The accuracy of trans cerebellar diameter in assessing gestational age in the second and third trimesters of pregnancy

Nasik Mahmood Majeed [1*]   Kataion Nadhim Khorsheed [2]   Alaa Jalal Hamasaleh [3]

Abstract

Background and objective: Accurate estimation of the fetal gestational age is the cornerstone for the management of all pregnancies. This study aims to assess the accuracy of Trans cerebellar diameter in comparison with the other previously established fetal biometric parameters in the second and third trimesters.

Methods: This is a prospective study conducted on 237 pregnant women who attended Erbil Maternity Teaching Hospital and a private clinic from January 2021 to July 2022.
The ultrasound of selected cases was performed on GE Voluson E6 and E8 ultrasound machines with a 3.5 MHz probe sector transducer.
Trans cerebellar diameter measurement was obtained by placing the electronic calibers from the outer portion of the proximal end of the cerebellum to the inner portion of the distal margin. Biparietal diameter, femoral length, head circumference, and abdominal circumference were measured using the standard technique by Hadlock tables. Data were tabulated and all the statistical analyses were done using SPSS version 26.

Results: The mean trans cerebellar diameter during different gestational ages was 19.95 (±1.2) mm between 18-22 weeks gestation, 25.45 (±1.7) mm between 23-28 weeks gestation, 29.79 (±1.15) mm between 29-32 weeks gestation, 34.29 (± 1.13) mm between 33-36 weeks gestation and 36.79 (±1.7) mm above 37 weeks gestation respectively. Differences between the estimated gestational age and the gestational age assessed by trans cerebellar diameter ranged from -7 to 6 days irrespective of the gestational age.

Conclusion: Even in the third trimester trans cerebellar diameter is a fairly accurate and better predictor of gestational age in comparison to other ultrasound parameters such as biparietal diameter, head circumference, abdominal circumference, and femoral length.

Keywords: Biparietal diameter; Gestational age; Trans cerebellar diameter; Ultrasound.

Introduction

Accurate estimation of the fetal gestational age is the cornerstone for the management of all pregnancies. [1,2] Because of the high incidence of natal mortality in patients whose gestational age is not known, ultrasound parameter measurements are used to assess fetal age. [3]

The most established biometric parameters are the biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femoral length (FL). However, because of the variability of these parameters, which increases with increased gestational age, many pregnant women who are not sure about the dates of their last cycle and do not possess early dating scans that help in estimating the gestational age. [4,5,6] Transverse cerebellar diameter (TCD) is an alternative parameter to assess fetal brain growth and estimate the gestational age as a way to address this problem [7].

The cerebellum appears in the embryo at the end of the 5th week of gestation and consists of a central part called the vermis

[1] Department of Radiology, Erbil Directorate of Health, Maternity Teaching Hospital, Erbil, Iraq.
[2] Department of General Surgery, College of Medicine, Hawler Medical University, Erbil, Iraq.
[3] Erbil Directorate of Health, Erbil, Iraq.
Correspondence: drnasik21@gmail.com

which connects to the lateral hemisphere. Sonographically, it can be easily visualized from the second trimester and onwards, and it is measured as the diameter of two cerebellar hemispheres in axial image in mm units.[8, 9]

The cerebellum is located in the posterior cranial fossa, dorsal to the pons and medulla, separated from them by a fourth ventricle encased by the petrous ridge and occipital bone, which protects it from extrinsic pressure and deformation. When the head is abnormal or in a difficult position cerebellum development is hardly influenced, even in cases of placental insufficiency due to brain sparing mechanism.[10]

The aim of this study is to assess the accuracy of TCD in comparison with the other previously established fetal biometric parameters in the second and third trimesters.

Methods

Study design: This is a prospective study conducted on 237 pregnant women who attended Erbil Maternity Teaching Hospital and a private clinic from January 2021 to July 2022.

Inclusion and exclusion criteria
The inclusion criteria were single tone uncomplicated pregnancy of 18-38 WKs gestational age with regular menstruation and known last menstrual period. Cases with congenital anomalies, twin pregnancies twin pregnancies, intrauterine growth retardation, or medical disorders like diabetes mellitus, hypertension, and other chronic maternal disease were excluded.

Informed consent was taken from each patient before the procedure.

Ethical consideration
The study was given ethical approval by the ethical committee of the College of Medicine/ Hawler Medical University.

The ultrasound of selected cases was performed on GE Voluson E6 and E8 ultrasound machines with a 3.5 MHz probe sector transducer.

The TCD was measured from a transverse view of fetal intracranial anatomy at the transthalamic view then inclination toward posterior fossa. The characteristic butterfly appearance of the cerebellum appears as two lobules on either side of the midline of the posterior cranial fossa.

Fetal TCD was measured using the widest diameter of the cerebellum, as shown in Figures 1 and 2.

The BPD, FL, HC, and AC were measured using the standard technique by Hadlock tables. Data were tabulated and all the

Statistical analyses
Statistical analyses were done the Statistical Package for Social Sciences (SPSS, version 26). Pearson chi-square and Pearson correlation coefficient tests were used. A *P* value of ≤ 0.05 was considered statistically significant.

Figure 1 Sonographic measurement of transcerebellar diameter of a 20-week fetus.

Figure 2 Sonographic measurement of transcerebellar diameter of a 35-week fetus.

Results

This study included 237 pregnant women who underwent routine ultrasonographic examinations and the following measurements were obtained.

The mean age (± SD) of the pregnant women was (29.5 ± 6.3) years. Ranging from 16 to 47 years with the most frequent percentage being among women between 20-29 years of age. Among the pregnant women almost half were multiparous 116 women (48.9%) as shown in Table 1.

The mean TCD during different gestational ages was 19.95 (±1.2) between 18-22 weeks gestation, 25.45 (±1.7) between 23-28 weeks gestation, 29.79 (±1.15) between 29-32 weeks gestation, 34.29 (± 1.13) between 33-36 weeks gestation and 36.79 (±1.7) above 37 weeks gestation respectively, as shown in Table 2.

Table 1 Basic characteristics of the patients

	No.	(%)
Age (years)		
< 20 years	20	(8.4)
20-29	101	(42.6)
30-39	100	(42.2)
40-49	16	(6.8)
Parity		
Primiparous	55	(23.2)
Multiparous	116	(48.9)
Nulliparous	66	(27.8)
Gestational age (weeks)		
18-22	28	(11.8)
23-28	44	(18.6)
29-32	25	(10.5)
33-36	71	(30.0)
≥ 37	69	(29.1)
Total	237	(100.0)

Table 2 Mean TCD according to the gestational age

Gestational age (Wks)	No.	(%)	Mean ± (SD)
18-22	30	13.52	20.18 (1.41)
23-28	45	20.27	26.14 (1.73)
29-32	26	11.71	31.18 (1.17)
33-36	86	38.74	35.21 (1.10)
≥37	35	15.76	37.83 (1.21)
Total	222	(100.0)	31.28 (6.49)

The mean (± SD) TCD obtained during the ultrasonographic examinations was 31.2 (± 5.95) mm. Table 3 shows the mean TCD in each week of gestation, and the findings were statically significant (P <0.001).

In this study, Spearman's Correlation test was used to show the relationship of various ultrasonographic parameters with the estimated GA. As it showed a statistically linear correlation between estimated gestational age and the various parameters used to assess the age of the fetus (BPD, FL, AC, HC, and TCD) as shown in Table 4, and the graphical representations of the collected data.

Table 3 Distribution of mean TCD according to estimated GA

Gestational age (Wks)	No.	(%)	Mean ± (SD)
18	5	2.25	18.26 (0.21)
19	9	4.05	19.34 (0.26)
20	8	3.60	20.41 (0.29)
21	4	1.80	21.70 (0.38)
22	4	1.80	22.47 (0.35)
23	5	2.25	23.30 (0.07)
24	9	4.05	24.44 (0.27)
25	5	2.25	25.50 (0.33)
26	9	4.05	26.43 (0.29)
27	10	4.50	27.50 (0.37)
28	7	3.15	28.54 (0.37)
29	4	1.80	29.32 (0.17)
30	7	3.15	30.41 (0.27)
31	5	2.25	31.36 (0.20)
32	10	4.50	32.39 (0.33)
33	16	7.20	33.47 (0.27)
34	16	7.20	34.51 (0.36)
35	24	10.81	35.35 (0.20)
36	30	13.51	36.39 (0.22)
37	35	15.76	37.83 (1.21)
Total	222	(100.0)	31.28 (6.49)

Table 4 Table showing correlation of EGA with TCD, BPD, FL, AC, and HC

Parameters	*P* value	r-value
EGA versus TCD	< 0.001	0.960
EGA versus BPD	< 0.001	0.949
EGA versus FL	<0.001	0.953
EGA versus AC	<0.001	0.947
EGA versus HC	<0.001	0.951

According to the findings in Figure 3, TCD was shown to be also a strong and reliable measure of GA assessment as it also had a statistically significant r value (r=0.960).
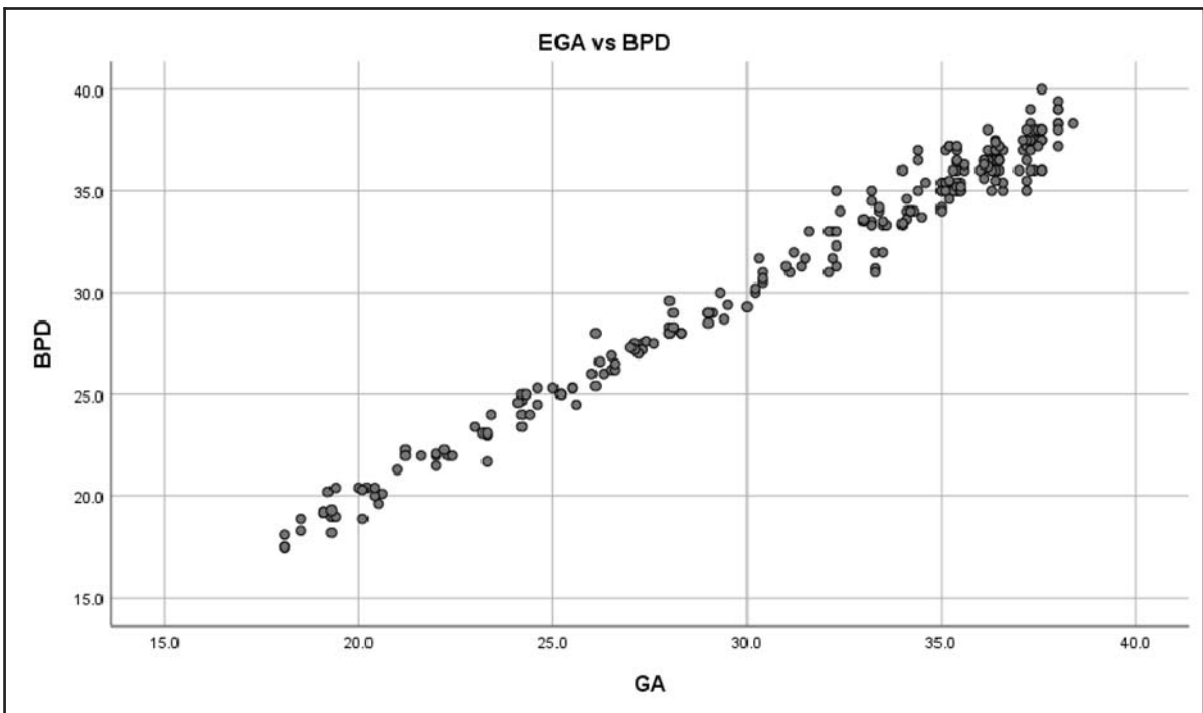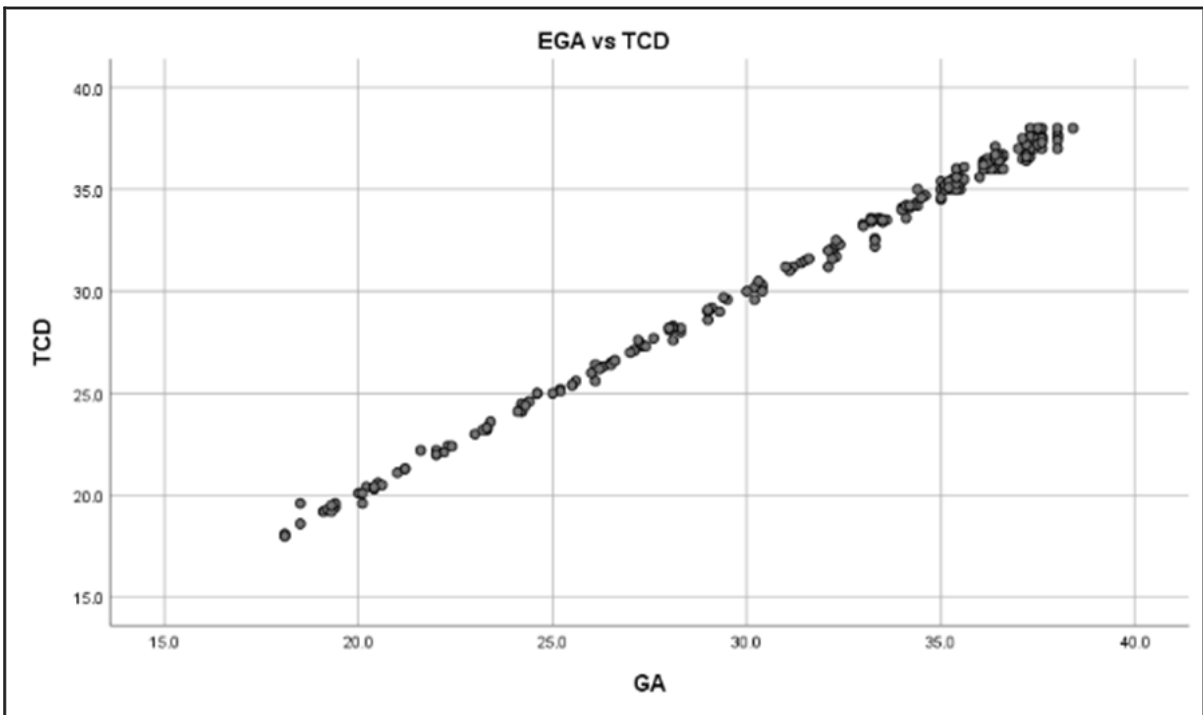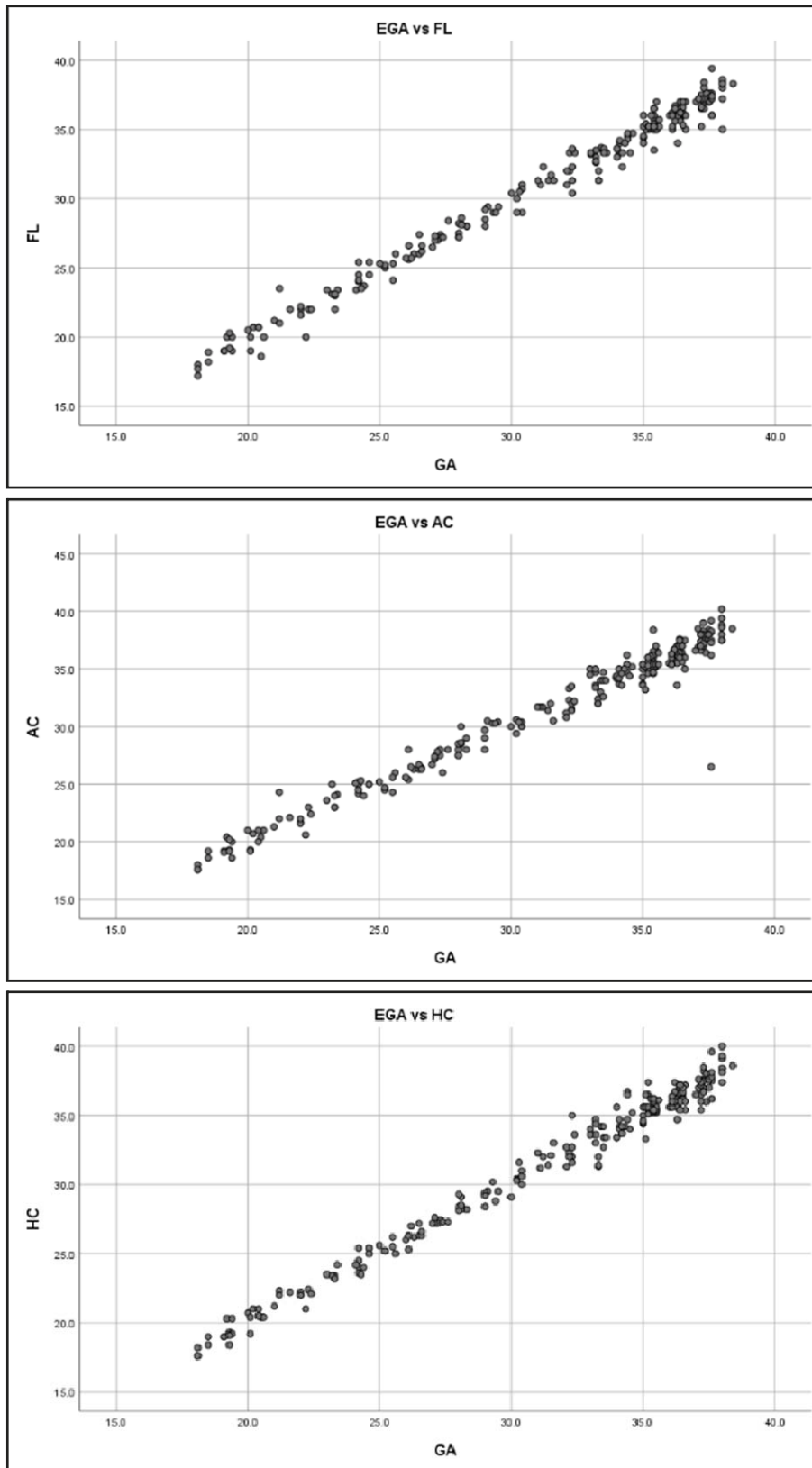
Figure 3 Scattered diagrams for TCD for its corresponding GA, showing a linear graph

Differences between the estimated GA and the GA assessed by TCD ranged from -7 to 6 days irrespective of the gestational age, as seen in Table 5. However, with the increase in estimated GA, there was a significant drop in accuracy of the GA assessed by TCD, the findings were statistically significant (P <0.001) as seen in Table 6.

Table 5 Difference in days of estimated gestational age and the age assessed by TCD

Difference in days		Frequency	Percent
Valid	+/- 1 day	124	52.3
	+/- 2-3 days	80	33.8
	> +/- 3 days	33	13.9
	Total	237	100.0

Table 6 Correlation of Trans cerebellar diameter with gestational age

	Trans cerebellar diameter difference in days			
Gestational age (weeks)	**+/- 1 day**	**+/- 2-3 days**	**>+/- 3 days**	**Total**
18-22	21 75.0%	6 21.4%	1 3.6%	28 100%
23-28	32 72.7%	10 22.7%	2 4.5%	44 100%
29-32	14 56.0%	8 32.0%	3 12.0%	25 100%
33-36	35 49.3%	27 38.0%	9 12.7%	71 100%
≥ 37	22 31.9%	29 42.0%	18 26.1%	69 100%
Total	124 52.3%	80 33/8%	33 13.9%	237 100%

Pearson Chi-square = P value < 0.001

Discussion

Precise gestational age measurement is the cornerstone for the management of a planned delivery regarding termination of pregnancy, elective induction of labor, elective caesarian section, management of high-risk pregnancies, and assessing the intrauterine growth restriction and it is one of the ways to assess the well-being of the fetus.[11,16]

With the introduction of high-resolution real-time ultrasonography, different parameters have been used to assess the GA of a fetus as BPD, FL, AC, and HC. Nevertheless, each of these parameters has its limitations, head shape is one of the factors that contributes to accurate BPD measurement as dolichocephaly underestimates the BPD parameter measurement and brachycephaly overestimates it, FL underestimated in cases of IUGR and bone dysplasia, AC may be overestimated in cases of ascites or organomegaly and underestimated in cases of IUGR. The variability in assessing gestational age using those parameters increases as the pregnancy advances.[3,7]

In this study, the mean age at presentation was 29.5 years. Ranging from 16 to 47 years, where similar results were found in studies conducted in Iraq and Turkey.[8,12] Among the pregnant women, almost half were multiparous 116 women (48.9%). Similar results were reported in an Iraqi study.[8]

According to this study, the maximum number of women (30%) were between 29-32 weeks gestation, in contrast to studies conducted in India and Nepal where the highest number of women were 21-25 weeks gestation and below 27 weeks of gestation respectively.[10,15,16] This can be explained by the fact that all of the patients in this study were examined in a maternity tertiary center where they came for managing their pregnancy-related complaints

Various studies have revealed that TCD in (mm) is almost equivalent to the gestational age of the fetus, As our study showed the mean (± SD) trans cerebellar diameter obtained during various gestational ages was 19.95 (±1.2) between 18-22 weeks gestation, 25.45 (±1.7) between 23-28 weeks gestation, 29.79 (±1.15) between 29-32 weeks gestation, 34.29 (± 1.13) between 33-36 weeks gestation and 36.79 (±1.7) above 37 weeks gestation respectively, similar findings were observed in a study conducted in India.[15]

Our study showed a strong direct relationship between the estimated gestational age and trans cerebellar diameter this is in agreement with other studies done in Egypt, India, and Nepal.[17-20]

In this study, TCD measurements correlated more with the estimated gestational age by LMP when compared to BPD, FL, and AC with the highest correlation coefficient (r= 0.960 for TCD vs r= 0.949, r= 0.953 and r= 0.947 for BPD, FL, and AC respectively) similar results were seen in a study conducted in Iraq. [8]

Conclusion

TCD can be used as a single parameter to estimate the gestational age in the second and third trimester, when the last menstrual period is uncertain.

Funding

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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