Placental Laterality May be a Random Event and Not the Result of Inherent Uterine Artery Pathology

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Objective: To determine whether placental laterality and discordant uterine artery impedance during pregnancy is a random event or the result of uterine artery pathology.

Methods: We identified 50 patients with unilateral placenta and pathologic uterine artery impedance during their current pregnancy and enrolled them in the study. Thirty-three of these patients met the inclusion criteria and returned during the first 10 days of their third normal menstrual cycle after delivery. We examined the pelvic anatomy to rule out any pelvic pathology and then used color and pulsed wave duplex Doppler to identify the uterine artery in the immediate vicinity of the paracervical area at the level of the isthmus. We obtained the uterine artery resistance index (RI) from each uterine artery. We performed statistical analysis by means of t-test.

Results: The uterine artery ipsilateral to the placenta exhibited significantly lower impedance than the contralateral in the pregnant state. When the placenta was right, the values (mean $\pm$ SD) were 0.60 $\pm$ 0.11 vs. 0.73 $\pm$ 0.09 for the right and left artery, respectively. When the placenta was left the values were 0.57 $\pm$ 0.08 vs. 0.77 $\pm$ 0.07 for the left and right uterine artery, respectively. In the nonpregnant state, the corresponding values were 0.90 $\pm$ 0.04 vs. 0.90 $\pm$ 0.05 and 0.91 $\pm$ 0.05 vs. 0.90 $\pm$ 0.04, respectively.

Conclusion: In patients with a unilateral placenta and discordant pathological uterine artery impedance during pregnancy, there is no evidence of discordant impedance between the two uterine arteries in the postpartum period. We speculate that the location of placental implantation may not be the result of preexisting uterine artery discordant impedance. *J. Matern.-Fetal Med. 2000;9:178–180.*   © 2000 Wiley-Liss, Inc.

Key words: placenta; pregnancy; Doppler; uterine artery

INTRODUCTION

Uterine artery Doppler has been studied extensively over the past decade. Pathological uterine artery changes were described in a number of clinical conditions. The risk of intrauterine growth restriction (IUGR), preeclampsia, abruptio, and poor perinatal outcome increases substantially in patients with evidence of pathological uterine artery Doppler. Uterine artery impedance declines progressively from conception and up to the end of pregnancy. The most dramatic decline in the uterine artery takes place up until 24 to 28 weeks of gestation when the second wave of trophoblastic invasion is complete [1–3].

Placental location was found to be associated with uterine artery discordance when the placenta is located unilaterally [4,5]. We have found in previous studies that patients with unilateral placenta and discordant uterine artery impedance are at increased risk for IUGR and/or preeclamp-

sia. It is not known whether placental location is a random event which then influences uterine artery impedance or if it is preexisting uterine artery discordant impedance that influences the location of the placenta.

We designed this prospective study to evaluate the uterine artery impedance in nonpregnant patients who had previously experienced a pregnancy with unilateral placenta, abnormal discordant uterine artery impedance and their pregnancy was complicated with preeclampsia and/or IUGR. The hypothesis is that preexisting discordant impedance of the uterine arteries may determine the location of placental implantation.

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MATERIAL AND METHODS

We identified 50 pregnant patients with unilateral placenta and abnormal discordant uterine artery impedance during the index pregnancy. The criteria for inclusion in the study were abnormal discordant uterine artery impedance, preeclampsia, and/or IUGR. IUGR was defined as birthweight below the 10th percentile of the normal curve. Preeclampsia was defined as hypertension (two readings of >150/90 mm Hg 6 h apart) with proteinuria (total protein >500 mg/24 h), with or without edema. Normality of the uterine artery impedance was defined according to our criteria taking in consideration placental laterality. Resistance index (RI) values >0.77 for the nonplacental artery with or without diastolic notch and RI >0.60 for the placental uterine artery with or without notch were considered abnormal. The presence of diastolic notch was considered abnormal regardless of the RI value. If the contralateral or both uterine arteries were abnormal the case was characterized as pathologic [3,4]. All patients were examined at least twice prior to delivery. Data from the last examination prior to delivery (0–7 days) were used for the analysis. These patients were asked to participate in the study at some point after their pregnancy, and none of the participating individuals intended to breastfeed or make use of oral contraceptives during the study period. Thirty-three of the 50 patients who responded to our request met the criteria for inclusion in the study and returned for the evaluation during the first 10 days of their third menstrual cycle after the index pregnancy. The timing within the cycle was chosen in order to avoid potential variability from hormonal differences in the proliferative and secretory phase of the cycle. The third menstrual cycle was chosen without any physiological effect in mind. We wanted to be as far away from the index pregnancy as possible but not to have a new pregnancy prior to completion of the uterine artery sampling in the nonpregnant state. The sampling of the uterine arteries thus took place at 14–16 weeks postpartum. At this time, most if not all of the pregnancy-related cardiovascular changes have subsided.

Doppler measurements during pregnancy were obtained by means of pulsed wave duplex Doppler. The point where the uterine artery crosses over the iliac artery was identified by means of color Doppler and the range gate was placed at the uterine artery segment immediately next to the iliac artery. In the nonpregnant state, the patients were examined with a full bladder in order to improve visualization of the paracervical area. The uterine artery was sampled at its segment between the cervix and the iliac artery. The RI was used as a measure of impedance because RI values are normally distributed in contrast to S/D ratio. Measurements were obtained during maternal apnea. Three waveforms of equal quality (shape and Doppler gain) were measured and the average of the three was used for the analysis. Placenta laterality was defined as described previously [5].

The Institutional Review Board approved the study and all patients gave written informed consent. Statistical analysis was performed by means of JMP Statistical Software (SAS Institute, Cary NC). Analysis of the data was done by t-test and statistical significance was set at a $P < 0.05$.

RESULTS

Of the 50 patients we originally asked to participate, 33 met the criteria and reported for the study at the predetermined appropriate time. Ten of the 50 patients failed follow-up either for unknown reasons or because they had moved away from our region. Seven patients were not included because of a previously unknown pregnancy at the time of the follow-up study or due to menstrual period noted at the time of the study.

The mean $\pm$ SD gestational age at the time of delivery was 34.8 $\pm$ 3.2 weeks (range, 27–40 weeks). The mean $\pm$ SD birth weight was 2,266.8 $\pm$ 739.8 g (range, 458–3,752 g). Thirteen pregnancies were complicated by IUGR only, 12 by preeclampsia only, and eight pregnancies were complicated by IUGR and preeclampsia. In 21/33 (63.6%) patients exhibited right-sided placenta and 12/33 (36.4%) left-sided. In the pregnant state, the uterine artery ipsilateral to the placenta exhibited significantly lower impedance than the contralateral in all patients. Diastolic notch was present in 28/33 (84.5%) of the contralateral uterine arteries. When the placenta was right-sided, the RI values (mean $\pm$ SD) were 0.60 $\pm$ 0.11 vs. 0.73 $\pm$ 0.09 for the right and left uterine artery, respectively. When the placenta was left-sided, the RI values were 0.57 $\pm$ 0.08 vs. 0.77 $\pm$ 0.07 for the left and right uterine artery, respectively. For both comparisons, $P < 0.001$.

In the nonpregnant state, the corresponding values were 0.90 $\pm$ 0.04 vs. 0.90 $\pm$ 0.05 and 0.91 $\pm$ 0.05 vs. 0.90 $\pm$ 0.04, respectively ($P = $ NS).

DISCUSSION

Placental implantation is achieved by means of trophoblastic invasion of the spiral arterioles of the progesterone primed secretory endometrium. Invasion of the arteriolar wall by the trophoblast leads to the replacement of arterial wall muscle with trophoblastic cells. This causes the arterioles to lose any inherent contractility, which in turn leads to a profound decrease in impedance. Thus, nature assures a low impedance vascular bed with continuous flow throughout the cardiac cycle and minimal pulsatility [7,8].

Normal (low) uterine artery impedance is associated with normal fetal growth and desirable perinatal outcomes. In contrast, abnormal (high) uterine artery impedance is associated with poor perinatal outcomes [9–13]. In addition, we have demonstrated that unilateral placenta location with discordant uterine artery impedance is associated with a 3-fold increase in the risk for IUGR and/or preeclampsia. Is the discordance in the uterine arteries the result of

preexisting uterine artery pathology or the result of different degrees of trophoblastic invasion?

In this group of patients who were found to have unilateral placenta with discordant and pathologic uterine arteries during the index pregnancy, we were unable to demonstrate discordant uterine artery impedance 3–4 months after the pregnancy. It is reasonable to speculate that since there is no measurable difference in the impedance between the right and left uterine arteries in the nonpregnant state, the regional distribution of the placenta may be a random event. Trophoblastic invasion of the spiral arterioles is not homogenous in patients with pathologic pregnancies [7].

In summary, we have demonstrated that in patients with unilateral placenta and abnormal discordant uterine artery impedance, the placental location may not be associated with measurable preexisting uterine artery discordant impedance. Instead, it appears that the regional distribution of the placenta in the uterus may be unrelated to inherent differences of the uterine arteries prior to conception.

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