

## Original Research Article

# Study of clinical profile of acute kidney injury in medical intensive care unit in a tertiary care center: a prospective study

Krishna Taparia<sup>1\*</sup>, A. A. Paritekar<sup>2</sup>, Shashi K. Verma<sup>3</sup>

<sup>1</sup>Rajarshee Chhatrapati Shahu Maharaj Government Medical College, Kolhapur, Maharashtra, India

<sup>2</sup>Department of General Medicine, Rajarshee Chhatrapati Shahu Maharaj Government Medical College and Chhatrapati Pramilatai Raje Hospital, Kolhapur, Maharashtra, India

<sup>3</sup>Department of General Medicine, Maharshi Vashishtha Autonomous State Medical College and OPEC Hospital, Basti, Uttar Pradesh, India

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### \*Correspondence:

Dr. Krishna Taparia,

E-mail: [krishnataparia5@gmail.com](mailto:krishnataparia5@gmail.com)

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## ABSTRACT

**Background:** Acute kidney injury (AKI) is a condition characterized by a sudden decline in renal function, which can lead to long-term complications including chronic kidney disease and increased mortality. In critically ill patients, particularly in intensive care units (ICU), AKI poses a significant health burden. The aim of the study was to evaluate the clinical profile of AKI in the medical ICU of a tertiary care center.

**Methods:** A prospective observational study was conducted over one year in the MICU of tertiary hospital. The study included 100 patients aged over 18 years, who developed AKI as per the acute kidney injury network (AKIN) criteria. Data on patient demographics, co-morbidities, clinical presentation, etiology, and treatment outcomes were recorded. Statistical analysis was performed using statistical package for the social sciences (SPSS) version 26.0.

**Results:** The majority of patients (62%) were aged between 18-40 years, with a male predominance (64%). Sepsis (30%), snake bites (23%) and drug induced (19%) were the leading causes of AKI. Of the patients, 54% were diagnosed with stage 3 AKI, and 31% required renal replacement therapy (RRT). The mortality rate was 26%, with significant associations found between RRT requirement, hyperkalaemia, metabolic acidosis, and increased mortality.

**Conclusion:** Sepsis especially pneumonia and snakebite were the predominant etiological factors for AKI. Comorbidities, stage of AKI, RRT, along with complications like hyperkaleamia and metabolic acidosis, are the key predictors of poor outcomes and higher mortality rate. This emphasizes the importance of early detection, effective management strategies and continuous monitoring to reduce mortality and improve patient outcomes in the ICU setting.

**Keywords:** Acute kidney injury, Sepsis, Haemodialysis, Mortality

## INTRODUCTION

Acute kidney injury (AKI), also referred to as acute renal failure, encompasses a wide clinical spectrum ranging from transient, mild dysfunction to severe impairment potentially culminating in irreversible loss of renal function.<sup>1</sup> AKI is characterized by an acute decrease in renal function that can be multifactorial in its origin and is associated with interrelated pathophysiological processes. In the acute phase, AKI contributes to prolonged

hospitalization, increased healthcare expenditures, and elevated in-hospital mortality rates.<sup>2</sup>

Timely recognition and diagnosis of AKI necessitate high clinical vigilance, particularly in settings with resource constraints. In low- and middle-income countries, early identification is often hindered by limited diagnostic infrastructure and low awareness among healthcare providers, resulting in delayed interventions and heightened risk of progression to irreversible renal damage. In such contexts, AKI commonly affects younger

individuals without pre-existing comorbidities, contrasting with high-income settings where elderly populations with chronic illnesses are predominantly affected and exhibit greater mortality rates.<sup>3,4</sup>

AKI remains a critical determinant of morbidity and mortality in intensive care units (ICUs).<sup>5</sup> In this regard, a recent study conducted in India demonstrated that nephrotoxic agents were the predominant cause of AKI in medical ward patients, whereas sepsis was the leading etiology in ICU and surgical ward cohorts.<sup>6</sup> These findings underscore the need for resilient diagnostic protocols and prompt, targeted management including renal replacement therapy when indicated, to mitigate AKI-related and all-cause mortality among critically ill patients. Thus, this study aims to evaluate the clinical profile of acute kidney injury in the medical intensive care unit of a tertiary care center, focusing on etiological factors, therapeutic interventions, and patient outcomes.

## METHODS

The study was conducted in the intensive medical care unit (MICU) of CPR Hospital, Kolhapur, a tertiary care center. The study spanned a full year observing and documenting cases of AKI in the ICU. This prospective observational study was designed to observe the real-time progression and outcomes of patients diagnosed with AKI after being admitted to the MICU.

Patients eligible for the study were those over 18 years of age who developed AKI according to the acute kidney injury network (AKIN) criteria after being admitted to the ICU. Patients with a prior diagnosis of chronic kidney disease (CKD) and those who were unwilling to provide informed consent for participation were excluded from the study.

Sample size was calculated using a formula for proportions, based on a study by Patel et al who reported that 37.14% of AKI patients presented with fever.<sup>7</sup> With a desired absolute error of 10%, the sample size was calculated to be approximately 93. Given the duration of the study and patient availability, the final sample size rounded off to 100 patients.

During the study period, 100 consecutive patients who met the inclusion criteria were enrolled. Informed consent was obtained from each patient or their legal guardian prior to enrollment. A detailed clinical profile of each patient was recorded, including medical history, risk factors, comorbid conditions, and the findings from a general physical and systemic examination. Urine output was strictly monitored as it is crucial in assessing the severity of AKI. Routine investigations such as complete blood count (CBC), renal function tests, serum electrolytes, ABG analysis, liver function tests, chest X-ray, and electrocardiography (ECG) were carried out on all patients. Additional tests were performed based on the clinical judgment of the nephrologist, and treatment was administered according to

the underlying cause of the AKI. Renal replacement therapy (RRT) was initiated where indicated.

The primary outcome of the study was the survival status of the patients, categorized into survivors and non-survivors. All patients were followed up for a period of 28 days post-discharge to assess their outcomes. This follow-up period provided ample time to observe short-term outcomes and assess the effectiveness of the treatment provided during their ICU stay.

Data management was performed using Microsoft Excel, and statistical analysis was conducted with statistical package for the social sciences (SPSS) software version 26.0 (IBM, Armonk, New York). Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were presented as means with standard deviations, while categorical variables were shown as frequencies and percentages. The independent t-test was used to compare continuous variables, and the Chi-square test was used for categorical variables. A p value of less than 0.05 was considered statistically significant.

## RESULTS

The age of the patients ranged from 18 to 75 years, with the majority of patients (62%) falling between the ages of 18-40 years. Among the study cohort, 64% were male and 36% were female (Table 1). Hypertension was the most prevalent comorbidity, followed by diabetes mellitus, both of which may have contributed to the development of AKI (Table 2).

**Table 1: Distribution of sociodemographic details of the study population.**

| Parameters         | N (%)   |
|--------------------|---------|
| <b>Age (years)</b> |         |
| 18-30              | 26 (26) |
| 30-40              | 36 (36) |
| 40-50              | 22 (22) |
| >50                | 16 (16) |
| <b>Sex</b>         |         |
| Male               | 64 (64) |
| Female             | 36 (36) |

Using the AKIN criteria, 54% of patients were diagnosed with AKI stage 3 upon admission to the intensive care unit (ICU). Sepsis was identified as the leading cause of AKI in 30% of cases, with pneumonia being the most common focus of infection. Snake bites were responsible for AKI in 23% of patients, while nephrotoxic drugs were implicated in 19% of cases (Table 3).

The mean baseline urea and creatinine on admission were  $29.37 \pm 9.15$  mg/dl and  $0.7 \pm 0.18$  mg/dl, respectively, while the mean levels at 48 hours increased significantly to  $90.92 \pm 34.13$  mg/dl for urea and  $3.49 \pm 1.26$  mg/dl for

creatinine. Severe metabolic acidosis (pH<7.1) was observed in 26% of patients, and 33% presented with hyperkalemia. A total of 31% of patients required RRT, with the majority receiving conservative treatment.

Mortality was recorded at 26%, with a significant association between the requirement for RRT, hyperkalaemia, and metabolic acidosis in non-survivors (Tables 4 and 5).

**Table 2: Distribution of study participants according to presenting clinical features, signs and co-morbidities.**

| Variables                  | N (%)   |
|----------------------------|---------|
| <b>Presenting features</b> |         |
| Dyspnoea                   | 35 (35) |
| Oliguria                   | 18 (18) |
| Leg swelling               | 14 (14) |
| Hematuria                  | 10 (10) |
| Fever                      | 9 (9)   |
| Altered sensorium          | 4 (4)   |
| Periorbital swelling       | 4 (4)   |
| Chest pain                 | 3 (3)   |
| Diarrhoea                  | 3 (3)   |
| <b>Signs</b>               |         |
| Tachypnea                  | 32 (32) |
| Hypotension                | 18 (18) |
| Ascites                    | 5 (5)   |
| Encephalopathy             | 6 (6)   |
| Edema                      | 16 (16) |
| <b>Co-morbidities</b>      |         |
| Hypertension               | 16 (16) |
| Diabetes mellitus          | 12 (12) |
| Chronic liver disease      | 8 (8)   |
| DM and HTN                 | 7 (7)   |
| HTN and IHD                | 5 (5)   |
| HIV                        | 4 (4)   |
| DM, HTN and IHD            | 3 (3)   |
| IHD                        | 1 (1)   |

**Table 1: Distribution of study participants based on staging of AKI and etiology of AKI.**

| Variables                   | N (%)     |
|-----------------------------|-----------|
| <b>Staging</b>              |           |
| AKIN 1                      | 5 (5)     |
| AKIN 2                      | 41 (41)   |
| AKIN 3                      | 54 (54)   |
| <b>Cause of AKI</b>         |           |
| <b>Sepsis</b>               | 30 (30)   |
| Pneumonia                   | 18 (60)   |
| Urosepsis                   | 6 (20)    |
| Cellulitis                  | 2 (6.7)   |
| Acute gastroenteritis       | 3 (10)    |
| Meningitis                  | 1 (3.3)   |
| <b>Snake bite</b>           | 23 (23)   |
| <b>Drug induced</b>         | 19 (19)   |
| Amphotericin B deoxycholate | 10 (52.7) |
| Remdesivir                  | 7 (36.8)  |
| Tenofovir                   | 2 (10.5)  |
| Grammaxone                  | 8 (8)     |
| Hepatorenal syndrome        | 5 (5)     |
| Cardiorenal syndrome        | 3 (3)     |

Continued.

| Variables                       | N (%) |
|---------------------------------|-------|
| Preeclampsia                    | 2 (2) |
| Glomerulonephritis              | 2 (2) |
| OP poisoning                    | 2 (2) |
| Leptospirosis                   | 2 (2) |
| Bilateral renal artery stenosis | 1 (1) |
| Dengue                          | 1 (1) |
| TTP                             | 1 (1) |
| Rhabdomyolysis                  | 1 (1) |

**Table 4: Distribution of study participants based on management and outcomes.**

| Variables           | N (%)   |
|---------------------|---------|
| <b>Management</b>   |         |
| Conservative        | 67 (67) |
| Hemodialysis        | 30 (30) |
| Peritoneal dialysis | 1 (1)   |
| Revascularization   | 1 (1)   |
| Plasmapheresis      | 1 (1)   |
| <b>Outcomes</b>     |         |
| Recovered           | 74 (74) |
| Mortality           | 26 (26) |

**Table 5: Predictor of mortality of AKI based on RRT, hyperkalemia and metabolic acidosis.**

| Mortality predictor       | Survivors (%) | Non-survivors (%) | $\chi^2$ | P value  |
|---------------------------|---------------|-------------------|----------|----------|
| <b>RRT required</b>       |               |                   |          |          |
| Yes                       | 11 (35.5)     | 20 (64.5)         | 34.641   | <0.001   |
| No                        | 63 (91.3)     | 6 (8.7)           |          |          |
| <b>Hyperkalemia</b>       |               |                   |          |          |
| Yes                       | 12 (36.4)     | 21 (63.6)         | 36.262   | <0.001 * |
| No                        | 62 (92.5)     | 5 (7.5)           |          |          |
| <b>Metabolic acidosis</b> |               |                   |          |          |
| Yes                       | 4 (15.4)      | 22 (84.6)         | 62.742   | <0.001 * |
| No                        | 70 (94.6)     | 4 (5.4)           |          |          |

\*P value statistically significant

## DISCUSSION

In India, AKI makes up 1.5% of hospital admissions, commonly caused by infections, comorbid conditions, and major surgeries. The present study emphasizes the key factors influencing AKI in a tertiary care center medical ICU. In the present study the prevalence of AKI in males is higher than females. Sex-based disparities in susceptibility to kidney injury are attributable to physiological and hormonal differences. Males exhibit heightened oxidative stress and diminished glutathione concentrations, impairing antioxidant defenses and exacerbating renal damage post-injury. In contrast, estrogen in females enhances antioxidative and anti-inflammatory mechanisms, mitigating injury severity.

Furthermore, males demonstrate an increased tendency toward progressive renal fibrosis, whereas females display relative resistance. Elevated nitric oxide production in females also contributes to vascular relaxation and preservation of renal function, collectively reducing their risk of kidney injury.<sup>8</sup> This is evident from studies conducted in intensive care settings, where males consistently show a higher incidence of AKI compared to females, reinforcing the role of sex-specific biological factors in renal vulnerability.<sup>9-11</sup>

This study elucidated a spectrum of etiological factors contributing to AKI, with sepsis emerging as the predominant cause (30%), followed by pneumonia (18%), urosepsis (6%), and drug-induced nephrotoxicity. These findings align with previous research, where septicemia was identified as the leading AKI trigger, accounting for 48% in Mathew et al and 38.6% in Eswarappa et al cases highlighting the persistent burden of infection-related AKI in critically ill populations.<sup>6,11</sup>

Snakebite accounted for 23% of AKI cases indicating a substantial regional burden. This is significantly higher than those reported by Mathew et al (0.7%) and Bhattacharya et al (1.33%).<sup>11,12</sup> This notable elevation underscores regional differences in environmental exposure and risk profiles, particularly in areas with greater prevalence of venomous snake encounters.

Notably, drug-induced nephrotoxicity accounted for a substantial proportion of cases, with amphotericin B deoxycholate (10%), remdesivir (7%), and tenofovir (2%) implicated. This trend mirrors Mathew et al observations but contrasts with Eswarappa et al findings, which suggest limited nephrotoxic impact. Such discrepancies may reflect geographic variations in prescribing patterns and therapeutic protocols.<sup>6,11</sup>

Additional contributors included hepatorenal syndrome (8.7%), cardiorenal syndrome (9.3%), and glomerulonephritis (2%), consistent with Bhattacharya et al where cirrhosis (10.7%) and cardiac-related (10.7%) AKI.<sup>12</sup> The presence of preeclampsia in two cases reinforces the need for vigilant renal monitoring during hypertensive pregnancies.

In the present cohort, leptospirosis-associated AKI was observed in 2% of cases—a markedly lower prevalence compared to the 22% reported by Mathew et al. This

divergence underscores substantial regional and epidemiological variability, potentially driven by differences in environmental exposures, healthcare infrastructure, and seasonal disease patterns.<sup>11</sup> Comparable observations were noted in the study by Basu et al which investigated AKI in the context of tropical acute febrile illnesses, further highlighting the influence of geographic and ecological determinants on AKI pathogenesis.<sup>10</sup>

The most common co-morbidities among patients with AKI were hypertension (HTN) and diabetes mellitus (DM), which were found in 16 and 12 patients, respectively. These findings align with previous studies, by Mehta et al (37%) and Mathew et al (41.82%), where HTN and DM were frequently associated with AKI.<sup>11,13</sup> The combination of DM and HTN was present in 7 patients, while hypertension and ischemic heart disease (IHD) co-existed in 5 patients. Other co-morbidities observed included chronic liver disease (8 patients) and HIV (4 patients), which are consistent with findings in studies by Prakash et al and Balushi et al.<sup>14,15</sup> In comparison, Bhattacharya et al reported a higher proportion of patients with chronic liver disease (10.67%) and chronic obstructive pulmonary disease (5.33%) as co-morbidities, indicating some regional differences in patient profiles.<sup>12</sup> The increased mortality rate observed in this study may be attributed to the presence of multiple co-morbidities, as these conditions can complicate the management of AKI and contribute to poorer outcomes.

Stage of AKI was a significant factor in determining patient outcomes. Mortality was higher in those with more severe forms of AKI (stage 3), similar to the findings of Mathew et al, Bhattacharya et al, and Lopes et al, who found that AKIN stages based on creatinine criteria could predict mortality.<sup>11,12,16</sup>

In terms of management, 67% of the patients in our study received conservative management, while 30% required hemodialysis. The proportion of patients receiving dialysis was consistent with the high mortality observed in this group. Despite a significant association between RRT requirement and mortality, no significant association was found between dialysis modality (hemodialysis or peritoneal dialysis) and outcome, aligning with previous studies suggesting that the need for dialysis itself is a strong mortality predictor.

In the present study, we observed a 26% mortality rate, with a significant proportion of patients requiring RRT, which was associated with a higher mortality rate. Specifically, 20 out of 31 patients who required RRT did not survive, and this was statistically significant ( $p < 0.001$ ). Our findings align with those of Bhadade et al and Mathew et al who also reported a higher mortality rate in patients requiring dialysis, with a rate of 50-70% and 48.5% respectively. Moreover, our findings revealed that patients with hyperkalemia had a significantly higher mortality rate, with 21 out of 33 patients (63.6%) with hyperkalemia

succumbing to the illness ( $p < 0.001$ ).<sup>11,17</sup> Additionally, metabolic acidosis was identified as another critical predictor of mortality in our study, with 22 out of 26 patients who developed metabolic acidosis (84.6%) dying, which was statistically significant ( $p < 0.001$ ). This is similar to findings by Kumar et al and Mathew et al who identified a strong association between metabolic acidosis, anuria, and mortality.<sup>11,18</sup> These results highlight the importance of early recognition and management of metabolic disturbances in patients with AKI, particularly those requiring intensive interventions such as dialysis.

### Limitations

This study is subject to few limitations. Its single-center design restricts the generalizability of findings to broader populations. The observational nature of the study precludes the establishment of causal inferences between comorbidities, interventions, and clinical outcomes. Retrospective data collection may introduce selection and information bias, potentially affecting the accuracy of clinical parameter assessment. Furthermore, the absence of long-term follow-up limits evaluation of AKI progression and the potential evolution into chronic kidney disease. Future multicenter investigations with extended follow-up durations are warranted to substantiate and expand upon these findings.

### CONCLUSION

Sepsis, pneumonia, and snakebite were the predominant etiological factors for AKI, with hypertension and diabetes mellitus being the most common co-morbidities. A significant association was observed between the need for RRT, hyperkalemia, and metabolic acidosis with increased mortality rates. Stage 3 AKI was associated with a higher risk of mortality, reinforcing the importance of early detection and appropriate management. These findings emphasize the critical role of timely interventions and the need for vigilant monitoring of metabolic disturbances in patients with AKI.

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