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Original Research Article

Clinical Profile and Factors Influencing the Outcome of Acute Kidney Injury Cases Admitted in A Tertiary Care Centre of New Delhi, India: A Cross-Sectional Study

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Abstract

Introduction: Risk factors and causes of acute kidney injury have been determined largely as a result of western studies conducted on the subject with limited data from India. There is a need to study the clinical profile of patients with acute kidney injury, identify the main causes and potential areas of intervention.

Methods: It is a hospital based descriptive cross-sectional study carried out among patients with acute kidney injury admitted in ward and intensive care unit carried out in a tertiary care hospital of New Delhi. Adult patients (18 years and above) admitted in the institute who were diagnosed to have Acute Kidney Injury [according to RIFLE (Risk, Injury, and Failure; and Loss and End-stage kidney disease) criteria] for the first time, with no previous history of Acute Kidney Injury.

Results: Sixty (61.2%) were males and thirty-eight (38.8%) were females. Maximum patients were in the age group 41-60 years. The mean age of study group was 55 (±16) years. A total of 39 (39.8%) patients required renal replacement therapy. Patients were classified based on RIFLE criteria and it was observed that 64 patients (65.3%) were classified into risk group, 25 patients (25.5%) into injury category and 9 patients (9.2%) were grouped into failure category. After 3 months of follow up, 59 patients (60.2%) had complete recovery, 10 patients (10.2%) had partial recovery and 29 patients (29.6%) had fatal outcome.

Conclusion: RIFLE criteria, electrolyte imbalance, kidney size can be used as useful prognostic indicators in predicting outcome of acute kidney injury and the necessary line of management for early correction.

Keywords: Acute Kidney Injury, RIFLE Criteria, BUN to Creatinine Ratio, Kidney Size, Renal Replacement Therapy.

Introduction

Acute kidney injury refers to a clinical entity characterized by a rapid decrease in renal excretory function with increase in levels of urea and creatinine and/or decreased urine output. Other abnormalities include accumulation of metabolic acids, increased potassium and phosphate concentrations. It was observed that a continuum of kidney injury exists long before the loss of kidney function can

be measured with standard laboratory tests. This led to a definition of acute kidney injury (then known as Acute Renal Failure) by the Acute Dialysis Quality Initiative[1]. They also proposed a classification system for AKI known as the RIFLE criteria. These RIFLE (risk, injury, failure, loss, end stage) criteria have also been supported by the Acute Kidney Injury Network and been validated by multiple studies [2].

Acute Kidney Injury has been an important topic of study for the past few years. The various risk factors and causes have been determined largely as a result of western studies conducted on the subject. The data from India however is limited. Hence there is a need to study the clinical profile patients in our setup to identify the main causes and potential areas of intervention. In view of this, the following study was undertaken with the main objective of determining the common causes of AKI and the prognostic indicators determining the outcome.

Methods

The present study was conducted in a tertiary care hospital of New Delhi January 2021 to June 2022. It is a hospital based descriptive cross-sectional study carried out among patients with acute kidney injury admitted in ward and intensive care unit. Ethical clearance has been obtained from the institutional ethics committee. The sample size was calculated based on formula for cross-sectional studies, wherein the prevalence of AKI was taken into consideration. In a study conducted by Henry Wang et al the occurrence of AKI in hospitalised patients was observed to be 22.7%. At 95% confidence level and 10% absolute error, the minimum sample size was calculated to be 66, we enrolled a total of 98 cases in the study [3]. Adult patients (18 years and above) admitted in the institute who were diagnosed to have Acute Kidney Injury (according to RIFLE criteria) for the first time, with no previous history of Acute Kidney Injury and having given informed written consent were considered for the study. Patients with a known past history of having been diagnosed as Acute Kidney Injury irrespective of their treatment history, age below 18 years and not willing to participate in the study were excluded.

Patients were selected if their serum creatinine level on the day of admission was more than 1.5 times of the baseline serum creatinine or the urine output was less than 0.5 ml/kg/hr for 6 hrs or the GFR was less than 25 % from the baseline. The GFR was estimated by using the Cockcroft-Gault formula and the patients were then classified into different categories according to the RIFLE criteria.

All the patients were asked about history of volume depletion (diarrhea, vomiting, blood loss, etc), exposure to nephrotoxic drugs, recent trauma/ major surgery, cardiovascular/renal/chronic liver disease prior to admission. Then they underwent necessary hematological, biochemical and radiological investigations. Serum creatinine was measured by kinetic Jaffe's method using semi-automated analyzer. Ultrasonography of the kidneys, ureter and bladder was done in all patients. Size of kidneys, echogenicity, corticomedullary differentiation and obstruction were recorded. The patients were followed up after 3 months to assess renal function and progression to ESRD as per the RIFLE criteria.

Statistical Analysis: The data collected was recorded and entered in the MS Excel master sheet. Data was tabulated and analyzed using software Statistical Package for Social Sciences (SPSS) version 22. Categorical data are presented as numbers and percentages (%) and analysed using Pearson's chi-square test and Fisher exact tests. Quantitative variables are presented using mean and standard deviation. ROC curve was used to identify the sensitivity and specificity of

predictor variable. A p value of <0.05 will be considered as statistically significant.

Results

Total number of patients included in the study was 98. Figure 1 shows the gender distribution the study. The mean age of study group was 55 (±16) years and figure 2 shows the distribution of patient among different age groups. Type 2 Diabetes Mellitus (18.4%) was the most common co-morbidity followed by Hypertension (17.3%). Stroke, chronic liver disease and malignancy were the other common co morbidities. Thirty four (36%) patients had chronic kidney disease. Various causes of Acute Kidney Injury can be observed in table 1.

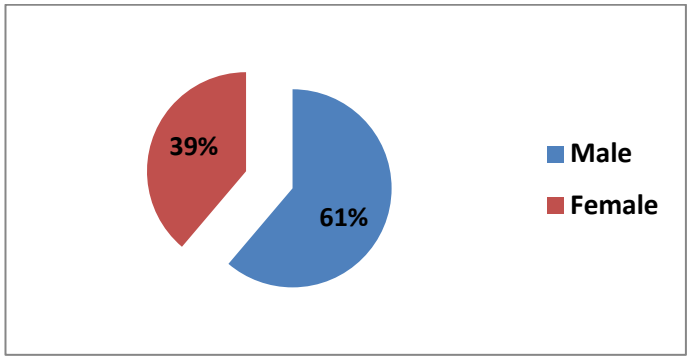

Figure 1: Gender Distribution of the study

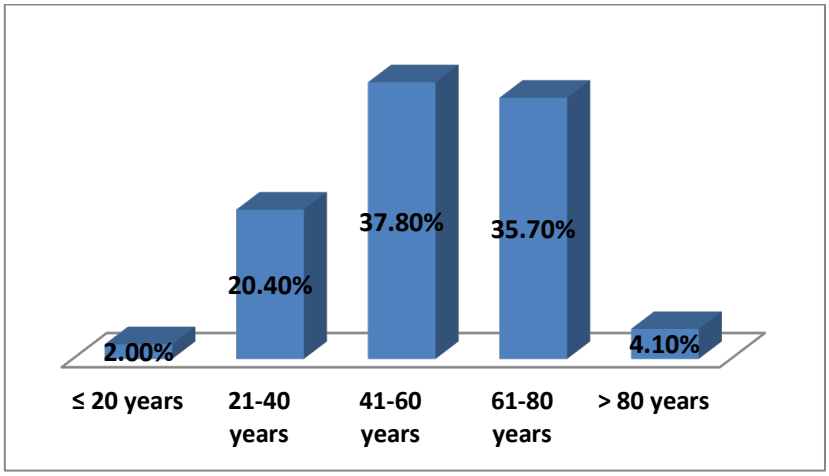

Figure 2: Age Distribution of the study

Table 1: Various Causes of Acute Kidney Injury (AKI)

Cause of AKI	Frequency	Percentage
Infection	46	46.9%
Volume loss	24	24.5%
Drug induced	16	16.3%
Hypotension	05	5.1%
Obstructive uropathy	03	3.1%
Autoimmune disease	02	2.0%
HRS	01	1.0%
Toxin	01	1.0%

Pre renal AKI was seen in 64.3% of the patients, followed by renal AKI in 32.7% and post renal AKI in 3.1% of patients.

Most common finding was pallor seen in 61 (62.2%) patients followed by pedal oedema in 41 (41.8%), Hypotension in 19 (19.3%) and Oliguria in 24 (24.4%) patients. A total of 25 (25.51%) patients developed hyperkalemia (Serum potassium > 5.5 mEq/L) which consisted of 7(28%) from pre-renal category, 16(64%) from renal category and 2(8%) from post renal category. Out of these 20(80%) patients required RRT.

A total of 39 (39.8%) patients required renal replacement therapy. Out of these 28(71.7%) underwent hemodialysis, 7(17.9%) underwent peritoneal dialysis and 4(10.2%) required Continuous Veno-Venous Hemodialysis. Of these 28(71.7%) patients had underlying CKD. Indications for RRT included hyperkalemia (Serum potassium>6.5 mEq/L) in 6(15.3%) patients, fluid overload in 26(66.6%) patients and metabolic acidosis in 9(23%) patients. Nearly one-third of study participants had a fatal outcome (29 patients, 29.5%).

Patients were classified based on RIFLE criteria and it was observed that 64 patients (65.3%) were classified into risk group, 25 patients (25.5%) into injury category and 9 patients (9.2%) were grouped into failure category. After 3 months of follow up, 59 patients (60.2%) had complete recovery, 10 patients (10.2%) had partial recovery and 29 patients (29.6%) had fatal outcome. Further analysis was done to identify factors associated with the outcome. It was noted that case fatality was highest among patients in failure category (77.8%) followed by patients in injury category (52.0%) and least among patients in risk group (14.1%). This difference was found to be statistically significant with a p value of less than 0.001. Fluid overload and metabolic acidosis were also found to have a significant association with outcome among study participants. Complete recovery was relatively better among patients who did not need renal replacement therapy (76.3%) when compared to those who needed RRT (35.9%). All patients whose baseline creatinine levels were within normal limits had complete recovery whereas about half of the patients (57.1%) with raised creatinine levels had complete recovery, however this difference was statistically not significant. Similarly, patients with normal BUN to creatinine ratio had better recovery and relatively lower mortality but the difference was statistically not significant (table 2).

Table 2: Factors influencing the outcome among AKI cases

Parameters	Outcome at 3 months			p-value
	Complete recovery	Partial recovery	Expired	
AKI category based on RIFLE criteria				
Failure	02 (22.2%)	0	07 (77.8%)	**<0.001**
Injury	08 (32.0%)	04 (16.0%)	13 (52.0%)	
Risk	49 (76.6%)	06 (9.4%)	09 (14.1%)	
Fluid overload				
Absent	50 (74.6%)	03 (4.5%)	14 (20.9%)	**<0.001**
Present	09 (29.0%)	07 (22.6%)	15 (48.4%)	
Metabolic acidosis				
Absent	58 (63.0%)	10 (10.9%)	24 (26.1%)	**0.023**
Present	01 (16.7%)	0	05 (83.3%)	
Renal replacement therapy requirement				
No	45 (76.3%)	05 (8.5%)	09 (15.3%)	**<0.001**

Yes	14 (35.9%)	05 (12.8%)	20 (51.3%)	
Baseline creatinine levels				
Normal	07 (100%)	0	0	0.110
Raised	52 (57.1%)	10 (11.0%)	29 (31.9%)	
BUN to creatinine ratio				
Normal	48 (55.2%)	10 (11.5%)	23 (44.3%)	0.151
Raised	05 (45.4%)	0	06 (54.6%)	

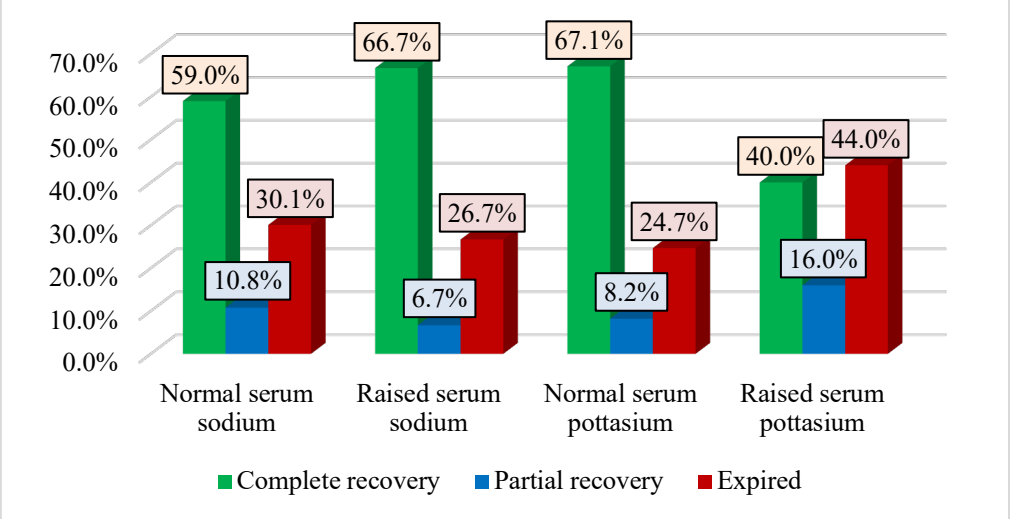

Figure 3: Comparison of serum electrolytes with outcome among study participants

There was statistically no significant difference in serum sodium and potassium levels and final outcome among study participants (figure 3). ROC curve analysis revealed a significant association between the kidney size, BUN to creatinine ratio in predicting outcome among AKI patients. Kidney size of 9 cm on ultrasound had a sensitivity of more than 80% and specificity of 50% and above in predicting the outcome. All the above findings were statistically significant with a p value of <0.01 (figure 4).

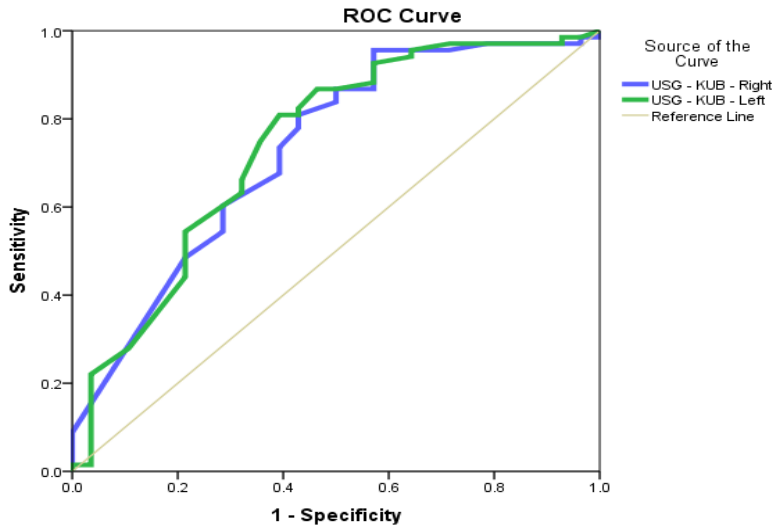

Figure 4: ROC curve for predicting the outcome among AKI patients

Test variable	Value	AUC	Sensitivity	Specificity	p-value
USG-KUB right	9 cm	0.728	80.9%	57.1%	**<0.001**
USG-KUB right	9 cm	0.740	86.8%	50.0%	**<0.001**

Discussion

AKI is a very common entity affecting patients suffering from a wide variety of illnesses. The etiology of AKI varies from dehydration to toxins like snake venom to sepsis. In the initial stages of AKI these patients can be easily managed by maintaining adequate fluid intake, withholding nephrotoxic drugs and ensuring a good urine output. However, AKI in the setting of multiple comorbidities is very difficult to manage and is a potentially fatal complication.AKI was predominantly encountered in the elderly age group. In the study conducted by Bagshaw et al. maximum number of patients belonged to more than 75 years age group and the incidence of AKI was also highest in them [4]. However mean age of the patients, in the study by Prakash et al. was 44±17 years [5]. Similarly in a study conducted by Eswarappa et al. in South India, the mean age of patients was 55.5 years [6]. Our study agrees with other Indian studies showing mean age of patients as 55±16 yrs.

Our study confirms the earlier finding that AKI is more common in male sex. This may be due to the fact thata greater number of patients get admitted in acute male wards in our hospital as compared to the female wards. Majority of patients with AKI had co morbidities with hypertension (26%) and Type 2 Diabetes Mellitus (22%) being the most common. Other significant co morbidities were chronic liver disease, stroke and malignancy. These findings are in agreement with a study by Cartin-Ceba Rodrigo et al., which demonstrated a significantly increased risk of AKI in critically ill patients with older age, diabetes, hypertension and multiple other risk factors [7].

Majority of cases of AKI were accounted for by pre-renal causes (64.3%) while the renal causes were responsible for 32.7% of the cases. Infection accounted for 46.9% of all cases followed by volume loss (24.5%) and drugs (16.3%). In a study conducted by Liano et al (Madrid Acute Renal Failure Group) the most frequent causes of ARF were Acute Tubular Necrosis (45%), pre-renal (21%), acute-onset chronic renal failure (12.7%) and obstructive ARF (10%) [8]. Studies by Jha et al., and Prakash et al., which evaluated AKI irrespective of ICU setting had shown that nephrotoxic drugs were the most common cause of AKI [5,9].

In our study, a total of 39 (39.8%) patients required renal replacement therapy. Previous Indian studies by Prakash et al. and Singh et al. reported that 54.3% and 25.5% of the cases respectively, required RRT [5,10]. Out of these 28(71.8%) underwent hemodialysis, 7(17.9%) underwent peritoneal dialysis and 4(10.3%) required Continuous Veno-Venous Hemodialysis.

Out of 98 patients, 29 (29.6%) patients died. In the study conducted by Prakash et.al. the mortality rate was 63% and in that conducted by Eswarappa et al. and Singh et al. the mortality was 37.2% and 37.2% respectively [5,6,10]. Our study shows lower mortality as compared to previous Indian studies. This could be due to inclusion of less severe AKI cases taken from acute medical ward. Out of these 9(31%) belonged to the risk category, 13(44.8%) belonged to the injury category and 7(24.2%) belonged to the Failure category. This is contrast to the study by Bagshaw et a which found that the mortality rates were 17.9% in the risk group, 27.7% in injury group and 33.2% in the failure group, However similar results were seen in a study of Singh et.al. in

which the mortality was maximum in RIFLE-I group in medical patients and RIFLE-R group in ICU patients [10,11].

At the end of 3 months follow up, out of 98 patients 59 (60.2%) patients had complete recovery of renal function, 10 (10.2%) recovered partially and 29(29.6%) could not be commented upon since they did not survive. None of the patients progressed to ESRD. The study by Eswarappa et al. shows complete recovery of renal function in 60% of patients and development of CKD in 2.4% of patients [6]. Another study by Ali et al. shows full recovery of renal function in 68% cases and partial recovery in 5% cases [12]. Our study findings are similar to other studies.

In the present study,upon classifying patients based on RIFLE criteria, it was noted that case fatality was highest among patients in failure category (77.8%) followed by patients in injury category (52.0%) and least among patients in risk group (14.1%). In a study by Eric Hoste et al maximum mortality was seen in failure class (28%), followed by injury class (11.4%) and least in risk class (8.8%) [13]. In another study conducted by Syed Hussain et al it case fatality was highest among patients in failure category (61.5%) followed by injury (15.8%) and risk category (14.7%) [14]. Though the fatality was relatively higher in present study but still consistent with the findings in other literature with respect to gradient of RIFLE criteria.

S Uchino et al also observed that hospital mortality was significantly less in patients with normal BUN to creatinine ratio [15]. The present study also observed that patients with normal baseline creatinine, normal BUN to creatinine ratio, without fluid overload or without metabolic acidosis and not on RRT had better survival. Mortality rate in the present study was significantly low (p value <0.01) in patients who didn't require RRT which is in accordance with the study conducted by Eswarappa M et al [6]. Kambiz Kalantarinia in a study on novel imaging techniques in AKI observed that enlarged kidneys are usually because of infiltrative disease and in acute settings whereas kidney size is expected to be smaller in chronic kidney disease [16]. In our study a kidney size of less than 9cm was found to be a sensitive prognostic indicator, which may also be because of long standing injury to kidneys before clinical manifestation and may need a more aggressive approach in management of AKI.

In conclusion acute kidney injury in hospital settings has multiple aetiologies with infection being the most common cause. Pre-renal causes of AKI are relatively more prevalent than renal and post-renal causes. RIFLE criteria, electrolyte imbalance, kidney size can be used as useful prognostic indicators in predicting outcome of acute kidney injury and the necessary line of management for early correction.

Limitations:

The present study included all patients with AKI and did not differentiate between AKI and Acute on CKD. Our study did not include severity scoring systems to further stratify the patients.

Author's contribution: Dr. Ravi Jain and Dr. Harpreet Singh designed the entire work. Dr. Byomakesh Swain and Dr. Arvinder Kaur Heer contribute in making necessary correction and revision of the manuscript. The final draft was checked by all the authors.

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