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Evolution of Proteinuria and Renal Function in Women with Pre-Eclampsia at the Gynecology Department of the Teaching Hospital of Cocody

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Abstract

Background: Pre-eclampsia has long been considered as a disease that disappears after the removal of the placenta. It has now been shown that its symptoms can persist for months after giving birth. **Objectives:** To study the evolution of proteinuria and renal function in women with pre-eclampsia. **Patients and Methods:** An analytical prospective study was carried out in the Hospitalization Unit of the Gynecology Department of the Teaching Hospital of Cocody (Abidjan) from May 3, 2021 to November 15, 2021. It focused on the follow-up of proteinuria and renal function in 50 women who had pre-eclampsia during their pregnancy, in the three months following their delivery. **Results:** The average age of the patients was 30.38 ± 6 years (range 18 and 40 years). Thirty-two percent were nulliparous and 62% had no risk factors for pre-eclampsia. The diagnosis of pre-eclampsia was made in 52% of cases before 37 weeks of amenorrhea. Sixty-two percent had Grade 3 arterial hypertension. The average proteinuria/creatininuria ratio was 3592.08 ± 7009.57 mg/g and 32% of women had glomerular grade proteinuria. The mean serum creatinine was 13.61 ± 12.62 mg/l. AKI (Acute Renal Failure) was present in 30% of women. All patients had received a central antihypertensive drug of which 88% were a calcium channel blocker. For the delivery mode, a Caesarean section was performed in 88% of cases. In the three months postpartum, 40% of women had persistent hypertension, 58% had persistent proteinuria and 6% had persistent impaired renal function. Prematurity ($p = 0.0091$), IUGR (intrauterine growth restriction) ($p = 0.0012$) and IUFD (intrauterine fetal death) ($p = 0.0012$) were associated with the persistence of proteinuria at M3 postpartum. **Conclusion:** Symptoms of pre-eclampsia do not automatically disappear after the delivery. Proteinuria and renal failure can persist beyond three months after the delivery and require treatment by a nephrologist.

Keywords

Proteinuria, Pre-Eclampsia, Renal Function

1. Introduction

Pre-eclampsia is defined as a systolic blood pressure greater than or equal to 140 mmHg and/or a diastolic blood pressure greater than or equal to 90 mmHg associated with a proteinuria greater than or equal to 300 mg per 24 hours, appearing during pregnancy after 20 weeks of amenorrhea [1]. It is a serious complication of pregnancy, occurring in 1% to 8% of pregnancies in developed countries [2] [3] [4] [5] [6]. In Africa, this proportion can be extended up to 15.3% [7] [8] [9], whereas it occurs in only 1% - 2% of pregnancies in France [5] and approximately in 4% of pregnancies in the United States [6]. In a Senegalese study, it complicated 15.3% of pregnancies [7], 7.10% in a Guinean study [8] and 9.5% in an Ivorian study [9]. Due to the morbidity and mortality that it causes, it constitutes a serious pathology both at the maternal level with nearly 70.000 deaths per year, and at the neonatal level with 500,000 fetal losses per year [3] [10]. For many years, delivery was considered to be the definitive treatment for preeclampsia, with renal function and proteinuria expected to return to normal values after it. However, recent studies show that even if maternal vascular disorders tend to regress after childbirth, and the immediate fatal risks fade, the mother unfortunately remains exposed to a severe alteration of her renal function, which can progress towards renal failure and Chronic Kidney Disease (CKD) [2]-[13]. Moreover, high blood pressure and proteinuria can persist for several months after delivery, therefore affecting short-term maternal vital prognosis. It is, therefore, imperative to establish a long-term monitoring of recent mothers in order to verify the normalization of renal function after giving birth. The main objective of our work was to study the evolution of proteinuria and renal function in women who presented with pre-eclampsia in the Gyneco-Obstetrics Department of the Teaching Hospital of Cocody, in the months following their delivery.

The secondary objectives were:

- Describe the sociodemographic characteristics of patients.
- Describe the clinical, paraclinical and evolving aspects of patients.
- Identify risk factors for the persistence of proteinuria and impaired renal function in the following3 months postpartum.

2. Material and Method

2.1. Material

2.1.1. Type and Location of the Study

This was a prospective study with an analytical aim that took place in the Gynecology Department of the Teaching Hospital of Cocody (Abidjan), from May 3,

2021 to November 15, 2021.

2.1.2. Study Population

- Inclusion criteria

All pregnant women with hypertension associated with a positive albuminuria on admission were included in the study.

- Non-inclusion criteriae

We did not include pregnant women with pre-existing hypertension at the time of pregnancy, patients who had a chronic kidney disease pre-existing at the time of pregnancy and patients with unavailable monitoring data of albuminuria, proteinuria/creatinuria ratio and serum creatinine at M3 of postpartum.

2.2. Methodology

Patients' data was collected via a standardized survey form.

Studied variables

The dependent variables were represented by the proteinuria/creatinuria ratio on spot urine and serum creatinine at the time of diagnosis of pre-eclampsia, at one month and at three months postpartum.

The independent variables were occupation, marital status, age, the existence of diabetes or hypertension, the existence of chronic kidney disease, a history of pre-eclampsia, twin pregnancy, hydatidiform mole, nulliparity, number of weeks of amenorrhea at diagnosis of pre-eclampsia, blood pressure arterial, lower limb edema (OMI), albuminuria, creatininemia, uremia, proteinuria/creatinuria ratio, uricemia; complications such as hepatic cytolysis, hemoglobin level, prothrombin, fibrinogen, use of central anti-hypertension treatment or Alpha blocker or calcium channel blocker, fetal extraction by cesarean section or vaginal delivery; maternal complications such as eclampsia, HELLP syndrome (Hemolysis Elevated Liver Enzyme and a Low Platelet), DIVC (Disseminated Intravascular Coagulation), RPH (Retro-Placental Hematoma), AKI (Acute Renal Failure), ALE (Acute Lung Edema); and fetal complications such as IUFD (Intrauterine Fetal Death), prematurity, IUGR (Intrauterine Growth Retardation).

2.3 Operational Definition of Terms

Albuminuria was determined using a urine strip. It was pathological when the value was greater than or equal to one cross. Serum creatinine was measured using the Jaffe colorimetric method.

Acute Kidney Failure (AKI) was defined by an increase in blood creatinine of at least 3 mg/l compared to baseline serum creatinine (KDIGO). Proteinuria was estimated by the ratio of proteinuria to creatinuria on spot urine.

Arterial Hypertension (HTA) was defined by Blood Pressure (BP) greater than or equal to 140/90, it was classified as follows:

Hypertension Grade 1 for a Systolic Blood Pressure (SBP) between 140 - 159 and/or a Diastolic Blood Pressure (DBP) between 90 - 99 mmHg; Grade 2 hypertension: SBP 160 - 179 mmHg and/or PAD 99 - 109; and hypertension Grade 3:

SBP ≥ 180 and/or DBP ≥ 110 mmHg.

Proteinuria was said to be persistent when a proteinuria/creatinuria ratio was ≥ 200 mg/g at M3 postpartum. Hypertension was said to be persistent for a systolic blood pressure ≥ 140 mmHg and/or a diastolic blood pressure ≥ 90 mmHg.

2.4. Data Analysis

The data was collected using a standardized survey form based on the medical files of the pregnant women, and processed using Microsoft Office Word and Excel 2016 software. The quantitative variables were expressed as an average and the qualitative variables by simple counting as well as their percentage, Chi-square and/or Fisher's exact probability tests were used to compare percentages. The significance threshold was set at 5%.

The parameters studied were as follows: sociodemographic characteristics, risk factors for preeclampsia, clinical and paraclinical parameters, treatment, complications, evolution, factors for persistence of postpartum hypercreatinine a M3 and factors for persistence of the proteinuria/proteinuria ratio. creatinuria ≥ 200 mg/g at M3 postpartum.

2.5. Ethical Considerations

Written agreement from the medical and scientific director of Cocody University Hospital was required and given, and oral informed consent from patients and a member of their families was obtained after explaining to them the usefulness of our study.

The confidentiality of the information collected was respected by the anonymity of the survey sheets. The data was only used for this study.

3. Results

Of 93 pregnant women who developed a hypertension after 20 weeks of amenorrhea (WA) and had a positive albuminuria, only 50 have a 3-month follow-up (**Figure 1**).

The average age was 30.38 ± 6 years with extremes of 18 and 40 years. The age group of 30 to 35 was the most represented (34%). The majority of women (60%) were in relationships. The average gestation number was 3.54 ± 1.92 with extremes of 1 and 9 pregnancies. More than half of the patients (62%) had no risk factors.

The diagnosis was made in more than half of the women (52%) before 37 weeks. The average gestational age at the time of diagnosis was 35 weeks of amenorrhea with extremes of 25 weeks + 5 days and 41 weeks + 6 days. More than half of the patients (62%) had Grade 3 hypertension. The mean systolic blood pressure was 179.18 ± 23.76 mm Hg with extremes of 140 and 250 mm Hg, the mean diastolic blood pressure was 112.36 ± 13.71 mm Hg with extremes of 90 and 140 mm Hg. In 82% of women, edema of the lower limbs was found. Albuminuria greater than or equal to 3 crosses was found in 52% of women (**Table 1**).

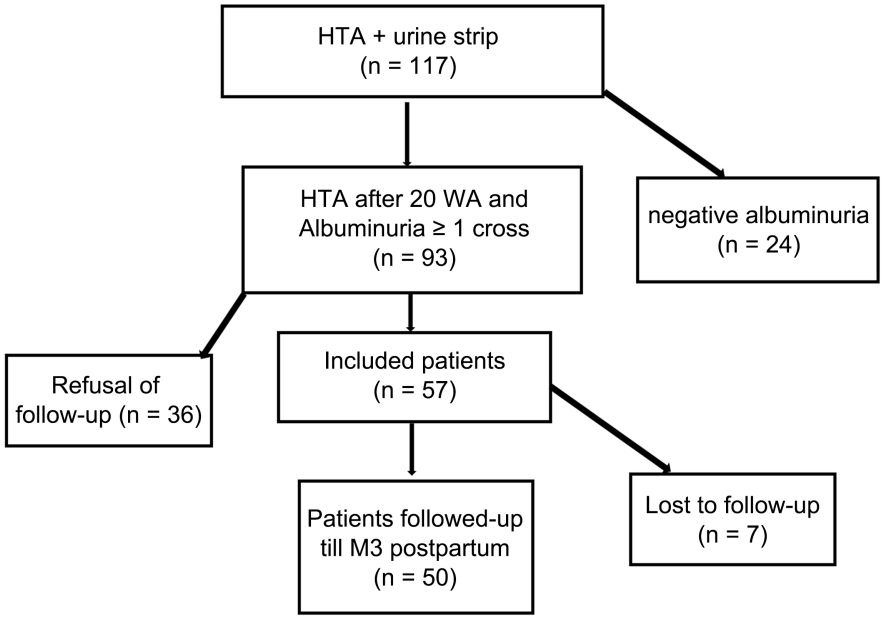

Figure 1. Diagram of flux.

The average proteinuria/creatinuria ratio was 3592.08 ± 7009.57 mg/g with extremes of 567 mg/g and 11,160 mg/g. This ratio was greater than or equal to 3000 mg/g in 32% of cases. Serum creatinine was on average 13.61 ± 12.62 mg/l with extremes of 5.5 and 83 mg/l. AKI was observed in 30% of patients. Other biological abnormalities were anemia in 43.2%, thrombocytopenia in 33% and an elevation of ALT and AST in 27.2 and 40.91% respectively (Table 1).

In addition to AKI, maternal complications such as eclampsia (22%), HELLP syndrome (16%) and retroplacental hematoma (2%) were observed.

Patients received treatment with a central antihypertensive drug (100%), a calcium channel blocker (88%), and a beta-blocker (2%). Caesarean section was the most common method of delivery (88%). Antibiotics were prescribed in 88%, corticosteroids in 28% and loop diuretics in 4% (Table 3).

Prematurity was the most common fetal complication of pre-eclampsia (26%) (Table 4).

Non-compliance with antihypertensive treatment at M1 postpartum was noted in 72% of women. Among the 36 women who had stopped antihypertensive treatment, only 3 had normal blood pressure. At M3 postpartum, persistent hypertension was found in 20% of cases, persistent proteinuria in 58% and persistent renal failure (IR) in 2% of cases (Table 2). There is no significant statistical link between hypercreatininemia at M3 postpartum and the different grades of hypertension, There is no significant association between postpartum M3 hypercreatininemia and maternal complications of pre-eclampsia (Table 3), there is no significant association between postpartum M3 hypercreatininemia and fetal complications of pre-eclampsiaand between the proteinuria/creatininuria ratio ≥ 200 mg/g and the different grades of hypertension at M3 postpartum and There is no significant link between maternal complications of preeclampsia and the prote-

inuria/creatininuria ratio ≥ 200 mg/g at M3 postpartum (Table 4). In multivariate analysis by logistic regression, no factor was associated with the risk of persistent IR (Table 3). On the other hand, factors such as: AKI [p; OR (95% CI) = 0.04; 5.61 (1.01 - 59.14)], MFIU [p; OR (95% CI) = 0.0012; 5.21 (1.5 - 25.20)], IUGR [p; OR (95% CI) = 0.001; 9.33 (2.05 - 60.97)], and prematurity [p; OR (95% CI) = 0.009; 5.34 (1.4 - 23.09)] were associated with the risk of persistent proteinuria (Table 4).

Table 1. General characteristics of patients.

Variables	Number count	Percentage (%)
Age (years)		
18 - 24 years	10	20%
25 - 34 years	25	50%
≥34 years	15	30%
Number of pregnancies		
1	10	20%
2 - 3	14	28%
≥4	26	52%
Matrimonial status		
Single	20	40%
In a relationship	30	60%
Preeclampsia risk factors		
Preeclampsia record in previous pregnancies	2	4%
Primiparity	16	32%
Twin pregnancy	1	2%
Diabetes	1	2%
Gestational age		
[24 - 28 WA[	2	4%
[28 - 32 WA[	8	16%
[32 - 37 WA[	16	32%
[37 - 40 WA[	33	46%
[40 - 44 WA[	1	2%
HTA grade		
1	2	4%
2	17	34%
3	31	62%
Albuminuria		
1 cross	4	8%
2 cross	20	40%
≥3 cross	26	52%

Continued

Biology		
Proteinuria/creatinuria ratio (mg/g)		
200 - 1000	9	18%
1000 - 2000	18	30%
2000 - 3000	7	14%
3000 - 12000	16	32%
Hypercreatininemia	15	30%
Anemia	19	43.18%
Thrompenia	15	33%
Elevated liver enzymes	30	68.18%
Low prothrombin	2	6%
AntiHTA treatment		
Calcium channel blockers	44	88%
Central antiHTA	50	100%
Alphablocker	2	4%
Fœtal extraction		
Vaginal delivery	6	12%
Cesarian-section	44	88%
Other treatment		
Corticoïds	14	28%
Loop diuretics	2	4%
Antibiotics	44	88%
Complications		
Maternal		
Eclampsia	11	22%
HELLP Sd	08	16%
RPH	1	2%
AKI	15	30%
Fœtal		
IUFD	11	22%
IUGR	21	42%
Prematurity	26	52%

HELLP syndrome: Hemolysis Elevated Liver enzyme and Low Platelletes count; IUFD: Intrauterine Fetal Death; IUGR: Intrauterine Growth Retardation; RPH: Retro Placental Hematoma.

Table 2. Factors associated with the persistence of proteinuria and/or kidney failure.

Variable	At M1 postpartum	At M3 postpartum
Persistence of high blood pressure	31 (70.46)	20 (40%)
Persistant Proteinuria	43 (97.73%)	29 (58%)
Persistant kidney failure	5 (11.36%)	3 (2%)

Table 3. Factors associated with the risk of persistent kidney failure at 3 months postpartum.

	Persistant kidney failure			
Variables	Number count	Percentage (%)	p-value	OR (IC à 95%)
Normal AP	1	33.4%	0.55	3.22 (0.272 - 38.151)
Persistant HTA	2	66.6%	0.45	-
Eclampsia	0	0.0%	1	0 (0 - 8.87)
AKI	1	33.3%	1	1.44 (0.02 - 30.18)
RPH	0	0.0%	1	1 (0 - 605.23)
HELLP Sd	1	33.3%	0.41	2.77 (0.04 - 60.52)
ALO	0	0.0%	1	0 (0 - 97.09)
IUFD	1	33.3%	0.53	1.82 (0.02 - 38.47)
IUGR	1	33.3%	1	0 (0.10 - 13.92)
Prematurity	1	66.7%	1	1.89 (0.09 - 117.82)

Table 4. Factors associated with the risk of persistent proteinuria at 3 months postpartum.

	Persistant proteinuria			
Variables	Number count	Percentage (%)	p-value	OR (IC à 95%)
Normal AP	15	51.8%	0.24	2.33 (0.71 - 7.70)
Persistant HTA	14	48.2%	0.76	0.73 (0.18 - 2.94)
Eclampsia	7	24.1%	0.74	1.34 (0.28 - 7.33)
AKI	11	37.9%	0.04	5.61 (1.01 - 59.14)
RPH	1	3.4%	1	-
HELLP Sd	4	13.8%	0.70	0.68 (0.11 - 4.22)
ALO	2	6.9%	0.50	-
IUFD	11	37.3%	0.0012	5.21 (1.5 - 25.20)
IUFG	18	62.1%	0.001	9.33 (2.05 - 60.97)
Prematurity	20	69%	0.0091	5.34 (1.4 - 23.09)

4. Commentary

The average age of the pregnant women was 30.38 ± 6 years, with an age range of 18 and 40 years. Our results are similar to those of Cabiddu *et al.* who found a mean age of 30 ± 8 years in a study carried out in France [13]. Rodríguez-Benitez *et al.* in Spain found 33.94 ± 6.29 years as the average age of pre-eclamptics [11] and Kaze *et al.* in Cameroon 26.3 ± 6.6 years [14].

This could be explained by the fact that it is the average age for women to procreate, but in some places in Africa, in contradiction to the situation in Europe, women marry earlier and therefore give birth much quickly, which is corroborated by the study of Rodríguez-Benitez in Spain and Kaze in Cameroon.

More than half of our patients (62%) had no risk factors for pre-eclampsia. When present, nulliparity was the most common risk factor (32%). Eswarappa *et al.* in India also found nulliparity as a major risk factor but at a higher percentage (54%) [15]. Nulliparity is the risk factor for pre-eclampsia found in several studies but in different percentages depending on the country. Diallo *et al.* in Guinea Conakry, Cabiddu *et al.* in Italy, Kaze *et al.* in Cameroon and Girsberger *et al.* in Switzerland found respectively 39.82%, 53.3%, 68.5% and 75.4% [8] [13] [14] [16].

The average gestational age at the time of diagnosis was 35 weeks. Boiro *et al.* in Senegal reported a mean gestational age at the time of diagnosis comparable to ours (35.2 weeks) [7]. Preeclampsia is a pregnancy complication that occurs after the 20th week but at different gestational ages from one study to another. Unverdi *et al.* in Türkiye found 26.3 weeks as the mean gestational age at the time of diagnosis of pre-eclampsia [17]. Kaze *et al.* reported 34.3 SA and Rodríguez-Benitez *et al.* 34.03 SA [11] [14].

The mean systolic blood pressure was 179.18 ± 23.76 mmHg and the mean diastolic blood pressure was 112.36 ± 13.71 mmHg. More than half of the patients (62%) had Grade 3 hypertension. Our results are comparable to those of Diallo *et al.* who found a mean systolic blood pressure of Grade 2, *i.e.* 170.18 mmHg, and a mean diastolic blood pressure of Grade 3, *i.e.* 111.7 mmHg (8). Kaze *et al.*, Boiro *et al.* and Rodríguez-Benitez *et al.* found a mean systolic pressure and a mean diastolic pressure in all Grade 2 [7] [11] [14].

The mean proteinuria/creatinuria ratio was 3592.08 ± 7009.57 mg/g. 32% had nephrotic grade proteinuria (≥3000 mg). Diallo *et al.* in Guinea Conakry found an average 24-hour proteinuria close to ours (3490 mg/24 hours) [8]. Cabiddu *et al.* in France, Kaleta *et al.* in Germany, Rodríguez-Benitez *et al.* in Spain and Eswarappa *et al.* in India had reported 1700 mg, 2639 mg, 2800 mg and 2800 mg respectively as 24-hour average proteinuria [11] [13] [15] [18]. The difference between the reported results would be due to the method used to quantify proteinuria and the characteristics of the populations studied.

The average serum creatinine was 13.61 mg/l or 120.31 µmol/l. Rodríguez-Benitez *et al.* and Kaleta *et al.* found 8.9 mg/l (78.67 µmol/l) and 7.56 mg/l (66.88 µmol/l) respectively as mean serum creatinine [11] [18]. These apparently low

mean serum creatinine values are due to the fact that during pregnancy, GFR increases 40% - 60% above normal levels, leading to a decrease in plasma creatinine levels (normal levels in pregnant women are 40 to 60 mg/l) [11].

Hypercreatininemia at the diagnosis of pre-eclampsia was found in 30% of pregnant women; Eswarappa *et al.* found it in 16%. The difference with our results lies in the threshold value for defining hypercreatininemia. It was >12 mg/l in our study and >13 mg/l in that of Eswarappa *et al.* [15].

Injectable nicardipine was used in 88% of patients in our study and alpha methyl dopa was prescribed to all patients. For Kaze *et al.*, injectable nicardipine was prescribed in 64.8% of participants and alpha methyldopa in 88% [14]. The high rate of injectable nicardipine in our study could be explained by the high blood pressure figures reported and by the fact that the injectable route is an emergency route. 60% of pregnant women had Grade 3 hypertension and the average systolic blood pressure was high (179.18 mmHg). Alpha methyldopa, due to its low cost compared to oral nicardipine, would explain the fact that it was prescribed to all the patients in our study.

Caesarean section was performed in 88% of pregnant women in our study. This high percentage of cesarean section could be explained by the fact that we recruited our patients in hospitalization and many pregnant women who were admitted presented severe pre-eclampsia. In this context, the maternal and fetal vital prognosis being brought into play, the need for urgent placental extraction was prescribed, therefore by cesarean section. The cesarean section rate varies from one study to another. Boiro *et al.* in Senegal, Cabiddu *et al.* in Italy, Diallo *et al.* in Guinea Conakry, Rodríguez-Benitez *et al.* in Spain and Tchente Nguefack *et al.* in Cameroon reported respectively 97.6%, 81.7%, 77.19%, 64.7% and 57.5% of cesarean sections [7] [8] [11] [13] [19]. The difference between these figures would be due to the clinical and paraclinical characteristics of the participants in the different studies.

Pre-eclampsia is a disease whose progression is punctuated by the occurrence of complications for both the fetus and the mother. The most frequent complications in decreased order were: prematurity (52%), IUGR (42%), AKI (26%) and eclampsia 22%.

More than half of the newborns (52%) were premature. Boiro *et al.* and Rodríguez-Benitez *et al.* reported similar results but with a higher percentage, 66% and 64% respectively [7] [11].

IUGR had been observed in 42% of cases, this figure is close to 42.7% reported by Cabiddu *et al.* in France [13], higher than 33.2% found by Ngowa *et al.* in Cameroon [20] and significantly lower than 68.53% observed by Boiro *et al.* [7]. Eclampsia was reported in eleven patients or 22%. If our result is lower than that found by Tchente Nguefack *et al.* (34.8%) [19], it is significantly higher than those found by Girsberger *et al.*, Rodríguez-Benitez *et al.*, Zelmat *et al.* and Ngowa *et al.*, respectively 2%, 3%, 8.5% and 12.14% [11] [15] [20] [21].

IUFD was observed in 22% of our patients. Ngowa *et al.* found 41.9% [20],

approximately double our result. This could be explained by the fact that 92.52% of its participants had severe blood pressure figures and vaginal delivery was done in 57.94% of cases.

Acute renal failure was observed in 26% of women. Our results are lower than 28.33% obtained by Diallo [22], Rodríguez-Benitez *et al.* (24.8%), Kaze *et al.* (24.1%), Eswarappa *et al.* (19%), Zelmat *et al.* (13.3%), Tchente Nguefack *et al.* (13.2%) and Girsberger *et al.* (8.6%) had found a lower percentage of IRA in their studies [11] [14] [15] [16] [19] [21]. These differences are due to the different definitions of AKI by the authors [14] [15] [16] [22].

Since preeclampsia is a pathology caused by the placenta, after delivery, proteinuria should gradually return to its physiological value; as well as blood pressure and kidney function.

Gynecologists at Cocody University Hospital send patients to the cardiologist for follow-up after a pre-eclamptic delivery.

Hypertension was persistent in 70% of women one month postpartum and in 40% at 3 months postpartum. Our result is comparable to 39% reported by Berks at M3 postpartum [23]. However, it is higher than 27.8% found by Kaze *et al.* in Cameroon and 23.8% found by Rodríguez-Benitez *et al.* in Spain [11] [14].

There are discrepancies in the literature regarding the time for blood pressure to normalize after pre-eclampsia; for some authors, it is within 6 weeks after delivery [18] and for others within 12 weeks [16]. However, hypertension can persist beyond three months or even for several years. Berks *et al.* in Holland and Amougou *et al.* in Cameroon reported respectively 18% of persistent hypertension two years after pre-eclampsia and 23.53%, 3.7 years after pre-eclampsia [23] [24].

After preeclampsia, proteinuria should decrease as the postpartum period progresses until it normalizes, *i.e.* becomes lower than physiological proteinuria. Proteinuria was nephrotic (≥3000 mg/g) in 32% of women at the diagnosis of pre-eclampsia, in 9% of women at one month postpartum and in no women at 3 months postpartum. However, at one month postpartum, 98% of women had persistent proteinuria, and at three months postpartum more than half, *i.e.* 58%.

Kaze *et al.*, Berks *et al.* and Rodríguez-Benitez *et al.* found respectively 31.5%, 14% and 11.1% of cases of persistence of proteinuria at M3 postpartum [11] [14] [23]. The high prevalence of persistent proteinuria found in our study could be explained by the non-uniformity of the definition of persistent proteinuria. We defined it as proteinuria/creatininuria ratio ≥200 mg/g or Kaze *et al.* defined it as proteinuria/creatininuria ratio >200 mg/g, Berks *et al.* as 24-hour proteinuria ≥300 mg/24 h and Eswarappa *et al.* as proteinuria of 24 h > 150 mg/24 h [14] [15] [23]. According to the recommendations, if pathological proteinuria persists beyond 6 months postpartum, the patient should be classified as chronic kidney disease and treated as such [25].

We looked for an association between the persistence of proteinuria and the grades of hypertension at M3 postpartum and with the different complications

of PE. We found a significant association between the persistence of proteinuria with MFIU (p = 0.0012), with prematurity (p = 0.0091) and with IUGR (p = 0.001). Our results agree with those of Kaze *et al.* who found that low birth weight was correlated with persistent proteinuria at 3 months postpartum [14]. who had persistence of renal abnormalities at M3 postpartum had hypercreatininemia. These women had benefited from a renal biopsy. Analysis of renal biopsy specimens revealed four cases of pre-eclampsia and 10 cases of underlying renal disease (4 cases of membranoproliferative glomerulonephritis, four cases of IgA nephropathy, one case of segmental and focal glomerulosclerosis and one case of amyloidosis) [17]. The cases of persistence of hypercreatininemia in our study may be part of glomerulonephritis which develops during pregnancy or subclinical nephropathy which worsens during pregnancy [14].

In our study, we did not find an association between the persistence of hypercreatininemia at M3 postpartum with the grades of hypertension on the one hand and with the complications of pre-eclampsia on the other hand.

5. Limitations of the Study

- Small size of our sample makes it difficult to extrapolate the results obtained on the general population.
- Short duration of participant follow-up (3 months).

6. Conclusion

At the end of this study on the evolution of proteinuria and renal function in the postpartum period of pre-eclampsia, it emerges that pre-eclampsia should no longer be considered as a pathology whose symptoms disappear automatically after childbirth. Renal abnormalities can persist beyond three months postpartum. Kidney failure persisted in 6% of patients and proteinuria in 58%. Grades of hypertension and complications of preeclampsia were not associated with the persistence of kidney failure. Prematurity, intrauterine fetal death and intrauterine growth retardation were associated with the persistence of proteinuria at 3 months postpartum.

Conflicts of Interest

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

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Appendix

SURVEY SHEET

SOCIODEMOGRAPHIC CHARACTERISTICS

Number: Age:

Profession: Contact:

Marital status: Married or Couple or Single or Widow

RISK FACTORS FOR PRE-ECLAMPSIA

Age Ethnic Factors HTA

Chronic kidney disease Thrombophilia Diabetes

History of pre-eclampsia Twin pregnancy Hydatidiform mole

Chromosomal abnormalities Number of partners

CLINICAL PARAMETERS

Gestational age: Arterial pressure: IMO: yes (1) no (2)

BU Albumin: Red blood cells:

PARACLINICAL PARAMETERS

Serum creatinine:…… ASAT:……. Hb:…… D-dimer:……

Urea:…… ALT:……..... Platelets:…… Fibrinigen:…….

Proteinuria:…….. Uricemia:……TP:……...

TREATMENT

Anti-hypertension treatment

Anti-HTA central Alpha blocker Calcium channel blocker

Fetal extraction: Cesarean Vaginal delivery

COMPLICATIONS

Eclampsia OAP HELLP syndrome DIC HRP AKI

IUFD Prematurity IUGR

EVOLUTION

Parameters	At diagnosis	1 MONTH	2 MONTHS	3 MONTHS
P.A.				
Weight				
Albuminuria				
Protéinuria/créatinuria				
Créatininemia				
Urea				

Size: