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Ultrasound correlation of transcerebellar diameter with last menstrual period for gestational age in second and third trimester of pregnancy

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Abstract

Background: Foetal biometry is useful modality in assessment of gestational age (GA) for good obstetric outcome.
Objectives: To compare ultrasonographic measurement of transverse cerebellar diameter (TCD) with other previously established foetal ultrasound biometric parameters.
Methods: An analytical cross-sectional study was conducted from August 2020 to February 2021 in Department of Radiology at Kathmandu Medical College after ethical clearance. Convenience sampling technique was utilised to include all pregnant women in second and third trimester with known last menstrual period (LMP). Written informed consent was taken from those willing to participate. Congenital malformations, multiple pregnancies, irregular menstrual cycle, and maternal illness were excluded. Data were entered and analysed by using SPSS v.22. Descriptive statistics like mean, standard deviation, and percent were used. Inferential statistics (t- test and Pearson correlation) was also used to see the correlation between different variables.
Results: Among 100 participants who participated in the study, 63 (63%) were primigravida with singleton pregnancy without any congenital anomalies. The mean foetal heart rate was 144.9 ± 13.6. The mean GA based on LMP, TCD, and other parameters were 30.86 ± 7.76 weeks, 31.07 ± 8.45 weeks, and 29.75 ± 6.61 weeks respectively. In 15-28 weeks, all parameters had nearly equal r-values. Among all, TCD revealed highest correlation (0.888). In 29-40 weeks, there was considerable difference in r-values. The second most accurate correlation was seen with head circumference (r = 0.874).
Conclusion: TCD being stable parameter not affected by foetal growth status maybe preferred over other parameters in estimating foetal gestational age.

Key words: Pregnancy; Transcerebellar diameter; Trimester; Ultrasound correlation.

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INTRODUCTION

Accurate foetal gestational age (GA) is important to facilitate prenatal care and for successful pregnancy outcome.[1] Ultrasonography (USG) is a useful modality in GA assessment which affects obstetric management and improves prenatal care.[2] Last menstrual period (LMP) usually correlates with gestational age but studies show that only one-half of women can accurately recall their LMP.[3] Therefore, USG is being widely used for the accurate assessment of GA using various parameters like biparietal diameter (BPD), head circumference

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(HC), abdominal circumference (AC), and femur length (FL).[4] Transverse cerebellar diameter or transcerebellar diameter (TCD) a new parameter for determining gestational age was developed. The TCD is least affected by external factors because it is surrounded by dense petrous bone which allows its use for assessing even GA.[5] In intrauterine growth restriction (IUGR), cerebellum is least affected and TCD remains one of the most reliable parameters for measurement of true gestational age.[6] The present study aimed to correlate GA determined by TCD with other biometric parameters.

METHODOLOGY

An analytical cross-sectional study was conducted at Radiology Department of Kathmandu Medical College Teaching Hospital (KMCTH) during six months period (from August 19, 2020 to February 2021). Ethical approval was received from the institutional review committee of Kathmandu Medical College Teaching Hospital (Ref. 1808202005; dated August 18, 2020). Written informed consent was taken from each participant and confidentiality of information of the participants was maintained. The information they provided was used only for research purpose.

The sample size calculated was 119 but the period during data collection was COVID-19 lockdown period in Nepal. So, patient flow during this period was very low compared to normal situation. Therefore, the investigators could hardly get 100 participants within six months period. Hence, the total participants taken for this study was 100. Taking the standard deviation (SD) of 3.09,[7] 119 participants were recruited for the study using formula: $n = Z^2(SD)^2/e^2$; where, Z (at 95% confidence level) = 1.96, SD = standard deviation = 3.09, margin of error (e) = 10% of SD = 0.309.

All pregnant women (second and third trimester pregnant with known LMP) who came for ultrasound in KMCTH were included in the study. It included patients of 18-40 years of age groups. Detailed questionnaire regarding the age, LMP, parity, maternal illness, congenital malformation of subjects along with ultrasonographic correlation of gestational age with TCD and other foetal biometry was filled. Participants were subjected to gray scale and gestational age with other foetal biometry (BPD, HC, AC, and FL) and TCD was correlated.

The TCD was measured along with routine parameters. Subjects were divided into two groups based on GA (18-26 weeks, 27- 40 weeks). Gestational age using TCD and other parameters was calculated and compared with gestational age based on LMP.

For foetal biometry, the patient was scanned in the supine position with the operator to the right of the patient. The patient's abdomen was covered with ultrasound gel to achieve acoustic coupling. The BPD was measured on an axial section of oval appearing foetal head at the level of thalami with no cerebellum visualised. The section included continuous midline echo of falx cerebri in anterior one-third which was broken in middle by cavum septum pellucidum and thalami on each side. The calipers were placed on outer table (leading edge) and the inner table of the skull vault. The HC was measured on the same section as for the BPD. The circumference was directly measured on the screen using electronic calipers to the circumference. The AC was measured at the level of the foetal liver using a cross-sectional view that included visualisation of intrahepatic portion of the umbilical vein and stomach bubble and non-visualisation of kidneys.

For FL measurement, the longest axis of ossified femoral diaphysis was measured. The measurement was made of the shaft only, excluding the unfused epiphysis.

For measuring TCD, the landmarks of the thalami, cavum septum pellucidum, and the third ventricle were identified; then by slightly rotating the transducer below the thalamic plane, the posterior fossa was revealed with the characteristic butterfly-like appearance of the cerebellum (Figure 1). The TCD measurements were obtained from the outer to outer margins of the cerebellum in the posterior fossa.

Pregnant women with normal singleton pregnancies of 18-40 weeks gestation with known LMP and clinically suspected IUGR were included in the study. Congenital malformations, multiple pregnancies, irregular menstrual cycle and maternal illness were excluded.

Data were entered and analysed in IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA). Descriptive statistics like mean, standard deviation, and percent were used. The collected data were analysed using statistical test, including t- test to estimate the mean of different parameters by considering the 95% confidence intervals (CI). Pearson correlation analysis was used to find the relation between TCD and study variables.

RESULTS

Only 100 participants were involved in the study, who were in the second and third trimester of their pregnancy. The mean age of the participants was 27.4 ± 4.2 years ranging from 18-40 years. Majority of them (63,

63%) were primigravida without any history of abortion and having a regular menstrual cycle. Almost all of the participants had a singleton pregnancy. Nearly two-thirds of the participants were in their third trimester of pregnancy. Almost all of them had singleton pregnancy without any congenital anomalies (Table 1).

The mean of foetal heart rate was 144.9 ± 13.6 beats per minute. Similarly, the mean of other foetal parameters like BPD, HC, AC, and FL were 72.8 mm, 268.7 mm, 245.3 mm, and 54.8 mm respectively. The GA based on LMP, TCD, and other parameters was 30.86 ± 7.76 weeks, 31.07 ± 8.45 weeks and 29.75 ± 6.61 weeks respectively.

Mean GA based on LMP was 21.13 weeks in second trimester and 34.69 weeks in third trimester (Table 2).

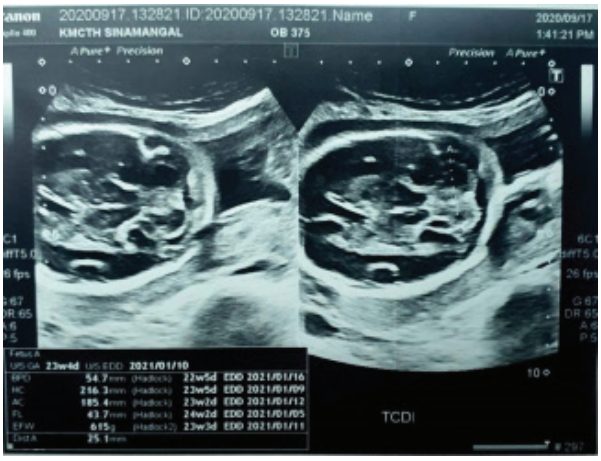

Figure 1: Axial scan directed posteriorly showing transverse cerebellar diameter measurement of two cerebellar hemispheres connectedin the midline on the superior cerebellar vermis

When mean GA based on BPD, HC, AC, FL were compared with that of LMP, all parameters in second trimester and third semester were showing GA which was far to that of LMP except mean GA based on TCD. The TCD had mean GA of 21.10 mm in second trimester which was very near to GA by LMP. In the third trimester TCD had mean GA of 35 weeks which was very close to GA by LMP.

In second trimester, all parameters had nearly equal Pearson's coefficient of correlation (r) values (Table 3). The TCD had correlation with value of 0.888. In third trimester, there was considerable difference in r-values; r-value was 0.768, when the GA by TCD was compared with the GA by LMP. The highest correlation was seen with TCD, r=0.888. The second most accurate correlation was seen with the HC with r-value of 0.874.

Table 1: Demographic parameters of pregnant women who came for ultrasonography (N=100)

Variable	n (%)
Age of the participants (years)	
<25	26 (26)
25 – 34	70 (70)
≥35	4 (4)
Menstrual cycle	
Regular	91 (91)
Irregular	9 (9)
Parity	
Primi	63 (63)
Multi	37 (37)
Abortion	
Yes	8 (8)
No	92 (92)
Gestational trimester	
Second	36 (36)
Third	64 (64)

Table 2: Mean and standard deviations of all parameters with confidence intervals

Parameters		N	Mean ± standard deviation	95% Confidence interval for mean	
				Lower	Upper
LMP	Second	36	21.13 ± 4.70	11.79	15.33
	Third	64	34.69 ± 3.23	11.98	15.14
HC	Second	36	194.00 ± 49.63	99.35	133.97
	Third	64	310.67 ± 17.79	103.05	130.27
AC	Second	36	164.17 ± 50.17	108.29	145.15
	Third	64	290.89 ± 30.13	110.80	142.64
FL	Second	36	36.19 ± 11.40	25.03	33.29
	Third	64	65.35 ± 6.17	25.68	32.64
BPD	Second	36	51.76 ± 13.70	28.11	37.78
	Third	64	84.72 ± 5.78	29.06	36.84
TCD	Second	36	21.10 ± 4.83	12.58	16.25
	Third	64	35.52 ± 3.47	12.75	16.07

LMP - Last menstrual period; HC - Head circumference; AC - Abdominal circumference; FL - Femur length; BPD - Biparietal diameter; TCD - Transcerebellar diameter.

Table 3: Correlation of gestational age with different parameters

Parameters		Trimester	Pearson correlation'r'	p-value
LMP	With BPD	Second trimester	0.869	<0.001
		Third trimester	0.610	<0.001
	With HC	Second trimester	0.874	<0.001
		Third trimester	0.699	<0.001
	With AC	Second trimester	0.827	<0.001
		Third trimester	0.725	<0.001
	With FL	Second trimester	0.822	<0.001
		Third trimester	0.710	<0.001
	With TCD	Second trimester	0.888	<0.001
		Third trimester	0.768	<0.001

*correlation significant at 0.01 level.

Table 4: Correlation of transverse cerebellar diameter with different parameters

Parameters		Pearson correlation'r'	p-value
TCD	LMP	0.967	<0.001
	HC	0.959	<0.001
	BPD	0.958	<0.001
	AC	0.967	<0.001
	FL	0.964	<0.001

correlation significant at 0.01 level.

DISCUSSION

The cornerstone for effective management of pregnancy is the accurate estimation of gestational age.[3] The present study aimed to correlate the TCD with last menstrual period for gestational age and other parameters such as: BPD, HC, AC, and FL in second and third trimester of pregnancy. The correlation between these parameters were assessed.

In this study, the correlation of GA according to LMP and TCD was found to be r = 0.888 and r = 0.768 in second and third trimester respectively. Similarly, positive correlation was seen in between GA according to TCD and GA according to other parameters in both trimesters. All of these correlations were found to be statistically significant ($p < 0.001$). The findings were similar to the studies conducted in various parts of India, Nepal and

Iraq.[3,8,9] Goel et al. in 2010 conducted a study on 50 normal pregnancies ranging from 14 to 40 weeks of GA which showed good correlation of TCD with GA ($r^2 = 0.91$, p-value < 0.001) which is similar to current study.[7]

McLeary et al. found close correlation between TCD and BPD while studying the measurement of TCD with USG in 225 normal fetuses ranging from 15 to 39 weeks of gestational age. As the cerebellum is well protected by the dense petrous and occipital bones, it is well protected by the extrinsic deforming forces unlike BPD. Thus, the authors proposed that the TCD may be used as an alternative in estimating foetal age where extrinsic pressure has deformed the skull and led to decreased biparietal diameter.[9]

Study conducted in West Bengal, India also concluded that TCD is a better parameter for gestational age assessment compared to BPD and FL. As TCD measurements are not affected by conditions which affect BPD, like moulding and dolicocephaly. The FL measurements can also be faulty due to inclusion of unossified epiphysis, however, such problems are not encountered during TCD measurement.[4]

Therefore, TCD being a stable parameter not affected by foetal growth status, may be preferred over other parameters in estimating foetal gestational age.[8,9]

CONCLUSION

Transverse cerebellar diameter has a linear relationship with gestational age in this clinical sample. A significant relationship was found between transverse cerebellar diameter, last menstrual period, and other foetal biometric parameters like femur length, biparietal diameter, head circumference, and abdominal circumference.

It is important to note that this study was performed in only one institution with small sample size. Therefore, further studies including multicentre studies in additional regions of the country are suggested to generate a reliable nationwide nomogram. Sonographic assessment of TCD in other comorbidities among pregnant women is suggested to validate these reference values.

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REFERENCES

1. Kalish RB, Chervenak FA. Sonographic determination of gestational age. Timisoara Med J. 2009;59(2):202-8. [Full Text | DOI]
2. Eze CU, Onwuzu QE, Nwadike IU. Sonographic reference values for foetal transverse cerebellar diameter in the second and third trimesters in a nigerian population. J Diagn Med Sonography.2017;33(3):174-81. [Full Text | DOI]
3. Sersam LW, Findakly SB, Fleeh NH. Foetal transcerebellar diameter in estimating gestational age in third trimester of pregnancy. J Res Med Dent Sci. 2019;7(5):60-6. [Full Text]
4. Mandal SK, Ghosh SK, Roy S, Prakash B. Evaluation of foetal transcerebellar diameter as a sonological parameter for the estimation of foetalgestational age in comparison to biparietal diameter and femur length. Int Arch Integr Med. 2019;6(6):41-50. [Full Text]
5. Reddy RH, Kumar P, Mahale A. Significance of foetal transcerebellar diameter in foetal biometry: A pilot study. J Clin Diagn Res. 2017 Jun;11(6):TC01-4. [PubMed | Full Text | DOI]
6. Hussain KA, Kadiyala S, Lakshmi AY, Hindumathi M. Foetal transcerebellar diameter to abdominal circumference ratio (TCD/AC) and to femur length ratio (TCD/FL) in the assessment of normal foetal growth. J NTR Univ Health Sci. 2019 Apr;8(1):5-10. [Full Text]
7. Goel P, Singla M, Ghal R, Jain S, Budhiraja V, Babu CR. Transverse cerebellar diameter-a marker for estimation of gestational age.J Anat Soc India.2010;59(2):158-61. [Full Text | DOI]
8. 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 Oct;7(10):4190-6. [Full Text| DOI]
9. Prasad VN, Dhakal V, Chhetri PK. Accuracy of transverse cerebellar diameter by ultrasonography in the evaluation gestational age of fetus. J Coll Med Sci Nepal. 2017 Mar;13(1):225-8. [Full Text | DOI]