



COMPARISON BETWEEN VARIOUS DOPPLER PARAMETERS FOR PREDICTING FETAL GROWTH RESTRICTION AND PERINATAL OUTCOME

Obstetrics & Gynaecology

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ABSTRACT

Aim:- Correlation between various doppler indices of feto-maternal vessels with respect to sensitivity, specificity, accuracy, positive and negative predictive value. 2) To evaluate the efficacy of doppler study of feto-maternal vessels (uterine, umbilical and middle cerebral arteries) in predicting perinatal outcome in FGR cases. **Materials & Methods:-** This observational study was conducted in 50 antenatal patients diagnosed with FGR who fulfilled the inclusion and exclusion criteria. After the clinical diagnosis of FGR, doppler studies of umbilical, uterine and middle cerebral artery were done. Sensitivity, specificity, accuracy, PPV, NPV of various doppler parameters were compared. Results were compiled and statistically analyzed. **Results:-** In our study, MCA doppler indices proved to be better predictor of FGR. The diagnostic accuracy of MCA PI in predicting FGR was found to be highest (68%) followed by MCA RI (62%) and MCA S/D (54%). Absent/reversed umbilical EDF had 100% specificity and 100% PPV in diagnosing FGR. Increased uterine S/D ratio and persistence of diastolic notch in late pregnancy suggested high sensitivity and a high degree of PPV for predicting FGR. Association of abnormal umbilical S/D, umbilical PI, AEDF/REDF and uterine notching with the adverse perinatal outcome has been proven statistically significant. Majority of the cases had term delivery. 58% cases underwent caesarean. 54% of the neonates had the adverse perinatal outcome. RDS was the most common neonatal complication and two cases of neonatal mortality were observed. **Conclusion:-** The present study concludes MCA doppler indices proved to be better predictor of FGR. Also, abnormal doppler indices directly correlate with poor neonatal outcome especially in cases of abnormal MCA study, uterine notching and absent or reversed umbilical end-diastolic flow in which early intervention is advised.

KEYWORDS

FGR, Umbilical artery, Uterine artery, MCA, S/D ratio, RI, PI, AEDF, REDF, Uterine notching, NICU.

INTRODUCTION

ACOG says that FGR is the most common and complex problem encountered by obstetricians leading to suboptimal growth and is linked with impaired intellectual performance, diseases such as hypertension, obesity in adulthood.¹

The most commonly used definition for FGR, used by ACOG and RCOG is fetal weight less than 10th percentile for a given gestational age.^{1,2} Other definitions of FGR include estimated weight less than 2 standard deviations below the mean weight, abdominal circumference <10 % for gestational age. Growth-restricted fetuses are at increased risk and are a leading cause of increased perinatal morbidity and mortality.^{3,5} Perinatal mortality rates in growth-restricted neonates are 6 to 10 times higher than those with normal growth.³

The prevalence of FGR is 10% in all pregnancies but it ranges from⁶⁻⁸ 3-25% depending upon health status of mothers.

It is important to diagnose FGR at an early gestation with the help of routine antenatal examination as well as ultrasound assessment. Highly sensitive and specific and non-invasive test is the color doppler to determine the placental-based FGR. Feto-maternal vessels studied are-umbilical, uterine, middle cerebral and ductus venosus. Indices calculated are: S/D Ratio, Pulsatility Index (PI), Resistance index (RI).

3) Uterine Artery	18-23 weeks	As it crosses the hypogastric vessels	Notching or elevated pulsatility index	Early prediction of FGR
4) Ductus venosus	>23 weeks	At the site of aliasing, where it branches from umbilical vein	Decreased, absent or reversed flow in a-wave	Neonatal academia, perinatal mortality

Perinatal Outcome:-

FGR fetuses have 4-8 fold⁶ increased risk of perinatal mortality and suffer from complications including intrapartum fetal distress, hypoglycemia, hypocalcemia, meconium aspiration pneumonia, neuro-developmental delay¹⁰.

MATERIALS AND METHODS:-

This prospective observational study was conducted in Obstetrics and Gynaecology department, MMIMSR, Deemed to be university, Mullana, Ambala, Haryana, a tertiary care rural hospital in North India. Approval from the ethics committee of our institute was taken.

Doppler study was done as per the conventional method. Informed consent was obtained from women who fulfill the inclusion criteria.

Inclusion Criteria:-

1. Last menstrual period of the patient known
2. Singleton pregnancy between 28-40 weeks of gestation
3. Clinically and sonologically detected cases of FGR
4. Normal fetal morphology

Exclusion Criteria:-

Multiple pregnancy, Congenitally malformed fetus, Intra-uterine fetal demise.

Collection of data:-

A minimum of 50 patients diagnosed with FGR were selected for the study. The diagnosis for FGR was made after confirming the gestational age and doing a detailed obstetrical examination. After clinical diagnosis, FGR was confirmed by estimating fetal biometry and doppler studies for the umbilical artery, uterine artery, and middle cerebral artery. The pregnant women were followed till delivery and

Table 1:- Characteristics Of Various Doppler Parameters.⁹

VARIABLE	GESTATIONAL AGE	LOCATION	ABNORMAL	ABNORMALITY LINKED WITH
1) Umbilical artery	>23 weeks	Abdominal cord insertion (preferred)	Decreased end-diastolic flow (includes AEDF, REDF)	Stillbirth, neurological impairment
2) Middle cerebral artery	>23 weeks	Proximal portion of vessel at zero degrees angle of incidence	Increased diastolic flow	Neonatal acidosis, neurological impairment

details were collected regarding mode of delivery, gestational age at birth, birth weight and various neonatal complications, neonatal mortality and need for monitoring in NICU. In our study, we considered the findings of doppler study which was done within one week prior to termination of pregnancy or spontaneous delivery. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of various doppler parameters were calculated and compared.

RESULTS:-

Table 2:- Sensitivity, Specificity, Ppv, Npv And Accuracy Of Doppler Study Of Various Feto-maternal Vessels In Predicting Fgr.

Criterion	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Umbilical S/D	53.13%	27.78%	56.67%	25%	44%
Umbilical RI	40.63%	33.33%	52%	24%	38%
Umbilical PI	40.63%	22.22%	48.15%	17.39%	34%
Absent/reversed end-diastolic flow	19.35%	100%	100%	43.18%	50%
Uterine S/D Ratio	71.88%	16.67%	60.53%	25%	52%
Uterine RI	40.63%	44.44%	56.52%	29.63%	42%
Uterine PI	56.25%	22.22%	56.25%	22.22%	44%
Uterine Notching	62.5%	5.56%	54.05%	7.69%	42%
MCA S/D Ratio	56.25%	50%	66.67%	40.91%	54%
MCA RI	56.25%	72.22%	78.26%	48.15%	62%
MCA PI	83.87%	42.11%	70.27%	61.53%	68%

MCA PI had the highest diagnostic efficacy of 68% in prediction of FGR, followed by MCA RI (62%) and MCA S/D (54%). The sensitivity of various doppler parameters in predicting FGR is as follows- MCA PI (83.87%)> uterine S/D (71.88%)> uterine notching (62.5%). MCA RI, MCA S/D and Uterine PI, each had a sensitivity of 56.25%. Umbilical artery absent/reversed end-diastolic flow had 100% specificity and 100% positive predictive value in diagnosing FGR.

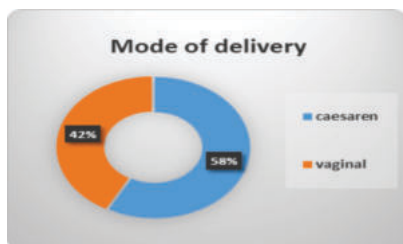


Figure 1:- Mode Of Delivery In Fgr Cases.

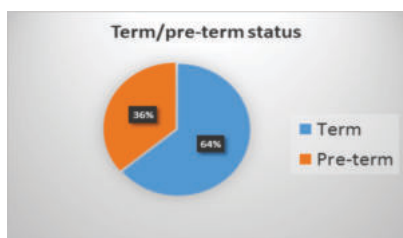


Figure 2: Term/pre-term Status Of The Fgr Cases At The Time Of Delivery.

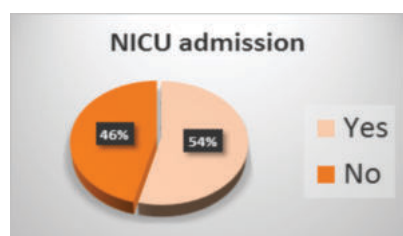


Figure 3: Nicu Admission In Fgr Cases

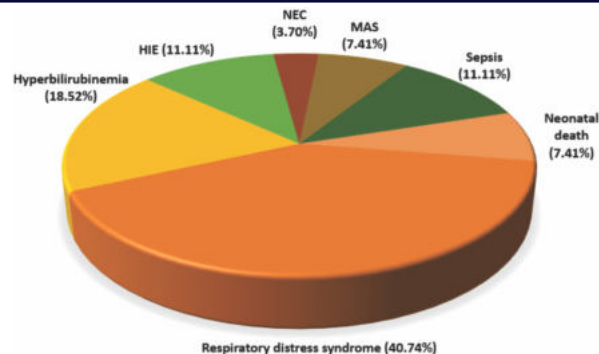


Figure 4:- Adverse Perinatal Outcome In Fgr Cases

DISCUSSION

Early diagnosis of FGR is important because early intervention can help avert unfavourable perinatal outcome. Many patients present in the last months of pregnancy for the first time for their ANC check up. Such patients require highly sensitive and specific and non-invasive test, like color doppler to determine FGR.

The present study was a prospective observational study conducted in 50 pregnant women attending antenatal clinic, beyond 28 weeks, who were suspected of FGR, in the department of Obstetrics and Gynaecology, Maharishi Markandeshwar Institute Of health Sciences and Research, Mullana, Ambala, Haryana. The definitive diagnosis of FGR was made after clinical examination and confirming with color doppler studies of various feto-maternal vessels. The FGR cases were managed according to the clinical status of the patient and doppler examination report.

Assessment Of Doppler Parameters In Predicting Fgr-

Color doppler velocimetry in FGR is considered more accurate for predicting pregnancy outcome. It is also useful for timely identification of fetal compromise and hypoxia so that timely termination of pregnancy can be done. Doppler assessment should be done periodically to assess the growth status of the fetus and abnormal patterns, which can help in predicting adverse perinatal outcome.

Diagnostic Efficacy Of Umbilical Artery Doppler Parameters In Predicting Fgr:-

In our study the umbilical artery S/D ratio had high sensitivity (53.13%) and high positive predictive value (56.67%) in detecting FGR. Umbilical PI and RI had high positive predictive value of 48.15% and 52% respectively. Gaikwad PR et al¹¹ reported similar results for umbilical PI, RI with high positive predictive value (85.71%, 81.48% respectively) and high specificity (93.55% and 91.94% respectively). The results of study done by Geetha M et al¹² were also comparable to our study. They reported high specificity of 100% & positive predictive value of 100% for absent and reversed end diastolic flow in detecting FGR, which is also similar to our study.

Uterine Artery Doppler Assessment- Diagnostic Efficacy Of Uterine Artery Doppler Parameters In Predicting Fgr:-

In our study, uterine artery S/D ratio has been proven highly sensitive (71.88%) with high positive predictive value (60.53%) in predicting FGR. In contrary to our study, Geetha M et al¹² proved uterine S/D ratio to be highly specific (92.4%) in predicting FGR. Chakraborty S et al¹³ in 2017 studied sensitivity and specificity of uterine artery PI to be 85.7% and 91.7% respectively and for RI was 71.4% and 87.5% respectively.

In our study, we found uterine diastolic notching sensitivity, specificity, PPV and NPV to be 62.5%, 5.56%, 54.05%, 7.69% respectively. Chakraborty S et al¹³ reported uterine diastolic notching to be highly sensitive (92.8%), highly specific (94.4%) with highest positive (94.4%) and negative predictive value (86.7%), in predicting FGR. Geetha M et al¹² also found uterine notching to be highly specific (94.3%).

Middle Cerebral Artery Doppler Assessment- Diagnostic Efficacy Of Middle Cerebral Artery Doppler Parameters In Predicting Fgr:-

From our study, we concluded MCA PI to be highly sensitive for predicting FGR, and RI to be highly specific. On the other hand,

Gaikwad PR et al¹¹ reported all MCA doppler parameters:- S/D, PI, RI to be highly specific (93.55%, 98.39%, 100% respectively). They also reported all MCA doppler parameters having high positive predictive value.

Gestational Age At Delivery

Mean gestational age of delivery in our study was found to be 37.1 weeks +/- 2.62. Gaikwad PR et al¹¹ reported similar result in their study. Sharma DD et al¹⁴ found mean gestational age to be 33.4 weeks, due to early termination of pregnancy in high risk patients.

Mode Of Delivery

More than half of the patients (58%) in our study underwent caesarean. Sharma DD et al¹⁴, Veerabathini MK et al¹⁵ and Sinha S et al¹⁶ have reported high incidence (61%, 60%, 59% respectively) of caesarean deliveries in FGR babies, which is also in concordance with our study.

Perinatal outcome

Maximum of 11 cases of respiratory distress syndrome (RDS) were reported in our study, which was in concordance with the study done by Sinha S et al¹⁶. 2 cases of mortality were seen in our study. Both of the fetuses were pre-term delivered at 28 and 30 weeks with reversed end diastolic flow in umbilical artery, diastolic notching in uterine artery with severely deranged umbilical and middle cerebral artery doppler parameters. Geetha M et al¹² reported high perinatal mortality of 11 cases in their study.

Correlation of various doppler parameters and fetal biometry with the birth weight:-

In our study, we observed that most of the doppler parameters-umbilical S/D ratio, umbilical RI, umbilical PI, uterine S/D ratio, uterine RI, uterine PI, middle cerebral artery S/D ratio and middle cerebral artery RI had negative relation with birth weight. Increased values of these parameters were associated with low birth weight babies.

However, middle cerebral artery PI showed positive relation with birth weight. Low MCA PI was associated with low birth weight babies.

Summary

In our study, The middle cerebral artery doppler indices had better sensitivity and positive predictive value for determining FGR. The overall diagnostic efficacy of MCA PI in predicting FGR was found to be 68% followed by MCARI (62%) and MCAS/D (54%).

The sensitivity of various doppler parameters in predicting FGR is as follows- MCA PI (83.87%)>uterine S/D ratio (71.88%)> uterine notching (62.5%)> MCA RI (56.25%)> MCA S/D ratio (56.25%)>Uterine PI (56.25%)> umbilical artery S/D ratio (53.13%). Increased uterine S/D ratio and persistence of diastolic notching in late pregnancy suggested high sensitivity and high degree of PPV for predicting FGR and unfavourable outcome. Absent or reversed umbilical end-diastolic flow had 100% specificity and 100% PPV in diagnosing FGR. AEDF/REDF and presence of uterine notching were associated with perinatal morbidity and mortality. In our study, majority of the cases had term delivery. 58% cases underwent caesarean section. 54% of the neonates had adverse perinatal outcome leading to NICU admission. RDS was the most common neonatal complication encountered. Neonatal mortality was seen in two cases with reversed end-diastolic flow in umbilical artery with severe FGR.

The present study concludes that the abnormal doppler indices directly correlate with the poor neonatal outcome, high neonatal morbidity and mortality especially in cases of abnormal MCA study, uterine notching and abnormal umbilical artery waveforms (AEDF, REDF) in which early intervention is advised.

CONCLUSION:

FGR is a common obstetric complication and often remain undiagnosed antenatally. Hence, accurate dating, regular antenatal check-up, clinical and sonographic evaluation for fetal growth in high-risk patients are recommended. Doppler velocimetry is a non-invasive, simple and reliable method for antepartum fetal surveillance and should be an integral part of protocols to assess FGR.

The present study noted the significance of doppler ultrasound study of various feto-maternal vessels in patients with FGR, to identify compromised fetuses in-utero and to take timely appropriate action.

Abnormal middle cerebral artery parameters were better predictor of FGR. Abnormal umbilical S/D ratio, umbilical PI, AEDF/REDF and uterine notching were associated with adverse perinatal outcome. The presence of uterine notching, AEDF and REDF were associated with significant perinatal morbidity and mortality. AEDF and REDF are ominous signs in doppler study and carries a grave prognosis and high mortality. Thus, helps the obstetricians to take prompt action to rescue the baby.

However, doppler velocimetry of the multiple vessels should be studied for fetal surveillance. Labour and delivery in FGR babies need to be monitored meticulously, should be attended by a qualified neonatologist to prevent adverse perinatal outcome and prolonged NICU stay.

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