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Original Research Article

Comparative Study of Fetal Color Doppler versus Modified Biophysical Profile as Predictor of Perinatal Outcome

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Abstract

Aim: To study the sensitivity and specificity, Positive and Negative Predictive value of Modified BPP and Color Doppler. Comparative analysis of Modified BPP and Color Doppler as a predictor of perinatal outcome.

Material and Methods: This comparative prospective observational study was carried out on 189 antenatal patients of > 32 weeks pregnancy in department of obstetrics and gynaecology, Geetanjali medical college hospital, Udaipur, Rajasthan during period of 18 months from February 2021 to July 2022. All patients have been subjected to colour Doppler and modified BPP after routine examination and investigations and divided into four groups. The sensitivity, specificity, PPV and NPV of Modified biophysical profile and color Doppler in predicting the neonatal outcome were calculated.

Results: Among 189 cases, MBPP and Doppler was normal in 164 patients, 6 cases had abnormal Doppler, MBPP were abnormal in 10 cases and both Doppler and MBPP was abnormal in 9 cases. Those with normal MBPP and Doppler have better neonatal outcome and it was statistically significant. The sensitivity of Doppler and MBPP was 40% and 57.1% respectively. The results of combination of MBPP and Doppler showed higher sensitivity of 70%.

Conclusion: Modified biophysical profile and color Doppler both combined together are excellent and cost effective antepartum screening methods for fetal well*b*eing and are widely available in most centers in India.

Keywords: Modified biophysical profile, Non stress test, Color Doppler, Perinatal outcome, Fetal surveillance

Introduction

The objective of any pregnancy is healthy mother and baby. To achieve this, we need proper antenatal care and continuous fetal surveillance. There are many methods for

ante partum fetal surveillance. Two commonly used are Modified Biophysical profile and Color Doppler.

Other methods of antenatal fetal evaluation are- DFMR, Clinical examination, Non-stress test, Contraction stress test and Biophysical profile [1]. All pregnant women should be monitored during pregnancy and labor for fetal well-being. Women who are in high-risk category should be particularly targeted for intensified monitoring as they are liable for fetal growth restriction and still birth.

Biophysical profile includes: Fetal breathing movements, Gross body movement, Fetal tone, Non stress test and Amniotic fluid volume. Modified biophysical profile includes NST and AFI only.

NST is an indicator of present fetal condition, while AFI reflects long-term intrauterine fetal status.

Original BPP takes long time to complete as it includes: fetal respiration and limb tone. Modified BPP on the other hand is less time consuming with more practicability. NST can be easily performed on outdoor basis. It indicates intact fetal neurological coordination with fetal heart rate.

Main components of NST[2] are baseline fetal heart rate, baseline variability of FHR, acceleration and deceleration. NST is considered reactive when ≥ 2 accelerations of ≥ 15 beats /minute lasting for ≥15 seconds with good beat to beat variability and no deceleration.

Decrease amniotic fluid is associated with placental insufficiency, impaired lung development in fetus and fetal growth restrictions (FGR)[3] which is an indirect marker of fetal well being. Normal Range of AFI is 5 to 25 cm.[2] The Low False negative rate and ease of performance of modified BPP make it an excellent approach for evaluation of large number of high-risk patients especially when Contraction Stress test is time consuming and has its own contraindications to perform routine clinical practice. Modified Biophysical Profile is considered abnormal when NST is non-reactive and /or AFI <5.[2]

Fetal color Doppler reflects arrangements and rearrangements of hemodynamics. In case of fetal hypoxia, it is an easy, noninvasive method to detect fetal wellbeing. Vessels which are scanned by Doppler[4] are fetal umbilical artery, fetal middle cerebral artery, both maternal uterine arteries and fetal ductus venous.

This study was formulated to measure sensitivity, specificity, positive and negative predictive values of modified biophysical profile and colour Doppler. We've also analysed these antenatal tests to conclude whether one is superior to other or complementary to each other.

Material and Methods

After obtaining approval from institutional research ethical board and written informed patient's consent, this comparative prospective observational study was carried out on 189 antenatal patients of > 32 weeks pregnancy in department of obstetrics and gynaecology, Geetanjali medical college and hospital, Udaipur, Rajasthan during period of 18 months from February 2021 to July 2022. Our study was comparative prospective observational study.

Inclusion criteria: All antenatal patients with gestational age >32 weeks visiting at obstetrics gynaecology department, GMCH, Udaipur.

Exclusion criteria: Any congenital anomaly, Preterm labour and Premature rupture of membranes.

All patients were subjected to colour Doppler and modified BPP after doing routine examination and investigations.

During interpretation of modified BPP, AFI was calculated in USG either by sum of the deepest vertical pockets from 4 uterine quadrants or single deepest vertical fluid pocket. The single deepest vertical pocket is normally between 2-8 cm. AFI normally ranges between 8-24 cm. Four aspects of NST will be traced (base line foetal heart rate, variability of foetal heart rate, presence or absence of acceleration and deceleration). NST was recognized Reactive when two or more foetal heart rate accelerations of at least 15 beats per minute and lasting at least 15 seconds from baseline during 20 minutes. If no spontaneous foetal movement occurred during initial 20 minutes of observation then the test was continued for another 20 min and during this period foetal movement were provoked by external manipulation. If no acceleration were found up to 40 min then the test was non-reactive. Foetal Colour Doppler measured by umbilical artery, middle cerebral artery, ductus venosus and uterine arteries to determine foetal health and to predict placental dysfunction.

Doppler was considered abnormal if:

1. PI of uterine artery >2SD or> 95th percentile for gestational age.
2. PI of MCA < 5th percentile for gestational age.
3. Absence of end diastolic flow or reversal of end diastolic flow in umbilical artery.
4. Presence of brain sparing effect in middle cerebral artery.

Based on the Doppler and Modified biophysical profile results the study population was divided into 4 groups:

1. Group 1 - Normal Modified biophysical profile and normal Doppler.
2. Group 2 - Normal Modified biophysical profile and abnormal Doppler.
3. Group 3- Abnormal Modified biophysical profile and normal Doppler.
4. Group 4- Abnormal Modified biophysical profile and abnormal Doppler.

Data analysis:

The data was entered into *an* Exel sheet and SPSS IBM version 21 was used for statistical analysis. The *Chi-square* test was used to determine significant difference between the groups.

Results

Based on MBPP and Doppler among 189 patients, 164 cases were included in group 1,6 cases in group 2,10 cases in group 3 and 9 cases in group 4. Three cases were twin pregnancy in group 1.

The most common (38.62%) age group was between 25 to 30 years, with mean age of 27.5 years. 173 (91.5%) cases were multipara and 16 (8.46%) were primipara. In group 1, maximum (88.4%) had gestational age of 37-40wks. In group 2, all cases had gestational age of 37-40wks. In group 3 and 4, maximum 80% and 66.67% cases respectively had gestational age of 37-40wks. In all groups, maximum cases had normal delivery. LSCS was most common in Group 4 (44.4%), followed by group 3(30%), 2(16.7%), and least in group 1(14%).

Table 1: Baseline characteristics of Participants

Baseline characteristics	Number of participants	Percentage
Age group(years)		7.9
<20	15	22.7
20-25	43	38.6
26-30	73	30.6

>30	58	
Parity status		
Primigravida	16	8.46
Multigravida	173	91.5

Table 2: Groupwise distribution of gestational age and mode of delivery

	Group 1		Group 2		Group 3		Group 4	
Number of cases	164		6		10		9	
Gestational age	**Number of cases**	**Percentage**	**Number of cases**	**Percentage**	**Number of cases**	**Percentage**	**Number of cases**	**Percentage**
<37 weeks	19	11.5	0	0	2	20	3	33.3
37-40 weeks	145	88.4	6	100	8	80	6	66.6
>40 weeks	0	0	0	0	0	0	0	0
Mode of delivery								
Normal	141	86	5	83.3	7	70	5	55.6
LSCS	23	14	1	16.7	3	30	4	44.4

Perinatal outcome

Out of 187 patients 16 patients had adverse perinatal outcome. In all groups, maximum cases had APGAR score >7. Less than 7 score was maximum in group 4 (44.4%) and group 3(40%). All babies in group 1 and 2 have APGAR >7.

The mean birth weight was 2.7 kg in both group 1 and 2. In group 3, it was reported to be 2.5kg and in group 4, it was 2.3kg. Highest perinatal complications were reported in group 4 followed by group 3. Maximum NICU admission were seen in group 4. Birth asphyxia was most common neonatal complication amongst the babies shifted to NICU. Other causes were prematurity, hypothermia and meconium-stained liquor.

Table 3: Distribution of perinatal outcome among all study groups

	Group 1		Group 2		Group 3		Group 4	
APGAR score	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
<7	0	0	0	0	4	40	4	44.5
>/=7	167	100	6	100	6	60	5	55.5
NICU admission								
No	165	98.8	4	66.6	6	60	2	22
Yes	3	1.7	2	33.3	4	40	7	77.7

Group 1 has 100% specificity. Group 2 had low sensitivity (40%) and PPV (33.3%) but high specificity (97.5%) and NPV (98.1%). Group 3 had moderate sensitivity (57.1%), low PPV (33.3%), high specificity (96.3%) and NPV (98.15%). Group 4 shows high sensitivity index (70%)

and PPV (77.7%) with high specificity (98.77%) and NPV (98.17%).

Table 4: GroupWise distribution of sensitivity, specificity, PPV and NPV

Groups	Sensitivity	Specificity	PPV	NPV
Group 1	NA	100	NA	98.17
Group 2	40	97.5	33.3	98.1
Group 3	57.1	96.3	40	98.15
Group 4	70	98.7	77.77	98.17

Discussion

We observed that maximum newborns had APGAR score more than 7. In group three, 40% and in group four, 44.4% had APGAR score less than 7. Statistical analysis revealed a significant (p-value<0.05) difference between study groups in relation to weight and APGAR score. We observed that in group 1, 2 and 3 NICU admission were lesser (1.7%, 33.3%, 40 %) compared to group 4 where 77.7% neonates needed NICU which was statistically significant (p-value<0.05). Luckily no perinatal mortality was reported in our study.

We assessed the relationship between MBPP and Doppler with neonatal outcome. Maximum cases with normal MBPP had good neonatal outcome, cases with abnormal MBPP had adverse effect on neonates. Similarly, most patients with normal Doppler had good neonatal outcome, whereas abnormal Doppler was associated with adverse outcome. The validity tests such as sensitivity, specificity, PPV, and NPV, accuracy of diagnosis in predicting the neonatal outcome applying MBPP and Doppler analysis independently and as a combination were done. True positive cases were maximum with combined MBPP and Doppler, followed by Doppler and MBPP.

Sensitivity was maximum (70%) with both MBPP and Doppler combined, followed by MBPP (57.1%) alone and least being with Doppler (40%). Specificity was maximum 98.7% with both MBPP and Doppler combined, followed by Doppler (97.5%) and least being 96.3% with MBPP. But both the methods alone or combined had very high specificity and negative predictive value. PPV values were maximum 77.7% with both MBPP and Doppler combined, followed by MBPP (40%) and least being 33.3% with Doppler. NPV was comparable in all groups.

Malhotra K et al.[5] observed that maximum NICU admission (78.1%) were seen in patients with abnormal MBPP and Doppler. Sensitivity, specificity, PPV and NPV of MBPP was 90.6%, 56.9%, 61% and 89% respectively. Sensitivity, specificity, PPV and NPV of Doppler was 88.3%, 53.3%, 55.7% and 87, 2% respectively. Combined MBPP and Doppler shows sensitivity of 96.8% and specificity of 45.7% respectively. They concluded that MBPP is a better predictor of perinatal outcome compares to Doppler in high-risk pregnant women. Both the tests must be performed in all high-risk pregnancies to improve perinatal outcome.

Sonia H et al.[6] found that Doppler sensitivity was 37.50% while MBPP was 62.50% in predicting an adverse outcome. The sensitivity increased to 73.52% once the MBPP and Doppler data were combined.The MBPP alone yielded maximum of 96.1% accuracy of diagnosis followed by combined MBPP and Doppler 88.7% and Doppler alone with 71.5% . They concluded that MBPP was more significant than Doppler analysis to determine foetal wellbeing.

Bardakci M et al.[7] also concluded that in the prediction of non-reassuring fetal status and perinatal outcome, MBPP (sensitivity,

60%) was found to be more significant than Doppler analysis (sensitivity, 40%), and sensitivity increased when both were combined (70%).

Similar to our study, Bakay K et al.[8] revealed that when MBPP was paired with uterine/umbilical artery Doppler ultrasonography to detect acute fetal distress, the approach had a sensitivity of 100% and a specificity of 89.2%, PPV 65.3% and NPV of 100%, making it the most sensitive test in their study. The MBPP alone showed a sensitivity of 94.12 % and a specificity of 89.2%.They concluded MBPP was more reliable than doppler in determining fetal outcome and acute fetal distress.

Putri, R.A. et al.[9] found that Modified biophysical profile was better in predicting neonatal outcome compared with middle cerebral artery Doppler (cerebroplacental ratio) with sensitivity 94.7%, specificity 52%, and NPV 96.5% for 5 minutes APGAR score <7; sensitivity 76.4%, specificity 55% and NPV 72.4% for NICU admission. Adverse or reverse end diastolic flow in umbilical artery Doppler had sensitivity 63.15%, specificity 98.1% and PPV 92.3% in predicting 5 minute APGAR score <7.

Gonzalez JM et al.[10] compared the efficacy of non-stress test, biophysical profile or abnormal Doppler 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.

Choudhary N et al,[11] reported that Doppler velocimetry was better in predicting fetal compromise than NST in high risk patients. Normal NST and normal Doppler were not significantly different in prediction of fetal outcome. Abnormal Doppler was better in predicting than fetal compromise than abnormal NST. Sensitivity of Doppler was 43% while that of NST was 12%. Specificity of Doppler was 100% while NST was 94%.

Nalamaru et al,[12] found that overall sensitivity and specificity of NST, AFI and MBPP are comparable to each other in detection of fetal distress. Though MBPP is marginally better. MBPP was proved to be more significant than Doppler analysis in prediction of perinatal results, but the sensitivity was increased when both were combined.

In conclusion, in order to effectively predict acute fetal distress and to maintain a reliable screening method, combined use of these tests, namely modified biophysical profile and Doppler analysis, has proven to be the most valuable and effective method as shown in our study.

Limitations of our study:

- Our study had included NST, but interpretation is observer dependent.
- Doppler study is radiologist dependent.
- Extreme premature pregnancies couldn't be assessed as NST is conclusive only after 32 weeks of gestation.
- Ductus venosus Doppler has not been included in the study which is also a good predictor of foetal wellbeing.

Conclusion

Modified biophysical profile and color Doppler both combined together are excellent ,complimentary to each other and cost effective antepartum screening methods for fetal well-being and are widely available in most centers in India.

Ethical approval: The study was approved by the Institutional Ethics Committee.

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