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Comparative Study between Fetal Biometry and Transverse Cerebellar Diameter in Estimating Gestational Age in Third Trimester

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ABSTRACT

Background: The exact determination of gestational age is so important in management of the antepartum care, and for adequate planning of proper intervention or therapy. Tanscerebellar diameter has great advantages in prediction of gestational age in cases of uncertain dates or in suspected intrauterine growth retardation. There are minimal data available about the relationship between tanscerebellar diameter and biparietal diameter in third trimester of pregnancy.

Objective: The aim of the present study was to assess the accuracy of transcerebellar diameter (TCD) measurement in estimation of the gestational age during the third trimester compared to the current fetal biometric measurements including femur length and biparietal diameter.

Patient and Method: The study included 500 pregnant women with sure and reliable dates fulfilling the inclusion criteria at the Department of Obstetrics and Gynecology, Al-Azhar (Bab Alsheria) university Hospital, (inpatient and outpatient) from May 2018 till November 2018. The entire subjects were in the third trimester of pregnancy seen at 31 – 36 weeks, the transcerebellar diameter, the biparietal diameter and femur length were measured for determination of gestational age.

Results: The results showed that the transcerebellar diameter (TCD) is more accurate than the biparietal diameter (BPD). There were insignificant statistical difference between transcerebellar diameter (TCD) and femur length (FL) for determination of gestational age in the third trimester whereas there was a significant difference between the transcerebellar diameter (TCD) and the biparietal diameter (BPD) for determination of gestational age in the third trimester. All those data were compared to the last menstrual period.

Conclusion: Transcerebellar diameter is more reliable method of gestational age determination in third trimester of pregnancy than biparietal diameter. Transcerebellar diameter (TCD) and femur length (FL) can be used as a tool to assist in the assessment of gestational age in third trimester.

Keywords: Transcerebellar diameter - femur length - biparietal diameter – gestational age.

INTRODUCTION

The estimate of the date of pregnancy is mandatory for pregnant women in order to obtain the expected time of delivery, in which different tests will be conducted to achieve the estimated time. There are methods used to determine the gestational age, including menstruation and clinical examination, as well as ultrasound imaging [(1)].Accurate pregnancy determination is one of the most useful assessments of pregnancy, which depends on whether or not the patient is pregnant. In order to decrease the biologic variability among fetuses traditional biometry, ancillary biometric also non biometric measurements will be used in addition those measurements can also be used for the assessment of the gestational age and maturity of the fetal lung and some specific clinical situations as cases of oligohydramnios that manifested by fetal head and abdominal compression resulting in difficult determination of accurate abdominal circumference and biparietal diameter [(2)].

The aim of the current Work was to assess the accuracy of transcerebellar diameter (TCD) measurement in estimation of the gestational age during the third trimester compared to the current fetal biometric measurements (femur length and biparietal diameter) according to last menstrual period.

SUBJECTS AND METHODS

This observational study included a total of 500 pregnant women attending at Department of Obstetrics and Gynecology, Al-Azhar (Bab Alsheria) University Hospital.

Approval of the ethical committee and a written informed consent from all the subjects were obtained.

This study was conducted between May2018 till November 2018.

All the subjects were in the third trimester of pregnancy, the transcerebellar diameter, the biparietal diameter and femur length were measured for determination of gestational age.

The inclusion criteria included women in childbearing period singleton uncomplicated pregnancy, at 31-36 weeks of pregnancy calculated by the first day of last menstrual periods.

The Exclusion criteria were women who were unsure of dates, or those with anomalous fetus, intrauterine fetal death, subjects with multiple gestation, and Subjects with medical disorders like hypertension.

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Women in this study were subjected to Full History Taking which included the name, age, occupation and address. Obstetric history and 1st day of last menstrual period (LMP), gestational age documentation, medical or operative history, and any drug allergy or obstetric or operative complication were verified. Ultrasound was done for all subjects at clinic of Obstetrics and Gynecology Department-Faculty of Medicine, Al-Azhar University, mainly to measure the fetal transcerebellar diameter, biparietal diameter and femur length as parameters of gestational age estimation. The technique of ultrasound was trans-abdominal, while women were in a tilted position with the head of the bed raised 30 degrees and with a small pillow under the right loin.

Measurement of the Biparietal diameter was taken in the lateral ventricles view, a rugby-football-shaped skull, rounded at the back (occiput) and more pointed at the front (sinciput). Along midline equidistant from the proximal and distal scale echoes. The cavum septum pellucidum bisected the midline one-third of the distance from the sinciput to the occiput. The two anterior horns of the lateral ventricles symmetrically placed about the midline. All or part of the posterior horns of the lateral ventricles symmetrically placed about the midline. The BPD includes the thickness of only the upper parietal bone (outer to outer measurement).

Regarding the measurement of the transcerebellar diameter, obtaining the trans thalamic view of BPD then rotation of the probe slightly downwards, toward the fetal neck, the posterior horns of the lateral ventricles would be disappeared from the view to be replaced by the cerebellum. The T.C.D measured at 90 degree to the long axis of the cerebellum across its widest point, by the use of the outer to outer method.

Regarding the measurement of the femur length, the FDL is imaged optimally with both ends of the ossified metaphysis clearly visible. The longest axis of the ossified diaphysis is measured. The same technique as that used to establish the reference chart should be used with regard to the angle between the femur and the insonating ultrasound beams. An angle of insonation between 45◦ and 90◦ is typical. Regarding the Caliper placement, each caliper is placed at the ends of the ossified diaphysis without including the distal femoral epiphysis if it is visible.

Ultrasound device:

- Voluson E6 ultrasound apparatus, astria software.

Statistical methods

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

Data were statistically described in terms of mean ± standard deviation (± SD), and range, or frequencies (number of cases) and percentages when appropriate. Comparison between the different methods of estimating gestational age was done using paired *t* test. Accuracy of different estimation parameters in relation to the LMP parameter was done within 1-week error. *p* values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).

The following tests were done:

- Paired sample t-test of significance was used when comparing between related sample.
- The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:
- Probability (P-value)
  - P-value <0.05 was considered significant.
  - P-value <0.001 was considered as highly significant.
  - P-value >0.05 was considered insignificant.

RESULTS

Table (1): Descriptive statistics

	N	Range	Mean±SD
Age (years)	500	19-47	31.20±5.77
GA-LMP	500	31-36	33.97±1.52
GA-TCD	500	30-36	33.41±1.32
GA-FL	500	29-38	33.25±1.90
GA-AC	500	29-39	32.25±1.84
GA-BPD	500	27-37	31.75±1.87

This table shows the mean age of the study population and the mean gestational age by the reference date LMP, TCD, FL, AVC and BPD.

Table (2): Parity GA-LMP

GA-LMP	No.	%
31	2	0.4%
32	57	11.4%
33	95	19.0%
34	140	28.0%
35	100	20.0%
36	106	21.2%
Total	500	100.0%

This table shows the study population was 500, the gestational age according LMP the frequency of gestational age and percentage at (31-36 weeks).

Table (3): Parity: GA-TCD

GA-TCD	No.	%
31	4	0.8%
32	34	6.8%
33	107	21.4%
34	162	32.4%
35	139	27.8%
36	50	10.0%
37	4	0.8%
Total	500	100.0%

This table shows the study population was 500, the gestational age according TCD the frequency of gestational age and percentage at (31-37 weeks).

Table (4): Parity GA-FL

GA-FL	No.	%
30	5	1.0%
31	27	5.4%
32	55	11.0%
33	79	15.8%
34	104	20.8%
35	104	20.8%
36	70	14.0%
37	42	8.4%
38	12	2.4%
39	2	0.4%
Total	500	100.0%

This table shows the study population was 500, the gestational age according FL the frequency and percentage of gestational age in (30-39 weeks).

Table (5): Parity GA-AC

GA-AC	No.	%
29	9	1.8%
30	13	2.6%
31	26	5.2%
32	49	9.8%
33	77	15.4%
34	99	19.8%
35	101	20.2%
36	68	13.6%
37	34	6.8%
38	14	2.8%
39	10	2.0%
Total	500	100.0%

This table shows the study population was 500, the gestational age according FL the frequency and percentage of gestational age in (29-39 weeks).

Table (6): Parity GA-BPD

GA-BPD	No.	%
28	2	0.4%
29	10	2.0%
30	32	6.4%
31	59	11.8%
32	107	21.4%
33	141	28.2%
34	92	18.4%
35	32	6.4%
36	19	3.8%
37	4	0.8%
38	2	0.4%
Total	500	100.0%

This table shows the study population was 500, the gestational age according BPD the frequency of gestational a and percentage in (28-38 weeks).

Table (7): Comparison between LMP and TCD according to gestational age (wks).

Gestational age (wks)	Mean±SD	Mean Diff.	95% C.I		*Paired t-test*	p value
			Upper	Lower		
GA-LMP	33.97±1.52	0.56	0.14	0.98	1.588	0.106
GA-TCD	33.41±1.32					

p-value >0.05 NS;

This table shows no statistically significant difference between LMP and TCD according to gestational age (wks), the average difference was weak 0.56 and C.I. 95% (0.14-0.98) with p-value >0.05 NS.

Table (8): Comparison between LMP and FL according to gestational age (wks).

Gestational age (wks)	Mean±SD	Mean Diff.	95% C.I		*Paired t-test*	p value
			Upper	Lower		
GA-LMP	33.97±1.52	0.72	0.18	0.97	-0.872	0.416
GA-FL	33.25±1.90					

p-value >0.05 NS;

This table shows no statistically significant difference between LMP and FL according to gestational age (wks.), the average difference was weak 0.72 and C.I. 95% (0.18-0.97) with p-value >0.05 NS.

Table (9): Comparison between LMP and AC according to gestational age (wks).

Gestational age (wks)	Mean±SD	Mean Diff.	95% C.I		*Paired t-test*	p value
			Upper	Lower		
GA-LMP	33.97±1.52	1.72	0.43	2.15	-0.811	0.496
GA-AC	32.25±1.84					

p-value >0.05 NS;

This table shows no statistically significant difference between LMP and AC according to gestational age (wks), the average difference was weak 0.1.72 and C.I. 95% (0.43-2.15) with p-value >0.05 NS.

Table (10): Comparison between LMP and BPD according to gestational age (wks).

Gestational age (wks)	Mean±SD	Mean Diff.	95% C.I		*Paired t-test*	p value
			Upper	Lower		
GA-LMP	33.97±1.52	2.21	0.56	3.22	7.416	<0.001**
GA-BPD	31.75±1.87					

***p-value <0.001 HS*

This table shows highly statistically significant difference between LMP and BPD according to gestational age (wks), the average difference was high 2.21 and C.I. 95% (0.56-0.3.22) with p-value <0.001 HS.

Table (11): Comparison between TCD and FL according to gestational age (wks).

Gestational age (wks)	Mean±SD	Mean Diff.	95% C.I		*Paired t-test*	p value
			Upper	Lower		
GA-TCD	33.41±1.32	0.16	0.06	0.25	-1.570	0.110
GA-FL	33.25±1.90					

p-value >0.05 NS;

This table shows highly statistically significant difference between TCD and FL according to gestational age (wks), the average difference was weak 0.16 and C.I. 95% (0.06-0.25) with p-value >0.05 NS.

Table (12): Comparison between TCD and AC according to gestational age (wks).

Gestational age (wks)	Mean±SD	Mean Diff.	95% C.I		*Paired t-test*	p value
			Upper	Lower		
GA-TCD	33.41±1.32	1.16	0.41	1.80	-1.460	0.131
GA-AC	32.25±1.84					

p-value >0.05 NS;

This table shows no statistically significant difference between TCD and AC according to gestational age (wks), the average difference was weak 1.16 and C.I. 95% (0.41-1.80) with p-value >0.05 NS.

Table (13): Comparison between TCD and BPD according to gestational age (wks).

Gestational age (wks)	Mean±SD	Mean Diff.	95% C.I		*Paired t-test*	p value
			Upper	Lower		
GA-TCD	33.41±1.32	1.66	0.58	2.57	8.347	<0.001**
GA-BPD	31.75±1.87					

***p-value <0.001 HS*

This table shows highly statistically significant difference between TCD and BPD according to gestational age (wks.), the average difference was high 1.66 and C.I. 95% (0.58-2.57) with p-value <0.001 HS.

From the numerical data from the above table, there were insignificant difference between the tree assessment tools we had compared (LMP and TCD), (LMP and FL) and (TCD and FL) while there were statistical difference between the (LMP and BPD) and (TCD and BPD).

Table (14): Accuracy within 1 week.

	Accuracy within 1 week		
	Accurate	Inaccurate	% accurate
TCD	490	10	98.0%
FL	375	125	75.0%
AC	360	140	72.0%
BPD	205	295	41.0%

This table shows represent the accuracy of gestational age measurement within 1 week among TCD, FL, AC, BPD, showed the accuracy of TCD 98% while the accuracy of FL was 75%, AC was 72% and BPD accuracy 41%.

DISCUSSION

A study assessed ultrasound examinations in the late third trimester of women who also had a first trimester and found that the difference in the General Assembly's estimates was three weeks or more. However, data from other studies have shown that the ultrasound estimation of GA in late pregnancy may be better than specified in the old publications [(3)].

The cerebellar diameter was considered a unique parameter, which was well established in ultrasound literature as a reliable parameter for estimating gestational age [(4)]. It was considered to be consistently advanced in GA prediction in both single pregnancies, twin pregnancies, and at the ends of the embryo growth [(5)].

A study conducted to verify the relationship between GA and TCD to identify the prediction of GA by TCD in addition to the evaluation of the reliability of TCD measurements. TCD was determined in a total of 221 infants with known GA. He found that TCD correlates strongly with GA and expected the GA to ±2.33 weeks. Measurements of TCD had excellent reproducibility [(6)].

A study was carried out on 50 antenatal subjects (20–40 years of age) between 14 and 40 weeks of pregnancy attended to the clinic for routine ultrasound examination. Measurement of Ultrasonograph of TCD was performed to assess the gestational age. The regression analysis indicated a significant relationship between TCD and GA, indicating that TCD is a good marker for the estimation of GA [(7)].

Another study [(5)] stated that there was a slight fluctuation in the growth curve of the fetal cerebellum, denoting multiple conditions that would result in difficulties in measuring the TCD in late gestations, so we also analyzed the data at the 31 and 36 weeks of gestation.

In 2014, a study conducted to evaluate the Accuracy of fetal transcerebellar diameter nomogram in the prediction of gestational age in singleton gestation at the second and the third trimesters of singleton pregnancy, he found that the TCD measurement appears to be an accurate predictor of gestational age, even in the third trimester of pregnancy. It is recommended to use TCD as an important ultrasound biometric parameter in normal singleton for the prediction of gestational age [(8)].

In 2000 a retrospective, cross-sectional analysis of 360 normally developing fetuses in the period of 17 and 34 weeks and 73 growth-restricted fetuses between 24 and 34 weeks gestation was done, he found that the TCD measurement is typically spared in cases of IUGR. Even in severe growth restriction, the TCD was only mildly affected [(9)].

Another study was conducted in 2014in order to determine the accuracy of fetal transverse cerebellar diameter measurement for the prediction of gestational age in growth restricted fetuses. The study sample was 100 pregnant women in the third trimester of pregnancy satisfying the eligibility criteria, 50 were fetuses with normal fetal growth and 50 growth restricted fetuses. The results showed that mean transverse cerebellar diameter in the fetuses showing normal growth was not statistically different from the mean transverse cerebellar diameter of that in the growth restricted fetus. They concluded that fetal TCD measurements seem to correlate well with the gestational age in both normal and growth restricted fetuses as there was no significant difference in TCD measurements in normal and growth restricted fetuses.

Transverse cerebellar diameter measurement could be used reliably for accurate estimation of gestational age in growth restricted fetuses [(10)].

A study was established that TCD measurement was both reliable and accurate in predicting gestational age even in extremes of fetal growth. while majority of data suggests that the TCD is extremely valuable when the gestational age is unknown or IUGR is suspected [(5)].

Some studies stated that the TCD was a useful predictor of gestational age for fetuses with asymmetric but not symmetric growth retardation [(11)].

Previous studies had found a close correlation between cerebellar dimensions and GA using fetal growth parameters including BPD, head circumference, FL, and estimated fetal weight, this relationship had been found to be independent on fetal gender [(12)].

A study in 1991, GA prediction intervals were derived from 270 normal fetuses in the period between 14 and 40 weeks' gestation for BPD, head circumference, abdominal circumference, FL, and TCD. TCD adequately predicted GA for six fetuses with asymmetric intrauterine growth retardation and was linked with the least amount of underestimation bias compared with other ultrasonographic parameters [(11)].

Correlation of the cerebellar circumference and area with GA and illustration of its usefulness in cases of unilateral cerebellar agenesis and hypoplasia was established in a study done in 2007. Accordingly, measurement of cerebellar dimensions, including the TCD might be useful in detecting cerebellar malformations, if nomograms of TCD were accessible for a selected population [(13)].

CONCLUSION

Transcerebellar diameter is more reliable method of gestational age determination in third trimester of pregnancy than biparietal diameter. Transcerebellar diameter and femur length used as a tool to assist in the assessment of gestational age in third trimester.

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