

## Relationship between altered level of serum electrolytes and risk of senile cortical cataract – A Case Control Study

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### **Abstract**

**Aim & Objectives:** To evaluate a correlation between altered serum electrolyte levels and development of senile cortical cataract. **Materials and Methods:** Venous samples were collected in fasting stage. Serum electrolytes levels were measured by Ion selective electrode method. **Setting and Design:** In this case control study, 100 senile cataract patients scheduled for cataract surgery in Ophthalmology department and 100 normal individuals of same age group were selected. **Statistical analysis:** Data analysis was done by Graph Pad online software. Means of electrolytes were compared between two groups by unpaired t-test. Interpretation was done according to p-value. **Results:** Mean levels of serum  $\text{Na}^+$ ,  $\text{Ca}^{+2}$ ,  $\text{Cl}^-$  were  $144.84 \pm 3.68$  mmol/L,  $1.25 \pm 0.08$  mmol/L,  $100.92 \pm 3.76$  mmol/L in case group respectively. Mean levels of serum  $\text{Na}^+$ , ionized  $\text{Ca}^{+2}$ ,  $\text{Cl}^-$  were  $138.69 \pm 3.87$  mmol/L,  $1.16 \pm 0.05$  mmol/L,  $98.53 \pm 2.87$  mmol/L in control group respectively. So, the case group had significantly higher  $\text{Na}^+$ , ionized  $\text{Ca}^{+2}$ ,  $\text{Cl}^-$  levels (\* $p < 0.001$ ) as compared to control group. Mean level of serum  $\text{K}^+$  was  $4.22 \pm 0.49$  mmol/L in case group as compared to  $4.40 \pm 0.46$  mmol/L in control group. So, the case group had significantly lower serum  $\text{K}^+$  levels (\* $p < 0.05$ ) as compared to control group. **Conclusion:** Altered levels of serum electrolyte in absence of other biochemical risk factors remain the significant risk factor associated with development of senile cataract.

**Key Words:** Serum electrolyte, senile cataract,  $\text{Na}^+$ -  $\text{K}^+$ - ATPase,  $\text{Ca}^{+2}$  ATPase  
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## Introduction

Senile cataract is one of the commonest consequences of the ageing process and it affects the normal vision. In India, cataract accounts for 80% of treatable blindness.<sup>[1]</sup>

Many factors such as ageing, altered blood electrolyte levels, diabetes mellitus, hypertension, nutrition and family history are involved in cataract genesis. Lens has a high content of potassium and low content of sodium. These two cations are in balance with each other due to Na<sup>+</sup>-K<sup>+</sup>-ATPase pump and lens capsular permeability. Hence alteration in cation concentration of aqueous humors can be attributed to changes in the serum electrolytes, these ultimately affect lens metabolism leading to cataract formation.<sup>[2]</sup>

Calcium and Ca<sup>2+</sup> dependent enzymes may also play specific role in the development of human cataract. Proper maintenance of Ca<sup>2+</sup> levels by regulating the activity of Ca<sup>2+</sup>-ATPase pump, Ca<sup>2+</sup> channels and inhibition of Ca<sup>2+</sup> dependent enzymes can help in prevention of cataract.<sup>[3]</sup>

The permeability of chloride is high in the lens. The Na<sup>+</sup>-K<sup>+</sup>-2Cl<sup>-</sup> co-

transporter has been identified by the dependence of cation flow on anion concentration. A disturbance in the chloride concentration or chloride handling by the lens will jeopardize the ability of the lens to maintain its hydrated state and threaten a loss of osmotic equilibrium that may result in cataract.<sup>[4]</sup>

In this study, an attempt is made to see the effect of serum electrolytes levels in development of senile cataract.

## Materials and Methods

The study was reviewed and approved by Human Ethics Committee. All participants gave informed consent.

A case control study was carried out on the 'outpatient and inpatient' attending Ophthalmology department. The study population consisted of total 200 participants aged between 50 to 80 years and they were divided in two groups viz cases and controls. Cases consisted of patients suffering from senile cataract and controls consisted of normal healthy individuals.

**Inclusion criteria:** 1) Patients diagnosed as a case of senile cataract 2) Normal healthy individuals 3) Age group of 50 to 80 years.

**Exclusion criteria:** 1) Not willing to participate in study 2) Cataract due to any other etiology like trauma, metabolic diseases, radiation therapy etc. 3) Any systemic disease like diabetes, hypertension etc. 4) Acute or chronic diarrhea 5) Patients of acute or chronic renal failure 6) Any H/O drug intake like steroid, antipsychotic, chemotherapy etc.

Venous blood samples were collected after an overnight fast (10-12 hours) from all cases and controls and serum was separated by centrifugation and was analyzed for electrolyte by ISE Electrolyte Analyzer. The plasma was analyzed for sugar and serum was analyzed for urea and creatinine on Fully Auto Analyzer-Miura. Investigations were carried out using commercially available ready to use reagent kits.

### Statistical analysis

Comparison of parameters was done between case and control group by using unpaired t- test. Interpretation was done according to p-value.

### Results

Table-1, Table-2, Table-3 (page: 195, 196)  
Result and data analysis of the present study shows that mean levels of serum Na<sup>+</sup>, Cl<sup>-</sup>

and ionized Ca<sup>+2</sup> in senile cataract patients were found to be statistically higher and serum K<sup>+</sup> level was lower as compared to control group, though electrolyte levels did not cross the upper level of reference limit. Similarly FBS levels were statistically higher in case group as compared to control group, but did not cross the upper level of normal reference range.

The findings of the present study were summarized as:

Out of 100 patients of senile cataract, there were 62 females and 32 males. It suggests higher incidence of development of senile cataract in females as compared to male. The levels of serum Na<sup>+</sup> in senile cataract patients were found to be elevated as compared to controls and were found highly significant (p < 0.001). Serum Na<sup>+</sup> levels more than 145 mmol/L were observed in 39 patients of senile cataract with the highest observed value of 156 mmol/L. The levels of serum K<sup>+</sup> in senile cataract patients were found to be lower as compared to controls and were found significant (p < 0.05). The levels of serum Ca<sup>+2</sup> in senile cataract patients were found to be elevated as compared to controls and

were found highly significant ( $p < 0.001$ ). The levels of serum  $\text{Cl}^-$  in senile cataract patients were found to be elevated as compared to controls and were found highly significant ( $p < 0.001$ ). The levels of fasting blood glucose in senile cataract patients were found to be elevated as compared to controls and were found highly significant ( $p < 0.001$ ).

### Discussion

Cataract is the leading cause of poor vision and blindness in the world, with an estimated 17 million individuals are bilaterally blind. The WHO and international agency for the prevention of blindness have developed a global initiative 'Vision 2020: the right to sight' for elimination of avoidable blindness by the year 2020.<sup>[05]</sup>

The incidence of senile cataract is increasing with age, which accounts for more than 50% of all cases of cataract. Important risk factors for senile cataract include exposure to ultraviolet-B (UV-B) radiation, the presence of diabetes, use of therapeutic drugs such as corticosteroids, smoking, alcohol and electrolyte imbalance.<sup>[06, 07]</sup>

Normally lens has high level of  $\text{K}^+$  (114-130 mmol/L) and low  $\text{Na}^+$  (14-26 mmol/L). These two cations are in balance with each other due to action of  $\text{Na}^+-\text{K}^+$ -ATPase pump, which in turn maintains permeability of lens membrane.<sup>1</sup> There is an increase in membrane permeability of the lens cells with age due to reduced activity of  $\text{Na}^+-\text{K}^+$ -ATPase pump, which leads to an increase in internal  $\text{Na}^+$ . Higher levels of extracellular  $\text{Na}^+$  might make it more difficult for  $\text{Na}^+-\text{K}^+$ -ATPase pump to maintain the low levels of intracellular  $\text{Na}^+$  required for lens transparency.<sup>[08, 09]</sup>

Calcium is an important cation in the body, which is required in optimum intracellular concentration to maintain lens transparency. As the membrane permeability increased in lens, it will also lead to increased intralenticular  $\text{Ca}^{+2}$ .<sup>09</sup> In addition to this alteration in  $\text{Cl}^-$  levels have also been suggested for the possible mechanism of cataract development by causing osmotic disturbances.<sup>[10]</sup>

Keeping in view the findings of earlier researchers, present study was designed to evaluate the effect of serum electrolyte

levels in development of senile cataract patients.

In the present study, out of 100 senile cataract patients, there were 62% female and 38% male. All females were postmenopausal and had not taken hormone replacement therapy. In a similar study conducted by A Amos Osei et al. there were 62% female and 38% male with senile cataract out of the 100 cases studied. The probable mechanism for the high prevalence in female is decreased level of estrogen after menopause, which is a protective factor against the development of cataract.<sup>[11]</sup>

Patients included in present study were devoid of diseases like diabetes, hypertension, acute and chronic renal failure and conventional risk factors for cataractogenesis like high blood glucose and urea were not present in these patients. Therefore role of serum electrolyte imbalance can be justified in the process of cataractogenesis.

From a clinical perspective, it has been suggested that after 50 years of age, serum electrolytes measurement as a screening investigation can predict early development of senile cataract. It is also critical issue

because most of the electrolyte changes are silent and one-half of all cataract cases occur among individuals with normal serum electrolyte levels.

### **Limitation of study:**

The limitations of this study include the small sample size and the setting of the study in a tertiary care centre. Larger prospective longitudinal population-based studies are required to categorically ascertain this association of altered levels of serum electrolyte with senile cortical cataract.

Exposure to high sodium level in the absence of other biochemical risk factors remains the most significant factor associated with senile cataract. Therefore, detail knowledge of risk factors can be expected to improve compliance and quality of life in patients of senile cataract, with recommendations concerning salt restricted diet.

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**Table-1: Mean Age in Case & Control Groups**

Group	Sex	Number (%)	Total	Mean of age in years	Significance of Age
Control	Male	61 (61%)	100	61.92 ± 5.56	t= 1.35 §p>0.05
	Female	39 (39%)			
Case	Male	38 (38%)	100	63.20 ± 7.68	
	Female	62 (62%)			

**Table-2: Comparison of Biochemical Parameters in Case & Control Group**

Parameters	Biological Reference Interval	Control group (n=100)			Case group (n=100)			Significance
		Mini.	Maxi.	Mean ± SD	Mini.	Maxi.	Mean ± SD	
<b>FBS</b>	70-100 mg/dl	68	109	85.76 ± 9.37	76	113	93.92 ± 9.12	t= 6.24 ** p < 0.0001
<b>Urea</b>	15-40 mg/dl	10	51	27.07 ± 8.84	16	42	28.9 ± 6.78	t= 1.64 §p>0.05
<b>Creatinine</b>	0.6-1.2 mg/dl	0.3	1.5	0.94 ± 0.24	0.3	1.6	0.93 ± 0.22	t= 0.30 §p>0.05

**Table-3: Comparison of serum electrolyte levels in Case & Control Group**

Parameters	Biological Reference Interval	Control group (n=100)			Case group (n=100)			Significance
		Mini.	Maxi.	Mean ± SD	Mini.	Maxi.	Mean ± SD	
Serum Na <sup>+</sup>	135-145 mmol/L	131	149	138.69 ± 3.87	137	156	144.84 ± 3.68	t = 11.51 ** p<0.0001
Serum K <sup>+</sup>	3.5-5.0 mmol/L	3.3	5.7	4.40 ± 0.46	3.1	5.6	4.22 ± 0.49	t= 2.67 * p = 0.008
Serum Cl <sup>-</sup>	96-108 mmol/L	90	106	98.53 ± 2.87	89	115	100.92 ± 3.76	t= 5.05 ** p<0.0001
Ionized Ca <sup>+2</sup>	1.16-1.32 mmol/L	0.94	1.27	1.16 ± 0.05	0.82	1.40	1.25 ± 0.08	t= 9.54 ** p < 0.0001

\* p < 0.05 = Significant, \*\* p < 0.001 = highly significant, § p ≥ 0.05 = Not significant