

Antenatal Doppler Fetal İyilik Durumu

Prof .Dr. Aydan Asyalı Biri

Koru Hastaneleri Kadın Hastalıkları ve
Doğum Kliniği



Fetal sorunlar

- Yapısal
- Kromozomal
- Gen düzeyinde
- Gelişimsel
- Fetusun iyilik hali





Fetal iyilik durumu değerlendirme yöntemleri

- ❑ Non-Stres Test(NST)
- ❑ Kontraksiyon StresTest (CST)
- ❑ Biyofizik profil
- ❑ Amnion Sıvı Hacim Ölçümü
- ❑ **Arterial ve Venöz Doppler**

First-, Second-, and Third-Trimester Screening for Preeclampsia and Intrauterine Growth Restriction



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Box 1 Candidate screening tests for preeclampsia and IUGR

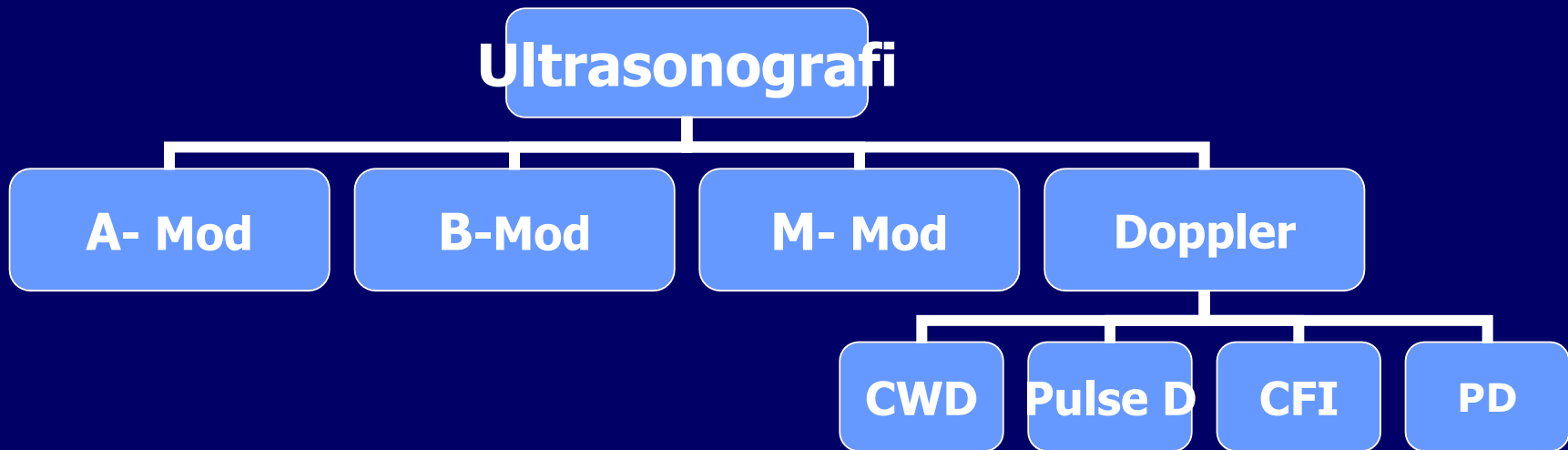
1. Clinical risk factor screening
2. Placenta perfusion dysfunction-related tests
 - Uterine artery Doppler ultrasonography
 - Two-dimensional (2D) placenta imaging
 - Three-dimensional (3D) placenta imaging
 - Placental volume
 - Placenta quotient
 - Placenta vascular indices
3. Maternal serum analytes
 - Down syndrome markers
 - α -Fetoprotein (AFP)
 - Human chorionic gonadotropin (hCG)
 - Estradiol
 - Inhibin A
 - disintegrin and metalloproteases (ADAM)
 - Placental protein 13
4. Endothelial dysfunction-related tests
 - Circulated angiogenic factors
 - Placental growth factor (PlGF)
 - Soluble fms-like tyrosine kinase 1
 - Vascular endothelial growth factor (VEGF)
 - Soluble endoglin (sEng)
 - Endothelial cell adhesion molecules
 - Selectin
5. Markers of insulin resistance
 - Tumor necrosis factor
 - Sex hormone-binding globulin (SHBG)
 - Adiponectin
 - Leptin
6. Genomics and proteomics

Box 1 Candidate screening tests for preeclampsia and IUGR

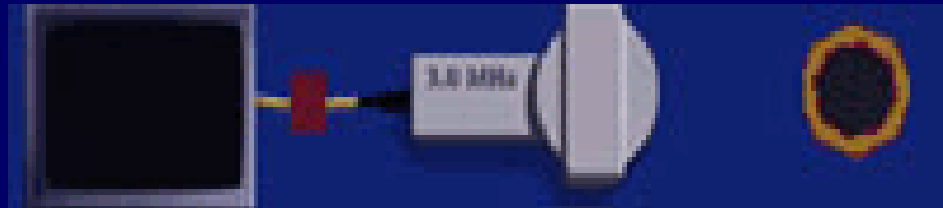
1. Clinical risk factor screening
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 - Placenta quotient
 - Placenta vascular indices
3. Maternal serum analytes

Ultrasonik Görüntüleme Modları (Tipleri)

- ❑ Temel olarak 4 ana görüntüleme modu vardır

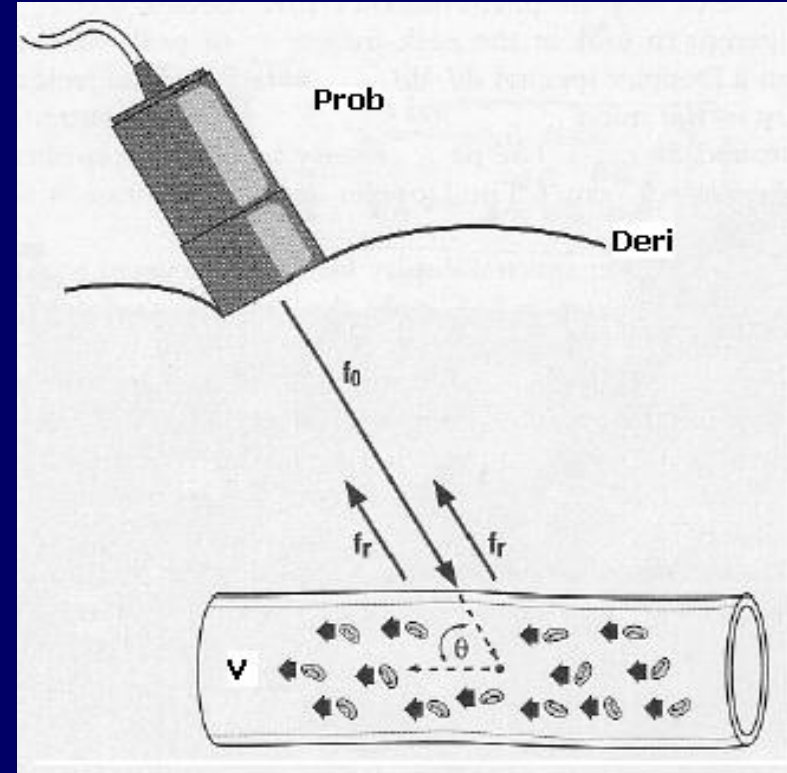


- ❑ Kullanım amaçları farklıdır



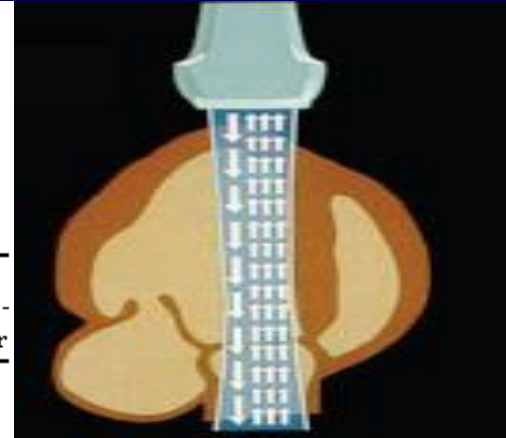
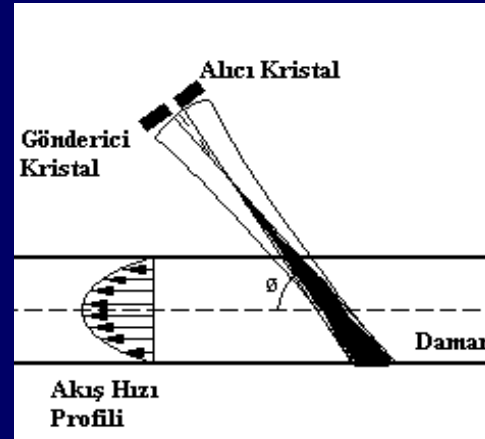
Dopler

- Dopler ile kan akış hızı ve kan akış özelliği hakkında bilgi verir



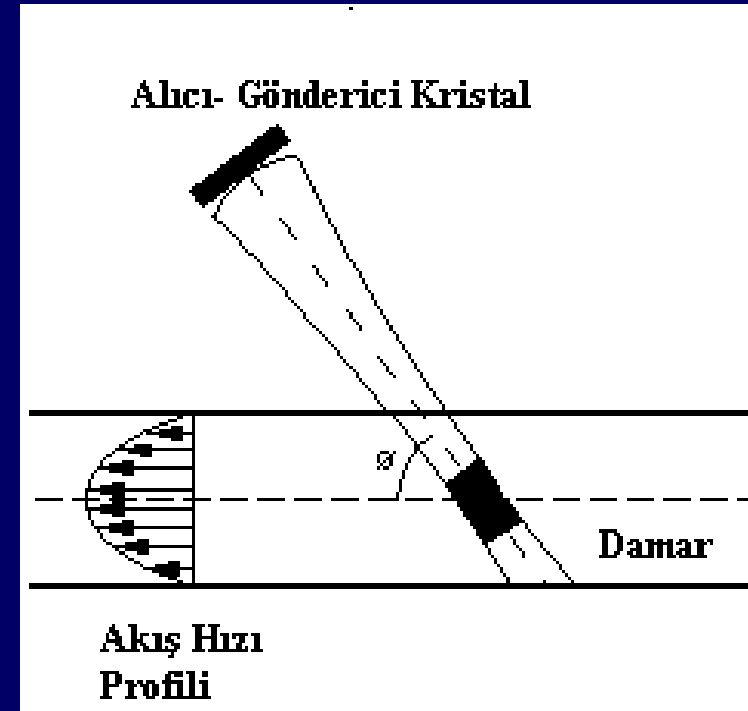
Sürekli Dalgalı Doppler (CWD)

- ❑ Yüksek akış hızlarının ölçümünde kullanılır
- ❑ Sinyaller, doppler demedinin yolu üzerinden geçen tüm damarlardan toplanır
- ❑ Ultrason dalgalarının tam kaynağını tespit edemez
- ❑ Obstetride fetal kalp atımının tespiti ve monitorizasyonu için kullanılır



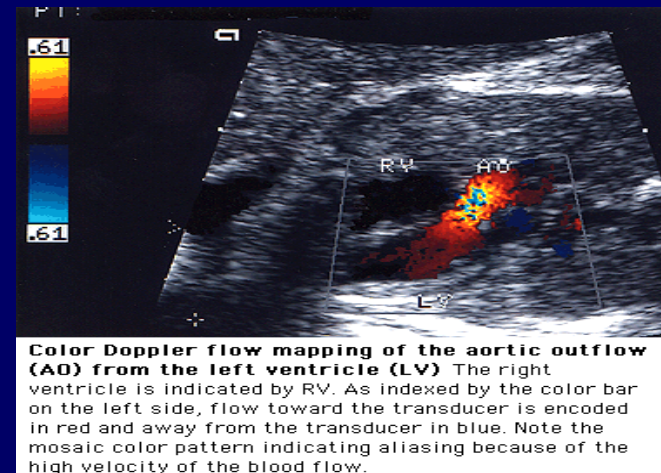
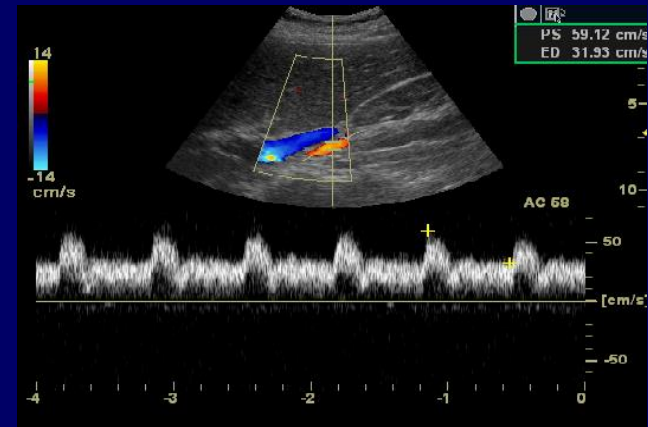
Pulse (PD) Doppler

- ❑ Hedef alanın görüntülenmesinde kullanılır
- ❑ İncelenen damardan hemodinamik bilgi elde edilebilir
- ❑ Klinikte yaygın kullanılır



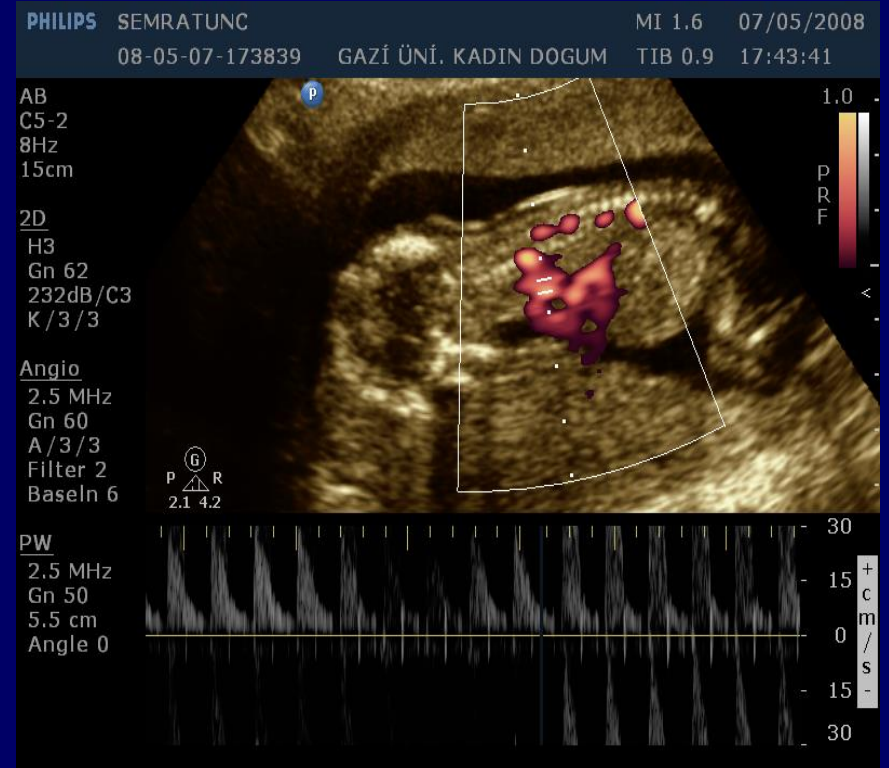
Renkli Akış Görüntüleme (CFI)

- ❑ Akım yönünü ve varlığını tespit etmek için kullanılır
- ❑ Kan akış hızına ve yönüne göre renk kodlaması bulunmaktadır
- ❑ Fetal ekokardiografide özellikle faydalıdır



Power Doppler

- Akım yönünü ve hızları belirleyemez
- Düşük akım ve hızlardaki ölçüm hassasiyetini arttırmak için kullanılır





Obstetrikte dopler

- 12 hf –term
- Plasentasyon
- Maternal ve fetal dolaşım hakkında bilgi sağlar

Obstetrikte dopler

Table 2. Disease-specific indications for Doppler surveillance

Maternal vascular disorders

- Lupus erythematosus
- Antiphospholipid antibody syndrome
- Hypertension
- Advanced classes of diabetes
- Thrombophilias

Fetal hemodynamic concerns

- Abnormal nuchal translucency or ductus venosus in first trimester
- Elevated maternal serum alphafetoprotein
- Red cell alloimmunization
- Proven fetal viral infection
- Small for dates
- Proved IUGR
- Congenital heart disease

Historical factors

- Maternal hypertension, preeclampsia, abruption
- Stillbirth, severe IUGR
- Previous unexplained cerebral palsy?

IUGR, Intrauterine growth restriction.

Obstetrikte dopler

- Maternal **Uterin arter**
- **Umb. arter** ve ven
- Fetal damarlar

DV

MCA

Aorta

Koroner arter

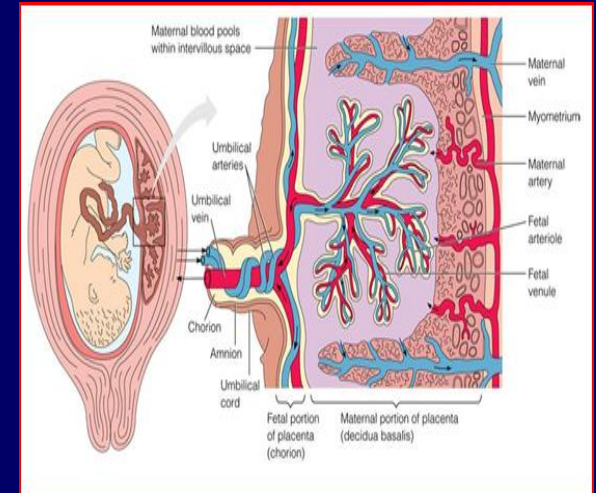
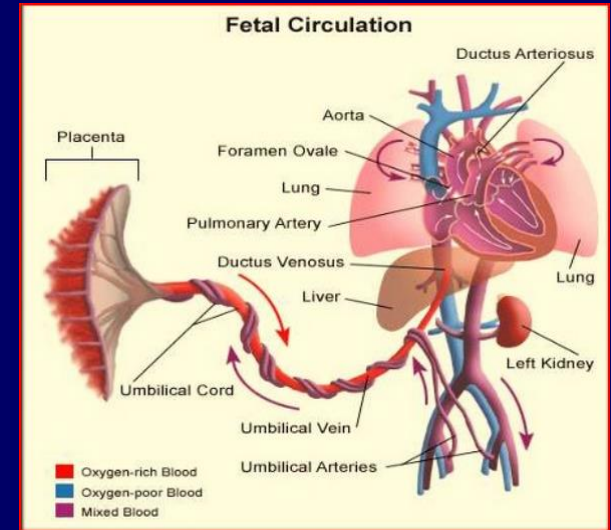
Renal arter

Hepatik arter

Splenik arter

VCİ

TK



Comprehensive assessment of fetal wellbeing: which Doppler tests should be performed?

Chris R. Harman and Ahmet A. Baschat

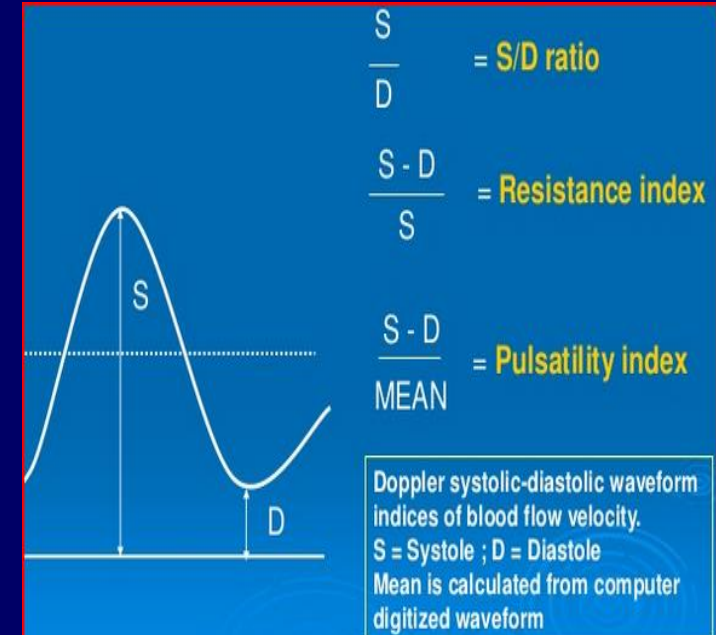
Table 1. Sequential Doppler applications

GA (weeks)	Vessel	Doppler parameter	P/D	Primary endpoint
12	DV	Retrograde a-wave	P	Aneuploidy Cardiovascular anomaly
18	Uterine	Notching	P	Hypertension, IUGR
	UA	AEDV/REDV	P	Severe IUGR, early demise
	Uterine	Notching, PI	P	Hypertension, IUGR
22–24	Uterine	PI, notching	P	Hypertension, IUGR
	UA MCA	PI, CRP, Peak SV	P + D	IUGR, anemia
	DV	PIV, AVR	D	IUGR, cardiac
3rd Trimester	UA MCA	PI, CRP, Peak SV	D	IUGR, anemia
	DV	PIV, AVR	D	IUGR, cardiac

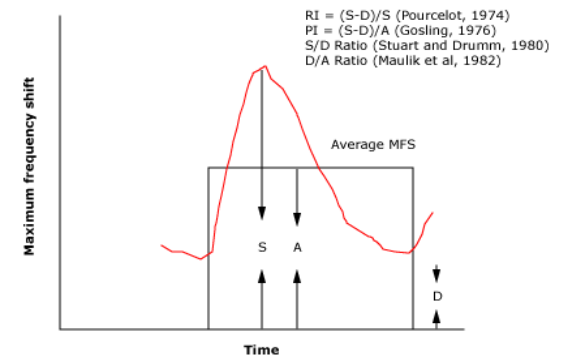
AEDV, absent end-diastolic velocity; AVR, arteriovenous ratio; CRP, cerebral-placental ratio; DV, ductus venosus; IUGR, intrauterine growth restriction; GA, gestational age; MCA, middle cerebral artery; P/D, predictive or diagnostic; PI, pulsatility index; PIV, pulsatility index for veins; REDV, reversed end-diastolic velocity; SV, systolic velocity; UA, umbilical artery.

Dopler analizleri

- 1-Dalga akım şekli analizi: cihaz ve açıdan bağımsız, kalitatif, fetal maternal dolaşımla ilgili çalışma çok
- 2-Kan akım hızının ölçülmesi: Kantitatif, iyi ölçülmeli, data daha az
- 3-Kan akım volüm ölçümü: Kantitatif volüm ölçümü, damarın alan ve çap bilgisi gerekir büyük damarlarda



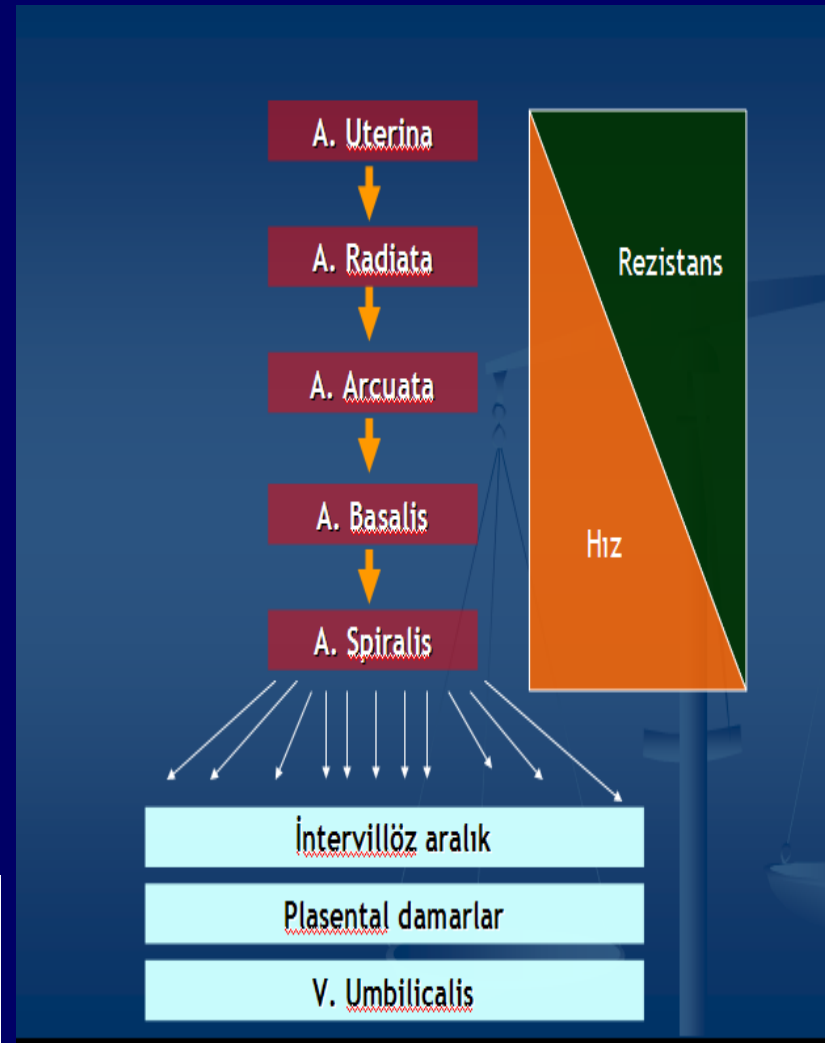
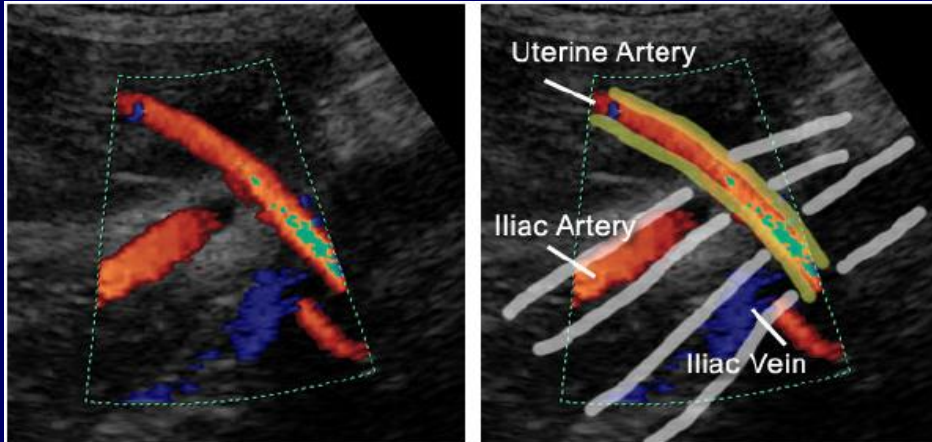
Doppler indices derived from the maximum frequency shift envelope



S: peak systolic frequency shift; D: end diastolic frequency shift; and A: temporal average frequency shift over one cardiac cycle.
With permission from Maulik, D, Yarlagadda, P, Youngblood, JP, Willoughby, L. Components of variability of umbilical arterial Doppler velocimetry: a prospective analysis. Am J Obstet Gynecol, 1989; 160:1406.

Uterin arter

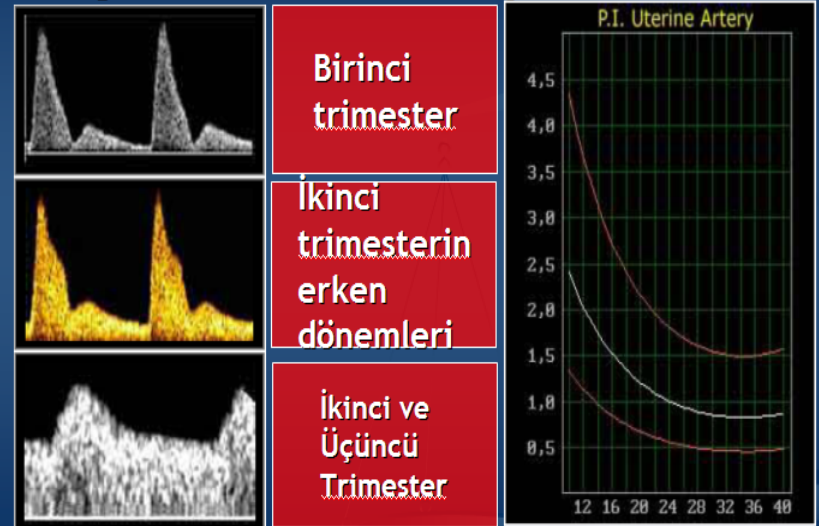
- İnternal iliak arterin dalı
- Gebelik öncesi ute. arterlerde yüksek direnç vardır, kan akım hızı 40 ml/dk
- Gebelik boyunca uterin arter kapasitesini artırabilir, kan akımı 400 ml/dk
- Kan spiral arterlerden yüksek hızla atılarak kotiledonları perfüze eder



Uterin arter

- Ut A kan akımı değişimi, maternal spiral arterlerde trofoblastik invaz. göstergesidir
- invazyon sırasında vasküler sistem minimal dirençli damarlara dönüşür
- Gebeliğin başında yüksek sistolik, düşük diastolik akım hızı, erken diastolik çentiklenme vardır
- Erken diastolik çentiklenme 12 hf kaybolmaya başlar, 20 hf önce düşük dirençli akım başlar, 23 hf sonra çentik görülmez
- Gebelik ilerledikçe plasentasyona sekonder vasküler direnç azalır ve diastol sonu akım artar

**UtA de karakteristik değişiklikler olur
gebelik haftası ilerledikçe DSA artar**



Özel ayarlarla 10 hf dan sonra diastolik akım görülebilir
15 hf sonra diastolik akım mutlaka görülür

Uterin arter dopler

- UtA akımlarında üç tip patoloji

- **1-Yüksek vasküler direnç**

$S-D/S=RI > 95.\text{per}$

$S-D/TAMX=\text{ortalama}$

$\text{mak.akım hızı}=PI >95.\text{per}$

24 hf sonra $S/D >2.6$

- **2-Sistol sonrası tek taraflı çentiklenme**

- **3-Sistol sonrası çift taraflı çentiklenme**

- Çentiklenme:Artmış vasküler dirençe bağlı(damar elastikiyerinin azlığını, yetersiz trofoblast invazyonu gösterir)

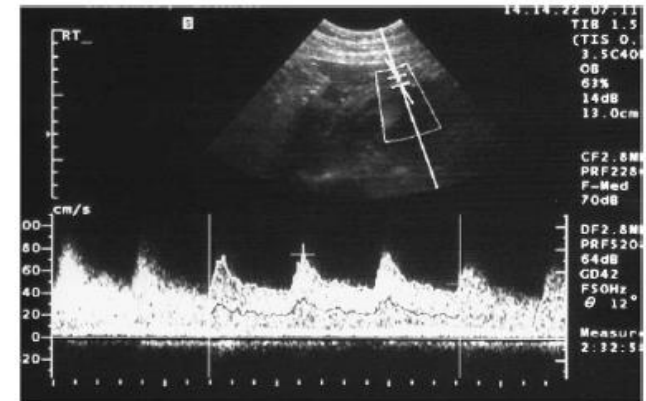


Figure 1 Normal uterine artery Doppler ultrasound.

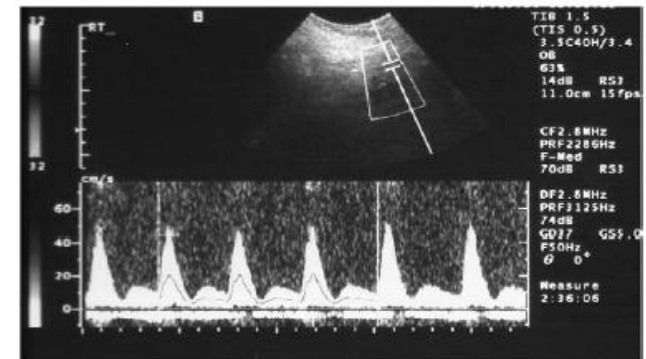
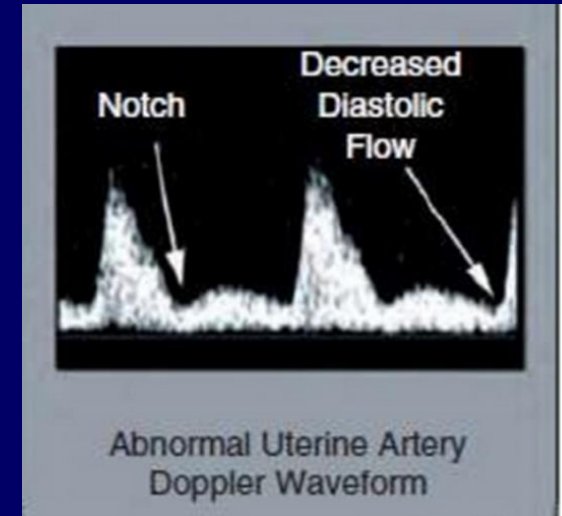
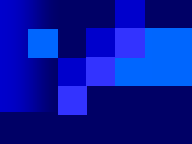


Figure 2 Abnormal uterine artery Doppler ultrasound demonstrating a notch at the end of systole.

Uterin arter dopler

- **Plasentasyon kusurlu ise yüksek direnç devam eder**
- UtA dopler ile patolojik akım bulguları ile yüksek riskli olguların önemli bir kısmı tespit edilebilir
- **Anormal UtA dopler tüm trimesterlerde kötü obstetrik sonuçlarla ilgili**
- İkinci trimester düşük, Preeklampsi, IUGR, ölü doğum, erken doğum ve plasenta dekolmanı





Uterin Arter Dopler

- Rutin uterin arter dopler ölçümünün düşük riskli gebeliklerde katkısı az

Uterin Arter Dopler

- Yüksek riskli gebeliklerde ölçülmelidir
- Klinik bulgular başlamadan uteroplental yetmezliğin tespiti sağlar
- Her iki uterin arter PI normal ise bu çok büyük olasılıkla gebenin PREEKLAMPSİ ve IUGR ile karşılaşmayacağını gösterir
- Uterin arter dopler negatif prediktif değeri 99% dur

Birinci trimester UtA dopler

- 1. tri UtAD kötü gebelik sonuçları ile ilgisi gösterilmiş
- 1. tri UtAD erken PE ve IUGR yi geç PE ve IUGR den daha iyi seçiyor
- Multiparametrik modellerle 1.-tri. UtAD PI, maternal özellikler ve biyokimyasal belirteçlerin birlikte kullanımı ile erken başlayan PE tespiti % 90 ulaşabilir
- İdeal kombinasyon henüz araştırılıyor



First-trimester uterine artery Doppler and adverse pregnancy outcome: a meta-analysis involving 55 974 women

	Sensitive	Specific
Early Preeclampsia	47.8% (39.0 – 56.8)	92.1% (88.6 – 94)
Early IUGR	39.2% (26.3 – 53.8)	93.1% (90.6 – 95.0)
Preeclampsia	26.4% (22.5 – 30.8)	93.4% (90.4 – 95.5)
IUGR	15.4% (12.4 – 18.9)	93.3% (90.9 – 95.1)



First-trimester uterine artery Doppler and adverse pregnancy outcome: a meta-analysis involving 55 974 women

Table 1 Accuracy estimates of first-trimester uterine artery Doppler in predicting maternal and fetal complications in low-risk women

<i>Outcome</i>	<i>Doppler test</i>	<i>Studies (n)</i>	<i>Women (n)</i>	<i>Sensitivity (% (95% CI))</i>	<i>Specificity (% (95% CI))</i>	<i>Positive LR (95% CI)</i>	<i>Negative LR (95% CI)</i>
Early-onset pre-eclampsia	FVW	7	38 611	47.8 (39.0–56.8)	92.1 (88.6–94.6)	6.1 (4.1–8.9)	0.57 (0.48–0.67)
Early-onset FGR	FVW	4	26 276	39.2 (26.3–53.8)	93.1 (90.6–95.0)	5.7 (4.3–7.6)	0.65 (0.52–0.81)
Pre-eclampsia at any gestation	FVW	8	37 971	26.4 (22.5–30.8)	93.4 (90.4–95.5)	4.0 (2.7–6.0)	0.79 (0.74–0.84)
FGR at any gestation	FVW	6	30 454	15.4 (12.4–18.9)	93.3 (90.9–95.1)	2.3 (1.9–2.8)	0.91 (0.88–0.93)
	Notching	4	4785	58.5 (49.7–66.7)	56.1 (49.6–62.5)	1.3 (1.2–1.5)	0.74 (0.65–0.84)
Late-onset pre-eclampsia	FVW	3	33 879	21.5 (18.0–25.4)	90.3 (89.8–90.8)	2.2 (1.9–2.6)	0.87 (0.83–0.91)
Stillbirth	FVW	1	9859	14.5 (6.9–25.8)	91.3 (90.8–91.9)	1.7 (0.9–3.1)	0.94 (0.84–1.0)
	Notching	1	76	100.0 (40.0–100.0)	63.9 (51.7–74.9)	2.5 (1.6–3.8)	0.16 (0.01–2.2)
Placental abruption	FVW	1	1123	44.4 (13.7–78.8)	95.2 (93.8–96.4)	9.3 (4.3–20.3)	0.58 (0.33–1.1)
	Notching	1	243	100 (15.8–100.0)	43.2 (36.8–49.7)	1.5 (0.87–2.5)	0.39 (0.03–4.9)
Composite adverse pregnancy outcome	FVW	3	4513	25.8 (15.5–39.7)	93.4 (90.8–95.3)	3.9 (2.8–5.5)	0.79 (0.68–0.92)

FGR, fetal growth restriction; FVW, flow velocity waveform; LR, likelihood ratio.

Review Article

First-Trimester Uterine Artery Doppler Analysis in the Prediction of Later Pregnancy Complications

Su Lynn Khong,^{1,2} Stefan C. Kane,^{1,2,3}
Shaun P. Brennecke,^{1,3} and Fabrício da Silva Costa^{1,2,3,4}

Disease Markers

TABLE 2: Detection rate (DR) of early preeclampsia at a 10% false positive rate using various multiparametric predictive models (i.e., those including maternal characteristics, uterine artery Doppler, and biochemical markers).

Predictive model	Parameters	DR%
Parra-Cordero [52]	BMI, smoking, lowest UtA-PI, and PIGF	47
Odibo [53]	HTN, mean UtA-PI, PAPP-A, and PP-13	68
Poon [54]	Maternal history, UtA-PI, and PAPP-A	71.9
Scazzocchio [55]	Ethnicity, BMI, parity, previous PE, age, HTN, renal disease, MAP, and mean UtA-PI	81
Poon [36]	Ethnicity, BMI, parity, previous PE, age, HTN, DM, thrombophilia, smoking, MAP, and lowest UtA-PI	89
Crovetto [56]	Maternal characteristics, MAP, UtA-PI, and sFlt-1	91.2
Poon [57]	Maternal characteristics, lowest UtA-PI, MAP, and PIGF	92.3
Poon [38]	Maternal factors, UtA-PI, MAP, PAPP-A, and PIGF	93.1 [*]
Poon [58]	Ethnicity, BMI, parity, previous PE, age, HTN, DM, thrombophilia, smoking, MAP, lowest UtA-PI, and PAPP-A	95
Akolekar [59]	Maternal factors, MAP, UtA-PI, PAPP-A, PIGF, PP13, sEng, inhibin-A, activin-A, PTX3, and P-selectin	95.2
Akolekar [60]	UtA-PI, MAP, PAPP-A, and PIGF	96.3

^{*}This study reported detection rates at a 5% false positive rate.

2 trimester UtA doppler



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2

The role of uterine artery Doppler in predicting adverse pregnancy outcome

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Table 1. Characteristics of second trimester uterine artery Doppler screening studies used in this review.

Reference	n	Type of Doppler	Abnormal result	GA (weeks)	Vessel	Screen +ve (%)
Newnham et al ¹⁴	501	CW	S/D ratio > 2.18	18	Uterine arteries	4.8
Steel et al ¹⁵	1014	CW and CW	RI > 0.58	18 and 24	Uterine arteries	11.6
Bewley et al ¹⁶	917 (913) ^a	CW	Mean RI > 95th centile	16–24	Uterine and arcuate arteries	5.6 (5.7) ^a
Bower et al ^{17b}	2058	CW	RI > 95th centile or notches	18–22	Uterine arteries	16.0
Bower et al ^{18b}	2026	CW and colour-PW	Bilateral notches	20 and 24	Uterine arteries	6.1
Valensise et al ¹⁹	272	Colour-PW	Mean RI > 0.58	22	Uterine arteries	9.6
North et al ²⁰	446 (457) ^a	Colour-PW	RI > 0.57	19–24	Uterine (placental side)	11.9 (12.3) ^a
Todros et al ²¹	916	CW or PW	S/D ratio > 2.7	19–24	Uterine arteries	6.4
Harrington et al ²²	1204	CW and colour-PW	RI > 95th centile or notches	20 and 24	Uterine arteries	9.1
Frusca et al ²³	419	CW and colour-PW	Mean RI > 0.58	20 and 24	Uterine arteries	8.6
Irion et al ²⁴	1159	Colour-PW	Mean RI > 0.57	26	Uterine (placental side)	12.8
Kurdi et al ²⁵	946	Colour-PW	Mean RI > 0.55 and bilateral notches ^c	19–21	Uterine arteries	12.4 ^c
Albaiges et al ²⁶	1757	Colour-PW	Mean PI > 95th centile or bilateral notches	22–24	Uterine arteries	7.3
Aquilina et al ²⁷	640	Colour-PW	Mean RI > 0.65 and notches	19–20	Uterine arteries	9.8
Papageorghiou et al ²⁸	7851	TV, Colour-PW	Mean PI > 95th centile	22–24	Uterine arteries	5.1

Colour-PW, colour flow imaging to identify the vessel followed by pulsed-wave Doppler; CW, continuous-wave Doppler without visualising the vessel; FGR, fetal growth restriction; GA, gestational age; n, number of cases used in the analysis after all exclusions; PI, pulsatility index; PW, pulsed-wave Doppler after identification of the vessel using B-mode ultrasound; RI, resistance index; S/D, systolic to diastolic ratio; TV, transvaginal.

^a Pre-eclampsia (fetal growth restriction).

^b These two studies report on the same population using one stage and two-stage Doppler screening.

^c In Kurdi et al 1998²⁵ this definition of an abnormal result was used for the prediction of pre-eclampsia and fetal growth restriction below the 5th centile. In the prediction of fetal growth restriction below the 10th centile an abnormal result was defined as the presence of bilateral notches and mean RI > 0.55, or unilateral notch and mean RI > 0.65 or mean RI > 0.7 (Screen positive rate 22.8%).

2.Tri UtA tarama PE

Table 2. Results of second trimester uterine artery Doppler screening studies for the prediction of pre-eclampsia, providing data on screen positive rate, definition and prevalence of the disease, sensitivity, specificity, positive and negative predictive values, and likelihood ratios of a positive and negative test with 95% confidence intervals.

Reference	SPR (%)	Prev (%)	Sens (%)	Spec (%)	PPV (%)	NPV (%)	Positive test			Negative test		
							n/n	LR	95% CI	n/n	LR	95% CI
Steel et al ¹⁵	11.6	1.9 ^a	63	89	10	99	12/118	5.93	3.73–8.17	7/896	0.41	0.21–0.66
Bewley et al ¹⁶	5.6	4.6 ^b	24	95	20	96	10/51	5.08	2.69–9.03	32/866	0.80	0.64–0.91
Bower et al ¹⁷	16.0	2.5 ^a	75	86	12	99	39/329	5.19	4.17–6.14	13/1729	0.29	0.18–0.45
Valensise et al ¹⁹	9.6	3.3 ^a	89	93	31	99	8/26	12.99	7.16–20.99	1/246	0.12	0.02–0.47
North et al ²⁰	11.9	3.4 ^a	27	89	8	97	4/53	2.35	0.93–4.88	11/393	0.83	0.54–1.01
Harrington et al ²²	9.1	3.7 ^c	77	93	31	99	34/110	11.79	8.84–15.28	10/1094	0.24	0.14–0.40
Frusca et al ²³	8.6	1.9 ^a	50	92	11	99	4/36	6.42	2.62–11.71	4/383	0.54	0.23–0.85
Irion et al ²⁴	12.8	3.3 ^a	26	88	7	97	10/148	2.14	1.19–3.51	28/1011	0.84	0.66–0.97
Kurdi et al ²⁵	12.4	2.2 ^b	62	89	11	99	13/117	5.51	3.52–7.59	8/829	0.43	0.23–0.67
Albaiges et al ²⁶	7.3	3.7 ^a	45	94	23	98	29/128	7.63	5.38–10.42	36/1629	0.59	0.46–0.71
Aquillina et al ²⁷	9.8	5.5 ^a	60	93	33	98	21/63	8.64	5.66–12.60	14/577	0.43	0.27–0.61
Papageorgiou et al ²⁸	5.1	1.4 ^a	41	95	12	99	46/401	8.87	6.86–11.16	67/7450	0.62	0.52–0.71
Pooled LR	–	–	–	–	–	–	230/1580	5.90	5.30–6.52	231/17 103	0.55	0.50–0.60

CI, confidence interval; LR, likelihood ratio; NPV, negative predictive value; PPV, positive predictive value; Prev, prevalence; Sens, sensitivity; Spec, specificity; SPR, screen positive rate.

^a Blood pressure $\geq$ 140/90 mmHg and proteinuria ($\geq$ 300 mg/24 h).

^b Blood pressure $\geq$ 140/90 mmHg and proteinuria ($\geq$ 150 mg/24 h).

^c Blood pressure rise (systolic $>$ 30 mmHg and diastolic $>$ 25 mmHg) with proteinuria ($\geq$ 500 mg/24 h).

2.Tri UtA tarama IUGR

Table 3. Results of second trimester uterine artery Doppler screening studies for the prediction of fetal growth restriction below the 10th centile for gestational age, providing data on screen positive rate, prevalence of the disease, sensitivity, specificity, positive and negative predictive values, and likelihood ratios of a positive and negative test with 95% confidence intervals.

Reference	SPR (%)	Prev %	Sens %	Spec %	PPV %	NPV %	Positive test			Negative test		
							n/n	LR	95% CI	n/n	LR	95% CI
Newnham et al ¹⁴	4.8	9.8	6	95	13	90	3/24	1.32	0.42–3.87	46/477	0.98	0.87–1.03
Steel et al ¹⁵	11.6	9.6	33	91	27	93	32/118	3.52	2.46–4.91	65/896	0.74	0.63–0.84
Bewley et al ¹⁶	5.7	12.9	15	96	35	88	18/52	3.57	2.08–6.01	100/861	0.89	0.81–0.94
Bower et al ¹⁷	16.0	3.5	47	85	26	92	84/329	2.79	2.26–3.41	141/1729	0.72	0.65–0.79
Valensise et al ¹⁹	9.6	7.7	67	95	54	97	14/26	13.94	7.33–25.69	7/246	0.35	0.18–0.57
North et al ²⁰	12.3	6.6	50	90	27	96	15/56	5.21	3.18–7.98	15/401	0.55	0.37–0.74
Todros et al ²¹	6.4	4.6	12	94	8	96	5/59	1.93	0.81–4.24	37/857	0.94	0.80–1.01
Harrington et al ²²	9.1	10.9	32	94	38	92	42/110	5.06	3.58–7.04	89/1094	0.73	0.64–0.81
Frusca et al ²³	8.6	7.2	43	94	36	96	13/36	7.33	4.05–12.56	17/383	0.60	0.42–0.77
Irion et al ²⁴	12.8	11	29	89	25	91	37/148	2.68	1.93–3.67	91/1011	0.80	0.70–0.88
Kurdi et al ²⁵	22.8	16.5	45	82	32	88	70/216	2.43	1.92–3.03	86/730	0.68	0.58–0.77
Albaiges et al ²⁶	7.3	8.1	22	94	25	93	32/128	3.76	2.60–5.34	111/1629	0.83	0.75–0.89
Papageorgiou et al ²⁸	5.1	9.4	16	96	30	92	121/401	4.15	3.40–5.06	619/7450	0.87	0.84–0.90
Pooled LR	-	-	-	-	-	-	486/1703	3.67	3.34–4.03	1424/17764	0.80	0.78–0.82

CI, confidence interval; LR, likelihood ratio; NPV, negative predictive value; PPV, positive predictive value; Prev, prevalence; Sens, sensitivity; Spec, specificity; SPR, screen positive rate.

2 tri UtA fetal perinatal ölüm

Table 5. Results of second trimester uterine artery Doppler screening studies for the prediction of fetal or perinatal death, providing data on screen positive rate, definition and prevalence of the event, sensitivity, specificity, positive and negative predictive values, and likelihood ratios of a positive and negative test with 95% confidence intervals.

Reference	SPR (%)	Prev (%)	Sens (%)	Spec (%)	PPV (%)	NPV (%)	Positive Test			Negative Test		
							n/n	LR	95% CI	n/n	LR	95% CI
Steel et al ^{15a}	11.6	15 (1.5%)	33	89	4	99	5/118	2.95	1.32–5.34	10/896	0.75	0.47–0.96
Bower et al ^{17b}	5.6	27 (1.3%)	19	84	2	99	5/329	1.16	0.51–2.32	22/1729	0.97	0.75–1.09
Harrington et al ^{22a}	9.1	12 (1.0%)	8	91	1	99	1/110	0.91	0.16–3.93	11/1094	1.01	0.71–1.09
Albaiges et al ^{26b}	7.3	6 (0.3%)	83	93	4	100	5/128	11.86	6.11–15.32	1/1629	0.18	0.03–0.61
Pooled LR	–	–	–	–	–	–	16/685	2.37	1.54–3.44	44/5348	0.82	0.68–0.93

CI, confidence interval; LR, likelihood ratio; NPV, negative predictive value; PPV, positive predictive value; Prev, prevalence; Sens, sensitivity; Spec, specificity; SPR, screen positive rate.

^a Perinatal death.

^b Fetal death.

Sonuçlar

Practice points

- increased impedance to flow in the uterine arteries is associated with increased risk for subsequent development of pre-eclampsia, FGR and perinatal death
- abnormal Doppler is better at predicting severe disease. The sensitivity for all pre-eclampsia is 40% and this increases to 80% for pre-eclampsia requiring delivery before 34 weeks
- the likelihood for the development of pre-eclampsia is halved in women with normal Doppler results
- pre-eclampsia can be predicted by abnormal Doppler in the first trimester but the sensitivity is lower than in second trimester Doppler studies

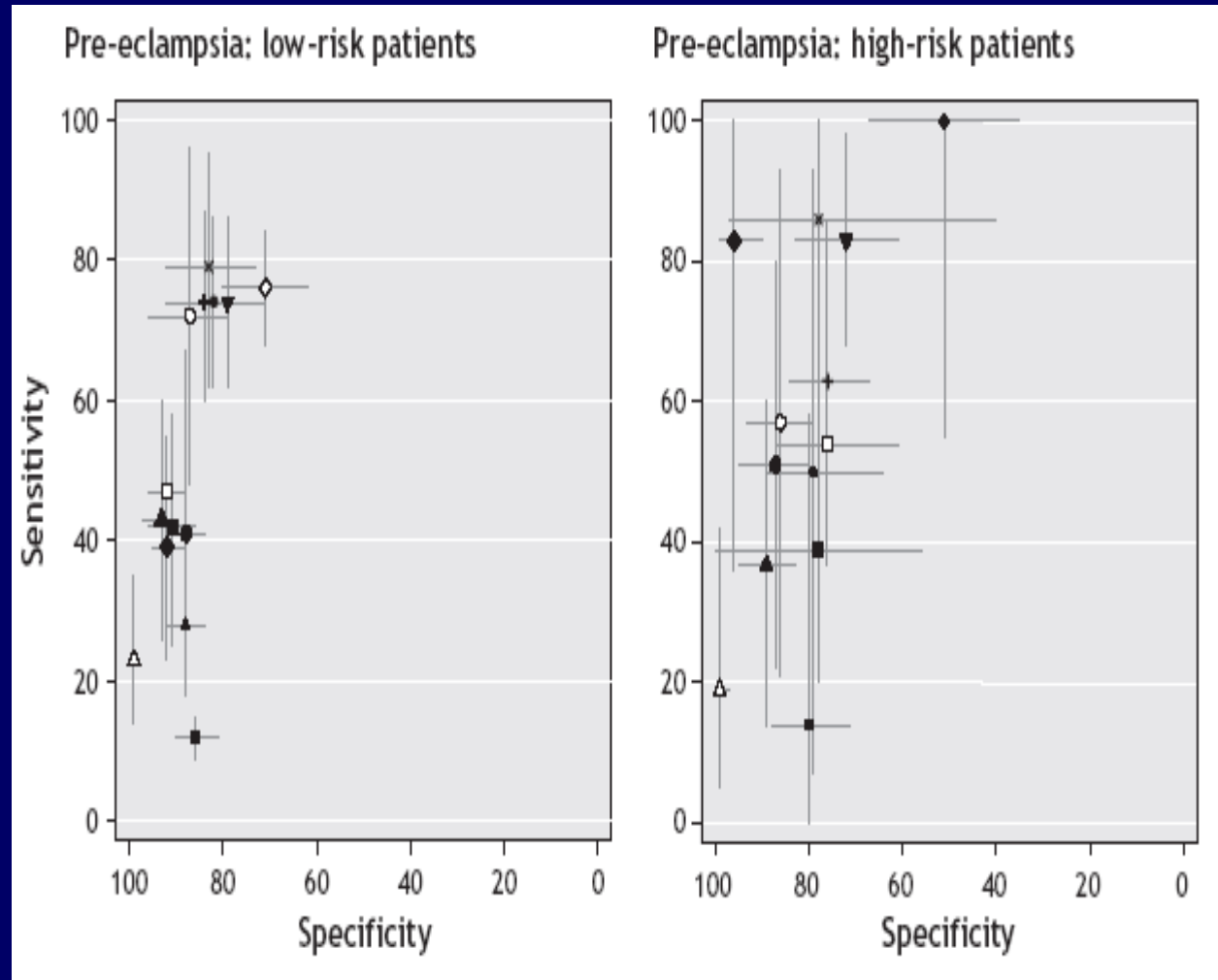
Use of uterine artery Doppler ultrasonography to predict pre-eclampsia and intrauterine growth restriction: a systematic review and bivariable meta-analysis

Jeltsje S. Cnossen MD, Rachel K. Morris MD, Gerben ter Riet MD PhD, Ben W.J. Mol MD PhD, Joris A.M. van der Post MD PhD, Arri Coomarasamy MD, Aeilko H. Zwinderman MSc PhD, Stephen C. Robson MD, Patrick J.E. Bindels MD PhD, Jos Kleijnen MD PhD, Khalid S. Khan MD

- 74 araştırma PE (total 79 547 olgu)
- 61 araştırma IUGR (total 41 131 olgu)
- UtA Dopler 2.tri sonuçları 1.tri sonuçların daha güvenilir
- Artmış PI ve çentiklenme PE için en iyi gösterge (pozitif LR yüksek riskli grupta 21.0, düşük riskli grupta 7.5)
- Artmış PI ve çentiklenme IUGR için en iyi gösterge (pozitif LR düşük riskli grupta 9.1 ve ciddi IUGR 14.6)

Jeltaje S, CMAJ, 2008

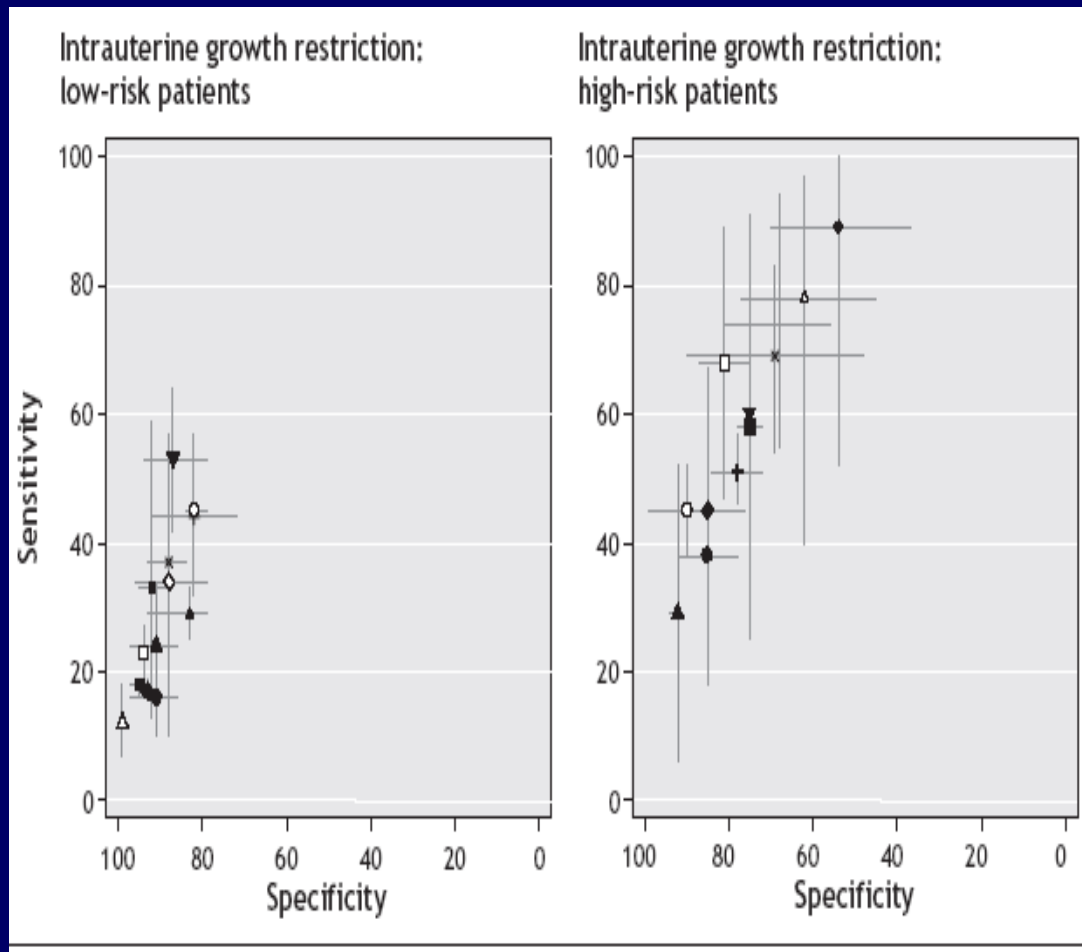
Artmış PI ve çentiklenme PE için en iyi gösterge



Doppler test indices

- ▼ Resistance index > 0.58
- Resistance index > 0.70
- Pulsatility index
- ▲ Bilateral notching
- ◆ Unilateral notching
- + Any notching
- × Resistance index or notching
- Resistance index and notching
- Pulsatility index or notching
- △ Pulsatility index and notching
- ◇ S/D ratio
- A/C ratio
- Notch index
- ▲ S/D or notching
- ◆ D/S or notching
- △ D/S ratio

Artmış PI ve çentiklenme IUGR için en iyi gösterge



Doppler test indices

- ▼ Resistance index > 0.58
- Resistance index > 0.70
- Pulsatility index
- ▲ Bilateral notching
- ◆ Unilateral notching
- + Any notching
- × Resistance index or notching
- Resistance index and notching
- Pulsatility index or notching
- △ Pulsatility index and notching
- ◇ S/D ratio
- A/C ratio
- Notch index
- ▲ S/D or notching
- ◆ D/S or notching
- △ D/S ratio

Jeltaje S, CMAJ, 2008

Predictive accuracy of second-trimester uterine artery Doppler indices for stillbirth: a systematic review and meta-analysis

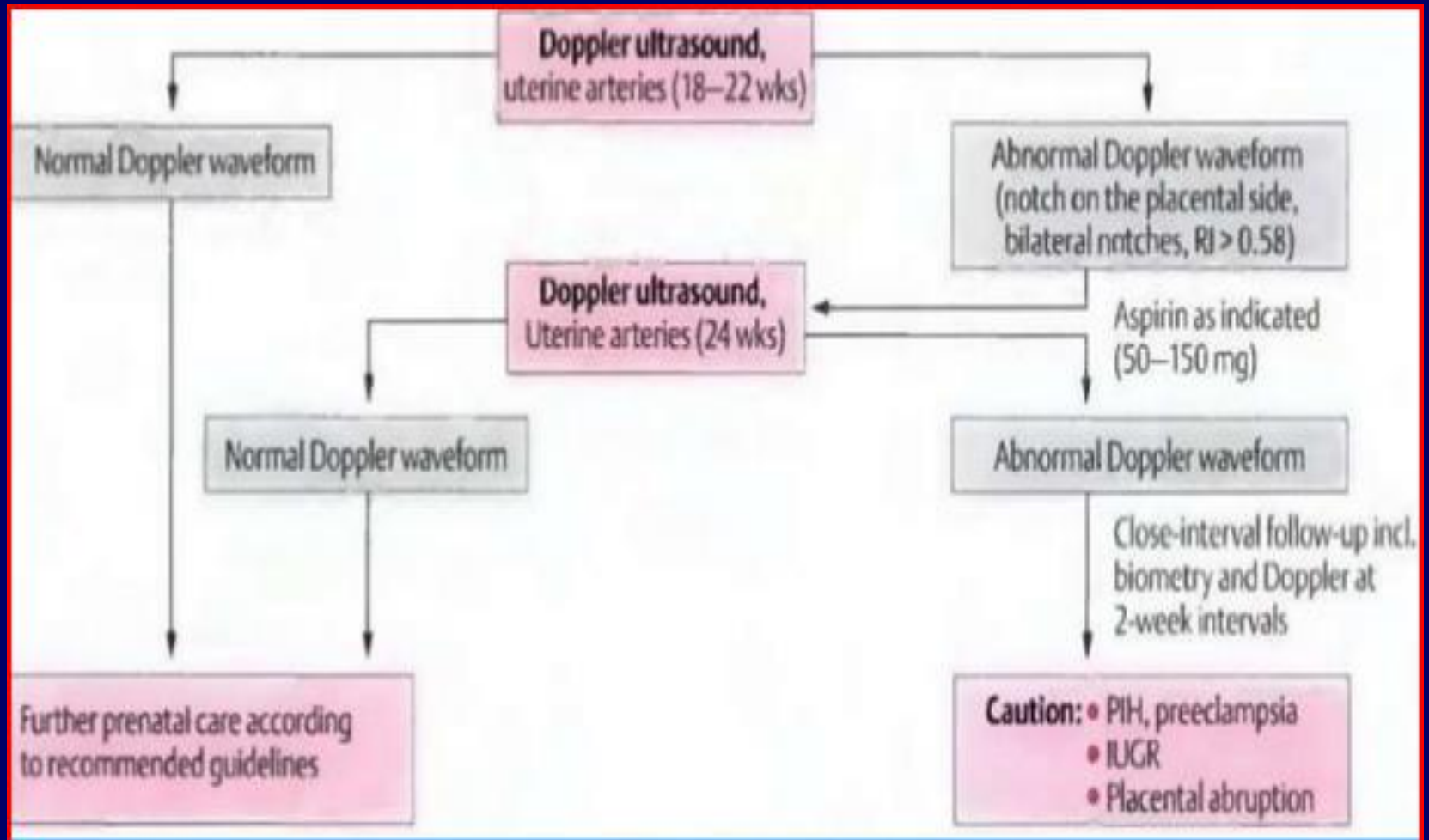
R. E. ALLEN*, M. MORLANDO†, B. THILAGANATHAN†, J. ZAMORA‡§, K. S. KHAN¶ **, S. THANGARATINAM¶ ** and A. BHIDE†

Table 1 Characteristics of studies included in systematic review evaluating association of uterine artery Doppler (UtAD) indices and stillbirth

Reference	Risk status	Definition of abn. UtAD	Stillbirths/women (n)			LR+ (95% CI)	Stillbirth rate (n/1000)
			Total	Normal UtAD	Abn. UtAD		
Madazli (2014) ²⁴	High	SD ratio > 2.6 and bilateral notching	3/65	0/52	3/13	5.25 (2.70–10.2)	46.2
Jamal (2013) ²²	Low	Mean PI > 95 th percentile and/or bilateral notching	5/435	2/389	3/46	6.00 (2.78–12.96)	11.5
Poon (2013) ²¹	Low	PI MoM > 90 th centile	306/65 819	184/59 142	122/6677	3.99 (3.47–4.58)	4.6
Singh (2012) ⁵	Any	Mean PI > 90 th centile	135/14 997	71/13 309	64/1688	4.34 (3.61–5.21)	9.0
Filippi (2011) ¹⁸	High	Mean PI > 1.45, bilateral or unilateral notching	2/159	0/127	2/32	4.32 (2.37–7.85)	12.6
Proctor (2009) ¹³	High	Mean PI > 1.45	15/89	9/58	6/31	1.18 (0.59–2.38)	168.5
Schwarze (2005) ²⁰	Any	Unilateral or bilateral notching	2/346	1/211	1/135	2.00 (1.19–3.37)	5.8
Axt-Flidner (2005) ¹⁶	High	Both RI > 0.58	4/52	1/38	3/14	2.98 (1.39–6.41)	76.9
Albaiges (2000) ¹⁹	Any	Bilateral notching or mean PI > 1.45	6/1757	2/1668	4/89	11.15 (7.31–17.00)	3.4
Coleman (2000) ¹⁴	High	Mean RI > 0.7	2/116	0/38	2/78	1.25 (0.74–2.11)	17.2
Bewley (1991) ¹⁷	Any	Mean RI > 95 th centile	12/925	9/871	3/54	4.47 (1.62–12.36)	12.9
Steel (1990) ²³	Any	Mean RI > 0.58	11/1014	8/896	3/118	2.38 (0.89–6.33)	10.8
Fleischer (1986) ¹⁵	High	SD ratio > 2.6	5/71	0/43	5/28	2.61 (1.74–3.92)	70.4

Only first author of each study is given. Abn., abnormal; LR+, positive likelihood ratio; MoM, multiples of the median; PI, pulsatility index; RI, resistance index; SD, systolic to diastolic.

Yüksek Riskli Gebeliklerde Ut A Dopler Bulgularına Göre Yönetim Akış Şeması



Uterine artery Doppler flow studies in obstetric practice

Anthony C. Sciscione, DO; Edward J. Hayes, MD

TABLE 2

Randomized control trials in women with abnormal uterine artery Doppler flow studies

Investigator	Intervention	Gestational age of Doppler	Preeclampsia placebo vs intervention	Rate of IUGR placebo vs intervention
Goffinet et al ¹⁸	Low dose aspirin	20-24 wk	1.5% vs 2.3% RR, 1.55 (95% CI, 0.7-3.3)	8.3% vs 7.0%; RR, 1.18 (95% CI, 0.93-1.51)
Yu et al ²⁴	Low dose aspirin	22-24 wk	18% vs 19%; <i>P</i> = .6	22% vs 24%; <i>P</i> = .36
Chappell et al ²⁸	Vitamin C 1000 mg and Vitamin E 400 IU	18-22 wk	25% vs 24%; RR, 0.95 (95% CI, 0.40-2.29)	N/A

CI, confidence interval; IUGR, < 10th percentile for gestational age; N/A, not applicable; RR, relative risk.

Sciscione. Uterine artery Doppler flow studies in obstetric practice. *Am J Obstet Gynecol* 2009.

3.Trimester uterin arter

- 3 tri Anormal UtA PI , Kötü obstetrik sonuçlarla ilişkili
- Geç başlayan IUGR
- Ölü doğum
- Perinatal ölüm
- Düşük doğum ağırlığı

Evaluation of third trimester uterine artery flow velocity indices in relationship to perinatal complications

G. GHOSH, A. BREBOROWICZ, M. BRAZERT, M. MACZKIEWICZ, M. KOBELSKI, M. DUBIEL, & S. GUDMUNDSSON

1-3.tri UtA PI, RI kötü perinatal sonuçlar için en iyi belirleyici
2-çentik derinliği arttıkça perinatal sonuçlar daha kötü

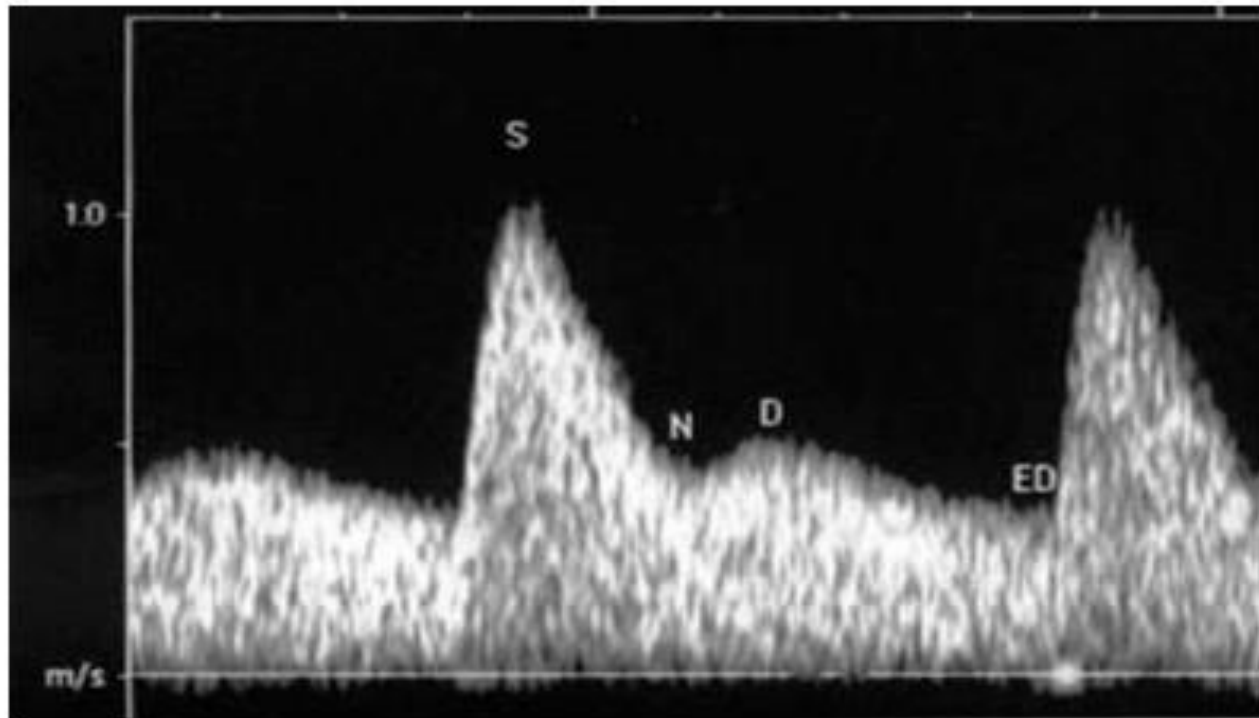


Figure 1. Spectrum of uterine artery blood velocity. S, systolic peak velocity; N: notch velocity; D, diastolic peak velocity; ED, end-diastolic velocity.



Value of third-trimester cerebroplacental ratio and uterine artery Doppler indices as predictors of stillbirth and perinatal loss

A. KHALIL, J. MORALES-ROSELLÓ, R. TOWNSEND, M. MORLANDO, A. PAPAGEORGHIU, A. BHIDE and B. THILAGANATHAN

Fetal Medicine Unit, St George's Hospital, St George's University of London, London, UK

Table 3 Results of third-trimester ultrasound assessment and pregnancy outcome in 2812 singleton pregnancies, according to uterine artery mean pulsatility index (UtA-PI) multiples of the median (MoM) in the third trimester

Characteristic	UtA-PI < 1.5 MoM (n = 2464)	UtA-PI ≥ 1.5 MoM (n = 348)	P
Ultrasound assessment			
GA at assessment (weeks)	36.3 (35.7–38.6)	34.5 (30.1–36.4)	< 0.001
EFW centile	46.40 (21.50–68.30)	10.60 (1.00–41.60)	< 0.001
UA-PI	0.88 (0.78–0.99)	1.07 (0.88–1.42)	< 0.001
UA-PI MoM	0.97 (0.87–1.09)	1.08 (0.92–1.36)	< 0.001
MCA-PI	1.63 (1.40–1.90)	1.57 (1.35–1.86)	0.087
MCA-PI MoM	1.23 (1.09–1.40)	1.08 (0.85–1.25)	< 0.001
CPR	1.86 (1.58–2.17)	1.54 (1.06–1.96)	< 0.001
CPR-MoM	1.00 (0.85–1.15)	0.80 (0.55–1.02)	< 0.001
CPR < 0.6765 MoM	143 (5.8)	128 (36.8)	< 0.001
Pregnancy outcome			
GA at delivery (weeks)	40.1 (39.0–41.1)	37.7 (33.2–39.6)	< 0.001
Birth weight (g)	3270 (2900–3630)	2380 (1320–3120)	< 0.001
Birth-weight centile	36.77 (15.02–63.67)	5.88 (1.09–28.52)	< 0.001
Small-for-gestational age	424 (17.2)	214 (61.5)	< 0.001
Stillbirth	5 (0.2)	5 (1.4)	< 0.001
Perinatal death	10 (0.4)	8 (2.3)	< 0.001

Data are given as median (interquartile range) or *n* (%). CPR, cerebroplacental ratio; EFW, estimated fetal weight; GA, gestational age; MCA, fetal middle cerebral artery; PI, pulsatility index; UA, umbilical artery.

Anormal 3.Tri UtAD SGA,ölü doğum ve perinatal ölüm ile ilişkili

Clinical utility of third-trimester uterine artery Doppler in the prediction of brain hemodynamic deterioration and adverse perinatal outcome in small-for-gestational-age fetuses

R. CRUZ-MARTINEZ*†‡, S. SAVCHEV*, M. CRUZ-LEMINI*, A. MENDEZ†, E. GRATACOS* and F. FIGUERAS*

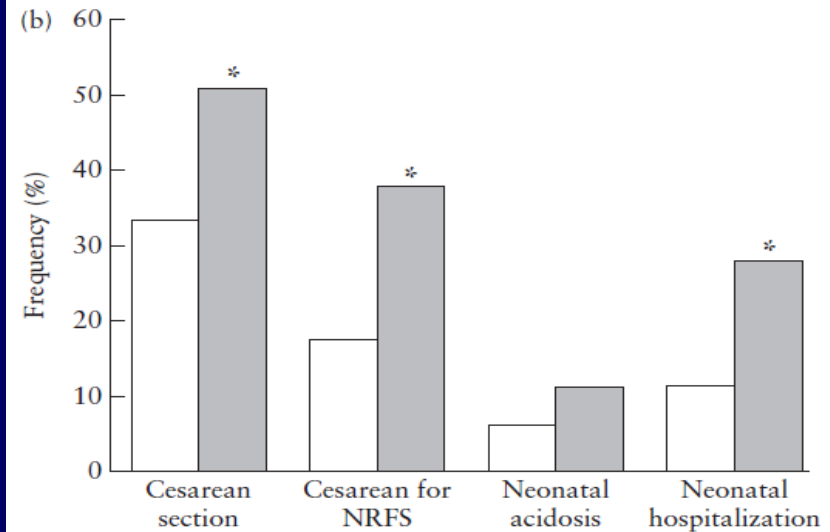
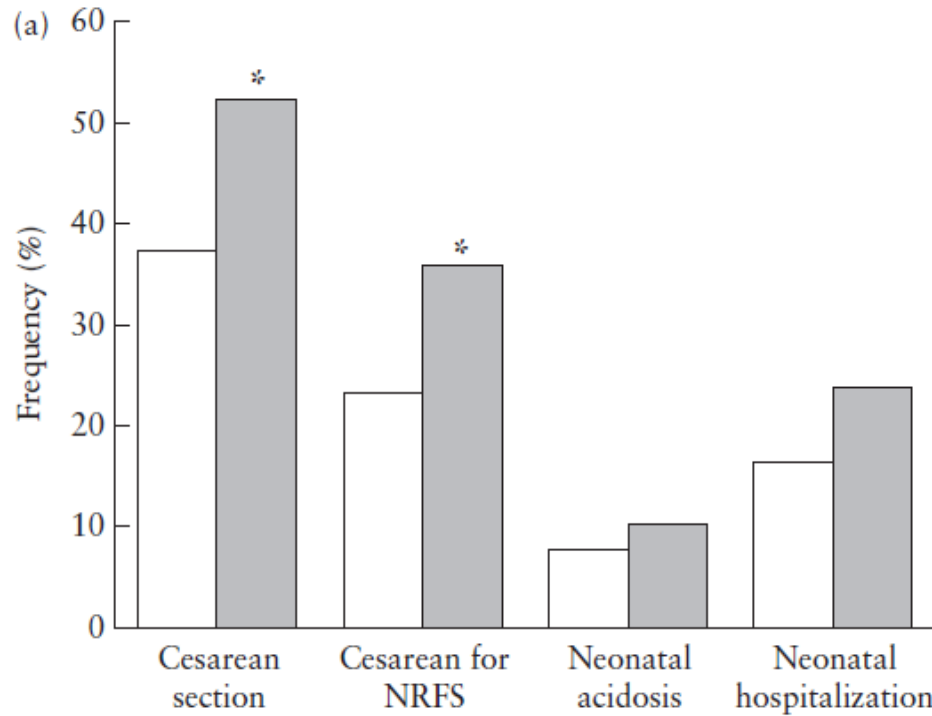
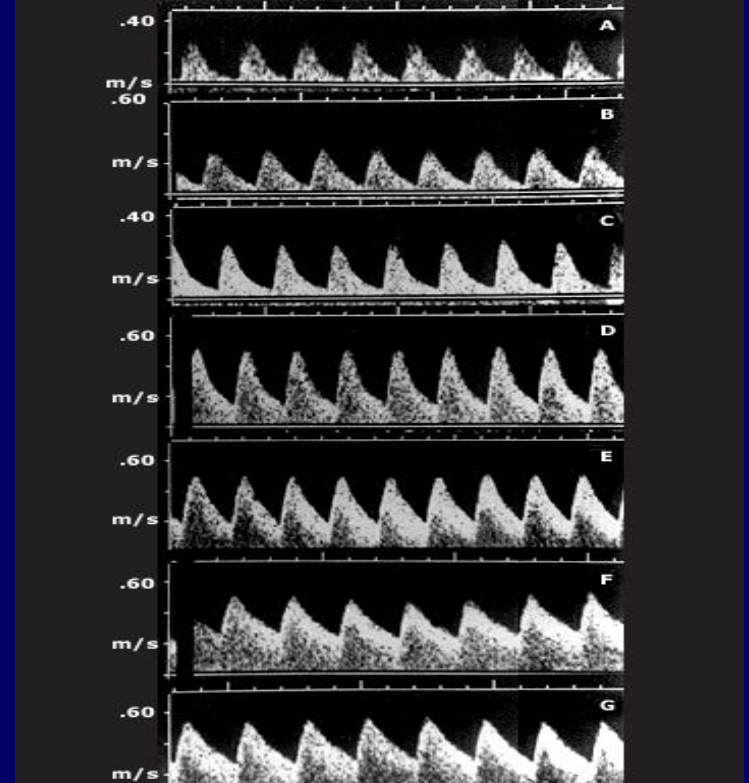


Figure 3 Frequency of intrapartum Cesarean section, emergency Cesarean section for non-reassuring fetal status (NRFS), neonatal acidosis and neonatal hospitalization in 327 small-for-gestational-age (SGA) fetuses with: (a) normal (□) and abnormal (■) uterine artery Doppler (* $P < 0.05$) and (b) no brain sparing (□) and brain sparing (■) (* $P < 0.01$).

Anormal 3.tr Ut AD artmış sezaryen, neoatal asidoz ve yenidoğan bakım ihtiyacında artışla ilişkili

2.Trimester umbilikal arter

- Fetal internal iliak dalı, umbilikal kordan plasentaya uzanır
- Normal gebelikte erken hf da plasentasyon tamamlanmadığı için direnç yüksektir
- UA direnci gebelik hf ilerledikçe azalır
- Vasküler impedans azalmasına bağlı olarak zamanla diastol sonu akım artar
- İyi bir plasental invazyonda 14-18. hf UA doplerinde direnç azalır ve sürekli diyastolik akım gerçekleştirir

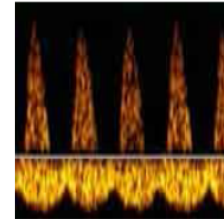


Umbilikal arter dopler

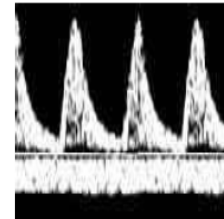
- UA Dopler incelenmesi bir plasental fonksiyon testi olarak tanısal ve prognostik önem taşır
- **Plasental vasküler yatağın direncini gösterir, plasental kan akımına ilişkin bilgi verir**



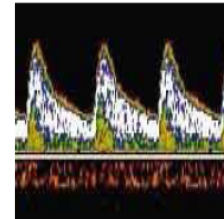
Normal Pregnancy - Development of the umbilical artery



Normal impedance to flow in the umbilical arteries and normal pattern of pulsatility at the umbilical vein in 1^o trimester



Normal impedance to flow in the umbilical arteries and umbilical vein in early 2^o trimester



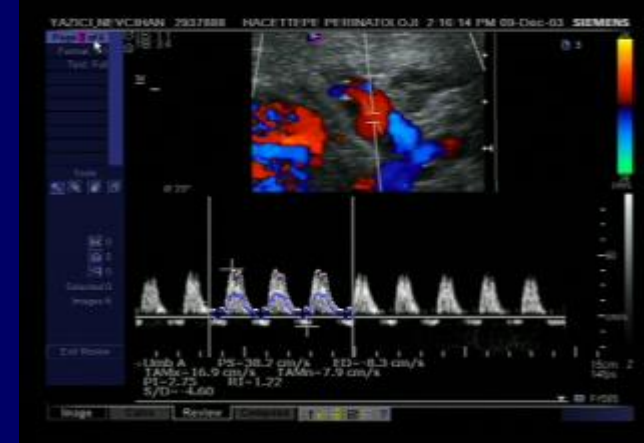
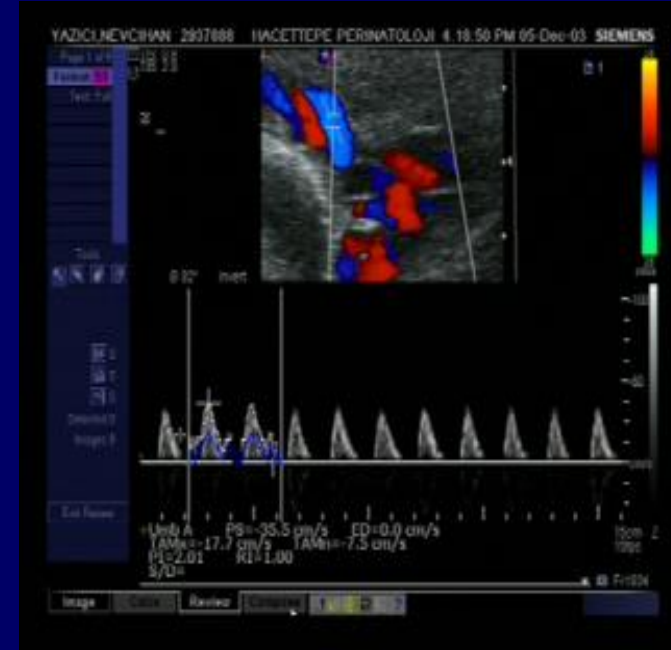
Normal impedance to flow in the umbilical arteries and umbilical vein in late 2^o and 3^o trimester

Umblikal arter Dopler

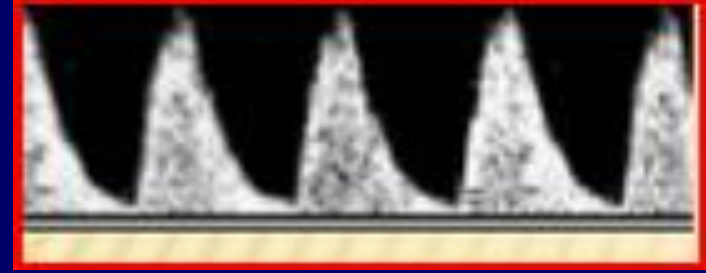
- UA direnci anormal vasküler tonus, Plasental villus damarlarında tıkanma daralma/azalmaya bağlı artar
- **Anormal UA Dopleri irreversibl plasental hasarı gösterir**
- UA anormal hale geldiğinde fetal durumun belirlenmesi için fetal sistemik damarlara ait dopler bilgisi gerektirir

Umbilikal arter Doppler

- UA akımında üç ana patoloji tanımlanmıştır
- 1-yüksek direnç (PI / RI 95.per üzerinde)
- 2-End-diastolik akım yok
- 3-End-diastolik akım tersine dönmüş
- UA DA azalan olgularda % 30 plasental hasar
- UA A/REDA olgularında % 60-70 plasental hasar

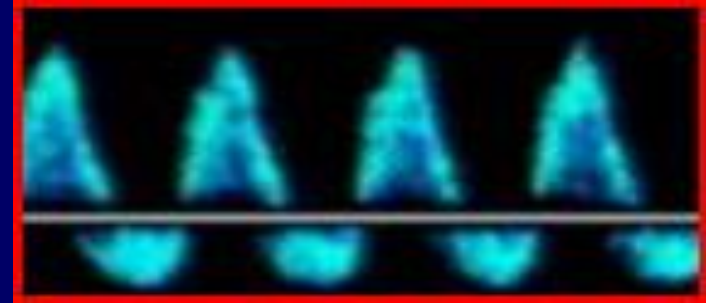
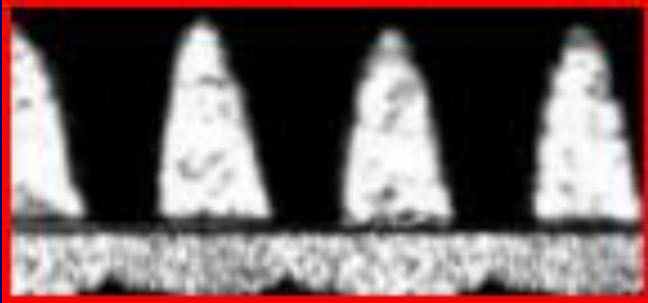


Anormal Umbilikal Arter Dalgaları



Yüksek pulsatile indeksi

Çok yüksek pulsatile indeksi



End diastolik akım kaybı

Reverse diastolik akım

Umbilikal arter dopler

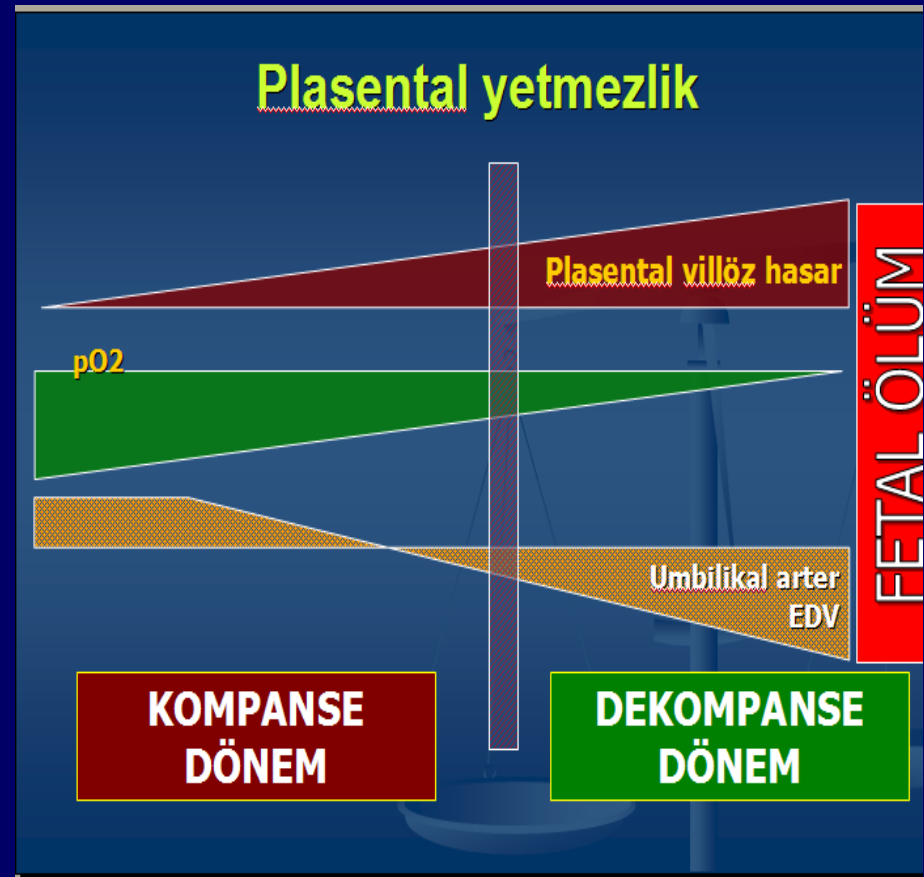
- 1-IUGR tanı

AC, EFW < %10, 5, 2.5

SGA? IUGR?

- 2-IUGR izlem

- 3-Perinatal sonuçları tahmin



UA Doppler

- UA doppler sonuçları kötüleştikçe perinatal mortalite artar
- UmA AEDV/REDV olgularında
- ❖ Perinatal morbitide
 - Fetal hipoksi
 - Asidoz
 - Serebral hemoraji
 - Anemi
 - Hipoglisemi
- ❖ Perinatal mortalite
- ❖ Çocukluk dönemi nörolojik sorunlar





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Cochrane Database of Systematic Reviews

Fetal and umbilical Doppler ultrasound in normal pregnancy (Review)

Alfirevic Z, Stampalija T, Medley N

AUTHORS' CONCLUSIONS: Existing evidence does not provide conclusive evidence that the use of routine umbilical artery Doppler ultrasound, or combination of umbilical and uterine artery Doppler ultrasound in low-risk or unselected populations benefits either mother or baby. Future studies should be designed to address small changes in perinatal outcome, and should focus on potentially preventable deaths.

- **DÜŞÜK RİSKLİ GEBELERDE MATERNAL VE FETAL RİSKLERİN TESPİTİ İÇİN RUTİN UA DOPLER VEYA UA+UtA DOPLERİN BİRLİKTE KULLANIMININ FAYDASI YOKTUR**



Fetal and umbilical Doppler ultrasound in high-risk pregnancies (Review)

Alfirevic Z, Stampalija T, Gyte GML

MAIN RESULTS: Eighteen completed studies involving just over 10,000 women were included. The trials were generally of unclear quality with some evidence of possible publication bias. The use of Doppler ultrasound in high-risk pregnancy was associated with a reduction in perinatal deaths (risk ratio (RR) 0.71, 95% confidence interval (CI) 0.52 to 0.98, 16 studies, 10,225 babies, 1.2% versus 1.7 %, number needed to treat (NNT) = 203; 95% CI 103 to 4352). There were also fewer inductions of labour (average RR 0.89, 95% CI 0.80 to 0.99, 10 studies, 5633 women, random-effects) and fewer caesarean sections (RR 0.90, 95% CI 0.84 to 0.97, 14 studies, 7918 women). No difference was found in operative vaginal births (RR 0.95, 95% CI 0.80 to 1.14, four studies, 2813 women), nor in Apgar scores less than seven at five minutes (RR 0.92, 95% CI 0.69 to 1.24, seven studies, 6321 babies).

AUTHORS' CONCLUSIONS: Current evidence suggests that the use of Doppler ultrasound in high-risk pregnancies reduced the risk of perinatal deaths and resulted in less obstetric interventions. The quality of the current evidence was not of high quality, therefore, the results should be interpreted with some caution. Studies of high quality with follow-up studies on neurological development are needed.



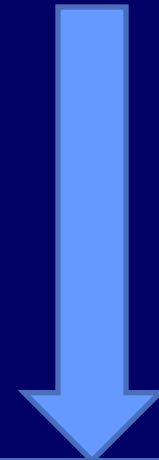
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Cochrane Database of Systematic Reviews

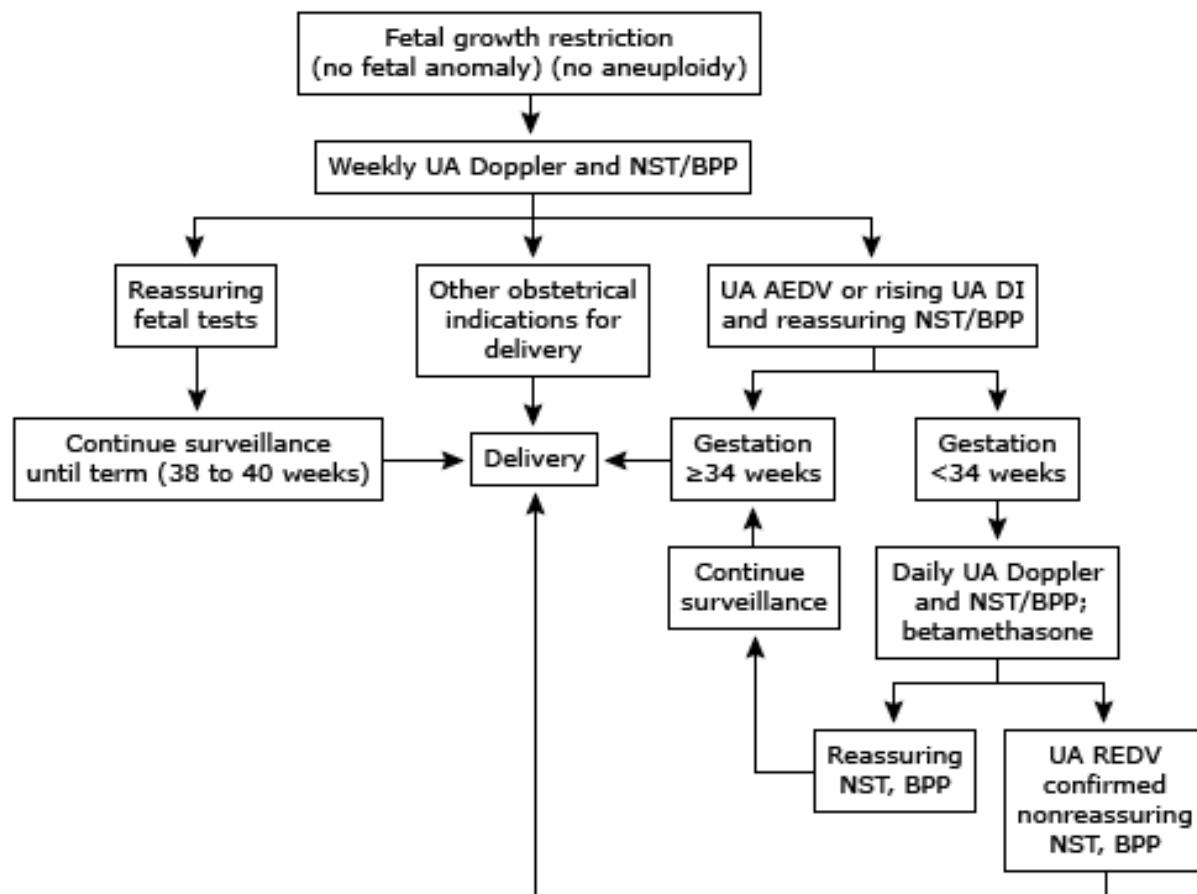
Fetal and umbilical Doppler ultrasound in high-risk pregnancies (Review)

Alfirevic Z, Stampalija T, Gyte GML

- ✓ Perinatal mortalite
- ✓ Doğum indüksiyon ihtiyacı
- ✓ Sezaryan oranı
- ✓ Hospitalizasyon

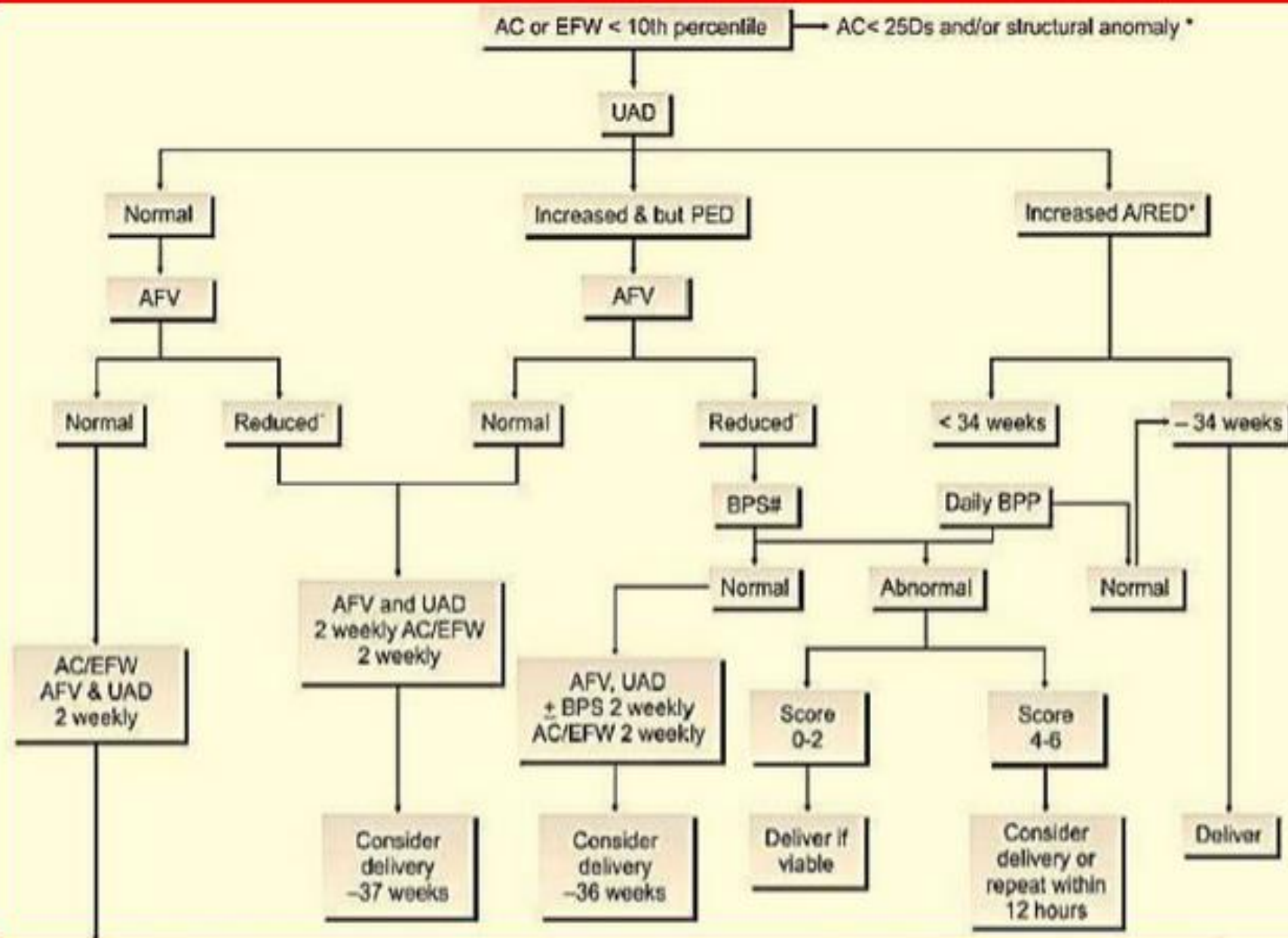


Clinical guideline for the use of umbilical artery Doppler ultrasound in managing pregnancies complicated with fetal growth restriction



UA: umbilical artery; NST: nonstress test; BPP: biophysical profile; AEDV: absent end-diastolic flow velocity in the umbilical artery; DI: Doppler index; REDV: reverse end-diastolic flow velocity in the umbilical artery.

Courtesy of Dev Maulik, MD, PhD.



Orta Serebral Arter(MCA)

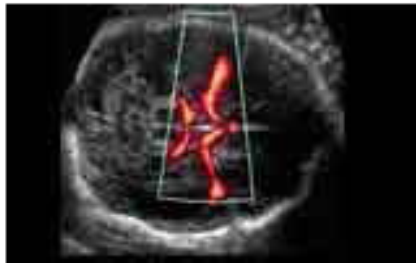
- MCA serebral arterler içinde en çok araştırılan
- **Fetal hipoksi (BSE)**
- Normal ve IUGR fetus da serebral kan akımı hakkında bilgi verir
- IUGR fetus için UA dopleri ile birlikte kullanılır (CPR=serebroplasental oran)
- **Fetal anemi** (peak sistolik akım hızı)



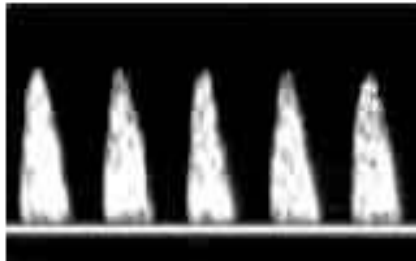
Figure 9: Transverse view of the fetal head with color Doppler showing the circle of Willis (left). Flow velocity waveforms from the middle cerebral artery at 32 weeks of gestation (right).

Normal MCA

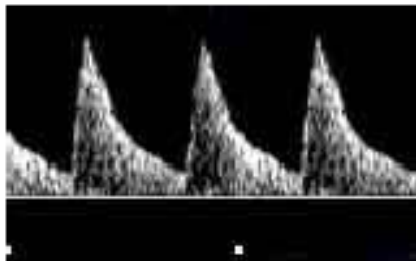
Normal Pregnancy - Development of the Middle Cerebral Artery



Color Doppler energy with visualization of the circle of Willis and the middle cerebral artery



Normal flow of the middle cerebral artery in 1^o trimester

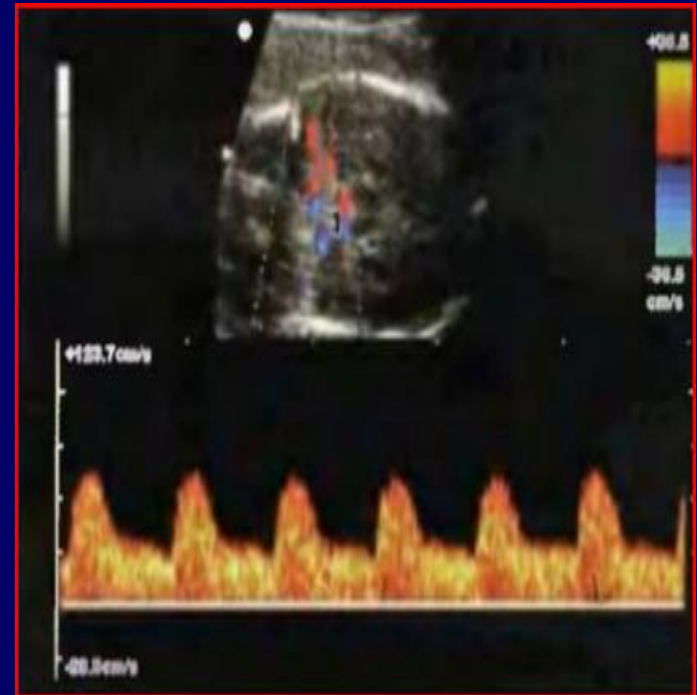


Normal flow of the middle cerebral artery in 2^o and 3^o trimester

Gebelik boyunca MCA S/D oranı UA S/D oranından büyük olmalıdır

Anormal MCA

- Kardiovasküler distress
- Hipoksi
- Anemi



Fetal hipoksi

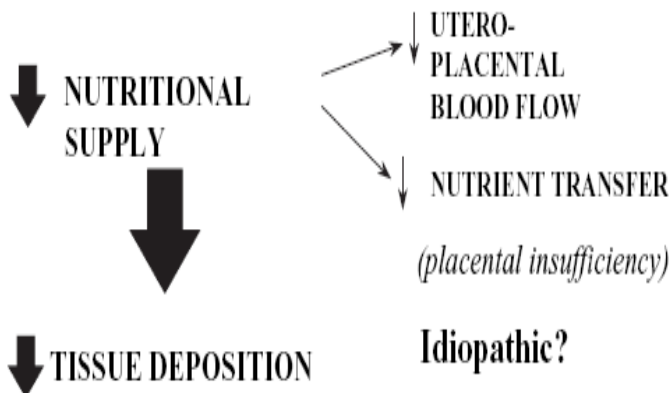
IUGR Fetal adaptasyon

754

Fetal growth restriction (IUGR)

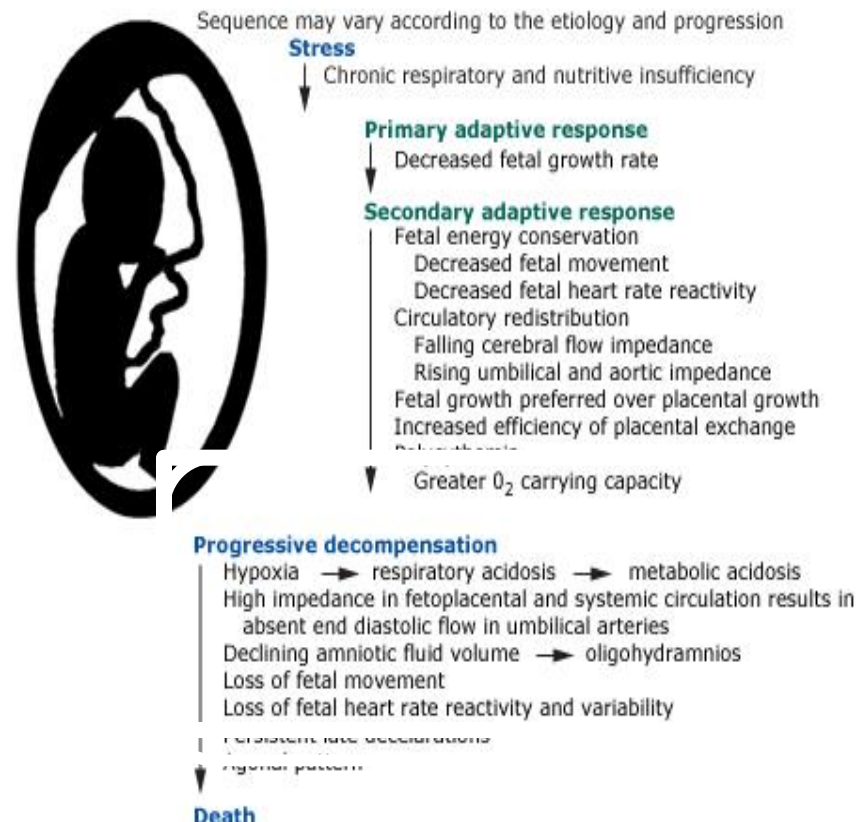
By definition: a fetus that fails to achieve its growth potential

MECHANISMS:



CAUSE OR ADAPTATION?

Figure 1. Mechanisms for reduced tissue deposition in fetal growth restriction.

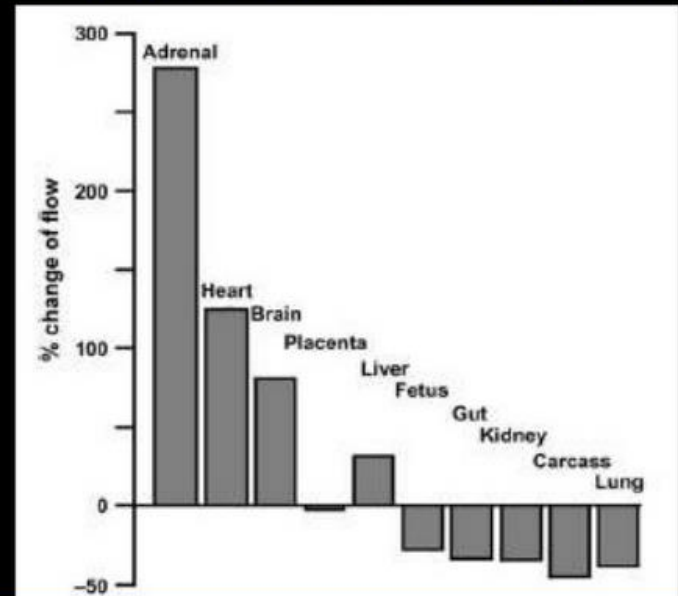


IUGR'de hipoksi ve asidoza yanıt

Fetal Kan Akımının Santralizasyonu

- Hipoksiye bağlı hasarı azaltmak için vital organların kan akımı yeniden düzenlenir (kompansatuar mekanizması)
- Fetal hipokseminde beyin, miyokard ve adrenal glandların kan akımı artarken, böbrek, GIS ve alt ekstremitelerin, plasenta perfüzyonu azalır

Redistribution During Fetal Hypoxemia [Clip slide](#)



IUGR MCA Dopler

Beyin koruyucu etki(BKE)

- IUGR / hipoksiye yanıt olarak akımın 70%'e varan kısmı beyin ve koronerlere gittiği serebrovasküler dilatasyon geliştiği ve vasküler direnç düştüğü gözlemlendi
- Bu etkiye BKE denir, MCA'de PI düşer (< 5 . per)
- MCA diastolik akım hızı artar-S/D,PI,RI oranı azalır
- UA S/D oranı plasental direnç artışına bağlı yükselir
- UA S/D oranı $>$ MCA S/D olur =Beyin Koruyucu Etki

Decrease in the carotid-, or middle cerebral artery Doppler index

Brain sparing: Cerebral vasodilatation in response to perceived hypoxemia.

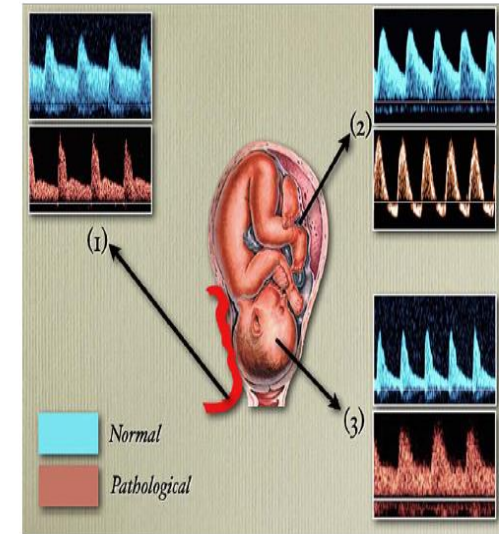
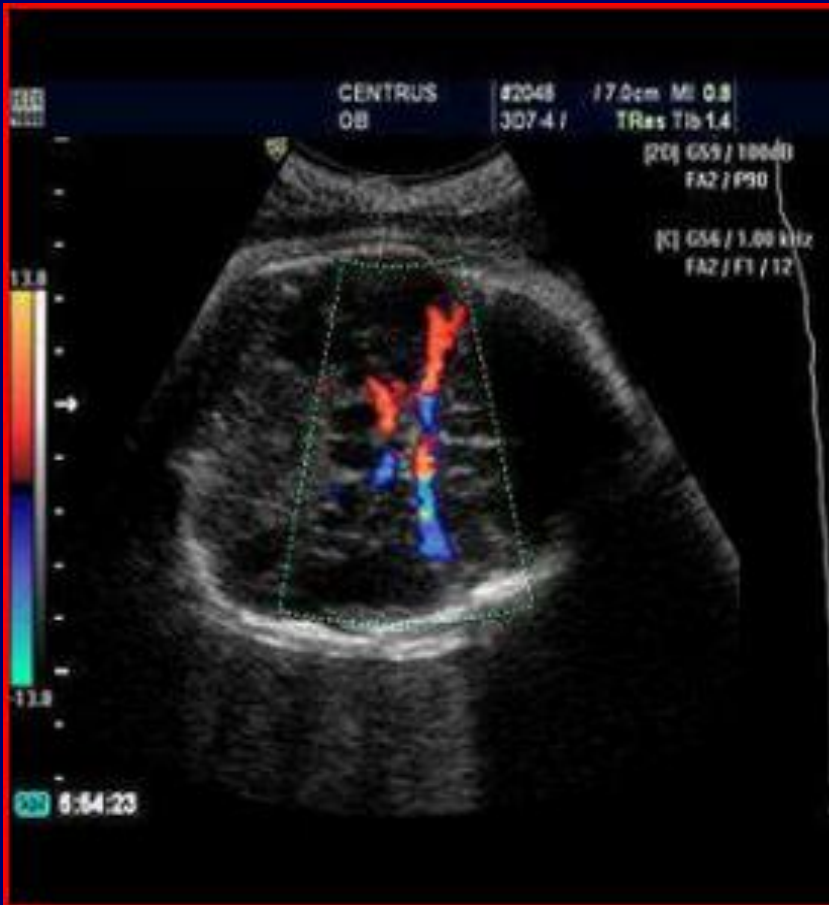


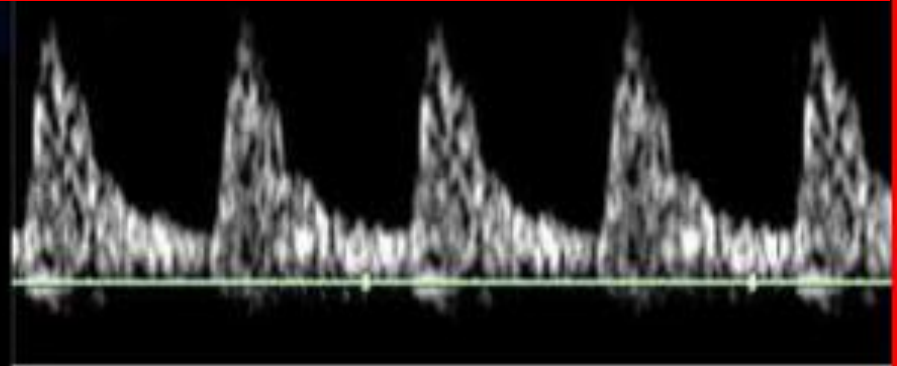
Figure 3 Normal and pathological uterine artery (1), umbilical arterial (2) and middle cerebral artery (3) Doppler waveforms. A compromised fetus will show a uterine artery waveform with 'notching', a reverse flow in the umbilical artery waveform and an increased diastolic component in the middle cerebral artery.

Ultrasound Obstet Gynecol, 1994
Br J Obstet Gynaecol, 1990

IUGR Hipoksi MCA



Normal fetus düşük diastolik akım

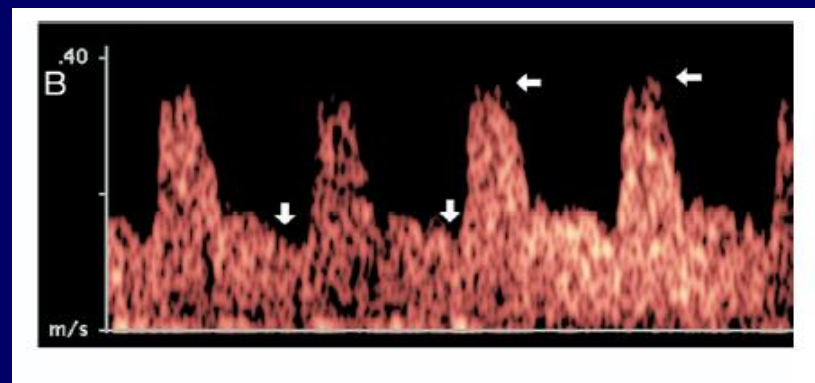
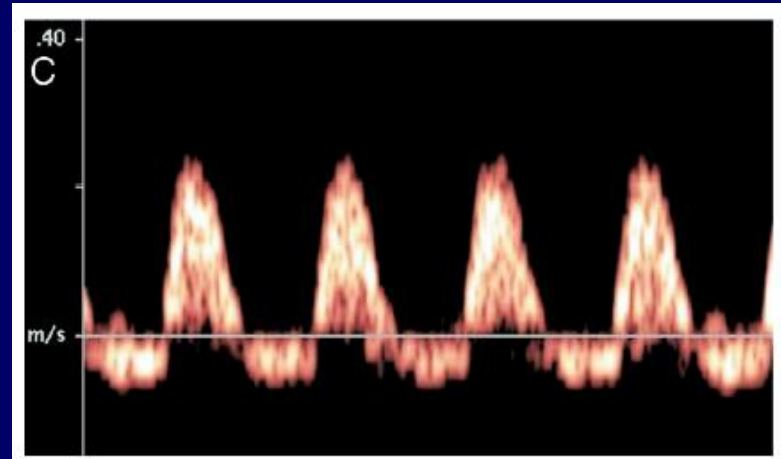


IUGR fetus yüksek diastolik akım



UA ve MCA serebroplasental oran

- IUGR'nin klinik yönetiminde MCA PI 10. persentil altında olması ve UA AEDA/REDA kombinasyonu
- perinatal mortalite ve neonatal şiddetli beyin hasarı riskini anlamlı derecede artırır



Serebroplasental Oran(CPR)

MCA PI /UA PI oranı

- Normal fetusda gebelik ilerledikçe plasental direnç azalır
- MCA direnci ise hemen hemen sabittir
- $CPR = MCA PI / UA PI > 1$
- CPR'nın UA veya MCA göre IUGR de olumsuz sonuçları ön görmek açısından daha duyarlı olduğu gösterildi
- Düşük CPR UA dopler iyi olsa bile kötü obsterik sonuçla ile ilişkilidir
- Düşük CPR kısa dönem kord kanı asidoz, acil operatif doğum ve NICU ihtiyacı, ölü doğum ve neonatal morbidite gibi sonuçlar ile de ilişkili bulunmuştur

Serebroplasental Oran(CPR)

- Hipoksi ile serebral reditribisyon sonucu MCA RI azalır, UA resistans indeksi artar ve CPR < 1 olur

TABLE 1

Studies reporting the value for an abnormal cerebroplacental ratio

Study	Year	Study type	Doppler indices	Computation of ratio	Abnormal criteria
Arbeille et al ¹	1988	Cross-sectional	S-D/S	MCA/UA	Ratio <1
Arias ⁶	1994	Cross-sectional	RI	MCA/UA	Ratio <1
Gramellini et al ⁵	1992	Cross-sectional	PI	MCA/UA	Ratio <1.08
Bahado-Singh et al ⁸	1999	Cross-sectional	PI	MCA/UA MoM	Ratio <0.05 MoM
Baschat and Gembruch ⁹	2003	Cross-sectional	PI	MCA/UA	Less than fifth centile
Odibo et al ¹⁰	2005	Cross-sectional	PI	MCA/UA	Ratio <1.08
Ebbing et al ¹¹	2007	Longitudinal	PI	MCA/UA	<2.5th centile
Morales et al ¹²	2014	Cross-sectional	PI	MCA/UA	Less than fifth centile or MoM <0.6765

MCA, middle cerebral artery; MoM, multiple of the median; PI, pulsatility index; RI, resistance index; S/D, systolic/diastolic ratio; UA, umbilical artery.

DeVore. Cerebroplacental ratio in fetal well-being in SGA and AGA fetuses. *Am J Obstet Gynecol* 2015.

Serebroplasental Oran

TABLE 3

CPR in comparison with UA Doppler in the prediction of adverse perinatal outcomes

Predictor	Adverse perinatal outcome		
	Sensitivity	Specificity	OR (95% CI)
UA (PI >95th centile)	85% (35/41)	54% (454/840)	6.9 2.9–16.5
UA (PI >95th centile, AEDF, REDF)	90% (37/41)	54% (452/831)	10.8 3.8–30.5
CPR (PI) <1.0	66% (27/41)	85% (721/840)	11.7 6.0–22.9

Perinatal outcome was defined as a composite outcome of intraventricular hemorrhage, periventricular leukomalacia, hypoxic ischemic encephalopathy, necrotizing enterocolitis, bronchopulmonary, sepsis, and death.

AEDF, absent end diastolic flow; CI, confidence interval; CPR, cerebroplacental ratio; OR, odds ratio; PI, pulsatility index; REDF, reversed end diastolic flow; UA, umbilical artery.

Flood. Brain sparing in IUGR. Am J Obstet Gynecol 2014.

Serebroplasental oran kötü obstetrik sonuçları ön görmede UA doplere göre daha üstündür

UA dopler bozuk olanlarda perinatal sonuçları öngörebilmek için CPR bakılmalı

The role of brain sparing in the prediction of adverse outcomes in intrauterine growth restriction: results of the multicenter PORTO Study

Karen Flood, MD; Julia Unterscheider, MD; Sean Daly, MD; Michael P. Geary, MD; Mairead M. Kennelly, MD; Fionnuala M. McAuliffe, MD; Keelin O'Donoghue, PhD; Alyson Hunter, MD; John J. Morrison, MD; Gerard Burke, FRCOG; Patrick Dicker, PhD; Elizabeth C. Tully, PhD; Fergal D. Malone, MD

TABLE 2
Various CPR calculations and the prediction of adverse perinatal outcomes

Predictor	Adverse perinatal outcome		
	Sensitivity	Specificity	OR (95% CI)
CPR (PI) < 1.0	66% (27/41)	85% (721/840)	11.7 6.0–22.9
CPR (RI) < 1.0	66% (27/41)	84% (698/831)	11.8 5.8–24.1
CPR (PI) < 1.08	73% (30/41)	80% (675/840)	11.2 5.5–22.7
CPR (PI) less than fifth centile (Baschat and Gembruch ¹²)	80% (33/41)	60% (505/840)	6.2 2.8–13.6
CPR (PI) less than fifth centile (Ebbing et al ¹³)	85% (35/41)	41% (345/840)	4.1 1.7–9.8
CPR (PI) < 1 before 34 wks	67% (26/39)	84% (451/540)	11.8 5.6–23.4
CPR (PI) < 1 after 34 wks	14% (1/7)	89% (634/713)	10.7 2.4–48.7

Perinatal outcome was defined as a composite outcome of intraventricular hemorrhage, periventricular leukomalacia, hypoxic ischemic encephalopathy, necrotizing enterocolitis, bronchopulmonary, sepsis, and death.

CI, confidence interval; CPR, cerebroplacental ratio; OR, odds ratio; PI, pulsatility index; RI, resistance index.

Flood. Brain sparing in IUGR. Am J Obstet Gynecol 2014.

Düşük CPR kötü obstetrik sonuçlar 11 kat artmış

OBSTETRICS

The importance of the cerebroplacental ratio in the evaluation of fetal well-being in SGA and AGA fetuses

Greggory R. DeVore, MD

- 34 hf önce SGA(erken başlayan IUGR) ya eşlik eden anormal CPR oranı olanlarda
 - Erken doğum
 - 10 presentil altı doğum ağırlıklı fetus
 - Fetal distress nedeni ile sezaryan oranı
 - Düşük Apgar skorlu bebek oranı
 - Neonatal asidoz oranı
 - Yenidoğan yoğun bakım ihtiyacı
 - Perinatal ölüm oranı **ARTAR**

OBSTETRICS

The importance of the cerebroplacental ratio in the evaluation of fetal well-being in SGA and AGA fetuses

Greggory R. DeVore, MD

TABLE 3

Studies evaluating the CPR as a diagnostic tool in fetuses with predominantly early-onset fetal growth restriction (SGA)

Variable	Gramellini et al (1992) ⁵	Arias et al (1994) ⁶	Bahado-Singh et al (1999) ⁸	Makhseed et al (2000) ²⁸	Ebrashy et al (2005) ²⁹	Flood et al (2014) ³⁰
Type of study	Retrospective	Prospective	Prospective	Prospective	Prospective	Retrospective
Purpose of the study	Compare CPR, UA, and MCA to predict adverse outcome in SGA	Evaluate CPR to predict adverse outcome in SGA	Evaluate CPR to predict adverse outcome in SGA	Compare CPR and UA to predict adverse outcome in SGA	Evaluate CPR to predict adverse outcome in women with preeclampsia	Evaluate CPR to predict adverse outcome in SGA
Gestational weeks ultrasound studies were obtained	30–41	24–38	<34	29–42	>28	29–36
Classification and number of fetuses studied (n)	Control (n = 45), SGA (n = 45)	Control (n = 25), risk SGA (n = 61)	Control (n = 82), risk SGA (n = 125)	No control, SGA (n = 70)	Control (n = 30), SGA (n = 38)	No control, SGA (n = 881)
Interval from ultrasound to delivery	Not stated	<2	<3	3.8–8.6	Not stated	32–42
Type of CPR measurement (abnormal value)	PI (<1.08)	RI (<1.0)	MoM (<0.5)	RI (<1.05)	RI (<1.0)	RI (<1); PI (<1, <1.08); PI (less than fifth centile ⁹); PI (less than fifth centile ¹¹)
Did CPR perform better than other tests?	Yes (UA and MCA)	Yes (UA and MCA)	Yes (UA)	Yes (BP, AEDV of UA)	Yes (BP, UA, MCA)	Equal (UA)

Erken IUGR tanısında CPR tek başına diğer testlerden daha etkin

The usefulness of fetal Doppler evaluation in early versus late onset intrauterine growth restriction. Review of the literature.

Daniel Mureşan*, Ioana Cristina Rotar*, Florin Stamatian

1st Obstetrics and Gynecology Department, "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca, Romania

*the authors shared the first authorship

- Geç başlayan IUGR 34 hf sonrasında başlayan ve fetal hipoksiye götüren plasental yetmezlik
- G-IUGR fetal mortalite morbitide, suboptimal nörogelişim ve post natal sorunlarla ilişkili
- UA normal sınırlardadır
- CPR ve MCA PI ana tanı kriterleri
- Geç IUGR tanısında CPR MCA den daha duyarlıdır

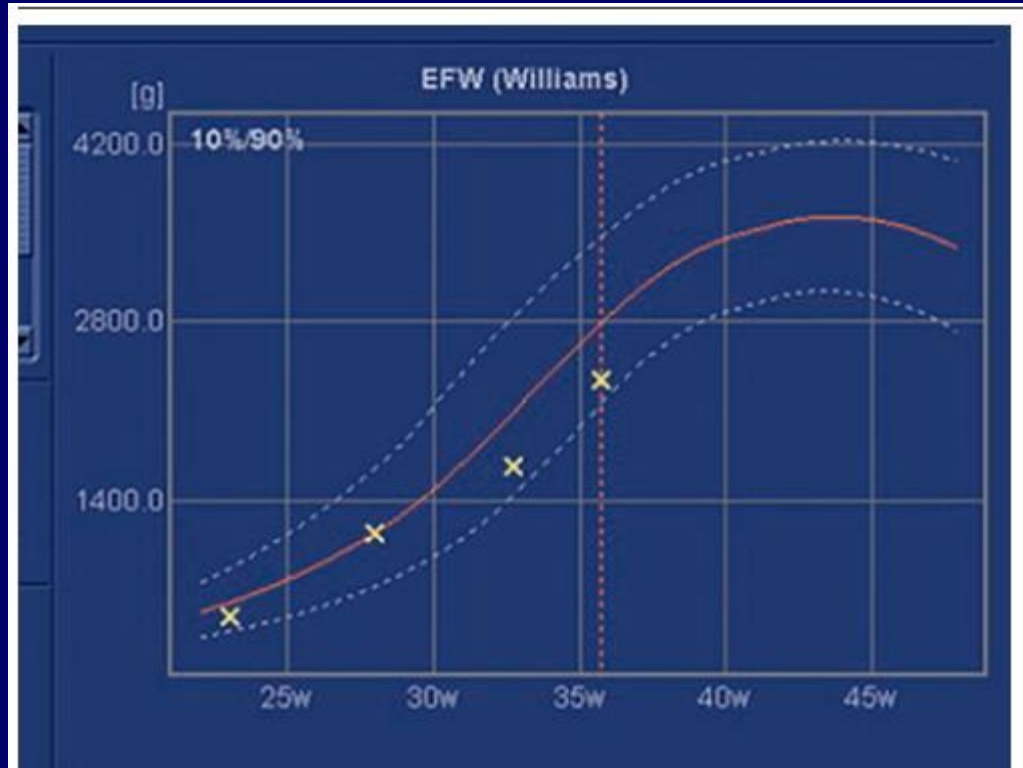


Fig 4. Ultrasound diagnosis of late IUGR. Slowing down of the fetal weight evolution.

OBSTETRICS

The importance of the cerebroplacental ratio in the evaluation of fetal well-being in SGA and AGA fetuses

Greggory R. DeVore, MD

- SGA / AGA anormal CPR oranlarında
 - Fetal distress
 - Acil sezaryan
 - Düşük kord pH
 - Yenidoğan yoğun bakımda takip oranları belirgin artar

OBSTETRICS

The importance of the cerebroplacental ratio in the evaluation of fetal well-being in SGA and AGA fetuses

Greggory R. DeVore, MD

- **CPR SGA'lı fetuslarda kötü obstetrik sonuçların ön görülmesinde UA, biyofizik profil ve MCA dan daha önce bulgu verir**

OBSTETRICS

Is fetal cerebroplacental ratio an independent predictor of intrapartum fetal compromise and neonatal unit admission?

Asma A. Khalil, MD, MRCOG; José Morales-Rosello, MD; Maddalena Morlando, MD; Hasina Hannan, MD; Amar Bhide, MD, MRCOG; Aris Papageorgiou, MD, MRCOG; Basky Thilaganathan, PhD, MRCOG

Düşük CPR fetal büyüklüken bağımsız olarak müdahaleli doğum ve NICU oranı artmıştır



Value of third-trimester cerebroplacental ratio and uterine artery Doppler indices as predictors of stillbirth and perinatal loss

A. KHALIL, J. MORALES-ROSELLÓ, R. TOWNSEND, M. MORLANDO, A. PAPAGEORGHIU, A. BHIDE and B. THILAGANATHAN

Fetal Medicine Unit, St George's Hospital, St George's University of London, London, UK

Table 1 Results of third-trimester ultrasound assessment and pregnancy outcome in 2804 singleton pregnancies, according to whether the pregnancy resulted in live birth or stillbirth

Characteristic	Live birth ^a (n = 2794)	Stillbirth (n = 10)	P
Ultrasound assessment			
UtA-PI	0.67 (0.56–0.84)	0.98 (0.78–1.87)	0.002
UtA-PI MoM	0.97 (0.82–1.21)	1.36 (1.02–2.23)	0.005
UtA-PI ≥ 1.5 MoM	340 (12.2)	5 (50.0)	< 0.001
UA-PI	0.89 (0.78–1.00)	1.82 (0.01–3.40)	< 0.001
UA-PI MoM	0.98 (0.87–1.10)	1.49 (1.10–2.91)	< 0.001
MCA-PI	1.63 (1.40–1.89)	1.59 (1.30–2.05)	0.992
MCA-PI MoM	1.22 (1.07–1.39)	0.88 (0.66–1.44)	0.028
CPR	1.84 (1.54–2.14)	0.82 (0.48–2.04)	0.006
CPR-MoM	0.98 (0.83–1.40)	0.41 (0.23–1.04)	0.003
CPR < 0.6765 MoM	265 (9.5)	6 (60.0)	< 0.001
EFW centile	43.25 (17.30–67.00)	1.78 (0.27–5.87)	< 0.001
Pregnancy outcome			
Birth-weight centile	32.63 (12.18–61.01)	0.28 (0.01–2.33)	< 0.001
Small-for-gestational age	629 (22.5)	9 (90.0)	< 0.001

Data are given as median (interquartile range) or *n* (%). ^aExcluding eight neonatal deaths. CPR, cerebroplacental ratio; EFW, estimated fetal weight; MCA, fetal middle cerebral artery; MoM, multiples of the median; PI, pulsatility index; UA, umbilical artery; UtA, uterine artery.

OBSTETRICS

Prediction of intrapartum fetal compromise using the cerebroumbilical ratio: a prospective observational study

Tomas Prior, BSc; Edward Mullins, BSc; Phillip Bennett, PhD; Sailesh Kumar, PhD

TABLE 3

Maternal demographics, intrapartum, and neonatal outcome according to C/U ratio percentile group

Demographic	Overall	C/U ratio <10th percentile	C/U ratio 10th-90th percentile	C/U ratio >90th percentile	ANOVA/ χ^2 P value
% primiparous	65.5% (262/400)	84% (37/44)	64.9% (205/316)	50% (20/40)	.15
Mean maternal age	32 (18-47)	32	32	34	.16
Mean BMI	25 (17-42)	25	25	24	.19
Ethnicity, %					
White	65.5 (262/400)	61.4 (27/44)	66.1 (209/316)	65.0 (26/40)	.94
Asian	16.0 (64/400)	15.9 (7/44)	16.5 (52/316)	12.5 (5/40)	.84
Afro-Caribbean	13.0 (52/400)	15.9 (7/44)	12.7 (40/316)	12.5 (5/40)	.85
Other	5.5 (22/400)	6.8 (3/44)	4.7 (15/316)	10.0 (4/40)	.38
Mean gestation at time of IUS	40 wks + 2 d	40 wks + 5 d	40 wks + 3 d	39 wks + 5 d	.004
Evidence of fetal compromise					
Rate of meconium stained liquor	10.8% (43/400)	22.7% (10/44)	10.1% (32/316)	2.5% (1/40)	.02
Rate of CTG abnormalities	35.3% (141/400)	86% (38/44)	31.0% (98/316)	12.5% (5/40)	< .001
Delivery category					
Cesarean section fetal compromise	11.5% (46/400)	36.4% (16/44)	9.5% (30/316)	0% (0/40)	< .001
Fetal compromise diagnosed at any time during labor	29.3% (117/400)	63.6% (28/44)	26.6% (84/316)	12.5% (5/40)	< .001
SVD	43.8% (175/400)	22.7% (10/44)	44.9% (142/316)	57.5% (23/40)	.04
Vaginal delivery of any kind	72.8% (291/400)	52.3% (23/44)	74.1% (234/316)	85% (34/40)	.18
Cesarean section other indication	15.8% (63/400)	11.4% (5/44)	16.5% (52/316)	15% (6/40)	.71
Length of labor before fetal compromise diagnosed	510 min (0-1817)	576 min	493 min	422 min	.40
Neonatal outcome					
Birthweight	3518 g (1780-4940g)	3448 g	3514 g	3622 g	.23
Birthweight percentile	53 (1-99)	47	53	63	.04
Apgar <7 at 5 min	4/400 (1%)	1/44 (2.3%)	3/316 (0.9%)	0/40 (0%)	.57
Cord arterial pH <7.20	114/400 (28.5%)	13/44 (29.5%)	90/316 (28.5%)	11/40 (27.5%)	.98
Neonatal unit admission	1.5% (6/400)	4.5% (2/44)	1% (3/316)	2.5% (1/40)	.19
Neonatal encephalopathy	0% (0/400)	0% (0/44)	0% (0/316)	0% (0/40)	n/a
Composite neonatal outcome score	0.71	0.75	0.71	0.70	.96

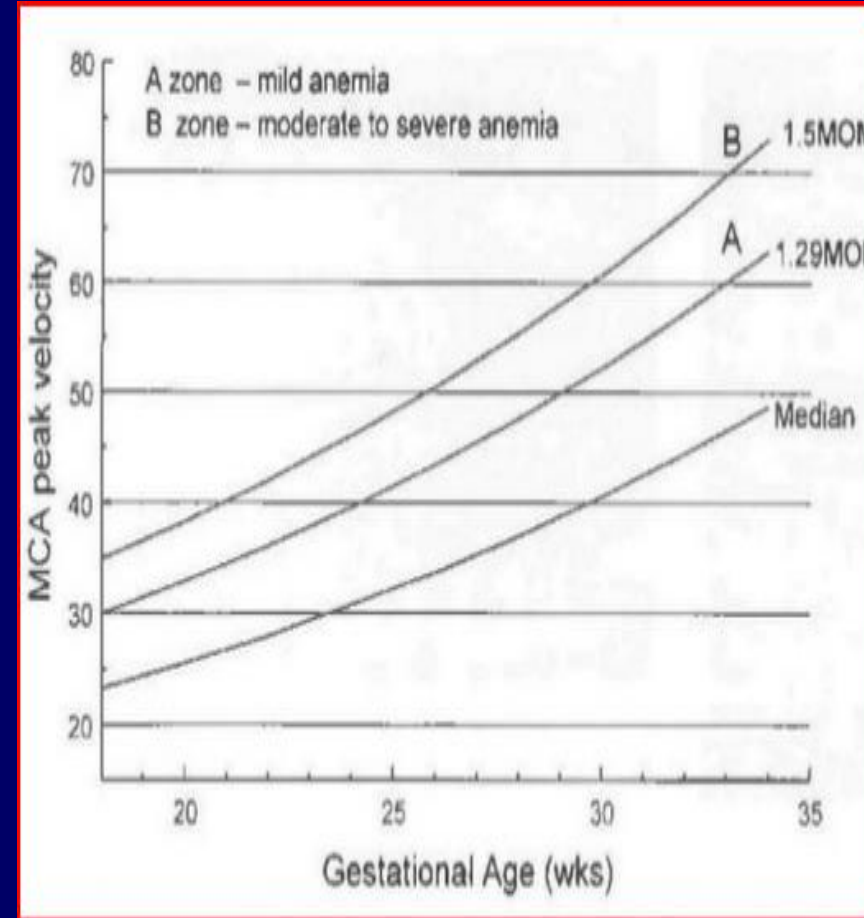
ANOVA, analysis of variance; BMI, body mass index; CTG, cardiotocography; C/U, cerebroumbilical; n/a, not applicable; SVD, spontaneous vaginal delivery; IUS, ultrasound.

Prior. Prediction of intrapartum compromise. Am J Obstet Gynecol 2013.

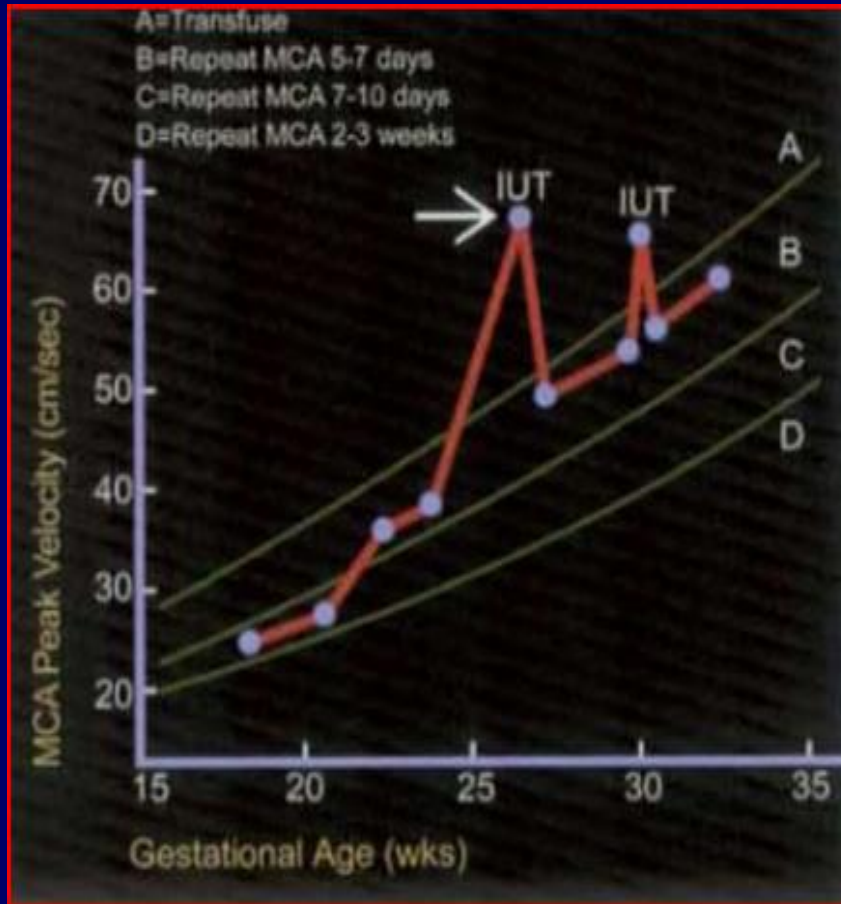
AGA fetuslarda intrapartum düşük CPR artmış sezaryen oranları ile ilişkili

MCA-PSV Fetal Anemi

- MCA PSV fetal anemi tansında OD 450 kadar iyi bir yöntem olduğu gösterildi
- MCA PSV alloimmünizasyon, fetomaternal hemoraji ve parvovirüs enfeksiyonlarında fetal anemiye bağlı değişen kan viskozitesi ile gerçek velositeleri tanımlar
- MCA PSV ile transfüzyon zamanlaması doğru olarak tanımlanmıştır
- MCA PSV 1.50 MoM üzerinde ise fetal anemi riski vardır
- MCA PSV gereksiz invazif testleri azaltır ve bir sonraki intrauterin transfüzyon gereksiniminin zamanını belirlemeye yardımcı olur



MCA Doplere Göre Fetal Anemi Tedavisi



- Zone A Tedavi
- Zone B.5-7 g sonra ölç
- Zone C 7-10 g sonra ölç
- ZoneD 2-3 hft sonra ölç

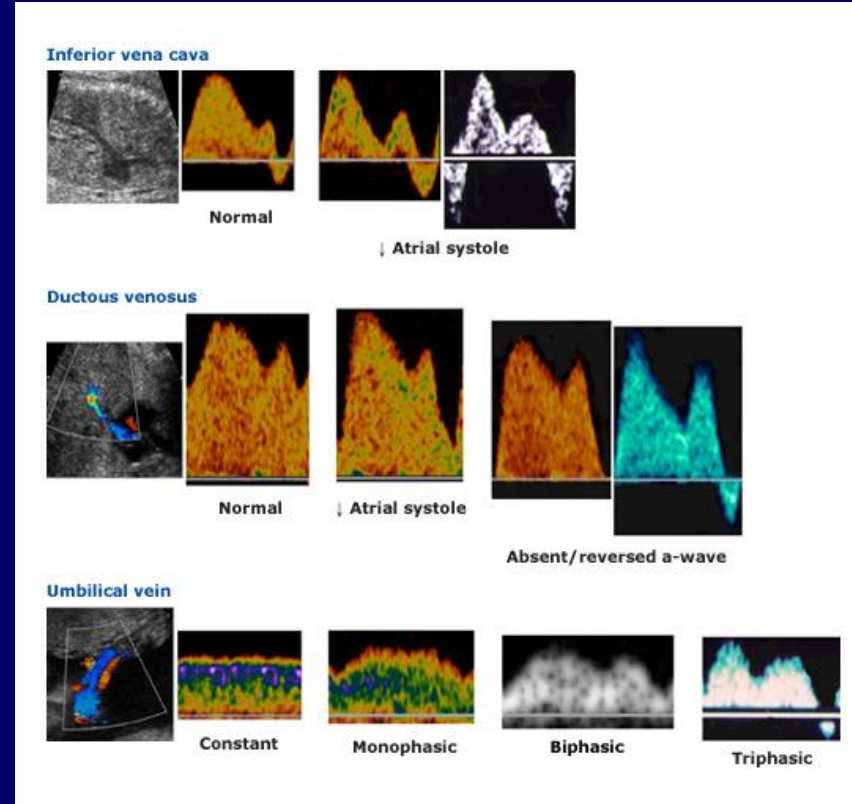
Venöz Doppler

- Fetal dolaşım bozukluğunun ileri evrelerinde fetal hipoksemiye bağlı dekompanzasyon başlar
- Bu evre UA da ters akıma ve MCA de 'brain sparing' etkinin kaybolmasına yol açan yeni başlayan kalp yetmezliği ile karakterizedir
- **Fetal KVS fonksiyonlar venöz akım ile incelenir**
- Fetal kardiyak fonksiyonun bozulması perinatal mortalitede belirgin artış ve hayatta kalanlarda kalıcı beyin hasarı ile ilişkilidir

Rizzo G, Early Hum Dev 1994
Kiserud T, Ultrasound Obstet Gynecol 1994
Hecher K, Circulation 1995

Venöz Doppler

- Venler kardiyak siklus boyunca atrium içindeki basınç değişikliklerine bağlı karışık bir dalga sekli gösterirler
- Venöz akım DV ve IVC da tipik trifazik akım şeklindedir
- UV akım devamlıdır ve monofazik akım normal gebeliklerin % 20 izole olarak görülebilirken, bifazik ve trifazik umbikal venöz akım her zaman patolojiktir



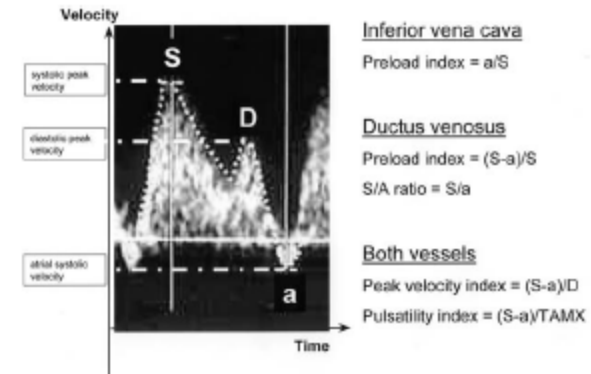
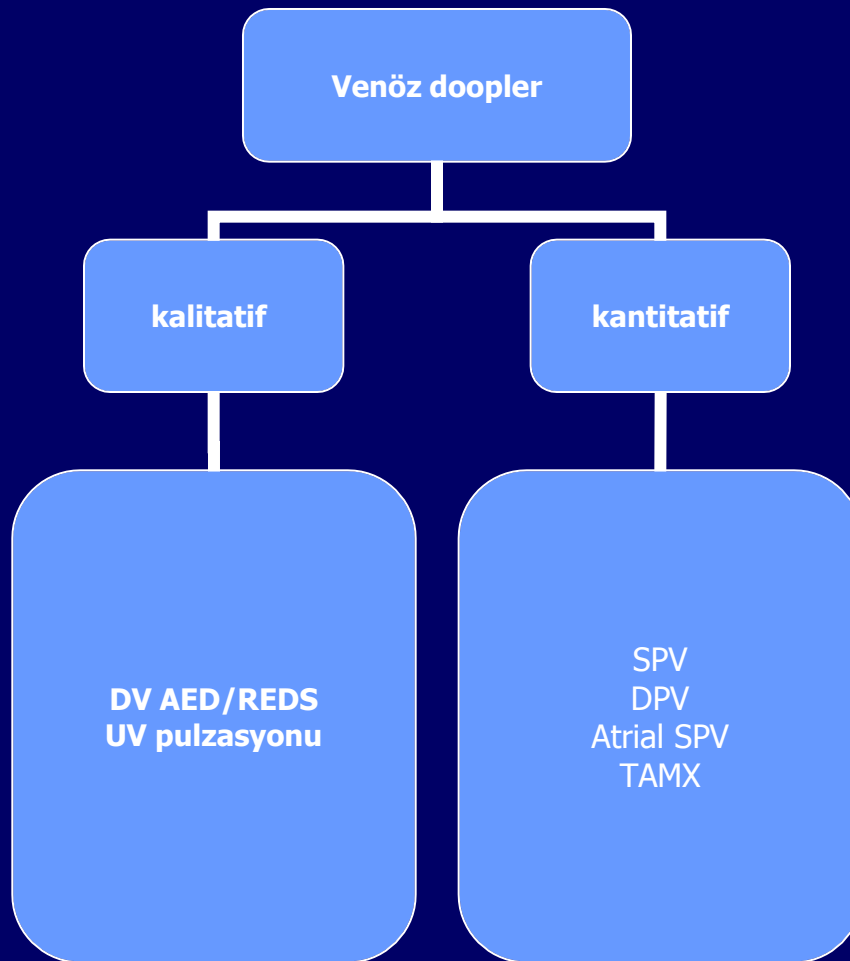


Figure A precordial venous flow profile is shown on the left to illustrate the components of the flow velocity waveform (S = systolic peak blood flow velocity, D = diastolic peak blood flow velocity, a = atrial systolic peak blood flow velocity, $TAMX$ = time averaged maximum velocity calculated from the area under the curve). The calculations for the various Doppler indices reported in the literature are displayed on the right.

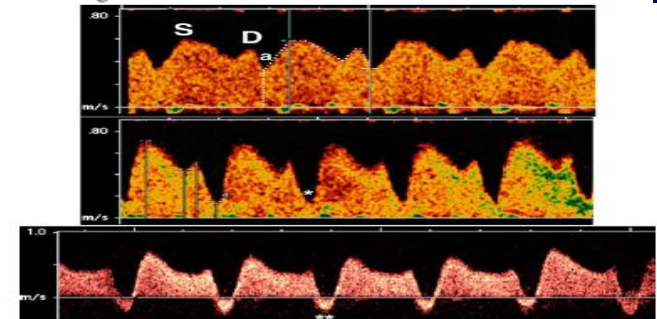


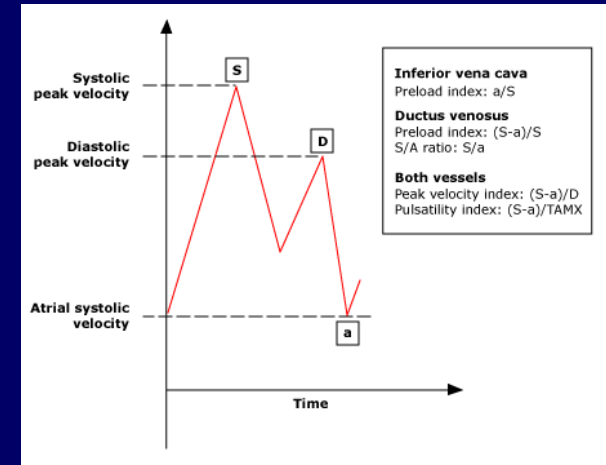
Figure 1 Top panel: In the venous Doppler waveform systolic and diastolic peaks (the S- and D-wave) are generated by the descent of the AV-ring during ventricular systole and passive diastolic ventricular filling, respectively. A second late diastolic trough after the D-wave is the consequence of sharply increasing right atrial pressures during atrial systole (the a-wave). Middle panel: With declining forward cardiac function forward velocity during atrial systole (*) and to a lesser degree during diastole decreased. This is associated with an increase in venous Doppler indices. Bottom panel: When ductus venosus Doppler indices escalate absence or reversal of forward flow during atrial systole (**) may be observed as the most marked Doppler abnormality.

Venöz Doppler

- Hangi venöz dalga formunun ve hangi spesifik analizin en iyi veriyi sağladığı halen araştırılmaktadır
- UV ven, IVC ve DV sık araştırılan venlerdir
- IVC dalga formu ve bunun göstergeleri normal fetüslerde geniş bir varyasyona sahiptir, bu nedenle asfiksi ve ölü doğum bakımından prediktif değeri zayıftır
- UV pulzasyonları ölü doğum riski bakımından bilgi sağlar

DV Dopleri

- UV ve VCI arasında bir bağlantı sağlar ve çapı umbilikal venin 1/3 kadarıdır bu daralma DV içinde akımın hızlanmasına neden olur
- Bu sayede VCI ile kalbe ulaşan kan akımının farklı hızı sayesinde FO aracılığı ile doğrudan sol atriuma yönlendirilir
- Oksijenize kan UV'den FO ile doğrudan fetal dolaşıma yönlendirilir
- DV venöz sistem içinde en yüksek akıma sahiptir ve tüm kardiyak siklus boyunca akım gözlenir



DV Dopler

- DV dopler ölçümü prekardiyak venler içinde kardiyak fonksiyonları ve miyokardiyal hemodinamik değişiklikleri en iyi gösteren ven olması nedeni ile en sık kullanılan ölçümdür
 1. Trimester taramasında : aneuploidi
 2. Trimesterde
 - IUGR da hipoksinin şiddeti
 - Miyokardiyal fonksiyon bozulması

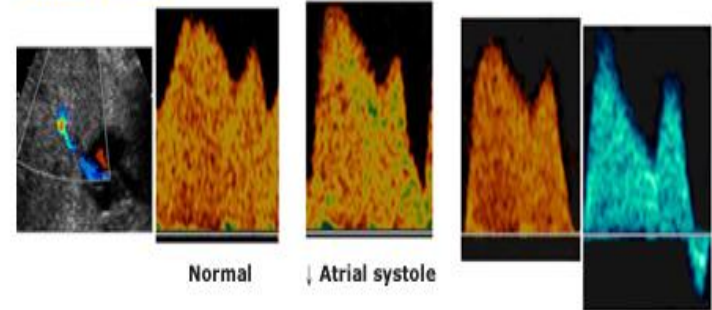
DV anormal dopler bulguları

- 1-Direnç artışı (pulsatilité indeksi 95.per üzerinde)
- 2-Bazale yaklaşan a dalgası
- 3-a-dalgasında tersine dönme

Table I Venous Doppler parameters

Venous Doppler indices	Calculation
IVC PLI	$\frac{\text{Peak velocity during atrial contraction}}{\text{systolic peak velocity}}$
PIV (calculated for IVC and DV)	$\frac{(\text{Systolic peak velocity} - \text{diastolic peak velocity})}{\text{time averaged maximum velocity}}$
PVIV (calculated for IVC and DV)	$\frac{(\text{Systolic peak velocity} - \text{peak velocity during atrial contraction})}{\text{diastolic peak velocity}}$
DV PLI	$\frac{(\text{Systolic peak velocity} - \text{diastolic peak velocity})}{\text{diastolic peak velocity}}$
DV S/a ratio	$\frac{\text{Systolic peak velocity}}{\text{peak velocity during atrial contraction}}$
Qualitative waveform analysis	Description
DV - velocity during atrial systole	1. Forward 2. Absent, or reversed
Umbilical venous blood flow	1. Constant 2. Pulsatile (including mono-, bi-, and triphasic)

Ductous venosus



Normal

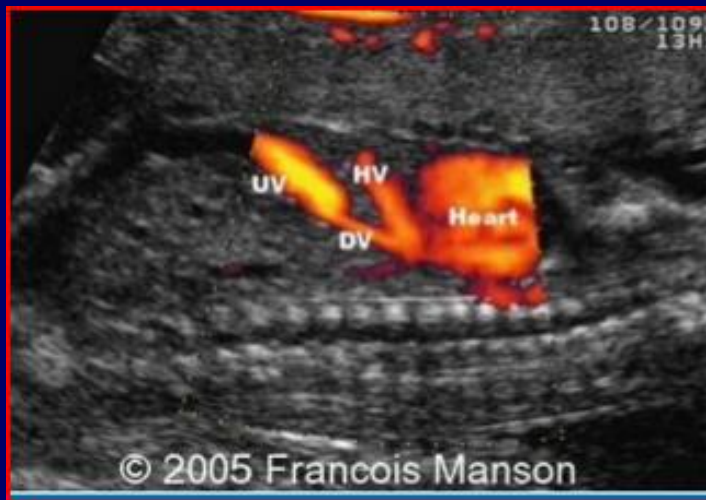
Atrial systole

Absent/reversed a-wave

Umbilical vein

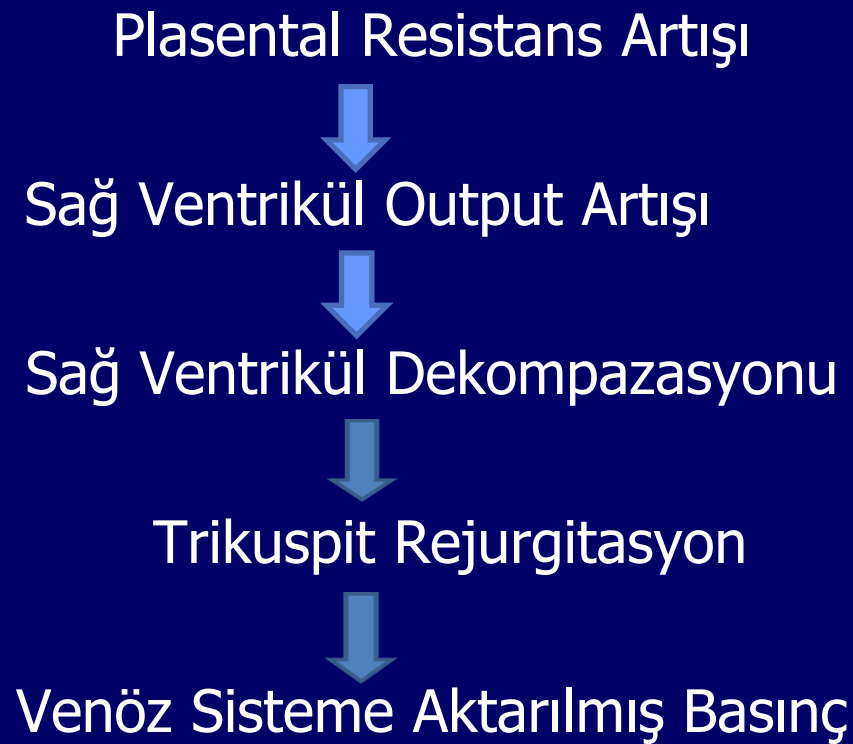
DV Doppler

- 12-40. hf arasında yüksek velosite renkli Doppler sinyali ve karakteristik odyosinyali nedeniyle kolayca görüntülenir
- Revers DV(DV RAV) atrial dalgası perinatal mortalite, neonatal sirkulatuar kollaps ve diğer kritik morbiditelerin en iyi prediktörüdür



Ozcan T, Ultrasound Obstet Gynecol 1998
Baschat AA, Ultrasound Obstet Gynecol 2000

IUGR 'da Patolojik Venöz Akım Değişiklikleri



DV Dopler perinatal sonuçlar

- DV indekslerinde yükselme ve DV-RAV ile
- Perinatal komplikasyonlar, mortalite 10 kat artar
- Anormal venöz bulguları takiben NST ve biyofizik profil değişiklikleri ortaya çıkar

Table 3 Summary of studies evaluating ductus venosus Doppler and perinatal outcome variables

Study	Group	n	Perinatal outcome variable						
			FDIU	NND	PNM	RDS	BPD	NEC	IVH
Bilardo <i>et al.</i> (2004) ⁵	Normal DV	33	0	—	—	—	—	—	—
	Elevated DV index	37	6	—	—	—	—	—	—
	DV-RAV	17	5	—	—	—	—	—	—
Muller <i>et al.</i> (2002) ⁴²	UA A/REDV	23	0	0	0	8	3	1	3
	DV-RAV	12	2	1	3	8	3	1	5
Baschat <i>et al.</i> (2003) ⁴³ (UA A/REDV only)	UA A/REDV	69	6	10	12	—	—	—	—
	Abnormal veins	21	11	6	17	—	—	—	—
Figueras <i>et al.</i> (2003) ⁴⁴	Normal DV	31	0	1	1	—	—	1	2
	Elevated DV index	27	0	7	7	—	—	0	1
Hofstaetter <i>et al.</i> (2002) ⁴⁵ (BFC III only)	UA A/REDV	9	0	0	0	—	—	—	—
	Abnormal veins	28	12	3	15	—	—	—	—
Baschat <i>et al.</i> (2000) ⁴¹	Normal DV	71	0	1	1	29	8	2	4
	Abnormal veins	50	11	7	18	33	12	6	6
Ozcan <i>et al.</i> (1998) ⁴⁰	Normal DV	14	0	2	2	8	3	6	0
	DV-RAV	5	1	3	4	4	1	0	0
Hofstaetter <i>et al.</i> (1996) ⁴⁶	Normal DV	65	0	0	0	—	—	—	—
	Elevated DV index	22	0	0	0	—	—	—	—

BFC III, blood flow class III (absent or reversed umbilical artery end-diastolic velocity); BPD, bronchopulmonary dysplasia; DV, ductus venosus; FDIU, fetal demise *in utero*; IVH, intraventricular hemorrhage; NEC, necrotizing enterocolitis; NND, neonatal death; PNM, perinatal mortality; RAV, reversed or absent a-wave; RDS, respiratory distress syndrome; UA A/REDV, absent or reversed umbilical artery end-diastolic velocity.

DV Doppler perinatal sonuçlar

■ UA A/REDV, Yüksek DV indeksleri , DV-RAV

Table 4 Perinatal outcomes in relation to umbilical and ductus venosus Doppler parameters

<i>Study reference</i>	<i>Parameter</i>	<i>Normal venous Doppler (n (%))</i>	<i>UA A/REDV (n (%))</i>	<i>Elevated DV index (n (%))</i>	<i>DV-RAV (n (%))</i>
5, 40-46	Stillbirth	6/315 (1.9)	6/101 (5.9)	51/202 (25.2)†‡	8/34 (23.5)†‡
40-46	Neonatal death*	14/276 (5.1)	10/95 (10.5)	27/128 (21.1)†	4/14 (28.6)†
40-46	Perinatal death	16/282 (5.6)	12/101 (11.9)	64/165 (38.8)†‡	7/17 (41.2)†
40-42	RDS	45/105 (42.9)		45/53 (84.9)†	
40-42	BPD	14/105 (13.3)		16/53 (30.2)†	
40-42	NEC	9/105 (8.6)		7/53 (13.2)	
40-42	IVH	7/105 (6.7)		11/53 (20.7)†	

*Live births only. † $P < 0.05$ compared to patients with normal venous Doppler. ‡ $P < 0.05$ compared to patients with UA A/REDV and normal venous Doppler. All tests Chi-square. BPD, bronchopulmonary dysplasia; DV, ductus venosus; DV-RAV, absence or reversal of atrial velocity in the DV; IVH, intraventricular hemorrhage; NEC, necrotizing enterocolitis; RDS, respiratory distress syndrome; UA A/REDV, absent or reversed umbilical artery end-diastolic velocity.

Anormal Duktus Venozus Doppler

- IUGR, Fetal Anemi.....Kardiak dekompanzasyon, asidemi
- 1. trimesterde kromozomal anomali
- Kardiyomyopati, myokardit
- Taşiaritmi
- Konjenital kardiak anomali
- İkizden ikize transfuzyon senromu
- AV malformasyona bağlı kardiak yetmezlik (Gallen ven anevrizması, hemanjioma, palsental koryoanjioma)
- Duktus venozus yokluğu

Qualitative venous Doppler waveform analysis improves prediction of critical perinatal outcomes in premature growth-restricted fetuses

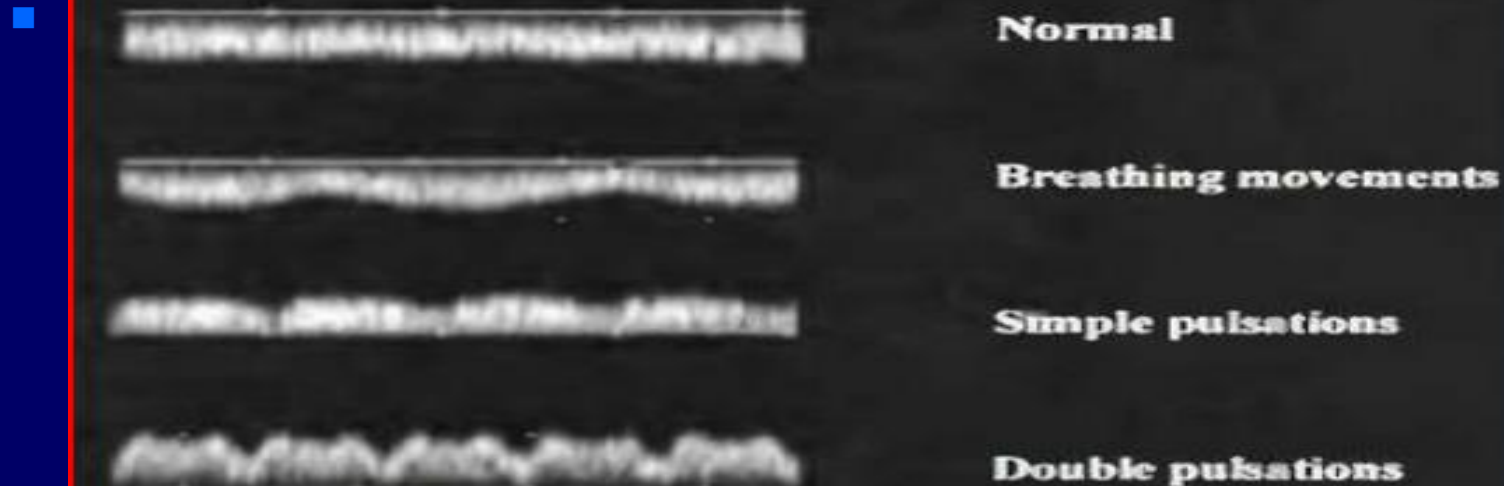
A. A. BASCHAT*, U. GEMBRUCH†, C. P. WEINER* and C. R. HARMAN*

Table 3 Critical short-term outcomes in relation to umbilical artery end-diastolic velocity and abnormal venous Doppler waveforms*

	n	UA-AREDV (n = 90)	Absent DV A-wave and UV pulsations (n = 22)	UA-AREDV and both veins abnormal (n = 21)	P
Stillbirths	17	17 (18.8)	11 (50)	11 (52.4)	< 0.001
Acidemia†	41	26 (35.6)	9 (81.8)	8 (80)	0.003
Asphyxia†	7	4 (5.5)	2 (18.2)	2 (20)	0.02‡
Neonatal death†	16	12 (16.4)	7 (63.6)	6 (60)	0.001
Perinatal death	33	29 (32.2)	18 (81.8)	17 (81%)	< 0.001

Umbilikal Ven Doppler

- Monofaziktir , akım hızı ortalama 15cm/saniye
- 2/3 trimesterde pulsatil UV kardiyak anomali, taşiaritmi ve kongestif kalp yetmezliğinden kaynaklanabilir
- UV pulzasyonu sağ atrium basıncının yetersiz dolaşım nedeniyle yansımaya bağlı premorbid bir bulgu olarak ortaya çıkar

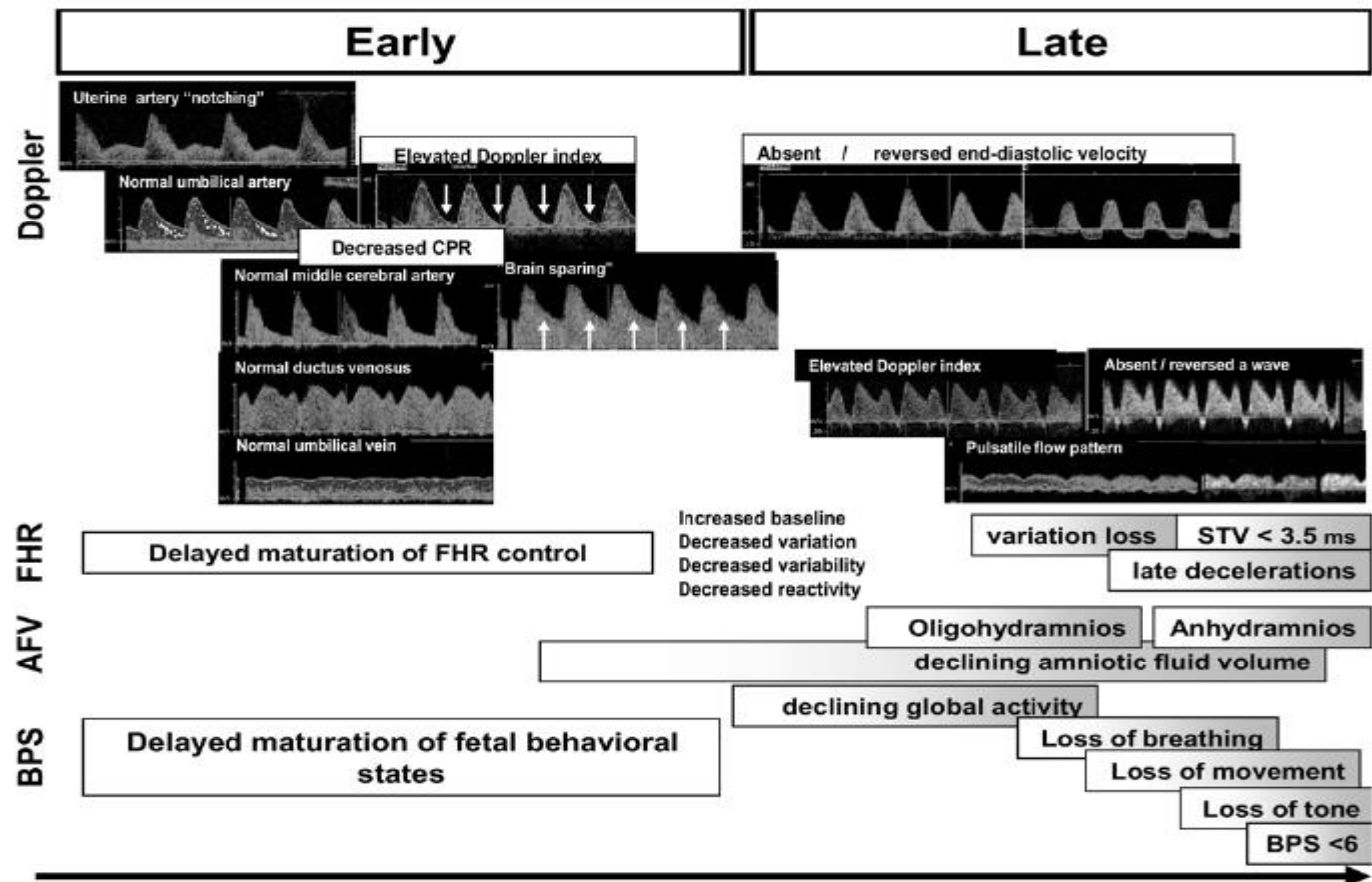


Plasental Disfoksyonda Dopler Parametrelerinin Bozulma Sırası

- Artmış umblikal arter S/D
- MCI PI < 5th persentil
- Umblikal arter –diastolik akım yokluğu
- Umblikal arter – reverse diastolik akım
- Duktus venozus- pulsatile indeks artışı
- Duktus venozus- ters a dalgası
- Umblikal ven pulsasyon

Fetal iyilik durumu

Integrated testing and management in FGR



Sonuç

- **Fetal iyilik durumu incelenmesinde dopler uygulamaları yerini almıştır**
- **Fetal ve neonatal sorunların öngörüleğinde (IUGR,PE, ölü doğum, hipoksi)**
- **IUGR de izlem ve doğum zamanlamasında**
- **Fetal aneminin tahmini**

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