

Fetal Arterial Doppler Ultrasound in Late Weeks of Pregnancy in Relation to Neonatal outcome

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Abstract

Early prediction of adverse neonatal outcome would be possible by Doppler impedance indices of middle cerebral artery (MCA), umbilical artery (UmA), and descending aortal artery (AO) that result in decrease neonatal morbidity and mortality rate. the present study was: at diagnosis of placental dysfunction and fetal hypoxia by evaluation of fetal arterial Doppler velocimetry of Umbilical artery (UmA), Middle cerebral artery (MCA) and fetal descending abdominal Aorta (AO).Evaluation of cerebro-placental ratio (MCA/UmA) and cerebro-aortic ratio (MCA/AO) in late weeks of pregnancy will be studied as predictors for neonatal outcome in complicated and uncomplicated pregnancies. This study conducted at the Department of Obstetrics and Gynecology and the Ultrasound Unit of Benha University Hospital and Benha Teaching Hospital on 100 pregnant women . 25% of included patients admitted to NICU , there was significant relation between NICU admission and MCA RI ,AO RI, AO PI. Ultrasound examination and Doppler monitoring provide a non-invasive repetitive method for supervising fetuses with any abnormalities in order to apply an adequate management.

Keywords: Doppler, outcome,Umbilical, Pregnancy.

1.Introduction

Doppler studies are noninvasive and help to identify the degree of placental insufficiency and also to detect worsening of the situation, thereby decision to intervene can be taken once the need arises [1]. The results of umbilical artery (UmA) Doppler is a reflection of the placenta status, whereas the results obtained from a middle cerebral artery (MCA) and aorta artery indicate the state of fetal circulation [2]. Doppler ultrasound is used in high-risk pregnancies, particularly the cases complicated by fetal growth retardation, preeclampsia, or other maternal medical conditions [3,4].

Abnormal MCA Doppler alone showed limited predictive accuracy for compromise of fetal and neonatal well-being [5,6].

Today, according to the evidence available, Doppler study of the umbilical arteries is the only test that has shown to improve the outcome, reducing perinatal mortality, and reducing obstetric interventions [1].

2.Subjects and methods

This study conducted at the Department of Obstetrics and Gynecology and the Ultrasound Unit of Benha University Hospital and Benha Teaching Hospital on 100 pregnant women with gestational age 36 weeks and above who attend for routine antenatal care upon the following criteria after obtaining their consent.

2.1Inclusion criteria

- 1-Singleton fetus
- 2-Pregnancy with no risk factors.(low-risk pregnancy).
- 3-Pregnancy with One or more of the following complications(High-risk pregnancy):(Small for gestational age fetus,Oligohydramnios, Hypertension with pregnancy ,Diabetes Mellitus

with pregnancy ,Placental vascular dysfunction documented by abnormal umbilical artery pulsatility index)

- 4-Approval of the Ethics and Research Committee of both hospitals will be taken.

2.2Exclusion criteria

- 1-Fetus with major congenital malformations confirmed by ultrasound examination.
- 2-Multiple pregnancy.
- 3-Patient planned for Emergency or elective termination of current pregnancy.

2.3 Methods

All the subjects of the study subjected to the following:

History Taking and full examination were done investigation in form of routine ANC investigations and further Lab tests as indicated by the condition of the woman.

Ultrasound study for assessment of fetal biometry including estimated Fetal Weight and Amniotic fluid index.

Doppler Ultrasound study

Trans abdominal ultrasound was performed to all patients while lying in a semi-recumbent position with slight lateral tilt with a small pillow under the right buttock (Voluson pro – V made in Australia) ultrasound machine with Doppler unit and aconvex linear transducer (3-5 MHZ) will be used.

Together with ultrasound scan ,Doppler study were scheduled every 2 weeks till delivery,RI, PI and Systolic to Diastolic standard deviation (SD) of consecutive flow velocity waveforms will be calculated.

The angle between the ultrasonographic beam and direction of blood flow should be < 30 degree. The

Doppler indices were calculated by the dedicated software supplied within the Doppler equipment [7].

1-Umbilical artery Doppler

2- Middle cerebral artery Doppler(MCA)

3-Fetal descending Aorta Doppler

Follow up of subjects

The mothers were followed for complications such as fetal growth restriction ,preeclampsia ,placental abruption and fetal distress until delivery.

Doppler study of the 3 arteries were scheduled every 2 weeks till delivery. During the evaluation RI, PI and S/D standard deviation (SD) ratio of each artery were measured.After collecting the data, the pregnant women were categorized into two groups;

1 - Complicated group(High-risk pregnancy):

Contains “FGR, hypertensive disorder, and vasculopathy that depends on overt diabetes or systemic lupus erythematosus (SLE) or renal disease”

2 - Uncomplicated group(low-risk pregnancy)

3.Results

This study conducted on 100 patients with mean age of the patients were 28.2 years with min-max 19-43 years and mean BMI 26.6 kg\m2, 25% of cases had positive family history of disease and most of them were parity 1 and parity 2 in 40% of cases Fig (1) As regard mean gestational age among patients was 37.5 and mean gestational age at delivery was 38.85 with 60% of patients had CS and 40% had ND.

75% of patients none complicated but 25% of them complicated, as regard factors that affecting complications the significant factors were increase in BMI ,lower GA higher parity ,positive family history of disease Table (1) regarding Doppler we found that there was significant relation between complications and Umbilical PI ,MCA RI,AO RI,AO PI, Cerebra placental ratio, Cerebra aortic ratio and there was significant relation between complications Table (2) and GA at delivery,NBW and apgar 1st ,5 min Table (3)

Table (1) Relation between complicated and non complicated patients and different maternal factors(n= 100).

	Non complicated (n = 75)		complicated (n = 25)		Test of Sig.	P
	No.	%	No.	%		
Age (years)						
Min. – Max.	19.0 – 43.0		25.0 – 33.0		t=	0.412
Mean ± SD.	28.0 ± 6.53		28.80 ± 3.06		0.824	
Median	26.0		29.0			
BMI (kg/m²)						
Min. – Max.	25.0 – 28.0		26.0 – 28.0		t=	0.001*
Mean ± SD.	26.40 ± 1.03		27.20 ± 1.0		3.395*	
Median	27.0		28.0			
GA						
Min. – Max.	36.0 – 40.0		36.0 – 37.0		t=	<0.001*
Mean ± SD.	37.93 ± 1.0		36.20 ± 0.41			
Median	38.0		36.0			
Parity						
.00	10	13.3	0	0.0	χ ² =	MC _p =
1.00	30	40.0	10	40.0		
2.00	25	33.3	15	60.0		
3.00	10	13.3	0	0.0		
Delivery Route						
CS	45	60.0	15	60.0	χ ² =0.0	1.000
ND	30	40.0	10	40.0		
Family history of disease						
No	60	80.0	15	60.0	χ ² =4.0*	0.046*
Yes	15	20.0	10	40.0		
Diastolic blood pressure						
Min. – Max.	76.0 – 100.0		78.0 – 100.0		t=	
Mean ± SD.	85.0 ± 6.53		88.0 ± 7.16		1.941	0.055
Median	87.0		87.0			
Systolic blood pressure						
Min. – Max.	100.0 – 150.0		100.0 – 160.0		t=	
Mean ± SD.	125.67 ± 12.31		126.0 ± 20.0		0.079	0.938
Median	120.0		120.0			

Table (2) Relation between complications and Doppler indices (n= 100)

	Non complicated (n = 75)		complicated (n = 25)		Test of Sig.	P
	No.	%	No.	%		
Umbilical RI						
Min. – Max.	0.57	–0.65	0.55	–0.65	t=	0.052
Mean ± SD.	0.62	±0.02	0.60	±0.04	2.026	
Median	0.62		0.62			
Umbilical PI						
Min. – Max.	0.95	– 1.05	0.99	– 1.20	t=	<0.001*
Mean ± SD.	0.97	± 0.02	1.08	± 0.10	4.987*	
Median	0.96		1.0			
Middle cerebral artery RI					2.301*	0.029*
Min. – Max.	0.75	–0.90	0.75	–0.90		
Mean ± SD.	0.78	±0.03	0.82	±0.07		
Median	0.78		0.78			
Middle cerebral artery PI					0.273	0.786
Min. – Max.	1.58	– 1.99	1.46	– 1.98		
Mean ± SD.	1.82	±0.16	1.83	± 0.20		
Median	1.89		1.90			
AO RI					18.536*	<0.001*
Min. – Max.	1.60	– 1.80	1.40	– 1.50		
Mean ± SD.	1.70	± .08	1.48	± .04		
Median	1.70		1.50			
AO PI					19.814*	<0.001*
Min. – Max.	0.70	–0.80	0.70	–0.72		
Mean ± SD.	0.77	±0.03	0.71	±0.01		
Median	0.78		0.71			
Cerebra placental ratio					9.398*	<0.001*
Min. – Max.	35.0	– 66.0	57.0	– 80.0		
Mean ± SD.	50.60	± 9.96	71.60	± 8.72		
Median	52.0		76.0			
Cerebra aortic ratio					9.319*	<0.001*
Min. – Max.	1.10	– 1.56	0.90	– 1.20		
Mean ± SD.	1.34	±0.13	1.06	±0.14		
Median	1.30		1.10			

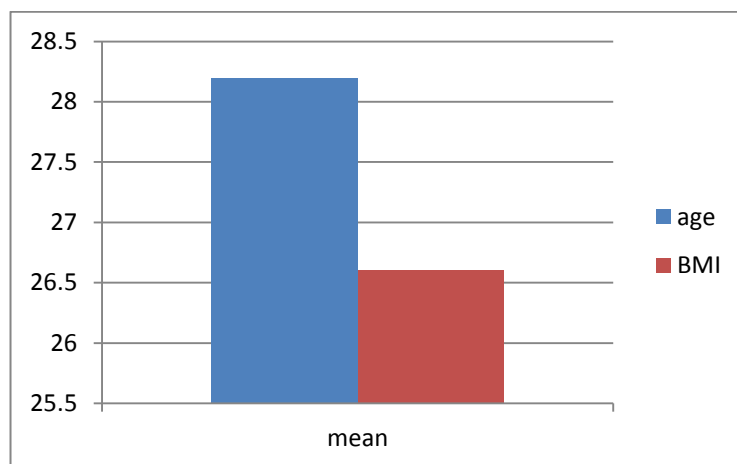
**Fig (1)** Distribution of the studied cases according to demographic data (n = 100).

Table (3) Relation between complications and fetal outcome.

	Non complicated (n = 75)	complicated (n = 25)	t	P
Gestational age at delivery				
Min. – Max.	37.0 – 42.0	36.0 – 38.0	10.143*	<0.001*
Mean ± SD.	39.47 ± 1.09	37.0 ± 0.91		
Median	39.0	37.0		
NBW				
Min. – Max.	2300.0 – 3400.0	1650.0 – 3500.0	4.546*	<0.001*
Mean ± SD.	2802.0 ± 323.92	2140.0 ± 703.71		
Median	2800.0	1800.0		
APGR 1min				
Min. – Max.	4.0 – 6.0	5.0 – 6.0	2.241*	0.027*
Mean ± SD.	5.07 ± 0.68	5.40 ± 0.50		
Median	5.0	5.0		
APGR 5min				
Min. – Max.	5.0 – 7.0	8.0 – 9.0	19.616*	<0.001*
Mean ± SD.	5.80 ± 0.75	8.40 ± 0.50		
Median	6.0	8.0		
UMA PH				
Min. – Max.	7.20 – 7.39	7.20 – 7.38	0.306	0.762
Mean ± SD.	7.28 ± 0.05	7.28 ± 0.07		
Median	7.27	7.26		

4. Discussion

Antepartum detection of the fetus at risk of death or compromise in utero remains a major challenge in modern obstetrics. The waveform analysis of the fetomaternal circulation by Doppler ultrasound has therefore become a quick and a simple way of screening and identifying fetal compromise [8].

In the current study we aimed to diagnosis of placental dysfunction and fetal hypoxia by evaluation of fetal arterial Doppler Velocimetry of Umbilical artery (UmA), Middle cerebral artery (MCA) and fetal descending abdominal Aorta (AO). Evaluation of cerebro-placental ratio (MCA/UmA) and cerebro-aortic ratio (MCA/AO) in late weeks of pregnancy were studied as predictors for neonatal outcome in complicated and uncomplicated pregnancies.

In the current study 100 patients were included with mean age of the patients were 28.2 years with min-max 19-43 years and mean BMI 26.6 kg/m², 25% of cases had positive family history of disease and most of them were parity 1 and parity 2 in 40% of cases

Askar AEA study conducted on 300 pregnant women with mean maternal age was 32.02 years, mean parity 1.72 [9].

In another study by Ghosh R showed that mean maternal age was 26.8 years with 5.9 SD and more than 50% participants belonged to 21 to 25 years age group. Almost 51.0% participants were primigravida and 53.6% birth was done through vaginal route [10].

In the current study as regard mean gestational age among patients was 37.5 and mean gestational age at delivery was 38.85 with 60% of patients had CS and 40% had ND

Similarly Askar AEA showed that mean gestational age at delivery was 37.98 weeks and 54% of patients had cesarean section, 46% had vaginal delivery [9].

In the current study the mean umbilical artery RI, PI was 0.62 and 1 respectively, the mean MCA RI and PI was 0.79 and 1.83 respectively, the mean AO RI and PI was 1.65 and 0.76 respectively, the mean Cerebro-placental ratio and cerebro-aortic ratio was 55.85 and 1.27 respectively

In comparison to other studies Askar AEA showed that regarding mean UA-PI and MCA-PI was 0.89, 1.17 respectively [9].

In the current study as regard fetal outcome, mean NBW was 2636.5, mean apgar 1st and 5 min was 5.15 and 6.45 respectively and mean UMA PH was 7.28, 75% of patients non complicated but 25% of them complicated

This higher than that found in Ghosh R they found that mean birth weight was 2150 gm with 256.7 SD [10].

In the current study 75% of neonates didn't admitted to NICU but 25% of them had NICU admission

The most common adverse perinatal outcome in Ghosh R study was admission in NICU >24 hours in about 40% in patients, fetal distress, APGAR score <7, Neonatal death respectively [10].

In the current study as regard maternal factors that affecting NICU admission the significant factors were increase in BMI, lower GA higher parity, positive family history of disease, there was significant relation between NICU admission and Umbilical PI

In agreement with our result Severi FM showed that Fetuses with abnormal Doppler MCA/UA PI ratio in our study had a significantly lower birth weight, lower gestational age at delivery, 1 significantly higher incidence of perinatal deaths, higher incidence of admission to NICU and longer duration of treatment there, lower Apgar score at 5 minute [11].

McCowan & Gudmundsson have also shown similar results [12,13], Thus the resistance and flow in the umbilical artery is a good indicator of placental function and neonatal morbidity. However the presence of normal umbilical artery Doppler does not rule out the chance of perinatal morbidity as the changes in the Doppler indices do not occur in mild forms of placental insufficiency and they become abnormal only in advanced stages of placental dysfunction.

In the current study there was significant relation between NICU admission and MCA RI

But Reddy A found that an abnormal MCA Doppler was observed in 17.5% of the high risk and 2.5% of the control group. Although correlation of abnormal MCA Doppler was seen with perinatal morbidities but none of them was significant. However, as with the other Doppler parameters, the specificity and the negative predictive value of abnormal MCA Doppler was high [14].

NOVAC MV agree with our result as they showed that Abnormal Doppler velocimetry of uterine, middle cerebral artery and umbilical arteries was correlated with SGA newborns, premature birth, Apgar score and admission to NICU. It seems that the three arteries UtA, MCA and UA have the ability to detect fetuses at perinatal outcome risk [15].

In the current study there was significant relation between NICU admission and AO RI, AO PI

In Ertan EK showed that Due to this reason the S/D ratio in the fetal aorta goes far than the S/D ratio in the UA. As pregnancy advances, the fetal aortic diameter gets wider, which decreases peripheral resistance and increases diastolic flow component, elevated S/D ratio, RI and PI is associated with adverse perinatal outcomes [16].

In the current study there was significant relation between NICU admission and Cerebra placental ratio, Cerebra aortic ratio

In Bano found that the MCA PI to the UA PI (C/U ratio) ratio was a better predictor of SGA newborns and adverse perinatal outcome than either the MCA PI or UA PI alone. The C/U ratio demonstrated a 100% specificity and PPV in diagnosing IUGR and predicting adverse perinatal outcome, but had a low sensitivity of 44.4% and an negative predictive values (NPVs) of 64.3% in diagnosing IUGR, but a relatively higher sensitivity of 83.3% and an NPV of 94.3% for predicting adverse perinatal outcome. The sensitivity and NPV of the C/U ratio were comparable to those of UA PI, but much higher than those of MCA PI [17].

In agreement with our result Ghosh R showed that MCA PI/UA PI ratio was <1 statistically significant ($p < 0.05$) in 25.5% and absent in 17.3% among cases of adverse perinatal outcome [18].

5. Conclusion

Ultrasound examination and Doppler monitoring provide a non-invasive repetitive method for supervising fetuses with any abnormalities in order to apply an adequate management.

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