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ROLE OF UTERINE ARTERY DOPPLER INDICES IN NON-PREGNANT FEMALES WITH ABNORMAL MENSTRUAL CYCLE

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Abstract

Background: *Abnormal menstrual cycles are common in reproductive-aged women and may result from structural or functional causes. While gray scale ultrasound detects structural abnormalities, it cannot assess uterine blood flow. Uterine artery Doppler helps evaluate hemodynamic changes through indices like PI, RI, and S/D ratio, improving the understanding of menstrual irregularities, especially in conditions like PCOS and oligomenorrhea.*

Objective: *To evaluate role of uterine artery doppler indices in non-pregnant females with abnormal menstrual cycle.*

Methodology: *This cross-sectional descriptive study was conducted at DHQ Hospital, Bahawalnagar, over a period of four months. A total of 77 non-pregnant females with menstrual irregularities (amenorrhea, dysmenorrhea, oligomenorrhea, metrorrhagia, menorrhagia, polymenorrhea, and hypomenorrhea). Pregnant, menopausal, postpartum females, and those with uterine pathology or prior hysterectomy were excluded. Uterine artery Doppler indices were assessed using a LOGIQ P5 ultrasound machine with a 7–10 MHz transducer*

Results: *The study assessed uterine artery Doppler indices in non-pregnant women with abnormal menstrual cycles, correlating findings with clinical and ultrasound features. Gray scale ultrasound identified structural abnormalities but could not fully explain functional causes of irregular menstruation. Most participants were reproductive-aged, married, and a significant number had infertility and irregular cycles. Common conditions included oligomenorrhea and PCOS, with many women experiencing moderate to heavy bleeding and pelvic pain. Ultrasound findings showed PCOS as the most frequent diagnosis, though many had normal uterine morphology. Doppler indices (PI, RI, S/D ratio) revealed variations in uterine blood flow and vascular resistance. Overall, abnormal menstrual cycles were associated with altered uterine hemodynamics not always detectable on gray scale imaging.*

Conclusion: *Uterine artery Doppler indices are effective in identifying changes in uterine blood flow in non-pregnant women with abnormal menstrual cycles. These hemodynamic alterations may not be detected on gray scale ultrasound alone, highlighting the added value of Doppler assessment. Therefore, uterine artery Doppler can serve as a useful complementary tool alongside conventional imaging for better evaluation of menstrual irregularities.*

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INTRODUCTION

The menstrual cycle is a complex physiological process regulated by hormonal interactions between the endocrine and reproductive systems. Disruptions in this balance can lead to menstrual irregularities, which are common worldwide and may affect fertility, quality of life, and overall health. These irregularities can arise from hormonal, metabolic, structural, or lifestyle-related factors, including conditions such as polycystic ovarian syndrome and thyroid disorders [1].

Uterine perfusion plays a key role in normal menstrual function, as adequate blood flow is essential for endometrial development and cyclic changes [2]. The uterine arteries supply blood to the uterus, and their flow characteristics vary throughout the menstrual cycle. Doppler ultrasonography provides a non-invasive method to assess this blood flow through indices such as Pulsatility Index (PI) and Resistance Index (RI), which reflect vascular resistance [3].

In normal cycles, uterine artery resistance decreases during ovulation and the luteal phase to support endometrial growth. However, in abnormal or anovulatory cycles, increased vascular resistance may impair uterine perfusion and contribute to menstrual disturbances [4]. Although Doppler studies are widely used in pregnancy, their role in non-pregnant women remains underexplored.

Evaluating uterine artery Doppler indices in women with abnormal menstrual cycles may help identify underlying vascular abnormalities that are not detected by routine ultrasound [5]. This can improve diagnostic accuracy and support better clinical management. Therefore, this study aims to assess the role of uterine artery Doppler indices in non-pregnant women with abnormal menstrual cycles [6].

The present study demonstrated that uterine artery Doppler indices play a significant role in evaluating abnormal menstrual cycles in non-pregnant women. Females with normal cycles showed stable PI and RI values, indicating adequate uterine perfusion, whereas those with menstrual irregularities exhibited altered Doppler indices [7]. Lower resistance values were associated with heavy menstrual bleeding, while higher resistance was observed in conditions such as amenorrhea, reflecting reduced uterine blood flow [8]. A high prevalence of infertility and irregular cycles suggested a strong association with hormonal and reproductive dysfunction, particularly in conditions like Polycystic Ovary Syndrome (PCOS), which was frequently observed both clinically and on ultrasound [9].Findings related to oligomenorrhea, menorrhagia, fibroids, and pelvic pain further supported the relationship between uterine vascular resistance and menstrual abnormalities. These results are consistent with previous studies, confirming that Doppler ultrasound is a reliable, non-invasive tool for assessing uterine hemodynamics. However, Doppler indices alone may have limited diagnostic value and should be interpreted alongside clinical and ultrasound findings for comprehensive evaluation [10].Overall, the study reinforces the importance of uterine artery Doppler in identifying underlying vascular, hormonal, and structural causes of menstrual disorders and improving diagnostic accuracy [11].

MATERIAL AND METHODS

This cross-sectional descriptive study was conducted at DHQ Hospital Bahawalnagar over a period of four months after approval of the synopsis. A total of 77 non-pregnant females of reproductive age (18–45 years) were included with menstrual irregularities, including amenorrhea, dysmenorrhea, oligomenorrhea, metrorrhagia, menorrhagia, polymenorrhea, and hypomenorrhea. Pregnant, menopausal, postpartum females, and those with a history of hysterectomy or uterine malignancy were excluded. Uterine artery Doppler assessment was performed using a LOGIQ P5 ultrasound machine with a 7–10 MHz transducer. Both transabdominal and transvaginal scans were conducted following standard protocols, with appropriate patient preparation and privacy measures. Doppler parameters including Pulsatility Index (PI), Resistance Index (RI), and Peak Systolic Velocity (PSV) were recorded. Data

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were collected through a structured questionnaire covering patient history, age, infertility status, and ultrasound findings. Statistical analysis was performed using SPSS version 25, with mean ± standard deviation calculated for quantitative variables and frequencies for qualitative variables. The paired sample t-test was applied to compare groups, and a p-value of <0.05 was considered statistically significant.

Table no 1: Age of Patient

Age Group	Frequency	Percent (%)
18–28 years	34	43.6
29–38 years	40	51.3
39–48 years	3	3.8

This table shows the age distribution of the study participants. Most patients (51.3%) were aged 29–38 years, followed by 43.6% in the 18–28 years group. Only a small proportion (3.8%) belonged to the 39–48 years category, indicating that most participants were in the reproductive age group.

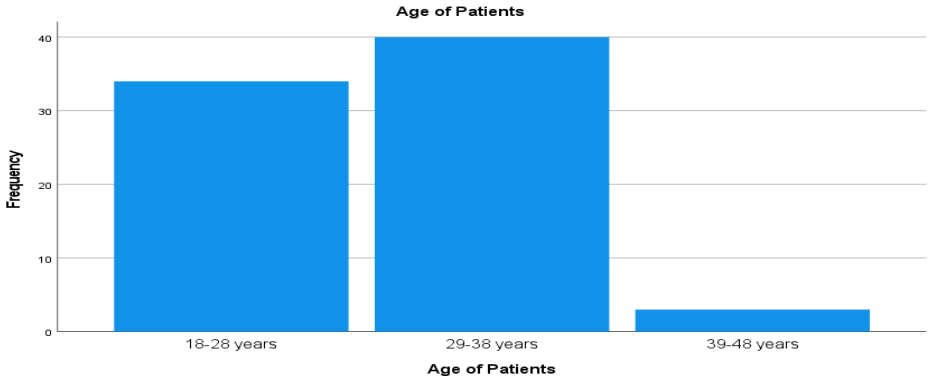

Figure no 1

Table no 2: Gravidity

Gravidity	**Frequency**	**Percent** (%)
G0	17	21.8
G1	19	24.4
G2	29	37.2
G3	12	15.4

This table illustrates the gravidity status of the participants. The largest group was G2 (37.2%), followed by G1 (24.4%) and G0 (21.8%), while G3 accounted for 15.4%. This indicates that most women had experienced at least one or more pregnancies.

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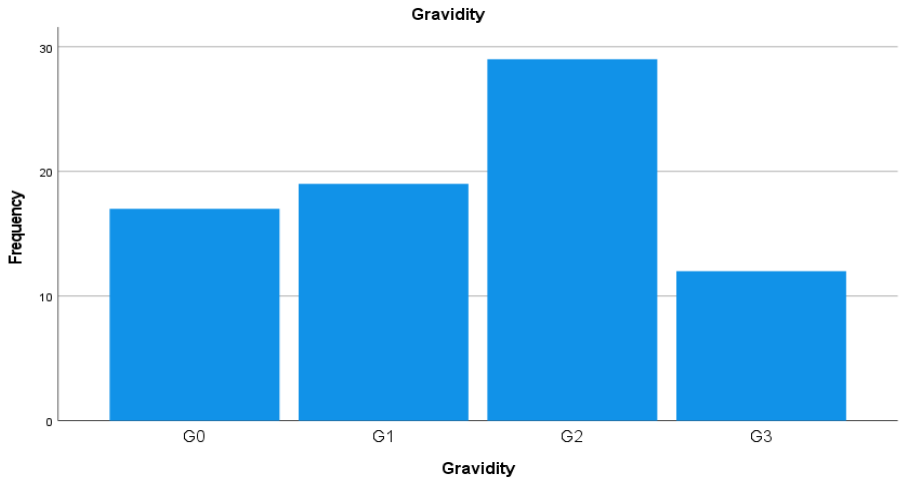

Figure no 2

Table no 3: Pariety

Parity	Frequency	Percent (%)
P0	33	42.3
P1	25	32.1
P2	8	10.3
P1+1	7	9.0
P2+1	4	5.1

This table shows the parity distribution. The highest proportion of women were nulliparous (P0, 42.3%), followed by P1 (32.1%). Smaller proportions were observed in higher parity categories, indicating fewer women had multiple deliveries.

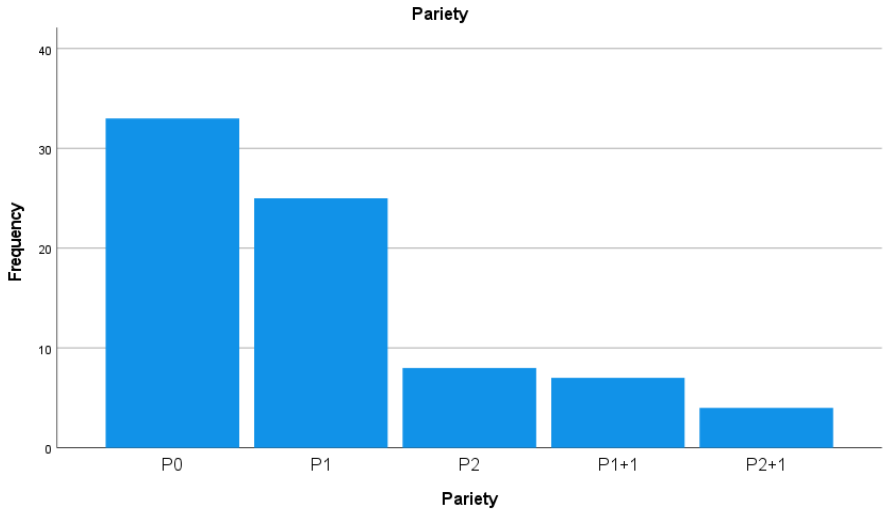

Figure no 3

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Table no 4: Infertility

Infertility	Frequency	Percent (%)
Yes	48	61.5
No	29	37.2

This table presents infertility among participants. A majority (61.5%) reported infertility, while 37.2% did not, highlighting a high prevalence of infertility in the study population

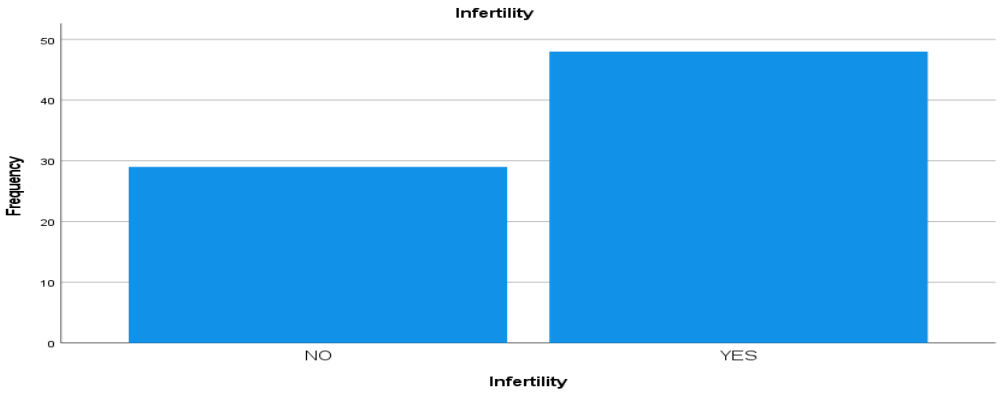

Figure no 4

Table no 5: Age at Menarche

Age at Menarche	Frequency	Percent (%)
12–13 years	58	74.4
14–15 years	19	24.4

This table shows the age at the onset of menstruation. Most participants (74.4%) experienced menarche between 12–13 years, while 24.4% reported it between 14–15 years, indicating a generally normal age of menarche.

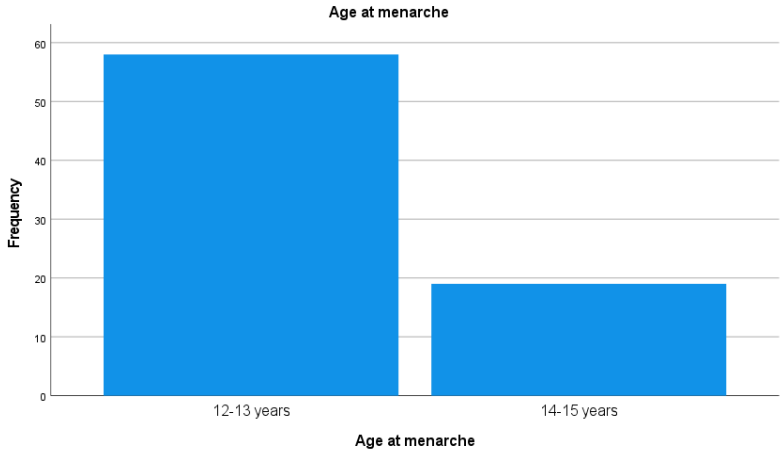

Figure no 5

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Table no 6: Cycle length

Cycle Length	Frequency	Percent (%)
20–29 days	30	38.5
30–39 days	30	38.5
40–49 days	17	21.8

This table presents menstrual cycle length. Equal proportions (38.5%) had cycle lengths of 20–29 days and 30–39 days, while 21.8% had longer cycles (40–49 days), suggesting variability in menstrual pattern.

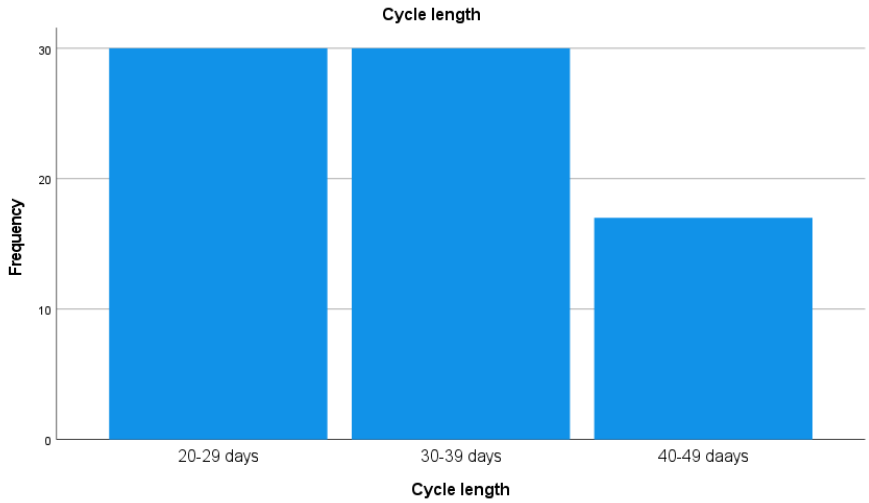

Figure no 6

Table no 7: Types of Abnormality

Abnormality	Frequency	Percent (%)
Oligomenorrhea	25	32.1
PCOS	20	25.6
Menorrhagia	8	10.3
Polymenorrhea	6	7.7
Anovulatory	6	7.7
Infertility	6	7.7
Dysmenorrhea	6	7.7

This table outlines different menstrual abnormalities. Oligomenorrhea was the most common (32.1%), followed by PCOS (25.6%). Other conditions such as menorrhagia (10.3%) and dysmenorrhea, polymenorrhea, anovulation, and infertility (each 7.7%) were less frequent.

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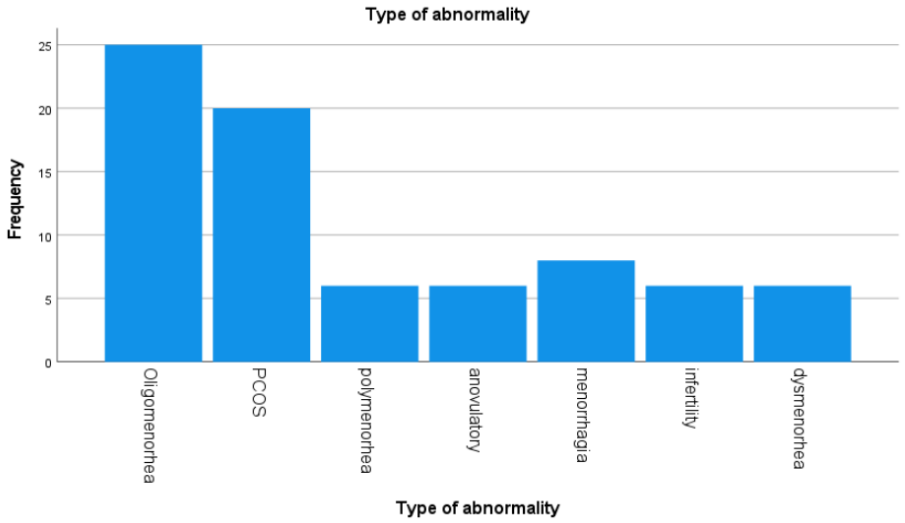

Figure no 7

Table no 8: Indices

Index	Mean ± SD	Range
Pulsatility Index (PI)	3.05 ± 0.25	2.7–3.5
Resistive Index (RI)	0.88 ± 0.03	0.84–0.92
Systolic/Diastolic Ratio (S/D)	4.2 ± 1.5	3.0–10.5
Peak Systolic Velocity (PSV, cm/s)	60.4 ± 8.2	52–76
End Diastolic Velocity (EDV, cm/s)	7.1 ± 2.0	3–10

The Doppler indices show that Pulsatility Index (PI) and Resistive Index (RI) are relatively stable with minimal variation, indicating consistent vascular resistance. In contrast, the Systolic/Diastolic (S/D) ratio, along with Peak Systolic Velocity (PSV) and End Diastolic Velocity (EDV), demonstrate greater variability, reflecting differences in blood flow dynamics among participants.

Table no 9: Mean ± SD Values of Uterine Artery Doppler Parameters (PI, RI, PSV, and EDV) in Various Abnormal Uterine Conditions

Abnormality	PI (mean ± SD)	RI (mean ± SD)	PSV (cm/s)	EDV (cm/s)
PCOS (n≈30)	2.9 ± 0.2	0.87 ± 0.02	58.2 ± 7.5	6.8 ± 1.8
Endometrial hyperplasia (n≈6)	3.3 ± 0.1	0.91 ± 0.01	65.0 ± 6.0	7.5 ± 1.5
Fibroid uterus (n≈5)	3.5 ± 0.2	0.92 ± 0.02	70.0 ± 5.5	8.0 ± 1.6
Adenomyosis (n≈4)	3.4 ± 0.2	0.91 ± 0.02	68.0 ± 6.2	7.8 ± 1.7
Hormonal imbalance / Anovulatory cycles (n≈8)	3.0 ± 0.2	0.88 ± 0.02	60.0 ± 7.0	7.0 ± 1.5

The table presents uterine artery Doppler indices (PI, RI, PSV, and EDV) across different menstrual and gynecological abnormalities. Higher PI and RI values are observed in conditions such as fibroid uterus and adenomyosis, indicating increased vascular resistance, while intermediate values are seen in endometrial hyperplasia. PCOS and hormonal

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imbalance/anovulatory cycles show comparatively lower PI and RI, reflecting altered uterine hemodynamics. PSV and EDV also vary across groups, demonstrating differences in uterine blood flow patterns among the different pathological conditions.

CONCLUSION

Uterine artery Doppler indices play a significant role in detecting alterations in uterine blood flow in non-pregnant women with abnormal menstrual cycles. The study demonstrates that while gray scale ultrasound is effective in identifying structural abnormalities, it often fails to explain functional causes of menstrual irregularities. In contrast, Doppler parameters such as Pulsatility Index (PI), Resistance Index (RI), and Systolic/Diastolic (S/D) ratio provide valuable insight into uterine hemodynamics and vascular resistance.

The findings indicate that abnormal menstrual patterns, including conditions like oligomenorrhea and PCOS, are associated with measurable changes in uterine perfusion. Importantly, these hemodynamic variations may be present even in cases where ultrasound findings appear normal, emphasizing the diagnostic importance of Doppler assessment.

Therefore, uterine artery Doppler should be considered a useful complementary tool alongside conventional ultrasound for a more comprehensive evaluation of menstrual disorders. However, further research with larger sample sizes and standardized protocols is recommended to strengthen its clinical applicability and routine use.

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