

## Original Contributions

### HYPOGLYCEMIA COMPLICATING DEHYDRATION IN CHILDREN WITH ACUTE GASTROENTERITIS

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**Abstract**—A study was done to estimate the prevalence of hypoglycemia among children with dehydration due to acute gastroenteritis, and to identify clinical variables associated with hypoglycemia in these children. A retrospective case series of children older than 1 month of age and younger than 5 years of age who presented to an urban children's hospital Emergency Department with acute gastroenteritis and dehydration was performed. Medical records were reviewed; demographic and clinical data, including pretreatment serum glucose concentrations, were recorded. There were 196 children comprising the study population. Eighteen children (9.2%) were hypoglycemic. The duration of vomiting was longer for the children with hypoglycemia (2.6 days, SD  $\pm$  1.5) than for those without hypoglycemia (1.6, SD  $\pm$  1.8), 95% CI 0.13 to 1.88. Hypoglycemia may complicate dehydration due to acute gastroenteritis in young children. Clinicians should examine the serum glucose concentration in these children. © 2005 Elsevier Inc.

**Keywords**—hypoglycemia; dehydration; gastroenteritis; pediatrics

#### INTRODUCTION

There is little literature describing hypoglycemia as a complication of dehydration due to acute gastroenteritis; that which exists is from undeveloped countries where bacterial pathogens are responsible for a considerable proportion of acute gastroenteritis cases and malnutrition

is a common co-morbidity (1–4). Standard pediatric textbooks and the American Academy of Pediatrics practice parameter regarding acute gastroenteritis in children do not discuss hypoglycemia as a potential complication (5–8). The purpose of this study was to estimate the prevalence of hypoglycemia among children with dehydration due to acute gastroenteritis who presented to an urban children's hospital emergency department in a developed nation. A secondary goal of this study was to identify clinical variables associated with hypoglycemia in these children.

#### MATERIALS AND METHODS

This is a retrospective case series. Medical records of children older than 1 month of age and younger than 5 years of age who presented to our urban children's hospital ED between January 1 and December 31, 1998 and received an ICD-9 code for acute gastroenteritis were reviewed by the authors. During the study period, our ED had a census of 33,816 patients. All patients were managed by board certified or board eligible pediatric emergency physicians or by pediatric Emergency Medicine fellows. For the purposes of this study, dehydration was considered to be present in children who received an intravenous fluid bolus. Children with a documented disorder that would predispose to hypoglycemia (e.g., a primary hypoglycemic disorder, insulin therapy, liver

disease, adrenal insufficiency, hypothyroidism, hypopituitarism, malignancy, sepsis, or ingestion of an oral hypoglycemic agent, a beta-blocking agent, a salicylate, or alcohol) were excluded.

Standard care for dehydration during the time period studied included measurement of serum electrolytes, blood urea nitrogen (BUN), creatinine and glucose; and the administration of intravenous rehydration. Oral and nasogastric rehydration were not practiced. Ancillary studies, such as complete blood count, urinalysis, fecal leukocytes, and cultures of urine, blood and stool, were not routinely performed.

A standard data collection form, completed by the authors, was used to record demographic and clinical patient characteristics. Demographic data included age and gender. Clinical data included presence and duration of vomiting and diarrhea, initial vital signs, weight, presence or absence of seizure activity, and level of consciousness. Laboratory data included serum concentrations of sodium (because hyponatremia can cause alterations in mental status), bicarbonate, BUN and glucose.

Systolic hypotension was defined as less than 70 mm Hg for children 1 month to 1 year of age; and less than  $70 + (2 \text{ multiplied by the age in years})$  mm Hg for children older than 1 year of age. Level of consciousness was defined as alert, responsive to verbal stimulus, responsive to painful stimulus, or unresponsive. Hypothermia, identified in previous studies as being associated with hypoglycemia in dehydrated children, was defined as a temperature less than 36°C. In our ED, standard practice is to measure rectal temperatures in children < 3 years old, and to measure oral or axillary temperatures in children  $\geq 3$  years old.

The definition of hypoglycemia was derived from standard pediatric textbooks (9–11). A serum glucose concentration < 60 mg/dL (3.3 mmol/L) was considered abnormally low. Glucose measurements were performed using the Dimension® clinical chemistry system and Glucose Flex™ reagent cartridges (Dade Behring Inc., Deerfield, IL).

The IRB of our institution exempted this study from formal review.

## STATISTICAL METHODS

Descriptive statistics were used to analyze and report data. These included numbers, percentages, means, standard deviations and 95% confidence intervals for single proportions, changes in proportions and changes in means.

## RESULTS

A total of 528 children received a diagnosis of acute gastroenteritis; 207 received intravenous rehydration, none received oral or nasogastric rehydration. None of these patients received intravenous fluid at another facility or from EMS personnel before arrival at our ED. Of the patients rehydrated intravenously, 199 had a serum glucose concentration determined. Medical records were not available for 3 of these children; therefore, 196 children comprised our study population.

The average age was 23 months ( $SD \pm 14$ ), median age 19 months, and range 1 to 57 months. Eleven children (5.6%) had an altered mental status. None had a seizure. Blood pressure was recorded for 185 children; one was hypotensive. No children were hypothermic.

### *Hypoglycemic Children*

Eighteen children (9.2%) were hypoglycemic. Their characteristics are summarized in [Tables 1](#) and [2](#). All presented with a history of vomiting. Seventeen children (94%) presented with a history of diarrhea. The duration of diarrhea was not documented for 1 of these 17 children. Mental status was documented for 15 children; none had an altered mental status. Systolic blood pressure was recorded for 17 children; none was hypotensive. None were subsequently admitted for inpatient care.

Of the hypoglycemic children, the average serum glucose concentration (mg/dL) was 51.6 with a range of 34 to 59. There were 11 children with a serum glucose concentration between 50 and 59 mg/dL, 6 children with a serum glucose concentration between 40 and 49 mg/dL, and one child with a serum glucose concentration of 34 mg/dL. Ten hypoglycemic children (56%) received intravenous dextrose to correct hypoglycemia; the remainder received various oral liquids containing sugar.

### *Non-Hypoglycemic Children*

There were 178 children (90.8%) who were not hypoglycemic. Selected characteristics are summarized in [Table 2](#). Vomiting was present in 172 children (97%). The duration of vomiting was not documented for 5 of these children. Diarrhea was present in 134 children (75%). The duration of diarrhea was not documented for 7 of these children; the presence or absence of diarrhea was not documented for 3 study patients. Mental status was documented for 155 children and, of these, 12 (8%) had altered mentation. Systolic blood pressure was recorded for 166 children, and one child was hypotensive. This

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