

The effect of parity on first trimester uterine artery Doppler waveforms in low-risk singleton pregnancies

Wpływ rodności na kształt fali przepływu Dopplera w pierwszym trymestrze pojedynczej ciąży niskiego ryzyka

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Abstract

Objectives: The aim of the study was to evaluate the effect of parity on uteroplacental blood flow during the first trimester in low-risk singleton pregnancies.

Materials and methods: Uterine artery Doppler examinations were performed in 190 singleton pregnancies between 11-14 gestational weeks. Twenty-five pregnancies were excluded from the study due to history of preeclampsia, diabetes mellitus or inherited thrombophilia. A total of 165 low-risk singleton pregnancies were included in the study. Mean uterine artery pulsatility index (PI) was recorded and compared between nulliparous and multiparous women. The relation between maternal age, gestational week, maternal weight, parity, biochemical markers and abnormal uterine artery Doppler flows was evaluated. T-test and logistic regression analyses were used for the statistical analysis.

Results: A total of 165 singleton pregnancies without any risk factors for uteroplacental insufficiency were included in the study. Of them, 58 (36.7%) were nulliparous and 107 (63.3%) were parous. Correlation analysis revealed that the uterine artery pulsatility indices during the first trimester were not affected by maternal age and parity.

Conclusions: Mean uterine artery pulsatility indices are not different in nulliparous and multiparous low risk pregnancies at 11-14 weeks of gestation.

Key words: **Doppler ultrasonography / uterine artery / parity / low-risk pregnancy /**

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Streszczenie

Cel: Celem badania była ocena wpływu rodności na przepływ maciczo-łożyskowy w pierwszym trymestrze pojedynczej ciąży niskiego ryzyka.

Materiał i metoda: Przepływ w tętnicy macicznej zbadano w 190 pojedynczych ciążach w 11-14 tygodniu. Z analizy wyłączono 25 ciąż z powodu dodatniego wywiadu w kierunku stanu przedrzucawkowego, cukrzycy lub wrodzonej trombofilii. Ostatecznie do badania włączono 165 pojedynczych ciąż niskiego ryzyka. Zmierzono średni indeks pulsacji w tętnicy macicznej (PI), który porównano pomiędzy nieródkami i wieloródkami. Oceniono również związek pomiędzy wiekiem matki, wiekiem ciążowym, masą matki, liczbą porodów, markerami biochemicznymi a nieprawidłowym przepływem w tętnicach macicznych. T-test i regresji logistycznej zostały wykorzystane do analizy statystycznej.

Wyniki: Do badania włączono 165 pojedynczych ciąż bez czynników ryzyka niewydolności maciczo-łożyskowej. Z tej grupy, 58 (36,7%) kobiet było nieródkami a 107 (63,3%) wieloródkami. Analiza statystyczna wykazała brak związku pomiędzy indeksem pulsacji w pierwszym trymestrze ciąży a wiekiem matki i rodnością.

Wnioski: Średni indeks pulsacji w tętnicy macicznej nie różni się pomiędzy nieródkami a wieloródkami w ciąży niskiego ryzyka w 11-14 tygodniu.

Słowa kluczowe: **doppler / ultrasonografia / tętnica maciczna / rodność / ciąża niskiego ryzyka /**

Introduction

The first trimester screen has an increasing importance, as it enables early diagnosis of chromosomal defects. Maternal age, measurement of nuchal translucency (NT) with the combination of serum pregnancy-associated plasma protein-A (PAPP-A) and free β -human chorionic gonadotropin (β -hCG) constitute the first trimester screening [1]. However, recent studies have highlighted that first trimester screening may also help in distinguishing high-risk pregnancies by adding Doppler evaluation of the uterine artery or its sub-branches [2-6]. Uterine artery Doppler ultrasonography is a noninvasive technique for evaluating uteroplacental circulation. Although recent data have pointed to the importance of the first trimester uterine artery Doppler screening in high-risk populations [6], its value in low-risk pregnancies remains to be fully elucidated.

Nulliparity is a well-known risk factor for preeclampsia [7]. Parity may affect the uterine artery blood flow in consecutive pregnancies. The effect of parity on uterine artery Doppler velocity forms between 18-23 gestational weeks have been studied in some researches [8, 9], but our study is unique for determining the parity effect on uterine artery Doppler velocity in the first trimester.

Materials and methods

Singleton uncomplicated pregnancies admitted to our perinatology outpatient department for 11+0 to 13+6 weeks screening (n=190) were recruited for the study. Twenty-five pregnancies were excluded from the study due to history of preeclampsia, diabetes mellitus or inherited thrombophilia. This retrospective study was approved by the Institutional Ethics Committee. All examinations were carried out via transabdominal probe by two experienced operators (B.A.U. and H.G.P.) accredited for the 11-14 week screening by the Fetal Medicine Foundation (FMF). The examinations were performed by one of the operators, at that time the other operator was observing the fetal planes and measurements independently.

A Voluson 730 Pro system with a RAB 4-8-MHz array probe (GE Medical Systems, Milwaukee, WI) was used. Gestational age was calculated from the last menstrual period and confirmed again by ultrasound examination. All cases with structural abnormalities or chromosomal disorders were excluded. Pregnancies with chronic hypertension, history of preeclamptic pregnancy, inherited thrombophilia, vascular or connective tissue disorders were also excluded.

During the 11-14 week ultrasound scan visit, uterine artery Doppler velocity evaluation was performed. The right and left uterine arteries were found at the crossover with the hypogastric artery which can be easily seen with color Doppler. Pulsed wave Doppler was performed in order to obtain the uterine artery wave forms. At least three proper consecutive waveforms were needed for calculating the pulsatility index (PI). Maternal age, parity, and maternal weight were also recorded. All pregnancies were followed-up at least until the third trimester. None of the subjects from study population developed early-onset preeclampsia.

T-test, the χ^2 test and Mann-Whitney U test were used for group comparisons. Correlation analysis was performed in order to establish the relation between uterine artery PI and parity, maternal weight, maternal age, and gestational week. All statistical analyses were performed using the SPSS 20 software package (SPSS Inc., Chicago, IL, USA). A p-value of <0.05 was regarded as statistically significant. The results were expressed as mean \pm standard deviation (SD).

Results

A total of 165 singleton pregnancies without any risk factor for uteroplacental insufficiency were included in the study. Of them, 58 (36.7%) were nulliparous and 107 (63.3%) were parous. Mean maternal age was 26.3 \pm 4.2 and 31.6 \pm 5.2 in the nulliparous and parous groups, respectively (p<0.001). First trimester biochemical markers regarding PAPP-A MoM and β HCG MoM were statistically insignificant in both groups. Demographic features of the study population are shown in Table I.

Table I. Demographic features of the study population

	Nulliparous (n=58)	Parous (n=107)	p
Maternal age	26.3±4.2	31.6±5.2	<0.001*
Maternal weight	64.3±11.4	67.6±11.8	0.097
Gestational week at scan	12.2±0.7	12.3±0.8	0.797
CRL	63.2±10.2	63.9±10.1	0.693
NT	1.1±0.3	1.3±0.5	<0.001*
Uterine artery mean PI	1.7±0.8	1.7±1.1	0.874
Ductus venosus mean PI	1.2±0.6	1.1±0.5	0.302
PAPP-A MoM	1.2±0.7	1.1±0.9	0.199
fβHCG MoM	1.3±0.8	1.3±1.1	0.938

Table II. Correlation analysis of mean uterine artery pulsatility index (PI) with maternal age, PAPP-A MoM, fβHCG MoM, parity, gestational week at scan and CRL measurements.

Mean uterine artery PI	Maternal age	PAPP-A Mom	fβHCG MoM	parity	gestational week at scan	CRL
r	0.145	-0.064	0.013	0.021	-0.044	-0.96
p	0.078	0.442	0.871	0.793	0.589	0.234

The correlation analysis of mean uterine artery PI with maternal age, PAPP-A MoM, fβHCG MoM, parity, gestational week at scan and CRL measurements is shown in Table II. Mean PI was not significantly affected by parity ($r=0.021$, $p=0.793$). Mean UA PI values versus the parity status are shown in Figure 1.

We found a negative correlation between gestational age and uterine artery PI ($r=-0.044$, $p=0.589$).

CRL measurement was highly negatively correlated with UA PI ($r=-0.96$, $p=0.234$). PAPP-A MoM levels were negatively correlated with UA PI ($r=-0.064$, $p=0.442$). However, these differences were statistically insignificant.

Discussion

The results of our study show that parity has no effect on uterine artery Doppler indices between 11-14 gestational weeks. This is an important finding, especially for screening for preeclampsia during early gestation in low-risk pregnancies. Recent studies have indicated that uterine artery Doppler velocimetry during the second trimester was significantly affected by parity as parous women had higher resistance indices in comparison to nulliparous women [8, 9]. Goynumer et al., demonstrated that uterine artery PI was affected by parity during the second trimester, especially before 21 weeks of gestation [10].

The results of our study need good understanding of the maternal vascular physiology during pregnancy. In early gestation, placentation occurs by the trophoblastic invasion of the maternal spiral arterioles, which results in progressive decrease in uterine vascular impedance during normal pregnancy [11]. The invaded muscular spiral arterioles becomes thin-walled

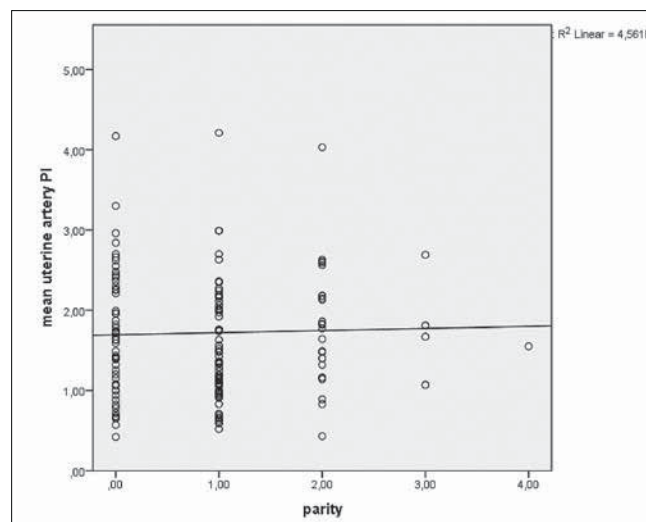


Figure 1. Distribution of mean uterine artery pulsatility index (PI) measurements according to the parity status in uncomplicated singleton first trimester pregnancies.

vessels which are minimally sensitive to sympathetic and parasympathetic pathways [12]. The persistence of the dilatation enables proper utero-placental blood flow during the pregnancy course [13]. Lower incidence of preeclampsia in parous women may be explained by the possibility of some permanent changes in the uterine vasculature in subsequent pregnancies [8].

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Doppler velocity waveforms regarding early gestation were evaluated in some studies. Stabile et al., studied uterine artery Doppler during 6-16 gestational weeks in 73 cases and found decrease of PI and RI as the pregnancy progressed [14]. Kurjak et al., conducted a study with 198 cases during 5-12 gestational weeks evaluating both, uterine and spiral arteries and indicated linear decrease of RI in both vessels [15]. Merce et al., analyzed 108 cases between 4-15 gestational weeks and showed again a progressive decrease in both, uterine and spiral arteries and an increase in velocity [16]. Similarly, we found a negative correlation between gestational age and uterine artery PI ($r=-0.044$, $p=0.589$). CRL measurement was highly negatively correlated with UA PI ($r=-0.96$, $p=0.234$). As the gestation progresses, the PI decreases in order to support adequate blood flow for the developing fetus.

Our study revealed that PAPP-A MoM levels were negatively correlated with UA PI ($r=-0.064$, $p=0.442$). PAPP-A is a protease which cleaves insulin-like growth factor binding protein-4 (IGFBP-4) [17]. Low PAPP-A levels may point to chromosomal anomalies, as well as preeclampsia [18]. UA PI may help in the management of pregnancies with low PAPP-A levels: increased resistance resulting in increased PI may alarm the clinician about the risk of preeclampsia [18, 19].

The main limitation of our study was the sample size. As the parity effect was not studied for the first trimester uterine artery Doppler indices before, we could not calculate the effect size and power of the study. We found that parity had no effect on the first trimester uterine artery Doppler indices. However, this preliminary finding should be confirmed by further studies with larger sample size.

As a result, evaluating UA PI during the visit for the first trimester screening test is reasonable. Our preliminary data show that uterine artery Doppler velocity forms in low-risk uncomplicated singleton pregnancies are not affected by maternal age, parity, and maternal weight. This is a great advantage for screening for preeclampsia in low-risk population, so that an increased UA PI may predict the subsequent development of the disease.

Authors' Contribution:

1. Burcu Artunc Ulkumen – concept, assumption, study design, acquisition of data, analysis and interpretation of data, article draft, corresponding author.
2. Halil Gursoy Pala – study design, acquisition of data, analysis and interpretation of data, corresponding author.
3. Yildiz Uyar – analysis and interpretation of data.
4. Yesim Bulbul Baytur – analysis and interpretation of data, revised the article critically.
5. Faik Mumtaz Koyuncu – revised the article critically.

Authors' statement

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