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Study of Serum Sodium and Potassium Levels in Senile Cataract Patients in PBM Hospital

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Abstract: ***Introduction: The crystalline lens, responsible for focusing light on the retina, relies on electrolyte balance for maintaining transparency. Alterations in serum sodium and potassium levels have been implicated in lens opacity and cataract formation. Current study aims to assess these alterations in senile cataract patients in PBM Hospital, Rajasthan. Objectives: 1) To estimate serum sodium and potassium levels in senile cataract patients. 2) To compare these levels with age - matched healthy controls. 3) To analyze role of these electrolytes in cataractogenesis. Materials and Methods: Case - control, hospital - based 200 subjects (100senile cataract patients, 100age and sex - matched controls). Diagnosed cases of senile cataract, aged 45–70years. Serum sodium and potassium levels measured using an automated electrolyte analyzer. Results: Demographics: Mean age of patients: 57.54±7.98 years. Male - to - female ratio in cases: 52: 48. Serum Electrolyte Levels: Significantly elevated in cataract patients (143.15 ± 1.54 mEq/L) compared to controls (139.47±8.86 mEq/L) (p<0.0001). Potassium: Decreased in cataract patients (4.19±0.99mEq/L) versus controls (4.35 ± 0.53 mEq/L), but difference was not statistically significant (p=0.07). Correlations: Positive correlation between sodium and potassium levels (r=0.2955; p=0.0026). Insignificant correlations between sodium, potassium, and chloride or calcium levels. Discussion: Findings highlight a significant elevation in serum sodium levels among cataract patients, aligning with earlier studies suggesting that increased dietary sodium intake might contribute to cataractogenesis. Potassium levels showed no significant variation, indicating that sodium might play a more critical role in altering lens permeability. Conclusion: Elevated serum sodium levels are a potential risk factor for senile cataract development. Monitoring and dietary modifications could mitigate this risk. Further studies should evaluate interplay of other electrolytes and their cumulative impact on lens health.***

Keywords: serum sodium, potassium levels, senile cataract, electrolyte balance, cataractogenesis

1. Introduction

Cataracts, characterized by lens opacity, are a leading cause of blindness worldwide, accounting for approximately 51% of global blindness. Senile cataracts, which occur due to age - related changes, impair vision by disrupting lens transparency and affecting its refractive properties. [1 - 3] The pathophysiology involves oxidative stress, metabolic dysfunctions, and electrolyte imbalances, particularly sodium (Na+) and potassium (K+). These electrolytes are essential for maintaining lens transparency by regulating its osmotic and ionic balance. [4 - 5]

The lens depends on aqueous humor, which derives its electrolytes from serum. Disruption in serum electrolytes can alter the lens's biochemical environment, leading to opacification. [6] While prior studies have indicated an association between serum sodium and cataract formation, the exact mechanism remains underexplored in the Indian population. [7] This study focuses on evaluating serum sodium and potassium levels in senile cataract patients and healthy controls to elucidate their role in cataractogenesis. [8]

2. Aims and Objectives

Aim:
- To investigate the relationship between serum sodium and potassium levels and the development of senile cataracts in patients attending PBM Hospital, Bikaner.

Objectives:
- Estimate serum sodium and potassium levels in senile cataract patients and age - matched healthy controls.
- Compare these levels to identify significant differences.
- Explore the potential role of these electrolytes in the pathogenesis of cataracts.

3. Materials and Methods

Study Design: Case - control, observational study.

Study Site: Sardar Patel Medical College and PBM Hospital, Bikaner, Rajasthan.

Study Duration: 2021–2022.
Sample Size: 200 participants (100 cataract patients, 100 healthy controls).

Inclusion Criteria:
- Patients aged 45–70 years diagnosed with senile cataracts.
- Age - and sex - matched healthy individuals without cataracts.

Exclusion Criteria:
- Presence of systemic diseases such as hypertension or diabetes.
- Renal disorders, acute or chronic diarrhea.
- History of steroid use or chemotherapy.

Data Collection:
Participants were selected based on inclusion criteria. A detailed clinical history and physical examination were conducted. Blood samples were drawn from the antecubital vein after overnight fasting. Samples were centrifuged to separate serum, which was analyzed for sodium and

potassium levels using an electrolyte analyzer. Standardized reference ranges were used for analysis:
- Sodium: 135–145 mmol/L
- Potassium: 3.5–5.5 mmol/L

Statistical Analysis:
Data were analyzed using SPSS version 17.0. Results were expressed as mean ± SD. Student's t - test was applied to assess differences between groups. Pearson's correlation coefficient was used to evaluate the relationship between variables. A p - value < 0.05 was considered statistically significant.

4. Results

1) **Demographics:**
- Mean age of cataract patients: 57.54 ± 7.98 years.
- Gender distribution: Males (52%), Females (48%).
- Religious distribution: Hindus (65%), Muslims (35%).
- Area of residence: Rural (53%), Urban (47%).

2) **Serum Electrolyte Levels:**

a) **Sodium:**
- Cataract patients: 143.15 ± 1.54 mEq/L.
- Healthy controls: 139.47 ± 8.86 mEq/L.
- Statistically significant increase in sodium levels in cataract patients ($p<0.0001$).

b) **Potassium:**
- Cataract patients: 4.19 ± 0.99 mEq/L.
- Healthy controls: 4.35 ± 0.53 mEq/L.
- No statistically significant difference ($p=0.07$).

3) Correlations:
- Positive correlation between sodium and potassium ($r=0.2955$, $p=0.0026$).
- No significant correlations between sodium, chloride, and calcium levels.

Table 1: Demographic Characteristics of Study and Control Groups

Characteristic	Cataract Patients (Cases)	Healthy Controls	Key Observations
Number of Participants	100	100	Equal distribution in both groups.
Mean Age (Years)	57.54 ± 7.98	56.16 ± 7.78	No significant difference in mean age.
Gender Distribution	Male: 52%; Female: 48%	Male: 60%; Female: 40%	Similar proportions of males and females.
Religion	Hindu: 65%; Muslim: 35%	Hindu: 63%; Muslim: 37%	Comparable religious distribution.
Area of Residence	Rural: 53%; Urban: 47%	Rural: 49%; Urban: 51%	Similar rural and urban representation.
Socio - Economic Status	Low: 28%; BPL: 25%	Low: 27%; BPL: 20%	Higher proportion of BPL cases in patients.

Table 2: Serum Electrolyte Levels in Cataract Patients vs. Controls

Parameter	Cataract Patients (Mean ± SD)	Healthy Controls (Mean ± SD)	p - value	Significance
Sodium (mEq/L)	143.15 ± 1.54	139.47 ± 8.86	<0.0001	Significant increase in patients.
Potassium (mEq/L)	4.19 ± 0.99	4.35 ± 0.53	0.07 (NS)	No significant difference observed.
Chloride (mEq/L)	104.20 ± 5.17	101.63 ± 4.00	<0.0001	Significant increase in patients.
Calcium (mg/dL)	9.21 ± 0.67	9.43 ± 0.66	0.020 (NS)	Insignificant decrease in patients.

Table 3: Correlation of Serum Electrolytes in Cataract Patients

Correlation	r - value	p - value	Significance
Sodium vs. Potassium	0.2955	0.0026	Positive and significant.
Sodium vs. Chloride	0.1904	0.0577	Positive but not significant.
Sodium vs. Calcium	0.00881	0.9305	No significant correlation.
Potassium vs. Chloride	0.1229	0.2233	No significant correlation.
Potassium vs. Calcium	0.0403	0.6901	No significant correlation.
Chloride vs. Calcium	0.1403	0.1640	No significant correlation.

5. Discussion

The study demonstrates a significant elevation in serum sodium levels in senile cataract patients compared to healthy controls. This finding supports previous research suggesting that higher sodium levels may disrupt lens transparency by interfering with its osmotic balance. Elevated sodium in the aqueous humor can alter lens membrane permeability, potentially leading to cataract formation.

Sodium and Cataractogenesis:
- The lens depends on a delicate sodium - potassium balance maintained by the Na+/K+ ATPase pump.
- In cataract patients, reduced pump activity increases intracellular sodium levels, leading to osmotic imbalance and lens opacity.
- Dietary sodium may exacerbate this process, highlighting the importance of dietary modifications as a preventive strategy.

Potassium and Cataractogenesis:
- Potassium levels in cataract patients were slightly lower but not statistically significant.
- Potassium is crucial for maintaining intracellular electrolyte balance, but its role in cataract formation remains less clear.
- The lack of significant findings aligns with previous studies, suggesting that potassium may not be a primary factor in cataractogenesis.

Comparative Analysis:
- Similar studies in the Indian population have shown consistent findings, with elevated sodium levels in cataract patients.

- In contrast, potassium levels have not shown significant differences, reflecting the multifactorial nature of cataracts.
- These variations may also be influenced by regional dietary habits and genetic predispositions.

Clinical Implications:

- Monitoring serum sodium levels may serve as an early indicator of cataract risk, especially in populations with high sodium dietary intake.
- Public health initiatives focusing on reducing sodium consumption could potentially slow cataract progression in at - risk populations.

Limitations:

- The study did not explore other biochemical parameters, such as chloride and calcium, in detail.
- A larger sample size and longitudinal follow - up could provide more robust conclusions.

6. Conclusion

This study highlights the significant role of serum sodium in the development of senile cataracts. Elevated sodium levels disrupt lens transparency by altering its ionic and osmotic balance, thereby contributing to cataractogenesis. While potassium levels showed no significant association, the findings emphasize the importance of dietary sodium regulation as a preventive measure against cataract progression. Future research should focus on exploring additional biochemical and environmental factors to develop comprehensive prevention strategies.

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