GLUCOSE AND ELECTROLYTES CONCENTRATIONS IN AQUEOUS HUMOUR IN DIABETIC, NON-DIABETIC, AND PRE-SENILE CATARACTS

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Abstract:
Cataract being opacification of lens fibres is a major cause of visual impairment in diabetic patient. Though the precise pathogenesis of cataract formation is not clear, the biochemical changes have been studied extensively. Cataract is considered a major cause of visual impairment in diabetic patient as the progression of cataract is elevated in patient with diabetes. Increased sorbitol levels inside the lens secondary to increase in aqueous glucose concentrations may be implemented in pathogenesis of diabetic cataract. Hypocalcemia is associated with increased risk of development of pre-senile cataract.

Keywords: Cataract, lens fibres, visual impairment


INTRODUCTION:
Cataract- Development of opacity in the lens due to opacification of lens fibers. Though the precise pathogenesis of cataract formation is not clear, the biochemical changes have been studied extensively. Cataract is considered a major cause of visual impairment in diabetic patient as the progression of cataract is elevated in patient with diabetes.

Increased sorbitol levels inside the lens secondary to increase in aqueous glucose concentrations may be implemented in pathogenesis of diabetic cataract. Hypocalcemia is associated with increased risk of development of pre-senile cataract.
This study aims to find out the aqueous concentration of sodium, calcium, and glucose in diabetic non-diabetic and pre-senile cataract patients. Raised serum sodium, low levels of serum calcium and increased serum glucose is implicated in development of cataract. Our study aims to determine the aqueous levels of sodium, calcium, and glucose in various types of cataracts including pre-senile cataract. Many studies have compared serum level of electrolytes among cataract and non-cataract groups but few have compared the aqueous levels of different electrolytes and glucose in various types of cataracts i.e., Diabetic, non-diabetic and pre-senile cataracts.

**AIMS AND OBJECTIVE:**

To compare the various electrolytes (sodium, calcium) and glucose levels in aqueous humour sampling among three different groups of patients with cataract.

After comparing the results, whether the sodium and calcium level changes in aqueous humour apart from glucose levels needs to be determined in diabetic cataracts.

Aqueous glucose concentration in non-diabetic cataract apart from electrolyte concentrations needs to be estimated.

To estimate raised or reduced glucose, electrolyte concentration in aqueous humour in patient with pre-senile cataracts

**MATERIAL AND METHODS:**

**Study design:** prospective Analytical studies.

**Place of study:** Dept. Of ophthalmology (Tertiary health centre)

**Setting:** The present study was conducted in the department of ophthalmology in a tertiary care teaching hospital.

**Ethical clearance:** The study has been cleared by the undergraduate review committee of the institute and the Institutional Human Ethics Committee. The study was initiated after Institutional Human Ethics Committee clearance.

**Consent:** Study protocol was explained to every prospective participant individually and they were also provided with printed format. Enough opportunity was given to them to get their doubts cleared. The participants were enrolled in the study after getting signature in the consent form.

The method used for statistics is CHI-square test by SPSS-version-23 used for Descriptive statistics to find frequency and percentage.

**Inclusion criteria:**

- Patients with senile cataracts more than 50 years of age with or without diabetes mellitus.
- Patients with pre-senile cataract less than 50 years of age.
Exclusion criteria:

- Patients with history of glaucoma.
- Patients with history of uveitis.
- Patients on chronic topical medications.
- Patients’ undergone previous intraocular surgeries.
- Patients on diuretics.
- Traumatic cataract

Methods

- A profoma was used to collect the baseline data and written informed consent was taken to perform cataract surgery and also for the sampling studies.

- Detail history, systemic and ocular examinations was done as per routine pre-operative protocol and to fulfills the inclusion and exclusion criteria.

- Patients were divided into 3 groups. Group 1 -Senile Cataract with Diabetes, Group 2- senile cataract without Diabetes, Group 3- Pre senile Cataract

- Under aseptic precautons with peri-bulbar/topical anaesthesia 0.2cc of aqueous humour was collected using a 26 gauge needle and an insulin syringe intra-operatively and the cataract surgery was completed.

- The aqueous sample collected was sent for biochemical analysis on the same day and the levels of sodium, calcium and glucose was estimated by using Dimensions RXL.

- Serum levels of sodium, calcium, glucose were also collected for all the study population.

OBSERVATION AND RESULTS:

<table>
<thead>
<tr>
<th>S No</th>
<th>Type of Cataract</th>
<th>Total No. Of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Senile with diabetes</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Senile without Diabetes</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>Presenile cataracts</td>
<td>9</td>
</tr>
</tbody>
</table>

-The total number of patients in our study is 81.

-Senile cataract without diabetes is 48.
Followed by senile cataract with diabetes is 24.

And percentile cataract contributing to 9 patients.

TABLE 2: Distribution of patients with senile cataract with diabetes - one sample statistics (group 1)

<table>
<thead>
<tr>
<th>Electrolyte/Glucose Concentration</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std.Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>24</td>
<td>139.00</td>
<td>3.23</td>
<td>0.65</td>
</tr>
<tr>
<td>Calcium</td>
<td>24</td>
<td>8.46</td>
<td>0.79</td>
<td>0.16</td>
</tr>
<tr>
<td>Glucose</td>
<td>24</td>
<td>131.91</td>
<td>35.27</td>
<td>7.20</td>
</tr>
<tr>
<td>Sodium AQ</td>
<td>24</td>
<td>147.66</td>
<td>3.69</td>
<td>0.75</td>
</tr>
<tr>
<td>Calcium AQ</td>
<td>24</td>
<td>5.65</td>
<td>0.39</td>
<td>0.08</td>
</tr>
<tr>
<td>Glucose AQ</td>
<td>24</td>
<td>61.25</td>
<td>18.56</td>
<td>3.78</td>
</tr>
</tbody>
</table>

Average age was 60.5 years.

The mean aqueous level of sodium was 147 mEq/L. Normal values (140 - 144 mEq/L)

The mean aqueous level of calcium was 5.65 mg/dl. Normal values (5.5 mg/dl)

The mean aqueous level of glucose was 61.25 mg/dl. Normal value (50-55 mg/dl)

The mean aqueous concentration of sodium was higher than normal.

Calcium was almost normal and the glucose was higher than normal in this group.

The mean Serum concentration of sodium was slightly below normal. Normal values (135-145 mEq/L)

The mean serum concentration of calcium was below normal. Normal values (8.5-10.5mg/dl)

The mean serum glucose was higher than normal.
TABLE 3: Distribution of Patients with senile cataract without diabetes (group 2) - one sample statistics

<table>
<thead>
<tr>
<th>Electrolyte/Glucose Concentration</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>48</td>
<td>139.000</td>
<td>3.326</td>
<td>0.480</td>
</tr>
<tr>
<td>Calcium</td>
<td>48</td>
<td>8.9250</td>
<td>0.68681</td>
<td>0.09913</td>
</tr>
<tr>
<td>Glucose</td>
<td>48</td>
<td>95.3271</td>
<td>28.21896</td>
<td>4.07306</td>
</tr>
<tr>
<td>Sodium AQ</td>
<td>48</td>
<td>141.542</td>
<td>22.7484</td>
<td>3.2834</td>
</tr>
<tr>
<td>Calcium AQ</td>
<td>48</td>
<td>5.8521</td>
<td>0.80873</td>
<td>0.11673</td>
</tr>
<tr>
<td>Glucose AQ</td>
<td>48</td>
<td>53.7917</td>
<td>17.09791</td>
<td>2.46787</td>
</tr>
</tbody>
</table>

Total no patients were 48 of which 21 males and 27 females.

- Average age was 66 years.

- The mean aqueous level of sodium was 141 mEq/L.

- The mean aqueous concentration of sodium was in normal limits.

- The mean aqueous level of calcium was 5.85 mg/dl.

- The mean aqueous concentration of calcium was in normal limits.

- The mean aqueous level of glucose was 53.79 mg/dl.

- The mean aqueous concentration of glucose was in normal limits.
TABLE 4: Distribution of patients with presenile cataract (group 3) - one sample statistics:

<table>
<thead>
<tr>
<th>Electrolyte/Glucose</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std.Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>9</td>
<td>138.7778</td>
<td>3.11359</td>
<td>1.03786</td>
</tr>
<tr>
<td>Calcium</td>
<td>9</td>
<td>8.8333</td>
<td>0.31623</td>
<td>0.10541</td>
</tr>
<tr>
<td>Glucose</td>
<td>9</td>
<td>101.6667</td>
<td>19.11151</td>
<td>6.37050</td>
</tr>
<tr>
<td>Sodium AQ</td>
<td>9</td>
<td>140.7778</td>
<td>16.73901</td>
<td>5.57967</td>
</tr>
<tr>
<td>Calcium AQ</td>
<td>9</td>
<td>6.0111</td>
<td>1.36606</td>
<td>0.45535</td>
</tr>
<tr>
<td>Glucose AQ</td>
<td>9</td>
<td>72.1111</td>
<td>14.92853</td>
<td>4.97618</td>
</tr>
</tbody>
</table>

Total no patients were 9 of which 2 males and 7 females.

-Average age was 45.5 years.

-The mean aqueous level of sodium was 140.7 mEq/L.

-The mean aqueous concentration of sodium was within normal limits.

-The mean aqueous level of calcium was 6.01 mg/dl.

-The mean aqueous concentration of calcium was in normal limits.

-The mean aqueous level of glucose was 72 mg/dl.

-The mean aqueous concentration of glucose was higher than normal limit as 4 out of 9 patients in this group are diabetic.

-The mean serum level of sodium, calcium and glucose were within normal limits.
TABLE 5: Distribution based on average serum and aqueous concentration in all 3 groups:

<table>
<thead>
<tr>
<th>Type of Cataract</th>
<th>No</th>
<th>Mean Serum</th>
<th>Aqueous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sodium</td>
<td>Calcium</td>
</tr>
<tr>
<td>Senile Cataract with Diabetes</td>
<td>24</td>
<td>139.0</td>
<td>8.4</td>
</tr>
<tr>
<td>Senile cataract without diabetes</td>
<td>48</td>
<td>139</td>
<td>8.92</td>
</tr>
<tr>
<td>Pre senile cataract</td>
<td>9</td>
<td>138.7</td>
<td>8.8</td>
</tr>
</tbody>
</table>

**DISCUSSION:**

Establishment of reference values of aqueous glucose in normoglycaemic senile cataract patients was done by Kapil Deb lahiri in west Bengal found the values were 50 mg/dl. This was similar to a study done by Davies et al who showed aqueous glucose concentration in non diabetic patients were 3.2 mM and in diabetic patients was 7.8 mM.

**IN GROUP 1-SENILE CATARACT WITH DIABETES**

-Though Aqueous level of mean sodium (147 mg/dl) and mean glucose (61.25 mg/dl) were marginally higher than normal aqueous concentration, it was not statistically significant (P-value being for sodium 0.22 and for glucose P-value being 0.51)

Reference - Similar to study done by Prof.Tasneen from Bangalore which showed Aqueous sodium levels were higher in cataract patients and calcium was found to be lower.

-The same in comparison to group-2 (Senile Cataract without Diabetes), again aqueous sodium was found to be higher in concentration (group-1 sodium 147 mg/dl and group-2 sodium 141 mg/dl)

Similar study was done by Dr.Reepa Bhora, which showed significant changes in serum aqueous sodium levels between diabetic and non-diabetic.

The mean aqueous glucose concentration were higher in group-1 compared to group-2 (ie , 61.2mg/dl in group-1 and 53.79mg/dl in group-2)
The mean aqueous concentration of calcium was comparable with normal values in this group.

The mean serum sodium levels were normal but the calcium was slightly lower than normal (8.4 mg/dl, which was found to be statistically significant P value being 0.04)

Reference- Similar study was done by QL Huang\(^8\) reduced calcium levels were associated with cataracts.

The mean serum glucose was higher than normal as this group had patients with diabetes. The mean value was 131mg/dl.

IN GROUP 2 - SENILE CATARACT WITHOUT DIABETES

- All the parameters except calcium which was tested in serum and aqueous was found to be lower than in Group-1

- The values were comparable with normal serum and aqueous concentration values except for serum sodium which was found to be statistically significant (P value being 0.012)

Reference- Similar to study done by Mansoor Mirsamadi\(^3\) which showed serum levels were significant difference between the cataract and normal patients.

IN GROUP 3 - PRESENILE CATARACT

In this group the total numbers of patients were 9 of which 4 are diabetic and 5 were non-diabetic.

- The mean aqueous level of glucose in this group was found to be highest (72.0 mg/dl) which was compared with normal aqueous concentration of glucose (50-55 mg/dl).

- This may be a contributing factor for early cataractogenesis in presenile cataract patients.

Reference-5 Similar study was done by Andreas Pollreisz\(^9\) -which showed diabetic cataract-Pathogenesis.

- We also found the mean aqueous calcium levels were marginally raised when compared to group-1 and group-2 and also from the normal aqueous level. This is contrary to other studies which shows low aqueous level of calcium to be associated with cataracts.

**CONCLUSION:**

- The mean aqueous level of sodium and glucose in senile cataract patients with Diabetes was found to be higher than normoglycemic cataract patients and also from the normal reference values.

- The serum levels of calcium in cataract patients with diabetes were slightly lower than normal which was found to be statistically significant.
- The mean aqueous glucose concentration was found to be significantly higher in pre-senile cataract patients.

- The mean aqueous calcium levels were marginally raised when compared to group-1 and group-2 and also from the normal aqueous level in pre-senile cataract group.

References:

7. Reepa Borah Choudhury¹, ParthaSarathiGayan ², Barnali Das³, Comparative Study Of Serum And Aqueous Humour Electrolytes In Diabetic And Non-Diabetic Cataract Patients Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 15, Issue 4 Ver. XIII (Apr. 2016)