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Comparative study of rapid biophysical profile and conventional biophysical profile in predicting perinatal outcome in high risk pregnancies

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Abstract
Introduction: Rapid Biophysical profile is quicker and easier to do than a full biophysical profile or a contraction stress test. Furthermore, the rBPP is regarded to be just as useful as a complete biophysical profile. Although the link between rBPP and BPP has been widely used, research is scarce. As a result, the current study looked into the relationship between the two tests, as well as their predictive ability in high-risk pregnancies.
Material and Methods: 60 pregnant women with ≥ 32 weeks of singleton gestation, were randomly selected during their hospital visit. They were subjected to USG scan. NST AFI, fetal breathing, fetal tone, and fetal movement will be examined to complete the BPP test. After a 10-minute break, SPFM will be carried out by the same examiner to finish rBPP test. These results were compared with the perinatal outcome.
Results: The present study showed that scores of rapid Biophysical Profile have strong positive correlation with scores of biophysical profile (r^2 = 0.531, P = <0.001) and it was statistically significant. The rapid/ modified biophysical profile test is 78% sensitive to Biophysical profile test, which means 78% times the function can identify the cases and classify correctly, as diseased cases with PPV of 61%.
Conclusion: The statistically significant positive correlation between rBPP and BPP has been revealed. Due to its simplicity, rapidity, less expensive and no need for experience interpreter, the rBPP can be used as a primary screening antepartum fetal surveillance in the overcrowded obstetric center.

Keywords: Rapid biophysical profile, antepartum fetal surveillance, AFI, NST

Introduction
No health issue has a greater impact on a country than maternal and perinatal death, as is widely acknowledged [1]. In the nineteenth century, fetal assessment included fetal heart sound auscultation and subjective monitoring of fetal movements. During the twentieth century, these procedures were enhanced with the addition of electronic fetal heart rate monitoring and sonographic examination of fetal activity and amniotic fluid content [2].
In such high-risk circumstances, the fetal biophysical profile is one of the most commonly acknowledged tests for assessing fetal well-being. Manning *et al*. proposed and described the first conventional biophysical profile (BPP), which included the investigation of five variables: respiratory movement, fetal tone, fetal body movement, amniotic fluid index, and non-stress test (fetal heart rate). It requires ultrasonography and an external Doppler device to measure the fetal heart rate in two phases. The entire biophysical is more labor-intensive, time-consuming, and costly [2].
The Nageotte *et al*. proposed modified or rapid biophysical profile (rBPP), which combines the non-stress test (NST) as a short term marker of fetal status and the amniotic fluid index (AFI) as a long term marker of placental function [3]. Many studies have advocated the rapid biophysical profile (rBPP) described by amniotic fluid index (AFI) measurement with sound-provoked fetal movement (SPFM) test as a potential approach for fetal surveillance.
It is easier to perform and takes less time than the complete biophysical profile or contraction stress test. In addition, the rBPP is also thought to be as beneficial as a full biophysical profile. Despite the widespread usage of rBPP, research on the relationship between rBPP and FBP is sparse. As a result, the current study investigated the relationship between the two tests, as well as their potential for predicting perinatal outcomes in high-risk pregnancies.

Material and Methods

Source of the data: The study consists of 60 women with an uncomplicated pregnancy whose gestational age between 32 - 40 weeks of a normal pregnancy who visiting to antenatal OPD and inpatients in the Department of the OBG during the study period November 2017 to July 2019. The study was approved by the Institutional Ethical Committee and written informed consent was obtained from the participants.

Our inclusion criteria were singleton pregnant women with the gestational age at the time of study ≥28 weeks, intrauterine growth retardation, decreased fetal movements and with co-morbid conditions like hypertensive disorder of pregnancy and diabetes mellitus. We excluded singleton pregnant women not willing to give consent and with gestational age <32 weeks.

Method of collection of data

After assessment of inclusion and exclusion criteria, 60 Antenatal women were selected for the study, their preliminary data were recorded and were subjected to ultrasound scan by using GE Voluson 730 pro machine. NST AFI, fetal breathing, fetal tone, and fetal movement will be examined to complete the BPP test. After a 10 minute break, SPFM will be carried out by the same examiner to finish rBPP test.

The FHR tracing will be considered reactive, if 2 or more acceleration of 15 beats above baseline lasting at least 15 seconds occur in 20 minutes. The test will be considered as non-reactive if the criterion is not met after 40 minutes, or if severe decelerations occur during that time.

According to Manning *et al*., each of five biophysical variables has a possible score of 2, for a total of 10.The score of ≤ 6 is said to be abnormal for BPP and indicates fetal hypoxia.

The five biophysical variables assessed include: 1.Fetal heart rate (NST), 2. Fetal breathing movement, 3. Gross fetal body fetal movement, 4. Fetal tone, 5. Amniotic fluid volume

For every variable a score of 2 is given which is considered as normal and for abnormal variables a score of zero is given. To make rBPP easier to understand, we employed the grading system which was proposed by Tongsong *et al*. The rBPP score of 4, characterizes the reassuring fetal circumstance while the score of ≤ 2 represents the non-reassuring fetal status.

Statistical analysis: Data was analysed by using SPSS statistical software version 16 (SPSS Inc., Chicago, Ill., USA). Variables was analysed using student-chi square test. Spearman Correlation Coefficient test was utilized to determine the relationship between rBPP with BPP. Sensitivity and specificity was analysed between rBPP and BPP.

Results

A total of 60 individuals were assessed in this study, with gestational ages ranging from 32 to 40 weeks. The following data was used to examine the results: *1. Maternal Variables*: a) Maternal age b) Gestation age at time of scanning c) Parity. *2. Fetal Parameters:* a) NST, b) AFI, c) Biophysical Profile, d) Rapid Biophysical Profile. *3. Perinatal Outcome Variables:* a) Mode of Delivery b) Meconium Stain c) NICU admission d) Apgar Score at 1 and 5 minutes e) Birth weight.

The mean ± S.D age of the study population was 25.70 ± 4.25 years. The maximum number of subjects was found in ≤ 25years of age. In the current study, the maximum number of subjects was found in between 37-38 weeks of age i.e. 33.3% with the mean gestational age of 37.00 ± 1.79 years (Table 1)

Table 1: Frequency and percentage of women according to their demographic and obstetrical characteristics

Characteristics	Frequency	Percent
Age (Years)		
<=25	34	56.7
>25	26	43.3
Gestational Age (weeks)		
33-34	5	8.3
35-36	19	31.7
37-38	20	33.3
39-40	16	26.7
Gravida		
Primi	21	35.0
G2	21	35.0
G3	14	23.3
G4	4	6.7
Mode of Termination		
LSCS	49	81.7
Vaginal Delivery	11	18.3

Table 2: Frequency of BPP and rBPP score distribution among the study population

Score	Frequency	Percent
BPP Score		
<6 (Abnormal	23	38.3
>8 (Normal)	37	61.7
rBPP		
0	2	3.3
2	16	26.7
4	42	70.0

Table 2 shows that BPP of 8 and above was deemed normal, accounting for 90% of the cases. In 10% of cases, a BPP score of 6 or less than 6 was found, which was considered abnormal. rBPP of 2 and less was considered abnormal, accounting for 30% of the cases. rBPP score of 0/4 was found in 3.3 percent of the cases and 2/4 in 26.7 percent. In 70% of cases, rBPP score of 4 was found, which was considered normal.

Table 3: Correlation of BPP and rBPP with study outcomes

Variables	Category	BPP		P-value	rBPP		P-value
		Abnormal	Normal		Abnormal	Normal	
NST	Non-Reactive	9 (39.1%)	2 (5.4%)	0.0001	4 (22.2%)	7 (16.7%)	0.610
	Reactive	14 (60.9%)	35(94.6%)		14 (77.8%)	35 (83.3%)	
AFI	<5	11 (47.8%)	0 (0.0%)	0.000	9 (50.0%)	2 (4.8%)	0.000
	>5	12 (52.2%)	37(100.0%)		9 (50.0%)	35 (95.2%)	
Mode of termination	LSCS	22 (95.7%)	27 (73%)	0.027	18 (100.0%)	31 (73.8%)	0.016
	Vaginal delivery	1 (4.3%)	10 (27%)		0 (0.0%)	11 (26.2%)	
APGAR at 1min	<=7	18 (78.3%)	19 (51.4%)	0.004	17 (94.4%)	20 (47.6%)	0.001
	>7	5 (21.7%)	18 (48.6%)		1 (5.6%)	22 (52.4%)	
APGAR after 5 min	<=7	16 (69.6%)	7 (18.9%)	0.000	17 (94.4%)	6 (14.3%)	0.000

	>7	7 (30.4%)	30 (81.1%)		1 (5.6%)	36 (85.7%)	
Meconium stain liquor	NO	16 (69.6%)	33 (89.2%)	0.056	9 (50.0%)	40 (95.2%)	0.001
	YES	7 (30.4%)	4 (10.8%)		9 (50.0%)	3 (4.8%)	
Birth Asphyxia	NO	17 (73.9%)	33 (89.2%)	0.123	11 (61.1%)	39 (92.9%)	0.002
	YES	6 (26.1%)	4 (10.8%)		7 (38.9%)	3 (7.1%)	
NICU Admission	NO	7 (30.4%)	29 (78.4%)	0.000	2 (11.1%)	34 (81.0%)	0.000
	YES	16 (69.6%)	8 (21.6%)		16 (88.9%)	8 (19.0%)	

Table 4: Correlation of rBPP with BPP with sensitivity and specificity

rBPP	BPP		Total
	Abnormal	Normal	
Abnormal	14	4	18
	77.8%	22.2%	100.0%
	60.9%	10.8%	30.0%
Normal	9	33	42
	21.4%	78.6%	100.0%
	39.1%	89.2%	70.0%
Total	23	37	60
	38.3%	61.7%	100.0%
	100.0%	100.0%	100.0%

The BPP and rBPP score when compared with study outcomes is shown in Table-2. The rapid/ modified biophysical profile test is 78% sensitive to Biophysical profile test, which means 78% times the function can identify the cases and classify correctly, as diseased cases with PPV of 61%. The test is 79% specific that means 79% times the function can identify the cases and classify correctly as normal cases with NPV of 89% (Table 3).

Discussion

The BPP is a well-known tool for assessing fetal well-being prior to delivery. The greatest advantage of this method is its low false-positive rate, which makes it exceedingly safe in the event of a normal result. The BPP is a tool used in hospitals to assess the accuracy of fetal sonography. Manning *et al*. proposed and described the first biophysical profile, which included the investigation of five variables: respiratory movement, fetal tone, fetal body movement, amniotic fluid index, and non-stress test (fetal heart rate). It requires ultrasonography and an external Doppler device to measure the fetal heart rate in two phases [4].

The approach necessitates the use of a professional and experienced sonographer, as well as up to 30 minutes for the procedure to be completed correctly. In an overloaded and underfunded hospital, it has limited utility. These restrictions required improvements in the system to minimise the process time and to need a competent examiner without sacrificing accuracy. The Nageotte *et al*. proposed modified or rapid biophysical profile (rBPP), which combines the non-stress test (NST) and the amniotic fluid index (AFI) [3].

Correlation of study outcomes with BPP

The mode of delivery among the study population with respect to BPP revealed that when BPP was normal, the incidence of LSCS and vaginal delivery were 73% and 27% respectively. 95.7 percent of patients with an abnormal BPP had LSCS, while 4.3 percent had vaginal delivery. Present study showed that the incidence of LSCS is higher comparatively with other study and revealed that the incidence of LSCS is positively associated with abnormal BPP score.

In the present study, we found in 23 women (38.3%) had <7 Apgar score at 5 min of delivery in the present study. Out of which, 16 cases which accounts for 69.6% had abnormal BPP and 7 cases which accounts for 30.4% had normal BPP. We observed in 11 cases (18.3%) showing meconium stain in the present study. Of these, 7 cases which accounts for 63.6% had abnormal BPP score and 4 cases which accounts for 36.4% had normal BPP score. The results of our study were compared to those of Yogitha V *et al*. [2] and Singh G *et al*. [5] Amongst 37 patients with normal BPP score, 4 (10.8%) patients experienced birth asphyxia while 33 (89.2%) patients had no birth asphyxia. While 6 (26.1%) of the 23 individuals with an abnormal BPP score had birth asphyxia, 17 (73.9%) of the patients did not have birth asphyxia.

In the present study, we found that the babies born to 23 women (38.3%) had been admitted to the NICU. There were 16 cases with aberrant BPP score, accounting for 69.6% of the total, and 7 cases with normal BPP score, accounting for 30.4 percent. The BPP score and NICU admission had a strong significant relationship (p value 0.001), according to our findings.

This indicates that when the BPP score was aberrant, the incidence of abnormal study outcomes was higher. Comparison of incidence of abnormal study outcomes in respect to abnormal BPP score with different population was tabulated and compared with the present study (Table 5). Present study showed that the incidence of abnormal outcomes is higher comparatively with other study and revealed that the incidence of study outcomes is positively associated with abnormal BPP score.

Table 5: Comparison of incidence of study outcomes in respect to abnormal BPP score in different studies

Authors	LSCS (%)	Apgar Score (%)	Meconium stain	NICU admission
Miller *et al*. [6]	36	-	-	-
Eden *et al*. [7]	15.8	1.5	-	-
Nageotte *et al*. [3]	8.6	0.8	-	-
Yogitha V *et al*. [2]	30.1	66.7	44.89	-
Soumya *et al*. [8]	30.1	-	-	-
Singh *et al*. [5]	-	-	42.9	85.7
Present study	95.7	69.6	63.6	69.6

Correlation of study outcomes with rBPP

The mode of delivery among the study population with respect to rBPP revealed that when rBPP was normal, the incidence of LSCS and vaginal delivery were 73.8% and 26.2% respectively. 100% percent of patients with an abnormal rBPP had LSCS, while zero percent had vaginal delivery. In the current study, we observed that 23 women (38.3%) had a <7 Apgar score at 5 minutes of delivery. There were 17 aberrant/abnormal rBPP cases (73.9%) and 6 normal rBPP cases (26.1%).

In the current study, we encountered meconium stain in 11 patients (38.3 percent). Nine of the cases (81.8 %) had aberrant rBPP scores, while two of the cases (18.2 %) had normal rBPP scores. Our findings were compared to those of Yogitha V *et al*. [2] and Soumya *et al*. [8] in previous research. Three (7.1 percent) of the 42 patients with a normal rBPP score had birth asphyxia, while 39 (92.9 percent) had no birth asphyxia. Although 7 (38.9%) of the 18 patients with an abnormal rBPP score suffered birth asphyxia, 11 (61.1%) of the patients did not.

In the present study, we observed that the babies born to 24 women (38.3%) had been admitted to the NICU. There were 16

cases with aberrant rBPP score, accounting for 66.7% of the total, and 8 cases with normal rBPP score, accounting for 33.3 percent. The current study found that the incidence of abnormal study outcomes is higher than in previous studies (Table 6), and revealed that the incidence of abnormal study outcomes is linked to an abnormal rBPP score.

Table 6: Comparison of incidence of study outcomes in respect to abnormal rBPP score in different studies

Authors	LSCS (%)	Apgar Score (%)	Meconium stain	NICU admission
Miller *et al.* [6]	8.8	-	-	-
Eden *et al.* [7]	6.8	-	-	-
Nageotte *et al.* [3]	5.6	-	-	-
Yogitha V *et al.* [2]	30.1	100	88.8	-
Soumya *et al.* [8]	25.7	60	100	31.42
Present study	100	94.4	63.6	88.9

The present study showed that scores of rapid Biophysical Profile have strong positive correlation with scores of biophysical profile ($r^2 = 0.531$, P=<0.001) and it was statistically significant. Similar results was reported by Prabhu AV *et al.* [9] Sensitivity, specificity, Negative Predictive value and Positive predictive value was done between rBPP and BPP. The rapid/ modified biophysical profile test is 78% sensitive to Biophysical profile test, which means 78% times the function can identify the cases and classify correctly, as diseased cases with PPV of 61%. The test is 79% specific that means 79% times the function can identify the cases and classify correctly as normal cases with NPV of 89%.

Conclusion

It has been discovered that there is a statistically significant positive association between rBPP and BPP. Rapid biophysical profile can be used as a primary fetal surveillance and use conventional biophysical profile for confirmation of abnormal results. The rBPP can be utilized as a primary screening antepartum fetal surveillance in busy obstetric and maternity centres due to its simplicity, speed, low cost, and lack of need for an experienced interpreter.

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