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EFFICACY OF COLOR DOPPLER SONOGRAPHY IN PRE NATAL ASSESSMENT FOR LOW AND HIGH RISK PREGNANCY OUTCOME

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ABSTRACT

Background: Numerous unfavourable perinatal outcomes are linked to high-risk pregnancies. For more than 30 years, Doppler ultrasonography has shown to be a useful obstetric tool.

Aim: This research seeks to determine how colour Doppler works in the prenatal diagnosis of both low-risk and high-risk pregnancies.

Methods: This was a one-year retrospective observational research conducted at the Department of Radiology, in collaboration with the Department of Obstetrics and Gynaecology, on 216 pregnant women. The research included pregnant women aged 20 to 40 who were carrying a singleton pregnancy with a gestational age of 26 weeks to term. Both typical variances and some foetal anomalies were taken into account in the study model. The foetal middle cerebral artery (MCA), the umbilical artery, and both mother uterine arteries underwent Doppler imaging. Information about the delivery and obstetric history was recorded. Patients were checked on a frequent basis.

Results: The colour Doppler scan was used to evaluate 216 pregnant women who were 26 weeks along with a single foetus. Pregnancies at high risk were more prevalent among women aged 31 and older. The most prevalent high-risk factor during pregnancy was hypertension brought on by pregnancy. Anomalies were discovered in 75 foetuses out of 216 Doppler scans. Whereby 15 foetuses died before term and 60 foetuses survived. In a prenatal colour Doppler scan, 8 (10.66%) cases of intrauterine growth retardation and a diastolic notch in the uterine artery were shown to be highly prevalent. Cardiac dysrhythmia found to be least prevalent i.e. 3(4%) in all anomaly scans.

Conclusion: Doppler can be used as a reliable tool for demonstrating prenatal fetal anomalies prenatal assessment of high-risk pregnancy. It provides useful guidance and early intervention to improve fetal outcome.

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

INTRODUCTION

The anomaly scan, which is a prenatal ultrasound carried out between 18 and 22 weeks of gestational age, is also occasionally referred to as the anatomy scan, 20 week ultrasound, or Level 2 ultrasound. As part of standard prenatal care, the International Society of Ultrasound in Obstetrics and Gynaecology (ISUOG) advises doing this ultrasound. The purpose of the ultrasound is to measure the foetus in order to detect congenital defects and multiple pregnancies

(i.e., twins) as well as to identify growth problems early in pregnancy.[1] Colour doppler is used to sample the blood velocity inside a specific blood artery and identify it by superimposing a blood flow map onto a standard two-dimensional picture.[2]

The developing foetus can be studied for morphology, bone structure, skeletal characteristics, foetal heart function, volume assessment, foetal lung maturity, and overall foetal health with the use of an abnormality scan.2. Foetal number, including the number of amnionic sacs and chorionic sacs for multiple gestations, cardiac activity, foetal position in relation to the uterus and cervix, and placental appearance, including the location of the umbilical cord insertion, amnionic fluid volume, gestational age assessment, and estimated foetal weight are all commonly included in a standard anatomy scan. In addition, a colour Doppler scan was performed to assess the mother's uterus, tubes, ovaries, and surrounding normal tissues as well as the foetal anatomical survey.[3,4]

The foundation of trimester ultrasound screening for aneuploidy, including Patau syndrome and Edwards syndrome, is the search for certain predetermined structural abnormalities as well as soft indicators. Soft markers, or deviations from normal anatomy, are more prevalent in foetuses with aneuploidy than in those with euploidy. These indicators frequently have no negative effects on pregnancy outcomes and are not clinically significant.[5]

Anencephaly, maxillofacial clefts, diaphragmatic hernia, gastroschisis, ophelecele, congenital heart defect, renal agenesis, spina bifida, osteochondrodysplasia, Edwards syndrome, and patau syndrome are among the abnormalities that are commonly checked for on a colour Doppler scan.[6] In order to aid in the diagnosis and ongoing observation of significant disorders such foetal growth restriction (FGR), foetal anaemia, and twin-to-twin transfusion syndrome (TTTS), it can be utilised to evaluate both the foetal and placental circulation.[7]

Doppler has been used more recently in the screening process for diseases including pre-eclampsia and aneuploidy.3. Doppler ultrasound examinations of the umbilical artery (UA), uterine artery, middle cerebral artery (MCA), and ductus Venosus (DV) are often utilised in obstetrics. Dopplers of the aortic isthmus, atrioventricular valves, and the umbilical vein (UV) are more specialised and infrequently done.[8]

The placenta's location is noted, particularly if it is lateral, and both arteries are inspected and reported. An aberrant trace has a modest predictive value for severe SGA in high-risk individuals; once an abnormal trace is found, there is little benefit in repeating the assessment. The uterine artery Doppler testing is often done on high-risk individuals as a screening procedure. Its goal is to identify pregnancies that might result in intrauterine growth retardation (IUGR) or preeclampsia. Usually, this is done between weeks 20 and 24 of pregnancy. To analyse the spectral Doppler waveform, a sample of the uterine artery is taken.[9]

Scanners were performed again in cases where the diagnosis was obtained early in the gestational age range because b-mode and colour Doppler's inadequate resolution can result in nonseparated flow signals and false-positive findings. The chord that is umbilical Normally, the umbilical cord has one vein and two arteries. The arteries transport the fetus's deoxygenated blood to the placenta, where it is combined with the mother's blood to facilitate the intake of nutrients, oxygenation, and removal of waste. The placenta transfers nutrient-rich, oxygenated blood to the foetus through the umbilical vein. Cerebral artery in the middle Foetuses at risk of prenatal morbidity or death from growth retardation are monitored using Doppler examinations.[10]

It is utilised to learn more about the foetal circulation in pregnancies where the umbilical artery Doppler waveform is aberrant. The foetal heart rate controls the pulsatile blood flow in the umbilical artery. The resistance to flow is minimal in a typical pregnancy, with forward flow occurring in both the diastole and systole. Therefore, Doppler ultrasonography provides a non-invasive means of examining the circulation of both the mother and the foetus and directing therapeutic care. This study aims to investigate the prenatal use of colour Doppler in assessing both normal and high-risk pregnancies.

MATERIAL AND METHODS

The Department of Obstetrics and Gynaecology recommended 216 pregnant women to the Department of Radiology, where they participated in a one-year retrospective observational research. The study involved the selection of pregnant women aged between twenty and forty. Every participant in the research had a singleton pregnancy with a gestational age of 26 weeks to term. The patients' ages ranged from 20 to 70. Prior to starting the investigation, institutional ethics committee permission was obtained.

Relevant data, including patient history, clinical findings, and investigation reports from specific instances, were recorded using a pre-designed Performa. We used a convex transducer operating at 3.5 MHz to do the ultrasound scanning. The patient was in the supine posture, with both sides of the abdomen—from the isthmus to the inguinal area—completely exposed.

The transducer was positioned longitudinally and transversely to produce scans, and measurements were taken in the plane that displayed the largest cross-sectional area. In order to maximise Doppler sensitivity and identify even little flow in the foetal vasculature, scanning was done utilising the slow frame rate, low pulse repetition frequency, narrow gate, low wall filter setting, and high Doppler gain for the colour Doppler evaluation of the cervical nodes.

Examination Technique

Arterial Doppler: Both cardiac output and vascular resistance affect the waveforms obtained from arterial Doppler exams. The use of arterial doppler alone is insufficient to examine foetal heart impairment.

Foetal venous Doppler: When detecting foetuses with IUGR who are at danger of dying in pregnancy, foetal venous Doppler is employed in addition to umbilical artery and middle cerebral artery Doppler testing. •Contains the IVC, ductus Venosus, and umbilical vein. In terms of repeatability and identifying the foetus that is "at risk," Ductus Venosus waveforms have been proven to be the most effective. •Use IUGR foetuses in the late second and early third trimesters.

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.

The probe is perfectly positioned to allow a transverse oblique plane or a mid-sagittal plane to pass through the foetal abdomen and to avoid contaminating the ductus Venosus with fluid from the foetal inferior vena cava. This allows sampling to be done where the umbilical vein enters the ductus Venosus. The foetus need to be as still as feasible. Cerebral artery in the middle Doppler: The foetal head is cut transversely, and the main cerebral arteries and Circle of Willis are visible by applying the colour box. (MCAs). To get the Doppler wave shape, the sampling gate is positioned in the proximal MCA.

The same two highly qualified physicians who were previously stated examined every photograph in hindsight. They conducted a blind analysis of the pictures as a group. SPSS software trial version 21.0 and Microsoft Excel 2010 were used for statistical analysis. We computed the mean and standard deviation.

RESULTS

The same two highly qualified physicians who were previously stated examined every photograph in hindsight. They conducted a blind analysis of the pictures as a group. Data was examined and organised appropriately. A statistical study was carried out. To determine the frequency of genetically impaired abnormalities and foetal developmental defects, the mean and standard deviation were computed.

About the three age categories, Table 1 provides details. Group 1 comprised 64 (29.63%) pregnant women in the age range of 20 to 25 years, of whom 14 (21.875%) had scans that revealed foetal abnormalities. Of the 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 included information on vascular problems, including umbilical artery, middle cerebral artery (MCA), and uterine artery, as well as growth abnormalities, heart flaws, genetic disorders, and other defects. 75 foetuses with defects were identified from 216 colour Doppler scans; of these, 60 lived to term and 15 died. In a prenatal colour Doppler scan, 8 (10.66%) cases of intrauterine growth retardation and a diastolic notch in the uterine artery were shown to be highly prevalent. Heart dysrhythmia was discovered to be the least common, accounting for 3(4%) of all abnormality scans.

The foetus had a 100% survival rate in cases of cardiac dysrhythmia (3%) and abnormal umbilical artery end diastolic velocity (6%) and reversal of end diastolic flow (5.66%). Out of all the defects, intrauterine growth retardation had the greatest rate of prenatal death.

Table 3 showed that 34 (15.74%) of group 1's women, who ranged in age from 20 to 25, were first-time mothers. 24 (11.11%) of the women in group 2, who ranged in age from 26 to 30, were pregnant for the first time. Of the women over 31, 25 (11.57%) were pregnant for the first time. Of the ladies in Group 1, who ranged in age from 20 to 25, 25 (11.57%) were expecting their second child. 36 (16.66%) of the women in group 2, who were between the ages of 26 and 30, were pregnant for the second time. Of the women over 31, 28 (12.96%) became pregnant for the second time. Five (2.314%) of the women in Group 1—whose ages ranged from 20 to 25—were pregnant for the third or more time.

In group 2, women of age range between 26-30 years, 20 (9.26%) were having third or more time pregnant. 19 (8.79%) women of age more than 31 years were having third or more time pregnant.

DISCUSSION

The majority of the regular singleton pregnant women in this observational research were 26 weeks along with their due date. A colour Doppler scan was performed on 216 pregnant patients to look for anomalies. The people differed in social status. Foetal abnormalities and normal development were detected using Doppler ultrasound technology on the uterine artery, umbilical artery, MCA, and ductus venosus.

Pregnancy-induced hypertension (PIH), short gestation age, and altered foetal circulation are pathological disorders that are closely linked to the development and operation of the utero placental and feto-placental circulations. This causes abnormal blood flow in the umbilical and uterine arteries. Normal foetal growth requires a healthy foetal circulation. Significant alterations in the maternal and placental vasculature take place to enable this.

Uterine artery: By 20 weeks of gestation, the uterine artery reflects the hemodynamic changes happening on the maternal side of the placenta. Within the inner third of the myometrium, trophoblastic cells enter the maternal spiral artery and break down the internal elastic lamina of the spiral artery by 25 weeks. As a result, by week 25, the vessels have reached their maximum dilatation and minimal vascular resistance, which causes the uterine arteries to become blood flow-impaired.Six If the uterine artery's S/D ratio is more than 2.6, it is deemed abnormal. If there is still a notch at 26 weeks, it is a poor sign that indicates higher blood flow resistance. The difference between S/D ratio greater than 1 in right & left uterine arteries suggests higher incidence of poor fetal outcome.

Umbilical artery: The fetoplacental circulation's hemodynamic alterations are correlated with umbilical artery velocimetry. The fetoplacental compartment develops and the umbilical artery's resistance lowers as the number of tertiary stem villi and arterial channels increases. Early in the second trimester, the waveform displays the diastolic component, and umbilical artery resistance begins to decrease about 15 weeks of gestation. A standard deviation (S/D) ratio of three or less is regarded as typical.

Foetal MCA: In a healthy foetus, the S/D ratio is higher than 4 and the MCA has little diastolic flow. Increased diastolic flow is seen in asymmetric IUGR; this pattern is thought to represent brain sparing phenomena seen in foetal hypoxia experimental models.

In their investigations, Bhatt et al.22 noted the same thing. 50% more had IUGR offspring. According to research by Fleischer et al., elevated umbilical artery resistance is present in around 40% of hypertensive pregnancies and is strongly linked to IUGR, perinatal mortality, and morbidity. In our investigation, the umbilical artery S/D ratio was elevated in 46% of hypertension patients (higher than 3). 11% also had an improper ratio of uterine arteries.

Just 2% of individuals had normal umbilical artery S/D ratios but elevated uterine artery S/D ratios; in these cases, the foetal prognosis was favourable. 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.

Of the patients whose first Doppler test results were normal, 18% gave birth to infants with IUGR. Follow-up tests on these individuals, however, revealed an elevated S/D ratio in the umbilical artery, highlighting the significance of a second Doppler scan for patients with PIH. This leads us to the conclusion that, because to the substantial correlation

between changes in uterine and umbilical circulation and pregnancy outcome, the colour Doppler is the key instrument for prenatal foetal imaging and monitoring in both normal and high-risk pregnancies. It facilitates prompt action, treatment planning, and patient counselling on subsequent pregnancies. Colour Doppler testing is highly advised in all instances, both healthy and diseased. In a prior investigation carried out in 1995 by DeVore GR et al.

A significantly greater number of fetuses with Trisomy 21 (87% [13 of 15] versus 29% [5 of 17], P < .002) were identified with real-time plus color Doppler than with real-time ultrasound. Color Doppler ultrasound identified a significantly higher rate of cardiovascular abnormalities in fetuses with Trisomy 21 (60% [9 of 15] versus 12% [2 of 17], P < .008) than did real-time ultrasound. Identification of abnormal fetal anatomy using real-time plus color Doppler in patients 35 years and older increases the likelihood of detecting Trisomy 21.

The two vessel cord may be found alone or in conjunction with a number of other abnormalities. The frequency varies greatly, ranging from 13% to 50%.6, 15, and 17 The most prevalent extra defects in our series were urogenital and cardiovascular malformations, with gastrointestinal system lesions being less common. The high frequency of related abnormalities seen in this study is most likely the result of individuals with varying levels of risk being referred, and it may differ in a group with lower risk. However, because there has been a documented frequent link between SUA and cardiac abnormalities, foetal echocardiography is advised in these circumstances.

DeVore GR, in addition to According to his research, individuals who may refuse genetic amniocentesis due to age-related risk have an alternate method for identifying Trisomy 21: real-time plus colour Doppler ultrasound imaging of the foetus.

In 2010, Molina G et al. discovered 19 trials with more than 10,000 women. In eighteen of these investigations, the use of cardiotocography or no Doppler ultrasonography in the umbilical artery of the foetus was contrasted with Doppler ultrasound. Another recent experiment compared computerised CTG (short-term variation) with Doppler evaluation of additional foetal blood arteries (ductus Venosus).

Because of poor methodological reporting and unreliability of results, the evidence from the included studies was rated as being of moderate to very low quality; when the strength of the evidence is low or very low, it indicates that the results might change in subsequent study, and we cannot be assured of them. The outcomes shown that umbilical artery Doppler ultrasonography may reduce the incidence of infant deaths as well as caesarean sections and labour inductions. The number of ventouse or forceps deliveries, stillbirths, and infants with poor Apgar scores five minutes after delivery did not significantly differ. Results about severe issues in the newborn varied throughout investigations.

When the choice to birth a baby with growth limitation was made based on anomalies or alterations in the late ductus Venosus on a computerised CT scan, the long-term (two-year) developmental prognosis seemed to be improved. According to the results of our investigation, the risk of foetal anomaly prevalence increases with age and parity. The studies conducted in 2003 by Bhatt et al., Oepekes D. et al., Shah AD et al., and Oepekes D. et al. likewise validated this conclusion.

CONCLUSION

Thus we conclude that the color Doppler is primary tool for prenatal fetal scan and surveillance in normal as well as high risk pregnancies because the changes in umbilical & uterine circulation strongly correlate with pregnancy outcome. It helps us to take timely action, plan the treatment & also counsel the patients in their future pregnancies. We strongly recommend the use of Color Doppler examination in all cases of normal and disease.

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Table 1: Age group and anomaly distribution of patients

Group	Age in years	No of patient (%)	Patients with anomaly (%)
Group 1	20-25	64 (29.63)	14 (21.875)
Group 2	26-30	80 (37.03)	23 (28.75)
Group 3	31<	72 (33.34)	35 (48.61)

Table 2: Abnormal Doppler findings and fetal outcome

	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
	Non-cardiovascular structural anomalies	5	1	6	8.00
Umbilical artery	Abnormal umbilical artery 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
Total	Anomaly/ total no of scan	60	15	75	34.72

Table 3: Parity of pregnant women

Parity of mother	Group 1(n =64)	Group 2 (n =80)	Group 3 (n=72)
One	34 (15.74%)	24(11.11%)	25 (11.57%)
Two	25 (11.57%)	36 (16.66%)	28 (12.96%)
Three and more	0 5(2.314%)	20 (9.26%)	19 (8.79%)