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Research Article

Ultrasound Doppler: The Game Changer in Fetal Growth Restriction Evaluation and Mode of Delivery

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Abstract

Introduction: Fetal growth restriction (FGR) is defined as the failure of the fetus to meet its growth potential due to a pathological factor, most commonly placental dysfunction. Worldwide, FGR is a leading cause of stillbirth, neonatal mortality, and short- and long-term morbidity. Our study aims to evaluate the patients with doppler changes and its effect on mode of delivery and neonatal outcome.

Material and Methods: The study was conducted at the Department of Obstetrics and Gynecology, Dr. R. N. Cooper Hospital, Mumbai, included all singleton pregnancies with a gestational age of more than 30 weeks, who presented with fetal growth restriction (FGR) and underwent Doppler ultrasound examination between July 2024 and December 2024. The data was evaluated in terms of maternal demographics, fetal demographics (gestational age), doppler ultrasound findings (umbilical artery, middle cerebral artery), mode of delivery (vaginal, cesarean section) and neonatal outcomes (with respect to, NICU admissions).

Results: Of the 1350 patients delivered during the study period, 40.20% were admitted with Ultrasound suggestive of doppler changes. Among them 59% presented with reduced diastolic flow in umbilical artery , 23.57% presented with reduced diastolic flow in umbilical artery with CPR = 1 and 13.2% with absent flow and 4%with reversal of diastolic flow. 54% of newborns who delivered preterm required nicu admissions

Conclusion: Our study highlighted the importance of identifying the high risk cases, proper referrals, timely evaluation by clinical examination and doppler and planning the time of delivery keeping in mind the chance of intrauterine fetal demise versus neonatal morbidity, the role of Obstetricians in collaboration with Radiologist or fetal medicine expert and Pediatrician.

Keywords: Fetal Growth Restriction; Doppler Ultrasound; Placental Dysfunction; Umbilical Artery; Middle Cerebral Artery; Neonatal Outcome

Introduction

Fetal growth restriction (FGR) is defined as the failure of the fetus to meet its growth potential due to a pathological factor, most commonly placental dysfunction. Worldwide, FGR is a leading cause of stillbirth, neonatal mortality, and short- and long-term morbidity [1].

Clinically, this is reflected by a drop in fetal size percentiles over the course of gestation. However, fetal growth potential is difficult to determine, and serial assessments of fetal size to detect a drop in fetal weight percentile are usually not available. Instead, care providers most commonly have only a "snapshot" of fetal weight estimation at a given point in time. Therefore, in clinical practice, small for gestational age (SGA), defined as estimated fetal weight (EFW) or abdominal circumference below a certain threshold such as the 10th or 3rd percentile, is most commonly used to suspect FGR [1].

Common etiology of FGR includes

- Maternal (preplacental) factors
  - Hypoxemia (chronic lung disease, high altitude)
  - Anemia
  - Smoking, substance abuse (cocaine, methamphetamines)
  - Malabsorption, poor weight gain
  - Environmental toxins: air pollution, heavy metals (lead, mercury), perfluorooctanoic acid (PFOA)
- Placental factors
  - Maternal vascular malperfusion pathology (infarction, fibrin deposition, chronic abruption)
  - Fetal vascular malperfusion pathology
  - Chronic placental inflammation (e.g. villitis of unknown etiology)
  - Confined placental mosaicism
- Umbilical cord (postplacental) factors
  - Increased coiling
  - Increased cord length
  - True cord knot
  - Single umbilical artery
  - Marginal or velamentous cord insertion
- Fetal disorders
  - Genetic disorders (chromosomal, micro deletions/duplications, single site mutations, epigenetic disorders)
  - Structural anomalies (e.g. congenital heart disease, gastroschisis)
  - Congenital infections (cytomegalovirus, toxoplasmosis, herpes, rubella, syphilis, Zika virus, malaria)
  - Teratogen exposure (drugs, toxins)

Placenta-based intrauterine growth restriction (IUGR) is predominantly a vascular disorder. It starts with abnormal tertiary villous vessels and ends with characteristic fetal multi-vessel cardiovascular manifestations. These effects can be documented with Doppler ultrasound examination of a number of vessels: maternal uterine arteries and the fetal 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. This presumed sequence and the anticipation of fetal deterioration form the basis for Doppler surveillance in IUGR. Deterioration in Doppler findings typically leads to several changes in clinical IUGR management: increased monitoring frequency, administration of antenatal steroids and delivery [2].

Small fetuses are defined as those with an ultrasound estimated weight below a threshold, most commonly the 10th percentile which includes both SGA and FGR fetuses. SGA fetuses are defined as those with an estimated fetal weight less than the 10th percentile for gestational age. FGR is a failure of the fetus to reach its full growth potential and is associated with maternal, placental, and fetal conditions, including hypertension, and other placental deficiencies. Suboptimal intrauterine growth affects up to 10% of pregnancies and confers an increased risk of perinatal morbidity and mortality. It increases the risks of stillbirth, birth hypoxia, neonatal death, and neurodevelopmental impairment [3].

Doppler assessment is an integral part of the diagnostic process and management of FGR. The presence of abnormal Doppler findings in the uterine, umbilical, or middle cerebral arteries is highly suggestive of placental dysfunction as the underlying etiology of FGR.

It should be noted that umbilical artery Doppler findings may be normal in the early stages of placental FGR. Therefore, normal umbilical artery Doppler studies do not rule out placental dysfunction, and therefore serial monitoring is recommended in all cases of suspected FGR [1].

Aims and Objectives

Primary objectives

- Evaluate the cause of FGR
- Doppler changes in FGR
- Mode of delivery Secondary objectives

To assess the neonatal morbidity and mortality and nicu admissions.

Material and Method

This retrospective observational study was conducted at the Department of Obstetrics and Gynecology, Dr. R. N. Cooper Hospital, Mumbai, India. The study was approved by the Institutional Ethics Committee.

Study population

The study included all singleton pregnancies with a gestational age of more than 30 weeks, who presented with fetal growth restriction (FGR) and underwent Doppler ultrasound examination between July 2024 and December 2024.

Inclusion criteria

- Singleton pregnancy
- Gestational age more than 30 weeks
- Fetal growth restriction (FGR)
- Doppler ultrasound examination performed

Exclusion criteria

- Multifetal pregnancy
- Pregnancy complicated by fetal anomaly
- Early-onset FGR (onset less than 30 weeks)

Data collection

The data was collected retrospectively from the hospital's electronic medical records. The following data was collected:

- Maternal demographics (parity, gestational age)
- Fetal demographics (gestational age)
- Doppler ultrasound findings (umbilical artery, middle cerebral artery, ductus venosus)
- Mode of delivery (vaginal, cesarean section)
- Neonatal outcomes (with respect to, NICU admissions)

Statistical analysis

The data was analyzed using descriptive statistics. The chi-square test was used to compare categorical variables, and the independent samples t-test was used to compare continuous variables.

Results

Demography

The total number of confinements from July 2024 to December 2024 were 1350. Among them the number of vaginal deliveries were 677 (50.14%).

Of the 1350 patients delivered during the study period, 543 were admitted with Ultrasound suggestive of doppler changes (40.20%) Figure 1.

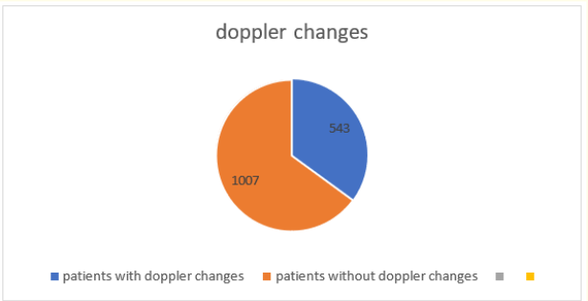

Figure 1: Number of patients who presented with doppler changes.

In our study, Out of 543 patients studied, 231 were primigravida, 215 were gravida 2, and 97 were Gravida 3 and above Figure 2.

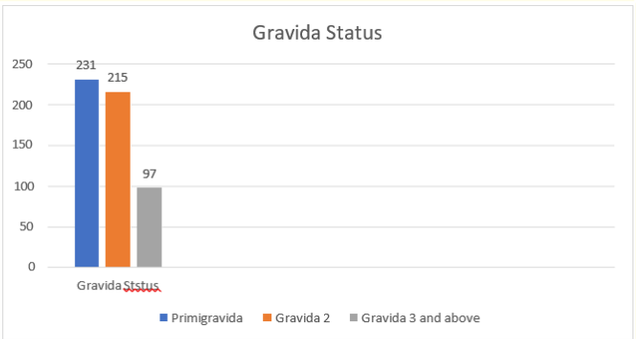

Figure 2: Gravida Status among Study Population.

Doppler changes

Of the 543 patients with doppler changes, 321 (59%) presented with reduced diastolic flow in umbilical artery with CPR > 1 (BRAIN SPARING EFFECT), 128 (23.57%) presented with reduced diastolic flow in umbilical artery with CPR = 1(Pathological MCA), 72 (13.2%) presented with absent flow and 22 (4%) presented with reversal of diastolic flow. Regarding mode of delivery, 256 (47%) delivered by LSCS and 287 (52.8%) delivered vaginally.

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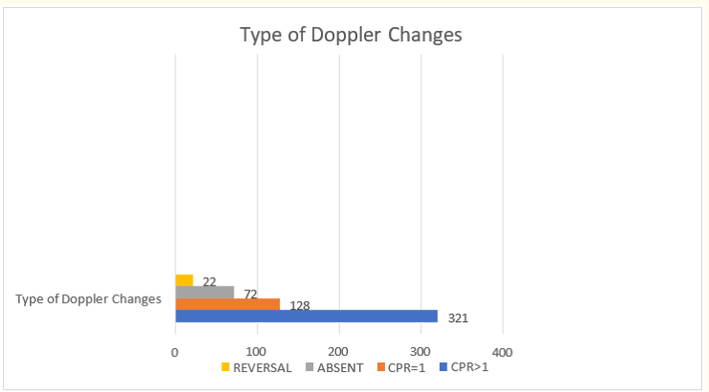

Figure 3: Various types of Doppler changes in study population.

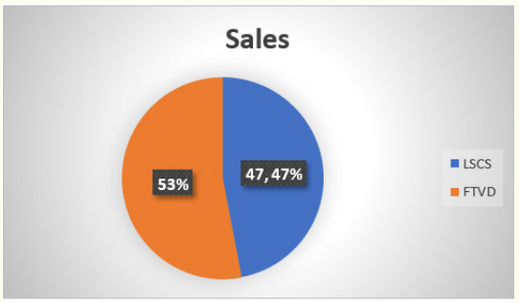

Figure 4: Mode of Delivery in patient with doppler changes.

Chart demonstrates 47% of patients delivered by Caeserian section. Our hospital being referral centre received many patients directly for LSCS WITH Ultrasound doppler suggestive of reversal of flow.

344 patients were induced for labour, out of which 277 (80%) delivered vaginally. And 10 progressed spontaneously.

189 were directly prepared for LSCS

- Previous LSCS
- Breech
- CPD
- Placenta previa
- Eclampsia

Presence of comorbidities

In our study of the total 543 patients studied, following number of patients were complicated with comorbidities (Table 1).

Comorbidity	No. of Patients
Hypertension	378 (69.6%)
Diabetes	127 (23.38%)
Anemia	234 (43%)
Heart disease	12 (22%)
Thrombocytopenia	211 (38.8%)
Alocohol abuse	0
Placenta Previa	15 (27.6%)

Table 1: Number of patients with doppler changes complicated with Pre existing illness.

Timing of delivery

Of the 543 patients studied, only 17% delivered at term. Among the preterm delivered patients 38% delivered between 32 to 34 weeks and 205 between 36 to 37%.

Table 2 and Figure 5 demonstrates the timing of delivery in terms of weeks of gestation in study population.

Timing of Delivery	No. of Patients
30 -32 weeks	96 (17.67%)
32- 34 weeks	211 (38.8%)
34-36 weeks	34 (6.26%)
36-37 weeks	110 (20%)
>37 weeks	92 (17%)

Table 2: Timing of delivery in terms of weeks of gestation in study population.

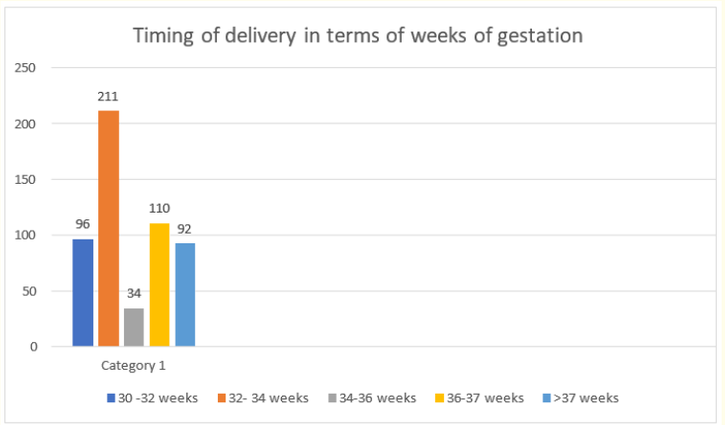

Figure 5: Timing of delivery in terms of weeks of gestation in study population.

NICU admissions

Out of 451 patients who delivered preterm, 247 (54%) required nicu admissions for low birth weight, respiratory distress and iv antibiotics and 23 (5%) were Neonatal death.

Discussion

In our study, we observed only 17% patients delivered at term, 38% delivered between 32 to 34 weeks and 20% between 36 to 37 weeks. The results are comparable to Patel., *et al*. [4], where the patients delivered at term, between 32 to 36 weeks were 18% and 38% respectively.

Regarding NICU Admissions and mortality ssen in our study the NICU admissions rate of 54% and mortality of 5% which is comparable to Patel., *et al*. [4] (38% and 6% respectively).

In terms of neonatal complications of FGR, a systematic review showed an overall prenatal death rate of 12.3% and a neonatal mortality rate among FGR fetuses of 6.6% [5]. The randomized umbilical and fetal flow study in Europe (the TRUFFLE study) also reported a perinatal mortality rate of 8%, significantly higher than that reported in our study [6].

In addition, A. Valcamonico., *et al*. showed that FGR infants with absent or reversed end-diastolic flow in the umbilical arteries have, in addition to increased fetal and neonatal mortality, a higher incidence of long-term permanent neurological damage compared with fetuses with growth delays with the diastolic flow in the umbilical circulation [7].

Once FGR has been identified, the principal management steps are the institution of fetal surveillance and determination of appropriate thresholds for delivery. The antenatal detection rates of FGR are estimated to be between 25% and 36% [8].

However, according to the RCOG, the use of umbilical artery Doppler in a high-risk population has been shown to reduce perinatal morbidity and mortality and should be the primary surveillance tool in the SGA fetus [9]. Umbilical artery Doppler monitoring should be initiated when the fetus is considered viable and FGR is suspected. Some recommendations indicate that although Doppler studies of the ductus venosus, middle cerebral artery, and other vessels have some prognostic value as part of the assessment of fetal well-being in pregnancy, these should be reserved for research protocols [10].

Conclusion

Our study highlighted the importance of identifying the high risk cases, proper referrals, timely evaluation by clinical examination and doppler and planning the time of delivery keeping in mind the chance of intrauterine fetal demise versus neonatal morbidity, the role of Obstetricians in collaboration with Radiologist or fetal medicine expert and Pediatrician to guide the time and mode of delivery is very important. Our study evaluated the effectiveness of various Doppler blood flow parameters in predicting adverse neonatal outcomes in fetuses with late-onset FGR.

Although late-onset FGR is associated with lower rates of perinatal morbidity and mortality compared with early-onset FGR, the incidence of adverse outcomes such as hypoxemic events and long-term neurodevelopmental abnormalities is still higher in fetuses with late-onset FGR than in normal fetuses. Keeping a high index of suspicion while providing daily antenatal care to our patients will definitely help assisted by modern evaluation techniques.

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