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*Original Article*

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# Correlation between transverse cerebellar diameter and gestational age in second and third trimester of singleton pregnancies

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## ABSTRACT

**BACKGROUND & OBJECTIVE:** Trans-cerebellar diameter stands out as an important fetal parameter for estimating gestational age in second and third trimester when all the other parameters start showing margin of error of 3 to 4weeks. The study was designed with intent to gather more evidence on TCD measurements validity. This will help us in using TCD on routine basis in advance pregnancies. Our objective is to determine the correlation between mean transverse cerebellar diameter and mean gestational age in 20 to 40 weeks of gestation.

**METHODOLOGY:** This research is being conducted at radiology department of Social Security Hospital Islamabad from 1-02-2022 till 01-06-2022. Non-probability convenient sampling was done and a total of sixty (n=60) healthy women with a singleton pregnancy between 18 to 40 years of age with gestational age of 20 to 40 weeks as confirmed by ultrasound were enrolled in the study. An expert radiologist used Logic P6 ultrasonography machine during the study. TCD, HC, BPD and FL was measured in each patient and correlated with gestational age. Pearson correlation coefficient was computed using SPSS-17.0.

**RESULTS:** Significant and strong positive correlation (r=0.98) and p<0.001 was found between TCD measured by ultrasonography and gestational age at a 0.05 significance level.

**CONCLUSION:** Significant and strong positive correlation was found between TCD measured by ultrasonography and gestational age.

**KEYWORDS:** Ultrasonography, Gestational age, Transverse cerebellar diameter.

## INTRODUCTION

The authentic data regarding gestational age is considered as a most important tool in obstetric management. It helps in the early diagnosis of preterm and post-term pregnancies. Nowadays, two most commonly used methods for predicting gestational age are the last menstrual period and calculation of date of delivery by ultrasonic measurement however, if the sonographer performs the scan with minimal errors, this could be more reliable than the actual LMP recalled by patient. Routinely used biometric fetal parameters are more accurate in early gestation and gets less authentic in late gestation [1]. In the past, registration of fetal movements and fetal heart rate auscultation were the only methods for assessing fetal status, especially by midwives however this method is subjected to a high frequency of errors [2]. Another conventional way of evaluating fetus is assessing fundal height however it is highly dependent on the expertise of the doctor, also limited by other factors like parity and obesity [3].

Development of brain in humans is a very intricate and dynamic process [4]. Cerebellum which is also known as little brain has longest developing process in antenatal period which appears early in gestation but takes the maximum time to mature [5]. In the last few years, work has been started on using TCD (transverse cerebellar diameter) as an emerging biometric parameter that has a strong correlation with gestational age (r=0.98 in the second trimester and r=0.997 in the third trimester). It also correlates well with other fetal parameters. Since cerebellum is situated in posterior cranial fossa and covered by dense protective petrous ridges and occipital bones, it can resist deformation by external pressures. Cerebellar growth is also least affected in fetal growth restriction or acceleration and also in cases of deformed skull shapes [6].

The aim of this study was to establish trans cerebellar diameter as an independent fetal parameter for gestational age assessment in late pregnancy (20 to 40 weeks), especially when all other parameters start showing a margin

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of error of 3 to 4 weeks [7]. This study is anticipated to add on the current literature and help in using TCD on routine basis in advance pregnancies. Researches have also been started regarding anteroposterior cerebellar diameter [8]. Our research will be considered a useful addition to the literature for further cerebellar workup.

## METHODOLOGY

This research is being conducted at the radiology department of Social Security Hospital Islamabad from Feb 2022 till June 2022. The sample size was evaluated using sample size calculation for correlation coefficient between trans cerebellar diameter and gestational age as r=0.98. This is a non-probability convenient sampling which exclusively included a healthy pregnant patients with singleton pregnancies between 20 to 40 weeks as confirmed by ultrasound. Pregnant patients unsure of LMP, anomalous babies, multiparous, pre or postdate, other co-morbid and IUGR are excluded from the study.

Formal approval from the hospital IERC committee was obtained, and women fulfilling inclusive criteria were included in the study (Certificate # No.SSR/Hospital (108) (1)(3107). Patients were informed about the procedure and consent was obtained. Questionnaire (Annexure A) regarding the basic demographic profile was filled. The patients under study were examined by a researcher under the supervision of a senior resident or consultant radiologist to minimize the risk of bias. Ultrasonic assessment was done with real time ultrasonographic equipment (GE Health care, LOGIC P6, Serial# LP6122757, America) having a 3.75 MHz Transabdominal curvilinear probe with the patient lying in a comfortable supine position. TCD was obtained by slightly rotating the probe axially on a thalamic plane and measuring the widest cerebellar diameter at this level. The measurements were then compared with a standard sonogram, and gestational age was calculated in weeks. All the data was collected and entered into SPSS (version 17). Quantitative variables like Trans cerebellar diameter, other routinely used sonographic parameters and gestational age were analyzed and presented as mean±standard deviation. Pearson's correlation coefficient (r) was used to find a strength of relationship between variables.

## RESULTS

A sample size of 60 cases is calculated by taking magnitude of the correlation coefficient between trans cerebellar diameter and gestational age as r=0.98 [9]. Keeping 5% level of significance. Healthy women with a singleton pregnancy between 18 to 40 years of age with the gestational age of 20 to 40 weeks, as confirmed by ultrasound, were recruited in this study. TCD was measured by ultrasonography in each female. The measurements were then compared with a standard sonogram of Altman and Chitty [10], and gestational age was calculated in weeks. The mean age of study subjects was 29.1 years±4.3 SD, the mean gestational age was 31.0 weeks±5.2 SD and the mean TCD measured through ultrasonography was 45.8 mm ±9.9 SD. The distribution of subjects with respect to different ages and gestational ages is tabulated (table-I).

**Table-I: Demographic characteristics of study population according to different age groups and gestational age groups.**

| Variable | Duration | Frequency | Percent |
|---|---|---|---|
| Gestational Age Groups | 20-30 Weeks | 25 | 41.7 |
| | > 30 Weeks | 35 | 58.3 |
| | **Total** | 60 | 100.0 |

Correlation coefficient (r) value showed a strong positive correlation between TCD and GA r=0.980, n= 60, p<0.001.

Furthermore, the correlation between TCD and gestational age was determined in different gestational age groups. In gestational age group 20-30 weeks, mean TCD was 36.3 mm±7.1 SD, mean gestational age value was 25.6 weeks ± 2.9 SD with correlation coefficient r = 0.969 and p<0.001. In gestational age group >30 weeks, mean value TCD was 52.6 mm±4.7 SD, mean gestational age measured showed a mean value of 34.9 weeks±2.1 SD with correlation coefficient r=0.95 and p<0.001. It implied a significant and strong positive correlation of TCD measured by ultrasonography with gestational age at a 0.05 significance level (2-tailed) (table-II).

Similarly, other routinely used sonographic biometric parameters (BPD, HC and FL) are also evaluated and showed a linear positive correlation with gestational age. Values increase linearly with the increase in gestational age and have a significant correlation. As r value of TCD is higher than that for HC BPD, and FL, this shows that TCD is a more accurate parameter which can be used for the estimation of the gestation age of the fetus. TCD, FL, BPD, and HC, in that order, are the more reliable parameters for the estimation of GA. Femur length–FL overestimates the gestational age, while other parameters under-estimates; TCD is the more reliable parameter, particularly after 30 weeks of gestation (table-III).

**Table-II: Correlation between TCD and Gestational age.**

| Correlation variables | Sample size (n) | Correlation Coefficient | p-value |
|---|---|---|---|
| Gestational Age and TCD | 60 | 0.980 | <0.001 |
| Gestational Age group (20-30 week) and TCD | 25 | 0.969 | <0.001 |
| Gestational Age group (>30 week) and TCD | 35 | 0.950 | <0.001 |

**Table-III: Correlation of TCD and routinely used parameters with gestational age.**

| Gestational Age | Correlation | Correlation Coefficient | p-value |
|---|---|---|---|
| Actual Gestational Age | BPD for GA | 0.897 | <0.001 |
| | HC for GA | 0.930 | <0.001 |
| | FL for GA | 0.934 | <0.001 |
| | TCD for GA | 0.980 | <0.001 |
| Actual Gestational Age >30 weeks | BPD for GA | 0.916 | <0.001 |
| | HC for GA | 0.912 | <0.001 |
| | FL for GA | 0.919 | <0.001 |
| | TCD for GA | 0.950 | <0.001 |

## DISCUSSION

Unfortunately, in our country, there is less advancement seen in maternal and antenatal health status over the period of years, leading to a constantly high maternal and fetal death rate. The only way to improve our health care facilities is to upgrade health facilities in terms of technological advancement [11]. Routinely used parameters are HC, FL and AC which themselves are compared with their standard normograms [12].

Among all other parameters, the evaluation of fetal brain structures and the nervous system holds very good importance in antenatal evaluation [13]. We correlated TCD and other routinely measured sonographic parameters with advancing gestational age and our results are quite similar with the already published data on the subject. The correlation coefficient of TCD in our study is 0.98 whereas a recently published study shows an r value of 0.958. The similarity between the two studies is that BPD, FL and HC has less correlation from gestational age than that of TCD and this further strengthens idea of using TCD as a routine fetal biometric parameter [14].

The maximum trans cerebellar diameter measured in our research is 59.1 mm at 39weeks which is relatively larger than the maximum TCD measured 47.4 mm by Mishra et al in India. This variability in maximum TCD diameter warrants the need of more research in South Asian cohorts as due to different socioeconomic status, the reference ranges of TCD as determined by western researchers cannot be entirely used in our setup. We need to establish our own normograms, which will help in diagnosing fetuses that are small or large for gestation [15].

TCD is also the least affected by increasing maternal age and parity [16]. Another Brazilian study was carried out by Araujo et al which investigated 3772 pregnancies. The results are in our favor as this study also established a satisfactory correlation between TCD and gestational age (R2=0.707) [17]. Another study determined grades of cerebellar maturity, which correlated clinically with gestational age [18].

TCD is being a very important predictor as any variation from the normal size range can help the doctor predict about other associated anomalies. A study published by Atallah et al in 2019 established data of 408 fetuses having TCD lesser the normal range, when investigated further, almost 46.4% had multiple anomalies. This study further strengthened the value of standardizing normal TCD ranges for using it as a routine biometric parameter as small TCD below 5th percentile could predict grave diagnosis [19]. A Nigerian study evaluated TCD on healthy 450 pregnant patients. The researcher classified cerebellar appearance according to gestational age and inferred that cerebellar appearance and size in terms of diameter increase linearly with progressing pregnancy. The author also emphasized further studies on posterior cranial fossa as they can be very helpful in future for diagnosis of CNS tubal defects [20].

Ravinder et al. established uniform correlation of transverse cerebellar diameter (TCD) with the rest of biometric parameters. Author furthermore emphasized use of TCD in cases of severe molding of skull or variable pathological skull contours [21]. It is important to evaluate new parameters to accurately assess the gestational age as it will help in better management of antenatal patients. Specially those antenatal patients who need intervention due to associated comorbidities or due to any fetal indication. This article is an important contribution towards finding such parameters, though more studies are required on large scale to set a protocol to follow for all.

Holando et al in their cross-sectional study, also studied the TCD but in a peculiar way. The study established a correlation between transverse cerebellar diameter and fetal age in normal singleton pregnancies by grouping the fetuses according to gender (male and female). The author concluded TCD as an independent biometric parameter that is not affected by the type of gender and strongly emphasized its application in the late trimester [22].

A similar study like ours highlighted TCD as a useful biometric parameter in late gestation. However, a comparison of TCD was only made with the routinely used head parameter which is BPD. Our study has also compared TCD with FL and validated that trans cerebellar diameter evaluation in late pregnancy (after 30 weeks) is even more then useful then FL (r value for TCD is 0.95 and for FL is 0.91 in our study) [23].

Hence our study is among few of the pioneer researches done on the Pakistani population and is an effort to make our own reference TCD normogram. This will encourage

other authors to study TCD as a routine useful biometric parameter especially in our population. However, it has a few limitations as TCD measurement could not be measured accurately in hypermobile fetuses hence the size of the research sample was narrowed down. Only normal fetuses were studied in this research work however further studies are required to access TCD correlation in growth restricted and anomalous fetuses, particularly in Pakistani cohort.

Further large-scale studies are also needed to establish normal reference range of TCD, especially in third-world countries like us where maternal habitus and fetal growth can be subjected to multiple other socio-economic factors as well. Having said that, all biometric measurements done during antenatal scans are dependent on the precision of the ultrasound machine and the technical expertise of the attending sonologist. Furthermore, its correlation with good outcome of respondenders with ICSI can provide additional [24].

## CONCLUSION

Significant and strong positive correlation was found in this cross-sectional study between TCD measured by ultrasonography and gestational age ranging from 20-40 weeks. TCD increased linearly with advancing gestational age and is a more reliable parameter then BPD, FL and HC.

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***Author's Contribution:***

**Beenish Nadeem:** Conception and design, acquisition of data, analysis and interpretation of data for the work.

**Anam Zahoor:** Statistical analysis and final approval of the version to be published.

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