

Original Article

Comparing Non-Stress Test versus Umbilical Artery Doppler Velocimetry among A sample of High-risk Pregnant Women in Erbil City

Rand Noori Hamad¹, Jwan Mohammed Sabir Zangana²

Abstract:

Background: The mainstay of care for lowering maternal and perinatal mortality and morbidity is antepartum foetal surveillance. Numerous techniques are used, including fetal movements, Vibroacoustic stimulation tests, contraction stress tests, biophysical profiles of the fetus, modified biophysical profiles, non-stress testing and Doppler Umbilical artery of the fetus's. The fetal heart reaction to internal and extrinsic stimuli is seen on electronic fetal monitoring devices. The benefit of high resolution dynamic ultrasonography and Doppler imaging is that it allows for the visualization of the fetus and its surroundings as well as the monitoring of fetal health by measuring utero-placental circulation.

Patients and techniques: The cross-sectional investigation including 120 pregnant women who visited the Maternity Teaching Hospital between 26 June and 31 August 2022 and complained of decreased uterine contractions have been included. The questionnaire included sociodemographic data, obstetrical data, information on the fetal outcome and method of delivery. In accordance with the American Academy of Obstetricians and Gynecologists, cardiotopography was utilized to conduct a non-stress test, and the outcomes were categorized as reactive and non-reactive. Cardiotopography was used to perform a non-stress test, and the results were classified as reactive or non-reactive in accordance with the American Academy of Obstetricians and Gynecologists. Also, during 32 weeks or more of gestation, the inferior vena cava was not compressed by the gravid uterus during ultrasonography of the umbilical arteries, which was performed in a semi-recumbent position with a slight lateral tilt.

Result: Based on NST and Doppler velocimetry of the umbilical artery, all cases were classified into two groups. The outcomes of the two tests didn't significantly differ from one another. The rate of Cesarean section (CS) was 46.1% among women with non-reactive (abnormal) CTG, compared with 25% among women with normal CTG ($p = 0.0316$). Only one neonate (1.3%) died among women with normal CTG, while none of the neonates died among women with abnormal CTG. The rate of CS among women with abnormal ultrasonography was 80% compared to women (11%) with normal ultrasonography. Furthermore, one neonate (2.1%) in the group of abnormal doppler, compared with 0% in the normal group.

Conclusion: NST and umbilical artery Doppler of are sensitive and specific tests with strong positive prognostic value to suggest a poor prognosis for the newborn. Doppler velocimetry of umbilical artery is more important than a non-stress test because it lowers the likelihood of a CS birth in non-reactive non-stress test situations without increasing the risk of perinatal morbidity and mortality.

Keywords: Non-stress Test, Doppler Velocimetry, pregnancy at a high risk, prenatal diagnosis

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Introduction:

Every mother hopes for a healthy child who will reach their fullest potential in both physical and psychological growth. High risk of pregnancy factors

is harmful to the mother's health or the life of her developing foetus. ^(1, 2), which involves medical illnesses like hypertension which is essential, kidney disease, thyroid disease, auto - immune disease,

1. M.B.Ch,B, KHCMS Trainee Family Medicine, Erbil/Iraq.
2. Department of Gynaecology and Obstetrics, College of Medicine, University of Diyala, Iraq.

Correspondence: Rand Noori Hamad, M.B.Ch,B, KHCMS Trainee family medicine, Erbil/Iraq, Email: rand.snsd90@yahoo.com

mother diabetes, and other circumstances that increase the risk to the fetuses include pregnancy prolongation, bleeding of vagina, fetus movement was decrease, protracted ruptured membranes, and restriction of intrauterine growth, disease, and multiple of pregnancies⁽³⁾. To identify foetuses that are healthy and those that are in threat, various antepartum surveillance techniques are performed with varying degrees of sensitivity and specificity. These methods include, a non-stress test and abdominal artery Using Doppler velocity⁽⁴⁾. Cardiotocography (CTG) is a non-invasive method for measuring the foetus's heart rate (FHR) and uterine activity. It's also referred to as electronic foetal monitoring⁽⁵⁾. Cardiotocography is the most commonly used indirect diagnostic method for monitoring of the foetus during pregnancy and labour, which has significantly decreased perinatal morbidity and mortality after the woman, is admitted to the labour ward. Due to limited resources, Cardiotocography is used as a diagnostic test to identify pregnant women who might need continuous electronic fetal observation during labor and impaired fetuses upon admission^(3, 6, 7). Later, the examination of the umbilical arteries with a Doppler ultrasound became a crucial clinical technique for identifying pregnant women who would experience negative pregnancy problems or outcomes^(8, 9). The benefit of Doppler ultrasound technique is quick, repeatable, and daily can be done⁽¹⁰⁾. Doppler sonography is used to measure the umbilical artery (UA) flow in pregnancy at third trimester to evaluate the fetus' health⁽¹¹⁾. unsuitable Dopple of umbilical artery is an indication of utero-placental insufficiency's, which limits growth of intrauterine⁽¹²⁾. Dopple of ultrasonography has been demonstrated to decrease perinatal mortality and morbidity, especially in high-risk obstetric situations and it is usefulness for identifying small pathological and naturally small foetuses^(9, 11-13). The middle cerebral artery (MCA) might be able to predict prenatal outcomes by variations in cerebral blood flow and its direction⁽¹⁴⁾. The objective of this research is to evaluate the effectiveness of non-stress and Dopple of umbilical artery measurements as a diagnostic test for assessing the wellbeing and outcomes of the developing foetus in high-risk pregnancies

Patients and Methods:

A cross-sectional investigation including 120 pregnant women who attended Maternity Teaching Hospital from 26 June 2022 to 31 August 2022 who complained from decreased foetal movements in a convenient type of sample study, the questionnaire included sociodemographic information's (age, residency, education, occupation) , obstetrical information's (gravidity, parity, abortion and GA, previous c/section), risk factor assessment (PROM, IUGR, DM, PE, gestational HTN, placenta previa, polyhydramnios, Eclampsia, Epilepsy, post-term pregnancy, thrombophilia) & fetal outcome & mode of delivery were collected.

All pregnant women underwent 2 methods for assessment of decreased fetal movement.

First method (non-stress test):

According to the ACOG, cardiotopography was used to classify non-stress test results as reactive or non-reactive. The reactive CTG contain the following features (baseline fetal heart 110-160 bpm , variability 5-25 bpm ,no decelerations , 2 or more accelerations in 20-30 minute)^(15, 16,17,18)

Second method (Umbilical artery Doppler):

Doppler ultrasonography of the umbilical arteries was carried out at 32 weeks or more of gestation using a semi-recumbent sitting with a modest lateral tilt to prevent inferior vena cava pressure by the gravid uterus^(18, 19, 20), and Both automatic and manual tracing were used to construct the spectral wave shape for the umbilical artery that was created⁽⁹⁾. Trans-abdominal ultrasound was used to measure indices of umbilical artery and the resistive index(RI).

The following formulas were used to calculate the frequency of peak systolic and diastolic end alteration:

$$RI = \frac{S-D}{S}$$

S is the maximum systolic speed. and the diastolic end flow is D.

If applicable, the cut-off thresholds were taken into account:

- RI less than 0.70 was regarded as normal
- RI greater than 0.70 was termed abnormal

Inclusion criteria: Singleton pregnancy, pregnant women at risk who are 32 weeks or more along

Exclusion criteria: Multifetal pregnancy, anaemia, congenital malformed foetus, and those who aren't at risk and pregnant women before 32 weeks of gestation.

Analysis of the Data:

The data were examined using the Statistical Program (SPSS, version 26) for Social Sciences. Chi square test was used to compare proportions of two groups. Fisher's exact test was used when the predicted frequency (value) in much more than 20% of the table's cells was less than 5. The same sample's proportions from two different tests were compared using test of McNemar. Statistically significant results revealed a P value (<0.05).

Results:

Out of 120 women, their age range was between 15 - 42 years, with a mean-age(SD) of 30.1(6.7)years and a median age of 31 years. A considerable proportion of them was either illiterate (20%) or can just read and write (19.2%). The majority of the women (52.5%) resided in Rural as revealed in table 1.

Table 1: Sociodemographic details groups under investigation

	No.	(%)
Age (years)		
< 25	30	(25.0)
25-34	55	(45.8)
≥ 35	35	(29.2)
Occupation		
Student	27	(22.5)
Non-governmental job	27	(22.5)
Governmental job	31	(25.8)
Housewife	35	(29.2)
Educational level		
Illiterate	24	(20.0)
Read and write	23	(19.2)
Primary	21	(17.5)
Intermediate	20	(16.7)
Secondary	19	(15.8)
Higher education	13	(10.8)
Residency		
Urban	57	(47.5)
Rural	63	(52.5)
Total	120	(100.0)

Two thirds (66.7%) of the women delivered prematurely (before 37 weeks gestation). Around two thirds of the women (67.5%) were multigravida women, and 51.7% were multiparous women.

Around half (43.3%) had history of abortion, and 36.7% had undergone Cesarean section previously. Only two women (1.7%) were smokers (Table 2).

Table 2: Obstetric and smoking history

	No.	(%)
Gestational age		
< 37	80	(66.7)
37-41	34	(28.3)
≥ 42	6	(5.0)
Gravida		
Primigravida G1	9	(7.5)
Multigravida G2-4	81	(67.5)
Grand multigravida	30	(25.0)
Parity		
Nulliparous P0	16	(13.3)
Primiparous P1	38	(31.7)
Multiparous P2-4	62	(51.7)
Grand multiparous P5	4	(3.3)
Abortion		
No	68	(56.7)
Yes	52	(43.3)
Previous Cesarean section		
Yes	44	(36.7)
No	76	(63.3)
Mother's smoking		
Yes	2	(1.7)
No	118	(98.3)
Total	120	(100.0)

The commonest risk factors were history of premature rupture of membrane (20%), history of gestational hypertension (15.8%), and history of diabetes mellitus (14.2%). The other risk factors are listed in Table 3.

Table 3: Classification of participants according to the risk factors

Risk factors	No.	(%)
History of premature rupture of membrane	24	(20.0)
History of gestational hypertension (PIH)	19	(15.8)
History of diabetes mellitus	17	(14.2)
History of pre-eclampsia	12	(10.0)
History of IUGR	12	(10.0)
History of placenta previa	11	(9.2)
History of polyhydramnios	6	(5.0)
History of epilepsy	6	(5.0)
Post term pregnancy	6	(5.0)

History of eclampsia	5	(4.2)
History of thrombophilia	2	(1.7)
Total	120	(100.0)

The degree of agreement between the CTG and doppler was 29.1%. The findings of the two tests did not significantly differ from one another (p=0.828), as expressed in table 4.

Table 4: CTG and Doppler results.

	Doppler			p
	Abnormal	Normal	Total	
Non -stress test (CTG)				
Non-reactive (abnormal)	3	41	44	
Reactive (normal)	44	32	76	0.828*
Total	47	73	120	
Agreement (3+32)/120 = 29.1%				

*By McNemar test.

The rate of Cesarean section (CS) was 46.1% among women with non-reactive (abnormal) CTG, compared with 25% among women with normal CTG (p = 0.0316). Only one neonate (1.3%) died among women with normal CTG, while none of the neonates died among women with abnormal CTG (p = 1.000) (Table 5).

Table 5: Mode of delivery and fetal outcome by CTG test results

	Non-stress test (CTG)			p
	Non-reactive (abnormal)	Reactive (normal)	Total	
	No. (%)	No. (%)	No. (%)	
Mode of delivery				
Normal vaginal delivery	41 (53.9)	33 (75.0)	74 (61.7)	

	Abnormal	Normal	Total	p
Cesarean section	35 (46.1)	11 (25.0)	46 (38.3)	0.0316*
Fetal outcome				
Alive	44 (100.0)	75 (98.7)	119 (99.2)	
Stillbirth	0 (0.0)	1 (1.3)	1 (0.8)	1.000**
Total	44 (100.0)	76 (100.0)	120 (100.0)	

* Chi square analysis. ** Chi square analysis.

Doppler abnormalities in women had an 80% CS rate, compared to 11% for women with normal umbilical artery Doppler (p<0.001). Only one neonate (2.1%) in the group of abnormal Doppler, compared with 0% in the normal group (p = 0.392) (Table 6).

Table 6: Mode of delivery and fetal outcome by doppler test results

	Doppler results			p
	Abnormal	Normal	Total	
	No. (%)	No. (%)	No. (%)	
Mode of delivery				
Normal vaginal delivery	9 (19.1)	65 (89.0)	74 (61.7)	
Cesarean section	38 (80.9)	8 (11.0)	46 (38.3)	< 0.001*
Fetal outcome				
Alive	46 (97.9)	73 (100.0)	119 (99.2)	
Stillbirth	1 (2.1)	0 (0.0)	1 (0.8)	0.392*
Total	47(100.0)	73(100.0)	120(100.0)	

* Chi-Square analysis. ** Fisher's exact test.

Discussion:

A healthy utero-placental circulation must be developed for both mother and fetus to have a normal result. The most significant improvements had make in the evaluation of fetuses at hypoxia risk and placental insufficiency which may lead to death ⁽¹⁵⁾.

The present study found that the results partially agreed with (4), which revealed that, the NST group's mean age was 29.15 ± 2.22 years, with range of 25 to 34 years, On the other hand, the ultrasonography of Doppler groups mean age was 28.99 ± 3.98 years, with ranges of 24-35 years. Both Educational level were Illiterate and higher education (30% and 30%), respectively. But most of the patients' lives in rural area (NST group (56%) and doppler groups (60%)). Regarding the baseline sociodemographic data, it was observed that there were no differences between the two groups. As well as, ⁽¹⁶⁾ which revealed that, the mother educational school 253 (63.25%) was under high school but 147 (36.75%) mothers were below high school. Furthermore, (9) expressed that, the study involved 200 pregnant women, 108 normal/low-risk and 92 high-risk pregnancies. Participants' ages ranged from 31.5 ± 4.36 years on average, with 30 to 34 years being the modal age group (40.5%).

The statistical analysis in the current study expressed that, Parity and gravidity do not statistically differ from one another. The result agreed with ⁽¹⁷⁾ which revealed that, 50 patients with GDM who were pregnant were evaluated. The mean ages were 31.5 ± 6 years, gestational age was 31.5 ± 6 years, and birth weight was 3555 ± 343 grams. Furthermore ⁽¹⁸⁾ which showed that, Regarding parity or gravidity, there were not statistically significant variations between the two groups. As well as, ⁽¹⁹⁾ who found that, Regardless of parity, there is no discernible effect on the unfavorable perinatal outcome. On the other hand, ⁽²⁰⁾ found that the likelihood of an unfavorable intrapartum occurrence was higher in nulliparity. Pre-eclampsia, dystocia by shoulder, CS, large gestational age, and premature birth are all more common in women with GDM. ⁽²¹⁾ Identification of fetuses at risk for negative outcomes, as well as a reduction in fetal morbidity and perinatal death, are the main objectives of fetal surveillance ⁽²²⁾.

The commonest risk factors were history of premature rupture of membrane history of gestational hypertension, and DM history, respectively, while, history of thrombophilia was found as a lowest rate of risk factor. The result agreed with (4) which showed that, the common risk-factors in the ultrasonography Doppler group were D.M. (23%), preeclampsia(14%), and IUGR (14%) while the most common risk-factors in the NST group were D.M.

(22%), labor preterm(18%), and membrane rupture of premature(14%). It was noted that, the variations between the two groups' risk variables were negligible. Conditions that impair pregnancy and need for extra methods of fetal well-being assessment may occur. These disorders include fetal health-related diseases, pregnancy-specific issues, and maternal health issues that could have an impact on fetus. Hypertension, renal disease and disease of autoimmune, and disease of thyroid are among the mother's medical conditions that are linked to an elevated risk to the fetus ^(23, 24). Moreover, pregnancy of prolongation, bleeding of vagina, fetal movement was decreased, and protracted membrane ruptures throughout pregnancy all increase the risk to the fetus' health ^(25, 26).

There were no clear differentiation between the CTG and doppler data ($p = 0.828$). The result correlated with ⁽²⁷⁾ showed that, Reactive test incidence was 85%, whereas non-reactive NST incidence was 15%. The prevalence of non-reactive NST increases with increasing gestational age. It is discovered that postdatism (gestation > 40 weeks) plays a significant role in non-reactive NST. As well as, ⁽¹⁷⁾ expressed that, unfavorable neonatal outcomes are better predicted by the NST than by the UA Doppler test. Furthermore ⁽²⁸⁾ revealed that, both tests (umbilical artery of ultrasonography and non stress) has been normal, The majority of pregnancies were properly carried to term. Similarly, when NST was nonreactive but Doppler was normal, there were only 7% of premature births. On the other hand, 53% of cases with abnormal Doppler and NST results were discontinued before term, indicating that adverse outcomes are more prevalent in this group. Despite Doppler being aberrant but NST are still reactive, 50% of Group IIB pregnancies might be carried to term. The CS rate was higher among women with non-reactive (abnormal) CTG, compared with among women with normal CTG ($p = 0.0316$). Only one neonate died among women with normal CTG, while none of the neonates died among women with abnormal CTG. The result correlated with ⁽²⁷⁾ which revealed that, terms of the maximal vaginal delivery in the Reactive groups, the method of successfully was linked to the non stress test findings. The rate of CS is somewhat greater in non reactive test. Certain indicators of fetal outcome are poor, such as alcohol stained meconium. Furthermore, ⁽²⁹⁾ revealed that,

Overall, in our study, the CS rate was higher (88.46% versus 60.22%) in the non reactive group while the delivery of vaginal rate was significantly higher (39.78% versus 11.54%) in the reactive group. On studying, relationship was not seen when specific maternal risk factors were examined. High risk women had a higher CS rate even with a reactive NST at admission. This may be due to the fact that the timing and method of pregnancy termination in high-risk women varied on maternal disease, its development, severity, and fetal affection, not just on the NST's reactivity at admission. ⁽³⁰⁾ Showed that, computerized analysis of fetal heart tracings, reactive NST indicates a healthy fetal state and ensures delivery of vagina in the absence of other concerns. Absence of accelerations or episodes of substantial variation at 24-28 weeks of gestation is not considered abnormal. On the other hand in this study the rate of CS was significant among women with abnormal Doppler in comparison to women with normal Doppler ($p < 0.001$). The result agreed with ⁽³¹⁾ which reported that, 70.3% of patients with abnormal Doppler of UA which gave delivery via CS, as opposed to 32.3% of those with normal Doppler of UA. Most CS (29.7%) in the group of women with abnormal Doppler were carried because of absences and/or reversed diastolic end (AEDV/REDV), and 21.6% were performed because of NRFHR, as opposed to 18.02% of CS performed for NRFHR in women with normal UA. Comparatively to the result, 11.3% of IUGR with normal Doppler and approximately 29.7% of the abnormal Doppler group had hypertension. The results of earlier research support this ^(32, 33). Demonstrated that, lower rates of cesarean births due to fetal distress, more successful labor inductions, fewer NICU admissions, and a higher Apgar score in pregnant of high risk populations who complain of fetal movement was decrease as compared with non-stress tests.

Concerning neonatal mortality in this study, only one neonate (2.1%) in the group of abnormal Doppler was stillbirth, compared with 0% in the normal group ($p = 0.392$) the result agreed with ⁽³¹⁾ which showed that, 15(8.8%) neonates in total die, 24.3% of whom had abnormal ultrasonography as compare to normal Doppler (4.5%). This means that neonates with aberrant Doppler studies had a fourfold increased risk of developing END. This discover was a little greater as compared to previous relevant studies ^(34, 35). This

could be as a result of the disparity in neonatal care standards between various nations and institutions, as preterm infant care is poor (low and middle) income countries ^(36, 37). In contrast to the abnormal UA group, which had none, the normal UA Doppler group reported just one stillbirth and the variation is insignificant, and it is likely due to intrapartum care and the varied thresholds that healthcare professionals utilize for surgical fetus intervention with Doppler normal and abnormal in labor. Both the method of birth and the existence of hypertension were unrelated to the outcomes of the perinatal period. However, newborns born at gestational ages under 34 weeks had a higher likelihood of needing NICU hospitalization, developing distress of respiration, and neonatal death. There was perinatal morbidity and death related to premature birth, which is consistent with data from other studies. ^(38, 39).

Conclusion:

NST is still important for fetal monitoring because it is a commonly used test that measures brain oxygenation and it is simple to use and is inexpensive. Both tests (NST and ultrasonography Doppler) are sensitive and specific assays with high positive predictive value for foretelling unfavorable newborn outcomes. Doppler of umbilical artery is important than a non-stress test because it lowers the incidence of a CS in non-reactive non-stress test cases without increasing the perinatal rate of morbidity and mortality.

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