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Severity of rotavirus gastroenteritis in an Indian population: Report from a 3 year surveillance study

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ABSTRACT

This study investigated the severity of rotavirus gastroenteritis (RVGE) in hospitalized children less than 60 months of age and compared severity in the first five months of life to severity in children 6 to 23 months of age. Results from a 3 year surveillance study show an early peak of rotavirus disease, with 117 (31%) RVGE hospitalizations in children <6 months old. Higher incidence of severe dehydration, acidemia and acidosis at admission and prolonged hospitalization ≥7 days were seen in infants 0–5 months of age. The findings support the need for consideration of timely immunization or an accelerated immunization schedule with a birth dose to protect this vulnerable age.

1. Introduction

Rotavirus is the leading cause of diarrhea related hospitalization among infants and young children worldwide. Annually in India, rotavirus diarrhea causes nearly 100,000 deaths and over half a million hospitalizations in children less than 5 years [1,2].

Severe dehydration, leading to acute shock with electrolyte imbalance is believed to be the major cause of death in rotavirus gastroenteritis (RVGE) [3–5]. A low serum bicarbonate or venous pH has been reported to be the best predictor of dehydration correlating strongly with worsening clinical dehydration, greater diarrhea severity and younger age [6]. The amount of bicarbonate lost in stool depends on the volume of diarrhea and the bicarbonate concentration of the stool which tends to increase with more severe diarrhea [7]. Studies have reported that in acute episodes of RVGE as compared to non-rotavirus diarrhea, there is a higher incidence of complications from severe dehydration and acid-base and electrolyte imbalances [8,9].

Vaccination is considered one of the most effective public health strategies to prevent rotavirus infection and reduce disease burden [10]. Data on the age-specific burden of RVGE and frequency of complications would better identify vulnerable age groups to target for rotavirus vaccination and guide research on rotavirus vaccines. The purpose of this study was to assess the age distribution of children with RVGE admitted to an urban pediatric unit and to evaluate the incidence of complications from severe dehydration, acid–base and electrolyte abnormalities in RVGE at admission.

2. Materials and methods

2.1. Setting

The study was conducted at St. Stephens' Hospital Delhi (SSH), India: a 595 bedded multi-specialty tertiary care hospital with approximately 3000 deliveries taking place annually. The pediatric department has 40 beds, an intensive care unit with 6 beds and a neonatal intensive care unit. Patients are admitted from the city and nearby villages, and referred from general practitioners, clinics and various hospitals in Delhi. Most patients are of middle and lower income groups.

2.2. Study design and definitions

During a 3-year period from December 2005 through November 2008, children less than 59 months of age hospitalized in the ward or pediatric intensive care unit with acute gastroenteritis (AGE) (>3 loose or watery stools in a 24 h period) were included in the study after written informed consent was obtained. The history, severity of dehydration and treatment were recorded in patients' hospital records. Electrolytes and blood gas analysis were done as clinically indicated by the admitting physician. Treatment for dehydration,

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electrolyte and fluid imbalance was based on WHO and department protocols [11].

2.3. Laboratory methods

Stool samples were collected within 48 h of admission and tested for rotavirus by an enzyme immunoassay (Dako IDEIA Rota, Ely, UK). Serum electrolytes were analyzed in a Roche Hitachi 917. The acid-base status was established by blood gas analysis done in a Radiometer ABL 555 blood gas analyzer. All machines are calibrated once daily, according to the standards provided by the manufacturer.

2.4. Data collection

Data was obtained from hospital charts on demographic details, severity of dehydration, serum electrolytes and blood gas analysis entered at admission. Three rotavirus positive and six rotavirus negative cases were excluded as age was not entered in the patient records.

2.4.1. Severe dehydration

The clinical definition of a case of severe dehydration at admission was diarrhea that required re-hydration therapy equivalent to WHO plan C (intravenous re-hydration therapy of 100 mL/kg over 3 or 6 h depending on age) [11].

2.4.2. Definitions of serum electrolyte and acid-base abnormalities

Severe acidemia was defined as pH ≤7.2; severe acidosis was defined as bicarbonate ≤8 mEq/L; moderate acidosis as bicarbonate 9–12 mEq/L; hypokalemia was defined as serum potassium <3.5 mEq/L; hypernatremia as sodium level ≥150 mEq/L; severe hypernatremia Na>160 mEq/L; hyponatremia as sodium level <130 mEq/L [7,12-14].

2.4.3. Prolonged hospitalization with RVGE

Prolonged hospitalization was defined as children with rotavirus gastroenteritis requiring admission for ≥7days.

2.5. Statistical methods

Analysis was done using SPSS v.11 software. Percentages, proportions and rates were computed and the statistical significance of the differences tested using the Chi-square test and Fisher's exact test.

3. Results

Over the 3-year period, of 1208 children hospitalized with gastroenteritis, 974 (80.6%) had a stool specimen collected. All results are only for children who tested rotavirus positive.

3.1. Age of children hospitalized due to RVGE

Over the 3 years of the study, 39% (379/974) of these children hospitalized with gastroenteritis from whom stool samples were collected tested positive for rotavirus. The age distribution of children hospitalized for RVGE from December 2005 to December 2008 is presented in Fig. 1. December 2008 was included, because the samples from December 2007 was lost during transport. Of the rotavirus hospitalizations, 31% occurred during the first 5 months of life, 49% by 8 months of age, and 64% by 11 months, 89% by 23 months. Approximately 11% were 2–5 years of age.

Rotavirus accounted for 33% of all hospitalizations for gastroenteritis among children in the 0–2 month age group, 46% of those

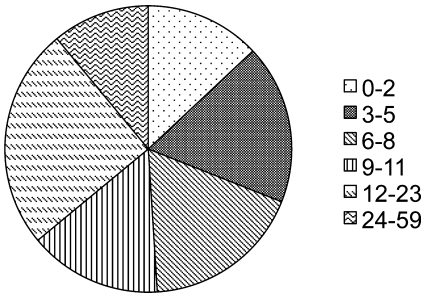

Fig. 1. Age in months of children less than 60 months hospitalized with rotavirus gastroenteritis at St. Stephen's Hospital, Delhi between December 2005 and December 2008.

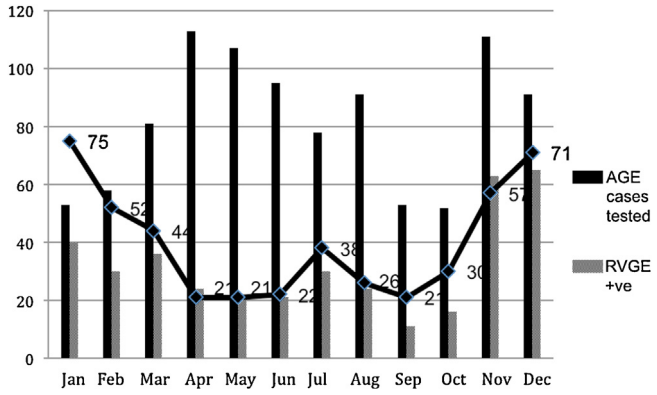

Fig. 2. Seasonal distribution of cases admitted with acute gastroenteritis (AGE) and positive for rotavirus (RVGE) over 3 years of surveillance at St. Stephen's Hospital, Delhi. The line indicates the percentage of cases positive for rotavirus by month.

3–5 months and about 27% of all hospitalizations for gastroenteritis among children 2–5 years of age.

3.2. Seasonality of RVGE

Delhi has a temperate climate. There was a winter peak during January and December with >70% of hospitalizations for gastroenteritis being associated with rotavirus (Fig. 2).

3.3. Complications at first evaluation of RVGE

The mean Vesikari score was 13 (inter-quartile range 11–16) indicating that the children had severe RVGE. The study found severe dehydration in 59 (15.6%) children and acidosis with bicarbonate ≤12 mEq/L in 70 (18.4%) children, this included 39 (10%) with severe acidosis with bicarbonate ≤8 mEq/L. We found acidemia with a pH of ≤7.2 in 44 (11.6%) children; hypernatremic dehydration (Na ≥150 mEq/L) in 44 (11.6%) children; hyponatremia Na <130 mEq/L in 9 (2.4%) children; hypokalemia (K <3.5 mEq/L) in 43 (11.3%) children and 16 (4.2%) had K ≤2.9 mEq/L.

Seizures during hospitalization occurred in 27 children, with 8/27 with hypocalcaemic seizures due to rickets based on reports of low calcium and raised alkaline phosphatase or raised parathormone. Two children with seizures were hypernatremic and one was hyponatremic. One child had cerebral palsy which could have pre-disposed to seizures.

The median duration of hospitalization was 3 days (inter-quartile range, IQR, 2–4), and 35 cases (9.2%) had hospitalization for ≥7 days.