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Original Research Article

To evaluate the tests of antepartum fetal surveillance for predicting adverse perinatal outcome in pregnancy with IUGR

Bhavya H U[1], **Mahesh Babu**[2,*], **Shyam Sundar S**[3]

[1]*Dept of Obstetrics & Gynecology, KVG Medical College & Hospital, Sullia, Karnataka, India*
[2]*Dept. of Ophthalmology, KVG Medical College & Hospital, Sullia, Karnataka, India*
[3]*Dept. of Pediatrics, KVG Medical College & Hospital, Sullia, Karnataka, India*

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ABSTRACT

Context: IUGR is one of the most common pregnancy complications which substantially increase risk of adverse neonatal outcome. The sequelae of IUGR include stillbirth, neuro-developmental delay in childhood and high risk of diseases like hypertension, diabetes in adulthood. Therefore, IUGR in pregnancy warrants intensive antepartum fetal surveillance to ensure optimal perinatal outcome.

Aims: To evaluate the tests of antepartum fetal surveillance like AFI, BPS and Doppler ultrasound, alone and in combination for predicting adverse perinatal outcome in pregnancy with IUGR.

Materials and Methods: This was a prospective observational study done on 100 pregnant IUGR women > 34weeks of gestation, at a tertiary care centre in Karnataka, from June 2017 till December 2018. They were monitored by tests of fetal surveillance like Amniotic Fluid Index (AFI), Bio Physical score (BPS) and Doppler ultrasound. Tests done within 48 hours before labour and its relation to perinatal outcome were assessed. Continuous data such as age, height, weight were described by mean and standard deviation. The sensitivity specificity, positive and negative predictive value were calculated for each test.

Results: The statistical difference between the normal and abnormal tests of antepartum fetal surveillance in relation to perinatal outcome was significant. Diagnostic accuracy of Doppler was 67%, BPS and AFI was 69%. In case of combination of findings of BPS and Doppler, the accuracy rose to 75%.

Conclusions: Biophysical profile was most reliable diagnostic method than Doppler in predicting adverse outcome. Sensitivity increased when BPS and Doppler was combined which is beneficial in predicting perinatal outcome.

1. Introduction

Intrauterine growth restriction (IUGR) is one of the most common pregnancy complications and it substantially increases the risk of adverse neonatal outcome. IUGR represents pathological inhibition of fetal growth and failure of the fetus to attain its growth potential.[1] It has been estimated that in developing countries, approximately 30 million newborns are affected with intrauterine growth restriction per year. This rate is six times higher than that in developed countries.[2] There is a strong association between stillbirth and fetal growth restriction.[3] Among all stillbirths, 20% are found to be due to IUGR.[4] The sequelae of IUGR include stillbirth, detrimental effects on neuro-developmental progress in childhood and higher risks of diseases like hypertension, vascular disease and diabetes in adulthood. Therefore these pregnancies need to be monitored closely to identify at risk fetus and initiate delivery before this critical event.

IUGR in pregnancy warrants intensive antepartum and intrapartum fetal surveillance to ensure optimal perinatal outcome. Though the ideal management protocol is still not determined, various modalities are available for the assessment of growth restricted fetus. Present day antenatal

* *Corresponding author*.
E-mail address: maheshbabu.oph@gmail.com (M. Babu).

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fetal surveillance modality consists of Daily fetal movement counts (DFMC), Non stress test (NST), Biophysical profile (BPP) and Doppler study of uterine and fetal vessels. An effective strategy for integration of these diagnostic tests needs to be defined yet. The use of combined fetal assessment tools may help in predicting the adverse perinatal outcome before the cardiovascular collapse. This study aims to evaluate the tests of antepartum fetal surveillance like Doppler ultrasound, Biophysical score (BPS) and AFI alone and in combination, for predicting adverse perinatal outcome in pregnancy with IUGR.

2. Materials and Methods

The present study was a prospective observational study done on 100 pregnant women with confirmed IUGR of > 34weeks of gestation admitted for safe confinement at a tertiary care centre in Karnataka, South India, from June 2017 till December 2018 after obtaining institutional ethical committee clearance. For the purpose of the study, IUGR was defined by one of the following criteria: Clinically by measuring fundal height which shows a lag of 4 weeks or more from the period of gestation or if estimated fetal weight by ultrasonography(USG) is less than 10^{th} percentile of weight based on the gestational age.[5] Cases with congenital malformation, placenta previa, multiple pregnancies, patients in active labour and systemic diseases (diabetes mellitus, thyroid disease, heart disease, severe anaemia) were excluded from the study.

A written informed consent was taken from the patient before enrolling in the study. A detailed history of present pregnancy and previous obstetric history which also included history of IUGR in previous pregnancy, drug intake, diet history, significant past history and family history were taken. Thorough general physical and systemic examination was done. Complete obstetric examination was done including assessment of fundal height, abdominal girth, Symphysio fundal height, amount of liquor, fetal heart rate and uterine contractions. Following routine examination and laboratory investigation, fetal heart rate, measurements of Biparietal diameter (BPD), head circumference (HC), femur length (FL) and abdominal circumference (AC) were taken using ultrasound machine with a 3.5 to 5 megahertz (Mhz) convex abdominal probe to determine estimated fetal weight using the Hadlock formula.

After excluding fetal anomalies, amniotic fluid index (AFI), umbilical(UA) and middle cerebral artery(MCA) Doppler USG indices and Biophysical profile(BPP) score were evaluated. Those with AFI less than 5 cm were considered oligohydramnios. Complete biophysical profile was performed for 30 minutes and scoring was done. Afterwards, by locating the freely floating umbilical cord, Doppler indices of the umbilical artery were measured and noted by colour-pulse wave (PW) Doppler. During Doppler analysis, S/D ratio of umbilical artery of more than 3.6, and loss of diastolic flow or reversed diastolic flow were considered abnormal. The indications of delivery were term pregnancy, AFI < 5, BPS ≤ 4, absent or reversed flow in umbilical artery Doppler or reversal of Cerebro placental ratio. Tests done within 48 hours before delivery were noted and its relation to perinatal outcome was assessed. Intrapartum monitoring was done by intermittent auscultation. The outcome parameters observed were APGAR < 7 at 5 min after birth, Umbilical cord blood pH< 7.2, NICU admission and perinatal death.

2.1. Statistical analysis

Statistical analysis of the observations and the results of the above study were carried out using the standard test of significance in order to find if the results were statistically significant. Continuous data such as age, height, weight etc were described by mean and standard deviation and these were compared by student t-test. The sensitivity specificity, positive predictive value and negative predictive value were calculated for each test.

3. Results

Mean age of women in our study was 24.5±3.4yrs. 58% were primipara and 42% were multipara. 60% of women delivered at gestational age of 37weeks and above whereas 40% delivered at the gestational age less than 37 weeks. The results of NST, BPS and Doppler analyses are given in Table 1.

In the present study, out of 100, 39 patients were in spontaneous labour. However, labour was induced in 61 subjects. Majority of the patients i.e. 84% (84/100) had normal vaginal delivery, 13% (13/100) had caesarean section and 3% (3/100) of them had instrumental vaginal delivery.

The average birth weight of the babies was 1.98±0.27kgs.

Out of 100, 71 neonates had normal neonatal outcome and 29 neonates had adverse neonatal outcome as shown in Table 2. Adverse neonatal outcome in the present study was measured in terms of Apgar score less than 7 at 1 minute and 5 minutes, umbilical cord pH <7.2 or admission to NICU for complications due to intrapartum hypoxia. Meconium aspiration was seen in13 newborn babies and all required admission to NICU. Comparison of various neonatal parameters with normal and adverse perinatal outcome is shown in Table 3.

In our study, the relation between antepartum fetal tests and neonatal outcome was studied separately and in combination. When the relation of AFI was evaluated regarding its relation to perinatal outcome, AFI was normal in 68 (68%) of the pregnant women, oligohydramnios was present in 32 (32%). Adverse perinatal outcome was more in

the oligohydramniotic cases than with normal AFI and the difference was statistically significant (p 0.006). While BPS was ≥8/10 in 70 (70%), it was <8/10 in 30(30%) pregnant women. Those with ≥8/10 BPS were proven to have better perinatal outcome and this was statistically significant (p value of 0.01).

The Doppler findings were normal in 72% and abnormal in 28%. Out of 50 patients with abnormal Doppler, 20 had raised S/D ratio of the umbilical artery, 3 had raised middle cerebral artery Peak systolic Velocity (MCA-PSV), 3 of them had Absent End Diastolic Flow (AEDF) and 2 had Reversed End Diastolic Flow (REDF). Patients with normal Doppler findings had better perinatal outcome and this was proven to be statistically significant (p value of 0.0002).

The relation between neonatal outcome and tests of fetal surveillance (AFI, BPS, Doppler) alone as well in combination (BPS + Doppler) is shown in Table 4.

The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the tests AFI, BPP, Doppler alone and in combination for predicting adverse perinatal outcome are shown in Table 5. In predicting the adverse perinatal outcome, Doppler sensitivity was 42%, BPS was 48% and AFI was 52%. In case of combination of findings of BPS and Doppler, the sensitivity rose to 66% with a diagnostic accuracy of 75%.

Table 1: Results of antepartum fetal surveillance tests

Parameter		N (100)
AFI	≤5	32
	>5	68
Biophysical score (BPS)	4/10	5
	6/10	25
	8/10	46
	10/10	24
US Doppler Fetal Umbilical artery (UA) and middle cerebral artery(MCA)	Normal	72
	UA S/D ratio raised	20
	UA AEDF	3
	UA REDF	2
	Raised MCA PSV	3

Table 2: Normal and adverse outcome in IUGR babies

Neonatal outcome		N (100)	%
Normal		71	71%
Adverse		29	29%
Apgar score <7	At 1 minute	20	20%
	At 5 minutes	1	1%
Umbilical pH < 7.2		10	10%
Admission to NICU (n=29)	Hypoxemia	9	9%
	Respiratory distress	6	6%
	Meconium aspiration	13	13%
	Neonatal seizures	1	1%

4. Discussion

Antenatal fetal surveillance is of utmost importance in cases of IUGR where decision to time of delivery is very crucial as the incidence of stillbirth is high among these cases. The goal of fetal surveillance in IUGR is to balance fetal and neonatal risks to optimize the timing of intervention. Although intense fetal surveillance is helpful in decision making for time of delivery, one has to keep in mind the cost and time expenditure associated with these procedures. The obstetrician is responsible for using all the available tests to obtain the best results for both mother and baby. One test will not be sufficient to make the right decision; all these tests need to be evaluated together for optimum outcome.[6]

Amniotic fluid is an important marker for fetal well being and its decrease should be considered as a serious obstetric condition usually associated with the underlying causes like IUGR, post maturity. It has been shown by various researchers that oligohydramnios is related with poor perinatal outcome.[7–9] In our study there was significant difference in predicting adverse perinatal outcome between normal and abnormal AFI (oligohydramnios) groups which is in correlation with the current literature.

The validity of BPS in the present study was sensitivity 48%, specificity 77%, positive predictive value 47% & negative predictive value 78%. The sensitivity and specificity are comparable to studies done by Bardakci et al.[10] (60% & 87.1%) and Jamal et al.[11]

Admission to NICU is an important parameter while evaluating perinatal outcome which was found to be statistically higher in the presence of abnormal UA Doppler analysis based on studies done on high risk pregnancies.[12–14] Brar et al.[13] found 35 abnormal UA S/D ratios in 200 high-risk pregnant women with Intra uterine growth restriction (IUGR), caesarean section, low 5-min APGAR score, low birth weight and admission to NICU. They reported that umbilical artery Doppler studies in high-risk pregnancies is useful to predict outcome. Jensen and Guimaraes[14] also found a significant relation between umbilical artery S/D ratio, intrauterine growth retardation and admission to NICU. In our study also newborn with an abnormal Doppler analysis had a statistically significant higher incidence of admission to the NICU.

Turan et al.[15] in their study on 58 pregnant women with IUGR, compared Doppler analysis, biophysical profile and fetal heart monitoring in predicting fetal acidosis. In all cases, delivery was by caesarean section and after that cord blood gases analysis and 5-min APGAR scoring was carried out in all. A pH value of <7.2 was found in 17 fetuses, and 8 of those had 5 min APGAR score of < 7. So they stated that using two or more antenatal tests is more beneficial in the prediction of fetal acidosis than using a single test. Similarly in the present study, the combination of antenatal

Table 3: Comparison of neonatal parameters with normal and adverse perinatal outcome

Parameter measured	Normal perinatal outcome (mean ± S.D)	Adverse perinatal outcome (mean ± S.D)	P value
Mean birth weight in kg	2.08±0.17	1.73±0.32	0.0001
Mean length in cm	46.1±1.4	44.5±2.06	0.0001
Mean Ponderal index	2.12±0.2	1.94±0.2	0.001
Mean placental weight in grams	382.2±29.08	345.3±41.3	0.0001
Mean umbilical cord pH	7.3±0.04	7.2±0.05	0.0001
Mean Apgar score at			
1 minute	6.3±0.7	7.8±0.5	0.0001
5 minute	8.2±0.6	8.6±0.5	0.0001
Mean duration of NICU stay in days	2.3±1.1	7.5±4.4	0.00002

Table 4: The relation between tests of antepartum fetal surveillance and neonatal outcome

Antepaartum fetal surveillance test		Neonatal outcome		P value
		Normal	Adverse	
AFI	>5(68)	54	14	0.006
	< 5(32)	17	15	
BPS	≥8/10(70)	55	15	0.01
	<8/10(30)	16	14	
Doppler	Normal (72)	55	17	0.05
	Abnormal(28)	16	12	
Doppler + BPS	Normal (66)	56	10	0.00002
	Abnormal(34)	15	19	

Table 5: Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the fetal surveillance tests in predicting adverse perinatal outcome

Test	Sensitivity	Specificity	PPV	NPV	Diagnostic accuracy
AFI	52%	76%	47%	79%	69%
BPS	48%	77%	46.6%	78%	69%
Doppler	42%	77%	42%	76%	67%
Doppler+BPS	65.5%	79%	55%	84%	75%

tests (Doppler+ BPS) provided higher sensitivity values.

Baschat et al.[16] compared Biophysical profile(BP) and Doppler analysis results in 328 pregnant women with IUGR. Umbilical artery, middle cerebral artery and ductus venosus were evaluated by Doppler analysis. In 55.5% of the cases, there was no correlation between BP and Doppler analysis and BP was normal in most of these cases. Doppler compared to BP showed non reassuring fetal state in 3-fold more cases and had a higher false positivity than BP. So they concluded that, instead of using each test separately, using combination of them is of more value for outcome prediction.

Based on previous studies, it was observed that Doppler analysis presages biophysical deterioration.

1. Combining multi vessel Doppler and composite biophysical profile scoring will provide significant early warning and a definitive indication for action in the management of severe intrauterine growth restriction.
2. Many authors have reported improved assessment of fetal well-being among small for- gestational-age fetuses using the modified biophysical score in combination with umbilical and middle cerebral artery Doppler velocimetry.

5. Conclusion

Biophysical profile was most reliable diagnostic method than Doppler in predicting adverse outcome. But sensitivity was increased when both BPS and Doppler analysis were combined and was beneficial in prediction of perinatal outcome. Each day gained in utero is boon to fetus but in IUGR cases prolongation of intrauterine life should be carefully balanced with risk of intrauterine death. The selection of appropriate time of delivery is of utmost importance in management of intrauterine growth restriction. More research including larger study groups are

needed to further validating the tests of antepartum fetal surveillance.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare that there is no conflict of interest.

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Author biography

Bhavya H U, Associate Professor https://orcid.org/0000-0003-2445-6865

Mahesh Babu, Associate Professor https://orcid.org/0000-0001-8708-1445

Shyam Sundar S, Associate Professor

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