

Correlation Between the Mean Gestational Age and Mean Transverse Cerebellar Diameter in Third Trimester of Pregnancy

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Abstract

Objective: To determine the correlation of mean gestational age and mean transverse cerebellar diameter in third trimester of pregnancy.

Methodology: This study was conducted in Department of Radiology at POF hospital wah cantt from August 2015 to February 2016. A total of 150 women singleton gestations refer to the ultrasound were included in this study. Fetal intracranial anatomy was reviewed through transverse views. Transverse Cerebellar Diameter was measured by ultrasound machine by placing calipers at the outer-to-outer margins of cerebellum. All the measurements were taken as average of two measurements to decrease intra observer variability. All the information was recorded on a predesigned performa.

Results: The mean age of the women in the study was noted to be 26.53±4.14 years. The average gestational age was 31.95±3.97 weeks in our study sample. The mean value of transverse cerebellar diameter was recorded as 29.49±5.90 mm. A significant positive correlation was observed between fetal Transverse Cerebellar Diameter (TCD) and gestational age of the women for the whole sample. The value of Pearson correlation coefficient (r) was calculated to be 0.945 with a highly significant P-value < 0.001.

Conclusion: A significant positive correlation was observed between fetal Transverse Cerebellar Diameter (TCD) and gestational age. It can be concluded that gestational age can be correctly and reliably estimated though transverse cerebellar diameter. It can be used as accurate and independent parameter for estimation of gestational age in second and third trimester.

Key Words: Gestational age, Transverse cerebellar diameter, Ultrasound.

Cite this article as: Rauf N, Adnan Z, Omar J, Zia MS. Correlation between the Mean Gestational Age and Mean Transverse Cerebellar Diameter in Third Trimester of Pregnancy. J Soc Obstet Gynaecol Pak. 2021; 11(1):51-55

Introduction

Clinically accurate and easily reproducible fetal biometric parameters measured through sonography are very important for gestational dating and optimal obstetric management of pregnancies and to differentiate term and pre-term infants. This becomes more important in assessing adequacy of growth, timing of various gestational tests and determining the best time of delivery for optimal pregnancy outcome.¹

The estimation of gestational age based on maternal memory for last menstrual period have chances of

error. The determination of fetal biparietal diameter (BPD) of fetal through ultrasound in early second trimester (16-18 weeks) is considered as gold standard.² In later pregnancy many other fetal biometric parameters are used to estimate gestational age like biparietal diameter, head circumference, abdominal circumference, and femur length. Therefore, an average of all four parameters is used as the composite gestational age, to improve the accuracy. However, these parameters have some limitations for example the shape of the skull affects the BPD. Gestational age

Authorship Contribution: ¹Conceived and planned the idea of the study, did part of data collection and wrote the manuscript, ²Collecting the data, carrying out the study and reviewing the literature, analyzed and corrected the article and provided the references, ⁴Supervised the study.

Funding Source: none
Conflict of Interest: none

Received: July 13, 2020
Accepted: Feb 19, 2021

estimation based on these systematic errors may cause complications like dysfunctional labor, unnecessary induction, and cesarean section, which can instigate maternal and neonatal morbidity.³

In recent years, transverse cerebellar diameter was found as an alternate to these parameters for a reliable estimation of gestational age with comparatively minimum chance of error.⁴ The largest part of the hindbrain is cerebellum and lies in the posterior cranial fossa. Transverse cerebellar diameter can also be used for prediction of gestational age in cases, which have variation in fetal head shape. Dense petrous ridges and occipital bone help posterior cranial fossa to bear extrinsic pressure better than parietal bones and cerebellum lies in this posterior cranial fossa, which keep it safe from alteration.⁵

Some studies have shown that it correlates well with gestational age in normal singleton pregnancies, as well as in setting of growth retardation.⁶ Studies have shown it to be a reliable method that can be used in both singleton and multifetal pregnancies to assess normal and deviant fetal growth.

Prediction of gestational age based on sonographic parameters is very important component in management of normal and growth arrested fetuses.⁴

Many studies demonstrate that TCD is spared in cases of intrauterine growth retardation. It has been estimated that there is preferential mechanism to preserve cerebellar growth relative to other intracranial structures.^{1, 4}

Many studies have shown a strong and significant association of transverse cerebellar diameter with gestational age specifying transverse cerebellar diameter as a reliable and good marker for gestational age estimation.⁷ In a study of 292 pregnant women, transverse cerebellar diameter was measured by ultrasonography and cerebellum was graded between 14-40 weeks of pregnancy. The grade progressively changed from I to III with advancing gestational age. In grade I, median gestational age was 20 weeks and median TCD was measured 22mm, in grade II median gestational age was 32 weeks and median TCD was 30mm and in grade III median gestational age and TCD were noted to be 36 weeks and 38mm. In a study Malik et al, demonstrated that there is linear correlation of TCD with gestational age having a significantly high Pearson correlation coefficient of ($r = 0.99$).⁸

This study was planned to assess the correlation of mean TCD measurement with mean gestational age. This would help in reliability identification of TCD as an armamentarium in addition to other parameters for estimation of gestational age with more accuracy despite fetal growth abnormalities.

Methodology

Approval of this cross-sectional descriptive study was taken from the hospital ethical review committee. Informed consent was taken from the patients before recruitment into the study. The patients were recruited through the Radiology OPD visiting or referred for routine antenatal ultrasound. The study was carried out over a six-month duration starting from the approval of synopsis from August 2015 to February 2016

The sample size was calculated using the software Stats Direct, with help of correlation of TCD with gestational age (Pearson correlation coefficient = 0.99), confidence level of 5% and power of 0.95, and 150 pregnant patients for evaluation. All the patients were selected though non-probability consecutive sampling.

All the pregnant women having knowledge of last menstrual period (LMP), viable singleton pregnancy, in third trimester pregnancy were enrolled for the study. Women with twin pregnancy (on ultrasound), History of previous adverse fetal outcome, Fetuses with gross anatomical defects or hydrocephalus, or IUGR on antenatal ultrasound were excluded from the study.

Patient's blood pressure and plasma random glucose checked and a history of hypertension, diabetes, previous adverse fetal outcome, intrauterine growth retardation and fetal hydrops were sought. On history the LMP (last menstrual period) date was ascertained, and gestational age was calculated by LMP using the Naegle's rule. It is the most common method of pregnancy dating. The EDD is calculated by counting back three months from the last menstrual period and adding seven days.

Sonography was carried out on each subject included in the study using Toshiba Aplio and GE logic 500 Pro series machine with 3.5MHz curvilinear transducer. It was performed in supine position with hips and knees in extension.

Fetal intracranial anatomy was reviewed through transverse views. Transverse Cerebellar Diameter was measured by ultrasound machine by placing calipers at the outer-to-outer margins of cerebellum. The

benchmarks of thalami, cavum, septum pellucidum and third ventricle were identified in this way, the transducer was slightly rotated below the thalamic plane. The appearance of the cerebellum was identified through its characteristic look of butterfly to reveal the posterior fossa. A standard method was followed for all study participants for imaging criteria, placement of caliper and average of at least two measurements was followed. A single radiologist performed all the measurements to minimize the inter-observer variability.

Data was entered and analyzed through SPSS v 25. Descriptive statistics were used to calculate mean \pm standard deviation for quantitative variables. Pearson's correlation coefficient (r) was computed between mean GA and TCD. Stratification was done to control effect modifiers like age and Pearson's correlation coefficient (r) was also computed between mean GA and TCD for different age groups. $P \leq 0.05$ was considered as statistically significant.

Results

A total of 150 women singleton gestations refer to the ultrasound were included in this study. The mean age of the women in the study was noted to be 26.53 ± 4.14 years. The average gestational age was 31.95 ± 3.97 weeks in our study sample. The mean value of transverse cerebellar diameter was recorded as 29.49 ± 5.90 mm in this study as presented in table I.

A significant positive correlation was observed between fetal Transverse Cerebellar Diameter (TCD) and gestational age of the women for the whole sample. The value of Pearson correlation coefficient (r) was calculated to be 0.945 with a highly significant P-value < 0.001 as shown in figure 1.

The correlation of Transverse Cerebellar Diameter and gestational age was also calculated for different age groups by stratifying data with respect to age. The stratified correlation coefficient of fetal Transverse

Table I: Descriptive statistics of age, gestational age and Transverse Cerebellar Diameter

Descriptive statistics	Age (Years)	Gestational Age (Weeks)	Transverse Cerebellar Diameter
Mean	26.53	31.95	29.49
Std. Deviation	4.14	3.97	5.90
Minimum	16	26	20
Maximum	37	39	42

Cerebellar Diameter and GA was also observed positive and highly significant (P -value > 0.05) in both age groups. The correlation coefficient (r) in 16-30 years age group was ($r=0.94$) and for age group of > 30 years it was noted to be ($r=0.95$) as elaborated in table II.

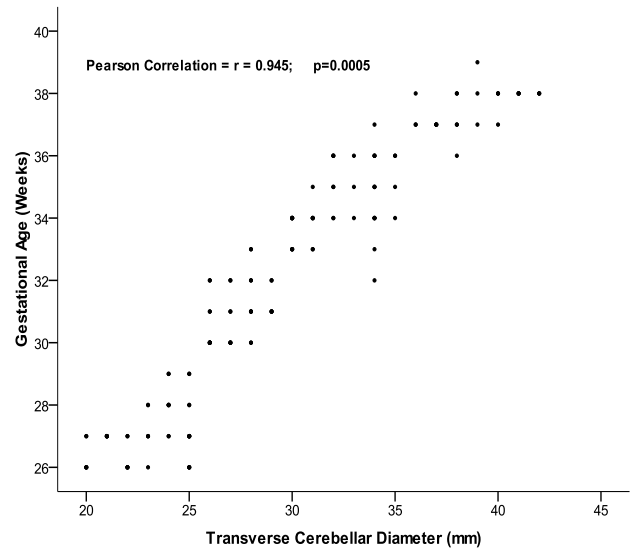


Figure 1. Correlation of Gestational age with Transverse Cerebellar Diameter in third Trimester of pregnancy.

Table II: Correlation of Gestational Age with Transverse Cerebellar Diameter in third Trimester of pregnancy with respect to Age groups

Age Groups	Pearson Correlation coefficient (r) between GA and TCD	P-Value
16 -30 (Years)	0.94	0.0005
>30 (Years)	0.95	0.0005

Discussion

Transverse cerebellar diameter can be practically applied in cases where it is difficult or impossible to calculate biparietal diameter, or cases where it is unsuitable because of the expressed moulding of head.

This is because cerebellum is not liable to change in its form and its size correlates with gestational age and biparietal diameter.⁹ In normal gestation fetal cerebellar diameter has also been found highly correlated with fetal growth indices like head circumference, biparietal diameter, abdominal circumference, femur length and estimated fetal weight having all (p -values < 0.001).¹⁰

Fetal growth parameters in fetuses having IUGR may lead to wrong results while estimating gestational age, but transverse cerebellar diameter can reliably be used

for estimation of gestational age in IUGR fetuses. Recently another method based on transverse cerebellar diameter has been used to estimate gestational age correctly. This method is the ratio of transverse cerebellar diameter to abdominal circumference, which can be used to estimate gestational age and prediction of intrauterine growth restriction (IUGR).¹¹ Results from other studies also demonstrated that both biparietal diameter and transverse cerebellar diameter measurements can be used as reliable techniques for estimation of gestational age.¹² Altered TCD may be used to diagnose congenitally abnormal fetuses, because TCD may be altered in abnormal fetuses. Similarly, asymmetrical intrauterine growth restriction may be identified on the basis of TCD values.¹³

This study finding suggests a correlation between the gestational age and transverse cerebellar diameter. This has also been proven by various other studies.¹⁴

The relationship of fetal cerebellar growth and gestational age is statistically significant.¹⁵ The growth of fetal cerebellum can be visualized in very early pregnancy period, and it starts visualizing from 10-20 weeks of gestation. Its growth shows a linear pattern second trimester but in third trimester its curve become flatten.¹⁶ The appearance of the cerebellum on ultrasound differs at increasing gestational age and accordingly is divided into different grades. Grade I cerebellum is seen up to 23 weeks and typically shows “a pair of eyeglasses” appearance. Grade II cerebellum is between 24-35 weeks and resembles “dumbbell” like outline and Grade III appearance is after 36 weeks and cerebellum hemispheres show “fan” shape.¹⁷

In this present study a highly significant and linear correlation was observed between TCD and gestational age with correlation coefficient of ($r = 0.945$ and $P\text{-value} < 0.001$). This result is similar with other studies like study by Malik et al, who found TCD as an independent predictor of gestational age in third trimester (26-38 weeks) of pregnancy. In this study gestational age was estimated through BPD, femur length and abdominal circumference in comparison to actual gestational age. It was observed that gestational age measured by TCD was consistently correlated with GA measured though BPD, femur length and abdominal circumference.⁸ The accuracy and clinical importance of TCD measurement in third trimester was proposed firstly by Chaves and Ananth. They predicted gestational age with 5-7 days of actual gestational age

in third trimester. Same findings have been proved in this present study supporting the accuracy of TCD measurement in third trimester.¹⁸

Malik et al, conducted a study between 16 – 40 weeks in 100 patients. TCD was found to be an accurate parameter with accuracy of 92% which also supports this study for TCD validation in third trimester.⁸ Some studies have proved that transverse cerebellar diameter, biparietal diameter and femur length can also be used to predict gestational age in intrauterine growth retardation.¹⁹ It has been demonstrated that both biparietal diameter and transverse cerebellar diameter have high correlation with gestational age. The ratio of TCD/AC can be used to identify asymmetric IUGR. It was also found that the fetal transverse cerebellar diameter was relatively mildly reduced compared to head circumference, abdominal circumference, and femur length, although a reduction in transverse cerebellar diameter of more than 2 SDS was highly predictive of increased incidence of prenatal death.¹⁹ In some studies, it was concluded that TCD/AC ratio greater than cut off value can be used as predictor of IUGR and value greater than cut off value shows antenatal IUGR.²⁰ So, it can be concluded that ratio of TCD/AC can diagnose antenatal IUGR, especially in cases where gestational age is unreliable. In some studies, correlation has also been found with other parameters e.g. Gazzato et al.²¹ found a statistically significant regression coefficient with gestational age, BPD and TCD. The transverse cerebellar diameter has not been found to be useful in abnormal fetal karyotype.²²

Conclusion

A significant positive correlation was observed between fetal Transverse Cerebellar Diameter (TCD) and gestational age. It can be concluded that gestational age can be correctly and reliably estimated though transverse cerebellar diameter. It can be used as accurate and independent parameter for estimation of gestational age in second and third trimester. Its values are significantly correlated with actual gestational age based on LMP. It is also a better predictor of GA as compared to other parameters in third trimester. Transverse cerebellar diameter along with other parameters can improve the accuracy of antenatal sonography.

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