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Research Article

A COMPARATIVE STUDY OF VIBROACOUSTIC STIMULATION AND NON-STRESS TEST FOR EARLY INTRAPARTUM FETAL ASSESSMENT

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A B S T R A C T

Introduction: Accurate perinatal recognition of foetal risk remains a major challenge in modern obstetrics. Several antepartum foetal assessment tests have evolved over the decade for the better management in high risk pregnancies.

Aims & Objectives: To compare Vibroacoustic Stimulation (VAS) test and Non-Stress Test (NST) for early intrapartumfetal assessment.

Methods- In this comparative study 100 women who were in the latent phase of labour at the time of admission to the labour unit were taken up for the study. In **Group I,** 50 women were subjected to NST whilst in **Group II** the other 50 were subjected to VAS. The fetal startle response and FHR acceleration following VAS and NST were observed. The results were co-related with perinatal outcome.

Results- Mean testing time for NST was 1348.64 secs while for VAS, it was 121.67 secs. In high risk patients NST was reactive in 87.5% while VAS was reactive in 84.6%. Meconium was detected in 20% patients with reactive NST where as it was found only in 8% subjects with reactive VAS. The specificity and positive predictive value of VAS test was 100%.

Conclusions- VAS test is a more reliable diagnostic test as compared to NST because of its simplicity, short testing time, non-invasiveness and high accuracy for early intrapartum foetal assessment.

INTRODUCTION

Accurate perinatal recognition of foetal risk remains a major challenge in modern obstetrics. Several antepartum foetal assessment tests have evolved over the decade for the better management in high risk pregnancies.The goals of antepartum foetal surveillance include prevention of foetal death and avoidance of unnecessary intervention.[1] Active foetal movements have long been considered indicative of foetal health. It is known that a decrease or cessation in foetal activity may indicate foetal distress or impending foetal demise.[2] The use of continuous foetal heart rate (FHR) monitoring and accelerations of the FHR associated with foetal movement has become a popular assessment tool for foetal wellbeing.

The non-stress test is the most common antepartum foetal assessment tool. However, the major drawback of NST is its high (30%) false positive rate.[3] This means that in about 30% of cases, the non-reactive NST falsely identifies foetal distress. A false positive result occurs when the foetus is in a quiet cycle during the test and exhibits no movements and/or no accelerations of its heart rate. Extending the length of the est to 80 to 120 mins reduces this problem by allowing the foetus time to enter an active cycle.[4]

With improvement in technology, researchers have been able to study and quantify FHR response to sound. Studies have shown that a healthy foetus will accelerate its heart rate in response to a sound stimulu.[5]

In modern obstetrics, foetal vibroacoustic stimulation is done using an acoustic stimulator placed on the mother's abdomen over the foetal head region. This is expected to induce a startle response in the foetus, with subsequent foetal movement and FHR acceleration.[6] It is hypothesized that FHR acceleration following VAS provides reassurance of foetal wellbeing, obviating the need for further intervention.[8,9] Moreover, acoustic stimulation of the foetus have been suggested to improve the efficiency of antepartum foetal heart rate testing.[10,11] Vibroacoustic stimulator provokes a physiological sympathetic range response characterised by foetal heart rate acceleration suggesting and intact non-hypoxic central nervous system. To improve the sensitivity, other variables (amniotic fluid index, behavioural state and foetal growth) should be added to acoustic stimulation. AST utilizes ultrasound to evaluate the foetal response to acoustic

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stimulation. Observation of foetal startle response to vibroacoustic stimulus was found to be associated with a foetal biophysical score of 8 and above.[12] Vibroacoustic stimulation has been reported to wake up the foetus from sleep cycles and hence reduce false positive results.[13] Vibroacoustic stimulation offers a unique opportunity to assess how the foetus responds to the external environment. Foetal VAS is commonly used for both antepartum and intrapartum testing. It is considered a simple and reliable prognostic evaluation of abnormal FHR detection. A number of studies were carried as intrapartumfoetal stimulation tests.[14] Early intrapartumfoetal assessment is aimed at identifying the foetuses that may be either already compromise in early labour or are at the increased risk of compromise during late labour. An early identification of such foetuses may help in instituting close surveillance to reduce perinatal morbidity and mortality. This may also help in utilizing the available resources optimally in the resource constraint setting.

Aims & Objectives: To compare Vibroacoustic Stimulation test and Non-Stress Test for early intrapartum foetal assessment.

METHODS

The present study was carried out during the period from Jan 2012- July 2013in the Department of Obstetrics & Gynaecology, Government Medical College and Rajindra Hospital, Patiala.100 women admitted to the labour unit of the hospital, who met the inclusion criteria were taken for the study. The women were recruited after taking informed consent. The findings were recorded on the proforma. The patients were selected according to the following criteria:

Inclusion Criteria

1. Gestational age $\geq$ 35 weeks
2. Singleton pregnancy
3. Cephalic presentation
4. Latent phase of labour - (cervical dilation< 4cm)

Exculsion Criteria

1. Delivery > 24 hours after the test
2. Emergency caesarean delivery because of placental abruption, placenta previa or cord prolapses.

The subjects were randomly divided into 2 groups of 50 each. In Group I50 women were subjected to Non-Stress Test (NST) andin Group II, 50 women were subjected to Vibroacoustic Stimulation (VAS) at the time of admission. NST - This test involves the use of Doppler detected foetal heart rate acceleration coincident with fetal movement perceived by the mother. NST was characterised by two or more accelerations of 15 bpm or more above baseline, each lasting 15 seconds or more and all occurring within 20 minutes of beginning the test.

VAS - PHILIPS ENVISOR-C USG Scanner system number MC15001 Model No. M2540-66500 was used. VAS was done with EMCO vibroacoustic stimulator (EMCO Health Care Pvt. Ltd, Sion, Mumbai, India) with 75 db sound intensity at 1.0 meter and frequency of 75 Hz. Women were positioned for the ultrasonographic examination in 15 degrees left lateral position. Fetal body was scanned in combined bimanual mode and the depth of the field was adjusted to bring the fetal heart chest and abdomen into the same section. Location of the marker on the fetal heart was selected to get the optimal wave form and the fetal heart rate was calculated.

Fetal VAS was done for 3 seconds by placing the stimulator on the abdominal wall over fetal head. Foetal startle response and foetal heart rate acceleration was observed. Foetal startle response was defined as a sudden movement of foetal extremities in response to vibroacoustic stimulus $\leq$2 second after the cessation of the stimulus. Foetal heart acceleration was defined as acceleration of $\geq$15 beats and lasting for $\geq$ 15 seconds. If there was no startle response the stimulus was repeated at 1 minute interval for a total of 3 stimuli.

The presence of startle response accompanied by fetal heart acceleration was considered reactive (negative) test. Absence of either 1 or both entities after 3 stimulations was considered non-reactive (positive) test. All women were monitored during active labour. Perinatal outcomes were assessed and recorded immediately after delivery. Results of women delivering $\leq$ 24 hours were correlated with perinatal outcome. Perinatal morbidity was defined as presence of at least 2 of the following variables of adverse perinatal outcome, which were - caesarean delivery for fetal distress, 5 minute Apgar <7, and admission to the NICU>24 hours. Various diagnostic values were calculated.
The results were analysed by SSP.

OBSERVATIONS & RESULTS

The mean maternal age in Group I (NST) was 25$\pm$3 years. In Group II (VAS) the mean age group was 24 $\pm$ 1 year. Theperiod of gestation gestation in Group I was 38.06 $\pm$ 1.3 weeks and in Group II it was 38.28 $\pm$ 1.2 weeks.We found in Group I 48% were primigravidas and 52% were multigravidas. In Group II 56% were primigravidas and 44% were multigravidas.

The mean time taken in Group I was 1348.64 secsand was 121.67 secs in Group II. (Table No. 1)

Table No 1 Comparison of subjects in both groups

Variables	Group I NST (50)	Group II VAS (50)	*p* value
Mean maternal age (years)	25 $\pm$ 3	24 $\pm$ 1	NS
Period of gestation (weeks)	38.06 $\pm$ 1.29	38.28 $\pm$ 1.21	NS
Primigravidas/Multigravidas (in %age)	48/52	56/54	NS
Time taken for test (secs)	1398.64	121.67	S

In Group I there were 32 (64%) high risk and 18 (32%) low risk subjects whereas in Group II there were 26 (52%) high risk and 24 (48%) low risk subjects. The high risk factors seen were pregnancy induced hypertension, foetal growth restriction, bad obstetrical history, cardiac diseases, anaemia and previous caesarean sections. In Group I, 44 (88%) of had a reactive and 6 (12%) had a non-reactive test. In Group II 46 (92%) had a reactive and 4 (8%) had a non-reactive test (Table No. 2). In Group II all the low risk subjects had reactive AST.

Table No 2 Results of NST/VAS in study groups

Test result	Group I NST (50)			Group II VAS (50)		
	High risk	Low risk	Total (% age)	High risk	Low risk	Total (% age)
Reactive	28	16	44 (88%)	22	24	46 (92%)
Non-reactive	4	2	6 (12%)	4	0	4 (8%)
Total	32	18	50(100%)	26	24	50(100%)

While comparing the results of both groups we found that in Group I, 9 (32.14%) of the high risk subjects had meconium stained liquor inspite of a reactive NST, whereas in Group II only 4 (18.80%) subjects had meconium stained liquor with a reactive test. On the other hand in Group I, only 1 (25%) subjects had meconium stained liquor inspite of the test being non-reactive as compared to Group IIwherein all the subjects 4 (100%) had meconium stained liquor with a non-reactive test. In Group I among the low risk 2 of the subjectsinsipte of a non-reactive test did not show the presence of meconium in the liquor (Table No. 3 & 4).

Table No 3 Showing association of MSL in High risk group

Study Group	R	MSL +ve No. (%)	MSL -ve No. (%)	NR	MSL +ve No. (%)	MSL -ve No. (%)
Group I NST (32)	28	9 (32.14%)	19 (67.86%)	4	1(25%)	3(75%)
Group II VAS (26)	22	4(18.80%)	18 (81.80%)	4	4(100%)	0

R-reactive, NR-non-reactive, MSL-meconium stained liquor

Table No 4 Showing association of MSL in low risk group

Study Group	R	MSL +ve No. (%)	MSL -ve No. (%)	NR	MSL +ve No. (%)	MSL -ve No. (%)
Group I NST (18)	16	1 (6.25%)	15 (93.75%)	2	0	2 (100%)
Group II VAS (24)	24	1 (4.17%)	23 (95.83%)	-	-	-

R-reactive, NR-non-reactive, MSL-meconium stained liquor

In study Group I, 10 (22.73%) of the subjects underwent LSCS in spite of reactive test result whereas the comparable figure in Group II was 4 (8.69%).

When the test was non-reactive, in Group I only one (16.67%) subject underwent LSCS due to foetal distress but in Group II all 4 (100%) delivered by LSCS. (Table No 5)

Table No 5 Showing correlation of test results with mode of delivery in study groups

Study Group	Test Result	No	Vaginal Delivery	LSCS due to		P value
				Foetal distress	Obstetrical indication	
Group I (NST)	R	44	16 (36.36%)	10 (22.73%)	18 (40.91%)	S
	NR	6	2 (33.33%)	1 (16.67%)	3 (50%)	
Group II (VAS)	R	46	20 (43.47%)	4 (8.69%)	22 (47.83%)	S
	NR	4	0	4 (100%)	0	

R-reactive, NR-non-reactive

Though the Apgar score in both the groups was comparable, 2 babies in reactive NST had Apgar <7 at five minutes whereas none of the reactive Group II babies had Apgar <7. There were two deaths of foetuses in the reactive NST group. There was no perinatal mortality in Group II; however a fewsubjects of non-reactive VAS had a prolonged stay in NICU which ranged from a minimum of 3 days to maximum of 6 days. (Table No 6)

Table No 6 Correlation of test result with perinatal outcome in study groups

Study Group	Result	Perinatal outcome (Death)
Group I (NST)	Reactive	2
	Non-reactive	NIL
Group II (VAS)	Reactive	NIL
	Non-reactive	NIL

We found that co-relation of meconium was more specific in Group II where all the subjects with non-reactive VAS had meconium staining and all the subjects underwent LSCS due to fetal distress. Thus, specificity of VAS in predicting fetal distress came out to be 100% in the present study.

DISCUSSION

Early intrapartum foetal assessment is aimed at identifying the foetuses that may be either already compromised in early labour or are at the increased risk of compromised during late labour. An early identification of such foetuses may help in instituting close surveillance to reduce perinatal morbidity and mortality. This may also help in utilizing the available resources optimally in the resource constraint setting. In our study the mean testing time for Non-Stress Test (Group I) was 1348.64 secs while for Vibroacoustic Stimulation (Group II), it was 121.67 secs. The results of our study are comparable to the study undertaken by Hemant Deshpande *et al*[14] who also reported significantly shortened testing time in VAS group. In our study, we observed that in traditional NST, 88% were reactive and 12% non-reactive while with VAS, 92% were reactive and 8% non-reactive. Our results are comparable to study done by Serafini *et al*[8] who reported 87.6% reactive and 12.4% non-reactive in their NST group and in their VAS group 82.5% were reactive and 17.5% were non reactive. Rate of foetal distress in the group of non-reactive fetuses in the study of Serafini *et al* was 70.0% in NST and 51.8% in VAS group, whereas in our study fetal distress in the VAS group was 100% and 25% in the NST group. Thus, Serafini *et al*'s study showed that although the rates of fetal distress in the group of non-reactive fetuses were significantly higher than those in the reactive fetuses but the interest of differences was not significant. But in our study the difference was significant. In our study in Group I (NST) 22.73% of subjects underwent LSCS due to foetal distress inspite of a reactive NST, and only 16.76% landed up in LSCS in non-reactive group. In contrast, in Group II only 8.69% had to undergo LSCS for foetal distress in reactive group and all delivered by caesarean section due to foetal distress in non-reactive group. C Kavitha *et al*[15] also reported an incidence of 50% caesarean section in the reactive NST group.We observed NST test was not sensitive in picking up all cases of intrapartumfetal distress whereas VAS did give better results.

Early intrapartumfoetal assessment with some form of test may help in identifying the fetus at risk of developing foetal distress during labour and requiring prompt delivery. A negative or reactive test may indicate a low probability of adverse outcome and thus reassuring. On the other hand a positive or non-reactive test may imply a significant of foetal compromise that may lead to prompt abdominal delivery.

CONCLUSION

We found that VAS shortens testing time as compared to NST. VAS had a high specificity and positive predictive value, thus implying that it is a reliable diagnostic test for assessing fetal wellbeing. The practical implication in resource constrained setting is that it is useful as a rapid predictor of fetal wellbeing, so that limited perinatal resources can be optimally utilized for compromised fetuses.

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