A correlation of trans-cerebellar diameter by ultrasonography and gestational age in second and third trimester

Ahmed Hassan Khedr, Hossam Abd ElMageed Abdou, Ahmed Mostafa Mohamed, Ihab Ibrahim Samaha

Department of Obstetrics and Gynecology, Faculty of Medicine, Helwan University, Egypt

*Corresponding author: Ahmed Mostafa Mohamed,
Ahmed_Alsayed@med.helwan.edu.eg

ABSTRACT

Background: Ultrasonography has recently become the principal means by which fetal well-being can be monitored and any deviation in fetal growth can be detected. Thus, the need for a gestational age independent parameter to assess fetal growth, has become a necessity. The trans-cerebellar diameter has been found to be nearly constant though-out gestation. Therefore, the present study was conducted with the aim to evaluate the diagnostic reliability and validity of the trans-cerebellar diameter to abdominal circumference ratio (TCD/AC) in assessment of normal fetal growth and derive population-specific trans-cerebellar diameter to abdominal circumference ratio (TCD/AC) for the Egyptian population. **Patients and methods:** This prospective study was carried out in Obstetrics and Gynecology Department, outpatient clinic, Helwan University Hospitals, From April 2022 to December 2022. Included 250 women with uncomplicated pregnancies, undergoing Obstetric ultrasound**. Results:** The correlation between abdominal circumference and gestational age was $r = 0.978$, while the correlation between transverse cerebellar diameter and gestational age was $r = 0.630$, P value was < 0.001 (highly significant). This study also found that at gestational age 18-34 weeks, the accuracy of the following parameters in prediction of gestational trimester was TCD = 92.4%, AC = 97.2%, HC = 96.8%, FL = 92.8%. **Conclusion:** Transverse cerebellar diameter can be used to predict fetal growth abnormalities, particularly fetal growth restriction.

Keywords: Ultrasonography, transverse cerebellar diameter, gestational age

Introduction:

Ultrasonography has become the principal tool by which fetal well-being is monitored and deviant fetal growth is detected. The biometric parameters used most frequently to evaluate fetal growth include the fetal bi-parietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). Precise knowledge of gestational age is required to accurately utilize these biometric parameters to assess the fetal growth[1].

Fetal growth abnormalities, particularly fetal growth restriction (FGR) areclassified among the leading causes of peri-natal mortality, prematurity being the first one. The incidence of mortality in preterm newborns is higher if growth restriction is also present, being subjected to increased two to ten times the usual numbers of peri-natal mortality. The factors involved in the etiology of fetal growth abnormalities can be classified into maternal, fetal and placental, which are the three compartments involved in fetal growth. However, it is more likely that most of

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the fetuses with impaired growth potential have aggression affecting all three compartments in varying degrees. In 40% of cases, it is not possible to identify the cause[2].

A major limitation of most of the biometric parameters in diagnosing abnormal fetal growth is their dependence on accurate knowledge of the gestational age. Therefore, the usefulness of these biometric parameters in establishing gestational age in the third trimester of pregnancy or in assessing fetal growth in pregnancies with uncertain dating is limited. In most of such cases, serial ultra-sonographic evaluation is required to differentiate normal from abnormal fetal growth, which may delay the diagnosis and appropriate intervention[3].

Many ultra-sonographic parameters are used in the diagnosis of fetal growth restriction, such as bi-parietal diameter (BPD), head circumference (HC), abdominal circumference, femur length, transverse cerebellar diameter (TCD) and estimated fetal weight. Parameters independent of gestational age, as the ratio of femur length to abdominal circumference ratio and the trans- cerebellar diameter to abdominal circumference ratio (TCD/AC), have been employed. The latter is considered, by some authors, as a parameter of choice in the diagnosis of fetal growth restriction[4].

The transverse cerebellar diameter (TCD) is well established in the ultrasound literature as a reliable parameter for estimating gestational age. Measurements of fetal TCD have been shown to correlate with gestational age. The TCD/AC ratio is a constant between 14 and 42 weeks and, therefore is a gestational age independent factor to assess the fetal growth. While all fetal biometric parameters are affected by intrauterine growth restriction, the effect on the size of the cerebellum is minimal. Hence, deviation of TCD/AC ratio is a sensitive indicator of IUGR[1].

As the biometric parameters change due to genetic and racial factors, there is a need to either develop population specific nomograms or to prospectively revalidate one of the chosen nomograms for appropriate clinical use[5].

The aim of the study was to evaluate the diagnostic reliability and validity of the trans-cerebellar diameter to abdominal circumference ratio (TCD/AC) in assessment of normal fetal growth and derive population-specific trans-cerebellar diameter to abdominal circumference ratio (TCD/AC) for the Egyptian population.

Patients and methods

This prospective study was carried out in the Obstetrics and Gynecology Department, outpatient clinic, Helwan University Hospitals, from April 2022 to December 2022. The included 250 women undergoing obstetric ultrasound aged 20–40, pregnant with singleton pregnancy, and in the second or third trimester. Exclusion Criteria were: age < 20 or >40 years old. Maternal comorbidities (such as hypertension or diabetes). Congenital anomalies in fetal life (either in the cerebellum or in any other organ). IUGR or macrosomic babies. Multiple pregnancies. All data of the participants was scored in codes to protect their privacy and confidentiality.

All patients had a thorough history-taking (pregnant ladies was asked about their age, obstetric code, LMP (last menstrual period), if they suffer from any medical condition). Then, gestational age in weeks was measured by using

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the gold standard method which is through measurement of BPD, AC, FL (Biparietal diameter, abdominal circumference, Femur length respectively) and then it was correlated with the trans cerebellar diameter in mm using ultrasound (Acuson X300, Siemens). The diameter was measured in the trans cerebellar plane by the placement of electronic calipers at the margins of the cerebellum. The characteristic butterfly appearance of the cerebellum hinted the location of posterior fossa.

Statistical analysis:

Data was analyzed using SPSS version 22. Qualitative data was presented as number and percent. Quantitative data was tested for normality by the Shapiro-Wilk test then described as mean and standard deviation for normally distributed data and median and range for non-normally distributed. The appropriate statistical test was applied according to the data type with the following suggested tests; Chi-Square for the categorical variable. To determine the survival rate, the Kaplan curve was used. Accepted level of significance when $P \leq 0.05$.

Results:

Table 1 showed that the mean age of the participants was (25.59 ± 3.35) (Mean $\pm$SD) and their gestational age m was 29.66 ± 6.21. Regarding the transverse cerebellar diameter of their fetus, it was 25.62 ± 9.10 and ranging from (1.60-36).

Table (1): Frequency distribution of the studied group according to the following characteristics (N= 250):

Variable	Group female
Age (years)	
• Mean ±SD	25.59 ± 3.35
• Range (min- max)	(18-33)
Height (cm)	
• Mean ±SD	162.10 ± 6.15
• Range (min- max)	(150 – 173)
Weight (Kg)	
• Mean ±SD	72.94 ± 6.60
• Range (min- max)	(60-89)
BMI	
• Mean ±SD	28.04±3.24
• Range (min- max)	(24-36)
Gestational age	
• Mean ±SD	29.66± 6.21
• Range (min- max)	(14-39)
Transverse cerebellar diameter	
• Mean ±SD	25.62±9.10
• Range (min- max)	(1.60-36)
Abdominal Circumference	
• Mean ±SD	26.52±6.51
• Range (min- max)	(9-36)
Head Circumference	
• Mean ±SD	26.65±6.30
• Range (min- max)	(9-37)
Femur length	
• Mean ±SD	5.72±2.82
• Range (min- max)	(1.50-27)
Expected fetal weight	
• Mean ±SD	1642.45±1040.55
• Range (min- max)	100-3600

Figure 1; the correlation between abdominal circumference and gestational age was r = 0.978, while the correlation between transverse cerebellar diameter and gestational age was r = 0.630. P value was < 0.001 (highly significant) Figure 2.

A correlation of trans-cerebellar diameter by ultrasonography and gestational age in second and third
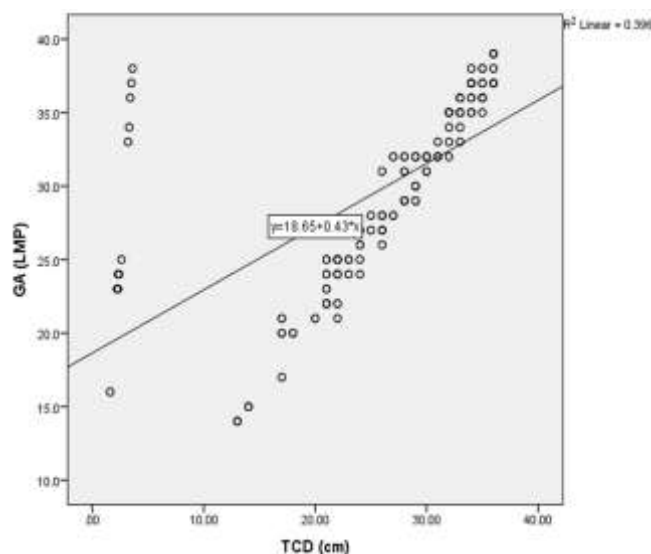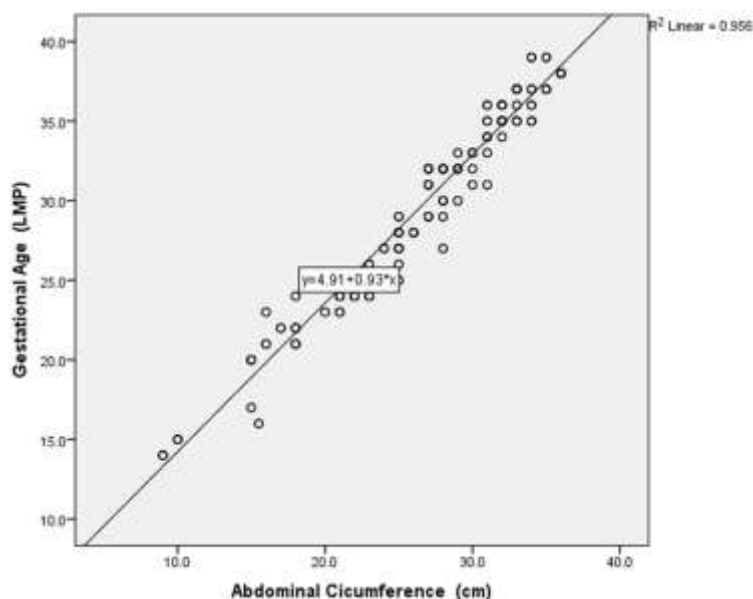trimester

Figure (1): Correlation between abdominal circumference and gestationalage

Figure (2): Correlation between Transverse cerebellar diameter and gestational age

Table (2) Accuracy of the following parameters in prediction of gestationaltrimester:

Variable	Accuracy %
Predicted Gestational trimester by:	
1-Transverse cerebellar diameter	92.4%
2-Abdominal circumference	97.2%
3- Head circumference	96.8%
4- Femur length	92.8%

Table 2 showed that Transverse cerebellar diameter can correctly predict the gestational trimester by
92.4%.

TCD measurement atgestational age 19w4d

TCD measurement atgestational age 20w6d

TCD measurement atgestational age 25w5d

TCD measurement atgestational age 26w6d

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**TCD measurement atgestational age
28w3d**

**TCD measurement atgestational age
30w4d**

**TCD measurement atgestational age
31w5d**

**TCD measurement atgestational age
33w5d**

Discussion:

The mean maternal age was 25.59 ± 3.35 (mean±SD) years old. The mean BMI was 28.04 ± 3.24 (mean±SD). The mean gestational age by LMP was 29.66 ± 6.21 (mean±SD) weeks.

Regarding parity the patients were distributed as follows: 33.2% of cases were (P1) 44% of cases were (P2) 18.4% of cases were (P3) 4.4% of cases were (P4) the mean neonatal birth weight was 1642.45 ± 1040.55 (mean±SD) with range between 100-3600 gm.

As shown in (**Figure, 1,2**), correlation between abdominal circumference and gestational age was r = 0.978, while the correlation between transverse cerebellar diameter and gestational age was r = 0.630. P value was < 0.001 (highly significant).

This was compatible with the results of *Dhumale et al*[1], who conducted a prospective observational study on 434 pregnant women, with gestational age between 18-34 weeks of singleton pregnancy, and found that the mean for TCD/AC ratio for different periods of gestation was as follows; (1. 18-22 weeks: 13.4, 2. 23-26 weeks: 13.5, 3. 27-39 weeks: 13.6 and 4. 31-34 weeks: 14.0).

This agrees with findings of *Meyer et al*[6], who studied 700 patients with uncomplicated pregnancies between 14 and 42 weeks of gestation and found strong correlation between GA, TCD and AC, with mean TCD/AC ratio of 13.6 (median= 13.7) and remained constant throughout pregnancy when compared to gestational age.

This also agreed with a study by *Malik R et al*[7], which proved that TCD/AC ratio was fairly constant throughout pregnancy.

Also in an earlier study made by *Chawanpaiboon et al*[8], which included 634 pregnant women between 13-40 weeks of gestation and attended the antenatal care clinic. The authors found that TCD/AC ratio was a stable gestational age independent parameter during the period of 20-30 weeks of gestation.

This also agreed with *Dhumale H et al*[1], who found that TCD/AC ratio was constant though-out gestation, with a mean value of 13.56 (SD=1.21) for normal fetal growth, and concluded that TCD/AC ratio is a gestational age independent parameter and relatively good predictor of growth abnormality in gestational age group 18-34 weeks.

This also agreed with a prospective study performed by *Jha A et al*[9], who studied 442 women with uncomplicated singleton pregnanciesbetween 15-40 weeks, and found that TCD/AC remained nearly constant throughout gestation with a mean value of (13.8).

This was also compatible with the results of **Bhimarao et al**[10], who studied 50 women with singleton pregnancies more than 20 weeks of gestation, and found TCD/AC to be a gestational age independent parameter that remained fairly constant throughout gestation with a mean value of (13.63).

As shown in (**table, 2**) at gestational age 18-34 weeks, the accuracy of the following parameters in prediction of gestational trimester was (TCD = 92.4%, AC = 97.2%, HC = 96.8%, FL = 92.8%).

It is agreed with *Bhimarao et al*[10], who studied the diagnostic accuracy of TCD in fetal growth assessment and validity in prediction of abnormal fetal growth pattern, and showed that TCD has a good diagnostic validity and accuracy when compared to HC, AC ratio in fetal growth assessment and prediction of fetal growth abnormality.

It's worth notice that the difference between the results of the current study and those from other studies could probably be due to different population types, necessitating the use of nomograms specific for the Egyptian population.

Conclusion:

Fetal transverse cerebellar diameter (TCD) ratio proved to be a gestational age independent parameter to assess fetal growth status in normal pregnancies, and a relatively good predictor of fetal growth abnormality, particularly fetal growth restriction. Therefore, measuring TCD could be

used as a routine step in antenatal obstetric scans in order to early detect deviation from normal growth, giving the chance for possible early intervention, and thereby possibly decreasing perinatal morbidity and mortality.

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