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Original Research Article

## Comparison of modified biophysical profile and vibroacoustic stimulation for intrapartum fetal assessment and prediction of perinatal outcome

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### ABSTRACT

**Background:** Present study was undertaken to evaluate the effectiveness and safety of intrapartum modified biophysical profile along with vibroacoustic stimulation test in the assessment of fetal well-being compared with modified biophysical profile for women with a singleton pregnancy.

**Methods:** This prospective study was carried out on a group of pregnant women of gestational age more than 35 weeks attending the labour room of obstetrics and gynecological department of Patna medical college and hospital, from October 2013 to October 2015. A total 220 pregnant women were selected and randomly divided into two groups, 110 women were given modified biophysical profile and 110 were underwent modified biophysical profile with VAST.

**Results:** Among 110 women, who underwent modified biophysical profile, 80(72.7%) showed reactive response and 30(27.3%) showed non-reactive response. A total 110 women, in whom modified biophysical profile was combined with VAST, 100(91%) showed reactive response and 10 (9%) showed non-reactive response. Statistical comparison for predicting perinatal mortality was done. Modified biophysical profile with VAST had a high sensitivity (100% vs. 80%), specificity (92.5% vs. 75.2%), negative predictive value (100% vs. 98.7%) and positive predictive value (20% vs. 13.3%) as compared to modified biophysical profile. Test accuracy for predicting perinatal mortality was more than mBPP (92.7% vs.75.4%).

**Conclusions:** Addition of VAST in place of NST in modified biophysical profile has high specificity & positive predictive value, shortens the testing time.

**Keywords:** Intrapartum fetal assessment, Modified fetal biophysical profile, Vibroacoustic stimulation

### INTRODUCTION

Intrapartum fetal assessment is aimed at identifying the fetus, that may be either already compromised in early labour or at an increased risk of compromise during late labour.<sup>1</sup> An early identification of such fetuses may help in instituting close surveillance to reduce perinatal morbidity and mortality. This may also help in utilising

the available resource optimally in resource- constraint setting.<sup>1</sup>

Various tests for intrapartum fetal assessments has been used like fetal kick count, non-stress test, biophysical profile, umbilical artery doppler and vibroacoustic stimulation. A good antenatal test will help to act judiciously by not waiting too long and thus will prevent adverse perinatal outcome. Modified biophysical profile

is reliably accurate in predicting perinatal outcome, but it takes long time to perform. Vibroacoustic stimulation has been reported to shorten the testing time as well as increases the sensitivity and decrease false positive results.<sup>2</sup>

The aim of this study was to evaluate the effectiveness and safety of intrapartum modified biophysical profile along with vibroacoustic stimulation test in the assessment of fetal well-being compared with modified biophysical profile for women with a singleton pregnancy. The main objective of this study is to compare modified biophysical profile with vibroacoustic stimulation by measuring the following outcome.

#### ***Maternal outcome by mode of birth***

- Spontaneous vaginal
- Instrumental delivery (vacuum delivery, forceps)
- Caesarean section for non-reassuring fetal heart rate

#### ***Perinatal outcome***

- Normal neonates
- Five minutes APGAR score <7
- NICU admission
- Perinatal death.

## **METHODS**

This study was carried out on a group of 220 pregnant patient of gestational age more than 35 weeks attending the labour room emergency, between October 2013 to October 2015. Women were randomly divided into two groups; 110 women were given modified biophysical profile and 110 were underwent modified biophysical profile with VAST.

#### ***Inclusion criteria***

- Gestational age >35 weeks
- Singleton pregnancy
- Cephalic presentation
- Latent phase of labour (cervical dilatation < 4cm)

#### ***Exclusion criteria***

- Delivery >24hrs after vibroacoustic stimulation test and modified biophysical profile
- Emergency caesarean delivery because of placental abruption
- Placenta previa
- Cord prolapses

Women were recruited after taking informed consent. For mBPP, non-stress test and amniotic fluid assessment was done. For Non-stress test, the equipment used in this test was cardiotocograph, which records fetal heart rate and uterine activity on a graph by means of external

transducer. All women were placed in left lateral recumbent position to avoid supine hypotension. The fetal heart rate was located with a stethoscope to place the external cardiac transducer on maternal abdomen, which was held in position with a strap. A 20 minute of record was obtained but recording also stopped earlier if the criteria of a reactive test was fulfilled.

Test was reactive when baseline fetal heart rate is 110-160 beats per minute and there were at least 2 or more acceleration of more than 15 beats/ min above the baseline and 15 secs in duration is recorded in a 20 mints observation. AFI was evaluated by using the 2D ultrasonography with a 3.5 MHz abdominal transducer. To obtain AFI, the uterus was divided into four equal quadrants, and then the transducer was placed along the maternal longitudinal axis and held perpendicular to the floor. AFI was calculated by adding the vertical, cord free depth of the largest amniotic fluid pocket in each quadrant together. For modified biophysical profile with vibroacoustic stimulation test known as rapid biophysical profile, which combines sound provoked fetal movement (SPFM) detected ultrasonographically and AFI, two-dimensional ultrasonography machine was used.<sup>3</sup> Vibroacoustic stimulation was done with vibroacoustic stimulator with 75db sound intensity at 1.0m and frequency of 75 HZ.

Women were positioned for ultrasonographic examination in 15 degree left lateral position. Fetal body was scanned, and depth of the field was adjusted to bring fetal heart, chest and abdomen into the same section. Location of the marker on the fetal heart was selected to get the optional waveform and the fetal heart rate was calculated. Vibroacoustic stimulation was done for 3sec by placing the stimulator on abdominal wall over fetal head. Fetal startle response and fetal heart rate acceleration was observed. Fetal startle response was defined as sudden movement of fetal extremities in response to vibroacoustic stimulus  $\leq 2$  sec after the cessation of stimulus. Fetal heart rate acceleration was defined as acceleration of  $\geq 15$  beats, lasting for  $\geq 15$  secs. If there was no response, the stimulus was repeated at 1 min intervals for a total of three stimuli. Presence of startle response accompanied by fetal heart rate acceleration was considered reactive (negative) test. Absence of either or both after three stimulations was considered nonreactive (positive) test. All women underwent continuous electronic fetal monitoring during active labour. Adverse perinatal outcomes were assessed and recorded immediately after delivery.

## **RESULTS**

The study was conducted from October 2013 to October 2015. A total of 220 women were recruited for the study. None were excluded. Mean age of the patient was 32.2 years. Most of the patient 110(50%) were second gravida. Majority of women 155(75.3%) were term gestation, 5 were of post term. A total 120 (54.5%) women included

in the study were without any risk factors. The various risk factors observed were fetal growth restriction (19.1%), pregnancy induced hypertension (13.6%), BOH (5.5%), heart disease (5%) and post term pregnancy (2.3%).

Mean testing time for mBPP was 23 minutes and for mBPP with VAST was 5 minutes. Addition of VAST significantly reduced the testing time. Among 110 women, who underwent modified biophysical profile, 80 (72.7%) showed reactive response and 30(27.3%) showed non-reactive response. 110 women, in whom modified

biophysical profile was combined with VAST, 100(91%) showed reactive response and 10(9%) showed non-reactive response. Among 220 women, 151 underwent spontaneous vaginal delivery and 30 women underwent caesarean section for fetal distress.

When Association between modified biophysical profile and mode of delivery was seen, after modified biophysical profile, among reactive traces 6.25% of women underwent caesarean section for fetal distress. In non-reactive group 50% women underwent caesarean section for fetal distress (Table 1).

**Table 1: Association between modified biophysical profile and mode of delivery.**

mBPP/ mBPP with VAST	Spontaneous vaginal	Forceps delivery	Vacuum delivery	LSCS
<b>Association between modified biophysical profile and mode of delivery</b>				
Reactive (80)	60(75%)	10(12.5%)	5(6.25%)	5(6.25%)
Non-reactive (30)	9(30%)	3(10%)	3(10%)	15(50%)
<b>Association between modified biophysical profile along with VAST and mode of delivery</b>				
Reactive (100)	80(80%)	10(10%)	8(8%)	2(2%)
Non-reactive (10)	2(20%)	0	0	8(80%)

When Association between modified biophysical profile along with VAST and mode of delivery was seen, after modified biophysical profile with VAST, among reactive traces 2% of women underwent caesarean section for fetal distress. In non-reactive group 80% women underwent caesarean section for fetal distress (Table 1).

With modified biophysical profile, 20 neonates had 5 mints Apgar score <7 and among 20, 11 underwent NICU admission. There were four perinatal mortality. With modified biophysical profile along VAST, 19 neonates had 5 mints Apgar score <7 and among 19, 7 underwent NICU admission. There were 2 perinatal mortality (Table 2).

**Table 2: Neonatal outcome.**

Neonatal outcome	mBPP	mBPP with VAST
Normal	90(81.8%)	91(82.7%)
5 mints APGAR score <7	20(18.2%)	19(17.2%)
NICU	11(10%)	7(6.4%)
Perinatal death	4(3.6%)	2(1.8%)

When Association of Modified biophysical profile with adverse perinatal outcome was seen, after modified biophysical profile, among reactive traces, 12.5% neonates had Apgar score <7, 6.3% had NICU admission with no perinatal mortality. Among non-reactive traces, 33.3% neonates had Apgar score <7, 20% had NICU admission with 13.3% perinatal mortality (Table 3).

When association of Modified biophysical profile along with VAST with adverse perinatal outcome was seen,

after modified biophysical profile along with VAST, among reactive traces, 10% neonates had Apgar score <7, 4% had NICU admission with no perinatal mortality. Among non-reactive traces, 90% neonates had Apgar score <7, 30% had NICU admission with 20% perinatal mortality (Table 4).

**Table 3: Association of modified biophysical profile with adverse perinatal outcome.**

mBPP	5min APGAR <7	NICU admission	Perinatal death
Reactive (80)	10(12.5%)	5(6.3%)	0
Non-reactive (30)	10(33.3%)	6(20%)	4(13.3%)

**Table 4: Association of modified biophysical profile along with VAST with adverse perinatal outcome.**

mBPP with VAST	5min APGAR <7	NICU admission	Perinatal death
Reactive (100)	10(10%)	4(4%)	0
Non-reactive (10)	9(90%)	3(30%)	2(20%)

When statistical comparison for predicting perinatal morbidity was done, modified biophysical profile with VAST had a high specificity, negative predictive value and positive predictive value but low sensitivity.

Test accuracy for predicting perinatal morbidity was more than mBPP (Table 5).

**Table 5: Comparison of mBPP with mBPP along with VAST in predicting perinatal morbidity.**

	mBPP with VAST (%)	No. of cases (n/n)	mBPP (%)	No. of cases (n/n)
Sensitivity	47.3	9/19	50	10/20
Specificity	98.9	90/91	77.7	70/90
Positive predictive value	90	9/10	33.3	10/30
Negative predictive value	90	90/100	87.5	70/80
Accuracy	90	99/110	72.7	80/110

When statistical comparison for predicting perinatal mortality was done, modified biophysical profile with VAST had a high sensitivity, specificity, negative predictive value and positive predictive value. Test accuracy for predicting perinatal mortality was more than mBPP (Table 6).

**Table 6: Comparison of mBPP with mBPP along with VAST in predicting perinatal mortality.**

	mBPP with VAST (%)	No. of cases (n/n)	mBPP (%)	No. of cases (n/n)
Sensitivity	100	2/2	80	4/5
Specificity	92.5	100/108	75.2	79/105
Positive predictive value	20	2/10	13.3	4/30
Negative predictive value	100	100/100	98.7	79/80
Accuracy	92.7	102/110	75.4	83/110

## DISCUSSION

Early intrapartum fetal assessment helps in identifying the fetus at risk of developing fetal distress during labor and requiring prompt caesarean delivery. A negative or reactive test may indicate a low probability of adverse outcome and thus reassuring. On the other hand, a positive or nonreactive test may imply a significant risk of fetal compromise that may lead to prompt abdominal delivery. A reliable fetal admission test may help in accurately identifying such high-risk fetuses so that limited perinatal resources can be utilized better and fetal distress resolved expeditiously by caesarean delivery.

Mean testing time for mBPP was 23 minutes and for mBPP with VAST was 5 minutes, so addition of VAST significantly reduces the testing time by one fourth. This finding was comparable with sood atul Kumar et al 2011 where mean testing time was 4.86+0.72 min.<sup>1</sup> Among 110 women, who underwent modified biophysical profile, 80(72.7%) showed reactive response and 30(27.3%) showed non-reactive response. A total 110

women, in whom modified biophysical profile was combined with VAST, 100(91%) showed reactive response and 10(9%) showed non-reactive response. In Kumar SA et al study, of the 210 fetuses subjected to VAS/mFBP, 200 (95.2%) were reactive and 10 (4.8%) nonreactive.<sup>1</sup>

With modified biophysical profile along VAST, 91(82.7%) neonates had favourable outcome, 19(17.2%) neonates had 5 mints Apgar score <7 and among 19, 7(6.4%) underwent NICU admission. There were 2(1.8%) perinatal mortality. This finding was comparable with Kumar SA et al as there were 198 (94.3%) favourable and 12 (5.7%) adverse perinatal outcomes with 2 (0.95%) perinatal deaths.

In terms of perinatal morbidity, modified biophysical profile with VAST had a high specificity (98.9% vs. 77.7%), negative predictive value (90% vs. 87.5%) and positive predictive value (90% vs. 33.3%) but low sensitivity (47.3%) as compared to modified biophysical profile. Test accuracy for predicting perinatal morbidity was more than mBPP (90% vs. 72.7%). This finding was comparable to those reported by Tongprasert et al, mBPP with VAST had a sensitivity of 50.0%, specificity of 99.07%, positive predictive value of 50.0%, and negative predictive value of 99.07% and an accuracy of 98.18%.<sup>3</sup> Kumar SA et al reported similar finding with sensitivity 66.7%, positive predictive value 80%, specificity 99%, negative predictive value 98%, and accuracy 97% with mBPP along with VAST.<sup>1</sup>

In the present study, when statistical comparison for predicting perinatal mortality was done. Modified biophysical profile with VAST had a high sensitivity (100% vs. 80%), specificity (92.5% vs. 75.2%), negative predictive value (100% vs. 98.7%) and positive predictive value (20% vs. 13.3%) as compared to modified biophysical profile.

Test accuracy for predicting perinatal mortality was more than mBPP (92.7% vs. 75.4%). Results were comparable with Petrović O et al in 1998 who reported that sensitivity, specificity and positive and negative predictive values of the mBPP score in predicting adverse perinatal outcome were 60, 99, 66.7 and 98.7%, respectively.<sup>4</sup>

The sensitivity, specificity and positive and negative predictive values of the VAST along with mBPP were 66.7, 100, 100 and 99.4%, respectively. Sood atul Kumar et al also reported comparable results in terms of perinatal deaths with sensitivity 100%, specificity 96.2%, positive predictive value 20%, negative predictive value 100%, and accuracy 96.2%.<sup>1</sup>

VAST has increased in use over recent years as various researchers have found it comparable, cheaper, faster and less invasive than other tests of fetal well-being.

Fetal biophysical activity is reflection of an intact central nervous system.<sup>5</sup> Modified biophysical profiles along with VAST and modified biophysical profile are simple, non-invasive and safe test for assessment of fetal well-being. VAS improves the biophysical profile scores and shortens testing time. Fetal startle response to vibroacoustic stimulus in a study was found to be associated with a FBP score of  $\geq 8$ .<sup>6</sup> Intrapartum fetal acoustic stimulation has also been reported to be useful in ruling out fetal acidemia.<sup>7</sup>

## CONCLUSION

Addition of VAST in place of NST in modified biophysical profile have high specificity and positive predictive value, shortening the testing times, simplicity and non-invasiveness. Thus, it is a reliable diagnostic test for assuring fetal well-being as negative or reactive test is unlikely to be associated with adverse perinatal outcome.

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