Ultrasonographic Prediction of Gestational Age in Pregnancy Using Foetal Transcerebellar Diameter

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ABSTRACT: *Background:* Estimation of gestational age is very crucial for providing antenatal care and it is a prerequisite to plan various interventions during pregnancies. Transcerebellar diameter can predict gestational age reliably as it grows progressively with gestation and is not affected by foetal lie, skull shape and foetal growth disorders. *Methods:* This cross-sectional type of descriptive study was conducted for 1 year from January 2023 to December 2023 in the Department of Anatomy in collaboration with the Department of Radiology and Imaging, Rajshahi Medical College Hospital, Rajshahi on 120 3rd trimester women aged 18-40 years with singleton pregnancy. Data was collected through a semi-structured questionnaire and sonographic examination was done using a sonoscape machine fitted 3.5 to 5.0 MHZ transabdominal transducer. *Results:* Out of 120 women, 80 (66.70%) were within the range of 21-30 years, 59 (49.20%) lived in semi-urban area, 46 (38.30%) had higher secondary level of education, 82 (68.30%) were housewives. Parity and gestational age revealed that 85 (70.83%) of the women were multiparous and the mean gestational age was 34.55±2.88 weeks based on LMP and 34.65±2.93 weeks based on TCD. Gestational age determined by TCD was positively highly correlated with gestational age determined by LMP (r=0.97, p < 0.001). *Conclusion:* TCD could serve as a reliable parameter for evaluation of GA in women whose LMP was unknown in late pregnancy without having a dating scan, because of strong and significant correlation of GA by TCD.

Keywords: Sonographic Prediction, Gestational Age and Foetal Transcerebellar Diameter.

Article at a glance:
Study Purpose: The purpose of the study was to determine the accuracy of gestational age in third trimester of pregnancy by TCD in comparison with a conventional parameter (LMP).
Key findings: The average gestational age was 34.55±2.88 weeks using LMP and 34.65±2.93 weeks using TCD.
Newer findings: TCD and LMP showed a strong positive correlation (r=0.97, p < 0.001) for gestational age.
Abbreviations: LMP: Last menstrual period, SPSS: Statistical Package for the Social Sciences and TCD: Transcerebellar Diameter.

INTRODUCTION

Accurate knowledge of gestational age is important to facilitate the best possible prenatal care & successful pregnancy outcome.[1] Gestational age means 40 weeks calculated from the first day of last menstrual period. Accurate last menstrual period is not always reliable parameter; therefore, transcerebellar diameter may be a more accurate tool for calculating gestational age. Gestational age estimation is one of the important decisions that guide medical care of a pregnant woman, gives appropriate timing of deliveries and management of complications. Studies showed that decisions based on inaccurate gestational ages result in higher foetal and maternal morbidity and mortality.[2] The traditional method of estimating gestational age is based on the last menstrual period. It could be influenced by the regular menstrual cycles, especially in the immediate three months pre-conception and by prior exposure to hormonal contraception. In women from developing countries, late antenatal checkup,

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32

absence of accurate menstruation records & menstrual cycle irregularities are additional challenges.[3] For assessment of gestational age, femur length, abdominal circumference, bi-parietal diameter, head circumference & crown rump length are commonly used biometric parameters. But each parameter has its own limitations. Diseases that alter the shape of the skull like dolichocephaly or brachycephaly cause inaccurate bi-parietal diameter.

In oligohydramnios, abdominal circumference is altered. The length of femur varies with ethnicity and congenital anomalies of skeleton. Even in severe growth restrictions, the transcerebellar diameter is not altered significantly and gives valid measurements leading to accurate estimation of age. So, transcerebellar diameter may be established as a substitute indicator for development of foetal brain growth and assessment of exact gestational age especially during third trimester.[4] The transcerebellar diameter is measured as the maximal diameter between the cerebeller hemispheres on an axial scan. It increases with gestational age and may be a reliable predictor of gestational age in the third trimester. Detection of transcerebellar diameter by ultrasonography is a quick, easy, non-invasive procedure, offering the advantages of widespread availability, low cost, simple, accurate, harmless and no ionizing radiation. Ultrasonographically, the cerebellum is easily viewed as a central rectangular echogenic structure (vermis) connecting two oval echolucent structures (hemispheres) after the 14th week of gestation.[5] The size of the cerebellum visualized as early as in the 10th or 11th week of conception shows a linear relationship with gestational age.[6] The cerebellum is not affected in the foetus with IUGR owing to the brain-sparing effect.[7] The study also showed that the foetal presentation or the parity of the mother does not affect transcerebellar diameter. It is a reliable method for estimating gestational age, even in complicated pregnancies by preterm labor or intrauterine growth restriction. Bangladeshi women usually do not seem to remember their last menstrual period and therefore rely on ultrasonography for estimating their gestational age. This study was conducted to evaluate the accuracy of the transcerebellar diameter for estimating gestational age in the third trimester.

METHODS

This was a cross-sectional type of descriptive study at the Department of Anatomy, Rajshahi Medical College, Rajshahi over a period of 1 year from January 2023 to December 2023 for sonographic determination of accuracy of transcerebellar diameter in estimating gestational age in the third trimester of pregnancy. Apparently healthy 120 women who were attending in the Department of Radiology and Imaging, Rajshahi Medical College Hospital, Rajshahi were included in this study by purposive sampling technique. Prior to the commencement of the study, approval was gained from the Ethical Review Committee (ERC), Rajshahi Medical College, Rajshahi. Informed written consent was taken from each participant informing about the study aim, objectives and procedure. Selection of the study populations was done according to inclusion and exclusion criteria and then a proper history taking was performed. The study population were included pregnant women between 18 and 40 years old who attended the hospital with singleton pregnancy in the 3rd trimester with a gestational age 29-40 weeks. Sonographic examination was done using a sonoscape machine fitted 3.5 to 5.0 MHZ transabdominal transducer. Focusing on age, the history of pregnancy status (LMP) was taken. All information was collected in separate data record form. After checking all the data, they were analyzed by SPSS software, version 25.0. Qualitative variables were described by frequency distribution, while quantitative variables were described by the mean and standard deviation. Correlation of gestational age determined by LMP and TCD was done by Pearson correlation coefficient test. The statistical significance was evaluated as an appropriate probability level $p < 0.05$ for all tests.

RESULTS

Age distribution of the pregnant women revealed that 80 (66.70%) of the women were within the range of 21-30 years, 33 (27.50%) were ≤ 21 years and 7 (5.80%) were > 30 years old. Residential status of the women showed that 59 (49.20%) of the pregnant women lived in semi-urban area, 36 (30.00%) in rural area and 25 (20.80%) in urban area. Educational status revealed that 46 (38.30%) of the women had higher secondary level of education followed by illiterate 42 (35.00%), primary level of education 28 (23.30%) and graduate 4 (3.30%). Occupational status revealed that 82 (68.30%) of the pregnant women were housewives

followed by NGO workers 17 (14.20%), government service holders 13 (10.80%) and day labourers 8 (6.70%) (Table 1).

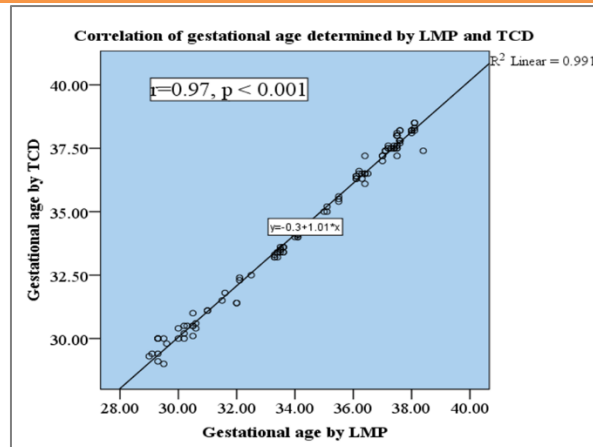**Table 1: Sociodemographic characteristics of the women (n=120).**

Variables	Frequency	Percentage
Age (Years)		
≤ 20 years	33	27.50%
21-30 years	80	66.70%
> 30 years	7	5.80%
Residential status		
Rural	36	30.00%
Urban	25	20.80%
Semi-urban	59	49.20%
Educational status		
Graduate	4	3.30%
Primary	28	23.30%
Illiterate	42	35.00%
Higher secondary	46	38.30%
Occupational status		
Day labour	8	6.70%
Govt. service	13	10.80%
NGO worker	17	14.20%
Housewife	82	68.30%

Parity and gestational age revealed that 85 (70.83%) of the women were multiparous, 35 (29.17%) were primipara and the mean gestational age was 34.55±2.88 weeks based on LMP and 34.65±2.93 weeks according to TCD (Table 2).

Table 2: Distribution of the pregnant women by parity and gestational age (n=120).

Variables	Frequency	Percentage
Parity		
Primipara	35	29.17%
Multipara	85	70.83%
Mean gestational age by LMP (weeks)	34.55±2.88 weeks	
Mean gestational age by TCD (weeks)	34.65±2.93 weeks	

Gestational age determined by TCD was positively highly correlated with gestational age determined by LMP (r=0.97, $p < 0.001$) (Figure 1).

Figure 1: Correlation of gestational age determined by LMP and TCD (n = 120)

Pearson correlation coefficient was done.

DISCUSSION

Gestational age (GA) estimation is highly desirable to plan and execute various interventions in pregnant women. It allows not only dating of pregnancy but also to distinguish normal and abnormal foetal growth patterns. In the modern era of advanced imaging, foetal biometry using USG plays an important role in estimation of gestational age. Most widely used parameters are BPD, HC, AC and FL. Transcerebellar diameter (TCD) is an additional parameter used over these parameters. Since cerebellum lies in posterior cranial fossa surrounded by dense petrous part of temporal bone and occipital bone, it is more resistant to deformation caused by external pressure. Also, it is least affected by mild to moderate utero-placental insufficiency. It can be used reliably for accurate determination of gestational age. This study was performed to compare the accuracy of TCD in comparison to LMP so that it can be included in routine foetal biometry to allow superior estimation of gestational age especially in cases of disparity in period of gestation and foetal growth disturbances.

In this study, age distribution showed that 80 (66.70%) women were within the 21-30 years, 33 (27.50%) were ≤ 21 years and 7 (5.80%) were > 30 years age groups. Sersam *et al.* 2019 showed that pregnant women belonged to age groups 20-24 years were 30.8% and 25-29 years were 30.8% which were similar with this study.[8] Lower age pregnancy and motherhood are generally associated with lower socioeconomic strata and less educated subsets of population. However, higher mean pregnancy is related with socioeconomically better condition and higher literacy rate. Occupational status revealed that 82 (68.30%) pregnant women were housewives, 17 (14.20%) were NGO workers, 13 (10.80%) were government service holders and remaining 8 (6.70%) were day labourers in this study. Similar and higher proportion of the study regarding occupational status was found in a study done by Dewangan *et al.* where 88% were housewives.[9] Multiparous women were 85 (70.83%) in the present study. Similar findings were observed on a study done by Bekele *et al.* where 63 (60.6%) were multiparous women.[10] Similar findings were also noticed on the studies done by Taha *et al.* and Ali *et al.*[7, 11] Different findings were showed with the study done by Sersam *et al.* where 46.2% women were multiparous.[8]

Mean gestational age was 34.55±2.88 weeks based on LMP observed in this study. Nearly similar findings were viewed with the study done by Dewangan *et al.* where mean gestational age was 34.06 weeks on LMP.[9] Nearly similar findings were also revealed on the studies done by Bekele *et al.* where mean gestational age was 34.99 weeks and Taha *et al.* where mean age was 34.4±2.6 weeks.[10, 11] Lower mean gestational age (27.39±6.74 weeks) was found with the study done by Dashottar *et al.* and another study by Iram *et al.*, (22.39±3.43 weeks).[12] Mean gestational age was 34.65±2.93 weeks according to TCD found in this current study. Similar findings were seen in a study done by Taha *et al.* where mean gestational age was 34.4±2.6 weeks.[11] In-line findings were viewed with the study done by Dewangan *et al.* where mean gestational age was 33.87 weeks on TCD.[9] Lower gestational mean age of 22.30±3.39 weeks on TCD was

found in a study done by Iram *et al.*[13] These differences might be due to the size of sample variations. This study sample was not large enough and therefore does not adequately represent the TCD values of total population. Moreover, racial and ethnic differences could also play a role in these differences.

In the present study, gestational age determined by LMP was positively highly correlated with TCD (r=0.97, p < 0.001). Similar findings were seen with the study done by Dewangan *et al.*, 2022 where gestational age by LMP showed correlation with GA by TCD (r=0.920 p < 0.001). Correlation was found with LMP when compared with TCD (r=0.92; p < 0.001) in a study done by Chavez *et al.* which was also similar with the study. Similar findings were also detected on a study done by Gupta *et al.*, S. N. *et al.*, George *et al.*, Cinnusamy *et al.*, Goldstein *et al.*, Zakaria *et al.*[14-20], Dashottar *et al.* and Bansal *et al.*, Meyer *et al.*, Bavini *et al.*, Naseem *et al.*, Iram *et al.*, Adeyekun and Orji and N *et al.*[12, 13, 21-43] TCD was more consistent with gestational age as compared to other biometric parameters. BPD and TCD were considered to be better predictors of gestational age as compared to other foetal biometric parameters.[27,28]

This finding might be useful in practice as it provides a basis to utilize the ultrasonogram estimation values for dating the pregnancies when LMP is unknown. Being a stable parameter irrespective of growth status of foetus, TCD acts as a base for its usefulness to predict perinatal outcomes. TCD is one of the most reliable ultrasound parameters for assessing GA in the 3rd trimester. Thus, it could be a routine biometry and an alternative parameter for the evaluation of gestational age when the LMP is unknown. TCD can be an independent parameter to assess gestational age where the other parameters are difficult to measure. Countries like Bangladesh where healthcare facilities are limited, need to have their own reference chart for transverse cerebellar diameter. This would prevent misdiagnosis of small or large for gestational age and avoid unnecessary obstetric intervention during perinatal period.

CONCLUSION

The study found that the gestational age determined by TCD is positively highly correlated with LMP. So, transcerebellar diameter (TCD) could be an additional parameter for estimation of gestational age. In foetal growth aberrations which affect mainly AC and FL causing discrepancy in estimation of gestational age, TCD can be used reliably as single most parameter as cerebellum is least affected by mild to moderate uteroplacental insufficiency. So, TCD measurement at a low-income setting might be feasible and reliable method of estimating gestational age in absence of the gold standard of measurement where LMP of the women is unknown.

Authors' Contributions

MFIM, ORP: Concept and design, data acquisition, interpretation, drafting and final approval. AI, JN and SKB: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval
Ethical approval of the study was obtained from the Ethical Review Committee, Rajshahi Medical College, Rajshahi. Informed consent was taken from all participants. All the study methodology was carried out following the relevant ethical guidelines and regulations.

Consent for Publication: Taken.

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