

Role of Foetal Trans-cerebellar Diameter in the Prediction of Gestational Age in Correlation with other Foetal Biometric Parameter: A Cross-sectional Study in a Secondary Hospital of Bangladesh

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Abstract

Introduction: Uncertain gestational age is associated with higher perinatal mortality rates. Accurate assessment of gestational age is an important parameter in obstetrics for the management of pregnancy and evaluation of foetal development.

Objective: To evaluate whether trans-cerebellar diameter (TCD) in singleton uncomplicated gestations can serve as a reliable predictor of gestational age (GA) in fetuses between 18-38 weeks of pregnancy.

Methods: This cross-sectional study was carried out in the department of Radiology and Imaging of CMH, Ghatail, from January 2019 to December 2019 among purposively selected 89 outpatient and admitted pregnant women without any complication having regular menstrual cycle and confirmed about last menstrual period (LMP). The transabdominal USG was performed in each patient and trans-cerebellar diameter was taken which was later correlated with other foetal biometric parameters like biparietaldiameter (BPD), femoral length (FL) etc.

Results: Most of the patients belonged to 21-25 years age group (32.6%). Mean age of the study subjects was 26.94±5.70 years ranging from 19 to 38 years and were predominantly (51.7%) primipara. Mean gestational age was 220.69±37.30 days by LMP, 216.20±36.06 days by BPD, 219.00±38.43 days by FL and 218.81±39.36 days by TCD. Mean of biparietal diameter, femoral length and transverse cerebellar diameter were 7.59±1.40cm, 5.91±1.33cm and 3.93±1.00cm respectively. A significant positive linear correlation between GA by LMP with GA by BPD, FL and TCD was observed (p<0.001).

Conclusion: Foetal trans-cerebellar diameter is a reliable sonological parameter for the estimation of foetal gestational age and dating of pregnancy can be made depending on TCD in the pregnant women with unsure of their LMP.

Key words: Trans-cerebellar diameter, Gestational age, Pregnancy.

Introduction

Accurate determination of Gestational age (GA) and Expected date of delivery (EDD) is very important in pregnancy for the management of various obstetrical conditions. Because GA is an important parameter in obstetrics for the evaluation of foetal development. High incidence of iatrogenic neonatal prematurity and perinatal mortality has been noted in patients whose accurate GA is not known¹.

In women with regular 28 days menstrual period, The GA is calculated as 280 days or 40 weeks from the first day of Last menstrual period (LMP). But miscalculations may made when the cycle is irregular². There are various foetal biometric parameters for the assessment of GA. The most frequently used biometric parameters are the BPD, HC, AC and FL³⁻⁴. But these parameters have their own limitations. The reliability of BPD also decreases with advancing GA due to factors like fetal skull molding, deeply engaged head, hydrocephalus, microcephalus, abnormalities of foetal head shape such as dolichocephalic and brachycephaly⁵. Genetic variation in head size of fetuses of same conceptual age of different pregnant woman may give different BPD⁶.

Femoral length measurement can be faulty due to include end of unossified epiphysis. During the measurement triangular spur artifacts could falsely increase femoral length⁷. FL is also unreliable in cases of chronic IUGR and femur achondroplasia. Similarly, AC is also unreliable for the direction of gestational age. So, it is observed that, no single parameter is reliable for accurate gestational age determination.

In this aspect, Transverse cerebellar diameter (TCD) is a well-established parameter in the world of ultrasound literature. It is a good marker to predict the gestational age from 14 to 40 weeks of gestation irrespective of foetal

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head shape and also a reliable parameter for unknown LMP⁸. We know that, the cerebellum is protected laterally by dense petrous ridges and inferiorly by occipital bone, thus withstanding the maximum extrinsic pressure better than parietal bone⁹. Cerebellum is surrounded by CSF fluid which makes a window to see the dumbbell shaped structure easily. The study was conducted to evaluate the foetal trans-cerebellar diameter as a sonological parameter for the estimation of foetal gestational age in comparison to other foetal biometric measurements (BPD, FL) in pregnant women who have regular menstrual cycle with no medical disorders.

Materials and Methods

This cross-sectional study was conducted at the department of Radiology and Imaging of Combined Military Hospital (CMH), Ghatail from January 2019 to December 2019. Purposively selected 89 admitted and outpatient pregnant women who came for antenatal checkup between the period of 18 to 38 weeks of gestation, has the regular menstrual cycle, sure about 1st day of last menstrual period, single pregnancy without any complication were included with an objective to evaluate whether trans-cerebellar diameter (TCD) in singleton uncomplicated gestations can serve as a reliable predictor of gestational age (GA) in fetuses between 18-38 weeks of pregnancy. Data were collected from the patient through face-to-face interview by semi structured questionnaire and review of medical records. Informed written consent was taken from all the respondents and either any intervention or any invasive procedure was undertaken. Prior to the commencement of the study ethical clearance was taken from the competent ethical committee of Combined Military Hospital Ghatail. According to the objective of the study data processing and analysis were done by SPSS version 23.

Ultrasound examination were performed on the high-resolution ultrasound medical system by SAMSUNG HS40 with a 3.75 MHz convex probe. Foetal TCD was measured from the transverse view of fetal intra-cranial anatomy, through the posterior fossa, that included visualization anatomic landmarks such as thalamus, cerebellar vermis, cavum septum pellucidum and cisterna magna. The posterior fossa is revealed with the characteristic echogenic butterfly like appearance of cerebellum. Measurements are taken with positioning the calipers on the outer margins of the cerebellar hemisphere¹⁰.

Results

Among the respondents, one third of the respondents (32.6%) belong to the age group 21-25 years which was followed by 31-35 years (23.6%), average age was

26.94 years (± 5.70) years and range was 19 to 38 years. More than half (51.70%) were primiparous and the rest (48.30%) were multiparous (Table-I).

Table-I: Distribution of the study subjects according to age (n=89)

	Attribute	Frequency	%
Age group in years	≤ 20 years	15	16.9
	21-25 years	29	32.6
	26-30 years	16	18.0
	31-35 years	21	23.6
	>35 years	8	9.0
	Mean \pm SD=26.94 \pm 5.70; Min-max=19-38		
Parity	Multiparous	43	48.3
	Primiparous	46	51.7
	Total	89	100.0

Considering gestational age of the fetus, the mean gestational age was 220.69 \pm 37.30 days by LMP, 216.20 \pm 36.06 days by BPD, 219.00 \pm 38.43 days by FL and 218.81 \pm 39.36 days by TCD. The mean biparietal diameter was 7.59 \pm 1.40cm with a range of 4.31-9.14 cm, the mean femoral length was 5.91 \pm 1.33cm and the mean transverse cerebellar diameter was 3.93 \pm 1.00 (Table-II).

Table-II: Gestational age of fetus by different parameters (n=89)

Attribute	Mean \pm SD	Min-max
<i>Gestational age by different method</i>		
Gestational age by LMP (days)	220.69 \pm 37.30	133.00-265.00
Gestational age by BPD (days)	216.20 \pm 36.06	133.00-260.00
Gestational age by FL (days)	219.00 \pm 38.43	128.00-265.00
Gestational age by TCD (days)	218.81 \pm 39.36	109.00-264.00
<i>Parameters of the fetus</i>		
Biparietal diameter (cm)	7.59 \pm 1.40	4.31-9.14
Femoral length (cm)	5.91 \pm 1.33	2.24-7.41
Transverse cerebellar diameter (CM)	3.93 \pm 1.00	1.47-5.38

Considering the correlation between gestational age by last menstrual period with biparietal diameter, femoral length and trans cerebellar diameter, it was revealed statistically significant strong positive correlation (Table-III).

Table-III: Correlation between gestational age by LMP with BPD, FL and TCD (n=89)

	r	p-value
BPD	0.921	<0.001
FL	0.892	<0.001
TCD	0.979	<0.001

Linear regression between gestational age by LMP with all the parameter e.g., biparietal (r=0.967, p=<0.001), femoral length (r=0.982, p=<0.001) and trans cerebellar diameter (r=0.984, p<0.001) revealed strong positive correlation (Figure-1, 2 & 3).

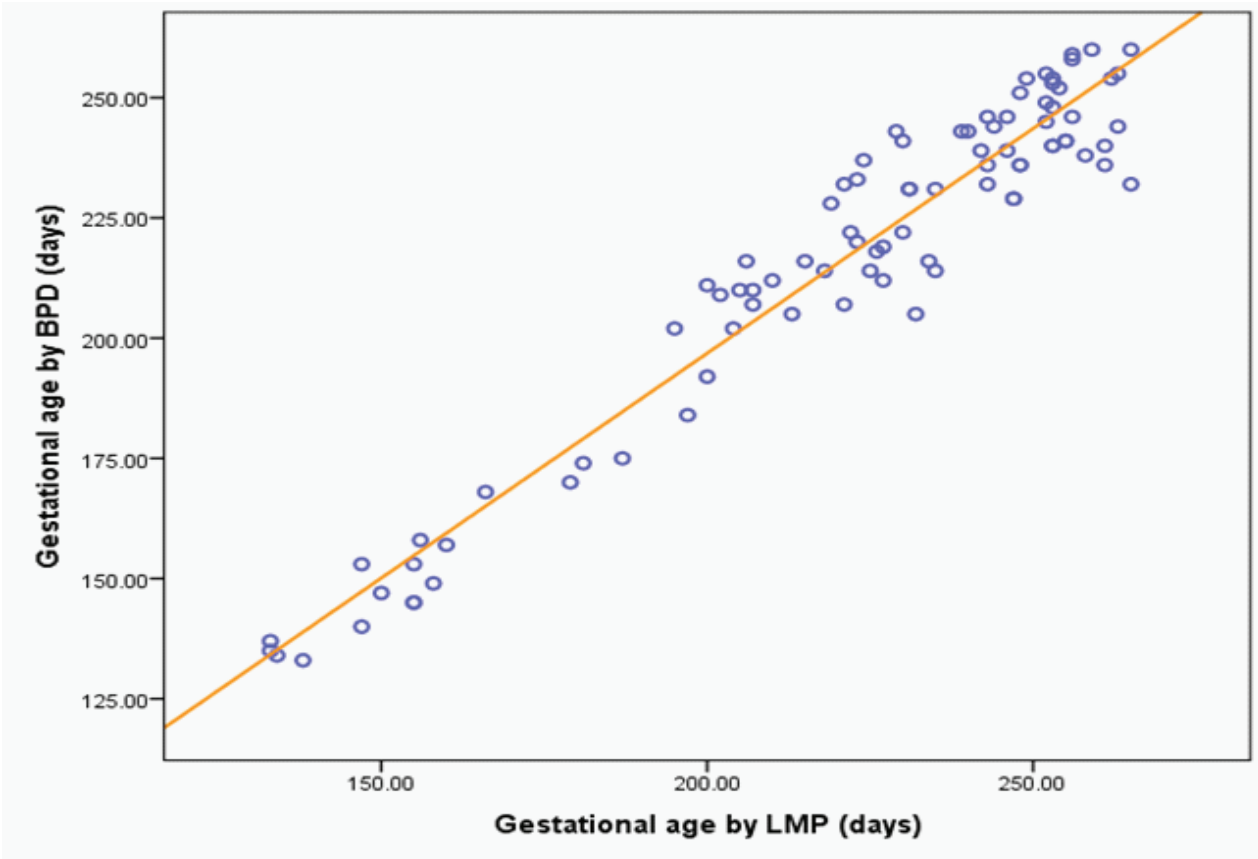


Figure-1: Correlation of gestational age by LMP with gestational age by BP

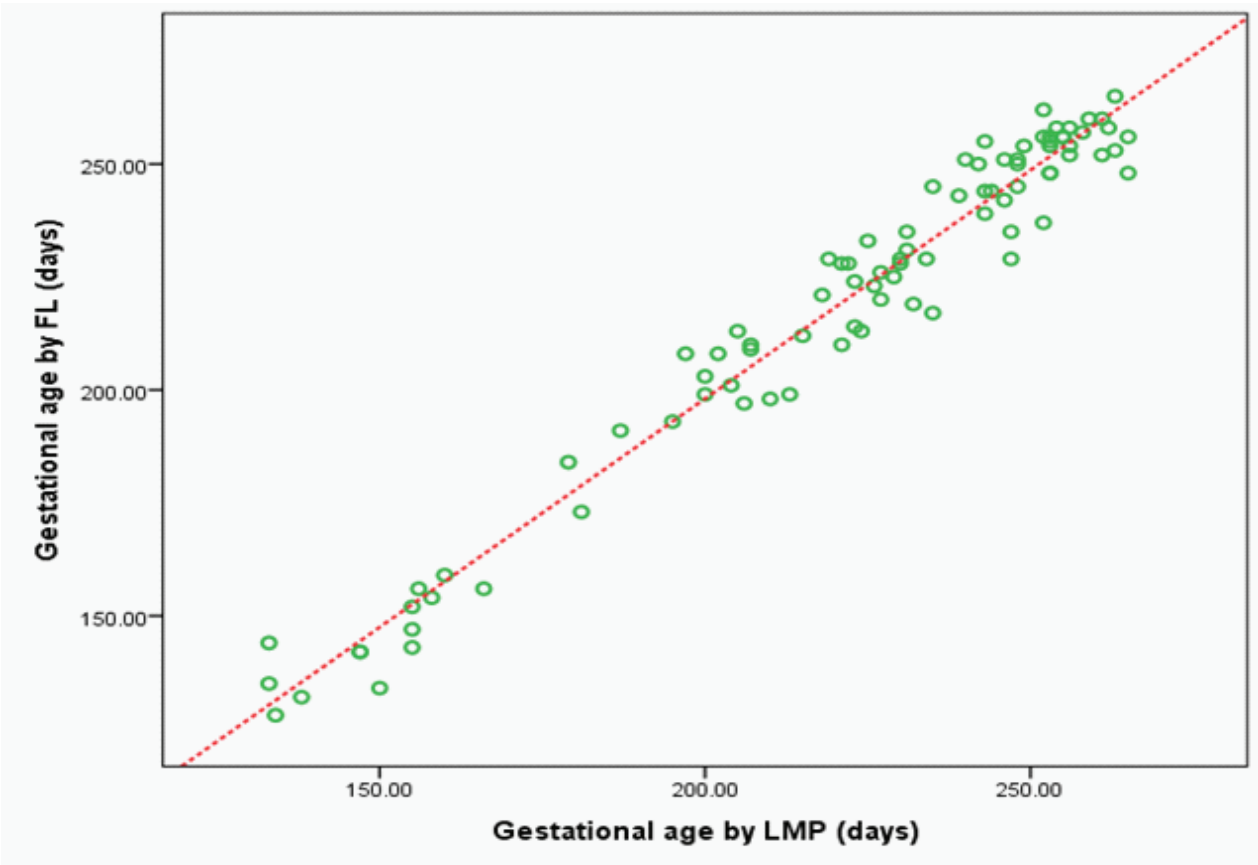


Figure-2: Correlation of gestational age by LMP with gestational age by FL

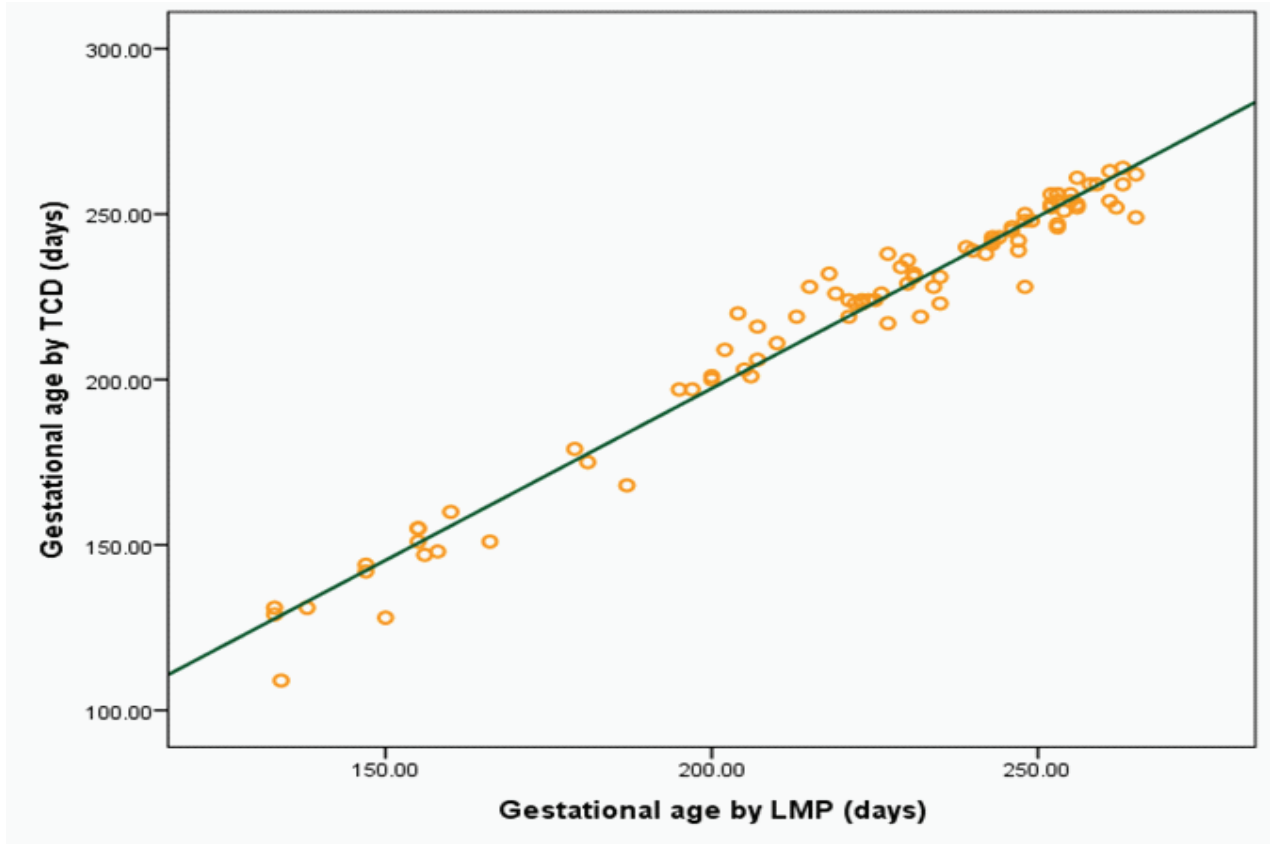


Figure-3: Correlation of gestational age by LMP with gestational age by TCD



Figure-4: Measurement of TCD by ultrasound

Discussion

The knowledge of precise gestational age is very essential for the management of obstetric patients. Often there are situations where women present herself for the first time in the third trimester of pregnancy with vague knowledge of pregnancy duration and many a times uncertain about her last menstrual period. The clinician in such situation is in dilemma and feels the need for some simple reliable means to estimate correct gestational age. This makes the ultrasound assessment of the gestational age by standard foetal biometric parameters like BPD and FL a central and integral part of obstetric practice.

However, each of these parameters have their own limitations and the variability in predicting gestational age with these parameters increases specially in third trimester. For instance, because of molding of head in third trimester, the reliability for BPD dimensions decreases during the last trimester of pregnancy. Similarly, femur length is not dependable in cases of achondroplasia. Foetal cerebellum is sonographically visualized as early as 10-11 weeks. Since, cerebellum lies in the posterior cranial fossa and covered by thick dura and bony calvarium, it is more resistant to deformation by extrinsic pressure. TCD is observed to be least affected by factors modifying foetal growth allowing it to determine accurate gestational age even in third trimester and cases of intrauterine growth restriction^{11,12}.

Several research have undergone in view of this and the measurement of the TCD is becoming an emerging accurate ultrasound parameter useful for the estimation of gestational age. Bansal et al studied 650 cases between 14-40 weeks of gestation and found a highly significant correlation between TCD and gestational age in both normal and intrauterine growth-retarded fetuses¹³. Eze et al in their study also reported that TCD measurement had a direct correlation with GA that is obtained from patient's LMP in both the second and third trimesters of pregnancy and that TCD has a strong linear relationship with GA¹⁴. Alalfy et al studied 60 Egyptian ladies in their second and third trimesters with both uncomplicated and complicated pregnancies and found trans cerebellar diameter was significantly correlated positively to menstrual gestational age¹⁵. Moreover, a study by Naseem F et al showed TCD had given more accurate gestational age in comparison to BPD¹⁶.

In this study, 89 normal pregnant mothers with known LMP were scanned between 18 to 38 weeks for foetal dating. There was strong positive correlation between GA by LMP with GA by BPD, FL and TCD in consistent with the previously mentioned studies. Reece et al and

Guan B found curvilinear relationship between TCD and gestational age^{17,18}. However, this study showed a strong linear relationship between these parameters which is in parallel to the findings of several South Asian studies performed by Bansal M et al, Nagesh R et al, Reddy RH et al and Dashottar S et al¹⁹⁻²².

TCD is not routinely done in foetal biometry. So, this study was done to demonstrate how accurately GA by TCD is correlating with that of GA by LMP so that TCD can be included in routine foetal biometry. In view of above, TCD seems to be a good biometric marker for gestational age determination and may be used in cases uncertain about LMP.

Conclusion

From this study, we concluded TCD is an accurate biometric measurement in uncomplicated pregnancies and dating of pregnancy can be made depending on TCD in the pregnant women with unsure of their dates.

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