World Journal of Pharmaceutical Sciences
ISSN (Print): 2321-3310; ISSN (Online): 2321-3086
Published by Atom and Cell Publishers
Available online at: http://www.wjpsonline.org/
Original Article

A Study on effect of Oxidative Stress in Senile Cataract

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Received: 14-09-2015 / Revised: 21-11-2015 / Accepted: 15-12-2015

ABSTRACT

As antioxidants play a protective role in the pathophysiology of age related diseases, understanding the physiological status of antioxidant concentration among people at high risk for developing senile cataract is of interest. In the present study 100 cases of senile cataract were taken and compared with 100 healthy age matched controls. Plasma levels of Vitamin E, Vitamin C and Superoxide dismutase between cataract cases and control groups were found to be statistically significant($P<0.001$). The present study suggests that if educational and social instructions can be popularized regarding the beneficial effects of vitamins and nutritional status of food that we eat, we can make the right decision to prevent or delay the initiation of cataract formation. It also throws a light on the probability that low level of antioxidants and increased oxidative stress may have a role to play in the etiopathogenesis of senile cataract.

Key Words: Oxidative stress, Antioxidant, Senile cataract, Vitamin E, Vitamin C, SOD.

INTRODUCTION

Cataract is one of the leading causes of visual impairment leading eventually to blindness. It accounts for approximately 42% of all the causes. [1] By far the most common type of cataract is "Senile cataract". It is due to age related changes in lenticular protein and development of lens opacities indicate age related alteration in metabolism of protein during aging process. [2] In developing countries like India, the magnitude of the problem is overwhelming with the annual incidence of cataract in India is estimated to be four million. Of these, the number that gets operated for better eye sight is only 2.5 million, leaving a backlog that accumulates yearly. [3] Free radical is simply defined as any atom, molecule, or ion with unpaired electron or an open shell configuration. [4] Free radicals are highly reactive species which may disrupt the equilibrium of biological systems, by damaging their major constituent molecules leading eventually to cell death. Following initiation by a single radical, if oxygen is present, long chains of lipid peroxide may be formed by a rapid free radical chain reaction causing serious disruptions of cell membrane functions. It has been seen that high concentrations of antioxidant enzymes serves as a marker for oxidative stress.

Age related cataract is the common cumulative response to various damaging influences attacking the capsule, epithelium, and constituent fibers of the lens of the eye. The oxidation of lens protein by free radicals is believed to play an important part in the multifactorial process leading to lens opacification. It is because of the age related decrease in efficiency of the body's natural anti-oxidative mechanisms, including enzymatic, and non-enzymatic (antioxidant micronutrients). One way of evaluating the role of oxidative stress in the disease process is to measure and evaluate the serum level of antioxidant enzymes in healthy patients and those with ocular disease. High systemic levels could be indicative of an increased level of oxidative stress.

Considering the magnitude of problem in blindness, caused by senile cataract, every possible causative factor in senile cataract should explored. In this view, the present case control study has been undertaken to study the levels of antioxidant enzyme Superoxide Dismutase(SOD) and antioxidant vitamins viz. Vitamin E and Vitamin C in the serum of the patients suffering from cataract and to correlate the relationship between Oxidative stress and Senile Cataract.

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MATERIALS AND METHODS

The present work was approved by the institutional ethics committee. 100 patients of senile cataract in the age group of 60 to 75 years, who attended the Outpatient Department of Ophthalmology GEMS Hospital from August 2012 to April 2014 were screened and enrolled for study. Control group comprised of 100 persons aged 60 to 75 years with a visual acuity of 6/6 or better in both eyes and no lens opacities in either eye on slit lamp or ophthalmoscopic examination. Patients with diabetes mellitus, carcinomas, cardiovascular disorders, rheumatoid arthritis, taking vitamin supplements, ocular surgery, trauma, infection, inflammation of the eye and hypertension where free radical damages has been commonly incriminated were excluded from the study.

After inclusion in study, 10 ml fasting venous blood sample was collected under sterile conditions from each participant by venepuncture under aseptic conditions. EDTA sterile plain vials were used to collect blood samples for estimation of Vitamin C, Vitamin E and SOD and stored using preservative at cold temperature till further use.

All the assays were carried out on the day of blood sample collection. Estimation of all anti-oxidant enzymes/vitamins was carried out by the ELISA kit methods. Estimation of Vitamin E was carried out using Vitamin E ELISA Kit from MYBIOSOURCE, LLC and Vitamin C was estimated in plasma using Vitamin C ELISA Kit from MYBIOSOURCE, LLC. Both the values were expressed as mg/dl of plasma. Estimation of Superoxide Dismutase (SOD) was done using Superoxide Dismutase ELISA Kit from MYBIOSOURCE, LLC. SOD levels were expressed as units/ml.

Statistical analysis: All results were expressed in Mean ±SD. Unpaired T test was used to test the significance of difference and Students T Test to test the significance of difference between two groups.

OBSERVATIONS & RESULTS Table I depicts the anthropometric characteristics of the study. The mean age of senile cataract group was 65.8 years and 65.9 years. There was no significant difference in the age among the groups. Thus both the groups were age matched. Also, there was no significant difference in height, weight, BSA and BMI; indicating that the groups were homogenous in this respect.

Table I: **Anthrpometric characteristics of the study groups**

Parameters	Senile cataract (n = 100)	Control (n= 100)
Age (years)	62.8 ± 1.7	61.9 ±1.5
Height (cm)	162.4 ±4.4	163.5±5.8
Weight (Kg)	59 ±10.7	61.1 ±5.01
BMI (Kg/m^2)	22.3 ±4.05	22.8 ±2.01

The numbers of patients were more from the rural areas i.e. 62 % were cases and 36 % patients were control. Prevalent was more among the lower class population. The middle and upper class population shows 9% and 28% prevalence rate of cases and control respectively. (Table II)

Table II: Demographic characteristics of the study groups.

Parameter	Control (n = 100)	Cases (n = 100)
AREA		
Rural	53 %	64 %
Urban	47 %	36 %
Socio-Economic status (Monthly Income in Rs/month)		
Low (<5,000)	56 %	63 %
Middle (5000-10,000)	15 %	09 %
High (> 10,000)	29 %	28 %

Table III: Oxidative stress profile of the study groups.

Parameters	Senile cataract (n = 100)	Control (n= 100)
SOD(units/ml)	2.19± 0.04*	3.08 ±0.081
Vit C (mg/dl)	0.74 ± 0.01*	0.88 ± 0.01
Vit E(mg/dl)	0.71 ± 0.03*	0.82 ± 0.01

n= number of cases or control groups, All values are expressed in Mean ± SD

* Significant when compared to control groups ($P<0.001$).

Serum SOD level was significantly lower in the senile cataract group as compared to control group. Vitamin C levels in plasma also showed a significantly lower range in senile cataract as compared to control group. Vitamin E level in plasma was also significantly lower in the senile cataract group, when compared to control group. (Table III)

DISCUSSION

The present study has shown that prevalence of senile cataract is more in the rural as compared to urban areas. Also it is more prevalent among the lower class population as compared to middle or higher class population. The probable reason for this finding is that the rural and low socio-economic status population lacks in knowledge, practice and affordability of a good nutritious diet, which has got a protective value in cataractogenesis. The present study findings were supported by the studies conducted in various populations by Hiller et al, Chatterjee et al, Brilliant et al, Bhatnagar et al and Badrinath et al.

In the present study, enzymatic antioxidant status was studied by estimating serum SOD. SOD levels were decreased in senile cataract when compared with control ($P<0.001$). SOD is the enzymatic antioxidant which provides first line of the defense that acts by quenching superoxide free radical and converting it into hydrogen peroxide. There are two possible reasons for lowering of SOD in the present study; a. There is age related increase in production of reactive oxygen species like superoxide. This superoxide is then converted into hydrogen peroxide by the action of SOD. Therefore this SOD is used up in this process. This will lead to decrease levels of SOD. b. Hydrogen peroxide also directly causes inhibition of SOD activity. The similar trend of SOD decrease was also observed by Feconodo et al and Garg et al.

In the present study, vitamin C levels in plasma were significantly decreased in age related senile cataract when compared with control group ($P<0.001$). Vitamin C is considered the most important antioxidant in extra cellular fluids and the only endogenous antioxidant that can completely protect the lipid from detectable peroxidative damage induced by aqueous peroxyl radical. Vitamin C acts as a co-oxidant by regenerating alpha tocopherol from alpha tocopherol radical produced during scavenging by reactive oxygen species. Jacques et al reported decreased incidence of cataract with elevated vitamin C level in blood. The present study findings are may be due to its utilization by counteracting reactive oxygen species or due to its oxidation by superoxide.

Plasma vitamin E levels were significantly lowered in age related senile cataract. Vitamin E is thought to be an important chain breaking antioxidant and can directly scavenge reactive oxygen species. It is a major lipid soluble antioxidant present in cellular membranes, which protects against lipid peroxides. As demonstrated by Jacques PF in1999, low serum concentration of vitamin E was associated with increased risk of cataract. Seddon JM et al proved that foods rich in vitamin with antioxidant properties have the potential to prevent cataract. Experimental studies have demonstrated that both Vitamin C and Vitamin E prevent lipid peroxidation in response to photo oxidative assault and limit lens damage after oxidative stress in animals fed with these vitamins. But the studies conducted by Olmedilia et al and Gale et al reported no significant co relation between serum or plasma levels of Vitamin E and age related cataract.

CONCLUSION

The present work suggests that the breakdown of anti-oxidant defense mechanism or increased oxidative stress leads to free radical injury resulting in oxidative damage to lens proteins. This causes initiation and progression of cataract. Enhancing the endogenous antioxidant capabilities may be an important prophylactic intervention of the process. If educational and social instructions can be popularized regarding the beneficial effects of vitamins and nutritional status of food that we eat, we can make the right decision to prevent or delay the initiation of cataract formation. Antioxidant therapy may have a role to play in delaying the onset and progression of age related cataract

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