e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(10); 684-688

Original Research Article

Serial Evaluation of Intra Uterine Growth Restriction (IUGR) Pregnancies by Colour Doppler and Correlation with Perinatal Outcome

Ruby Kumari[1], Bulbul[2], Puja Mahaseth[3]

[1]Senior Resident, Department of Obstetrics and Gynaecology, Darbhanga Medical College & Hospital, Laheriasarai, Bihar

[2]Senior Resident, Department of Obstetrics and Gynaecology, Darbhanga Medical College & Hospital, Laheriasarai, Bihar

[3]Associate Professor, Department of Obstetrics and Gynaecology, Darbhanga Medical College & Hospital, Laheriasarai, Bihar

Received: 25-07-2024 / Revised: 23-08-2024 / Accepted: 26-09-2024

Corresponding Author: Dr. Bulbul

Conflict of interest: Nil

Abstract:

Background: Intra uterine growth restriction refers to fetus with an estimated fetal weight below 10th percentile corrected for sex and ethnicity which has features of chronic hypoxia and/or malnutrition. However a consensus does not exist for definition of IUGR.) It is associated with adverse fetal outcomes including acidosis, still birth, oligohydramnios, low birth weight and adverse events during labor including fetal distress in labor. IUGR is often suspected by poor maternal weight gain and a fundal height that is less than expected for the gestational age and is an indication for the ultrasound at presentation. Aim of this study to prospectively evaluate all IUGR pregnancies by color Doppler.

Methods: This non-interventional descriptive study was conducted at Department of Obstetrics and Gynaecology with collaboration of Department of Radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar from March 2023 to February 2024. A total of 58 patients were selected for study which fulfill the inclusion criteria.

Results: There were a significant number of preterm babies in our study group - 30 (51.7%). Thirty-five babies were admitted into neonatal intensive care unit for treatment - 6 babies died. Of the remaining, 15 required admission for more than 10 days for various complications. Two babies could not be admitted to NICU because of poor parental resources. Of that one baby died. Neonatal complications developed.

Conclusion: Doppler studies of multiple vessels in the fetoplacental circulation can help in the monitoring of compromised fetus and can help us predicting neonatal morbidity. This may be helpful in determining the optimal time of delivery in complicated pregnancies.

Keywords: Colour Doppler, Intrauterine Growth Retardation.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Conceptually, intrauterine growth restriction (IUGR) is failure of a fetus to achieve its genetically endorsed growth potential. However, the difficulty in accurately determining the growth potential for a given fetus limits the applicability of this definition, although birth weight centiles (1) and estimated fetal weight charts, customized for individual maternal and fetal characteristics (2) represent attempts to use this concept in clinical practice.

Hence, in clinical practice birth weight is classified using population-based sex adjusted centiles, with a newborn being small for gestational age (SGA) if the birth weight is <10th centiles. However, this definition includes a large proportion of cases that are constitutionally small and otherwise healthy newborns.

Small for gestational age, defined as a birth weight below the 10th centiles for the gestational age at delivery represents in Europe 600,000 cases amongst the 6,000,000 deliveries/year. Intrauterine hypoxia and hypo nutrition promote a wide and different spectrum of adaptative and pathological changes that manifest at different periods during postnatal life.

IUGR is considered a major contributor to perinatal morbidity and mortality, and has been described as responsible for 50% of perinatal deaths occurring preterm and 20% at term. (3) SGA neonates have a higher risk of respiratory distress syndrome, intraventricular haemorrhage and necrotizing

enterocolitis. (4) SGA are also associated with an increased need for prolonged respiratory support and retinopathy of prematurity, and a four to six times higher risk of cerebral palsy among near term and term neonates.(5)

In 1842, Christian Johann Doppler described the Doppler equation (d=2V (cost0)f/c where d is the Doppler shift frequency. V is the speed of moving blood. 0 is the angle between ultrasound beam and f is the direction of movement of blood is the transmitted ultrasound frequency, and c is the speed of ultrasound (1540 m/s). Doppler has revolutionized the field of obstetrics since its introduction in late 1950's (2). Blood flow velocity in the fetal circulating system depends on type of vessel. The arteries always have a pulstile pattern, where as veins have either a pulsatile or continuous pattern (6). Gosling proposed Pulstality Index (P.1) (Pl=peak systole- end diastole/mean peak value) (7) in 1971 and A/B ratio in 1976. Resistive Index (R.I) (RI=peak systole –end diastole / peak systole) was devised for the first time in 1973 (8). It is independent of factors like beam/ vessel angle and only requires measurement of two precisely defined points (9). S/D (S/D ratio = peak systole/end diastole) ratio is a variation of resistive index (R.1) (10).

The objectives of this study To determine the diagnostic performance of color Doppler sonography of fetal Middle cerebral artery, uterine artery, umbilical artery, descending abdominal aorta in evaluation of IUGR pregnancies.

Materials and Methods

This non interventional descriptive study was conducted at Department of Obstetrics and Gynaecology with collaboration of Department of Radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar from March 2023 to February 2024.

A total of 58 patients were selected for study which fulfill the inclusion criteria.

Inclusion criteria:

All singleton IUGR pregnancies based on clinical parameters and Ultrasonic fetal biometry.

Exclusion criteria:

- All normal pregnancies.
- Pregnancies with multiple gestations.
- Pregnancies with congenital anomalies.

Procedure

Before start of study, procedure was explained to patient. Just before start of study patient was asked to pass urine to ensure empty bladder and was advised not to move during Doppler examination which was carried out in supine position.

Doppler Vascular Technique

Study of various fetal vessels was performed using pulsed Doppler ultrasound with 3.5 MHz curvilinear probe with a high pass filter.

The following vessels were studied with the mother in a recumbent position during fetal inactivity and apnea.

1. Umbilical Artery (UA)
2. Uterine Artery (UTA)
3. Middle Cerebral Artery (MCA)
4. Descending Abdominal Aorta (DAA)

The above vessels were located in the standard plane:

The umbilical artery measurements were made from free loop of cord midway between the placental and abdominal wall insertion.

The middle cerebral artery was located in a transverse plane at the level of the lesser wing of the sphenoid bone with sample gate placed on proximal portion of the vessel.

The descending abdominal aorta was located in the transverse section of abdomen above the level of the bifurcation of the aorta.

Flow velocity waveforms, the resistance index (R.I), pulsatility index (P.I), systolic/diastolic ratio (S/D) of umbilical artery, middle cerebral artery and descending abdominal aorta were noted. During Doppler ultrasound, initially the blood vessels were recognized. Than various indices (P.I R.1, S/D ratio) were recorded. Sampling site for umbilical artery was mid cord level from a free floating loop of the umbilical cord, for uterine artery the retro placental bed (93), for descending thoracic aorta above diaphragm in lower thorax and in Sylvain fissure for middle cerebral artery. Three different screens were obtained and averaged.

The ratios examined were considered abnormal when

S/D of MCA/UA < 1 (5)
P.I. of MCA/UA < 1 (2)

Fetal outcome-

Fetal outcome was studied under major and minor adverse outcome :

1. Major adverse outcomes were perinatal deaths -including intrauterine and early neonatal deaths. Major complications like hypoxic ischemic encephalopathy, intraventricular hemorrhage, periventricular leukomalacia, pulmonary hemorrhage and necrotizing enterocolitis.
2. Minor outcomes include-cesarean delivery for fetal distress, APGAR score below 7 at 5 minutes, admission to NICU (neonatal intensive care unit) for treatment. The patients were followed by serial Doppler assessment and

non-stress test and the result of the last Doppler examination within 10 days of delivery was considered in the subsequent correlation with perinatal outcomes.

Data Collection and Statistical Analysis

The collected data was entered into the computer upon the completion of each case in SPSS version 20. Descriptive statistics were used to calculate frequencies and means from the recorded data.

Results

Table 1: Maternal, Fetal and Perinatal characteristics of study population (n=58)

Maternal Characteristics	No. of cases	Percentage
Parity		
Primipara	35	60.3%
Multipara	23	39.7%
Pregnancy complication		
Pre-eclampsia	8	13.7%
Intrauterine growth restriction	21	36.3%
Pre-eclampsia and IUGR	29	50.0%
Delivery		
Spontaneous vaginal delivery	3	5.1%
Induced	19	32.7%
Cesarean section	36	62.0%
Indication for cesarean sections		
Fetal distress	14	38.8%
Severe pre-eclampsia	4	11.2%
Others	18	50.0%
Perinatal outcome		
Still birth	5	8.6%
Survival	46	79.3%
Neonatal deaths	7	12.06%

Table 2: Neonatal characteristics of study population (n=58) POG at Birth (week) 35.8

Live Births	53
Still birth	5
Term babies	28(48.2%)
Preterm babies	30(51.7%)
Average Birth weight (gm)	1798.7gms
Birth weight (gm)	>2500[6(10.3%)] 1500-2500[31(53.4%)] 1000-1500[17(29.3%)] <1000[4(6.8%])
Apgar at 5 to <7	4
Admission to NICU	35(66.0%)
Neonatal complications	17(32.07%)
Duration of stay >10days	15(42.8%)

There were a significant number of preterm babies in our study group - 30 (51.7%). Thirty-five babies were admitted into neonatal intensive care unit for treatment - 6 babies died. Of the remaining, 15 required admission for more than 10 days for various complications. Two babies could not be admitted to NICU because of poor parental resources. Of that one baby died. Neonatal complications developed.

Table 3: Neonatal Complications developed (Complication in 53 live birth)

Complications	
Hypoglycemia	1
Hypocalcaemia	1
Polycythemia	1
Neonatal hyperbilirubinaemia	14

Table 4: Diagnostic accuracy of Doppler in predicting adverse perinatal outcome (Major and Minor)

Index	Sensitivity(%)	Specificity(%)	PPV(%)	NPV(%)

U.AR.I	44.4%	81.8%	80%	47.3%
U.AP.I	50%	59%	66.6%	41.9%
U.AS/D	66.6%	45.4%	66.6%	45.4%
MCAP.I	41.6%	90.9%	88.2%	48.7%
DAAP.I	44.4%	59%	64%	56.5%
P.I of MCA/UA	47.2%	86.3%	85%	50%
S/D of MCA/UA	55.5%	72.7%	76.7%	50%

Table 5: Efficacy of various Doppler parameters in predicting major adverse perinatal outcome

Abnormal vessels	Sensitivity(%)	Specificity(%)	PPV(%)	NPV(%)	Accuracy
U.AP.I	58%	56.5%	35%	86.8%	56.8%
U.AR.I	58%	71.7%	35%	86.8%	68.9%
USS/D	75%	41.3%	25%	86.3%	48%
MCAP.I	66.6%	71.7%	47%	90%	77%
DAAP.I	41.6%	56%	20%	78.7%	53.4%
S/D of MCA/UA	83%	75%	38.4%	93.7%	68.9%
P/I of MCA/UA	66.6%	73.9%	40%	89.4%	72.4%
All Parameters	91.6%	15%	22%	87.5%	31%

Discussion

Doppler wave form analysis has definite role in obstetrics especially in the diagnosis of placental insufficiency and in establishing prognosis (11). Doppler velocimetry has improved our understanding of` the pathophysiological processes leading to IUGR and our possibilities of monitoring fetal health. It is an excellent method for differentiating between healthy and truly growth retarded Scan fetuses and it may help obstetricians to identify pregnancies that need special surveillance. Doppler is often giving earlier warning of fetal distress than other tests. For this reason, all fetuses with suspected intrauterine growth restriction should undergo umbilical artery (12). However it should be applied as a secondary diagnostic test in preselected groups of high- risk pregnancies by manual palpation and ultrasound. Persistent notching of the uterine artery flow velocity Waveform appears to be a useful and sensitive indicator of' potential obstetrical problems as is measurement of resistive index (13). It means that normal adaptation of Pregnancy has not occurred if the notch has not been lost by 24-26 weeks. In our study, only 39 patients had diastolic notch at 22 weeks. Gosling RG, Dunbar G, King DH. has shown that end diastolic velocity should be present at 20th week in umbilical artery (14). In our study it was present in all the 100 normal patients at 22 weeks.

Pozniak MA, Kelez F, Stratta RJ, Oberly TD (15) unlike our study in which patients were selected, examined both umbilical artery in 2475 pregnant women at 28 gestational weeks. PI was 1.2 ± 0.5, RI was 0.67 ± 0.1 and S/D ratio was 3 ± 0.6.

Tudinger BJ, Giles WB, Cook CM. assess uterine and uteroplacental circulation at 21- 24 weeks proved that Doppler was more efficient at predicting a complicated pregnancy in those patients who were at risk. Persistent notches in the main stem uterine arteries and elevated RI of > 0.68 in the uterine arteries and > 0.38 in the uteroplacental arteries were defined as abnormal waveform (16).

McCallum WD, Williams CS, Napel S, Daigle RE showed that S/D ratio decreases throughout pregnancy in the umbilical artery obtained at mid-cord level. Mean S/D ratio was 3.5 at 24 weeks, 2.8 at 32 weeks and 2.2 at 40 weeks (17).

Cameron et al. showed that normal systolic/diastolic ratio decreases with progress of pregnancy in second and third trimesters. At 22 weeks of gestation arcuate S/D ratio was 1.6, umbilical S/D ratio was 4 and aortic S/D ratio was 5.1 (18).

Conclusion

S/D ratio of MCA/UA is the most sensitive and specific index in predicting major perinatal adverse outcome (83% and 75%), while umbilical artery S/D ratio is the most sensitive index (66.6%) in predicting any adverse perinatal outcome i.e. including both major and minor outcome. MCA pulsatility index (P.I) is the most specific index (90.9%) for predicting in any adverse perinatal outcome. The sensitivity of the Doppler studies can be significantly increased by studying multiple vessels (91.6%). Hence we conclude that Doppler studies of multiple vessels in the fetoplacental circulation can help in the monitoring of compromised fetus and can help us predicting neonatal morbidity. This may be helpful in determining the optimal time of delivery in complicated pregnancies.

References

1. Figueras F, Meler E, Iraola A, Eixarch E, Coll O, Figueras J, et al. Customized birthweight standards for a spanish population. Eur J ObstetGynecolReprodBiol 2008, Jan; 136(1):20-4.
2. Gardosi J, Chang A, Kalyan B, Sahota D, Symonds EM. Customised antenatal growth charts. Lancet 2012, Feb 1; 339(8788):283-7.
3. Wilcox AJ. Intrauterine growth retardation: Beyond birthweight criteria. Early Hum Dev 2013, Oct; 8(3-4):189-93.
4. Sankaran S, Kyle PM. Aetiology and pathogenesis of IUGR. Best Pract Res Clin ObstetGynaecol 2009, Dec; 23(6):765-77.
5. M Kady S, Gardosi J. Perinatal mortality and fetal growth restriction. Best Pract Res Clin ObstetGynaecol 2004, Jun; 18(3):397-410.
6. Schulman H, Fleischer A, Farmakides G, Bracero L, Rochelson B, Grunfeld L. Development of uterine artery compliance in pregnancy as detected by Doppler ultrasound. Am J ObstetGynecol2016;155:1031–6
7. Bewley S, Campbell S, Cooper D. Uteroplacental Doppler flow velocity waveforms in the second trimester. A complex circulation. Br J ObstetGynaecol1989;96:1040–6
8. Arduini D, Rizzo G, Boccolini MR, Romanini C, Mancuso S. Functional assessment of uteroplacental and fetal circulations by means of color Doppler ultrasonography. J Ultrasound Med 1990;9: 249–53
9. Maulik D, Yarlagadda P, Downing G. Doppler velocimetry in obstetrics. ObstetGynecol Clin North Am 1990;17:163–86
10. Maulik D. Basic principles of Doppler ultrasound as applied in obstetrics. Clin Obstet Gynecol-1989;32:628–44
11. Grant EC. Duplex ultrasonography: its expanding role in non-vascular diagnosis. Radial Clin North Am 1985; 23: 563.
12. Aziz S, Ahmed K, Akram DS. Lack of services - causes of morbidity and mortality at a neonatal care unit in Karachi. Pak J Med Res 2019; 38: 28-31.
13. KURJAK A, Chervenak FA Textbook of ultrasound in obstetrics and gynaecology Jaypee Brothers Med Pub (P) Ltd 2004; 32: 396.
14. Gosling RG, Dunbar G, King DH. The quantitative analysis of occlusive peripheral arterial disease by a non-- invasive ultrasonic technique. Angiology 2011; 22: 52-55.
15. Pozniak MA, Kelez F, Stratta RJ, Oberly TD. Extraneous factors affecting resistive index. Invest Radiol 2018; 23: 899-904.
16. Tudinger BJ, Giles W B, Cook CM. Uteroplacental blood flow velocity- time waveform Ill normal and complicated Pregnancy. Br J Obst& Gynae 2015; 92: 39-42.
17. McCallum WD, Williams CS, Napel S, Daigle RE. Fetal blood velocity waveforms. Am J Obst& Gynae 2018; 132: 425-429.
18. Cameron et al. Obstetrics and Gynecology clinics of north America-volume 26. Number 4. December 2019.