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ORIGINAL ARTICLE

Evaluation of Electrolyte Imbalance and Blood Gas Parameters in Patients Who Had Rotavirus Gastroenteritis

Rotavirus Gastroenteriti Olan Hastalarda Elektrolit Dengesizliği ve Kan Gazı Parametrelerinin Değerlendirilmesi

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ABSTRACT

Aim: In the present study, the cases admitted to the hospital because of acute gastroenteritis and diagnosed with common rotavirus gastroenteritis were evaluated in terms of demographic, epidemiological, clinical and laboratory data.
Methods: The clinical and laboratory data of the cases who applied to Pediatric Emergency Clinic of Selçuk University Faculty of Medicine because of acute gastroenteritis aged 0-18 were evaluated retrospectively in the study. Clinical findings, time of admission, place of observation, blood gas and electrolyte levels, electrolyte imbalance, and length of hospital stays of the patients were recorded.
Results: Among the acute gastroenteritis patients who were included in the study, 148 (61.2%) were male and 94 (38.8%) were female. The incidence of hypokalemia in patients who had rotavirus (+) gastroenteritis was statistically significant. Statistically significant differences were detected between the groups in terms of creatinine, potassium and albumin values of biochemical parameters. When the blood gas analyzes of the patients with acute gastroenteritis were evaluated; While acidosis was detected in 24 (9.9%) patients, alkalosis was found in 27 (11.2%) patients. The mean pH value of the patients was found as 7.39±0.05. There was a statistical difference between the rotavirus (-) and rotavirus (+) gastroenteritis groups in terms of pH values (p: 0.015).
Conclusion: Cases with metabolic acidosis in rotavirus gastroenteritis are hospitalized more frequently, and for this reason, blood gas studies in cases of rotavirus gastroenteritis will guide clinicians.

Keywords: Pediatric, rotavirus gastroenteritis, blood gas

ÖZ

Amaç: Bu çalışmada akut gastroenterit nedeniyle hastaneye başvuran ve yaygın rotavirüs gastroenteriti tanısı konulan olgular demografik, epidemiyolojik, klinik ve laboratuvar verileri açısından değerlendirildi.
Yöntemler: Çalışmada Selçuk Üniversitesi Tıp Fakültesi Çocuk Acil Kliniğine akut gastroenterit nedeniyle başvuran 0-18 yaş arası olguların klinik ve laboratuvar verileri retrospektif olarak değerlendirildi. Hastaların klinik bulguları, başvuru zamanı, gözlem yeri, kan gazı ve elektrolit düzeyleri, elektrolit dengesizliği ve hastanede kalış süreleri kaydedildi.
Bulgular: Çalışmaya alınan akut gastroenterit hastalarının 148'i (%61,2) erkek, 94'ü (%38,8) kadın idi. Rotavirüs (+) gastroenteriti olan hastalarda hipokalemi insidansı istatistiksel olarak anlamlıydı. Biyokimyasal parametrelerin kreatinin, potasyum ve albümin değerleri açısından gruplar arasında istatistiksel olarak anlamlı fark saptandı. Akut gastroenteritli hastaların kan gazı analizi değerlendirildiğinde; 24 (%9,9) hastada asidoz saptanırken, 27 (%11,2) hastada alkaloz saptandı. Hastaların ortalama pH değeri 7,39±0,05 olarak bulundu. Rotavirüs (-) ve rotavirüs (+) gastroenterit grupları arasında pH değerleri açısından istatistiksel olarak fark vardı (p: 0,015).
Sonuç: Rotavirüs gastroenteritinde metabolik asidozlu olgular daha sık hastaneye yatırılmaktadır ve bu nedenle rotavirüs gastroenterit gastroenterit olgularında kan gazı çalışmaları klinisyenlere yol gösterici olacaktır.

Anahtar kelimeler: Çocuk, Rotavirüs gastroenteriti, Kan gazı

Introduction

Acute Gastroenteritis (AGE) is a serious global public health problem and causes approximately 2 million deaths annually, especially among children under the age of five (1). It is a problem that still maintains its importance because it is the most common cause of mortality and morbidity after lower respiratory tract infections. Detecting acute gastroenteritis agents is important in terms of treatment and prognosis (2). Viral agents are responsible for 30-40% of childhood diarrhea, and rotavirus is the most common cause of AGEs in children worldwide. According to WHO, approximately two million children die from AGE every year, especially in developing countries; and it is estimated that 600.000 of these deaths are caused by rotavirus infections (2). Unlike other agents causing Acute Gastroenteritis, rotavirus positif (RV+) gastroenteritis (GE) is seen with the same frequency in developed and developing countries, regardless of socioeconomic conditions and hygiene measures (3). Although mortality is low in developed countries, the morbidity rate is high. Infection requires hospitalization at a rate of 20-60% in developed countries (4). Almost every child is infected with RV before the age of 5 years. In our country, acute gastroenteritis affects more than 350,000 children annually, and studies have revealed that RV is responsible for 30-50% of diarrhea in children

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under 5 years of age, and especially for 6-28% of childhood gastroenteritis cases of group a RV (5).

The clinical manifestation of RV(+) GE is variable in children. It can be asymptomatic, but it is important as it also causes life-threatening complications with severe diarrhea, vomiting, and abdominal pain, which cause epidemics from time to time. RV causes severe dehydration at a higher rate than other viral pathogens (6). It is possible to face electrolyte irregularities, high urea, and metabolic acidosis in laboratory values in patients who had dehydration. Babies and toddlers who are younger than 6 months are especially susceptible to fluid and electrolyte losses. This is because of the extracellular fluid that plays a greater role in the volume balance of the body (7).

Emergency and intensive care units use blood gases as an indispensable part of the evaluation of the clinical condition of patients (8). These tests are very useful in the emergency department in clarifying and following the causes of shock. Monitoring blood gases and evaluating lactate in emergency patients resulted in lower mortality outcomes when compared to patients treated with standard methods (8).

Blood gas and electrolyte values result in an average of 60-90 minutes as a standard in the biochemistry laboratory in the emergency departments, and therefore, rapid corrective treatments depending on electrolyte values in emergency cases are delayed (9). Electrolyte measurements with blood gas analysis are used in patients who present with severe/fatal arrhythmias because of electrolyte disorders e.g. hyperkalemia, to measure electrolyte values as they result in approximately two minutes (10). Since all measurements are completed in a short time in the blood gas analyzer, it is the most important advantage of having fast results and making an early diagnosis.

In the present study, the cases admitted to the hospital because of acute gastroenteritis and diagnosed with RVGE were evaluated in terms of demographic, epidemiological, clinical, and laboratory data. It was also aimed to examine the changes in blood gas parameters of patients who were diagnosed with RV diarrhea to obtain auxiliary parameters for serological tests to be used in the diagnosis and treatment, and compare the duration of hospitalization and emergency observation room.

Materials and Methods

Patient Group

The clinical and laboratory data of the cases who were aged 0-18 and admitted to the Department of Pediatrics, and Pediatric Emergency Clinic of Selçuk University Faculty of Medicine, between January 2015 and January 2020 because of acute gastroenteritis were evaluated retrospectively in the study. The study included 162 patients with RV (+) gastroenteritis and 80 pediatric patients with RV (-) gastroenteritis. The inclusion criteria were that the patient was between the ages of 0-18 and that the patients had diarrhea for 14 days or less. Patients with chronic disease, patients with diarrhea lasting longer than 14 days, and patients with diarrhea but whose blood gas parameters were not measured were excluded from the study.

The gender, age, clinical findings, breastfeeding duration, time of admission, seasonal distribution, chronic diseases, place of observation, blood gas and electrolyte levels, electrolyte imbalance and length of hospital stays of the patients were recorded in the data recording form. Those who did not have stool examination, patients who had deficient blood gas and electrolyte tests, and patients who had chronic diarrhea were not included in the study.

Acute gastroenteritis patients were divided into 2 groups as rotavirus positive and negative. According to the age groups of the patients, they were divided into 5 groups as 0-24 months, 25-60 months, 61-120 months, 121-180 months and >180 months. The patients were further divided into three groups according to the place of observation as emergency observation, hospitalization and intensive care unit.

Laboratory Data

The hematological and biochemical parameters, acute phase reactants, blood gas, and stool examination results of the patients at the time of admission were recorded. White Blood Cell Count (WBC), Hemoglobin (Hgb), Platelet Count (Plt), Absolute Neutrophil Count (ANC), Absolute Lymphocyte Count (ALC) and Mean Platelet Volume (MPV) were recorded. The blood gas parameters of the patients were pH, pCO2, paO2, HCO3, base excess, lactate value, Na, K, Cl, urea, creatinine, ALT, AST and albumin values were analyzed as biochemistry parameters. 4.3-10.3 K/uL for WBC, 12.9-18.1 g/dl for Hgb, 37.7-53.7 % for HCT, 81-96 fl for MCV, 142- 424 K/uL for PLT, 0.10-0.41 % for PCT, 6.8-10.68 fl for MPV, 137-144 mmol/L for Na, 3.7-4.9 mmol/L for K, 101-109 mmol/L for Cl, K, 3,5-5,2 g/dL for albumin, <45 U/L for ALT and <50 U/L for AST were considered within the normal range (11). For pH in blood gas analysis, 7.35-7.45, for PCO2, 38-55 mmHg; for PaO2, 83-108 mmHg; for HCO3, 21.2-28.3 mmol/L; for base excess, -3.2-2.7 mmol/L; for lactate, ≤2 mmol/L was considered normal.

The complete blood count samples of the patients were examined with Beckman Coulter LH780 brand device and biochemistry samples were examined with Beckman Coulter AU5800 and Beckman Coulter AU680 brand devices in the biochemistry laboratory of our hospital. ABL 800 BASIC device was used for blood gas. Stool samples taken from patients in our hospital laboratory were examined by using the rotavirus antigen rapid kit BIOTECH, INC Test.

Statistical Analysis

The data that were obtained in the study were analyzed statistically by using the SPSS program 22.0. The Kolmogorov-Smirnov method was used to examine whether the data of the patients were normally distributed. Descriptive statistical methods were used in evaluating the study data. In the comparison of the quantitative data, the Student t-test

was used to compare two independent groups. When the normality assumption was not met, the Mann-Whitney U test was used. The blood gas results of the patients were compared with the triple group analysis of variance (One-Way ANOVA). The Chi-Square Test was used to compare categorical data. Correlation analyzes and Pearson Test were used. Significance was evaluated at the p<0.05 level.

Results

Among the AGE patients who were included in the study, 148 (61.2%) were male and 94 (38.8%) were female. The mean age of the patients was 46.21±50.28 months, and the median value was 24 months. The demographic data of the patients are shown in Table 1.

Diarrhea was detected in all patients who had acute gastroenteritis in the study. Bloody diarrhea was present in 12 (5.0%) of the patients. When the patients were examined in terms of diseases accompanying diarrhea, it was observed that 66 (27.3%) of the patients had a concomitant disease. Febrile convulsions were found in 7 (2.9%) of our patients who had AGE, and epilepsy was found in 16 (6.6%) patients. On the other hand, 5 (2.0%) patients who were diagnosed with epilepsy had a history of seizures when they applied to the emergency department. Hypoglycemic seizure was detected in one of our patients (0.4%).

Among the patients applying for rotavirus gastroenteritis, 101 (62.30%) were male and 61 (37.70) were female. When rotavirus GE patients were compared according to gender, no statistically significant differences were detected. The comparison of patients who had RV(+) and RV(-) GE is shown in Table 2.

Anemia was detected in 18 (7.4%) patients and polycythemia in 18 (7.4%) patients who had AGE in the hemogram parameters. The mean values of hemogram, biochemical, and blood gas parameters of patients who had RV(+) GE and RV(-) GE are shown in Table 3. Leukopenia was detected in 17 (7%) patients, neutropenia in 10 (4.1%) patients, lymphopenia in 127 (52.5%) patients, thrombocytopenia in patients 9 (3.7%). MPV was low in 14 (5.8%) patients and high in 1 (0.4%). A statistically significant difference was detected between the RV(-) GE and RV(+) GE groups in terms of hgb and MPV values, which are among the hemogram parameters.

When the blood gas analyzes of the patients with AGE were evaluated; While acidosis was detected in 24 (9.9%) patients, alkalosis was found in 27 (11.2%) patients. The mean pH value of the patients was 7.39±0.05. There was a statistical difference between the RV(-) GE and RV(+) GE groups in terms of pH values (p: 0.015).

When the bicarbonate parameter was evaluated in the blood gas analysis of patients who had AGE, the HCO3 value was lower than the normal reference value in 151 (62.4%) of the patients while it was found higher in one (0.4%). The mean value of HCO3 was statistically lower in patients who had RV(+) GE than in patients who had RV(-) GE. While the base excess parameter was lower than the normal reference value in 151 (62.4%) patients, it was higher in one (0.4%). There was a statistical difference between RV(-) GE and RV(+) GE groups in terms of base excess values. When the lactate parameter was evaluated in the blood gas analysis of patients who had AGE, it was higher than the normal reference range in 86 (35.5%) patients. The mean lactate value was not statistically different between the RV(-) GE and RV(+) GE groups.

When pCO2 was analyzed in the blood gas analysis of patients who had AGE, it was found that the pCO2 was lower than the normal reference value in 197 (81.4%) of the patients, but it was higher in 1 (0.4%). The pO2 value was low in 1 (0.4%) of the patients, while it was higher than the normal value in 83 (34.3%) patients. There was no statistical difference between the RV(-) GE and RV(+) GE groups in terms of paO2 and pCO2.

The patients who were included in the study were divided into two groups as emergency observation and pediatric service according to the place they were followed. While 158 (65.3%) of the patients who had dehydration were followed up in the emergency observation, 84 (34.7%) of them were hospitalized and followed up in the pediatric service. The mean values of hemogram, biochemical, and blood gas parameters according to the emergency observation and service follow-up of the patients are shown in Table 4.

When the hospitalization durations of the patients were examined, the mean hospitalization durations of the patients who were followed up in the emergency observation was 1.16±0.41 days, and the mean hospitalization durations of the patients followed in the service was 6.21±5.58 days. Statistically significant differences were detected when the hospitalization durations of the patients were compared according to the place of follow-up (p:<0.001).

When the hospitalization durations of the patients who were followed up with the diagnosis of AGE were examined according to electrolyte levels, the hospitalization period was 5.13±5.38 days in patients who had hypernatremia, 3.01±4.37 days in patients who had hyponatremia, and 2.71±3.55 days in patients who had normonatremia. The comparison of blood gas and electrolyte disturbances and hospitalization durations of patients who had RV(+) GE and RV(-) GE is shown in Table 5. When the hospitalization durations of the patients who had AGE were examined in terms of blood pH, the duration of hospitalization in patients who had acidosis was statistically and significantly higher than the others (p:0.017). No significant differences were detected between the other groups in terms of hospitalization duration and HCO3 and lactate levels of patients who had AGE.

The correlation between hospital stays and blood gas parameters (pH, paO2, pCO2, HCO3, base excess, lactate) and biochemical (Na, K, Cl) values of patients who had RV(+) and RV(-) GE were also examined. The correlation between blood gas and biochemical parameters in hospital stays in patients who had AGE

is shown in Table 6. A strong and negative correlation was found between the length of stay in the pediatric service and the pO2 levels of the patients. A weak and negative correlation was found between pediatric emergency observation hospitalizations and pH levels. Also, a weak positive correlation was found between the duration of hospitalization in pediatric emergency observation and lactate levels of the patients.

Table 1: The demographic data of the patients

Gender		Male	Female	Total	p
Age (Month)	Mean±SD	48.49±52.39	42.62±46.82	46.21±50.28	0.577
	Median (min-max)	26.50 (1-215)	24 (1-192)	24 (1-215)	
Breastfeeding duration/ month	Mean±SD	13.82±6.49	13.47±6.55	13.68±6.50	0.770
	Median (min-max)	13.00 (1-26)	12.00 (1-25)	12.5 (1-26)	
Diarrhea Duration	Mean±SD	2.94±2.12	2.61±1.39	2.81±1.88	0.185
	Median (min-max)	2.00 (1-15)	2.00 (1-10)	2.00 (1-15)	
Age Group n (%)	0-24 month	73 (%59.8)	49 (%40.2)	122 (%50.4)	0.806
	25-60 month	32 (%58.1)	23 (%48.9)	55 (%22.7)	
	61-120 month	27 (%65.8)	14 (%34.2)	41 (%16.9)	
	>121 month	16 (%66.6)	8 (%33.4)	24 (%10.0)	
Season n (%)	Winter	35 (61.4)	22 (23.6)	57 (23.6)	0.845
	Spring	26 (60.5)	17 (39.5)	43 (17.8)	
	Summer	57 (58.8)	40 (41.2)	97 (40.1)	
	Autumn	30 (66.7)	15 (33.3)	45 (18.6)	
Clinical Symptoms n (%)	Vomiting	104 (60.45)	68 (39.55)	172 (71.01)	0.455
	Stomach ache	99 (60.0)	66 (40.0)	165 (68.2)	0.153
	Fever	77 (58.33)	55 (41.67)	132 (54.54)	0.196
	Weakness	48 (52.17)	44 (47.82)	92 (38.01)	0.243
	Seizure	4 (57.15)	3 (42.85)	7 (2.89)	0.345
Diarrhea Duration n (%)	1-4 days	130 (60.5)	85 (39.5)	215 (88.8)	0.717
	5 days	8 (61.5)	5 (38.5)	13 (5.4)	
	> 6 days	10 (71.4)	4 28.6)	14 (5.8)	
Degree of Dehydration n (%)	Mild	85 (57.4)	56 (59.6)	141 (58.3)	0.327
	Middle	60 (40.5)	38 (40.4)	98 (40.5)	
	Severe	3 ((2.1)	0 (0)	3 (1.2)	
Fever Classification (C) n (%)	<38	75 (65.2)	40 (34.8)	115 (47.5)	0.915
	38-38.5	59 (55.1)	48 (44.9)	107 (44.2)	
	38.5-38.9	5 (50.0)	5 (50.0)	10 (4.1)	
	>39	9 (90.0)	1 (10.0)	10 (4.1)	

Table 2: The comparison of patients who had RV(+) and RV(-) GE

		Rotavirus (+)	Rotavirus (-)	p
Gender n(%)	Male	101 (62.30)	47 (58.75)	0.344
	Female	61 (37.70)	33 (41.25)	
Age Group n(%)	0-24 month	90 (73.8)	32 (26.2)	
	25-60 month	37 (67.3)	18 (32.7)	0.530
	61-120 month	23 (56.1)	18 (43.9)	
	>121 month	12 (50.00)	12 (50.00)	
Clinical Symptoms n(%)	Vomiting	125 (72.7)	47 (27.3)	**0.017**
	Stomach ache	122 (73.9)	43 (26.1)	**0.001**
	Fever	100 (75.8)	32 (24.2)	**0.001**
	Weakness	72 (78.2)	20 (27.8)	**0.001**
Diarrhea Duration	1-4 day	143 (66.5)	72 33.5)	
	5 day	10 (76.9)	3 (23.1)	0.723
	> 6 day	9 (64.3)	5 (35.7)	
Fever Classification (C) n(%)	<38	66 (57.4)	49 42.6)	
	38-38.5	78 (72.9)	29 (27.1)	**0.002**
	38.5-38.9	10 (100)	0 (0)	
	>39	8 (80.00)	2 (20.00)	
Degree of Dehydration n(%)	Mild	80 (56.7)	61 43.3)	
	Middle	79 (80.6)	19 (19.4)	**0.001**
	Severe	3 (100)	0 (0)	
Sodium n(%)	Hyponatremia	86 (68.8)	39 (31.2)	
	Normnatremia	69 (63.3)	40 (36.7)	0.305
	Hipernatremia	7 (87.5)	1 (12.5)	
Potassium n(%)	Hypopotassium	44 (83.0)	9 (17)	
	Normopotassium	102 (62.2)	62 (37.8)	**0.019**
	Hiperpotassium	16 (64.0)	9 (36.0)	
Chlorine n(%)	Hypochloremia	21 (77.8)	6 (22.2)	
	Normochloremia	112 (63.6)	64 (36.4)	0.195
	Hiperchloremia	29 (74.4)	10 (25.6)	
Age	Mean±SD	39.67±44.56	59.42±58.32	**0.017**
	Median (Min-max)	21.00 (1-204)	41.50 (1-215)	
Breastfeeding duration/month	Mean±SD	13.53±6.16	13.98±7.15	0.616
	Median (Min-max)	12.50 (1-24)	12.50 (1-26)	
Diarrhea Duration	Mean±SD	3.90±2.01	2.15±1.55	**0.001**
	Median (Min-max)	3.15 (1-15)	2.00 (1-10)	
Hospitalization Durations	Mean±SD	3.84±2.13	2.23±2.68	**0.001**
	Median (Min-max)	4.54 (1-12)	2.12 (1-7)	

Table 3: The mean values of hemogram, biochemical, and blood gas parameters of patients who had RV(+) GE and RV(-) GE

	Rotavirus (+)		Rotavirus (-)		Total		
	Mean±SD	Median (Min-mak)	Mean±SD	Median (Min-mak)	Mean±SD	Median (Min-mak)	p
WBC	10.95 ± 5.1	10.05 (4.1-31.5)	11.45 ± 4.87	10.2 (3-31.5)	11.38 ± 5.48	10.8 (3.4-31.5)	0.472
ALC	3.5 ± 2.37	2.88 (0.17-14.53)	3.47 ± 2.67	2.83 (0.17 - 17.9)	3.51 ± 2.38	3.1 (0.17 - 10.5)	0.941
ANC	6.24 ± 4.54	5.05 (0.6 - 26.32)	6.8 ± 4.56	5.35 (0 - 26.32)	6.16 ± 4.75	5.7 (1 - 25)	0.366
Hgb	12 ± 1.61	11.9 (7.3 - 18.1)	12.67 ± 1.84	12.2 (7.3 - 18.1)	11.88 ± 2.09	11.6 (7.3-15.9)	**0.004**
Plt	355.23± 142.82	336 (117 - 934)	346.51 ± 156.09	325.5 (43 - 1110)	341.69±165.94	287 (43 - 794)	0.665
MPV	7.64 ± 0.99	7.5 (5.49 - 12.2)	7.98 ± 0.96	7.6 (5.49 - 12.2)	8.29 ± 1.24	8.2 (6.3 - 12.2)	**0.012**
Sodium	136.43 ± 5.09	136 (122 - 168)	136.83 ± 3.14	137 (130 - 150)	136.56 ± 4.54	136 (122-168)	0.525
Potassium	4.02 ± 0.66	4 (2.4 - 6.05)	4.23 ± 0.52	4.24 (2.89 - 5.56)	4.09 ± 0.62	4.11 (2.4 - 6.05)	**0.011**
Chlorine	105.96 ± 5.32	106 (94 - 140)	105.65 ± 3.33	105 (98 - 114)	105.86 ± 4.75	105.5 (94 - 140)	0.639
Urea	24.1 ± 16.75	21.5 (2 - 141)	24.44 ± 10.42	22 (8 - 69)	24.21 ± 14.94	22 (2 - 141)	0.869
Creatinine	0.33 ± 0.16	0.3 (0.06 - 1.63)	0.41 ± 0.27	0.34 (0.16 - 2.26)	0.36 ± 0.21	0.31 (0.06-2.26)	**0.006**
ALT	34.23 ± 74.76	23 (6 - 891)	18.05 ± 10.74	16 (6 - 94)	28.88 ± 61.88	19 (6 - 891)	**0.001**
AST	53.56 ± 80.01	41 (10 - 745)	35.43 ± 20.93	32 (16 - 194)	47.57 ± 67.03	37 (10 - 745)	**0.001**
Albumin	3.93 ± 0.59	4.06 (2.4 - 5.2)	4.28 ± 0.51	4.3 (2.9 - 5.3)	4.05 ± 0.58	4.1 (2.4 - 5.3)	**0.001**
pH	7.37 ± 0.06	7.38 (7.13 - 7.58)	7.39 ± 0.05	7.39 (7.27 - 7.51)	7.38 ± 0.05	7.38 (7.13 - 7.58)	**0.015**
paO2	49.46±16.44	47.25 (22.8 - 116)	45.57±16.87	44.9 (10.7 - 127)	48.18 ± 16.66	45.9 (10.7 - 127)	0.087
CO2	32.58 ± 5.84	32.4 (13.5 - 51)	36.56 ± 27.31	34.1 (17.1 - 272)	33.9 ± 16.45	33 (13.5 - 272)	0.077
HCO3	18.82 ± 3.97	18.6 (7 - 33.2)	20.35 ± 3.21	20.9 (13.6 - 27.8)	19.32 ± 3.8	19.3 (7 - 33.2)	**0.003**
BE	-5.4 ± 3.94	-5.35 (-19 - 2.9)	-3.47 ± 3.19	-2.9 (-10.8 - 2.7)	-4.76 ± 3.81	-4.35 (-19 - 2.9)	**0.001**
Lactat	1.99 ± 1.32	1.7 (0.7 - 13.6)	2.01 ± 0.93	1.85 (0.7 - 5.3)	2 ± 1.2	1.7 (0.7 - 13.6)	0.898

White Blood Cell Count (WBC): 10^3/UL. Absolute Lymphocyte Count (ALC): 10^3/UL. Absolute Neutrophil Count (ANC): 10^3/UL. Hgb: gr/dl, Platelet: K/uL. MPV: fl. Na: mEq/L. Cl: mmol/L. K: mmol/L. Urea: mg/dL. creatinine: mg/dl. ALT: U/L. AST: U/L. Alb: gr/dL. pH:-log[H]. pCO2: mmHg. paO2: mmHg. HCO3: mmol/L. BE: mmol/L. Lactat: mmol/L.

Table 4: The mean values of hemogram, biochemical, and blood gas parameters according to the emergency observation and service follow-up of the patients

	Pediatric Emergency Observation		Pediatric Service		p
	Mean±SD	Median (Min-mak)	Mean±SD	Median (Min-mak)	
WBC	10.55 ± 4.16	10.35 (4.1 - 31.5)	12.21 ± 6.34	10.05 (3 - 28.8)	**0.017**
ALC	3.24 ± 2.09	2.86 (0.44 - 17.9)	3.91 ± 3.05	2.7 (0.17-14.53)	**0.030**
ANC	6.21 ± 3.89	5.56 (0 - 26.32)	6.93 ± 5.68	5.3 (0.6 - 22.6)	0.328
Hgb	12.52 ± 1.65	11.6 (7.3 - 16.5)	11.67 ± 1.69	12.45 (7.4 - 18.1)	**<0.001**
PLT	335.31±124.67	343 (43 - 1110)	384.55±181.18	310 (46.1 - 934)	**0.013**
Sodium	136.19 ± 3.32	136 (122 - 168)	137.18 ± 6.29	136 (128 - 150)	0.081
Potassium	4.07 ± 0.49	4 (2.57 - 6.05)	4.09 ± 0.82	4.12 (2.4 - 5.2)	0.462
Chlorine	105.21 ± 3.52	106 (95.5 - 140)	107.11 ± 6.41	105 (94 - 114)	**0.003**
Urea	24.72 ± 11.23	17.5 (2 - 141)	23.06 ± 20.65	23 (4 - 70)	0.469
Creatinine	0.37 ± 0.21	0.28 (0.06 - 1.63)	0.33 ± 0.21	0.32 (0.14-2.26)	0.121
ALT	22.28 ± 15.11	22 (7 - 891)	42.18 ± 104.67	19 (6 - 134)	**0.015**
AST	41.95 ± 38.04	38.5 (10 - 745)	59.48 ± 102.99	37 (13 - 484)	0.373
Albumin	4.21 ± 0.47	3.7 (2.4 - 5.3)	3.75 ± 0.65	4.2 (2.6 - 5.2)	**0.001**
pH	7.38 ± 0.05	7.38 (7.14 - 7.58)	7.38 ± 0.06	7.38 (7.25-7.51)	0.262
paO2	48.58 ± 16.7	48.85 (21.1-127.0)	47.43 ± 16.64	43.50(10.7-16.0))	0.608
pCO2	34.45 ± 19.88	33.45 (13.5 - 46.2)	33.05 ± 6.11	32.65(17.1-272)	0.478
HCO3	19.32 ± 3.41	19.6 (7 - 33.2)	19.5 ± 4.38	19.3 (11.4-27.8)	0.991
Base Excess	-4.56 ± 3.42	-4.5 (-19 - 2.9)	-4.97 ± 4.28	-4.2 (-14.2- 2.7)	0.254
Lactat	1.98 ± 1.31	1.8 (0.7 - 5.7)	1.99 ± 0.94	1.7 (0.7 - 13.6)	0.725

WBC: 10^3/UL. ALC: 10^3/UL. ANC: 10^3/UL. Hgb: gr/dl. Plt: K/uL. Na: mEq/L. Cl: mmol/L. K: mmol/L. Urea: mg/dL creatinine: mg/dl ALT: U/L AST: U/L. Alb: gr/dL. pH:-log[H]. pCO2: mmHg. paO2: mmHg. HCO3: mmol/L. Base Excess: mmol/L. Lactat: mmol/L

Table 5: The comparison of blood gas and electrolyte disturbances and hospitalization durations of patients who had RV(+) GE and RV(-) GE

	RV(+) GE	RV(-) GE	Total	
Hospitalization Durations	**Mean±SD**	**Mean±SD**	**Mean±SD**	**p**
Hyponatremia	3.08 ± 4.68	2.59 ± 3.42	3.01±4.37	
Normonatremia	3.39 ± 4.25	1.7 ± 1.67	2.71 ± 3.55	**0.020**
Hipernatremia	6.33 ± 5.79	1.0 ± 0.20	5.13 ± 5.38	
Hypokalemia	2.62 ± 1.97	3.67 ± 3.77	2.77 ± 2.37	
Normokalemia	3.48 ± 5.35	1.48 ± 1.3	2.66 ± 4.36	**0.001**
Hiperkalemia	4.69 ± 3.71	5 ± 5.36	5.08 ± 4.39	
Hypochloremia	3.38 ± 3.64	1.17 ± 0.41	2.89 ± 3.33	
Normochloremia	2.88 ± 3.83	2.27 ± 2.95	2.66 ± 3.54	**0.041**
Hiperchloremia	5.07 ± 6.89	1.8 ± 1.14	4.23 ± 6.11	
Acidosis	3.76 ± 5.53	3.73 ± 4.22	3.95 ± 2.44	
Normal	3.17 ± 4.23	1.95 ± 2.4	2.90 ± 4.27	**0.017**
Alkalosis	3.67 ± 4.3	1.5 ± 1.73	2.97 ± 3.76	
Low Level of Bicarbonate	3.04 ± 4.12	2.16 ± 2.77	2.72 ± 3.8	
Normal Level of Bicarbonate	4.04 ± 5.45	2.09 ± 2.61	3.31 ± 4.49	0.593
High level of Bicarbonate	3.0 ± 0.12	2.13 ± 2.68	3 ± 0	
Normal level of Lactat	2.9 ± 4.1	2.13 ± 2.95	2.67 ± 3.8	0.128
High level of Lactat	4.25 ± 5.29	2.12 ± 2.29	3.43 ± 4.49	

Table 6: The correlation between blood gas and biochemical parameters in hospital durations in patients who had AGE

	RV(+) GE		RV(-) GE	
	p	**r**	**p**	**r**
pH	0.786	-0.022	0.127	-0.172
paO2	0.247	-0.091	0.639	-0.053
pCO2	0.701	0.03	0.789	-0.03
HCO3	0.649	0.036	0.367	0.102
Base Excess	0.796	0.022	0.747	0.037
Lactat	0.417	0.064	0.872	-0.018
Na	0.599	0.042	0.698	-0.44
K	0.292	0.083	0.381	0.099
Cl	0.074	0.141	0.984	0.002
	Pediatric Emergency Observation		**Pediatric Service**	
pH	**0.037**	**-0.146**	0.401	0.007
paO2	0.563	-0.046	**0.007**	**-0.793**
pCO2	0.779	-0.022	0.151	0.085
HCO3	0.967	0.003	0.536	0.070
Base Excess	0.537	-0.049	0.326	0.111
Lactat	**0.007**	**0.217**	0.571	0.64
Na	0.806	0.02	0.533	-0.071
K	0.435	-0.062	0.734	0.039
Cl	0.641	-0.037	0.791	0.030

Discussion

Rotavirus gastroenteritis, which is the most common viral infection, causes morbidity and mortality in patients who are younger than five years of age. Extreme dehydration accompanied by electrolyte imbalance is the most common cause of mortality in RV Gastroenteritis (12). Increased diarrheal attacks, high fever, excessive acidosis, and negative base deficit are frequently observed in these patients (13). In the study, evaluation of clinical, blood gas, and electrolyte levels of the cases that were admitted to our hospital with acute gastroenteritis, comparison of electrolyte imbalance and blood gas disorders of patients who had RV(+) GE and RV(-) GE were compared according to gender, observation and follow-up period, and length of stay in hospital.

It is reported in the literature that the majority of patients, who had AGE, are younger than two years old. In two studies on AGE, it was found that 60-86% of gastroenteritis cases were seen in children aged 0-48 months (14,15). In the study of Tagbo et al., the mean age of patients who had positive RV was 9 months (16). It was reported in the study of Mathew et al. that 89% of patients hospitalized for RV were younger than 23 months (17). Our study was also similar to the literature data.

Breastfeeding is the most important preventive factor in preventing diarrhea as the RV vaccine is not included in the routine vaccination program in our country. Diarrhea is generally not severe in breastfed infants and the risk of developing dehydration is much less than in infants not breastfed. Breastfeeding has important factors that increase the immunological response of the child, protect the intestine, and ensure the continuation of the appropriate intestinal flora (18). Diarrhea is 25 times less common in infants fed with breast milk than in infants who do not receive breast milk (19). In a study conducted by Adal et al., RV positivity was found higher in children aged 6-12 months and attributed this to the protective effect of breast milk from viral infections in the first 6 months (18). Our study results suggest that the reason why the majority of patients were discharged in a short time after emergency room observation may be because of the high rate of breast milk intake.

Diarrhea is the most important clinical manifestation of acute gastroenteritis and is accompanied by clinical symptoms such as abdominal pain, vomiting, fever, weakness, dehydration, and seizures. The most common complications of rotavirus gastroenteritis are dehydration, electrolyte imbalance, metabolic acidosis, and malnutrition (20). In the study that was conducted by Aydın et al., diarrhea is most common in children with acute gastroenteritis, followed by vomiting (70%) and abdominal pain and fever. In the same study, they found the mean duration of diarrhea to be 2±1.6 days (21). In the study of Gürbüz et al., the most common complaint of vomiting was among patients who had viral AGE (22). Consistent with the results of the studies in the literature, the most common symptom in our study was diarrhea.

It is already known that dehydration symptoms will develop more rapidly in children in case of diarrhea because their fluid and electrolyte needs are high. Deaths and complications in RV diarrhea are more common than other viral pathogens. In the study of Aydın et al., various degrees of dehydration were detected in 16% of patients who had AGE, and severe dehydration was found only in 3.3% (21). Our study is compatible with the literature data in terms of degree and rate of dehydration.

It was reported in previous studies that MPV value is not affected by age and gender, and for this reason, it can be used as a negative acute phase response in every age group (23). In various studies, it was found that the MPV value was lower in RV(+) gastroenteritis cases than in the healthy group. For this reason, it was recommended the use of MPV as a negative acute phase reactant in patients who had RV(+) GE (24,25). In our study, statistical differences were detected between the MPV values of the RV(-) GE and RV(+) GE groups. In this respect, we think that MPV can be used as a negative acute-phase reactant in patients who had RV(+) GE.

In a study conducted in Kenya, statistically significant differences were detected in terms of hypernatremia, hypokalemia, and elevated creatinine levels in cases with RV(+) GE (26). In the study of Çubuk et al., no differences were detected between the rota positive and negative groups in terms of hypernatremia and hypokalemia (27). In our study, statistically significant differences were detected between the potassium values of the patients in the RV(-) GE and RV(+) GE groups. There were no significant differences in terms of sodium and chlorine values of RV(-) GE and RV(+) GE groups.

Conditions such as dehydration, electrolyte imbalance, and metabolic acidosis develop secondarily to fluid loss in patients with AGE. In a previous study, a significant correlation was reported between metabolic acidosis and rotavirus association (26). In a Thailand-based study, when metabolic acidosis was detected in blood gas evaluation, and when the RV(+) and (-) groups were compared, metabolic acidosis was detected in the rotavirus positive group at a rate of 57% (28). In our study, when the blood gas analysis of patients who had AGE was evaluated, acidosis was found in 24 (9.9%) and alkalosis in 27 (11.2%) patients. In the present study, the pH and HCO3 values were lower in patients who had RV(+) GE, and base excess was higher in patients who had RV(-) GE.

Many factors affect the length of hospital stay of patients with rotavirus infection. The degree of dehydration, electrolyte imbalance, and blood gas disorders of patients affect the length of stay. Publications have reported that the duration of hospitalization in RV gastroenteritis cases varies between 3.1 and 5.7 days (6,29). In different studies conducted in our country, the length of stay was found as four days, 8.17±5.69 days, and 5.4±2.9 days (22,27,30). In our study, the mean hospitalization durations of the patients followed in the emergency observation was 1.16±0.41 days, while the mean hospitalization period of the patients followed in the ward was 6.21±5.58 days. Statistically significant differences were detected when the hospitalization durations of the patients were compared statistically according to the place of follow-up. Similar to the literature data, our patients were discharged in a shorter time when compared to the hospitalization durations in the literature in emergency observation. This may be attributed to the early admission to the hospital and IV hydration in the early period.

When the hospitalization durations of the patients who were followed up with the diagnosis of AGE were analyzed according to their electrolyte levels, it was found that the hospitalization period was higher in patients who had hypernatremia and hyperkalemia when compared to the others. Also, hospitalization durations were significantly higher in patients who had RV(+) GE and with hypernatremia and hyperkalemia.

Many previous studies reported that metabolic acidosis is an important clinical condition in RV gastroenteritis. However, few studies in the literature have evaluated the relations between blood gas parameters measured at the time of admission to the hospital and the length of hospital stay in RV(+) patients. In a study that was conducted by Wildi-Runge S et al., metabolic acidosis was found in blood gas in 84.8% of the cases hospitalized because of RV(+) GE (30). In line with these data, it was claimed that RV gastroenteritis cases with metabolic acidosis in blood gas between pediatric service and pediatric emergency observation were more common in the hospitalized group. In our study, it was determined that the duration of hospitalization was statistically significant in patients who had acidosis when compared to the others. The data obtained in our study show that the detection of metabolic acidosis in blood gas means that the patient's hospitalization period will be longer.

A weak and negative relation was detected between the duration of hospitalization for pediatric emergency observation and pH levels of patients who were diagnosed with AGE. This was interpreted as patients with metabolic acidosis in blood gases being hospitalized earlier, and patients with metabolic acidosis being kept longer in the emergency observation room. Also, a weak and positive correlation was found between the pediatric emergency observation hospitalization period and lactate levels of the patients.

One of the limitations of the study was the small number of patients. In addition, not knowing the vaccination status of the patients was a limitation. There is a need for multicenter studies with more patients.

Conclusion

RV gastroenteritis still maintains its importance in our country where there is no routine vaccination against rotavirus. Vaccination, which is known to reduce both the incidence of rotavirus gastroenteritis cases and the duration of hospitalization in the emergency departments, must be included in the routine vaccination program in our country. Cases with metabolic acidosis in Rotavirus gastroenteritis are hospitalized more frequently, and for this reason, blood gas studies in cases of RV gastroenteritis will guide clinicians. After the diagnosis of RV gastroenteritis, routine examinations of the patients will enable clinicians to comment on the course of the disease, and this will strengthen their hand in the fight against the disease. There is a need for studies estimating the length of service stays in RV gastroenteritis cases treated in the ward.

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