ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4

Journal of Coastal Life Medicine

Role Of Doppler Studies in Evaluation Of Intrauterine Growth Restriction and Prediction Of Adverse Perinatal Outcome

Received: 12 October 2022, **Revised:** 18 November 2022, **Accepted:** 21 December 2022

Dr. Pramod Shaha

Professor, Department Of Radiodiagnosis Symbiosis Medical College For Women, Pune .
hodradiology@kimskarad.in

Dr. Frennysam E.

M.B.B.S., Department Of Radiodiagnosis Krishna Institute Of Medical Sciences Karad-415110, Maharashtra State. 2023

Keywords

Multivessel Doppler, IUGR (Intrauterine growth restriction), Adverse perinatal outcome.

Abstract

Background: Fetal growth restriction is associated with an increased risk of perinatal morbi-mortality and long-term complications; therefore, antenatal detection and surveillance with the optimization of delivery timing are necessary to improve pregnancy outcomes. Serial ultrasonography (US) for the evaluation of fetal growth and assessment of uteroplacental and fetoplacental circulation with Doppler studies are used to guide pregnancy management decisions.

Purpose: To study Doppler parameters in diagnosed intrauterine growth-restricted pregnancies and to correlate them with perinatal outcomes.

Methodology: The study included 63 pregnant patients with intrauterine growth-restricted fetuses in their third trimester who have attended OPD, got admitted to antenatal wards and labor room, and been referred to the Department of Radiodiagnosis bythe Department of Obstetrics and Gynaecology, Krishna institute of medical sciences, from January 2020 to June 2021. Doppler US evaluation was performed following a detailed clinical history, US biometry, assessment of amniotic fluid, and placental maturity.

Results: The study group was stratified into six categories based on the severity of the Doppler abnormalities and was assessed in terms of adverse perinatal outcomes. There was a significant increase in the frequency of adverse perinatal outcomes with the worsening of Doppler parameters. The positive predictive value of categories V & VI was 100% and the negative predictive value of category I was 100%. UA AEDF/REDF, DV A/R "a" wave, and UV pulsatility showed statistically significant associations with perinatal mortality. UA AEDF/REDF was more sensitive than DV A/R "a" wave and UV pulsatility in predicting perinatal mortality. However, DV A/R "a" wave was more specific than UA/AEDF/REDF and UV pulsatility in the prediction of perinatal mortality. Cases with mild Doppler abnormalities had a higher rate of adverse perinatal outcomes than those with marked Doppler abnormalities. IUGR cases with abnormal Doppler had a statistically significant higher risk of oligohydramnios than those with normal Doppler. Asymmetrical IUGR cases had a statistically significantly higher rate of adverse perinatal outcomes than symmetrical IUGR cases.

Conclusion: Multivessel Doppler ultrasonography can effectively stratify IUGR fetuses into risk-based categories and has a higher prognostic value. Therefore, rather than using a single Doppler parameter to evaluate IUGR pregnancies, multivessel Doppler parameters should be used. When it comes to predicting perinatal mortality, UA AEDF/REDF is a better screening modality as it has higher sensitivity than DV A/R "a" wave and UV pulsatility. UA AEDF/REDF, DV A/R "a" wave and UV pulsatility are all alarming signs that suggest a poor prognosis and a high death rate and therefore immediate intervention is warranted.

1. Introduction

In general, intrauterine growth restriction (IUGR) is described as a fetal growth rate that is less than normal for a certain infant's growth potential based on race and gender. Although there are some differences between the terms IUGR and small for gestational age (SGA), they are frequently used interchangeably. To distinguish between SGA and IUGR fetuses, Doppler is employed, and they are characterized accordingly.

The placenta is the only source of nutrients for the fetus's optimal development. Maintaining excellent uteroplacental circulation is essential for a healthy pregnancy. During pregnancy, the maternal, placental, and fetal vasculatures undergo a multitude of alterations and adaptations. The inability to adjust to these changes results in aberrant vascular resistance patterns, which affect fetal well-being and eventually contribute to IUGR. To a large extent, the capacity to examine maternal, placental, and fetal vascular patterns adequately and efficiently is critical for the early detection of IUGR and the prediction of severe perinatal outcomes. These vascular patterns are assessed using Doppler technology. Doppler studies of the uterine artery, umbilical artery, middle cerebral artery, cerebro-placental ratio (CPR), ductus venosus, and aortic isthmus are commonly utilized for IUGR evaluation.

When compared to those born with normal growth, intrauterine growth-restricted fetuses are at increased risk for perinatal mortality & morbidity and poor long-term outcomes such as neurological and cognitive developmental abnormality, cardiovascular diseases (atherosclerosis, hypertension, coronary heart disease), renal disease, diabetes, and obesity. Timely delivery of the IUGR fetus can be facilitated by monitoring the pregnancy with Doppler ultrasound which is important to prevent perinatal morbi-mortality.

In the present study, an attempt has been made to evaluate the role of multivessel Doppler studies to predict adverse perinatal outcomes in IUGR in third-trimester pregnancies.

Aims and objectives:

Aim: To study Doppler parameters in diagnosed intrauterine growth-restricted pregnancies and to correlate them with perinatal outcomes.

Objective: To calculate the systolic/diastolic (S/D ratio), pulsatility index (PI), and resistance index (RI) of umbilical & middle cerebral arteries and to calculate the cerebroplacental ratio. To study the waveforms of the umbilical vein and ductus venosus. To study the values of these blood flow indices and waveforms in the prediction of adverse fetal outcomes.

2. Methodology

This prospective analytical study was approved by the Ethical Committee of our institution. The study was conducted for a period of 18 months from January 2020 to June 2021.

Source of data

The study included 63 pregnant patients with intrauterine growth-restricted fetuses in their third trimester who have attended OPD, got admitted to antenatal wards and labor room, and been referred to the Department of Radiodiagnosis from the Department of Obstetrics and Gynaecology, Krishna Institute of Medical Sciences, from January 2020 to June 2021. Doppler US evaluation was performed following a detailed clinical history, US biometry, assessment of amniotic fluid, and placental maturity. Follow-up Doppler studies were performed if clinically indicated to determine a favorable or a worsening trend in the Doppler indices. However, for perinatal outcome analysis, only the initial Doppler ultrasound results were employed.

Inclusion Criteria:

1. All pregnant women with intrauterine growth-restricted fetuses irrespective of age and parity.
2. Singleton pregnancy.

Exclusion Criteria:

1. Documented congenital abnormality.

2. Multiple gestations.

3. Unknown LMP.

Statistical analyses

The collected data were analyzed with IBM SPSS Statistics for Windows, Version 23.0. (Armonk, NY: IBM Corp). To explain the data descriptive statistics, frequency analysis was utilized, percentage analysis was used for categorical variables, and mean and SD was used for continuous variables. To find the significance in categorical data Chi-Square test was used similarly if the expected cell frequency is less than 5 in 2×2 tables then Fisher's Exact was used. In each of the statistical tools mentioned above, the probability value is .05 is regarded as a significant level. The diagnostic statistics were used to find the diagnostic value of UA AEDF/REDF, DV A/R "a" wave, and UV pulsatility concerning perinatal mortality. Microsoft Word and Excel have been used to generate graphs, tables, etc. The sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were determined by using the formulas.

Sensitivity = $\frac{A}{A+B} x\ 100$

Specificity $\frac{D}{B+D} x\ 100$

Positive Predictive Value= $\frac{A}{A+B} x\ 100$

Negative Predictive Value$\frac{D}{C+D} x\ 100$

Diagnostic Accuracy= $\frac{A+B}{Total\ number\ of\ cases}$

A = True positive

B = False positive

C = False negative

D = True negative.

3. Results

The study included 63 IUGR instances, with all of them yielding appropriate waveforms. 16 % (n=10) of the 63 instances of IUGR had normal Doppler values, while 84 % (n=53) had abnormal Doppler parameters as shown in table 1.

Patients involved in this study were all between the ages of 19 and 36. 6% (n=4), 33 % (n=21), 46% (n=29), 13% (n=8), and 2% (n=1) cases were in the age group <21 years, 21 – 25 years, 26-30 years, 31-35 years and > 35 years respectively. Most of the patients (79 %, n=50) are between the ages of 21 and 30. The age group of more than 35 years had the smallest number of patients.

Table 1: Doppler parameters in the study group.

Doppler parameters	No. of patients	Percentage (%)
Normal	10	**16**
Abnormal	**53**	**84**

Distribution of gestational age at initial Doppler examination

Antenatal mothers were evaluated at different stages of pregnancy. 13 % (n=8) of the prenatal mothers evaluated were less than 32 weeks gestation, 55 % (n=35) were between 32 and 36weeks gestation, and 32% (n=20) were more than 36 weeks gestation. After 40 weeks of pregnancy, none of the prenatal patients were investigated.

Categorization of the study group

We divided the study group into six categories based on the severity of Doppler abnormalities in the 63 IUGR cases, from Category I to Category VI. 22% (n=14) were found in Category I, 8% (n=5) in category II, 6%(n=4) in category III, 21%(n=13) in category IV, 7%(n=4) in category V and 36%(n=23) in category VI.

Table 2: Categories based on the severity of Doppler abnormalities.

Category	Doppler findings	No. of patients	Percentage (%)
I	Normal PI & spectral waveforms of UA, MCA, DV & UV.	14	22%
II	UA PI >95th percentile	5	8%
III	UA PI >95th percentile, CPR < 1.08	4	6%
IV	UA PI > 95th percentile, CPR < 1.08 MCA PI <5th percentile	13	21%
V	UA AEDF or REDF, MCA PI <5th percentile with increased diastolic flow	4	7%
VI	DV PI > 95th percentile, DV and UV waveform alteration	23	36%

To make comparisons easier, we divided the cases into two groups: those with mild Doppler abnormalities (Categories I, II, and III) and those with marked Doppler abnormalities (Categories IV, V, and VI). 36% (n=23) had mild Doppler parameters and 64% (n=40) had marked Doppler abnormalities.

End diastolic flow was preserved in 56 % (n=35) of the 63 cases, absent in 22% (n=14), and reversed in 22 % (n=14).

Out of 63 cases, 71% (n=45) had forward flow in “a” wave of DV, 19% (=12) had absent flow in “a” wave of DV, and 10 % (n=6) had reverse flow in “a” wave of DV.

Out of 63 cases, 67% (n=42) had non-pulsatile (continuous) flow in the umbilical vein and 33% (n=21) had pulsatile flow in the umbilical vein.

Distribution of associated risk factors

44.4% (n=28) of the antenatal mothers had Pregnancy Induced Hypertension (PIH), 22.2% (n=14) had anemia, 12.6% (n=8) had placenta previa, 9.5% (n=6) had previous history of preterm baby, 9.5% (n=6) had diagnosed Diabetes Mellitus, 3.1% (n=2) had heart disease, 3.1% (n=2) had a chronic placental hematoma and 1.5% (n=1) had antiphospholipid antibody syndrome. Few patients had more than 1 risk factor. There were no risk factors in 17.4% (n=11) of the participants.

Distribution of amniotic fluid

At the initial Doppler examination, 22.2% (n=14) had normal liquor, 73% (n= 46) had Oligohydramnios and 4.8% (n=3) had polyhydramnios.

Distribution of placental maturity

At the time of the initial Doppler examination, 79% (n=50) of the women had Grade III placental

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4

Journal of Coastal Life Medicine

maturity, whereas 21 % (n=13) had Grade II placental maturity.

Distribution of type of IUGR

65 % (n=41) of the 63 cases had asymmetrical IUGR, while 35 % (n=22) had symmetrical IUGR.

Distribution of Mode of delivery

In the 63 cases studied, 27% (n=17) were delivered naturally, 18% (n=11) were delivered by induction of labor, and 55% (n=35) were delivered by Caesarean section.

Distribution of perinatal outcome

67 % (n=42) of the 63 cases analyzed had adverse perinatal outcomes, whereas 33 % (n=21) had favorable outcomes. Most neonates experienced more than one adverse prenatal outcome.

Distribution of adverse perinatal outcomes

11.1 % (n=7) had at least one adverse outcome, and 55.6 % (n=35) had more than one adverse perinatal outcome. The remaining 33.3 % (n=21) had a favorable outcome. There were 7 perinatal deaths and 57 live births. 30.2 % (n=19) had fetal distress. 30.2 % (n=19) were admitted to NICU. 22.2 % (n=14) had birth asphyxia. Thick meconium-stained liquor was noted in 9.5 % (n=6) cases, 19 % (n=12) had low Apgar scores at 5 minutes, 9.5 % (n=6) had respiratory distress syndrome, 3.2 % (n=2) had septicemia, 3.2 % (n=2) had necrotizing enterocolitis, 8% (n=5) had IPH/IVH/GMH and % 1.6 (n=1) had necrotizing enterocolitis. The table shows that the most common adverse fetal outcomes were fetal distress and NICU admissions.

Distribution of perinatal mortality and morbidity

In the 63 instances studied, 11.1% (n=7) had perinatal mortality, 55.6% (n=35) suffered perinatal morbidity, and 33.3% (n=21) had a favorable perinatal outcome.

Table 3: Correlation between Doppler and adverse perinatal outcome

			Adverse perinatal outcome		**Total**	**2 - value**	**p-value**
			Normal	Abnormal			
Doppler	Abnormal	Count	11	42	53	23.774	0.0005 **
		%	52.4%	100.0%	84.1%		
	Normal	Count	10	0	10		
		%	47.6%	0.0%	15.9%		
Total		Count	21	42	63		
		%	100.0%	100.0%	100.0%		

**** Highly Statistical Significance at p < 0.01 level**

The above table shows the Pearson Chi-Square test results for Doppler and adverse perinatal outcome, which reveal that there is a highly statistically significant correlation between Doppler and adverse perinatal outcome, with a Chi-Square value of 23.774 and a p=0.0005 (<0.01 level).

The comparison between categories and adverse perinatal outcomes using the Pearson Chi-Square test is shown in table 4, which shows that there is a highly statistically significant association between the severity of Doppler abnormalities and adverse perinatal outcome with Chi-Square value = 50.746 and p=0.0005 (<0.01 level).

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

Table 4: Correlation between categories and adverse perinatal outcome.

			Adverse perinatal outcome		**Total**	**2-value**	**p-value**
			Normal	Abnormal			
Category	I	Count	14	0	14		
		%	66.7%	0.0%	22.2%		
	II	Count	4	1	5		
		%	19.0%	2.4%	7.9%		
	III	Count	2	2	4		
		%	9.5%	4.8%	6.3%		
	IV	Count	1	12	13		
		%	4.8%	28.6%	20.6%		
	V	Count	0	4	4	50.746	**0.0005****
		%	0.0%	9.5%	6.3%		
	VI	Count	0	23	23		
		%	0.0%	54.8%	36.5%		
Total		Count	21	42	63		
		%	100.0%	100.0%	100.0%		
****Highly Statistical Significance at p<0.01 level**							

The correlation between categories and perinatal mortality using the Pearson Chi-Square test, which demonstrates that there is no statistically significant correlation between the severity of Doppler abnormalities and perinatal death with a Chi-Square value of 10.504 and a p-value of 0.062 (> 0.05 level).

The correlation between categories and perinatal morbidity using the Pearson Chi-Square test, which indicates that there is a highly statistically significant correlation between the severity of Doppler abnormalities and perinatal morbidity with a Chi-Square value of 50.746 and a p-value of 0.0005 (<0.01 level).

Correlation between categories and mode of delivery using the Pearson Chi-Square test, which reveals that there is a highly statistically significant association between severity of Doppler abnormalities and modes of Delivery, with a Chi-Square value of 65.223 and a p-value of 0.0005 (<0.01 level).

The Pearson Chi-Square test results for UV EDF and perinatal mortality, reveal that there is a highly statistically significant correlation between UV AEDF/REDF and perinatal mortality, with a Chi-Square value of 10.205 and a p-value of 0.006 (<0.01 level) as shown in table 5.

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4

Journal of Coastal Life Medicine

Table 5: Correlation between UA end-diastolic flow pattern and perinatal mortality.

			Perinatal mortality		**Total**	**2-value**	**p-value**
			Alive	Dead			
UA EDF	Absent	Count	11	3	14	10.205	**0.006****
		%	19.6%	42.9%	22.2%		
	Forward	Count	35	0	35		
		%	62.5%	0.0%	55.6%		
	Reverse	Count	10	4	14		
		%	17.9%	57.1%	22.2%		
Total		Count	56	7	63		
		%	100.0%	100.0%	100.0%		
**Highly Statistical Significance at p<0.01level							

The Pearson Chi-Square test correlation between DV 'a' flow and Perinatal mortality was displayed, which demonstrates that there is a highly statistically significant correlation between DV A/R 'a' flow and Perinatal mortality, with Chi-Square value = 15.131 and p=0.001 (<0.01% level).

The Pearson Chi-Square test correlation between UV pulsatility and perinatal mortality was displayed, which demonstrates that there is a highly statistically significant correlation between UV pulsatility and perinatal mortality, with Chi-Square value = 9.723 and p=0.004 (< 0.01% level).

Table 6: Comparison of performance values of UA AEDF/REDF, DV A/R "a" wave, and UV pulsatility in the prediction of perinatal mortality in IUGR.

Doppler parameters	Sensitivity	Specificity	PPV	NPV	Diagnostic accuracy
UA AEDF/REDF	100%	63%	25%	100%	67%
DV A/R "a" wave	86%	79%	33%	98%	79%
UV pulsatility	86%	75%	29%	98%	75%

The comparison between the term of delivery in patients with PIH as a risk factor and adverse perinatal outcome by using the Pearson Chi-Square test, which shows that there is a highly statistically significant association between the term of delivery in such patients and adverse perinatal outcome with Chi-Square value = 10.182 and p=0.002 (< 0.01 level).

The correlation between mode of delivery and adverse perinatal outcome by using the Pearson Chi-Square test, which shows that there is a highly

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

statistically significant association between mode of delivery and adverse perinatal outcome with Chi-Square value = 53.182 and p=0.0005 (< 0.01 level).

The correlation between the type of IUGR and adverse perinatal outcome by using the Pearson Chi-Square test, which shows that there is a highly statistically significant association between type of IUGR and Adverse perinatal outcome with Chi-Square value = 23.607 and p=0.0005 (< 0.01 level).

The correlation between A.F.I and Doppler by using the Pearson Chi-Square test, which reveals that there is a highly statistically significant association between A.F.I and Doppler with Chi-Square value = 20.221 and p=0.0005 (< 0.01 level).

4. Discussion

Grayscale Ultrasound fetometry is a valid means of determining whether a fetus has intrauterine growth-restricted or not. This is likely because the first symptom of IUGR fetuses is stunted growth, which may be easily detected by measuring the abdominal circumference, which consistently shows lower values than those expected for the gestational age. Grayscale ultrasonography, on the other hand, does not reliably detect adverse perinatal outcomes. Hence, the purpose of our study was to analyze blood flow in the umbilical artery, middle cerebral artery, ductus venosus, and umbilical vein using Doppler ultrasound as well as their ability to predict adverse perinatal outcomes.

While there is a lot of evidence that specific Doppler abnormalities are linked to poor perinatal outcomes, single-vessel Doppler's predictive accuracy hasn't been great. According to Odibo et al.[1,] the UA and MCA had an area under the ROC curve of 70% and 48%, respectively, in predicting unfavorable perinatal outcomes. This means that utilizing the MCA Doppler to distinguish between pregnancies with abnormal and normal perinatal outcomes is as accurate as guessing at random. As a result, to be used in clinical practice, more sensitive and specific prognostic markers are needed, which can be accomplished by using multivessel longitudinal Doppler. Therefore, our study is aimed at studying the role of multivessel Doppler in evaluating IUGR and predicting its adverse outcome.

Our study reveals that the majority of the cases (55%) were between 32 to 36 weeks of gestation, 13% (n=8) were less than 32 weeks of gestation and 32 % (n=20) were above 36 weeks of gestation. Yash et al. reported 34% of the patients were above 36 weeks, 24% were above 32 weeks and 42% were above 30 weeks[2]. Lakshmi et al. found out that 60% of the patients were above 37 weeks, 29% were above 32 weeks and 11% were above 28 weeks[3]. Most of the cases in our study were 30 weeks or more by gestational age. This is explained by 2 reasons:

- Patients diagnosed with IUGR in peripheral hospitals were referred late for delivery and NICU care, by which time they had advanced gestational age and, in some cases, severe Doppler abnormalities, resulting in a poor fetal outcome.

- We discovered that each kid has its growth profile, which is established only around 24-26 weeks in patients who have been booked and observed regularly. As a result, growth retardation can only be detected after 28 weeks if there is a deviation from this growth profile. This agreed with the research of Harold Schulman et al., which said that the most accurate period to screen for IUGR is after 24-26 weeks. These patients were also carefully monitored with repeat Doppler examinations at regular intervals, and they were delivered before the Doppler findings deteriorated, ensuring the baby's highest chances of survival and fewer perinatal and long-term complications.

40% of the patients in our study were primigravida. Yash et al., BN Lakhkar et al., and Lakshmi et al. in their studies reported 54%, 77.7 %, and 69% primigravida patients respectively[2,3,4]. Our study revealed that the majority (44%) of the cases had PIH as the risk factor. This is explained by the lack of a physiological change in spiral arteries that produces IUGR in hypertensive patients. This finding is consistent with the findings of Martin et al.[5], who identified hypertension as a significant risk factor in IUGR. Furthermore, we discovered that patients with PIH as a risk factor had more preterm deliveries than term births in our study. Preterm deliveries had a higher rate of unfavorable perinatal outcomes than mature births among

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

patients with PIH as a risk factor (P-value 0.002), which is extremely significant.

IUGR cases with abnormal Doppler had a higher risk of oligohydramnios than those with normal Doppler (P-value 0.0005), a highly statistically significant difference. This finding is consistent with the study of Sameena et al.[6], who found that oligohydramnios was more prevalent in patients with abnormal Doppler findings than in cases with normal Doppler findings.

With substantial statistical significance, asymmetrical IUGR cases had a higher rate of adverse perinatal outcomes than symmetrical IUGR cases (P-value 0.0005). This could be explained by the fact that asymmetrical IUGR is usually caused by late-onset IUGR, which causes abrupt fetal deterioration and a higher risk of adverse perinatal outcomes. This is again statistically significant.

We discovered that as the severity of Doppler abnormalities increased, the likelihood of emergency LSCS increased as well (P-value 0.0005), which is highly statistically significant once again. The prevalence of adverse perinatal outcomes is higher in cases delivered by emergency LSCS than those by other modalities with high statistical significance (P-value 0.0005). The indication for LSCS was fetal distress in the majority of our cases.

The most common adverse perinatal outcomes were fetal distress and NICU admissions (30.2% each). This agrees with the findings of Gaikwad PR et al., who found that NICU admission was the most prevalent prenatal outcome (88.8%)[7]. However, there is a considerable difference in the prevalence of adverse perinatal outcomes between their study and ours, which is likely owing to better pregnancy management, prompt delivery, and better neonatal care, all of which have been shown to prevent adverse outcomes.

Perinatal mortality in our study was 11.1 %, which is comparable to Kushal Gandhi, et al.[8] and Fong KW et al.[11], who found 13.2 % and 4.77 %, respectively. The contributing factors to the neonatal deaths in our study were Meconium Aspiration Syndrome, respiratory distress syndrome, and neonatal Sepsis. Perinatal mortality was 25%, 32% & 39% in cases with UA AEDF/REDF, UV pulsatility, and DV A/R "a" wave respectively, which denotes that chances of perinatal mortality are highest when ductus venosus shows absence or reversal of "a" wave.

Most of the studies (Arduini et al.[9], Gramellini D al.[76], Fong KW et al.[11], etc) have analyzed the test performance of individual Doppler parameters in IUGR cases to predict the adverse outcome. However, we have studied the role of multivessel Doppler in predicting adverse perinatal outcomes in IUGR by stratifying the study group into 6 categories based on the increasing severity of Doppler abnormalities.

On Doppler examination, 10 of the 63 IUGR cases exhibited normal results. Except for low birth weight, none of these instances had an adverse perinatal outcome. The reason for this could be that these cases were only mildly affected and did not progress beyond the IUGR sequence of events' reduced growth phase. This finding was comparable to that of Benson et al.[12] who found that all IUGR infants with normal Doppler waveforms were healthy in gestation, despite having lower biometric values. All 53 cases with abnormal Doppler waveforms were analyzed for their perinatal outcome. Only 42 of them had adverse perinatal outcomes of some kind except low birth weight, the remaining 11 cases had a favorable perinatal outcome.

From these findings, it is obvious that a negative Doppler evaluation (normal Doppler findings) has a 100% predictive value for the outcome of an IUGR case, implying that all patients with a negative Doppler evaluation would have a better outcome without catastrophic perinatal problems. A positive Doppler evaluation without any grading of the abnormality, on the other hand, has a predictive value of just 79 %, meaning that only 79 out of every 100 instances with an abnormal Doppler test will have a serious consequence. It is comparable to the study conducted by Deependra et al.[85], which reported the PPV of abnormal Doppler as 78%.

To evaluate the link between arterial and venous Doppler and perinatal outcome in IUGR, Baschat et al.[13] divided their study group into three categories: 1) abnormal UA PI alone, 2) abnormal

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

UA PI and MCA PI (>2SD for mean gestational age = Brain sparing), and 3) DV or IVC peak velocity index > 2 SD for mean gestational age and pulsatile UV flow.

Similarly, we divided our study group into 6 categories based on the severity of Doppler abnormalities, which yielded the following statistics.

Category I - had a negative predictive value of 100%

Category II - had a negative predictive value of 80%

Category III - had a negative predictive value of 75 %

Category IV - had a positive predictive value of 92%

Category V - had a positive predictive value of 100%

Category VI - had a positive predictive value of 100%

This demonstrates the importance of categorizing the study group into categories based on the severity of Doppler abnormalities to accurately prognosticate IUGR cases, with Categories I to III having a high negative predictive value for adverse outcomes and Categories IV to VI having a high positive predictive value for adverse outcomes.

When the perinatal outcome was assessed based on the severity of Doppler abnormalities, it is obvious that the likelihood of adverse perinatal outcome increased significantly as the severity of Doppler abnormalities increased (P-value 0.0005). Similarly, there was a statistically significant increase in perinatal morbidity with increasing severity of Doppler abnormalities (P-Value – 0.0005). All perinatal deaths, including intrauterine deaths, neonatal deaths, and stillbirths, occurred exclusively when Doppler abnormalities were severe (Category V & VI). However, it does not exhibit statistical significance (P-value 0.062).

We also discovered that cases with mild Doppler abnormalities had a higher rate of adverse perinatal outcomes than those with marked Doppler abnormalities. In addition, our study reveals that the majority of the cases with marked Doppler abnormalities had worse perinatal outcomes (like mortality, GMH, IVH, IPH, MSL, Sepsis, NEC, NICU admission, HIE) as compared to the cases with mild Doppler abnormality. This is in line with the findings of Baschat et al.[13], who observed that the majority of severe problems were found in his research groups with aberrant MCA and DV Doppler.

Furthermore, our study reveals that,

- UA AEDF/REDF was highly associated with perinatal mortality (P value 0.006), with 100% sensitivity, 62% specificity, 25 % PPV, 100 % NPV & 66% diagnostic accuracy.

- DV A/R “a” wave was strongly linked to perinatal mortality (P-value 0.001), with a sensitivity of 85 %, specificity of 78 %, PPV of 33 %, NPV of 97 %, and diagnostic accuracy of 79 %.

- UV pulsatility was again strongly associated with perinatal mortality (P value 0.004) with 100% sensitivity, 73% specificity, 28% PPV, 98 % NPV, and 75 % diagnostic accuracy.

5. Conclusion

We concluded that multivessel Doppler ultrasonography can effectively stratify IUGR fetuses into risk-based categories and has a higher prognostic value. Therefore, rather than using a single Doppler parameter to evaluate IUGR pregnancies, multivessel Doppler parameters should be used. When it comes to predicting perinatal mortality, UA AEDF/REDF is a better screening modality as it has higher sensitivity than DV A/R “a” wave and UV pulsatility. UA AEDF/REDF, DV A/R “a” wave and UV pulsatility are all alarming signs that suggest a poor prognosis and a high death rate and therefore immediate intervention is warranted. Growth-restricted fetuses with normal Doppler parameters are at a lower risk than those with abnormal Doppler parameters in terms of adverse perinatal outcomes, where expectant management will suffice.

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

References

1. Odibo AO, Riddick C, Pare C, Stamilio DM, and Macones GA: Cerebroplacental Doppler ratio and adverse perinatal outcomes in intrauterine growth restriction: evaluating the impact of using gestational age-specific reference values, J Ultrasound Med2005; 24(9):1223-8.
2. Jardosh Y, Mahesh K, Purvi Desai. ColourDoppler study in the evaluation of Intrauterine Growth Restriction. Int J Sci Res 2016;5(8):932-5.
3. Lakshmi V, Indira K, Neeraja M, P Chandrashekhar Rao. Role of Doppler in pregnancy-induced hypertension and IUGR. Int J Res Health Sci. 2015;3(1):191-8. 8.
4. Lakhkar BN, Rajagopal KV, Gourisankar PT. Doppler prediction of adverse perinatal outcome in PIH and IUGR. Indian J Radiol Imaging. 2006; 16(1):10-16.
5. Martin et al..., 2002. Final data for 2001. National vital statistics reports. Vol.51, No.1, 2002.
6. Manoj Kumar Veerabathini, Sudhanshu Sekhar Mohanthy, Nilanjan Mukherjee, Aavula Adarsh, B Arun Kumar, Girendra Shankar. Role of color Doppler in the evaluation of intrauterine growth retardation. International Journal of Contemporary Medicine Surgery and Radiology. 2020;5(1):A148-A152.
7. PChitrarasan; S Kanagarameswarakumaran. Role of obstetric Doppler in prediction of adverse perinatal outcome in intrauterine growth retardation. International Journal of Advances in Medicine, 2017;4(2):529-533.
8. Kushal Gandhi, Ami Vishal Mehta. Role of Doppler Velocimetry in growth restricted fetuses. NHL J. of Medical Sciences, 2015; 4: 27-30.
9. Arduini D, Rizzo,Romanini C. Changes of pulsatility index from fetal vessels preceding the onset of late decelerations ingrowthretardedfetuses.ObstetGynecol1992;79:605–10
10. Gramellini D, Folli MC, Raboni S, Vadora E, et al... Cerebral-umbilical Doppler ratio as a predictor of adverse perinatal outcome. ObstetGynecol 1992; 79: 416– 420.
11. Fong KW, Ohlsson A, Hanah Me, Kingdom J et al.. - Prediction of Perinatal Outcome in Fetuses Suspected to Have Intrauterine Growth Restriction. Doppler US Study of Fetal Cerebral, Renal, and Umbilical Arteries - Radiology 1999;213:681-689.
12. Kurmanacricius J, Florio J, Wisser J, Hebisch G, Zimmermann B, Muller R, Huch R, Huch H. Reference resistance indices of the umbilical, fetal middle cerebral, and uterine arteries at 24- 42 weeks of gestation. Ultrasound Obstet Gynecol.1997;10:112-20.
13. Baschat AA, Gembruch U, Reiss I, Gortner L, et al... Relationship between arterial and venous Doppler and perinatal outcome in fetal growth restriction. Ultrasound Obstet Gynecol. 2000 Oct;16(5):407-13.