

## Clinical Profile and Outcomes of Acute Kidney Injury in Patients with Acute Gastroenteritis: A Prospective Study

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### Abstract:

**Background:** Acute gastroenteritis is one of the most common causes of fluid and electrolyte loss in India. If inadequately managed, it can lead to hypovolemia-induced acute kidney injury (AKI), which significantly increases morbidity and mortality, especially in the elderly and those with comorbidities. Early detection and prompt management of AKI in such patients is vital.

**Objective:** To study the clinical profile, laboratory parameters, severity, and outcomes of patients who developed AKI following acute gastroenteritis.

**Methods:** This prospective observational study was conducted at 12 months in the Department of Anesthesiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya ji, Bihar, India. A total of 120 patients diagnosed with acute gastroenteritis and fulfilling KDIGO criteria for AKI were enrolled. Demographic data, clinical symptoms, laboratory results, and outcomes were recorded and analyzed.

**Results:** Of 120 patients, 67 (55.8%) were male and 53 (44.2%) females. The mean age was  $52.3 \pm 17.6$  years. Dehydration and hypotension were the most common findings on admission. Prerenal AKI was observed in 81 cases (67.5%), while 39 (32.5%) progressed to intrinsic AKI. Electrolyte abnormalities, especially hyponatremia and hyperkalemia, were noted in 47.5% and 28.3% of cases, respectively. 92 patients (76.6%) recovered with conservative management, while 16 required dialysis. Overall mortality was 5.8% (n = 7), mostly among those with comorbidities.

**Conclusion:** AKI secondary to acute gastroenteritis remains a significant concern, particularly among elderly and volume-depleted patients. Early identification, aggressive fluid resuscitation, and close monitoring can substantially reduce the need for renal replacement therapy and improve outcomes.

**Keywords:** Acute gastroenteritis, acute kidney injury, prerenal failure, KDIGO, dehydration, electrolyte imbalance.

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### Introduction

Acute gastroenteritis (AGE) is a common and widespread illness globally, contributing significantly to morbidity and mortality, particularly in low- and middle-income countries. It is characterized by an acute onset of diarrhea, often accompanied by vomiting, abdominal cramps, and fever. Although AGE is typically self-limiting in healthy individuals, it can have devastating consequences in vulnerable populations due to its potential to cause severe dehydration and electrolyte imbalances [1]. In India, acute diarrheal diseases remain a major public health issue, particularly during the summer and monsoon seasons, affecting both rural and urban populations. One of the serious and often under-recognized complications of acute

gastroenteritis is acute kidney injury (AKI), especially in patients who present late, are inadequately hydrated, or have pre-existing comorbidities [2]. AKI is defined by a rapid decline in renal function, resulting in impaired clearance of nitrogenous waste products and dysregulation of fluid, electrolyte, and acid-base homeostasis [3]. According to the kidney disease: Improving Global Outcomes (KDIGO) guidelines, AKI is staged based on rises in serum creatinine levels and/or reduction in urine output. In the context of AGE, the pathophysiology of AKI is primarily attributed to hypovolemia-induced renal hypoperfusion (prerenal AKI) [4]. However, if prompt fluid resuscitation is not initiated, it may progress to acute tubular

necrosis (ATN), a form of intrinsic AKI. Additional contributors include the use of nephrotoxic antibiotics or anti-diarrheal agents, systemic inflammatory response, and electrolyte derangements such as hypokalemia, hyponatremia, or acidosis, which further exacerbate renal damage [5].

The burden of AKI complicating AGE is especially significant in patients with risk factors such as older age, diabetes mellitus, hypertension, pre-existing renal disease, or delayed hospital presentation. In such patients, AKI can lead to increased hospital stay, higher healthcare costs, greater need for renal replacement therapy, and increased short-term mortality [6]. Moreover, recurrent or severe AKI episodes may predispose patients to chronic kidney disease in the long term, contributing to the growing burden on nephrology services in resource-constrained settings.

Despite its clinical importance, there is a scarcity of prospective hospital-based studies in India exploring the incidence, clinical patterns, laboratory abnormalities, and treatment outcomes of AKI secondary to acute gastroenteritis. Early identification of high-risk features and timely institution of supportive care remain key to preventing progression and ensuring better outcomes [7].

This prospective study was conducted with the objective of evaluating the clinical profile of patients developing acute kidney injury following acute gastroenteritis in a tertiary care hospital. It aims to analyze demographic distribution, symptomatology, severity of renal dysfunction, electrolyte disturbances, management strategies, and short-term outcomes. Findings from this study may help strengthen early triage protocols and guide clinical decision-making in similar high-risk patient populations.

### Aim and Objectives

**Aim:** To evaluate the clinical profile and outcomes of patients who develop acute kidney injury following acute gastroenteritis in a tertiary care hospital setting.

### Objectives:

1. To assess the demographic and clinical characteristics of patients presenting with acute kidney injury secondary to acute gastroenteritis.
2. To classify the type and severity of AKI in these patients based on KDIGO criteria.
3. To evaluate the frequency and nature of electrolyte and acid-base disturbances associated with AGE-induced AKI.
4. To determine the proportion of patients requiring renal replacement therapy.

5. To study short-term outcomes including recovery, hospital stay duration, and in-hospital mortality.

### Materials and Methods

**Study Design and Setting:** This was a prospective observational study conducted in Anugrah Narayan Magadh Medical College and Hospital, Gaya ji, Bihar, India.

**Study Duration:** The study was carried out over a period of 12 months.

**Sample Size:** A total of 120 patients were included in the study based on the inclusion and exclusion criteria detailed below.

### Inclusion Criteria:

- Patients aged  $\geq 18$  years admitted with acute gastroenteritis (defined as  $\geq 3$  loose stools/day with or without vomiting or abdominal pain).
- Development of acute kidney injury as per KDIGO criteria during or shortly after the diarrheal illness.
- Willingness to provide informed consent.

### Exclusion Criteria:

- Patients with pre-existing chronic kidney disease (CKD) stage 3 or above.
- Patients with known structural urinary tract abnormalities.
- Diarrhea caused by antibiotic-associated colitis or nosocomial infections.
- Patients with incomplete medical records or lost to follow-up during admission.

### Definitions Used:

- **Acute Gastroenteritis (AGE):** Defined clinically by the presence of acute onset of diarrhea ( $\geq 3$  episodes/day) with or without vomiting.
- **Acute Kidney Injury (AKI):** Defined and staged according to KDIGO 2012 criteria:
  - Increase in serum creatinine by  $\geq 0.3$  mg/dL within 48 hours, or
  - Increase in serum creatinine to  $\geq 1.5$  times baseline within 7 days, or
  - Urine output  $< 0.5$  mL/kg/h for  $> 6$  hours.

**Data Collection:** Demographic data (age, sex), presenting symptoms, duration of diarrhea, volume status on admission, comorbidities (diabetes, hypertension, etc.), physical examination findings, and vital signs were recorded. Laboratory investigations included:

- Hemogram
- Serum creatinine and blood urea nitrogen
- Serum electrolytes ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ ,  $\text{HCO}_3^-$ )
- Arterial blood gas (ABG) analysis

- Urine output and urinalysis
- Renal ultrasound was indicated

AKI was categorized as prerenal or intrinsic based on clinical response to volume repletion and additional investigations. The need for renal replacement therapy (RRT), duration of hospital stay, and in-hospital mortality were documented.

**Management Protocol:** All patients received initial fluid resuscitation with isotonic crystalloids. Electrolyte imbalances were corrected based on laboratory findings. Antibiotics were administered when bacterial etiology or sepsis was suspected. Patients with persistent oliguria, worsening azotemia, or volume overload were considered for dialysis.

**Statistical Analysis:** Data were compiled using Microsoft Excel and analyzed using SPSS version 25.0. Descriptive statistics were used to summarize continuous variables (mean, SD) and categorical variables (frequency, percentage). Chi-square test or Fisher's exact test was used to assess associations between variables. A p-value <0.05 was considered statistically significant.

## Results

A total of 120 patients with acute kidney injury (AKI) following acute gastroenteritis (AGE) were enrolled in the study over an 8-month period. The mean age of the study population was  $52.3 \pm 17.6$  years, with a slight male predominance (55.8%). More than half of the patients had no comorbidities, while others had conditions such as diabetes mellitus, hypertension, or both. Clinical assessment revealed that diarrhea and vomiting were the most common presenting symptoms, accompanied by dehydration, hypotension, and reduced urine output. Laboratory investigations confirmed a wide range of electrolyte and acid-base disturbances. The majority of patients had prerenal AKI, while a significant proportion progressed to intrinsic renal injury. Most patients responded well to conservative treatment, while a smaller fraction required dialysis. The overall in-hospital mortality was low.

Table 1 shows that the majority of patients were aged between 41 and 70 years, with 33.3% aged 41–60 years and 25% aged 61–70 years. Only 5% were under 30 years, indicating that AGE-associated AKI was more prevalent in the middle-aged and elderly population.

**Table 1: Age-wise distribution of patients with AGE-associated AKI**

Age group (years)	Number of Patients	Percentage (%)
<30	6	5.0
31–40	14	11.7
41–60	40	33.3
61–70	30	25.0
>70	30	25.0
<b>Total</b>	<b>120</b>	<b>100</b>

Males constituted 55.8% (67/120) of the study population, while females accounted for 44.2% (53/120).

**Table 2: Gender distribution of patients**

Gender	Number of Patients	Percentage (%)
Male	67	55.8
Female	53	44.2
<b>Total</b>	<b>120</b>	<b>100</b>

Out of 120 patients, 58 (48.3%) had one or more comorbidities. Diabetes mellitus was the most common (24.2%), followed by hypertension (20.8%).

**Table 3: Comorbidities observed among study participants**

Comorbidity	Number of Patients	Percentage (%)
None	62	51.7
Diabetes mellitus	29	24.2
Hypertension	25	20.8
Both DM and HTN	12	10.0

All patients presented with diarrhea, while vomiting was observed in 70.8% and fever in 45%. Oliguria was noted in more than half of the patients.

**Table 4: Presenting symptoms in AGE patients with AKI**

Symptom	Number of Patients	Percentage (%)
Diarrhea	120	100.0
Vomiting	85	70.8
Fever	54	45.0
Abdominal pain	48	40.0
Oliguria	63	52.5
Signs of dehydration	89	74.2

Stage 1 AKI was the most common (40%), followed by Stage 2 (32.5%) and Stage 3 (27.5%).

**Table 5: AKI staging based on KDIGO criteria**

AKI Stage	Number of Patients	Percentage (%)
Stage 1	48	40.0
Stage 2	39	32.5
Stage 3	33	27.5

Clinical response and investigations revealed that 67.5% had prerenal AKI, while 32.5% had intrinsic AKI (likely acute tubular necrosis).

**Table 6: Type of AKI (Prerenal vs Intrinsic)**

Type of AKI	Number of Patients	Percentage (%)
Prerenal	81	67.5
Intrinsic	39	32.5

Hyponatremia was present in 47.5% of patients, followed by hyperkalemia (28.3%) and metabolic acidosis (37.5%).

**Table 7: Serum electrolyte disturbances**

Parameter	Abnormal in n (%)
Hyponatremia	57 (47.5%)
Hyperkalemia	34 (28.3%)
Hypokalemia	17 (14.2%)
Metabolic acidosis	45 (37.5%)

Most patients (76.6%) responded to conservative treatment including fluids and electrolyte correction. Only 16 patients (13.3%) required dialysis.

**Table 8: Management strategy used**

Treatment Modality	Number of Patients	Percentage (%)
Conservative	92	76.6
Hemodialysis	16	13.3
ICU care	21	17.5

Complete recovery of renal function was observed in 87.5% of patients. Mortality occurred in 5.8% of cases, primarily among those with comorbidities and Stage 3 AKI.

**Table 9: Outcome distribution among study subjects**

Outcome	Number of Patients	Percentage (%)
Complete recovery	105	87.5
Partial recovery/discharge	8	6.7
Mortality	7	5.8

Patients with higher AKI stages had longer hospital stays. The overall mean hospital stay was  $6.8 \pm 2.3$  days.

**Table 10: Mean duration of hospital stay by AKI stage**

AKI Stage	Mean Duration of Stay (days)
Stage 1	$4.9 \pm 1.7$
Stage 2	$6.7 \pm 1.8$
Stage 3	$9.2 \pm 2.1$

Dialysis was required in 13 of the 58 patients with comorbidities, compared to only 3 of the 62 without.

**Table 11: Relationship of comorbidities with need for dialysis**

Comorbidity Status	Patients Requiring Dialysis	Total Patients	Percentage (%)
With comorbidities	13	58	22.4
Without comorbidity	3	62	4.8

Mortality was highest in patients with Stage 3 AKI (15.2%).

**Table 12: Mortality distribution by AKI stage**

AKI Stage	Number of Deaths	Total in Stage	Mortality Rate (%)
Stage 1	0	48	0.0
Stage 2	1	39	2.6
Stage 3	6	33	15.2

The results reveal that AKI secondary to acute gastroenteritis was more prevalent in middle-aged and elderly males, particularly those with underlying diabetes and hypertension. Most cases were prerenal in origin, and Stage 1 was the most common presentation. Electrolyte imbalances, especially hyponatremia and metabolic acidosis, were frequent and required active correction. The majority of patients recovered fully with conservative management. The need for dialysis and mortality were significantly higher in those with comorbidities and advanced AKI stages.

### Discussion

Acute kidney injury (AKI) remains one of the most serious complications arising from acute gastroenteritis (AGE), particularly in resource-limited settings where delayed presentation and inadequate fluid resuscitation are common. This prospective study involving 120 patients provides a comprehensive overview of the clinical presentation, biochemical disturbances, and outcomes associated with AGE-related AKI in a tertiary care hospital [8].

The study population showed a slight male predominance (55.8%), and most patients were in the middle-aged to elderly group, which aligns with prior studies suggesting that aging kidneys and comorbidities increase the risk of AKI. Nearly half of the patients had at least one comorbid condition, with diabetes mellitus and hypertension being the most prevalent. These conditions are known to predispose patients to impaired renal perfusion and reduce renal reserve, making them more vulnerable to even transient hypovolemia [9].

All patients in the study presented with diarrhea, while vomiting, fever, and signs of dehydration were common associated features. These findings are in concordance with the pathophysiological basis of AGE-induced AKI, where excessive fluid and electrolyte losses lead to intravascular volume depletion and renal hypoperfusion. The significant incidence of oliguria (52.5%) and hypotension on admission further underscores the critical role of early volume assessment and replacement [10,11].

KDIGO staging revealed that most patients presented with Stage 1 or 2 AKI, yet nearly one-third progressed to Stage 3. This progression likely reflects the combined effects of delayed hospital presentation, ongoing fluid losses, and inadequate pre-hospital management. Prerenal AKI was the predominant form (67.5%), although 32.5% developed intrinsic AKI, possibly due to acute tubular necrosis following prolonged hypoperfusion [12].

Electrolyte abnormalities were frequent, with hyponatremia (47.5%) and hyperkalemia (28.3%) being the most common. Metabolic acidosis was noted in more than a third of patients, likely due to bicarbonate loss through diarrhea and impaired acid excretion. These disturbances, if not corrected promptly, can exacerbate renal dysfunction and contribute to poor outcomes [13].

The majority of patients (76.6%) responded to conservative management with fluid resuscitation, correction of electrolyte imbalances, and supportive care. However, 13.3% required hemodialysis due to worsening azotemia, oliguria, or fluid overload. Importantly, the requirement for dialysis was significantly higher among patients with comorbidities and advanced-stage AKI, reflecting a more severe disease course [14].

The overall mortality rate was 5.8%, with deaths primarily occurring in patients with Stage 3 AKI and coexisting comorbidities. This is consistent with existing literature which associates higher AKI stages and chronic illnesses with poor outcomes. Despite the high prevalence of complications, the recovery rate was encouraging, with 87.5% of patients achieving complete renal recovery [15].

This study emphasizes the importance of early recognition and aggressive management of dehydration and electrolyte abnormalities in patients with AGE. Furthermore, it highlights the need for heightened vigilance in patients with comorbidities who are more prone to develop severe AKI and its complications. Clinician awareness, patient education, and timely referral from primary care settings can significantly reduce the burden of AGE-related AKI.

## Conclusion

This prospective study underscores that acute kidney injury is a frequent and potentially serious complication of acute gastroenteritis, particularly among elderly patients and those with underlying comorbidities. Most cases of AGE-associated AKI are prerenal in origin and respond well to timely fluid resuscitation and supportive care. However, progression to intrinsic AKI and the need for dialysis occur in a significant subset, especially in those with delayed presentation or advanced KDIGO stages. Early clinical suspicion, prompt correction of volume and electrolyte imbalances, and careful monitoring are essential to reduce morbidity, the need for renal replacement therapy, and mortality.

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