Original Research Article

USEFULNESS OF TRANS-CEREBELLAR DIAMETER IN ESTIMATION OF GESTATIONAL AGE IN COMPARISON TO OTHER ROUTINELY USED FOETAL BIOMETRIC PARAMETERS

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Abstract

Background: Estimation of gestational age is very important in day-to-day obstetric ultra-sonographies for management of entire pregnancy, delivery, and newborn. The trans-cerebellar diameter is a better parameter to calculate gestational age in cases of wrong dates, abnormal and variable foetal head shapes such as dolichocephalic and brachycephalic head or when foetus is deep in the pelvis or in posterior position. Trans-cerebellar diameter (TCD) may be more appropriate in estimation of gestational age. **Aim and Methodology**: To determine the usefulness of trans-cerebellar diameter in estimation of gestational age and its comparison with other conventional parameters such as head circumference, biparietal diameter, abdominal circumference and femur length in the estimation of gestational age. This study is done in Department of Radiodiagnosis, Mahatma Gandhi Hospital Jaipur Rajasthan. Patients were referred to the department for a routine foetal wellbeing and growth monitoring (antenatal ultra-sonogram). **Results**: When gestational age calculated by trans-cerebellar diameter and compared with gestational age derived from last menstrual period, there is a linear relationship throughout the gestational ages. This study indicates strong correlation of trans-cerebellar diameter with other conventional parameters egs biparietal diameter, head circumference, abdominal circumference and Femur length. Correlation of trans cerebellar diameter with gestational age shows a R2 of 0.9995 (p value<0.001). **Conclusion**: Trans-cerebellar diameter is excellent and comparable to other biometric parameters (biparietal diameter, head circumference, femur length and abdominal circumference) commonly used for estimation of gestational age. The regression formula derived from trans-cerebellar diameter is applied to determine the gestational age of foetus. **Abbreviations**: BPD: Bi-parietal diameter; HC: Head circumference; AC: Abdominal circumference; FL: Femur length; TCD: Trans-cerebellar diameter; LMP: Last menstrual period; IUGR: Intrauterine growth retardation; USG: Ultra sonogram; PCPNDT: Pre-conception and pre-natal diagnostic techniques.

BACKGROUND

Estimation of gestational age is very important in day-to-day obstetric ultra-sonographies for management of entire pregnancy and delivery.[1] Various parameters are used for estimation of gestational age and prediction of expected date of delivery, these are date of last menstrual periods, clinical examination, and ultrasonography.[2] Ultrasonography can differentiate a normal foetus from growth restricted foetus.[3] Assessment of various foetal biometric parameters by ultrasonography is widely acceptable and easily available method for assessing foetal growth and estimation of gestational age.[4] The cerebellum is the important part of posterior cranial fossa.[5] Trans-cerebellar diameter can be easily measured and predict gestational age, that's why this becomes more useful in case of difficult/ deep pelvic foetal head positions or abnormal foetal head shape like dolichocephaly and brachycephaly.[6] Estimation of Biparietal diameter (BPD) and Head circumference (HC) in such cases is not reliable specially in third trimester due to excessive moulding of foetal head.[1,2]

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Aims

To determine the accuracy of Trans-cerebellar diameter in the estimation of gestational age of intra uterine foetus and comparison of trans cerebellar diameter with other conventional parameters like head circumference, abdominal circumference, biparietal diameter and femur length routinely used for measurement of gestational age.

MATERIALS AND METHODS

The present study was done in the Department of Radiodiagnosis, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India.

Inclusion Criteria: It includes patients who were referred for routine antenatal ultrasonogram check-up had normal singleton pregnancies of 15–36 weeks who clearly knows the first day of the last menstrual period (LMP) or have got their dating scan done between 10-14 weeks of gestation to get a reference value for comparison of gestational age calculated by various biometric parameters. Complete PCPNDT documentation was done in all these patients.

Exclusion Criteria: All those who are not sure of their LMP or not have any dating scan for reference value or those detected to have congenital malformations or IUGR were not included in the study.

Sample size: 199 patients were included in study. Calculated sample size was 160 based on Sensitivity of Trans-cerebellar Diameter for the estimation of gestational age as 90% from a previous study with 5% absolute precision and 10% nonresponse rate.[7]

Material: The machines used in this process were Siemens Acuson X300, GE voluson E6 and GE Voluson S6 with 3.5 MHz Convex probe. 199 patients who fulfilled all the inclusion criteria were included in the study.

Method: Biparietal diameter (BPD), Head circumference (HC), Femur length (FL) were measured with standard technique. Trans-cerebellar diameter (TCD) of each of the participants were measured in axial view focusing the thalamus as done while measuring BPD and tilting probe posteriorly to see the bilateral cerebellar hemispheres. For TCD measurement image should show visibility of cerebellum, cistern magna and cavum septum pellucidum if properly taken (Fig.1 & 2). Cerebellum gives the appearance of bilobed structure which is on both sides of the midline in posterior fossa. widest diameter of the cerebellum is measured as the trans-cerebellar diameter (TCD). measurement of all the above parameters was done, then gestational age of the foetuses was calculated by the ultrasound machine based on Hadlock formula. All the parameters such as BPD, HC, AC, FL and TCD were measured in millimetres. Gestational age recorded in weeks plus days.

Statistical Analysis

Each parameter that is BPD, AC, HC, FL and TCD were correlated with GA using regression analysis. p value was obtained. BPD, HC, AC and FL were correlated with TCD using regression formula and p value calculated. Study results were compared with the similar studies done earlier.

RESULTS

Distribution of participants based of gestational age is given in table 1, majority of patients are between 15week to 20-week 6 days range. Each parameter i.e., BPD, HC, AC, FL and TCD were correlated with GA using regression analysis as given in Table 2, of which TCD shows better regression values.

BPD, HC, AC and FL was correlated with TCD using regression analysis as given in table 3, BPD shows good correlation with TCD in.

Multiple linear regression equation to predict gestational age based upon various parameters are GA=0.134+0.997×BPD in cm, GA=0.001+1.00×HC in cm, GA=-0.385+1.02×AC in cm, GA=0.441+0.985×FL in cm and GA=0.414+0.986×TCD in cm.

Correlation between the gestational age and BPD, AC, HC, and FL is shown in the scatter diagram (fig 3a,3b,3c &3d). The scatter diagrams also showing correlation between the gestational age and TCD is given in (fig -4).

Fig.1 & 2: Transabdominal ultrasonography image showing trans-cerebellar diameters of 20weeks 1 day and 21weeks 6 days respectively.
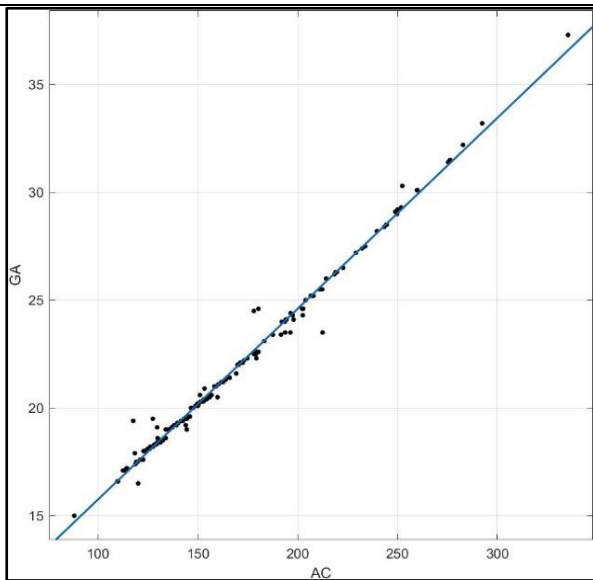
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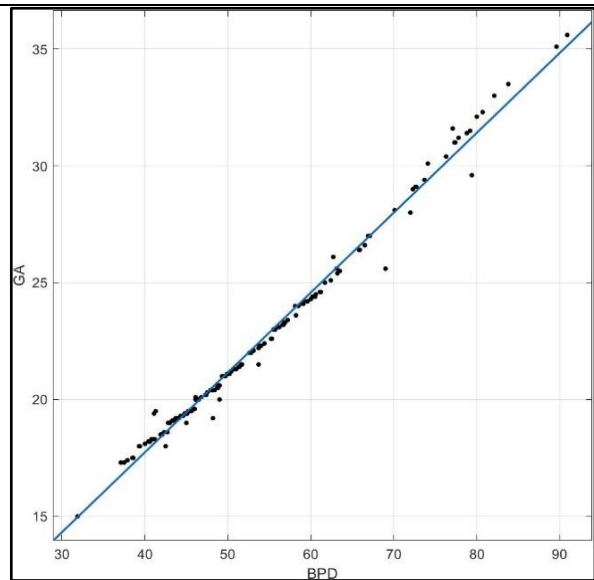**Fig 3a: Scatter diagram showing correlation between GA and AC**

Fig 3b: Scatter diagram showing correlation between GA and BPD
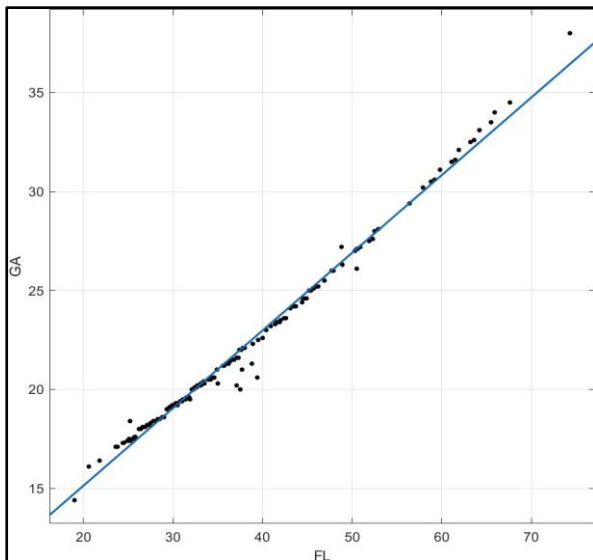

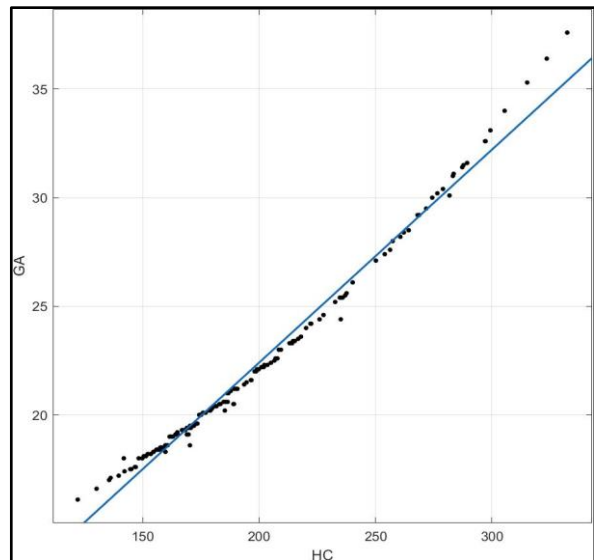**Fig 3c: Scatter diagram showing correlation between GA and FL**

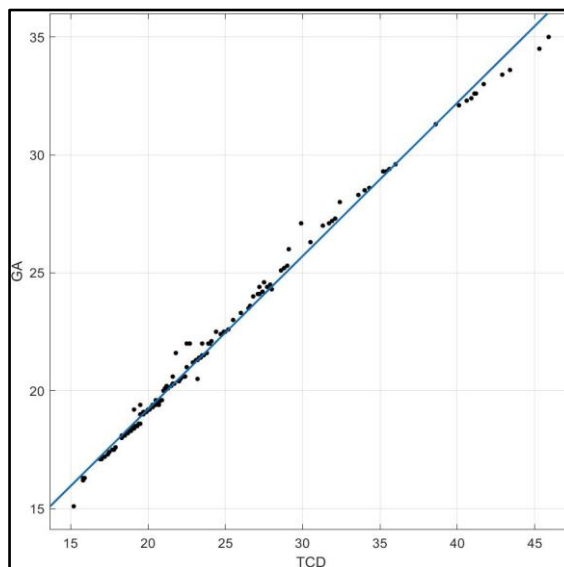**Fig 3d: Scatter diagram showing correlation between GA and HC**

Fig 4: Scatter diagram showing correlation between GA and TCD

Table 1: Distribution of gestational age

S.No.	Gestational age	Frequency	Percentage
1	15-20 w 6 d	100	50.25
2	21-28 w 6 d	78	39.20
3	29 – 32 w 6 d	14	7.03
4	31 – 40 w 6 d	7	3.52
	Total	199	100.0

Table 2: Correlation of parameters with GA using regression analysis

S.No.	Parameters Compared	R^2	p-value
1	GA vs BPD	0.9910	<0.001
2	GA vs HC	0.9874	<0.001
3	GA vs AC	0.9905	<0.001
4	GA vs FL	0.9913	<0.001
5	GA vs TCD	0.9995	<0.001

Table 3: Correlation of TCD with BPD, HC, AC and FL.

S.No.	Parameters Compared	R^2	P value
1	TCD vs BPD	0.9475	<0.001
2	TCD vs HC	0.9120	<0.001
3	TCD vs AC	0.8246	<0.001
4	TCD vs FL	0.8652	<0.001

Table 4: Accuracy of TCD with GA- Comparison of different studies

Study	Pearson Coefficient	P Value
Reece et al.	0.948	0.0001
Chave et al.	0.950	0.001
Present Study	0.9995	<0.001

Table 5: Correlation between mean predicted GA by TCD with the GA by LMP in both second and third trimester.

15-20 w 6 d	<2 days	6 days
21-28 w 6 d	<2 days	3 days
29 – 32 w 6 d	<2 days	2 days
31 – 40 w 6 d	<2 days	3 days

DISCUSSION

Gestational age measurement is important and key elements for the management of pregnancies especially in case of foetuses with disturbances of normal growth.

Last menstrual period date in a normal regular menstrual cycle correlates well with the gestational age of the foetus, but it does not correlate with gestational age many times when the patient is not sure about her LMP or had irregular periods. Ultrasonography is being used as a reliable tool for the dating of pregnancy since last many years because it is easily available, inexpensive and free of radiations. The biometric parameters which are being used traditionally for gestational age estimation are BPD, HC, FL, and AC.[8] All of these parameters have their own advantages and limitations. Trans-cerebellar Diameter can be used as a reliable growth parameter for estimating the gestational age of foetus. some studies also showed good correlation between Trans-cerebellar diameter and other parameters. Further equations were derived to seek out the relation between gestational age and all parameter commonly used to estimate gestational age.

Patil et al.[9] had described that there is evidence of strong relationship between the age of the gestation and trans-cerebellar diameter and it can be used as a reliable parameter for estimation the gestational age.

Ravinder Nath et al.[10] also showed similar results as that of our study, which proves good correlation of transverse cerebellar diameter (TCD) with other parameters and also says that the TCD measurement is vital in GA estimation in case of excessive skull moulding or skull shapes variations .

Reece et al.[11] in a prospective ultrasonography study conducted on 371 pregnant women, with gestational ages between 13 and 40 weeks found strong relationships between the trans-cerebellar diameter and the gestational age (R2=0.948; P=0.001), the biparietal diameter (R2=0.956; P=0.0001), and the head circumference (R2=0.969; P=0.0001). during entire pregnancy, normative cerebellar measurements are very helpful in calculating the age of the gestational which is independent of foetal head shape.

Hanna et al.[12] concluded that TCD is a reliable and precise foetal growth parameter for estimation of gestational age as it has good correlation with that of GA by LMP.

They concluded that TCD is a better predictor for gestational age estimation when compared to other routinely used parameters particularly between 14 and 22 weeks.

Reddy et al.[13] also concluded that TCD measurements perfectly predict gestational age in the third and second trimester. When compared with the other foetal biometry parameters, TCD shows least variation in case of IUGR, that's why it can be used

as a single parameter for the estimation of gestational age. Comparison of the accuracy of TCD with GA is also done in other studies which showed good correlation such as studies done by Patil et all and Reddy et al.[9,13] Our study showed good correlation between mean GA by TCD and Gestational age by LMP in both second and third trimester with a difference of 1–2 days, which is correlating with the study done by Chavez et al.[14]

CONCLUSION

On comparison of gestational age estimated from trans-cerebellar diameter and gestational age calculated from the last menstrual period, a linear relationship was seen. Trans-cerebellar diameter showed good correlation with other conventionally used parameters (biparietal diameter, femur length and abdominal circumference). Study results concluded that Trans-cerebellar diameter is equally or sometime more reliable in the estimation of gestational age in comparison to biparietal diameter, femur length and abdominal circumference. The regression formula derived from Trans-cerebellar diameter measurement can be reliably applied to
We would determine the gestational age of the foetus.

Limitations

The study was restricted to second and third trimester patients because of difficulty in the evaluation of cerebellum in the first trimester.

Acknowledgments

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