Is Transverse Cerebellar Diameter more accurate than Femoral Length in the Assessment of Fetal Age in Late Pregnancy

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ABSTRACT

Background: The measurement of gestational age is clinically essential to ensure safe labour and healthy neonates. Wide spectrum of literatures adopted the transverse cerebellar diameter of fetuses as a better choice in assessment of gestational age by ultrasonography.

Objective: To evaluate the reliability of fetal transverse cerebellar diamete (TCD)r measurement by ultrasonography in prediction of gestational age at third trimester in comparison to fetal femoral length(FL) measurement by ultrasonography.

Patients and methods: A prospective follow up study conducted in Al-Elwiya Maternity Teaching Hospital from August 1, 2016, to September 1, 2017. The study included a convenient sample of 300 pregnant women at third trimester which followed up to labor.

Results: Transverse cerebellar diameter mean with gestational age mean measured by ultrasonography were significantly increased with higher gestational age measured by last menstrual period (p<0.001).The fetal transverse cerebellar diameter accuracy in assessing gestational age was (91.6%) that was higher than accuracy of (79.3%) for fetal femoral length in assessing gestational age.

Conclusions: The fetal transverse cerebellar diameter is good reliable ultrasonography parameter for assessment of gestational age at third trimester of pregnancy.

Keywords: Transverse cerebellar diameter, Femoral length, Last menstrual period.

1. INTRODUCTION

Determining the gestational age is crucial in clinical practice to ensure proper care of labour and babies. Distinguishing between typical and atypical foetal growth is of utmost significance. The estimation of gestational age using sonographic data is a fundamental aspect of contemporary obstetrics and remains a crucial element in the care of pregnancies involving foetuses with growth abnormalities. Several metrics are utilised to determine gestational age, such as Biparietal diameter (BPD), Head circumference (HC), Abdominal circumference (AC), Femur length (FL), and Transcerebellar diameter (TCD)(1). The transcerebellar diameter refers to the measurement between the lateral parts of the cerebellum, including the breadth of the cerebellar vermis. The size of the cerebellum increases as the pregnancy progresses, regardless of the trimester (2). Similar to BPD, femur length exhibits a high level of repeatability as a result of its well-defined locations. The measurement of femur length during the 12-22 week period has a variation of only ± 6 to 7 days. The growth curve of the femur exhibits a non-linear pattern, similar to that of the BPD growth curve. The measurement of the length of the femur in a foetus can be used as an additional tool to estimate the age of the pregnancy. The length of the foetal femur can be measured from the proximal diaphysis to the distal metaphysis. The femur exhibits a high degree of echogenicity, and its width can only be assessed to a limited extent due to the presence of posterior shadowing (3). When assessing femur length, it is important for the ends of the bone to be rounded or dull. Acquiring measurements from various pictures of the femur is a beneficial procedure. The presence of sharp edges suggests that none of the photographs have been cropped (4).

2. METHODOLOGY

Study design & settings

The study is a prospective study conducted in Al-Elwiya Maternity Teaching Hospital from 1st of August, 2016, to 1st of September, 2017.

Study Population

All pregnant women presented to Consultancy Departments of Al-Elwiya Maternity Teaching Hospital were the study population.

Inclusion criteria

1. Age 16-45 years.

2. Documented LMP or 1st trimester US.

3. Gestational age 28-40 weeks.

4. Parity 0-5.

5. Singleton pregnancy.

Exclusion criteria

1. Doubtful LMP or irregular cycle or unknow 1st trimester U/S .

2. Fetal anomalies.

3. Multiple gestations .

4. Pregnant ladies refused to participate.

Sampling

A convenient sample of 300 pregnant women was selected from women attending the Consultancy Department of Al-Elwiya Maternity Teaching Hospital after eligibility to inclusion criteria.

Data Collection

The data was collected by researcher through direct interview with ladies and fulfilling a prepared questionnaire. The questionnaire was designed by the supervisor and researcher depending on previous literatures. The questionnaire included the followings.

1. Age of pregnant ladies.

2. Gestational age by LMP and/or early US.

3. Past obstetrical history.

4. Current pregnancy problems.

After taking full history and examination, the eligible women were referred to Radiology Department of Al-Elwiya Maternity Teaching Hospital. The ultrasonography was done by a Specialist in Radiology with help of researcher. The ultrasonography equipment used was convex transducer frequency 3.5 MHZ /SIMENS-ACUSON x300.

3. RESULTS

A total of 300 pregnant ladies were included in this study with mean age of 29.9±7 years; 120 (40%) pregnant ladies were in age group 30-39 years, 116 (38.7%) pregnant ladies were in age group 20-29 years, 41 (13.6%) pregnant ladies were in age group ≥40 years and 23 (7.7%) pregnant ladies were in age group <20 years (**Table 1**). Mean gestational age (GA) of studied pregnant ladies as measured by LMP & early US was 36.89±2.6 weeks; 205 (68.3%) pregnant ladies were ≥37 weeks of GA. and 95 (31.7%) pregnant ladies were 28-36 weeks of GA Mean gestational age of pregnant ladies as measured clinically by symphysial fundal height was 36±2.6 weeks; 148 (50.7%) pregnant ladies were 28-36 weeks of GA and 144 (49.3%) pregnant ladies were ≥37 weeks of GA (**Table 2 and Figure 1**). Past obstetrical history problems of pregnant ladies were PE 57 (42.5%), preterm labour 20 (14.9%), large for date 19 (14.2%), PIH 14 (10.5%), small for GA 8 (5.9%), IUD 8 (5.9%), GDM 6 (4.6%) and CP babies 2 (1.5%) (**Table 3 and Figure 2**). The current pregnancy problems were present among 181 (60.1%) studied pregnant ladies; PE 110 (60.7%), GDM 41 (22.6%), PIH 15 (8.3%), APH 10 (5.5%) and PROM 5 (2.7%) (**Table 4**). Mean transverse cerebellar diameter (TCD) of pregnant ladies fetuses was 50.5±5 mm and GA mean as measured by TCD was 36.81±2.4 weeks; 210 (70%) pregnant ladies had GA of ≥ 37 weeks, and 90 (30%) pregnant ladies had GA of 28-36 weeks and Mean femoral length (FL) of pregnant ladies fetuses was 71.3±6.3 mm and GA mean as measured by FL was 36.5±3 weeks; 115 (38.3%) pregnant ladies had GA of 28-36 weeks and 185 (61.7%) pregnant ladies had GA of ≥ 37 weeks. The mean difference of TCD-GA from early US-GA was 0.08±1.2 mm while mean difference of FL-GA from early US-GA was 0.38±2.2 mm (**Table 5 and Figure 3**). TCD mean with GA mean measured by TCD of pregnant ladies fetuses were significantly increased with higher GA measured by LMP (p<0.001). FL mean with GA mean measured by FL of pregnant ladies fetuses were significantly increased with higher GA measured by LMP (p<0.001). At term, mean GA measured by TCD was closer to GA measured by LMP than GA measured with FL, while at preterm, mean GA measured by FL was closer to GA by LMP than GA measured by TCD (**Table 6 and Figure 4**). Statistically, no significant differences were observed between GA means measured by three different methods LMP, TCD and FL (p=0.1). No significant difference was observed between GA mean measured by TCD and GA mean measured by LMP (p=0.9). Similarly, no significant difference was observed

between GA mean measured by FL and GA mean measured by LMP (p=0.1). Finally, no significant difference was observed between GA mean measured by FL and GA mean measured by TCD (p=0.3). Although no significant difference, the GA mean measured by TCD was closer to GA mean measured by LMP (**Table 7 and Figure 5**). The validity results of TCD regarding GA measurement in comparison to GA measured by LMP (sensitivity (95.1%), specificity (84.2%)), positive predictive value (92.8%), negative predictive value (88.8%) and accuracy (91.6%) (**Table 8**). The validity results of FL regarding GA measurement in comparison to GA measured by LMP was (sensitivity (80%), specificity (77.9%)), positive predictive value (88.6%), negative predictive value (64.3%) and accuracy (79.3%) (**Table 9**).

Table 1. Age distribution of pregnant ladies.

Variable		No.	%
Age (years)	<20	23	7.7
	20-29	116	38.7
	30-39	120	40.0
	≥40	41	13.6
	Total	300	100.0
	Mean ± SD	29.9 ± 7	

Table 2. Gestational age of pregnant ladies in early pregnancy.

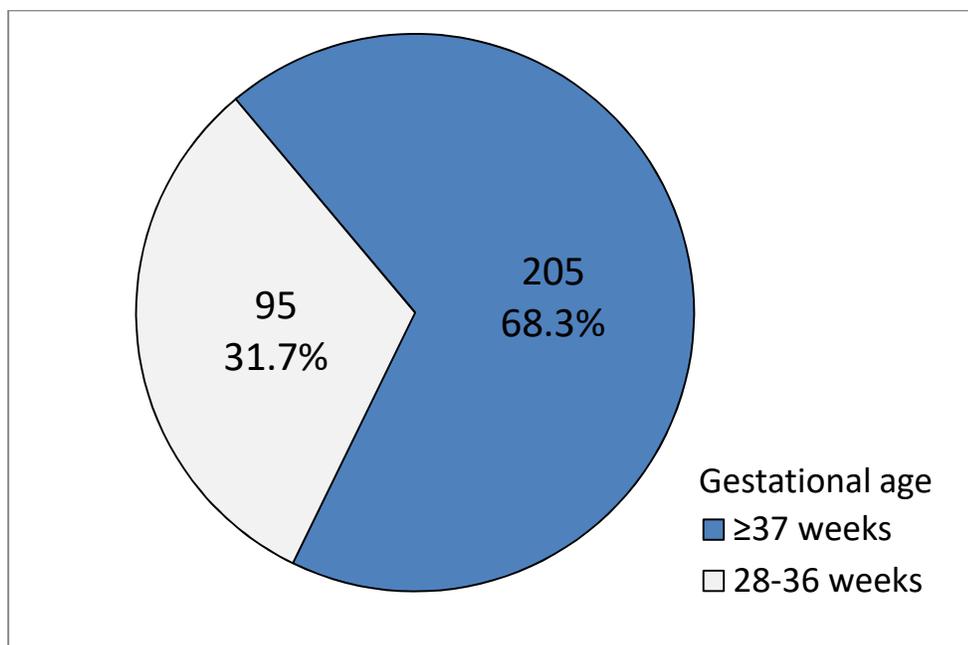| Variable		No.	%
Gestational age by LPM & early US (weeks)	28-36	95	31.7
	≥37 weeks	205	68.3
	Total	300	100.0
	Mean ± SD	36.9 ± 2.6	
Gestational age clinically by SFH (weeks)	28-36 weeks	152	50.7
	≥37 weeks	148	49.3
	Total	300	100.0
	Mean ± SD	36 ± 2.6	

Figure 1: Distribution of Gestational age for pregnant ladies according LMP & early U/S

Table 3. Obstetrical history of pregnant ladies.

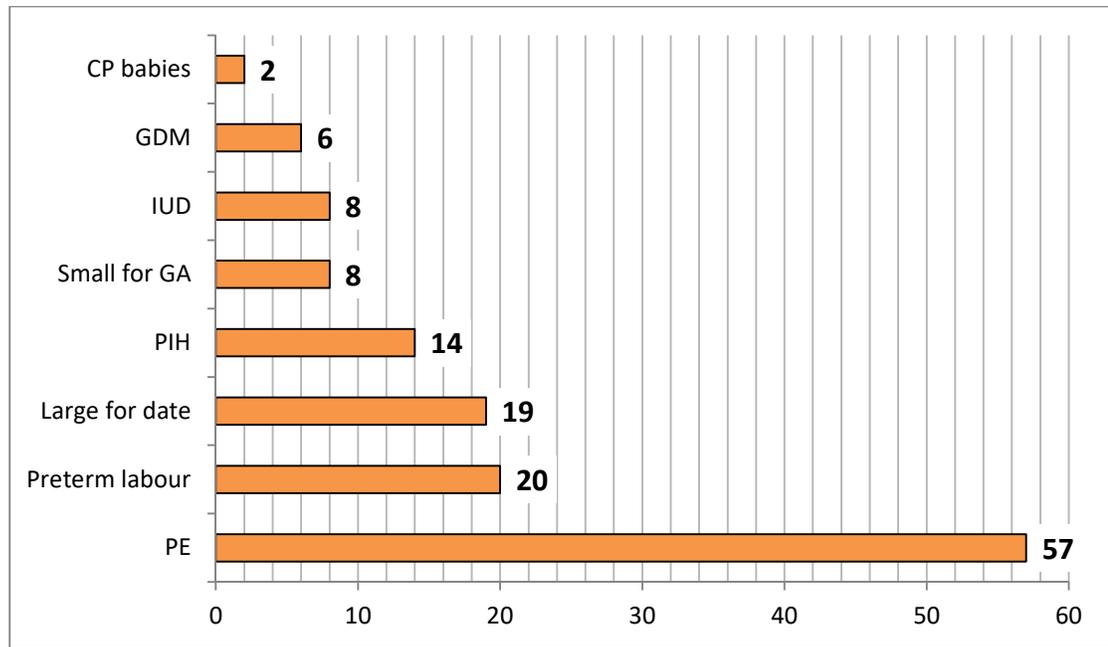| Past obstetrical history problems	No.	%
PE (mild)	57	42.5
PIH (mild)	14	10.5
GDM	6	4.6
preterm labour	20	14.9
Large for date	19	14.2
Small for GA	8	5.9
IUD	8	5.9
CP babies	2	1.5
Total	134	100.0

Figure 2. Past obstetrical history problems

Table 4. Current pregnancy problems.

Problems of current pregnancy	No.	%
PE	110	60.7
PIH	15	8.3
GDM	41	22.6
APH	10	5.5
PROM	5	2.7
Total	181	100.0

Table 5. TCD and FL of pregnant ladies' fetuses.

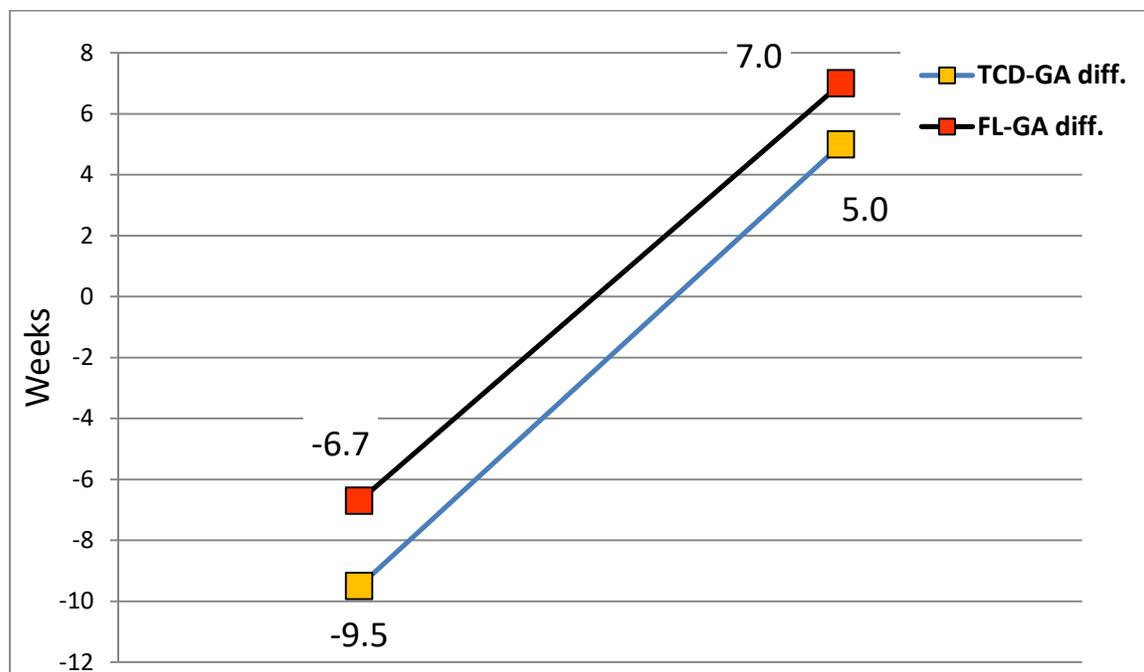| Variable		No.	%
Gestational age by TCD (weeks)	28-36 weeks	90	30.0
	≥37 weeks	210	70.0
	Total	300	100.0
	Mean ± SD	36.81 ± 2.4	
Gestational age by FL (weeks)	28-36 weeks	115	38.3
	≥37 weeks	185	61.7
	Total	300	100.0
	Mean ± SD	36.5 ± 3	
Transverse cerebral diameter (TCD) (mm)	Mean ± SD	50.5 ± 5	
Femoral length (FL) (mm)	Mean ± SD	71.3 ± 6.3	
Difference between early US-GA and TCD-GA (mm)	Mean ± SD	0.08 ± 1.2	
Difference between early US-GA and FL-GA (mm)	Mean ± SD	0.38 ± 2.2	

Figure 3. Maximum and minimum values of TCD-GA and FL-GA differences from early US-GA (diff. = difference)

Table 6. Distribution of TCD and FL with GA means according to GA by LMP.

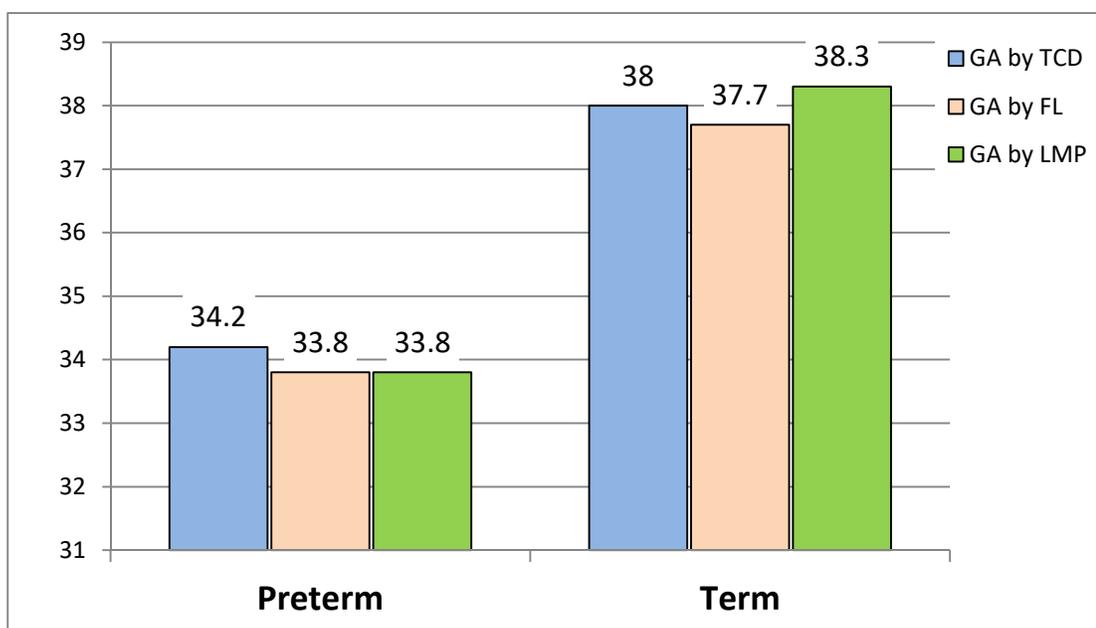| Variables	Preterm (Mean ± SD)	Term (Mean ± SD)	t-test	P. value
TCD (mm)	45.2 ± 4.8	53 ± 2.5	18.3	<0.001*
GA by TCD (weeks)	34.2 ± 2.4	38 ± 1.2	18.3	<0.001*
FL (mm)	65.8 ± 6.8	73.8 ± 4.4	12.1	<0.001*
GA by FL (weeks)	33.8 ± 3.1	37.7 ± 2.1	12.9	<0.001*

* Highly significant.

Figure 4. Distribution of different GA means according to maturity of pregnancy.

Table 7. Distribution of GA according to study groups.

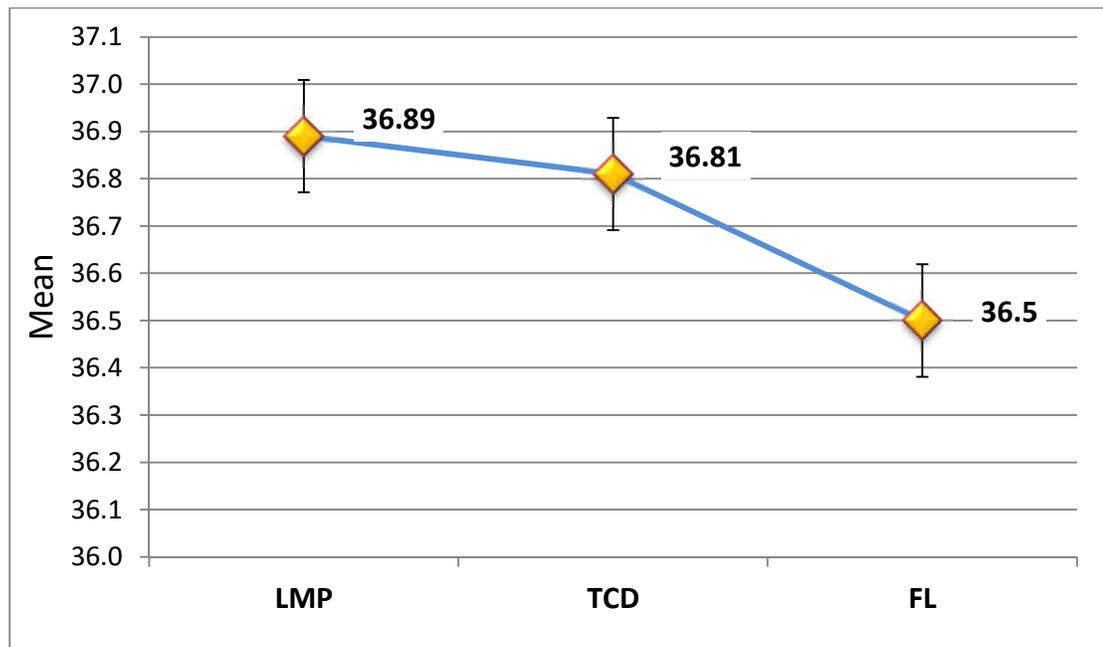| Study groups		No.
GA (weeks) (Mean ± SD)	LMP and/or US	36.89 ± 2.6
	TCD	36.81 ± 2.4
	FL	36.5 ± 3
P. value	*ANOVA*	0.1*
	LMP vs. TCD	0.9*
	LMP vs. FL	0.1*
	TCD vs. FL	0.3*

*Not significant.

Figure 5. Distribution of GA according to study groups.

Table 8. Validity test results of GA by TCD in comparison to GA by LMP.

Validity test		No.	%
TCD	Term	210	70.0
	Preterm	90	30.0
	Total	300	100.0
LMP	Term	205	68.3
	Preterm	95	31.7
	Total	300	100.0
Sensitivity		-	95.1
Specificity		-	84.2
+ve predictive value		-	92.8
-ve predictive value		-	88.8
Accuracy		-	91.6

Table 9. Validity test results of GA by FL in comparison to GA by LMP.

Validity test		No.	%
TCD	Term	185	61.7
	Preterm	115	38.3
	Total	300	100.0
LMP	Term	205	68.3
	Preterm	95	31.7
	Total	300	100.0
Sensitivity		-	80
Specificity		-	77.9
+ve predictive value		-	88.6
-ve predictive value		-	64.3
Accuracy		-	79.3

4. DISCUSSION

The gestational age is an interesting obstetrical indicator used in evaluation and treatment of pregnancy complications and fetal development (5). It was shown that inaccurate gestational age estimation is highly related to perinatal mortality and failure in gestational age certainty is directly linked to preterm delivery, low birth weight and post maturity (6). Our study showed that the accuracy of fetal transverse cerebellar diameter (TCD) by ultrasonography in prediction of gestational age is (91.6%) which was higher than accuracy of fetal femoral length (FL) by ultrasonography in prediction of gestational age as (79.3%). This finding is consistent with results of AKL et al (7) study in Egypt which revealed that accuracy of TCD in prediction of gestational age at third trimester is higher than accuracy of biparietal diameter (BPD) and FL. Similarly, Naseem et al (8) study in Pakistan conducted on 327 pregnant women and reported that the TCD had accuracy of 80.1% in prediction of gestational age at third trimester while the FL had accuracy of 70.9% in prediction of gestational age at third trimester.

Present study showed that the fetal TCD was significantly correlated with gestational age by LMP with an equation of GA=0.4*TCD+18 mm. This finding is close to results of Mahmoud et al (9) study in Sudan which stated that the TCD was significantly predicting the gestational age with equation of GA=0.6*TCD+19 mm. On other hand, the FL was significantly correlated with gestational age of pregnant women by LMP with equation of GA=0.3* FL+15 mm. This finding is close to results of Gupta et al (10) study in India which reported a significant correlation equation of GA=0.4*FL+12 mm. Differences in values of correlation equations are attributed to discrepancies in sample size and current pregnancy complications between different studies in addition to differences in inclusion and exclusion criteria for each study.

Our study found a significant association between mean fetal TCD and mean GA of pregnant women by LMP. This finding is in agreement with results of Goel et al (11) study in India which reported a significant relationship between fetal TCD and gestational at third trimester of pregnancy. The fetal femoral length of pregnant women measured by ultrasonography in our study was significantly associated with gestational age by LMP. This finding is similar to results of Dare et al (12) study in Nigeria which found that the fetal femoral length was significantly related to gestational age of pregnant women. This study also reported that the BPD had chance of error caused by some growth abnormalities of fetal head like intrauterine growth

restriction and hydrocephalus (13). Butt et al (14) in their review in Society of Obstetricians and Gynecologists of Canada (SOGC) guidelines revealed that in third trimester the gestational age could be measured by ultrasonography through measuring abdominal circumference, BPD, FL and TCD, but the most reliable accurate method in detecting the gestational age at third trimester is the TCD. Davies et al (15) study in Australia evaluated the fetal TCD relationship with gestational age and revealed that the TCD of fetuses is closely correlated with gestational age with confidence interval of ±2.3 weeks and the TCD measurements had great benefits for assessing the pregnancy and development of fetuses.

Afshan et al (16) study in Iran reported no statistically significant difference in TCD between fetuses with normal growth and fetuses with intrauterine growth restriction and concluded that the TCD is a useful indicator of gestational age for children with intrauterine growth restriction. Elkafrawy et al (17) study in Egypt stated that TCD of normal fetuses and those fetuses with intrauterine growth retardation are similar and regarded the TCD as the most reliable predictor of gestational age in third trimester. So, the transcerebellar diameter is regarded as the best accurate ultrasound fetal diameter predicting growth. Goldstein et al study in Palestine reported that the normal cerebellar growth rate is maintained even in intrauterine growth restriction and the cerebellar growth rate of single pregnancies is similar to that of multiple pregnancies (18). Pinar et al study in USA revealed that fetal TCD was significantly correlated with gestational age of pregnant women at end of second trimester (19). In present study, no significant differences were observed between GA means measured by three different methods LMP, TCD and FL (p=0.1). This no difference revealed close gestational age assumptions of these diameters to gestational age by LMP. The present study showed that studied pregnant women who had current pregnancy problems like pre-eclampsia, gestational diabetes mellitus, pregnancy induced hypertension, antepartum hemorrhage and premature rupture of membranes, showed no significant effect on transverse cerebellar diameter measures of gestational age in late pregnancy.

5. CONCLUSIONS

- The fetal transverse cerebellar diameter is good and reliable ultrasonography parameter for assessment of gestational age at third trimester of pregnancy.

- The fetal femoral length is as accurate as fetal transverse cerebellar diameter but less close to the real gestational age

Ethical Approval:

All ethical issues were approved by the author. Data collection and patients enrollment were in accordance with Declaration of Helsinki of World Medical Association , 2013 for the ethical principles of researches involving human. Signed informed consent was obtained from each participant and data were kept confidentially.

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