Original Article

PREVALENCE OF GROUP A ROTAVIRUS, ENTERIC ADENOVIRUS, NOROVIRUS AND ASTROVIRUS INFECTIONS AMONG CHILDREN WITH ACUTE GASTROENTERITIS IN AL-QASSIM, SAUDI ARABIA

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ABSTRACT

***Objective*:** To investigate the prevalence of Rotavirus, Adenovirus, Norovirus, and Astrovirus among Saudi children with gastroenteritis.

Methodology: This study was conducted at the Department of Medical Laboratories, Qassim University during the winter seasons of the years 2004 and 2005. A total of 284 diarrhoeal fecal specimens collected from children were tested for the gastroenteritis causing viruses using enzyme immunoassay.

***Results*:** Of the 284 specimens, 142 (50%) were found to be positive for viruses causing gastroenteritis. Rotavirus (66.2%) was the most frequently detected, followed by adenovirus (15.5%), norovirus and astrovirus each with 9.2%. All of rotavirus detected belonged to group A. Eight specimens were found positive by two viruses.

***Conclusions*:** The introduction of simple and rapid tests for diagnosis of viruses causing gastroenteritis in our pediatric hospitals will improve patient care by reducing unnecessary treatments and hospital stay for patients.

KEYWORDS: Rotavirus, Enteric Adenovirus, Acute gastroenteritis.

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INTRODUCTION

Acute gastroenteritis continues to be a significant cause of morbidity and mortality worldwide.[1] An estimated of more than 700 million cases of acute diarrhea occurred in children under five years of age every year.[2] The mortality rate has been estimated to be 3-5 million cases per year, the majority of these which occur in developing countries.[3,4]

Rotavirus causes more than 130 million episodes of severe diarrhea in children under five years throughout the world.[5,6] In developing countries an estimated of 870,000 children die from rotavirus diarrhea each year which reflects an urgent need to develop a vaccine.[3] The rate of enteric adenovirus varies from 1-8% in developed countries[7,8] to 2-31% in developing countries.[9,10] Using enzyme immunoassay and reverse transcription-polymerase-chain reaction recognized calicivirus and especially norovirus as the most common cause of illness with a food origin.[11] The rate of detection of astrovirus increased from 1% using electron microscopy[12] to 2-13% using monoclonal antibodies in enzyme immunoassays.[13]

Since most viruses causing gastroenteritis cannot be isolated in cell culture,[14] direct

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visualization in stool specimens by electron microscopy is still the mainstay of diagnosis although it is limited to reference laboratories.[15] The introduction of more sensitive techniques for antigen detection in stool based on immunoassay and molecular biology techniques has improved the diagnosis of newly recognized viruses as norovirus and sapovirus.[16-19]

The present study determined the prevalence of rotavirus and other viruses in children hospitalized with acute gastroenteritis using monoclonal antibodies in enzyme immunoassay kits in association with clinical data from patients.

MATERIALS AND METHODS

Stool specimens: A total of 284 diarrheal specimens were collected from children with gastroenteritis admitted to the Buraidah Maternity and Pediatric Hospital, Al-Qassim, Saudi Arabia during the winter seasons of the years 2004 and 2005. The Buraidah Maternity and Pediatric Hospital is the only and largest specialized hospital in Al-Qassim area. It was established in 2003 with 255 beds. It provides free medical care and serves about 500 patients per day with 12000 deliveries per year of the Buraideh city populations and its suburbs. Information concerning children under study was recorded using a data collection protocol. The collected specimens were stored at -70° C until tested for the viral antigens.

Enzyme immunoassay (EIA) for antigen virus detection: Group A human rotavirus antigen was detected by Rotavirus Screen EIA (Microimmune Ltd, Cat, No. Rota.003, UK). The test employs a monoclonal antibody to the inner capsid protein in rotavirus group A for a capture and detection of the virus.

Adenovirus was detected by Ridascreen Adenovirus (R-Biopharm, Art. No. C 1001, Germany). The test employs a monoclonal antibody directed against the hexon-antigen of adenovirus.

Norovirus (Previously Norwalk-like viruses) was detected by Ridascreen Norwalk-like virus (R-Biopharm, Art. No. C 1401, Germany). The test employs a monoclonal antibody to the specific Norwalk-like virus antigen of the genogroup I and II in stool specimens. Astrovirus was detected by Ridascreen Astruvirus (R-Biopharm, Art. No. C 1301, Germany). The test employs a monoclonal antibody to the specific astrovirus antigen. All assays were run according to the manufacturer's instructions. Results were spectrophotometrically read at 450 nm. Cutoff values were calculated as specified in the package insert.

Data analysis: Data analysis was carried out using statistical program SPSS version 10.0 for windows (SPSS Inc., Chicago, Illinois, USA). The differences in proportions were compared using a X^2-test.

RESULTS

Viruses causing gastroenteritis were detected in 142/284 (50%) of specimens from children admitted to the Buraidah Maternity and Pediatric Hospital, Al-Qassim, Saudi Arabia. Table-I shows the distribution of viruses causing gastroenteritis by age group. Rotavirus (66.2%) was the most common virus, followed

Table-I: Distribution of viruses causing gastroenteritis by age group in 284 children.

*Age group** (years)	*No. of* patients	Viruses				
		Rotavirus	*Adenovirus*	*Norovirus*	*Astrovirus*	*Total viruses*
< 1	106 (37.3)	45 (42.5)	11 (10.4)	9 (8.5)	9 (8.5)	73 (68.9)
1	106 (37.3)	30 (28.3)	9 (8.5)	2 (1.9)	2 (1.9)	44 (41.5)
2	35 (12.3)	11 (31.4)	0 (0.0)	0 (0.0)	2 (5.7)	13 (37.1)
3	19 (6.7)	4 (21.1)	0 (0.0)	0 (0.0)	0 (0.0)	4 (21.1)
4	18 (6.3)	4 (22.2)	2 (11.1)	2 (11.1)	0 (0.0)	8 (44.4)
Total viruses		94 (66.2)	22 (15.5)	13 (9.2)	13 (9.2)	142 (100)

* Rotavirus was predominant in the age group less than 2 years of age (P= 0.032)

by adenovirus (15.5%), norovirus and astrovirus each with 9.2%. In eight specimens, two infected agents were recovered: Rotavirus plus norovirus or adenovirus or astrovirus; adenovirus plus norovirus. Out of 212 of children under than two years of age, 117 (55.2%) children were found positive. Rotavirus was found predominant in this age group (P= 0.032).

The clinical data on children with diarrhea as a result of rotavirus infection are shown in Table II. The results show that children with rotavirus infection are significantly associated with vomiting (72.3%, P<0.001) and dehydration (81.9%, P=0.002).

Table-II: Clinical observations in 94 children positive for rotavirus group A.

Clinical observation	*No. (%) of children positive for rotavirus*	*Total No. (%)*
Clinical diagnosis		
Vomiting	68 (72.3)	242 (85.2)[a]
No vomiting	26 (27.7)	42 (14.8)
Dehydration	77 (81.9)	200 (70.4)
No dehydration	17 (18.1)	84 (29.6)
Weakness	42 (44.7)	121 (42.6)
No weakness	52 (55.3)	163 (57.4)
Fever	20 (21.3)	64 (22.5)
No fever	74 (78.7)	220 (77.5)
Abdominal pain	22 (23.4)	59 (20.8)
No abdominal pain	72 (76.6)	225 (79.2)
Duration of hospitalization (days)		
2	55 (58.5)	170 (60.0)
3 - 5	37 (39.4)	103 (36.3)
> 5	2 (2.1)	11 (3.9)

* Significant at (P<0.001)[a], (P<0.002)[b]

DISCUSSION

To our knowledge, this study is the first to investigate the distribution of viruses causing gastroenteritis in Al-Qassim, Saudi Arabia. The prevalence of rotavirus disease is similar in children in both developed and developing countries. However, children in developing countries die more frequently, possibly due to poorer access to hydration therapy and prevalence of malnutrition.[20]

Although the viral diarrhea as a major cause of morbidity and mortality in developing countries is well recognized,[21-24] there are few reports which document the viral gastroenteritis in Saudi Arabia.[25-27] The present study showed that the overall rate of infection with viruses causing gastroenteritis was 142/284 (50%). As has been found previously in many studies,[21-23, 28] rotavirus was the most causative agent of acute gastroenteritis in children. Our result reinforced the previous results that rotavirus is responsible for 20-60 per cent of severe diarrheal illness requiring hospitalization in infants and young children in developed as well as in developing countries.[21,22,29]

Fecal adenovirus infection is probably the second most common cause of gastroenteritis in children associated with diarrhea as reported in several countries.[23,25,29-31] In the present study adenovirus was detected in 15.5 per cent.

The introduction of enzyme immunoassay (EIA) as a rapid, sensitive, and specific viral diagnostic technique for the diagnosis of rotavirus, adenovirus, norovirus, and astrovirus has led to increased detection of these viruses and, therefore, physicians will be able to make more accurate treatment decisions, reduce unnecessary antibiotic treatment, and isolate patients to reduce nosocomial spread.[20] Previously, since most viruses causing gastroenteritis cannot be isolated in cell culture, direct visualization of them by electron microscopy was the mainstay of diagnosis. The EIA used in this study employs a genus-specific monoclonal antibody to detect a specific viral antigen in the virus.

Commercial EIA and reverse transcription-polymerase chain reaction have also been adapted for the detection of norovirus and astrovirus. Since the introduction of these tests, the viruses have been recognized significantly as a cause of diarrhea in infant and young children. In community, astrovirus is responsible for 2-13 percent of cases that need hospitalization.[7,8,28,32] The prevalence of norovirus and astrovirus in this study is similar to the rate measured previously in hospitalized children.

In both developed and developing countries, about 90% of infants by the age of three years, develop rotavirus infection.[33] EIAssouli *et al*., reported that the rotavirus group A was common in the first two years of life in Saudi

children with a peak in children aged 2-12 months.[27] In Oman, Aithala *et al*., reported that most infection with rotavirus was in children less than two years old.[24] In the present study, our results are in consistence with these results and others[22,23,30,31] as this age group was significantly related to infection with rotavirus group A (P=0.032).

Bern *et al*., reported that rotavirus group A was significantly associated with watery diarrhea in Bangladesh.[34] In this study 41 per cent of the patients had watery diarrhea (results not shown). In parallel with Collier *et al*.[35] results, in the current study most of the patients had symptoms for less than five days. Concerning the other clinical symptoms, it has been reported that vomiting, dehydration, and fever are the most common clinical symptoms shown in patients with rotavirus infection.[23,29,36] Modarres *et al*., reported that most children with rotavirus infection had vomiting (86.7%), and dehydration (87.8%).[37] In this study, rotavirus group A infection was significantly associated with vomiting (P< 0.001) and dehydration (P=0.002). However, in the present study, there was no difference in diarrhea and fever (P=0.422), diarrhea and weakness (P=0.355) or diarrhea and abdominal pain (P=0.268) in patient infected with rotavirus group A. Similar results were reported by Bon et al.[28]

The introduction of the two new rotavirus vaccines, *RotaTeq* and *Rotarix* that are currently in the late stage of development, will hopefully protect children against the numerous rotavirus serotypes that are currently predominant.[38,39]

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