

## Assessment of Uterine Artery Blood Flow in Threatened Miscarriage by 2D Doppler Ultrasound

Ahmed Mohammed El Hussiney, Shahenda Ahmed El-Sayed,  
Mohammed Fathi Abo Hashim, Basma Sobhy Abd-Elhameed\*

Department of Obstetrics and Gynecology, Faculty of Medicine, Zagazig University, Egypt

\*Corresponding author: Basma Sobhy Abd-Elhameed, Mobile: (+20)01021290018, E-mail: basmasobhy339@gmail.com

### ABSTRACT

**Background:** Transvaginal Doppler ultrasound is a non-invasive and commonly available screening approach for disorders of placental function early in pregnancy that can be used to predict a range of obstetric issues that can be associated to improper placentation and implantation. The present study aimed to assess uterine artery blood flow in threatened miscarriage using Doppler indices of uterine arteries to predict the fate of threatened miscarriage in 1st trimester. **Patients and methods:** A comparative study was conducted in Departments of Obstetrics and Gynecology in Zagazig University Hospitals and Kafr Saqr Central Hospital during the period from December 2019 to September 2021. The study included 64 pregnant women divided two groups; Group A (study group), included 32 pregnant women with threatened miscarriage, and Group B (control group) included 32 pregnant women with normal pregnancy. Transvaginal ultrasound Doppler studies of both uterine arteries flow indices including pulsatility index (PI), resistance index (RI) and peak systolic velocity (PSV) were carried out. **Result:** Peak systolic velocity (PSV) of uterine arteries was significantly higher in group (A) ( $44.46 \pm 16.56$ ) compared to group (B) ( $26.96 \pm 5.97$ ). On the other hand other flow indices did not significantly differ between by Mean the groups. **Conclusion:** Information regarding the uteroplacental circulation obtained with the use of color Doppler ultrasound could provide relevant and important prognostic information in cases of threatened miscarriage.

**Keywords:** Uterine artery Doppler, Threatened Miscarriage, Doppler Ultrasound, Pregnancy, Zagazig University.

### INTRODUCTION

A pregnancy loss that occurs prior to 20 weeks of gestation is referred to medically as a miscarriage. Threatened, inevitable, incomplete, complete, septic, and missed abortion are the several forms of spontaneous abortion [1].

Vaginal bleeding before 20 weeks gestational age in the presence of a positive urine and/or blood pregnancy test with a closed cervical OS and no passage of foetus products is referred to as a threatened abortion. Early in a pregnancy, lower stomach discomfort and/or vaginal bleeding might indicate a threatening abortion. During the first two trimesters, roughly 25% of pregnant women have some vaginal bleeding, and 50% of these cases result in a real abortion [1].

Due to obtaining a history of vaginal spotting and discovering a closed cervix during a subsequent vaginal examination, the diagnosis of threatening abortion is routinely made in clinical practice. After an ultrasound examination shows foetal heart activity in an intrauterine pregnancy, a conclusive diagnosis of threatening abortion should be made [2].

First-trimester bleeding may be a sign of underlying placental malfunction, which might lead to later-pregnancy complications such pre-eclampsia, preterm labour, preterm premature rupture of membranes (PPROM), placental abruption, and intrauterine growth restriction (IUGR). Pregnancy bleeding may make a woman anxious, and new research indicates that it may also have a negative impact on both the foetus and the mother. In order to prevent maternal or foetal mortalities or morbidities, it is therefore vital to be detected and managed [3].

Ultrasound used as a routine investigation to measure the Mean gestational sac diameter, crown-rump length, and presence or absence of embryo heart activity. Trans-vaginal ultrasound criteria alone can distinguish viable from non-viable empty gestational sacs at a single examination. A uterine artery Doppler can predict the outcome of viable embryo in normal pregnancy and in threatened miscarriage, as placental dysfunction that occurred in threatened miscarriage affects uterine artery indices [4].

The aim of this study is to assess the role of uterine artery Doppler in early prediction of pregnancy outcome in cases of threatened miscarriage.

### PATIENTS AND METHODS

This comparative study included 64 pregnant women divided two groups; 32 women with normal intrauterine pregnancy (Group A) and 32 women with normal pregnancy (Group B).

#### Ethical consent:

After Clear explanation of the study was made to all patients and a written informed consent was taken. The study was approved from Faculty of Medicine, Zagazig University Research Board and subjects in compliance with the Code of Ethics of the World Medical Association (Declaration Helsinki).

**Inclusion criteria:** Pregnant women with threatened miscarriage attending outpatient clinic. Age between 18 and 35 years. Single intrauterine pregnancy with a living embryo. Gestational age between 6-13 weeks calculated from first day of the last menstrual period.

**Exclusion criteria:** Inevitable miscarriage. Recurrent early pregnancy loss. History of coagulation defect. Age <18- and >35 years. Any uterine or ovarian masses. Short cervix, less than 2.5cm by trans-vaginal ultrasound.

All the women in this study were subjected to full history taking including age, residence, parity, pain, bleeding, and menstrual history. Full general clinical examination was done including vital signs (blood pressure measurement, pulse, temperature and respiratory rate), conscious level and color changes. Obstetric examination included abdominal and pelvic examinations to detect uterine size and any adnexal masses. Laboratory investigations included complete blood picture (CBC), liver and kidney function tests, bleeding profiles and fasting blood sugar (FBS). Trans-vaginal obstetric Ultrasonography (U/S) was done in a lithotomy position, using Siemens ACUSON X300U. Smachine at Zagazig University Hospitals and GE A6 VOLSUN U.S machine at Kafr Saqr Central Hospital.

All sonographic data of the pregnancy (number of fetuses, viability, gestational ages using Crown Rump length, placentae and retro-placental areas and cervical length) were evaluated and reported.

Trans-vaginal ultrasound color Doppler gate was activated to localize uterine arteries (lateral to the cervix at the level of internal OS) then blood flow indices:

pulsatility index (PI), resistance index (RI), peak systolic velocity (PSV) of both uterine arteries were measured using spectral Doppler and means were reported.

**Statistical analysis**

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data were described using number and percentage. The Kolmogorov-Smirnov test was used to verify the normality of distribution Quantitative data were described using range (minimum and maximum), mean and standard deviation. Chi square test ( $\chi^2$ ) to calculate difference between two or more groups of qualitative variables. Independent samples t-test or U Mann Whitney test was used to compare between two independent groups of normally distributed variables (parametric data). P value <0.05 was considered significant.

**RESULT**

A total of 64 pregnant women between 6-13 weeks' gestational age were enrolled in the study divided into 2 groups, 32 women with normal intrauterine pregnancy (group A), 32 women with normal pregnancy (group B). Demographic data of the studied groups did not significantly differ, thus both groups were prognostically comparable (**Table 1**).

**Table (1): Basic characteristics of the studied groups.**

Variable	Group (A) (n=32)		Group (B) (n=32)		U	P value
<b>Age (years)</b>						
<b>Min.-Max.</b>	19-35		20-33		456.00	0.451
<b>Mean± S.D</b>	25.44±5.22		26.47±5.08			
<b>Gestational Age (weeks)</b>						
<b>Min.-Max.</b>	6-13		6-13		475.50	0.620
<b>Mean± S.D</b>	9.75±2.489		10.06±2.40			
<b>Gravidity</b>						
<b>Min.-Max.</b>	1-5		1-5		989.50	0.256
<b>Mean± S.D</b>	3.06±1.34		2.65±1.48			
<b>Parity</b>						
<b>Min.-Max.</b>	0-4		0-4		495.00	0.821
<b>Mean± S.D</b>	2.00±1.524		1.91±1.467			
<b>Residence</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	$\chi^2$	P value
<b>Urban</b>	19	59.4	17	53.1	---	0.801
<b>Rural</b>	13	40.6	15	46.9		
<b>Menstrual History</b>						
<b>Regular</b>	18	56.3	13	40.6	---	0.317
<b>Irregular</b>	14	43.8	19	59.4		

U: Mann Whitney test.  $\chi^2$ : Chi square test.

The (PSV) was significantly higher in group (A) (44.46±16.56) compared to group (B) (26.96±5.97). However, other flow indices did not significantly different between both groups (Table 2).

**Table (2): Blood flow indices of uterine arteries of studied groups.**

Uterine artery indices	Group (A) (n=32)	Group (B) (n=32)	Test of Sig.	P value
<b>PSV (cm/s)</b>				
<b>Min.-Max.</b>	23.65-90.25	15.15-38.44	U=124.50	<0.001*
<b>Mean± S.D</b>	44.46±16.559	26.96±5.973		
<b>RI</b>				
<b>Min.-Max.</b>	0.61-0.90	0.60-0.88	U=394.50	0.113
<b>Mean± S.D</b>	0.81±0.087	0.80±0.066		
<b>PI</b>				
<b>Min.-Max.</b>	1.14-4.05	1.16-2.94	t=1.573	0.121
<b>Mean± S.D</b>	2.52±0.832	2.26±0.424		

t: Student T-test. U: Mann-Whitney test. \*: Statistically significant at P value <0.05

Furthermore, PSV was significantly higher in patients failed pregnancy outcomes compared to those with normal outcome in both groups (Table 3).

**Table (3): Relation between pregnancy outcome and uterine artery blood flow indices.**

Variable	Group (A) (n=32)		Group (B) (n=32)	
	Successful pregnancy	Failed pregnancy	Successful pregnancy	Failed pregnancy
<b>PSV</b>	30.01±4.056	52.02±15.556	25.65±5.141	36.14±1.611
<b>P value</b>	<0.001*		<0.001*	
<b>RI</b>	0.83±0.061	0.80±0.097	0.79±0.066	0.83±0.067
<b>P value</b>	0.584		0.209	
<b>PI</b>	2.67±0.821	2.45±0.847	2.24±0.424	2.41±0.457
<b>P value</b>	0.481		0.461	

\*: Statistically significant at P value <0.05

## DISCUSSION

The present study aimed to assess the role of uterine artery Doppler in early prediction of pregnancy outcome in cases of threatened miscarriage. The study groups were balanced regarding all demographic data maternal age, gestational age, gravidity, parity, residence and menstrual history.

In the present study, blood flow analysis was performed on the uterine artery because this vessel is easily recognized and detected [5].

Small vessels such as the peri-trophoblastic vessels are more difficult to detect, and require sophisticated equipment, thus the results obtained may be more imprecise and may vary greatly [6,7].

In our study, the mean uterine artery RI and PI of both groups did not significantly differ. A potential explanation is that women with threatened spontaneous abortion could have a vascular disorder caused by placentation anomalies that cannot be detected before the second trimester using Doppler ultrasonography or vascular compromise in the uteroplacental circulation in abnormal pregnancies was extremely minimal to be detected by the Doppler ultrasound.

The uterine artery represents the sum of the vascular resistance of the whole uterine vascular bed; thus small differences between normal and abnormal pregnancies cannot be detected. Some authors have proposed investigating the small vessels of the

vascular uterine bed such as the spiral arteries and the subchorionic vessels [7,8].

Interestingly, No definite reference values are present for Doppler indices in early pregnancy due to the paucity of Doppler studies before the eight weeks of gestation because of patients' infrequent referral for scanning in early pregnancy. However, the results of a previous study indicated a linear decrease in the values of PI, RI, and S/D ratio with the progression of pregnancy between 4-6 weeks and 16-32 weeks [9]. In addition, no definite cutoff values were reported for abnormal results [10].

**Sheehata et al.** [11] in their study of women with a diagnosis of threatened abortions, found there was no significant differences in RI, PI and PSV of Uterine artery between women who had got spontaneous abortion and those who continued their pregnancies. However, this study did not contain a control group of women with normal pregnancy.

Similar to our study, **Alcazar and Ruiz-Perez** [12] found no difference in PI for the uterine arteries on comparing patients with threatened abortion and control normal ones. Furthermore, they reported that PI was within the normal reference range in most patients with threatened abortion, even those who ultimately had a miscarriage.

On the other hand, **Kumari1 and Wanjari** [13], on their study evaluating RI, PI and S/D ratio of uterine arteries in pregnant ladies with threatened abortion,

found that RI and S/D ratio were significantly higher in women who aborted compared to those who continued their pregnancy but PI did not significantly differ between both groups.

Also, **Leible *et al.*** [14] reported discordant uterine artery blood flow velocity waveforms with an abnormally high PI in one of the two uterine arteries in patients at risk of subsequent miscarriage. In particular, the discordant uterine artery PIs were strongly associated with subsequent pregnancy loss. However, most cases of miscarriage reported in this work were missed miscarriages in which it has been demonstrated that the main cause of miscarriage is poor vascularization. It is probable that in missed miscarriage, as suggested by the authors, the exclusion of one uterine artery may produce an ischemic injury which leads to pregnancy failure.

**Gustavo *et al.*** [15] showed a significantly higher uterine artery resistance index in women with an abortion. However, this study was a cross-sectional one including patients with pregnancy <20 weeks with a diagnosis of threatened abortion that were followed up and their pregnancy outcomes was reported and then related to uterine artery RI. It did not include a control group of women with healthy pregnancy and their RI for comparison with studied group.

**Al Halaby *et al.*** [16] reported that uterine arteries RI was a good predictor of pregnancy outcome in cases of threatened miscarriage as RI was higher in patients with threatened abortions who get aborted before 24 weeks of their pregnancy. Whereas, and similar to ours, RI did not differ between those with normal pregnancies and those with threatened abortions who continued their pregnancies.

We have reported a statistically significant higher mean PSV of uterine in Group A (threatened abortion) compared to Group B (normal pregnancy). Additionally, a significantly higher PSV was reported in women with failed pregnancy compared to those with successful pregnancy outcomes.

Contrary to ours, **Alcazar and Perez** [12], found no difference in PSV of the uterine arteries between patients with threatened abortion and controls, also PSV was within the normal reference range in most patients with threatened abortion even those who ultimately had a miscarriage. They concluded that no apparent alteration occurs in the early uteroplacental circulation in patients with threatened abortion with a living embryo. Additionally, the use of transvaginal color Doppler ultrasound is not helpful for predicting pregnancy outcome in these cases.

Contrary to ours, **Mohamed *et al.*** [17] reported that PSV of uterine artery was significantly lower in women with threatened abortion with subsequent pregnancy loss compared to those who continued their pregnancies.

Additionally, **Shehata *et al.*** [11] reported that the Doppler indices of uterine arteries did not differ

significantly between women who did or did not experience a spontaneous abortion in a group of pregnant women with a diagnosis of threatened abortion.

## CONCLUSION

Information regarding the uteroplacental circulation obtained with the use of color Doppler ultrasound could provide relevant and important prognostic information in cases of threatened miscarriage. Larger controlled diagnostic studies and systematic reviews are still needed to elucidate these conflicts. More patients, longer follow-up, and multicenter experience are all necessary to accurately figure out the outcome of pregnancy and threatened miscarriage by uterine artery Doppler ultrasound.

**Conflict of interest:** The authors declare no conflict of interest.

**Sources of funding:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Author contribution:** Authors contributed equally in the study.

## REFERENCES

1. **Alves C, Rapp A (2020):** Spontaneous abortion. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK560521/>
2. **Mouri M, Hall H, Rupp T (2021):** Threatened abortion. Treasure Island (FL): StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK430747/>
3. **Weiss J, Malone F, Vidaver J *et al.* (2004):** Threatened abortion: a risk factor for poor pregnancy outcome, a population-based screening study. *Am J Obstet Gynecol.*, 190:745-5.
4. **Murugan V, Murphy B, Dupuis C *et al.* (2020):** Role of ultrasound in the evaluation of first-trimester pregnancies in the acute setting. *Ultrasonography*, 39(2):178-83.
5. **Deutinger J, Rudelstorfer R, Bernaschek G (1988):** Vagisonographic velocimetry of both main uterine arteries by visual recognition and pulsed Doppler method during pregnancy. *Am J Obstet Gynecol.*, 159:1072-6.
6. **Kurjak A, Zalud I, Predanic M *et al.*** Transvaginal color and pulsed Doppler study of uterine blood flow in the first and early second trimesters of pregnancy: normal versus abnormal. *J Ultrasound Med.*, 13(1):43-7.
7. **Jaffe R, Warsof S (1992):** Color Doppler imaging in the assessment of uteroplacental blood flow in abnormal first trimester intrauterine pregnancies. *J Ultrasound Med.*, 11:41-4.
8. **Trudinger B, Giles W, Cook C (1985):** Uteroplacental blood flow velocity-time waveforms in normal and complicated pregnancy. *Br J Obstet Gynaecol.*, 92:39-45.
9. **Dickey R (1997):** Doppler ultrasound investigation of uterine and ovarian blood flow in infertility and early pregnancy. *Hum Reprod Update*, 3(5):467-503.

10. **Khong S, Kane S, Brennecke S *et al.* (2015):** First-trimester uterine artery Doppler analysis in the prediction of later pregnancy complications. *Dis Markers*, 15:679730.
11. **Shehata N, Ali H, Hassan A *et al.* (2018):** Doppler and biochemical assessment for the prediction of early pregnancy outcome in patients experiencing threatened spontaneous abortion. *Int J Gynecol Obstet.*, 143:150-5.
12. **Alcazar J, Perez R (2000):** Uteroplacental circulation in patients with first-trimester threatened abortion. *Fertil Steril.*, 73:130-5.
13. **Kumari P, Wanjari S (2020):** Comparison of transvaginal colour doppler ultrasound and progesterone level estimation in outcome of threatened abortion in early pregnancy. *Journal of Clinical and Diagnostic Research*, 14(4):11-5.
14. **Leible S, Cumsille F, Walton R *et al.* (1998):** Discordant uterine artery velocity waveforms as a predictor of subsequent miscarriage in early viable pregnancies. *Am J Obstet Gynecol.*, 179:1587-93.
15. **Romero-Gutiérrez G, Huebe-Martínez A, Amaral-Navarro I *et al.* (2013):** Doppler ultrasound assessment in women with threatened abortion. *Clinical Medicine Research*, 2(3):24-8.
16. **Al Halaby A, Fahmy M, Khallaf H *et al.* (2020):** Resistance index of uterine and spiral arteries as a predictor of threatened miscarriage outcome. *The Egyptian Journal of Hospital Medicine*, 81(6): 2195-8.
17. **Mohamed M, Gar-elnabi M, Alseed M *et al.* (2013):** Evaluation Of Uterine Blood Flow In Threaten Abortion Using Color Doppler. *Asian J Med Radiol Res.*, 1(2):1-3.