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To find the correlation between transverse cerebellar diameter measured by cranial ultrasound within 48 h of birth and gestational age as estimated by last menstrual period

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ABSTRACT

Background: Gestational age (GA) may be assessed at any time during pregnancy, and several modes of assessment exist, each requiring better diagnostic techniques that may result in more precise estimates of GA, which could lead to quicker medical management of a pregnant patient. The largest diameter across both hemispheres, measured from outer to outer margin, is the transverse cerebellar diameter (TCD). **Aims and Objectives:** We aimed to predict the correlation between TCD measured by cranial ultrasound within 48 h of birth and GA as estimated by the last menstrual period. **Materials and Methods:** The present study was conducted in the Department of Pediatrics, Dr. S. N. Medical College, Jodhpur, Rajasthan. Ethical clearance was obtained from the Institutional Ethical Committee. It was a cross-sectional observational study and the duration of the study was 6 months. We split the population into three groups based on GA: (a) <32 weeks of GA, (b) 32–36+6 days of GA, and (c) 37–42 weeks of GA. We enrolled 25 neonates from each group. **Results:** A very strong positive correlation between TCD and GA in infants was <32 weeks of gestation age, in infants 32–36 weeks+6 days of gestation age, and in infants 37–42 weeks of gestation age. Regression analysis shows a very strongly significant relationship. Hence, the TCD is a better predictor of GA in the third trimester. Our study reported that there is a close relationship between TCD and GA, with TCD increasing linearly from <32 weeks to 42 weeks. GA can be predicted to be 1.43 weeks by assessing TCD on neonatal cranial ultrasonography images. **Conclusion:** The TCD is a better predictor of GA in the third trimester. Our study reported that there is a close relationship between TCD and GA, with TCD increasing linearly from <32 weeks to 42 weeks.

Key words: Transverse cerebellar diameter; Gestational age; Last menstrual period

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INTRODUCTION

Estimating the length of gestation is of critical importance in clinical practice to ensure appropriate management of newborns and to distinguish pre-term from the term. Knowledge of maturity is useful at the time of delivery on complicated pregnancies, evaluation of intrauterine growth, optimal management of a newborn infant, prediction of the infant's clinical course, and subsequent evaluation. The gestation age is most accurately measured from the 1st day of the mother's last menstrual period (LMP), provided her cycles are regular, and her remembrance is correct.[1]

For optimal obstetric treatment at the moment of delivery, accurate measurement of gestational age (GA) and fetal growth is necessary. When the GA of the fetus cannot be ascertained by the date of the previous period or an early pregnancy scan, the transverse cerebellar diameter (TCD)

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acts as a reliable predictor of GA and a benchmark against which anomalies in other fetal measures can be evaluated.[2-4]

A straightforward, affordable way for determining gestation age is to estimate the EDD based on LMP. Menstrual-based gestation age calculation has limitations that include reporting issues including confusion about the LMP date, which may be caused by bleeding unrelated to menstruation, and worries about the prevalence of delayed ovulation, which can lead to inaccurate estimation. Clinicians in poor nations use pre-natal and post-natal markers such as first-trimester ultrasonography (USG), LMP, and neonatal assessments such as the Dubowitz et al.,[5] or Ballard et al., scoring system[6] to assess GA in neonates. The most precise way to compute GA will be to combine LMP with the first-trimester USG. Therefore, the current study is conceived to evaluate the correlation between the TCD within 48 h of birth and GA as estimated by the LMP.

Aims and objectives

To predict the correlation between transverse cerebellar diameter measured by cranial ultrasound within 48 hours of birth and gestational age as estimated by last menstrual period.

MATERIALS AND METHODS

The present study was conducted in the Department of Pediatrics, Dr. S. N. Medical College, Jodhpur, Rajasthan. Ethical clearance was obtained from the Institutional Ethical Committee. It was a cross-sectional observational study and the duration of the study was 6 months. The sample size was calculated by keeping R-value of 0.89 based on a previous study and the sample size was 73 patients at a 99% confidence interval (CI) and 99% power. We split the population into three groups based on GA: (a) <32 weeks of GA, (b) 32–36+6 days of GA, and (c) 37–42 weeks of GA. We enroll 25 neonates from each group.

Inclusion criteria

All infants from the GA up to 42 weeks (Term).

Exclusion criteria

1. Neonates with congenital malformation, any anomaly of the central nervous system (neurological malformation), syndromic facies, chromosomal anomaly, evidence of congenital infection/meningitis, and clinical evidence of metabolic disease and cerebellar hemorrhage
2. Symptoms of neurological dysfunction (seizures, encephalopathy, abnormal muscle tone or posture, perinatal asphyxia, and poor control of respiratory function)
3. Craniosynostosis, closed fontanel, and USG views are not visible.

After enrolment, consent was obtained by informing about the study and its aims and objectives to the caregiver/parents along with the methodology in Hindi. Cranial USG was done in the Department of Pediatrics and USG was done within 48 h of the birth of neonates. The USG machine used for this study was ALOKA PRO SOUND (model No. Prosound Alpha 6) and SAMSUNG (Model No. SONOACE X7) with a curvilinear probe and USG was done by a single Trained Sonologist to eliminate inter-observer errors and fetal parameter TCD was measured.

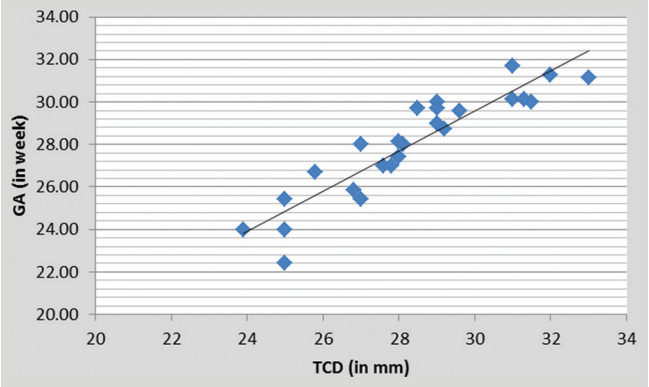
Techniques of measurement TCD

We obtained a posterior coronal scan through the mastoid fontanel in the same space at the level of the quadrigeminal cistern, which provides a cross-sectional view of the cerebellar body for each neonate.

Then, we measured the TCD for each infant. The measurement was obtained by positioning the calipers on the outer margins of the two hemispheres. The widest diameter of the cerebellum was taken as the TCD (Figure 1).

RESULTS

In our study, we found a statistically significant (P<0.001) very strong positive correlation between TCD and GA in infants <32 weeks of gestation age (Table 1).



Scatter Plot

The regression equation with TCD in millimeters as the predictor (independent) variable and GA in weeks as the outcome (dependent) variable is:

$$GA\ (\text{in weeks}) = 0.944 \times TCD\ (\text{in mm}) + 1.2459$$

In our study, we found a statistically significant (P<0.001) very strong positive correlation between TCD and GA in infants 32–36 weeks + 6 days of gestation age (Table 2).

Table 1: Pearson correlation coefficient between TCD and gestational age (<32 weeks of gestation group)

N	R	P-value
25	0.918	<0.001

TCD: Transverse cerebellar diameter

Table 2: Pearson correlation coefficient between TCD and gestational age (32–36 weeks and 6 days group)

N	R	P-value
25	0.934	<0.001

TCD: Transverse cerebellar diameter

Table 3: Pearson correlation coefficient between TCD and gestational age (37–42 weeks group)

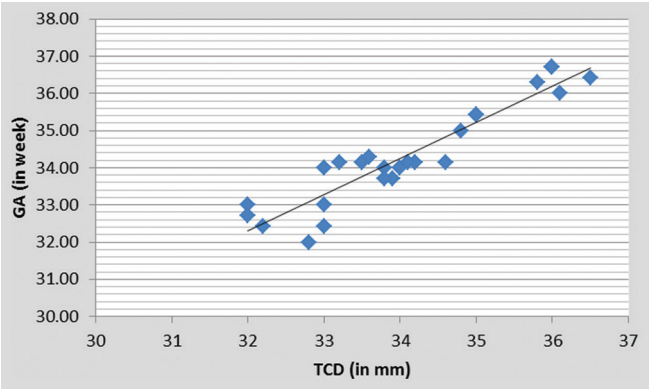
N	R	P-value
25	0.938	<0.001

TCD: Transverse cerebellar diameter

Table 4: Pearson correlation coefficient between TCD and gestational age (All study participants)

N	R	P-value
25	0.990	<0.001

TCD: Transverse cerebellar diameter

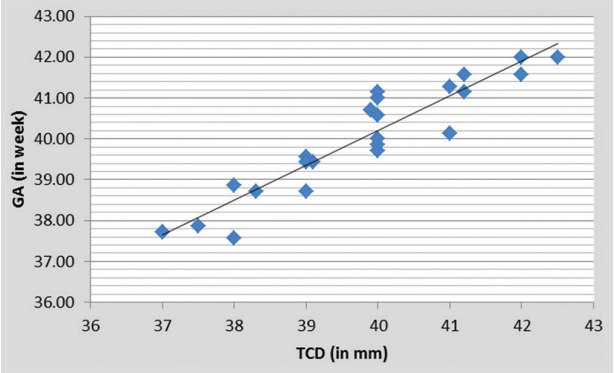


Scatter Plot

The regression equation with TCD in millimeters as the predictor (independent) variable and GA in weeks as the outcome (dependent) variable is:

$$\text{GA (in weeks)} = 0.9748 \times \text{TCD (in mm)} + 1.1018$$

In our study, we found a statistically significant (P<0.001) very strong positive correlation between TCD and GA in infants 37–42 weeks of gestation age (Table 3).

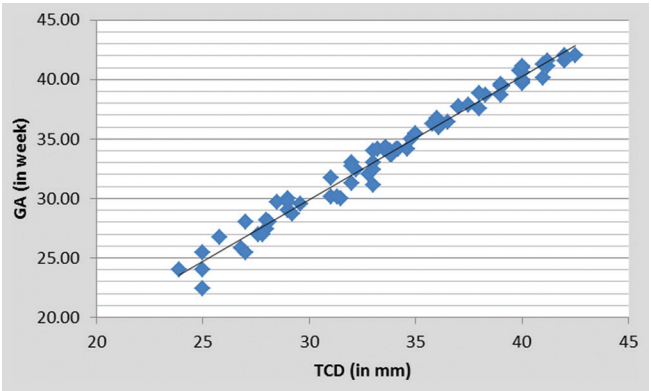


Scatter Plot

The regression equation with TCD in millimeters as the predictor (independent) variable and GA in weeks as the outcome (dependent) variable is:

$$\text{GA (in weeks)} = 0.8512 \times \text{TCD (in mm)} + 6.1643$$

In our study, we found a statistically significant (P<0.001) very strong positive correlation between TCD and GA in all infants in the study (Table 4).



Scatter Plot

The regression equation with TCD in millimeters as the predictor (independent) variable and GA in weeks as the outcome (dependent) variable is:

$$\text{GA (in weeks)} = 1.0367 \times \text{TCD (in mm)} - 1.1981$$

The present study predicts GA to be within (95% CI)±1.43 weeks (10.01 days).

DISCUSSION

In this study, 75 neonates were selected after fulfilling the inclusion and exclusion criteria. A variety of circumstances

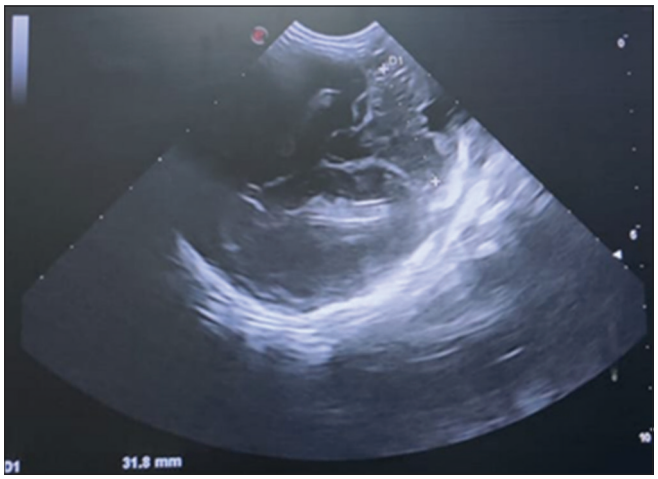


Figure 1: The measurement of transverse cerebellar diameter was taken in the coronal plane

call for an accurate GA determination, which is essential to obstetric care. Due to inaccuracies in calculating GA, macrosomia or fetal growth retardation may go undetected.[7] An accurate assessment of the fetus depends on the operator's skill, knowledge of typical embryology and the ultrasound images it corresponds to, and the availability of high-resolution equipment.[8]

Each method of determining GA has benefits and drawbacks that should be carefully examined.[1] Primary approaches for estimating GA: Estimation of ultrasound-based GA, neonatal estimating GA, and estimation based on LMP.

The cerebellum's distinctive appearance on USG shows two lobules on either side of the midline in the posterior cerebral fossa.[9] This study correlates the TCD and GA. Studies on fetuses have shown that TCD and GA have a close association.[2,10,11] Even in the presence of aberrant skull shapes, fetal growth restriction, repeated pregnancies, and large-for-dates fetuses, measuring TCD in the fetus remains a helpful signal for GA.[4,10-14] As a result, these effects on other fetal measurements do not affect the fetus's TCD measurement. In a study by Swaminathan,[18] they reported that when measurements are obtained in the newborn infant, TCD rises with GA in a linear pattern from 23 to 32+6 weeks gestation.[15] Likewise, Davies concluded that TCD increases linearly from 23 to 32+6 weeks and correlates closely with GA.[1] In line with these results, we have also found a strong positive correlation between TCD and GA among infants of <32 weeks, 32–36 weeks+6 days, and 37–42 weeks of gestation age.

TCD grows linearly with GA and might be used to calculate GA at any stage of pregnancy. In our study, on sonographic assessment of cerebellar growth, a linear relationship was found when TCD was compared to gestation age. According to Saifon et al.,[19] the human cerebellum is resistant to persistent hypoxia due to the brain-sparing phenomenon, and cerebellar growth in the human fetus may be least affected by intrauterine growth retardation.[16] This discovery is consistent with the findings of Jose et al.,[20] who discovered that TCD is an easier parameter to utilize to determine the GA of a fetus in situations such as breech presentation and dolichocephaly (except in anencephaly), where other fetal measures cannot be employed.[17] This suggests that TCD can help estimate GA in patients whose LMP date is unclear.

In our study, the measurement of TCD in mm up to 42 weeks is almost equal to GA. Thus, in conclusion, it can be stated that TCD serves as a more reliable parameter in the estimation of GA.

Limitations of the study

1. One of the limitation of this study is sample size, it could be more for better results.
2. Assessment of TCD in this study was carried out on normal newborn only therefore, the effect of IUGR or fetal anomalies on TCD was not assessed, there is scope for more studies in future to confirm effect of IUGR and fetal anomalies on TCD. Further large scale studies are also needed to establish normal reference range of TCD, especially in asian countries like us where maternal habitus and fetal growth can be subjected to multiple other socioeconomic factors.

CONCLUSION

The present study was conducted with a view to explore the applicability of TCD for the prediction of GA in Indian subjects and the findings conclude that TCD is a better predictor of GA in the third trimester. Our study reported that there is a close relationship between TCD and GA, with TCD increasing linearly from <32 weeks to 42 weeks. GA can be predicted to 1.43 weeks by assessing TCD on neonatal cranial USG images. This level of error outperforms any clinical evaluation of GA in newborn babies. TCD measurement on neonatal cerebral ultrasound images has high intra- and inter-observer reliability.

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Authors Contribution:
MKG- Definition of intellectual content, literature survey, prepared the first draft of the manuscript, implementation of the study protocol, data collection, and data analysis; **HKM**- Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision and submission of the article; **SM**- Design of study, statistical analysis and interpretation, editing, and manuscript preparation and revision; **BD**- Review manuscript, preparation of a master chart, tables, and coordination; **PC**- Review manuscript, preparation of master charts, tables, and graphs; **ST**- Literature survey, master chart, tables, and preparation of figures; **VKK**- Coordination, preparation of master charts, graphs, tables, and manuscript revision.

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