

# Use of Intravenous Therapy in the Management of Acute Gastroenteritis in Young Children: A Retrospective Analysis

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## Abstract

Oral rehydration therapy is underused in the management of dehydration secondary to acute gastroenteritis in young children in developed countries. We have reviewed the situation in a regional hospital. **Methods:** Medical records of 413 young children admitted because of acute gastroenteritis were reviewed. Comparison was made between the group that was given intravenous fluid (IV) and the group that was not (No-IV). **Results:** 241 (58.4%) patients received intravenous therapy. Vomiting and decreased oral intake before admission were factors most commonly found in the group who had been given intravenous fluid (85% & 81% vs 52% & 58% respectively,  $P < 0.001$ ). Electrolytes abnormalities were found in 14 patients (3.6%). The duration of hospital stay was significantly longer ( $4.12 \pm 1.61$  days vs,  $3.48 \pm 1.4$  days  $P < 0.001$ ) in the group who had received intravenous fluid. **Conclusion:** Acute gastroenteritis in our locality was commonly managed with intravenous fluids. Vomiting and decreased oral intake are major determinants for starting intravenous fluid. Routine blood examination was of little value in majority of patients admitted for acute diarrhoea and the patients given intravenous therapy had a longer duration of hospital stay.

**Key words** Children; Gastroenteritis; Oral rehydration

## Introduction

Acute gastroenteritis accounts for a significant number of paediatric outpatient visits as well as hospitalisations. Although the disease is itself self-limiting, a substantial number of paediatric patients will run a severe course and the associated dehydration remains the most common cause of morbidity or even mortality.

The feasibility of using oral rehydration fluid in the

management of dehydration was first demonstrated in the 1960s when it was shown that intestinal water absorption is mediated by the cotransport of sodium and glucose. This finding provided the basis to the formulation of sodium- and glucose-based oral rehydration solutions (ORS). From the 1970s, WHO has promoted the use of ORS to treat dehydration secondary to diarrhoea in developing countries.<sup>1</sup> The effectiveness of ORS in children with dehydration has also been demonstrated in developed countries.<sup>2-4</sup>

Oral rehydration therapy is recommended as the preferred treatment of mild to moderate dehydration in young children.<sup>5</sup> Despite the evidence that ORS is safe and effective in the management of dehydration from acute gastroenteritis, oral rehydration is still underused. It has been estimated that 55-82% of children admitted to hospital for acute gastroenteritis receive intravenous rehydration as an initial treatment.<sup>6,7</sup>

Intravenous therapy is likely to be more expensive and more complicated as it is necessary to calculate the volume of fluid required, the amount of electrolytes to be added, and the rate of infusion. It is also associated with more severe complications such as extravasation, thrombophlebitis, and

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fluid overload. More importantly, successful oral rehydration means that dehydrated children can be managed as outpatients or short stay inpatients, thereby reducing costs. The objective of this study is to review the usage of intravenous fluid in children admitted for acute gastroenteritis in a regional hospital and to explore the reasons that lead to the decision to start intravenous therapy.

## Methods

Within the period January 2002 to December 2002, patients were selected from the General Paediatric Discharge Records of the Department of Paediatric and Adolescent Medicine, Pamela Youde Nethersole Eastern Hospital. Patients with the diagnostic keywords, diarrhoea, gastroenteritis, enteritis/colitis, rotavirus, salmonella, shigella/shigellosis, campylobacter, and giardiasis, in the primary and secondary diagnoses were identified and the medical records were reviewed. The inclusion criteria were young children with age between 1 and 60 months admitted because of acute gastroenteritis. Acute gastroenteritis was defined as passage of loose or watery stools for a period of less than 14 days. Patients were excluded if they developed diarrhoea more than 48 hours after admission. Patients with comorbidities, which might have lengthened the hospital stay, were also excluded. Specific data on demographic information, clinical data (clinical condition before admission, such as the subjective information provided by parents or caretakers on the severity of diarrhoea, the presence of poor oral intake, and vomiting etc., the clinical condition on admission, and the assessment of level of dehydration), laboratory findings, and progress were abstracted from the records. The assessment of severity of dehydration was based on the weight loss classification of <5% (mild), 5-10% (moderate), and >10% (severe),<sup>6</sup> attending officer's overall assessment of the level of dehydration was specifically looked for from the case notes. The records were gone over to look for reasons for starting intravenous therapy, including poor oral intake, vomiting, severe diarrhoea, and dehydration etc. Comparison was made between the group that was given intravenous fluid (IV) and the group that was not (No-IV). Statistical analysis was performed by using SPSS 9.0 for windows (SPSS Inc., Chicago, IL, USA). Continuous variables were compared by unpaired *t* test, categorical variables were compared by chi square or Fisher's exact test.

## Results

Six hundred and sixty-three patients were identified from the Discharge Record with cases notes reviewed. Five hundred and forty-six patients fulfilled the inclusion criteria. Forty-six patients were excluded because of nosocomial diarrhoea. Seventy-one patients were excluded because of the presence of comorbidities, including upper respiratory infection (42), otitis media (4), acute bronchiolitis (6), pneumonia (2), asthma (2), chickenpox (1), convulsion (8), severe mental retardation and global developmental delay (2), urinary tract infection (2), drug allergy (1), and cow's milk protein intolerance (1). Another 14 patients who did not pass any stool after admission and were excluded. Two additional patients were excluded because of wrong coding. Four hundred and thirteen patients were included in the final analysis.

### *Diarrhoea Pattern (Figure 1)*

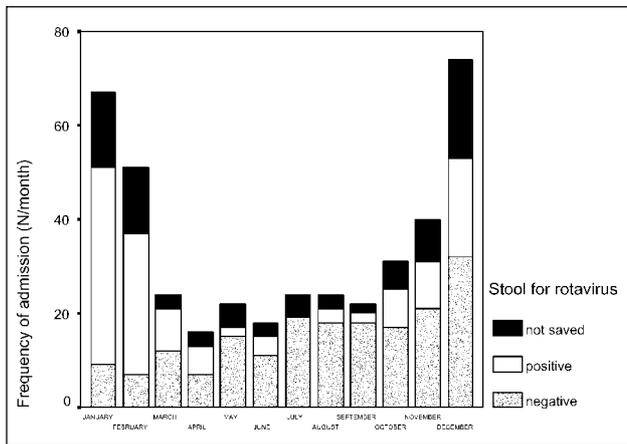
The disease followed a seasonal pattern which peaked in winter time (December to February). Stool specimens were collected and sent for rotavirus study and bacterial cultures in 323 and 346 patients respectively. Rotaviral diarrhoea accounted for 42% ( $\frac{137}{323}$ ) of all the stools sent. The pathogen also followed a seasonal pattern and peaked in winter time. Stool for bacterial cultures was positive in 22% ( $\frac{76}{346}$ ) of all the specimens sent.

### *Laboratory Investigations*

Serum electrolytes were measured in 386 patients (93%) of the patients. The mean serum sodium (Na), potassium (K), urea (Ur), and creatinine (Cr) levels were, 137.7 mmol/L, 3.98 mmol/L, 4.32 mmol/L, and 40.99  $\mu$ mol/L respectively. Fourteen patients (3.6%) were found to have electrolyte abnormalities. Of these 14 patients, 9 of them were found to have mild dehydration, the hydration status of the remaining 5 patients were not clearly documented. Three patients (0.8%) were found to have a serum Na below 130 mmol/L (all 129 mmol/L). There was no hypernatraemia (Na >150 mmol/L). Eleven patients (2.8%) had serum potassium level below 3 mmol/L (lowest 2.7 mmol/L), 9 of them were given potassium supplement via intravenous route, none of them required bolus intravenous replacement.

### *Clinical Management*

The hydration status was documented in 310 patients



**Figure 1** Seasonal pattern of acute gastroenteritis and prevalence of rotavirus.

(75.1%). The majority of patients were found to have mild dehydration (305/310, 98%). Moderate dehydration accounted for 1.6% (5/310) of these admission. Of all the

patients with their hydration status assessed, none of them were found to have severe dehydration.

Of these 413 patients, 241 (58.4%) of them received intravenous therapy, the majority of them were given intravenous therapy within 24 hours of admission. Reasons for starting IV fluid were recorded in 80/241 (33%) patients, these included poor oral intake (32), vomiting (18), dehydration (12), decreased urine output (3), frequent diarrhoea (1), suspected surgical cause (2), sepsis and shock (1), and hypokalaemia (1). Ten patients were found to have a combination of poor oral intake, vomiting, and dehydration as reasons for starting IV fluid. The mean duration of intravenous fluid given was 23.4 hours. Complications occurred in 34 patients (14.5%), including extravasation (17), thrombophlebitis (2), blocked catheter (13), fluid overload (1), and dislodged catheter (1).

Comparison was made between the group that was given intravenous fluid (IV) and the group that was not (No-IV) (Table 1). The presence of vomiting and decreased oral

**Table 1** Comparison between the group that was given intravenous fluid (IV) and the group that was not (No-IV).

	IV N=241 (58.4%)	No-IV N=172 (41.6%)	
Age (months)	24.41±15.05	15.47±13.27	
Gender (% male)	120 (49.8%)	105 (61%)	
<i>Before admission</i>			
Amount of diarrhoea (N)			<i>p</i> =0.335
Mild	58	42	
Moderate	84	61	
Severe	60	52	
Poor oral intake (%)	196 (81%)	99 (58%)	<i>p</i> <0.001
Vomiting (%)	206 (85%)	90 (52%)	<i>p</i> <0.001
<i>Condition on admission</i>			
Fever (T>38°C)	67 (38.5%)	37 (21.5%)	<i>p</i> =0.147
% dehydration			<i>p</i> =0.068
Mild	167	138	
Moderate	5	0	
Severe	0	0	
<i>Investigations</i>			
Rotavirus (% positive)	112/186 (60%)	25/137 (18%)	<i>p</i> <0.001
Serum Na (mmol/L)	137.9±3.07	137.49±2.30	<i>p</i> =0.185
Serum K (mmol/L)	3.89±0.49	4.13±0.52	<i>p</i> <0.001
Urea (mmol/L)	4.76±1.96	3.36±1.31	<i>p</i> <0.001
Creatinine (µmol/L)	41.79±6.75	39.68±8.08	<i>p</i> =0.006
<i>Progress</i>			
Reduced oral intake on Day 1 admission	168 (69.7%)	18 (10.5%)	<i>p</i> <0.001
Hospital stay (days)	4.12±1.61	3.48±1.4	<i>p</i> <0.001

Data are expressed as mean±SD or %

intake before admission were factors more commonly related to the commencement of intravenous therapy (85% & 81% in IV group vs 52% & 58% in No-IV group respectively,  $p < 0.001$ ). Whereas the severity of diarrhoea before admission and the severity of dehydration were not different between the 2 groups. Rotavirus was found to be more prevalent in the IV group ( $112/186$ , 60%) as opposed to the No-IV group ( $25/137$ , 18%). The IV group had a lower mean serum potassium level, higher serum urea and creatinine levels) on admission, but the levels were within normal limits. One hundred and sixty-eight (69.7%) patients in the IV group had a poor oral intake on the first day after admission as opposed to 18 (10.5%) patients in the oral group ( $p < 0.001$ ). The duration of hospital stay was significantly longer in the IV group as compared with the No-IV group,  $4.12 \pm 1.61$  days vs,  $3.48 \pm 1.4$  days,  $p < 0.001$ .

## Discussion

Although oral rehydration therapy is recognised as an effective, inexpensive treatment for dehydration in children with acute gastroenteritis, it is widely underused in western countries and a substantial portion of patients with acute diarrhoea are treated with intravenous therapy.<sup>7-10</sup> We have found a similar situation in a regional hospital in Hong Kong, which showed that 58.5% of the children admitted because of acute gastroenteritis had been put on intravenous fluid.

The reasons for the underuse of oral rehydration are multiple, important ones include: it is widely believed that intravenous rehydration is fast and effective, and is generally accepted by parents as the preferred route to the oral or nasogastric route, particularly in face of a vomiting child.<sup>9</sup> In this study, the presence of vomiting and reduced oral intake before admission were more commonly related to the commencement of intravenous therapy. Whether it might reflect parental wishes or our reluctance in relying on oral rehydration alone needs further exploration. It is interesting to note that more than 50% of patients in the No-IV group were also found to have poor oral intake and vomiting before admission, these patients were managed with oral rehydration alone. Owing to the limitation of the retrospective nature of the study, we were not able to verify how these patients could be managed successfully without using intravenous therapy. In recently published guidelines for the management of acute diarrhoea in young children, it is suggested that oral rehydration therapy can successfully rehydrate most children even with vomiting.<sup>5</sup> Alternative

measures include administering small volumes of ORS frequently, but this requires a compliant and motivated caretaker. Continuous and slow infusion of ORS via a nasogastric tube is another option, but this has been noted to be unpleasantly invasive.<sup>11</sup> However, the feasibility of these alternative measures has not been studied in our locality. Of note a proportion of patients in the IV group ( $73/241$ , 30%), who were found to have normal oral intake after admission, had already been put on intravenous fluid early during the admission. These patients could have been managed successfully without resorting to intravenous therapy. There is also consistent belief that oral rehydration is more time-consuming.<sup>11</sup> However, successful oral rehydration means that the patient can be managed as an outpatient, and hospitalisation can be avoided. Although we have shown that the duration of hospital stay was significantly longer in children receiving intravenous therapy, we believe this has not reflected the situation completely. Confounding factors such as the degree of dehydration on admission and the disease process itself would have affected the outcome. In addition, the discharge criteria were not standardised among physicians, which highlights the limitation of this retrospective analysis. A prospective randomised control trial would be more appropriate in studying the clinical benefit of oral rehydration therapy, including the duration of hospital stay.

The value of serum biochemistries in guiding the management of acute gastroenteritis has been questioned.<sup>2,12,13</sup> We have shown that abnormal serum biochemistries were infrequently encountered. Hyponatraemia and hypokalaemia occurred in 0.8% and 2.8% of the admission respectively. It is recommended that serum biochemistry tests are indicated for patients with severe dehydration and probably also for those patients with some signs of dehydration who requires intravenous fluid replacement.<sup>5</sup> The value of serum electrolytes and urea level is obvious in the situation of severe dehydration. For lesser degrees of dehydration, the need for investigation is less clear cut and should be individualised.<sup>5</sup> In the current study, the number of patients with electrolyte abnormalities in the current study was too small to provide a meaningful prediction on which patients were more likely to have abnormal results. Although statistically significant differences have been demonstrated in serum potassium, urea and creatinine concentration between the IV and No-IV groups, the differences were not clinically important. A simpler method of collecting urine for specific gravity and detection of

ketones may serve the purpose as indicators of moderate dehydration and the effectiveness of treatment.<sup>4</sup>

The prevalence of rotavirus in the present study was 42.4%. This was higher than the 28% found in a concurrent hospital-based surveillance study of rotavirus disease burden in 4 public hospitals in Hong Kong (including our hospital).<sup>14</sup> This discrepancy might be related to the exclusion of a significant portion of patients with comorbidities from the analysis. Nevertheless, it reflects a significant disease burden caused by rotavirus.

## Conclusion

It is a common practice in our locality to treat dehydration secondary to acute gastroenteritis by intravenous route. Vomiting and decreased oral intake are major determinants for starting intravenous fluid, nasogastric administration of oral rehydration fluid may be an alternative. Routine blood examination for electrolytes is of little value in the majority of children admitted for diarrhoea. Patients given intravenous therapy may have a longer duration of hospital stay. A prospective randomised control trial would be more appropriate in studying the clinical benefit of oral rehydration therapy in acute diarrhoea.

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