Clinical Outcomes of Acute Kidney Injury in Federal Medical Center Owo: Patterns and Determinants

Olalekan E. Ojo[1], Ayoola Odeyemi[1], Chinwe Okogbaa[1] and Olubukola A. Ojo[2]

[1]Department of Medicine, Federal Medical Centre, Owo, Ondo State, Nigeria
[2]Endocrinology Unit, Department of Medicine, Federal Medical Centre, Owo, Ondo State, Nigeria

ABSTRACT

Introduction: Acute Kidney injury (AKI) is a serious disorder of kidney function associated with prolonged hospital stay and mortality. The differences seen between developed and developing countries in the epidemiologic pattern of AKI include, the individuals affected, the etiology of AKI, the setting in which AKI occurs, the modalities of renal replacement therapy available, and the patient outcomes

Methods: We present a retrospective 3 year review of AKI patients admitted to a tertiary level hospital, Federal Medical Center. The medical records of all adult patients admitted during the period from January 1st, 2018 to December 31st, 2020 were extracted and reviewed for the presence or diagnosis of AKI. Acute kidney injury was defined in accordance with Kidney Disease Improving Global Outcome (KDIGO) guidelines. The medical records of 86 patients with AKI were reviewed. About a quarter of the studied population (26.1%) died in the course of the treatment.

Results: Dialysis treated AKI patients contributed to >70% of the population. 45.3% of our patients who had dialysis-requiring AKI and survived did recover sufficient kidney function to become dialysis independent over a short period of time. Age is a significant predictor of mortality in this study. Serum creatinine, hyponatremia and elevated blood pressures are also predictors of mortality and progression to CRF in this study.

Conclusion: Our data highlight the public health importance of AKI and the need for adequate resources for Nephrology.

INTRODUCTION

Uncertainties of management strategies and prognosis have made Acute Kidney Injury (AKI) a complex disease. AKI is a serious disorder of kidney function associated with prolonged hospital stay and significant morbidity and mortality[1,2]. Mortality from AKI is high, with mortality in patients admitted to hospital with AKI ranging from 16% to 63.3%[1,3]. The epidemiologic pattern of AKI differs significantly between developed and developing countries and is thought to closely mirror the socioeconomic status of the community[4,5]. The differences seen between developed and developing countries in the epidemiologic pattern of AKI include, the individuals affected, the etiology of AKI, the setting in which AKI occurs, the modalities of renal replacement therapy available, and the patient outcomes. This study aimed to determine the outcomes of patients admitted with AKI at our hospital as well as identify the determinants of poor outcomes in these patients.

METHODS

A retrospective, hospital-based study was done in Federal Medical Center, Owo, Nigeria. Federal Medical Center, Owo is a 300-bed capacity tertiary Health institution, known to have an accessible, good

Corresponding author: **Olalekan E. Ojo,** Department of Medicine, Federal Medical Centre, Owo, Ondo State

Email: ayolekan2001@yahoo.co.uk Telephone: +234806 228 3308

quality hospital medical records system designed for research purposes.[6]

The medical records of all adult patients managed for AKI and admitted during the period from January 1st, 2018 to December 31st, 2020were extracted. Data for analysis obtained from the hemodialysis case records and the in-patient case files, include the demographic data, the aetio-pathologic cause of AKI as documented by the managing renal team, the hematocrit level at presentation, the electrolytes, urea and creatinine profiles, as well as the clinical indication(s) for hemodialysis which includes intractable vomiting, hiccups, uremic encephalopathy, acute pulmonary edema, bleeding diatheses etc. Other indications for dialysis include severe metabolic acidosis (plasma bicarbonate <12 mmol/l), severe hyperkalemia (plasma potassium level >6.5 mmol/l), severe azotemia (serum creatinine level >500umol/l) and evidence of hyper-catabolism.

Acute kidney injury was defined in accordance with Kidney Disease Improving Global Outcome (KDIGO) guidelines as an increase in serum creatinine by e"26.6µmol/l within 48hours or increase in serum creatinine by e"1.5x baseline known or presumed to have occurred within prior 7days or urine volume <0.5mL/kg/h for 6hours. Because the urine output records as obtained in the case records were found not likely to be accurate, the serum creatinine level (sCr) in µmol/L was used for the diagnosis of AKI[7]. Patients less than 18 years of age, known chronic kidney patients or ultrasonographic evidence of chronic kidney disease, patients already on maintenance hemodialysis were excluded from the study.

Outcome measures were death during course of treatment, failure of recovery of kidney function at 3 months, full recovery and referral or discharge against medical advice (DAMA). AKI was stated as fully recovered and patient discharged home when the serum creatinine had returned to levels within the normal laboratory reference values (60–110µmol/L) or its prior baseline levels within three months. Patients who had not recovered their renal function by three months were deemed to have chronic kidney disease (CKD). Indications for referral are patients/ relatives request and faulty hemodialysis equipment.

The study was approved by the ethical committee of the Federal Medical Center, Owo.

Statistical analysis

Data analysis was done using Statistical Package for Social Science (SPSS) version 21. Descriptive analysis of continuous data was applied using means with standard deviations (SD). Chi square test and Fischer's exact test were applied for discrete data with the levels of significance being set at <0.05.

RESULTS

A total of 92 AKI patients were managed during the studied. However, due to unavailability or incomplete medical records, six patients were excluded from the analysis. Of the 86 patients whose medical records were available for analysis, male patients (53.5%)

Table 1: Characteristics of AKI patients

Parameter	**n=86**
Demography	
Mean Age(years)	39.62 ±15.42
Gender %	
Female	40 (46.5)
Male	46 (53.5)
Marital status %	
Married	68 (79.1)
Single	18 (20.9)
Clinical features	
Mean SBP (mmhg)	143.39±28.27
Mean DBP (mmhg)	86.79±16.00
Laboratory features	
Mean PCV (%)	22.71±8.09
Mean potassium(mmol/l)	4.49±0.92
Mean sodium(mmol/l)	134.55±6.73
Mean urea(mmol/l)	33.53±12.27
Mean creatinine(umol/l)	815.72±422.73
Ward	
ICU	3 (3.5%)
Open ward	83 (96.5)
Outcomes %	
Dialysis	67 (77.9)
CKD	21 (24.4)
Death	23 (26.1)
Recovered	39 (45.3)
Referred/DAMA	3 (3.5)

Fischer's exact test were applied for discrete data with the levels of significance being set at <0.05.

were more than the female patients (46.5%); and majority of the patients were married (79.1%).

The pattern of the outcome as presented on Table 2 indicate that a majority of 39 (45.3%) of the total number of patients analyzed in this study recovered; this was followed by 23(26.1%) who died in the course of treatment. As presented on table 2, dialysis was performed on (77.9%) of the patients, and they were mostly (96.5%) admitted into the general ward.

Table 2: Clinical outcomes of AKI patients

	Freq (n=86)	%
CKD	21	24.4
Death	23	26.1
Recovered	39	45.3
Referred/DAMA	3	3.5

Table 3 presents the results of chi square test carried out to investigate possible association between outcome and dialysis, ward, gender and marital Status. The result indicates no significant association between outcome and these demographic parameters (*P>0.05*).

Table 3: Pattern of distribution of dialysis, ward, gender and marital Status

	Freq. (n=86)	%
Gender		
Female	40	46.5
Male	46	53.5
Marital Status		
Married	68	79.1
Single	18	20.9
Ward		
ICU	3	3.5
General	83	96.5
Dialysis		
No	19	22.1
Yes	67	77.9

Table 4 compared the possible differences in laboratory parameters across the various outcomes. No significant difference (*P=0.094*) was noted in the mean PCV of patients across outcomes. A significant difference (*P<0.001*) was noted in mean creatinine level of samples obtained from patients across outcomes. Patients with CKD had the highest mean creatinine level(1620.0±141.4umol/l) while patients who were referred/ DAMA had the least mean level (597.7±245.4umol/l). No significant difference (*P=0.073*) was noted in the mean serum urea level of patients across the outcomes. A significant difference (*P=0.003*) was noted in the mean serum sodium level across outcomes. Patients with CKD had the least mean sodium level while patients who were referred/ DAMA had the highest mean serum sodium levels.

Table 4: Comparison between demographic and clinical outcomes parameters

	CKD	Death	Recovered	Referred /DAMA	P value
Marital Status					
Married	16	21	29	2	0.419
Single	5	2	10	1	
Gender					
Female	10	9	18	3	0.410
Male	11	14	21	0	
Ward					
ICU	0	3	0	0	0.074
Open	21	20	39	3	
Dialysis					
No	1	7	10	1	0.274
Yes	20	16	29	2	

Table 5 presents the results of analysis of variance test carried out to investigate possible differences of outcomes in age, systolic BP, diastolic BP and electrolytes. Patients who died had the highest mean age (54.61 years) while those who were referred/ DAMA had the least mean age (26years). . Patients with CKD had the highest mean systolic BP (160.0±14.1mmHg) and mean diastolic BP (100.0±14.1mmHg), while patients who were referred had the least mean systolic BP (126.7±15.3mmHg) and mean diastolic BP (83.3±15.3mmHg). Age was significantly different across the outcomes. No significant difference (*P=0.313*) was noted in the serum potassium level across outcomes. A significant difference (*P<0.05*) was noted in the mean systolic BP and mean diastolic BP of patients across outcomes.

Table 5: Comparison between laboratory parameters and clinical outcomes

	Outcomes	N	Mean±SD	p. value
Age	CKD	21	41.47±16.60	
	Death	23	54.61±19.68	
	Recovered	39	34.38±13.82	0.0001*
	Referred/DAMA	3	28.00±3.46	
Diastolic BP	CKD	21	101.05±17.61	
	Death	22	79.09±17.70	
	Recovered	38	83.68±13.44	0.0001*
	Referred/DAMA	3	83.33±15.27	
Systolic BP	CKD	21	166.32±35.15	
	Death	22	141.36±33.42	
	Recovered	38	139.23±29.23	0.025*
	Referred/DAMA	3	126.67±15.27	
Potassium	CKD	20	4.64±1.06	
	Death	23	4.85±1.29	
	Recovered	38	4.32±0.87	0.0001*
	Referred/DAMA	3	4.17±0.46	
PCV	CKD	19	23.63±7.14	
	Death	23	28.22±9.72	
	Recovered	36	25.31±10.89	0.094
	Referred/DAMA	3	12.67±4.62	
Sodium	CKD	18	130.12±9.45	
	Death	22	128.14±8.92	
	Recovered	39	130.59±7.54	0.003*
	Referred/DAMA	3	149.33±9.82	
Urea	CKD	21	38.67±16.12	
	Death	23	33.87±17.67	
	Recovered	39	27.84±14.14	0.073
	Referred/DAMA	3	33.73±1.16	
Creatinine	CKD	18	130.12±9.45	
	Death	22	128.14±8.92	
	Recovered	39	130.59±7.54	0.003
	Referred/DAMA	3	149.33±9.82	

** Significant variables at 0.05*

DISCUSSION

About a quarter of the studied population (26.1%) died in the course of treatment, this is similar to 26.4% and 28.8% reported by Makusidi et al[8] and Okunola et al[9] respectively. This however is in sharp contrast with the 48% reported by Emem-Chioma et al[10]. Studies done in United Kingdom and China revealed mortality rates of 28.1%[11] and 23.9%[12] respectively. In-hospital mortality rate for AKI has been reported to vary between 35%-50%[13]; and this is consistent across numerous clinical contexts[14,15,16]. However, emerging data including our study showed that mortality rates in AKI patients is decreasing[17]. Possible reasons attributable to this finding are prompt referral to Nephrologist, early diagnosis and commencement of dialysis.

Surprisingly, dialysis treated AKI patients contributed to >70% of the studied group. This percentage may however be higher because some may require dialysis but its poorly accessible in Nigeria due to the high cost of hemodialysis[18]. This finding is similar to epidemiological trend in South Indian region in a study by Jayakumar et al[19] which

recorded 69% of AKI patients requiring dialysis. Similar work by Hassan et al[20] recorded all their patients requiring dialysis. Several studies done in Nigeria showed that about 29-91% of AKI patients needed RRT during the course of management[9,21,22].

In this study, we found that 45.3% of our patients who had dialysis-requiring AKI and survived did recover sufficient kidney function to become dialysis independent before discharge home. There is however a relatively high risk of developing progressive CKD (including ESRD) months or years later. The underlying mechanism of how AKI leads to the progression of CKD is not fully understood. But damage to the renal parenchyma acquired during episodes of acute tubular necrosis can lead to persistent tubulointerstitial fibrosis and a decrease in the number of functioning nephrons[10].

Age is a significant predictor of mortality in this study. Many studies define the elderly as those who are 65 years old or older, while others accept a cutoff of 60 years. The life expectancy in Nigeria is 60.87 years, as compared to 72–82 years in more developed countries[23]. Thus, this cutoff of 65 years may not be appropriate in the Nigerian context. Aging is associated with the development of multi-organ dysfunction, which may influence the outcome of AKI. It is still uncertain if increasing age per se is a predictor of mortality, however increasing age is associated with higher co-morbid conditions. Holmes et al[24] in a study done in low income region, found out that age is an independent risk factor for AKI mortality especially in elderly.

Serum Creatinine was associated with outcome in our study, higher creatinine levels were found in patients that progressed to CRF. There is also an association between hyponatremia and elevated blood pressures with mortality and progression to CRF in this study. This finding was similar to works done by Gao and colleagues[25], they found increased mortality amongst AKI patients with hyponatremia. Kolhe et al.[11] also evaluated data from the United Kingdom Intensive Care National Audit and Research Center Case Mix Program, they noted increased mortality in AKI patients with hyponatremia.

Limitations of this study include its single center retrospective nature. There is also a possibility that some patients died before a nephrological assessment was carried out. Other limitations include incomplete manual medical records and inability to predict long term patient renal and survival outcome.

REFERENCES

1. Chertow GM, Burdick E, Honour M, Bonventre J V, Bates DW. Acute kidney injury, mortality, length of stay, and costs in hospitalized patients. J Am Soc Nephrol. 2005;16(11):3365-3370. doi:10.1681/ASN.2004090740
2. Thadhani R, Pascual M, Bonventre J V. Acute renal failure. N Engl J Med. 1996;334(22):1448-1460. doi:10.1056/NEJM199605303342207
3. Kadiri S, Ogunlesi A, Osinfade K, Akinkugbe OO. The causes and course of acute tubular necrosis in Nigerians. Afr J Med Med Sci. 1992;21(1):91-96. http://europepmc.org/abstract/MED/1288251
4. Naicker S, Aboud O, Gharbi MB. Epidemiology of acute kidney injury in Africa. Semin Nephrol. 2008;28(4):348-353. doi:10.1016/j.semnephrol.2008.04.003
5. Levin A, Kellum JA, Mehta RL. Acute kidney injury: toward an integrated understanding through development of a research agenda. Clin J Am Soc Nephrol. 2008;3(3):862-863. doi:10.2215/CJN. 04841107
6. HOME Federal Medical Centre Owo.
7. KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney Int Suppl. 2013; 3(1):4-4.
8. Chijioke A, Makusidi A. Severe acute kidney injury in adult Nigerians from university of Ilorin teaching hospital, Ilorin, Kwara state. BOMJ. 2011;8(1):5-9.
9. Okunola OO, Arogundade FA, Sanusi AA, Akinsola A. Acute renal failure in the intensive care unit: aetiological and predisposing factors and outcome. West Afr J Med. 2009;28(4):240-244.
10. Emem-Chioma PC, Alasia DD, Wokoma FS. Clinical outcomes of dialysis-treated acute kidney injury patients at the University of Port Harcourt teaching hospital, Nigeria. Int Sch Res Not. 2013;2013.

11. Kolhe N V, Stevens PE, Crowe A V, Lipkin GW, Harrison DA. Case mix, outcome and activity for patients with severe acute kidney injury during the first 24 hours after admission to an adult, general critical care unit: application of predictive models from a secondary analysis of the ICNARC Case Mix Programme dat. Crit Care. 2008;12 Suppl 1(Suppl 1):S2. doi:10.1186/cc7003\

12. Lu R, MuciAo-Bermejo M-J, Armignacco P, et al. Survey of acute kidney injury and related risk factors of mortality in hospitalized patients in a third-level urban hospital of Shanghai. Blood Purif. 2014;38(2):140-148.

13. Waikar SS, Liu KD, Chertow GM. Diagnosis, epidemiology and outcomes of acute kidney injury. Clin J Am Soc Nephrol. 2008;3(3):844-861.

14. Nisula S, Kaukonen K-M, Vaara ST, et al. Incidence, risk factors and 90-day mortality of patients with acute kidney injury in Finnish intensive care units: the FINNAKI study. Intensive Care Med. 2013;39(3):420-428.

15. Vaara ST, Pettilä V, Reinikainen M, Kaukonen K-M. Population-based incidence, mortality and quality of life in critically ill patients treated with renal replacement therapy: a nationwide retrospective cohort study in Finnish intensive care units. Crit care. 2012;16(1):1-8.

16. Liangos O, Wald R, O'Bell JW, Price L, Pereira BJ, Jaber BL. Epidemiology and outcomes of acute renal failure in hospitalized patients: a national survey. Clin J Am Soc Nephrol. 2006;1(1):43-51.

17. Waikar SS, Curhan GC, Wald R, McCarthy EP, Chertow GM. Declining mortality in patients with acute renal failure, 1988 to 2002. J Am Soc Nephrol. 2006;17(4):1143-1150.

18. Unuigbe E. Funding renal care in Nigeria: a critical appraisal. Trop J Nephrol. 2006;1(1):33-38.

19. Jayakumar M, Ram Prabahar M, Fernando EM, Manorajan R, Venkatraman R, Balaraman V. Epidemiologic trend changes in acute renal failure—a tertiary center experience from South India. Ren Fail. 2006;28(5):405-410.

20. Hassan I, Junejo AM, Dawani ML. Etiology and outcome of acute renal failure in pregnancy. J Coll Physicians Surg Pak. 2009;19(11):714-717.

21. Muhammad MA, Liman HM, Yakubu A, Isah MD, Abdullahi S, Chijioke A. Clinical pattern and outcome of acute kidney injury patients from a Tertiary Health Institution in Northwestern Nigeria. Sahel Med J. 2016;19(3):142.

22. Bello BT, Busari AA, Amira CO, Raji YR, Braimoh RW. Acute kidney injury in Lagos: Pattern, outcomes, and predictors of in hospital mortality. Niger J Clin Pract. 2017;20(2):194-199.

23. Popoola OT. Population Growth and Life Expectancy in Nigeria/ : Issues and Further Population Growth and Life Expectancy in Nigeria/ : Issues and Further Considerations. 2018;(May). doi:10.30560/hssr.v1n1p30

24. Holmes J, Phillips D, Donovan K, et al. Acute kidney injury, age, and socioeconomic deprivation: evaluation of a national data set. Kidney Int reports. 2019;4(6):824-832.

25. Gao X, Zheng C, Liao M, et al. Admission serum sodium and potassium levels predict survival among critically ill patients with acute kidney injury: a cohort study. BMC Nephrol. 2019;20(1):1-10.