Original Research Paper

Volume - 13 | Issue - 02 | February - 2023 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Nephrology

A PROSPECTIVE CROSS-SECTIONAL STUDY OF AKI AMONG PATIENTS ADMITTED IN ICU IN A TERTIARY CARE HOSPITAL IN NORTH EAST INDIA.

Dr. Prodip Kr Doley	Associate Professor, Department of Nephrology Gauhati Medical College & Hospital
Dr. Benjamin S Sangma*	Senior resident, Department of Nephrology Gauhati Medical College & Hospital*Corresponding Author
Dr. Manjuri Sharma	Professor, Department of Nephrology Gauhati Medical College & Hospital
Dr. Gayatri Pegu	Assistant Professor, Department of Nephrology Gauhati Medical College & Hospital

ABSTRACT **Background:** Globally, AKI affects over 13 million people per year and results in 1.7 million deaths. KDIGO defines AKI as a subgroup of AKD and classify AKI according to the severity and cause, which impacts both the prognosis and management. The clinical outcome of AKI involves morbidity, mortality, and considerable cost. Four in five cases of AKI occurs in the developing world. Geographical, etiological, cultural, and economic reasons may underlie potential disparities in the risk for AKI between lower and higher income countries. AKI is found in 20% of patients admitted for hospitalization and is found in approximately 30–60% of patients admitted in critical care unit. Objectives: To study the incidence, associated risk factors and outcomes. **Methodology:** This was a single center cross-sectional prospective observational study done over a period of 1 year. Results: A total of 102 patients diagnosed to have AKI after fulfilling the inclusion criteria were included in the study. Mean age of the study population was 51.47 ± 16.85. Male subjects were predominant 60 (58.8%). All the study subjects had normal kidney function on admission 0.93 (range 0.39 - 1.25) with SD of 0.22. AKI staging was stage 1(30.3%), stage 2 (22.5%) and stage 3(47.06%). Among the study subjects, HTN was the most frequent co-morbidity (46, 45.1%) followed by diabetes (24, 23.5%). In our study patients with sepsis (66.6%) developed AKI followed by stroke (30.3%) and respiratory disorders (25.9%). Subjects in the study were on ACEi (36, 35.2%), ARBs (33, 32.2%), NSAIDs (6, 5.8%), amino-glycosides (5, 4.9%) and chemotherapy (2, 1.96%). The incidence of AKI in our study was 11.5%. The significant predictors for developing AKI were age (OR- 2.9, $p < 0.001$), sepsis (OR-3.01, $p< 0.04$), HTN (OR- 4.1, $p <0.001$), T2DM (OR- 4, $p < 0.03$) and SOFA score (OR-0.83, $p < 0.01$). The patients requiring mechanical ventilation were 40 (39.2%). Dialysis requiring patients were 28(27.45%). The mortality was 23.5% among the AKI patients while 59.4% had complete recovery during the ICU stay. There was a statistically significant relationship between outcome (mortality) and AKI stages ($p< 0.009$). **Conclusion-** In our cohort of patients from the northeastern part of India, majority of patient with sepsis developed AKI. Age, sepsis, HTN, DM and SOFA score were predictor for the development of AKI, but it was not found to be an independent predictor of mortality outcome except for the AKI staging. The KDIGO AKI staging and SOFA score reliably predicted outcome among survivors and non-survivor.

KEYWORDS : Acute kidney injury, ICU, KDIGO, sepsis, dialysis

Globally, AKI affects over 13 million people per year and results in 1.7 million deaths [1]. KDIGO define AKI as a subgroup of AKD and classify AKI according to the severity and cause, which impacts both the prognosis and management [2]. The clinical outcome of AKI involves morbidity, mortality, and considerable cost. Four in five cases of AKI occurs in the developing worlds. Geographical, etiological, cultural, and economic reasons may underlie potential disparities in the risk for AKI between lower and higher income countries.

AKI is found in 20% of hospitalized patients [3], and is found in approximately 30–60% of patients admitted in critical care unit [4,5]. AKI is also a frequent cause of organ dysfunction in intensive care units (ICUs) and the occurrence of even mild AKI is associated with a 50% higher risk of death [6]. AKI results in a significant burden for the society in terms of health resource use during the acute phase, and the potential long-term sequelae including the development of CKD and subsequently ESRD [7]. The International Society of Nephrology has called the nephrology community and the broader health care community to work collaboratively to develop effective programs to stem the tide of preventable deaths due to untreated AKI in developing countries. The "0 by 25" initiative has been launched with a goal that no one should die of untreated AKI by 2025 [8]. Despite the consensus in the definition of AKI, there is still a wide variation in its incidence and the associated risk factors.

In a systemic review of AKI, which was conducted to estimate the world incidence of AKI and stage its severity and associated mortality, the pooled incidence rate of AKI was 21.6% with 10% required dialysis and the highest rate was in critical care setting [9].

The rationale for conducting the study in our center is that still exists huge variations in the incidence and associated risk factors. Therefore, exploring the variation in risk will assist in understanding the contributory factors and identify the knowledge gap.

Aims and objectives:

1. To estimate the incidence of AKI
2. To study the associated risk factors
3. To study the outcome of AKI

Methodology:

1. This study commenced after approval of the protocol by the Institutional Ethics Committee.
2. Study design- Cross-sectional, prospective observational study.
3. Study population- All patients admitted in ICU and meeting the published criteria for AKI were enrolled in the study.
4. Study duration- 1 year.
5. Inclusion criteria- Patients above 18 years of age, not presenting with AKI at admission to the ICU and developed AKI during ICU stay period.
6. Exclusion criteria- Subject with prior CKD or ESRD, history of renal transplantation or organ donor and subject readmitted to the ICU.
7. Working definition- The clinical practice guidelines for AKI set by Kidney Disease Improving Global Outcomes (KDIGO) was used to define and stage the severity of AKI.
8. Data was recorded in MS Excel and data analysis was done by SPSS.

Statistical analysis

Descriptive statistical analyses was used to summarize the result (mean standard deviation [SD]). Analysis of association (Chi squared test $\chi 2$) and multivariate logistic regression was done to analyze data using statistical package for social science software (SPSS version 23). The odds ratio (OR) and 95% confidence interval (CI) was executed to assess the independent risk factors for the development of AKI and logistic regression done to assess for mortality risk. P value<0.05 was considered statistically significant.

RESULTS-

A total of 102 patients diagnosed to have AKI after fulfilling the

inclusion criteria were included in the study. Mean age of the study population was 51.47±16.85. Male subjects were predominant 60 (58.8%). All the study subjects had normal kidney function on admission 0.93 (range 0.39 - 1.25) with SD of 0.22. AKI staging was stage 1 (30.3%), stage 2 (22.5%) and stage 3 (47.06%). The demographic details are presented in table below.

Table 1- Baseline characteristics and the co-morbidities of the patient admitted

Parameters	AKI post admission	%
Gender		
Female	42	41.18%
Male	60	58.8%
Age (in years)		
18-28	15	14.7%
29-39	8	7.8%
40-49	10	9.8%
50-60	49	48%
>60	20	19.6%
Co-morbidities		
HTN	46	45.1%
T2DM	24	23.5%
CVD	10	9.8%
CLD	7	6.8%
Neurological	31	30.3%
Post surgical	12	11.7%
Post partum sepsis	10	9.8%
Post LSCS	7	6.8%
	Mean/Range	SD
Creatinine on admission	0.93 (0.39 - 1.25)	0.22
Creatinine at diagnosis	3.4 (1.6 -7)	1.31
Creatinine at discharge	1.2 (0.7 -2)	0.29
SOFA score (admission)	7.37(4 - 13)	3.03

AKI - acute kidney injury HTN- hypertension, T2DM- diabetes mellitus, CVD- cardiovascular disease, CLD- chronic liver disease, LSCS- lower segment caesarean, SD- standard deviation, %- percent

Among the study subjects, HTN was the most frequent co-morbidity (n=46, 45.1%) followed by diabetes (n = 24, 23.5%). Subjects in the study were on ACEi (n = 36, 35.2%),

ARBs (n = 33, 32.2%), NSAIDs (n=6, 5.8%), Amino-glycosides (n=5, 4.9%) and chemotherapy (n=2, 1.96%). Some medications mentioned above were added during course of hospitalization. The indications for ICU admission or transfer were sepsis and septic shock (n=68, 66.6%), community acquired pneumonia (n=26, 25.9%), stroke (n=31, 30.3%), decompensated CLD (n=7, 6.8%), acute pancreatitis (n=4, 3.9%) , scrub typhus (n=5, 4.9%), malaria (n=3, 2.9%), dengue (n=2, 1.9%), leptospirosis (n=2, 1.9%).

The incidence of AKI in our study was 11.5%. The risk factors for AKI were age, sepsis, HTN, diabetes and medications. The significant predictors for developing AKI were age (OR - 2.9, $p < 0.001$), sepsis (OR - 3.01, $p < 0.04$) HTN (OR - 4.1, $p < 0.001$), T2DM (OR - 4, $p < 0.03$) and SOFA score (OR - 0.83, $p < 0.01$).

Table 2- Indications for ICU admission

Reason for admission	Developed AKI	Total N %
Sepsis and septic shock	68	66.6%
Hypovolemic shock	29	28.4%
CVS complication	10	9.8%
Respiratory disorder	26	25.9%
Stroke	31	30.3%
CLD	7	6.8%
Pancreatitis	4	3.9%
Infection		
-Scrub typhus	5	4.9%
- Malaria	3	2.9%
- Dengue	2	1.9%
- Leptospirosis	2	1.9%
Others		
- Snake bite	2	1.96%
- Herbicidal poisoning	2	1.96%

AKI-acute kidney injury N- number %-percent CVS- cardiovascular CLD- Chronic liver disease

AKI- Acute kidney injury ICU- intensive care unit %- percent n-number NSAID-non steroidal anti-inflammatory drug ACEi-Angiotensinogen converting enzyme inhibitor ARBs- Angiotensin receptor blockers

The patients requiring mechanical ventilation were 40 (39.2%). Dialysis requiring patients were 28(27.45%). The mortality was 28(27.4%) among the AKI patients while 74 (72.5%) patients recovered during the ICU stay. There was a statistically significant relationship between outcome (mortality) and AKI stages ($p < 0.009$).

Table 4- Survivor vs non-survivors

Variables	Non- survivor (n=28)	Survivor (n=74)	P - value
Age	55.04 ± 13.6	50.07 ±17.94	0.19
Gender (M:F)	19:9	40:33	0.23
HTN vs non HTN	29:44	16:12	0.11
DM vs non DM	10:18	17:56	0.20
LOS in ICU	24.57 ± 10.43	21.81 ±6.32	0.19
Number of HD	1.64 ± 1.95	1.01 ±1.93	0.06
AKI staging (1,2,3)	4:20:4	27:28:19	0.009
SOFA score	11.89 ± 0.69	5.63 ± 1.23	<0.001

N-number HTN- Hypertension M- male F- female DM- diabetes mellitus LOS- length of stay ICU- Intensive care unit HD-hemodialysis AKI- Acute kidney injury

Table 5- Multivariate analysis for risk factors (OR 95% CI) and predictors for the development of AKI in subjects admitted in ICU.

Variable parameters	Odd's ratio	95% CI	P value
Gender	3.03	1.23- 7.44	0.16
Age	2.9	34.7 -46.3	<0.001
Sepsis	3.01	1.02 - 8.92	0.04
HTN	4.1	5.3-32.3	<0.001
Hypovolemia	0.86	0.09-8.67	0.90
T2DM	4	1.1-14.5	0.03
CVD	0.56	0.11-2.75	0.47
MV	0.64	0.26-1.61	0.34
SOFA score	0.83	0.72-0.96	0.01

Drugs	AKI post admission (n)	%
NSAID	6	5.8%
Aminoglycoside	5	4.9%
Chemotherapy	2	1.96%
ACEi	36	35.2%
ARBs	33	32.3%

OR- Odds ratio CI- confidence interval HTN- hypertension T2DM-Type 2 diabetes mellitus CVD- cardiovascular disease MV-mechanical ventilation

Table 6- Predictors Of Mortality By Multivariate Logistic Regression Analysis.

Independent variable	Beta coefficient	P Value
Age	0.02	Not significant
CVD	0.84	Not significant
Hepatic	0.09	Not significant
GIT	0.04	Not significant
CNS	0.58	Not significant
KDIGO AKI staging	1.22	0.05
SOFA score	14.38	Not significant

CVD- Cardiovascular disease GIT- Gastrointestinal tract CNS-Central nervous system KDIGO- Kidney disease improving global outcome AKI- acute kidney injury

Table 7- AKI staging and outcome

AKI staging	Number of patients	RRT required	Mortality
Stage 1	31 (30.3%)	0	0%
Stage 2	23 (22.5%)	8.82%	3.92%
Stage 3	48 (47.06%)	16.6%	19.61%

AKI- Acute kidney injury RRT- Renal replacement therapy

DISCUSSION: -

Various epidemiological studies have shown that the spectrum of acute kidney injury varies from place to place and the morbidity and mortality depends upon the underlying aetiology causing AKI.

In the current study, the incidence of AKI was 11.5% which is comparable to the study done by Cruz et al [10] 10.8%. A study done by Rashid et al [11] also found an incidence of 11.5%. Lakhal et al [12] found an incidence of 14% in their study. This variation could be due to different inclusion criteria used for the study.

There was male preponderance in our study 58.8%. Study by Priyamvada PS et al [13] also found that majority of the patients were male (73.3%). The mean age ± SD was 51.47 ± 16.85. Most of the Indian studies had reported mean age of patients varying between 40 to 60 years. [14]

It is reported that sepsis accounts for 31 to 86% of AKI in Indian ICU's [15]. The present study also found that the 66.6% of the AKI patients were in sepsis. ICU referral patterns and admission policies could also contribute to this variation, which could be due to regional differences in epidemiology and inclusion of single discipline versus multidiscipline units. A significant proportion of patients with sepsis in this study had an identifiable infection focus. Tropical environments with high humidity and poor living conditions might predispose to infection. Other preventable etiologies included poisonings, snake envenomation, trauma, and tropical infections such as dengue and leptospirosis. 30.3% stage 1 AKI, 22.5% Stage 2 AKI and 47.06% in stage 3 AKI, which imply that there was in-hospital delay in recognition and referral especially to the nephrology department.

24.7% needed dialysis while 74% were managed conservatively. The dialytic modality provided was either intermittent hemodialysis or SLED. Similar dialysis needs have been reported in a few Indian studies. Korula et al found that 39.1% need RRT [15]. Similarly, Avasthi G et al found that 40% needed RRT [16]. The requirement of RRT was significantly affected by increasing age and HTN in our study.

Mortality rates as high as 90% and as low as 7.8% have also been reported from different parts of India. In our study the mortality was 23.5% while study by Korula et al found that morality was 49% [15]. Cruz et al. reported a mortality rate of 36.3% in a multicentric study [10]. There has been no significant change in the mortality rates of patients with AKI in the last decade. While the facilities and care have improved over these years, there is still an increase in the mortality rate due to more critically ill patients being admitted to ICUs and the comorbidities associated with them. Older age, requirement of vasopressors, and requirement of MV and RRT increased the risk of mortality.

In our study, patient in AKI stage 3 (47.06%) had the highest mortality 19.61%. The observed mortality in AKI stage 3 was 23.7% in a study by Wang W.E et al [17]. The reason might be due to delayed admission to the hospital and poor triage ultimately progressing to advanced AKI.

There was 59.4% complete recovery in all our patients however 14.85% were discharged or transferred back to the parent unit when the creatinine was declining. Age, sepsis, the presence of HTN, DM and the SOFA score were significantly associated with the risk for the development of AKI in the multivariate analysis. In the logistic regression analysis, only AKI staging was found to have significant relation to mortality. However, age of the patient, presence of co-morbid conditions and SOFA score did not influence the mortality in our study.

Limitations of the study:

This was a single-center, prospective study of only 12 months duration. After the shifting of patients back to the primary wards the follow-up could not done to know further status of the kidney function and the need for further RRT and the patients included in the study never reviewed back in our nephrology OPD. Only few post-operative AKI have been included in the study since the study was done in medical ICU which consisted of predominantly medical cases. A larger multicenter study can provide a more information on the incidence, risk factors and outcome of AKI.

CONCLUSION:

In our cohort of patients from the northeastern part of India, majority of patient with sepsis developed AKI. Age of the patient, underlying sepsis, HTN, DM and SOFA score were predictor for the development of AKI, but it was not found to be an independent predictor of mortality outcome except for the AKI staging. The KDIGO AKI staging and SOFA score reliably predicted outcome among survivors and non-survivors. These observation highlights the need to improve the detection of AKI to reduce the incidence and improve the outcome.

REFERENCES:

1. Lamer NH, Bagga A, Cruz D, De Maesenner J, Endre Z, Kellum JA et al. Acute kidney injury: An increasing global concern. Lancet 2013; 382:170-9
2. Kellum JA, Lamer N, Aspelin, Barsoum RS, Burdmann EA, Goldtsein SL et al. Kidney disease improving global outcomes (KDIGO) acute kidney injury workgroup. KDIGO clinical practice guideline for acute kidney injury. Kidney Int. Supply. 2012;2(1):1-138
3. Wonnacott A, Meran S, Amphlett B, Talabani B, Philips A. Epidemiology and outcomes in community acquired vrs hospital acquired AKI. Clin J Am Soc. Nephrol 2014; 9:1007-14
4. Santos PR, Montero DLS. Acute kidney injury in intensive care unit of a general hospital with emergency room specialising in trauma: an observational prospective study. BMC Nephrol. 2015; 16:1
5. Kane Gill SL, Sileanu FE, Murugan R, Trietly GS, Handler SM, Kellum JA. Risk factor for acute kidney injury in older patients with critical illness: A retrospective cohort study. Am J Kidney Dis. 2015;65(6):860-9
6. Linder A, Fjell C, Levin A, Walley KR, Russel JA, Boyh JH. Small acute increases in serum creatinine are associated with decreased long-term survival in critically ill. Am J Respir Critic Care Med. 2014; 189:1075-81
7. Chawla LS, Eggers PW, Star RA, Kimmel PL. Acute kidney injury and chronic kidney disease as interconnected syndromes. N Engl J Med 2014; 371:58-66.
8. Mehta RL, Cerdia J, Burdmann EA, Tonelli M, Garcia G, Jha V et al. Inetrnational society of Nephrology's 0 by 25 initiative for acute kidney injury. Lancet 2015;385(9987):2616-43
9. Susantiphong P, Cruz DN, Cerda J, Abulfaraj M, Alqathani F, Koulouridis I et al. Acute kidney injury advisory group of the American Society of Nephrology. World incidence of AKI: A met analysis
10. Cruz DN, Bolgan I, Perazella MA, Bonello M, de Cal M, Corradi V, et al. North east Italian prospective hospital renal outcome survey on acute kidney injury (NEiPHROS-AKI): Targeting the problem with the RIFLE criteria. Clin J Am Soc Nephrol. 2007; 2:418–25.
11. Dr A. H. Rashid, M.B., B.S., B.Sc., F.J.F.I.C.M., J. L. Brieva, F.J.F.I.C.M., Incidence of Contrast-induced Nephropathy in Intensive Care Patients Undergoing Computerised Tomography and Prevalence of Risk FactorsVolume 37, Issue 6 https://doi.org/10.1177/0310057X0903700613
12. Lakhal K , Ehrmann S, Chaari A, Laissy J, Régnier B et al: Acute Kidney Injury Network definition of contrast-induced nephropathy in the critically ill: Incidence and outcome
13. Priyamvada P, Jayasurya R, Shankar V, Parameswaran S et al:Epidemiology and Outcomes of Acute Kidney Injury in Critically Ill: Experience from a Tertiary Care Center Indian JNephrol. 2018 Nov-Dec; 28(6): 413–420.
14. Gurjar M, Baronia AK, Azim A, Prasad N, Jain S, Singh RK, et al. Septic acute kidney injury in critically ill Indian patients. Indian J Crit Care Med. 2013; 17:49–52.
15. Korula S, Balakrishnan S, Sundar S, Paul V, Balagopal A. Acute kidney injury-incidence, prognostic factors, and outcome of patients in an Intensive Care Unit in a tertiary center: A prospective observational study. Indian J Crit Care Med. 2016; 20:332–6.
16. TB Singh, Rathore SS, Choudhary TA, Shukla VK, Singh DK, Prakash J. Hospital acquired acute kidney injury in medical, surgical and intensive care unit: A comparative study. Indian J Nephrol. 2013 Jan-Feb;23(1):24-29
17. Wang W.E, Muntner P, Cheroot G.M, Warnock D.G : Acute kidney injury and mortality in hospitalised patients. Am J Nephrol 2012; 35:349-355.