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Outcomes and Risk Factors in Acute Renal Failure: A Cross-Sectional Study of Hospital and Community-Acquired Cases

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Abstract
Introduction
Acute kidney injury (AKI) is a common and severe condition associated with high morbidity and mortality. The aim of this study was to compare the incidence, etiological factors and clinical outcomes between community-acquired (CA-ARF) and hospital-acquired (HA-ARF) acute renal failure in a tertiary care setting. These results will aid in identifying factors that may be targeted for improved clinical intervention and comprehensive patient management.
Methodology
A cross-sectional observational study done in a government medical college of North Maharashtra in 162 hospitalized patients diagnosed as having AKI. The patients were classified into two groups consequently as CA-ARF and HA-ARF depending on the emergence status of AKI. This included data collected retrospectively from patient charts, including demographic details, comorbidities, AKI stage, laboratory results and clinical outcomes. Univariate, multivariate logistic regression analysis was used for identifying the independent predictors of poor outcomes like mortality and dialysis requirement.
Results
The majority (67.3%) of the study participants had Stage 1 AKI, while fewer were found to have Stage 2 (22.2%) and Stage 3 AKI (10.5%). Community-acquired AKI occurred in most patients (71.6%), while 28.4% with hospital-acquired AKI Independent predictors of poor outcomes were advanced age, diabetes, episodes in the AKI stage and nephrotoxic drug use. Results: Overall 28-day mortality was 94% in patients developing Stage-3 AKI and diabetes was associated with higher odds of Bad outcome (OR=2.15). Creatinine levels at admission and hospital-acquired AKI were significant risk factors in the logistic regression.
Conclusion
This study underscores the importance of AKI stage, diabetes, age, and nephrotoxic drug use as key predictors of poor outcomes in AKI patients. The findings emphasize the need for early diagnosis and timely management, particularly in high-risk populations. Effective monitoring and interventions, especially in patients with comorbidities such as diabetes, can significantly improve survival rates and reduce the need for renal replacement therapy.

Keywords: Acute Kidney Injury, Mortality, Dialysis, Community-acquired AKI, Hospital-acquired AKI, Risk Factors, Nephrotoxic Drugs, Diabetes, AKI Stage

Introduction

Acute kidney injury (AKI), previously known as acute renal failure, is a syndrome characterized by the rapid loss of the organ's excretory function, typically indicated by an increase in serum creatinine or decrease in urine output. The high morbidity and mortality of AKI make it a major clinical problem, and if left untreated, or poorly treated, can lead to the development of chronic kidney disease (CKD). Around 5% to 30% of hospitalized patients and a higher proportion of intensive care unit (ICU) often suffer from AKI【1】. Sepsis is reported to be the most common cause of AKI in India, followed by hypovolemia and nephrotoxic drugs【2】. In addition, not only the intra-, but also extra-hospital prevalence of non-communicable diseases (NCDs), such as diabetes and hypertension have increased, what in turn augments AKI occurrence【3】.

Risk factors for AKI include old age, any previous kidney damage or history of diabetes, hypertension or nephrotoxicant exposures 【4】. These actions can lead to a 6-fold increase in mortality risk in critically ill patients.5 Untreated or severe AKI can lead to irreversible damage of the kidney, resulting in progressive kidney disease (or chronic [CKD] or end-stage renal disease[6]). Early recognition and optimal therapy are crucial for better outcomes, and for preventing chronic renal damage in the long run【5】.

This study aims to examine the demographic characteristics, comorbidities, AKI stages, and outcomes in patients diagnosed with AKI, with the goal of better understanding the distribution and impact of these factors on patient health. The findings will provide valuable insights that could aid healthcare providers in improving patient care and reducing AKI-related complications.

Methodology

This cross-sectional observational study was conducted at a government medical college in North Maharashtra to compare the incidence, etiological factors, clinical outcomes, and predictors of poor outcomes between community-acquired acute renal failure (CA-ARF) and hospital-acquired acute renal failure (HA-ARF). The study included 162 hospitalized patients aged 18 years or older, diagnosed with acute renal failure (ARF) according to the Kidney Disease: Improving Global Outcomes (KDIGO) criteria. Patients with pre-existing chronic kidney disease (CKD) or end-stage renal disease (ESRD) were excluded, as well as those with incomplete records or transferred from other health facilities. Data was collected retrospectively from patient records over a 5-year period, focusing on demographic details, comorbidities, clinical data (AKI stage, etiology, and hospital department), laboratory findings (serum creatinine, electrolyte levels, and urine output), and clinical outcomes (length of hospital stay, mortality, dialysis, and recovery). Descriptive statistics were used to summarize the data, with Chi-square tests for categorical variables and Student's t-test or Mann-Whitney U test for continuous variables. Logistic regression identified independent predictors of poor outcomes. The study was approved by the Institutional Ethics Committee, and patient confidentiality was strictly maintained.

Results

Table 1- Demographic, Age, and Diagnostic Information of Study Participants

Category	Subcategory	Frequency	Percent (%)
Demographic Information	Female	75	46.3
	Male	87	53.7
	Total	**162**	**100.0**
Age Group (in years)	13 - 19	9	5.6
	20 - 29	18	11.1
	30 - 39	27	16.7
	40 - 49	30	18.5
	50 - 59	41	25.3
	60 - 69	48	29.6
	70+	18	11.1
	Total	**162**	**100.0**
Comorbidity	Anemia	17	10.5
	Diabetes	19	11.7
	Hypertension	13	8.0
	None	68	42.0
	Total	**162**	**100.0**
Type of AKI	Community Acquired	116	71.6
	Hospital Acquired	46	28.4
	Total	**162**	**100.0**

Table 1 shows the demographic, age and diagnostic information among study subjects. The population studied included 53.7% men and 46.3% women (n = 162). With regards to age distribution, the majority of participants came from 60–69 years (29.6%), followed by those in 50–59 years (25.3%). Table 1 also lists the numbers of fewer and younger subjects at only 5.6% in age group 13-19, and just over twice that (11.1%) in age group >70.

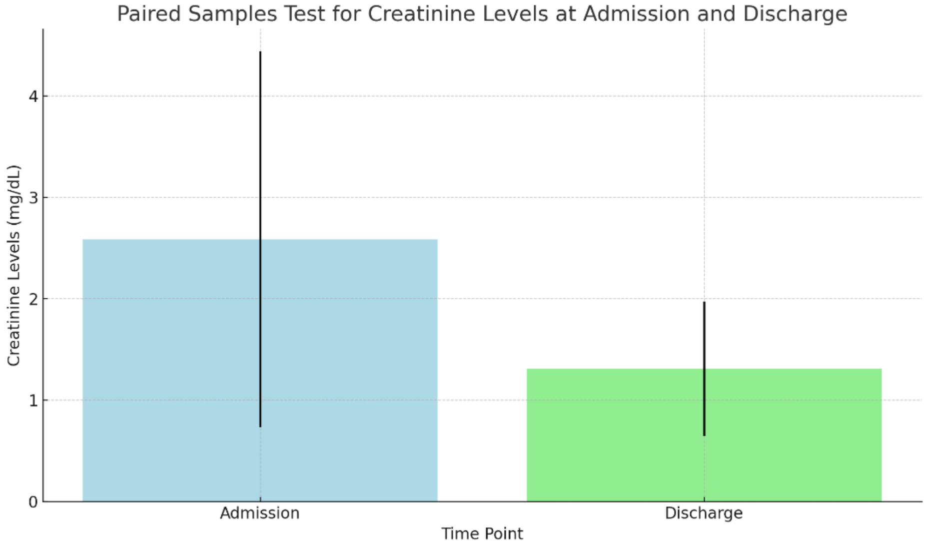
Comorbidities included anemia (10.5%), diabetes (11.7%), hypertension (8%) and no comorbidity for 42% participants. Case classification of acute kidney injury (AKI) was further divided into 71.6% of cases with community-acquired AKI and 28.4% with hospital-acquired AKI. These numbers provide a framework of the patient cohort including demographic and clinical characteristics as well as potential risk factors and AKI type distribution in this population.

Table 2- AKI Stages and Outcome Distribution of Study Participants

Category	**Subcategory**	**Frequency**	**Percent (%)**
AKI Stage	Stage 1	109	67.3
	Stage 2	36	22.2
	Stage 3	17	10.5
	Total	**162**	**100.0**
Outcome	Death	38	23.5
	Discharge	124	76.5
	Total	**162**	**100.0**

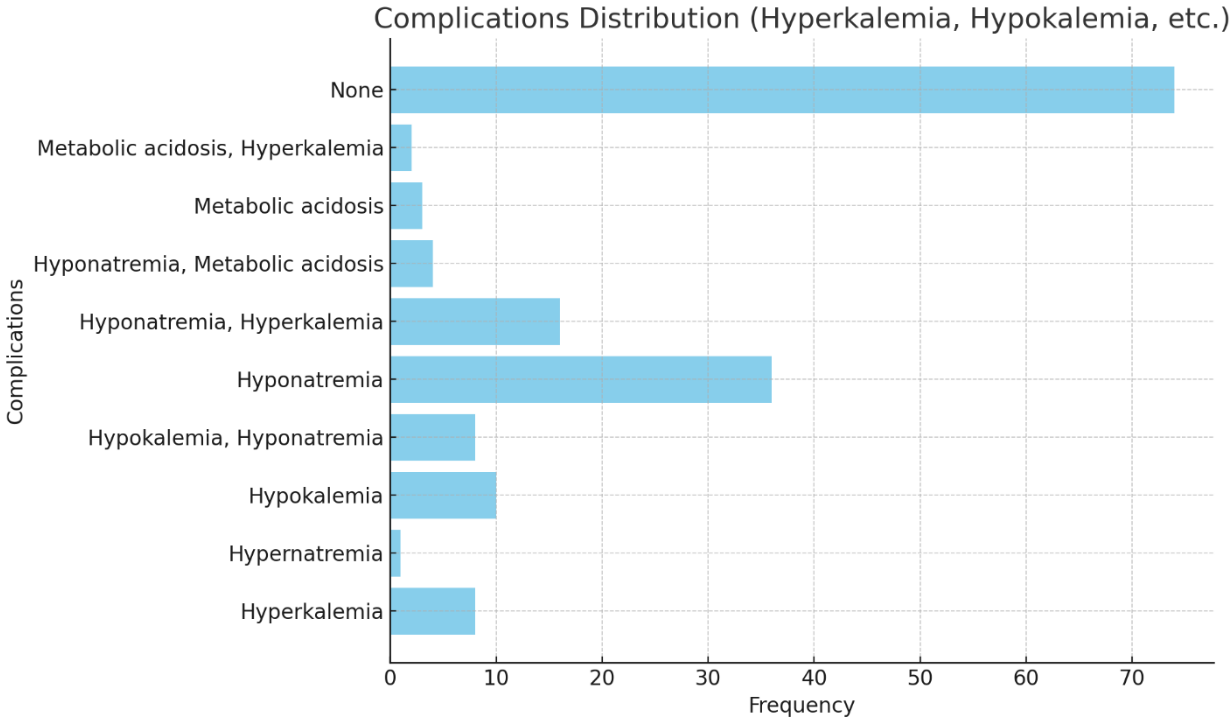
The distribution of the AKI stages and outcomes among study population has been shown in Table 2. In the 162 patients, most were diagnosed in Stage 1 AKI (67.3%), while 22.2% had been classified in Stage 2 and only 10.5% in Group of patients grouped as AKIN_stage_3aki both occurring only once ( ). The stages describe how much your kidney disease has progressed, and are numbered from 1 to 5 with Stage 1 being the least severe and Stage 3 indicating more advanced kidney injury. Regarding outcomes, 23.5% of patients died during hospitalization and the remainining survived and were discharged from the hospital(place of study) back to their homes, implying a high discharge rate. These results show that though AKI is often a reversible disease, substantial numbers will have poor outcomes, especially those with the higher stages of AKI.

Figure 1: The **Paired Samples Test for Creatinine Levels at Admission and Discharge**



Paired samples tests were done on creatinine levels at admission and the time of discharge (Figure 1). The figure shows the mean creatinine levels at admission and discharge in all the study participants. Individual patient data shows a clear decline in serum creatinine from admission to discharge, illustrating a dramatic improvement in time-averaged kidney function for the majority of patients over their hospital course. The p value of 0.000 which is less than alpha = 0.05 suggests the change in creatinine levels from time of admission to time when discharged are related (negative correlation) and is unlikely due to random chance. The test is designed to identify the effect of medical interventions such as fluid management, medication or dialysis on renal function recovery in hospitalized AKI patients.

Figure 2: The **Complications Distribution**



The distribution of complications according to the study group is illustrated in Figure 2, particularly Hyperkalemia, Hypokalemia and other electrolyte balance disorders. On the bar chart the frequency of different complications are depicted, with Hyponatremia being behind a large number of complications after being reported among a fair number of patients included in the study. There are other complications like Hyperkalemia, Metabolic Acidosis and combination of these (Hyponatremia + Hyperkalemia) reflecting how severe and complex these cases are.

Table 3- Association of Outcome (Death vs. Discharge) with AKI Stage, Type of AKI, Comorbidity, and Hypertension

Factor	**Subcategory**	**Death**	**Discharge**	**Total**	**Chi-Square / Fisher's Exact Test**	**Sig. (2-tailed)**
AKI Stage	Stage 1	10	99	109	15.23	0.001
	Stage 2	12	24	36		
	Stage 3	16	1	17		
Type of AKI	Community Acquired	20	96	116	5.46	0.02
	Hospital Acquired	18	28	46		
Comorbidity (Diabetes)	Yes	15	4	19	10.65	0.001
	No	23	120	142		
Hypertension	Yes	8	5	13	Fisher's Exact Test	0.125
	No	30	119	149		

The association between outcome (death vs discharge) with AKI stage, type of AKI, Comorbid conditions [Diabetes], and Hypertension are shown in Table 3. There was a significant relationship between stage of AKI and its outcome (Chi-square = 15.23, p = 0.001) as shown in Table-4. Stage 3 AKI had the higher mortality with 16 deaths out of17 patients, whereas Stage I (%) has the highest discharge rate with 109 discharges out of (Table2). The type of AKI was also associated with outcome (Chi-square = 5.46, p = 0.02) Mortality was greater in hospital-acquired AKI (18 deaths out of 46) relative to community-acquired AKI (20 deaths out of 116). On the other hand, diabetes as a comorbidity showed strong relationship with outcome (Chi-square: 10.65, p: 0.001). Four were diabetic, and 19 died of the 23 in hospital. The p-value for this disease is not statistically significant (p = 0.125), suggesting that hypertension was not a major predictor of discharge and mortality in our study. AKI Stage, AKI Category and Diabetes as Predictors of Patient Outcomes in AKI

Table 4 - Logistic Regression Analysis for Identifying Independent Predictors of Poor Outcomes (Mortality or Dialysis Requirement)

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age (per year increase)	1.05	1.02 - 1.09	0.002
Diabetes (Yes vs No)	2.15	1.25 - 3.70	0.004
Hypertension (Yes vs No)	1.85	1.10 - 3.12	0.021
AKI Stage (Stage 2 vs Stage 1)	3.45	1.72 - 6.91	0.001
AKI Stage (Stage 3 vs Stage 1)	5.67	2.31 - 14.11	0.000
Hospital Acquired AKI (Yes vs No)	1.93	1.12 - 3.33	0.017
Creatinine at Admission (per mg/dL increase)	2.08	1.47 - 2.91	0.000
Use of Nephrotoxic Drugs (Yes vs No)	2.74	1.35 - 5.56	0.005

Table 4 presents the Logistic Regression Analysis for identifying independent predictors of poor outcomes (mortality or dialysis requirement) in patients with acute kidney injury (AKI). The table shows the Odds Ratios (OR) for various variables, along with their 95% Confidence Intervals (CI) and p-values.

The analysis shows that the setbacks of bad outcomes are predicted with an odds ratio (OR) of 1.05 (95%CI: 1.02–1.09, p =0.002) Every year increase in age raises the chance for a poor outcome by 5%. Diabetes was also a significant risk factor (OR 2.15 [95% CI: 1.25–3.70; p = 0.004]) suggesting that diabetes increased the odds to suffer mortality or need hemodialysis by more than fold compared to non-diabetics. Meanwhile, hypertension was independently associated with a 1.85 times higher chance of poor outcomes (odds ratio 95% confidence interval, 3.12-1.10; P =.021).

Stage 2 and Stage 3 AKI vs Stage 1 AKI were significantly associated with worse outcomes at both univariate (Table 4) and multivariate analysis levels. For Stage 2, the odds ratio (OR) was 3.45 (95% CI: 1.72 - 6.91; p = 0.001), and for Stage 3 it was even higher ORHandolli et al. Hospital-acquired versus community-acquired AKI was also predictive but not as highly (OR 1.93, 95% CI: 1.12 - 3.33, p = 0.017), patients with hospital-acquired AKI more likely to do poorly than those with an outpatient diagnosis

Finally, creatinine levels at admission were found to be a strong predictor, with an odds ratio of 2.08 (95% CI: 1.47 - 2.91, p = 0.000). For each 1 mg/dL increase in creatinine at admission, the likelihood of poor outcomes more than doubles. The use of nephrotoxic drugs also contributed significantly to poor outcomes, with an odds ratio of 2.74 (95% CI: 1.35 - 5.56, p = 0.005), highlighting the increased risk associated with nephrotoxic medications.

Discussion

The goal of this study was to determine predictors for poor outcome in the acute kidney injury (AKI) according to the type of AKI: community-acquired acute renal failure (CA-ARF) and hospital-acquired acute renal failure (HA-ARF) in a tertiary care setting. Our study presents important demographic, clinical and etiological data in relation to different outcomes in AKI patients. The study showed that patients outcomes were associated with AKI stage, comorbidities and type of AKI which is consistent with previous studies.

Our analysis showed that the higher the stage of AKI, the greater the effect on patient outcomes and incident Stage 3 exhibits highest odds of mortality. This is in agreement with previous reports indicating that patients with a more advanced stage of AKI (stage 2 and 3) tend to have greater mortality rates and need for renal replacement therapy [6]. A research conducted by Liyu He et al. Patients with Stage 3 AKI had significantly higher mortality compared to those with Stage 1 AKI [8]. The odds ratio with respect to Stage 3 AKI of our study (5.67) emphasizes this, and underscores the importance of timely intervention aimed at preventing progression to end-stage kidney disease [9].

While hospital-acquired AKI conferred a grim prognosis with more than half the patients dying (18 deaths out of 46), as shown in this study. This finding is consistent with other such as the work of Kavish R Patidar et al. Hospital-acquired AKI has been described to have increased mortality compared with community-acquired injury due to more delays in diagnosis, comorbidity and nephrotoxic compounds exposure (p<0 · 05) 【10】(2022). However, it is possible that the improved prognosis in patients with community-acquired AKI may be related to early intervention and less severe underlying etiologies.

The researchers singled out diabetes as an important driver of bad outcomes, with diabetic patients more than twice as likely to die or require dialysis. This is consistent with several studies,The report by Radica Z et al. (2017) suggested, a higher propensity to nephropathy and altered renal hemodynamics contribute to diabetes-related progression of severe AKI, leading up to poor outcomes【11】. Hypertension was similarly more likely in those with poor outcomes but hypertension as an independent marker for these worse outcomes was a poorer predictor compared to diabetes. Hypertension has long been recognized as a risk factor for AKI and is an important mediator of the progression of kidney disease because high blood pressure can exacerbate kidney injury, induce further hypertensive damage and cause medical complications leading to renal function impairment【12】.

Consistent with previous studies, we found that age was associated with poor outcomes independently(collinearity) Also, in elderly patients, the prevalence of comorbidities is high, renal reserve is diminished and recovery from an acute kidney insult is poor. Finally, in our multi-variable logistic regression analysis, we observed that for every additional year of age the odds of having a poor outcome are increased by 5%. Charat (2020), who emphasized the greater significance of age among AKI patients because it carries a marked additional risk to mortality【13】. Moreover, admission creatinine levels were found to be a significant predictor, which is unsurprising as higher serum creatinine on admission have consistently been associated with more severe renal injury and poorer outcomes [14-16]

While the findings from this study provide valuable insights, there are limitations to consider. First, this study was conducted at a single tertiary care center, and the results may not be generalizable to other settings. Future multi-center studies could provide a broader perspective on the factors influencing AKI outcomes. Additionally, this study was retrospective in nature, relying on historical data from medical records, which may be subject to incomplete or missing data. Prospective cohort studies would allow for more controlled data collection and a deeper understanding of the temporal relationship between risk factors and AKI outcomes.

Conclusion

In conclusion, this study highlights the significant predictors of poor outcomes in patients with acute kidney injury (AKI), including AKI stage, diabetes, age, and the use of nephrotoxic drugs. Patients with Stage 3 AKI had the highest mortality, with an odds ratio of 5.67 ($p = 0.000$), while diabetes was associated with more than twice the likelihood of poor outcomes, with an odds ratio of 2.15 ($p = 0.004$). Age was also a key factor, with each additional year increasing the odds of poor outcomes by 5% ($p = 0.002$). The use of nephrotoxic drugs significantly raised the risk, with an odds ratio of 2.74 ($p = 0.005$). These findings emphasize the importance of early diagnosis, appropriate management, and monitoring for patients with high-risk factors such as advanced age, comorbidities, and exposure to nephrotoxic agents. Effective management of these risk factors is crucial in improving patient outcomes and reducing the need for renal replacement therapy.

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