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ULTRASOUND ASSESSMENT OF PLACENTA PREVIA »MIGRATION« IN RELATIONSHIP TO MATERNAL DEMOGRAPHIC FACTORS

ULTRAZVUČNA PROSUDBA MIGRACIJE PLACENTE PREVIJE U ODNOSU NA MAJČINE DEMOGRAFSKE ČIMBENIKE

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Original paper

Key words: placenta previa, ultrasound, migration, delivery, parity

SUMMARY. ***Objective.*** To assess the association between maternal age, parity, history of prior cesarean delivery and placental location in evaluating the persistence and rate of placental migration in low-lying or complete placenta previas followed by serial ultrasound examination. ***Study design.*** This is a retrospective study of 92 cases of low-lying/placenta previa diagnosed at 28 weeks of gestation followed serially by transvaginal ultrasound. The patients were stratified into three groups depending on the placenta to internal cervical os distance: (1) an overlap of 0.0 cm and over the cervical os (complete previa), (2) 0.1 to 2.9 cm (marginal placenta previa), (3) 3.0 cm or above (normal placental location). The prevalence of complete and marginal placenta previas, and the mean rate of placental »migration« (mm/week) were obtained at 28 and 36 weeks of gestation, and compared with maternal age, parity, history of prior cesarean delivery and placental location. ***Results.*** At the time of delivery, 51 patients had placenta previa: 22 complete and 29 marginal placenta previas. In contrast, 41 patients had sufficient placental 'migration' to be categorized into the normal placental location group. The prevalence of complete placenta of 3.3% and 6.5% at 28 weeks, and 3.3% and 5.4% at 36 weeks' gestation, for patients who had parity ≥2, or history or prior cesarean delivery (CD), respectively, was not statistically significant. The rate of placental migration was significantly associated with maternal age (p=0.002), while did not differ when stratified by parity (p=0.672) or prior history of CD (p=0.805), or placental location (p=0.147). ***Conclusion.*** Maternal age significantly modifies the rate of placenta previa migration. A history of prior CD, maternal parity and placental location did not affect the rate of placental migration in our sample of patients with complete or marginal placenta previa diagnosed by ultrasound at 28 weeks' gestation.

Izvorni rad

Ključne riječi: placenta previja, ultrazvuk, migracija, porod, paritet

SAŽETAK. ***Cilj rada.*** Prosuditi povezanost dobi majke, pariteta, prethodnog carskog reza i smještaja posteljice, s perzistiranjem ili migracijom posteljice kod nisko nasjele ili predležeće placente previje, praćene serijskim ultrazvučnim pregledima. ***Način istraživanja.*** Retrospektivna studija 92 nisko nasjele posteljice ili placente previje, dijagnosticirane s 28 tjedana i serijski ultrazvučno praćene. Bolesnice su bile podijeljene u tri skupine, ovisno o udaljenosti posteljice od unutrašnjeg ušća cerviksa: 1) preraštanje više od 0,0 mm preko ušća cerviksa (kompletna previja); 2) 0,1 do 2,9 cm (marginalna previja); 3) 3,0 ili više cm od ušća cerviksa (normalni smještaj posteljice). Zastupljenost kompletnih i marginalnih placenta previja i srednja vrijednost »migracije« posteljice (mm/tjedan) su utvrđeni s 28 i 36 tjedana trudnoće te uspoređeni s dobi majke, paritetom, ranijim carskim rezom i smještajem posteljice. ***Rezultati.*** Od 92 trudnice s 28 tjedana, u vrijeme poroda 51 trudnica je imala placentu previju: 22 kompletnu i 29 marginalnu, dok je u 41 trudnice posteljica dovoljno »migrirala« da bi bila razvrstana u skupinu s normalnim smještajem. Zastupljenost kompletne previje za trudnice s ≥2 poroda od 3,3% s 28 i 3,3% s 36 tjedana, odnosno s prethodnim carskim rezom od 6,5% s 28 i 5,4% s 36 tjedana, nije statistički signifikantno različita. Stopa »migracije« posteljice je znakovito povezana s dobi trudnice (p=0,002), a nije s paritetom (p=0,672), ranijim carskim rezom (p=0,805) ili ležištem posteljice (p=0,147). ***Zaključak.*** Dob trudnice znakovito modificira stupanj migracije placente previje. U našem uzorku kompletnih i marginalnih posteljica otkrivenih ultrazvukom s 28 tjedana, raniji carski rez, paritet majke i ležište posteljice (sprijeda/straga) ne utječu na stupanj migracije posteljice.

Introduction

The prevalence of placenta previa at term is less than 1%.[1] It is associated with advanced maternal age, higher parity, and history of prior Cesarean delivery (CD).[2–8] It is postulated that endometrial damage is an etiologic factor. Presumably, each pregnancy damages the endometrium underlying the implantation site, rendering the area unsuitable for future implantation.[9] Therefore, subsequent pregnancies are more likely to become implanted in the lower uterine segment by a process of elimination. Implementation of prenatal ultrasound demonstrated that placenta previa resolves at a steady rate from 20 weeks' gestation until delivery. Thirty four percent, 49%, 62% and 73% of placenta previas would persist as such if diagnosed at 20–23, 24–27, 28–31, and

32–35 weeks of gestation, respectively.[10] This phenomenon was described as placental »migration« attributed to placental trophotropism,[11] or dynamic placentation.[12] Regardless of the mechanism that is responsible for »placental migration«, it was noted that the mean rate of placental migration, ranging from 0.1 to 4.1 mm/wk, correlated with the final placental distance from the internal cervical os,[13] and was 0.3 and 5.4 mm/wk for those patients who had been delivered via CD vs. normal vaginal delivery, respectively.[14] However, from the published data it is not clear if maternal age, parity or history of prior CD affect the ability of the placenta to migrate away from the cervical os after implantation. The goal of our study was to compare the rates of placental migration in the third trimester of pregnancy, and correlate these findings with the maternal age, parity and history of prior CD.

Study Design

We reviewed 12,435 ultrasound examinations that were stored in the software program ASOBGYN Computerized Patients Records v.4.972.19. (AS Software Inc., Englewood, New Jersey, USA, 2000) between October 2002 and April 2004. A total of 234 patients were evaluated for possible or presumed placenta previa. Study exclusion criteria were as follows: multifetal pregnancy and ultrasound exams performed in the late third trimester for antepartum hemorrhage or abnormal fetal presentation. A total of 163 patients with singleton pregnancies were found to have a diagnosis of placenta previa at the initial fetal anatomical survey between 18 and 20 weeks of gestation. These patients had a follow-up transvaginal ultrasound exam at 28 gestational weeks (range 26 to 29 weeks) for confirmation of the abnormal placental location. Additional 71 patients were excluded from the study due to placenta to internal cervical os distance > 3.0 cm, and associated minimal risk of significant bleeding in labor that would require interventional delivery. In the remaining 92 patients, where the placental location was determined to be close, partially or completely overlapping the internal cervical os, had serial ultrasound exams performed approximately every 4 weeks to reconfirm a marginal or complete placenta previa. These follow-up ultrasound exams were performed approximately at 32 weeks (range 30 to 34 weeks) and 36 weeks (range 35 to 38 weeks) of gestation. For the purpose of statistical analysis, we stratified the follow-up ultrasound scans into »28-«, »32-« and »36-week« categories.

Ultrasound records demonstrated that all ultrasound examinations were performed using 5.0–7.5 MHz transvaginal transducer, with multihertz and harmonic capability (Sequoia System 512; Acuson, a Siemens Company, Mountaint View, California, USA). The placental distance from the internal cervical os was measured in a longitudinal/axial scan of the cervix in all subjects, as described elsewhere.[13] If the placenta was found to cover the internal cervical os, a distance from the overlapping placental edge to the internal cervical os was measured and entered in a database as a negative number. Because of the controversy and inconsistency in the placenta previa classification,[9,15] patients were stratified into three groups depending on the placenta to internal cervical os distance: (1) an overlap of 0.0 cm and above over the cervical os, (2) 0.1 to 2.9 cm, and (3) 3.0 cm and above.

The rate of placental »migration« was defined as an increasing distance of the lower placental edge from the internal cervical os in millimeters per week. The mean rate of placental »migration per week« was generated using a formula that utilized a difference between distances of the lower placental edge from the internal cervical os at 28 to 36 weeks of gestation, and dividing that number by the number of weeks.[13] The rate of placental migration was correlated with maternal characteristics such as age, parity and prevalence of previous abortion, history of previous CD and mode of delivery, and placental location (anterior vs. posterior). In each instance, the attending physician made the final decision concerning the mode of delivery. In the majority of the patients, the decision was made according to the final placental distance from the cervix. If the mode of delivery was determined to be an elective and/or repeated CD for a placenta previa (regardless of the placental distance from the cervical os), a delivery was scheduled for 38–39 weeks of gestation. All patients' medical records were reviewed for maternal and neonatal demographic characteristics, as well as maternal history of previous gynecological surgery and assisted reproduction. Due to nature of retrospective study, a measurement of placenta to internal cervical os distance was recorded only once per each patient and ultrasound evaluation. Therefore, it was not possible to calculate intra- and inter-observer differences associated with the ultrasonic assessment of the placenta previa migration.

Statistical analysis was performed using Prism software v.3.02. (GraphPad Software Inc. 2002; San Diego, California, USA). Arithmetic mean, standard deviation (SD), median with interquartile range, were used where appropriate to present maternal demographic data. The Committee for Human Rights in Research and the Institutional Review Board of the Weill Medical College of Cornell University evaluated and approved the study.

Results

From a total of 12,435 retrieved ultrasound records, 92 (0,74%) patients with a viable singleton pregnancy had a diagnosis of placenta previa on transvaginal ultrasound exam performed at 28 gestational weeks (range 26 to 29 weeks). *Table 1* demonstrates placenta previa prevalence at 28, 32 and 36 weeks' gestation. At 28 weeks of gestational age, 30 and 62 patients were included in groups 1 and 2, respectively. Due to the substantial placental migration noted with the advancement of pregnancy, 19 patients were reassigned to group 3 at 32 weeks, and did not have further ultrasound follow-up. The remaining 73 patients (22 and 51 in group 1 and 2, respectively) had a final ultrasound exam at 36 weeks' gestation. All reviewed records had adequate ultrasound images of the cervix, lower uterine segment

Table 1. A distribution of placenta previa during serial ultrasound examination at 28, 32 and 36 weeks of gestation. Due to the placental »migration« noted with the advancement of pregnancy, some patients were added, and some removed (italic cursive) from the placenta previa categories

Tablica 1. Razdioba placente previje temeljem serijskih ultrazvučnih pregleda s 28, 32 i 36 tjedana trudnoće. Zbog »migracije« posteljice ustanovljene napredovanjem trudnoće neke su pacijentice dodate, a neke nestale (kurzivom) iz kategorije placenta previja

Placenta to internal cervical os distance Udaljenost ruba do ušća cerviksa	Outcome	28 weeks	32 weeks	36 weeks
Group 3 ≥3.0 cm	Removed Nestale	*0*	*0*	*19*
	New – Nove	0	19	22
	Total Ukupno	0	19 (20.7%)	41(44.6%)
Group 2 0.1 to 2.9 cm	Removed Nestale	*0*	*19*	*22*
	Persistent Perzistiraju	62	43	29
	New – Nove	0	8	0
	Total Ukupno	62 (65.2%)	51 (55.4%)	29 (31.5%)
Group 1 An overlap of 0.0 cm and above Preraš ta ili više od 0,0 cm	Removed Nestale	*0*	*8*	*0*
	Persistent Perzistiraju	30	22	22
	Total Ukupno	30 (34.8%)	22 (23.9%)	22 (23.9%)

and placental location, as well as complete demographic and labor data. However, in regard of patients' history of major gynecologic surgery, or artificial reproduction, medical records were incomplete and inconsistent to be used for statistical analysis. From a total of 92 patients, we were able to obtain the records of 6 patients with history of abdominal or transvaginal myomectomy performed elsewhere, while 11 patients had significant history of artificial reproduction assistance; 4 patients were enrolled in in-vitro fertilization program, whereas 7 patients had an insemination.

The mean maternal age was 34.3 ± 5.4 years, ranging from 16 to 44 years, with a median gravidity of 3 (range 1 to 8) and parity of 2 (range 0 to 6). A total of 22% of patients (21 out 92) had history of ≥1 abortion. However, data regarding the nature of the abortion (spontaneous vs. elective termination of pregnancy) were incomplete for analysis. Maternal age did not differ significantly when stratified by maternal parity (p=0.843). The mean maternal age was 35.2 ± 4.9 years (range 23 to 44) and 34.3 ± 7.3 years (range 16 to 40) for patients with parity ≤2 and > 2, respectively.

The majority of patients delivered at term (74.5%) with the mean gestational age at delivery of 38.5 ± 1.3 weeks (range 34 to 42 weeks of gestation). The mean neonatal birth weight was 3333 g ± 498 g (range 2035 g to 4655 g). Thirty-five patients delivered by spontaneous vaginal delivery (NVD), whereas 57 patients delivered via CD: 46 by primary (1-CD) and 11 by repeated CD (R-CD). From a total of 46 patients delivered by primary CD, 9 patients delivered for reason of significant

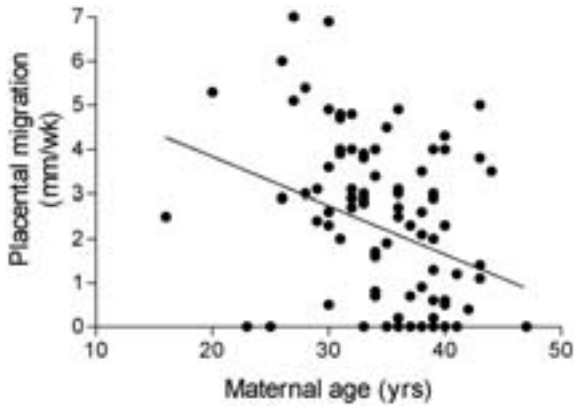

Figure 1. A scattergram of placental migration rates in mm/wk stratified by maternal age. A slope of linear regression is statistically significant (p=0.002; 95% CI –0.1789 to –0.04013; r^2=0.09878)

Slika 1. Dijagram brzine placentarne migracije s obzirom na dob trudnice. Pravac linearne regresije je statistički znakovit (p=0,002; 95% CI –0,1789 do –0,04013; r^2=0,09878)

vaginal bleeding, 9 for fetal breech presentation, 5 for non-reassuring fetal status in labor, 21 and 2 patients as elective procedure for the reason of placenta previa and placenta previa-accreta, respectively. In the group of 11 patients delivered by repeated CD, one patient had a significant vaginal bleeding, 3 for fetal breech presentation, 2 for the reason of suspected placenta previa-accreta, and 5 patients as an elective procedure. Maternal age was significantly associated with the mode of delivery mainly due to younger age of those patients delivered vaginaly (p<0.045). The mean maternal age was 35.8 ± 2.3, 35.6 ± 5.6 and 32.8 ± 5.4 years when delivered by R-CD, 1-CD, or NVD, respectively.

The mean placental rate of migration was 2.7 ± 2.1 mm/wk. Maternal age was significantly associated with the rate of placental migration. Older patients had a significantly lower rate of placental migration compared to younger ones *(Figure 1)*. This was demonstrated with a significant linear regression slope (p=0.002) that provided the equation to predict the rate of placental migration based on maternal age:

$$y = 6.026 – 0.1095 * x$$

where *y* is the rate of placental migration in mm/wk, and *x* is maternal age in years.

Table 2 demonstrates distribution of placenta previa at 28 and 36 weeks' gestation, stratified by maternal parity. There was no statistical significance between the prevalence of placenta previa in groups 1 and 2 when compared at 28 and 36 weeks of gestation (p=0.914 and p=0.771, respectively). In addition, there was no statistical correlation between the rate of placental migration and maternal parity (p=0.843). The mean rate of placental migration was 2.3 ± 1.9 mm/wk and 2.1 ± 1.5 mm/wk in patients with parity <2 and ≥2, respectively, that was statistically not significant (p=0.672).

The majority of patients had posterior placenta previa (67 out 92, 72.9%). Twenty patients (21.7%) had anterior and 5 patients (5.4%) had central placenta previa.

Table 2. Distribution of placenta previa during serial ultrasound examination at 28 and 36 weeks of gestation, stratified by maternal parity
Tablica 2. Razdioba placente previje temeljem serijskih ultrazvučnih pregleda s 28, 32 i 36 tjedana prema paritetu trudnice

Placenta to internal cervical os distance Udaljenost ruba do ušća cerviksa	Parity Paritet	28 weeks	36 weeks
Group 3 > 3.0 cm	0	0	24 (26.1%)
	1	0	11 (12.0%)
	≥2	0	6 (6.5%)
Group 2 0.1 to 2.9 cm	0	39 (42.4%)	20 (21.7%)
	1	16 (17.4%)	7 (7.6%)
	≥2	7 (7.6%)	2 (2.2%)
Group 1 An overlap of 0.0 cm and above Prerašta ili više od 0,0 cm	0	18 (19.6%)	13 (14.1%)
	1	9 (9.8%)	6 (6.5%)
	≥2	3 (3.3%)	3 (3.3%)

Table 3. Distribution of placenta previa during serial ultrasound examination at 28 and 36 weeks of gestation, stratified by the mode of delivery
Tablica 3. Razdioba placente previje temeljem serijskih ultrazvučnih pregleda s 28, 32 i 36 tjedana prema načinu poroda

Placenta to internal cervical os distance Udaljenost ruba do ušća cerviksa	Mode of delivery	28 weeks	36 weeks
Group 3 > 3.0 cm	NVD	0	31 (33.7%)
	1-CD	0	6 (6.5%)
	R-CD	0	4 (4.3%)
Group 2 0.1 to 2.9 cm	NVD	35 (38.1%)	2 (2.2%)
	1-CD	22 (23.9%)	25 (27.2%)
	R-CD	5 (5.4%)	2 (2.2%)
Group 1 An overlap of 0.0 cm and above Prerašta ili više od 0,0 cm	NVD	0	0
	1-CD	24 (26.1%)	17 (18.5%)
	R-CD	6 (6.5%)	5 (5.4%)
Total		92 (100%)	92 (100%)

NVD: normal vaginal delivery – normalni vaginalni porod; 1-CD: primary cesarean delivery – primarni carski rez; R-CD: repeated casarean delivery – ponovljeni carski rez

The mean rate of placental migration was 2.2 ± 2.1 mm/wk and 2.4 ± 1.8 mm/wk for anterior and posterior placenta previas, respectively, that was not statistically significant (p=0.147). In addition, there was no statistical difference in prevalence of vaginal delivery between anterior and posterior located placenta previas (p=0.815).

Table 3 represents distribution of placenta previa at 28 and 36 weeks' gestation, stratified by the mode of delivery. There was no statistical significance between the prevalence of placenta previa in groups 1 and 2 at 28 and 36 weeks of gestation, when compared in those patients who had 1-CD or R-CD (p=1.0 and p=0.42, respectively). The rates of placental migration significantly differ between patients who delivered vaginally vs. those who delivered by CD (p<0.001). This statistical difference was mainly caused by a high rate of placental migration in patients who delivered vaginally *(Table 3)*. However, when the rates of placental migration were compared between patients who had previous vs. no history of CD, no significant difference was noted (p=0.805). The mean rate of placental migration was 1.3 ± 1.6 mm/wk and 1.5 ± 1.6 mm/wk in patients with no history of previous CD and those with one or more CD, respectively.

Discussion

Serial ultrasound examinations documented the presence of a low-lying or placenta previa in the second trimester of pregnancy with subsequent conversion to an upper uterine segment placenta by the end of the third trimester.[10,15,16] The mechanism of placental migration has not been fully elucidated. It is believed that the thin placental margins atrophy due to a poor vascular supply, compared to other placental regions that continue to grow and, therefore, »migrate« towards more vascular sites.[9] It is also possible that the placental migration is modified by more rapid growth of the lower uterine segment with advancing pregnancy.[12,17] The mean rate of placental migration of 0.3 mm/week and 5.4 mm/week, for those patients who had been delivered via CD vs. normal vaginal delivery, respectively, has been observed.[14] In addition, it was noted that the deceleration pattern of placenta previa migration in the third trimester of pregnancy is associated with a higher rate of placenta accreta or manual placental removal at the time of delivery.[13] It was suggested that the maternal age, parity or history of prior CD is a risk factor for higher placenta previa prevalence at the time of delivery.[2–8] A higher prevalence of placenta previa in these patients was attributable to damaged endometrial lining due to multiple deliveries, aging and scarring in the lower uterine segment caused by CD, which render the growth and elongation of the uterine wall impaired; hence, the inability of the placenta to »migrate« from the internal cervical os.[9]

In the present study, between 28 and 36 weeks' gestation ultrasound assessment we did not observe significantly decreased prevalence of complete placenta previa in patients with parity equal or above 2, and history of prior CD. In contrast, we noted marked reduction of marginal placenta previa prevalence at 36 weeks of gestation due to significant placental migration and reassignment of patients from group 2 to group 3. These changes were directly related to the rate of placental migration. We observed a mean rate of placental migration of 2.7 mm/week from 28 to 36 weeks of gestation. This rate of placental migration significantly correlated with maternal age. Older patients had lower rate of migration compared with younger women. Interestingly, maternal age also correlated with the mode of delivery. The mean age of the patients who had primary or repeated CD was significantly higher than in patients who delivered vaginally. It appears that maternal age was associated with the mode of delivery because of the lower rates of placental migration; therefore, a smaller final placenta to internal cervical os distance at 36 weeks that required CD would be observed. It is possible that maternal aging affects the elasticity and vascular perfusion of the uterus that is reflected in the decreased adjustability of the lower uterine segment tissue to placental trophotropism.

In contrast, in our sample of patients, maternal age was not associated with parity, and maternal parity was not associated with the rate of placental migration. This is likely due to the absence of great or grand multiparas

in our study population where the median parity was 2. As opposed to, most of the previously published reports associated maternal grand-multiparity with the higher prevalence of placenta previa.[3–5]

In regard of placenta previa location, we did not observe and difference in rates of migration between anterior and posterior placenta previas. This was in disagreement with previous report that described higher rate of placenta previa resolution noted with advancement of pregnancy rather in the anterior than in the posterior placenta previas.[18] We were unable to explain a difference between contradictory results except for the possibility that differences in population sample between these two studies (e.g. different mean maternal age and parity) could play a significant role.

Although our results indicate that the responsible variable for altered rate of placenta previa migration was maternal age rather than parity, history of previous CD, or placental location, following limitations of the study were recognized. First, our data about patient parity in terms of spontaneous vs. elective abortion history, other major gynecologic surgery than CD (e.g. myomectomy), and history of artificial reproduction in index pregnancies, were incomplete. Therefore, an appropriate multivariate regression analysis was not conducted. As such, our results and subsequently conclusions may not truly present all possible confounder variables of altered placental migration. And second, due to nature or retrospective study, we were unable to present intra- and inter-observer differences in the assessment of placental migration. Therefore, the reproducibility of our data could be questioned due to possible inherited measurement inaccuracy that could affect study alpha-error and, therefore, faulty accept a hypothesis that maternal age significantly influence rate of placental migration.

In conclusion, our data concur with previously described correlation between the higher prevalence of placenta previa in older women, and those with history of prior CD. However, we did not observe maternal parity as a significant cofounder that may affect the rate of placental migration. These observations may provide an additional insight into the understanding of placenta previa »migration« patterns in pregnancy. However, due to limitations of our retrospective study, further investigation is required to evaluate placental rates of migration in relation to other risk factors for placenta previa and associated phenomenon of placental migration.

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