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Research Article

Correlation between ultrasonography measured transcerebellar diameter of foetus with early and late gestational age

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ABSTRACT

Background: Traditionally, the gestational age of the foetus is determined from the date of the last menstrual period. Prediction of gestational age (GA) based on sonographic foetal parameters is perhaps the cornerstone in modern obstetrics and continues to remain an important component in the management of pregnancies with foetuses who have growth disturbances. The objective of the study was to study the correlation between foetal transcerebellar diameter (TCD) and pregnancy age, addressing early and late gestation periods.

Methods: This prospective observational study was conducted in the 100 pregnant women. Ultrasound examination for TCD and gestation age was done between 20-28 weeks of gestation and between 30-36 weeks of gestation. For the measurement of TCD transverse view of the foetal intracranium was obtained. Statistical analysis was performed using suitable tests.

Results: Mean age of the women was 24.82±3.31 and 85% women were in age group 21-30. The mean TCD in early gestational age i.e. 20-28 weeks was 24.7 ± 3.86 and in late gestational age i.e. 30-36 weeks was 39.31 ± 2.51. Median TCD increases from 20.35 mm at 20 weeks to 41.7 mm at 36 weeks of gestation. The correlation coefficient between gestational age and TCD was 0.971, which indicated high degree of relation with p value <0.0001.

Conclusions: This study shows linear relationship between TCD and gestational age at 20-28 weeks & 30-36 weeks. So, TCD is a reliable method of gestational age determination in early as well as in late pregnancy.

Keywords: Transcerebellar diameter, Gestational age, Foetus, Menstrual period

INTRODUCTION

Traditionally, the gestational age of the foetus is determined from the date of the last menstrual period. Only 71% women can accurately recall their date of last menstrual period.¹ Even when the date of last menstrual period can be recalled reliably, the gestational age so determined is not always reliable. This may be because of irregular cycles, lactation, recent use of hormonal contraceptives, intrauterine devices, bleeding in first trimesters, hormone therapy etc. Therefore, even in women with regular menstrual cycles, ultrasound dating of pregnancy provides a more accurate estimation of gestational age than by menstrual history.² Prediction of

gestational age (GA) based on sonographic foetal parameters is perhaps the cornerstone in modern obstetrics and continues to remain an important component in the management of pregnancies with foetuses who have growth disturbances.³ Prenatal Ultrasonography provides an opportunity to more accurately assess foetal growth, as it is highly reliable and reproducible. Ultrasound biometry of the foetus is now the gold standard for assessing the foetal growth.⁴ Transcerebellar diameter (TCD) is one such foetal parameter that has remained consistently superior in predicting GA and foetal growth in both singleton and twin gestations.⁵⁻⁷ It is therefore an organ that can provide information on the prediction of gestational age during

the entire pregnancy. Although there are ultrasound studies on the correlation between the Transverse cerebellar diameter (TCD) in fetuses and gestational age, most studies address the third trimester of pregnancy.^{5,8-11} It is therefore important to study the correlation between foetal TCD and pregnancy age, addressing early and late gestation periods. So, this study was planned to evaluate the role of foetal transverse cerebellar diameter in predicting gestational age.

METHODS

This prospective observational study was conducted in the pregnant women attending the antenatal clinic of a tertiary care teaching hospital for a period of one and a half year. A total of 100 pregnant women were recruited in this study after taking approval from Institutional Ethics Committee. Written informed consent was taken from the patients. All singleton pregnancies women between 20 to 36 weeks of gestational age, pregnant women with confirmed gestational age (having regular menstrual history and knowing confirm date of last menstrual period) were include in the study. The exclusion criteria included uncertain date of last menstrual period (LMP), multiple pregnancies and major structural anomaly identified with ultrasound.

Women were studied on two antenatal visits. During each visit thorough history, clinical and ultrasound examinations were performed. First ultrasound examination was done between 20-28 weeks of gestation and second ultrasound examination was done between 30-36 weeks of gestation. All ultrasonic examinations were performed with an ALOKA [SSD 4000 SV] ultrasound machine with a 2.5-6 MHz convex transducer. Electronic calipers were used and all measurements were taken in millimeters. During each ultrasound examination, in addition to various routine sonographic foetal biometers like BPD, HC, FL, AC, the transverse cerebellar diameter (TCD) was also measured.

The transverse cerebellar diameter was measured by the method as described by Goldstein et al.¹² For the measurement of TCD transverse view of the fetal intracranium was obtained. The landmarks of the thalami, cavum, septum pallucidum and third ventricle were identified followed by slight rotation of the transducer below the thalamic plane to view the butterfly like structure (cerebellum) in the posterior cranial fossa. The measurement was obtained by placing electronic calipers of the ultrasound machine at the outer to outer margins of the cerebellum.

Statistical analysis

Mean and standard deviation of TCD was determined at each week of gestation, in addition the 5th, 50th 90th and 95th percentiles were also calculated. Statistical analysis was performed using Student's 't' test, Analysis of Variance (ANOVA), Pearson's Correlation, Regression

analysis and Chi-Square Test wherever applicable. A "P" value of <0.05 was considered to be statistically significant.

RESULTS

Table 1: Mean TCD at 20-28 and 30-36 weeks of gestation.

| | MEAN ± SD |
|--------------------|--------------|
| TCD AT 20-28 Weeks | 24.7 ± 3.86 |
| TCD AT 30-36 Weeks | 39.31 ± 2.51 |

Table 2: Transverse cerebellar diameter (TCD) percentiles (5th, 50th and 95th) relative to gestational age (weeks).

| Gestational Age (weeks) | TCD Percentiles (mm) | | |
|-------------------------|----------------------|------------------|------------------|
| | 5 th | 50 th | 95 th |
| 20 | 18.56 | 20.35 | 22.19 |
| 21 | 19.6 | 21.15 | 23.22 |
| 22 | 20.05 | 21.85 | 24.75 |
| 23 | 21.35 | 23.6 | 25.2 |
| 24 | 22.22 | 24.1 | 26.54 |
| 25 | 24.17 | 26.6 | 27 |
| 26 | 27.15 | 28.6 | 31.6 |
| 27 | 27.28 | 30.2 | 31.35 |
| 28 | 30.32 | 31 | 36.47 |
| 30 | 32.5 | 34.3 | 37.37 |
| 31 | 34.94 | 36.5 | 40.8 |
| 32 | 35.4 | 38.4 | 42 |
| 33 | 34.85 | 38.7 | 41.56 |
| 34 | 38.02 | 40.7 | 41.3 |
| 35 | 38.27 | 42 | 43.36 |
| 36 | 39.7 | 41.7 | 46.97 |

The study included 100 pregnant women who attended the antenatal clinic. Mean age of the women was 24.82±3.31 and 85% women were in age group 21-30.

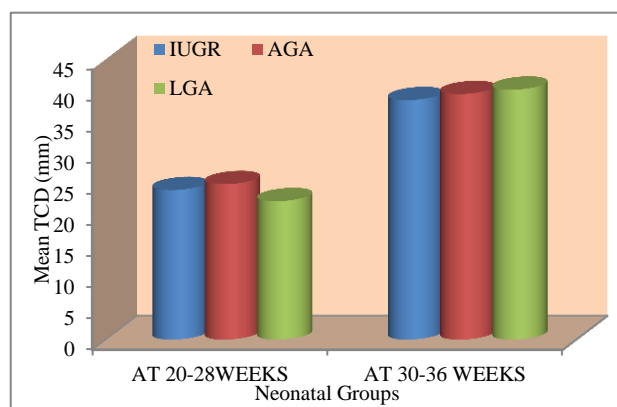


Figure 1: Mean TCD at 20-28 and 30-36 Weeks in neonates of different groups.

The mean TCD in early gestational age i.e. 20-28 weeks was 24.7 ± 3.86 and in late gestational age i.e. 30-36 weeks was 39.31 ± 2.51 . At 20-28 weeks of gestational age minimum TCD was 18 mm and maximum TCD was 38.6 mm and at 30-36 weeks it was 34 mm and 48.2 mm respectively (Table 1).

There was no statistically significant difference (P value >0.05) in mean TCD at 20-28 weeks as well as in mean TCD at 30-36 weeks in growth restricted (IUGR) neonates, appropriately grown neonates (AGA) and large for gestational age (LGA) neonates (Figure 1).

Median TCD (50th percentile) increases from 20.35 mm at 20 weeks to 41.7 mm at 36 weeks of gestation. The 5th and 95th percentiles at 20 weeks were 18.56 and 22.19 mm and at 36 weeks these were 39.7 and 46.97 mm respectively. The inference shows that the normal foetal TCD exhibit a more than two fold increase in size between 20 to 36 weeks of gestation (Table 2).

The scatter diagram between gestational age and TCD in weeks shows linear relationship between gestational age and TCD, which was statistically significant as $R^2 = 0.942$. The correlation coefficient between gestational age and TCD was 0.971, which was statistically significant (p value <0.0001) and indicates high degree of correlation (Figure 3).

DISCUSSION

Cerebellum lies in the posterior cranial fossa, surrounded by the dense petrous ridges and occipital bone so it can withstand deformation by extrinsic pressure better than the parietal bones. Prediction of gestational age is important for the management of the complicated pregnancies. TCD is considered as important parameter for estimation of gestational age.

Table 3: Comparison of present study with previous studies for relationship between TCD and gestational age.

| Study | Correlation Coefficient (r) | R ² | P value |
|---|-----------------------------|----------------|-----------|
| Present study | 0.971 | 0.942 | <0.0001 |
| Goldstein I et al 1987 ¹² | – | 0.948 | <0.001 |
| Guan et al 1992 ¹⁸ | 0.996 | – | <0.0005 |
| Vinkesteijn ASM et al 2000 ⁹ | – | 0.96 | <0.0001 |
| Araujo J et al 2008 ¹⁰ | 0.98 | 0.969 | <0.0001 |
| Goel P et al 2010 ¹³ | 0.991 | – | <0.0001 |
| Das Gupta A et al 2012 ¹⁴ | 0.946 | 0.896 | <0.0001 |

In this study mean age of the women was 24.82. Another study done by Chavez et al, the mean maternal age was 30 years.³ This difference in age may be explained by the fact that in India there is a trend of early marriage and pregnancy at an early age.

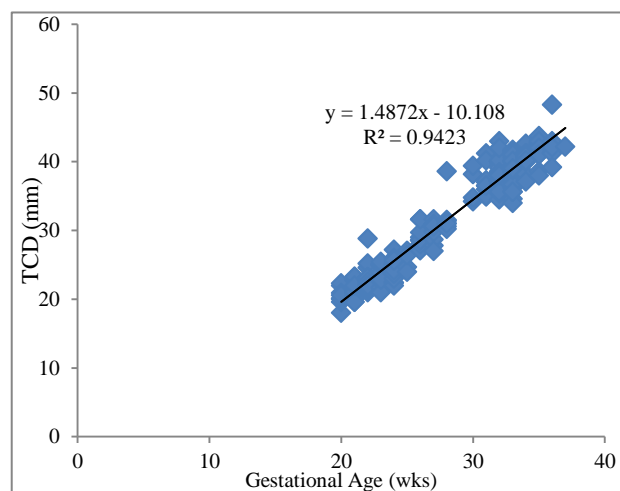


Figure 2: Relationship between TCD and gestational age.

The mean TCD in early gestational age i.e. 20-28 weeks is 24.7 ± 3.86 and in late gestational age i.e. 30-36 weeks was 39.31 ± 2.51 . In a similar study done by Goel P et al, the mean TCD at 21-30 weeks of gestational age was 26.63 mm and at 31-40 weeks of gestational age was 40.73 mm. The minimum and maximum TCD at 21-30 weeks was 18.40 mm and 35 mm and at 31-40 weeks it was 36 mm and 48.4 mm respectively.¹³ In another study done by Das gupta et al, the mean TCD during 21-27 weeks was 23.2 mm with minimum and maximum TCD 20 mm and 28 mm respectively, and during 28-34 weeks the mean TCD was 30.6 mm, minimum and maximum TCD were 24 & 35 mm respectively. During 35-40 weeks the mean, minimum and maximum TCD were respectively 35.2 mm, 30 mm and 40 mm.¹⁴ Reece EA et al has stated that the growth of the transverse cerebellar diameter is unaffected by intrauterine growth retardation.¹⁵ Strizhova NV et al measured the TCD in normal and growth retarded fetuses and concluded that TCD of small-for gestational age did not much differ from that in the normal reference group.¹⁶ Goldstein I et al in their study also concluded that there was no significant difference between growth of the transverse cerebellar diameter in the appropriately grown and growth restricted children.¹⁷ These data confirm the relative preservation of normal cerebellar growth in growth restricted fetuses.

In our study the normal foetal TCD exhibit a more than two fold increase in size between 20 to 36 weeks of gestation. Similar results were obtained by Vinkesteijn ASM et al, in which median TCD (50th percentile) increases more than two fold during second half of pregnancy. They obtained median TCD of 17.5 mm at 17

weeks which increased to 45.2 mm at 34 weeks of gestation.⁹ Dasgupta A et al also calculated the percentiles (5th, 50th and 95th) of TCD relative to gestational age, which are comparable to our study.¹⁴

Our study shows linear relationship between gestational age and TCD, which is statistically significant ($R^2 = 0.942$, P value = 0.0001). Similar observations were obtained in other studies and their results are also comparable to our study as shown in the Table 3.

CONCLUSION

In this study, the relationship was established between TCD and gestational age 20-28 weeks & 30-36 weeks. This study shows linear relationship between gestational age and TCD. So, transcerebellar diameter is a reliable method of gestational age determination in early as well as in late pregnancy.

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee of Government Medical College, Udaipur, India

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