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ORIGINAL RESEARCH

Study of Etiology, Clinical Profile and Prognosis in Acute Kidney Injury Patients of Guntur District

Uppalapati Ganga prasad[1], Gorijala Aparna[2] Pillarisetty Meroz[3]

[1]Associate Professor, Department of General Medicine, NRI Medical College & Hospital, Chinakakani, Guntur, Andhra Pradesh, India
[2]Associate Professor, Department of General Medicine, NRI Medical College & Hospital, Chinakakani, Guntur, Andhra Pradesh, India
[3]Assistant Professor, Department of General Medicine, Department of General Medicine, NRI Medical College & Hospital, Chinakakani, Guntur, Andhra Pradesh, India

ABSTRACT

Background: Acute renal failure (ARF) is a generic term for an abrupt and sustained decrease in renal function resulting in retention of nitrogenous (urea and creatinine) and non-nitrogenous waste products. To determine the cause, prognosis and outcome in patients of Acute Kidney Injury (AKI) admitted in a tertiary care hospital.

Materials and Methods: A Hospital based Prospective study was conducted in Department of Medicine, NRI Medical College for a 1 year period (From Septembet 2021 to Aug 2022). Universal Sampling Technique was used for selection of study subjects. All the patients coming to medicine department during the study period and fulfilling the xiii inclusion criteria were taken for study after taking prior informed consent. Final sample size was 138 subjects of Acute Kidney Injury of varied etiology.

Results: Mean of study subjects was 48.9 years (range from 19-87 years) with M:F ratio of 4.75:1. Most common etiology for AKI was Sepsis (14.5%) and Malaria infection (14.5%) followed by Dengue, AGI and Leptospirosis (11.6% each). Multi organ dysfunction (14.5%) was observed in patients of Sepsis and Lepto. Out of total patients, 92 (66.7% %) had stage II AKI, while 46 (33.3 %) had stage III AKI according to AKIN staging.A total of 11.6% patients were on dialysis. Two out of 46 patients of AKI stage III (8.7%) and one patient out of 92 (2.2%) belonging to AKI stage II died during the study.

Conclusion: AKI was observed at a relatively younger age in present study with male preponderance. Most common etiologies were Sepsis and Malaria. Most of the patient of Sepsis, MODS and Leptospirosis were having stage III AKI. Overall mortality observed was 4.34%.

Keywords: Acute kidney injury, etiology, clinical profile, prognosis, patients.

Corresponding Author: Dr. Gorijala Aparna, Associate Professor, Department of General Medicine, Department of General Medicine, NRI Medical College & Hospital, Chinakakani, Guntur, Andhra Pradesh, India, Email id: aparna7gorijala@gmail.com

INTRODUCTION

Acute renal failure (ARF) is a generic term for an abrupt and sustained decrease in renal function resulting in retention of nitrogenous (urea and creatinine) and non-nitrogenous waste products.[1] Depending on the severity and duration of the renal dysfunction, this accumulation is accomplished by metabolic disturbances, such as metabolic acidosis and hyperkalemia, changes in body fluid balance, and effects on many other organ systems. ARF

range from severe (that is requiring dialysis) to slight increases in serum creatinine concentration.[1] Recent evidence has shown that relatively small changes in renal function are associated with substantial increases in mortality.[2,3]

For this reason, the term ARF was replaced by that of Acute Kidney Injury (AKI) which encompass the entire spectrum of the syndrome from minor changes in markers of renal function to requirement for Renal Replacement Therapy (RRT).[4] In May 2004, a new classification, the RIFLE (Risk, Injury, Failure, Loss of kidney function and End stage kidney disease) classification, was proposed by the Acute Dialysis and Quality Initiative Group (ADQI) in order to define and stratify the severity of AKI.[5] Three years later in March 2007, the Acute Kidney Injury Network (AKIN) classification, a modified version of the RIFLE was released in order to increase the sensitivity and specificity of AKI diagnosis [6]. AKI has been reported among 2-7% of hospitalised patients.[7,8] In a study of hospital acquired acute renal insufficiency 2002, 7.2% of patients experienced an episode of renal insufficiency.[9] Hospital acquired acute kidney injury is at least 5-10 times more common than community acquired AKI.[10] These rates are increasing not only due to aggressive treatment of an ageing population but also the impact of newer nephrotoxic medications and diagnostic procedures.[7,11]

The most common drugs associated with renal toxicity in elderly individuals are NSAIDS and nephrotoxic antibiotics such as aminoglycosides.[12] This predisposition to drug-associated renal adverse effects is the result of many age-related changes in the kidney. Moreover, although patients with AKI did not die directly as a result of their renal failure, renal failure was an independent risk factor for death.[13] The burden of AKIis most significant in developing countries with limited resources for the care of these patients once the disease progresses to kidney failure necessitating RRT.[14] However, early detection and treatment leads to partial or total reversal of renal damages caused by AKI.[15,16] Since AKI is associated with higher mortality, timely identification and intervention can mitigate the poor outcomes associated with it. AKI is associated with complications like fluid overload, hyperkalemia and life threatening complications like cardiac arrhythmia, myocardial infarction, pulmonary embolism, gastrointestinal ulcers, seizures, coma, haemolysis, bleeding tendencies and severe infections.[17]

MATERIALS AND METHODS

Study Design: A Hospital based Prospective study was conducted in Department of Medicine, NRI Medical College for a 1 year period (September 2021 – August 2022) after taking approval from Hospital Ethics and Research Committee.

Sampling Technique and Sample Size: Universal Sampling Technique was used for selection of study subjects. All the patients coming to medicine department during the study period and fulfilling the inclusion criteria were taken for study after taking prior informed consent. The patients included in the study were from both ICU and wards. Final sample size came to be 138subjects of Acute Kidney Injury of varied etiology.

Inclusion Criteria

1. Age >18 years
2. Patients who fulfill AKIN Criteria

Exclusion criteria

1. Age <18 years
2. Established End Stage Renal disease and on hemodialysis
3. Death within 1 day of admission
4. Patients already on hemodialysis

Methods

All the study subjects were followed up on daily basis, till discharge, death or return of their renal function to baseline. Demographic, biochemical and clinical profiles of all patients were

recorded. Serum creatinine was measured by buffered kinetic Jaffe reaction without deproteinization at admission and during follow up. Variables assessed were: age, sex, type of primary disease (medical or surgical), type of AKI (pre-renal/renal/post-renal), risk factors, indications and type of dialysis and outcomes (recovery/death/discharge on dialysis). Association between qualitative variables was done with the help of Chi-square test. P value <0.05 was taken as significant. Quantitative data was represented using mean ± sd and median & IQR (Interquartile range).

RESULTS

Over half of the subjects were above 50 years of age with average of study subjects was 48.9 years (range from 19-87 years). There were 8 (11.6 %) patients with age > 70 yrs.

Table 1: Age Distribution

Age (years)	N	%
<30	28	20.3%
30-50	40	29.0%
50-70	54	39.1%
<70	16	11.6%
Total	138	100.0%

Table 2: Gender Distribution

Sex	N	%
F	24	17.4%
M	114	82.6%
Total	138	100.0%

There were 82.6% males and 17.4% females with M:F ratio of 4.75:1.

Table 3: Distribution based on Age and Investigation findings

Variables	Mean	SD	Minimum
Age (years)	48.9	17.0	19.0
Hb (gm%)	13.1	1.0	10.6
TC	15542.0	19036.0	2900.0
S. Calcium	9.1	0.3	8.8
Platelets	190540.6	124910.4	3500.0
S. Sodium	133.8	4.1	121.0
S. Potassium	4.1	0.6	2.7

The mean age of study subjects was 48.9 years while mean Hb level was 13.1 gm%. Mean calcium, Sodium and potassium level was 9.1, 133.8 and 4.1gm%.

Table 4: Distribution based on S. Urea Levels

S. Urea Levels	Mean	SD	Minimum
On admission	107.8	59.043	41
On discharge	51.58	28.602	22
At 3 months	36.26	10.766	23

Mean S. urea level on admission was 107.8 mg%, at discharge it was 51.6 mg% and at 3 month follow up it was 36.26 gm% (68% had S. urea < 40 mg%). The difference at admission, discharge and 3 month follow up was statistically significant (p< 0.05).

Table 5: Distribution based on S. Creatinine Levels

S. Creatinine Levels	Mean	SD	Minimum
On admission	4.03	2.3994	1.8
On discharge	3.2	12.3579	0.9
At 3 months	1.2	0.1413	0.9

Mean S. Creatinine level on admission was 4.03 mg%, at discharge it was 3.26 mg% and at 3 month follow up it was 1.2 gm% (56% patients had S. Creat. <1.2 mg%). The difference at admission, discharge and 3 month follow up was statistically significant ($p< 0.05$).

Table 6: Distribution based on Input- output Charting

IO Chart	Mean	SD	Minimum	Maximum
Input on Admission	1525	490.393	200	2900
Output on Admission	890.74	635.446	0	3500
Input on Discharge	1799.42	442.496	800	3200
Output on Discharge	1676.81	479.934	0	2700

Mean input and output volume of patient significantly improved at discharge from their admission values ($p< 0.05$).

Table 7: Distribution based on Urine Analysis

Urine Analysis		N	%
Albumin	Nil/Trace	16	23.2%
	Present	39	56.5%
Pus Cells (>5)	No	55	79.7%
	Yes	14	20.3%
RBC (>3)	No	60	87.0%
	Yes	9	13.0%

Urine Albumin was present in 56.5% patients while pus cells and RBC was present in 20.3% and 13% patients.

Table 8: Distribution based on LFT

LFT	N	%
Normal	106	76.8 %
Abnormal	32	23.2 %
Total	138	100.0 %

Abnormal LFT was observed in 23.2% patients of Acute Kidney Injury.

Table 9: Distribution based on USG Findings

USG Findings	N	%
Normal Kidneys	72	52.2%
Grade 1 RPC	42	30.4%
Grade 2 RPC	6	4.3%
Cystitis	6	4.3%
Pyelonephritis	6	4.3%
Prostatomegaly	4	2.9%

Obstructive uropathy	2	1.4%
Total	138	100.0%

On USG, normal kidneys was observed in over half of the patients while grade I and II RPC was observed in 30.4% and 4.3% patients. Other findings included Cystitis, Pyelonephritis, Prostatomegaly and obstructive uropathy.

Table 10: Distribution based on Investigation Findings

Investigation findings		**N**	**%**
Malaria	No	59	85.5%
	P. Vivax	4	5.8%
	P. Falciparum	6	8.7%
Dengue	No	61	88.4%
	Yes	8	11.6%
Leptospirosis (ELISA)	No	61	88.4%
	Yes	8	11.6%
Blood Culture	Not done/Negative	60	87.0%
	Staphylococcus aureus	7	10.1%
	Pseudomonas	1	1.4%
	E. Coli	1	1.4%
Urine Culture	Not done/Negative	59	85.5%
	Staphylococcus aureus	2	2.9%
	Pseudomonas	2	2.9%
	E. Coli	4	5.8%
	Klebsiella	2	2.9%

Malaria was found positive in 10 patients (14.5%), while Lepto and Dengue in 16 patients each (11.6%). Blood culture for Staph, pseudomonas and E.coloi was found positive in 7,1 and 1 patients respectively.

Table 11: Distribution based on Radiological Investigation

Radiological Investigation		**N**	**%**
Chest X-Ray	Normal	59	85.5%
	ARDS	7	10.1%
	Pul. Oedema	8	4.3%
Echo	Normal	65	94.2%
	Abnormal	4	5.8%

ARDS was observed in 10.1% while pulmonary oedema in 4.3% patients. Abnormal echo findings were observed in 5.8% patients.

Table 12: Distribution based on Diagnosis

Diagnosis	**N**	**%**
Sepsis (with MODS)	6 (+14)	14.5%
Malaria	20	14.5%
Dengue fever	16	11.6%
Gastroenteritis	16	11.6%
Leptospirosis (with MODS)	10 (+6)	11.6%
Cellulitis	10	7.2%

CCF	08	5.8%
Cystitis	08	5.8%
Pyelonephritis	06	4.3%
UTI	06	4.3%
NSAIDS Induced	04	2.9%
Obstructive uropathy	04	2.9%
Diabetic ketoacidosis	02	1.4%
Enteric fever	02	1.4%
Total	138	100.0%

Most common diagnosis for AKI was Sepsis (14.5%) and Malaria infection (14.5%) followed by Dengue, AGI and Lepto (11.6% each). Multi organ dysfunction (14.5%) was observed in patients of Sepsis and Lepto.

Table 13: Distribution based on AKIN Staging

AKIN Stage	**N**	**%**
I	0	0.0%
II	92	66.7%
III	46	33.3%
Total	138	100.0%

Out of total patients, 92 (66.7% %) had stage II AKI, while 46 (33.3 %) had stage III AKI according to AKIN staging.

Table 14: Distribution based on Dialysis

Dialysis	**N**	**%**
No	122	88.4%
Yes	16	11.6%
Total	138	100.0%

A total of 16 (11.6%) patients were on dialysis while 122(88.4%) were not on dialysis.

Table 15: Distribution based on Outcome

Outcome	**N**	**%**
Death*	6	3 4.3%
Recovered	132	95.7%
Total	138	100.0%
* All the deaths were in patients with Sepsis (3/3)		

A total of 3 patients died during the study, all of which were cases of Sepsis.

Table 16: Sex Distribution based on AKIN staging

Sex		**AKIN stage**		**Total**
		II	**III**	
Female	N	18	6	24
	%	75.00%	25.00%	100.00%
Male	N	74	40	114
	%	64.90%	35.10%	100.00%
Total	N	92	46	138
	%	66.70%	33.30%	100.00%
p- value 0.5				

Out of total, 75% females and 64.9% males had stage II AKI. No gender difference was observed in the distribution of patients according to AKI stage.

Table 17: Age Distribution based on AKIN Grading

Age		**AKIN stage**		**Total**
		II	**III**	
<30	N	22	6	28
	%	78.60%	21.40%	100.00%
30-50	N	22	18	40
	%	55.00%	45.00%	100.00%
51-70	N	26	18	54
	%	66.70%	33.30%	100.00%
>70	N	12	4	16
	%	75.00%	25.00%	100.00%
Total	N	92	46	138
	%	66.70%	33.30%	100.00%
p- value 0.49				

No age difference was observed in the distribution of patients according to AKI stage.

Table 18: Outcome based on AKIN grading

AKIN Stage		**Outcome**		**Total**
		Death	**Recovered**	
II	N	2	90	92
	%	2.20%	97.80%	100.00%
III	N	4	42	46
	%	8.70%	91.30%	100.00%
Total	N	6	132	138
	%	4.30%	95.70%	100.00%
p- value 0.21				

Two out of 46 patients of AKI stage III (8.7%) and one patient out of 92 (2.2%) belonging to AKI stage II died in the study.

Table 19: Dialysis based on AKIN grading

AKIN Stage		**Dialysed**		**Total**
		No	**Yes**	
II	N	92	0	92
	%	100.00%	0.00%	100.00%
III	N	30	16	46
	%	65.22%	34.78%	100.00%
Total	N	122	16	138
	%	88.41%	11.59%	100.00%
p- value 0.01				

All the patients with AKI stage III were on Dialysis.

Table 20: Distribution of diagnosis based on AKIN grading

Diagnosis		AKIN Stage		Total
		2	3	
CCF	N	8	0	8
	%	100.00%	0.00%	100.00%
Cellulitis	N	10	0	10
	%	100.00%	0.00%	100.00%
Cystitis	N	6	2	8
	%	75.00%	25.00%	100.00%
Dengue fever	N	14	2	16
	%	87.00%	12.50%	100.00%
Diabetic Ketoacidosis	N	2	0	2
	%	100.00%	0.00%	100.00%
Enteric fever	N	2	0	2
	%	100.00%	0.00%	100.00%
Gastroenteritis	N	12	4	16
	%	75.00%	25.00%	100.00%
Leptospirosis	N	2	14	16
	%	12.50%	87.50%	100.00%
Malaria	N	18	2	20
	%	90.00%	10.00%	100.00%
NSAIDS induced AKI	N	4	0	4
	%	100.00%	0.00%	100.00%
Obstructive uropathy	N	2	2	4
	%	50.00%	50.00%	100.00%
Pyelonephritis	N	2	4	6
	%	33.30%	66.70%	100.00%
Sepsis	N	4	16	20
	%	20.00%	80.00%	100.00%
UTI	N	6	0	6
	%	100.00%	0.00%	100.00%
Total	N	92	46	138
	%	66.70%	33.30%	100.00%

Most of the patient of Sepsis and Leptospirosis (80% and 87.5%) were having stage III AKI, while all patients of MODS were having Stage III AKI.

DISCUSSION

A Hospital based Prospective study was conducted in Department of Medicine of NRI Medical College for a 1 year period. A total of 138 subjects of Acute Kidney Injury (AKI) were studied with the objective of assessing its etiology, clinical profile and prognosis. Epidemiology of AKI It is recognized that the epidemiology of AKI in developing countries differs from that of the developed world in many important ways. Whereas in developed regions elderly patients predominate, in developing countries, AKI is a disease of the young and children, in whom volume-responsive "prerenal" mechanisms are common. Although overall mortality seems to be lower than in developed countries, this finding is not true across all age groups: In these regions, AKI affects predominantly the young and children and mortality is high.[23] Over half of the subjects were above 50 years of age with age of study

subjects was 48.9 years (range from 19-87 years). There were 8 (11.6 %) patients with age > 70 yrs. The mean age in our group was 48.9 years (range from 19-87 years).

The mean age reported by Shusterman et al.[3] was 52.4 ± 12, by Shema et al.[24] was 62.3 ± 14.3 and 67.9 ± 7.6 yrs by HS Kohli et al.[12] However, HS Kohli et al.[12] studied only elderly group with age ≥ 60 yrs hence the mean age was higher in their study. The mean age reported by V Jha et al.[21] was 42.9 ± 16.8 yrs as their group had many young patients.

In present study there were 82.6% males and 17.4% females with M:F ratio of 4.75:1. Similar results were also observed in studiy by Kohli et al.[12], Jha et al.[21] and various other authors,[3,9,12,22] where males outnumbered females.

Mean S. urea level on admission was 107.8 mg%, at discharge it was 51.6 mg% and at 3 month follow up it was 36.26 gm% (68% had S. urea < 40 mg %). Mean S. creatinine level on admission was 4.03 mg%, at discharge it was 3.26 mg% and at 3 month follow up it was 1.2 gm% (56% patients had S. Creat. < 1.2 mg %). The difference at admission, discharge and 3 month follow up was statistically significant ($p< 0.05$). Mean input and output volume of patient significantly improved at discharge from their admission values ($p< 0.05$). The results showed continuous improvement in Renal function tests in the patients during the course of treatment.

HS Kohli et al,[12] demonstrated that in their group mean peak serum creatinine was 4.2 ± 2.21 (2.0- 10.6 mg/dl). In a study by Ravindra et al. to assess the mortality and recovery of renal functions in ARF, mean S. creatinine level on admission was 4.1 mg% and on discharge 53% patients had S. creat. Levels of < 1.2 mg%.[25] Bouchard et al. in a similar study observed the mean S. creatinine level on admission as 2.5 mg% and 47% patient's recovered normal renal functions at the time of discharge after treatment.[26] Nash et al,[9] reported complete recovery of renal function in 38.6 % of their patients, HS Kohli et al,[12] reported this in 86.3% and AnupamaKaul,[18] in 45 % of patients.

Urine Albumin was present in 56.5% patients while pus cells and RBC was present in 20.3% and 13% patients. Albumin is the preferred urinary protein. Increased urinary excretion of albumin is the earliest manifestation of CKD due to diabetes, other glomerular diseases, and hypertensive nephrosclerosis. Albuminuria may also accompany tubulointerstitial diseases, polycystic kidney disease, and kidney disease in kidney transplant recipients.[27]

On USG, normal kidneys was observed in over half of the patients (52.5%) while grade I and II Renal Paranchymal Changes(RPC) with normal sized kidneys was observed in 30.4% and 4.3% patients. Other findings included Cystitis, Pyelonephritis, Prostatomegaly and obstructive uropathy. ARDS on X-ray was observed in 10.1% while pulmonary oedema in 4.3% patients. Abnormal echo findings were observed in 5.8% patients. In present study deranged LFT was observed in 23.2% patients of Acute Kidney Injury. In a study by Bouchard et al. deranged liver functions were observed in 27% of patients with Acute Kidney Injury.[26]

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In present study deranged LFT was observed in 23.2% patients of Acute Kidney Injury. In a study by Bouchard et al. deranged liver functions were observed in 27% of patients with Acute Kidney Injury.[26]

Most common etiology for AKI was Sepsis (14.5%) and Malaria infection (14.5%) followed by Dengue, AGI and Leptospirosis (11.6% each). Multi organ dysfunction (14.5%) was observed in patients of Sepsis and Leptospirosis. Other diagnosis included cellulitis (7.2%), CCF and Cystitis (5.8% each), Pyelonephritis and UTI (4.3%), NSAID induced and obstructive uropathy (2.9%), diabetic ketoacidosis and enteric fever (1.4% each).

When blood cultures are positive, acute renal failure occurs in roughly 19% of patients with moderate sepsis, 23% of patients with severe sepsis, and 50% of patients with septic shock. Acute renal failure alone is associated with a death rate of 45%; however, when combined with sepsis, the mortality rate increases to 70%. Sepsis and acute renal failure together represent a particularly dangerous medical issue. According to earlier research, sepsis affects 12–48% of patients' chances of developing AKI or making it worse.[28-30]

In a study by Ravindra et al.[31] sepsis as a cause of AKI was observed in 28%, while Bouchard et al.[26] found the incidence of sepsis as 22%. V Jha et al,[22] reported in 26% while in other studies it was 45.7%12 and 15.8 %.[18]

Hou et al,[19] and Nash et al,[9] reported 2.3% and 2.1 % of AKI associated with urinary tract obstruction, which is similar to present study (2.9%).

In present study out of total patients, 92 (66.7% %) had stage II AKI, while 46 (33.3 %) had stage III AKI according to AKIN staging. No age and gender difference was observed in the distribution of patients according to AKI stage. Two out of 46 patients of AKI stage III (8.7%) and a single patient out of 92 (2.2%) belonging to AKI stage II died in the study.

Most of the patient of Sepsis and Leptospirosis (80% and 87.5%) were having stage III AKI, while all patients of MODS were having Stage III AKI. A total of 8 (11.6%) patients were on dialysis while 88.4% were not on dialysis. All the patients with AKI stage III were on Dialysis. A total of 3 patients died (mortality rate – 4.3%) during the study, all of which (100%) were having sepsis induced AKI.

Neveu et al. performed a prospective study involving 345 patients who had acute renal failure with or without sepsis. The most dramatic differences were the increased requirement for mechanical ventilation (70 percent vs. 47 percent, P=0.001) and the higher mortality (74.5 percent vs. 45.2 percent, P<0.001) in the patients with sepsis.[32] In a study by Ravindra et al.[31] Mortality rates for patients with sepsis induced AKI were higher than in sepsis-free patients (48% vs. 21%; p< 0.01). Compared with sepsis-free patients, those with sepsis were also more likely to be dialyzed (70 vs. 50%; p<0.01).

When staging the AKI patients according to the AKIN criteria, we found that the mortality rate went up with increasing severity of AKI. In our group the mortality rate the mortality with AKIN stages 2 and 3 were 2.2% and 8.7% respectively. AnupamaKaul,[18] found a mortality of 8.75%, 19.3% and 21.2% in stage I, II and III respectively. Hoste et al,[11] found that the mortality as 8.8 %, 11.4% and 26.3% respectively. Yi Fang et al,[20] demonstrated that the mortality rates with AKIN stage 1, 2 and 3 were 7%, 49.5% and 66.7% respectively.

CONCLUSION

The conclusions and decisions reached as a result of this investigation are those that are presented below. In this analysis, a male preponderance and AKI were found at ages that were substantially younger than predicted. The two diseases that were shown to be the most frequent causes of death were sepsis and malaria, with sepsis affecting the majority of patients. Leptospirosis and MODS were both discovered to be linked to stage III acute renal injury. The results showed that the fatality rate was 4.34 percent overall.

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