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Relationship between placental localisation, birth weight, umbilical Doppler parameters, and foetal sex

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Background/aim: The aim of this study is to examine the relationship between placental localisation, birth weight, and foetal sex. It also evaluates umbilical artery Doppler parameters and their relationship with placental localisation.

Materials and methods: This is a retrospective study of 500 healthy pregnant women who gave birth at our university. All women had undergone a detailed ultrasound and Doppler examination at 20–23 weeks. The ultrasonography results of the patients were examined retrospectively. Foetal biometry, birth weight, and umbilical artery Doppler parameters were recorded and compared according to placental localisation.

Results: Birth weight was significantly higher in foetuses with anteriorly located placenta. The incidence of female foetuses was higher (62%) in relation to anteriorly located placentas, whereas male incidence was higher (51.9%) in relation to posterior placentas. A comparison of Doppler parameters between groups revealed significantly higher pulsatility index (PI) and resistance index (RI) values in posteriorly located placentas.

Conclusion: Foetal sex might affect placental localisation. Doppler parameters and birth weight might also differ according to placental side. These factors should be taken into consideration during the evaluation of obstetric patients.

Key words: Placenta, birth weight, Doppler, foetal sex

1. Introduction

Normal placental function is important for foetal growth and development. The placenta is the site of nutrient and waste exchange, so adequate placental growth is essential for adequate foetal growth (1).

In most pregnancies, implantation occurs in the upper portion of the fundus. It has been found that 37% of placentas attach anteriorly, 24% posteriorly, and 34% in fundal position (2). Placental position and morphology may change considerably during pregnancy. If the area of implantation is less than optimal for placental development, the placenta moves to a more suitable region of the endometrium for adequate blood supply. Parts of the placenta located in less favourable positions atrophy with time. For example, low implantation of the placenta occurs frequently in early pregnancy, but this may change through differential growth of the placenta and uterus.

The relationship between placental morphology (placental width, volume, and circumference), foetal development, and pregnancy-related complications has been investigated previously (3–6). However, the relationship between placental localisation, birth weight, foetal sex, and Doppler parameters is less known. Lateral placentation may predispose certain women to uteroplacental insufficiency and low birth weight. Similarly, the blood supply of the anterior and posterior parts of the uterus may differ, possibly causing differences in birth weight and Doppler parameters.

In this study, we examine the relationship between placental localisation, birth weight, and foetal sex. Umbilical artery Doppler parameters and their relationship with placental localisation are also evaluated.

2. Materials and methods

This is a retrospective study of 500 healthy pregnant women who gave birth at the Turgut Özal University Faculty of Medicine's Department of Obstetrics and Gynaecology between January 2010 and October 2011. The exclusion criteria were multiple pregnancy, polyhydramnios or oligohydramnios, foetal death, existence of congenital

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anomalies, systemic disease, and pregnancy complications (e.g., diabetes or hypertensive disorders). The study also excluded subjects with placental abnormality or with maximal placental thickness of >4 cm. Women who did not have a detailed ultrasonography at 20–23 weeks were also excluded from the study. Age, gravida, parity and gestational age, birth weight, foetal sex, and delivery type were recorded for all subjects. Approval of this study was obtained from the Local Institutional Review Board of the Faculty of Medicine, Turgut Özal University.

Five hundred subjects were selected by simple randomisation among healthy pregnant women. All women had undergone a detailed ultrasound and Doppler examination at 20–23 weeks. The same radiologist performed ultrasound measurements on each woman in semirecumbent position. The ultrasonography results of the patients were examined retrospectively. Ultrasound examinations were performed by using an HDI 3000 ultrasound system (ATL Ultrasound, Bothell, WA, USA). Foetal biometric parameters and placental localisation were recorded. Umbilical artery waveform was measured with a free-floating loop of cord during foetal quiescence. The pulsatility index (PI) [(maximum velocity – minimum velocity)/mean velocity], resistance index (RI), and systole/diastole (S/D) of the umbilical artery were calculated.

Data were analysed with SPSS 15.0 for Windows (SPSS Inc., Chicago, IL, USA). Data were transferred to computer media. Error control and necessary corrections were carried out. Groups were controlled in terms of conformity to normal distribution by graphical check and Shapiro–Wilk test. Median (IQR) was used for groups that were not normally distributed. Categorical variables were expressed as numbers and percentages. Chi-square tests were conducted to test the distribution between categorical variables. The Mann–Whitney test was used to compare groups. $P \leq 0.05$ was taken as significant. Power analysis of the study showed that 352 patients were needed to gain 80% power when alpha error was set to 0.05, beta error to 0.20, and effect size to 0.30.

3. Results

A total of 500 healthy pregnant women who gave birth at the Turgut Özal University Faculty of Medicine's Department of Obstetrics and Gynaecology, were examined retrospectively. Mean age, gravida, parity, and gestational age were 30 (7) years, 2 (1), 1 (1), and 21 (2) weeks, respectively. Distribution of data according to placental localisation is given in the Table. It was detected that birth weight was significantly higher in foetuses with anteriorly located placenta ($P = 0.040$). The incidence of female foetuses was higher (62%) in relation to anteriorly located placentas, whereas male incidence was higher (51.9%) in relation to posterior placentas ($P = 0.023$) (Table).

A comparison of groups for Doppler parameters revealed no difference in terms of systolic and end-diastolic flow and S/D ratio ($P > 0.05$). PI and RI values were significantly higher in posteriorly located placentas than in anterior placentas ($P = 0.005$ and $P = 0.035$, respectively) (Table).

4. Discussion

Adequate trophoblast invasion and placental perfusion is required for normal foetal growth (7,8). The study of Belogolovkin et al. examined the effect of placental localisation on birth weight in twin pregnancies. It did not find any correlation between birth weight and placental location (9). However, another study comparing placental location in intrauterine growth retardation (IUGR) cases and non-IUGR controls found that the most common placental location in both cases was the anterior, accounting for roughly 1/3 in the IUGR group and 1/2 in the non-IUGR group. IUGR pregnancies were nearly 4 times more likely than non-IUGR pregnancies to have lateral placentation compared to anterior or posterior placentation (10).

The main blood supply of the uterus comes from uterine and ovarian arteries. The blood supply of the uterus is not uniformly distributed, so placental location is an important determinant of placental blood flow (11–14). The lateral parts of the uterus may receive less blood flow from the ipsilateral uterine artery than the central regions, which can derive flow from both uterine arteries. In pregnancies with unilateral placentation, uterine artery resistance is lower in the ipsilateral side than in the contralateral side. This resistance is similar in the left and right uterine arteries in pregnancies with centrally located placentas (12,14,15). Therefore, lateral placentation may predispose foetuses to less uteroplacental perfusion and low birth weight.

In our study, we found that the birth weight of anteriorly implanted foetuses was significantly higher than that of posteriorly implanted ones. Difference in birth weight between the anterior and posterior placenta could be caused by difference in blood flow. Although the comparison of groups for umbilical artery Doppler parameters revealed no difference in terms of systolic and diastolic blood flow and S/D ratio, PI and RI were significantly higher in posteriorly located placentas. It is possible that placental position and placental distance from the uterine arteries are important for placental perfusion and foetal weight. Higher birth weight and lower RI in anterior placentas are indicators of better blood supply and/or better trophoblastic invasion in the anterior uterus. An explanation of better placentation on the anterior part may be the greater extent of anastomoses between the uterine arteries on the anterior part and

Table. Demographic characteristics and ultrasonographic findings of the subjects according to placental localisation.

		Anterior (n = 273)	Posterior (n = 227)	P-value
Age		30 (7)	30 (7)	0.899
Gravida		2 (2)	2 (1)	0.061
Parity		2 (1)	1 (1)	0.050
Gestational week		22 (1)	21 (2)	0.194
BPD		51 (6)	50 (6)	0.409
FL		35 (5)	36 (5)	0.963
AC		165 (27)	168 (20)	0.914
Birth weight		3475 (530)	3390 (575)	0.040
Type of labour	VB	84 30.8	84 37.0	0.154
	C/S	189 69.2	143 63.0	
Sex	Female	169 61.9	117 51.5	0.023
	Male	104 38.1	110 48.5	
Systole		31 (9)	31.7 (9)	0.374
Diastole		10.1 (4.3)	9.8 (3.6)	0.327
RI		0.7 (0.1)	0.7 (0.1)	0.035
PI		1.1 (0.3)	1.2 (0.3)	0.005
S/D		3.2 (1)	3.2 (1.1)	0.197

BPD: Biparietal diameter, FL: femur length, AC: abdominal circumference, VB: vaginal birth, C/S: caesarean section, RI: resistance index, PI: pulsatility index, S/D: ratio of systole to diastole.

better blood supply. The position of the uterus is mostly anteverted. This position, and better blood supply to the anterior, could make implantation on the anterior wall physiologically easier.

Another important result of the present study is the detection of a higher female foetus ratio to anterior placenta than to posterior ones. The female-male ratio of anterior placenta was 1.63. Although the exact cause of this placental localisation according to sex is not known, some suggestions have been made. According to Kavraiska et al. (16), the right side of the uterus receives a higher blood flow than the left side. This differential blood flow may affect sex determination, or the foetus may prefer the most suitable area for blood flow according to its sex. Several previous studies have shown that endometrial movement and electrical activity appear to affect sperm transport; positively charged male sperm can be transported selectively to one side of the uterus, and negatively charged female sperm can be transported to the other. Polarity of uterine wall and sperm might be another possible explanation for different implantation sides according to sex (17).

There are some limitations to this study. Although the number of subjects was sufficient, new studies including larger series and additional placental locations (lateral, fundal, etc.) would offer a better explanation of the condition. In this study, we only evaluated umbilical artery Doppler results. The addition of Doppler parameters of other vessels would increase the explanatory power of the study.

In conclusion, foetal sex might affect placental localisation. Doppler parameters and birth weight might also differ according to placental side. These factors should be taken into consideration during the evaluation of obstetric patients.

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