TRANSVERSE CEREBELLAR DIAMETER - A MARKER FOR ESTIMATION OF GESTATIONAL AGE

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ABSTRACT

The cerebellum lies in the posterior cranial fossa. In the embryo, cerebellum appears at the end of fifth week. The cerebellum is easily visualized sonographically. Measurement and demonstration of fetal cerebellum is a new and unique parameter of fetal brain growth and also useful in assessing gestational age. The prospective study was carried out on 50 antenatal patients (20-40 years of age) between 14-40 weeks of pregnancy attending the clinic for routine ultrasound examination. Ultrosonographic measurement of Transverse cerebellar diameter (TCD) was done to assess the Gestational age. Mean TCD was 17.32 mm in 14-20 weeks of gestation, 26.63 mm in 21-30 weeks and 40.73mm in 31-40 weeks. Regression analysis indicates a significant relationship between TCD and gestational age, indicating that TCD is a good marker for estimation of gestional age.

KEY WORDS:- Transverse cerebellar Diameter, Gestational age, Ultrasound, Fetus.

INTRODUCTION

The cerebellum, the largest part of hind brain, lies in the posterior cranial fossa. It lies dorsal to the pons and the medulla, separated from them by fourth ventricle. Cerebellum is separated from the cerebrum by a fold of duramater called the tentorium cerebelli. The cerebellum consists of a midline part called the vermis and two lateral hemispheres. It is roughly spherical but somewhat constricted in its median region and flattened, the greatest diameter being transverse.[1]

The cerebellum develops from the dorsolateral part of the alar lamina of the metencephalon. In the embryo cerebellum appears at the end of the fifth week as a swelling overriding the fourth ventricle.[2]

Assessment of gestational age (G.A.) is important in the management of pregnancy. The most frequently used biometric parameters for the estimation of gestational age are the fetal biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). These parameters have few limitations as conditions altering the shape of skull will affect the BPD which is a well accepted indicator of GA. So transverse cerebellar diameter (TCD, developed as an alternative parameter of fetal brain growth and for estimation of gestational age.

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Since cerebellum lies in the posterior cranial fossa, surrounded by the dense petrous ridges and the occipital bone so it can withstand deformation by extrinsic pressure better than the parietal bones. The fetal cerebellum can be visualized with ultrasound easily therefore imaging the posterior fossa is becoming an integral part of many routine fetal sonogram.[3,4] Several authors working on transverse cerebellar diameter (TCD) have correlated it well with gestational age, even in the presence of growth retardation[5] and found it as a better marker for GA estimation as compared to other clinical and biometric parameters.[6]

In the present study, an attempt has been made to evaluate the fetal cerebellar development ultrasonographically which in turn is helpful in assessing the fetal gestational age.

MATERIAL AND METHODS

The present study was conducted in the Department of Anatomy in collaboration with the department of Radiodiagnosis, LLRM Medical College and Associated SVBP Hospital, Meerut in association with other ultrasound clinics.

The study was carried out on 50 pregnant women attending the clinic for routine ultrasound examination and seeking antenatal care between 14 to 40 weeks of pregnancy and the cases were divided into three groups- (14 to 20 weeks, 21-30 weeks and 31-40 weeks). Patients who had any medical complications of pregnancy were not included in the study.

All measurements were made by scanning the

patients using LOGIQ TM WIPRO GE-400 PRO Version - 5.0 real time ultrasonographic machine with linear and sector array 3.5 MHz frequency transducers. (Fig.I)

TECHNIQUE OF MEASUREMENT OF TRANSVERSE CEREBELLAR DIAMETER

The measurement of TCD was obtained by placing electronic calipers at outer margins of cerebellum. The landmarks of the thalami, cavum, septum pellucidum and third ventricle were identified thereby slightly rotating the transducer below the thalamic plane. The posterior fossa is revealed with the characteristic butterfly like appearance of cerebellum. In all cases cerebellum was seen as two lobules on either side of midline in the posterior cranial fossa.

The Statistical evaluation between fetal transverse cerebellar diameter and gestational age was assessed.

OBSERVATIONS

The mean transverse cerebellar diameter (TCD) was 17.32 mm at 14-20 weeks, 26.63 mm at 21-30 weeks and 40.73 mm at 31-40 weeks. (Table-I)

When individual observation of mean transverse cerebellar diameter was studied in relation to period of gestation in weeks, linear relationship was seen between gestation age and TCD. The relationship has been shown in the scatter diagram. (Fig. II)

At 14-20 weeks of gestation age, the minimum TCD was 13 mm and maximum TCD was 21.4 mm, at 21 to 30 weeks of gestation, it was 18.4 mm and 35.0 mm and at 31 to 40 weeks, it was 36.0 mm and 48.4 mm respectively (Table II).

The correlation coefficient between period of gestation and TCD was found to be +0.991, which was statistically significant ($p < 0.001$). (Table-III)

TABLE I

Mean transverse cerebellar diameter during different GA

S. No.	Period of gestation (Weeks)	No. of Cases	Mean transverse cerebellar diameter (mm)
1.	14 - 20	18	17.32
2.	21 - 30	23	26.63
3.	31 - 40	9	40.73

Table I shows relationship between transverse cerebellar diameter and period of gestation. The cases were divided into 3 groups.

TABLE II

Cerebellar measurements during different gestation ages

S. No.	Gestation age (Weeks)	TCD (minimum) (mm)	TCD (maximum) (mm)
1.	14 - 20	13.0	21.4
2.	21 - 30	18.4	35.0
3.	31 - 40	36.0	48.4

TABLE III

Coefficients : Dependent variable = TCD (mm)

Model	*Unstandardized coefficients*		*Standardized coefficients*	*t*	*Significance*	*95% Confidence interval for B*	
	B	*Standard Error*	*Beta*			*Lower bound*	*Upper bound*
Constant	*-5.821*	*0.623*		*-9.347*	*0.000*	*-7.073*	*-4.569*
GA	*0.188*	*0.004*	*0.991*	*52.766*	*0.000*	*0.180*	*0.195*

From regression analysis, a strongly significant relationship has been observed between fetal TCD and gestational age.

y = 5.821 + 0.188x

where x = Gestational age

y = TCD

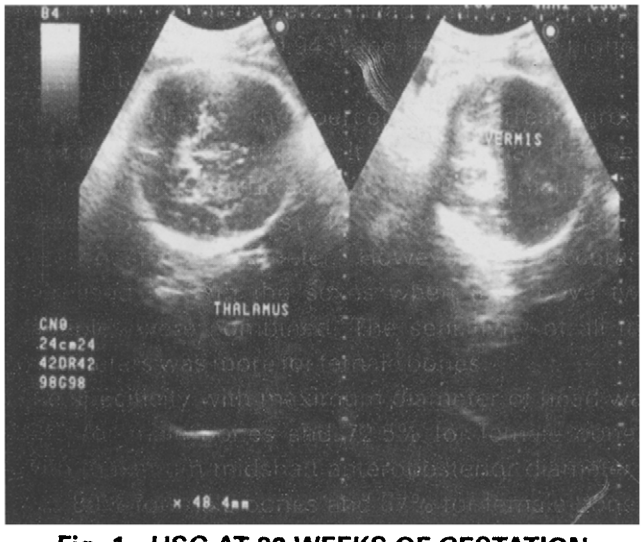

Fig -1 : USG AT 39 WEEKS OF GESTATION

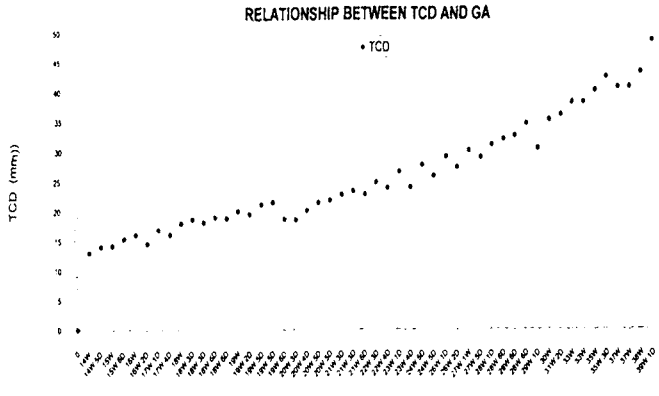

Fig - II GA in Weeks (W) and days (D)

DISCUSSION

The determination of gestational age is important in obstetrics for management of pregnancy and evaluation of fetal development. Higher perinatal mortality has been reported in patients whose expected date of delivery is not known. An error in the gestational age estimation can result in prematurity and postmaturity. Extremes of fetal growth contribute disproportionately to overall perinatal and infant morbidity and mortality.[7]

Among the various clinical criteria, Last Menstural Period (LMP) preceded by normal cycle, is known to correlate best with the gestational age but it is not reliable when a woman is not sure about her last menstrual period.

Other 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.

TCD is another new and unique parameter, well established in the ultrasound literature as a reliable parameter for estimating the duration of gestation.[8] and it is consistently superior in predicting GA in both singleton and twin gestation.[9,10,11] Measurement of the transverse cerebellar diameter can be done on most of the fetuses, irrespective of the fetal head shape.

In our study, early sonographic visualization of the cerebellum occurred as early as 12 to 13 weeks gestation. During 14th to 20th week of gestation, TCD in millimeters is equivalent to the gestation age in

weeks. After 20 weeks, however the TCD in millimeters exceeds gestational age in weeks. According to another study, the normal fetal TCD exhibited a more than two fold increase in size during the second half of pregnancy.[12]

Present study showed linear relation of transverse cerebellar diameter with gestational age (Scatter diagram fig-1) which makes present study highly significant and proved that transverse cerebellar diameter may serve as a reliable indicator of gestational age, and fetal growth.

CONCLUSION

In the normally developing fetus, the TCD increases with advancing gestational age. TCD showed good correlation with gestational age (correlation coefficient 0.991 and $p < 0.001$).So Transverse cerebellar diameter is a good marker for gestational age estimation and can be used in cases who are not sure about their LMP. The present data offer the normal range of the cerebellar measurements throughout gestation. These values may allow intrauterine assessment of the development of the cerebellum as well as the posterior fossa.

REFERENCES

1. William PL Gray's Anatomy, 38th edition, Churchill Livingstore, Edinburgh: London. 1995; P-1027 - 1028.
2. Richard D McIlary, Lawrence R Kuhns, Mason Barr Jr. Ultrasonography of the fetal cerebellum. Radiology 1984; 151: 439-442.
3. Altman NR, Naidich TP, Braffman BH. Posterior fossa malformations. Am J Neuroradiol 1992; 13: 691-724.
4. Goldstein RB, Podrasky AE, Filly RA, Callen PW. Effacement of the fetal cisterna magna in association with myelomeningocele. Radiology 1989; 172: 409-413.
5. Mark W, Davies MS, and Frex Measurement of the transverse cerebellar diameter in preterm Neonates and it's use in assessment of gestational age. Australian Radiology 2001; 45(3) : 309-312.
6. Montenegro NA, Leite LP. Fetal cerebellar measurements in second trimester ultrasonography clinical value. J Perinat Med 1989; 5: 365-369.
7. Kramer MS, Ananth CV, Platt RW, Joseph KS. US Black US White disparities in foetal growth: physiological or pathological? Int J Epidemiol 2006; 35: 1187-1195.
8. Pinar H, Burke SH, Huang CW, Singer DB, Sung CJ. Reference values for transverse cerebellar diameter throughout gestation. Pediatr Dev Pathol 2002; 5: 422-424.
9. Chavez MR, Ananth CV, Smulian JC, Lashley S, Kontopoulos EV, Vintzileos AM. Fetal transcerebellar diameter nomogram in singleton gestations with special emphasis in the third trimester: a comparison with previously published nomograms. Am J Obstet Gynecol 2003; 189: 1021-1025.
10. Chavez MR, Ananth CV, Smulian JC, Yeo L, Oyelese Y, Vintzileos AM. Fetal transcerebellar diameter measurement with particular emphasis in the third trimester: a reliable predictor of gestational age. Am J Obstet Gynecol 2004; 191: 979-984.
11. Chavez MR, Ananth CV, Kaminsky LM, Smulian JC, Yeo L, Vintzileos AM. Fetal transcerebellar diameter measurement for prediction of gestational age in twins. Am J Obstet Gynecol 2006; 195: 1596-1600.
12. Vinkensteijn AS, Mulder PG, Wlaclimiroff JW. Fetal transverse cerebellar diameter measurements in normal and reduced fetal growth. Ultrasound Obstet Gynecol 2000; 1: 47-51.