



ORIGINAL RESEARCH PAPER

Radiodiagnosis

CORRELATION OF ANTENATAL DOPPLER AND NON STRESS TEST IN 3RD TRIMESTER PREGNANCIES(A STUDY OF 100 PATIENTS)

KEY WORDS: Doppler , Amniotic fluid, Placental insufficiency, Fetal heart rate, preeclampsia, Non stress test

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ABSTRACT

The most common methods of antepartum surveillance of fetal health are amniotic fluid index (AFI), the biophysical profile (BPP), the non stress test (NST) and the antenatal Doppler ultrasound examination. It has been suggested that the best prediction of perinatal outcome can be obtained by combined biophysical and hemodynamic evaluation. Doppler ultrasound complements these methods of maternal-fetal assessment to more precisely determine the degree of fetal compromise and help in the management of these pregnancies based on the presence or absence of vasculopathy. It determines the need to deliver the fetus or not with more precision. It is also used to evaluate the presence and degree of fetal anemia. Non stress test (NST) is a non invasive method to identify fetal wellness. It comprises continuous electronic monitoring of the fetal heart rate along with recording of fetal movements. There is an observed association of fetal heart rate acceleration with fetal movements, which when present, indicates a healthy fetus. In this present study, the correlation of antenatal Doppler and non stress test is determined to know the usefulness of each of these parameters for evaluation of 3rd trimester pregnancies.

I. INTRODUCTION

The Doppler Effect, first described by Christian Doppler in 1842, describes the apparent variation in frequency of a light or sound wave as the source of wave approaches or moves away from the observer. Doppler is a safe, reliable and reproducible way to image and make measurements of normal and abnormal flow in arteries and veins. Doppler ultrasound allows for a non-invasive examination of utero-placental and fetal circulation and helps in evaluation and management of fetuses at risk of hypoxia and acidosis secondary to placental insufficiency. In normal gestation, there is invasion of trophoblastic cells into the media of the spiral arteries of uterine artery which leads to dilatation and tortuosity of spiral arteries. Hence more blood reaches to the developing fetus. While in case of pre-eclampsia, there is failure of invasion of trophoblastic cells beyond spiral arteries. So spiral arteries remain contracted and less blood will reach to the developing fetus. Hence there is increased incidence of fetal growth retardation in patients with pre-eclampsia.

II. AIMS AND OBJECTIVES

1. To perform antenatal doppler study and non stress test in high risk patients and establish correlation between them.
2. To compare efficacy of antenatal doppler study and non stress test in 3rd trimester pregnancies.
3. To define better modality, between antenatal doppler study and non stress test, for early prediction of adverse perinatal outcome in normal as well as in pre-eclampsia patients.

III. MATERIALS & METHODS

This is a prospective observational study conducted from May 2010 to November 2012 in our Department of Radiology. A total of 100 singleton pregnancies were studied. All patients were evaluated first by gray scale ultrasound. Fetal biometry which includes biparietal diameter (BPD), abdominal circumference (AC) and femur length (FL) were measured and fetal weight was estimated according to Hadlock's

formula. AFI was calculated by adding the vertical depths of the largest pocket of liquor in each of the uterine quadrants, free of umbilical cord loops. Uterine artery, umbilical artery and fetal MCA waveform were taken in all patients. The waveform of ductus venosus was studied when there was increased resistance in umbilical artery with increased diastolic flow in MCA. Expected date of delivery was calculated by Naegle's formula (EDD = LMP + 9m7d). The pregnancies were followed up and data were collected regarding mode of delivery, gestational age at birth, birth weight, 5-min Apgar score, number of intrauterine and perinatal deaths, neonatal complications and admission to NICU along with its duration.

INCLUSION CRITERIA:

Pregnancies beyond 28 weeks (3rd trimester) which were referred to us for antenatal Doppler were selected.

EXCLUSION CRITERIA:

Pregnancies with congenital anomalies, dysmorphism or multiple gestations were excluded.

1. EXAMINATION TECHNIQUE FOR DOPPLER EXAMINATION

The patient lies in supine position with a slight lateral tilt to prevent supine hypotension due to caval compression. Measurements were taken when fetus was in quiet resting and apneic state. The patient was examined by the trans-abdominal approach using the 3.5-5 MHz curvilinear transducer on Toshiba Color Doppler machine.

A. Fetal Biometry: Gray scale B-mode imaging was used to measure and record the biometric parameters (BPD, FL, AC and estimated fetal weight), amount of liquor (AFI) and site and grading of placenta.

B. Doppler Vascular Study: Velocities and indices were recorded in addition to examining the waveform subjectively for presence of notches and absence or reversal in diastolic flow velocities. Doppler waveform recordings were obtained

from the individual vessels as follows-

a. Uterine Artery- Color flow imaging was used to identify the bifurcation of the common iliac artery in longitudinal section. The transducer was moved medially and angled towards the symphysis pubis to reveal the uterine artery just medial to the bifurcation, as it ascends towards the uterus. The sample gate was placed at the level of maximum color brightness close to the bifurcation.

b. Umbilical Artery- With the help of color flow imaging, a free floating portion of the umbilical cord was identified and the sample gate placed over one of the arteries. The angle between beam and direction of flow was kept under 35°.

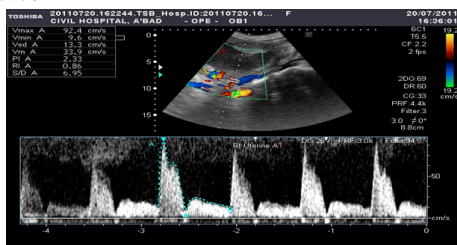
c. Middle Cerebral Artery- From the BPD section, the transducer was moved towards the base of skull at the level of lesser wing of the sphenoid bone. The sample gate was placed on the M2 segment with an insonation angle less than 10°.

d. Ductus Venosus- Ductus venosus was seen as a small vessel running from portal sinus to junction of inferior vena cava at the level of intrahepatic portion of the umbilical vein. It was identified by its high velocity flow and color turbulence. It can be seen in its full length in a mid sagittal longitudinal section of the fetal trunk.

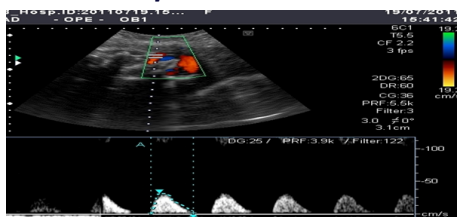
INTERPRETATION OF DOPPLER FINDINGS^{1,2,3,4}

Doppler study was considered abnormal when-

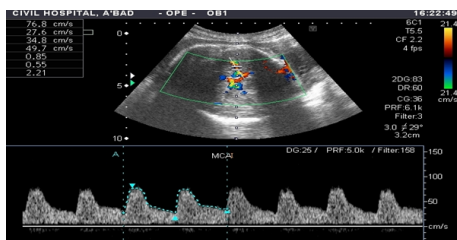
- a. Uterine artery having bilateral diastolic notches or mean RI>0.56.
- b. Uterine artery S/D ratio>2.6 on the side of placenta. In a central placenta, mean of two sides were considered.²
- c. Uterine artery PI>1.45 on the side of placenta. In a central placenta, mean of two sides were considered.
- d. Umbilical artery PI>1.5.
- e. Umbilical artery S/D ratio>3.
- f. Middle cerebral artery PI<1.45.
- g. Cerebroplacental ratio (MCA/UA PI ratio) <1.
- h. Ductus venosus having absent or reversed frequencies in 'a' wave.



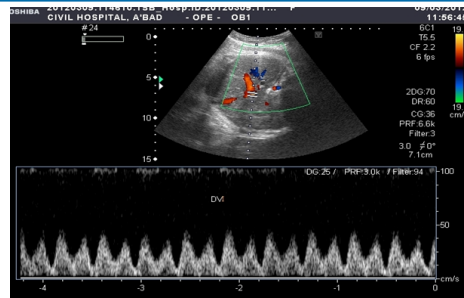
Deep Early Diastolic Notch With Reduced Diastolic Flow In Right Uterine Artery At 33 Wks



Absent End Diastolic Velocity In Umbilical Artery At 30 WKS



Brain Sparing Effect, Increased Diastolic Flow In Mca At 28WKS



DEEP 'a' WAVE IN DUCTUS VENOSUS WAVEFORM

1. EXAMINATION TECHNIQUE OF NON STRESSTEST^{5,6,7}

- a. A nonstress test (NST) measures the fetal heart rate in response to the fetus' movements. Generally, the heart rate of a healthy fetus increases when the fetus moves.
- b. The NST is usually performed in the last trimester of pregnancy. The mother lies down and has a belt placed around her abdomen with a transducer positioned over the fetal heartbeat, called an external fetal heart rate monitor. The fetal heart rate is recorded on the monitor and on a paper printout.
- c. The mother pushes a button on the monitor each time she feels fetal movement. This places a mark on the paper printout. Testing usually lasts for 20 to 40 minutes.
- d. Sometimes, the testing occurs during a fetal sleep cycle, when there is little fetal movement. A special acoustic (sound) device is sometimes used to awaken the fetus.

INTERPRETATION OF NON STRESSTEST^{5,6,7}

The non stress test is considered

- a. **Reactive:** If there are two or more fetal heart rate accelerations of more than 15 beats per minute above the base line and longer than 15 seconds in duration are present in a 20-minute observation, with or without fetal movement discernible by the woman.
- b. **Non reactive:** Non reactive stress test lacks sufficient fetal heart rate accelerations over a 40-minute period.
- c. **Equivocal:** Findings in between the above mentioned two criteria.

2. ADVERSE OUTCOME PARAMETERS

- a. Fetal demise (IUD/ Stillbirth).
- b. Neonatal death within 30 days.
- c. 5min Apgar score<7.
- d. Admission to NICU>24 hours.
- e. Cesarean section for fetal distress.

I. RESULTS AND DISCUSSION

In our study, 100 patients were included. Out of these 100 patients, 65 patients had pregnancy induced hypertension while 35 patients were without signs and symptoms of pregnancy induced hypertension; however some were having other complications like gestational diabetes, HIV positive status, associated neuro fibromatosis or polio etc. Most common age group is 21-25 years followed by 26-30 years. Out of 100 patients, 49 patients were primipara while 28 patients were first gravida. 46 patients out of 100 had no complaints and came for routine check-up. Next common clinical complaints were abdominal pain and pedal edema.

In the present study, 50% of the patients had undergone lower segment caesarean section while 46% of the patients had undergone full term vaginal delivery. Most common indication for lower segment caesarean section (LSCS) was previous history of LSCS followed by fetal distress.

In present study, most of fetuses were full term within the range of 34-37 weeks of gestational age. The next most common study group of fetuses were pre term within the range of 30-33 weeks of gestational age. 38% of neonates had birth weight within the range of 2.1-2.5 kgs, while 22% of

neonates had birth weight within the range of 2.6-3 kgs.37% of the neonates had been admitted in NICU for more than 1 day as a perinatal complication while 35% of neonates had APGAR score <7.82 neonates out of 100 survived while 18 neonates had perinatal death. Out of these 18 neonates, 6 neonates had still birth while 12 neonates died during the neonatal period Out of 100 patients, 65 patients were having pregnancy induced hypertension while 35 patients were not having pregnancy induced hypertension.

All patients undergone both antenatal doppler study and non stress test. It is evident from below that when both these studies are abnormal, the chances of adverse perinatal outcome were both high.

Table 1: Incidence Of Abnormal Doppler Findings (ADF)

	N	PERCENTAGE
Pt WITH ADF	36	36
Pt WITHOUT ADF	64	64
TOTAL	100	100

36% of the patients were having abnormal findings on antenatal doppler study, while 64% of patients were having normal findings on antenatal doppler study.

Table 2: Incidence Of Abnormal Non Stress Test (NST)

NON STRESS TEST	N	PERCENTAGE
REACTIVE	95	95
NON REACTIVE OR EQUIVOCAL	5	5
TOTAL	100	100

95% of patients were having normal or reactive non-stress test findings while 5% of patients were having non reactive or equivocal non-stress findings.

Table 3: Correlation Of Pregnancy Induced Hypertension (PIH) And Abnormal Doppler Findings (ADF)

	PT WITH ADF	PT WITHOUT ADF	TOTAL
Pt WITH PIH	33(50.76%)	32(49.24%)	65
Pt WITHOUT PIH	3(8.57%)	32(91.42%)	35

33 (50.76%) patients with PIH had abnormal doppler findings while remaining 32(49.24%) patients had normal doppler findings.3 (8.57%) patients without PIH had abnormal doppler findings.The reason for these findings may be due to confounding factors like gestational diabetes or PLHA status of mother which may be responsible for abnormal doppler findings.

Table 4: Correlation Of Pregnancy Induced Hypertension (PIH) And Abnormal Non Stress Test (NST)

	REACTIVE NST	NON-REACTIVE OR EQUIVOCAL NST	TOTAL
Pt WITH PIH	60(92.3%)	5(7.7%)	65
Pt WITHOUT PIH	35(100%)	0(0%)	35

60 (92.3%) patients with PIH had reactive non stress test while 5(7.7%) patients with PIH had non-reactive or equivocal non stress test. 35(100%) patients without PIH had reactive non stress test.

Table 5: Correlation Of Abnormal Doppler Findings (ADF) And Abnormal Non Stress Test (NST)

	REACTIVE NST	NON-REACTIVE OR EQUIVOCAL NST	TOTAL
Pt WITH ADF	32(88.88%) (Group B)	4(11.12%)(Group D)	36
Pt WITHOUT ADF	63(98.43%) (Group A)	1(1.57%)(Group C)	64

32(88.88%) patients having abnormal doppler findings were associated with reactive non stress test. 4(11.12%) patients

had both non-reactive or equivocal non stress test and abnormal Doppler findings. Only 1(1.57%) patient had non-reactive or equivocal non stress test, but had normal doppler findings.

The study population was divided into four groups:

- Group A (N=63): Reactive NST and normal doppler findings.
- Group B (N=32): Reactive NST and abnormal doppler findings.
- Group C (N=1): Non-reactive NST and normal doppler findings.
- Group D (N=4): Non-reactive NST and abnormal doppler findings.

Table 6: Correlation Of Adverse Doppler Findings (ADF) And Adverse Perinatal Outcome

STUDY GROUPS	TOTAL NO. OF PATIENTS	ADVERSE PERINATAL OUTCOME PRESENT	PERCENTAGE (%)
A	63	23	36.5
B	32	16	50
C	1	1	100
D	4	4	100

Here group A is associated with adverse perinatal outcome in 36.5% of cases. Group B is associated in 50% of cases while group C and group D were associated with adverse perinatal outcome in 100% of cases.

However, among antenatal doppler and non stress test, antenatal doppler was proved to be more reliable and helpful in management of the patients with pregnancy induced hypertension.

Approximately 50.76% of the patients with pregnancy induced hypertension had abnormal doppler findings while only 7.7% of the patients had non-reactive or equivocal non stress test. This emphasises the importance of antenatal doppler.

When non stress test was non-reactive or equivocal (Group C & D), then perinatal outcome of those pregnancies was adverse in all the cases. But when there were abnormal doppler findings and reactive non stress test (Group B), and then there were 50% incidences of adverse perinatal outcome.

So when abnormal doppler findings were seen in patients with or without pregnancy induced hypertension, those patients should be followed up closely for early changes of fetal growth retardation.

Exact lead time was not calculated in this study; however it had been observed that doppler study detects changes of pre-eclampsia earlier than non stress test. This earlier detection of changes is very important because during this time, babies can be delivered or steroid prophylaxis can be given to preterm fetuses to achieve lung maturity and perinatal outcome can be improved.

The hemodynamic changes picked up by doppler occur in the compensatory phase of growth restriction. Fetal heart rate abnormalities occur much later in the decompensation phase, which is a late sign of fetal compromise.

When non stress test shows non reactive fetus but other growth parameters like antenatal doppler, liquor, feta biometry are within normal limits, then management of those fetuses do not differ on the basis of non reactive NST alone. But if antenatal doppler findings show brain sparing effect or deep 'a' wave in ductus venosus waveform or pulsations of the umbilical vein, then it indicates necessity of urgent appropriate management in form of termination of pregnancy

to avert or reduce adverse perinatal outcome.

I. CONCLUSION

Antenatal doppler study detects sequential changes of fetal adaptation to placental insufficiency earlier than non stress test. Abnormal doppler study is more specific than non stress test in prediction of adverse outcome and it helps in decision making regarding the termination of pregnancy than non stress test. Antenatal doppler study complements the biophysical methods of fetal surveillance to determine earlier and more precisely the degree of fetal compromise and aids in deciding the appropriate timing of delivery.

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