



ESTIMATION OF ACCURACY OF TRANSCEREBELLAR DIAMETER FOR PREDICTION OF GESTATIONAL AGE IN NORMAL FETUSES

Radiology

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ABSTRACT

Accurate estimation of fetal gestational age is very important, as management options vary with fetal age. Conventional sonological fetal age determination is done by biparietal diameter (BPD), Head circumference (HC), Femur length (FL) and Abdominal circumference (AC) measurements. However, in various conditions like hydrocephalus, achondroplasia, skeletal dysplasia and moulding of head, the desired accuracy is not obtained. Intrauterine growth retardation (IUGR) may underestimate fetal age.

Cerebellum, a posterior fossa structure, is surrounded by tough bones which resists its deformity by external pressure.

No significant change in size and shape of cerebellum is seen in various cranial malformations. In such situations, fetal trans-cerebellar diameter can be a reliable ultrasound parameter. The authors propose to assess the reliability of trans-cerebellar diameter as an independent biometric parameter for gestational age determination.

KEYWORDS

Transcerebellar, gestational, biometric, fetal, ultrasound.

INTRODUCTION:

Accurate estimation of gestational age is crucial for favorable pregnancy outcome. Various conventional methods are used for fetal age determination like calculation from last menstrual period (LMP), Gestational Sac /crown rump length (CRL), Biparietal diameter (BPD), Head circumference (HC), Femur length (FL), Abdominal circumference (AC) measurement. In the first trimester, Yolk Sac Diameter (YSD), Gestational Sac Diameter (GSD), and Crown Rump Length (CRL) measurements have been reported as the primary means of evaluating the gestational age.

Fetal head, body and extremity measurements have been widely reported and found to be used in the second and third trimester [1].

These parameters are affected in various conditions. Menstrual history may not be accurate in every case. Conventional parameters like BPD, HC, FL and AC may be affected in different craniofacial deformities, conditions of skeletal dysplasia like achondroplasia, hydrocephalus and conditions of change of head shape (dolichocephaly /brachycephaly). Intrauterine growth retardation (IUGR) may underestimate fetal age.

Cerebellum, a posterior fossa structure, is surrounded by tough bones which resists its deformity by external pressure.

No significant change in size and shape of cerebellum is seen in various cranial malformations. It is also not affected in IUGR due to brain sparing effect, unlike other conventional biometric parameters. Transverse cerebellar diameter can be practically applied in cases where it is difficult or impossible to calculate biparietal diameter, or cases where it is unsuitable because of the expressed moulding of head. This is because cerebellum does not change much in its form and also its size correlates with gestational age and biparietal diameter [2].

Fetal cerebellar diameter in normal gestation is also highly correlated with fetal growth parameters, such as biparietal diameter, head circumference, abdominal circumference, femur length and estimated fetal weight (all $p < 0.0001$) [3]. Transverse cerebellar diameter can be used to establish the gestational age in normal fetuses and in restricted growth fetuses (IUGR).

The cerebellum can be identified easily as early as 14 weeks by USG.

Fetal cerebellum grows progressively with gestational age. Hence, trans-cerebellar diameter can be a very significant biometric parameter to assess gestational age in normal fetuses and in conditions where BPD is unreliable due to alteration in size and shape of head.

In recent scenario, the ratio of transverse cerebellar diameter to abdominal circumference (TCD/AC) is being increasingly used to predict intrauterine growth restriction (IUGR).

Moreover, in current times, population-specific obstetric charts depicting biometric parameters for gestational age determination are being developed for more accurate determination. It has been found in studies, conducted in Israel and Britain, that there is significant variation in fetal growth parameters in different ethnic groups [4]. There is paucity of such study in the eastern region of India.

The purpose of this study is to assess reliability of Transcerebellar diameter (TCD) for fetal age determination in a sample population in Eastern India.

MATERIALS AND METHODS:

This is a prospective observational study, performed in the Department of Radiodiagnosis at a tertiary care referral center of West Bengal, Eastern India.

Study Population

Consecutive patients, between 14 and 38 weeks of gestation, referred to Radiology Department from antenatal clinic were included in the study.

Inclusion Criteria

Regular menstrual cycle with definite LMP, irrespective of parity.

Exclusion Criteria

1. Medical conditions which can affect fetal growth like diabetes, hypertension, thyroid diseases.
2. Fetuses with various skeletal and cranio-facial anomalies and other congenital malformations.
3. Multiple pregnancies.
4. Cases where the mother was unsure about her LMP
5. Cases where the mother complained of irregular menstrual cycle.
6. Cases where the mother was using contraception in the last three months of conception.

Study Procedure–

The ultrasonography machine, PHILIPS SCANNER HD7 with 3.5 MHz convex probe was used for biometric measurements. All the conventional fetal biometric parameters for gestational age determination like BPD, HC, AC and FL measured.

TCD was measured as per technique described by **McLeasy et al (1984)** and **Goldstein et al (1987)** [5]. The fetal head is first viewed at the level of thalamus, cavum septum pellucidum and 3rd ventricle. The transducer is then slightly rotated to subthalamic level. Characteristic butterfly shaped cerebellum is identified. In all the cases, cerebellum was seen as two lobules on either side of the midline in the posterior cranial fossa. Transverse diameter of cerebellum is measured by placing calipers end-to-end.

Hashimoto has classified sonological appearance of cerebellum in three grades [6].

Grade I- Hypoechoic, eyeglass shape.

Grade II- Dumbbell shaped and intermediate echogenic.

Grade III- Hyperechoic, fan shape.



FIG. 1 – Arrows showing cerebellum as a bilobed butterfly shaped structure in the posterior fossa.

STATISTICAL ANALYSIS AND RESULTS:

The dataset included 132 antenatal patients of 14 to 38

weeks menstrual gestation age. All the fetal biometric parameters were measured including BPD, HC, AC, FL and TCD.

Equation:

$GA = 43.233 + 0.863 * TCD + 4.957 * FL + 4.422 * AC$

CORRELATION:

TABLE 1

		TCD	BPD	HC	FL	AC
GA BY LM P	Pearson Correlation	.865**	.949**	.938**	.613**	.911**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
N		132	132	132	132	132
95% C.I.	Lower	0.676	0.916	0.902	0.434	0.822
	Upper	0.967	0.968	0.963	0.959	0.965

** . Correlation is significant at the 0.01 level (2-tailed).

The above table shows that GA_LMP is highly linearly related with the parameters TCD, BPD, HC and AC, and moderately related with FL, i.e., GA_LMP grows almost in linear fashion, when any of these parameters except FL grow. Therefore, TCD, BPD, HC and AC can be used for predicting LMP. Priority should be given to BPD and then to HC, AC, and TCD.

Mean Values-

From the present study, the calculated mean TCD is 17.6 mm at 14 to 20 weeks of pregnancy, 24.4 mm at 21 to 26 weeks of pregnancy and 34.2 mm at 27 to 38 weeks of pregnancy.

Table 2: Showing Mean Values Of Tcd Corresponding To Gestational Age

GESTATIONAL AGE	MEAN TCD (IN mm)
14-20 WEEKS	17.6 mm

21-26 WEEKS	24.4 mm
27-38 WEEKS	34.2 mm

DISCUSSION:

Accurate estimation of gestational age is a basic requirement for obstetric management. But, sometimes, the patient is unsure about her last menstrual period (LMP) with unavailability of her early dating scan documentation. Conventional biometric parameters are affected in various craniospinal malformations, skeletal dysplasia, molding of head and IUGR.

The appearance of cerebellum, as already discussed above, has been divided into grades, owing to the change with increasing gestational age. Grade I cerebellum is seen up to 23 weeks and typically shows “a pair of eye glasses” appearance. Grade II cerebellum is between 24-35 weeks and resembles “dumb-bell-like” outline and Grade III appearance is after 36 weeks and cerebellum hemispheres show “fan” shape.

Many studies have concluded that, in such conditions, fetal trans-cerebellar diameter (TCD) is a very reliable alternative because cerebellum is not affected by external pressure as it is surrounded by hard occipital bones and petrous ridges [7,8]. It remains unchanged in IUGR due to brain sparing effect, where other biometric parameters may be affected. Therefore, TCD/AC can also be a good predictor of IUGR.

In a study from Meerut in western India, Goel et al [9] demonstrated the following table of TCD measurements –

Table 3

PERIOD OF GESTATION (in weeks)	MEAN TRANSVERSE CEREBELLAR DIAMETER (in mm)
14-20	17.32
21-30	26.63
31-40	40.73

In the study by **Malik et al [2]**, it was observed that gestational age measured by fetal transverse cerebellar diameter was consistently correlated with that measured by biparietal diameter, femur length and abdominal circumference. There was a linear relationship of increase in cerebellar diameter with gestational age, although there was flattening of the curve at term.

Goldstein [5] reported that fetal trans-cerebellar diameter can be used to assess fetal growth. So, for evaluation of IUGR, comparing TCD with other parameters like AC may be useful.

Limitations and conclusion -

Although the limited sample considered for this study population is not enough for developing a nomogram, yet this study can serve as a guideline for similar such studies in the future, especially in Eastern India, which will help to develop a nomogram for the selected ethnic group of people.

Also, here LMP was used as a baseline tool for estimation of gestational age. All such cases were, thus, excluded where the mother was unsure of her LMP, had irregular menstrual cycle, or was using contraceptive methods in the last three months of conception. The study results could have been more certain had early dating scan documentation been made available in all cases. In that case, CRL measurement can be used as a baseline tool for comparison with other biometric parameters, for estimation of gestational age, since CRL is an established parameter in early gestational age measurement.

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