

Ovarian blood flow before and after conservative laparoscopic treatment for endometrioma

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Summary

To evaluate the vascular changes in ovaries affected by endometriomas 28 women with ovarian endometriosis underwent transvaginal ultrasound with color flow imaging and blood flow analysis of the ovarian artery before and after laparoscopic conservative treatment of the ovarian cyst. Mean pulsatility index (P.I.) and resistance index (R.I.) of the ovarian artery on the side affected by endometrioma were compared using Student's t-test. Mean P.I. after laparoscopy (1.59) was significantly lower ($p=0.001$) than before surgical intervention (2.17). Analogously the mean R.I. was significantly different ($p=0.001$) when compared before (0.81) and after (0.73) laparoscopy. Color Doppler velocimetry may add greater understanding of the ovarian hemodynamic changes that occur after conservative surgery on the ovary.

Key words: Ovarian endometriosis; Ovarian artery blood flow; Transvaginal Color Doppler.

Introduction

Transvaginal ultrasound color flow Doppler has allowed us to study the female reproductive system on an anatomical and physiological basis [1, 2, 3, 4]. Besides being an excellent tool for the early diagnosis of ectopic pregnancy [5, 6, 7], the use of color flow Doppler seems to have extraordinary value in discriminating benign from malignant ovarian masses [8, 9]. However according to recent reports the blood flow velocimetry waveform indices recorded from benign and malignant adnexal tumors showed considerable overlap [10, 11, 12]. The role of color Doppler in the diagnosis of benign ovarian tumors has not been yet defined. This is because the study of blood flow velocimetry in cases of benign ovarian mass does not seem to be superior to morphological studies or even helpful once a sonographic diagnosis has been made [13, 14, 15]. Three studies have mainly evaluated the role of transvaginal Color Doppler in the diagnosis of endometrioma. Aleem *et al.* [16] in a series of 16 surgically proven endometriomas did not assess the efficiency of color Doppler in the diagnosis of endometrioma. In another study conducted by Alcazar *et al.* [17] the Authors concluded that the use of this technique does not improve the diagnostic accuracy of transvaginal ultrasonography alone in the diagnosis of ovarian endometrioma. However, Kurjak [18] reported an improvement of the diagnostic accuracy by developing a scoring system for prediction of endometriomas using transvaginal color and pulsed Doppler sonography. Besides these controversies, transvaginal ultrasound with color Doppler represents an excellent tool for the study of blood vessels within the female pelvis. The objective of the present study was to examine the flow velocity waveforms from

the ovarian artery of the side affected by endometrioma not only before the surgical treatment but also after conservative laparoscopy, in order to evaluate the changes that occur after operating on the ovary.

Material and Methods

Twenty-eight women with regular menstrual periods (20 to 45 years of age; mean 29.7 years) with endometrioma were selected for this study. All women had an ultrasound diagnosis of monolateral endometrioma and, as stated in the study protocol, should not have taken any hormonal therapy in the previous six months. The ultrasonographic examinations were performed, by the same operator (R.L.T.), with an endovaginal probe for morphology imaging, color Doppler mapping and blood flow analysis in the follicular phase of the menstrual cycle. Throughout the study a real time and pulsed color Doppler transducer of 5-7.5 MHz. (Aloka SSD 2000) was used. During the ultrasound the criteria for the diagnosis of endometriosis such as thick walls, regular margins and homogenous low echogenicity of the inner fluid, were fulfilled in all cases. After measuring the ovarian cyst, the blood flow velocity waveform from the ovarian artery of the involved side was recorded at the ovarian hilus (Fig. 1). The pulsatility index (P.I.) was calculated according to the formula:

$$P.I. = (S-D)/\text{mean}$$

where S is the peak Doppler shifted frequency, D is the minimum Doppler shifted frequency and mean is the mean maximum Doppler shifted frequency over the cardiac cycle. The resistance index (R.I.) was calculated according to the formula:

$$R.I. = (S-D)/S$$

The day after the ultrasound the patients underwent laparoscopy for removal of the ovarian mass. The surgical procedures were all carried out by the senior surgeon (G. M.), using a three-puncture technique with drainage of the endometriotic fluid followed by total stripping of the cyst capsule. The remaining ovary was left open after some bipolar coagulation on the ovarian edges in order to achieve complete hemostasis and promote ovarian closure. At the end of the procedure 100cc of Ringer's Lactate were left in the peritoneal cavity. The day after laparoscopy the

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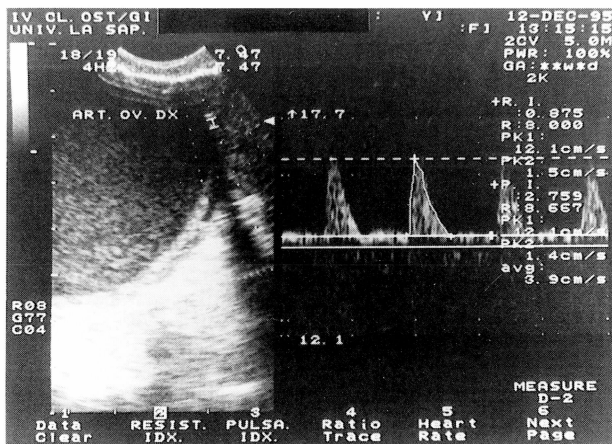


Figure 1. — Transvaginal color flow Doppler ultrasonography of a right ovary endometrioma. The white mark indicates the Doppler gate on the ovarian artery at the entrance to the ovarian hilus. The corresponding flow velocity waveform is depicted on the right.

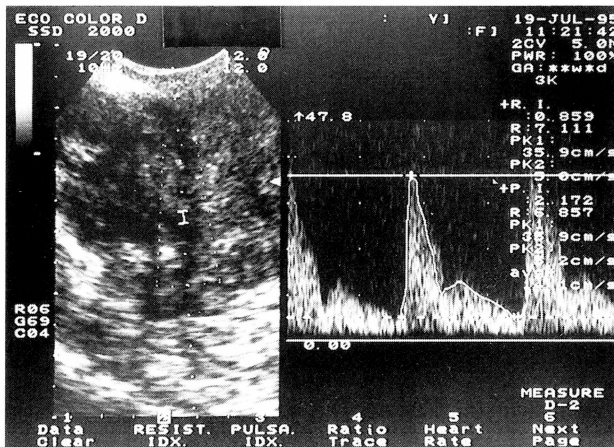


Figure 2. — The same patient the day after laparoscopy. Pulsed color Doppler, calculated on the ovarian artery at the entrance to the ovarian hilus, shows a decrease of impedance indices.

ultrasound was repeated and pulsatility and resistance indices were newly calculated on the ovarian artery of the treated ovary (Fig. 2). Pulsatility index and resistance index were compared before and after the surgical procedure, using the paired Student's *t* test. *P* value ≤ 0.05 was considered to be significant.

Results

Endometriomas were identified laparoscopically and confirmed histologically in 28 patients. At the ultrasound performed the day before surgery the mean diameter of the cysts was 48 mm (range 28-70 mm). With the use of color Doppler the ovarian artery close to the hilus was clearly detected in all patients using the transvaginal transducer. The pre-operative mean P.I. (\pm SD) value of the ovarian artery on the side of the cyst was $2.17 (\pm 0.58)$ and the mean R.I. (\pm SD) of the same ovary was $0.81 (\pm 0.07)$. All laparoscopies were uneventful and in all cases a complete stripping of the cyst's capsule was possible.

Table 1. — Ovarian artery pulsatility index (P.I.) and resistance index (R.I.) in ovarian endometrioma before and after removal at laparoscopy.

	P.I.	R.I.
Pre-operative	2.17 ± 0.58 (1.09-3.65)	0.81 ± 0.07 (0.62-0.90)
Post-operative	1.59 ± 0.57 (0.87-3.33)*	0.73 ± 0.10 (0.57-0.91)†

Values are mean \pm SD with minimum and maximum in parenthesis.

* = $P \leq 0.001$ versus pre-operative P.I.

† = $P \leq 0.001$ versus pre-operative R.I.

The average surgical time was 60 minutes (range 35-120) and no post-operative complications were observed. At the second transvaginal ultrasound performed the day after surgery the mean P.I. (\pm SD) was $1.59 (\pm 0.57)$ whereas the R.I. was $0.73 (\pm 0.10)$. The mean values of P.I. and R.I. calculated after laparoscopy both showed a tendency to decrease when compared with the pre-operative indices. This difference resulted in being highly statistically significant for both parameters (Table 1).

Discussion

It has been suggested that blood flow velocimetry increases the sensitivity and specificity of diagnosis in cases of endometrioma [18]. However other Authors [13, 16, 17, 19, 20] have shown how the clinical value of transvaginal Doppler has been tempered; in fact, they reported a large variation of flow within the same tumor and a significant overlap among the flow characteristics of different adnexal masses. Based on the literature [10, 13] and on our personal experience, the use of B-mode ultrasonography seems to provide a good correlation between ultrasound examination and laparoscopic findings. Otherwise, the use of pulsed color Doppler ultrasonography might be more useful in the follow-up of patients that undergo conservative ovarian surgery than in the diagnosis of endometrioma. Consequently better evaluation of the functional recovery of the treated ovary, reassurance of the quality of the surgery and better understanding of the ovarian morphophysiology when an endometrioma is present can be obtained. Ultrasonography in this study resulted in being an excellent tool for the diagnosis of endometrioma in women in reproductive age. In order to obtain a good correlation between the impedance indices, calculated before and after surgery in the same ovary, we believe that it is mandatory to identify a standardized anatomical site where the blood flow can be measured and obtained values can be correctly compared. For this purpose we prefer to calculate the blood flow velocimetry of the ovarian artery at the entrance of the ovarian hilus, before the division in the branch that supplies the blood to the tube. Other Authors have calculated the blood flow of intraovarian arteries [21], which may be useful in case of ovarian endometriosis as these cysts are frequently surrounded by a substantial number of blood vessels. However, based on the opinion that a diagnosis of endometrioma can be easily made with the use of B-mode ultrasound with no

need of color Doppler [13, 15] we believe that after removal of the ovarian mass evaluation of the vascular modification of the ovary using a well identified spot, such as the ovarian artery at the hilus is indicated. After removal of an ovarian cyst the blood vessels within the ovarian stroma are traumatized resulting in a great difference of blood flow parameters. On the contrary the P.I. and R.I. calculated on the ovarian artery at its hilus better reflect the real vascular impedance of the operated ovary. Therefore the assessment of ovarian vascularity, the day before and the day after a conservative surgical intervention on the ovary, may add greater understanding of the ovarian hemodynamic changes that occur after surgery. Whether laparoscopy induces better morphological and hemodynamic results than laparotomy needs more investigation.

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