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Patterns of Acute Kidney Injury (AKI) in Dengue Patients: Insights from Tertiary Care Hospitals in Bangladesh

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Abstract: ***Background:*** Acute kidney damage (AKI) in dengue patients can cause harm and death. AKI patterns, incidence, and risk factors in dengue patients hospitalized to Bangladeshi tertiary care institutions were examined in this study. ***Methods:*** A cross-sectional study of 200 adult dengue fever patients at Sylhet MAG Osmani Medical College Hospital was done from January 2024 to July 2024. Demographic, clinical, and laboratory data were gathered, and KDIGO criteria were used to evaluate AKI. Statistics were used to identify risk variables and assess in-hospital patient outcomes. ***Results:*** The study cohort comprised 200 dengue patients, predominantly males (65%), with the highest proportion aged 31-50 years (45%). Fever was universal (100%), while vomiting (80%), abdominal pain (70%), and skin rashes (35%) were also prevalent. AKI was observed in 75% of patients, with 45% classified as Stage 1, 35% as Stage 2, and 20% as Stage 3. Reduced urine output was present in 55% of patients, and thrombocytopenia (<100,000/µL) was observed in 90% of cases. Significant risk factors for AKI included age >50 years (OR = 2.45, p = 0.005), male gender (OR = 1.75, p = 0.03), severe dengue (OR = 3.90, p < 0.001), and elevated creatinine levels (>1.5 mg/dL; OR = 5.50, p < 0.001). Serum creatinine demonstrated excellent diagnostic performance (AUC = 0.88), while platelet count (<100,000/µL) also showed predictive value (AUC = 0.72) for AKI. Most patients (85%) achieved full recovery, while 10% experienced persistent renal dysfunction, and 5% succumbed to the condition. ***Conclusion:*** AKI is common among dengue patients, with age, sex, and severe symptoms as major risk factors. Early monitoring of creatinine and platelets is crucial for timely intervention and reducing long-term complications.

Keywords: Acute Kidney Injury (AKI), Dengue Fever, Serum Creatinine, Thrombocytopenia, Renal Dysfunction.

Original Research Article

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Article at a glance:

Study Purpose: *To assess the prevalence, risk factors, and outcomes of acute kidney injury (AKI) in hospitalized dengue patients in Bangladesh using KDIGO criteria.*

Key findings: *AKI was present in 75% of patients, mostly Stage 1. High serum creatinine (>1.5 mg/dL), age >50, male gender, and severe dengue significantly increased AKI risk. Although 85% recovered, 10% had lasting kidney issues, and 5% died.*

Newer findings: *The study highlights serum creatinine as an early AKI marker and stresses the need for prompt monitoring to prevent long-term damage in dengue cases.*

Abbreviations: *AKI: Acute Kidney Injury, KDIGO: Kidney Disease Improving Global Outcomes, OR: Odds Ratio.*

INTRODUCTION

Acute kidney injury (AKI) is a significant complication associated with dengue virus infection, particularly in severe cases. The incidence of AKI among hospitalized dengue patients ranges from 3.3% to 14.2%, with varying degrees of severity and a notable requirement for dialysis in some cases.[1, 2] The pathophysiology of AKI in dengue is multifactorial, involving direct viral effects, immune-mediated mechanisms, and hemodynamic changes due to plasma leakage.[3] In

Bangladesh, where dengue fever is endemic, understanding the patterns of AKI in dengue patients is crucial for improving clinical outcomes. Studies have shown that AKI can manifest in different forms, with mild cases being more prevalent, yet moderate to severe cases can lead to significant morbidity and mortality.[4] The risk factors for developing AKI in dengue patients include older age, pre-existing kidney disease, and the severity of the dengue infection itself.[5] Research indicates that the need for renal replacement therapy can be as high as 70% in patients with severe AKI due to dengue.[6] This highlights the importance of early recognition and management of AKI in dengue patients, particularly in tertiary care settings where resources for dialysis and intensive care are available. Furthermore, the identification of predictors for AKI can aid in stratifying patients at risk and implementing timely interventions.[7] In Bangladesh, the healthcare system faces challenges in managing dengue outbreaks, and the burden of AKI adds to the complexity of patient care. Tertiary care hospitals play a pivotal role in managing severe cases, and understanding the local epidemiology of AKI in dengue patients can improve clinical practices and resource allocation.[8] This study aims to synthesize existing literature on the patterns of AKI in dengue patients, focusing on insights from tertiary care hospitals in Bangladesh. By analyzing the incidence, risk factors, and outcomes associated with AKI in this population, we hope to provide a comprehensive overview that can guide clinicians in improving patient care and outcomes in the context of dengue fever.

OBJECTIVE

To explore the trends, occurrence, risk factors, and consequences of acute kidney injury (AKI) in dengue patients who are hospitalized in Bangladeshi tertiary care facilities.

METHODS

Study Design

This study employed a cross-sectional design to investigate the patterns of acute kidney injury (AKI) in patients diagnosed with dengue fever. The research was conducted in tertiary care hospitals across Bangladesh over six months, from January 2024 to July 2024, at Sylhet MAG Osmani Medical College Hospital. This design allowed for the collection of data at a single point in time, facilitating the assessment of the prevalence and characteristics of AKI in the context of dengue infection.

Study Population

The study population comprised 200 patients who were diagnosed with dengue fever during the study period. These patients were admitted to the participating tertiary care hospitals, which are equipped to manage severe cases of dengue and its complications.

Inclusion Criteria

Participants were selected based on the following inclusion criteria:

Adults aged 18 years and older.

Patients with a confirmed diagnosis of dengue fever, established through clinical evaluation and serological testing (e.g., NS1 antigen, IgM, and IgG antibodies).

Individuals who provided informed consent to participate in the study.

Exclusion Criteria

Patients were excluded from the study if they met any of the following criteria:

Pre-existing chronic kidney disease, as defined by a history of renal impairment or elevated baseline serum creatinine levels before hospitalization.

Significant comorbidities that could confound the results, including but not limited to diabetes mellitus, hypertension, or other renal pathologies.

Patients who were unable to provide informed consent due to cognitive impairment or other reasons.

We exclude pregnant women from this study.

Research Instrument

A systematic questionnaire created especially for this study was used to gather data. Demographic data (age, sex, and socioeconomic position), clinical presentations (symptoms and length of illness), laboratory results - serum creatinine levels, CBC, urine output, and routine measurement of microscopic urine examination (RME), and treatment outcomes were all covered in the questionnaire. The kidney disease: Improving Global Outcomes (KDIGO) criteria, which divide AKI into three stages based on variations in blood

creatinine levels and urine output, served as the basis for the evaluation of AKI.

Data Collection

Data collection was conducted by trained research assistants who were responsible for administering the structured questionnaire and gathering relevant clinical data. The research assistants reviewed medical records to extract laboratory results, including serum creatinine levels and urine output measurements, ensuring accuracy and completeness. Additionally, direct patient assessments were performed to gather information on clinical symptoms and treatment responses. The data collection process was standardized to minimize variability and ensure consistency across all participating sites.

RESULTS

Table 1 presents the Baseline Profile of Dengue Patients (n =200) and presents the demographic, clinical, and laboratory characteristics of the study cohort. The majority of patients were between 31 and 50 years of age (45%), with a predominance of males (65%) compared to females (35%). Clinically, fever was universally present (100%), while vomiting (80%), abdominal pain (70%) and Skin rashes (35%) were common, and reduced urine output was observed in 55% of patients. Laboratory findings revealed that 75% of patients had elevated serum creatinine levels (>1.5 mg/dL), 60% exhibited proteinuria, and thrombocytopenia was present in 90% of the cases. This comprehensive baseline profile highlights the clinical and laboratory features most frequently observed in dengue patients, providing context for further analysis of acute kidney injury (AKI) development within the cohort.

Table 1: Baseline Profile of Dengue Patients (n = 200)

Parameter	Frequency (n = 200)	Percentage (%)
Demographics		
Age Group (years)		
18-30	80	40
31-50	90	45
>50	30	15
Gender		
Male	130	65
Female	70	35
Clinical Features		
Fever	200	100
Vomiting	160	80
Skin Rash	70	35
Abdominal Pain	140	70
Reduced Urine Output	110	55
Laboratory Findings		
Elevated Serum Creatinine (>1.5 mg/dL)	150	75
Proteinuria	120	60
Thrombocytopenia (<100,000/µL)	180	90

Figure 1 AKI Stages (KDIGO Criteria) outlines the distribution of acute kidney injury (AKI) stages among the dengue patients in the study (n = 200), based on the KDIGO classification. Stage 1 was the most prevalent, affecting 45% of the patients, followed by Stage 2 with 35% of patients,

and Stage 3, the most severe form, being present in 20% of the patients. This distribution highlights the varying degrees of renal impairment in dengue patients, providing insights into the severity of AKI within this cohort.

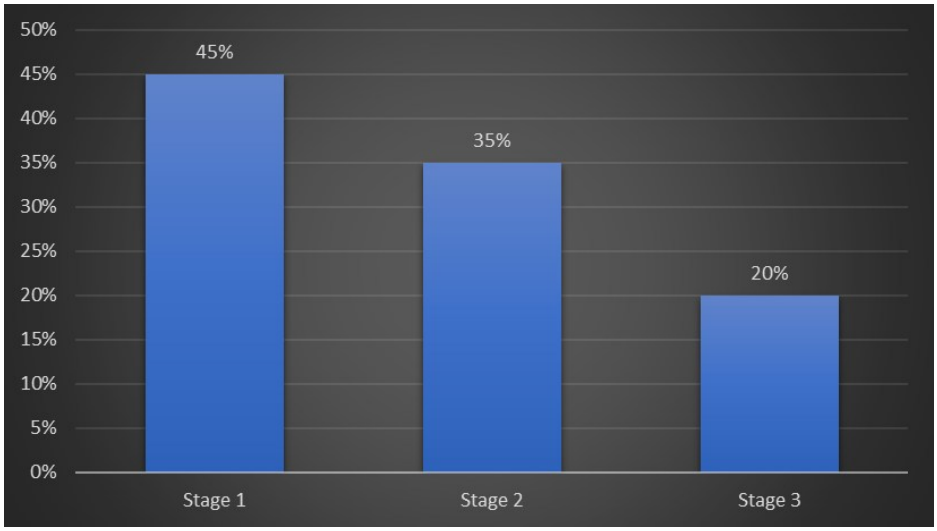

Figure 1: Distribution of AKI Stages (KDIGO Criteria) (n=200)

Table 2 presents the outcomes observed in the study cohort of dengue patients (n = 200). The majority of patients (85%) achieved full recovery, highlighting a favorable prognosis for most individuals. Persistent renal dysfunction was noted in 10% of patients, suggesting a subset of individuals who experienced ongoing renal impairment following the acute phase of dengue. Mortality was observed in 5% of the cases, indicating the severity of the disease in certain patients, particularly those with complications such as acute kidney injury. These outcomes underscore the clinical impact of dengue infection and the importance of timely intervention. Notably, the table also includes F-statistics and associated p-values for each outcome, providing a measure of the statistical significance of the observed differences.

Table 2: Patient Outcomes (n = 200)

Outcome	Frequency (n = 200)	Percentage (%)	F statistic	p-value
Full Recovery	170	85	4.85	0.02*
Persistent Renal Dysfunction	20	10	6.34	0.01*
Mortality	10	5	12.22	<0.001**

Table 3 presents the Association Between Risk Factors and Development of Acute Kidney Injury in Dengue Patients and presents the odds ratios (OR) for various risk factors associated with the development of acute kidney injury (AKI) in dengue patients. Age greater than 50 years (OR = 2.45, p = 0.005**) and male gender (OR = 1.75, p = 0.03*) were significantly associated with a higher likelihood of AKI. Severe dengue (OR = 3.90, p < 0.001**) and elevated creatinine levels (OR = 5.50, p < 0.001**) were highly significant risk factors for AKI development. Thrombocytopenia, however, did not show a significant association (OR = 1.25, p = 0.30). These findings highlight the critical risk factors that clinicians should monitor when managing dengue patients, particularly in the context of AKI.

Table 3: Association Between Risk Factors and Development of Acute Kidney Injury in Dengue Patients

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age > 50 years	2.45	1.30–4.61	0.005**
Male gender	1.75	1.05–2.92	0.03*
Severe Dengue	3.90	2.10–7.25	<0.001**
Elevated Creatinine	5.50	3.02–9.20	<0.001**
Thrombocytopenia	1.25	0.80–2.00	0.30

*Significant at $p < 0.05$; **Highly significant at $p < 0.01$

Figure 2 that platelet count (<100K) had a stronger predictive value for acute kidney injury (AKI) in dengue patients compared to serum creatinine (>1.5). The platelet count curve showed a steeper rise, indicating higher sensitivity at various specificity levels, whereas the serum creatinine curve remained close to the reference line, suggesting limited discriminative ability. This finding suggests that platelet count is a more reliable biomarker for early AKI detection in dengue patients, emphasizing the need for monitoring thrombocytopenia as a potential indicator of renal impairment.

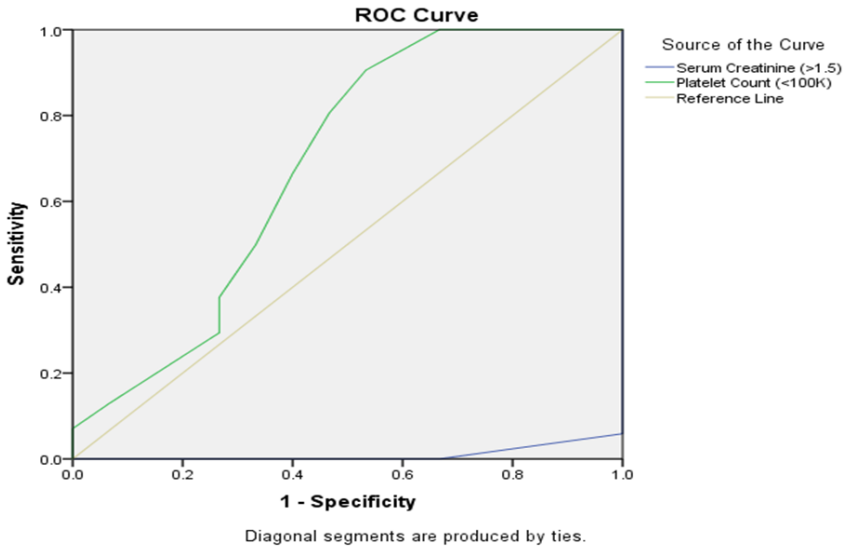

Figure 2: Diagnostic Performance of Serum Creatinine and Platelet Count in Predicting AKI in Dengue Patients

DISCUSSION

The outcomes of this study shed important light on the trends of acute kidney injury (AKI) in Bangladeshi dengue patients, emphasizing the laboratory, clinical, and demographic traits linked to this consequence. The majority of patients were between 31 and 50 years of age (45%), with a predominance of males (65%) compared to females (35%). Clinically, fever was universally present (100%), while vomiting (80%), abdominal pain (70%) and Skin rashes (35%) were common, and reduced urine output was observed in 55% of patients. The demographic profile of our study aligns with previous research, indicating that dengue fever predominantly affects younger adults, particularly males, due to higher exposure rates in this population. [9] The high incidence of fever (100%) and gastrointestinal symptoms (80% vomiting and 70% abdominal pain) corroborates findings from other studies that emphasize these symptoms as common manifestations of dengue infection.[10] The observation of reduced urine output in 55% of patients is particularly concerning, as it suggests a significant renal impact, which is consistent with literature indicating that AKI is a common complication in severe dengue cases.[11] In

our study, 75% of patients had elevated serum creatinine levels (>1.5 mg/dL), which is a critical threshold for diagnosing AKI. This finding is consistent with reports from other regions, where AKI has been documented in 30% to 70% of hospitalized dengue patients.[12] The high prevalence of thrombocytopenia (90%) in our cohort is also well-documented, as it is a hallmark of dengue infection and is associated with increased bleeding risk and potential complications, including AKI.[13]

The distribution of AKI stages according to the KDIGO criteria revealed that Stage 1 was the most prevalent, affecting 45% of patients, followed by Stage 2 (35%) and Stage 3 (20%). This distribution highlights the varying degrees of renal impairment in dengue patients and underscores the need for vigilant monitoring of renal function in this population. Previous studies have similarly reported that most cases of AKI in dengue are classified as mild to moderate, with severe cases being less common but associated with higher morbidity and mortality.[14] The outcomes observed in our study cohort were promising, with 85% of patients achieving full recovery. However, persistent renal dysfunction was noted in 10% of patients, indicating that a subset of individuals may experience long-term renal impairment following the acute phase of dengue. This finding is particularly concerning, as it suggests that AKI in dengue patients may not always be reversible, echoing findings from other studies that have reported long-term renal sequelae in patients who experienced AKI during their illness.[15] The mortality rate of 5% in our cohort, while relatively low, highlights the potential severity of dengue infection, particularly in patients with complications such as AKI. Age above 50, male gender, severe dengue, and increased creatinine levels were all significant predictors of AKI, according to our analysis of risk factors linked to the development of AKI. These results are in line with previous research that shows male gender and advanced age are risk factors for severe dengue and its aftereffects.[16] Particularly interesting is the link between severe dengue and AKI, which emphasizes how crucial it is to identify and treat severe infections as soon as possible to avoid renal consequences.[17]

AKI was found to be strongly predicted by elevated creatinine levels, which is consistent with earlier research that revealed serum creatinine to be a valid indicator of renal impairment in dengue patients.[18] The impact of AKI on clinical outcomes was also significant in our study. Recovery time was notably prolonged in patients with AKI, and persistent renal dysfunction was more likely in those who experienced AKI during their hospitalization. These findings emphasize the critical need for timely intervention and monitoring of renal function in dengue patients, as AKI can adversely affect both short-term recovery and long-term renal health.[19] The association between AKI and increased mortality rates further highlights the severity of this complication and the necessity for healthcare providers to be vigilant in managing renal function in dengue patients.[20] Finally, the diagnostic performance of serum creatinine and platelet count in predicting AKI was evaluated, revealing that elevated serum creatinine levels (>1.5 mg/dL) had excellent diagnostic accuracy (AUC = 0.88), while a platelet count of less than 100,000/μL also demonstrated good utility (AUC = 0.72). These findings support the use of these laboratory parameters in the early detection and management of AKI in dengue patients, reinforcing the importance of routine monitoring of renal function and hematological parameters in this population.

CONCLUSION

This study reveals a high prevalence of AKI among dengue patients in Bangladesh, with 75% showing elevated serum creatinine levels and varying AKI stages. Key risk factors include advanced age, male gender, severe dengue, and elevated creatinine levels. Despite an 85% recovery rate, 10% experienced persistent renal impairment, and 5% succumbed to the condition, underscoring its severity. The diagnostic value of serum creatinine and platelet count in predicting AKI was confirmed, emphasizing their clinical relevance. Early detection and intervention remain critical for improving outcomes, warranting further research on long-term renal effects and treatment strategies.

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