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Research Article

The Renal Function of the Cameroonian Pregnant Woman: Pilot Study at the Laquintinie Hospital in Douala for a Draft Reference System in a Black African Context

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ABSTRACT

The onset of pregnancy is accompanied by multifaceted changes in women, including an anatomical and functional impact of the kidneys.

Research question: is it possible to determine threshold values of renal function in our black pregnant women that can serve as reference data in our context?

Objective: Our study aimed to determine the renal profile of pregnant women, to assess its evolution during pregnancy and to establish threshold values for basic metabolites.

Methods: We conducted a prospective cross-sectional analytical study at Laquintinie Hospital in Douala from January 2022 to March 2022. Our study compared two groups of women, one of which (exposed) was made up of pregnant women and had recently given birth and another (unexposed or control) consisted of non-pregnant women. Our sampling was consecutive and not exhaustive. All our participants consented after been informed and the data were collected using a structured and pre-tested technical sheet. The study variables were sociodemographic, gestational, and biochemical. A bivariate analysis was performed with the ANOVA test as well as a Tukey post hoc analysis and a P value < 0.05 was the reliability threshold.

Results: Out of 349 consenting women, we selected 200 eligible participants (100 pregnant and postpartum women, 100 controls). Relative to the control group, there were statistically significant differences in pregnant and postpartum participants regarding serum creatinine (8.7 vs 7.6 mg/l; P < 0.001), urea (21. 7 vs 15.1 mg/dl; P < 0.001), uric acid (48 vs 43.3 mg/l; P=0.034), sodium (137 vs 136 mmol/l; P = 0.002) and potassium (3.6 vs. 3.5 mmol/l; P < 0.001). We considered as threshold or reference the following values: 7.5 ± 1.1 mg/L throughout pregnancy for creatinine; 17.7 ± 4.7 mg/dl in the first trimester and postpartum, 14 ± 4.7 mg/dl in the second and third trimesters for urea; 35.5 ± 14.7 mg/l in the first two trimesters for uric acid; 135.6 ± 2.1 mmol/l for sodium throughout pregnancy; 3.5 ± 0.2 mmol/l for potassium during gestation.

Conclusion: Our study, in the light of the already known, confirms, with a few nuances (chloride), a decrease in the basic metabolites of the renal function of the pregnant woman and initiates an outline of the reference values of the basic metabolites in our context.

Keywords: Creatinine; Urea; Uric acid; Pregnancy; Cameroonian

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INTRODUCTION

During pregnancy, the woman's body is subject to many anatomical and physiological upheavals, including numerous circulatory and hemodynamic changes, including renal function [1, 3, 4].

The kidneys undergo an anatomical increase of 1 to 1.5 cm as well as an increase in glomerular filtration reaction to the physiological hypervolemia of the gestational state [5]. As a result, there is an impact on the serum levels of the renal biomarkers creatinine, urea and uric acid, as well as on the concentration of electrolytes (sodium, potassium, chloride) often different from those of women not speakers [1-3, 5-7].

It is important to note that these hemodynamic changes begin as early as the 6th week of gestation, persist throughout pregnancy, and begin to gradually regress around the preterm and throughout the postpartum period [8].

Very few authors from the same racial and geographical area as us have looked into the subject. With the exception of Ondo in Nigeria, most of our review was Caucasian.

Hence our scientific challenge to conduct this study in our context given the biological and biochemical disparity often observed in other themes [8, 13].

MATERIALS AND METHODS

Type of study

We conducted a prospective cross-sectional analytical case-control study.

Period, Duration and Location of the study

Our study took place from January 01, 2022 to March 31, 2022 (three months) in the gynecology-obstetrics department of the Laquintinie Hospital in Douala.

Collection of data

We carried out a prospective collection of data from patient files, hysteroscopy reports and recorded them on a computerized file. The parameters studied were: socio-demographic characteristics, gynecological, obstetrical, medical and surgical history, clinical aspects, diagnostic hysteroscopy data, procedures associated with hysteroscopy, agreement between hysteroscopy results diagnosis and those of the ultrasound and the treatments instituted.

Study population

Our study population consisted of pregnant and non-pregnant women as well as new mothers received during our study period.

Inclusion criteria: Depending on whether or not they were exposed to pregnancy, we included consenting pregnant and postpartum women aged between 18 and 45 years constituting the CASE group (exposed), and non-pregnant women serving as the CONTROL group (unexposed). .

Our target population (CASE) was matched to the three stages of pregnancy and thus divided into four subgroups: first trimester (from the date of the last menstrual period to 12 weeks), second trimester (from 13 to 28 weeks), third trimester (from 29 to 41 weeks), and postpartum (up to 6 weeks after delivery).

Exclusion criteria: Were excluded any women pregnant or not with proteinuria (more than 1+ on the urine dipstick), systolic blood pressure ≥ 140 mm Hg, diastolic blood pressure ≥ 90 mm Hg, history of pre-eclampsia/eclampsia, history of gestational diabetes, blood sugar fasting ≥ 92 mg/dl during ANC, HIV, kidney disease, viral hepatitis B and C, liver cirrhosis, sickle cell disease, patients taking common medications other than iron +/- folic acid, multivitamins and mineral complexes (such as NSAIDs, H2 antagonists, PPIs, phenytoin, herbal medicine); alcohol (> 14 units/week); tobacco (≥ 5 cigarettes/day); and illicit drugs (heroin, cocaine, marijuana); patients with acute illness (those with sepsis or hemorrhage).
And from the CASE group the non-evolving pregnancies as well as the cases of abortion
Sampling: We proceeded to a sampling by convenience, consecutive and not exhaustive.

PROCEDURE

Administrative procedures: The study protocol had received the approval of the Institutional Ethics Committee for Human Health Research of the University of Buea by issuing an ethical clearance No 1550-01. Data collection was carried out with respect for confidentiality by means of anonymous files. We have also obtained the authorizations of the director of the Laquintinie hospital for this purpose.

Data collection: After obtaining informed consent following explanations relating to the study, the data were collected using a structured technical sheet whose variables of interest were: socio-demographics, personal history, physical examination and biochemical analyzes.

Biological data: kidney function parameters; we explored kidney function through blood levels of creatinine, urea, uric acid, sodium, chlorine, potassium, magnesium, calcium.

Sampling location: The samples were taken by venipuncture at the elbow crease in antenatal consultation, in the pathological pregnancy department, in the post-partum unit, in the family planning unit.

Sampling and analysis method: For each patient was collected by venipuncture at the bend of the elbow 5ml of blood in a dry tube precisely labeled for the concentrations of serum creatinine, urea and uric acid, and in a lithium heparinized tube for the concentrations of ions. The tubes were centrifuged at 3000 rpm for 5 minutes, 30 minutes to 3 hours following the day's sampling. 300 µl of serum from heparinized tubes were pipetted into wells, then aspirated and analyzed by an electrolyte analyzer (Cornley AFT-300). 1000µL of serum from dry tubes were aliquoted and then stored in a freezer at -20°C, to be analyzed using a spectrophotometer (Genrui WP21A), 4 hours to 4 days following sampling.

The Jaffe, Berthelot urease, enzymatic colorimetric (uricase) and potentiometric methods were used to measure the respective concentrations of creatinine, urea, uric acid and electrolytes.

Statistical analysis: The data was collected using a structured and pre-tested technical sheet and then analyzed using Epi info 7.2.5 R 4.1.3 software. The quantitative variables were grouped in the form of mean with standard deviation and the qualitative variables in the form of counts and percentages.
The comparison of the qualitative values was made using the Chi^2 test and the quantitative variables using the student test. A bivariate analysis was carried out using the ANOVA test together with a Tukey post hoc analysis in order to explain the differences in the significant results. The significance threshold was defined for a value of $P < 0.05$.

RESULTS

In our study, we approached a total of 349 consenting women, and excluded 149. The final size of our sample was 200 respondents, including 100 pregnant women and those who had given birth, matched with 100 non-pregnant women. All the participants had a mean age of 29.7 ± 6.2 years with extremes of 18 and 45 years and a majority falling within the range [26-35] (Table 1).

Estimated Glomerular Filtration Rate (eGFR) was significantly elevated in CASE (pregnant and delivered) as was also statistically significant decrease in creatinine, urea, uric acid, potassium and sodium, with the exception of chlorine where gestational status and its postpartum counterpart revealed no difference with the CONTROL group (Table 2).

With the exception of the sodium concentration which was significantly elevated in postpartum women compared to the controls, there was no statistical difference between the two groups concerning the concentrations of the other metabolites concerned in our study. Compared to the postpartum group, pregnant women had significantly higher levels of serum creatinine, urea, uric acid and potassium (Table 3).

Although concentrations of creatinine, potassium, and eGFR during gestation and postpartum were significantly low compared to controls, their levels across different stages of pregnancy and postpartum were comparable (P > 0.05) (Table 4).

There was also no significant difference in serum chloride levels between our target population and the control group, neither through the different periods of pregnancy nor in the postpartum period.

DISCUSSION

Except for chloride, all metabolites were significantly lowered in pregnant and postpartum women compared to controls and baselines. These deviations reflect the overall hemodynamic changes that occur during gestation.

Serum creatinine was significantly lower in pregnant than in postpartum women, but was comparable throughout pregnancy and the postpartum period (P = 0.203), although an increase toward values preconception was observed after delivery at 8.1 mg/l. Almost the same pattern of serum creatinine variations was observed by Egwuatu et al. [14]. Unlike Caucasian studies [8,10-13], the further decrease in creatinine described during the second trimester of gestation was not observed in our study as well as in Nigerian studies [4, 14,15]. To this end, it seemed appropriate to question and even validate the hypothesis of racial (and possibly ethnic) variations. Given that there was no significant difference between the different gestational trimesters, but rather between pregnant women and those who had given birth, we find it relevant to use 7.5 ± 1.1 mg/l as a threshold or reference value. Serum creatinine throughout gestation in Cameroonian pregnant women.

Serum urea concentration was significantly different between trimesters of gestation. Specifically, the concentration in the postpartum (19.1 mg/dl) was significantly higher than those in the second and third trimesters (14.5 mg/dl and P = 0.007; 13.6 mg/dl and P = 0.003 respectively). As reported in the literature [6], the lowest mean value was that of the third trimester, similar to the study carried out by Miri-Dashe et al. [15]. The pattern of changes in estimated glomerular filtration rate (eGFR) in our study reflected changes in serum urea levels. Tukey post hoc analyzes revealed a significantly higher urea concentration in the postpartum than in the second and third trimesters. But there was no significant difference between the first trimester and the postpartum period, nor between the second and third trimesters. For these reasons, the first trimester and postpartum can therefore have the same reference values, just like the second and third trimesters, which are respectively 17.7 ± 4.7 mg/dl and 14 ± 4. 7 mg/dl.

Serum uric acid was significantly different in different periods of pregnancy. We noticed a decrease of 22-30% during the first two trimesters with a lowest value in the first (33.1 mg/l). A return to pre-conceptual levels was observed from the third trimester. These results are consistent with those of other studies [4, 12-14], and are due to the increase in blood volume and the decrease in tubular reabsorption of uric acid in early pregnancy [7, 16]. According to (Figure 1A and 1B), there was a statistically significant difference between postpartum and the first trimester, as well as the second trimester. Likewise, there was a significant difference between the second and third trimesters. As shown in Table 4, the uric acid concentrations of the third trimester and postpartum were almost the same as those of non-pregnant women. Therefore, the first and second trimesters may have the same reference values (35.5 ± 14.7 mg/l), while the normal values of the third trimester and postpartum will be considered similar to those of the control group.

Serum sodium and potassium levels in pregnant and postpartum women were significantly low compared to controls (P = 0.002 and P < 0.001 respectively). Unlike potassium, sodium was statistically different between gestational and postpartum stages. Its levels were significantly higher in the postpartum period compared to the first (P = 0.002), second (P < 0.001), and third (P = 0.001) trimesters. As with the findings of Miri-Dashe et al. [15], we observed the lowest value of sodium in the first trimester (135.0 mmol/l), while those of potassium were in the second and third trimesters (3.5 mmol/l). Considering that serum potassium concentration was comparable from one trimester to another of pregnancy, but there was a significant difference between the pregnant and postpartum groups, we considered as reference values 3.5 ± 0.2 mmol/l throughout gestation. As shown in Table 4 and (Figure 1C), serum sodium concentrations were significantly higher in the postpartum period compared to the first, second, and third trimesters. Therefore, the first, second and third trimesters can use the same reference values for serum sodium (135.6 ± 2.1 mmol/l).

In contrast to our findings and those of related studies, we were able to note that similar work carried out in China [12, 13] reported the lowest values for creatinine, urea and uric acid. These differences, in our opinion, can be explained by multiple differences in their eating habits, their height and their body mass as opposed to our respondents.

CONCLUSION

Our study, in the light of what is known, confirms, with a few nuances (chloride), a drop in the basic metabolites of renal function in pregnant. Cameroonians and begins an outline of the reference values of the basic metabolites in our context.

CONTRIBUTION TO SCIENCE

Our study is a pioneer in Cameroon in evaluating the renal function of

pregnant and postpartum women in apparent good health and in formulating benchmarks of renal function metabolites that can be used in our context.

THANKS

The entire team thanks the management of Laquintinie hospital as well as its staff for the multifaceted facilities granted to them during this study.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest; the concerns were essentially scientific.

CONTRIBUTION OF AUTHORS

Essome: coordinated the study and wrote the manuscript Ndamb: collected the data Tocki: provided the English translation and formatting of the manuscript Ngambi, Njamen, Balepna, Mangala, Bilkissou, Ndolo, Ofakem, Ngaha, Mounchikpou, Ngono, Ekono read and corrected the manuscript. Nana, Tchente and Foumane supervised the study and corrected the manuscript. All co-authors have read and approved the final manuscript.

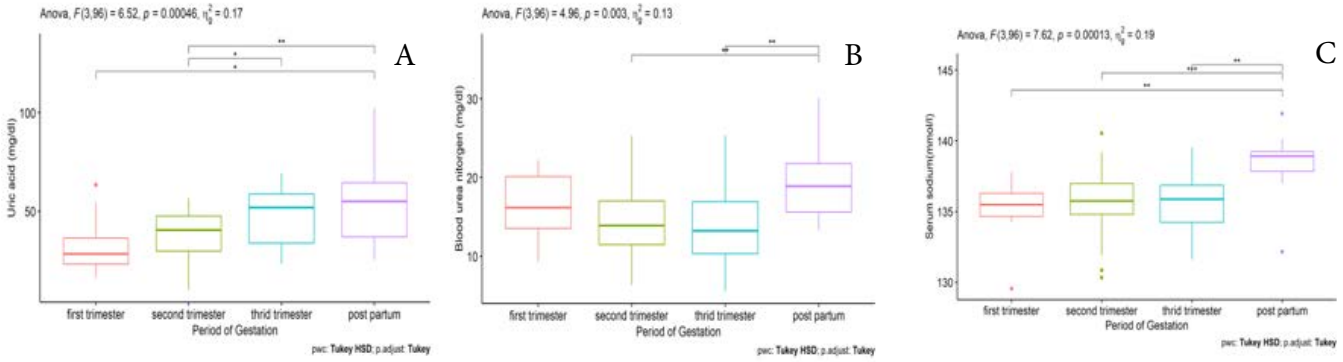

Figure 1: Tukey post hoc analysis of urea (A), uric acid (B), and sodium (C) concentrations

Table 1: Distribution by age group of participants.

Variable	Pregnant and in post-partum	Non-pregnant	Total
	(n = 100)	(n = 100)	(N= 200)
Age (SD)	29.4 (± 5.6)	30.1 (± 6.8)	29.7(±6.2)
[18-25] years	23 (23.0%)	33 (33.0%)	56(28.0%)
[26-35] years	60 (60.0%)	42 (42.0%)	102(51.0%)
> 35 years	17 (17.0%)	25 (25.0%)	42(21.0%)

Table 2: Comparison of renal profile between pregnant and non-pregnant participants

Metabolites	Pregnant and post partum	Non-pregnant	Total	p-value
Cr (mg/l)	7.6 (± 1.1)	8.7 (± 1.6)	8.1 (± 1.5)	<0.001
eGFR (ml/min)	113.1 (± 21.8)	97.5 (± 24.1)	105.3 (± 24.2)	<0.001
Urea (mg/dl)	15.1 (± 4.9)	21.7 (± 6.6)	18.4 (± 6.7)	<0.001
U.A (mg/l)	43.2 (± 18.0)	48.0 (± 13.9)	45.6 (± 16.2)	0.034
K^+ (mmol/L)	3.5 (± 0.3)	3.6 (± 0.3)	3.6 (0.3)	<0.001
Na^+ (mmol/L)	136.0 (± 2.3)	137.0 (± 2.1)	136.5 (± 2.3)	0.002
Cl^- (mmol/l)	107.3 (± 4.2)	107.0 (± 2.6)	107.2 (± 3.5)	0.531

Cr : serum creatinine ; eGFR : estimated glomerular filtration rate ; Urea: blood urea ; U.A : Uric acid ; K+ : potassium ; Na+ : sodium ; Cl- : chloride.

Table 3: Comparison of renal profile between non-pregnant and postpartum women, and between pregnant and postpartum women.

Metabolites	Non-pregnant (n = 100)	Postpartum (n = 15)	P-value	Postpartum (n = 15)	Pregnant (n = 85)	P-value
Cr (mg/l)	8.7 (± 1.6)	8.1 (± 0.8)	0.155	8.1 (± 0.8)	7.5 (± 1.1)	0.045
eGFR (ml/min)	97.0 (± 23.4)	102.7 (± 13.2)	0.364	102.7 (± 13.2)	114.1 (± 21.9)	0.054
Urea (mg/dl)	21.6 (± 6.4)	19.1 (± 4.7)	0.146	19.1 (± 4.7)	14.4 (± 4.7)	0.001
U.A (mg/dl)	47.3 (± 13.2)	54.1 (± 23.0)	0.099	54.1 (± 23.0)	40.6 (± 14.3)	0.003
K^+ (mmol/l)	3.6 (± 0.3)	3.6 (± 0.4)	0.332	3.6 (± 0.4)	3.5 (± 0.2)	0.258
Na^+ (mmol/l)	137.0 (± 2.1)	138.4 (± 2.1)	0.014	138.4 (± 2.1)	135.6 (± 2.1)	<0.001
Cl^- (mmol/l)	107.1 (± 2.6)	106.6 (± 2.8)	0.538	106.6 (± 2.8)	107.5 (± 4.4)	0.477

Cr: serum creatinine; eGFR: estimated glomerular filtration rate; Urea: blood urea; U.A: uric acid; K+: potassium; Na+: sodium; Cl- : chlorid

Table 4: Variations in metabolites between gestational trimesters and the postpartum period.

Metabolites	1st trimester	2nd trimester	3rd trimester	Post-partum	p-value
Cr (mg/l)	7.4 (± 1.1)	7.6 (± 1.1)	7.4 (± 1.2)	8.1 (± 0.8)	0.203
eGFR (ml/min)	114.8 (± 15.3)	113.1 (± 22.2)	115.7 (± 23.4)	102.7 (± 13.2)	0.268
Urea (mg/dl)	16.3 (± 4.6)	14.5 (± 4.5)	13.6 (± 4.9)	19.1 (± 4.7)	0.003
U.A (mg/l)	33.1 (± 17.0)	37.9 (± 12.4)	47.9 (± 14.4)	54.1 (± 23.0)	<0.001
K^+ (mmol/L)	3.6 (± 0.2)	3.5 (± 0.2)	3.5 (± 0.3)	3.6 (± 0.4)	0.519
Na^+ (mmol/L)	135.0 (± 2.5)	135.6 (± 2.1)	135.8 (± 2.1)	138.4 (± 2.1)	<0.001
Cl^- (mmol/l)	108.3 (± 3.5)	107.5 (± 4.6)	107.2 (± 4.3)	106.6 (± 2.8)	0.827

Cr : serum creatinine ; eGFR : estimated glomerular filtration rate ; Urea : blood urea ; U.A : uric acid ; K+ : potassium ; Na+ : sodium ; Cl- : chloride.

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