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Viral Diarrhea in HIV-Positive Children: Clinical and Immunological Features

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Abstract The virological and immunological characteristics and changes in HIV-positive children with viral diarrhea were studied and analyzed in this article. Viral diarrhea is a significant cause of morbidity and mortality in HIV-positive children, exacerbated by their compromised immune systems. This review explores the clinical and immunological features of viral diarrhea in pediatric HIV patients, focusing on common pathogens such as rotavirus, norovirus, and adenovirus. Clinical manifestations often include prolonged and severe diarrhea, dehydration, and malnutrition, which contribute to worse outcomes compared to HIV-negative children. Immunologically, the depletion of CD4+ T cells and impaired mucosal immunity in HIV-infected children increase susceptibility to persistent and recurrent viral infections. Understanding these clinical and immunological dynamics is crucial for improving diagnostic, therapeutic, and preventive strategies in this vulnerable population. Further research is needed to optimize management and reduce the burden of viral diarrhea in HIV-positive children.

Keywords HIV infection, Diarrhea, Rotavirus, Adenovirus, Norovirus

1. Introduction

Today, the global spread of HIV remains one of the greatest threats to human security. This issue was officially acknowledged by the United Nations General Assembly in its founding document, the "Declaration of Commitment on HIV/AIDS." According to the World Health Organization (WHO), by 2021, approximately 38.4 million people were living with HIV worldwide, including 1.7 million children. Newborns can contract HIV from their mothers in three ways: during pregnancy, at the time of birth, and through breastfeeding [1,5,7].

Acute intestinal infections also remain a pressing public health concern due to their widespread nature, severe clinical course, potential complications, and their tendency to cause long-term gastrointestinal disorders. While bacterial infections are more familiar to many healthcare providers, viruses are responsible for 30–40% of acute diarrhea episodes in young children, with rotavirus being the leading cause in 60–80% of cases. In immunocompromised individuals—such as organ transplant recipients, cancer patients receiving chemotherapy, and individuals with HIV/AIDS—viral infections of the gastrointestinal tract can lead to serious complications and even death, despite adequate medical care. Recently, reports of viral diarrhea caused by non-rotavirus agents have increased, prompting the need to better understand the main viruses responsible for epidemic outbreaks of acute gastroenteritis.

Viral diarrhea often begins suddenly and can rapidly lead to dehydration. If properly treated with timely rehydration, outcomes are usually positive. However, these viruses show strong resistance to environmental conditions and remain highly contagious even when containment measures are applied. Patients may continue shedding the virus even after recovering clinically, and there is ongoing debate about potential aerosol transmission. Dehydration occurs rapidly due to the breakdown of disaccharides and lipids without changes in adenyl cyclase or sAMF levels, leading to damage of intestinal cells and resulting in secondary lactose intolerance [5,8,11].

In HIV-infected individuals, many pathogens can cause enteritis or enterocolitis, leading to acute, chronic, or recurrent diarrhea. In children, common culprits include *Salmonella spp.*, *Shigella spp.*, *Campylobacter jejuni*, *Giardia lamblia*, *Cryptosporidium parvum*, cytomegalovirus, adenovirus, rotavirus, and herpes simplex virus. Studies show that viruses are responsible for around 80% of intestinal infections in children. Rotavirus accounts for up to 50% of cases, and norovirus for around 30% in developed countries. The range of identified viral agents continues to expand, now including astrovirus, adenovirus, and torovirus [4,7,14].

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Monitoring liver enzymes, pancreatic enzyme activity, and bilirubin levels is essential to ensure the safety of antiretroviral therapy. If signs of hepatitis or pancreatitis emerge during treatment, it's necessary to switch medications. Gastrointestinal damage in HIV-infected children plays a key role in the disease's clinical picture and influences both its progression and outcome. These children are prone to diarrhea due to intestinal changes triggered by various fecal-oral infections. Dysfunction of the gastrointestinal system has a major impact on their nutrition and immune function, which can impair growth, physical development, and even central nervous system maturation. HIV affects all parts of the digestive tract [6,7].

2. Purpose of the Research

To study of clinical and laboratory features of viral diarrhea in HIV-infected children. The purpose of this research is to investigate the clinical and immunological characteristics of viral diarrhea in HIV-positive children, with the aim of improving understanding, diagnosis, and management of this condition.

3. Material and Methods

In the course of the study, children under the age of 18 were divided into two groups. The main group included 110 HIV-positive children who were diagnosed with viral diarrhea, while the control group consisted of 70 children with viral diarrhea but without HIV infection.

The diagnosis of HIV in children was carried out in accordance with official guidelines: the "National Clinical Protocol for the Organization and Delivery of Medical Care to Individuals with Confirmed HIV Status" (Order No. 206 dated August 19, 2021, issued by the Ministry of Health of the Republic of Uzbekistan), and Order No. 122 dated March 25, 2015, "On Measures to Improve the Control of Typhoid Fever, Paratyphoid Fever, Salmonellosis, and Acute Intestinal Infections."

4. Results and Discussion

To evaluate the severity of acute infectious diarrhea in HIV-infected children, several factors were taken into account. These included the degree of dehydration (as defined by WHO criteria), the frequency and duration of diarrhea episodes, as well as the physical characteristics of the stool —such as form, consistency, odor, color, volume, and the presence of pathological inclusions. Diagnoses were established through a combination of patient-reported symptoms, clinical examinations, anthropometric measurements, and laboratory analyses including serological, bacteriological, immunological, virological, and instrumental diagnostic methods.

Table 1. Distribution of patients in the main and control groups by gender

Gender	Main group, n=110		Control group, n=70	
	abs.	%	abs.	%
B	79	71,8	44	62,9
G	31	28,2	26	37,1

In the main group, 79 patients (71.8%) were male and 31 (28.2%) were female. In the control group, boys accounted for 62.9% and girls for 37.1%. Overall, the majority of patients in both the main and control groups were male.

Table 2. Age distribution of patients in the main and control groups

Age of the patient	Main group, n=110		Control group, n=70	
	abs.	%	abs.	%
0-3	1	0,91	7	10,0
3-7	2	1,8	34	48,6
7-14	42	38,2	29	41,4
14-18	65	59,1	0	0

In our study, age-based grouping showed that in the main group, the majority of patients were between 14–18 years old (65 children, 59.1%), followed by those aged 7–14 years (42 children, 38.2%). Children aged 0–3 years were rarely represented, with only 1 child (0.91%) in this age group. In the control group, there were no patients aged 14–18 years. The majority were between 7–14 years (48.6%) and 3–7 years (41.4%). Children under 3 years of age accounted for a smaller portion, with only 7 cases (10%).

Table 3. Clinical stages of HIV-infection in the main group

Stages of HIV-infection	Main group, n=110	
	abs.	%
I	0	0
II	28	25,4±6,61
III	82	74,5±4,2
IV	0	0

Analysis of the clinical stages of HIV infection among patients in the main group revealed that stages I and IV were not observed in any of the cases. Clinical stage II was identified in 28 patients (25.4%), while the majority—82 patients (74.5%)—were diagnosed at clinical stage III.

Table 4. Immunological indicators in the main group

CD4+lymphocyte count	Main group, n=110	
	abs.	%
>500	66	60,0±4,7
200-499	40	36,4±4,6
<200	4	3,6±1,8

An analysis of the immunological parameters, as presented in Table 4, showed that 66 patients (60%) in the main group had normal CD4+ lymphocyte counts, indicating no signs of immunodeficiency. Moderate immunodeficiency was observed in 40 patients (36.4%), while severe immunodeficiency was identified in a small number of cases—only 3.6% of the children.

Table 5. Viral load in the main group

HIV RNA copy	Main group, n=110	
	abs.	%
No viral count	17	15,5±3,5
less than 1000	85	77,3±4,0
1000-10000	2	1,8±1,3
10000-100000	2	1,8±1,3
100000-500000	1	0,91±0,91
500000-1000000	2	1,8±1,3
more than 1000000	1	0,91±0,91

According to the analysis of viral load results based on immunological tests (Table 5), 17 patients (15.5%) in the main group showed no detectable HIV RNA in their blood. Among the remaining HIV-infected children with viral diarrhea, 85 patients (77.3%) had detectable viral loads. The distribution of viral load levels—less than 1,000, 1,000–10,000, 10,000–100,000, and 500,000–1,000,000 HIV RNA copies/mL—was relatively uniform, with each category accounting for approximately 1.8% of cases ($P > 0.05$). Viral loads between 100,000–500,000 and those exceeding 1,000,000 copies/mL were observed at about half the frequency compared to the 1,000–10,000 and 10,000–100,000 categories, recorded in only 0.91% and 1.8% of cases respectively ($P > 0.05$), suggesting no statistically significant difference.

Table 6. Occurrence of clinical signs in the main and control groups

Clinical signs	Main group, n=110		Control group, n=70	
	abs.	%	abs.	%
Fever	70	63,6±4,6***	38	54,3±6,0***
Fatigue	110	100,0±0,0	70	100,0±0,0
Headache	35	31,8±4,5*	20	28,6±5,4**
Nausea	31	28,2±4,3	17	24,3±5,2
Vomiting	16	14,5±3,4^	19	27,1±5,4**
Abdominal pain	42	38,2±4,7	24	34,3±5,7
Meteorismus	37	33,6±4,5**	20	28,6±5,4**
Decreased appetite	110	100,0±0,0	70	100,0±0,0
Abdominal cramps	64	58,2±4,7	34	48,6±6,0*

Clinical examination revealed that weakness and loss of appetite were present in all patients (100%) across both the main and control groups. Among the common symptoms of intoxication, fever was observed more frequently in the main group (63.6%) compared to the control group (54.3%). Headaches were reported in approximately one-third of patients in both groups. Abdominal cramps were experienced by nearly half of the patients in each group, while abdominal pain was noted in around one-third of the cases, with similar frequency across both groups. Notably, abdominal distension was twice as common in the main group compared to the control group.

Table 7. General fecal analysis in patients in the main and control groups

Fecal analysis	Main group, n=110		Control group, n=70	
	abs.	%	abs.	%
Leukocyte 10-20 in the field of view	18	16,4±3,5	11	15,7±4,4
Mucus	35	31,8±4,5*	17	24,3±5,2
Iodophilic flora	42	38,2±4,7**^	18	25,7±5,3***
Neutral fat feces +++/+	40	36,4±4,6*	22	31,4±5,6
Soap	28	25,5±4,2	13	18,6±4,7
Fatty acids +++/+	60	54,5±4,8*	29	41,4±5,9
Undigested fiber +++/+	51	46,4±4,8*	26	37,1±5,8**
Non-digestible muscle fibers	43	39,1±4,7	22	31,4±5,6
Starch +++/+	41	37,3±4,6	19	27,1±5,4*
Connective tissue	35	31,8±4,5^	13	18,6±4,7*
Crystals	27	24,5±4,1	11	15,7±4,4*
Epithelium	29	26,4±4,2	12	17,1±4,5*

The presence of elevated leukocyte counts in stool samples was observed at nearly equal rates in both the main and control groups—16.4% and 15.7% of cases, respectively. Increased mucus content was more frequently detected in the main group (31.8%) compared to the control group (24.3%), a difference that was statistically significant ($P < 0.05$). Similarly, a higher prevalence of iodophilic flora was noted in the main group (38.2%) than in the control group (25.7%) ($P < 0.05$). Neutral fats, undigested muscle fibers, and starch were found in approximately one-third of patients in both groups, while fatty acids were more commonly identified —54.5% in the main group and 41.4% in the control group. An increased amount of undigested cells was also observed. Additionally, elevated levels of crystals and epithelial cells in feces were recorded in 24.5% and 26.4% of patients in the main group, which was nearly 1.5 times higher than in the control group (15.7% and 17.1%, respectively), also with statistical significance ($P < 0.05$).

5. Conclusions

1. **Gender Distribution**: In both the main and control groups, the disease was more prevalent among boys, accounting for 71.8% of cases in the main group and 62.9% in the control group.
2. **Clinical Stage of HIV**: Among patients in the main group, only clinical stages II and III of HIV infection were identified, occurring in 25.4% and 74.5% of cases, respectively.

3. **Immunological Characteristics**: Immunological assessment revealed that severe immunodeficiency was rare in the main group, found in only 3.6% of patients. Additionally, the majority of these children (77.3%) had a low viral load, with HIV RNA levels below 1,000 copies/mL.
4. **Clinical Symptoms**: Weakness and loss of appetite were universal symptoms, observed in 100% of patients across both groups. Fever was the most common sign of intoxication, reported more frequently in the main group (63.6%) than the control group (54.3%). Headaches were noted in roughly one-third of patients in both groups.

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