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# Acute Kidney Injury in Hospitalized patients at the University of Calabar Teaching Hospital: An aetiological and outcome study

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***Abstract:***

***Background :*** *The burden of Acute Kidney injury in developing countries especially in Sub- Saharan Africa is enormous. The morbidity and mortality appears to be rising despite the availability of dialysis therapy in some parts of Africa.*

***Objective****: To determine the causes and the factors that influence outcome of acute kidney injury in hospitalized patients at the University of Calabar Teaching Hospital (UCTH), Calabar, Nigeria.*

***Design*** *: This was a prospective study of patients with acute kidney injury admitted in UCTH, Calabar over a 12 month period from January 2014 to December 2014. Data was analysed using SPSS version 18.*

***Results*** *: A total of 1138 patients were admitted with 42 of them developing AKI giving an incidence rate of 3.6%. Eighteen (42.9%) of the participants were males while 24 (57.1%) were females. Age ranged from 11 to 81 years with a mean age of 44.2±17.32 years. The common causes of AKI were septicaemia 20 (47.6%), malignant phase hypertension 7 (16.7%) and hypovolaemia 4 (9.5%).Other causes accounted for the remaining 11 (26.1%). Thirty one (73.8%) had co-morbidities and hypertension 12 (38.7%) was the commonest co-morbid condition. For outcome, 29 (69.0%) of the patients were discharged home while 13 (31.0%) of them died in the hospital. Survivors had more dialysis sessions than those that died (P < 0.05).*

***Conclusion*** *: Septicaemia is the commonest cause of AKI in our centre. In-hospital mortality rate is high. The severity of AKI at presentation and lack of dialysis therapy are contributory factors.*

***Keywords*** *– Acute kidney injury, Aetiological, Factors, Outcomes, Teaching.*

## I. Introduction

Acute kidney injury (AKI), previously referred to as acute renal failure, is defined as a sudden decline in kidney function, with falling glomerular filtration rate and the inability to regulate acid, electrolyte balance and to excrete waste and fluid [1,2]. Acute kidney injury (AKI) in adults is a common cause of hospitalization, associated with high morbidity and mortality especially in developing countries. Community acquired AKI is more frequently encountered in developing countries, while hospital-acquired AKI is more prevalent in developed countries [2, 3]. Community-acquired AKI is responsible for about 1.4–1.9 percent of medical admissions in most reports from Nigeria [4–6], while hospital-acquired AKI is responsible for about 1 percent of hospital admission in most countries in Europe and North America [2, 3]. Some cases are difficult to categorise, due to the complex nature of different underlying conditions. Acute Kidney Injury in humans is a heterogeneous condition as it runs a variable course largely determined by the cause, the severity, comorbid conditions and whether or not renal replacement therapy is administered.

Despite advances in the understanding of the pathophysiology of AKI and its management, mortality rates have remained high [7]. Mortality varies between 40 – 50% in hospitalized patients and 70 – 90% among patients admitted into intensive care units [7-10]. There is an increasing use of Renal Replacement Therapy (RRT) in the form of intermittent haemodialysis (IHD) or continuous therapies (CRRT) for AKI. Delay in initiating dialysis has been shown to contribute to poor outcome with some studies even suggesting improved outcome with early initiation of dialysis treatment [10,11]. In spite of this, in- hospital mortality rates remain high even in the developed countries of Europe and North America [12, 13].

Renal Replacement Therapy in the form of haemodialysis is now more commonly available in Nigeria. However, the high cost of this service and its accessibility (majority are in urban areas) means patients who otherwise would survive eventually die. Currently in Nigeria, there is no policy on subsidy of renal replacement therapy (RRT) and the public sector administered National Health Insurance Scheme does not cover any form of RRT.

Most published studies in Nigeria have described the causes of AKI, but not much is known regarding the factors that influence outcomes of AKI. In our centre located in southern Nigeria, where specialist renal care has only become available in the past three years, the paucity of data is even more evident.

The purpose of this study is to determine the various aetiology, outcome and factors that influence outcome of AKI patients in our centre.

## II. Materials And Method

This was a prospective observational study of adult patients with AKI admitted from January to December 2014 at the University of Calabar Teaching Hospital, Calabar, Southern Nigeria. AKI was defined and categorized into three stages based on the Kidney Disease Improving Global Outcomes (KDIGO) Criteria [14] as follows:

**Stage 1** – Serum creatinine 1.5 – 1.9 times baseline or ≥ 26.5μmol/l increase OR Urine output < 0.5ml/kg/hr for 6 – 12 hours.

**Stage 2 –** Serum creatinine 2 – 2.9 times baseline OR Urine output < 0.5ml/kg/hr for 12 hours.

**Stage 3 –** Serum creatinine 3.0 times baseline or increase in serum creatinine to ≥ 353.6μmol/l OR Initiation of dialysis OR Urine output < 0.3ml/kg/hr for >24hours OR anuria for >12hours.

All the subjects with a diagnosis or suspicion of AKI admitted into the medical, surgical, obstetric wards as well as the intensive care units of the University of Calabar Teaching were included in the study. Patients with a prior history of chronic kidney disease but who were yet to initiate dialysis were also included.

Oral and/or written informed consent were obtained from all the participants in the study.

Using a structured pretested data sheet, we collected demographic information including age and gender.. Clinical data included date of admission, date of discharge, presence of co-morbidities (hypertension, diabetes, chronic liver disease, malignancy etc.), a previous history of chronic kidney disease, likely cause of AKI, medications, primary diagnosis and treatment administered including haemodialysis. For those admitted in the ICU, we added the need for mechanical ventilation, support with fluids and/vasopressors and supplemental oxygen.

### 2.1. Laboratory Evaluation

For all patients, data on laboratory tests included, serum electrolytes (sodium, potassium), bicarbonate urea, creatinine as well as blood sugar, , haemoglobin, platelet and white cell count. Results of screening for HIV, hepatitis B & C were obtained. Urine output was also recorded. The e-GFR of the patients was calculated using the Cockcroft and Gault [15] equations for males and females.

### 2.2. Data Analysis

The data obtained were analysed using Statistical Package for Social Sciences (SPSS) version 18. Quantitative data are presented as mean ± S,D, and categorical variables as percentages. Statistical comparisons were done using independent sample *t*-test and Chi-square test as appropriate. Significant levels were set at $p<0.05$

## III. Results

A total of 1138 patients were admitted during the study period. Of these, 42(3.6%) patients developed AKI. Among those with AKI, 26 (61.9%), 8 (19.0%), 7 (16.7%) and 1 (2.4%) were admitted into the medical wards, surgical wards, ICU and obstetrics wards respectively. Eighteen (42.9%) were males while 24 (57.1%) were females with a ratio of 1:1.3. The mean age was 44.2 ± 17.3 years, while mean ages for males and females respectively were 51.9 ± 17.5 and 38.4 ± 15.1 years. Most patients were in the 39 – 58 years age group and over 80% of the patients were under 60 years of age. Clinical parameters are as enumerated in Table 1. The mean age was significantly higher in males as compared to females ( $p = 0.013$). The mean systolic and diastolic blood pressures were 146.67 ± 49.52 (70 – 240) mmHg and 88.81 ± 25.18 (40 – 140) mmHg respectively. Hypertension (BP ≥ 140/90 mmHg) was observed in 24 (57.1%) while hypotension (BP < 90/60 mmHg) occurred in 6 (14.3%). Medical disorders were the commonest cause of AKI occurring in 71.4% of patients. The main causes were septicaemia 20 (48.0%), malignant hypertension 7 (17.0%) and hypovolaemia 4 (10.0%), respectively (Fig 1). The commonest co-morbidity was hypertension 23(54.8%) while diabetes was seen in 10(23.8%). Both conditions existed in 6(14.3%) patients. Fifty nine percent (25) of all patients had Severe AKI (KIDIGO stage 3). Of these, 9(21.4%) had intermittent Haemodialysis dialysis. The rest had financial constraints 12 (66.7%) and haemodynamic instability 2 (11.1%). Haemodialysis intervention was required in 27 (64.3%) of patients. For outcome, 69% survived with recovery of renal function and were discharged home while 31% died.

The comparison of clinical and biochemical parameters (Table 2) showed that age, systolic and diastolic blood pressures, haemoglobin levels, bicarbonate, and GFR were higher in survivors while potassium, urea, and creatinine levels were higher in those that died. The differences were however not statistically significant ($P > 0.05$). The overall mean number of dialysis sessions received was 3.2 ± 1.86, with a range of 1

to 7 sessions. However, the number of dialysis sessions was significantly higher in survivors when compared with those that died ($P < 0.05$).

## IV. Figures And Tables

**Table 1: Baseline clinical parameters of AKI patients**

| Parameters | Mean ± SD, % p – value |
|---|---|
| Age | 44.2 ± 17.3 |
| Gender | |
| Male | 51.9 ± 17.5 0.13 |
| Female | 38.4 ± 15.1 |
| Ratio | 18/24 (1:1.3) |
| Blood Pressure | |
| Systolic | 146.67 ± 49.52 |
| Diastolic | 88.81 ± 25.18 |
| Aetiological Categories | |
| Medical | 30 (71.4%) |
| Surgical | 9 (21.4%) |
| Obstetrics | 3 (7.1%) |
| Background CKD | |
| Present | 15 (35.7%) |
| Absent | 27 (64.3%) |
| Co morbidity* | |
| Present | 31 (73.8%) |
| Absent | 11 (26.2%) |
| KDIGO staging | |
| Stage 1 | Nil |
| Stage 2 | 17 (40.5%) |
| Stage 3 | 25 (59.5%) |
| Dialysis Requirement | |
| Yes | 27 (64.3%) |
| No | 15 (35.7%) |
| Dialysis administered | |
| Yes | 9 (21.4%) |
| No | 33 (78.6%) |
| Outcome | |
| Alive | 29 (69.0%) |
| Died | 13 (31.0%) |
| *Comorbidities included Hypertension, diabetes, Chronic Liver Disease, Malignancy, Cerebrovascular Accident. | |

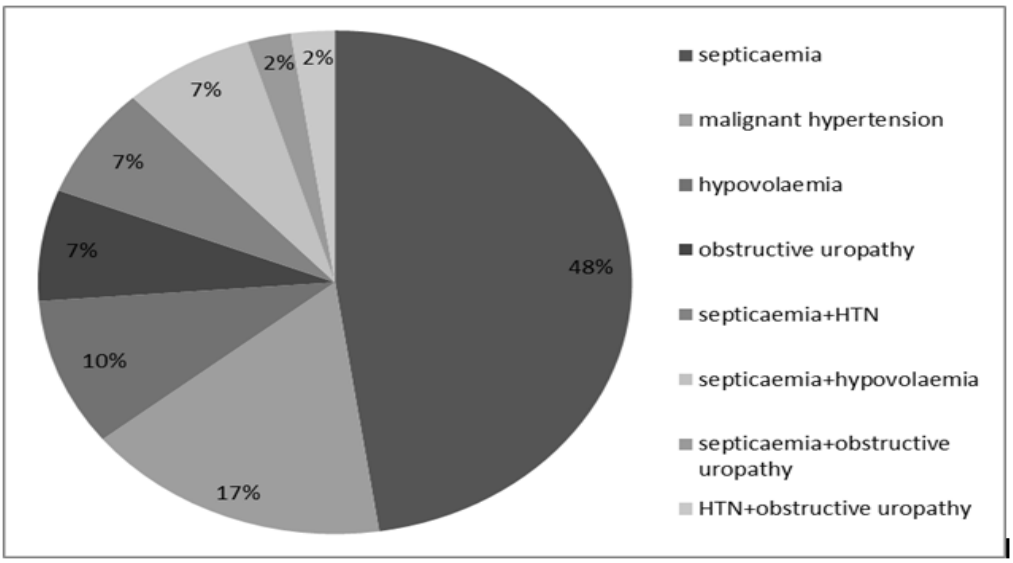


**Figure 1 : Aetiological factors in AKI**

**Table 2 : Clinical and biochemical parameters of AKI outcomes**

| Parameters | Survivors (n = 29) | Mortalities (n =13) | P - value |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Age | 46.0 ± 17.9 | 40.2 ± 15.8 | 0.327 |
| Systolic BP (mmHg) | 151.4 ± 40.8 | 136 ± 65.8 | 0.363 |
| Diastolic BP (mmHg) | 93.6 ± 22.2 | 78.1 ± 28.8 | 0.064 |
| Haemoglobin (mg/dl) | 8.04 ± 2.02 | 7.81 ± 2.30 | 0.753 |
| Sodium (mmol/l) | 134.3 ± 11.7 | 130 ± 13.7 | 0.319 |
| Potassium (mmol/l) | 5.1 ± 1.24 | 5.8 ± 1.26 | 0.097 |
| Bicarbonate (mmol/l) | 17.1 ± 3.62 | 14.9 ± 5.3 | 0.136 |
| Urea (mmol/l) | 21.7 ± 9.9 | 27.8 ± 7.5 | 0.055 |
| Creatinine (µmol/l) | 535.17 ± 440.02 | 601.93 ± 261.79 | 0.615 |
| e-GFR (mls/min/1.73m$^2$) | 19.78 ± 16.09 | 14.31 ± 7.47 | 0.251 |
| KDIGO staging<br>Stage 1<br>Stage 2<br>Stage 3 | <br>Nil<br>14 (48.3%)<br>15 (51.7%) | <br>Nil<br>3 (23.1%)<br>10 (76.9%) | <br><br><br>0.179 |
| Dialysis administered<br>Yes<br>No | <br>6 (20.7%)<br>23 (79.3%) | <br>3 (23.1%)<br>10 (76.9%) | <br><br>0.579 |
| Number of dialysis sessions | 4.17 ± 1.47 | 1.33 ± 0.58 | 0.017 |

## V. Discussion

The true prevalence of AKI in Nigeria is to an extent unknown. However, hospital based data shows that it may account for 10% of patients seen in renal units and over 40% of patients admitted into the intensive care units [16]. We have demonstrated in our study an incidence rate of 3.6%.We imagine that this result may be an underestimate given that some people with medical disorders may prefer to consult traditional and religious healers. Secondly, as the study took place in several different wards, some patients with stage 1 AKI may have been missed. Our results also show that that there were more females with AKI in keeping with a similar study [16]. The reason for this may not be clear. It may well be that females tend to present earlier than males for medical attention. Most of the AKI patients were admitted in the medical wards reflecting the fact of timely medical consultation requests compared with surgical and obstetrics consults.

Dialysis, mainly haemodialysis, appear to be the preferred mode of therapy for AKI especially in the severe form and this is evident in this study as 64.3% of the AKI patients required haemodialysis although only 21.4% had the intervention. The factors that influenced mode of AKI therapy were severity of AKI using the KDIGO staging, cardiovascular instability, co-morbid conditions and financial constraints. These findings are similar to other reports in Nigeria [16,17]. Out of pocket payment is the main mode of financing medical care in Nigeria and the cost of dialysis is quite high at an average of $150 per session. In a country with a Gross Domestic Product (GDP) per capita of 1097 USD in 2013(9% of the world's average), this is a huge burden on the population majority of who live below the poverty line. Haemodialysis is certainly a relevant intervention in the setting of AKI. Its viability as a long term option in resource poor settings such as ours however needs careful and adequate healthcare financing planning [18].

The commonest cause of AKI in our study was septicaemia. This has also been reported in several studies especially in developing countries [16,17,19,20]. The high overall mortality of 31% in this study is similar to reports from other studies [9,16,17,21]. The main reason for this appears to be lack of dialysis treatment due to high cost. This has been demonstrated in many hospital based studies in Nigeria [22,23]. Other factors that are associated with high mortality are presence of comorbid conditions and severity of AKI as reported from other studies [16,17]. The comparison between survivors and those that died in our study showed that there were no statistically significant differences in the demographic and metabolic characteristics. Survivors however had a statistically higher number of dialysis sessions compared with those that died ($P < 0.05$) (Table 2). This suggests that haemodialysis therapy may influence the outcome of dialysis treated AKI with a better outcome in those with higher delivered dialysis dose. However, two large randomized controlled trials have failed to show any significant benefit on mortality even in those with more intensive dialysis [24,25]. Our study design probably may not show this. In addition, the study was underpowered to detect this lack of benefit.

Acute kidney injury serious enough to require renal replacement therapy (RRT) has been found to be associated with high in-hospital mortality and progression to chronic kidney disease (CKD) and end-stage kidney disease (ESRD) in 5–20 percent of survivors within a few years [26]. A US based multicenter analysis of data among US Veteran Affairs population, followed up for over 60 months after episodes of RRT requiring AKI, showed that AKI increased the risk of developing stage 4 CKD by 303 to 550 percent [27]. All the patients who developed CKD did so within 20 months of discharge from the hospital. This emphasizes the need to keep AKI survivors under close medical surveillance over a long period of time. AKI progressing to CKD and ESRD possibly contribute to the high prevalence of CKD in our populations. A proportion of the 3–5 percent of the indeterminate causes of CKD in our environment [28, 29] may be due to partially resolved AKI which gradually progress to CKD over time. Follow up of discharged AKI patients is relatively poor in Nigeria.

## VI. Conclusion

Septicaemia and malignant phase hypertension are the leading causes of AKI in our hospital. High cost of dialysis appears to be a hindrance to optimal treatment of AKI in resource poor settings like ours.

In-hospital mortality rate was high and the main contributory factors were advanced KDIGO stage at presentation and lack of haemodialysis therapy. Therefore, early recognition of AKI is necessary and the institution of prompt and appropriate treatment of infection and elevated blood pressure is required.

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