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Original Article

Role of USG Biometry At 34 Weeks of Pregnancy in Early Detection of Fetal Growth Restriction in Clinically Unsuspected Patients and Role of Doppler in Evaluating Such Growth Restricted Babies Born in Government T. D. MCH, Alappuzha

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ABSTRACT

Objective – To detect FGR in clinically unsuspected patients, by doing USG biometry at 34 weeks of pregnancy and to detect the role of doppler in evaluating such growth restricted babies to differentiate constitutional and pathological FGR, which is an important cause for perinatal morbidity and mortality.
Methodology – In this Descriptive study, out of 4480 patients who attended OPD/IP in the Department of Obstetrics and Gynaecology, TDMCH Alappuzha, in the period of June 2014 to June 2015, 175 cases of FGR were included in the study, with the stipulated selection criteria. Primary outcome methods were, detection rates of FGR(customised birth weight less than 10th centile) and severe FGR(customised birth weight less than 3rd centile).
Results and Interpretation – By doing USG biometry at 34 weeks of pregnancy, 175 cases of FGR were picked up from clinically unsuspected pregnancies, followed by serial growth scan and Doppler studies, thereby showing ability to significantly reduce perinatal mortality and morbidity by early intervention.
Conclusion – In clinically unsuspected patients, routine USG biometry at 34 weeks gestation was found effective in detecting FGR and by doing Doppler studies in such cases, by early intervention, perinatal mortality and morbidity could be significantly reduced.

Keywords*: Gestational age, fetal growth restriction, fundal height, Ultrasonogram, Growth scan, Doppler.*

INTRODUCTION

Of the twenty million infants born worldwide, 15.5% of all babies are born with low birth weight, of which 95.6% are from developing countries.[1] In India low birthweight is a major problem with nearly 3 million low birth weight babies born annually.It is seen to account for more than half of neonatal deaths.Incidence of low birth weight babies in India varies from 15% to 25%,among which more than 50% are due to IUGR.[2] In Kerala, National family health survey of India, in 1992, reported that 18.2% of new borns have low birth weight.[3]. Fetal growth restriction is seen to represent the second primary cause for perinatal mortality and morbidity, accounting for 30% of still births, and higher frequencies of premature births and intrapartum asphyxia. [4]

DEFINITION

Fetal growth restriction (FGR)is a pathological condition in which a fetus has not achieved his genetic growth potential, regardless of fetal size. FGR is not synonymous with SGA. Small -for -gestational age(SGA) is defined as an estimated fetal weight (EFW) or abdominal circumference(AC) less than the 10th percentile and severe SGA as an EFW or AC less than 3rd centile .[5] Growth restricted fetuses/infants ,some ,but not all are SGA, while 50-70% of SGA are constitutionally small, with fetal growth appropriate for maternal size and ethinicity. Hence fetal growth restricted fetuses may manifest

evidence of fetal compromise(abnormal doppler studies, reduced liqour volume).Low birth weight(LBW) refers to an infant with birth weight <2.5kg.[6]

Small fetuses are divided into normal, constitutionally small and non-placenta mediated growth restriction, for example; structural or chromosomal anomaly,inborn errors of metabolism,fetal infection,placenta mediated growth factor.SGA due to Placental insufficiency,may start from second trimester,will be assymetrically small,has low first trimester risk of aneuploidy but placental hormones like PAPP-A,shows a progressive deceleration in growth velocity and show abnormal fetoplacental Doppler patterns.

Different methods used to detect SGA Fetuses include abdominal palpation,measurement of symphysial fundal height, ultrasound to ensure accurate dating ,estimated fetal weight and to determine whether there is decreased growth rate[7]. Fetal biometry and ultrasound Doppler flow velocimetry are the mainstay for investigation and diagnosis of IUGR[8]

Sonographic estimations of fetal diameters BPD,HC,AC,FL,EFW), placental grading, amniotic fluid index(AFI) and Umbilical artery Doppler waveforms provide clue to the diagnosis of FGR and fetal wellbeing. Coyaji and Otiv from Pune compared the sensitivity of individual ultrasonographic parameters for detecting fetal growth retardation as given in Table 1

Table 1: Sensitivity of USG diameters for detecting IUGR

Parameter	Sensitivity (%)
Abdominal circumference (AC)	96–100
Femur length (FL)	20–45
Head/abdominal circumference (HC/AC)	About 70
Femur length/abdominal circumference (FL/AC)	About 63
Estimated fetal weight percentile	About 87
Ponderal index (PI)	47–54

Serial measurements of AC or EFW in prediction of FGR (abnormal neonatal ponderal index and skinfold thickness), can predict poor perinatal outcome.One single measurement of greatest value in suspecting the possibility of IUGR is AC. If this is normal it almost excludes the diagnosis of IUGR. Doppler waveforms provide guide lines for instituting obstetric intervention to save the fetus.[9]

Doppler ultrasonography has proven to be an invaluable obstetric tool for over 30 years used to assess both the fetal and placental circulation, with the aim of facilitating the diagnosis and monitoring of important conditions, such as fetal growth restriction (FGR), fetal anaemia and twin-to-twin transfusion syndrome (TTTS). Doppler assessment in obstetrics encompasses that of the umbilical artery (UA), middle cerebral artery (MCA), uterine artery and ductus venosus (DV).Of these, UA Doppler is most commonly used for the monitoring and timing of delivery of the fetus compromised by FGR.[10] UA Doppler assesses impedance within the fetoplacental circulation and the pulsatility index (PI) and resistance index serve as surrogate markers of placental vascular resistance. This is known because the number of placental arteries per high power field is lower in cases of an abnormal UA Doppler. UA Doppler serves as both a prognostic and diagnostic tool in the assessment of the growth-restricted fetus.23 An abnormal UA Doppler waveform (absent or reversed end-diastolic flow) has been demonstrated to predict fetal compromise. This pattern appears to be present 12 days preceding acute fetal deterioration.[11]

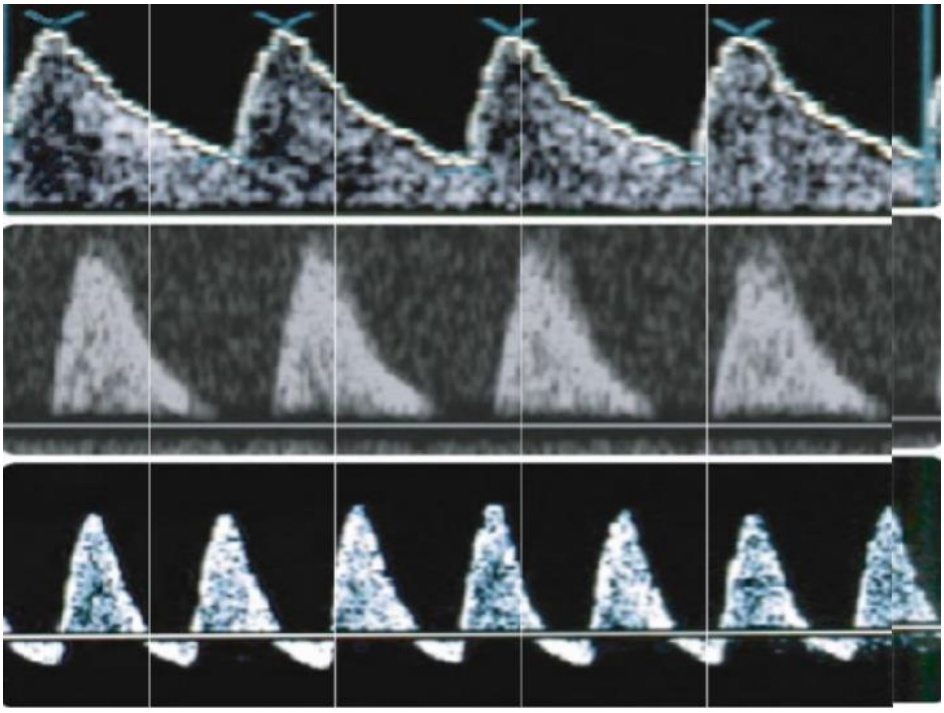
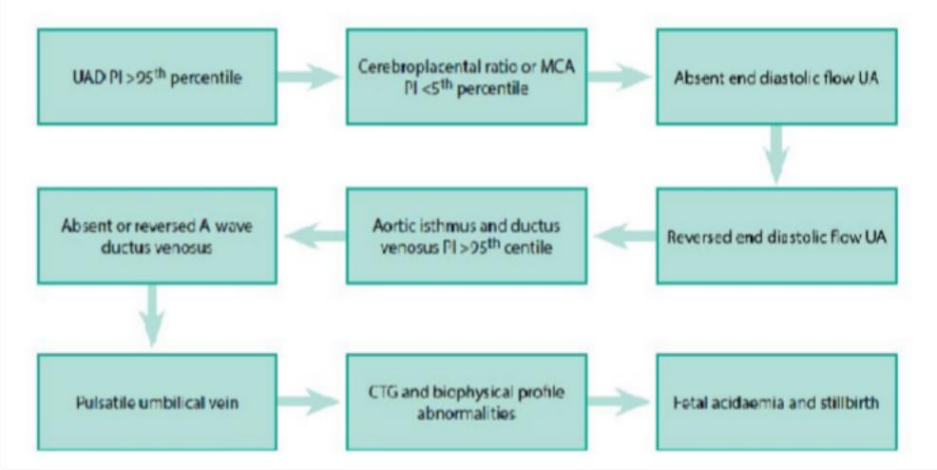


Figure 1: Umbilical artery Doppler. (a) Normal waveform; (b) absent end-diastolic flow; (c) reversed end-diastolic flow. Reproduced under the CC-BY 3.0 licence, with permission from Cambridge Medical Journal.25



UA Doppler remains the most extensively studied fetal surveillance tool.26 A publication from the Royal College of Obstetricians and Gynaecologists (RCOG) proposes an algorithm to guide clinicians on the frequency of surveillance and timing of delivery.21

Figure 2: Apparent temporal sequence of fetal Doppler abnormalities in the growth-restricted fetus. This sequence has not been verified by other work27 CTG = cardiotocograph; DV = ductus venosus; MCA = middle cerebral artery; PI = pulsatility index; UA = umbilical artery; UAD = umbilical artery Doppler.

This guidance advises that in terms of surveillance, women who are at high risk of having a baby affected by fetal growth restriction (such as a previously small-for-gestational age baby, smoking, advancing maternal age) should undergo serial UA Doppler assessment fortnightly from 26–28 weeks of gestation. In terms of timing of delivery, in preterm (below 32 weeks of gestation) small-for-gestational age fetuses with absent or reversed end-diastolic flow in the UA Doppler, delivery is recommended at 32 weeks of gestation with delivery prior to this time recommended when the DV becomes abnormal or there are UV pulsations. At later gestations (after 32 weeks) in the coexistence of absent or reversed end-diastolic flow in the

UA Doppler, delivery is recommended no later than 37 weeks of gestation.21

The aim of the study is, early detection of fetal growth restriction in otherwise normal pregnancies being managed at T.D.MCH Alappuzha, by doing USG biometry at 34 weeks of pregnancy and role of Doppler in evaluating such growth restricted babies and to differentiate between constitutional and pathological small fetus.

METHODOLOGY

a. Study Design and Setting

The present study is a descriptive observational study conducted at the Department of Obstetrics & Gynaecology and Department of Radiodiagnosis, Government T.D. Medical College Hospital (TDMCH), Alappuzha, a major tertiary care center in the district with approximately 4000 deliveries annually. The study duration spanned from June 2014 to June 2015. Ethical clearance was obtained from the Institutional Ethical Committee prior to commencement, and informed consent was obtained from all participants. Confidentiality of patient information was strictly maintained throughout the study.

b. Study Population

The study population comprised clinically unsuspected antenatal patients attending the outpatient and inpatient departments of Obstetrics & Gynaecology at TDMCH, Alappuzha, who fulfilled the inclusion criteria during the study period.

Inclusion Criteria:

- Clinically unsuspected antenatal patients with fetal growth restriction (FGR) identified by ultrasound biometry at 34 weeks of gestation.
- Patients attending OPD/IPD of the Department of Obstetrics & Gynaecology, TDMCH, Alappuzha, within the study period.

Exclusion Criteria:

- Women with adverse medical and obstetric history.
- Women with a previous history of intrauterine growth restriction (IUGR).
- Women with fetal abnormalities detected at routine second-trimester scan.

Sample Size Calculation:

A pilot study conducted over one month at TDMCH O&G department identified 15-20 cases of FGR among 350 deliveries. Based on this observation, the sample size was estimated to be approximately 200 cases over one year.

Sampling Technique:

Consecutive sampling was employed, wherein all eligible patients meeting the inclusion criteria during the study period were enrolled until the desired sample size was achieved.

c. Data Collection

Study Tools:

Data collection involved a pre-tested questionnaire administered by the investigator to record demographic and clinical information. Laboratory investigations included hemoglobin, total count, renal and liver function tests, coagulation profile, thyroid-stimulating hormone (TSH), 75g glucose tolerance test (GTT), and urine routine examination.

Ultrasound biometry was performed at 34 weeks gestation using Hadlock's normogram to assess fetal parameters including biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL), amniotic fluid index (AFI), and estimated fetal weight (EFW). Doppler studies at 34 weeks included umbilical artery (UA) systolic/diastolic (S/D) ratio, middle cerebral artery (MCA) S/D ratio, and ductus venosus flow assessment.

In cases where FGR was suspected based on biometry, Doppler studies were used to evaluate the severity and differentiate between constitutional and pathological small fetuses. Repeat growth scans and Doppler assessments were conducted at 36 weeks to monitor progression.

Statistical Analysis:

Data were entered into an Excel sheet and analyzed using Epi Info and SPSS version 16.0. Descriptive statistics involved summarizing qualitative variables as proportions and quantitative variables using means and standard deviations. Inferential statistics included chi-square tests for associations between qualitative variables and Student's t-test or ANOVA for quantitative variables. P-values <0.05 were considered statistically significant.

Ethical Consideration:

The study was conducted after obtaining approval from the Institutional Ethical Committee. Written informed consent was obtained from all participants. Patient confidentiality was maintained, and participation was voluntary with the right to withdraw at any time without affecting medical care.

RESULTS

In the present study on the role of USG biometry at 34 weeks in early detection of fetal growth restriction (FGR) among clinically unsuspected patients, 175 cases of FGR were identified from a cohort of 4480 pregnancies. The prevalence of FGR was 4%, with co-morbid intrauterine growth restriction (IUGR) observed in 14%. Significant associations were found between fetal birth weight and obstetric score, abnormal Doppler scores, and gestational age. Specifically, low birth weight

incidence decreased with higher obstetric scores ($P < 0.05$), while abnormal Doppler findings strongly correlated with low birth weight ($P < 0.05$). Preterm births had a higher proportion of low birth weight infants compared to term births ($P \leq 0.05$). Group comparisons revealed significant differences in fetal biometric parameters and umbilical artery S/D ratios at 34 and 36 weeks between low and normal birth weight groups ($P < 0.05$). These results demonstrate that routine USG biometry at 34 weeks, combined with Doppler evaluation, effectively detects FGR early, enabling timely clinical intervention to reduce perinatal morbidity and mortality.

Out of 4480 patients, 14% presented with co-morbid IUGR, while 4% had FGR in clinically unsuspected pregnancies, aligning with global statistics.(Table 1)

The proportion of low birth weight babies significantly decreases with increasing obstetric score: 80.3% of babies with obstetric score 1 had low birth weight, compared to 68.9% with score 2, and 50% with score 3. This association was statistically significant (Chi-square test, $P < 0.05$), indicating that higher obstetric scores correlate with improved fetal birth weight outcomes.(Table 2)

A strong association was observed, with higher abnormal Doppler scores correlating with a greater proportion of low birth weight infants. Specifically, 71.4% of fetuses with normal Doppler (score 0) had low birth weight, increasing to 93.1% at score 1, and 100% at scores 2 and 3. This association was statistically significant (Chi-square test, $P < 0.05$), underscoring the utility of Doppler studies in identifying pathological FGR.(Table 3)

The data reveal a higher incidence of low birth weight among preterm births (93.3%) compared to term births (78.9%). This difference was statistically significant (Chi-square test, $P \leq 0.05$), emphasizing the increased risk of low birth weight in preterm deliveries.(Table 4)

Significant differences were noted in gestational age by ultrasound ($P = 0.039$), abdominal circumference ($P = 0.001$), estimated fetal weight ($P = 0.003$), and umbilical artery S/D ratio ($P = 0.046$) at the initial 34-week scan. Follow-up growth scans at 36 weeks showed further significant differences in multiple fetal biometric parameters (gestational age by LMP and USG, BPD, HC, AC, FL, EFW) and UA S/D ratio (all $P < 0.05$). These findings demonstrate that USG biometry at 34 weeks, combined with Doppler studies, effectively differentiates between low and normal birth weight fetuses, facilitating early detection and management of FGR.(Table 5)

Overall, the present study confirms that routine USG biometry at 34 weeks gestation, supplemented by Doppler evaluation, enables early detection of FGR in clinically unsuspected pregnancies, allowing timely intervention to reduce perinatal morbidity and mortality.

Table 1: Prevalence of IUGR and FGR

Normal	82%
Co-morbid IUGR	14%
FGR in unsuspected pregnancy	4%

The prevalence of IUGR in group studied was 627 (N=4480) that is, 14% and that of FGR in clinically unsuspected pregnancy was 4%. This data was well in accordance with global statistics.

Table 2: Association between Fetal Birth Weight and Obstetric Score

Obstetric Score	Low Birth Weight (n=133)	Percentage (%)	Normal Birth Weight (n=42)	Percentage (%)	Total (n=175)	Percentage (%)
1	98	80.3	24	19.7	122	100
2	31	68.9	14	31.1	45	100
3	4	50.0	4	50.0	8	100
Total	133	76.0	42	24.0	175	100

Among 175 cases, 98 (80.3%) with obstetric score 1 had low birth weight, decreasing to 31 (68.9%) at score 2, and 4 (50.0%) at score 3, showing a significant inverse relationship between obstetric score and low birth weight (Chi-square test, $P < 0.05$).

Table 3: Association between Fetal Birth Weight and Abnormal Doppler

Abnormal Doppler Score	Low Birth Weight (n=133)	Percentage (%)	Normal Birth Weight (n=42)	Percentage (%)	Total (n=175)	Percentage (%)
0 (Normal Doppler)	100	71.4	40	28.6	140	100
1	27	93.1	2	6.9	29	100
2	3	100	0	0	3	100
3	3	100	0	0	3	100
Total	133	76.0	42	24.0	175	100

Out of 175 fetuses, 100 (71.4%) with normal Doppler (score 0) had low birth weight, increasing to 27 (93.1%) at score 1, and 3 (100%) at scores 2 and 3, indicating a strong positive association between abnormal Doppler scores and low birth weight (Chi-square test, $P < 0.05$).

Table 4: Association between Fetal Birth Weight and Gestational Age

Gestational Age	Low Birth Weight (n=133)	Percentage (%)	Normal Birth Weight (n=42)	Percentage (%)	Total (n=175)	Percentage (%)
Term (≥37 weeks)	105	78.9	40	21.1	145	100
Preterm (<37 weeks)	28	93.3	2	6.7	30	100
Total	133	76.0	42	24.0	175	100

Among 175 cases, 105 (78.9%) term births had low birth weight compared to 28 (93.3%) preterm births, indicating a significantly higher proportion of low birth weight infants in preterm deliveries (Chi-square test, $P \leq 0.05$).

Table 5: Group statistics and t-test for equality of means

Group Statistics							t-test for Equality of Means		
	Fetal Birth Weight (kg)		N	Mean	Std. Deviation		t	Df	Sig. (2-tailed)
Age	dimension1	LBW	133	24.68	4.213	Equal variances assumed	-1.694	173	0.092
		Normal	42	25.95	4.389				
GA by LMP	dimension1	LBW	133	34.3707	0.50141				
		Normal	42	34.486	0.5775	Equal variances assumed	-1.251	173	0.212
GA by USG	dimension1	LBW	133	32.3953	1.04874				
		Normal	42	32.7807	1.04192	Equal variances assumed	-2.08	173	0.039
BPD	dimension1	LBW	133	32.328	1.45351	Equal variances assumed	-1.857	173	0.065
		Normal	42	32.7812	1.10557				
HC	dimension1	LBW	133	32.3919	1.32882	Equal variances assumed	-1.046	173	0.297
		Normal	42	32.6393	1.36004				
AC	dimension1	LBW	133	31.6424	1.42904	Equal variances assumed	-3.37	173	0.001
		Normal	42	32.4757	1.28886				

Initial scan done at 34 weeks+days, Gestational age, Abdominal circumference and Estimated Fetal weight showed a statistical difference among Low birth weight and Normal babies with corresponding P-Value of 0.001 and 0.003.

Growth scan done at 36weeks+days ,also showed a significant difference with P-Value of GA by growth scan(.000),Gestational age by USG(.002),BPD growth scan(.001),HC growth scan (.002), AC growth scan(.001),FL growth scan(.019),EFW growth scan(.000),S/D ratio UA(.039) among the Low birth weight and Normal babies.

DISCUSSION

Fetal growth restriction (FGR) is a significant contributor to perinatal morbidity and mortality, influenced by various demographic and medical factors such as advanced maternal age and assisted conception technologies. Placental insufficiency is a primary cause in uncomplicated FGR, necessitating careful management through early or delayed delivery guided by fetal surveillance. Traditional physical examination methods like abdominal palpation and symphysial fundal height (SFH) measurement exhibit limited sensitivity and specificity in detecting FGR. Although customized SFH charts improve detection rates, they remain suboptimal compared to ultrasound (USG) biometry.[12]

This study demonstrates that performing USG biometry at 34 weeks gestation enhances early detection of FGR compared to earlier or later scans. While previous meta-analyses of routine third-trimester scanning showed limited benefit, advancements in ultrasound technology and expertise have improved diagnostic accuracy. The 34-week mark is critical as placental insufficiency-related FGR becomes phenotypically apparent, allowing more reliable identification via fetal abdominal circumference (AC) and estimated fetal weight (EFW).[13]

Statistical analysis revealed significant differences between low birth weight and normal birth weight groups in gestational age by ultrasound, AC, and umbilical artery (UA) systolic/diastolic (S/D) ratio at 34 weeks, underscoring the value of early third-trimester scanning. Doppler studies play a crucial role in differentiating pathological FGR from constitutional small fetuses. Abnormal UA Doppler findings, such as increased S/D ratios, indicate placental vascular resistance and fetal compromise, guiding timely intervention to reduce stillbirth and neonatal complications.[14]

When Doppler velocimetry is normal, surveillance continues with serial growth scans, typically after two weeks, to monitor fetal growth parameters and amniotic fluid index (AFI). This study found growth scan parameters at 36 weeks, including biparietal diameter (BPD), head circumference (HC), AC, femur length (FL), EFW, and UA S/D ratio, significantly differed between groups, highlighting the importance of serial monitoring for accurate diagnosis.[15]

Supporting literature corroborates these findings. Ultrasound measurement of fetal AC is recognized as the most effective antenatal diagnostic test for detecting fetuses below the 10th percentile in birth weight. Population studies have demonstrated that antenatal detection of small-for-gestational-age (SGA) fetuses substantially reduces stillbirth rates, emphasizing the clinical importance of timely diagnosis and delivery.[9]

In conclusion, routine USG biometry at 34 weeks, combined with Doppler assessment, provides an effective strategy for early detection of FGR in clinically unsuspected pregnancies. This approach facilitates timely clinical intervention, including early delivery when indicated, thereby reducing perinatal morbidity and mortality. Serial ultrasound and Doppler evaluations remain essential for differentiating pathological FGR from constitutional smallness and guiding management decisions to improve neonatal outcomes.

Limitations were

Setting being a tertiary centre most of the cases that are dealt are complicated cases, hence there can be an overestimation of the parameters.

Lesser sample size: as the study is conducted in women attending one academic institution, there might be differences in study population so that the results may not be applicable to the general population.

RECOMMENDATIONS

For early detection of FGR, USG biometry is to done at 34 weeks of pregnancy along with Doppler if AC and EFW is less than 10th centile.

It is recommended to review the underlying causes: Placental histology to prevent recurrent risk of FGR in subsequent pregnancy as prevalance is 25%. Studies should be conducted with the sampling frame consisting of secondary as well as tertiary health care system.

CONCLUSIONS

FGR is a pathological complication of pregnancy associated with increased perinatal mortality and morbidity, and also is a risk factor for late complications such as impaired neurodevelopment, adult type 2 diabetes and hypertension. The important steps in identifying FGR babies are accurate pregnancy dating scanning, abdominal palpations, symphysio fundal height measurements and ultrasound biomety.FGR due to placental insufficiency is diagnosed when there is decreased amniotic fluid volume, abnormal umbilical artery Doppler and failure of evidence of growth in serial growth scans, provided that chromosomal anomalies, malformations and infections are excluded. Doppler analysis should be the most important tool to grade the severity of foetal disease, once FGR is suspected. In FGR, Doppler of the UA remains the most extensively investigated tool.MCA and DV Dopplers have lesser importance. Current RCOG guidance recommends the use of these Doppler in the surveillance and timing of delivery.

From this study by doing a routine 3rd trimester scan at 34 weeks of gestation, instead of 32 weeks, detection of FGR is possible by assessing EFW and AC (less than 10th percentile),and will be beneficial. Doppler abnormalities indicating pathological IUGR needs early intervention by termination of pregnancy to minimize perinatal mortality and morbidly. If the Doppler is normal, a growth scan should be done 2 weeks later to assess AC,EFW and AFI & if again it is suspicious, a repeat Doppler again has to be done to decide regarding necessity for early intervention to reduce the perinatal mortality and morbidly which is the ultimate aim.

To conclude ,when compared to a 32 week or a 36 week scan ,which will be either too early or too late, the current study has shown significant changes in the fetal growth parameters ,a stage at which appropriate clinical intervention, and doing early termination, in order to prevent perinatal mortality and morbidity. In the long run this could bring down the perinatal mortality rates.

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