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Frequency of Acute Kidney Injury in Children Admitted with Acute Diarrhea

Saddam Hussain[1], Irfana Hassan[1], Abdul Raheem[2], Mir Qutab Khan[1], Abdul Malik[1], Muhammad Saddam[1], Komal Qayum[1]

[1]Department of Medicine, Bolan Medical Complex, Quetta, Balochistan, Pakistan.
[2]Department of Medicine, Sandeman Provincial Hospital, Quetta, Balochistan, Pakistan.

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Correspondence to: Saddam Hussain, Department of Medicine, Bolan Medical Complex, Quetta, Balochistan, Pakistan.
Email: hussains9331@gmail.com

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ABSTRACT

Background: Worldwide, diarrheal disease continues to be a leading cause of pediatric morbidity and mortality, particularly in areas with limited resources. Acute kidney damage (AKI) is a dangerous but avoidable consequence that is frequently brought on by electrolyte imbalance and dehydration from diarrhea. Improving outcomes for children and minimizing long-term kidney impairment require early detection and intervention. **Objective:** to evaluate related clinical parameters, including the degree of dehydration, length of illness, and laboratory abnormalities, and to ascertain the prevalence of acute kidney damage (AKI) in children admitted with severe diarrhea to a tertiary care hospital in Quetta, Pakistan. **Methods:** 200 children with acute diarrhea, ages 1 month to 12 years, were enrolled in this six-month observational study. Individuals with congenital urinary tract abnormalities or a history of renal disease were not included. Using the most recent KDIGO criteria, AKI was diagnosed and staged following clinical evaluation and laboratory testing. **Results:** Acute kidney injury (AKI) occurred in 24% of the 200 children who were admitted with acute diarrhea. In 88% of instances, there was severe or moderate dehydration, and the majority of affected children were younger than five. All individuals with AKI had elevated blood urea nitrogen (BUN), and almost all had elevated serum creatinine. 64.6% of AKI cases had metabolic acidosis and electrolyte abnormalities, especially those involving salt and potassium. 43.8% were in Stage 1, which indicates early but perhaps reversible kidney damage, based on KDIGO staging. **Conclusion:** AKI was observed in 24% of children with acute diarrhea, which is frequently associated with severe dehydration and delayed treatment. The majority of instances were in the early stages, indicating that they might be reversible with prompt treatment. In order to stop progression and long-term renal impairment, the study emphasizes the importance of early diagnosis, timely rehydration, ORS use, and increased clinical awareness.

INTRODUCTION

The most common reason for morbidity and mortality in children throughout the world is diarrheal disease; it is the fifth commonest cause of years lost globally and the fourth cause of child's death from all ages less than five years [1]. Diarrheal illness continues to be the leading cause of US hospitals admission and particularly among young children in spite of almost 50 percent decline in admissions post introduction of the Rotavirus Vaccine. [3-5]

It is remarkable that the United States has the rate of mortality from diarrheal illness larger than that of the other high economies (1.5 per 100 000 against 0.7-0.8 pere100 000 people in Canada and the United Kingdom) [2].

Hypovolemic acute renal injury is among the worst complications of acute severe diarrheal disease (AKI). Hospital survival and length of stay in children admitted into hospital are lower in those with AKI. [6].

Moreover, children with AKI are reported to be in high risk of suffering from chronic kidney disease (CKD), hypertension and proteinuria, which may affect kidney affection negatively for a longer period. [7, 8]

Despite being common, very little is understood about risk factors to having AKI through diarrheal illness. By identifying and verifying people with these risk factor then it is possible to reduce or even erase AKI.

Different from other diseases, one of the most common afflictions requiring hospitalization all around the world is diarrhea. [9,10] Particularly in the USA, hospitalizations for Clostridium difficile nearly tripled among persons over 65 years old. Admissions for ischemic colitis over the last three decades have

quadrupled, but in young, diverticulitis increases 5% year. [11, 12]

We know very little about prevalence and correlates of a highly catastrophic outcome from diarrheal disease, acute kidney damage (AKI) given the severity and high coverage. The fact that volume depletion in severe diarrheal disease is implicated, and likely culprits such as multimorbidity and polypharmacy can be found in a well-kitted risk factor for AKI. As AKI had been linked to mortality; longer hospitalization, additional costs and chance to develop chronic kidney disease (CKD), it is important to define burden of AKI in terms of diarrheal sickness. [13, 14]

One of the most frequent pathogenetic mechanisms of such affection among children is child kidney hypoperfusion, or prerenal AKI [15]. 12% of children AKI can be caused by AGE in this way [16]. During the short duration hospitalized children who advance to AKI may experience prolonged hospital stay and more deaths; long term will be prone to proteinuria, hypertension, and chronic kidney disease (CKD) [17].

Acute kidney injury (AKI) is a comparatively sudden deterioration of excretory renal function exhibited at the level of creatinine and nitrogenous waste product blood concentrations which increase in response to the impairment but remains correctable. [18] quite frequently, due to the decreased volume of urine discharged and because of failure of the kidney to equalize the fluids and electrolytes. One etiology of acute kidney disease adds immensely to childhood illness and mortality as well. [19]. AKI has hospital acquisition since it develops as an acquired condition; community-acquired when it's caused by an injury or infection pre-hospitalization. AKI is more prevalent in younger patients' comorbidities that are very important and multiorgan failure and in low resource countries (LRCs).[20]

As major purpose for this study the prevalence of acute kidney damage (AKI) in pediatric patients admitted due to acute diarrhea, in an environmental hospital of tertiary care, it is estimated.

LITERATURE REVIEW

Acute diarrhea is a major source of morbidity and mortality in underdeveloped nations, where young patients are particularly vulnerable to acute kidney damage (AKI). Because of their greater metabolic rates, smaller fluid reserves, and reliance on caregivers for nourishment and hydration, children are especially at risk. Acute diarrhea-induced dehydration can result in AKI, hypovolemia, and subsequent renal hypoperfusion, which, if left untreated, might develop to acute tubular necrosis [21].

Research has indicated that the prevalence of AKI in children who have diarrhea varies. According to an Indian study, AKI developed in 15–30% of pediatric patients admitted with acute diarrhea, particularly those who had significant electrolyte abnormalities and dehydration [22]. Similarly, studies conducted in Pakistan showed that the majority of children under five who were treated with diarrhea had moderate to severe dehydration at presentation, and approximately 18% of them had indications of AKI [23].

In low-resource settings, the World Health Organization (WHO) has identified dehydration from diarrheal disease as the main preventable cause of pediatric AKI [24]. The risk of renal problems is greatly decreased by prompt rehydration, particularly with oral rehydration salts (ORS) and intravenous fluids as necessary. Delays in rehydration therapy, however, raise the risk of kidney injury in places with poor access to healthcare [25].

The renin-angiotensin-aldosterone system (RAAS) is activated by hypovolemia, which pathophysiological results in decreased renal perfusion pressure. This exacerbates fluid retention and impairs glomerular filtration. Reduced urine production and intrinsic kidney damage may result from this condition if it persists [26]. Hypernatremia and hyperkalemia are examples of electrolyte imbalances that can complicate the clinical course and necessitate careful management [27].

In children, though not very sensitive they do not have symptoms of oliguria, raised blood levels of creatinine and urea serve as the early markers of AKI. To diagnose subclinical AKI in diarrheal disease new biomarkers like cystatin C and NGAL (neutrophil gelatinase-associated lipocalin) are the current recommendation [28].

The evidence of the reduction of the burden of diarrhea-related AKI among pediatric populations, by preventive measures such as maternal education, early introduction of ORS, early health-seeking behavior, and improved sanitation has been shown [29]. In spite of meeting these developments underdiagnosis remains an issue due to a lack of knowledge and access to diagnostic equipment especially in poorly funded and rural health establishments [30].

It has the potential to significantly reduce both long term renal complications and pediatric deaths this emerging field of study serves to highlight the importance of early diagnosis and treatment of AKI in children who present with acute diarrhea.

RESEARCH OBJECTIVE

As is the case with the present research, the determination of the prevalence of acute kidney damage (AKI) in pediatric cases admitted with acute diarrhea in a tertiary care hospital environment was the current investigation's rationale. AKI can occur due to dehydration, electrolyte imbalance and hypovolemia and

acute diarrhea remains a significant culprit for morbidity and mortality in children, especially in low-income areas. The aim of this study is to establish pre-valence of AKI in such cases and associate clinical measures: degree of dehydration, length of illness before the patient went to hospital, electrolytes, and volume of urine produced. Also, this study through creating a connection between acute diarrhea and AKI in children suffering in hospitals will try to focus on the importance of early detection and timely treatment. Finally, the results should enhance clinical results and reduce the risk of severe, long-term kidney damage among affected pediatric populations by helping doctors perform urgent interventions and preventative care.

METHODOLOGY

Within a period of six months, a tertiary hospital in Quetta, Pakistan was where this qualitative, observational study was conducted. The aim of the study was to measure the prevalence of the acute kidney damage (AKI) and associated clinical variables among children with the acute diarrhea who were admitted. Inclusion criteria of 200 pediatric patients aged between 1months-12 years of age were hospitalized to the pediatric unit once they presented with acute diarrhea by non-probability purposive sampling. Patients with a chronic disease, natal urinary tract defect, or previous renal disorders were not considered.

A complete clinical assessment was carried out at admission, and included obtaining the patient's medical history, hydration status, urine output, and evidence of systemic issues. Serum creatinine, blood urea nitrogen (BUN), serum electrolyte and monitoring of urine output were incorporated under the Laboratory studies. The updated KDIGO (kidney disease: In order to describe and classify AKI, the criteria of Improving Global Outcomes) were applied. In order to identify proportion of AKI patients and correlation between them and dehydration, electrolytes imbalance and length of illness, empirical data were collected using structured interviews and thematically analyzed.

RESULTS

Table 1

Age Distribution of Study Population (n=200)

Age Group	Frequency	Percentage (%)
1–12 months	68	34%
1–5 years	96	48%
6–12 years	36	18%
Total	200	100%

Table 2

Hydration Status at Presentation

Hydration Status	Frequency	Percentage (%)
No dehydration	24	12%
Mild to moderate	108	54%
Severe dehydration	68	34%
Total	200	100%

Table 3

Frequency of Acute Kidney Injury (AKI)

AKI Status	Frequency	Percentage (%)
AKI Present	48	24%
AKI Absent	152	76%
Total	200	100%

Table 4

Laboratory Findings in Children with AKI (n=48)

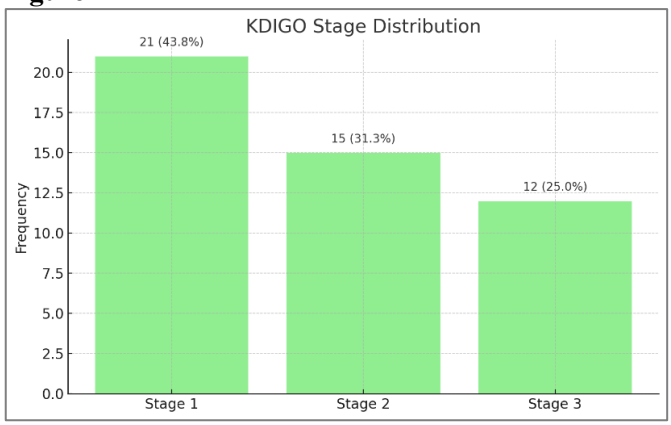
Parameter	Abnormal Value Detected in n (%)
Serum Creatinine ↑	48 (100%)
Blood Urea Nitrogen ↑	46 (95.8%)
Sodium Imbalance	28 (58.3%)
Potassium Imbalance	22 (45.8%)
Metabolic Acidosis	31 (64.6%)

Table 5

AKI Staging Based on Modified KDIGO Criteria (n=48)

KDIGO Stage	Frequency	Percentage (%)
Stage 1	21	43.8%
Stage 2	15	31.3%
Stage 3	12	25.0%
Total	48	100.0%

Figure 1



DISCUSSION OF THE RESULTS

Assessment of the related clinical indicators and determination of the prevalence of the acute kidney damage (AKI) in the children admitted with acute diarrhea was the objective of this research. Spending a significant kidney risk related to pediatric populations of diarrheal diseases, especially in low resource settings as the case with Quetta, whereby 24% of the 200 children enrolled were diagnosed with AKI during admission at the hospital.

As table 1 demonstrates, infants aged 1-12 months were the highest at risk with 34% then the rest aged 1-5 years 48%. Such finding is in accordance with studies indicating that the faster metabolic rate and smaller physiological stores of younger children place them at greater risk of fluid and electrolyte imbalance [21, 22]. In addition, younger children are more prone to dehydration's effects as they many times depend on adults to get hydrated.

The majority of children presented late, or after significant fluid loss as reflected by the hydration state

at presentation (Table 2): 34 and 54% were extremely or mild to moderately dehydrated respectively. This is consistent with the results obtained by the World Health Organization (WHO), that one of the most significant risk factors of AKI among the children with diarrheal diseases is the late arrival to rehydration therapy [24; 25]. Dehydration-driven hypovolemia reduces renal perfusion with consequent prerenal AKI and, if left alone the development of intrinsic renal damage [26].

AKI occurred in 48 of the 200 children (Table 3) or 24% of all children. This conforms to regional reports of India and Pakistan with outcomes indicating that between 15 and 30 percent of children admitted in hospital with diarrhea exhibit AKI [22, 23]. This shows that acute diarrhea remains an important cause of AKI among South Asian pediatric hospitalizations.

In AKI patients, laboratory abnormalities are indicated in Table 4. Serum creatinine values were all elevated in 48 (100 %) patients, consistent with reduced renal function. 95.8% of patients had an elevated blood urea nitrogen (BUN), consistent with the diagnosis AKI according to the updated KDIGO criteria [18]. Electrolyte imbalances were prevalent: 45.8% were found with potassium abnormalities that lead to cardiac and its neuromuscular variants and 58.3% with sodium abnormalities (likely hypernatremia due to loss of fluids) [27]. As described in prior pathophysiologic descriptions, 64.6 % of cases displayed the metabolic acidosis suggestive of poor renal acid excretion and bicarbonate loss from diarrhea [26].

For classifying severity of AKI, Table 5 of the KDIGO classification was used. Most of the AKIs (43.8%) were in stages 1, meaning that early-stage renal harm is more common. There was a lower rate of patients increasing to Stage 2 (31.3%) and Stage 3 (25%). Provided the prompt fluid and electrolyte correction, even initial AKI can be reversible, meaning these findings are promising. The proportion of patients with advanced AKI is 25% with implications for the need for early detection and treatment and questions about delays in care or severity of presentation.

Taking everything into account the results offer striking evidence in support of the previously conducted studies, which placed electrolyte abnormalities, dehydration and delayed presentation on a list of the major causes of AKI in children with diarrhea. Although there has been global progress, low resource setting still has a high burden of AKI associated with diarrhea. The burden could significantly be reduced by enhancing community information, the early use of ORS, and quick referral of patients to hospitals. Notwithstanding, additional capabilities of earlier detection and intervention may be achieved through improved diagnostic infrastructure, which involves the use of more recent biomarkers like NGAL and cystatin C [28].

In the pediatric diarrhea cases avoidance of AKI is dependent on early diagnosis and rehydration techniques, this study found. Children's renal morbidity over years and short-term challenges could be reduced by using these results in local therapy.

CONCLUSION

Acute kidney injury (AKI) is much more prevalent in children's patients (24%) being admitted to a Quetta tertiary care hospital with acute diarrhea, according to the present study. The results emphasize the need to screen and remedy dehydration and electrolyte deficiencies in children promptly and to stop complications to the kidneys. Most of those affected were infants and young children and a typical clinical feature on admission was severe dehydration. Majority of the cases of AKI were in Stage 1, indicating that if a kidney dysfunction is detected early enough and corrected, damage could be reversible. However, a large proportion progressed to subsequent more severe stages which probably would have been due to poor early treatment or lack of prompt care seeking. Findings in laboratory revealed common pies such as raised blood urea nitrogen and serum creatinine with severe electrolyte imbalance.

These results back regional and international statistics show that AKI remains a preventable complication of diarrheal disease in disadvantaged settings. Better access to oral rehydration therapy, increased awareness among caregiver and healthcare professionals, and the use of early biomarkers to identify subclinical AKI are the recommendations of the study. Finally, rapid treatment algorithms and attentive preventive activities can significantly decrease AKI morbidity and improve the results for the young patients with acute diarrhea.

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