e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(9); 93-97

Original Research Article

Role of Modified Biophysical Profile and Doppler Ultrasonography Studies in Predicting Perinatal Outcome in High-Risk Pregnancies: A Comparative Study

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Received: 09-02-2023 Revised: 06-03-2023 / Accepted: 25-04-2023

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Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to compare MBPP and umbilical artery Doppler flow in high-risk pregnant women in prediction of perinatal outcome in high-risk pregnancies.

Material & Methods: A prospective observational and comparative study was done on 100 high-risk pregnant women over 12 months. Antenatal women with singleton pregnancy who delivered within 48 hours of performing MBPP and Doppler USG, with presence of ≥1 high-risk factor like pre-eclampsia/gestational HTN, BOH, post-dated pregnancy, FGR, GDM, maternal heart disease, anaemia, hypothyroidism and IHCP were included in the study. MBPP (NST and AFI) and umbilical artery Doppler was performed. Perinatal outcome was measured in terms of stillbirth/IUD, LBW, Apgar <7 at 5 minutes, admission to NICU, neonatal death within 48 hours of delivery, MSL and neonatal seizures within 24-48 hours.

Results: Out of 140 Patients included in our study 84 new born had adverse perinatal outcome. Umbilical artery Doppler velocimetry and MCA was done in all 140 study participants. The three categories of neonatal outcomes were healthy baby, IUGR, and neonatal death. 56 of the 70 patients with normal MBPP (70%) delivered healthy babies. 65 (72.22%) patients delivered healthy neonates. APGAR score was more than 7 in 70 (87.5%) and less than 7 in 10 cases, when Doppler studies was normal while APGAR was more than 7 in 82 patients (91.11%) and less than 7 in 8 patients when Doppler studies was abnormal this was statistically significant. It was seen that MBPP had a sensitivity of 90.60%, specificity 57.93%, PPV 61.06%, NPV 89.08% while that of Umbilical artery Doppler was 88.32%, 53.37%, 55.75% and 87.23% respectively.

Conclusion: MBPP is a better predictor of perinatal outcome compared to umbilical artery Doppler USG in high-risk pregnant women. MBPP should be done in all high-risk pregnancies even if Doppler is normal. Both the tests must be performed in all high-risk pregnancies to improve perinatal outcome.

Keywords: High risk pregnancy, Modified biophysical profile, Non-stress test, Perinatal outcome, Umbilical artery Doppler

Introduction

Identification of foetuses at risk for growth restriction and hypoxemia is the main objective of antepartum foetal surveillance. [1] It is anticipated that fulfilling this objective will lead to better perinatal outcomes. Any protocol for the surveillance of high-risk pregnancies must start with the avoidance of unnecessary intervention. Biophysical Physical Profile (BPP) described by Manning [2] assesses five different fetal parameters to assess fetal well-being, which include a non-stress test, fetal movements, fetal muscle tone, fetal breathing movement, and amniotic fluid volume. The limitation of the BPP is that it is time-consuming, taking an average of 30 minutes for the procedure. [3]

In modified BPP, the same goal is achieved using two parameters. Amniotic fluid index (AFI), which measures the long-term adequacy of placental function [4] and nonstress test (NST), a screening procedure used to determine the health of the foetus by monitoring the foetal heart rate. [5] It can be completed in less time (15 to 20 minutes) than a biophysical profile. [6] A modified biophysical profile (MBP) consisting of a nonstress test (NST) and an amniotic fluid index (AFI) is used widely. The modified profile seems practical for the routine

assessment of fetal well-being in high-risk pregnancy, and affords insights unavailable with ultrasound surveillance alone. [7] Umbilical artery angle-independent indices (pulsatility index or systolic/diastolic (S/D) ratio) decrease with advancing gestation because of a decreased placental vascular resistance, which occurs physiologically with advancing gestation. [8]

The modified biophysical profile (MBPP) suggested by Nageotte et al, combines non-stress test (NST) as a short term marker of foetal status and the amniotic fluid index (AFI) as marker of long term placental function and is easier to perform and less time consuming than complete biophysical profile or contraction stress test. [9] Also, MBPP is considered to be as effective as complete biophysical profile. Doppler ultrasound is a non- invasive procedure that aims to evaluate blood flow in the vessels supplying the placenta and the foetus. Different vessels examined are - uterine artery, umbilical artery, middle cerebral artery and ductus venosus. It is necessary in pregnancy complicated by FGR, oligohydramnios, twin-twin transfusion syndrome and discordant twins. High-risk pregnancies increase the maternal and foetal morbidity and mortality; and there is a need for appropriate investigation which can diagnose it early and improve perinatal outcome. Hence, this study was undertaken to compare MBPP (NST and amniotic fluid index) and umbilical artery Doppler findings in assessing the perinatal outcome in high-risk pregnancy.

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Material & Methods

A prospective observational and comparative study conducted in the Department of obstetrics and Gynaecology, JLN Medical College and Hospital, Bhagalpur, Bihar, India over a period of 12 months (Jan 2022 to Dec 2022). Patients who presented to the obstetric unit who met the below inclusion criteria were recruited in this study to determine the efficacy of MBBP vs Doppler studies to determine poor perinatal outcome. high-risk antenatal women with singleton pregnancy, who delivered within 48 hours of performing MBPP and Doppler ultrasound and who were willing to participate in the study were enrolled into the study after informed consent and ethical clearance. 140 patients were included in the study.

Inclusion criteria

Singleton pregnancy above 37weeks of gestation and high-risk pregnancies which includes:

- Pregnancy-induced hypertension (PIH)
- Post-dated pregnancy (>42 weeks)
- Foetal growth restriction (FGR)
- Gestational diabetes mellitus (GDM)
- Maternal heart disease
- Anemia
- RH negative status
- Amniotic fluid disorders
- Hypothyroidism

Exclusion criteria

- Below 37 weeks of gestation
- Multiple gestation
- Low-risk pregnancies

In all cases, accurate gestational age was established from detailed menstrual history and first trimester ultrasound. Detailed history, examination, investigation and monitoring were done as per the hospital protocol. All the 140 participants initially sent for routine investigations (complete blood count (CBC), blood group and RH typing and later USG (GE, Model - Logiq P3) - AFI and NST, Doppler studies (umbilical artery and MCA) were done. These women were subjected to umbilical artery Doppler study and modified BPP evaluation as close to delivery as possible. Results of these tests were correlated with perinatal outcome. Termination of pregnancy was done as per the routine management protocol. Maternal outcome in terms of type delivery (spontaneous/induced) and mode of delivery were recorded.

Doppler study was considered abnormal when any of the following parameters were met:

- Pulsatility index of UA>95th percentile for the gestational age.
- Absence or reversal of end diastolic flow in umbilical artery or persistent early diastolic notch in uterine artery.
- S/D ratio more than 3 in umbilical artery after 30 weeks of gestation and more than 2.6 in uterine artery was considered abnormal.

NST was considered as reactive with more than or equal to 2 accelerations of more than or equal to 15 beats/minute lasting for more than or equal to 15 seconds, with good beat-to-beat variability and no decelerations. AFI less than or equal to 5 and more than or equal to 25 was considered abnormal.

Based on the Doppler velocimetry and MBPP results, the study population was divided into four groups:

- A-Normal MBPP and normal Doppler velocimetry
- B-Normal MBPP and abnormal Doppler velocimetry
- C-Abnormal MBPP and normal Doppler velocimetry

- D-Abnormal MBPP and abnormal Doppler velocimetry.

Perinatal outcome was measured in terms of stillbirth/IUD, LBW, Apgar <7 at 5 minutes, admission to NICU, neonatal death within 48 hours of delivery, MSL and neonatal seizures within 24-48 hours. Mother and neonate were followed up till they were discharged from the hospital.

Statistical Analysis

The data obtained was entered in a Microsoft Excel sheet, and statistical analysis was performed using a statistical package for the social sciences (SPSS Version 20). For normally distributed continuous variables between the groups were compared using ANOVA, for not normally distributed variables Kruslal walli's test were used. $p<0.05$ were considered statistically significant. All statistical tests were performed two tailed.

Results

Table 1: Group wise perinatal outcome

Groups	Group A N =50	Group B N=30	Group C N=40	Group D N=20	P Value
Nicu admission	3	29	36	16	0.01
LBW <2.5 kgs	15	11	16	10	0.03
Resuscitaion at birth	5	24	26	13	0.001
Meconium stained liquour	0	12	20	8	0.001
Apgar at birth <7 at 5 minutes	0	3	2	3	0.0170
Perinatal mortality	0	1	0	1	0.001
Total with adverse perinatal outcome	3	29	36	16	0.01

Out of 140 Patients included in our study 84 new born had adverse perinatal outcome.

Table 2: MBPP V/S Doppler studies with respect to adverse perinatal outcome

		MBPP			DOPPLER STUDIES		
		Normal n=80	Abnormal N=60	P value	Normal N=90	Abnormal N=50	P value
Neonatal Outcome	Healthy	56 (70%)	34 (56.66%)	0.001	65 (72.22%)	30(60%)	0.001
	IUGR	16 (20%)	24 (40%)	0.7	25(27.78%)	10 (5%)	0.6
	Neonatal death	8 (10%)	2 (3.33%)	0.01	0	10 (5%)	0.001
APGAR At 5 Minutes	0-3	2 (2.5%)	5 (8.33%)	5.5	2(2.2%)	12(6%)	<0.001
	4-6	8 (10%)	12(20%)		6(6.6%)	15(30%)	
	6-10	70 (87.5%)	43(71.66%)		82(91.11%)	23(46%)	
Fetal Distress Intrapartum		24(30%)	45(75%)	<0.001	34(37.77%)	26(52%)	0.02
Low Birth Weight <2.5kgs		32 (40%)	25 (41.66%)	0.002	28(31.11%)	18(36%)	0.4544
Caesarean due to fetal distress		14 (17.5%)	24(40%)	0.0016	14(15.5%)	22(44%)	0.001
Resuscitation Required at Birth	Routine Care	56 (70%)	6 (10%)	0.001	54(60%)	10(5%)	<0.001
	Bag and Mask	16 (20%)	24 (40%)		20(22.2%)	22(42%)	
	Intubation	8 (10%)	30 (50%)		14(15.55%)	18(36%)	
Neonatal Complications	Hypoglycaemia	2(2.5%)	2 (3.33%)	0.001	2(2.2%)	1(2%)	<0.001
	Sepsis	1 (1.25%)	5 (8.33%)		3(3.3%)	1(2%)	
	MAS	12 (15%)	24 (40%)		16(17.7%)	22(44%)	
	RDS	8 (10%)	6 (10%)		4(4.4%)	9(18%)	
	TTN	8 (10%)	6 (10%)		50(55.55%)	7(14%)	
	Seizures	49 (61.25%)	17 (28.33%)		10(11.11%)	10(20%)	
Meconium-stained liquor	Clear	64 (80%)	32 (53.33%)	0.001	72(80%)	28(56%)	0.002
	MSL	16 (20%)	28 (46.66%)		18(20%)	22(44%)	

Umbilical artery Doppler velocimetry and MCA was done in all 140 study participants. The three categories of neonatal outcomes were healthy baby, IUGR, and neonatal death. 56 of the 70 patients with normal MBPP (70%) delivered healthy babies. 65 (72.22%) patients delivered healthy neonates. APGAR score was more than 7 in 70 (87.5%) and less than 7 in 10 cases, when Doppler studies was

normal while APGAR was more than 7 in 82 patients (91.11%) and less than 7 in 8 patients when Doppler studies was abnormal this was statistically significant.

Table 3: Sensitivity, specificity, PPV, NPV, positive likelihood ratio

	Sensitivity	Specificity	PPV	NPV	Positive likelihood ratio
MBPP	90.60%	57.93%	61.06%	89.08%	2.6
Doppler	88.32%	53.37%	55.75%	87.23%	1.88
MBPP + Doppler combined	96.84%	45.75%			
Any one abnormal	86.94%	74.16%			

It was seen that MBPP had a sensitivity of 90.60%, specificity 57.93%, PPV 61.06%, NPV 89.08% while that of Umbilical artery Doppler was 88.32%, 53.37%, 55.75% and 87.23% respectively.

Discussion

Perinatal mortality is one of the most important public health issues in the developing countries and high-risk pregnancy is a major contributor of increased perinatal morbidity and mortality.[10] About 7.3 million perinatal deaths occur every year around the world and majority occur in Asia. In India alone, around 890000 deaths of the infants occur annually. [11] Antepartum foetal surveillance is of immense importance for detection of foetal compromise in utero in high-risk pregnancies. Various tests that assess high risk pregnancy are non-stress test (NST), contraction stress test (CST), biophysical profile (BPP), modified BPP (MBPP) and Doppler velocimetry. Various authors compared the efficiency of NST, BPP and abnormal Doppler findings in predicting adverse perinatal outcome in high-risk pregnancies in search of a better tool for perinatal outcome. [12] In high-risk pregnancies, fetal biophysical profile is a well-established method of antepartum surveillance. Manning et al. described classical biophysical profile which includes the following five parameters: Fetal tone, breathing movements, gross body movements, amniotic fluid volume, and non-stress test (NST)—which is more complicated, not feasible, and costly. [13] Nageotte et al. first described MBP which includes amniotic fluid index (AFI) and a NST. Amniotic fluid index is an indicator of long-term placental function and NST is a marker of short-term fetal status. [6]

Out of 140 Patients included in our study 84 new born had adverse perinatal outcome. Umbilical artery Doppler velocimetry and MCA was done in all 140 study participants. The three categories of neonatal outcomes were healthy baby, IUGR, and neonatal death. 56 of the 70 patients with normal MBPP (70%) delivered healthy babies. 65 (72.22%) patients delivered healthy neonates. APGAR score was more than 7 in 70 (87.5%) and less than 7 in 10 cases, when Doppler studies was normal while APGAR was more than 7 in 82 patients (91.11%) and less than 7 in 8 patients when Doppler studies was abnormal this was statistically significant. In the study by Choudhary N et al, the highest percentage of perinatal complications, NICU admissions and perinatal deaths were seen in groups with abnormal test results of both NST and velocimetry similar to this study. This study concluded that Doppler velocimetry was better in predicting foetal compromise in comparison to NST in high-risk pregnancies. [9]

It was seen that MBPP had a sensitivity of 90.60%, specificity 57.93%, PPV 61.06%, NPV 89.08% while that of Umbilical artery Doppler was 88.32%, 53.37%, 55.75% and 87.23% respectively. In another study, Gonzalez compared the efficacy of nonstress test, biophysical profile, or abnormal Dopplers for predicting adverse perinatal outcomes in 151 singleton pregnancies with intrauterine growth restriction. Sensitivity, specificity, PPV, NPV of Doppler in predicting adverse perinatal outcomes were 28%, 88%, 42%, 79% whereas that of NST were 33%, 89%, 50% and 81% respectively. [12]

The study conducted by Mehmet Bardakci et al [14] on 315 high risk patients in which Amniotic fluid index, uterine, and umbilical artery Doppler indices were assessed following standard examination. The findings demonstrated that MBPP had sensitivity was 60%, umbilical artery Doppler was 50%, and uterine artery Doppler was 30% in predicting the NRFS. The sensitivity increased to 70% in cases where MBPP and umbilical artery Doppler tests were combined. Hence, MBPP was more relevant than Doppler analysis in predicting NRFS, but when combined, the predictive value had more significant value. In research by Dr. Urvashi Verma [15] involving 100 patients, the sensitivity and specificity of the doppler were 83.58% and 72.73%, respectively, while those of the non-stress test were 74.32% and 61.54%. This was in contrast to our study, in which MBPP was a stronger predictor of neonatal outcome.

Conclusion

MBPP was proven to be a better predictor of perinatal outcome compared to umbilical artery Doppler ultrasound in high-risk pregnant women. MBPP should be done in all high-risk pregnancies

even if Doppler is normal. Doppler or MBPP can predict adverse perinatal outcome in pregnancy complicated by any high-risk factor irrespective of FGR. Hence, both these antenatal surveillance tests must be performed in all high-risk pregnant women to improve perinatal outcome.

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