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CLINICAL AND MICROBIOLOGIC PATTERNS OF ACUTE GASTROENTERITIS IN INFANTS OF DIFFERENT AGE

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ABSTRACT

Objective: Acute gastroenteritis is one of the most common infections in childhood with increased frequency within the first 12 months of life, having higher risk of moderate and severe dehydration. The aim of this study was to to evaluate the clinical pattern of acute gastroenteritis in infants according to the age (0-6 months and 7-12 months), to correlate the severity of the disease related to the type of nutrition and to determine the possible microbiological causes of the acute gastroenteritis in infants in two age groups

Material and Methods: A total of 58 infants with acute gastroenteritis divided into 4 groups based on the feeding patterns (type of milk) were included in the study. Investigated indicators were severity of symptoms, dehydration degree and the need for parenteral rehydration.

Results: It was identified a statistically significant association between group affiliation and severity of symptoms depending on the feeding type between first and second group and between third and fourth group The most common cause of acute gastroenteritis in infants was Rotavirus. Our study has shown that exclusive breastfeeding reduces the risk of Rotavirus infection especially in the first 6 months of life OR=0.0758, 95% CI (0.0071-0.8074).

Conclusion: Breast milk has an effect on the severity of the clinical picture of acute gastroenteritis by reducing the vomiting frequency, the number and severity of diarrheal episodes, the risk of moderate and severe dehydration and fever frequency.

Key words: acute gastroenteritis, Rotavirus, breastfeeding, infants, diarrhea

INTRODUCTION

Acute gastroenteritis is a leading cause of morbidity and mortality in developing and undeveloped countries where malnutrition and poor local health care are responsible for the increased severity of the clinical signs of acute gastroenteritis[1]. Acute gastroenteritis can be particularly dangerous in the first 12 months of life with a higher risk of increased water and electrolyte loss with consequent moderate to severe dehydration. Acute gastroenteritis is defined as a decrease in stool consistency and/or an increase in the frequency of discharges (≥ 3 in 24 hours) with or without fever and vomiting[2]. Acute diarrhea lasts between 7 and 14 days. The incidence of acute gastroenteritis ranges from 0.5 to 2 episodes per child per year in children younger than three years. At this age, acute gastroenteritis is

the most common cause of hospitalization[2]. Rotavirus is the most common cause of acute gastroenteritis, rarer causes are Adenovirus, Norovirus, and Astrovirus. Bacterial pathogens include Salmonella, Shigella, and less commonly Escherichia coli, Campylobacter jejuni, and Yersinia enterocolitica. Enterocyte infection leads to cell death, lumen extrusion, and atrophy of the intestinal villi, resulting in reduced intestinal surface area, with impaired digestive and absorption functions and acute transient malabsorptive diarrhea.

Breast milk is an optimal nutrition for infants and key factor in maintaining health and building the solid ground for growth and cognitive development. Breast milk is not only a source of energy, but also a very complex dynamic biological fluid that has a protective and immunomodulatory role[3]. Human milk is a link between the mother's immune system and the infant's one. Although infants have antibodies vertically transmitted, they remain unprotected when they come in contact with new microorganisms. Breast milk can reduce this risk through the antibodies present in it and thus modify the infant's immune, metabolic and micro flora systems[3]. Human milk has its own immune system and a variety of soluble and cellular components that ensure the development and maturation of the immune system in infants[4]. Breast milk has antimicrobial activity against viruses, bacteria and protozoa, may reduce the incidence of gastrointestinal and non-intestinal infections in infants[5]. A number of studies have confirmed that breastfeeding has a protective role and reduces the risk of diarrhea, especially in infants up to 12 months of age[6-8].

The aims of the study were:

-to evaluate the clinical pattern of acute gastroenteritis in infants according to the age (0-6 months and 7-12 months).

-to correlate the severity of the disease related to the type of nutrition.

-to determine the possible microbiological causes of the acute gastroenteritis in infants in two age groups.

MATERAL AND METHODS

Study design

This was a prospective cohort study started in the period November 15, 2018 until December 31, 2019. The study included newborns and infants from birth to 12 months of age who were diagnosed with acute gastroenteritis. All infants were hospitalized at the Children's Department in Clinical Hospital - Shtip. Parents' written consent was obtained for each infant included in the study after extensive communication with them. An appropriate survey questionnaire was designed and responses were obtained from the infants' mothers. The questionnaire covered the following segments: infant age, nutrition (breast milk, milk formula or cow's milk) and weaning practice. Information on the onset of symptoms of acute gastroenteritis in the last 24 hours before admission, as well as information on the diet and health status of the nursing mother were included. Infants were divided into 4 groups according to age in months and according to milk nutrition and introduction of complementary food.

Group I included newborns and infants from birth to 6 months who were exclusively breastfed. Group II included newborns and infants from birth to 6 months of age who weren't exclusively breastfed and were on mixed milk nutrition. Group III included infants from 7 to 12 months of age in whom, were receiving complementary food and continued breastfeeding. Group IV included infants from 7 to 12 months of age in whom a complementary food was introduced and no breast milk at all but, milk formula or cow's/goat's milk. Exclusively breastfed were infants who were fed only with breast milk and didn't receive additional food or fluids (excluding oral rehydration solution, vitamins, minerals, and medications). The clinical picture and degree of dehydration were determined by physical examination and the degree of dehydration was graded as mild, moderate and severe through the use of a clinical scoring system. (World Health Organization: Integrated management of childhood illness-Module 4, Diarrhea). For each infant included in the study, a record sheet was filled and according to the severity of the clinical signs the need for parenteral rehydration was assessed during the hospital stay. The study didn't include infants whose diarrhea was due to a surgical or extra-intestinal cause, as well as infants who had received immunosuppressive therapy.

Laboratory methods

From each infant included in the study, one sample of diaper stool was taken with a plastic spatula. This stool sample was collected in a sterile plastic cup with the general data of the patient and the code written on it and within 30 minutes was brought to the Microbiological Laboratory in the Center for Public Health (CPH) - Shtip. In this stool sample the presence of Rotavirus and

Adenovirus with Immunochromatographic test (DUO ROTA-ADENOVIRUS - Check-1 VEDA.LAB, Alencon-France) was analyzed. From the same stool sample, a coproculture was performed which was supposed to identify the presence of enteropathogenic bacteria by sowing the stool sample on a suitable substrate.

Statistical analysis

The collected data were processed using the statistical program SPSS 20 and the following statistical methods:

-Descriptive method: attributive statistical series were analyzed by determining percentages and numerical series with central tendency measures and with data dispersion measures.

-Statistical significance of the probability between the distributions of the frequencies of two attributive variables was estimated by the Difference test, and between the numerical series exploring the Student t-test.

-The Odds ratio-OR cross-correlation is used to determine the relationship between the dependent-criterion variable and the independent. For CI (confidence interval 95% CI) statistical significance was defined at the level of standard error less than 0.05 (p). The results are shown in tables and figures.

RESULTS

The analysis included 58 hospitalized infants from birth to 12 months of age with a diagnosis of acute gastroenteritis, divided in four groups.

The first group included 7(12.1%) infants, the second group included 16(27.6%), the third group included 19(32.7%) and the fourth group included 16(27.6%) infants divided by age expressed in months and type of nutrition.

Table 1 and Table 2 present the infants with acute gastroenteritis by gender and sex

The average infant age in the first group was 2.1±0.9 months, in the second group was 3.4±1.5 months, in the third group was 9.3±1.2 months and in the fourth group it was 9.5±1.4 months.

Table 1. Distribution of the infants according to the gender and age (I and II group)

Group	I		II	
Gender	Number	%	Number	%
Male	4	57.1	9	56.25
Female	3	42.9	7	43.75
Age in months	Number	Mean ! SD	Number	Mean ! SD
	7	2.1 ! 0.899735	16	3.4 ! 1.454877

SD: Standard deviation

Table 2. Distribution of the infants according to the gender and age (III and IV group)

Group	III		IV	
Gender	Number	%	Number	%
Male	11	57.9	6	37.5
Female	8	42.1	10	62.5
Age in months	Number	Mean ! SD	Number	Mean ! SD
	19	9.3 ! 1.249561	16	9.5 ! 1.366260

SD: Standard deviation

The distribution of the clinical signs in the first two groups is presented in Table 3, which included the average number of vomiting, average number of liquid stools, fever, degree of dehydration, number of days of parenteral rehydration and length of hospital stay. The average number of vomiting 24 hours before admission in infants in the first group was 0.3±0.5, in the second group was 4.6±3.3, the difference was statistically significant (p=0.002669). The average number of liquid stools in infants 24 hours before admission in the first group was 3.7±0.8, in the second group 10.4±4.9, and the difference was statistically significant (p=0.002152). Fever was reported in 14.3% of infants in the first group and in 81.25% in the second group, with statistically significant percentage difference (p=0.0025). All infants from the first group had mild degree of dehydration, in the second group a mild degree of dehydration was registered in 25.0%, moderate in 43.75% and a severe degree of dehydration in 31.25% of infants. The average number of liquid stools during treatment in the first group was 9.0±2.2, and in the second group was 21.2±8.5, the difference between the average number of liquid stools was statistically significant (p=0.001419). The average number of vomiting during treatment in the first group was 0.3±0.8, and in the second group was 3.0±2.4, the difference between the average number of vomiting was statistically significant (p=0.008516). The average number of parenteral rehydration days in the first group was 0.7±0.8, and in the second group it was 2.0±1.0, the difference between the average number of parenteral

rehydration days was statistically significant (p=0.005246). The average number of hospital days (lenght of stay) in the first group was 4.1±1.6 and in the second group it was 4.9±1.8, the difference between the average number of hospital days was statistically insignificant for p>0.05 (p=0.318302).

Table 3. Clinical condition 24 hours before admission and during the hospitalization (I and II group)

Group Number of vomiting 24 hours before admission	Average I	Average II	t-test	p	N I	N II	SD I	SD II
	0.285714	4.56250	-3.40460	0.002669	7	16	0.487950	3.265348
Number of stools 24 hours before admission	3.7	10.4	-3.49610	0.002152	7	16	0.755929	4.951431
Number of stools during the hospitalization	9.0	21.2	-3.67211	0.001419	7	16	2.236068	8.549610
Number of vomiting during the hospitalization	0.3	3.0	-2.90250	0.008516	7	16	0.755929	2.394438
Number of parenteral rehydration days	0.7	2.0	-3.11436	0.005246	7	16	0.755929	0.966092
Number of hospitalization days	4.1	4.9	-1.02224	0.318302	7	16	1.573592	1.768945

SD: Standard deviation; N: Number

The distribution of the clinical signs in the second two groups is presented in Table 4. The average number of vomiting 24 hours before admission in infants in the third group was 2.7±3.3 in the fourth group was 4.6±3.3 the difference was statistically insignificant (p=0.113598). The average number of liquid stools in infants 24 hours before admission in the third group was 5.9±2.4, in the fourth group 9.0±4.2 and the difference was statistically significant (p=0.011505). Fever was reported in 26.3% of infants in the third group and in 68.75% in the fourth group with statistically significant percentage difference (p=0.0120). In the third group 78.9% of infants had mild degree of dehydration and 21.1% of infants had moderate degree of dehydration. In the fourth group mild degree of dehydration was registered in 18.75% of infants, moderate in 62.5% and severe degree of dehydration in 18.75% with statistically significant percentage difference between the two groups for mild (p=0.0004) and for moderate degree of dehydration (p=0.0128). The average number of vomiting during treatment in the third group was1.4±1.9, in the fourth group was 3.4±3.0 the difference between the average number of vomiting was statistically significant (p=0.025661). The average number of liquid stools during treatment in the third group was 14.1±7.9, and in the second group was 18.6±10.3 the difference between the average number of liquid stools was statistically insignificant (p=0.152484). The average number of parenteral rehydration days in the third group was 1.7±1.2 and in the fourth group it was 2.1±1.1 the difference between the average number of parenteral rehydration days was statistically insignificant (p= p=0.336684). The average number of hospital days (length of stay) in the third group was 3.9±1.6 and in the fourth group was 4.9±1.4 the difference between the average number of hospital days was statistically insignificant (p=0.054966)

Table 4. Clinical condition 24 hours before admission and during the hospitalization (III and IV group)

Group Number of vomiting 24 hours before admission	Average III	Average IV	t-test	p	N III	N IV	SD III	SD VI
	2.736842	4.562500	-1.62537	0.113598	19	16	3.280280	3.346018
Number of stools 24 hours before admission	5.9	9.0	-2.67615	0.011505	19	16	2.391505	4.242641
Number of stools during the hospitalization	14.1	18.6	-1.46463	0.152484	19	16	1.865350	3.03040
Number of vomiting during the hospitalization	1.4	3.4	-2.33692	0.025661	19	16	1.865350	3.03040
Number of parenteral rehydration days	1.7	2.1	-0.97494	0.336684	19	16	1.240166	1.08781
Number of hospitalization days	3.9	4.9	-1.98968	0.054966	19	16	1.629408	1.43614

SD: Standard deviation; N: Number

Rotavirus was positive in 26 stool samples with a prevalence rate of 44.8%. Rotavirus was positive in one (14.3%) infant in the first group, in 11(68.75%) in the second group, in 6(31.6%) in the third group, and in 8(50%) infants in the fourth group. In one infant from the second group was isolated Shigella flexneri and in one infant from the same group was isolated Adenovirus. In the fourth group Salmonella enteritidis was isolated in two infants, Proteus mirabilis in one infant and Adenovirus in one infant also (Figure 1).

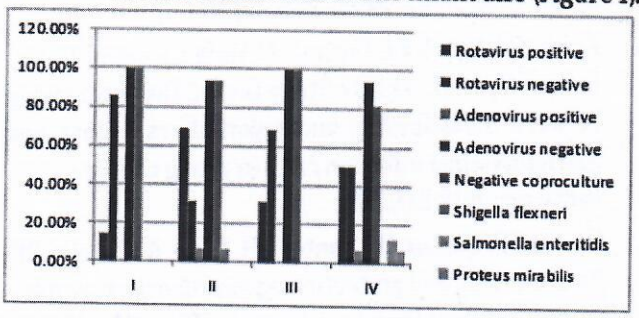

Figure 1: Microbiological findings in stool

DISCUSSION

Several studies have confirmed that breastfeeding has a protective role and reduces the risk of diarrhea, especially in infants up to 12 months of age. Frank et al. 2019[6] have shown that breastfeeding can play a protective role against respiratory and gastrointestinal acute illness in infants for at least the first 6 months of life by continuing to play the same role if breastfeeding continues after the sixth month of life. It has been observed that infants who are exclusively breastfed for up to 6 months and in which breastfeeding is continued for up to 12 months, have a lower rate of hospitalizations due to diarrhea, while in infants who have been fed with milk formula have had a higher incidence and rate of hospitalizations due to diarrhea[7]. Dialo et al. 2019[8] noticed that breastfeeding discontinuation before the third month was found to be significantly associated with a high incidence of diarrhea at 6 months of age and between 6 and 12 months. Breastfeeding discontinuation (weaning) before the sixth month was also associated with a higher incidence of diarrhea at 6 months of age. Infants who were on milk formula for ≥ 3 months had a higher incidence of diarrhea between 6 and 12 months.

In the studies by Duffy et al., 1986[9] and Misra et al. 2007[10] was found that there was no difference in the incidence of Rotavirus diarrhea among exclusively breastfed and non-exclusively breastfed infants. Contrary to these claims, a study by Maranhão et al. 2008[11] found that diarrhea was more common in infants less than 6 months of age who were not breastfed or were on non-exclusive breastfeeding. Krawczyk et al. 2016[12] and Plenge-Bönig et al. 2010[13] have found that exclusive breastfeeding is effective in preventing Rotavirus infection by reducing the risk of Rotavirus infection in children, especially in the first 6 months of life. Some studies have shown that Rotavirus is a more common cause of acute gastroenteritis in infants than Adenovirus[14,15]. These results support our findings that the most common cause of acute gastroenteritis in infants was Rotavirus. In this study, clinical signs and symptoms 24 hours before hospital admission were evaluated and clinical condition during treatment was assessed, as well as the need for parenteral rehydration, and the length of hospitalization. A statistically significant difference ($p<0.05$.) for the average number of vomiting before admission was registered between the first and second group with less frequent vomiting in exclusively breastfed infants in the first group, while between the third and fourth group that difference was insignificant ($p>0.05$). Regarding the number of liquid stool 24 hours before admission, high statistically significant difference was registered between the first and second group and less statistically significant difference between the third and fourth group. It has been proved that there is a statistically significant percentage difference for fever between the first two and between the second two groups. Sherif et al., 2015[16] did not prove statistical significance for the degree of dehydration between groups, but in our study all infants from the first group who were exclusively breastfeed had a mild degree of dehydration while in the second group only 25% of infants had a mild degree of dehydration, the rest had a moderate and severe degree of dehydration. Regarding the degree of dehydration in infants between the third and fourth group, it was noted that the mild degree of dehydration is more present in the third group while moderate degree of dehydration is more common in the fourth group. Similar results were obtained in a study by Fuchs et al. 1996[17]. In the present study vomiting during treatment was less common in infants in the first group versus the second group and in the third versus the fourth group with a statistically significant difference between the average number of vomiting by $p<0.05$. In the study of Weinberg et al. 1984[18] was shown that the vomiting frequency was significantly lower in breastfed infants. A study by Eaton-Evans and Dugdale, 1987[19]

found that infants up to 6 months of age had a lower number of liquid stools and a lower vomiting frequency in those who were breastfed compared to other types of milk, indicating that breast milk has a protective effect on the intestines of infants younger than 6 months. In infants older than 6 months, the protective role of breast milk was not confirmed. Regarding the average number of liquid stool during the treatment, there was a statistical significance for $p<0.05$ between the first and second group, but not for the third and fourth group $p>0.05$. In the study of Weinberg et al. 1984[18] it was noticed that there was no significant difference between the groups for diarrhea duration, the number of liquid stools in 24 hours period of time, or the fever frequency. In this study, it was observed statistical significance for the number of days of parenteral rehydration between the first and second group but not betwean third and the fourth group. For the number of hospital days, no statistical significance was proved either between the first and the second group and betwean the third and the fourth group In contrast to our results in a study by Boccolini et al. 2012[20] was shown that the increase in the prevalence of exclusive breastfeeding in infants younger than 4 months with acute diarrhea has a negative correlation with the duration of hospitalization (Rho=-0.483, p=0.014). This study has shown that exclusive breastfeeding is effective in preventing Rotavirus infection by reducing the risk of Rotavirus infection in children especially in the first 6 months of life OR=0.0758, 95% CI(0.0071-0.8074).

CONCLUSION

This study gives support to the findings that breast milk has strong effect on the severity of the clinical signs of acute gastroenteritis by reducing the vomiting frequency, the number and severity of diarrheal episodes, the risk for moderate and severe dehydration and fever frequency. The study will be continued exploring additional effects of the breast milk on the gastrointestinal function.

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