

COMPARISON OF NON STRESS TEST AND UMBILICAL ARTERY DOPPLER IN HIGH-RISK PREGNANCY

Nooren Mirza^{*1}, Veena Meena², Reinu Garg³, Vineeta Gupta⁴, Rabinder Iqbal⁵, Kiran Meena⁶, Neha Agarwal⁷, Shivani Gupta⁸

1. Assistant Professor, 2. Senior Resident, 3. Senior Resident, 4. Medical officer, 5, 6, 7,8. Resident, Department of Obstetrics and Gynecology, S.M.S. Medical College Jaipur,

*Email id of the corresponding author- mirza.nooren@gmail.com

Received: 19/01/2017

Revised: 02/03/2017

Accepted: 11/03/2017

ABSTRACT

Background: The study aimed to compare the screening ability of two different modes of the antepartum fetal testing i.e. Non stress test and umbilical artery Doppler for the presence of peripartum morbidity, as measured by the cesarean delivery rate for fetal distress. **Materials and Methods:** A total 100 women with high risk pregnancy of gestational age ≥ 32 weeks attending the ANC of a tertiary health centre were enrolled in the study. Antepartum fetal surveillance of these women was done by either non stress test or umbilical artery Doppler velocimetry alternately. If either of these tests was normal, patients were screened with the same method as per the study protocol. If abnormal results were obtained, induction and delivery were recommended within next 24 hours. Statistical comparisons were done with the X^2 test. **Results:** 73.52% women with a reactive NST had vaginal delivery while 67.85% of women with normal S/D ratio had vaginal delivery. Out of the total 31 women who had fetal distress in labor, 17 belonged to the NST groups and 14 to the Doppler group of the total cesareans done in the NST and Doppler group were 63.63% and 50% respectively for fetal distress. The probability of having fetal distress in the Doppler group is 0.823 times that of the NST group. **Conclusion:** Umbilical artery Doppler stands out as a better screening test for high risk pregnancies as the proportion of having fetal distress in labor is less than that of NST.

KEYWORDS: Doppler velocimetry, High risk pregnancy, Non stress test

INTRODUCTION:

Due to availability of obstetrical anaesthesia, laboratory diagnosis, improvement in surgical techniques, we have been able to reduce the maternal mortality rate during the past few decades. A small proportion of pregnancy was responsible for the large majority of poor fetal outcomes and the knowledge about these pregnancies at risk has affected all aspects of

prenatal care. High risk pregnancies include women with chronic hypertension, diabetes, anemia, Rh allo-immunization, cardiac, renal diseases, post dated pregnancies, decreased fetal movements, hypothyroidism and bad obstetric history etc. (1,2,3)

According to the American College of Obstetricians and Gynaecologists (1999) the goal

of antepartum fetal surveillance is to prevent fetal death and fetal surveillance should be started by 32 to 34 weeks for high risk pregnancies. (4) For fetal assessment variety of noninvasive tests like fetal movement counts, non-stress test (NST), acoustic stimulation tests, contraction stress test, biophysical profile, blood flow studies etc, have been evolved to detect possible intrauterine compromise. Color Doppler ultrasound plays an important role in monitoring high risk pregnancies. Umbilical arteries are the first and most extensively studied vessels of the utero-placental circulation. Recording of umbilical artery flow velocity waveforms (UAFVW's) provide a direct measure of downward placental flow resistance, which has been correlated with fetal wellbeing.(5) As the gestation advances there is a decrease in placental flow resistance which is reflected as an increased flow in diastole in UAFVW's resulting in a reduction in systolic/diastolic (S/D) ratio. An elevated S/D ratio is the result of a reduced number of arteries in the tertiary stem villi affecting the placental capacity to provide oxygen, glucose and other nutrients to the fetus.(6) NST reflects fetal oxygenation and CNS function while Doppler velocimetry identifies impaired fetoplacental & uteroplacental circulation. (6)

This study determines the abilities of these two tests to provide effective screening for intra uterine compromise.

MATERIALS AND METHODS:

This screening study was carried out at tertiary care hospital on 100 pregnant women of any age or any parity with high risk pregnancy ≥ 32 weeks after taking informed written consent. Antepartum fetal surveillance of these women was done by either non stress test or umbilical artery Doppler velocimetry alternately after taking obstetrical history, clinical examination

and routine investigations. Interpretation of NST and Doppler velocimetry was done as per standard guidelines. If either of these was normal, patients were screened with the same method as per the study protocol. The perinatal outcome of each of these pregnancies was studied, including the presence or absence of IUGR, meconium passage, Apgar score at 5 min, admission to NICU, perinatal deaths and still births. If abnormal results were obtained, induction and delivery were recommended within next 24 hours. Statistical comparison was done with the X^2 test. The study was approved by institutional ethics committee.

RESULTS

A total of 100 pregnant women of any age or any parity with high risk pregnancy ≥ 32 weeks were enrolled in this study. Maximum patients who were subjected to either NST or Doppler; had pregnancy induced hypertension.

About 73.5% patient with normal NST result had normal vaginal delivery while in the Doppler group, 67.8% of patients with normal S/D ratio had normal vaginal delivery. Out of the total cesarean sections that were done in the NST group, 63.6% were due to fetal distress, while in Doppler group it was 50%. Out of the total 31 patients who had fetal distress, 17 and 14 patients belonged to NST and Doppler group respectively. The proportion of having fetal distress in the Doppler group is 0.823 times that of NST group. Number of patients who had abnormal fetal outcome were 17 (34%) and 20 (40%) in NST and Doppler group respectively ($p \geq 0.05$).

NST appears to be better than Doppler in predicting fetal distress but the difference is not statistically significant ($p > 0.05$).

There was no perinatal mortality in both the group of patients with reactive NST and

abnormal NST patterns. But there were two perinatal deaths in patients who showed a non reactive pattern.

Out of the total 50 patients in the Doppler group, there were 3 perinatal deaths and 17 pregnancies ended in morbid neonates.

Table 1: Mode of delivery in relation to the result of Doppler

S. No.	Mode of delivery	Result of Doppler			
		S/D <3 (N=28)	S/D ≥3 (N=15)	AEDFV (N=5)	REDFV (N=2)
1	Normal vaginal delivery	19 (67.8%)	6 (40%)	0	0
2	IUFD vaginal delivery	0	0	0	1 (50%)
3.	LSCS	9 (32.1%)	9 (60%)	5 (100%)	1 (50%)

Table 2: Distribution of fetal distress according to interpretation of NST and Doppler

	Fetal distress		
	Reactive NST / Normal doppler	Abnormal Doppler / Non reactive NST	Total
NST	5 (14.7%)	12 (75%)	17
Doppler	5 (17.8%)	9 (40.9%)	14
	10	21	31

Table 3: Distribution of abnormal neonatal outcome in NST group

Parameter	N = 34 NST reactive	N = 6 NST Non-reactive	N = 10 NST abnormal
SGA	6 (17.6%)	2 (33.3%)	4 (40%)
Apgar < 7 at 5 min	2 (5.88%)	2 (33.3%)	3 (30%)
Meconium	5 (14.7%)	5 (83.3%)	5 (50%)
NICU admission	2 (5.9%)	2 (33.3%)	6 (60%)
Perinatal mortality	0	2 (33.3%)	0
Total abnormal outcome	5 (14.7%)	4 (66.6%)	8 (80%)

Table 4: Neonatal outcome in NST group

Neonatal outcome	NST		
	Reactive (34)	Non reactive (6)	Abnormal (10)
Normal	29 (85.3%)	2 (33.3%)	2 (20%)
Abnormal	5 (14.7%)	4 (66.6%)	8 (80%)

Table 5: Neonatal outcome in Doppler group

Neonatal outcome	Doppler			
	S/D ratio normal (N=28)	Elevated S/D ratio (N=15)	AEDFV (N=5)	REDFV (N=2)
Normal	24 (5.72%)	6 (40%)	0	0
Abnormal	4 (14.28%)	9 (60%)	5 (100%)	2 (100%)

Table 6: Distribution of abnormal perinatal outcome in Doppler group

Parameter	N = 28 S/D normal	N = 15 S/D ≥ 3	N = 5 AEDFV	N = 2 REDFV
SGA	4 (14.3%)	4 (26.7%)	4 (80%)	2 (100%)
Apgar <7 at 5 min	0	5 (33.3%)	2 (40%)	2 (100%)
Meconium	5 (17.8%)	5 (33.3%)	2 (40%)	2 (100%)
NICU admission	3 (10.7%)	6 (40%)	4 (80%)	1 (50%)
Perinatal mortality	0	0	2 (40%)	1 (50%)
Total abnormal outcome	4 (14.3%)	9 (60%)	5 (100%)	2 (100%)

DISCUSSION

This study was undertaken to determine the best screening protocol for pregnant women at a gestational age 32 weeks and onwards whose

pregnancies were at increased risk for poor perinatal outcome because of utero placental compromise.

In this study out of the 50 patients in each NST and Doppler velocimetry group, about 86% and 88% respectively were either primigravida or gravida-2. The study conducted by Williams et al (10), in both NST and Doppler group only 29% patients were primigravidae. Freeman et al (7) stated that NST can begin from 26-28 weeks gestation. In this study, the earliest gestational age when monitoring with either NST or doppler group was done was 32 weeks.

The most common indication in both NST and doppler group was PIH. Perception of decreased fetal movements, being the next indication. In the study of Atul K. Sood (8) the most common indication was IUGR followed by BOH and post term pregnancy.

Non stress test is interpreted as reactive when a minimum of 2 accelerations of 15 bpm or above the baseline lasting for 15 seconds, in a 20 minute period are present. This criteria has been used in most of the studies - Keegan and Paul (9) and Williams et al (10). In this study the authors have included normal baseline variability in addition to accelerations as an indicator of reactivity, since it has been shown to increase the diagnostic value.

In the present series, out of 50 patients with high risk pregnancy who were screened with NST, 34 (68%) showed a reactive tracing, 6 (12%) showed a non-reactive tracing, 10 (20%) showed an abnormal tracing. Tandon S.N. in their study on 100 high risk cases reported reactivity of 74%, 6% non reactive and 20% abnormal test. (11) The reason for higher incidence of non reactive test in this series may be that the authors have not used vibro acoustic stimulation.

In this series in the group of patients subjected to Doppler test, 28 (56%) of patients had normal S/D ratio, 15 (30%) had elevated S/D ratio, 5 (10%) had AEDFV and 4% patients had REDFV. Findings were similar to the study conducted by Trudinger B.J. et al. (12) Out of these 50 doppler values in the present series, no equivocal result was obtained. In study done by Williams et al (10), 17% patients had equivocal doppler result and required measurement of amniotic fluid while 45 patients in NST group in this series had equivocal result requiring amniotic fluid index measurement.

Out of 34 patients with a reactive NST 25 underwent cesarean section. Among the patients with non reactive / abnormal NST 3 (18.75%) delivered vaginally while 13 (81.25%) had cesarean section.

In the present study the authors found that out of all the patients with reactive NST 73.52% patients has normal vaginal delivery and only 16.66% of patient with non reactive NST had vaginal delivery. Sood A.K. (8) in his study found that 81.1% patients with reactive NST and 68% with non reactive NST had vaginal delivery.

The authors found an overall increase in the rate of cesarean section as the result of NST worsened. It was seen that 26.48% of patient with reactive NST had LSCS in this study while Sood A.K. (8) found that 18.9% patients with reactive NST had cesarean section. In this study 80% of the patients with abnormal NST and 83% patients with non reactive tracings had LSCS which is very much higher than Sood A.K. (8) findings of 32% cesarean section rate in non reactive NST cases.

About 50% of the neonates of patients with non reactive or abnormal NST required NICU admission while only 5.88% of neonates in the reactive group required NICU admission. These findings were similar to the study of Jensen

O.H.R. (13) done on 94 high risk women. In the study done by Sood A.K. (8) on 240 high risk women found that non reactive pattern was associated with statistically significant increase in incidence of NICU admission.

About 37.5% of newborn were SGA in the groups of mother with non reactive or abnormal tracing on NST, while 17.64% of newborn were SGA in women with reactive tracing. In the studies done by and Sood A.K. (8) there were 20% low birth weight babies in reactive group while 40% were newborn low birth weight in cases with abnormal / non reactive NST.

Passage of meconium is a potential warning of fetal asphyxia. If any test predicts asphyxia before passage of meconium then it may help in reducing perinatal morbidity. The authors found that 14% of patients with reactive NST had meconium stained liquor while 60% of those with non reactive or abnormal test had meconium stained liquor. Tandon SN et al⁷ in 1986 found meconium in liquor in 3% of reactive NST cases and 15% of non reactive NST patients.

Out of the 28 patients with normal S/D ratio 19 patients (67.85%) delivered vaginally, while 9 patients (32.15%) delivered by cesarean section. In the category of abnormal waveform (elevated S/D ratio, AEDFV or REDFV) there were 22 patients, out of which 6 (27.27%) had vaginal delivery, 15 (68.18%) had cesarean section and one patient had IUFD vaginal delivery (4.54%).

The authors found that incidence of cesarean section almost doubled in the abnormal waveform group (68.18%) as compared to normal S/D ratio group (32.15%), which is similar to the findings of Trudinger et al. 1991 (12).

Out of all the cesarean section done in the Doppler group in the present study 50% alone were due to fetal distress in labour and the rest

were elective. In the study of Trudinger B et al. 1991, (12) 70.63% LSCS were elective LSCS and 29.34% were emergency cesarean section.

Absence end diastolic flow velocity (AEDFV) in the umbilical artery is found to be frequently associated with fetal hypoxia, acidemia and poor perinatal outcome. Out of all the 50 patients with high risk pregnancy who were subjected to Doppler study 10% (5 patients) had AEDFV. 100% of these pregnancies had abnormal perinatal outcome. 80% of the patients in this group were SGA, 80% required admission to NICU, 40% neonates had Apgar <7 at 5 minute and there were 2 (40%) perinatal mortalities.

Rochelson et al in (14) studied the outcome of 10 fetuses with AEDFV between 31-36 weeks and compared them with 151 fetuses at similar gestational ages. He concluded that AEDFV heralds an adverse perinatal outcome. Fetuses with AEDFV weighed less, were delivered earlier, and required prolonged NICU admission. The results of the present study are comparable to the above studies.

When the resistance in the umbilical artery is in the extreme range with the development of reverse end diastolic flow velocity (REDFV), there is extremely high incidence of catastrophic pregnancy outcomes with perinatal mortality reaching to about 50%. (15) In the present study, two (4%) patients showed REDFV all of which had adverse perinatal outcome. Both these patients had SGA babies, both had low Apgar scores, one baby had NICU admission the other was IUFD baby as the relatives of the patients did not give consent for emergency cesarean section. The findings are similar to those of Brar et al. (15)

In 2003 Williams et al (10) conducted a randomized controlled clinical trial in 1360 women with high risk pregnancies comparing the non stress test with umbilical artery doppler

velocimetry. They found that the incidence of cesarean delivery rate for fetal distress was significantly lower in the Doppler group, compared with the NST (4.6% vs 8.7% respectively $P < 0.006$) with no increase in neonatal morbidity.

In the present study, the authors found the cesarean delivery rate for fetal distress to be 28% in the NST group and 24% in the Doppler group that does not tally with the findings of William et al. (10)

In the NST group 66% pregnancies had normal perinatal outcome while 60% of the high risk pregnancies subjected to monitoring by Doppler waveform analysis had normal perinatal outcome. This is similar to the findings of Williams et al. (10)

Probably the cause of higher incidence of LSCS in the Doppler group in this study was that as compared to NST group, less number of patients had normal velocity waveform indicating that more number of patients assigned to this group already had some level of utero-placental compromise at the time of entering into this study

Gramellini D et al (16) after analysis of a large number of studies in order to assess, the status of NST, found it to be less capable of predicting perinatal morbidity and mortality giving a diagnostic accuracy of 66% of non reactive NST. Doppler velocimetry study stands as a reference prognostic test of perinatal outcome giving it a diagnostic accuracy of 92.5%.

In the present study it was found that the probability of having fetal distress is lesser in the Doppler group as compared to the NST group. (0.823 times that of NST group)

CONCLUSION

In the present study the authors tried to compare the non stress test with the umbilical artery Doppler velocimetry in screening for fetal well being in a high risk pregnant population . Recognition of fetal compromise was better in the Doppler group as compared to NST. On the other hand, doppler velocimetry is a good predictor of perinatal outcome in high risk pregnancies. It allows the identification of fetuses at risk of intrapartum hypoxia before the start of labour thus influencing obstetric management. Doppler stands out as a better screening test for high risk pregnancies as the proportion fetal distress in labour is less than that of NST group.

Acknowledgement: We acknowledge Radiology department team for supplying material and for carrying out this research.

REFERENCES

1. Fellows GF, Chance GW. High Risk Pregnancy: Detection and Management. *Canadian Family Physician*. 1982;28:1553-1557.
2. Hailu A, Kebede D. High-risk pregnancies in urban and rural communities in central part of Ethiopia. *East Afr Med J*. 1994 Oct;71(10):661-6.
3. Sun L, Yue H, Sun B, et al. Estimation of high risk pregnancy contributing to perinatal morbidity and mortality from a birth population-based regional survey in 2010 in China. *BMC Pregnancy and Childbirth*. 2014;14:338. doi:10.1186/1471-2393-14-338.
4. Preboth M. ACOG guidelines on antepartum fetal surveillance. *American College of Obstetricians and Gynecologists*. *Am Fam Physician*. 2000 Sep 1;62(5):1184, 1187-8.
5. Giles WB, Trudinger BJ, Baird PJ. Fetal umbilical artery flow velocity waveforms and placental resistance: pathological correlation. *Br J Obstet Gynaecol*. 1985 Jan;92(1):31-8.
6. Browne VA, Julian CG, Toledo-Jaldin L, Cioffi-Ragan D, Vargas E, Moore LG. Uterine artery blood flow, fetal hypoxia and fetal growth. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2015;370(1663): 20140068 . doi:10.1098/rstb.2014.0068.
7. Freeman RK, Garite TJ, Nageotte MP, Miller LA. History of fetal monitoring. Fetal heart rate monitoring (Eds: Freeman RK, Garite TJ). William & Wilkins, Baltimore. 1981:1-6.
8. Sood AK. Evaluation of Non-stress test in high risk pregnancy. *J Obstet Gynecol*. 2002;52:71-5.
9. Keegan KA, Paul RH et al. Antepartum fetal heart rate testing. The non stress test as a preliminary approach. *Am. J. Obstet. Gynecol* 1980 136(1) 75.
10. Willaims KP, Farguharson DF, Bebbington M. et al. Screening for fetal well being in a high risk pregnant population, comparing the non stress test with umbilical artery doppler velocimetry : A randomized controlled clinical trial. *Am. J. Obstet Gynecol* 2003 ; 188 (5) : 1366-1371.
11. Tandon SN, Rao GS, Vaidya PR. Antenatal electronic FHR monitoring in high risk pregnancies. *J. Obstet. Gynecol of India*. 1986 ; 36(5) : 868-872.
12. Trudinger BJ, Cook CM, Giles WB, Fong SNGE, Connelly A, Wilcox W et al. Fetal umbilical artery velocity waveforms and subsequent outcome. *Br. J. Obstet Gynecol*. 1991 (98) ; 378-384.
13. Rognerud Jensen OH, Guimaraes MS. Prediction of fetal outcome by Doppler examination and by the non-stress test. *Acta obstetricia et gynecologica Scandinavica*. 1991 ;70(4-5):271-4.
14. Rochelson BL, Schulman H, Fleischer A, Farmakides G, Bracero L, Ducey J, Winter D, Penny B. The clinical significance of Doppler umbilical artery velocimetry in the small for gestational age fetus. *American journal of obstetrics and gynecology*. 1987; 156(5):1223-6.
15. Harbinder S. Brar, Lawrence D et al. Reverse end diastolic flow velocity on umbilical artery velocimetry in high risk pregnancies. Am ominous finding with adverse pregnancy outcome. *Am. J. Obstet. Gynecol*. 1988 ; 159 : 559-561.
16. Gramellini D, Piantelli G, Verrotti C, Fieni S, Chiaie LD, Kaihura C. Doppler velocimetry and non stress test in severe fetal growth restriction. *Clinical and experimental obstetrics & gynecology*. 2000 (1):33-9.