EFFECT OF PROTEIN MALNUTRITION ON THE WEIGHT AND SERUM ALBUMIN OF ALBINO RATS

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Background: Protein Malnutrition is one of the major mortality factors in the children of Pakistan. Not only do the children suffer from infections (because of low resistance secondary to malnutrition), but they also lose weight significantly. The two spectra of the diseases are Kwashiorkor and Marasmus. We conducted this study on laboratory animals to assess the weight change and correlated it with the extent of malnutrition by studying and estimating the serum albumin levels as well.

Methods: 40 male albino rats of 2 weeks’ age were used for the experiment. They were divided into Control and Experimental groups containing equal number of animals. The experimental group was subjected to protein malnutrition for 3 to 6 weeks. They were killed with the paired control animals. The parameters of the two groups were compared for statistical analysis.

Results: The results showed significant change in weights of the experimental animals right from the first week of malnutrition while the change in serum albumin level became significant after prolonged malnutrition.

Conclusion: Protein malnutrition is reflected from the decrease in the serum albumin levels of the animals and their weights are also decreased significantly.

INTRODUCTION

Protein Malnutrition is one of the leading public health issues in the third world1. Millions of children are affected under five years of age2. In Pakistan, one or the other form of malnutrition causes nearly 50% of deaths in the pediatric age group directly or indirectly3. Children suffering from these conditions easily fall ill and the usual cause of death in them is superimposed infection4. In these children the diet is deficient in one or more of the essential amino acids resulting in disturbance in nitrogen balance.

Various studies have been conducted on the animals subjected to experimental protein malnutrition. Most of these studies were conducted on albino rats belonging to various groups e.g. the effects were observed in rats during gestation and postnatal periods5. Lactating rats6 and young rats7. The inference drawn from all these studies showed that the protein deficient diet produced abnormal structural changes in a number of organs in these animals. The effects of PEM on the structure of some of the glands like submandibular gland, pancreas, parotid gland8 and the thyroid gland9 have been reported.

The awareness of balanced nutrition therefore cannot be ignored. We therefore conducted this study to see the effects of protein malnutrition on the weight change and serum albumin levels in rats subjected to experimental protein malnutrition. We also wanted to correlate the extent of weight reduction in these experimental animals with the extent of protein malnutrition.

MATERIALS AND METHODS

The study was conducted in 1994. Forty (40) male albino rats (Wistar strain) of 2 weeks’ age were used in the present study. They were kept in animal house of the zoology Department of Punjab University under standard conditions. The animals were given a period of two weeks to acclimatize with the environment. During this period, they were supplied with food (commercial diet) and water ad libitum. The experiment was started when the animals were 4 weeks old.

The animals were divided randomly into 2 groups before the commencement of the experiment. They were grouped as 'Control' and 'Experimental' group. Both the groups comprised of 20 animals. The Control group was further divided randomly into 4 sub-groups containing 5 animals each. They were named as Control “A” to Control “D”. The Experimental group was also divided randomly into 4 sub-groups with 5 animals each. They were named as Experimental “A” to Experimental “D”. These animals were weighed at the onset of the experiment and each sub-group was kept in a separate cage. The diet given to all the animals was ‘isocaloric’ but the protein content of the diet of different groups varied from 20% to 2.5%.

The experimental time varied from 3 to 6 weeks. The animals of Experimental “A”, Experimental “B” Experimental “C” and Experimental B were given 2.5% protein in their ration for 3,4,5 and 6 weeks respectively. The animals of Experimental groups were then weighed and killed. The animals of the Control “A” to “D” sub groups were also weighed and killed with them for comparison.

Before killing each animal was deeply anaesthetized with ether. The thorax and neck were opened by a midline incision blood was collected directly from aorta, while the animal was still breathing. It was analyzed for the estimation of serum albumin level in the Biochemistry laboratory of Sheikh Zayed Hospital Lahore. The results were compared statistically with the control group.
RESULTS

The animals of the Experimental were compared with the paired control group A to D for statistical significance. The results are summarized in tables 1 to 3. The values in the tables are expressed as mean ± Standard deviation. Table 3 shows the weight change and serum albumin of the Experimental group.

Table-1: Final age, initial weight and final weight of the control and experimental groups (The values are expressed as Mean ± SD)

<table>
<thead>
<tr>
<th>GROUP</th>
<th>SUB GROUP</th>
<th>AGE AT KILLING (weeks)</th>
<th>INITIAL WEIGHT (grams)</th>
<th>FINAL WEIGHT (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>7</td>
<td>55.42 ± 3.15</td>
<td>99.30 ± 6.18</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>8</td>
<td>56.7 ± 3.04</td>
<td>111.02 ± 4.69</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>9</td>
<td>58.75 ± 11.93</td>
<td>127.71 ± 7.75</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>10</td>
<td>58.96 ± 1.47</td>
<td>141.9 ± 8.82</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>7</td>
<td>51.32 ± 1.53</td>
<td>91.04 ± 3.72</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>8</td>
<td>56.86 ± 2.61</td>
<td>104.92 ± 3.97</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>9</td>
<td>54.36 ± 2.46</td>
<td>97.08 ± 4.30</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>10</td>
<td>57.65 ± 1.12</td>
<td>105.73 ± 4.49</td>
</tr>
</tbody>
</table>

Table-2: Weight change & serum albumin in the control group (Subgroups A-D) (values are expressed as Mean ±SD)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>CONTROL GROUP</th>
<th>EXPERIMENTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Weight change</td>
<td>gms</td>
<td>43.88 ± 3.02</td>
<td>54.32 ± 4.35</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>mg/dl</td>
<td>4.55 ± 0.35</td>
<td>3.34 ± 0.29</td>
</tr>
</tbody>
</table>

Table-3: Weight change & serum albumin in the experimental group (Subgroups A-D) (The values are expressed as Mean ± SD)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight change</td>
<td>gms</td>
<td>39.72 ± 1.37*</td>
<td>48.06 ± 1.89*</td>
<td>42.72 ± 1.90***</td>
<td>48.08 ± 3.60***</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>mg/dl</td>
<td>3.20 ± 0.14*</td>
<td>3.09 ± 0.15*</td>
<td>2.70 ± 0.23**</td>
<td>2.50 ± 0.28***</td>
</tr>
</tbody>
</table>

DISCUSSION

The protein deficient diet is known to produce abnormal structural changes in a number of organs in man as well as in experimental animals. The effects of PEM on the weight changes of the animals and their serum albumin level were. The changes in the weight of the animals were secondary to the changes found in the thyroid gland. As there is clear sexual dimorphism in the thyroid follicles of the rat, all the animals used in this study were of the same sex. The age of the animals at the time of commencement of the experiment was 4 weeks because in normally growing rats, the thyroid appears most active at about 4 weeks of age.

We observed the weight changes of the animals in various sub-groups. We found that when exposed to protein malnutrition, the animals showed a significant decrease in weight. The animals facing prolonged malnutrition showed more decrease as compared to the ones malnourished for a shorter duration. This suggests that the protein content of the diet is a major determinant of feed efficiency, as judged by the weight gain in the normal growing rats. This was in agreement with the findings of Andik, De Castro and Boyd cited by Orien et al., Heard and Stewart, Fleagle et al., Ramos et al., Muaku et al., Escriva et al., Resnick et al., and Tulp and Horton.

The serum albumin levels were measured in order to confirm that protein malnutrition had actually occurred. The results were in accordance with our expectations. The serum albumin levels decreased according to the degree of malnutrition. The animals kept on protein malnourished diet for prolonged periods showed significant decrease as compared to those who faced protein malnutrition for shorter periods. However, there was certainly a decrease as compared to the control group. These findings were also observed by Onura et al., who observed that both total proteins as well as serum albumin were moderately depressed in marasmic- Kwashiorkor children. The same changes were also observed by Ashraf et al., Truswell et al., and Wittman et al., cited by Allyene et al. and Akingbemi and Aire.

From this study, we conclude that the Protein Malnutrition primarily causes a significant decrease in the total weights of the albino rats. The ratio of the weight change was proportionate to the change in the serum albumin level.

CONCLUSION

It is concluded that protein malnutrition has an adverse effect on the growth of the albino rat. Correlating our results with the already established effects of protein malnutrition on the thyroid gland, it is suggested that the structural changes are mainly responsible for the functional changes in the thyroid gland and its target organs.
REFERENCES


