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ORIGINAL ARTICLE

Correlation of Fetal Orbital Biometry with Gestational Age in Second and Third Trimester of Pregnancy

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ABSTRACT

Objective: The aim of this study is to determine the normal pattern of growth of various fetal orbital parameters (BOD, OD & IOD) and their correlation with gestational age in the local population.

Materials and Methodology: A cross-sectional study was conducted at University of Lahore Teaching Hospital, during the period from January 2020 till July 2020 on 300 pregnant females in the second and third trimester of pregnancy.

Results: Using linear regression analysis with gestational age as an independent variable, a strong linear relationship was found between gestational age and fetal orbital parameters including BOD, OD and IOD with R^2=0.891, R^2=0.829 and R^2=0.714. It was generally more strong with BOD in comparison with the rest of orbital biometric measurements. Study also showed significant correlation between fetal orbital biometric parameters (BOD, OD & IOD in mm) with gestational age with correlation coefficient r = 0.944, 0.911 and 0.845 respectively with all showing p value of <0.001.

Conclusion: Fetal orbital parameters including BOD, IOD and OD have also found their usefulness in assessing gestational age of fetus especially in cases where the patient is unsure of dates or on clinical examination fundal height does not correspond with gestational age. Routine evaluation of orbital parameters during obstetrical scans can help in diagnosing ocular/orbital pathologies at any early gestation.

Keywords: Binocular distance, Interocular distance, Orbital diamtere.

INTRODUCTION

Ultrasound has an established role in evaluation of fetal well-being and gestational age by taking four main fetal parameters into consideration i.e., head circumference, biparietal diameter, abdominal circumference and femur length [1-3]. After detailed review of the available literature it is observed that wide research has been done to implicate other fetal parameters that can be helpful in evaluation of fetal well-being and gestational age with fetal orbital parameters having the utmost importance. On gray scale ultrasound fetal orbits become recognizable more clearly by second trimester of pregnancy and appears well defined rounded bilaterally symmetrical (if normal) anechoic structures. Outline of the globe of eye can be appreciable on US however beside fetal lens no other intraorbital structure could be seen clearly [4].

Growth of fetal orbits can be assessed at any point during the second and third trimester of pregnancy by three main parameters including Binocular distance (BOD), the orbital diameter and intraocular distance (IOD) [6]. Importance of assessments of fetal orbit lies in the fact that if routinely practiced it can help in identifying various ophthalmic abnormalities; which can be isolated or part of a broader spectrum of disease or syndrome. It has also been postulated by some researchers previously that orbital growth possibly has a correlation with fetal anthropometric growth and gestational age, therefore knowledge of normal growth patterns of different orbital parameters would help in determining the normal fetal growth and might also aid in early diagnosis of ophthalmic abnormalities [5-6].

Several studies have been conducted throughout the world, correlating fetal orbital growth and gestational age. However, like all other parameters these values may have racial and ethnic variations [7]. The present study was performed to determine the normal pattern of growth fetal orbit and various parameters (BOD, OD & IOD) and their correlation with gestational age in local population. If established, this can be helpful in assessing gestational age in females who are unsure of dates i.e., LMP, and also in cases where fundal height does not correspond with gestational age

MATERIALS AND METHODOLOGY

This was a cross-sectional study conducted to correlate growth of various orbital parameters with fetal gestational age and anthropometric measurements in second and third trimester of pregnancy in local population. It was conducted at University of Lahore Teaching Hospital, during the period from January 2020 till July 2020.

The sample size was 300 pregnant females in second and third trimester. All women with normal singleton pregnancies in second and third trimester, with complete visualization of binocular distance were included while all patients with multiple pregnancies, fetal congenital anomalies, pregnancy complicated by premature ruptures of the membrane or any other abnormalities that may affect fetal orbital growth were excluded. The patient was examined in supine position using standard ultrasound units (Canon Aplio 300, Logiq C5, Toshiba Xario), with the abdomen exposed after applying ultrasonographic gel. The fetal orbital parameters are assessed and measured in two planes:

(1) A coronal scan at the point of visualization of both orbits showing symmetrical appearance

(2) A transverse scan at a level below the biparietal diameter.

Measurements of the inter-ocular distance (IOD) should be made from the medial border of one orbit to the medial border of the opposite, and the binocular distance (BOD) should be measured from the lateral border of one orbit to the lateral wall of the opposite side. Similarly orbital diameter (OD) is measured between medial and lateral orbital walls.

The data was collected by data collection sheet and analyzed by using SPSS v.21. Study variables included; patients' age, gestational age by ultrasound, inter-ocular distance, binocular distance and orbital diameter. Data for orbital parameters was collected for both axial and coronal sections and later average measurement was calculated. Frequency statistics including mean, median, minimum and maximum ranges were calculated for age and gestational age. Correlation was tested among all the study variables by computing Pearson correlation. Multiple linear regression was done to predict for estimate of BOD using IOD and orbital diameter. Results were compiled in form of tables and graphs.

RESULTS

In this study, 300 pregnant females in second and third trimester were enrolled.

The range and mean for study variables including age, gestational age, BOD, IOD and OD were 18 to 40 years with mean age of 26.09 years, 13 to 38 weeks with mean of 26.58, 15 to 65

mm with mean BOD of 43.04, 6 to 22mm with mean IOD of 14.24 and 4 to 21 mm with mean OD of 13.65 mm respectively.

Using linear regression analysis with gestational age as independent variable strong linear relationship was found between gestational age and fetal orbital parameters including BOD, OD and IOD with R^2=0.891, R^2=0.829 and R^2=0.714, generally stronger with BOD in comparison with the rest of orbital biometric measurements.

Study also showed significant correlation between fetal orbital biometric parameters (BOD, OD & IOD in mm) with gestational age with correlation coefficient r = 0.944, 0.911 and 0.845 respectively with all showing p value of <0.001.

Formula for estimated GA = 1.695 + 0.443 (BOD) + 0.426(OD) and for BOD = 1.836 + 0.915 (GA) + 1.237 (OD).

Multiple linear regression was done to predict for estimate of BOD using IOD and orbital diameter (OD) and shows that there was strong linear relationship with R2 =0.899 with p value of <0.01, estimated BOD can be calculated from following regression formula:

1.3 + 2 (OD) + 1.03 (IOD)

Table 1: Correlation between GA (weeks) and BOD, IOD & OD in mm

		Gestational age (weeks)	Binocular distance (mm)	Orbital diameter (mm)	Interocular distance (mm)
Gestational age (weeks)	Pearson Correlation	1	.944**	.911**	.845**
	Sig. (2-tailed)		.000	.000	.000
	N	300	300	300	300
Correlation is significant at the 0.01 level (2-tailed).					

Table 2: Regression equation to predict BOD using IOD and OD per mm

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	1.30	.895		1.369	.172
	Orbital diameter (mm)	2.00	.095	.677	20.861	.000
	Interocular distance (mm)	1.03	.108	.309	9.511	.000
a. Dependent Variable: Binocular distance (mm)						

Table 3: Predicted mean BOD (mm) for each gestational age

Gestational age (weeks)	BOD (mm)	Gestational age (weeks)	BOD (mm)
13	19.07	28	45.28
17	26.04	29	45.95
18	29.22	30	47.64
19	31.6	31	50.62
20	32.98	32	51.49
21	34.8	33	52.33
22	34.81	34	55.18
23	39.07	35	55.73
24	39.76	36	57.14
25	40.08	37	59.04
26	42.19	38	61.28

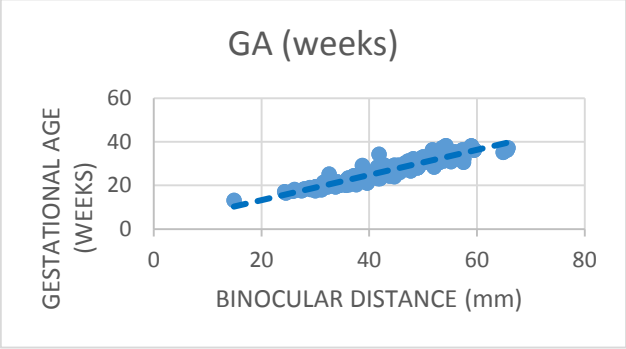

Fig-1: Scatter plot shows linear relationship between BOD and GA

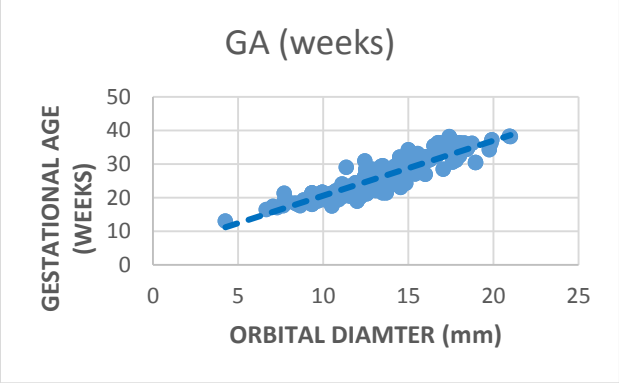

Fig 2: Scatter plot shows linear relationship between OD and GA

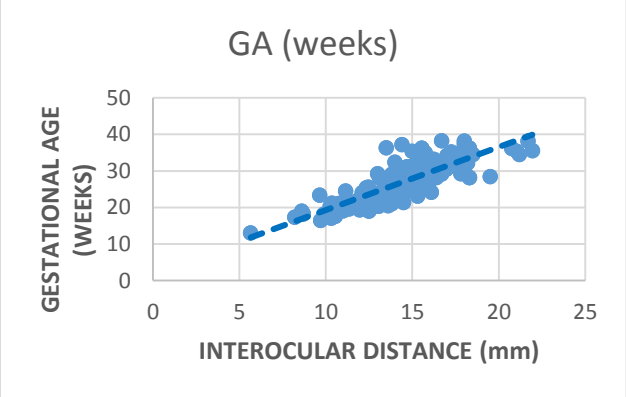

Fig 3: Scatter plot shows linear relationship between IOD and GA

DISCUSSION

This study was conducted to establish correlation between sonographic measurements of fetal orbital parameters including binocular distance, orbital dimeter and intraocular distance (BOD, OD & IOD) with gestational age in second and third trimester of pregnancy in local population settings. A total of 300 normal pregnant females were included in the study. Gestational age was calculated by the ultrasound software using biparietal dimeter, head circumference, abdominal circumference and femur length (BPD, HC, AC and FL), with the aforementioned orbital parameters taken simultaneously both in coronal and axial planes. The mean value for BOD, IOD and OD was calculated for axial and coronal measurements as on data analysis both the value were approximately same. The mean and ranges for GA, BOD, OD and IOD was calculated. It was noted that there is a progressive increase in the orbital biometric values as gestational age reaches near term with a strong linear relationship between them (p value = <0.001), as reported similarly by other authors. Among the three orbital parameters BOD and OD show relatively stronger linear relation, with GA (r2 = 0.891 and 0.829 respectively, p = <0.001) as seen in another study conducted by Islam et al which mainly focused on relationship between BOD and GA revealing a strong linear relation with r2= 0.952 and p value of <0.001 [6].

The pattern of orbital parameters seen in our study were almost similar to studies conducted in other south Asian population as seen in research conducted on Bangladeshi population [6] as well as on western population revealing that there is not much variation in orbital parameters considering the ethnicity and racial differences [8-10]. The predicted fetal orbital biometric parameters including BOD, OD and IOD at various gestational corresponds well with the measurements reported by other researchers [6,12-15].

Excellent correlations were found to exist between fetal orbital biometric parameters and gestational age (p<0.001). On

data analysis it has been seen that this holds true only if orbital biometry is performed precisely in accordance with the ocular landmarks described in methodology section, otherwise the measurements can be erroneous. However, it has been observed that exact delineation of the exact site of landmarks is sometimes difficult due to varied fetal head and face position besides distal orbital margin is sometimes not visible due to acoustic shadowing by the nose. Besides these there are certain other limitations to our including the fact that three different ultrasound units were used for documenting measurements, by three different researchers due to which it has been observed that the data has inconsistencies due to interobserver variation. Despite these limitations orbital biometry has been found very useful in evaluation of gestational age especially in females with unknown date of last menstrual age as well as for case in which fundal height do not correspond with estimated GA [16-20]. Inclusion of orbital biometry in routine practices can also be beneficial and evaluating and diagnosis ocular/orbital pathologies at an early gestation [21].

CONCLUSION

Fetal biometry has been used routinely for assessing fetal growth however, in addition to known fetal parameters including BPD, HC, AC and FL, fetal orbital parameters including BOD, IOD and OD has also found their usefulness in assessing gestational age of fetus especially in cases where the patient is unsure of dates or on clinical examination fundal height does not correspond with gestational age. Routine evaluation of orbital parameters during obstetrical scans can help in diagnosing ocular/orbital pathologies at any early gestation.

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