

# The Role of Ultrasonography in Predicting First Trimester Pregnancy Loss

## İlk Trimester Gebelik Kayıplarını Öngörmeye Ultrasonografinin Yeri

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### ABSTRACT

**Objective:** The aim of this study is to determine the predictive value of gestational sac (GS), yolk sac (YS), Crown rump length (CRL) measurement, fetal heart rate (FHR) and decidual thickness in determining the risk of miscarriage, according to sonographic findings at the 6-7th week of pregnancy. **Materials and Methods:** 108 patients aged 20-45, who were in the 6-7th week of pregnancy and who were admitted to our hospital between March 2018-2023, were included in the study. Those with chronic disease, history of recurrent miscarriage, uterine anomaly, history of genetic disease, and multiple pregnancy were not included in the study. The patients' data were obtained retrospectively from the hospital database. The parameters of cases who had abortions and cases whose pregnancies continued were compared. **Results:** There was no significant difference in the presence of abortion according to the age of the participants ( $p=0.643$ ). GS diameter and CRL measurement were found to be significantly lower in patients who had an abortion ( $p<0.001$ ,  $p=0.007$ , respectively). The decidual thickness and progesterone levels of patients who had an abortion were found to be significantly lower ( $p=0.028$ ,  $p<0.001$ , respectively). The YS diameter of patients who had an abortion was found to be significantly higher ( $p=0.002$ ). **Conclusion:** It was concluded that YS diameter and morphology, GS diameter, CRL measurement, decidual thickness and progesterone level at the 6th-7th weeks of pregnancy are significant in predicting pregnancy prognosis. In the light of our study data, it is suggested that evaluation of ultrasonography parameters in predicting first trimester pregnancy losses may be meaningful in predicting pregnancy prognosis and providing counseling to the patient.

**Keywords:** Ultrasonography; abortion; 1. trimester

### ÖZET

**Amaç:** Bu çalışmanın amacı gebeliğin 6-7.haftasındaki sonografik bulgulara göre gestasyonel kese (GS), yolk kesesi (YS), fetal kalp hızı ve desidual kalınlığının abortus riskini belirlemedeki prediktif değerini saptamaktır. **Gereç ve Yöntem:** Hastanemize Mart 2018-2023 tarihleri arasında başvuran, gebeliğin 6-7.haftasında olan 20-45 yaş arası 108 hasta çalışmaya dahil edilmiştir. Kronik hastalık, tekrarlayan düşük öyküsü, uterin anomali, genetik hastalık öyküsü, çoğul gebeliği olanlar çalışmaya alınmamıştır. Hastaların verileri hastane veritabanından retrospektif elde edilmiştir. Abortus yapan olgularla gebelikleri devam eden olguların parametreleri karşılaştırılmıştır. **Bulgular:** Katılımcıların yaşına göre abortus varlığı arasında anlamlı farklılık saptanmamıştır ( $p=0.643$ ). Abortus yapan hastaların GS çapı, CRL ölçümü anlamlı olarak düşük saptanmıştır ( $p<0.001$ ,  $p=0.007$  sırasıyla). Abortus yapan hastaların desidual kalınlığı ve progesteron düzeyleri anlamlı olarak düşük saptanmıştır ( $p=0.028$ ,  $p<0.001$  sırasıyla). Abortus yapan hastaların YS çapı anlamlı olarak yüksek saptanmıştır ( $p=0.002$ ). **Sonuç:** Gebeliğin 6-7.haftalarında YS çapının ve morfolojisinin, GS çapının, CRL ölçümünün, desidual kalınlığının ve progesteron seviyesinin gebelik prognozunu öngörmeye anlamlı olduğu sonucuna varılmıştır. İlk trimester gebelik kayıplarını öngörmeye ultrasonografisini parametrelerinin değerlendirilmesi, gebelik prognozunu öngörmeye ve hastaya buna yönelik danışmanlık verilmesinde anlamlı olabileceği çalışmamız verileri ışığında önerilmektedir.

**Anahtar Kelimeler:** Ultrasonografi; abortus; 1. trimester

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With the widespread use of transvaginal ultrasonography approach in early pregnancy, the process and development of first trimester pregnancies has been increasingly clarified.<sup>1,4</sup> Despite advances in modern medicine, the cause of abortions is often unknown. The most important cause of abortions is chromosomal anomalies. Apart from that, infections, teratogenic drugs, radiation are important causes of abortion. The abortion rate that occurs after the implantation period is 30-40% on average.<sup>5</sup> Even under the best conditions, 10-15% of all pregnancies end in abortion. The expected gestational sac diameter is defined 35 days after the last menstrual period (LMP) in the first trimester of pregnancy.<sup>3,6</sup> In addition, a number of studies have shown that a smaller-than-expected gestational sac diameter predicts impending loss in pregnancies 5.5 weeks and above.<sup>7,8</sup> Most subsequent studies have examined first-trimester pregnancies that are over the 37<sup>th</sup> day from the last menstrual period. Little is known about the value of such measurements in pregnancies <37 days of last menstrual period.<sup>7,8</sup> The aim of this study is to determine the predictive value of gestational sac (GS), yolk sac (YS), Crown rump length (CRL) measurement, fetal heart rate (FHR) and decidual thickness in determining the risk of miscarriage, according to sonographic findings at the 6-7<sup>th</sup> week of pregnancy.

## MATERIALS AND METHODS

108 pregnant women aged 20-45 years who applied to our hospital between March 2018- 2023 and whose gestational sac measurements were in the 6<sup>th</sup> and 7<sup>th</sup> weeks were included in the study. Pregnant women with chronic disease, with a history of recurrent miscarriage, with uterine anomaly (such as uterine fibroids, uterine septus or endometrial polyps) that may cause abortion, with a baby with anomaly or a genetically transmitted disease, with multiple pregnancies, and with a threat of miscarriage at the first follow-up were not included in the study. Age, last menstrual period, gravida, parity and abortion numbers of the cases were recorded. Pregnant women whose GS values measured by TV USG were at 6<sup>th</sup> and 7<sup>th</sup> weeks were included in the study. Evaluation, examination and follow-up were done by the same gynecologist and radiologist each time. The pregnant women in-

cluded in the study were examined by transvaginal ultrasonography in the dorsolittotomy position after urinating. In the pregnant women included in the study, it was first checked whether the gestational sac was regular or not. Cases with irregular gestational sac or subchorionic hemorrhage were excluded from the study. Later, in order to determine the size of the gestational sac, the measurements of the anterior-posterior and longitudinal diameters were taken in the sagittal plane. The transverse diameter of the gestational sac was also measured in the coronal plane. The average of these three values was recorded. Ultrasonographic age was recorded according to the mean gestational sac diameter. The morphology of the yolk sac was carefully examined, it was checked whether it was regular and whether it contained calcification. When the yolk sac was best viewed in the sagittal plane, its transverse diameter was measured from the longest point inside out, and its length was noted in millimeters. For decidual reaction thickness measurement, the hyperechoic halo around the gestational sac was measured at its widest point and recorded. Then, the heart rate of the embryo was evaluated. Cases without a heartbeat were excluded from the study. The heart rate of the embryo was calculated and recorded. All data of these patients were obtained retrospectively from the hospital database and patient files. The ultrasound data of this patient group between 10 and 12 weeks were also evaluated retrospectively. The parameters of the cases who had abortion and those whose pregnancies continued were compared. First, descriptive statistics for the data obtained from the participants were calculated. Then, difference and relationship tests were carried out. The study was written in accordance with the Principles of the Declaration of Helsinki. In our study, an Informed Consent form was obtained from the patients. Ethics committee approval numbered 2023/28-21 was received from 9 Eylül University Ethics Committee. Numerical variables were summarized as mean  $\pm$  standard deviation. Categorical variables were shown in numbers and percentages. Mann-Whitney U test was used to evaluate data between two independent groups. Chi-Square test was used to compare categorical variables Spearman correlation coefficient was used to examine the correla-

**TABLE 1:** Relationship between abortion and ultrasonographic data.

	All Patients n=108 mean±SD	Abortion (+) n=11 mean±SD	Abortion(-) n=97 mean±SD	p
Age (year)	29.5±4.7	29.2±4.5	29.7±4.9	0.643
GS diameter (mm)	19.5±2.7	17.6±3.1	20.1±2.1	<0.001
CRL (mm)	8.4±1.9	7.1±1.1	8.9±1.4	0.007
YS diameter (mm)	4.6±2.1	5.6±1.1	4.3±0.6	0.002
Fetal heart rate (bpm)	138.8±21.2	120.2±19.4	142.4±14.5	<0.001
Decidual reaction thickness(mm)	7.6±1.1	6.7±0.8	7.9±0.8	0.028
Pregnancy progesterone level (nmol/L)	16.9±5	12.1±2.2	18.8±3.1	<0.001

\*GS: Gestational sac; CRL: Crown rump length; YS: Yolk sac; FHR: Fetal hearth rate

tion between different variables. Statistical analysis was performed by SPSS version 26.0 (IBM Inc., Chicago, IL, USA).

## RESULTS

The mean age of the participants was 29.5±4.7, the mean GS diameter was 19.5±2.7 mm, the mean CRL was 8.4±1.1 mm, the mean YS diameter was 4.6±0.6 mm. The mean fetal heart rate was 138.8±16.2, the mean decidual reaction thickness was 7.6±0.4 mm, and the mean pregnancy progesterone was 16.9±3.4 nmol/L .There was no significant difference between whether or not there was an abortion according to the age of the participants ( $p=0.643$ ). GS diameter and CRL measurement were found to be significantly lower in patients who had an abortion ( $p<0.001$ ,  $p=0.007$  respectively). Fetal heart rate was found to be significantly lower in patients who had an abortion ( $p<0.001$ ). Decidual reaction thickness and pregnancy progesterone levels were found to be significantly lower in patients who had an abortion ( $p=0.028$ ,  $p<0.001$  respectively). YS diameter was

**TABLE 2:** Relationship between smoking and abortion.

		Smoking (+) n-(%)	Smoking (-) n-(%)	Total n-(%)	p
Abortion	Yes	3-(37.5%)	8-(8.0%)	11-(10.2%)	0.008
	No	5-(62.5%)	92-(92.0%)	97-(89.8%)	

found to be significantly higher in patients who had an abortion ( $p=0.002$ ) (Table 1).

When the relationship between smoking and abortion was examined, the abortion rate of smokers was found to be significantly higher than that of non-smokers ( $p=0.008$ ) (Table 2).

A statistically significant, positive and moderate correlation was found between abortion and GS diameter and fetal heart rate ( $p<0.01$ ;  $r=0.376$  and  $r=0.455$ , respectively). A statistically significant, positive and moderate correlation was found between abortion and pregnancy progesterone level ( $p<0.01$ ;  $r=0.524$ ). On the other hand, a statistically significant,

**TABLE 3:** Correlation of abortion and ultrasonographic parameters.

	1	2	3	4	5	6
1.GS diameter (mm)	,376	-				
2.CRL (mm)	,260	,727	-			
3.YS diameter (mm)	-,302	-,076	-,044	-		
4.FHR (bpm)	,455	,074	,140	-,178	-	
5.Decidual reaction thickness (mm)	,212	,220	,183	,013	,039	-
6.Pregnancy progesterone level (nmol/L)	,524	,003	-,088	-,133	,189	,156

GS: Gestational sac; CRL: Crown rump length; YS: Yolk sac; FHR: Fetal hearth rate

positive and weak correlation was found between abortion and CRL and decidual reaction thickness ( $p < 0.01$ ;  $r = 0.260$  and  $r = 0.212$ , respectively). When YS diameter and abortion were considered, a statistically significant, negative and moderate relationship was found between them ( $p < 0.01$ ;  $r = 0.302$ ) (Table 3).

## DISCUSSION

Ultrasonography has a place in determining the course of pregnancy and predicting its prognosis. With ultrasonography, gestational sac, CRL, yolk sac, and fetal heart rate are evaluated during the first trimester. In this study, where we aimed to determine the role of these ultrasonographic findings in predicting the prognosis of pregnancy, the above parameters were scanned in 108 pregnant women at 6<sup>th</sup> and 7<sup>th</sup> weeks according to gestational sac measurements and the results were compared with the studies in the literature. The width, length and depth of the gestational sac were measured in millimeters from the inner edge to the inner edge by high resolution transvaginal ultrasonography. The mean value of the three diameters was taken. In our study, it was found that the gestational sac diameter of the cases who had abortion was found to be smaller according to the gestational week compared to the cases who did not have abortion. In a study conducted by Fatma P. et al., the relationship between gestational sac and abortion was found to be similar to our study.<sup>9</sup> In another study, mean gestational sac diameters were measured by transvaginal ultrasonography on the 28<sup>th</sup>-35<sup>th</sup> and 36<sup>th</sup>-42<sup>nd</sup> days of the last menstrual period of 67 pregnant women. 32 pregnant women followed in the study gave birth and 35 pregnancies were resulted in miscarriage. There was no difference between the sac diameters of the cases who had abortion between the 28<sup>th</sup> and 35<sup>th</sup> days and those who did not. However, there was a difference between gestational sac diameters on days 36-42. GS diameters of cases who had abortion were smaller than those who did not.<sup>10</sup> In our study, the mean yolk sac diameter of the cases who had abortion was found to be larger and statistically significant compared to the cases who did not have abortion. In our study, it was concluded that calculating the size of the yolk sac diameter and evaluating

its morphology in early pregnancy may be useful in predicting abortion. In a study reported by Stampone C. et al., 101 pregnant women were evaluated in the early pregnancy period, and 8 of the 16 pregnant women who ended in miscarriage had no yolk sac and were considered anembryonic. While the yolk sac was normal in five of the other eight cases, the volume of the yolk sac increased in three cases.<sup>11</sup> In a study reported by Varelas FK et al., 219 pregnant women in the first trimester were included in the study and 12 of 219 pregnancies ended in abortion. It was concluded that low yolk sac size is associated with poor obstetric outcomes.<sup>12</sup> In a study reported by Lindsay DJ et al., it was determined that the pregnancy prognosis was poor in cases with a yolk sac volume larger than normal, and the prognosis was better in pregnant women with a normal or small yolk sac volume.<sup>13</sup> In the study of Cho et al., 154 pregnant women between the 6<sup>th</sup> and 10<sup>th</sup> weeks were included in the study. Irregularly shaped yolk sac was present in one of 13 patients who were found to have yolk sac and had abortion. While normal yolk sac was detected in another patient, a relatively wide yolk sac was detected in other 11 pregnant women.<sup>14</sup> In our study, fetal heart rate calculated by transvaginal ultrasonography was found to be slower in cases with abortion. In the light of this statistically significant finding, counting the embryo heart rate can be recommended. Therefore, counting the embryo heart rate in early pregnancy with transvaginal ultrasonography can be recommended depending on the data of our study, as it is useful in predicting pregnancy prognosis. Similarly, a statistical relationship was found between heart rate and abortion in a study.<sup>9</sup> In a study reported by Achiron R et al., 629 pregnant women were followed from the early pregnancy period, 580 of these patients remained in the study until the end of the 13<sup>th</sup> week, and 23 of 580 pregnancies ended in miscarriage.<sup>15</sup> A significant difference was found between the mean heart rate in eight of the pregnancies resulted in abortion and the embryo heart rate of the pregnant women who did not have abortion. In 15 of the pregnant women, it was observed that the mean heart rate was outside the 95% confidence interval.<sup>15</sup> In a study by Theodor et al., 2164 pregnant women were evaluated by transvaginal ultrasonography at 6-

8<sup>th</sup> weeks and the heart rate of the cases was counted. While the mean heart rate was 125±15 beats/min in cases without abortion, it was found as 85 beats/min in cases with abortion. A correlation was found between abortion and a heart rate of 85 beats/min.<sup>16</sup> In our study, the decidual reaction thicknesses of the cases with and without abortion were compared. A statistically significant, positive and weak correlation was found between abortion and decidual reaction thickness. In a study by Bajo J et al., they measured the trophoblastic thickness in the embryonic implantation area in women between the 5<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy and found that the gestational age and trophoblastic thickness exceeded the 3 mm limit in 15% of the cases.<sup>17</sup> In our study, the relationship between smoking and abortion risk was evaluated. The abortion rate of smokers was found to be significantly higher than non-smokers. In our study, progesterone levels were obtained in the hospital database at the time of the diagnosis of pregnancy, and it was found that the progesterone level in patients with abortion was significantly lower than in patients with a healthy pregnancy. The fact that the study is retrospective and evaluated based on data in patient files is considered a limitation. Evaluating all parameters of the first trimester and examining their correlation can be shown as the strength of the study.

## CONCLUSION

It was concluded that yolk sac diameter and morphology, gestational sac diameter, CRL measure-

ment, embryo heartbeat count, decidual reaction thickness and progesterone level at 6<sup>th</sup> and 7<sup>th</sup> weeks of pregnancy are significant in predicting pregnancy prognosis. It was found that an increase in the diameter of the yolk sac was associated with a poor prognosis. It was found that the increase in gestational sac diameter was associated with good prognosis. In the light of the findings of our study, it is suggested that the evaluation of various parameters by ultrasonography in predicting first trimester pregnancy loss may be meaningful in predicting the pregnancy prognosis in the ongoing process and in providing counseling to the patient.

### Source of Finance

*During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.*

### Conflict of Interest

*No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.*

### Authorship Contributions

**Idea/Concept:** Ufuk Atlıhan; **Design:** Ufuk Atlıhan; **Control/Supervision:** Mehmet Güney; **Data Collection and/or Processing:** Begüm Ertan; **Analysis and/or Interpretation:** Eyüp Özgözen; **Literature Review:** Ufuk Atlıhan; **Writing the Article:** Begüm Ertan; **Critical Review:** Mehmet Güney.

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