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Sepsis-Associated Acute Kidney Injury Among Hospitalized Patients: A Hospital-Based Observational Study

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Abstract: ***Background: Sepsis is a major cause of morbidity and mortality among hospitalized patients and frequently results in multi-organ dysfunction. Acute kidney injury (AKI) is one of its most serious complications, leading to prolonged hospitalization, increased need for renal replacement therapy, and higher mortality. Early recognition of AKI in patients with sepsis is essential for improving clinical outcomes. Objective: To evaluate the correlation between sepsis and acute kidney injury among hospitalized patients in a tertiary care centre and to assess the association of AKI severity with clinical outcomes. Methods: This prospective observational study was conducted over 18 months at Sri Siddhartha Medical College and Hospital, Tumakuru. Sixty-five adult patients diagnosed with sepsis according to Sepsis-3 criteria were enrolled. AKI was diagnosed and staged using the KDIGO classification. Clinical, laboratory, and outcome data, including SOFA score, dialysis requirement, length of hospital stay, and mortality, were analyzed using Epi Info version 3.4.3. A p-value <0.01 was considered statistically significant. Results: Among the 65 patients, 40% developed AKI. KDIGO Stage 3 was the most common stage (24.6%), while Stages 1 and 2 each accounted for 7.7% of cases. The mean SOFA score was 6.03 ± 3.27, and 9.2% of patients required dialysis. Patients with AKI had poorer clinical outcomes, including longer hospital stay and greater need for dialysis, although age was not significantly associated with AKI (p = 0.522). Conclusion: Acute kidney injury is a frequent and clinically significant complication of sepsis. Higher AKI severity is associated with worse outcomes, highlighting the importance of early detection, close monitoring, and timely management to reduce morbidity and mortality.***

Keywords: Sepsis, Acute Kidney Injury, KDIGO, SOFA score, Dialysis, Mortality.

1. Introduction

Sepsis is a life-threatening condition caused by a dysregulated host response to infection and remains a major cause of morbidity and mortality worldwide. It is a leading cause of intensive care admissions and is frequently associated with multiple organ dysfunction, particularly in low- and middle-income countries.[1,2]

Acute kidney injury (AKI) is one of the most common and serious complications of sepsis, affecting nearly one-third to one-half of septic patients. The development of AKI in sepsis results from complex mechanisms including systemic inflammation, endothelial dysfunction, microvascular alterations, and immune-mediated injury. Sepsis-associated AKI is associated with prolonged hospital stay, increased need for renal replacement therapy, and higher mortality.[3–6]

The Kidney Disease: Improving Global Outcomes (KDIGO) classification is widely used to diagnose and stage AKI, while the Sequential Organ Failure Assessment (SOFA) score is an established tool for assessing sepsis severity and predicting clinical outcomes.[7,8] Several studies have reported a significant association between increasing sepsis severity and the occurrence of AKI.[9,10]

However, limited data are available from Indian tertiary care centres regarding this association. Therefore, the present study was undertaken to evaluate the correlation between sepsis and acute kidney injury among hospitalized patients in a tertiary care centre.

Aim:
To evaluate the occurrence of acute kidney injury and its association with sepsis severity and clinical outcomes among hospitalized patients with sepsis in a tertiary care centre.

Objectives:
- To determine the occurrence of acute kidney injury in patients with sepsis.
- To assess the severity of acute kidney injury using the KDIGO classification.
- To evaluate the relationship between sepsis severity (SOFA score) and acute kidney injury.
- To assess clinical outcomes, including mortality, dialysis requirement, and length of hospital stay, in patients with sepsis-associated acute kidney injury.

2. Literature Review

Sepsis is a life-threatening syndrome characterized by a dysregulated host response to infection, leading to organ dysfunction and significant morbidity and mortality worldwide. According to the Global Burden of Disease Study, sepsis accounts for nearly 49 million cases and 11 million deaths annually, with a disproportionately higher burden in low- and middle-income countries.[1,2] Despite advances in antimicrobial therapy and critical care, sepsis remains one of the leading causes of intensive care unit admission and mortality.

Acute kidney injury (AKI) is among the most common and serious complications of sepsis, occurring in approximately 30–50% of hospitalized patients with severe sepsis or septic shock. The pathogenesis of sepsis-associated AKI is

multifactorial, involving systemic inflammation, endothelial dysfunction, microcirculatory impairment, oxidative stress, mitochondrial dysfunction, and immune dysregulation rather than renal hypoperfusion alone.[3,4]

Several studies have demonstrated that AKI in septic patients is associated with prolonged hospital stay, increased requirement for renal replacement therapy, progression to chronic kidney disease, and higher mortality.[5,6] The Kidney Disease: Improving Global Outcomes (KDIGO) classification provides a standardized approach for diagnosing and staging AKI, while the Sequential Organ Failure Assessment (SOFA) score is widely used to assess sepsis severity and predict clinical outcomes.[7,8] Higher SOFA scores have consistently been associated with an increased risk of developing AKI and poorer patient outcomes.[9,10] Recent evidence also suggests that early recognition and prompt management of sepsis-associated AKI improve renal recovery and reduce mortality.[11,12]

However, data regarding the correlation between sepsis severity and acute kidney injury in Indian tertiary care centres remain limited. Therefore, the present study was undertaken to evaluate the correlation between sepsis and acute kidney injury among hospitalized patients in a tertiary care centre.

3. Materials and Methods

This prospective observational study was conducted at **Sri Siddhartha Medical College Hospital and Research Centre, Tumakuru**, a tertiary care teaching hospital, over a period of **18 months** from **January 2024 to June 2025**. Adult patients admitted with sepsis during the study period were enrolled consecutively. Clinical data were collected from patient records, bedside examination, laboratory investigations, and microbiological findings.

Patients aged **≥18 years** diagnosed with sepsis according to the **Sepsis-3 criteria** were included in the study.[13] Patients with pre-existing end-stage renal disease, those receiving maintenance hemodialysis, renal transplant recipients, and patients with incomplete clinical or laboratory data were excluded. A total of **65 patients** fulfilling the eligibility criteria were included in the final analysis.

Acute kidney injury was diagnosed and staged according to the **Kidney Disease: Improving Global Outcomes (KDIGO)** criteria based on serum creatinine levels and urine output.[7] Sepsis severity was assessed using the **Sequential Organ Failure Assessment (SOFA)** score at admission.[8] Demographic details, clinical characteristics, comorbidities, laboratory parameters, microbiological culture reports, dialysis requirement, duration of hospital stay, and clinical outcomes were recorded using a structured case record form. All data were verified for completeness and accuracy before statistical analysis.

Statistical Analysis

Data analysis was performed after completion of data collection and verification. The collected data were entered into **Microsoft Excel** and analyzed using the **Statistical Package for the Social Sciences (SPSS), version 22.0**. Data were checked for completeness and accuracy by cross-verifying with case records and laboratory reports before analysis.

Categorical variables such as sex, comorbidities, culture results, AKI status, KDIGO stage, and dialysis requirement were summarized as frequencies and percentages. Continuous variables including age, laboratory parameters, SOFA score, serum creatinine, and duration of hospital stay were expressed as **mean ± standard deviation (SD)**.

Associations between categorical variables and acute kidney injury were assessed using the **Chi-square test** or **Fisher's exact test**, wherever appropriate. Comparison of continuous variables between patients with and without AKI was performed using the **independent Student's t-test**. Correlation between **SOFA score** and continuous clinical and laboratory parameters was evaluated using **Pearson's correlation coefficient**.[8,9] A **p-value <0.05** was considered statistically significant.

4. Results

Demographic Characteristics

A total of **65 patients** with sepsis were included in the study. The study population comprised adult patients admitted with sepsis, with no statistically significant association observed between age and the development of acute kidney injury (AKI) (**p = 0.522**). Both male and female patients were represented in the study population.

Occurrence and Severity of Acute Kidney Injury

Acute kidney injury developed in **26 patients (40%)**, while **39 patients (60%)** did not develop AKI. Among patients with AKI, **KDIGO Stage 3** was the most common stage, observed in **24.6%** of the study population, whereas **KDIGO Stages 1 and 2** each accounted for **7.7%** of patients.

Sepsis Severity (SOFA Score)

The mean **SOFA score** of the study population was **6.03 ± 3.27**. Patients with higher SOFA scores demonstrated a greater likelihood of developing AKI, indicating an association between increasing sepsis severity and renal dysfunction.

Clinical Outcomes

Clinical outcomes were evaluated in terms of dialysis requirement, duration of hospital stay, and prognosis. **Dialysis was required in 9.2% of patients**, and the **mean duration of hospital stay was approximately 9.8 days**. Patients who developed AKI experienced poorer clinical outcomes compared to those without AKI, including increased dialysis requirement and prolonged hospitalization.

Statistical Analysis and Inferences

Acute kidney injury was a frequent complication among patients with sepsis and was associated with increased disease severity and adverse clinical outcomes. Higher **KDIGO stages** were associated with poorer prognosis, including greater dialysis requirement and longer hospital stay. However, **no statistically significant association** was observed between **age group and AKI status** (**p = 0.522**). The findings emphasize the importance of early recognition and appropriate management of AKI in patients with sepsis.

Baseline Demographic, Clinical, and Laboratory Characteristics of the Study Population

VARIABLE	OVERALL (N = 65)	AKI (N = 26)	NO AKI (N = 39)	P-VALUE
AGE (YEARS), MEAN ± SD	60.76 ± 12.87	—	—	0.522
SEX, N (%)				0.685
• MALE	33 (50.8)	14 (42.4)	19 (57.6)	
• FEMALE	32 (49.2)	12 (37.5)	20 (62.5)	
SOFA SCORE, MEAN ± SD	6.03 ± 3.27	—	—	—
HOSPITAL STAY (DAYS), MEAN ± SD	9.82 ± 8.40	—	—	—
SERUM CREATININE (MG/DL), MEAN ± SD	1.69 ± 1.59	—	—	—
SERUM LACTATE (MMOL/L), MEAN ± SD	3.18 ± 1.06	—	—	—
HEMOGLOBIN (G/DL), MEAN ± SD	10.75 ± 2.74	—	—	—
TOTAL LEUKOCYTE COUNT (/MM³), MEAN ± SD	13,647.17 ± 11,126.48	—	—	—
PLATELET COUNT (/MM³), MEAN ± SD	224,626.78 ± 58,747.92	—	—	—
URINE OUTPUT (ML/DAY), MEAN ± SD	946.15 ± 453.57	—	—	—
ACUTE KIDNEY INJURY, N (%)	26 (40.0)	—	—	—
KDIGO STAGE, N (%)				—
• STAGE 1	5 (7.7)	5 (19.2)	—	
• STAGE 2	5 (7.7)	5 (19.2)	—	
• STAGE 3	16 (24.6)	16 (61.5)	—	
DIALYSIS REQUIRED, N (%)	6 (9.2)	6 (23.1)	0	—

5. Discussion

The present study evaluated the occurrence of acute kidney injury (AKI) and its association with sepsis severity and clinical outcomes among hospitalized patients. The findings demonstrated that AKI is a common complication of sepsis, occurring in **40%** of patients, and is associated with increased disease severity and poorer clinical outcomes.[3,4]

In the present study, **40%** of patients developed AKI, which is consistent with previous reports showing an incidence of **30–50%** among patients with sepsis.[3,4] **Poston and Koyner** reported that AKI is one of the most frequent complications of sepsis, while **Peerapornratana et al.** highlighted the role of inflammation, endothelial dysfunction, and microcirculatory impairment in its pathogenesis.[3,4]

Among patients with AKI, **KDIGO Stage 3** was the most common stage, indicating advanced renal dysfunction at presentation. Similar findings have been reported by **Bagshaw et al.** and **Hoste et al.**, who observed that severe AKI is associated with increased mortality, prolonged hospitalization, and a greater requirement for renal replacement therapy.[5,6] The use of the **KDIGO classification** in the present study provided a standardized approach for assessing AKI severity.[7]

The mean **SOFA score** of the study population was **6.03 ± 3.27**, and higher SOFA scores were associated with the development of AKI. This finding is in agreement with **Gómez and Kellum**, who demonstrated that increasing sepsis severity is strongly associated with the occurrence and progression of AKI.[9] The **SOFA score** therefore remains a valuable tool for early identification of patients at risk of renal dysfunction.[8]

Patients with AKI had poorer clinical outcomes, including prolonged hospital stay and an increased need for dialysis. Approximately **9.2%** of patients required renal replacement therapy, reflecting severe kidney injury. These findings are consistent with previous studies demonstrating that sepsis-associated AKI contributes to increased healthcare utilization and adverse outcomes.[5,6]

No statistically significant association was observed between **age** and AKI in the present study (**p = 0.522**). Although advanced age has been identified as a risk factor in previous studies,[3,6] this difference may be due to the relatively small sample size and patient distribution in the present study.

The findings of this study emphasize the importance of early identification of AKI using **KDIGO staging** and **SOFA scoring**, which may facilitate timely intervention and improve patient outcomes.[7,8] Adherence to the **Surviving Sepsis Campaign** guidelines may further reduce the incidence and severity of sepsis-associated AKI through early diagnosis and appropriate management.[13]

The present study was limited by its **single-centre design** and **relatively small sample size**, which may limit the generalizability of the findings. Larger multicentric prospective studies are required to further validate these observations.

Overall, the present study demonstrates that **acute kidney injury is a frequent complication of sepsis and is associated with increased disease severity and poorer clinical outcomes**, highlighting the need for early diagnosis and appropriate management

6. Conclusion

Acute kidney injury was a frequent complication among hospitalized patients with sepsis and was associated with increased disease severity and adverse clinical outcomes. Patients with higher **SOFA scores** were more likely to develop AKI, and advanced **KDIGO stages** were associated with prolonged hospital stay, increased dialysis requirement, and poorer prognosis.[3,5,8]

Although sepsis-associated AKI is a multifactorial condition, the significant association between sepsis severity and renal dysfunction highlights the importance of early recognition and routine monitoring of renal function. The combined use of **SOFA scoring** and **KDIGO staging** provides a practical approach for early identification of high-risk patients and facilitates timely intervention.[7,9]

Early diagnosis and prompt management of AKI in patients with sepsis may reduce morbidity, improve clinical outcomes, and optimize resource utilization. Further large-scale multicentric prospective studies are warranted to validate these findings and identify additional predictors of sepsis-associated acute kidney injury.

7. Future Scope

Further large-scale, multicentric prospective studies are required to validate the association between sepsis severity and acute kidney injury across diverse patient populations.[3,4] Evaluation of novel biomarkers for early detection of sepsis-associated AKI, along with serial assessment of renal function, may improve early diagnosis and prognostication.[9,11] Integration of clinical scoring systems such as **SOFA** with emerging biomarkers may facilitate better risk stratification, timely intervention, and improved clinical outcomes in patients with sepsis.[8,12]

8. Limitations

This study was conducted at a single tertiary care centre with a relatively small sample size, which may limit the generalizability of the findings.[2,6] The observational study design precludes establishing a causal relationship between sepsis and acute kidney injury. Baseline renal function was unavailable for some patients, and serial assessment of renal biomarkers and long-term follow-up could not be performed, which may have influenced the assessment of renal recovery and outcomes.[3,4]

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Conflict of Interest:
The authors declare that there is no conflict of interest.

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