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Biochemical parameters in Patients of Protein energy malnutrition

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ABSTRACT

To study the alteration in levels of serum electrolyte, serum enzymes and thyroid profile abnormalities in protein energy malnutrition and to assess their clinical significance. **MATERIAL AND METHOD:** The study extended for a period of 5 years from September 2010 to September 2015. PEM (115 cases) and 45 normal healthy children (controls). All children, who either came to outpatient department or were admitted in the Pediatric Ward of Government Medical College and Hospital, Nagpur,. All the clinical details, along with the relevant clinical history were noted. Venous blood sample was collected for estimation of serum electrolyte, serum enzymes and thyroid profile **RESULTS AND OBSERVATIONS:** Patients with PEM we have found that the mean serum values of sodium & potassium were sig decreased in cases when compared to control groups. Increase in aspartate aminotransferase, alanine aminotransferase was found in PEM. Significant decrease in activity of serum ALP in all the groups of malnourished children as compared to control.It was observed that the T3 and T4 levels decreased with increase in severity of malnutrition, with maximal decrease beennoted in Grade IV PEM, TSH slightly decreased as compared to conrtol. **DISCUSSION:** Many of these alternations of enzymes and hormones may be due to metabolic readjustment resulting from protein deficiency.

Keywords: PEM,Electrolyte,enzymes,Thyroid profile.

INTRODUCTION

Protein energy malnutrition is a major public health problem in the tropical & subtropical regions of the world and often arises because of inadequate nutrition, severe infections, poor socio-economic status and environmental conditions. It is most common nutritional disorder affecting children in developing childhood in such countries by **Akuyam SA**.[1]The World Bank estimates that after Bangladesh, India is ranked 2nd in number of children suffering from Protein Energy Malnutrition (PEM) .In India is a very common problem in children between 6month to five years of age.[2]

The prevalence of underweight children in India(47%) is more common than Sub-Saharan Africa(29%)which is nearly double ,there is dire consequences for mobidity, mortality, productivity and economic growth under the age of 5 years.[3] As there are various disturbances in biochemical parameters during protein energy malnutrition. In addition, abnormal total body and serum electrolyte concentration are common in PEM and appear to be related to the prognosis.[4]

With increasing severity there is increasing failure in the homeostatic mechanisms of the body and damages to the immune defences, which may leads to infections and death.[5] During undernutrition phase, various clinical and anthropometric features of PEM appear late result of whichdiagnosis and management get delayed. Biochemical parameter which helps in over-all management which act as an effective indicator before clinical feature appears. Hence biochemical parameters will act as sensitive

indicators during the development of PEM. Biochemical value will trace the real nutritional status and also help in optimal specific and precise management of PEM in Hospital set up.

Here, we are studying various available biochemical parameters and their relationship with healthy controls and various Grades of PEM.

Undernourishment not only affects physical appearance and energy levels, but also directly affects many aspects of the children's mental functions, growth and development which has adverse effects on children's ability to learn and process information and grow into adults that are able to be productive and contributing members of society.[6]

Material and Methods

Study Design: Analytic epidemiology case control Study. The study extended for a period of 5 years from September 2010 to September 2015. PEM (115 cases) and 45 normal healthy children (controls). All children, who either came to outpatient department or were admitted in the Pediatric Ward of Government Medical College and Hospital, Nagpur and satisfied the case definition criteria of PEM as **Gomez classification of PEM** were included in the study. Informed consent was obtained from the parentsof the children.

Inclusion Criteria

Cases: Total 115 cases enrolled in this study,All children below 5 yrs who either came to the outpatient department or were admitted in the pediatrics ward of Government Medical College and Hospital Nagpur, and satisfied the case definition criteria of PEM as per **Gomez classification of PEM**.

Controls: Total 45 controls enrolled, All children below 5yrs, age and sex matched normal healthy children who visited the Immunization Clinic of Government Medical College and Hospital,Nagpur

Exclusion Criteria

Children with

1. Family history of Thyroid disease
2. Tuberculosis or family history of Tuberculosis
3. Leukemia
4. Diarrhea
5. Clinical evidence of infections or septicemia,
6. Acute renal failure in which there is an excessive loss of proteins,
7. Liver cirrhosis
8. Cardiac failure
9. Severe anemia or any other systemic disease leading to weight loss
10. Patients with lead poisoning
11. Thalassemia
12. Any congenital anomalies
13. Children who were being given intravenous fluids and also children of parents who refused to give consent for blood examination wereexcluded from the study

The study protocol was approved by the institutional ethics committee before the commencement of the study. Informed and written consent was obtained from the parents/caregivers of participants. Aseptically 5 ml of venous blood was collected from patients and controls. As soon as the blood was collected from the patients, it was carried to the laboratory in an ice-container. The blood was allowed to clot and serum was separated by centrifugation at 5000 rpm for 5 minutes. It was used to estimate various parameters.

A semi–structured questionnair was used to obtainan information from the subjects using interview method. Relevant information on the child's socio-demographic characteristics, nutritional indices and laboratory findings were documented. Study participants were grouped into upper, middle and lower socioeconomic classes based on the modified Kuppuswami scale.[7]

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Table 1

Gomez classification of PEM [10]

This is based on weight for age values.

Degree of PEM	Percent of desired bodyweight for age and sex
Normal (n=45)	90%-100%
Grade I (n=45)	75% - 89% (mild malnutrition)
Grade II (n=40)	60%-74% (moderate malnutrition)
Grade III (n=30)	<60%severe malnutrition)

Table 2

Sr.No	**Biochemical Parameters**	**Method of Estimation**
1.	Serum Electrolytes SODIUM POTASSIUM	**Ion selective electrode (ISE)**
2.	Serum Enzymes	
	SGOT	Reitman & Frankel's method
	SGPT	Reitman & Frankel's method
	Alkaline Phosphatase	**Alkaline Phosphatase (AP) Enzymatic Assay Kit Manual**
3.	Thyroid Profile	
	T3	**Enzyme-linked immunosorbent assay**
	T4	**Enzyme-linked immunosorbent assay**
	TSH	**Enzyme-linked immunosorbent assay**

Table 3: Comparison of age, gender distribution and anthropometric measurements among cases (PEM group) and controls

Parameter	**Control** **n=45**	**Grade-I** **PEM** **n=45**	**Grade–II** **PEM** **n=40**	**Grade-III** **PEM** **n=30**

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Age (months)	25 to 60 months	26 to 56 months	25 to 58 months	28 to 56 moths
Gender (Male: Female)	25/20	26/19	19/21	16/14

Results

STATISTICAL ANALYSIS: - The p value less than 0.05 was considered as significant and the p value less 0.001 was considered as highly significant. GraphPad Prism version 6.00 software was used for analysis.

Parameters	Control n=45 Mean ± SD	Grade-I PEM n=45 Mean ± SD	Grade–II PEM n=40 Mean ± SD	Grade-III PEM n=30 Mean ± SD
Serum Sodium	136.7±0.31	131.6±0.34 ***	130.9 ± 0.41***	130.5 ± 0.49***
Serum Potassium	4.01 ± 0.02	3.40 ± 0.02***	3.39 ±0.02***	3.39 ± 0.02***
SGOT	36.80±0.58	94.04±0.40***	74.03±1.13 ***	66.20± 0.61***
SGPT	36.58 ± 0.60	92.71 ± 0.59***	69.68± 1.25***	63.00± 1.11***
Alkaline Phosphatase	11.87±0.16	6.822±0.18****	6.225± 0.16****	5.829 ± 0.21****
T3	154.6±1.11	129.5±0.49***	128.6±0.99***	110.8 ± 1.89***
T4	11.38±0.16	10.48 ± 0.13***	9.870 ± 0.15***	9.723 ± 0.22***
TSH	2.918±0.073	2.816 ± 0.07	2.795 ± 0.08	2.780 ± 0.09

Discussion

Serum Electrolyte

In the present study, we have found that the mean serum values of sodium & potassium were sig decreased in cases when compared to control groups. Because of increase in intracellular water, the total sodium may be increased but the actual serum level may be relatively decreased as a result of excessive increase in water in comparison to increase in sodium.[8,9]

The mean K+ values in cases was not statistically significant, In various other studies[8,9] there is hypokalemia.

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Serum Enzymes

In our study, serum SGOT and SGPT levels in grade –1, grade-II, and grade –III PEM were significantly higher than that of control. This finding of our study is in correlation with various other studies [11,12,13,14] .The increase in mean serum SGOT and SGPTlevel is maximum in grade–I PEM. In grade–II, increase serum SGOT and SGPT is significantly higher than grade–III PEM.The probable reason of raised SGOT and SGPT,marked tissue breakdown & considerable muscle wasting in early stage of disease,in order to metabolise amino acids released by breakdown of muscle protein ,enzymes elevated. As the disease progresses, muscle mass diminishes and process of muscle breakdown slow down ,that why increase serum SGOT and SGPT is significantly higher than grade–III PEM. Above findings this study may help in the prognosis of disease and could help to detect its severity.

Serum Alkaline Phosphatase

In the study, we observed a significant decrease in activity of serum ALP in all the groups of malnourished children as compared to control. Similar findings were reported by **Karmacharya K [14], Singh R.S et al [15] and Schwartz R [16]** In PEM.Low serum values of ALP could be explained on the basis of generalized protein deficiency leading to impaired synthesis. Failure of bone growth may be another contributing factor for the lowering ALP value. Another probable mechanism given by A Jain et al that low intake of Zn coupled with the high incidence of low protein intake are contributory factors for the reported low serum ALP activity.In malnourished children the significant increase in serum MDA concentration associated with the decrease in serum Total Antioxidant Capacity Zn and ALP suggest that these children were potentially susceptible to high oxidative stress.

Thyroid Profile

In the present study, T3 levels were found to be significantly decreased in PEM cases. TSH levels were elevated in PEM cases when compared to controls.It was observed that the T3 and T4 levels decreased with increase in severity of malnutrition, with maximal decrease beennoted in Grade IV PEM..This finding of our study is similer with previous studies done by **PankajAbrol et.al [17] &Turkey et al [18] have showed similar results,** who have found that there was significant decrease in T3 and T4 levels in PEM cases,

Various possible mechanism of low T3 and T4 levels in PEM,

A) A large majority of the thyroid hormone secreted from the thyroid gland is **T4**, but **T3** is the considerably more active hormone. Although some **T3** is also secreted, the bulk of the T3 (which is metabolically more active than T4) is derived from peripheral deiodinization of T4,, especially liver and kidney. the remaining lo-20% of T3 is derived from direct thyroidal T3 secretion [19,20]. An alternative pathway for peripheral T4 metabolism is its conversion to reverse T3 (rT3) which is calorigenically inactive [21]. It appears that in PEM later pathway is more stimulated resulting in energy conservation and slow metabolism in order to protect the malnourished child with reduced lean body from an otherwise earlier demise [22].

B) This reduction of T3 in PEM patients could be also explained by impaired liver function [23], carbohydrate deficiency since glucose is an important factor for the liver microsomal enzyme responsible for conversion of T4 to T3 [24] or interestly due to vitamin deficiencies which are usually present in PEM [25]. lastly, elevated corticosteroids which was found to be elevated in th acute stages of PEM also inhibits T3 generation from T4 be inhibiting the activity of 5- deiodinase enzyme.

C) Animal studies have shown that during starvation, T4 uptake by liver [15] and the activity of enzyme 5-deiodinase are decreased [16]. Low level of thyroid hormones binding proteins in malnutrition are thought to be due to decreased proteins intake and their reduced hepatic biosynthesis [17]

D) Low T4 levels in children with PEM can be due to lower rate in thyroid secretion, depletion of reserves and failure of the adaptive mechanism. [26]

E) Another mechanism for decrease in thyroid hormone levels is due to low levels of binding proteins, altered rate of total and free fractions

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and decreased peripheral conversion of T4 to T3 [13]

Serum TSH

In the present study mean TSH levels in cases and controls were similar; TSH level of different grades of PEM was also similar. Studies conducted by **Abrol P et al,Turkey et al and Das BK et al**, also showed similar results.[17,18,27.]

CONCLUSION: The present study shows that malnourished children still have a higher risk of mortality and morbidity than well nourished ones .PEM can be associated with alteration in levels of serum electrolyte, serum enzymes and thyroid profile. Many of these abnormalities are probably due to metabolic readjustment resulting from PEM. The ultimate practical objective of the electrolyte, serum enzymes and thyroid profile studies which have been described is to help in the management of PEM, as it is often supposed that this is a practical problem for which new scientific knowledge is not needed. Above mentioned view is a superficial. But this can be done with the electrolyte, serum enzymes and thyroid profile studies described above. The altered thyroid hormone status in children with PEM is perhaps a defense mechanism and protects the PEM pateints with low calorie reserve from an early death.

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