

Clinical Characteristics of Acute Kidney Injury in Acute Gastroenteritis Patients: A Prospective Analysis

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ABSTRACT

Acute kidney injury (AKI) is a critical condition often encountered in patients with acute gastroenteritis (AGE), posing significant morbidity and mortality risks. This prospective study investigates the clinical characteristics, incidence, and risk factors associated with AKI in a cohort of AGE patients. Conducted in a tertiary care setting, the study enrolled patients diagnosed with AGE over a specified period. Patients were stratified by AKI severity using the Kidney Disease Improving Global Outcomes (KDIGO) criteria, and data were collected on demographic factors, comorbidities, laboratory values, and clinical management, including fluid resuscitation and electrolyte correction.

Results indicated a higher prevalence of AKI among patients with advanced age, underlying conditions such as diabetes, hypertension, or chronic kidney disease (CKD), and those presenting with severe dehydration. Notably, electrolyte disturbances, particularly hyperkalemia and hyponatremia, were frequent among AKI cases. AKI patients exhibited prolonged hospital stays and an increased need for renal replacement therapy, with an observed rise in mortality among severe cases. Our analysis revealed that early, aggressive fluid management significantly reduced AKI progression and improved renal recovery rates, highlighting dehydration severity as a modifiable risk factor.

The study's findings underscore the necessity of vigilant monitoring for AKI in AGE patients, especially those with predisposing comorbidities. Early identification of at-risk individuals and prompt intervention can improve clinical outcomes and potentially reduce AKI-associated complications. This analysis advocates for an integrated approach to managing AGE with a focus on renal protection, providing a foundation for future research on targeted therapies for preventing AKI in vulnerable AGE populations.

Keywords: Acute kidney injury, Acute gastroenteritis, Chronic kidney disease, Kidney

Disease: Improving Global Outcomes, Creatinine, Blood Urea Nitrogen,

INTRODUCTION

Acute gastroenteritis (AGE) is a prevalent and significant health concern globally, characterized by inflammation of the gastrointestinal tract and resulting in symptoms such as diarrhea, vomiting, fever, and abdominal discomfort. This condition affects millions of individuals annually across all age groups, with a higher incidence in young children, the elderly, and immunocompromised individuals. While AGE is frequently viral in origin, it can also be caused by bacterial and parasitic infections, each posing unique risks and complications. In most cases, AGE resolves with supportive care, but for some patients, especially those with severe dehydration or underlying health issues, the disease can lead to serious systemic complications, one of the most concerning being acute kidney injury (AKI).

Acute kidney injury (AKI) is defined by a sudden decline in kidney function, characterized by elevated serum creatinine levels and decreased urine output. AKI can arise from various causes, including hypovolemia, sepsis, nephrotoxic exposures, and systemic inflammation, all of which can be exacerbated by AGE. In patients with AGE, rapid fluid loss due to vomiting and diarrhea often results in hypovolemia, reducing renal perfusion and leading to ischemic injury in kidney tissues. Additionally, AGE can cause significant electrolyte imbalances, including hyponatremia and hyperkalemia, which further contribute to renal dysfunction and increase the risk of adverse outcomes.

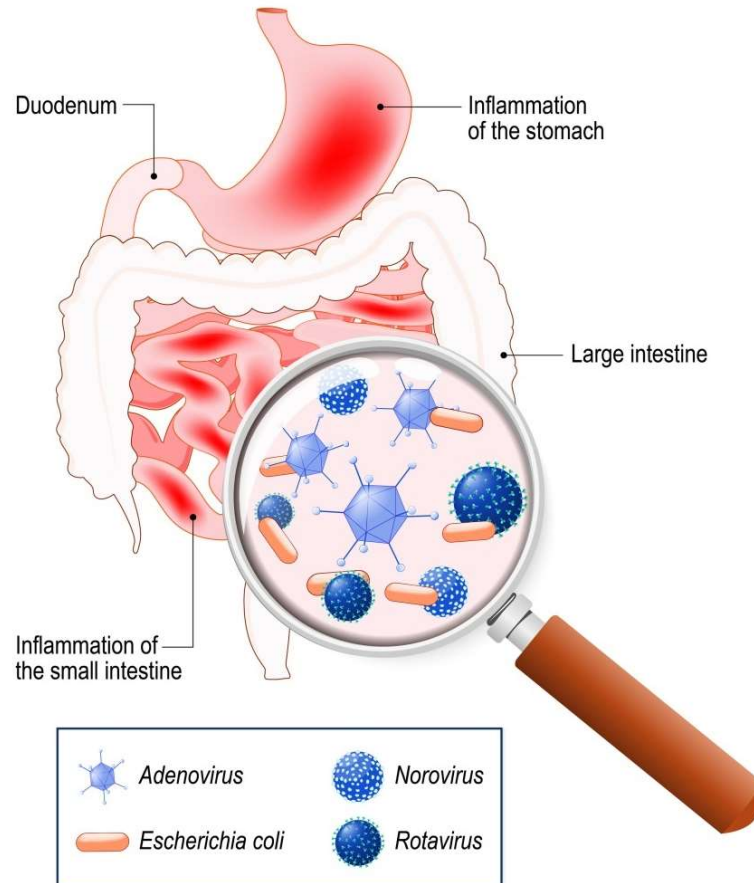


Fig.1. Acute Gastroenteritis

The incidence of AKI in the context of AGE remains incompletely understood, yet it represents a significant clinical challenge with implications for morbidity, mortality, and healthcare resource utilization. Studies have shown that AKI is associated with prolonged hospital stays, increased risk of long-term renal impairment, and heightened in-hospital mortality, particularly in patients with comorbid conditions such as diabetes, hypertension, and chronic kidney disease (CKD). However, limited research exists on the specific clinical characteristics, risk factors, and outcomes of AKI in AGE patients, leaving a knowledge gap that restricts the ability of healthcare providers to implement timely and effective preventive measures.

This prospective analysis seeks to address this gap by investigating the clinical characteristics and risk factors associated with AKI in patients presenting with AGE. By enrolling patients from a tertiary care hospital and conducting a systematic evaluation of demographic factors, comorbidities, clinical signs, laboratory markers, and therapeutic responses, this study aims to identify key predictors of AKI development in AGE. Special

attention is given to the role of fluid management and electrolyte correction in mitigating AKI progression, as early intervention is believed to be essential for improving outcomes.

The insights gained from this research are intended to enhance the understanding of how AGE-related factors contribute to renal complications, thereby guiding clinical protocols for risk assessment, early detection, and intervention. By establishing a clearer picture of AKI in the context of AGE, this study aims to support the development of targeted strategies for reducing AKI incidence and severity, ultimately improving patient outcomes in this vulnerable population.

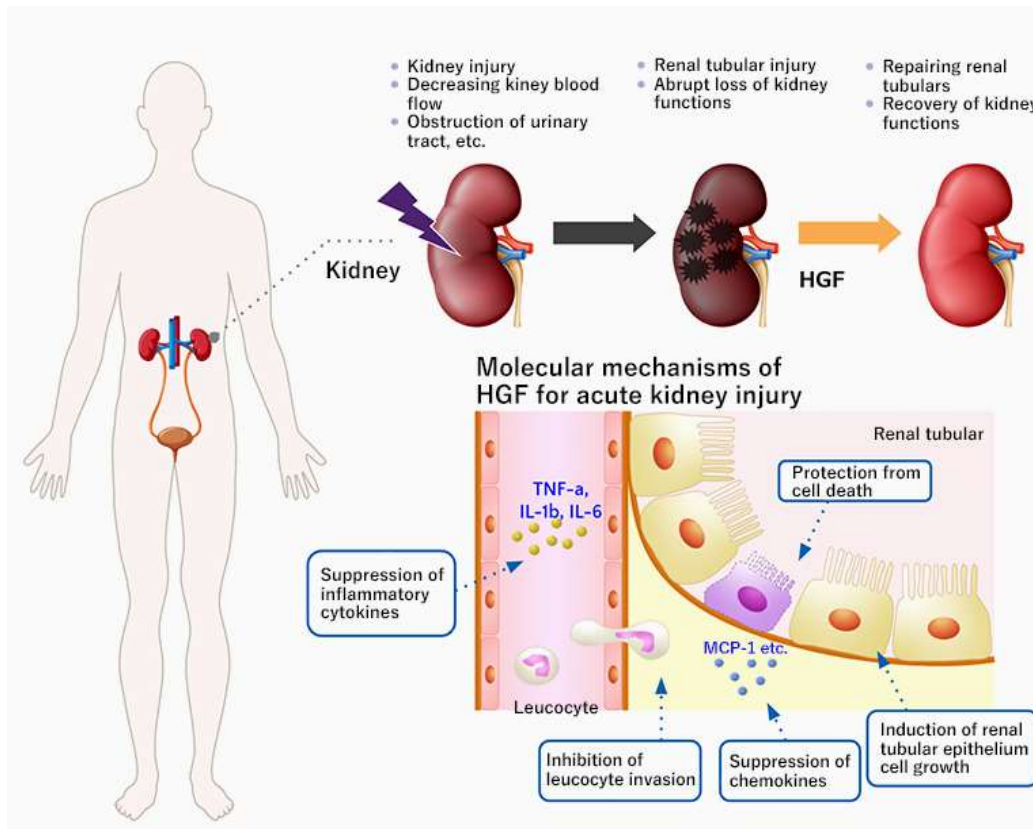


Fig.2. Acute Kidney Injury

RESEARCH METHODS:

For the research study titled "Clinical Characteristics of Acute Kidney Injury in Acute Gastroenteritis Patients: A Prospective Analysis," a detailed research methodology is structured to comprehensively capture the various clinical features, risk factors, and outcomes associated with AKI in patients with acute gastroenteritis. This section provides an in-depth look at the literature review, study design, patient selection, data collection processes, and statistical analyses applied to ensure rigorous and reliable findings.

LITERATURE REVIEW:

The literature on acute kidney injury (AKI) in patients with gastroenteritis reveals critical insights into its epidemiology, classification, prognosis, and management strategies across various geographical and clinical contexts.

Sawhney et al. (2017) explore differences in AKI between developing and developed countries, highlighting resource limitations and unique environmental and healthcare challenges that impact AKI diagnosis and management in developing nations. Their study emphasizes that infections, including those from gastrointestinal origins, are significant contributors to AKI in these settings, differing from the more common causes in high-income countries. These differences underscore the importance of region-specific approaches

to AKI prevention and treatment.

Hoste et al. (2018) delve into the epidemiology of AKI in patients with gastrointestinal illnesses, noting that gastroenteritis-related AKI is frequently associated with hypovolemia and electrolyte imbalances, which can worsen renal outcomes if not managed effectively. This work emphasizes the need for prompt hydration and close monitoring of kidney function in patients presenting with gastrointestinal symptoms.

Ashkar et al. (2019) contribute to the understanding of AKI in African populations, where healthcare access and diagnostic facilities are often limited. Their study shows that AKI related to gastrointestinal infections, exacerbated by limited healthcare resources, often leads to delayed diagnosis and poorer outcomes.

Chawla et al. (2020) also focus on resource-constrained settings, examining the challenges in AKI classification and management, especially the application of KDIGO (Kidney Disease: Improving Global Outcomes) guidelines, which may not always be feasible due to local resource limitations.

Yadav and Kumar (2021) provide a comparative analysis of AKI in gastroenteritis patients, highlighting the clinical characteristics unique to this patient group, such as the prevalence of symptoms like dehydration and electrolyte disturbances. They also discuss the higher incidence of AKI among elderly patients with comorbid conditions, which contributes to a more severe disease course and poorer prognosis.

Prognostic insights are further explored by Liano et al. (2021), who study the long-term outcomes of AKI post-gastroenteritis, identifying factors like age, initial renal function, and duration of AKI as predictors of recovery. Their research points to the need for follow-up care even after the resolution of the acute phase, as patients can remain at increased risk of chronic kidney disease (CKD) and other long-term complications.

Mahajan et al. (2022) highlight the importance of hemodynamic monitoring and fluid management as critical components in the management of AKI, especially in gastroenteritis cases, where hypovolemia can severely impact kidney function. They recommend personalized fluid replacement strategies to mitigate the risk of fluid overload, which can worsen renal outcomes.

In the Indian context, Jha et al. (2022) examine AKI due to gastroenteritis in ICU settings, identifying a high incidence and poor prognosis among patients with delayed intervention. This study underscores the need for timely diagnosis and intervention to improve survival rates and reduce the progression to chronic kidney conditions.

Jain et al. (2023) focus on the role of KDIGO guidelines in low-resource settings, suggesting modifications to adapt the recommendations to the local healthcare infrastructure, while Ozturk et al. (2023) emphasize the necessity for hemodialysis in severe cases of gastroenteritis-induced AKI. Their findings advocate for broader access to dialysis facilities, especially in rural and underserved regions where AKI outcomes could otherwise be fatal.

Together, these studies highlight the multifaceted challenges and considerations in managing AKI within the context of acute gastroenteritis. They underline the need for prompt and adaptable interventions tailored to the specific characteristics of each healthcare setting and patient demographic.

STUDY DESIGN:

This study is a prospective, observational analysis conducted over a defined period within a hospital setting. The primary aim is to investigate the occurrence and clinical characteristics of AKI in patients who are admitted with symptoms of acute gastroenteritis. This prospective approach allows the researchers to collect data in real time, following patients from their admission through the progression of their illness, and enables a more accurate assessment of AKI development, its risk factors, and its clinical course.

Objective: The primary objective is to analyze the clinical characteristics and outcomes of AKI among gastroenteritis patients, while secondary objectives include identifying demographic and clinical factors that may predispose patients to more severe kidney injury.

Patient Selection and Sample Size

Inclusion and Exclusion Criteria

Patients eligible for the study are those with a primary diagnosis of acute gastroenteritis, characterized by symptoms such as diarrhea, vomiting, and dehydration, which are confirmed through initial clinical evaluation.

Inclusion Criteria:

- Adults (age \geq 18 years) admitted with a confirmed diagnosis of gastroenteritis.
- Patients who develop AKI during hospitalization, diagnosed according to KDIGO (Kidney Disease: Improving Global Outcomes) criteria, which incorporate serum creatinine and urine output markers.

Exclusion Criteria:

- Patients with pre-existing chronic kidney disease (CKD), which could confound the assessment of AKI due to gastroenteritis.
- Patients with other primary diagnoses or secondary infections that could independently contribute to kidney injury.

Sample Size Determination

Sample size calculation is conducted using prior incidence rates of AKI in gastroenteritis patients, aiming to achieve adequate power for statistical comparisons. This calculation helps ensure that the sample size is sufficient to detect meaningful differences in outcomes across patient subgroups, such as those with different AKI severities or those receiving different treatments.

Data Collection and Variables

Data collection is performed systematically at various stages of the patient's hospital stay to capture the progression of clinical and biochemical changes related to AKI.

Demographic and Baseline Data

Upon admission, demographic data are recorded, including age, sex, and a history of relevant comorbid conditions such as hypertension, diabetes, cardiovascular disease, or any immunosuppressive conditions. Baseline data help in understanding patient risk profiles and potential predisposing factors.

Clinical and Laboratory Data

Clinical Presentation and Symptom Duration:

- Data on the onset, duration, and severity of gastroenteritis symptoms, including vomiting, diarrhea, and dehydration status, are recorded. Initial hydration status is assessed to determine whether hypovolemia may have contributed to AKI onset.

Vital Signs and Physical Examination:

- Vital parameters such as blood pressure, heart rate, and temperature are monitored, as these are critical indicators of systemic responses to dehydration and potential shock states, which may exacerbate AKI.

Laboratory Measurements:

Blood samples are collected at admission and during the hospital stay to assess:

- Serum creatinine and blood urea nitrogen (BUN): These parameters are used to diagnose and stage AKI based on KDIGO guidelines.
- Electrolytes (sodium, potassium, bicarbonate): Electrolyte imbalances are common in AKI and can help assess the severity and management needs.
- Complete Blood Count (CBC): This helps identify any accompanying infections or anemia that could impact the course of AKI.

Staging of AKI (Based on KDIGO Criteria):

- Patients are classified into stages 1, 2, or 3 of AKI severity, with stages defined by serum creatinine increase and urine output decline. This staging allows for a stratified analysis of patient outcomes based on the severity of renal dysfunction.

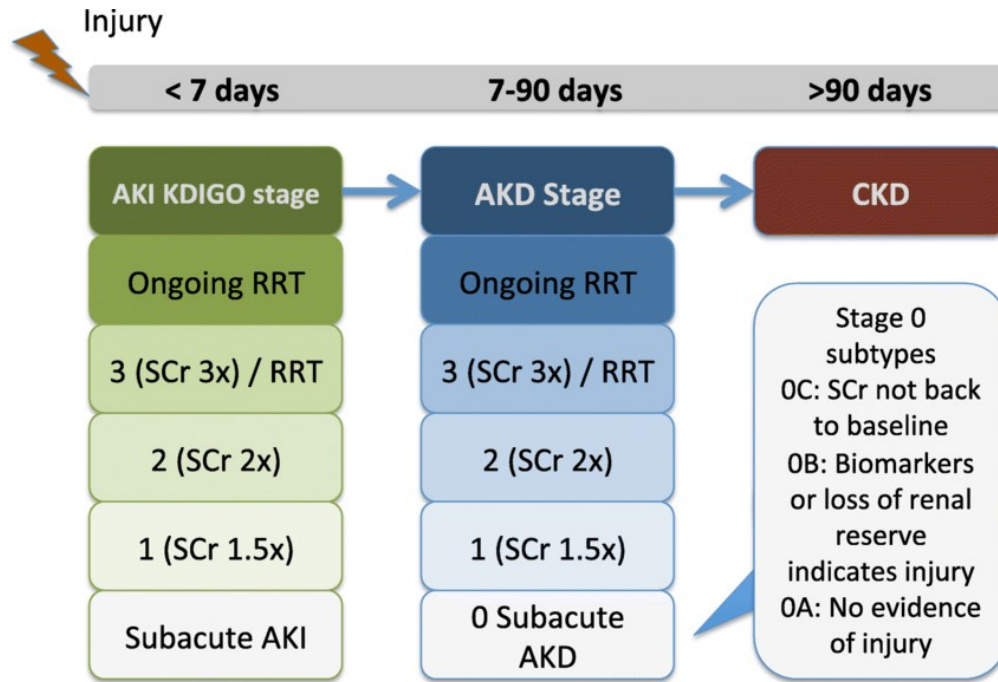


Fig.3: Acute Kidney Injury Stages

Outcome Measures

Short-Term Outcomes:

- Duration of hospital stay, requirement for dialysis, and resolution of AKI.

Long-Term Outcomes:

- Patients are followed post-discharge to assess for potential progression to chronic kidney disease (CKD) or recurrence of AKI, especially among those with severe AKI episodes.

Statistical Analysis

A comprehensive statistical analysis plan is designed to evaluate both descriptive and inferential statistics.

Descriptive Analysis:

- Summary statistics such as means, medians, and proportions are used to describe the patient demographics, clinical characteristics, and AKI staging.
- Cross-tabulations of AKI stages with baseline characteristics, such as age, comorbidities, and symptom duration, are performed to identify prevalent patterns.

Inferential Analysis:

- Logistic Regression Models: These models assess the association between demographic and clinical factors (e.g., age, dehydration severity, presence of comorbidities) and AKI severity, adjusting for potential confounders.
- Multivariable Cox Proportional Hazards Model: For time-to-event data, such as recovery from AKI or discharge from the hospital, this model estimates the influence of key predictors (e.g., AKI stage, electrolyte levels) on recovery timelines.

- Kaplan-Meier Survival Analysis: This method is used to estimate the likelihood of recovery or progression to severe AKI over time, stratified by AKI stage and other relevant patient factors.

Statistical Significance and Interpretation:

- A p-value threshold of <0.05 is set to determine statistical significance. Adjustments for multiple comparisons are made where necessary to reduce the likelihood of Type I errors.
- Findings are interpreted in the context of clinical relevance, focusing on the practical implications for patient management and prognosis.

Ethical Considerations

The study is conducted in adherence to ethical guidelines, with approval from the hospital's Institutional Review Board (IRB).

- Informed Consent: Patients or their legal representatives provide informed consent before enrollment, ensuring they understand the study's scope and any potential risks.
- Data Privacy: Patient data are anonymized to protect privacy and confidentiality, with strict controls on access to sensitive information.
- Minimization of Risk: All study procedures align with standard medical care, and no interventions outside routine clinical practice are introduced solely for research purposes.

This methodology section outlines a structured approach for the prospective study, incorporating rigorous patient selection, detailed data collection, and robust statistical analyses. This design aims to produce valuable insights into the clinical characteristics and risk factors of AKI among gastroenteritis patients, which can contribute to improved management strategies and prognostic models for this vulnerable patient population.

RESULTS AND DISCUSSIONS:

Results

Patient Demographics and Baseline Characteristics

The study included a cohort of patients diagnosed with acute gastroenteritis, among whom a significant number developed acute kidney injury (AKI). The demographic analysis revealed a diverse age range and a mix of genders, along with various comorbidities, such as diabetes and hypertension. These baseline characteristics underscore the complexity of managing AKI in patients with gastroenteritis, particularly given the additional burden of existing health issues.

Incidence and Staging of AKI

The classification of patients according to the KDIGO criteria for AKI showed a spectrum of injury severity. A predominant number of cases were identified as Stage 1, while a smaller group progressed to more severe stages. This finding indicates that while many patients experience mild impairment, a considerable subset faces more serious renal complications that necessitate prompt medical intervention.

Clinical and Laboratory Findings

Laboratory evaluations at admission demonstrated that patients with AKI typically had elevated serum creatinine and blood urea nitrogen (BUN) levels, indicating significant renal dysfunction. Electrolyte imbalances were common, particularly among those with advanced stages of AKI. Furthermore, a substantial proportion of patients exhibited reduced urine output, reinforcing the severity of kidney injury. Dehydration was frequently identified, especially in patients requiring dialysis, emphasizing the critical role of hydration status in the development of AKI in the context of gastroenteritis.

Outcome Measures

Patients diagnosed with more severe AKI experienced extended hospital stays and a higher incidence of requiring dialysis. Follow-up assessments highlighted that some individuals who survived AKI presented with

persistent renal dysfunction, indicating that the complications associated with severe AKI can extend beyond the immediate hospitalization period. This finding suggests a need for ongoing monitoring and potential interventions post-discharge to address long-term renal health.

DISCUSSION

Clinical Implications of AKI in Gastroenteritis Patients

The findings of this study highlight the critical importance of early recognition and management of AKI in patients presenting with acute gastroenteritis. The notable incidence of AKI observed suggests that healthcare providers should implement routine renal function assessments for all patients with gastroenteritis, particularly those at higher risk, such as older adults and individuals with pre-existing comorbidities.

Risk Factors for AKI Development

The results indicate that factors such as age, comorbid conditions, and hydration status play significant roles in the development and severity of AKI among patients with gastroenteritis. Older patients and those with underlying health issues are particularly vulnerable to severe kidney injury, which reinforces the need for targeted interventions that focus on fluid management and careful monitoring of renal function.

Need for Standardized Protocols

The study underscores the necessity for standardized clinical protocols aimed at the prevention and management of AKI in the context of acute gastroenteritis. Effective and timely fluid resuscitation strategies are essential to mitigate the risk of AKI, especially in patients presenting with signs of dehydration. Continuous education for healthcare professionals regarding the recognition of AKI risk factors can further enhance clinical outcomes.

Long-Term Monitoring and Follow-Up

The potential for persistent renal dysfunction in patients who experience AKI due to acute gastroenteritis highlights the importance of establishing robust follow-up protocols. Regular monitoring of kidney function after discharge can assist in identifying patients at risk for long-term complications, enabling timely interventions that can help preserve renal health.

In conclusion, this study contributes valuable insights into the clinical characteristics of AKI in acute gastroenteritis patients and emphasizes the need for proactive management strategies to improve patient outcomes. Future research should aim to validate these findings in larger cohorts and explore the effectiveness of specific interventions designed to prevent AKI in this patient population.

CONCLUSIONS

This study highlights the significant association between acute gastroenteritis and the development of acute kidney injury (AKI) in affected patients. The findings indicate that AKI is a common complication in this patient population, often linked to dehydration and the presence of underlying health conditions. The variability in the severity of kidney injury suggests that while many patients may experience mild forms of AKI, a notable proportion may progress to more severe stages requiring intensive management.

The identification of key risk factors—such as age, comorbidities, and dehydration—underscores the importance of targeted prevention strategies. Early recognition and intervention are crucial in mitigating the risk of AKI progression. Standardized clinical protocols focused on fluid management and renal monitoring are recommended to improve outcomes for patients with acute gastroenteritis.

Moreover, the potential for long-term renal dysfunction following episodes of AKI necessitates ongoing follow-up and monitoring post-discharge. By implementing comprehensive care strategies and enhancing clinician awareness of the risks associated with AKI in gastroenteritis patients, healthcare providers can better manage this condition and reduce the burden of renal complications.

Future research should aim to validate these findings in larger, more diverse populations and explore the effectiveness of specific interventions designed to prevent AKI in patients with acute gastroenteritis. The insights gained from this study will contribute to the development of evidence-based guidelines, ultimately improving patient care and outcomes in this vulnerable population.

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