

Diagnostic Accuracy of Transcerebellar Diameter for Gestational Age

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Abstract

Background: To determine the correlation of mean transcerebellar diameter and mean gestational age in third trimester of pregnancy

Methods: In this cross sectional study all pregnant women with previous regular menstrual period aged 25-35 years, gestational age between 26 to 38 weeks assessed on LMP and having single fetus assessed on ultrasound were enrolled. Ultrasound measurements of TCD (in mm) were made.

Results: Mean age of the patients was 29.53 \pm 3.60 years. Mean gestational age of the patients was 32.56 \pm 3.51 weeks. There were 61% nulliparous and 39% multiparous women. Spearman's Correlation test was applied to see the relationship of TCD with gestational age. Strong positive correlation was observed (ρ 0.968, p-value <0.001).

Conclusion: Strong positive correlation of mean transcerebellar diameter and mean gestational age is observed in third trimester of pregnancy

Key Words: Gestational Age, Third trimester of pregnancy, Transcerebellar diameter

Introduction

The accurate knowledge of gestational age is a keystone in an obstetrician's ability to successfully manage the antepartum care of a patient and is of critical importance in ante-natal tests and successful planning of appropriate therapy or intervention. Failure can result in iatrogenic prematurity which is associated with increased perinatal morbidity and mortality.

Ultrasonography of fetal measurements is highly reliable in the first and second trimester of pregnancy but reliability of any ultrasound method greatly diminishes as gestation advances. In third trimester, reliability of any single ultrasound parameter is poor.¹ Since the last decade, ultrasound parameter 'transcerebellar diameter (TCD)' is considered a reliable predictor for gestational age in third trimester.²⁻³ Size of cerebellum is less affected by deviation in fetal growth restriction or growth

acceleration.⁴ The predicted gestational age by TCD between 22 - 28 weeks is within 0-2 days, between 29-36 weeks is within 05 days and at 37 week is 09 days of actual gestation. TCD normogram predicts gestational age with accuracy of 94% in the third trimester.⁴

Although both BPD and TCD are accurate biometric parameters at 36 weeks of gestation, transcerebellar diameter is more reliable method of gestational age determination in third trimester of pregnancy than biparietal diameter.⁵ TCD can be used as a tool to assist in the assessment of gestational age in third trimester.⁶ Regression analysis indicated a strong relationship between TCD and gestational age indicating TCD is a good marker for estimation of gestational age.⁷

Transverse cerebellar diameter varied in a linear fashion in third trimester, while transverse cerebellar diameter/abdominal circumference (TCD/AC) ratio remained constant in second half of pregnancy. All the parameters were expressed by regression equations and correlation coefficients were found to be statistically significant ($r=0.99$ for TCD, $r=0.98$ for TCD/AC all $p<0.0001$).⁴

Patients and Methods

This cross sectional study was performed in Department of Obstetrics and Gynaecology, DHQ Hospital, Rawalpindi, from October, 2014 to April, 2015. Inclusion criteria was all pregnant women between age 25-35 years with previous regular menstrual period, gestational age between 26 to 38 weeks (assessed on LMP) and single fetus assessed on ultrasound. Exclusion criteria was pregnant women not willing to participate, not sure of date of last menstrual period, with hypertensive disease or multiple pregnancies or fetal malformation detected on ultrasound and smokers. Fetal TCD was measured using the widest diameter of the cerebellum by USG in mm. Gestational age was assessed by LMP. Ultrasound measurements of TCD (in mm) were made as per operational definition with commercially available real time ultrasound. The measurement of TCD was obtained by placing electronic callipers at outer margins of cerebellum. The landmarks of the

thalami, cavum, septum pellucidum and third ventricle were identified thereby slightly rotating the transducer below the thalamic plane. The posterior fossa is revealed with the characteristics butterfly like appearance of cerebellum. In all cases cerebellum was seen as two lobules on either side of midline in the posterior cranial fossa. The statistical evaluation between fetal transverse cerebellar diameter and gestational age was assessed. Pearson correlation coefficient "r" in the range of (+1, -1) was calculated. P value ≤ 0.05 was significant. Stratification of age and parity was done to control effect modifiers. Correlation was calculated post stratification and p value less than or equal to 0.05 was taken as significant.

Results

Mean age of the patients was 29.53 \pm 3.60 years. Majority of the patients (64%) were presented with ≤ 30 years of age. Mean gestational age of the patients was 32.56 \pm 3.51 weeks. Majority of the patients (76%) presented with ≤ 32 weeks of gestation (Figure 1). There were 61% nulliparous and 39% multiparous women. Mean TCD of the patients was 37.60 \pm 7.02 mm (Table 1).

Table 1: Gestational age and transcerebellar diameter

	Mean \pm SD	Min	Max
Age of the patients (years)	29.53 \pm 3.60	25	35
Gestational Age (weeks)	32.56 \pm 3.51	26	38
Transcerebellar Diameter (mm)	37.49 \pm 5.651	27	38

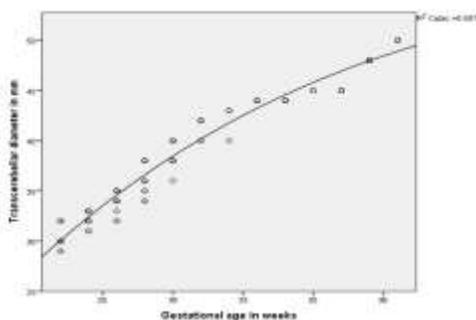


Figure 1: Gestational age

Spearman's Correlation test was applied to see the relationship of TCD with gestational age. Strong positive correlation was observed (rho 0.968, p-value < 0.001). Stratification was done to see the effect of age and parity on the outcome.

Discussion

The transcerebellar diameter (TCD) has been one of the most reliable ultrasound parameters for growth. The TCD was shown to be a reliable parameter that is significantly correlated with gestational age by the end of the second trimester.⁸

There is relative preservation of normal cerebellar growth even in fetal growth restriction and a similar rate of growth in both singleton and multiple pregnancies.⁹ Accurate gestational dating is of paramount importance and the cornerstone for management of pregnancies, easily reproducible sonographic fetal biometric parameters for gestational dating are clinically important for the optimal obstetric management of pregnancies. This is especially true in determining timing of a variety of gestational tests, assessing adequacy of growth and timing of delivery for the optimal obstetric outcome.²

Campbell et al. demonstrated that 45% of pregnant women are uncertain of menstrual dates as a result of poor recall, irregular cycles, bleeding in early pregnancy, or oral contraceptive use within 2 months of conception.²

Even if menstrual history is correct, the exact time of ovulation, fertilization, and implantation cannot be known. Women may undergo several "waves" of follicular development during a normal menstrual cycle, which may mean ovulatory inconsistency during any given cycle.¹¹

TCD with some combination of other fetal biometric parameters, including head circumference, biparietal diameter, and femur length. Nevertheless, the best combination of biometric measurements remains to be determined. Furthermore, our analysis, especially for large fetuses, was based on a fairly small number of observations (n = 16), warranting caution in the interpretation of our results. Future large studies are therefore required to corroborate our findings. Until the results of these studies become available, on the basis of the encouraging results of this and previous studies, we recommend that TCD be used as an important sonographic biometric parameter in singleton IUGR and large fetuses for accurate prediction of GA.¹²

The conventional methods used to estimate gestational age are date of onset of the last menstrual period (LMP), clinical assessment of the fundal height and fetal weight, and ultrasonographic fetal biometry.¹³

Naegle's rule is the most common, and, if reliable, an accurate method of pregnancy dating. The expected date of delivery (EDD) is calculated by counting back three months from and adding seven days to the onset

of LMP. Estimation of the gestational age based on menstrual dates is, sometimes however, erroneous or inaccurate. Some pregnant women are not sure of their menstrual dates or do not have regular 28-day cycles. In addition, bleeding in early pregnancy or a recent use of hormonal contraception may lead to incorrect assumption of the date of ovulation.¹⁴

Clinical examination is inaccurate in estimating the GA. It may be affected by fetal growth disorders and liquor volume, and subject to errors due to maternal obesity or inter-and intra-observer variations.¹⁴

Sonographic fetal biometry is a method devoted to the measurement of the several parts of fetal anatomy and their growth. Several diameters and circumferences have been studied concerning their correlation to the true gestational age. The most reliable diameters used in estimation of the GA in the second and early third trimester is the biparietal diameter (BPD); femur length (FL) is the most accurate for the late third trimester. The measurement of BPD in second trimester routine scan is performed in all good antenatal care centers.¹⁵

Regression analysis indicated a strong relationship between TCD and gestational age indicating TCD is a good marker for estimation of gestational age.⁷

Transverse cerebellar diameter varied in a linear fashion in third trimester, while transverse cerebellar diameter/abdominal circumference (TCD/AC) ratio remained constant in second half of pregnancy. All the parameters were expressed by regression equations and correlation coefficients were found to be statistically significant ($r=0.99$ for TCD, $r=0.98$ for TCD/AC all $p<0.0001$).⁴

In our study, Spearman's Correlation test was applied to see the relationship of TCD with gestational age. Strong positive correlation was observed ($\rho=0.968$, p -value <0.001).

The BPD is, however, subject to inaccuracy related to its affection by growth abnormalities of the fetal head e.g. in fetal growth restriction and also in congenital fetal malformations of the head or intracranial structures e.g. hydrocephalus.¹⁶

In the current study, analysis of agreement showed insignificant differences between estimated gestational age using LMP/CRL and each of BPD/FL and TCD. Some authors stated that there may be a slight fluctuation in the growth curve of the fetal cerebellum, indicating multiple conditions that would lead to difficulties in measuring the TCD in late gestations.²

Hill et al., reported that the TCD was within two standard deviations in only 40% of IUGR cases, and in 60% of cases was greater than two standard deviations

below the mean. However, they included 44 consecutive singleton gestations with an estimated fetal weight of less than the 10th percentile, and it was unclear whether fetuses with chromosomal abnormalities were excluded.¹⁶

Lee et al., reported that the TCD was a useful predictor of gestational age for fetuses with asymmetric, but not symmetric, growth restriction.¹⁷

Vinkesteijn et al.¹⁸, performed a retrospective, cross-sectional analysis of 360 normally developing fetuses between 17 and 34 weeks and 73 growth-restricted fetuses between 24 and 34 weeks gestation, and demonstrated that the TCD measurement is typically spared in cases of IUGR. Even in severe growth restriction, the TCD was only mildly affected. They also concluded that the second half of pregnancy is characterized by a more than twofold increase in fetal TCD.

Smulian et al., stated that the perspective from a biological point of view confirms that cerebellar size is relatively unaffected by fetal growth disturbances. This is at variance with several other biometric parameters, especially abdominal circumference, which may be drastically altered by extremes of fetal growth.¹⁹

Chavez et al.²⁰, observed that although there was a positive correlation between gestational age and fetal TCD throughout the assessed period (13- 40 week of gestation), a number of studies have revealed that as the pregnancy approaches full term, there is a slight fluctuation in the growth curve of the fetal cerebellum, indicating multiple conditions that would lead to difficulties in measuring the TCD after the 36th week of gestation.

Malik et al., stated that the fluctuation may be explained that when the fetal head goes into the pelvis, a relative reduction of the amniotic fluid around the cephalic pole occurs; a very close contact between the mother's uterine musculature and cranial vault; a low penetration of the ultrasound beam into the posterior fossa of the fetus and the occipito-posterior position of the head of the fetus at the end of the gestation.⁴

Chavez et al, prospectively demonstrated that their institution-specific TCD nomogram was both reliable and accurate in predicting gestational age, even at extremes of fetal growth. ² Whereas the majority of data suggests that the TCD is extremely valuable when the gestational age is unknown or IUGR is suspected.

Chavez et al, also concluded that additional small improvements in accurate gestational dating can be achieved by incorporating the results of TCD with some combination of other fetal biometric parameters,

including head circumference, biparietal diameter, and femur length, and recommended that TCD be used as an important sonographic biometric parameter in singleton IUGR and large fetuses for accurate prediction of GA.²In a recent study conducted on 228 Pakistani women at 36 weeks of gestation, the accuracy of TCD in corresponding to gestational age by LMP was higher than that of BPD (91.7% vs. 77.2%).²⁴TCD can be used as a tool to assist in the assessment of gestational age in third trimester.⁶

Conclusion

Strong positive correlation of mean transcerebellar diameter and mean gestational age is observed in third trimester of pregnancy

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