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Predictive value of Biophysical Profile score in Intrauterine Growth Restricted Fetuses

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Abstract
Introduction: *High risk of perinatal mortality is seen in IUGR fetuses. The Biophysical Profile Score can predict the perinatal outcome and hence timely intervention can improve the fetal outcome.*
Objective: *To predict perinatal outcome by Biophysical Profile Score (BPS) in Intrauterine Growth Restricted Fetuses.*
Material and Methods*: Our study included 25 IUGR fetuses at 28-40 weeks of gestation without any congenital anomaly. Five variables i.e NST, FBM, FM, FT and AFV were recorded to calculate BPS. Adverse perinatal outcome was assessed as still birth and neonatal death due to fetal hypoxia, APGAR score of less than 7 at 5 minutes, LSCS for fetal asphyxia and admission into ICU.*
Observations: *Negative predictive value of normal BPS for LSCS, low APGAR score, ICU admission and perinatal mortality was 52.9%, 83.2%, 70% and 100% respectively. Positive predictive value of abnormal BPS was 75% for LSCS, 62.5% for low APGAR score/ICU admission and 37.5% for perinatal mortality.*
Conclusion: *Low BPS has high predictive valve for adverse perinatal outcome. NST and FM had better predictive value for fetal hypoxia.*
Keywords/Abbreviations: *IUGR - Intrauterine Growth Restriction, NST -Non Stress Test, FBM - Fetal Breathing Movements, FM - Fetal Movements, FT- Fetal Tone, AFV - Amniotic Fluid Volume, BPS - Biophysical Profile Score, LSCS - Lower Segment Cesarian Section, ICU - Intensive Care Unit, NVD – Normal Vaginal Delivery.*

Introduction

Intrauterine growth restriction (IUGR) is associated with high risk of perinatal mortality and morbidity. There is 4-8 times increased perinatal mortality in these fetuses and 30% of the still born fetuses are growth restricted. IUGR is defined as a condition in which the weight of the fetus is below the 10th percentile for gestational age or at least 2 standard deviations below the mean for age. IUGR can be symmetric or asymmetric. Asymmetric IUGR is seen in cases of placental insufficiency. Symmetric IUGR results due to early insult such as chromosomal anomaly or infection in early pregnancy. Symmetric IUGR fetuses can be constitutionally or genetically small. Different methods like, Daily Fetal Movement Count (DFMC), Oxytocin Challenge Test (OCT) and Non Stress Test (NST) were initially used to evaluate fetal well-being in utero. The limitation of DFMC is that it is subjective and can be confused with Braxton Hick's contractions of the uterus. Fetal heart rate is the only parameter

used in non-stress test and oxytocin challenge test resulting in high false positive test.[1]With the introduction of real time ultrasonography, it became possible to evaluate multiple fetal activities. In Biophysical Profile Score, combined observation of multiple biophysical activities significantly reduce the false positive rate reported with individual biophysical activity. Doppler velocimetry is also valuable for assessing fetal asphyxia. Fetal Biophysical Profile score is used to evaluate fetal well-being. It distinguishes non-asphyxiated from asphyxiated fetuses. Five fetal variables are used to predict the perinatal outcome.[2] BPP score is a combination of acute and chronic markers reflecting fetal well-being. Fetal heart rate reactivity, fetal breathing movements, fetal movements and fetal tone are the acute markers. These are controlled by different centers in the central nervous system. The center regulating fetal tone is the earliest to function at 7.5 to 8.5 weeks of gestation. Fetal body movements start around 9 weeks of gestation. The center for breathing starts functioning after 21 weeks. Fetal heart rate reactivity is seen by the end of 2nd or early 3rd trimester. Amniotic fluid volume is the chronic marker of fetal hypoxia.[3]The biophysical activity that becomes active early in fetal development is the last to disappear when fetal hypoxia is seen. This is known as the gradual hypoxia concept. The presence of normal biophysical activity is an indirect evidence that a given portion of CNS which controls the activity is intact and functioning, therefore nonhypoxemic.[4]The oxygen utilization by the fetus is reduced when hypoxia occurs, which leads to reduction or even absence of biophysical activity. The first manifestations of fetal acidosis are non-reactive NST and loss of fetal breathing. Fetal movements and tone are compromised in severe acedemia. There is significant relationship between a low biophysical score and abnormal perinatal outcome as reflected by low APGAR score after 5 minutes, fetal distress in labour, intensive care unit (ICU) admission and perinatal death. However, the long-time taken to perform biophysical profile score is a great disadvantage of this method.

Material and Methods

The present study was conducted on 25 IUGR fetuses with disparity of at least 4 weeks in period of gestation and fundal height. The females with singleton fetus at 28-40 weeks of gestation were included. Fetuses with congenital anomalies were excluded. The study was done on Toshiba Core vision Pro diagnostic Ultrasound System SSA-350A machine with 3-5 MHz convex probe.
The biophysical score was done as follows

Table 1

Variables	Results	Criteria	Score
Non Stress Test	Reactive (Normal)	Two or more fetal heart rate accelerations of at least 15 beats per minute (bpm) associated with fetal movements in a 30 minute period.	2
	Non-reactive (Abnormal)	One or no fetal heart rate acceleration	0
Fetal breathing movements	Present (Normal)	Presence of at least one episode of fetal breathing of at least 30 seconds duration within a 30 minute observation period.	2
	Absent (Abnormal)	Absence of fetal breathing movements during a 30 minute period	0
Gross Fetal Body Movements	Present (Normal)	Presence of at least 3 discreet episodes of fetal movements within 30 minute period; simultaneous limb and trunk movements considered as single movement.	2
	Decreased (Abnormal)	Two or less discreet movements in 30 minutes	0
Fetal Tone	Normal	At least one episode of motion of a limb from a position of flexion to extension.	2
	Decreased (Abnormal)	Fetus in a position of semi or full limb extension with no return to flexion with movement; absence of fetal movement is counted absent tone.	0
Amniotic Fluid Volume	Normal	Largest pocket of fluid > two centimetre in vertical diameter	2
	Decreased (Abnormal)	Largest pocket of fluid < two centimetre in vertical diameter	0

Maximum score 10, Minimum score 0

Observation & Results

The age of the patients ranged from 19-30 years with mean age of 24.52 years (Figure 1). Maximum patients were Primi Gravida (Figure 2). Period of Gestation at the time of first examination ranged between 29-40 weeks (Figure 3). Ninety two percent cases were having disparity of 4-6 weeks in period of gestation and height of uterus. Thirteen cases showed BPS of 8 or less (Table 2). Non-reactive NST was seen in 8 (32%) cases, out of which 4 (50%) fetuses were born with LSCS for fetal distress (FD). Five (62.5%) neonates had low APGAR score and 5 were admitted to ICU. Perinatal death was reported in 2 (25%) cases. Decreased FBM was found in 2 (8%) cases, one of them was delivered by LSCS and was admitted to ICU. Fetal movement was seen decreased in 5 (20%) fetuses, of which 3 (60%) were born by LSCS. Low APGAR was seen in 2 (40%) fetuses and two were admitted to ICU. There were three perinatal deaths. Fetal tone was abnormal in two cases. One case was delivered by LSCS, there was one (50%) ICU admission, low Apgar was seen in one case. Decreased AFV was present in five fetuses and all of them were born by LSCS. Four (80%) of them had low Apgar score, 4 (80 %) were admitted to ICU and there was one (20%) perinatal death (Table 3).

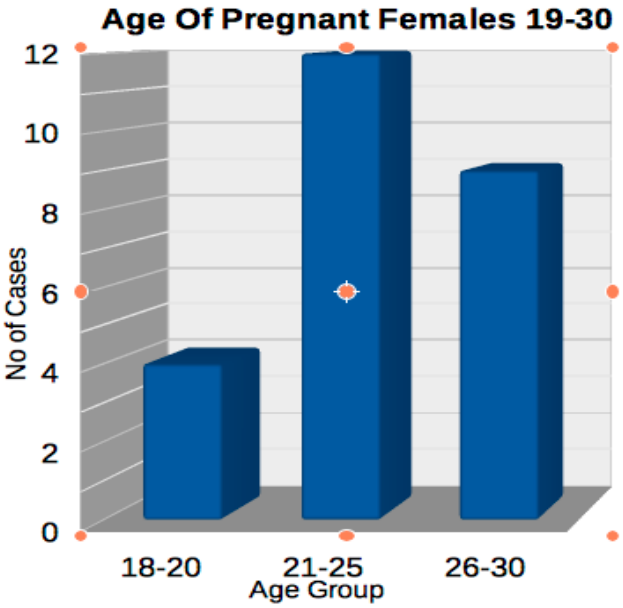

Fig 1: Age

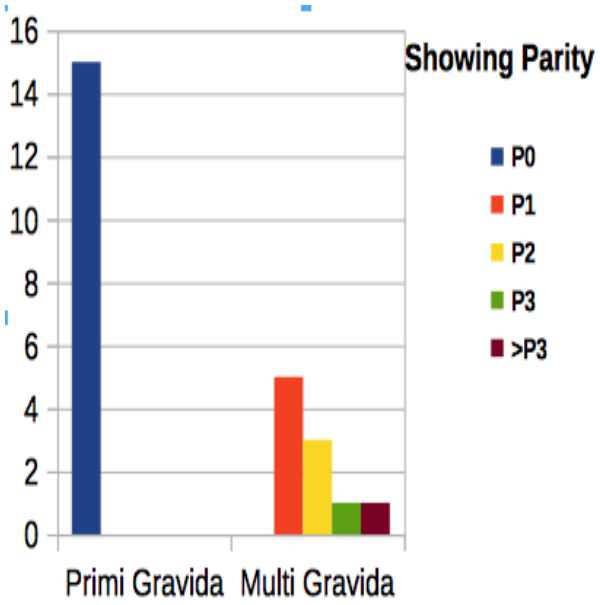

Fig 2: Showing Parity

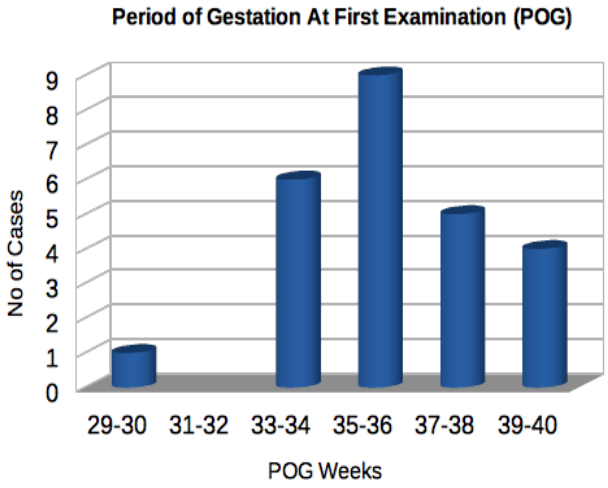

Fig 3: POG

Table 2: Showing Biophysical Profile Score

S No	BPS	No of Cases	Percentage (%)
1	10	12	48%
2	8	5	20%
3	6	7	28%
4	4	1	4%
5	2	0	0
6	0	0	0
	Total	25	100%

Table 3: Showing Biophysical Profile (BPP) And Perinatal Outcome

S No	BPS Variables	Test Results		Mode of Delivery			Perinatal Outcome			
		N (%)	Ab (%)	NVD (%)	Operative Delivery		Low Apgar Score (%)	ICU Admission		Still Birth & Neonatal Death (%)
					For FD	For Others		For FD	For Others	
1	NST	17 (68%)		6(35.2%)	10 (58.8%)	1(5-8%)	3 (17.6%)	5 (29.4%)	2(11.7%)	1 (5.8%)
			8 (32%)	3(37.5%)	4 (50%)	1(12.5%)	5 (62.5%)	5(62.5%)	0	2 (25%)
2	FBM	23 (92%)		8(34.7%)	13 (56.5%)	2(8.6%)	8 (34.7%)	9(39.1%)	2 (8.6%)	3 (13%)
			2 (8%)	1 (50%)	1 (50%)	0	0	1 (50%)	0	0
3	FM	20 (80%)		7 (35%)	11 (55%)	2 (10%)	6 (30%)	8 (40%)	2 (10%)	0
			5 (20%)	2 (40%)	3 (60%)	0	2 (40%)	2 (40%)	0	3 (60%)
4	FT	23 (92%)		8(34.7%)	13 (56.5%)	2 (8.6%)	7 (30.4%)	9 (39.1%)	2 (8.6%)	3 (13%)
			2 (8%)	1 (50%)	1 (50%)	0	1 (50%)	1 (50%)	0	0
5	AFV	20 (80%)		9 (45%)	9 (45%)	2 (10%)	4 (20%)	6 (30%)	2 (10%)	2 (10%)
			5 (20%)	0	5 (100%)	0	4 (80%)	4 (80%)	0	1 (20%)

Discussion

IUGR is a significant antenatal condition requiring intensive monitoring. These fetuses are prone to develop hypoxia. Frequent assessment of these fetuses is done by Doppler velocimetry and biophysical profile score to detect significant hypoxia. Five variables i.e NST, FBM, FM, FT and AFV are evaluated to assess the fetal hypoxia and perinatal outcome.

Normal BPP score

Manning FA and Morrison I et al[5,6] reported that BPP score of more than 8 is not usually associated with fetal asphyxia. The fetuses with score of 8 and above, the mode of delivery is decided on other factors and there is high probability of perinatal survival in these fetuses. Platt LD et al[7] observed that out of 224 cases having BPS of 10, fetal distress was seen in 4 cases only. BPS of 8 was present in 45 cases, out of which 5 had fetal distress during labour. Johnson JM et al (1986)[8] reported 3.3% cases of LSCS for fetal distress when BPS was normal. Platt LD et al(1983)[7] reported low APGAR score in 6 (2.2%) cases having BPS of 8 or 10 out of 269 cases. In our study low APGAR score was found in 3 (17.6%) cases which was higher as compared to them. ICU admission was required for 5 (29.4%) cases for fetal distress. In our study 17 (68%) cases were having BPS of 8 and 10, out of which 7 (41%) cases were delivered normally. LSCS was done in 8 (47%) cases for fetal distress and in two cases LSCS was done for other indications. The rate of LSCS was higher in present study. Negative predictive value for adverse outcome was 47% in our study as compared to 88.1% reported by Basket TF(1984)[9] et al. The survival was 100% in this group which was in concordance with study of Manning et al.(1985)[5,6].

Low biophysical profile score

Mills MS et al(1990)[10]Baskett TF et al (1984)[9] and Manning FA et al (1990)[11] observed significant linear relationship between low BPP score and perinatal outcome. Baskett TF et al (1984)[9] reported positive predictive value of 79.2% for abnormal BPP score. In our study low BPP score (6 or <6) was seen in 8 (32%) cases. Operative interference in these cases was high as 6 (75%) of them were delivered by LSCS. We found higher LSCS rate than Baskett et al who reported LSCS rate of 23.35 and 66.6% for BPS of 6 and 4 respectively. Manning et al (1980)[2] reported LSCS rate of 43.5% for BPS of 6 and 57.6% for BPS of4.In our study, out of 8 fetuses 2 were still born; one each from LSCS and NVD

group. Of the remaining 6 fetuses, 5 had low APGAR score. All of them were admitted to ICU; one of these neonates died after 5 days. In all there were 3 perinatal deaths (2 still born and 1 neonatal death). Positive predictive value for adverse perinatal outcome was 87.5%. However, sensitivity was 43.7%. Baskett TF et al (1984)[9] reported positive predictive value of 79.2%, sensitivity of 7.6% and specificity of 99.7% for low BPS.

Markers of acute hypoxia (NST, FBM, FM, FT)

Vintzileos AM Gaffney SE et al (1987)[12] proposed that antepartum fetal evaluation should be based on the individual component rather than the total score. Non stress test, Fetal breathing movements, Fetal movements and Fetal tone are considered markers of acute fetal hypoxia. Vintzileos AM et al (1991)[13] reported that the first manifestations of fetal hypoxemia were non reactive non stress test and loss of fetal breathing movements. In advanced acidemia, fetal movements and fetal tone are compromised. In our study, Non stress test was non reactive in 8 (32%) cases, fetal breathing movements were absent in 2 (8%) cases, fetal body movements in 5 (20%) and fetal tone in 2 (8%) cases.

Non stresstest

Nijhuis IJM et al (2000)[14] observed that NST is a sensitive indicator of fetal condition. Baskett TF et al(1984)[9] however, concluded that NST was least able to predict an abnormal perinatal outcome with positive predictive value of 24.9%.

In the present study, NST was observed to be a good marker of fetal hypoxia. Out of 8 cases showing nonreactive NST, 4 (50%) cases had operative delivery for fetal distress. Out of these 8 fetuses, one (12.5%) fetus was still born and another one died in perinatal period after 5 days. Low APGAR score was seen in 5 (62.5%) neonates. Five (62.5%) neonates were admitted to ICU. Positive predictive value of nonreactive NST was 62.5%.

Fetal breathing movements

Vintzileos AM et al (1991)[13] observed that loss of fetal breathing movements is the early manifestation of acute fetal hypoxia. In our study, fetal breathing movement was not found to be a sensitive marker for fetal hypoxia as loss of FBM was observed in 2 (25%) fetuses out of the total of 8 fetuses having abnormal Biophysical Profile Score. Of these 2 cases; one (50%) had operative delivery for fetal distress and was admitted to ICU. Manning FA, Morrison I et al (1990)[11] also observed a similar relationship.

Fetal body movement and fetal tone

Fetal Movement and Fetal Tone are compromised in advanced acidemia (Vintzileos AN 1987)[4]. In our study, fetal movement was abnormal in 5 (20%) cases, out of them 3 (60%) had operative delivery for fetal distress, 2 (40%) had low Apgar score and 2 (40%) were admitted to ICU. A high rate of perinatal deaths (60%) was recorded in the cases with abnormal fetal movements. Abnormal fetal tone was recorded in 2 (8%) cases but no adverse perinatal outcome was seen in them.

Markers of chronic hypoxia

Low Amniotic Fluid Volume reflects fetal hypoxia of long duration. Chamberlain PF et al (1984)[15] concluded that decreased Amniotic Fluid Volume was associated with poor perinatal outcome. Perinatal mortality was 109.4/1000 and corrected still birth rate was 93.75/1000. Bastide A et al(1986)[16] reported that perinatal mortality was 132.7/1000 in patients with severe oligohydramnios. Baskett TF et al (1984)[9] reported that AFV had significantly better positive predictive value.In the present study, 5 (20%) cases had decreased Amniotic Fluid Volume. All these cases had operative delivery for fetal distress and 4 (80%) neonates were found to have low APGAR score. Four (80%) neonates were admitted to ICU for fetal distress and one (20%) was still born. Low AFV was found to be a good marker for predicting adverse perinatal outcome in the present study. Our finding of AFV is

consistent with the above mentioned studies[15,16] regarding perinatal outcome. There was 100% positive predictive value for adverse perinatal outcome as regards decreased AFV.

Total BPP score/individual components of biophysical profile score

Manning FA, Morrison I et al (1990)[11] observed that importance of individual variable is more than total BPP score. Total equal score may carry different predictive value because of individual components in it. They reported adverse perinatal outcome for BPS of 6 if NST was no reactive and fetal tone was abnormal. Low predictive value was reported for BPS of 6 having abnormal FBM and AFV. In the present study a combination of abnormal NST and FM was found to be good predictor of abnormal outcome in fetuses having BPS of 6. Only in one case with BPS of 6, who was having combination of abnormal FM and AFV, was still born. Manning FA, Morrison et al (1990)[11] further observed that for BPS of 4, adverse perinatal outcome was best predicted if NST, FBM and AFV were abnormal. In the present study, BPS of 4 was reported in one (4%) case, who had non reactive NST, abnormal FM and fetal tone. However there was no perinatal complication in this case. This can be explained by the small sample size and timely intervention.

Conclusion

Low Biophysical Profile Score carries high predictive value for adverse perinatal outcome in IUGR fetuses. In our study, 87.5% fetuses showing low biophysical profile score had adverse perinatal outcome. However, normal biophysical profile score does not necessarily ensure normal perinatal outcome. Abnormal NST and FM were found to have better predictive value for acute fetal hypoxia.

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