Indian Journal of Basic and Applied Medical Research; September 2020: Vol.-9, Issue- 4, P. 344 - 354
DOI: 10.36848/IJBAMR/2020/18215.56122

Original article:

Study of long term outcomes of acute renal failure

***Dr Sai Sekhar P , Dr Y Kondal Rao , Dr S Surya Prakasa Rao**

General Medicine, NRI Institute of Medical Sciences, Thagarapuvalasa, Andhra Pradesh 531163

*Corresponding author: Dr Sai Sekhar P , Assistant Professor , General Medicine, NRI Institute of Medical Sciences, Thagarapuvalasa, Andhra Pradesh 531163

Abstract:

Introduction: Acute kidney injury (AKI) is a major public health problem affecting millions of patients worldwide and leading to decreased survival, increased progression to underlying chronic kidney disease (CKD).

Materials and methods: This was Prospective follow up study conducted at NRI INSTITUTE OF MEDICAL SCIENCES for two years duration. Study subjects were individuals who are aged above 15 years and diagnosed to have AKI according to AKIN (or) RIFLE criteria.

Results and Conclusion: About 97.5% of study population got completely recovered from AKI by the end of 1 year. There was significant drop in serum urea, creatinine levels, electrolyte imbalances. ,eGFR is normalized in majority of patients through-out the study period and also between every follow-up which statistically highly significant. None among the study population had progressed to dialysis dependency.

Keywords: Acute kidney injury , RIFLE criteria.

Introduction:

Acute kidney injury (AKI) is a major public health problem affecting millions of patients worldwide and leading to decreased survival, increased progression to underlying chronic kidney disease (CKD). AKI is not a single disease but rather a syndrome comprising multiple clinical conditions. Outcomes in AKI are influenced by the underlying disease causing the condition, as well as by the severity and duration of renal impairment and by the baseline condition of the patient. The detrimental effects of AKI are not limited to classical well-known symptoms such as fluid overload and electrolyte abnormalities. AKI can also lead to problems that are not readily appreciated at the bedside and can extend well beyond the ICU stay. This study will is done to look for long-term outcome in survivors of AKI based on definition and classification criteria for AKI given by AKIN and RIFLE systems.[1]

The incidence of acute kidney injury (AKI) is increasing in hospitalized patients. The Acute Dialysis Quality Initiative (ADQI) consensus defines complete renal recovery as return to baseline classification within the RIFLE criteria and partial recovery as a change in RIFLE status in patient free of dialysis. In spite of this, few studies have evaluated renal recovery in the context of this recommendation. [2-8] Ali et al found that 68% of their population had full renal recovery and 5% had partial recovery based on the return of serum creatinine to its baseline value. [9] The factors associated with renal recovery or with progression to ESRD after an episode of AKI are not well established. Despite increasing recognition that renal recovery after AKI is an important outcome, surprisingly little data defining this outcome is available. In our study we included 80 patients who are diagnosed to have acute

kidney injury (including both the patients with and without renal replacement therapy) and followed up periodically for about one year from the date of discharge describing the pattern of renal recovery accordingly.

Materials and methods:

This was Prospective follow up study conducted at NRI INSTITUTE OF MEDICAL SCIENCES for two years duration. Study subjects were individuals who are aged above 15 years and diagnosed to have AKI according to AKIN (or) RIFLE criteria.

INCLUSION CRITERIA:

Patients who were diagnosed with AKI according to AKIN

EXCLUSION CRITERIA:

1. Patients with acute worsening of chronic kidney disease.
2. Patients who are already diagnosed with chronic kidney disease and on treatment.
3. Patients with co-morbid conditions like diabetes mellitus, essential hypertension and structural kidney diseases like polycystic kidney disease, medullary sponge kidney etc. are excluded.

METHODOLOGY:

This study included follow-up study of 80 survivors of AKI patients with serum urea, serum creatinine, serum electrolytes (low Hco3, hyperkalemia, hyponatremia), Haemogram (abnormal haemoglobin, leukocytosis, thrombocytopenia), Urine routine examination (pyuria, hematuria and proteinuria), Renal biopsy (where-ever indicated), Ultrasonography of abdomen and pelvis (as required), at admission, at discharge, at three months, at six months and at one year from NRI INSTITUTE OF MEDICAL SCIENCES, VISAKHAPATNAM from AUGUST 2018 To JULY 2019.

Observations and results:

This is a prospective follow-up study done in NRI INSTITUTE OF MEDICAL SCIENCES, VISAKHAPATNAM. The data was collected as per proforma and analysed. The results of study are depicted below.

TABLE 1: GENDER DISTRIBUTION

SEX	FREQUENCY	PERCENT
F	31	39
M	49	61
TOTAL	80	100

Indian Journal of Basic and Applied Medical Research; September 2020: Vol.-9, Issue- 4, P. 344 - 354
DOI: 10.36848/IJBAMR/2020/18215.56122

TABLE 2: Incidence of AKI based on etiology

DIAGNOSIS	FREQUENCY	PERCENT
ACUTE GASTROENTERITIS	4	5
ACUTE TUBULAR NECROSIS	3	3.75
LEPTOSPIROSIS	18	21.25
LOWER LIMB CELLULITIS	1	1.25
MALARIA	9	11.25
NEPHROTIC SYNDROME	2	2.5
PANCREATITIS	3	3.75
SCRUB TYPHUS	2	2.5
SEPSIS	34	42.5
SNAKE BITE	5	6.25
TOTAL	80	100

Based on the above study and data analysis, sepsis contributes as a cause for majority of patients with AKI by different mechanisms (either direct or indirect). Following sepsis, leptospirosis and malaria accounts for second and third major cause of AKI which shows endemicity and increased prevalence of disease .

TABLE 4: Showing Mean, Standard deviation and Friedman test of S.creatinine during study

S. Creatinine	N	Minimum	Maximum	Mean	Std. Deviation	Median	Friedman test	P value
At admission	80	1.2	11.1	5.34	2.24	5.10	227.004	0.000 HS
At discharge	80	0.3	4.2	1.85	0.70	1.80		
At 3 months	80	0.4	2.5	1.25	0.33	1.20		
At 6 months	80	0.5	1.9	1.07	0.37	1.00		
At 1 year	80	0.4	1.4	0.82	0.19	0.80		

TABLE 5: Showing pairwise comparisons by Wilcoxon signed rank test

Parameter	Mean difference	Change	P value	Significance
S. Creatinine At Admission				
At Discharge	3.486	65.28	0.000	HS
At 3 Months	4.094	76.65	0.000	HS
At 6 Months	4.273	80.02	0.000	HS
At 1 Year	4.520	84.74	0.000	HS
S. Creatinine At Discharge				
At 3 Months	0.608	32.76	0.000	HS
At 6 Months	0.787	42.46	0.000	HS
At 1 Year	1.330	56.05	0.000	HS
S. Creatinine At 3 Month				
At 6 Months	0.180	14.42	0.000	HS
At 1 Year	0.430	34.63	0.000	HS
S. Creatinine At 6 Months				
At 1 Year	0.250	23.62	0.000	HS

Above tables 4 and 5 represent the change in serum creatinine levels during follow-up period. By Friedman test and pairwise comparison by Wilcoxon signed rank test it is evident that there was significant drop in serum creatinine levels from admission till the end of 1 year (i.e., in every follow-up till end of study period) with P value 0.000 (<0.05).

TABLE 6: Showing McNemer test analysis in study population during study period

Parameter (Serum Creatinine)	McNemer Test Value	Significance
At Discharge – At Admission	0.000	Hs
At 3months – At Admission	0.000	Hs
At 6 Months – At Admission	0.000	Hs
At 1 Year – At Admission	0.000	Hs
At 3 Months – At Discharge	0.000	Hs
At 6 Months – At Discharge	0.000	Hs

At 1 Year – At Discharge	0.000	Hs
At 6 Months – At 3months	0.527	Ns
At 1 Year – At 3months	0.000	Hs
At 1 Year – At 6 Months	0.000	Hs

TABLE 7: Showing study population with normal and abnormal creatinine during study period

Parameter	**Normal**		**Abnormal**		**Total**	
Serum Creatinine	**No. Of Patients**	**%**	**No. Of Patients**	**%**	**No. Of Patients**	**%**
At admission	2	2.5	78	97.5	80	100
At discharge	18	22.5	62	77.5	80	100
At 3 month	60	75	20	25	80	100
At 6 months	62	77.5	18	22.5	80	100
At 1year	79	98.7	1	1.3	80	100

From the above tables 6, 7 and figure 5 it is evident that

1. At admission 97.5% of patients had abnormal creatinine and at the end of 1year only 1.3% of patients had abnormal serum creatinine.
2. Improvement of S.creatinine to normal level during follow-up period was significant till end of study period i.e., 1 year (which is evident by P value < 0.000 from McNemer test).

eGFR calculated at the end of 1 year for all study population as per MDRD eGFR formula (according to KDOQI CKD criteria [10] showed that only 2 individuals (2.5%) had eGFR less than 60 ml/min/1.73m^2 and are labelled as chronic kidney disease according to KDOQI guidelines. Remaining 78 individuals (97.5%) had eGFR above 60 ml/min/1.73m^2.

Indian Journal of Basic and Applied Medical Research; September 2020: Vol.-9, Issue- 4, P. 344 - 354
DOI: 10.36848/IJBAMR/2020/18215.56122

TABLE 8: Showing percentage and no. of subjects with CKD at end of 1year.

CKD	NO.OF SUBJECTS	% PERCENTAGE	P VALUE
ABSENT	78	97.5	0.000 HS
PRESENT	2	2.5	

TABLE 9: Showing Mean, Standard deviation and Friedman test of Blood urea during study

Blood Urea	N	Min	Maximum	Mean	S. Deviation	Median	Friedman Test	P Value
At Admission	80	51	319	131.54	62.60	118	**238.583**	**0.000 Hs**
At Discharge	80	14	103	54.37	19.23	53		
At 3 Months	80	15	56	31.85	8.61	30		
At 6 Months	80	14	49	27.35	7.78	27		
At 1 Year	80	14	52	25.38	7.76	23		

TABLE 10: Showing pairwise comparisons by Wilcoxon signed rank test

Parameter	Mean Difference	Change	P Value	Significance
Blood Urea At Admission				
At Discharge	77.177	58.67	0.000	Hs
At 3 Months	99.696	75.79	0.000	Hs
At 6 Months	104.190	79.21	0.000	Hs
At 1 Year	106.165	80.71	0.000	Hs
Blood Urea At Discharge				
At 3 Months	22.519	41.42	0.000	Hs
At 6 Months	27.013	49.69	0.000	Hs
At 1 Year	28.987	53.32	0.000	Hs
Blood Urea At 3 Months				
At 6 Months	4.494	14.11	0.000	Hs
At 1 Year	6.468	20.31	0.000	Hs
Blood Urea At 6 Months				
At 1 Year	1.975	7.22	0.013	Sig

From the above tables 9 and 10, the drop in blood urea levels are analysed during follow-up period by Friedman test and pairwise comparison by Wilcoxon signed rank test .It is evident that there was significant drop in blood urea level from admission to 6 months (about 79.21%) with P value <0.000which is statistically highly significant whereas from 6 months to the end of 1 year, there was slight significant drop in blood urea levels (about 7.22%) with P value of 0.013 (<0.05) which is just statistically significant.

TABLE 11: Showing McNemer test analysis in study population during study period

Parameter (Blood Urea)	McNemer Test P Value	Significance
At Discharge – At Admission	0.000	Hs
At 3months – At Admission	0.000	Hs
At 6 Months – At Admission	0.000	Hs
At 1 Year – At Admission	0.000	Hs
At 3 Months – At Discharge	0.000	Hs
At 6 Months – At Discharge	0.000	Hs
At 1 Year – At Discharge	0.000	Hs
At 6 Months – At 3months	0.046	Sig
At 1 Year – At 3months	0.046	Sig
At 1 Year – At 6 Months	1.000	Ns

TABLE 12: Showing study population with normal and abnormal Blood Urea during study period

Parameter	Normal		Abnormal		Total	
Blood Urea	No. Of Patients	%	No. Of Patients	%	No. Of Patients	%
At Admission	0	0	80	100	80	100
At Discharge	24	30	56	70	80	100
At 3 Month	74	92.5	6	7.5	80	100
At 6 Months	78	97.5	2	2.5	80	100
At 1year	78	97.5	2	2.5	80	100

From the above tables 11, 12 and figure 8 it is evident that

1. At admission 100% of patients had abnormal blood urea and at the end of 1 year 2.5% of patients had abnormal blood urea.
2. Improvement of blood urea to normal level during follow-up period was significant till 6months (which is evident by P values 0.000 and 0.046 < 0.05 from McNemer test) and after 6months it is statistically insignificant (which is evident by P value 1.000 > 0.05 from McNemer test)

TABLE 13: Showing study population with normal and abnormal S.electrolytes during study period.

Parameter	Normal		Abnormal		Total	
Serum Electrolytes	No. Of Patients	%	No. Of Patients	%	No. Of Patients	%
At Admission	11	13.75	69	86.25	80	100
At Discharge	11	13.75	69	86.25	80	100
At 3 Month	78	97.5	2	2.5	80	100
At 6 Months	79	98.75	1	1.25	80	100
At 1year	78	97.5	2	2.5	80	100

TABLE 14: Showing McNemer test analysis in study population during study period.

Parameter (Serum Electrolytes)	McNemer Test P Value	Significance
At Discharge – At Admission	1.000	Ns
At 3months – At Admission	0.000	Hs
At 6 Months – At Admission	0.004	Hs
At 1 Year – At Admission	0.000	Hs
At 3 Months – At Discharge	0.000	Hs
At 6 Months – At Discharge	0.004	Hs
At 1 Year – At Discharge	0.000	Hs
At 6 Months – At 3months	0.000	Hs
At 1 Year – At 3months	1.000	Ns
At 1 Year – At 6 Months	0.000	Hs

From the above table 13, 14 and figure 9 it is evident that

- About 86.25% of study population had abnormal serum electrolytes at the time of admission and 2.5% abnormal at the end of study period (1year).
- Serum electrolytes took about 3 months duration to get normalised which is statistically significant with P value <0.05.
- After 3 months there was no significant percentage of patients becoming normal which is statistically insignificant with P value >0.05.

DISCUSSION:

Acute kidney injury (AKI) [1, 2] is defined as an abrupt decline in renal function resulting in the inability to excrete metabolic wastes and maintain proper fluid and electrolyte balance.. This study was done in survivors of AKI who are defined based on definition and classification criteria for AKI given by AKIN and RIFLE systems to know the long term outcome and sequelae of AKI. The recovery of kidney function following AKI is an important

determinant of morbidity and may have long-term implications for the health and well-being of patients. Accordingly, the long-term follow-up study by Schiffl and Fischer is an important addition to our understanding of the natural history of AKI in critical illness. [10,11] They performed a prospective 5-year follow-up study of 425 patients with severe AKI treated with RRT. Notably, no patient had evidence of pre-existing CKD when defined by radiologic signs of CKD, persistent abnormal urinalysis or a decreased estimated glomerular filtration rate (eGFR) or elevated serum creatinine [>1.3 mg/dl (115 μmol/L)].

At the time of hospital discharge, only 57% had achieved complete recovery, while the remaining 43% had partial recovery and no patient was receiving chronic dialysis. This study also showed that at end of 1 year, 26% of survivors had evidence of CKD (stages 2–5) and at 5 years, the prevalence of CKD in survivors was only 14%, yet, the apparent improvement with time was largely attributable to deaths for those who had partial recovery. This study had also shown that if patients failed to normalize function by 6–12 months after their episode of AKI, no further recovery occurred. Remarkably, only 2% of survivors progressed to ESRD and required re-initiation of dialysis.

Based on the long-term follow-up study in AKI patients done by Schiffl and Fischer, we had conducted a prospective follow-up study for 1 year on long-term outcome and sequelae of AKI within the survivors of AKI of varied aetiology without any pre-existing evidence of CKD in our hospital setting. In this study, we studied the pattern of recovery and time duration required for recovery of renal function after AKI. We also studied the recovery of other parameters like urine analysis, serum electrolytes and complete haemogram to the normal limits following AKI. This study also analysed the percentage of survivors of AKI progressed into the chronic kidney disease and dialysis dependency.

We studied a total of 80 cases of survivors of episode of AKI of varied aetiology who are admitted in NRI INSTITUTE OF MEDICAL SCIENCES based on purposive sampling technique with both inclusion and exclusion criteria as mentioned above. Patient's data was collected as per proforma at time of admission, discharge, 3months, 6months and 1year. Collected data was analysed by frequency, percentage, Mean and S.D. Tests such as Friedman test used to compare the change within the group and post hoc analysis by Wilcoxon signed rank test is performed. McNemer test was carried out to compare the change in parameter if any from abnormal to normal in study population during the follow-up period.

Majority of individuals enrolled in our study are males which was around 61.25%.Majority of the patients with AKI falls between 21 to 30 years. Therefore incidence of AKI is more during 3rd decade of life. Based on the above study and data analysis, sepsis contributes as a cause for majority of patients with AKI by different mechanisms (either direct or indirect). Following sepsis, leptospirosis and malaria accounts for second and third major cause of AKI which shows endemicity and increased prevalence of disease in South-Karnataka region. Based on the recovery of renal function with serum creatinine as a determinant it is evident from the analysis that, at admission 97.5% of patients had abnormal creatinine and at the end of 1 year only 1.3% of patients had abnormal creatinine. Recovery of S.creatinine to normal level during follow-up period was significant till the end of 1 year (which is evident by P value < 0.000 from McNemer test). Significant changes in serum creatinine are assessed by Friedman test and pairwise comparison by Wilcoxon signed rank test and it is evident that there was significant drop

in serum creatinine levels from admission till the end of 1 year (i.e., in every follow-up till end of study period) with P value 0.000 (<0.05).

Progression of AKI to CKD is assessed by calculating the reduced effective glomerular filtration rate (to less than 60 ml/min/1.73m^2) according to KDOQI CKD guidelines. eGFR calculated at the end of 1 year for all study population as per MDRD eGFR formula showed that only 2 individuals (2.5%) had eGFR less than 60 ml/min/1.73m^2 and are labelled as chronic kidney disease. Remaining 78 individuals (97.5%) had eGFR above 60 ml/min/1.73m^2. Data analysis of blood urea levels showed that, at admission 100% of patients had abnormal blood urea and at the end of 1 year 2.5% of patients had abnormal blood urea. Improvement of blood urea to normal level during follow-up period were significant till 6months (which is evident by P values 0.000 and 0.046 < 0.05 from McNemer test) and after 6months drop in blood urea levels were statistically insignificant (which is evident by P value 1.000 > 0.05 from McNemer test) From the end of 3 months to end of 1 year, study population who got normalised are statistically insignificant with McNemer test P value 0.317 (>0.05).

From this study we observed that there was significant drop in serum creatinine levels through-out the study period. It is also observed from the pairwise comparison that drop in creatinine is statistically highly significant in every follow-up.

Conclusion:

1. About 97.5% of study population got completely recovered from AKI by the end of 1 year.
2. There was significant drop in serum urea, creatinine levels, electrolyte imbalances. ,eGFR is normalized in majority of patients through-out the study period and also between every follow-up which statistically highly significant.
3. None among the study population had progressed to dialysis dependency.

References:

1. Kidney Disease: Improving Global Outcomes (KDIGO) Acute Kidney Injury Work Group. KDIGO Clinical Practice Guideline for Acute Kidney Injury. Kidney inter., Suppl. 2012; 2: 1–138.
2. Kellum JA, Levin N, Bouman C, Lameire N. Developing a consensus classification system for acute renal failure. Curr Opin Crit Care 2002; 8: 509–514.
3. Uchino S, Kellum JA, Bellomo R, Doig GS, Morimatsu H, Morgera S et al. Acute renal failure in critically ill patients: a multinational, multicenter study. JAMA 2005; 294: 813–818.
4. Bellomo R, Kellum J, Ronco C. Acute renal failure: time for consensus. Intensive Care Med 2001; 27: 1685–1688.
5. Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P, ADQI workgroup. Acute renal failure - definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. Crit Care 2004; 8: R204–R212.
6. Mehta RL, Kellum JA, Shah SV, Molitoris BA, Ronco C, Warnock DG et al. Acute kidney injury network: report of an initiative to improve outcomes in acute kidney injury. Crit Care 2007; 11: R31.
7. Hoste EA, Kellum JA. Acute kidney injury: epidemiology and diagnostic criteria. CurrOpin Crit Care 2006; 12: 531–537.
8. Bagshaw SM, George C, Bellomo R, ANZICS Database Management Committee. A comparison of the RIFLE and AKIN criteria for acute kidney injury in critically ill patients. Nephrol Dial Transplant 2008; 23: 1569–1574.

9. Ali T, Khan I, Simpson W, Prescott G, Townend J, Smith W et al. Incidence and outcomes in acute kidney injury: a comprehensive population-based study. J Am Soc Nephrol 2007; 18: 1292–1298.
10. National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Am J Kidney Dis 2002; 39: S1–266.
11. Schiffl H, Fischer R. Five-year outcomes of severe acute kidney injury requiring renal replacement therapy. Nephrol Dial Transplant 2008; 23: 2235-2241.

Date of Submission: 21Aug 2020 Date of Publishing: 30 September 2020
Author Declaration: Source of support: Nil, Conflict of interest: Nil
Ethics Committee Approval obtained for this study? YES
Was informed consent obtained from the subjects involved in the study? YES
For any images presented appropriate consent has been obtained from the subjects: YES
Plagiarism Checked: Using duplichecker.com

DOI: 10.36848/IJBAMR/2020/18215.56122