International Journal of Sciences & Applied Research

www.ijsar.in

Fetal acoustic stimulation test for early Intrapartum fetal monitoring

Juhi Agrawal*, Manju Sharma, Seema Mehta, Lata Rajoria

Department of Obstetrics and Gynaecology, SMS Medical College, India.

Corresponding author: *Dr. Juhi Agrawal, Department of Obstetrics and Gynaecology, SMS Medical College, India.

Abstract

Introduction: Fetal acoustic stimulation test (FAST) is a well known test for antepartum fetal monitoring which can also be used in early intrapartum period. Fetuses react to FAST by fetal heart rate acceleration if they are non-acidotic.

Aim and objectives: To evaluate FAST as a screening test for early intrapartum fetal monitoring.

Materials and methods: A total of 150 women with ≥ 37 weeks gestation with singleton pregnancy in early labour selected for study purpose. An initial 20minute non stress test (NST) was done which was followed by FAST. Fetomaternal outcome was noted in terms of mode of delivery, meconium stained liquor, Apgar score at 5minute, NICU admission.

Results: FAST decreased false positive rate by 20%. FAST was equally sensitive and more specific than NST.

Conclusion: Reactive FAST mitigates the chances of poor neonatal outcome and it is an efficacious tool for intrapartum fetal monitoring.

Keywords: Intrapartum fetal monitoring, fetal acoustic stimulation test, fetomaternal outcome, non stress test

Introduction

Intrapartum fetal monitoring simply means to watch the fetal behaviour during labour. The purpose of intrapartum fetal monitoring is to detect hypoxia in labour and to initiate management depending upon severity of hypoxia. Even in normal labour, the baby is subjected to stress due to uterine contraction curtailing the uteroplacental circulation and head compression affecting the functions of vital centres of the brain.A healthy fetus can withstand this stress within physiological limits. But in compromised fetus, the fetal distress may appear abruptly. Severe hypoxia in labour when associated with metabolic acidosis can cause organ damage and fetal death.

In 1975 the non-stress test (NST) was first introduced to show the association between fetal heart acceleration and fetal movement. NST has got high predictivity and low false negative rate, but the main disadvantage being its high frequency of false positive rates and interpretation relies only on one variable, that is acceleration of fetal heart rate associated with movement. Many times,

fetus is asleep at the time of testing and it takes longer time waiting for sufficient acceleration to occur to correctly interpret the results.[1]

It is known that fetal heart rate (FHR) acceleration can be induced by sound stimulus in antenatal period which is similar to neonatal startle reflex.[2,] [3]Acoustic stimulation of the fetus can convert a false positive (non-reactive) NST to a reactive one and also shortens the time duration that a NST needs to be carried out.[4] In this study an attempt has been made to assess fetal vibroacoustic stimulation test for intrapartum fetal monitoring.

Methodology

This prospective comparative study was conducted in our department after Institute Ethics Committee approval and written informed consent from March 2015 to January 2017 in 150 patients with singleton live pregnancy of ≥37weeks with cephalic presentation and patient with uterine contraction <3 in 10minutes and/or cervical dilatation <3cm. Exclusion criteria for our study were multi-fetal pregnancy, intrauterine fetal demise, women with absolute indications of caesarean section, fetus with congenital malformation and fetal distress.

Pregnant women were selected for the study after considering the inclusion and exclusion criteria.An initial 20min non stress test was performed and interpreted as reactive when FHR acceleration of at least 15 bpm from baseline for at least 15 sec was noted or otherwise as non-reactive when no FHR accelerations were observed. Then fetal vibroacoustic stimulation test (FAST) was done in these patients in semi-recumbent position by placing a vibroacoustic stimulator frequency of 75Hz and sound intensity of 80db on mother's abdominal wall over fetal head region and a stimulus of 1-2 sec was applied. FAST was similarly interpreted as reactive when FHR acceleration from the baseline by at least 15 bpm for at least 15 sec was seen. This was repeated up to 3 times for progressively longer durations up to 3 seconds to elicit FHR acceleration after which the test was being treated as non-reactive i.e absence of FHR acceleration after 3 stimuli. Parturients with reactive FAST were allowed to go in spontaneous labour, while those with non-reactive test were delivered by caesarean section. We compared the efficacy of FAST for early intrapartum fetal monitoring in terms of feto-maternal outcome, mode of delivery (normal vaginal delivery/caesarean section), fetal distress (colour of liquor), APGAR score at 5 min and NICU admission.

Data were analyzed statistically using software SPSS (Statistical Package for the Social Science) version 20.0.0 (SPSS Inc., Chicago, IL). Statistical significance was considered if $P< 0.05$. The sample size was calculated to be 142 at alpha e`rror 0.50 and power 80% assuming accuracy of FAST 90.5% predicting fetal outcome to be as per study conducted by Goonewardene M *et al*.[5] Hence, 150 subjects were taken for our study purpose.

Results

All 150 patients completed the study.The mean age of our study population was 25.4±4.2 yr. The proportion of rural and urban population was almost equal.Majority of subjects (74%) were booked case.Around 81% of our subjects were educated while 19% were illiterate. Majority of subjects were from middle class family (44%).

Majority of subjects were between 37 to 40 weeks (78%). Only 22% were post-dated pregnancy (Table 2).

We found out that NST was non-reactive in 59 cases (39.3% while FAST was non-reactive in 29 cases (19.3%). NST was reactive in 91 cases (60.7%) while FAST was reactive in 121 cases (80.7%). Thus, 30 cases (20%) which were found to be non-

reactive by NST became reactive when FAST was performed (Fig. 1).

Table 1: Demographic data.

Area of residence	Number	Percentage
Rural	76	50.7
Urban	74	49.3
Type of pregnancy		
Booked	96	64.0
Unbooked	54	36.0
Educational status		
Educated	122	81.0
Illiterate	28	19.0
Socioeconomic class		
Lower	49	32.7
Middle	66	44.0
Upper	35	23.3

Table 2: Distribution of Study subjects according to gestational age (weeks).

Gestational Age (weeks)	Number	Percentage
37	51	34.0
38	32	21.3
39	20	13.3
40	14	9.3
41	13	8.7
42	16	10.7
43	4	2.7
Grand Total	150	100.0

We also derived from our trial that 49 subjects required LSCS, out of which NST was non-reactive in 30 cases (sensitivity=61.2%). 72 cases who delivered vaginally had reactive NST (specificity=71.3%). Out of 91 cases that had reactive NST, 19 (20.8%) cases required caesarean section while 72 (79.2%) cases delivered vaginally and out of 59 cases with non-reactive NST, 30 cases (50.9%) required caesarean section while 29 (49.1%) cases delivered vaginally. This shows that caesarean rate is higher in non-reactive cases. In 49 subjects who required LSCS, FAST was able to correctly identify about 29 cases (60%) with a specificity of 100% and a positive predictive value of 100% i.e. all those subjects with nonreactive FAST were delivered by LSCS. Out of 121 cases with Reactive FAST, 20 (16.5%) needed emergency caesarean section while 101 (83.5%) cases were delivered vaginally. Sensitivity was not significantly different, but overall positive predictive value and diagnostic accuracy of FAST were significantly better ($P< 0.001$) as compared to NST (Table 3).

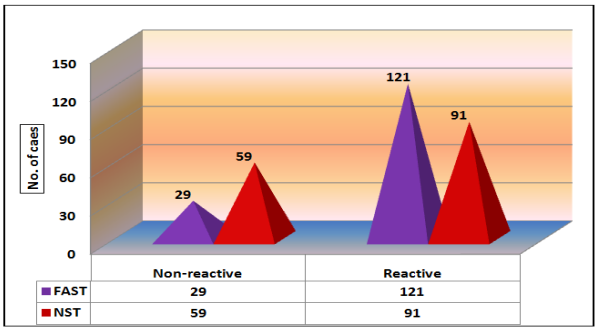

Figure 1: Distribution of study subjects according to interpretation of NST and FAST.

Table 3: Comparison of NST and FAST in predicting mode of delivery.

Diagnostic Parameters	NST	FAST	*P* value
Sensitivity	61.2%	59.2%	0.997
Specificity	71.3%	100%	**<0.001***
Positive predictive value	50.8%	100%	**<0.001***
Negative predictive value	79.1%	83.5%	0.575
Diagnostic accuracy	68.0%	86.7%	**<0.001***
Positive LR	2.1	-	-
Negative LR	0.5	0.4	-

*indicates significant difference

In this present trial, 42 subjects had fetal distress (meconium stained liquor) out of which NST was able to correctly predict 24 cases (sensitivity=57.1%) with specificity of 67.6%.18 cases having fetal distress were missed by NST (false negative rate=42.9%). 35 cases with non-reactive NST did not have fetal distress (false positive rate= 32.4%). Positive predictive value, negative predictive value and diagnostic accuracy were 40.68%, 80.22% and 64.67%, respectively. On the other hand FAST was able to correctly predict fetal distress in 26 cases (sensitivity = 61.9%) with specificity of 97.2%. 16 cases having fetal distress were missed by FAST (false negative rate=38.1%) and 3 cases with non-reactive FAST did not have fetal distress (false positive rate=2.8%). Positive predictive value, negative predictive value and diagnostic accuracy were 89.66%, 86.78% and 87.33%, respectively. Sensitivity of both NST and FAST did not differ significantly (*P* value=0.807). But the specificity of FAST was better than NST (*P* value <0.001). It shows that FAST has lower false positive rate than NST. Diagnostic accuracy of FAST (87.33%) was significantly better than NST (*P* <0.001). Positive predictive value of FAST was significantly more (*P* < 0.001) compared to NST (Table 4).

From the present study, we found that NST was able to correctly predict poor APGAR score at 5 minute in 21 cases (sensitivity=65.6%) and correctly ruled out poor APGAR score in 80 cases (specificity=67.8%).However, it was falsely non-reactive in 38 cases (32.2%) and falsely reactive in 11 cases (34.4%). Positive predictive value, negative predictive value and diagnostic accuracy of NST for prediction of poor APGAR score at 5 minute were 35.59, 97.91 and 67.33% respectively (Table 5). Also this table shows that sensitivity and specificity of FAST for predicting poorAPGAR score at 5 minute was 71.9% and 94.9% respectively.

Neonatal asphyxia detected in 23 cases (88.5%) of non-reactive FAST, and 9 cases (7.4%) of reactive FAST. 6 cases (5.1%) were false positive and 9 cases (28.1%) were false negative. Positive predictive value, negative predictive value and diagnostic accuracy of FAST were 79.31, 92.56 and 90% respectively. FAST was significantly more specific (94.9%) as compared to NST (67.8%) for prediction of neonatal asphyxia (*P* value< 0.001), but sensitivity of both these tests were not statistically significant (*P* value=0.804). Diagnostic accuracy of FAST in predicting poor APGAR score at 5 minutes was much more significant than NST (*P* value<0.001).

Table 4: Comparison of NST and FAST in predicting fetal distress (colour of liquor).

Diagnostic Parameters	**NST**	**FAST**	***P* value**
Sensitivity	57.1%	61.9%	0.807
Specificity	67.6%	97.2%	**<0.001***
Positive predictive value	40.7%	89.7%	**<0.001***
Negative predictive value	80.2%	86.8%	0.417
Diagnostic accuracy	64.7%	87.3%	**<0.001***
Positive LR	1.7	22.3	-
Negative LR	0.6	0.4	-

*Significant difference

Table 6 unveils that the PPV, NPV and diagnostic accuracy of NST in detecting requirement of NICU admission were 37.3%, 86.8% and 64.7% respectively. While the PPV, NPV and diagnostic accuracy of FAST were 82.7%, 88.4% and 87.3% respectively in this regard.

Table 5: Comparison of NST and FAST in predicting poor APGAR score at 5 min.

Diagnostic Parameters	NST	FAST	P value
Sensitivity	65.62%	71.88%	0.804
Specificity	67.80%	94.92%	**<0.001***
Positive predictive value	35.59%	79.31%	**<0.001***
Negative predictive value	97.91%	92.56%	0.176
Diagnostic accuracy	67.33%	90%	**<0.001***
Positive LR	2.04	14.14	
Negative LR	0.51	0.30	

(* denotes significant differences)

Table 6: Comparison of NST and FAST in predicting requirement of NICU admission.

Diagnostic Parameters	NST	FAST	P value
Sensitivity	64.7%	70.6%	0.833
Specificity	68.1%	95.7%	**<0.001***
Positive predictive value	37.3%	82.7%	**<0.001***
Negative predictive value	86.8%	91.7%	0.525
Diagnostic accuracy	64.7%	87.3%	**<0.001***
Positive LR	2.0	16.4	-
Negative LR	0.5	0.3	-

(* denotes significant differences)

Sensitivity of both methods was not significantly different but specificity of FAST was significant higher than NST (*P* value<0.001). Also in this case the diagnostic accuracy of FAST for predicting NICU admission was higher (87.3%) as compared to NST (64.7%) and this difference was statistically significant (*P* value <0.001).

Discussion

NST is simple and quick test to perform but its interpretations can be difficult because of its poor specificity and low positive predictive value. Nonreactive NST does not indicate fetal status and subsequent perinatal outcome accurately. Reactive FAST mitigates the chances of operative delivery, meconium-stained liquor, NICU admission, neonatal asphyxia.

M.Goonewardene*et al*[5]also demonstrated that FAST reduces nonreactive NST from 42% to 9%. They reported that FAST was better than NST for predicting neonatal asphyxia (specificity= 91.1 vs. 63.3%, positive predictive value= 45.2% vs. 19.2 and accuracy =90.5% vs. 66.3%).

Smith CV *et al*[6] performed a retrospective analysis and reported that FAST decreases false positive nonreactive by 50%.

Imam Bano*et al*[7]demonstrated that NST was slightly more sensitive but FAST was more specific for predicting neonatal asphyxia.

PradipSambarey*et al*[8] reported similar results. They demonstrated that 88% cases with nonreactive FAST and 11% cases of reactive FAST needed emergency caesarean section while 42% cases of reactive NST and 50% cases with nonreactive NST needed emergency caesarean section. They reported sensitivity, specificity, positive predictive value and negative predictive value of FAST for fetal distress was 88.46%, 92.3%, 92%, 88.89%, respectively.

Conclusion

FAST is a better tool than NST in predicting fetal and maternal outcome. Reactive FAST is associated with decreased chances of operative delivery, meconium-stained liquor, NICU admission and neonatal asphyxia. The specificity, diagnostic accuracy and positive predictive value of FAST are better than NST, so FAST is

highly desirable in non-reactive group prior to obstetric intervention. A reactive FAST in cases of non-reactive NST nullifies the necessity of more complicated tests. Because of high accuracy, easy administration, shorter testing time, we recommend FAST should be considered as an integrated part of intrapartum fetal monitoring.

References

1. Williams Obstetrics 24th edition, McGraw Hill Medical publishing division.
2. Sontag LW, Bernand J. Fetal reactivity to tonal stimulation: A preliminary report. J Gen Psychol 1947;70:205.
3. Grimwade JC, Walker DW, Barlett M, Gordon S, Wood C. Human fetal heart rate change and movement in response to sound and vibration. AMJ ObstetGynecol 1971;109:86.
4. Tan KH, Smyth RMD. Fetal vibroacoustic stimulation for facilitation of tests of fetal wellbeing (Review). The Cochrane Library2001, issue1.
5. M Goonewardene, K Hanwellage. Fetal acoustic stimulation test for early intrapartum fetal monitoring. Ceylon Medical Journal 2011; 56: 14-18.
6. Imam Bano, Nasreen Noor, LataMotwani, Zakia Arshad. Comparative study of non stress test and fetal acoustic stimulation test in assessment of fetal wellbeing. Journal of South Asian Federation of Obstetrics and Gynaecology, jan-Apr 2011; 3(1); 6-9.
7. Pradip Sambarey, Daksha Mrutyunjay Bilagi. Non-stress test and vibroacoustic stimulation test in high risk pregnancies and its relation to perinatal outcome. International Journal of Scientific Study; Feb 2016;3(11).
8. Smith CV, Phelan JP, Paul RH, Broussard P. Fetal acoustic stimulation testing: a retrospective experience with the fetal acoustic stimulation test. Am J Obstet Gynecol. 1985 Nov 1; 153(5):567-9.