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Original Article

Acid base and electrolyte disturbance in diarrhoea

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Abstract

Objective: The present study was undertaken to study the frequency of electrolyte imbalance in children with diarrhoea and the relationship between electrolyte abnormalities and mortality.

Materials and methods: This is a retrospective, observational hospital based study. Fifty seven children admitted to paediatric ward with diarrhoea and dehydration was evaluated for electrolyte and acid base status at presentation. The variables were analyzed using chi-square and student t- test.

Results: Majority (70%) of patients were below 2 years of age. There were 37 (65%) males and 20(35%) females. Electrolyte disturbance was observed in 46 (80%) patients while acid base disturbance was observed in all (100%) where the estimations were done. The major electrolyte disturbances noted were hyponatremia (56%), which was either isolated (26%) or associated with hypokalemia (26%). The second common abnormality was hypokalemia (46%) which was again either isolated (14%) or associated with hyponatremia (26%). About 10% patient had hypernatremia and about 3% had hyperkalemia. Twenty one (37 %) patients had mixed electrolyte imbalance. ABG analysis was performed only in 16 patients. Arterial blood gas analysis could be performed only in 16 patients. Metabolic acidosis was present in 15 (94%) while one (6%) had metabolic alkalosis. Out of 57, five patients (8.7%) expired. All of them had electrolyte abnormalities. Out of five patients who died one had isolated hyponatremia, 2 had hyponatremia + hypokalemia, while one each had hypernatremia + hypokalemia and hypernatremia+ hyperkalemia. Statistically significant mortality was observed in patients presenting with either hyponatremia or hypokalemia as compared to the group with normal electrolytes.

Conclusion: Hyponatremia, hypokalemia and metabolic acidosis are common electrolyte and acid-base abnormalities in children with diarrhoea and dehydration and often responsible for mortality.

Key words: Diarrhoea, Dehydration, Electrolytes, Acid-Base status

According to WHO estimates, in every eight seconds a child dies from a water related disease. In developing countries, 50% of paediatric hospitalization is due to acute diarrhoea[1]. Electrolyte abnormalities are common in children with diarrhoea. It may remain unrecognized and may result in raised mortality and morbidity. Timely recognition, a high index of suspicion and thorough understanding of common electrolyte abnormalities is necessary to ensure their correction. The present work was undertaken to study the common electrolyte abnormalities in diarrhoea and its impact on the mortality in hospitalized patients.

Materials and methods

This study was carried out in BP Koirala Institute of Health Sciences, Dharan, Nepal during the period April 2005 to March 2006. It was a retrospective, observational hospital based study and included 57 cases of diarrhoea in the age group below 15 years. All the patients were of severe dehydration and required intravenous fluids. Cases of dysentery were excluded from the study. However cases with features of systemic toxicity received intravenous antibiotics like ceftriaxone and gentamycin. At the time of admission, the patient's age, sex, provisional diagnoses were recorded in a data sheet. The electrolyte and acid base studies were done at admission before starting intravenous fluid. Chi-square test was used to test the significant difference in mortality in patients with normal and abnormal electrolytes. The analysis was done using EPI info version 6 statistics package.

Results

Fifty seven patients aged below 15 years presenting with diarrhoea and dehydration were evaluated for electrolyte and acid base status at admission. Majority (70%) of patients were below 2 years of age. There were 37(65%) males and 20 (35%) female. The electrolyte and acid base abnormalities are depicted in Table 1.

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The mean serum sodium was 136.9 ± 11.8 mEq/l (range of 116 -182 mEq/l). The mean serum potassium was 3.7 ± 1.12 mEq/l (range 1.8 - 7.5 mEq/l). Forty six (79%) children had some form of electrolyte abnormality while rest 11 (21%) patients had normal electrolyte levels (Table-2). The major electrolyte abnormalities noted were hyponatremia (56 %) either isolated (26%) or associated with hypokalemia (26%). The second common abnormality was hypokalemia (46%) which was either isolated (14%) or associated with hyponatremia (26%). 10% patients had hypernatremia and 3% had hyperkalemia. Twenty one (37%) patients had mixed electrolyte imbalance (Table-1). Arterial blood gas analysis was performed in 16 patients. The mean arterial pH and bicarbonate level was 7.3 ± 0.14 and 14.15 ± 6.1 mEq/l, respectively. Metabolic acidosis was present in 15 (94%) while one (6%) patient had metabolic alkalosis. Out of 57, 5 patients (8.7%) expired. All five patients had electrolyte abnormalities. The patients who died had significantly higher serum sodium, potassium and lower arterial pH and bicarbonate levels. ($p < 0.05$ each). Out of 5 patients who died, 1 had isolated hyponatremia, 2 had hyponatremia + hypokalemia, and one each had hypernatremia + hypokalemia and hypernatremia + hyperkalemia. The mortality was also analyzed in relation to electrolyte abnormalities. Out of 46 patients with abnormal electrolyte pattern 5 died while there was no death amongst 11 patients with normal electrolytes. However, statistically significant mortality was observed in patients presenting with either hyponatremia or hypokalemia as compared to the group with normal electrolytes ($p < 0.05$ each).

Table 1: Electrolyte disturbances in children with diarrhoea

Electrolyte disturbances	Survivors (%)	Died (%)	Total (%)
Isolated Hyponatraemia	14 (26.9%)	1 (20%)	15 (26.3%)
Hyponatraemia + Hypokalemia	13 (25%)	2 (40%)	15 (26.3%)
Hyponatraemia + Hyperkalemia	2 (3.8%)	0 (0%)	2 (3.5%)
Isolated Hypernatremia	2 (3.8%)	0 (0%)	2(3.5%)
Hypernatremia + Hypokalemia	2 (3.8%)	1(20%)	3(5.2%)
Hypernatremia + Hyperkalemia	0 (0%)	1(20%)	1(1.7%)
Isolated Hypokalemia	8 (15.3%)	0(0%)	8(14%)
Isolated Hyperkalemia	0 (0)	0(0)	0(0)

Table 2: Serum electrolytes and acid base status in children with diarrhoea

Parameters	Survivors (Mean ± SD)	Died (Mean ± SD)	P value
Serum sodium (mEq/l)	136.0 ± 10.3	146.2 ± 22.0	<0.05
Serum potassium (mEq/l)	3.69 ± 1.01	4.28 ± 2.08	<0.05
Bicarbonate (mEq/l)	15.65 ± 5.95	9.67 ± 4.55	<0.05
pH	7.37 ± 0.10	7.14 ± 0.11	<0.05

Discussion

An electrolyte abnormality was observed in about 80% patients presenting with diarrhoea and dehydration. The common electrolyte disturbance were hyponatremia (56%) followed by hypokalemia (46%). However, about 37% patients had mixed electrolyte disturbance. Pizzoti et al reported hyponatremia in 34% of the hospitalized patients[2]. Subba Rao and Thomas[3] reported hyponatremia in 6.9% of children admitted to paediatric intensive care unit. However, the authors did not include children with diarrhoea in their study. The pathogenesis of hyponatremia in diarrhoea is due to a combination of sodium and water loss and water retention to compensate the volume depletion. However, most fluid that is lost in diarrhoea has a lower sodium concentration. So patients with only fluid loss may have hypernatremia[4]. This may be the reason of hypernatremia observed in some of our patients. The alternative explanation for hypernatremia could be due to inadequate free water intake or increased sodium intake through improperly prepared oral rehydration solution. The incidence of hypokalemia was much higher in the present study as compared to other reports where the authors observed hypokalemia frequency of around 14%[5,6]. However, the authors have included a variety of conditions

including diarrhoea in their study. In diarrhoeal disease, the same authors[7] observed hypokalemia in only 20% cases. In almost all the patients, arterial blood gas analysis showed metabolic acidosis. This is due to gastrointestinal loss of bicarbonate in diarrhoea. The hypokalemia noted in our patient could be due to increased potassium loss through diarrhoea. The bicarbonate loss is also partly responsible for hypokalemia in those patients. The present study showed significant mortality in patients presenting with hypokalemia and hyponatremia as compared to children with normal electrolytes. Other workers also reported 3-3.5 times increase in risk of mortality in patients with hyponatremia when compared to those with normal sodium levels[7, 8].

To conclude, hyponatremia, hypokalemia and metabolic acidosis are common electrolyte and acid-base abnormalities in children with diarrhoea and dehydration and often responsible for mortality.

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