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Original Article

Role of Non-stress Test and Vibroacoustic Stimulation Test in Prediction of Perinatal Outcome in High-risk Pregnancies

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Abstract

Objectives: The aim of the study was to evaluate the fetal well being by non-stress-test (NST) and vibroacoustic stimulation test (VAST) in high-risk pregnancies, to assess the perinatal outcome, to study the ability of the VAST to convert a false-positive (non-reactive) NST to a reactive one.

Materials and Methods: A total of 100 pregnant women with >32 weeks gestation having certain high-risk factors were subjected to NST and if NST came out to be non-reactive, vibroacoustic stimulation was given with artificial larynx. Perinatal outcome was assessed by various parameters (meconium stained liquor, Apgar score at 5 min, neonatal intensive care units admission). The results were analyzed by Chi-square test to find the association between NST, VAST results, and perinatal outcome.

Results: It was found that VAST reduced the number of false-positive results by 31%. As compared to NST, VAST had less sensitivity (78.05% vs. 80.48%), and better specificity (95.08% vs. 83.61%), better positive predictive valve (91.43% vs. 82.35%) in predicting perinatal outcome.

Conclusion: The addition of vibroacoustic stimulation to the NST reduced significantly the number of non-reactive tests. NST when reactive does represents a satisfactory indicator for fetal well-being but non-reactive test needs further evaluation before any active intervention.

Key words: Non-stress test, Perinatal outcome, Vibroacoustic stimulation test

INTRODUCTION

The main aim of antenatal care is the delivery of a healthy baby without impairing the health of the mother. The assessment of fetal well-being is widely practiced by monitoring the fetal heart rate and its patterns. Fetal morbidity and mortality are greater in high-risk women with Intrauterine growth restriction, hypertension, prolonged pregnancy or other high risk factors.[1] Non-stress test (NST) was introduced to describe fetal heart rate acceleration in response to fetal movement as a sign of fetal health.[2] This test involves the use of Doppler to detect fetal heart rate acceleration which is coincident with fetal movements that are perceived by the mother.

Some pregnancies can be complicated by medical problems in the mother which may have impact on the fetus and pregnancy-specific problems in which fetal health may be affected. In such cases, it becomes all the more important to monitor fetal well-being. The NST is a useful test in the management of high-risk pregnancies. It has high predictive value and a low false-negative rate but has high false-positive results. Attempts have been made to find a suitable stimulant to help decrease non-reactive results as well as to shorten the duration of testing. The vibroacoustic stimulation test (VAST) may have such attributes. The addition of VAST for the fetal assessment in high-risk pregnancies has been proved to be a reliable test due to higher accuracy, ease of performing test and shorter duration of test.[3,4]

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Aim and Objectives

The objective of the study was to compare the VAST with the NST with regard to the ability of detecting a compromised fetus in women with high-risk pregnancies of >32 weeks of gestation, to assess the perinatal outcome and to study the ability of the VAST to convert a false-positive NST to a reactive one.

MATERIALS AND METHODS

This prospective study was conducted on 100 antenatal cases having certain high-risk factors necessitating fetal monitoring in the Department of Obstetrics and Gynaecology, Government Medical College, Amritsar.

After taking a complete history of the patient with special reference to high-risk factors and doing a detailed clinical examination, the women having high-risk pregnancies were recruited for the study after taking informed consent. The risk factor, for which the patient was included, was noted. They underwent NST and vibroacoustic stimulation test in the third trimester of pregnancy. In the study, Hewlett Packard, Avalon Fetal Monitor (FM30) at paper speed of 1 cm/min was used for conducting NST and VAST. For giving vibroacoustic stimulation, an artificial larynx with sound intensity of 85 dB was used.

The NST was performed and recording of fetal heart rate and fetal movements were done. The patient was asked to press the event marker each time she perceived a fetal movement. The trace was designated as reactive, if there were two or more acceleration of ≥15 beats/min lasting for 15 s or more.

If the reactive pattern was not recorded within 20 min period, the fetus was stimulated with artificial larynx and the test continued for another 10 min period. If there was no reactivity in this extended period, only then the trace was deemed non-reactive.

If the NST and VAST were reactive, the tests were repeated weekly or biweekly depending on the risk factor present until the patient went into labor. If the test continued to be non-reactive, then the patient was subjected to further evaluation, i.e., color Doppler and biophysical profile.

The last NST and VAST (within 1 week of delivery) observations were correlated with outcome of pregnancy.

To assess perinatal outcome, the following parameters were taken into account:

- Evidence of fetal distress in labor (meconium stained-liquor)
- Five minutes Apgar score <7 was considered as abnormal
- Perinatal morbidity (neonatal intensive care units [NICU] admission)
- Perinatal mortality.

Analysis of Data

Data from the above-mentioned parameters were compiled and statistically analyzed for their significance. "*P*" < 0.05 and <0.01 were considered significant and highly significant, respectively. The relevance of the results in light of statistical analysis is displayed and discussed.

RESULTS

In the present study, 56% women who presented with high-risk factors were from the unbooked category. The majority of the pregnant women were from rural background (62%). The mean age of the study group was 25.01 years (SD 4.20). Mean gestational age was 38.5 weeks (SD 1.94). The distribution, i.e., the number of patients in the study as per the high-risk factors is shown in Figure 1. The hypertensive disorder of pregnancy comprises the most common high-risk factor in the study as shown below. X-axis shows the high-risk factors and Y-axis shows the number of patients.

The majority of the women having high-risk pregnancies were primigravida (57%). In this study, a total of 213 NSTs were done on 100 women. Two women had twin pregnancy. Hence, the interpretation of NST and VAST of both the fetuses was taken into account. The interpretation of the last NST was correlated with the perinatal outcome. Last NST was non-reactive in 39 (38.2%) women but after VAST, only 27 (26.5%) women have a non-reactive test. Thus, the incidence of false-positive rate of NST was reduced by about 31%. The majority of the women delivered within 24 h of last NST, of which 16% delivered within 6 h of last NST and 68% delivered between 6 and 24 h of test. Regarding mode of delivery, 45% women had normal vaginal delivery. About 53% women underwent caesarean section lower segment

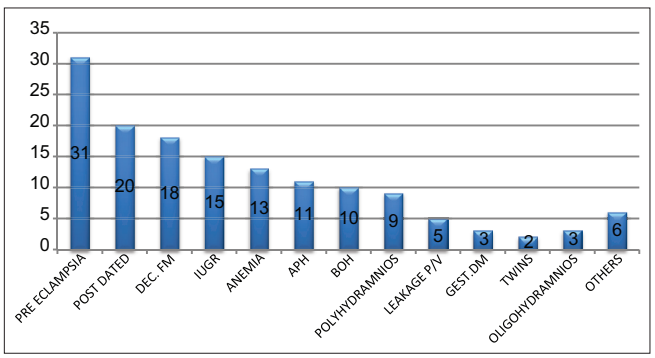

Figure 1: Distribution of patients according to high risk factors

cesarean sections (LSCS) and only 2% of the women had instrumental delivery.

Among the women who underwent LSCS, 39 had emergency section constituting 73.58% of the total LSCS done and only 14 had planned elective section. In our study, when NST was non-reactive, the incidence of emergency cesarean section (71.05%), ($P < 0.001$), was increased as shown in Table 1.

When VAST was also nonreactive, the incidence of emergency cesarean section (79.49%) ($P < 0.001$) was further increased as shown in Table 2.

In the present study, there were six perinatal deaths. The cause of perinatal mortality along with the results of NST and VAST and Apgar score is shown in Table 3.

In our study, when NST was nonreactive, the incidence of thick meconium stained liquor (58.97%) ($P < 0.001$), 5 min Apgar score <7 (33.33%), ($P < 0.001$) and perinatal morbidity ($P < 0.001$) (51.28%) in the form of NICU admissions, need for resuscitation was increased as shown in Table 4.

When VAST was also nonreactive, the incidence of thick meconium stained liquor (70.37%) ($P < 0.001$), 5 min Apgar score <7 (48.15%), and perinatal morbidity (70.37%) ($P < 0.001$) was further increased as shown in the Table 4.

Overall outcome is defined as abnormal outcome if at least one of the predictors of perinatal outcome (namely meconium stained liquor, Apgar score, NICU admission, and perinatal mortality) is abnormal.

The results show that a VAST scores over NST across the board as it is a better predictor of basic parameters of fetal and neonatal prognosis as shown in Table 5.

Table 1: Co-relation of non-stress test with mode of delivery

Mode of delivery	Reactive non-stress test		Non-reactive non-stress test		*P* value
	No.	%	No.	%	
Vaginal delivery	36	58.06	9	23.69	<0.001*
Instrumental	1	1.61	1	2.64	
Lower segment cesarean sections - Emergency	12	19.35	27	71.05	
Lower segment cesarean sections - Elective	13	20.97	1	2.63	
Total (*n*=100)	62	100	38	100	

*P<0.001; highly significant

Table 2: Corelation of vast with mode of delivery

Mode of delivery	VAST reactive		VAST nonreactive		*P* value
	No.	%	No.	%	
Vaginal delivery	40	54.05	5	19.23	<0.001*
Instrumental	1	1.35	1	3.85	
Lower segment cesarean sections - Emergency	8	20.51	31	79.49	
Lower segment cesarean sections - Elective	14	27.03	0	0	
Total (*n*=100)	74	100	26	100	

*P<0.001; highly significant. VAST: Vibroacoustic stimulation test

Table 3: Perinatal mortality and cause of mortality

S. No.	Case No.	Risk factor	Non-stress test	Vibroacoustic stimulation test	Mode of delivery	Apgar score		Outcome	Cause
						1 min	5 min		
1	8	PIH with ADF	NR	NR	LSCS-E	4	6	Baby died 48 h after birth	Severe IUGR
2	17	Post-term	NR	NR	LSCS-E	6	6	Baby died 3 days after birth	Meconium aspiration
3	18	Twins with abnormal Doppler	NR	NR	LSCS-E	0	0	Fresh still birth	Severe IUGR (discordant twins)
4	36	Abruption	R	R	LSCS-E	1	4	Baby died 3 days after birth	Perinatal asphyxia
5	80	Pre-eclampsia	NR	NR	LSCS-E	2	4	Baby died 4 h after birth	Prematurity and IUGR
6	83	Eclampsia	NR pre-term IUGR	NR	LSCS-E	1	6	Baby died 3 days after birth	Severe asphyxia

LSCS-E: Lower segment cesarean sections-E, IUGR: Intrauterine growth restriction

Table 4: comparison of NST and VAST in relation to perinatal outcome

Indicator of perinatal outcome	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
Meconium stained liquor					
NST	82.14	78.38	58.97	92.06	79.41
VAST	67.86	89.19	70.37	88.00	83.33
APGAR score at 5 min					
NST	81.25	69.77	33.33	95.24	71.57
VAST	81.25	83.27	48.15	96.00	83.33
NICU admission					
NST	71.43	74.32	51.28	87.30	73.53
VAST	67.86	89.19	70.37	88.00	83.33
Perinatal mortality					
NST	83.33	64.58	12.82	98.41	65.69
VAST	83.33	77.08	18.52	98.67	77.45

NST: Non-stress test, VAST: Vibroacoustic stimulation test

Table 5: Comparison of NST and VAST with overall outcome

Overall outcome	NST (%)	VAST (%)
Sensitivity	80.48	78.05
Specificity	83.61	95.08
Positive predictive value	76.74	91.43
Negative predictive value	87.93	86.57
Accuracy	82.35	88.24

NST: Non-stress test, VAST: Vibroacoustic stimulation test

DISCUSSION

A screening test should have a good sensitivity to minimize the number of false-negative results. However, good specificity is also needed to reduce false positives, leading to undue anxiety and the need for further investigations. In this prospective clinical study, the women were followed up until delivery. The perinatal outcome was assessed taking into account the various parameters.

The most common indication of antenatal monitoring was hypertensive disorders accounting for 21.23% of the women. The present study is comparable in this regard to the studies done by TM Batcha and Goonewardene[5] and Xi *et al.*[6] which had similar percentage of the women with hypertensive disorders.

Last NST was reactive in 63 cases (61.8%) and was nonreactive in 39 cases (38.2%). After VAST, 12 cases who were initially nonreactive became reactive. Only 27 cases remained nonreactive after VAST. Thus VAST reduced the number of false-positive results by 31%. The results were almost similar to the study conducted by Goonewardene and Hanwellage,[7] in which VAST reduced the false-positive results by 31%.

Sambarey and Bilagi[8] in their study concluded that VAST is easy to perform adjunct to NST with higher specificity, sensitivity, positive and negative predictive value in predicting perinatal outcome that can be compared to our study.

Gupta *et al.*[9] found that the VAST had higher specificity, sensitivity, positive and negative predictive, value in predicting perinatal outcome.

However, in the study conducted by Batcha and Goonewardene,[5] VAST reduced the number of false-positive results by 48% which was higher than the present study. This may be explained by the fact that every study had women with different risk factors leading to this wide variation in the false-positive rate of NST.

Out of 27 cases which remained nonreactive after VAST, 31 (79.49%) underwent emergency LSCS (1 LSCS in patient with twin gestation), of which 14 babies (70% had Apgar score <7), one patient had forceps delivery for fetal bradycardia and only five had normal vaginal delivery.

Of the 13 cases which became reactive after initial non-reactive NST, only three women underwent emergency LSCS.

One of the objectives of the present study was to evaluate the overall usefulness of NST in relation to overall perinatal outcome. The sensitivity and positive predictive value of the present study is higher than that in similar studies. This may be explained by the fact that in the present study, four parameters of perinatal outcome, i.e. meconium stained liquor, Apgar Score, NICU admission, and perinatal mortality were taken into account whereas in other studies either two or three of the above mentioned parameters were considered. At the same time, the specificity and negative predictive value of NST in the present study is close to that demonstrated by above studies.

The sensitivity of VAST in the present study is comparable to the study conducted by Saracoglu *et al.*[10] but is much

higher than that demonstrated by studies of Khatun,[11] Xi *et al.*[6] The positive predictive value of the present study is much higher and negative predictive value is comparatively less when compared to other studies. As said earlier, this may be due to the difference in number of parameters of perinatal outcome which were taken into account. Thus, the addition of VAST to NST prevents undue intervention by decreasing the false-positive rate of NST.

CONCLUSION

Our study is largely a clinical study where an endeavor has been carried out to critically assess the reliability of NST and vibroacoustic stimulation test for decreasing the fetal morbidity and mortality by appropriate intervention and treatment. From the study, it can be concluded that antenatal NST along with VAST provokes a response in non-hypoxic fetuses who have non-reactive NST, thus significantly reducing the false-positive (non-reactive) NST. It has a good sensitivity, accuracy, and negative predictive value in detecting fetal hypoxia. The VAST complement NST but cannot replace it as it is thought that in some cases it may provoke response in hypoxic fetus who is trying to conserve energy by not moving. They cannot predict an acute asphyxia event. However, it can serve as a useful cost effective and reliable preliminary screening procedure for antepartum fetal monitoring where resources for more sophisticated investigations are not freely available.

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