Chapter 9

Conclusions and future prospects
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9.1 CONCLUSIONS

Data presented in this study report have provided insights into the effect of alterations of some biochemical components of fibre membranes of the crystalline lens. These biochemical alterations are associated with changes in the physical properties of these membranes as evident from the scanning electron microscopic images of our investigation. Crystalline lenses are formed by numerous fibres. These fibres are in fact elongated transparent cells. The membranes of these fibre cells play a vital role in their transparency. The transparency of the crystalline lens is by virtue of the transparency of its fibre cells. Like any other cell membrane, the fibre cell membranes of the crystalline lens are composed of lipid protein complexes. Proteolipids and phosphatido-peptides are the major lipid protein complexes of these cell membranes. Phospholipids and proteins are the most important components of both proteolipids and phosphatido-peptides of human lenticular cell membranes.

This study aimed to investigate whether there is any alteration of phospholipids and protein content of proteolipids and phosphatido-peptides during the process of senile cataractogenesis. The results show that proteolipid bound phospholipids decreases progressively during cataractogenesis and its advancement till its maturity in comparison to the clear crystalline lenses. This depletion occurs in capsule-epithelium region as well as the cortex-nucleus region. Simultaneous alteration of proteins in proteolipids is also an important phenomenon. Similar changes also occur in the phospholipids and protein content of phosphatido-peptide of human senile cataractous lenses. Another aspect of the novel observations of this study is that different types of proteolipids are formed at different stages of
maturation of senile human cataract as evident from the fractionations of proteolipids on silicic acid columns during different stages of the age related cataract. The quantitative alteration in phospholipids composition of proteolipids is also associated with a change in the percentage of individual phospholipids bound to proteolipids at different stages of cataract. All these changes lead to a cleavage of the proteolipids as well as phosphatido-peptides during cataract formation. These two lipid protein complexes being the major constituents of membranes of lens fibers, their compositional alterations and cleavages cause alteration of the semi-permeability of the membranes or even membrane disintegration in cataractous lenses.

In addition, investigations to see whether the lenticular changes have got any relation to the corresponding serum constituents reveals that there is an increase in serum total phospholipids and serum total cholesterol coupled with a reduction in the serum total proteins in cataractous individuals causing rising trend in the ratio of total phospholipids to total proteins and total cholesterol to total proteins. These alterations in senile individuals may be some of the factors responsible or associated with cataractogenesis. Cataract is a multifactorial disease related to genetic, environmental and nutritional factors. We do not insist on increased serum total phospholipids, increased serum total cholesterol and decreased serum total protein level to be the conclusive alteration in the processes of senile cataract formation. Of course, it is possible that a gradual and constant variation in these parameters together with the phospholipids and protein changes in the senile lens may be some of the predisposing factors in cataractogenesis.

One of the aims of the current study was to determine whether the pattern of changes in the phospholipids and protein contents of proteolipids and phosphatido-peptides during the process of senile cataractogenesis in human lenses is similar to that of experimental galactosemic cataract lenses. It was found that in the cataractous lenses of experimental galactosemic rats the alteration in the
proteolipid bound phospholipids is insignificant associated with a significant
decrease in content of proteins in proteolipids while these components are compared
to those of non-opaque rat lenses. Similar changes were noticed in phosphatido-
peptides as well. It is evident that both these cataracts of different aetiology have got
some similarity in the mechanism of cataractogenesis in that both have got alteration
in some content of proteolipids and phosphatido-peptides. It indicates that alteration
in the quality of lens membranes is a major change during the process of lenticular
opacification irrespective of the aetiology in both galactosemic rat lenses and senile
human lenses.

Comparative ultramicroscopic examinations of surface morphology in
lenses with different stages of cataract and without cataract reveal the occurrence of
alteration in the membrane architecture during cataractogenesis. There is similarity
in the changes of appearance of the fibre cell membranes from different stages of
cataract while compared to the corresponding membranes from non-opaque lenses.
With extreme advancement of the cataract the cortical fibre-membranes rupture.
Remnants of the ruptured membranes, which remain attached to the intact epinuclear
or nuclear fibres also show the physical alteration.

The data and observations of this research work are novel information
related to the development and progression of cataract. Phospholipids and proteins of
proteolipids and phosphatido-peptides get altered in the lens tissue and thereby cause
qualitative changes of proteolipids and phosphatido-peptides in human lens during
cataractogenesis. These biochemical changes results in physical disturbance in the
membrane characteristics of the lens fibre cells leading to the alteration in
semipermeability or even rupture of the fibre cell membranes. The outcome of these
changes is cataract formation and its progression. Biochemical changes in the morbid
lenses have got some relation to the alterations of corresponding serum components.
Though the aetiology is different in senile human cataract and experimental
galactose cataract, both have got some amount of similarity in the mechanism of opacification of the lenses.

9.2 FUTURE PROSPECTS

A systematic combined approach in biochemical estimations with newer methods associated with latest technology and examining ultrastructure in several regions within each lens in a number of lenses in the future will permit to gather the conclusive knowledge of the mechanism of cataractogenesis.

Further research works may lead to the invention of safe drugs to stabilize phospholipids and proteins of crystalline lenses and blood as well. It may then be possible to prevent or reverse the progression of cataract at its early stage. Medical treatment will then replace the surgical management of cataract.

There are several published works on the relation of nutrition and cataract. The deficiency of some dietary nutrients, mostly lutein and zeaxanthin, are implicated to be an important factor causing cataractogenesis. Yet, adequate intake of these nutrients has not been reported to permanently cure or prevent the visual disturbance due to cataract. In fact some of the micronutrients are demonstrated to have adverse affect to the human health. Further investigations on the relationship of safe micronutrients to cataract may help in eliminating cataract related blindness.

Research for genetic basis and treatment of cataract is another scope for cataract related study. There are very few published works on this aspect. Further genetic research may lead to discoveries regarding genetic prevention and gene
therapy of cataract, which may be the future way of management and prevention of cataract.

Finally it can be sincerely hoped that multidisciplinary research and approach to solve the problem of cataract will one day eradicate cataract related blindness from the world.