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RESEARCH ARTICLE

Role of fetal biometry and color Doppler indices in pregnancies with early onset fetal growth restriction in a tertiary care hospital

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ABSTRACT

Background: Fetal growth restriction, FGR is a leading cause of stillbirth, neonatal mortality, and short-term and long-term neonatal morbidity. The most recent consensus based definition for defining early and late FGR is through Delphi procedure. **Objectives:** In this study we assessed the role of fetal biometry and colour Doppler indices for detection and surveillance early onset fetal growth restriction, so as to identify fetuses most at risk and manage these pregnancies to improve the perinatal outcome. **Methods:** It was a prospective, non-invasive, descriptive study of 60 pregnant females presenting with gestational age of 22+0 wks to 31 wks + 6 days complicated with early onset fetal growth restriction. Written informed consent was taken. After thorough history and examination, they underwent ultrasonography for fetal biometry and colour Doppler to confirm clinical diagnosis. They were followed till pregnancy was terminated and their fetomaternal outcomes were analyzed. **Results:** In the study, 41.67% cases were primigravida, with mean age of 26.98 ± 4.83 years. 65% of cases were associated with pre-eclampsia. On fetal biometry it was found that, 83.33% of cases had EFW / AC less than 3rd percentile and 16.67% cases had EFW / AC between 3rd percentile to 10 percentile. On ultrasound Doppler assessment, 10% cases were with normal Doppler. Maximum 61.66% cases had abnormal umbilical artery Doppler and 28.33% had abnormal uterine artery Doppler at the time of diagnosis. During surveillance 35% cases developed brain sparing effect, 36.66% patients had CPR <1 and 8.33% cases had abnormal ductus venosus Doppler. 55% of deliveries were terminated for fetal indication, majority 38.33% were for pathological Doppler (AEDF /REDF). Mean gestation age at delivery was 32.73 ± 2.90 weeks. Caesarean section was done in 81.67% women In our study, 2 fetuses out of 60 had intrauterine death, 6 were stillbirth and rest were live birth. Mean birth weight was 1349 ± 416.81 gms. 53.33% fetuses had Apgar score <7. 41.66% fetuses were admitted to NICU and 4 neonatal mortality happened during study period. **Conclusion :** Fetal biometry and colour Doppler has got significant role in improving perinatal morbidity and mortality in pregnancies with early onset fetal growth restriction.

Keywords: Fetal growth restriction, Delphi consensus, umbilical artery Doppler.

Fetal growth restriction, FGR is a common pregnancy complication that worldwide is a leading cause of stillbirth, neonatal mortality, and short-term and long-term neonatal morbidity[1]. FGR is condition in which the fetus fails to attain the growth potential as determined by the genetic makeup. Clinically, this is reflected by a drop in fetal size percentiles over the course of gestation. FGR has been classified according to gestational age at onset, as early and late, with an arbitrary cut-off conventionally set at 32 weeks.

Multiple definitions of FGR have been suggested over the decades. The most recent consensus based definition for defining early and late FGR is through a Delphi procedure [2], absolute size measurements as well as functional parameters were introduced into the definition. For early onset FGR

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(<32 weeks), three solitary parameters were established: Abdominal circumference <3rd percentile, estimated fetal weight <3rd percentile and absent end diastolic flow in the umbilical artery and four more additional parameters: AC or EFW <10th percentile with pulsatility index (PI) >95th percentile in umbilical artery (UA) or uterine artery (UtA).

Conditions leading to FGR, are the disorders inherent to the fetal-placental-maternal unit, fetal undernutrition, and intrauterine space constraints restricting the fetal growth. Improvements in identification and effective monitoring is critical for the management of pregnancies with FGR, to balance the risk of worsening intrauterine fetal hypoxia against the consequences of preterm deliveries. Doppler studies of multiple vessels in the fetoplacental circulation can help in the monitoring of compromised fetus and predicting neonatal morbidity and mortality. In this study we assessed the role of fetal biometry and colour doppler indices for detection and surveillance of pregnancies with early onset fetal growth restriction, so as to identify fetuses most at risk and manage these pregnancies to improve the perinatal outcome.

Materials and methods

The study was conducted in Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur from May 2020 to August 2021. It was a hospital based descriptive study conducted on 60 pregnant women with early onset fetal growth restriction fulfilling inclusion criteria and exclusion criteria.

Inclusion criteria were singleton viable pregnancies with gestational age of 22+0 wks to 31 wks+6 days complicated with early onset fetal growth restriction AC / EFW <3rd percentile, AEDF or AC/EFW <10th percentile with UA / UtA PI >95th percentile.

Exclusion criteria were multifetal pregnancy, major congenital abnormality or chromosomal abnormality. Approval of the Institute's Ethical Committee was obtained before beginning this study. After proper counseling regarding the purpose of study, a written and informed consent was taken. In clinically suspected FGR cases transabdominal ultrasound was performed for fetal biometry and colour doppler studies of umbilical artery and uterine artery for confirmation of diagnosis as per consensus based definition of early onset FGR. Associated causes of fetal growth restriction for example hypertension, preeclampsia, underlying heart disease, renal disease, smoking, drug intake or any disorder and data of previous pregnancy were noted. Along with routine investigation of pregnancies, relevant biochemical investigation like LFT, RFT, HbA1c, TORCH, antiphospholipid antibodies and urine complete and microscopy was done.

After confirmation of diagnosis, cases were managed conservatively by supportive treatment, and fetal surveillance by serial colour doppler studies (UA, UtA, MCA, DV), growth scan and CTG. In cases of FGR with early Doppler changes or mild associated abnormalities (oligohydramnios, suboptimal interval growth, pre-eclampsia), patient monitoring was done including NST and Doppler every week until 37 weeks. In cases of FGR with umbilical artery absent end diastolic flow (AEDF), inpatient monitoring was done with NST and Doppler twice a week, until 34 weeks. In cases of FGR with umbilical artery reversed end diastolic flow (REDF), inpatient monitoring was done with NST and Doppler thrice a week, until 32 weeks. In cases of FGR with abnormal ductus venosus Doppler, termination was done after discussion with the parents and neonatology team as per intrauterine fetal risks and consequences of extreme preterm birth. Monitoring and supportive management was continued, until recommended weeks of gestation, unless there was inevitable indication of termination of pregnancies which can be either maternal or fetal. The administration of antenatal steroids followed the same protocol as used in pregnancies not affected by FGR. Neonatal data were analysed in terms of birth weight, Apgar score, resuscitation, NICU admission and neonatal complication like meconium aspiration, RDS or sepsis.

Results

In the study, it was seen that 41.67% cases were primigravida, and most of the cases were between age group of 25 to 30 years with mean age of 26.98 ±4.83 years. Mean gestation age at delivery was 32.73 ± 2.90 weeks. Among the study cases, caesarean section was done in 81.67% women (table 1). Mean BMI of cases in study was 21.3 kg/m^2. 65% of cases were associated with pre-eclampsia; this was followed by 10 % cases with chronic hypertension. The underlying placental pathology is frequently similar that is maternal vascular malperfusion, which explains the strong association of early onset FGR with pre-eclampsia. 55% of deliveries were terminated for fetal indication, majority 38.33% were for pathological Doppler (AEDF /REDF) and 45% terminations done for maternal indications, maximum 35% were for severe preeclampsia (table 2).

On fetal biometry it was found that, 83.33% of cases had EFW / AC less than 3rd percentile and 16.67% cases had EFW / AC between 3rd percentile to 10 percentile. Mean

EFW at admission was 1137.18 ± 307.77 gms. Mean AC at admission was 229.58 ±32.17 mm. On ultrasound Doppler assessment of 60 cases, 10% cases were with normal Doppler. Maximum 61.66% cases had abnormal umbilical artery Doppler and 28.33% had abnormal uterine artery Doppler at the time of diagnosis. During surveillance 35% cases developed brain sparing effect, 36.66% patients had CPR <1 and 8.33% cases had abnormal ductus venosus Doppler (table 3). 83.33% cases in the study had AC/EFW less than 3rd percentile and 41.67% cases had absent/reverse end diastolic flow in umbilical artery. 13.33% cases were included in study as per contributory parameters. So, majority of the cases were diagnosed as FGR, by solitary parameters of consensus based definition (table 4).

Table 1: Distribution of cases according to maternal obstetric characteristics

Parameters		No.	%
Obstetric History	G_1	25	41.67
	G_2	19	31.67
	G_3	10	16.66
	Multipara	6	10.00
Gestation age at delivery (in weeks)	28 or less	7	11.67
	>28 to 32	27	45.00
	>32 to 37	20	33.33
	>37	6	10.00
Mode of delivery	Caesarean Section	49	81.67
	Vaginal Delivery	11	18.33

Table 2: Distribution of cases according to indication of termination

Indication of termination	No.	%
Fetal	33	55.00
NR NST	10	16.66
REDF	6	10.00
AEDF	7	11.66
Severe oligohydramnios with AEDF	10	16.66
Maternal	27	45.00
Severe pre-eclampsia	21	35.00
PPROM	2	3.33
APH	4	6.66

Table 3: Distribution of cases according to consensus based definition (n=60)

Solitary parameters	No.	%
AC /EFW <3rd percentile	50	83.33
A/REDF	25	41.67
Contributory parameters		
AC/EFW <10th percentile with UA PI >95 percentile	2	3.34
AC/EFW <10th percentile with UtA PI >95 percentile	6	10.00

In our study, 2 fetuses out of 60 had intrauterine death, 6 were stillbirth and rest were live birth. Among 6 stillbirth, 2 fetuses were with abnormal DV Doppler, 2 cases were terminated for maternal complications, antepartum hemorrhage and eclampsia, and in 2 cases consent for caesarean was not given because of extremely low birth weight.

Mean birth weight in study was 1349 ± 416.81 gms. 53.33% fetuses had Apgar score <7, and mean Apgar was 5.18 ± 2.23. 41.66% fetuses were admitted to NICU after preterm birth for further management, among all neonates 23.33% developed complications like respiratory distress syndrome, sepsis, meconium aspiration syndrome (table 5). 4 neonatal mortality happened during study period, 2 had extremely low birth weight, and 2 because of meconium aspiration syndrome.

Table 4: Distribution of cases according to intrauterine ultrasound fetal biometry and colour Doppler indices

Parameters	No.	%
Fetal biometry		
AC and EFW <3rd Percentile	32	53.33
EFW <3rd Percentile	14	23.33
AC <3rd Percentile	4	6.67
AC and EFW <10th Percentile	5	8.33
EFW <10th Percentile	4	6.67
AC <10th Percentile	1	1.67
Doppler indices in FGR cases		
Normal Doppler	6	10.00
UtA PI >95 Percentile	17	28.33
UA PI >95 Percentile	37	61.66
PEDF	12	20.00
AEDF	18	30.00
REDF	7	11.67
Abnormal MCA	21	35.00
CPR <1	22	36.66
Abnormal ductus venosus	5	8.33

Table 5: Distribution of cases according to fetal outcome (n=60)

Fetal outcome	No.	%
Birth weight in gm (mean ± SD)	1349 ± 416.81	
IUD	2	3.33
SB	6	10.00
Apgar <7	32	53.33
NICU admission	25	41.66
Neonatal complication	14	23.33
Neonatal mortality	4	6.66

Discussion

Fetal growth restriction is associated with increased risk of perinatal and long term mortality and morbidity compared to newborns with normal growth. The development of a good uteroplacental circulation is essential for achievement of a normal pregnancy. Early detection and timely intervention in fetal growth restricted babies can significantly improve perinatal outcome. With the advent of Doppler, it has become much easier to identify FGR cases. Doppler velocimetry has been extensively studied in the setting of fetal growth restriction and is a valuable tool for predicting perinatal outcomes.

Gordijn SJ et al [2], in their consensus based study came up with the most recent and accepted definition for FGR , in which absolute size measurements in themselves were defined at lower cut-offs (3rd centile) than are commonly used (10th gentile). Functional parameters were introduced into the definition, either as solitary (absent end diastolic flow in the UA) or contributory parameters (UA-PI or UtA-

PI >95th centile). Fetal biometry with colour Doppler parameters plays vital role in identification as well as surveillance of cases with early onset fetal growth restriction. In our study majority of cases were identified as per solitary criteria of definition.

Explicit recommendations for the management of early onset FGR are still lacking. Umbilical artery Doppler is most commonly used to appreciate diagnosis and prognostic information for the management of early onset FGR along with middle cerebral artery Doppler.

With increasing degrees of placental blood flow resistance, the umbilical artery Doppler waveform can be quantified using the pulsatility index, high PI (above the 95th percentile per GA) with positive end diastolic flow (EDF) or as absent (AEDF) or reversed (REDF). High umbilical artery PI more than 95% tile with positive end diastolic flow PEDF, AEDF and REDF reflect that placental insufficiency is more than 50%, 70% and 90% respectively.

There are prior studies available that addressed similar populations. In the study, it was seen that 41.67% cases were primigravida, on comparing maternal reproductive and obstetric characteristics with other studies. Hoellen F et al [3], in their retrospective study on 92 cases of early FGR also found that, 40.5% females in the study were primigravida and 85.9% cases were delivered by caesarean section. 46% deliveries were indicated for fetal conditions, and among that also pathological Doppler was the main indication of terminating early FGR pregnancies, so as in our study also 41.67% cases were primigravida and 81.67% deliveries were by caesarean section. 55% of deliveries were terminated for fetal indication, majority 38.33% were for pathological Doppler (AEDF /REDF). In our study 65% of cases were associated with pre-eclampsia similarly, Torrance HL et al [4], had 77.77% cases associated with maternal hypertensive disease. Lees C et al [5], found mean gestation age of delivery at 30.7 ± 2.3 weeks which was less as compare to ours study where mean gestation age of delivery was 32.73 ±2.90 weeks.

On colour Doppler assessment, 61.66% cases had abnormal umbilical artery Doppler and 28.33% had abnormal uterine artery Doppler at the time of diagnosis. During surveillance 35% cases developed brain sparing effect, 36.66% patients had CPR <1 and 8.33% cases had abnormal ductus venosus Doppler. These results were comparable with Novac MV et al [6], they found 39.28% cases with abnormal uterine Doppler and 57.14% cases with abnormal umbilical artery Doppler. In their study, 42.85% cases had CPR <1.

On comparing neonatal outcomes, Hoellen F et al [3], had mean Apgar score of 5.9 at one minute in their study of 92 cases. 79 were born live before 30 weeks remaining 10 died in utero and three neonatal mortality happened. Schwarze A et al [7] in their study had 12 (16.1%) perinatal death, out of which eight were stillbirth and two neonatal deaths occurred among 74 fetuses. Whereas in our study 2 fetuses out of 60 had intrauterine death, 6 were stillbirth and rest were live birth. Mean birth weight was 1349 ±416.81 gms. 53.33% fetuses had Apgar score <7 and 4 neonatal mortality happened.

FGR is one of the most important set-ups for high risk delivery, in which resuscitation at the time of delivery may be required. An interprofessional team, comprised of obstetricians, anesthesiologists, neonatologists, neonatal nurse practitioners should be present at the delivery. Effective communication and interaction among the team members help in decreasing the risk of sentinel events. In early onset FGR cases, informed consent of the patient and close monitoring are mandatory. These cases remain a challenge in clinical practice in terms of early diagnosis as well as management.

Conclusion

Integrating colour Doppler studies with fetal biometry provides us a non-invasive method for early identification of early onset fetal growth restriction. It also helps in planning the surveillance frequency and the decision regarding mode and time of delivery. Thus, fetal biometry and colour Doppler has got significant role in improving perinatal morbidity and mortality in pregnancies with early onset fetal growth restriction.

Conflict of interest: None. **Disclaimer:** Nil.

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