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ORIGINAL ARTICLE

Assessment of Antepartum Fetal Growth by Customized "GROW" Curves Versus Noncustomized Growth Curves in Correlation with Neonatal Growth Pattern

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Abstract

Objective To study the antepartum fetal growth between customized "GROW" curves and noncustomized growth curves with neonatal growth pattern.

Method Fetal growth scans are performed between 30 and 35 weeks to singleton mother. Estimated fetal weights (EFWs) were determined using ultrasound variables (biparietal diameter, head circumference, abdominal circumference, and femur length). This EFW is plotted on SONOCARE software [noncustomized growth curves developed by Medialogic solutions (P) Ltd., Chennai, India] and customized "GROW" curves to determine the type of antenatal fetal growth as AGA, small for gestational age (SGA), or large for gestational age (LGA). The fetuses were followed longitudinally till birth, and the newborns' growth patterns were determined according to birth weight at the gestational age of delivery (<10th percentile for gestational age as SGA and >90th percentile as LGA) and compared to antenatal prediction of fetal growth patterns determined by noncustomized growth curves and customized "GROW" curves.

Results According to noncustomized growth curve at antenatal period, 93 % fetuses are AGA; 5.6 % are LGA, and 1 % are SGA. According to customized GROW curves, when the same EFW is plotted on GROW curves, 83 % are found to be AGA, 6.8 % LGA, and 10 % SGA. At postnatal period, according to newborn growth curve, 87.8 % are AGA, 8.8 % LGA, 3.4 % SGA. Sensitivity of customized "GROW" curves is more than that of noncustomized growth curves (45.45 vs. 18.18 %) for detection of SGA fetus.

Conclusion Antenatal predictions of SGA baby by ultrasonography can be almost doubled with customized "GROW" curves than noncustomized growth curves. Customized GROW curves also better predict perinatal morbidities like neonatal jaundice and NICU admission. Antenatal serial fetal growth monitoring should be done with customized GROW curves.

Keywords Customized growth curves · Fetal growth

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Introduction

Fetal growth is a dynamic process which has to be assessed serially. Abnormal growth pattern can be either small or large for gestational age. Assessment of estimated fetal weight (EFW) by ultrasound is the most accurate among diagnostic measurements to predict birth weight [1].

However, mere prediction of EFW which is derived by biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL) is not helpful, unless the EFW is plotted in fetal growth curves to classify the various fetal growths such as average for gestational age (AGA), small for gestational age (SGA), and large for gestational age (LGA). Only then, the EFW can have impact in further serial monitoring of the fetus.

The reference fetal growth curves can be of two types:

1. Noncustomized growth curves (SONOCARE software; Medialogic solutions (P) Ltd., Chennai, India).
2. Customized "Gestation Related Optimal Weight" (GROW) curves.

Noncustomized growth curves (SONOCARE software) are derived from the local population from the database of fetal birth weights at different gestational ages. The concept of customized growth chart is developed by Prof. Gardosi et al. [2]. They recognized that the main nonpathological factors affecting birth weight were gestational age, maternal height, maternal weight at booking, parity, and ethnic group. This resulted in the development of GROW software which is useful for the assessment of fetal growth. EFW obtained by USG can be plotted on customized "GROW" curves. Again, at birth, the neonatal growth pattern are described according to birth weight of gestational age at delivery (<10th percentile for gestational age as SGA and >90th percentile as LGA).

The aim is to study is to determine whether customized GROW curves or noncustomized growth curves can better predict the newborn growth pattern.

Methodology

This is a prospective longitudinal study done at Fernandez Hospital Private Limited, Hyderabad, Andhra Pradesh, India, a tertiary, referral, and perinatal center with about 5,000 deliveries per year. The population of this study comprised mothers of routine antenatal visit greater than 26 weeks of gestational age visiting Fernandez Hospital during the study period from January 2010 to October 2010. Study was approved by the hospital ethical committee. The criteria were as under:

Inclusion criteria:

1. Singleton pregnancy.
2. Booking before 22 weeks.
3. Accurate pregnancy dating.

Exclusion criteria:

1. Multiple pregnancies.
2. Booking after 22 weeks.
3. No dating scan.
4. Congenital anomaly.
5. Referral cases.

Definition used in study

Antenatal

1. *Large for gestational age* Fetuses EFW of which is greater than the 90th centile for the gestational age.
2. *Average for gestational age* Fetuses EFW of which is between the 10th and the 90th centile for gestational age
3. *Small for gestational Age* Fetuses EFW of which is less than the 10th centile for gestational age

Postnatal

1. *Small for gestational age* Newborns with birth weight less than the 10th percentile for gestational age
2. *Large for gestational age* Newborns with birth weight greater than the 90th percentile for the gestational age
3. *Average for gestational age* Newborns whose weight is between the 10th and the 90th percentiles for gestational age]

The protocol followed is to order for ultrasound evaluation at least three times during the entire pregnancy.

First trimester scan including nuchal translucency (NT) ($11–13^{+6th}$ week).

First trimester scan is done between 11 and 13^{+6th} weeks of gestation, and simultaneous accurate dating of gestational age is done by measuring crown rump length (CRL).

Second trimester scan (Targeted Imaging for Fetal Anomalies) (19–22 weeks). This scan is done around 20 weeks of gestation to detect the congenital abnormalities of the fetus. This scan is also used to determine the accurate dating if it has not been done before.

Third trimesters scan (Fetal well being): It is done between 30 and 35 weeks of gestation, and the growth of the fetus is plotted on the graph.

Ultrasound examinations are performed with Voluson 730 expert (GE Medical system, Voluson i (GE Medical system), Philips, $LogiqP_3$ (GE Medical system). All ultrasound measurements were done by trained obstetric sonologists in fetal medicine unit at Fernandez hospital. EFW performed using ultrasound variables (BPD, HC, AC, and FL). This EFW plotted on noncustomized growth curves (Sonocare software) and customized "GROW" curves to determine the type of antenatal fetal growth as AGA, SGA, or LGA. The fetuses are followed longitudinally till birth, and at birth, the newborn growth patterns are determined according to birth weight at the gestational age of delivery and compared with antenatal prediction of pattern of fetal growth.

Results

A total of 647 women were included in the study according to the inclusion and exclusion criteria. Demographic variables of the mother are as shown in Table 1. Among antenatal mothers, 49.61 % are primigravida, 28.44 % are 2nd gravida, and 11.43 % are 3rd gravida. 92 % of the first (dating) scans were done in the first trimester. In 498 (77 %) cases, the LMP dating and scan dating correlate; in 149 (23 %) cases where they did not coincide, scan date was preferred over LMP date.

According to noncustomized growth curve, the following growth patterns are determined: 93 % fetuses are AGA; 5.6 % are LGA; and 1 % are SGA.

According to customized GROW curves, when the same EFWs are plotted on GROW curves; 83 % fetuses are found to be AGA, while 6.8 % are LGA and 10 % are SGA.

The mean GA is 38 weeks. 89 % delivered between 37 and 40 weeks, 4.8 % delivered between 34 and 36 weeks, 5.6 % delivered at >40 weeks, and 0.7 % delivered at <34 weeks. The mean birth weight is 2.965 ± 0.467 kg, and the median is 2.96 kg with a range of 1.2–4.55 kg. 53.6 % of delivered newborns are male and 46.4 % are female.

At postnatal period; according to actual birth weight; 87.8 % of newborns are AGA, 8.8 % of newborns are LGA, and 3.4 % of newborns are SGA.

In the comparison between noncustomized growth curves and customized GROW curves, the sensitivities for predictions of AGA (96.3 vs. 85.91 %) and LGA (35.1 vs. 31.58 %) fetuses are almost similar; but the sensitivity for prediction of SGA fetus (45.45 vs. 18.28 %) is considerably high with customized GROW scan. (Table 2)

Among the 647 delivered newborns, overall 5.72 % (37/647) develop neonatal jaundice, with 18.9 % among them needing phototherapy; 0.46 % have 1 min APGAR <5; 0.77 % have hypoglycemia; and 1.7 % have NICU admission.

24.3 % of SGA fetuses predicted by customized GROW curves develop neonatal jaundice (9/37) compared with 8.1 % SGA fetuses predicted by noncustomized growth curve, which develop neonatal jaundice (3/37). Similarly, 18.2 % of SGA fetuses predicted by customized curves have NICU admission compared with none predicted by noncustomized curves.

Table 1 Demographic variables

Maternal characteristics	Mean ± SD	Median (range)
Age (years)	26.70 ± 4.188	26 (18–40)
Height (cm)	158.49 ± 6.005	158 (140–181)
Weight (kg)	60.89 ± 11.371	60.00 (34–122)
BMI (cm/m^2)	24.17 ± 4.456	24.00 (15–48)

Table 2 Comparison of Mediscan curve and GROW curve in prediction of AGA/LGA/SGA group (Lubchenco curves)

	Mediscan	GROW
Sensitivity		
AGA	96.3 %	85.91 %
LGA	35.1 %	31.58 %
SGA	18.18 %	45.45 %
Specificity		
AGA	30.38 %	36.79 %
LGA	97.29 %	95.59 %
SGA	99.2 %	91.2 %
Positive likelihood ratio		
AGA	1.38 (95 % CI 1.2–1.6)	1.36 (95 % CI 1.1–1.6)
LGA	12.9 (95 % CI 7.11–23.5)	7.17 (95 % CI 4.19–12.2)
SGA	22.7 (95 % CI 6.5–78.9)	15.4 (95 % CI 7.6–26.5)
Area under ROC curve		
AGA	0.63	0.61
LGA	0.66	0.63
SGA	0.59	0.68

Conclusion

The first and the most important step for successful fetal and maternal outcome is early antepartum detection of abnormal fetal growth. Both SGA and LGA babies are associated with increased perinatal mortality and morbidity [3]. Because of the shortcomings of detecting intrauterine growth restriction from clinical examination, both ACOG and RCOG recommend biometric measurements of the fetus and EFW. Both guidelines agree that if the AC or EFW is less than 10 % for GA, then abnormal growth should be suspected [4].

In this study, sensitivity of antenatal predictions of SGA baby can be almost doubled with customized "GROW" curves in comparison with noncustomized growth curves. Our finding is well correlated with the study of Gardosi and Francis [5] which concluded that customized antenatal charts had a significantly higher antenatal detection rate of SGA babies (48 vs. 29 %) and LGA babies (46 vs. 24 %).

From this study, it is recommended that the use of customized antenatal growth curves for ultrasonography monitoring of fetal growth is better than that of noncustomized growth curves. Customized growth curves are better correlated with newborn growth curves at least in the SGA fetus and better predictive of neonatal morbidities like neonatal jaundice and NICU admission, especially for SGA fetus.

Conflict of interests None.

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