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STUDY ON PREDICTIVE ACCURACY OF TRANSCEREBELLAR DIAMETER IN COMPARISON WITH OTHER FOETAL BIOMETRIC PARAMETERS FOR GESTATIONAL AGE ESTIMATION IN SINGLETON PREGNANCIES:

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ABSTRACT
OBJECTIVE: To assess the accuracy of transverse cerebellar diameter in determining the gestational age of the fetus in second and third trimester in patients with reliable dates and to compare it with other conventional parameters.
METHODS: The study was conducted in the tertiary care teaching hospital from May 2019 to May 2020. 100 pregnant women of gestational age between 15-40 weeks of pregnancy from Dept of Obs and Gynae comprised our study sample. It is a prospective cross-sectional study.
RESULTS: Evaluation of accuracy of different biometric parameters in gestational age estimation among normal pregnant women between 15 to 40 weeks of gestation based on pearson correlation and regression analysis.
CONCLUSIONS: TCD being a stable parameter irrespective of growth status of fetus, provides a basis for its usefulness in determining gestational age. It can be used as a single growth parameter for estimating GA.

KEYWORDS : Transverse cerebellar diameter, Gestational age.

INTRODUCTION

Knowledge of the expected date of delivery is essential in the management of all pregnancies, particularly with regard to the termination of pregnancy, management of high-risk pregnancies, elective planned induction of labor and allowing vaginal birth after caesarean sections. Hence, accurate dating of pregnancy is extremely important for managing the obstetric patient In India where most pregnant women have no accurate idea of their last menstrual periods it is very difficult to assess the accurate gestational age of fetus.

Before sonography, practitioners had to rely on detailed histories and physical exam findings. In particular, determining the date of the last known menstrual period was of significance.

In recent years, ultrasound assessment of gestational age has become an integral part of Obstetric practice. Both transvaginal and transabdominal probe assessments are used to obtain a more accurate measurement of gestational age.

Sonographic estimation of gestational age is the gold standard in antenatal care, with the measurement of crown rump length (CRL) which is considered the most reliable index. However, most pregnancies are booked after the first trimester, where the lack of proper recording of menstruation dates further contribute to the challenge of accurate gestational age estimation.

Hence, fetal biometry came into practice in gestational age estimation. The most frequently used fetal biometric parameters after the first trimester include the biparietal diameter (BPD), femur length (FL), head circumference (HC) and abdominal circumference (AC).

Nevertheless, the reliability of these biometric methods could be affected by extrinsic factors such as alteration in the shape of the fetal head (as it occurs in the breech presentation and hydrocephalus) and abnormalities of the long bones such as achondroplasia.

More recently another fetal parameter, trans cerebellar diameter (TCD) has evolved as a promising indicator for assessing fetal growth and gestational age.

TCD is an additional parameter over those four basic paramaters. It is calculated by the maximum diameter between the cerebellar hemispheres on axial scan. The value of TCD in millimetres corresponds roughly to the period of gestation.

The aim and objective of the present study were to evaluate the usefulness of transcerebellar diameter as against the conventional parameters of biparietal diameter, head circumference and femur length in normal pregnant mothers between 15 to 40 weeks and to determine its accuracy.

METHODS

The study was conducted in the tertiary care teaching hospital from May 2019 to May 2020. It is a prospective cross-sectional study. A total of 100 antenatal women were included in this study. Pregnant women of gestational age 15-40 weeks of pregnancy from Dept of Obstetrics and Gynaecology where subjected for antenatal scan. The sampling frame was bound by the following inclusion and exclusion criteria.

INCLUSION CRITERIA:
- Antenatal patients with no comorbidities and also with reliable dates as suggested by known last menstrual period and first trimester crown rump length measurement is used.
- Gestational age from 15 – 40 weeks, both primigravida and multigravida.
- Singleton pregnancies.

EXCLUSION CRITERIA:
- Antenatal patients with complications like
  - hypertension,
  - gestational diabetes,
  - jaundice,
  - chronic medical disorders,
- Congenital anomalies,
- Multiple pregnancies.
- Clinically suspected IUGR.

An informed consent taken from all patients and f- FORM is filled before the procedure. Procedure was performed with patient in supine position with hips and knees in extension.

The probe was held with right hand and the same observer was to perform all the measurements. Measurements was obtained by placing on screen calipers of ultrasound machines. The results are as follows.

RESULTS:
To determine accuracy among biometric parameters, correlation was evaluated between each parameter and gestational age.

The P values obtained for all the biometric parameters was 0.001, which implies significant relationship between biometric parameters and gestational age. Here, the study sample included patients with reliable dates i.e., the patients with CRL measurements who also have known LMP. The results obtained by biometric parameters where also compared with previous nomograms.

Table1-Pearson correlation:

TCD (mm)	Pearson Correlation	0.996
	Sig. (2-tailed)	<0.001
BPD	Pearson Correlation	0.864
	Sig. (2-tailed)	<0.001

| FL (mm)	Pearson Correlation	0.993
	Sig. (2-tailed)	<0.001
HC (mm)	Pearson Correlation	0.992
	Sig. (2-tailed)	<0.001

This above table shows best correlation between TCD (transcerebellar diameter) and gestational age (r = 0.996). The correlation was comparatively less strong between gestational age and other parameters. Following scatter diagrams also demonstrates correlation between gestational age and individual biometric parameters:
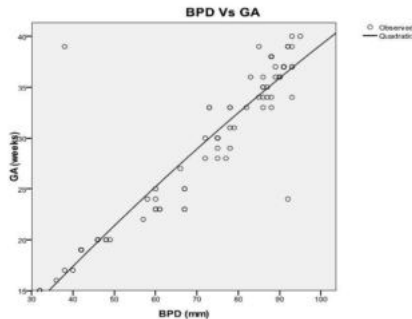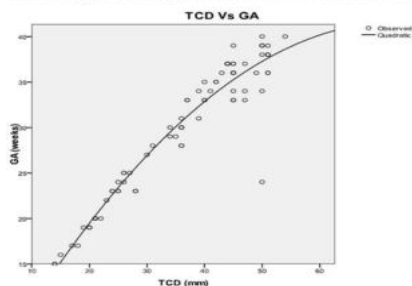

Scatter diagram showing the correlation between GA and BPD.
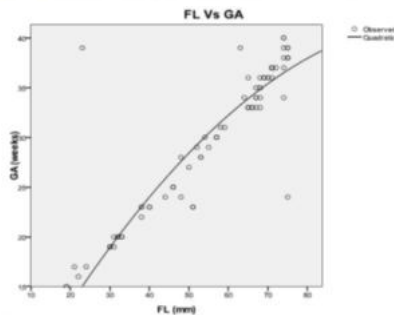
Scatter diagram showing correlation between GA and FL.
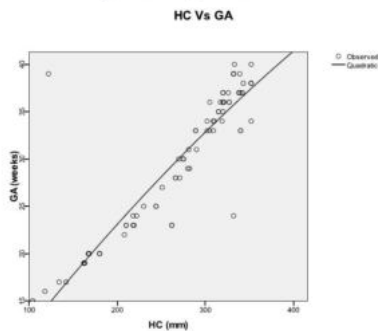
Scatter diagram showing the correlation between GA and HC.

Scatter diagram showing correlation between GA and TCD.

Table2-Comparison of mean TCD across Difference GA:

GA	TCD mm				
	N	Mean	SD	Coefficient of variance	Range
14 - 20	22	19.27	1.638	8.5	14-22
21 - 27	31	26.84	2.865	10.02	22-33
28 - 34	31	37.16	3.917	10.54	33-46
35 - 40	16	47.38	1.821	3.84	45-53

The above results explain that the mean TCD was 19.27 between 14-20 weeks, 26.8 between 21-27 weeks, 37.16 between 28-34 weeks and 47.38 between 35-40 weeks. When individual observations of mean transverse cerebellar diameter were studied in relation to gestational age in weeks, linear relationship was found between these two that is shown in above scatter diagram.

At 14-20 weeks the minimum was 14mm and maximum TCD was 22mm, at 21 to 27 weeks, it was 22mm and 33mm, at 28 to 34 weeks, it was 33mm and 46mm and at 35 to 40 weeks, it was 45mm and 53mm respectively. These values imply that in early second trimester comparatively better linear correlation was found between TCD and gestational age than in third trimester.

Table3-Comparison of TCD (mm) across GA:

GA	TCD mm Percentiles						
	5th	10th	25th	50th	75th	90th	95th
14 - 20	14.60	18.00	18.75	19.00	20.25	21.00	21.85
21 - 27	22.00	22.00	25.00	27.00	28.00	31.00	31.80
28 - 34	33.00	33.00	34.00	36.00	40.00	43.00	46.00
35 - 40	45.00	45.70	46.00	47.00	48.00	50.20	51.00.

The above table shows that TCD 50th centile were corresponding to actual gestational age up to 27 weeks, whereas beyond that there is wide variation from gestational age.

Table4-Regression analysis of TCD in comparison with other biometric parameters:

	Beta	P value	95% CI		R^2 Value (%)
			Lower	Upper	
TCD	0.996	<0.001	1.56	1.64	98.8%
BPD	0.864	<0.001	2.36	2.50	97.7%
FL	0.993	<0.001	2.21	2.32	98.7%
HC	0.992	<0.001	9.19	9.61	98.6%

The Regression analysis was calculated for all the biometric parameters. R2 = 98.8%, indicates a strong relationship between TCD and gestational age in comparison with other parameters which is significant.

DISCUSSION:
Accurate gestational dating is of paramount importance and cornerstone for management of pregnancies.

In our study, 100 patients who met inclusion criteria falling between 15-40 weeks with definitive gestational age were scanned for biometric parameters and also transcerebellar diameter. And the results are compared as follows.

Martin R Chavez et al[113] study shows concordance between actual and predicted gestational age was high (r = 0.92); P<0.0001). This agreement was superior in second trimester (r = 0.93; P< 0.0001) than in third trimester (r = 0.81; P<0.001). Between 17 and 21 weeks, and between 22 and 28 weeks of gestation, the predicted gestational age ranged between 0 and 4 days, and between 0 and 2 days, respectively, of actual gestational age. Between 29 and 36 weeks of gestation, predicted gestational age was within 5 days of actual gestational age; at 37 weeks of gestation, the predicted gestational age was discrepant by 9 days.

This analysis indicates that TCD nomogram predicts gestational age within 3 days in 96.3% in the second trimester and 94% in the third trimester. In summary, TCD measurement appears to be an accurate predictor of GA, even in third trimester and nomograms has to be established after rigorous statistical methods to increase the sensitivity and reduce false positive diagnosis.

The present study shows similar results (r =0. 996), indicating good correlation between TCD and gestational age. The Pearson correlation between BPD and GA was 0.864, between FL and GA was 0.993, between HC and GA was 0.992. From above results, TCD correlation was better in comparison with others.

It was noticed that early visualisation of cerebellum by ultrasonography occurred as early as 14 weeks. Technically, visualisation was better from 18 weeks and thereafter.

Hata T and Hata k studied the fetal transverse cerebellar diameter in

116 women with regular menstrual cycles, at 17- 40 weeks of gestation. They found that TCD correlated well with gestational age (r = 0.96), P<0.001. The 95% confidence interval of the linear regression was also given. They concluded that TCD may be a more useful indicator of the accurate gestational age in case of dolichocephaly or brachycephaly and facilitate antenatal detection of congenital disorders.

Mccleary et al studied the measurement of transcerebellar diameter with ultrasonography in 225 normal fetuses ranging from 15 to 39 weeks of gestational age and found it closely correlate with BPD. They proposed that the transcerebellar diameter may be useful in estimating fetal age, particularly in breech presentation where extrinsic pressure may deform the skull and decrease the biparietal diameter. Also, they highlighted the importance of the imaging the posterior fossa. Transverse cerebellar measurement also allows to concurrently establish posterior fossa malformations. Hence, understanding the embryology of cerebellar development is critical to the accurate interpretation of images of the fetal posterior fossa during prenatal sonography.

Guan B 112found curvilinear relationship between TCD and gestational age ($R2 = 0.99624$), P value less than 0.0005. He concluded the function of the TCD in the evaluation of fetal growth and development is better than any other parameter. The growth of TCD slowed down in primary symmetric IUGR and was unaffected in asymmetric IUGR.

In 2007, DR. BR. Joshi study115 on fetal transcerebellar diameter devised nomogram for TCD among Nepalese population and found that TCD had better correlation with GA which was similar to previously published nomograms before 28 weeks. Also, supported the argument that there is a need to have specific nomograms for their own population after large institutional studies.

Cabbad M et al.,109 in another study with ultrasound examination in patients with suspected IUGR showed that fetal weight was affected to a greater extent than the cerebellar diameter, leading to discordance between TCD and fetal weight, identifying almost all IUGR fetuses with a sensitivity of 95.6% and specificity of 96.3%. In contrast, the HC/AC ratio remained normal in more than 50% fetuses. Thus, concluding that fetal weight to cerebellar diameter discordance is very sensitive and specific indicator of asymmetrical fetal growth impairment.

CORRELATION OF TRANSCEREBELLAR DIAMETER WITH GESTATIONAL AGE IN COMPARISON WITH OTHER STUDIES:

PRESENT STUDY	REECE ET AL	CHAVEZ ET AL	BANSAL ET AL	HATA P ET AL	GUAN B ET AL
r = 0.996, p < 0.001	r = 0.948, p < 0.001	r = 0.92, p < 0.0001	r = 0.97, p < 0.001	r = 0.96, p < 0.001	r = 0.996, p < 0.0005

Therefore, our present study in comparison with other studies has similar correlation between TCD and Gestational age better than other biometric parameters.

Hence, predictive accuracy of Transcerebellar diameter is superior than other biometric parameters.

CONCLUSION:
The sonographic measurement of TCD may serve as an independent and reliable parameter of gestational age against which potential deviations of growth may be compared. As its predictive accuracy is better, it may be used in multifetal pregnancies and IUGR pregnancies.

There are pitfalls in the other fetal measurements, like biparietal diameter is subjected to changes in varied fetal skull shapes and acquiring technical correct images of the femoral diaphysis is difficult and requires great skill and expertise. Correct measurement of the diaphysis while excluding the epiphysis also poses a challenge. Whereas, technical difficulties are less in visualizing cerebellum.

Cerebellum is found to be least affected by IUGR due to brain sparing effect. This fetal measurement indirectly helps in compulsory visualisation of posterior fossa and thereby facilitating better diagnosis of anomalies.

It is useful in patients with unknown dates came for first booking visit

in second trimester. It is also cost effective. Therefore, Transcerebellar diameter nomograms should be derived based on rigorous statistical methods and large samples from own population and perhaps nomograms for other fetal biometry also.

REFERENCES
1. Reece EA, Goldstein I, Pilu G, Hobbins JC. Fetal cerebellar growth unaffected by intrauterine growth retardation: a new parameter for prenatal diagnosis. American journal of obstetrics and gynecology. 1987 Sep 1;157(3):632-8.
2. Guan B. Surveillance of fetal growth and fetal cerebellar transverse diameter by ultrasonographic measurement. Zhonghua yi xue za zhi. 1992 Feb;72(2):65.
3. Chavez MR, Ananth CV, Smulian JC, Yeo L, Oyelese Y, Vintzileos AM. Fetal transcerebellar diameter measurement with particular emphasis in the third trimester: a reliable predictor of gestational age. American journal of obstetrics and gynecology. 2004 Sep 1;191(3):979-84.
4. Bansal M, Bansal A, Jain S, Khare S, Ghai R. A study of correlation of transverse cerebellar diameter with gestational age in the normal & growth restricted fetuses in Western Uttar Pradesh. Peop J Sci Res. 2014;7(2):16-21.
5. Hata K, Hata T, Senoh D, Makihara K, Aoki S, Takamiya O, Kitao M. Ultrasonographic measurement of the fetal transverse cerebellum in utero. Gynecologic and obstetric investigation. 1989;28(2):111-2.
6. Kramer MS, McLean FH, Boyd ME, Usher RH. The validity of gestational age estimation by menstrual dating in term, preterm, and postterm gestations. Jama. 1988 Dec 9;260(22):3306-8.