

Doppler Ultrasound Abnormalities in Intrauterine Growth Restrictions

ZAHID NAZIR¹, SHAMAILA HUSSAIN², SAMINA RAZA³, MUHAMMAD AZAM⁴, SYED WAQAS AHMED⁵

¹Assistant Professor of Radiology, Government Kot Khawaja Saeed Teaching Hospital, KEMU Lahore.

^{2,3}Consultant Gynaecologist, Government Kot Khawaja Saeed Teaching Hospital, KEMU Lahore.

⁴Associate Professor of Anesthesia, Services Hospital, Lahore

⁵Consultant Neurosurgeon, DHQ Hospital, Jehlum

Correspondence to Dr. Zahid Nazir, Email: drzahidradiologist@gmail.com

ABSTRACT

Background: Intrauterine growth restriction is the second most common and leading cause of perinatal morbidity and mortality after prematurity. It has substantial effects on fetal, neonatal life and later in adulthood. IUGR can be detected during pregnancy by using ultrasonography, which is a non-invasive and reliable tool. Different parameters on ultrasound can help to predict the IUGR.

Aim: To determine the abnormalities of Doppler ultrasound in pregnant females with intrauterine growth restricted fetus.

Methods: This cross sectional study was conducted in the Department of Radiology in collaboration with Department of Obstetrics & Gynecology, Kot Khawaja Saeed Teaching Hospital, KEMU Lahore from 1st August 2019 to 30th January 2020. Females of age 18-42 years, presenting at gestational age >32 weeks undergoing Doppler ultrasound for assessment of features of IUGR. All scans were done by a senior radiologist. Findings i.e., abdominal circumference, umbilical artery pulsatility index, cerebroplacental ratio, absent end-diastolic velocity and reversed end-diastolic velocity were recorded on proforma.

Results: In this study, we included 200 pregnant females with IUGR fetus. The mean age of females was 29.86 ± 6.34 years. The mean BMI of females was $29.89 \pm 12.73 \text{ kg/m}^2$. The mean gestational age at presentation was 35.76 ± 0.96 weeks. On Doppler ultrasound, abdominal circumference of fetus was $11.54 \pm 4.21 \text{ cm}$, mean estimated fetal weight was 2021 ± 105.96 grams, mean uterine artery pulsatility index was 96.23 ± 24.56 and mean Cerebro-placental ratio was 0.98 ± 0.13 . Abnormal Doppler Uterine artery was observed in 83(41.5%) patients, middle cerebral artery was noted in 119(59.5%) patients, Absent/Reversed end diastolic flow was noted in 121(60.5%) patients while Cerebro-placental ratio <1 was noted in 127(63.5%) patients.

Conclusion: Thus there is high rate of variation in Doppler parameters in IUGR fetuses. Thus changes in features of Doppler scan early in third trimester can help to predict the IUGR and IUGR can be prevented or managed on time in order to improve the outcome of pregnancy.

Keywords: Doppler ultrasound, intrauterine growth restriction, pulsatility index, abdominal circumference

INTRODUCTION

Intrauterine growth retardation or restriction (IUGR) is defined as "the velocity of fetal growth less than the normal fetus growth potential for a specific neonate or it is the failure of the fetus to achieve its growth potential"¹. Inside the uterus or during post-natal period, the neonate with reduced birth weight or length i.e. $<10^{\text{th}}$ percentile is called as small-for-gestational-age, as defined by World Health Organization². IUGR is the second most common complications of pregnancy which have inadequate fetal growth, and is mostly because of problem in placenta³.

There is a considerable difference in the incidence of IUGR across different populations. In babies born with a birth weight less than 2500 grams, its prevalence is almost 33%. The incidence of IUGR shows a dependence on economic growth too, with a relatively lower incidence in developed countries (4-8%) as compared to that in developing countries (6%-30%). The average incidence of IUGR is nearly 8% in the general population⁴.

For a better physical and cognitive development and growth, during first three years of life, the ideal intrauterine environment is important. If intrauterine requirements of fetus are compromised, the risk of IUGR increases, while

delivery can occur in premature phase, low birthweight, or small for gestational age can also occur⁵. Infants who have IUGR may develop different short- and long-term complications. IUGR is the silent factor leading to several complications and perinatal mortality. IUGR is normally ends in maternal, fetal, placental and genetic causes⁶.

IUGR is mostly occurred due to placental deficiency, resulting that the fetus adjusts the blood circulation to reserve the oxygen level and nutrients supply to brain ('brain-sparing'). Scarce information is available regarding the postnatal course and outcomes of this prenatal alteration of blood circulation to the cerebral. The transformed cerebral hemodynamics may continue even after delivery of fetus with the IUGR, which would indicate a diverse approach regarding the cerebral monitoring and clinical management of IUGR neonates⁷.

The rationale of the study, role of Doppler ultrasonography for assessment of abnormalities in pregnant females with intrauterine growth restricted fetus. This would help us to determine the benefits of Doppler in prediction of features of IUGR and helps the obstetricians to early predict the IUGR and prevent it timely and promptly to improve the outcome of pregnancy. But, in routine females usually present in third trimester of pregnancy and most of them diagnosed with IUGR, so the evidence favoring Doppler ultrasound is of important concern.

Received on 27-09-2020

Accepted on 05-01-2021

The objective of study was to determine the abnormalities of Doppler ultrasound in pregnant females with intrauterine growth restricted fetus

MATERIAL AND METHODS

This cross sectional study was conducted in the Department of Radiology in collaboration with department of Obstetrics & Gynecology, Kot Khawaja Saeed Teaching Hospital, KEMU Lahore during six months i.e., 1st August 2019 to 30th January 2020. Sample size of 200 patients is estimated using 95% confidence level, 6% margin of error and taking frequency of IUGR i.e., 23.5%⁸ in pregnant females. Non-Probability, consecutive sampling technique was used. Females of aged between 18-42 years presenting at gestational age >32 weeks with IUGR (fetal weight <10th percentile for gestational age) were included in the study. Females with twin or multiple fetus, fetuses with congenital anomalies; advanced fetal vascular diseases (brain sparing, increased ductus venosus pulsatility index, reversed or absent a-wave in ductus venosus and umbilical vein pulsation), pregnancy induced hypertension, preeclampsia, gestational diabetes were not included.

Data Collection Procedure: 200 patients fulfilled the selection criteria was included in the study. Informed consent was obtained. Demographic details of patients (name, age, BMI, gestational age, parity and fetal weight) were obtained. Patients underwent Doppler ultrasonography for assessment of features of IUGR. All scans were done by a senior radiologist. Findings i.e. abdominal circumference, umbilical artery pulsatility index, cerebroplacental ratio, absent end-diastolic velocity and reversed end-diastolic velocity were recorded on proforma. SPSS v. 22 was used to enter and analyses the collected data.

RESULTS

In this study, we included 200 pregnant females with IUGR fetus. The mean age of females was 29.86±6.34 years. There were 105(52.5%) females of age 18–30 years and 95(47.5%) were of age 31–40 years. The mean BMI of females was 29.89±12.73kg/m². The mean gestational age at presentation was 35.76±0.96 weeks. There were 97(48.5%) primigravida, 46(23%) were gravida 2-4 and 57(28.5%) were gravida 4-5 (Table 1).

Table 1: Demographic characteristics of pregnant females (n=200)

	F (%), mean ± SD
Age (years)	29.86 ± 6.34
18-30 years	105 (52.5%)
31-42 years	95 (47.5%)
BMI	29.89 ± 12.73
Gestational age (weeks)	35.76 ± 0.96
Parity	
Primigravida	97 (48.5%)
Gravida 2-4	46 (23.0%)
Gravida 4-5	57 (28.5%)

On Doppler ultrasound, abdominal circumference of fetus was 11.54±4.21cm, mean estimated fetal weight was 2021±105.96 grams, mean uterine artery pulsatility index was 96.23±24.56 and mean Cerebro-placental ratio was 0.98±0.13. Abnormal Doppler Uterine artery was observed

in 83(41.5%) patients, middle cerebral artery was noted in 119 (59.5%) patients, Absent/Reversed end diastolic flow was noted in 121(60.5%) patients while Cerebro-placental ratio <1 was noted in 127(63.5%) patients (Table 2).

Table 2: Doppler ultrasound features of IUGR

Characteristics	F (%)
Abdominal circumference (cm)	11.54 ± 4.21
Estimated fetal weight	2021 ± 105.96
Uterine artery pulsatility index	96.23 ± 24.56
Cerebro-placental ratio	0.98 ± 0.13
Uterine artery abnormal Doppler	83 (41.5%)
Middle cerebral artery abnormal Doppler	119 (59.5%)
Absent/Reversed end diastolic flow	121 (60.5%)
Cerebro-placental ratio <1	127 (63.5%)

DISCUSSION

Intrauterine growth retardation or restriction is the common complication of pregnancy, which leads to poor biological growth potential of a fetus. It mostly occur due to placental dysfunction⁹. Furthermore, neonates may also be categorized as preterm, low birthweight or small for gestational age¹⁰⁻¹². Remarkably, INTERGROWTH-21st has established the newest worldwide fetal, new-born, and post-natal prescriptive protocols. These are harmonizing with WHO Child Growth Standards, which offer recommendations for size and growth of fetus and neonate. These are especially important when diagnosing the IUGR infants^{13,14}.

IUGR increases the risk for neurodevelopmental impairment. Brain imaging is usually used at or near term-equivalent age to predict the prognosis of fetus.¹⁵ IUGR is the fetal pathology in pregnancy which can cause several different neonatal or fetal complications. Moreover, few epidemiological and experimental trials showed that IUGR is significantly associated with higher frequency of metabolic, cardiovascular and renal diseases in later life of an IUGR neonate¹⁶.

Antepartum surveillance by using Doppler ultrasonography of umbilical artery must be initiated when the fetus has suspicion of IUGR. Though Doppler findings for ductus venosus, or middle cerebral artery, have high accuracy level for detection of fetus having IUGR, but scarce information available regarding the benefits of Doppler ultrasound to detect IUGR. Thus, Doppler applied for arteries other than umbilical artery, as the part of fetal surveillance during pregnancy complicated by IUGR, must be reticent for research conventions¹⁷.

In our study, we included 200 pregnant females with IUGR fetus. The mean age of females was 29.86±6.34 years. There were 105(52.5%) females of age 18–30 years and 95(47.5%) were of age 31–40 years. The most common age of females for pregnancy was <30 years. On Doppler ultrasound, mean abdominal circumference of fetus was 11.54±4.21cm, mean estimated fetal weight was 2021±105.96 grams, mean uterine artery pulsatility index was 96.23±24.56 and mean Cerebro-placental ratio was 0.98±0.13. Abnormal Doppler Uterine artery was observed in 83(41.5%) patients, middle cerebral artery was noted in 119(59.5%) patients, Absent/Reversed end diastolic flow was noted in 121(60.5%) patients while Cerebro-placental ratio <1 was noted in 127(63.5%) patients.

Novac et al., found that mean abnormal Doppler Uterine artery was observed in 39.28% patients, middle cerebral artery was noted in 46.42% patients, Absent/Reversed end diastolic flow was noted in 57.14% patients while Cerebro-placental ratio <1 was noted in 42.85% patients¹⁸. Turan et al., also found that reduce cerebro-placental ratio was observed in 78.8% cases of IUGR, reduced abdominal circumference in 52.9%, Umbilical artery Absent end diastolic flow in 23.1% while Reversed end diastolic flow in 17.3%¹⁹.

Abdominal circumference is quite a sensitive parameter and has high sensitivity for detection of IUGR in third trimester. But, it showed less specificity. The pulsatility index of middle cerebral artery alone is not a valued tool as it has very low sensitivity and must not be applied alone to detect the IUGR in third trimester²⁰.

Eixarch et al showed that small for gestational age fetuses with redistribution of cerebral blood flow show, in a high proportion of cases, a neurological development deficit at the age of two years with communication problems²¹. Thus parent counseling for future pregnancies, development of ultrasound diagnosis and IUGR risk assessment is very important for couples²².

Khazardoost et al., concluded that gestational age at birth and Absent/Reversed end diastolic flow in the umbilical artery and ductus venosus within a week before childbirth were reliable Doppler parameters of cranial ultrasound abnormalities during the neonatal period²³.

CONCLUSION

Thus there is high rate of variation in Doppler parameters in IUGR fetuses. Thus changes in features of Doppler scan early in third trimester can help to predict the IUGR and IUGR can be prevented or managed on time in order to improve the outcome of pregnancy. Further large studies can be done to get more authentic results in favor of Doppler ultrasound in prediction of IUGR.

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