

STUDIES ON PROTEIN AND TAURINE IN NORMAL, SENILE AND DIABETIC CATARACTOUS HUMAN LENSES

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Abstract : An attempt has been made to explore the possible role of Taurine in cataractogenesis. Normal lenses were obtained from eye bank donors and cataractous lenses from patients who had undergone surgery for cataract extraction. Lenses were weighed and homogenised. Extraction, isolation and estimation of protein and taurine were carried out. It has been found that the lens wet weight increased progressively with the stage of maturation of cataract, i.e., from mature to hypermature which was significant and also with increase in age. Diabetic cataract group also showed an increase similar to that of senile cataract. Taurine and total protein decreases with different stages of maturation of cataract but not with age. It may be suggested that in the process of development of human senile cataract, there is (a) alteration in the structural integrity and permeability of lens membrane to protein and amino acids including taurine, (b) changes in the lens function including possible inhibition of proteins and amino acids (taurine) synthesis and transport across the cell membrane.

Key words : senile cataract
total protein

diabetic cataract
taurine

INTRODUCTION

Blindness is a major problem in the developing countries like India. A major cause of blindness is cataract (55%) and about 85% of cataract is classified as

‘Senile’, the cause of which is unknown. “Senile Cataract” is observed to some extent in 65% of normal individual between the age of 51–60 years 95% in case of persons above the age of 65 years (1). The present understanding of the complex biochemical

and structural events leading to the formation of senile cataract is quite incomplete. Under these circumstances, the present investigation, i.e., lens "total protein" and "taurine", was carried out with a view to explore their possible role in the basic mechanisms involved in the cataract formation.

METHODS

Normal lenses were collected from patients of 20–40 years within 1–6 hours of death (2). The cataractous lenses in different age groups and sex were grouped according to the clinical finding with different stages of maturity of cataract (immature–20, mature–35, hypermature–20 and diabetic–10). Diabetic cases were confirmed by blood and urine sugar. The criterion employed to label the stages of maturation of senile cataract were based on visual acuity, ophthalmoscopic and slit lamp examinations (2). The wet weight of the lenses were taken within 1–6 hours in case of normal and within 1 hour in case of senile and diabetic cataract. The free amino were extracted by the method of Mathur et al. (3). The total protein and taurine were estimated by the method of Lowry et al. (4) and Gaitonde and Short (5) respectively.

RESULTS AND DISCUSSION

The present understanding of the complex biochemical and structural events leading to the formation of senile cataract is quite incomplete. It is probable that diet, malnutrition, especially deficiency of proteins, amino acids, vitamins etc. may bring about development of cataract at an earlier age. The present experiment is aimed to delineate the role of total protein and

taurine in human normal lenses, senile cataract lenses and diabetic cataract lenses at different stages of maturation.

The mean lens wet weight increases significantly ($P < .001$) with maturation of cataract, the maximum being in hypermature cataract. (Table) The lens wet weight in diabetic cataract was also increased significantly ($P < .001$) as compared to normals which was similar to that of mature cataract. Agarwal et al. (6) and Sreekumar et al. (7) also reported an increase in lens wet weight with the stages of maturation of cataract. But Mathur et al. (8) found the maximum weight for immature cataract. In the present study, the lens wet weight increased not only with the stage of maturation of cataract, but also with increase in age. Duke Elder (1) and Agarwal et al. (9) were of the opinion that the crystalline lens gradually increases its weight with increases in age. The wet weight of the lens has no relation with sex. Both male and female showed the same lens wet weight in different groups and followed the same pattern of increase in lens weight as the stage of maturation of cataract.

The levels of total proteins in human senile cataract lenses were decreased significantly ($P < .001$) but gradually from immature to hypermature cataract (Table). A reduction in total soluble protein in senile cataract lenses of different stages of maturation have also been reported in the past (10). Agarwal et al. (6) also observed a reduction in total soluble protein in senile cataractous lenses of different stages of maturation which is in agreement with the present observation. The reduction in soluble proteins in the lens during cataractogenesis could be due to the leak

TABLE I: Mean lens wet weight, total protein and taurine in normal, senile and diabetic cataract.

		<i>Normal</i> (15)	<i>Immature</i> (20)	<i>Mature</i> (35)	<i>Hyper-mature</i> (20)	<i>Diabetic</i> (10)
Lens wet weight (mg/lens)	Mean±SE	185.40±4.86	211.70±4.47	234.05±4.46	259.05±9.90	233.00±13.86
Total protein (mg/gm/lens)	Mean±SE	70.96±3.04	54.32±4.17	47.74±2.54	34.68±2.05	52.91±7.65
Taurine (U mole/gm/lens)	Mean±SE	27.29±0.42	12.16±0.35	6.98±0.22	4.68±0.14	6.47±0.42

No in the parenthesis indicates number of observations.

in the lens fibre membranes which is supported by the observation of an increase in protein concentration in aqueous humour (11, 6). It is proposed that "Osmotic Swelling" due to accumulation of proteogenic amino acids may also causes direct leakage of soluble protein from the lens (12, 13). The diabetic cataract cases also showed a reduction in total proteins in comparison to normal lenses which was statistically significant ($P<.05$). The total proteins in diabetic cataract was very much close to that of senile immature cataract. It is probable that under this circumstances, there is an increase in the level of sorbitol in diabetic lens which draws water, thus reputering the lens fibre which in turn causes opacification of lens cortex.

Taurine is proposed to be a factor important in the stability of cell membrane and for osmotic and ionic balance (8). In the present study, the concentration of lens taurine decreased significantly ($P<.001$) in comparison to normal but progressively with the stage of maturation of senile by about 50% in immature, 74% in mature, 83% in hypermature and 76% in diabetic cataract. Gupta and Mathur (2) also found a reduction of about 50% taurine content of crystalline lens after the onset of cataractogenesis. They were of the opinion that the concentration of taurine in lens may be

derived by (a) active transport from aqueous humour, (b) synthesis, (c) secretion of ciliary body. Mathur et al. (8); Gupta and Mathur (2) and Chauhan et al. (14) reported a progressive decrease in lens taurine with the formation of cataract both in human senile and galactose cataract in experimental animals. It was also observed in the present study that the human diabetic cataractous lenses showed a reduction in taurine content which was statistically significant ($P<0.001$) and was similar to that of senile mature cataract. Barber (15) also observed a depletion of taurine in alloxan diabetic rabbits.

The levels of proteins and taurine in the present experiment was not altered with age or sex but altered with the maturity of cataract. Chauhan et al. (14) observed that the concentration of most of the free amino acids present in the normal lens decrease gradually with various stage of maturation of cataract, and it seems that the free amino acids of normal lenses are utilised in the formation of proteins responsible for the formation of cataract. But Agarwal (6) found no change in the levels of total free amino acids in serum and aqueous humour of patients with different stages of maturation of senile cataract. That is aqueous humour seem to maintain fairly constant levels of total free amino acids during the maturation

of human senile cataract, despite the decrease observed in the levels of total amino acids in cataractous lens at different stages of maturation of senile cataract (6, 14, 15). It is noteworthy that taurine concentration decreases sharply even at the immature stage of senile cataract where only some of the fibres are opaque. Therefore, it appears that the alteration in taurine concentration in senile cataract may be related to some early changes in lens opacification in cataractogenesis.

In short taurine and total protein decreased with stage of maturation of cataract, but not with age, while lens wet weight increased with stage of maturation of cataract and also with increase in age. It may be suggested from this study that in

the process of development of human senile cataract there is (a) alteration in the structural integrity and permeability of lens function including possible inhibition of protein and amino acids (taurine) synthesis and transport across cell membrane. Thus it creates scope for the assessment of the wider significance of soluble proteins and amino acid taurine in human ocular tissues, especially lens (both normal and cataractous lenses) for their probable role in cataractogenesis.

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