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Original Contributions

SUCCESSFUL DISCHARGE OF CHILDREN WITH GASTROENTERITIS REQUIRING INTRAVENOUS REHYDRATION

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□ **Abstract—Background: Emergency Department (ED) revisits are very common in children with gastroenteritis administered intravenous rehydration. Study Objectives: To determine if bicarbonate values are associated with ED revisits in children with gastroenteritis. Methods: We conducted a secondary analysis of prospectively collected data, which included children >3 months of age with gastroenteritis treated with intravenous rehydration. Regression analysis was employed to determine whether, among discharged children, bicarbonate independently predicts revisits within 7 days (primary outcome) and successful discharge (secondary outcome). The latter composite outcome measure was defined as discharge at the index visit and the absence of a revisit requiring intravenous rehydration. Results: Of 226 potentially eligible children, 174 were discharged and were included in the primary outcome analysis. Of the eligible children, 18% (30/174) had a revisit that was predicted by a higher baseline bicarbonate (odds ratio [OR] 1.1; 95% confidence interval [CI] 1.0–1.3; $p = 0.03$), absence of a primary care provider (OR 7.8; 95% CI 1.2–51.0; $p = 0.03$), and ondansetron administration (OR 2.4; 95% CI 1.0–5.5; $p = 0.05$). Bicarbonate was not associated with successful discharge. Negatively associated independent predictors of successful discharge were volume of intravenous fluids administered (OR 0.84/10 mL/kg increase; 95% CI 0.76–0.93; $p < 0.001$), and baseline clinical dehydration score (OR 0.75/unit increase; 95% CI 0.58–0.97; $p < 0.001$). Revisits requiring intravenous rehydration and hospitalization were associated with higher bicarbonate values (21.2 ± 4.6 mEq, $p = 0.001$, and 22.3 ± 5.0 mEq/L, $p < 0.001$, respectively). Conclusion: Lower serum bicarbonate values at the time of intravenous rehydration are not associated with unfavorable outcomes after discharge.** © 2014 Elsevier Inc.

□ **Keywords—gastroenteritis; ambulatory care facilities; emergencies; intravenous infusions; acidosis**

INTRODUCTION

Gastroenteritis remains a common Emergency Department (ED) diagnosis accounting for 2 to 4 million outpatient

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Clinical Trial Registration Number: The clinical trial which served as the basis for data collection for this study was registered at www.ClinicalTrials.gov (number, NCT00392145).

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visits annually among children < 5 years of age in the United States (1). Although treatment guidelines recommend the use of oral rehydration therapy (ORT) in children with mild to moderate dehydration, it remains underused in those with moderate dehydration (2,3). Furthermore, children with severe dehydration and certain children with mild to moderate dehydration require the administration of intravenous fluids (e.g., those with ileus, excessive stool output, carbohydrate malabsorption, intractable vomiting) (2). Consequently, up to 50% of children with rotavirus gastroenteritis receive intravenous rehydration in academic pediatric EDs (4).

Although most children with gastroenteritis are discharged home, there is little evidence available regarding risk factors for revisits among those who are administered intravenous rehydration. Research to date into predictors of repeat ED visits has included predominantly children receiving only ORT (5). Among children receiving intravenous rehydration, serum bicarbonate is postulated to predict the ability to tolerate ORT, to improve physician assessment of dehydration severity, and to influence patient disposition determination (6–8). This is because many children with gastroenteritis and dehydration are believed to have an anion gap acidosis from ketosis, which may result in nausea, persistent vomiting, and poor oral intake (9). However, although serum bicarbonate may be a sensitive marker of severe dehydration, its specificity is low, particularly at the recommended thresholds, and these findings have not consistently been reported (7,10–12). Moreover, the studies are limited by methodologic concerns. Thus, we sought to fill this gap by analyzing prospectively collected data from a cohort of children who underwent standardized laboratory testing to address many of the methodologic issues of the existing literature.

Our primary objective was to determine, among children discharged to home after the administration of intravenous rehydration, if the baseline serum bicarbonate is an independent predictor of an ED revisit within 7 days.

MATERIALS AND METHODS

Study Design and Setting

We conducted a secondary analysis employing data collected prospectively on 226 children >3 months of age with gastroenteritis who received intravenous rehydration. Eligible children were enrolled in the ED of The Hospital for Sick Children, a pediatric tertiary care center in Toronto, Canada, between December 2006 and April 2010. The data set was created during the conduct of a pragmatic clinical trial evaluating the impact of large volume intravenous rehydration (13). This analysis was approved by the hospital's research ethics board. Written informed consent was obtained from all caregivers; participant assent was obtained when appropriate.

Population

Participating children were diagnosed with gastroenteritis by the supervising physician and were deemed to have dehydration requiring intravenous rehydration. All potentially eligible children were administered ORT. Caregivers were instructed to administer 5 mL of a flavored oral rehydration solution through a syringe every 5 min (2). For children with persistent vomiting, ondansetron was administered orally in an attempt to prevent the need for intravenous rehydration; prescriptions for home administration were not provided. A research nurse was present to recruit patients from 8 AM to midnight; overnight coverage was provided by the principal investigator. Children deemed to require intravenous rehydration for failed ORT were assessed for eligibility (2). Dehydration was defined as a clinical dehydration scale (CDS) score of ≥ 3 (Table 1) (14–16). Children were ineligible if they weighed < 5 or > 33 kg (unable to administer required fluid volume over 60 min); required fluid restriction; had a surgical abdomen; history of a significant chronic systemic disease; abdominal surgery; head, chest, or

Table 1. Clinical Dehydration Scale*

Characteristic	Score of 0	Score of 1	Score of 2
General appearance†	Normal	Thirsty, restless, or lethargic but irritable when touched	Drowsy, limp, cold or sweaty, comatose
Eyes	Normal	Slightly sunken	Very sunken
Mucous membranes‡	Moist	Sticky	Dry
Tears	Present	Decreased	Absent

* Higher scores indicate more severe dehydration. Scores range from 0 to 8. This four-item scale has previously been shown to have good inter-rater reliability (intra-class correlation coefficient = 0.77; 95% confidence interval [CI] 0.68–0.86) and discriminatory power (Ferguson's δ = 0.83; 95% CI 0.77–0.88) (13). Subsequent prospective validation has demonstrated that it correlates with length of stay and need for intravenous rehydration (14). Furthermore, it has been validated independently in two Emergency Departments (15). A score of 0 correlates with no dehydration, scores of 1–4 correlate with some dehydration (40) and 5–8 correlates with moderate to severe dehydration (14,40,41).
† "Normal" includes children who may be sleeping but are easily aroused to a normal level of conscious. This assessment takes into account the time of day and the child's usual pattern as described by the child's guardian.
‡ This is assessed on the buccal mucosa and tongue, and not the lips.

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