Original Research Article

Accuracy of Fetal Transcerebellar Diameter in Estimation of Gestational Age in Small for Gestational Age Fetus

Abstract

Background: Transcerebellar diameter (TCD) is a novel unique measure that is well established in the ultrasound literature as a dependable criterion for estimating gestation length, and it is steadily predominant in predicting GA in singleton and twin gestation, as well as at the foetal growth extremes. The aim of this work was to evaluate the value of use of TCD as a reliable predictor in singleton gestations of GA in SGA pregnancies.

Methods: This cross-sectional research enrolled 40 pregnant women clinically suspected to have SGA fetus. All participants underwent the following: history taking, investigation of the abdomen, ultrasound to assess (fetal viability, circumference of the head, biparietal circumference, TCD, length of the femur, estimation weight of fetus, circumference of the abdomen,)

Results: The multivariate linear regression analysis shows that the most important measures associated with actual GA was found TCD followed by BPD and lastly FL with p-values of 0.001, 0.005, and 0.013, respectively.

Conclusions: TCD has an advantage over other growth markers in situations of growth limited babies since it corresponds well with GA.

Keywords: accuracy of fetal transcerebellar diameter, small for gestational age fetus, gestational age

Introduction:

Infants classified as small for gestational age (SGA) have a birth weight that is less than the 10th percentile for their gestational age (GA). SGA infants are predisposed to preterm birth morbidity as well as a variety of unfavorable perinatal outcomes linked with early birth. Adults born SGA are more likely to develop metabolic syndrome, diabetes, and hypertension, regardless of whether the delivery was preterm [1].

SGA is not synonymous with foetal growth restriction (FGR). Certain, but not all, growth-restricted fetuses/infants are classified as SGA, although between 50% and 70% of SGA fetuses are fundamentally tiny, with foetal development commensurate with mother size and ethnic origin [2].

The screening and diagnosis of SGA is based on precise early dating, risk factor evaluation, and foetal growth ultrasonography. Accurate gestational age can be estimated by menstrual history, clinical examination and ultrasound [3].

Predicting GA using sonographic foetal characteristics is a cornerstone of contemporary obstetrics and remains a critical element in the care of pregnancies with babies with growth abnormalities [4]. Ultrasound has been used to assess foetal health and a number of other sonographic characteristics have been used to test for and diagnose SGA.

The biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal circumference (AC) are the four fundamental measures which can be performed using standard AIUM guidelines (AIUM, 2013). The reliability and accuracy of different biometry measures are varied, although BPD is a highly repeatable parameter after 14 weeks; and its form might alter BPD detection [5].

Goel et al., [6] found that the cerebellum of the foetus exhibits a gradual increase in size over the pregnancy period. Thus, it is an organ capable of conveying information about the gestational age throughout pregnancy. Transcerebellar diameter (TCD) is one such foetal

measurement that has consistently outperformed other foetal parameters in predicting GA in singleton and twin gestations [7, 8]. TCD is capable of predicting GA throughout the second and third trimesters [7].

The aim of this work was to evaluate the value of use of TCD as a reliable predictor in singleton gestations of GA in SGA pregnancies

Patients and Methods:

This cross-sectional research had 40 participants who are pregnant women, aged between 18-38 years, clinically suspected to have SGA fetus at Tanta University Hospital. The study lasted for 12 months. Cases with singleton viable pregnancy, GA of 28-40 weeks, sure and reliable dates and/or 1st trimester ultrasound between 10-13 weeks and clinically suspected SGA fetus (two or more of the ultrasound fetal biometry measure are less than 10th percentile by customized growth chart) were included.

Exclusion criteria were ultrasonographically detected congenital fetal malformation, fetal hydrops and multiple pregnancies

All participants in this study provided informed consent. There were sufficient sessions to protect the participants' privacy and the confidentiality of the data.

Any pregnant woman who is having a scan for suspected SGA fetus was subjected to history taking with emphasis on the latest menstrual period's date, abdominal examination (symphysis-fundal height), ultrasound to assess (fetal viability, BPD, HC, TCD, FL, AC, Estimation of weight of the fetus using Hadlock et al.'s formula [9] and customized growth chart: this was done using Hadlock II).

Technique of ultrasound

Trans-abdominal ultrasound was performed by SAMSUNG MEDISON H60 (Seoul, Korea & 50/60 HZ transabdominal probe on all patients)

Measurement of fetal Bi-Parietal Diameter (BPD) HC, AC, and FL estimated fetal weight (EFW) using standard techniques according to AIUM guidelines [10].

Measuring TCD (develop a transthalamic perspective on BPD The posterior horns of the lateral ventricles will vanish from view when the probe is rotated slightly lower toward the foetal neck and will be replaced by the cerebellum. The TCD is determined at 90 degrees to the cerebellum's long axis at its widest point, utilizing the outer-to-outer approach).

Statistical analysis

Version 20 of IBM SPSS (Chicago, USA) was used for the analysis. Qualitative data was presented in the form of percentages and numbers, while quantitative data was presented in the form of mean, standard deviations, and median with interquartile ranges for parametric and non-parametric data, respectively.

Spearman correlation coefficients were used to determine the statistical significance of a correlation between two quantitative parameters in the same group. GA was evaluated using multivariate linear regression analysis, which accounted for the most relevant variables. Setting the confidence interval to 95 percent, the margin of error was set to 5 percent. The significance level was set at a two-tailed P value of 0.05.

Results:

Table 1 illustrates patient characteristics, GA (weeks) & EFW (gm)

Table 1: Patients' characteristics, Gestational age (weeks) & estimated fetal weight(gm)

		Total no. = 40
Age (years)		28.43 ± 5.57
Parity	**Nulliparous**	16 (40.0%)
	Multipara	24 (60.0%)
Co-morbidity	**Preeclampsia**	7 (17.5%)
	Gestational HTN	12 (30.0%)

ACTUAL GA (LMP or CRL)	31.23 ± 2.06
EFW	1300.88 ± 296.07
TCD	30.03 ± 2.33
BPD	27.83 ± 1.99
FL	27.85 ± 1.83
AC	27.45 ± 1.85
HC	28.25 ± 1.94

Data are presented as mean ± SD or frequency (%), GA: gestational age, CRL: crown-rump length, LMP: last menstrual period, EFW: estimated fetal weight, TCD: transcerebellar diameter, BPD: biparietal diameter, FL: femur length, AC: abdominal circumference, HC: head circumference.

There was positive correlation between of actual GA and GA by TCD and there was positive correlation between actual GA (LMP or CRL) and GA by BPD. **Figure 1**

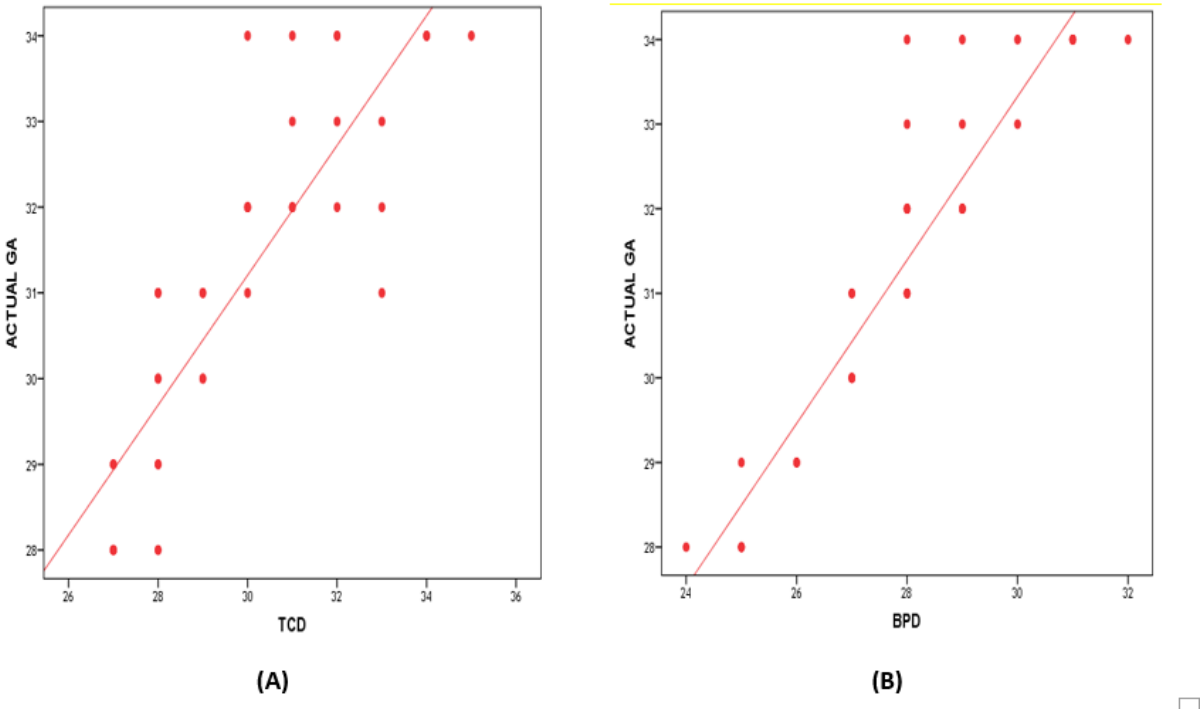

Figure1**: (A) Correlation of actual GA (LMP or CRL) with GA by TCD (B) correlation of actual GA (LMP or CRL) with GA by BPD**

There was positive correlation between actual GA (LMP or CRL) and GA by HC, there was positive correlation between actual GA (LMP or CRL) and GA by FL and there was positive correlation between actual GA (LMP or CRL) and GA by AC. **Figure 2**

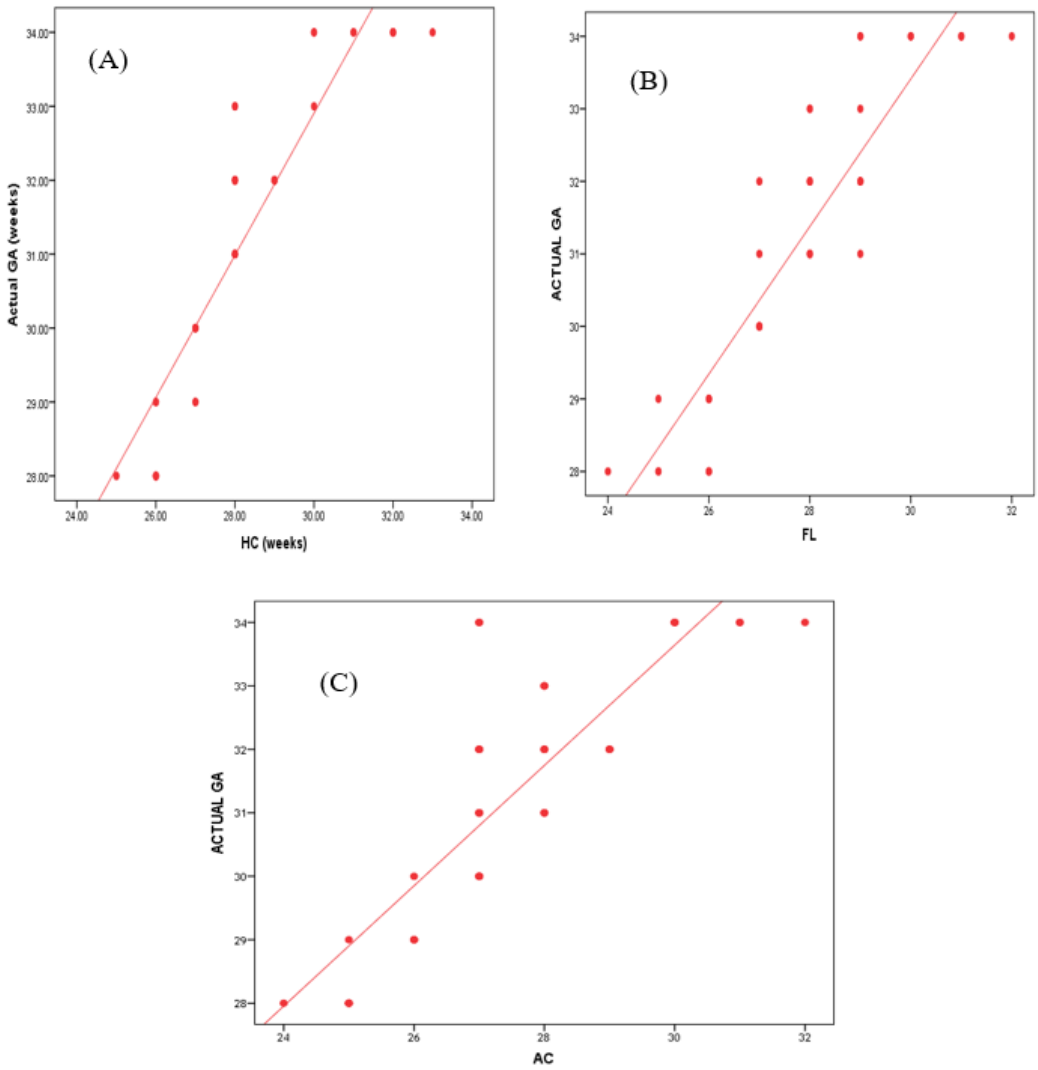

Figure 2: (A) Correlation of actual GA (LMP or CRL) with GA by HC (B) Correlation of actual GA (LMP or CRL) with GA by FL (C) Correlation of actual GA (LMP or CRL) with GA by AC

The multivariate linear regression analysis shows that the most important measures associated with actual GA was found TCD followed by BPD and lastly FL with p-value = 0.001, 0.005 and 0.013, respectively. **Table 2**

Table 2: Multivariate linear regression analysis for measures associated with actual gestational age among the studied patients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.677	1.402		1.196	0.240
ESTIMATED GA	-0.046	0.227	-0.041	-0.204	0.840
TCD	0.233	0.066	0.263	**3.497**	**0.001**
BPD	0.521	0.173	0.503	**3.022**	**0.005**
FL	0.426	0.163	0.379	**2.610**	**0.013**
AC	-0.249	0.184	-0.225	-1.356	0.184
HC	0.153	0.113	0.145	1.357	0.184

GA: gestational age, TCD: transcerebellar diameter, BPD: biparietal diameter, FL: femur length, AC: abdominal circumference, HC: head circumference.

Discussion

TCD is a novel, one-of-a-kind indicator that has been thoroughly established in the ultrasound literature as a trustworthy criterion for determining gestational length [11], and it is steadily superior at predicting GA in singleton and twin gestation, as well as at foetal growth extremes. TCD measurements can be taken on the majority of fetuses, regardless of the foetal head shape [12].

The Spearman correlation coefficients were utilised in this study to determine the existence of a significant relationship between two variables actual GA LMP or CRL and estimated gestational age by other fetal biometric measurements (T.C.D., B.P.D., H.C., A.C. & F.L.) there was positive correlation between actual GA and estimated GA.

We performed multivariate linear regression analysis to determine the most significant variables associated with actual GA was found TCD followed by BPD and lastly FL with p-value = 0.001, 0.005 and 0.013 respectively.

According to AIUM guidelines for redating based on ultrasonography TCD is more accurate.

These findings are explained by the fact that growth restriction has no effect on cerebellar development in fetuses, as a result, it may be beneficial in determining GA in both normal and growth limited fetuses. Thus, as a result of the brain sparing phenomenon, the concept of human cerebellar growth is particularly resistant to persistent hypoxia.

The current study confirms findings from a retrospective cross-sectional investigation of 360 normally growing fetuses between 17- and 34-weeks' gestation and 73 growth-restricted fetuses between 24- and 34-weeks gestation that the TCD measurement is usually omitted in cases of IUGR. Even when growth was severely restricted, the TCD was only minimally altered [13]. Also, there have been several research published on the importance of TCD measures in fetuses with unknown GA and FGR. According to one of these studies, the transverse cerebellar diameter was modest in 44 GA fetuses between 27 and 42 weeks. The cerebellar diameter was normal in 12 (27.3%) cases, between one and two standard deviations below the mean for GA in six (13.6%) cases, and higher than two standard deviations below the mean in 26 cases (59.1 %) [14].

Another study was conducted to determine the correlation between Transverse Cerebellar Diameter and GA in pregnancy of normal and IUGR. 200 pregnant women of GA between 15 and 40 weeks of gestation were referred for a prenatal scan by the Department of Obstetrics and Gynecology. The greatest number of cases with clinical suspicion of IUGR occurred in GA >36-40 weeks (50 %). The discrepancy between real and estimated GA between normal and actual GA is evaluated and demonstrated that the mean difference between estimated and actual GA was smallest in TCD for both normal and IUGR pregnancies, followed by other known criteria [15].

On the other hand, few studies have proven that TCD analysis cannot be used as a primary tool for evaluating the GA. The TCD was found to be a useful predictor of GA in fetuses with asymmetric, but not symmetric, growth limitation in one study [16].

A research by Eze et al., [14] noted that in the late stages of the third trimester, Several pregnant women reported experiencing discomfort while rocking the probe on the fetal head to get the sub-occipito-bregmatic view necessary for TCD measurement, and shadows from the embryonic skull obscured the cerebellum's margins in some cases. A couple cases in which the foetus was extremely active this created some complications for the sonographic determination of TCD so TCD measurements could have been suboptimal.

Conclusions:

This study showed that TCD has a benefit in instances where growth restricted fetuses as it has a strong correlation with GA when compared to other growth indicators.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

References:

1. Marzouk A, Filipovic-Pierucci A, Baud O, Tsatsaris V, Ego A, Charles M-A, et al. Prenatal and post-natal cost of small for gestational age infants: a national study. BMC health services research. 2017;17:1-8.

2. Nardozza LM, Caetano AC, Zamarian AC, Mazzola JB, Silva CP, Marçal VM, et al. Fetal growth restriction: current knowledge. Arch Gynecol Obstet. 2017;295:1061-77.

3. Detti L, Francillon L, Christiansen ME, Peregrin-Alvarez I, Goedecke PJ, Bursac Z, et al. Early pregnancy ultrasound measurements and prediction of first trimester pregnancy loss: A logistic model. Sci Rep. 2020;10:1545-7.

4. Pedroso MA, Palmer KR, Hodges RJ, Costa FDS, Rolnik DL. Uterine Artery Doppler in Screening for Preeclampsia and Fetal Growth Restriction. Rev Bras Ginecol Obstet. 2018;40:287-93.

5. Njeze NR, Ogbochukwu JO, Chinawa JM. Correlation of ultrasound placental diameter & thickness with gestational age. PaK J Med Sci. 2020;36:1058-60.

6. Goel P, Singla M, Ghal R, Jain S, Budhiraja V, Babu CR. Transverse cerebellar diameter-a marker for estimation of gestational age. J Anat Soc India. 2010;59:158-61.

7. Reddy RH, Prashanth K, Ajit M. Significance of Foetal Transcerebellar Diameter in Foetal Biometry: A Pilot Study. J Clin Diagn Res. 2017;11:158-60.

8. Zakaria AM, Mohamed AH, Eldarder AKM. Comparison between Transcerebellar Diameter, Biparietal Diameter and Femur length for Gestational Age Measurement Accuracy in Third Trimester of Pregnancy. The Egyptian Journal of Hospital Medicine. 2019;74:17-22.

9. Hadlock FP, Harrist RB, Sharman RS, Deter RL, Park SK. Estimation of fetal weight with the use of head, body, and femur measurements--a prospective study. Am J Obstet Gynecol. 1985;151:333-7.

10. AIUM practice guideline for the performance of obstetric ultrasound examinations. J Ultrasound Med. 2013;32:1083-101.

11. Deb S, Mohammed MS, Dhingra U, Dutta A, Ali SM, Dixit P, et al. Performance of late pregnancy biometry for gestational age dating in low-income and middle-income countries: a prospective, multicountry, population-based cohort study from the WHO Alliance for Maternal and Newborn Health Improvement (AMANHI) Study Group. The Lancet Global Health. 2020;8:545-54.

12. Debbink MP, Son SL, Woodward PJ, Kennedy AM. Sonographic Assessment of Fetal Growth Abnormalities. Radiographics. 2021;41:268-88.

13. Mishra S, Ghatak S, Singh P, Agrawal D, Garg P. Transverse cerebellar diameter: a reliable predictor of gestational age. Afr Health Sci. 2020;20:1927-32.

14. Eze CU, Onu IU, Adeyomoye AA, Upeh ER. Estimation of gestational age using trans-cerebellar diameter: a sonographic study of a cohort of healthy pregnant women of Igbo ethnic origin in a suburb of Lagos, southwest Nigeria. Journal of Ultrasound. 2021;24:41-7.

15. Dashottar S, Senger KPS, Shukla Y, Singh A, Sharma S. Transcerebellar diameter: an effective tool in predicting gestational age in normal and IUGR pregnancy. Int J Reprod Contracept Obstet Gynecol. 2018;7:4190-7.

16. Hiersch L, Melamed N. Fetal growth velocity and body proportion in the assessment of growth. Am J Obstet Gynecol. 2018;218:700-11.