Original Research

A study of serum total protein, serum albumin and thyroid hormones in protein-energy malnutrition in children

Anil M Gamit[1], Asha S Khubchandani[1], Mital R Gamit[2], Utsav Parmar[1], Anuja Adarsh[1], Pankaj Gaadhe[1]

[1]Department of Biochemistry, B.J. Medical College, and Civil Hospital, Ahmedabad, Gujarat, India.
[2]Department of Microbiology, B.J. Medical College, and Civil Hospital, Ahmedabad, Gujarat, India.
Correspondence to: Anil M Gamit, E-mail: gamit.anil@gmail.com

Received August 15, 2016. Accepted August 29, 2016

Abstract

Background: Protein Energy Malnutrition (PEM) is one of the most common nutritional problems of developing countries of the world and an important cause of childhood mortality and morbidity leading to permanent impairment of physical and mental growth.

Objective: The objective of the study was to evaluate and compare serum total protein, serum albumin and thyroid hormones in children with Protein-energy malnutrition (PEM) and in healthy controls.

Materials and Methods: Serum total protein, serum albumin, and thyroid hormones were estimated in Fifty children (age, 1- 5 year) with PEM (PEM group). And an equal number of age, sex matched healthy controls were included for the control group.

Results: PEM children have low serum total protein and albumin levels as compared to healthy controls (p<0.001), Serum Total T3 (TT3), Total T4 (TT4) levels are lower in children with PEM as compared to healthy controls and the difference is statistically significant (p<0.001). Mean TSH levels in cases and controls were nearly similar. There was no significant difference between serum TSH concentrations in our children with PEM and the controls.

Conclusion: PEM children have low serum total protein and albumin levels this is probably due to decreased intake of proteins and reduced biosynthesis. Serum TT3, TT4 levels are lower in children with PEM as compared to healthy controls. The cause for decreased levels of TT3, TT4 in a malnourished child is probably due to a reduction in circulating plasma proteins.

KEY WORDS: Protein Energy Malnutrition (PEM), Serum total protein, Serum albumin, Serum Total T3 and Serum Total T4.

Introduction

Child malnutrition is a widespread public health problem having international Consequences.[1] It is estimated that PEM is the primary or associated cause of nearly half of the 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.[2,3]

Prevention of PEM is becoming an important issue worldwide; almost any "Summary Index" of the child development indicators would place India at the bottom level of this list. As per National family health survey 3 (NFHS-3) report prevalence of underweight, stunting and wasting in India is 43%, 48%, and 20% respectively.[4] The term protein-energy malnutrition applies to a group of related disorders that include Marasmus, kwashiorkor, and intermediate states of marasmic-kwashiorkor. Marasmus is characterized by gross wasting of muscles and subcutaneous tissues resulting in

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2017.15082016633	

emaciation, while kwashiorkor is characterized by retarded growth, psychomotor changes, and edema.[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."

Thyroid hormone plays an important role in the regulation of lipid and carbohydrate metabolism and necessary for normal growth and maturation. Absence of thyroid hormone causes mental and physical slowing, mental retardation and dwarfism.[6]

In cases of severely malnourished wasted children, serum total protein and albumin are reduced whereas increased globulin level is anticipated since malnutrition is commonly associated with infections.[6,7]

Studies have shown that in PEM, there is a marked change in secretion and metabolism of thyroid hormones and in the structure of the thyroid gland. These result in a 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 the 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.[8]

The present study was aimed to know the concentration of serum total protein, serum albumin and thyroid hormones in protein-energy malnutrition in children and compare with normal children.

Materials and Methods

The present Cross-sectional study consisted children of age group 1- 5 years selected from the civil hospital and B.J Medical College, Ahmedabad, Gujarat. This study was conducted during the period of January 2014 to December 2014. Fifty children with PEM were included in the study as cases (PEM group) and an equal number of age and sex, matched healthy children formed the control group. Children with protein energy malnutrition as per IAP classification of PEM (which is based on weight for age) i.e. whose weight for age was less than 80% of expected for age constituted cases (PEM group) they were further subdivided into Grade I-IV as per IAP classification of PEM.[9] Children whose weight was more than 80% of expected weight formed control group.

For Serum total protein, serum albumin and thyroid hormones, 5 ml of blood collected with clot activator Vacuett and samples are transported to the laboratory at 2-8°C within half an hour. Serum was removed from the clot within 2 hours of draw. If testing was delayed for more than 24 hours, serum specimens are stored at 2-8°C and analyzed next day (Ueland PM 1993).[10]

All samples were immediately subjected to assay Serum total protein, serum albumin, and thyroid hormones after thawing at 37°C on an Erba XL 640 Fully Automated Analyzer by the kit of crest biosystems, a division of coral clinical systems. And Serum Thyroid stimulating hormone (TSH), serum total triiodothyronine (TT3), serum total thyroxine (TT4), level were estimated by chemiluminescence method (using ARCHITECT i1000sr Immunoassay system- ABBOTT).

Result

The present study was conducted in two groups of patients. Group-1 included 50 patients with protein-energy malnutrition, while group-2 included 50 normal controls.

Numerical variables were reported in terms of mean and standard deviation. Comparison between two groups is made. The analysis was carried out using Graph Pad prism version 3.03 statistical software.

The interpretation was done according to the *p*-value.

$P < 0.05$ - Significant
$P < 0.001$ - Highly significant
$P \geq 0.05$ - Not significant

(Table 1) shows the results of Serum total protein, serum albumin, Serum globulin, A:G ratio and serum Thyroid stimulating hormone (TSH), serum total triiodothyronine (TT3), serum total thyroxine (TT4) expressed as mean±standard deviation.

Table 1: Comparison of serum total protein, Serum Albumin, Serum globulin, A:G ratio and serum Thyroid stimulating hormone (TSH), serum total triiodothyronine (TT3), serum total thyroxine (TT4) in cases and controls

Parameter	Biological Reference Interval	Group-1 (PEM) *n*=50	Group-2 (Control) *n*=50
		Mean ± SD	Mean ± SD
Serum Total protein	6-8 g/dL	4.9±1.29	6.80±0.933
Serum Albumin	3.7 - 5.3 g/dL	2.58±0.88	3.74±0.66
Serum Globulin	2.3 – 3.6 mg/dL	2.33±0.88	3.05±0.77
A:G ratio	1 – 2.3	1.27±0.68	1.32±0.50
Serum TSH	0.4 - 4 µIU/mL	1.50±1.32	1.60±1.23
Serum TT3	0.56 -1.88 ng/mL.	0.56±0.32	1.13±0.62
Serum TT4	59 - 153 mmol/L.	66.23±30.18	106.10±41.06

Mean serum total protein, serum albumin, and Serum globulin levels were lower in cases as compared to controls and the difference was statistically significant (p<0.001). But mean A/G ratio of PEM group is altered as compared to that of controls, but not significant (p=0.7119).

Mean TT3, TT4 levels were lower in cases as compared to controls and the difference was statistically significant (p<0.001).

Mean TSH levels in cases was nearly similar to that of controls with no statistically significant difference been noticed between the mean values of cases and controls (p-0.6960).

Discussion

The present study was undertaken to know the status of serum total protein, Serum Albumin, Serum Thyroid stimulating hormone (TSH), serum total triiodothyronine (TT3) and serum total thyroxine (TT4) levels in children with PEM.

In the present study mean serum total protein and albumin levels were significantly lower in cases as compared to controls with a p value of <0.001. Mean A/G ratio of PEM group is altered as compared to that of controls, but not significant (p=0.7119).

Results of the present study correlate with a study conducted by Adegbusi HS et al.[11], Rahman MA et al.[12] and Mishra SK et al.[6]. The alterations in serum total protein, albumin and A/ G ratio in PEM could be explained on the basis of decreased protein intake and reduced biosynthesis.

In the present study mean TSH levels in cases and controls were nearly similar. There was no significant difference between serum TSH concentrations in our children with PEM and the controls (p-0.6960).

Results of the present study correlate with studies conducted by Abrol P et al., [13] and Turkey et al.[14] In contrast to present study, a study conducted by Orbak Z et al.15] found that mean TSH levels of children with PEM were higher as compared to controls. A study conducted by Kumar S et al.[16] found that mean TSH levels showed a positive increase with an increase in the severity of PEM.

Normal TSH levels in children with PEM is possibly due to T4 undergoing intracellular mono deiodination to form T3 at a pituitary level causing negative feedback inhibition of secretion of TSH, central unresponsiveness to low T3 levels due to low intracellular receptor capacity.

In the present study mean T3 levels was significantly lower in cases as compared to controls (p<0.001).

Results of the present study correlate with studies conducted by Abrol P et al.,[13] and Turkey et al.[14]. Low T3 levels in children with PEM is probably due to low binding proteins, altered rate of total and free fractions, impaired thyroxine mono deiodination in the liver which leads to decreased peripheral conversion of T4 to T3.

In the present study mean T4 levels was significantly lower in cases as compared to controls with a p value of <0.001.

Results of the present study correlate with studies conducted by Abrol P et al., [13] and Turkey et al.[[14] In contrast to our study, Das BK et al.[17] found no significant difference in mean T4 levels of cases and controls, they concluded that normal T4 levels in PEM children was secondary to an adaptive process. 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.

Limitations of the study: In the present study mean TSH levels in cases and controls were nearly similar but the studies conducted by Orbak Z et al. and Kumar S et al. Shows that mean TSH levels of children with PEM were higher as compared to controls. Also, the mean TT4 levels in the present study were significantly lower in cases as compared to controls but the study conducted by Das BK et al. shows no significant difference in mean TT4 levels of cases and controls.

So a further study is required with more sample size and also better techniques are needed.

Conclusion

PEM children have low serum total protein and albumin levels as compared to healthy controls (p<0.001), this is probably due to decreased intake of proteins and reduced biosynthesis. Serum TT3, TT4 levels are lower in children with PEM as compared to healthy controls and the difference is statistically significant (p<0.001). The cause for decreased levels of TT3, TT4 in a malnourished child is probably due to a reduction in circulating plasma proteins. 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.

References

1. De Onis M, Monteiro C, Akre J, Glugston G. The worldwide magnitude of Protein-energy malnutrition: an overview from the WHO global database on Child growth. World Health Organization 1993; 71(6):703-12.
2. UNICEF.Committing to child survival: a promise renewed-progress report 2013. New York: UNICEF; 2014.
3. UNICEF.Tracking Progress on child and maternal nutrition: a survival and development priority. New York: UNICEF; 2009.
4. International Institute for Population Sciences. National Family Health Survey 3 (NFHS-3), 2005-06: India.
5. Mehta M. Malnutrition. In: Parthasarathy A, editor.IAP textbook of Pediatrics. 5th ed. New Delhi, India: Jaypee; 2013. p. 129-44.
6. Mishra SK, Bastola SP, Jha B. Biochemical nutritional indicators in children with protein energy malnutrition attending Kanti Children Hospital, Kathmandu, Nepal. Kathmandu Univ Med J (KUMJ) 2009 Apr-Jun; 7(26):129-134.
7. Pelletier JG. Severe malnutrition: A global approach. Children in the Tropics 1993; 208-9:1-80.
8. Brown PI, Brasel JA. Endocrine changes in the malnourished child. In: Suskind RM, Suskind LL, editors. Nestle nutritional workshop series. Vol. 19. New York: Raven Press; 1990. p. 213-28.
9. Nutrition Sub-committee of Indian Academy of Pediatrics. Report. Indian Pediatr 1972; 9:360.

10. Ueland PM, Refsum H, Stabler SP et al. Total homocysteine in plasma or serum: methods and clinical applications. Clin Chem 1993; 39: 1764-1779.
11. Adegbusi H, Sule MS. Anthropometric and biochemical assessment among under-five children in Kusada local government area, Katsina state, Nigeria. Bajopas 2011; 4(2):137-40.

Afr J Med Med Sci. 1999 Mar-Jun; 28(2):81-5.

12. Rahman MA, Mannan MA, Rahman MH. Serum iron and total iron binding capacity in severely malnourished children. Bangladesh J Pharmacol 2007; 2:61-65.
13. Abrol P, Verma A, Hooda HS.Thyroid hormone status in protein energy malnutrition in Indian children. Indian J Clin Biochem 2001 Jul;16(2):221-3.
14. Turkay S, Kus S, Gokalp A, Baskin E, Onal A. Effects of protein energy malnutrition on circulating thyroid hormones. Indian J. Pediatr. 1995 Feb; 32(2):193-7.
15. Orbak Z, Akin Y, Varoglu E, Tan H. Serum thyroid hormone and thyroid gland weight measurements in protein-energy malnutrition. J Pediatr Endocrinol Metab 1998 Nov-Dec; 11(6): 719-24.
16. Kumar S, Nadkarni J, Dwivedi R. Thyroid hormone status in malnourished children. Indian Pediatr 2009 Mar; 46(3):263-4.
17. Das BK, Panda BK, Dhingra R, Mishra OP, Agarwal JK. Thyroid hormone studies in protein-energy malnutrition. J Trop Pediatr 1999 Dec; 45(6):375-6.

How to cite this article: Gamit AM, Khubchandani AS, Gamit MR, Parmar U, Adarsh A, Gaadhe P. A study of serum total protein, serum albumin and thyroid hormones in protein-energy malnutrition in children. Int J Med Sci Public Health 2017;6:409-412

Source of Support: Nil, **Conflict of Interest:** None declared.