Niger J Paed 2012; 39 (2):63 - 66

ORIGINAL

Ntia HN
Anah MU
Udo JJ
Ewa AU
Onubi J

Prevalence of hypoglycaemia in under-five children presenting with acute diarrhoea in University of Calabar Teaching Hospital, Calabar

DOI:http://dx.doi.org/10.4314/njp.v39i2.5

Received: 7th march 2011
Accepted: 27th June 2011

Ntia HN (✉) Anah MU, Udo JJ, Ewa AU
Department of Paediatrics

Onubi J
Department of Chemical Pathology, University of Calabar Teaching Hospital, PMB 1278, Calabar, Nigeria.
Email: mnhappiness237@yahoo.com

Abstract *Background:* The clinical features of hypoglycaemia and severe dehydration are similar, and these two can occur in a child presenting with acute diarrhoea. Hypoglycaemia occurring in a growing brain is deleterious and must be detected and treated.
Objective: To determine the prevalence of hypoglycaemia among under-five children presenting with acute diarrhoea in UCTH, Calabar.
Method: This was a prospective study of 150 children aged six weeks to five years presenting with acute diarrhoea in UCTH, Calabar from June 1st to October 31st 2008. Consecutive children who met the inclusion criteria were recruited into the study. Blood samples were collected for random blood sugar and serum electrotype estimation using One Touch Ultra Test Strips 2006 model and Flame photometry respectively.
Results: The overall prevalence of hypoglycaemia in under-five children presenting with acute diarrhoea was 4%. There was no sex difference. It was commonest among children of the low socio-economic class (83.3%). Risk factors to developing hypoglycaemia were longer duration of last feeds greater than five hours and severe dehydration, both reaching statistically significant differences (p=0.022 and 0.002; FET respectively). Forty percent of patients who died had hypoglycaemia constituting 33.3% of patients with hypoglycaemia.
Conclusion: Children with diarrhoea complicated with severe dehydration are prone to developing hypoglycaemia. It causes high mortality and thus this parameter should be checked for and managed on time.

Key words: Hypoglycaemia, acute diarrhoea, under-five children.

Introduction

Diarrhoea is a common cause of childhood morbidity and mortality in the developing world accounting for an estimated 1.7 million under-five deaths globally.[1-3] An estimated one billion episodes of diarrhoea occur yearly among under-five children in Africa, Asia and Latin America.[2] The peak age incidence of childhood diarrhoea is 6-24months.[4] This is attributable to poverty and ignorance among affected groups who usually constitute up to 80% of the population.

It has been observed that in developing countries, including Nigeria, childhood diarrhoea is grossly underreported and the incidence, underestimated.[5,6] In developing countries, there is an inverse relationship between breastfeeding and diarrhoea-related mortality.[7-9] Diarrhoea kills infants directly as a result of shock, and indirectly as a major cause of protein energy malnutrition, especially marasmic-kwashiorkor.[2,5,7]

Acute diarrhoea can be complicated by electrolyte imbalance, dehydration and hypoglycaemia.[10-14] Interestingly, the symptoms of severe dehydration and hypoglycaemia are similar, and hence difficult to differentiate [10-12]. Indeed, the two complications may operate in concert with a consequent worsening of morbidity and mortality, thus an early detection and treatment of hypoglycaemia in such patients would be expected to improve outcome[12]. The prevalence of hypoglycaemia varies from time to time and from place to place. For instance, in the same centre in Dhakar different prevalence rate were recorded at different times by Bennish et al[10] and Huq et al[11].

The aims of the current study were, therefore, to determine the prevalence of hypoglycaemia among diarrhoea admissions in the University of Calabar Teaching Hospital, Calabar as well as identify its risk factors and outcome in these children.

Subjects and Methods

The study was conducted in the Diarrhoea Treatment and Training Unit (DTU) of the University of Calabar Teaching Hospital (UCTH), Calabar, where children with acute diarrhoea are managed. The DTU is a subunit of the children's emergency room (CHER). The unit was established in 1995, and provides a 24-hour service. The medical team in the CHER consists of consultants, senior and junior residents in paediatrics, house officers and paediatric-trained nurses. [15]

In the DTU, children receive oral rehydration solution (ORS), and their mothers are trained on home management of diarrhoea. In addition, the DTU offers training for medical students, nurses, resident doctors and house officers. It has a median admission of 20-40 patients per month. Admission peaks are recorded during the dry season.

The study was approved by the Ethical Committee of the Hospital. In addition, a written consent was obtained from the Care givers.
Consecutive children aged six weeks to 59 months presenting with acute diarrhoea and had not received oral rehydration solution (ORS) before admission into the DTU were recruited. Subjects who were less than six weeks, or those that had received ORS and whose parents did not give consent were excluded.

On enrolment, a questionnaire detailing bio-data (age, sex, parents' educational level and employment), history of duration of diarrhoea, presence of vomiting, 24hrs food recall and time of last feed were completed for each subject. This was done by the principal investigator who was occasionally assisted by a House officer in training in the unit.

Information obtained was on a one-on-one basis with the parent/guardian of the children. Socioeconomic class (SEC) was assigned to each subject using Olusanya et al [16] classification. Physical examination was carried out with emphasis on weight, height, pallor, and level of dehydration.

Finger prick was done to estimate random blood sugar and venous blood taken into a plain bottle for serum electrolyte estimation. Random blood sugar was tested using the One Touch Ultra Test Strip 2006 model and serum electrolyte with Flame photometer model 420 with two channels. Hypoglycaemia was considered at blood sugar level below 2.2mmol/l, hypokalaemia at serum potassium level below 3.2mmol/l and hyponatraemia at serum levels of sodium below 132mmol/l as well as metabolic acidosis at serum level of bicarbonate below 22mmol/l. These are reference values for our laboratory. All the equipment used were standardized on a daily basis before use.

Data collected were checked for accuracy and entered into a computer. Epi-Info (version 2002) was used. Data analysis was done using stata version 10. A Stattrans software was used to import data from Epi-Info. Descriptive statistics included frequency and percentages were made. Categorical variables were compared using the chi-square test which was used to identify the validity of the observed differences in the prevalence. Fisher's exact test (FET) was used for frequency tables with cells with small numbers (<5). The level of statistical significance was $P<0.05$.

Results

One hundred and fifty subjects were recruited for the study; there were 80(53.3%) males and 70(46.7%) females, with a male: female ratio of 1.1:1. The mean age of the subjects was 14.6±10.5months. The peak age prevalence for diarrhoea was at 2-11months constituting 46.7% of the study population. A large proportion (78.7%) of the children was of the low socioeconomic class. Five (3.3%) out of 150 children died during the study period with hypoglycaemia contributing 40% of the mortality.

Out of the 150 children that were studied, six children (4%) had hypoglycaemia, with a male to female ratio of 1:1. Vomiting was present in 81 children among whom four had hypoglycaemia, while of the 69 children who did not have vomiting, two had hypoglycaemia. The difference in vomiting in children with hypoglycaemia and those without hypoglycaemia was not statistically significant. P=0.684(FET). Ninety-eight (65.3%) children were fed within five hours prior to presentation, while 52(34.7%) children had not eaten for more than 5hours before presentation. Those who had not fed for more than 5hours before presentation were more likely to develop hypoglycaemia than those who ate within 5hours prior to presentation, p=0.022(FET).Table 1

Table 1: Blood glucose status and time of last feed prior to presentation.

Blood glucose status	Time of last feeds in hours (%)		Total
	<5hrs	>5hrs	
Hypoglycaemia	1(16.7)	5(83.3)	6(100)
Nomoglycaemia	97(67.4)	47(32.6)	144(100)
Total	98(65.3)	52(34.7)	150(100)

Fisher's exact = 0.022

Of the six who had hypoglycaemia, two (33.3%) were moderately dehydrated while four (66.7%) had severe dehydration. The difference was statistically significant between children who had hypoglycaemia and dehydration and those who did not have dehydration, p=0.002 (FET). Table 2.

Table 2: Blood glucose and hydration status.

Blood glucose status	Hydration status			
	Mild	Moderate	Severe	Total
Hypoglycaemia	0	2	4	6(4%)
Nomoglycaemia	9	13	122	144(96%)
Total	9	15	126	150 (100%)

Fisher's exact = 0.002

Five children (83.3%) out of the six subjects who had hypoglycaemia were from the lower socioeconomic class. The relationships between hypoglycaemia and serum electrolytes did not reach statistically significant difference. Only one out of ten children who had hyponatraemia also had hypoglycaemia, p=0.340(FET). Nineteen children had hypokalaemia out of whom one also had hypoglycaemia, p=0.558(FET). Out of the sixty -six children who had metabolic acidosis, five children had hypoglycaemia, p=0.086(FET).

Although five out of six children who had hypoglycaemia also had metabolic acidosis, but this was not statistically significant. This is most probably due to the small number (5) compared to the large number of children (61) that had metabolic acidosis alone.

The mean length of stay in the hospital was 3.8days (SD=4.1).Three (2.1%) children out of the 144(97.9%) children who did not have Hypoglycaemia died while two (33.3%) of the six children who had hypoglycaemia died. The difference in death in children with or without hypoglycaemia was statistically significant p=0.013 (FET). Table 3.

Table 3: Outcome of the study population. (N=150)

Outcome	Hypoglaecemia		Total	FET
	Present	Absent		
Duration of admission (days)				
≤2 days	1(1.9)	52(98.1)	53	
Compared				0.304
> 2 days	5(5.2)	92(94.8)	97	
Discharge	4(2.8)	141(97.3)	145	
Compared				0.013
Death	2(40.0)	3(60.0)	5	

Figures in bracket represent percentage.

Discussion

The overall prevalence rate of hypoglycaemia among children with diarrhoea in the DTU of the University of Calabar Teaching Hospital was 4%. This prevalence is comparatively lower than 11% and 9.2% recorded earlier by Huq et al[11] in Dhakar, as well as that of Reid and Losek[12] in Minnesota USA, respectively. Though our sample size was smaller as compared to 196 and 782 in these respective studies [11,12,] the difference in prevalence was not due to differences in methodology or sensitivity of the instrument since they were comparable. However, this prevalence is comparable to the 4.5% reported by Bennish et al[10] also in Dhakar. There were slightly more males than females admitted into DTU in this study, though not statistically significant. This was similar to the 1.4:1 male to female ratio recorded on childhood diarrhoea admissions in the same centre four years earlier.[15] The reasons for this male preponderance are not quite clear.

The assertion by Mitra et al [17] of delay in presentation to hospital of females nor Madrigal[18] assertion that males are the pillars of the family cannot stand the inheritance system in Calabar, an Efik tribe predominant community where both sexes have equal rights (personal communication with parents and some indigenes).

More than half of our subjects were below 24months of age in this study, which agrees with other reports that diarrhoea is more common in children aged less than 24 months[4,5,9,11,15]. Many reasons have been advanced for this high incidence in children less than 24months, one of which is the causative agent that is common in this age group. Our study did not assess the causative agent. Weaning food and poor hygiene have also been implicated.

Hypoglycaemia was more in the low social class in this survey. This group is exposed to the vicious cycle of poverty, hunger and disease; hence it was not surprising that hypoglycaemia was commonest in this group.

Furthermore, parents tend to withhold feeds on the belief that it would reduce the frequency of diarrhoea especially when accompanied with vomiting hence the possible reason while hypoglycaemia was common. Longer duration of last feeds was found to be a risk factor to the development of hypoglycaemia. This is consistent with the earlier observations of Reid and Losek[12]. The probable explanation may be due to the fact that these patients have low levels of gluconeogenetic substrate, thus when counter regulatory hormones are secreted, the glycogen stores are easily depleted and so enough glucose is not produced[11]. More so, our patients had not received any form of oral rehydration solution prior to presentation which could further explained the reduced blood sugar level.

There was no statistically significant association between vomiting and the development of hypoglycaemia in children with acute watery diarrhoea. However, there is a tendency to withholding feeds from these children, to reduce vomiting and this could lead to starvation and hence hypoglycaemia. It is both difficult to know the quality as well as the quantity of food consumed especially in our community where food items are consumed at random and children commonly share food as group consumption from one plate. Thus no significant association was found with hypoglycaemia. In our study, most of our patients were below two years, thus the

presence of other co-morbidities like malaria, pneumonia and septicaemia could increase their chances of having hypoglycaemia as earlier reported[11,19].

A significant association was found between severe dehydration and hypoglycaemia. Hypoglycaemia observed in these children may have been due to reduced blood supply to the liver with subsequent reduction in glucose metabolism. The clinical importance of this finding is that children who are admitted with diarrhoea complicated by severe dehydration should have their blood sugar checked as they are likely to develop hypoglycaemia.

Generally the association between serum electrolytes and hypoglycaemia was not statistically significant but most of our subjects with hypoglycaemia had metabolic acidosis. This agrees with the study by Wathen et al [20] who reported abnormally low levels of bicarbonate as a significant finding associated with hypoglycaemia in children who were severely dehydrated, as well as those requiring intravenous fluid administration.

The overall case fatality of children with diarrhoea and hypoglycaemia was 33.3%. This was a little higher than the 28% reported by Huq et al[11]. This shows that hypoglycaemia must be identified and treated in children with diarrhoea.

Conclusion

The prevalence of hypoglycaemia in diarrhoea admissions was 4%. Longer duration from time of last feeds and severe dehydration were risk factors to developing hypoglycaemia. Mortality was high in the children who had both diarrhoea and hypoglycaemia. Thus there is need to intensify education on continued oral feeding and administration of ORS during diarrhoea episodes in children to reduce severe dehydration and subsequent hypoglycaemia.

Conflict of interest: None
Funding: None

References

1. Lancet. Global, Regional and National causes of child mortality in 2008: a systematic analysis. *Lancet 2010; 375(730): 1969-87.*
2. Margaret K, Caryn B, Richard L. Global burden of diarrhoeal Disease. In: *Bull Wlto Hlth Org. 81:197-204 Geneva 2003.*
3. Grant JP. The State of the World's Children 2008. UNICEF, New York.
4. Robert C. Diarrhoeal disease in early childhood. In: Child Health in the Tropics, Jellife DB, Mill-Road, Duntron Green, Sevenoaks. (eds) 5th Ed Kent TN 132YA (Publishers) 2001; 102-9.
5. Carl ET, William BG. Control of diarrhoeal diseases. http:// www.annual reviews. Org/ aronline. Assessed May 30th. 2010.
6. Ogbonnaya O, Nebe A, Chigozie U, Ekperechi SA; Aetiology of acute infantile diarrhoea and antibiotic sensitivity profile. *Intern J Third World Med 2008 ; 5: 1539-4646.*
7. Asindi AA, Meremikwu MM, Antia -Obong OE; Influence of breastfeeding on the occurrence of dysentery, persistent diarrhoea and malnutrition among Nigerian children. *W Afr J Med. 1997;16: 20-23.*
8. Yakubu AM. Diarrhoea in children. In: Azubuike JC and Nkanginieme KEO eds. Paediatrics and child health in a tropical region 2nd Ed. African Educational Services Nigeria. 2007; 268-282.
9. Cardenos de Saude Publica. Risk factors for diarrhoea disease in Brazilian infants: A special case control design application. 2002; 18(3) P464.
10. Bennish ML, Azad AK, Rahman O, Philips RE. Hypoglycaemia during diarrhoea in Childhood. Prevalence, pathophysiology and outcome. International Centre for Diarrhoea Disease Research, Bangladesh, Dhaka. *N Engl J Med 1990; 322: 1357-63.*
11. Huq S, Hassan MI, Malek MA, Faruque AS, Salam MA. Hypoglycaemia in Under Five Children with Diarrhoea. *J Trop Pediatr 2007; 53: 197-201.*
12. Reid SR, Losek JD: Hypoglycaemia complicating dehydration in children with acute gastroenteritis. *J. Emerg Med 2005; 29: 141-5.*
13. Elliot EJ and Dalby-payne JR. Acute infectious diarrhoea and dehydration in children. *Med J Aust 2004; 181(10):565-570.*
14. Gastroenteritis in Children. Published by Bupals Health Information Team, 2008.
15. Ochigbo SO, Anah MU, Udo JJ, Uniga JA, Ogon PM. Childhood diarrhoea in Calabar: An 8-year review. *Global J Med Sci 2007; 6: 85-90.*
16. Olusanya O, Okpere E, Ezimokhai M. The importance of social class in voluntary fertility control in a developing country. *W Afr J Med 1985; 4:205-12.*
17. Mitra AK, Rahim KMM, Fuchs GJ. Risk factors and gender differentials for death among children hospitalized with diarrhoea in Bangladesh. *J. Health Pop Nutr 2000; 18: 151-6.*
18. Madrigal L. Differential sex mortality in a rural nineteenth century population: Escazu, Costa Rica. *Human Biol 1992; 64:199-213.*
19. Elusanya JBE, Adejuyibe EA, Adeodu O. Hypoglycaemia in a Nigerian Paediatric Emergency Ward. Obafemi Awolowo University, Ile Ife, Nigeria. *J Trop Pediatr 2005; 52: 96-102.*
20. Wathen JE, Todd M, Joan PB. Usefulness of serum electrolyte panel in the management of paediatric dehydration treated with intravenous administratered fluids. Published online Nov 2004; 114(5): 1227-1234. Available as http:// pediatrics.aappublications.org/cgi/ content/abstract/114/5/1227. Accessed Jan 30, 2011.