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ORIGINAL ARTICLE

Doppler Study of Uterine and Ovarian Arteries in Predication of Post Insertion Heavy Menstrual Bleeding in IUCD Patients

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Abstract

Background: **Worldwide, intrauterine contraceptive devices (IUCDs) are widely utilized. Uterine hemorrhage and/or period pain are copper IUD side effects. Resistance index (RI) and pulsatility index (PI) did not change significantly following copper-medicated IUD insertion (PI). Power Doppler investigation showed that the copper-IUD affected sub endometrial microvascularization in side-effect patients (dysmenorrhea or menorrhagia). Doppler assessment of blood flow indicators before insertion can identify women prone to menorrhagia or menstrual pain.**

Aim: **To evaluate resistance index of the uterine and ovarian arteries as well as power Doppler energy of sub-endometrial microvascularization, before and three months after insertion of IUCD, using vaginal pulsed and color Doppler ultrasonography.**

Subjects and methods: **This study was performed at Al-Hussein and Sayed Galal Hospitals, and El-Sheikh Zayed Specialized Hospital Al-Azhar University. Sixty women were selected to enter this study.**

Results: **The research population's initial subendometrial RI values varied from 0.62 to 0.78, while post-insertion subendometrial RI values ranged from 0.61 to 0.82. The study population's initial uterine artery RI ranged from 0.66 to 0.86, whereas the population's post-insertion uterine artery RI ranged from 0.63 to 0.83. Most patients suffer from Sub-endometrial Vascular RI Δ Percentage of (<10%) in the study population. Most patients suffer from bleeding according to IUCD-related Side Effects.**

Conclusion: **The findings of this study imply that women with IUCD-induced menorrhagia had increased uterine blood flow. You can employ endometrial, ovarian, and sub-endometrial Doppler vascular indices to predict severe monthly bleeding brought on by IUCD.**

Keywords: Doppler study, Intrauterine device, Ovarian arteries, Uterine arteries

1. Introduction

A widely popular technique of family planning used all over the world is an intrauterine device (IUCD), however to our knowledge, very few research have been done to assess its potential effects on the pelvic artery's blood flow. There is probably a link between the negative effects of intrauterine devices (IUDs) and uterine vascularization.[1]

These vascular changes may have a role in the pathophysiology of several side symptoms associated with IUD users, making them potentially useful as predictors in clinical practise because they are the primary cause of IUD removal **(Cox** et al., **2002).**

Uterine haemorrhage and/or period pain are the most significant side effects associated with copper intrauterine devices (IUDs).[2]

Resistance index (RI) and pulsatility index showed that the copper-medicated IUD did not appreciably change the uterine artery or ovarian blood flow (PI).[4] Color Doppler studies on patients with

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primary dysmenorrhea revealed increased blood flow resistance in the uterus (Sen et al., 2020). Other studies found an increase in menstrual discomfort but no change in uterine artery PI during menstruation following IUD installation. This may be a symptom of uterine microvascular dysfunction, which increases these patients' risk of adverse IUD consequences (Jarvela et al., 2000). By using power Doppler analysis, it was demonstrated that the copper-IUD changed the subendometrial microvascularization in individuals who complained of side symptoms (dysmenorrhea or menorrhagia).[3]

Therefore Doppler measurement of blood flow indices before insertion may be used for patient selection to identify women who are prone to develop menorrhagia or menstrual pain.

The aim of the work was to evaluate resistance index of the uterine and ovarian arteries as well as power Doppler energy of subendometrial microvascularization, before and three months after insertion of IUCD, using vaginal pulsed and color Doppler ultrasonography.

2. Patients and methods

This prospective observational study was performed at Al-Hussein and Sayed Galal Hospitals, and El-Sheikh Zayed Specialized Hospital Al-Azhar University.

2.1. Participants

Sixty women was selected to enter this study keeping in mind inclusion and exclusion criteria. Before and three months after the TCu 380 A IUD was implanted, Doppler blood flow measurements of the uterine, ovarian, and subendometrial microvascularization were performed on each study participant. In this study, we looked at how the TCu 380 A IUD affected the uterine and ovarian arteries' Doppler indices both before and after insertion. We also examined the key concerns related to IUD adverse effects, such as the severity of menstrual bleeding, the grades of dysmenorrhea, and the different types of subendometrial vascularization. Patients must have regular cycles (28–32 days), not be lactating, be under 40 years old, have no adnexal, uterine, or endocrine abnormalities or cardiovascular diseases, and have a normal pap smear before to administration (No douching for at least 24 h before examination, no menstruation, speculum is placed in vagina after it has been lubricated with water only, a plastic or wooden spatula is applied to cervix and rotated 360°, specimen is applied on slide and fixed with alcohol and send to laboratory).

2.2. Exclusion criteria

Pregnant women, lactating, nulligravida, acute and chronic PID, cervicitis, genital tumor, copper allergy, abnormalities of blood clotting, severe dysmenorrhea, thick endometrium, previous IUCD removed at least 3 months before, no OCPs or any kind of hormonal medications in last 3 months before the study and use of non-steroidal anti-inflammatory drugs within 24 h of examination, dysplasia of the cervix.

2.3. Study procedures

Doppler examination was performed at day 24 of cycle. To prevent changing the impedance of the arteries, all patients would have empty bladders. The same observer would use the same tools to conduct the Doppler evaluation, to avoid inter-observer, inter-ultrasound transducer. Doppler study for uterine and ovarian arteries was done on both sides, whereas three waves was examined and the mean value was considered for analysis.

Details of the methodology A thorough medical history was taken, including information on contraception, reproductive history, menstrual pattern, length and intensity of monthly discomfort, need for medical attention, capacity to function during menstruation, smoking, etc. General and gynecological examination was be done to look for height, weight and any evidence of medical or gynecological diseases. Endovaginal B mode pelvic sonography assessment was done for the selected patients to be sure that inclusion and exclusion criteria was considered. All women enrolled in our study was examined in day 20–24 of cycle before and after insertion of TCu 380 A IUD. The IUCD was applied according to standard methods of application.

The ultrasound equipment used was a GE logiq P7 E8C-RS [3.6–10 MHz] transvaginal transducer.

Endovaginal sonography was done immediately after application to be sure of correct placement. Then pulsed color flow Doppler was applied. At the internal os, cervico-uterine junction of the cervix, On both sides of the transverse scan, the uterine artery was discovered. Real-time imaging and pulsed transvaginal Doppler blood flow evaluation with a 5–10 MHz are employed to measure the uterine artery blood flow indices on both sides. S-D/S, where S is the maximum (systolic) and D is the minimum (diastolic) Doppler frequency shift, is used to measure the resistance index. For each artery, three waves were analysed, and the mean value was used for analysis. On both sides, ovarian arteries were visible. It is located as a sizable vessel at the ovarian hilum, close to the infundibulopelvic ligament, situated laterally to the upper pole of the ovary. The stromal vessels of the ovary are recognised by colour signals present in the ovarian stroma of both ovaries. Three waves were analysed for each artery after the detection of blood flow and examining the ovarian artery waveform, and the mean value was taken into consideration for analysis., whereas RI was calculated. The setting for power Doppler energy (PDE) sonography for examining subendometrial vascularization indices was standardized for the highest sensitivity in the absence of apparent noise using a high pass filter at 50 Hz, pulse repetition frequency at 750 Hz, and moderate long persistence.

2.4. Primary outcome

To evaluate resistance index of the uterine and ovarian arteries as well as power Doppler energy of subendometrial microvasculization, before and three months after insertion of TCu 380 A IUD, using vaginal pulsed and color Doppler ultrasonography. To investigate whether findings could predict potential side effects, such as abnormal heavy bleeding and/or dysmenorrheal which may happen after TCu 380 A insertion, a step that may be used for potential selection of Cu IUCD users who could not be prone to develop such side effects.

2.5. Statistical analysis

Using SPSS 26.0 for Windows, all data were gathered, tabulated, and statistically examined (SPSS Inc., Chicago, IL, USA). Difference between parametric variables of two related groups was analyzed using paired student's t-test. Difference between two unrelated groups was analyzed using independent student's t-test (for parametric variables), Mann–Whitney's U-test (for numeric nonparametric variables), or chi-squared test as well as odds ratio and its 95% confidence interval (for categorical variables). Binary logistic regression analysis was performed for estimating the association between adverse effects and measured variables, the results was expressed in terms of odds ratios and their 95% confidence intervals. Significance level was set at 0.05. When predicting menorrhagia in female patients using IUCD, Analysis of the receiver-operating characteristic (ROC) curve was used to evaluate the effectiveness of ultrasonic indices. In order to compare the areas under distinct ROC curves, the DeLong approach was utilised.

3. Results

Table 1 showed Demographic characteristics among the study population. Age in the study population ranged from 23.6 to 36.4 with mean ± SD = 30 ± 3.2.

Table 2 showed Initial and Post-Insertion Endometrial Thickness among the study population. INITIAL Endometrial Thickness in the study population ranged from 9 to 12 with mean ± SD = 11 ± 0.8. Post-Insertion Endometrial Thickness in the study population ranged from 10 to 14 with mean ± SD = 12 ± 1.2.

Table 3 showed Initial and Post-Insertion Subendometrial RI among the study population. INITIAL Subendometrial RI in the study population ranged from 0.62 to 0.78 with mean ± SD = 0.7 ± 0.04. Post-Insertion Subendometrial RI in the study population ranged from 0.61 to 0.82 with mean ± SD = 0.72 ± 0.05.

Table 4 showed Initial and Post-Insertion Uterine Artery RI among the study population. INITIAL Uterine Artery RI in the study population ranged from 0.66 to 0.86 with mean ± SD = 0.76 ± 0.05. Post-Insertion Uterine Artery RI in the study population ranged from 0.63 to 0.83 with mean ± SD = 0.73 ± 0.05.

Table 5 showed Initial and Post-Insertion Ovarian Artery RI among the study population. INITIAL Ovarian Artery RI in the study population ranged from 0.58 to 0.82 with mean ± SD = 0.7 ± 0.06. Post-Insertion Ovarian Artery RI in the study population ranged from 0.57 to 0.81 with mean ± SD = 0.69 ± 0.06.

Table 6 showed Subendometrial Vascular RI Δ Percentage among the study population. Number of patients with Sub-endometrial Vascular RI Δ Percentage of (<10%) in the study population was 28 (46.67%). Number of patients with Sub-endometrial Vascular RI Δ Percentage of (<25%) in the study population was 17 (28%) (Fig. 1).

The number of patients with pain as IUCD-related side effect in the study population was 5 (8%). Number of patients with Bleeding as a IUCD-related side effect in the study population was 10 (17%). Number of patients with pain and bleeding

Table 1. Demographic characteristics among the study population.

	Study population (n = 60)
Age (years)	
Mean ± SD.	30 ± 3.2
Median (IQR)	30 (27.84–32.16)
Range (Min–Max)	12.8 (23.6–36.4)

IQR, interquartile range; **SD**, standard deviation.

Table 2. Initial and post-insertion endometrial thickness among the study population.

	Study population (n = 60)
Initial Endometrial Thickness (mm)	
Mean ± SD.	11.1 ± 0.8
Median (IQR)	11 (10.46−11.54)
Range (Min-Max)	3.2 (9−12)
Post-Insertion Endometrial Thickness (mm)	
Mean ± SD.	12.2 ± 1.2
Median (IQR)	12 (11.19−12.81)
Range (Min−Max)	4.8 (10−14)
Endometrial Thickness (mm) mean paired difference	
Mean difference	0.1

IQR, interquartile range; **SD**, standard deviation.

Table 3. Initial and Post-Insertion Subendometrial RI among the study population.

	Study population (n = 60)
Initial Subendometrial RI	
Mean ± SD.	0.7 ± 0.04
Median (IQR)	0.8 (0.67−0.73)
Range (Min-Max)	0.16 (0.62−0.78)
Post-Insertion Subendometrial RI	
Mean ± SD.	0.72 ± 0.05
Median (IQR)	0.69 (0.68−0.75)
Range (Min−Max)	0.22 (0.61−0.82)
Subendometrial RI mean paired difference	
Mean difference	0.02

IQR, interquartile range; **SD**, standard deviation.

as IUCD-related side effects in the study population was 2 (3%). The number of patients with severe pain and/or bleeding as IUCD-related side effects in the study population was 1 (2%).

4. Discussion

Menorrhagia in people with IUDs may be caused by a number of different factors. According to one of these hypotheses, the endometrium's increased synthesis of prostaglandins increases vascularity and vascular permeability, inhibits platelet function, and so increases menstrual bleeding.[4]

Table 4. Initial and post-insertion uterine artery RI among the study population.

	Study population (n = 60)
Initial Uterine Artery RI	
Mean ± SD.	0.76 ± 0.05
Median (IQR)	0.72 (0.72−0.79)
Range (Min-Max)	0.2 (0.66−0.86)
Post-Insertion Midluteal Uterine Artery RI	
Mean ± SD.	0.73 ± 0.05
Median (IQR)	0.71 (0.69−0.77)
Range (Min-Max)	0.21 (0.63−0.83)
Midluteal Uterine Artery RI mean paired difference	
Mean difference	0.01

IQR, interquartile range; **SD**, standard deviation.

Table 5. Initial and post-insertion ovarian Artery RI among the study population.

	Study population (n = 60)
Initial Ovarian Artery RI	
Mean ± SD.	0.7 ± 0.06
Median (IQR)	0.71 (0.66−0.74)
Range (Min-Max)	0.24 (0.58−0.82)
Post-Insertion Midluteal Ovarian Artery RI	
Mean ± SD.	0.69 ± 0.06
Median (IQR)	0.68 (0.65−0.73)
Range (Min-Max)	0.24 (0.57−0.81)
Midluteal Ovarian Artery RI mean paired difference	
Mean difference	0.01

IQR, interquartile range; **SD**, standard deviation.

Table 6. Subendometrial vascular RI Δ percentage among the study population.

	Study population (n = 60) n (%)
Subendometrial Vascular RI Δ Percentage	
I (< 10%) n (%)	28 (47%)
II (< 25%) n (%)	17 (28%)
III (< 50%) n (%)	15 (25%)
IV (< 75%) n (%)	0 (0%)
V (100%) n (%)	0 (0%)

This prospective observational study was performed at Al-Hussein and Sayed Galal Hospitals, and El-Sheikh Zayed Specialized Hospital Al-Azhar University. Sixty women were selected to enter this study keeping in mind inclusion and exclusion criteria. The duration of the study ranged from 6 to 12 months.

Regarding baseline characteristics of the analysed group, the study population's age varied from 23.6 to 36.4, with a mean standard deviation = 30 3.2.

With regard to weight, the study population's parity ranged from 1 to 3, with a mean SD = 2.0.4.

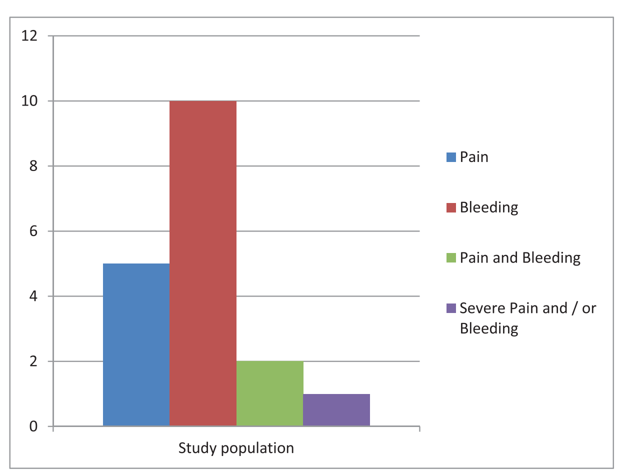

Fig. 1. Bar chart showing study population data regarding IUCD-related Side Effects.

The study population's weight ranged from 62 to 114 pounds, with a mean and standard deviation of 88 13. Regarding the study population's BMI measurements. With a mean and standard deviation of 32.5 and 4.75, the research population's BMI ranged from 23 to 42. While 110 women were included in the study of Sweed et al., just 9 of the 158 women who were evaluated for eligibility did so. Women's median parity was two, mean age was 27.6 3.1 (20–35) years, and mean BMI was 24.2 1.9 kg/m^2 (1–3).

In the study by Attia et al., At three and six months following IUCD implantation, there was no statistically significant difference between the two groups in terms of age or parity. The average age and mean parity of the 10 patients in group 1 who did not complain of menorrhagia were 28.01 and 5.51 (20–40) years, respectively (1–5). Menorrhagia patients in Group 2 were, on average, 28.43 5.86 (20–39) years old, with a mean parity of 2.08 1.02 in this group (1–5). Regarding Initial and Post-Insertion Endometrial Thickness among the study population, the current study demonstrated that. The study population's INITIAL Endometrial Thickness ranged from 9 to 12, with a mean SD of 11 0.8. In the study population, post-insertion endometrial thickness ranged from 10 to 14, with a mean SD of 12 1.2.

Our results were supported by study of **El-Mazny** et al.,[5] Women with IUD-induced menorrhagia (n = 47) and women without menorrhagia (n = 73) did not have substantially different clinical features, endometrial thickness and volume, or Doppler indices before IUD insertion, and there was no difference between the two groups after insertion either.

The current study showed that as regard Initial and Post-Insertion Subendometrial RI among the study population. INITIAL Subendometrial RI in the study population ranged from 0.62 to 0.78 with mean ± SD = 0.7 ± 0.04. Post-Insertion Subendometrial RI in the study population ranged from 0.61 to 0.82 with mean ± SD = 0.72 ± 0.05. Regarding Subendometrial Vascular RI Δ Percentage among the study population.

The number of patients with sub-endometrial vascular RI Δ percentage of (<50%) in the study population was 15 (25%). No patients in the study population had a sub-endometrial vascular RI Δ percentage of (<75%). No patients in the study population had a sub-endometrial vascular RI Δ percentage of (100%).

According to **El-Mazny** et al.,[5] There was no discernible change in the Doppler indices between the women with IUD-induced menorrhagia (n = 47) and those without menorrhagia (n = 73) prior to IUD insertion. But in menorrhagic women, the endometrial and subendometrial vascularization index, flow index, and vascularization flow index all significantly increased following IUD implantation. Also, **Sweed** et al.,[6] demonstrated that 3 months following the insertion of the IUCD, a substantial alteration was seen in the sub-endometrium vascular parameters. Those who later had IUCD-induced menorrhagia had significantly different baseline vascular indices of the sub-endometrium than women who did not. Additionally, When Jiménez et al.,[7] compared the uterine artery PI and RI before IUD insertion during the midluteal phase and 90 days after insertion, they found no appreciable differences in the sub-endometrial vascularization between the 25 patients who received Cu-T380A and the 27 patients who received LNG-IUS. As opposed to, 3 months following the installation of the IUCD, 9 uterine artery markers in the Sweed et al. experiment showed a substantial shift. The baseline vascular indices for all uterine arteries were significantly different in women who later had IUCD-induced menorrhagia compared to those who did not. While Attia et al.[8] showed a significantly significant link between severe menstrual bleeding associated with IUCD insertion and the uterine artery's Doppler indices (RI and PI), both prior to the insertion and three and six months later, When compared to the healthy, non-bleeding group (1) at baseline, three and six months after IUCD implantation, and at the end of the trial, women in group[9] with menorrhagia displayed lower uterine artery PI and RI (P0.05).

In a different study by Mansour et al.,[10] of the women who reported abnormal bleeding related to the use of IUCDs had significantly lower uterine artery PI and RI levels (1.780.33 and 0.680.09) than the women who did not report bleeding (2.280.35 and 0.870.13, respectively). In past investigations of the Doppler uterine artery, conflicting results were discovered. Rezk et al.,[12] showed that neither group with nor without IUCD-related heavy menstrual periods displayed any apparent alterations in the uterine artery Doppler indices three or six months after IUCD implantation (PI and RI). El-Mazny et al. also observed that the Doppler indices for the uterine artery, endometrial volume, PI, and RI did not significantly differ between the two groups. The present study showed that as regard Initial and Post-Insertion Ovarian Artery RI among the study population. INITIAL Ovarian Artery RI in the study population ranged from 0.58 to 0.82 with mean ± SD = 0.7 ± 0.06. Post-Insertion Ovarian Artery RI in the study population ranged from 0.57 to 0.81 with mean ± SD = 0.69 ± 0.06.

Our results were supported by study of **Özbay & Şanlõkan**,[13] as they pointed out that there was no statistically significant difference between patients in groups A and B in terms of the PI and RI value differences between the initial and subsequent measurements of the uterine, arcuate, and utero-ovarian arteries.

Also, in the study of **Shen** et al.,[11] No distinctions between pre- and post-insertion PIs were seen in any of the ovarian blood arteries that were tested (pulsatility indices). About 30−50% of the time, irregular uterine bleeding, pelvic discomfort, and dysmenorrhea are the side effects most frequently linked with IUCD use. In the first year of use, 10%−20% of users ask to have their IUCD removed. Premature cessation has an impact on lots of ladies. IUCDs are implanted in over 40 million women each year. Within the first year of use, 5−15% of people stop using the IUCD because to bleeding or pain. A contraceptive method based on the discharge of spermicidal copper ions is called Cu-T380A. However, the device might cause an inflammatory reaction that makes the uterus hostile.[2]

According to Jiménez et al.[3] 's findings, which are consistent with our own, patients with adverse effects from copper IUDs have increased sub-endometrial vascularization. This suggests that power Doppler analysis may be able to detect certain vascular abnormalities in these individuals' midluteal phases. The most significant copper IUCD-related adverse effect, according to Fouda et al.,[14] is increased menstrual haemorrhage of 30−50%, frequently accompanied by cramps. The amount of menstrual blood may be large enough to result in anaemia from a lack of iron.

4.1. Conclusion

The findings of this study imply that women with IUCD-induced menorrhagia had increased uterine blood flow. You can employ endometrial, ovarian, and sub-endometrial Doppler vascular indices to predict severe monthly bleeding brought on by IUCD.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

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Conflict of interest

No conflicts of interest.

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