Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

To Assess the Degree of Dehydration and Type of Dyselectrolytemia in Acute Gastroenteritis in Children from 3 Months to 2 Years of Age

Palwinder Singh[1], Gaganpreet[2], Kuldip Singh[3], Akanksha Tiwari[4], Vikrant Singh[5], Nishleen Kaur[6]

[1]Professor, Department of Paediatrics, Govt. Medical College, Amritsar.
[2]Junior Resident, Department of Pediatrics, Govt. Medical College, Amritsar.
[3]Professor, Department of Biochemistry, Govt. Medical College, Amritsar.
[4]Senior Resident, Department of Paediatrics, Govt. Medical College, Amritsar.
[5]MBBS Student, SGRD Medical College, Amritsar.
[6]MBBS (Intern), SGRD Medical College, Amritsar.

Received: February 2020
Accepted: February 2020

ABSTRACT

Background: To assess the degree of dehydration and type of dyselectrolytemia in acute gastroenteritis in children from 3 months to 2 years of age. To study the correlation between different degrees of the dehydration and types of dyselectrolytemia in these cases. **Methods:** This cross sectional study was conducted on 200 children of acute gastroenteritis aged 3 months to 2 years, over the period of one year from 1st January 2018 to 31st December 2018 in the department of Pediatrics, Bebe Nanki Mother and Child Care Centre of Guru Nanak Dev Hospital, Government Medical College, Amritsar in collaboration with department of Biochemistry, Government Medical College, Amritsar. Those children meeting the inclusion criteria were recruited for the study. After assessing the symptoms and signs of dehydration, the child was categorized into 3 degrees (mild, moderate and severe dehydration) as per table. After clinical assessment for type of deselectrolytetmia (isonatremic, hyponatremic, hypernatremic, hyperkalemia and hypokalemia) as mentioned below, it will be further confirmed by laboratory investigations. **Results:** Out of 200 patients admitted for acute gastroenteritis 73.5 % cases had mild, 11.5% cases had moderate and 15% cases had severe degree of dehydration. Hypernatremia was seen in 14.5% cases and there was significant corelation between degree of dehydration and serum sodium and it's clinical assessment also. 30.5% cases of moderate and 70% cases of severe dehydration had hypernatremia. **Conclusion:** It is very important to assess clinically not only for degree of dehydration but also for type or pattern of electrolyte disturbances. Then we should confirm this clinical assessment of dyselectrolytemia by appropriate biochemical investigations.

Keywords: Dyselectrolytemia, Hypernatremia, Sodium.

INTRODUCTION

Acute diarrhoeal disease is a major public health problem and a leading cause of childhood morbidity and mortality. In Indian health institutions, up to one third of paediatric admissions are due to diarrhoeal disease and 17% of all deaths in indoor paediatric patients are due to diarrhoea.[1] The global annual measure of diarrhoea and dehydration is huge, affecting 3.5 billion cases and causing approximately 2 million deaths per year. Diarrhoea accounts for over 20% of all deaths in under 5 years of age children. Significant dehydration with abnormal electrolytes and acid base status occurs in 2.5% of all cases of diarrhoea which may be fatal.[2] The main cause of death in acute diarrhoea is dehydration which results from the loss of fluids and electrolytes in diarrhoeal stools. The clinical manifestations of acute diarrhoea are related to the severity of water deficit and the type of electrolyte disturbances.[3] The global annual measure of diarrhoea and dehydration is huge, affecting 3.5 billion cases and causing approximately 2 million deaths per year. Diarrhoea accounts for over 20% of all deaths in under 5 years of age children. Significant dehydration with abnormal electrolytes and acid base status occurs in 2.5% of all cases of diarrhoea which may be fatal.[2] Electrolyte disturbances are well known in dehydration. Disturbance in sodium, potassium, chloride and bicarbonate have been studied by many workers. The major ion of ECF is sodium (Na+).[4] Electrolyte imbalance is common in children with diarrhoea, so timely recognition, a high index of suspicion and thorough understanding of common electrolyte abnormalities is necessary to ensure their correction. Dyselectrolytemia is most common

Name & Address of Corresponding Author
Dr. Gaganpreet
Junior Resident,
Department of Paediatrics,
GMC, ASR.

complication seen in acute gastroenteritis which leads to long term morbidity and sometimes mortality which is easily preventable by simple measures.

Clinical recognition of water and electrolyte disturbances becomes very important, particularly hypernatraemic dehydration, due to its serious neurological consequences.[3] Ultimately such an approach of clinical assessment of degree and type of dehydration in children can definitely help us in early and effective treatment of dehydration and dyselectrolytemia.

MATERIALS AND METHODS

This cross sectional study was conducted on 200 children of acute gastroenteritis aged 3 months to 2 years, over the period of one year from 1st January 2018 to 31st December 2018 in the department of Pediatrics, Bebe Nanki Mother and Child Care Centre of Guru Nanak Dev Hospital, Government Medical College, Amritsar in collaboration with department of Biochemistry, Government Medical College, Amritsar after approval from the Institutional Thesis and Ethical Committee. In the present study, by only those patients were included who fulfilling the inclusion criteria of study and admitted in the department of Pediatrics at Bebe Nanki Mother and Child Care Centre of Guru Nanak Dev Hospital, Government Medical College, Amritsar and were divided into two groups based on their age. In Group-1: Children in the age range of 3 months to 12 months were included and in the Group-2: Children in the age range of 13 months to 24 months were considered to correlate different degrees of the dehydration and types of dyselectrolytemia.

Inclusion and Exclusion criteria as follows:

Inclusion Criteria:

1. Children between the ages of 3 months to 2 year.
2. Passage of loose stools more than 3 times per day.
3. Duration of illness less than fourteen days.
4. Symptoms and signs suggestive of dehydration.

Exclusion Criteria:

1. Infants <3 months of age or Children >2 years of age.
2. Children with no symptoms or signs of dehydration.
3. Children with causes of dehydration other than acute gastroenteritis.
4. Persistent diarrhea (>14 days).
5. Children with associated chronic diseases like renal disorders, cystic fibrosis, diabetes mellitus, metabolic diseases, congestive heart failure adrenocortical disorders and malnutrition.
6. Children on drugs which can cause electrolyte imbalance such as diuretics, anticonvulsants etc.
7. Children treated with intravenous rehydration therapy in last 24 hours.

At the time of admission, an informed written consent was obtained from the parents. Detailed history and demographic data was obtained from the parents/ guardians with relevance to the case and detailed examination was done as per prescribed Performa (Annexure A). Those children meeting the inclusion criteria were recruited for the study. After assessing the symptoms and signs of dehydration, the child was categorized into 3 degrees (mild, moderate and severe dehydration) as per table. After clinical assessment for type of deselectrolytetmia (isonatremic, hyponatremic, hypernatremic, hyperkalemia and hypokalemia) as mentioned below, it will be further confirmed by laboratory investigations. Correlation between different types and degrees of dehydration was assessed and analysis was done by using SPSS 19.0 software.

RESULTS

This cross sectional study was conducted on 200 children of acute gastroenteritis aged 3 months to 2 years. Our study showed that acute gastroenteritis with dehydration was very common in infants under two years of age. Out of 200 cases, 71.5% cases were in the age group of 3-12 months and 28.5% were in age group of 13-24 months. In our study the incidence of acute gastroenteritis with dehydration was greater in males 122 (61.0%) as compared to females 78 (39.0%). Sex ratio was 1.6:1 in favour of males

Table 1: Incidence of Various Degrees of Dehydration

Degree of Dehydration	Frequency	Percent
Mild	147	73.5
Moderate	23	11.5
Severe	30	15.0
Total	200	100.0

The highest number of cases 147 (73.5%) belonged to mild degree of dehydration followed by 30 (15.0%) cases of severe and 23 (11.5%) cases of moderate degree of dehydration as shown in table above.

Table 2: Serum sodium level in relation to various degrees of dehydration.

Degree of Dehydration	Type of Dyselectronemia biochemically (Sodium)			Total
	Hypernatremia	Hyponatremia	Isonatremia	
Mild	1(0.68%)	6(4.08%)	140(95.24%)	147(100.00%)
Moderate	7(30.43%)	3(13.04%)	13(56.52%)	23(100.00%)
Severe	21(70.00%)	5(16.67%)	4(13.33%)	30(100.00%)
Total	29(14.50%)	14(7.00%)	157(78.50%)	200(100.0%)

p<0.001 (Highly Significant)

Above table shows that in mild dehydration most common type of the dehydration was isonatremia

(95.24%) followed by hyponatremia (4.08%) followed by hypernatremia (0.68%). In moderate dehydration most common type of the dehydration was isonatremia (56.52%) followed by hypernatremia (30.43%) followed by hyponatremia (13.04%). In severe dehydration most common type of the dehydration was followed by hypernatremia (70%) followed by hyponatremia (16.67%) followed by isonatremia (13.33%). The result was statistically significant (p<0.05; Significant).

Table 3: Clinical Signs Suggestive Of Dyselectrolytemia (Sodium)

Dyselectrolytemia	Total No. of cases	Dyselectrolytemia Clinically (Sodium)			
		Lethargy	Irritability	Seizures	Thick Skin
Isonatremia	157	4 (2.5%)	17 (10.8%)	0 (0%)	0 (0%)
Hyponatremia	14	9 (64.3%)	7 (50.3%)	8 (57.1%)	0 (0%)
Hypernatremia	29	19 (65.5%)	27 (93.1%)	10 (34.5%)	23 (75.9%)
Total	200	32 (16.0%)	51 (25.5%)	18 (9.0%)	23 (11.5%)

p<0.001 (Highly Significant)

Above table shows that neurological signs were uncommon in isonatremia. In hyponatremia 64.3% cases showed lethargy, 50.3% cases showed irritability, 57% showed seizures. In hypernatremia 65.5% cases showed lethargy, 93% cases had seizures and 34.5% cases had seizures; and 76% cases presented with thick skin. In Isonatremic dehydration 2.5% cases presented with lethargy and 11% cases presented with irritability. The result was statistically significant.

Table 4: Serum Potassium Level In Relation To Various Degrees of Dehydration

Degree of Dehydration	Type of Dyselectronemia biochemically (Potassium)		Total
	Isokalemia	Hypokalemia	
Mild	138(94.0%)	9(6.0%)	147(100.0%)
Moderate	21(91.3%)	2(8.7%)	23(100.0%)
Severe	30(100.00%)	0(0.0%)	30(100.0%)
Total	189(100.0%)	11(100.0%)	200(100.0%)

p>0.05 (Not Significant)

Above table shows that in mild dehydration most common type of the dehydration was isokalemia (94%) followed by hypokalemia (6%). In moderate dehydration most common type of the dehydration was isokalemia (91.3%) followed by hypokalemia (8.7%). In severe dehydration all cases had isokalemia. The result was not statistically significant (p>0.05; Not Significant).

Table 5: Clinical Signs Suggestive Of Dyselectolytemia (Potassium)

Dyslectrolytemia	Total No. of Cases	Dyselectrolytemia clinically (Potassium)
		Paralytic Ileus
Normokalemia	189	0
Hypokalemia	11	5 (45.5%)
Hyperkalemia	-	-

p<0.05 (Significant)

Table 6: Final Outcome In Relation To Various Degrees of Dehydration

Final Outcome	Total No. of cases	Degree of Dehydration		
		Mild	Moderate	Severe
Death	4	-	-	4 (100%)
Discharge	196	147 (75%)	23(12%)	26(13.0%)
Total	200	147 (73.5%)	23 (11.5%)	30 (15.0%)

p<0.001(Highly significant)

Above table shows that patient those who had hypokalemia biochemically. Out of those 45.5% presented with paralytic ileus as clinical sign.

The above table shows that death was seen in 2% of cases and all the cases had severe degree of dehydration. The result was statistically highly significant (Highly Significant)

Table 7: Final Outcome In Relation To Various Types of Dyselectronemia

Final Outcome	Type of Dyselectronemia biochemically			Total
	Hypernatremia	Hyponatremia	Isonatremia	
Death	3(75.0%)	-	1(25.0%)	4(100.0%)
Discharge	26(13.0%)	14(71.0%)	156(80.0%)	196(100.0%)
Total	29(14.5%)	14(7.0%)	157(78.5%)	200(100.0%)

0.002 (p<0.05; Significant)

The above table shows that death was seen in 2% of cases out of which 75% cases had hypernatremia and 25% cases had isonatremia. No mortality was seen in hyponatremic cases.

DISCUSSION

The present study was conducted on 200 children in the age range of 3 months to 2 years old admitted over the period of one year from 1st January 2018 to 31st December 2018 in the department of Pediatrics, Bebe Nanki Mother and Child Care Centre of Guru Nanak Dev Hospital, Government Medical College, Amritsar to assess the degree of dehydration and type of dyselectrolytemia in acute gastroenteritis. In present study, acute gastroenteritis was the cause of dehydration in all 200 study cases. Our study showed that acute gastroenteritis with dehydration was very common in infants under two years of age.

Out of 200 cases, 71.5% cases were in the age group of 3-12 months and 28.5% were in age group of 13-24 months. It was more common in age group of 3-12 months because infants and young children, tend to be more susceptible to volume depletion as a result of vomiting, diarrhea or increase in insensible water losses. Sarita KC et al (2018) showed a similar trend with 18.7%, 61.5%, 19.8% of the cases in age

group of 1 - 5 months, 6 - 23 months and 24-60 months respectively.[5]

In our study the incidence of acute gastroenteritis with dehydration was greater in males 122 (61.0%) as compared to females 78 (39.0%). Sex ratio was 1.6:1 in favour of males. It is because in our society male children are given preferential treatment over female children as surviving males are more likely to earn for their families later and stay with their parents in their old age. Shah GS et al (2007), also showed the sex ratio to be 1.8:1 with 65% of his cases being males and 35% of cases being females.[6]

In this study most common degree of dehydration was mild (73.5%) followed by 30 (15%) cases of severe and 23 (11.5%) cases of moderate dehydration. Gauchan E and Malla KK reported that most common degree of dehydration was some (61.11%) followed by no (22.9%) and severe (11.7%). Once the degree of dehydration is established, the type of dehydration, defined by serum sodium concentrations, needs to be determined. Out of different types of dyselectrolytemia in this study 78.5% cases had isonatremia; 14.5% had hypernatremia and 7.0% cases had hyponatremia at the time of admission. Babar H et al showed 66.7% cases had electrolyte abnormality.[7,8]

Table 8: Comparison of Sodium Level In Various Studies

Sodium levels	Gauchan E and Malla KK(2015)40	Sarita KC et al (2018)47	Present Study
Normal	72.9%	59.2%	78.5%
Hypernatremia	16.0%	7.7%	14.5%
Hyponatremia	11.2%	23.1%	7.0%

In our study, serum sodium showed significant correlation with severity of dehydration, 30.5% cases of moderate and 70% of severe dehydration had hypernatremia. The results were statistically significant (p<0.001). The results were in agreement with study conducted by Gauchan E and Malla KK (2015), in which 24.3% of some and 59% of severe dehydration cases had serum sodium abnormalities. In both moderate and severe dehydration, hypernatremia was more common than hyponatraemia.[7] Hypernatremia occurs in condition with deficit of sodium and water, when water deficit exceeds sodium deficit and this occurs only if child is unable to ingest adequate water. In our study, sodium imbalance was assessed on the basis of various clinical signs which were mostly neurological in nature. Among the clinical sings of hyponatremia 64.3% cases of hyponatremia showed lethargy, 50.3% cases showed irritability, 57% showed seizures. Whereas in hypernatremia 65.5% cases showed lethargy, 93% cases had irritability and 34.5% cases had seizures. Also in hypernatremic cases 76% cases had thick skin. In isonatremic dehydration, 2.5% cases presented with lethargy and 11% cases presented with irritability with no incidence of seizures. The results were statistically highly significant for assessment of type of dyselectrolytemia on clinical basis (p=0.001) for various neurological signs of sodium imbalance. Most important non neurological clinical sign was thick skin seen in 76% cases of hypernatremia, which further help to differentiate hypernatremia and hyponatremia clinically.

Shahrin L et al (2013) showed that there is significant association between serum sodium concentration and abnormal mental status which includes lethargy, irritability or convulsion.[9]

As far as potassium is concerned, in this study majority of cases had isokalemia, 5.5% cases had hypokalemia and no case had hyperkalemia.

Table 9: Comparison Of Potassium Level In Various Studies

Potassium	Gauchan E and Malla KK (2015)7	Sarita KC et al (2018)10	This Study
Normal	92.6%	58.2%	94.5%
Hypokalemia	7.4%	37.4%	5.5%
Hyperkalemia	-	4.4%	-

The volume depletion raises aldosterone levels, further increasing urinary K+ losses and preventing correction of metabolic alkalosis and hypokalemia until the volume depletion is corrected.[11] Sarita KC et al (2018),[10] also reported that hypokalemia was more common than hyperkalemia which implies that loss of potassium is relatively greater than loss of water during diarrhea. Therefore, hypokalemic children are required to have close monitoring of serum potassium level, and potassium replacement is necessary as early as needed. In this study, there was no significant (p value 0.315) relationship found between degree of dehydration and serum potassium this may be because of the reason that potassium is major intracellular ion. In our study, potassium imbalance was assessed on basis of clinical signs. Among clinical signs of hypokalemia, 45.5% cases presented with paralytic ileus and result was statistically significant (p <0.05). The study conducted by Majeed R et al,[12] was in agreement showing that potassium imbalance presented with various clinical sign like abdominal distension (84.6%) weakness of limbs (26.92%) and paralytic ileus (23.07%) cases.

In our study, mortality was seen in 4 cases out of 200 study (2%). The main cause of death in acute diarrhea is dehydration which results from loss of fluid and electrolyte in diarrheal stool.[3] All cases who expired were severely dehydrated and 75% cases had hypernatremia. Dehydration is major cause of morbidity and mortality in infants and young children worldwide. Hypernatremic dehydration is most dangerous form of dehydration because of complications of hypernatremia itself and its therapy, mortality might be more common in

hypernatremic dehydration because of serious neurological damage, including central nervous system hemorrhages and thrombosis.[9] Various studies have shown that disorder in sodium levels leads to adverse effect on outcome, increasing severity of hypernatremia leads to increase in mortality rate and is associated with significant difference in Denver Developmental Screening II test results.[13] Case fatality rate in study conducted by Dastidar RG was 0.005%. The only child who succumbed was a 1 year 6 months old girl who had convulsions, hypernatremia and was severely dehydrated.

CONCLUSION

It is very important to assess clinically not only for degree of dehydration but also for type or pattern of electrolyte disturbances. Then we should confirm this clinical assessment of dyselectrolytemia by appropriate biochemical investigations. Also, we must find out whether there is any correlation between different degrees of dehydration and types of dyselectrolytemia. Such a strategy can definitely help us to plan an appropriate, timely and more effective management of these patients by restoration of their body homeostasis in terms of osmolality in addition to the volume depletion. Such an effort can go a long way to significantly reduce the morbidity and mortality in infants suffering from acute gastroenteritis and dehydration especially in developing countries like India.

REFERENCES

1. Shah BH, Gosai DK, Chaudhari MR, Prajapati JS. Study of clinical profile in acute gastroenteritis patients with special reference to dyselectrolytemia. IJAR. 2016;2(8):255-7.
2. Srivastava A, Jagadisan B, Yacha SK. Diseases of gastrointestinal system and Liver. In: Paul VK, Bagga A, editors. Ghai Essential Pediatrics. 8thed. New Delhi. CBS Publishers. 2009;278-329.
3. Dastidar RG, Konar N. A study of Electrolyte disturbances in a child presenting with Acute Gastroenteritis with Special Emphasis on Hyponatremic Dehydration – A Hospital based Cross-Sectional Study. Pediatr Ther. 2017;7:2.
4. Nicholson J, Pesce M. Laboratory testing and reference values in infants and children. In: Nelson W, Behrman R, Kliegman R. Nelson Textbook of Pediatrics. Philadelphia: Saunders WB; 2002;2031-84.
5. Takayesu JK. Pediatrics, Dehydration.eMedicine Emergency Medicine 2010 March 29th. Available from: https://s.docworkspace.com/d/AE8GcR-g-vAlgaOayJqdFA
6. Tutay GJ, Capraro G, Spirko B, Garb J, Smithline H. Electrolyte profile of pediatric patients with hypertrophic pyloric stenosis. Pediatr Emerg Care. 2013;29(4):465-8.
7. Gauchan E, Malla KK. Relationship of Renal Function Tests and Electrolyte Levels with Severity of Dehydration in Acute Diarrhea.Journal of Nepal Health Research Council. 2015;13:8.
8. Babar H, Sanaullah MR, Rahim M. Serum Electrolyte Disturbances in Acute Diarrhoea among Children Less Than 5 Years of Age. Pakistan Journal of Medical & Health Sciences. 2016;10(4):1231-3.
9. Shahrin L, Chisti MJ, Huq S, Nishath T, Christy MD, Hannan A, et al. Clinical manifestations of hyponatremia and hypernatremia in under-five diarrheal children in a diarrhea hospital. Journal of Tropical Pediatrics. 2016;62(3):206-12.
10. Sarita KC, Bhandari S, Khanal B. Impact of Serum Electrolyte Changes in Children with Acute Diarrhea: Identifying the Risk Factors on Children's Health Outcomes and Its Impact in Society. Journal of Development Innovations. 2018;2(2):1-9.
11. Green Baum LA. Fluid and electrolyte disorders. In: Kliegman RM, Geme JW, Blum NJ, Tasker RC, Shah SS, Wilson KM, editors Nelson Textbook of Pediatrics, 21st edn. Vol. 1, WB Saunders Philadelphia, 2019, p.391-431.
12. Majeed R, Shamsi HA, Rajar UD. Clinical manifestations of hypokalaemia. J Liaquat Uni Med Health Sci. 2006;50-3.
13. Ahmad MS, Wahid A, Ahmad M, Mahboob N, Mehmood R. Prevalence of electrolyte disorders among cases of diarrhea with severe dehydration and correlation of electrolyte levels with age of the patients. Journal of the College of Physicians and Surgeons--Pakistan: JCPSP. 2016; 26(5): 394-8.

How to cite this article: Singh P, Gaganpreet, Singh K, Tiwari A, Singh V, Kaur N. To Assess the Degree of Dehydration and Type of Dyselectrolytemia in Acute Gastroenteritis in Children from 3 Months to 2 Years of Age. Ann. Int. Med. Den. Res. 2020; 6(2):PE04-PE08.

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