EVALUATION OF VIBRO ACOUSTIC STIMULATION TEST AS A PREDICTOR OF FETAL OUTCOME IN HIGH RISK PREGNANCIES IN EARLY LABOUR

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BONAFIDE CERTIFICATE

This is to certify that the study entitled "**Evaluation of Vibro Acoustic Stimulation Test as a Predictor of Fetal Outcome in High Risk Pregnancies in Early Labour"** is the bonafide work done by **Dr.M.Neela,** at the Institute of Obstetrics and Gynaecology and Govt. Hospital for Women and Children attached to Madras Medical College, Chennai during the period of her Post Graduate study for MD Branch II Obstetrics and Gynaecology, from 2003 – 2006 under the guidance of **Prof.Dr.Anjalakshi Chandrasekar, M.D. DGO.,**

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CONTENTS

INTRODUCTION

Cry of a child is the most enchanting symphony that could be ever heard in any house. On the other hand, adverse outcome after a completed term pregnancy has severe emotional and psychological trauma to both the patient and obstetrician. All the available tests for antepartum and intrapartum fetal well being are aimed at a common goal of delivering a healthy child with not trace of hypoxia.

The days where caesareans were performed for dead fetuses have become historical. In the last century, we have witnessed several monitoring methods to diagnose fetal distress where immediate intervention has been rewarding. However today, the tests are aimed in detecting the fetuses who are prone for distress rather than detecting the fetal distress perse.

Routine antepartum fetal surveillance is mandatory in patients with high risk pregnancies, in which the testing protocols attends to distinguish fetuses that can be safely managed expectantly from fetuses that need to be delivered promptly to prevent perinatal morbidity and mortality. However intrapartum fetal surveillance is a must for all pregnant patients in labour (even in pregnancies posed with no risk). Since intrapartum events by itself places the fetuses under the stress of labour. And there is a good evidence that the stress of labour in term of fetal hypoxia and metabolic acidosis can lead to cerebral damage and fetal death and that such insults are not limited to the pregnancies determined as high risk by virtue of maternal disease or antenatal placental compromise **(Skyes et al., 1983).**

The predominant goal of antepartum and intrapartum fetal testing is to lower perinatal morbidity and mortality rates. To accomplish this goal, physicians need to know which fetuses are at risk, what test are available to assess them and how often to use the tests. Unfortunately, we will never be able to reduce perinatal mortality to zero. Some causes of fetal death, such as cord accidents and maternal trauma, cannot be predicted in advance. In addition, congenital anomalies which contribute significantly to perinatal and neonatal mortality rates, cannot be entirely prevented.

The biophysical profile and the NST has been reaching the near gold standard. Fetal vibro acoustic stimulation or scalp stimulation should be considered as one facet of comprehensive fetal evaluation. When these techniques are used in this manner the clinician evaluating the fetus in the antepartum or intrapartum period may prevent unnecessary intervention and improve maternal and neonatal outcome. In the present study, VAST is being evaluated in predicting the fetal outcome in high risk pregnancies.

AIM OF THE STUDY

1. To evaluate the role of VIBRO-ACOUSTIC STIMULATION TEST to discrimate the compromised from the non compromised fetus in high – risk pregnancies in early intrapartum period.

2. To evaluate the effectiveness of VAST in predicting the adverse perinatal outcome in high risk pregnancies

REVIEW OF LITERATURE

HISTORY

It was not until, 1818 that **FRANCOSIS ISSAC**, Mayor of Geneva, a surgeon, reported the fetal heart audibly different from the maternal pulse by applying the ear directly to the pregnant mothers abdomen.

LAENNEC, a physician working in Paris (1806), was the father of the technique of auscultation of the adult heart and lungs.

JOHN CREERY FERGUSON, the first professor of Medicine at the Queen's University of Belfast, in 1827 was the first person in Britain to describe the fetal heart sounds.

ANTON FRIEDRILH HOHL was the first to describe the design of the fetal stethoscope in 1834.

Although **PINARD'S** name is most commonly associated with the stethoscope, his version followed several others, only appearing in 1876.

WINKEL in 1893 empirically set the limits of the normal heart rate at 120 b.p.m. to 160 b.p.m.

In 1958 **HON** pioneered electronic fetal monitoring in the USA.

Abdominal electrocardiography was introducted by **CREMER** in 1906. But it was only in 1974 that this method became commercially available.

REYNOLDS et al., (1941) were the first to devise an external tocodynamometer for external registration of uterine contractions.

Intrauterine pressure can also be recorded using a catheter inserted transcervically. This method was first described by **WILLIAM** and **STALLWORTHY** in 1952.

CALDEYRO BRACIA et al., (1950) described recording of intrauterine pressure by transabdominally inserted devices.

Vibro – acoustic stimulation test was added to the ante – partum and intrapartum fetal surveillance in late 1970s and it was not until 1984 that external sound was used to arouse the quiet fetus, eliciting a startle response.

Radiotelemetry – This technology is now available to record F.H.R. and uterine contraction on a centrally located monitor while the patient is either ambulatory in the hospital or some times even at home. This is done by utilizing a special equipment which allows the F.H.R. and uterine contraction signals to be transmitted over long distances.

CONTROL OF THE FETAL HEART

Control of the fetal heart is complex. The fetal heart has its own intrinsic activity and a rate determined by the spontaneous activity of the pacemaker in the S.A. node. This structure has the fastest rate and determines the rate in the normal heart. The next fastest pacemaker is in the atrium. The AV node has the slowest rate of activity and generates the idioventricular rhythm seen in complete heart block.

The fetal heart is modulated by a number of stimuli. CNS influence is important with cortical and subcortical influences which is not under voluntary control. The cardiorespiratory centre in the brain stem also play a part. Other

physiological factors regulate the heart rate such as circulatory catecholamines, chemoreceptors, baroreceptors and their interplay with ANS.

VARIOUS TESTS FOR ASSESSING FETAL WELL BEING

Fetal movement counts.

Maternal perception of fetal movement is an expensive, non-invasive method of assessing fetal well being. This test can be performed in various ways. Generally the patient is asked to relax on her left side, 30 min after eating and to concentrate on FM. The patient should record the time, she starts the test and note each time the baby kick or moves. A healthy fetus should move approximately 3 to 5 times within one hour in this setting.

An alternative method is the “Cardiff” count to ten chart, whereby the patient records fetal movements during the course of usual daily activity. A period of 12 hours without atleast 10 perceived movements is considered a warning signal. If the test result is not reassuring, the patient should be evaluated and should undergo further testing such as evaluation with NST.

Studies have shown that FM counts are an effective screening measure with reported reductions in fetal mortality from 8.7 deaths / 1000 live birth to 2.1 death / 1000 live birth.

Although the ideal method for performing the test, including how often it should be repeated, has not been defined, it is clear that complaints of decreased FM are significant and warrant further evaluation. The use of fetal kick counts, as a primary testing tool remains controversial since this method of fetal surveillance is neither standardized nor proven in large prospective randomized trials.

Non – Stress Test

The non-stress test is an indirect measurement of utero-placental function. The test requires specialised equipment and trained personnel.

The patient is usually seated in a reclining chair (Fowlers' position), slightly titled to the left to avoid supine hypotension. A Doppler ultrasound transducer and a tocodynamometer are used to monitor the fetal heart rate and uterine activity simultaneously. Fetal movements can also be recorded during the test. The patient presses a button that makes a mark on the tracing every time she perceives a fetal movement. A reassuring or reactive, non-stress test exhibits at least two accelerations in the fetal heart rate in a 20-minute period that are at least 15 beats per minute above the baseline and last atleast 15 seconds A non-reactive test does not meet these criteria.

Fetal heart rate reactivity is a reflection of the balance between the fetus's sympathetic and parasympathetic tone. It is an acquired neurological reflex and is therefore dependant on gestational age: about 65 percent of healthy fetuses will have a reactive non-stress test at 28 weeks of gestation, 85 percent at 32 weeks of gestation and 95 percent at 34 weeks of gestation.

Fetal heart rate accelerations are coupled to fetal movement as the fetus matures; consequently, they will be seen more frequently when the fetus is awake or in an active sleep. Since fetuses can have normal sleep cycles lasting up to 40 minutes, a non stress test might require over an hour to complete if it is initially non-reactive. It is important to differentiate whether a non-reactive tracing truly represents a compromised fetus or merely reflects a temporary behavioural state. This can often be accomplished either by extending the test or by using additional testing modalities.

Other factors that may be responsible for a non-reactive test are maternal use of sedatives or narcotics, as well as severe fetal anomalies of the cardiovascular or central nervous system.

As originally designed, the non-stress test involved the detection of accelerations associated with perceived fetal movements. Subsequent studies showed that these accelerations are predictive of fetal well being regardless of the presence of maternaly perceived fetal movement. A non-reactive non-stress test suggests that the fetus may be compromised, and further studies are indicated to evaluate fetal well being.

Contraction Stress Test

The contraction stress test, also referred to as the oxytocin challenge test, is more cumbersome to perform and more costly than the non-stress test; it also presents more risks. However, this test may identify fetuses that are only marginally compromised by assessing their reserve when subjected to the stress of uterine contractions. The goal of the test is to achieve three uterine contractions in a 10-minute period. This can occur spontaneously, with the aid of nipple stimulation, or with an oxytocin infusion.

With nipple stimulation the patient is instructed to stroke the nipple for two minutes followed by 5 minute period of rest. The cycle is repeated until adequate contractions are observed. If oxytocin is used, it should be started at an Infusion rate of 0.5 to 1.0 mU per minute and doubled every 15 minutes until the desired contraction pattern is achieved. The test carries a small risk of uterine hyperstimulation.

The test is considered negative if no late decelerations are observed. It is

considered positive if late decelerations are detected with more than 50 percent of the contractions. The test should raise suspicion if an occasional late deceleration is seen. A late deceleration is a decrease in fetal heart rate that occurs after the peak of a contraction and returns to baseline after the contraction has subsided. The latter two findings are more ominous if the tracing is also nonreactive. If variable decelerations occur, an Ultrasound examination should be performed to assess amniotic fluid volume. Variable decelerations are decreases in fetal heart rate that usually occur at the same time as a contraction and vary in duration and drop in heart rate.

Biophysical Profile

The biophysical profile was first introduced in the late 1970s. Because it is an ultrasonographic assessment of fetal behavior, it requires more expensive equipment and more highly trained personnel than the other testing modalities.

The study is based on the concept that hypoxic fetuses lose certain behavioural parameters in the reverse order in which they were acquired in the course of fetal development It evaluates indicators of CHRONIC FETAL HYPOXIA and placental function, such as amniotic fluid volume, in addition to more ACUTE INDICATORS, such as fetal breathing, movements and tone. The biophysical profile is a scored test with five components, each of which is worth 2 points if present, given in Table.

COMPONENTS OF THE BIOPHYSICAL PROFILE

Parameters	**Normal (score = 2)**	**Abnormal (Score =0)**
Non – stress test	Greater than or equal to 2 acceleration greater than or equal to 15 beats per minute above baseline during test lasting greater than or equal to 15 seconds in 20 minutes	< 2 qualifying acceleration during test
Amniotic fluid test	AFI * greater than or equal to or at least 1 pocket measuring 2 cms x 2cm in perpendicular plane	AFI < 5 or no pocket > 2cm x 2cm
FBM	Sustained FBM (≥ 30 seconds)	Absence of FBM or short gasps only < 30 seconds total
Fetal body movement	≥ 3 episodes of either limb or trunk movement	> 3 episodes during test
Fetal tone	Extremities in flexion at rest and ≥ 1 episode of extension of extremity, hand or spine with return to flexion	Extension at rest or no return to flexion after movement

AFI = amniotic fluid index; FBM = fetal breathing movement

* Amniotic fluid index = the sum of the largest vertical pocket in each of four Quardrants on the maternal abdomen intersecting at the umbilicus.

A score of 8 to 10 points considered reassuring. A score of 6 points is suspicious and indicates the need to further evaluation. A score of 4 points or less is ominous and indicates the need for immediate intervention.

Modified Biophysical Profile

An alternative to the biophysical profile is a combination of the Non-Stress Test and an assessment of Amniotic Fluid Volume so-called Modified Biophysical Profile. Such a test provides a means of evaluating the acute condition of the fetus and long-term utero-placental function. It has been shown to be as effective as a full biophysical profile in assessing fetal well being.

Vibro-acoustic Stimulation Test

Vibro-acoustic stimulators are artificial larynxes that generate sound pressure levels of approximately 80 to 100 decibels when applied in two or three one-second bursts to the maternal abdomen near the fetal head. This essentially wakes a sleeping fetus, thereby changing its behavioural state. Vibro-acoustic stimulation (VAS) is an easy, relatively inexpensive way to shorten testing times and reduce the false-positive rates for non-stress test and biophysical profiles. Fetuses that respond to VAS with an acceleration on a non-stress test or a startle response on a biophysical profile have very low rates of death within one week of the test.

FETAL NEURODEVELOPMENT AND SEQUENCE OF FETAL DETERIORATION

Fetal Neurodevelopment
Tone (Cortex/Sub cortex - 7.5 to 8.5 weeks)
Movement (cortex / nuclei-9 weeks)
Breathing (ventral surface of fourth Ventricle 20-2 1 weeks)
Fetal heart rate reactivity. (Posterior Hypothalamus-Medulla - 24 weeks)

Sequence of fetal deterioration
Late decelerations appear (CST)
Accelerations disappear (NST, BPP, CST)
Fetal breathing stops (BPP)
Fetal movement stops (BPP)
Fetal tone• absent (BPP)
Amniotic fluid decreases (chronic hypoxia resulting in redistribution of cardiac output away from the kidneys towards the brain)
CST = Contraction Stress Test : NST = Non-Stress Test BPP = Biophysical Profile

Hypoxic fetuses lose certain behavioural parameters in the reverse order in which they were acquired in the course of fetal development.

STATISTICAL CHARACTERISTICS OF SELECTED ANTE-PARTUM FETAL TESTS

Characteristic	NST	CST	BPP
Sensitivity	Poor	Average	High
Specificity	High	High	High
False-positive rate	High	High	High
False-negative rate	Low	Low	Average
NST = Non-Stress Test; CST = Contraction Stress Test BPP = Biophysical Profile			

FREQUENCY OF FETAL TESTING

Traditionally, antepartum testing has been repeated at weekly intervals. Several studies, however, have shown improved outcomes with twice-weekly testing, particularly when the non-stress test is used as the primary screening modality. More frequent testing is indicated in some very-high-risk situations in which rapid deterioration of the fetal condition can occur, such as preterm rupture of the membranes, severe intrauterine growth restriction with oligohydramnios, and severe, acute maternal illness. General guidelines for antepartum testing are given in Table 5. It is important for the physician to establish an individual protocol for each pregnant patient based on a risk assessment and gestational age.

GENERAL GUIDELINES FORANTEPABTUM TESTING

Indication	Initiation	Frequency
Post-term pregnancy	40 weeks	Twice a week
Preterm rupture of the membranes	At onset	Daily
Bleeding	26 weeks or At onset	Twice a week
Oligohydramnios	26 Weeks or At onset	Twice a week
Polyhydramnios	32 Weeks	Weekly
Diabetes		
Class A 1 (well- controlled, No complications)	32 Weeks	Weekly

Class A 2 (well- controlled, No complications)	32 Weeks	Twice a week
Class A or B with poor control, Class C- R	28 weeks	Weekly
Chronic or Pregnancy – induced Hypertension	28 weeks	Weekly
Steroid – dependent or poorly controlled Asthma	28 weeks	Weekly
Collagen vascular disease including Anti-phospholipid antibody syndrome	28 weeks	Weekly
Impaired renal function	28 weeks	Weekly
Uncontrolled thyroid disease	32 weeks	Weekly
Maternal heart disease (NHYA class III or IV)	28 weeks	Once a week
Substance abuse	32 weeks	Weekly
Cholestasis	32 weeks	Weekly
Prior still birth	Atleast before prior fetal death	Weekly
Multiple gestation	32 weeks	Weekly
Congenital anomaly	32 weeks	Weekly
Significant isoimmunization	26 weeks	Twice a week
Fetal growth restriction	26 weeks or at onset	Once
External cephalic version	At time of Procedure	Once
Autologous blood donation	At time of Procedure	Once, during duration of donation

NHYA = New York Heart Association

VIBRO – ACOUSTIC STIMULATION TEST

Introduction :

Fetal stimulation has been used in an effort to change the fetal behavioral state, thereby inducing normal FHR monitoring patterns in non compromised fetuses. Reactive FHR patterns induced by stimulation have been shown to be reliable indicators of fetal well – being.

Different types of stimuli have been studied in an attempt to change the fetal sleep state and evoke a fetal cardioacceleratry response. These include maternal administration of glucose, exposure to noise and external physical stimulation of the fetus.

Fetal responses to environmental noise, characterized by large movements subjectively felt by the mother were documented by Peiper as early as 1925.

In 1930s fetal movement responses were elicited with two boards clapped together.

FHR accelerations and movements induced by vibroacoustic stimulation were first reported in 1936 by **SONTAG** and **WALLACE**. In the 1960s, fetal responses to various stimuli, including musical recordings and high – frequency puretones, were being studied more intensively.

GRIMWADE and co-workers detected acceleration of the FHR at term with an external heart rate monitor after stimulation with a loud speaker placed on the maternal abdomen. The stimuli consisted of the 20 second pulses of pure tones at 500 to 1000 Hz applied 1 to 22 times. In antepartum patients at 38 to 42 weeks, heart rate

accelerations (mean of 27 bpm, lasting and average of 3.4 minutes) were detected in 94% of fetuses.

Recently VAS has been suggested as an alternative to these methods.

The sound environment within pregnant uterus

This has been studied by placing miniaturized microphones (Hydrophones) within the uterus during labour.

Internal noise

Intrauterine sound level has been reported to vary between 85 – 95 dB, with background noise level of about 60 dB. The sources of these noises are.

- Maternal vascular turbulence (peak sound is noted about 300ms after the R wave of maternal ECG).
- Maternal muscular activity
- Maternal bowel sounds

External Noise

All external noises are attenuated by abdominal and uterine wall – particularly when the frequency of sound exceeds 1000 HZ with maximum attenuation at 4000 Hz. Hence fetus does not receive noises of high frequency. However, it may be noted that external low frequency sounds of less than 125 HZ are enhanced.

Basis of VAST

The test is based on the following observations. The finding that fetal cochlear apparatus gets mature enough to appreciate acoustic stimulation from 28 weeks of gestation. (**Smith 1994**).

The observation and assumption that auditory sensation is one of the first to get affected by hypoxia (**Arulkumaran, 1992**).

Methodologic Characteristics

Sound Intensity

Acoustic impedance is higher in tissue and fluid than in air. Therefore clinicians should be aware that the intrauterine sound level during VAS is much higher than the output sound level measured in air.

Smith et al., studied nine patients at term using an artificial larynx with an average output of 84 dB at 1m in air and found that intrauterine peak sound levels reached 91 – 111 dB.

Similar Nyman et al., studied 16 patients at term. Their artificial larynx had a sound level of 99 dB at a distance of 1m air, and the mean recorded sound pressure level inutero was 115 dB. Their highest recorded intrauterine sound level was 129 dB. In studies performed on the ewe, Gerhardt et al., reported that a sound pressure level of 103 dB correlated with an intrauterine pressure level of 129.7 – 140.9 dB.

Various sound internsities have been used in different clinical studies. **Smith et al.,** used a device with an average sound pressure level of 82dB measured at 1m in air **Kisilevsky** and **Muir** used a vibrator with a sound pressure level of 64dB measured in air at a distance of 4in. **Grade** and **Lovett** used an artificial larynx with an output of 100 dB measured in air at a distance of 2in,. **Yao et al.,** assessed fetal response to three different intensity levels; 92, 103 and 109 dB.

Fetal movements as perceived by the mother were significantly greater after 103 and 109 dB stimuli compared with the 92 dB stimulus. Fetal heart rate accelerations occurred slightly more often at 109 dB stimulation than at the 92 dB

level, but the difference was not significant. Thus, depending on the index being evaluated, different requirements must be set. Based on the data presented by **Yao et al.,** a 103 dB device seems to be a suitable tool for evoking FHR accelerations, whereas maternal perception of fetal movements might require a louder sound source.

Duration

Stimulus application have lasted from 1 – 5 seconds in different studies. **Pietrantoni et al.,** evaluated the effect of stimulus duration on the initial FHR acceleration response following VAS of 1, 3 or 5 seconds. Using an artificial larynx, with a sound pressure level of 83dB measured at a distance of 1m, they found a significant difference was found between 3 and 5 sec of stimulation. Therefore these author suggested that a 3 sec sound stimulus is adequate to evoke a fetal response. Most clinical studies have adopted these results and have used a standard 3 sec stimulus in various clinical situation.

REPETITION RATE

In many studies in which fetuses were stimulated only once, an absence of response was regarded as fetal non – reactivity. In other studies fetuses were repeatedly stimulated (two to five times) to evoke a response. Further research seems necessary to establish a definite criterion so that all conclusions can be standardized.

POSITION OF THE ACOUSTIC STIMULATOR

Virtually identical fetal heart rate response and increases in fetal movement were observed after VAS over the fetal vertex or breech. The fetal starle response was

uniformly observed in both groups. **(Daniel P.Eller, Lucinda J.Robinson, Roger B. Newman).**

FETAL RESPONSE

Different variable have been used to define fetal response to VAS. The most common are FHR accelerations and fetal gross body movements. However in some studies, other criterias such as fetal eye blinking, breathing, behavioural states and limb movements have been used.

The time lag between the stimulus and the expected fetal response has varied between studies. Where as some investigators looked only for immediate changes in fetal activity, others followed the fetus for upto 2 hours after stimulations. It should also be noted that the mode and duration of the fetal response vary at different gestational ages.

GESTATIONAL AGE

Morphological studies have shown that by 20 weeks gestation, the human cochlea has achieved a development status comparable to that found in other mammals, when the first response to sound can be readily evoked. However, investigators could only demonstrate a human fetal response to an acoustic stimulus several weeks later. **Birnhotz** and **Benacerraf** evaluated the blink-startle response to VAS. Responses were first elicited between 24-25 weeks gestation and were presented consistently after 28 weeks. In the study of **Gangon et al.,** FHR response to VAS was noted in 11 to 13 fetuses between 24 – 26 weeks.

Crade and **Lovett** reported no fetal startle response to VAS before 24 weeks

gestation. Between 24 – 27 weeks 30% of fetuses reacted and after 31 weeks, 96% reacted based on these data, clinicians should be aware that normal and healthy fetuses of less than 30 – 31 weeks gestation might not respond to VAS.

Several investigators have reported FHR changes following VAS. The mode of response is probably related to gestational age. **Jensen** found that the FHR response to VAS increased (i.e.a. larger FHR acceleration) as gestational age progressed from 32 to 39 weeks. **GAGNON et al**. reported that before 30 weeks, the FHR response was usually characterized by a single prolonged acceleration. After 30 weeks, there was a significant and prolonged increase in the basal FHR, which lasted upto 1 hour. In fetuses of more than 33 weeks gestation, there was also a delayed increase in the number of FHR acceleration 10 and 20 minutes after the stimulus. Other studies documented an increase in baseline FHR and accelerations in term fetuses. **Gagnon et al.,** noted a negative correlation between the FHR response to vibro – acoustic stimulation and the pre-stimulation basal FHR.

If stimulation was performed during a period of fetal tachycardia, more than 50% of fetuses responded with an FHR acceleration of less than 15 beats per minute.

The authors therefore concluded that VAS might have limited clinical value in tachycardiac fetuses. A fetal startle response was observed in healthy fetuses following VAS. The mother usually perceives this immediate fetal movement. **THOMAS et al.,** found that in preterm gestations, mother perceived a fetal movement in 87.5% of cases, whereas in term pregnancies the incidence was 96.7%.

In the study of **NYMAN** and **WESTGREN** 97% of the mothers noted a fetal movement after stimulation. Different results were reported by **KISILEVSKY et al.,** In their study on pregnancies at 23-36 weeks, mothers perceived 27 – 75% less movement than observed by USG. However, the investigators used a virbator with a

low sound output (64 dB), which probably elicited less vigorous fetal movements.

Gagnon et al., found that breathing activity in the preterm fetus (26 – 35 weeks gestation) was not affected by VAS in term fetuses, a significant reduction inbreathing movements occurred for 1 hour after VAS. Breathing during this period was also more irregular than in the prestimulus period.

DEVOE et al., also noted a decrease in breathing activity in term fetuses following VAS but did not observe changes in the breathing rate.

BEHAVIOURAL STATES

Obvious changes in fetal behavioural states have been found following VAS. **GAGNON et al.,** performed VAS in 14 fetuses in quiet sleep (State 1F) change to active sleep (State 2F) was noted in 12 fetuses. The remaining two fetuses demonstrated only isolated. FHR accelerations without a shift in behavioural state. In the study of VISSER et al., VAS during state 1F was associated with a state change in seven of nine observation (four times into state 2F, three times into state 4F). Stimulation during state 2F was associated with a change into 4F in four of nine observation. In the study of DEVOE et al., all four fetuses, stimulated during state 1F moved into state 4F. Of the 16 fetuses stimulated during state 2F, 11 changed to stage 4F. **VISSER et al.,** expressed concern as to the safety of VAS because in normal unstimulated fetuses, a change from state 1F to 4F is rare and in newborns, such a change is associated with painful stimuli.

NEUROLOGICAL STATE ASSESSMENT

The normal neonatal response to sound stimulus consists of a generalised paroxysmal startle reflex. **DIVON et al.,** and others have shown a similar response in

healthy fetuses after VAS. It was therefore suggested that the startle response might indicate an intact fetal brainstem.

Habituation is progressive decrease in response that occurs when a stimulus is repeatedly presented. There is evidence that a normal habituation pattern may reflect a normal central nervous system. Habituation to VAS was reported in normal healthy fetuses near term. Fetuses who failed to habituate demonstrate an increased incidence of distress and adverse outcome.

It is yet unclear whether the VAS influences the human fetus by auditory or by vibratory pathways. **Ohel et al.,** and Park and Kim evaluated. anencephalic fetuses who lacked auditory capabilities. Both studies reported no response to VAS in these fetuses. It was therefore assumed that an acoustic mechanism is needed to elicit a fetal response. In contrast Gagnon et al., found that a pure low frequency vibratory stimulus applied during episodes of low FHR variability caused a change from a state of quiet sleep to a state of rapid eye movement sleep in healthy term fetuses. However no fetal response was elicited if the stimulus was delivered during periods of high FHR variability.

VAST – An eight – parameter Test

VAST directly or indirectly elicits and thereby tests the following fetal systems or junctions:

- Functional state of CNS
- Reflex CVS response to CNS stimulation
- Startle response / stress response
- Motor response (flexion – extension type of limb movement)
- Ability of integration (intact somatomotor sensory pathway)
- Auditory acuity

- Fetal behaviours
- Fetal learning ability (Habituation)

Antepartum Vibro Acoustic Stimulation

Antepartum testing of fetal well being based on the response to VAS has been extensively studied. **READ** and **MILLER** studied a high risk population with sound stimuli and oxytocin challenge testing (OCT). When FHR accelerations evoked by sound exceeded 15 bpm the subsequent OCT was always negative. Suspicious or positive OCTs were common when there was no response to auditory stimuli.

TRUDNIGER and **BOYLAN** found that in high risk pregnancies, an impaired response to sound had greater predictive value than a non reactive NST. **SERAFINE et al.,** reported that fetuses with spontaneous or sound generated reactivity had comparably good outcomes. On the other hand, fetuses that lacked spontaneous or sound stimulated reactivity had an increased risk for intrapartum fetal distress. **SMITH et al.,** reviewed their experience with 7763 tests of antepartum FHR recordings. Fetal death occurred within 7 days of a reactive test with an incidence of 1.9 per 1000 in patients received acoustic stimulation. This finding contrasted favourably with a death rate of 1.6 per 1000 fetuses with spontaneous reactivity. **CLARK et al.,** performed 4793 antepartum tests, 17% of NSTs that were non reactive with sound stimulation were followed by a positive CST or BPP score of 4 or less. There was no unexpected antepartum fetal deaths in this study population.

INTRAPARTUM VIBRO – ACOUSTIC STIMULATION

A normal intrapartum FHR recording is usually associated with good fetal outcome. In contrast, fetal acidosis is not a consistent finding when an ominous FHR pattern is recorded. Many perinatal centres routinely determine the pH of the fetal scalp blood whenever an abnormal FHR is observed. However, this is an invasive

procedure with technical limitations in cases of an undilated cervix. Because VAS is non invasive and easy to perform, several investigators have addressed the possibility of performing it instead of fetal pH sampling.

Smith et al., studied 64 patients with an abnormal FHR tracing. Thirty fetuses responded to VAS with FHR accelerations and all had a scalp pH of 7.25 or greater. Of the 34 fetuses who did not respond with FHR acceleration, 18 (53%) had a pH of 7.25 or less. **Ohel et al.,** evaluated the fetal response to VAS in 100 women during active labour, including fetuses with both normal and abnormal FHR recordings. All fetuses with FHR response to stimulation, including those with an abnormal prestimulation FHR tracing, had a good outcome.

Edersehim et al., reported that fetal acidosis (pH less than 7.20) never occurred in fetuses that responded to VAS within an FHR acceleration. However, of the 72 who did not respond, 39 had a pH greater than 7.25, 27 had a pH less than 7.20. **Polzin et al.,** studied 100 patients with an abnormal FHR recording. The meanscalp pH was 7.29 in those fetuses who reacted to the stimuli and 7.22 in those who did not. Despite this significant difference, the lack of response to VAS predicted a pH less than 7.20 in only 39% of patients. **Ingermarson** and **Arul Kumaran** obtained similar results. In their study, the mean scalp pH values were significantly higher in fetuses who showed reactive responses compared with those who demonstrated no response or an FHR deceleration (pH of 7.30 and 7.22, respectively).

However, acidotic pH values (7.16 and 7.18) were found in two fetuses that had shown a reactive response to VAS. **Strong et al.** reported a case of intrapartum death within 20 minutes of a reassuring acoustically stimulated FHR acceleration. The cause of death was sepsis and meconium aspiration.

Zimmer et al., studied the possible effect of maternal analgesia on VAS results.

Fetuses were stimulated during a quiet state following maternal intravenous administration of meperidine and promethazine. Fetal response in terms of gross body movements and FHR accelerations occurred in all 12 patients who were evaluated.

Recently, VAS was used as an admission test in early labour. It was suggested that the test could differentiate between the fetuses that is likely to tolerate the stress of labour and the fetus that may develop fetal distress. **Ingermarsson et al.,** found that out of 694 fetuses with a normal FHR response to VAS only 12 (1.7%) developed distress later in labour. Of the nine fetuses that had an equivocal or ominous FHR and did not respond to VAS, five developed fetal distress later. Similarly, **Sarno et al.,** reported that among fetuses that did not react to VAS in the early intrapartum period, the incidence of caesarean delivery due to fetal distress was 35.7% and the 1 minute Apgar Score was less than 7 in 50% of cases.

The summary, VAS during labour has high negative predictive value. That is fetuses that respond to VAS usually have a normal outcome. On the other hand, an abnormal response is not an accurate predictor of adverse outcome. Therefore, diagnosis of fetal distress is labour based solely on the VAS results should probably be avoided.

Acoustic testing is not yet widely used or even studied on a large scale. As a results, there are several protocols and methods of interpretation. There have been two basic approaches to the use of sound for fetal stimulation.

ACOUSTIC STIMULATION TEST AS A REPLACEMENT FOR THE NST

In the first approach, the acoustic test was evaluated as a replacement for NST; the reactivity criteria are those of the classic NST. The practicality of the acoustic test was assessed by comparing 340 patients undergoing NST with 366 patients who received acoustic stimulation (upto 3 seconds in duration) by an artificial larynx after monitoring the heart rate for 5 minutes.

The stimulus was repeated at 1 minute intervals for an arbitary maximum of three times if no 'qualifying accelerations' (presumably the absence of a 15 bpm acceleration lasting 15 seconds) response occurred. A reactive test was defined as the presence of atleast two 15 bpm accelerations lasting 15 seconds in a 10 minute period. 76% of term fetuses responded with one stimulus; 15% required two stimuli and approximately 9% required, three stimuli. Using the acoustic test, the incidence of non reactive test was reduced from 14% (Classic NST) to 9%. Reduced testing time (mean of 27 minutes with a reactive NST vs. 20 minutes with a reactive acoustic test) was also noted.

VAST AS A FOLLOW – UP OF THE NON REACTIVE NST.

Kathleen et al., have evaluated acoustic testing prospectively by comparing the outcome of fetuses, with either a non reactive acoustic test or a reactive acoustic test following a non reactive NST. With the outcomes of control fetuses who had non reactive NSTs and were evaluated and managed in the traditional manner using the OCT / CST. As a part of the analysis of the predictive ability of the acoustic test, this study addressed whether the stimulation of a fetus with non reactive tracing might result in artificial reactivity with a consequent high incidence of false – negative tests. This study demonstrated that the addition of the acoustic test improved discrimination over NST testing alone.

SAFETY OF VAST

Despite extensive research over the last decade, there is still concern as to the safety of VAS. As previously noted, both human and animal studies have found that the intrauterine sound level evoked by an artificial larynx is much higher than its output in air. In fact, the fetus is exposed to sound levels similar to those generated by

a jet airplane at takeoff. In an attempt to establish the safety of this device. **Ohel et al.,** tested the auditory nerve and brain stem evoked responses in neonates after intrauterine VAS and failed to document any evidence of hearing loss.

Arulkumaran et al., evaluated the auditory acuity in 465 children at the age of 4 years and also reported no hearing impairment that could be attributed to VAS. Several case reports have described severe fetal distress following VAS. Vigorous fetal movements evoked by the stimulus may result in tightening of a nuchal cord, bradycardia and subsequent caesarean for fetal distress.

Visser et al., studied fetal behavioural states after VAS and noted that some fetuses moved from state 1F and 4F. Such state transition were not observed in near term low risk fetuses before stimulation and therefore were deemed nonphysiologic. Furthermore, on several occasions, an atypical FHR pattern was recorded and disorganization of behavioural states was observed. The authors suggested that pain perception might cause these changes.

Recently, **Zimmer et al.,** reported that VAS was followed by immediate fetal micturition. (**Zimmer EZ, Chao CR, Guy GP, Marks F, Fifer WP** VAS stimulates human fetal voiding). Micturition is an accepted measure of emotionality. Therefore, it is possible that VAS causes pain and stress in the fetus. Abrams et al., questioned the safety of VAS when they noted an increase in brain glucose metabolism after sound stimuli. It was suggested that the increased glucose uptake associated with VAS is anaerobically metabolized by a process that increased lactate production in the fetal brain. Such an increase may be harmful in a fetus that is already in distress, has an abnormal FHR tracing, and is exposed to VAS in an attempt to differentiate a true positive FHR abnormality from a false positive tracing.

Despite these concerns, **Nyman et al.,** concluded that intrauterine exposure to

VAS did not result in impaired neurological development or hearing loss.

MATERIALS AND METHODS

The study was conducted in the labour ward of Government Hospital for Women and Children, Institute of Obstetrics, MMC, Chennai for a period of 2 years from February 2004 – January 2006.

The study was conducted for assessing the role of VAST in the fetal monitoring of term high risk pregnancies in early labour in 400 patients.

INCLUSION CRITERIA

1. All singleton cephalic presentations
2. After 37 completed weeks in early labour
3. Medical illness complicating pregnancy like hypertension, anemia, Rh incompatibility, gestational diabetes mellitus, and Heart disease
4. Obstetric complications like pre-eclampsia, ante – partum hemorrhage, fetal growth restriction and post EDD pregnancies.

Exclusion Criteria

1. USG showing evidence of congenital anomaly
2. Malpresentations
3. Pregnancy without complication (low risk)
4. Preterm
5. Multiple Pregnancy

Method Of Study

After admission

- History
- General Examination

Height Weight Blood pressure

Pulse Anemia Edema

CVS R.S

- Obstetric examination

Fundal height Abdominal Girth

F.H. E.B.W. (formula)

Liquor

- Basic investigations
- USG

After all these preliminary measures, all patients were subjected to VAST. Fetal heart rate tracing were recorded 5 minutes before and 10 minutes after fetal acoustic stimulation. The reactivity of the traces was analysed with the perinatal outcome, taking Apgar scores at 1 and 5 min as a marker.

CARDIOTOCOGRAPHY

Consists of

1. Ultrasound transducer
2. Tocodynamometer
3. Transducer belt and buckle set
4. Chart paper 25 mt roll

5. Ultrasound coupling gel
6. AC line cord

After fixing the fetal heart transducer on the mothers abdomen, she is asked to turn slightly and lie on her left side or use pillow under one of her hips to displace the weight of the uterus away from the IVC. The patients blood pressure is recorded every 10 minutes during the procedure.

The remote event marker is then given in her hand so that she can indicate her perceived FM by pressing its button. The transducer belt for uterine contraction is tied around the abdomen over the fundus. 5 minutes of non stress CTG is done.

At the end of this period, the fetus is given a vibroacoustic stimulation with the help of an acoustic stimulator using 82dB at 80 Hz for a period of three seconds on the maternal abdomen over the fetal head and the acceleration in the fetal heart rate is observed.

If the qualifying acceleration fails to occur with one stimulus, same stimulus reapplied at 1 min intervals for a maximum of three times. If reactive criteria are met, monitor for atleast 5 minutes after stimulation.

If reactive criteria not met even after repeat stimulation, trace interpreted as non reactive.

VAST INTERPRETATION CRITERIA

Type I - Prolonged (at least 3 minutes) acceleration by 15 BPM above the baseline

Type II - Two accelerations by 15 BPM and lasting for atleast 15 seconds over 10 minutes period or one such acceleration over the same period but lasting for atleast 1 minute

Type III - Biphasic response is an acceleration followed by a deceleration of usually 60 BPM magnitude from the baseline lasting for 60 seconds

Type IV - No acceleration at all

Type V - Deceleration following the stimulus

Type I & II- Reactive

Type III, IV & V - Non reactive

OBSERVATIONS

AGE DISTRIBUTION

Age (Yrs)	R VAST	NR VAST	Total
< 20	26	3	29
20 – 25	219	68	287
26 – 30	55	13	68
31 – 35	10	2	12
> 35	3	1	4

Among the 400 patients who were included in the study, majority of them, 287 were between 20 – 25 years of age.

PARITY DISTRIBUTION

Parity	**Reactive VAST**	**Non reactive VAST**	**Total**	**%**
Primi gravida	193	64	257	64
Multi gravida	120	23	143	36

Majority of patients were primi gravida 257 (64%).

VAST – TRACING PATTERNS

VAST	Number	%
Reactive (R)	313	78
Non reactive (NR)	87	22

VAST tracing were recorded for 10 minutes after the stimulus. Of the 400 patients, 313 (78%) had a reactive trace in contrast to 87 (22%) traces which were NON – REACTIVE.

AMNIOTIC FLUID CHARACTER

Colour of Liquor	Number	%
Clear	325	81
Thin meconium	35	9
Thick meconium	40	10

Of the 400 patients who were followed to delivery after VAST 325 (81%) had clear liquor, 35 (9%) had thin meconium, and 40 (10%) had thick meconium stained liquor.

VAST VS LIQUOR CHARACTER

Colour Of Liquor	R VAST	NR VAST	TOTAL
Clear	273 (87%)	52 (60%)	325
Thin Meconium	26 (9%)	9 (10%)	35
Thick meconium	14 (4%)	26 (30%)	40

$X^2 = 50.6$ P = 0.001

Among clear liquor, VAST was reactive in 84% and non reactive in 16%.

Among non reactive VAST 30% had thick meconium stained liquor.

TEST – DELIVERY INTERVAL (HOURS)

Test Delivery Interval (hrs)	R VAST	NR VAST	TOTAL
≤ 2 hours	15	33	48 (12%)
2 hrs 1min – 4 hrs	63	22	85 (21%)
4 hrs 1min – 6 hrs	73	18	91 (23%)
> 6 hrs	162	14	176 (44%)

$X^2 = 39.1$ P = 0.001

The patient were selected in early intrapartum period. Majority of patients with reactive VAST delivered later than 6 hrs after the test. In selected cases (33%) where fetal distress was indicated by a Non – reactive VAST or meconium staining of the liquor. Earlier intervention was undertaken. They were delivered within 2 hrs.

From the studies of **Arul Kumaran et al.,** it has been shown that the best correlation between the test and fetal outcome was seen when the test – delivery interval was 6 hours or less.

MODE OF DELIVERY

Mode of delivery	Number	%
Labour natural	225	56
Forceps	15	4
LSCS	160	40

225 patients (56%) were delivered by Labour Natural, while caesarean sections were performed for 160 patients (40%) and 15 (4%) patients were delivered by forceps. Fetal distress was the main indication for termination by LSCS and forceps.

CAESAREAN RATES

Indications	R VAST	NR VAST	Total
Fetal distress	29 (43%)	39 (57%)	68 (100%)
Others	83 (90%)	9 (10%)	92 (100%)
	112	48	160

$X^2 = 43.14$ P = 0.001

Of the 112 patients (LSCS) with reactive VAST 29 patients (26%) had fetal distress for their indication. Those were taken for caesarean 6 hours after test. Of the 48 patients (LSCS) with non – reactive VAST 39 patients (81%) had fetal distress for their indication.

Of the LSCS for the fetal distress 29 patients in reactive VAST group. 39 patients in the non reactive VAST group.

MODE OF DELIVERY IN RELATION TO VAST

Mode of Delivery	Reactive VAST		Non reactive vast		Total
	No	%	No	%	
LN	190	61	35	40	225
Forceps	11	3	4	5	15
LSCS	112	36	48	55	160

$X^2 = 11.7$ P = 0.002

Of the patients subjected to VAST 190 patients (61%) were delivered by labour natural.

11 (3%) by forceps,

112 (36%) by LSCS following reactive VAST

Of the non reactive VAST 35 patients (40%) were delivered by labour natural while 48 (55%) and 4 (5%) were delivered by LSCS and forceps respectively.

HIGH RISK PREGNANCIES

Obstetric complications	Reactive VAST	Non reactive Vast	Total
Post EDD (Post EDD)	128	28	156 (39%)
Mild Preeclampsia	64	14	78 (19.5%)
Post EDD Mild PE	17	4	21 (5%)
Mild PE and Others	13	-	13 (3%)
Oligohydramnios + JUGR	25	14	39 (10%)
Oligohydramnios+Others	17	4	21 (5%)
Severe preeclampsia	15	6	21 (5%)
GDM complicating	5	4	9 (2%)
Other complications (Anemia, Heart disease, APH)	29	13	42 (11.5%)

The study was conducted in High risk pregnant patients. Among 400, 177 (44%) patients had crossed EDD, 112 patients (28%) were preeclamptic patients and 60 patients (15%) were complicated by oligohydramnios. Few (9) had Gestational Diabetes mellitus complicating pregnancy. The rest, 42 patients had other high risk factors like anemia, placenta previa, heart disease, epilepsy and recurrent pregnancy loss.

BIRTH WEIGHT DISTRIBUTION

Birth weight (kgs)	R VAST	NR VAST	Number	%
< 2 kg	2	4	6	1

2.0 – 2.5	65	28	93	23
2.6 – 3	130	31	161	40
3.1 – 3.5	97	17	114	29
3.6 – 4	15	7	22	7
> 4 kg	4	-	4	1

Among the 400 patients who were followed to delivery most patients (161) delivered babies with birth weight between 2.6 – 3 kgs. 6 babies weighed less than 2 kg and 4 babies weighed more than 4 kg. The mothers of 4 macrosomic babies had gestational diabetes mellitus.

APGAR

APGAR	NUMBER	%
≥ 7	373	93
5 and 6	21	5
≤ 4	6	2
NICU	38	

The apgar score were 7 and above in 373 babies (93%) 21 (5%) babies had moderate asphyxia with an apgar of 5 and 6 while 6 (2%) babies had severe asphyxia with an apgar less than / equal to 4 of the 38 babies admitted to NICU, 18 babies only admitted for birth asphyxia. Other were admitted for IUGR care and GDM care.

APGAR IN RELATION TO VAST

Apgar	Reactive VAST		Non reactive VAST		Total
	No.	%	No	%	
≥ 7	302	96	71	81	373
5 and 6	9	3	12	14	21
≤ 4	2	1	4	5	6

$X^2 = 23.9$ P = 0.001

Among 313 patients with reactive trace. 302 babies (96%) had good apgar. 9 and 2 babies had moderate and severe asphyxia respectively.

Among 87 patients with non – reactive trace. 71 babies (81%) had good apgar. 12 and 4 babies were moderately and severely asphyxiatd respectively.

INCIDENCE OF FETAL DISTRESS AND NICU ADMISSION

FETAL DISTRESS	R VAST	NR VAST
Incidence	35 (11%)	42 (48%)
NICU	3	9

Fetal distress was low in patients with reactive VAST i.e. 11%.

Of the 35, 29 delivered by CS, 6 babies delivered by forceps. Highest incidence of fetal distress was encountered with non – reactive VAST which is 48%.

Of the 42, 39 were delivered by CS 3 were delivered by forceps delivery.

PREDICTIVE VALUE OF VAST

Vast	FETAL OUTCOME		TOTAL
	ABNORMAL	NORMAL	
Non – reactive	33	54	87
Reactive	21	292	313
Total	54	346	400

$X^2 = 56.8$ P = 0.001

Reactive VAST (313) → Normal outcome 292 (93.4%)

Reactive VAST (313) → Abnormal outcome 21 (6.6%)

Reactive VAST (87) → Normal outcome 54 (62%)

Reactive VAST (87) → Abnormal outcome 33 (38%)

			95 % Confidence Interval
Sensitivity	-	61%	47 - 74
Specificity	-	84%	80 - 88
PPV	-	38%	27 - 49
NPV	-	93%	90 - 96

False Positive	-	15%	12 - 20
False negative	-	39%	26 - 53

The factors which were considered as abnormal outcome are: a 5 min Apgar score less than 7, thick meconium stained amniotic fluid or admission to the neonatal intensive care unit. In the VAST reactive group of 313 patients, only 21 babies were found to be with poor fetal outcome which constitutes 6.6%.

In the VAST non – reactive group of 87 patients 38% of the babies were found to be with poor fetal outcome. Of the 16 babies delivered with low apgar, 3 babies had hypoxic ischemic encephalopathy. Details of the babies are as follows.

1. S.No.174 - NR VAST showing meconium staining of liquor. Emergency LSCS was done to deliver the baby which was severely asphyxiated (TD interval – 30 min). Discharged on 7th POD. B.wt – 2 kg.

2. S.No.87 - NR VAST with clear liquor. Baby was delivered by labour natural with episiotomy with 1/10, 3/10, 8/10 apgar (TD interval – 5hrs 30 min) B.wt – 3.1 kg which was discharged on 11th PND after admission to NICU.

3. S.No.94 - NR VAST with clear liquor delivered labour natural an alive asphyxiated baby of low apgar (TD interval – 5 hours) which discharged from NICU on 6th PND.

   All the above babies are in follow up.

In non reactive VAST group only one baby expired – details are non reactive VAST showing thick meconium stained liquor. Emergency LSCS was done to delivery the baby which was severely asphyxiated. (TD interval 5

hours) admitted in NICU. Expired on 3rd POD due to MAS.

In the study, only one baby expired. Details are 1.R VAST with clear liquor. Delivered by low mid cavity forceps. Alive moderately asphyxiated baby of apgar 6/10 which was admitted in NICU and connected to ventilator (T.D. interval 10 hours) B.wt – 3 kg. baby expired on 3rd PND of severe HIE due to severe intra partum birth asphyxia.

DISCUSSION

Sarno and co – workers studied 201 women who had VAS induced FHR accelerations in early labour and found that the failure to respond may predict subsequent fetal condition. Non response was associated with positive predictive value of 50%, 50% and 14% for meconium passage, caesarean sections for fetal distress and apgar scores less than 7 respectively. Negative predictive values were better at 78%, 88%, and 98% for meconium passage, caesarean section for fetal distress and apgar scores less than 7 respectively.

In the present study, 400 patients with high risk pregnancies in early labour were taken. Non response was associated with positive predictive values of 40%, 45% and 18% for meconium passage, CS for fetal distress and Apgar scores less than 7 respectively. Negative predictive values were better at 87%, 90% and 96% for meconium passage, CS for fetal distress and apgar scores less than 7, respectively.

Nyman and co – workers studied FHR monitoring in response to VAS as a test to fetal wellbeing in a population of gravidae with high risk pregnancies (n – 517) admitted to high risk ward. The sensitivity and specificity was 81% and 89% respectively.

T annirandorn and co-workers studied FHR reactions to the FAST in 140 women in early labour. All were with a singleton, vertex presenting fetus, and GA ranged from 37 – 43 weeks. The results of VAST were compared with fetal outcome which was considered poor when there was perinatal death, a 5 min Apgar less than 7, thick MSAF or admission to the NICU. FAST has

better sensitivity (71.4%), specificity (99%), PPV (80%) and NPV (98.5%) for poor fetal outcome. In **Ingemarsson** and **Arulkumaran** study for VAST, sensitivity, specificity, PPV and NPV were 60% 71%, 27% and 91% respectively.

In the present study, the role of VAST in predicting, poor fetal outcome sensitivity, specificity PPV and NPV are 61%, 84%, 38% and 93% respectively.

SUMMARY

1. 400 cases of High risk pregnant women after 37 completed weeks in early labour were recruited for the study.

2. All the cases were clinically examined routine ultrasonogram was performed for gestational age and liquor status.

3. Vibro – acoustic stimulation was performed using an electronic artificial larynx in all these cases and the tracings were classified as reactive and non reactive based on the fetal heart acceleration to the acoustic stimuli.

4. In the non – reactive VAST traces cases, early artificial rupture of the membrane was performed to see the colour of liquor.

5. The mode of delivery and test delivery interval was noted.

6. The adverse perinatal outcome was analysed with relevance to the thick meconium stained liquor, and Apgar score of < 7.

In the present study majority were primigravida in the age group of 20 – 25 years.

Of the 400 patients 78% had reactive and 22% had non – reactive VAST.

Among clear liquor, VAST was reactive in 84% and non reactive in 16%. Among thick MSL, VAST was reactive in 35% and NR in 65%. VAST non

reactive in 60% of clear liquor and 40% meconium stained liquor.

In selected cases (33 patients) where fetal distress was indicated by non reactive VAST or meconium staining of liquor, earlier intervention was undertaken. They were delivered within 2 hours by Emergency LSCS.

- Among those two were moderately asphyxiated and 1 was severely asphyxiated and admitted in NICU. The rest had good apgar because of earlier intervention.

- Of the patients subjected to VAST 61% were delivered by LN while 3% and 36% were delivered by LSCS and forceps respectively following reactive VAST.

- Of the non reactive VAST group more than half delivered by LSCS. Among those 79% babies had good Apgar.

- Among patients who undergone CS for fetal distress 57% had non reactive VAST and 43% had reactive VAST.

- The study was conducted in High risk pregnancy patients. Among 400 patients, 44% had crossed EDD. 28% were preeclamptic patients and 15% were complicated by Oligo hydramnios. Few had GDM. The rest had high risk factor like anemia, placenta previa, heart disease, epilepsy, BOH.

- Most patients (40%) delivered babies with birth weight between 2.6 – 3 kg. 24% were low birth weight babies and 1% macrosomic babies whose mother had GDM.

- Among patients with reactive VAST 96% babies had good apgar and 4% only had apgar < 7.

- It indicates reactive VAST was associated with high specificity and negative predictive value.

Among patients with non reactive VAST 81% babies had good apgar and 19% babies had apgar < 7. It indicates VAST was associated with low sensitivity and positive predictive value.

Incidence of fetal distress was highest with non reactive than with reactive VAST (11%).

The factors that were considered as abnormal outcome are : a 5 min apgar score less than 7, thick meconium stained liquor or admission to the NICU.

In reactive VAST group 93.4% of babies had good fetal outcome. It gives assurance that reactive response indicates fetal well being.

In non reactive VAST group, 38% of babies had poor fetal outcome and 62% had good fetal outcome.

CONCLUSION

- Vibroacoustic stimulation in the early intrapartum period may be used as a non invasive screening method for rapid intrapartum assessment of fetal well being.
- It gives an early prediction of fetal compromise in high risk pregnancies
- A reactive response to VAST was associated with high specificity and negative predictive value. VAST was associated with low sensitivity and positive predictive value.
- In the abnormal VAST, high correlation with adverse perinatal outcome was seen.
- In crowded labour rooms with limited monitors as in teaching hospitals, the VAST is very useful to detect high risk cases and to monitor them effectively and helps the obstetricians in the appropriate and timely intervention.
- It is therefore suggested to add VAST to NST monitors in the busy labour rooms which allow immediate intervention to be taken in non reactive traces.
- VAST thus proves to be a safe and rapid test of fetoplacental sufficiency.

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PROFORMA

Name	Age	IP No	Unit
		SL. No	
LMP	Booked/		
EDD	Unbooked		

Menstrual History :

Marital History :

Obstetric History : Gravida, Para , Abortion, Live Children

Past History :

Family History :

General Examination :

Height	Anemia
Weight	Odema
Pulse	C.V.S.
B.P.	R.S.

OBSTETRIC EXAMINATION

Fundal Height E.B.E.

Abdominal Girth Bimanual Pelvic Examination

Fetal Heart

Liqour

USG

VAST

Type of Labour - Spontaneous / Induced

Duration of Labour - 1st Stage 2nd Stage

Mode of Delivery - Vaginal

LSCS
(Indication)

TEST DELIVERY INTERVAL

Baby Details Placenta Liquor

Weight

Apgar

NICU Admission

Any Complication

Inference