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Serum electrolytes in senile cataract patients

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Abstract: *Introduction:* Cataract refers to opacification of crystalline lens in the human eye. Globally, cataract accounts for 50% of blindness and remains the leading cause of visual impairment all over the world, despite improvements in surgical outcomes. Age is the strongest known non-modifiable risk factor for cataract formation. One of the proposed risk factors for cataract formation is rise in serum sodium ion level. Role of potassium and chloride are inconclusive Even though ageing cannot be prevented, physiological changes that occur in electrolytes can be modified. The aim of the study was to estimate serum electrolyte levels in senile cataract patients as compared to those without cataract. *Methods:* This study includes hundred senile cataract patients and age matched hundred healthy people without cataract. Serum electrolytes were estimated by using an electrolyte analyzer which works on the principle of ion selective electrodes. *Results:* We noted a highly significant ($p<0.0001$) rise in sodium levels in cases (146.35 ± 3.49 meq/l) as compared to controls (142.77 ± 3.75meq/l).Chloride levels were also significantly elevated ($p<0.05$) in cases (102.32 ± 4.10meq/l) as compared to controls (100.82 ± 4.12 meq/l). Serum potassium level, even though elevated in cases, it was statistically insignificant. *Conclusion:* From this study we can conclude that sodium and chloride may be used as markers of senile cataract formation. Dietary salt restriction may help to lower the sodium and chloride levels and delay the process of cataract formation.

Keywords: Electolytes; old age; cataract

Introduction

There are about 50 million blind people in the world, a third of them being due to cataract. Its prevalence in developing countries is much more than the developed ones [1]. In India alone, cataract accounts for 80% of treatable blindness [2]. One of the most common types of cataract is the senile cataract which occurs as a consequence of the aging process [3]. Senile cataract usually occurs after the age of 45 years. Approximately 75 percent of population above the age of 75 years suffers from cataract [3-4].

Many risk factors such as age, sex, radiation, genetics, metabolic disorders, [4-6] protein aggregates (http://www.medsci.org/v01p0165.htm-B13 [7]) oxidative stress [8], post translational protein changes [9-10], phase separation are proposed for cataract formation, though the exact pathogenesis is not yet known. Aqueous humour is the main source of nourishment for the lens. This thin fluid, is produced from the serum. Therefore, serum electrolytes concentration directly affects electrolytes of aqueous humor and in turn regulates lens metabolism [4]. It has been proved that, in aqueous humour potassium is replaced with excess sodium and hence there is an alteration in their ratio in cataract patients. This was attributed to the changes that occur in the serum cations [11]. As this fluid is derived from the plasma, derangement in serum electrolytes appears to be one of the risk factor for cataractogenesis.

Some studies have shown significant difference in serum electrolytes concentration in senile cataract patients when compared to those without cataract [4-5]. The purpose of the study is to estimate serum electrolytes in senile cataract patients as compared to the healthy age and gender matched people without cataract. To the best of our knowledge, there are a few studies in this field [3, 12-15] and the results are inconclusive. As cataract is one among the treatable causes of blindness, it is justifiable to make an attempt to identify a probable risk factor for the cataractogenesis.

Aims and objectives:

1. Estimate the serum sodium and potassium levels in patients with senile cataract
2. To compare the electrolyte levels with the age and gender matched healthy controls without cataract
3. To study the association of serum electrolytes with risk of cataract formation

Material and Methods

It is a cross sectional observational study conducted in the department of Biochemistry in collaboration with the department of Ophthalmology, IGMC &RI, Puducherry. The duration of the study was two months. Senile cataract patients who were scheduled to undergo cataract surgery in the Department of Ophthalmology were taken as cases. The patients with complicated cataract, those with renal disorders, liver cirrhosis, hypertension, diabetes mellitus, thyroid disorders, infections, those who have sustained trauma, those on medications which alter electrolytes like steroids, smokers, and alcoholics were excluded from our study. Exclusion was done based on the relevant history, physical examination and minimum investigations required in making the diagnosis.

Based on this, two groups were made:

- Group I: Senile cataract patients, who were scheduled to undergo cataract surgery
- Group II: Age and gender matched normal healthy individuals without cataract, who were attending the government medical college hospital for routine checkup.

Each group included 100 subjects. Approval from the institutional ethics committee was obtained. Informed written consent of the participants was taken. A pre structured proforma was used to collect the baseline data and the cases were examined by an ophthalmologist of our hospital.

Methodology: Biochemical estimation: Two ml of blood sample will be collected with aseptic precautions for the estimation of serum electrolytes. Electrolytes will be estimated by using the electrolyte analyzer which works on the principle of ion selective electrodes. Fasting blood sugar was estimated in automated chemistry analyzer, using reagent kits which work on Glucose oxidase-Peroxidase method.

Statistical analysis: The data wasanalyzed by unpaired Student's T test. SPSS 17 software package was used for the statistical analysis. The association between electrolytes and risk of cataract formation wasstudied by using Odd's ratio.

Results

In this study the case group consisted of 100 patients suffering from age-related cataract (64 female, 36 male) and the control group consisted of 100 healthy subjects who were attending the OPD for regular checkup or patient's bystanders (61female, 39 male). Mean age and standard deviation of case and control groups were 60.92±9.5 years and 58.32±10.5 years, respectively. Age group of patients and controls were 43-87years and45-99 years respectively. Reference range for sodium was taken as 135-145 meq/l , for potassium is 3.5 – 5.0 meq/l and that for chloride 98-105 meq/l. Senile cataract patients had a highly significant elevation in sodium levels 146.35 ± 3.49 meq/l ($p<0.0001$) as compared to controls, 142.77 ± 3.75 meq/l.It has also been found that potassium levels were also elevated, 4.34 ± 0.53 meq/l as compared to controls,4.24 ± 0.65 meq/l, but statistically insignificant ($p>0.05$).Serum chloride levels in cases were 102.32 ± 4.10meq/l and that in controls was 100.82 ± 4.12meq/l. The elevation of chloride is significantly high in cataract patients ($p<0.05$).Values are depicted in Table 1.

Table-1: Comparison of serum electrolytes in senile cataract patients versus controls

	Senile cataract patients (n= 100)	Controls (n= 100)	P value
Sodium (meq/l)	146.35 ± 3.49	142.77 ± 3.75	<0.0001*
Potassium (meq/l)	4.34 ± 0.53	4.24 ± 0.65	>0.05**
Chloride (meq/l)	102.32 ± 4.10	100.82 ± 4.12	< 0.05 ***
Blood sugar (mg/dl)	97.97 ± 17.22	96.81 ± 22.72	0.068**
*Very highly significant, ** Insignificant, ***Significant, n:Number of subjects			

The association of serum electrolytes and risk of cataract formation is as shown in Table 2. Chances of senile cataract formation is 5 times greater in people with serum sodium > 145 meq/l.

Table-2: Odd's Ratio		
	Senile Cataract	**Controls**
Increased serum sodium	64 (a)	26(b)
Normal serum sodium	36 (c)	74(d)
Odd's Ratio = ad/bc = (64x74)/ (36x26) = 5		

Similarly odd's ratio is calculated to find the risk associated with elevated chloride (>105 meq/l) and cataract formation. People with high serum chloride levels are 1.7 times at a higher risk of developing senile cataract. Potassium levels did not show any significant correlation with cataract formation.

Discussion

We have found a significant elevation in serum sodium and chloride levels in senile cataract patients as compared to healthy controls and an elevation in potassium levels even though statistically insignificant. Elevation in serum sodium levels is in accordance with the studies by Rewatkar *et al* and Mathur *et al* [3, 13]. Our results are matching with the conclusions drawn by various studies, even though controversies exist [12,14-15].

A study among Ghanians [16] showed a very strong association between the level of exposure to serum sodium and the probability of developing the senile cataract. Comparing the serum electrolyte levels, there was a statistically significant difference between the mean serum Na+ level in senile cataract patients and normal individuals. The mean serum K+ levels of senile cataract patients was statistically insignificant as compared to controls. The study concluded that exposure to sodium in the absence of other biochemical risk factors remained the most significant risk factor for the development of senile cataract.

A study in Iranian population [2] by Mansour Mirsamadi et al, showed that the mean of serum Na^+ of cataract patients were in the normal range but were in the upper limit of this range and in comparison with control group, the serum Na^+ of the patients was significantly elevated.But potassium did not show any significant difference.

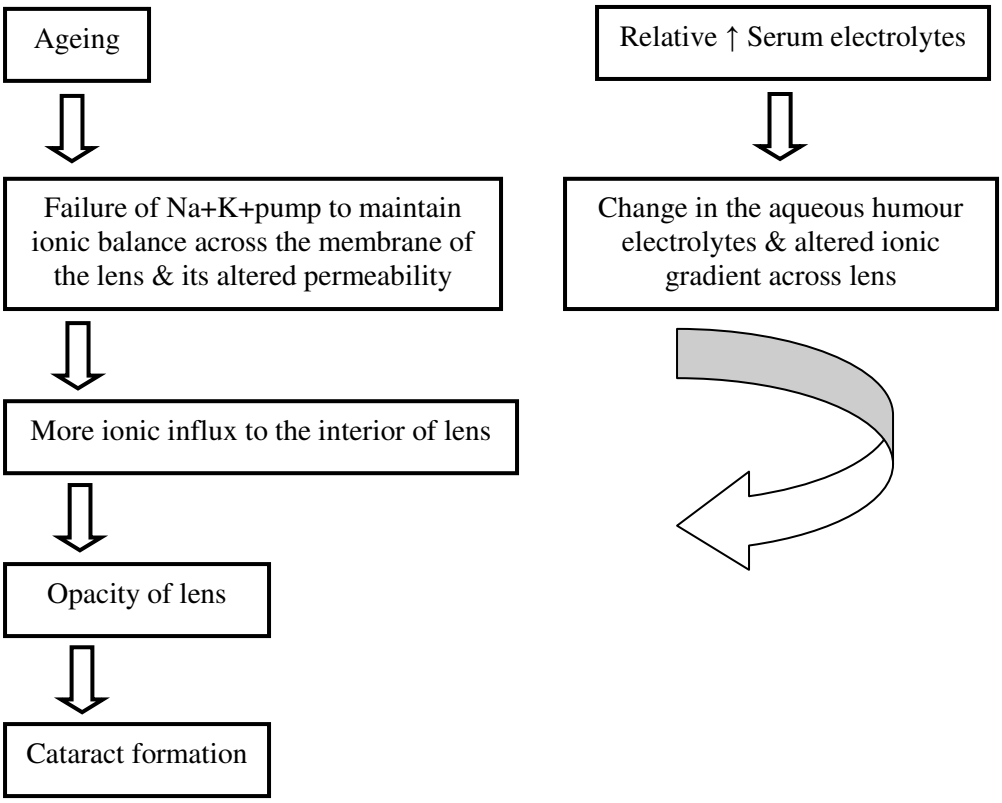
Elevation of serum electrolyes in senile cataract patients can be explained as follows: Lens has a high content of potassium and low content of sodium. These two cations are in balance with each other due to Na+- K+-ATPase pump and lens capsular permeability. Normally lens has high level of K+ (114-130 mmol/L) and low Na+ (14-26mmol/L). These two cations are in balance with each other due to action of Na+ K+ATPase pump, which in turn maintains permeability of lens membrane [2].

With ageing there is an increase in membrane permeability of the lens cells due to reduced activity of Na+ K+ ATPase pump, which leads to an increase in internal Na+. Higher levels of extracellular Na+ might make it more difficult for Na+ K+ ATPase pump to maintain the low levels of intracellular Na+ required for lens transparency [17-18]. Variation of electrolytes in the serum in turn alters cation concentration of aqueous humors, which ultimately affect lens metabolism leading to cataract formation [19].

Alteration in cation concentration of aqueous humor which is attributed to alterations in serum cation concentration, can be an important risk factor for cataract formation [20]. Previous studies notify the significant difference between serum sodium of those suffering from age-related cataract versus those without cataract. But serum potassium did not show significant variation. Diets with high sodium contents could be a risk factor for senile cataract formation. As it seems, a high level of serum sodium in turn contributes to cataract formation [21].

The permeability lens is high for the chloride. The Na+-K+ 2Cl- co transporter has been identified defect of which hampers chloride handling by the lens. The ability of the lens to maintain its hydrated state is lost, imbalance in osmotic equilibrium may result in cataract [22].

The mechanism of cataractogenesis can be depicted as follows;



Conclusion

We can conclude from our study that,

- Serum sodium and chloride levels can be used as markers to determine the risk involved in senile cataract formation.
- Simple measures like dietary restriction of salt may prolong cataractogenesis, which can be a preventive measure useful to the community

This study may be useful in patient care as follows:

- Cataract surgery is the commonest surgery in the field of ophthalmology .Much cost spent on cataract surgery may be minimized.
- Prevents disabilities and helps to improve quality of life, useful for the health care system.

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