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AN ANALYSIS OF THE LEVELS OF SERUM SODIUM AND POTASSIUM IONS IN SENILE CATARACT PATIENTS

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Abstract :
Back ground Senile cataract is one of the consequences of ageing. With ageing the alteration in membrane permeability of the lens epithelium coupled with the changes in sodium and potassium ion levels in aqueous humour may accentuate ionic imbalance within the lens and progression of cataract.Aim To compare serum sodium and potassium ion levels in senile cataract patients with that of normal individuals. Materials and methods 50 males with senile cataract were randomly selected from the outpatient facility of department of ophthalmology, Government Rajaji Hospital, Madurai. 50 age matched males without senile cataract were taken as controls. Both cases and controls were on normal, mixed, south Indian diet. Individuals with secondary cataract, hypertension or diabetes, individuals on medications and disorders affecting serum sodium or potassium ion levels, dehydration, edema or on salt restricted diet were excluded from the study. After getting written informed consent, basal parameters were measured. Ophthalmic evaluation of all participants was done. Under strict aseptic precautions 2 ml of venous blood was collected and levels of serum sodium and potassium ions were estimated by auto analyzer Easylyte method.Results The data obtained was analyzed using Students t test. Serum levels of sodium ions were found to be higher in cases 142mEq per l than in controls 139.5mEq per l with a significance of less than 0.001. There was no significant difference in the serum levels of potassium ions in cases 4.192mEq per l compared to controls 4.136mEq per l.Conclusion An elevated level of serum sodium ions may be a risk factor for progression of senile cataract.
Keyword : Senile cataract, serum sodium, serum potassium.

EXPLANATIONS FOR THE QUERIES RAISED BY THE REVIEWERS

1) Care was taken to ensure that there was no major dietary disparity between the cases and the controls, by excluding patients on salt restricted diet, and by

ensuring that both the cases and the controls were on normal, mixed, south Indian diet.Ours being a preliminary study, the authors did not design it in such a way as to regulate the actual milligrams of sodium consumed by every patient on a daily basis, but we have concluded that there is a pertinent need for such meticulous studies to firmly establish a causal relationship between serum sodium level and the risk of developing cataract.

2) We have re-checked the p value and found it to be the same. (< 0.001).

3) If a causal relationship is established between serum sodium level and cataractogenesis, it would be of significant benefit to both the clinicians and the patients. The clinicians would get a simple, cost effective preliminary tool to assess the risk of cataract development in a given patient, who, in turn would be benefitted from appropriate dietary advice and potentially delay the onset and progression of senile cataract. From a broader perspective, this would make a great impact on a major public health problem.

AN ANALYSIS OF THE LEVELS OF SERUM SODIUM AND POTASSIUM IONS IN SENILE CATARACT PATIENTS.

Blindness is one of the most significant social problems in India. There are about 4 million new cases of senile cataract in India annually **Minassian DC, Mehra V, 1990** and 2 million cases of cataract induced blindness. About 50 million people in the world are affected by senile cataract **Bunce GE et al., 1990**, **Minassian DC, Mehra V, 1990**. In South-East Asian region, cataract is the single most common cause of blindness, being responsible for 50-80 percentage of all blindness. 75% of people above 75 years of age have senile cataract **Van Heyningaen R, 1961.** Hence cataract surgery is by far the most common surgical procedure done in the field of ophthalmology **Sperduto RD, 2000.**

Lens:

The crystalline lens is a transparent structure playing a main role in the focussing mechanism for vision. The human lens continues to grow throughout life. It is composed of 64% water, 35% protein and 1% lipids, carbohydrates and trace elements. The lens is composed of epithelial cells, surrounded by a capsule. These epithelial cells give rise to the lens fibres. The cells contain Na^{+} K^{+} ATP-ase and a calmodulin-dependent Ca^{++} activated ATP-ase for active transport of electrolytes. Transparency of the lens is due to:

(i) perfect organization and regularity of these lens fibres,

(ii) paucity of organelles in the epithelial cells and lens fibres and

(iii) maintenance of a state of relative dehydration of the lens fibres.

Cataract:

Any opacity in the lens or its capsule, whether developmental or acquired is called a cataract. It is caused by the degeneration and opacification of the lens fibres already formed, the formation of aberrant lens fibres or deposition of other materials in their place.

Biochemically, three factors are responsible for the formation of cataract.

(i) Hydration of lens causes actual droplets of water to accumulate under the capsule forming lacunae between the fibres causing the entire tissue to swell making the lens opaque.

(ii) Denaturation of lens proteins produces dense opacities in the lens which is irreversible and

(iii) Degenerative changes produce slow sclerosis of the lens.

As the lens ages, many morphological changes occur in the epithelial cells, fibers and capsule. Ageing produces changes in the intercellular junctions and alterations in cation permeability of the lens.

Studies by **Van Heyningaen R, 1961** have revealed that any change in serum electrolyte levels, affects the electrolyte levels in the aqueous and hence affects the metabolism of the lens**.** Studies by **Mirsamadi M et al., 2004** have shown that an elevation of serum sodium ion levelmay increase sodium ion concentration in the aqueous humor. This makes it difficult for the sodium pumps which have become inefficient due to ageing, to maintain a low intracellular sodium ion level.
A higher sodium ion concentration of the aqueous humour, coupled with an altered membrane permeability of lens, increases the intra cellular sodium ion concentration. This causes hydration of the lens which results in loss of its transparency and development of cataract.
There are various risk factors like ageing, sunlight, severe dehydration, vitamins A, C and E deficiency, diet, diabetes, smoking, corticosteroids and heredity which are associated with the formation and progression of cataract. Avoidance of these risk factors may delay the development of cataract and thus help in reducing the burden of this disease in the community

Aim:
(i) To estimate the serum levels of sodium and potassium ions in senile cataract patients and controls.

(ii) To compare the serum levels of sodium and potassium ions in senile cataract patients with that of normal individuals.

Materials and methods:
This is a hospital based , case control study with participants randomly selected from patients attending the outpatient dep artment of Ophthalmology in the Government Rajaji hospital , Madurai. The study was carried out after getting institutional ethical clearance.
Inclusion criteria:
Study group: A random sample of 50 senile cataract male patients of age >50years , attending the outpatient facility at the department of Ophthalmology , Government Rajaji Hospital , Madurai.
· Control group: 50 age matched males without senile cataract

Exclusion criteria:
Individuals with age <50 years, individuals with secondary cataract, diabetics, hypertensives, individuals on any medication like steroids or diuretics , those with endocrine disorders, renal diseases , systemic diseases affecting serum sodium levels , dehydration or edema were excluded from the study. Patients on salt restricted diet were excluded and care was taken to ensure that both the cases and controls were consuming normal, mixed, south Indian diet.
Written consent was obtained from the subjects after their requirements for participation in the study were explained. The height, weight, pulse rate and blood pressure of all the participants were measured.
Both the case and control groups were subjected to routine ophthalmic examination including visual acuity determination*, intraocular pressure estimation, slit lamp and fundus examination.*

Biochemical analysis:

Under strict aseptic precautions, 2 ml of blood was collected by venipuncture from the cubital fossa and collected in sterile vacuum tubes. Serum was separated and the serum levels of sodium and potassium ions were estimated using Auto analyzer Easylyte method.

Statistical analysis:

The values were expressed as mean ± standard deviation. The data from the cases and control groups were compared by using Student's t-test using SPSS (Statistical Package for Social Science) software version 3.5. p values < 0.05 were considered to indicate statistical significance.

RESULTS:

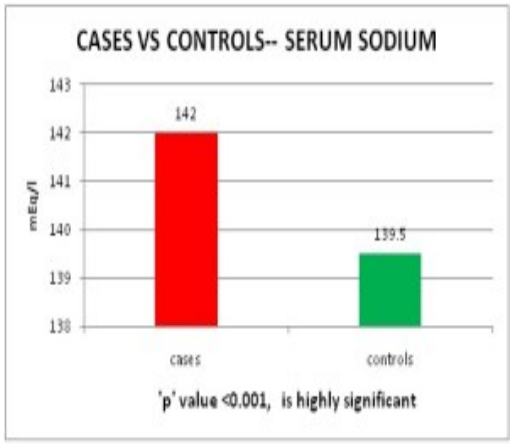
Variables	Cases (n = 50)	Controls (n = 50)	p value
Age (in years)	63.86 ± 6.13	62.22 ± 4.2	0.614
BMI (kg/m^2)	22.140 ± 2.238	21.989 ± 2.298	0.740
Pulse rate (per min)	80.76 ± 8.27	79.13 ± 9.68	0.634
Systolic BP (mm of Hg)	118.4 ± 11.147	119.44 ± 7.103	0.579
Diastolic BP (mm of Hg)	76.360 ± 6.511	75.600 ± 5.299	0.524
Serum sodium ions (mEq/l)	142 ± 2.981	139.5 ± 3.196	<0.001
Serum potassium ions (mEq/l)	4.192 ± 0.674	4.136 ± 0.497	0.637

p-value < 0.05 is significant.

The findings of the current study show that the mean age for case group was (63.86 ± 6.13) and that of control group was (62.22 ± 4.2). The mean BMI for the cases and controls were 22.140 (±2.238) and 21.989(±2.298) respectively. There was no significant difference in BMI between the cases and controls.

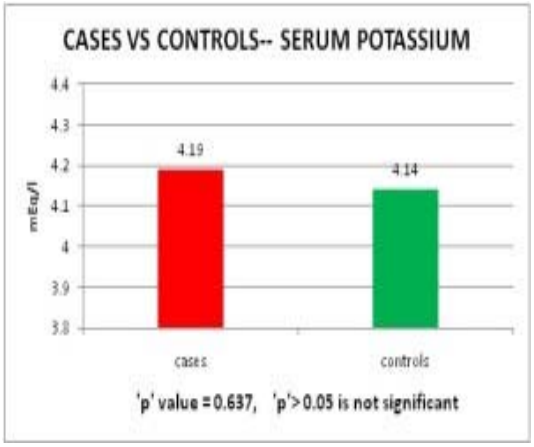
The mean pulse rate of the cases 80.76 (±8.27) was higher than that of the controls 79.13(±9.68) but it was not statistically significant.There was no significant difference between the mean systolic blood pressure of the cases 118.4 (±11.147) and that of the controls 119.44 (±7.103). Similarly no significant difference was noted in the mean diastolic blood pressure of the cases 76.360 (± 6.511) and that of the controls 75.600 (±5.299)

Fig 1: Comparison of Serum Sodium ion levels between the cases and con-



The serum sodium ion level of senile cataract patients 142 ± 2.981
was found to be significantly higher when compared to that of normal individuals 139.5 ± 3.196 with a p-value of <0.001

Fig 2: Comparison of Serum Potassium ion levels between the cases and controls.



The serum potassium ion levels of senile cataract patients 4.192 ±0.674 compared with that of normal individuals 4.136 ±0.497, showed no significant difference between them.

Discussion:

In the present study, it is clear that there is an elevation of serum Sodium ion levels in those with senile cataract which is in agreement with previous studies **by Van Heyningaen R, 1961, Donnelly CA, Seth J et al.,1995.**

Though ageing by itself is a risk factor for cataractogenesis, other factors like genetic factor, UV -B light exposure, diet, occupation, geographic factors and biochemical changes in the blood may intervene in the progression of the disease **Leske MC, Chylack LT, Wus Y 1991.** Various studies have been done to ascertain the relationship between these factors and cataract formation.

Studies by **Nourmohammadi I, 2001** and **Duncan G, Bushell AR, 1995**, have shown relationship between serum sodium ion levels and cataract formation**.** But, **the Italian-American cataract study, 1991** has shown no relationship between serum sodium ion levels and cataract formation. This difference may be due to variation in the quality and quantity of diets all over the world **ShoenfeldER et al., 1993, Barber CW, 1963, Phillips CI et al., 1980.**

Lens has a high content of potassium ions and a low content of sodium ions. These two ions are in optimal balance with each other. This balance is maintained by the membrane permeability of the lens and the $Na^+ K^+$ ATP- ase pump.

With ageing, there is an increase in membrane permeability due to age related increase in the cholesterol to phospholipid ratio according to studies by **Maraini G, Pasino M, 1983** .The $Na^+ K^+$ permeability ratio of the lens increases approximately six fold resulting in a proportionately greater increase in sodium ion concentration of the lens as documented by **Clayton RM et al.,1980**. Potassium ion concentration of the lens is not altered.

An increase in serum sodium ion levels increases the concentration of the sodium ions in the aqueous humour. In their studies**, Lucas VA, 1986 and Gandolfi SA, 1985** documented that with ageing, there is a reduction in the functioning of the Na^+K^+ATP-ase pump and maintenance of a low intra cellular sodium ion concentration by this pump becomes more difficult. This in turn increases the sodium ion concentration of the lens. This results in hydration and swelling of the lens with disruption of the compact arrangement of lens fibres, as

a consequence of which there is a loss of transparency of the lens **Parson, 2002.**
This cationic imbalance has been predicted as a risk factor for cataract by **Iran University of Medical Sciences** and is supported by the **New York Eye study**.Hence a significantly elevated sodium ion level may be predicted as a risk factor for the progression of cataract. It is also noted that the same is not true for serum potassium ion levels which is in agreement with studies by **Clayton et al., 1980, Shoenfeld ER et al., 1993 and Philips et al., 1980.**

Conclusion:
In this study, serum sodium ion levels of senile cataract patients were found to be significantly higher than that of control group. From our study, it may be inferred that increased serum sodium ion levels could be a potential risk factor for the development of senile cataract.
However, large scale multi-centric studies with due emphasis on dietary habits across various racial populations are needed to establish a causal relationship between serum sodium level and cataractogenesis. Such a relationship, if established, would be a simple, cost effective tool to assess the risk of cataractogenesis and would be a boon to the clinicians in resource-poor settings like ours

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