

Evaluation of serum potassium level in pediatric gastroenteritis at children-welfare teaching hospital

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Abstract

Objective To measure the incidence of the hypokalemia in children who suffered from acute gastroenteritis and to estimate their complications.

Methods A prospective clinical study enrolled 153 patients from January 1, 2017 to December 1, 2017, at the Children-Welfare Teaching Hospital and included children from 1 to 5 years who are firstly admitted to the emergency department, then to the pediatric wards who suffered from acute gastroenteritis and their serum potassium levels were below 3.5 mmol/l. We excluded the children with chronic diarrhea or bloody diarrhea or with any nutritional diseases, like marasmus disease, kwashiorkor or iron-deficiency anemia disease or parenteral diarrhea, like pneumonia, urinary tract infection, or their ages either below 1 year or more than 5 years. The study depends on history, physical examination and serial serum potassium levels.

Results A total of 153 patients with acute gastroenteritis were included in the study. 91 male patients, 62 female patients with male to female ratio of 1.4:1. The majority of the patients were from urban areas. In this study, 61 (39%) of patients with acute gastroenteritis were complicated by hypokalemia, 92 (61%) were not. Of those with a severe dehydration, 11 (23%) had mild hypokalemia, 17 (36%) moderate, 19 (41%) a severe one. Of patients with a moderate dehydration, 7 (50%) had mild hypokalemia, 5 (38%) moderate, 2 (15%) a severe one. Concerning the main complaint, 65 (44%) had both diarrhea and vomiting, 61 (39%) had only diarrhea, 28 (17%) had only vomiting. According to degree of dehydration, there were 72 (47%) with moderate dehydration, 81 (53%) with a severe dehydration. UOP is poor in 70 with a severe dehydration, and 21 with a moderate dehydration, and is good in 8 with moderate dehydration, 53 with a severe dehydration. The percentages of the complications were: 51 (83%) had generalized weakness, 10 (17%) had both generalized weakness and paralytic ileus.

Conclusions Children with acute gastroenteritis were complicated by hypokalemia 61 (39%) paralytic ileus. Diarrhea and vomiting were the commonest complaint of acute gastroenteritis.

Keywords Serum potassium, Hypokalemia, Pediatric gastroenteritis.

Introduction

Hypokalemia is defined as serum potassium level less than 3.5 mEq/l, and is divided into mild when the level is between 3 and 3.5 mmol/l, and moderate when the level is between 2.5 and 3 mmol/l, and severe when the level is less than 2.5 mmol/l. The main cause of hypokalemia in pediatric patients is diarrhea.¹

The clinical manifestations involve changes to the muscles and bowel and cardiovascular system. Mild to moderate hypokalemia is associated with generalized weakness, and severe hypokalemia is associated with generalized weakness & paralytic ileus because of slowing of the gastrointestinal motility.²

Most causes of hypokalemia are readily apparent from the history. It is important to review diet history, gastrointestinal losses, and medication. Concomitant electrolytes abnormalities are useful clues to the combinations of hypokalemia and metabolic acidosis is characteristic of diarrhea or of distal and proximal renal tubular acidosis and a concomitant metabolic alkalosis is characteristic of emesis or nasogastric losses or aldosterone excess or use of the diuretics.³

This study is done to identify the rate of the hypokalemia in children with an acute gastroenteritis, and to compare the incidence of complications (generalized weakness & generalized weakness with paralytic ileus), with a degree of the dehydration. To identify the incidence of acute gastroenteritis in a respect to age group, residence, socioeconomic status, educational status of both parents.

Patients and methods

A prospective clinical study enrolled 153 patients from January 1, 2017 to December 1, 2017, at the Children-Welfare Teaching Hospital and the data were collected at specific days of a week, at the day time. Most of them done by me and the rest by my colleagues.

A study was conducted including the children from 1 to 5 years who suffered from acute gastroenteritis and their serum potassium levels were below 3.5 mmol/l. We excluded the children with chronic diarrhea or bloody diarrhea or with any nutritional diseases, like marasmus disease, kwashiorkor disease or iron deficiency anemia or parenteral diarrhea, like pneumonia, UTI, or their ages either below 1 year or more than 5 years.

Firstly, the children were admitted to the emergency department and were diagnosed as acute gastroenteritis (<14 days duration of illness) by history (diarrhea & vomiting, or only diarrhea, or only vomiting), physical examination (general examination, skin turgor, mucous membrane, tears, UOP), with investigations (CBC & differential count, renal function tests, RBS, GSE, GUE), and the following electrolytes (Na, K, CL, the samples were drawn by a nursing staff), and were treated by rehydration either by ORS or intravenous fluid. Then who were indicated for admission at pediatric wards, were followed on daily base to measure their potassium levels, and their main complications which were either generalized weakness or both generalized weakness and paralytic ileus.

The generalized weakness was diagnosed by history (easy fatigability, poor physical activities), physical examination (poor muscle tone, walking test, reflexes), and the paralytic ileus was diagnosed by history (decrease bowel motion, vomiting), physical examination (abdominal distension, decrease bowel sounds), with a plain X-ray of abdomen, and sometimes CT-scan of abdomen.

In collecting the data, I firstly depend on the verbal contents of the parents to include the patients in the study, and then a questionnaire was filled.

About the residence, a study was divided into urban (inside Baghdad city), and rural (outside Baghdad city, from different villages), about the onset of gastroenteritis (acute that is less than 14 days), the severity of dehydration (moderate: lethargic patient, capillary refill 2–4 sec, dry mucous membrane, decreased tears, increased heart rate, increased respiratory rate, thready pulse, slow skin turgor, depressed fontanel, sunken eyes, decreased UOP, and severe: obtunded patient, more than 4 sec capillary refill, very dry mucous membrane, absent tears, more increase in heart rate and respiratory rate than moderate dehydration, impalpable pulse, tenting skin turgor, sunken fontanel, very sunken eyes, very decreased UOP), and about the UOP (poor is less than 0.5 ml/kg/hr, and good is 2 ml/kg/hr, but I depend on asking a mother about the napkin of a patient if it is filled of urine or not or the frequency and amount of urine if a patient can use the WC), about the socioeconomic status (I depend on the following criteria to divide families into good, fair, poor: education and occupation of parents, family income, cleanliness and general hygiene, own house or rent, gromal index {number of members, number of rooms}, source of water, sewage disposal, domestic animals).

Then the data were enrolled in tables and figures and *p*-value was calculated according to the Fisher exact test by the (Chi-square), and the peak age and mean age are calculated.

Results

A prospective clinical study of 153 patients with acute gastroenteritis between 1 and 5 years were admitted to Children-Welfare Teaching Hospital from January 1, 2017 to December 1, 2017. The peak age was 3 years, and the mean age was 3 ± 1 years old. Regarding the sex distribution, there were 91 (59%) males and 62 (41%) females, and the male to female ratio was 1.4:1. Regarding the residence of the patients, there were 90 (78%) came from the urban areas, and 63 (42%) came from the rural areas. Regarding the socioeconomic status and the occurrence of the gastroenteritis, there were 40 (26%) with a good status, and 50 (32%) with a fair status, and 63 (42%) with a poor. Regarding the educational status of the parents and the occurrence of the gastroenteritis, there were 63 (42%) with high educational study, and 47 (31%) with high school study, and 30 (19%) with primary school study, and only 13 (8%) with illiterate. Regarding the complaints of the gastroenteritis and the age, the most common complaint was diarrhea & vomiting 65 (44%), with a more significant *p*-value that was 0.03, and only diarrhea 61 (39%), with a significant *p*-value, that was 0.05, and lastly only vomiting 27 (17%), with a non-significant. Regarding the degree of the dehydration and the age, there were 81 (53%) with severe degree and the *p*-value was significant (0.04), and there were 72 (47%) with a moderate dehydration and the *p*-value was non-significant as shown in Table 1.

Regarding of the urine output, and the degree of dehydration, there were (70) with a poor UOP, severe dehydration, with a significant *p*-value (0.02), and there were 21 with a poor UOP, moderate dehydration, with a significant *p*-value (0.03), and there were 8 with a good UOP, severe dehydration, with a non-significant *p*-value, and 54 with a good UOP, moderate dehydration, with a non-significant *p*-value, as shown in Table 2.

Table 1. Distribution of degree of dehydration and age group.

Dehydration	1 year–2 year		2 year–3 year		3 year–4 year		4 year–5 year		Total		<i>p</i> -value
	No.	%	No.	%	No.	%	No.	%	No.	%	
Severe	29	35	31	38	11	13	10	14	81	53	0.04 **
Moderate	30	42	28	38	9	12	6	8	72	47	0.1*

*= non-significant **= significant.

Table 2. Urine output and dehydration.

UOP	1 year–2 year		2 year–3 year		3 year–4 year		4 year–5 year		Total of UOP		<i>p</i> -value
	No	%	No	%	No	%	No	%	No	%	
Poor UOP & Severe dehydration	21	31	29	42	11	15	9	12	70	86	0.02***
Poor UOP & Moderate dehydration	6	29	5	23	6	29	4	19	21	24	0.03**
Good UOP & Severe dehydration	3	37	3	37	1	13	1	13	8	11	0.5*
Good UOP & Moderate dehydration	24	46	16	29	8	14	6	11	54	89	0.9*

*= non-significant **= significant ***= most significant.

Regarding the occurrence of the hypokalemia and the acute gastroenteritis, there were 61 (39%), complicated with a hypokalemia, and there were 92 (61%) who were not complicated with a hypokalemia. Regarding the degree of the hypokalemia and dehydration, there were 11 (23%), with mild hypokalemia, 17 (36%), with moderate hypokalemia, 19 (41%), with a severe hypokalemia, and severe dehydration respectively, the *p*-value was significant (0.01). There were 7 (50%) with a mild hypokalemia, 5(35%) with a moderate, and 2 (15%) with a severe one respectively, the *p*-value was a non-significant as shown in Table 3.

Regarding the complications of the hypokalemia (generalized weakness and paralytic ileus) and the age, there were 51 (83%), with generalized weakness, the *p*-value was significant (0.03). There were 10 (17%) with a paralytic ileus, the *p*-value was non-significant (0.07), as shown in Table 4.

Regarding the degree of the dehydration, and the main complications of the hypokalemia, there were 41 (80 %) with a severe degree of the dehydration and the generalized weakness, the *p*-value was significant (0.02), and 10 (100%) with both generalized weakness and paralytic ileus, the *p*-value was non-significant (0.8). The moderate degree of dehydration was 10 (20%) with a generalized weakness, the *p*-value was non-significant (0.9), and no paralytic ileus.

Discussion

In this study, the peak age for acute gastroenteritis was 3 years and the mean age was 3.15years, and this finding is close to John¹ who found that the peak age is 2.5 years and also by Danial² (2.7 years) but, is relatively more than that reported by Weisberg¹⁰ who found that peak age (2 year).

Male to female ratio was (1.4:1) and this agree with Corral⁴ who found male to female ratio (1.4:1) and also Schaefer¹³ who found the same ratio but is relatively different from a study done by Begum¹⁴ who found 1.8:1. This difference is because of a number of cases that were included in his study (1051), where my study was only 153.

Acute gastroenteritis is more common in urban areas [90 (78%)] than rural areas [63 (42%)]. This agrees with Mirza⁶ who found the same results and differs from Adam¹⁵ who found that acute gastroenteritis is more common in rural areas than urban areas. This difference is because of the pollution that is more at the urban areas than the rural areas.

Regarding the socioeconomic status, there was 40 (26%) with good, 50 (32%) with fair and 63 (42%) with poor. This agrees with Aude¹⁹ and differs from Leuhardil⁹ who found that most of the patients belong to the families with a good

Table 3. Distribution of degree of hypokalemia and dehydration.

	Degree of hypokalemia						Total of hypokalemia		Total of dehydration		<i>p</i> -value
	Mild		Moderate		Severe		No	%	No	%	
Dehydration	No	%	No	%	No	%	No	%	No	%	
Severe	11	23	17	36	19	41	47	77	81	53	0.01**
Moderate	7	50	5	35	2	15	14	33	72	47	0.5*

*= non-significant **= significant.

Table 4. Distribution of main complication and age group.

Complication	1 year–2 year		2 year–3 year		3 year–4 year		4 year–5 year		Total		<i>p</i> -value
	No.	%	No.	%	No.	%	No.	%	No.	%	
G. weakness	21	43	19	37	7	13	4	7	51	83	0.03**
Generalized weakness & Paralytic ileus	4	40	3	30	2	20	1	10	10	17	0.07*

*= non-significant **= significant.

Table 5. Distribution of degree of dehydration and complication.

Severe dehydration and complications	>1 year–<2 year		>2 year–<3 year		>3 year–<4 year		>4 year–<5 year		Total		<i>p</i> -value
	No.	%	No.	%	No.	%	No.	%	No.	%	
Generalized weakness	18	43	15	36	4	10.5	4	10.5	41	80	0.02**
Generalized weakness & Paralytic ileus	7	70	2	20	1	10	zero	zero	10	100	0.8*
Moderate dehydration and complications	No.	%	No.	%	No.	%	No.	%	No.	%	
Generalized weakness	4	40	3	30	2	20	1	10	10	20	0.9*
Generalized weakness & Paralytic ileus	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero

*= non-significant **= significant

status. This difference is because of the socioeconomic difference between the areas of the studies.

With regard to educational status, there was 63 (42%) with high-educational study, 47 (31%) with high school study, 30 (19%) with primary school study, and only 13 (8%) with ignorance. This agrees with Lee¹⁷ and differs from Hollander¹¹ who found that most of the patients have parents with a low educational status.

Diarrhoea was seen in 61 (39%) and vomiting was 27 (17%), both diarrhoea and vomiting in 64 (44%). This agrees with John¹ and Kayleen⁵ and slightly differs from Begum¹⁴ who found that the most common complaint was diarrhoea, and this difference is because of the different causative agents for acute gastroenteritis.

Dehydration was severe in 81 (53%) and moderate in 72 (47%), and this agrees with Danial² and Memon¹⁸ and differs from Weisberg⁹, who found that a moderate dehydration is more common than severe one. This difference is because of the different weather areas in that my study is in subtropical area, and Weisberg's study is in cold area.

Urine output was poor in 70 (86%) with a severe dehydration, 21 (24%) with a moderate dehydration. Urine output was good in 8 (11%) with a severe dehydration, 54 (89%) with a moderate dehydration. This agrees with Miraz⁶ and Corral⁴ and differs from Geunari¹² who found that most of the patients have good UOP.

Regarding hypokalemia and gastroenteritis, there were 61 (39%) with hypokalemia and 92 (61%) without hypokalemia. This agrees with Kayleen⁵ and Goldman⁷ and differs slightly from Schaefer¹³ who found that the incidences of gastroenteritis with hypokalemia and without hypokalemia are same. This

difference is because of the different methods of collecting the samples and the machines that were used to measure the potassium level.

Regarding types of hypokalemia, there were 11 with a mild, 17 with a moderate, and 19 with a severe hypokalemia with a severe dehydration, whereas 7 with a mild, 5 with a moderate, 2 with a severe hypokalemia and a moderate dehydration. This agrees with John¹ and slightly differs from Begum¹⁵ who found that the most common type was moderate hypokalemia.

About the age and the complications, there were 51 (83%) with generalized weakness, 10 (17%) with generalized weakness and paralytic ileus. This agrees with Danial², Amon¹⁶ and slightly differs from Weisberg⁹ who found that the incidences of both complications were the same. This difference is because of the different age group of the samples that were collected.

Regarding the severe dehydration and the complications, there were 41 (80%) with a generalized weakness and 10 (100%) were generalized weakness with paralytic ileus. The moderate dehydration and generalized weakness were 10 (20%) and generalized weakness with paralytic ileus (0). This agrees with John¹ and Danial² and differs slightly from Goldman⁷.

Conclusions

The gastroenteritis is usually affecting young infants with little more incidences in males than females and more in urban areas than rural areas.

The children with acute gastroenteritis will complain of hypokalemia in about one-third of total numbers of the patients.

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