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Female Contraception: Comparative Study of Biometrics and Vascularization of the Uterus at Sylvanus Olympio University Hospital (Togo)

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Abstract

Female contraception uses both hormonal and non-hormonal methods. The aim of the study is to determine the impact of female contraception on uterine vascularisation and the endometrium. **Method:** It was a descriptive comparative study with an analytical aim. It took place at the University Clinic of Obstetrics Gynaecology and the Radiology and Medical imaging Department of Sylvanus Olympio University Hospital in Lomé over a two-month period from May 15, 2023 to July 15, 2023. Group 1 included women using a modern contraceptive method and group 2 women not using a modern contraceptive method. Epidata 3.1 and R 4.0.4 software were used to process the data. **Results:** Each group included 50 women. There were no significant differences in uterine and endometrial biometrics. All women on contraception had their zone 1 vascularized, without vascularisation of zone 2, without significant difference with women without contraception The pulsatility index was greater than 3 in 51% (n = 51) of women, including 62.7% (n = 32) of women without contraception and 37.3% (n = 19) of women on contraception, with a statistically significant difference (p = 0.009). **Conclusion:** Contraceptive methods do not influence the biometry of the uterus. However, uterine artery Doppler indices can predict abnormal uterine bleeding.

Keywords

Contraception, Endometrium, Uterine Artery, Doppler

1. Introduction

Family planning through the adoption of contraceptive methods is recognized as

one of the fundamental objectives of socio-economic development. Contraception is defined as the use of agents, devices, methods, or procedures to decrease the probability of conception or to avoid it according to the WHO. It uses hormonal and non-hormonal methods [1]. The contraceptives methods cause side effects which must be known by the patient to facilitate continuity of use. Hormonal contraceptives contain a combination of estrogen and progestin or only progestin. Copper intra uterine device is a non-hormonal contraception, referred to as "mechanical" which respects the natural menstrual cycle. It is inserted through the cervix and into the womb [1] [2] [3]. The main side effects of hormonal contraception are menstrual disruption, pelvic cramps, and excessive pelvic bleeding. Copper IUD can cause longer and heavier menstrual periods bleeding, pelvic cramps and painful periods [2] [3]. The action of contraceptives can influence the functioning of the female reproductive system, in particular uterine vascularisation and the characteristics of the endometrium [4]. The uterine arteries play a crucial role in blood perfusion of the uterus and endometrium, as well as female fertility [4] [5]. Few African studies have been carried out on the influence of contraceptive methods on uterine vascularization and consequently on fertility. However, this information could contribute to improving contraceptive choices and optimizing the reproductive health of women of childbearing age. It therefore seemed important to us to take stock of the link between female contraception and uterine vascularization as well as the appearance of the endometrium.

The objective of this study was to determine the impact of female contraception on uterine vascularization and the endometrium.

2. Patients and Methods

This was a comparative case study with prospective data collection, which took place at the Sylvanus Olympio University Hospital Center in Lomé (University clinic of obstetrics and gynecology and radiology and medical imaging department). The study took place over a period of two months from May 15, 2023 to July 15, 2023. The sample size was calculated using the formula for estimating the difference in means between two independent samples by Kirkwood and Sterne.

$$n = \frac{2 \partial 2 \left(Z< + Z® \right)^2}{\left(\int 1 - \int 2 \right)^2}$$

N = 38 women for each group.

2.1. Inclusion Criteria

Our study included two groups of women aged 18 to 40, who were not pregnant and who gave informed oral consent.
- Group 1: women using a modern contraceptive method

The modern contraceptive methods used were those available in health services in Togo. These are hormonal contraceptives (combined pills, progestin-only injectables, subcutaneous implants) and non-hormonal (copper intrauterine de-

vice).

- Group 2: women not using a modern contraceptive method.

2.2. Non-Inclusion Criteria

Women with cardiovascular disease (arterial hypertension), those with a history of menstrual disorders, recurrent miscarriages, ectopic pregnancies, previous uterine or ovarian surgery and women on current hormonal or vasodilator treatment were not included.

2.3. Data Collection Techniques

The patients were selected at the family planning consultation of the university clinic of the CHU Sylvanus Olympio of Lomé. Those who agreed to participate in the study were taken to the radiology department of the CHU Sylvanus Olympio of Lomé. We conducted an individual interview and collected patients' clinical data and pelvic ultrasound results on a pre-established survey form. We assigned a study identification number to each study participant in order to preserve anonymity. The study was carried out in both departments after the necessary authorisations had been obtained.

2.4. Technique

All ultrasound scans were performed by the same operator and on the same ultrasound machine to avoid the bias of inter-operator variation in the results. We used a MIND RAY brand ultrasound machine, equipped with a reprograph and 03 transducers. For our study, we used the convex probe at a frequency of 4 MHz for all measurements. This device has Doppler measurement parameters.

A suprapubic ultrasound was done for general evaluation of the pelvic organs and morphological analysis of the uterus and adnexa under B mode. Doppler mode was used to identify each uterine artery in the paracervical region. Pulsed Doppler was used for spectral analysis and determining the Doppler indices (VMS, VDM, IP and IR) of the right and left uterine arteries with the Doppler angle maintained below 60 degrees to obtain optimal Doppler signals. Color Doppler also assessed endometrial blood flow.

Epidata 3.1 and R 4.0.4 software were used to process the data. Quantitative variables were described as means ± standard deviation, and were compared using Wilcoxon or anova tests. Qualitative variables were described in terms of numbers and percentages, and were compared using Chi^2 or Fisher tests. The significance threshold was set at a p-value strictly less than 0.05.

2.5. Operational Definitions

- Overweight and obese: body mass index between 25 and 30 kg/m^2 and greater than 30 kg/m^2 respectively.
- normal MSV (Maximum Systolic Velocity): ≤100 cm/s.
- normal MDV (Maximum Diastolic Velocity): ≤50 cm/s.

- IR (resistance index) normal: ≤0.7.
- PI (pulsatility Index) normal: ≤3.

3. Results

We enrolled 50 women of childbearing age in each group.

3.1. Epidemiological Data

Age

The mean age of the women in both groups was 28.2 ± 5.5 years. The average age of women using contraception was 28 years, with extremes of 18 and 38 years. The average age of women without contraception was 28.3 years, with extremes of 18 and 40 years (Figure 1).

Marital status, occupation, level of education and body mass index were summarized in Table 1. We found a statistically significant association between marital status and contraceptive use. The mean body mass index was 25.1 ± 4.65 kg/m². We found no statistically significant association between occupation, education, body mass index and contraceptive use.

3.2. Clinical Data

Contraceptives methods used

The average duration of contraceptive use was 27.92 + 30.4 months, with extremes of 1 month and 108 months. The copper intrauterine device was the most commonly used method, with a frequency of 40% (n = 20) and its average duration was 35, 65 months. The average duration of implants was 9, 25 months. The various contraceptive methods were summarized below (Figure 2).

Information on the menstrual cycle

The average menstrual cycle length was 29.7 + 3.2 days. It was 30.04 + 3.1 days in women with contraception and 29.3 + 3.2 days in women without contraception. Period duration was 4.71 + 1.3 days, with 4.74 + 1.3 days for women on contraception and 4.69 + 1.3 days for women without contraception.

Seventeen women using contraceptives had an irregular cycle (11 cases of secondary non-pregnancy amenorrhea and 6 cases of irregular bleeding) with a statistically significant difference. Among those who had secondary non-pregnancy
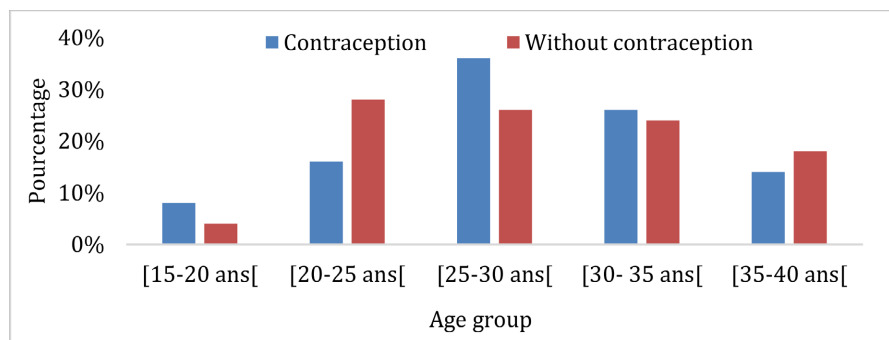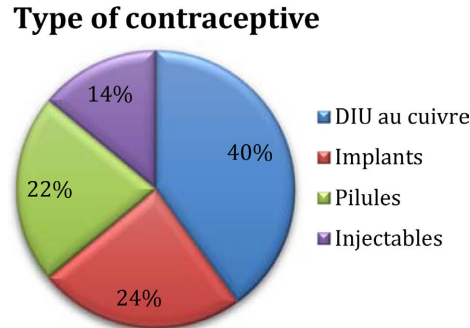

Figure 1. Age distribution of respondents.

Table 1. Distribution according to epidemiological data.

	Contraception			
	With n (%)	without n (%)	Total n (%)	p value
Marital status				
Married	19 (38)	12 (24)	31 (31)	0.008
Unmarried	31 (62)	38 (76)	69 (69)	
Profession				
*IGA	31 (62)	23	54 (54)	0.5013
non IGA	19 (38)	27	46 (46)	
Instruction				
Unschooled	2 (4)	03 (6)	05 (05)	0.8694
Schooled	48 (96)	47 (94)	95 (95)	
Body Mass Index				
Slimmer	3 (6)	3 (6)	6(6)	
Normal	27 (54)	24 (48)	51 (51)	0.2374
Overweight	11(22)	19 (38)	30 (30)	
Obesity	9 (18)	4 (8)	13 (13)	

*IGA: income-generating-activity.

Figure 2. Distribution of Group 1 respondents according to contraceptives used.

amenorrhea: 05 used implants, 03 used injectables, 02 used the IUD and 01 used pills. Among the 6 women who had irregular bleeding, 4 used the IUD, 2 used implants and 01 used the injectable method. The distribution according to menstrual cycle regularity in the two groups was shown in **Table 2**.

3.3. Ultrasound Data

Uterine and endometrial biometry

Uterine and endometrial measurements in women without contraception were greater than in those using contraception. However, there was no statically significant difference in uterine and endometrial biometry. All women on contraception had vascularisation of zone 1 and no vascularisation of zone 2, with

Table 2. Distribution according to menstrual cycle regularity.

	Contraception			
	With n (%)	Without n (%)	Total n (%)	p-value
Regular	43 (86)	50(100)	93 (93)	
Irregular	7 (14)	0 (0)	7 (7)	0.006
Total	**50 (100)**	**50 (100)**	**100 (100)**	

Table 3. Distribution according to biometry and type of uterine vascularisation.

	Contraception			
	Avec Moy ± Sd	Sans Moy ± Sd	Total Moy ± Sd	p-value
Uterus (in mm)				
Length	84.1 ± 19.2	85.2 ± 16.5	84.6 ± 17.8	0.7722
Width	53.5 ± 14.3	51.3 ± 14.3	52.4 ± 14.3	0.4317
Thickness	35.4 ± 13.5	35.2 ± 11.7	35.3 ± 12.6	0.9386
Endometrium				
Thickness (in mm)	6.2 ± 3.3	7.5 ± 8.4	6.8 ± 6.4	0.2948
Volume (in ml)	4.8 ± 7.9	3.2 ± 1.3	4 ± 5.7	0.1423
Type of vascularisation	**n (%)**	**n (%)**	**n (%)**	0.056
Zone 1	50 (100)	45 (90)	95 (95)	
Zone 2	0 (0)	5 (10)	5(5)	

no significant difference from women not on contraception. The vascularisation of zone 1 indicates that penetration of the uterine artery was limited to the myometrium and did not extend to the endometrium, which is normal (Table 3).

3.4. Spectral Analysis

The PI was greater than 3 in 51% (n = 51) of women, including 62.7% (n = 32) of women without contraception and 37.3% (n = 19) of women on contraception, with a statistically significant difference. The distribution of MSV, MDV, RI and PI according to contraception is shown in Table 4.

3.5. Comparison between Different Contraceptives

The VDM was normal (less or equal to 50 cm/s) in 68% (n = 34) of women on contraception, including 50% (n = 17) on IUDs, with a significant difference in MDV between the different contraceptive methods. We did not find any statistical difference between RI and PI of the different types of contraceptives (Table 5).

Among the 6 women with irregular bleeding, 5 had normal RI and PI (including 4 IUD users and one implant user). Of the women who had secondary

Table 4. Distribution according to spectral analysis.

	Contraception			
	With n (%)	without n (%)	Total n (%)	p-value
MSV				1.00
≤100	20 (40)	20 (40)	40 (40)	
>100	30 (60)	30 (60)	60 (60)	
MDV				0.061
≤50	34 (68)	42 (84)	76 (76)	
>50	16 (32)	8 (16)	24 (24)	
RI				0.5478
≤0.7	25 (50)	28 (56)	53 (53)	
>0.7	25 (50)	22 (44)	47 (47)	
PI				0.0093
≤3	31 (62)	18 (36)	49 (49)	
>3	19 (38)	32 (64)	51 (51)	

MSV: maximum systolic velocity; MDV: Maximum Diastolic Velocity; RI: Resistance Index; PI: Pulsatility Index.

Table 5. Distribution of spectral analysis by contraceptive type.

	Type of contraceptive					
	DIU n (%)	Implants n (%)	Injectables n (%)	Pills n (%)	Total n (%)	p-value
MSV						0.3432
≤100	9 (45)	3 (25)	5 (71.4)	3 (27.3)	20 (40)	
>100	11 (55)	9 (75)	2 (28.6)	8 (72.7)	30 (60)	
MDV						0.021
≤50	17 (85)	610 (50)	6 (85.7)	5 (45.5)	34 (68)	
>50	3 (15)	610 (50)	1 (14.3)	6 (54.5)	16 (32)	
RI						0.7725
≤0.7	8 (40)	7 (58.3)	4 (57.1)	6 (54.5)	25 (50)	
>0.7	12 (60)	5 (41.7)	3 (42.9)	5 (45.5)	25 (50)	
PI						0.0665
≤3	14 (70)	8 (66.7)	4 (57.1)	5 (45.5)	31 (62)	
>3	6 (30)	4 (33.3)	3 (42.9)	6 (54.5)	19 (38)	

non-pregnant amenorrhea, RI and PI were normal in users of implants, pills and injectables. On the opposite, RI and PI were high in IUD users and one pill users.

4. Discussion

Using contraceptives methods is a guarantee of safe motherhood. It is a preventive measure against unwanted pregnancies and closely-spaced pregnancies. According to the World Health Organization, they can reduce avoidable deaths by 30% among mothers and 10% among children [1]. Hormonal contraception is the most widely used in the world. However, the copper intrauterine device (IUD) was the most represented contraceptive method used in Group 1. It consists of a flexible, T-shaped, copper-coated plastic rod that is placed in the uterine cavity. It contains no hormone [1] [2].

Thanks to the repositioning of family planning through postpartum family planning, in particular the postpartum intrauterine device, this method has seen a resurgence in use. It has also made it possible to reduce unmet needs [6]. The reproductive health law in Togo has made it possible on the one hand to have subsidized contraceptive products available, and has also given women a free choice of contraceptive methods [7]. However, this free access to contraceptive methods is interpreted by some as a means of making women infertile. According to DARE *et al.* in 2018 found that the woman's residence, religion, age and especially her marital status influence the use of modern contraception in Togo [8] [9] [10]. The different contraceptive methods have side effects known to the client in order to make an informed choice. Thus, the copper IUD would cause a local inflammatory reaction. As for hormonal contraceptives, being endocrine disruptors, after their cessation, they are responsible for the subfertility of women by acting on their menstrual cycles [1] [2] [11] [12].

Given individual anatomical variability, knowledge of uterine biometry and Doppler indices prior to the adoption of modern contraceptives would allow a better assessment of their influence. However, we used a control group which enabled us to carry out statistical tests.

4.1. Uterine Biometry

The mean age of the women in both groups was 28.2 ± 5.5 years, with extremes of 18 and 40 years, which correspond to adult age. The dimensions of the uterus in both groups were consistent with adulthood. The thickness of the endometrium varied according to the phase of the menstrual cycle (ranging from 3 mm at the start of menstruation to 15 mm in the luteal phase) as well as the use of hormones [1] [11] [12]. Contraceptives In our study, women on contraception had a thinner endometrium (mean endometrial thickness = 6.2 + 3.3 mm) than those not using contraception (mean endometrial thickness = 7.5 + 8.4 mm) with no significant difference. Hormonal contraceptives cause atrophy of the endometrium, thereby reducing its thickness. The endometrial atrophy is responsible for intermittent or irregular bleeding [11].

The absence of a statistical link may be linked to the sample mainly represented by IUD users (40%). In fact, the copper IUD causes local inflammation of the endometrium without any significant change in endometrial thickness [1] [2].

The thickness of the endometrium of women using contraception in our study is close to that of the study by Attia *et al.* in Egypt. The study found an average thickness of the endometrium of 5.700.36 mm and 6.39 1.00 mm respectively in women under contraception and among women without contraception. Pellizzari *et al.* in Italy [13] had also revealed that the thickness of the endometrium in patients with estrogenic amenorrhea (2.76 ± 0.94 mm) was significantly lower (p = 0.001) than that of the control group (5.43 ± 2.2 mm). Secondary non-pregnancy amenorrhea could be due to a reduction in subendometrial flow, as observed in the majority of the participants. Attia's study also showed that there was a significant difference between the thickness of the endometrium of women without metrorrhagia and women with metrorrhagia [14]. The uterus is sensitive to hormonal variations. Ovarian steroids (Estrogen and progesterone) are active on the vascular system. Hormonal variations during the cycle cause morphological changes in the uterus which are visible on ultrasound. Hormonal treatments modify the appearance of the endometrium, myometrium, and appendages. The performance and interpretation of radiological examinations must therefore be done with knowledge of the hormonal status, in order to optimize their performance [15].

4.2. Spectral Analysis

The uterine artery supplies the uterus and the medial two-thirds of the fallopian tube. The uterine artery is the main source of blood supply to the myometrium. Doppler allows blood flow conditions to be analyzed (flow quality) while ultrasound allows structures and vessels to be visualized. Uterine Doppler would reflect endometrial well-being [5] [16]. Thus, the decrease in IP and IR expresses a drop in resistance to the flow of blood flow [4]. Women with unexplained infertility have increased uterine artery Doppler (PI = 2.8 ± 0.61 et RI = 0.8 ± 0.08) and reduced endometrial perfusion compared with fertile controls [17].

Our study found an increase in systolic, diastolic speeds, and resistance indexes within the group of women on contraception compared to women without contraception, with no significant difference between the two groups. According to Bastianelli's study [18], there is no relationship between the IR and the PI of women before and after contraception for women whose menstrual cycle has remained normal or in amenorrhea. On the other hand, in cases of metrorrhagia, Bastianelli noted a relationship between the IR and the PI of women before and after contraception [18]. Mutlu *et al.* also came to a similar conclusion [19].

Within group 1, we found a statistically significant difference in MDV between the different methods of contraception. Thus, women who used the copper IUD had a high MSV and low MDV. On the other hand, we did not note any statistical link between MSV, RI and PI. According to literature data, there is a very significant association between endometrial thickness and Doppler indices (RI and PI) of the uterine artery with menorrhagia. Menorrhagia is induced by the IUD before the insertion and after three and six months after insertion of the copper IUD. The menorrhagia is induced by the IUD before the insertion and after three and

six months after insertion of the copper IUD. [20] [21] [22] [23]. PI and RI would be predictive of bleeding in women using contraception. In our study, few women presented with metrorrhagia (7/50). These metrorrhagias were found in women who used the IUD, implants and injectables. When using the IUD, the incidence of abnormal bleeding decreases after 6 months [24] [25]. Pre-insertion uterine artery Doppler indices may predict intrauterine contraceptive device-related heavy menstrual bleeding [22] [23]. Metrorrhagia occurred in women on contraception whose RI was close to 1 and the PI was above 2 [19]. In our study, abnormal bleeding was found in women with RI ≤ 0.7 and a PI ≤ 3 (normal RI and PI). Attia *et al.* also found abnormal bleeding in women with normal RI and PI. Thus, RETZ found that abnormal bleeding was significantly correlated with a PI of 1.35 and RI 0.62 [22] [23].

While we confirmed what was already reported on the effect of the LNG-IUS on endometrial thickness. We also found a significant alteration in uterine artery blood flow, as evidenced by the RI and PI variability, but only in women with prolonged bleeding. This can be a function of varying local effect of the system [18]. Agrawal therefore recommends that initial measurement of uterine artery Doppler indices (PI and RI) before IUCD insertion could be useful in predicting IUCD-induced abnormal uterine bleeding, which is the major cause of withdrawal during the first year of use. Accordingly, women could be counseled to consider another method of contraception. [21]. In order to prevent metrorrhagia in women who wish to use a contraceptive method, performing a Doppler of the uterine artery before contraception and during the contraceptive period will make it possible to detect significant changes [24] [25] [26] [27].

Secondary non-pregnancy amenorrhea affected 22% of patients, (n = 11), nearly three-quarters of whom used progestins. These women had a PI > 3. The significant reduction in blood flow observed in hypoestrogenic amenorrhoea suggests that estrogens play an important role in regulating both uterine and ovarian blood flow [14]. Women with unexplained infertility have increased uterine artery Doppler PI and RI and reduced endometrial-sub endometrial perfusion compared with fertile controls [17].

5. Conclusions

Women using contraception showed a reduction in the average endometrial thickness without a significant difference compared to women without contraception. The mean systolic velocity (MSV) and resistance index (RI) of women using contraception were high, with no significant difference from those of women without contraception. The elevation of the pulsatility index (PI) and the mean diastolic velocity (MDV) of women on contraception had a significant difference with those of women without contraception. These data can be used to reassure users of contraceptive methods in order to promote the continuity of these methods.

Given the advantages of Doppler ultrasound (low cost, safety and portable), it

would be important to continue this work which could be multicenter, with a large sample in order to obtain much more representative results.

Conflicts of Interest

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

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