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Comparison of modified biophysical profile and doppler ultrasonography studies in predicting perinatal outcome in high-risk pregnancies

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Abstract
In order to improve perinatal outcomes and reduce mother and foetal morbidity and mortality especially in high-risk pregnancies, there is an immense need to do thorough antepartum surveillance test.
Aims and Objectives: To compare modified biophysical profile (MBPP) and Doppler studies results for prediction of perinatal outcome and to evaluate the association between the mode of delivery and abnormal Doppler and MBPP.
Methodology: This is a prospective observational and comparative study. High-risk term patients were taken in this study, following which MBPP and Doppler studies were performed within 48 to 72 hours of delivery.
The study population were divided as follows and perinatal outcome was assessed:

- 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.

Results: The high-risk factor for the greatest number of patients, which accounted for 39.33% of patients, was pregnancy-induced hypertension. Age was less than 25 years in 88 patients (55%). 67 patients were primigravida (44.7%), LSCS was the mode of termination of pregnancy in 127 (84.7%) patients.
Greatest prenatal complications occurred in individuals who had abnormal MBPP and Doppler, with a significant P value of < 0.05., Subsequently followed by MBPP, which had a significantly higher NPV than Doppler studies (63.64% vs. 59.41%), which makes it helpful for identifying healthy new-borns.
Conclusion: In our study, it was determined that better prediction of adverse perinatal outcome was observed when both Doppler studies and MBPP was done in combination followed by MBPP.

Keywords: High- risk, Doppler studies, MBPP, adverse perinatal outcome, NICU admission

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].
The aim of the evaluation of fetal health during the antenatal period is to prevent intra uterine fetal demise and to avoid fetal complications due to asphyxia.
A non-invasive technique doppler ultrasound is used to measure the blood flow in the vessels supplying the placenta and the foetus. The foetus's middle cerebral artery and umbilical artery were the two vessels that were evaluated. Aberrant umbilical artery Doppler is a sign of intrauterine growth restriction (IUGR), probable pre-eclampsia, and placental insufficiency [7, 8]. For all high-risk pregnancies, it is crucial.

In this new era of technological and medical advancements, earlier interventions are expected from obstetricians to improve maternal and perinatal outcomes even before the complications sets in during pregnancy. Hence, we conducted this study to compare Modified BPP (NST and amniotic fluid index) and Doppler findings in evaluating a pregnancy's perinatal outcome.

Material and Methods

Patients who presented to the obstetric unit at BLDE (Deemed to Be University) Shri B. M. Patil Medical College Hospital & Research Centre, Vijayapura Karnataka, India and which met the below inclusion criteria were recruited in this study to determine the efficacy of MBBP vs Doppler studies to determine poor perinatal outcome. All the participants initially sent for routine investigations (complete blood count (CBC), blood group and RH typing and later USG- AFI and NST, Doppler studies (umbilical artery and MCA) were done.

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

Sample size

150 patients

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 Verson 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.

Non-stress test

According to ACOG [8]. If there are two or more foetal heart rate accelerations within 20 minutes, with or without maternally perceptible foetal movement. The NST is generally observed to be reactive from 32 weeks [9]

Amniotic Fluid Index (AFI)

By summing the four deepest, clearest, vertical fluid pockets, the AFI is obtained. The typical AFI ranges from 5 to 25 cm and any derangement from these values are considered abnormal [10].

Doppler study

The umbilical cord's indices measured at its placental, free loop, and foetal ends are all different, with the foetal end's impedance being the highest [11].

Measurements were made of the middle cerebral artery's and umbilical artery's RI, PI, and SD ratios.

When any of the following criteria were satisfied, Doppler studies are deemed abnormal.

- UA>95th percentile for the gestational age pulsatility index.
- After 30 weeks of pregnancy, end-diastolic flow either absent or reversed in the umbilical vein.
- The umbilical artery's S/D ratio is higher than 3.
- At the gestational age, the middle cerebral artery's RI is less than the fifth percentile.
- The umbilical artery's end diastolic flow, whether it is present, absent, or in reverse.
- Middle cerebral artery has a brain-sparing effect.

Based on the Doppler velocimetry and MBPP results, the participants were 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.

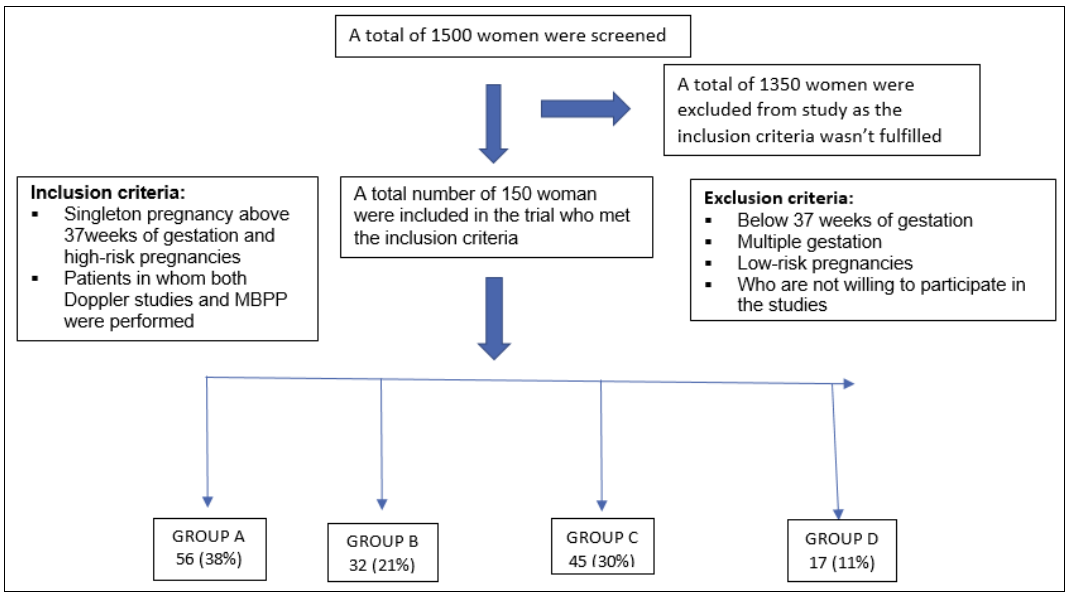
The modified biophysical profile will be considered abnormal if any of the following parameters are deranged AFI or NST

Perinatal outcomes will be noted within 48 hours of delivery

In our study adverse perinatal outcome were measured in terms of the following factors**.**

- NICU admission
- Neonatal Outcome
- APGAR At 5 Minutes
- Fetal Distress Intrapartum
- Caesarean section due to fetal distress
- Resuscitation Required at Birth
- Neonatal Complications
- Meconium-stained liquor

Results



Consort flow chart representing the recruitment of women

A total of 150 patients who fulfilled the pre-established criteria were included int this study.

Following are the results of the study as per statistical analysis of all the cases:

56 (38%) of the patients met the criteria of Group, 32 (21%) in Group B, 45 (30%) Group C and 17 (11%) in group D.

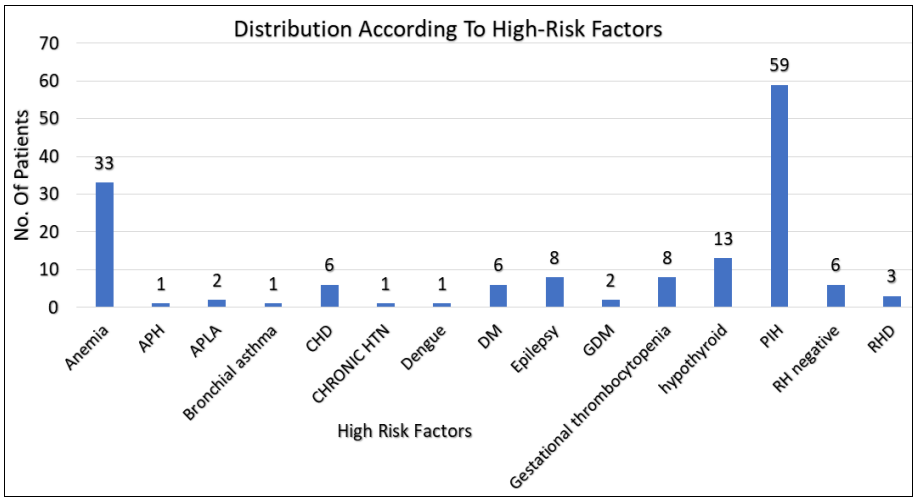


Fig 1: showing high risk factors

The high-risk factor for the greatest number of patients, which accounted for 39.33% of patients, was pregnancy-induced hypertension, followed by anaemia (22%).

Maximum number of patients i.e., 83 patients were of the age below 25 years (55.33%) while least number of patients were above 30 years i.e., 18 (12%) while 49 patients were of the age group 25 to 30 years (32.67%).

67 patients (44.7%) out of 150 patients were primigravida who had a high-risk pregnancy which was significantly lower than multigravida patients (55.3%).

Higher number of participants i.e., 127 (84.7%) among the total patients underwent lower segment C section and while only 23 (15.4%) delivered vaginally. It was attributed to the fact that the study was carried out in a tertiary care facility where the majority of cases are referred or unbooked cases with inadequate antenatal care.

Perinatal outcome group wise distribution

Out of 150 Patients included in our study 88 new born had adverse perinatal outcome.

Table 1: showing group wise perinatal outcome

Group	A N =56	B N=32	C N=45	D N=17	P Value
Nicu admission	2	30	39	17	*0.01
LBW <2.5 kgs	14	10	17	11	*0.02
Resuscitaion at birth	4	26	29	14	*0.001
Meconium stained liquour	0	13	21	9	*0.001
Apgar at birth <7 at 5 minutes	0	4	2	3	*0.0165

Perinatal mortality	0	1	0	1	*0.001
Total with adverse perinatal outcome	2	30	39	17	*0.01

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

		MBPP			DOPPLER STUDIES		
		Normal n=88	**Abnormal N=62**	**P value**	**Normal N=101**	**Abnormal N=49**	**P value**
NICU admission		32 (36.3%)	56 (90.3%)	<0.001*	42 (41.5%)	47(95.9%)	0.0020*
Neonatal Outcome	Healthy	69 (68.3%)	2 (4.8%)	0.001*	69 (68.3%)	2(4.8%)	0.001*
	IUGR	4 (45.4%)	13 (20.9%)	0.8	5(49.5%)	12(24.4%)	0.6
	Neonatal death	1 (1.1%)	1 (1.6%)	0.01*	0	2(4.8%)	0.001*
APGAR At 5 Minutes	0-3	2 (2.2%)	4 (6.4%)	5.3	3(2.9%)	3(6.1%)	<0.001*
	4-6	8 (9%)	12(13.3%)		7(6.9%)	13(26.5%)	
	6-10	78 (88.6%)	46(74.1%)		91(90.9%)	33(67%)	
Fetal Distress Intrapartum		14(28%)	47(75.8%)	<0.001*	35(4.6%)	26(53%)	0.03*
Low Birth Weight <2.5kgs		19 (42%)	28 (45.1%)	0.002*	31(30.6%)	18(36.7%)	0.4593
Caesarean due to fetal distress		14 (15.9%)	24(38.7%)	0.0016*	16(15.8%)	22(44.8%)	0.001*
Resuscitation Required at Birth	Routine Care	60 (68.1%)	6 (9.6%)	0.001*	60(59.4%)	2(4.8%)	<0.001*
	Bag and Mask	15(17%)	26 (41.9%)		23(22.7%)	21(42.8%)	
	Intubation	13(14.7%)	30 (48.3%)		18(17.8%)	26(53.06%)	
Neonatal Complications	Hypoglycaemia	2(2.2%)	2 (3.2%)	0.001*	3(2.9%)	1(2.04%)	<0.001*
	Sepsis	1 (1.1%)	4(6.4%)		4(3.9%)	1(2.04%)	
	MAS	13 (14.7%)	27 (43.5%)		18(17.8%)	21(42.8%)	
	RDS	7 (7.9%)	7 (11.2%)		4(3.9%)	9(18.3%)	
	TTN	7 (7.9%)	5 (8%)		5(4.9%)	7(14.2%)	
	Seizures	2 (2.2%)	11 (17%)		7(6.9%)	6(12.2%)	
Meconium-stained liquor	Clear	75 (85.2%)	32 (51%)	0.001*	80(79.2%)	27(55.1%)	0.002*
	MSL	13 (14.7%)	30 (48.3%)		21(20.2%)	22(44.8%)	

We may derive from the data in this table that Group D (abnormal Doppler studies and abnormal MBPP) had the highest rate of complications, followed by Group C (only abnormal MBPP).

Corelation between MBPP, Doppler studies and adverse perinatal outcome

Umbilical artery Doppler velocimetry and MCA was done in all 150 study participants, normal umbilical artery flow was seen in 114 patients. High resistance flow pattern (increased S/D ration was seen in 9 patients (6%), AEDF in 14 (9.3%), REDF 13 patients 8.6%, 137 patients had normal MCA Doppler Studies, 13 had low resistance flow (8.6%).

MBPP was abnormal in 62 out of 150 cases in our study. In 13 patients' AFI was less than 3 cm, 8 patients' AFI was 3 to 5 cm, and 29 patients' AFI was 5-8. While it was normal i.e., between 8 to 25 cm in 100 patients.

The three categories of neonatal outcomes were healthy baby, IUGR, and neonatal death. 4 of the 69 patients with normal MBPP (68.3%) delivered healthy babies. 13 (20.9%) individuals with abnormal MBPP had IUGR, while 2 (4.8%) patients had healthy pregnancies.

69 (68.3%) patients delivered healthy neonates while normal Doppler studies healthy baby, 5 (49.5%) had IUGR while 2(4.8%) delivered a healthy baby, 12(24.4%) had IUGR with abnormal Doppler studies.

APGAR score was more than 7 in 91 (90.1%) and less than 7 in 10 cases, when Doppler studies was normal while APGAR was more than 7 in 33 patients (67%) and less than 7 in 16 patients when Doppler studies was abnormal this was statistically significant.

APGAR score was less than 7 in 6 neonates delivered by patients of Group A, 13 of Group B, 5 of Group C and 11 of Group D.

Fetal distress was there in 14 (28%) when MBPP was normal, and 47 patients when MBPP was abnormal. Fetal distress was there in 35 (4.6%) when Doppler studies were normal, and 26 patients when Doppler studies was abnormal.

19 patients had LBW when MBPP was normal while 28 (45.1%) had LBW when MBPP was abnormal. 31 (30.6%) had LBW when Doppler studies was normal and 18 (36.7%) when Doppler studies were abnormal.

14 patients underwent C section due to festal distress when MBPP was normal while 24 underwent C section for festal distress when MBPP was abnormal (38.7%).16 patients underwent C section due to fetal distress when Doppler studies was normal while 22 underwent C section for festal distress when Doppler studies was abnormal (44.8%) since P value was 0.001 it was statistically significant.

It was observed that when Doppler studies were abnormal 26 new born were intubated at birth (53.06%) while when MBPP was abnormal 30 (48.3%) were intubated.

Liquor was clear in 75(85.2%) patients when MBPP was normal while 80 (79.2%) when Doppler studies were abnormal.

Doppler studies were abnormal in 49 out of 150 patients and it was able to predict adverse perinatal outcome in 47 patients (95.9%) which was statistically significant <0.002*.

MBPP were abnormal in 62 out of 150 patients and was able to predict adverse perinatal outcome in 56 (90.3%) which was statically significant <0.001

Corelation between MBPP, Doppler studies and combined test and adverse perinatal outcome

Table 3: Table showing corelation between MBPP, Doppler studies and combined test and adverse perinatal outcome

	Sensitivity	**Specificity**	**PPV**	**NPV**	**Acuracy**
Doppler Studies					

NICU Admission	53.41%	96.77%	95.92%	59.41%	71.33%
APGAR <7	61.54%	73.39%	32.65%	90.10%	71.33%
Fetal Distress	42.62%	74.24%	60.47%	58.33%	59.06%
Low birth weight	40.38%	73.64%	42.00%	72.32%	62.96%
Resuscitation at birth	59.06%	78.30%	53.06%	82.18%	72.67%
Neonatal complication	53.41%	96.77%	95.92%	59.41%	71.33%
C section for festal distress	42.62%	74.24%	60.47%	58.33%	59.06%
Staining of liquor	51.16%	74.77%	44.90%	79.21%	68.00%
Modified Biophysical Profile					
NICU Admission	65.96%	90.32%	91.18%	63.64%	75.64%
APGAR <7	62.96%	63.41%	27.42%	88.64%	63.33%
Fetal distress	77.05%	83.33%	81.03%	79.71%	80.31%
Low birth weight	53.85%	65.31%	45.16%	72.73%	61.33%
Resuscitation at birth	67.44%	40.91%	52.73%	56.25%	54.02%
Neonatal complication	65.96%	90.32%	91.18%	63.64%	75.64%
C section for fetal distress	77.05%	83.33%	81.03%	79.71%	80.31%
Staining of liquor	69.77%	70.09%	48.39%	85.23%	70.00%
Combined (Doppler studies and MBPP)					
NICU Admission	100.00%	96.43%	89.47%	100.00%	97.26%
APGAR <7	100.00%	84.85%	41.18%	100.00%	86.30%
Fetal Distress	85.00%	100.00%	100.00%	92.68%	94.83%
Low birth weight	100.00%	90.32%	64.71%	100.00%	91.78%
Resuscitation at birth	100.00%	91.80%	70.59%	100.00%	93.15%
Neonatal complication	100.00%	96.43%	89.47%	100.00%	97.26%
C section for festal distress	85.00%	100.00%	100.00%	92.68%	94.83%
Staining of liquor	100.00%	87.50%	52.94%	100.00%	89.04%

From the above data it was noted that combined when done MBPP and Doppler studies sensitivity, specificity, NPV, PPV and accuracy was highest in detecting adverse perinatal outcome as compared to when any of these tests were done alone. Following which MBPP was a better predictor for NICU admission, foetal distress, neonatal complication, C section for fetal distress and staining of liquor.

Discussion

This study had highest percentage of adverse perinatal outcome was in Group D where both tests were abnormal (100%), followed by MBPP (75.64%) which had higher accuracy as compared to Doppler studies (71.33%) in detecting perinatal outcome.

Out of 150 patients included in our study 88 new born had neonatal complications/ adverse perinatal outcome. The sensitivity of MBPP was 65.96%, Specificity 90.32%, PPV 91.18%, NPV 63.64%and Accuracy was 75.64%. Which was greater than that of Doppler studies, where the Sensitivity was 53.41%, Specificity was 96.77%, PPV was 95.92%, NPV was 59.41%, and Accuracy was 71.33%. However, the outcomes were as follows when both tests were conducted together, Sensitivity was 100.00%, specificity was 96.43%, positive predictive value (PPV) was 89.47%, negative predictive value (NPV) was 100.00%, and accuracy was 97.26%. Based on these results, we can conclude that the combined test was a better predictor of a poor perinatal outcome followed by MBPP.

In a study [12] by Khushboo Malhotra *et al.*, 150 high-risk pregnant women were studied. Both MBPP and umbilical artery Doppler were investigated. It was seen that MBPP had a sensitivity of 90.62%, specificity 56.98%, PPV 61.05%, NPV 89.09% while that of Umbilical artery Doppler was 88.33%, 53.33%, 55.79% and 87.27% respectively. These test's combined had sensitivity and specificity were 96.87% and 45.76%, respectively. The group with combined test had the highest rate of perinatal problems, followed by abnormal MBPP. These findings were consistent with our research.

The study conducted by Mehmet Bardakci *et al.* [13] 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 [14] 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

This study's primary goal was to compare Doppler velocimetry and MBPP, two foetal surveillance techniques, in order to accurately predict the perinatal outcome in high-risk pregnancies.

Perinatal outcome can be predicted by using MBPP and Doppler studies. The sensitivity, specificity, positive predictive value, and negative predictive value are all valid for both criteria.

When both of these tests were abnormal, there was a higher frequency of preterm induction, caesarean sections for foetal distress, low APGAR, NICU admissions, and the need for ventilation. So, the likelihood of a poor perinatal outcome may be decreased by integrating the two tests and taking appropriate action.

Out of both the parameters MBPP showed a better role in predicting perinatal outcome, MBPP can be performed as a standard screening technique to detect adverse perinatal outcome in term gestation especially in high-risk cases. Doppler studies though being good especially as a predictor of sudden detoriation in IUGR and also placental status assessment should not be used alone and is not a primarily tool of antenatal surveillance for high or low risk pregnancies.

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Conflict of interest
None declared

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Approved by the Institutional Ethics Committee

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