



İnfertilitede Doppler Ultrasonografinin Yeri Var mıdır?

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İnfertilitede Ultrasonografi

- **Transvajinal ultrasonografi**

TANISAL

İnfertilite değerlendirmesi

Siklus takibi

GİRİŞİMSEL

OPU

ET

Literatür Bilgileri

İnfertilitede Doppler Ultrasonografi

Tedavi Öncesinde

Tedavi Sırasında

Tedavi Sonrasında

**Uterin
Ovaryen**

Yorumlama

- Literatürdeki bilgiler ışığında;

İnfertil hastalarda doppler ultrasonografi için:

1. Anlamlı ilişkiler var mı?

**2. Klinik fark yaratıyor mu?
(Asıl hayalimiz)**

Doppler Kullanımı

- **Uterin Değerlendirme**
 - Uterin perfüzyon
 - Endometrial vaskülarite
 - Anomaliler, lezyonlar
- **Ovaryen Değerlendirme**
 - Ovaryen perfüzyon
 - Perivasküler vaskülarite

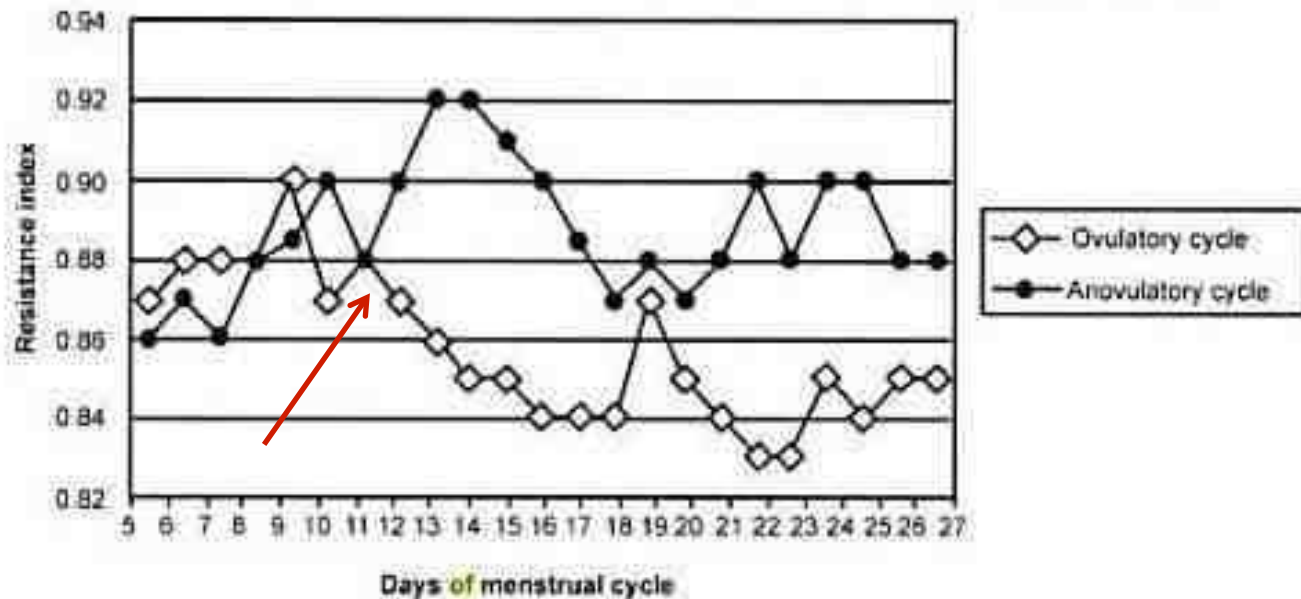
Uterin Perfüzyon



FIGURE 9.2: Uterine circulation demonstrated by color Doppler ultrasound. The **uterine artery** is demonstrated lateral to the cervix at the level of the cervicocorporeal junction. The arcuate arteries are visualized in the outer third of the myometrium. Radial arteries are demonstrated within the myometrial portion of the uterus (From reference 1, with permission).

Uterin Perfüzyon

- Anovülatuar siklusların artmış uterin arter RI ile beraberliği tanımlanmıştır.

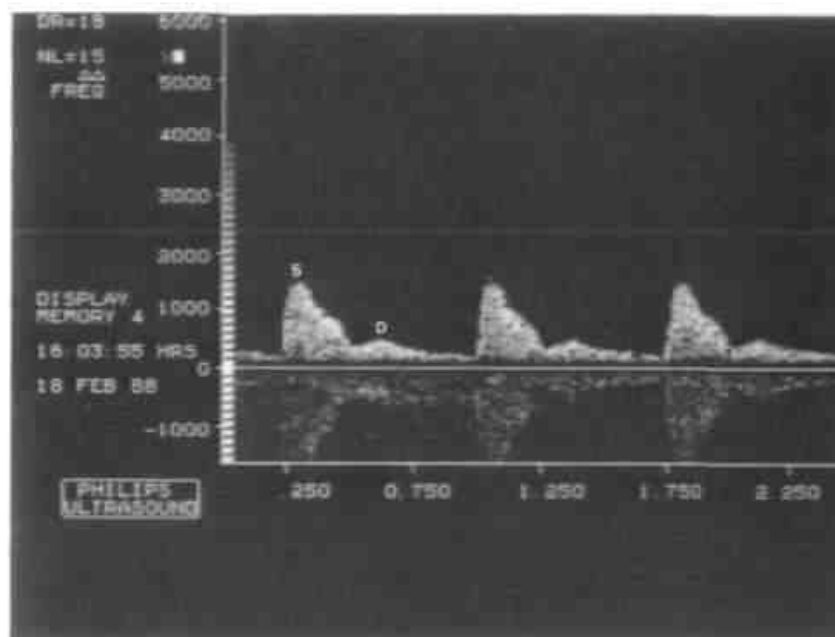
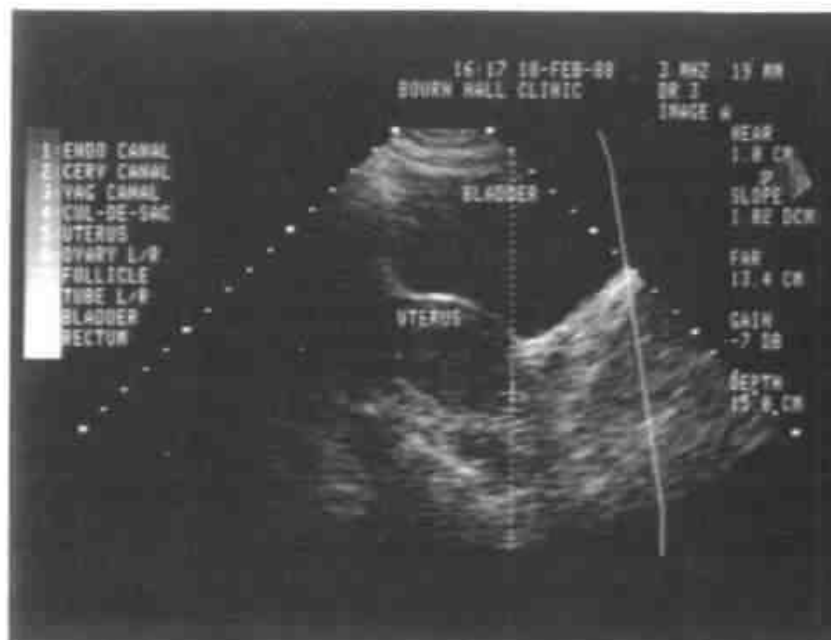


GRAPH 9.1: Changes in the uterine artery blood flow in ovulatory and anovulatory cycles (From reference 1, with permission)

[Fertil Steril](#). 1991 Nov;56(5):870-3.

Transvaginal color flow Doppler in the assessment of ovarian and uterine blood flow in infertile women.

[Kuriak A¹](#), [Kupesic-Urek S](#), [Schulman H](#), [Zalud I](#).



Her gruptaki hasta sayısı analiz için yeterli değil

Ancak trend, kötü uterin kan akımının infertilite nedenleri arasında olabileceği izlenimi vermekte

Type O	—	50 (67%)	
Type A	—	24 (33%)	
Type B	24 (30%)	—	
Type C	55 (70%)	—	
	79 (52%)	74 (48%)	= 153

Type O, high uterine impedance. Type A, poor uterine perfusion. Type B, low uterine impedance. Type C, excellent uterine perfusion.

- **Grup 2** →

Table IV. Results of embryo replacements in patients after hormone therapy (Group II and IIA) and with good perfusion response (Group I)

Group	Number of patients	Pregnancies
I	16	5 (31%)
II	14	6 (43%)
IIA	4	2 (50%)
	34	13 (38%)

44 vs. 26

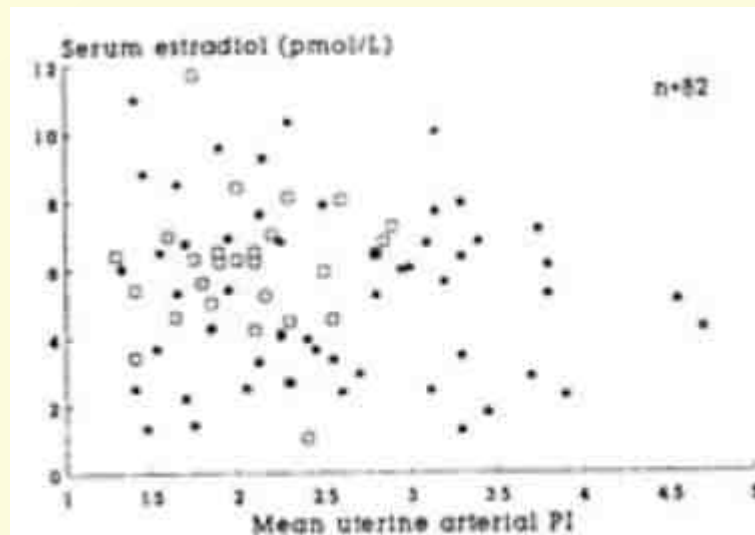
The use of transvaginal color flow imaging after in vitro fertilization to identify optimum uterine conditions before embryo transfer.

Steer CV¹, Campbell S, Tan SL, Crayford T, Mills C, Mason BA, Collins WP.

- **Low PI** → **41% PR (27 hasta)**
- **Medium PI** → **47% PR (36 hasta)**
- **High PI (>3)** → **No pregnancy (19**

hasta)

ET öncesi





İlk çalışmaların sonuçları benzer şekilde bir ilişkiyi işaret ediyor

Uterin Arter - Endometrium

- **Uterin arter doppler indeksleri gerçek endometrial kan akımını tam olarak yansıtır mı?**
 - **Uterusun ana birleşeni myometrium**
 - **Kollateral dolaşım**

Relationship between uterine blood flow and endometrial and subendometrial blood flows during stimulated and natural cycles

Endometrial ve subendometrial kan akımları, farklı PI gruplarında benzer

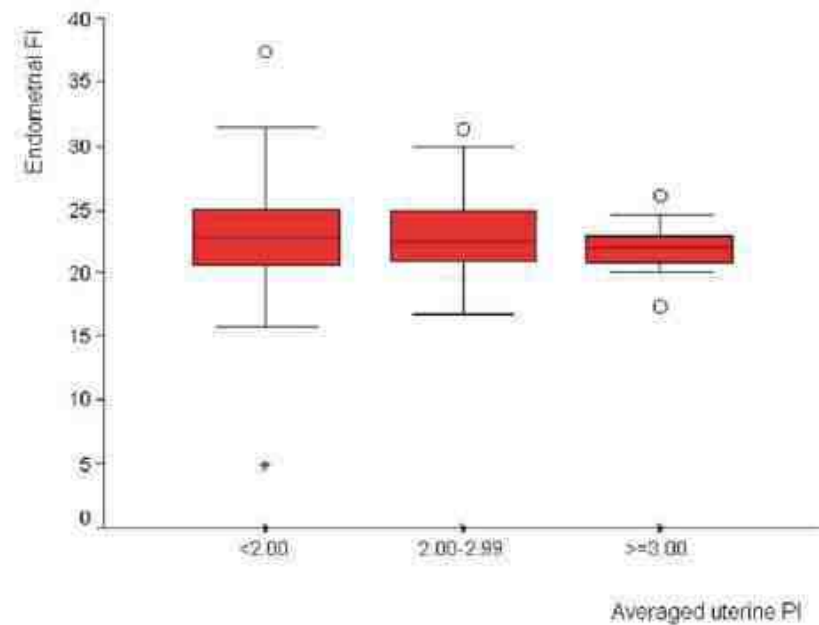
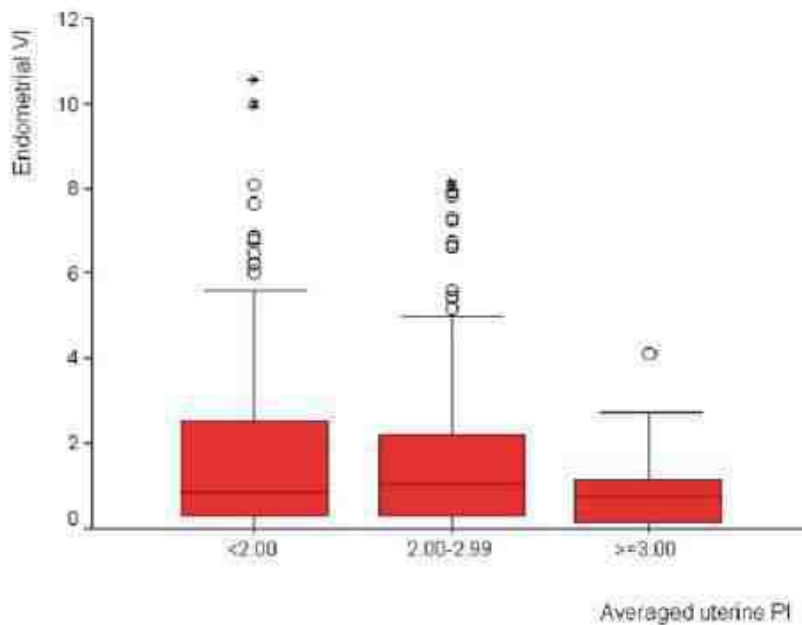


TABLE 1

Summary of demographic data, ovarian responses, endometrial and subendometrial 3D power Doppler flow indices during stimulated and natural cycles.

Parameters	Stimulated cycles (n = 475)	Natural cycles (n = 107)
Age (y)	35 (32–37)	35 (32–32)
Duration of infertility (y)	4.0 (3–6)	5.0 (3–7)
Primary infertility ^a	317 (66.7)	58 (54.2)
BMI (kg/m ²)	21.4 (20.0–23.3)	21.4 (20.2–22.9)
hMG dosage (IU)	1,950 (1,650–2,250)	—
hMG duration (days)	11.0 (9–12)	—
Total number of eggs obtained	10.0 (6–15)	—
E ₂ concentration ^b (pmol/L)	10,023 (6,344–10,030)	955 (810–1,266)
Endometrial thickness (mm)	11.8 (10.0–12.6)	10.6 (9.6–12.2)
Endometrial volume (cm ³)	4.76 (3.55–6.47)	4.21 (3.14–5.53)
Averaged uterine PI	2.04 (1.77–2.36)	2.09 (1.77–2.43)
Averaged uterine RI	0.83 (0.79–0.87)	0.85 (0.80–0.89)
Endometrial VI (%)	0.943 (0.288–2.291)	1.669 (0.402–3.373)
Endometrial FI (0–100)	22.687 (20.910–24.976)	23.970 (22.037–26.246)
Endometrial VFI (0–100)	0.226 (0.061–0.578)	0.413 (0.097–0.919)
Subendometrial VI (%)	1.819 (0.618–4.421)	3.178 (1.241–8.97)
Subendometrial FI (0–100)	23.818 (21.628–25.841)	25.171 (23.226–27.613)
Subendometrial VFI (0–100)	0.448 (0.141–1.121)	0.816 (0.299–2.35)

Endometrial ve subendometrial kan akımları, natürel siklularda daha yüksek olma trendinde

Uterin Arter - Endometrium

- **Uterin arter doppler indeksleri gerçek endometrial kan akımını tam olarak yansıtır mı?**
 - **Uterusun ana birleşeni myometrium**
 - **Kollateral dolaşım**

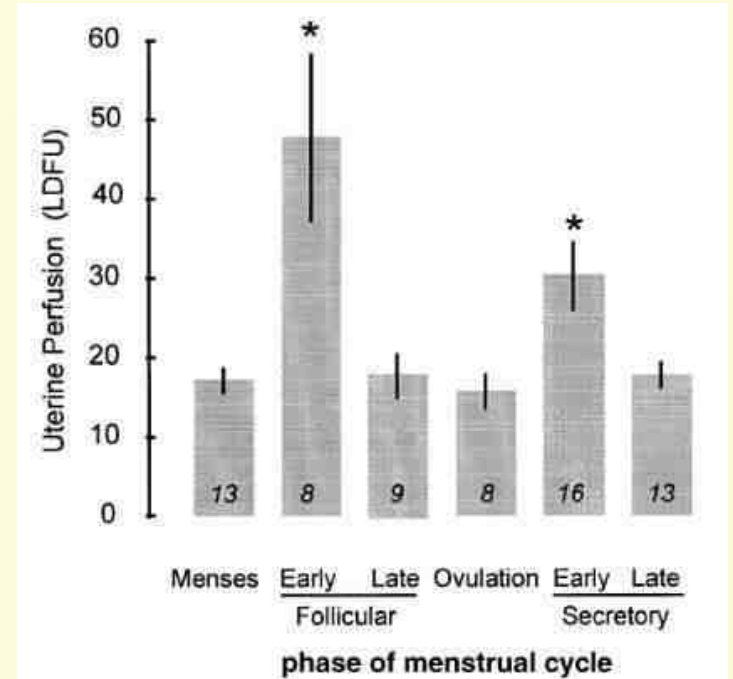
Direk olarak endometrial kan akımının değerlendirilmesi

Endometrial Değerlendirme

- **Endometrial kan akımı esas olarak radial arterlerden gelir.**
- **Radial arterler myometrium-endometrium birleşkesinden sonra bazal arterleri oluşturur.**
- **Spiral arterler**

Fizyolojik Durum

- Gannon ve ark. endometrial kan akımını intrauterine laser Doppler ile değerlendirmişler.



- Erken folliküler ve erken luteal dönemde kan akımında artış izlenmiş.

Gannon BJ, Carati CJ, Vercio CJ. Endometrial perfusion across the normal human menstrual cycle assessed by laser Doppler fluxmetry. Hum Reprod 1977;12:132-9.

- **Transvajinal renkli doppler**
- **Endometrial akımın doppler ile değerlendirildiği ilk çalışma**
- **Periovulatuar dönemde 78 hasta**

Endometrial perfusion presents accurate noninvasive assay of uterine receptivity that may be used to predict implantation success rate

Study	IVF cycles	USS parameters	USS day	Results
Zaidi et al. [22]	96 cycles using a long protocol	Spiral PI and PSV	hCG	No difference in subendometrial PI and PSV between pregnant and non-pregnant cycles Absent subendometrial flow associated with no pregnancy
Battaglia et al. [24]	60 cycles	Uterine and spiral PI	TUGOR	Uterine and spiral PI lower in pregnant than non-pregnant cycles Absent subendometrial flow associated with no pregnancy
Chien et al. [28]	623 cycles using ultrashort and ultralong protocols	Uterine and spiral PI and RI	ET	Significantly lower implantation and pregnancy rates in patients without endometrial/subendometrial flow Presence of subendometrial flow 5.9 times to become pregnant than those with absent flow

USS: ultrasound; PI: pulsatility index; PSV: peak systolic velocity; TUGOR: transvaginal ultrasound guided oocyte retrieval; ET: embryo transfer.

• 2D TV Renkli Doppler

Study	IVF cycles	USS parameter	USS day	Results
Yang et al. [26]	95 cycles using long and short protocols endometrium ≥ 10 mm	Intraendometrial power Doppler area (EDPA) $< 5 \text{ mm}^2$; $\geq 5 \text{ mm}^2$	TUGOR	Higher EDPA in pregnant cycles. Lower implantation and pregnancy rates when EDPA $< 5 \text{ mm}^2$
Yuval et al. [23]	156 cycles using a long protocol	PI and RI	TUGOR and ET	No difference in any USS parameters between pregnant and non-pregnant cycles
Contart et al. [27]	185 cycles using a long protocol	Fundal region along transverse plan; grades I, II, III and IV according to visualization of power Doppler in the quadrants	hCG	Implantation and pregnancy rates similar in all grades of endometrial vascularity
Schild et al. [8]	135 cycles using a long protocol; first cycle only	PI and PSV of vessels in endometrium and subendometrial area ($< 5 \text{ mm}$)	TUGOR	No difference in spiral artery PI and PSV between pregnant and non-pregnant cycles. Non-detectable spiral blood flow was not associated with a lower implantation rate
Maugey-Laulon et al. [29]	144 cycles using a long protocol	Presence of endometrial and subendometrial blood flow	ET	Absent endometrial and subendometrial flow associated with a lower pregnancy rate

• 2D TV Power Doppler

Study	IVF cycles	USS parameters	USS day	Results
Zaidi et al. [22]	96 cycles using a long protocol	Spiral PI and PSV Presence of endometrial and subendometrial flow	hCG	No difference in subendometrial PI and PSV between pregnant and non-pregnant cycles Absent subendometrial flow associated with no pregnancy
Battaglia et al. [24]	60 cycles	Uterine and spiral PI Presence of endometrial blood flow	TUGOR	Uterine and spiral PI lower in pregnant than non-pregnant cycles Absent subendometrial flow associated with no pregnancy
Chien et al. [28]	623 cycles using ultrashort and ultralong protocols	Uterine and spiral PI and RI Presence of endometrial and subendometrial (<10 mm) blood flow	ET	Significantly lower implantation and pregnancy rates in patients without endometrial/subendometrial flow Presence of subendometrial flow 5.9 times to become pregnant than those with absent flow

USS: ultrasound; PI: pulsatility index; PSV: peak systolic velocity; TUGOR: transvaginal ultrasound guided oocyte retrieval; ET: embryo transfer.

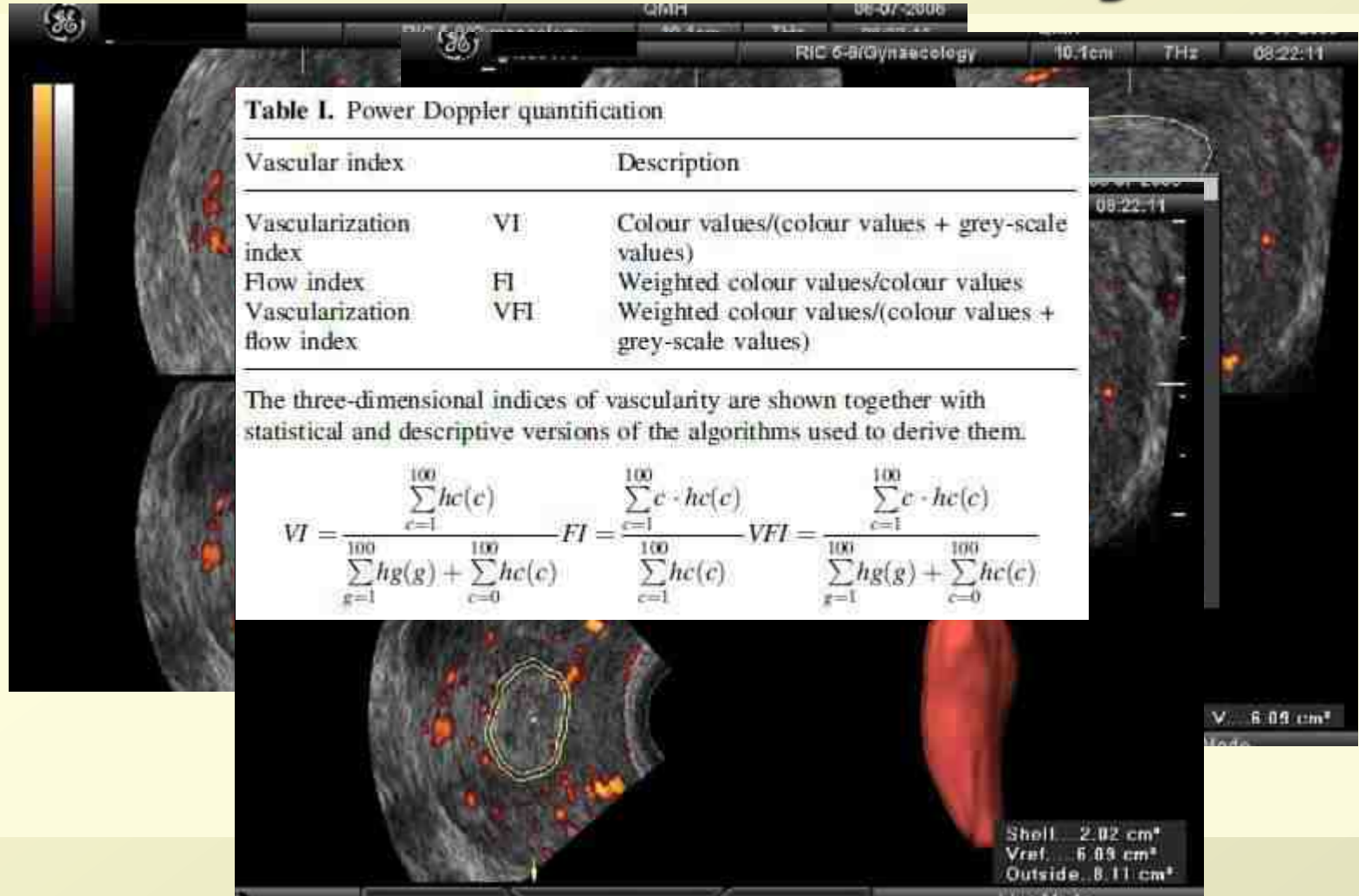
• 2D TV Renkli Doppler

Study	IVF cycles	USS parameter	USS day	Results
Yang et al. [26]	95 cycles using long and short protocols endometrium ≥ 10 mm	Intraendometrial power Doppler area (EDPA) <5 mm ² ; ≥ 5 mm ²	TUGOR	Higher EDPA in pregnant cycles. Lower implantation and pregnancy rates when EDPA <5 mm ²
Yuval et al. [23]	156 cycles using a long protocol	PI and RI	TUGOR and ET	No difference in any USS parameters between pregnant and non-pregnant cycles
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• 2D TV Power Doppler

Bildirilen sonuçlar birbirlerini konfirme etmiyor

3D Power Doppler ile Endometrial Akım Ölçümü



Study	IVF cycles	Inclusion/exclusion criteria	USS day	Results
Schild et al. [33] 2000	75 cycles using a long protocol. ET 2 days after TUGOR	Inclusion criteria: down-regulation confirmed (endometrium <5 mm; no ovarian cyst of >2.5 cm; serum oestradiol <60 pg/mL)	Before stimulation	Subendometrial VI, FI and VFI lower in pregnant than non-pregnant cycles. Subendometrial FI is the strongest predictive factor for IVF in logistic regression analysis
Kupesic et al. [25] 2001	89 cycles using a long protocol. Blastocyst transfer 5 days after TUGOR	Inclusion criteria: serum FSH <10 IU/L; no fibroid, ovarian cysts and ovarian endometriosis	ET (hCG +7)	Higher subendometrial FI in pregnant cycles
Wu et al. [34] 2003	54 cycles; first cycles only (details of ovarian stimulation and ET not given)	Inclusion criteria: age<38 years; normal uterine cavity; serum FSH <15 IU/L; ≥2 good quality embryos	hCG	Subendometrial VFI higher in pregnant cycles
Dorn et al. [35] 2004	42 cycles using a long protocol	Exclusion criteria: polycystic ovary syndrome; endometrium <6 mm; gynaecological surgery	TUGOR Contrast-Levovist	No difference in subendometrial VI, FI and VFI between pregnant and non-pregnant cycles
Järvelä et al. [36] 2005	35 cycles using a long protocol. ET 2 days after TUGOR	Exclusion criteria: uterine fibroids; endometriosis; single ovary; previous operation on uterus or salpingectomy	After stimulation and TUGOR	No difference in endometrial and subendometrial VI between pregnant and non-pregnant cycles on both day
Ng et al. [37] 2006	451 cycles using a long protocol; first cycle only. ET 2 days after TUGOR	Inclusion criteria: normal uterine cavity on scanning	TUGOR	Endometrial VI and VFI lower in pregnant cycles ???

- Düşük akımlara daha sensitif
- Açıdan bağımsız
- Multiplanar hacimsel değerlendirme

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

Adakan S¹, Yoldemir T, Tavmergen E, Goker E, Killi R.

- 46 hasta analiz edilmiş
- Trigger öncesi doppler
- Uterin a, arkuat a, perifoliküler

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 $P < .05$.

The role of endometrial and subendometrial blood flows measured by three-dimensional power Doppler ultrasound in the prediction of pregnancy during IVF treatment

Ernest Hung Yu Ng¹, Carina Chi Wai Chan, Oi Shan Tang, William Shu Biu Yeung and Pak Chung Ho

- İlk IVF siklusu
- OPU zamanı 3D Power Doppler
- 451 siklus, Long protocol
- PI, RI VI, FI, VFI

Table IV. Receiver operator characteristics curve analysis of ultrasound parameters of endometrial receptivity

Test variables	Area (95% confidence interval)	
	All cycles (<i>n</i> = 451)	Good prognosis cycles (<i>n</i> = 205)
Uterine PI	0.468 (0.400, 0.535)	0.478 (0.373, 0.583)
Uterine RI	0.441 (0.373, 0.509)	0.451 (0.346, 0.556)
Endometrial thickness	0.502 (0.433, 0.571)	0.506 (0.396, 0.616)
Endometrial volume	0.489 (0.418, 0.559)	0.514 (0.400, 0.628)
Endometrial VI	0.430 (0.366, 0.494)	0.463 (0.362, 0.565)
Endometrial FI	0.484 (0.418, 0.551)	0.450 (0.347, 0.552)
Endometrial VFI	0.432 (0.368, 0.495)	0.459 (0.358, 0.560)
Subendometrial VI	0.465 (0.401, 0.529)	0.475 (0.369, 0.580)
Subendometrial FI	0.514 (0.448, 0.580)	0.463 (0.351, 0.576)
Subendometrial VFI	0.472 (0.407, 0.537)	0.477 (0.370, 0.584)

PI = pulsatility index; RI = resistance index; VI = vascularization index; FI = flow index; VFI = vascularization flow index.

		Implantation rate	Pregnancy rate
Endometrial flow			
Absent		13/61 (21.3)	9/31 (29.0)
Present		100/818 (12.2)	85/20 (20.2)
<i>P</i>		0.065	0.350
Subendometrial flow			
Absent		9/43 (20.9)	7/23 (30.4)
Present		104/834 (12.5)	87/428 (20.3)
<i>P</i>		0.167	0.369
Endometrial and subendometrial flows			
Absent		8/39 (20.5)	6/20 (30.0)
Present		105/840 (12.5)	88/431 (20.4)
<i>P</i>		0.224	0.453

**Fark
yok**

The role of endometrial and subendometrial blood flows measured by three-dimensional power Doppler ultrasound in the prediction of pregnancy during IVF treatment

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**Endometrial akım yok – 31 hasta
Subendometrial akım yok – 23 hasta**

**İlginç olarak akım olmayan grupta
implantasyon ve gebelik oranları
daha yüksek !!!**

Hum Reprod. 2006 Apr;21(4):1062-9. Epub 2005 Dec 22.

Factors affecting endometrial and subendometrial blood flow measured by three-dimensional power Doppler ultrasound during IVF treatment.

Ng EH¹, Chan CC, Tang OS, Yeung WS, Ho PC.

**Hasta yaşı, sigara içmek, ve
infertilite tipinin 3D Doppler
indekslerine etkisi izlenmemiş**

Donma-Çözme Siklusları

Table I. Comparison of demographic data and ovarian responses of the stimulated cycle between nonpregnant and pregnant patients

	Nonpregnant	Pregnant	P-value
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Ng ve ark.

Table II. Comparison of ultrasound parameter for endometrial receptivity between the nonpregnant and pregnant patients

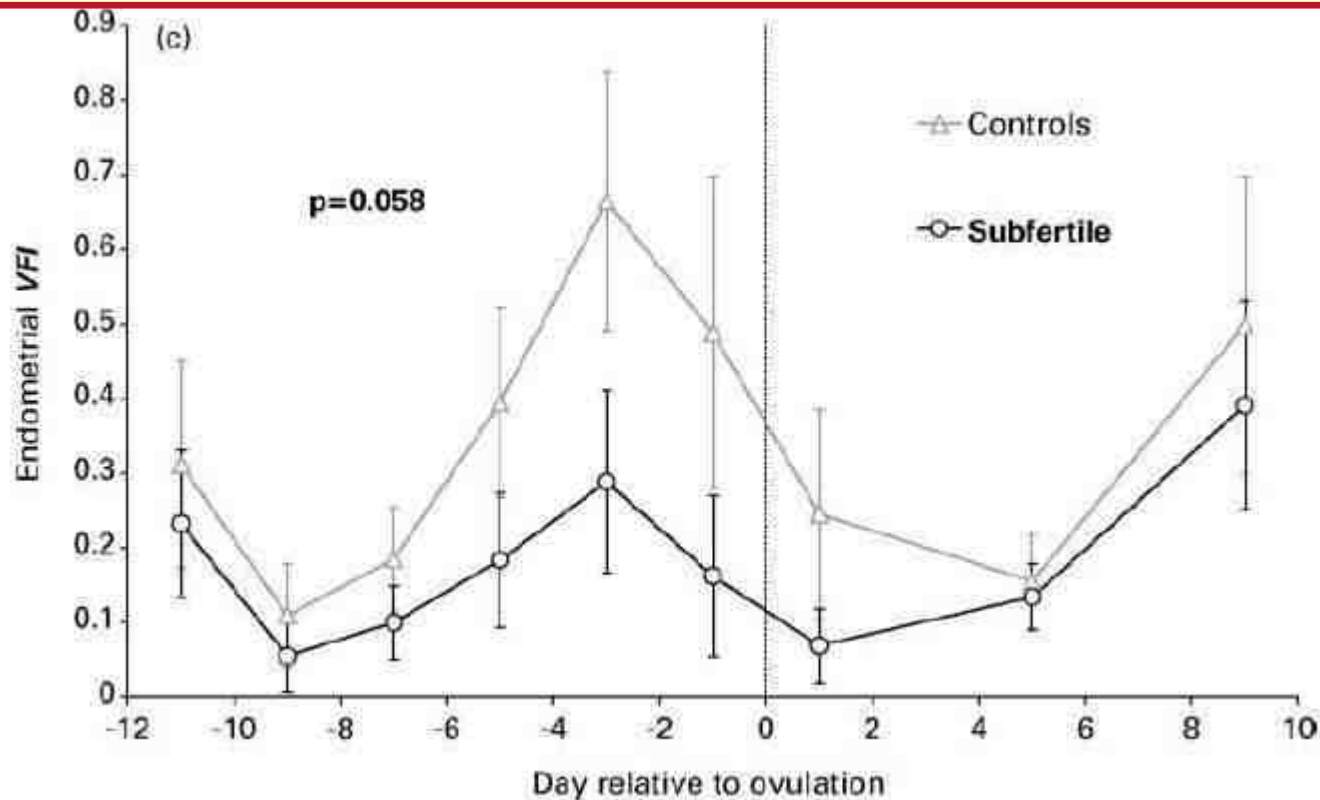
	Nonpregnant (n = 151)	Pregnant (n = 42)	P-value
Endometrial thickness (mm)	10.9 (9.7–13.1)	11.4 (9.5–13.2)	0.503
Endometrial volume (cm ³)	4.34 (3.32–5.60)	4.68 (3.31–6.06)	0.411
Endometrial pattern [n (%)]			0.911
Multilayered	149 (98.7)	42 (100.0)	
Nonmultilayered	2 (1.3)	0 (0)	
Uterine pulsatility index	2.00 (1.73–2.34)	1.97 (1.68–2.46)	0.911
Uterine resistance index	0.83 (0.78–0.87)	0.83 (0.78–0.87)	0.821
Endometrial vascularization index (VI) (%)	1.669 (0.558–3.647)	1.447 (0.558–3.435)	0.760
Endometrial flow index (FI) (0–100)	23.970 (22.052–26.351)	24.020 (22.235–26.348)	0.754
Endometrial vascularization flow index (VFI) (0–100)	0.425 (0.125–0.972)	0.330 (0.124–0.914)	0.801
Subendometrial VI (%)	3.407 (1.367–8.365)	3.043 (1.447–8.733)	0.933
Subendometrial FI (0–100)	25.043 (23.007–27.305)	24.661 (22.090–26.980)	0.399
Subendometrial VFI (0–100)	0.910 (0.294–2.064)	0.756 (0.322–2.310)	0.999

Bu anlamsızlık, Doppler ölçümünü tek bir anda yapıyor olmamızla ilgili olabilir mi?

Data given as median (interquartile range).

*Statistically significant.

- Endometrial akım dinamikidir
- Geç follikülerden erken luteal döneme geçişteki değişikliğin derecesi – endometrial reseptivite



Changes in endometrial and subendometrial blood flow in IVF



Dr Ernest Ng is an Associate Professor at the Department of Obstetrics and Gynaecology, The University of Hong Kong. His main research interests are assisted reproduction technology, assessment of ovarian reserve and three-dimensional ultrasound in reproductive medicine. He has published about 100 papers in refereed journals.

Dr Ernest Ng

Ernest Hung Yu Ng¹, Carina Chi Wai Chan, Oi Shan Tang, William Shu Biu Yeung, Pak Chung Ho

Table 2. Comparison of endometrial thickness, endometrial volume, endometrial and subendometrial 3D power Doppler indices on the days of human chorionic gonadotrophin (HCG) administration and embryo transfer (HCG + 4) between non-pregnant and pregnant patients.

<i>Parameter</i>	<i>On day of HCG</i>		<i>On day of embryo transfer</i>	
	<i>Non-pregnant (n = 151)</i>	<i>Pregnant (n = 142)</i>	<i>Non-pregnant (n = 151)</i>	<i>Pregnant (n = 142)</i>
Endometrial thickness (mm)	12.7 (7.3–23.3)	12.7 (5.7–22.0)	13.6 (7.1–25.0)	13.8 (7.8–23.1)
Endometrial volume (cm ³)	5.96 (0.54–18.81)	6.15 (1.85–15.06)	4.79 (1.42–15.30)	5.13 (1.29–15.48)
Endometrial VI (%)	2.744 (0–28.885)	2.352 (0–14.519)	0.212 (0–7.53)	0.155 (0–13.583)
Endometrial FI (0–100)	25.549 (0–35.096)	25.037 (0–32.307)	21.476 (0–41.323)	21.089 (0–30.494)
Endometrial VFI (0–100)	0.679 (0–8.641)	0.584 (0–15.000)	0.058 (0–2.450)	0.031 (0–3.201)
Subendometrial VI (%)	6.822 (0–31.350)	5.618 (0–26.487)	0.410 (0–12.347)	0.275 (0–11.101)
Subendometrial FI (0–100)	26.243 (0–34.417)	25.655 (0–35.652)	22.471 (0–35.188)	20.810 (0–31.099)
Subendometrial VFI (0–100)	1.770 (0–9.321)	1.484 (0–8.692)	0.092 (0–2.990)	0.060 (0–2.637)

Values are median (range). There were no statistically significant differences between the groups.
FI = flow index; VFI = vascularization flow index; VI = vascularization index.

Changes in endometrial and subendometrial blood flow in IVF



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Table 3. Comparison of change in endometrial and subendometrial 3D power Doppler indices from the day of human chorionic gonadotrophin (HCG) administration to the embryo transfer day between non-pregnant and pregnant patients.

	<i>Non-pregnant</i> (n = 151)	<i>Pregnant</i> (n = 142)
Change in endometrial VI (%)	90.7 (69.6–99.0)	89.6 (64.7–99.8)
Change in endometrial FI (%)	15.2 (2.5–30.6)	17.2 (7.2–35.7)
Change in endometrial VFI (%)	91.6 (69.7–99.4)	91.8 (68.9–100)
Change in subendometrial VI (%)	93.2 (80.7–98.7)	94.4 (83.0–99.8)
Change in subendometrial FI (%)	15.5 (4.2–29.3)	21.9 (6.0–39.1)
Change in subendometrial VFI (%)	94.2 (82.4–99.0)	95.6 (82.5–99.9)

Values are median (interquartile range). There were no statistically significant differences between the two groups.
FI = flow index; VFI = vascularization flow index; VI = vascularization index.

İki ölçüm arasındaki değişikliğin derecesinin de sonuca etkisi yok

CONCLUSION: In an unselected group of patients undergoing IVF or IVF-ICSI and embryo transfer, serial Doppler ultrasound examination of the uterine artery does not discriminate between cycles resulting in ongoing pregnancy, miscarriage and no pregnancy.

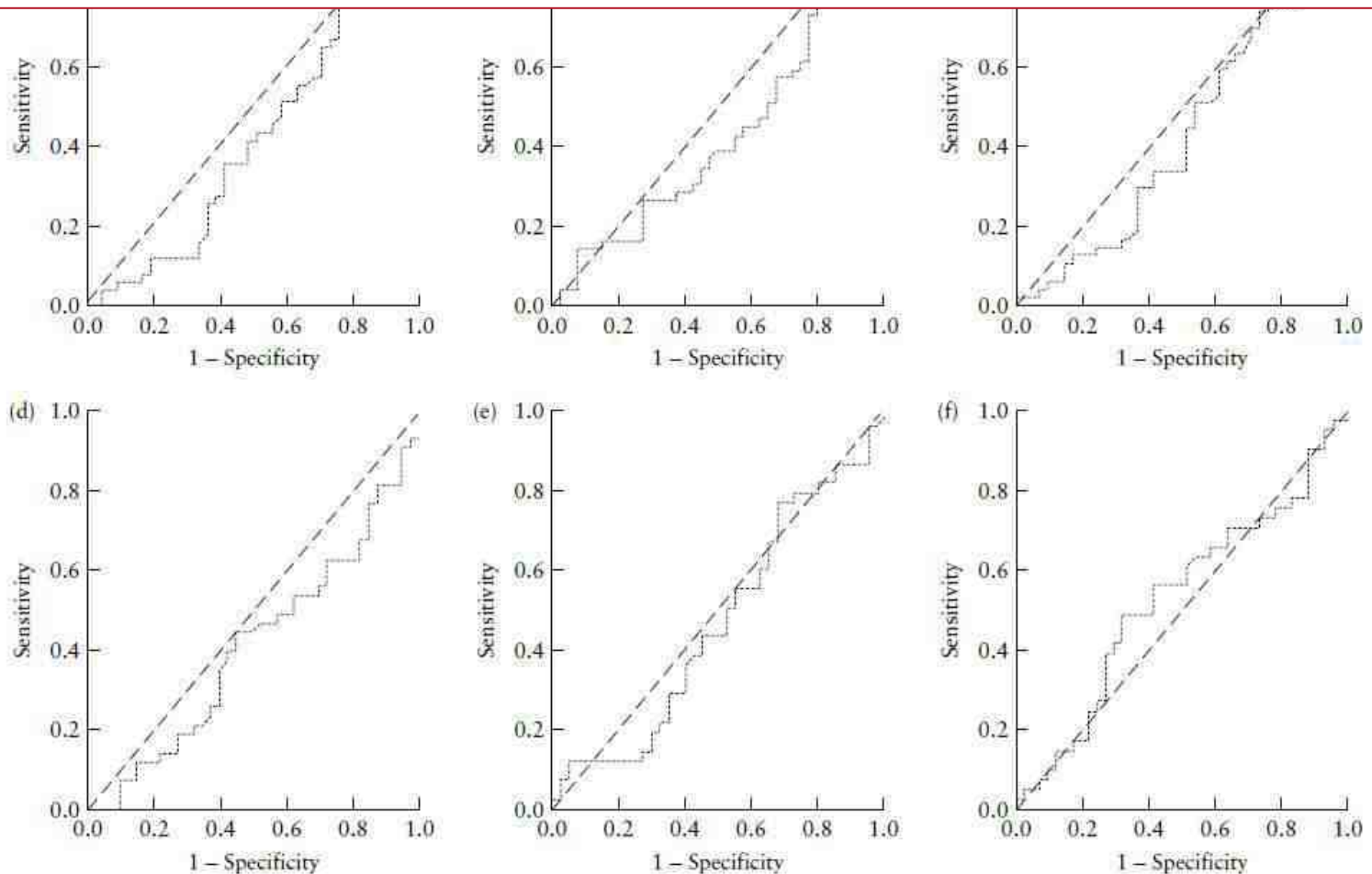


Figure 1 Receiver–operating characteristics curves for uterine artery pulsatility index measurements during *in-vitro* fertilization–intracytoplasmic sperm injection treatment cycles, with assessment: (a) on day of start of the cycle (area under the curve (AUC) = 0.41), (b) at end of stimulation phase (AUC = 0.43), (c) at ovum pick-up (AUC = 0.44), (d) at embryo transfer (AUC = 0.41), (e) at mid-luteal phase (AUC = 0.46) and (f) on day of pregnancy test, 14–16 days after ovum pick-up (AUC = 0.53).

- **Non-reseptif endometriumun önceden tanınması**
- **Cryo opsiyonu**
- **Delay hCG**



Uterin Perfüzyon

Doppler study of uterine hemodynamics should therefore be considered in infertility work-up

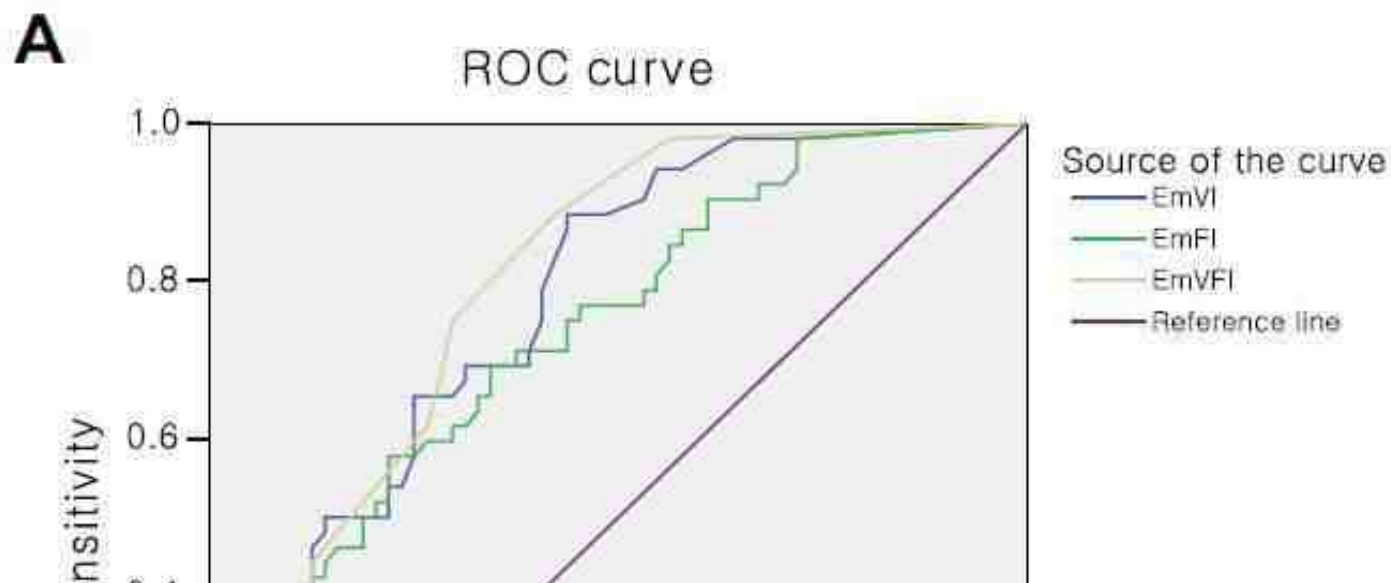
Table 2
Comparison of endometrial measurements and Doppler indices between unexplained infertility group and control group.

Variable	Infertility group	Control group	P value
Number of patients	40	40	
Endometrial thickness (mm)	9.69 ± 2.90 (8.77–10.62)	9.15 ± 3.24 (8.12–10.19)	0.435
Uterine artery PI	2.12 ± 0.49 (1.96–2.28)	1.81 ± 0.42 (1.68–1.94)	0.003
Uterine artery RI	0.89 ± 0.23 (0.82–0.96)	0.76 ± 0.19 (0.70–0.82)	0.007
Endometrial volume (cm ³)	4.35 ± 1.34 (3.92–4.78)	3.98 ± 1.29 (3.57–4.39)	0.212
Endometrial VI (%)	0.53 ± 0.18 (0.47–0.59)	0.63 ± 0.22 (0.56–0.70)	0.029
Endometrial FI (0–100)	25.24 ± 8.57 (22.50–27.98)	29.55 ± 8.98 (26.68–32.43)	0.031
Endometrial VFI (0–100)	0.25 ± 0.06 (0.23–0.27)	0.31 ± 0.09 (0.28–0.34)	0.001
Subendometrial VI (%)	1.97 ± 0.59 (1.78–2.16)	2.27 ± 0.64 (2.07–2.47)	0.032
Subendometrial FI (0–100)	31.18 ± 10.23 (27.91–34.45)	36.70 ± 13.19 (32.48–40.92)	0.040
Subendometrial VFI (0–100)	0.83 ± 0.27 (0.74–0.92)	1.02 ± 0.31 (0.92–1.12)	0.005

Values are given as mean ± SD (95% CI).

Detection of endometrial and subendometrial vasculature on the day of embryo transfer and prediction of pregnancy during fresh in vitro fertilization cycles.

Kim A¹, Jung H², Choi WJ³, Hong SN⁴, Kim HY⁵.



In conclusion, 3D PD-US was an effective and useful tool for mapping endometrial and subendometrial blood flow, even on the morning of ET. Excellent endometrial blood supply, which is indicative of endometrial receptivity, was associated with successful IVF outcome. No correlation was observed between subendometrial or uterine artery blood flow and pregnancy. These findings suggest that endometrial evaluation with 3D PD-US can be a useful prognostic protocol for pregnancy in infertile women undergoing a fresh GnRH agonist long protocol.

Farklılıkların Nedeni

- **Heterojen gruplar**
- **Farklı zamanlarda ölçüm**
- **Bazı çalışmalarda endometrial indeksler yok**
- **Subendometrial alanın tanımı (1, 5, 10 mm)**
- **Firmaların standardize ürünleri yok**

Sonuç

- **3D Ultrasonografi, endometriumun değerlendirilmesi için ümit vaadeden non-invaziv bir değerlendirme modalitesidir.**

Bu değerlendirmenin klinikte fark yaratacağı yönünde konfirme edilmiş kanıt mevcut değildir

Ovaryen Değerlendirme

- **Amaç İVF başarısını yükseltmek**
- **En kaliteli oositi barındıran follikülün saptanması**
- **hCG için en uygun zamanlama**

Table IX. Studies of ovarian blood flow in normal cycles

Investigation	Wave form	Flow volume	TAMV, TAMX	Vmax, PSV, MPSV	MDV	PI	RI	S/D ratio
Taylor <i>et al.</i> (1985) (A)	x					x		
Scholtes <i>et al.</i> (1989)						x		
Bourne <i>et al.</i> (1991)				x		x		
Collins <i>et al.</i> (1991)	x			x		x		
Kurjak <i>et al.</i> (1991)							x	
Jurkovic <i>et al.</i> (1991)						x		
Campbell <i>et al.</i> (1993)				x		x		
Kupesic and Kurjak (1993) (E)				x		x	x	
Sladkevicius <i>et al.</i> (1993)						x		
Strigini <i>et al.</i> (1995) (E)						x		
Tekay <i>et al.</i> (1995) (E,H)				x		x		
Bourne <i>et al.</i> (1996)				x		x		
Tan <i>et al.</i> (1996)				x		x		
Zaidi <i>et al.</i> (1996b) (C)				x		x		

A = abdominal ultrasound; C = circadian rhythm also studied; E = relationship to oestrogen, progesterone, or ovulation induction also studied; H = hyperstimulation syndrome also studied. See Table II for other abbreviations.

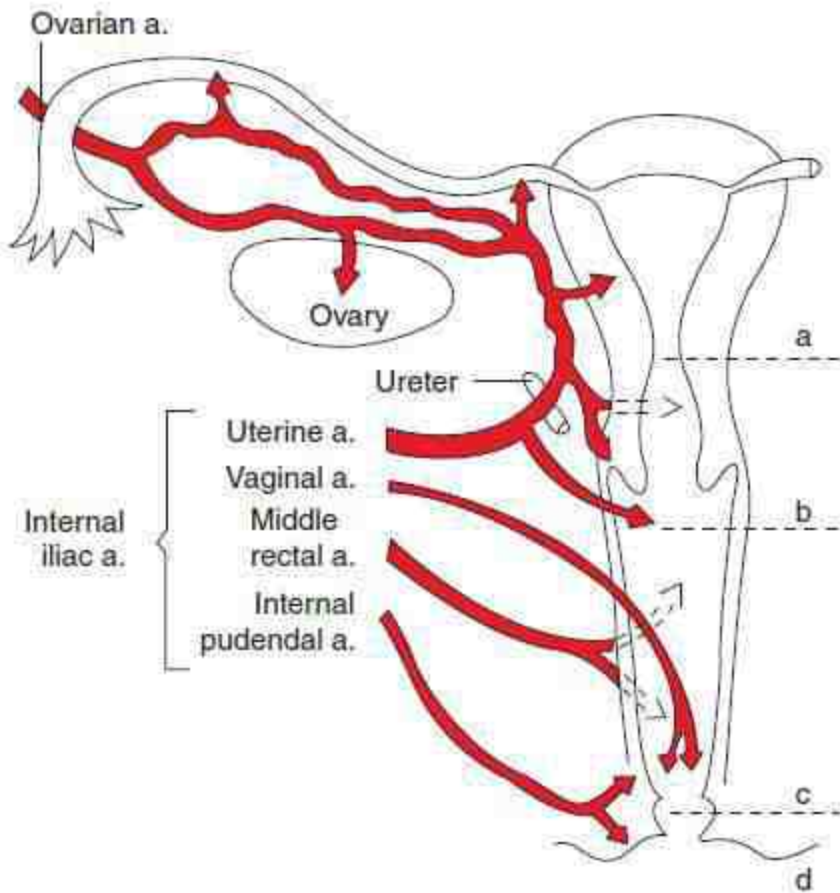


Figure 14.2. Diagram illustrating the vascular genital arcade and the ovarian blood supply from both the ovarian and uterine arteries.

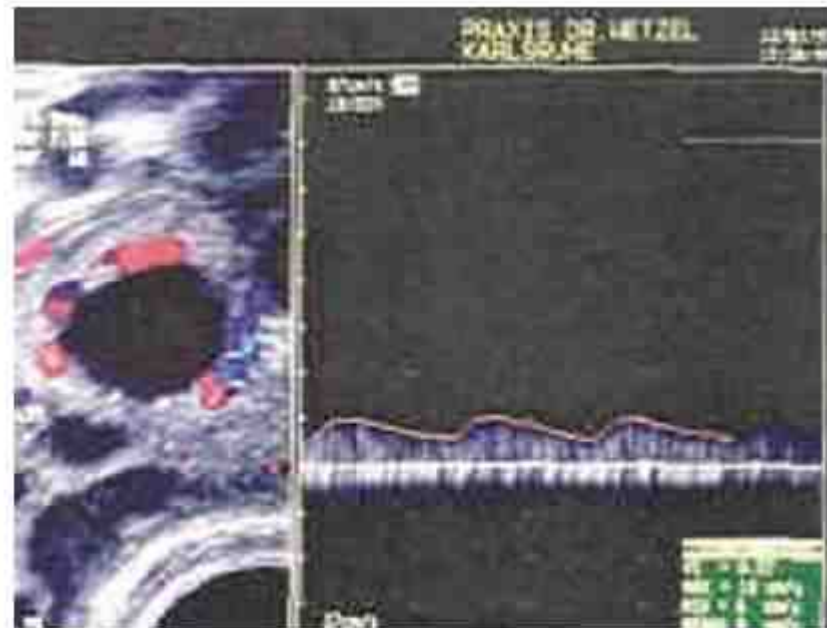


Figure 14.4. Blood flow characteristics of the corpus luteum. Note that corpus luteum blood flow is of low impedance and high flow pattern.

Fizyoloji

- Ovülatuar siklustaki overde kan akımı, folliküler faz boyunca hemen hemen sabittir.
- Anovülatuar siklularda farklı akım paternleri olur (daha yüksek yüksek RI)
- İntra-folliküler kan akımı ise periovülatuar giderek artar (dominant follikülde)

Fizyoloji

- Bourne *et al.* (1991): ovülasyon ile ilgili ilk intraovaryen kan akımı değişikliklerini tanımlamış.
- Zaidi *et al.* (1995): Ovarian folliküler veya stromal PI ve PSV için sirkadian ritim gösterilememiş.

İVF'de Ovaryan Değerlendirme

- Oyesanya *et al.* (1996)
- Norgund *et al.* (1996)
- Akım indeksleri ile oosit eldesi arasında anlamlı ilişki.

Ultrasound derived indices of follicular blood flow before HCG administration and the prediction of pregnancy recovery and preimplantation embryo quality.

Nargund G¹, Doyle PE, Bourne TH, Parsons JH, Cheng WC, Campbell S, Collins WP.

G I veya II embryo:

PSV > 10cm/s → %70

PSV < 10cm/s → %40

No flow → %24

PI veya PSV

Gebelik için anlamlı değil

Index (PI) and peak systolic blood velocity (PSV) before human chorionic gonadotrophin (HCG) administration and the subsequent production of a preimplantation embryo after in-vitro fertilization

	Embryo produced				<i>P</i> value*
	Yes		No		
	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	
PI	18	0.71 (0.16)	13	0.71 (0.36)	>0.05
PSV (cm/s)	18	12.7 (6.0)	13	8.5 (5.0)	<0.05**

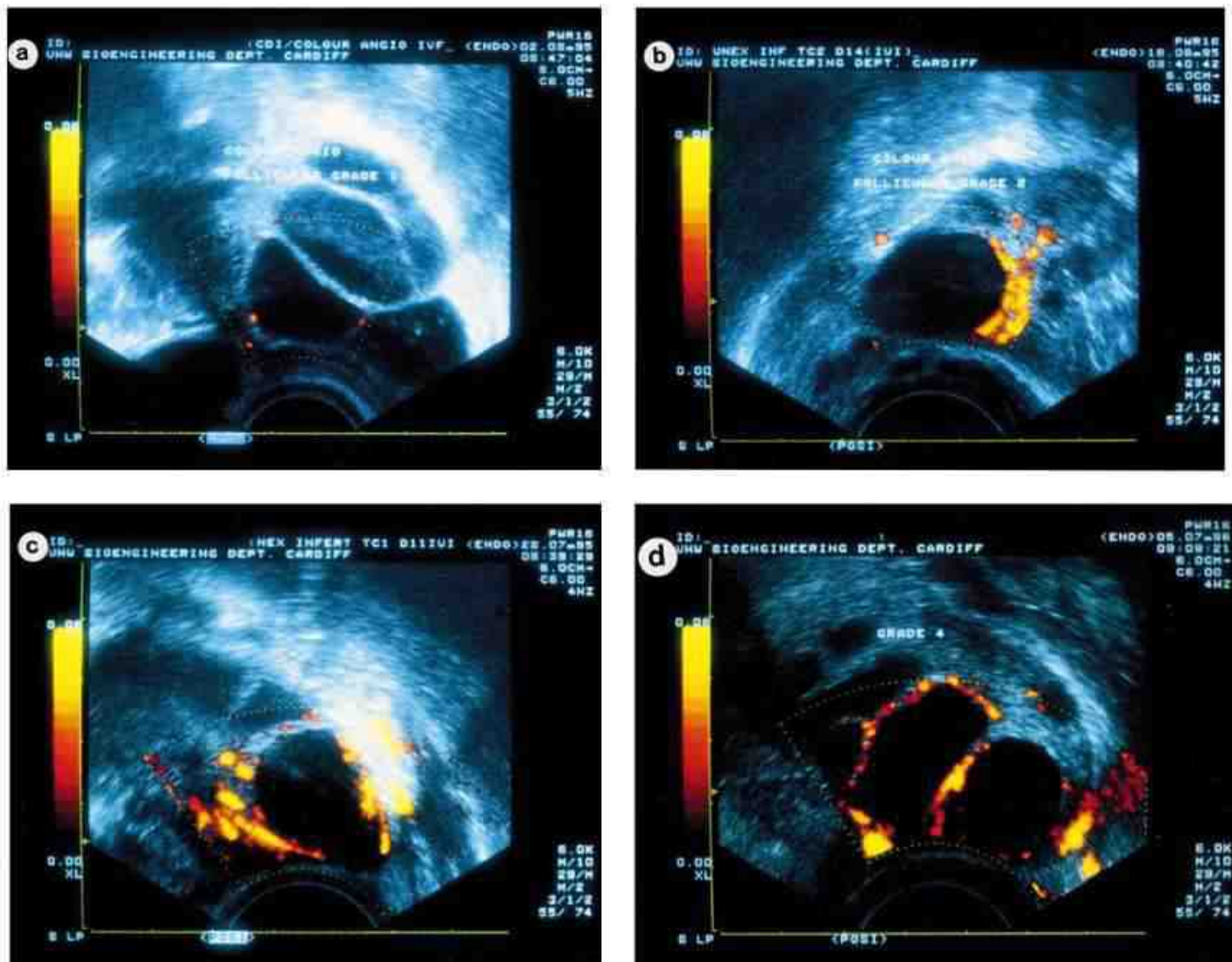


Figure 1. Power Doppler scans showing grading system used to assess follicular vascularity. (a) shows <25% circumferential flow (grade F1); (b) 26–50% flow (F2); (c) 51–75% flow and (d) >75% flow (F4).

Table II. Pulsatility indices of the left and right uterine and intra-ovarian arteries in the pregnant and non-pregnant groups (on day of oocyte collection)

	Uterine artery		Intra-ovarian artery	
	Pregnant	Not pregnant	Pregnant	Not pregnant
Left (mean $\pm$ SD)	3.42 $\pm$ 1.89	2.82 $\pm$ 1.27	1.00 $\pm$ 0.34	1.13 $\pm$ 0.77
Right (mean $\pm$ SD)	3.02 $\pm$ 1.02	2.88 $\pm$ 0.66	0.93 $\pm$ 0.13	0.97 $\pm$ 0.26
Mean ($\pm$ SD)	3.22 $\pm$ 1.46	2.85 $\pm$ 0.97	0.97 $\pm$ 0.24	1.05 $\pm$ 0.52

Differences not significant.

Table IV. Breakdown of pregnancy rate and follicular vascularity grading

	Follicular vascularity grading				Total
	F1	F2	F3	F4	
No. of pregnancies (%)	0 (0)	0 (0)	2 (12.5)	8 (61.5)	10 (26.3)
No. of patients	2	7	16	13	38

Pregnancy rate for F4 significantly higher than for F1, F2 or F3 ($P < 0.01$)

Triploid embryo:

F1, F2 $\longrightarrow$ 25-30%

F3, F4 $\longrightarrow$ < 6%

Perifollicular vascularity monitoring and scoring: a clinical tool for selecting the best oocyte.

Borini A¹, Tallarini A, Maccolini A, Prato LD, Flamigni C.

Table 1

Total	Group 1 follicular vascular grades 3–4	Group 2 follicular vascular grades 1–2	Group 3 follicular vascular grades 1–4
Transfers	20	3	20
Embrios transferred	43	5	47
Pregnancies	10	1	3
Gestational sacs	12	1	4
Pregnancy (%)*	50	33.3	15
Implantation (%)**	27.9	20	8.5
Miscarriages	1	0	0
Mean age	33.1	28	33.8
±DS	3.6	4.7	2.5

χ^2 squared test. *Groups 1 and 2, $P > 0.05$; groups 1 and 3, $P < 0.05$; group 2 and 3, $P > 0.05$. **Group 1 and 2, $P > 0.05$; groups 1 and 3, $P < 0.05$; group 1 and 3, $P > 0.05$. *Group 1 and 2 + group 3, $P > 0.05$. **Group 1 and 2 + group 3, $P < 0.05$.

- (1) follicular vascular grades 3–4;
- (2) follicular vascular grades 1–2;
- (3) follicular vascular grades mixed (control group).

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

Adakan S¹, Yoldemir T, Tavmergen E, Goker E, Killi R.

- 46 hasta analiz edilmiş
- Trigger öncesi doppler
- Uterin a, arkuat a, perifoliküler

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 $P < .05$.

Farklı Sonuçlar

Balakier H, Stronell RD. Colour Doppler assessment of folliculogenesis in in vitro fertilization patients. Fertil Steril 1994;62:1211–6.

Tekay A, Martikainen H, Jouppila P. Blood flow changes in uterine and ovarian vasculature and predictive value of transvaginal pulsed colour Doppler ultrasonography in an in vitro fertilization programme. Hum Reprod 1995;10:688–93.

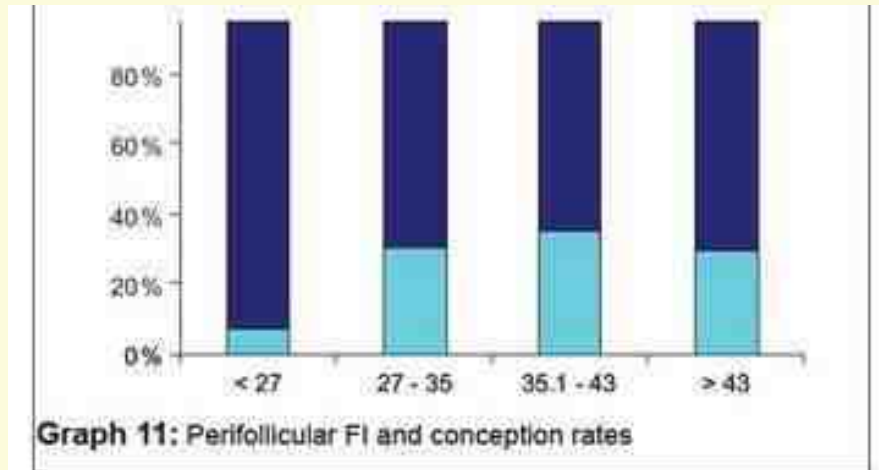
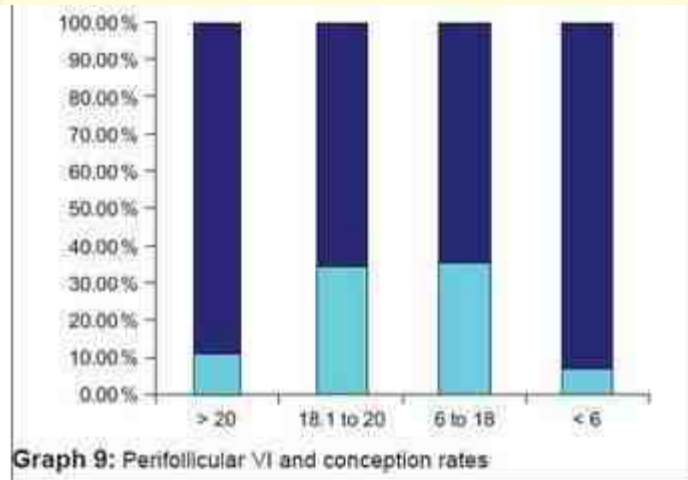
- **PSV iyi kalite embryo ya da gebelik için anlamlı bulunmamış**

3D Power Doppler

J Hum Reprod Sci. 2009 Jul;2(2):62-7. doi: 10.4103/0974-1208.57224.

Pre-hCG 3D and 3D power Doppler assessment of the follicle for improving pregnancy rates in intrauterine insemination cycles.

Panchal S¹, Nagori CB.



Assessment of endometrial and ovarian characteristics using three dimensional power Doppler ultrasound to predict response in frozen embryo transfer cycles

Tamara Žáčková*^{1,2}, Ilkka Y Järvelä¹, Juha S Tapanainen¹ and Jaroslav Feyereisl²

Table 2: Comparison of ultrasonographic and hormonal parameters on the day of FET between the pregnant and nonpregnant groups.

	Pregnant (n = 15)	Nonpregnant (n = 15)	P- value
Endometrial thickness (mm)	11,1 ± 0,3	11,2 ± 0,7	0,882
Endometrial Volume (ml)	3,7 ± 0,4	3,4 ± 0,7	0,669
Endometrial pattern triple line (n, %)			0.005
Homoechogenic	1 (6,7)	9 (60,0)	
Tripple line	14 (93,3)	6 (40,0)	
Endometrial vascularization index (VI) %	0,9 ± 0,3	1,1 ± 0,4	0,661
Endometrial vascularization** (ml)	0,04 ± 0,02	0,04 ± 0,02	0,887
Subendometrial Volume (ml)	11,2 ± 0,9	11,3 ± 1,2	0,996
Subendometrial vascularization		1,2 ± 0,4	0,110
Subendometrial vascularization (ml)		0,2 ± 0,1	0,075
Endometrial echogenity*			
Subjective evaluation (n,%)			
Hyperechogenic	15 (100)	15 (100)	
Hypoechoogenic	0 (0)	0 (0)	
MG endsubend	1,24 ± 0,05	1,25 ± 0,06	0,917
MG subend	29,25 ± 1,60	26,95 ± 2,56	0,453
Dominant -ovary Volume (ml)	17,0 ± 2,9	15,1 ± 1,8	0,562
Dominant ovary vascularization index (VI) %	9,2 ± 1,5	7,6 ± 1,1	0,382
Dominant ovary vascularization** (ml)	1,4 ± 0,2	1,0 ± 0,1	0,134
Nondominant ovary Volume (ml)	9,0 ± 1,1	7,8 ± 0,7	0,376
Nondominant-ovary vascularization index(VI) %	3,7 ± 0,7	5,2 ± 1,2	0,287
Nondominant ovary vascularization** (ml)	0,4 ± 0,1	0,4 ± 0,1	0,725
Progesterone on the day of FET (nmol/l)	25,4 ± 3,2	45,9 ± 12,7	0,130
17-OHP on the day of FET (nmol/l)	8,6 ± 0,4	9,6 ± 0,8	0,263
Estradiol on the day of FET (nmol/l)	0,31 ± 0,02	0,33 ± 0,03	0,695

**Akım parametreleri
anlamlı değil**

Reprod Biol Endocrinol. 2009 Dec 25;7:151. doi: 10.1186/1477-7827-7-151.

Assessment of endometrial and ovarian characteristics using three dimensional power Doppler ultrasound to predict response in frozen embryo transfer cycles.

Žáčková T¹, Järvelä IY, Tapanainen JS, Feyereisl J.

Sonuç

Bu nedenle intraovaryan kan akımının değerlendirilmesi, ovülasyon parametreleri hakkında prediksiyon yapılmasında ve asiste siklusların başarısının arttırılmasında faydası olabilir

Cumhuriyet bayramınız kutlu olsun





"Sevgili arkadaşlarım, tanıdığım tanımadığım, dünyanın bütün insanları. Dakikalar sonra bir uzay mekiği beni dünyadan uzaklara taşıyacak. Size şu an ne söyleyebilirim ki? Bütün hayatım bu güzel andan ibaretmiş gibi geliyor. **Yaptığım, yaşadığım her şey, hep bu an içindi.**"

Teşekkürler



- **CC sikluslarında uterin arter doppleri**
 - 80 açıklanamayan infertilite
 - CC başlanmadan önce doppler ölçümü

Table 2: Doppler velocimetries of uterine and ovarian arteries among the pregnant and non-pregnant groups

Pregnant group	Non-pregnant group	P (95% CI)
n=6	n=74	

Uterin ve ovaryen arter doppler indekslerinin prognoz ile ilişkisi yoktur

[Int J Fertil Steril](#). 2015 Apr-Jun;9(1):41-6. Epub 2015 Apr 21.

Are uterine and ovarian artery Doppler velocimetry values good pregnancy predictors in clomiphene citrate cycles?

[Guzel AI](#)¹, [Erkilinc S](#)¹, [Ozer I](#)¹, [Tokmak A](#)¹, [Kurt Sahin A](#)¹, [Ugur M](#)¹.

- 
- **3D Ultrasound has been proposed as a promising tool for evaluating the endometrium, but a review of the literature regarding its role for assessing endometrial function did not confirm the suggested benefits of this technique. yaman**

- 
- Studying the intraovarian blood flow may be of value in prediction of the ovulation process and can increase the precision and efficacy of some of the assisted reproductive mtechniques.

- 
- The noninvasive Doppler technique offers great potential in the assessment of the physiology of hemodynamic regulation of spontaneous and induced cycles; its clinical impact on daily practice in IVF programs is variable.

- 
- there is a physiological relationship between follicular vascularity and oocyte recovery and the production of a high-grade preimplantation embryo. Ovarian blood flow correlates well with oocyte recovery rates and hence may be useful in determining the most appropriate time to administer hCG in order to optimize oocyte recovery rate

Table II. Hormone supplementation regimen for Group IIA patients for replacement of frozen-thawed embryos

Day of cycle	Oestradiol valerate (tablets) (mg/day)	Intramuscular progesterone (Gestone, Paines & Byrne Ltd, Middlesex, UK) (mg)
5-9	2	
10	4	
11-13 ^a	6	
14	2	
15	2	50
16	4	50
17 ^b -30	4	100
If pregnant	Continue to 8 weeks' gestation	Continue to 14 weeks' gestation
If not pregnant	STOP THERAPY	STOP THERAPY

^aCheck Doppler study performed.

^bEmbryos replaced in uterus.

