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Study of laboratory profile in children with acute gastroenteritis with reference to acid-base and electrolyte imbalance

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ABSTRACT

Background: Diarrhoeal disease is the second leading cause of death in children. Electrolyte disturbances may remain unrecognized, results in increased morbidity and mortality. The present study was conducted to assess the spectrum of electrolyte and acid base disturbances in children with acute gastroenteritis with relationship to mortality. **Methods:** In this prospective clinical study total patients selected were 210, admitted in paediatric ward and paediatric intensive care unit of tertiary care hospital over a period of 2 years. All patients enrolled in the study were classified according to WHO guidelines, monitored clinically and investigated for electrolytes and arterial blood gas analysis. The data collected was compiled, tabulated, analyzed and subjected to statistical tests done using SPSS. **Results:** In the present study total acute gastroenteritis patients were 210 in which 57.14% were males and 42.86% were females. Out of 210 patients 85.71% patients had some dehydration, 14.29% patients had severe dehydration. Incidence of isonatremia was 74.29%, hyponatremia was 20.47, hypernatremia was 5.24%, hypokalemia was noted in 4.76% of patients. Out of 210 patients metabolic acidosis was observed in 12.86%. Time taken for correction of electrolyte imbalance after standard treatment was 81.25% of patients in < 24 hour,10.94% of patients in 24-48 hours, 6.25% patients in >48 hours, not corrected in 1.56% of patients. **Conclusion:** Our study concluded that most common electrolyte imbalance in acute gastroenteritis was hyponatremia followed by hypernatremia and hypokalemia. Metabolic acidosis was common in severe dehydration compared to some dehydration. Our study shows monitoring of electrolyte and acid base levels to decrease morbidity, mortality in acute gastroenteritis.

Keywords: acute gastroenteritis, electrolytes, acid-base imbalance

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INTRODUCTION

Diarrhoeal disease is the second leading cause of death in children under five years old, it is both preventable and treatable. Each year diarrhoea kills around 5,25,000 children under five. Globally, there are nearly 1.7 billion cases of childhood diarrhoeal disease every year.[1] Diarrhoea is the third leading cause of childhood mortality in India, and responsible for 13% of all deaths/year in children under 5 year of age.[2,3] Diarrhoea is generally defined as three or more loose or watery stools within a 24-hour period, or decrease in the consistency of the stool from that which is normal for the patient. The main cause of death in acute diarrhoea is dehydration, which results from the loss of fluid and electrolytes in diarrhoeal stools, vomit, sweat, urine and breathing. The clinical manifestations of acute diarrhoea are related to the severity of water deficit and the type of electrolyte disturbances. Electrolyte disturbances may remain unrecognized and result in increased morbidity and mortality.[4] Timely recognition, a high index of suspicion and a thorough understanding of common electrolyte abnormalities is necessary to ensure their correction. In this regard, the biochemical derangement in children with dehydration may be hyponatraemic, isonatraemic or

hypernatraemic.[5] Other biochemical disturbances observed include hypokalaemia and metabolic acidosis. Often laboratory facilities are not available or, even if available; there is a considerable time lag in obtaining the results. Consequently, clinical recognition of water and electrolyte disturbances becomes important due to its serious consequences. Therefore, purpose of study, an attempt has been made to outline the spectrum of electrolyte and acid base disturbances in children suffering from acute diarrhoea who are all admitted in paediatric ward and paediatric intensive care unit.

METHODS

In this prospective clinical study was conducted in the department of paediatrics, Dr. V.M. Govt. Medical College,Solapur, Maharashtra, India over a period of 2 years. The study was approved by the ethical committee of Dr.V.M.GMC, and Shri.C.S.M. General Hospital, Solapur, Maharashtra, India. The study group was consisted of 210 paediatric patients admitted in paediatric ward and paediatric intensive care unit. Patients were enrolled in the study after obtaining written informed consent from parents. Patients were included in this study all paediatric patients admitted in paediatric ward and paediatric intensive care unit with diarrhoea age 1 month to 14 years. Patients were excluded from this study were age <1 month, >14 years, acute gastroenteritis due to non-infective causes, chronic diarrhea, HIV. Detailed clinical history including associated symptoms was noted and history regarding urine output in last 24 hours was noted. Systemic examination of patients was done with assessment of severity of dehydration, sensorium of patient, nutritional status and immunization status were noted in preformed proforma. Laboratory investigation like Hemogram, serum Sodium, Potassium, Creatinine, Urea and ABGA (Arterial Blood Gas Analysis) were done. All the patients were treated according to WHO guidelines for treatment of diarrhoea. The electrolyte abnormalities and acid base abnormalities detected were treated according to standard treatment. The data collected was compiled, tabulated, analyzed and subjected to statistical tests. Analysis was done using SPSS. The data collected was evaluated using standardized statistical methods i.e. Mean, Standard Deviation, Pearson Chi-square test in order to derive a logical conclusion.

RESULTS

A total of 210 children met the inclusion criteria admitted for diarrhoeal disease during the study period. Out of these,120 (57.14%) were males and 98 (42.86%) were females. The distribution of subjects according to age 25 (11.90%), 110 (52.38%) and 75 (35.72%) of the subjects belonged to 1 month-1 year, 1 year-5 year and 5-14 year respectively. Out of 210 patients,152 (72.38%) of the subjects had their residence in rural area whereas 58 (27.62%) of the subjects live in urban area. No malnutrition was found in 41 (19.52%) cases, MAM (Moderate Acute Malnutrition) was reported in 145 (69.05%) cases, SAM (Severe Acute Malnutrition) was reported in 24 (11.43%) cases. Out of 210 patients 85.71% patients had some dehydration, 14.29% patients had severe dehydration. Incidence of isonatremia was 74.29%, hyponatremia was 20.47, hypernatremia was 5.24%, hypokalemia was noted in 4.76% of patients. Out of 210 patients metabolic acidosis was observed in 12.86%. Time taken for correction of electrolyte imbalance after standard treatment was 81.25% of patients in < 24 hour,10.94% of patients in 24-48 hours, 6.25% patients in >48 hours, not corrected in 1.56% of patients. Out of 210 patients 99.52% recovered and discharged, 0.48% died.

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Table 1: Distribution Of Cases According to Severity of Dehydration

Severity Of Dehydration	Cases	Percentage
Some Dehydration	180	85.71%
Severe Dehydration	30	14.29%

Table 2: Electrolyte Disturbance with Respect To Serum Sodium Level

Serum Sodium Level	Cases	Percentage
Isonatremia	156	74.29%
Hyponatremia	43	20.47%
Hypernatremia	11	05.24%

Table 3: Electrolyte Disturbance with Respect to Potassium Level

Potassium Level	Cases	Percentage
Normal	200	95.24%
Hypokalemia	10	04.76%
Hyperkalemia	00	00.00%

Table 4: Distribution of Cases with Respect to Bicarbonate Level

Bicarbonate Level	Cases	Percentage
Normal	183	87.14%
Decreased	27	12.86%

Table 5: Distribution Of Cases with Respect to Acid Base Imbalance

pH	Some Dehydration	Severe Dehydration
<7.25	00	10
7.25-7.35	00	16
7.35-7.45	180	04

Table 6: Time Taken for Correction Of Electrolyte Imbalance After Standard Treatment

Time In Hours	Hyponatremia	Hypernatremia
<24	39	05
24-48	03	03
>48	01	02
Not corrected	00	01

Table 7: Distribution Of Cases Regarding Survival

Survival	Cases	Percentage
Yes	209	99.52%
No	01	00.48%

Survival	Cases	Percentage

DISCUSSION

The diarrheal diseases are responsible for considerable morbidity and mortality in developing world. Dehydration, acid base and electrolyte imbalance are common complications of acute diarrhoeal disease in children.[5] This is due to children exhibit major physiologic differences from adults in their total body surface area, immature renal structures, endocrine systems and higher metabolic rate. Each of these factors predisposes them to developmental variations in fluid and electrolyte balance.[6] Electrolyte disorders may remain unrecognized and result in increased morbidity and mortality. Timely recognition, a high index of suspicion and a thorough understanding of common electrolyte abnormalities is necessary to ensure their correction. The present study was undertaken, to outline the spectrum of electrolyte and acid base disturbances in children suffering from acute diarrhoea who are all admitted in paediatric ward and paediatric intensive care unit.

In our study acute gastroenteritis was more in males 120 (57.14%) as compared to females 90 (42.86%) with the ratio of 1.33:1, a finding which is similar to that reported by Ritika Ghosh Dastidar et al,[7] Srivastava et al[8] and Behera et al.[9] The type of dehydration had no significant association with gender. In the present study, acute gastroenteritis was found in 25 (11.90%), 110 (52.38%) and 75 (35.72%) of the subjects belonged to 1 month- 1 year, 1 year- 5 year and 5-14 year respectively. Maximum cases were found in the age group of 1-5 year was 110 (52.38%) and minimal cases were found in the age group of 1 month–1 year was 25 (11.90%) which was approximately similar to the study done by Ritika Ghosh Dastidar et al[7] reported acute gastroenteritis among 11.5%, 44%, and 44.5% respectively in the infants, 1-5 yrs, and >5 yrs age group. However, the results of the present study differs from those found in studies conducted by Srivastava et al[8] and Behera et al[9] which report a higher incidence of AGE in Infants. The difference may be accounted for by the fact that those with no dehydration usually not requires hospital admission were not considered. There was no significant association between age of the child and type of electrolyte abnormality.

152 (72.38%) of the subjects suffered from acute gastroenteritis live in rural area while 58 (27.62%) of the subjects had acute gastroenteritis reside in urban area, indicating more acute gastroenteritis in rural area as compared to urban area. C. Karsten et al[10] reported that urban area people had more incidence of gastroenteritis compared to the rural area, constitutes 58.83% and 41.16% respectively. This study is contrary to the present study. This can be explained but people living in urban area had better lifestyle and better hygiene maintenance as compared to the subjects of rural people. In this study conducted in tertiary care center, most of the patients seeking medical advice coming from rural area. Majority of the patients belong to MAM was 145 (69.05%). We found significant association in this study between malnutrition and diarrhoea which is similar to the other studies. Dr. Bela H Shah et al[11] showed 79% patient had malnutrition, S.K. Behara et al,[9] Deivanayagam et al[12] observed malnutrition in 89% of patients.

In our study 180 (85.71%) and 30 (14.29%) of the subjects were suffering from some and severe dehydration respectively. Most of the cases belongs to some dehydration 180 (85.71%). The findings were in contrary to study done by Mittal et al[13] who has reported 50.52%of moderate dehydration and 21.95% severe dehydration in their study. But similar with the study reported by Ritika Ghosh Dastidar et al[7] who revealed 166 (83%) of the children had moderate degree of dehydration and 34 (17%) children had severe dehydration.

Isonatremia, hyponatremia and hypernatremia was reported in 156 (74.29%), 43 (20.47%) and 11 (5.24%) of the cases respectively in the present research. Most of the patients had isonatremic dehydration 156 (74.29%). Similar findings were reported by Ritika Ghosh Dastidar et al[7] who in their study found isonatremic dehydration as the commonest 71.5%, followed by Hyponatremic dehydration 22% and Hypernatremic dehydration 6.5%. Sanatha Krishnan et al128 and Samadi et al129 reported the incidence of Hyponatremic dehydration as 25.3% and 20.8% respectively. But study conducted by Dr. Bela H Shah et al93 reported hyponatremia dehydration 62% was the predominant type of dehydration followed by isonatremic and hypernatremic dehydration was 37% and 2% respectively. Gauchan E *et al* reported that isonatremic dehydration 70.66% was the predominant one, followed by hypernatremic and hyponatremic dehydration was 19.34% and 10.00% respectively.

In the current research normal, hypokalemia and hyperkalemia was reported in 200 (95.24%), 10 (4.76%) and 0 (0%) of the cases respectively. Majority of the cases in the study had normokalemia followed by hypokalemia. Approximately similar results were shown by Ritika Ghosh Dastidar,[7] they found 170 children (85%) had normokalemia and 30 cases (15%) had hypokalemia and none of the cases had hyperkalemia. 6 cases of hyponatremia had associated hypokalemia. Dr. Bela H Shah[11] found that normokalemia is more common followed by hypokalemaia. Gauchan E et al[16] reported that 90.66% of normal potassium, 02.66% of hyperkalemia and 06.68% of hypokalemia which cannot be explained.

Normal and decreased bicarbonate level was reported in 183 (87.14%) and 27 (12.86%) of the cases respectively in the present research, all cases whose having decreased bicarbonate level having severe dehydration. Majority of the cases had normal bicarbonate level. It is contrary to the study conducted by Teuta Faik et al,[17] had more number of patients showed decreased bicarbonate level, 19.3%, 50.00%, 81.80% of mild dehydration, moderate dehydration and severe dehydration respectively. Dr. Bela H Shah et al[11] conducted a study showed that 17% cases of severe dehydration had reduction in bicarbonate level.In present study majority of patients had no acidosis, pH of about 7.35-7.45 was184 (87.62%), followed by pH was 7.25-7.35 was 16 (07.62%), <7.25 was 10(04.76%) contrary to a study by Dr. Bela H Shah et al[11] where 14% had pH <7.2, 7.2-7.3 was 79% and 7.35-7.45 was 7% more cases were in metabolic acidosis.

In the present study, 52 (81.25%) of dyselectrolytemia was corrected within 24 hours, 7 (10.94%) requires 24-48 hours, only 4 (06.25%) requires >48 hours and 1 (01.56%) patient's hypernatremia was not corrected and that patient expired, was comparable with the study conducted by Dr. Bela H Shah[11] reported 92% of hyponatremia and 81% of

hypokalemia was corrected within 24 hours of starting the therapy. Very few percent of dyselectrolytemia required treatment for 48 hours. In the present study, 209 (99.52%) patients got discharged, 1 (00.48%) child who succumbed was 9 months old girl who had convulsions, hypernatremia and was severely dehydrated. The child died within 24 hours of hospital stay Ritika Ghosh Dastidar et al[7] in their study case fatality rate was 0.005%.

CONCLUSION

Our study concluded that most common electrolyte imbalance in acute gastroenteritis was hyponatremia followed by hypernatremia and hypokalemia. Metabolic acidosis was common in severe dehydration compared to some dehydration. Our study showed monitoring of electrolyte and acid base levels to decrease morbidity, mortality in acute gastroenteritis.

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