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Original article

Doppler Ultrasound Assessment In Women With Threatened Abortion

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ABSTRACT

Background: Threatened abortion is assumed clinically when, during the first half of pregnancy, a bloody vaginal leak or bleeding through a closed cervical os occur. Around half of these gestations will terminate, and the risk of abortion is significantly smaller if the cardiac activity of the fetus is detected.
Aim and objectives: We aimed to evaluate the role of greyscale and color Doppler ultrasonography in the early detection of threatened abortion.
Patients and methods: This study was performed prospectively during the period from December 2018 to May 2019 at Zagazig University Hospital and Zagazig General Hospital. The study was carried out on 60 pregnant women divided into two groups; one group had vaginal bleeding, and the other group had an uncomplicated pregnancy.
Results: We detected a statistically significant increase in both uterine artery resistance index (RI) and trophoblastic flow RI; moreover, a statistically significant decrease regarding fetal heart rate (FHR) among Group A compared to Group B was observed (all P<0.001). There was a positive correlation between corpus luteum resistance index (CLRI) and uterine artery RI, between CLRI and trophoblastic flow RI, and between uterine artery RI and trophoblastic flow RI. Moreover, there was a negative correlation between FHR and CLRI, Uterine Artery RI, and trophoblastic flow RI (all P<0.001).
Conclusions: Transvaginal color Doppler ultrasound may add new information on RI of both uterine and subtrophoblastic arteries in addition to serial measurements of crown-rump length and FHR if present to allow further evaluation of the early pregnancy outcome.
Keywords: Pregnancy, Transvaginal Color Doppler, Vaginal Bleeding

INTRODUCTION

Abortion is defined as the termination of pregnancy earlier to the 20th week of pregnancy or the pregnancy termination of an embryo with a weight less than 500 grams. Threatened abortion is assumed clinically when, during the first half of pregnancy, a bloody vaginal leak or bleeding through a closed cervical os occur. Around one-half of women experience threatened abortion throughout early pregnancy, and it can last for days or even weeks. Around half of these gestations will terminate, and the risk of abortion is significantly smaller if the cardiac activity of the fetus is imagined [1]. Ultrasound examination is an essential auxiliary procedure for the diagnosis of abortion other than the clinical symptoms. The sonographic findings retrieved by using conventional ultrasound have been evaluated and are considered to have a predictive power that combines with other clinical and maternal factors analyzed [2]**.**Some conventional ultrasound outcomes such as the morphological characteristics of the yolk sac, adequate visualization of the embryo by transvaginal technique, changes in fetal heart rate, and macroscopic lesions of the placenta are considered as prognostic factors [2]**.**The assessment of the hemodynamic status of women from the first trimester of gestation is now available because of the doppler ultrasound administration in the obstetrics field. In Romero-Gutiérrez et al.[3] included women at the first trimester and used transvaginal pulsed-wave Doppler ultrasound. Uterine arteries were detected in all participants and the flow in the peri

trophoblastic area was visualized in 94% of the included women. Blood flow in the umbilical artery and fetal aorta was detected in the last 7th week, and the corpus luteum flow blood was detected in 75% of the included participants [3].

One of the measures retrieved by using Doppler ultrasonography is uteroplacental blood flow which is known as trophoblastic flow. Evidence suggests that trophoblastic flow may have a predictive value to the gestation's progression.

Included 100 women with viable gestations, with a gestational age of (7-12 weeks). Jaffe evaluated the uteroplacental flow and predicted the outcomes of 1st-trimester pregnancies by using Doppler sonography. Findings showed that the abnormal Doppler findings were linked with a high rate of complicated pregnancies; whereas of participants with abnormal vs. with normal Doppler findings, 43% and 1.4% ended in abortion [3] .Corpus luteum flow assessment showed distinctions in normal pregnancy participants relative to cases with abortion. A higher mean resistance index was documented in women with abortion than in the healthy pregnancy group [4]. In our study, we aimed to evaluate the role of greyscale and color Doppler ultrasonography in the diagnosis and Early detection of threatened abortion

PATIENTS AND METHODS

This study was performed prospectively during the period from December 2018 to May 2019 at Zagazig University Hospital and Zagazig General Hospital, Zagazig, Egypt. Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans **Patients:** Sixty pregnant women divided into two groups: The study group (Group A) consisted of pregnant women in the first trimester of pregnancy who were referred from The Emergency Department or the outpatient clinic of Obstetrics and Gynecology. Patients were presented with vaginal bleeding with or without lower abdominal pain and were clinically diagnosed as threatened abortion. While the control group (Group B) consisted of pregnant women in their first trimester of pregnancy with normal uncomplicated pregnancies attended to the outpatient clinic for routine antenatal care.The nature and aims of the study were fully explained to all the participants **Eligibility criteria** :

We included women with a singleton pregnancy and who had regular cycles before pregnancy and the specified date of last menstrual period was known. Pregnancies with a gestational age ranging from 5-12 weeks calculated from the first day of the last menstrual period and patients with mild vaginal bleeding with or without abdominal pain (uterine cramps) were included. Women with visible intrauterine gestational sac with a living embryo visualized on real-time ultrasound.

We excluded women with multiple pregnancies, patients with a missed abortion,blighted ovum, or incomplete abortion. Moreover, we excluded patients with severe bleeding (inevitable abortion) and patients with ectopic or molar pregnancy. The selected patients were subjected to the following

Careful history taking including age, gravidity, parity, date of onset and severity of vaginal bleeding, presence of abdominal pain, any maternal medical problem, and date of the last menstrual period from which the gestational age was calculated. **Methods**: For the assessment of the fetus, an Ultrasound scan is a reliable, valid investigation which is characterized by its non-invasiveness and cost-effectiveness; thus, the Ultrasound scan is an essential obstetric method and has a principal role in the maternal and fetal care [5].**Technique and equipment**

Transabdominal and/or transvaginal Ultrasonography (greyscale and color Doppler studies) were performed for the all patients using a color Doppler machine (Voluson 730 pro 50/60 HZ) and using a convex multifrequency transabdominal probe (3.5 to 5MHz) with a frequency selected according to the patient's body built and a transvaginal probe with a frequency of 6 MHz.**Transabdominal sonography**

We performed transabdominal ultrasonography of the pelvic region when the gestational sac and fetus were visualized by transabdominal ultrasonography or when the patient refused transvaginal ultrasonography.

The patient lied in the supine position with a full urinary bladder; the abdominal transducer was lubricated with a coupling gel.

First, we placed the transducer vertically above the symphysis pubis in the midline, producing a middle sagittal image, from this position we moved the transducer in a continuous scanning on each side of the lower abdomen and pelvis to obtain parasagittal scans. Then the transducer was rotated through 90˚, and we started immediately superior to the symphysis pubis, transverse images were gathered moving cranially towards the fundus of the uterus using a continuous scanning. Additional oblique projections are necessary to complete the examination. **Transvaginal sonography (TVS)**

During the scanning, the urinary bladder should be empty. The full bladder may occupy most of the screen of the pelvis, displacing the relevant possible ovarian or tubal pathology beyond the reach of the transducer**.** We performed TVS

ultrasonography when the gestational sac and fetus were not visualized by transabdominal ultrasonography. We covered the transducer with a condom or a digit of surgical glove, and we used a lubricant on the outside of the condom before insertion into the vagina. We inserted the TVS probe inside the vagina with the patient in the lithotomy position. We positioned the upper body of the patient higher than the pelvis to permit pooling of any fluid in the cul-de-sac. The patient was allowed to lift her knees towards her chest for better imaging of the higher structures.

We manipulated the transvaginal transducer to image sagittal and coronal sections of the uterus and adnexa. By rotation through 90˚ degrees, we could present a sagittal or longitudinal scan. Rotation of the transducer for another 90˚degree in the same direction could obtain a coronal scan.

Ultrasonographic greyscale parameters

Fetal parameters Crown Rump Length (CRL)

We measured the fetal CRL from the top of the head to the bottom of the rump in millimeters (mm), (Fig. 1)**Fetal Heart Rate (FHR) or pulsations**:

We measured FHR by the M-mode of the real-time ultrasound in a longitudinal section of the fetus when the movements of the valves of the hearts were identified and placing the sampling gate on the fetal heart when movements of the valves of the heart were not detected we used color Doppler for measuring FHR. It was calculated from two consecutive fetal heart waves when at least three or more successive waveforms were identified. It was estimated by beat per minute (bpm), (Fig. 2)

Color Doppler studies: Uterine artery resistive index (RI): The transducer was inserted in the lower lateral quadrant of the uterus. We angled it medially to identify a prominent view of the main uterine artery, the external iliac artery, and external iliac vein. And then we measured the RI of the uterine artery for each ultrasound session (Fig. 3).

Subtrophoblastic arteries RI:

The views assumed for Doppler study of the subtrophoblastic vessels were transverse or slightly oblique views because most of the vessels in an implanted ovum would lie in the posterior part of the decidua basalis.

Several vessels were selected by the help of color Doppler, and the arteries were identified then we measured the RI of these arteries for each ultrasound session, (Fig .4)**Corpus luteum RI:**

Corpus luteum was identified by visualization of each ovary then RI of blood vessels surrounding corpus luteum was measured, (Fig. 5)

Statistical analysis Data were collected and coded using Microsoft Excel sheet. Data on each of our study parameters were analyzed for the threatened study group and the control group using the Statistical Package for the Social Sciences (SPSS) software version 20.0 for windows. P-value was set at <0.05 for significant results and <0.001 for high significant results.

RESULTS

Sixty women were included in our study. Patients were divided into two groups; group A included 30 pregnant women that were clinically diagnosed as threatened abortion while group B included 30 pregnant women with normal, uncomplicated pregnancies. In group A, the mean age of patients was 26.23 (3.84) years, and the mean gestational age was 7.87 (0.94) weeks. While in group B, the mean age of patients was 25.07 (3.13) years, and the mean gestational age was 7.80 (1.13) weeks, **Table 1.** Most of the group A patients were gravida 3 (43.3%) and 46.7% were para 1 while most of group B participants were gravida 2 (40%) and half of group B participants were para 1, **Table 2**.

Ultrasound and Doppler ultrasound parameters As shown in Table 3, regarding CRL and CLRI, there was no statistically significant difference between the two studied groups (7.78 ± 0.97 and 0.56 ± 0.02 in group A vs. 7.73 ± 1.13 and 0.54 ± 0.01 in group B, P>0.05). There was a statistically significant decrease in FHR among Group A compared to Group B (146.53 ± 5.47 vs. 158.07 ± 1.84, P<0.001). Moreover, there was a statistically significant increase in both uterine artery RI and trophoblastic flow RI among Group A compared to Group B (0.84 ± 0.08 and 0.54 ± 0.05 in group A vs. 0.76 ± 0.01 and 0.44 ± 0.02 in group B, P<0.001).**Correlation analysis**

There was a positive statistically significant correlation between CRL and GA (r= 0.969, P<0.001), between CLRI and uterine artery RI (r= 0.472, P<0.001), between CLRI and trophoblastic flow RI (r= 0.606, P<0.001), and between uterine artery RI and trophoblastic flow RI (r= 0.583, P<0.001).Moreover, there was a negative statistically significant correlation between FHR and CLRI (r= -0.547, P<0.001), between FHR and uterine artery RI (r= -0.565, P<0.001), and between FHR and trophoblastic flow RI (r= -0.832, P<0.001), as shown in Table 4.

Table (1): Characteristics of the included population (N= 60)

Variable	Group A (n=30)	Group B (n=30)	P value *
Maternal Age (years) Mean ± SD	26.23 ± 3.84	25.07 ± 3.13	0.20
Gestational Age (weeks) Mean ± SD	7.87 ± 0.94	7.80 ± 1.13	0.80
*** non-significant at P>0.05; SD: standard deviation**			

Table (2): Gravidity and parity of the two studied groups

Variable	Group A (n=30)		Group B (n=30)		P value *
	No	**%**	**No**	**%**	
Gravidity					
1	5	16.7	6	20	0.56
2	8	26.7	12	40	
3	13	43.3	8	26.7	
4	4	13.3	4	13.3	
Parity					
0	5	16.7	6	20	0.55
1	14	46.7	15	50	
2	10	33.3	6	20	
3	1	3.3	3	10	
*** non-significant at P>0.05**					

Table (3): US and Doppler US parameters among the two studied groups

Variable	Group A (n=30)	Group B (n=30)	P value
CRL Mean ± SD	7.78 ± 0.97	7.73 ± 1.13	0.86
FHR (beat/min) Mean ± SD	146.53 ± 5.47	158.07 ± 1.84	**<0.001 ****
CLRI Mean ± SD	0.56 ± 0.02	0.54 ± 0.01	0.21
Uterine artery RI Mean ± SD	0.84 ± 0.08	0.76 ± 0.01	**<0.001 ****
Trophoblastic flow RI Mean ± SD	0.54 ± 0.05	0.44 ± 0.02	**<0.001 ****
****: Highly significant (P<0.01); CRL: Crown rump length; FHR: Fetal heart rate; CLRI: Corpus luteum resistance index; SD: standard deviation**			

Table (4): Correlation between Doppler US parameters and age, GA, parity, and gravity

Variable		CRL	FHR	CLRI	Uterine Artery RI	Trophoblastic flow RI
Maternal Age	r	0.081	-0.086	0.034	0.254	0.124
	P	0.541	0.513	0.796	0.050	0.347
Gestational Age	r	**0.969****	0.016	-0.079	-0.156	-0.065
	P	**<0.001**	0.902	0.551	0.234	0.623
Gravidity	r	0.148	-0.131	-0.147	0.156	0.160
	P	0.260	0.318	0.264	0.235	0.221

Variable		CRL	FHR	CLRI	Uterine Artery RI	Trophoblastic flow RI
Parity	r	0.140	-0.035	-0.216	0.025	0.053
	P	0.288	0.794	0.097	0.849	0.685
CRL	r	---	0.008	-0.086	-0.134	-0.062
	P	---	0.950	0.515	0.308	0.636
FHR	r	0.008	---	**-0.547****	**-0.565****	**-0.832****
	P	0.950	---	**<0.001**	**<0.001**	**<0.001**
CLRI	r	-0.086	**-0.547****	---	**0.472****	**0.606****
	P	0.515	**<0.001**	----	**<0.001**	**<0.001**
Uterine Artery RI	r	-0.134	**-0.565****	**0.472****	---	**0.583****
	P	0.308	**<0.001**	**<0.001**	----	**<0.001**
Trophoblastic flow RI	r	-0.062	**-0.832****	**0.606****	**0.583****	---
	P	0.636	**<0.001**	**<0.001**	**<0.001**	----

r: Pearson's correlation coefficient; **: Highly significant (P<0.01); CRL: Crown rump length; FHR: Fetal heart rate; CLRI: Corpus luteum resistance index

Fig 1: Crown rump length

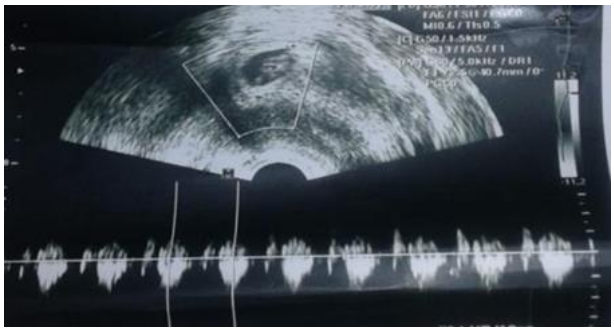

Fig 2: Fetal heart rate

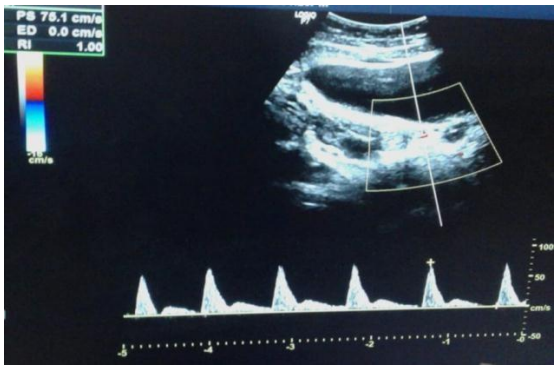

Fig 3: Uterine artery resistive index

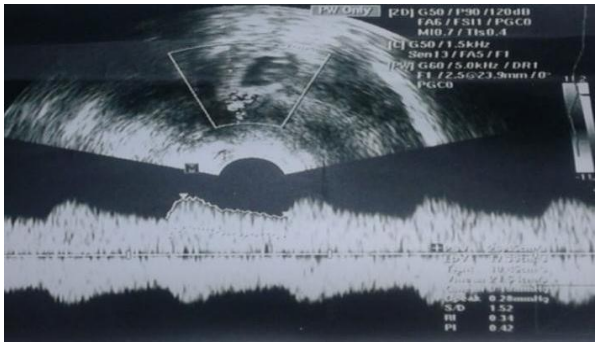

Fig 4: Subtrophoblastic arteries RI

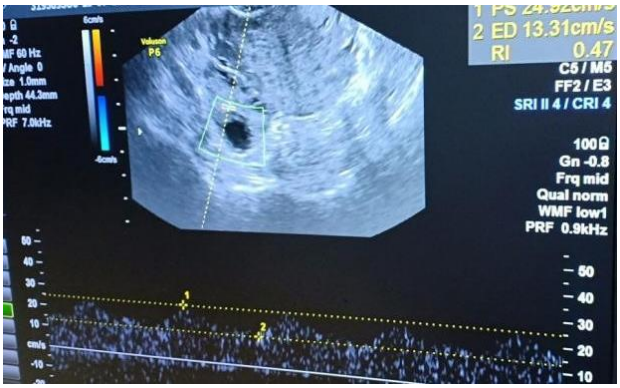

Fig 5: Corpus luteum RI:

DISCUSSION

Our prospective study aimed to evaluate the prognostic value of correlating the crown-rump length and fetal heart rate, Doppler study of the uterine artery, corpus luteum, and subtrophoblastic flow in the prediction of early pregnancy outcome among cases of the first trimester threatened abortion. The present study included 60 pregnant females between 5th and 12th weeks; of them, 30 women were diagnosed at the first presentation as threatened abortion with a living (pulsating) positive fetal heart pulsation, and 30 participants of normally ongoing pregnancies were considered as the control group. In the present study, we found that the mean values for CRL diameter showed no statistically significant differences between the two groups (P>0.05). This finding is against the results of Reljic M. study [6]; where he detected that in fetuses with CRL< 18 mm, there was a notable positive correlation between the CRL deficit for gestation and the frequency of consequent inevitable abortion. While in fetuses with CRL ≥ 18 mm, there was a significant positive correlation between the CRL deficit for gestation and the incidence of small for gestational age. Reljic M. stated that, as an indicator of inevitable spontaneous abortion and small for gestational age in women with threatened abortion, assessment of fetal CRL might be helpful. Reljic M. documented that the early delay of the embryo growth might be regarded as a risk factor in threatened abortion. If a fetus has grown up to 5 mm, 6–10 mm, and over 10 mm, the loss of viability occurs with a rate of 7.2%, 3.3%, and 0.5% of cases, respectively [6].

El-Ashmawi et al. found that as regards the CRL, there was a statistically significant difference between the control mean value and that of the aborted group at 10-11 weeks but no significant difference at 6-7 weeks or 8-9 weeks was detected [7].The deficit between the CRL and that prophesied by the last menstrual period is defined as early growth restriction [8].

Jauniaux et al. documented that there was contradictory data for a relationship between early growth restriction and karyotypic anomalies. A less than expected CRL has been linked with consequent abortion [8]. In our study, we detected that the mean values of FHR showed statistically significant differences between the two groups (P<0.05), and FHR among group A participants was lower than group B participants. Romero-Gutiérrez et al. [3] assessed the FHR and Doppler velocimetry and documented one patient with a FHR below 100 beats per minute who later had an abortion. Authors analyzed the FHR and observed that bradycardia was associated with an increased risk of spontaneous abortion.

Jauniaux et al. stated that there is an association between the unusual pattern of FHR with or without bradycardia and consequent abortion; notably, at 1.5–2 months, a slow FHR is linked with subsequent miscarriage. Authors informed that throughout the first trimester, FHR increase is observed in healthy gestations, and fetal bradycardia is an indicator of poor pregnancy outcome. Authors suggested that physicians should not consider a single measurement of an abnormal slow FHR as an indication for fetal death and continuous deterioration of fetal heart activity is unavoidably linked with miscarriage [8].

Moreover, Maged & Mostafa explained the higher rate of miscarriage in cases with a lower FHR due to poor growth of the heart as the initial rise of FHR from 110 bpm at the fifth week of pregnancy to 170 bpm at the ninth week of pregnancy corresponds to a morphological heart growth [9].

Our study findings showed that regarding the Doppler studies for the subtrophoblastic flow RI, there was a significant difference between the two groups mean values (P<0.001) with a higher subtrophoblastic RI in group A participants than group B participants. This finding is in line with the results of Sieroszewski et al. [10] who evaluated the Doppler indices of the flow velocity waveforms in uterine arteries (S/D and RI) in pregnant women in the first trimester of pregnancy. Authors concluded that there were statistically significant differences for RI in the uterine arteries in threatened abortion compared with normal early pregnancies (P<0.05).On the other hand, Ertan et al. [11] evaluated the changes of the uteroplacental, fetal aorta, and umbilical circulation during early pregnancy in healthy uncomplicated pregnancies. They concluded that Doppler sonography is not a routine diagnostic tool during the first three months of pregnancy, although it has the potential to speculate the pathophysiological changes in early pregnancy.

Also, Pellizzari et al. included 81 participants divided into two groups; the case group included 46 pregnant women with uterine bleeding while the control group included 35 women with normal pregnancies. They compared the blood flow of the uterine artery of both groups, and they stated that clinical role of the Doppler analysis of the uterine artery blood flow for the control of early gestations with a complication of uterine bleeding is questionable[12].Alcazar JL and Ruiz-Perez ML performed a study on 129 women with low risk normally developing pregnancies in the first trimester and 49 patients with the first trimester threatened abortion, from which 13 patients spontaneously aborted. They observed that there was no significant difference regarding any Doppler findings between both groups even in gestations which was terminated by inevitable

miscarriage. However, in uterine arteries of the control group, there was a notable correlation between the age of the fetus and the peak systolic velocity and pulsatility index [13].Giacobbe et al. stated that in the threatened abortion group, the RI in the uterine arteries was significantly more eminent than the normal pregnancy group, and in both groups, the uterine arteries RI diminished with the advancement of gestational age [14]. Romero-Gutiérrez et al. reported an altered measurement of the RI of the uterine artery, and there was a statistically significant difference in terms of adverse pregnancy outcomes; moreover, it was reported mostly higher in patients who experienced abortion [3]. Furthermore, they stated that Doppler studies for the uterine artery RI showed a highly significant difference between normal pregnancy and threatened abortion with a higher resistive index in the threatened abortion group.

CONCLUSIONS

Transvaginal color Doppler ultrasound may add new data on RI of both uterine and subtrophoblastic arteries in addition to serial measurements of CRL and FHR if present to allow further evaluation of the early pregnancy outcome.

RECOMMENDATIONS

This study recommends follow up cases of threatened abortion by the serial greyscale and color Doppler ultrasonography.

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