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Original Article

Ultrasonographic Evaluation of Foetal Binocular Distance in Second & Third Trimester of Pregnancy and Correlation with Gestation Age

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Abstract

Background: Foetal Binocular Distance in Second & Third Trimester of Pregnancy and correlation with Gestation Age is important. **Objective:** The purpose of the study was to sonographically measure the foetal binocular distance, determine the foetal gestational age & to find out relationship between them in 2nd & 3rd trimester of gestation. **Methodology:** This cross sectional study was carried out in the department of radiology and imaging Mymensingh Medical College Hospital, Mymensingh and Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh during the period of July 2012 to June 2013. In all the cases BPD, FL, AC, Binocular distance (BD) in cm and gestational age in weeks were measured by USG. Each patient was voluntary enrolled into the study without any specific indication. The measurement was performed only once for each patient. The foetal outer binocular distance was identified in the occipito-transverse or occipito-posterior-foetal positions. With the head in the occipito-posterior position, the transducer was placed in a plane that transected the occiput, orbits, and nasal processes. Measurements were obtained only when the fetal face was directly perpendicular to the uterine wall, since measurements in an oblique plane were considered to be unreliable. **Result:** The correlation between binocular distance (BD) in cm and gestational age (GA) in wks was calculated. This correlation was highly significant ($r = 0.973$; $p<0.001$).**Conclusion:**Excellent correlation was found to exist between binocular diameter and gestational age. In the absence of known date of last menstrual period or where fundal height does not agree with dates, these parameters are valuable in estimating the gestational age of the foetus.[*Journal of Current and Advance Medical Research, 2016;3(1):10-15*]

Keywords: Foetal binocular distance; second & third trimester of pregnancy; gestation age

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Background

Ultrasound has been used extensively to assess gestational age of the fetus which is very important to perinatologist and obstetric physician. Several foetal parameters like biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) have been used to estimate the foetal age. Orbital architecture has become increasingly important in the evaluation of gestational age assessment. The foetal orbital measurement is the most interesting parameter useful in predicting gestational age. Binocular distance (BD), the ocular diameter (OD) and intraocular distance (IOD) can be measured. Of them the first one (i.e. BD) draws maximum attention due to its accuracy and convenience.

The relation between foetal binocular distance and gestational age was determined by cross-sectional analysis of 120 normal fetuses (12-40 weeks) using real-time sonography[1]. Mathematical modeling of the data demonstrated that the binocular distance growth curve, similar to the biparietal diameter, is nonlinear. Predicted binocular values at various points in gestation were comparable to the results of other investigators[2]. Predicted gestational age in weeks for specific binocular distance measurements in millimeters were calculated and are reported in tabular form. The variability associated with predicting gestational age from binocular distance in 2nd trimester was higher than that of the 3rd trimester which was statistically significant[3].

From the analysis an excellent correlation was found to exist between binocular distance and gestational age. Binocular distance can be used as an adjunct in estimating gestational age and may be useful in the diagnosis of some abnormalities like hypotelorism or hypertelorism[4]. As is true of all measurements made with ultrasound, binocular distance must be performed precisely or the data will be misleading.The Purpose of the study was to sonographically measure the foetal binocular distance, determine the foetal gestational age and to find out relationship between them in 2nd and 3rd trimester of gestation.

Methodology

This cross sectional study was carried out in the department of radiology and imaging Mymensingh Medical College Hospital, Mymensingh and Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladeshduring the period of July 2012 to June 2013. In all the cases BPD, FL, AC, Binocular distance (BD) in cm and gestational age in weeks were measured by USG. The subject had to meet the following criteria like women with singleton pregnancies between 12th to 40th weeks, women with normal pregnancy with reliable LMP after 12th weeks of gestation, complete visualization of binocular distance.

Patients with multiple pregnancies, foetal congenital anomaly, pregnancy complicated by premature ruptures of membrane and poly or oligohydramnios and breech presentation were excluded from the study. Purposive sampling technique was used. Appropriate data collected by using a preformed data sheet. Each patient was voluntary enrolled into the study without any specific indication. The measurement was performed only once for each patient. All scanning was done by using Toshiba power vision ultrasonography machine (Model 6000 SSA370) and Volusion 730 Machine equipped with a 3.5 MHz convex transducer. The foetal outer binocular distance was identified in the occipito-transverse or occipito-posterior-foetal positions. With the head in the occipito-transeverse position, the transducer canbe placed in two possible planes: (1) along the coronal plane, approximately 2 cm posterior to the glabella-alveolar line, or (2) along the orbitomeatal line, approximately 2-3 cm below the level of the biparietal diameter. In both of these views, the midline, orbital rings, nasal processes, and portions of the maxillae can be demonstrated. With the head in the occipito-posterior position, the transducer was placed in a plane that transected the occiput, orbits, and nasal processes. Measurements were obtained only when the fetal face was directly perpendicular to the uterine wall, since measurements in an oblique plane were considered to be unreliable.

The outer orbital diameter was measured by means of electronic calipers from the lateral border of the orbit to the opposite lateral border (outer to outer). Each measurement was obtained from the average of the three best measurements obtained at each examination.Result of the study was calculated and analyzed by standard statistical method and was presented in forms of tables and graphs. Data were expressed as Mean $\pm$ SD. A value of $P < 0.05$ was considered statistically significant. Difference between two groups was analyzed by the unpaired student "t" test. For analysis of data SPSS for Windows (IBM SPSS Statistics for Windows, version 19.0, Armonk, NY: IBM Corp.) software was used. The total study was summarized as per the standard procedures and unbiased conclusion was drawn.

Results

A total number of 120 healthy subjects were included in this study, who attended at OPD for USG scanning of pregnancy profile.

Relationship between BD and GA

The mean BD and standard deviation for each gestational week are calculated and shown in Table I. Additionally, 5th, 50th, 95th percentiles are also shown in the following table.

Table 1: Mean foetal BD with standard deviation, 5th, 50th and 95th percentile for GA

GA(wk)	No.	Mean (cm)	SD (cm)	5th Percent	50th Percent	95th Percent
12	3	12.30	0.082	12.21	12.30	12.39
13	3	13.37	0.047	13.31	13.40	13.40
14	4	14.33	0.109	14.22	14.30	14.47
15	2	15.35	0.250	15.13	15.35	15.58
16	4	16.43	0.143	16.23	16.45	16.59
17	3	17.13	0.125	17.01	17.10	17.28
18	3	18.40	0.163	18.22	18.40	18.58
19	1	19.00	0.000	19.00	19.00	19.00
20	3	20.43	0.094	20.32	20.50	20.50
21	3	21.40	0.082	21.31	21.40	2149
22	4	22.43	0.205	22.15	22.50	22.60
23	5	23.18	0.160	23.00	23.20	23.38
24	3	24.07	0.094	24.00	24.00	24.18
25	7	25.13	0.205	25.00	25.00	25.47
26	7	26.31	0.173	26.30	26.40	26.47
27	6	27.20	0.125	27.03	27.20	27.37
28	6	28.17	0.137	28.00	28.20	28.35
29	5	29.18	0.075	29.10	29.20	29.28
30	7	30.26	0.150	30.03	30.30	30.40
31	7	31.11	0.112	31.00	31.10	31.27
32	7	32.06	0.105	32.00	32.00	32.24
33	1	33.00	0.000	33.00	33.00	33.00
34	3	34.30	0.187	34.05	34.35	34.49
35	7	35.07	0.139	35.00	35.00	35.31
36	3	36.17	0.236	36.00	36.00	36.45
37	4	37.00	0.000	37.00	37.00	37.00
38	5	38.26	0.233	38.00	38.30	38.56
39	1	39.00	0.000	39.00	39.00	39.00
40	3	40.03	0.047	40.00	40.00	40.09

Comparison of predicted GA

Mean predicted gestational age in 2nd and 3rd trimesters were 21.30 weeks and 33.20 weeks respectively. The variability (SD±4.105) associated with predicting GA from BD in 2nd trimester was higher than that of the 3rd trimester (SD±4.105). This difference of variability was statistically highly significant ($p<0.001$ (Table 2).

Predicted binocular distance

Predicted mean binocular distances (mm) for each gestational week were presented in the table III.

With increasing GA the BD was also increasing. An almost curvilinear relationship was found.

Table 2: Comparison of predicted gestational age between 2nd and 3rd trimester

Summary measures	2nd trimester (n=64)	3rd trimester (n=56)
Mean	21.30	33.20
Median	22.60	32.10
Std. Deviation	4.901	3.450
Minimum	12.2	28.2
Maximum	28	40.1
p-value	<0.001	

Table 3: Predicted mean binocular distance (mm) for each gestational week

GA (wks)	BD (mm)	GA (wks)	BD (mm)
12	16.17	27	42.14
13	17.44	28	42.50
14	18.10	29	42.96
15	21.45	30	43.37
16	23.30	31	45.80
17	24.10	32	47.07
18	27.27	33	48.50
19	29.00	34	51.10
20	31.30	35	52.40
21	33.50	36	52.64
22	33.57	37	53.10
23	36.01	38	55.04
24	37.57	39	56.00
25	41.35	40	58.00
26	42.28	-	-

Comparison of GA and BD

Table IV shows the comparison of GA and BD with their corresponding predicted values. No significant difference was observed between traditionally measured mean of GA and predicted GA from foetal binocular distance (p=0.498). This statement was also applicable for binocular distance and predicted binocular distance from GA (p=0.481).

Table 4: Comparison of GA and BD with their corresponding predicted values

Summary measures	GA (weeks)	Predicted GA	BD (mm)	Predicted BD
Mean	26.90	28.07	40.01	43.17
Median	27.30	28.00	42.20	44.00
Std. Deviation	7.32	4.468	11.18	7.520
Minimum	12.20	13	16	17
Maximum	40.10	36	59	53
p-value	0.498		0.481	

Correlation of GA and BD

Table V shows the correlation between binocular distance (BD) in cm and gestational age (GA) at 2nd trimester, 3rd trimester and as a whole. All the correlation were highly significant (p<0.001).

Correlation between BD and GA

The correlation between binocular distance (BD) in cm and gestational age (GA) in wks was calculated. This correlation was highly significant (r = 0. 973; p<0.001).

Table 5: Correlation between binocular distance (BD) in cm and gestational age (GA)

BD	r value	p-value
GA at 2nd trimester	0.980	<0.001
GA at 3rd trimester	0.915	<0.001
GA as a whole	0.973	<0.001

Regression equations

Regression equations to predict GA and BD are presented in the Table VI. In the first equation, foetal binocular distance could explain 95% of the variance whereas, GA could explain 96% variance to predict BD. Formulas for predicted GA= $5.791+0.567 \times BD+0.411 \times (BD)^2$ and for predicted BD = $-13.622+1.724 \times GA-0.760 \times (GA)^2$.

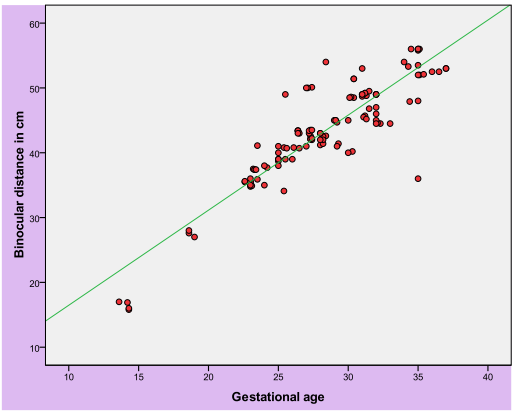

Figure 1: Scatter diagram showing relationship between BD and GA

Discussion

This study was done to evaluate the relationship between sonographically measured foetal binocular distance and gestational age in second and third trimester of pregnancy in Bangladesh setting. A total of 120 measurements of foetus BD (binocular distance) were obtained from 120 normal pregnant women. The mean BD and standard deviation for each gestational week are calculated. In addition, 5th, 50th, 95th percentiles are also shown. A progressive increase from the second trimester towards term was noted. Linear quadratic function could be considered an optimal model for predicting gestational age from BD (r^2 = 0.952, P <0.001). The

regression equation for these data is gestational age (weeks) = 5.791+0.567 x BD+0.411 x $(BD)^2$.

Table 6: Regression equations to predict GA and BD

Dependent variable	B_0	B_1	B_2	*p*-value	R^2
GA(Weeks)	5.791	0.567†	0.411†	<.001	0.932
BD(mm)	-13.622	1.724‡	-0.760‡	<.001	0.960

B_0= constant; $B_{1,2}$†= Binocular distance coefficients; $B_{1,2}$‡= Gestational age coefficients;R^2= Regression coefficient

The predicted BD value for a given gestational week based on the quadratic function was determined. In comparison with other studies, the BD growth pattern was consistent with sonographic studies of the western investigators throughout pregnancy[5-7]. The predicted binocular diameters at various points in gestation agree relatively well with the values reported by others[9-12]. The correlation between binocular distance (BD) in cm and gestational age (GA) at 2nd trimester, 3rd trimester and as a whole are calculated. Excellent correlations were found to exist between binocular diameter and gestational age ($p<0.001$).

This is true of all measurements made with ultrasound and binocular distance must be performed precisely or the data will be misleading. Tangential cuts through the orbits can easily produce erroneous measurements. Also, it is occasionally difficult to define accurately the distal orbital margin in the occipital transverse position because of acoustic shadowing from the nose[8]. Nevertheless, despite these pitfalls, it has been found that this technique to be valuable in evaluating gestational age and essential in assessing foetal orbital architecture in patients at risk for ocular abnormalities[13-16].

The binocular distance is a parameter that has occasionally proven useful in our practice. To obtain the right plane, one should start from the conventional section of the BPD and move the transducer caudally until the orbits are visualized. In the correct plane, both eyes should have the same diameter, and the image should be symmetrical. The largest diameter of eye should be used; the intraocular distance should be the smallest.

The foetal BD growth patterns agree relatively well with those of western studies[17-18]. This finding indicates that racial factors have only minimal effect on binocular growth. The values from this study provide useful baseline data for the evaluation of foetal BD growth in the population. In addition, these data may also serve as an adjunct parameter in predicting gestational age, especially in cases where biparietal diameter could not be obtained, or in abnormal head shape where biparietal diameter may prove to be unreliable or virtually impossible to obtain when the foetal head is facing straight up or down. In these cases, however, orbits can be identified and binocular diameters can be used to date pregnancies instead of biparietal diameter measurements. Additionally, foetal BD may also be helpful in diagnosis of some abnormalities like hypotelorism or hypertelorism.

Conclusion

Foetal biometry is a discipline devoted to the measurement of the several parts of foetal anatomy and their growth. The real-time ultrasound scanners have given a number of ultrasonic biometric parameters. The most commonly used among these are foetal biparietal diameter, head circumference, abdominal circumference and femur length. The new parameter i.e. binocular diameter was studied here and an excellent correlation was found to exist between binocular diameter and gestational age. In the absence of known date of last menstrual period or where fundal height does not agree with dates, these parameters are valuable in estimating the gestational age of the foetus.

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