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The Frequency of Rotavirus Infection among Children under the age 5 years in Erbil Province, Kurdistan Region, Iraq, a hospital based study

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Abstract

Background: Globally, rotavirus infection, which results in gastroenteritis, is one of the major health problems. Millions of children are infected with the disease. Viral gastroenteritis must be recognized early because it causes wasteful antibiotic use and hospitalizations for kids.
Objective: To investigate the frequency of rotavirus in stool samples from children with acute gastroenteritis.
Patients and Methods: Cross-sectional study consisting of one hundred fifty-three fresh stool samples collected from children less than 5 years were admitted to Raparin pediatric hospital in Erbil city between November 2021 and April 2022. Rotavirus antigens were detected by Rapid test.
Results: Rotavirus antigen was detected at an estimated rate of 61 (40%) in 153 studied cases. The frequency of rotavirus among male and female patients was 44.1% and 33.3% respectively. According to age of infants, rotavirus was detected most frequency in eight months of age. As well as the frequency rate among rural and urban patients was 40% and 39.8% respectively. Rotavirus was detected among vaccinated and non-vaccinated patients by the frequency 26.3% and 54.8% respectively. The highest frequency rate was detected in January 46.4%. Detection of rotavirus by age group was and vaccinations were significant in this study by p-value of 0.001. Conclusion: The most common cause of acute gastroenteritis in children in our area is rotavirus . Rotavirus infection is most frequently occurring during the winter season and among children between 6 months to 24 months.
Conclusion: In this study we found cigarette smoking was more commonly practiced than water pipe .Nicotinic stomatitis is more prevalent in cigarette smoking and its incidence increased with duration and frequency of the habit.
Keywords: Rotavirus; Rapid test; Prevalence; Age Group; Vaccination

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Introduction

One of the typical pathogens causing acute diarrhea in newborns and young children is the rotavirus [1]. Between 20 and 30 percent of pediatric hospitalizations are attributable to rotavirus infection [2]. The rotavirus was initially identified in calves from Nebraska.

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Bishop et al. discovered it in humans for the first time in 1973 [3]. Rotaviruses have a double-stranded segmented RNA genome and are members of the Reoviridae family. The mature virus has three layers and a diameter of around 70 nm. Six viral proteins, known as VP1, VP2, VP3, VP4, VP6 & VP7, and six nonstructural proteins make up the rotavirus (NSP1-NSP6). The eight distinct subgroups of rotavirus are categorized based on the VP6 capsid protein (A-H). Only A, B, and C of these groups have been shown to be known to cause severe episodes of pediatric diarrhea in humans [4]. A rotavirus infection can range from mild to severe. It might range from having no symptoms to having severe vomiting, diarrhea, and fever [5]. A surge in rotavirus infections is noted in children between the ages of six months and two years old, when almost all children under the age of five will experience it at least once. Before the age of one year, severe gastroenteritis can occur [6]. Children with the sickness distribute it to other kids by shedding the virus. Virus excretion lasts for nine days in patients. During the winter, there is a rise in rotavirus diarrheal cases [7, 8]. Since adults have protection from childhood viruses, rotavirus infections are seldom encountered in them. Therefore, the morbidity and death of children are significantly impacted by rotavirus infection [3]. Additionally, it puts a financial strain on the family owing to the cost of the kid's treatment and the parents' time away from their jobs to care for the child [6]. In several nations, two rotavirus vaccines—monovalent (RV1) and pentavalent (RV5)—have been licensed and authorized for use in preventing rotavirus diarrhea. Data on the efficiency and effectiveness of both vaccinations allowed researchers to draw the conclusion that they are both successful in avoiding severe rotavirus gastroenteritis (RVGE) and rotavirus-related mortality in children under the age of five in both developed and developing nations [9]. The World Health Organization (WHO) has advised that rotavirus vaccinations be included in the national immunization programs of all nations; nevertheless, the coverage rate for rotavirus vaccines is only about 25% worldwide [10]. Both vaccines are available and have been introduced into national immunization program in Iraq since 2014. This study aimed to determine the frequency of rotavirus in stool samples from children with acute gastroenteritis in Erbil city Kurdistan region, Iraq.

Patients and Methods

This Study design & Patients' selection

Cross-sectional study consist of one hundred fifty-three fresh stools samples were collected from children less than 5 years were admitted to Raparin pediatric hospital in Erbil city who suffered from watery diarrhea for a period that lasted 1-8 days with vomiting, fever, abdominal pain, and various degrees of dehydration were evaluated.

Stool Samples collection and processing

Fresh stool samples were collected from diarrheic children in clean plastic containers and processed directly according to the diagnostic kit's instructions.

A Rapid One Step Chromatographic Immune Assay [11, 12, 13] for the qualitative detection of rotavirus antigen was used in stool samples (IRO-602. ACRO Biotech, Inc. USA) following the instructions provided by the

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manufacturer, which showed relative sensitivity more than (99.9%), relative specificity (97.8 %).Children aged from 4 months to 5 years as well as only yellow-watery diarrheic stool samples which were suspected to be rotavirus were included in this study while bloody, green and white stool samples and children over 5 years were excluded in this study.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 25). Chi square test of association was used to compare the proportions. A p-value of ≤ 0.05 was considered statistically significant.

Results

The total number of children was 153, 61 (40%) were positive for rotavirus antigen and 92 (60%) were negative for rotavirus antigen by rapid test as shown in Figure (2).

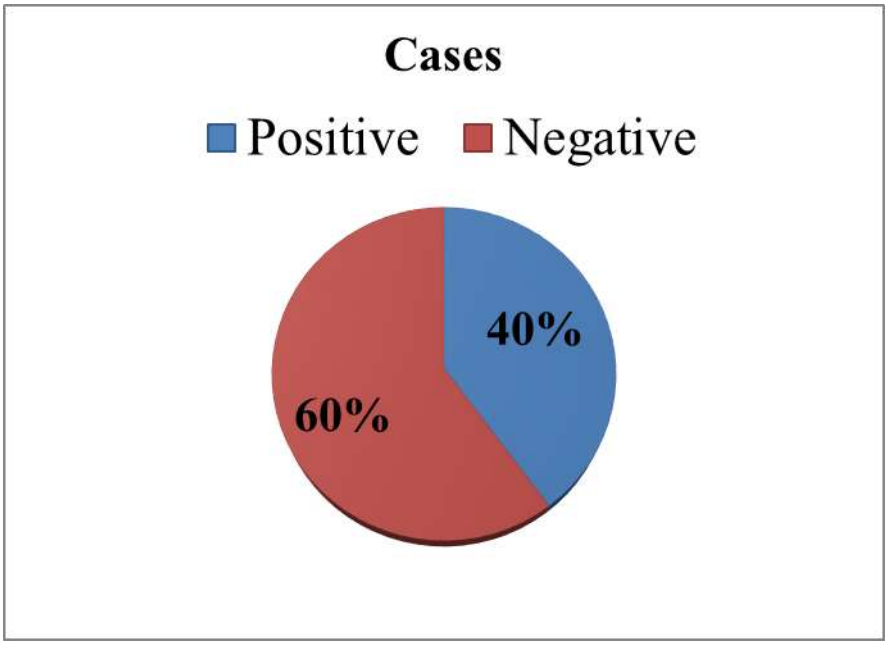

Figure (1): The rate of rotavirus antigen among children using rapid

According to the age groups, statistical analysis revealed that the higher rotavirus positive results were seen respectively in the age group 8 months (80.0%) followed by the age group of 12 months (66.7%) the age group 24 months (61.1%) after this group, the age group of 9 months (58.3%) following 10 months (53.8%). Moreover, the age group of thirty-six months and more which is younger than 3 years till 5 years the rate of rotavirus antigen was (17.4%). Finally, the age group of 4 months (14.3%) had the lowest rate of infection. This result shows that there is a statistically significant difference between rapid test result and age of infant with p-value (0.001) Table (1).

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Table (1): The prevalence rate of rotavirus infection in relation to age groups

			Rapid Test Result for Rotavirus Detection			
			Negative	Positive	Total	p-value
Ages in Month	Four months	N %	6 85.7%	1 14.3%	7 100.0%	0.001
	Five months	N %	12 100.0%	0 0.0%	12 100.0%	
	Six months	N %	11 73.3%	4 26.7%	15 100.0%	
	Seven months	N %	9 52.9%	8 47.1%	17 100.0%	
	Eight months	N %	2 20.0%	8 80.0%	10 100.0%	
	Nine months	N %	5 41.7%	7 58.3%	12 100.0%	
	Ten months	N %	6 46.2%	7 53.8%	13 100.0%	
	Eleven months	N %	11 78.6%	3 21.4%	14 100.0%	
	Twelve months	N %	4 33.3%	8 66.7%	12 100.0%	
	Twenty-four months	N %	7 38.9%	11 61.1%	18 100.0%	
	Thirty-six months and more	N %	19 82.6%	4 17.4%	23 100.0%	
Total		N %	92 60.1%	61 39.9%	153 100.0%	

Among the 153 children 93 (60.8%) were boys and 60 (39.2%) were girls. Out of 93 (60.8%) boy patients 41 (44.1%) were positive for rotavirus antigen and 52 (55.9%) were negative, while in girl patients 60 (39.2%) the rotavirus positive antigen was 20 (33.3%) and 40 (66.7%) for negative rotavirus antigen. The result found non-significant differences between rapid test result and the gender with P-value 0.123 Figure (2).

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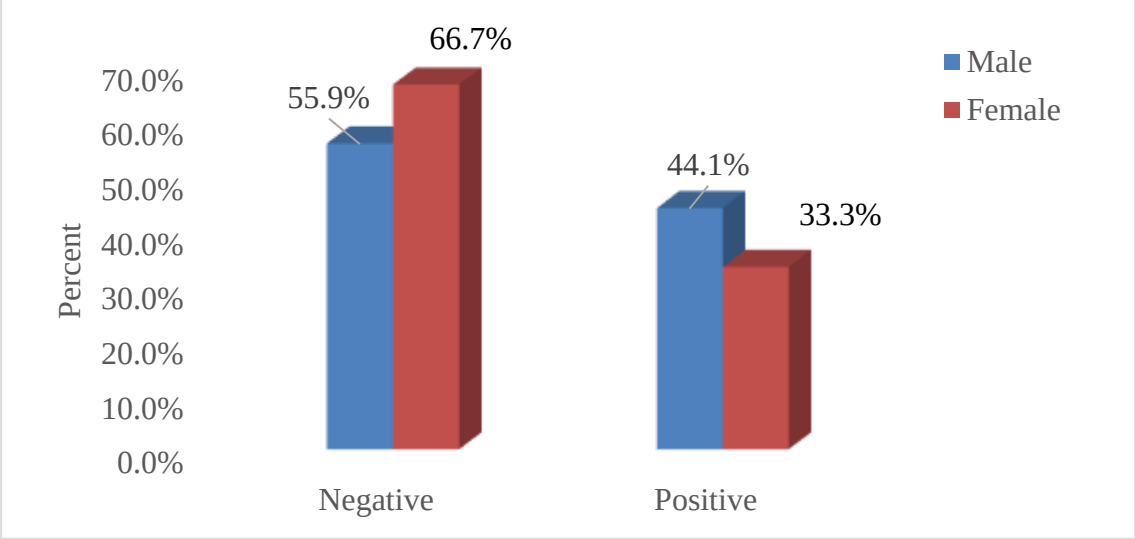

Figure (2): The distribution of rotavirus infection among children according to gender

In association between rapid test results and vaccination; the result of current study showed that among 153 participants 80 (52.3%) were vaccinated and 73 (47.7%) were not vaccinated. In the vaccinated group 21 (26.3%) cases were positive for rotavirus antigen and 59 (73.8%) cases were negative for rotavirus antigen. While in non-vaccinated groups 40 (54.8%) cases were positive for rotavirus antigen and 33 (45.2%) cases were negative for rotavirus antigen by rapid test and the associations demonstrates that there is a statistically significant difference between rotavirus infection among children and vaccination with p-value (0.001) as shown in Table (2).

Table (2): The distribution of rotavirus infection among vaccinated and non-vaccinated children

			Rapid Test Result for Rotavirus Detection		Total	p-value
			Negative	Positive		
Vaccination	Yes	N	59	21	80	0.001
		%	73.8%	26.3%	100.0%	
	No	N	33	40	73	
		%	45.2%	54.8%	100.0%	
Total		N	92	61	153	
		%	60.1%	39.9%	100.0%	

In association between rate of rotavirus antigen among children and the residency, among the 153 patients 40 (26.1%) were from urban region and 113 (73.9%) were from rural area. Among the patients from Urban region 16 (40.0%) cases were positive for rotavirus antigen and 24 (60.0%) patients were negative for rotavirus antigen test. However, patients from rural area 45 (39.8%) cases were positive for rotavirus antigen test and 68 (60.2%) patients were negative for rotavirus antigen by rapid test with statistically non-significant difference (P-value =0.564) see Table (3).

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Table (3): The percentage of rotavirus infection according to residency

			Rapid Test Result for rotavirus detection		Total	p-value
			Negative	Positive		
Residency	Urban	N	24	16	40	0.564
		%	60.0%	40.0%	100.0%	
	Rural	N	68	45	113	
		%	60.2%	39.8%	100.0%	
Total		N	92	61	153	
		%	60.1%	39.9%	100.0%	

In association with months of infection in November among 14 patients 3 (21.4%) cases were positive and 11 (78.6%) were negative for rotavirus infection, while in December among 28 children, 12 (42.9%) were positive and 16 (57.1%) were negative. However, in January recorded the highest rate of infection as among 56 patients 26(46.4%) were positive and 30(53.6%) were negative. In February among 29 patients 13(44.8%) positive and 16(55.2%) were negative. In March there were 6 patients among them 2(33.3%) were positive and 4(66.7%) were negative. And finally in April among 20 admitted patients 5 (25.0%) were positive and 15 (75.0%) were negative with non-significant difference P-value = 0.375 as shown below in Table (4).

Table (4): The seasonal distribution of rotavirus positive and negative among studied children

			Rapid Test Result		Total	p-value
			Negative	Positive		
Date	November 2021	N	11	3	14	0.375
		%	78.6%	21.4%	100.0%	
	December 2021	N	16	12	28	
		%	57.1%	42.9%	100.0%	
	January 2022	N	30	26	56	
		%	53.6%	46.4%	100.0%	
	February 2022	N	16	13	29	
		%	55.2%	44.8%	100.0%	
	March 2022	N	4	2	6	
		%	66.7%	33.3%	100.0%	
	April 2022	N	15	5	20	
		%	75.0%	25.0%	100.0%	
Total		N	92	61	153	
		%	60.1%	39.9%	100.0%	

Discussion

The result of current study demonstrated the frequency of rotavirus gastroenteritis among children less than 5 years and the result was (40%). However, another study which was also done in Erbil Province, Iraq in 2017 by rapid detection of antigen , the detection rate of rotavirus was 32.0% [13]. the result of the current study was comparable with other Iraqi studies and the result of this study was higher than in Ramadi which the frequency of rotavirus

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infection was (32.6%) by rapid chromatographic immunoassay [14], in Kirkuk province, by rapid chromatographic test, rotavirus antigens frequency was (14.36%) by using ELISA rotavirus frequency was (18.62%) [15]. However in Baghdad city in 2016; the frequency of rotavirus infection by rapid chromatographic test was (22.8%) [16]. While in 2015 the frequency of rotavirus infection in Baghdad city by both rapid antigen testing and ELISA was (24%) [17]. In Suleimania province rotavirus was detected in (22%) by rapid chromatographic test [18]. Occurrence, more research revealed that the burden of rotavirus gastroenteritis was significant and estimated in several investigations. The result of this study was lower than other studies in Iraq like in Diyala city in 2021 the frequency was (47.33%) [19] And in Babylon city in 2018 the frequency was (48%) [20]. The frequency of rotavirus gastroenteritis in comparable with neighboring countries was as the followings, in Egypt 58% [21], in Turkey (19%) and (21.1%) [22][26]. in Colombia 30.53% [23] and in Saudi Arabia a study performed in 2 different years and the result showed that the frequency of rotavirus-positive gastroenteritis significantly decreased from 38.5% in 2012 to 13.2% in 2016 [24]. And finally a study performed in Iran and their result showed the same frequency as this study by the rate of 40% [25]. The various frequency of the rotavirus infection in different city or countries may be due to various study settings, including number of collected samples, the sampling season and the sample techniques, may account for these various detection rates. Also presence or absent of vaccination also take a role in rotavirus prevalence Since virtually all children become sick during the first few years of life, when they are most vulnerable to the disease, rotavirus infection is also known as infantile diarrhea or winter diarrhea.

Rotavirus infection occurred in all age groups between 1 month and 18 years with a peak in infants. There was a low rate of rotavirus isolation among the adults [27]. In the present study the distribution of rotavirus infection mostly was in the age groups of 6 months to 24 months and there were statistically differences of p-value 0.001. In local regions, the majority of rotavirus-positive cases were found in children under the age of five, with children in the age range of 18 to 24 months showing the highest infectivity percentage (61.5%) [28]. A study performed by Alani et al., 2012, the majority of the cases was found between 7-12 months age 68% [29]. Occurrence, another study showed more age groups were between 11-15 months (28.9%) of the patients infected with rotavirus, there are statistically significant differences between the age groups (P<0.01) [30] which agreed with our result. While in regions other than our country, neighboring or other countries the results were as the following, 57.1% were between the ages of 0 and 2 years and 26.9% were between the ages of 2 years and 5 years in Anatolia [31]. A study performed by John and Devgan., in 2014; the age wise distribution of patients showed maximum number of patients in the age group of 6 months to 15 months 78.3% for rotavirus gastroenteritis [32]. In a research the age of rotavirus positive patients ranged in the age group of 0 to 12 months (38.7%), in the age group of 13 to 24 months,

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466 (28.3%). The prevalence of rotavirus infection was significantly higher in the age group of 13 to 24 months than the other age groups ($p<0.05$) [33]. Accordingly the rotavirus infection observed mostly between age group of 6 months to 24 months and this may be due the fact that in these age groups children unintentionally touching anything they see, play and try eat each other's toy, play outside and drink from water which may be contaminated with the virus.

In relation to the gender factor, boys (41.1%) were tending to be more effected by rotavirus comparing to girls (33.3%). These boy predominate in the present study was in agreement with the results of some local studies [34-38] and some regional neighboring countries also was in agreement with our result that boys are predominant over girls e in infecting with the rotavirus gastroenteritis [39-43] A correlation between the occurrence of rotavirus diarrhea and boy gender has been shown in various research, in addition to other factors including poor education levels, filthy drinking water, and inadequate sanitation [44].

In our study it showed that the prevalence of rotavirus infection was about the same among children from rural area than in urban area by the frequency of 40% and 39.8% for urban and rural regions respectively with no significant different as 0.564 is greater than 0.005. Another study in local region also agreed with our result as a study done in Diyala Province, Iraq by Salman., 2017 [37]. While in another study their result didn't agree with our result as rural regions showed higher rates of rotavirus infection than in urban region by the frequency of 10.52% and 13.15% for urban and rural respectively [45] and the frequency of rotavirus infection was significantly ($p<0.05$) higher among children who were from urban. However a study by Laith *et al*., 2018; showed that more percentages of rotavirus gastroenteritis were in the urban area [46]. Although children who live in rural areas were found to be exposed to rotavirus gastroenteritis more than others, but this difference was not significant this finding is similar to most studies on rotavirus gastroenteritis [47]. Furthermore, the results from the study by Al-Tabtabai *et al*., 2020 showed that the ratio of acute gastroenteritis infection caused by rotavirus was higher in the rural area (61.1%) Urban area (38.9 %) [48]. In regions other than Iraq, a study was done in Iran which showed the prevalence of rotavirus was higher in urban area 65.5% than in rural area 43.2% [49]. Also, regarding the area of residence, only 7.0% of rotavirus infections; 36.3% were from urban area, whereas 56.7% were from rural area. However, this difference was not statistically significant ($P=0.48$) [50-8]. Inadequate hygiene standards, crowded homes, abuse, neglecting, as well as a lack of health education and subpar medical care. Children from rural regions have a high frequency of rotavirus gastroenteritis, which may be attributed to the unhygienic techniques used in child development. As a risk factor for Rotavirus transmission, socioeconomic position, including mother's education level and place of residence, was also investigated [5].

In our study it showed that the frequency of patients who were vaccinated and had rotavirus 21 (26.3%) and those who were non-vaccinated and had rotavirus 40 (54.8%). There is a statistically significant difference

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because its p-value (0.001) and it is less than the Signiant level of α =0.05. In other findings it revealed that the prevalence of rotavirus among vaccinated children was 38.2% while in non-vaccinated children (65.9%) [13]. A study by Habash et al., 2018 in Basrah Province, Iraq their result was with agreement with ours as 25.5% of the patients with positive test were vaccinated and non-vaccinated patients had higher frequency of positive test (38.9%) with statistically significant result (P value=0.04) [50]. While in 2019; a study performed by Sadeq and Ali, the frequency of children who were non-vaccinated was 19.2% and those who were vaccinated was 30.9% [51]. However, a study in Ramadi showed the prevalence of rotavirus among those who were vaccinated was 23% and those who were not vaccinated were 41% [34]. In the target population for rotavirus vaccine, a decrease of hospitalization rates due to rotavirus gastroenteritis of 74% was observed compared to the area before the introduction of the vaccine. The field effectiveness of the vaccine was estimated between 61% and 98%, depending on assumptions about the vaccination statues [52].

On the other hand, in foreign countries also agreed with our result as the rotavirus vaccine significantly protected against rotavirus as p-value<0.001 [53]. Most Children 353 (97.5%) had been fully vaccinated against rotavirus, while 9 (2.4%) children had not been vaccinated for rotavirus. The 53 positive rotavirus cases had been fully vaccinated against rotavirus while the 12 children who didn't receive vaccination were rotavirus negative [54]. RVA infection was more frequent in the pre-vaccine period 34.9% (2015) than in the post-vaccine period 21.8% (2016–2019) and the significant level was (p = 0.001). Rotavirus A frequency by year after vaccine introduction was 14.6% in 2016, 37.5% in 2017, 14.8% in 2018 and 20.0% in 2019 [55]. Occurrence, Rotavirus frequency in fully vaccinated and non-vaccinated individuals was 11.9% and 24.5%, respectively. And the (p < 0.001) which is shows there is a statistically significant difference [56]. In a study which was done by Payne et al., 2015; Among the 1214 children with AGE further stratified by having received any dose of rotavirus vaccine, a statistically significant difference in secretors' status was observed by rotavirus test result: non-secretors made up 1% of the rotavirus test–positive vaccines compared with rotavirus test–negative participants (18%) who received any dose of rotavirus vaccine (P< .001) [57] Although it has been shown that rotavirus vaccines are effective when administered, this should not lead to a delay of the first dose of rotavirus vaccination [58].

Differences in seasonal prevalence of rotavirus disease occur globally. Seasonal rotavirus outbreaks are known to occur in the coldest time of the year. However, percentage rotavirus positivity remained relatively high during most of the year (8 months), although it dropped to 0 during the other 4 months of the year [59]. In our region peak rotavirus season occurred during the cold months of November to April which 95% of all cases occurred during this period. Similar findings by other authors in our country [13, 18-19, 33, 60] while in other countries also similar findings detected as our result by the authors [59, 61-65] However in

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other findings the result was different with our region for seasonal distribution, higher frequency during the summer season and lower frequency during the winter season [8].

Conclusions

Rotavirus is the most common cause of acute gastroenteritis in children under five years of age in Erbil city. The high prevalence of rotavirus and its link to severe gastroenteritis highlight the need to prevent rotavirus gastroenteritis by getting vaccinated, especially in the winter and spring and among infants aged 6 months to 24 months.

Recommendations

In order to plan the management of gastroenteritis and reduce the overuse of antibiotics in children, rapid antigen testing for rotavirus antigen should be conducted frequently in fresh stool specimens in hospitals. As well as taking rotavirus vaccine. As rotavirus vaccine gets interrupted in our region; Ministry has to regularly send rotavirus vaccine to health centers so that every child will have chance to get it.

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Conflict of interest: Nil

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تكرار عدوي الإصابة بالفايروس العجلي بين الأطفال دون سن الخامسة في محافظة أربيل ، إقليم كردستان العراق ، دراسة مستشفوية

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الملخص

خلفية الدراسة: على الصعيد العالمي ، تعد عدوى فيروس الروتا ، التي تؤدي إلى التهاب المعدة والأمعاء ، واحدة من المشاكل الصحية الرئيسية. يصاب الملايين من الأطفال بهذا المرض. يجب التعرف على التهاب المعدة والأمعاء الفيروسي مبكرًا لأنه يسبب الإسراف في استخدام المضادات الحيوية ودخول المستشفى للأطفال.

اهداف الدراسة: لفحص وتيرة فيروس الروتا في عينات براز الأطفال المصابين بالتهاب المعدة والأمعاء الحاد.

المرضى والطرائق: دراسة مقطعية تتكون من مائة وثلاثة وخمسين عينة من البراز الطازج تم جمعها من الأطفال الذين تقل أعمارهم عن ٥ سنوات وتم إدخالهم إلى مستشفى رابارين للأطفال في مدينة أربيل بين نوفمبر ٢٠٢١ وأبريل ٢٠٢٢. تم الكشف عن فيروس الروتا عن طريق الاختبار السريع.

النتائج: تم اكتشاف مستضد فيروس الروتا بمعدل تقديري ٦١ (٤٠٪) في ١٥٣ حالة مدروسة. بلغت نسبة الإصابة فيروس الروتا بين المرضى الذكور والإناث ٤٤,١٪ و ٣٣,٣٪ على التوالي. وفقًا لعمر الأطفال ، تم اكتشاف فيروس الروتا أكثر شيوعًا في ثمانية أشهر من العمر. وكذلك كان معدل التكرار بين مرضى الريف والحضر ٤٠٪ و ٣٩,٨٪ على التوالي. تم الكشف عن فيروس الروتا بين المرضى الملقحين وغير الملقحين بنسبة ٢٦,٣٪ و ٥٤,٨٪ على التوالي. تم اكتشاف أعلى معدل تردد في يناير ٤٦,٤٪. كان الكشف عن فيروس الروتا حسب الفئة العمرية وكانت اللقاحات معنوية في هذه الدراسة بقيمة p 0.001.

الاستنتاجات: السبب الأكثر شيوعًا لالتهاب المعدة والأمعاء الحاد لدى الأطفال في منطقتنا هو فيروس الروتا. تحدث عدوى الفيروسة العجلية بشكل متكرر خلال فصل الشتاء وبين الأطفال الذين تتراوح أعمارهم بين ٦ أشهر و ٢٤ شهرًا.

الكلمات المفتاحية: فيروس الروتا، اختبار سريع انتشار، الفئة العمرية، تلقيح

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