activities have a role in the early development of cataract in senile patients with diabetes. Thus, diabetic cataract seems to be associated with decrease in serum levels of SOD and catalase.

Keywords: Serum level, Cataract, Diabetes mellitus, Oxidative stress, Superoxide dismutase, Catalase

INTRODUCTION

Cataract is one of the leading causes of blindness in the world, responsible for 48% of blindness worldwide. Different types of cataract exist and the pathophysiology responsible for its formation is not completely understood. Oxidative stress is considered as a putative cause for cataract in senile patients.¹

For maintaining the transparency of lens, the state of balanced redox is required. The first line of defense against exogenous and endogenous reactive oxygen species (ROS) that keeps lens proteins in a reduced state

includes a high level of glutathione and some other enzymes.²

It has been found from various studies that damage of various cell components, interruption in physiological functions, ageing and various diseases are associated with oxidative-stress. Occurrence of diseases such as cancer, cardiovascular diseases, nerve degenerations, macular degeneration and cataracts is because of the rise in intracellular levels of ROS.³

Cellular defense mechanism plays an important role in defense against cataractogenesis, as it protects the lens

against the toxic effects of oxidative insult. The two major anti-oxidant enzymes, which protect lens proteins against ROS mediated oxidative damage, are Superoxide dismutase (SOD) and catalase (CAT).⁴ There are strong evidences to show that diabetes and oxidative stress are significantly associated with each other and therefore oxidative stress plays an important role in the pathogenesis of various diabetic complications. In diabetic patients, the process responsible for cataract starts very early and worsens over the course of the disease due to overproduction of ROS and decreased efficiency of antioxidant defenses which leads to increase in the level of oxidative stress.

The oxidation of lipids, proteins and DNA increases with the development of diabetes over time. However, the cause of the hyperglycemia-induced oxidative stress is not clear. In this study we assessed the serum levels of SOD and catalase in senile cataract patients with and without diabetes mellitus.

METHODS

This study was done in the Department of Ophthalmology with the support of Department of Biochemistry at Geetanjali Medical College and Hospital, Geetanjali University, Udaipur, Rajasthan. The study has been conducted during the time period of October 2014 and October 2015, to study the serum levels of SOD and catalase in senile cataract patients with diabetes and without diabetes.

The sample size for the study has been calculated using statistical formulae of determination of sample size by proportion:

$$n = \frac{Z^2 P(1 - P)}{E^2}$$

Here, absolute error (E) was taken 20% of prevalence of cataract in diabetic patients which was found to be 63%. 95% Confidence level was taken under consideration. Thus total of 120 senile cataract patients were taken out of which 60 patients were having diabetes and 60 patients were non-diabetic. Informed consent was obtained from all subjects after explaining the nature of study. Blood samples of all the study subjects were taken and levels of superoxide dismutase and catalase were studied. Patients

of both groups had a significant vision loss and cataract respectively in at least one eye.

Exclusion criteria

Patients with secondary cataract i.e. due to trauma, drug use, uveitis, and other known causes.

The statistical analysis has been done using descriptive statistics such as mean and standard deviation. Unpaired student t-test' has been used to find difference among the diabetic and non-diabetic patients with cataract.

RESULTS

Mean age of senile cataract patients without diabetes was found to be 70.83±0.97 years whereas, it was 64.58±1.13 years in senile cataract patients with diabetes (t value=32.508, p<0.001) Table 1.

Table 1: Age and sex wise distribution of diabetic and non-diabetic cataract patients.

Age in years	Non Diabetic patient (%)	Diabetic patient (%)	Total (%)
60-65	02 (03.3%)	30 (50.0%)	32 (26.67%)
65-70	12 (20.0%)	14 (23.33%)	26 (21.67%)
70-75	26 (43.4%)	9 (15%)	35 (29.17%)
80-85	14 (23.3%)	5 (8.33%)	19 (15.83%)
85-90	06 (10.0%)	2 (3.33%)	8 (6.67%)
Total	60 (100.0)	60 (100.0%)	120 (100.0%)
Mean±SD	70.83±0.97	64.58±1.13	
T value	32.508		67.71±1.22
P value	<0.001(HS)		

It shows that cataract occurs early in senile patients with diabetes as compared to senile non diabetic patients. Thus highly significant difference was seen between the diabetic and non-diabetic groups with respect to age and development of cataract.

Differences among the groups for serum level of SOD and catalase were also statistically highly significant (p<0.001). Serum levels of diabetic and non-diabetic patients were shown in Table 2. When the serum levels of both the groups were compared, SOD (t value=17.273) and catalase (t value=22.514) levels were found to be low in diabetic patients as compared to non-diabetic patients (p<0.001 for both) Table 2.

Table 2: Comparison of serum level of superoxide dismutase and catalase in cataract patients (in unit/ml).

Anti-oxidant enzyme	Level (in units/ml)	Diabetic patient (n ₁ =60)	Non diabetic patient (n ₂ =60)	t-value	P value
Superoxide dismutase	Mean	9.57	24.30	17.273	<0.001 (HS)
	SD	2.99	5.89		
Catalase	Mean	15.29	56.21	22.514	<0.001 (HS)
	SD	9.39	10.49		

DISCUSSION

An imbalance of antioxidants and pro-oxidants results in increase in oxidative stress. It is not possible to avoid secondary oxidations that are involved in ordinary metabolism since oxygen is a strong oxidant. Common ocular diseases such as age-related macular degeneration, retinopathy of prematurity and age-related cataract occurs because of involvement of oxidative stress. Diabetes seems to be associated with oxidative stress and osmotic stress in the mechanism of cataractogenesis.⁵⁻⁷

The association of oxidative stress with diabetes mellitus plays an important role in the initiation and progression of cataract. It has been observed that free oxygen radicals trigger cataract which is one of the degenerative manifestations of diabetes. The high enzymatic antioxidants (SOD and catalase) levels neutralize the toxic effects of the reactive oxygen species in the lens which prevents cataract formation. The decrease in these enzyme activities in the lens and aqueous humor during ageing are responsible in the development of senile cataract.⁸

In senile diabetic cataract patients, it has been found that serum levels of anti-oxidant enzymes were low. The study supports the hypothesis that diabetes and cataract development were associated with each other due to decreased antioxidant enzyme activities.⁹⁻¹²

The study also shows that the serum levels of these anti-oxidant enzymes decrease, which lead to early cataract formation in diabetic patients. Antioxidant capacity in the diabetic cataractous lens tissues was decreased and suggested a role of antioxidant enzymes in the genesis of diabetic cataracts.⁸

One of the most important findings in the current study is that decreased serum levels seem to be associated with cataract development in senile diabetic patients. In the current study, cataract patients with diabetes had low levels of SOD and catalase as compared to cataract patients without diabetes. However, our results show that serum levels have an association with early cataract development in diabetics. This study shows that increased oxidative stress and decreased antioxidant enzyme activities have a role in the development of senile diabetic cataract.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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