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DOPPLER ULTRASOUND IN THE THIRD TRIMESTER FOR PREDICTING ADVERSE NEONATAL COMPLICATION

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ABSTRACT

Purpose: this study was conducted to determine the predictive value of uterine, umbilical and cerebral arteries in determining adverse neonatal complications.

Material and Methods: One hundred and four women with gestational age between 37 to 40 weeks with no pregnancy related complication were enrolled. All women underwent Doppler sonographic examinations of maternal uterine artery (UtA), umbilical artery (UmA) and middle cerebral artery (MCA) of the neonates. Using the reference range, performance characteristics in the prediction of pregnancy outcomes were calculated. All mothers were followed up till delivery to register neonatal complications.

Results: Mean age and gestational age were 28.9±4.7 years and 38.2±1 weeks, respectively. The most common neonatal complication was hyper-bilirubinemia followed by TTN (transient tachypnea of the newborn). PI index of uterine artery (UtA) was significantly higher in neonates with neonatal complications. Umbilical cord pH and the 5th minute Apgar score were significantly different between the two groups (with and without complications). UtA PI showed a higher sensitivity for predicting neonatal complications.

Complication: In women with borderline amniotic fluid and without pregnancy complications, UtA PI could be a sensitive method for determining neonatal complications.

Keywords: Neonatal complication, Doppler, pregnancy

INTRODUCTION

Defective placentation could lead to preeclampsia, Intrauterine Growth Restriction (IUGR), abruption, stillbirth or other related complications(1).

High impedance to flow in the uteroplacental circulation is the consequence of impaired placentation, which will result in hypoxemia and necrosis(2). In normal pregnancies, by advancing gestational age, the resistance in the uterine

artery flow will decrease(3). Doppler velocimetry can be used for screening patients with uteroplacental perfusion adequacy (4). It is a non-invasive, fast and cost-effective technique that can be applied along with routine ultrasound examinations. By means of this technique, we would easily detect high risk cases and predict adverse pregnancy outcomes (5).

Doppler findings of the uterine artery (UtA) have been considered good predictors of adverse pregnancy outcomes in previous studies with different sensitivities and specificities (6-8). On the other hand, in cases with decreased placental blood flow, blood supply to the fetal brain will increase. Hence, middle cerebral artery (MCA) blood flow alterations 2–3 weeks prior to delivery can be suggestive of unfavorable pregnancy outcome (9). According to other studies, MCA/UmA PI ratio compared with MCA PI alone had higher sensitivity in detecting adverse pregnancy outcomes (10). The goal of this study was to determine the predictive value of uterine, umbilical and middle cerebral arteries in determining adverse neonatal complications.

MATERIAL AND METHODS

This study involved 104 women with gestational age between 37 to 40 weeks referred to Women's hospital (affiliated hospital of Tehran University). Exclusion criteria were: previous cesarean section, diabetes, hypertension, cardiac, renal disease, preeclampsia, a multiple pregnancy, IUGR (Intra uterine growth restriction), and an obvious anomaly in screening programs.

All women were asked to fill the informed consent forms, while the study had been approved by a local ethics committee.

All sonographic examinations were performed by a single expert obstetric sonographer trans-abdominally using a (Siemens ACUSON Antares) with multi-

frequency volumetric trans-abdominal transducer.

The transducer was placed above the inguinal canal and directed into the para-uterine area in the region of the lower uterine segment. The iliac artery and vein can be seen running obliquely along the pelvic side wall. Using color Doppler for guidance, the operator rotated the probe, moving the upper end medially until the uterine artery is recognized as it crosses the iliac vessels.

Umbilical artery flow velocity waveforms were obtained from the free loop of the umbilical cord, and UmA S/D, UmA PI, and UMBRI were recorded.

For MCA evaluation, axial images of the brain including the thalami and cavum septum pellucidum were obtained, placing the color Doppler box over the middle anterior part of the brain to the thalami to identify the circle of Willis.

Ratio of MCA PI to UmA PI was calculated.

Maternal age, parity, gestational age, and amniotic fluid index were recorded for all cases, and all were followed up to delivery. At the time of delivery, type of delivery, umbilical cord pH, Apgar score at the 5^{th} minute, neonatal weight, and complications were recorded.

Statistical analysis was performed with SPSS software version 20 and presented as Mean ± SD. The Student's t-test was applied for continuous variables, and the Pearson $\chi 2$ test and Fisher's exact test were used for categorical variables. P-value < 0.05 was considered statistically significant.

RESULTS

One hundred and four pregnant women in the third trimester were enrolled.

Mean age and gestational age were 28.9±4.7 years and 38.2±1 weeks (table 1).

In 80 (76.9%) type of delivery was NVD (normal vaginal delivery) and in 24 (23.1%) was cesarean section.

Complication after delivery reported in 41 (39.4%).

The most common neonatal complication was hyper-bilirubinemia followed by TTN (Transient tachypnea of the newborn) (table2).

PI index of uterine artery was significantly higher in neonates with neonatal complications (table 3).

Number of cases with UTAPI less and more than 95^{TH} percentile were significantly different between two groups (table 4).

Umbilical cord PH and 5^{th} minute apgar were significantly different between two groups (table 5).

UTPAPI has higher sensitivity for predicting neonatal complications (table 6).

Table 1: characteristics of all participants

Age (mean± SD) (year)	**28.9±4.7**
Gravidity (mean± SD)	**1.7±0.7**
Gestational age (week)	**38.2±1**
Neonatal weight	**3167±425**
5th minute apgar	**8.4±1**
Umbilical cord PH	**7.2±0.11**
AFI	**6.9±0.8**
UMB PI	**0.84±0.19**
UMB RI	**0.54±0.1**
UMB S/D	**2.2±0.43**
MCA PI	**1.58±0.5**
MCA RI	**0.72±0.12**
UTA PI	**1±0.6**
UTA S/D	**1.94±0.69**
MCA PI/UMB PI ratio	
< 1	**7 (6.7%)**
> 1	**97 (93.3%)**

Table 2: frequency of neonatal complications

	Number (%)
Hyper-bilirubinemia	**20 (48.8%)**
TTN	**9(22%)**
Hyper-bilirubinemia+ TTN	**4(9.8%)**
Hyper-bilirubinemia+ NICU admission	**4(9.8%)**
Hyper-bilirubinemia+ NICU admission+sepsis	**2(4.9%)**
Hyper-bilirubinemia+ NICU admission+TTN	**1(2.4%)**
NICU admission+sepsis	**1(2.4%)**

Table 3: Comparison of different factors in two groups: with and without neonateal complications.

	Without complication N=63	**With complication N=41**	**P value**
Neonatal weight	**3253.7±282.8**	**3033.8±559.3**	**0.02**
5th minute apgar	**8.8±0.6**	**7.9±1.1**	**<0.001**
Umbilical cord PH	**7.2±0.6**	**7.1±0.16**	**0.005**
AFI	**6.9±0.88**	**6.9±0.87**	**0.9**
UMB PI	**0.83±0.16**	**0.87±0.24**	**0.3**
UMB RI	**0.54±0.09**	**0.55±0.12**	**0.5**
UMB S/D	**2.2±0.37**	**2.3±0.51**	**0.2**
MCA PI	**1.61±0.46**	**1.54±0.56**	**0.5**
MCA RI	**0.72±0.09**	**0.71±0.16**	**0.5**
UTA PI	**0.84±0.42**	**1.2±0.79**	**0.004**
UTA S/D	**1.87±0.62**	**2±0.79**	**0.2**
MCA PI/UMB PI ratio			
< 1	**3(4.8%)**	**4(9.8%)**	**0.3**
> 1	**60(95.2%)**	**37(90.2%)**	

Table 4: Doppler characteristics in two groups

	Without complication N=63	**With complication N=41**	**P value**
MCA PI/UMB PI ratio			
< 1	**3(4.8%)**	**4(9.8%)**	**0.3**
> 1	**60(95.2%)**	**37(90.2%)**	
UMBS/D			
<3	**63(100%)**	**40(97.6%)**	**0.2**
>3	**0**	**1(2.4%)**	

UTA S/D **<2.6** **>2.6**	 **55(87.3%)** **8(12.7%)**	 **30(73.2%)** **11(26.8%)**	**0.06**
UTAPI **<95TH percentile** **>95th percentile**	 **52(82.5%)** **11(17.5%)**	 **25(61%)** **16(39%)**	**0.01**

Table 5: different factors in two groups: UTAPI less and more than 95th percentile

	UTAPI <95TH percentile	UTAPI >95th percentile	P value
AFI	**6.8±0.85**	**7±0.93**	**0.5**
5th minute apgar	**8.6±0.89**	**7.9±1.1**	**0.001**
Umbilical cord PH	**7.2±0.06**	**7.1±0.17**	**<0.001**
Neonatal weight	**3182 ±471**	**3124±254**	**0.5**

Table 6: sensitivity and specificity of different indexes in predicting neonatal complications

	UTAPI	UTA S/D	UMBS/D	MCA PI/UMB PI ratio
Sensitivity	**39%**	**26.8%**	**2.4%**	**9.7%**
Specificity	**82.5%**	**87.3%**	**100%**	**95.2%**

DISCUSSION

The results of this study showed that mean UtA PI was significantly higher in mothers who born neonates with complications. (These women had no evidence of IUGR, preeclampsia, etc., and had borderline AFI). This was compatible with Jamal et al findings that reported mean UtA PI of 0.99 in normal pregnancies and 1.2 in those with an adverse pregnancy outcome. The sensitivity of abnormal uterine artery Doppler for all adverse outcomes was 33%, while in this study the sensitivity was 39%. In previous studies, the range of UtA PI sensitivity was reported between 20-60% (11-13). According to Afrakhteh et al complicated pregnancies had significantly higher RI and PI in uterine artery Doppler evaluation than normal pregnanciesin the third trimester, while in the current study, the mean RI values were not significantly different between the two groups (14).They reported sensitivity and specificity of 63% and 89% for UtA PI in their survey, which were higher than those in our study.

We also found that the 5th minute Apgar score and Umbilical cord pH were significantly different in cases with UtA PI less and more than 95th percentile. This finding is compatible with Shwarzman et al findings. They reported lower cord pH and higher number of cases with Apgar score less than 7 in pathologic group (15). In another study, de Melo et al (21) showed a relationship between abnormal uterine artery Doppler findings in the third trimester with pregnancy complications and adverse postpartum outcomes (16). In accordance with our findings, Cooley at el found that elevated uterine artery indices were

associated with adverse perinatal outcomes (17).

On the other hand in the current study, UmA and MCA artery indexes were not significantly different between normal and complicated neonates. We also found that MCA/UmA PI ratio less or more than 1 was not significantly different between the two groups and its sensitivity was low. In a previous study, 36 women with gestational age between 36-40 weeks were evaluated by Doppler examination of UmA and MCA. Comparing to our results, UmA S/D and UmA PI were not significantly different within normal pregnancy group, but UmA S/D sensitivity was calculated as 88% and MCA/UmA PI as 81%, which were higher than those in our study (18).

Abnormal Doppler indices of fetal vessels had been considered to be related to adverse perinatal outcomes in previous studies (19-22). While other studies demonstrated that abnormal cerebral Doppler findings of neonates were associated with adverse perinatal outcome (23-24). Fong et al evaluated 293 fetuses who were small for gestational age (SGA) according to Doppler US of UmA, MCA and RA (renal artery), and found that the MCA PI was the most sensitive but the least specific variable in predicting adverse outcomes (25).

Wladimiroff et al and Gramellini et al declared that cerebral–umbilical ratio is a better predictor of adverse perinatal outcome than each index alone [20,22]. In this study, the mean PI values of MCA and UmA were not significantly different between the two groups, and both tests had low sensitivity but higher sensitivity. Arias et al considered that when growth retardation falls below the 10th percentile, fetal vascular redistribution occurs (26), while Ozeren et al believed that fetal brain sparing is independent of growth retardation [18]. However, as the MCA is the most accessible vessel in neonates, it is used more for Doppler evaluation of neonates.

CONCLUSION

UtA PI in women with borderline amniotic fluid and without pregnancy complication could be a sensitive method for determining neonatal complications.

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