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ORIGINAL ARTICLE

Evaluation of Uterine Artery Doppler Indices in Cases of Intrauterine Contraceptive Device Associated Heavy Menstrual Bleeding

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ABSTRACT

Background: Despite the fact that copper IUD family planning has been used for decades globally, many side effects are still being reported, including extensive uterine bleeding. The aim of the study was to use Doppler ultrasonography to predict abnormal uterine bleeding in women after intrauterine contraceptive device (IUCD) insertion. **Methods:** This study was a prospective clinical trial that included women who presented to the Obstetrics and Gynecology department at Zagazig University hospitals and had been using an IUCD. Three groups of 111 women participated in the study: Thirty-seven women in Group I who used the Cu-380A copper intrauterine device have reported menorrhagia or menometrorrhagia. Thirty-seven women in group II are CIUD users who have not reported abnormal uterine bleeding. As a control group, Group III consists of 37 women who did not use CIUD and did not report abnormal uterine bleeding. Every patient had their uterine arteries examined with ultrasound technology, their resistance and pulse indices were measured using the doppler technique. **Results:** Resistance Index (RI) and Pulsatility Index (PI), were substantially lower in group I women than in groups II and III women ($p < 0.001$). The optimal threshold value for menorrhagia prediction in IUCD women using uterine artery (UA) RI was less than 0.77. This had 83.02% specificity and 94.34% sensitivity. A (UA PI) of less than 2.06 was the best cutoff value for predicting menorrhagia in women with IUCD. **Conclusions**: Uterine artery doppler indices can be used in prediction of menorrhagia for proper patient selection for IUCD insertion.

Keywords: Uterine artery doppler indices, IUCD, Menstrual bleeding.

INTRODUCTION

Copper is the most often used long-acting reversible contraception as an intrauterine contraceptive device (IUCD) worldwide [1].

Up to 30% of women endure severe monthly bleeding throughout their reproductive lifetimes, and menstrual issues make for a significant share of medical visits among fertile women [2].

Abnormal uterine bleeding (AUB) is defined as any deviation from the regular menstrual cycle, which might include changes in the frequency and regularity of menstruation, the length of the flow, or the volume of blood lost [3].

The most serious side effect of copper IUCD is an increase in menstrual bleeding of 30 to 50%, which is commonly accompanied by cramping. Menstrual blood can be so plentiful that iron deficiency anemia develops [4]. Because of these changes, the removal rate within the first year after IUCD insertion was 4-15% [5].

It is still unknown how the copper IUCD affects uterine hemodynamics, which has significance for the pathophysiology of the illness, generated an abnormally heavy menstrual flow [6]. Using three-dimensional (3D) doppler analysis, researchers discovered that women with IUCD-induced heavy menstrual bleeding had increased sub-endometrial vascularization. A power doppler can be used to examine vascularization within a specific volume of interest [7].The present study aimed at using color doppler ultrasonography in prediction of abnormal uterine bleeding in women after IUD insertion.

Methods

This prospective clinical study was conducted at the Obstetrics and Gynecology department of Zagazig University hospitals from January 2022 to December 2022. The study was authorized by our local ethics commission (IRB # 9072-2-11-2021). Consent was obtained in writing, informed by each participant. The protocol for the study complied with the Helsinki Declaration (1975), which is the World Medical Association's guideline of ethics for research involving human subjects.

Inclusion criteria: Regularly menstruating women before CIUD insertion,age between 20 and 35 years,hormonal treatment should notbe taken at least 2 months before the study andnon-steroidal anti-inflammatory shouldnot be taken 24 hours before the examination. **Exclusion Criteria:**pregnancy, nulligravida, present or history of pelvic inflammatory disease, other causes of abnormal uterine bleeding such as adenomyosis and the presence of pelvic pathology as ovarian cysts, pelvic endometriosis, endometrial polyps and uterine fibroids or medicated IUD.

Every woman participated in the study was requested to provide a detailed medical history, both before and after the IUCD was adjusted, including the duration of the cycle and its regularity, the number of napkins used per cycle, the existence of intermenstrual spotting, and the presence of pelvic pain. contraceptive history, including duration of IUCD use, timing of IUCD insertion, and preceding contraceptive techniques utilized. Vaginal examination (including speculum examination) to look for IUD threads and rule out any local or general causes of irregular bleeding or pelvic pain (such as polyps and erosion). Routine tests included blood type, full blood count, random blood sugar, and Rh factor.

The study involved 111 women divided into three groups;Thirty-seven women using copper IUDs (TCu-380A) and complaining of menorrhagia or menometrorrhagia make up group I (TCu-380A). Group II consists of thirty-seven women who use CIUD but do not experience abnormal uterine bleeding. As a control group, group III includes thirty-seven women who do not use CIUD and do not have abnormal uterine bleeding.

Ultrasound examination:

After instructing the patient to empty their bladder, each of the ladies was subjected to a transvaginal ultrasound. The ultrasonic equipment used was a 7.5 MHz transvaginal transducer with color doppler capability (MindrayDC-70Exp).

The IUCD was detected due to its echogenicity in comparison to the normal endometrium. An IUCD's sonographic appearance is determined by its shape and composition. Plastic and metal (copper) are the materials utilized to construct intrauterine contraceptive devices. When the IUCD is parallel to the ultrasonic beam, the metal generates a "reverberation artifact" in the shape of a series of parallel lines that weaken

posteriorly. Two parallel lines made of plastic tubing represent a shadow for an entry and an exit. A properly placed IUCD is halfway along the endometrial canal, exactly midway between the uterine boundaries[8].

Once the IUCD was discovered inside the uterus, the myometrium was measured from the top of the vertical arm of the instrument to the endomyometrial junction (IUCD myometrium). The uterine artery is found as it ascends cranially to reach the uterine body, and a transvaginal probe is advanced to view the paracervical vascular plexus laterally while doppler color is triggered[8].

The uterine artery is identified as it turns cranially to make its ascent to the uterine body measurements are taken at this point, before the uterine artery branches into the arcuate arteries.The operation is repeated on the contralateral side. The arcuate arteries, as well as the artery that connects the cephalad to the cervicovaginal to the caudad, should not be sonated. Uterine arteries often travel at speeds more than 50cm/s, which can be used to distinguish this channel from arcuate arteries [9].

The Resistance Index (RI) and Pulsatility Index (PI), which measure blood flow in the uterus, are averaged by determining the greatest frequency of doppler shift that occurs during a heartbeat. The average PI and RI Three waveforms of the left and right uterine arteries were recorded for statistical analysis **(figure 1,2).**

Statistical analysis:

Data were entered checked and analyzed using Epi-Info version 6 and SPP for Windows version 2020. The threshold of significance is fixed at 5% level (p-value).

RESULTS

Table 1; showed that there was no significant difference between patients in three study groups regarding age, parity, and body mass index (BMI) of the studied groups.

Table 2; showed that there were no statistically significant differences between groups concerning uterus dimensions and endometrial thickness measure by transvaginal sonography (TVS).

Table 3; showed that RI and PI were significantly lower in women of group I than in women of groups II and III ($p < 0.001$).

Area under the curve (AUC) = 0.975 (95% CI 0.924 to 0.996). Best cutoff point is PI of <2.06. This has a sensitivity of 90.57% and specificity of 94.34%.Area under the curve (AUC) = 0.942 (95% CI, 0.879 to 0.978). Best cutoff point of RI is <0.77. This has a sensitivity of 94.34% and specificity of 83.02% (**figure 3).**

Best cutoff point is RI of ≤ 0.077 and PI ≤ 2.06 this has a sensitivity of 94.34% and specificity of 83.02% (**table 4)**.

Table (1): Demographic data of the studied cases.

		Group I (n = 37)		Group II (n = 37)		Group III (n = 37)		Chi-square test	
		No.	%	No.	%	No.	%	X^2	P-value
Age(years)	25 - 35	29	78.3%	30	81.08%	31	83.7%	1.071	0.585
	35 - 40	8	21.7%	7	12.92%	6	16.3%		
Parity	P1	20	54.05%	17	45.9%	18	48.64%	10.204	0.116
	P2	8	21.62%	10	27.02%	9	24.32%		
	P3	7	18.91%	6	16.20%	8	21.62%		
	P4	2	5.40%	3	8.10%	1	1.70%		
	P5	0	0.0%	1	2.70%	1	1.70%		
BMI (kg/m2)		Group I (n = 37)		Group II (n = 37)		Group III (n = 37)		F	p
Mean ± SD.		23.70 ± 3.65		24.75 ± 3.58		24.15 ± 3.58		0.085	0.467 N.S.

Data are presented as ratio or number (%). p> 0.05 (non-significant difference)

Table (2): Difference between the studied groups concerning uterus dimensions and endometrial thickness measured by transvaginal sonography (TVS) (analysis using one-way anova test)

	Group I (n = 37)	Group II (n = 37)	Group III (n = 37)	F	p
Uterus length (mm) (Mean ± SD)	76.4 ± 9.6	81.7 ± 14.1	82.6 ± 12.6	1.49	0.23 (NS)
Width (mm) (Mean ± SD)	48.5 ± 13.8	49.1 ± 12.7	46.9 ±11.68	0.15	0.85(NS)
Endometrial thickness (mm) (Mean ± SD)	8.1 ± 1.1	7.9 ± 1.6	7.6 ± 2	0.48	0.61(NS)

Table (3): Comparison between the RI and PI of the women of the three groups

RI	Group I (n = 37)	Group II (n = 37)	Group III (n = 37)	F	p
Mean ± SD	0.69 ± 0.07	0.79 ± 0.1	0.82 ± 0.12	15.69	< 0.001 (HS)
Range	0.59-0.8	0.6-0.89	0.61-0.9		
PI					
Mean ± SD	1.9 ± 0.05	2.2 ± 0.269	2.3 ± 0.25	13.7	< 0.001 (HS)
Range	1.65-2.42	1.87-2.63	1.89-2.65		

PI: Pulsatility index, RI: Resistance index

Table (4): Show ultrasonic indices with highly suggestive value in cases of menorrhagia after IUD insertion.

Variable	Cut-off point	Sensitivity	Specificity	PPV	NPV
Average uterine artery PI	≤ 2.06	90.57	94.34	94.1	90.0
Average uterine artery RI	≤ 0.77	94.34	83.02	82.3	98.7

PPV: Positive predictive value
NPV: Negative predictive value

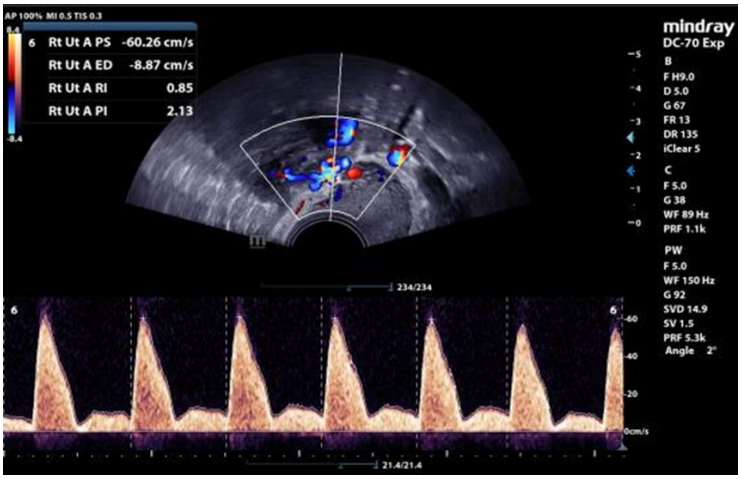

Figure 1: Doppler of uterine artery (RI :0.85, PI:2.13)

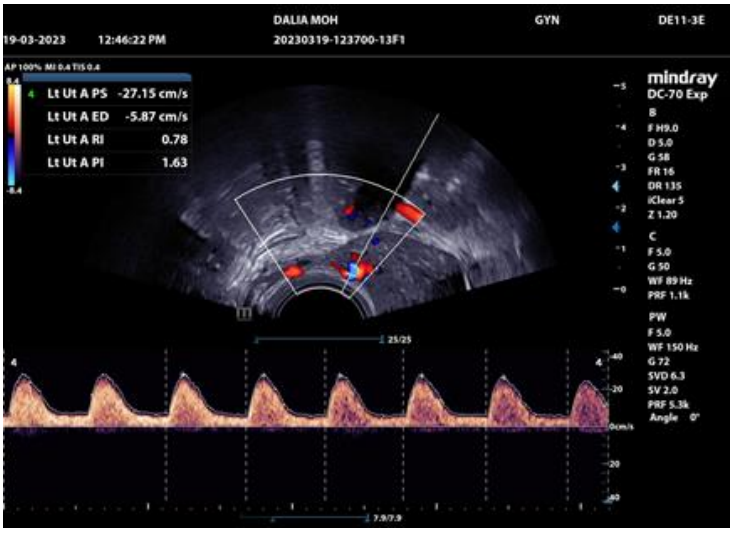

Figure 2: Doppler of uterine artery (RI :074, PI:1.41)

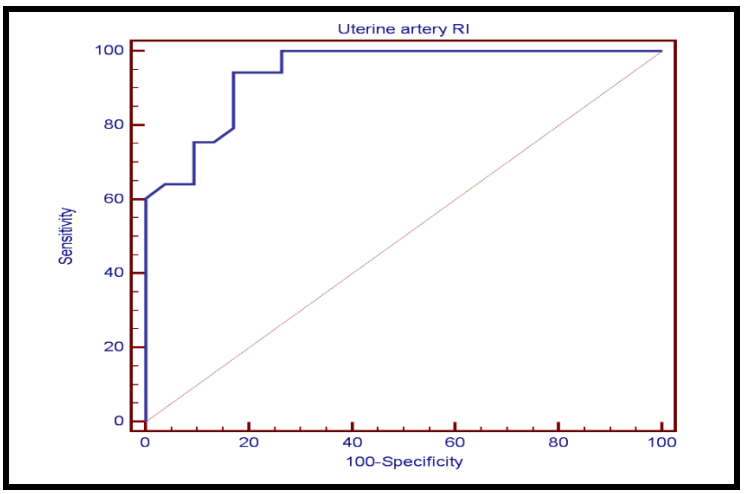

Figure (3): Receiver-operating characteristic (ROC) curve for prediction of menorrhagia in women with IUCD using UA RI.Area under the curve (AUC) = 0.942 (95% CI, 0.879 to 0.978). Best cutoff point of RI is <0.77. This has a sensitivity of 94.34% and specificity of 83.02%.

DISCUSSION

There were no significant differences in age between the three groups of patients, regardless of BMI or length of IUCD administration. Strict inclusion criteria revealed no differences in demographic

features between women suffering from menorrhagia as a result of an IUD and those who did not.Our findings support the claim made by **Fouda et al.**that the patients' age, parity, and body mass index (BMI) did not differ significantly between the three groups [4].

Furthermore, there were no statistically significant differences between the groups in terms of uterine dimensions and transvaginal sonography (TVS)-measured endometrial thickness in this experiment. Our findings are consistent also with those of **Şahin et al.** who discovered no association between the number of days of bleeding, spot or endometrial thickness while using the levonorgestrel IUD [10].

The current study found that, in comparison to women in group II, women in group I who experienced menorrhagia had significantly smaller uterine artery diameters than women in group III (the control group), who did not report abnormal uterine bleeding and were wearing copper IUDs Resistance Index (RI) and Pulsatility Index (PI).

Furthermore, the findings of the study revealed that there were no statistically significant differences in the PI and RI of the uterine arteries between females who used copper IUDs and did not report atypical uterine hemorrhage, as well as females who used copper-free control group IUDs.

When comparing the current findings to those of previous research, **El-Mazny et al.**evaluated the uterine arteries' PI and RI in 120 women three months before and after the copper IUD was inserted, and the results revealed no discernible differences between the two [11].

The current study was a prospective study that looked at uterine artery doppler in specific patient groups after IUD placement, whereas the other two were cross-sectional studies that looked at uterine artery doppler before and after copper IUD insertion.

In agreement with the current study's findings **Foudaet al.**93 based on the PI and RI of their uterine arteries, women were divided into three groups: group I included 32 women who reported menorrhagia, group II included 30 women who had CIUD but did not report abnormal uterine bleeding, and group III was the control group [12]. Thirty-one females were CIUD-free. When group I was compared to groups II and III, the uterine artery PI and RI were significantly lower in group I. However, the PI and RI did not find any statistically difference between the women in groups II and III.

In contrast to the findings of this investigation, **Yigitet al.**examined the uterine arteries on both sides of 100 individuals before and after the copper IUD was placed; there were no statistically significant differences in these values [13].

A lot of explanations have been proposed as to how the IUD produces bleeding. One of the most widely accepted theoriesis that menorrhagia develops as a result of a localized inflammatory response in vascularized areas and increased prostaglandin synthesis in endometrial changes.

Xin et al.observed that after the IUCD was implanted, there was an increase in prostaglandin production in the endometrium due to overexpression of the COX-2 enzyme's mRNA and protein [14].

Other vasoactive molecules, such as the vascular endothelial-produced strong vasodilator nitric oxide (NO), could potentially be at work. NO is found in the human myometrium and endometrium. NO appears to contribute to both acute and

chronic inflammation [15].

In the second case (RI), we obtained a ROC area of 0.804 and picked 0.7 as the cutoff point; the value of the area indicated the accuracy of the test. PI has a delicate 84.4% and a specificity of 83.3%. When it comes to identifying CIUD-afflicted women who report atypical uterine bleeding, RI has a sensitivity of 78.1% and a specificity of 80%. As a result, women who are at risk of irregular bleeding after receiving a CIUD can be diagnosed using transvaginal color doppler.

In the current study, using receiver operating characteristic (ROC) curves, the ideal uterine artery cutoff doppler indices to identify between women who take IUCD and have regular monthly bleeding and those who have irregular uterine bleeding due by IUCD were discovered. The ROC curves using IUCD utilizing UA RI demonstrate that the optimal threshold for menorrhagia prediction in women is 0.77. The sensitivity is 94.34% and the specificity is 83.02%. 2.06 is the best cutoff value for predicting women's menorrhagia with IUCD using UA PI. The sensitivity is 90.57% and the specificity is 94.34%.

In agreement with Fouda et al. using the ROC curves for PI and RI to choose the cutoff values for discriminating between women using CIUD and complaining of menorrhagia or menometrorrhagia and women using CIUD who were not complaining of abnormal uterine bleeding. (PI) he chose 2.07 as the cutoff point, the value of the area showed the accuracy of the test. (RI) he chose 0.7 as the cutoff point, the value of the area showed the accuracy of the test. PI has sensitivity 84.4% and specificity 83.3% in the detecting women with CIUD complaining of abnormal uterine bleeding and RI has sensitivity 78.1% and specificity 80% in the detecting women with CIUD complaining of abnormal uterine bleeding. So, transvaginal color doppler can be used to identify women at risk of developing abnormal uterine bleeding after CIUD insertion.[7].

Individuals with IUD-induced menorrhagia exhibited altered subendometrial mcirovascularization as a result of changes in prostaglandin synthesis, which increased blood flow in the uterus, according to the current study and other researches.

CONCLUSIONS

The results of our study confirmed the hypothesis that there is an increase in the uterine blood flow (indicated by decreased PI and RI in the uterine artery) in patients with CIUD-induced abnormal uterine bleeding. Uterine artery doppler indices can be used in prediction of menorrhagia for proper patient selection for IUCD insertion

Declaration of interest

The authors report no conflicts of interest.

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None declared.

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