Predictivity of uterine artery, arcuate artery, and intraovarian artery Doppler indices measured on the day of human chorionic gonadotropin injection on pregnancy outcomes

The uterine, arcuate, and intraovarian blood flow measurements by transvaginal color doppler ultrasonography on the day of hCG injection in 46 women undergoing treatment by IVF at Aegean University Family Planning and Infertility Research and Treatment Center were evaluated. In the pregnant group, average uterine and arcuate arteries blood flow resistance values were lower than those in nonpregnant women. (Fertil Steril® 2005;84:529–32. ©2005 by American Society for Reproductive Medicine.)

The aim of this study was to determine the predictivity of uterine, arcuate, and intraovarian artery pulsatility (PI), resistance (RI), and velocity (Vs) indices measured on the day of hCG injection day on pregnancy outcomes in the IVF treatment program. Fifty-one women undergoing IVF at the Aegean University Family Planning and Infertility Research and Treatment Center between May and November 2000 were randomly selected for longitudinal prospective evaluation. Institutional Review Board approval was obtained.

Women undergoing ovulation induction for intracytoplasmic sperm injection were routinely down-regulated with triptorelin acetate (Decapeptyl, 0.1 mg; ER-KIM, Ilac San., Istanbul, Turkey; 0.1 mg/d) starting from the 21st day of the preceding cycle in long down-regulation protocol and from the 2nd day of the cycle in the short down-regulation protocol. The analogue was continued until the day of hCG. After the down-regulation, ovulation induction was performed by daily injections of 150–300 IU of urinary hMG (Humegon ampules, Organon Ilac San. or Pergonal ampules, Serono Lab. Ltd. [Istanbul, Turkey] or Menogon ampule, ER-KIM Ilac San.)

When the average follicule diameter of the leading follicule was ≥18 mm, uterine artery, arcuate artery, and intraovarian blood flow were measured by 7.5-MHz endovaginal probe B-mode color and pulse Doppler ultrasonography. Ultrasonographic intensity which was <50 mW/cm^2 was within the safety limits approved by the American Medical Ultrasound Institute. All of the color-pulse Doppler measurements were performed by the same person (R.K.). The ascending branch of both of the uterine arteries was visualized at lateral to the internal cervical os on a longitudinal plane. Perifollicular artery was used for intraovarian blood flow, and arcuate artery, for endometrial blood flow assessment. The angle between the Doppler wave and the vessels was kept close to 0°. Measuring angle was less than 40°, and angle correction was performed for all cases. Pulsatility index (PI), resistance index (RI), and maximum peak systolic velocity (Vs) were recorded. Index values for each vessel were calculated electronically after good wave forms in three consecutive cardiac cycles were obtained.

After the Doppler measurements, ovulation was triggered by 10,000 IU of hCG (Profasi, 5,000 IU ampule, Serono; or Pregnyl, 5,000 IU amp, Organon Ilac San.). After 36 hours, egg collection was performed by transvaginal ultrasound (Kretz Combison 310, Zipf, Austria). Intracytoplasmic sperm injection and embryo transfer (ICSI-ET) was performed for all the patients. Luteal phase support was performed by progesterone (P, 25 mg ampule, IM, twice per day; or Utrogestan, 100 mg cap., two vaginal capsules three times per day; Besins-İscovesco Lab., Paris, France) and 1,500–2,000 IU of hCG (Pregnyl 1,500 IU ampule, Organon Ilac San., Profasi 2,000 IU amp, Serono Lab. Ltd.) once every 3 days for 12 days. Embryo transfer was performed 48–56 hours after the oocyte aspiration.

Estradiol, P, FSH, LH, and hCG blood values were measured by the Automated Chemiluminescence System: 180 (ACS:180, Chiron Diagnostics Corp., United Kingdom). Pregnancy was determined by the serum hCG, E_2 and P levels measured 12 days after the ET. Clinical pregnancy was determined by the gestational sac during ultrasonography exam. Pregnancy and clinical pregnancy rates were calculated per cycle. When clinical viable pregnancy was determined, luteal support was continued until the 10th gestational week.

Statistical evaluation of the study was performed by the SPSS program (SPSS for Windows, Release 6.0; Statistical Package for the Social Sciences, UK Ltd., Chertsey, Surrey, England). Results were shown as mean ± SD. Mann-Whitney *U* test was used to find the difference between the

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pregnant and nonpregnant groups. Logistic regression analysis was used for predictivity signs. P value of $<.05$ was considered to be statistically significant.

Of the 51 women undergoing IVF, 2 women did not have fertilization, and no mature oocyte was retrieved from the other 3 women. These 5 women were excluded from the study. The average age of the women in the study was 32.04 ± 5.60 years. Total pregnancy rate per cycle was 43.50% (20/46), with clinical pregnancy rate of 32.60% (15/46).

When the pregnant and nonpregnant women were compared, there was no significant difference in the duration of infertility, number of hMG and FSH ampules used for ovulation induction, hCG injection day, number of aspirated follicules, obtained metaphase II oocyte number, fertilized oocyte numbers, number of transferred embryos, morning and afternoon serum E_2, P, and LH values, or endometrium thickness between the groups ($P>.05$).

The average values of right or left uterine and intraovarian artery PI, RI, and Vs values were used in the analysis. In the pregnant group average uterine artery PI and RI were significantly lower than in the nonpregnant group. Arcuate artery RI in the pregnant group was significantly lower than that in the nonpregnant group. Intraovarian artery average RI value in the pregnant group was significantly lower than that in the nonpregnant group (Table 1). There was no statistically significant correlation between average uterine artery, arcuate artery, and intraovarian blood flow; PI, RI, and Vs; endometrium thickness; and serum E_2 values ($P>.05$).

Logistic regression analysis revealed the following ratios: when the cutoff value for the average uterine artery PI was taken as 1.93, the positive predictive value for pregnancy was 75%, and negative predictive value was 76.92%. When the cutoff value for the average uterine artery RI was taken as 0.75, the positive predictive value for pregnancy was 90.00%, and negative predictive value was 84.62%. When the cutoff value for the arcuate artery RI was taken as 0.65, the positive predictive value for pregnancy was 95%, and negative predictive value was 53.85%.

Zaidi et al. (1) found the mean uterine artery PI values to be lower in the pregnant women than in the nonpregnant women (2.52 ± 0.50 vs. 2.64 ± 0.80, $P>.05$). In our study, we found the same results but with statistical significance. Strohmer et al. (2) found significant decrease in the uterine artery vascular impedance (PI) in the pregnant women compared with the nonpregnant women. In our study, uterine artery PI and RI values were significantly lower in the pregnant group than in the nonpregnant group ($P<.05$). Steer et al. (3) found that in women with low uterine artery PI value on the day of ET, the rates of pregnancy, embryo implantation, and multiple pregnancy were 41%, 15.3%, and 27.3%, respectively. No pregnancy was achieved in the high PI group. In our study, when the cutoff values for mean uterine artery PI and RI were taken as 1.93 and 0.75, respectively, positive predictive value for pregnancy was found to be 75% and 90%.

Coulam et al. (4) had measured blood flow in the perifollicular on the day of hCG administration in women during assisted reproduction treatment and found that follicular flow predicted pregnancy. Weiner et al. (5) found a correlation between the blood flow and the number of developing follicules. An inverse ratio was shown between the blood flow impedance in the ovaries and the number of follicules >15 mm in diameter. Kupesic and Kurjak (6) found that uterine artery PI decreased in stimulated cycles during the periovulatory period, more than in spontaneous

TABLE 1

Doppler values in pregnant and nonpregnant group.

Parameter	Pregnant (n = 20)	Nonpregnant (n = 26)
Average uterine artery PI	1.79 ± 0.25	2.21 ± 0.49*
Average uterine artery RI	0.69 ± 0.08	0.81 ± 0.13*
Average uterine artery Vs	21.07 ± 7.92	18.03 ± 8.26
Arcuate artery PI	1.08 ± 0.19	1.32 ± 0.43
Arcuate artery RI	0.57 ± 0.05	0.70 ± 0.24[a]
Arcuate artery Vs	10.02 ± 8.87	6.57 ± 1.88
Average intraovarian artery PI	0.83 ± 0.24	0.93 ± 0.29
Average intraovarian artery RI	0.54 ± 0.05	0.61 ± 0.12*
Average intraovarian artery Vs	12.89 ± 5.22	12.14 ± 5.26

Note: All values are mean ± SD.
[a] $P<.05$.

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