Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 01, pp.64025-64030, January, 2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

BI-PARIETAL DIAMETER MEASUREMENT BY ULTRASOUND AND ITS EFFICACY IN ESTIMATING THE GESTATIONAL AGE

[1]Hisham Al-Hammami, [1,*]Mhd Nezar Alsharif, [2]Yaser Fawaz, [3]Alnour Soliman, [3]Hayat Abdulhadi and [3]Nour Al-midany

*[,1,2,3]Department of Obstetrics and Gynecology, Syrian Private University, Damascus, Syrian Arab Republic
[1]PhD in Obstetrics and Gynecology

ARTICLE INFO

Article History:
Received 26th October, 2017
Received in revised form
25th November, 2017
Accepted 21st December, 2017
Published online 19th January, 2018

Key words:

Syrian women, Gestational age, Ultrasound.

ABSTRACT

Objective: This research aimed to determine the efficacy of Bi-Parietal Diameter (BPD) by ultrasound in estimating the Gestational Age (GA) compared to GA by Naegele's rule using Last menstrual period (LMP) date.

Materials and Methods: This was a prospective observational study of women with a normal spontaneously conceived viable singleton pregnancy, a regular menstrual cycles, and spontaneous onset of labor at term. The LMP was considered certain in all cases. We used ultrasound to scan 2067 fetuses (894 healthy women) and we had 1586Bi-Parietal Diameter (BPD) measurements. Data were collected prospectively and used for statistical analysis. We used Descriptive Statistics to calculate the Mean, Standard Deviation (SD), Median and Percentiles values (3rd, 5th, 10th, 50th, 90th, 95th, and 97th) for BPD measurements on gestational age. We found a regression equation to estimate the GA using BPD measurements. The results of the current study were compared with different studies using the Paired Differences (t-test analysis). The results were represented as tables & diagrams.

Results: The best-fit equation for the estimate of GA $\hat{Y}_i$ from BPD (in mm) was:

$$\hat{Y}_i = 7.567 + 0.236\,(BPD)_i - 1.02*10^{-4}(BPD)_i^2 + 1.08*10^{-5}\,(BPD)_i^3$$

The Mean Sum of Squares of regression deviations of the GA regression model using (BPD) was 36939.5and this value is significant at P <0.001. The standard error of the Estimate (Std.Error) and the standard deviation (SD) for the GA regression model (using BPD measurements) was 1.38 and (0.8, 1.1, 1.4, 1.6, 1.7) weeks when the GA were (12-18, 18-24, 24-30, 30-36, 36-42), respectively.

Conclusion: In this study, we presented diagrams and tables for the estimation of GA using BPD measurements in a group of pregnant Syrian women. These results can be useful in women who cannot recall their last menstrual period (LMP). Our criteria will provide useful references for estimating gestational age and fetal care. A larger study might be needed to include a larger sample of the population.

Citation: Hisham Al-Hammami, Mhd Nezar Alsharif, Yaser Fawaz *et al.* 2018. "BI-Parietal diameter measurement by ultrasound and its efficacy in estimating the gestational age", *International Journal of Current Research*, 10, (01), 64025-64030.

INTRODUCTION

Monitoring fetal growth and assessing the growth predictors has an important role in the care of pregnant women. Accurate estimation of GA gestational age and Fetal Weight (FW) are clinically important. Ultrasound is useful as an accurate method for estimating Gestational Age (GA). Different embryonic measurements can be used to date pregnancy. Accurate estimation of GA is important in for normal and pathological pregnancies management. (National Collaborating Centre for Women's and Children's Health (UK), 2008; Wu *et al*., 2015; Ana *et al*., 2015) We used BPD to predict the GA in pregnant women reviewing ALTAWLID Hospital. Up to our Knowledge, this study is the first of its kind in Syria.

Corresponding author:* **Mhd Nezar Alsharif,
Department of Obstetrics and Gynecology, Syrian Private University, Damascus, Syrian Arab Republic

MATERIALS AND METHODS

1- Study design: This study is a prospective descriptive longitudinal population study.
2- Setting: ALTAWLID University Hospital- Damascus, Syria
3- Description of populations and variables: All the participants were pregnant women representing a specific geographic region from Damascus and its suburbs, who reviewed the hospital either to confirm

pregnancy or for following up. 51% (455/894) of all participants were between 22-30 years old and most of them were housewives of a low socioeconomic status.

4- Inclusion criteria: 1-) voluntary participation with informed consent. 2-) A correct, accurate and reliable patient's knowledge of the first day of the LMP. 3-) Regular menstrual cycles (at least three previous regular menses). 4-) Singular alive normal fetus with a gestational age between 13-41 weeks. (Ana *et al*., 2015). 5-) Spontaneous labor by full term pregnancy (259-293 days/37-41 weeks).

5- Exclusion criteria: Women who have one of the following: 1-) Uncertainty of the LMP date. 2-) Irregular menstrual cycles. 3-) Multigestation or fetal demise. 4-) Oral contraceptive use (OCP) or any recent hormonal treatment (3-4 months) before current pregnancy. 5-) Pregnancy during lactation. 6-) History of previous abortion or recent delivery preceding the current pregnancy. 7-) Diagnosis of fetal malformations during examination or after birth. 8-) Presence of any medical or obstetric complication with known effect on fetal growth. 9-) Smoking or drug addiction. 10-) BPD measures taken after week 41 of pregnancy. 11-) Pregnancies that ended in abortion preterm or postterm deliveries. 12-) Date of delivery (vaginal or cesarean section) is inaccurate. 13-) Malpositioned deliveries. 6- Ultrasound examination: An ultrasound examination was made for 894 pregnant women (2067 fetuses) who were selected according to the previously explained inclusion and exclusion criteria and reviewed the hospital between March 2017 and November 2017 to determine gestational age by measuring different fetal parameters (in this study BPD). We had 1586BPD measurements.

Statistical Analysis Methods

The regression model of the BPD was used to determine the GA and in order to choose the best regression model we used the: 1- Coefficient of Determination (r^2) and the adjusted Coefficient of Determination ($\overline{r^2}$) and chose the one with the higher value. 2- The standard error (Std.Error) of both methods and chose the one least value. 3- Durbin–Watson Test and chose the one that gives a value close to the Std.Error. 4- The significance of regression model by doing an analysis of variance. 5- The significance of the regression model constants' (parameters) using T test. 6- Estimating the SD of the GA using the BPD regression model. Paired – Samples T-TEST were done to test each method accuracy.

DISCUSSION

The Embryonic Parameters have several applications in clinical practice such as estimating the gestational age, fetal weight, and fetal growth. In this study, we presented Growth Charts & Tables with the (3rd, 5th, 10th, 50th, 90th, 95th, and 97th) Percentile Values and the standard deviation of BPD during the concordant pregnancy periods. We set a regression model equation that can be used to estimate the expected GA using BPD measurements (mm).This equation was statistically significant (P <0.001). A strong correlation was found between the dependent variable (GA) and the independent variable (BPD). We presented charts and tables that can estimate the GA (weeks) using BPD measurements (mm). We found a third degree valuable regression equation (p<0.001) that we can use to get the expected GA from BPD measures (mm). The Adjusted Coefficient of Determination ($\bar{r}$)^2 of the regression model of GA (weeks) using BPD measurements (mm) was 0.97.

RESULTS

Table 1. Growth chart of the BPDmeasurements (mm) showing the Percentile Values and Standard deviation (SD) during 11-42 weeks of pregnancy

Biparietal Diameter (BPD) (mm)							SD	GA (weeks)
%97	%95	%90	%50	%10	%5	%3		
21.0	20.6	19.9	17.8	15.6	14.9	14.5	1.7	11
24.4	23.9	23.3	21.1	18.9	18.3	17.8	1.7	12
27.7	27.1	26.1	22.8	19.5	18.6	18.0	2.6	13
32.1	31.4	30.4	26.9	23.4	22.4	21.8	2.7	14
35.5	35.0	34.1	31.2	28.2	27.4	26.8	2.3	15
41.0	40.2	38.9	34.4	29.9	28.7	27.8	3.5	16
45.1	44.4	43.2	39.1	35.0	33.9	33.1	3.2	17
48.7	47.9	46.5	41.8	37.1	35.8	34.9	3.7	18
52.2	51.4	50.1	45.4	40.7	39.4	38.5	3.6	19
56.1	55.1	53.7	48.5	43.3	41.8	40.9	4.0	20
57.5	56.7	55.4	51.0	46.6	45.4	44.6	3.4	21
62.2	61.3	59.9	55.2	50.4	49.0	48.1	3.7	22
63.8	63.2	62.3	59.1	55.9	55.0	54.5	2.5	23
65.8	65.1	63.9	60.0	56.1	54.9	54.2	3.1	24
70.0	69.1	67.8	62.9	58.0	56.7	55.8	3.8	25
74.8	73.9	72.4	67.2	61.9	60.4	59.5	4.1	26
77.4	76.5	75.1	70.2	65.3	63.9	63.0	3.8	27
78.6	78.0	76.9	73.3	69.6	68.6	67.9	2.8	28
81.7	80.8	79.3	74.2	69.0	67.6	66.6	4.0	29
85.2	84.3	82.8	77.7	72.6	71.1	70.2	4.0	30
85.4	84.6	83.4	79.2	75.1	73.9	73.1	3.2	31
89.0	88.2	86.9	82.4	78.0	76.7	75.9	3.5	32
91.2	90.4	89.2	84.9	80.6	79.4	78.6	3.4	33
93.6	92.7	91.5	87.0	82.5	81.3	80.5	3.5	34
95.5	94.7	93.5	89.2	85.0	83.8	83.0	3.3	35
96.3	95.5	94.2	89.7	85.2	83.9	83.1	3.5	36
99.7	98.9	97.6	93.1	88.5	87.2	86.4	3.6	37
100.0	99.2	97.9	93.4	88.9	87.6	86.8	3.5	38
101.9	100.9	99.5	94.3	89.2	87.7	86.8	4.0	39
102.0	101.3	100.2	96.4	92.6	91.5	90.8	3.0	40
102.8	102.2	101.1	97.4	93.7	92.6	91.9	2.9	41
103.0	102.5	101.8	99.2	96.7	95.9	95.5	2.0	42

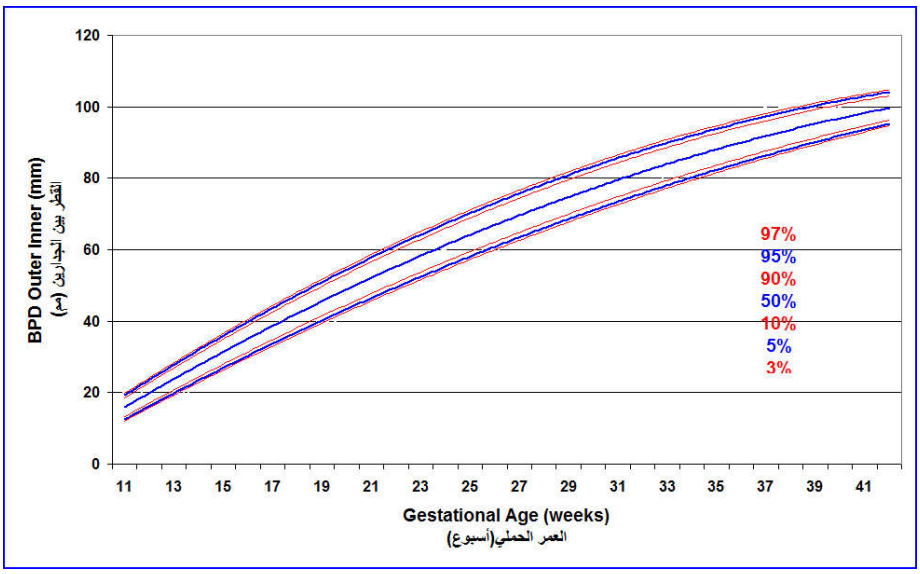

Figure 1. BPD growth chart showing the fitted Percentile Values (3rd,5th,10th,50th,90th,95th,97th) of the BPD and GA

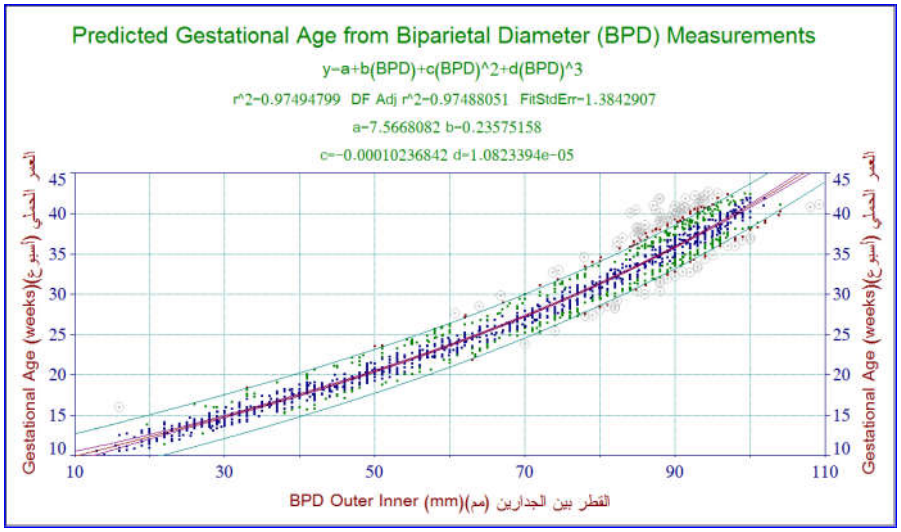

Figure 2. Predicted GA (weeks) using BPDmeasurements (mm). Each point represents one fetus result

Table 2. Expected GA (weeks) using the BPD measurements (mm) and the lower and upper limits of both the 95% Prediction Limits and the 95% Confidence Limits based on the regression model

95% Confidence Limits		95% Prediction Limits		$\hat{Y}_i$	X_i
Upper	Lower	Upper	Lower	GA (weeks)	BPD (mm)
11.3	10.4	13.6	8.1	10.9	14
11.5	10.7	13.9	8.4	11.1	15
11.7	11.0	14.1	8.6	11.4	16
12.0	11.2	14.3	8.9	11.6	17
12.2	11.5	14.6	9.1	11.8	18
12.4	11.8	14.8	9.4	12.1	19
12.6	12.0	15.1	9.6	12.3	20
12.8	12.3	15.3	9.8	12.6	21
13.1	12.6	15.5	10.1	12.8	22
13.3	12.8	15.8	10.3	13.1	23
13.5	13.1	16.0	10.6	13.3	24
13.8	13.4	16.3	10.8	13.6	25
14.0	13.6	16.5	11.1	13.8	26
14.2	13.9	16.8	11.4	14.1	27
14.5	14.2	17.0	11.6	14.3	28
14.7	14.4	17.3	11.9	14.6	29
15.0	14.7	17.6	12.1	14.8	30
15.2	15.0	17.8	12.4	15.1	31
15.5	15.2	18.1	12.6	15.4	32
15.8	15.5	18.3	12.9	15.6	33
16.0	15.8	18.6	13.2	15.9	34

16.3	16.0	18.9	13.4	16.2	35
16.6	16.3	19.1	13.7	16.4	36
16.8	16.6	19.4	14.0	16.7	37
17.1	16.8	19.7	14.3	17.0	38
17.4	17.1	20.0	14.5	17.2	39
17.7	17.4	20.2	14.8	17.5	40
17.9	17.7	20.5	15.1	17.8	41
18.2	18.0	20.8	15.4	18.1	42
18.5	18.2	21.1	15.7	18.4	43
18.8	18.5	21.4	15.9	18.7	44
19.1	18.8	21.7	16.2	19.0	45
19.4	19.1	22.0	16.5	19.2	46
19.7	19.4	22.3	16.8	19.5	47
20.0	19.7	22.6	17.1	19.8	48
20.3	20.0	22.9	17.4	20.1	49
20.6	20.3	23.2	17.7	20.5	50
20.9	20.6	23.5	18.0	20.8	51
21.2	20.9	23.8	18.4	21.1	52
21.5	21.3	24.1	18.7	21.4	53
21.8	21.6	24.4	19.0	21.7	54
22.1	21.9	24.7	19.3	22.0	55
22.5	22.2	25.1	19.6	22.3	56
22.8	22.6	25.4	20.0	22.7	57
23.1	22.9	25.7	20.3	23.0	58
23.5	23.2	26.1	20.6	23.3	59
23.8	23.6	26.4	21.0	23.7	60
24.1	23.9	26.7	21.3	24.0	61
24.5	24.3	27.1	21.7	24.4	62
24.8	24.6	27.4	22.0	24.7	63
25.2	25.0	27.8	22.4	25.1	64
25.5	25.3	28.1	22.7	25.4	65
25.9	25.7	28.5	23.1	25.8	66
26.3	26.0	28.9	23.4	26.2	67
26.6	26.4	29.2	23.8	26.5	68
27.0	26.8	29.6	24.2	26.9	69
27.4	27.2	30.0	24.6	27.3	70
27.8	27.5	30.4	24.9	27.7	71
28.2	27.9	30.8	25.3	28.1	72
28.6	28.3	31.2	25.7	28.4	73
29.0	28.7	31.6	26.1	28.8	74
29.4	29.1	32.0	26.5	29.2	75
29.8	29.5	32.4	26.9	29.6	76
30.2	29.9	32.8	27.3	30.1	77
30.6	30.3	33.2	27.8	30.5	78
31.0	30.8	33.6	28.2	30.9	79
31.4	31.2	34.0	28.6	31.3	80
31.9	31.6	34.5	29.0	31.7	81
32.3	32.1	34.9	29.5	32.2	82
32.7	32.5	35.3	29.9	32.6	83
33.2	33.0	35.8	30.3	33.1	84
33.6	33.4	36.2	30.8	33.5	85
34.1	33.9	36.7	31.3	34.0	86
34.5	34.3	37.1	31.7	34.4	87
35.0	34.8	37.6	32.2	34.9	88
35.5	35.3	38.1	32.7	35.4	89
36.0	35.7	38.6	33.1	35.8	90
36.4	36.2	39.0	33.6	36.3	91
36.9	36.7	39.5	34.1	36.8	92
37.4	37.2	40.0	34.6	37.3	93
37.9	37.7	40.5	35.1	37.8	94
38.5	38.2	41.0	35.6	38.3	95
39.0	38.7	41.6	36.1	38.8	96
39.5	39.2	42.1	36.6	39.3	97
40.1	39.7	42.6	37.2	39.9	98
40.6	40.2	43.1	37.7	40.4	99
41.2	40.7	43.7	38.2	40.9	100
41.7	41.2	44.2	38.8	41.5	101
42.3	41.8	44.8	39.3	42.0	102
42.9	42.3	45.3	39.9	42.6	103

Table 3. Standard Deviation (SD) of estimated the GA (weeks)

Standard Deviation	GA (weeks)
0.8	18 – 12
1.1	24 – 18
1.4	30 – 24
1.6	36 – 30
1.7	42 – 36

Table 4. Comparison between our study and reference studies

Sig.	Correlation (r)	N	Comparison
0.000	0.998	27	Present Study & Kawin Kankeow (2007)
0.000	0.999	31	Present Study & Sabbagha and Hughey (MacGregor and Sabbagha, 2008; Sabbagha and Hughey, 1978)
0.000	0.999	31	Present Study & ASUM (2001)
0.000	0.998	27	Present Study & Schluter et al. (2007)
0.000	0.999	29	Present Study & Hadlock et al. (1984, 1990 & 1983)

Table 5. Comparison of Paired Differences between our study and reference studies about predicting the GA (weeks) using BPD (mm)

Statistical Significance	Sig	df	T	Paired Differences					Comparison
				95% Confidence Interval of the Difference		Std. Error/Mean	Std. Deviation	Mean	
				Upper	Lower				
Yes	0.000	26.00	7.60-	3.18-	5.53-	0.57	2.98	4.36-	Present Study & Kawin Kankeow (2007)
Yes	0.000	30.00	4.87-	0.86-	2.11-	0.31	1.70	1.49-	Present Study & Sabbagha and Hughey (2008, 1978)
Yes	0.000	30.00	6.30-	1.37-	2.69-	0.32	1.79	2.03-	Present Study & ASUM (2001)
Yes	0.000	26.00	10.63-	2.17-	3.21-	0.25	1.31	2.69-	Present Study& Schluter et al. (2007)
Yes	0.000	28.00	16.65-	3.11-	3.98	0.21	1.15	3.55	Present Study& Hadlock et al. (1984, 1990 & 1983)

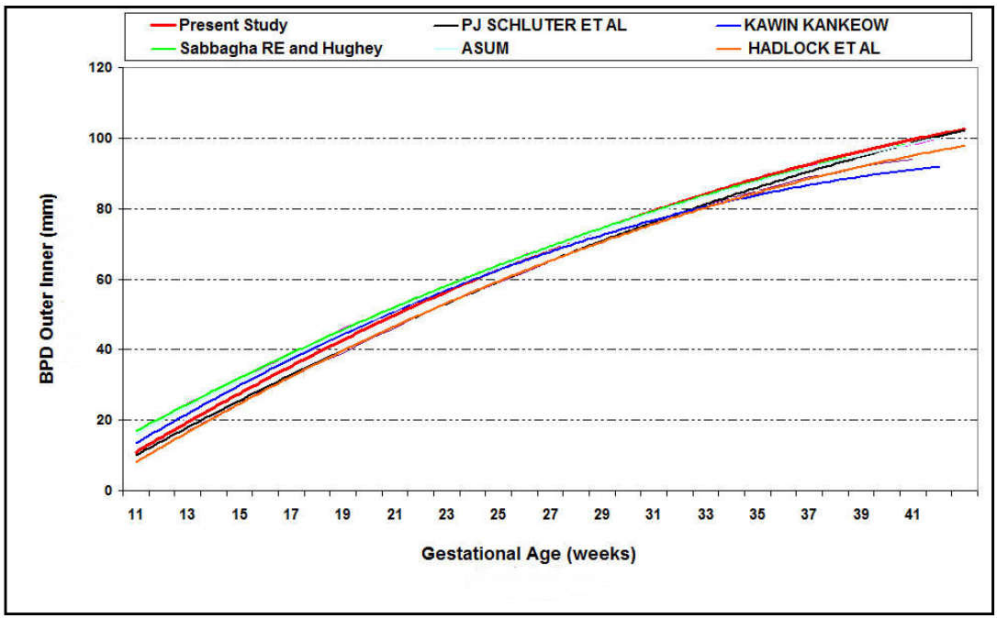

Figure 3. Comparison between GA using BPD in our study (red line) and the GA using BPD in reference studies (all lines except the red line)

GA from BPD measures (mm):

$$\hat{Y}_i = 7.567 + 0.236\,(BPD)_i - 1.02{*}10^{-4}(BPD)_i^2 + 1.08{*}10^{-5}\,(BPD)_i^3$$

$\bar{r}^2 = 0.97$ Std. Err =1.38 Sig=0.000

The coefficient of determination is greater than 0.75 (75%), therefore, the correlation between the dependent variable Y line (GA) and the independent variable X line (BPD) is very strong (Figure 2). The Mean Sum of Squares of regression deviations of the GA regression modelusing (BPD) was 36939.5and this value is significant at P <0.001. The standard error of the Estimate (Std.Error) for the GA regression model (using BPD measurements) was 1.38 (Figure 2). This value represents the effect of many factors that were not included in the regression model which affect the dependent variable Y line (GA) (Figure 2). Figure 2 shows the expected GA (weeks) usingBPD measurements (mm). Based on the regression model, we also demonstrated the expected GA, the lower and upper limits of the confidence interval (Table 2). The standard deviation (SD) of estimated the GA (weeks) from the actual GA using BPD measurements (mm) were (0.8,1.1,1.4,1.6,1.7) weeks when the GA were (12-18, 18-24, 24-30, 30-36, 36-42), respectively (Table 3). We compared this study to many similar studies such asKawin Kankeow, Sabbagha RE and Hughey, ASUM, Schluter *et al* and Hadlock *et al*. We compared the correlation coefficient, the mean, standard deviation, standard Error, lower and upper limits of the confidence interval (95% Confidence Interval of the Difference), the T value, the degree of freedom df, P value and Statistical Significance. The comparison results were: the correlation coefficients values were strong (0.998, 0.999, 0.999, 0.998, 0.999) and significant (0.000, 0.000, 0.000, 0.000, 0.000) between this study and the compared studies (Kawin Kankeow, Sabbagha and Hughey, ASUM, Schluter *et al* and Hadlock *et al*), respectively (P <0.001) (Table 4). The mean difference in the BPD measurements (mm) using the Paired-Samples T-TEST between this study and the compared studies was (-4.36,-1.49,-2.03, -2.69, 3.55) mm, respectively according to GA (weeks). The negative values indicates that the values of the compared studies were higher. There is statistical significance (P <0.001) between the current study and all the compared studies. (Table 5, Figure 3).

Conclusion

Many women do not recall their LMP and most pregnant women review the clinic in the first three months of pregnancy and the estimation of GA is important for the follow up and setting the Expected delivery date (EDD) for assessing growth during the rest of pregnancy and predicting the expected date of delivery (EDD). We presented diagrams and tables for the estimation of GA using BPD measurements in a group of pregnant Syrian women reviewing ALTAWLID Hospital according to the inclusion and exclusion criteria stated before. These results can be useful in women who cannot recall their last menstrual period (LMP). Our criteria will provide useful references for estimating gestational age and fetal care. A larger study might be needed to include a larger sample of the population.We also compared our results with similar studies abroad, and we found that our results were lower than their counterparts were. These results could help in estimating the gestational age, diagnosing fetuses who are younger than their GA, and IUGR embryos. Thus, ultrasound may be more accurate and could replace LMP method.

Recommendations

1. Emphasize the importance of doing a bigger more inclusive study to determine the accuracy of the fetal measurements in predicting the delivery date.
2. Using the BPD by ultrasound to determine the GA especially in women who cannot recall their LMP accurately.

REFERENCES

Ana I.L. Namburete, Richard V. Stebbing, Bryn Kemp, Mohammad Yaqub, Aris T. Papageorghiou and J. Alison Noble, 2015. Learning-based prediction of gestational age from ultrasound images of the fetal brain, In Medical Image Analysis, Volume 21, Issue 1, Pages 72-86, ISSN 1361-8415, https://doi.org/10.1016/j.media.2014.12.006.

Australasian Society for Ultrasound in Medicine. Statement on normal ultrasonic fetal measurements. *ASUM Bull*., 2001; 4: pp 28–31.

Hadlock FP, Deter RL, Harrist RB. and Park SK. 1983. Computer assisted analysis of fetal age in the third trimester using multiple fetal growth parameters. *J Clin Ultrasound*., 11(6):pp313-6.

Hadlock FP, Deter RL, Harrist RB. and Park SK. 1984. Estimating Fetal Age: Computer-Assisted Analysis of Multiple Fetal Growth Parameters. *Radiology*, 152(2): pp. 497-501.

Hadlock, FP. 1990. Sonographic estimation of fetal age and weight. *Radiol Clin North Am*., 28(1):pp 39-50.

Kawin Kan Keow, 2007. Charts of fetal biometries at Sukhothai Hospital. *J Med Assoc Thai*., 90(5): pp 844-51.

MacGregor S. and Sabbagha R. 2008. Assessment of Gestational Age by Ultrasound.Glob libr women's med

National Collaborating Centre for Women's and Children's Health (UK). Antenatal Care: Routine Care for the Healthy Pregnant Woman. London: RCOG Press; 2008 Mar. (NICE Clinical Guidelines, No. (62) 12, Fetal growth and wellbeing.

Sabbagha RE. and Hughey M. 1978. Standardization of sonar cephalometry and gestational age. *Obstet Gynecol*., 52: pp 402.

Schluter PJ, Pritchard G. and Gill MA. 2007. Using ultrasonic fetal size measurements to estimate gestational age in Brisbane, Australia, Australasian. *Radiology*, 51: pp 46–52.

Wu M, Shao G, Zhang F, Ruan Z, Xu P. and Ding H. 2015. Estimation of fetal weight by ultrasonic examination. *International Journal of Clinical and Experimental Medicine*, 8(1):540-545.

****