ORIGINAL RESEARCH

Efficacy of color doppler sonography in prenatal assessment for low and highrisk pregnancy outcome

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ABSTRACT

Background: High-risk pregnancies are associated with a number of adverse perinatal outcomes. Doppler ultrasonography has shown to be a valuable obstetric technique for over 30 years. **Aim**: The purpose of this study is to ascertain the role that color Doppler plays in the prenatal diagnosis of both high-risk and low-risk pregnancies. **Methods**: 216 pregnant women participated in a one-year retrospective observational study that was carried out on women between the ages of 20 and 40 who were carrying a singleton pregnancy with a gestational age of 26 weeks to term were included in the study. The study model included both normal variations and some fetal abnormalities. Both mother uterine arteries, the umbilical artery, and the fetal middle cerebral artery (MCA) were imaged using Doppler. Records were kept of the obstetric history and the delivery. Regular checks were performed on the patients. **Result**: color 216 pregnant women with a single fetus at 26 weeks were evaluated using a Doppler scan. The prevalence of high-risk pregnancies was higher among women aged 31 and above. Pregnancy-induced hypertension was the most prevalent high-risk factor throughout pregnancy.Anomalies were discovered in 75 fetuses out of 216 Doppler images. Fifteen of the fetuses died before term, while sixty survived. A prenatal color Doppler scan showed that there were eight (10.66%) occurrences of intrauterine growth retardation and a diastolic notch in the uterine artery.Out of all abnormality scans, cardiac dysrhythmia was determined to be the least common, at 3 (4%). **Conclusion**, Doppler is a valid diagnostic technique for identifying fetal abnormalities in high-risk pregnancies. It offers helpful direction and prompt action to enhance fetal outcomes.

Keywords: Colour Doppler, Ultrasound; High-Risk Pregnancy; Perinatal Scan, Fetal Outcome.

INTRODUCTION

The anomaly scan, also known as the anatomy scan, 20-week ultrasound, or Level 2 ultrasound, is a prenatal ultrasound performed between 18 and 22 weeks of gestation. This ultrasound is recommended by the International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) as part of routine prenatal treatment. The ultrasound is used to measure the fetus in order to uncover growth issues early in pregnancy, as well as congenital malformations and multiple pregnancies (such as twins).[1] A blood flow map is superimposed onto a typical two-dimensional image to identify a particular blood artery and sample its blood velocity using a color doppler.[2]

A developing fetus's morphology can be examinedand overall foetal health with the use of an abnormality scan.Standard anatomy scans typically include the following: placental appearance, including the location of the umbilical cord insertion, amnionic fluid volume, gestational age assessment, estimated foetal weight, cardiac activity, foetal number, including the number of amnionic sacs and chorionic sacs for multiple gestations, and foetal position in relation to uterus and cervix. Furthermore, the uterus, tubes, ovaries, surrounding normal tissues, and the fetal anatomical survey were evaluated using a color Doppler scan.[3,4]

Searching for certain predefined structural abnormalities and soft indications is the basis of trimester ultrasound screening for aneuploidy, including Patau syndrome and Edwards syndrome. The prevalence of soft markers, or anatomical abnormalities, is higher in aneuploid fetuses than in

euploid ones. These markers are not clinically significant and often do not have adverse consequences on pregnancy outcomes.[5]

Commonly examined anomalies on a color Doppler scan include anencephaly, maxillofacial clefts, diaphragmatic hernia, gastroschisis, ophelecele, congenital heart defect, renal agenesis, spina bifida, osteochondrodysplasia, Edwards syndrome, and patau syndrome.6. Both the fetal and placental circulation can be assessed to help diagnose and monitor serious conditions such twin-to-twin transfusion syndrome (TTTS), foetal growth restriction (FGR), and foetal anemia.[6]

More recently, Doppler has been utilized in the screening procedure for conditions including aneuploidy and pre-eclampsia. Doppler ultrasonography exams of the ductus Venosus (DV), middle cerebral artery (MCA), uterine artery, and umbilical artery (UA) are often used in obstetrics. Aortic isthmus, atrioventricular valve, and umbilical vein (UV) Dopplers are more specialized and rarely performed.[7]

The placement of the placenta is recorded, especially if it is lateral, and the two arteries are examined and documented. There is no advantage to repeating the examination after an abnormal trace is discovered; in high-risk patients, an aberrant trace provides a limited predictive value for severe SGA. Uterine artery A common screening method for high-risk patients is Doppler testing. Preeclampsia or intrauterine growth retardation (IUGR) are potential outcomes of this type of pregnancy detection. Between weeks 20 and 24 of pregnancy is when this is often done. A sample from the uterine artery is obtained in order to analyze the spectral Doppler waveform.[8]

The umbilical artery's pulsatile blood flow is regulated by the fetal heart rate. In a normal pregnancy, forward flow occurs in both the diastole and the systole, with no impediment to flow. Doppler ultrasound, thus, offers a non-invasive way to assess the mother's and the fetus's circulation and guide therapeutic treatment. Investigating the prenatal use of color Doppler in evaluating both normal and high-risk pregnancies is the goal of this study.

MATERIAL AND METHODS

For the research, 216 pregnant women between the ages of 20 and 40 were chosen. All research participants were singleton pregnant, meaning their gestational ages were 26 weeks to term. The age range of the patients was 20 to 70. The institutional ethics committee gave its approval before the probe began.

A Performa was pre-designed to capture pertinent information, such as clinical findings, patient history, and investigative reports from certain cases. The ultrasonic scanning was performed using a convex transducer running at 3.5 MHz. The patient was in the supine position, exposing the whole abdomen from the isthmus to the inguinal region.To create scans, the transducer was positioned both longitudinally and transversely.

Measurements were made in the plane with the biggest cross-sectional area. The slow frame rate, low pulse repetition frequency, narrow gate, low wall filter setting, and high Doppler gain were used for the color Doppler evaluation of the cervical nodes in order to maximize Doppler sensitivity and detect even minimal flow in the fetal vasculature.

Waveforms of Ductus Venosus:

- S wave: represents the systolic contraction of the foetal ventricle
- D wave: represents early ventricular diastole in a foetus.
- A wave: represents an atrial contraction in the foetus.

A transverse oblique plane or a mid-sagittal plane can pass through the fetal abdomen thanks to the probe's ideal positioning, which also prevents fluid from the fetal inferior vena cava from polluting the ductus Venosus. This enables the location of the umbilical vein's entry into the ductus Venosus to be sampled. As motionless as possible is required for the fetus. The middle cerebral artery Doppler: Applying the color box makes the Circle of Willis and major cerebral arteries apparent when the fetal head is sliced transversely (MCAs). In the proximal MCA, the sampling gate is placed to obtain the Doppler wave form.

The two very skilled doctors who were previously mentioned looked back at each picture.Together, they blindly analyzed the images. For statistical analysis, Microsoft Excel 2010 and the SPSS software trial version 21.0 were utilized. We determined the standard deviation and mean.

RESULTS

In retrospect, the two extremely skilled doctors who had previously been mentioned looked at each picture. Together, they blindly analyzed the images. Data was analyzed and arranged properly. A statistical analysis was performed. The mean and standard deviation were calculated to ascertain the prevalence of fetal developmental problems and genetically deficient anomalies.

Table 1 gives specifics on the three age groups. 14 (21.875%) of the 64 (29.63%) pregnant women in Group 1 who were between the ages of 20 and 25 had scans that showed abnormalities in the fetus. Out of 80 (37.03) pregnant women in Group 2 (aged 26–30), 23 (28.75%) had scans that revealed a foetal abnormality. Of the women in Group 3 (over 31 years old), 72 (33.34%) became pregnant, and 35 (48.61%) of them had scans that revealed foetal abnormalities. The first age group had the fewest foetal abnormalities, whereas the third age group had the most. This indicates that the prevalence of foetal abnormalities rose along with age.

Table 2 listed vascular issues, such as uterine, middle cerebral, and umbilical arteries, along with growth

abnormalities, heart anomalies, genetic illnesses, and other deformities. Out of 216 color Doppler scans, 75 fetuses with abnormalities were found; 60 of them died and 15 survived to term. A prenatal color Doppler scan revealed that a diastolic notch in the uterine artery and eight (10.66%) cases of intrauterine growth retardation were quite common. It was shown that heart dysrhythmia was the least frequent, making up 3 (4%), out of all abnormality scans.

The fetus was 100% likely to survive if there was cardiac dysrhythmia (3%), abnormal umbilical artery end diastolic velocity (6%), or end diastolic flow reversal (5.66%). Prenatal deaths from intrauterine growth retardation were the highest of all abnormalities.

Of group 1's women, ages 20 to 25, 34 (15.74%) were first-time moms, according to Table 3. Of the women in group 2 (ages 26 to 30), 24 (11.11%) were pregnant for the first time. 25 (11.57%) of the ladies over 31 were expecting their first child. Twenty-five (11.57%) of the women in Group 1, who were between the ages of twenty and twenty-five, were expecting their second child. Of the women in group 2 who were between the ages of 26 and 30, 36 (16.66%) were pregnant for the second time. 28 (12.96%) of the women over 31 fell pregnant for the second time.Of the women in Group 1 (ages 20–25), five (2.314%) became pregnant for the third or more time. Twenty (9.26%) of the 26–30 year old women in group 2 became pregnant for the third or more time. Of the women over 31, 19 (8.79%) were pregnant for the third or more time.

Table 1: Age group, anomaly and parity distribution of patients

Group	Age in years	No of patient(%)	Patients with anomaly (%)	Parity of mother		
				One	Two	Three and more
Group 1	20-25	64 (29.63)	14 (21.875)	34 (15.74%)	25 (11.57%)	0 5(2.314%)
Group 2	26-30	80 (37.03)	23 (28.75)	24(11.11%)	36 (16.66%)	20 (9.26%)
Group 3	31<	72 (33.34)	35 (48.61)	25 (11.57%)	28 (12.96%)	19 (8.79%)

Table 2: Abnormal Doppler findings and fetal outcome

Defects	Doppler findings	Fetal outcome			
		Survival	Death	Total	%
	Intrauterine growth retardation	5	3	8	10.66
	Cardiac dysrhythmia	3	0	3	4.00
Genetic defects	Abnormal karyotype (Trisomy 13–18 and 21, Turner's syndrome)	8	2	10	13.33
	Anencephaly	6	2	8	10.66
Umbilical artery	Non-cardiovascular structural anomalies	5	1	6	8.00
	Abnormal umbilicalartery having end diastolic velocity	6	0	6	8.00
	Absent end diastolic flow	5	2	7	9.33
	Reversal of end diastolic flow	5	0	5	6.66
Middle cerebral artery (MCA)	Abnormal middle cerebral artery with normal umbilical artery	6	1	7	9.33
	Abnormal umbilical artery with normal middle cerebral artery	5	2	7	9.33
Uterine artery	Diastolic notch in uterine artery	6	2	8	10.66

DISCUSSION

Most of the normal singleton pregnant women in this study were 26 weeks along with their due date. To check for abnormalities, 216 pregnant individuals had a color Doppler scan. Social standing varied among the individuals. Doppler ultrasound technology was used to identify fetal anomalies and normal development on the ductus venosus, umbilical artery, MCA, and uterine artery.

The uterine placental and feto-placental circulations' growth and function are intimately related to the pathological conditions known as pregnancy-induced hypertension (PIH), short gestation age, and altered fetal circulation. This results in aberrant uterine and umbilical artery blood flow.

Uterine artery: The uterine artery shows hemodynamic alterations occurring on the placenta's maternal side by 20 weeks of pregnancy. By 25 weeks, the internal elastic lamina of the maternal spiral artery is broken down by trophoblastic cells that enter the inner third of the myometrium, since of this, the uterine arteries experience reduced blood flow by week 25 since the vessels have reached their maximal dilatation and minimum vascular resistance.6 The uterine artery is considered abnormal if its S/D ratio is more than 2.6.

At 26 weeks, a notch that still exists is a bad indicator that suggests increased blood flow resistance. There is a larger chance of a poor fetal outcome if the difference between the right and left uterine arteries' S/D ratios is greater than 1.

Umbilical artery: Umbilical artery velocimetry's hemodynamic changes are associated with fetoplacental circulation. More tertiary stem villi and arterial channels result in the development of the fetoplacental compartment and a decrease in the resistance of the umbilical artery. The diastolic component of the waveform appears early in the second trimester, and about week 15 of pregnancy, the umbilical artery resistance starts to drop. Normal is defined as a standard deviation (S/D) ratio of three or less. A healthy fetus has an MCA with minimal diastolic flow and a S/D ratio greater than 4.

Asymmetric IUGR has increased diastolic flow, which is believed to reflect brain sparing characteristics observed in experimental forms of fetal hypoxia. Bhatt et al.22 made the same observation in their research. 50% more had children who were IUGR. Fleischer et al. found that IUGR, infant mortality, and morbidity are all substantially associated with high umbilical artery resistance, which is found in around 40% of hypertensive pregnancies. According to our study, 46% of individuals with hypertension had an increased umbilical artery S/D ratio (more than 3). Additionally, 11% had an incorrect uterine artery ratio. The fetal prognosis was favorable in the 2% of people with normal umbilical artery S/D ratios but increased uterine artery S/D ratios.

This shows that, in comparison to uterine arteries, umbilical arteries are a better predictor of foetal outcome. Six individuals had a uterine artery increased S/D ratio and the early diastolic notch persisted. The Doppler examination's specificity was 100% when anomalies were found in the uterine and umbilical arteries. In 18% of cases, children born to individuals with normal first Doppler test findings had IUGR. However, these patients' follow-up tests showed an enhanced S/D ratio in the umbilical artery, underscoring the importance of a second Doppler scan for PIH patients. Based on the strong relationship between uterine and umbilical circulation alterations and pregnancy outcomes, we conclude that the color Doppler is the most important tool for prenatal fetal imaging and monitoring in both normal and high-risk pregnancies. Prompt action, treatment planning, and patient counseling for subsequent pregnancies are all made easier by it. Color Doppler testing is strongly recommended in both healthy and sick conditions. DeVore GR et al. conducted a previous study in 1995.

Real-time + color Doppler was used to identify a considerably higher percentage of fetuses with Trisomy 21 than real-time ultrasonography (87% [13 of 15] versus 29% [5 of 17], P <.002). When compared to real-time ultrasound, color Doppler ultrasound revealed a considerably greater rate of cardiovascular anomalies in babies with Trisomy 21 (60% [9 of 15] versus 12% [2 of 17], P <.008). The probability of finding Trisomy 21 is increased when individuals 35 years of age and older have aberrant fetal anatomy identified utilizing real-time plus color Doppler.

The cord may be discovered by itself or in combination with several other anomalies. The frequency ranges widely, from 13% to 50%.6, 15, and 17. Urogenital and cardiovascular abnormalities were the most common additional problems in our serieswith gastrointestinal system lesions being less common. The high prevalence of associated anomalies seen in this study is probably the consequence of referrals from people with different risk levels, and it could be different in the lower-risk group. However, fetal echocardiography is recommended in these situations due to the proven common association between SUA and cardiac anomalies.

DeVore GR, together with According to his research, real-time plus color Doppler ultrasound imaging of the fetus offers an alternative way for diagnosing Trisomy 21 in those who would decline genetic amniocentesis because of age-related risk.

Molina G. et al. found 19 trials with over 10,000 women in 2010. Doppler ultrasonography was compared to cardiotocography or no Doppler ultrasonography in the fetus's umbilical artery in 18 of these studies.

Another recent study contrasted Doppler examination of extra fetal blood vessels (ductus venosus) with computerized CTG (short-term fluctuation). The evidence from included studies was rated as moderate to very low quality due to poor methodological reporting and unreliability of results; when the strength of the evidence is low or very low, it means that the results may change in future studies and we cannot be sure of them. According to the results, umbilical artery Doppler ultrasonography may lower the number of caesarean sections, labor inductions, and baby fatalities. There was no significant difference in the number of stillbirths, infants with low Apgar scores five minutes after delivery, or ventouse or forceps deliveries. The findings of the newborn's serious problems differed throughout the studies.

A two-year developmental prognosis appeared to be better when the decision to deliver a child with growth limitation was based on abnormalities or changes in the late ductus Venosus on a computerized CT scan. Our study's findings indicate that as people age and parity grow, so does the danger of fetal abnormality prevalence. Therefore, as alterations in uterine and umbilical circulation are highly correlated with pregnancy outcome.

CONCLUSION

We conclude that the color Doppler is the principal instrument for prenatal fetal imaging and monitoring in both normal and high-risk pregnancies. We may use it to plan treatments, intervene promptly, and provide them advice about their next pregnancies.

Color Doppler examinations are highly recommended in all normal and diseased situations.

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