

Research Article

Biparietal diameter (BPD) growth rate between the first and second trimester as a predictor of poor obstetric and neonatal outcome among the Indian population

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ABSTRACT

Background: The Objective of this study was to evaluate the association of BPD at 11-14 weeks and pregnancy outcome and to determine the role of incremental BPD growth from 11-14 weeks and 17-20 weeks in pregnancy outcome.

Methods: Women (n=910) with singleton pregnancies were included in this prospective observational study after an early anomaly scan (11 to 14 weeks). Outcomes noted were the incidence of adverse events and the neonatal birth weight.

Results: Irrespective of their original BPD at 11 to 14 weeks, fetuses had acquired optimum BPD growth rate on a follow up scan at 17-20 weeks, i.e., a majority of them fell in the 10th to 90th percentile group (P value <0.001). Fetuses with BPD below the 10th percentile were small for gestational age (SGA) at birth despite an optimal growth rate. Also, a significant majority of the fetuses with BPD in the 10th to 90th percentile were Appropriate for Gestational Age (AGA) at birth.

Conclusion: The BPD at 11 to 14 weeks scan predicts the incidence of SGA and AGA babies, independent of BPD growth rates between first and second trimester. The BPD growth rates were neither significantly different nor predictive of the birth weight or adverse pregnancy outcomes.

Keywords: Early BPD growth rate, IUGR, Pregnancy outcome, Ultrasound

INTRODUCTION

Abnormal fetal growth is a leading cause of perinatal morbidity and mortality in both developed and developing countries. It has been suggested that a low first-trimester measurement of Crown-Rump Length (CRL) in pregnancies dated by last menstrual period is linked with adverse outcome such as prematurity and fetal growth restriction.¹ A majority of adverse pregnancy outcomes such as second trimester abortions, preterm births, IUGR (Intra-uterine growth restriction), Small for

Gestational Age (SGA), preeclampsia and perinatal deaths are still alarming problems in our country. Also, premature, SGA and growth restricted babies are prone to long-term poor cardiovascular and neurological prognosis, associated with increased neonatal morbidity and mortality.^{2,3} If we could determine the sonographic predictive factors of adverse pregnancy outcomes with this study, it would be helpful in timely intervention thereby, preventing these problems. This would lead to a healthier population reducing the burden on the health system.

Generally, it is assumed that the variations in fetal growth occur during the second half of pregnancy. But, a considerable amount of fetal growth occurs during the early part of pregnancy also. Fetal growth in the first 14 weeks occurs by the process of hyperplasia, from 14-32 weeks by the process of hyperplasia and hypertrophy, and thereafter by the process of hypertrophy alone. Moreover, the genetic growth potential of each fetus is reflected in its early size and growth.

Hence, we set out to study and compare the effects of diminished as well as increased early pregnancy size and growth, as assessed from measurements in the first and second trimesters, on the pregnancy outcome. We hypothesized that at these early gestations, the rate of fetal growth could be a better predictor of subsequent pregnancy outcome than the actual size for a particular gestation.

METHODS

A total of 910 women were enrolled in our prospective observational study from November, 2011 to September, 2012 at our tertiary care center following an early anomaly scan (11-14 weeks). We excluded those with multiple pregnancies, chronic hypertension, pre-gestational diabetes and a history of any bleeding per vaginum in the first trimester. We also excluded women with questionable dating. For all those included in our study, gestational age was established based on either a reliable last menstrual period (LMP) date or a transvaginal ultrasound between 6 and 10 weeks or both.

Prior to enrollment, ethical clearance for the study was obtained from the institutional ethics committee.

After obtaining a written informed consent, a detailed medical history was taken. General physical examination including weight, height and BMI, systemic examination including cardiovascular and respiratory system, and an

obstetric examination were done. The recruited patients had an early anomaly scan at 11-14 weeks and a routine anomaly scan at 17-20 weeks of gestation, and were followed up till their delivery at our hospital.

The biometric growth parameters of the fetus were measured using Toshiba Nimio ultrasound machine with a 6.5 MHz transvaginal transducer and a 5 MHz trans-abdominal transducer for measurement of Biparietal Diameter (BPD).

The patients were divided as per BPD measured at 11- 14 weeks scan into three groups: Group 1 (BPD below the 10th percentile), group 2 (BPD between 10th-90th percentiles) and group 3 (BPD above the 90th percentile).

The interval growth from the two scan findings was measured and expressed in terms of an incremental BPD growth in millimeters per day and patients were grouped as group A (Growth rate below the 10th percentile), group B (Growth rate between 10th -90th percentiles) and group C (Growth rate above the 90th percentile).

These patients were followed up to observe obstetric outcomes such as incidence of second trimester abortion, preterm birth, gestational hypertension, preeclampsia, gestational diabetes mellitus and IUGR. We also noted neonatal morbidity in terms of birth weight (SGA, AGA and LGA) and incidence of fetal anomalies and stillborn.

Statistical analysis was done using SPSS-16 package and a P value of less than 0.05 was considered significant.

RESULTS

Of the 910 women enrolled, only 723 women delivered in our hospital and the outcomes of these pregnancies were analyzed. The patient characteristics in the three BPD and the three BPD growth rate groups were matched as shown in Tables 1 and 2.

Table 1: Patient characteristics in the BPD Groups (N=723).

Patient characteristics	Group 1 (n=79) Mean ± SD	Group 2 (n=557) Mean ± SD	Group 3 (n=87) Mean ± SD	P value
Mean age (y)	27.29 ± 3.09	27.47 ± 1.16	27.97 ± 3.01	0.555
Mean weight (kg)	51.20 ± 5.79	51.75 ± 2.19	51.53 ± 5.56	0.399
Mean height (cm)	151.87 ± 17.19	152.26 ± 6.45	152.55 ± 16.44	0.401
BMI (kg/m ²)	22.19 ± 2.51	22.32 ± 0.94	22.09 ± 2.38	0.634
Parity				
• Primigravida	59 (74.7%)	378 (67.9%)	51 (58.6%)	0.081
• Multigravida	20 (25.3%)	179 (32.1%)	36 (41.4%)	

The incidence of maternal obstetrics complications like gestational hypertension, preeclampsia and gestational

diabetes mellitus in all three BPD as well as the three BPD growth rate groups was similar.

The mean gestational age at delivery was found to be 37.14 ± 1.38 weeks. The mean birth weight was 2719 ± 101.20 grams as mentioned in Table 3. Out of 723

pregnancies, 12 (2%) aborted and 15 (2.5%) were stillborn. But over 96% were live births with an incidence of 5 neonatal deaths.

Table 2: Patient characteristics in the BPD growth rate groups (N=723).

Patient characteristics	Group A (n=72) Mean ± SD	Group B (n=582) Mean ± SD	Group C (n=69) Mean ± SD	P value
Mean age (y)	28.02 ± 3.32	27.44 ± 1.13	27.59 ± 3.34	0.642
Mean weight (kg)	52.40 ± 6.21	51.60 ± 2.14	51.48 ± 6.24	0.467
Maternal height (cm)	153.11 ± 18.17	152.31 ± 6.31	150.89 ± 18.29	0.547
Maternal BMI (Kg/sq.m)	22.35 ± 2.65	22.23 ± 0.92	22.63 ± 2.74	0.704
Parity				
• Primigravida	44 (61.11%)	396 (68.04%)	48 (69.56%)	0.460
• Multigravida	28 (38.89%)	186 (31.96%)	21 (30.44%)	

Table 3: Birth weight in the BPD groups (N=723).

Body weight BPD group	SGA (n=145)	AGA (n=565)	LGA (n=13)
	Group 1 (n=79) (%)	25 (31.6%)	53 (67.6%)
Group 2 (n=557) (%)	102 (18.3%)	447 (80.3%)	8 (1.4%)
Group 3 (n=87) (%)	18 (20.7%)	65 (74.7%)	4 (4.6%)
P value	0.021	0.021	0.111

*Group 1 - BPD <10th percentile
 Group 2 - BPD = 10th-90th percentile
 Group 3 - BPD >90th percentile

Table 4: Comparison of BPD groups and BPD growth rate group.

BPD growth rate groups**	Group A (n=72) (%)	Group B (n=582) (%)	Group C (n=69) (%)	P Value
Group 1 (n=79) (%)	15 (19%)	50 (63.3%)	14 (17.7%)	<0.001
Group 2 (n=557) (%)	48 (8.6%)	455 (81.7%)	54 (9.7%)	
Group 3 (n=87) (%)	9 (10.3%)	77 (88.5%)	1 (1.1%)	
P Value	0.016	<0.001	0.001	

*Group 1 - BPD <10th percentile
 Group 2 - BPD = 10th-90th percentile
 Group 3 - BPD >90th percentile
 **Group A - Growth rate <10th percentile
 Group B - Growth rate = 10th-90th percentile
 Group C - Growth rate >90th percentile

It was noted that the incidence of fetal obstetric complications IUGR, macrosomia, preterm delivery, stillbirth and neonatal deaths were similar in all the three BPD as well as the BPD growth rate groups. A majority of the cases in each of the groups did not have any of the complications and among those who did, no significance could be established.

Out of the 79 patients belonging to the BPD group 1, twenty five (nearly one third) delivered SGA babies. This was significantly more than those belonging to groups 2 or 3 (18.3 and 20.7 percent respectively). Again, among patients belonging to group 2, a significant majority delivered AGA babies as compared to groups 1 or 3. Hence, it can be deduced that an early scan showing a normal measurement of BPD was associated with an increased chance of having an AGA baby. Similarly, an early BPD measurement, lesser than the 10th percentile, was seen to be associated with an increased incidence of SGA babies.

Out of 145 SGA babies, 65 babies were diagnosed to have IUGR, and 80 were constitutionally small. Out of 65 IUGR fetuses, 24 fetuses had Doppler changes; raised indices were seen in 9 (6.2%), 1 had increased MCA flow (0.7%), and an absent end diastolic flow was seen in 14 (9.7%).

It was noted that the fetuses, irrespective of their original BPD measurement in the 11 to 14 weeks scan, had acquired optimum BPD growth rate on follow up scan at 17-20 weeks, i.e., majority of them fell into the 10th to 90th percentile group (P value <0.001). So, the BPD growth rate, in the time period between the two scans, i.e., 11 to 14 weeks scan and 17 to 20 weeks scan, does not depend on the original BPD measurement. Also it was noted that, fetuses with a BPD below the 10th percentile, belonging to group 1, were SGA despite an optimal growth rate. Also, a significant majority of the fetuses belonging to group 2 (BPD being 10th to 90th

percentile) were appropriate for gestational age at birth (Table 4).

DISCUSSION

In our study, we assessed the relation between early fetal size as well as early fetal growth and subsequent adverse pregnancy outcomes using BPD measurements in the first and second trimesters, longitudinally assessed by ultrasound.

An early scan showing a normal measurement of BPD was associated with an increased chance of having an AGA baby. Similarly, an early BPD measurement, lower than the 10th percentile, was associated with an increased incidence of SGA babies.

We noted that the early fetal size as well as growth rate could not be used to predict incidence of preterm labor. Fetal complications like intrauterine growth restriction, macrosomia and preterm delivery were similar in all three BPD groups as well as three BPD growth rate groups. Hence, these complications could not be predicted by measurement of BPD or BPD growth rate.

Previous publications on growth in early pregnancy have looked at early fetal size in relation to the last menstrual period. However, there would be an inevitable factor of error if we did not consider the day of conception which is possible only if assisted reproductive technology was used.⁴⁻⁸ By using two sequential ultrasound measurements of the BPD, the method used in our study becomes independent of gestational-age error.

The central finding of our study is that there is a significant relation between the BPD measured at 11 to 14 weeks and the development of SGA and AGA babies. The restricted growth of the fetus in very early pregnancy may be causally related to these outcomes.

Traditional thinking is that early fetal growth is principally controlled by genetic factors and occurs at a constant exponential rate with little biological variation; IUGR has been assumed to occur mainly in the latter half of pregnancy.¹ Our study supports this view, showing that fetal growth rate between the first and second trimesters does vary between fetuses and is not associated with perinatal death and low birth weight.

The maternal complications like gestational hypertension, preeclampsia and gestational diabetes were found to have similar incidence in all BPD as well as BPD growth rate groups. The overall incidence of these complications among patients in our study was roughly 5%.

The prevalence of pre-eclampsia was 5.5% in our study group, which is higher than the 3-5% prevalence normally reported.¹⁰ The high prevalence reflects the fact that there is an increase in incidence of preeclampsia in our ethnic group.

We chose BPD over CRL in our study as BPD is repeatedly measured throughout pregnancy as compared to CRL, which is not measured beyond 12 weeks as the flexion of fetal spine renders it less accurate. Also it would be difficult to compare the CRL measured in 1st trimester with BPD measured in 2nd trimester for the same fetus in order to obtain a precise growth rate. BPD can be measured at 8 weeks.

In our study, growth rate was adjusted only for gestational age. More complex models, additionally including biochemical markers, uterine artery pulsatility index and adjustment for fetal gender and parental characteristics, would most likely identify at-risk pregnancies more accurately. Such a model is outside the scope of our study, but would probably be a valuable clinical tool, enabling resources to be focused more accurately on the pregnancies at highest risk.

In the Copenhagen first trimester study done by Pederson et al., the BPD measurements at 11-14 and 17-21 weeks from 8215 singleton pregnancies at the Copenhagen University hospital, Denmark were analyzed.¹¹ They found a significant relationship between the growth rate of BPD from the first to the second trimester and adverse pregnancy outcome. Low growth rates were associated with an increased odds ratio for perinatal death and IUGR, while high growth rates are associated with an increased odds ratio for macrosomia and preterm delivery. Growth rate showed no association with pre-eclampsia.

Gordon et al. studied the relation between the outcome of 4229 pregnancies and the difference between the measured and the expected CRL in the first trimester, expressed as equivalent days of growth.⁹ They found that a first-trimester CRL that was two to six days smaller than expected was associated with an increased risk of a birth weight below 2500 g, a birth weight below 2500 g at term, a birth weight below the fifth percentile for gestational age, and delivery between 24 and 32 weeks of gestation. They concluded suboptimal first-trimester growth may be associated with low birth weight, low birth weight percentile and premature delivery.

Vafae et al. from Iran included 269 women attending an antenatal clinic for a fetal sonographic examination between 9 and 14 weeks of gestation, who were followed up to delivery and similar outcomes as those in our study were recorded.¹² The only difference was that instead of the BPD, the Crown Rump Length (CRL) was measured. A significant relation was established between low birth weight and low CRL recording. Difference between observed and expected CRL (days) showed significant associations by low birth weight (relative risk = 0.257), abortion (relative risk = 4.850) and need for an emergency termination of pregnancy (relative risk = 0.367).

In conclusion, we found a significant relationship between the BPD measurement done during the 11 to 14 weeks scan and the development of SGA and AGA babies, irrespective of BPD growth rates. These findings

underline the importance of focusing on first trimester ultrasonography instead of later pregnancy when irreparable damage might already have occurred.

Table 5: Comparison of our study with other studies.

Parameters	Present study	Copenhagen study ¹¹	Gordon et al. ⁹	Vafae et al. ¹²
Type of study	Prospective	Prospective	Prospective	Prospective
Number of subjects	723	8215	4229	269
Parameter recorded in the first trimester and second trimesters	BPD and BPD growth rate	BPD growth rate	First trimester CRL	First trimester CRL
Outcome noted	Low BPD is associated with SGA, but not preterm labor	Low growth rates are associated with perinatal death and IUGR	Smaller CRL was associated with low birth weight and preterm labor	Smaller CRL was associated with low birth weight

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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