DOI: https://doi.org/10.53350/pjmhs202317572

ORIGINAL ARTICLE

Doppler Evaluation of Uterine Arteries in Different Phases of Menstrual Cycle in Young Adult Females with Regular Cycles

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ABSTRACT

Background: The menstrual cycle is nature's cyclical method of getting ready for pregnancy. The uterine lining grows each month in preparation for implantation by a fertilized ovum. Cyclic endometrium may be non-invasively assessed with Doppler sonography and leads to alterations in local vascular patterns. The pulsatility index (PI), which measures the uterine artery (UtA) impedance, displays a predictable pattern during the typical menstrual cycle.

Aim: To evaluate the flow of blood through the uterine arteries in young adult women with regular cycles during various menstrual cycle stages.

Place of study and duration of study: Department of Radiology, University Ultrasonography Clinic in Green Town, Lahore. Between January 2022 and October 2022.

Methodology: A comparative study was carried out at the University Ultrasonography Clinic in Green Town, Lahore, Pakistan. In this study, 180 patients between the ages of 16 and 35 were enrolled using a convenient sampling technique.All the married, and unmarried ages between 13- and 40 years old having regular periods once a month were involved in this study.

Results: 180 patients in all were involved in this study comprising 60 females of each phase of the menstrual phase, 23 patients age were 25 age, 19 patients were 23 age, 20 patients were 18 age, 15 patients were 22, and 9 patients were the age of 29,30,31 years. RI of the right ovary was 0.5938 ± 0.8, the mean RI of the left ovary was 6.5083 ± 0.92357 forthe 10-20 days phase cycle, RI of the right ovary was 0.5937 ± .05266, the mean RI of the left ovary was 10.6967 ± 1.13466 of 11-20 days phase cycle, RI of right ovary was 0.5925 ± .05423, mean RI of left ovary was 6.7083±1.10258 of 21-30 days phase cycle.The uterine artery's resistivity index is compared in three menstrual cycle phases which are days 1 to 10, 11 to 20, and 21 to 30. No statistical difference was found in the right three means of the uterine artery's resistivity index as P-value=0.989 > ∞=0.05. The averages of the Resistivity index of the uterine artery(left)in the three phases of the menstrual cycle are proved to be equal as we failed to find statistically significant differences where P-value=0.975 > ∞=0.050.

Conclusion: In this study, we have concluded that endometrial thickness and uterine artery resistivity index, determined ultrasonographically depend upon the phase of the menstrual cycle. The endometrialthickness progressively increases throughout the menstrual phase with no change in the resistive index of both uterine arteries.

Keywords: Doppler ultrasound, uterine arteries, resistive index, pulsative index, endometrium stripe thickness.

INTRODUCTION

The primary vessels carrying blood to the uterus are called uterine arteries. Particularly during pelvic and gynecologic surgery, they have a crucial clinical role in a variety of medical disorders. The uterine arteries undergo significant modifications throughout pregnancy, growing larger and more tortuous, which has a significant impact on postnatal outcomes[1].

The monthly loss of a woman's uterine lining, more frequently referred to as the womb, is known as the menstrual cycle, also known as menstruation or periods. Menstruation is sometimes referred to as menses, the menstrual cycle, period, or period. 2 The monthly blood leaves the uterus through the cervix and exits the body through the vagina. Menstrual blood is partially blood and partially tissue from the interior of the uterus. 3 When the egg doesn't fertilize, the uterus expels the egg and all of the endometrial partial lining for at least 3 to 5 or at most 8 to 10 days.[4]

Ultrasound is very useful for monitoring the functional changes that occur during naturally occurring and artificially induced menstrual periods as well as for investigating the female reproductive system. By using Doppler ultrasonography, the uterine radial artery resistance index can reveal alterations in uteroplacental circulation and be linked to worse prenatal outcomes. 5 In the right and left uterine arteries, The RI's mean is between 0.59 and 0.65 respectively, having a 0.37-1.16 and 0.41-0.82 range.6 the maximum, minimum, and mean Doppler frequency changes over the course of a certain cycle are used to determine the flow parameter in ultrasonography called the pulsatility index (PI), also known as the Gosling index. 7 As a gauge of peripheral resistance, The ratio of flow velocities' systolic to diastolic (S/D) beats was calculated.Throughout the 20th to 40th week of a typical pregnancy, the S/D ratio ofumbilical artery velocity wave decreased from 3.9 to 2.1 while the S/D ratio ofuterine artery stayed persistent at 1.8 to 1.9.8. Receptivity ofendometriumis described by way of a transiently specific combination with elements that prepares the endometrium for embryonic implantation. Many researchershas looked at the histology and genomics of endometrial biopsies, endometrial cytokines in uterine flushing, and endometrium inspection in order to better understand endometrial receptivity[9].

As ultrasonography is a non-invasive method that may be used safely during the peri-implantation period, it is the method of choice for determining endometrial receptivity.[10]endometrial thickness, pattern, and uterine artery, and endometrial vasculature Doppler studies are among the ultrasound parameters that have been studied. In IVF-ET cycles, endometrial thickness and pattern have been proposed as potential pregnancy predictors. It is still debatable whether the endometrial thickness is useful in predicting pregnancy[11].

The study's objective is to assessthe flow of blood in the uterine artery in a female withh regular menstrual cycle through several menstrual cycle phases, by using Doppler ultrasound, and further this study helps in promoting other research to further investigate the causes of different diseases to make a possible treatment plan for females with menstrual problems.

Received on 12-11-2022
Accepted on 22-04-2023

MATERIAL AND METHODS

This comparative study was conducted at University Ultrasonography Clinic, Green Town, Lahore, Pakistan for a period of 4 months after the approval of the synopsis. Sample size was180 patients between the ages of 16 and 35were included in this study. The sample size is calculated at 90%level of significance at 5% margin of error. Sampling technique used was Convenient sampling technique. All married, and unmarried ages between 13- and 40 years old having regular periods once a month were included in this study. Pregnant women age more than 40 years were excluded from the study.

Inclusive criteria:

- All the married and unmarried women
- Age group between 13 and 40 years
- Women with regular menstrual period cycles

Exclusive criteria:

- Pregnant women
- Women above the age of 40 years
- Women who don't give consent to be included in this study

RESULTS

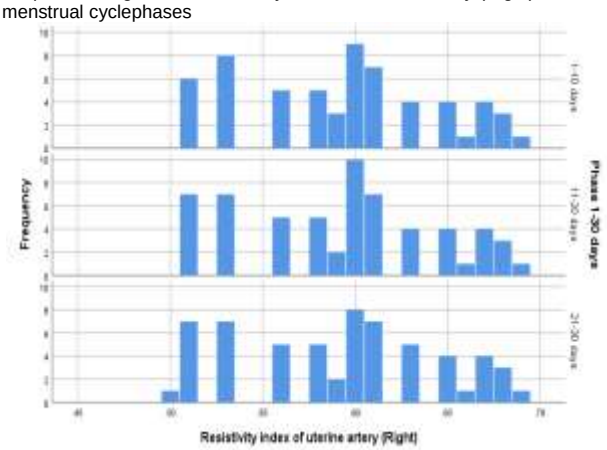
Total number of 180 patients were included in this research comprising 60 females of each phase of the menstrual phase, 23 patients age were 25 age, 19 patients were 23 age, 20 patients were 18 age, 15 patients were 22, and 9 patients with the age of 29,30,31 years. RI of right ovary was 0.5938 ± 0.5218 of, mean RI of left ovary was 6.5083 ± 0.92357 of 10-20 days phase cycle, RI of right ovary was 0.5937 ± .05266, mean RI of left ovary was 10.6967 ± 1.13466 of 11-20 days phase cycle, RI of right ovary was 0.5925 ± .05423, mean RI of left ovary was 6.7083 ± 1.10258 of 21-30 days phase cycle.The measure of resistivity (RI)of the uterine artery is compared in three phases of the menstrual cycle which are days 1-10, days 1, 1-20, and days 21-30. No statistical difference was found in the right three means of a resistive index of the uterine artery as P-value=0.989 > ∞=0.05. The averages of Resistivity index of the uterine artery (left)in three phases of the menstrual cycle is proved to be equal as we failed statistically significant differenceswhere P-value=0.975 > ∞=0.050.

Table 1: Descriptive statistics of Resistivity index of uterine artery (left and right) and Endometrial thickness with respect to three menstrual cyclephases

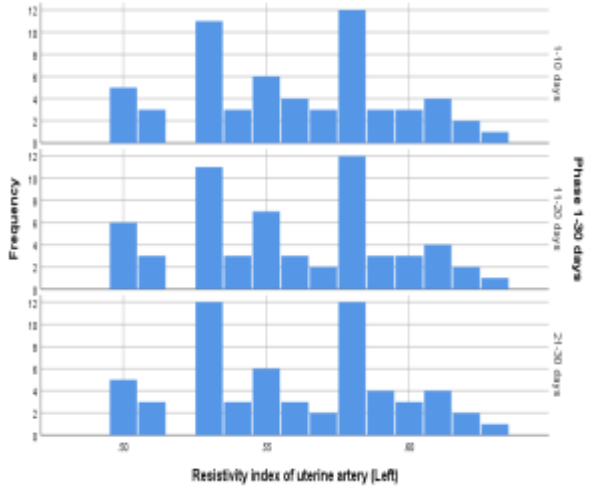
Report			
Phase	**Resistivity index of uterine artery (Right)**	**Resistivity index of uterine artery (Left)**	**Endometrial thickness**
1-10 days			
Mean	.5938	.5595	6.5083
N	60	60	60
Std. Deviation	.05218	.03491	.92357
Minimum	.51	.50	5.00
Maximum	.69	.63	8.30
11-20 Days			
Mean	.5937	.5582	10.6967
N	60	60	60
Std. Deviation	.05266	.03572	1.13466
Minimum	.51	.50	8.80
Maximum	.69	.63	13.00
21-30 Days			
Mean	.5925	.5593	6.7083
N	60	60	60
Std. Deviation	.05423	.03531	1.10258
Minimum	.50	.50	5.00
Maximum	.69	.63	10.00
Total			
Mean	.5933	.5590	7.9711
N	180	180	180
Std. Deviation	.05274	.03512	2.20181
Minimum	.50	.50	5.00
Maximum	.69	.63	13.00

Table 1 shows that descriptive statistics of resistivity index of Uterine artery (left and right) and Endometrial thickness with respect to three phases of Menstrual cycle, In which mean RI of right ovary was 0.5938 ± 0.5218 of, mean RI of left ovary was 6.5083 ± 0.92357 of 10-20 days phase cycle, **RI of right ovary was 0.5937 ± .05266, mean RI of left ovary was 10.6967 ± 1.13466 of 11-20 days phase cycle**, RI of right ovary was 0.5925 ± .05423, mean RI of left ovary was 6.7083 ± 1.10258 of 21-30 days phase cycle.

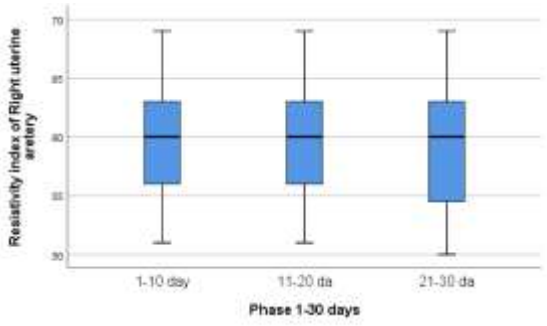
Graph 1: Histograms of Resistivity Index of Uterine artery (Right) in three menstrual cyclephases



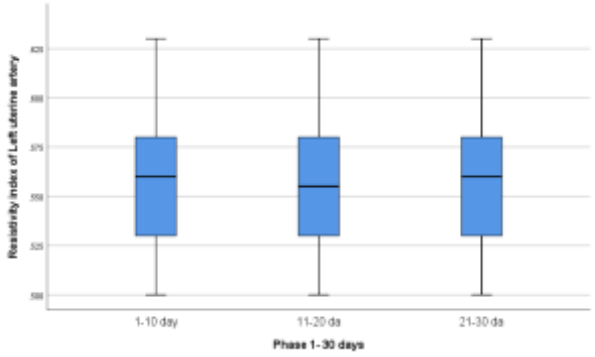
Graph 2: Histograms of Resistivity Index of Uterine artery (Left) in three menstrual cycle phases



Graph 3: Box plot of Resistivity Index of Uterine artery (right) in three menstrual cycle phases



Graph 4: Box plot of Resistivity Index of Uterine artery (left) in three menstrual cycle phases



Graph 5: Box plot of Endometrial thickness in three menstrual cycle phases.

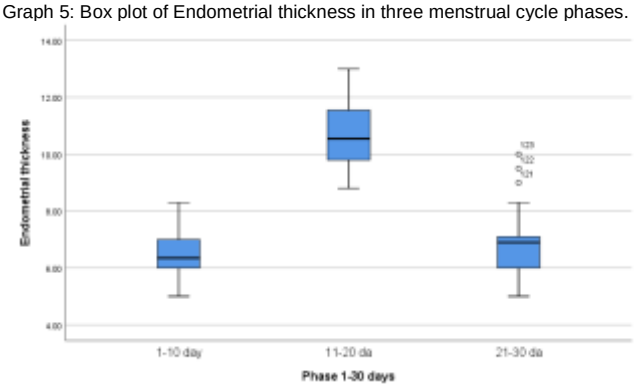


Fig 1 shows the uterine artery doppler of RT Uterine artery, RI: 0.64 S/D ratio: 2.81

Fig 2 shows the uterine artery doppler of LT Uterine artery, RI: 0.75 S/D ratio: 3.94

Table 2: ANOVA

		Sum of Squares	DF	Mean Square	F	Sig.
Resistivity index of right uterine artery	Between Groups	.000	2	.000	.011	.989
	Within Groups	.498	177	.003		
	Total	.498	179			
Resistivity index of left uterine artery	Between Groups	.000	2	.000	.025	.975
	Within Groups	.221	177	.001		
	Total	.221	179			
Endometrial thickness	Between Groups	669.779	2	334.889	299.354	.000
	Within Groups	198.011	177	1.119		
	Total	867.790	179			

Table 3: Multiple Comparisons of Average of Resistivity Index in Uterine artery (right and left) in three menstrual cycle phases

Dependent Variable	(I) Three phases	(J) Three phases	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Resistivity index of right uterine artery	1-10	2.00	.00017	.00968	.986	-.0189	.0193
		3.00	.00133	.00968	.891	-.0178	.0204
	11-20	1.00	-.00017	.00968	.986	-.0193	.0189
		3.00	.00117	.00968	.904	-.0179	.0203
	21-30	1.00	-.00133	.00968	.891	-.0204	.0178
		2.00	-.00117	.00968	.904	-.0203	.0179
Resistivity index of left uterine artery	1-10	2.00	.00133	.00645	.836	-.0114	.0141
		3.00	.00017	.00645	.979	-.0126	.0129
	11-20	1.00	-.00133	.00645	.836	-.0141	.0114
		3.00	-.00117	.00645	.857	-.0139	.0116
	21-30	1.00	-.00017	.00645	.979	-.0129	.0126
		2.00	.00117	.00645	.857	-.0116	.0139
Endometrial thickness	1-10	2.00	-4.18833*	.19311	.000	-4.5694	-3.8072
		3.00	-.20000	.19311	.302	-.5811	.1811
	11-20	1.00	4.18833*	.19311	.000	3.8072	4.5694
		3.00	3.98833*	.19311	.000	3.6072	4.3694
	21-30	1.00	.20000	.19311	.302	-.1811	.5811
		2.00	-3.98833*	.19311	.000	-4.3694	-3.6072

*. At the 0.05 threshold, the mean difference becomes significant.

Analysis of Variance: The resistivity index of the uterine artery is compared in three phases of the menstrual cycle which aredays 1 to 10, 11 to 20, and 21 to 30.. No statistical difference was found in the right three means of a Uterine artery's resistive index as P-value=0.989 > ∞=0.05. The averages of the Uterine artery's resistive index (left) in three phases of the menstrual cycle is proved to be equal as we failed to find statistically significant differences where P-value=0.975 > ∞=0.050

A statistically significant difference was found between Endometrial thickness in the three phases of the menstrual cycle as P-value=0.000 < ∞=0.05

Table 3 demonstrations the multiple comparisons of an average of resistivity index in a uterine artery (right and left) in three phases of the menstrual cycle, the mean value of right uterine and left uterine artery in different phase of cycle. Endometrium stripe thickness means value in different phase pf cycle.

DISCUSSION

Investigating the blood flow through the uterine artery was the goal of our investigation in a female with a regular menstrual cycle through different menstrual cyclephases, by using Doppler ultrasound, and further this study helps in promoting other research to further investigate the causes of different diseases and impact of hormonal imbalances and make a possible treatment plan for females with menstrual problems.

El-Mazny et al. conducted research in 2020 to assess the uterine hemodynamics Doppler investigation in women with unexplained infertility. His study reveals that the FI, VFI, and FII endometrialas well as VI, FI, and VFI sub-endometrial, were suggestively decreased in the unexplained infertility group while the PI, RI, and VI of the uterine artery were considerably increased[12]. Thus, uterine hemodynamics while assessing infertility, Doppler analysis should be considered. According to results of our study, shows that descriptive statistics of resistivity index of Uterine artery (left and right) and Endometrial thickness with respect to three of the Menstrual cyclephases, In which the mean RI of the right ovary was 0.5938 ± 0.5218 of, mean RI of left ovary was 6.5083 ± 0.92357 of 10-20 days phase cycle, RI of right ovary was 0.5937 ± .05266, mean RI of left ovary was 10.6967 ± 1.13466 of 11-20 days phase cycle, RI of right ovary was 0.5925 ± .05423, mean RI of left ovary was 6.7083 ± 1.10258 of 21-30 days phase cycle[13]. Blood flow in the uterine and spiral arteries was investigated by Kupesic and Kurjak et al. during both spontaneous and induced cycles. One day before ovulation, they said, the uterine artery blood flow pulsatility index reduced in spontaneous menstrual cycles, but not in stimulated cycles[14].

William F et al conducteda study in November 2016 in which they investigated at whether the changes are correlated with the hormonal environment.If the reactions of the uterine and systemic hemodynamic systems to the menstrual cycle vary, no matter which side of ovulation affects uterine artery hemodynamic adaptation. With a drop in the RI, from a follicular stage mean (standard deviation) of 22.4 7.3 mL/minute to a luteal phase mean (standard deviation) of 30.7 13.7 mL/minute, each uterine artery's blood flow increased slightly. The ovulation side had no bearing on the modifications. 15 with a flow of 27.2 13.9 mL/min through the follicles. And 24.7 10.5 mL/min of luteal blood flow, the radial artery did not alter in tandem with these changes. These alterations and blood E2 or progesterone concentrations were not shown to be significantly correlated. In our results, According to results of our study, shows that descriptive statistics of the Uterine artery (left and right) resistivity index of the Endometrial thickness with respect to the Menstrual cyclethree phases, In which the mean RI of the right ovary was 0.5938 ± 0.5218 of, mean RI of left ovary was 6.5083 ± 0.92357 of 10-20 days phase cycle, RI of right ovary was 0.5937 ± .05266, mean RI of left ovary was 10.6967± 1.13466 of 11-20 days phase cycle, RI of right ovary was 0.5925 ± .05423, mean RI of left ovary was 6.7083 ± 1.10258 of 21-30 days phase cycle.[16]The uterine artery's resistivity index is compared in three phases of the menstrual cycle which are days 1 to 10, 11 to 20, and 21 to 30. No statistical difference was found in the right three means of a uterine artery'sresistive index of the as P-value=0.989 > ∞=0.05Averages of the uterine artery (left)Resistivity index in three menstrual cycle phases are proved to be equal as we failed to find statistically significant differences where P-value=0.975 > ∞=0.050. A statistically significant difference was found between Endometrial thickness in the three menstrual cycle phases as P-value=0.000 < ∞=0.05.[17]

Madina SRI et al conducted research in 2020 to compare the resistive indices restrained in the uterine as well as inophthalmic arteries of normotensive and preeclamptic patients by using Doppler US. According to his study, the uterine artery's mean resistance index was 0.50 0.08 in participants with normotension and 0.64 0.09 in preeclamptic women, with a p-value of 0.001.[18]With a p-value of 0.001, the mean resistive index of the ophthalmic artery was 0.70 0.05 in normotensive contributorsand 0.63 0.04 in women with preeclampsia, indicating the uterine and ocular arteries resistive index significantly correlated negatively in preeclampsia females and significantly correlated positively in normotensive individuals.Based on hemodynamic adjustments in response to vascular modifications in the ophthalmic as well as in uterine arteries, preeclampsia might be quickly identified using Doppler ultrasonography[19].

Yoichi M et al in May 2017 in office gynecology, it is deemed crucial to identify the median endometrial thickness (ET) for clinical practicethe' average ageof the contributors was 38.5 years. The quantiles for the 90% and 95% were 13.8 and 15.8 mm, correspondingly, while the median ET was 8.6 mm. The ET had nothing to do with the symptoms of women's age, location obstetric history, or risk factors for endometrial cancer. The ET in the women who had a menstrual cycle was 7 mm on days 1-6, but it rose to 9.2 mm on days 13–14 from 5.4 mm the day after menstrual bleeding (day 7 or 8).[20]Afterwards, the ET enlargedmore to 11.1 mm on day 18. In results of our studyshows that descriptive statistics of the Uterine artery (left and right) resistivity index of the and Endometrial thickness in relation to three Menstrual cycle phases, In which the mean RI of right ovary was 0.5938 ± 0.5218, mean RI of the left ovary was 6.5083 ± 0.92357 of 10-20 days phase cycle, RI of right ovary was 0.5937 ± .05266, mean RI of left ovary was 10.6967 ± 1.13466 of 11-20 days phase cycle, RI of right ovary was 0.5925 ± .05423, mean RI of left ovary was 6.7083 ± 1.10258 of 21-30 days phase cycle.[21]

CONCLUSION

In this study, we have concluded that endometrial thickness and uterine artery resistivity index, determined ultrasonographicall depend upon the phase of the menstrual cycle. The endometrial thickness progressively increases throughout the menstrual phase with no change in the resistive index of both uterine arteries.

Source of Funding: There is no funding source.
Conflict of interest: There is no conflict of interest

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