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Original Research Article

Clinical Profile and Outcomes of Acute Kidney Injury in a Medical Intensive Care Unit: A Prospective Observational Study

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Abstract: ***Background:*** Acute kidney injury (AKI) is a common complication in critically ill patients and is associated with high morbidity and mortality. Data describing the clinical profile and outcomes of AKI in medical intensive care units remain limited. ***Methods*** This prospective observational study was conducted in the medical intensive care unit of a tertiary care teaching hospital. Adult patients admitted with AKI were included and classified using KDIGO criteria. Clinical features, biochemical parameters, and urine output were recorded at admission, day 3, and day 7. Etiology, AKI severity, need for hemodialysis, and in-hospital outcomes were analyzed. Multivariable logistic regression was performed to identify predictors of mortality. ***Results*** A total of 127 patients were studied. The mean age was 54.2 ± 20.9 years, with a slight female predominance. Intrinsic renal causes were most common. KDIGO stage 2 was the most frequent, while 26.77% had stage 3 AKI. Overall mortality was 25.98%, and 74.02% recovered. Mortality increased significantly with advancing KDIGO stage and was highest in stage 3. All deaths occurred among patients requiring hemodialysis. Higher serum urea, creatinine, potassium levels, and reduced urine output at admission were associated with mortality. KDIGO stage 3 and low urine output on day 0 were independent predictors of death. ***Conclusion*** AKI in the medical intensive care unit is associated with substantial mortality. Disease severity and early oliguria are key determinants of outcome.

Keywords: Acute kidney injury; Intensive care unit; KDIGO staging; Mortality; Urine output.

INTRODUCTION

Acute kidney injury (AKI) is a common clinical problem in hospitalized patients. It is defined by a sudden decline in kidney function. This leads to accumulation of metabolic waste. Fluid and electrolyte imbalance is common. AKI is associated with high morbidity and mortality. The burden is greatest in critically ill patients.

Over time, the understanding of AKI has changed. It is no longer considered a fully reversible condition. Even small changes in kidney function have clinical significance. The Acute Kidney Injury Network emphasized the importance of early detection. Minor rises in serum creatinine were shown to worsen outcomes [1]. This led to greater focus on standardized definitions.

The Kidney Disease: Improving Global Outcomes (KDIGO) guidelines provided a unified definition

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and staging system for AKI. These guidelines are based on serum creatinine and urine output. KDIGO criteria are now widely used in clinical practice and research [2]. Earlier work by the Acute Dialysis Quality Initiative highlighted the need for uniform outcome measures. It also stressed the prognostic value of AKI severity staging [3].

AKI is frequently encountered in intensive care units. ICU patients are exposed to multiple renal insults. These include sepsis, hypotension, nephrotoxic drugs, and multi-organ dysfunction. Large international studies have shown a high incidence of AKI in critically ill patients. Increasing AKI severity is linked to higher mortality and longer ICU stay [5].
The consequences of AKI extend beyond the acute phase. Survivors of AKI remain at risk even after apparent recovery. A systematic review showed a strong association between AKI and future chronic kidney disease. The risk of end-stage kidney disease and long-term mortality was also higher [4]. This highlights the importance of early identification and appropriate management.

Despite its clinical impact, AKI often goes unrecognized. This is especially true in resource-limited settings. Delayed diagnosis is common. Awareness remains inadequate. Many deaths related to AKI are preventable. AKI has been described as a silent killer at the global level [6].

The International Society of Nephrology launched the "0by25" initiative to address this problem. The goal was to eliminate preventable deaths from AKI by 2025. The initiative focused on awareness, early diagnosis, and access to care [7]. These goals are particularly relevant for low- and middle-income countries.

In India, AKI is a frequent reason for ICU admission. Medical ICUs manage patients with sepsis, infections, and multi-system illness. Data describing AKI in this setting remain limited. Information on clinical profile, biochemical abnormalities, severity, and outcomes is needed.
The present study was conducted to evaluate the clinical and biochemical profile of patients with AKI admitted to a medical intensive care unit. The study also assessed disease severity and in-hospital outcomes using KDIGO criteria. Factors associated with mortality were analyzed.

Aim

To assess the clinical profile of patients admitted with acute kidney injury in the medical intensive care unit.

Primary Objective

To study the clinical and biochemical abnormalities of patients admitted with acute kidney injury in the medical intensive care unit.

Secondary Objectives

- To assess the outcome of patients with acute kidney injury in the medical intensive care unit and classify the outcome as recovery or death based on clinical profile and biochemical parameters at admission (day 0), day 3, and day 7.
- To study the correlation between clinical and biochemical abnormalities associated with acute kidney injury in the medical intensive care unit and patient outcome.

Materials and Methods

Study Design and Setting

This was a prospective observational study. The study was conducted in the medical intensive care unit of a tertiary care teaching hospital. The study period extended over the duration approved by the institutional authorities.

Study Population

All adult patients admitted to the medical intensive care unit with acute kidney injury were screened. A total of 127 patients were included in the study.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients diagnosed with acute kidney injury based on KDIGO criteria.
- Patients admitted to the medical intensive care unit during the study period.

Exclusion Criteria

- Patients with known end-stage renal disease on maintenance dialysis.
- Patients with chronic kidney disease on regular follow-up.
- Patients with a history of renal transplantation.
- Patients with incomplete clinical or laboratory data.

Definition and Staging of Acute Kidney Injury

Acute kidney injury was defined according to the KDIGO 2012 guidelines. AKI was diagnosed by an increase in serum creatinine or a reduction in urine output as per KDIGO criteria. Severity of AKI was classified into Stage 1, Stage 2, and Stage 3 based on KDIGO staging.

Data Collection

Demographic data were recorded at admission. Clinical history was obtained from patients or attendants. Comorbid conditions were documented. Relevant past history was noted.

Clinical examination findings were recorded at admission. Urine output was monitored hourly. Daily urine output was calculated.

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Laboratory investigations included serum urea, serum creatinine, serum electrolytes, and serum bicarbonate. Investigations were performed at admission (day 0), day 3, and day 7.

Etiology of acute kidney injury was classified as prerenal, renal, or postrenal based on clinical assessment, laboratory findings, and imaging studies where required.

Management Protocol

Patients were managed according to standard ICU protocols. Fluid therapy was guided by clinical assessment. Nephrotoxic drugs were avoided whenever possible.

Renal replacement therapy was initiated based on clinical indications. Indications included refractory hyperkalemia, severe metabolic acidosis, fluid overload, and uremic complications. Hemodialysis was the modality used.

Outcome Measures

The primary outcome was in-hospital outcome. The outcome was classified as recovery or death. Recovery was defined as improvement in renal function with declining serum creatinine and adequate urine output. Death was defined as in-hospital mortality during the same admission.

Statistical Analysis

Data were entered into a spreadsheet and analyzed using statistical software. Continuous variables were expressed as mean and standard deviation. Categorical variables were expressed as frequency and percentage. Comparisons between groups were performed using appropriate statistical tests. A p-value less than 0.05 was considered statistically significant.

Multivariable logistic regression analysis was performed to identify predictors of in-hospital mortality. Variables were selected based on clinical relevance. Adjusted odds ratios were calculated.

Ethical Considerations

The study was approved by the institutional ethics committee. Informed consent was obtained from patients or their legal representatives. Confidentiality of patient data was maintained throughout the study.

RESULTS

1.Baseline characteristics of patients with acute kidney injury

The study cohort comprised adult patients with acute kidney injury admitted to a medical intensive care unit, representing a broad age spectrum with a predominance of older individuals. Both sexes were well represented, with a slight female predominance. A substantial proportion of patients had pre-existing medical illnesses, particularly cardiometabolic conditions, and a notable subset had prior renal vulnerability or exposure to recognized nephrotoxic factors. These baseline demographic features, comorbid conditions, and relevant past clinical history of the study population are summarized in **Table 1**.

Table 1. Baseline demographic and clinical characteristics of patients with AKI (n = 127)

Characteristic	Value
Age (years)	
Mean ± SD	54.18 ± 20.93
Range	15–94
Age group, n (%)	
0–20 years	5 (3.94)
21–40 years	35 (27.56)
41–60 years	34 (26.77)
61–80 years	40 (31.50)
>80 years	13 (10.24)
Sex, n (%)	
Male	55 (43.31)
Female	72 (56.69)
Comorbidities, n (%)	
Hypertension	53 (41.73)
Diabetes mellitus	40 (31.50)
Heart disease	26 (20.47)
Tuberculosis	15 (11.81)
Relevant past history, n (%)	
Previous acute kidney injury	29 (22.83)
Previous hemodialysis	11 (8.66)
Previous hospitalization	61 (48.03)
NSAID use	37 (29.13)

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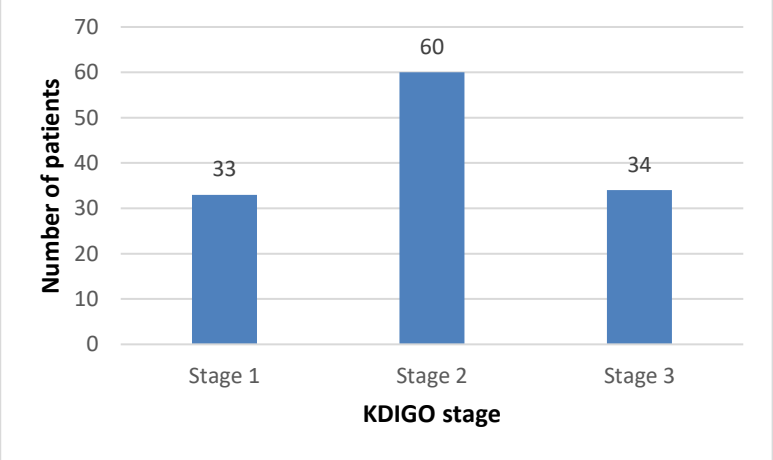
2. Etiology, severity, and management of acute kidney injury

Acute kidney injury in this cohort was predominantly attributable to intrinsic renal causes, followed by prerenal and postrenal etiologies. The severity of AKI varied across the study population, with nearly half of the patients presenting with moderate AKI, while a significant proportion had severe disease at admission. Correspondingly, a substantial subset of patients required renal replacement therapy, reflecting the overall illness severity of the cohort managed in the intensive care setting. The distribution of AKI etiology, severity as per KDIGO staging, and management approach is summarized in Table 2, while the severity distribution is illustrated in Figure 1.

Table 2. Etiology, severity (KDIGO stage), and management profile of AKI (n = 127)

Variable	n (%)
Etiology of AKI	
Prerenal	39 (30.71)
Renal (intrinsic)	70 (55.12)
Postrenal	18 (14.17)
KDIGO stage	
Stage 1	33 (25.98)
Stage 2	60 (47.24)
Stage 3	34 (26.77)
Management	
Conservative treatment	81 (63.78)
Hemodialysis required	46 (36.22)

Figure 1. Distribution of AKI severity according to KDIGO staging (n=127)



3. Clinical and biochemical profile of patients with acute kidney injury

At admission, patients with AKI demonstrated variable degrees of azotemia, electrolyte imbalance, and reduced urine output, consistent with the heterogeneous severity observed in the intensive care setting. Serial assessment revealed progressive improvement in renal function parameters and urine output over time, reflecting partial or complete recovery in a substantial proportion of patients. Trends in serum urea, creatinine, electrolyte parameters, and urine output measured at admission and during follow-up are summarized in Table 3, while changes in urine output over time are depicted in Figure 2.

Table 3. Clinical and biochemical parameters at admission and during follow-up in patients with AKI (n = 127)

Parameter (mean ± SD) SD)	Day 0	Day 3	Day 7
Serum urea (mg/dL)	38.91 ± 14.32	36.44 ± 13.87	34.12 ± 12.51
Serum creatinine (mg/dL)	2.18 ± 1.21	1.98 ± 1.13	1.79 ± 1.02
Serum potassium (mEq/L)	4.41 ± 0.89	4.32 ± 0.84	4.19 ± 0.79
Serum bicarbonate (mEq/L)	20.96 ± 1.97	21.08 ± 1.92	21.23 ± 1.88
Urine output (mL/day)	704.6 ± 212.9	732.8 ± 198.4	908.4 ± 176.6

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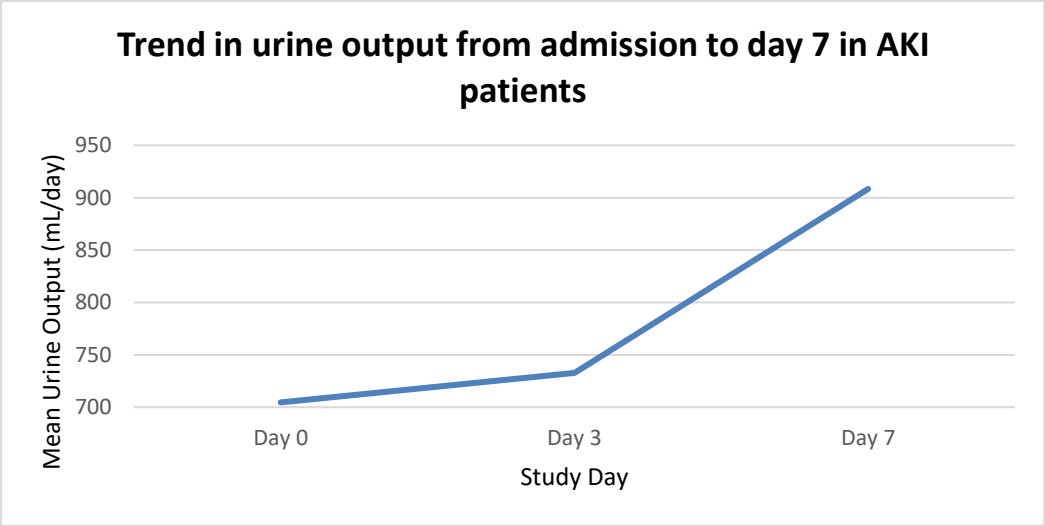
Figure 2. Trend in urine output from admission to day 7 in patients with AKI



4. Outcomes and factors associated with mortality in patients with acute kidney injury

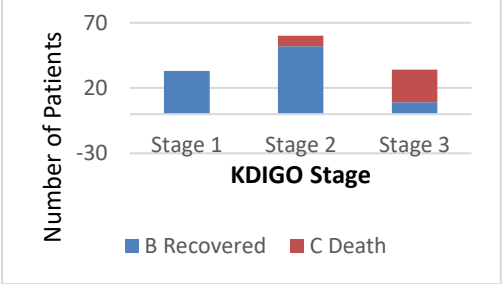
Overall, approximately three-quarters of patients experienced renal recovery, while one-quarter had an in-hospital mortality, underscoring the significant burden of AKI in the intensive care setting. Mortality was not uniformly distributed across the cohort and was strongly influenced by disease severity and treatment requirements.

Death occurred predominantly among patients with intrinsic renal etiology and those presenting with advanced AKI severity. In particular, patients with KDIGO stage 3 AKI demonstrated a markedly higher risk of mortality compared with those in lower stages. The requirement of hemodialysis was also closely associated with poor outcome, reflecting severe renal dysfunction and overall critical illness. Additionally, a history of previous kidney injury and NSAID exposure was more frequently observed among non-survivors. The relationship between clinical variables and patient outcomes is summarized in Table 4.

Table 4. Outcomes and factors associated with mortality in patients with AKI (n = 127)

Variable	Recovered n (%)	Death n (%)	p value
Overall outcome	94 (74.02)	33 (25.98)	—
Etiology of AKI			
Prerenal	32 (82.05)	7 (17.95)	0.248
Renal (intrinsic)	45 (64.29)	25 (35.71)	0.010
Postrenal	17 (94.44)	1 (5.56)	0.065
KDIGO stage			
Stage 1	33 (100)	0 (0)	<0.001
Stage 2	52 (86.67)	8 (13.33)	
Stage 3	9 (26.47)	25 (73.53)	
Management			
Conservative	81 (100)	0 (0)	<0.001
Hemodialysis	13 (28.26)	33 (71.74)	
Relevant history			
Previous AKI	1 (3.03)	28 (29.79)	0.004
NSAID use	4 (12.12)	33 (35.11)	0.023

Figure 3. Mortality according to KDIGO stage in patients with AKI



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5. Multivariable analysis of predictors of in-hospital mortality

On multivariable logistic regression analysis, AKI stage 3 emerged as the strongest independent predictor of in-hospital mortality, while higher urine output at admission was associated with improved survival (Table 5).

Table 5. Multivariable predictors of in-hospital mortality in patients with acute kidney injury

Predictor	Adjusted Odds Ratio
AKI Stage 3 (vs Stage 1)	3.04
Urine output on Day 0	1.76
AKI Stage 2 (vs Stage 1)	1.17
Prerenal etiology	1.13
Renal (intrinsic) etiology	1.01
Serum creatinine on Day 0	0.95

Adjusted odds ratios derived from penalized multivariable logistic regression analysis. Variables were selected based on clinical relevance and univariable association. Results should be interpreted cautiously given the modest sample size.

DISCUSSION

The present study analyzed 127 patients with acute kidney injury admitted to a medical intensive care unit. AKI was classified using KDIGO criteria. The study evaluated clinical profile, biochemical abnormalities, disease severity, and outcomes. The overall mortality was 25.98%, while 74.02% of patients recovered. These findings confirm that AKI in the medical ICU remains associated with significant morbidity and mortality.

The mean age of the study population was 54.2 ± 20.9 years. Nearly 58% of patients were between 41 and 80 years of age. This age distribution is comparable to Indian ICU studies where mean age ranged from 55 to 58 years [8–10]. International ICU cohorts have reported older populations, with mean ages above 60 years [11,12]. The relatively younger age in the present study may reflect differences in population demographics and referral patterns.

Female patients constituted 56.7% of the cohort. This contrasts with most international studies that report male predominance [11,12]. Several Indian studies have reported a similar sex distribution [13]. The reason remains unclear. Regional healthcare access and social factors may contribute.

Hypertension (41.73%) and diabetes mellitus (31.5%) were the most frequent comorbidities. These rates are similar to Indian studies reporting hypertension in 55–60% and diabetes in 45–50% of ICU AKI patients [13, 14]. In the present study, previous kidney injury (22.83%) and NSAID use (29.13%) showed a statistically significant association with mortality. This highlights the role of pre-existing renal vulnerability and nephrotoxic exposure as modifiable risk factors.

Clinical presentation was nonspecific. Change in urine color (78.74%), malaise (59.06%), fatigue (56.69%), and oliguria (53.54%) were common. No presenting symptom showed a significant association with outcome. Similar observations have been reported in earlier studies, where symptoms failed to predict mortality [15, 16]. This reinforces the importance of objective biochemical and urine output monitoring.

Intrinsic renal causes accounted for 55.12% of AKI cases. Prerenal and postrenal causes accounted for 30.71% and 14.17%, respectively. This etiological distribution is consistent with ICU-based Indian studies [17, 18]. Recovery was highest in postrenal AKI (94.44%). Mortality was highest in intrinsic renal AKI (35.71%, $p = 0.0102$). This reflects the reversibility of obstruction and the severity of parenchymal injury in intrinsic AKI. Similar etiological outcome patterns have been reported previously [19, 13].

Biochemical abnormalities at admission were strongly associated with outcome. Non-survivors had significantly higher serum urea, creatinine, and potassium levels on Day 0 ($p < 0.0001$). Mean urine output on Day 0 was significantly lower among patients who died. These findings are consistent with reports identifying severe azotemia, hyperkalemia, and oliguria as predictors of mortality [20,4,7]. Improvement in urine output over time was most marked in postrenal AKI, supporting its prognostic value.

KDIGO stage 2 was the most frequent stage (47.24%). Stage 3 accounted for 26.77% of cases. Mortality increased sharply with advancing stage. Recovery was 100% in Stage 1, 86.67% in Stage 2, and only 26.47% in Stage 3. Mortality in Stage 3 reached 73.53%. These findings confirm the strong prognostic relevance of KDIGO staging. Similar stage-dependent mortality has been reported in large international cohorts [12,5].

Most patients (63.78%) were managed conservatively and all survived. Hemodialysis was required in 36.22% of patients. All 33 deaths occurred in the dialysis group ($p < 0.0001$). This association reflects disease severity rather than dialysis-related harm.

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Similar conclusions have been drawn in previous studies [19,14,8]. These findings emphasize the importance of early intervention before progression to dialysis-requiring AKI.

Multivariable logistic regression identified KDIGO Stage 3 as the strongest independent predictor of mortality (OR 3.04). Reduced urine output on Day 0 was also independently associated with death (OR 1.76). Other variables showed neutral effects. These results are consistent with outcome models reported in ICU AKI literature [22, 7]. The findings reinforce the clinical value of early staging and urine output assessment.

Overall mortality in the present study (25.98%) is comparable to large international ICU studies such as Hoste et al. (24.1%) and Uchino et al. (19.6%) [5,11]. Recovery rates were slightly higher than several Indian cohorts. Early recognition and conservative management may have contributed to this outcome.

The study demonstrates that AKI in the medical ICU is strongly influenced by disease severity, biochemical derangement, and early oliguria. KDIGO staging remains a reliable prognostic tool. Early detection and timely management may improve outcomes and reduce progression to severe AKI.

Limitations

This was a single-center study conducted in a medical intensive care unit, which may limit generalizability. The sample size was modest. Long-term renal outcomes after discharge were not assessed. The findings may not be applicable to surgical or pediatric ICU populations.

Conclusion

Acute kidney injury in the medical intensive care unit was associated with significant morbidity and mortality. Intrinsic renal causes and advanced KDIGO stages were commonly observed. Mortality increased progressively with worsening AKI severity. Early oliguria and biochemical derangements at admission were strongly associated with poor outcomes. KDIGO staging and urine output assessment remain simple and reliable tools for early risk stratification. Timely recognition and appropriate management may improve recovery and reduce progression to severe AKI.

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