

Is Placental Localization in the Third Trimester of Pregnancy Related to the Intrauterine Ultrasound and Postpartum Parameters?

Gebeliğin Üçüncü Trimesterindeki Plasenta Lokalizasyonu
İntrauterin Ultrasonografi ve Postpartum Parametrelerle İlişkili midir?

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Abstract

Background: The relationship between placental localization and fetus is unclear. This study was aimed to determine the relationships between placental localization, ultrasound findings and pregnancy outcomes of the third trimester of pregnancies.

Materials and Methods: Three-hundred and two women were included in the study. Maternal age, gravidity, parity, abortion and live birth numbers, types of previous births, gestational age, femur length (FL), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), placental localization (anterior/posterior/lateral/fundus), umbilical artery systolic/diastolic ratio (S/D), fetal presentation, type of delivery, post-partum parameters of infant were obtained from archive records.

Results: The placentas were located in the anterior, posterior, fundal and lateral uterine wall in 38.1%, 30.1%, 19.9%, and 11.9% of individuals, respectively. Measurements of the HC in the third trimester were differed according to the localization of the placenta, and the HC measurements were significantly higher if the placental localization was anteriorly ($p=0.045$). There were no differences in other ultrasonographic measurements (S/D, BPD, AC ve FL), in the height, weight, and gender of the baby, gestational week at delivery, APGAR scores and type of delivery according to the placental localization ($p>0.05$).

Conclusions: In this study, we found that placental localization did not affect pregnancy outcomes, type of delivery and gender of the baby in risk-free, spontaneous and single pregnancies in the third trimester. Also, we stated that the previous birth type did not give an idea about placental localization. We think that placenta implantations, except placental location anomaly and invasion anomaly, do not provide precise information about pregnancy outcomes and type of delivery.

Key Words: Placenta localization, Third trimester, Ultrasonography

Öz.

Amaç: Plasenta lokalizasyonu ve fetüs arasındaki ilişki belirsizdir. Bu çalışmada, gebeliğin üçüncü trimesterdeki plasenta lokalizasyonu ile ultrasonografi bulguları ve gebelik sonuçları arasındaki ilişkilerin belirlenmesi amaçlanmıştır.

Materyal ve Metod: Çalışmaya 302 kadın dahil edildi. Anne yaşı, gravidite, parite, düşük ve canlı doğum sayısı, önceki doğum şekilleri, gebelik yaşı, femur uzunluğu (FL), biparietal çap (BPD), baş çevresi (HC), abdominal çevre (AC), plasenta lokalizasyonu (anterior/posterior/lateral/fundus), umbilikal arter sistolik/diyastolik oranı (S/D), fetal prezantasyon, doğum şekli, bebeğin doğum sonrası parametreleri arşiv kayıtlarından elde edildi.

Bulgular: Plasenta lokalizasyonları sırasıyla bireylerin %38.1, %30.1, %19.9 ve %11.9'unda anterior, posterior, fundal ve lateral uterin duvarda bulunuyordu. Üçüncü trimesterde HC ölçümleri plasenta lokalizasyonuna göre farklılık gösteriyordu ve plasenta lokalizasyonu anteriorda ise HC ölçümleri anlamlı olarak daha yüksekti ($p=0.045$). Diğer ultrasonografik ölçümlerde (S/D, BPD, AC ve FL), bebeğin boy, kilo ve cinsiyeti, doğum hafzası, APGAR skorları ve doğum şeklinde plasenta lokalizasyonuna göre farklılık yoktu ($p>0.05$).

Sonuç: Bu çalışmada üçüncü trimesterdeki risksiz, spontan ve tekil gebeliklerde plasenta lokalizasyonunun fetal sonuçları, doğum şeklini ve fetal cinsiyeti etkilemediğini saptadık. Ayrıca önceki doğum şeklinin plasenta lokalizasyonu hakkında fikir vermediğini tespit ettim. Plasenta lokalizasyon anomalisi ve invazyon anomalisi dışındaki plasenta implantasyonlarının fetal sonuçlar ve doğum şekli hakkında kesin bilgi vermediğini düşünmektediyiz.

Anahtar kelimeler: Plasenta lokalizasyonu, Üçüncü trimester, Ultrasonografi

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Introduction

Ultrasonography is a routinely performed evaluation in pregnant women to gain an idea about the fetus's anatomy and development, placenta and its structures (1). The placenta is a nutrient structure, and also a site of waste exchange between the mother and fetus (2). It is known that placental localization may change during pregnancy according to the adequate blood supply of the placenta. The placenta is usually implanted on the anterior wall or the posterior wall of the uterine where the blood supply is the highest (3). Also, the placenta can be implanted on the fundal part, right lateral and left lateral regions of the uterus. Some studies in the literature stated that the placental migration to the different uterine walls could affect the type of placental separation, type of delivery, dynamics of labor and postpartum parameters (4). Studies have indicated that the implantation regions of the placenta at various rates (5-8).

However, the mechanism of placental implantation is not fully understood, and the relationships of placental regions with pregnancy outcomes and ultrasound findings have not been adequately explained. When the literature is reviewed, it is seen that there is a need for studies towards identifying the relationships of placental localization. Therefore, in this study, we aimed to examine the relationships between placental localization, ultrasound findings and pregnancy outcomes of the third trimester of pregnancies.

Materials and Methods

This retrospective study was performed on the data of third trimester pregnant women at Dicle University Department of Obstetrics and Gynecology archives between June 2019 and October 2019. Ethics committee approval was obtained from The Ethical Committee of Dicle University Faculty of Medicine (decision no:252, dated: 14.11.2019).

Maternal age, gravidity, parity, abortion, and live birth numbers, types of previous births, gestational age, femur length (FL), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), placental localization (anterior/posterior/lateral/fundus), umbilical artery systolic/diastolic ratio (S/D), fetal presentation (cephalic/brech/transverse/oblique), type of delivery (Cesarean/vaginal delivery), post-partum parameters of infant (height/weight/gender of the baby/gestational week at delivery/APGAR scores at 1. minute and 5. minutes) were obtained from archive records.

Pregnant women who were in the third trimester of pregnancy and evaluated by ultrasonography during pregnancy follow-ups were included in the study. Pregnancies with intrauterine ex, twin pregnancies, those with pregnancy complications (diabetes, hypertension, etc.), those with placental location anomaly, amniotic fluid anomalies (polyhydramnios, oligohydramnios), congenital anomalies, preeclampsia, ablation placenta, intrauterine growth retar-

dation were not included in this study. Patients with missing parameters that we evaluated in the archive records for our study were not included in the study.

In our study, the ultrasound examination was applied transabdominally. Ultrasonographic measurements were made with the Voluson 730 Expert ultrasound device (GE Medical Systems, Zipf, Austria). The bladder did not have to be full. However, if the pelvis was not seen well, the patient's bladder should had to be filled until to a suitable capacity. Uterine localization of the placenta was noted as anterior, posterior, fundal and lateral (Figure 1).

If the placenta located in the anterior inner surface of the uterus corpus, it was defined as anterior located placenta. If it is located in the right or left lateral inner wall of the uterus then that was defined as lateral localization of placenta. Fundal localization of the placenta is defined where the placenta located in the fundus of the uterus. The most important clinically useful distinction of the location is the relationship between the lower portions of the placenta and the internal os of the uterus (9). Terms such as low-lying placenta, marginal placenta previa, partial and total placenta previa, all refer to an abnormally low placenta. A total placenta previa completely covers the internal os (10). The BPD was measured on a plane of the section that intersects both the third ventricle and thalamus. The cursors were then placed on the outer edge of the proximal skull and the inner edge of the distal skull. This length was noted as BPD. The calvarium was always displayed symmetrically in the image. HC measurements were obtained by placing the cursors on the outer margins of the calvarium bilaterally. Image for FL aligned along the long axis of transducer femoral bone (11). The proper view was obtained by visualizing either the femoral head or the greater trochanter at the proximal end of the femur and the femoral condyle at the distal end. The calipers were placed at the junction of bone and cartilage to measure only ossified bone (12). Image for AC was taken at the level of the largest diameter of the fetal liver, denoted by the point of union of the right and left portal veins, which had a "hockey stick" appearance (13).

The amniotic fluid index (AFI) was calculated by dividing the uterus into four quadrants using the linea nigra for the right and left divisions, and the umbilicus for the upper and lower quadrants. The maximal vertical amniotic fluid pocket diameter in each quadrant not containing cord or fetal extremities was measured in centimeters; the sum of these measurements was defined as the AFI. If the AFI \leq 5 cm it is called oligohydramnios, if AFI \geq 24 cm it is defined as polyhydramnios, the fluid index $>$ 5 cm and $<$ 24 cm it is normal (14).

By looking at the structure of the fetus leading to the birth canal by transabdominal ultrasonography, the fetal presentation was noted as cephalic, breech, oblique and transverse.

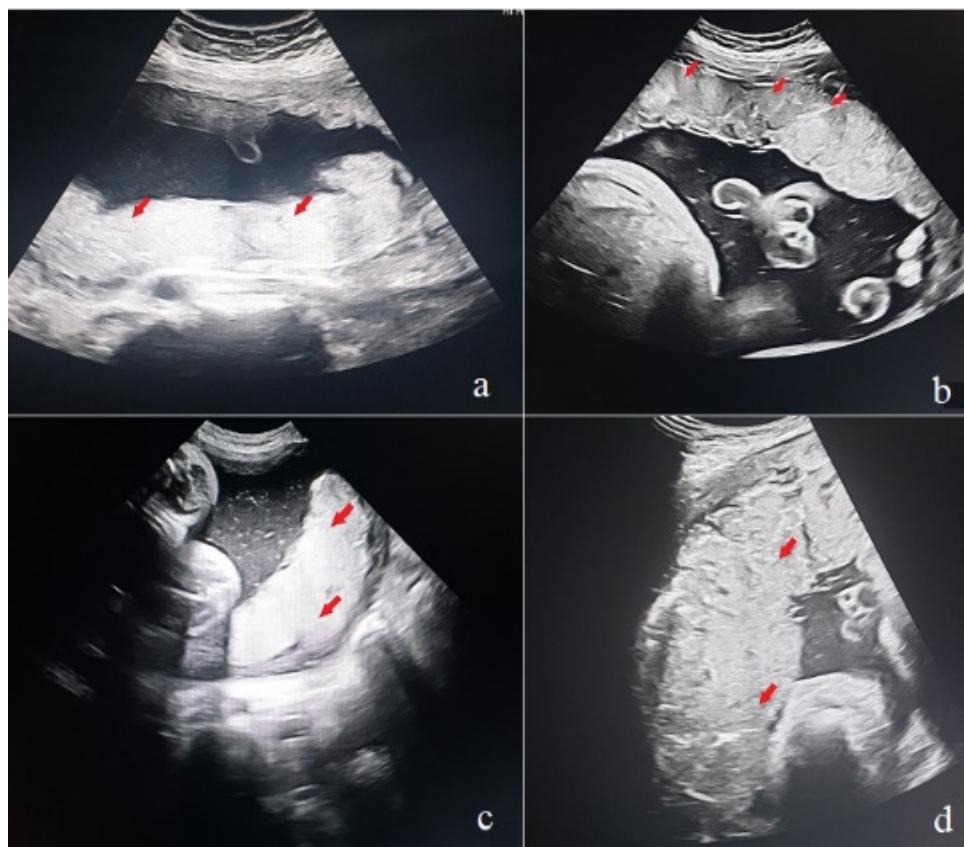


Figure 1. Posterior (a), anterior (b), left lateral (c) and fundal (d) localization of the placenta

All data were analyzed using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, ABD). The distribution of the data was evaluated by the Shapiro-Wilk test. The quantitative data were described as mean and standard deviation and qualitative data were described using frequencies and percentages. Differences in categorical variables were evaluated by the chi-square test. The comparison of placental location and pregnancy outcome was done using one-way analysis of variance (ANOVA) for quantitative variables. If there was a difference between groups Games Howell post-hoc test was applied to determine which measurement causes to difference. Pearson's correlation coefficient was used to investigate the relationships between the placental localization and parameters. A p-value of < 0.05 was considered as statistically significant.

Results

Totally 602 pregnant women's retrospective data were examined. The average age of 302 pregnant women who met the inclusion and exclusion criteria of this study was 30.25 ± 5.63 years. The mean period of gestation was 36.60 ± 2.25 weeks. At the third-trimester ultrasound screening, the placentas were located in the anterior uterine wall, posterior uterine wall, fundal uterine wall and lateral uterine wall in 38.1%, 30.1%, 19.9%, and 11.9% of individuals, respectively. The demographic and clinical characteristics of pregnant women are given in Table 1.

According to the previous pregnancy stories of individuals

who participated in this study, 39 (12.9%) of the pregnant women did not give birth before, 185 (63.3%) gave birth by cesarean and 78 (25.8%) delivered normal vaginal delivery. And it was determined that placental localization did not differ according to the previous delivery method ($p > 0.05$) (Table 1). The normal vaginal birth rate was 23.5% and cesarean rate was 76.5% in terms of delivery type in current pregnancies. According to the placental localization, there was no significant difference in terms of delivery of current pregnancy ($p > 0.05$) (Table 3).

Table 1. Demographic and clinical data of pregnant women included in the study and frequency distribution of placental localization in the third trimester

Variables	Results
Maternal age (years)*	30.25 ± 5.63 (18-45)
Gravidity**	4 (1-13)
Parity**	3 (0-9)
Abortion**	1 (0-8)
Live birth**	2 (0-9)
Previous birth (cesarean) n (%)	185 (63.3)
Previous birth (normal) n (%)	78 (25.8)
Previous birth (none) n (%)	39 (12.9)
Period of gestation (weeks)*	36.60 ± 2.25 (26-41)
Placental localization	n (%)
Anterior	115 (38.1)
Posterior	91 (30.1)
Fundal	60 (19.9)
Lateral	36 (11.9)

*Mean±standard deviation (min-max), **Median (min-max)

It was observed that the anterior location of the placenta is most common in > 30 years of age group pregnants, followed by posterior location (Table 2). However, there was no relationship between maternal age and placental localization ($p > 0.05$).

Biometric measurement results, ultrasound findings and postpartum parameters of the fetus according to the placement of the placenta are given in table 3. It was determined that HC measurements in the third trimester of pregnancy differ according to placental localization, and HC measurements were significantly higher in the anterior localization

of placenta ($p=0.045$). There were no difference in other ultrasonographic measurements (S/D, BPD, AC ve FL) in terms of placental localization ($p > 0.05$). According to gestational week intervals, there was no difference in terms of localization of the placenta ($p=0.819$). The placental localizations of fetuses, which were presented as cephalic, breech and transverse, generally found in the anterior surface of uterine and, in the oblique presentation the placental localization was generally observed as anterior and fundal part of uterine ($p=0.024$).

Table 2. Placental localization in different age groups.

Age groups	Anterior		Posterior		Fundal		Lateral		P
	N	%	N	%	N	%	N	%	
<20	2	0.66	2	0.66	1	0.33	4	1.32	
21-25	26	8.60	14	4.63	12	3.97	8	2.64	0.171
26-30	37	12.25	35	11.58	18	5.96	12	3.97	
>30	50	16.55	40	13.24	29	9.60	12	3.97	

$p<0.05$ is statistically significant, chi-square test

Table 3. Biometric measurements, ultrasound findings and postpartum results of fetuses in the third trimester according to placental localization.

	Anterior	Posterior	Fundal	Lateral	P
Pre-natal parameters					
Umbilical artery S/D ratio	2.37±0.38	2.38±0.46	2.37±0.30	2.31±0.29	0.907 ²
Biparietal diameter (BPD)	35.76±2.21	35.93±1.84	35.63±2.09	36.22±2.21	0.700 ²
Head circumference (HC)	37.25±2.07	36.06±1.98	35.18±2.09	36.13±2.01	0.045 ^{2*}
Abdominal circumference (AC)	36.69±2.58	36.96±2.16	36.52±2.36	37.28±2.28	0.561 ²
Femur length (FL)	36.63±2.23	36.65±2.12	36.27±2.37	36.92±2.13	0.623 ²
Period of gestation (week) n (%)					
26-30	4 (44.44)	2 (22.22)	2 (22.22)	1 (11.11)	
30-34	12 (37.5)	9 (28.12)	8 (25)	3 (9.37)	0.819 ¹
34-38	82 (37.10)	68 (30.76)	44 (19.90)	27 (12.21)	
38-42	17 (42.5)	12 (30)	6 (15)	5 (12.5)	
Fetal presentation n (%)					
Cephalic	100 (36.63)	89 (32.60)	50 (18.31)	34 (12.45)	
Breech	7 (43.75)	2 (12.5)	5 (31.25)	2 (12.5)	0.024 ^{1*}
Transverse	5 (71.42)	-	2 (28.57)	-	
Oblique	3 (50)	-	3 (50)	-	
Post-partum parameters					
Baby height (cm)	49.43±3.58	50.11±2.77	49.43±4.50	50.61±2.73	0.176 ²
Baby weight (gr)	3014.31±466	3090.54±499	2988.33±486	3217.50±527	0.308 ²
Gender of the baby n (%)					
Female	52 (36.87)	44 (31.20)	27 (19.14)	18 (12.76)	0.841 ¹
Male	63 (39.13)	47 (29.19)	33 (20.49)	18 (11.18)	
APGAR score at 1. minute	5.37±1.19	5.76±1.28	5.72±1.34	5.58±1.29	0.123 ²
APGAR score at 5. minute	7.97±0.88	8.22±0.77	8.17±0.92	8.00±1.12	0.177 ²
Gestational week at delivery	37.30±1.97	37.73±1.86	37.33±2.13	37.67±2.23	0.457 ²
Type of delivery n (%)					
Normal vaginal delivery	22 (30.98)	25 (35.21)	13 (18.30)	11 (15.49)	0.235 ¹
Cesarean section	93 (40.25)	66 (28.57)	47 (20.34)	25 (10.82)	

* $p<0.05$ statistically significant, ¹chi-square test, ²one-way ANOVA

It was seen that, pregnancy outcomes were not differ according to the placental location ($p > 0.05$). There was no difference in the height, weight, and gender of the baby according to placental localization ($p=0.176$, $p=0.308$, $p=0.841$, respectively). And also, there wasn't seen a difference according to placental localization in terms of gestational week at delivery and APGAR scores ($p > 0.05$) (Table 3).

According to the results of correlation analysis, there was no correlation between placental localization and age, gravidity, parity, live birth numbers, abortus number, previous birth type, gestational week at delivery, gestational week, fetal presentation, umbilical artery S/D ratio, BPD, HC, AC, FL, type of delivery, height, weight, and gender of the baby, APGAR scores ($p > 0.05$).

Discussion

A total of 302 healthy pregnant women in the third trimester of pregnancy were examined in this study. The study showed that the placental localization did not affect the height, weight, and gender of the baby, APGAR scores of baby, gestational week at delivery and type of delivery. On the other hand, placental localization could affect on fetal presentation and HC measurements of the fetus.

In the present study, most of the placenta (38.1%) were located in the anterior inner surface of the uterus corpus. We ranked as secondary the posterior placenta rate (30.1%). In the study performed by Nagwani et al. on 100 pregnant women in the third trimester of pregnancy, the rate of the fundal placenta was found 37% and the rate of the anterior placenta was 29% (6). However, in our study, we found the rate of the fundal placenta as 19.9%. Fidan et al. who studied on 292 pregnant women in the third trimester of pregnancy and found the placenta was located in anterior, posterior and fundal wall in 52.7%, 37.7%, and 9.6% respectively (4). In a study conducted by Köroğlu et al. on the second trimester of pregnant women, the anterior placenta rate was determined as 40.6 % and the posterior placenta rate was 35.9% (1). These results were consistent with our study results. It is seen that placental localization rates were determined at different rates in various studies. Since the placental localization mechanism is unclear, we think that the variability of the placenta's presence anterior, posterior, lateral or fundal region of uterus cannot be explained.

We determined that, the type of delivery did not change due to the placental localization. Similar to our study, Köroğlu et al. found that the type of delivery did not change according to the placental localization (1). Granfors et al. determined that the placental localization rate is 47.8% anteriorly and, the normal vaginal delivery rate is 78.4% in their study (5). However, it was not examined whether there was a difference in terms of the delivery type according to placental localization.

In our study, we found that neither the previous type of delivery nor giving or not before did not affect the placental localization in the next pregnancy. Studies have found that if the previous delivery was cesarean, the risk of placenta previa increased by the ratio of 47% (15), and 60% (16). However, when we examined the literature, we did not find any studies which investigated whether the previous delivery method affected placental localization other than placental implantation anomaly. We think that more studies are needed on this subject.

In our study, no significant correlation was found between placental localization and maternal age, but it was determined that the placenta was mostly in anterior localization in the group which is above 30 years of age. Mirbolouk et al. found a significant relationship between maternal age (26- 35 years) and placental localization (17). In the study of Magann et al., no significant difference was found

between maternal age and placental localization by following our study (18). However, we think that more studies are needed to reveal the existence of this relationship. In terms of fetal biometric measurements, we found that HC measurement was significantly associated with placental localization. In our study, no difference was found in other measurements (BPD, FL, AC) in terms of placental localization. In accordance with our study Erdolu et al. stated no significant difference in terms of placental localization and BPD, FL, AC measurements (3). The researchers have not measured HC in their study. In our study, we found that HC measurement was higher, in those with an anterior placental localization than other placental localizations. We thought that depending on the placement of the placenta, the blood flow to the fetus may be variable and, accordingly the measurements of HC may change. However, due to the lack of difference in placental localization in terms of other biometric measurements, we think that the studies to strengthen this interpretation are needed.

Filipov et al. stated that placental localization is effective on fetal presentation, and emphasized that fundal placental localization is associated with cephalic presentation and mostly with breech presentation (19). Granfors et al. found that fundal and lateral placenta localization is mostly associated with breech presentation (5). In our study, we found that patients with fundal placental localization had more fetal cephalic presentations. In the study carried out by Granfors et al., only nulliparous patients, smokers, and patients who became pregnant with in-vitro fertilization method were included, and in the study of Filipov et al., only those with nulliparous and placental location anomalies were included (5,19). In our study, these individuals were the criteria for exclusion, so we think that other reasons except placental localization could affect fetal presentation.

Uterine and ovarian arteries are the main blood supply of the uterus. Placental localization is an important determinant of placental blood flow (3). Nagwani et al. stated that the low placental blood flow and perfusion may cause low birth weight (6). We didn't find a relationship between birth weight and placental localization. Although it was not statistically significant, we found the baby weights of patients with lateral placental localization more than those with anterior placental localization. In a study conducted by Devarajan et al., in accordance with our study, they determined that newborn birth weights were different due to placental localization, but this difference was not significant (20). Therefore, we think that placental localization cannot provide information about whether the fetus will have a risk of intrauterine growth retardation (IUGR) or macrosomia.

In our study, we found that gender of the baby is not related to placental localization. While some studies indicate that placental localization may affect gender of the baby

(3,17,21), Torricelli et al. stated that there is no significant relationship between the gender of the baby and placenta localization (22). In the studies which are indicating that placental localization is related to gender of the baby, researchers stated female fetuses have anterior placental localization and male fetuses have posterior placental localization (3,9). Mirbolouk et al. found that right anterior located placenta could be seen in male fetuses, and left posterior located placenta in female fetuses (17). In conducted studies, we see that there is not enough evidence to support this information. Based on the results of our study, we cannot say that placental localization affects gender of the baby. We think the factors which affect gender of the baby are the chromosomal ones.

When we examined in terms of APGAR scores, it was seen that there was no difference in scores of APGAR 1. and 5. minutes according to the placental localization. Although it is not clear, Magann et al. stated that high lateral implantations are associated with low APGAR scores (18). However, in the study of Magan et al., it is seen that risky pregnancies such as placental location anomalies, and detachment placenta, IUGR, preeclampsia, which are the exclusion criteria in our study, are also included. Similar to the results of our study, Körögülu et al. found that APGAR scores at 1. and 5. minutes did not differ according to placental localization (1).

The limitation of our study is a retrospective study and, the ultrasonographic measurements were made by different individuals could be considered as limitations of our study. Examining different vessels with Doppler ultrasonography could contribute to the future studies.

In conclusion, we found that the placental localization of risk-free, single and spontaneous pregnancies in the third trimester did not affect pregnancy outcomes, type of delivery and gender of the baby. We can say that the previous type of delivery does not give an idea about the placental localization. As a result, we think that excluding placental location and invasion anomalies, placenta localization do not provide precise information about pregnancy outcomes and type of delivery. Prospective studies with more patient participation are needed.

Ethical Approval: Approval for the study was granted by the Ethics Committee of *** University Medical Faculty (decision no:252, dated: 14.11.2019).

Author Contributions:

Concept: R.G., B.T.

Literature Review: R.G., B.T., E.A.

Design : R.G., B.T., S.Y.T.

Data acquisition: R.G., M.S.

Analysis and interpretation: R.G., B.T., M.S., S.Y.T., E.A.

Writing manuscript: R.G., B.T.

Critical revision of manuscript: R.G., B.T., M.S., S.Y.T., E.A.

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References

- Körögülu N, Sudolmuş S, Ölmez H, Tunca AF, Gulkilik A, Yetkin Yıldırım G. İkinci Trimester Plasenta Lokalizasyonunun Gebelik Sonuçlarına Etkisi. JOPP Derg. 2013;5(2):70-5.
- Murphy VE, Smith R, Giles WB, Clifton VL. Endocrine regulation of human fetal growth: the role of the mother, placenta, and fetus. Endocrine Reviews. 2006;27(2):141-69.
- Erdolu MD, Köşüş A, Köşüş N, Dilmen G, Kafali H. Relationship between placental localisation, birth weight, umbilical Doppler parameters, and foetal sex. Turk J Med Sci. 2014;44(6):1114-7.
- Fidan U, Ulubay M, Bodur S, Kinci MF, Karaşahin KE, Yenen MC. The effect of anatomical placental location on the third stage of labor. Clin Anat. 2017;30(4):508-11.
- Granfors M, Stephansson O, Endler M, Jonsson M, Sandström A, Wikström AK. Placental location and pregnancy outcomes in nulliparous women: A population based cohort study. Acta Obstet Gynecol Scand. 2019;98(8):988-96.
- Nagwani M, Sharma PK, Singh U, Rani A, Mehrotra S. Ultrasonographic evaluation of placental location in third trimester of pregnancy in relation to fetal weight. IOSR-JDMS. 2016;15(10):29-33.
- Suresh KK, BhAgwAt AR. Ultrasonographic measurement of placental thickness and its correlation with femur length. Int J Anat Radiol Surg. 2017;6(1):46-51.
- Zia S. Placental location and pregnancy outcome. J Turkish-German Gynecol Assoc. 2013;14:190-3.
- Mohammad Jafari R, Barati M, Bagheri S, Shajirat Z. Fetal gender screening based on placental location by 2-dimensional ultrasonography. Tehran Univ Med J. 2014;72(5):323-8.
- Rumack CM, Wilson SR, Charboneau JW, Levine D. Diagnostic ultrasound. 4th ed. Mosby, Philadelphia; 2011, p. 1502-4.
- Filly RA, Hadlock FP. Sonographic determination of menstrual age. In: Ultrasonography in Obstetrics and Gynecology. 4th ed. WB Saunders, Philadelphia; 2000, p. 146-70.
- Goldstein RB, Filly RA, Simpson G. Pitfalls in femur length measurements. J Ultrasound Med. 1987;6(4):203-7.
- Chinn DH, Filly RA, Callen PW. Ultrasonic evaluation of fetal umbilical and hepatic vascular anatomy. Radiology. 1982;144(1):153-7.
- Lim KI, Butt K, Naud K, Smithies M. Amniotic fluid: technical update on physiology and measurement. J Obstet Gynaecol Can. 2017;39(1):52-8.
- Klar M, Michels KB. Cesarean section and placental disorders in subsequent pregnancies-a meta-analysis. J Perinat Med. 2014;42(5):571-83.
- Ananth CV, Smulian JC, Vintzileos AM. The association of placenta previa with history of cesarean delivery and abortion: a metaanalysis. Am J Obstet Gynecol. 1997;177(5):1071-8.
- Mirbolouk F, Mohammadi M, Leili EK, Heirati SF. The Association between Placental Location in the First Trimester and Fetal Sex. JPRI. 2019;27(5):1-8.
- Magann EF, Doherty DA, Turner K, Lanneau GS, Morrison JC, Newnham JP. Second trimester placental location as a predictor of an adverse pregnancy outcome. J Perinatol. 2007;27(1):9-14.

19. Filipov E, Borisov I, Kolarov G. Placental location and its influence on the position of the fetus in the uterus. Akush Gi-nekol (Sofia). 2000;40(4):11-2.
20. Devarajan K, Kives S, Ray JG. Placental location and newborn weight. J Obstet Gynaecol Can. 2012;34(4):325-9.
21. Hammad HM, Elgyoum AMA, Abdelrahim A. Role of ultrasound in finding the relationship between placental location and fetal gender. IJMCR. 2016;47:216-9.
22. Torricelli M, Vannuccini S, Moncini I, Cannoni A, Voltolini C, Conti N, et al. Anterior placental location influences onset and progress of labor and postpartum outcome. Placenta. 2015;36(4):463-6.