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# Visual Acoustic Stimulation Test (Vast) As A Predictor Of Fetal Wellbeing

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**ABSTRACT**

*Objectives: To study the effectiveness of Visual Acoustic Stimulation Test (VAST) by assessing sensitivity, specificity, false positive and false negative tests of significance. Methods: VAST is a prospective observational study conducted in Obstetrics and Gynecology department, Smt. Kashibhai Navale Medical College, Nahre-Ambegaon, Pune, utilizing real-time ultrasound machine and acoustic vibrator of approximately 75 dB. A total of 70 pregnant women with high risk factors for fetal morbidity and with gestation period of 34 weeks or more consented and were subjected for the study. The perinatal outcome recorded as abnormal when the five minutes APGAR score of less than 7, thick meconium liquor, low birth weight, neonatal intensive care requirements and perinatal death. Results: Sensitivity - 75%, Specificity - 88.7%, Positive predictive value (PPV) - 46.15%, Negative Predictive value (NPV) - 96.49%. Conclusions: The study concludes that VAST fairly detects probable abnormal perinatal outcome and thereby alerts for better perinatal care. VAST is a simple, easy to perform procedure and can be performed by a gynecologist, who has basic knowledge of ultrasound. VAST can be performed as a bedside procedure and faster than Bio Physical Profile (BPP).*

**Keywords : High-risk factor, Perinatal outcome, Real-time Ultrasound machine**

## Introduction

Tests based on assessment of biophysical activity have been widely used to determine fetal well-being. Visual Acoustic Stimulation Test (VAST) has been described as a biophysical test for fetal well-being.[1,2] It utilizes real-time ultrasound to evaluate fetal responses to acoustic stimulation. A mix of acute and chronic markers for utero-placental insufficiency is assessed.

VAST evaluation includes: -

1 Chronic Responses
   - A. Fetal growth
   - B. Amniotic Fluid Index (AFI)

2. Acute responses
   - A. Sympathetic responses
     - i. Startle responses
     - ii. Fetal heart acceleration.
   - B. Behavioural state
     - i. Breathing movement
     - ii. General body movement

The observation time after VAST is maximum 10 minutes.

Vibroacoustic stimulation produced with a standard artificial laryynx is safe and no evidence of hearing impairment or other abnormality has been reported in neonates exposed to the same in-utero. [12,3,4,8]

## Materials And Methods

The aim of the study was to evaluate the effectiveness of VAST by assessing the sensitivity, specificity, false positive and false negative tests of significance. The prospective observational study was conducted in the Obstetrics and Gynecology department, Smt. Kashibhai Navale Medical College, Nahre-Ambegaon, Pune, utilizing real-time ultrasound machine and acoustic vibrator of approximately 75 dB.

### Inclusion Criteria

A total of 70 pregnant women, who have consented for the study, with high risk factors for fetal morbidity and with gestation period of 34 weeks or more were subjected for the study. High-risk factors include:

1. Pregnancy induced hypertension (PIH), pre-eclampsia
2. Gestational diabetes mellitus (GDM), diabetics complicating pregnancy
3. Post dated pregnancy (>41 weeks to 42 weeks)
4. Post term pregnancy (>42 weeks)
5. Bad obstetrics history (BOH)
6. Intra Uterine Growth Restriction (IUGR)
7. Medical disease complicating pregnancy such as severe anemia, heart disease, renal disease, and etc.,
8. Pregnancy with twin fetus

The protocol for the test is an initial orientation scan with growth assessment by biometry variables. The fetal heart rate is measured and the behavioral state is assessed. Vibro-Acoustic stimulus is given on the cephalic pole for 3 seconds. The startle response and the heart rate acceleration are measured and noted. Assessment of behavioral state criteria of breathing and movement is done. If any are absent or abnormal, a repeat stimulus is given and observation is extended to a maximum of 10 minutes.

Format for observation:

Visual Acoustic Stimulation Test (VAST)

Referring Dr. OPD/IPD No.

Patient Name Risk: Low / high Gest-age: Date / Early scan

Placenta: Anomaly Cord

| Date | 1 Chronic Responses | | 2 Sympathetic Responses | | 3 Behavioural state responses | | Remarks |
|---|---|---|---|---|---|---|---|
| | Fetal Growth | AFI | Startle | Acceleration | Breathing Movement | Body Movement | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Delivery: Spontaneous / Induced / LSCS Outcome: Alive / MSB** / FSB++

Anomaly:

Birth Weight: kg Meconium: Yes / No

APGAR Score: 1 minute / 5 minute

Remarks:

** MSB Macerated Still Birth

++ FSB Fresh Still Birth

The test was performed on patients at high risk for fetal morbidity. The criterion for an abnormal VAST is that any two independent observed variables are abnormal, i.e. 1 + 2 or 1 + 3 or 2 + 3 or 1+2+3. All cases of abnormal VAST were subjected to induction of labor with continuous fetal monitoring using Cardiotocography (CTG) or caesarean section for obstetric reasons. Normal VAST cases were subjected to the same test twice a week. The perinatal outcome was recorded as abnormal if the five minute APGAR score of less than 7, thick meconium liquor, low birth weight, neonatal intensive care requirements, and perinatal death.

**Results:**

The observed values are shown in the Tables 1 4.

Table 1 VAST observed values

| S.No | High Risk | Total No | VAST Normal | VAST Abnormal |
|---|---|---|---|---|
| 1 | Diabetes Mellitus | 2 | 2 | 0 |
| 2 | Twins | 3 | 3 | 0 |
| 3 | Heart Disease | 1 | 0 | 1 |
| 4 | Equivocal Non Stress Test (NST) | 1 | 1 | 0 |
| 5 | Decreased Fetal movements | 1 | 1 | 0 |
| 6 | Severe Anemia | 5 | 4 | 1 |
| 7 | Prolonged pregnancy >41 wks to 42 wks | 15 | 13 | 2 |
| 8 | Post term >42 wks | 4 | 4 | 0 |
| 9 | Bad obstetric history (BOH) | 6 | 6 | 0 |
| 10 | Pregnancy induced hypertension (PIH) | 19 | 15 | 4 |
| 11 | Intra uterine growth restriction (IUGR) | 8 | 5 | 3 |
| 12 | Premature rupture of Membranes (>12 hrs) | 5 | 3 | 2 |
| | Total | 70 | 57 | 13 |

Table 2 Correlation of normal VAST and perinatal outcome in individual risk situations.

| S.No | High Risk | VAST Normal | Perinatal Outcome | |
|---|---|---|---|---|
| | | | Abnormal | Normal |
| 1 | Diabetes Mellitus | 2 | 0 | 2 |
| 2 | Twins | 3 | 1 | 2 |
| 3 | Heart Disease | 0 | 0 | 0 |
| 4 | Equivocal Non Stress Test (NST) | 1 | 0 | 1 |
| 5 | Decreased Fetal movements | 1 | 0 | 1 |
| 6 | Severe Anemia | 4 | 0 | 4 |
| 7 | Prolonged pregnancy >41 wks to 42 wks | 13 | 0 | 13 |
| 8 | Post term >42 wks | 4 | 0 | 4 |
| 9 | Bad obstetric history (BOH) | 6 | 0 | 6 |
| 10 | Pregnancy induced hypertension (PIH) | 15 | 1 | 14 |
| 11 | Intra uterine growth restriction (IUGR) | 5 | 0 | 5 |
| 12 | Premature rupture of Membranes (>12 hrs) | 3 | 0 | 3 |
| | Total | 57 | 2 | 55 |

Table 3 Correlation of abnormal VAST and perinatal outcome in individual risk situations.

| S.No | High Risk | VAST Abnormal | Perinatal Outcome | |
|---|---|---|---|---|
| | | | Abnormal | Normal |
| 1 | Diabetes Mellitus | 0 | 0 | 0 |
| 2 | Twins | 0 | 0 | 0 |
| 3 | Heart Disease | 1 | 0 | 1 |
| 4 | Equivocal Non Stress Test (NST) | 0 | 0 | 0 |
| 5 | Decreased Fetal movements | 0 | 0 | 0 |
| 6 | Severe Anemia | 1 | 1 | 0 |
| 7 | Prolonged pregnancy >41 wks to 42 wks | 2 | 1 | 1 |
| 8 | Post term >42 wks | 0 | 0 | 0 |
| 9 | Bad obstetric history (BOH) | 0 | 0 | 0 |
| 10 | Pregnancy induced hypertension (PIH) | 4 | 2 | 2 |
| 11 | Intra uterine growth restriction (IUGR) | 3 | 1 | 2 |
| 12 | Premature rupture of Membranes (>12 hrs) | 2 | 1 | 1 |
| | Total | 13 | 6 | 7 |

Table 4 Comparision of VAST and perinatal outcome.

| | | Perinatal Outcome | |
|---|---|---|---|
| | | Abnormal | Normal |
| VAST | Abnormal | 6 | 7 |
| | Normal | 2 | 55 |

Sensitivity = Abnormal perinatal outcome given abnormal VAST / Total abnormal perinatal outcome = 6/8 = 75%

Specificity = Normal perinatal outcome given normal VAST / Total normal perinatal outcome = 55/62 = 88.7%

Positive predictive value = Abnormal perinatal outcome given abnormal VAST/ Total abnormal VAST = 6/13 = 46.15%

Negative predictive value = Normal perinatal outcome given normal VAST / Total normal VAST = 55/57 = 96.49%

The above findings shows that the sensitivity of VAST is 75 % with confidence interval (C.I) ranging from 64 % to 86 %, specificity is 89 % with confidence interval (C.I.) from 81.14 to 96.26. The positive predictive value is 46.15 with C.I. 34.25 to 58.05. The negative predictive value is 96.4 with C.I. being 92 to 100.

The sensitivity being 75 %, indicates that VAST fairly detects abnormal outcome. All participants with an abnormal VAST were subjected to labor induction or caesarean section as per the institutional protocol.

The specificity was high (89%) with a low false positive rate (3.5%). Similarly the negative predictive value of 97 % indicates that when VAST is normal, fetuses have a normal outcome.

**Discussion:**

Effectiveness of VAST over the other available fetal well being tests are discussed below.

Non Stress Test (NST) Cardio-tocography (CTG) is perhaps the most commonly performed antenatal test of fetal well-being. Although it is quick and simple to perform, interpretation can be difficult. Predictive value for an abnormal NST for perinatal morbidity and mortality is less than 40%. Analysis of 4 trials of NST [5] has failed to demonstrate any significant effect on perinatal outcome.

Systematic review of 7 trials demonstrates that vibro acoustic stimulation [6] may well reduce the number of false positive NST CTGs.

Biophysical activity: Assessment of fetal activity has been used as a predictor of fetal compromise, with perhaps the best known system being described by Manning in the 1980's. Observational data [7] based on over 80000 high risk pregnancies show that the Bio physical Profile (BPP) has a negative predictive value (NPV) of 99.946% and a Positive predictive value (PPV) of 35% for perinatal morbidity including low APGAR scores, acidemia at birth, fetal distress and fetal growth restriction. BPP is a time-consuming test to perform especially in high risk pregnancies where number of true positives is high. Combined data from the two high quality trials suggest an increased rate of unnecessary obstetric intervention[7].

While performing VAST the physician can check on more diversified parameters of fetal well being, such as detection of abnormal growth, response to acoustic stimulus etc., VAST is faster [1,2,3,6,8] to perform and can also be done as a bedside test.

The increased parameters in VAST aids in increasing the sensitivity (75%) and thus lowering the false negative rates (3.5%)

Even though the VAST study was published many years ago[1], the test has not become popular. At our institution, we decided to evaluate the effectiveness and convenience of using VAST as a test of fetal well-being. VAST has proved to be a simple, reliable and effective test of fetal well being.

Umbilical Artery Doppler waveform (UADW): Review analysis of 11 good quality trials involving 7000 women shows that Umbilical Artery Doppler waveform (UADW) in high-risk pregnancies appears to improve a number of obstetric care outcomes.[9] However, UADW require specialist ultra-sonologist / radiologist availability. In instances where Doppler equipment or specialists are unavailable, VAST can be recommended as an alternative for monitoring high-risk pregnancies, since the predictive values are favorable.

In a prospective open intervention study of 335 high-risk pregnancies conducted by Damania KR [1,2], VAST performed well as a test for fetal well being with a sensitivity of 87.8%, Specificity of 82%, Positive Predictive Value (PPV) of 87.3% and a false negative rate of 12.2%.

**Conclusion:**

The results show that VAST fairly detects an abnormal perinatal outcome and thereby alerts for better perinatal care. VAST is a simple, easy to perform procedure and can be performed by a gynecologist, who has basic knowledge of ultrasound. It can be performed as a bedside procedure and it aids in effective monitoring in high rik pregnancies.

VAST can be performed in situations where Color Doppler facilities and/or expertise are not instantly available. Further multi-centric studies with large number of participants and comparative studies with other tests of fetal well being are recommended. As of now, VAST be used in conjunction with other tests like NST and Doppler waveform.

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