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Comparison of Transcerebellar Diameter with Biparietal Diameter on Ultrasound for Gestational Age Measurement in Third Trimester of Pregnancy Using First Day of Last Menstrual Period for Actual Period of Gestation

Saira Noreen, Muhammad Usman Khan*, Nisar Ahmed, Atiq ur Rehman Salehria**, Muhammad Zeeshan Ali**, Muhammad Rizwan Bashir Kiani*****

Department of Radiology, Armed Forces Institute of Radiology & Imaging/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, *Department of Radiology, Combined Military Hospital, Quetta/National University of Medical Sciences (NUMS) Pakistan, **Department of Radiology, Armed Forces Institute of Radiology & Imaging/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, ***Department of Anatomy, Army Medical College/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: to evaluate how well biparietal diameter and transcerebellar diameter performed in estimating the gestational age of pregnant women in their third trimester.

Study Design: Cross-sectional study.

Place and Duration of Study: Armed Forces Institute of radiology and Imaging, Rawalpindi Pakistan, Feb to Aug 2022.

Methodology: There were 120 pregnant women who went to the Obstetrics and Gynecology Departmental walk-in clinic or Emergency room between weeks 28 and 40 of their pregnancies. Ultrasound was done on all patients that had been preselected after a complete history and physical examination had been completed; transcerebellar diameter (TCD) and biparietal diameter (BPD) were measured and compared with LMP.

Results: Mean age of the participants recruited in the study was 27.08±1.45 years. There was a significant increase in mean BPD from 28 weeks of gestation (68.01±7.4 mm) to 36 weeks of gestation (89.77±2.35 mm). During 28 weeks of gestation, the mean TCD was 30.3±1.49 mm, whereas at 36 weeks it peaked at 48.1±1.21 mm. By looking at the median gap between real and estimated GA by BPD, we find that when real GA rises, the magnitude of the age estimation error decreases significantly. The error was 3.22±0.17 days for GA at 28 weeks, 2.48±0.09 days at 34 weeks, and 2.18±0.01 days at 36 weeks. A statistically significant (p<0.001) shift in the mean error was observed. In 28 weeks (1.91±0.015) and 34 weeks (2.06±0.06), the mean difference between actual and estimated GA by TCD was larger than at 36 weeks (0.72±0.01). This difference was also statistically significant (p<0.0001).

Conclusion: Both TCD and BPD were shown to be helpful in this study's context, however statistically speaking, TCD was superior to BPD. Further research is required to verify the generalizability and validity of these findings under a looser sampling framework.

Keywords: BDP, Gestational age, Pregnancy, TCD.

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INTRODUCTION

Medical treatment during pregnancy is heavily influenced by estimates of the mother's gestational age (GA). It serves as the foundation for determining whether to induce labour and how to handle difficulties if they arise. Higher rates of fetal and maternal illness and death have been linked to choices based on erroneous gestational ages.[1] The accuracy of the conventional technique of calculating gestational age, using the last menstrual period, may be affected by the regularity of menstrual cycles, particularly in the three months before to conception, and by previous exposure to hormonal contraception. Late prenatal booking, inaccurate menstruation data, and unpredictable menstrual cycles are further obstacles for women in underdeveloped nations.[2] Others regard evaluation of gestational age by ultrasonography to be the 'gold standard' in prenatal care, with the first-trimester measurement of crown-rump-length (CRL) acknowledged as the most trustworthy index.[3] Fetal biometric measurements most often employed after the first trimester are femur length (FL), biparietal diameter (BPD), and abdominal circumference (AC).[1] Some of these parameters, like fetal growth and menstrual cycle regularity, make diagnosis of uteroplacental insufficiency difficult; for example, fetal aortic circumference (AC), fetal head circumference (HC), fetal uterine prolapse (BPD), and fetal length

Correspondence: Dr Saira Noreen, Department of Radiology, Armed Forces Institute of Radiology & Imaging, Rawalpindi Pakistan

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(Fl), are negatively affected in uteroplacental insufficiency, leading to the redistribution of cardiac output and brain-spar.[4] Follicle length (FL) is shorter in fetuses with achondroplasia, and anomalies in the amniotic fluid volume significantly impair the accuracy of FL assessment by ultrasonography after 26 weeks of gestation in fetuses with dolichocephaly and brachycephaly.[5,6] At the 14th week of gestation, the cerebellum is clearly visible on ultrasonography as a core rectangular echogenic structure (vermix) linking two oval echolucent structures (hemispheres).[7] Brain size, as shown in ultrasounds beginning in the 10th or 11th week of pregnancy, increases linearly with gestational age.[8] Fetuses with IUGR have a brainsparing effect that prevents damage to the cerebellum.[9] Hence, the transcerebellar diameter (TCD) has been characterized as a valid single estimate of GA in the third trimester.[8] The purpose of this research was to evaluate how well BPD and TCD performed in estimating the gestational age of pregnant women in their third trimester.

METHODOLOGY

The cross sectional study was conducted from February to August 2022 at Armed Forces Institute of Radiology and Imaging. (IERB Aspproval certificate number. 0063). The sample size was determined using the MedCalc® version 12.3.0.0 tool. Previous research indicated that TCD gave accurate assessments of gestational age by LMP (i.e. 36 weeks) in 91.7% of instances (p=0.001), whereas BPD gave accurate assessments in 77.2% of cases.

Inclusion Criteria: Women who were 28–36 weeks pregnant at the time of the study and who were sure of their dates (as determined by the first day of their last menstrual period) were included.

Exclusion Criteria: Women were not included in the study if they had medical conditions such as diabetes, multiple pregnancies, hypertension, or an uncertain due date.

Through non-probability consecutive sampling technique, researchers observed 120 prenatal patients in their third trimester (28-40 weeks) of pregnancy who were seen in the outpatient clinic (OPD) and emergency room (ER) of the Armed Forces Institute of radiology and Imaging. The research was conducted with participants' informed permission.

In all of the instances that were chosen for ultrasonography, it was conducted after a complete history and physical examination. TCD and BPD were measured using ultrasound and compared to LMP. Hadlock calculated the biparietal diameter by measuring from the outer table of the proximal skull to the inner table of the distal skull, which corresponds to the leading edge to edge measurement. This was done at the thalamic level. Goldstein evaluated transcerebellar diameter by turning transducer 300 degrees below thalamic plane to see butterfly-shaped structure in posterior fossa and then taking measurement at the cerebellum's periphery. At 28, 34, and 36 weeks gestation, measurements were obtained.

IBM SPSS Statistics, version 26 was used for the statistical analysis, and it was run on a personal computer. Information was gathered, collated, and examined using suitable statistical methods. Numerical data were presented as means and standard deviations. Categorical data were presented as numbers and percentages, or as ratios. T-test or chi-square were used to determine the precision of GA by TCD and BDP. The p-value of ≤0.05 was considered statistically significant.

RESULTS

A total 120 prenatal patients in their third trimester (28-40 weeks) of pregnancy were studied in the present research. Mean age of the participants recruited in the study was 27.08±1.45 years. About 62(52%) of the study participants were in the age group 26-30 years and remaining 58(48%) were in the age group 20-25 years. About 66(55%) of the participants belonged from nearby rural areas, while the remaining 54(45%) were from the urban areas. There was a significant increase in mean BPD from 28 weeks of gestation (68.01±7.4 mm) to 36 weeks of gestation (89.77±2.35 mm). When looking at GA 34 weeks, the average BPD was 81.4±2.2mm (p<0.001). During 28 weeks of gestation, the mean TCD was 30.3±1.49 mm, whereas at 36 weeks it peaked at 48.1±1.21 mm. Among GA 34-week-olds, the average TCD was 40.35±1.39mm (p<0.001). Regardless of GA, the discrepancy between actual and BPD-assessed GA was between 4 and 8 days (Table-I). Regardless of GA, the discrepancy between actual and TCD-assessed GA was between 5 and 7 days (Table-II). By looking at the median gap between real and estimated GA by BPD, we find that when real GA rises, the magnitude of the age estimation error decreases significantly. The error was 3.22±0.17 days for GA at 28 weeks, 2.48±0.09 days at 34 weeks, and 2.18±0.01 days at 36 weeks. A statistically significant (p<0.001) shift in the mean error was observed (Table-III). In 28 weeks (1.91±0.015) and

34 weeks (2.06±0.06), the mean difference between actual and estimated GA by TCD was larger than at 36 weeks (0.72±0.01). This difference was also statistically significant (p<0.001). The total mean error was significantly larger for BPD than for TCD (p<0.001), and this difference was also present when comparing assessments at various GAs.

Table-I Extent of accuracy of Gestational Age (GA) estimate by Biparietal Diameter (BPD) and Transcerebellar Diameter (TCD) (n=120)

Difference from actual GA	BDP n(%)	TCD n(%)
±1 day	24(20%)	60(50%)
±2-3 days	55(46%)	40(33%)
>±3 days	41(34%)	20(17%)
Mean±SD	1.91±2.56	0.89±3.4

Table-II: Association between actual Gestational Age (GA) and extent of error between actual and estimated Gestational Age by BDP and TCD (n=120)

Actual GA	Biparietal Diameter				Transcerebellar Diameter			
	±1 day n(%)	±2-3 days n(%)	>±3 days n(%)	Mean±S.D	±1 day n(%)	±2-3 day's n(%)	>±3 days n(%)	Mean± SD
28 weeks	25(21%)	38(23%)	57(48%)	3.22±0.17	20(17%)	69(57%)	25(21%)	1.91±0.015
34 weeks	35(29%)	55(46%)	30(25%)	2.48±0.09	30(25%)	35(29%)	5(4%)	2.06±0.06
36 weeks	60(50%)	25(21%)	35(29%)	2.18±0.01	70(57%)	16(13%)	1(0.5%)	0.72±0.01

Table-III: Comparison of extent of error in estimation by BDO and TCD(n=120)

Actual GA	Biparietal Diameter	Transcerebellar Diameter	p-value
Overall	2.86±0.12	1.87±0.009	<0.001
28 weeks	3.22±0.17	1.91±0.015	<0.001
34 weeks	2.48±0.09	2.06±0.06	<0.001
36 weeks	2.18±0.01	0.72±0.01	<0.001

DISCUSSION

The current research found that there was less variance in BPD estimations compared to standards, leading to less order errors in GA estimates. These findings shown that in over two-thirds of instances, BPD could estimate the GA within 3 days. Although many research have used the BPD as a foundation for GA predictions, this study is one of the few that finds the probability of mistakes in GA estimations to be over 3 weeks. Biological variability and an increased risk of deformation of cranial shape owing to fetal position and other clinical situations render BPD a less accurate instrument for GA determination in the third trimester, as shown by previous investigations.

The magnitude of estimate inaccuracy decreased in the current research for BPD as real GA increased. Most research have shown that the reliability of BPD measures declines as pregnancy progresses, therefore this conclusion is disputed. There are a variety of potential sources of error or variance in BPD measurements. It has been observed that BPD measurement accuracy is affected by the subject's head shape. Hadlock *et al*.[9] compared the BPD to the front occipital diameter to assess whether the head shape was suitable. Cephalic index refers to the correlation between these two measurements (CI). Fetuses with an abnormal cephalic index may have inaccurate due dates. None of these discrepancies were found in the current investigation, suggesting that the BPD measures may be more representative of reality. When these conditions weren't present, anatomic localization became considerably simpler as the pregnancy progressed, leading to a higher degree of precision.

The fetus's transcerebellar diameter is a useful marker for gauging its GA. While this research only collected data during the third trimester of pregnancy, the sequence of changes confirmed the accretive tendency with increasing GA. The current research found a decreasing trend in the percentage of women who's predicted GA by TCD was off by more than one day as actual GA increased. TCD was also shown to be very accurate, with the mean error being lower for TCD estimations than for BPD estimates, with this trend of accuracy persisting throughout the evaluation. Despite the existence of growth retardation, TCD has been reported by many writers in the field to have a strong correlation with GA, making it a more accurate marker for GA assessment than other clinical and biometric markers. As this research was conducted in a relatively growth-restriction risk-free setting, it is possible that this explains the much higher accuracy levels observed. Estimates of TCD have been shown to be beneficial in fetal growth restriction, however.

Similar findings were reported by Naseem *et al*.[10] who concluded that TCD measures, rather than BPD, gave more reliable estimations of GA in the third trimester. Justification for TCD's superior utility and accuracy compared to BPD may also be found in its practical use in situations where measuring BPD is challenging or impossible, or when it is inappropriate due to head molding. The accuracy of TCD seems to be

comparable to that of BPD in late pregnancies, both term and preterm, according to the research conducted by Akl *et al*.[11] In spite of this, they nevertheless acknowledged TCD's pinpoint precision. TCD is a more trustworthy measure for evaluation of GA compared to BPD and FL, and similar to our work, Ravindernath *et al*.[12] observed a high association between TCD and other examined values in pregnancies ranging from 15-40 weeks. Along from making sure the BPD wasn't messed with, he also made sure the TCD measures weren't impacted. It was also determined by Pavithra *et al*.[13] that the value of TCD rose as GA increased. Findings from this research indicated that fetal TCD measurement was an accurate predictive biometric marker for determining the true GA. Moreover, Bansal *et al*. reported similar outcomes.[14] They also found that although TCD levels were lower in IUGR babies than in normal growth foetuses, the gap between the two was still within acceptable parameters, indicating a strong correlation between TCD and GA in both growth patterns.

By combining BPD and femoral length, Gameraddin *et al*.[15] found that they could more accurately assess the success of a GA. Ultrasound measurement of fetal TCD has been suggested as a biometric parameter that may predict GA in the third and fourth trimesters of pregnancy, as reported by Mahmoud *et al*.[16]

According to the research conducted by Sharma *et al*.[17] TCD may be utilised to accurately estimate GA in IUGR patients and can be considered a separate parameter in GA calculation. In their comparison of TCD to BPD and FL, Satish Prasad and Likhitha.[18] found that TCD was superior for assessing GA because it did not suffer from the measurement issues that plagued BPD and FL, provided an additional benefit in the event of IUGR pregnancies, and could be used as a single growth parameter to predict the GA using various obtained formulas and nomograms for both normal and IUGR pregnancies.[19-21]

CONCLUSION

Accuracy of 1 week was much improved in the current trial, and the relative discrepancies between BPD and TCD were small and did not account for a qualitative difference. It was shown that both TCD and BPD were helpful in this case, however statistically speaking, TCD was superior to BPD. Further research is required to verify the generalizability and validity of these findings under looser sampling framework.

Conflict of Interest: None**.**

Author's Contributon

Following authors have made substantial contributions to the manuscript as under:

SN & MUK: Data acquisition, data analysis, critical review, approval of the final version to be published.

NA & AURS: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

MZA & MRBK: Concept, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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