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Comparative study of serum Na⁺ and K⁺ levels in senile cataract patients and normal individuals

Mansour Mirsamadi¹, Issa Nourmohammadi², Manuchehr Imamian²

¹ Department of Ophthalmology, School of Medicine, Iran University of Medical Sciences, Tehran, Iran

² Department of Biochemistry and Nutrition, School of Medicine, Iran University of Medical Sciences, Tehran, Iran

Abstract

Many factors such as aging, changes in blood electrolytes levels, and possibly family history are involved in senile cataract formation. Changes in serum electrolytes levels can induce changes in aqueous electrolytes levels and effect on lens metabolism and probably cataract formation. In this paper, we study serum level of Na⁺ and K⁺ in senile cataract patients and normal individuals. Methods and materials: 155 senile cataract patients scheduled for cataract surgery in eye clinic of Rasoul hospital and 155 normal individuals were selected. Serum Na⁺ and K⁺ levels were measured by Flame Photometry technique and means compared between two groups by t-test. Results: 1. Mean serum Na⁺ level in senile cataract patients and normal individuals was 144.96 ± 6.04 mEq/lit and 140.88 ± 2.27 mEq/lit respectively, and there was statistically significant difference ($P < 0.0001$). 2. Mean serum K⁺ level in senile cataract patients and normal individuals was 4.20 ± 0.34 mEq/lit and 4.15 ± 0.32 mEq/lit respectively, and there was no statistically significant difference. Conclusion: Serum Na⁺ level in senile cataract patients was higher than normal individuals in this study. This result might suggest that diets with high Na⁺ content are a risk factor for age-related cataract formation, as high Na⁺ content of the diet leads to high level of serum Na⁺, which in turn contributes to formation of age-related cataract.

Key words

Senile cataract, Na⁺, K⁺

Author biography

Mansour Mirsamadi obtained MD degree from University of Tehran in 1978, and then studied ophthalmology for three years in Iran University of Medical Sciences. He is currently an associate professor in Department of Ophthalmology, Iran University of Medical Sciences, with research interests in epidemiology in ophthalmology.

Issa Nourmohammadi obtained BSc (Chemistry) from Langston University, Oklahoma, in 1976, MSc (Biochemistry) from University of Oklahoma in 1978, and PhD (Nutritional Biochemistry) from University of Arizona in 1981. He is currently an associate professor in Department of Biochemistry and Nutrition in Iran University of Medical Sciences. He is interested in study of nutrition and trace elements in human blood.

Manuchehr Imamian obtained BSc in Chemistry from Payam-Nour University of IRAN in 1996 and MSc in Biochemistry from Iran University of Medical Sciences in 2001. His areas of research focus on nutrition field.

Corresponding address

Mansour Mirsamadi, MD, P.O. Box 14455-397, Niayesh St. Satarkhan Ave., Tehran 14455 Iran. Tel: ++ 98 21) 6504001-5, 6505001-9. Fax: ++ 9821) 6506864. E-mail: m_smm@yahoo.com

1. Introduction

One of the often seen consequences of the aging process is the development of senile cataract, a disease that affects one of our most precious gifts, that of sight. This so-called senile cataract usually occurs in those over 45 years of age. Approximately 75 percent of population over 75 suffer from lens opacity or cataract, which is the major cause of poor vision and blindness in the world [1,2,3,4]. The commonest form of cataract that is mainly found in ages more than 45 is named age-related or senile cataract [3]. It should be mentioned that cataract surgery is the commonest case of surgery in the field of ophthalmology [5].

Up to 50 millions in the world suffer from age-related cataract [6-7] and its prevalence in developing countries is much more than the developed ones [8]. Annual new cases of cataract in India is 4 millions [7], and more than one million cataract surgeries are done annually in United States of America, although the accurate number of those suffering from cataract might be unknown [5]. In Iran, there is no exact data for annual cataract surgery, but it seems to be more than 100000. Much cost is spent on cataract surgery each year to prevent disabilities and improve quality of life, making it difficult for the health system to carry on [5,9,10].

For the importance of cataract, research for clarifying its etiology is a necessity, so that many future disabilities can be prevented, surgical costs reduced and quality of life improved. Multiple mechanisms such as osmotic graduation [11,12], protein aggregates [13,14] oxidative stress [15,16], post translational protein changes [17, 18, 19, 20, 21, 22], phase separation [3,11,24] are proposed for cataract formation, though the exact pathogenesis is not known yet. Combined factors of heritage, UV light exposure, diet, some metabolic disorders, quality of life, cationic pump malfunction and lens metabolism disorder are believed to have a role in cataract formation [2, 25].

Since the lens metabolism is associated with aqueous humor [26, 27] and this thin fluid itself is produced from blood secretions, serum electrolytes concentration directly affects electrolytes of aqueous humor and in turn lens metabolism [2]. Biochemical studies have shown significant difference (meaningful) in some serum electrolytes concentration in those suffering from age related cataract versus those not [2,25].

In literature review no article was found about serum Na^+ level in senile cataract patients, but particular consideration has been given by many researchers to the underlying role of nutritional status in the process of cataract formation and the possibility that biochemical parameters can be used as markers to determine the risk involved for cataractogenesis, considering the fact that it is possible to modify these factors [5,7].

In a study in Iranian population – present study – plasma level of Na^+ , K^+ in age-related cataract cases has been compared with an Iranian control group, without cataract.

2. Methods & Material:

Patients diagnosed as age-related cataract in ophthalmology ward of hazrat Rasool hospital, Tehran, Iran hospitalized or in operation waiting list were selected as the case group. The control ones were mainly selected from the close relatives of the patients. Both groups were investigated for any drug intake, hypertension and any other systemic disease. Then positive ones of both groups were excluded from the study.

Case and control groups were both examined by an expert ophthalmologist and routine ophthalmic examinations including visual acuity determination, slit lamp examination, ophthalmoscopy and intraocular pressure measurement were done for all of them.

Patients suffering from age-related cataract with any other ophthalmologic disease or any past history of ophthalmic surgery were excluded from the study. This exclusion criteria was also true for the control group. Then a fasting-state blood sample was obtained from both case & control group and sent to the laboratory. Serum Na^+ , K^+ levels were measured with flame photometry method by the aid of SEAC model FLP20, Italy. Outcoming data was assessed by spss 11 software and mean of above electrolytes in both groups were compared by t-test.

3. Results

In this study the case group consisted of 155 patients suffering from age-related or senile cataract (79 female, 76 male) and the control one consisted of 155 of cases' close relatives (79 female, 76 male). Mean age and standard deviation of patients and control group were 61.96 ± 14.5 , 59.63 ± 13.8 , respectively. Age range of patients and controls were 44-85 year and 43-86 year respectively.

Table 1 shows serum Na^+ , K^+ of case and control groups, with a significant difference in serum Na^+ of case and control ones.

Table 1. Comparison of Mean & SD of serum Na^+ , K^+ in 155 patients with cataract and 155 without cataract.

Study group Serum cations	Age-related cataract patients	Control group	P-value
Na^+ mean (mEq/lit)	144.96 ± 6.04	140.88 ± 2.27	<0.0001
K^+ mean (mEq/lit)	4.20 ± 0.34	4.15 ± 0.32	0.200

According to Table 1 serum Na^+ level in age-related cataract cases was more versus non-cataract ones (control group). This table notifies meaningful difference of serum Na^+ level between two groups.

4. Discussion

The most important result of this study is elevated serum Na^+ level in those suffering from senile cataract which verifies previous studies [2, 25, 28]. Though aging by itself is the most important risk factor for cataract formation, other factors such as cataract family history, some biochemical elements alterations in blood, may be the intervening ones [29]. Multiple studies have been done to clarify the relationship between human biochemical elements and cataract formation.

Interestingly in some of these studies relationship between some serum biochemical elements (such as Na^+) and cataract have been verified [2,25,28]. In spite of this, in other studies, such as the Italian – American cataract study [30], no relation between blood biochemical elements and cataract has been shown. This contrast may be due to nutrition quality and different diets in nations all over the world [31,32,33].

One of the proposed risk factors for cataract formation is serum Na^+ level [34,35]. Lens has high content of potassium and low content of sodium. Lens K^+ level is 125 mmol/kg of lens water and lens Na^+ is 14-26 mmol/kg of lens water [36]. These two cations are in balance with each other, which is mainly due to Na^+ - K^+ ATP-ase pump and lens membrane permeability. Alteration in either of these ions leads to cation imbalance in lens which in turn results in cataract formation [36]. Hence alteration in cation concentration of aqueous humor which is attributed to alterations in serum cation concentration, can be known as a risk factor for cataract formation.

Na^+ pump activity in lens is as in other cells and it is related to intracellular Na^+ , extracellular K^+ and eventually to serum concentrations of these ions [37,38]. Clayton et al [35,39] & Philips et al [37] studies notify significant and meaningful difference between serum Na^+ of those suffering from age-related cataract versus those not. It should be mentioned that, this is not true about K^+ in their studies.

In the present study of Iranian population the mean of serum Na^+ in age-related or senile cataract cases was 144.6 ± 6.04 versus 140.88 ± 2.27 of the control group, which declares meaningful difference ($P < 0.0001$). Though the mean of serum Na^+ of the patients were in the Na^+ normal range but it was in the upper limit of this range (135-150 mEq/Lit) and in comparison with control group, the serum Na^+ of the patients was elevated, which notifies significant difference. Results of the present study in Iranian population is in favor of studies such as Clayton et al [35,39], Philips et al [37] and Shoepheld-ER et al [31].

At last, it seems that diets with high Na^+ content are a risk factor for age-related cataract formation. As it seems, high Na^+ content of the diet leads to high level of serum Na^+ , which in turn contributes to formation of age-related cataract [31, 32, 33]. Eventually, further studies in certain regions of the world in age-related cataract cases with certain diets is suggested. In this order, results can be compared with similar studies.

Conflict of interest

The authors have declared that no conflict of interest exists.

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