International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Check for updates

A prospective study of acute kidney injury in intensive care setting according to Rifle definition and its mortality predictors

SHARHAN P.P *, HABIBULLA D ATTAR, MUHAMMED MUSHTAQ AHMED and SAIFUDDIN SARGIRO

Department of General Medicine, Al-Ameen Medical College and Hospital, Vijayapura, Karnataka, India.

International Journal of Science and Research Archive, 2024, 13(01), 2614–2623

Publication history: Received on 02 September 2024; revised on 14 October 2024; accepted on 16 October 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.13.1.1942

Abstract

Background: Acute Kidney Injury (AKI) in ICUs is associated with high morbidity, mortality, prolonged hospital stays, increased costs, and risk of progression to Chronic Kidney Disease (CKD). Early identification of AKI is essential.

Aims and Objectives: To determine the incidence of AKI in ICU patients using the RIFLE criteria.

- To identify etiological factors and comorbid conditions associated with AKI.
- To assess the outcomes of AKI based on the RIFLE criteria.
- To explore age, gender, serum creatinine, Fe Na, and urine spot Na as predictors of AKI mortality.

Materials and Methods: A prospective observational study was conducted at Al-Ameen Medical College and Hospital, Vijayapura, with 83 patients over two years. ICU patients were monitored for AKI development using the RIFLE criteria.

Results: Univariate logistic regression showed oliguria as a significant predictor of mortality (OR: 0.461). Among AKI survivors (n=51), the highest number (41.2%) were aged 50–59 years. In AKI deaths (n=32), most (40.6%) were over 60 years. Sepsis (39.2%) and shock (31.4%) were common in survivors, while sepsis (71.9%) dominated among deaths

Conclusion: Early identification of high-risk AKI patients is crucial. Infections and hypotension drive significant mortality risk. Oliguric patients and those on ventilation require close monitoring. Timely diagnosis and management, especially of infections and multi-organ dysfunction, are key to improving outcomes. Haemodialysis was the preferred treatment.

Keywords: Risk prediction model RIFLE criteria;Acute kidney injury (AKI); Intensive Care Unit (ICU); Chronic kidney injury (CKD);Glomerular filtration rate (GFR); Fractional excretion of sodium (FE Na)

1. Introduction

The concept of Acute Renal Failure (ARF) has evolved into the broader term Acute Kidney Injury (AKI), recognizing that even mild impairments in kidney function can lead to serious clinical outcomes. The purpose of this study is to evaluate mortality predictors in AKI within the ICU setting, as AKI is common in critically ill patients and associated with high mortality, prolonged hospital stays, and increased costs.[1,2] The hypothesis was developed based on the increasing incidence of AKI globally, especially in ICU patients, where early identification is crucial due to the lack of effective therapies beyond renal replacement therapy (RRT) in severe cases.[3,4] The study addresses the need for improved risk prediction models for AKI, as current models have limitations, and aims to contribute valuable insights into identifying

* Corresponding author: SHARHAN P.P

high-risk patients early. Understanding these mortality predictors is essential to improve patient outcomes and guide treatment decisions.[5-12]

2. Materials and method

2.1. Study Design

Prospective observational study.

2.2. Source of Data

Patients with acute kidney injury (AKI) admitted to the ICU at Al-Ameen Medical College and Hospital, Vijayapura. A total of 83 cases were included over a period of 18 months.

2.3. Inclusion Criteria

- AKI diagnosed according to RIFLE criteria.
- Patients developing AKI during the hospital stay or in the community.
- Patients with a new insult to pre-existing disease.

2.4. Exclusion Criteria

- CKD patients on maintenance dialysis.
- Patients who died within 24 hours of admission.
- Unwilling participants.
- Postoperative and post-traumatic AKI cases.

2.5. Sample Size

83 patients.

2.6. Study Period

September 2022 to March 2024.

2.7. Ethical Approval

This study was conducted following the approval of the Institutional Human Ethics Committee of Al-Ameen Medical College and Hospital. Written informed consent was obtained from all participants.

2.8. Study Procedure

Patients admitted with or developing AKI were monitored and diagnosed using RIFLE criteria (creatinine levels, urine output). AKI differentiation from chronic renal disease was done using patient history, ultrasonograms, and lab values. Etiologies and comorbidities were documented, with sepsis-related AKI being a key focus. Medical cases only.

2.9. Data Collection Methods

History and physical examination (pulse, BP, respiratory rate, etc.).

Investigations: BUN, serum creatinine, urine electrolytes, CBC, ABG, and ultrasonography.

2.10. Definitions

Serum creatinine: 0.7-1.3 mg/dL (men), 0.6-1.1 mg/dL (women).

AKI identified through creatinine/urine output (oliguric and non-oliguric).

2.11. Statistical Tests

Categorical data: Chi-square test.

Continuous variables: Mann-Whitney U test.

Significance level set at p<0.05. Multivariate logistic regression for variables with p<0.15 in univariate analysis. Odds ratio (OR) and confidence intervals (CI) were calculated.

3. Result

Table 1 Distribution of age with outcome (mortality)

Age in years	Outcome (MORTALITY)		Total	Chi-value	P-value
	IMPROVED	EXPIRED			
<30 YEARS	2 3.9%	6 18.8%	8 9.6%	17.988	0.001***
31-39 YEARS	8 15.7%	2 6.2%	10 12.0%		
40-49 YEARS	8 15.7%	9 28.1%	17 20.5%		
50-59 YEARS	21 41.2%	2 6.2%	23 27.7%		
>60 YEARS	12 23.5%	13 40.6%	25 30.1%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p=0.001*** highly statistically significant

Inference: Among the total 51(100%) improved of AKI patient, maximum 21(41.2%) were from age of 50-59 years and only 2(3.9%) were from <30 years. Among total 32(100%) expired of AKI patient, maximum 13(40.6%) were >60 years of age and only 2(6.2%) were from 31-39 years and 50-59 years of age. Results were found to be highly significant when comparing outcome with age.

Table 2 Distribution of gender with outcome (mortality)

GENDER	Outcome (MORTALITY)		Total	Chi-value	P-value
	IMPROVED	EXPIRED			
MALE	35 68.6%	17 53.1%	52 62.7%	2.019	0.15
FEMALE	16 31.4%	15 46.9%	31 37.3%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p>0.05 insignificant

Inference: Among the total 51(100%) improved of AKI patient, maximum 35(68.6%) were males and 16(31.4%) were females. Among total 32(100%) expired of AKI patient maximum 17(53.1%) were males and 15(46.9%) were females.Results were found to be insignificant when comparing outcome with gender.

Table 3 Distribution of admission for with outcome (mortality)

Admission for	Outcome (MORTALITY)		Total	Chi-value	P-value
	IMPROVED	EXPIRED			
CVD	10 19.6%	0 0.0%	10 12.0%	22.909	0.001***
SEPSIS	14 27.5%	19 59.4%	33 39.8%		
DCLD	15 29.4%	2 6.2%	17 20.5%		
RENAL	8 15.7%	5 15.6%	13 15.7%		
HYPOKALEMIA	2 3.9%	0 0.0%	2 2.4%		
CNS	2 3.9%	4 12.5%	6 7.2%		
CuSO4	0 0.0%	2 6.2%	2 2.4%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p=0.001*** highly statistically significant

Inference : Among the total 51(100%) improved of AKI patient, maximum 15(29.5%) were admitted for DCLD followed by 14(27.5%) were admitted for sepsis and 2(3.9%) were admitted for CNS. Among total 32(100%) expired of AKI patient, maximum 19(59.4%) were admitted for sepsis and 5(15.6%) were admitted for renal. Results were found to be highly significant when comparing outcome with admission.

Table 4 Distribution of urine output with outcome (mortality)

Urine output	Outcome (MORTALITY)		Total	Chi-value	p-value
	IMPROVED	EXPIRED			
Non Oliguria	32 62.7%	5 15.6%	37 44.6%	17.671	<0.001***
Oliguria	19 37.3%	27 84.4%	46 55.4%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p<0.001 highly statistically significant

Inference : Among the total 51(100%) improved of AKI patient, maximum 32(62.7%) were non oliguria and 19(37.3%) were oliguria. Among total 32(100%) expired of AKI patient, maximum 27(84.4%) were oliguria and 5(15.6%) were non oliguria.Results were found to be highly significant when comparing outcome with urine output.

Table 5 Distribution of spot NA with outcome (mortality)

SPOT Na	Outcome (MORTALITY)		Total	Chi-value	p-value
	IMPROVED	EXPIRED			
<40	18 35.3%	10 31.2%	28 33.7%	.144	.70
>40	33 64.7%	22 68.8%	55 66.3%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p>0.05 insignificant

Inference : Among the total 51(100%) improved of AKI patient, maximum 33(64.7%) were having >40 SPOT Na and 18(35.3%) were having <40 SPOT Na. Among total 32(100%) expired of AKI patient, maximum 22(68.8%) were having >40 SPOT Na and 10(31.2%) were having <40 SPOT Na.Results were found to be insignificant when comparing outcome with SPOT Na

Table 6 Distribution of FeNa with outcome (mortality)

FeNa	Outcome (MORTALITY)		Total	Chi-value	p-value
	IMPROVED	EXPIRED			
<1	10 19.6%	6 18.8%	16 19.3%	.009	.92
>1	41 80.4%	26 81.2%	67 80.7%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p>0.05 insignificant

Inference : Among the total 51(100%) improved of AKI patient, maximum 41(80.4%) were having >1 FeNa and 10(19.6%) were having <1 FeNa. Among total 32(100%) expired of AKI patient, maximum 26(81.2%) were having >1 FeNa and 6(18.8%) were having <1 SPOT Na.Results were found to be insignificant when comparing outcome with FeNa

Table 7 Distribution of etiology of AKI with outcome (mortality)

Etiology of AKI	Outcome (MORTALITY)		Total	Chi-value	p-value
	IMPROVED	EXPIRED			
SHOCK	16 31.4%	1 3.1%	17 20.5%	17.497	0.004**
INFECTION	20 39.2%	23 71.9%	43 51.8%		
HRS	7 13.7%	4 12.5%	11 13.3%		
HUS	4 7.8%	0 0.0%	4 4.8%		
GN	2	4	6		

	3.9%	12.5%	7.2%		
TOXIN	2 3.9%	0 0.0%	2 2.4%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p=0.004** highly statistically significant

Inference : Among the total 51(100%) improved of AKI patient, maximum 20(39.2%) were having infection followed by 16(31.4%) were having shock and 2(3.9%) were having GN and toxin. Among total 32(100%) expired of AKI patient, maximum 23(71.9%) were having infection and 4(12.5%) were having HRS and GN. Results were found to be highly significant when comparing outcome with etiology of AKI

Table 8 Distribution of DM with outcome (mortality)

DM	**Outcome (MORTALITY)**		**Total**	**Chi-value**	**p-value**
	IMPROVED	EXPIRED			
YES	18 35.3%	9 28.1%	27 32.5%	.460	.49
NO	33 64.7%	23 71.9%	56 67.5%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p>0.05 insignificant

Inference : Among the total 51(100%) improved of AKI patient, maximum 33(64.7%) were not diabetes 18(35.3%) were diabetes. Among total 32(100%) expired of AKI patient, maximum 23(71.9%) were not having diabetes and 9(28.1%) were diabetic. Results were found to be insignificant when comparing outcome with diabetes mellitus

Table 9 Distribution of HTN with outcome (mortality)

HTN	**Outcome (MORTALITY)**		**Total**	**Chi-value**	**p-value**
	IMPROVED	EXPIRED			
YES	22 43.1%	17 53.1%	39 47.0%	.787	.37
NO	29 56.9%	15 46.9%	44 53.0%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p>0.05 insignificant

Inference : Among the total 51(100%) improved of AKI patient, maximum 29(56.9%) were not hypertensive and 22(43.1%) were hypertensive. Among total 32(100%) expired of AKI patient, maximum 17(53.1%) were hypertensive and 15(46.9%) were not hypertensive. Results were found to be insignificant when comparing outcome with hypertension

Table 10 Distribution of urine routine with outcome (mortality)

Urine routine	Outcome (MORTALITY)		Total	Chi-value	p-value
	IMPROVED	EXPIRED			
Normal	19 37.3%	13 40.6%	32 38.6%	.094	.75
Sediment	32 62.7%	19 59.4%	51 61.4%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p>0.05 insignificant

Inference : Among the total 51(100%) improved of AKI patient, maximum 32(62.7%) were having sediment urine routine and19(37.3%) were normal. Among total 32(100%) expired of AKI patient, maximum 19(59.4%) were sediment urine routine and 13(40.6%) were normal urine routine. Results were found to be insignificant when comparing outcome with urine routine

Table 11 Distribution of RIFLE with outcome (mortality)

RIFLE	Outcome (MORTALITY)		Total	Chi-value	p-value
	IMPROVED	EXPIRED			
R	4 7.8%	0 0.0%	4 4.8%	6.342	.04*
I	8 15.7%	1 3.1%	9 10.8%		
F	39 76.5%	31 96.9%	70 84.3%		
Total	51 100.0%	32 100.0%	83 100.0%		

Test used- chi square test, p<0.05 significant

Inference : Among the total 51(100%) improved of AKI patient, maximum 39(76.5%) were having failure of kidney. Among total 32(100%) expired of AKI patient, maximum 31(96.9%) were having failure of kidney. Results were found to be significant when comparing outcome with RIFLE.

Table 12 Distribution of Dialysis with outcome (mortality)

Dialysis	Outcome (MORTALITY)		Total	Chi-value	p-value
	IMPROVED	EXPIRED			
NO	35 68.6%	9 28.1%	44 53.0%	12.949	<0.001***
YES	16 31.4%	23 71.9%	39 47.0%		
Total	51 100.0%	32 100.0%	83 100.0%		

Inference : Among the total 51(100%) improved of AKI patient, maximum 35(68.6%) were having normal. Among total 32(100%) expired of AKI patient, maximum 23(71.9%) were having heamodialysis. Results were found to be significant when comparing outcome with dialysis.

Table 13 Univariate logistic regression to predict mortality of AKI

PARAMETER	Odds ratio (EXP(B))	p-value
Oliguria	0.461	<0.001***

Inference : Univariate logistic regression analysis was performed to analyse the parameters which were significantly influencing mortality in AKI in the univariate model (with p value <0.05). Oliguria was the factors which were more likely to predict mortality in AKI with Odds ratio of .461 respectively.

Table 14 Mean of age, initial creatinine, peak creatinine and spot Na and Fe Na

PARAMETERS	OUTCOME	Mean	Std. Deviation	p-value
AGE	IMPROVED EXPIRED	51.90 48.41	11.777 16.966	.31
Initial creatinine	IMPROVED EXPIRED	2.514 2.375	1.6016 .5640	.57
Peak creatinine	IMPROVED EXPIRED	5.027 5.947	2.2117 1.2480	.055
SPOT Na	IMPROVED EXPIRED	63.65 50.88	35.306 19.367	.06
FeNa	IMPROVED EXPIRED	1.937 2.228	1.0785 2.1163	.41

Test used- mannWhintney U test, p>0.05 insignificant;Mean ±SD of age of improved outcome and expired outcome 51.90± 11.777 and 48.41±16.966. Results were found to insignificant when comparing age with outcome; Mean ±SD of initial creatinine of improved outcome and expired outcome 2.514± 1.6016 and 2.375±.5640. Results were found to insignificant when comparing age with initial creatinine; Mean ±SD of age of improved outcome and expired outcome 5.027± 2.2117 and 5.947±1.2480 Results were found to insignificant when comparing age with peak creatinine; ±SD of age of improved outcome and expired outcome 63.95± 35.306 and 50.88±19.367. Results were found to insignificant when comparing age with spot Na; Mean ±SD of age of improved outcome and expired outcome 1.937± 1.0785 and 2.228±2.1163; Results were found to insignificant when comparing age with FeNa

4. Discussion

Acute kidney injury (AKI) is prevalent in ICUs with high morbidity and mortality, emphasizing the need for accurate prediction models. Our study, conducted at Al-Ameen Medical College and Hospital, included 83 AKI patients, where outcomes were improved in 51 cases and fatal in 32. Mortality was significantly associated with older age[14], oliguria, sepsis, and advanced stages according to the RIFLE criteria. Infections were the most common etiology linked to mortality[13], aligning with previous findings. While dialysis improved outcomes[13], parameters such as gender[15], Spot Na[14], FeNa[13], and hypertension[16] did not show significant outcome correlations. Our prospective design allowed for a comprehensive risk factor assessment, highlighting the significant association of RIFLE staging[17] and sepsis with AKI mortality. Limitations include sample size and lack of long-term patient survival data[18-20]

5. Conclusion

Predicting AKI remains crucial due to its high morbidity and mortality. Our developed risk model enables early identification and intervention for high-risk ICU patients, using easily obtainable variables. Future work will focus on expanding the sample size, validating the model externally, and incorporating refined biomarkers. A multi-faceted approach including risk prediction is essential for improving AKI outcomes

Compliance with ethical standards

Acknowledgments

The authors would like to thank all the Teaching and Non-Teaching Staff and postgraduate residents of Al-Ameen Medical College & Hospital, Vijayapura for their cooperation and support throughout the study and for timely help in preparing charts and tables.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

The study was approved by the Institutional Ethical Committee.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Doi Kent. Role of kidney injury in sepsis. J Intensive Care. 2016;4(1):17.

[2] Stevens LA, Coresh J, Greene T, Levey AS. Assessing kidney function—measured and estimated glomerular filtration rate. N Engl J Med 2006;354:2473-83.

[3] Chertow GM, Burdick E, Honour M, Bonventre JV, Bates DW. Acute kidney injury, mortality, length of stay, and costs in hospitalized patients. J Am Soc Nephrol 2005;16:3365-70.

[4] Uchino S, Bellomo R, Goldsmith D, Bates S, Ronco C. An assessment of the RIFLE criteria for acute renal failure in hospitalized patients. Crit Care Med 2006;34:1913-7.

[5] Zhou J, Yang L, Zhang K, et al. Risk factors for the prognosis of acute kidney injury under the acute kidney injury network definition: a retrospective, multicenter study in critically ill patients. Nephrology. 2012;17(4):330–7.

[6] Wang Na, Jiang Li, et al. Fluid balance and mortality in critically ill patients with acute kidney injury: a multicenter prospective epidemiological study. Crit Care. 2015;19(1):371.

[7] Daley J. Independent association between acute renal failure and mortality. Am J Med. 1998;104(4):343–8.

[8] Hoste EA, Kellum JA. Acute renal failure in the critically ill: impact on morbidity and mortality. Contrib Nephrol. 2004;144:1–11.

[9] Waikar SS, Liu KD, Chertow GM. Diagnosis, Epidemiology and Outcomes of acute kidney injury. Clin J Am Soc Nephrol. 2008;3(3):844–61.

[10] Chawla LS, Amdur RL, Amodeo S, et al. The severity of acute kidney injury predicts profession to chronic kidney disease. Kidney Int. 2011;79(12):1361–9.

[11] Dasta JF, Kanegill SL, Durtschi AJ, et al. Costs and outcomes of acute kidney injury (AKI) following cardiac surgery. Nephrol Dial Transplant. 2008;23(6):1970–4.

[12] Hsu CY, McCulloch CE, Fan D, Ordoñez JD, Chertow GM, Go AS. Community-based incidence of acute renal failure. *Kidney Int*. 2007;72(2): 208-212.

[13] Teo SH, Lee KG, Koniman R, Tng AR, Liew ZH, Naing TT, Li H, Tan RY, Tan HK, Choong HL, Foo WM. A prospective study of clinical characteristics and outcomes of acute kidney injury in a tertiary care Centre. BMC nephrology. 2019 Dec;20:1-8.

[14] DAVID GOMEZ de Moraiz Urinary sodium excretion is low prior to acute kidney injury in patients in the intensive care unit Front Nephrol. 2022; 2: 929743.Published online 2022 Sep 30. doi: 10.3389/fneph.2022.929743

[15] Iqbal Sa*,ChowdhuryTAb*,AnannaMAc,RahimMAc, HaqueWMMa, Outcome of Acute Kidney Injury in Patients with Type 2 Diabetes Mellitus (BIRDEM Med J 2016; 6(2): 95-99)

[16] Teresa K. Chen; Chirag R. Parikh .Management of Presumed Acute Kidney Injury during Hypertensive Therapy Subject Area: Nephrology Am J Nephrol (2020) 51 (2): 108–115

[17] Ricci Z, Cruz D, Ronco C. The RIFLE criteria and mortality in acute kidney injury: A systematic review. Kidney Int. 2008;73:538–46.

[18] Ahlstrom A, Tallgren M, Peltonen S, Rasanen P, Pettila V. Survival and quality of life of patients requiring acute renal replacement therapy. Intensive Care Med. 2005;31:1222–8

[19] Bellomo R, Cass A, Norton R, Gallagher M, Lo S, Su S, et al. Intensity of continuous renal-replacement therapy in critically ill patients. N Engl J Med. 2009;361:1627–38.

[20] Amdur RL, Chawla LS, Amodeo S, Kimmel PL, Palant CE. Outcomes following diagnosis of acute renal failure in U.S. veterans: focus on acute tubular necrosis. Kidney Int. 2009;76:1089–97.