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Electrolyte disturbances during vomiting in pediatrics under 2 years old

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Abstract

Objectives: to demonstrate the electrolyte disturbances in vomiting among children under 2 years who attend Al-Batool teaching hospital in Diyala governorate.

Patients and methods: This is a cross sectional study. It was conducted in the period from October 2022 to March 2023. We collected a sample of 80 patients who attend Al-Batool teaching hospital. Every infant under 2 years with repeated vomiting old was eligible for study and we excluded the patients who were older. We collected informations about age, baby gender, duration of vomiting, baby weight, the serum electrolyte levels (Na, K, Cl and HCO3), and the mode of feeding.

Results: 80 children with vomiting were enrolled in the study. 54 (68%) were males and 26 (32%) were females. Their mean age was 9.6 months with upper limit of 20 months and lower limit of one month. frequency of hyponatremia was 36% children while hypernatremia was observed in 40% children with Acute gastroenteritis. Hypokalemia was found to be present among 20% children while hyperkalemia was found in 40% of the cases, Hyperchloremia was observed in 12% of the cases, hypochloremia was observed in 52% of the cases. 56% had decrease in their serum bicarbonate and 28% has an increase.

Conclusion: electrolyte disturbances in pediatrics represent serious issue due to its lethal effect on their health.

Introduction

Electrolytes are involved in many homeostatic and metabolic functions that include biochemical and enzymatic reactions to maintain hormone function, cardiovascular function, cell membrane and structure-function, nerve signal conduction, neurotransmission, muscle contraction, fluid and acid-base regulation, and bone composition. Abnormalities of electrolytes associated with the appearance of signs and symptoms should be monitored in patients with electrolyte disturbances. These symptoms are related to disorder severity and rate of disorder development [1].

Vomiting is a complex reflex that leads to the forceful expulsion of stomach contents through the mouth and requires the coordination of the gastrointestinal, musculoskeletal, and nervous systems. Many structures are involved in the vomiting process. These include the emetic center located in the reticular formation of the medulla oblongata, the chemoreceptor trigger zone located on the floor of the fourth ventricle within the brain, and the vagal and sympathetic neurons stimulated by receptors in the abdominal viscera. Activation of the vomiting reflex can occur for many reasons. These include local or systemic inflammation, irritation, distention, hypertonicity, emetogenic substances including toxins and medications (eg, apomorphine, nonsteroidal anti-inflammatory drugs, some antineoplastic agents), and impulses that arise from the vestibular center because of motion sickness [2,3].

Vomiting produces dehydration, metabolic alkalosis, and hypokalemia. One to two liters of stomach secretions containing up to 150 MEq of hydrogen and sodium ion per liter and an isoelectric quantity of chloride ion are produced each day. Distention increases the volume of gastric secretion. During vomiting episodes, bicarbonate ion generated by gastric acid production remains in the

vascular space and initiates metabolic alkalosis. Vomiting decreases intravascular volume and increases reabsorption of sodium and water by the proximal renal tubule. Since the intravascular concentration of bicarbonate is increased relative to chloride, high concentrations of bicarbonate are delivered to the kidney. Bicarbonate is reabsorbed as the major anion accompanying sodium throughout the renal tubule, and alkalosis is maintained. Increased tubular concentrations of bicarbonate and increased reabsorption of sodium in the distal tubule promote potassium loss in the urine [4,5].

Expelling the gastric acid contents causes the loss of chloride and hydrogen ions which can lead to hypochloremic metabolic alkalosis, where there are high levels of bicarbonate and carbon dioxide but low levels of chloride, leading to an increased blood pH. In addition, there may be a low level of potassium (hypokalemia). Another problem is that vomiting makes it very difficult to both consume foods and fluids and to keep them down. This further aggravates the electrolyte depletion and deficiencies, worsening the condition [6].

Both gastric and intestinal fluid losses can result in hypernatremia because in each instance, the fluid lost has sodium + potassium concentrations far lower than serum (Secretory diarrheas are notable exceptions, in which fluid losses are usually equivalent to serum in sodium + potassium concentrations). Examples include acquired viral enteritis, iatrogenic diarrhea (lactulose, charcoal, antibiotic-induced), and chronic nasogastric suctioning. Isotonic fluid replacement does not provide sufficient solute-free water, potentiating the issue [7].

Although vomiting can cause fluid loss directly from gastrointestinal tract, potassium depletion in this setting is primarily due to increased urinary losses from the fact that concentration of potassium in gastric secretions is only 5 to 10 mEq/L. Loss of gastric acid induces metabolic alkalosis and high plasma bicarbonate level.

Water and sodium bicarbonate are transported to the distal potassium secretory site. In addition, hypovolemia from vomiting induces increase in aldosterone release. These 2 effects increase renal potassium loss in the urine and cause hypokalemia [8].

Severe vomiting may lead to the most disproportionate loss of chloride compared to sodium since gastric chloride content is greater than 100 mEq/L and gastric sodium content is relatively low (20 to 30 mEq/L). In individuals with protracted vomiting or nasogastric suction, the serum sodium concentration may be only mildly depressed (130 mEq/L), whereas the serum chloride concentration is usually markedly lowered (80 to 90 mEq/L). The most reduced levels of serum chloride (range 45 to 70 mEq/L) are associated with pernicious forms of vomiting due to gastric outlet obstruction, protracted vomiting in alcoholics, or self-induced vomiting. Individuals with hypochloremia secondary to total body chloride depletion will have physical findings that indicate ECF volume contraction (e.g., hypotension, tachycardia, and orthostatic changes in blood pressure) [9].

Aims

To demonstrate the electrolyte disturbances in vomiting among children under 2 years who attend al-batool teaching hospital in Diyala governorate.

Patients and methods

This is a cross sectional study. It was conducted in the period from October 2022 to March 2023. We collected a sample of 80 patients who attend Al-Batool teaching hospital. Every infant under 2 years with repeated vomiting old was eligible for study and we excluded the patients who were older. We collected informations about age, baby gender, duration of vomiting, baby weight, the serum electrolyte levels (Na, K, Cl and HCO3), and the mode of feeding. We used the normal ranges (GENEX®) below to determine the increase and decrease in electrolytes.

- Na 147 (126-166) (mEq/L)
- K 7.8 (5.6-12) (mEq/L)
- Cl 103 (98-110) (mEq/L)
- HCO3 20 (16-24) (mEq/L)

we collected the informations using prepared written questionnaire and by direct interview with the mothers. We preserved the privacy and we coded the patients for the reasons of confidentiality and risk of bias.

Statistical analysis

SPSS Version 80 was used for the description of the data. We expressed the quantitative data by arithmetic mean, standard deviation and mode and the qualitative data by frequencies.

Results

80 children with vomiting were enrolled in the study. 54 (68%) were males and 26 (32%) were females. Their mean age was 9.6 months with upper limit of 20 months and lower limit of one month. Their age groups is demonstrated in table 1.

Table 1. age groups

Age groups	Frequency	Percent
Up to 6 months	32	40.0
6-12 months	19	24.0
12-18 months	23	28.0
18-24 months	6	8.0
Total	80	100.0

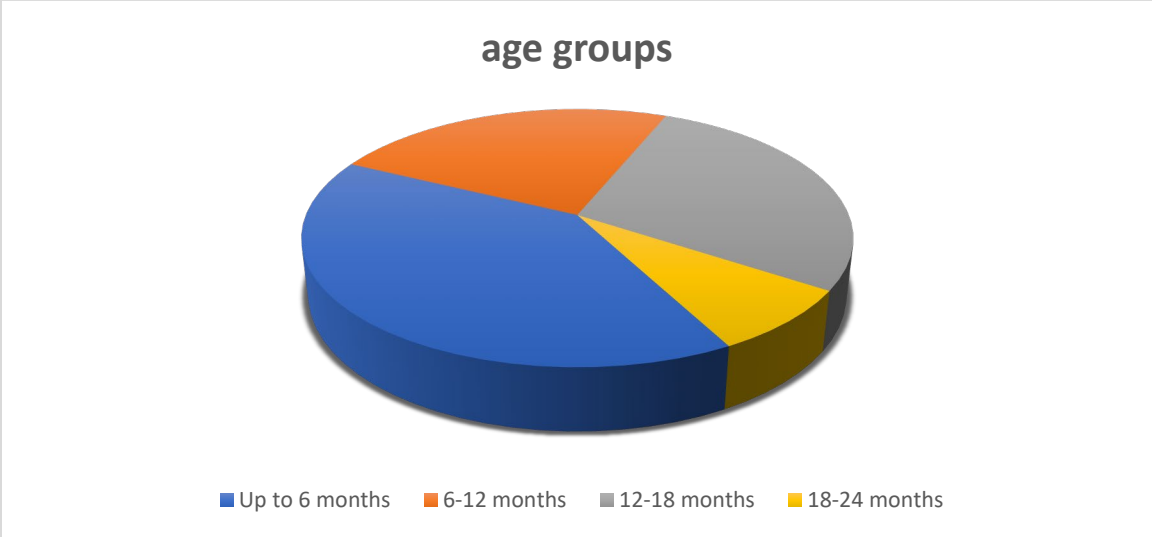

Figure 1. age groups

76% of them live in rural areas and 24% of them live in urban areas. Their mode of feeding is demonstrated in table 2.

Table 2. mode of feeding

Mode	Frequency	Percent
Breastfeeding	22	28.0
Bottle feeding	45	56.0
Mixed feeding	13	16.0
Total	80	100.0

Their serum electrolyte levels are demonstrated in table 3.

Table 3. electrolyte levels

Electrolyte	Normal	Increased	Decreased
Sodium	19 (24%)	29 (36%)	32 (40%)
Potassium	32 (40%)	32 (40%)	16 (20%)
Chloride	29 (36%)	10 (12%)	41 (52%)
Bicarbonate	13 (16%)	22 (28%)	45 (56%)

Table 4. distribution of electrolyte imbalance among the age groups

Electrolytes		Age groups				Total
		Up to 6 months	6-12 months	12-18 months	18-24 months	
Na+	Normal	0	10	7	3	20
	Increased	19	0	6	3	28
	Decreased	13	13	6	0	32
Total		32	23	19	6	80
K+	Normal	13	13	3	3	32
	Increased	13	6	10	3	32
	Decreased	6	0	10	0	16
Total		32	19	23	6	80
HCO3	Normal	0	3	10	0	13
	Increased	13	6	0	3	22
	Decreased	19	10	13	3	45
Total		32	19	23	6	80
Cl-	Normal	13	10	3	3	29
	Increased	6	0	3	0	9
	Decreased	13	10	16	3	42
Total		32	20	22	6	80

Discussion

The loss of fluid in vomiting disorders is also associated with loss of many electrolytes. The later mainly includes sodium, potassium and bicarbonate. The amount of loss of these electrolytes is influenced by the amount and type of fluid lost from the body by the kidneys. In addition to this the overwhelming infection associated with vomiting might affect other organ systems.

Newborns and infants because of their immature immunological response are particularly susceptible to infection especially if they are not breast fed. Moreover, they are easily prone to dehydration and electrolyte imbalance because of greater water content, large turnover and increased insensible water loss from their body [10].

In this study, we noted that 68% children with vomiting were males. This is consistent with the findings of an Indian study where authors revealed 65% cases of acute gastroenteritis to be male [11].

We noted frequency of hyponatremia to be 36% children while hypernatremia was observed in 40% children with AGE (Acute gastroenteritis). Hypokalemia was found to be present among 20% children while hyperkalemia was found in 40% children with AGE. Pratima P et al analyzing children with AGE to be present in 62.5% children while no cases of hypernatremia were reported in that study.

Hypokalemia was observed in 26.5% children [12] Ukarapol N et al evaluating children with digestive tract manifestations found hyponatremia to be present in 17% children while hypernatremia, hypokalemia and hyperkalemia was noted in 9.4%, 22.6% and 3.8% respectively [13]. Hyperchloremia was observed in 12% of

the cases, hypochloremia was observed in 52% of the cases. 56% had decrease in their serum bicarbonate and 28% has an increase.

Conclusion

Frequency of electrolyte abnormalities was found to be high among children with vomiting especially in acute gastroenteritis. Timely identification and treatment of children presenting with acute gastroenteritis coupled with electrolyte abnormalities needs to be done to reduce the morbidity and mortality associated with these diseases.

The electrolyte disturbances among children represent serious continuous problems that could be resolved by correct management. There is high percentage of electrolyte disturbances among children with vomiting which can be life threatening.

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