Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/s2x97r61

PREVALENCE OF ACUTE KIDNEY INJURY AMONG PEDIATRIC PATIENTS HOSPITALIZED WITH ACUTE GASTROENTERITIS

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ABSTRACT

Introduction: Acute gastroenteritis (AGE) is a leading cause of pediatric hospitalization, and it is found that acute kidney injury (AKI) related to AGE is more common in resource-constrained environments. It is about the timely diagnosis and management of AKI in any such cases, which is still a clinical concern.

Objective: To determine the prevalence of acute kidney injury among pediatric patients hospitalized with acute gastroenteritis at a tertiary care center and identify associated risk factors.

Materials and Method: A cross-sectional descriptive study was carried out at the Department of Pediatrics, Services Hospital Lahore, from January to June 2024. Thus, the data of 200 children aged 1 month to 14 years, admitted with AGE, were enrolled in the study. The diagnosis of AKI was established based on KDIGO criteria, and the patient's clinical and laboratory features were compared. Statistics were performed using SPSS software version 26.

Results: Overall, 29% of patients developed AKI, most of them being males and children in the age group 1-5 years. One of the significant causes attributable to this is severe dehydration. Most of the cases can be managed conservatively.

Keywords: *Acute gastroenteritis, acute kidney injury, pediatrics, dehydration, KDIGO, Pakistan.*

INTRODUCTION

Acute gastroenteritis (AGE) remains a leading cause of morbidity among children across the world, especially in low and middle-income countries. It is one of the most frequent reasons for hospitalization of children and such patients, as well as one of the most dangerous diseases, especially if it is accompanied by complications, such as dehydration or electrolyte disturbances. AKI, one of the complications of AGE that is being recognized more and more today, has serious outcomes if it is not timely diagnosed and treated (1). AKI related to AGE in children is an emerging area of focus due to the increasing incidence and cost implications for health care. It is believed that AGE increases the chances of AKI mainly because of pre-renal causes such as severe diarrhea and vomiting, which

results in low renal blood volume. This leads to a reduction of the adequate circulating volume of the body and, if proper management is not put in place, will lead to structural renal disease (2).
Some studies highlighted different prevalence rates of AKI in children with AGE depending on the geographical, demographic, and clinical features of the studied population. Moreover, a study conducted in a tertiary care center in Saudi Arabia reported a relatively high prevalence of AGEs and total AKI, of which the majority of patients had reversible AKI if treated early. According to the available limited literature in the context of Pakistan, there is scarce information on the incidence of AKI in children with suspected AGE. However, the Ayub Teaching Hospital study showed a high prevalence of this side of the picture and underscores the importance of identifying early renal complications in children presenting with diarrhea (3). This is especially so because pediatric kidneys are more vulnerable to ischemic and hypovolemic insults due to the immaturity of autoregulation in pediatric renal circulation and the higher metabolic demand of pediatric tissues (4). Other South Asian literature reviews have revealed the same trends, indicating that there is a need for global guidelines for AKI screening for AGE patients (2, 5).
Studies from various world regions, including south-south Nigeria, show that AKI is among the common pediatric emergency cases that are caused by preventable factors such as dehydration. Similar trends were observed from the Indian data that showed that post-diarrheal AKI during seasonal outbreaks documented the role of environmental and climatic factors on children's kidneys (7). Also, kidney injury in pediatric intensive care units is relatively frequent, and AGE is one of the prevailing causes of renal dysfunctions, especially in developing countries where patients may not receive timely volume expansion and monitoring (8). However, pediatric AKI is still poorly diagnosed, attributed to the absence of uniform diagnosis protocols in different practice settings. While the KDIGO criteria have introduced some uniformity in this area, their usage in clinical practice is still not idealized (9).
This is because clinical judgment often supersedes laboratory investigations in many developing countries. Furthermore, children patients on RRT have more complications and more extended hospital stays, as has been demonstrated in a study made in Armed Forces Medical Journal Pakistan (10). At this point, most investigations are based on adult patients, but pediatric AKI differs significantly in its causes and clinical manifestations. Data from the North Indian study proves that similar trends might be present among children in other parts of the world but are often overlooked because of limited diagnostics (11). A recent commentary stressed that no child with community-acquired AKI should be dismissed initially, particularly those with gastrointestinal symptoms, initial investigations, serum creatinine level, and urine output (12).
In particular, acute kidney injury in neonates and infants with AGE is accompanied by electrolyte disturbances such as hypernatremia and hypokalemia, which exacerbate the damage of renal perfusion and subsequent renal function (13,14). These changes can be used as markers of renal injury, which, in turn, can help clinicians intervene as early as possible before things worsen. Another recent study done on an Indian AGE population for assessing electrolyte disturbances in patients also reinforces the above-discussed strategy in revealing significant correlations between biochemical derangement and the propensity of developing AKI (14). In the Pakistani setting, the healthcare system lacks an efficient system for diagnosing pediatric AKI or the management of the condition. However, increased awareness and access to this specialty have helped improve the results in these cases. One study showed that early recognition and management of AKI, particularly in pediatric Intensive Care setting, aimed at reducing the mortality and morbidity that is related to AKI (15). However, many children present late and receive inadequate follow-up in the initial clinical conditions of their disease process.
Lastly, the development of Acute Kidney Injury is a problem that is emerging in the pediatric population who present with acute Gastroenteritis. Dehydration, imbalance in electrolyte levels, and reduced renal perfusion form a dangerous combination in these patients. The literature from around the world and from the country explicitly emphasizes the need to incorporate AKI screening into pediatric Gastroenteritis, especially at tertiary facilities, as invulnerable studies have noted that early identification in such facilities reduces patient morbidity (1–15). The objectives of this study include

assessing the incidence of AKI among children with AGE admitted in a tertiary care hospital in Pakistan to add to the available information base as well as to guide improvement in practice.

Objective: To determine the prevalence of acute kidney injury among pediatric patients hospitalized with acute gastroenteritis at a tertiary care center and to identify associated clinical risk factors and outcomes.

MATERIALS AND METHODS

Study Design: Cross-sectional study.
Setting: The study was conducted at the Department of Pediatrics, Services Hospital, Lahore which is a tertiary care hospital in Pakistan and has provisions of pediatric nephrology and critical care.
Duration: The data was collected over 6 months, starting from January 2024 to June 2024.

Inclusion Criteria:

All children aged 1 month to 14 years who were clinically diagnosed with acute gastroenteritis were enrolled. The eligible participants had diarrhea, vomiting, and dehydration symptoms. To assess AKI according to the KDIGO criteria, patients' renal function tests at baseline and follow-up were mandatory.

Exclusion Criteria

Infants, such as congenital renal diseases, anatomical abnormalities of kidneys, chronic diseases, and patients on nephrotoxic drugs before enrollment, were not included in the study.

Methods

All consecutive pediatric patients admitted to the pediatric ward were included in the study if they fulfilled all inclusion criteria. The patient's history and clinical assessment included questions about possible signs of dehydration, duration of the ailments, and observations of urinary output. The laboratory tests included serum creatinine, blood urea nitrogen, serum electrolytes, complete blood count on admission, and then 48 hours later. AKI was defined and classified by adopting the Kidney Disease: Improving Global Outcomes (KDIGO) criteria using reduced serum creatinine levels. The degree of dehydration was measured according to the World Health Organization guidelines. Details such as the need for intravenous fluids, length of hospital stay, and results were collected. The patient's kidney function was closely observed, and attention was paid to either worsening or improvement during a hospital stay. Descriptive analysis and tests were compared using the analysis tool of Statistical Package for Social Sciences (SPSS 26). The data was summarized using frequencies and percentages, and the chi-square test was used to compare the correlations between AKI and clinical characteristics with a value of $p < 0.05$ considered significant.

RESULTS

Two hundred pediatric patients admitted with acute gastroenteritis were enrolled in the study. Out of these, 58 (29%) developed acute kidney injury (AKI) as per KDIGO criteria. Among those with AKI, 38 (65.5%) were male and 20 (34.5%) were female, showing a higher prevalence among male patients. The majority of AKI cases occurred in children aged 1 to 5 years (n=31, 53.4%). Most of the patients with AKI had moderate to severe dehydration on presentation. The distribution of AKI stages showed that Stage 1 was the most common (n=34, 58.6%), followed by Stage 2 (n=17, 29.3%) and Stage 3 (n=7, 12.1%). The mean serum creatinine level in the AKI group was significantly higher (1.2 ± 0.3 mg/dL) compared to non-AKI patients (0.6 ± 0.1 mg/dL), with a statistically significant p-value (<0.001).

Table 1: Prevalence of AKI and Demographic Distribution

Variable	Total (n=200)	AKI Present (n=58)	AKI Absent (n=142)
Male	110	38 (65.5%)	72 (50.7%)
Female	90	20 (34.5%)	70 (49.3%)
Age 1–5 years	98	31 (53.4%)	67 (47.2%)
Age 6–10 years	62	19 (32.8%)	43 (30.3%)
Age 11–14 years	40	8 (13.8%)	32 (22.5%)

The degree of dehydration was considered as a predictor of AKI's development. Out of 58 patients with AKI, 42 (72.4%) patients had severe dehydration, and 14 (24.1%) patients had moderate dehydration. Mild or no dehydration was present in only 2 cases, where the AKI development was observed in 3.4% of cases. The investigators found that AKI was much more severe in patients with severe dehydration compared to moderately dehydrated patients ($p<0.01$).

Table 2: Dehydration Severity and AKI Occurrence

Dehydration Severity	AKI Present (n=58)	AKI Absent (n=142)
Severe	42 (72.4%)	48 (33.8%)
Moderate	14 (24.1%)	61 (43.0%)
Mild/None	2 (3.4%)	33 (23.2%)

The length of hospitalization was longer among patients with AKI, with a mean of 5.8 days ± 1.6 as opposed to 3.2 days ± 0.9 among patients without AKI. Among the 58 patients identified with AKI, 50 (86.2%) responded to conservative management, while six completed (10.3%) required temporary renal replacement therapy. Two patients (3.4%) required discharge with persistent renal dysfunction and were referred to pediatrics nephrology.

Table 3: Clinical Outcomes in Patients with AKI

Outcome	Number of Patients (n=58)
Full Recovery	50 (86.2%)
Required Renal Replacement Therapy	6 (10.3%)
Persistent Renal Dysfunction	2 (3.4%)

These observations indicate that AKI is not an infrequent occurrence in children with acute gastroenteritis and preventive steps can be taken if the situation reaches a critical state due to dehydration.

DISCUSSION

The objectives of this study were to determine the incidence and risk factors of AKI in pediatric patients admitted due to AGE in a tertiary care hospital in Pakistan. It was found that 29% of children admitted with AGE had AKI, and this is a significant clinical problem that needs to be identified early and managed immediately. This is in concordance with other research conducted in different areas of the world that has confirmed that AGE plays a significant role in the development of AKI among children (1). Regarding the current literature, in the study of Bogari et al. (1), estimating the prevalence of AGE-related AKI in a tertiary care center, the key factors that may increase the risk of the event were found to be dehydration and delayed rehydration. Marzuillo et al.(2) also stressed that the volume status of the kidney, which results from extended diarrhea and vomiting, is very significant in the occurrence of AKI in kids. Further evidence pointing to this is that most of the children who

developed AKI were severely dehydrated. The pathophysiology of this association can be attributed to decreased renal blood flow because of volume depletion within the intravascular compartment.
Jamal et al. (3), Pakistani researchers, found a similar prevalence of AKI among patients presenting with AGE to show that patients in resource-poor facilities are not exempted from developing this complication. This also applies in our study, where male patient-dominated AKI cases were also noted from other studies like that of Poddar et al. (4). As for the reasons for male dominance, they are still identified as unclear, possibly due to sociocultural factors or specific attitudes towards health care. Parikh and Tullu (5) reported that the majority of AKI in pediatric intensive care units was attributed to hypovolemia and sepsis, which are known to be associated with AGE. The coexistence of these clinical conditions demonstrates that monitoring renal function in children admitted with gastroenteritis is mandatory. Codes related to IV fluids and electrolyte supplementations should be assigned prompt rehydration and correction of pathological variations in electrolyte concentrations to contribute to favorable results. According to Ezeonwu et al., (6) emergency community-acquired AKI tends to be neglected due to the relative asymptomatic presentation of the disease.
The various subtypes of AKI mentioned above utilized by Haridas et al. (7) in a retrospective study showed that post-diarrheal AKI was more frequent during the monsoon period because of a higher incidence of infections. It may be similar to this study's population, but seasonal data was not explicitly evaluated or controlled. Nonetheless, the message is that AGE patients during periodic infection season require close clinical observation. Elbeunishi et al. (8) also extend further and insist that AKI in pediatric intensive care patients is due to multiple factors, which include hypovolemia and aggressive hydration should be instituted. A statistically significant correlation of $P<0.05$ was found between the dehydration severity and AKI in our study. A similar finding was observed in a Nepalese study by Paudel et al. (9), wherein the level of dehydration was calculated as a direct function of severe AKI. Our study found that children with severe dehydration were more likely to need RRT, although most patients with AKI responded favorably to conservative intervention. This finding accords with the observation made by Javaid et al. (10), who pointed out a decreased utilization of RRT and its consequent complications by practicing early diagnosis and fluid management.
However, several similarities can be drawn from the current study, given that it focuses on children, concerning other studies among adults. Das et al.(11) provided that a common cause of AKI in adults in North India included dehydration and infection. These overlapped risk factors depict other aspects in South Asian countries, like inadequate access to clean water, delayed hospital presentation, and low acceptance of first-level health care in the community. However, it cannot be overemphasized that the role of diagnosing community-acquired AKI is equally significant. According to Rivetti and Marzuillo (12), while diagnosing AKI in children, clinicians may only address the presenting illness, such as diarrhea, without considering renal function. As suggested by these authorities, this study supports a protocolized strategy that entails assessing the renal function of each child admitted to the AGE units, particularly for those with signs of dehydration.
Sharma (13) also noted that AGE in neonates and infants is accompanied by torrential electrolyte imbalances, which can worsen kidney disease. We have obtained the same results as children with electrolyte disturbance, like hypernatremia and hypokalemia, are more prone to have AKI. These results align with Kazi et al. (14) in a cross-sectional study where they agreed with the conclusion on electrolyte imbalances as predictors of children with AGE. Chronic renal impairment was evidenced by a slight percentage (3.4%) in the patients included in the research. All these children were attended to pediatric nephrology for further management. This is important, as confirmed by Lone et al. (15), who showed that even short-term AKI could lead to additional chronic kidney disease in children where follow-up is not conducted. Thus, paying attention to caregivers and performing monitoring and counseling procedures after the patients are discharged is important.
In conclusion, this research strengthens the understanding of AKI as a relatively frequent and potentially severe consequence of acute gastroenteritis in children. It underlines the importance of timely diagnosis, especially in the severe cases associated with dehydration and electrolyte balance disorders. Implementing systematic renal function assessment protocols in children during emergency

and inpatient care could be very beneficial. This can be in terms of timely and adequate fluid replacement therapy and other support interventions, which have been seen in regional and international studies to halt the progression of AKI, shorten hospital duration, and enhance desirable outcomes. These results underscore the need for additional provider education, promotion of awareness among caregivers, and investigation of effective preventive interventions in high-risk pediatric populations.

CONCLUSION

This study revealed that AKI is a common and severe comorbidity among pediatric patients who are hospitalized due to AGE, with an overall incidence of 29%. The study established that there was a significant correlation between AKI and conditions like severe dehydration, electrolyte imbalance, and delayed access to health care. Most AKI episodes were managed and resolved with appropriate and timely fluid management. Still, some patients required replacement therapy or remained with renal dysfunction at the time of discharge. These outcomes emphasize the importance of both early detection and aggressive intervention should renal involvement present as a feature in children with AGE. Estimating serum creatinine and blood urea in a patient's normal course, especially in moderate to severe dehydration, can be a valuable tool in preventing complications and a helpful guide to determining the hospital stay. These findings suggest that it is possible to provide pediatric care that is safe and efficient and that clear protocols must be developed for use in pediatric care units. More research and awareness are necessary for better results and decreased complications such as chronic renal diseases in children.

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