Prevalence of Rotavirus Gastroenteritis at a University Teaching Hospital in Oman: A Four-Year Study

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Abstract

Objectives: The study was undertaken to determine the prevalence of rotavirus infection in children with gastroenteritis, and to correlate this prevalence with demographic and climatic conditions that might influence virus transmission.

Methods: Stool samples from 991 children with gastroenteritis who were seen at Sultan Qaboos University Hospital between January 1996 and December 1999 were tested for rotavirus antigen by a latex agglutination test. Data on patients' age and gender, and the unit within the hospital where the patient was treated, were recorded. Monthly temperature and relative humidity data were obtained from reports of the Department of Meteorology of the Directorate General of Civil Aviation.

Results: Rotavirus antigen was detected in 114 (11.5%) of the children with diarrhoea. Ninety percent of rotavirus gastroenteritis cases were under 2 years of age but neonatal rotavirus was not encountered and the youngest patient was 3 months of age. The prevalence of rotavirus infection was significantly higher in hospitalised than non-hospitalised children (12.6% vs 7.0%, p <0.05). Infection was also more common in males than females (12.5% vs 10.0%), but this difference was not statistically significant (p <0.25%). More infections occurred during the cooler months of December, January and February than in the hotter months but there was no correlation with relative humidity.

Conclusions: Rotavirus is a significant cause of gastroenteritis in young children seen at Sultan Qaboos University Hospital. Environmental temperature has some influence on virus transmission but not relative humidity.

Key words: prevalence, gastroenteritis, rotavirus, climate.

Introduction

Rotavirus is the major cause of dehydrating diarrhoea in both developed and developing countries. It accounts for between 11 and 71 percent of all episodes requiring hospitalisation in children under the age of two. The peak incidence of rotavirus gastroenteritis occurs between 3 and 15 months of life. However, considerable morbidity is seen throughout the second year. The virus is spread by the faecal-oral route but airborne or droplet transmission has also been postulated.

The relationship between rotavirus infection and climatic conditions such as environmental temperature, relative humidity and rainfall has been the subject of many studies. In most parts of the world, infection is present all the year round but is more common in the cooler months of autumn, winter or spring in temperate climates, and in the dry months in tropical and subtropical regions. It has been hypothesised that lower environmental temperature and relative humidity facilitate virus transmission, perhaps by prolonging viral survival on fomites.

Oman is mostly characterised by desert conditions where summer is extremely hot and winter is temperate and dry. The climate is hot and humid in the coastal regions. The average maximum temperature in the hottest month (May) in Muscat is 39°C, decreasing to 25°C in the coolest month (January). In the summer,
maximum temperatures often reach 43°C, with humidity as high as 90 percent. The inland desert regions are hot and dry, with an average high temperature of 41°C in July, and 25°C in January.

In a previous prospective study among children admitted at Sultan Qaboos University Hospital (SQUH) due to gastroenteritis, rotavirus was found to be the commonest cause. We carried out a retrospective study to determine the prevalence of rotavirus in children hospitalised due to gastroenteritis and those managed in outpatient clinics from 1996 to 1999. We attempted to determine if rotavirus prevalence was correlated with age, sex, hospitalisation, environmental temperature and relative humidity.

Materials and Methods

Subjects
Between January 1996 and December 1999, 991 consecutive faecal samples obtained from 991 children aged 3 days to 12 years were tested for rotavirus antigen by a latex agglutination test (Murex Rotavirus Latex Test, Murex Diagnostics S.p.A, Italy, or Virotect-Rota, Omega Diagnostics, UK). Manufacturers' instructions were followed regarding sample preparations, testing and interpretation. Information about the patient's age, sex, diagnosis and location where the patient was managed within SQUH had been recorded at the time of receipt of the faecal sample. Of the 991 children in the study, 804 had been hospitalised. The rest were treated at the children's outpatient clinic, accident and emergency department, or the University Health Centre.

Meteorological data
Meteorological data of monthly temperature and relative humidity were obtained from reports of Meteorology Department, Directorate General of Civil Aviation and Meteorology, Ministry of Communications. Meteorological records for Seeb Weather Station were taken to represent the climate of the geographical areas where most of the patients admitted at SQUH come from.

Statistics
Differences in prevalence rates between different groups of children and between years of study were compared by X2 test. The level of significance was 0.05 (5%).

Results
A total of 991 children with gastroenteritis were seen at SQUH over a 4-year period. Approximately 90% of children with gastroenteritis were <5 years of age. Of the 382 children aged 0-12 months, 15 (3.9%) were neonates.

Table 1 shows the prevalence of rotavirus in the population studied. Overall, the antigen was detected in 114 (11.5%) of the 991 children. The yearly prevalence varied from 9.6% in 1999 to 13.1% in 1997. However, the observed differences were not significant.

Table 1: Prevalence of rotavirus infection in children with gastroenteritis according to year.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. tested</th>
<th>No. (%) positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>296</td>
<td>33 (11.1)</td>
</tr>
<tr>
<td>1997</td>
<td>198</td>
<td>26 (13.1)</td>
</tr>
<tr>
<td>1998</td>
<td>217</td>
<td>28 (12.9)</td>
</tr>
<tr>
<td>1999</td>
<td>280</td>
<td>27 (9.6)</td>
</tr>
<tr>
<td>Total</td>
<td>991</td>
<td>114 (11.5)</td>
</tr>
</tbody>
</table>

The age distribution of rotavirus infection is shown in Fig. 1. Most of the rotavirus cases were children <2 years of age: 54 (47.4%) and 48 (42.1%) were aged 3-12 months, and 13-24 months, respectively. Rotavirus was not found in stool samples of children below 3 months.
Table 2 compares the prevalence of rotavirus in different groups of children. The frequency of rotavirus infection detected in hospitalised cases (12.6%) was significantly higher than in non-hospitalised cases (7.0%, p < 0.05). Rotavirus antigen was also detected more frequently in male than female children (12.5% and 10% respectively), but this difference was not statistically significant (p < 0.25).

Table 2: Comparison of rotavirus infection rates between different groups of children

<table>
<thead>
<tr>
<th>Patient group</th>
<th>No. tested</th>
<th>(%) positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalised</td>
<td>804</td>
<td>101 (12.6)</td>
</tr>
<tr>
<td>Outpatient</td>
<td>187</td>
<td>13 (7.0)</td>
</tr>
<tr>
<td>Male</td>
<td>582</td>
<td>73 (12.5)</td>
</tr>
<tr>
<td>Female</td>
<td>409</td>
<td>41 (10.0)</td>
</tr>
</tbody>
</table>

During the four-year study period, rotavirus was present all the year round in 1997. In the other 3 years, rotavirus was not detected in June, July or August (monthly data for each of the four years not shown). However, these months coincided with a drop in the number of faecal samples which were submitted for testing as a result of a general pattern of a drop in the number of patients who come to hospital during the same period. In view of the small number of cases during these months, it is more likely that rotavirus was present at a level that was lower than the limit of detection.

Monthly distribution of rotavirus detection and the mean monthly temperature are plotted in Fig.2 (the data for the 4 years were averaged). When data for the study period were combined, rotavirus was found to be present all the year round with significant peaks above the yearly median in December, January and February. Monthly frequency of rotavirus infection in relation to relative humidity is shown in Fig.3. There was correlation between temperature and monthly rotavirus detection rate (r = -0.75) but none with relative humidity (r = -0.15).

Rotavirus was found previously to be the commonest cause of gastroenteritis among children in SQUH where it accounted for 31% of all diarrhoeal cases. Other etiological agents included Giardia lamblia, Escherichia coli, Shigella spp and Entamoeba histolytica[10]. Studies from neighbouring countries with comparable socioeconomic, cultural and climatic conditions showed rates of rotavirus infection ranging from 20 to 30%[7,11]. This study indicates that rotaviruses accounted for over 11% of paediatric gastroenteritis at SQUH from 1996 to 1999. This rate is much lower than that reported previously, even after taking into account that hospitalised patients only (i.e. with severe disease) were included in the earlier study. The reasons for this difference are not clear. It is likely to be due to differences in methods of virus
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detection. The latex agglutination test used in the present study may be of lower sensitivity than the enzyme linked immunosorbent assay used previously. We are currently investigating this in a prospective study where stool samples are tested by both techniques. In addition, the difference may be partly due to patient selection as children with acute gastroenteritis only were included in the earlier study, whereas in this study cases of gastroenteritis, irrespective of duration, were tested. Rotavirus is associated with acute, rather than chronic, diarrhoea(4).

Rotavirus antigen was commonest in children less than 2 years of age which is consistent with observations elsewhere(7,11,12). A significant proportion (42%) of rotavirus positive cases in the present study were 1 to 2 years of age, a picture similar to that of developed countries, where most disease occurs at an older age. In contrast, up to 80% of hospitalisations for rotavirus in developing countries occur in infants(11,12).

Neonatal rotavirus infections are predominantly asymptomatic but in some cases they may be associated with diarrhoea(13). In this study, the virus was not found in children younger than 3 months, including 15 neonates. During the first three months of life, infants appear to be relatively resistant to rotavirus infection, most likely due to passive transplacental transfer of maternal antibody, as well as antibodies in breast milk(4,6).

Rotavirus gastroenteritis was significantly more prevalent in hospitalised patients than in those treated as outpatients. Comparisons of hospital-versus community-based studies show that rotavirus is detected more frequently among children with severe disease (i.e. hospitalised) than in a community setting(7,14), or is detected with same frequency(1). Similar to observations of Paul and Paul(15), infection was equally common among male and female children. However, other investigators have shown a higher preponderance of male children infected with rotavirus as compared to females, but were unable to explain the reasons for this difference (5,7).

Reports from different countries show seasonal fluctuations in the incidence of rotavirus diarrhoea(1,3,5,8). However, seasonal variation of infection is not universal, and the pattern may not be consistent in a given geographical area(3,6). In each of the 4 years of our study, peaks of infection above the median were consistently observed during December, January and February, coinciding with the cool season. Most studies that have reported seasonality of rotavirus were based on one year's data(3). The consistency of seasonal trends can only be tested in studies that last for more than one year.

Both the present and previous(10) studies show that rotavirus is a common cause of diarrhoea in hospitalised and non-hospitalised children with gastroenteritis at SQUH. Although it is likely that a similar situation prevails in other health care institutions in Oman, the magnitude of the problem can only be assessed by more detailed, hospital- and community-based studies across the country. Furthermore, serotypes of rotavirus strains in circulation in Oman have not been determined. This information is crucial if Oman is going to consider immunizing infants when safe rotavirus vaccines become available(16). Finding unusual serotypes not included in the vaccine, as was the case in other countries(17), implies that the vaccine will be ineffective against rotaviruses circulating in this part of the world.

References

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