

Assessment of Transcerebellar Diameter Accuracy in Detection of Gestational Age in Third Trimester in Cases of Intrauterine Growth Restriction

Youssef Abo Elwan El-Sayed, Mohamed El Sayed Mohamed,
Walid Abdallah Abdel Salam, Rana Ramadan Ibrahim Soliman

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

*Corresponding Author: Rana Ramadan Ibrahim Soliman, Mobil: (+20)1117633096,

E-mail: ranaramadanibrahim88@gmail.com

ABSTRACT

Background: Intrauterine Growth Restriction (IUGR) is defined as decreased fetal birth weight less than 10th percentile as regard to gestational age also diagnosed when there is a delay more than 2 weeks in a serial ultrasound monitoring of fetal gestational age.

Objective: The aim of the work was to evaluate accuracy of transcerebellar diameter (TCD) in detection of gestational age in pregnancies with intrauterine growth restriction IUGR.

Patients and Methods: Case-Control study was carried out on 52 women with normally progressing pregnancies during the third trimesters, with gestational ages between 27 and 37 weeks of gestation came to outpatient clinic of department of Obstetrics and Gynecology, Zagazig General Hospital and Zagazig University Hospital from June 2019 to March 2020, of them, 26 subjects were normal pregnancies and 26 subjects diagnosed as IUGR in 3rd trimester at gestational age (27week to 37 week). Trans-abdominal ultrasound was performed on all subjects; Fetal TCD was measured using the widest diameter of the cerebellum, measurement of fetal Bi-Parietal Diameter (BPD), Abdominal Circumference (AC), and Femur Length (FL).

Results: There was statistically significant difference between gestational age (GA) by Last Menstrual Period (LMP) and sonar parameters at normal group but highest was TCD with P value 0.000 but in IUGR group only TCD, AC and FL were significantly positive correlated with GA; and TCD were highly significant.

Conclusions: It could be concluded that the TCD measurement appears to be an accurate predictor of gestational age, even in the third trimester of pregnancy.

Keywords: Transcerebellar Diameter, Intrauterine growth restriction, gestational age.

INTRODUCTION

Intrauterine growth restriction (IUGR) is characterized as a decreased fetal birth weight of less than 10th percentile in terms of gestational age.

It is diagnosed when the fetal gestational age measured by transabdominal ultrasound less than estimated gestational age measured using first day of last menstrual period by more than 2 weeks. It is also diagnosed when there is a delay more than 2 weeks in a serial ultrasound monitoring of fetal gestational age (1).

IUGR has a prevalence of 5–8% in the general population. It is the second cause of perinatal mortality after prematurity (2).

IUGR mostly associated with maternal, fetal and placental problems. Maternal as: hypertension, diabetes mellitus and malnutrition; fetal as: stillbirth, oligohydramnios, fetal anomalies, perinatal morbidity and mortality. Placental abnormalities as: placenta previa, true knot of the cord (3).

The cerebellum, the largest portion of the hind brain, consists of a midline part called the vermis and two lateral hemispheres. It is approximately spherical, but somewhat constricted in its median region and flattened, with the largest diameter being transverse (4).

The transverse cerebellar diameter (TCD) is one of the most reliable growth ultrasound parameters,

especially early gestation 6. The fetal cerebellum displays progressive growth over the entire gestation period of 5, 7; thus, it is an organ capable of providing information on the prediction of GA during pregnancy. TCD is well known in ultrasound literature as a valid parameter for the estimation of GA. This parameter can be especially useful for accurate pregnancy dates in the third trimester (5).

The TCD is a reliable indicator of GA in the fetus and is a normal to which aberrations in other fetal parameters can be compared, particularly when GA cannot be determined by routine methods of early pregnancy scanning or the date of the last menstrual cycle (6).

Nomograms have been developed for TCD and gestational age during pregnancy, and several studies have reported a better relationship between TCD and gestational age in the second and third trimesters, and even in IUGR patients, its utility as a growth assessment parameter compared to other routine ultrasound parameters (4,7).

This study was aimed to evaluate accuracy of transcerebellar diameter (TCD) in detection of gestational age in pregnancies with intrauterine growth restriction IUGR.



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PATIENTS AND METHODS

This Case-Control study included a total of 52 women during the third trimester, with gestational age between 27 and 37 weeks, attending at Outpatient Clinic, Department of Obstetrics and Gynecology, Zagazig General Hospital and Zagazig University Hospital. This study was conducted between June 2019 to March 2020.

Ethical approval:

Documented written consent has been obtained from all participants. **Approval of the ethical committee of Zagazig University was obtained. Research has been carried out on research involving humans in compliance with the Code of Ethics of the World Medical Association (Helsinki Declaration).**

The included subjects were divided into two groups; **Group 1** consisted of 26 women with normal pregnancy and **Group 2** consisted of 26 cases with intrauterine growth restriction (IUGR) during 3rd trimester.

Inclusion criteria:

Age (19-40) year's old, pregnant women with singleton pregnancy, gestational age from (27 to 37) week of gestation according to first day of last menstrual period or first trimester visit ultrasound, Pregnant women with IUGR or normal pregnancy were diagnosed with ultrasound and fetal Doppler.

Exclusion criteria:

Pregnant women aged <19 or > 40 years, multiple pregnancies, congenital fetal malformations, premature rupture of membranes, pregnant women were using any vasodilator drugs in treatment of medical diseases preconception, Fetal hydrops, Post-term pregnancy, Intrauterine fetal death, autoimmune diseases, smoking or alcohol abusers.

Pregnant women included in the study were subjected to the following: Careful and detailed history taking: Personal history included name, age, special habits, occupation, and address). Menstrual history included, first day of last menstrual period. Obstetric history included gravidity, parity, and mode of previous deliveries or abortions history of IUGR in previous pregnancies. Past history of diabetes mellitus and hypertension. Menstrual history to calculate duration of pregnancy from the date of first day of last menstrual period. General examination especially vital signs and lower limb edema.

Obstetric abdominal examination to detect fundal level, fundal grip, umbilical grip and Pelvic grip. Trans-abdominal ultrasound examination by **GE Voluson 730 Pro- and GE Logic P7 ultrasound** machines with a **3.5MHz** abdominal probes were performed to all patients. All of the sonographic examinations were recorded digitally to:

Correlate gestational age according to first day of last menstrual period in regular cycle patients or first trimester visit ultrasound and current gestational age by ultrasound by measurement Biparietal diameter, Transcerebellar diameter (TCD), Femur length and Abdominal circumference. Fetal TCD was measured using the widest diameter of the cerebellum by US in mm. **Technique of ultrasound:** Trans-abdominal ultrasound was performed on all patients while women are in a slightly tilted position with the head of the bed raised 30 degrees and with a small pillow under the right loin. measurement of fetal Bi-Parietal Diameter (BPD), Abdominal Circumference (AC), and Femur Length (FL).

Measuring Trans cerebellar diameter: Obtain the trans thalamic view of BPD then rotate the probe slightly downwards, towards the fetal neck, the posterior horns of the lateral ventricles will disappear from view to be replaced by the cerebellum. The T.C.D. is measured at 90 degree to the long axis of the cerebellum across its widest point, using the outer to outer method Figure (1).

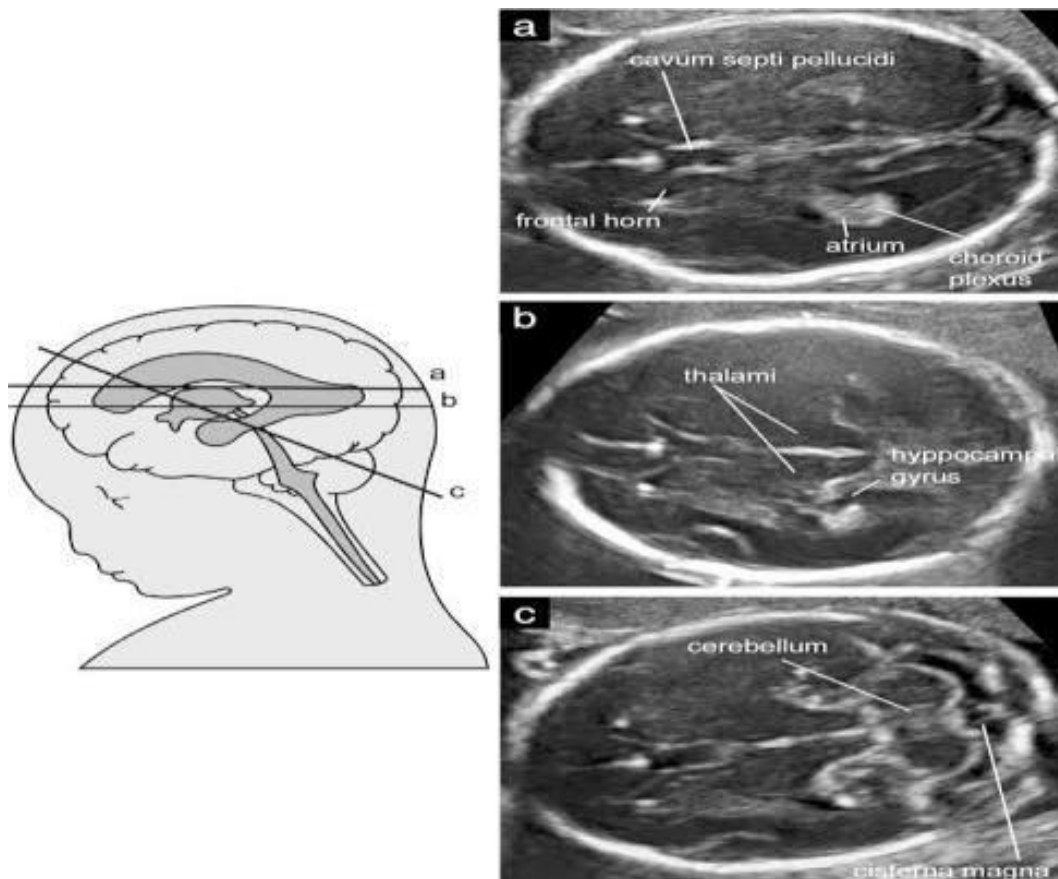


Fig. (1): Method of measure of TCD.

A-Obtain the trans thalamic view of BPD .B-Rotate probe slightly downward, towards the fetal neck, the posterior horn of the lateral ventricle will disappear from view to be replace by the cerebellum .C-The T.C.D. is measured at 90 degree to the long axis of the cerebellum across its widest point, using the outer to outer method.

Statistical Analysis:

Data collected over the course of the history, basic clinical evaluation, laboratory investigations and outcome measures are coded, entered and analysed using Microsoft Excel software. Data was then imported into the Research Program Statistical Package for Social Sciences (SPSS version 20.0) (Statistics Package for Social Sciences). Depending on the form of qualitative results, the quantitative continuous category represents \pm SD on average. Differences between parametric independent t-test group and paired t-test data, Pearson correlation and linear regression correlation. The P value was set at <0.05 for significant results and <0.001 for high significant results.

RESULTS

Table 1 shows that maternal age (years) was distributed as 31.84 ± 6.96 and 31.33 ± 6.09 respectively between Normal and IUGR with no significant difference. BMI (kg/m^2) was 26 ± 2.6 and 28 ± 2.9 respectively between Normal and IUGR with no

significant difference. There was no significant difference between groups regard gestational age.

Table 2 shows that there was no significant difference regard parity and fetal sex.

Table 3 shows that at 27-30 w of GA there was no significant difference between groups except in FL. At GA 31-33 w, normal was significantly higher than IUGR except in TCD and HC as there was no significant difference between groups regard them. At GA 34-37 w IUGR group was significantly lower than Normal group regard all parameters except TCD.

Table 4 shows that at normal group all parameters were highly significantly positive correlated with GA but highest was TCD. At IUGR only TCD, AC and FL were significantly positive correlated with GA but TCD were highly significant but AC and FL were only significant and much weaker than TCD.

Table 5 shows that no significant difference between actual GA and estimated GA by all sonar parameters at normal group. At IUGR group all GA estimated by sonar were significantly underestimated except GA estimated by TCD.

Table (1): Demographic Data.

	Normal	IUGR	t	P
Maternal age (years)	31.84±6.96	31.33±6.09	0.294	0.770
BMI (kg/m ²)	26±5.5	28±6.5	1.198	0.233
GA LMP (weeks)	31.23±3.56	32.0±3.36	-0.829	0.411

BMI: body mass index. GA: gestational age. LMP: last menstrual period.

P: p value. t: student's t test.

Table (2): Parity and Fetus sex distribution between groups.

			Group		Total	χ ²	P
			Normal	IUGR			
Parity	PG	N	10	11	21		
		%	38.5%	42.3%	40.4%		
	Multi gravida	N	16	15	31	0.08	0.77
		%	61.5%	57.7%	59.6%		
Fetal sex	Female	N	11	11	22		
		%	42.3%	42.3%	42.3%		
	Male	N	15	15	30	0.00	1.0
		%	57.7%	57.7%	57.7%		
Total	N	26	26	52			
	%	100.0%	100.0%	100.0%			

PG: primigravida.

χ²: chi square test.

Table (3): Sonar parameters distribution between studied groups at each gestational age GA stage.

GA by weeks (w)		Normal	IUGR	t	P
27-30 w	BPD(mm)	72.58±2.31	69.93±5.41	1.78	0.085
	TCD(mm)	33.06±0.98	32.46±2.51	0.838	0.414
	HC(mm)	273.35±8.73	267.0±18.23	1.242	0.225
	AC(mm)	250.65±20.71	235.78±20.79	1.958	0.060
	FL(mm)	56.23±1.81	51.26±6.89	2.779	0.010*
31-33 w	BPD(mm)	77.60±1.38	63.16±1.32	15.17	0.00**
	TCD(mm)	35.66±0.57	34.0±2.09	1.31	0.231
	HC(mm)	290.06±4.91	256.81±32.71	2.43	0.055
	AC(mm)	261.66±7.91	231.71±19.51	2.58	0.042*
	FL(mm)	59.86±1.27	48.0±3.79	5.14	0.001**
34-37 w	BPD(mm)	85.0±3.65	69.63±7.85	4.64	0.001**
	TCD(mm)	40.28±2.81	39.83±2.31	0.318	0.761
	HC(mm)	323.85±8.80	266.75±28.89	4.991	0.00**
	AC(mm)	304.42±16.21	245.51±29.75	4.534	0.001**
	FL(mm)	68.64±3.63	56.85±6.41	4.164	0.002*

BPD: biparietal diameter. TCD: Trans cerebellar diameter.

HC: head circumference. AC: abdominal circumference.

FL: femur length.

Table (4): Correlation between gestational age by LMP and sonar parameters at each group.

Group			GA_LMP	
Normal	BPD	r	.894**	
		P	.000	
	TCD	r	.978**	
		P	.000	
	HC	r	.916**	
		P	.000	
	AC	r	.818**	
		P	.000	
	FL	r	.944**	
		P	.000	
	IUGR	BPD	r	.161
			P	.395
TCD		r	.828**	
		P	.000	
HC		r	.323	
		P	.081	
AC		r	.445*	
		P	.024	
FL		r	.447*	
		P	.021	

BPD: biparietal diameter. **TCD:** Trans cerebellar diameter.
HC: head circumference. **AC:** abdominal circumference.
FL:femur length.

Table (5): Paired analysis for difference between gestational age (GA) by first day of last menstrual period and estimated GA by Ultrasound parameters in normal and IUGR groups.

Group		Mean	SD	Paired t	P
Normal	GA_LMP	31.2308	3.56716	0.256	0.800
	Estimated GA BPD	31.1486	2.84865		
	GA_LMP	31.2308	3.56716	-0.487	0.630
	Estimated GA TCD	31.3015	3.48989		
	GA_LMP	31.2308	3.56716	1.479	0.082
	Estimated GA HC	29.7200	3.72132		
	GA LMP	31.2308	3.56716	0.598	0.555
	Estimated GA AC	30.9900	2.98619		
	GA_LMP	31.2308	3.56716	0.939	0.357
	Estimated GA FL	31.0061	3.02996		
IUGR	GA_LMP	32.0000	3.36821	5.511	0.00**
	Estimated GA BPD	27.8181	3.09669		
	GA_LMP	32.0000	3.36821	1.708	0.091
	Estimated GA TCD	31.1843	3.94404		
	GA_LMP	32.0000	3.36821	3.556	0.001**
	Estimated GA HC	29.4037	3.00269		
	GA LMP	32.0000	3.36821	5.128	0.00**
	Estimated GA AC	28.8477	3.12934		
	GA_LMP	32.0000	3.36821	6.084	0.00**
	Estimated GA FL	27.8854	4.24469		

BPD: biparietal diameter. **TCD:** Trans cerebellar diameter.
HC: head circumference. **AC:** abdominal circumference.
FL: femur length. **GA:** gestational age. **LMP:** last menstrual period.

DISCUSSION

Intrauterine growth restriction (IUGR) represents pathological inhibition of fetal growth and failure of the fetus to attain its growth potential. There is a strong association between stillbirth and fetal growth restriction. A newborn infant is classified as growth restricted or small for gestational age, if his birth weight falls below the 10th percentile for his particular gestational age. It is also diagnosed when there is a delay more than 2 weeks in a serial ultrasound monitoring of fetal gestational age ⁽⁴⁾.

The current study was a case-control study carried out on 52 women during the third trimesters, divided into two groups; Group 1 consisted of 26 women with normal pregnancy and Group 2 consisted of 26 cases with intrauterine growth restriction (IUGR) during 3rd trimester.

There was no statistically significant difference in demographic parameters between the two groups (age, parity, gestational age and fetal gender). There was a statistically significant difference between 2 groups according to BPD, HC, AC and FL of fetuses but there were no statistically difference between 2 groups in TCD in normal group and in IUGR group.

This was similar to the study of **Satish and Likhitha** ⁽⁷⁾ who obtained data from Ultrasonic examinations of normal pregnancies and they found high correlation between TCD with BPD, FL, AC, HC and GA which showed good correlation with P value 0.0001.

Vinkesteijn et al. ⁽⁸⁾ carried out a retrospective, cross-sectional study of 360 commonly growing fetuses in the 17 and 34-week range, and 73 growth-restricted fetuses in the 24-to 34-week gestation period, found that TCD measurements are usually avoided in IUGR cases. Even with extreme growth constraints, the TCD was only marginally affected.

Chavez et al. ⁽⁹⁾ found that TCD measurements were both reliable and precise when predicting gestational age, even in severe fetal development, and indicate that TCD is extremely useful when the gestational age is uncertain or IUGR is suspected.

Naseem et al. ⁽⁶⁾ conducted a study of 327 patients in their third trimester for the identification of an effective method for assessing gestational age in the third trimester of pregnancy by comparing the transcerebellar diameter, biparietal diameter and femur length, and concluded that TCD was the most accurate method for assessing gestational age in the third trimester followed by FL.

Afshan et al. ⁽¹⁰⁾ conducted a study of 100 pregnant women in the third trimester of pregnancy who met the eligibility requirements, 50 fetuses with normal fetal growth and 50 fetuses with reduced

growth. The findings showed that the mean transverse cerebellar diameter of the foetus showing normal growth was not statistically different from the mean transverse cerebellar diameter of the foetus with reduced growth. They concluded that fetal TCD measurements seem to correlate well with gestational age in both normal and growth-restricted fetuses so reliable measurement of transverse cerebellar diameter may be used for accurate calculation of gestational age in growth-restricted foetuses.

Prssad and Likhitha ⁽⁷⁾ detected a good correlation between the GA and TCD throughout the third trimester and even in the case of Intrauterine growth retardation (IUGR).

Akl et al. ⁽¹¹⁾ performed a research in Egypt conducted in the third trimester of 150 pregnant women to evaluate the accuracy of TCD in the assessment of gestational age, concluded that TCD is a reliable tool for assessing gestational age in the third trimester of pregnancy.

Ananthareddy et al. ⁽¹²⁾ study was done on the 20 pregnant women between 15 to 40 weeks, and reported that in IUGR pregnancies the gestational age was correlated to TCD and various ultrasonic parameters including BPD, FL, AC and HC. There was a very good correlation between gestational age and TCD.

Reddy et al. ⁽¹³⁾ Evaluated accuracy of predicting GA using the Fetal Transcerebellar Diameter (TCD) and comparing TCD with other existing GA parameters in 15 to 40 weeks of gestation. They have shown that TCD is a reliable parameter in the estimation of gestational age in the second and third trimesters, since its values are closely related to those of GA by LMP. It is also a better predictor of gestational age compared to other parameters, particularly in the third trimester.

Ali et al. ⁽¹⁴⁾ the study included 500 pregnant women with sure and reliable dates. The entire subjects were in the third trimester of pregnancy seen at 31 – 37 weeks, for the determination of gestational age, the transcerebellar diameter, biparietal diameter and femur length were measured. There was no statistically significant difference between LMP and TCD, FL and AC according to gestational age. But there was highly statistically significant difference between LMP and BPD according to gestational age with p-value <0.001 HS.

Conclusions

It could be concluded that the measurement of TCD tends to be a reliable indicator of gestational age, also in the third trimester of pregnancy. It is recommended that TCD be used as an important biometric ultrasound parameter in normal singleton for predicting gestational age.

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