



# Comparative study of community acute kidney injury in young patients versus elderly patients in an internal medicine department in Abidjan (Côte d'Ivoire)

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## ABSTRACT

**Introduction:** Numerous studies have shown that the recovery of renal function was slower and less complete in the elderly patients than in adults.

**Objectives:** To compare the profile of acute kidney injury (AKI) of the young patients with that of the elderly patients.

**Patients and Methods:** This is a prospective study carried out during the period from January 2010 to December 2015 in the department of Nephrology-Internal Medicine of the University hospital of Treichville. The diagnosis of AKI was retained according to Kidney Disease: Improving Global Outcomes (KDIGO) criteria.

**Results:** The mean age of patients was 26.8±6 years in the young and 69.4±7 years in the elderly. The proportion of males was 51.9% (55/106) in the young patients against 77.8% (84/108) in the elderly patients ( $P=0.0001$ ). The proportion of hypertension and diabetes in the elderly patients, respectively 30.6% and 36.1% was statistically higher than in the young patients ( $P=0.001$ ). However, human immunodeficiency virus (HIV) infection was more prevalent in the young patients ( $P=0.0001$ ). Anemia was observed in 84.9% in the young patients against 58.3% in the elderly patients ( $P=0.001$ ). It was severe in 34% among the young patients against 15.7% among the elderly patients ( $P=0.002$ ). The proportion of drug AKI was 17% in the young patients against 2.8% in the elderly patients ( $P=0.0001$ ). Malignant hypertension ( $P=0.002$ ) and urinary tract tumors ( $P=0.001$ ) were more observed in the elderly patients. Mortality was 31.1% in the young patients against 47.2% in the elderly patients ( $P=0.011$ ).

**Conclusion:** The etiologies are the same with different proportions, except malignant hypertension observed only in the elderly patients. Mortality is higher in the elderly patients.

### Implication for health policy/practice/research/medical education:

In our study, we found that regardless of age, infection is the leading cause of acute kidney injury (AKI). Drug-induced AKI is more common in young adults. On the other hand, benign tumor of the urinary tract and malignant hypertension are more found in the elderly. In addition, mortality and non-recovery of renal function are higher in the elderly. The causes of death and the factors associated with mortality and non recovery of renal function differ in both groups.

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## Introduction

Acute kidney injury (AKI) is characterized by a sudden drop in glomerular filtration rate. It is commonly seen in our medical practice. Its incidence varies from 1.9% to 24.4% depending on the series (1-4). In intensive care

units, this incidence is in the order of 20% to 50% (5). The etiologies of AKI vary from one region to the other of the world. In the West countries, septic shock, hypovolemia, cardiogenic shock and post-operative AKI are the most common in adults (4). In Africa, the



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causes are dominated by infections, toxic and obstetric gynecology causes are responsible (6).

AKI may occur at any age. If chronic kidney diseases (CKDs), related to polypharmacy and renal manifestations of chronic diseases are common among the elderly patients, AKI is a reality in this population. The etiologies of AKI among the elderly patients seem to be the same in the general population. Only the distribution seems different with a higher proportion of obstructive AKI (2). The mortality of patients with AKI is worrisome, since it remains high despite the progress of methods of dialysis and resuscitation (2,3). Regarding renal survival, studies have shown that the recovery of renal function was slower and less complete in the elderly patients than in adults (4). AKI is a reality in our daily practice.

### Objectives

Our study aims to compare the profile of AKI in the young patients with that of the elderly patients in order to describe the features.

### Patients and Methods

#### Patients

We analyzed the cohort of patients hospitalized for AKI in the period from January 2010 to December 2015. It is therefore a prospective study which involved 214 cases of AKI distributed in two groups, one of young patients (aged 35 years at the most) and the other of the elderly (65 years at least). This study was carried out in the Nephrology Internal-Medicine Department at the University Hospital of Treichville. This department consists of a consulting unit, a support unit for human immunodeficiency virus (HIV), infected patients and a conventional hospitalization unit.

#### Definitions

AKI was defined and classified according to the Kidney Disease: Improving Global Outcomes (KDIGO) recommendations (7) on the basis of serum creatinine values determined in hospitalization. We excluded from the analysis, all patients without normal serum creatinine within 3 months prior to hospitalization.

AKI has been grouped into three stages according to KDIGO classification (7); stage 1 for a serum creatinine less than 3 mg/dL stage 2 between 3 and 4.4 mg/dL and stage 3 for a serum creatinine higher than 4.4 mg/dL. Anemia is defined for a hemoglobin level below 12 g/dL. It was said severe for a hemoglobin level below 8 g/dL. Diabetes mellitus and hypertension were diagnosed according to the criteria of the World Health Organization (WHO) (8,9). Patients with cancer including those having a solid or hematopoietic malignant tumor, sepsis was diagnosed in accordance with the consensus of "the American College of Chest Physicians and the Society of Critical Care Medicine Consensus" (10). HIV infection was detected by a quick test and confirmed by ELISA test in the laboratory. It was then classified in AIDS stage

according to the classification of the Center for Disease Control and Prevention (CDC) (11).

AKI is assumed to be functional in the presence of a factor of renal hypoperfusion (diarrhea, vomiting and low-cardiac output) or in the presence of extracellular signs of dehydration. It is obstructive in the presence of AKI associated with bilateral dilatation of pyelocalyceal cavities on ultrasound scan. Acute tubular necrosis has been raised in the presence of AKI associated with proteinuria less than 1 g/24 hours with or without oliguria. Oliguria is defined by a diuresis less than 500 mL/24 hours. Acute glomerulonephritis is retained in the presence of edema, hypertension, and positive albuminuria with a decrease in the fraction of C3 complement. Acute interstitial nephritis is suggested in the presence of AKI with positive leukocyturia and preserved diuresis (1 to 2 L/d) or in the presence of AKI with preserved diuresis kept in a context of proven drug intake. Renal biopsy was not performed.

#### Variables

The measurement of serum creatinine and blood urea was performed on admission of patients. For each patient enrolled, we collected the following information using a standardized survey form; demographic data (age, gender), co-morbidities (diabetes mellitus, hypertension and HIV infection). The causes of AKI such as sepsis, water loss, and benign tumors of the urinary tract, cancer and also administration of nephrotoxic drugs were analyzed.

Clinical data (reason for admission, blood pressure on admission, temperature, level of consciousness, state of hydration, diuresis and CDC classification of HIV infection), laboratory data (serum creatinine, blood urea, serum calcium, blood glucose, hemoglobin, leukocyte count and formula, platelets count, urinalysis, blood culture, HIV status, lymphocyte CD4 count) and imaging data (renal ultrasound) were also analyzed.

Each patient has had a mean follow-up of 12 weeks. A regular determination of serum creatinine and in particular to three months allowed to assess the evolution in AKI. This evolution has been said favorable if serum creatinine was less than 1.5 mg/dL or when we observed a decrease of 50% compared with the baseline creatinine. We also analyzed serum creatinine in the last 48 hours before the death of patients.

#### Ethical issues

The research followed the tenets of the Declaration of Helsinki; informed consent was obtained; and the research was approved by the ethical committee of Felix Houphouët-Boigny University of Medical Sciences. Participants were informed of the purpose of the study and were assured that data confidentiality would be maintained. They were also informed that the results of their examinations will be used in this study. In the context of this in-patient cohort study, the verbal consent of all participants was obtained before data collection.

### Statistical analysis

Data were processed into an Excel database and analyzed using SPSS software version 22. We performed a bivariate analysis. The proportions of qualitative variables were compared between the young and elderly subjects by a chi-square test or a Fisher's exact test. Regarding quantitative variables, the averages were compared by Search Results Image result for analysis of variance (ANOVA) test. Quantitative variables were transformed into categorical variables according to pathological standards. Qualitative or categorical variables with  $P < 0.05$  were included in a binary logistic regression model to highlight the association between these variables and AKI. The association is assessed by the odds ratio (OR). The  $P < 0.05$  threshold was considered significant.

### Results

Our study involved 106 young patients and 108 elderly patients, all presented AKI. The mean age of patients was  $26.8 \pm 6$  years in the young and  $69.4 \pm 7$  years in the elderly. The proportion of males was 51.9% in the young patients against 77.8% in the elderly patients ( $P = 0.001$ ). The proportion of hypertension and diabetes in the elderly patients, respectively 30.6% and 36.1% was statistically higher than in the young patients ( $P = 0.001$ ). However, HIV infection was more common in the young patients ( $P = 0.001$ ; Table 1).

Biologically, anemia was observed in 84.9% among the young subjects against 58.3% among the elderly patients ( $P = 0.001$ ). It was severe in 34% among the young subjects against 15.7% among the elderly patients ( $P = 0.002$ ; Table

1).

The main etiologies of AKI in the young patients were in descending order, infections (56.6%), medications (17%) and water loss (10.4%). In the elderly patients, infections (47.2%), benign tumors of the urinary tract (16.7%), malignant hypertension (8.3%), decompensated heart disease (8.3%) and cancer (8.3%) were observed. The proportion of drug-induced AKI was 17% in the young patients against 2.8% in the elderly patients ( $P = 0.0001$ ). Malignant hypertension ( $P = 0.002$ ) and urinary tract tumors ( $P = 0.001$ ) were more observed in the elderly patients (Table 1).

Among the types of infection, malaria was observed only in the young adults in 11.2% ( $P = 0.001$ ). In the other cases, we have not found significant differences in both groups (Table 2).

Mortality was 31.1% in the young patients against 47.2% in the elderly patients ( $P = 0.011$ ). Survival was statistically different between groups ( $P = 0.027$ ; Figure 1). The main causes of death were respectively severe sepsis (33.3%) and end-stage kidney disease (18.2%) in the young subjects against severe sepsis (23.5%), cancer (23.5%) and stroke (17.6%) in the elderly patients (Table 3). In multivariate analysis, severe sepsis appears to be the factor associated with mortality in the young patients with AKI ( $P = 0.027$ ; OR [CI] = 5.18 [1.21-22.22]). Factors such as HIV positive status ( $P = 0.003$ ; OR [CI] = 2.29 [1.83 to 2.86]) and severe sepsis ( $P = 0.015$ ; OR [CI] = 3.96 [2.08 to 7.18]) were associated with death among the elderly patients (Table 4). Renal function was not fully recovered in 31.1% among the young subjects against 68.2% among the elderly patients

**Table 1.** General features of patients with acute kidney injury

Features	≤35 years (n = 106)	≥65 years (n = 108)	P value	OR (95% CI)
Male gender	51.9% (55/106)	77.8% (84/108)	0.0001	1.88 (1.32-2.69)
<b>Co-morbidities</b>				
Hypertension	8.5% (9/106)	30.6% (33/108)	0.0001	1.80 (1.42-2.27)
Diabetes	0%	36.1% (39/108)	0.0001	2.53 (2.11-3.04)
HIV	43.4% (46/106)	6.5% (7/108)	0.0001	2.32 (1.85-2.92)
<b>AKI Stage</b>				
Stage 1	29.2% (31/106)	25% (27/108)	0.29	1.11 (0.83-1.48)
Stage 2	7.5% (8/106)	19.4% (21/108)	0.009	1.54 (1.17-2.02)
Stage 3	63.2% (67/106)	55.6% (60/108)	0.15	1.17 (0.88-1.56)
Anemia	84.9% (90/106)	58.3% (63/108)	0.0001	2.24 (1.44-3.48)
Severe Anemia	34% (36/106)	15.7% (17/108)	0.002	1.56 (1.21-2.01)
<b>Etiologies</b>				
Decompensated heart disease	2.8% (3/106)	8.3% (9/108)	0.25	1.34 (0.82-2.17)
Water loss	10.4% (11/106)	5.6% (6/108)	0.14	1.34 (0.91-1.96)
Malignant hypertension	0%	8.3% (9/108)	0.002	2.07 (1.79-2.38)
Infections	56.6% (60/106)	47.2% (51/108)	0.108	1.21 (0.91-1.59)
Drugs	17% (18/106)	2.8% (3/108)	0.0001	1.88 (1.48-2.37)
Benign tumors of urinary tract	0.9% (1/106)	16.7% (18/108)	0.0001	2.05 (1.70-2.47)
Cancers	3.8% (4/106)	8.3% (9/108)	0.13	1.40 (0.95-2.07)
Others	8.5% (9/106)	5.6% (6/108)	0.28	1.23 (0.79-1.90)
Mortality	31.1% (33/106)	47.2% (51/108)	0.011	1.38 (1.06-1.79)
Non recovery of renal function	31.8% (28/106)	68.2% (60/108)	0.0001	1.65 (1.30-2.10)

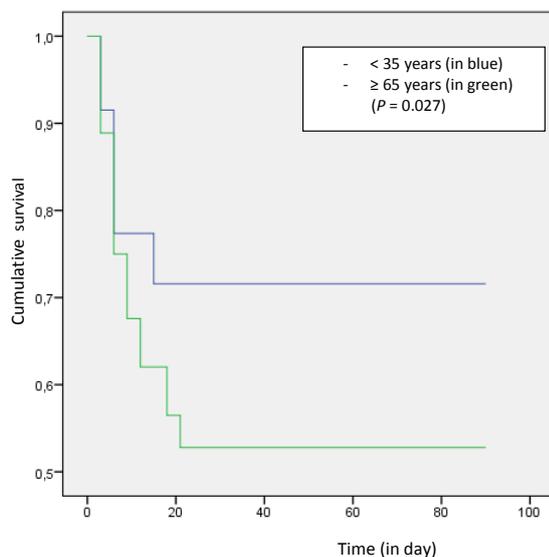
Abbreviation: Human immunodeficiency virus.

**Table 2.** Distribution by type of infection

Type of infection	≤ 35 years (n = 60)	≥ 65 years (n = 51)	P value	OR (95% CI)
Acute pyelonephritis	5.7%(6/106)	11.1%(12/108)	0.11	1.36 (0.95-1.94)
Infectious diarrhea	2.8%(3/106)	8.3%(9/108)	0.07	1.53 (1.07-2.18)
Pleuropneumopathy	11.3%(12/106)	5.6%(6/108)	0.10	1.39 (0.97-1.98)
Severe sepsis	14.2%(15/106)	19.4%(21/108)	0.19	1.19 (0.87-1.63)
Malaria	11.3%(12/106)	0%	0.0001	2.14 (1.85-2.49)
Other infections	8.5%(9/106)	2.7%(3/108)	0.06	1.56(1.09-2.23)

**Table 3.** Distribution of patients by cause of death

Parameters	Cause of death*			
	≤ 35 years		≥ 65 years	
	No. (n=33)	(%)	No. (n=51)	(%)
Stroke	-	-	09	(17.6)
Cancer	03	(09)	12	(23.5)
Heart disease	-	-	03	(05.8)
Pulmonary embolism	01	(03)	-	-
Hepatic failure	03	(09)	06	(11.7)
End-stage renal disease	06	(18.2)	02	(3.9)
Lymphoma	-	-	01	(1.9)
Severe sepsis	11	(33.3)	12	(23.5)
Hemolytic and uremic Syndrome	03	(09)	-	-
AIDS	03	(09)	03	(05.8)
Tuberculosis	03	(09)	03	(05.8)

**Figure 1.** Cumulative survival curve

( $P=0.0001$ ; OR [CI] = 1.65 [1.30-2.10]) (Table 1). Anemia was associated with non-recovery of renal function in the young patients ( $P=0.016$ ; OR [CI] = 1.79 [1.08-2.98]). In the elderly patients, factors such as hypertension ( $P=0.014$ ; OR [CI] = 3.16 [1.26- 7.92]), coma ( $P=0.0001$ , OR [CI] = 7.77 [2.73- 22.14]) and cancer ( $P=0.009$ ; OR [CI] = 2.36 [1.48- 3.76]) were associated with the non-recovery of renal function during AKI (Table 5).

## Discussion

The risk of occurrence of AKI is determined by factors related to patients, including advanced age, CKD and other underlying chronic conditions, and exhibitions such as sepsis, surgery and nephrotoxic drugs (12-14).

The male predominance is observed in several studies (15,16) as in ours and can be explained by the predominance of males in the general population. AKI is a common reason for admission in intensive care unit (ICU) and its incidence increases with age (17).

Infections, toxics and obstetric gynecological pathologies are the main causes of AKI in African series (6). According to Baraldi et al, drugs (35.7%) and renal hypoperfusion (30.2%) are the main etiologies in the West. In Italy, renal hypoperfusion (38%) and sepsis are the most observed (18). Other authors have found septic shock, hypovolemia, cardiogenic shock and post-operative AKI as the major causes of AKI in adults in the West countries (4).

The causes of AKI in the elderly patients are not different from those of the general population in the West countries (19). In our study, infections, obstructive nephropathy, and functional AKI are the most observed in the elderly patients. Prostatic hyperplasia affects 50% of men over 50 and 90% of men over 90 years (20). Similarly, the incidence of cancer pathology of the pelvis increases with age (21). It should also be underlined a significant proportion of AKI due to malignant hypertension in the elderly patients that could be explained by the fact that medical care are out of reach of our patients.

In our study, drug-induced AKI is significantly more frequent in the younger patients compared with the elderly patients. Drug-induced AKI which accounts for only 2.8% of the causes of AKI in the elderly patients in our work, is a major cause of AKI in the West countries, up to 44.9% depending on the authors (16,18). Some authors emphasize the growing part of iatrogenic as a risk factor for AKI in the elderly, frequently exposed to polypharmacy (19,22).

Regarding the type of infection, all AKI cases by malaria were observed in the young patients. The impact of AKI during malaria varies in the order of 15 to 48% according to studies (23). This variation could depend on the age of patients and the anti-malarial immunity, which are in their turn influenced by the intensity of malaria transmission (24). This anti-malarial immunity could explain the absence of AKI cases by malaria in the elderly patients in

**Table 4.** Death risk factors

Variables	P value	OR	95% CI	
			Inferior	Superior
<b>≤ 35 years</b>				
Female gender	0.052			
Severe sepsis	0.027	5.18	1.21	22.22
<b>≥ 65 years</b>				
HIV positive	0.003	2.29	1.83	2.86
Severe sepsis	0.015	3.87	2.08	7.18
Cancer	0.999	-	-	-

**Table 5.** Risk factors of non recovery of renal function

Variables	P value	OR	95% CI	
			Inferior	Superior
<b>≤ 35 years</b>				
Anemia	0.016	1.79	1.08	2.98
Cancer	0.99	-	-	-
<b>≥ 65 years</b>				
Hypertension	0.014	3.16	1.26	7.92
Coma	0.0001	7.77	2.73	22.14
Cancer	0.009	2.36	1.48	3.76

our study. AKI during malaria is considered as a disease primarily of adults and older children (25).

The lethality is high during AKI, in the order of 32% according to African data (6). This mortality varies from 21.9% to 67.3% depending on the series (26-28). For patients with severe AKI, it is from 51% to 28 days and 60% to three months (29).

Severe sepsis was a death risk factor common to both groups. In the elderly patients, HIV positive status also seems to favor death. In the study of Liaño et al, mortality factors were coma, respiratory support, hypotension and oliguria (17). For others, factors such as the presence of neoplasia, heart or liver disease, sepsis and oliguria are of poor prognosis (30). Prognosis for life depends more on the severity of the disease causing AKI than its consequences (31).

As for renal survival, recovery of renal function seems slower and less complete in the elderly patients than in adults (32,33). A meta-analysis revealed that 31% of elderly patients could not recover renal function after an episode of AKI compared with 26% of younger patients (34). The largest proportion in our study could be explained by the delay in the management of our patients related to the precarious socio-economic conditions of these and the lack of social security system. Factors such as sepsis, hypertension and cancer seem associated with the non recovery of renal function during AKI (35,36).

## Conclusion

The etiologies are the same with different proportions, except malignant hypertension observed only in the elderly patients. The drug causes are more common in young. Mortality is higher in the elderly patients and the non-recovery of renal function was significantly greater in

this group. An early management could help improve the vital and functional renal prognosis.

## Limitations of the study

The small number and low socio-economic status of patients, the single-center nature are the limitations of our study. Additional tests have not been systematically carried out in time for all patients.

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## Authors' contribution

KHY has made a substantial contribution to conception and design, analysis and interpretation of data. He has also been involved in drafting the manuscript and revising it critically for important intellectual content. GMC, KSD and DSP have collected data. WMT and SS have revised the manuscript critically for important intellectual content.

## Conflict of interests

The authors declare no conflict of interest.

## Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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