

Relationship of Early Diastolic Notch in Uterine Artery Doppler Measurements With Pregnancy Complications in Low Risk Pregnancies

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Abstract

Objective: To investigate the incidence of early diastolic notch in uterine artery Doppler measurements and analyze relationship of early diastolic notch with perinatal outcome such as preeclampsia, preterm delivery, intrauterine growth retardation, neonatal birth weight and apgar scores.

Methods: Two hundred sixty-one pregnant women underwent uterine artery Doppler measurements at 24 weeks of gestation. Patients were divided in two groups. Group 1: Early diastolic notch negative and group 2: Early diastolic notch positive. The relationship between early diastolic notch and perinatal complications were assessed prospectively.

Results: Of 243 consecutive pregnancies, early diastolic notch was observed in 41 (16.8%) patient. Mean value of uterine artery pulsatility indices, resistivity indices and neonatal birth weight were statistically different between the two groups ($p = 0.00$). Preeclampsia, and preterm delivery were significantly frequent in group 2.

Conclusion: Diastolic notch might be an important indicator for early identification adverse perinatal outcomes such as preterm birth, intrauterine growth retardation.

Keywords: Doppler ultrasonography, diastolic notch, perinatal outcome.

Düşük riskli gebelerde arteria uterina'da elde edilen erken diyastolik çentiklenmenin gebelik sonuçları ile ilişkisi

Amaç: Doppler ultrasonografide arteria uterina'da elde edilen erken diyastolik çentiklenme sıklığının saptanması ve erken diyastolik çentiklenme varlığının, fetal doğum ağırlığı, doğum sonrası apgar skorları, erken doğum, intrauterin gelişme geriliği ve preeklampsi gelişimi gibi perinatal sonuçlar ile ilişkisinin araştırılması amaçlandı.

Yöntem: Antenatal polikliniğine başvuran düşük riskli tek fetus gebeliği olan, 261 olguya 24. gebelik haftasında ultrasonografik inceleme yapıldı. Anomali tespit edilmeyen gebelere bilateral uterin arter Doppler kan akım analizi yapıldı. Prospektif olarak olgular iki gruba ayrıldı. Grup 1: Erken diyastolik çentiklenme izlenmeyen grup ve Grup 2: Erken diyastolik çentiklenme izlenen grup. Daha sonra bu gebelikler doğuma kadar takip edilerek perinatal sonuçlar belirlendi.

Bulgular: Doppler ultrasonografisi yapılan 243 gebenin 41'inde (%16.8) Erken diyastolik çentiklenme izlendi. Grup 1 ve grup 2'de yenidoğan doğum ağırlıkları ($p = 0.00$), uterin arter Pulsatilité indeksi ve Rezistans indeksi değerleri arasında ($p = 0.00$) istatistiksel olarak anlamlı fark tespit edildi. Preeklampsi, düşük doğum apgar skoru ve erken doğum açısından grup 1 ve grup 2 arasında istatistiksel olarak anlamlı fark saptandı.

Sonuç: Düşük riskli gebelerde gelişebilecek preeklampsi, intrauterin gelişme geriliği, erken doğum gibi komplikasyonlar için antenatal takip sırasında Doppler ultrasonografide uterin arterde çentiklenme varlığı önemli bir bulgu olabilir.

Anahtar Sözcükler: Doppler ultrasonografi, diyastolik çentiklenme, perinatal sonuçlar.

Introduction

Diseases that may be causes of perinatal mortality and morbidity such as preeclampsia, intrauterine growth retardation (IUGR) are often seen in the third month or even just before the time of birth. Pathophysiologic mechanisms are believed to originate at the earlier times in pregnancy.^{1,2} During the period of a normal pregnancy beginning from the first three months till the 24th week, becoming more evident as time goes by, there is an increase in the diastolic blood flow of the uterine vessels. The high resistant blood flow seen in the uterine artery until 12-14 week pregnancy is replaced by the low resistant flow after trophoblast invasion in the spiral arteries takes place.³

In the patients who are determined to have high resistance index (RI) and high pulsatility index (PI) in Doppler ultrasound examinations, the frequency to have preeclampsia, IUGR and placental failure compared to the ones who have normal Doppler ultrasound findings has been found to be higher.⁴ Early diastolic notch (EDN) within the uteroplacental Doppler flow curves during the second half of pregnancy shows a pathologic flow turn in the spiral artery region, probably due to inadequate trophoblast invasion during the time of placental formation.

In this study the objective was to study, at the 24th week, the incidence of early diastolic notch in uterine artery Doppler measurements and analyze relationship

of early diastolic notch with perinatal outcomes such as preeclampsia, preterm delivery, intrauterine growth retardation, neonatal birth weight and apgar scores of the low risk population of pregnant women who applied to the polyclinic.

Methods

The low risk pregnant women, who applied to the antenatal clinics of the Department of Gynaecology in Mersin University, Faculty of Medicine between July 2003 and June 2004 got involved in this study. Doppler ultrasound examination was applied to 261 patients, in whom no fetal anomaly had been observed by ultrasound examination, who did not have preeclampsia, IUGR, preterm delivery, history of intrauterine death, systemic diseases such as

chronic hypertension, diabetes and kidney disease and risk factors during their previous pregnancy, and who had one fetus, at the 24th week of pregnancy. The results of pregnancy could not be reached in 18 patients, because some did not apply to Mersin University Hospital for their follow-ups, and some had the antenatal follow-ups at other hospitals. The results of 243 cases, whose measurements were taken by Doppler ultrasonography at the 24th week and whose perinatal results could completely be obtained, were studied. All of the patients, who got involved in the study, were given approval forms, as demanded by Mersin University ethics committee.

Technique: Ultrasonography and Doppler measurements were applied to all of the patients by the same person (GÖ). For the ultrasonography measurements General Electric Logic 500 Pro ultrasound machine (Wi, USA) and C357 abdominal probe were used. All of the pregnant women rested by sitting for about 15 minutes before Doppler ultrasonography examination took place, and blood pressure levels were taken. First fetal biometry measurements were made. Analysis of both uterine artery blood flow were made for patients with pregnancy time corresponding to 24th gestational week and the ones who had no considerable constitutional anomaly. By using Color Doppler ultrasonography, the place, where uterine arteries cross the external iliac arteries, was determined. By using "cut-flow" pulse-wave Doppler, flow rate wave forms at the portion of the artery on the side of uterus was recorded.⁵ RI and PI values of right and left uterine arteries were evaluated separately. After consecutive five waves were obtained, according to presence of EDN, cases were divided into two groups. Group 1: Group without EDN and Group 2: Group with EDN (Diagram 1). Then these pregnancies were followed until birth.

For the determination of perinatal outcomes, hospital records and the information taken from parents were used. The cases, who had systolic pressure > 140 mmHg and/or diastolic pressure > 90 mmHg and ≥ 500 mg/day proteinuria, were accepted to have preeclampsia. Delivery before 37th week was defined as preterm delivery and birth weight under 10th percentile with respect to expected gestational week was defined as IUGR. The limit to be accepted as low birth apgar score was 5th minute apgar score ≤ 7.



Figure 1. Early diastolic notch at the uterine artery Doppler ultrasound.

The frequency of unilateral and bilateral EDN at the 24th week was calculated. Statistical analyses were made by using "Student's t-test" and the percentage comparison was made by using ki-square test. In all groups uterine artery Doppler analysis results and perinatal outcomes were compared. The effect of the presence of EDN on perinatal outcomes such as newborn apgar scores, birth weight and preterm delivery was studied.

Results

In 202 of 243 pregnant women (83.1%) diastolik EDN was not observed (group 1). In 41 of 243 pregnant women (16.8%) EDN was observed (group 2). EDN was seen 9.46% bilaterally and 7.41% unilaterally. In the group, in which EDN was not seen, 75 women were primigravida (37.1%), 127 women were multipar (62.8%) and the average age was 27.7 ± 5.0 . Average value of PI of uterine artery at ultrasound Doppler examination was found to be 0.87 ± 0.36 and the average value of RI 0.52 ± 0.11 . The average birth weight of the newborns was 3106 ± 264 (Table 1). In group 2 25 of the pregnant women (61 %) were multipar and 16 (39 %) of them were primigravida, the average of ages of the mothers was 26.9 ± 5.0 . In the group, in which EDN was seen, the average of PI values was 1.45 ± 0.61 and the average of RI values was 0.67 ± 0.13 . The average of the weight of the newborns was 2945 ± 527 . There was no con-

siderable statistical difference of patient ages between the groups with EDN and without EDN ($p=0.32$). There was considerable statistical difference of newborn birth weights ($p=0.00$) and the average of PI and RI values of uterine artery between two groups.

Table 1. Comparison of averages of PI, RI and newborn birth weight in Groups 1 and 2 (average $\pm$ standard deviation).

	Group 1 (n=202)	Group 2 (n= 41)	P value
Average of age (year)	27.7 ± 5.0	26.9 ± 5.0	0.32
Pulsatility index	0.87 ± 0.36	1.45 ± 0.61	0.00
Resistance index	0.52 ± 0.11	0.67 ± 0.13	0.00
Birt weight (gramm)	3106 ± 264	2945 ± 527	0.00

When perinatal outcomes were evaluated in the group without EDN, preeclampsia rate was found to be 3.4%, IUGR 3%, low apgar score 1.4 %, preterm delivery 8.4% and cesarean section 16% (table 2). In the group with EDN, preeclampsia rate was found to be 12.9%, IUGR 9.8%, low apgar score 7.3%, preterm delivery 21 % and sectio 24% (Table 2). There was no considerable statistical difference of cesarean section rates between the groups with EDN and without EDN ($p=0.15$). There was significant statistical difference of low apgar score at birth and preterm delivery between two groups (Table 2).

Table 2. Comparison of the perinatal results in Groups 1 and 2.

Clinical results	Group 1 (%)	Group 2 (%)	P value
Preeclampsia	3.4	12.2	0.00
IUGR	3.0	9.8	0.04
Low Apgar score*	1.4	7.3	0.03
Preterm delivery	8.4	21.0	0.00
Cesarean rate	16	24	0.15

*5th minute Apgar score ≤ 7

Discussion

Uterine artery Doppler findings within the second trimester of pregnancy are thought to have significant role in the anticipation of complications that could be seen due to placental failure. Doppler ultrasonography examination has been used more often recently. It is a noninterventional, simple and repeatable method, which allows the evaluation of blood flow alterations during pregnancy.^{5,7}

The muscle layer of spiral arteries turns to be a fibrinoid structure due to the invasion of trophoblasts.¹ Thus uteroplacental circulation becomes low resistant. A significant increase in end-diastolic rates, in the later weeks of pregnancy, is seen. A progressive decrease in the RI and PI values are observed due to this low resistant flow.⁴ EDN, seen before 24th gestational week, is expected to disappear after this week.⁸

There is not a method for the exact anticipation of preeclampsia and IUGR. One of the studies, for this goal, is Doppler analysis to find out high vascular resistance. With Doppler ultrasonography there have been many surveillance studies in low and high risk pregnancies.⁹⁻¹² Presence of different Doppler indices (high PI, RI values) or EDN have been investigated in these studies. Because uterine artery indices may show a large range of variability due to the location of vessel section studied and the location of placenta, many researchers claim that EDN finding is more convenient rather than uterine artery indices.

Hafner et al compared PI and RI values bilaterally and the presence of EDN between the ones having their first and second pregnancies in a study of 1102 pregnant women who were in the

22th gestational week, and they found no significant statistical difference.¹³ They also found that the location of placenta did not change Doppler findings and that there was no significant statistical difference between right and left uterine artery PI and RI average values. In some studies it has been reported that uterine artery resistance is asymmetrical, that it has been calculated lower on the side of placenta, that this difference due to placental location disappears after 24th week of gestation.^{14, 15} It is believed that location of placenta has no effect on uterine artery Doppler findings after 24th week.¹⁵ In our study, just like Hafner's study, we evaluated PI and RI values of right and left uterine artery separately and reaching the conclusion that there was no significant statistical difference between both sides, we used the mean values in the evaluations.

EDN frequency determined in uterine arteries varies according to the week of Doppler analysis, ratio of the risky pregnancies in the population. Zimmermann et al found that there was EDN bilaterally in 8% of 172 low risk pregnancies at the 21-24th weeks, and unilaterally in 12.2 % and in the same study for the 175 high risk pregnant women the ratios were 17.8% and 6.3% respectively.¹⁶ Coleman et al reported that there was EDN in 17% of 114 risky pregnant women bilaterally, and 23% unilaterally at the 22-24th gestational weeks. In addition Albaiges et al determined EDN bilaterally in 4.4% of 1757 pregnant women with no risks at the 23rd gestational week.¹⁸ Because placentation has not been completed yet, Doppler analyses made during early weeks of gestation, presence of EDN is more often.^{1,4} Murakoshi et al reported that bilaterally EDN finding with a very high ratio of 40.7% at the 18th week decreased to 6.9% in the later gestational weeks.¹⁹ In some studies the presence of EDN seen bilaterally has a range of 3-17%.^{10,11,18} Harrington et al found that there was EDN bilaterally in 3.9% of 1326 pregnant women with no risks in a surveillance study that took place at the 20th and 24th weeks.¹⁰ In this study they also reported that there was EDN bilaterally in the Doppler ultrasonography examination at the 24th gestational week in 55% of the cases who had preeclampsia and 18% of the cases with IUGR.

Albaiges et al evaluated the perinatal outcomes of pregnant women, who came to the hospital for the routine follow-ups, under the circumstances that there was high PI measurements (≥ 1.45) and EDN bilaterally.¹⁸ In the presence of EDN, the sensitivity for preeclampsia has been reported to be 32 %. The sensitivity of fetal death and ablatio placenta has been reported to be 83% and 50% respectively. Cobian et al studied the relationship between pathological uterine artery Doppler findings (high RI ratios and diastolic EDN) in the second trimester and spontaneous preterm delivery retrospectively and found that there was no increase in the risk.²⁰

In a study in our country it has been reported that the presence of EDN is more effective than other Doppler findings in the anticipation of probable preeclampsia at the 18-26 week.²¹ Today there is no effective therapy for the prevention of preeclampsia in the cases having pathological uterine artery Doppler findings during second trimester.⁶ Though for the close follow-ups for these pregnant women, EDN might be a considerable finding. When abnormal Doppler findings are found, more aggressive approach to the patients and an increase in cesarean section rates are observed.¹⁰ In this study we also found that the ones with EDN at the 24th gestational week had higher cesarean section rates. But there was no significant statistical difference between these rates.

Conclusion

Surveillance studies of analysis of Doppler blood flow wave form have gained a great acceleration during last 10 years owing to technological improvements. Today surveillance studies of preeclampsia and/or IUGR in low risk pregnant women by using Doppler ultrasonography are controversial. There are some conclusions suggesting that uterine artery Doppler ultrasonography examination is useful only when there is EDN and in low risk pregnant women it is a limited routine surveillance method.²² In this study it has been reported that the cases with EDN had an increased risk of pregnancy complications, such as preeclampsia, IUGR, preterm delivery. In low risk pregnancies, predictive value of abnormal Doppler

ultrasonography findings for these complications may be exposed in larger studies.

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