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ORIGINAL ARTICLE

Clinical Predictors of Severe Dehydration in Pediatric Acute Gastroenteritis. A Clinical Study

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ABSTRACT

Background: Acute gastroenteritis ranks among the major problems of morbidity in children all over the world, and the most severe complication of this situation is severe dehydration. The early detection of predictable clinical factors is necessary to start management in time, particularly in resource-constrained environments.
Objectives: The shortcoming procedure aims to identify clinical predictors of severe dehydration in children who present with acute gastroenteritis.
Methods: This was a cross-sectional study of the clinical population of 100 children (aged 6 months to 12 years) with acute gastroenteritis who were presented to a tertiary care hospital. The patients were assessed with the detailed history and systematic clinical examination. The severity of dehydration was categorized as per the world health organization (WHO) criteria. Demographic factors, frequency of diarrhea and vomiting, and the significant clinical manifestations, such as sunken eyes, dryness of the mucous membranes, time of capillary refill, skin turgor, heart-rate, mental status, peripheral pulses, and urine output, were measured on structured proforma. The statistical analysis was done to identify relationships between clinical predictors and severe dehydration.
Results: Out of 100 children, Dehydration was severe in 38% of them. Markedly poor skin turgor, prolonged capillary refill time (>2 seconds) was also found to be significantly related to severe dehydration, as well as, sunken eyes (92.1%), dry mucous membranes (86.8%), tachycardia (71%), and lethargy (55.2%). Children who had 8 or more episodes/day diarrhea and 5 or more diarrhea episodes/day vomiting also exhibited the increased risk of severe dehydration. Another good predictor was decreased urine output which was reported in 81.5% of children who were severely dehydrated.
Conclusion: Significant clinical features of severe dehydration such as sunken eyes, delayed capillary refill, dry mucous membranes, and poor skin turgor are good predictors of severe dehydration in pediatric acute gastroenteritis. It is possible to use these available bedside cues to contribute to fast triage and prompt action, especially in resource-limited settings.
Keywords: Acute gastroenteritis, Severe dehydration, Pediatrics, Clinical predictors, Capillary refill time, Diarrhea.

INTRODUCTION

Acute gastroenteritis has been one of the leading causes of morbidity and hospitalization among children across the world and especially in low and middle-income

countries [1]. It is manifested by diarrhea, vomiting, and different levels of fever, that causes considerable fluid and electrolyte loss. Nevertheless, regardless of the improvements in the care of children, dehydration remains the most severe and potentially fatal complication of acute gastroenteritis in children [2]. The effects of dehydration are considered to be causing a significant percentage of emergency care among pediatric patients globally with infants and young children being more vulnerable to dehydration-related outcomes because of limited physiological reserves, high metabolic rate and elevated percentage of total body water [3].

The initial identification of the severity of dehydration is crucial to avoid the hazardous outcomes in the form of hypovolemic shock, acute kidney diseases, metabolic acidosis, and even death [4]. Nevertheless, it is difficult to clinically assess it due to the difficulty in distinguishing between the symptoms and the fact that caregivers can underestimate the loss of fluid, especially in the facilities where the delay in hospitalization is a frequent occurrence [5]. Multiple clinical manifestations, such as prolonged capillary refill time, sunken eyes, loss of skin turgor, an altered mental status, tachycardia, and reduced urine output are conventionally considered to categorize dehydration although not all populations and disease severity predict it [6].

In the resource constrained areas such as Pakistan where laboratory services may not be readily available, bedside clinical predictors with precision are very essential [7]. Triage Timely Triage Timely triage and complications Reduction of complications and improving the use of the appropriate fluid management approach can be achieved by identifying meaningful clinical indicators of severe dehydration that are identified early [8]. Furthermore, the significance of the study of these predictors among local pediatric populations is that factors like malnutrition, repeated infections, and environmental determinants may impact the presentation and the outcome[9]. Thus, the purpose of this study is to compare clinical predictors related to severe dehydration in children with acute gastroenteritis in the tertiary care hospital. This study will improve early diagnosis, treatment procedures and eventually lower gastroenteritis morbidity among children by determining the most reliable and practical clinical indicators [10].

MATERIAL AND METHOD

The current study was developed in the form of a cross-sectional clinical study in a hospital department where the primary unit was the Department of Pediatrics at a tertiary care hospital. During the study period, 100 children with age 6 months to 12 years were enrolled with acute gastroenteritis. Acute gastroenteritis was considered to be the passage of three or more abnormally loose or watery stools per day with or without vomiting of less than 14 days. Inclusion criteria were that the patient had to present with signs and symptoms indicative of gastroenteritis and must have no history of chronic diarrhea, chronic renal, cardiac or endocrine conditions or received intravenous fluid resuscitation prior to hospital admission. The children who were dysentic, had severe acute malnutrition, had known congenital anomalies, or who had the refusal of their parents/guardians were not included. Informed consent was acquired via written forms by the parents or legal guardians before enrolment or by the institutional ethical review committee.

During admission, a comprehensive history was taken which included the length and frequency of diarrhea and vomiting, fever, oral intake, urine output, and other previous treatment. Clinical examination was conducted attentively and specifically on the indicators of dehydration, which included general appearance, the level of consciousness, the dryness of the mucous membrane, the skin turgor, the capillary refill period, heart rate, respiratory rate, blood pressure, and the temperature of the extremities. The severity of dehydration (no, some, or severe dehydration) was determined based on the conventional world health organization (WHO) criteria and to suit the study, those children who met the WHO conditions of severe dehydration formed the severe group. Baseline laboratory investigations, including serum electrolytes, blood urea and creatinine, where available and clinically indicated, were used to support clinical assessment but were not in the inclusion criteria. All data were presented on an already prepared proforma. The patients were treated as based on the pediatric gastroenteritis and dehydration treatment options and no alteration was provided to the regular care. Correlation between clinical predictors and severe dehydration was tested with the help of corresponding statistical tests and the level of $p < 0.05$ was taken as statistically significant.

RESULTS

The study involved 100 pediatric patients with acute gastroenteritis. The percentage of these comprised of 38% (n=38) with severe dehydration and 62% (n=62) with no or some dehydration. The patients were aged 3.4 /2.1 years, with most of them (55) falling in the age bracket of 6 months to 3 years. The study population was dominant in males 57%. Severe dehydration increases the amount of time taken in diarrhea and vomiting. Diarrhea ≥ 8 episodes/day was seen in 68.4 percent of children with severe dehydration but not in 29 percent children without

severe dehydration (Table 1). In the same manner, vomiting 5 times or more/day was more frequent among children with severe dehydration.

Clinical observation showed that the capillary refill time (>2 seconds) was significantly longer, the eyes were deeply sunken, the skin turgor was poor, and the peripheral pulse was weakly presented, which was closely related to severe dehydration (Table 2). Tachycardia was found in 71 percent of the extreme dehydration group and decreased urine output was reported in 81.5 percent. Investigation in the laboratory conducted on selected patients revealed an increase in the mean serum sodium and urea level in the severe dehydration group, but lab values were not utilized to classify. In total, the demonstration of 3 or more important clinical predictors (sunken eyes, prolonged CRT, dry mucosa, poor turgor), demonstrated high correlation with severe dehydration (p less than 0.05).

In tabular form, Table 2 indicates the distribution of the key clinical predictors relating to severe dehydration among children who present with acute gastroenteritis. Sunken eyes, dry mucous membranes, and poor skin turgor were much more frequent in children with severe dehydration with frequencies of 92.1, 86.8 and 78.9 compared to much lower rates in children with none or some dehydration. A long capillary refill time (>2 seconds) was also a good predictor with prevalence of 81.5 percent in severely dehydrated children and 22.5 percent in the comparison group. Vital signs and overall appearance also confirmed this tendency: tachycardia was observed in 71 out of 120 cases of severe cases, whereas in milder cases only 27.4% of the cases had an increased heart rate. Also, significantly high in the severe dehydration group were lethargy and poor peripheral pulses. The predictors were associated statistically significantly ($p < 0.001$) and thus are very reliable in predicting the threat of severe dehydration in children.

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n=100)

Variable	Total (n=100)	Severe Dehydration (n=38)	No/Some Dehydration (n=62)	p-value
Mean Age (years)	3.4 ± 2.1	3.1 ± 1.9	3.6 ± 2.2	0.18
Male Gender (%)	57	60.5	54.8	0.56
Duration of Diarrhea (days)	2.8 ± 1.5	3.6 ± 1.4	2.3 ± 1.2	<0.001
Diarrhea ≥8 episodes/day (%)	43	68.4	29	<0.001
Vomiting ≥5 episodes/day (%)	49	73.6	33.9	<0.001
Fever (%)	61	65.7	58	0.44
Reduced Urine Output (%)	52	81.5	33.8	<0.001

Table 2: Clinical Predictors Associated with Severe Dehydration

Clinical Predictor	Severe Dehydration (n=38)	No/Some Dehydration (n=62)	p-value
Sunken Eyes (%)	92.1	35.4	<0.001
Dry Mucous Membranes (%)	86.8	32.2	<0.001
Poor Skin Turgor (%)	78.9	19.3	<0.001
Capillary Refill Time >2 sec (%)	81.5	22.5	<0.001
Tachycardia (%)	71.0	27.4	<0.001
Lethargy / Altered Sensorium (%)	55.2	9.6	<0.001
Weak Peripheral Pulses (%)	68.4	17.7	<0.001

DISCUSSION

The current research assessed the clinical predictors that were related to severe dehydration in children with acute gastroenteritis. Our results indicate that some bedside clinical features, especially sunken eyes, dry mucous membranes, prolonged capillary refill time, and poor skin turgor were closely related to the presence of severe dehydration [11]. These findings are more or less consistent with World Health Organization recommendations, which highlight the importance of such clinical characteristics in the determination of the level of dehydration, particularly when there is a lack of laboratory facilities that can provide such evaluations.

The most valid signals in this study were found to be prolongation of the capillary refill time, and sunken eyes, which were found in over 80 percent of severely dehydrated children[12]. These easily observable signs have been shown to be predictive, as regional and international studies have reported similar trends [19]. Also, systemic signs like tachycardia, decreasing urine output, and lethargy were much more evident in the severe cases of dehydration, which is likely to proceed towards hypovolemia and early shock unless timely addressed [13].

The fact that older children, especially those with persistent vomiting and diarrhea, are more susceptible to severe cases of dehydration, shows that this age group is vulnerable due to its limited physiological reserves and

increased relative fluid turnover. The complications should be avoided with timely intervention and detection early [14]. This paper justifies using a combination of clinical signs over using one indicator to maximize the level of diagnostic accuracy. In general, the results indicate the persistence of clinical assessment in determining the degree of dehydration despite the development of diagnostic methods [20]. Further reduction of morbidity related to the occurrence of pediatric acute gastroenteritis can be further achieved by strengthening caregiver education and providing prompt triage in emergency departments [15].

The results of this research explain the need to focus on the primary bedside clinical symptoms in the diagnosis of severe dehydration in children with acute gastroenteritis [16]. Sunken eyes, dry mucous membranes, poor skin turgor, and long capillary refill time were considerably related to severe dehydration reaffirming their usefulness as highlighted in WHO guidelines. Systemic signs of tachycardia, decreased urine production, lethargy, and weak pulses were also more likely in those children who had been severely dehydrated, which signifies an early hemodynamic dysfunction [17]. Children of younger age and those with a long period of diarrhea and vomiting were the most susceptible, which further highlights the importance of an early diagnosis and timely fluid replacement. These findings are consistent with those that have been published earlier and substantiate the importance of integrating various clinical signs to improve the accuracy of diagnosis, particularly in the situations with limited resources when the laboratory assistance can be lacking [18].

DECLARATION

Conflict of Interest
The authors declare no conflict of interest.

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Author's Contribution
All authors contributed equally in the complication of current study.

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Data Availability Statement
The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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