

DETERMINATION OF MEAN FETAL TRANSCEREBELLAR DIAMETER AS A PREDICTIVE BIOMETRIC PARAMETER IN THIRD TRIMESTER OF PREGNANCY IN CORRELATION WITH FETAL GESTATIONAL AGE

Khushboo Fatima, Rahat Shahid*, Aruj Virk**

Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, *Combined Military Hospital Lahore/National University of Medical Sciences (NUMS) Pakistan, **Shalimar Hospital Lahore Pakistan

ABSTRACT

Objective: To determine mean transcerebellar diameter (TCD) in third trimester of pregnancy on ultrasound as a predictive biometric parameter of gestational age.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Radiology Combined Military Hospital, Lahore, from Feb to Aug 2013.

Material and Methods: A total of 100 pregnant women in their third trimester were included in this study. TCD was measured on ultrasound, by identifying the cerebellum in the posterior cranial fossa and measuring it in from outer edge to outer edge.

Results: Mean age of the patients was 26.80 ± 2.71 years. Mean gestational age was 33.18 ± 2.42 weeks. In present study mean TCD was 36.47 ± 4.30 cm. After applying ANOVA test on parity, gestational age and maternal age it revealed that gestational age and TCD (mm) had significant relation ($p < 0.001$).

Conclusion: In the normally developing fetus, the TCD increases in a linear fashion with advancing gestational age. The data of this study suggest fetal TCD on ultrasound is a reliable predictive biometric parameter of gestational age.

Keywords: Gestational age, Transcerebellar diameter, Third trimester of pregnancy.

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INTRODUCTION

Ultrasound assessment for gestational age is becoming increasingly important. Many parameters are being used for establishing gestational age, for example, biparietal diameter, head circumference and abdominal circumference. Recently the evaluation of the posterior fossa of the fetal cranium has been accepted as part of routine obstetric ultrasonographic examination and therefore, can predict fetal gestational age at any trimester. Parameters such as biparietal diameter are thought to compute gestational age more correctly when performed at an earlier gestation¹.

Transcerebellar diameter (TCD) can better

predict gestational age especially in cases where there is variation of fetal head shape, such as dolichocephaly and brachycephaly²⁻⁴. Transcerebellar 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 molding of head. This is because cerebellum is not liable to change in its form and also its size correlates with gestational age and biparietal diameter³.

Fetal cerebellar diameter in normal gestation is also highly correlated with fetal growth indices, such as biparietal diameter, head circumference and abdominal circumference⁵. TCD can be used to establish the gestational age in normal fetuses and in fetuses with growth restriction⁶.

Fetal TCD measured by ultrasound suggest that it can be used as a predictive biometric

Correspondence: Dr Khushboo Fatima, Classified Radiologist AFIRI Rawalpindi Pakistan (Email: amcolian82@gmail.com)
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parameter or gestational age independently of fetal gender in the last two trimesters of a pregnancy⁷.

TCD varies in a linear fashion in third trimester, while TCD ratio remained consistent in second half of pregnancy. Mean TCD at 31 weeks of pregnancy is 34.9 ± 0.885 mm.

This study was designed to assess the mean TCD with gestational age in third trimester of pregnancy so that further studies could be done to assess the accuracy of TCD in measurement of gestational age because it is very important in those cases especially when pregnant women report first time for antenatal ultrasound in third trimester of pregnancy. It also reduces the requirement of serial ultrasonographic

2013 to 26-08-2013. Non-probability consecutive sampling was used to select 100 patients presenting for ultrasound assessment in the Radiology Department of Combined Military Hospital, Lahore fulfilling the inclusion criteria after proper history taking. An informed consent was taken from the women. Demographic data (e.g. age, and address) and gestational age of the women were also recorded. Brief history taking regarding their parity, educational level and economical status and ultrasound examination was done in isolation and patient's comfort was taken care of. Exclusion criteria was strictly followed to avoid bias in study results.

A total of one hundred pregnant women of age between 21 to 35 years with parity 1-4 with

Table-I: Stratification regarding parity, gestational age and maternal age.

	Transcerebellar diameter (mm)					Total	Mean± SD	p value
	≤30.0	30.1-34.0	34.1-38.0	38.1 - 42.0	42.1+			
Gestational age								
31 – 32 Wks	3	27	24	1	0	55	31.4 ± 0.49	<0.001
33-34 Wks	0	0	2	17	0	19	33.5 ± 0.50	
35 – 36 Wks	0	0	0	0	0	17	35.5 ± 0.51	
37 – 38 Wks	0	0	0	0	4	04	37.0 ± 0.00	
Over 39 wks	0	0	0	0	5	05	40.0 ± 0.00	
Total	3	27	26	35	9	100	33.1 ± 2.42	
Maternal age								
21 -23 Yrs	0	1	03	08	1	13	22.23 ± 0.59	0.253
24 -26 Yrs	1	8	11	11	1	32	25.16 ± 0.88	
27 -29 Yrs	2	10	09	10	6	37	27.97 ± 0.86	
Over 30 Yrs	0	5	03	06	1	18	30.61 ± 0.50	
Total	3	27	26	35	9	100	26.80 ± 2.71	
Parity								
Para 1	0	5	10	15	1	31	1.99 ± 0.83	0.201
Para 2	3	13	12	10	5	43		
Para 3	0	8	3	9	2	22		
Para 4	0	1	1	1	1	04		
Total	3	27	26	35	9	100		

evaluation, required to differentiate normal from abnormal fetal growth, which may delay the diagnosis and appropriate intervention⁷.

MATERIAL AND METHODS

This study was conducted in the Department of Radiology, Combined Military Hospital, Lahore over a period of six months from 27-02-

singleton uncomplicated pregnancy were included in study during their third trimester between 31 to 40 weeks of gestation assessed on last menstrual period, with previous history of regular menstrual period for the last 6 months. Pregnant women who are unsure of date of last menstrual period, were of age less than 21 years

and of more than 35 years with multiple gestations and also who were diagnosed patients of hypertension or diabetes were excluded from study to avoid bias.

TCD was measured by identifying the cerebellum in the posterior fossa and measuring it in from outer extent. All these measurement was done by qualified consultant radiologist who were having >3 years practicing experience after post-graduation on ultrasound machine Toshiba using 5MHz frequency probe.

All the collected information was transferred to SPSS version 12 and were analyzed accordingly. Mean standard deviation was calculated for age of women gestational age and transcerebellar diameter. Frequency and percentage was also calculated for parity. ANOVA and post hoc tests were applied and *p*-value <0.05 was taken as significant.

RESULTS

Out of a total of 100 pregnant women, majority of the patients were between 27-29 years of age and minimum number of patients were

Stratification regarding parity, gestational age and maternal age presented in table-I.

After applying ANOVA test on parity, gestational age and maternal age it revealed that only gestational age and TCD (mm) had significant relation ($p < 0.001$). Post hoc test applied to confirm the significant relationship of these variables which confirmed the results by ANOVA test, results are mentioned in table-II & fig.

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 known¹⁹. 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. Among the various clinical criteria, last menstrual period preceded by normal cycle, is known to correlate best with the gestational age but it is not reliable when a

Table-II: Dependent variable-transcerebellar diameter (mm).

(I)- Gestational age(weeks) Binned	(J)-Gestational age (weeks) Binned	Mean-Difference (I-J)	Std Error	Sig
<32	33-34	-6.1972	0.5515	0.001
	35-36	-7.8533	0.5751	0.001
	37-38	-9.0959	1.0733	0.001
	Over 39	-9.2909	0.9681	0.001
33-34	35-36	-1.6560	0.6919	0.026
	37-38	-2.8987	1.1402	0.090
	Over 39	-3.0937	1.0417	0.030
35-36	37-38	-1.2426	1.1518	0.081
	Over 39	-1.4376	1.0544	0.065
37-38	Over 39	-0.1950	1.3903	1.000

between 21-23 years old. Mean age of the patients was 26.80 ± 2.71 years (table-I). Mean gestational age was 33.18 ± 2.42 weeks (table-I).

Out of 100 women, 31 (31.0%) were para 1, 43 women (43.0%) were para 2, 22 women (22.0%) were para 3 while 4 women were para 4. Mean parity was 1.99 ± 0.83 (table-I).

woman is not sure about her last menstrual period⁸.

Other biometric parameters for gestational age assessment are biparietal diameter, femur length and head circumference. These parameters have their own limitations as biparietal diameter 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 gestation⁹, and it is consistently superior in predicting GA in both singleton and twin gestation^{9,8}. Measurement of the transcerebellar diameter can be done on most of the fetuses, irrespective of the fetal head shape^{10,11}.

The determination of gestational age is important in obstetric for management of pregnancy and evaluation of fetal development. Most of the patients usually report in their third trimester for their first antenatal examination and some other patients do not have regular serial follow up ultrasonographic evaluations in their pregnancy which is usually required to differentiate abnormally growing fetuses from normally developing fetuses. Determination of mean TCD helps in this scenario avoiding need of serial sonographic examinations especially those who are nonaffordable and do not have easy access to medical facilities in remote areas.

Fetal studies have demonstrated the close relationship between the TCD and gestational age with linear growth of the TCD during the second trimester¹². The measurement of TCD in the fetus continues to be a useful indicator for gestational age even in the presence of abnormal skull shapes fetal growth restriction multiple pregnancies and large-for-dates fetuses¹³. Therefore, the TCD measurement of the fetus is resistant to these effects on other fetal measurements.

Using ultrasound, several authors have observed that the biparietal diameter may be affected by variations in the shape of the skull^{14,15}.

McLeary et al¹⁶ have found on ultrasonography of the fetal skull that the posterior fossa is not affected by the pressure effects, and the cerebellar diameter is more accurate reflection of gestational age than the biparietal diameter particularly in the presence of

abnormal skull shapes like brachycephaly or dolicocephaly.

Antenatally the transcerebellar dimension of the fetus has been used to assess gestational age. In the fetus a good correlation has been reported between the transverse cerebellar diameter measured by ultrasound and gestational age in appropriate for gestational age, small for gestational age (SGA) fetuses and large for gestational age fetuses (LGA).

TCD is a good predictor of gestational age in intrauterine growth retardation. Most cases of intrauterine growth retardation are as a result of placental insufficiency and poor maternal nutrition. Moreover in cases with intrauterine growth retardation caused by reduced utero

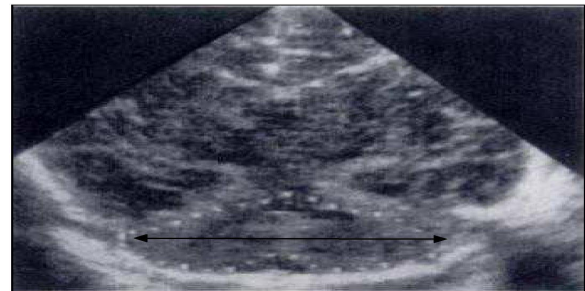


Figure: The cerebellum in the axial view via the quadrigeminal cistern maximum width is taken as the transverse cerebellum diameter.

placental flow, a redistribution of cardiac output occurs, preserving blood flow to the brain¹⁷. Montenegro¹⁸ during a routine ultrasound examination of 178 normal pregnant women at 17-24 weeks performed several biometric measurements and stated that TCD seems to be good marker for gestational age compared to other clinical and biometric parameters. Similar results were obtained by Strizhova¹⁹.

Hata and Hata²⁰ studied the ultrasonographic measurements of the cerebellum and found that it decreased in small for date babies, but was normal in large for date babies and he proposed ultrasonic cerebellar diameter as an additional measurement for fetal growth.

Mikovic and Markovic et al²¹ studied the growth of fetal cerebellum in normal pregnancy

between 20 and 40 weeks and proposed that TCD can be practically applied in cases where it is difficult or impossible to measure BPD or in cases where it is unsuitable because of the expressed moulding of the head.

Campbell²² studied 162 measurements of the TCD and abdominal circumference obtained between 15 - 38 weeks of gestation. The ratio between the TCD and abdominal circumference was calculated. The mean ratios remained constant and proved that it was gestational age independent.

Guan²³ generated a nomogram for TCD with respect to gestational age and compared fetal TCD, biparietal diameter, head circumference, abdominal circumference and femur length measurements by ultrasound. Correlation coefficient between the birth weight and their parameters were studied and concluded that the function of the transverse cerebellar diameter in the evaluation of fetal growth and development is better than any other parameter.

Chavez²⁴ developed a similar nomogram with a special emphasis in the 3rd trimester stated that TCD had a similar relationship with gestational age across previously published nomogram before 28 weeks.

Since the TCD can enable accurate assessment of gestational age and cranial ultrasound is performed routinely in neonates at high risk, assessment of gestational age with the use of cerebellar dimensions is both feasible and of clinical value. On the basis of these studies assessment of mean TCD in third trimester of pregnancy, is of important clinical value.

In present study mean TCD was 36.47 ± 4.30 cm. TCD increase was observed with the advancement of gestational age. TCD 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. The data of this study suggest TCD fetal ultrasound

as a predictive biometric parameter of gestational age.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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