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# Pediatric Acute Renal Failure in Chad: Epidemiological, Clinical and Evolutionary Aspects

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**Abstract**

**Introduction:** Acute kidney injury (AKI) is a clinical syndrome characterized by a sudden and potentially reversible reduction in kidney function, as measured by glomerular filtration rate (GFR) affecting the exocrine functions of the kidney. It engages the short-term vital prognosis and the long-term renal function prognosis. It is an important cause of morbidity and mortality in sub-Saharan Africa. Our objective was to study the epidemiological, clinical, paraclinical, therapeutic and evolutionary aspects of acute renal failure in children at the Renaissance University Hospital Center and Mother and Child University Hospital in N'Djamena, Chad.

**Methodology:** This was a descriptive and analytical cross-sectional study for six months from March to August 2020. All children aged 1 year to 15 years that were hospitalized in the emergency room of the Mother and Child University Hospital and went for follow-up consultations in the Nephrology and Dialysis Department of the Renaissance University Hospital Center with acute renal failure defined by the KDIGO 2012 criteria were included in the study. The data were analyzed by Excel 2019 and SPSS 18.0 with significance ($p<0.05$).

**Results:** Thirty children were included in the study with a hospital prevalence of 0.56%. The mean age was 8.33 years with a sex ratio of 3.28. The average consultation time was 10.1 days. Vomiting was the main reason for consultation (46.7%). About 27% of patients had oligoanuria. There were 86% of the cases that were anemic, half of which were severe. Mean serum creatinine was 434.02 µmol/l and the mean urea level was 26.86 mmol/l. Severe malaria was the main cause of AKI (33.3%). All patients suffering from malaria received antimalarials based on artemisinin derivatives. Intermittent hemodialysis was indicated in 22 patients (73.4%). The evolution was marked by a total recovery of renal function in 20 patients, 8 deaths and 2 transitions to chronic kidney disease. Deaths were statistically related to AKI severity, age range 1-5 years, femoral catheters and infections ($p<0.0000$).

**Conclusion:** Acute kidney injury is an uncommon pathology in pediatrics and in Chad. It is often linked to severe malaria and has a high mortality rate.

**Abbreviations:** AKI: Acute Kidney Injury; GFR: Glomerular Filtration Rate; UHC: University Hospital Center

**Keywords:** Acute kidney injury; Child; Dialysis; Chad

## Introduction

Acute kidney injury (AKI) is a clinical syndrome characterized by a sudden and potentially reversible increase in serum creatinine and blood urea associated with the kidney's inability to regulate exocrine functions (hemostasis of water, electrolytes and purification) [1]. It involves the vital prognosis of the patient in the short term and the functional prognosis of the organ in the longer term [2]. In some African countries, during hospital admission, AKI is mainly due to sepsis. Unlike in developed countries, it often occurs in patients post hospitalization following medical and/or surgical pathologies, particularly in complications of cardiac surgery and cancer treatment [3,4]. In sub Saharian Africa and Sudan, AKI is a major cause of morbidity and mortality due to the high prevalence of tropical diseases such as severe malaria, sepsis, diarrheal diseases and respiratory tract infections [5,6]. The prognosis depends on the initial pathology and early management, made possible by the progress made in current methods of extrarenal replacement [7,8]. In a recent meta-analysis of pediatric AKI in sub-Saharan Africa, 66% of children with severe AKI were in need of dialysis, compared to 11% globally. However, only 64% of the children with an indication for dialysis received it [9,10]. The worldwide incidence of AKI was 33.7% in children with a mortality rate of 13.8% respectively [11]. AKI poses a problem in the

diagnosis and management. Few data are available on this issue in sub-Saharan Africa and Chad, this is the reason why we conducted this descriptive and analytical cross-sectional study whose objective was to describe the epidemiological, clinical, paraclinical, therapeutic and evolutionary aspects of acute renal failure in children in N'Djamena, Chad.

## Patients and Method

This was a descriptive and analytical cross-sectional study conducted over a period of six months (March to August 2020). The subjects included in this study were children aged 12 months to 15 years that were admitted for an AKI defined according to the KDIGO 2021 criteria (Table 1) and hospitalized in the pediatric emergency department of the Mother and Child University Hospital in N'Djamena. All cases requiring emergency intermittent hemodialysis were sent to the Nephrology (UHC La Renaissance). The included variables were socio-demographic, clinical, paraclinical and therapeutic. They had been collected using a pre-established survey sheet and analyzed using Excel 2013 and SPSS version 18.0 (Statistics Package for Social Sciences 18.0) software. All of the patients' legal guardians had given their informed consent and all ethical and administrative authorizations had been obtained.

## Results

During the study period, 5419 patients were admitted to the emergency department of the Mother and Child University Hospital. There were 30 children with AKI, with a hospital prevalence of 0.56%. The average age was 8.3 ± 4.3 years [1-15 years]. The 1-5 years age group represented 40% (n=12). The male sex accounted for 76.7% (n=23), with a sex ratio of 3.28. On admission, 63.3% (n=19) of the children had consulted directly to the emergency room without being referred by a medical facility. The mean consultation time was 10.1 ± 9.5 days with 1-35 days. The medical history was marked by SS sickle cell disease in 1 patient, 2 cases of HIV infection, one case of chronic kidney disease (hematuria) and 1 case of valvular heart disease. Vomiting was the main reason for consultation (46.7%). On admission, there was conjunctival pallor (87.6%), jaundice (20%) and tachycardia (80%). Oliguria-anuria and arterial hypertension were found in 23.3% (n=7) and 13.3% (n=4) respectively. Eleven patients (36.7%) had positive nitrites on the urine dipstick. On physical examination, there was hepatomegaly and splenomegaly in 16.7% (n=5) and 13.3% (n=4) respectively. Mean serum creatinine was 434 µmol/l [132.6-1535.2 µmol/l] and mean uremia level was 26.8 mmol/l [5.9-72.6 mmol/l]. Figure 1 summarized the distribution of patients according to the KDIGO classification of the AKI.

**Table 1:** Definition of AKI according to KDIGO.

| Stages | Criteria according to creatinine or basal GFR | Criteria according to hourly diuresis |
|---|---|---|
| 1 | Increase >26 µmol/L (3 mg/L) in 48 h or >50% in 7 days. | <0.5 ml/kg/h for 6 to 12 h |
| 2 | Serum creatinine x 2 in 7 days | <0.5 ml/kg/h ≥ 12 h |
| 3 | Serum creatinine x 3 in 7 days or serum creatinine >354 µmol/L (40 mg/l) in the absence of previous value or need for dialysis. | <0.3 ml/kg/h ≥ 24 h Ou anurie ≥ 12 h |

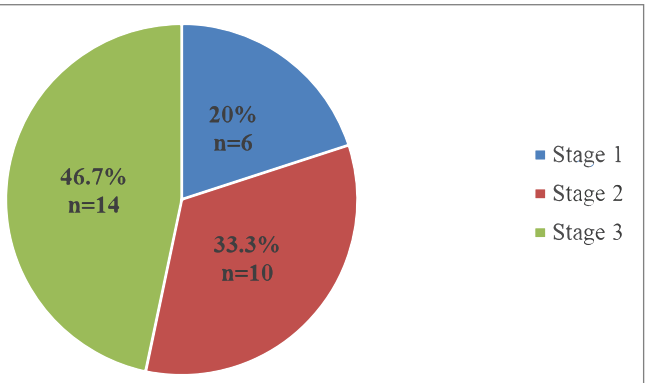


**Figure 1:** Distribution of patients according to the AKI KDIGO classification.

Anemia was found in 86.7% of cases. The mean hemoglobin level was 7.7 g/dl [3.7-13.6 g/dl]. It was severe (50%), defined by a hemoglobin level below 6 g/dl. The average CRP (C reactive protein) was 90 mg/l [9.8-160 mg/l]. Thirteen patients (43.3%) had a positive thick smear. The cyto-bacteriological examination of the urine had isolated an Escherichia coli from 4 patients.

Renal ultrasound revealed hydronephrosis with bilateral renal lithiasis in 3 patients. Abdominal computed tomography performed in one patient found bilateral multinodular nephroblastoma with compression of both ureters. Parenchymal AKI accounted for 76.6% (n=23) of the cases. It was functional in 3 patients (10%) secondary to vomiting and obstructive in 4 patients (13.3%). Regarding the etiologies of AKI, infections accounted for 96.7% of the cases. The causes of organic AKI were shown in figure 2.

Obstructive AKI was found in 4 patients (13.4%) and its etiologies are dominated by renal lithiasis.

Antimalarials, antibiotic therapy and rhesus iso group whole blood transfusion per dialysis were prescribed in 63.3%, 12% and 10% of the total population, respectively.

Periodic hemodialysis was indicated in 22 patients (73.4%). The approach was in all cases a central catheter with a diameter of 10 French. The catheter was femoral in 15 patients (50%) and internal jugular in 5 patients (16.6%). The average duration of a femoral catheter was 17 days and that of a jugular catheter 35 days. The average number of dialysis sessions was 7 sessions ± 1.8 [5 to 10 sessions]. A blood urea level above 38 mmol/l with clinical repercussions (vomiting) represented 36.3% of the indications for dialysis. The evolution was marked by a total recovery of renal function in 20 patients, including 15 on hemodialysis (50%) and 3 patients with functional AKI (10%). Eight patients (26.6%) died, including 6 patients with septic shock and 2 patients with acute pulmonary edema (6.6%). Two patients had progressed to chronic renal failure. The age group from 1 to 5 years was statistically linked to non-recovery of renal function with a $p<0.02$. Deaths were statistically related to terrain, duration and type of catheter and severity of AKI with a significance ($p<0.0000$). All 3 patients with obstructive lithiasis had received urological treatment. For the case of nephroblastoma, chemotherapy had been instituted in oncology. The evolution of the obstetric causes was favorable.

## Discussion

This study highlights the difficulties of the management of AKI in children in Chad and in sub-Saharan countries. The hospital

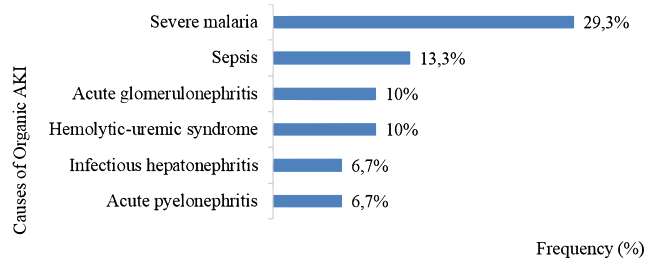


**Figure 2:** Distribution of etiologies of organic AKI.

prevalence of AKI in this work was 0.56%. AKI is common, affecting approximately 5% to 10% of hospitalized patients and up to 60% of patients admitted to the intensive care unit [12]. This is largely explained by severe malaria and poor access to health care as claimed by the WHO and Unicef [13-15]. In Senegal and Togo, the hospital prevalence of AKI was 0.91% and 2.4%, respectively. The diagnostic delay and the delay in consultation would increase the risk of the occurrence of pediatric AKI as demonstrated by several other African studies [1,8,16,17].

The average age was 8.33 years. Children aged between 1-5 years were the most affected (40%). In many studies, early age, male gender, severe sepsis, the presence of diabetes, hypovolemia or the use of nephrotoxic drugs are risk factors for developing AKI [9,18,19]. Vomiting was the main symptom (46.7%), reflecting poorly tolerated uremia. Nearly half of the patients were admitted in stage 3 of the AKI [9,11,20]. The average consultation time was 10.1 ± 9.5 days with 1 to 35 days. This delay is relatively long and is consistent with the observation made by many African authors. The causes of this delay are insufficient access to health care due to lack of financial means and a lack of information and awareness [1,20]. The delay in consultation would have a negative impact on the treatment time. The mean time to resumption of diuresis was 4.5 days. The definition of AKI according to the KDIGO has made it possible to standardize practices and raise practitioners' awareness of monitoring plasma creatinine and especially diuresis [21]. Severe malaria (33%) was the main cause of childhood AKI in our study. It was complicated by a severe acute hemorrhagic syndrome as demonstrated by the presence of hepato-splenomegaly and jaundice in almost ¼ of the patients. The same is true in Togo and Niger with 63.8% [22-24] and 55.5%, respectively [1]. On the other hand, in developed countries, the causes of AKI in children are dominated by cardiac surgery, urological congenital malformations and hemolytic-uremic syndrome [4,5,22-24]. These neonatal comorbidities can lead to neonatal AKI, associated with the risk of future chronic kidney disease [25]. All patients had received medical treatment. Careful assessment of volume status and hemodynamics should be undertaken and treated with intravenous fluids, diuretics, or other means of hemodynamic support as indicated. In a quality improvement initiative, a pharmacy leading for pediatric patients receiving 3 or more nephrotoxic medications (aminoglycoside) resulted in a decrease in nephrotoxic medication exposure (38%) and decrease in AKI incidence (64%) [12]. In stub-Saharan Africa, access to dialysis is very limited [9,24]. No patient benefited from peritoneal dialysis which is the treatment technique best indicated in young children. Intermittent hemodialysis is the only extra renal purification technique available in Chad.

The immediate evolution was marked by a total recovery of renal function in 20 patients (66.6%) and partial in 2 patients who then progressed to chronicity. In Chelghoum S, et al. series [7], recovery was complete in 48%, partial in 20% with 7% transition to chronicity. AKI is a true systemic general pathology comprising circulatory, endothelial, epithelial and cellular functional damage. We have demonstrated this with the average CRP level, which was 90 mg/l, explaining the generalized infectious and inflammatory process. The AKI is not accompanied by ad integrum reparation. After prolonged aggression, cell cycle arrest, epithelial-mesenchymal transition and mitochondrial dysfunction are thought to be the cause of inadequate repair. A continuum therefore exists between acute renal failure and chronic renal failure, linked by different renal recovery phenotypes [21]. The average hospital stay was 11.2 days with [2 to 32 days]. It is 12.7 ± 7.7 days for Akolly DAE, et al. [20] and 13.8 ± 1.2 days for Batouche DD, et al. [18]. AKI is responsible for increased morbidity (duration of hospitalization, dependence on dialysis) and mortality [21]. Mortality rates during AKI vary depending on the type and context of occurrence [7,26]. In this series, ¼ of the patients had died. Among the children who died, there were 2 cases of HIV and one case of SS sickle cell disease. This explains the negative impact of the terrain on the prognosis. In sub-Saharan Africa, the mortality rate during AKI varies between 20.9% to 46.8% [10,27,28]. We have demonstrated in this work, the statistical link between the presence of anuria, acute pulmonary edema and the severity of the AKI which are all factors associated with death.

## Conclusion

AKI is an uncommon pathology in pediatrics and represents 0.56% of hospitalizations in our study. The difficulty of obtaining additional blood tests and access to dialysis were the main limitations. In 3/4 of cases, AKI is organic. Etiologies remain dominated by infectious causes. Nearly half of the patients were admitted at the stage of severe AKI requiring dialysis. In spite of a good rate of recovery of the renal function, the evolution remains punctuated by a significant mortality (33.3% in our series) which should justify an awareness campaign among the population in order to refer patients in time for a better quality of care in Chad. Rapid and adequate management of AKI would improve the vital prognosis of the patient and the functional outcome of the kidney.

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## Conflicts of Interest

The authors declare no conflicts of interest.

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