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Research Paper

Study of Serum Malondialdehyde Levels: A Marker of Oxidative Stress in Patients of Senile Cataract and Control Group

Medical Science

KEYWORDS : Age-related cataract, oxidative stress, serum malondialdehyde, risk factors

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ABSTRACT

Background: Recent reports suggest an association between oxidative stress and age-related cataracts (ARC). Aim: This study was planned and carried out to evaluate oxidative stress as possible risk factors for ARC. Materials and Methods: We compared serum malondialdehyde level in 120 cases of ARC and 120 age- and gender-matched controls. Statistical analysis was done using t-test.Signifi cance was set at P ≤ 0.05. Results: The overall mean serum levels of malondialdehyde were significantly higher (P < 0.001) in the cases (3.35 ± 0.28 nmol/ml) as compared to controls (2.71± 0.13 nmol/ml). Conclusion: This study suggests that oxidative stress is a risk factor for development and progression of senile cataract.

INTRODUCTION

Cataract is a major cause of blindness and low vision worldwide. It is estimated that 44.1% of blind cases and 51.6% of patients with low vision suffers from cataract.[2,3] Age is the most important risk factor and about 85 percent of involved patients have age-related cataract. This type of cataract is called "senile cataract". It has been shown to be the main cause of blindness in patients over 50 years of age.[4]

In India cataract has been reported to be responsible for 50-80% of the bilateral blindness in general.[5,6] It is presumed that population above 60 years of age which was around 56 million in 1991 may rise twice by 2016.[5,7]

It is estimated that a ten-year delay in the onset of cataracts could decrease the number of cataract surgeries by 45 per cent, thus considerably diminishing cost of care. Also, Patients with cataracts in low resource areas and developing countries have a poor chance for surgery due to economic reasons. This results in an increased risk of blindness in such population.[2,8]

The development of senile cataract is a complex multifactorial process. Several factors such as genes, gender, diabetes, geographic location, UV light exposure, level of education, occupational status, oxidative stress, nutritional factors and raised body mass index have been found to be associated with cataract formation.[2] Some risk factors for cataract are modifiable; and the disease can be prevented by the elimination of these factors.

Oxidative stress is a term used to describe any challenge in which pro- oxidants predominate over antioxidants; it may be due to either increased production of reactive oxygen species (ROS) or decreased levels of antioxidants or both.[9,10] Mounting evidence suggests that chronic exposure to oxidative stress over the antioxidant levels may damage the lens and predispose it to senile cataract development.[11-14] Oxidative stress leads to lipid peroxidation. The level of lipid peroxidation can be estimated by measuring serum (MDA) Malondialdehyde level.[15] Many studies suggested increase in the levels of lipid peroxidation products like malondialdehyde in the patients of senile cataract.[9,16-19]

MATERIAL AND METHODS

This study was conducted in the Department of Biochemistry, with the help of Ophthalmology Department during the period of May 2013 to October 2014 in our institute. The study population consisted of total 240 participants aged between 50 to 80 years and they were divided in two groups viz cases and controls. Cases consisted of patients suffering from senile cataract and controls consisted of normal healthy individuals.

Inclusion criteria:1) Patients diagnosed as a case of senile cataract

2) Normal healthy individuals as control group

3) Age group of 50 to 80 years.

Exclusion criteria: 1) Not willing to participate in study

2) Cataract due to any other etiology like trauma, metabolic diseases, radiation therapy etc.

3) Any systemic disease like diabetes, hypertension etc. 4) Acute or chronic diarrhea 5) Patients of acute or chronic renal failure

6) Any H/O drug intake like steroid, antipsychotic, chemotherapy etc

5 ml venous blood samples were collected after an overnight fast (10-12 hours) from all cases and controls and serum was separated by centrifugation and was analyzed for serum malondialdehyde levels by Kei-Satoh method. The plasma was analyzed for sugar and serum was analyzed for creatinine on ICON WP Semi-Automatic Analyzer. Investigations were carried out using commercially available ready to use reagent kits.

STATISTICAL ANALYSIS:

Comparison of parameters was done between case and control group by using
unpaired t- test. Interpretation was done according to p-value.

RESULTS

Table No. 1: Serum Malondialdehyde, Creatinine and plasma Glucose level in cataract and control group

Parameter	Cases (n=120) [mean ± SD]	Controls (n=120) [mean ± SD]	P value	
Serum Malondialdehyde (nmol/ml)	3.35 ± 0.28	2.71 ± 0.13	<0.001	Highly Significant
Serum Glucose (mg/dL)	90.8 ± 14.2	87.5 ± 13.2	0.073	NS

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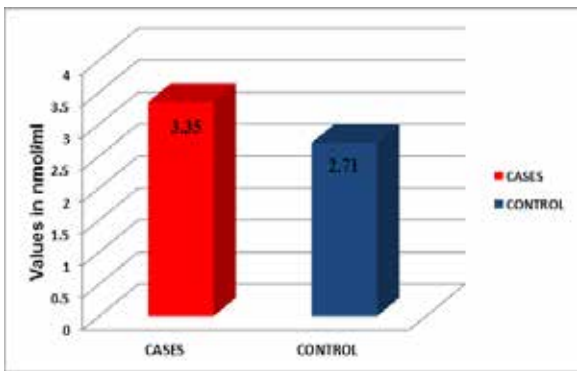
Parameter	Cases (n=120) [mean ± SD]	Controls (n=120) [mean ± SD]	P value	
Serum Creatinine (mg/dL)	1.005 ± 0.14	0.95 ± 0.14	0.11	NS

NS: Non significant

Normal serum Malondialdehyde level: 1 – 2 nmol/ml

GRAPH 1: COMPARISON OF MEAN SERUM MALONDIALDEHYDE LEVEL IN SENILE CATARACT CASES AND CONTROL-GROUP.



DISCUSSION

Multiple studies have been done to clarify the relationship between human biochemical elements and cataract formation. Different mechanisms such as osmotic graduation, protein aggregates, oxidative stress, nutritional factors like vitamins are proposed for cataract formation by certain workers in recent past. Result of this study shows elevated serum malondialdehyde in cataract pts *i.e.* mean 3.35 ± 0.28 compared to control 2.71 ± 0.13 which is statistically significant (pvalue < 0.001) (Table no. 1 and Graph 1). In this study it was found that oxidative stress is a risk factor for development and progression of age related cataract.

Oxidative stress may result from an imbalance between the production of the reactive oxygen species and the cellular antioxidant defence mechanisms. Oxidative stress is widely recognized to be an initiating factor in the development of age-related cataracts. The most important oxidants are reactive oxygen species like superoxide radicals ($O2^-$), hydroxyl radicals (OH^-) and hydrogen peroxide (H_2O_2).[17,18]

Lipid peroxidation represents the oxidative tissue damage which is caused by hydrogen peroxide, the superoxide anions and the hydroxyl radicals, resulting in a structural alteration of the membrane, with the release of the cell and the organelle contents and the loss of cytosolic aldehyde and peroxide products. Malondialdehyde is a major end product of the free radical reaction on the membrane fatty acids.[15,17]

In the lens, the reactive oxygen species may initiate a chain of toxic biochemical reactions such as peroxidation of the membrane lipids and extensive damage of the proteins, receptors and enzymes e.g. Na^+-k^+ ATPase leading to increase leaking of ions resulting in lens hydration, protein modification and aggregation. Also, there is extensive damage to the DNA which leads to the loss of epithelial cell viability and death by necrosis or apoptotic mechanisms. All these changes leads to the development of lens opacities[20,21]

Hence, serum malondialdehyde may be used as a generalised marker of oxidative stress in patients of senile cataract. This hypothesis is also supported by many previous studies.[16-19]

CONCLUSION:

Serum malondialdehyde level was significantly raised in senile cataract cases compared to controls. So, it can be used as a risk marker for the development and progression of senile cataract. Hence, strengthening antioxidant system by consuming antioxidative vitamins like tochopherols, ascorbic acid and retinoids may be beneficial to prevent development of cataract.

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