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"Transcerebellar Diameter for Determination of Gestational Age in Comparison to Conventional Fetal Biometry in The Second Half of Pregnancy "

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Abstract:

Background: Ultrasonography can measure a variety of fetal factors, which have been linked to gestational age. It has become the most common way to check on a fetus's health. The fetal biparietal diameter (BPD), abdominal circumference, transcerebellar diameter (TCD), and femur length (FL) are the most common biometric markers used to evaluate fetal growth.

Aim: Detection of the accurate gestational age evaluation method in second half of pregnancy comparing TCD and conventional fetal biometry.

Materials and methods: This cross-sectional observational study was carried out on 294 pregnant women in their second half of pregnancy at the Department of Obstetrics and Gynecology, Port Said University Maternity Hospital and Diarb Negm Hospital.

Results: TCD was accurate in 91.5% of the cases. While the FL was accurate in 83% of the cases.The BPD was accurate in 80 % of the cases and by combination of TCD and FL the accuracy of G.A estimation was 95.9%.

Conclusion: For determining gestational age in secand part of pregnancy TCD is most accurate approach followed by FL while BPD is least accurate.

Keywords: femur length, fetal growth, gestational age, Transcerebellar Diameter.

Introduction

Ultrasonography measures a variety of fetal characteristics, many of which have been linked to gestational age (GA). The main method for keeping an eye on fetal health is now ultrasound. The biometric measurements such as the fetal biparietal diameter (BPD), abdominal circumference (AC), transcerebellar diameter (TCD), and femur length (FL) that are most frequently employed to assess fetal growth. To use these biometric measures to effectively gauge foetal growth, precise information of gestational age (GA) is necessary (1).

An obstetrician's ability to adequately manage antepartum care of cases and to successfully plan suitable therapy or intervention depends in large part on their accurate knowledge of GA. Iatrogenic preterm, which is related to higher perinatal mortality and morbidity, can come from failure. In the first and second trimesters of pregnancy, ultrasound measures of the fetus are very trustworthy, but reliability of any ultrasound approach significantly declines as gestation progresses (2).

Many pregnant women who are unclear of dates and do not have an early dating scan attend their first antenatal checkup. When growth is restricted or accelerated, making management decisions is more challenging. Proper evaluation of GA and fetal growth is of paramount importance in managing any pregnancy. It helps determine fetal organ development and maturity, thereby allowing the obstetrician to plan antenatal care and time of delivery (3).

In the ultrasound literature, the transcerebellar diameter (TCD) is well-established as a valid metric for determining GA. Because the posterior fossa is not impacted by external pressure such as fetal malposition, breech presentation, or oligohydrammnios, which may result in distortion of the fetal head, TCD may be a more accurate predictor than BPD. When femur length is unsatisfactory due to femoral achondroplasia, the TCD might be utilized instead (4).

TCD is a more accurate technique of determining GA in the third trimester of pregnancy than BPA, despite the fact that both biometric data (BPD and TCD) are correct. TCD is a tool that can be used to help determine GA in the third trimester (5,6).

The cerebellum, located in the posterior cerebral fossa, is a crucial component of the hind brain. Beginning in the second trimester, it begins to expand swiftly. Even in circumstances of problematic foetal head positioning or aberrant foetal head shape, such as dolichocephaly and brachycephaly, TCA can predict GA (7).

This study aimed to detect the accurate GA evaluation method in second half of pregnancy comparing TCD and conventional fetal biometry.

Materials and methods

This cross sectional observational study in the second half of pregnancy was conducted in Port Said University Maternity Hospital and Diarb Negm hospital from July 2021 to July 2022. Informed and written consent collected after informing the cases about the procedure and its risks. The study protocol was approved by institutional ethical committee approval.

“Cases with following characteristics were included in the study; reliable menstrual history, sure of dates, normal Singleton pregnancies, ultrasonographic normal structural scanning, Maternal age 20-35 years old, low risk pregnancy and GA in the second half of pregnancy.”

Exclusion criteria included; Maternal age less than 20 years and older than 35 years, unreliable date, not sure of date, irregular cycle 3 months before pregnancy, use of contraception 3 months before pregnancy, congenital anomalies, IUFD, high risk pregnancy, smokers, any maternal medical conditions complicating pregnancy, multiple pregnancy, cases with evident congenital fetal anomalies by ultrasound, cases with Intra-uterine growth restriction, or macrosomia and failure to clearly visualize/measure fetal cerebellum (drop-out cases).

All patients in our study were underwent full history taking, physical examination, routine examination to exclude any risk factors, and calculation of EDD according to Naegele's rule (8).

Ultrasonographic examination:

Mindray DC-8 expert with X-insight shenzhen china 2019 ultrasound system using transabdominal probe (SC5-1E) was used for US examination.

According to the Hadlock method, measurements of femur length (FL) taken in the longitudinal plane, which is parallel to the ultrasonic beam. It is evaluated from one end to the other of the osseous section in a straight line, disregarding the curvature of the

bone, along the long axis of the bone. The measurement excludes the proximal and distal epiphyseal cartilages, as well as the femoral neck (9).
In the trans-axial plane of the fetal head, the biparietal diameter.

(BPD) is visualized at a level that shows the thalami in the midline, equally spaced from the temporoparietal bones, and typically the cavum septum pellucidum anteriorly (10).

Electronic calipers were placed at the cerebellum's outer edges to quantify TCD. The cerebellum's distinctive butterfly-like form reveals the posterior fossa. In every instance, the cerebellum was visible as two lobules in the posterior cranial fossa, one on either side of the midline. Using the outer to outer approach, the TCD was assessed at 90 degrees to the cerebellum's long axis across its widest point (11).

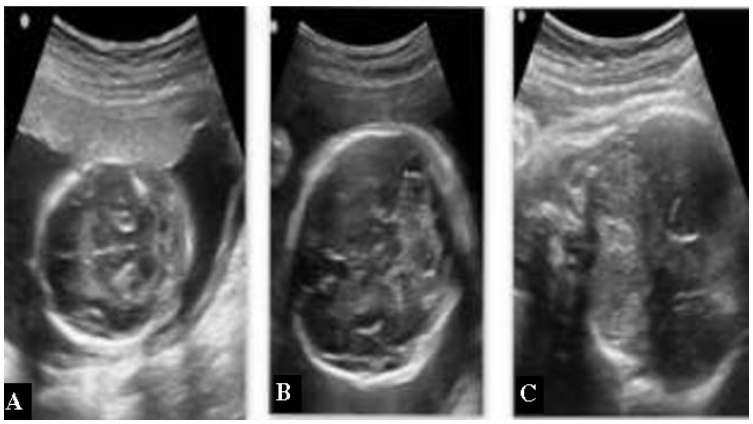
Sonographic grading of the cerebellum:

Grade I - The cerebellar hemispheres appear as two cystic globules, on either side of the midline and the vermis is not developed.

Grade II - The vermis is seen as an echogenic rectangular tissue connecting the two hemispheres with the cerebellum resembling a dumbbell with the echogenic margins.

Grade III - The appearance of the cerebellar hemispheres changes to that of a triangular structure, which is homogeneously echogenic and looks more solid.

Gestation Age (weeks)	n	Mean TCD (mm)	SD	Co-efficient of variation	TCD range
14-20	34	16.7	1.7	10.2	13-20
21-27	50	23.2	2.2	9.5	20-28
28-34	83	30.6	2.5	8.2	24-35
35-40	125	35.2	1.7	4.8	30-40



Spot US images of posterior fossa with Gr I (A), Gr II (B), and Gr III (C) cerebellum with advancement from a fluid filled cystic eyeglass appearance to dumbbell configuration and final homogenous echogenic solid cerebellar tissue.

Statistical analysis

Data analyzed by SPSS (Statistical Package for the Social Sciences, version 20.0). The following tests were used to check for significance differences and associations of qualitative variable by Chi square test (X2). Depending on the type of data, qualitative represent as number and percentage, while quantitative continues group represent by mean SD. t test comparisons between quantitative independent groups. P value at 0.001 considered highly significant and below 0.05 considered significant.

Results

The mean age of cases was 26.95 years with mean parity of 2.53, BMI of 25.76. The mean gestational age was 22.73 week (Table 1).

Table 1. Demographic and menstrual gestational age data of the studied cases.

Variable	Cases (n=294) Mean±SD
Age	26.95±4.63
Parity	2.53±0.43
BMI	25.76±2.019
GA	22.73±3.029

About 88.8%of cases show G2 cerebellum appearance and 11.1% shows G1 cerebellum appearance (Table 2).

Table 2. Sonographic grading of the cerebellum

Grade	**N**	**%**
G1	50	17
G2	244	83
G3	0	0.0
Total	294	100.0

TCD showed correct assessment in 91.5% of the studied population TCD was the most accurate parameter (Table 3).

Table 3. Percentages of correct assessment

Variable		N	%
TCD	**Not correct**	25	8.5
	Correct	269	91.5
FL	**Not correct**	50	17
	Correct	244	83
BPD	**Not correct**	57	19.3
	Correct	237	80.7
	Total	294	100.0

Mean G.A were 25, 23, and 23 weeks for TCD, FL, and BPD respectively. While the mean cm was 2.44, 4.38, and 5.85 for TCD, FL, and BPD respectively (Table 4).

Table 4. TCD, FL and BPD measurements among studied population:

	Cm	**GA**
TCD		
Mean±SD	2.44±0.54	25±1.04
Min-Max	1.79-3.46	20-34
FL		
Mean±SD	4.38±1.16	23±1.13
Min-Max	2.13-6.32	20±36
BPD		
Mean±SD	5.85±1.09	23±1.45
Min-Max	4.07-7.61	20-38

There was significant difference between the methods with higher accuracy for TCD ($p<0.05$) (Table 5).

Table 5. Comparison between TCD with FL and with BPD:

		TCD		FL		BPD		X2	P
		N	%	N	%	N	%		
	Not correct	25	8.5	50	17	57	19.3	**12.3**	**0.002***
	Correct	269	91.5	244	83	237	80.7		
	Total	**294**	**100.0**	**294**	**100.0**	**294**	**100.0**		

The combination of TCD and FL enhanced the accuracy with 95.9% (Table 6).

Table 6. Combination of TCD&FL measurements:

	Combining TCD&FL	%
Correct	**282**	95.9
Not correct	**12**	**4.1**
Total	**294**	**100**

Discussion

Due to socioeconomic factors, many patients in Egypt schedule their first antenatal appointment in the second trimester. They mostly originate from isolated locations and are illiterate. Many women who are lactating are also unaware about their LMP or have irregular periods. Due to the lack of any dating scans or earlier ultrasounds and the uncertainty in LMP, it is exceedingly difficult to determine their due dates, which leads to many pregnancies being incorrectly categorised as preterm or post-term (12).

The current study compared TCD with FL and BPD regarding GA accuracy evaluation in second half of pregnancy.

We found that TCD showes correct assessment in 91.5% of the studied population, TCD is the most accurate parameter, FL shows correct assessment in 83% of the studied population, BPD showes correct assessment in 80% of the studied population.

Hendrix and Berghella studied the foetus' posterior cranial fossa and established that ultrasounds may show the anatomy of the foetal posterior cranial fossa. The cerebellar hemispheres, vermis, and cisterna magna could all be clearly seen. They also suggested a methodical strategy for doing a posterior fossa ultrasonography evaluation during pregnancy. They proposed that an accurate GA might be detected by measuring the foetal TCD in utero between 17 and 40 weeks of pregnancy. (13). The TCD is also demonstrated in the current work as a helpful indication of precise GA in pregnancy second trimester.

According to **Uikey et al** ultrasound's study of 178 healthy pregnant women between 17 and 24 weeks, which included various biometric measurements, TCD appears as a potential marker for calculating GA when compared to other biometric criteria (14). This was further demonstrated in the current work, where TCD appears to be a more reliable marker for determining GA than BPD and FL.

In order to classify the embryonic cerebellum's ultrasonic appearance, Chawanpaiboon et al divided it into three categories: Grade I: Hypoechoic ("eyeglass" shape), Grade II: Intermediate echogenicity ("dumbbell" outline), and Grade III: Hyperechoic ("fan" shape) (15). These grades were seen in our investigation along with the cerebellum. A G2 cerebellum appears in 88.8% of cases, while a G1 cerebellum appears in 11.1% of cases.

In our study the mean sonographig age was 24 weeks+1 day and the mean menstrual age was 22.73. In our study by combination measurement of TCD and FL, the accuracy of GA estimation was 95.9%

According to research by Hoffman et al., early LMP reporting yields gestational age dating that is comparable to that obtained from early ultrasonography. By using LMP and ultrasound, more than 90% of women were correctly categorised as preterm, term, or postterm. When there was a discrepancy between the LMP estimate of GA and the GA determined by ultrasound, it tended to be higher (by an average of about 1 day), which led to a higher percentage of newborns being labelled as post-term. Additionally, key maternal variables affected how much LMP and ultrasound-based estimates differed from one other (16).

In a number of circumstances, accurate gestational age estimation is crucial to obstetric care. Since previous research indicates that the use of LMP to predict GA can be erroneous and that even a single second trimester sonogram may be more accurate, clinicians may decide to include sonographic data in their final estimation of gestational age (17).

TCD is a more accurate way to determine GA in the second trimester than BPD, according to our results.

80 of the 100 patients with normal pregnancies and 20 with intrauterine growth retardation were discovered by Chavez et al. to have had scanning for the TCD and other measures, including BPD, head circumference, belly circumference, and FL. The findings showed that there was no statistically remarkable variation between cases with normal pregnancy and those with IUGR in terms of age or parity. It revealed that only three patients' TCD measurements fell below the 5th percentile, while 18 out of 20 patients' BPD and FL measurements and all 20 patients' AC and HC measurements fell below the 5th percentile. However, 17 out of 20 patients' TCD measurements fell within the normal range (between the 5th and 95th percentile). This variation was statistically marked (P=0.0001), meaning that a greater proportion of patients had TCD values that were within the normal range than had other ultrasonic tests (18).

In 135 patients between the ages of 26 and 38 weeks, Malik et al. evaluated the value of TCD as an independent criterion for GA in pregnancy third trimester. They contrasted actual gestation with the predictions of BPD, FL, and AC about gestational age. They noticed a continuous association between GA as determined by TCD and

that as determined by BPD, FL, and AC. This investigation between TCD and BPD also found an association between the two. (19).

In a cross-sectional study, Sharma and Gupta examined 198 cases who were eligible and in the third trimester and had early scans that revealed Crown rump length. For precisely determining the gestational age based on LMP, TCD was assessed and compared with 1st trimester CRL. It was discovered that TCD increases linearly with GA and that TCD in mm equaled GA in weeks. TCD was accurate in 90.6% of the women between 29 and 31 weeks, and accuracy elevated to 94.7% between 33 and 35 weeks and 93.8% between 37 and 40 weeks. For estimating GA, 3rd trimester TCD is as effective as 1st trimester CRL (20). Every parameter had approximately identical r-values in the second trimester. The highest correlation was found with TCD. With TCD being a parameter with high correlation, there was a significant difference in r-value in the third trimester.

Conclusion

For determining of gestational age in secand part of pregnancy ,TCD is the most accurate approach followed by FL ,while BPD is least accurate .

List of Abbreviations:

TCD: Transcerebeller diameter

GA: gestational age

BPD: Biparietal diameter

FL: Femoral length

CRL: Crown rump length

LMP: Last menstrual period

BMI: Body mass index

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