<u>Original Research Article</u>

Role of Transverse Cerebellar Diameter as a Predictor of Gestational Age

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Abstract:
Introduction: Gestational age is an important parameter to provide the standard of care medical management for both mother and fetus. Pregnancy is monitored objectively in terms of fetal growth compared to the period of gestation for planning the mode of delivery, managing complications in midcourse, and managing high-risk cases. Antenatal ultrasound is the standard of care in monitoring gestation. Gestational age is calculated based on certain fetal parameters. Transverse cerebellar diameter (TCD) has evolved as a promising indicator for assessing gestational age.
Aims and Objectives: To determine the significance of transverse cerebellar diameter in the estimation of the gestational age of the fetus and compare it with other conventional parameters of fetal biometry.
Methods: A cross-sectional study was conducted in the Department of Radiodiagnosis, Government Medical College, Jammu on 100 pregnant women who presented for an antenatal scan with a 15-40 weeks period of gestation.
Result: Mean Gestational Age based on all parameters was compared with that of LMP; all parameters were showing GA which was near to GA by LMP. Of all parameters, TCD had a mean GA nearest to that GA by LMP in both the second and third trimesters. By comparing the GA by TCD with GA by other conventional parameters, there was Linear relationship.
Keywords: Gestational age, Fetal biometry, Transverse cerebellar diameter, Last Menstrual Period.

Introduction

Gestational age is an important parameter to provide the standard of care medical management for both mother and fetus. Pregnancy is monitored objectively in terms of fetal growth compared to the period of gestation for planning the mode of delivery, managing complications in midcourse, and managing high-risk cases. An accurate estimate of gestational age is vital for determining viability in preterm labor. In women with uncertain gestational age high incidence of perinatal mortality has been noted as it is associated with preterm delivery, low birth weight, and post-maturity. [1]

The true measure of pregnancy's age is the number of days since conceptional is termed conceptional age. Historically, however, pregnancies were dated by the number of days since the first day of the last menstrual period, termed as menstrual age. In females with regular 28 days cycles, the menstrual age is equal to the gestational age i.e. 2 weeks more than the conceptional age. Naegele's rule which depends on LMP is a well-accepted method for estimating the delivery date but is not useful for women with irregular cycles who don't recall LMP accurately. [2]

Antenatal ultrasound is the standard of care in monitoring gestation. Gestational age is calculated based on certain fetal parameters including biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length. The accuracy of gestational age by measuring fetal parameters is maximum in the first trimester and reduces as fetal age advances from the second to the third trimester. The accurate measurement of these parameters depends on the fetal lie, shape of the skull, placenta's location, flexion, fetal head engagement, maternal obesity, and multiplicity of gestation. Transverse cerebellar diameter (TCD) has evolved as a promising indicator for assessing gestational age. Cerebellum is located in the posterior cranial fossa surrounded by the dense petrous ridges and the occipital bone making it withstand the deformation caused by extrinsic pressure. Another added advantage is its non-variance in intrauterine growth restriction (IUGR) cases. So TCD can be used as an independent parameter when gestational age cannot be calculated by LMP. [3,4]

Aims / Objectives

- To determine the significance of transverse cerebellar diameter in the estimation of the gestational age of the fetus.
- To compare it with other conventional parameters of fetal biometry (head circumference, biparietal diameter, abdominal circumference, and femur length).

Method and Material

The study was conducted in the Department of Radiodiagnosis, Government Medical College, Jammu on pregnant women who presented for an antenatal ultrasound scan with a 15-40 weeks period of gestation with known LMP which had been confirmed by first-trimester Ultrasound (dating scan). After explaining the procedure, written and informed consent was taken.

Study Design: Cross-sectional observational study.

**No. Of subjects:** 100

Inclusion Criteria

- Pregnant women with the sure date of their last menstrual period which had been confirmed by a dating scan.
- Pregnant women with a 15-40 weeks period of gestation.

Exclusion Criteria

- Women with unknown LMP.
- Pregnancy with a congenital malformation or suspected IUGR.
- Multiple pregnancies.

**Measurement of Transverse Cerebellar Diameter:** A plane with thalami, cavum septum pellucidum, and third ventricle was identified and the transducer was slightly rotated below the thalamic plane to visualize the posterior cranial fossa. Cerebellum was seen as two lobules on either side of the midline in the posterior cranial fossa The measurement was obtained by positioning the calipers on the outer margins of the two lobes. A single measurement was used for each pregnancy. Other parameters were measured according to standard planes (figure 1)

A

B

C

D
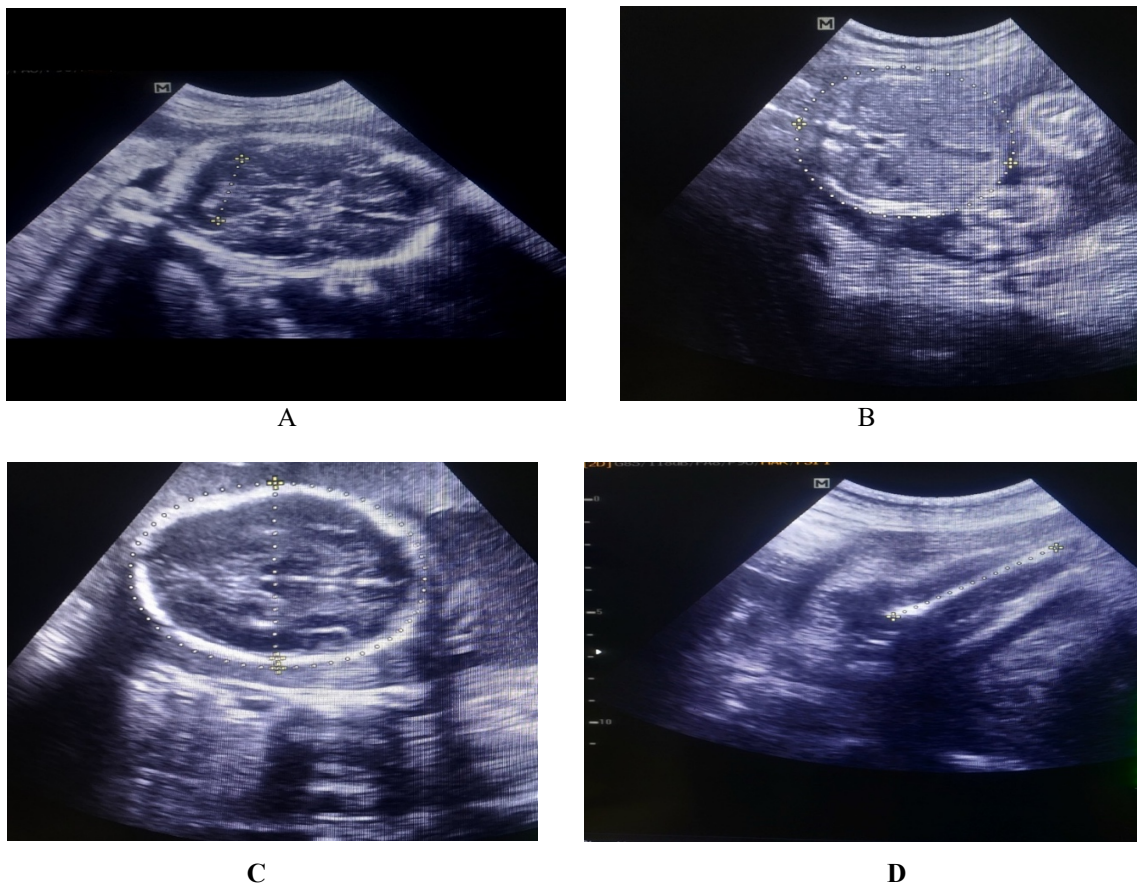
Figure 1: Transabdominal Ultrasound Images Showing Measurements Of (A) Transverse Cerebellar Diameter (B) Abdominal Circumference (C) Biparietal Diameter And Head Circumference And (D) Femur Length
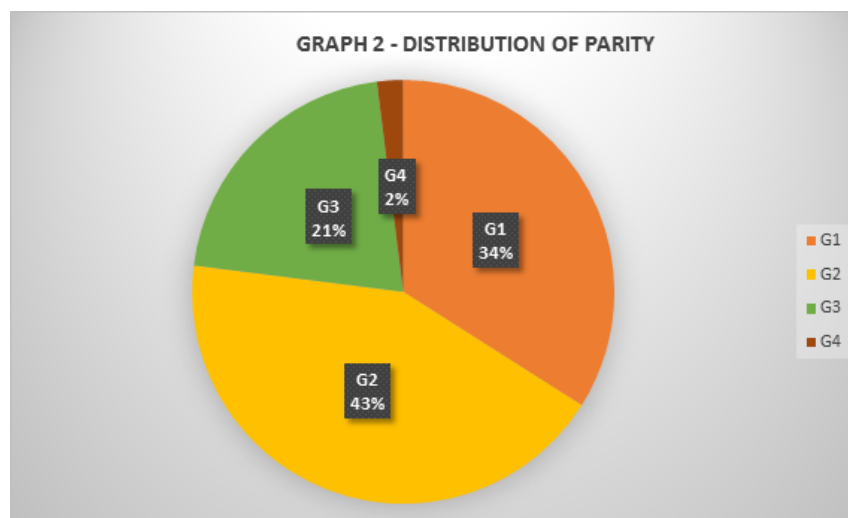
Results

Age distribution of the women (graph 1):
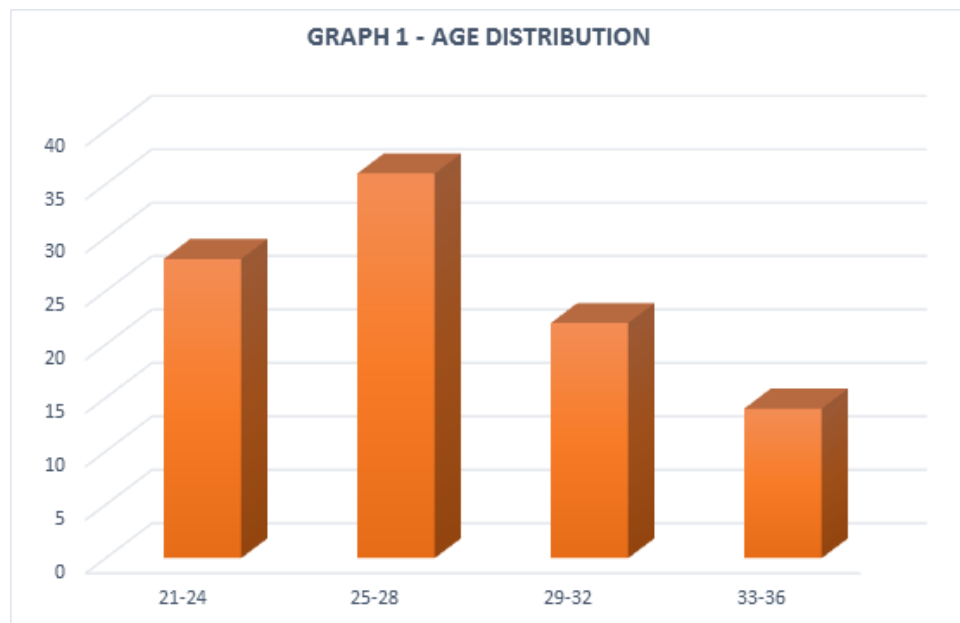
Graph 1: Age Distribution

The age of women ranged from 21 to 36 years with the maximum number of patients aged 25-28 years (n=36; 36%) followed by those aged 21-24years (n=28; 28%), 29-32 years (n=22; 22%) and 33-36 years (n=14; 14%). Distribution of the women according to their parity (graph 2):

Graph 2: Distribution of Parity

Maximum number of females were gravida 2 (n=43; 43%) followed by gravida 1(n=34; 34%), gravida 3 (n=21;21%) and gravida 4 (n= 2; 2%).

The gestational age of cases ranged from 15 weeks 6 days to 38 weeks 4 days (as per LMP). We divided the sample population into 2 groups-

1. Group 1 included pregnant females in the second trimester i.e. with a gestation age between 15-28 weeks.

2. Group 2 included pregnant females in the third trimester i.e. with a gestation age between 29-39 weeks.

Group 1 had 36 females (36%) and group 2 had 64 females (64%).

In the second trimester, the mean gestational age in weeks based on LMP was 22.15 (table 1). When gestational age based on BPD, HC, AC, FL, and TCD (shown in table 1) were compared with that of LMP, all parameters in the second trimester were showing a linear relationship with LMP (figure 2). TCD had a mean gestational age of 22.14 weeks (table 1), closest to the gestational age by LMP. HC was having mean gestational age which was second close to gestational age by LMP. AC had a mean gestational age that was farthest from the mean

gestational age by LMP among all parameters. TCD had the highest correlation with r value of 0.998 (P value - <0.005)

In the third trimester, the mean gestational age by LMP was 34.17 weeks (shown in Table 1).

Table 1: Showing mean gestation age in weeks calculated by LMP and biometric parameters including TCD in the second and third trimesters.

Trimester	Biometric Parameters	Mean GA In Weeks	Standard Deviation
Second Trimester			
	LMP	22.15	1.5
	HC	22.11	2.4
	AC	21.98	2.5
	FL	22.21	2.6
	BPD	22.28	2.5
	TCD	22.14	2.1
Third Trimester			
	LMP	34.17	3.3
	HC	33.25	4.5
	AC	33.18	4.1
	FL	33.70	4.2
	BPD	33.28	4.3
	TCD	33.80	3.7

When gestational age based on BPD, HC, AC, FL, and TCD was compared with that of LMP, all parameters in the third trimester were showing a linear relationship with LMP shown in the scatter diagram (Figure 2).
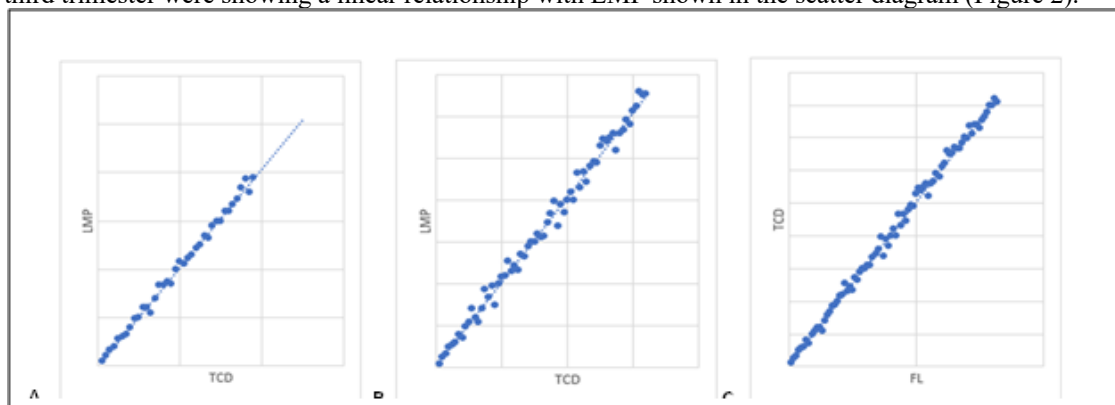
Figure 2
A - Scatter Diagram Showing The Linear Relationship Between Ga By Lmp With Ga By Tcd In The Second Trimester.
B - Scatter Diagram Showing The Linear Relationship Between Ga By Lmp With Ga By Tcd In The Third Trimester.
C - Scatter Diagram Showing Linear Relationship Between Ga By Tcd With Ga By Fl In Second And Third Trimester.

TCD had a mean gestational age of 33.80 weeks (table 1), closest to the gestational age by LMP. FL was having a mean gestational age of 33.90 weeks (table 1) which was the second close to the gestational age by LMP. AC had a mean gestational age that was farthest from the mean gestational age by LMP among all parameters. The r-value was 0.984 when the gestational age by TCD was compared with the gestational age by LMP, which was more than that for other parameters
When GA based on TCD was compared with that of other parameters such as BPD, HC, AC, and FL, all parameters in the second and third trimesters were showing a linear relationship with TCD. All parameters had nearly equal R-values. FL has the

maximum r-value (.997) (shown in figure 2) and HC has the least r-value (.993).

Discussion

Accurate knowledge of gestational age measurement is key for obstetric care management. The last menstrual period (LMP) anteceded by a normal menstrual cycle is thought to correlate well with the gestational age of the fetus, but it is not corroborative when pregnant women do not remember their LMP accurately. [5] Ultrasonography is used for the dating of pregnancy for many decades. Professor Ian Donald of Glasgow was the first to use diagnostic ultrasonography to investigate the gravid uterus and is considered the father of modern ultrasound. BPD,

HC, FL, and AC are biometric parameters utilized for gestational age estimation. [6] The accuracy of gestational age by measuring fetal parameters is maximum in the first trimester and accuracy reduces as fetal age advances Routine biometric parameters for GA assessment such as BPD, HC, AC, and FL have their limitations like BPD and HC because of molding of the head in the third trimester. Similarly, femur length is not reliable in some cases of skeletal dysplasia such as achondroplasia. Trans-cerebellar Diameter is a distinct growth parameter for estimating the gestational age of a fetus. Cerebellum is resistant to deformation by extrinsic pressure. The fetal cerebellum is visualized as early as 10-11 weeks on ultrasound. TCD is least affected by factors affecting fetal growth allowing it to determine accurate gestational age even in the third trimester and cases of intrauterine growth restriction. It was found that there is a good correlation between Trans-cerebellar diameter and other parameters. [7,8]

In our study, when the mean gestational age based on all parameters was compared with that of LMP; all parameters in the second and third trimesters were showing gestational age which was near to that of gestational age by the Last Menstrual Period. Of all parameters, TCD had a mean gestational age nearest to that gestational age by LMP in the second and third trimesters. [9]

Pearson's coefficient of correlation (r) was calculated between gestational age by LMP and gestational age by all other parameters and also between gestational age by TCD and gestational age by other parameters. In both the second and third trimesters, TCD had the highest correlation among all. TCD also showed a correlation with other conventional parameters. [10]

Similar comparable results were seen in studies done by Uikey PA et al (2016), Fatima K et al (2017), and Mishra S et al. (2020) showing a significant correlation between gestational age by LMP and gestational age by TCD. [11.12]

Thus, as a reliable parameter, TCD can effectively predict gestational age.

Conclusion

- Our study findings provide useful information and establish TCD as a reliable marker for estimating gestational age in the second and third trimesters. TCD is a fairly accurate and better predictor of gestational age in comparison to other ultrasound parameters such as BPD, HC, AC, and FL.
- TCD shows a linear correlation with other parameters of biometry.
- Our results show that TCD is not affected by age of the mother and parity also does not seem to affect TCD.

Abbreviations:

- TCD – Transverse cerebellar diameter
- BPD – Biparietal diameter
- AC- Abdominal circumference
- HC- Head circumference
- FL- Femur length
- LMP- Last menstrual period
- GA – Gestational age

Reference

1. Uikey PA, Kedar KV, Khandale SN. Role of trans cerebellar diameter in estimating gestational age in the second and third trimester of pregnancy. International Journal of Reproduction, Contracep, Obstet Gynecol. 2016; 5(10): 3411-5.
2. Satish Prasad BS, Likhitha S. Cerebellar Measurements with Ultrasonography in the Evaluation of Fetal Age. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). 2014; 13(9): 49-56.
3. Mishra, S., Ghatak, S., Singh, P., Agrawal, D., & Garg, P. Transverse cerebellar diameter: a reliable predictor of gestational age. African health sciences, 2020; 20(4): 1927–1932.
4. Fatima K, Shahid R, Virk A. Determination of mean fetal trans cerebellar diameter as a predictive biometric parameter in the third trimester of pregnancy in correlation with fetal gestational age. Pak Armed Forces Med J. 2017; 67(1):155-60.
5. Mahmoud MZ, Mahmoud OA and Abdulla AA. Fetal Transverse Cerebellar Diameter Measurement for Prediction of Gestational Age in Pregnant Sudanese Ladies. Int J Life Sci Med Res. 2013;31(3):89-93.
6. George R., Amirthalingam, U., Hussain, M.R.K., et al. Can trans-cerebellar diameter supersede other fetal biometry in measuring gestational age? A prospective study. Egypt J Radiol Nucl Med. 2021; 52: 197.
7. Naseem F, Fatima N, Yasmeen S and Saleem S. Comparison Between Transcerebellar Diameter with Biparietal Diameter of Ultrasound for Gestational Age Measurement in Third Trimester of Pregnancy. J Coll Physicians Surg Pak. 2013; 23(5):322-5.
8. Gupta AD, Banerjee A, Rammurthy N, Revati P, Jose J, Karak P et al. Gestational age estimation using trans cerebellar diameter with the grading of fetal cerebellar growth. Nat J Clinical Anat. 2012;1(3):115-120.
9. Goel P, Singla M, Ghai R, Jain S, Budhiraja V, Rameshbabu CS. Transverse cerebellar diameter - a marker for estimation of gestational age. J. Anat. Soc. India 2010; 59(2):158-61.
10. Gameraddin M, Alhaj B, Alabdeen MZ. The Reliability of Biparietal Diameter and Femoral Length in Estimation of the Gestational Age Using Ultrasonography. J Gynecol Obstet. 2014;2(6):112-5.

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11. Dashottar S, Senger KPS, Shukla Y, Singh A, Sharma S. Transcerebellar diameter: an effective tool in predicting gestational age in normal and IUGR pregnancy. Int J Reprod Contracept Obstet Gynecol 2018;7: 4190-6

12. Bansal M, Bansal A, Jain S, Khare S, Ghai R. A study of Correlation of Transverse Cerebellar Diameter with Gestational Age in the Normal & Growth Restricted Fetuses in Western Uttar Pradesh. People's J Sci Res. 2014;7(2):16-21.