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Comparison between Trans-cerebellar diameter, Bi-parietal diameter and Femur length for gestational age measurement accuracy in the third trimester of pregnancy

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Abstract

Background: In obstetric treatment, it is critical to accurately evaluate the gestational age of the pregnant woman. Low birth weight, spontaneous preterm delivery, and perinatal death have all been linked to pregnancies in which the gestational age was not known. The study's goal is to assess the accuracy of gestational age measurement in the third trimester between trans-cerebellar diameter, bi-parietal diameter, and femur length. The patient and the procedure are both in good hands. From December 2020 to June 2021, a prospective cohort study at the Department of Obstetrics and Gynecology at Imbaba General Hospital and Tabark private hospital evaluated 220 pregnant women in their third trimester using two-dimensional ultrasound to determine an accurate method for calculating gestational age during the third trimester of pregnancy. TCD correctly predicted gestational age in 96.4 percent of 220 pregnant women within 3 days, 97.5 percent within 5 days, and 97.5 percent within 7 days (98.8 percent). However, in 169 (76.8%), 202 (91.8%), and 211 (91.8%) cases, the FL correctly predicted gestational age within 3 days, 5 days, and 7 days, respectively (95.9 percent). BPD was the least reliable, correctly determining gestational age within 3 days in just 68% of pregnant women, 95% within 5 days in 199, and 96% within 7 days in 212 pregnant women. For third-trimester gestational age estimation, we may say that TCD is most accurate, followed by FL, and the least accurate, BPD.

Key word: Transcerebellar Diameter, Biparietal Diameter, femur length ,Gestational Age, third trimester

1. Introduction

Predicting gestational age and term accurately is essential for safe obstetric care, and this is widely acknowledged. This is done using Naegele's rule or ultrasonic biometry. When the latest menstrual cycle isn't trustworthy, ultrasounds are utilised to estimate the due date (LMP). [8]

Thus, the use of foetal biometric markers such as BPD, femur length (FL), abdominal circumference (AC) and head circumference (HC) in the calculation of gestational age (GA) has become more significant in the treatment of pregnancy. However, these criteria have limits since BPD beyond 26 weeks becomes inaccurate under situations that change the form of the skull. 6 As an added bonus, ethnicity has an effect on Femur length. Femurs that are shorter than usual might suggest foetal growth limitation, aneuploidy, and even skeletal dysplasia when they are significantly shortened. [2]

When it comes to determining gestational age, trans-cerebular diameter (TCD) is better than BPD and FL because TCD measures are not impacted by conditions that affect BPD, such as mould and dolicocephaly. Although difficulties with unossified epiphyses sometimes occur during FL measurements, they do not occur with TCD measurements. [7]

2. Patient and method

Study type: prospective cohort study.

Study setting: The study was conducted at department of obstetrics and gynecology at Benha University Hospital and

Study period: The study was conducted in the period from December 2020 to June 2021 after being approved by the local research ethics committee.

Study population

220 pregnant women from 28 to 40 weeks of gestation

Recruitment

antenatal clinic and/or admitted in the maternity ward in the governmental hospital (Imbaba general hospital) and private hospital (Tabark hospital

A-Inclusion criteria:

- Singleton uncomplicated pregnancy at third trimester between 28 and 40 weeks
- Sure date of last menstrual period
- Viable fetus.
- History of regular menstrual cycles at least three cycles before pregnancy.
- Gestational age in third trimester calculated from the first day of last menstrual period or by first-trimester ultrasound examination.

B-Exclusion criteria:

- pregnants unsure of their dates or non-reliable dates.
- Irregular cycles.
- Medical disorders with pregnancy such as hypertension and diabetes mellitus
- Pre-labor rupture of membranes.
- Polyhydramnios.
- Multiple pregnancies.
- Congenital fetal anomalies
- Intrauterine fetal death.
- Intra uterine growth retardation

Intervention

Trans-abdominal ultrasound was performed to all patients while in a slightly tilted position with the head of the bed raised 30 degrees. The apparatus which used was the Mindray DC-7 3D/4D Ultrasound Machine having multiple transducers. The probe that

2, Convex Array Transducer-C5 was used in this study.

Statistical analysis

Data were coded and entered using the statistical package SPSS version 22. The percentages of accurate assessment of gestational age by the three

measurements (TCD, BPD and FL) within 3 days and 5days from the actual gestational age measured by LMP. Then comparison between these percentages and Chi square (x2) test was performed. Exact test was used instead when the expected frequency is less than 5. P-values less than 0.05 were considered as statistically significant. The significance level was set at P ≤0.05 within all tests.

4. Result

Table (1) shows that 90(40.9%) patients out of 220 were primi-gravida and 130(59.1%) patients were multigravida. The mean gestational age by LMP/days 222.6±18.6. the mean gestational age by TCD/days is 220.5±25.6 and by FL /days is 221.9±18.36 and by BPD/days is 224.2±18.53

Table (2) shows that TCD significantly is the most accurate measurement for diagnosis of gestational age 96.40% followed by FL 76.80% and the BPD is the least accurate measurement 66.80% (p value <0.001).

Table (3) shows that TCD significantly is the most accurate measurement for diagnosis of gestational age 97.70% followed by FL 91.80% and the BPD is the least accurate measurement 90.50% (p value <0.005).

Table (4) shows that TCD non-statistically significantly is the most accurate measurement for diagnosis of gestational age 98.60%followed by BPD 96.40% and the FL is the least accurate measurement 95.90% (p value 0.2).

Table (1) criteria of studied population

Variable	**Summary statistics**
Gravidity	**N (%)**
1	90(40.9)
2	71(32.3)
3	37(16.8)
4	18(8.2)
5	4(1.8)
Parity	**N (%)**
0	130(59.1)
1	64(29.1)
2	21(9.5)
3	5(2.3)
Gestational age /days:	
Mean ± SD	244.84±19.72
Median(range)	248(206-278)
Gestational age by LMP/days:	
Mean ± SD Median (range)	222.6±18.6 217.5(196-263)
Gestational age by TCD/days:	
Mean ± SD	220.5± 25.6
Median (range)	217(35-262)
Gestational age by BPD/days:	
Mean ± SD	224.2±18.53
Median (range)	220 (194-264)
Gestational age by FL/days:	
Mean ± SD	221.9±18.36
Median (range)	217 (186-261)

Table (2) Comparison between Trans-cerebellar Diameter, Bi-parietal Diameter, and FL accuracy in diagnosis of gestational age within 3 days:

3days			**TCD**	**FL**	**BPD**	**P value**
accuracy	yes	count	212	169	147	<0.001
		%	96.40%	76.80%	66.80%	
	no	count	8	51	73	
		%	3.60%	23.20%	33.20%	

Table (3) Comparison between Trans cerebellar Diameter, Bi-parietal Diameter, and FL accuracy in determination of gestational age within 5 days:

5days			TCD	FL	BPD	P value
accuracy	yes	count	215	202	199	<0.005
		%	97.70%	91.80%	90.50%	
	no	count	5	18	21	
		%	2.3%	8.20%	9.50%	

Table (4) Comparison between Trans cerebellar Diameter, Bi-parietal Diameter, FL accuracy in diagnosis of gestational age within 7 days:

7days			TCD	FL	BPD	P value
accuracy	yes	count	217	211	212	0.2
		%	98.60%	95.60 %	96.40 %	
	no	count	3	9	8	
		%	1.4%	4.1%	3.6%	

4. Discussion

For the treatment of pregnancy and the assessment of foetal growth, gestational age is critical in obstetrics. 14 Ultrasound is used to verify the gestational age determined by LMP, particularly when the foetal measures differ. Pregnant women's differing ovulation times might lead to incorrect decisions, therefore this helps to prevent them. [1]

When it comes to accuracy in calculating foetal gestational age, previous research studies have shown that TCD measurements are more reliable than those obtained using HC, FL, BPD, and AC. This is widely believed to be true when comparing TCD measurements with those obtained using these other methods.[1]

In 2020, Cletus et al. [5]performed a cross-sectional research. Women who were 16 to 40 weeks pregnant at the time of the research's inception were included in the study. To arrive at an estimate of GA, the bi-parietal diameter, head circumference, abdomen circumference, and femur length were all measured. The LMP date was utilised as the standard criteria, as it was in our research. There was a substantial correlation between TCD and GA (R = 0.988%; R2 = 0.975%; P 0.001), and the mean TCD was 32.0 mm. In the second and third trimesters of pregnancy, they found that TCD was more accurate than other foetal indicators in predicting the actual gestational age (GA).

In the third trimester of pregnancy, Zakaria et al. (2019)[14] compared TCD, BPD, and FL for gestational age measurement accuracy.

In Egypt, 200 pregnant women participated in the research. TCD&BPD, TCD&FL, and BPD&FL all had a P-value of 0.0001 for the accuracy of measurement within three days after LMP. In addition, the accuracy of measurement within 7 days after LMP in TCD&BPD, TCD&FL, and BPD&FL was revealed to have clinical importance. The P values were 0.0001,0.03, and 0.0001, and they were all significantly different. The accuracy of measurement within three and five days had a P-value of 0.001 and 0.005, respectively, whereas the accuracy of measurement within seven days had a P-value of 0.2 and was not clinically significant. Similar to our findings, they came to the conclusion in their research that TCD is the most reliable technique for determining gestational age in the third trimester. TCD was followed by FL, while BPD was considered the least accurate.

Pregnant women between the 15th and 40th week of pregnancy who were scheduled for standard prenatal sonography participated in a prospective research conducted by Reddy and colleagues in 2017. In 15-28 weeks, the Pearson Correlation Coefficient for all variables was virtually the same (r-values). TCD had the strongest connection of any metric, with a r2 of 0.997. The r-values varied widely during the course of 29-40 weeks. There is a correlation of 0.982 between TCD and LMP GAs, which is higher than the other measures. BPD had the lowest correlation, r=0.951. A correlation coefficient of 0.981 was found with the FL, which was the second most accurate. They concluded that TCD is an accurate parameter in the estimation of gestational age in the second and third trimesters because its values are closely related to those of GA by LMP, in addition to being a better predictor of the gestational age when compared to other parameters, particularly in the third trimester.[9]

In both singleton and twin gestation, TCD might even be considered an accurate, reliable, and trustworthy instrument for determining foetal age.[1]

For the second and third trimester, Charles et al.p [4]conducted a research on the Nigerian population to determine the sonographic reference values for foetal transverse cerebellar diameter. The Pearson Correlation Coefficient (r values) for TCD measures in the second, third, and combined trimesters were 0.875, 0.759, and 0.933, respectively. The TCD exhibits a positive correlation with FL, BPD, HC, and AC, with r values of.957,.941,.940, and.949 (P .001) for Pearson Correlation Coefficient (r).

It is also worth noting that TCD and GA have a strong linear connection. In the second, third, and

combined trimesters, we found Y = 0.63 (TCD) + 7.16; Y = 0.54 (TCD) + 14.32; and Y = 0.79 (TCD) + 4.91 as the model equation for estimating GA (Y) for any known TCD. The GA may be calculated by inserting the observed TCD into the calculations above. A model equation showing the relationship of the four common fetal biometric parameters with TCD is (TCD =3.917 + 0.316FL + 0.088BPD – 0.008HC + 0.017AC).

As a result of this linear connection, foetal GA may be determined by using TCD and FL, HCP, BPD, and AC in combination.

The drawback of these equations is that they need knowledge of ultrasonography.

When it comes to younger physicians, it's not a simple task at all! In an emergency, they just require one basic characteristic to assess and quantify gestational age. TCD accuracy in the third trimester was 96.40 percent within three days and 97.70 percent within five days in our research.

It has been shown that the foetal trans-cerebellar diameter may be used to estimate foetal gestational age in contrast to bi-parietal diameter and length of the femur. (Sumanta et al., 2019) [12]During the 15-37 week gestation period, they examined 100 healthy pregnant women. The BPD, FL, and TCD of each patient were all evaluated. Hadlock tables were used to calculate gestational age based on the above-mentioned data. Normal pregnancies were compared to those with TCD and BPD and FL, respectively. Pregnant women with normal pregnancies have a statistically significant curvilinear association between TCD and gestational age, according to an established nomogram.

Extremes of fetal growth contribute disproportionally to overall perinatal and neonatal morbidity and mortality. A stable metric like TCD, which can be used to predict the fetus's growth status and other perinatal consequences, has been employed in various research. [13]

Pregnant women between the ages of 14 and 40 were recruited for the study by Goel et al in 2010 [6]. Mean TCD at 14-20 weeks, 21-30 weeks, and 31-40 weeks was 17.32 mm, 26,63 mm and 40.73 mm, respectively based on this study's findings. That's not all: The correlation coefficient between gestational age and TCD was determined to be +0.991, which was statistically significant (p0.001).

A cross-sectional nomogram of TCD was developed by Chavez et al. (2007)[3] using data from 24,026 well-dated singleton babies, and it was subsequently verified using 2597 foetuses from a different group. IUGR and big foetuses had significant concordance between the actual and projected GA, according to our previously reported singleton TCD nomogram (Pearson correlation, r = 0.98 and 0.95, respectively; P .001), according to the research results. In IUGR foetuses, the mean gestational age (GA) was 24.9 weeks (SD: 6.5 weeks) while the anticipated GA was 25.1 weeks (SD: 6.3 weeks). Second and third trimester TCD predicted the gestational age (GA) of 97.5 percent and 93.3 percent, respectively, of IUGR foetuses, respectively. Predicted vs actual gestational age (GA) discrepancies in big foetuses were 100 percent in both trimesters.

At Gilani ultrasonography facility ferozpur road Lahore, a cross-sectional research with a sample size of 319 healthy participants was undertaken. A routine second and third trimester ultrasound examination was performed. The trans-cerebellar diameter was assessed in addition to the usual biometric data. = 0.01) was used as the threshold of statistical significance for the Pearson product-moment correlation coefficient. The connection between BPD and TCD (r=0.976), GA of FL (r=0.976), and LMP (r=0.976) was shown to be statistically significant, strong, and linear.

Case control studies at the Cairo Fetal Medicine Unit by Alalfy et al. (2017)[1]. Using diverse foetal development trends in Egypt, they looked at the significance of foetal trans cerebellar diameter for identifying GA. Sonographic gestational ages differed most from menstrual ages by a small margin when trans-cerebellar diameter was taken into account, rather than bi-parieteal diameter, head size, belly circumference, and femur length, for example (0.43 mm, 1.27 mm, 1.0 mm, 1.56 mm and 1.28 mm, respectively). When compared to abdominal circumference, however, the difference was statistically significant. In both uncomplicated and complicated pregnancies, tran-scerebellar diameter is the most accurate biometric measurement, they said. This is because the cerebellar growth is unaffected by these conditions, which include foetal macrosomia or intrauterine growth restriction, as well as structural abnormalities affecting other organs.

An ultrasound research was done at the Department of Obstetrics and Gynaecology (DHQ Hospital) in Rawalpindi on pregnant women who were 26 to 38 weeks pregnant and had a single baby based on LMP measures.

Using Spearman's Connection test, it was shown that gestational age (rho 0.968, p-value 0.001) had a high positive correlation with TCD.

5. Conclusion

From the ongoing study, we can conclude that TCD is the most accurate method for assessment of gestational age in third trimester followed by FL, and the least accurate is the BPD.

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