*International Journal of Anatomy and Research,*
*Int J Anat Res 2018, Vol 6(1.2):4947-50. ISSN 2321-4287*
*DOI: https://dx.doi.org/10.16965/ijar.2017.520*

**Original Research Article**

# TRANSVERSE CEREBELLAR DIAMETER-AN ULTRASONOGRAPHIC PARAMETER FOR ESTIMATION OF GESTATIONAL AGE AND GRADING OF FETAL CEREBELLAR GROWTH

**Sandhyarani M.Patil *[1], Mahadeo R.Patil [2], Swati Gaikwad [3].**

*[1] Associate Professor, Department of Anatomy, Rajarshee Chhatrapati Shahu Maharaj Govt. Medical College, Kolhapur, India.

[2] Assistant Professor, Department of Surgery, Dr. D. Y. Patil Medical College, Medical College, Kolhapur, India.

[3] Radiologist, Apple Diagnostic Centre, Pune, India.

## ABSTRACT

**Introduction:** Several parameters are used for the estimation of gestational age by ultrasonography. Measurement and demonstration of fetal cerebellum is a new and unique parameter of fetal brain growth and also useful for assessment of gestational age. The cerebellum is part of hindbrain and lies in posterior cranial fossa. In the embryo it appears at the end of 5th week of intrauterine life.

**Aim:** 1. To measure and correlate transvrerse cerebellar diameter (TCD) with fetal gestational age (GA) and derive regression equation. 2. To evaluate cerebellar growth pattern by ultrasonographic cerebellar grading.

**Material and Methods:** This prospective study was carried out on 100 pregnant women between12-40 weeks of pregnancy attending the R.C.S.M. Govt. Medical College Kolhapur for routine ultrasound examination,Transverse cerebellar diameter was measured and cereballar grading was done by ultrasongraphically.

**Results:** We observed a linear correlation between TCD and GA (correlation coefficients-r=0.995, p=0.000 ) Fetal cerebella were found to be 61,15 and 24% cases as grade I,II and III respectively.The grade changed from I to III with advancing gestational age. The median gestational age and TCD were 18.42 weeks and 1.9cm for grade I, and 28.42 weeks and 3.3cm for grade II and 35.99 weeks and 4.2cm for grade III.

**Conclusion:** Regression analysis indicated a strong relationship between TCD and gestational age indicating TCD can be used as reliable parameter for estimation of gestational age.Its grading can be used in evaluation of development of fetus.

**KEY WORDS:** TCD, Gestational Age, Cerebellar Grading, Ultrasonograph

**Address for Correspondence:** Dr.Sandhyarani M.Patil, Associate Professor, Department of Anatomy, Rajarshee Chhatrapati Shahu Maharaj Govt. Medical College, Kolhapur, India.
**E-Mail:** drsandhyapatil.2009@gmail.com

| Access this Article online | Journal Information |
|---|---|
| Quick Response code | **International Journal of Anatomy and Research** |
| | ICV for 2016 90.30 |
| | ISSN (E) 2321-4287 \| ISSN (P) 2321-8967 |
| | **https://www.ijmhr.org/ijar.htm** |
| | **DOI-Prefix:** https://dx.doi.org/10.16965/ijar |
| **DOI:** 10.16965/ijar.2017.520 | **Article Information** |
| | Received: 05 Dec 2017 Accepted: 02 Jan 2018 |
| | Peer Review: 05 Dec 2017 Published (O): 05 Feb 2018 |
| | Revised: None Published (P): 05 Feb 2018 |



## INTRODUCTION

The cerebellum is the largest part of hind brain situated in the posterior cranial fossa.It lies dorsal to the pons and medulla and separated from them by 4th ventricle.Cerebellum is separated from cerebrum by a fold of duramater called the tentorium cerebellae. The cerebellum consists of midline vermis and two lateral hemispheres.

It is roughly spherical but constricted in its median region and flattened , the greatest diameter being transverse [1].

The cerebellum develops around 5th week of embryonic life from the dorsolateral part of alar lamina of the metencephalon. It appears as swelling overriding the furth ventricle [2]. Assessment of fetal gestational age is an essential part of obstetric ultrasonography (USG). It helps in the evaluation of growth and management. Sonographic determination of gestational age is becoming increasingly important. For the estimation of fetal gestational age the commonly used parameters are-Mean Sac Diameter (MSD), Crown Rump Length (CRL), Biparietal Diameter (BPD),Head Circumference (HC),Abdominal Circumference (AC),and Femoral Length (FL).Out of all the parameters used Transverse Cerebellar Diameter is a reliable parameter for estimation of gestational age [3].

Since cerebellum lies in the posterior cranial fossa, surrounded by dense petrous ridges and occipital bone it can withstand deformation by extrinsic pressure better than parietal bones. The fetal cerebellum can be visualized with ultrasonography easily. Therefore imaging the posterior cranial fossa is becoming integral part of many routine fetal sonograms. It is observed that fetal TCD in normal gestation correlates well with fetal growth indices. It is least affected in cases of growth retardation [4] and hence proved itself a better marker for estimation of gestational age as compared other biometric parameters.[5] Ultrasonography being non-invasive cost effective can be used for imaging fetal cerebellum. It is said that USG fetal biometry is reliable in first two trimesters and reliability diminishes as gestation advances [6]. Usually average gestational age is calculated using one or more parameters is the currently practiced method in routine obstetric USG.

The aim of our study was to correlate the Transverse cerebellar diameter with fetal gestational age and derive regression equation. To asses cerebellar growth pattern by ultrasonographic grading.

## MATERIALS AND METHODS

The present study was carried out in the Department of Anatomy R.C.S.M. Govt.Medical College Kolhapur in collaboration with Radiology Department G.M.C.Kolhapur and Apple Diagnostic Centre, Pune.The study was carried out on 100 pregnant women attending the clinic for routine ultrasound examination and seeking antenatal care between 12 to 40 weeks of pregnancy and the cases were divided into 3 groups.

Patients who had any medical complications of pregnancy were not included in the study.The study was approved by the ethical committee of our institution and consent was taken from all the patients before USG examination. All the gestations were evaluated by USG to confirm the gestational age and compared with their Last Menstrual Period. Patients with incorrect last menstrual period and USG dating scan difference of more than a week in first trimester were excluded from the study. Women with systemic disorder or obstetric disorder, anomalous fetuses and multiple gestations were also excluded from the study.

All the selected pregnant women were scanned transabdominally in supine posture with 3.25 Mhz convex probe using LOGIQ TM WIPROGE 400 PRO Version -5.0 real time ultrasonographic machine. All the Transverse Cerebellar Diameter (TCD) were measured in centimeters.The fetal cerebellum was identified in the transverse view of posterior cranial fossa by using thalami ,cavum septum pellucidum, and 3rd ventricle as land marks followed by rotation of transducer below the thalamic plane to view the butterfly like structure the cerebellum. The TCD was obtained by placing the calipers at the outer to outer margin measuring the widest diameter of the cerebellum. A single best and widest transverse diameter of cerebellum was recorded. [Fig-1]

In our study cerebella were grouped into three categories according to following ultrasonographic features [7].

**Grade 1**: The cerebellar hemispheres appears as two cystic globules on either side of midline and vermis is not developed.

**Grade 2:** The vermis is seen as an echogenic rectangular tissue connecting the two hemispheres with the cerebellum resembling a dumbbell with the echogenic margins.

**Grade 3:** The appearance of cerebellar hemispheres change to that of a triangular struc-

ture, which is homogenously echogenic and looks more solid.

**Fig. 1:** Ultrasonographic image showing TCD measurement


## OBSERVATIONS

**TCD measurements:** The mean transverse cerebellar diameter (TCD) was 1.3cm at 12-20 weeks 2.7cm at 21-30 weeks and 4.2cm at 31-40 weeks. (Table-1)

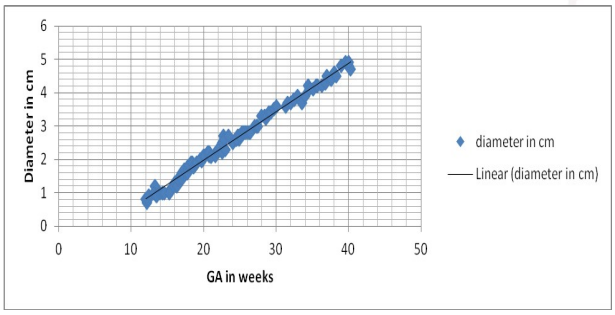
**Table 1:** Mean Transverse Cerebellar diameter during different gestational age.

| Period of gestation | No. of cases | Minimum TCD cm | MaximumTCD cm | Mean TCD cm |
|---|---|---|---|---|
| 12-20 weeks | 37 | 0.7 | 2.1 | 1.3 |
| 21-30 weeks | 38 | 2.1 | 3.6 | 2.7 |
| 31-40 weeks | 25 | 3.7 | 4.9 | 4.2 |

At 12-20 weeks of gestation the minimum TCD was 0.7cm and maximum TCD was 2.1cm, at 21-30 weeks of gestation the minimum TCD was 2.1cm and maximum TCD was 3.6cm,at 31-40 weeks of gestation the minimum TCD was 3.7cm and maximum TCD was 4.9cm respectively.

When individual observation of transverse cerebellar diameter is studied with gestational age in weeks the linear relationship was seen between gestational age and transverse cerebellar diameter.The relationship has been shown in scatter diagram.[Figure-2]

**Fig. 2:** Scatter plot-transverse cerebellar diameter in cm versus gestational age in weeks.




The correlation coefficient between period of gestation and TCD was found to be 0.995 which was statistically significant (p<0.000)

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

Y=-0.9330+0.1451 X

Where X=gestational age , Y=TCD

**Table 2**: Statistical analysis.

| Model | Unstanderdized Coefficients | | t | Significance | 95%confidence Interval for B | |
|---|---|---|---|---|---|---|
| | B | Standered error | | | Lower bound | Upper bound |
| Constant | 0.933O | 0.03695 | -25.25 | 0 | -1.0063 | -0.8597 |
| GA | 0.1451 | 0.0014 | 100.92 | 0 | 0.1423 | 0.148 |

**Cerebellar grading**: Among the 100 cases in this study USG cerebellar grading showed 61,15 and 24 of grade I,II and III respectively.There was progressive change from grade I to grade III with advancing gestational age.Results have been shown in Table-3

**Table 3:** Results of ultrasonographic cerebellar grading.

| Gestational Age | Number of cases | Grade I | Grade II | Grade III |
|---|---|---|---|---|
| 12-20 weeks | 37 | 37 | - | - |
| 21-30 weeks | 38 | 24 | 14 | - |
| 31-40 weeks | 25 | - | 1 | 24 |
| Total | 100 | 61 | 15 | 24 |

The median gestational age and TCD were 18.42 weeks and 1.9cm for grade I, and 28.42 weeks and 3.3cm for grade II and 35.99 weeks and 4.2cm for grade III.

## DISCUSSION

The accurate gestational age estimation is important for any obstetric management.Fetal development monitoring is now possible with the introduction of USG.If expected date of delivery is not known higher perinatal mortality is obvious outcome. Erroneous menstrual GA estimates leads to un-necessary induction, dysfunctional labour and unnecessary Caesarean section and resultant neonatal and maternal morbidity. Hence determination of gestational age is of crucial importance in obstetric [8]. An error in the gestational age estimation can result in prematurity and post maturity.

Though LMP is known to correlate best with gestational age it may act as false guide when

a woman is ignorant about her menstrual status. The measurement of TCD in the fetus continues to be useful indicator for GA even in presence of abnormal skull shapes [9], multiple pregnancies [10] and large for date fetuses [11]. The transverse cerebellar diameter therefore represents an independent biometric parameter that can be used in both singleton and multifetal pregnancies to asses normal and deviant fetal growth [12].

In this study linear relation of TCD with GA was established indicating the reliability of this new parameter in estimating gestational age and monitoring foetal growth.Moreover progressive histological development, purkinje cell differentiation in the cerebellum[13] and progressive decrease in cerebellar water content [14] with advancing gestational age was aptly reflected by the progressive change in cerebellar grade with advancing gestational age.Our findings are consistent with observations made in previous studies.

## CONCLUSION

It is observed that there is linear relationship between Transverse cerebellar diameter and gestational age between 12 to 40 weeks of normal gestations.(r= 0.995,p<0.0001).The TCD increased with advanced gestational age and the USG cerebellar growth pattern changed progressively. TCD showed a good correlation with gestational age. Hence TCD can be used as a reliable and accurate biometric parameter for estimation of gestational age. It can be used in cases who are not sure about their LMPs. These values may allow intrauterine assessment of the development of cerebellum. Increase in TCD along with gestational age and progressive change of cerebellar grade also indicates that the utility of this study in assessing the development of fetus by measuring transverse cerebellar diameter.

## ACKNOWLEDGEMENTS

Authors are thankful to Radiology Department and Statistician of R.C.S.M.G.M.C.Kolhapur for their co-operation.

**Conflicts of Interests: None**

## REFERENCES

[1]. Wiliam PL Gray's Anatmy,38th edition,Churchill Livingstone Edinburgh; London.1995 p-1027-1028.

[2]. Richard D Mcllary Lawrence R Kuhns, Mason Barr J. Ultrasnography of the fetal cerebellum.Radiology 1984;151:439-442.

[3]. Reece EA,Goldstein I,Pilu G.Fetal cerebellar growth unaffected by intrauterine growth retardation new parameter for prenatal diagnosis.Am.J.Obstet Gynecol.1987;157;632-82.

[4]. Mark W Davies MS,and Frex Measurement of transverse cerebellar diameter in preterm neonates and its use in assessment of gestational age. Australian Radiolo gy 2001;45(3)309-312.

[5]. Montenegro NA, Leite LP Fetal cerebellar diameter in second trimester ultrasonography clinical value.J Perinat Med 1989;5;365-369.

[6]. Dr Faiza Naseem Dr Sabir Ali, Dr Umbreen Basit,Dr Naheed Fatima. Assessment of gestational age comparison between transcerebellar diameter versus femur length on ultrasound in 3rd trimesterof pregnancy.Professional Medical J. 2014;2:412-417.

[7]. Malik R ,Pandya VK,Shrivastava P.Gestationa age estimation using trans cerebellar diameter with grading of fetal cerebellum and evaluation of TCD/AC (transverse cerebellar diameter /abdominal circumference) ratio as a gestational age independent parameter.Indian J Radiol Imaging. 2003;13;95-7.

[8]. Kramer MS,Mclean FM,Boyd ME,Usher RH. The validity of gestational age estimation by menstrual dating in term,preterm,and post-term gestation. JAMA 1988;260;3306.

[9]. McLeary RD,Kuhans LR,Barr M Jr.ultrasonography of fetal cerebellum.Radiology 1984;151 (2),439-42.

[10]. ShimizuT.Gaudette S,Nimrod C.Transverse cerebellar diameter in twin gestation.Am. J.Obstet Gynecol.1992;167(1);1004-8.

[11]. Hill LM,GuzickD,Fries J,Hixson J,Rivello D the Transverse Cerebellar Diameter in estimating gestational age in large for gestational age foetus.Obstet. Gynecol. 1990 ;75;981-5.

[12]. Cabbad M,Kofinas A,Simon N ,King K,Lyttle E.Fetal weight-cerebellar diameter discordance as an indicator of asymmetrical fetal growth impairment.J Reprod. Med. 1992;37;794-8.

[13]. Zecevic N,Rakic P Differentiation of purkinje cells and their relationship to other components of the developing cerebellar cortex in man.J Comp Neurol.1976;176;27-47.

[14]. Selzer ME ,Myers RE,Holstein SB Maturational changes in brain water and electrolytes in rhesus monkey with some implications for electrogenesis. Brain Res.1972;45;193-204.

**How to cite this article**: Sandhyarani M.Patil, Mahadeo R.Patil, Swati Gaikwad. TRANSVERSE CEREBELLAR DIAMETER- AN ULTRASONOGRAPHIC PARAMETER FOR ESTIMATION OF GESTATIONAL AGE AND GRADING OF FETAL CEREBELLAR GROWTH. Int J Anat Res 2018;6(1.2):4947-4950. **DOI:** 10.16965/ijar.2017.520