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Electrolyte Imbalance: Risk factor for developing senile Cataract

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Abstract

Background: Cataract refers to opacification of crystalline lens in the human eye.(1) It is the most common cause of blindness which accounts for 50% of blindness and remains the leading cause of visual impairment all over the world. (2) 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 that alters lens membrane permeability & leads to progression of cataract formation.(3) The aim of the study is to estimate serum electrolyte levels in senile cataract patients as compared to those without cataract.

Materials & Methods: This study includes Group I - 100 senile cataract patients and Group II 100 age matched healthy control without cataract. Cataract patients attending Ophthalmology and Biochemistry OPD,IGGMC, Nagpur for routine Blood sugar checkup prior to surgery were selected for the study .Blood samples were drawn for estimation of Sugar, Creatinine, serum electrolyte level i.e. Sodium, Potassium which was compared with normal healthy age related (45-75 yrs) control by students ' t' test. Plasma Glucose level (to rule out Diabetes) and serum Creatinine (to rule out renal disorder) in both cases and control were estimated & compared in both groups. History was taken as per designed proforma and consent form was obtained. Blood Glucose, Creatinine tests was done on Autoanalyser EM 460 in clinical Biochemistry Laboratory. Electrolytes serum Sodium & Potassium were estimated on Easy lyte Electrolyte Analyser. Serum values of electrolytes of both cases and control were compared & correlated. The data was analysed & Student's t -test was used for the calculation. P <0.05 was considered significant.

Result: Result of our study showed that there was elevation in serum sodium level in cataract patients mean 143.5 ±3.6 meq/lt compared to control mean 139.7 ±2.4 meq/lt (p value 0.001) while serum Potassium mean 4.21 ± 0.31 in cataract compared to mean 3.71 ± 0.25 in normal controls.These values were statistically significantly high in cataract patients reflecting its role in formation of senile cataract .So

decreasing Serum sodium level can prevent progression of cataract.

Conclusion: We conclude that salt restricted Diet must be advised in Cataract patients so as to maintain normal electrolyte balance which may prevent further progression of disease. From this study we can conclude that sodium and potassium may be used as markers of senile cataract formation. Dietary salt restriction may help to lower the sodium levels and delay the process of cataract formation.

Keywords: Electrolytes (Sodium Na+ and Potassium K+), senile cataract

Introduction

In India alone, cataract accounts for 80% of treatable blindness [4]. One of the most common types of cataract is the senile cataract which occurs as a consequence of the aging process [5]. Senile cataract usually occurs after the age of 45 years. Approximately 75 percent of population above the age of 65 years suffers from cataract [6]. Many risk factors such as age, sex, radiation, genetics, metabolic disorders, [7] protein aggregates oxidative stress [8], are proposed for cataract formation, though the exact pathogenesis is not yet known. Aqueous humor 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 [9]. It has been proved that, in aqueous humor 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 [10]. As this fluid is derived from the plasma, derangement in serum electrolytes appears to be one of the risk factor for cataractogenesis.[11]

The purpose of the study is to estimate serum electrolytes in senile cataract patients as compared to the healthy age matched people without cataract. 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 [12]

Objectives of the study

The aim of this study is to

1) Estimate serum sodium and potassium level in cataract patients.

2) Compare serum electrolyte level in cataract patients and normal healthy age related individuals.

3) Study association of sodium level and development of cataract.

Method of collection of data & selection of subjects:

100 patients attending the outpatient department of Ophthalmology & clinical Biochemistry, IGGMC, Nagpur were selected for study. 5 ml of blood sample was drawn from cataract patients who were attending biochemistry OPD for blood sugar level prior to cataract surgery. History was taken as per designed proforma and consent form was obtained. Their Blood samples were analysed for blood sugar level as well as serum electrolytes ie Serum Sodium and Potassium level .To rule out renal disorders Serum creatinine was also estimated in clinical Biochemistry Laboratory to know status of kidney function tests in both groups cataract and non-cataract age & sex matched cases & controls.

Based on this, two groups were made:

Group I: 100 senile cataract patients, who were scheduled to undergo cataract surgery

Group II: Age and gender matched normal healthy individuals without cataract, who were attending Biochemistry OPD from June 2019 to April 2020, IGGMC, Nagpur

Inclusion Criteria

1. Age group in between 45 - 75 yrs.
2. Both male and female cataract patients attending ophthalmology & biochemistry OPD, IGGMC, Nagpur advised for cataract surgery.

Exclusion Criteria

1. Renal failure, cushing's syndrome, hyperaldosteronism
2. Cataract due to any other aetiology like trauma, radiation, diabetes mellitus, hypertension etc.
3. Patients with asthma, acute or chronic renal failure, any history of drug intake like antipsychotics, chemotherapy etc.

The data was analysed & Student's t -test was used for the calculation. P <0.05 was considered significant.

Methods

For Serum Creatinine Estimation - Kit based on Jaffes method (Autoanalyser)

(Normal range – 0.8 to 1.5 mg%)

For Serum Na & K Estimation - Easylyte Electrolyte Analyser

(Normal range – Na – 135 to 145 meq/lit , K – 3.5 to 5.2 meq/lt)

For Blood Sugar Estimation: Kit based on GOD – POD method (Autoanalyser)

(Normal range – 70 to 120 mg %)

Analysis was carried on Autoanalyser EM – 460 in clinical Biochemistry lab, IGGMC for Blood Sugar & Creatinine, On Easylyte Machine for Na & K electrolytes . All estimation was done in cataract patient as well as normal healthy controls & their values were compared & correlated

Results

Table 1: Showing Mean ± SD of Electrolytes in both the Groups

Analytes	Group-1 (Test Group – Cataract) n=100 Mean ± SD	Group-2 (Control Group) n=100 Mean ± SD	'P' value
Serum Na+	143.5 ±3.6	139.7 ±2.4	< 0.001 (S)
Serum K+	4.21 ± 0.31	3.71 ± 0.25	< 0.001 (S)
Blood Glucose	90.8 ± 13.94	85.34 ± 11.85	0.073 (NS)
Serum Creatinine	0.98 ± 0.14	1.006 ± 0.16	0.12 (NS)

'P' value < 0.05= statistically significant, 'p' value < 0.001= statistically highly significant.

Normal serum Sodium: 135 - 145 mmol/L

Normal serum Potassium: 3.5 - 5.5 mmol/L

Discussion

Result of our study showed that mean ± SD of serum Sodium is 143.5 ± 3.6, K+ is 4.21 ± 0.31 in Group I, that is in Cataract group. The mean ± SD of serum Sodium is 139.7±2.4, K+ is 3.71 ± 0.25 in Group II that is in control group.) while serum Potassium mean 4.21 ± 0.31 in cataract compared to mean 3.71 ± 0.25 in normal controls. These values were statistically significantly high in cataract patients

We have found a statistically significant elevation in serum sodium and potassium levels in senile cataract patients as compared to healthy controls. Elevation in serum sodium level is in accordance with the studies by Zhang JJ, Jacob *et al* [10,13]. Our results are matching with the conclusions drawn by various studies. There was a statistically significant difference between the mean serum sodium level in senile cataract patients and normal individuals. Multiple studies have been done to clarify the relationship between human biochemical elements and cataract formation [14]. Different mechanisms such as osmotic gradient , protein aggregates, oxidative stress, nutritional factors like vitamins are proposed for cataract formation by certain workers in recent past. In this study increased sodium level in cataract patients if persists for longer time then

disorder may progress .[15] Because higher level of serum sodium might make it more difficult for sodium pumps to maintain the low level of intracellular sodium which is required for lens transparency (**Table**).

It is known that Sodium is a major cation of extracellular fluid and it regulates extracellular fluid volume. Sodium pump is operating in all the cells, so as to maintain extracellular sodium level.[15] Normally, lens has high content of Potassium (125 meq/ lt) and low Sodium (14-26 meq/lt). These two cations are in balance with each other, which is mainly due to action of NaK ATPase pump which in turn maintain lens membrane permeability.[16]

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 sodium. 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 humor, which ultimately affect lens metabolism leading to cataract formation [19].

Alteration in cation concentration of aqueous humor which is attributed to alterations in serum caption 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. Diets with high sodium content 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]. Elevation in serum sodium level in cataract patients may result into its further increase in aqueous humor of lens which may lead to osmotic imbalance across lens membrane and aggravate, progression of disease.[22] So, reducing Serum sodium by dietary restriction of salt will surely be helpful in prevention of progression of disease..

Conclusion

We can conclude from our study that, Serum sodium and potassium levels can be used as markers to determine the risk involved in formation and progression of senile cataract. Simple measures like dietary restriction of salt may prolong cataract genesis, which can be a preventive measure useful in the community in patient care.

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