Original Article

Frequency of Hyponatremia and Hypokalemia in Children with Protein Energy

Hyponatremia and Hypokalemia in Children

Arshia Munir[1], Muhammad Ibrahim[1], Ashraf Khan[2] and Kalimullah Khan[1]

ABSTRACT

Objective: To determine the frequency of hypokalemia and hyponatremia in pediatric patients with protein calorie malnutrition.

Study Design: Descriptive / cross sectional study.

Place and Duration of Study: This study was conducted at the Department of Pediatrics, PGMI, LRH, Peshawar, from August 2015 to February 2016.

Materials and Methods: 109 children with protein calorie malnutrition were selected by non-probability consecutive sampling technique.

Results: A total of 109 children with protein calorie malnutrition were included in the study. Male to female ratio was 0.94:1.Average age of the patients was 27.232 Months ±15.59 SD with range 5-60 months. Hypokalemia in PEM was observed in 38 (34.9%) while Hyponatremia was little bit high which was observed in 44(40.4%) of patients.

Conclusion: Hypokalemia and Hyponatremia are found high in patients with protein calorie malnutrition.

Key Words: Frequency, malnutrition, Hyponatremia, Hypokalemia

Citation of articles: Munir A, Ibrahim M, Khan A, Khan K. Frequency of Hyponatremia and Hypokalemia in children with Protein Energy. Med Forum 2018;29(6):68-71.

INTRODUCTION

Balanced diet and optimal nutrition is required for normal body growth an. Nutritional deficiencies, referred to as malnutrition, are common problems in found in pediatric age group in the developing countries especially under five years of age.[1]. Malnutrition (under nutrition) involve protein and energy (macronutrients) or vitamins and/or minerals (micronutrients). Protein energy malnutrition (PEM) is a disorder of macronutrients whereby the body fails to access adequate energy and protein needed for normal growth and development [3]. Approximately 10.6 million children die before the age of five years each year. A major portion i.e. seven out of ten of these deaths is constituted by diarrhea, pneumonia, measles, malaria or malnutrition[4]. Malnutrition may occur in children with dietary history revealing marked deficiency in the amount and/or quality of food intake[5]. Several conditions and predisposing factors are responsible for malnutrition in children under five years of age including premature birth or low birth weight, lack of breastfeeding, twin birth; chronic diarrhea, pneumonia and tuberculosis, HIV infection, malignancies and parental death [6, 7]. World health organization (WHO0 has designed guidelines for malnourished children and if followed can lead to survival of children with protein energy malnutrition. The deaths reduced to almost half of previously happening i.e. from 40% to 20% when WHO guidelines were followed including special feeds day and night, use of proper antibiotics, taking care of electrolytes, avoiding intravenous fluids administration except in shock, and also avoiding diuretics for edema)[8, 9]. The electrolytes including sodium and potassium are essential for human health and are extremely important required for human body and are responsible for a lot of physiologic and pathophysiologic processes of the body[10].

Multiple alterations occur in body composition including loss of heart and skeletal muscle mass, and is further complicated by electrolyte abnormalities and mineral or vitamin deficiencies; with further fatal complications, including hypotension, cardiac arrhythmias, cardiomyopathy, cardiac failure and even sudden death [11]. PEM-related diarrhea is another major problem responsible for morbidity and mortality in children under five years of age. Approximately 500 million children suffer from acute diarrhea each year and 5 million of these children die each year[12]. In severe PEM risk factor for fatal diarrhea includes hypokalemia and metabolic acidosis as intracellular sodium ion retention occurs in PEM. The increase in intracellular in Na+ and decrease in K+ may affect the function of important enzymes of carbohydrate metabolism and oxidative phosphorylation adversely [13,14,15].

[1.] Department of Pediatrics / Pathology[2], HMC / KGMC, Peshawar.

Correspondence: Dr Arshia Munir, Assistant Professor of Pediatric, B Unit, MTI KTH/KMC, Peshawar.
Contact No: 03333 9343865
Email: drarshia@yahoo.com

Received: December, 2017; Accepted: March, 2018

The purpose of this study to identify the prevalence of hypokalemia and hyponatremia in children up to the age of five years of age presenting with protein energy malnutrition.

MATERIALS AND METHODS

This Descriptive cross-sectional study was conducted at the department of pediatrics PGMI Lady Reading Hospital, Peshawar from August 2015 to February 2016. Consecutive (non probability) sampling technique was used for all those pediatric patient who visited the tertiary level hospital and diagnosed as Protein Energy Malnutrition (Marasmus, Kwashiorkor and Marasmus-Kwashiorkor) with age group 6 months to 5 years were included in the study. Patients with history of intravenous fluid administration in the last week, diagnosed as malabsorption on medical record and having renal disorder were excluded from the study.

The study was carried after approval from hospital ethical and research committee. The attendants of all children fulfilling the inclusion criteria were explained the purpose of the study and informed consent were taken in all cases. The bio-data of all patients was entered on proforma. All PEM patients with or without diarrhea were included in the study. In all cases detailed history was taken from the attendants and detailed examination was also done on all patients. A blood sample of 5 cc was taken from all cases under aseptic technique and immediately sent to hospital laboratory for measuring serum sodium and potassium level to detect hyponatremia and hypokalemia. The investigations were carried out by one expert pathologist. The patients result was documented on the proforma and patients were treated on ward protocol. Exclusion criteria were strictly followed to control confounders and bias.

Data Analysis: The data was analyzed by SPSS version 20. In case of numerical variables like age, serum sodium and potassium; mean $\pm$ SD was calculated; while for categorical variables like gender, type of PEM and status of diarrhea frequencies and percentages were calculated. Hyponatremia and hypokalemia were stratified among age, gender, type of PEM and status of the diarrhea to see the effect modifications. All results were presented in table form.

RESULTS

A total of 109 children with protein energy malnutrition were included in the study. There were 53(48.62%) male children and 56 (51.3%) female children with male to female ration of 0.94:1. Average age of the patients was 27.23 ± 15.59 SD with range of 5-60 months. The patient's age was divided into four groups with highest prevalence of PEM in age group ≤ 15 months as documented in table 1. The most common type of PEM in our study was kwashiorkor which constituted about 42 (38.53%) followed by marasmus 37 (33.94%) and marasmic kwashiorkor 30 (27.52%) as shown in table 2. Hypokalemia was observed in 38 (34.9%) cases while hyponatremia in 44 (40.4%) cases as given in table 3.

Table No.1: Age wise distribution of PEM

Age Group	Frequency of PEM	Percentages
≤ 15 months	36	33
16-30 months	30	27.5
31-45 months	26	23.9
46-60 months	17	15.6

Table No.2: Type of Protein Energy Malnutrition in children ≤ 5 years of age

Type of PEM	**Number**	**Percentages**
Kwashiorkor	42	38.53
Marasmus	37	33.94
Marasmic-Kwashiorkor	30	27.52

Table No.3: Incidence of Hypokalemia and Hyponatremia in children with PEM

Type of Disorder	**Number**	**Frequency**
Hypokalemia		
Yes	38	34.9 %
No	71	65.1 %
Hyponatremia		
Yes	44	40.4 %
No	65	59.6 %

Table 4: Age wise distribution of hypokalemia and hyponatremia in children with pem

Age Group	Hypokalemia		Hyponatremia	
	Yes	No	Yes	No
≤ 15 months	9 (13%)	27 (75%)	13 (36.1%)	23 (53.9%)
15-30 months	25 (43.3%)	17 56.7%	11 36.7%	19 63.3%
41-45 months	10 (38.5%)	16 (61.5%)	10 (38.5%)	16 (61.5%)
46-60 months	6 (35.3%)	11 (64.7%)	10 (58.8%)	7 (41.2%)
p- value	0.451	0.451	0.409	0.409

Table No.5: Gender-wise distribution of hypokalemia and hyponatremia in children with pem

Gender	Hypokalemia		Hyponatremia	
	Yes	No	Yes	No
Male	16 (14.7%)	37 (33.9%)	26 (22.0%)	29 (26.6%)
Female	22 (20.2%)	34 (32.2%)	20 (18.3%)	36 (33.0%)
p-value	0.319	0.319	0.309	0.309

The incidence of hypokalemia and hyponatremia varied in different age groups. The details have been given in table 4. Hypokalemia was found in 14.7% of male patients and 20.2% of female patients while

hyponatremia was found in 22.0% of male and 18.3 % of female patients as shown in table 5. There was insignificant role of diarrhea and type of PEM on hypokalemia and hyponatremia.

DISCUSSION

Under five mortality is quite high and each year 10.6 million children die and do not reach their 5th birthday celebration Seven out of ten die because of pneumonia, diarrhea, malaria, measles and malnutrition[16]. Malnutrition play an important role in under five children morbidity and mortality as these children can't cope with the pneumonia and diarrheal episode because of their low immunity. Severe acute malnutrition in an important condition which can be prevented and treated easily and thus under five mortality and morbidity can be easily decreased in this age group[17]. One of the study showed that out of sixty malnourished children seven suffered from septic showed. Out of these seven children, three malnourished children died. But shock was also associated by other co-morbid conditions including hypothermia, hypoglycemia, severe anemia, hyponatremia and hypokalemia[18]. Bronchopneumonia was also associated and close association has been established between malnutrition and infection [19,20].

In our study we found that there is definite association between malnutrition and electrolyte disturbance. We found both hyponatremia and hypokalemia in our study. Almost similar results have been given by a study done at Nepal. In this retrospective study they found that hyponatremia was present in 56% of study population while hypokalemia was present in 46% of cases. In another prospective study conducted in Nigeria where the study population age was up to fifteen years, they found hypokalemia incidence was 23.4% in their study population while hyponatremia was present in 13% of the patients[21,22].

Hypokalemia can alter all major body systems function but most commonly cause flaccid paralysis of muscles in the body[23,24]. Though hypokalemia is subclinical in children with protein energy malnutrition but become clinical and prominent if these children suffer from diarrheal disease episodes. In our study population we found that hypokalemia is significantly present in children with PEM but the condition became prominent and clinical in patients suffering from diarrheal diseases. An other study documented that diarrheal episodes in PEM not only signify hypokalemia but also hyponatremia[25]. Almost similar results were given in a study conducted in Egypt[26].

Wakwe VC et al found a significant decline in serum potassium level (p value <0.001) in patients with protein energy malnutrition cases compared to control group[27]. The prognosis association with the type on electrolyte imbalance was different in different studies. Garrow JS et al found poor prognosis associated with hyponatremia in patients with PEM[28], while the results given by Mittal et al[29] in their study found otherwise results to the study results of Garrow JS et al[28].

CONCLUSION

Both hypokalemia and hyponatremia are highly associated in children with protein energy malnutrition. The clinical must evaluate the biochemical abnormalities very cleverly while dealing with patients of PEM

Recommendation: We recommend more clinical trials with larger sample sizes to clarify role of potassium and sodium in dealing and treating patients with protein energy malnutrition.

Author's Contribution:

Concept & Design of Study:	Arshia Munir
Drafting:	Muhammad Ibrahim
Data Analysis:	Ashraf Khan, Kalimullah Khan
Revisiting Critically:	Arshia Munir, Muhammad Ibrahim
Final Approval of version:	Arshia Munir

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Antwi S. Severe Malnutrition: Assessment and Management. West African J Med 2011;30(1): 11-18.
2. Laghari GS, Akbar M, Radhan AH, Hussain Z. The Analysis of Risk Factors in Severe Protein Energy Malnutrition in Order to know their Significance for Outcome in Children from 2 Months to 5 Years of Age. JLUMHS 2013;12(02):103.
3. Prasot RM, Verma SK, Kashyap S, Kanaujiya MK. An epidemiological study of Protein Energy Malnutrition (PEM) among 1-6 years children in rural Lucknow, Uttar Pradesh, India. IOSR J Dental Med Sci 2014;13(3):10-4.
4. Shah RH, Javdekar BB. Management of children with severe acute malnutrition: experience of nutrition rehabilitation centre at Baroda, Gujarat. Int J Contemporary Pediatr 2014; 1(1):1-6.
5. Lee DER. Children's Protein Consumption in Southeast Asia: Consideration of Quality as well as Quantity of Children's Protein Consumption in Southeast Asia. 2014. Available at; http:// repository.upenn.edu/wharton_research_scholars/ 115.
6. Sharghi A, Kamran A, Faridan M. Evaluating risk factors for protein-energy malnutrition in children under the age of six years: a case-control study from Iran. Int J General Med 2011; 4:607.
7. Basit A, Nair S, Chakraborthy KB, Darshan BB, Kamath A. Risk factors for under-nutrition among children aged one to five years in Udupi taluk of 96

Karnataka, India: A case control study. The Aust Med J 2012;5(3):163.
8. Alcoba G, Kerac M, Breysse S, Salpeteur C, Galetto-Lacour A, Briend A, et al. Do children with uncomplicated severe acute malnutrition need antibiotics? A systematic review and meta-analysis. PloS one 2013; 8(1):e53184.
9. Guideline: Update on the management of severe acute malnutrition in infants & children. World Health Organizations. Available at; http://apps.who.int/iris/bitstream/10665/95584/1/9789241506328_eng.pdf
10. Pohl HR, Wheeler JS, Murray HE. Sodium and Potassium in Health and Disease. Metal Ions in Life Sciences 2013;13:29-47.
11. Hassan N, Faddan A, El Sayh KI, Shams H, Badrawy H. Myocardial dysfunction in malnourished children. Ann Pediatr Cardiol 2010; 3(2):113–118.
12. Oyagbemi AA, Odetola AA. Hepatoprotective and nephroprotective effects of Cnidoscolus aconitifolius in protein energy malnutrition induced liver and kidney damage. Pharmacognosy Research 2013;5(4):260.
13. Manary M, Iannotti L, Trehan I Weisz A. Systematic review of the care of children with diarrhoea in the community-based management of severe acute malnutrition. Geneva: World Health Organization. 2012. Available at; http://www.who.int/nutrition/publications/guidelines/updates_management_SAM_infantandchildren_review4.pdf
14. Akhter S, Alauddin, Rahman A, Chowdhury MA. Effect of Protein Energy Malnutrition on the Diarrheal Electrolyte Imbalance in Children of Chittagong Region, Bangladesh. Ind J Nutr 2014; 1(1):1-5.
15. Memon Y, Majeed R, Ghani MH, Shaikh S. Serum electrolytes changes in malnourished children with diarrhea. Pak J Med Sci 2009;23(5):760-4.
16. Ann Ashworth S, Khanum, Alan Jackson, Clarie Schofield. Guidelines for the Inpatient treatment of severely malnourished children. In: Ann Ashworth S, Khanum, Alan Jackson, Clarie Schofield, editors. WHO Guidelines. Geneva: World Health Organization; 2003: 10-48.
17. Bhatnagar S, Lodha R, Choudhury P, Sachdev HPS, Shah N, Narayan S, et al. IAP guidelines 2006 on hospital based management of severely malnourished children (adapted from the WHO Guidelines). Ind Pediatr 2007; 44(6): 443-61.
18. Shah RH, Javdekar BB. Management of children with severe acute malnutrition: experience of nutrition rehabilitation centre at Baroda, Gujarat. Int J Contemp Pediatr 2014;1(1):3-6.
19. Cervantes-Ríos E, Ortiz-Muñiz R, Martínez-Hernández AL, Cabrera- Rojo L, Graniel-Guerrero J, Rodríguez-Cruz L. Malnutrition and infection influence the peripheral blood reticulocyte micronuclei frequency in children. Mutat Res 2011;731: 68-74.
20. Kim MY, Baik SK, Yea CJ. Hepatic venous pressure gradient can predict the development of hepatocellular carcinoma and hyponatremia in decompensated alcoholic cirrhosis. Eur J Gastroenterol Hepatol 2009; 21(11):1241-6.
21. Shah GS, Das BK, Kumar S, Singh MK, Bhandari GP. Acid base and electrolyte disturbance in diarrhoea.Kathmandu Univ Med J (KUMJ) 2007;5:60–2.
22. Odey FA, Etuk IS, Etukudoh MH, Meremikwu MM. Hypokalaemia in children hospitalised for diarrhoea and malnutrition in Calabar. Niger Postgrad Med J 2010;17:19–22.
23. Uysal G, Sokmen A, Vidinlisan S. Clinical risk factors for fatal diarrhea in hospitalized children. Ind J Pediatr 2000;67: 329–33.
24. Ortuno AF, Cabello CN, De Diego GR, Salaverria GI, Vazquez RS. Hypokalemia induced paraplegia secondary to acute diarrhea. An Med Int 2002; 19:76-8.
25. Majeed R, Shamsi AH, Rajar U. Clinical manifestation of hypokalemia. J Liaquat Univ Med Health Sci 2006;(2):50-3.
26. Heuman DM, Abou-Assi SG, Habib A, Williams LM, Stravitz RT, Sanyal AJ. Persistent ascites and low serum sodium identify patients with cirrhosis and low MELD scores who are at high risk for early death. Hepatol 2004; 40(4):802-10.
27. Wake VC, Okon KO. Plasma electrolyte pattern of children with protein energy malnutrition and children with prolonged diarrhoea. J Tropical Paediat 1995;41(1):59-60.
28. Garrow JS. The treatment and prognosis of infantile malnutrition in Jamaican Children. West Ind Med J 1962; 11: 217-27.
29. Mittal SK, Saxena S, Mundkur N, Srivastava G, Gupta S. Acute diarrhea in malnourished children: Clinical, biochemical and bacteriological profile. Ind J Paediatr 1980;9(3); 247-53.