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Original Research Article

A retrospective study of umbilical artery S/D ratio assessment on color doppler for monitoring of fetal well-being in patients with intrauterine growth retardation and its correlation with perinatal outcomes

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ABSTRACT

Background: Intrauterine growth restriction (IUGR) is associated with an increased risk of perinatal morbidity, mortality and impaired neurodevelopment. The objective of this study is to evaluate the role of umbilical artery S/D ratio on color doppler for monitoring of fetal well-being in patient with intrauterine growth retardation and correlation with perinatal outcome.
Methods: This retrospective observational study is carried out at a tertiary health care hospital over a period of 1 year. All clinically diagnosed cases of IUGR on the basis of fundal height are included in this study. The suspected cases of IUGR, color doppler tests were done to confirm the diagnosis of IUGR. The perinatal outcomes of the pregnancy of women with abnormal doppler parameters are then compared with women with normal Doppler parameters.
Results: Out of the total sample size, 58.7% of the study population had abnormal doppler findings which were suggestive of IUGR, and 41.3% had normal doppler parameters. Our study showed that 18.2% newborns of study participants with abnormal S/D ratio had APGAR score at 5 minutes less than 7 as compared to 0% neonates of study participants with normal S/D ratio. This association was statistically significant. Also, statistically significant association was seen between 40 (90.9%) participants having abnormal S/D ratio whose neonates required NICU Admission as compared to 15 (48.4%) study participants having normal S/D ratio whose babies required NICU admission.
Conclusions: Ultrasound examination and Doppler monitoring provide a non-invasive repetitive method for supervising fetuses with growth restriction in order to apply an adequate management.

Keywords: Umbilical artery doppler, IUGR, Non-invasive test

INTRODUCTION

Intrauterine growth restriction (IUGR) is associated with an increased risk of perinatal morbidity, mortality and impaired neurodevelopment.[1]

According to ACOG guidelines, a fetus with IUGR is a fetus with an estimated weight less than 10th percentile for gestational age.[2] With a prevalence of 5-8% in the general population, IUGR can complicate 10-15% of all pregnancies.[3]

Ultrasonographic biometry helps to identify a heterogenous group of small for Gestational age fetuses that include fetuses with IUGR, fetus with small constitution, and fetuses with appropriate growth. The correct detection of the compromised IUGR fetus to allow for timely intervention is the main objective of antenatal care.

IUGR represents the second cause of perinatal mortality after prematurity, and it is related to an increased risk of perinatal complication as hypoxemia, low APGAR scores

and cord blood acidemia with possible negative effects for neonatal outcome.[4]

The maintenance of good utero-placental circulation is necessary to continue a normal pregnancy. The progression of pregnancy is marked by a number of changes and adaptations in the maternal, placental and fetal vasculature[5].An inability to adapt to these changes results in the development of abnormal vascular resistance patterns, which might consecutively lead to compromise of fetal well- being and ultimately IUGR.[6]

A number of indices based on color Doppler flowmetry have been proposed to evaluate the risk of IUGR in an ongoing pregnancy such as Umbilical artery S/D ratio, the pulsatility and resistive index of the umbilical artery and that of middle cerebral artery (MCA) and S-wave/isovolumetric A wave index of ductus venosus (DV) in predicting fetal growth restriction.[7,8]

Umbilical artery doppler velocimetry is the most rigorously evaluated test amongst the non-invasive tests of fetal well-being.

In the present study, an attempt has been made to evaluate the efficacy of umbilical artery S/D ratio on color doppler in patients with intrauterine growth retardation and its correlation with perinatal outcomes.

METHODS

The present study is a retrospective observational study of clinically diagnosed cases of IUGR based at MGM women's hospital, Kalamboli, Navi Mumbai over a period of 1 year (i.e. March 2021 to March 2022).

All pregnant females clinically diagnosed with intra-uterine growth restriction who had attended the antenatal outpatient department in our hospital who were willing for USG Doppler after counselling.

A sample size of 75 pregnant females were included in this study. Written and informed consent was taken from all patients.

All pregnant women registering in the 1st or 2nd trimester who attended our antenatal clinic were included for the study. Pregnancies were dated by the combination of last menstrual period and the first trimester dating scan. Each patient were evaluated for fetal malformations prior to the study. These women underwent a basal ultrasound examination to confirm the clinical diagnosis of IUGR and were subjected to do a color doppler test.

Detailed history, clinical examination and some basic laboratory investigations were recorded. Various studies were done to compare severity of IUGR, fetal well-being and compare their perinatal outcome with all studies. Color Doppler was performed as soon as IUGR was suspected.

Arterial doppler provides information in early compensatory phase of IUGR. Abnormalities in Doppler flow characterize early versus severe fetal growth restriction and represents transition from fetal adaptation to fetal failure. Umbilical artery doppler is a good test to predict adverse perinatal outcome. Umbilical artery S/D ratio is the most sensitive index in predicting any adverse outcome.

This study aims at evaluating the prognostic value of umbilical artery velocimetry in predicting the poor outcome in IUGR fetuses.

Inclusion criteria

This study includes all pregnant patients registering in antenatal OPD in tertiary hospital and who are clinically diagnosed cases of IUGR, and those having Singleton pregnancies with well documented dates.

Also, this study includes, patients with clinical suspicion of IUGR and those willing for a color doppler test with due consent.

Exclusion criteria

The study excludes patients with Multiple pregnancies, patients with Uncertain dates and patients with USG suggestive of fetus with congenital malformation. Also, this study excluded Patients seen first time in labour and those who were not willing for the diagnostic tests.

Statistical analysis

Data thus collected on the preformed questionnaire was analysed using SPSS version 21.

The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were determined for the Doppler study.

Standard treatment was given to all the patients of suspected IUGR.

After delivery, birth weight was measured on a weighing machine, anthropometry was measured. Baby anthropometry i.e. Length, head circumference, abdominal circumference were measured. Ponderal index was calculated. Ponderal index of <10 indicates growth restriction.

RESULTS

The age of the women enrolled in the study ranged from 18 years to 40 years age. Majority of the participants i.e. 65% were in the age group of 21-30 years followed by 29% in the age group of 31-40 years.

Few study participants (5.3%) were below 20 years age.

Table 1: Distribution of study group as per age.

Age in years)	N	Percentages (%)
Less than 20	4	5.3
21 to 30	49	65.3
31 to 40	22	29.3
Total	75	100

Table 2: Distribution of study group as per.

UA S/D ratio	N	Percentages (%)
Abnormal	44	58.7
Normal	31	41.3
Total	75	100

In present study, 52% of participants were multigravida whereas 48% participants were primigravida.

Study group who was clinically suspicious for IUGR were then subjected to umbilical artery S/D color doppler study.

Out of the total sample size, 58.7 percent of the study population had abnormal doppler findings which were suggestive of IUGR, and 41.3% had normal doppler parameters.

Table 4 describes the association of S/D ratio in color doppler examination with preterm deliveries 21 (47.7%) participants with abnormal S/D ratio delivered preterm as compared to 9 (29.09%) with normal S/D ratio.

But statistically significant association was not seen between preterm delivery and abnormal S/D ratio.

Table 4 shows that 40 (90.9%) participants having abnormal S/D ratio required NICU Admission as compared to other study participants 15(48.4%) having normal S/D ratio.

This difference was statistically significant.

The above Figure 1 shows, 32 (72.7%) participants having abnormal S/D underwent cesarean section as compared to 18 (58.1%) study participants with normal S/D ratio.

It describes that fetal distress was indication of 23 (71.8%) study participants with abnormal S/D ratio whereas 6 (33.4%) participants with normal S/D ratio.

The Table 6 shows 50% of the study participants having birth weight less than 2 kg had abnormal umbilical artery

Table 3 describe the various findings of ultrasonographic biometry.

In this study, of 75 study participants, abnormal biparietal diameter, head circumference, abdominal circumference and femur length were observed in 58.7%, 64%, 90.7% and 77.3% respectively.

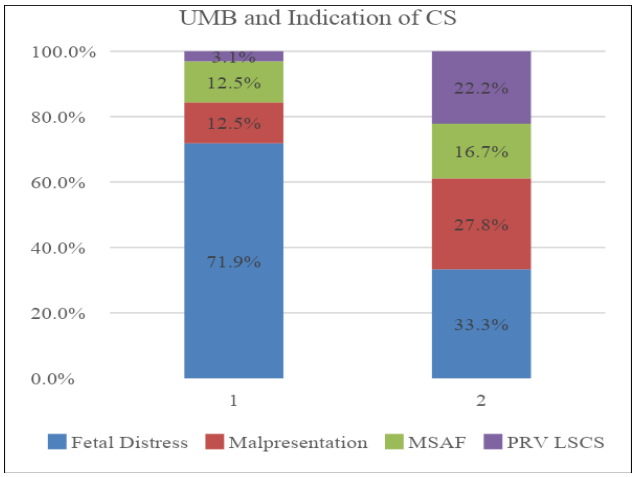

Figure 1: Association of umbilical artery S/D ratio and indication of cesarean section.

S/D ratio as compared to 25.8% participants had normal S/D ratio.

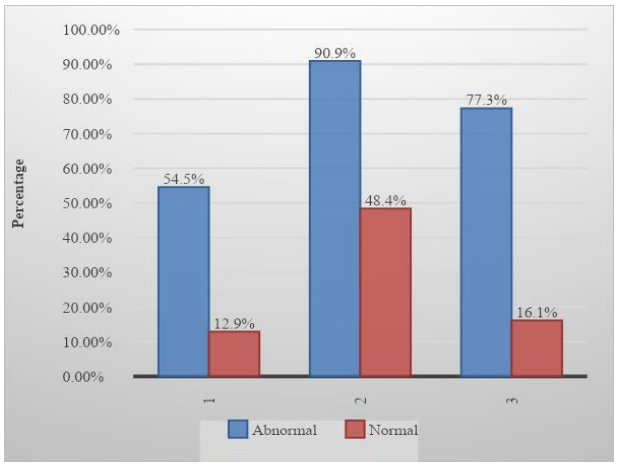

Figure 2: Depicting the relationship between umbilical artery S/D ratio and adverse neonatal outcomes.

Figure 2 shows the relationship between umbilical S/D ratio and adverse neonatal outcomes such as need for NICU admission and need for resuscitation.

Table 3: Distribution of study group as per ultrasonographic biometry.

Variables	N	Percentages (%)
Distribution of study group as per biparietal diameter		
DOP BPD		

Continued.

Variables	N	Percentages (%)
Low	45	60
Normal	30	40
Total	75	100
Distribution of study group as per head circumference		
DOP HC		
Low	48	64.0
Normal	27	34.7
Total	75	100
Distribution of study group as per abdominal circumference		
DOP AC		
Low	68	90.7
Normal	7	8.0
Total	75	100
Distribution of study group as per femur length		
DOP FL		
Low	58	76
Normal	17	22.7
Total	75	100

Table 4: Association of umbilical artery S/D with perinatal outcome.

UMB S/D		Gestational age (week)		Total
		Preterm	Term	
Abnormal	N	21	23	44
	%	47.7	52.3	100.
Normal	N	9	22	31
	%	29	71	100
Total	N	30	45	75
	%	40	60	100
Chi-square test	**Value**	**Df**	**P value**	**Association is**
Pearson chi-square	B	1	0.104	Significant
Continuity correction	1.927	1	0.165	Significant
Fisher's exact test			0.151	Significant

Table 5: Association of umbilical artery S/D ratio and mode of delivery.

Umbilical artery S/D ratio	Cesarean section, N (%)	Vaginal delivery, N (%)	Total, N (%)
Abnormal	32 (72.7)	12 (27.3)	44 (100)
Normal	18 (58.1)	13 (41.9)	31 (100)
Total	50 (66.7)	25 (33.3)	75 (100)

Table 6: Association of umbilical S/D ratio with birth weight.

UMB S/D		Birth weight			Total
		Below 2000 gm	2000 to 2500 gm	More than 2500 gm	
Abnormal	N	22	22	0	44
	%	50	50	0	100
Normal	N	8	22	1	31
	%	25.8	71	3.2	100
Total	N	30	44	1	75
	%	40	58.7	1.3	100
Chi-square test	**Value**	**Df**	**P value**	**Association is**	
Pearson chi-square	5.444	2	0.066	Not significant	

Table 7: Association among study group between umbilical artery S/D and APGAR Score at 5 min.

UMB S/D		A. S. 5 min		Total
		Less than 7	7 and above	
Abnormal	N	8	36	44
	%	18.2	81.8	100
Normal	N	0	31	31
	%	0	100	100
Total	N	8	67	75
	%	10.7	89.3	100
Chi-Square test	**Value**	**Df**	**P value**	**Association is**
Pearson chi-square	6.309	1	0.012	Significant
Continuity correction	4.546	1	0.033	Significant
Fisher's exact test			0.018	Significant

Table 8: Association among study group between UMB S/D and NICU admission.

UMB S/D		NICU AD		Total
		Yes	No	
Abnormal	N	40	4	44
	%	90.9	9.1	100
Normal	N	15	16	31
	%	48.4	51.6	100
Total	N	55	20	75
	%	73.3	26.7	100
Chi-square test	**Value**	**Df**	**P value**	**Association is**
Pearson chi-square	16.816	1	0.000	Significant
Continuity correction	14.711	1	0.000	Significant
Fisher's exact test			0.000	Significant

DISCUSSION

The present study is a retrospective study conducted in a tertiary health care hospital that included 75 suspected IUGR patients. The Study was carried out over a period of 1 year.

In our study, maximum number of cases i.e. 49 (65.3%) were seen in the age group of 21-30 years of age, as this is the optimum age for reproduction in India. In a study conducted by Acharya in their study of 101 cases of IUGR and 202 controls showed that 77 (76.2%) cases were between the age group of 20 to 30 years of age which was comparable to our study.[9]

In our study, fundal height was measured by a non-elastic tape calibrated in centimeters applied over the abdominal curvature from the upper edge of the pubic symphysis to the upper edge of the uterine fundus, which was identified by palpation. In our study 75 cases had fundal height less than expected for that gestational age. Field et al in his studies showed that fundal height measurement has a sensitivity of 70% for IUGR.[10]

In our study, 44 (58.7%) cases had S/D ratio above 3 and 31 (41.3%) cases had normal S/D ratio (i. e., <3). Sekizuka et al in a cross-sectional study showed that in abnormal pregnancies complicated by pregnancy induced hypertension and IUGR, the incidence of adverse perinatal outcome was significantly higher in patients with abnormal spiral artery resistance indices.[11] With the progression of pregnancy, the umbilical artery S/D ratio becomes a useful tool to predict IUGR.

In our study, 50(66.7%) study participants underwent LSCS. Fetal distress, malpresentation, MSAF and previous lower segment cesarean section were the indications for LSCS in 29,9,7 and 5 study participants respectively.

In our study, 2 (2.7%) babies had severe IUGR with birth weight less than 1 kg, 5 (6.7%) babies had moderate IUGR with birth weight 1-1.5 kg, 68 (90.6%) babies had mild IUGR with birth weight 1.5-2.5 kg. Bais in his study on IUGR has shown delivery by cesarean section was most prevalent in severe IUGR (24%), less in moderate IUGR (8%), and low in AGA cases (4%).[12]

In our study, significant association was seen between neonatal adverse events and S/D ratio in color Doppler examination. The 34 (77.3%) of newborns with poor outcome has abnormal S/D ratio compared to 10 (22.7%) newborns with normal outcome, this difference was statistically significant.

In terms of fetal distress, 40.9% of newborns having distress had abnormal S/D ratio compared to 16.1%

newborns having distress had normal S/D ratio. The difference was statistically significant.

The 40 (90.9%) newborns required NICU admission had abnormal S/D ratio compared to 4 (9.1%) newborns without NICU admission. Similarly, statistically significant difference was noted between newborns with normal and abnormal S/D ratio in terms of resuscitation, APGAR Score at one and five minutes, gestational age at delivery.

Limitations

A major limitation of the study in assessing the accuracy of tests for predicting FGR is the outcome measures utilized in our study. There is still no convincing evidence on which is the best definition of FGR at birth or which is the best predictor of future infant and childhood morbidity and mortality for term infants. Another limitation of the study is the limited number of studies that met the inclusion criteria, and the small sample sizes of those that did.

CONCLUSION

The findings in the present study thus suggest that Doppler flowmetry is a useful method for the prediction of IUGR in high-risk pregnancies. Worldwide accepted guidelines about fetal growth restriction monitoring are not available and the decision to deliver a preterm IUGR Fetus still remains one of the great challenges in obstetrics. The findings of the present study must be viewed in context with a high risk population with clinical suspicion of IUGR.

Further cross-sectional studies on a larger population are recommended for pregnant women with different risk levels.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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