

# Outcome of Acute Kidney Injury in Pregnancy in N'Djamena, Chad

Guillaume Mahamat Abderraman<sup>1\*</sup>, Senoussi Charfadine<sup>1</sup>, Adano Hissein<sup>2</sup>

<sup>1</sup>Nephrology-Dialysis Department, CHU la Renaissance, N'Djamena, Chad

<sup>2</sup>Gynecology-Obstetrics Department, Mother and Child University Hospital of N'Djamena, N'Djamena, Chad

Email: \*zalba2001@yahoo.fr

**How to cite this paper:** Mahamat Abderraman, G., Charfadine, S. and Hissein, A. (2023) Outcome of Acute Kidney Injury in Pregnancy in N'Djamena, Chad. *Open Journal of Nephrology*, 13, 369-377. <https://doi.org/10.4236/ojneph.2023.134034>

**Received:** October 4, 2023

**Accepted:** November 19, 2023

**Published:** November 22, 2023

Copyright © 2023 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

**Introduction:** Acute kidney injury (AKI) is a relatively rare but serious complication during pregnancy. It is often the consequence of a delay or poor management of a given complication that constitutes as a public health problem in developing countries. The objective of our study was to determine the epidemiological, diagnostic, therapeutic and evolutionary aspects of obstetric acute kidney injury in Chad. **Methodology:** This was a cross-sectional study with descriptive and analytical aims over a period of 6 months from June 1, 2020 to November 30, 2020 and conducted in the Gyneco-Obstetric Emergency Department of the Mother and Child University Hospital in N'Djamena. All patients admitted for obstetric AKI and requiring hemodialysis were referred to the Nephrology Department of the Renaissance University Hospital. AKI was defined according to the KDIGO 2012 classification. All pregnant women with more than 20 weeks of gestation until immediately postpartum who were admitted for acute kidney injury were included in the study. **Results:** During our work, 1238 patients were collected. Among them, 56 cases of obstetric AKI were included, representing a hospital prevalence of 4.5%. The average age was  $26.1 \pm 5.8$  years (16 and 37 years). The majority of our patients were primigravidas which was 42%, rural women represented 35.7% of our sample and nearly 67.8% of pregnancies did not benefit from regular prenatal consultation. AKI during the 3rd trimester was found in 42.9% of cases. Oligo-anuria was present in 28.6% of cases. Acute tubular necrosis was found in 52 cases. It was secondary to preeclampsia in 60.7%, to HELLP syndrome in 17.9% and to a hemorrhagic delivery complicating a retroplacental hematoma in 7.1%. According to the KDIGO 2012 classification, Stages 1, 2 and 3 represented 32%, 23% and 25% of cases, respectively. Hemodialysis was initiated in 1/4 of cases. Recovery of renal function was complete in 78.6% of cases and partial in 7.1%. We recorded eight (14.3%) maternal deaths and twenty-four cases of in-utero fetal death. The average length of hospital stay was  $9.21 \pm 5$  days (2

and 20 days). **Conclusion:** Obstetric AKI remains a serious complication of pregnancy and postpartum. Despite the good renal prognosis, severe preeclampsia is the main cause. Prevention through monitoring pregnancies would be the most effective measure.

## Keywords

Obstetric Renal Failure, Preeclampsia, Hemodialysis, Chad

---

## 1. Introduction

Obstetric acute kidney injury (AKI) is a sudden and temporary alteration of renal function during pregnancy or during the peripartum period [1] [2]. Its incidence in developed countries has fallen due to improvements in prenatal monitoring and early detection of pregnancy complications [2] [3]. On the other hand, in developing countries, pregnancy is responsible for 20% to 25% of the occurrence of AKI [4]. Obstetric AKI is complicated by heavy maternal morbidity and mortality [5]. The incidence of AKI during pregnancy was 16% (96 patients) of women admitted to the intensive care unit [6]. The main etiologies are represented by preeclampsia, HELLP syndrome and retroplacental hematoma [7]. Preeclampsia represents one of the leading causes of maternal and neonatal mortality and morbidity in developing countries [8]. According to the Chad Demographic and Health and Multiple Indicator Survey (EDS-MICS 2014 2015), Chad had one of the highest maternal mortality rates in Africa, with a ratio of 860 deaths per 100,000 births alive, which represents almost 45% of all deaths among women aged 15 - 49 [9]. Among the causes of this maternal mortality, obstetric AKI remains poorly appreciated. This is how we conducted this study with the aim of determining the epidemiological, etiological, therapeutic and progressive profiles of obstetric AKI.

## 2. Methodology

This was a cross-sectional study with descriptive and analytical aims over a period of 6 months from June 1, 2020 to November 30, 2020 and carried out in the Gyneco-Obstetric Emergency Department of the Mother and Child University Hospital (CHU-ME) of N'Djamena. All pregnant women with more than 20 weeks of amenorrhea until the immediate postpartum period, hospitalized in the obstetric emergency room of the "Mother and Child" University Hospital Center of N'Djamena in Chad, for acute renal failure diagnosed according to the KDIGO 2012 criteria had been included in the study. These patients were then referred to emergency intermittent hemodialysis at the Nephrology Department of the Renaissance University Hospital Center. Parturient with chronic renal failure, AKI before 20 weeks of gestation and non-consenting patients were excluded from the study. For each patient included in the study, the study data was collected using a pre-established survey form. These data were socio-demographic

(age, profession, level of study, area of residence), clinical data (medical and gynecological history and clinical signs), paraclinical (biological examinations, renal ultrasound and urinary analysis) and the therapeutic data. The patients were called at 3 months for clinical and paraclinical follow-up. Those whose files needed to be completed for missing information had been summoned by telephone. The evolving modalities were noted for each patient included. The outcome was favorable when recovery of renal function was total or partial. Total recovery was assessed by a return to normal in baseline creatinine levels upon discharge from hospitalization. It was unfavorable in the event of progression to chronic renal failure or the occurrence of death. Obstetric AKI is defined according to the KDIGO classification summarized in **Table 1**. Pregnant or gestational hypertension is defined by a systolic blood pressure (SBP)  $\geq 140$  mm Hg and/or a diastolic blood pressure (DBP)  $\geq 90$  mm Hg, occurring after 20 weeks and disappearing before the end of the sixth week of pregnancy. Preeclampsia is defined by the association of pregnancy-induced hypertension with proteinuria ( $>0.3$  g/24h). Eclampsia is an acute paroxysmal accident of vascular-renal syndromes of pregnancy defined from the clinical point of view by having a convulsion occurring by repeated attacks, followed by a comatose state. Oliguria is defined as diuresis  $< 300$  ml/24 hours, anuria as diuresis  $< 100$  ml/24 hours. Disseminated intravascular coagulopathy (DIC) is defined by the presence of thrombocytopenia  $< 100,000$  mm<sup>3</sup>, a decrease in fibrinogen  $< 3$  g/l, fibrin degradation products  $> 40$  m/dl and a prolongation of overall times: TQ and TCA from 1.5 to two times. HELLP syndrome is retained as defined by Weinstein [3]: hemolysis: increase in indirect bilirubin with drop in hemoglobin, hepatic cytolysis and thrombocytopenia  $< 100,000$  mm<sup>3</sup>. Pregnancy monitoring was regular if patients received at least 4 prenatal consultations during pregnancy.

The data collected were analyzed using Excel 2013 software, SPSS version 18.0 (Statistical Package for Social Sciences 18.0) and were presented in the form of tables and figures. Quantitative data are expressed as medians, means  $\pm$  standard deviation and qualitative variables as percentages. The Chi-square test was used for the comparison of qualitative variables and the student t-test for the comparison of quantitative variables.

### 3. Results

During our work, 1238 patients were collected. Among them, 56 cases of obstetric AKI were included, representing a hospital prevalence of 4.5%. The average age was  $26.10 \pm 5.86$  years (16 and 37 years). There were 42.9% of patients ( $n = 24$ ) who were aged over 30 years. It was noted that 64.3% of patients ( $n = 36$ ) lived in an urban area and 35.7% ( $n = 20$ ) in a semi-urban or rural area. There were 82.1% ( $n = 48$ ) housewives. Arterial hypertension was found as a history in 10.7% ( $n = 6$ ). There were 42% ( $n = 24$ ) primigravidas, 32.1% pauciparous ( $n = 18$ ) and 25% multiparous ( $n = 14$ ). Pregnancy monitoring was regular in 32.1% ( $n = 18$ ) and irregular in 35.7% ( $n = 25$ ). However, 67.8% patients ( $n = 38$ ) had not had any prenatal consultation (**Table 1**). On admission, consciousness was

altered in 32.1% patients (n = 18). Anuria was observed in 7.1% (n = 4) and oliguric in 28.6% (n = 16). There were 17.8% of patients (n = 10) who had a mucocutaneous pallor. Hypertension was found in 57.1% (n = 32) of patients. The 53.6% of patients (n = 30) had an edematous syndrome. By using a urine dipstick, 96.4% (n = 54) had proteinuria. Metrorrhagia was noted in 5.5% of patients (n = 3) and convulsions with tongue biting in 7.1% of patients (n = 4).

Biologically, the mean serum creatinine was  $311.6 \pm 302.9$   $\mu\text{mol/l}$  with (91 to 990  $\mu\text{mol/l}$ ). The average urea was  $2.2 \pm 4.4$  g/l (0.2 to 3.5 g/l). The classification of AKI according to the severity stages of KDIGO is shown in **Figure 1**. Anemia was found in 50% of patients (n = 28) with an average hemoglobin level of 9.98 g/dl (5.2 and 17.3 g/dl). In 35.7% (n = 20), hepatic cytolysis was noted with a transaminase level greater than 5 times the normal. This cytolysis was related to thrombocytopenia (platelet level less than 100,000  $\text{mm}^3$ ) as part of HELLP syndrome in 17.9% of patients (n = 10) and severe malaria with thick blood showing the presence of *Plasmodium Falciparum* in 17.9% of patients (n = 10). Renal ultrasound did not reveal any renal abnormality. Obstetric AKI was found in the 2nd trimester in 21.4%, in the 3rd trimester in 42.9% and postpartum in 28.6% of patients. Organic AKI due to acute tubular necrosis was noted in 52 cases. The causes of obstetric AKI are represented by preeclampsia in 60.7%, HELLP syndrome in 17.9% and hemorrhagic delivery which is complicated by a retroplacental hematoma in 7.1% (**Table 2**). Obstetrically, the pregnancy was progressive in 37.5% (n = 21) of cases. The pregnancy was terminated in 62.5% (n = 35), with a vaginal fetal extraction in 33.9% (n = 19) and by cesarean section in 28.5% (n = 16) of cases.

**Table 1.** Socio-demographic characteristics of patients.

Population characteristics	Effective (n)	Frequency (%)
<b>Age (year)</b>		
≤19	8	14.3
20 - 24	16	28.6
25 - 29	8	14.3
≥30	24	42.9
<b>Number of gestures</b>		
Primiparous	24	42
Pauciparous	18	32.1
Multiparous	14	25
<b>Origin</b>		
Urban	36	64.3
Rural	20	35.7
<b>Prenatal consultation</b>		
Followed	18	32.1
Not followed	38	67.8

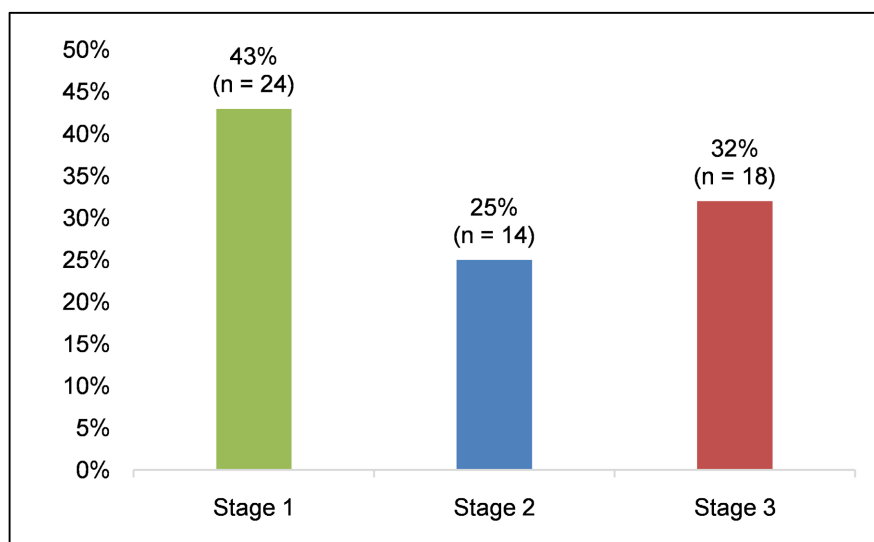
Eclampsia (n = 9), retroperitoneal hematoma (n = 4) and acute fetal distress (n = 3) were the main indications for cesarean delivery.

Calcium channel blockers were prescribed in 87.5% of patients (n = 61) and blood transfusion in 53.5% of patients (n = 30). Hemodialysis was indicated in 20 patients whose indications were acute lung edema (n = 8) and hyperkalemia (n = 3) which was refractory to medical treatment, poorly tolerated uremia (n = 5) and anuria for more than 48 hours (n = 4).

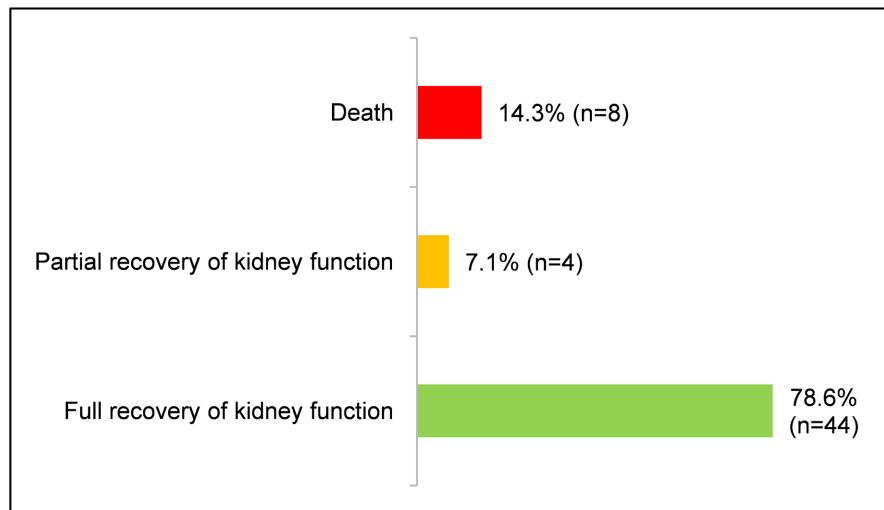
The average length of hospital stay was  $9.2 \pm 5$  days (2 and 20 days). The outcome was favorable in 78.6% (n = 44) with a resumption of diuresis and total recovery of renal function (**Figure 2**). In 7.1% of patients (n = 4), recovery of renal function was partial with a mean serum creatinine varying between 185 - 219.7  $\mu\text{mol/l}$ . We recorded 14.3% (n = 8) maternal deaths, linked to complications of AKI namely acute lung edema (n = 4); uremic encephalopathy (n = 2) and septic shock (n = 2). The fetal prognosis was marked by fetal death in utero in 37.5% (n = 21) cases. The 32.1% of newborns (n = 18) were hospitalized in neonatology, the indications for which were prematurity in 14.2% (n = 8), neonatal infection in 10.7% (n = 6) and perinatal asphyxia in 7.1% (n = 4) of cases.

**Table 2.** Etiology of obstetric AKI (n = 56).

Causes	Effective (n)	Frequency (%)
Preeclampsia	34	60.7
HELLP syndrome	10	17.9
Retroplacental hematoma	4	7.1
Chronic hypertension	2	3.6
Severe malaria anemic form	4	7.2
Hypertensive heart disease	2	3.6



**Figure 1.** Classification of obstetric AKI according to KDIGO.



**Figure 2.** Evolution after treatment.

#### 4. Discussion

Limitations of the study were the small sample size and the difficulty of recruiting patients who lost their children due to AKI. The second problem concerns the difficulty of obtaining a place on dialysis because there are only 2 dialysis centers in N'Djamena. The present study carried out in Chad demonstrated that obstetric AKI constitutes 4.52% of pregnancy and immediate postpartum complications. The prevalence of obstetric AKI varies depending on the series and the causes. In Sub-Saharan Africa, it still remains high compared to developed countries [4] [10] [11]. In the sub-region, particularly in Niger [12], the hospital prevalence was around 14.94%, while in Senegal [13] and Algeria [14], it was 4.65% and 29%, respectively. The lack of prenatal monitoring through early detection of pregnancy complications would largely explain this high prevalence. The majority of patients were young primigravidas (40%), more than a third of whom were rural. This would explain the absence of regular prenatal consultation (67.8%). Primigravida is a risk factor for preeclampsia due to immunological intolerance of certain elements of the sperm, and insufficient attendance at prenatal consultations increases the risk of pregnancy and postpartum complications [12] [15] [16]. Arterial hypertension was noted in more than half of cases and the discovery of proteinuria on the urine dipstick in almost all patients should prompt a search for these markers in pregnant women from the 2nd trimester in order to prevent complications of preeclampsia. Preeclampsia is often the main cause of organic AKI [11] [13] [17]. The frequency of preeclampsia varies depending on the series with 19% and 67.2%, respectively [11] [18]. In the series by Mahamat Abderraman *et al.*, in a study involving 3067 parturient patients, the prevalence of preeclampsia represented 2.6% of all pregnancies [15]. In our study, it was found in 60.7% of patients, like other African studies [12] [19]. Other risk factors for the occurrence of obstetric AKI are HELLP syndrome and retroplacental hematoma. In Niger, Yaya *et al.* found 15% with re-

troplacental hematoma complicating preeclampsia [12], while in our series, it was observed in 7.1% of patients. The endothelial damage of preeclampsia, the activation of coagulation and the obstruction of renal vessels explain this constant renal damage. In general, HELLP syndrome, disseminated intravascular coagulation and retroplacental hematoma cause obstetric AKI and when this triad is associated with hemorrhagic shock or amniotic embolism, this will increase the risk of cortical necrosis [2]. In Morocco, in a 5-year observational study that included 356 patients with HELLP syndrome, 31.7% (n = 113) developed AKI. Dialysis was used in 36 patients. Recovery of renal function was noted in 85% of patients, persistence of chronic kidney disease in 12.4% of patients (n = 14) and maternal death in 14.2% (n = 16) of patients [7]. These vascular complications are all the more formidable as the patients present with anemia which was found in half of the patients. Hemodialysis was initiated in 25% of patients (n = 14) in contrast to the high indication for dialysis. In our study, few had access to dialysis due to a lack of dialysis generators or family refusal who do not have confidence in this purification technique. The use of hemodialysis has been estimated between 70% - 100% in other studies [1] [11] [20]. The outcome is often favorable under hemodialysis. In a study carried out at Morocco in 2011, 17 out of 44 patients (38.6%) included had undergone dialysis with total recovery of renal function in 29 patients [21]. The cure rate in our series was much higher than that reported by other authors [13] [19]. Nevertheless, in our series, as in most developing countries [12] [13], maternal mortality was high. This mortality would be attributed to septic shock and the delay in treating postpartum complications. According to a Tunisian study, a poorly managed pregnancy was significantly associated with a high rate of maternal mortality (p = 0.047 or 0.23 (0.05 - 1.09)). Complications statistically significantly associated with maternal mortality were disseminated intravascular coagulation (p = 0.012) and multiple organ dysfunction syndrome (p = 0.001) [6]. We deplore 24 cases of fetal death in utero. The fetal mortality found in a study carried out in Oujda in Morocco in 22 patients admitted for obstetric AKI was 17.3% [22]. Perinatal mortality remains high and reaches 43% in the literature [11]. Deaths were linked to perinatal asphyxia, sepsis and maternal complications. The lack of neonatal intensive care units and the lack of responsiveness to acute kidney injury would explain this neonatal mortality in Sub-Saharan Africa. Before 34 weeks, early termination of pregnancy is the cause of high perinatal morbidity and mortality. The pregnancy was terminated in 62.5% of patients (n = 35) in our study. The final treatment for preeclampsia remains termination of the pregnancy and delivery of the placenta. This obstetric treatment can cause fetal complications such as prematurity or maternal complications (eclampsia, HELLP syndrome, retroplacental hematomas), requiring close monitoring and stopping expectancy at the slightest sign of maternal or fetal seriousness. Termination of pregnancy should be considered from 38 weeks, without precipitation, in order to reduce maternal and infant deaths [8].



## 5. Conclusion

Obstetric AKI remains a serious complication of pregnancy and postpartum. Despite the good renal prognosis, fetal-maternal morbidity and mortality remain high in developing countries and severe preeclampsia constitutes the main cause. The use of hemodialysis has improved maternal and fetal prognosis. Improving patient care and prognosis requires adequate perinatal consultations with good monitoring of clinical and biological, such as blood and urine indicators. Emphasis must be placed on mandatory monitoring of pregnancies and early management of complications.

## Abbreviations

AKI: acute kidney injury; PE: preeclampsia.

## Conflicts of Interest

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

## References

- [1] Prakash, J., Niwas, S.S., Parekh, A., *et al.* (2010) Acute Kidney Injury in Late Pregnancy in Developing Countries. *Renal Failure*, **32**, 309-313. <https://doi.org/10.3109/08860221003606265>
- [2] Fakhouri, F., Vercel, C. and Fremeaux-Bacchi, V. (2012) Obstetric Nephrology: AKI and Thrombotic Microangiopathies in Pregnancy. *Clinical Journal of the American Society of Nephrology*, **7**, 2100-2106. <https://doi.org/10.2215/CJN.13121211>
- [3] Belenfant, X., Pallot, J.L., Reziz, K. and Saint Leger, S. (2004) Insuffisance rénale aiguë et grossesse. *EMC—Néphrologie*, **1**, 44-54. <https://doi.org/10.1016/j.emcnep.2004.01.002>
- [4] Gopalakrishnan, N., Dhanapriya, J., Muthukumar, P., Sakthirajan, R., Dinesh Kumar, T., Thirumurugan, S. and Balasubramanian, T. (2015) Acute Kidney Injury in Pregnancy—A Single Center Experience. *Renal Failure*, **37**, 1476-1480. <https://doi.org/10.3109/0886022X.2015.1074493>
- [5] Ricci, Z., Ronco, C., D'amico, G., *et al.* (2005) Practice Patterns in the Management of the Acute Renal Failure in the Critically Ill Patients: An International Survey. *Nephrology Dialysis Transplantation*, **21**, 690-696. <https://doi.org/10.1093/ndt/gfi296>
- [6] Kammoun, A., *et al.* (2022) Facteurs prédictifs de la mortalité maternelle lors d'une insuffisance rénale aiguë au cours de la grossesse: Étude retrospective. *Gynécologie Obstétrique Fertilité & Sénologie*, **50**, 436. <https://doi.org/10.1016/j.gofs.2022.02.029>
- [7] Zoukal, S., Zagdan, S., Hassoune, S. and El Youssoufi, S. (2023) Insuffisance rénale aiguë au cours du HELLP syndrome: Expérience du service de réanimation du CHU Ibn Rochd de Casablanca, Maroc. *Revue d'Épidémiologie et de Santé Publique*, **71**, Article ID: 101744. <https://doi.org/10.1016/j.respe.2023.101744>
- [8] Haddad, B., Louis-Sylvestre, C., Doridot, V., Touboul, C., Abirached, F. and Paniel, B.J. (2002) Critères d'extraction foetale dans la preeclampsia. *Gynécologie-Obstétrique et Fertilité*, **30**, 467-473. [https://doi.org/10.1016/S1297-9589\(02\)00363-6](https://doi.org/10.1016/S1297-9589(02)00363-6)
- [9] Ministère du Plan et de la Coopération du Tchad (2015) Enquête Démographique



- et de Santé et à Indicateurs Multiples au Tchad (EDS-MICS) 2014-2015. Institut National de la Statistique, des Études Économiques et Démographiques (INSEED) N'Djaména. <https://www.inseed.td/>
- [10] Mjahed, K., Alaoui, S. and Barrou, L. (2004) Acute Renal Failure during Eclampsia: Incidence, Risks Factors and Outcome in Intensive Care Unit. *Renal Failure*, **26**, 215-221. <https://doi.org/10.1081/JDI-120039518>
- [11] Miguil, M., Salmi, S., Moussaid, I., et al. (2011) Insuffisance rénale aiguë hémodialysée en obstétrique. *Néphrologie & Thérapeutique*, **7**, 178-181. <https://doi.org/10.1016/j.nephro.2010.12.003>
- [12] Yaya, K., Moumouni, G., Hamet, T.L., Hassan, D.M., Idé, A., et al. (2016) Insuffisance rénale aigue obstétricale, expérience de la maternité Issaka Gozaly de Nyamey (Niger). *European Scientific Journal*, **12**, 281-289.
- [13] Lemrabott, A.T., Cissé, M.M., Faye, M., et al. (2019) Insuffisance rénale aiguë du Post-Partum au Sénégal: Profils épidémiologique, étiologique, thérapeutique, pronostique et évolutif. *RAMReS Sciences de la Santé*, **1**, 70-76.
- [14] Zelmat, S.A., Batouche, D.D., Sadaoui, L., Kerboua, K.E.D., Chaffi, B., Mazour, F. and Benatta, N.F. (2016) L'insuffisance rénale aiguë et grossesse: Quels sont les facteurs prédictifs de sa survenue? *Néphrologie & Thérapeutique*, **12**, 402. <https://doi.org/10.1016/j.nephro.2016.07.119>
- [15] Mahamat Abderraman, G., et al. (2022) Apport de la bandelette urinaire dans le diagnostic de la prééclampsie au CHU le Bon Samaritain de N'Djamena (Tchad). *Journal of Nephrology & Therapeutics*, **12**, 11.
- [16] Arora, N., Mahajan, K., Jana, N. and Taraphder, A. (2010) Pregnancy-Related Acute Renal Failure in Eastern India. *International Journal of Gynecology & Obstetrics*, **111**, 213-216. <https://doi.org/10.1016/j.ijgo.2010.06.026>
- [17] Alaoui, S., Alaoui, F., ChemLal, A., Haddiya, I., Brahim, H. and Bentata, Y. (2016) Insuffisance rénale aiguë obstétricale: Pronostic rénal et général. *Néphrologie & Thérapeutique*, **12**, 344. <https://doi.org/10.1016/j.nephro.2016.07.164>
- [18] Batouche, D.D., Sadaoui, L., Kerboua, K.E.D., Diakite, S., Negadi, A. and Mentouri, Z. (2016) Profil clinico-bactériologique de l'infection urinaire dans un service de réanimation pédiatrique. *Néphrologie & Thérapeutique*, **12**, 402. <https://doi.org/10.1016/j.nephro.2016.07.118>
- [19] Abdelkader, F., et al. (2020) Insuffisance rénale aigüe du post-partum: À propos de 102 cas au Centre Hospitalier National de Nouakchott, Mauritanie. *PAMJ Clinical Medicine*, **4**, Article 48. <https://doi.org/10.11604/pamj-cm.2020.4.48.24286>
- [20] Ali, A., Ayesha Ali, M., Usman, A.M., et al. (2011) Hospital Outcomes of Obstetric-Related Acute Renal Failure in a Tertiary Care Teaching Hospital. *Renal Failure*, **33**, 285-290. <https://doi.org/10.3109/0886022X.2011.560400>
- [21] Kabbali, N., et al. (2011) Insuffisance rénale aiguë et grossesse: Résultats d'une étude prospective nationale au Maroc. *Néphrologie & Thérapeutique*, **7**, 274. <https://doi.org/10.1016/j.nephro.2011.07.037>
- [22] Oujidi, H., et al. (2021) Insuffisance rénale aiguë obstétricale. *Néphrologie & Thérapeutique*, **17**, 338. <https://doi.org/10.1016/j.nephro.2021.07.231>