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# Socio-demographic, Clinical and Laboratory Features of Rotavirus Gastroenteritis in Children Treated in Pediatric Clinic

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## ABSTRACT

**Aim:** The aim of work was presentation of several socio-demographic, clinical and laboratory characteristics of gastroenteritis caused by rotavirus.

**The examinees and methods:** The examinees were children under the age of five years treated at the Pediatric Clinic due to acute gastroenteritis caused by rotavirus. Rotavirus is isolated by method chromatographic immunoassay by Cer Test Biotec. **Results:** From the total number of patients (850) suffering from acute gastroenteritis, feces test on bacteria, viruses, protozoa and fungi was positive in 425 (49.76%) cases. From this number the test on bacteria was positive in 248 (58.62%) cases, on viruses it was positive in 165 (39.0%), on protozoa in 9 (2.12%) cases and on fungi only one case. Rotavirus was the most frequent one in viral test, it was isolated in 142 (86.06%) cases, adenoviruses were found in 9 (5.45%) cases and noroviruses in only one case. The same feces sample that contained rotavirus and adenoviruses were isolated in five cases, whereas rotavirus with bacteria was isolated in the same feces sample in five cases. The biggest number of cases 62 (43.66%) were of the age 6-12 months, whereas the smallest number 10 (7.04%) cases were of the age 37-60 months. There were 76 (53.52%) of cases of male gender, from rural areas there were 81 (57.04%) cases and there were 58 (40.80%) cases during the summer period. Among the clinical symptoms the most prominent were diarrhea, vomiting, high temperature, whereas the different degree of dehydration were present in all cases (the most common one was moderate dehydration). The most frequent one was isonatremic dehydration in 91 (64.08%) cases, less frequent one was hypernatremic dehydration in 14 (9.85%) cases. The majority of cases (97.89%) had lower blood pH values, whereas 67 (47.17%) cases had pH values that varied from 7.16 -7.20 (curve peak), normal values were registered in only 3 (2.11%) cases. Urea values were increased in 45 (31.07%) cases (the maximum value was 26.5 mmol/L), whereas creatinine value was increased in 41 (28.87%) cases (maximum value was 302 mmol/L). **Conclusion:** The results show the high frequency of rotavirus infections in children hospitalized with acute gastroenteritis. Rotavirus may cause different dehydration degree with electrolyte, acid-base and other biochemical disorders. Preventing the infection caused by rotavirus is of a great importance.

**Key words:** Rotavirus gastroenteritis, demographic, clinical, laboratory features.

## 1. INTRODUCTION

Gastroenteritis caused by rotavirus is spread in a whole world and it affects people of all age groups, especially the children. In the developing countries, this disease afflicts mostly the children of the age 6-12 months, whereas in the developed countries it afflicts the children of the age 12 -14 months. The disease is endemic with different clinical manifestations that depend on infectious dose, local immunity of mycosis, the state of nutrition and breast feeding (anti-groups IgG, IgA and immunocompetent cells in human milk) that protect the infant from rotavirus infection (17, 20, 21, 22). Rotavirus gastroenteritis is the most common cause of severe gastroenteritis among children under 5 years of age, causing considerable morbidity and mortality worldwide. In Europe rotavirus gastroenteritis causes

approximately 230 deaths, more than 87.000 hospitalizations and 700.000 outpatient visits annually, consuming substantial health resources (8). Although costs for treatment of severe causes (i.e. those admitted to hospital) are relevant in Europe, rotavirus vaccine is still too expensive to encourage the implementation of generalized immunization strategy in areas of low incidence (4, 5, 8, 13, 18). In the USA, rotavirus causes an estimated 410.000 medical consultations, more than 200.000 emergency visits, about 50.000-70.000 hospital admissions per year, 20-60 deaths and >billion dollars of medical care costs (3). Rotaviruses which are in the Reoviridae family, cause disease in virtually all mammals and birds (6, 13). The virus is a wheel like, triple shelled icosahedron containing 11 fragments of double stranded RNA. Rotaviruses are classified by serogroup (A, B,

C, D, E, F and G) and subgroup (I or II). Group A includes the common human pathogens as well as variety of animal viruses (3, 4, 28, 31).

Rotavirus is transmitted from person to person through the fecal-oral route. This occur when the viruses found in stool of infected child is swallowed by another child other words children become infected if they put their finger in their mouth after touching something such as toys, books, clothing etc., that has been contaminated by stool of an infected person, this usually happen when children forget to wash their hands after using the toilet or before eating (3, 25). Health care workers also spread this disease if they don't wash their hands after changing diapers, frequent hand washing is the best tool to limit the spread of rotavirus infection. Rotavirus may also be transmitted through intake of fecally-contaminated water or food which usually occur when infected food handlers who prepare salads, sandwiches, carrots and other foods that requires no cooking can spread the disease. It may also be transmitted by respiratory droplets that people sneeze, cough, drip or exhale (9). Nosocomial transmission is frequent in Pediatric words with poor sewage water treatment and sanitation (7-10).

## 2. THE EXAMENEEES AND METHODS

During 2011, there were 1013 children of age 2-5 years treated at the Pediatric Clinic. 850 of them i.e. (83.90%) suffered from acute gastroenteritis, out of that number the feces examination on bacteria, viruses, parasites and fungi was positive in 423 (49.76%) cases, and negative in 427 (50.23%) cases.

The treated patients were children of the age from two months old (except the newborns) until the age of 5 years suffering from acute infectious diarrhea treated with the Pediatrics Clinic in Prishtina during the period of one year (2011).

This prospective, observational study was conducted a 12-month period. All children under five years of age at admission and admitted to Pediatric Clinic between 1 January and 31 December 2011 were assessed for eligibility. Inclusion criterion was acute gastroenteritis at enrolment. Acute gastroenteritis was defined as three or more loose stools per day for less than 14 days at enrolment.

A stool samples were collected from children the age range at 2 month-5 years with gastroenteritis. The stool samples were collected using sterile wide mouth universal containers and these containers were covered and labeled accordingly. Between 4-5 g of diarrheic stool samples were collected from each child and immediately stored at -20°C, and shipped frozen to the Institute of Public Health-Microbiology, for analysis. One step colored chromatographic immunoassay by Cer Test Biotec (Spain) for qualitative detection of rotavirus, adenoviruses and noroviruses in stool samples have been used. The membrane is pre-coated with monoclonal antibodies, on the test band regions against the viral antigens.

Statistic data were presented by the tables and charts.  $\chi^2$  test was used to analyze the data and the p- value less than 0.05 was considered statistically significant.

## 3. RESULTS

During 2011, there were 1013 children of age 2-5 years treated at the Gastroenterology department of the Pediatric Clinic. 850 of them i.e. (83.90%) suffered from acute gastroenteritis, out of that number the feces examination on bacteria,

Type of feces examination	Number	%	$\chi^2$ - test
Bacteriological	248	58.6	$\chi^2 = 209.66$ ; Df=2; P<0.00001
Virusological	165	39.0	
Protozoae (Giardia-Lambliia)	9	2.1	
Fungi (Candida albicans)	1	0.2	
Total	423	100.0	-

Table 1. Findings in examination of feces with bacteria, viruses, protozoa and fungi

Types of viruses	Number	%	$\chi^2$ - test
Rotavirus	142	86.1	$\chi^2 = 451.21$ ; Df = 4; P<0.00001
Adenoviruses	9	5.5	
Noroviruses	1	0.6	
Associated rotavirus and adenoviruses	5	3.0	
Associated rotavirus and bacteria	8	4.8	
Total	165	100.0	-

Table 2. Types of viruses isolated in feces examination

viruses, parasites and fungi was positive in 423 (49.76%) cases, and negative in 427 (50.23%) cases.

Bacteriological examination of feces was positive in 248 (58.62%) cases, viral in 165 (36.00%) cases, with protozoa in 9 (2.12%) cases and Candida albicans in only 1 case (Table 1). The difference was statistically significant (p<0.00001).

Types of isolated viruses in feces are shown in Table 2. Rotavirus is isolated in the absolute majority of cases i.e. in 142 (86.06%) cases, Adenovirus was isolated in 9 (5.45%) cases, whereas Noravirus was isolated in only one case. Rotavirus and Adenovirus were isolated with the same feces in 5 (3.03%) cases, whereas rotavirus with bacteria (S.Wien, S.Gloucester, Enteropathogenic E.coli serotype O86, O111) was isolated in

Characteristics	Category	N	%	$\chi^2$ - test
Total	142	100	-	
Age (in months)				
	<6 months	12	8.5	$\chi^2 = 79.2$ ; Df = 4; P<0.001
	6-12 months	62	43.7	
	13-24 months	45	31.7	
	25-36 months	13	9.2	
	37-60 months	10	7.0	
Gender				
	Female	66	46.5	$\chi^2 = 0.70$ ; Df = 1; P>0.05 *NS
	Male	76	53.5	
Place of residence				
	Rural	81	57.0	$\chi^2 = 4.9$ ; Df = 1; P<0.05 *S
	Urban	55	38.7	
Season				
	Spring	18	12.7	$\chi^2 = 46.11$ ; Df = 3; P<0.01
	Summer	68	47.9	
	Autumn	37	26.1	
	Winter	19	13.4	

Table 3. Some socio-demographic characteristics of patients with gastroenteritis caused by rotavirus. \*S- significant for p<0.05 relevance 95%, \*NS- non significant

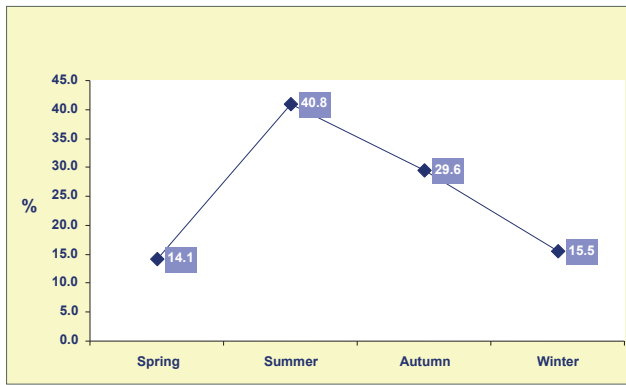


Figure 1. Seasonal pattern of rotavirus infection in our patients with rotavirus gastroenteritis

8 (4.84%) cases ( $p < 0.00001$ ).

Table 3 presents several socio-demographic characteristics of infants suffering from gastroenteritis caused by rotavirus. Most of the children, 62 of them (43.66%), were of the age 6-12 months, then there were 45 cases (31.60%) of the age 13-24 months, 13 case (9.15%) were of the age 25-36 months, 12 (8.40%) cases were of the age < 6 months, and there were 10 cases (7.04%) at the age 37-60 months ( $p < 0.001$ ). Regarding the gender, majority of patients were male 76 cases (53.52%), whereas 66 cases (46.47%) were of female gender, the difference was not statistically significant ( $p > 0.05$ ). The children from rural area were the most dominant, 81 (57.04%) cases, in comparison with the children from the town 55 (38.73%) cases, ( $p < 0.05$ ). The biggest number of children, 68 (47.88%) cases, suffered from gastroenteritis caused by rotavirus during the summer season, during the autumn there were 37 cases (26.05%), during the winter (13.38%) cases and in spring there were 18 (12.67%) cases ( $p < 0.01$ ), (Figure 1).

Symptoms and signs	N	%	X <sup>2</sup> - test
Total	142	100.0	-
Diarrhea	140	98.6	X <sup>2</sup> =19.11; Df = 3; P<0.001
Vomiting	125	88.0	
Fever	77	54.2	
All symptoms (diarrhea, vomiting and fever)	112	78.9	
Dehydration (degree)			
Mild	52	36.6	X <sup>2</sup> =27.10; Df = 2; P<0.00001
Moderate	70	49.3	
Severe	20	14.1	

Table 4. Clinical features of patients with rotavirus gastroenteritis

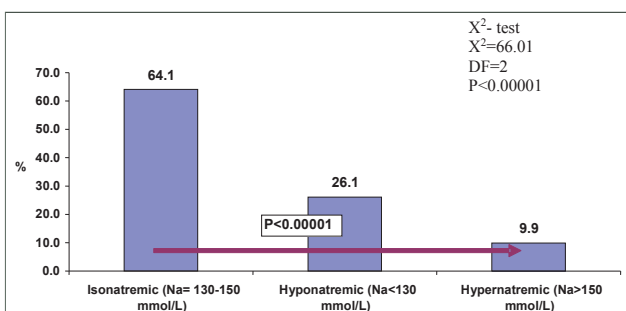


Figure 2. Types of dehydration of patients with rotavirus gastroenteritis

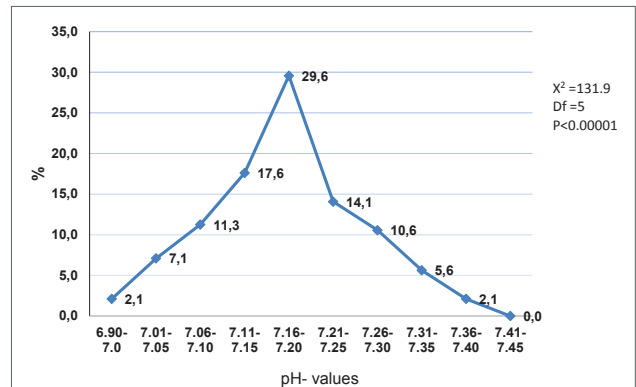


Figure 3. pH values of patients with rotavirus gastroenteritis

Value	Urea (Referent value 1.8-6.4mmol/l)		Creatinine (Referent value 27-62mmol/l)	
	N	%	N	%
Normal	97	68.3	101	71.1
Increased	45	31.7	41	28.9
Total	142	100.0	142	100.0
X <sup>2</sup> - test	X <sup>2</sup> =19.04; Df =1; P<0.00001		X <sup>2</sup> =25.35; Df =1; P<0.00001	

Table 5 The values of urea and creatinine of patients with rotavirus gastroenteritis

Diarrhea was the most frequent symptom in 140 (98.59%) cases, followed by vomiting in 125 (88.02%) cases, higher body temperature in 77 (54.22%) cases ( $p < 0.001$ ) and dehydration as a result of gastroenteritis was present in all cases (the most common one was moderate dehydration) in 70 (49.29%) cases,  $p < 0.00001$  (Table 4).

Figure 2 presents the types of dehydration in regard to the sodium concentration in plasma. The biggest number of patients 91 (64.08%) cases suffered from isonatremic dehydration, then 37 (26.05%) cases suffered from hyponatremic dehydration, and 14 (9.85%) cases suffered from hypernatremic dehydration ( $p < 0.00001$ ).

The pH was under the relevant values (metabolic acidosis), whereas only in 3 cases (2.11%) the pH was on the limit of the reference values.

The blood pH values were between 6.9 up to the limit of the reference values (7.35-7.45). The peak of curve was in pH values between 7.16-7.20 in 42 (29.57%) cases, whereas in 3 cases (2.11%) the pH value was between 6.90-7.0 ( $p < 0.00001$ ). we have registered not even a single case with the above upper limit of reference values (Figure 3).

Table 5 presents the values of urea and creatinine. In 97 (68.30%) cases values of urea were in referential values (1.8-6.4 mmol/L), whereas increased values were recorded in 45 (31.70%) cases ( $p < 0.00001$ ), with the maximal value of 26.5 mmol/L. The values of creatinine were in referential values (27-62 mmol/L) in 101 (71.12%), whereas increased values were recorded in 41 (28.87%) cases ( $p < 0.00001$ ), with maximal value of 3.2 mmol/L. Decreased values were not recorded in not even one single case.

#### 4. DISCUSSION

In feces examination, there were most frequently isolated various pathogenic bacteria (58.62%), compared to viruses (39.01%), whereas, there were rarely isolated protozoa and only the Giardia-Lambliia (2.15%), while fungi (Candida albicans)

was only in one case (0.23%) isolated. According to the data of Amal Rohan (33) about the children with infectious acute diarrhea in examining feces, viruses were isolated more frequently at 34.3%, then the bacteria at 26.8% and parasites at 42% of the cases. Davidson (39) believes that 50-70% of cases with acute diarrhea are caused by viruses.

According to the authors (5) rotavirus has been isolated in 13.8% cases suffering from acute gastroenteritis. Among children from northern Italy suffering from acute gastroenteritis (39), rotavirus has been isolated in 33.8% from 521 cases. According to the data of Isidore JO Bonkuongou et al. (37), rotavirus has been isolated in 33.8% of cases with acute gastroenteritis. The highest percentage (63%) of cases with positive rotavirus has been registered by T Christopher Mast et al. (38). Šukrija Zvizdić et al. (11) registered 170 (32.2%) of cases with positive rotavirus. According to the data given by Votava (32) rotavirus has been isolated in 8.7% of cases with acute gastroenteritis. The identical percentage (18%) has been registered by Hodić (23). According to data of Teylor et al. (29) rotavirus has been isolated in 48% of cases with acute gastroenteritis in the rural areas of Bangladesh. The lowest percentage of only 4% of cases with rotavirus has been registered by Having among children from South Africa suffering from.

Regarding the types of viruses, the most frequently isolated has been Rotavirus in 86.06% cases, whereas the most rarely isolated has been adenoviruses in 5.45% of cases and norovirus in only one case (0.65%). According to data of Khire Sdiri-Loulizi et al. (2) out of 51.2 % of cases in which the feces examination proved to be positive on different viruses, rotavirus has been isolated in 22.5% of cases, norovirus in 17.4% of cases, astrovirus in 4.1% of case, Aichi virus has been isolated in 3.5% of cases, adenovirus (types 40 and 41) in 2.7% of cases and Sapovirus in 1.0% of cases. Among the children from Tanzania (34) suffering from acute gastroenteritis, rotavirus has been isolated in 18.1% of cases, whereas norovirus in 13.7% of cases. In one study conveyed in Tripoli, Libya (33), the most frequent has been norovirus in 15.3% of cases followed by rotavirus in 13.4 % of cases.

Rotavirus accompanied by adenovirus have been isolated in the same feces sample in 5 (3.03%) cases, whereas in 8 (4.84%) cases it has been isolated together with bacteria (S.Wien, S.Gloucester, enteropathogenic E.coli O86 and O111). The authors (2) in 276 feces samples positive on viruses, only one virus has been isolated in 234 samples, whereas in 42 samples there have been two viruses isolated.

Regarding several socio-demographic characteristics, the biggest number i.e. 62 (43.66%) cases with acute gastroenteritis caused by rotavirus were of the age 6-12 months, then followed by the age 13-24 months 45 (31.60%) cases. Those of male gender were 76 (53.52%) cases and from the rural area there were 81 (57.04%) cases. Other authors (1, 10, 11, 24, 35, 36) have reached almost identical results like ours.

Seasonal spread of our patients with rotavirus gastroenteritis is typical for the developing countries, like our country. The biggest number of cases have been registered during the summer i.e. 58 (40.80% of case, whereas during the autumn 42 (29.50%) cases were registered. In general acute gastroenteritis in Kosovo is still the most frequent during the summer due to high temperatures, bad hygienic conditions, poor health education, water and food contamination by viruses, bacteria and so on. In the developed countries the gastroenteritis caused by ro-

tavirus appears mostly during the winter and spring. According to Khira Sdiri-Louzi et al. (2), the biggest number of cases was registered in January. Children from Bangladesh were mostly afflicted by rotavirus during the summer, above 50% of cases (3). Gianvincenzo Zuccotti et al. (39) registered the biggest number of cases during the March, April and May (spring season), whereas the smallest number of cases was registered during the summer. Isidore Jo Bonkuongou et al from Burkina Faso (37) came to the identical results with the above-mentioned authors regarding the spread of gastroenteritis caused by rotavirus. According to her there were only 2.9% of cases registered during the summer, whereas during the winter there were 53.3% of cases registered in Burkina Faso.

Among the clinical manifestations the most dominant one was diarrhea (98.59%), vomiting (88.02%) and dehydration (100%). The diarrhea was watery in the majority of cases (138), in 4 cases it contained some mucous and the average durability of diarrhea was 5 days. All patients with rotavirus gastroenteritis suffered from dehydration. The sign of moderate dehydration was present in 49.29% of cases, but it should also be mentioned that 14.08% of cases showed signs of severe dehydration that may be life threatening. The patients with severe dehydration were brought to hospital from other regional hospitals of Kosovo, were sent to hospital by instruction of the family doctor or were brought by a parent after the unsuccessful treatment at home. The clinical manifestations in patients were identical with the data of other authors (11, 19, 29, 37, 39), except dehydration that was present in all cases whereas according to the other authors' data it was present 49.4% to 70% of cases, on the other side bloody diarrhea was not present in even one single case whereas the authors (11, 15, 16, 26, 29, 37) registered up to 1.8% of cases with the bloody diarrhea.

Isonatremic dehydration was present in the majority of patients (64.08%). The reason for this is that during mild and moderate dehydration physiological compensatory mechanisms are activated (kidneys, aldosterone and antidiuretic hormone) and they manage to preserve homeostasis of body fluids, sodium concentration in plasma and its osmolarity. 9.85% of patients suffered hypernatremic dehydration that was severe and often with neurologic sequelae. (4 patients suffered from repeated convulsions).

Rotavirus gastroenteritis may also cause severe acid-base disorders, where only in 2.11% of cases the pH values was on the limit of reference values (pH: 7.35-7.45), whereas in other cases metabolic acidosis was present. The pH values in three patients were under 7.0 and that is clinically considered to be the pH value incompatible with life. The peak of curve of pH was from 7.16 to 7.20, and those are the values that require the necessary correction of metabolic acidosis with sodium bicarbonate that is not corrected with use of oral rehydration solution in the regional pediatrics departments and at home. According to the data of Votava (27) the pH values of not even one single patient suffering from rotavirus were above <7.0, whereas the peak of curve was registered to have the pH values from 7.25 to 7.30.

Urea values were increased up to 31.70% (maximal value 26.5 mmol/L), whereas lower creatinine value in 28.87% of patients (maximal values 302 mmol/L) with gastroenteritis rotavirus were not registered in not even one single case. The higher values were registered with patients who suffered the moderate and severe dehydration and with artificial feeding (cow's milk).

Due to dehydration (especially the severe one) hypovolemic shock occurs and is followed by prerenal acute insufficiency. Due to hypovolemia, blood flow in kidneys decreases, as well as glomerular filtration, whereas tubular reabsorption that manifest oliguria and high concentration of urea in blood. Also the cow's milk contains a lot of proteins and if it is not diluted with water it remains undiluted. The high percentage of proteins is not absorbed by organism and therefore it can not be eliminated through kidneys in form of urea and creatinine that causes the increase in their values in blood.

## 5. CONCLUSION

Rotavirus is an important and very frequent cause of infectious gastroenteritis among children under five years of age, especially among children under two years of age and during summer season. Rotavirus gastroenteritis is manifested with very different clinical features such as dehydration, electrolyte, acid-base and other biochemical disorders.

The strategy for rotavirus control include identifying the target population for rotavirus vaccination (rotavirus vaccination is not used in Kosovo), educating parents on how to identify and recognize the signs of dehydration and also to know that rotavirus infection in children is unavoidable and should be looked out for.

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