ORIGINAL ARTICLE

SONOGRAPHIC BIOPHYSICAL PROFILE IN DETECTION OF FOETAL HYPOXIA IN 100 CASES OF SUSPECTED HIGH RISK PREGNANCY

Nadeem Ullah, Muhammad Usman*, Abdur Rehman Khan

Department of Radiology, *Neurosurgery, Government Lady Reading Hospital Peshawar, Pakistan

Background: The foetus has become increasingly accessible and visible as a patient over the last two decades. Ultrasound imaging has broadened the scope of foetal assessment. Dynamic real time B-Mode ultrasound is used to monitor cluster of biophysical variables, both dynamic and static collectively termed as biophysical profile. The purpose of this study was to determine the effect of sonographic biophysical profile score on perinatal outcome in terms of mortality and morbidity. **Methods:** This descriptive study was carried on 100 randomly selected high risk pregnant patients in Radiology Department PGMI, Government Lady Reading Hospital, Peshawar from December 2007 to June 2008. Manning biophysical profile including non-stress was employed for foetal screening, using Toshiba ultrasound machine model Nemio SSA-550A and 7.5 MHZ probe. **Results:** Out of 100 cases 79 (79%) had a normal biophysical profile in the last scan of 10/10 and had a normal perinatal outcome with 5 minutes Apgar score >7/10. In 13 (13%) cases Apgar score at 5 minute was < 7/10 and babies were shifted to nursery. There were 2 (2%) false positive cases that showed abnormal biophysical profile scores of 6/10 but babies were born with an Apgar score of 8/10 at 5 minutes. There were 2 (2%) neonatal deaths in this study group. The sensitivity of biophysical profile was 79.1%, specificity 92.9%. Predictive value for a positive test was 98.55%; predictive value for a negative test was 41.93%. **Conclusion:** Biophysical profile is highly accurate and reliable test of diagnosing foetal hypoxia.

Keywords: Foetal biophysical profile, High risk pregnancy, Perinatal outcome

INTRODUCTION

A pregnancy is defined as high risk when there is a likelihood of an adverse outcome to the woman and or her baby that is greater than the incidence of that outcome in the general pregnant population.

Maternal appreciation of foetal life has been, since ancient times, a traditional indication that the pregnancy progression is normal. Ultrasound imaging has broadened the scope of foetal assessment.[1] Dynamic real time B-Mode ultrasound is used to monitor cluster of biophysical variables, both dynamic and static collectively termed as biophysical profile (BPP).[2]

The BPP is non-invasive test that predicts the presence or absence of foetal asphyxia and, ultimately, the risk of foetal death in the antenatal period. When the BPP identifies a compromised foetus, measures can be taken to intervene before progressive metabolic acidosis leads to foetal death.[3]

The BPP combines data from two sources, i.e., ultrasound imaging and Foetal Heart Rate [FHR] monitoring. Dynamic real-time B-mode ultrasound is used to measure the Amniotic Fluid Volume (AFV) and to observe several types of foetal movements. The FHR is obtained using a pulsed Doppler transducer integrated with a high-speed microprocessor, which provides a continuously updated reading.

The BPP has become a standard tool for providing ante partum foetal surveillance and criteria for scoring is demonstrated in Table-1.[4]

Table-1: Criteria for coding BPP as normal or abnormal[4]

Components of 30 minute Biophysical Profile Score	
Component	**Definition**
Foetal movements	≥3 body or limb movements
Foetal tone	One episode of active extension and flexion of the limbs; opening and closing of hand
Foetal breathing movements	≥1 episode of ≥30 seconds in 30 minutes
Amniotic fluid volume	A single 2 cm x 2cm pocket is considered adequate
Non-stress test	2 accelerations >15 beats per minute of at least 15 seconds duration

The BPP allows 2 points for each parameter that is present; yielding a maximum score of 10. Sonographic examination is scheduled to last for 30 minutes to exclude foetal sleep wake cycle. The profile may be completed when all the variables have been observed; however a full 30 minutes must elapse before the profile is judged to be abnormal.

Acute markers such as FHR, foetal breathing, foetal movements and tone are biophysical activities that are initiated and controlled by different foetal CNS centres which develop at different times in foetal life.

There is convincing data that during hypoxia and acidosis the earliest biophysical activity to become compromised are foetal heart reactivity and foetal breathing movements.[4]

In case of decreased foetal movements in third trimester, screening for foetal vitality remains necessary through study of foetal heart rate and the

foetal BPP.[5] when biophysical profile score (BPS) is abnormal, back up studies such as umbilical artery Doppler is requested.

The BPS and Doppler sonography effectively stratify Intrauterine Growth Restricted (IUGR) foetuses into risk categories.[6] The role of sonographic biophysical profile in intrapartum foetal surveillance is established in high risk pregnancies and it has been found to be associated with significant reduction in incidence of cerebral palsy compared with an untested population (1.33 per 1000 versus 3.68 per 1000).[7]

The BPP should not be performed in fasting state, as hypoglycaemia reduces foetal activity.[8] The BPS ≤6 has significant association with early neonatal morbidiy.[9]

As living in a developing country, where perinatal mortality is so high, the purpose of my study is to know whether Sonographic BPP can effectively identify a compromised foetus, so that appropriate timely measures can be taken to intervene before progressive metabolic acidosis leads to foetal death.

PATIENTS AND METHODS

The study was carried on 100 randomly selected high risk pregnant patients, referred from in/out-door patient departments from December 2007 to June 2008 at the Department of Radiology Lady Reading Hospital Peshawar. Manning's biophysical profile including non-stress was employed for foetal screening, using Toshiba ultrasound machine model Nemio SSA-550A and 7.5 MHZ Probe. These parameters included biophysical variables, i.e., foetal breathing movement, foetal tone, foetal gross body movements, amniotic fluid volume and Non-stress test. Doppler studies were used as backup tests where biophysical profile was abnormal.

All cases selected were admitted in the hospital and each had an admission biophysical profile followed by subsequent monitoring. Parameters for abnormal perinatal outcome included foetal distress in labour; five minute Apgar score less than 7/10, admission of newborn to intensive care unit and stillbirth or neonatal death. Patients with twin pregnancy, intra uterine foetal congenital anomalies, ante-partum haemorrhage, and pregnancy with obstetrical complications needing early intervention with Caesarean section were excluded from the study.

The result of last biophysical profile was compared with perinatal outcome. For statistical analysis the predictive value, specificity and sensitivity were used to determine the ability of biophysical profile to predict an abnormal perinatal outcome using SPSS version 11.

RESULTS

During study period, 100 high risk pregnant patients were examined through sonographic biophysical profile. Patient's ages were in the range of 18–45 years. Mean maternal age was calculated as 28.67±6.425 SD years. Out of 100 patients 34 (34%) were primigravida and 66 (66%) were multigravida. The most common obstetrical indications for antepartum evaluation are mentioned in Table-2.

Last BPP to delivery interval was within 07 days, with a minimal interval of 4 hours to four days. In 97 (97%) cases neonatal birth weight was normal except in 3 (3%) cases birth weight was <2.5 kg.

Out of 100 cases 79 (79%) had a normal biophysical profile in the last scan of 10/10 and had a normal perinatal outcome with 5minutes A/S >7/10 and no element of intra-partum foetal distress. Six (6%) cases had a BPS 8/10 with normal perinatal outcome. Fifteen (15%) case had abnormal scores of 6/10 (4%), 4/10(10%), and 2/10 (1%). In 13 (13%) cases A/S at 5 minutes was <7/10 and babies were shifted to NICU for delayed cry after delivery.

Backup tests including Doppler studies were done in 8 (8%) cases with abnormal BPP and suspected IUGR, which showed reverse flow in 5 (5%) cases, absent flow in 2 (2%) cases and normal flow in 1 (1%) case. There were 2 (2%) false positive cases that had an abnormal BPS of 6/10 but baby had an A/S of 8/10 at 5 minutes.

The sensitivity of BPP score in this study was 79.1%; specificity 92.9% Predictive value for a positive test was 98.55%. Predictive value for a negative test was 41.93%.

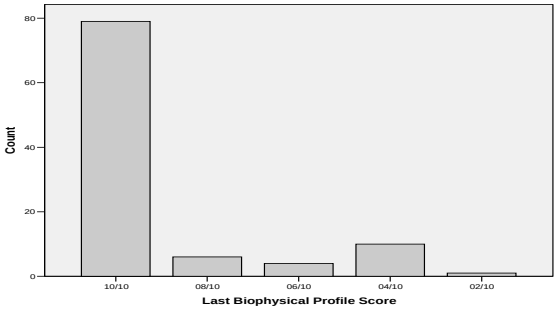

Figure-1: Frequency of Last Biophysical Profile Score (n=100)

Table-2: Obstetrical indications for biophysical profile scoring (n=100)

Indications	Patients	Percentage
Diabetes Mellitus	11	11.0
Hypertension	5	5.0
Asthma	3	3.0
PIH	16	16.0
Anaemia	9	9.0
DM,HTN	1	1.0
Cardiac disease	2	2.0
Reduced foetal movements	53	53.0

Table-3: Distribution of neonatal morbidity among Biophysical Profile Scores (n=100)

BPS	Patients	Foetal distress in labour	5 min Apgar Score <7	Low birth weight	NICU admission	Perinatal Death
10/10	79	-	-	-	-	-
8/10	6	-	-	-	-	-
6/10	4	2	2	-	2	-
4/10	10	10	10	3	10	1
2/10	1	1	1	-	1	1-

DISCUSSION

The perinatal mortality within 1 week of a normal biophysical profile has remained around 0.8/1000 for over 10 years. It should be noted that the use of historical controls may lead to conclusions that are not subsequently supported by properly controlled comparative studies. Even when stringent criteria's are established, differences can arise between groups selected at different points in time. Approximately 50% of studies using historical controls lead to an incorrect assumption that a particular treatment regime is effective.[10]

In a more recent study Dayal determined the cause of stillbirth in 27 structurally normal foetuses that had a normal biophysical profile score within 1 week of foetal demise. The maternal and foetal causes of stillbirth were random events that would not be detected by the biophysical profile score. When Dayal compared results from two different facilities, the false negative rate (foetal death within 1 week of a normal biophysical profile score) was $1/10^{th}$ the institution's perinatal mortality. The false-negative rates at the two facilities were 0.7/1000 and 2.3/1000. On an individual basis, the greater the maternal and foetal risk factors, the higher the false negative rate.[11]

In developed countries the perinatal mortality has remarkably reduced (7/1000), whereas in developing countries the figure is still high even in tertiary care hospitals. There is no reliable perinatal mortality for Pakistan and most of the data is hospital based. A multi-centre survey from hospital based facilities indicated an overall perinatal mortality rate (PMR) of 92 per thousand births with a majority of deaths (72%) due to stillbirths[12], whereas in developed countries the end point of improved obstetrical services is reduction in perinatal morbidity.[13] We still aim at both aspects of perinatal outcome.

Our study has shown a specificity of 92.9%, thus the predictive value of normal BPP can be ranked excellent regarding the absence of ominous, intrapartum foetal heart rate pattern, normal 5minute Apgar score and baby's cry with in one minute after birth. Nevertheless, it should be emphasized that many intrapartum events can lead to low Apgar score or delayed cry. The best predictive value of normal test was found when all the BPP through out pregnancy were considered. We had our sensitivity of 79.1%. Fifteen cases had abnormal scores of 6/10 (4%), 4/10 (10%), and 2/10 (1%). Out of abnormal BPS there were two false positive cases where the BPP was 6/10 and baby born with A/S>8/10 with good cry with in first 5 minutes. This may be because of very immediate intervention, i.e., patient was delivered with in one hour of abnormal BPP.

The positive predictive value was excellent, i.e., 98.55% and the negative predictive value was 41.93%. The results are comparable to another study done at a tertiary care hospital New Delhi India[14], where full BPP including CTG was utilized in high risk term or near term pregnancies for predicting foetal outcome. One hundred and fifty-four high risk pregnant patients were consecutively included in the study. At a cut off score of <8/10 sensitivity was 70.83% and specificity 91.53% as compared to each individual variable, the positive predictive value of abnormal perinatal outcome improved considerably after combining all the variables. The negative predictive value for normal perinatal outcome did not improve.

In another study at Nashville TN[15] modified ultrasonography based BPP was used which included expanded scores of foetal movements, foetal breathing , and qualitative assessment of accelerated placental maturity, and this method was compared with method of Vintzileos *et al* and applied to 180 high risk pregnancies to determine correlation with perinatal outcome. Relationship of results of last total score and perinatal outcome showed good predictive values with specificity of 98.8% and sensitivity of 82.4%.

In mother and child health centre PIMS Islamabad Pakistan another study was carried out[16], which concluded that admission intra-partum biophysical profile is better predictor of perinatal outcome than electronic foetal heart rate monitoring alone. They evaluated 620 low risk labouring woman and sensitivity, specificity, positive and negative predictive value of BPP were 87%, 98%, 75%, and 99.5% respectively.

It is evident from the data presented that results of our study are comparable to the different studies carried out on predictive accuracy of biophysical profile.

CONCLUSIONS

The goal of antenatal surveillance is to prevent foetal injury and death. Antenatal testing should improve long-term neurological outcome through optimal timing of delivery while avoiding unnecessary

intervention, such as caesarean delivery or preterm delivery.

Techniques to monitor the foetus through pregnancy have been developed with the aim of providing sufficient information to enable the clinician to diagnose foetal hypoxia, characterize development and detect abnormality.

The role of biophysical profile in intrapartum surveillance is established in high risk pregnancies and it has been found to be associated with significant reduction in incidence of cerebral palsy compared with an untested population.

REFERENCES

1. Afzal A, Nasreen K. Biophysical Score; high risk pregnancy. Prof Med J 2006; 13:362–9.
2. William D, Alfred B, Barbra S. Fetal growth and well being in: The Requisites ultrasound. 2nd ed. China, Mosby 2004;330–41.
3. Filho GHA, Araujo E, Nardozza LM, Costa DLL, Moron AF, Mattar R. Ultrasound assessment of the fetal biophysical profile: what does a radiologist need to know? Eur J Radiol 2008;66:122–6.
4. MC Grath, Ling M. Fetal well – being and fetal death in: Clinical Sonography, 4thed. Philadelphia: Roger C Sanders; 2005.p.173–82.
5. Sergent F , Lefevre A , Verspyck E , Marpeau L. Decreased fetal movements in the third trimester: what to do? Gynecol Obstet Fertil 2006;34:874–6.
6. Bachat AA, Galan HL, Bhide A, Berq C, Kush ML, Oepkes D, *et al*. Doppler and Biophysical assessment in growth restricted fetuses. Ultrasound Obstet Gynecol 2006;27:41–7.
7. Manning FA, Bondaji N, Harman CR, Casiro O, Menticoglou S, Morrison I, *et al*. Fetal assessment by fetal biophysical profile score. The incidence of cerebral palsy among tested and untested perinates. Am J Obstet Gynecol 1990;76:36.
8. Mirghani HM, Weerasinghe DS, Ezimokhai M, Smith JR. The effect of maternal fasting on the fetal biophysical profile. Int J Gynecol Obstet 2003;81:17–21.
9. Arauz RJF, Chequer MJC, Lopez AAG, Hernandez JVH, Mendez AJA. Usefulness of Biophysical profile in preterm rupture of membranes with treatment. Gynecol Obstet Mex 2005;73:415–23.
10. Sacks HS, Chalmers TC, Smith H. Sensitivity and specificity of clinical trials: Randomized versus historical controls. Arch Intern Med 1983;143:753–5.
11. Dayal AK, Manning FA, Berck DJ, Mussalli GM, Avila C, Harman CR, *et al*. Fetal death after normal biophysical profile score: An eighteen year experience. Am J Obstet Gynecol 1999;181:1231–6.
12. Bhutta ZA. Priorities in newborn care and development of clinical neonatology in Pakistan: where to know? J Coll Physicians Surg Pak 1997;7:231–4.
13. Soothill PW, Ajayi RA, Cambel P, Nicolaides KH. Prediction of mortality in small and normal grown fetuses by fetal heart rate and variability, biophysical score and umbilical artery Doppler studies. Br J Obstet Gynaecol 1993;100:742–5.
14. Begum F, Buckshee K, Pande JN. Antenatal assessment using biophysical profile score. Bangladesh Med Res Counc Bull 1996;22(2):51–9.
15. Nashvill, TN, Shah DM, Brown JE, Salyer SL, Fleischer AC, Boehm FH. A modified scheme for biophysical profile scoring. Department of Obstetric and Gynaecology, Vanderbilt University School of Medicine. Am J Obstet Gynecol 1989;160:586–91.
16. Mahmood G, Tasnim N, Qazi A. Admission biophysical profile. A better predictor of perinatal out come. Mother and Child Health Centre, Pakistan Institute of Medical Sciences Islamabad. J Surg Pak 2000;16:6–11.

Address for Correspondence:

Dr. Nadeem Ullah, Department of Radiology, PGMI, Government Lady Reading Hospital, Peshawar, Pakistan.
Cell: +92-345-9055915
Email: abcnadeem@gmail.com