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Significance of trans-cerebellar diameter over other biometric parameters in the estimation of gestational age

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ABSTRACT

Background: Trans-cerebellar diameter (TCD) is a crucial fetal biometric parameter used in modern radiology to assess the progress of fetal growth which is vital for prosperous maternal and fetal well-being. Despite advances in ultrasound technology, the accurate measurement of fetal biometers continues to pose considerable challenges. TCD provides a more accurate gestational age, especially in late pregnancy when other parameters may be less reliable due to organic conditions. **Aims and Objectives:** The aim of this study was to evaluate the significance of TCD as a reliable biometric parameter in estimating gestational age and to measure the TCD in different gestational ages and establish a reference range. Assessing the correlation between TCD and other biometric parameters to that of gestational age. **Materials and Methods:** A cross-sectional study was conducted at SKIMS MCH Bemina, with 60 pregnant female participants recruited in the study, with consecutive purposive sampling used in the study. Consent was obtained with ethical clearance sought. The correlation between TCD, biparietal diameter (BPD), and crown-rump length (CRL) with gestational age was evaluated using the Statistical Package for the Social Sciences 24.0 to determine the strength of these relationships. **Results:** The study found strong correlations between fetal biometric measurements and gestational age: TCD (r = 0.995), BPD (r = 0.993), and CRL (r = 0.988). A linear increase in BPD and CRL with increasing gestational age was observed, consistent with previous research the TCD was found particularly as a strong reliable parameter with a higher correlation for assessing fetal growth, especially in cases where other measurements may be less reliable. **Conclusion:** Findings suggest that TCD could be a valuable addition to standard fetal biometric measurements in clinical practice. The strong correlation between TCD and gestational age has pivotal implications for improving gestational age estimation. More research is needed to emphasize the use of TCD across many population samples and to explore its potential in fetal growth assessment.

Key words: Correlation; Trans-cerebellar diameters; Biparietal diameter; Fetal biometery

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INTRODUCTION

Gestational dating is an important indicator for favorable outcomes in maternal and neonatal health.[1] Over a period of time, ultrasonography uses different fetal biometers for the estimation of gestational age that has been reported in the literature.[2] Fetal ultrasonography is a non-invasive, non-ionizing, and affordable procedure with higher acceptability providing reliable and pivotal information about fetal parameters. This procedure is based on measuring the several anatomical characteristics of the fetus throughout the intrauterine life. During fetal growth, time-dependent changes occur in the body dimensions of the fetus. Sonographic values of the fetus are of valuable support in providing information about fetal growth in contrast to already defined values of fetal biometrics as

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per the gestational age.[3] Precise information on gestational age is the way to prosperous antepartum care that leads to the planning of appropriate and tailored interventions at different stages.[4] Different fetal biometric parameters are documented for the evaluation of gestational age such as measurement of the gestational sac, crown-rump length (CRL), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). The most frequently used parameters in the second and third trimesters of pregnancy are the BPD, HC, AC, and FL. Such measurements are regarded as the gold standards in radiology.[5] Transverse cerebellar diameter as a fetal biometric is an emerging tool in radiology to assess fetal growth and its implications in the prediction of fetal well-being.[6,7] The trans-cerebellar diameter (TCD) is rarely affected due to organic disorders that may lead to changing the coordinates of the skull. The reason being not affected is the deep location of cerebellum, robustness of development, and surroundings of petrous ridges.[8] Such a study has not been conducted in our institute so far as the population, so keeping in view, it becomes imperative to assess the transcerebellar diameter as a reliable biometric parameter.

Aims and objectives

Aims

The aim of this study was to evaluate the significance of TCD as a reliable biometric parameter in estimating gestational age.

Objectives

The objective of this study was to measure the TCD in different gestational ages and establish a reference range.

Assessing the correlation between TCD and other biometric parameters to that of gestational age.

MATERIALS AND METHODS

Our study was conducted in the Department of Radiology Sheri Kashmir Institute of Medical Sciences Bemina Srinagar. Pregnant females with a fetus who were declared as normal, with a normal singleton pregnancy by the obstetrician were subsequently referred to the Department of Radiodiagnosis and Imaging for assessment of antenatal fetal well-being using fetal biometry the evaluation was done. Healthy females with normal menstrual cycles who knew their last date were recruited for the study. The present study was cross-sectional. Convenience-based consecutive sampling technique was used for the present study. Fetuses from 15 to 30 weeks of gestation (calculated based on the last menstrual period [LMP]) of these pregnant females were recruited. The participants were duplicated by double cross-checking. Privacy and confidentiality were maintained. Before participation in the study, the procedure was fully explained to the patient, and the use of this study and data were explained in both Urdu and Kashmiri languages. The patients acknowledged their will to withdraw from the study at any point of time if they desired. The consent was taken from the patient, then females were taken for ultrasonography after they completely filled the institutional, duly signed by the radiologist conducting sonography and the women undergoing sonography. These obstetrical ultrasounds were carried out using a 2–5 MHz convex array transducer on a DC80 ultrasound machine. Measurements of TCD, BPD, and CRL of all the fetuses were taken by a consultant radiologist using the standard methods. Any abnormality detection during the scan in the fetus would exclude the fetus from the study.

Ethics

The ethical approval was taken for the study vide no: IEC/161/2024 from the Institutional Ethical Committee which was conducted from January 2024 to June 2024 on pregnant females referred from the Department of Gynecology and Obstetrics of Sher Kashmir Institute of Medical Sciences Bemina Srinagar for antenatal evaluation, before proceeding the form was filled. Privacy and confidentiality were maintained.

Statistics

Microsoft Excel sheet version 2021 was used for data management. Statistical analysis was carried out using the Statistical Package for the Social Sciences 24.0. To calculate the mean with standard deviation, descriptive statistics was used. The graph was used to emphasize the comparison of trends of fetal parameters against the gestational age.

Inclusion criteria

The following criteria were included in the study:

- Pregnancies from 14 and 40 weeks of gestation
- Only singleton pregnancies were included
- Patients with accurate LMP
- Pregnancies have normal amniotic fluid levels
- Pregnant woman for giving consent to ultrasound examination.

Exclusion criteria

The following criteria were excluded from the study:

- Patients with multiple gestations
- Patients with fetal anomalies
- Patients with oligohydramnios or polyhydramnios
- Patients have inadequate ultrasound visualization due to maternal obesity, fetal position, or any other condition
- Known cases of intrauterine growth restriction as they may affect standard biometric measurement

Technique/Procedure

TCD is measured in mm with the help of the widest anteroposterior diameter of the cerebellum. After getting trans thalamic, the probe is slightly rotated below the thalamic plane, going toward the fetal neck, when posterior horns of the lateral ventricles disappear from view and are replaced by the normal dumbbell-shaped cerebellum. The intersection of the cross of the calipers was positioned on the outer edge of each hemisphere to obtain an outer-to-outer measurement at 90° to the midline (Figure 1).[9] The transducer is adjusted to obtain a transverse (axial) view of the fetal head. The plane for measuring BPD is through the thalami and cavum septi pellucid, midline falx visible as a linear echogenic structure bisecting the brain. The linear calipers are placed on the outer edge of the parietal bone closest to the transducer (Figure 2).[10] To measure CRL, the fetus is positioned at a 90° angle to the ultrasound beam in a midsagittal section and in a neutral position, with the head neither flexed nor extended, and the inferior limbs should not be seen. Amniotic fluid is visible between the chin and chest. Calipers should be placed to measure the greatest width between the crown and rump. Can be measured trans-vaginal or abdominal.[11]

Figure 1: Trans cerebellar diameter

Figure 2: Bi-parietal diameter

RESULTS

Table 1 indicates that 11.6% were 23 years old, 20% were 25, 40% were 27, 18.33% were 29, and 10% of study participants were 30 years old. Mean age 26.8 years with S.D±2.06. The above table indicates that 3.33% had 15 weeks of gestation, 6.66% had 16 weeks, 10% had 17 weeks, 13.33% had 18 weeks, 8.33% 19 weeks, 10% 20 weeks, 3.33% had 21, 3.33% had 22, 5% had 23 weeks of gestation, 24 and 25 weeks of gestation had a percentage of 3.33. 5% had 26 weeks of gestation, 3.33% had 27 weeks of gestation, 6.66% had 28 weeks of gestation, 5% had 29 weeks of gestation, and 10% had 30 weeks of gestation.

Table 2 indicates that in study, participants at 15 weeks of gestation had a mean BPD of 35 mm, and CRL of 129 mm, in 16 weeks mean BPD was 37.5 and CRL of 139, 17 weeks BPD was 40 mm and CRL of 148.33 mm, 18 weeks BPD 40.25 mm CRL of 159.5, 19 weeks BPD 45.8 and CRL of 168.8, 20 weeks BPD 48 and CRL of 173, 21 weeks BPD 50.5 and CRL of 179.5, 22 weeks BPD 52.5 and CRL of 183, 23 weeks BPD 53.3 and CRL of 188, 24 weeks BPD 56.5 and CRL of 193, 25 weeks BPD 58.5 and CRL of 199, 26 weeks BPD 60.33 and CRL of 204.66, 27 weeks BPD 62.5 and CRL of 208.5, 28 weeks BPD 64.5 and CRL of 213.25, 29 weeks BPD 66.33 and CRL of 219, and in 30 weeks mean BPD was 68.5 and CRL was 223.5, respectively. A correlation of 0.995 was seen between transcranial diameter (TCD) of gestational age and 0.009 to that growth rate, however, 0.993 between gestational age that of BPD and 0.008 to BPD and growth rate. A corelation of 0.995 was seen between trancranial diameter (TCD) to gestational age and 0.009 to that of growth rate.However a corelation of 0.993 between BPD and gestastional age and 0.008 to that of growth rate.A corelation of 0.988 was seen between gestational age and the CRL.

Above Figure 3 is a scatter diagram that explains the comparison of three fetal biometers, that is, TCD, BPD, and CRL, and their correlation with gestational age. To increase gestational age, TCD is seen to increase in linearity. The scatter diagram is evidence of the strong correlation of 0.995 gestational age with TCD as compared to others.

DISCUSSION

Radiodiagnosis has seen advancement in ultrasonographic techniques used for the dating of pregnancies, maternal, and fetal well-being. Fetal bioparameters have been constantly used in different health centers across the world.[12] In our study, patients recruited had a mean age of 26.8 years with SD 2.06, ranging from 23 to 30 years old. This age group is a typical childbearing population, which was also in contrast to the study by Drukker et al., likely reason may be that the population being studied might

Table 1: Radiological variants of patients

AGE in years	n	%
23 years	7	11.6
25 years	12	20.0
27 years	24	40.0
29 years	11	18.33
30 years	6	10.0
Mean age in years	26.8	
Standard deviation	2.06	
Gestational age in weeks		
15	2	3.33
16	4	6.66
17	6	10.0
18	8	13.33
19	5	8.33
20	6	10.0
21	2	3.33
22	2	3.33
23	3	5.0
24	2	3.33
25	2	3.33
26	3	5.0
27	2	3.33
28	4	6.66
29	3	5.0
30	6	10.0

Gestational age	Transcranial diameter (Mean)	Standard deviation
15	15	0
16	16.3	0.12
17	17.27	0.23
18	18.23	0.21
19	19.3	0.3
20	20.15	0.29
21	21.35	0.7
22	21.4	0.14
23	23.6	0.1
24	24.65	0.21
25	26.2	0.14
26	26.97	0.57
27	29.4	0.14
28	30.45	0.37
29	31.67	0.15
30	33.38	0.21

be from a region or community where early pregnancies are more common, particularly in rural areas. The group of gestational ages evaluated was from 15 to 30 weeks, encompassing a significant part of the second and early third trimesters, which are vital periods for fetal growth and development and were in accordance with studies.[13-15] The majority of the patients in our study were 27 years old that was in contrast with the study.[16] Likely reason for this could be that the majority of females plan a child at this age. Our study documented a linear increase in both BPD and CRL with increasing gestational age. Our study results are consistent with the study that has resulted in the need for these measurements for estimating fetal age and growth Hadlock et al.,[17] our study witnessed a strong correlation between biometric measurements and gestational age. TCD showed the strongest correlation with gestational age (r=0.995), followed by BPD (r=0.993) and CRL (r=0.988).

Table 2: Other biometric variables

Gestational age	Mean BPD	Mean CRL
15	35	129
16	37.5	139
17	40	148.33
18	40.25	159.5
19	45.8	168.8
20	48	173
21	50.5	179.5
22	52.5	183
23	53.33	188
24	56.5	193
25	58.5	199
26	60.33	204.66
27	62.5	208.5
28	64.5	213.25
29	66.33	219
30	68.5	223.5
Correlation (TCD vs. gestational age and growth rate	0.995/0.009	
Correlation (BPD vs. gestational age and growth rate)	0.993/0.008	
Correlation (CRL vs. gestational age and growth rate)	0.988/0.007	

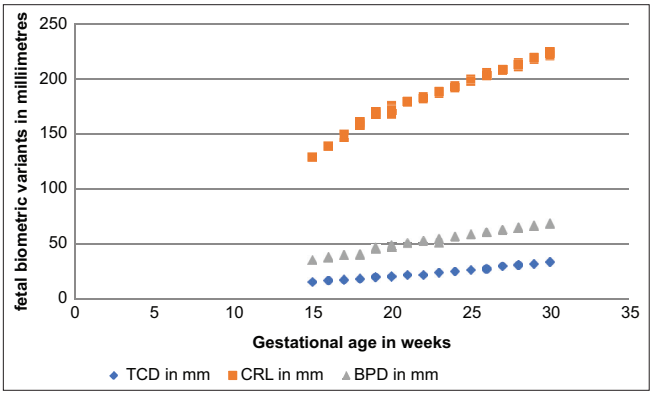

Figure 3: Scatter diagram for comparison of fetal biometric variants

Such measurements are reliable indicators of gestational age, notably TCD, which offers a slight advantage in accuracy. Strong correlation of TCD to gestational age is a highlighting feature and corresponds to the research by Chavez et al.,[18] that found that TCD was an approximate predictor of gestational age, particularly in the second and third trimesters. Our study findings are evident in the constant increase in mean BPD values from 35 mm at 15 weeks to 68.5 mm at 30 weeks of gestation, which is in line with a study by.[17] Our study showed an increase trend of CRL vlaues,such an trend allows the continued utility of CRL measurements beyond the first trimester providing valuable insight into the growth projection that robinson and flimi ngo echoed[19] where authors highlighted the mean CRL trend and iits mplications.[19] In our study, TCD has been seen as a highly reliable parameter that we found a strong correlation between TCD and gestational age (r=0.995), surpassing BPD (r=0.993) and CRL (r=0.988) measurements. Our study findings support the evidence

provided in the study by Goldstein et al.,[20] where authors have highlighted the excellence of TCD, especially in cases where other fetal biometric parameters may be less reliable due to fetal position or growth disorders and other anomalies. Our study also documented a strong correlation between fetal growth rate and BPD.[21]

Limitations of the study

- The research was conducted at a single study center which limits its generalizability
- This study was cross-sectional in nature. A longitudinal study is needed to validate the findings and see changes over a period of time
- Our study did not include fetuses with growth disorders or anomalies, that may affect the reliability of the biometric measurements in such cases.

CONCLUSION

Our study found a significant relationship between fetal biometric measurements and their correlation with gestational age. Strong correlations were found between fetal biometric measurements and gestational age with TCD=0.995, BPD=0.993, CRL=0.988. We also observed a linear increase in BPD and CRL with gestational age. TCD was found as a particularly reliable parameter for assessing fetal growth, especially in cases where other biometric measurements may be less reliable due to different fetal positions or growth disorders.

Implications

- The results of our study suggest that TCD could be a reliable addition to standard fetal biometric measurements
- The correlation between TCD and gestational age could lead to a more accurate estimation of gestational age
- Validation of TCD use in different populations should be recommended
- Longitudinal studies as a future direction should be performed to confirm the findings.

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