

# Patterns of Acute Kidney Injury in a Medical Emergency Department in Sub-Saharan Africa

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## Abstract

**Background:** Acute kidney injury (AKI) is a common in community and a serious outcome in hospital setting. Despite the progress of dialytic and non-dialytic therapeutic means, its mortality remains high. Our objective was to contribute to a better knowledge of how AKI managed in an emergency medical ward in an African country located in the southern part of the Sahara. **Patients and Methods:** We conducted a retrospective study from January 1 to December 31, 2019, conducted at the emergency department of the University Teaching Hospital of Bouake, on cases of AKI. **Results:** During the study period, we collected 221 cases of AKI out of a total of 1778 files giving a prevalence of 12.4%. The mean age was  $54 \pm 19$  years. A male predominance with a sex ratio of 1.4 was observed. The main past histories were hypertension in 40.4%, cardiac disease in 16.9%, and diabetes in 14.3%. The patients in were classified in 63.8% of cases as stage I, in 22.1% as stage II and in 14.1% as stage III according to the AKIN criteria. AKI was functional in 93.2% of cases. Hemodialysis was indicated in 15 (6.8%) patients, but only 3 (1.4%) underwent it. The mortality rate was 45.2%. Factors associated with mortality were: creatinine level greater than or equal to 30 mg/l, sepsis and impaired vigilance. **Conclusion:** Acute renal failure was frequent in subjects under 60 years old. Its mechanism of occurrence is functional and therefore it can be prevented by vascular filling. The majority of patients were seen at AKIN Stage I. The outcome was favorable in more than one third of the cases and the mortality rate remains high.

## Keywords

AKI, African Setting, High Mortality

## 1. Introduction

Acute kidney injury (AKI) is a clinico-biological syndrome whose etiologies are multiple. It is defined by an increase in plasma creatinine as a rapid and reversible failure of renal functions. It is an often preventable and treatable pathology, frequently encountered in all in-patients services. Its worldwide incidence is 21% in adults and 33% in children, and mortality is 23% in adults and 13% in children [1]. It can be community-acquired, occurring before hospital admission, or it can be hospital-acquired, being then a complication related to hospitalization. Community-acquired AKI is more frequent in resource-limited countries and affects young subjects, whereas hospital-acquired AKI is more common in developed countries and occurs in elderly subjects with multiple comorbidities [2]. The epidemiological impact of AKI in Africa is less well known. According to a meta-analysis that included data from 154 countries worldwide in 2015, the data from sub-Saharan Africa are for the incidence of AKI in Nigeria [3]. The lack of data maybe due to high mortality due to limited access to renal replacement therapies; these studies identify in-hospital AKI, already it is community-acquired AKI that is more common in Africa [3]. Whatever the type of community or acquired AKI, it is important to identify the subjects at risk because after an episode of AKI, inflammatory lesions will evolve towards renal fibrosis and chronic kidney disease occurs. In Côte d'Ivoire, there is little data on AKI outside of the Abidjan Nephrology Department. We initiated this work in order to contribute to a better knowledge of the epidemiological profile of AKI in the Medical Emergency Department of the University Teaching Hospital of Bouaké.

## 2. Methods

Our study was cross-sectional study. It focused on the records of patients admitted to the medical emergency department of the University Teaching Hospital of Bouaké during the period from January 1 to December 31, 2019, who had undergone a routine check-up including a creatinine and a blood urea. We enumerated any patient aged 15 years and older with AKI. Patients who were not included were those with AKI whose records were incomplete and those with chronic kidney disease treated or not by hemodialysis. For each included patient, the following data were collected using a standardized survey form:

- epidemiological data (age, sex, nationality, place of residence)
- anamnestic data (notion of hypertension, diabetes, heart disease, medication, reason for hospitalization)
- clinical data (blood pressure on admission, temperature, state of consciousness, hydration status, diuresis)
- biological data (serum creatinine, plasma urea, blood count, blood ionogram, HIV serology)
- imaging data (renal ultrasound)
- treatment received
- outcomes data (discharge, death, discharge against medical advice, transfer).

The operational definitions adopted were as follows:

-AKI was defined according KDIGO classification with baseline creatinine level and was stage I for an increase of 1.5 times baseline creatinine, stage II for an increase of 2, times baseline creatinine and stage III for an increase of 3 times baseline creatinine [4]. For baseline creatinine values, we referred to the standards of the study by Levey *et al.* [5]. AKI was classified according to the mechanism of occurrence, *i.e.*, pre-renal, renal and post-renal, on the basis of the interview, physical examination, blood and ultrasound tests. Thus, AKI was said to be functional in the presence of diarrhea, vomiting, hemorrhage, heart failure, cirrhosis, sepsis and intake of NSAIDs, diuretics and ACE inhibitors in the history, and the ratio of urea (mg/l) to creatinine (mg/l)  $\geq 20$ ; it was of organic type in case of taking nephrotoxic drugs such as aminoglycosides or traditional toxicants and if the Urea (mg/l)/creatinine (mg/l) ratio was  $\leq 10$ . AKI was considered obstructive if bilateral or unilateral pyelocalicavity dilatation was found on kidney-centered abdominal ultrasound. According to the evolution of renal-function, total recovery was defined by the return to normal renalfunction *i.e.* serum creatinine  $\leq 13$  mg/l, partial recovery was defined by a 50% decrease of the maximum serum creatinine value.

The confidentiality of the data collected on the patients' files was ensured by the correct filing of the files and the identification of the patients by anonymity numbers assigned in ascending order of admission.

Data analysis was performed using Epi info version 7 software. The distribution of quantitative variables was described by means and standard deviations, medians and extremes. On the other hand, in bivariate analysis, the proportions of qualitative variables were compared between patients who died and those who had a favourable outcome by a Chi-2 test or Fisher's exact test. The association between the variable and mortality was assessed by the odds ratio (OR). All these statistical tests were performed at the 5% significance level ( $p \leq 0.05$ ).

### 3. Results

We collected during the study period, 221 cases of acute renal failure out of a total of 1778 records, giving a prevalence of 12.4%. The mean age was  $54 \pm 19$  years with extremes of 16 to 85 years and patients over 65 years of age represented 31.67% of our population. There were 58.4% male patients, *i.e.* a sex ratio (male/female) of 1.40 (Table 1). The main reasons for admission were fever (21.8%) and coma (18.8%). In response to the symptoms presented before hospitalization, 78.1% of patients used herbal remedies. The majority, 95.9% of patients had a past history of illnesses. These were hypertension in 39.8%, heart failure in 15.3% and diabetes in 14.3% of cases. The most frequent complaint was fever (54.8%), vomiting (21.8%), diarrhea (11.1%). On physical examination, hyperthermia was noted in 37.3%, hypertension in 21.39% and normal urine output in 52.5% (Table 2). In blood tests, the abnormalities encountered were high level of urea in 61.9% of cases, moderate anemia in 52.4%. Normal values of platelets

**Table 1.** Socio-demographic characteristics of 221 patients with AKI hospitalized in the medical emergency room of the University Teaching Hospital of Bouaké in 2019.

Parameters	Number	Percentage
<b>Age</b>		
15 - 24	14	6.3
25 - 34	31	14
35 - 44	20	9.1
45 - 54	34	15.4
55 - 64	52	23.5
≥65	70	31.7
<b>Gender</b>		
Male	129	58.4
Female	92	41.6
<b>Residence</b>		
Bouaké	151	68.9
Outside Bouaké	70	32.1
<b>Professional status</b>		
Employee	13	5.9
Retired	19	8.8
Informal	63	28.4
Unemployee	126	56.9

**Table 2.** Clinical data of 221 patients with AKI hospitalized in the medical emergency room of the University Teaching Hospital of Bouaké in 2019.

Parameters	Number	Percentage
<b>Cause of admission</b>		
Fever	52	21.8
Coma	45	18.8
Adynamia	17	7.1
Oedema	16	6.7
Dyspnea	15	6.3
Cardiac failure	14	5.9
<b>Comorbidities</b>		
Hypertension	93	40.4
Heart disease	39	16.9
Diabetes	33	14.3
HIV	14	6.2
Gastritis	15	6.5
Sickle cell disease	8	3.4

**Continued**

Herbal remedies exposure	25	11.3
NSAID intake	3	1.3
<b>Complains</b>		
Fever	153	54.8
Vomiting	61	21.8
Diarrhea	31	11.1
Edema	27	12.2
Digestive hemorrhage	7	2.5
<b>Physical signs</b>		
Fever	150	37.3
High blood pressure	86	21.3
Tachycardia	36	8.9
Anuria	2	0.9
Oliguria	103	46.6
Normal urine output	116	52.5
hypovolemia	49	12.1
Cutaneous pallor	48	11.9
Ascites	36	8.9

HIV: Human Immunodeficiency Virus; NSAID: Non-steroidal anti-inflammatory drug.

and potassium were found in the following proportions: 63.3%, 42.1% and 59.7% respectively. Hyponatremia was observed in 51.5% of cases. In our study, 93.7% of the patients were HIV negative. Acute kidney injury was functional in 93.1% of cases (**Table 3**). Patients who had a hospital stay of 2 days represented 46.15% of the total. The mean length stay was  $2 \pm 1.3$  days. The treatments administered were mainly fluids in 45.7% and antibiotic therapy in 44.4%. Dialysis was necessary in 6.7% of cases and was performed in 1.37%. Determinants of outcomes of AKI were death in 45.2% of patients and 36.6% of patients were discharged on medical treatments (**Table 4**). The causes of death were cardiopulmonary arrest (25%) and stroke (13%) (**Table 5**). There was no significant difference in the mortality rate among the gender and the comorbidities of the patients. Univariate analysis showed a mortality associated with a creatinine level between 30 and 60 mg/l. Others factors associated with death in our patients were sepsis ( $p = 0.009$ ), coma ( $p = 0.0008$ ) (**Table 6**).

#### 4. Discussion

In this cross-sectional study, we describe the epidemiological profile of AKI in our practice conditions in a semi-urban area in subjects with precarious socio-economic conditions, who cannot always afford the biological tests and treatment. The risk of AKI is determined by patient factors, including advanced age. In the

**Table 3.** Severity and type of acute renal failure of 221 patients hospitalized in the medical emergencies of the University Teaching Hospital of Bouaké in 2019.

Diagnosis of acute kidney injury	Number	Percentage
<b>Severity of AKI (KDIGO)</b>		
AKI stage 1	141	63.8
AKI stage 2	49	22.1
AKI stage 3	31	14.1
<b>Type of AKI</b>		
Functional	206	93.1
Organic	15	6.9

**Table 4.** Outcomes of 221 patients hospitalized for AKI in the medical emergency department of the University Teaching Hospital of Bouaké in 2019.

Outcome	Number	Percentage
Death	100	45.2
Discharge on medical treatment	81	36.6
Discharge	21	9.5
Transferred	19	8.6
Total	221	100

**Table 5.** Probable causes of death of patients hospitalized for AKI at Bouaké University Teaching Hospital in 2019.

Cause of death	Number	Percentage
Cardio respiratory arrest	25	25
Stroke	13	13
Cardiovascular shock	12	12
Hemodynamic shock	13	13
Hypovolemic shock	6	6
Sepsis	11	11
coma	9	9
Respiratory distress	10	10
Acute pulmonary oedema	1	1

CVA: APO: acute pulmonary oedema.

**Table 6.** Univariate analysis of demographic, clinical and biological parameters according to the occurrence or non-occurrence of death during AKI observed in patients hospitalized in the medical emergency room of the University Teaching Hospital of Bouaké in 2019.

Parameters	Death n (%)	Survivors n (%)	p value
Male	55 (55%)	53 (65.43%)	0.2

**Continued**

Female	45 (45%)	28 (34.57%)	0.2
High blood pressure	34 (56.67%)	21 (67.74%)	0.42
Diabetes	9 (15%)	0 (0%)	0.057
Heart disease	17 (28.33%)	10 (32.26%)	0.88
Coma	35 (35%)	10 (12.4%)	0.0008
Non coma	65 (65%)	71 (87.6%)	0.0008
Creat [14- 30[ mg/l	53 (53%)	39 (48.15%)	0.61
Creat [30 - 60] mg/l	38 (38%)	18 (22.22%)	0.032
Creat > 60 mg/l	9 (9%)	24 (29.63%)	0.0007
Sepsis	11 (11%)	22 (27.2%)	0.006
No sepsis	89 (89%)	59 (72.8%)	0.006
Functional	96 (64%)	75 (92.6%)	0.5
Organic	4 (4%)	6 (7.4%)	0.5

HBP: high blood pressure.

study by Baraldi *et al.*, the elderly accounted for 64.1% of all AKI cases [6]. The preferential involvement of elderly subjects is due to several reasons. Elderly individuals (>70 years) are more susceptible to nephrotoxic factors, due to the accumulation of comorbidities and their lower renal reserve. The loss of renal reserve (approximately 0.75 ml/1.73m<sup>2</sup> per year from age 30 on wards) may be partially masked by the decrease in muscle mass in elderly subjects. In general, glomerular filtration rate is approximately 125 ml/min in young adults, 80 ml/min at age 60 and 60 ml/min at age 80. Elderly individuals are more susceptible to volume depletion due to a reduced sensation of thirst, coupled with a decreased ability to preserve salt and concentrate urine to the maximum [7]. Conversely, subjects whose age was less than 65 years were the most affected by this pathology, in our series or a proportion of 68% due to the relative youth of the Ivorian population. AKI affects more male subjects which is observed in most studies [8]. In our study, we had no obstructive nephropathy, functional AKI was in first place (93%) and organic AKI in second place. In functional AKI, only functional renal alterations without structural alterations are present. When this hypoperfusion is not corrected rapidly, it will result in organic AKI by ischemic acute tubular necrosis (ATN). Functional AKI and ischemic ATN are therefore part of a continuum of manifestations that reflect renal hypoperfusion. Pre renal azotemia can be corrected by treating the extra renal factors causing renal hypoperfusion. During the functional phase, restoration of renal blood flow, by expansion of extracellular volume or by vasodilators, may still normalize renal function. However, once AKI is fixed, organ damage is present and restoration of perfusion is no longer able to improve renal function [9]. In our series, patients received fluids in 45%. The evolution of the picture was favorable in more than one third of the cases and 45.2% of the patients died. The risk factors for death

in our patients were mainly sepsis ( $p = 0.009$ ), coma ( $p = 0.0008$ ) and creatinine level  $\geq 30$  mg/l ( $p = 0.007$ ). Infection and/or sepsis was the leading cause of AKI and the leading cause of death in our patients. The death rate from septic AKI is very high and can reach 74.5% according to the authors [10]. Renal hypoperfusion is considered the predominant factor in the occurrence of post-septic AKI. The mechanisms of occurrence involve many interrelated factors such as: systemic hemodynamic changes, in particular episodes of hypotension; renal hemodynamic changes leading to renal ischemia, such as vasoconstriction and/or disturbances in renal blood flow distribution; infiltration of the renal parenchyma by inflammatory cells; and toxicity of antibiotic therapy. Cardio-vascular disease was the first cause of death in our patients, contrary to the literature which places it in seconde position [11]. The proportion of severe AKI as a cause of death is lower in our study (20%) which is similar to the literature [11]. Severe AKI is therefore an important marker of the severity of the underlying pathology, but is a less important cause of death in the West (3%) [12]. This low rate of death from severe AKI may be related to the prompt management of certain diseases that may cause AKI.

This study presents many limitations. It includes the design of the study; we collected retrospectively data with forms missed and less informations recorded in the medical files. Due to missing patients we were not able to precise the causes of AKI. Another limitation in our study was the lack of information about renal function after 90 days of follow up. Our study is unique among studies in this region of the country. To our knowledge, other studies on AKI in the country have only focused on nephrology departments.

## 5. Conclusion

AKI is frequent in medical emergencies at the University Teaching Hospital of Bouaké. It is of functional type and has a fatal evolution in the majority of cases. It can be prevented by expansion of extracellular volume. This improves renal blood flow, decreases vasoconstrictor stimulation and can potentially limit exposure to nephrotoxic agents by increasing urinary flow.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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