

# Repercussions of previous cesarean uterine scar at uterine arteries Doppler velocimetry between the 26th and 32nd gestational weeks\*

*Repercussões da cicatriz uterina resultante de cesariana prévia na dopplervelocimetria das artérias uterinas entre 26 e 32 semanas*

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**Abstract Objective:** To evaluate the possible repercussions of the previous cesarean scar at uterine arteries Doppler velocimetry between the 26th and 32nd gestational weeks. **Materials and Methods:** Prospective cross-sectional study including 45 women between 11 and 14 weeks of gestation, divided into three groups: 17 pregnant women with uterine scar resulting from a previous elective cesarean section (group A); 14 with uterine scar resulting from a previous cesarean section performed during labor (group B); and 14 pregnant women with a single previous vaginal delivery (group C). Uterine arteries Doppler velocimetry was performed with transabdominal approach. Means, medians and standard deviation (SD) were calculated for each group in the study. The groups comparison regarding pulsatility index was performed with the non-parametric Kruskal-Wallis test. **Results:** In group A, the pulsatility index ranged from 0.60 to 1.60 (mean: 0.90; SD: 0.29), in group B, from 0.53 to 1.43 (mean: 0.87; SD: 0.24), and in group C, from 0.65 to 1.65 (mean: 1.01; SD: 0.37); with  $p = 0.6329$ . **Conclusion:** No repercussion of previous cesarean scar was observed at uterine arteries Doppler velocimetry performed in the period between the 26th and 32nd gestational weeks. **Keywords:** Pregnancy; Uterine scar; Previous cesarean section; Uterine arteries Doppler velocimetry.

**Resumo Objetivo:** Avaliar as repercussões da cicatriz uterina na dopplervelocimetria das artérias uterinas, entre 26 e 32 semanas, em gestantes primíparas com uma cesariana prévia, considerando quando esta foi realizada fora (cesárea eletiva) ou durante o trabalho de parto. **Materiais e Métodos:** Estudo prospectivo transversal em 45 gestantes, divididas em três grupos: 17 gestantes com cicatriz prévia resultante de cesariana eletiva (grupo A); 14 gestantes com uma cicatriz prévia oriunda de cesariana executada em trabalho de parto (grupo B); 14 gestantes cujo único parto anterior foi realizado por via vaginal (grupo C). A dopplervelocimetria das artérias uterinas foi realizada pela via abdominal. Foram calculados as médias, medianas e desvios-padrão (DP) para cada grupo em estudo. Em relação ao índice de pulsatilidade, a comparação dos grupos foi conduzida pelo teste não paramétrico de Kruskal-Wallis. **Resultados:** Os valores médios do índice de pulsatilidade no grupo A variaram de 0,60 a 1,60 (média: 0,90; DP: 0,29), no grupo B, de 0,53 a 1,43 (média: 0,87; DP: 0,24), e no grupo C, de 0,65 a 1,65 (média: 1,01; DP: 0,37);  $p = 0,6329$ . **Conclusão:** Não houve repercussões da cicatriz de cesariana prévia na dopplervelocimetria das artérias uterinas avaliadas de 26 a 32 semanas de gestação.

**Unitermos:** Gestação; Cicatriz uterina; Cesariana prévia; Doppler das artérias uterinas.

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## INTRODUCTION

The adverse effects that a previous cesarean uterine scar may cause highlight the increasing frequency of placenta previa, placenta accreta, ectopic pregnancy at the scar niche and uterine rupture, in future pregnancies<sup>(1-5)</sup>. Anatomic changes result from decreased local vascularization

caused by fibrosis, which is greater in elective cesarean sections performed without appropriate formation of the lower uterine segment<sup>(6)</sup>. Several imaging methods have been utilized in the assessment of the integrity of this region in uteri with scars from previous cesarean section. In the seventies, hystero-graphy played a relevant role in demonstrating defective scarring (presence of scar niche), recently replaced by sonohystero-graphy, hysteroscopy and magnetic resonance imaging, also performed

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out of the gestational period<sup>(7-9)</sup>. Ultrasonography, a safe and noninvasive method<sup>(10)</sup>, has been utilized during the gestational period with this purpose since the eighties<sup>(2,11,12)</sup>.

It is possible that previously performed cesarean sections, whether electively or during labor, cause differences in the evaluation of the uteroplacental flow. The choice of the uterine artery for dopplervelocimetric evaluation of the uteroplacental circulation offers better accuracy than small arteries such as the arcuate or radial arteries, not only for being of easier insonation, but also because it reflects the total distal resistance of the vascular flow of this circulation<sup>(13)</sup>.

During pregnancy, the uterine artery flow is 10 times greater than the non-pregnant flow, thus enhancing the blood supply to the fetal-placental unit. Such increase in flow depends on the trophoblastic invasion of spiral arteries which occurs in phases, starting at the decidual segments and later at the myometrial segments<sup>(14,15)</sup>. The irregularity in the physiological process of the trophoblast invasion is associated with placental insufficiency, occurrence of pre-eclampsia, placental abruption, fetal growth restriction and/or fetal death<sup>(16-18)</sup>. Relevant factors such as placental location must be considered during the performance of exams. Additionally, other important factors are parity and presence of uterine scars, particularly those caused by previous cesarean section, which could change the local circulation to an extent capable of affecting the results from uterine arteries dopplervelocimetry.

The present study is aimed at assessing in current pregnancies the possible repercussions of previous cesarean section scars on uterine arteries dopplervelocimetry between the 26th and 32nd gestational weeks, considering the characteristics of the indication for cesarean section: electively or during labor.

## MATERIALS AND METHODS

The present prospective, cross sectional study was developed between April, 2007 and November, 2009, with pregnant women with one previous cesarean section selected at the first prenatal visit at the

Hospital Celso Pierro – Pontifícia Universidade Católica de Campinas (PUC-Campinas), SP, Brazil. All the patients who agreed to participate in the study duly signed a term of free and informed consent.

The study was approved by the Committee for Ethics in Research of Universidade Federal de São Paulo (Unifesp).

The patients with a single previous parturition, were divided into three groups: GA – pregnant women with a previous scar resulting from elective cesarean section; GB – pregnant women with a previous scar resulting from cesarean section performed during labor; GC – pregnant women whose single previous delivery was vaginal, constituting the control group.

The gestational age was determined by the last menstrual period (LMP), reported with certainty by the patient at the moment of the examination and confirmed by first trimester ultrasonography through the crown-rump length (CRL). For the purpose of division of the patients into the three groups, they were asked whether the previous cesarean section was performed before or after the onset of uterine contractions. The homogeneity of the groups was measured by age, ethnicity and body mass index (BMI). The considered age (in years) was that reported by the patient on the day of the US scan. The BMI calculation was based on the women habitual pre-pregnancy weight and height. As regards ethnicity the women were classified as white, mulatto, black or other. Based on the findings by Guidoni et al.<sup>(19)</sup> the previous suture type was not taken into consideration in the present study.

Only primipara pregnant women aged between 18 and 35 years were included in the present study. Exclusion criteria were the following: chronic, gestational hypertension or pre-eclampsia; fetal growth restriction; antiphospholipid antibody syndrome and collagenoses; vaginal bleeding in the current pregnancy; low lying placenta; alcoholic patients, smokers or illicit drug users; patients with BMI > 35 at the beginning of pregnancy; multiple gestation; pregnancy resulting from assisted fertilization; endometriosis; leiomyoma or other gynecopathy that might potentially affect the uterine flow; history of repetitive miscarriages; endometritis in previous

pregnancy; polyhydramnios; patients with more than one previous cesarean section; previous cesarean section in preterm pregnancy; previous longitudinal cesarean section and primipaternity.

A Sonoace 8000 Live (Medison; Seul, Korea) apparatus with a 3.5 MHz sector transducer was utilized for the dopplervelocimetry study of the uterine arteries by abdominal approach, between the 26th and 32nd gestational weeks. The scans were performed with the patients in the semi-Fowler position and the transducer was placed on the longitudinal plane along the inguinal region, at 2 to 3 cm from the anterior superior iliac spine, directed to the lateral wall of the uterus, at the level of the internal uterine cervical os. The uterine arteries were identified at color Doppler and insonated at approximately 1 cm from the crossing point with the external iliac artery<sup>(20,21)</sup>. A 100 Hz filter was utilized and the waves quality was maximized by the use of the smallest insonation angle (60°). The analysis of the waveforms was only performed when at least three uniform and consecutive waveforms were obtained<sup>(13)</sup> (Figure 1). From the obtained and selected waveform, the pulsatility index (PI) was measured. The S point is the systolic velocity peak and D is the final diastolic velocity (Figure 2). The PI was automatically calculated by the system. The procedure was repeated three times for each uterine artery, in order to obtain the mean PI value for each side. Subsequently, the mean between the two obtained values was calculated, resulting in a final PI value for each pregnant woman, thus eliminating the interference of the placental location<sup>(16)</sup>.

The data were recorded on an Excel 2003 (Microsoft; Redmond, WA, USA) worksheet and were then analyzed by means of the statistical package SPSS version 13.0 for Windows (SPSS Inc.; Chicago, IL, USA). The main quantitative variable of interest, PI, was described by means of mean value, standard deviation (SD), median, minimum and maximum values, thus allowing the comparison of the values obtained for the different groups. The same statistical measurements were utilized to characterize the groups according to the following variables: age, BMI and respective gestational ages. As regards ethnicity, the groups

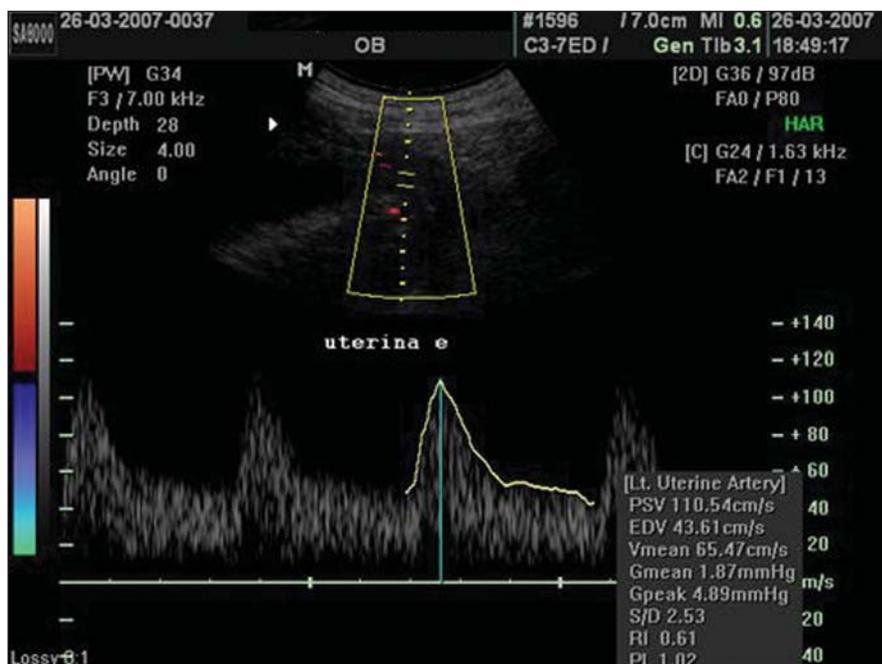


Figure 1. Uterine artery Doppler ultrasonography with uniform waveforms.

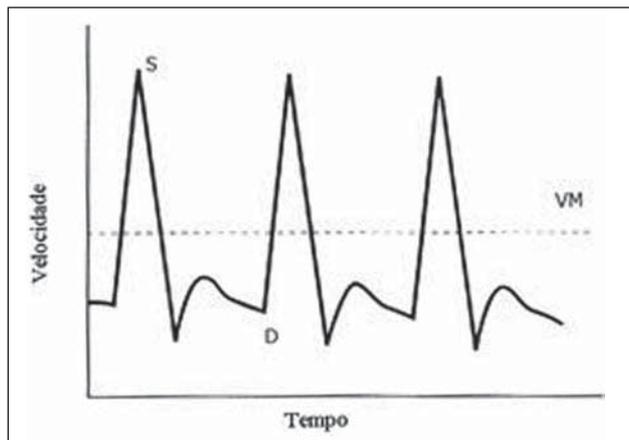


Figure 2. Diagram representing uterine artery Doppler ultrasonography representing the peak of systolic velocity and final diastolic velocity.

were described by means of frequency distribution. The studied groups were compared by means of variance analysis (ANOVA) as the variable distribution presented a normal distribution (Gaussian), as in the cases of the variables of interest such as age, BMI and gestational ages. Whenever evidence of statistically significant difference was observed between the groups identified by ANOVA ( $p < 0.05$ ), the Duncan method for multiple comparisons was utilized, with the purpose of recognizing the intergroup differences. As regards the mean PI values, the groups were compared by means of the Kruskal-Wallis test. A significance level of ( $p < 0.05$ ) was utilized.

### RESULTS

The present study sample included 45 pregnant women, divided into three groups: 17 elective cesarean sections, 14 cesarean sections in labor and 14 in the

control group. As regards the patients' age, no statistically significant difference was observed between the three groups ( $p = 0.95$ ). The mean age was around 26 years. Approximately 80% of the patients were white, in the three groups, with very similar ethnic profiles, with no statistically significant difference ( $p = 1.00$ ). The BMI also did not present evidences of statistically significant intergroup differences ( $p = 0.33$ ), with a mean value close to 23. Gestational age at the time of ultrasonography examination did not present any evidence of statistically significant intergroup difference, with a mean gestational age of 27.9 weeks.

As regards PI values, in group A it ranged from 0.60 to 1.60 (mean: 0.90; SD: 0.29); in the group B, from 0.53 to 1.43 (mean: 0.87; SD: 0.24); and in group C, from 0.65 to 1.65 (mean: 1.01; SD: 0.37), with no evidence of statistically significant intergroup differences ( $p = 0.6329$ ) (Table 1).

### DISCUSSION

The increase in the number of cesarean sections is noticeable in the entire world since the 1970's. Brazil is currently one of the countries with the highest index of cesarean sections, with significant increase over the years, oscillating from 14.6% in the early 1970's to 41.8% in 2005<sup>(22)</sup>.

With the increase in the index of cesarean sections, the evaluation of uterine scars, particularly those resulting from previous Cesarean section, gained great importance in obstetric assistance, as it can change the local anatomy and affect the obstetric outcomes, predisposing the patients to disorders such as placenta previa, placental accreta, scar dehiscence, uterine rupture or ectopic pregnancy at the scar niche<sup>(1,2,20,23)</sup>. Zimmer et al.<sup>(24)</sup> have evaluated, by means of transvaginal US, the lo-

Table 1. Distribution of the pulsatility indices among the three pregnant women groups.

Group	n	Mean	SD	Median	Minimum	Maximum
GA	17	0.90	0.29	0.76	0.60	1.60
GB	14	0.87	0.24	0.85	0.53	1.43
GC	14	1.01	0.37	0.87	0.65	1.65

Kruskal-Wallis ( $p = 0.6329$ ). SD, standard deviation; GA, pregnant women with uterine scar resulting from previous elective cesarean section; GB, pregnant patients with a uterine scar resulting from previous cesarean section performed during labor; GC, pregnant women with a single previous vaginal delivery, constituting the control group; n, number of pregnant women in each group.

cation of uterine scar resulting from previous cesarean section, between the 14th and 16th gestational weeks, to compare the uterine scar in patients whose previous cesarean section was performed electively or during labor. They have separated the patients by asking them whether the previous cesarean sections were performed before or after the onset of uterine contractions. They considered the sonographic image corresponding to the scar as a hypoechogenic line seen at the isthmocervical region. The results have demonstrated that such line was most easily visualized when the previous cesarean section was performed during labor (75.7% versus 52.7%;  $p = 0.001$ ) and that the scar was most distant from the internal cervical os in the same conditions (17.9 versus 14.6 mm). The prematurity variable had an influence only in cases where the previous cesarean section was elective, and the scar was closer to the uterine body. Thus, the authors have concluded that when the cesarean section is performed during the labor, it is done at the level of the isthmus (cervical structure); on the other hand, when it is performed out of the labor section includes the myometrial structure.

Such findings are in agreement with the physiological process of cervical effacement, shortening and softening during uterine contractions, when the cervix becomes part of the segment. However, such a process is still to be histologically defined. In this study, the parity or the number of previous cesarean sections have not been considered. The results from such study lead to important clinical reflections: elective cesarean sections should be avoided whenever possible in the appropriate assistance to delivery, thus decreasing the aggravation to the uterine matrix and decreasing the risk for placenta previa, placenta accreta, uterine rupture or ectopic pregnancy at the scar niche.

Oosterhof et al.<sup>(13)</sup> have elected the uterine arteries as the best option to study the uteroplacental circulation, as such arteries provide better accuracy than the small arteries such as the arcuate, straight and radial arteries, not only for being easier to be insonated, but also for reflecting the total distal resistance of the vascular flow in this

circulation. However, no study on the evaluation of the uterine scar vascularization by means of ultrasound Doppler was found in literature. In the present study, comparing the findings at uterine arteries dopplervelocimetry, no changes in the pulsatility indices of such arteries were found among the three studied groups. Based on such results, the authors believe that the uterine matrix circulation is of such a magnitude, that it cannot be changed by scarring process secondary to cesarean sections. Thus, the circulatory damages caused by collagen deposition would be restricted only to the scar location or to the microcirculation, impairing its evaluation by uterine arteries dopplervelocimetry.

Possibly three-dimensional ultrasonography, for allowing the local circulation quantification, may be a valuable method to study circulatory changes of uterine scars. However new studies will be required to confirm such assumptions.

## CONCLUSIONS

No repercussion of previous cesarean section scars was observed at dopplervelocimetry of uterine arteries performed in the period from the 26th to the 32nd gestational weeks.

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