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Improvement of uterine artery Doppler velocimetry indices after metroplasty in arcuate uteri

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Abstract

Objective: Our study aimed to evaluate the effect of metroplasty performed in arcuate uteri on uterine artery Doppler velocimetry.
Study design: We performed uterine artery Doppler velocimetry transvaginally before and after metroplasty in 36 women with arcuate uteri. Pulsatility indexes (PI) of uterine arteries were calculated and the presence or absence of a protodiastolic notch was evaluated.
Results: Comparing Doppler indexes before and after metroplasty, we found that uterine artery impedance improves as assessed by lower mean PI. We observed that PI after intervention was significantly lower compared with indexes before for mean Doppler index evaluations (mean uterine PI pre: 2.07 ± 0.61 and post: 1.49 ± 0.24 [$p < 0.03$]). No differences were observed as regards bilateral protodiastolic notch absence or presence. A protodiastolic notch was present in 22 out of 36 women before metroplasty (61%), and a notch was observed in 19 out of 36 (52%) after metroplasty.
Conclusions: Our results suggest that, metroplasty, as well as making the uterine cavity wider, leads to better uterine perfusion.

Keywords: Uterine arteries; Doppler velocimetry; Arcuate uterus; Metroplasty

1. Introduction

The uterus is formed by the fusion of Müller's ducts between 8 and 12 weeks' gestation. Arteries and veins develop simultaneously, establishing an anastomotic medial network that joins the circulation of both hemiuteri in fusion [1]. The arcuate uterus is a minor uterine anomaly caused by a defect in the fusion of the Müllerian ducts [2]. It is one of the most important categories in the AFS (American Fertility Society) classification system. Previously, this anomaly was considered to be a variant of septate uterus or a ''mild'' form of a bicornuate uterus [3], but in the latest ASRM (American Society for Reproductive Medicine) system for classification of uterine anomalies, formalized in 1988 and currently in use [4], it was placed in its own group because its clinical characteristics are completely different from those seen with septate and bicornuate uterus. It is currently the subject of considerable controversy, because some studies consider it to be potentially associated with poor reproductive outcome [5], while others consider it a normal variant with no adverse influence on reproduction [6]. Transvaginal ultrasound allows an easy diagnosis upon observation of a normal uterine fundus next to a normal endometrial cavity, except at the level of the fundus, where a separation of the endometrial cavity into two parts is seen [7].

Hysteroscopy is considered the gold standard for the assessment of intrauterine abnormalities, including septa. It has been demonstrated to be superior to hysterosalpingography in diagnosing intrauterine abnormalities. In addition, the use of hysteroscopy facilitates treatment as well as diagnosis.

In Müllerian duct anomalies, where duct fusion is incomplete, it is easy to imagine a lack of anastomoses between arteries and veins of the fused hemiuteri, especially at the level of the uterine fundus because of the caudal to cranial course of the fusion [8].

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In fact, some authors [8,9] hypothesized that altered uterine circulation could be the cause of their findings in studies performed on pregnant women with malformed uteri.

Blood supply to the uterus is provided by the uterine and ovarian arteries. The former are branches of the internal iliac artery. Upon reaching the isthmic portion of the uterus, they ascend through the lateral wall before anastomosing with the ovarian arteries at the cornu of the uterus [10]. Each uterine artery lead on, at different levels of the uterine walls, to the arcuate arteries, which run circumferentially around the uterus anastomosing at the midline. Radial branches extend from the arcuate arteries at right angles toward the endometrium, where they divide into two or more spiral arteries [11–14].

Color Doppler imaging allows accurate mapping of the uterine arteries in real time. Transvaginal ultrasound is used in studies performed in non-pregnant women or during the first trimester of pregnancy. Uterine artery waveforms obtained from the non-pregnant uterus are characterized by high impedance of blood flow. Doppler indexes change according to the phase of the menstrual cycle [15]. In a study of 150 normal women, Kupesic and Kurjak reported that the RI (resistance index) is 0.8 ± 0.04 until day 13 of the 28-day menstrual cycle [16]. Kupesic-Urek et al. [17] also described the RI starting to drop one day before ovulation, reaching a nadir on day 18, and remaining at this level for the rest of the cycle. A high resistance to flow during the midluteal phase of the cycle (day 21) has been associated with infertility. Steer et al. [18] observed that the PI was higher in infertile women. Furthermore, it has been reported that Doppler indexes are lower in the uterine artery homolateral to the ovulating ovary compared with the non-ovulating side [19].

We aimed to evaluate by means of Doppler velocimetry technology a possible improvement in uterine blood flow after correction of arcuate uteri using hysteroscopic metroplasty.

2. Materials and methods

Our study was conducted in the Department of Gynecology, Perinatology, and Child Health of the University "La Sapienza" (Rome, Italy), from October 2001 to December 2004. The study group included 36 women diagnosed with an arcuate uterus. Diagnosis was suspected by transvaginal ultrasound performed in women taking part in infertility protocols (11 women underwent at least one in vitro fertilization [IVF] procedure) or presented to our ultrasound service for ultrasound controls as suggested by their physicians for metrorrhagia. Once arcuate uterus was suspected, diagnosis was subsequently confirmed by hysteroscopy.

Uterine artery Doppler velocimetry was obtained transvaginally (7.5 MHz probe) by means of a Duplex Color Doppler machine (Aloka 2000 SSD; Aloka, Tokyo, Japan), carried out by only two operators to avoid interoperator variations.

The patients had regular menstrual periods, ranging from 25- to 30-day cycles. We assessed the periovulatory phase by monitoring the dominant follicle. The evaluation was performed in the same phase of the menstrual cycle (exactly in the periovulatory phase, mean 14th day) for all patients, in order to avoid variations due to hormonal influences on uterine artery Doppler indexes.

We considered the following Doppler velocimetry parameters: pulsatility index (PI) and the presence or absence of a protodiastolic notch, obtained from both right and left uterine arteries. When diastolic velocity is extremely low, PI gives us further information regarding the time velocity average (as calculated by US software).

We also considered the mean value of the right and left uterine artery to avoid the influence of the ovulating ovary on homolateral uterine artery indexes.

Women underwent hysteroscopic metroplasty by means of a continuous-flow operative sheath of 4.2 mm and semirigid hysteroscopic scissors. One to 2 months after intervention we repeated uterine Doppler velocimetry in the periovulatory phase as described above.

Data were entered into an electronic worksheet and all hysteroscopic procedures were recorded on videotape.

3. Statistical analysis

For the differences among groups, a *t*-test was performed. When the test for normality did not satisfy the criteria of Gaussian distribution, a non-parametric test (Mann–Whitney rank sum test) was performed.

Statistical analysis was performed using Sigma Stat 3.01 (Jandel Scientific, Ekrath, Germany) and MedCalc statistical package (version 5.00.17, Mariekerke Belgium).

Doppler velocimetry values were set in order to allow the comparison between before and after metroplasty by means of the paired *t*-test. If numeric normality is not reached, the statistical package suggests that the signed rank test is performed.

We considered statistical significance to be $p < 0.05$.

4. Results

Table 1 depicts the descriptive data for the study group. The mean age was 34 years, the mean day of the cycle on which Doppler velocimetry study was performed was the 14th (range 12–16 days) and the mean day after metroplasty for second evaluation considered as the Doppler velocimetry sign of the effect of metroplasty on uterine flow was 42 days (range 32–49 days).

When comparing uterine Doppler velocimetry indexes before and after metroplasty, we observed that PI after