Ultrasound Comparative Study between Trans-cerebellar Diameter with Bi-parietal Diameter and Femur Length for Gestational Age Measurement in Second Trimester of Pregnancy

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ABSTRACT

Background: : It is important to detect gestational age in order to better pregnancy and fetal outcome management. Several biometric measures were indicated to be reliable in measuring gestational age.

Aim of the work: to assess the accuracy of trans-cerebellar diameter (TCD) measurement in estimation of the gestational age during the second trimester of pregnancy compared to current fetal biometric measurements of femur length (FL) and bi-parietal diameter (BPD) according to last menstrual period (LMP).

Patients and methods: This observational study included 200 cases in their second trimester of pregnancy. They were recruited and assessed for eligibility from at the outpatient clinic and causalities of the Obstetrics and Gynecology Department, El-Monira general hospital, Cairo.

Results: a significant differences were found when comparing GA-LMP with each of GA-TCD (p value=0.038), GA-FL and GA-BPD. Our results indicated that regarding the gestational age detected according to the TCD and comparing it with the gestational age determined by FL and BPD, they were statistically highly significantly different. Regarding the accuracy rate of the biometric parameters within one week, our results indicated that TCD showed the highest accuracy rate (98.5%) in compare with BPD (95.5%), and FL (94.0%) accuracy. Results also indicated the presence of significant correlations between all biometric measurement and their gestational age estimation. On the other hand we found that the TCD had the highest correlation in comparison to the other biometric measurements.

Conclusion: Study concludes that trans-cerebellar diameter (TCD) is more accurate measurement in detecting gestational age during second trimester of pregnancy.

Keywords: *Diagnostic accuracy of 3D Ultrasound; Hysteroscopy; Premenopausal uterine bleeding.*

INTRODUCTION

Accurate detection of gestational age is crucial to the assessment of pregnancy, fetal development, and neonatal care. Before ultrasonography, obstetricians rely on the use of the last menstrual period (LMP) for detecting the gestational age (GA). Physical examination such as determining uterine fundal height was also a method for estimating gestational age [1].

However, previous studies indicated that about thirty percent of women cannot be sure about their LMP [2]. Several studies indicated that ultrasound is an accurate tool in detecting gestational age [3].

During first trimester of pregnancy, crown rump length (CRL) and embryonic volumes measurements are considered as reliable elements in detecting the gestational age [4].

During second Trimester most commonly used biometric parameters for estimating gestational age are Biparietal diameter (BPD), Femur length (FL) abdominal circumference (AC) and head circumference (HC) [5]. Other biometric parameters including transverse cerebellar diameter, binocular distance and fetal foot length are recently studied to detect the gestational age [6].

Previous studies indicated that biometric parameters including Bi-parietal diameter (BPD), Femur length (FL) abdominal circumference (AC) and head circumference (HC) could be get affected from abnormal fetal growth in contrary with trans-cerebellar diameter [7].

Trans-cerebellar diameter is the breadth of the cerebellar vermis is included in the distance between the lateral aspects of the cerebellum. The anatomical location of the cerebellum in the posterior cranial fossa makes it less affected by fetal growth abnormalities either fetal growth restriction or growth acceleration [8].

Trans-cerebellar diameter is considered as there is a link between the size of the fetal cerebellum, particularly the transverse cerebellar diameter, and gestational age, this is a valid metric for determining gestational age [9].

The present study aimed to assess the accuracy of trans-cerebellar diameter (TCD) measurement in estimation of the gestational age during the second Trimester of pregnancy compared to current fetal biometric measurements of Femur length (FL) and Bi-parietal diameter (BPD) according to last menstrual period (LMP).

PATIENTS AND METHODS

This study is a prospective observational study was conducted on included two hundred women in their second trimester of pregnancy during a period of one year starting from April 2019 till March 2020 after approval of ethical committee of obstetrics and gynecology department, ElMonira general hospital, cairo.

The study included patients with ages between 18-47 years old, with singleton uncomplicated intrauterine pregnancy, gestational age in second trimester calculated from the first day of last menstrual period with ultrasound in first trimester and history of regular menstrual cycles at least three cycles before pregnancy.

While patients who were unsure of their gestational age, or non-reliable dates, patients with history of irregular cycles, multiple pregnancies, patients with pregnancy complications such as intrauterine growth restriction (IUGR) or with multiple gestations, congenital fetal anomalies, intrauterine fetal death, medical disorders with pregnancy such as hypertension or diabetes mellitus and antepartum hemorrhage were excluded from the study.

Place of recruitment :

Outpatient Clinic and Causalities of the Obstetrics and Gynecology Department, El-Monira general hospital, Cairo.

Research Ethics Committee Approval and quality control:

The study purpose and procedures were explained in detail and got approval by the ethical committee. Quality control of screening, handling of data and verification of adherence to protocols were done on a regular basis by the trial coordinator.

Subjects consent:

All subjects, were informed about the details of the study, the risks and the benefits, and were all asked to give their verbal consent before the start of the study.

Procedures applied in the study

Taking full medical history: personal history, menstrual history , past history .

Examination:

General examination: temperature and respiratory rate, abdominal examination and routine laboratory investigations including: Blood typing (ABO Grouping) and antibody testing (Rh antibody, in cases of Rh negative), Complete blood count (CBC), liver and kidney functions .

Ultrasound examination:

Subject preparation: subjects were asked to put on a gown or cover for the procedure, Trans-abdominal ultrasound performed to all patients while in a slightly tilted position with the head of the bed raised 30 degrees and with a small pillow under the right loin.

Device used: Voleson 730 ProV ultrasound machine with Doppler unit and convex linear transducer 3.5 Mega Hertz.

Procedure:

Trans-cerebellar diameter

To determine the trans-cerebral diameter, the trans-thalamic view of BPD can be detected first. The posterior horns of the lateral ventricles disappeared from view and be replaced by the cerebellum when you spin the probe slightly below, towards the fetal neck. Using the outer to outer approach, the TCD is measured at 90 degrees to the long axis of the cerebellum across its widest point (**El-Sayed et al., 2021**)

Bi-parietal diameter and **head circumference** were taken in the lateral ventricles view, a skull fashioned like a rugby ball, with a rounded rear (occiput) and a more pointed front (synciput).

Femur length was illustrated in the best possible light, with both ends of the ossified metaphysis plainly visible.

RESULTS

The statistical package for social sciences, version 20.0, was used to analyze the data (SPSS Inc., Chicago, Illinois, USA). The mean and standard deviation were used to convey quantitative data (SD). The frequency and percentage of qualitative data were used to represent the data.

The following tests were done:

Paired sample t-test of significance was used when comparing between related samples .

The degree of relationship between two sets of variables was determined using Pearson's correlation coefficient (r) test.

Accuracy of different estimations parameters in relation to LMP parameter was done within 1 week error. P values less than 0.05 was considered statistically significant.

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: P-value <0.05 was considered significant.

Baseline characteristics	Total (n=200)
Age (years)	
Range	**20-47**
Mean±SD	**31.14±7.26**
Gravida	
Range	**1-4**
Median (IQR)	**2 (2)**
Parity	
Primigravida	**144 (72%)**
Multipara	**56 (28%)**
Weight (kg)	
Range	**59-77**
Mean±SD	**64.96±4.94**
Length (cm)	
Range	**157.6-169**
Mean±SD	**162.76±3.04**

IQR: Interquartile range

Table 1: Distribution of pregnancy women's according to their baseline characteristics regarding age, gravida, weight and length (n=200).

GA- LMP/ weeks	No.	%
13-15 wks.	**50**	**25.0%**
16-20 wks.	83	41.5%
21-25 wks.	67	33.5%
Total	**200**	**100.0%**

Table 2: Distribution of pregnancy women's according to their gestational age regarding LMP/weeks.

GA-TCD/weeks.	No.	%
14-15 wks.	**51**	**25.5%**
16-20 wks.	74	37.0%
21-25 wks.	75	37.5%
Total	**200**	**100.0%**

Table 3: Distribution of pregnancy women's according to their gestational age regarding TCD/weeks.

GA-FL/weeks.	No.	%
13-15 wks.	**53**	**26.5%**
16-20 wks.	84	42.0%
21-25 wks.	63	31.5%
Total	**200**	**100.0**

Table 4: Distribution of pregnancy women's according to their gestational age regarding FL/weeks.

GA-BPD/weeks.	No.	%
13-15 wks.	**50**	**25.0%**
16-20 wks.	81	40.5%
21-25 wks.	69	34.5%
Total	**200**	**100.0%**

Table 5: Distribution of pregnancy women's according to their gestational age regarding BPD/weeks.

GA-AC/weeks.	No.	%
13-15 wks.	**52**	**26%**
16-20 wks.	77	38.5%
21-24 wks.	71	35.5%
Total	**200**	**100.0%**

Table 6: Distribution of pregnancy women's according to their gestational age regarding AC/weeks.

Parameters	Gestational age (weeks)		Paired Difference						
	Range	**Mean±SD**	**Mean**	**±SD**	**SE**	**95% C.I.**	**t-test**	**df**	**p-value**
Last menstrual period									
GA-LMP	**13-25**	**19.02±3.51**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
#Primary outcome									
GA-TCD	**14-25**	**19.17±3.53**	**-0.15**	**0.391**	**0.027**	**-0.184 – -0.023**	**-2.443**	**199**	**0.038***
#Secondary outcome									
GA-FL	**13-25**	**18.80±3.42**	**0.22**	**0.516**	**0.036**	**0.191–0.391**	**5.377**	**199**	**<0.001****
GA-BPD	**13-25**	**18.70±3.43**	**0.32**	**0.611**	**0.043**	**0.036–0.337**	**4.222**	**199**	**<0.001****
GA-AC	**13-24**	**18.38±3.22**	**0.64**	**0.704**	**0.050**	**0.301–0.894**	**9.894**	**199**	**<0.001****

Table 7: Comparison between multiple measurements GA-LMB with TCD, FL, BPD and AC of the pregnant women.

Parameters	Gestational age (weeks)		Paired Difference						
	Range	Mean±SD	Mean	±SD	SE	95% C.I.	t-test	df	p-value
Primary outcome									
GA-TCD	14-25	19.17±3.53	--	--	--	--	--	--	--
#Secondary outcome									
GA-FL	13-25	18.80±3.42	0.37	0.632	0.044	0.292–0.629	5.895	199	<0.001**
GA-BPD	13-25	18.70±3.43	0.47	0.704	0.050	0.437–0.862	5.021	199	<0.001**
GA-AC	13-24	18.38±3.22	0.79	0.776	0.055	0.363–0.960	10.218	199	<0.001**

Table 8: Comparison between multiple measurements GA-TCD with FL, BPD and AC of the pregnant women

	Accuracy in 1 week		
	Accurate	**Inaccurate**	**% Accurate**
TCD	197	3	98.5%
BPD	191	9	95.5%
FL	188	12	94.0%
AC	190	10	95.0%

Table 9: Accuracy rate in one week of the biometric measurements in comparison with the TCD during the second trimester.

Biometric Measurements and GA estimation	r	P-value
Trans Cerebellar Diameter (TCD)mm & GA- TCD	**0.995**	**<0.001****
Bi-parietal Diameter (BPD) mm & GA - BPD	**0.986**	**<0.001****
Femur Length (FL) mm & GA-FL	**0.944**	**<0.001****

R-Pearson Correlation Coefficient; **p-value <0.001 HS

Table 10: Correlation between the biometric measurements and the gestational age estimation during the second trimester.

DISCUSSION

Accurate detection of gestational age is considered as of crucial importance in order to better pregnancy outcome management and antenatal care. Several biometric measures were indicated to be reliable in measuring gestational age however such measurements were found to be affected by abnormal fetal growth patterns [10,11].

Our results indicated a significant differences when comparing GA-LMP with each of GA-TCD (p value=0.038), GA-FL (p value <0.001) and GA-BPD (p value <0.001).

Such results were in agreement with a previous population-based register cohort study by Kullinger et al. [12] that indicated discrepancy between gestational age detected by ultrasound and gestational age detected by LMP.

However, Ali et al., [6] study comparing between gestational age detected by LMP and each of TCD, FL, AC, and BPD in third trimester of pregnancy showed no statistically significant difference between LMP and each of TCD (P value = 0.106), FL (P value = 3), and AC (P value = 0.496), while significant difference was only detected between LMP and BPD (P value <0.001).

Study was done by Naseem et al. [13] on 327 patients with gestational age range 28- 40 weeks measuring TCD and FL by ultrasonography. They compared GA by TCD and FL with LMP. TCD had given accurate gestational age in (80.1% of patients while FL had given less accurate gestational age (70.9%).

Our results indicated that regarding the gestational age detected according to the TCD and comparing it with the gestational age determined by FL and BPD, they were statistically highly significantly different (P <0.001).

Such results were in agreement with Rajendra [14] study which indicated significant difference between TCD and each of BPD, HC, AC and FL (P <0.001).

A previous study by Matur and Chauhan [15] demonstrated that the TCD remained unaffected by fetal growth retardation, whereas most biometric parameters measured on ultrasonography were significantly affected by the overall growth retardation.

Regarding the accuracy rate of the biometric parameters in detecting gestational age within one week, our results indicated that TCD showed the highest accuracy rate (98.5%) in compare with BPD (95.5%), and FL (94.0%) accuracy.

Such results were in agreement with Matur and Chauhan [15] study that indicated a linear relationship between TCD and GA in the second trimester of pregnancy and that TCD measurements in millimeters are approximately equal to GA in weeks.

A previous study comparing the accuracy of biometric measurements during third trimester of pregnancy indicated that the accuracy of TCD was 88.3% of the cases, while FL accuracy was 65% of the cases and BPD had the lowest accuracy which was 51.5% [16].

A study performed by Zakaria et al. [17] indicated that each of the TCD, FL, and BPD gave correct

assessment of gestational age within one week in 89%, 81.5% and 61.5% of the patients respectively.

Another study performed by El-Ebeisy et al. [18] on one thousands of pregnant women during their second and third trimester between 14-40 weeks of pregnancy indicated that accuracy of TCD in late second trimester was 91.6% and 82% in early third trimester while in late third trimester TCD had the lowest accuracy (68.1%).

TCD is considered as an accurate measurement of gestational age. Leibovitz et al. [7] have observed that the posterior fossa is unaffected by pressure effects on ultrasonography of the fetal skull; thus, the cerebellar diameter is a more accurate reflection of gestational age than the bi-parietal diameter, especially in the presence of abnormal skull shapes such as brachycephaly or dolicocephaly..

In contrary, several studies indicated the presence of differences of the measured cerebellar diameter according to their ethnicity [19,20]; moreover, Lomholt et al. [21] found that cerebellar diameters in Down syndrome fetuses were lesser than normal controls (p<0.005).

Our results indicated the presence of significant correlations between all biometric measurement and their gestational age estimation (P-value < 0.001). Moreover, we found that the TCD had the highest correlation in comparison to the other biometric measurements.

Such results were in agreement with Desdicioglu et al. [22] study that revealed that in the second trimester of pregnancy, the trans-cerebellar diameter is increasing in correlation with the gestational age.

Our results were also in agreement with Uikey et al. [23] study which indicated the correlation of TCD with BPD was (r = 0.960), with HC (r = 0.979), with AC (r = 0.980) and with FL (r = 0.976). The same study revealed that trans-cerebellar diameter to be a precise measurement in the detection of gestational age during second and third trimester of pregnancy without being affected by abnormal fetal growth patterns.

Reddy et al. [11] evaluated accuracy of predicting GA using the fetal trans-cerebellar diameter (TCD) and comparing TCD with other existing GA parameters in 15 to 40 weeks of gestation and concluded that TCD is an accurate measurement in detecting gestational age particularly in the second trimester.

A cross-sectional survey study by Eze et al. [24] indicated that the mean TCD was 32.0 ± 11.6 mm and that TCD had a strong positive linear relationship with GA (R = 0.988; R2 = 0. 975; P < 0.001) during second and third trimester of pregnancy.

CONCLUSION

We conclude that trans-cerebellar diameter (TCD) is more accurate measurement in detecting gestational age during second trimester of pregnancy.

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