International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Dewangan B et al. Int J Reprod Contracept Obstet Gynecol. 2022 Sep;11(9):2494-2498
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20222316

Original Research Article

Comparison of transcerebellar diameter with conventional fetal biometric parameters like biparietal diameter, head circumference, femur length and abdominal circumference in predicting gestational age in third trimester

Bhagyashree Dewangan*, Shivani Agarwal, Suman Lata Mendiratta

Department of Obstetrics and Gynecology, Kasturba Hospital, New Delhi, India

Received: 21 July 2022
Revised: 11 August 2022
Accepted: 12 August 2022

***Correspondence:**
Dr. Bhagyashree Dewangan,
E-mail: bhagya2991@gmail.com

ABSTRACT

Background: Gestational age estimation in third trimester is very crucial to impart holistic antenatal care and a pre-requisite to plan various interventions. Transcerebellar diameter can predict gestational age reliably as it grows progressively with gestation and is not affected by fetal lie, skull shape and fetal growth disorders. This study was performed to compare TCD with conventional parameters like BPD, HC, FL and AC in accurate prediction of gestation age.
Methods: Fetal biometry was performed on 140 women with singleton pregnancy by abdominal ultrasound. Women included were sure of their LMP, had dating scan and fetal anomalies were ruled out. Analysis was done using Pearsons coefficient (r) and regression, $p<0.05$ was considered statistically significant.
Results: GA by LMP showed maximum correlation with GA by TCD ($r=0.920$ $p<0.001$) followed by HC ($r=0.871$) and AC ($r=0.833$). Least correlation was seen with BPD ($r=0.789$). On comparing GA by TCD and GA by conventional parameters, TCD correlated maximally with HC ($r=0.882$) followed by FL ($r=0.868$) and BPD ($r=0.853$) and least correlation was seen with AC ($r=0.793$).
Conclusions: TCD can serve as a reliable parameter for evaluation of GA in women whose LMP is unknown or when they present late in pregnancy without having a dating scan because of strong and significant correlation of GA by TCD. Moreover, TCD can also provide accurate GA in cases of fetal growth restriction, macrosomia, skeletal dysplasia where BPD, AC, FL becomes unreliable. Therefore, it should be included in routine fetal biometry.

Keywords: Fetal biometry, Third trimester, Transcerebellar diameter, Gestational age

INTRODUCTION

Gestational age (GA) estimation plays a crucial role in imparting holistic antenatal care and deciding time of delivery and/or various interventions. Accurate assessment of gestational age can prevent adverse neonatal outcomes in the form of iatrogenic preterm deliveries, perinatal morbidity and mortality. There are various methods for estimation of gestational age like clinical dating by last menstrual period (LMP) or clinical examination of fundal height, retrospective neonatal evaluation and ultrasound (USG). In modern era, USG has become primary way of confirming pregnancy, assessment of fetal growth and estimation of gestation age through fetal biometry.

Fetal biometry includes ultrasonographically determined different fetal body parts measurements. Most widely used parameters also known as conventional parameters are crown-rump length (CRL) in first trimester, Biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) in second and third trimester.[1] It is critical to note that no single parameter can accurately indicate gestational age in all cases especially in third trimester due to their limitations causing discrepancy in estimation of gestation age. BPD and HC becomes unreliable in abnormal head shapes like dolico/brachy/hydrocephalus, fetal lie, position, etc. FL becomes unreliable in skeletal dysplasia, achondroplasia. AC becomes unreliable in fetal growth disorders like fetal growth restriction (FGR), macrosomia, Oligo/ polyhydramnios etc. Transcerebellar diameter (TCD) is an additional parameter to these convention parameters with various advantages. It is due to location of cerebellum in posterior fossa which is surrounded by dense petrous and occipital bone making its measurement least susceptible to changes in external factors. Measured by maximum diameter(mm) between cerebellar hemispheres on axial plane in the cerebellar view i.e. with a slight rotation of the transducer approximately 30° from the conventional thalamic plane.[2] Also, cerebellar measurements (TCD and vermis) are least likely to be affected from mild to moderate FGR.[3] As fetal cerebellum grows in linear fashion with advancing gestational age and has various benefits over conventional parameters it can predict gestational age reliably in third trimester. Hence this study was conducted to compare accuracy of TCD with conventional fetal biometric parameters in estimation of gestational age in third trimester.

METHODS

A prospective study was conducted on 140 pregnant women in their third trimester (28-40 weeks of gestation) who came for routine antenatal scan in obstetrics and gynaecology OPD in Kasturba Hospital, New Delhi, India from January 2020 to May 2021. Women included in the study were those whose last menstrual period was known, were having early pregnancy dating scan and single live non anomalous fetus without any high-risk factors. Period of gestation was calculated from LMP (using Naegeles formula) and confirmed with dating scan. After explaining the procedure to these women written informed consent was taken, form F was filled and abdominal USG was performed using GE LOGIQ 5 PRO ultra sound scanner. Fetal characteristics (lie, position, weight,) were noted and gestational age were obtained through biometry by following parameters BPD, HC, FL, AC and TCD. The collected data was entered into MS-Excel sheet and analysis was done using SPSS software version 21.0. Statistical analysis was done using paired t tests, Karl Pearsons correlation coefficient (r), and regression methods to compare different parameters in estimation of gestational age.

RESULTS

There was no significant influence of age, religion, occupation, parity and presentation on estimation of gestational age (GA) by different parameters. Mean age of participants was 24.14 years. Majority of them were Hindu, belonged to upper lower socioeconomic status and period of gestation (POG) between 32-36 weeks. (Table1, Figure 1-4).

Table 1: Mean age of participants.

Variable	Minimum	Maximum	Mean	SD
Age	18.00	35.00	24.14	3.1

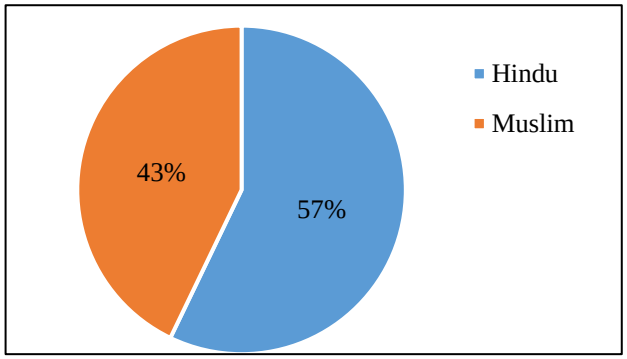

Figure 1: Distribution of subjects according to religion.

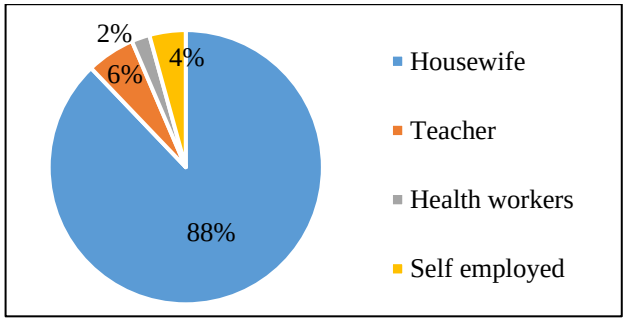

Figure 2: Distribution of subjects according to occupation

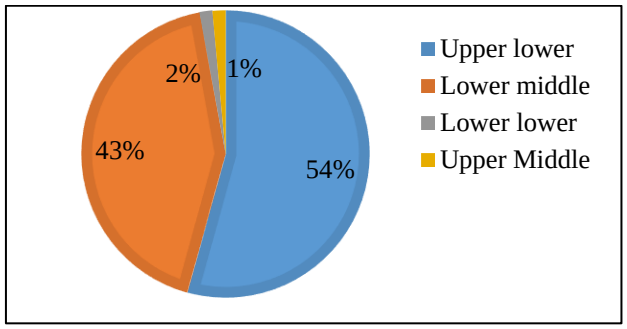

Figure 3: Distribution of subjects according to socioeconomic status.

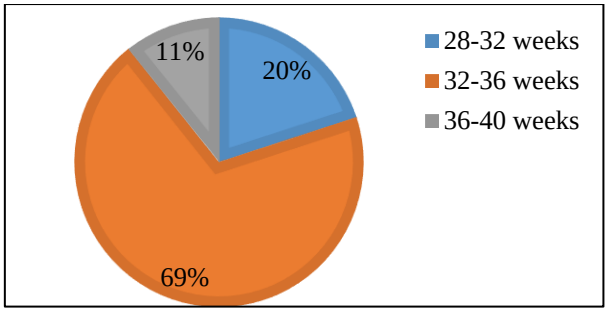

Figure 4: Distribution of participants according to gestational age in third trimester.

Mean GA based on LMP was found to be 34.06 weeks and all the parameters including TCD estimated it very close to mean value. Mean GA based on TCD was closest to it and was 33.87 weeks (Table 2).

Table 2: Mean gestational age by different parameters in weeks.

Variables	Minimum	Maximum	Mean	SD
POG-LMP	28.0	39	34.06	2.27
POG-CRL	28.0	38.0	33.71	2.18
BPD	29.0	38.0	34.47	2.28
HC	29.0	38.0	34.30	2.27
AC	28.0	38.0	32.62	2.20
FL	27.0	41	33.78	2.35
TCD	28.0	38.0	33.87	2.16

Mean difference in gestational age based on LMP and various parameters in third trimester is shown in Table 3. Least difference was seen with TCD, 0.348 weeks (2-3 days) followed by HC and FL. Maximum difference was seen with BPD, 0.830 weeks (6-7days).

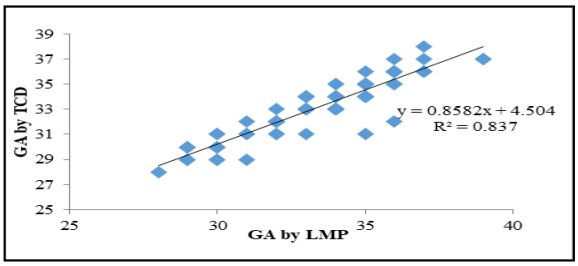

Figure 5: Regression analysis of GA by TCD with GA by LMP.

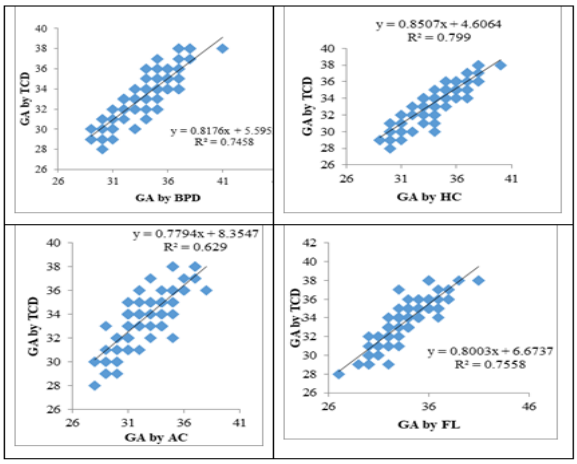

Figure 6: Regression analysis of GA by TCD with GA by different parameters.

Table 3: Mean difference between the GA by LMP with estimated GA by different parameters.

Paired samples test									
Variables		**Paired differences**					**t**	**Df**	**Sig. (2-tailed)**
		Mean	**SD**	**SEM**	**95% CI of the difference**				
					Lower	**Upper**			
Pair 1	POG-LMP-TCD	0.2214	0.8982	0.0759	0.0713	0.3715	2.917	139	0.348
Pair 2	POG-LMP-BPD	-0.5714	1.4989	0.1267	-0.8219	-0.3210	-4.511	139	0.830
Pair 3	POG-LMP-HC	-0.4143	1.2918	0.1092	-0.6302	-0.1984	-3.794	139	0.788
Pair 4	POG-LMP-AC	1.3214	1.3372	0.1130	1.0980	1.5449	11.693	139	0.747
Pair 5	POG-LMP - FL	0.1571	1.1891	0.1005	-0.0416	0.3558	1.564	139	0.788

Table 4: Pearson's correlation of gestational age by LMP compared with other methods.

Variables		POG LMP	POG CRL	BPD	HC	AC	FL	TCD
POG LMP	r	1	0.963*	0.789*	0.871*	0.833*	0.861*	0.920*
	Sig.	-	0.001	0.001	0.001	0.001	0.001	0.001
POG CRL	r	0.963*	1	0.823*	0.888*	0.814*	0.864*	0.934*
	Sig.	0.001	-	0.001	0.001	0.001	0.001	0.001
BPD	r	0.789*	0.823*	1	0.883*	0.604*	0.800*	0.864*
	Sig.	0.001	0.001	-	0.001	0.001	0.001	0.001
HC	r	0.871*	0.888*	0.883*	1	0.737*	0.810*	0.894*
	Sig.	0.001	0.001	0.001	-	0.001	0.001	0.001

Continued.

Variables		POG LMP	POG CRL	BPD	HC	AC	FL	TCD
AC	r	0.833*	0.814*	0.604*	0.737*	1	0.753*	0.793**
	Sig.	0.001	0.001	0.001	0.001	-	0.001	0.001
FL	r	0.861*	0.864*	0.800*	0.810*	0.753*	1	0.869*
	Sig.	0.001	0.001	0.001	0.001	0.001	-	0.001

*Correlation is significant at the 0.01 level (2-tailed).

On Pearsons correlation, as depicted in (Table 4), TCD showed strong positive association and correlated the most with GA by LMP, r value=0.920 r^2=84.0%, p<0.001. Other parameters in sequence were first HC (r=0.871 r^2=74.9%, p<0.001) followed by FL (r=0.861 r^2=74.2%, p<0.001) followed by AC (r=0.833, r^2=70.3%, p<0.001). The parameter that correlated least with GA by LMP was BPD (r=0.789 r^2=61.6%, p<0.001). On correlation of GA by different parameters with GA by TCD, HC showed maximum correlation with GA by TCD (r=0.894). Second parameter that correlated most with GA by TCD was FL (r=0.869) and least correlation was seen with AC (r=0.793). Regression analysis is shown in (Figure 5-6). TCD showed significant curvilinear association with GA by LMP and various conventional parameter indicating TCD as significant predictor of gestation age in third trimester. Using this method, equations can be derived to calculate gestational age by TCD.

DISCUSSION

Gestational age (GA) estimation is highly desirable to plan and execute various interventions in pregnant females. It not only allows dating of pregnancy but also help distinguishing normal and abnormal fetal growth patterns. In modern era of advanced imaging, fetal biometry using USG plays an important role in estimation of gestational age. Most widely used parameters are BPD, HC, AC and FL. Nevertheless, they have certain limitations that leads to discrepancies in determining gestational age. Transcerebellar diameter (TCD) is an additional parameter over these parameters. Since cerebellum lies in posterior fossa surrounded by dense petrous and occipital bone, it is more resistant to deformation caused by external pressure. Also, it is least affected by mild to moderate utero-placental insufficiency. Hence it can be used reliably for accurate determination of gestational age. This study was performed to compare the accuracy of TCD with the conventional fetal biometric parameters so that it can be included in routine fetal biometry to allow superior estimate of gestation age especially in cases of disparity in period of gestation and/or fetal growth disturbances. The study showed that all the parameters estimated mean gestational age close to GA by LMP which was 34.06 weeks. TCD was closest to the mean value among all parameters showing mean GA of 33.87 weeks which determines that TCD is comparable with convention parameters. In the present study, the mean difference in gestation age from GA by LMP in third trimester was least with TCD 0.348 weeks (±2-3days) when compared to other parameters making it more accurate. Maximum difference was seen with BPD, 0.830 weeks (±6-7days) which was similar to the study performed by Dashottar et al that showed difference of 0.011±1.18 weeks with TCD followed by BPD (0.09±1.04 weeks).[4] On Pearson's correlation, GA by LMP showed maximum correlation with GA by TCD (r=0.920, r^2=84.0%, p<0.001) compared to the others. Correlation of GA by LMP with other parameters were first HC (r=0.87) followed by FL (r=0.861) followed by AC (r=0.833). The parameter that correlated least with GA by LMP was BPD (r=0.789). Similar to present study, the study performed by Chavez MR revealed maximum correlation with TCD (r=0.92; p<.001).[5] Gupta et al in their study observed that in women who are not sure of their LMP, TCD can be measured for accurate estimation of gestation age (r=+0.946, r^2=89.6% and p<0.001).[6] Pavithra et al found that correlation of TCD (r=0.983) was superior when compared with HC (r=0.979), BPD (r=0.978), FL (r=0.976) and AC (r=0.966).[7] According to a study by George et al when compared to BPD, FL and AC, TCD provides the most accurate estimate of gestational age (r=0.995 p<0.001). The regression method obtained from trans-cerebellar diameter measurement can be used to calculate a gestational age of fetus.[8] In the present study, on correlation of GA by different parameters with GA by TCD there was significant association with conventional parameters. TCD showed maximum correlation with GA by HC (r=0.894) followed by FL (r=0.869) and least correlation was seen with AC (r=0.793). Matthur et al in their study also found similar curvilinear relationship between TCD and BPD, TCD and HC, TCD and AC and TCD and FL with correlation coefficient being 0.9810, 0.9181, 0.9649 and 0.9513.[9] In concordance with our study, study performed by Goldstein et al TCD correlated more with HC (r=0.969) than BPD (r=0.956).[10] Another study performed by Zakaria AM et al., also found TCD to be the most reliable (p<0.001) followed by FL and least accurate was BPD.[11]

Limitations

Our study included small sample size (140 subjects). As TCD is not routinely performed in fetal biometry, women with irregular cycles and high-risk factors were excluded to get accurate results further decreasing our sample size. Hence, studies with large sample size may be required to corroborate our findings to establish TCD as better predictor of gestational age in third trimester.

CONCLUSION

This study showed significant curvilinear relationship of TCD with advancing gestational age and on comparison of TCD with conventional fetal biometric parameters like BPD, HC, FL and AC it demonstrated similarity and

agreement in estimation of gestational age in third trimester. Moreover, TCD was found to be strongly correlated with HC and FL and more accurate than BPD and AC in third trimester. Therefore, it can be used for dating of pregnancy in women who are not sure of their LMP or with irregular cycles and present late in pregnancy without a dating scan. In addition, in fetal growth aberrations which affects mainly AC and FL causing discrepancy in estimation of gestational age, TCD can be used reliably as single most parameter as cerebellum is least affected by mild to moderate utero-placental insufficiency. Similarly, TCD can also be used in skeletal dysplasia and conditions altering shape of skull as cerebellum is resistant to deformation caused by external factors. TCD can act as an internal check for the conventional parameters and hence should be included in routine fetal biometry.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. Adarsh Kaur Gakhar and department of radiology for their assistance and technical support.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Callen P. Ultrasonography in obstetrics and gynecology. 3rd ed. Philadelphia, PA: WB Saunder; 1994.
2. Sharma G, Ghode R. Fetal transcerebellar diameter and transcerebellar diameter abdominal circumference ratio as a menstrual age independent parameter for gestational age estimation with grading of cerebellar maturity. Int J Reprod Contracept Obstet Gynecol. 2015;4:2036-40.
3. Fleischer AC. Ultrasonography of the prenatal and neonatal brain. J Perinatol. 2002;22(5):431.
4. 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 Contraception Obstet Gynecol. 2018;7(10):4190.
5. Chavez MR, Ananth C V, Smulian JC, Yeo L, Oyelese Y, Vintzileos AM. Fetal transcerebellar diameter measurement with particular emphasis in the third trimester: a reliable predictor of gestational age. Am J Obstet Gynecol. 2004;191(3):979-84.
6. Gupta A, Banerjee A, Rammurthy N, Revati P, Jose J, Karak P, et al. Gestational age estimation using transcerebellar diameter with grading of fetal cerebellar growth. Natl J Clin Anat. 2012;1(3):115-20.
7. Priya P. Determination of gestational age: correlation between foetal biometry and transverse cerebellar diameter in women with uncomplicated pregnancy. Int J Reprod Contracept Obstet Gynecol. 2017;6(8): 3599-603.
8. George R, Amirthalingam U, Hussain MRK, Aditiya V, Anand AM, Padmanaban E, et al. Can trans-cerebellar diameter supersede other fetal biometry in measuring gestational age? A prospective study. Egypt J Radiol Nucl Med. 2021;52(1):197.
9. Cinnusamy M, Shastri D, Martina J. Estimation of gestational age by ultrasound measurement of fetal transcerebellar diameter. J Anat Soc India. 2021; 70(1):19-24.
10. Goldstein I, Reece EA, Pilu G, Bovicelli L, Hobbins JC. Cerebellar measurements with ultrasonography in the evaluation of fetal growth and development. Am J Obstet Gynecol. 1987;156(5):1065-9.
11. Zakaria AM, Mohamed AH, Eldarder AKM. Comparison between transcerebellar diameter, biparietal diameter and femur length for gestational age measurement accuracy in third trimester of pregnancy. Egypt J Hosp Med. 2019;74(1):17.

Cite this article as: Dewangan B, Agarwal S, Mendiratta SL. Comparison of transcerebellar diameter with conventional fetal biometric parameters like biparietal diameter, head circumference, femur length and abdominal circumference in predicting gestational age in third trimester. Int J Reprod Contracept Obstet Gynecol 2022;11:2494-8.