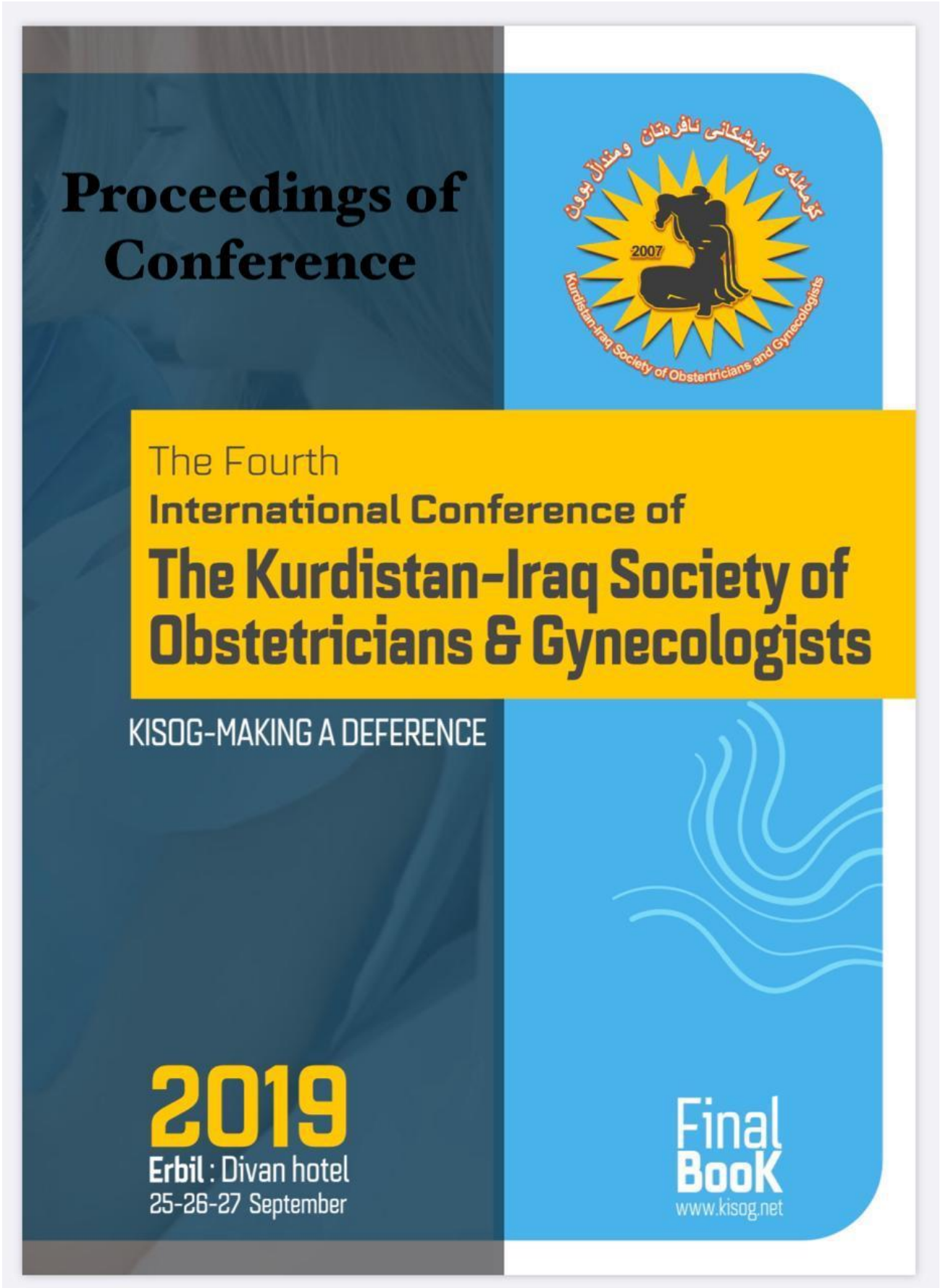
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Assessing the validity of Modified Biophysical Profile & Doppler Ultrasound in the third trimester of pregnancy to determine perinatal outcome.

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Abstract

Objectives*:* In this paper, modified biophysical profile (MBP) and umbilical artery Doppler ultra-sonographic (USG) analysis were compared in predicting the perinatal outcome in the third trimester of pregnancy.

Methodology*:* This test is a clinical comparative one. The subjects were 232 pregnant women in the third trimester followed up at obstetric unit in Erbil Maternity Teaching Hospital, Erbil city, Kurdistan Region, Iraq. The study was launched from the 1st of January 2019 until the 1st of September 2019. Following routine examination, amniotic fluid index and umbilical artery Doppler RI were evaluated. Non-stress test (NST) was done and MBP was generated. Meconium, fetal distress, neonatal intensive care unit admission and 5-min APGAR score results were used in evaluating the perinatal outcome.

Results*:* The test is based on 232 pregnant patients between 18 and 45 years old who are in their third trimester that were admitted to Maternity teaching hospital. Patients' median age was 28±5.67, gravida changing between 0 and 8 with a median of 2 and parity changing between 0 and 7 with a median of 1. Birth weight measurements varied from1100g to 4700g with a median of 3,000±598 grams.

A total of 44.9% with abnormal Doppler results had a FD compared with only 20.2% of those with normal Doppler results ($p < 0.004$). Admission to the neonatal intensive care unit was significantly more frequent in women with abnormal Doppler results than in those with normal Doppler results (55.1% vs. 23%, $p < 0.017$). FD was about 29.3% and 20.2% in those with abnormal and normal MBP respectively ($p<0.001$), NICU admission was higher about 34.6% in those with abnormal MBP compare to those with normal MBP that was 23.2% ($p<0.001$). The sensitivities of MBP in predicting FD and NICU admission were 66.1% and 66.7% respectively, the sensitivity of Doppler RI analysis in predicting FD and NICU parameters were 37.3% vs. 39.1%, the statistical difference between the groups of normal and abnormal MBP and Doppler analysis was significant.

In case of the combination of findings of MBP and umbilical artery Doppler, the sensitivity increases, for FD it was 86.4% and for NICU admission was 88.4%.

Conclusion*:* MBP was proved to be more significant than Doppler analysis in prediction of FD and perinatal results, but the sensitivity was increased when both were combined, so combination of MBP and Doppler analysis instead of MBP alone is more significant in antenatal assessment

Keywords: Modified biophysical profile, Doppler ultrasonography, fetal distress, neonatal intensive care unit admission

Introduction

The aim of intrapartum fetal monitoring is to reduce perinatal mortality and long-term morbidity by identifying fetal compromise in utro, so appropriate intervention can be done to obtain desired clinical effect while also avoiding unnecessary obstetric interventions (1).

The most common methods used by obstetricians in order to assess antepartum evaluation which are: The Non-stress test (NST), contraction stress test, Doppler ultrasonography, Biophysical profile (BP) and examining fetal anatomy by ultrasound.

None of these antenatal approaches are adequate when used alone hence, it is common practice to combine them to reach a healthy and effective decision. This is also true for Comparison of Modified Biophysical Profile with Doppler Ultra sonographic Analysis in Determining Fetal Well Being in the third Trimester.

In addition, there is limited evidence of randomized clinical trials that support daily practice modalities that can be used for antenatal and intrapartum fetal wellbeing assessment. The testing method for which there is Level 1 evidence is the use of umbilical artery Doppler for fetal surveillance in growth restricted fetuses (2).

A modified biophysical profile (MBP) was formed with both amniotic fluid volume (AFV), which is a definitive marker for chronic hypoxia, and NST which illustrations acute hypoxia. Presence of oligohydramnios and/or non-reactive NST was considered to be an abnormal MBP and its ability of detection fetal distress and perinatal outcomes was based on this (3).

Umbilical arterial (UA) Doppler evaluation is used in the third trimester of pregncy to monitor fetal wellbeing, which is a marker of uteroplacental insufficiency and consequent intrauterine growth restriction (IUGR) or suspected pre-eclampsia. Umbilical artery Doppler assessment has been shown to reduce perinatal morbidity and mortality in high risk pregnancy (4,5,6).

The commonly used parameters in Doppler study are: umbilical arterial S/D ratio (systolic velocity / diastolic velocity), pulsatility index (PI)which is (PSV - EDV) / TAV, resistance index (RI) which is (PSV - EDV) / PSV, PSV (peak systolic velocity) and EDV (end diastolic velocity) (7,8).

Some studies used S/D ratio as their Doppler parameter but in our study we used RI which is slowly decrease through the course of gestation due to progressive maturation of the placenta (9).

The tests of fetal well-being should have sufficient specificity and sensitivity, so we decided to conduct this study in which MBP and umbilical artery Doppler ultra-sonographic (USG) analysis were compared in predicting the perinatal outcome in third trimester's pregnant women.

Method

This is a clinical comparative study that examines 232 pregnant women in the third trimester followed up at obstetrics unit at Erbil Maternity Teaching hospital, Erbil city, Kurdistan Region, Iraq, from 1 January 2019 until 1 September 2019. The Ethics and Scientific Committee at Kurdistan Board of Medical Specialty approved the study. Verbal informed consent was obtained from all women after the procedure was explained to them.

We included women with a viable singleton pregnancy and a gestational age of 28 - 42 weeks. Those who were in active labor, those who had congenital abnormal babies, multiple pregnancies, those with known fetal cardiovascular anomalies or ruptured membranes were excluded in this study. A history was taken regarding the age, obstetric history, gestational age (measured by the last menstrual period and ultrasound).

After a routine examination and investigation, by using Evolution 6 ultra-sonogram machine and 3.5-5 MHZ abdominal convex probes, amniotic fluid index (AFI) and umbilical artery Doppler USG indices were evaluated. To reduce the variation in measurements of Doppler and AFI recordings, all of the women were evaluated by the same sonographer (in the Ultrasound and X-Ray Department of the Maternity Teaching Hospital), who was an expert in this field.

During Doppler studies, the mother was asked to lie down with a slight left lateral tilt in a semi-recumbent position. This was intended to minimize the risk of supine hypotension syndrome. AFI made by amniotic fluid volume measurement in four quadrants, when taken in the vertical plane, AFI below or equal to 5cm are considered to be oligohydramnios (10). Doppler analysis was performed by locating freely floating umbilical cord. Doppler index of umbilical arteries

was measured and noted by power wave Doppler in a period of no respiration and no movement. In this study we measure systolic and diastolic velocity then Resistance Index (RI) was evaluated which is S-D/S (11,12). The cutoff point of 0.6 or less for RI was considered as normal.

Non-Stress Test (NST) was performed for patients in semi sitting position by using

(GIMA, FC700) CTG machine for (30) minutes, the plotting speed was set to 1cm/min; if it is non-reactive, we repeat it for another (30) minutes after putting patient in left lateral position with intravenous fluid, if no positive result was obtained after (60) min. the NST consider non-reactive.

The CTG was classified as nonreactive or abnormal if: Tachycardia (fetal heart rate >160), bradycardia (FH<110), variable deceleration, late deceleration, sinusoidal pattern, reduced or absent variability.

MBF (modified biophysical profile) was generated by measuring both AFI (Amniotic Fluid Index) & NST (Non-Stress Test), presence of oligohydramnios and /or non-reactive NST regarded as abnormal MBP.

Perinatal result evaluation documented which include meconium, fetal distress, Apgar score in (1st & 5th min.) and NICU admission. Neonates assessed initially by pediatrician on call for detection of the Apgar score at 1and 5minutes after delivery. Neurological assessment for signs of hypoxia and fetal distress were carried out. Data were obtained and recorded in a questionnaire that was designed by the researchers.

The Apgar score was classified as abnormal if it was <7 and excellent condition (7–10). Fetal respiratory distress was defined as presence of a characteristic difficulty in breathing and the requirement of oxygen.

The statistical analysis of this study was performed using SPSS version 22, McNemar test was used, a P value ≤ 0.05 was considered statistically significant

Results

The research examined the case of 232 women with their ages ranging from 18 to 45 years. The median was 28 years of age. It is evident in Table 1 that more than half of the sample (53.5%) aged 25 to 34 years, and 19.8% aged ≥ 35 years. More than half of the women (57.8%) were multi-parous, and the gestational age of the majority (84.1%) of the women was ≥ 37 weeks but ranging from 31-42 weeks.

Table 1. Basic characteristics of the studied sample.

	No.	%
Age (years)		
< 25	62	26.7
25-34	124	53.5
≥ 35	46	19.8
Parity		
Nulliparous	75	32.3
Multi-parous	134	57.8
Grand multi-parous	23	9.9
Gestational age		
< 37	37	15.9
≥ 37	195	84.1
Total	232	100.0

In our study, the relation between MBP and Doppler analysis findings and neonatal outcome was studied separately and in combination. While MBP was normal in 99 (42.7%), it was abnormal in 133 (57.3%) pregnant women. Those with normal MBP were proven to have better perinatal

outcome and this was statistically significant ($p < 0.001$). The relation between MBP and neonatal outcome is shown in table 2a.

Table 3 (3a &3b) shows the relation between RI results and the outcomes, The RI of the umbilical artery was normal in183 (78.9%) pregnant women, and abnormal in 49(21.1%); the specificities were relatively high, but this is on the expense of the sensitivities (less than 40%). No significant differences were detected between the RI result and the development of fetal distress ($p = 0.260$), and the RI results with the APGAR scores after 5 minutes (0.298).

Table 2a. Prediction of the outcome by Modified Biophysical Profile (MBP).

	Outcome frequencies			
MBP	**Abnormal**	**Normal**	**Total**	**p (McNemar)**
	Meconium			
Abnormal	23(17.3%)	110(82.7%)	133	
Normal	3(3%)	96(97%)	99	< 0.001
Total	26	206	232	
	Fetal distress			
Abnormal	39(29.3%)	94(70.7%)	133	
Normal	20(20.2%)	79(79.8%)	99	< 0.001
Total	59	173	232	
	APGAR first minute			
Abnormal	51(38.3%)	82(61.7%)	133	
Normal	22(22.2%)	77(77.8%)	99	< 0.001
Total	73	159	232	
	APGAR fifth minute			
Abnormal	27(20.3%)	106(79.7%)	133	
Normal	13(13.1%)	86(86.9%)	99	< 0.001
Total	40	192	232	
	NICU admission			
Abnormal	46(34.6%)	87(66.4%)	133	
Normal	23(23.2%)	76(76.8%)	199	< 0.001
Total	69	163	232	

Table 2b. Accuracy indicators of MBP in predicting the outcomes.

	Accuracy indicators			
Outcomes	**Sensitivity%**	**Specificity%**	**PV+ %**	**PV- %**
Meconium	88.5	46.6	17.3	97.0
Fetal distress	66.1	45.7	29.3	79.8
APGAR1	69.9	48.4	38.3	77.8
APGAR5	67.5	44.8	20.3	86.9
NICU admission	66.7	46.6	34.6	76.8

Table 3a. Prediction of the outcome by the Doppler resistant index (RI) results.

	Outcome frequencies			
RI	**Abnormal**	**Normal**	**Total**	**p (McNemar)**
	Meconium			
Abnormal	7(14.3%)	42(85.7%)	49	
Normal	19(10.4%)	164(89.6)	183	0.004
Total	26	206	232	
	Fetal distress			
Abnormal	22(44.9%)	27(55.1%)	49	
Normal	37(20.2%)	146(79.8%)	183	0.260
Total	59	173	232	
	APGAR first minute			
Abnormal	25(51%)	24(49%)	49	
Normal	48(26.2%)	135(73.8%)	183	0.006
Total	73	159	232	
	APGAR fifth minute			
Abnormal	15(30.6%)	34(69.4%)	49	
Normal	25(13.7%)	158(86.3%)	183	0.298
Total	40	192	232	
	NICU admission			
Abnormal	27(55.1%)	22(44.9%)	49	
Normal	42(23%)	141(77%)	183	0.017
Total	69	163	232	

Table 3b. Accuracy indicators of RI in predicting the outcomes.

	Accuracy indicators			
Outcomes	**Sensitivity%**	**Specificity%**	**PV+ %**	**PV- %**
Meconium	26.9	79.6	14.3	89.6
Fetal distress	37.3	84.4	44.9	79.8
APGAR1	34.2	84.9	51.0	73.8
APGAR2	37.5	82.3	30.6	86.3
NICU admission	39.1	86.5	55.1	77.0

Table 4a. Prediction of the outcome by the combination of MBP & RI results.

	Outcome frequencies			
Combination MBP & RI	**Abnormal**	**Normal**	**Total**	**p (McNemar)**
	Meconium		Total	
Abnormal	24(15.3%)	132(84.7%)	156	
Normal	2(2.7%)	74(97.3%)	76	< 0.001
Total	26	206	232	
	Fetal distress			
Abnormal	51(32.69%)	105(67.7%)	156	
Normal	8(10.53%)	68(89.47%)	76	< 0.001
Total	59	173	232	
	APGAR first minute			
Abnormal	63(40.38%)	93(59.62%)	156	
Normal	10(13.16%)	66(86.84%)	76	< 0.001
Total	73	159	232	
	APGAR fifth minute			
Abnormal	36	120	156	
Normal	4	72	76	< 0.001
Total	40	192	232	
	NICU admission			
Abnormal	61	95	156	

Normal	8	68	76	< 0.001
Total	69	163	232	

Table 4b. Accuracy indicators of combination of MBP & RI in predicting the outcomes.

	Accuracy indicators			
Outcomes	**Sensitivity %**	**Specificity%**	**PV+ %**	**PV- %**
Meconium	92.3	35.9	15.4	97.4
Fetal distress	86.4	39.5	32.7	89.5
APGAR1	86.3	41.5	40.4	86.8
APGAR5	90.0	37.5	23.1	94.7
NICU admission	88.4	41.7	39.1	89.5

For the combination of tests, the sensitivities were follows for each outcome: Meconium (92.3%), fetal distress (86.4%), APGAR1 (86.3%), APGAR5 (90%), and NICU admission (88.4%) and all the differences were significant ($p < 0.001$). While the combination of MBP and umbilical artery Doppler was normal in76 (32.8%) pregnant women, one or both of them were abnormal in 156 (67.8%) pregnant women. The perinatal outcome of the normal group was better than for the abnormal group and the difference was statistically significant ($p< 0.001$).

The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the results obtained from each differences prediction using MBP and Doppler analysis separately or as a combination are shown in table (2b,3b,4b).

in the study. Chi-square test, Mc Nemar test were also used for comparing the data.

Discussion

This research shows that evaluations to predict fetal outcome can help decrease perinatal mortality rates. Aside from its shortcomings, NST is practically the most widely used method in

deciding acute FD intrapartum. NST, as a CTG based-methods, along with contraction stress test and biophysical profile is considered to be a reliable tool in determining the healthy fetus in routine practice (13).

But these methods have high false positive rates ranging from 30% to 60%, it is fairly high in a non-reactive CTG (50-80%). According to previous studies perinatal mortality rates in the week following a reactive CTG are 3-5/1000 (14). Therefore, a good perinatal outcome is expected if the CTG is reactive, but the same cannot be said for the opposite.

Doppler indices are a non-invasive predictor of adverse perinatal outcomes in complicated pregnancies. Doppler velocimetry is a quick procedure that provides important information about the fetus ' hemodynamic situation. This technique is also an effective fetal risk diagnostic test that helps manage high-risk pregnancies (15).

Giles et al. (16) showed that in high-risk pregnancy the diagnostic efficacy of the umbilical artery appears to be more sensitive, but less specific than the non-stress test in predicting fetal growth restriction and fetal distress, our results were different from this above study in which non stress test is more sensitive.

In our study group we aimed to predict perinatal outcome and acute fetal distress in pregnant women in their third trimester with the help of Doppler ultrasonography and cardiotocography using MBP and Doppler analysis methods. Results obtained were compared both individually and in combinations.

While determining perinatal outcome; acute respiratory distress (ARD), presence of meconium, admittance to NICU and APGAR scores were all evaluated and the effectiveness of MBP and Doppler analysis were discussed according to these parameters. In our study, in women with abnormal Doppler results, the rate of admission to the neonatal intensive care unit was significantly higher than those with normal Doppler findings (55.1% vs.23%). The same pattern was observed regarding the Apgar score in the first and fifth minutes and an abnormal Doppler outcome was associated with a poor outcome of delivery. A prospective study conducted by Urmila and Beena showed that the rates of neonates who were admitted to the nursery care unit

and neonates with a low Apgar score were higher in women with abnormal Doppler results than in those with normal Doppler findings (17).

According to data gathered; those who had abnormal MBP and abnormal Doppler analysis had the worst prognosis and the difference between the normal and the abnormal group was statistically meaningful. FD was observed in 29.3% of the group that had an abnormal MBP along with 34.6% admittance to NICU and 17.3% meconium (Table 2a). When Doppler analysis results were evaluated, FD was observed in 44.9% of the group that had an abnormal umbilical artery RI along with 55.1% of admittance to NICU and 14.3% meconium. (Table 3a). Bardakci M et al. (18) in their study on 350 pregnant women stated that using two or more antenatal tests is more beneficial in predicting perinatal outcome. Similar to the above study when Doppler analysis results of umbilical artery and MBP results were compared in combination for determining FD, NICU admission, meconium and APGAR in 5th minute sensitivities were higher, 86.4%, 88.4% ,92.3 and 90%respectively (Table 4a), so combination of tests we used provided higher sensitivity value.

Conclusion

Through this research paper MBP was found to be a more dependable instrument rather than Doppler in terms of defining perinatal outcome and in forecast of AFD. Nonetheless, merging MBP with Doppler has generated a higher sensitivity helping in the diagnosis of perinatal outcome and AFD. To efficiently expect AFD and in order to continue a reliable screening technique and procedure, combined use of these kind of tests, namely MBP and UA Doppler, has shown to be the most operative technique as also revealed within our research paper. More study investigations and more research groups are required to further experiment test on this topic.

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