

# Nonstress Test and Umbilical Artery Doppler Examinations in the Assessment of Fetal Prognosis

FETAL PROGNOZU DEĞERLENDİRMEDE NONSTRESS TEST VE UMBİÜKAL ARTER DOPPLER İNCELEMELERİ

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## SUMMARY

**Objective:** The value of color Doppler ultrasonography and fetal heart tracings for early diagnosis of fetal distress were evaluated in pregnant women.

**Institution:** The study was carried on in Turkish Health and Therapy Foundation Medical Center Hospital, Departments of Radiology, pediatrics and Gynecology and Obstetrics, ANKARA

**Material and Method:** 121 pregnant women between 24th and 42nd weeks of gestation were evaluated with color Doppler velocimetry and fetal heart tracing (Nonstress test-NST). The cases with normal and abnormal results of these test were prospectively reevaluated at birth by pediatricians. Sensitivity, specificity, (+) and (-) predictive values of these tests were calculated.

**Findings:** 15 mothers had pathological indices in Doppler examination and ten cases turned out to have adverse fetal prognosis. Fourty mothers had abnormal NST test and 14 subsequently proved to have poor fetal prognosis. Only two cases with pathological results of both tests had favourable fetal prognosis. The sensitivity, specificity, (+) and (-) predictive values of Doppler indices were 40%, 95%, 57% and 90.4% respectively. These values for nonstress test were 58.8%, 80.8%, 30.3% and 93.3% respectively. The combination of these tests yielded higher values which were 54.4%, 97.7%, 75%, 94.6% respectively.

**Conclusion:** The two tests compliment each other. Doppler velocimetry may be a good alternative method in the prenatal evaluation of fetal well-being and the two techniques should be concurrently used rather than making a preference.

Key Words: Doppler Ultrasonography, Fetal Prognosis, Nonstress Test

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Ultrasonography is a valuable method for the follow up of fetal growth and development. However it

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## ÖZET:

**Amaç:** Gebe kadınlarda renkli Doppler ultrasonogramları ile fetal kalp hızı monitorizasyonu (nonstress test) fetal distreste erken tanılabilirliklerinin araştırılması.

**Çalışmanın Yapıldığı Yer:** Türkiye Sağlık ve Tedavi Vakfı Tıp Merkezi Hastanesi, Radyoloji, Pediatri ve Kadın Hastalıkları ve Doğum Departmanları.

**Materyal ve Metod:** Gebelik haftaları 24-42 haftalar arasında olan 121 gebe kadın renkli Doppler ultrasonografi ve fetal kalp hızı izlemi ile incelendi. Bu testlerin normal ve anormal sonuçları doğumda pediatristler tarafından prospektif olarak tekrar gözden geçirildi. Doppler ultrasonografi ve nonstress testi sensitivite, spesifisite, (+) ve (-) prediktif değerleri hesaplandı.

**Bulgular:** Doppler ultrasonogram incelemede 15 annede patolojik indeksler saptandı. 10 vakada kötü fetal prognoz tesbit edildi. NST incelenmesinde 40 annede anormal trase saptandı; 14 vakada kötü fetal prognoz gözlemlendi. Her iki testten de patolojik sonuç alınan vakada fetal prognoz iyi olarak tesbit edildi. Doppler indeksi için sensitivite, spesifisite, (+) ve (-) prediktif değerler sırasıyla %40, %95, %57, ve 90.4 bulundu. NST için bu değerler %58.8, %80.8, %30.3, ve %93.3 idi. Bu iki testin kombinasyonu olarak ise %54.4, %97.7, %75 ve %94.6 ile daha yüksek değerlere ulaşıyordu.

**Sonuç:** Bu iki testin birbirini tamamladığı Doppler velosimetrisinin fetüsün iyilik halinin belirlenebilmesi için prenatal değerlendirilmede alternatif metod olduğu ve bu iki tekniğin arasında tercih yapılmasından ziyade birarada kullanılmasının uygun olacağı sonucuna varıldı.

Anahtar Kelimeler: Doppler Ultrasonography, Fetal Prognosis, Nonstress Test

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has controversial value in the diagnosis of fetal distress. Several randomized investigations on the potential usefulness of umbilical artery Doppler velocimetry in the prediction of fetal jeopardy have been reported. Studies by Cameron et al (1) and Trudinger and colleagues (2) have indicated that the umbilical artery flow velocity wave form may be more sensitive than electronic fetal heart rate monitoring for detection of fetal distress during late pregnancy, and that flow veloci-

ty wave form changes commonly precede fetal heart rate changes. Tyrell and associates (3) randomized 250 pregnancies and concluded that neonatal outcome was improved when Doppler velocimetry was used. On the other hand, Newnham et al (4) and Hofmeys and coworkers (5) were unable to demonstrate benefits for Doppler velocimetry in the management of a combined total of over 1400 complicated pregnancies.

Therefore the aim of this study was to assess the value of color Doppler ultrasonography for early diagnosis of fetal distress and to establish the relationship between the nonstress test (NST) and umbilical artery blood flow velocity.

### MATERIAL AND METHOD

Pregnant women with prenatal ultrasonographic measurements for predicting gestational age (biparietal diameter, femur length, abdominal circumference) that were in accordance to the last menstrual date were evaluated in the study. Doppler ultrasound of the umbilical artery flow waveform was studied prospectively as an admission test in 121 pregnant women between the 24th to 42nd gestational weeks, after conventional ultrasonography. Except the criteria of appropriate fetal growth for gestational age, the subjects were all selected randomly and women that gave birth in the following 72 hours (last antepartum) were included in the study. Informed consent was obtained from all the cases. A systolodiastolic index of 3.0 or more were classified as abnormal in color doppler ultrasonography (6-8). The results of the pregnant women with and without pathological patterns were prospectively evaluated. Babies with congenital anomalies were excluded. The results of antepartum fetal heart rate tracings were evaluated by obstetricians according to the criteria of FIGO subcommittee classification of fetal heart rate pattern (9): The FIGO subcommittee proposed the useful classification of fetal heart rate tracing as (a) normal (b) suspicious and (c) pathological

Normal pattern:

1. Baseline rate 110-150 bpm.
2. Amplitude of baseline variability 5-25 bpm.
3. Absence of decelerations except for sporadic, mild decelerations of very short duration.
4. Presence of two or more accelerations during a 10 minute period.

Suspicious pattern: Any of the following.

1. Baseline rate 150-170 bpm or 110-100 bpm
2. Amplitude of variability between 5-10 bpm for more than 40 minutes
3. Increased variability above 25 bpm.
4. Absence of accelerations for more than 40 minutes

5. Sporadic decelerations of any type unless severe

Pathological pattern: Any of the following,

1. Baseline heart rate below 100 bpm or above 170 bpm.
2. Variability less than 5 bpm for more than 40 minutes.
3. Periodically recurring and repeated decelerations of any type
4. Sporadic and non recurrent severe variable, prolonged or late decelerations
5. A sinusoidal pattern: frequency 6 cycles/min; amplitude 10 bpm, duration 20 minutes

Normal implies that the trace assures fetal health. Pathological warrants some action in the form of additional tests or delivery on the clinical picture. The women with suspicious results of NST were excluded from the study. The women with pathological NST had all cesarean section.

All the neonates were examined by pediatricians immediately after delivery and the following criteria were regarded as adverse fetal prognosis:

1. The small for gestational age babies
2. Five minute Apgar score under 7
3. Meconium under vocal cords
4. Admittance to neonatal intensive care unit
5. Neonatal death

No selection for high-risk pregnancies was not carried out, thus randomizing the results. An aloka 680 SSD ultrasonography and 3.5 MHz probe was used.

### RESULTS

The mean age of the pregnant women was  $26.33 \pm 5.45$  years, mean gestational period was  $39.76 \pm 1.87$  weeks. The mean birthweight of the babies

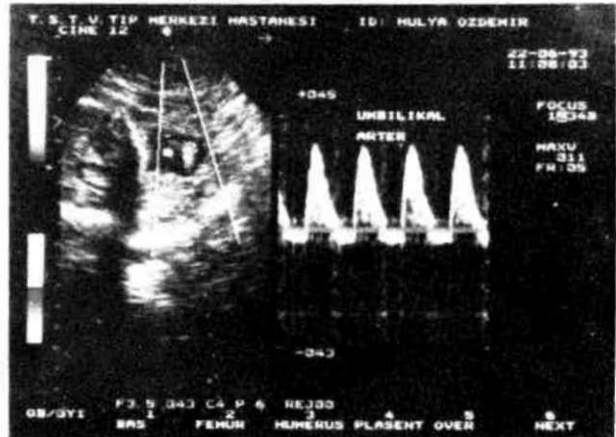


Figure 1. Reversed end diastolic umbilical artery flow in color Doppler velocimetry.  
Şekil 1. Renkli doppler velosimetride ters dönmüş enddiastolik umbilikal arter akımı

**Table 1.** NST and doppler indices in assessing fetal prognosis**Table 1.** Fetal prognozu değerlendirmede NST ve Doppler göstergeleri.

	Sensitivity %	Spesificity %	(+)predictive value%	(-)predictive value%
Umbilical artery Doppler index	40.0	95.0	57.0	90.4
Nonstress test (NST)	58.8	80.8	30.3	93.3
NST+umbilical artery Doppler	54.4	97.7	75	94.06

of 121 women was 3383±509.21 gr. Seventy-three cases had spontaneous vaginal birth, the rest had cesarean section (25 cases for fetal distress and 23 cases electively-repeat C/S, aged primipara etc). Eleven babies were under 37 weeks of gestational age.

Two cases had pregnancy induced hypertension and negative end diastolic umbilical artery flow (Figure 1). One of these pregnancies resulted in fetal loss before intervention as the fetus was in the 24th week, the other pregnancy was terminated at 32 nd week by cesarean section and the baby was discharged uneventfully after three weeks of follow up in the neonatal intensive care unit.

Fifteen mothers had pathological indices in doppler examination and ten cases turned out to have adverse fetal prognosis. Among these ten mothers six had pathological nonstress test.

Fourty mothers had abnormal NST test in the study group and among these 14 turned out to have poor fetal prognosis. The sensitivity, sepcificity, positive and negative predictive values of umbilical artery doppler indices, NST and both of these tests are shown in Table 1. We encountered only two cases with pathological results of both tests and good fetal prognosis. There were also five (one with menengocel, four with chronic meconium aspiration) cases with normal test results and poor fetal outcome. Altogether 19 cases had poor fetal prognosis. Abnormal doppler indices were recorded in 10 of them. The remaining 9 cases consisted of 1 case of menengocel, 4 cases of chronic meconium aspiration, and 5 cases of postdate fetuses.

## DISCUSSION

The value of ultrasonography in the assessment of fetal growth and development is without debate. However even color doppler ultrasonography may prove inadequate in the demonstration of fetal distress due to meconium aspiration and surmaturation al-

though it is useful in revealing fetal distress due to plasental insufficiency (10-12).

Ogunyemi et al found the sensitivity, specificity, positive and negative predictive value of umbilical S/E index to be 65%, 83%, 20% and 91% respectively (13). In many centers, NST patterns are taken as the criteria for predicting fetal distress. This results in the elevation of cesarean section rate due to false positive NST reports (14-16). Brar et al (17) claimed that in the discrimination of false positive late decelerations, umbilical artery doppler indices might be valuable. Malcus et al (11) showed that doppler indices are helpful in the assessment of small for date fetuses in their series of 377 patients. They reported the sensitivity, specificity, negative and positive predictive value of doppler examination to be 0.39, 0.86, 0.95 and 0.16 respectively. On the other hand NST was reported to have a sensitivity of 0.23, positive predictive value of 0.15 and negative predictive value of 0.97. The same study reported no significant correlation between doppler indices and the other parameters for assessing fetal prognosis (such as APGAR score and umbilical artery pH measurements). Jensen et al (18) reported that doppler indices are related to redistribution of blood flow during fetal asphyxia, hence doppler examination could be of value only if the fetal distress is primarily of placental origin. Doppler examination may prove inadequate in fetal distress due to other reasons, e.g. acid base disturbances (19). The results of the present study is harmonious with the results of Malcus et al (11). The high sensitivity and specificity values of Ogunyemi et al (13) may in part be due to the selection of high risk pregnancies. In the normal population, assessment of fetal distress and decision for the method of birth by the doppler indices alone may not be appropriate (11). Therefore in the present study the combination of these two techniques was used and apparently was more reliable than using a single technique, although it may of concern that the patient population was a heterogenous one and admittance to the neonatal intensive care unit may be related to high cesarean section rate.

As cost-effective investigation, doppler studies are helpful in detecting the poor prognosis babies and should not be regarded as a research tool although the relatively high initial cost of establishment and required expertise comprise the two major obstacles for rapid dissemination of this technique. It is concluded that NST and doppler examinations are two valuable techniques in which a normal result often indicates a fetus without distress. The two techniques compliment each other and their combination result in a more reliable assessment.

## KAYNAKLAR

1. Cameron AD, Nicholson SF, Nimrod CA, Harder JR, Davie DM. Doppler waveforms in the fetal aorta and umbilical artery in patients with hypertension in pregnancy. *Am J Obstet Gynecol* 1988, 158,339-45.

2. Trudinger BJ, Cook Cm, Jones L, Giles WB. A comparison of fetal heart rate monitoring and umbilical artery waveforms in the recognition of fetal compromise. *Br J Obstet Gynaecol* 1986;93:171-5.
3. Tyrell SW, Lilford LJ, MacDonakj HN, Nelson EJ, Porter J, Grupta JK. Randomized comparison of routine vs highly selective use of Doppler ultrasound and biophysical scoring to investigate high risk pregnancies. *Br J Obstet Gynecol* 1990; 97:909.
4. Newnham JP, O Dea MR, Reid KP, Diepeveen DA: Doppler bw velocimetry waveform analysis in high risk pregnancies: A randomized controlled trial. *Br J Obstet Gynaecol* 1991 ;98:956
5. Hofmeyr GJ, Pattinson R, Buckley D, Jennings J, Redmon CWG. Umbilical artery resistance index as a screening test for fetal well-being. II. Randomized feasibility study. *Obstet Gynecol* 1991, 78:359
6. Fleischer A, Schulman H, Farmakides G, Bracero L, Blattner P, Randolph G: Umbilical velocity wave forms in intrauterine growth retardation. *Am J Obstet Gynecol* 1985; 151:502.
7. Rochelson B, Schulman H, Fleischer A, Farmaside G, Bracero L, Ducey J, Winter D, Penny B: The significance of doppler umbilical artery velocymetry in the small for gestational age fetus. *Am J Obstet Gynecol* 1987; 156:1223-6.
8. Dilmen G, Aytaç S, Toppare MF, Öztürk M, Gökşin E. Umbilical artery blood flow characteristics in normal pregnancies. *J. Obst Gyn Invest.*, 1994 38:96-99.
9. FIGO. Guidelines for the use of fetal monitoring. *Int J Gyn Obstet.* 1987; 25; 1159.
10. Trudinger BJ, Giles WB, Cook CM, Bombardieri J, Collins L, Fetal umbilical artery flow velocity wave forms and placental resistance: Clinical significance. *Br J Obstet Gynaecol* 1985:92:23-30.
11. Malcus P, Gudmunsson S, Marsal K, Kwok HH, vengadasalam D, Ratnat SS: Umbilical artery doppler velocymetry as a labor admission test. *Obstetrics Gynecology.* 1991; 77:10.
12. Guidetti DA, Divom MY, Cavalieri RI\_ Langer O, Merkatz IR, Fetal umbilical artery flow velocymetry in postdate pregnancies. *Am J Obstet Gynecol* 1987;157;1521-3.
13. Ogunyemi D, Stanley R, Lynch C, Fukushima T, Umbilical artery velocymetry in predicting perinatal outcome with intrapartum fetal distress. *Obstet Gynecol* 1992;80:377-80.
14. Parer JT, Livingstone EG: What is fetal distress? *Am J Obstet Gynecol* 1990;162;1421 -7.
15. Sykes GS, Malloy PM, Johnson P, Stirrat GM, Turnbull AC, Fetal distress and the condition of the newborn infants. *Br Med J* 1983,287:943-5.
16. Gilstrap LC.III, Hauth JC, Hankins GDV, Beck AW. Second stage fetal heart rate abnormalities and type of neonatal acidemia. *Obstet Gynecol* 1987;70:191-5.
17. Brar S, Platt LD, Paul RH, Fetal umbilical flow velocity waveforms using doppler ultrasonography in patients with late decelerations. *Obstet Gynecol* 1989;73:363-6.
18. Jensen A, Hohmann M, Kunze! W, Dynamic changes in organ blood flow and oxygen concentration during acute asphyxia in fetal sheep. *J Dev Physiol* 1987;9:543-59.
19. Yeomans ER, Gilstrap LC III, Levano KJ, Burns JS, Meconium in the amniotic fluid and fetal acid-base status *Obstet Gynecol* 1989;73:175-8.