Original Research Paper

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ACCURACY OF FETAL TRANSCEREBELLAR DIAMETER (TCD) IN ESTIMATION OF GESTATIONAL AGE IN THIRD TRIMESTER SINGLETON PREGNANCY

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ABSTRACT Ultrasonographically measured Fetal Transcerebellar diameter (TCD) can predict gestational age(GA) reliably because unlike the routine fetal biometric parameters like BPD, HC, FL and AC, fetal cerebellum is not liable to change in its form and size due to the fetal lie, shape of skull, growth disorders and grows progressively with gestation.Therefore it can be used for assessing GA accurately even in third trimester. A prospective study conducted on 140 pregnant women with singleton pregnancy in third trimester with known LMP, gestational age by TCD showed highest correlation with clinical gestational age (calculated from LMP) when compared with routine parameters. TCD can serve as an independent and reliable indicator of gestational age and can be used a standard against which abberrations in fetal growth may be compared.

KEYWORDS : Transcerebellar diameter (TCD), gestational age(GA), ultrasonography, reliable

INTRODUCTION

Precise estimation of gestational age is of paramount importance to clinicians in order to decide time of delivery to prevent adverse perinatal outcomes in form of preterm delivery, low birth weight and perinatal mortality.

In clinical practice most commonly employed method for assessment of gestational age is Naegele's Rule that depends only upon last menstrual period(LMP). Hence it becomes unreliable in women who are not sure of their LMP, with irregular cycles or in lactational amennorhea.

Fetal biometry has become primary way of confirming gestational age and fetal growth. It uses ultrasonographically determined fetal body parts measurements like CRL(1st trimester) Biparietal diameter(BPD), Head Circumference (HC). Abdominal Circumference (AC) Femur length (FL). But these parameters have their own limitations. BPD and HC becomes unreliable in conditions altering shape of skull (dolico/brachycephaly, hydrocephalus), FL becomes unreliable in skeletal dysplasias (achondroplasia), AC is highly susceptible to changes in fetal growth disorders (macrosomia/FGR).[1]

Transcerebellar diameter(TCD) is an additional parameter over above routine parameters. It is measured as maximum diameter(mm) between cerebellar hemispheres on axial plane in the cerebellar view i.e. with a slight rotation of the transducer approximately 30° from the conventional thalamic plane. As the fetal cerebellum is located in posterior fossa surrounded by dense petrous and occipital bone it is least liable to change in its form and size with fetal lie, shape of skull, oligo/polyhydramnios, maternal obesity. From second trimester onwards it grows with linear correlation with gestational age and is least affected by mild-moderate utero-placental insufficiency.[2] With these advantages of TCD over other parameters, this study was conducted to evaluate accuracy of TCD in assessment of gestational age in third trimester singleton pregnancy and to compare it with other routine parameters (BPD, HC, AC, FL).

MATERIALS AND METHODS

A prospective study was conducted on 140 pregnant women with singleton pregnancy in third trimester attending obs and gynae OPD. Women included were sure of their last menstrual period (LMP), had 1st trimester dating scan, normal study on level 2 scan and no associated high risks factors. Ultrasonography was performed and following parameters were obtained- TCD, BPD, HC, AC, FL, Fetal heart rate (FHR), Estimated fetal weight (EFW),Amniotic fluid index (AFI) and Placental position. Main purpose of this study was to demonstrate how accurately GA by TCD correlates with GA by LMP so that TCD can be included in routine fetal biometry.

STATISTICAL ANALYSIS

The collected data was entered into MS-Excel sheet and analysis was done using SPSS software version 21.0 by Karl Pearsons correlation coefficient (r) and regression analysis.

RESULTS

Mean age of participants was 24.14±3.10yrs, majority of them were primigravida and presentation of fetus was cephalic in 85.0%. Measurement of TCD was not affected by any of these factors.

Mean GA based on LMP was 34.06 weeks which was very close to mean GA by TCD i.e 33.88 weeks as depicted in [Table1].

[Table1]: Showing the mean gestational age by different parameters.

	Minimum	Maximum	Mean	SD
POG_LMP	28.0	39	34.06	2.27
POG_CRL	28.0	38.0	33.71	2.18
BPD	29.0	38.0	34.47	2.28
HC	29.0	38.0	34.30	2.27
AC	28.0	38.0	32.62	2.20
FL	27.0	41	33.57	2.35
TCD	28.0	38.0	33.88	2.16

The similarity and agreement between different parameters to evaluate GA with GA by LMP with paired t tests within the confidence interval is shown in [Table2]. The mean difference between GA by BPD, HC, AC, FL and TCD was not significantly different and was seen least with TCD (0.348).

[Table 2]: Showing the mean difference between the GA by LMP with estimated GA by different parameters

Paired Samples Test								
	Paired Differences					t	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 POG_LMP - TCD	.2214	.8982	.0759	.0713	.3715	2.917	139	0.348

Pair 2	POG_LMP - BPD	-.5714	1.4989	.1267	-.8219	-.3210	-4.511	139	0.830
Pair 3	POG_LMP - HC	-.4143	1.2918	.1092	-.6302	-.1984	-3.794	139	0.788
Pair 4	POG_LMP - AC	1.3214	1.3372	.1130	1.0980	1.5449	11.693	139	0.747
Pair 5	POG_LMP - FL	.1571	1.1891	.1005	-.0416	.3558	1.564	139	0.788

On assessment of correlation between the LMP and different parameters in predicting the gestational age in third trimester a significantly strong positive association was found between the TCD and LMP (r=0.915, r^2= 83.7%, p<0.001) which was highest when compared to other parameters. The strength of association in the sequence was found as FL(r=0.866, r^2= 74.9%, p<0.001), followed by HC(r=0.850, r^2= 72.2%, p<0.001), AC(r=0.839, r^2= 70.3%, p<0.001) and the least correlation was seen with BPD (r=0.785, r^2=61.6%, p<0.001) as shown in [Table 3].

[Table3]: Pearson's correlation of GA by LMP compared different parameters.

		POG LMP	POG CRL	BPD	HC	AC	FL	TCD
POG LMP	r	1	.963**	.789**	.871**	.833**	.861**	.920**
	Sig.		.001	.001	.001	.001	.001	.001
POG CRL	r	.963**	1	.823**	.888**	.814**	.864**	.934**
	Sig.	.001		.001	.001	.001	.001	.001
BPD	r	.789**	.823**	1	.883**	.604**	.800**	.864**
	Sig.	.001	.001		.001	.001	.001	.001
HC	r	.871**	.888**	.883**	1	.737**	.810**	.894**
	Sig.	.001	.001	.001		.001	.001	.001
AC	r	.833**	.814**	.604**	.737**	1	.753**	.793**
	Sig.	.001	.001	.001	.001		.001	.001
FL	r	.861**	.864**	.800**	.810**	.753**	1	.869**
	Sig.	.001	.001	.001	.001	.001		.001
**. Correlation is significant at the 0.01 level (2-tailed).								

Actual gestation age can be calculated by deriving equation from regression analysis as depicted in [Fig 1 to 4]. GA = GA by TCD -4.504 x 1/0.858
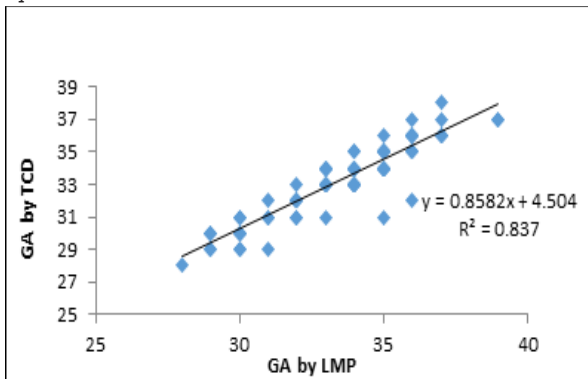

Fig 1: REGRESSION ANALYSIS OF GA by TCD WITH GA by LMP
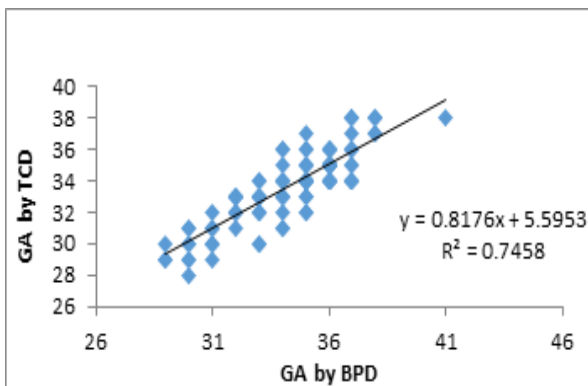

Fig 2: REGRESSION ANALYSIS OF GA by TCD WITH GA by BPD
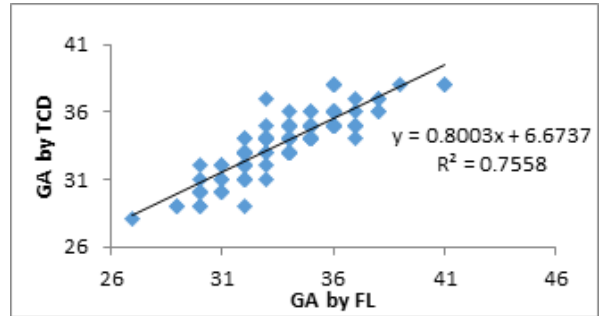

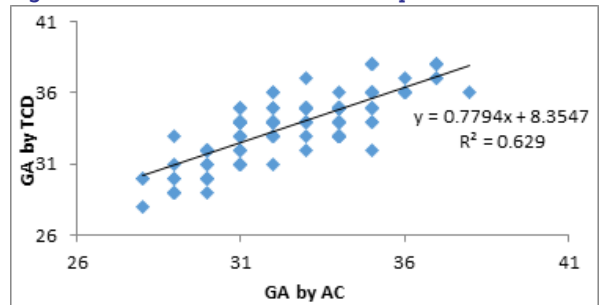Fig 3: REGRESSION ANALYSIS OF GA by TCD WITH FL

Fig 4 : REGRESSION ANALYSIS OF GA by TCD WITH AC

DISCUSSION

Ultrasonography is habitually used for dating of pregnancy since many decades by biometric parameters like BPD, HC, FL and AC. Nevertheless each of these parameters have their own limitations. TCD is an additional parameter with various advantages over these parameters. The present study was undertaken to establish Transcerebellar diameter (TCD) as a distinct and accurate parameter for estimation of gestational age in third trimester and to compare it with previously established parameters.

Majority of pregnant mothers in present study were in age group of 32-36 weeks of gestation(by LMP). The period of gestation(POG) was obtained ultrasonographically by various parameters. The gestational age calculated by BPD, HC, AC, FL and TCD were comparable with LMP and CRL (p>0.05) and TCD showed least difference.

On Pearson's correlation, GA by LMP showed maximum correlation with GA by TCD (r=0.920, r^2= 84.0%, p<0.001) compared to the others. The corelation with other parameters in the sequence was found as FL (r=0.861, r^2= 74.9%, p<0.001), followed by HC (r=0.871, r^2= 74.2%, p<0.001), AC (r=0.833, r^2= 70.3%, p<0.001) and BPD (r=0.789, r^2=61.6%, p<0.001).

Similar to present study, the study performed by Chavez MR revealed maximum correlation with TCD (r=0.92; p<.001).[3]

Gupta AD et al. observed that the gestational age of pregnant women not sure of their LMP can be reliably estimated by measuring the TCD (r=+0.946, r^2=89.6% and p<0.001).[4] Similarly, **Bavini S et al.** in their study documented that TCD had the highest correlation (r = 0.979; p<0.0001) and the AC had the lowest correlation.[5] **Pavithra SN et al.** found that correlation of TCD (r = 0.983) was superior when compared with BPD (r = 0.978), HC (r = 0.979), AC (r = 0.966) and FL (r = 0.976).[6]

In study by **George R et al.,** when compared to BPD, FL and

AC, TCD provides the most accurate estimate of gestational age (r=0.995 p<0.001). The regression method obtained from trans-cerebellar diameter measurement can be used to calculate a gestational age of fetus.[7]

In present study, the mean difference in gestation age was least with TCD (0.348) when compared to other parameters making it more accurate which was similar to the study performed by **Dashottar et al,** that showed difference of - 0.011±1.18 weeks with TCD followed by BPD (0.09±1.04 weeks).[8]

In our study, on comparing TCD with already established parameters (BPD, HC, AC and FL), the results were similar and comparable. Correlation of TCD was maximum with HC(r=0.882) followed by FL(r=0.868) and BPD (r=0.853) and least with AC (r=0.793, p<0.05) making it reliable to be included in fetal biometry for gestational age estimation in third trimester. **Matthur Y et al.** found curvilinear relationship between TCD and BPD(r=0.9810), TCD and HC(r=0.9181), TCD and AC(r=0.9649) and TCD and FL(r=0.9513).[9]

LIMITATIONS:

TCD is not routinely performed in fetal biometry and women with irregular cycles/high risks were excluded from the study hence reducing the sample size. Further studies with larger sample size may be required to support the establishment of TCD as accurate and reliable parameter in third trimester.

CONCLUSION:

This study established TCD as most accurate and independent parameter for estimation of gestational age amongst the routinely used fetal biometric parameters like BPD, HC, FL and AC. Hence it can be used reliably in pregnant women who are not sure of their LMP, have irregular menstrual cycles and present late in pregnancy without a dating scan to make an obstetric care decision and prevent adverse pregnancy outcomes in form of iatrogenic preterm delivery. Moreover TCD can serve as a standard against which aberrations in fetal growth (FGR/macrosomia) can be compared as it is least affected by growth disturbances and external factors.

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