ORIGINAL ARTICLE

Effect of Color Doppler Indices on the Diagnosis of Intrauterine Growth Restriction in High-Risk Pregnancies: A Cross-Sectional Study

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ABSTRACT

Aim: To assess the effect of Color Doppler indices on intrauterine growth restriction diagnosis in high-risk pregnancies

Study design: Across-sectional study

Place and duration: This study was conducted at Al Shifa Hospital Quetta, Pakistan. from January 2020 to July 2020.

Methodology: In this study, 100 patients with suspected intrauterine growth restriction (IUGR) in their 31 to 41 weeks of pregnancy have participated. The patients were studied till the babies were delivered. The Doppler indices and the grayscale results were correlated to the baby's weight.

Result: The HC/AC ratio was found to be sensitive (84.4%). Whereas the most specific was oligohydramnios and C/U ratio that was 100% and 68.8% respectively. The lowest sensitivity was of the fetal MCA, which was 7.7%.

Conclusion: For the diagnosis of IUGR, the highest specific parameter is oligohydramnios and the HC/AC ratio is very sensitive. However, the MCA PI should not be utilized for screening purposes in IUGR because it has very low sensitivity alone. C/U ratio is notably more specific than HC/AC ratio and more sensitive than oligohydramnios. It is the most appropriate parameter to use for the diagnosis of IUGR in the 3rd trimester.

Keywords: IUGR,Fetal Doppler, Placentation and IUGR, C/U pulsatility ratio, Small for gestational age

INTRODUCTION

High-risk pregnancies are more likely to complicate Intra Uterine Growth Retardation (1, 2). The antenatalexamination is mostly conducted in the third trimester in such patients. Ahighly specific and sensitive, noninvasive test is needed (3). The reason behind conducting this study is to find out the role of ultrasonography in screening pregnant women to detect IUGR if the fetal parameters affect the intensity of IUGR, the different fetal parameters and their sensitivities, their comparison with each other and with the birth weight, and the relationship between birth weight and the sonographic pattern of IUGR.

METHODOLOGY

The study was done with the consent of the patients between the periods from January 2020 to July 2020.Permission was taken from the ethical review committee of the institute. The patients were scanned for their Doppler parameters and the greyscale, and the patients were studied till the babies were delivered. The total number of patients was 118. However, 18 of them were lost in follow-up. Therefore, 100 patients were observed and their baby's mode of delivery and weight at birth were noted.

A few parameters were needed for the study. The first criteria for inclusion were that the woman's last menstrual cycle should be fully known. The second was gestational age of the woman being observed lay between 31 to 41 weeks. The third criteria was that the pregnancy was single. The final criteria was that the woman had been diagnosed case of IUGR.The criteria for exclusion were congenital anomalies in fetus and more than one pregnancy.

The given format was used for evaluating the patients of the study:Ultrasonographic evaluation, thorough clinical history of the patient, and laboratory workup. Scanning techniques include Biparietal Diameter that was measured using scan was the one that showed thalami, the widest diameter of the interhemispheric fissure, and 2 lateral ventricles. The transducer was placed between the bladder and the heart at a right angle for abdominal circumference and measured with electronic calipers (4).After locating the femur, the clinician defined the ends of the calcified portion of the femur. The measurement of Amniotic fluid volume was done by observing the deepest vertical pocket of amniotic fluid that does not have any fetal parts or umbilical cord. If a measurement was less than 2 cm, it was oligohydramnios (5). If it lay in the range of 2 to 8 cm, it was considered to be normal. If the largest pocket was greater than 8 cm, it was taken aspolyhydramnios.

The placental site was first identified to study the uterine artery. Uterine artery of that side was observed if the placenta was unilateral. The pulsatility index and the waveforms of the contralateral uterine artery were observed for comparison. The two uterine arteries were observed for the central placenta. For the examination of the umbilical artery, an appropriate amniotic fluid pocket was selected which has the umbilical cord in it.

Measurements were taken at three points, near placenta, at mid free floating part and near fetal umbilicus (6). The values of the pulsatility index were noted and their average was taken. An axial view of the head of the fetus was taken for the examination of the MCA, arising as main lateral branch of Circle of Willis, using the color Doppler (7). The final step was placing the Doppler samples within 1 cm of the MCA's origin.

The Pulsatility Index requires digitalized waveform analysis to calculate the mean frequency. The formula is:

$$PI = \frac{S - D}{\text{Mean of Frequencies}}$$

The PI ratio of MCA and umbilical artery were taken. This ratio was compared the HC/AC ratio and birth weight. The fetal parameter was considered normal if it was within ±2SD. However, considered abnormal if more or less than ±2SD. Statistical analysis was carried out by finding out the deviation from mean gestational age. Each parameter's sensitivity was found. T-test was utilized for statistical analysis. A P value of 0.05 was deemed important. SPSS version 22 was used for data analysis.

RESULTS

The patients' ages were between 18 to 40 years. Most of the observed patients, around 48% of all patients, were 21 to 25 years of age. Most cases (48%) were primipara. Around 31% of the patients were at risk due to PIH. Whereas 20% of the women had history of growth-retarded babies. Out of all the cases, 11% were without any risk factor .In 21–25-years age group, most cases (65%) were found with history of IUGR. In 31% of the patients, their gestational age at examination was 35 to 37 weeks. Whereas in 28% of the patients, it was 33 to 35 weeks. Together, these groups made 59% of the total pregnancies being observed. The lateral position of the placenta was mostly linked with SFD cases (22%) as compared to AFD cases (10%). Whereas in both SFD and AFD cases, an anterior position of the placenta was commonly noted. Babies with low birth weight were delivered in 88% of the high-risk pregnancies. The classification of newborns' weight was done using the Lubchenco classification, that

is, low birth is <2500g weight, and an appropriate weight is >2500g. 29% of the newborns weighed in the range of 2 kg to 2.1 kg. In the detection of SFD cases, the sensitivity of the HC/AC ratio was 22%, with a specificity of 99.99%, a negative predictive value of 13, and a positive predictive value of 99.89. The relationship between abnormal outcome (SFD) and abnormal HC/AC was also noticed (p-value 0.0001). The correlation between abnormal outcome (SFD) and oligohydramnios was not significant (p-value 0.2). Another significant relationship was noticed between the outcome of cesarean section and abnormal uterine artery PI (p-value 0.0098). The relationship between an outcome of cesarean section and abnormal umbilical artery PI was not found to be important (p-value 0. 1409). The correlation between an outcome of cesarean section and an abnormal fetal MCA PI was also not significant (p-value 0. 15). The relationship between an outcome of cesarean section and abnormal C/U ratio was not found to be very important (p-value 0. 93). PIH was found in largest number of cases that is 31% of the patients in our study. PIH cases were present mostly in the 21–25-year group (16/31). In the detection of SFD cases, the sensitivity of the HC/AC ratio was 85%, and 89% specificity, a negative predictive value of 12, and a positive predictive value of 99 (As shown in Table 1).

Oligohydramnios is a very good predictor of abnormal fetal outcomes (7). The patients in our study were diagnosed with oligohydramnios if the depth of their amniotic fluid vertical pocket<2 cm. In the detection of IUGR, the sensitivity of oligohydramnios was 22%, with a 99.99% specificity, a negative predictive value of 13, and a positive predictive value of 99.89 (As shown in Table 2). In most cases, the pervaginal delivery occurred (64%). LSCS was used for delivery in 36% of cases. Fetal distress was the most frequent indication for LSCS (8). In 89 newborns, the weight was less than 2500 g. While normal weight that is a weight of more than 2500 g, was observed in 10 newborns (As shown in Table 3). The UA Doppler indices' sensitivity for the identification of abnormal fetal outcome was 38%, a negative predictive value of 12, a positive predictive value of 92, and a specificity of 69% (As shown in Table 5).

Table 1: HC/AC ratio to detect abnormal fetal outcome

Fetal outcome	Number of findings				Sensitivity	Specificity	Predictive value	
	TP (a)	FP (b)	TN (d)	FN (c)	a/ (a + c)	d/ (b + d)	Positive a/ (a + b)	Negative d/ (c + d)
SFD	77	2	10	15	85%	89%	99	12

Table 2: Oligohydramnios' predictive value to detect abnormal fetal outcome

Fetal outcome	No. of findings				Sensitivity	Specificity	Predictive value	
	TP (a)	FP (b)	FN (c)	TN (d)	a/ (a + c)	d/ (b + d)	Positive a/ (a + b)	Negative d/ (c + d)
SFD	20.0	0	72.0	11.0	22.0%	99.99%	99.89	13

Table 3: Perinatal outcome distribution

Perinatal Outcome	Number of Patients	Percentage (%)
Normal birth weight (AFD)	10	10
Perinatal mortality	1	1
Low birth weight (SFD)	89	89
	100	100

Table 4: Cases distributed based on abnormal and normal umbilical, uterine, and MCA indices

Doppler Index (PI)	Number of cases	Percentage
Normal UA Doppler indices	64	64
Abnormal UA Doppler indices	40	40
a. Increased Doppler indices	30	30
b. Increased Doppler indices and diastolic notch	10	10
Normal UA Doppler indices	39	39
Abnormal UA Doppler indices	58	58
a. Reduced end-diastolic velocity	30	30
b. Absent end-diastolic velocity	15	15
c. Reversed end-diastolic velocity	1	1
Normal MCA Doppler Indices	91	91
Abnormal MCA Doppler Indices	7	7
Normal cerebral/umbilical Doppler index	40	40
Abnormal cerebral/umbilical Doppler index	59	59

Table 5: Predictive value of Doppler for detecting abnormal fetal outcome

Doppler Indices	No. of findings				Sensitivity	Specificity	Predictive value	
	TP (a)	FP (b)	TN (d)	FN (c)	a/ (a + c)	d/ (b + d)	Positive a/ (a + b)	Negative d/ (c + d)
UA Doppler Indices	35	4	8	58	38%	69%	92	12
UMA Doppler Indices	60	3	9	31	65%	79%	87.2	19
MCA Doppler Indices	11	2	10	84	9%	88%	88.2	10
C/U Ratio	59	0	11	30	70%	100%	100	27

DISCUSSION

The purpose of this study was to understand the role of ultrasonography in identifying IUGR in women with high-risk pregnancies. Therefore, we could reduce and prevent maternal and infant mortality and morbidity rates. We studied cases where the patients were at a high risk of IUGR, or a patient was suspected to have IUGR even though there were no risk factors involved in her pregnancy. The patients were observed till the babies were delivered. On delivery, the weight of the newborn and the mode of delivery were noted. In our study, only in 15% of the cases, the mother's age was above 30 years. Therefore, we observed that women in active reproductive age groups were at higher risk. IUGR and Primipara were found to have a significant association (48%).

In the Doppler ultrasonography, for the central placenta, bilateral uterine arteries were observed (9). For the case of the unilateral placenta, the main branch of the uterine artery was observed (10). In the 100 cases that were observed, 40 patients were noted to have abnormal uterine artery indices. Out of these 40 cases, in 10 cases, increased Doppler indices with uterine artery diastolic notch were observed. In the leftover cases, only abnormal uterine artery PI without diastolic notchingwas noticed. The caesarian section was done alot more in both groups. In 20 out of 40 cases with abnormal uterine artery, a cesarean section was carried out. The adverse outcome was noticed in all 10 patients that showed early diastolic notching. The results of our study showed that if the Doppler indices increase along with the diastolic notch, then it is considered as a bad sign. If this is noticed, the fetus and mother require proper surveillance and intervention (11).

After Doppler ultrasound was introduced in obstetrics, the artery that has been studied the most is the umbilical artery (12). Adverse outcomes of pregnancy, such as fetal hypoxia or IUGR, are generally linked to the absence of diastolic flow (13). According to the results of ARFV, there

is a significant relationship between acidosis and hypoxia (14). Our findings were: 31 cases out of 60 cases were seen to have a decreased end-diastolic flow and 26 patients out of 31 suffered adverse fetal outcomes. In 15 cases, the absent end-diastolic flow was found. While revered end-diastolic flow was found in 1 case (Table 4). On SFD outcomes, every single patient displayed reduced forward diastolic flow. The one patient that did display reversed end-diastolic flow ended in perinatal death. Therefore, ultimate reversal and changes in diastolic flow could have a relationship with the severeness of fetoplacental insufficiency (15).Twenty-six women out of sixty had cesarean section and the frequency of the C-sections with abnormality in the UA Doppler waveforms was 43.3%. In our study, the UMA Doppler Indices' sensitivity was 65%, a negative predictive value of 19, a positive predictive value of 87.2, and a specificity of 79% (Table 5).

In our study, the MCA (middle cerebral artery) Doppler Waveform's sensitivity was 9%, a negative predictive value of 10, and positive predictive value of 88.2, and a specificity of 88% (Table 5). Out of the 100 patients observed, abnormal MCA indices were noted in 7 cases (Table 4). Five out of the seven women had a cesarean section done.

The C/U ratio has been noticed as one of the more specific and sensitive predictors of bad outcomes for the fetus such as IUGR (16). This ratio is better in predicting adverse perinatal outcomes compared to UA PI and MCA PI utilized alone (17). Fetal distress cannot be identified with just MCA PI. Therefore, the C/U ratio effect is the most reliable (18). In our study, the C/U ratio's sensitivity was 70%, a negative predictive value of 37, a positive predictive value of 100, and a specificity of 100%.

One of the most common causes of asymmetric IUGR is pregnancy-induced hypertension (19). This is most common for women who are 21 to 25 years of age. The incidence of intrauterine growth retardation is also

associated with the laterality of the placenta (20). The reason behind this factor is the unilateral uterine artery supplies the placenta.

CONCLUSION

To diagnose intrauterine growth retardation, oligohydramnios is used as it is a very specific parameter. However, it is not sensitive. One of the more sensitive ratios is the HC/AC ratio but it is not as specific. C/U ratio in doppler ultrasound is the extremely sensitive parameter that is used to check for fetal well-being and is compromised in PIH. As compared to the umbilical artery PI, the C/U ratio is more sensitive and more specific. It is well suited for diagnosing and predicting adverse perinatal outcomes. The MCA PI should not be utilized for screening purposes in IUGR because it has very low sensitivity alone. C/U ratio is notably more specific than HC/AC ratio and more sensitive than oligohydramnios. It is the most appropriate parameter to use for the diagnosis of IUGR in the 3rd trimester.

Ultimate reversal and changes in diastolic flow were noticed to have a link with this severeness of fetoplacental insufficiency. Therefore, identifying these results will help in early intervention and therapy. To identify the severity of PIH, uterine artery color Doppler is used. In conclusion, there is an urgent requirement of standardizing Doppler terminology as well as finding the reference values of Doppler indices to compare with other studies.

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