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Original Research Article

Electrolyte Analysis of Serum and Aqueous Humour in Cataract Patients

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Abstract

Background: Cataract, the most common preventable cause of blindness in the world, is an age-related illness that impairs vision and is defined by a slow, increasing thickening of the lens. The etiopathogenesis of cataracts involves changes in serum electrolyte content, which is a critical factor. Using patients with cataracts and healthy controls, this study examined and evaluated the levels of serum sodium, potassium, and chloride.

Methodology: A cross-sectional comparison study including 100 participants, 50 of whom had cataracts and the remaining 50 were healthy controls, was done on adults between the ages of 45 and 85. For statistical analysis, Excel 13 version was utilized.

Results: Cataract patients had considerably higher mean serum sodium, potassium and chloride levels than controls. The comparison of electrolytes in serum and aqueous humour of patients revealed that sodium, potassium and chlorides were higher in aqueous humour than in serum. Between the two groups, the mean potassium level did not significantly differ.

Conclusion: Changes in the serum electrolyte concentration can affect how much is in the aqueous humour, which could be more than the lens membrane's pumps and channels can handle, leading to volume overload and lens opacities. Therefore, serum salt and potassium levels can be utilized as indicators of the development of cataracts. Reducing your salt intake can slow the development of cataracts.

Keywords: Cataract, Electrolytes, Aqueous humour, Sodium, potassium, Chloride

Introduction

The translucent crystalline lens is found in the eyes and is a vital organ of vision that aids in viewing this lovely world. The condition known as a cataract occurs when this lens becomes opaque. The most common cause of vision loss worldwide is a cataract. According to the World Health Organization (WHO), cataracts account for 47.8% of global cases of blindness and 17.7 million cases worldwide. Cataracts account for 80% of blindness in India [1]. Vashist P *et al*. 2011 observed a high incidence of untreated cataracts in senior

citizens in north and south India [2]. There are around 3.8 million cataract cases each year. According to certain research, the population's cataract blindness is caused by a variety of variables, including social, economic, and environmental issues [3]. According to the findings, aqueous humour plays a big part in cataractogenesis. Cataract, an opacity in the lens at first, is a physiological condition of the eye that affects elderly people. Osmotic graduation, protein aggregation, oxidative stress, UV radiation exposure, metabolic problems, food, and quality of life are a few of the factors that can contribute to cataract formation. Incorrect functioning of the cationic pump and issues with the metabolism of the lens are also thought to contribute to cataract development [4]. Aqueous humour is related to lens metabolism. Water and electrolytes are crucial for controlling lens permeability because they maintain the proper balance between extracellular and intracellular components. Any change in osmotic pressure alters the concentration of electrolytes and the permeability of the lens, which causes the lens to become opaque [5].

The study intended to measure the electrolyte concentration in the aqueous humour and serum, as well as their association.

Methodology

The current investigation, which was conducted on 50 cataract patients in the age range of 45 to 85 years in the outpatient department of ophthalmology at a tertiary care hospital, was a case-control study. The study also included 50 age-matched controls. Patients with type 2 diabetes, renal conditions, history of eye surgery, hypertension, and other systemic problems were excluded. With the patients' consent, 5ml of venous blood was aseptically obtained, and electrolytes were estimated. The serum was isolated after the blood was allowed to be coagulated and centrifuged. A completely automated Erba EM 350 equipment was used to estimate random sugar, creatinine, and electrolytes. On the electrolyte analyzer (Medilyte), the electrolyte was analyzed using the ISE method [6].

Analysis of Statistics Version 13 of Excel was used for data analysis. The mean and Standard Deviation (SD) values were used to represent the data. The students' t-tests were used to analyse the difference between the groups. The cutoff for significance was fixed at 0.05.

Results

The goal of the current study was to assess how senile cataract patients' serum electrolytes, specifically Na, K, and Cl, have changed over time. 100 participants between the ages of 45 and 85 were chosen, and they were divided into two groups. 50 were cataract sufferers, and 50 were age- and sex-matched healthy persons. The results of the statistical analysis were presented as mean ± SD (Standard deviation). Figures 1 & 2 below provide a summary of the findings. Cases had greater serum sodium levels than controls, and this difference was statistically significant (P = 0.0001) [Table 1 & Figure 1]. The serum potassium levels in the patients and controls did not differ significantly, and the P-value was not statistically significant (P = 0.36) [Table 1 & Figure 2]. When compared to controls, cases were found to have higher serum chloride levels, and this difference was statistically significant (P = 0.0001). [Table 1 & Figure 1]

Table 1: Comparison of Electrolytes in control and Cataract patients

Parameters	Cataract Patient (n= 50)		P- value	Controls (n= 50)	P- Value
	Serum	Aqueous humour	Serum Vs Aq. humour	Serum	Control vs Cases
RBS (mg/dL)	107± 5.43	66 ± 1.6	--	102 ± 6.46	--
Creatinine (mg/dL)	0.88± 0.08	1.74 ± 0.78	--	0.9 ± 0.45	--
Sodium (mEq/L)	143± 0.48	146 ± 0.67	0.0001	141 ± 1.96	0.0001
Potassium (mEq/L	4.38 ± 0.27	4.5 ± 0.56	0.17	4.3 ± 0.56	0.36
Chloride (mEq/L)	106 ± 1.0	118 ± 0.61	0.0001	103 ± 0.78	0.0001

Discussion

The goal of the current investigation was to determine how serum electrolytes impacted senile cataract formation. According to the study, cataract patients had considerably higher serum sodium, potassium and chloride levels than healthy controls. In comparison to controls (141 ± 1.96 mEq/L), cases had mean serum sodium levels that were higher (143 ± 0.48 mEq/L). (P = 0.0001) The difference was statistically significant. P-value was 0.0001 and the mean serum chloride concentrations in cases were substantially higher than those in controls (103 ± 0.78 mEq/L vs. 106 ± 1.0 mEq/L). Additionally, potassium levels were observed to be higher in cases (4.38 ± 0.27 mEq/L) than in controls (4.3 ± 0.56mEq/L). Insignificant as compared to controls, the increase in serum potassium levels in patients was seen (P = 0.36).

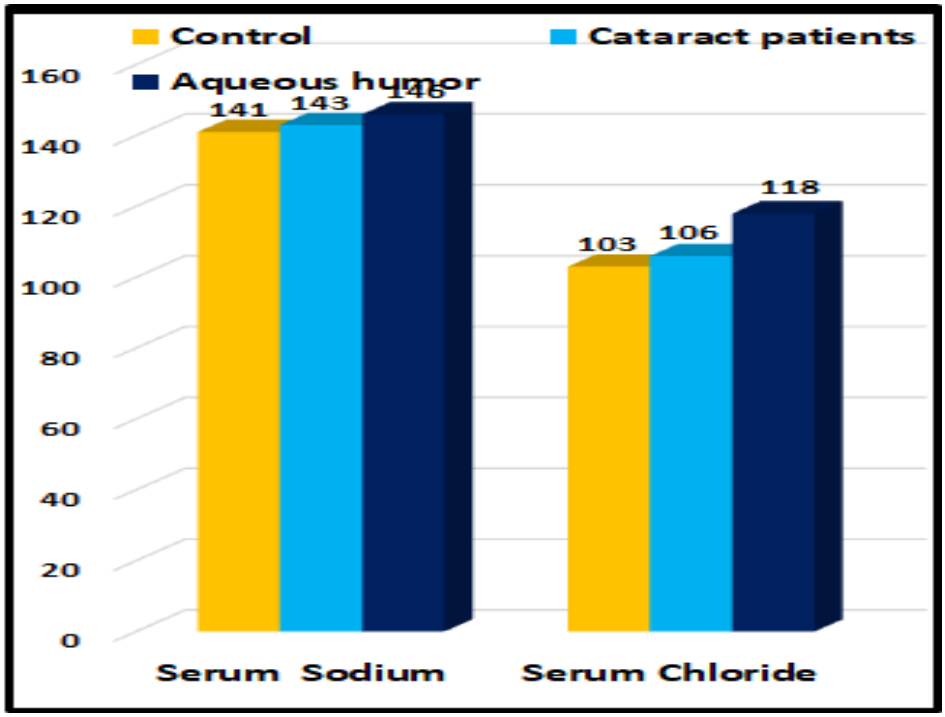

Figure 1: Sodium and Chloride levels in control, cataract patients and aqueous humour.

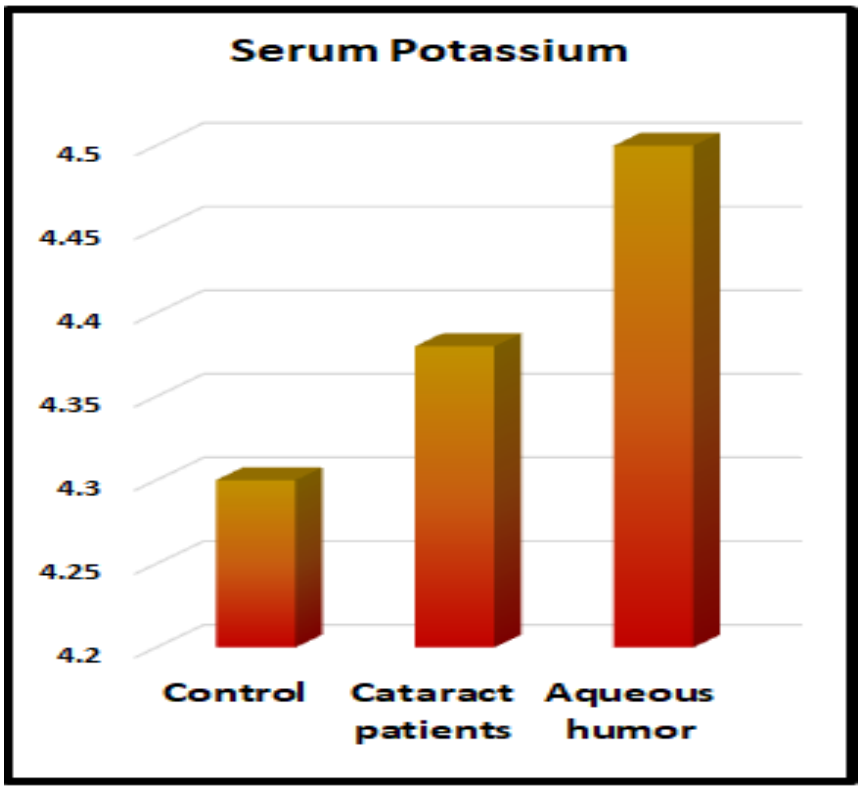

Figure 2: Chloride levels in control, cataract cases and Aqueous humour.

Numerous research in the literature produced similar findings. In addition, senile cataract patients in Adiga *et al* study had considerably higher serum salt and chloride levels than healthy controls. In this trial, which is comparable to the current investigation, the increased serum potassium was not statistically significant [7]. Researchers Donnelly *et al*., Mirsamadi *et al*., and Lucas *et al*. found that senile cataract patients had considerably higher serum sodium levels than normal controls [8-10]. The current study's significantly higher serum chloride levels compared to controls were consistent with those of Adiga *et al*. and Soni *et al*. [7,11] Similar findings in serum potassium levels were also observed by Schoenfeld *et al*. and Phillips *et al* [12, 13].

Globally, age-related cataract is a cause of blindness that is influenced by both inherited and environmental factors. Free radical oxidation of lens protein is thought to be a significant element in the multifactorial process that results in lens opacification. It results from the body's natural antioxidative processes, both enzymatic and non-enzymatic, becoming less effective with ageing (antioxidant micronutrients) [14]. The electrolytes are then impacted by oxidative alterations, which also disturb the permeability of the lens membrane between intracellular and extracellular spaces [15].

Normal lens composition includes high potassium (114–130 mEq/L) and low sodium (14–26 mEq/L) concentrations. The permeability of the lens capsule and the Na+-K+ ATPase pump maintain equilibrium between these two cations [8]. The decrease in membrane fluidity brought on by the age-related rise in the cholesterol: phospholipid ratio can be used to explain the change in ion permeability of the lens capsule [16]. The Na+-K+ ATPase becomes more crucial to the epithelial cells' ion permeability. But as

people age, Na+-K+ ATPase activity also declines, which causes sodium levels in the lens to rise. The Na+-K+ ATPase pump may not be able to keep the low level of lenticular sodium necessary for lens transparency due to an imbalance in the levels of sodium in the serum, which causes an increase in the sodium concentrations in the aqueous humour. Therefore, cataract development may result from increased serum salt levels alone.

The results of the comparison of aqueous humour and serum electrolytes in cataract patients revealed that sodium, potassium and chlorides were higher in aqueous humour (Na^+ was 146 ± 0.67 mEq/L K^+ was 4.5 ± 0.56 mEq/L and Cl^- was 118 ± 0.61 mEq/L) than serum (Na^+ was 143 ± 0.48 mEq/L K^+ was 4.38 ± 0.27 mEq/L and Cl^- was 106 ± 1.00 mEq/L). The potassium levels did not differ significantly (P = 0.17) while sodium and chloride were statistically significant (P= 0.0001). A thin fluid made from serum called aqueous humour provides nutrition for the lens.

Aqueous humour electrolytes, which are influenced by serum electrolytes, control the lens metabolism [14]. Any change in the ratio of these two ions coincides with an increase in the lens' optical density because the concentration of sodium and potassium in the lens keeps the osmotic pressure constant [17].

The lens has a high chloride permeability. The dependency of cation flow on anion concentration has allowed scientists to identify the Na+ K+2Cl- cotransporter in the lens. A change in the concentration of chloride or how the lens handles chloride will have an impact on the lens' ability to stay hydrated and result in a loss of osmotic equilibrium [18]. The lens's capacity to control volume may be overwhelmed by prolonged exposure to osmotic challenges, which can cause unopposed volume changes, a disruption in the structure of the lens fibre cell, the formation of fluid-filled pockets in the extracellular space, and a disturbance in the hydration of the lens proteins. These events all increase light scattering and may eventually lead to protein aggregation and cataracts [19].

In the current study, cataract patients had higher Na+ and Cl levels than did controls. Serum salt and chloride concentrations may function as modifiable risk factors for the onset of cataracts. Limiting salt in the diet may assist to slow the development of cataracts, which can be a preventive action beneficial to the community, avoid disability, and enhance the quality of life, all of which are beneficial to the healthcare system.

Conclusion

The goal of the current investigation was to determine how serum electrolytes affected the etiology of senile cataracts. 100 participants made up the study group, 50 of whom were elderly cataract patients and 50 of whom were age- and sex-matched controls. When serum electrolytes (Na+, K+, and Cl) were examined in the study population, it was found that senile cataract patients had considerably higher serum sodium and chloride levels than healthy controls, although an increase in serum potassium levels was statistically insignificant.

Changes in the serum electrolyte concentration may cause changes in the aqueous humour concentration, which may be greater than the capacity of the pumps and channels found in the lens membrane, leading to volume overload and lens opacities. Therefore, serum salt and chloride levels can be utilized as indicators of the development of senile cataracts. Additionally, this study shows how cutting back on salt in the diet might significantly slow the development of cataracts.

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