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"Estimation of Copper, Malondialdehyde and Ceruloplasmin Levels in Senile and Diabetic Cataract"

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I. Introduction

Cataract is one of the major causes of impaired vision and blindness worldwide and is most simply defined as opacity of the crystalline lens. Any alteration in the optical homogeneity of the lens or decrease in its transparency is known as a cataract [1].

Senile cataract, a major cause of blindness worldwide, is an-age associated condition[2,3]. The term senile refers to the fact that no specific ophthalmic or metabolic diseases are known to precede or to be involved in this type of cataract [4]. Based on the etiology cataract can be divided into senile or age-related cataract, congenital cataract and cataract associated with systemic disease [5].

Opacity of the ocular lens and cataract occurs earlier and more frequently in patients with diabetes[6]. First noted that the proteins of human cataractous lenses contain a greater number of disulfide bonds than did normal lenses, which reflects markedly increased sulfhyrdryl oxidation. Since disulfide bonds can function as intermolecular cross links, these bonds participate in the polymerization of lens proteins to form high molecular weight aggregates. These high molecular weight aggregates are capable of scattering light [7]. The formation of the high molecular weight aggregates in diabetes is facilitated by an increased susceptibility of lens proteins to sulfhyrdryl oxidation as a result of nonenzymatic glycosylation[8].

Increasing experimental evidences suggest that glycation of lens proteins is involved in cataract formation.

Another mechanism in the development of diabetic cataracts is the intracellular accumulation of polyols. This causes osmotic swelling and eventual disruption of cell architecture. The swelling has adverse effects since it increases the permeability to substances normally retained in the lens at concentrations higher than surrounding intraocular fluids. Thus the concentrations of potassium, amino acids, glutathione, inositol and ATP begin to decrease and sodium and chlorine ions slowly begin to build up. Eventually the increase in these electrolytes becomes the predominant factor in lens swelling. The swollen lens fibers eventually rupture with the liquefaction of the fibers resulting in vacuole formation.

The lens, which is behind the iris, refracts light entering the eye through the pupil, thus focusing it on the retina. The perfect physiochemical balance of the lens proteins gives it transparency. The lens, like the erythrocyte, is not dependent on insulin for glucose uptake and hence the intracellular glucose concentration reflects the extra cellular milieu**,** hence develops diabetic cataract.

Several risk factors have been identified for the development of human cataract: aging, diabetes, diarrhea, malnutrition, poverty, sunlight, smoking, hypertension, and renal failure. Cataract formation is mostly considered to be a multi-factorial disease, and oxidative stress might be one of the leading causes for cataract.

The imbalance between the rate of free radical production and the antioxidant defense causes cellular damage resulting in lipid peroxidation. Oxidative stress is involved in many ocular diseases such as age-related macular degeneration, retinopathy of prematurity, retinal light damage, and cataract. Reactive oxygen species (ROS) are thought to play a role in a variety of physiological and pathophysiological processes in which increased oxidative stress may play an important role in disease mechanisms. In diabetic conditions, ROS are produced via glucose autoxidation and also via non-enzymatic protein glycation in various tissues. ROS is considered to have an important role in the development of microvascular complications in patients with diabetes.

Aim of the Study:

The aim of the present study is to identify persons of senile and diabetic cataract and study their biochemical parameters. Early identification of risk factors can help in decreasing the severity of the senile and diabetic cataract. Mortality and morbidity can be decreased by simple measures like periodical examination of eyes and pharmacotherapy.

The objectives of the present study are:

- To compare blood sugar and antioxidant levels in diabetic senile cataract with those of non-diabetic senile cataract persons.

- To assess the severity of the disease process in cataracts with diabetic senile cataract by assessing the biochemical parameters.

The biochemical parameters included in the study are:
1. Blood sugar
2. Serum Malondialdehyde (MDA)
3. Serum Copper
4. Serum Ceruloplasmin

II. Materials and Methods

The present study is conducted in the Department of Biochemistry and Department of Ophthalmology, S.V.S. Medical College and Hospital, Mahabubnagar. A Total of 20 cases of Senile & Diabetic Cataract were studied.Each subject was selected under the following inclusion criteria.

- Cataract patients were selected based on the vision less than 6/18 and visible opacity in the lens.
- All the patients were above 45 – 65 years of age.
- Both patients and control subjects were not on vitamin, mineral, any drug or such supplementation.

Old age persons with any other complications than cataracts were excluded from the study. The biochemical parameters of cases(Senile & Diabetic) were compared with those of normal persons.

Collection of Blood Samples:

About 6ml of blood is collected under aseptic condition. About 1ml dispensed into clean dry bottle with EDTA (ethylene diamine tetra acetic-acid) for estimation of Random Blood Glucose, the rest of blood is allowed to clot serum is obtained, with precautions to avoid hemolysis.

The following investigations are done.

1). Blood glucose is estimated by glucose oxidase peroxidase method
2). Copper is estimated by Colorimetric Method
3). Ceruloplasmin is estimated by Copper Oxidase Activity Method.
4). Malondialdehyde(MDA) is estimated by Thiobarbituric Acid Method.

All investigations were done on same day of sample collection using semi auto analyzer and spectrophotometry.

Statistical Analysis:

Mean and standard deviation (S.D.) of all variables were calculated and compared with those of controls. Statistically significant.

III. Results

The present study on Senile and Diabetic cataract levels in copper, MDA and ceruloplasmin in Senile and Diabetic cataract includes a total number of 60 subjects, comparing 20 Senile cataract, 20 diabetic cataract and 20 controls (normal old age people) was assessed by applying the student's t-test, p-value<0.01 were considered significant.

Comparative statistical analysis of all biochemical parameters

RBS(Senile)		Control	Cases
	Mean	103.6	124.15
	S.D	16.44	12.04
	S.E.M	4.45	
	t-test	4.61	
	p-Value	<0.01	

RBS(Diabetic)		Control	Cases
	Mean	103.6	233.9
	S.D	16.44	41.06
	S.E	11.55	
	t-test	10.9	
	p-Value	<0.01	

MDA (Senile)		Control	Cases
	Mean	250.4	317.3
	S.D	16.68	7.57
	S.E	4.09	
	t-test	16.33	
	p-Value	<0.01	

MDA (Diabetic)		Control	Cases
	Mean	250.4	348.75
	S.D	16.68	16.43
	S.E	4.09	
	t-test	16.33	
	p-Value	<0.01	

Copper (Senile)		Control	Cases
	Mean	111.7	126.75
	S.D	16.62	11.18
	S.E	4.48	
	t-test	3.35	
	p-Value	<0.01	

Copper (Diabetic)		Control	Cases
	Mean	111.7	153.35
	S.D	16.62	6.61
	S.E	4.0	
	t-test	10.4	
	p-Value	<0.01	

Ceruloplasmin (Senile)		Control	Cases
	Mean	31.05	35.1
	S.D	4.33	4.45
	S.E	1.44	
	t-test	8.08	
	p-Value	<0.01	

Ceruloplasmin (Diabetic)		Control	Cases
	Mean	31.05	42.7
	S.D	4.33	4.76
	S.E	1.39	
	t-test	2.91	
	p-Value	<0.01	

IV. Discussion

Cataract is a major cause of blindness in the developing world like India. It accounts for 47.8% all cases of visually impairment people. Cataracts appear early in life in developing countries and the incidence is higher.

In India cataracts appears 14year earlier than in the U.S. the age adjusted prevalence of cataract is 3times that of U.S.

In the present study blood sugar, MDA (malondialdehyde), copper, and ceruloplasmin are studied in senile as well as diabetic cataract.

The results of the present study are discussed under 3 groups.

Groups – 1 Control Subjects.
Groups – 2 Senile cataracts Subjects.
Groups – 3 Diabetic cataracts Subjects.

Group 1: Control Subjects:

A total number of 20 normal subjects were studied. The age group of those controls ranged from 45 to 65 yrs. All the subjects are normal healthy adults the results of estimation of RBS, MDA, copper and ceruloplasmin are with in the normal limits.

Group 2: Senile Cataract:

A total number of 20 cases were studied the age group of these patients ranged from 45 to 65 years .All senile cataract subjects showed normal to impaired values of blood sugar. The mean SD of senile people are 124.15 $\pm$ 12.04. The p–Value is below <0.01 which is significant.

The MDA levels are 317.3 $\pm$ 7.57 in these patients. The p–Value is <0.01 which is significant.

The copper values were found to be 126.75 $\pm$ 11.18 in these cases. The p–Value is <0.01 which is significant.

The ceruloplasmin values were found to be 35.1 $\pm$ 4.45 in these cases. The p–Value is <0.01 which is significant.

The investigations like RBS, MDA, copper & ceruloplasmin were found to be important in the outcome of senile cataract.

The elevated levels found in these investigations co-related with the age related changes found in the senile cataract people.

Group 3: Diabetic Cataract:

A total number of 20 cases of known diabetic were studied. Methodical history in previous investigations was observed. The random blood sugar, MDA, copper & ceruloplasmin investigations were undertaken in these subjects. The blood sugar levels ranged from 233.9 $\pm$ 41.06 was found the p–Value <0.01 which is significant.

The mean value of MDA is 348.75 $\pm$ 16.43 in these cases. The p–Value <0.01 which is significant.

The mean value of copper is 153.35 $\pm$ 6.61 in these cases. The p–Value <0.01 which is significant.

The mean value of ceruloplasmin in diabetic patients is 42.7 $\pm$ 4.76 in these cases. The p–Value <0.01 which is significant.

The 20 cases of senile cataract with that of diabetic cataract when compared the random blood sugar levels were found to be much higher in diabetic cataract patients than senile cataracts.

The MDA levels which is an end product of lipid peroxidation were found to much higher in diabetic senile cataract patients than in senile cataract patients. This correlates with the pathogenesis and microvascular complications found in diabetic senile cataract patients.

The copper levels found to much higher in diabetic senile cataract patients than in senile cataract patients

The ceruloplasmin levels found to much higher in diabetic senile cataract patients than in senile cataract patients.

V. Conclusion

1. A comparative study was done between normal non-diabetic senile cataract and diabetic senile cataract. With the help of random blood sugar, MDA, Copper and Ceruloplasmin.
2. The patients were carefully chosen between normal and non-diabetic senile cataract and diabetic senile cataract based upon age clinical symptoms signs and previous investigation reports available with the patients.
3. The blood samples were obtained from as controls non-diabetic senile cataract and diabetic senile cataract patients at the time of their of admission. The RBS, MDA, Copper and Ceruloplasmin levels were estimated by standard methods.
4. There was definite elevation of RBS, MDA, Copper and Ceruloplasmin in the non-diabetic senile cataract as well as in diabetic senile cataract.
5. The RBS is normal to impaired to non-diabetic senile cataract consistence elevation in diabetes senile cataract the difference between control, the non-diabetic senile cataract, diabetic senile cataract subjects were significantly increased .
6. The MDA levels were higher in diabetes senile cataract. The Copper and Ceruloplasmin levels were on higher side in these patients.
7. It can be concluded from the above study that estimation of RBS, MDA, Copper and Ceruloplasmin may receive as a predictive guide and understanding the pathogenesis, the intervention may be initiated it an early date to avoid the complications.

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