ORIGINAL ARTICLE

Uterine and Subendometrial Arteries Doppler in Patients with Recurrent First Trimestric Abortion

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Abstract

Background: **Abortion is characterized as the removal or expulsion of conception products from the uterus prior to fetal viability, or when the baby weighs under five hundred grams or measures below twenty-five centimeters in length.**

Aim: **To assess the Doppler characteristics of the uterine and subendometrial arteries in cases having recurrent first-trimester abortions.**

Patients and methods: **This prospective research has been carried out at the Obstetrics and Gynecology Department, Al-Hussein University Hospital (Al-Azhar University Hospital). This study was conducted on recurrent 1st trimestric abortion cases. Cases have been separated into two groups: Group A: 50 cases with recurrent first-trimester abortion underwent uterine and subendometrial arteries Doppler at 7 – 9 weeks of pregnancy, and Group B: 50 normal control group underwent uterine and subendometrial arteries Doppler at 7 – 9 weeks of pregnancy. This study was conducted from January 2024 to October 2024.**

Results: **Pulsatility index (PI) had a sensitivity of 92% and specificity of 82%, which was highly significant for detecting miscarriage. A statistically insignificant correlation has been observed between the number of previous pregnancy losses and months of pregnancy. A highly statistically significant positive association has been observed among the number of previous pregnancy losses and left and right uterine artery PI and mean uterine artery PI.**

Conclusion: **Color Doppler ultrasonography is a non-invasive, safe, cost-effective modality that can identify abnormal uterine Doppler indices predictive of pregnancy outcomes.**

Keywords: Color Doppler ultrasound; PI; Abortion

1. Introduction

Abortion is characterized as the removal or expulsion of conception products from the uterus prior to fetal viability, or when the baby weighs under five hundred grams or measures under twenty-five centimeters in length. The precise frequency of spontaneous abortion remains uncertain; nevertheless, roughly fifteen percent of clinically confirmed pregnancies and sixty percent of biochemically confirmed pregnancies result in spontaneous abortion.[1]

Approximately 80% of spontaneous abortions transpire before twelve weeks of gestation. RPL is described as 3 or more consecutive spontaneous abortions. The ASRM has recently redefined POL as 2 or more unsuccessful clinical gestations confirmed by ultrasonography or histological analysis.[2]

Etiology is frequently unclear and might be complicated, accompanied by significant discussion concerning diagnosis and therapy. Accepted etiological factors involve anatomical anomalies, genetics, endocrine disorders, placental irregularities, hormonal imbalances, infections, tobacco use, alcohol intake, exposure to environmental risk factors, stressful life events, psychological trauma, specific coagulation disorders, and defects in immunoregulatory proteins.[3]

The prevalence of recurrent pregnancy loss is between one and two percent among the fertile population. The probability of recurrence rises with the advancing age of the mother and the frequency of successive losses. RPL could result from curable illnesses, including autoimmune diseases, hypercoagulable states, endocrine changes, or maternal anatomical anomalies, with a significant percentage of cases (up to forty to fifty percent) having an indiscernible etiology.[4]

Uterine receptivity is probably dependent on various factors, involving uterine perfusion, and is crucial for attaining normal gestation. Prior research indicates that perfusion of the uterine artery might influence endometrial receptivity, and that inadequate uterine perfusion might contribute to unexplained abortions and even to impaired implantation.[5]

Prior to pregnancy, the flow of blood in the uterine artery exhibits significant resistance, characterized by reversed or absent diastolic flow. Transvaginal pulsed Doppler ultrasound facilitates noninvasive assessment of uterine blood flow.[6]

Color Doppler is utilized in obstetrical ultrasound as a supplementary instrument to obtain information regarding the existence, direction, and blood flow velocity. The pulsatility index of the uterine artery is recognized to decrease gradually throughout the luteal phase, coinciding with the occurrence of implantation. Consequently, it was suggested that evaluating the uterine artery PI during the mid-luteal phase of spontaneous cycles may identify cases with RPL related to compromised uterine circulation.[7]

This investigation aimed to assess the Doppler characteristics of the subendometrial and uterine arteries in cases with recurrent first-trimester abortions.

2. Patients and methods

This prospective research was performed at the Obstetrics and Gynecology Department of Al-Hussein University Hospital (Al-Azhar University Hospital). This study was conducted on recurrent first-trimester abortion cases. Cases have been separated into two groups: Group A: 50 cases with recurrent first-trimester abortion underwent uterine and subendometrial arteries Doppler at 7 – 9 weeks of pregnancy, and Group B: 50 normal control group underwent uterine and subendometrial arteries Doppler at 7 – 9 weeks of pregnancy. This study was conducted from January 2024 to October 2024

Inclusion criteria: Two or more successive unexplained first-trimester abortions. Women aged between twenty and forty, with normal menstrual cycles for the 3 cycles preceding the research, and without the use of intrauterine devices or hormonal contraception. Normal hormonal state, involving free thyroxine (T4), glucose tolerance test, serum thyroid-stimulating hormone, and progesterone concentrations between days nineteen and twenty-one of the menstrual cycle.

Exclusion criteria: Systemic conditions that may influence hemodynamic indices include thrombocytopenia, thyroid disorders, and autoimmune illnesses. Cardiovascular illness, diabetes mellitus, etc. Consanguinity history. Familial history of chromosomal anomalies (such as trisomy 13, Turner syndrome, trisomy 21) and case age under twenty or over forty years old.

Methods:

All cases have been exposed to: Complete history taking, physical examinations, and investigational studies:

Procedures

Type of ultrasound machine: Sonography has been conducted utilizing an ultrasound machine (Voluson E6) fitted with a vaginal transducer.

Examination technique:

The vaginal probe has been wrapped in an inspection glove containing a small amount of gel. The gel has been used to provide excellent contact between the overlying and the transducer glove. Measures were implemented to prevent the entrapment of air bubbles, which could contribute to undesirable artifacts on the screen. Cross-contamination has been reduced by the utilization of probe coverings and antiseptics. After the woman adopted the lithotomy posture post-evacuation of her urinary bladder, the transvaginal probe was carefully inserted into the vagina and positioned in the anterior fornix. The internal and external cervical os were assessed, and the uterus was examined for any anomalies that may hinder gestation, like a bicornuate uterus, uterine myomas, or uterine septum, in addition to evaluating the thickness of the endometrium. The probe was laterally adjusted, and the right artery of the uterus was detected via color Doppler as an aliasing vessel crossing the lateral side of the cervix at the internal os; the left artery was similarly located. Pulsed wave Doppler was applied to acquire consistent and clear flow velocity waveforms for both arteries of the uterus. The PI determined by the standard deviation divided by the mean was evaluated bilaterally alongside subendometrial blood flow.
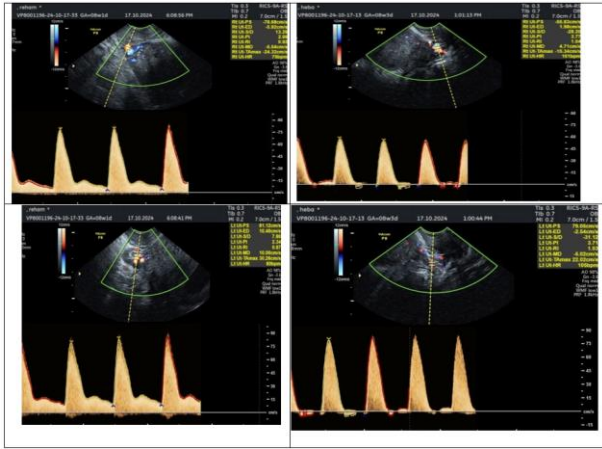
Figure 1. Uterine artery Doppler in first-trimester pregnancy

Ethical Considerations

The protocol has been submitted for permission to the Research Ethics Committee. Informed consent has been secured from the cases prior to their involvement in the trial. All information was maintained confidentiality. All participants possessed the right to withdraw from the research without influencing their management.

3. Results

Table 1 shows that, a statistically insignificant variance has been observed among examined groups according to age and BMI While there was highly statistically significant variance among examined groups consistent with gravidity and parity.

Table 1. Distribution of baseline characteristics among the examined groups.

	CASE GROUP (NUMBER=50)	CONTROL GROUP (NUMBER =50)	P-VALUE
AGE (YEARS)			
MEAN± SD	27.8±3.26	28.7±4.04	0.22
BMI (KG/M²)			
MEAN± SD	26.39±2.5	25.8±2.4	0.23
GRAVIDITY			
MEAN± SD	3.28±0.85	2.36±1.02	<0.001
PARITY			
MEAN± SD	1.7±0.7	2.36±1.02	0.0003

P value >0.05: Not significant, P value <0.05 is statistically significant, p<0.001 is highly significant., SD: standard deviation.

Table 2 illustrates that there was a statistically significant higher in case group than control group regarding right, left and mean uterine artery PI.

Table 2. Distribution of Uterine artery Doppler among the examined groups.

	CASE GROUP (NUMBER=50)	CONTROL GROUP (NUMBER=50)	P-VALUE
RIGHT UTERINE ARTERY PI (MM)			
MEAN± SD	2.64±0.34	1.84±0.33	<0.001
LEFT UTERINE ARTERY PI (ML)			
MEAN± SD	2.69±0.46	1.85±0.28	<0.001
MEAN UTERINE ARTERY PI			
MEAN± SD	2.66±0.26	1.85±0.21	<0.001

Table 3 shows a statistically insignificant correlation that has been observed between the number of pervious pregnancy loss and months of pregnancy.

Table 3. Correlation between number of pervious pregnancy loss and months of pregnancy.

	NUMBER OF PERVIOUS PREGNANCY LOSS	
	r	p
GESTATIONAL AGE (WEEKS)	-0.321	0.48

r: Pearson correlation

Table 4 illustrates that there was a highly statistically significant positive association among number of pervious pregnancy loss and left and right uterine artery pulsatility index and mean uterine artery PI.

Table 4. Correlation between number of pervious pregnancy loss, uterine and sub endometrial blood flow.

	NUMBER OF PERVIOUS PREGNANCY LOSS	
	r	p
RIGHT UTERINE ARTERY PI (MM)	0.775	<0.001
LEFT UTERINE ARTERY PI (ML)	0.777	<0.001
MEAN UTERINE ARTERY PI	0.815	<0.001

PI had sensitivity of 92% and specificity of 82% with highly significance for detecting miscarriage (Table 5).

Table 5. ROC analysis for PI for detecting miscarriage.

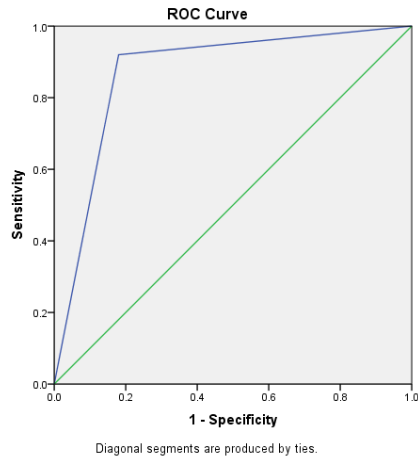| AREA	SENSITIVITY	SPECIFICITY	STD. ERROR[A]	ASYMPTOTIC SIG.[B]	ASYMPTOTIC 95% CONFIDENCE INTERVAL	
					Lower Bound	Upper Bound
0.88	92%	82%	0.039	<0.001	0.794	0.946

Figure 2. ROC curve for PI for detecting miscarriage.

4. Discussion

Regarding demographic data, the present research illustrated a statistically insignificant variation has been observed among studied groups according to age and BMI. While there was a highly statistically significant variance among examined groups consistent with gravidity and parity. As patients with recurrence pregnancy loss (RPL) have significantly higher gravidity and lower parity than control group. This was justified by the higher pregnancy loss rate among patients with RPL compared to controls.

Consistent with the present research, Elhessy et al.,[1] included 80 participants with a history of idiopathic RPL group and found statistically significant decreased parity among women with RPL than control (P-value less than 0.001). Nonetheless, they found insignificant variation between cases and controls in terms of age, BMI, and gravidity.

Regarding the distribution of Uterine artery Doppler among the studied groups, the present research illustrated that there was a statistically significantly higher value in the case group than the control group regarding right, left, and mean uterine artery PI.

Similarly, Mostafa et al.,[8] illustrated that there was significant increase in left and right uterine artery PI and mean uterine artery PI among patients with RPL than control group (P-value=0.000 all).

Also, Khalil et al.,[9] demonstrated that the cases with recurrent pregnancy loss have significantly higher uterine artery PI compared to matched controls.

As well, Mohammed et al.,[10] demonstrated that there was a highly statistically significant enhanced left and right uterine arteries pulsatility index in the RPL cases group than the control group (p-value < 0.001).

Concerning the correlation between the number of previous pregnancy losses and months of pregnancy, our results exhibited a statistically insignificant association between the number of previous gestation losses and months of pregnancy.

Consistent with Andersen et al.,[11] who aimed to assess the correlation between the frequency of prior pregnancy losses and gestational age, it was exhibited that advanced maternal age is a significant risk factor for spontaneous abortion, regardless of the number of previous miscarriages. The heightened risk of fetal loss was absent in females under twenty years of age, while the elevated risk in women over thirty-five was marginally reduced, with advancing gestational age correlating with a greater probability of pregnancy loss.

Regarding correlation between number of pervious pregnancy loss, uterine and sub endometrial blood flow, our results demonstrated that there was highly statistically significant positive association among number of pervious pregnancy loss and left and right uterine artery PI and mean uterine artery PI. Also, PI had sensitivity of 92% and specificity of 82% with highly significance for detecting miscarriage.

Wahab et al.[12] aimed to assess the blood flow of the uterine artery of the uterus and subendometrial blood flow in females having unexplained recurrent miscarriage (RM) in comparison to normally fertile women. They discovered a significant positive correlation between UAPI and the number of previous pregnancy losses in the study group, with a p-value of 0.00.

As well Elhessy et al.,[1] aimed to investigate the ability of uterine Doppler in assessing uterine reasons of recurrent pregnancy loss and they showed that there was statistically significant association among number of pervious pregnancy loss and left uterine artery PI, with p value =0.1, however right uterine artery PI exhibited insignificance, with p value=0.8.

In contrast with Yildiz et al.,[13] who aimed to study the impact of uterine artery blood flow on RPL and their research conducted on twenty eight cases of RPL, in addition to twenty eight control group to evaluate the relationship between RPL and uterine artery Doppler flow and revealed statistically insignificant variance has been observed among both groups as regards PI and RI with P values 0.703 and 0.333, respectively.

4. Conclusion

Pulsatility index demonstrated a sensitivity of ninety-two percent and a specificity of eighty-two percent, exhibiting high relevance in the detection of miscarriage. In conclusion, adequate blood flow to the uterus is crucial for pregnancy outcomes.

We discovered a highly significant association among the number of previous pregnancy losses and the duration of pregnancy, as well as the right and left uterine artery PI, and the mean uterine artery PI. Consequently, inadequate sub-endometrial blood flow may be a contributing factor to unexplained recurrent abortion and could serve as an independent risk factor for miscarriage. Color Doppler ultrasonography is a safe, non-invasive, cost-effective modality that can identify abnormal uterine Doppler indices predictive of pregnancy outcomes.

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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Conflicts of interest

There are no conflicts of interest.

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