EFFECT OF THE ARTIFICIAL RUPTURE OF THE MEMBRANES ON THE BLOOD FLOW IN DESCENDING AORTA AND THE UMBILICAL ARTERY OF THE FETUS

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S. Özsoy, M.D / A. Hanlıoğlu, M.D***/ A. Esmer, M.D** / N. Göker,M.D***

* *Chief, 1. Gynecology and Obstetrics Clinic, Şişli Etfal Hospital, Istanbul, Türkiye.*
** *Specialist, 1. Gynecology and Obstetrics Clinic, Şişli Etfal Hospital, Istanbul, Türkiye.*
*** *Research Assistant, 1. Gynecology and Obstetrics Clinic, Şişli Etfal Hospital, Istanbul, Türkiye.*

SUMMARY

Doppler velocity waveform analysis from descending aortic and umbilical artery signals was performed in 30 term pregnancies without complications before and after artificial rupture of the membranes (AROM). There was no significant difference between the umbilical artery and descending aorta S/D ratios, during acute changes in amniotic fluid volume.

Key Words : Doppler velocimetry, artificial rupture of membranes, S/D ratio.

INTRODUCTION

Doppler velocity waveform analysis of the umbilical artery or descending aortic blood flow has been proposed as a nonnegative method to study the placental circulation in the human fetus (1,2). Several indices that are derived from the peak systolic, mean, and end-diastolic velocity are in clinical use and the method has been widely applied to assess fetal well-being and to predict neonatal outcome (1,3). Increased indices have been related to reduced umbilical blood flow as a result of increased placental vascular resistance (1). These alterations of the umbilical artery waveform without uterine contractions, describe a chronic state of the placenta rather than acute parameters of the fetal condition. However, the acute changes of flow patterns that might occur in labor have been examined so far by a few authors. It is axiomatic that the rupture of membranes increases uterine tonicity and can initiate fetal heart rate deceleration and bradycardia (4). The fetus can be at risk because of cord compression, that may occur as a result of oligohydramnios after membrane rupture.

In this study we tried to investigate the influence of acute alteration of amniotic fluid volume on the umbilical artery and the fetal aorta blood flow velocimetry.

MATERIAL AND METHODS

Thirty term pregnancies without complications underwent amniotomy in the active phase of labor. In all patients regular contractions were present. The cervix was dilated from 4 to 7 cm. Prior to amniotomy an amniotic fluid index was obtained by ultrasonography. Umbilical artery and descending aortic blood flow velocimetry was performed using pulsed-wave Doppler system with a 3 MHz/80 deg. mechanical sector probe (Aloka SSD-630 Doppler unit: model UGR-38). Fetal movement and fetal breathing were absent during the flow recordings. A 100 Hz. thump filter was used. The sample volume was positioned first on one umbilical artery and then on the descending thoracic aorta. It spans the entire vessel at its point of measurement. These measurements were repeated immediately following amniotomy; All the measurements were obtained between uterine contractions. Peak systolic, end diastolic, and mean velocities were measured from the maximum spectral display of the Doppler shift that was sampled in the fetal descending aorta and umbilical artery S/D ratio was calculated as in fig 1.

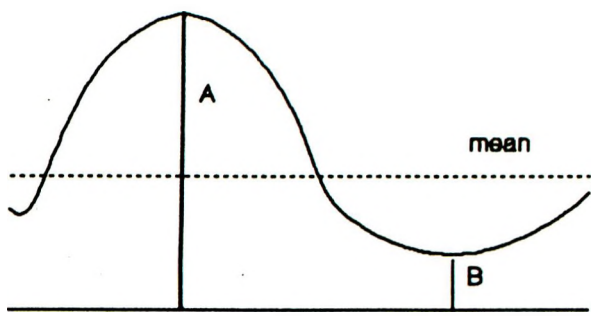

Fig. 1 : Blood flow velocity waveform.

Systolic/diastolic ratio = Peak systolic/end-diastolic velocity (A/B).

Statistical analysis of the Doppler results (S/D Ratios) was carried out with the student t Test, and significance was considered at $p<0.05$.

RESULTS

Table I shows the values of peak systolic and end diastolic velocities from the umbilical artery and the fetal descending aorta. Data are given as mean + SD. The systolic/diastolic ratios from the descending aorta and from the umbilical artery before artificial rupture of membranes (AROM) and after AROM are summarized in table II.

Our data suggest that acute changes in amniotic fluid volume during the active phase of labor do not significantly effect umbilical artery or fetal aortic S/D ratios.

DISCUSSION

During normal labor the blood flow curves of the fetal descending aorta are unchanged. The umbilical artery flow velocity waveform shows no significant changes in the systolic/end-diastolic (S/D) ratio throughout normal labor as well (5).

Oligohydramnios in the presence of ruptured membranes increases the risk for fetal distress as a result of acute cord compression (6). The effect of a reduction of the umbilical perfusion on fetal blood circulation were examined by several authors in sheep fetuses. Künzel et al. have shown that the reduction of umbilical vein perfusion by partial cord compression results in a marked increase of the umbilical vein blood pressure (7).

The direct evidence of the linear relationship between the increase of umbilical vein pressure and the decrease of the blood flow in the umbilical arteries was performed by Berman et al (5).

Schmidt et al. performed Doppler velocity waveform analysis from descending aortic and umbilical artery signals in fetal lambs, when umbilical blood flow was altered acutely. When blood flow was severely reduced (< 50 % of baseline value), mean placental resistance increased almost fourfold and mean heart rate fell by 30 % from baseline levels. There were only weak correlations between Doppler waveform indices and the actual blood flow. They conclude that Doppler waveform analysis is not sensitive enough to detect acute mild to moderate reductions in placental flow (1). This finding suggests, that early changes in the placental vascular bed that lead to an increase in resistance are not detected by Doppler waveform analysis.

Table I: Umbilical artery and fetal aorta, systolic and diastolic flow velocimetries.

	PRE-AROM	POST-AROM	P
	cm/sec (SD)	cm/sec(SD)	
A.umbilicalis			
Systolic	41.35(9.03)	43.48(10.94)	0.20
Diastolic	18.17(3.96)	18.56(6.31)	0.38
Fetal aorta			
Systolic	45.57(12.62)	45.95/6.78)	0.23
Diastolic	14.67(3.57)	14.59(2.63)	0.36

Table II: S/D ratios from the umbilical artery and fetal aorta.

S/D Ratio	PRE/AROM	POST-AROM	P
	R (SD)	R (SD)	
Umbilical	2.31(0.34)	2.40(0.48)	0.23
Aorta	3.15(0.72)	3.21(0.60)	0.36

In our study, we found that changes in amniotic fluid volume during artificial rupture of the membranes do not significantly effect umbilical artery or aortic S/D ratios. Our patients were pregnant women in labor without any complication. The importance of maternal and fetal blood flow to fetal growth and development is widely acknowledged. Doppler umbilical artery velocimetry has been used to evaluate high-risk pregnancies (8,9). Previous studies by Fleischer et al., (3) Trudinger et al., (10) and Brar et al. (11) have established a relationship between impaired end-diastolic flow velocity, intrauterine growth retardation and adverse fetal outcome (6).

Doppler velocimetry during artificial rupture of the membranes in high risk pregnancies may be different. Further measurements in these patients are being carried out.

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