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Observational Study of Rotavirus Related Gastrointestinal Tract Infection in Pediatric Age Group in Kut City Hospitals

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Abstract

In this study, the prevalence and impact of rotavirus infections on pediatric patients under six years old were investigated. Rotaviruses emerged as a predominant cause of severe diarrheal illness in newborns and young children globally. A comprehensive observational study in Al Kut city from May to September 2022 included 99 cases, revealing a 46.5 % positive rate for rotavirus. Statistical analysis indicated a significant association between rotavirus infection and increased frequency of diarrhea episodes (P=0.004) and severe dehydration (P=0.001). Moreover, rotavirus-positive cases were more likely to require intravenous fluid therapy (P=0.02). These findings underscore the substantial burden of rotavirus on both the healthcare system and society, emphasizing its role as a major contributor to infant gastroenteritis, often leading to severe complications and hospitalization.

Keywords: Rotavirus, gastroenteritis, dehydration.

1. Introduction

Rotavirus is the most common cause of severe diarrheal illness in newborns and young children worldwide. The virus was first isolated from the cytoplasm of mature epithelial cells lining duodenal villi and from the feces of children complaining of diarrhea. This discovery was made in 1973 by Ruth Bishop and her colleagues, and at that time, no other infectious agents could be identified from their stool samples [1]. Rotaviruses are categorized as a genus within the Reoviridae family. These viruses are double-stranded RNA viruses and are often described as

"wheel-shaped" when viewed under electron microscopy. The triple-layered viral particle contains a viral genome consisting of 11 double-stranded RNA genome segments that code for both structural and non-structural viral proteins (NSPs) [2]. At least 11 distinct VP4 antigens (P-types) and 11 distinct VP7 antigens (G-types) have been discovered in humans, indicating the diversity of rotaviruses in terms of their surface proteins.

Rotaviruses are known to be released in very high numbers and can persist in the stool and vomit of affected individuals for several days. The primary mode of transmission is through the fecal-oral route, which can occur directly from person to person or indirectly through contact with contaminated objects (fomites). Rotaviruses are categorized into ten different species, denoted as species A through J. Among these species, species A is the most common and is responsible for most rotavirus infections in children. Species B and C also account for a smaller but still significant portion of infections globally. This diversity in rotavirus species and strains underscores the need for effective vaccination and public health measures to prevent the spread of the virus [3].

Rotavirus infections have a significant global impact, leading to approximately two million hospital admissions and over 25 million outpatient visits each year. In developed countries, the first episode of rotavirus diarrhea typically occurs between the ages of two and five years. However, in underdeveloped countries, a staggering 75 % of children experience rotavirus infection before reaching the age of twelve months. Children between the ages of 6 and 24 months are particularly at risk for severe rotavirus gastroenteritis. Tragically, rotavirus contributes to the death of about 600,000 children every year. Sub-Saharan Africa and South Asia account for more than 80 % of all rotavirus-related deaths. It's estimated that approximately 5 % of all deaths in children under the age of five worldwide are attributable to rotavirus infections. Furthermore, rotavirus is often considered a winter illness, especially in more temperate regions of the world. This information underscores the significant public health challenge posed by rotavirus and the importance of vaccination and preventive measures, particularly in regions where the disease has a high impact [4].

Tropical areas typically experience less of a seasonal trend and have more year-round occurrences of rotavirus infections. In temperate areas, however, the frequency of rotavirus infections may be correlated with the amount of precipitation. A study

conducted in Washington, D.C., found that months with lower precipitation levels were associated with a 45 % greater increase in rotavirus-related hospitalizations compared to months with higher precipitation levels. This indicates that environments with lower humidity, such as those found in winter and dry months throughout the year, may facilitate increased rotavirus transmission. The study suggests that environmental factors, like humidity and precipitation, can play a role in the prevalence of rotavirus infections in certain regions [5].

Rotavirus multiplies within the lumen of the small intestine, particularly in mature enterocytes. This viral infection leads to changes in the epithelial cells of the small intestine, which can have several effects on the digestive process. One effect is that an osmotically active food bolus is transported into the large intestine. This change impairs water absorption in the large intestine, leading to increased water content in the stool. This alteration in water absorption is a key factor in the typical watery diarrhea associated with rotavirus infections. Additionally, rotavirus infection may increase intestinal motility, which refers to the movement and contractions of the intestines. This increased motility can further contribute to the diarrhea observed in rotavirus-infected individuals. However, the exact mechanism and reason for this increase in intestinal motility are not fully understood and may be a subject of ongoing research.

In summary, rotavirus-induced diarrhea is primarily caused by impaired water reabsorption in the large intestine, resulting in watery diarrhea, and increased intestinal motility may also play a role in this process [6]. Rotavirus symptoms typically manifest suddenly with various presentations following an incubation period of one to three days. While rotavirus infections can lead to more severe symptoms than some other gastrointestinal illnesses, the symptoms are essentially similar [7]. In rotavirus infections, watery diarrhea often follows early vomiting, approximately 33 % of infected individuals may experience fever. It typically takes five to seven days for symptoms to fully resolve after the onset of the illness. Patients who experience their first infection after the age of three months tend to have more severe symptoms. It's worth noting that certain newborns have been found to exhibit necrotizing enterocolitis because of rotavirus infection [8].

Physical examination findings can sometimes make it challenging to distinguish between rotavirus and other viruses that commonly affect the gastrointestinal system.

Symptoms such as fever, stomach cramps, fatigue, and signs of dehydration, including dry mucous membranes, reduced skin turgor, increased heart rate (tachycardia), reduced urine output, and prolonged capillary refill time, may all be observed in individuals with rotavirus infection [9].

The goal of rotavirus treatment is to alleviate symptoms and prevent or manage dehydration. Oral rehydration salt solutions (ORS) are recommended for children with mild to moderate dehydration. These solutions can be prepared using the World Health Organization (WHO) formulation or any of the various commercial formulations available. In cases of severe diarrhea, uncontrollable vomiting, altered consciousness if the child is unable or unwilling to swallow, intravenous fluids should be administered [7]. Furthermore, to help alleviate symptoms and control diarrhea in adults' medications like, codeine, loperamide, and diphenoxylate may be prescribed. Bismuth salicylate has also been found effective in treating rotavirus symptoms, although it should be considered only after ruling out other potential infectious agents [10].

The oral administration of human serum immunoglobulins can have a significant positive impact on a patient's clinical condition and stool patterns [11]. Further research indicates that medications such as ondansetron, zinc, and probiotics may also prove useful in managing acute gastroenteritis. Over the years, several rotavirus vaccines have been developed. Most of these vaccines are live-attenuated versions of strains naturally found in the virus [3]. Various methods, such as polyacrylamide gel electrophoresis, antigen detection assays, reverse transcription polymerase chain reaction (RT-PCR), and virus isolation, can be used to identify rotavirus in stool samples from children with gastroenteritis. The use of antigen detection techniques, like commercially available ELISAs and immunochromatographic assays, is common. These tests typically exhibit high specificity and sensitivity. In many research laboratories, RT-PCR is employed to detect the viral genome. The goal of this study is to gain a comprehensive understanding of the epidemiological prevalence of rotavirus-related gastrointestinal infections in pediatric patients at the hospitals in the center of Al Kut city. The study aims to assess the severity of these infections and determine appropriate management strategies for such cases.

2. Materials and methods

An observational study was conducted on pediatric patients under the age of six months

who presented with symptoms of gastroenteritis during the period from May to September 2022. Cases were collected from various hospitals in Al Kut city through a questionnaire that included demographic information and the history of the present illness for each patient. Stool samples were also collected for the purpose of conducting an immunochromatographic assay using the rotavirus rapid test device by EcotestTM.

The information obtained from these cases was processed and analyzed using Excel and the SPSS statistical software. This analysis aimed to assess the prevalence, demographic distribution, symptoms (including their duration), treatment methods, and their relationship with rotavirus-positive cases.

3. Results

Ninety-nine cases were collected, all of whom reported varying degrees of gastrointestinal symptoms. The mean age of all the cases was 10 months. The collected cases include, 71 (72 %) resided in urban areas. Out of the total cases 46 were tested positive for rotavirus, representing 46.5 % of the total cases as shown in (table 1). There was no statistically significant correlation between rotavirus positivity and gender, residence, or treatment location. However, a statistically significant association was observed in relation to age, with a concentration around the mean age of eight months old. As for the symptoms, their severity, and duration, it was observed that rotavirus-positive cases had a slightly higher temperature 38.4 °C compared to the negative cases of 38.1 °C, with no statistical significance as shown in (table 2). The results revealed a higher number of vomiting episodes per day and a longer duration of this symptom, but without reaching statistical significance as listed in (table 3).

Additionally, it was observed that rotavirus-positive cases experienced a higher number of diarrhea episodes per day, with a mean of 7.1 episodes (table 4). This suggests a relationship between rotavirus infection and the frequency of daily diarrhea episodes. However, there was no observed relationship between rotavirus infection and the duration of this symptom. In our observation, there was no discernible relationship between positive cases and the duration of all symptoms. The positive cases have a higher percentage of individuals reporting severe dehydration compared to the negative cases, whereas the negative cases tend to have a higher number of individuals falling into the 'moderate or no dehydration' category as shown in (table 5).

Table 1: The demographic distribution of rotavirus case negative, and positive.

		Fr. (%)	Gender		Residence		Treatment location		Age
			Male	Female	Urban	Rural	Outpatient	Wards	
Rotavirus	Positive	46 (46.5 %)	30 (65 %)	16 (35 %)	32 (70 %)	14 (30 %)	23 (50 %)	23 (50 %)	8 Months
	Negative	53 (53.5 %)	32 (60 %)	21 (40 %)	39 (74 %)	14 (26 %)	26 (49 %)	27 (51 %)	12 Months
Total cases		99	62(63 %)	37 (37 %)	71 (72 %)	28 (28 %)	49 (49.5 %)	50 (50.5 %)	10 Months
P-value		<0.001	0.62		0.65		0.9		0.044

Table 2: Cases fever and temperature.

		Fever		Temperature
		Yes	No	
Rotavirus	Positive	45 (98 %)	1 (2 %)	38.4 °C
	Negative	50 (94 %)	3 (6 %)	38.1 °C
Total cases		95 (96 %)	4 (4 %)	38.3 °C
P-value		0.38		0.12 °C

Table 3: Cases episodes of vomiting and the duration.

		Vomiting		Number of episodes per day	Duration of symptoms per days
		Yes	No		
Rotavirus	Positive	40 (87 %)	6 (13 %)	4.1	3.9
	Negative	39 (74 %)	14 (26 %)	3.2	3.2
Total cases		79 (80)	20 (20 %)	3.6	3.5
P-value		0.09		0.18	0.25

Table 4: Cases episodes of diarrhea and the duration.

		Diarrhea**l**		Number of episodes per day	Duration Per days
		Yes	No		
Rotavirus	Positive	53 (100 %)	0	7.1	4.78
	Negative	46 (100 %)	0	5.7	4.6
Total		99 (100 %)	0	6.3	4.69
P-value				0.004	0.7

Table 5: Cases degree of dehydration.

		Degree of dehydration		
		None	Moderate	Severe
Rotavirus	Positive	1 (2.2 %)	14 (30.4 %)	31 (67.4 %)
	Negative	6 (11 %)	31 (59 %)	16 (30 %)
Total		7 (7.1 %)	45 (45.5 %)	47 (47.5 %)
P-value		0.001		

There was a significant relationship between rotavirus-positive cases and the use of intravenous fluid as the primary treatment. Regarding vaccination, there were 13 confirmed cases of vaccination nine in the negative cases and four in the positive cases. However, no relationship was found between vaccination and the acquisition of rotavirus as shown in (table 6).

Table 6: Cases treatment.

		Oral rehydration solution (ORS)		Duration of treatment by ORS cases per days	Intravenous fluid (IVF)		Duration of treatment by IVF cases per days
		Yes	No		Yes	No	
Rotavirus	Positive	5 (11 %)	41 (89 %)	2.6	42 (91 %)	4 (9 %)	2.1
	Negative	11 (21 %)	42 (79 %)	3	39 (74 %)	14 (26 %)	2.13
Total		16 (16.2 %)	83 (83.8 %)	2.87	81 (81.8 %)	18 (18.2 %)	2.11
P-value		0.18		0.14	0.02		0.8

4. Discussion

Rotavirus is a significant contributor to gastrointestinal infections, as our research indicates that approximately 46 % of the collected cases of gastrointestinal infection were attributed to rotavirus. This underscores the severity of its prevalence and the associated morbidity. These results are notably higher than global trends. A systemic review of studies on hospitalized diarrhea cases in countries without vaccination programs reported that approximately 38 % of all cases in children under the age of 5 years were due to rotavirus [12]. Another systemic analysis estimated that approximately 27 % of severe diarrhea cases worldwide were attributed to rotavirus, with a range of 23 to 33 % by WHO region. Interestingly, only two countries, Afghanistan and the Democratic Republic of Congo, reported a higher prevalence of Rotavirus-related gastroenteritis, ranging from 60 % to 70 % [13]. This contrasts with the results of our study, which found an even higher proportion of cases linked to rotavirus, emphasizing the local impact of the virus.

In comparison, these figures contrast with a median of 17 % of hospitalized diarrhea cases due to rotavirus in 14 countries that have incorporated rotavirus vaccination into their healthcare systems. This difference represents a substantial 29 % variation, even considering that our country is vaccinated against rotavirus [14]. Comparing these results with previous studies conducted in Iraq, it is evident that the prevalence of rotavirus-related pediatric diarrhea varies within different regions of the country. For

instance, one study in Mosul city reported that approximately 31 % of pediatric diarrhea cases were attributed to rotavirus [15]. In Kurdistan region, another study found a percentage of 37 % [16], while in mid-Iraq cities, the figure was even higher at 42 %. These regional differences in rotavirus prevalence underscore the importance of local epidemiological factors in understanding the impact of the virus [17]. Furthermore, additional studies conducted in various regions of Iraq have shown varying rates of rotavirus-related gastroenteritis. In Karbala and Basra, for instance, a prevalence of 56 % was found, even higher than the results obtained in this study [18]. In Al Ramadi city, 32 % of enteritis cases were attributed to rotavirus [19]. Additionally, a study conducted in Wasit in 2014 reported that a substantial 55 % of gastroenteritis cases were due to rotavirus. These findings underscore the regional variability in rotavirus prevalence within Iraq and the significance of understanding the local context in managing and preventing the disease [20]. The demographic distribution, with a male-to-female ratio of 2:1, was found to be consistent with what was observed in a pooled analysis of sex differences in rotavirus enteritis across three countries [19]. This ratio is also like the findings in the Al Ramadi study [20]. In terms of age, it was calculated to be 8 months for rotavirus-positive cases, and this was found to be statistically significant with a P-value of 0.04. This age range is in alignment with the global review study of the age distribution of rotavirus disease in children, which indicated a range of 6 to 12 months of age [21]. It's also like the previous study conducted in Wasit [22]. When examining symptom distribution, it was observed that rotavirus-positive cases had a higher mean temperature of 38.4 Celsius, and 87 % of cases experienced vomiting. These findings are in line with a study conducted in Iran, indicating similarities in symptom presentation [23]. Approximately 97 % of the cases reported experiencing moderate to severe dehydration, which is notably high when compared to the negative cases. These results align with findings from a study conducted in Vietnam [24].

Regarding the choice of treatment, most of the cases approximately 91 % responded well to intravenous fluid administration, and this relationship was found to be statistically significant with a P-value of 0.02. This aligns with the severity of dehydration observed in

positive rotavirus cases, where around 31 % experienced severe dehydration, and this was also found to be statistically significant with a P-value of 0.001. These treatment methods are consistent with recommendations in various guidelines [25]. As for vaccination, there was a low rate of vaccination, with only 13 cases out of the 99 having been vaccinated. This suggests a potential lack of commitment to vaccination among parents. It's noteworthy that there was no infant deaths reported throughout the study, and the recovery rate for all cases was good.

5. Conclusion

Rotavirus poses a serious health challenge in Kut city, contributing significantly to the burden on the healthcare system and the local community. It is a major cause of gastroenteritis in infants, often leading to severe complications such as dehydration necessitating hospital admission for treatment. The low vaccination rate among infants further compounds the issue. These combined factors place a substantial burden on the national health system and have ripple effects on affected families, disrupting their daily lives. Toward address these challenges, we recommend implementing better educational campaigns to increase awareness of the importance of vaccination and home-visiting vaccination initiatives. Early fluid therapy should be encouraged to prevent dehydration in suspected rotavirus cases. Additionally, there is a need for laboratory facilities in each hospital to assess diarrhea cases for rotavirus, enabling more accurate and timely diagnoses.

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