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Research Article

Acute Kidney Injury in Patients With Covid 19 in Ivory Coast (West Africa) Intensive Care Unit

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Abstract

Background: To describe the epidemiological profile, risk factors and evolutionary aspects of patients who contracted acute renal dysfunction during their stay in a covid 19 critical care unit in Ivory Coast (West Africa).

Methods: Observational and cross-sectional study of four months (From May 1 to September 1, 2020) carried out in the intensive care unit of the infectious and tropical diseases department of Treichville University Hospital (Abidjan-Ivory Coast). All patients with a positive RT-PCR test were included. They were then categorized into two groups: the "AKI-CoV-2" group for patients who had developed acute renal failure (AKI); the "non-AKI-CoV-2" group concerning patients who didn't developed acute renal failure during their stay in intensive care. The diagnosis and classification of AKI were based on the 2012 KDIGO recommendations.

Results: The prevalence of AKI was 26.5%. Regarding co-morbidities, there were no significant differences between the two groups apart from the arterial hypertension mainly found in the "AKI-CoV-2" group ($p< 0.001$). The majority of patients were at KDIGO 1 (58.97%) at the time of diagnosis. The average time to onset of acute renal failure was 3.2 days. There was a statistical difference between the two populations when compared for the need for mechanical ventilation, vasopressor amines and blood trasfusion requirement, with the AKI group requiring all this as opposed to the non-AKI group. Mortality was higher in the "AKI-CoV-2" group (81.6%, $p < 0.001$).

Conclusion: AKI complicating covid 19 is responsible for excess mortality with mechanical ventilation, the use of vasopressors and arterial hypertension as a risk factor.

Keywords: Covid 19; Acute Kidney Injury; Intensive Care; Ivory Coast

Introduction

Appeared in China (Wuhan) in 2019, the new Coronavirus called "SARS-CoV-2" is responsible for the current pandemic known as Coronavirus Disease 19 or Covid-19. It currently affects more than two hundred and seventy million people as we are written. This condition is characterized by symptoms, the most feared of which is severe acute respiratory failure leading 5% of patients to intensive care [1,2]. Other manifestations, such as cardiac, neurological, hematological, thromboembolic, renal, and so, have been described during the stay in intensive care, making covid 19 a multisystem disorder. Kidney impairment worsens the prognosis in intensive care patients [2]. Its prevalence is variable, which can be very high in certain regions, particularly in Europe and the United States [3,4].

The purpose of this study was to describe the epidemiological profile, risk factors and evolutionary aspects of patients who contracted acute kidney injury during their stay in a covid 19 intensive care unit in Ivory Coast (West Africa).

Patients and Methods

It was a four months observational and cross-sectional study (From May 1 to September 1, 2020) carried out in the intensive care unit of the infectious and tropical diseases department of Treichville University Hospital (Abidjan-Côte d'Ivoire). Were included all patients admitted to the unit during the study period and whom test for SARS-CoV-2 by RT-PCR were positive. Samples were taken by the nasopharyngeal route in patients with spontaneous ventilation and after bronchial aspiration in intubated patients under mechanical ventilation. The analysis of the samples was carried out at the Institute Pasteur in Abidjan. Patients with a negative RT-PCR test were not included. The patients were then categorized into two groups: the "AKI-CoV-2" group concerning patients who had developed acute renal failure; the "Non-AKI-CoV-2" group concerning patients who didn't developed acute renal failure during their stay in intensive care. The diagnosis and classification of AKI were based on the 2012 KDIGO recommendations.

- **KDIGO 1:** Increase in serum creatinine 1.5-1.9 x baseline over 1 to 7 days or increase≥ 26.5 µmol/l (≥0.3 mg/dl) over 48 hours and diuresis < 0.5 ml/kg/h over 6-12 hours.
- **KDIGO 2:** Increase in serum creatinine of 2-2.9 x baseline and dieresis< 0.5 ml/kg/h over> 12 hours
- **KDIGO 3:** 3 x increase from baseline or increase in serum creatinine >350 µmol/l or dialysis and dieresis< 0.3 ml/kg/h for 24 hours or anuria over> 12 hours.

The variables studied were epidemiological, clinical, paraclinical, therapeutic and evolutionary obtained from medical records. The data collected were recorded on a standardized data collection sheet. The anonymity and confidentiality of the information collected were preserved by assigning an anonymity number to each survey sheet.

Data were entered into a Microsoft Excel 2010 database and analyzed using Epi info version 7 software. Descriptive statistics presented for categorical variables were frequencies and percentages. The comparisons between the "AKI-CoV-2" and "Non-AKI-CoV-2" groups were made using the ANOVA test (for averages and medians) and Fisher's test (qualitative variables). The threshold of p <0.05 was considered significant.

Results

During the study period, 204 patients were admitted to intensive care unit. 185 met the inclusion criteria (positive RT-PCR). Of these, 49 developed AKI during their stay at hospital, for a prevalence of 26.5%. The characteristics of the patients are presented in table 1. Regarding the co-morbidities, there were no significant differences between the two groups apart from the arterial hypertension mainly found in the "AKI-CoV- 2" group, (p < 0.001). On admission, there was no difference between the two groups of patients in vital parameters (Table 2).

	IRA-CoV-2 (n = 49)	**Non IRA-CoV-2 (n = 136)**	**p**
Socio-démographics			
Age (average)	52	53	0,80
Male n (%)	36 (73,5)	93 (68,4)	0,31
Comorbidities			
BMI (kg/m^2)	30,11	28,7	0,186
HBP n (%)	31 (63,3)	48 (35,3)	< 0,001
Diabetes n (%)	12 (24,5)	23 (16,9)	0,170
Heart disease n (%)	5 (10,2)	15 (11)	0,5563
Stroke n (%)	5 (10,2)	4 (2,9)	0,056
Pregnancy n (%)	2 (4,1)	4 (2,9)	0,601
HIV n (%)	4 (8,1)	6 (4,4)	0,255
Asthma n (%)	2 (4,1)	9 (6,6)	0,404
Pulmonary embolism n (%)	2 (4,1)	5 (3,7)	0,595
Neoplasia n (%)	1 (2,1)	3 (2,2)	0,711
Hemopathy n (%)	1 (2,1)	1 (0,7)	0,460

Table 1: Patient characteristics (socio-demographic, co-morbidities).

Vital parameters	**IRA-CoV-2 Average**	**Non IRA-CoV-2 Average**	**p**
PsO2*	79	83	0,13
Glasgow score*	13	13	0,20
SBP*	142	120	0,15009
DBP*	81	72	0,07
HR*	104	101	0,53

Table 2: Vital parameters on admission

PsO_2*: Pulsed Oxygen Saturation; SBP*: Systolic Blood Pressure; DBP*: Diastolic Blood Pressure; HR*: Heart Rate.

Figure 1 distribute the patients according to the 2012 KDIGO classification. The majority of patients were at KDIGO stage 1 (58.97%) at the time of diagnosis. The average time to onset of AKI was 3.2 days.

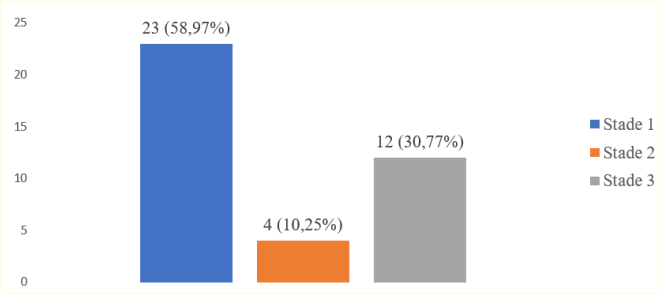

Figure 1: Distribution of patients according to the KDIGO classification.

Regarding the therapeutic data, there was a statistical difference between the two populations when compared for the need for mechanical ventilation, vasopressor amines and blood trasfusion requirement, with the AKI group requiring all this as opposed to the non-AKI group (Table 3). All the patients received antibiotic therapy at some point in their course of stay in the hospital and all also received corticosteroid therapy in the same proportions. Concerning antivirals therapeutics, lopinavir/ritonavir and darunavir/ritonavir were the most used. Ten patients (20.4%) in the "AKI-CoV-2" group received intravenous antimalarial treatment versus 49 patients (36%) in the "Non-AKI-CoV-2" group. Only 11 patients (22.4%) had renal replacement therapy (RRT). There were more metabolic and respiratory complications in the "AKI-CoV-2" group ($p < 0.005$) (Table 4). Mortality rate was also higher in this same group 81.6% ($p < 0.001$).

Treatments	IRA-CoV-2 n = 49	Non IRA-CoV-2 n = 136	p
Oxygen therapy n (%)	42 (85,7)	96 (70,6)	0,05
Mechanical ventilation n (%)	28 (57,1)	53 (38,9)	0,05
Vasopressor n (%)	20 (44,9)	32 (23,5)	0,05
Transfusion n (%)	13 (26,5)	13 (9,5)	0,05
Corticosteroid therapy n (%)	49 (100)	136 (100)	
Lopinavir/Ritonavir n (%)	45 (91,8)	45 (33)	< 0,005
Darunavir/Ritonavir n (%)	32 (65,3)	33 (24,2)	< 0,005
Hydroxychloroquine n (%)	Not available	Not available	
Antimalarial n (%)	10 (20,4)	49 (36)	
RRT n (%)	11 (22,4)	0	

Table 3: Therapeutic data.

Complications	IRA-CoV-2 (n = 49)	Non IRA-CoV-2 (n = 136)	p
Metabolic n (%)			
Anuria	23 (46,9)	0	< 0,05
Metabolic acidosis	23 (46,9)	6 (4,4)	< 0,05
Anemia	18 (36,7)	9 (6,6)	< 0,05
Hyponatremia	18 (36,7)	8 (5,8)	< 0,05
Hypoglycemia	5 (10,2)	2 (1,5)	< 0,05
Hyperglycemia	15 (30,6)	16 (11,7)	< 0,05
Respiratory n (%)			
ARDS*	27 (55,1)	23 (16,9)	< 0,05
Pulmonary superinfection	24 (48,9)	16 (11,7)	< 0,05
Pneumothorax	2 (4,1)	0	0,0690
Pleurisy	2 (4,1)	2 (1,5)	0,2860
Cardiovascular n (%)			
Heart failure	4 (8,1)	6 (4,4)	0,25553
Rhythm disturbance	3 (6,1)	3 (2,2)	0,19049
Myocarditis	2 (4,1)	1 (0,7)	0,17179
Myocardial ischemia	3 (6,1)	2 (1,5)	0,11687
Evolution n (%)			
Favorable	9 (19,4)	77 (56,7)	
Death	40 (81,6)	59 (43,3)	< 0,001

Table 4: Complications, evolution.

ARDS *: Acute Respiratory Distress Syndrome.

Discussion

The complications of covid 19 in intensive care are numerous and among them, AKI seems to hamper the prognosis according to the available literature. The prevalence is quite variable. While the

first Chinese studies estimated it at 23% on average (14 to 35%) [5,6], more recent studies report a higher prevalence, especially in Europe and the United States. It varies from 76% in the study of Hirsch [3] in the United States, to 80 and 81% in the studies of Rubin in Bordeaux [7] and Joseph in Paris [8]. The proportion of AKI in the African-American population in Hirsch's study (20.8%) is close to ours (26.5%). But at this stage, it is difficult to conclude that only genetic factors can explain these differences in proportions. Our population is much younger than those reported in the series out of Africa with an average age of 53 years (30 - 87 years), but that doesn't seem to protect from kidney dysfunction. The male predominance is found as in almost all the published series.

At the time of diagnosis, the majority of patients in our series were classified as KDIGO 1 (58.97%) and AKI was diagnosed on the third day of admission in 75.3% of patients. Other studies report a 37% frequency of occurrence of AKI within 24 hours of admission in the intensive care unit [3].

The main co-morbidity associated with the occurrence of AKI was high blood pressure (63.3% vs. 35.3%; p <0.001). However diabetes was not a risk factor in our series, as was overweight or obesity. AKI was also more common in mechanically ventilated patients (57.1% vs 39%; p < 0.005) and in those treated with vasopressors (44.9% vs 23.5%; p < 0.005), data in agreement with the literature [2,3,9]. Hirsch thus reported a prevalence of 89.7% of AKI in mechanically ventilated patients against 21.7% in others. The higher than usual ventilation pressures in these patients with the most severe forms of ARDS associated with fluid restriction could explain this situation. Indeed, the reduction in the incidence of severe AKI (KDIGO 3) by applying PEEP <12 cm H_2O and good perfusion (MAP> 75 mmHg) has been reported by Beurton [10]. In addition, the systematic use of antiretrovirals at the begining of the pandemic (91.8% vs 33%; p < 0.005) in all patients, associated with antibiotics would probably have contributed with mechanical ventilation and vasopressors to the impairment of kidney function.

AKI was associated with greater patient severity. They indeed presented more complications than the others. These were respiratory complications: ARDS (55.1% vs 16.9%; p < 0.005), pulmonary superinfection (49% vs 12%; p < 0.005) and metabolic complications: anuria, metabolic acidosis, hypoglycemia and hyperglycemia. However, we did not note more cardiovascular events in the AKI group as reported by Nishiga., *et al*. [11]. In addition, several authors have reported a strong correlation of AKI with high mortality in intensive care [3,12,13,14]. This is the case in our series where we found an excess mortality linked to AKI of 81.6%, the overall mortality being 53.2%. This excess mortality could be explained by the fact that we didn't have RRT means (ERP) in the covid intensive care unit in the first hours of the pandemic. Indeed, patients admitted to intensive care for respiratory distress linked to SARS-CoV-2 were in new units, set up before the surge of the first waves of patients. The RRT generators were acquired later which did not allow the first RRT to be carried out in the unit; the patients were each time transferred to nephrology units for their RRT. Eleven patients, or 22.4% of cases, benefited from RRT. The use of RRT is still very variable in the literature. Hirsch [3] noted the need for dialysis in 23.2% of patients and Gupta in 20.6% [15]. A meta-analysis of eight Chinese studies and one American study noted a pooled incidence of AKI at 19% in intensive care with use of ERP of 13% [16]. This variability is related to the type of study and the size of the populations included.

Conclusion

AKI is common in ICU patients with severe forms of covid-19 and has affected their prognosis. It is responsible for excess mortality and the risk factors found are mechanical ventilation, the use of vasopressors and high blood pressure. The role of antiretrovirals or some antibiotics is unclear.

Conflict of Interest

We have no known conflict of interest to disclose.

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