Clinical Characteristics of Rotavirus Gastroenteritis in Children in a Medical Center

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1. Introduction

Rotavirus infection is one of the most common causes of severe gastroenteritis in infants and young children in both developed and developing countries. In developing countries, rotavirus gastroenteritis is responsible for approximately half a million deaths per year of children aged under 5 years.¹ Little information on the disease burden and epidemiological profile of rotavirus infection in Taiwan is available to help decide whether or not to introduce a rotavirus vaccine. The aim of this study was to collect and examine the available epidemiologic and clinical data on rotavirus infection at a hospital in Taiwan.

2. Materials and Methods

We retrospectively analyzed the age, sex, clinical symptoms and signs, laboratory findings, complications, coexisting diseases, and hospital courses of children with rotavirus infection hospitalized at Cathay General Hospital from May 2004 to April 2007. A total of 279 children under 15 years old who were hospitalized for gastroenteritis were enrolled.
in the study. Their stool specimens were tested for the presence of rotavirus antigens using the Rapid Immunochromatographic Test (Veda Laboratory, France). Gastroenteritis was defined as the occurrence of diarrhea, including the passage of more than three liquid or semi-liquid stools and a clinical history, with or without vomiting.

We excluded patients who had any of the following: (1) had received rotavirus vaccine; (2) had coexisting salmonellosis (n = 5); (3) had coexisting diseases such as acute otitis media, urinary tract infection, respiratory tract infection, or herpangina (n = 36). The discharge criteria included (1) no vomiting, (2) improvement of diarrhea symptom to the passage of fewer than two liquid or semi-liquid stools, (3) no fever, and (4) improvements in appetite and activity.

Clinical symptoms and laboratory data were used to identify severe gastroenteritis. Admission days, seasons, and patient’s age were used to determine the incidence of gastroenteritis at different times. The spring season was from March to May, summer was from June to August, autumn from September to November, and winter from December to February. The admission dates of patients with different clinical symptoms and laboratory data were assessed using t tests. All analyses were conducted using SAS version 9.0 (SAS Institute, Cary, NC, USA).

3. Results

The male to female ratio of the 238 patients in this 3-year study was 1.3. The mean age was 3.2 ± 2.1 years. The study patients were divided by age into less than 2 years (43%), 3–5 years (44%), 6–8 years (10%), and 9–12 years of age (3%; Table 1). The most common symptom of rotavirus gastroenteritis was diarrhea (98.7%; Table 2). Of the 238 patients, 95 patients (39.9%) had leukocytosis (white blood count > 10 × 10⁹/L); 128 patients (53.8%) had a left shift (segments > 74%); 112 patients (46.7%) had elevated C-reactive protein level (> 4.8 nmol/L). More than half of all patients experienced their illness in spring, including May (20.4%), April (17.2%) and March (14.2%), followed by summer (17.2%), winter (16.2%) and fall (14.2%; Table 1). The most common length of hospital stay was 4 days (38.2%), followed by 5 days (27.5%). The shortest hospital stay was 2 days (1.3%) and the longest was 11 days (0.4%; Table 1). The most frequently identified bacteria in specimens were non-enteropathogenic Escherichia coli (194 specimens, 81.5%), followed by non-enteropathogenic Klebsiella pneumoniae (22 specimens, 9.2%), non-enteropathogenic Enterococcus species (18 specimens, 7.5%), and other non-enteropathogenic pathogens (4 specimens, 1.6%). All 238 study patients were discharged alive with no complications, and none were rehospitalized. No lactose intolerance was found in any patient.

Table 1  Clinical month, admission days and age of patients with rotavirus gastroenteritis

<table>
<thead>
<tr>
<th>Month</th>
<th>Frequency n (%)</th>
<th>Hospitalization (d)</th>
<th>Frequency n (%)</th>
<th>Age (yr)</th>
<th>Frequency n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>12 (5.0)</td>
<td>1</td>
<td>0 (0)</td>
<td>≤1</td>
<td>41 (17.2)</td>
</tr>
<tr>
<td>Feb</td>
<td>19 (7.9)</td>
<td>2</td>
<td>3 (1.3)</td>
<td>2</td>
<td>61 (25.4)</td>
</tr>
<tr>
<td>Mar</td>
<td>34 (14.2)</td>
<td>3</td>
<td>48 (20)</td>
<td>3</td>
<td>50 (21.0)</td>
</tr>
<tr>
<td>Apr</td>
<td>41 (17.2)</td>
<td>4</td>
<td>91 (38.2)</td>
<td>4</td>
<td>33 (13.8)</td>
</tr>
<tr>
<td>May</td>
<td>49 (20.4)</td>
<td>5</td>
<td>66 (27.5)</td>
<td>5</td>
<td>23 (9.6)</td>
</tr>
<tr>
<td>Jun</td>
<td>16 (6.7)</td>
<td>6</td>
<td>19 (7.9)</td>
<td>6</td>
<td>14 (5.8)</td>
</tr>
<tr>
<td>Jul</td>
<td>10 (4.2)</td>
<td>7</td>
<td>5 (27.5)</td>
<td>7</td>
<td>4 (1.7)</td>
</tr>
<tr>
<td>Aug</td>
<td>15 (6.3)</td>
<td>8</td>
<td>4 (1.7)</td>
<td>8</td>
<td>5 (2.1)</td>
</tr>
<tr>
<td>Sep</td>
<td>11 (4.6)</td>
<td>9</td>
<td>1 (0.4)</td>
<td>9</td>
<td>2 (0.8)</td>
</tr>
<tr>
<td>Oct</td>
<td>8 (3.3)</td>
<td>10</td>
<td>0 (0)</td>
<td>10</td>
<td>4 (1.7)</td>
</tr>
<tr>
<td>Nov</td>
<td>15 (6.3)</td>
<td>11</td>
<td>1 (0.4)</td>
<td>11</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Dec</td>
<td>8 (3.3)</td>
<td>12</td>
<td>0 (0)</td>
<td>12</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Total</td>
<td>238 (100)</td>
<td>Total</td>
<td>238 (100)</td>
<td>Total</td>
<td>238 (100)</td>
</tr>
</tbody>
</table>

Table 2  Clinical symptoms and laboratory data of patients with rotavirus gastroenteritis (N = 238)

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
<td>220 (92.4)</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>235 (98.7)</td>
</tr>
<tr>
<td>Poor appetite &amp; activity</td>
<td>230 (96.6)</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>75 (31.3)</td>
</tr>
<tr>
<td>Fever</td>
<td>171 (71.8)</td>
</tr>
<tr>
<td>Bloody stool</td>
<td>8 (3.4)</td>
</tr>
<tr>
<td>Seizure</td>
<td>3 (1.3)</td>
</tr>
</tbody>
</table>
4. Discussion

In this study, rotavirus gastroenteritis was characterized by vomiting, diarrhea, fever, abdominal pain, poor appetite, and poor activity. Diarrhea was particularly prominent, but vomiting was usually the first sign. This was in agreement with the results of other studies. 

Rotavirus infections are the leading cause of severe acute gastroenteritis among infants and young children, accounting for an estimated 527,000 deaths worldwide in 2004 among children aged under 5 years, mainly in low-income countries. 

Rotavirus causes few deaths (20–60 cases) in the United States each year, but remains a substantial cause of morbidity among children, resulting in approximately 55,000–70,000 hospitalizations, 205,000–272,000 emergency department visits, and 410,000 physician office visits. In the European Union, the annual burden of rotavirus disease is estimated at more than 200 deaths, over 87,000 admissions, and almost 700,000 outpatient visits in children younger than 5 years old.

Rotaviruses are 70-nm non-enveloped RNA viruses belonging to the family Reoviridae. The outermost layer contains two structural viral proteins (VP): VP4, the protease-cleaved protein (P protein), and VP7, the glycoprotein (G protein). These two proteins define the serotype of the virus and are considered critical to vaccine development, since they provide targets for neutralizing antibodies that might be important for protection. Many different variants have been described, but most strains in Europe, Asia and the United States belong to the genotype P[4]G2 or combinations of P[8] with G1, 3 or 4. According to a recent report by Wu et al, the prevalence of serotypes of rotavirus infection in Taiwan between 2004 and 2006 was group A VP7 G (2004, 2005, 2006): G1 (11.9%, 23.4%, 34.4%), G2 (35.9%, 17.6%, 6.3%), G3 (26.1%, 19.1%, 34.4%), G4 (0, 0.68%, 0), G9 (26.1%, 21.7%, 24.6%), respectively. Current vaccines include an oral live attenuated human rotavirus vaccine derived from the most common circulating strain G1P[8], which has been developed by GlaxoSmithKline, while the Merck vaccine is composed of five bovine-human reassortants intended to induce serotype-specific protection against the four main G types (G1–G4), plus the common P[8] antigens. Both vaccines are used in Taiwan, where they have efficacy against G1, G2, G3, G4 and G9 strains.

Rotavirus-related hospital admissions occur all year round, but rates vary by month. Spring was the peak season for rotavirus gastroenteritis in our study. However, outbreaks reported in other developed countries occurred during the winter. It is possible that the location and temperate climate of Taiwan at a latitude of 21–25°N is associated with a year-round pattern of disease that is more similar to that found in a developing country than an industrialized one. Most children with rotavirus gastroenteritis in our study were between the ages of 3 and 5 years (44%), which also contrasted with the situation in many developed countries, where about 60% of hospitalizations due to this infection were among children under 2 years old. This suggests that rotavirus could remain an important pathogen of gastroenteritis in 3–5-year-old children in our study.

According to a recent report by Chen et al, the annual social and hospital costs of rotavirus-associated hospital admissions in Taiwan represented about 40% of the monthly salary of an unskilled or service worker, and 5.9% of the gross national income. In this study, the total annual social and hospital costs for rotavirus-hospital admission was around US$ 5947, and on average, families spent at least US$ 66 when their child’s admission was associated with rotavirus infection (data not shown). Current vaccines might have the potential to reduce not only the morbidity and mortality, but also the health care costs associated with rotavirus infection.

Rotaviruses invade and replicate in the differentiated absorptive columnar cells of the small intestinal epithelium. The result is partial disruption of the intestinal mucosa, with loss of microvilli and a decrease in the villus/crypt ratio. The secretory crypt cells proliferate extensively to compensate, leading to substantial fluid and electrolyte secretion into the gut. The damage also leads to reduced expression of certain digestive enzymes. Lactase is usually the first affected disaccharidase, presumably because of its distal location on the villus. The immature epithelial cells that replace the disrupted mucosa are often lactase deficient, leading to secondary lactose deficiency and lactose malabsorption. However, these symptoms were not found in our study.

There are several limitation to the current study. First, the results only provided demographic data for hospitalized patients and did not include patients who visited the out-patient and emergency departments. Second, the rotavirus grouping was not genotyped, and could therefore not identify any new or unusual strains. These limitations could be reassessed in future surveillance studies.

The results of this study provide baseline estimates of the current burden and epidemiological profile of rotavirus infection in CGH. Gastroenteritis due to rotavirus infection was found not only in children under 5 years old, but also in older children aged between 6 and 12 years. Rotavirus-related hospital admissions occurred year-round, but there was month-to-month variability in rates, which were especially high during the spring.
References


