

## Role of Transcerebellar Diameter Measurement with Ultrasonography in Evaluation of Gestational age in Normal and Growth Restricted Fetuses

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### Abstract

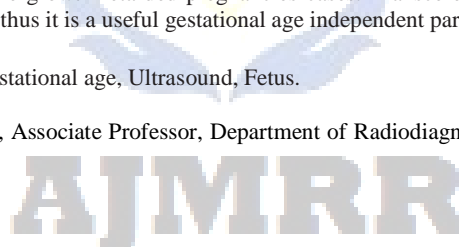
**Background:** To study the usefulness of transcerebellar diameter measurement ultrasonographically for the detection of gestational age in normal and intra uterine growth restricted fetuses and compare the gestation age determined by transcerebellar diameter with that determined by other parameters i.e. biparietal diameter, head circumference, abdominal circumference and femur length. **Subjects and Methods:** A prospective study with ultrasonographic evaluation of five hundred antenatal patients in gestational age of 14-39 weeks. The transcerebellar diameter was measured and the corresponding gestational age determined. The gestational age was also determined with other parameters such as biparietal diameter, head circumference, abdominal circumference and femur length. Transcerebellar circumference to abdominal circumference ratio was calculated. **Results:** There is statistically significant relationship between Transcerebellar diameter and gestational age in normal and intra uterine growth retarded pregnancies. Transcerebellar diameter showed good correlation with gestational age (correlation coefficient=0.979) in case of normal pregnancies and (correlation coefficient=0.942) in cases of intra uterine growth retarded pregnancies. Gestational age estimated by transverse cerebellar diameter measurements correlated well with gestational age estimated by biparietal diameter, head circumference, abdominal circumference and femur length. Transcerebellar circumference to abdominal circumference ratio remained fairly constant. **Conclusion:** Transcerebellar diameter can be used as an independent growth parameter to predict the gestational age in normal and in intrauterine growth retarded pregnancies cases. Transcerebellar diameter to abdominal circumference ratio is fairly constant throughout gestation and thus it is a useful gestational age independent parameter.

**Keywords:** Transverse cerebellar Diameter, Gestational age, Ultrasound, Fetus.

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### Introduction

Sonographic prediction of gestational age (GA) based on fetal parameters is the cornerstone in modern obstetrics and plays a crucial role in the management of pregnancies. The methods used to estimate gestational age (GA) and to predict the expected date of delivery are:<sup>[1]</sup> Menstrual history, Clinical examination Perception of fetal movement, The Nagele's rule. The obstetrician calculates the EDD as 280 days or 40 weeks from the first day of the LMP. Among the various clinical criteria, Last Menstrual Period (LMP) preceded by normal cycle, is known to correlate best with the gestational age. LMP may be unreliable or misleading because of oligomenorrhea, abnormal bleeding events, becoming pregnant in the first ovulatory cycle after a recent delivery and use of oral contraceptives or if ovulating very early (< day 11) or very late (>day 21) in the menstrual cycle.

The use of obstetric ultrasonography is related to the uncertainty regarding the gestational age and is presently

the most effective way in dating of pregnancy.<sup>[2]</sup> The commonly used ultrasound biometric parameters include the biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and Femur length (FL).<sup>[3-5]</sup> However the variability in assessing the gestational age with these parameters goes on increasing with increasing gestational age.<sup>[6-9]</sup>

Transverse cerebellar diameter (TCD) measurement is emerging as a new parameter and has been proposed to be more accurate in estimation of gestational age. Also it has emerged as a useful parameter in growth restricted fetuses.<sup>[10]</sup>

The aim of this study is to evaluate the usefulness of transverse cerebellar diameter measurement ultrasonographically for the detection of gestational age in normal and intra uterine growth restricted fetuses and to compare the gestation age determined by transcerebellar diameter with gestational age determined by other parameters i.e. biparietal diameter, head circumference, abdominal circumference and femur length

## Subjects and Methods

This was a prospective study which included 500 antenatal women between 14 to 39 weeks, who had regular periods and are sure about their last menstrual period or have first trimester ultrasound confirmation of gestational age by means of crown rump length measurement and others included those who were clinically suspected intrauterine growth retardation. Cases were excluded if women had multiple gestation, women not sure of its last menstrual date or in case of any fetal malformation. Out of 500 cases, 76 were IUGR fetuses. The patients written consent to participate in this study has been obtained.

All the measurements were made by scanning the cases using GE VOLUSON E8 system using 3.5 Mhz transducer

### Technique of Measurement of Transverse Cerebellar Diameter-

The measurement of TCD was obtained by the technique described by McLeasy et al (1984) and Goldstein et al (1987), in which the usual thalamic plane used for BPD is obtained, the transducer is then rotated about 300 below the thalamic plane to see the cerebellum.<sup>[11]</sup> TCD is now measured and TCD/AC ratio is calculated. In all cases cerebellum was seen as two lobules on either side of midline in the posterior cranial fossa as shown in [Figure 1].

## Results

In this study 500 cases were studied out of which 424 were normal pregnancies and 76 were IUGR pregnancies. For both the groups mean age and range of deviation were calculated using student t test and p values were estimated. The p value was found out to be 0.697 which indicates that there is no statistically significant difference between the age distributions of two groups.

Among the 500 normal pregnancies 236 were primigravida, 133 were gravida 2, 32 were gravida 3, 21 were gravida 4 and 2 were gravida 5. Among the IUGR pregnant women 45 were primigravida, 21 were gravida 2, 6 were gravida 3, 4 were gravida 4.

Comparison was done between the two groups with regards to parity using Chi Square test. The p value was found to be 0.936 which indicates that there is no stastically significant difference between the parity distributions of two groups [Figure 2].

For the 424 normal pregnancy patients all the parameters i.e TCD,BPD,HC,AC and FL were measured ultrasonographically in millimeters. Regression analysis was used to find out the correlation between TCD and each of the other parameters. Correlation coefficient (R) and p values were calculated. Good correlation was found between TCD and other parameters (p value<0.001) [Table 1].

For the 424 normal pregnancy patients each parameter i.e TCD,BPD,HC,AC and FL was correlated with gestational age (GA) using regression analysis. The analysis showed of all the parameters TCD shows best correlation with gestational age [Table 2]. By using the ultrasonographically

derived data, scatter diagram was devised showing linear correlation of TCD with gestational age as shown in [Figure 3].

**Table 1: Table showing correlation of TCD with BPD,HC, AC,FL in normal pregnancies.**

Parameters Compared	Correlation Coefficient (R)	P Value
TCD VS BPD	0.984	<0.001
TCD VS HC	0.976	<0.001
TCD VS AC	0.977	<0.001
TCD VS FL	0.983	<0.001

**Table 2: Table showing correlation of GA with BPD,HC,AC AND FL and TCD in normal pregnancies**

Parameters	R	P Value
GA VS BPD	0.975	<0.001
GA VS HC	0.968	<0.001
GA VS AC	0.973	<0.001
GA VS FL	0.975	<0.001
GA VS TCD	0.979	<0.001

**Table 3: Normogram showing mean TCD( mm) measurements at 5th, 50th and 95th percentile for the corresponding gestational age**

GA	5th Percentile	50th Percentile	95th Percentile
15th Week	1.47	1.60	7.64
16th Week	1.54	1.56	4.92
17th Week	1.60	1.78	4.80
18th Week	1.68	1.71	1.84
19th Week	1.86	1.94	2.18
20th Week	1.59	2.06	2.43
21th Week	1.97	2.19	4.59
22nd Week	1.95	2.29	2.48
23rd Week	2.24	2.47	2.61
24th Week	1.85	2.64	3.76
25th Week	2.10	2.72	4.40
26th Week	2.35	2.96	4.40
27th Week	2.43	3.14	3.39
28th Week	2.87	3.38	3.83
29th Week	2.60	3.51	4.21
30th Week	3.36	3.68	4.42
31th Week	3.34	3.79	4.33
32nd Week	2.88	3.98	2.80
33rd Week	3.91	4.19	4.74
34th Week	2.19	4.47	4.96
35th Week	3.02	4.60	5.05
36th Week	2.63	4.8	5.18
37th Week	2.35	5.01	5.17
38th Week	4.78	5.37	5.49
39th Week	4.86	5.54	5.66

**Table 4: Table showing correlation of GA with BPD,HC,AC AND FL and TCD in IUGR pregnancies**

Parameters	R	P Value
GA VS BPD	0.879	<0.001
GA VS HC	0.866	<0.001
GA VS AC	0.845	<0.001
GA VS FL	0.862	<0.001
GA VS TCD	0.942	<0.001

The normogram was devised for TCD in case of normal pregnancies using ultrasonographically derived data. The normogram show mean measurements in millimeter (mm) at 5th, 50th and 95th percentile for the corresponding gestational age. [Table 3].



Figure 1-Ultrasound image showing transcerebellar diameter measurement.

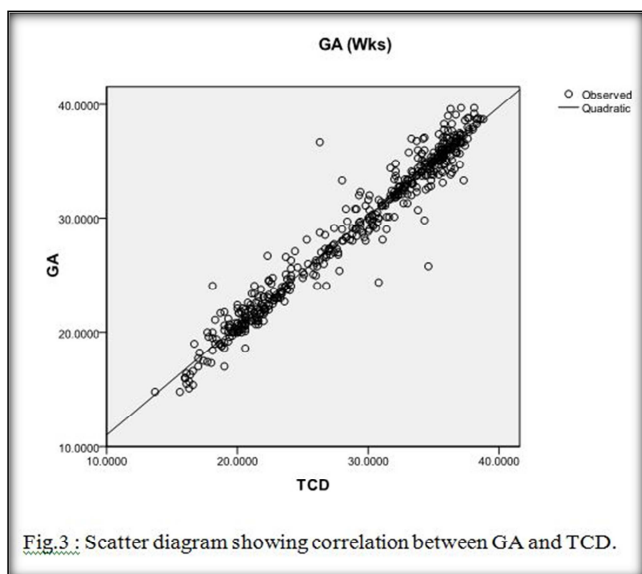


Fig.3 : Scatter diagram showing correlation between GA and TCD.

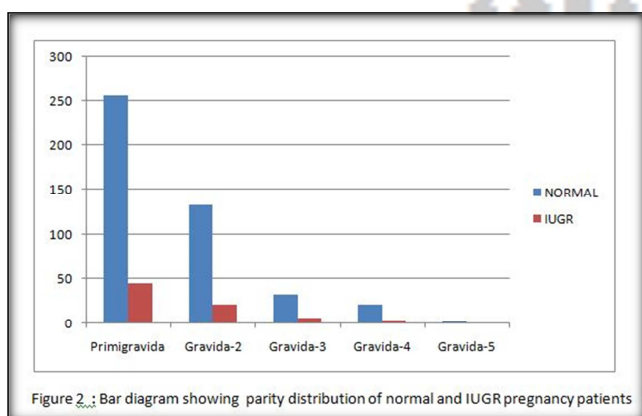


Figure 2; Bar diagram showing parity distribution of normal and IUGR pregnancy patients

In IUGR pregnancy cases each parameter-BPD,HC,AC,FL and TCD was correlated with gestational age using regression analysis. Of all parameters TCD showed best correlation with gestational age ( $R=0.942$ ).The correlation was comparatively less strong between gestational age and other parameters [Table 4].

Also for all IUGR pregnancies the BPD,HC,AC,FL and TCD measurements were compared with normograms derived from normal pregnancies. Number of patients with

BPD,HC,FL,AC and TCD values below 5th percentile values were recorded. It was seen that 20 cases were below the fifth percentile for AC and FL,21 cases were below the fifth percentile for BPD and 29 cases were below the fifth percentile for FL. In 72 cases out of 76 the TCD values were within normal range. Only in 4 cases the TCD values were below the 5th percentile.The difference in number of cases below the 5th percentile for BPD,HC,AC,FL and TCD was statistically significant( $p$  value  $<0.001$ ). In this study the mean TCD/AC ratio in normal pregnancy was found to be  $0.1529 \pm 0.07$  (SD) which remained fairly constant throughout pregnancy and thus it is a useful gestational age independent parameter. The mean TCD/AC ratio in IUGR pregnancies was found to be  $0.1711 \pm 0.02$  (SD).

## Discussion

Identification of aberrant growth as well as growth disturbances across the spectrum of GA in both healthy fetuses and those with genetic abnormalities will be helpful for optimal fetal surveillance. The biometric parameters used for gestational age assessment are BPD, HC, AC and FL.<sup>2,3,4</sup> However each of these parameters have their own limitation. TCD serves as a unique parameter for estimation of gestational age and is a standard against which deviation in other parameters may be compared.<sup>[13]</sup>

The cerebellum, the largest part of the hind brain, is surrounded laterally by the dense petrous ridges and inferiorly by the occipital bone, which is aligned perpendicular to the plane of maximum extrinsic compression. Thus, the cerebellum and posterior fossa should theoretically be able to withstand deformation by extrinsic pressure better than the parietal bones.<sup>[14]</sup>

In this study 500 pregnant patients with known LMP were studied out of which 424 were normal pregnancies and 76 were IUGR pregnancies .There was no statistically significant difference between two groups with regards to age and parity( $p$  values were  $>0.05$ ).

In all these patients, ultrasonographic parameters like BPD,HC,AC,FL and TCD were measured ultrasonographically and gestational age was correlated. Also attempt was made to correlate TCD with other parameters. Normogram was established for the mean TCD values at 5th, 50th and 95th percentiles for the corresponding gestational age. In case LMP is not known this normogram can be used for assessing the fetal gestational age and to assess any deviation from normal growth. Present study showed linear relation of transverse cerebellar diameter with gestational age which makes present study highly significant and proved that transverse cerebellar diameter may serve as a reliable indicator of gestational age, and fetal growth.

Goldstein et al,<sup>[15]</sup> prospectively studied ultrasonography of 371 normal pregnant women,with gestational ages ranging from 13 weeks to 40 weeks. They found curvilinear relationships between the transverse diameter of the cerebellum and the gestational age ( $R = 0.948$ ;  $P = 0.001$ ), the biparietal diameter ( $R = 0.956$ ;  $P = 0.0001$ ), and the



head circumference ( $R=0.969$ ;  $P = 0.0001$ ). A nomogram of cerebellar measurements estimating gestational age was generated. They concluded that throughout pregnancy normative cerebellar measurements allows for estimation of gestational age that is independent of the shape of fetal head. The result of this study is in concurrence with the above observation. In the present study there was good correlation between TCD and gestational age. ( $R = 0.942$ ,  $p$  value  $< 0.001$ ). Also good correlation was found between TCD and BPD ( $R = 0.984$ ,  $p$  value  $< 0.001$ ) and between TCD and HC ( $R= 0.975$ ,  $p$  value  $< 0.001$ ). In this study TCD nomogram was established from ultrasonographically measured data which can be used for estimating the gestational age of fetus.

## Conclusion

Transcerebellar diameter shows good correlation with gestational age in case of normal pregnancies and in case of IUGR and can be used as a independent growth parameter to predict the gestational age in normal and in intrauterine growth retarded pregnancies cases. Transcerebellar diameter to abdominal circumference ratio is fairly constant throughout gestation and thus it is a useful gestational age independent parameter.

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