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

Muhammad Imran Qureshi and Zaheeruddin Qureshi

Department of Anatomy, Ayub Medical College. Abbottabad and 'Department of Surgery, Ayub Teaching Hospital, Abbottabad

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 the 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 world[1]. Millions of children are affected under five years of age[2]. In Pakistan, one or the other form of malnutrition causes nearly 50% of deaths in the pediatric age group directly or indirectly[3]. Children suffering from these conditions easily fall ill and the usual cause of death in them is superimposed infection[4]. 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 periods[5], Lactating rats[6] and young rats[7]. 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 gland[8] and the thyroid gland[7] 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 I 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)*

GROUP	SUB GROUP	AGE AT KILLING (weeks)	INITIAL WEIGHT (grams)	FINAL WEIGHT (grams)
CONTROL	A	7	55.42 ±3.15,	99.30 ±6 18
	B	8	56.7 ±3.04	111.02 ±4.69
	C	9	58.75 11.93	127.71 ±7.75
	D	10	58.96 ± 1.47	141.9 ±8.82
EXPERIMENTAL	A	7	51.32 ± 1.53	' 91.04 :. ±3.72
	B	8	56.86 ±2,61	104.92 ±3.97
	C	9	54.36 ± 2.46	97.08 ±4.30
	D	10	57.65 ±1.12	105.73 ±449

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

Parameter	Unit	CONTROL GROUP			
		A	B	C	D
Weight change	gms	43.88 ±3.02	54.32 ± 4.35	6896 ± 4.05	82.94 ± 3.32
Serum albumin	mg/dl	4.55 ±0.35	3.34 ± 0.29	3.46 ±0.25	3.45 ±0.26

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[7], As there is clear sexual dimorphism in the thyroid follicles of the rat[9], 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[10].

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

Parameter	Unit	EXPERIMENTAL			
		A	B	C	D
Weight change	Gms	39.72. ± 1.37*	48.06 ± 1.89*	42.72 ± 140***	48:08 ± 3.60***
Serum albumin	mg/dl	3.20± 0.1	3.09 ± 0.14	2.70 ± 0.23**	2.50 ± 0.28***

** : p value <0.05 ** : p value <0.01 ***: p value <0.001*

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, Decastro and Boyd cited by Orien *et al.,* Heard and Stewart," Fleagle *et al.,*[12] Ramos *et al*[6] Muaku *et al.,*[5] Escriva *et* a/.,[13] Resnick *et al*,[14] and Tulp and Horton.[15].

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.,* [6] 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 at.,*[17] Truswell *et al.,* and Wittman *et al.,* cited by Allyene *et al.* and Akingbemi and Aire[19].

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

1. Davidson S.. Passmore R.. Brok .I F., Truswell A.S. Proteins and Protein energy malnutrition. In: Human Nutrition and Dietetics. 6th edition, Churchill Livingstone. Edinburgh. 1982; pp 55-72, 303-316.
2. Udani P.M. "Protein Energy Malnutrition (P.E.M), Brain and various facets of child development". Indian Journal of Pediatrics, 1992; 59 (2): 165-186 Khan M., Baker J. Protein Energy Malnutrition. In: Nutrition in Primary Health Care for the young child Health publication Ltd., the Medical centre, 58 Khyaban-e-Iqbal, Shalimar 7/2, Islamabad. 1979; pp. 45-54.
3. Khan M.. Baker J. Protein Energy Malnutrition. In: Nutrition in Primary Health Care. National Nutrition Foundation, the Medical centre, 47-College Road. Shalimar 7/2. Islamabad. 1988; pp. 72-80.
4. Rodwell S., Williams. Essentials of Nutrition and Diet Therapy. 3rd edition. The C.V, Mosby Company, St. Louis, Missouri. 1982; pp. 3-10,35-47 and 191.
5. Muaku S.M., Beauloye V., Thissen J.P.. Underwood L.E.. Fossion C.. Gerard G. Ketelslegers J.M. “Long term effects of gestational protein malnutrition on postnatal growth, Insulin like growth factor (IGF)-I and IGF binding proteins in rat progeny". Pediatr Res 1996 Apr; 39(4ptl):649-55.
6. Ramos C.F., Teixeira C.V., Passos M.C., Pazos-Moura C.C.. Lisboa P.C., Curty F.H., de Moura E G. “Low protein diet changes thyroid function in lactatin rats". Proc Soc Exp Biol Med 2000 Sep; 224(4):256-63.
7. Qureshi M l.. Draz U., Feroze, N.. Jafri S.A. “Effects of protein malnutrition on the thyroid follicular cell size of albino rats". JAMC 1998:10(2):27-31
8. Jacob S.. Lawrence A.G. "Effects of Protein malnutrition on the mouse submandibular gland" J. Anat, 1989; 165 169- 175.
9. Delverdier M . Cabanie P.. Roome N., Enjalbert F , Van Haverbeke (}.: “Quantitative Histology of Rat Thyroid Influence of Histologic Technique on the Morphometric Data". Analytical and Quantitative Cytology and Histology. 1991a; 13, (2): 110-114.
10. Orien L.T.. Patricia P K.. Danforth E; Horton E S. "Characteristics of Thyroid Function in Experimental Protein Malnutrition". J. Nutr. 1979; 109 1321-1332.
11. 1 I Heard C.R.C.. Stewart R.J.C. Protein-calorie deficiency and disorders of the endocrine glands. Hormones. 1971.2: 40-64
12. Fleagle J.G.. Samonds K W., I legs ted D.M. "Physical growth of cebus monkeys, cebus albifrons. during protein calorie deficiency". Am. J. Clin.Nutr. 1975; 28: 246-253.
13. 13 Escriva F., Kergoat M., bailbe D., Pascual-Leone A M.. Portha B. “Increased Insulin action in the rat after protein malnutrition early in life". Diabetologia 1991: Aug; 34(8): 5 59-64.
14. Resnik O., Morgane P.J., Hasson R.. Miller M “Overt and hidden forms of chronic malnutrition in the raland their relevance to man". Neurosci Biobehav rev 1982 Spring;6(l):55-75.
15. Tulp O.L., Horton E.S. “Effect of prolonged experimental protein malnutrition and of refeeding on growth, adipose tissue development and body composition in rats". J Nutr 1981 Jul; 111(7): 1145-56.
16. 16 Onura C., Maharajan G,. Singh A., Etta K.M. "Thyroid status in various degrees of protein-calorie malnutrition in children". Clin. Endocrinol. Oxf. 1983; 18(1): 87-93.
17. Ashraf T.S., Abd EL, Hadi H., Alan D.R. "Endocrine and Amino acid changes in Protein Energy Malnutrition (PEMJ" Journal of Tropical Pediatrics 1991; 37:331-332
18. Alleyne G A.O, Hay R W,, Picou D.I . Stanfield J.P . Whitehead. R.G. “Protein Energy Malnutrition". Edward Arnold Publishers Ltd. London. 1979; pp. 25-53.
19. Akingbemt B.T., Aire T.A. “Haematological and serum biochemical changes in the rat due to protein malnutrition and gossypo;-abanol interactions". J Comp pathol 1994 Nov; 111(4):413-26