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A Study of Correlation of Individual Biophysical Variables and Vibroacoustic Stimulation with Perinatal Outcome

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Abstract

Background: Vibroacoustic stimulator provokes a physiological sympathetic range response characterized by fetal heart rate acceleration suggesting an intact non-hypoxic CNS. *Objectives:* To assess the adjunctive use of vibroacoustic stimulation to alter fetal behavioral states, reduce the false positive non-reactive tests. *Materials and Methods:* A prospective study was conducted at Sri Adichunchanagiri institute of Health and Research Centre. 100 women performing VAST test and control group (n=100) without VAST test. It was done by placing vibroacoustic stimulator, with 75Db sound intensity at one meter, frequency of 75Hz on abdominal wall over fetal head for 3 seconds. Fetal startle response was observed along with fetal heart rate acceleration. If the test comes non-reactive, it is considered as positive test and if the test comes reactive it is considered as negative. *Statistical Analysis:* Chi-square test with descriptive and inferential statistical analysis was done. *Summary and Results:* With VAST, startle response was observed in 85% of patients in study group, 42 (89.4%) had normal perinatal outcome and 43(81.1%) had abnormal perinatal outcome. Association between BPP scoring before and after VAST was statistically significant($p<0.001$). 85% of patients had reactive NST, 51(77.3%) had normal perinatal outcome and 34(100%) had abnormal perinatal outcome. Association between them were found to be statistically significant. *Conclusion:* It is simple, rapid and non- invasive tool for detection of fetal well being. VAST appears to be a safe and reliable method of antenatal fetal evaluation.

Keywords: VAST; NST; BPP.

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Introduction

Pregnancy is a normal physiological state and the purpose of antenatal care should be to provide optimal conditions for the mother and growing fetus to achieve the best possible outcome.

Vibroacoustic stimulator provokes a physiological sympathetic range response characterized by fetal heart rate acceleration suggesting an intact non-hypoxic CNS.

VAST utilizes ultrasound to evaluate the fetal responses to acoustic stimulation. Observation of fetal startle response to VAST was found to be associated with BPP score of 8 and above. VAST has been shown to shorten the testing period and reduce false positive results by awakening fetus [1].

Fetal biophysical profile is a reliable antepartum test for determination of fetal well being. While low scores are associated with very high morbidity and mortality, normal scores virtually assure an uncomplicated intrauterine survival for a period of 3 days to 1 week [2].

The benefits of using fetal vibroacoustic stimulation in conjunction with tests of fetal well being must be weighed with respect to its effect on the predictive reliability of the test and safety of the procedure [3].

Objectives

1. To assess the merits or adverse effects of the use of fetal vibroacoustic stimulation in conjunction with tests of fetal well being.
2. To assess whether the adjunctive use of vibroacoustic stimulation to alter fetal behavioral states leads to less false positive non-reactive tests.
3. To assess whether the use of fetal vibroacoustic stimulation improves perinatal outcome.

Methodology

This prospective study was conducted at Sri Adichunchanagiri institute of Health and Research Centre from November 2013 to May 2015.

200 women with uncomplicated and high risk singleton pregnancies above 32 weeks gestation attending the antenatal clinic were recruited after taking informed consent.

Study Subject

Group A -100 Singleton pregnant women performing VAST test.

Group B- 100 Singleton pregnant women not performing VAST test.

Equipment Used

1. Ultravoluson S6 PRO
2. Ultrasound Siemens Acuson X 300
3. Vibroacoustics Stimulator

(Corometrics model 146, Electronic artificial larynx model 5C).

Method

In the study group, women were subjected to ultrasonographic examination in supine position. The routine fetal biometric measurements were obtained at beginning of each examination. After determining the fetal position, the fetal body was scanned continuously in sagittal plane. Fetal heart rate was determined using the M mode.

Fetal vibroacoustic stimulation test was done by placing Coromerics model 146; Electronic vibroacoustic stimulator model 5C, with 75Db sound intensity at one meter and frequency of 75Hz on abdominal wall over fetal head for 3 seconds andstartle response was observed along with fetal heart rate acceleration. If either are absent or abnormal, a repeat stimulus is given and observation is extended for maximum 10 seconds. Fetal breathing movement (30 seconds of sustained breathing movement during 30 minutes observation), Fetal movements (3 or more gross movements), Fetal tone (one or more episodes of limb motion from a position of flexion to extension and rapid return). The test was initiated at 32 weeks of gestation later at which risk factor was identified. The test was repeated weekly or biweekly or daily depending on severity of the risk factor.

Similarly, 5-10 minutes of nonstress CTG is taken. If within 5-10 minutes, no spontaneous 2-3 fetal movements with good acceleration is noted, the fetus is given stimulus with the help of vibroacoustic stimulator by placing it anywhere over the baby's upper half of the body.

In a healthy fetus, cardiac acceleration occurs almost instantly on giving the stimulus. If the qualifying acceleration fails to occur with one stimulus, it may be repeated at 1-3 minutes interval for a maximum of three times.

If the test comes non-reactive, it is considered as positive test and if the test comes reactive it is considered as negative.

The end point to assess the efficacy of NST is

a. Fetal distress during labour

b. 5 min Apgar score

c. Perinatal mortality.

Risk Factors Included in this Group

1. Polyhydramnios
2. Fetal growth restriction (FGR)
3. Post prolonged pregnancies (>41 weeks)
4. Rh negative pregnancy
5. Gestational Diabetes
6. Gestational Hypertension/Pre-eclampsia
7. Decreased fetal movements
8. Oligohydramnios

Exclusion Criteria

Patient with hyperthyroidism, heart disease, hemoglobinopathies, systemic lupus erythematosus, multiple gestation, accidental hemorrhage were excluded in this study.

If all parameters were normal the test was repeated

weekly, biweekly or daily and if reactive earlier. Delivery was prompted if the test results were abnormal. Either a spontaneous labour awaited or labour induced depending on Gestational age and Bishop's score. The details of the delivery viz., Induced or spontaneous, vaginal or operative and the indication for the same were noted. The details of intrapartum monitoring, the amount and color of liquor, and the outcome details like APGAR, birth weight, need for resuscitation and NICU admission.

Statistical Analysis

A comparative case- control study.

Descriptive and inferential statistical analysis wascarried out. Student t test (two tailed, independent) was used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters.

Chi-square/ Fisher Exact test was used to find the significance of study parameters on categorical scale between two or more groups.

Statistical Software: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Results

Two groups were studied; each consisted of 100 pregnant patients. Mean age parity,gestational age and socioeconomic status were comparable in both the groups.Vibroacoustic stimulation test was performed on 100 patients in the study group (group A) whereas VAST was not performed on group B patients. The following observation was made.

NST before Distribution in two Groups of Patients Studied

41 out 100 patients in group A had non- reactive nonstress tests compared to 35 out of 100 in group B (Table 1). Remaining 59% in group A had reactive NST compared to 65% in group B.

Table 1:

NST	Cases		Controls	
	No	%	No	%
Non reactive NST	41	41.0	35	35.0
Reactive NST	59	59.0	65	65.0
Total	100	100.0	100	100.0

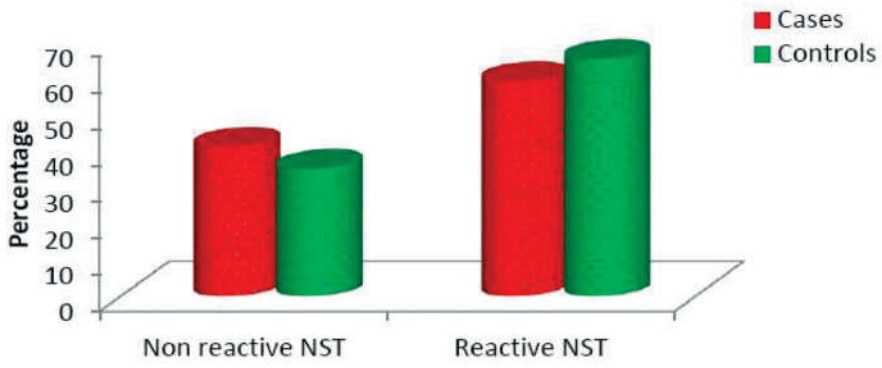


Table 2:

BPP score Before VAST	Cases		Controls	
	No	%	No	%
6	4	4.0	2	2.0
8	44	44.0	36	36.0
10	52	52.0	62	62.0
Total	100	100.0	100	100.0
Mean ± SD	8.96 ± 1.15		9.20 ± 1.06	

P=0.128, Not Significant, student t test

BPP Score before VAST

4% of patients in group A (vs. 2% in group B) had BPP 6/10. 44% in group A (vs. 36% in group B) had BPP 8/10 whereas 52% in group A compared to 62% in group A had BPP 10/10. None of the patients in both study groups had BPP <6/10.

Mode of Delivery Distribution in Two Groups of Patients Studied

Out of 82 patients, 7 (5 in group A and 2 in group B) had vacuum assisted vaginal deliveries, 3 (2 in group A and 1 in group B) had forceps and rest 72% had normal vaginal deliveries with no complications.

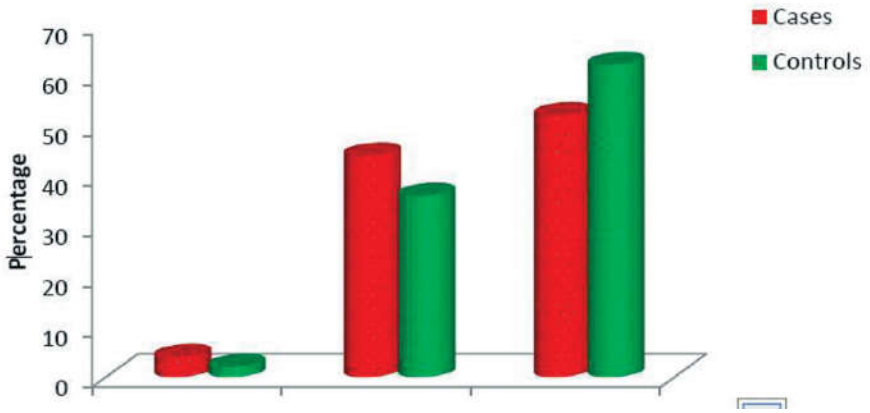
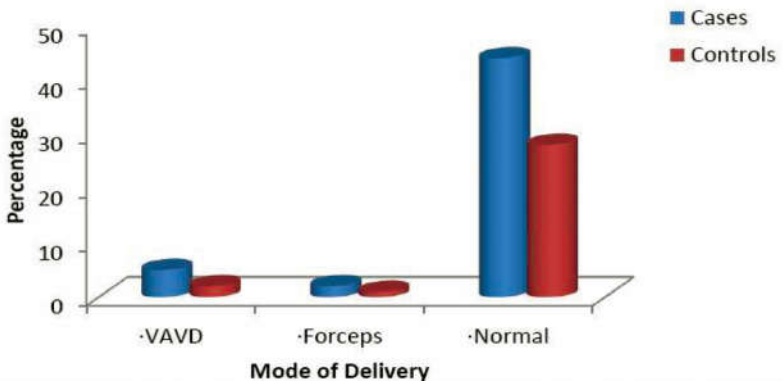


Table 3:

Mode of Delivery	Cases(n=100)		Controls(n=100)	
	No	%	No	%
LSCS	49	49.0	69	69.0
Vaginal Delivery	51	51.0	31	31.0
• VAVD	5	5.0	2	2.0
• Forceps	2	2.0	1	1.0
• Normal	44	44.0	28	28.0

P=0.04**, Significant, Chi-Square test



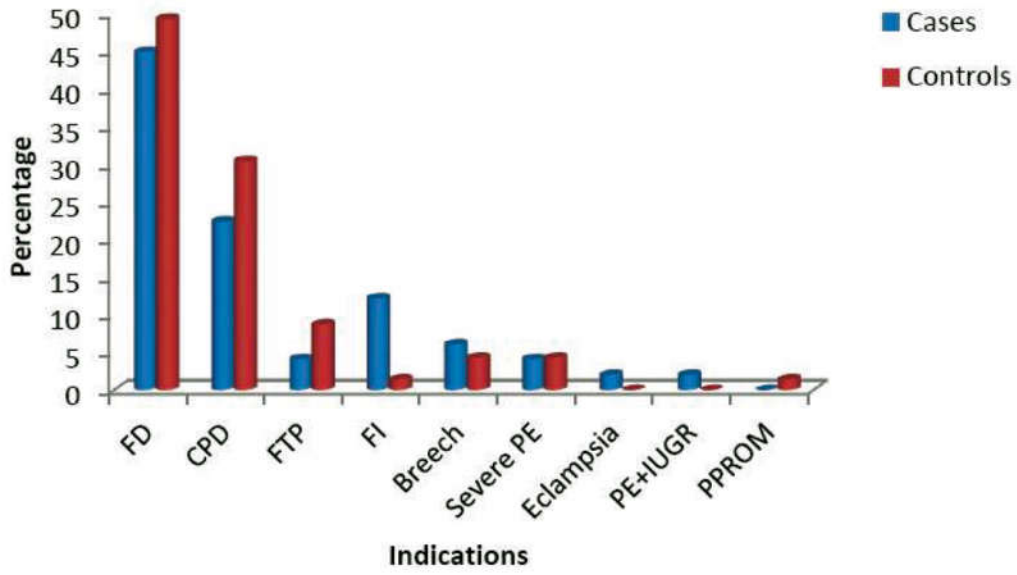
Indications of LSCS and Distribution in two Groups of Patients Studied

In group A, majority of caesarean section (44.9%) were indicated in view of fetal distress compared to 49.3% in control group B.

Other indications considered in the present study were CPD (22.4% in group A vs 30.4% in group B), failure to progress(4% in group A vs 8.7% in group B), failed induction (12.2 % vs 1.4%), breech(6.1% vs 4.3%),4.1% vs 4.3%) (Table 4).

Table 4:

Indications	Cases(n=49)		Controls(n=69)	
	No	%	No	%
Fetal distress	22	44.9	34	49.3
CPD	11	22.4	21	30.4
Failure to progress	2	4.1	6	8.7
Failed induction	6	12.2	1	1.4
Breech	3	6.1	3	4.3
Severe PE	2	4.1	3	4.3
Eclampsia	1	2.0	0	0.0
PE=IUGR	1	2.0	0	0.0
PPROM	0	0.0	1	1.4

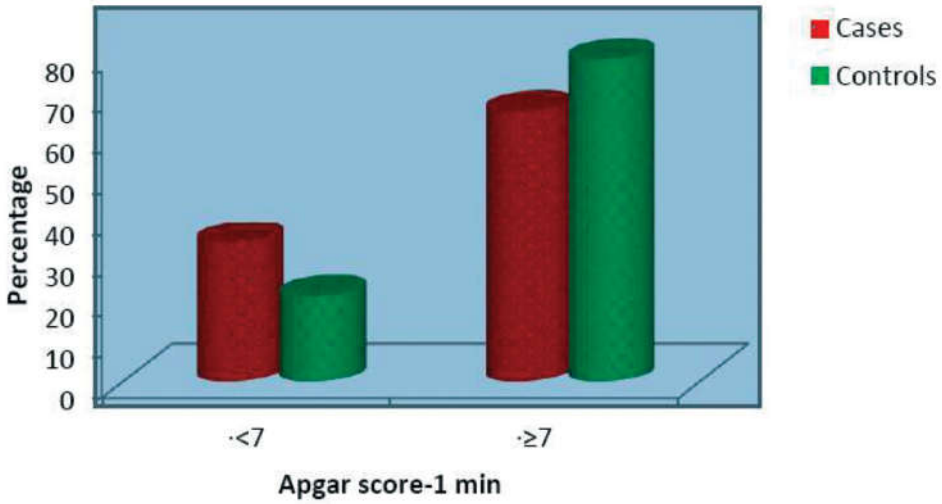


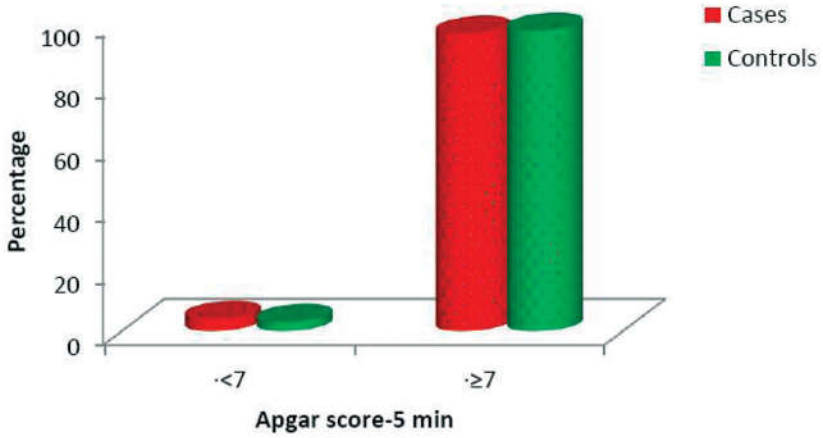
Apgar Score Distribution in two Groups of Patients Studied

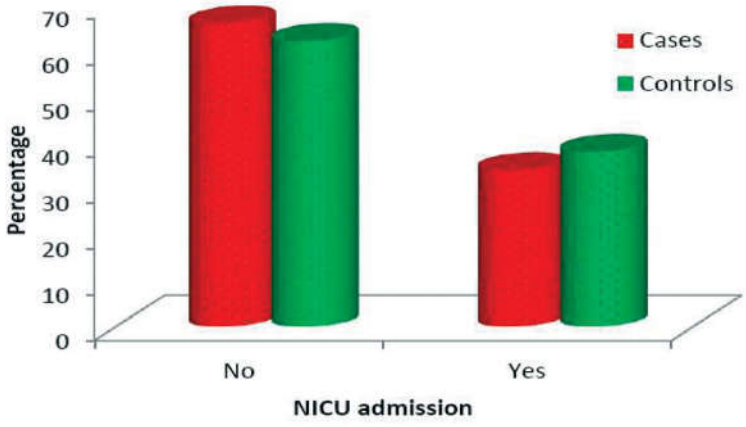
34% in apgar<7 at 1 minute compared to 21 % in group B. 66% had apgar>7 at 1 minute compared to 79% in group B. 4% in group A had apgar<7 at 5 minute compared to 3% in group B. 96% in group A apgar>7 at 1 minute compared to 97% in group B. (Table 5). Association between apgar score at 1 minute between cases and control groups were found to be significant. (p <0.05)

Table 5:

Apgar score		Cases(n=100)		Controls(n=100)		P value
		No	%	No	%	
1 min						
•	<7	34	34.0	21	21.0	0.040*
•	≥7	66	66.0	79	79.0	
5 min						
•	<7	4	4.0	3	3.0	1.000
•	≥7	96	96.0	97	97.0	







34 % of newborns in study group were admitted in NICU compared to 38% in group B. (Table 6). 66% in group A and 62% in group B did not required NICU admission.

NST Distribution in two Groups of Patients Studied (Table 7)

After application of VAST, out of 41 % non- reactive NSTs, 26% of them became reactive, hereby reducing rate of false positive NSTs in group A patients. (Table 7) Hence, 85% of NSTs done in VAST group had become reactive compared to 65% in control group B. (Table 7).

BPP Score Distribution in two Groups (Table 8)

Similarly, after application of VAST, number of

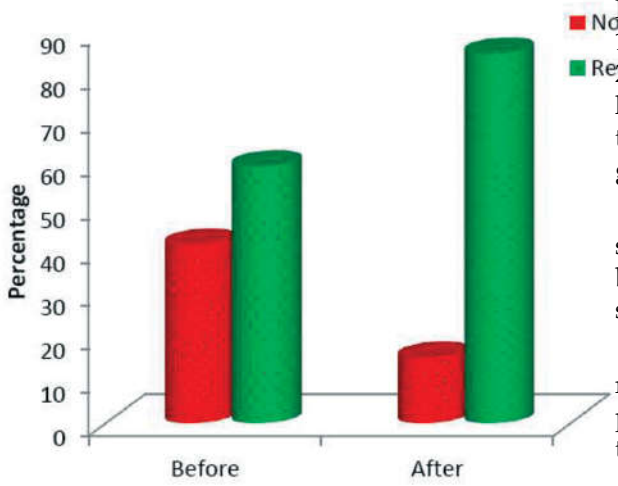
Table 6:

NCU admission	Cases(n=100)		Controls(n=100)	
	No	%	No	%
No	66	66.0	62	62.0
Yes	34	34.0	38	38.0
Total	100	100.0	100	100.0

P=0.556, Not Significant, Chi-square test

Table 7:

NST	Before	After	% Change
Non reactive NST	41(41%)	15(15%)	-26.0%
Reactive NST	59(59%)	85(85%)	26.0%
Total	100(100%)	100(100%)	-



Patients having BPP 6/10 and 8/10 were reduced to only 1% and 27% respectively and patients having BPP 10/10 were increased to 72% (compared to 62% in control group).f patients studied.

Association between BPP scoring before and after VAST has been explained which is statistically significant. (p<0.001)

With application of VAST, startle response was observed in 85% of patients in study group. Among them, 42 (89.4%) had normal

Table 8:

BPP Score	Before VAST	After VAST	% Change
6	4 (4%)	1 (1%)	-3.0%
8	44(44%)	27(27%)	-17.0%
10	52(52%)	72(72%)	20.0%
Total	100(100%)	100(100%)	-

Table 9:

BPP Score	Min-Max	Mean ± SD	difference	T value	P value
Before VAST	6.00-10.00	8.96±1.15	-	-	-
After VAST	6.00-10.00	9.42±0.96	0.460	5.438	<0.001**

Student t test

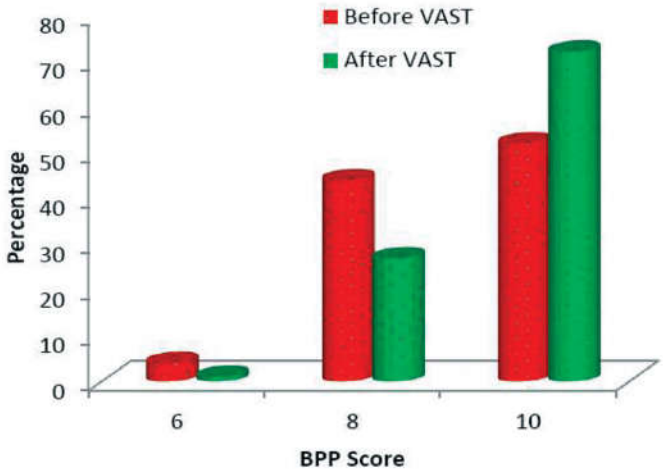


Table 10:

Startle response	Perinatal outcome Normal	Abnormal	Total
Present	42(89.4%)	43(81.1%)	85(85%)
Absent	5 (10.6%)	10(18.9%)	15(15%)
Total	47(100%)	53(100%)	100(100%)

P=0.250

Table 11:

NST	Perinatal outcome Normal	Abnormal	Total
Reactive	51(77.3%)	34(100%)	85(85%)
Non-reactive	15 (22.7%)	0(0%)	15(15%)
Total	66(100%)	34(100%)	100(100%)

P=0.001**

Table 12:

Vast	Perinatal outcome Normal	Abnormal	Total
Normal	48(92.3%)	32(66.7%)	80(80%)
Abnormal	4 (7.7%)	16(33.3%)	20(20%)
Total	52(100%)	48(100%)	100(100%)

perinatal outcome and 43(81.1%) had abnormal perinatal outcome. Table 10 Association between them were not found significant.

With the application of VAST, 85% of patients had reactive NST. Among them, 51(77.3%) had normal perinatal outcome and 34 (100%) had abnormal perinatal outcome. Association between them was found to be statistically significant (p=0.003).

In the study group, 80 (80%) had normal response to VAST. Out of them, 48 (92.3%) had normal perinatal outcome and 32(66.7%) had abnormal outcome. Association between them was found to be significant (P=0.001).

Discussion

Marden D and associates randomized 297 women to the test group where fetal acoustic stimulation test was done. 81% had fetal movement by palpation or visualization compared with 19% of the control group(p<0.0001). Also, 95% had reactive non stress test and 15% had non reactivenonstress test [4].

Perez-Delboy et al. (2002) compared the impact on pregnancy outcomes of vibroacoustic stimulation (1 sec on maternal abdomen, repeated for 2 and then 3 seconds at 10 min intervals if nonreactive; intervention), vs. traditional non-stress test (controls) [5].

Nyman M et al. studied maternal perception of fetal movements in response to vibroacoustic stimulation test with fetal heart rate monitoring in 517 high risk pregnancies. The sensitivity and specificity of the test compared to fetal heart rate tracing was 81% and 89% respectively [6].

Kavitha C, Imam, Nasreen Noor studied 125 high risk pregnancies and compared VAST and CTG with perinatal outcome. Increase in number of reactive trace from 62 patients (49.6%) in CTG group to 95 patients (76%) in VAST group was observed. Also the incidence of mechonium staining is less in VAST group [7].

In Inglis at al study group, VAST improved abnormal or equivocal biophysical profile score to normal in 82% cases [8].

In Papadopoulos et al study group, VAST significantly decreased the number of positive tests (4.74% vs 6.67%, p<0.05)without altering perinatal outcome [9].

FHR accelerations occurred within 10 seconds after vibroacoustic stimulation in 94%of the fetuses studied regardless of behavioral state. In the present study, association of mode of deliveries between two groups of patients studied was found to be moderately significant (p=0.004).

BPP score before and after VAST was found to be statistically significant (p=0.001).

Association between fetal breathing movement and prenatal outcome was also significant (p=0.001).

Association between VAST and perinatal outcome was highly significant(p=0.001)

Conclusions

Vibroacoustic stimulation testing can significantly reduce the number of falsely non reactivenonstress test and thus reduce the number of patients who would otherwise undergo more prolonged or invasive forms of monitoring or unnecessary operative interventions.

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