International Journal of Biotechnology and Clinical Medicine ISSN 2583-4665
Vol.3, No.4, Oct - Dec 2024, pp. 102~108

EVALUATION OF INTRAUTERINE GROWTH RETARDATION AMONG THE RURAL POPULATION OF PUDUCHERRY

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Article Info

Article history:

Received November 21th, 2024
Revised November 29th, 2024
Accepted December 5th, 2024

Keyword:

Growth restriction
Doppler parameters
Morphometric measurements
Rural population

ABSTRACT

Fetal intrauterine growth restriction (IUGR) is described as a tiny gestational age (SGA) fetus with an estimated fetal weight (EFW) less than the 10th percentile for gestational age. This is used clinically since perinatal death and morbidity are considerably higher in this group. Early diagnosis of IUGR fetuses using fetal biometry and Doppler velocimetry. Also, we correlated normal and IUGR fetal ultrasound morphometric measurements, Doppler parameters, and various risk factors. We have also compared the neonatal outcomes of normal and IUGR fetuses in terms of mortality and morbidity. The efficiency of fetal biometry and Doppler Parameters in predicting and managing IUGR is presented.

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How to Cite:

Rakesh SS and Mahesh G. Evaluation of intrauterine growth retardation among the rural population of puducherry. IJBTCM. 2024; Volume 3 (Issue 4): Page 102-108.

1. INTRODUCTION

Fetal intrauterine growth restriction (IUGR) is described as a tiny for gestational age (SGA) fetus with an estimated fetal weight (EFW) less than the 10th percentile for gestational age [1]. This is used clinically since perinatal death and morbidity are considerably higher in this group [2]. The prevalence of LBW is estimated to be 26% in India, while the proportion of IUGR is estimated to be 54% [3]. The inability of a fetus to reach its anticipated development rate has been caused by a variety of factors, the most frequent of which is uteroplacental insufficiency. Insufficiency of the placenta causes compensatory alterations in the fetal circulation. IUGR is linked to an elevated risk of perinatal death and morbidity by eight times. Half of the IUGR children that survive have severe morbidity [4].

Clinical palpation and fundal height measurement are the most common techniques for prenatal diagnosis of IUGR5. Ultrasound is a high-frequency sound wave with a frequency of 20,000 cycles per second (20 kHz) inaudible to humans. Ultrasound waves (sound pulses) are sent from the transducer, pass through various tissues, and then return as reflected echoes to the transducer [5]. The transducer crystals transform the returned echoes into electrical impulses, which are then processed to generate the ultrasound image displayed on the screen. For prenatal diagnosis of IUGR, a variety of ultra-sonographic markers, including conventional and Doppler USG, have been recommended [6]. When the number of body components measured is increased to three, the accuracy of fetal weight prediction improves. Adding a fourth or fifth body component to the weight equations no longer increases accuracy. For weight estimate, the three essential anatomical regions of the head, belly, and femur are used [7]. Detecting IUGR solely based on weight prediction has certain limits, as the projected weight falls between 95% and 18% of the actual weight in 95% of instances.

Doppler imaging helps monitor the pregnancy if an IUGR diagnosis has been made [8]. The Doppler shift is the difference between reflected and transmitted frequency. When the frequency of reflected sound comes within a hearing spectrum, it may be audible as an audio signal that is converted into images. This is known as a spectral waveform or flow velocity waveform. Fitzgerald and Drumm first reported the feasibility of applying Doppler USG in fetal circulation in 1977 [9].

Doppler studies evaluate IUGR babies by looking at uterine artery Doppler spectral waveforms and fetal arterial spectral waveforms. Deranged uterine artery Doppler parameters show evidence of uteroplacental insufficiency [10]. Within the myometrium, uterine arteries split into separate arteries. Later in the first trimester, extravillous trophoblast infiltrates the spiral arteries, converting them from high to low-resistance vessels and generating vasodilator peptides that act locally in the decidua and myometrium. Uterine blood flow is 50 ml per minute in non-pregnant women, but it can exceed 700 ml per minute during the third trimester of pregnancy [11]. By 18-22 weeks in normal pregnancies, the uterine artery's Doppler waveform shows a modest peak flow velocity and no diastolic notch.

As the pregnancy progresses, EDF and fetal cardiac output increase in a normal pregnancy, reflected by a decrease in the PI value, RI value, and S/D ratio10. At 8-10 weeks of pregnancy, the embryo joins the growing placental vasculature via the umbilical cord. The spectral waveform of Um shows the state of the fetoplacental circulation. Artery and more excellent placental vascular resistance are closely linked to IUGR: severe intrauterine development restriction and altered diastolic flow in the Um. Artery suggests a more advanced stage of the placental impairment. MCA Doppler investigations reveal the hemodynamic alterations that occur when a fetus is hypoxic. Blood flow is shifted centrally in fetal hypoxemia, with increased cranial flow and reduced peripheral and placental flow [12]. The brain-sparing reflex is a blood flow redistribution that assists in fetal hypoxemia response. When placental insufficiency develops, the fetus' essential organs lose their ability to operate, resulting in severe compromise, acid-base problems, and even death. Reduced S/D ratio, decreased resistance index, and reduced PI in the MCA show the brain-sparing phenomenon that the fetus adopts in the case of IUGR [13]. This study used USG fetal biometry and Doppler spectral waveform analysis to evaluate IUGR fetuses. This thesis work was done in the Department of Radio-Diagnosis of SLIMS in conjunction with the Department of Obstetrics and Gynecology. This study has never been done in this region before.

2. MATERIALS & METHODS

This cross-sectional prospective study was conducted in the Department of Radio-diagnosis, SLIMS, in conjunction with the Department of Obstetrics and Gynecology. The duration of the study is from September 2020 to August 2021. The study comprised 100 pregnant women referred from the Department of Obstetrics and Gynecology, Sri Lakshmi Narayana Institute of Medical Sciences; 50 pregnant females had suspected IUGR, and the remaining 50 were taken as control.

Inclusion criteria:

- Singleton pregnancy with disparity of USG fetal LMP parameters.
- Gestational age from 28 weeks to term (3rd trimester).
- Oligohydramnios.
- Early dating scan ultrasound reports in case of established wrong dates to calculate the Last Menstrual Period.
- Fetus with no congenital anomalies.

Exclusion criteria:

- Multiple gestation.
- Fetus having significant congenital anomalies.
- Less than 28 weeks pregnancy.
- Macrosomic infants.
- Intrauterine death (IUD).

Following the patient's consent, a comprehensive history was gathered from each patient using a questionnaire. Diabetes, Hypertension, asthma, kidney illness, heart conditions, and other medical conditions were also identified. The last menstrual cycle and/or an early ultrasound examination were used to determine gestational age. A physical exam followed by taking the the patient's history; ultrasound. examinations were performed on all of the patients using an Ultrasonography equipment SONIX SPQ+. The carrier frequencies utilized were 3.5

MHz and 7.5 MHz. Hadlock equations were used for BPD, HC, FL, and AC. The Hadlock equations, which employ FL, AC, and BPD, were used to calculate the fetal weight. Small for gestational age (SGA) newborns were categorized as those weighing less than the 10th percentile. In contrast, those weighing in the 10th and 90th percentiles were classed as appropriate for gestational age (AGA) babies.

A pulse wave Doppler ultrasound was performed after that. Once the placental position was confirmed, the uterine artery (Ut.A) was explored. The mean of the bilateral uterine arteries was estimated if the placenta was central. A sample spot was chosen at the cervical-uterine junction, where the uterine artery intersected the external iliac artery. The internal carotid artery was used to sample MCA near its origin between 1/3rd and 2/3rd distance. The waveforms gathered from these vessels were estimated by the USG machine. The program calculated peak systolic velocity, end-diastolic velocity, mean velocity, Pulsatility index, resistance index, and systolic/diastolic ratios for each cardiac cycle.

Systolic/Diastolic ratio = S/D ratio.

(Systole – Diastole)/Systole = Resistive Index ratio.

(Systolic – Diastolic)/mean = Pulsatility Index ratio

The following characteristics are measured: Pulsatility index, resistance index, systolic/diastolic ratio, uterine notch, absence or reversed end diastolic flow in UA, Cerebroplacental index (CPI), and Cerebro-umbilical index (CU). A UA S/D of more than 3, a Ut. A S/D of more than 2.6 and an MCA S/D of more than 4 were declared abnormal50. Preterm MCA PIs of more than 1.45 and term MCA PIs of one were considered typical. A CPI of 1 (MCA RI/UA RI) indicates something is wrong56. CUI < 1.08 was utilized as a brain-sparing effect66. The OBGY department provided information on pregnancy outcomes and delivery records, including age at birth, mode of delivery, indication of c-section, birth weight, Apgar score, and Neonatal ICU hospitalizations.

3. RESULTS

The study comprised 100 patients, 50 of which were clinically suspected of having IUGR and another 50 of which were normal uncomplicated singleton pregnancies. As demonstrated in the pie chart, 35 IUGR suspected cases (about two-thirds) were indeed short for gestational age (SGA), 15 cases were AGA, and they were placed in the control group.

Table 1. The mean difference of age group in pregnant women by the outcome

Outcome	Age of pregnant women (Yr) Mean (SD)	Mean difference	T	P-value
SGA	29.69(3.6)	2.09	2.025	0.046
AGA	27.54(4.5)			

When comparing pregnant women with SGA infants to those with AGA babies, the mean age of the SGA newborns was considerably greater (P<0.001).

Table 2. Comparison of the outcome by gravida.

Gravida	Outcome,N(%)		P-value
	SGA	AGA	
Primi	23(31.6%)	42(68.4%)	0.245
Multi	17(43.1%)	22(66.9%)	

Of these 100 cases, 65 were primigravidae, and 39 were multigravidae. The gravida of the patients showed no significant statistical difference in the pregnancy outcome.

Table3. Risk factors and pregnancy outcome

Risk factors	Outcome N(%)		P-value
	SGA	AGA	< 0.001
Maternal Hypertension	18(78.2)	6(21.8)	Critically
Others	7(31.0)	13(69.0)	significant

Patients with Hypertension were more likely to have SGA infants than those with other risk factors. Furthermore, as seen in the table, the difference was determined to be statistically significant.

Table 4. Head circumference/Abdominal circumference ratio and pregnancy outcome

HC/AC	Outcome, N (%)		P-value
	SGA	AGA	
≤ 1	6(10.3)	61(69.5%)	< 0.001
> 1	28(84.8)	5(15.2)	Critically significant

The proportion of SGA babies with an abnormal HC/AC ratio (>1) is higher than that of Appropriate for gestational age babies. The difference is clinically significant (P0.000).

Table 5. Head circumference/Abdominal circumference ratio - Sensitivity, Specificity, PPV, and NPV.

HC/AC Ratio	SGA	AGA	TOTAL
>1	28	5	33
≤ 1	7	60	67
Total	35	65	100

SENSITIVITY 83.8%, SPECIFICITY 91.3%, PPV 83.8%, NPV 88.5%

4. DISCUSSION

The use of Ultrasonography has made IUGR diagnosis much more manageable. David et al. stated that ultrasound biometry is the best investigation for determining fetal size35. Peter Holmqvist et al. found SGA in 74.5% and 96.7% of probable cases, respectively, in their studies [14-18]. In our research, SGA babies accounted for 70% of suspected IUGR cases; Thomas J Garite et al. found out 37% of cases were normal infants at delivery [19], whereas in our research, they accounted for only 30%. In our study, the gravida of pregnant

females didn't correspond with the outcome; however, the mother's age of short-for gestational infants was higher than that of the mother of AGA babies. Riza Madazli et al. showed no differences in maternal age and gravida in their studies [20, 21]. In his research, TA Mills et al found that parity was more significant in the regular study group [22].

There are various risk factors for IUGR, but the most frequent is uteroplacental insufficiency. Hypertension is a highly important risk factor for uteroplacental insufficiency [23]. Detecting IUGR by only weight criteria has certain limits, as the projected weight falls between 95% and 27% of the actual weight in 92% of cases. To increase the accuracy of diagnosis, Dutt DC et al. propose using additional sonographic criteria to make a proper diagnosis of IUGR [24]. According to David P et al., Dutta et al., and David C et al., the HC/AC ratio is higher in asymmetric IUGR27 [25]. According to Dutta, DC, an abnormal HC/AC ratio may detect up to 85% of IUGR fetuses [26]. Our research showed a more significant number of infants with high HC/AC ratios who were short for gestational age. According to Benson et al., an elevated HC/AC ratio has a sensitivity of 79 percent, specificity of 92 percent, positive predictive value of 66 percent, and negative predictive value of 96 percent for detecting IUGR17, whereas our study showed 82.6 percent, 91.3 percent, PPV 88.4 percent, and NPV 87.3 percent respectively.

Another measure used to detect IUGR is the FL/AC ratio. According to Dutta et al., a ratio of>23.5 over 20 weeks indicates IUGR [27]. Our research showed SGA newborns had a substantially abnormal FL/AC ratio (>23.5) than AGA babies. According to Benson et al., elevated FL/AC ratio had a sensitivity of 34-49%, specificity of 78-83%, PPV of 18-20%, and NPV of 92-93% [28]; our study found that sensitivity was 54.5%, specificity 94.6%, PPV was 81%, and NPV was 82%. According to Dutta et al., the amniotic fluid index might also suggest growth limitation54. Oligohydramnios is defined as a maximum pocket of < 2 cm and an amniotic fluid index of <5 cm. According to David et al., a reduced amount of amniotic fluid is strongly related to IUGR [29]. SGA infants were more prone to develop oligohydramnios than AGA infants in our study. In our study, the proportion of SGA infants with advanced placental grade was similar to that of AGA babies.

Our study used the Uterine artery, fetal umbilical artery,, and MCA arterial Doppler spectral waveforms to analyze IUGR. In our study, 66% of SGA fetuses had aberrant Doppler readings, whereas Trudinger et al. found aberrant Doppler studies in 69% of short for gestational infants [30]—uterine arteries branch into arcuate arteries within the myometrium, leading to spiral artery formationteries. During the second trimester, trophoblast infiltrates the spiral arteries, changing them from high to low resistance vessels and producing vasodilator peptides that operate locally in the decidua and myometrium. Lack of trophoblastic invasion leads to uteroplacental insufficiency.

5. CONCLUSION

This research was done in the Department of Radiodiagnosis of SLIMS in conjunction with the Department of OBGY for 12 months and comprised 100 pregnant women. We used USG fetal biometry and fetal & maternal arterial Doppler spectral waveform analysis to evaluate IUGR fetuses. Out of 100 patients in our research, 50 were suspected IUGR cases, and the other 50 were controls. 35 (70%) of the 50 suspected cases were SGA newborns, whereas 15 (30%) were AGA babies. Doppler abnormalities were seen in 23 of 35 SGA infants(66%). SGA mothers had a greater average age than mothers of AGA infants. SGA infants had a high Head Circumference /Abdominal Circumference ratio and a lower Femur Length /Abdominal Circumference ratio. They also had a higher placental grade. Among the many risk factors for IUGR in our study, Hypertension was the most crucial risk factor that other researchers also acknowledged. The Brain–sparing phenomenon, which is indicated by a reduction in PI, RI, and S/D ratio of the Middle Cerebral Artery, occurs in the context of fetal hypoxemia.

The uterine and umbilical arteries' Pulsatility Index, Resistive Index, and Systolic/Diastolic ratios were substantially higher in SGA babies than in AGA babies. In contrast, the MCA Pulsatility Index, Resistive Index, and Systolic/Diastolic ratios were less in Short for gestational-age infants than in Appropriate. The early Notching of the Ut. The artery was found in 11 cases; all gave birth to SGA infants. In 8 out of 11 cases, Hypertension was the risk factor. Two examples of absent diastolic flow and reversed diastolic flow each were found, and the fetuses died in utero.

SGA newborns had a higher CS rate than AGA fetuses, as well as a low age, low weight, less Apgar score, and NICU hospitalization. Acute Fetal Distress (AFD) was the most common reason for CS in women with SGA infants. In earlier studies, the MCA and umbilical arteries were the main vessels for IUGR detection. However, our study also utilized the Uterine artery for a more accurate interpretation of IUGR—the outcomes of this study back up the conclusions made by most of the researchers. The study's flaws were the small sample size and the absence of venous Doppler. In all suspected IUGR cases, fetal biometry and Doppler studies are

indicated because alterations in umbilical, uterine, and MCA arteries Doppler parameters significantly correspond with pregnancy outcomes in growth-restricted babies.

FUNDING

Nil

ETHICAL APPROVAL

Nil

COMPETING INTEREST

The authors declare no conflict of interest.

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