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Reliability of trans-cerebellar diameter for gestational age in comparison to crown rump length

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Abstract

Background and objective: accurate estimation of gestational age is important for perfect antenatal care, as many pregnant women may don't know their last menstrual period & not have a first-trimester ultrasound that is accurate in estimating the gestational age, and the routine fetal biometry in the second & third trimesters may be unreliable for some reason. Therefore, it's necessary to develop an ultrasonographic parameter capable of reliably estimating gestational age at any point during pregnancy. This study aims to compare the accuracy of trans-cerebellar diameter (TCD) in n 2nd and 3rd trimesters for the calculation of estimated gestational age with the first-trimester crown rump length (CRL) which is the most accurate measurement for the estimation of gestational age.

Methods: This is a prospective study conducted in Erbil from the 1st of January 2021 to the 10thof August 2022. A total sample of 258 antenatal women was included. The ultrasound examination was performed by a GE Voluson ultrasound system (GE health care 2015) machine using a 3.5 MHZ curved transducer. The CRL was taken between 6-13 weeks of gestational age, and TCD between 15-38 weeks. TCD is measured by keeping the calibers on the outer margin of the cerebellar hemisphere. Data were analyzed using the statistical package for social science SPSS V. 26.

Results: The mean transcerebral diameter during different gestational ages was 16.35 (±0.76) less than 18 weeks gestation, 21.48 (±1.7) between 18-25 weeks gestation, 28.03 (±1.79) between 25-32 weeks gestation, 35.52 (± 1.84) above 32 weeks gestation respectively. There is a statistically significant linear correlation between TCD and ECRL with (rho=0.992) (*P* <0.001)

Conclusion: The accuracy of the TCD in the second & third trimester of pregnancy is comparable with the estimated CRL in the first trimester, so this will help us in the estimation of the gestational age for pregnant women with unknown LMP and unavailable first-trimester dating scan.

Keywords: Crown-rump length; Trans-cerebellar diameter; Estimated gestational age; 1st trimester; 3rd trimester.

Introduction

There are significant implications in neonatal and maternal morbidity as a result of unnecessary induction, dysfunctional labor, and cesarean section, [1] therefore, an accurate estimation of gestational age is fundamental for the obstetrician for dating the expected date of delivery and provide high-quality antenatal health.[2-4]

There are two ways for accurate estimation of the gestational age in the first trimester, first based on the date of the last menstrual cycle. However, this method to be accurate for estimation of the gestational age if the cycle was regular, fertilization in mid-cycle, and knowing the accurate first day of LMP.[5]

The second way is based on the

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crown-rump length which is the most accurate measurement for assessing fetal gestational age by ultrasonography either by transabdominal or tranasvaginal approach.[6-8]

The CRL is the longest measurable length from the cranial to the caudal end of the embryo excluding the limbs and yolk sac.[9]

Women may not have a first-trimester ultrasound that has good gestational accuracy and they may come for their first visit at the late second trimester or even in the third trimester due to socioeconomic reasons. most of them are uneducated come from remote areas. some of them lactating or they have irregular cycles, and fetal biometry in the second & third trimesters may be inaccurate as reliability of any ultrasound method greatly diminish as gestation advances. It is, therefore, necessary to develop an ultrasonographic parameter capable of reliably estimating gestational age at any point during pregnancy.[10,11]

The cerebellum begins to develop at 5 weeks of gestation and continues throughout the pregnancy. On ultrasonography (USG) the growth changes of the cerebellum can be evaluated by measuring the maximum diameter of the cerebellum.[12]

The cerebellum is located in the posterior cranial fossa and is the largest part of the hindbrain. A fourth ventricle separates it from the pons and medulla. The tentorium cerebelli separates the cerebrum from the cerebellum. There are two lateral hemispheres and a midline part of the cerebellum called the vermis.[13]

This study aims to compare the accuracy of TCD in 2nd and 3rd trimesters with the first-trimester CRL for the calculation of estimated gestational age

Methods

Design and sample collection:

This is a prospective study conducted on antenatal women of any age and parity attending Erbil maternity teaching hospital and my private clinic for regular checkup, in Kurdistan region-Iraq from the 1st of January 2021 to the 10th of August 2022. As a result, a total sample of 316 women was examined.

Inclusion criteria:

all women with confirmed last menstrual period, regular cycles and

single-tone non-complicated pregnancies. Women having first trimester ultrasound and consenting to participate in the study.

Exclusion criteria:

High risk pregnancies were excluded including, hypertensive, diabetic mothers, fetal growth restrictions and congenital anomalies. In addition we have excluded (58) cases due to loss of follow-up, the remaining 258 cases enrolled in the study.

Procedure:

The ultrasound examination was performed by a specialist radiologist with 14 year experience in obstetrics and gynecology ultrasound examination. The CRL was taken between 6-13 weeks of gestational age, and TCD between 15-38 weeks. The patient lying supine with straight lower limbs. The CRL was measured in the first trimester by applying the international society of ultrasound in obstetric and gynecology (ISUOG) criteria,[9,14] these include accurate magnification of the image, neutrality of the fetus, horizontal position of the fetus, accurate placement of the calipers, and the presence of a pocket of amniotic fluid under the fetus chin (Figure 1). The difference between the gestational age calculated from LMP and the use of CRL was assessed. TCD was measured in a transverse plain focusing on thalami and then shifting the probe caudally to show the characteristic butter-fly-shaped appearance of the cerebellar hemisphere. TCD is measured by keeping the calibers on the outer margin of the cerebellar hemisphere (Figure 2).

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Figure 1 The CRL is measured in the first trimester by applying the international society of ultrasound in obstetric and gynecology (ISUOG) criteria

Figure 2 TCD is measured in a transverse plane by keeping the calibers on the outer margin of the cerebellar hemisphere

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Ethical considerations:
The study protocol was approved by the Medical Ethics Committee of the College of Medicine of Hawler Medical University. Informed consent was obtained from all patients.

Statistical analysis:
Data were analyzed using the statistical package for social science (SPSS V. 26.) Spearman's correlation test was used and Correlation coefficients were also used to compare TCD and CRL with estimated GA. A *P* value of less or equal to 0.05 was considered statistically significant.

Results

This study included 258 pregnant women who underwent routine ultrasonographic examinations and the following measurements were obtained. The mean age (± SD) of pregnant women was (29.3 ± 6.4) years. Ranging from 16 to 47 years. The sample's highest percentage was among 20-29 years (43.8%), while the lowest was among 40-49 years (7%).

Among the pregnant women almost half were multiparous 124 women (48.1%), 75 women (29.1%) were nulliparous and about 59 women (22.9%) were primiparous.

Gestational age of the pregnant women ranged from 15 weeks and 2 days to 38 weeks and 4 days. About half (52.3%) of the pregnant were beyond 32 weeks gestation as shown in Table 1.

The mean transcerebral diameter during different gestational ages was 16.35 (±0.77) less than 18 weeks gestation, 21.47 (±1.69) between 18-24 weeks gestation, 28.03 (±1.79) between 25-32 weeks gestation, 35.52 (± 1.84) above 32 weeks gestation respectively, as shown in Table 2.

Table 1 Gestational age distribution of pregnant women

Gestational age	Frequency	Percent
Less than 18 weeks gestation	8	3.1
18-24 weeks gestation	56	21.7
25-32 weeks gestation	55	21.3
More than 32 weeks gestation	139	53.9
Total	258	100.0

Table 2 Mean TCD according to the gestational age

Gestational age	Number	%	Mean	Std. Deviation
Less than 18 weeks gestation	8	3.1%	16.350	0.7672
18-24 weeks gestation	56	21.7%	21.479	1.6888
25-32 weeks gestation	55	21.32	28.025	1.7936
More than 32 weeks gestation	139	53.88%	35.523	1.8427
Total	258	100%	30.282	6.4899

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There is a statistically significant linear correlation between TCD and ECRL with (rho=0.995) (*P* <0.001) as shown in Figure 3. In this study, Spearman's Correlation test was used to show the relationship between CRL during the first trimester and TCD for the same fetus in either the second or third trimester with the estimated GA. As it showed a statistically linear correlation between estimated gestational age and both parameters used. However, CRL was found to be a more reliable tool with (r=0.999) while TCD had (r=0.997), Figure 4

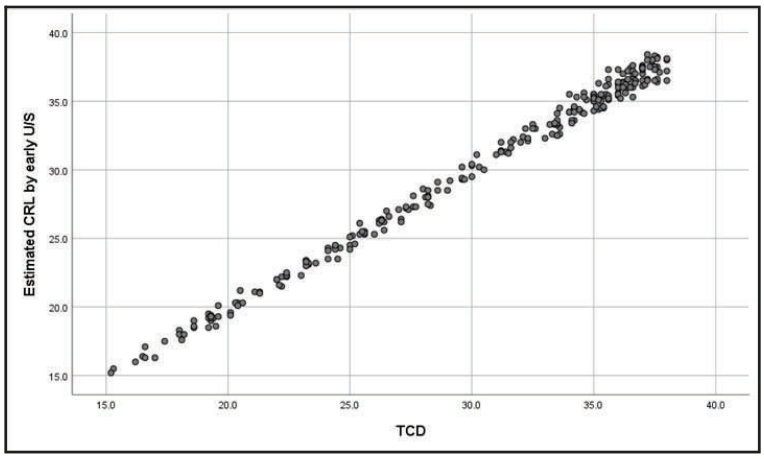

Figure 3 Scatter plot of TCD (measured in weeks) against CRL (in weeks)

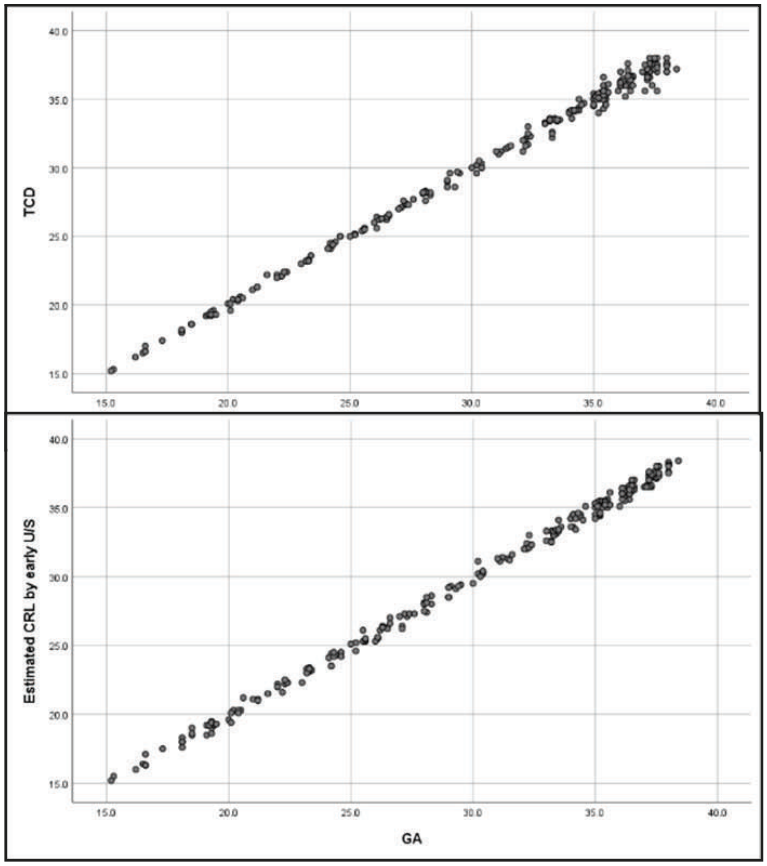

Figure 4 Scatter plot of TCD and CRL (measured in weeks) against estimated GA (in weeks)

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Discussion

A knowledge for calculating accurate gestational age is very helpful for the best possible prenatal care and successful pregnancy outcome[15]

Using of ultrasonography for measuring the gestational age in the first trimester is a highly reliable method,[16] for pregnant women who did not have a first-trimester dating scan. The most frequently used biometric parameters for estimating gestational age in the second and third trimester are biparietal diameter (BPD), head circumference (HC), femoral length (FL), and abdominal circumference (AC), but each of these parameters has their limitations & decreases accuracy with increasing fetal age.[17]

In this study, the mean age (± SD) of pregnant women was (29.3 ± 6.4) years. Ranging from 16 to 47 years. The sample's highest percentage was among 20-29 years (43.8%), which is comparable with a study done in India& Iraq.[10,18]

Among the pregnant women, almost half were multiparous 124 women (48.1%) similar results were seen in a study conducted in Pakistan[19]

Gestational age of the pregnant women ranged from 15 weeks and 2 days to 38 weeks, while in a study conducted in Turkey the gestational age was between 18-24 weeks.[20] Due to the difference in inclusion criteria.

Various studies have revealed that TCD in (mm) is almost equivalent to the gestational age of the fetus, The mean transcerebral diameter during different gestational ages was 16.35 (±0.77) less than 18 weeks gestation, 21.47 (±1.69) between 18-24 weeks gestation, 28.03 (±1.79) between 25-32 weeks gestation, 35.52 (± 1.84) above 32 weeks gestation respectively, similar findings were observed in a study conducted in India.[21]

This study revealed a strong correlation between TCD and the gold standard first-trimester CRL measurement where similar results was found in two studies conducted in the United States.[22,23]

Spearman's Correlation test was used to show the relationship between CRL and TCD with the estimated GA. As it showed a statistically linear correlation between estimated gestational age and both parameters there is a statistically significant correlation between TCD and ECRL with (R=0.992) (P <0.001, similar results were seen in a study done in India.[10]

Conclusion

The accuracy of the TCD in the second & third trimester of pregnancy is comparable with the estimated CRL in the first trimester on the same patients, so this will help us in the estimation of the gestational age for pregnant women with unknown LMP and unavailable first-trimester dating scan.

Funding

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

1. Prasad V, Dhakal V, Chhetri P. Accuracy of transverse cerebellar diameter by ultrasonography in the evaluation gestational age of fetus. JCMS Nepal 2017; 13(1):225–8
2. Ohuma E, Papageorghiou A, Villar J, Altman D. Estimation of gestational age in early pregnancy from crown-rump length when gestational age range istruncated: the case study of the intergrowth-21st Project. BMC Medical Res Methodol 2013; 13:151
3. Rintu G, Umamageswari A, Mohammed R, Vigneshwar A, Anand A, Elamparidhi P, 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. https://doi.org/10.1186/s43055-021-00576-0
4. Merit K, Michaela G, Helle K, Alkistis S. Adhere to Swedish national pregnancy dating guidelines and management of discripancies between pregnancy dating methods: a survey study. 2019; 16:95. https://doi.org/10.1186/s12978-019-0760-3
5. Adeyekun A, Orji M. Predictive accuracy of transcerebellar diameter in comparison with other foetal biometric parameters for gestational age estimation among pregnant Nigerian women.

East Afr Med J 2014; 91(4):138–44
6. Christian P, James G, Yasser E, Methods for estimating the due and date. AIUM 2017; 129:150–4. https://doi.org/10.1097/AOG.0000000000002046
7. Rashid H. Frist-trimester fetal growth restricyion and occurrence of miscarriage in rural Bangladesh: A prospective cohort study. PLoS One 2017; 12(7) e0181967 https://doi.org/10.1371/journal.pone.0181967
8. Pexters A, Daaemen A, Bottomley C, Schoubroek DV, Catte LD, Moor BD, et al. New crwon-rump length curve based on 3500 pregnancies. ISUOG 2010; 35: 650–5
9. Jakub D, Owski O, Jedrzejek M,Salloum D, Torbe A, Kwiatkowski S. The crown rump length measurement-ISUOG criteria and clinical practice. Ginekologia Polska 2021; 91(11):674–8
10. Sharma R, Gupta N. Comparative Accuracy of Trans Cerebellar Diameter and Crown Rump Length for Estimation of Gestational Age. International Journal of Medical Imaging 2017; 5(3):38–41.
11. Naseem F, Ali S, Basit U, Fatima N. Assessment of gestational age; comparison between transcerebellar diameter versus femur length on ultrasound in third trimester of pregnancy. Preoffesional Med J 2014; 21(2): 412–7.
12. Nagesh R, Pramila S, Shukla A. Transverse Cerebellar Diameter – An Ultrasonographic Parameter For Estimation of Fetal Gestational Age. Int J Contemp Med Res 2016; 3(4):1029–31
13. Goel P, Singla M, Ghal R, Jain S, Budhiraja V, Babu C. Trans-cerebellar diameter- a marker for estimation of gestational age. J Anat Soc India 2010; 59(2) 158–61
14. Wanyonji S, Napolitano R, Ohuma E, Salmon L, Papageorghiou A. Image-scoring system for crown–rump length measurement. Ultrasound Obstet Gynecol 2014; 44(6):649–54 https://doi.org/10.1002/uog.13376
15. Charles E, Queendaline O, Innocent N. Sonographic reference values for fetal transverse cerebellar diameter in the second and third trimesters in a Nigerian population. JDMS 2017; 33(3):174–81. https://doi.org/10.1177//8756479316687997
16. Ruqqyah S, Sobiia N. Diagnostic Accuracy of Trancerebellar Diameter for gestational Age. JRMC 2017; 21(1):60–3. https://www.researchgate.net/publication/336459533
17. Sanjay M, Surajit G, Pratibha S, Dushyant A, Pawan G. Transverse cerebellar diameter: a reliable predictor of gestational age. Afri Health Sci 2020; 20(4):1927–32. https://dx.doi.org/10.4314/ahs.v20i4.51
18. Lilyan S, Najlaa F, Sura F. Fetal transcerebellar diameter in estimating gestational age in third trimester of pregnancy. J Res Med Dent Sci 2019; 7(5):60–6. https://www.researchgate.net/publication/337623322
19. Ruqqyah S, Sobiia N. Diagnostic Accuracy of Trancerebellar Diameter for gestational Age. JRMC 2017; 21(1):60–3
20. Raziye D, Ali I. Determination of Fetal Transcerebellar Diameter Nomogram in the Second Trimester. J Fetal Med 2019; 6:177–82. https://doi.org/10.1007/s40556-019-00223-9
21. Prabhat G, Mukesh S, Rashmi G, Shilpi J, Virendra B, Ramesh CS. Transverse cerebellar diameter – A marker for estimation of gestational age. J Anat Soc India 2010; 59(2):158–61. https://doi.org/10.1016/S0003-2778(10)80017-6
22. Saikat D, Mohammad M, Usha D, Arup D, Syed A, Pratibha D, et al. Performance of late pregnancy biometry for gestational age dating in low in comeand middle income countries: aprospective, multi-country, population-based cohort study from the WHO Alliance for Maternal and Newborn Health Improvement (AMANHI) study group, Lancet Glob Health 2020; 8(4):e545–54.
23. Michelle D, Shannon S, Paula W, Anne K. Sonographic assessment of fetal growth abnormalities. RG 2021; 41(1):268–88. https://doi.org/10.1148/rg.2021200081