Incidence of Acute Kidney Injury in Acute Gastroenteritis Patients Presenting to Sheikh Zayed University Teaching Hospital Khost, Afghanistan

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Abstract

Background: Acute gastroenteritis (AGE) affects all age groups alike, is a common cause of hospitalization worldwide and is the most common known cause of preventable acute kidney injury. Acute Kidney Injury (AKI) may be defined as a sudden decrease in kidney function, which results in reduced filtration capability of the kidneys, accumulation of waste products and their resultant clinical manifestations. Early detection of AKI caused by AGE can significantly decrease mortality rates. In Khost, studies investigating the incidence of AKI in AGE Patients are limited; thus, we aimed to fill this knowledge gap.

Materials and Methods: Aprospective observational study was conducted on 79 patients with AKI secondary to acute gastroenteritis admitted to Sheikh Zayed University Teaching Hospital Khost, Afghanistan , in 3 months duration from July 2023 to September 2023. Data were analyzed using SPSS 28.

Findings: In this study, 79 individuals were enrolled, including 58.2% male and 41.8% female. Of them, 79 patients with acute gastroenteritis, 40 (50.6%) had acute renal failure (ARF). Hypertension was the most common type of comorbidity 10 (12.6%), followed by diabetes mellitus 3 (3.8%). Diarrhea was the most commonly reported gastrointestinal symptom among the patients (78.5%), followed by vomiting (58.2%) and dysentery (20.3%). Dehydration was reported in all patients. Severe dehydration (48.1%) was the most common among patients with AGE-induced ARF. The proportion of patients with diarrhoea (90% vs. 66%, P<0.012) was significantly higher among patients with ARF than in those without ARF. Patients older than 40 years had a significantly higher frequency of ARF (67.5%) as compared to patients less than 40 years of age (13.5%) (P = 0.000). The median serum creatinine, sodium, and potassium levels in patients with age related ARF were 4.1mg/dl, 130mEq/L and 4.3 mEq/L, respectively. The serum creatinine level was higher in those with ARF (P = 0.490).

Conclusion: The study concluded that the incidence of acute kidney injury in patients presenting with acute gastroenteritis to Sheikh Zayed University Teaching Hospital is 40 (50.6%), due to hypovolemia caused by fluid losses in acute diarrheal illnesses. It can be prevented by prompt diagnosis and treatment by fluid administration.

Keywords: Acute kidney injury, Creatinine Level, Chronic kidney disease, Dehydration, Diarrhoea, Dysentery, Hemodialysis.

Introduction

Acute gastroenteritis (AGE) affects all age groups alike, is a common cause of hospitalization worldwide and is the most common known cause of preventable acute kidney injury

Gastroenteritis is the inflammation of the stomach, small intestine, or large intestine accompanied by clinical signs such as abdominal pain, nausea, vomiting, and watery or bloody diarrhea.[1] Definitions of diarrhea include increases in volume or fluidity of stools, changes in consistency, and increased frequency of defecation. The World Health Organization (WHO) defines diarrhea as the "passage of loose or watery stools at least three times in a 24 h period", with more emphasis on the change in stool consistency rather than on frequency.[2] Gastroenteritis of infectious origin is the most common cause of morbidity and mortality after lower respiratory tract infections in the world.[3] Its etiology is broad, with infectious agents such as viruses, bacteria, and parasites being the principal culprits. Noroviruses and rotaviruses are notable viral causes, often instigating outbreaks in enclosed environments and causing severe disease in children, respectively. Bacterial agents include Escherichia coli, Salmonella, Shigella, and Campylobacter, generally causing gastroenteritis through food or water contamination. Although less common, parasites like Giardia and Cryptosporidium can also induce the condition.[4] norovirus and *Clostridioides* (*Clostridium*) *difficile* are 2 commonly detected pathogens among adults with AGE.[5] Noroviruses (NoV) are a leading cause of overall AGE worldwide and the main viral cause of AGE. NoV AGE frequently presents as isolated vomiting without diarrhea.[6]

The epidemiology is changing, with salmonellosis decreasing in industrialized countries and diarrhoeagenic *Escherichia coli* contributing to an increasing burden of disease worldwide.[7] is an illness characterized by acute diarrhea, which may or may not be accompanied by nausea, vomiting, fever, and abdominal pain.[8] episodes of vomiting and abdominal pain have been reported less frequently among older adults with viral gastrointestinal illness compared with younger adults. Fever is also less common in older adults with a gastrointestinal infection.[9] Mild dehydration presented with dry mouth, fatigue, headache, and concentrated urine whereas severe dehydration may manifest with dry mucosa, poor cognitive function, blurred/loss of consciousness, delirium, oliguria, orthostatic hypotension, tachycardia, weak pulse, and prolonged capillary refill time.[10]

Although antibiotics can be useful in specific situations, appropriate rehydration remains the most important management strategy for acute diarrhea in all populations.[11] In most cases, gastroenteritis can be managed conservatively, or if severe dehydration is clinically suspected, i.v. fluids can improve a patient's condition or prevent deterioration [12]. The type, amount, and infusion rate of IV rehydration therapy may vary according to body composition, dehydration level, and cardiac output status of each patient, as well as clinical and hemodynamic parameters such as daily urine output or blood pressure.[13] AKI may be defined as a sudden decrease in kidney function, which results in reduced filtration capability of the kidneys, accumulation of waste products and their resultant clinical manifestations, and abnormality of body fluid volume status as well as fluctuations in serum electrolyte levels.[14] AKI is observed in 7% of patients requiring hospitalization and in 36% to 67% of critically ill patients depending on the definition used.[15]

Acute kidney injury (AKI) affects 13.3 million people worldwide per year and causes up to 1.7 million deaths annually . Regardless of whether renal function recovers fully or not, AKI survivors are at high risk of transitioning to chronic kidney disease (CKD) and, in some cases, progressing to end-stage kidney disease (ESKD).[16] AKI occurring outside of the hospital setting is called community-acquired (CA)-AKI, and it has been reported a common event in the population,[17] acute kidney injury (AKI) have a higher risk of developing atrial fibrillation (AF), heart failure (HF), acute coronary syndrome (ACS), and major adverse cardiac events (MACE) in the short and long term compared to patients without AKI, and if that risk is related to the severity of AKI.[18] The latest classification of AKI was implemented following the Kidney Disease Improving Global Outcomes Guidelines (KDIGO) 2012, which come from both the Acute Kidney Injury Network (AKIN) criteria and the Risk, Injury, and Failure, Loss, and End-stage kidney disease (RIFLE) criteria. A diagnosis of AKI might be made in any one of the following clinical scenarios. A 48-hour period during which SCr levels increase by 0.3 mg/dL or higher; SCr levels that have increased by 1.5 times or more from baseline in the last week; or a urine flow rate for at least six hours of less than 0.5 mL/kg/h [36,37]. Moreover, KDIGO suggests categorizing the severity of AKI into stages. It depends on the SCr increase or drops in urine output. The first stage is characterized by a decrease in urine output of 0.5 mL/kg/h lasting more than 6 hours or an increase in SCr of 1.5-1.9 times over baseline. Stage two is a decrease of 0.5 mL/kg/h in urine output over 12 hours or more or a 2.0-2.9-fold increase in Scr from baseline. Stage 3 is defined as a decrease in urine output to less than 0.3 mL/kg/h for 24 hours or more, as well as a tripling of SCr, or anuria lasting 12 hours or more[19] The causes of AKI can be categorised as:

Pre-renal, generally in which decreased renal blood flow results in a drop in GFR

Intrinsic/intra-renal, in which a disease process causes damage to the kidney itself

Post-renal, in which a process downstream of the kidney prevents drainage of urine (urinary tract obstruction).[20] AKI arises from various insults, such as renal hypoperfusion, sepsis, major surgery, immunological diseases affecting kidney parenchyma, administration of radiocontrast or nephrotoxic agents, and post-renal causes.[21] Most common causes of AKI are predominantly caused by communicable diseases such as acute diarrheal diseases, malaria, snakebites, insect sting, intravascular hemolysis due to septicemia, chemical poisoning such as copper sulfate, vasmol, pregnancy, and leptospirosis, cause 40% of AKI in India.[22] AKI can be challenging to define because it is based on changes in kidney function and therefore requires multiple creatinine measures and evaluation of urine output to make a diagnosis.[23] Detection of AKI in the early stage of disease and aggressive management of underlying cause will reduce mortality.[24] The investigations and the probable results would be as under, BUN/Creatinine Ratio, Creatinine Levels, Indicators of Kidney Conditions, Complete Blood Count (CBC), Blood Chemistry, Urine Chemical Indices, Imaging Studies, and Procedures like renal biopsy.[25]

Methods And Materials

Study Design and setting

An observational cross-sectional study was conducted on patients who presented with the history, signs, and symptoms of acute diarrheal diseases without any prior known kidney diseases, to the Emergency and Medicine Departments of Sheikh Zayed University Teaching Hospital Khost, Afghanistan. A total of 79 patients were stratified over the duration of 3 months, from 1st July- 30th Sep, 2022, these patients were selected based on specific criteria. The criteria were as follows: the patients had to be of either sex, aged 18 years or older. Additionally, all patients with acute gastroenteritis who developed AKI were included. AKI was defined as an increase in serum creatinine to ≥2 times baseline, known or presumed to have occurred within the prior 7 days, or urine volume <0.5 ml/kg/h for 12 hours (RIFLE criteria). However, AKI caused by conditions

other than gastroenteritis was not included. Patients with acute gastroenteritis who also had chronic kidney disease (CKD) were excluded, as were patients with co-morbidities such as diabetes mellitus and hypertension. Patients who presented with the history, signs, and symptoms of acute diarrheal diseases without any prior known kidney diseases or Co-morbidities like Diabetes mellitus and Hypertension to the Emergency Department of Sheikh Zayed University Teaching Hospital Khost were selected. A preliminary renal function test, FBS, and HBA1C were sent, and blood pressure readings were taken.

Data Collection and Pateints Characteristics

A simple Performa was used to record the patient's Biodata, history, and tests with informed consent. Those completing the above criteria were selected and observed over their hospital stay with daily fresh RFTs and urine output record along with recording of intervention in the form of hemodialysis along with prolonged hospital stay and mortalities.

Statistical Analysis

For statistical analysis, the original data were exported after entering them into an Excel spreadsheet in SPSS version 28.0. We used the Shapiro-Wilk test to check the normality of the quantitative data distribution. For variables with approximately normal distribution, the means ± standard deviations are used to summarize the data. Data are summarized using medians and interquartile ranges (IQRs) for continuous variables with skewed distributions. All qualitative information was documented as percentage (%) and number (n) of responses. Additionally, chi-square analysis (χ2) was used to examine the association between the independent and primary outcome variables.

Terms Definition

Acute kidney injury

Defined as, an increase in serum creatinine by 0.3mg/dl or more within 48 hours. By RIFLE criteria, AKI is defined as an increase in serum creatinine to 2 times baseline or more within the last 7 days or urine output less than 0.5 mL/kg/h for 12 hours.

Acute gastroenteritis

The diarrheal disease of rapid onset with or without accompanying symptoms or signs such as nausea, vomiting, fever, or abdominal pain.

Results

Sociodemographic characteristics of Study participants

In this study, 79 individuals were enrolled, with a median (IQR) age of 35 (60–25) years (range, 18–80 years). Of them, 58.2% were male and 41.8% were female. Of the 79 patients

with acute gastroenteritis (AGE), 40 (50.6%) had acute renal failure (ARF). Hypertension was the most common type of comorbidity 10 (12.6%), followed by diabetes mellitus 3 (3.8%). The other baseline information and clinical characteristics are summarized in Table 1.

Gastrointestinal and Kidney-related characteristics of the patients

Diarrhoea was the most commonly reported gastrointestinal symptom among the patients (78.5%), followed by vomiting (58.2%) and dysentery (20.3%). Dehydration was reported in all patients. Severe dehydration (48.1%) was the most common subcategory among patients with AGE-induced ARF. The proportion of patients with diarrhoea (90% vs. 66%, P<0.012) was significantly higher among patients with ARF than in those without ARF. Regarding the comparison of mortality with age groups, one mortality was seen in the age group of < 40 years; however, there were two mortalities in the age group of > 40 years. We did not observe any statistically significant association between mortality and age groups (P = 0.153). Patients older than 40 years had a significantly higher frequency of ARF (67.5%) as compared to patients less than 40 years of age (13.5%)(P = 0.000). Additionally, of the 40 with ARF, 2 (6.1%) had developed chronic renal failure (CRF) secondary to ARF.

Hemodialysis was performed in only 12 patients (15.18%). Three patients showed improvement after having one session, six patients showed improvement after having 2 sessions, Three patients showed improvement after having 3 sessions, two patinets did not showed improvement after having 10 dialysis sessions had developed CRF secondary to ARF. The study revealed that 3 patients were expired after having 10 dialysis sessions and prolonged stay at the hospital. Furthermore, 28 did not have dialysis sessions and were

Table 1: Sociodemographic and clinical characteristis of study participants[N=79]

Variables	Frequency	Percentage	P value†
Age (in years)*			
≤ 40	46	58.2 %	
> 40	33	41.8 %	0.177[a]
Gender*			
Male	46	58.2 %	0.177 [a]
Female	33	41.8 %	
Residence*			
Urban	41	51.9 %	0.822 [a]
Rural	38	48.1 %	
Comorbidities*			
HTN	10	12.6%	0.000[b]
DM	3	3.8%	
Blood Pressure *			
Systolic BP (mmHg)	100 (20)		
Diastolic BP (mmHg)	70 (10)		

Notes: * Data presented as number, percentage, or median (interquartile range). †P- values were obtained from a Binomial test; b Chi-square test.

discharged after improvement with medical management.

A few laboratory tests were performed on the sample, including serum creatinine, sodium, and potassium. The median serum creatinine, sodium, and potassium levels in patients with age related ARF werem 4.1mg/dl, 130mEq/L and 4.3 mEq/L, respectively. The serum creatinine level was higher in those with ARF (P = 0.490) (Table 2).

Discusstion

In this study, 79 individuals were enrolled, including 58.2% male and 41.8% female. Of them, 79 patients with acute gastroenteritis, 40 (50.6%) had acute renal failure (ARF). Hypertension was the most common type of comorbidity (10%), followed by diabetes mellitus (3.8%). Diarrhea was the most commonly reported gastrointestinal symptom among the patients (78.5%), followed by vomiting (58.2%) and dysentery (20.3%). Dehydration was reported in all patients. Severe dehydration (48.1%) was the most common among patients with AGE-induced ARF. The proportion of patients with diarrhoea (90% vs. 66%, P<0.012) was significantly higher among patients with ARF than in those without ARF. Patients older than 40 years had a significantly higher frequency of ARF (67.5%) as compared to patients less than 40 years of age

Table 2: Gastrointestinal and Kidney-related variables of the patients [N = 79]

Clinical characteristics	Acute Kidney Injury		P values†
	Yes (n = 40)	No (n = 39)	
Age (in years) *			
≤ 40	13 (32.5%)	33 (84.6%)	0.000^b
> 40	27 (67.5%)	6 (15.4%)	
Gender*			
Male	16 (40 %)	30 (76.9%)	0.001^b
Female	24 (60 %)	9 (23.1%)	
Diarrhoea*	36 (90%)	26 (66.7%)	0.012^b
Dysentry*	4 (10 %)	12 (30.8%)	0.022^b
Vommiting*	23 (57.5%)	23 (59 %)	0.894^b
Dehydration*			
Mild	14 (35 %)	24 (61.5%)	0.012^b
Moderate	13 (32.5%)	12 (30.8%)	
Sever	13 (32.5%)	3 (7.7%)	
Hemodialysis*			
Required	12 (30 %)	0.0%	0.000^b
Not required	28 (70 %)	39 (100%)	
Condition of the patient			
CKD	2 (5 %)	0.0%	0.074^b
Dead	3 (7.5 %)	0.0%	
Laboratory parameters*			
Serum creatinine	4.1 (3.2)	1.1 (0.2)	0.490^c
Serum potassium	4.3 (2.8)	4.2 (0.7)	0.489^c
Serum sodium	130.5 (5)	138 (3)	0.933^c

Notes:* Data presented as number, percentage, or median (interquartile range). †P- values were obtained from a Binomial test; b Chi-square test; c Mann-Whitney U-test

(13.5%) (P = 0.000). The median serum creatinine, sodium, and potassium levels in patients with age related ARF werem 4.1mg/dl, 130mEq/L and 4.3 mEq/L, respectively. The serum creatinine level was higher in those with ARF (P = 0.490).

The study concluded that the incidence of acute kidney injury in patients presenting with acute gastroenteritis to Sheikh Zayed University Teaching Hospital is 50.6%, due to hypovolemia caused by fluid losses in acute diarrheal illnesses. It can be prevented by prompt diagnosis and treatment by fluid administration.

In this study, 79 individuals were enrolled, with a median (IQR) age of 35 (60–25) years (range, 18–80 years). Of them. A compartive study frome pakistan by Nighat Jamal et al,. reported a study on total 140 patients with minimum age was 14 years and the maximum age was 70 with a mean of 38 years.[13]

In the study of Clinical Profile and Management of Patients Admitted with Acute Kidney Injury Secondary to Gastroenteritis in a Tertiary Care Teaching Hospital on acute kidney injury secondary to gastroenteritis reported that mean age for males was 30.96 ± 6.40.and mean age for females was 30.84±6.81.[26] AKI due to acute gastroenteritis was more in male (58.2%) and 41.8% were female. An Indian study by Umang Patil shows the incidence of AKI due to gastroenteritis greater in males. Males were 72.86% and females were 27.14%.[27] In our study out of the 79 patients with acute gastroenteritis (AGE), 40 (50.6%) had acute renal failure (ARF) and another study conducted by Rizvi, Nabiha, et al., in 92 patients 54% had ARF.[28] Hypertension was the most common type of comorbidity 10 (12.6%), followed by diabetes mellitus 3 (3.8%), A study by Safari S, et al., show the most common comorbidity was hypertensio (45.7%) followed by diabetes mellitus (16.4).[29] In current study diarrhea is most commonly reported symptome (78.5%) and vomiting (58.2) And another study conducted by Bogari, Mohammed Hisham, et al show that Diarrhea was most common (99.7%) followed by vomiting (38.0%) the little deference maybe due to environmental factors and etiology.[30]

In current study among those 40 (50,6%) patients had AKI whereas 39(49,4) patients didn't developed AKI following acute gastroenteritis. In another comparative study from Pakistan by Nabiha Rizvi in 92 cases Among those 48(54%) patients had AKI whereas 44(46%) patients didn't developed AKI following acute gastroenteritis.[28]

In this study Hemodialysis was performed in only 12 patients (15.18%). But in anather study in pakistan by Nabiha Rizvi (94%) patients were managed conservatively and (6%) required hemodialysis.[28] The difference is Due to poor socioeconomic situations, limited access to care, lack of awareness of personal cleanliness, crowding, and climatic factors that encourage the spread of infection of diarrheal illnesses, late presentation, poor management in primary care this all result worse AKI which need hemodialysis for good management.

In this study in 79 patient 3 (3.7%) patient were died. In the study in india 4% mortality was noted.[31]

In current study a few laboratory tests were performed like serum creatinine, sodium and potassium. The median serum creatinine, sodium, and potassium levels in patients with age related ARF were 4.1mg/dl, 130mEq/L and 4.3 mEq/L, respectively. A study conducted by Bogari, Mohammed Hisham, et al. level of serum creatinine, sodium and potassium in ATN group were 1.789 mg/dl, 129.2 mEq/L and 7.6 mEq/L respectively, the deference may be due to not proper fluid management and lack of ICU.[30]

Conclusion

The study concluded that the incidence of acute kidney injury in patients presenting with acute gastroenteritis to Sheikh Zayed University Teaching Hospital is 40 (50.6%), due to hypovolemia caused by fluid losses in acute diarrheal illnesses. It can be prevented by prompt diagnosis and treatment by fluid administration.

Suggestions

The results showed that delayed treatment of gastroenteritis patients may lead to acute kidney injury. Based on this, we have the following recommendations:

- The responsible authorities are obligated to carry out public awareness campaigns in the community so that gastroenteritis patients seek medical attention at health centers in a timely manner.
- Healthcare workers and relevant authorities are obligated to promptly address and manage water and electrolyte deficiencies in gastroenteritis patients.
- Healthcare workers and relevant authorities are responsible for providing timely dialysis to patients with acute kidney injury resulting from gastroenteritis.
- Healthcare workers and centers should ensure that the treatment of gastroenteritis patients is carried out by specialist doctors in specialized clinics.

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