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A Cross-Sectional Study to Evaluate Sonographic Foetal Transcerebellar Diameter for Estimation of Gestational Age in Normal Singleton Pregnancies At A Tertiary Care Centre

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ABSTRACT

Introduction: Assessment of gestational age is of paramount importance to an obstetrician for management of pregnancy from conception to delivery. The aim of the study was to evaluate foetal transcerebellar diameter for estimation of gestational age.

Material and methods: This was a cross-sectional study. 180 women with normal singleton pregnancy between 18 to 36 weeks of gestation were included in the study. Foetal transcerebellar diameter was measured by USG. The relationship between gestational age to transcerebellar diameter was analyzed by simple linear regression.

Results: There was a significant linear relation between Transcerebellar diameter and gestational age [Transcerebellar diameter =0.9003 X gestational age + 3.288] with high degree of correlation (R^2 = 0.5913, p value-<0.0001). The mean transcerebellar diameter at 18 and 36 weeks was 18.9 ± 2.88 mm and 36.4 ± 6.77 mm respectively. Foetal transcerebellar diameter exhibit a more than two fold increase in size between 18 to 36 weeks of gestation.

Conclusion: Transcerebellar diameter can be used as an alternate parameter to assess gestational age when other routine parameters are not conclusive or when LMP is not known.

Keywords: Transcerebellar diameter, Gestational age, ultrasonography, normal pregnancy

INTRODUCTION

Assessment of gestational age is of paramount importance to an obstetrician as it helps in scheduling chorionic villous sampling and amniocentesis in early pregnancy, in anticipating normal spontaneous delivery or to plan elective delivery and instituting measures that will optimize foetal outcome when labour ensues before 37 weeks or fails to ensue after 42 weeks. Failure to assess gestational age can result in iatrogenic premature delivery which is responsible for increased perinatal morbidity and mortality.[1]

Ultrasonography helps in evaluating the duration of pregnancy based on measurement of various foetal parameters. Mean sac diameter (MSD) and crown rump length (CRL) measurement are the commonest parameters used in first trimester of pregnancy.[2] In second trimester various parameters which are being used include the biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL).[3-5] The variability in assessing the gestational age with these parameters goes on increasing with increasing age [6-8]

Cerebellum is the largest part of the hindbrain and occupies the posterior cranial fossa. It comprises of two cerebellar hemispheres connected together by midline vermis. Cerebellum is visualized by rotating the transducer in the axial plane centered on the thalamus to show the cerebellar hemispheres. This view shows the cerebellum, the cistern magna and the cavum septum pellucid. The cerebellum characteristically appears as two lobules on either

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side of midline in the posterior cranial fossa. The widest diameter of the cerebellum is measured. [9]

The foetal cerebellum in the embryo appears at the end of 5th week of pregnancy and can be reliably measured using ultrasonography from the 12th to 14th week of gestation till delivery.[10-12] The anatomical location of the cerebellum in the posterior cranial fossa makes the organ less vulnerable to external pressures on the foetal cranium. [10-13] Ultrasonographically, the cerebellum, in the second trimester, can be easily viewed as a central rectangular echogenic structure (vermix) connecting two oval echoluscent structures (hemispheres) after the 14th week of gestation. [11, 14] Since the last ultrasound parameter decade. 'transcerebellar diameter (TCD) is considered a reliable predictor for gestational age in third trimester.[3-7]The cerebellum is well protected in the foetal head and size of cerebellum is least affected by decrease in blood flow and deviation in fetal growth restriction or growth acceleration .[4-8]

Transverse cerebellar diameter (TCD) measurement is highly accurate in correct assessment of gestational age especially in cases where the last menstrual periods are not exactly known or suspected to have IUGR. [15] Although both BPD and TCD are accurate biometric parameters at 36 weeks of gestation, transcerebellar diameter is more reliable method of gestational age determination in third trimester of pregnancy than biparietal diameter.[15]therefore, TCD can be used as a tool to assist in the assessment of gestational age in third trimester.[16]

Very few studies have been done of using foetal transcerebellar diameter (TCD) for estimation of gestational age in our state of Rajasthan so the present study was done to establish baseline TCD values between 18 to 36 weeks of pregnancy for accurate prediction of gestational age and to determine the correlation between TCD and the gestational age.

MATERIAL AND METHODS

This was a cross-sectional study conducted on 180 women with normal singleton gestations between 18 to 36 weeks of pregnancy after obtaining written informed consent. The study was done between April 2017 to November 2018. Women who conceived spontaneously and knew their LMP were included. Women with IUGR, associated medical disorders and with congenital malformation of foetus were excluded. Gestational age was assessed by LMP. A transabdominal ultrasound scan was done in all cases. Fetal TCD was measured using the widest diameter of the cerebellum. The transventricular or transverse axial plane defined by the appearance of 'arrow-like' image of central midline echo intercepted in the anterior third by the cavum septum pellucid and the frontal horns of the lateral ventricles (feathers) was first identified. The transducer was slightly rotated $(\sim 30^{\circ})$ from this plane to get the transcerebellar plane that was used to acquire the image of the cerebellum. The measurement was made in plane showing the cisterna magna (CM) and nuchal fold (NF), with callipers placed 'out- to - out' on the margin of the widest diameter of the cerebellum. (image 1)

All the data collected were entered in the MS Excel sheet and statistically analyzed. The statistical evaluation between fetal transcerebellar diameter and gestational age was assessed. Linear regression analysis was obtained. P value ≤ 0.05 was significant.

RESULTS

Majority of the women belong to age group 25 - 30 years (47.2%) followed by age group 30 years or above (34.5%) and 20-25 years (18.3%). Regarding the gravidity, 95 women (52.8%) were primigravida and 85 women (44.2%) were second gravid or above. (Table I). Mean age of the woman was 27.9 ± 4.15 years and mean gravidity was 1.67 ± 0.86 .

The TCD and GA measurements between 18 and 36 weeks were analyzed as shown in Table 2. The mean TCD at 18 weeks was 18.9 ± 2.88 mm with a range of 15.9 mm and 23.7 mm while at 36 weeks, the mean TCD was 36.4 ± 6.77 mm with a range of 26.3 mm – 40.9 mm.

A positive linear correlation was observed between the TCD and increasing GA with a equation TCD = 0.9003 X gestational age + 3.288 and a high degree of correlation (R^2 = 0.5913, p value-<0.0001) (Figure 1)

A positive linear correlation was observed between the GA and TCD with a equation GA = 0.6568 XTCD + 7.503 and a high degree of correlation ($R^2 = 0.5913$, p value-<0.0001) (Figure 2)

5th, 25th, 50th, 75th and 95th percentiles for TCD were obtained for GA and a nomogram of TCD was plotted. Median TCD (50th percentile) increases from 18.4 mm at 18 weeks to 39.2 mm at 36 weeks of gestation. The 5th and 95th percentiles at 18 weeks were 15.9 and 23.7 mm and at 36 weeks these were 26.3 and 40.9 mm respectively. The inference shows that the normal foetal TCD exhibit a more than two fold increase in size between 18 to 36 weeks of gestation. (Table 3)

DISCUSSION

Correct estimation of gestational age is essential in management of women from conception till delivery. Wrong calculation of gestational age can result in iatrogenic prematurity, therefore assessment of fetal maturity is important for obstetrician to decide the timing and method of delivery. Various methods used to estimate gestational age are menstrual history and LMP, clinical examination, perception of foetal movement by the women. Most commonly used method to calculate EDD is Naegele's rule. It is calculated as 280 days or 40 weeks from the first day of LMP. [17] It requires regular menstrual cycle and not suitable for women having irregular menstrual cycle or do not remember their LMP.

Clinical examination is inaccurate in estimating the GA. It may be affected by fetal growth disorders and liquor volume, and subject to errors due to maternal obesity or inter-and intra-observer variations.[14]

Various biometric parameters for GA assessment are biparietal diameter (BPD), femur Length (FL) and head Circumference (HC).These parameters have their own limitations as BPD after 26 weeks becomes more related to growth and also unreliable in conditions altering the shape of skull i.e. in breech presentation and oligohydramnions. Similarly femur length is also unreliable in cases of femur achondroplasia. [11] Recently TCD has evolved as a new and unique parameter for estimation of gestational age. Use of TCD is consistently superior in predicting GA in both singleton and twin gestation.[6,7,10]

The present study was done on 180 normal singleton pregnancy for estimation of gestational age by TCD. Maximum number of the women were in age group 25 - 30 years (47.2%) which was consistent with study of Dashottar S et al [18] and in contrast to that

observed by Naseem F et al 2013 [15] and Chowdary J S et al 2016 [19]. Majority of the women in our study were primigravida (52.8%). Gravidity of the women in our study was consistent with that observed by Naseem F et al 2013 [15], Chowdary J S et al 2016 [19] and Ruqyyah Salim et al 2017 [9]. Mean age of the woman (27.9 \pm 4.15 years) in our study was lower than that observed by Ruqyyah Salim et al 2017 (29.53 \pm 3.60 years). [9]

Linear regression equation was derived for estimation of GA by TCD and a strong positive correlation was observed (R^2 = 0.5913, p value-<0.0001). The study observes that as gestational age increases the diameter of foetal cerebellum also increased. Results of our study were consistent with other studies done in the past by various authors. [5,9-11, 18-23]. All of them in their studies showed a positive linear relation of TCD with gestational age. Regression analysis indicated a strong relationship between TCD and gestational age indicating TCD is a good marker for estimation of gestational age. [24]

The mean TCD at 18 weeks was 18.9 ± 2.88 mm with a range of 15.9 mm and 23.7 mm. Result of our study are consistent with that of Aneesh MM et al 2018 [22] and Oloyede OA et al 2017 [25] who in their study observed mean TCD at 18 weeks to be 18.03 ± 0.92 mm and 18.5 ± 0.96 mm respectively. The mean TCD at 23 weeks was 22.3 ± 2.83 with a range of 19.7 to 29.1 mm. Oloyede OA et al 2017 [25] in their study observed mean TCD at 23 weeks to be 19.9 \pm 1.65 mm with a range of 23.1mm -26.7 mm. The mean TCD between 20 to 30 weeks of gestation was 22.35±4.32 mm and between 31 to 36 weeks was 25.17±8.51 mm. In a study done by Agarwal C et al [21] the mean TCD in early gestational age i.e. 20-28 weeks is 24.7 ± 3.86 and in late gestational age i.e. 30-36 weeks was 39.31 \pm 2.51. In a similar study done by Goel P et al [11], the mean TCD at 21-30 weeks of gestational age was 26.63 mm and at 31-40 weeks of gestational age was 40.73 mm. The minimum and maximum TCD at 21-30 weeks was 18.40 mm and 35 mm and at 31-40 weeks it was 36 mm and 48.4 mm respectively. In another study done by Das gupta et al [23], the mean TCD during 21-27 weeks was 23.2 mm with minimum and maximum TCD 20 mm and 28 mm respectively, and during 28-34 weeks the mean TCD was 30.6 mm, minimum and maximum TCD were 24 & 35 mm respectively. During 35-40 weeks the

mean, minimum and maximum TCD were respectively 35.2 mm, 30 mm and 40 mm. There was twofold increase in foetal TCD from 18 weeks to 36 weeks. Our observation was similar to Agarwal C et al [21] and Vinkesteijn et al [26] who in their study concluded that the second half of pregnancy is characterized by a more than twofold increase in fetal TCD.

We calculated the percentiles (5th, 25th, 50th, 75th, and 95th) of TCD at different gestational age. Our results were comparable to that of Agarwal C et al [21] and Das gupta A et al.[23]

Various studies in the past have shown that transcerebellar diameter (TCD) is a more simple, accurate, independent, reliable and consistently superior predictor of gestational age in normal and as well as in IUGR foetuses. [27,28] TCD was found to be a reliable predictor of gestational age in the third trimester.[23,24,28]. The TCD is mostly gaining acceptance as a reliable tool for estimating GA because it is not influenced by abnormalities of foetal growth such as intrauterine growth restriction, shape of the foetal cranium or multiple pregnancy and neither has any adverse safety issues, related to the use of ultrasound scan at this gestational period, been documented. [15,18,] In our study we observed a linear relationship between TCD and gestational age indicating the reliability in the estimation of gestational age and monitoring fetal growth therefore TCD should be used along with other sonographic parameters of the foetus for estimation of gestational age.

CONCLUSION

In the normally developing fetus, the TCD increases with advancing gestational age. We observed a linear relationship between TCD and foetal gestational age between 18 to 36 weeks in normal singleton pregnancies. Transcerebellar diameter can be used as an alternate parameter to assess gestational age when other routine parameters are not conclusive or when LMP is not known.

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Image 1: Measurement of Transcerebellar diameter

Table 1: Distribution of cases according to maternal age/gravidity (n = 180).

Demographic profile of the women	Number	Percentage	
Age (years)			
20-25	33	18.3	
25-30	85	47.2	
≥30	62	34.5	
Mean Age = 27.9 ± 4.15			
Gravidity			
Gravida 1	95	52.8	
Gravida 2	61	33.9	
Gravida ≥3	24	13.3	
Mean gravidity = 1.67 ± 0.86			

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Gestational age	Number of cases	TCD (mm)			
(weeks)		Mean ± SD	Minimum TCD	Maximum TCD	
18	5	18.9 ± 2.88	15.9	23.7	
19	42	21.7 ± 3.53	16	27.7	
20	30	22.4 ± 3.24	17.1	28.3	
21	17	21.1 ± 2.62	18.2	28.9	
22	9	21.9 ± 3.11	19.1	28.9	
23	13	22.3 ± 2.83	19.7	29.1	
24	9	22.7 ± 3.21	20.1	29.4	
25	7	23.4 ± 4.34	20.5	30	
26	3	23.8 ± 5.23	20.8	29.9	
27	0	-	-	-	
28	4	25.1 ± 4.14	21.6	30.5	
29	5	29.7 ± 4.34	22.1	32.6	
30	3	30.3 ± 6.43	22.9	34.2	
31	6	31.5 ± 5.34	23.4	36	
32	5	33.6 ± 5.79	24.2	38.9	
33	9	33.7 ± 5.76	24.9	39.8	
34	5	35.4 ± 5.72	25.8	40.5	
35	4	36.3 ± 6.93	26.0	40.8	
36	4	36.4 ± 6.77	26.3	40.9	

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Table 2: TCD and GA measurements

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Figure 1: Correlation between gestational age (X-axis) and Transcerebellar diameter (Y-axis)



Figure 2: Correlation between Transcerebellar diameter (X-axis) and gestational age (Y-axis)



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Gestational	No. of	5 th	25 th	50 th	75 th	95 th
age (weeks)	cases	percentile	percentile	percentile	percentile	percentile
18	5	15.9	18	18.4	18.5	23.7
19	42	16.1	18.7	20.75	23.6	27.3
20	30	18.3	19.1	22.7	25.1	27.6
21	17	18.2	19.8	20.5	22.1	28.9
22	9	19.1	20	20.9	22.8	28.9
23	13	19.7	20.3	21.3	24	29.1
24	9	20.1	20.4	21.3	23	29.4
25	7	20.5	20.6	21	27.5	30
26	3	20.8	20.8	20.9	29.9	29.9
27	0	-	-	-	-	-
28	4	21.6	21.8	24.1	28.3	30.5
29	5	22.1	30.4	31.4	32.1	32.6
30	3	22.9	22.9	33.9	34.2	34.2
31	6	23.4	27	33.2	35.9	36
32	5	24.2	33.6	33.8	37.8	38.9
33	9	24.9	27.2	36.5	37.5	39.8
34	5	25.8	35	36.8	38.7	40.5
35	4	26	32.5	39.3	40.1	40.8
36	4	26.3	32.7	39.2	40.1	40.9

Table 3: Nomogram for TCD at gestational age between 18 to 36 weeks
