ejpmr, 2017,4(4), 592-594

SJIF Impact Factor 4.161

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

THYROID HORMONE STATUS IN CHILDREN WITH SEVERE ACUTE MALNUTRITION

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Article Received on 14/02/2017 **Article Revised on 05/03/2017** **Article Accepted on 25/03/2017**

ABSTRACT

Background: Severe Acute malnutrition (SAM)continues to be a major public health problem throughout the developing world. It affects several aspects of secretion and metabolism of thyroid hormones. The present study has been conducted to study the effect of SAM on thyroid hormone. **Methods:** Present study was a cross sectional hospital based study. 50 children with SAM, equal number of controls of age group 1-5 years were included in the study; details were collected in predesigned proforma. Triiodothyronine (T3), thyroxine (T4), thyroid stimulating hormone (TSH) levels were estimated. The parameters were compared among cases and controls using appropriate statistical tool. **Results:** T3 and T4 levels were significantly low in SAM children as compared to controls. TSH levels were similar in both groups. **Conclusions:** SAM is associated with reduction in T3 and T4 levels without any alteration in TSH levels. The altered thyroid hormone status in children with PEM is perhaps a defense mechanism against excessive metabolic stimulation and energy consumption.

KEYWORDS: Severe Acute Malnutrition, Thyroxine, Triiodothyronine.

INTRODUCTION

Protein Energy Malnutrition (PEM) is one of the most common nutritional problem of developing countries and an important cause of childhood mortality and morbidity leading to permanent impairment of physical and mental growth.[1,2] According to estimates in the world there are about 162 million children suffering from various forms of PEM. It is estimated that PEM is the primary or associated cause of nearly half of approximately 3 million deaths in children under the age of 5 years. Three-quarters of the world's stunted children live in South Asia and Sub-Saharan Africa; India is home to nearly one-third of world's malnourished children, as per national family health survey-3 (NFHS-3) report prevalence of underweight, stunting and wasting in India is 43%, 48% and 20% respectively.[3-5]

The World Health Organization (WHO) defines malnutrition as "The cellular imbalance between the supply of nutrients and energy, and the body's demand for them to ensure growth, maintenance, and specific functions". PEM initially leads to failure in maintaining adequate weight gain and growth rate in early stages, as the condition progresses there is loss of weight associated with loss of subcutaneous tissue and muscle mass. It affects every organ system, as PEM progresses organ dysfunction develops and leads to variety of clinical features; several metabolic derangements are expected.

Thyroid hormone plays an important role in regulation of lipid and carbohydrate metabolism and is necessary for normal growth and maturation. Absence of thyroid hormone causes mental and physical slowing, mental retardation and dwarfism.[6] There is marked change in secretion and metabolism of thyroid hormones and in structure of thyroid gland. These result in reduction of activity of thyroid gland and hence decrease in triiodothyronine (T3) and thyroxine (T4). The alteration of thyroid function is attributed to changes in iodine metabolism and decreased level of circulating proteins. These changes play an important role in the adaptive process of energy and protein metabolism in children with PEM; and help in conservation of energy when energy producing substrate is scarce and protects the child from early death due to low calorie reserve.[7] In this study, an attempt has been made to study the concentration of serum thyroid hormone levels in SAM children.

MATERIAL AND METHODS

The present study was a cross sectional hospital based study; it consisted of 50 children in age group 1-5 years. These children were enrolled on basis of WHO's criteria for severe acute malnutrition, which included children with weight for height (W/H) or length (W/L) with Z score less than 3 standard deviation, and /or W/H or W/L with Z score less than 2 SD with mid upper arm circumference (MUAC)<11.5 cm and/ or presence of

bilateral pitting edema. Subjects were included in the present study after obtaining informed written consent from parents/ guardian. Details were entered in predesigned proforma. Detailed anthropometric measurements and systemic examination was done. Weight was recorded to the nearest 100g, length/height of the child was measured to the nearest cm, mid arm circumference (MAC) was measured to the nearest mm.

Taking aseptic precaution, 3ml of venous blood was collected and was kept in EDTA (Ethylene Diamine Tetra acetic Acid) vacutainer and test tube. The blood sample collected in test tube was centrifuged at 5000 rpm (rotation per minute) for 5 minutes; serum thus obtained was used to estimate T3, T4, thyroid stimulating hormone (TSH) T3, T4 and TSH were estimated by chemiluminescence method (using Immulite 1000 Immunoassay system- Siemens). The data obtained was entered in MS Excel spread sheet; the results were expressed in mean ± standard deviation (SD) for continuous variables and as percent (%) for categorical data. Observations were statistically analyzed using Epi Info software version 3.5.1. Descriptive statistics was applied for categorical data. Independent sample- t test, One-way ANOVA and Scheffe's post hoc test were used. Pearson's correlation coefficient was used to determine correlation between different variables. P value of <0.05 was considered statistically significant.

RESULTS

A total of 50 children in age group 1- 5 years were included in the study. 30 children included in the study were male and 20 were female (sex ratio M: F: 1.5:1). Age and sex distribution among both the study groups was identical and is depicted in **[Table 1].**

Mean T3, T4 and TSH levels of cases and controls is depicted in **[Table 2,3].** Mean T3, T4 and TSH levels in SAM group was 122.58 ng/dL, 9.18 µg/dL and 2.51 mIU/L respectively and that of controls were 160.82 ng/dL, 9.87 µg/dL and 2.50 mIU/L respectively. Mean T3 and T4 levels were significantly lower in cases as compared to controls (p <0.001 for both parameters). Mean TSH levels of cases and controls was identical.

DISCUSSION

Protein energy malnutrition continues to be a major problem throughout the developing world.[8] In India almost half of children under the age of 5 years are suffering from various grades of SAM.[5] As already stated effects of PEM on the body are protean involving almost all the organ systems, SAM leads to failure in homeostatic mechanism of the body leading to increased susceptibility of an individual to infections. Globally, nearly half of under-five deaths are attributed to PEM either as direct/ indirect cause. SAM is associated with reduction in synthesis of plasma proteins.[9] It affects several aspects of secretion and metabolism of thyroid hormones. Hormones play important role in energy and protein metabolism in PEM.[10] This study was conducted to know about thyroid hormones level in children with SAM and their comparison with age matched controls.

In the present study mean T3 and T4 levels **(Table 2)** (were significantly lower in cases as compared to controls (p <0.001). Studies conducted by Abrol P et al and Turkey et al have showed similar results.[11,12] Similar results are reported by study done by Kumar S et al, Orbak Z et al and study conducted by Das BK et al, found that mean T3 levels was significantly lower in malnourished children as compared to controls, however in their study they found no significant difference in mean T4 levels of cases and controls.[13-15] Low T3 levels in children with PEM is probably due to low binding proteins, impaired thyroxine monodeiodination in liver which leads to decreased peripheral conversion of T4 to T3 and elevated corticosteroids which is often seen in children with malnutrition (acts by inhibiting 5' deiodinase system) and low T4 levels in children with PEM can be due to fall in thyroid secretion rate, depletion of reserves and failure of the adaptive mechanism.

In the present study mean TSH levels in cases and controls were similar. Studies conducted by Abrol P et al, Turkey et al and Das BK et al, also showed similar results. 17,18,21 In contrast to present study, study conducted by Orbak Z et al, found that mean TSH levels of children with PEM were higher as compared to controls. Normal TSH levels in children with PEM is possibly due to T4 undergoing intracellular monodeiodination to form T3 at pituitary level causing negative feedback inhibition of secretion of TSH, central unresponsiveness to low T3 levels due to low intracellular receptor capacity.

Table 1: Comparison of age, gender distribution and anthropometric measurements among cases (SAM group) and controls.

PARAMETER	CASES	CONTROLS	t-value	Pvalue
Age (months)±SD	26.49±13.76	29.26±13.27	0.131	0.788
Gender (Male: Female)	30:20	32:18	0.024(c*)	0.703
Weight (kg)±SD	9.26±1.56	12.84±2.91	-14.082	<0.001
Length/ Height (cm)±SD	81.51±9.73	87.77±7.23	-7.691	<0.001
MAC (cm)±SD	11.35±1.26	13.24±0.54	-12.494	<0.001

Table 2: Mean T_3, T_4 levels in various grades of SAM and controls.

	T3 Mean (ng/dL)±SD	t-value	p-value	T4 Mean (µg/dL)±SD	t-value	p-value
Cases total (n=50)	122.58±35.51	-7.069	<0.001	9.18±1.92	-5.160	<0.001
Controls (n=50)	160.82±42.07			9.87±1.92		

Table 3: Mean TSH levels in various grades of SAM and controls.

	(TSH) Mean (mIU/L)±SD	t-value	p-value
Cases total (n=50)	2.51±1.16	0.144	0.765
Controls (n=50)	2.50±1.15		

CONCLUSION

To conclude Protein energy malnutrition is associated with reduction in T3 and T4 levels without any alteration in TSH levels. The altered thyroid hormone status in children with PEM is perhaps a defense mechanism against excessive metabolic stimulation and energy consumption and protects the malnourished child with low calorie reserve from an early death.

Funding: No funding sources.

Conflict of interest: None declared.

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