

Acute kidney injury in Lagos: Pattern, outcomes, and predictors of in-hospital mortality

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Abstract

Context: The pattern of acute kidney injury (AKI) differs significantly between developed and developing countries.

Aims: The aim of the study was to determine the pattern and clinical outcomes of AKI in Lagos, Southwest Nigeria.

Settings and Design: A retrospective review of hospital records of all patients with a diagnosis of AKI over a 20-month period.

Subjects and Methods: Records of 54 patients were reviewed. Information retrieved included, bio-data, etiology of AKI, results of laboratory investigations, and patient outcomes.

Statistical Analysis Used: Continuous data are presented as means while categorical data are presented as proportions. The Student's *t*-test was used to compare means while Chi-square test was used to compare percentages. Logistic regression analysis was used to determine the factors that predicted in-hospital mortality.

Results: Twenty-seven (50%) of the patients were male. The mean age of the study population was 39.7 years \pm 16.3 years. Sepsis was the etiology of AKI in 52.1% of cases. Overall, in-hospital mortality was 29.6%. Patients who died had a shorter mean duration of hospital stay (9.2 days vs. 33.9 days [$P < 0.01$]), lower mean serum bicarbonate (19.5 mmol/L vs. 22.9 mmol/L [$P = 0.02$]), were more likely to be admitted unconscious (82.4% vs. 17.6% [$P = 0.01$]) and to have been admitted to the Intensive Care Unit (37.5% vs. 7.9% [$P = 0.01$]). In addition, when dialysis was indicated, patients who did not have dialysis were more likely to die (58.3% vs. 41.7% [$P = 0.02$]).

Conclusions: The pattern of AKI in this study is similar to that from other developing countries. In-hospital mortality remains high although most of the causes are preventable.

Key words: Acute kidney injury, etiology, in-hospital mortality, outcomes

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Introduction

Acute kidney injury (AKI) is a serious disorder of kidney function associated with prolonged hospital stay and

significant morbidity and mortality.^[1-4] Mortality from AKI is high, with mortality in patients admitted to hospital with AKI ranging from 16% to 63.3%.^[1,3,5] The epidemiologic pattern of AKI differs significantly between developed and developing countries and is thought to closely mirror the socioeconomic status of the community.^[5,6] The differences seen between developed and developing countries in the epidemiologic pattern of AKI include, the individuals

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affected, the etiology of AKI, the setting in which AKI occurs, the modalities of renal replacement therapy available, and the patient outcomes.

Most cases of AKI in developed countries are hospital-acquired and usually follow major surgical procedures or trauma, medications, sepsis, and multiple comorbidities. The affected individuals also tend to be older, most patients being generally older than 60 years of age.^[6] Conversely, in developing countries, most cases of AKI are community acquired with community-acquired infections and obstetric complications being responsible for the majority of cases and the affected individuals being generally younger.^[6] There is a paucity of data on AKI from the West African sub-region to which Nigeria belongs^[5,7] compared to that from other parts of the world.^[1-4] The last published study on AKI among adult patients from our center was over 20 years ago.

The aim of the study is to describe the pattern and outcomes of adult patients admitted with AKI at our center as well as identify factors associated with poor outcomes in these patients.

Subjects and Methods

The study was a retrospective review of patients who were admitted with AKI or acute renal failure at our tertiary healthcare facility located in Lagos, Southwest Nigeria. Our center is one of two government-funded centers providing tertiary multidisciplinary care to residents of Lagos, a cosmopolitan state with a population of about 9 million people.

Data collection

The renal unit of the hospital is responsible for providing both in- and out-patient care (including renal replacement therapy) for patients with kidney disease who present to the hospital. The unit admits directly, patients presenting with kidney disease as the primary diagnosis and co-manages, with other specialties, patients whose primary reason for admission was not kidney disease but developed renal impairment while on admission. The unit keeps a record of all patients admitted by the unit as well as those co-managed with other specialties as in-patient referrals. Information available in this database includes the patient's biodata, admitting diagnoses, date of hospital admission, date of first nephrology review, and the outcomes. We identified all patients with a diagnosis of AKI or acute renal failure from the database and retrieved their hospital records.

Patient data were retrieved from the hospital notes using a structured questionnaire. Information retrieved included, age, gender, occupation, duration of illness before presentation, duration of hospital admission, etiology of AKI,

associated comorbidities, urine volume per day, whether or not dialysis was carried out, indications for dialysis, number of dialysis sessions, any delay in initiating dialysis, and duration of delay before dialysis was initiated. Results of hematological and biochemical investigations done on admission as well as the outcome in each patient were also recorded.

Definition of the acute kidney injury

For the purpose of this study, AKI was defined as the presence of any one of the following:

- A serum creatinine value of >4 mg/dL (354 μ mol/L) in the absence of a prior history of, or clinical features to suggest the presence of, chronic kidney disease
- A 150% (1.5-fold) increase in serum creatinine from baseline occurring within 48 h
- Urine output <400 ml/day for patients admitted into the open wards or urine output of <0.5 ml/kg/h lasting at least 6 h for patients admitted into the Intensive Care Unit (ICU), provided obstruction of the urinary tract had been ruled out.

The above definitions for AKI were adopted in order to address the peculiar challenges in the population from which the study sample was pooled. For example, because of nursing staff shortages, urine output of patients admitted into the open wards are not charted hourly. Furthermore, although tests of renal function are routinely requested at the time of admission and when indicated, often times there are delays in carrying out the test and in a few cases, the tests are not carried out at all because of issues of affordability.

Indications for dialysis

B.B.T and B.A.A independently reviewed the records of all patients included in the study to determine the presence of any indication for dialysis during the period of the illness. For the purpose of the study, an indication for dialysis was defined as present when both reviewers opined that the patient required dialysis. The presence of any of the following was agreed by both B.B.T and A.B.B as an indication for dialysis:

- Uremic encephalopathy
- Other symptoms of uremia (e.g., evidence of gastrointestinal bleeding, pericarditis)
- Pulmonary edema
- Severe metabolic acidosis (plasma bicarbonate <12 mmol/L)
- Severe hyperkalemia (plasma potassium >6.5 mmol/L)
- Severe azotemia (plasma urea >120 mg/dL).

Statistical analysis

Data retrieved were analyzed using Epi Info™ statistical software (United States Centers for Disease Control and Prevention, Clifton Rd. Atlanta, Georgia, USA) version 7.0. Continuous data are presented as means and standard deviation while categorical data are presented as

percentages. The Student's *t*-test was used to compare means while Chi-square test was used to compare percentages. Logistic regression analysis was used to determine the factors that predicted in-hospital mortality.

The level of statistical significance was set at a $P < 0.05$.

Results

A total of 59 patients were identified, of these, five patients were excluded from the analysis because their hospital records were not available or were incomplete. Of the 54 patients whose hospital records were available for review, 27 (50%) were male, giving a male to female ratio of 1:1. Figure 1 shows the age range distribution of the study population. More than 50% of the patients were below 40 years of age. Table 1 shows the etiologic spectrum of AKI in the study population. Sepsis was the most common cause of AKI accounting for 50% of all cases. Obstetric causes accounted for 9.3% of cases, of which 7.4% were due to preeclampsia/eclampsia. Table 2 shows the clinical and laboratory parameters of the study population at the time of hospital admission.

Dialysis was indicated in 88.9% of the patients. As shown in Figure 2, the most common indications for dialysis were uremia and severe azotemia, together accounting for more than 80% of indications for dialysis in the study population. Dialysis was however not carried out in 22.2% of those in which it was indicated. Among the patients in whom dialysis was indicated but not carried out, 33.3% died before dialysis could be commenced while in the

remaining 66.7%, dialysis could not be carried out because the patients could not afford to pay for the procedure. The causes of delay in initiating dialysis in those patients who died before dialysis could be commenced were mainly; delay in sourcing fund for the procedure by the patients and delay in paying for laboratory investigations. There was small, but insignificant difference between men and women regarding patients in whom dialysis was indicated but not carried out (18.5% vs. 25.9% for men and women, respectively; $P = 0.52$).

Overall, in-hospital mortality was 29.6%. Patients who died had a shorter median duration of hospital stay (7.5 days vs. 25.5 days [$P < 0.01$]), lower mean serum bicarbonate on admission (19.5 mmol/L vs. 22.9 mmmol/L [$P = 0.02$]), were more likely to have been admitted unconscious (82.4% vs.

Table 1: Etiology of acute kidney injury in study population

Etiology AKI	Patient number (%)
Sepsis	27 (50)
Obstructive nephropathy	7 (13)
Gastroenteritis	6 (11)
Preeclampsia/Eclampsia	4 (7.4)
Postsurgery	3 (5.6)
Contrast nephropathy	2 (3.7)
Toxic nephropathy	2 (3.7)
Antepartum hemorrhage	1 (1.9)
Acute MI	1 (1.9)
HUS	1 (1.9)

AKI=Acute kidney injury; MI=Myocardial infarction; HUS=Hemolytic uremic syndrome

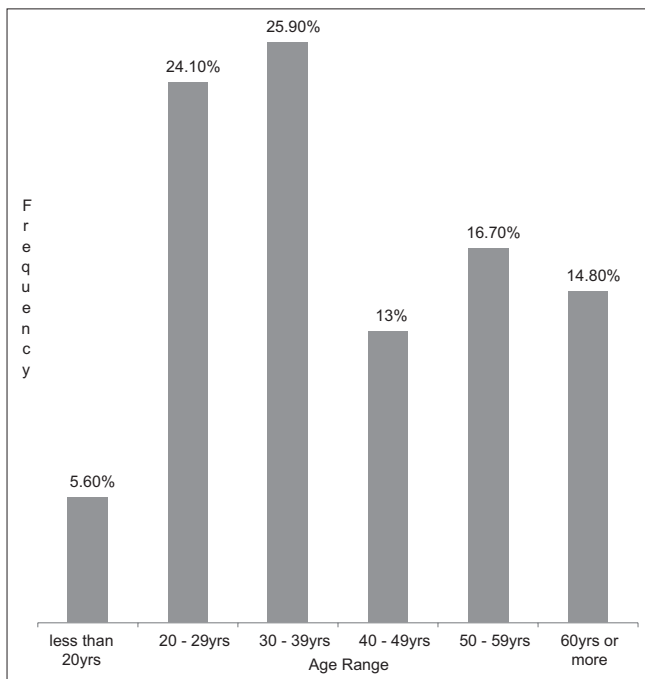


Figure 1: Age distribution of the study population

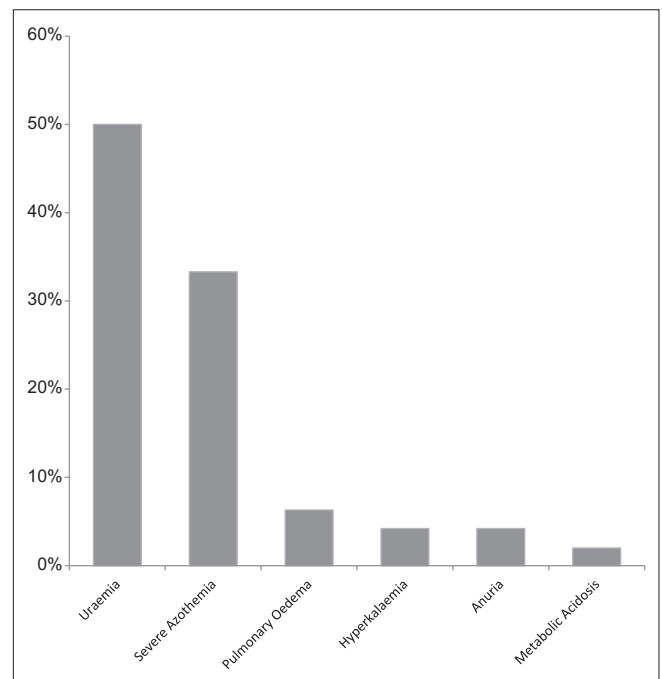


Figure 2: Indications for dialysis in the study population

Table 2: Clinical characteristics of the study population at the time of admission

Characteristic	Total	Survived	Died	P
Number of patients (%)	54	38 (70.4)	16 (29.6)	
Mean age (years)	39.7±16.3	37.6±16.2	44.8±15.8	0.14
Female gender	50	40.7	59.3	0.07
Mean (median) duration of illness before presentation (days)	17.8±33.0 (7.0)	15.2±36.9 (7.0)	24.0±44.7 (4.0)	0.48
Mean (median) duration of hospital stay (days)	26.6±24.8 (19.0)	33.9±25.6 (25.5)	9.2±9.7 (7.5)	<0.01
Proportion admitted to the ICU (%)	16.7	7.9	37.5	<0.01
Presence of oliguria (%)	85.2	84.2	87.5	0.56
Presence of peripheral edema (%)	38.9	57.9	68.8	0.46
Proportion admitted unconscious (%)	18.5	17.6	82.4	0.01
Mean (median) systolic BP (mmHg)	129.9±39.5 (129.5)	131.6±35.8 (130.0)	125.9±38.4 (120.0)	0.63
Mean (median) diastolic BP (mmHg)	75.9±20.9 (79.0)	75.4±19.1 (80.0)	77.2±25.3 (70.0)	0.78
Mean (median) serum creatinine (mg/dl)	7.5±5.1 (6.7)	7.6±4.9 (7.3)	7.2±5.8 (5.8)	0.83
Mean (median) serum urea (mg/dl)	172±96.3 (144.0)	177.7±103.7 (144.0)	158.8±76.9 (144.5)	0.83
Mean (median) serum sodium (mmol/L)	133.9±9.5 (135.0)	133.0±10.4 (135.0)	136.1±6.4 (136.5)	0.27
Mean (median) serum potassium (mmol/L)	4.6±1.1 (4.5)	4.6±1.0 (4.5)	4.8±1.1 (4.5)	0.49
Mean (median) serum bicarbonate (mmol/L)	21.9±5.0 (24.0)	22.9±3.8 (24.0)	19.5±6.6 (20.0)	0.02
Mean (median) Hb concentration (g/dl)	9.3±2.7 (9.2)	9.3±2.6 (8.7)	9.3±3.0 (9.3)	0.94
Mean (median) WBC count. (/mm ³)	13,936±8369 (12,200)	12,902±8003 (12,902)	16,391±8952 (16,392)	0.16
Proportion in which dialysis was indicated but not carried out (%)	22.2	41.7	58.3	0.02

ICU=Intensive Care Unit; BP=Blood Pressure; Hb=Hemoglobin; WBC=White blood cell

Table 3: Factors predicting in-hospital mortality in the study population

Characteristic	OR	95% CI	Z-statistic	P
Admitted to ICU (yes/no)	7.02	0.84-58.94	1.80	0.07
Admitted unconscious (yes/no)	2.78	0.46-16.70	1.12	0.26
Dialysis not done when indicated (yes/no)	11.87	1.35-104.37	2.23	0.03
Serum bicarbonate <20 mmol/L (yes/no)	2.68	0.39-18.43	1.00	0.32
Duration of hospital stay <10 days (yes/no)	20.82	3.12-139.09	3.13	<0.01

CI=Confidence interval; ICU=Intensive Care Unit; OR=Odds ratio

17.6% [$P = 0.01$]) and to ICU (37.5% vs. 7.9% [$P = 0.01$]). Furthermore, when dialysis was indicated but not carried out, patients were more likely to die (58.3% vs. 41.7% [$P = 0.02$]). Table 3 shows the logistic regression analysis of factors predicting in-hospital mortality; not having dialysis when it was indicated (odds ratio [OR] - 11.87; 95% confidence interval [CI] - 1.3–104.37; [$P = 0.03$]) and a duration of hospital stay <10 days (OR - 20.82; 95% CI - 3.12–139.09; [$P < 0.01$]).

Discussion

The pattern of AKI in our series is similar to that reported from other centers in Nigeria^[7-9] as well as from other developing countries.^[10-17] The majority of the affected individuals were young, with more than half of the patients being <40-year-old. Sepsis was by far the most common cause of AKI followed by obstructive nephropathy and gastroenteritis. In addition, pregnancy-related causes such

as preeclampsia/eclampsia and antepartum hemorrhage contributed significantly to the etiology of AKI. AKI complicating major surgical procedures contributed only slightly to the burden of AKI. This pattern of AKI however differs sharply from that obtainable in developed countries where AKI is frequently diagnosed in people above the age of 60 years and most commonly follows major surgical procedures.^[11,18,19]

Another significant observation is the fact that the diagnosis of AKI appears to be made rather late in the course of the patients' illness. This is evidenced by the rather high-median serum creatinine of the study population (6.7 mg/dl) as well as the fact that majority of the patients required dialysis and uremia and severe azotemia were the leading indications for dialysis. These observations suggest some delay in the diagnosis of AKI and that many patients with milder disease may have inadvertently been missed.

The overall in-hospital mortality of 29.6% in this study falls within the range documented in the literature. It is similar to the 28.8% reported by Okunola *et al.* from Osogbo in Nigeria,^[9] the 26% reported Ghacha *et al.* from Dammam, Saudi Arabia,^[17] the 22.6% reported by Al-Taei *et al.* from Iraq,^[20] the 29.2% and 26.2% reported by Kumar *et al.*^[10] and Kaul *et al.*,^[11] respectively from India. Arogundade *et al.*^[17] however reported significantly higher in-hospital mortality of 43.2% in AKI patients studied at Ile-Ife in Nigeria. The most likely explanation for this difference could be the fact that a larger proportion of patients in their study were admitted to the ICU where overall mortality in patients with AKI is known to be generally higher.^[21,22]

Depressed level of consciousness at admission, being admitted into the ICU, a lower serum bicarbonate level at admission, a short duration of hospital stay and not having dialysis when it was indicated, were all found, to be associated with higher in-hospital mortality. The first three conditions probably represent surrogate markers for the severity of the patient's illness at the time of admission. Altered consciousness may represent the presence of uremia while a low-serum bicarbonate level indicates the presence of metabolic acidosis. Both are seen with severe impairment of kidney function and have previously been strongly associated with increased mortality.^[23,24] Patients admitted to the ICU are generally, critically ill and tend to have a failure of more than one organ system. The patients with AKI who were admitted to the ICU; therefore, represent severely ill patients either because of the underlying illness or as a result of the severity of renal failure and would otherwise be expected to have poorer outcomes.

The association between a short duration of hospital stay and increased mortality may represent a delay in presentation to hospital and therefore more advanced disease at presentation. It is not uncommon for patients in this country to initially try spiritualists, herbalists/diviners, and self-medication on account of their beliefs, and poverty before seeking medical attention,^[25] usually at a time when their illness would have become quite advanced. A short duration of hospital stay had previously been reported by Chijioke *et al.*^[26] to be associated with better outcomes in patients with AKI, who received hemodialysis in Ilorin, Nigeria. The reason for this difference in findings between the two studies is unclear.

Not having dialysis when indicated as well as delay in institution of dialysis has both been reported to be associated with poorer outcomes by Arogundade^[7] and Chijioke *et al.*,^[26] respectively. Institution of renal replacement therapy is known to reverse some of the life-threatening complications of AKI such as severe metabolic acidosis, severe hyperkalemia, and pulmonary edema; therefore, it is not unexpected that not having dialysis when indicated was associated with in-hospital mortality in our study. Nephrologists in developed countries rarely experience situations where they are unable to provide dialysis for patients requiring the procedure; however, for nephrologists practicing in resource-poor settings such as ours, caring for patients who require dialysis but are unable to pay for the procedure may not be an infrequent experience as funding for health care in these settings is out-of-pocket. This fact when combined with the low-income levels of the majority of the population and the relatively high costs of dialysis means that a significant proportion of patients with AKI requiring dialysis are unable to access the procedure.

Logistic regression analysis identified two variables that predicted in-hospital mortality among patients in this study.

These factors were duration of hospital admission <10 days and not having dialysis when it was indicated. Patients with duration of hospital stay <10 days had >20-fold odds of dying while on admission compared to patients whose duration of hospital stay was >10 days while patients who did not have dialysis done when it was indicated had >11-fold odds of dying while on admission compared to patients who were dialyzed.

One important inference that can be drawn from our findings is that the epidemiology AKI seen at our center may be changing. Compared to with the study by Bamgboye *et al.*^[27] which was carried out in the same institution over 20 years ago, it would seem that there has been a dramatic reduction in the contribution of obstetric complications to the burden of AKI. This reduction in the contribution of obstetric complications to the burden of AKI may be a reflection of better access to obstetric care, early detection of pregnancy-related complications, safe and early delivery of complicated pregnancies, and more effective treatment of preeclampsia that has accompanied the recent improvements in the socioeconomic status of residents of the state.

Conclusion

In conclusion, the pattern of AKI in this study is similar to that reported from other developing countries. In-hospital mortality was high and was predicted by duration of hospital admission less than 10 days and not having dialysis when it was indicated.

There is a need for a large, multicenter, study of AKI in Nigeria to determine the pattern, and outcomes of AKI in the country.

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Conflicts of interest

There are no conflicts of interest.

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