A Prospective Study To Assess The Role of Modified Bio Physical Profile and Cerebroplacental Ratio in Prediction of Adverse Perinatal Outcome in Pregnancies Beyond 40 Weeks of Gestation

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Abstract

Aim: To assess the role of modified bio physical profile and cerebroplacental ratio in prediction of adverse perinatal outcome in pregnancies beyond 40 weeks.

Methodology: Pregnancies beyond 40 weeks admitted to the labor room were selected based on specific inclusion and exclusion criteria. Informed consent was obtained, and ethical approval was secured from the institute's review board. A thorough patient assessment was conducted, including a detailed medical history, general and obstetric examinations, and routine investigations, including a Non-Stress Test (NST). Patients underwent ultrasonography to evaluate fetal well-being, gestational age, amniotic fluid index (AFI), cord status, placental localization, and Doppler studies of the umbilical artery and middle cerebral artery. This information was used to determine the Modified Biophysical Profile (BPP) and Cerebroplacental Ratio (CPR).

Results: The Modified Biophysical Profile (MBPP) showed high sensitivity for NICU admissions (87.5%), APGAR scores (87.5%), and neonatal mortality (100%), with moderate sensitivity for fetal distress (78.26%) and low sensitivity for meconium-stained amniotic fluid (45.45%). Its specificity ranged from 71.59% to 93%. The Cerebroplacental Ratio (CPR) had high specificity (93.67% to 100%) but lower sensitivity (0% to 31.25%).

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Combined analysis indicated perfect sensitivity (100%) for NICU admissions and APGAR scores, moderate sensitivity (54.55%) and specificity (65.82%) for meconium-stained liquor, and high sensitivity (91.3%) and specificity (82.09%) for fetal distress.

Conclusion: The primary aim of this study was to evaluate the effectiveness of the Modified Biophysical Profile (MBPP) and Cerebroplacental Ratio (CPR) in predicting adverse perinatal outcomes in pregnancies beyond 40 weeks. Results indicated that MBPP was significantly more sensitive than CPR for various adverse outcomes. While CPR had low sensitivity, it demonstrated high specificity, meaning abnormal CPR results indicate a higher likelihood of adverse outcomes. The combination of MBPP and CPR improved sensitivity rates, suggesting that both tests should be performed for better predictions. Further research with larger study groups is needed to enhance predictions for adverse outcomes in this population

Keywords: MBPP- Modified biophysical profile, CPR - cerebroplacental ratio

Introduction

Singleton pregnancies typically last about 40 weeks from the last menstrual period [1]. Pregnancies extending beyond the expected delivery date pose significant obstetric challenges, often leading to increased maternal and fetal morbidity. The American College of Obstetricians and Gynecologists (ACOG) classifies deliveries from 37 weeks onward, highlighting that pregnancies beyond 40 weeks can be categorized as full term, late term, or post term. In Western populations, about 18% of singleton pregnancies extend beyond 41 weeks, while in India, the prevalence is lower, ranging from 2% to 7.7% [1].

Accurate gestational age assessment is crucial for diagnosing postdated pregnancies, with first-trimester ultrasound being the most reliable method. Various risk factors for prolonged pregnancies include nulliparity, prior history of delivery beyond 40 weeks' pregnancy and maternal obesity [2-6]. Beyond 40 weeks, placental function declines, leading to complications such as fetal distress and increased risk of macrosomia, which can cause delivery-related injuries [2].

Pregnancies beyond 40 weeks are associated with higher rates of perinatal morbidity and mortality, including lower APGAR scores and increased neonatal intensive care unit admissions. Maternal risks also rise, including severe perineal lacerations and postpartum hemorrhage. Continuous antepartum surveillance is essential to improve outcomes, with the Modified Biophysical Profile (MBPP) and Doppler ultrasound emerging as key tools for assessment.

The MBPP focuses on the Amniotic Fluid Index (AFI) and Non-Stress Test (NST) for faster evaluation, while Doppler ultrasound assesses blood flow in maternal and fetal vessels [7]. The Cerebroplacental Ratio (CPR) serves as an important marker for detecting fetal hypoxia. This study aims to evaluate the effectiveness of MBPP and CPR in predicting adverse perinatal outcomes in pregnancies beyond 40 weeks, facilitating timely interventions to reduce morbidity and mortality.

Methods

This observational, prospective study was conducted in the Department of Obstetrics and Gynecology at SMS Medical College, Jaipur, starting in December 2022 and lasting for one year for data collection. It focused on women with singleton pregnancies beyond 40 weeks of gestation, who were not in labor. The study required ethical clearance and included pregnant women with confirmed last menstrual periods, regular cycles, and consent to participate, while excluding those with fetal anomalies or chronic diseases.

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A sample size of 90 women was determined based on a 95% confidence level and a 7.5% allowable error. Detailed patient assessments included history taking, routine investigations, and non-stress tests (NST). Ultrasonography evaluated fetal well-being, amniotic fluid index (AFI), and Doppler studies to calculate the Modified Biophysical Profile (MBPP) and Cerebroplacental Ratio (CPR). Outcomes measured included NICU admissions, low APGAR scores, meconium-stained liquor, fetal distress, and neonatal mortality.

The mode of delivery was based on MBPP and color Doppler results. Patients with normal findings (MBPP and CPR) were induced with dinoprostone gel, reassessed after 6 hours, and progressed based on the Bishop score. If no progression occurred after two gels, a cesarean section was performed. Labor was closely monitored for fetal distress, which would prompt cesarean delivery.

For abnormal results:

1. Both MBPP and CPR abnormal: Cesarean section.

2. Normal MBPP, abnormal CPR (CPR < 1.08, brain sparing effect, absent or reverse end diastolic flow): Cesarean section.

3. Abnormal MBPP, normal CPR: Decision based on NST and AFI. If NST non-reactive and AFI adequate, a complete biophysical profile (BPP) was conducted. If BPP < 6/10, cesarean section; if BPP > 6/10, labor induction proceeded with continuous fetal monitoring. If AFI < 5 cm and NST reactive, labor was induced with gel, with cesarean section if fetal distress occurred.

Results

There are 90 pregnant mothers included into the study.

Table 1: Modified Biophysical Profile parameters.

Modified Biophysical Profile	No. of Patients	Percentage
Adequate Amniotic Fluid Index / Reactive Non-Stress Test	57	63.33
Adequate Amniotic Fluid Index / Non-Reactive Non-Stress Test	11	12.22
Inadequate Amniotic Fluid Index / Reactive Non-Stress Test	10	11.11
Inadequate Amniotic Fluid Index / Non-Reactive Non-Stress Test	12	13.33
Total	90	100.00

Table 2: Correlation of Modified Biophysical Profile and Various Perinatal Outcomes

MBPP	No.	NICU admission (No.) (%)	APGAR score <7(No.) (%)	MSL(No.) (%)	Fetal Distress (No.) (%)	Neonatal Mortality (No.) (%)	LSCS (No.) (%)
Adequate Amniotic Fluid Index / Reactive Non-Stress Test	57	0 (0%)	0 (0%)	5 (8.77%)	2 (3.51%)	0 (0%)	19 (33.33%)
Adequate Amniotic Fluid Index / Non-Reactive Non-Stress Test	11	6 (54.54%)	6 (54.54%)	5 (45.45%)	10 (90.91%)	0 (0%)	10 (90.91%)
Inadequate Amniotic	10	1	1	0	1	0	6

Fluid Index / Reactive Non-Stress Test		(10%)	(10%)	(0%)	(10%)	(0%)	(60%)
Inadequate Amniotic Fluid Index / Non-Reactive Non-Stress Test	12	9 (75%)	9 (75%)	1 (8.33%)	10 (83.33%)	2 (16.37%)	12 (100%)

Table 3: Correlation of Cerebroplacental Ratio and Various Perinatal Outcomes

Cerebroplacental Ratio		NICU Admission	APGAR Score<7	MSL	Fetal Distress	Neonatal Mortality
		Yes	Low	Yes	Yes	Yes
Favourable	No. of Patients (85)	11	11	11	18	0
	Percentage	12.84	12.84	12.84	21	0
Unfavourable	No. of Patients (5)	5	5	0	5	2
	Percentage	100	100	0	100	40
P-Value		0.0001	0.0001	0.23	<0.0001	<0.0001

Table 4: Sensitivity, Specificity, PPV and NPV of MBPP, CPR and combine (MBPP+CPR) w.r.t Various Perinatal Outcomes

Perinatal Outcomes	Sensitivity	Specificity	PPV	NPV
	Modified Biophysical Profile			
NICU Admission	87.5	82.43	51.85	96.83
APGAR Score <7	87.5	82.43	51.85	96.83
MSL	45.45	72.15	18.52	90.48
Fetal Distress	78.26	86.57	66.67	92.06
Neonatal Mortality	100	71.59	7.41	100
	Cerebroplacental Ratio			
NICU Admission	31.25	100	100	87.06
APGAR Score <7	31.25	100	100	87.06
MSL	0	93.67	0	87.06
Fetal Distress	21.74	100	100	78.82
Neonatal Mortality	100	96.59	40	100
	Combined (MBPP+CPR)			
NICU Admission	100	77.03	48.48	100
APGAR Score<7	100	77.03	48.48	100
MSL	54.55	65.82	18.18	91.23
Fetal Distress	91.3	82.09	63.64	96.49
Neonatal Mortality	100	64.77	6.06	100

Discussion

The mean age for the group was 26.7 years. In this study, 55.56% of cases were nulliparous, 27.78% primiparous, and 16.67% multiparous. Among the pregnancies, 67.78% were full-term, 24.44% late-term, and 7.78% post-term.

According to the Modified Biophysical Profile, 63.33% had adequate Amniotic Fluid Index / Reactive Non-Stress

Test, 12.22% had adequate Amniotic Fluid Index / Non-Reactive Non-Stress Test, and 11.11% had inadequate Amniotic Fluid Index / Reactive Non-Stress Test and 13.33% had inadequate Amniotic Fluid Index / Non-Reactive Non-Stress Test.

Among patients with adequate AFI and reactive NST, none required NICU admission (P < 0.0001). For those with adequate AFI and non-reactive NST, 54.54% required NICU admission (P < 0.0001). Among patients with inadequate AFI and reactive NST, 10% required NICU admission (P < 0.0001), whereas 75% required NICU admission in those with inadequate AFI and non-reactive NST (P < 0.0001).

For newborns with adequate AFI and reactive NST, none had APGAR scores <7 (P < 0.0001). Among those with adequate AFI and non-reactive NST, 54.55% had APGAR scores <7. For newborns with inadequate AFI and reactive NST, 10% had APGAR scores <7. In patients with inadequate AFI and non-reactive NST, 75% had APGAR scores <7 with a P value of 0.0001, indicating statistical significance.

In cases with adequate AFI and reactive NST, 8.77% had MSL (P < 0.0001). Among those with adequate AFI and non-reactive NST, 45.45% had MSL. For women with inadequate AFI and reactive NST none had MSL, whereas 8.33% had MSL in those with inadequate AFI and non-reactive NST (P < 0.0001).

In the group with adequate AFI and reactive NST, 3.51% experienced fetal distress (P < 0.0001), while 90.91% had fetal distress in the adequate AFI and non-reactive NST group. Among those with inadequate AFI and reactive NST, 10% experienced fetal distress, and in the inadequate AFI and non-reactive NST group, 83.33% had fetal distress (P < 0.0001).

In a study, there were no neonatal deaths among patients with adequate amniotic fluid index (AFI) and either reactive or non-reactive non-stress tests (NST). Similarly, no deaths occurred with inadequate AFI and reactive NST. However, 16.67% of patients with inadequate AFI and non-reactive NST experienced neonatal deaths, indicating a statistically significant risk (P = 0.01).

In the group of patients with adequate AFI and reactive NST 33.33% required LSCS while patients with adequate AFI but non-reactive NST had 90.91% LSCS. In the group of patients with inadequate AFI but reactive NST had 60% LSCS while inadequate AFI and non-reactive NST had 100% LSCS.

Our study shows that 94.44% of cases had a normal CPR, indicating balanced fetal blood flow, while 5.56% show abnormal CPR.

CPR is significantly linked with NICU admission (P < 0.0001), occurrence of fetal distress (P <0.0001), neonatal mortality rates (P < 0.0001). CPR shows a non-significant trend (P = 0.23) with MSL outcomes. With favorable CPR, 49.41% of patients underwent LSCS, while 50.58% had a normal delivery (P = 0.87), suggesting no significant difference between the groups. In contrast, with unfavorable CPR, 100% of patients underwent LSCS (P < 0.0001), indicating a highly significant difference between the groups.

Gupta et al [8]observed that adverse perinatal outcomes i.e., asphyxia and NICU admissions were found to be significantly higher in patients with CPR<1. We also observed APGAR<7 at 1 and 5 minute with CPR<1.

MBPP had high sensitivity for NICU admission and APGAR scores (87.5%) and neonatal mortality (100%), moderate sensitivity for fetal distress (78.26%), and lower sensitivity for meconium-stained amniotic fluid (45.45%). Specificity ranges from 71.59% to 93%, reflecting its accuracy in specific predictions with some limitations. CPR had high specificity for most outcomes (93.67% to 100%) but lower sensitivity overall (0% to

31.25%), indicating its effectiveness in specific predictions but limitations in detecting all cases.

The combined analysis of the Modified Biophysical Profile (MBPP) and Cerebro Placental Ratio (CPR) demonstrates varying effectiveness in predicting neonatal outcomes. For NICU admission and APGAR scores, the method shows perfect sensitivity (100%). In predicting meconium-stained liquor (MSL), it has a sensitivity of 54.55%, specificity of 65.82%. For fetal distress, the combined method exhibits a high sensitivity (91.3%), and specificity (82.09%). Regarding neonatal mortality, the method shows 100% sensitivity but lower specificity at 64.77%. These results highlight the method's strengths in sensitivity, particularly for NICU admission, APGAR scores, and fetal distress, while also noting limitations in specificity for certain outcomes.

Fernandes and Mudanur [9] found that the Modified Biophysical Profile (MBPP) had a sensitivity of 65.96% and specificity of 90.32%, outperforming Doppler studies, which had a sensitivity of 53.41% and specificity of 96.77%. The highest adverse perinatal outcomes were observed when both tests were abnormal (100%), followed by MBPP (75.64%), indicating MBPP's greater accuracy compared to Doppler studies (71.33%) in detecting perinatal outcomes.

Conclusion

Our study shows that MBPP is significantly more sensitive than CPR in prediction of various adverse perinatal outcomes. Though the sensitivity of CPR is low but it's specificity is high hence if CPR is abnormal then chances of adverse perinatal outcome are very high. Combining MBPP with CPR analysis has yielded a higher sensitivity rate so combination of MBPP and CPR instead of MBPP alone is more significant and both test must thus be performed to predict adverse perinatal outcomes.

More research on larger study groups is needed to effectively predict adverse perinatal outcomes in pregnancies beyond 40 weeks of gestation.

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