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Acute Kidney Failure in Intensive Care at the Parakou University Hospital in Benin in 2019: Epidemiological and Evolutionary Aspects

Ahoui S[1], Tchaou BA[2], Tchégnonsi NCF[2], Djarra A[2], Eteka E[1], Houeto N[1], Aliho DG[1], Agboton BL[3], Vigan J[3], Chobli M[4]

[1]Department of Nephrology and Hemodialysis - University and Departmental Hospital Center of Borgou / Alibori, Parakou, Bénin.

[2]Anesthesia-Resuscitation and Emergency Department - University and Departmental Hospital Center of Borgou / Alibori, Parakou, Bénin.

[3]Nephrology - Dialysis University Clinic, CNHU HKM Cotonou, Benin.

[4]Anesthesia-Resuscitation and Emergency Department - Faculty of Health Science, Cotonou.

***Corresponding Author:** Ahoui Séraphin, BP, Department of Nephrology and Hemodialysis - University and Departmental Hospital Center of Borgou / Alibori, Parakou, Bénin.*

Summary

***Background:** Acute kidney failure (AKF) is a relatively common complication in patients hospitalized in intensive care and grafted with significant morbidity and mortality.*

***Objective:** To study the epidemiological and evolutionary aspects of AKFin intensive care at the Parakou University Hospital in Benin in 2019.*

***Patients and method:** This was an observational study for descriptive and analytical purposes with prospective data collection carried out over a period of six months (March 1st to August 31st, 2019). AKF was selected according to the 2012 Kidney Disease Improving Global Outcomes (KDIGO) criteria (an increase in plasma creatinine of at least 3 mg / l in 48 h or more than 1.5 times the base value in the last 7 days). The factors associated with the unfavorable outcome of AKF were sought and the significance level retained was 5%.*

***Results:** During the study period 42 cases of AKF were collected representing 11.93% of admissions. The average age was 39 ± 19.61 years with a sex ratio of 0.44. Altered state of consciousness was the most common reason for consultation. The most common risk factors were high blood pressure (14.29%) and taking nephrotoxic drugs (4.76%). Acute kidney failure was found in 97.61% of patients on admission or during the first 48 hours. Medical causes were the most represented in 80.95%. The average length of stay was 5 ± 1.5 days. Mortality was 64.28%. The unfavorable prognostic factors were oliguria, anuria, association with other organ failures, length of stay, high APACHE II score.*

***Conclusion:** The frequency of acute kidney failure is very important in intensive care with high multifactorial mortality. Early and effective management of factors would improve the prognosis.*

Keywords: *Acute renal failure, Resuscitation, Prognosis, Parakou*

Introduction

Acute renal failure (AKI) is a relatively common complication in intensive care hospital patients with significant morbidity and mortality due to the severity of the underlying pathologies and the high incidence of complications [1]. A sudden decline in renal function is responsible not only for retention of so-called uremic toxins and other nitrogenous wastes, but also for dysregulation of the homeostasis of extracellular fluids and electrolytes (internal environment) [2].

Its epidemiology is not stable. In France in 2014, Ichai et al. reported a frequency of 25 to 35% with mortality

varying between 10 and 60% [3]. In Algeria in 2017 Benouaz et al. found an incidence of 32.5% with a mortality of 53.6% [4].

In Africa, Kane et al. In Senegal in 2014 reported an incidence and mortality of 32.2% and 42.1%, respectively [5]. In Benin, and more specifically in Parakou in 2015, a previous study concerning cases of postoperative AKI done in intensive care at the Departmental University Hospital Borgou / Alibori (CHUD-B / A) found a frequency of 12.31% [6].

The functional or vital prognosis of AKI is poor in the short to medium term due to the context of the occurrence of AKI, extra-renal complications and risk factors such as age ≥ 65 years, male sex, African ethnicity, diabetes, high blood pressure, the surgery period, nephrotoxic agents [7]. The survivors of an AKI, whoneed dialysis in the intensive care unit and completely recover their kidney function, are 80% of cases. About 7 to 15% of patients transiently require dialysis on discharge from intensive care and 5 to 15% of patients will need long-term dialysis depending on the cause of the AKI and the presence of previous renal impairment [8]

The current strategy is aimed at the prevention of AKI and the replacement in the event of irreversible damage. Prevention combines general measures (hemodynamic optimization and elimination of nephrotoxic substances) and, where appropriate, measures adapted to certain clinical contexts [7]. This work was initiated in order to study the epidemiological and evolutionary aspects of acute renal failure in intensive care settings at the Parakou University Hospital in Benin in 2019.

Patients and Method

Study Framework

The resuscitation unit at Parakou University Hospital in Benin served as the study setting. It is a multi-purpose intensive care unit with 11 beds.

Study Method

Type and period of study: This was a cross-sectional descriptive and analytical study with prospective data collection carried out over a period of six months (March 1st, 2017 to August 31st, 2019). That study had received the approval of the ethics committee.

Study population: The study population consisted of patients admitted to intensive care regardless of the reason for admission and in whom the diagnosis of renal failure was made. Included were all adult patients aged at least 18 who had given their informed consent or, failing that, that of a legal representative of the family.

Sampling: This was a non-probability sampling by exhaustive recruitment of all the patients admitted who fulfilled the inclusion criteria during the study period and in whom the serum creatinine was measured and the urine output assessed according to the criteria of KDIGO 2012.

- The dependent variable was the presence of acute renal failure (AKI). It is a dichotomous dummy variable with a 'yes' or 'no' term. AKI was retained according to the *KidneyDiseaseImprovingGlobalOutcomes* (KDIGO) criteria of 2012 by an increase in plasma creatinine of at least 3 mg / l in 48 h or of more than 1.5 times the baseline in the last 7 days [7].

- The independent variables were socio-demographic data (sex, age, marital status, socio-professional group), clinical data (mode of admission, reason for admission, delay in admission, previous treatment, personal history, general signs, physical signs, organ failure), paraclinical data (uremia, natremia, serum potassium, chloremia, blood ionogram, calcium level, phosphoremia,, hemoglobin level, white blood cell number, urinary ionogram, creatininuria and renal ultrasound), diagnostic data (time to onset of AKI, type of AKI, probable causes and repercussions), therapeutic data and progress and prognostic data (duration of hospitalization, APACHE II score and progress under treatment)

AKI was classified according to KDIGO criteria in three stages. The type was also selected. Thus, dilation of the pyelocalicular cavities by renal ultrasound was in favor of an obstructive AKI. A functional AKI was retained before the excretion fraction (FeNa) was <1% and the organic AKI was then diagnosed with elimination or before an FeNa>2%

The formula $\frac{\text{Natriuresis} \times \text{creatininemia}}{\text{Natrémia} \times \text{creatininuria}}$ X100 allowed to calculate FeNa. Serum creatinine was measured on admission and specifically from the 48th hour to the 7th day and to the 14th day and to one month.

The favorable outcome of AKI with complete recovery

of renal function was retained when serum creatinine returned to normal (or previous value) and not good without complete recovery of renal function, when serum creatinine did not return to normal (or to the previous value). Death was considered an unfavorable outcome.

The collection technique was a direct or indirect interviewer-interviewer followed by documentary analysis, clinical examinations, the renal assessment and the assessment required for the calculation of the APACHE II score. The APACHE II score was calculated on the automatic calculator of the French Society of Anesthesia Réanimation. Visceral failures were investigated using the SOFA score. All of this collected data was entered, processed and analyzed with EPI DATA version 3.1 and EPI-INFO version 7 software. The qualitative data were expressed in frequencies and percentages; the quantitative data are expressed as averages and medians depending on whether the distribution is normal or not. The *chi2* test or *Fisher's* exact test were used to compare frequencies; while *Student's* test was used to compare averages. The analytical study was bivariate and multivariate in nature. The strength and the sense of stability of the associations between variables were estimated using odds ratios with their 95% confidence intervals, obtained using a logistic regression model. The significance level retained was 5%.

Results

Frequencies

During the study period, 352 patients were admitted to intensive care and among them we collected 42 cases of acute renal failure representing 11.93% of admissions. Out of the 42 cases of acute renal failure respectively 27 (64.29%) and 15 (35.72%) were functional and organic. From a stage point of view, stage 1, 2 and 3 ARIs were found in 38.09%, 19.05% and 42.86% of cases, respectively.

Socio-Demographic Data

The average age of the patients was 39 ± 19.61 years with extremes of 18 years and 90 years. The most represented age group was that of patients from 18 to 38 years (64.29%) followed by that of 58 to 78 years (or 21.43%). In our series, 29 patients (69.05%) were female with a sex ratio of 0.44. Of the 42 patients, 45.24% were self-employed and 33.33% were housewives.

Clinical Data

In our series, 19 patients (45.24%) were referred from another health center versus 30.95% direct admission and 23.81% transferred from another hospital department. 64.29% were admitted to intensive care for an altered state of consciousness and 16.67% for postoperative monitoring. The other reasons for admission were dyspnea (9.52%), seizures (7.14%), and severe envenomation from snakebite (2.38%), respectively. The average time to admission was 4 ± 2.21 days. Admission times of less than 24 hours, that between 72 and 96 hours and that greater than or equal to 96 hours were 23.81%, 23, respectively. 81% and 38.1%. In the series, it was found, respectively, 14.29%, 9.53%, 7.14% and 2.38% of hypertensive, diabetic, cirrhotic and victim of myocardial infarction. In the series, 7 patients (16.66%) had aneamia and 6 (14.28%) had jaundice. Similarly, 8 (19.04%) had the folds of dehydration and seven (16.66%) had edema of the lower limbs. Anuria and oliguria were found in 21.43% and 30.95% of subjects, respectively. As physical signs, crackles, convulsion, ascites and dyspnea were found in 14.28%, 9.52%, 9.52% and 7.14% of cases, respectively. In addition, neck stiffness, muscle contracture, bruising, hemorrhages and rales of congestion were each found in 2.38%. Neurological, hemodynamic, hepatic, hematological and respiratory organ failures were objectified in 64.28%, 45.23%, 45.23%, 42.85% and 21.42% respectively. The Glasgow score less than or equal to 8, between 8 and 12, 13 and 14 were found respectively in 64.29%, 11.90% and 2.38%. Nine subjects (21.43%) had a Glasgow score of 15.

Paraclinical Data

Blood Test

The average uremia was 0.96 ± 0.45g / l with extremes of 0.35 and 2.55g / L. The average natreamia was 140.18 ± 2.05mEq / l with extremes varying between 138-145mEq / l]. The average serum potassium was 5.5 ± 1.10 mEq / l with extremes varying between 4.5 and 8.5 mEq / l. The mean serum calcium was 88 ± 1.50 mg / l and extremes between [85-100 mg / l] and the average phosphoremia of 34 ± 1.20 mg / l

with extremes between 28 and 42 mg / l. The average hemoglobin level was 10 ± 1.05 g / dl with extremes of 9 and 11g / dl. The average hematocrit was 30 ± 1.5% with extremes of 28 and 35%. The average leukocyte count was 9218 ± 7856 GB / mm3 with extremes of 5000-30000 GB / mm3.

Renal Ultrasound

The renal ultrasound did not show any dilation of the pyelocalicular cavities. Of the 42 patients, 28 (66.67%) had conservation of renal morphology and structure and 14 patients (33.33%) had bilateral pain in both kidneys.

Diagnostic Data

In our series, 41 patients (97.62%) had presented with acute renal failure within the first 48 hours of hospitalization and one patient (2.38%) presented with acute renal failure within one week of hospitalization. Over 42 patients, 27 (64.29%) had a functional AKI including 12 cases of eclampsia (28.58%), six cases (14.29%) of dehydration, two cases (4.76%) of diabetic ketoacidosis, one case (2.38%) of hypertensive cardiomyopathy, one case (2.38%) of cirrhosis and one case (2.38%) of severe preeclampsia as medical causes. In the series, three cases (7.15%) of post-traumatic hemorrhage and one case (2.38%) of post-cesarean hemorrhage as surgical causes of functional AKIs were identified. As for organic AKIs, the most probable etiologies were: sepsis (9.52%), eclampsia (7.14%), acute pyelonephritis (4.76%), severe envenomation by snakebite (2.38%), peritonitis (4.76%) and intestinal obstruction (2.38%). The complications of AKI encountered objectified were: hyperkalaemia (11.90%), severe metabolic acidosis (11.90%), acute edema lung (4.76%) and uremic encephalopathy (2.38%).

Therapeutic Data

As symptomatic treatment, patients with AKI had received oxygen therapy (71.42%), antihypertensive treatment based on Nicardipine (21.42%), transfusion: red blood cell (7.14%) and fresh plasma (2.38%).

As aetiological treatment, the patients had benefited from hydration with saline 0.9% (71.42%), a bi-antibiotic therapy based on 'Ceftriaxone' and 'Metronidazole' (21.42%), 'noradrenaline' (4,76%) and antivenom. Complications of AKI were managed by loop diuretics (16.66%), alkalinization (11.90%), ion exchange resin (9.52%), calcium gluconate (2.38%) and hemodialysis (2.38%).

Evolutionary and Prognostic Data

The average length of stay was 5 ± 1.5 days. The length of hospitalization of less than 24 hours and that of 96 hours or more were 11.91% and 50.00% respectively

The average APACHE II score was 26 ± 1.5. Scores less than or equal to 4, 20 to 24 and 25 to 29 were respectively found in 2.38%, 19.04% and 45.23% of cases. Of the 42 patients with AKI, 27 (64.28%) had died, 13 (30.95%) had complete recovery of renal function before one month, and two patients (4.76%) had persistent impaired kidney function beyond one month.

The probable causes of the 27 cases of death were: four cases of septic shock (14.81%), 18 cases (66.67%) of neurological failure, 16 cases (59.26%) of liver failure, 14 cases (51, 85%) of haematological failures, eight cases (29.63%) of respiratory failures and five cases (18.52%) of hemodynamic failures. Table I shows the distribution of patients with ARI in intensive care according to the evolution data.

Table I. *Distribution of patients with AKI in intensive care according to the evolution data*

Data	Numbers	%
Hospitalisation length (hours)		
< 24	**5**	11,91
[24 -48]	**2**	4,76
[48 -72]	**1**	23,81
[72 -96]	**4**	9,52
≥96	**21**	**50**

APACHE II score (points)		
0-4	**1**	2,38
5-9	**2**	4,76
10-14	**5**	**11,90**
15-20	**4**	9,52
20-24	**8**	19,04
25-29	**19**	45,23
30-34	**1**	2,38
35-100	**2**	4,76
Evolution within 1 month		
Death	**27**	64,28
Favorable with complete renal function recovery	**13**	30,95
Favorable with partial renal function recovery	**2**	4,76
Death causes		
Septic shock	**4**	14,81
Neurological failure	**18**	66,67
Hepatic failure	**16**	59,26
Haematological failure	**14**	51,85
Respiratory failure	**8**	29,63
Hemodynamic failure	**5**	18,52

Identification of Factors Associated with Mortality

The occurrence of death during AKI in the intensive care unit was associated with the APACHE II score, i.e. a score greater than or equal to 25 (p = 0.002) and a hospital stay of less than 24 hours (p = 0.005), or between 24 and 48 hours (p = 0.030) or between 48 and 72 hours (p = 0.023), a diuresis abnormality such as anuria (p = 0.04) or oliguria (p = 0.046) failures of organs mainly hemodynamic (p = 0.023), neurological (p = 0.003), hepatic (p = 0.023) and hematological (p = 0.044). Table II shows the factors associated with mortality due to AKI in intensive care at the CHUD / B in 2019.

Table II. *Factors associated with mortality due to AKI in intensive care in 2019*

	Favorable		Unfavorable		p	OR
	N	(%)	N	(%)		
APACHE II score (points)						
0-4	1	100,00	--	--	0,000	
5-9	2	100,00	--	--	0,761	3,167 [1,358–7,274]
10-14	4	80,00	1	20,00	0,525	2,399 [1,162–5,637]
15-20	3	75,00	1	25,00	0,676	1,8 [0,113–8,446]
20-24	5	62,50	3	37,50	0,179	0,325 [0,033–1,386]
25-29	--	--	19	100,00	0,002	1,125 [1,02–1,386]
30-34	--	--	1	100,00	0,002	1,125 [1,02–1,386]
35-100	--	--	2	100,00	0,002	1,125 [1,02–1,386]

Hospitalisation length (heures)						
< 24	--	--	5	100,00	0,005	1,9 [1,10–1,46]
[24 – 48]	--	--	2	100,00	0,030	--
[48 – 72]	1	10,00	9	90,00	0,048	1,11 [1,450–2,977]
[72 – 96]	3	75,00	1	25,00	0,023	2,727 [1,234–3,172]
> 96	11	52,38	10	47,62	0,003	3,81 [1,26–7,662]
Diuresis abnormality						
Preserved	11	55,00	9	45,00	**0,046**	
Oliguria	2	16,67	11	83,33	0,046	1,164 [1,028–1,57]
Anuria	2	12,50	7	87,50	0,04	1,116 [1,2–1,77]
Organ failures						
None	9	90,00	1	10,00	**0,016**	
Neurological	1	5,26	18	94,74	0,003	1,036 [1,04–1,32]
Hemodynamic	0	0,00	5	100,00	0,023	1,068 [1,35–1,72]
Respiratory	1	11,11	8	88,89	0,085	1,169 [1,18–1,56]
Hepatic	3	15,79	16	84,21	0,023	1,172 [1,038–1,77]
Haematological	3	17,65	14	82,35	0,044	1,232 [1,02–1,33]

Discussion

Our study remains mono-centric, with a small staff and therefore of low statistical power. The limited period of six months remains relatively short to better understand all the contours of the subject. The use of urea and creatinine to assess kidney function is not without its drawbacks as they are not true markers.

Frequency of AKI

In our series the frequency of AKIs was 11.93% of admission cases. This frequency is close to the 9.4% found by **Dione et al**. in Morocco in 2015 [9] but much lower than the 30 to 50% found by **Rimmenlé et al**. in France in 2012 [10].

The variations in frequency observed can be explained by the differences in the diagnostic criteria used, the delays of the studies, the factors linked to the characteristics of the patients studied (improvement in the life expectancy of the patients, their multiple comorbidities) and admission criteria for the service (general purpose, medical or surgical resuscitation).

Sociodemographic Data

Frequency of the AKI Mechanism

In our sample, 64.28% of patients had acute functional kidney failure and 35.71% organic type. These results are similar to those of **Diallo et al**. In 2015 in Mali, who found a predominance of functional AKI in 59.23% [11]. On the other hand, **Payen et al**. found acute organic kidney failure in the 1st plan, followed by functional ARI in intensive care [12]. This difference can be explained by the existence in other countries of specialized intensive care units so that they can resolve AKI problems in their departments. Admission of patients to intensive care meets the criteria.

Frequency of AKI Stage

In our study, stage 3 KDIGO is the most represented in 42.86%, while **Diallo et al**. in 2018 in Mali had regained a predominance of stage 1 of 56.9% [11]. Our resuscitation service is the only one in the entire northern region of Benin and received serious cases referred from other centers.

Age

In our study, the mean age of the patients was 39 ± 19.61 years, which was higher than that of 27.68 ± 12.87 years found by Diallo et al. in 2018 in Mali [11] but very low than that of 53 ± 1.5 years found by Saudan et al. in 2013 in Switzerland [13]. This is justified by the young age of our study population. Both Benin and Africa faced a relatively short life expectancy problem.

Clinical Data

In our series, the reason for admission was predominantly altered state of consciousness (64.29%). A similar observation was made by **Bibongo et al**. [14], **Samaké et al**. [15] which reported frequencies of 81.7% and 22.8%, respectively. In our study, the coma cases were all complicated by an initial pathology other than AKI.

General Signs

In our series, 19.04% of subjects were admitted in a state of dehydration. This observed clinical condition could be explained by the lack of preferred care. This is comforted by oliguria and anuria present in 30.95% and 21.42% of cases respectively. These results were similar to those reported by **Errami et al**. [16] who found oliguria and anuria respectively in 35% and 21% of cases

In fact, renal hypoperfusion causes a reduction in glomerular filtration rate, acute functional renal failure appears when the protective mechanisms are exceeded. The urine produced is scant (oliguria). Tubular function is spared at this stage and the kidney retains its power to concentrate urine. Ischemia occurs when such a situation continues. Tubular dysfunction will appear especially in intensive care in a context of hypoxia [17]. It will lead to cell death which will lead to destruction of the tubular epithelium which ultimately results in obstruction of the tubules and interstitial infiltration by the primary urine: anuria then appears.

Time to Onset of IRA

In our sample, the vast majority of patients (97.61%) presented with acute renal failure on admission. This result is similar to the work of **Diallo et al**. [11] in 2018 in Mali and who recovered 100% ARI on admission within the first 48 hours. This observation can be explained by the fact that the first symptoms of diseases are underestimated by the majority of the population in general illiterate in Africa. In addition, the absence of universal health insurance and the low socioeconomic level bring patients to self-medication or to consult radiotherapists. All of this favors the installation of multi-visceral failures and then the IRA occurs.

Evolution

In our study the mortality was 64.29%. Our results were similar to those of **Errami et al**. in 2007 in Morocco which found a 45% mortality [16]. This finding confirms the data for the APACHE II score.

Factors Associated with Mortality

In our sample, oliguria and anuria were significantly associated with mortality. The hydrosodium retention induced by ARI disrupts homeostasis and leads to death from acute edema of the lung in the absence of correction.

The presence of organ failure was significantly associated with mortality ($p = 0.016$). The outcome was favorable for 90% of the patients who had no failures. In contrast, mortality was high varying between 82.35% and 100% for patients with organ failure. The outcome was unfavorable for all (100%) of the patients with associations of failure, regardless of the number. Our results are corroborated by the study by **Diallo et al**. in 2018 [11] who found a statistically significant difference for the presence of visceral failures

Duration of Hospitalization

In our series, the mean length of stay was 5 ± 1.5 days. Our results are different from the results of Errami et al. in 2007 in Morocco, which found an average hospital stay of 9.3 ± 6.3 days [16]. Length of stay was significantly associated with mortality ($p = 0.005$). The chances of survival increase as the length of hospital stay increases. The mortality rate drops from 100% for patients who have been hospitalized for less than 24 hours to 47.62% for patients who have been hospitalized for more than 96 hours. Our results are similar to the work of **Dione et al**. who found the length of stay as a factor of poor prognosis [9].

This fairly short length of stay can be justified by the complexity of the clinical picture leading to the death of the patient very early.

APACHE II Score

In our series, the mean APACHE II score was 26 ± 1.5 [range 4 and 38] and a high mean predicted mortality of 51.5 ± 2.5% [range 9% -83.5%]. Our results were higher than the 21.8 ± 5.8 found by **Errami et al**. in 2007 in Morocco [16].

In our work, the APACHE II score was significantly associated with mortality (p = 0.00). Mortality increased with the change in APACHE II score, from 0.00% for scores of 0-4 points to 100% for scores of 25-100 points. This observation was made by **Dione et al**. [9] who found the APACHE II score to be a factor of poor prognosis. This therefore allows us to justify the fact that the majority of our patients had a serious clinical condition. The APACHE II score is a general prognostic score based on clinical, laboratory, age and certain pre-existing diseases. Its variation is closely related to the clinical condition of the patient. The more severe the clinical condition, the higher the score, the greater the predicted mortality.

Conclusion

The frequency of acute renal failure in intensive care at CHUD / B was high and dominated by the functional type. The causes are multiple and intricate and dominated by hypovolaemia and infectious syndrome. The prognosis for acute renal failure depended on the timeliness of management and the associated organ failure.

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