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Hospitalisations for gastroenteritis: the role of rotavirus☆

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Abstract

To determine the proportion of hospitalisations for gastroenteritis caused by rotavirus, we tested for rotavirus stool samples of all children under the age of five hospitalised for gastroenteritis between 1 December 1999 and 30 May 2000 in seven community and specialised hospitals in Quebec. Of 944 children hospitalised, 565 (59.9%) were screened for rotavirus and 405 (71.7%) tested positive. From December to April, the proportion of positive results rose from 51.6 to 78.1%. Compared with children whose test results were negative, children who tested positive presented vomiting more frequently upon admission (88.9 versus 60.4%) and needed IV fluids in greater proportion (94.1 versus 78.0%), but spent less time in hospital (2.8 versus 3.3 days). Aside from dehydration, no complications were noted. In Quebec, a large majority of winter and spring hospitalisations for gastroenteritis in children is attributable to rotavirus.

Keywords: Rotavirus; Gastroenteritis; Epidemiology

1. Introduction

Although the impact of rotavirus gastroenteritis is more severe in developing countries, these viruses affect people in all regions of the world. Globally, the viruses cause over 125 million cases of diarrhea, 25% of mortality due to diarrheal diseases, and 6% of deaths among children under 5 years of age. Regardless of the population studied, 20–40% of hospitalisations for gastroenteritis are linked to rotavirus infections [1].

In 1998, RotaShield™ (Wyeth-Lederle Inc., Marietta, PA) became the first rotavirus vaccine approved for use in the United States [2]. However, RotaShield™ was withdrawn from the market in October 1999 because of an increased risk of intussusception following administration of the vaccine [3–6]. Research is ongoing to develop a vaccine that is as effective as, and safer than, RotaShield™ and may lead to new products being approved in the next few years [7]. However, does rotavirus morbidity in Canada justify a vaccination programme, given the unknown hazards of a new live vaccine [8–10]?

The goals of our study were to determine the proportion of hospitalisations for gastroenteritis caused by rotavirus among children under 5 years of age, and describe the morbidity associated with this pathogen.

2. Materials and methods

Seven Quebec hospitals were selected because in 1997 they had had at least 100 hospitalisations for gastroenteritis among children less than 5 years old, and they routinely tested stool samples for rotavirus. Among these seven institutions, five were general-care community hospitals and two were tertiary paediatric hospitals. Four used the Pathfinder™ test (Sanofi Diagnostics Pasteur, Marnes La Coquette, France); two used Testpack Rotavirus™ (Abbott, North Chicago, IL). These two ELISA tests have a sensitivity and specificity of over 95% [11,12]. The other hospital used Rotalex™ (Orion Diagnostica, Espoo, Finland), a latex agglutination test with sensitivity estimated at 88% and specificity at 100% [13].

In each hospital, the head of paediatrics informed paediatricians of the project and asked them to test for rotavirus

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the stools of all children under the age of five admitted for gastroenteritis, within 48 h of admission. Faecal cultures, testing for *Clostridium difficile* toxin, and testing for parasites were all carried out at the discretion of the attending physician. Stool tests for rotavirus were conducted from 1 December 1999 to 30 May 2000. These two months correspond to the beginning and end of annual rotavirus activity in northeastern North America [14,15].

A few months later, in each participating hospital, admissions dating between December 1999 and May 2000 were retrieved from Med-Echo (Quebec's hospital database) under one of the following ICD codes: 008.6, 008.8, 009.0, 009.1, 009.2, 009.3, 558.9. All files were reviewed using a standardised questionnaire. Data collected were entered into a database using Epi Info, Version 6.04a (Centers for Disease Control and Prevention, Atlanta, GA). The Kruskal-Wallis test was used to assess the differences between continuous variables, and the Mantel–Haenszel χ^2 or χ^2 linear trend test for discrete variables, when appropriate. The Spearman rank correlation coefficient was used to verify the correlation between the proportion of cases tested and positivity rates from one hospital to another. Logistic regression was used to identify possible associations between a positive rotavirus test result and the variables that were statistically significant in the univariate analysis. Odds ratios (OR) with 95% confidence intervals (CI) were calculated.

The Montréal Public Health Department's research ethics committee had evaluated and approved the project. Either the Director of professional services or the ethics committee of each hospital had also approved the study.

3. Results

Of 1069 identified cases, 28 could not be analysed because their files were not available. Also, 97 were excluded from subsequent analyses: 7 because the patients lived outside Quebec, and 90 because although gastroenteritis was present at the time of admission or developed during hospitalisation, it was not the reason for admission. Among the 835 hospitalised patients for whom the information was available, 685 (82.0%) had gastroenteritis as the reason for admission.

Of the 944 children who were hospitalised, 565 (59.9%) were tested for rotavirus (Table 1). The proportion of patients who underwent testing varied from 27.1 to 94.4%, depending on the hospital ($P < 0.001$). A total of 405 (71.7%) of the 565 children had a positive test result. The proportion of patients who tested positive varied by hospital from 47.1 to 79.8% ($P < 0.001$). The highest rate of positivity (81.6%) was among 1-year-old children; the rate decreased with age to 61.5% in 4-year-olds ($\chi^2_{\text{linear trend}} = 6.68$; $P < 0.001$). From December to April, the proportion of positive results increased from 51.6 to 78.1% ($\chi^2_{\text{linear trend}} = 11.82$; $P < 0.001$) (Fig. 1). Although the proportion of cases tested for rotavirus and the rate of positivity varied significantly from one hospital to another, there was no statistically significant correlation between the two (Spearman's rank correlation coefficient $=-0.14$, $P > 0.20$).

Table 1
Characteristics of hospitalised, tested cases whose results were positive

Characteristics	Cases hospitalised N (%)[a]	Cases tested n_1 (%)[b]	Rotavirus-positive cases n_2 (%)[c]
Sex			
Male	467 (49.5)	300 (64.2)	223 (74.3)
Female	477 (50.5)	265 (55.6)	182 (68.7)
Age (years)			
<1	254 (26.9)	185 (72.8)	115 (63.2)
1	289 (30.6)	177 (61.2)	142 (81.6)
2	178 (18.9)	87 (48.9)	67 (77.0)
3	140 (14.8)	74 (52.9)	57 (78.1)
4	83 (8.8)	42 (50.6)	24 (61.5)
Hospital			
A	263 (27.9)	216 (82.1)	161 (74.5)
B	220 (23.3)	122 (55.5)	80 (65.6)
C	157 (16.6)	84 (53.5)	67 (79.8)
D	116 (12.3)	47 (40.5)	29 (61.7)
E	100 (10.6)	60 (60.0)	46 (76.7)
F	70 (7.4)	19 (27.1)	14 (73.7)
G	18 (1.9)	17(94.4)	8 (47.1)
Total	944 (100)	565 (59.9)	405 (71.7)

[a] The percentage represents the number of cases out of a total of 944.
[b] The percentage represents the number of cases tested out of the number of cases hospitalised.
[c] The percentage represents the number of cases infected with rotavirus out of the number of cases tested.

Table 2 compares children who were tested and those who were not. In Table 3, contrary to children who tested negative, children with a positive result presented vomiting at admission more often, needed IV fluid in greater proportion, and stayed less time in hospital (Table 3). Results of the multivariate analysis showed that the presence of rotavirus in stools was significantly associated with vomiting at admission (OR: 3.91; 95% CI: 2.18–6.99) and with starting an intravenous solution during hospitalisation (OR: 2.37; 95% CI: 1.15–4.85). Aside from dehydration, no complications were noted and no deaths occurred.

4. Discussion

A large majority of winter and spring hospitalisations for gastroenteritis among children under 5 years of age can be attributed to rotavirus. Although the acute-care hospitals in our sample were not randomly selected, hospitals in both urban and semi-urban settings as well as specialised and general paediatric hospitals from seven regions of the province were included. Therefore, our results are likely to be representative of the entire paediatric population of Quebec.

Although it was requested by the study protocol that all children admitted to hospital for gastroenteritis be systematically tested for rotavirus infection, only 59.9% of these