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Original Research Paper

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A CLINICAL STUDY OF ETIOLOGY, OUTCOME AND PROGNOSTIC FACTORS OF ACUTE KIDNEY INJURY AMONG ICU ADMISSIONS IN RURAL TERTIARY CARE HOSPITAL

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ABSTRACT

INTRODUCTION: Acute kidney injury is a common occurrence in ICU admissions causing increased morbidity and mortality. Present study aimed to determine the causes and prognostic factors of acute kidney injury in intensive care unit.

MATERIAL AND METHODS: This Hospital based Cross sectional Study was conducted at a tertiary care Hospital and Research Center, including 100 patients aged >18 years with Acute Kidney Injury admitted in ICU from the period of October 2018 to June 2020. Patients with chronic renal disease, previous renal transplantation, congenital renal disease were excluded from the study.

RESULTS: Most of the patients (63%) were aged above 50 years. Diabetes was found in 55% and hypertension in 26% of AKI cases. Most common cause identified were sepsis, CLD, renal, CNS and CVD. Hypotension occurred in 48% patients, while oliguria occurred in 45% patients. Ventilatory support was required by 43% patients, while 31% patients required haemodialysis. Mortality rate in AKI was 51%. Mortality was significantly associated with advanced age, presence of Diabetes, and RIFLE criteria. Spot urine <40 meq/L, hyperkalemia, serum creatinine >4 mg/dl, blood urea >100 mg/dl and acidosis were associated with higher mortality.

CONCLUSION: Continuous monitoring parameters like Spot Fe Na, Serum Potasium and pH especially in patients at risk, like elderly patients with diabetes, those with sepsis, can help in early identification and appropiate management, thus reduce the incidence or severity of AKI.

KEYWORDS : Acute kidney injury, Acute renal failure, RIFLE, ICU

INTRODUCTION:

Acute kidney injury (AKI), previously called acute renal failure (ARF), refers as reduction in kidney function which is sudden and often reversible, as measured by Glomerular filtration rate (GFR) [1-3]. Creatinine, blood urea nitrogen may be normal immediately after a renal insult and decline in urine output may be the only sign of acute kidney injury. AKI can lead to the accrual of water, sodium, and other metabolic products. Various electrolyte disturbances can be seen. AKI is a very common condition now days, especially among hospitalized patients. It can be seen in up to 7% of hospital admissions and 30% ICU admissions. The rapid change in criteria for the definition of AKI has led to significant debate on the exact incidence of AKI. Incidence varies from 1% to 31% according to the available literature. Though there is no clear definition of AKI; however, a number of different criteria have been used in research studies such as RIFLE (Risk, Injury, Failure, Loss, ESRD), AKIN (Acute Kidney Injury Network) and KDIGO (Kidney Disease Improving Global Outcomes) criteria. The most common and recent tool is KDIGO.

According To Kdigo, Aki Is The Presence Of Any Of The Following: [5]

1. Increase in serum creatinine by 0.3 mg/dL or more (26.5 micromoles/L or more) within 48 hours
2. Increase in serum creatinine to 1.5 times or more baseline, within the prior seven days
3. Urine volume less than 0.5 mL/kg/h for at least 6 hours

AKI may be associated with various etiologies, these may be singly or in combination including infectious diseases or conditions such as diarrheal disease, HIV, malaria, glomerulonephritis and sepsis, toxins or herbal medications, autoimmune diseases, pregnancy-related conditions, trauma-related tubular injury, and iatrogenic causes including medications such as nonsteroidal anti-inflammatory drugs, hypovolemia, and contrast induced nephropathy[5,6].

Most of these etiologies of AKI are basically preventable to the larger extent, and even if AKI starts, it can be reversible if diagnosed and treated early. Failure to diagnose or delay in treatment usually leads to significant consequences. It is associated with a high morbidity and even permanent loss of kidney function[7]. All stages of AKI are associated with significantly higher short and long-term mortality[8]. However, if detected early and treatment leads to partial or total reversal of renal damages caused by AKI.

Etiology and clinical outcome of AKI can vary significantly from country to country depending on various genetic and environmental conditions and health infrastructure. Very few studies are available in India regarding etiology, clinical profile, and outcome of patients with AKI.

Present study aimed to determine the causes, risk and prognostic factors of acute kidney injury in intensive care unit and to study the final outcome of acute kidney injury patients in intensive care unit.

MATERIAL AND METHODS:

This Hospital based Cross sectional Study was conducted at Intensive Care unit of a tertiary care Hospital and Research Center of southern India. A total of 100 patients with Acute Kidney Injury admitted in ICU from the period of October 2018 to June 2020 were included in the study. Patients aged >18 years who satisfied any one of the following criteria in ICU were included in the study -

- Increase in Serum Creatinine by *0.3mg/dl within 48 hrs.
- Increase in Serum Creatinine to *1.5 times the baseline, which is known or presumed to have occurred within the past 7 days
- Urine volume <0.5ml/kg/hr for 6 hours

Patients with chronic renal disease, previous renal transplantation, congenital renal disease, evidence of contracted kidneys on ultrasound scan abdomen were excluded from the study. Ethical clearance was obtained from the Institutional Ethical Committee, and written informed consent was obtained from all patients prior to data collection. Information was collected by detailed history taking, clinical examination and investigations of patient presenting with Acute Kidney Injury in ICU using a semi-structured proforma. Patients were followed up till discharge / inhospital death to assess the final outcome. Other outcomes assessed include occurrence of hypotension, oliguria, ventilatory support requirement, and type of management.

Statistical analysis: Continuous variables were expressed as mean and standard deviation. Categorical variables were expressed as number and percentage and were analyzed using Chi square test. A p value <0.05 was taken as statistically significant. All statistical analysis was done using Epi info version 7.2.1.0 statistically software.

RESULTS:

Mean age of AKI patients in ICU was 52.28 ± 11.66 years. Most of the patients (63%) were aged above 50 years. Few (4%) patients with AKI were below 30 years of age. Most (67%) patients were male. Diabetes was found in 55% and hypertension in 26% of AKI cases. On classification of RIFLE criteria, most (55%) patients were in Risk category, 23 patients were in injury category and 22 patients were in Failure category (Table 1). Most common cause of initial admission among these patients were sepsis, CLD, renal causes, CNS and CVD (Table 2). Mortality rate in AKI in present study was found to be 51% (Figure 1). Mortality was found to be significantly associated with increasing age, presence of DM, and increasing severity grading of RIFLE criteria (Table 1). Higher mortality was seen in patients with spot urine <40 meq/L, hyperkalemia, serum creatinine >4 mg/dl, blood urea >100 mg/dl and acidosis (Table 2).

Ventilatory support was required by 43% patients. Hypotension was found in 48% patients, while oliguria occurred in 45% patients. Most patients were managed conservatively (69%), while 31% patients required haemodialysis. Mortality was significantly higher in patients who developed hypotension or oliguria and patients who required ventilatory support (Table 4).

Figure 1: Survival outcome of AKI patients

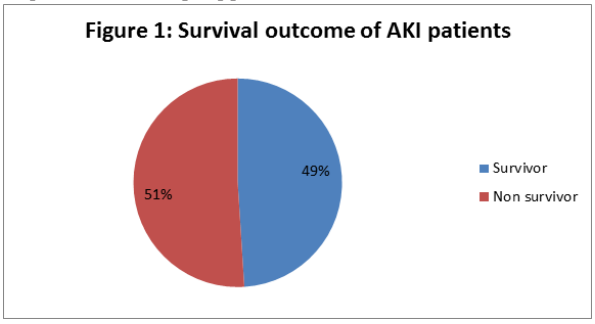

Table 1: Baseline Demographic And Clinical Characteristics Of Aki Patients

		Total cases	Survivors	Non-survivors	P value
Age groups (years)	< 30	4	3 (75%)	1 (25%)	0.009 (S)
	30-39	13	9 (69.2%)	4 (30.8%)	
	40-49	20	13 (65%)	7 (35%)	
	50-59	30	16 (53.3%)	14 (46.7%)	
Gender	Male	67	30 (44.8%)	37 (55.2%)	0.098
	Female	33	19 (57.6%)	14 (42.4%)	
DM	Yes	55	19 (345%)	36 (65.5%)	<0.001 (S)
	No	45	30 (66.7%)	15 (33.3%)	
HTN	Yes	26	11 (42.3%)	15 (57.7%)	0.330
	No	74	38 (51.4%)	36 (48.6%)	
Type of AKI	Pre-renal	29	16 (55.2%)	13 (44.8%)	0.352
	Intrinsic renal	71	33 (46.5%)	38 (53.5%)	
RIFLE criteria	R	55	36 (65.5%)	19 (34.5%)	<0.001 (S)
	I	23	10 (43.5%)	13 (56.5%)	
	F	22	03 (13.6%)	19 (86.4%)	

DM- Diabetes, HTN-Hypertension, AKI- Acute kidney injury, R-Risk, I-Injury, F-failure

Table 2: Distribution Of Aki Patients According To Cause Of Admission

Cause of admission	No. of cases	Survivors	Non-survivors	P value
CLD	16	5 (31.2%)	11 (68.8%)	0.202
CNS	09	5 (55.6%)	4 (44.4%)	0.950
CVD	09	5 (10.2%)	4 (44.4%)	0.950
Drug induced	02	1 (50%)	1 (50%)	0.493
Hepatitis	05	2 (40%)	3 (60%)	0.963
Malaria	02	2 (100%)	0 (0%)	0.457
Malignancy	01	0 (0%)	1 (100%)	0.984
Pancreatitis	04	2 (50%)	2 (50%)	0.963
Poisoning	02	2 (100%)	0 (0%)	0.457
Renal	10	6 (60%)	4 (40%)	0.689
Sepsis	36	17 (47.2%)	19 (52.8%)	0.777
Snake bite	04	2 (50%)	2 (50%)	0.963

CLD-Chronic liver disease; CNS- Central Nervous system, CVD-Cardiovascular disease

Table 3: Laboratory Parameters And Their Association With Mortality

		Total cases	Survivors	Non-survivors	P value
Urine abnormality	Normal	43	16 (32.7)	27 (52.9)	**0.065**
	Sediment	57	33 (67.3)	24 (47.1)	
Spot Urine Na(meq/L)	< 40	33	10 (30.3%)	23 (69.7%)	<0.001 (S)
	> 40	67	39 (58.2%)	28 (41.8%)	
Spot Urine Fe Na (%)	< 1	35	20 (57.1%)	15 (42.9%)	0.103
	> 1	65	29 (44.6%)	36 (55.4%)	
Serum Potassium (K+)	> 5.0 mmol/L	50	16 (32%)	34 (68%)	<0.001 (S)
	<5.0 mmol/L	50		17 (34%)	
Serum Creatinine	< 4.0 mg/dl	48	29 (60.4%)	19 (39.6%)	0.003 (S)
	> 4.0 mg/dl	52	20 (38.5%)	32 (61.5%)	
Blood Urea	< 100 mg/dl	45	28 (62.2%)	17 (47.8%)	0.001 (S)
	> 100 mg/dl	55	21 (38.2%)	34 (61.8%)	
Acidosis	Yes	47	14 (29.8%)	33 (70.2%)	<0.001 (S)
	No	53	35 (66%)	18 (34%)	

Table 4: Clinical Characteristics during course of admission

		Total cases	Survivors	Non-survivors	P value
Ventilatory support	Yes	43	14 (32.6%)	29 (67.4%)	<0.00
	No	57	35 (61.4%)	22 (38.6%)	1 (S)
Hypotension	Yes	48	15 (31.2%)	33 (68.8%)	<0.00
	No	52	34 (65.4%)	18 (34.6%)	1 (S)
Urine output	Oliguria	45	13 (28.9%)	32 (71.1%)	<0.00
	Normal output	55	36 (65.5%)	19 (34.5%)	1 (S)
Intervention	None	69	35 (50.7%)	34 (49.3%)	0.352
	Haemodialysis	31	14 (45.2%)	17 (54.8%)	

DISCUSSION:

Acute kidney injury is a frequent and serious complication in hospitalized patients. Early detection and aggressive management of AKI is necessary to bring down mortality. In a country like India the true epidemiological picture of AKI is still not well understood due to late presentation to tertiary care centers and lack of documentation of health care, hence this study was done to identify factors associated with AKI and its outcome in ICU patients.

Mean age of AKI patients was 52.28 ± 11.66 years. Most (66%) of the AKI cases were aged ≥ 50 years. Significantly higher mortality was seen in older age group patients. **Dr. Shafeeq Usman V et al** [9] reported mean age of 58 years among AKI patientss. Similar studies had shown that mean age of expired patients was higher than that of recovered patients[10,11]. Male preponderance was seen among patients with AKI, as has been reported by past studies [9,12]. Common aetiology in present study were sepsis (36%), Chronic liver disease (16%), Renal (10%), CNS disease (9%), CVD (9%). **Bresolin et al** [13] reported shock and sepsis as predominant etiology in AKI.

Past studies have supported this finding showing Sepsis as a common causes for AKI and an independent predictor of mortality in AKI patients. [14,15] Shock associated with sepsis leading to intravascular volume depletion is a significant predictor of mortality in AKI patients[15].

Mortality rate was higher in diabetic patients with AKI. **Prasanta Kumar Bhattacharya et al**[16] found higher mortality in various comorbidities. Existing medical comorbidities have been shown to be associated with AKI[16.] or adverse renal outcomes, particularly in the elderly age group.[17] The PICARD group reported extensive comorbidities in patients with AKI, with 37% having coronary artery disease, 29% having diabetes mellitus, and 21% having chronic liver disease. [18]

In this study 43 patients needed ventilatory support during their illness. Nearly half patients had hypotension and needed ionotrops for maintaining blood pressure. out of these 33(68.75%) died. Oliguria developed in 45% patients. Mortality was higher in patients developing hypotension or oliguria.

Past studies have reported oliguria in 36.6 to 55.3% of AKI patients, and oliguria had been associated with worse prognosis.[9,19] Need of inotrope support and ventilatory support have been reported in 14.3%% to 36% patients with AKI and are taken as poor prognostic sign. This variation in patients developing hypotension and requiring ventilatory support may be due to varying etiologies in different study or due to difference in time of presentation to the hospital.

Prerenal (caused renal perfusion, mainly because of hypovolemia), intrinsic renal (caused by kidney injury) and post renal (caused by obstruction) are the three categories of AKI. It may either be community acquired or hospital acquired. Staging of AKI was done as per KIDGO guidelines after examination. Most of the patients 71% in our study had intrinsic renal cause while remaining 29% cases had pre renal causes. Mortality was more in intrinsic renal cause of AKI. Out of 100 patients 31 patients needed dialysis. Approximately 16 to 29% of patients with AKI needed dialysis as reported in different settings. Mortality rate were found to be significantly higher among patients requiring Haemodialysis. [9,20]

Spot urine sodium is a marker used in AKI patients. A value of >40 implies tubular dysfunction and intrinsic renal involvement, in the absence of diuretic usage. In our study 67 patients had spot urine sodium levels >40 meq/L and these patients showed higher mortality.

Most (65%) patients had Spot Urine Fe Na >1 %. Values greater than 1% are consistent with Prerenal-AKI due to inappropriate sodium excretion in the setting of tubular damage. The interpretation of FeNa is based on the premise that intact tubules reabsorb sodium in the prerenal states while the injured tubules do not.[21,22]

In our study hyperkalemia was seen in half of the patients, of those two third patients. Similar study conducted by Grace Igiraneza et al reported hyperkalemia as a predictor of mortality in AKI irrespective of its cause.[23]

In this study 52% patients had S. creatinine levels ≥4.0 mg/dl, while 55% patients had B. urea levels ≥100 mg/dl. Mortality rates were significantly higher in these patients. Worsening blood urea and creatine values despite optimum conservative management have been associated with poor survival outcomes.[9] Monitoring these parametes in critically ill patients can pick up AKI very early for timely management.

In this study of 47% patients develops acidosis, and these patients with acidosis had poor prognosis. Metabolic acidosis is the most common acid-base disturbance associated with acute kidney injury, developing as the result of impaired excretion of the daily load of metabolic fixed acid. Although initially a hyperchloremic metabolic acidosis develops, widening of the anion gap is often seen as the result of accumulation of phosphate, sulfate and small organic anions. On RIFLE criteria classification, 55% patients were in Risk category, 23% in injury category and 22% in Failure category; and severity grading of RIFLE criteria was associated with increased mortality. A study by P**. Vijai Ananth et al**[20] found that based on RIFLE classification, almost half of the patients in their study remained in class R and one-fourth persevered in class I and class F each. Studies have demonstrated the independent association of various RIFLE categories with in-hospital mortality.[24,25]

CONCLUSION:

Most common aetiology of AKI among ICU admissions was sepsis. Mortality was higher in older patients and those who had Diabetes. Spot Fe Na >1%, hyperkalemia, azotemia and acidosis were significantly associated with mortality, hence continous monitoring of these parameters among ICU patients can help in early identification and management and could prove to be life saving. Occurrence of hypotension or oliguria and need for ventilatory support or hemodialysis were also associated with higher mortality. The progressions of AKI lead to increased hospital mortality rates and increased length of stays leading to wastage of limited resources in a setting like India. Hence timely identification of patients at risk and appropiate management could reduce the incidence or severity of AKI.

Conflict Of Interest: Nil

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