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A prospective study on role of Doppler ultrasound in prediction of perinatal outcome of cases of Intrauterine Growth Retardation

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Abstract
Objectives: *This study was used Doppler ultrasonograpy to evaluate the abonrmalities in fetuses of women with clinical suspicion of IUGR.*
Methods: *A detail history, clinical examination and relevant investigations were performed to all cases. Parameters was used included Doppler indices like Pulsatility Index (PI) values of the Umbilical Artery (UA), the Middle Cerebral Artery (MCA) and the descending Thoracic Aorta (TA) of the foetus and the ratio of the PI values of MCA to UA (cerebroplacental ratio).*
Results: *Data was analyzed by using simple statistical methods with the help of MS-Office software.*
Conclusions: *Women with less than 30 years age group was more common to develop IUGR. Majorities of women were undergone caesarean section. Changed EDF was very common in both umbilical artery and thoracic artery of foetuses. AEDF was commonly seen in umbilical artery. Majorities of babies who had MCA and UA abnormality were admitted in NICU. Majorities of cases of caesarean section had foetal distress. Perinatal death was commonly seen in foetal with MCA involvement. Hence, we were found that Doppler ultrasonography is one of the best investigative modalities to diagnose intrauterine growth retardation.*
Keywords: *Doppler ultrasonography, IUGR, EDF, AEDF.*

Introduction
IUGR is defined as a foetus that has failed to achieve a specific and arbitrary anthropometric or weight threshold (<10th percentile) by a specific gestational age due to some pathologic process that inhibits expression of the normal intrinsic growth potential.[1] SGA is a statistical definition while IUGR is a clinical definition and includes neonates with clinical evidence of malnutrition. It can be symmetric (33%), asymmetric (55%) or mixed (12%). Several factors either maternal foetal or placental can lead to IUGR, commonest being Placental insufficiency (pre eclampsia chronic HT, DM, renal disease, cardiac disease, anaemia) 75-80%, maternal condition not associated with Placental insufficiency (Severe malnutrition, Smoking, Alcohol ingestion, Hemoglobinopathies) 5%, Foetal chromosomal

abnormality 5%, Multifactorial foetal abnormalities 2-3 %, Foetal infections 1%. It is associated with an increased risk of perinatal mortality, morbidity, and impaired neurodevelopment.[1,2] Thus, prediction of risk and correct detection of the compromised IUGR foetus to allow for timely intervention is a main objective of antenatal care. Clinical examination as well as ultrasound parameters helps in early detection of IUGR. The most common methods for evaluating health in foetuses identified as SGA have been the biophysical profile (BPP) and the non-stress test (NST). Unfortunately, neither of these tests is particularly sensitive for predicting poor outcome in IUGR pregnancies. Ultrasound is frequently utilized in antenatal period to assess foetal size through serial biometric measurement, amniotic fluid index and the velocimetry analysis of UA and MCA.[3] It is here that role of Colour Doppler comes to detect these abnormal vascular resistance patterns.[4]

Objectives of our study were to evaluate the role of Doppler ultrasound to detect uteroplacental insufficiency and acid base status of foetuses of intra uterine growth retardation.

Materials & Methods

This present study was conducted in department of Obstetrics & Gynaecology, with collaboration of department of Radiology, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India.

A total of 100 pregnant women of clinical suspicion of IUGR with age 18 to 38 years were enrolled in this study. Attendants/patients signed an informed consent approved by institutional .

ethical committee of Anugrah Narayan Magadh Medical College, Gaya, Bihar was sought. Data was collected during a period from October 2017 to March 2018.

Methods

A detail history, clinical examination and relevant investigations were performed to all cases. Patients were on regular follow up. Doppler Ultrasonography was performed to all cases.

Study parameters included Doppler indices like Pulsatility Index (PI) values of the Umbilical Artery (UA), the Middle Cerebral Artery (MCA) and the descending Thoracic Aorta (TA) of the foetus and the ratio of the PI values of MCA to UA (cerebroplacental ratio).

Statistical Analysis

Data was analyzed by using simple statistical methods with the help of MS-Office software.

Observations

A total of 100 cases of pregnant women with age group 18 to 38 years were enrolled in this study. Mean age group was 25.91years. 80% women were below the age of 30 years. 14% women were preexisting illness. 30% women had significant past history. And majorities of women 55% were multigravida. 32.6 weeks was the mean foetal gestational age during the time of Doppler ultra sound examination. On Doppler ultrasound study mean foetal birth weight was found 1995 grams. Abnormality was found in 60% fetuses. Abnormal pulsatility index (PI) values was found in middle cerebral artery (MCA) 0f 40 foetuses, umbilical artery of 35 foetuses and thoracic aorta of 25 foetuses.

Table.1. Changes of end diastolic flow (EDF) in each vessels (N=28).

MCA	UA	TA	UA+TA	MCA+UA	MCA+TA	MCA+UA+TA
3	6	4	7	0	6	2

In this present study, out of 100 cases, 28 cases had changed end diastolic flow (EDF) in each vessels. Changes of EDF was seen in MCA of 3 foetuses, UA of 6 foetuses and TA in 4 foetuses. Changes of EDF in UA and TA was seen in 7

foetuses. Changes of EDF in MCA and TA was seen also in 6 foetuses. And 2 foetuses had Changed EDF in all three vessels (MCA+UA+TA).

Table.2 Showing the end diastolic flow.

Umbilical artery(16)	End diastolic flow changes
AEDF	13(13%)
REDF	3(3%)
Middle cerebral artery(11)	
AEDF	7(7%)
REDF	4(4%)
Thoracic aorta(18)	
AEDF	8(8%)
REDF	10(10%)
Distribution of changes	
AEDF in UA+TA	8(8%)
A/REDF in MCA + TA	6(6%)
A/REDF in MCA + TA + UA	2(2%)
Only UA	6(6%)
Only TA	4(4%)
Only MCA	2(2%)
Total	28(28%)

In this present study, changes in end diastolic flow of cases in umbilical artery were 13(13%) AEDF and 3(3%) REDF. Cases of middle cerebral artery were 7(7%) AEDF and 4(4%) REDF. And cases of thoracic aorta were 8(8%) AEDF and 10(10%) REDF. Distribution of changes were seen in total 28(28%) cases. 8(8%) cases of AEDF were seen in both UA and TA. 6(6%) cases of A/REDF were seen in both MCA and TA. Only MCA was seen in 2(2%) cases.

Table 3 Strength of association

		CS(59)	NICU(34)	PD(7)
MCA	Normal (89) AEDF (7)	48/89 (53.93%) 7/7 (100%)	28/89 (31.46%) 2/7 (28.57%)	7/89(7.86%) 0
	REDF (4)	4/4(100%)	4/4(100%)	0
UA	Normal (84) AEDF (13)	48/84(57.14%) 11/13(84.61%)	30/84(35.71%) 4/13(30.77%)	2/84(2.38%) 2/13(15.38%)
	REDF (3)	0	0	3/3(100%)
TA	Normal (82) AEDF (8)	41/82(50%) 8/8(100%)	22/82(26.83%) 8/8(100%)	3/82(3.65%) 2/8(25%)
	REDF (10)	10/10(100%)	4/10(40%)	2/10(20%)

In this present study, out of 100 cases, 59(59%) cases were undergone caesarean section. 34(34%) foetuses were admitted in NICU. And perinatal death was seen in 7(7%) foetuses. In MCA artery involvement, 89(89%) cases were normal. Out of 89 cases, 48(53.93%) cases were undergone caesarean section. 28(31.46%) fetuses were admitted in NICU. Perinatal death was found in 7(7.86%) fetuses. AEDF in MCA was seen in 7(7%) cases. All cases of AEDF were undergone CS. Only 2(28.57%) fetuses were admitted in NICU. REDF was seen in 4(4%) cases of MCA involvement. In this all cases were undergone CS and all fetuses were admitted in NICU.

In UA involvement, 84(84%) cases were normal. Among them 48(57.14%) mothers were undergone caesarean. 30(35.71%) fetuses were admitted in NICU. And 2(2.38%) fetuses were perinatal death. AEDF in UA was seen in 13(13%) cases. Among them 11(84.61%) cases were undergone caesarean section. 4(30.77%) fetuses were admitted in NICU. And 2(15.38%) cases were perinatal death. REDF in UA was seen in 3(3%) cases. Among them all fetuses were found perinatal death.

In TA involvement, 82(82%) cases were normal. Among them 41(50%) cases were undergone caesarean section, 22(26.83%) fetuses were

admitted in NICU. 3(3.65%) fetuses were found perinatal death. AEDF in TA was seen in 8(8%) cases. Among them, no any cases were undergone CS and no fetuses were admoitted in NICU. 2(25%) fetuses were found perinatal death. REDF in TA was seen in 10(10%) cases. Among them 4(40%) fetuses were admitted in NICU and 2(20%) fetuses were found perinatal death.

Table 4. Showing the perinatal outcome.

Conditions	No. of cases
Normal delivery	41(41%)
Caesarean section for foetal distress	59(59%)
Admission to NICU	34(34%)
Only CS	26
Only NICU	8
CS + NICU	36(36%)
IUFD	5
Perinatal death	2

In this present study, out of 100 cases, 41(41%) cases were undergone normal delivery. Caesarean section for foetal distress was seen in 59(59%) cases. 34(34%) fetuses were admitted in NICU. Only caesarean section was performed in 26(26%) cases. 8(8%) fetuses were admitted in NICU. 36(36%) fetuses were delivered by caesarean section and admitted in NICU. IUFD was found in 5(5%) fetuses. And perinatal death was found in 2(2%) foetuses. Mean gestational age of fetuses was 34.78±2.23 weeks. And mean birth weight was 2280.56±350.67 grams.

Discussions

Doppler study is a non-invasive and easily available technique in patients diagnosed with IUGR. The Doppler study finding are very useful for obstetrical decisions, especially in pregnancies diagnosed with IUGR. Still some disagreement is available to decide the best fetal vessel which should be used for Doppler study for continuation or discontinuation of pregnancy. There are several recommendation from authorities for the use of umbilical artery Doppler but it also require supplemented information for other vessels like middle cerebral artery and ductus venous for a better decision making. Deviation of Doppler waveforms of venous system is a strong forecaster

for fetalanomalies especially prior to 32 weeks of gestation.[5]

In this present study, Mean age group was 25.91years. Majorities of women (80%) were below the age of 30 years. 14% women were preexisting illness. And majorities of women 55% were multigravida. 32.6 weeks was the mean foetal gestational age during the time of Doppler ultra sound examination. On Doppler ultrasound study mean foetal birth weight was found 1995 grams. Abnormality was found in 60% fetuses. Abnormal pulsatility index (PI) values was found in middle cerebral artery (MCA) 0f 40 foetuses, umbilical artery of 35 foetuses and thoracic aorta of 25 foetuses.

In this present study, changes in end diastolic flow of cases in umbilical artery were 13(13%) AEDF and 3(3%) REDF. Cases of middle cerebral artery were 7(7%) AEDF and 4(4%) REDF. And cases of thoracic aorta were 8(8%) AEDF and 10(10%) REDF. Distribution of changes were seen in total 28(28%) cases. 8(8%) cases of AEDF were seen in both UA and TA. 6(6%) cases of A/REDF were seen in both MCA and TA. Only MCA was seen in 2(2%) cases.

Gramellini et al (1992) found neonatal complications in 33.3% newborns of the mothers with abnormal MCA/UA ratio as compared to 1.38% newborns with normal MCA/UA ratio.[6] Kassanos et al also found similar results in 2004[7]. As the MCA/UA ratios were more accurate than the individual Doppler indices in the detection of IUGR, the patients with abnormal MCA/UA ratio had higher incidence caesarean delivery (44%), low apgar score (32%), need for admission to NICU (26%)and neonatal complications (24%)as compared to those with normal MCA/UA ratio which is statically significant.[8]

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caesarean section. 28(31.46%) fetuses were admitted in NICU. Perinatal death was found in 7(7.86%) fetuses. AEDF in MCA was seen in 7(7%) cases. All cases of AEDF were undergone CS. Only 2(28.57%) fetuses were admitted in NICU. REDF was seen in 4(4%) cases of MCA involvement. In this all cases were undergone CS and all fetuses were admitted in NICU.

In UA involvement, 84(84%) cases were normal. Among them 48(57.14%) mothers were undergone caesarean. 30(35.71%) fetuses were admitted in NICU. And 2(2.38%) fetuses were perinatal death. AEDF in UA was seen in 13(13%) cases. Among them 11(84.61%) cases were undergone caesarean section. 4(30.77%) fetuses were admitted in NICU. And 2(15.38%) cases were perinatal death. REDF in UA was seen in 3(3%) cases. Among them all fetuses were found perinatal death.

In TA involvement, 82(82%) cases were normal. Among them 41(50%) cases were undergone caesarean section, 22(26.83%) fetuses were admitted in NICU. 3(3.65%) fetuses were found perinatal death. AEDF in TA was seen in 8(8%) cases. Among them, no any cases were undergone CS and no fetuses were admoitted in NICU. 2(25%) fetuses were found perinatal death. REDF in TA was seen in 10(10%) cases. Among them 4(40%) fetuses were admitted in NICU and 2(20%) fetuses were found perinatal death.

Hackett GA et al[9] studied the perinatal outcomes in 29 foetuses showing AEDF in thoracic aorta and found a higher incidence of perinatal death, necrotising enterocolitis and haemorrhage in the AEDF group than the control. Marsal K et al[10] also observed that the absence of EDF in thoracic aorta is the best predictor of foetal well-being. In foetuses with AEDF, the incidence of adverse perinatal outcome is significantly higher than in foetuses with normal aortic flow. Similar results were obtained in studies by Eronen M et al[8] and Arabin B et al.[11] Eronen M et al[12] in their study of 65 pregnant women with PIH observed that the presence of AEDF/REDF was associated with a mortality rate of 30%. In a study of 35 foetuses

with severe IUGR, Illyes M et al[13] observed death of all 5 cases, which showed REDF in the thoracic aorta. Ertan et al[14] found an increased incidence of neonatal morbidity and mortality in the REDF group than the AEDF group. This was not supported in our study probably because the number of perinatal deaths was very low in our study, although the risk of NICU admission was higher in REDF group than AEDF group.

Placenta-based intrauterine growth restriction (IUGR) is predominantly a vascular disorder. It starts with abnormal tertiary villous vessels and ends with characteristic foetal multi-vessel cardiovascular manifestations.[15] These effects can be documented with Doppler ultrasound examination of a number of vessels: maternal uterine arteries and the foetal umbilical arteries for the placenta; middle cerebral artery (MCA) for preferential brain perfusion; and precordial veins for the cardiac effects of placental dysfunction. As IUGR worsens, Doppler abnormalities in these vascular territories also deteriorate, suggesting a sequential pattern of disease progression.[15] This presumed sequence and the anticipation of foetal deterioration forms the basis for Doppler surveillance in IUGR. In normal pregnancy, the three indices; S/D; Pl and Rl decrease with advancing gestation in Umbilical artery.[16] But in IUGR first there is decreased diastolic flow in the umbilical artery due to increase in the resistance that occurs in small arteries and arterioles of the tertiary villi. This raises the S/D ratio; Pl and Rl of umbilical artery. As the placental insufficiency worsens, the diastolic flow decreases, then become absent, and later reverses. Yoon et al demonstrated in their study that absent umbilical artery waveform is a strong and independent predictor of adverse perinatal outcome.[17] Foetal MCA is a low resistance circulation throughout pregnancy. It is highly sensitive to foetal hypoxia which induces redistribution of cardiac output towards foetal brain (brain sparing effect) which leads to increase in diastolic flow with decreased pulsatility index of MCA. As MCA/UA ratio incorporates data not only on placental status but

also on foetal response, an abnormal MCA/UA PI Doppler ratio is strongly correlated with worse foetal prognosis.[18]

In this present study, out of 100 cases, Mean gestational age of fetuses was 34.78±2.23 weeks. And mean birth weight was 2280.56±350.67 grams. Majorities of cases (59%) were undergone caesarean section. 34(34%) fetuses were admitted in NICU. 36(36%) fetuses were delivered by caesarean section and admitted in NICU. IUFD was found in 5(5%) fetuses. And perinatal death was found in 2(2%) foetuses.

Conclusions

This present study was concluded the women were less than 30 years age group was more common to develop IUGR. Majorities of women were undergone caesarean section. Changed EDF was very common in both umbilical artery and thoracic artery of foetuses. AEDF was commonly seen in umbilical artery. Majorities of babies who had MCA and UA abnormality were admitted in NICU. Majorities of cases of caesarean se4ction had foetal distress. Perinatal death was commonly seen in foetal with MCA involvement. Hence, Doppler ultrasonography is one of the best investigative modalities to diagnose intrauterine growth retardation.

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