COMPARATIVE BIOCHEMICAL OBSERVATIONS ON RAT PINEAL GLAND AND SERUM

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ABSTRACT

The comparative biochemistry of the pineal gland and the serum in 24 rats is reported in the present study. Glucose, urea, alkaline and acid phosphatases, aspartate and alanine aminotransferases, calcium and phosphorous values were estimated and these values were represented in terms of milligrams of protein. Glucose and urea values were about three and forty six times higher in the pineal tissue than in serum. The activity of phosphatases, aminotransferases were also higher in the pineal. The higher value of glucose and alkaline phosphatase activity is indicative high level of energy metabolism going on in the pinealocytes. The calcium: phosphorus ratio in the pineal gland and serum were 1.68:1.00 and 1.00:1.01 respectively. The present study indicates that the pineal gland represents a glandular tissue having high metabolism and cannot be considered as brain sand or vestige.

INTRODUCTION

The pineal gland, described as a rudimentary organ or brain sand or vestige with no physiological function in past is now considered to play an important role in the circadian and seasonal rhythms and also in the endocrine control of the reproduction (Matthews et al., 1993). Presence of large number of compounds (Quay, 1981) and enzymes have been demonstrated in the pineal tissue (Saigal and Nanda, 1977). In addition to this, the pineal gland contains several calcified concretions called corpora areacea, which are predominantly composed of calcium salts are reported (Vigh et al., 1988; Getty, 1975). With a view that the estimation of biochemical components could be of value in assessing metabolism of pineal gland, the present study was undertaken for comparison of certain biochemical parameters of the pineal gland tissue with that of serum. In the present study effort is also made to compare the calcium and phosphorus concentrations in the pineal gland with that of serum.

MATERIAL AND METHODS

The pineal glands (26mg) obtained from twenty four adult male albino rats maintained under laboratory conditions (light: dark cycle, 14L:10 D) were used for the study. The pineal glands were pooled together immediately after sacrificing the rats using excess ether anaesthesia. All the sacrifices were made between 16:00 to 16:30 hours. The glands were homogenized in 5 ml of tris-HCl buffer (pH 7.4). The homogenate was centrifuged at 2500 X g at 4°C for 20 minutes and the supernatant was stored. The serum was separated from the blood collected from rats at the time of sacrifice. The pineal supernatant and randomly selected ten serum samples obtained from rats were used for biochemical estimations as follows.

Glucose and urea were measured using commercial kit (Span Diagnostics, Surat, India). Aminotransferases (alanine aminotransferase, ALP and aspartate amino transferase, AST) and phosphatases (alkaline phosphatase, ALP and acid phosphatase, ACP) were estimated using method of Reitman and Frankel (1957) and Raphael (1976) respectively. The calcium and phosphorus concentrations were estimated method of Morin

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(1974), Kessier (1964) and Daly (1972) respectively. Protein was estimated according to Lowry et al. (1951). All the above parameters were expressed in terms of per milligram protein. The comparison of serum data was done with t-test using Instat-Graph Pad V 2.05 Software (Graph Pad Software, San Diego, USA).

RESULTS AND DISCUSSION

The values of the biochemical parameters studied for pineal gland tissue and serum is indicated in Table 1. The amount of all biochemical parameters studied namely, glucose, urea, calcium, phosphorus and enzymes-ALP, ACP, AST and ALT were significantly higher in the pineal gland than in serum. There was also significant difference between the serum values.

The glucose concentration of the pineal tissue was about three times the corresponding value in the serum, indicating high level of metabolism in the pinealocytes. In mammals, glucose is the only fuel that the brain uses under non-starvation conditions and therefore glucose concentration of a tissue primarily depends upon its energy metabolism and hence requirement (Berg et al., 2002). As the energy requirement of the pineal tissue increases more glucose is transported from blood to the pineal. The higher glucose values in the pineal, compared to serum could be attributed to the time the sacrifice, which was done around 16:00 hours, a time when the melatonin level begins to increase (unpublished observations), the higher glucose values (in comparison to serum) observed in the present study might be due to this. In mammals urea is found in almost all tissues of the body (Altman and Dittmer, 1971) and the high content of urea in comparison to serum might be due to high amino acid metabolism in the pineal gland. The phosphatases activity of the pineal tissue was higher than serum values. The values observed in the present study are lower than that reported by Korde (1997) for brain areas other than pineal. Saigal and Nanda (1977) has reported ACP activity in corpora arnccea, the mineral deposit present in the pineal tissue. The presence of ALP in the pineal was reported by Vigh et al. (1988).

As the transaminases values were also much higher than the corresponding serum values but the present values in the pineal were lower than those reported for other brain areas (Korde, 1997). The calcium: phosphorus ratio in the pineal gland and serum were 1.68:1.00 and 1.00:1.01 respectively. Vigh et al. (1988) reported a higher calcium concentration in the rat pineal than in surrounding brain tissue. The observation regarding the mineral content of pineal tissue in the present study is in concurrence to various authors (Ramakrishna, 2000; Vigh et al. 1988 ; Saigal and Nanda, 1977).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pineal gland</th>
<th>Serum (Mean±SE)</th>
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</thead>
<tbody>
<tr>
<td>Glucose (mg/mg protein)</td>
<td>2.72x10^2</td>
<td>9.32x10^2±5.26x10^4</td>
</tr>
<tr>
<td>Urea (mg/mg protein)</td>
<td>2.68x10^1</td>
<td>5.77x10^2±6.43x10^4</td>
</tr>
<tr>
<td>Alkaline phosphatase (KA Units/mg protein)</td>
<td>2.41</td>
<td>1.05x10^2±1.34x10^4</td>
</tr>
<tr>
<td>Acid phosphatase (KA Units/mg protein)</td>
<td>1.14</td>
<td>0.26x10^2±2.61x10^4</td>
</tr>
<tr>
<td>Alanine aminotransferase (Units/mg protein)</td>
<td>14.20</td>
<td>7.77x10^2±8.78x10^4</td>
</tr>
<tr>
<td>Aspartate aminotransferase (Units/mg protein)</td>
<td>17.86</td>
<td>8.21x10^2±8.97x10^4</td>
</tr>
<tr>
<td>Calcium (mg/mg protein)</td>
<td>6.85x10^2</td>
<td>1.16x10^2±8.91x10^5</td>
</tr>
<tr>
<td>Phosphorus (mg/mg protein)</td>
<td>4.07x10-2</td>
<td>1.26x10^2±8.3x10^5</td>
</tr>
</tbody>
</table>

*Significant at P<0.05.
The results of the present study indicate that the pineal tissue cannot be considered as brain sand or vestige. However, further studies are needed to compare metabolism of pineal tissue with that of other body tissue especially brain areas.

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REFERENCES