Correlation of Sonographically Measured Abdominal Circumference with Menstrual Age in Bangladeshi Women, Comparison with other Established Obstetric Tables

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Abstract

Background:
Ultrasound is the best and safest modality to obtain information about the fetus and its environment directly and it is an accurate method for determining the gestational age. It has been postulated that each population should use their own normograms because of the interpopulation differences in the ultrasound measurements.

Objectives:
This study was designed to correlate the abdominal circumference with gestational age by using real time ultrasonogram in Bangladeshi population and also comparison with other established obstetrical chart/table.

Methods:
A comparative descriptive study was carried out in the department of radiology and imaging BIRDEM, during the period of June 2005 to May 2006 on three methods. In this study gestational age was determined on the basis of abdominal circumference and a correlation was established between weeks of gestation calculated from LMP and estimated gestational age which measured from Hadlock, Campbell and Tokyo chart or tables.

Results:
A strong positive significant correlation was found between menstrual age and predicted gestational age measured from the AC in Hadlock chart ($r=0.9968$, $p<0.001$), in Campbell chart ($r=0.9966$, $p<0.001$) and in Tokyo chart ($r=0.9926$, $p<0.001$).

Conclusions:
It has been postulated that each population should use their own normograms because of the inter population differences in the ultrasound measurements.

Key words: Gestational age, LMP, AC and Hadlock, Campbell, Tokyo chart/table

Introduction:

Diagnostic ultrasound is an established, effective imaging technique, to determine gestational age and has become an integral part of maternal antenatal care. Ultrasound is a non invasive diagnostic procedure considered safe even when used repeatedly. There is no scientific evidence of any deleterious biologic effects from ultrasound on the developing fetus. Now a day in Bangladesh, ultrasound is available in Upazilla level, so it is readily available, less expensive modality for detection of gestational age accurately. Various parameters have been proposed to establish gestational age by ultrasound. However the most popular method remains the estimation of gestational sac size, Crown Rump length (CRL), Biparietal diameter(BPD), Head circumference(HC), Abdominal circumference(AC) and femur length(FL)[1]. Gestational age in second and third trimaster of pregnancy is usually calculated by measurement of BPD, FL, HC and AC. Accurate knowledge of gestational age is very important to deliver the fetus at risk and decision about timing and route of delivery[2]. The role of AC measurement is of prime importance because it is a soft tissue measurement of fetus and so gives a picture of the fetal nourishment. Fetal weight calculation is only possible by using AC measurement with BPD or FL, or both.

The obstetrical tables used in our country are produced from the data collected in the population of developed countries which may vary from our population. The most popular tables for measurement of obstetrical data in our country is Hadlock[3], Campbell[4], Tokyo[5], Hansemann[6], Shephard[7] etc. There is discrepancy among these systems which may be critical for the survival of an infant who has to be delivered early because of some antenatal complication. For this reason this study was designed to correlate the abdominal circumference with gestational age by using real time ultrasonogram in Bangladeshi population and also comparison with other established obstetrical chart/table.

Methods:

This comparative descriptive study was carried out on 358 normal pregnant women with apparently normal fetuses between 15 to 42 weeks of gestational age referred to the department of Radiology and Imaging, BIRDEM for ultrasonic evaluation of pregnancy profile with well known first day of last menstrual period, regular menstrual cycle and singleton pregnancy. Exclusion criteria were multiple pregnancies, uterine anomaly, fetal anomaly and maternal disease. At first all these subjects were evaluated by detail history specially about the first day of last menstrual period (LMP). After taking proper consent, Gestational age was determined on the basis abdominal circumference and a correlation was established between weeks of gestation calculated from LMP and estimated gestational age which measured from Hadlock[3], Campbell[4] and Tokyo[5] charts/tables. The study was approved by the ethical review committee of BIRDEM. Samples were collected by random sampling as per inclusion and exclusion criteria.

Result:

In this study the age of pregnant women ranged from 18 to 39 years and the maximum number was found in the age group 21 to 30 years. The mean age was 28.74±0.23 years. Gestational age was determined on the basis of abdominal circumference (Table-I).

Table-I: Distribution of mean ± SD percentile of estimated AC at different weeks of gestation (n=358)

Week of gestation	Number of fetuses (n=358)	AC (mm)				
		Mean	±SD	10th	15th	90th
15	12	91.58	5.42	85.30	89.00	101.80
16	14	103.31	6.65	94.00	104.50	11.40
17	15	114.61	4.82	108.60	115.00	222.48
18	13	125.98	4.20	119.20	127.00	131.00
19	13	137.35	2.19	134.00	138.00	140.30
20	14	147.89	5.50	139.50	147.20	155.30
21	12	158.79	5.50	147.40	159.25	164.00
22	11	169.61	6.81	161.36	167.50	181.66
23	13	179.74	4.77	172.04	180.00	185.78
24	13	190.59	2.09	187.38	190.50	193.80
25	12	201.07	6.74	191.02	203.95	209.22
26	14	211.74	4.24	205.50	212.55	217.50
27	13	222.13	5.39	214.46	223.30	228.64
28	13	233.26	5.12	224.72	234.00	240.10
29	13	243.98	6.89	237.40	243.00	258.24
30	15	254.48	5.29	246.60	255.00	262.10
31	14	264.89	4.11	260.50	264.15	272.60
32	14	275.85	9.33	267.10	272.75	293.20
33	15	286.29	12.31	265.68	289.30	300.08
34	14	295.86	4.51	289.50	295.50	302.90
35	13	304.94	5.51	297.44	305.00	311.40
36	14	314.37	3.57	310.00	315.00	319.30
37	12	323.34	7.53	312.60	323.50	333.80
38	13	332.28	5.55	322.00	335.00	337.60
39	12	340.04	5.36	332.60	339.50	346.80
40	11	347.50	5.78	339.64	346.80	358.44
41	8	351.95	7.96	346.00	351.00	359.70
42	8	356.00	5.50	349.00	356.00	364.00

The result from the study was compared with Hadlock chart[3], Campbell chart[5], Tokyo chart[5] and results are shown in Table-II and Figure-1, 2 and 3. In Hadlock chart/table it was found that the estimated gestational age measured from AC, the variation was only 2 to 4 days less from the weeks of gestation (LMP) up to 36 weeks of gestation. In Campbell chart, it was found that the estimated gestational age measured from AC varies from 3-4days less from the weeks of gestation (LMP) between 15-27weeks of gestation, after that the variation was 4-18days less from the weeks of gestation In Tokyo chart, the estimated gestational age measured from AC varies from 2-4 days more from weeks of gestation (LMP) and after 27 weeks it varies 1week to more than 2weeks more from weeks of gestation.

Table-II shows that a strong positive significant correlation between weeks of gestation and predicted gestational age measured from AC in Hadlock chart (r=0.9968, p<0.001), in Campbell chart (r=0.9966, p<0.001) and in Tokyo chart (r=0.9926, p<0.001); also shown in Figure 1, 2 & 3 respectively.

Table-II: Comparison (AC) scenario among Hadlock, Campbell and Tokyo chart Table-II: Correlation between weeks of gestation and predicted gestational age measured from AC in Hadlock chart, Campbell chart and Tokyo chart.

Table-II: Comparison (AC) scenario among Hadlock, Campbell and Tokyo chart

Parameters	Hadlock [3]	Campbell [4]	Tokyo [5]
AC(mm) measurement	Available 51 to 380 mm	Available 86 to 360 mm	Available 100 to 330 mm
Estimated gestational age	2 to 4 days less from menstrual age upto 36 weeks and 4-18days less after 36weeks.	3-7 days less from menstrual age upto 27 weeks and 4-18 days less after 27 weeks.	2-4 days more than menstrual age upto 27weeks and 1week to more than 2 weeks more thereafter.
Correlation(r)	0.9968	0.9966	0.9926
R^2	0.9992	0.9983	0.9978

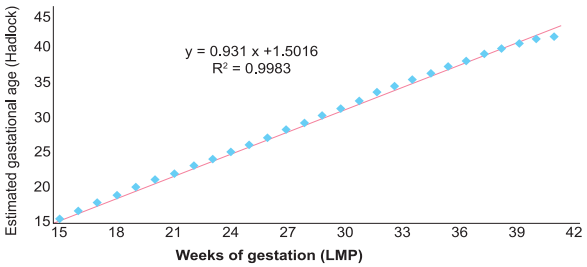


Figure-1: The scatter diagram shows significant relationship (r=0.9966) between estimated gestational age measured by AC in Hadlock chart and weeks of gestation (LMP).

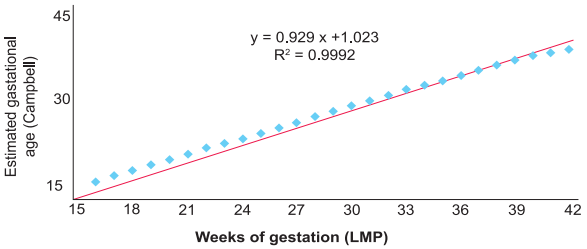


Figure-2: The scatter diagram shows significant relationship (r=0.9968) between estimated gestational age measured by AC in Campbell chart and weeks of gestation (LMP).

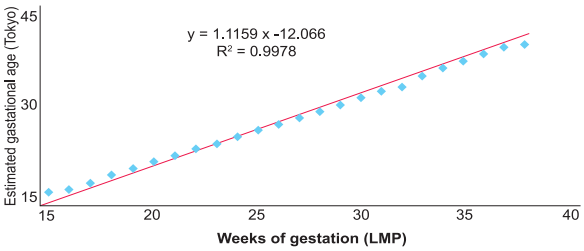


Figure-3: The scatter diagram shows significant relationship (r=0.9926) between estimated gestational age measured by AC in Tokyo chart & weeks of gestation (LMP)

Discussion:

Ultrasound is the best and safest modality to obtain information about the fetus and its environment directly. Ultrasound is a non invasive diagnostic procedure and there is no scientific evidence of any deleterious biologic effects from ultrasound on the developing fetus. Determination of gestational age by ultrasound has become an integral part of maternal antenatal care. Accurate assessment of gestational age by sonography can be of great importance in making decisions during pregnancy.

For example, timing of elective cesarean delivery and the decision whether to consider a fetus at risk for intra uterine growth retardation depending part on the estimated age[8]. Several sonographic fetal measurements during the second and third trimesters have been proposed for this purpose. These include biparietal diameter (BPD), Head circumference (HC), Corrected BPD, Abdominal circumference (AC) Femoral length (FL), Length of other long bones and binocular distance[9]. The aim of this study was to determine the relationship between the menstrual age and abdominal circumference (AC), and to elucidate correlation abdominal circumference of our population with different established obstetrical tables such as; Hadlock, Campbell, Tokyo etc. of developed countries. Fetal abdominal circumference measurement have been demonstrated to be important in assessing fetal age, in plotting fetal growth and in detecting intrauterine growth retardation, isoimmunization and macrosomia[3]. Rashid (2000) conducted a study on abdominal circumference of 615 fetuses from 17-42 weeks of normal gestation. It was observed in the study that measurement of abdominal circumference using the western chart, the estimated gestational age was constantly smaller than menstrual age after 24 weeks. From 17-24 weeks it is more or less coincided with the gestational age. From 24 to 33weeks it remained it remained 1 week smaller but from 34 to 38 weeks it gave a gestational age 3weeks smaller and after that, up to 42 weeks it remained 3 or more weeks smaller[10]. The present study showed that the estimated gestational age measured from abdominal circumference (AC) were 2-4 days less from menstrual age up to 36weeks of gestation and 4 days to more than 2weeks less after 36weeks of gestation and there was a significant ($p<0.001$) positive correlation $r=0.9968$ and $R2=0.9992$ between weeks of gestation (LMP) and estimated gestational age in Hadlock Chart[3]. In Campbell chart[4], the estimated gestational age measured from AC, which varies from 3-4 days less from weeks of gestation (LMP) between 15 weeks to 27 weeks and after 27 weeks the variation was 4 to 18 days. There was a significant ($p<0.001$) positive correlation $r=0.9966$ and $R2=0.9978$ between weeks of gestation (LMP) and estimated gestational age. In Tokyo chart[5], the estimated gestational age measured from AC between 15 weeks to 38 weeks. The estimated gestational age varies from 2-4 days more than the weeks of gestation from 15 week to 27 weeks and after 27 weeks it varies 1 week to more than 2 weeks from weeks of gestation (LMP). There was a significant ($p<0.001$) positive correlation $r=0.9926$ and $R2=0.9983$ between weeks of gestation (LMP) and estimated gestational age. All these findings suggest that ultrasonologist should use fetal biometry which is originated from the same population. Until now the sonographers of this country are using the measurement parameters of western standard to calculate the period of gestation and to assess the fetal growth chart of this country is so far available. Therefore, the above results indicate the variation of estimated gestational age measurement from AC from the weeks of gestation (LMP) were less in Hadlock chart than Campbell and Tokyo. The hypothesis test result indicates that the gestational age and estimated gestational age measures by abdominal circumference of our population better corresponds to Hadlock system than any other.

Conclusion:

Ultrasound is the best and safest modality to obtain information about the fetus and its environment directly and it is an accurate method for determining the gestational age. It has been postulated that each population should use their own normograms because of the inter population differences in the ultrasound measurements. For this reason this study was designed to correlate the abdominal circumference with gestational age by using real time ultrasound in Bangladeshi population and were compared with other established parameters and found that AC verses gestational age curve, correlate better with Hadlock than Campbell, Tokyo chart/table

References:

1. Nisa L, Hassan M, Moslem F. Gestational age determination. Bangladesh journal of ultrasonography 1996;3:1-2.
2. Moslem F, Latifa S, Iffat Ara B, Shamsuddin AKM, Nasreen, Momen A, Hossain S. Relation of biparietal diameter with gestational age in Bangladeshi fetus. Bangladesh journal of ultrasonography 1996; 3:3-8.
3. Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal abdominal circumference as a predictor of menstrual age. AJR Am J Roentgenol. 1982 Aug;139(2):367-70.doi:10.2214/ajr.139.2.367.
4. Campbell S, Thoms A. Ultrasound measure-

ment of the fetal head to abdomen circumference ratio in the assessment of growth retardation. Br J Obstet Gynaecol. 1977 Mar; 84(3):165-74. doi: 10.1111/ j.1471- 0528. 1977.tb12550.x.
5. Gallagher RJ. Accuson 128XP/4 user's mannual.4th ed. Acuson corporation:Mountain view;-CA.p10(1)-10(66).
6. Hannsman et al. Ultrasound Diagnosis in Obstretics and Gynecology. New York: Springer-Veriag;1986.p.431.
7. Shepard M, Filly RA. A standardized plane for biparietal diameter measurement. J Ultrasound Med. 1982 May;1(4):145-50. doi: 10.7863/-jum.1982.1.4.145.
8. Doubilet PM, Greenes RA. Improved prediction of gestational age from fetal head measurements. AJR Am J Roentgenol. 1984 Apr;142(4):797-800. doi: 10.2214/ ajr . 142. 4. 797.
9. Benson CB, Doubilet PM. Sonographic prediction of gestational age: accuracy of second- and third-trimester fetal measurements. AJR Am J Roentgenol. 1991 Dec;157(6):1275-7. doi: 10.2214/ajr.157.6.1950881.
10. Rashid SQ. Ultrasonographic measurement of fetal abdominal circumference in context to Bangladeshi population. Bangladesh Medical Journal 2000; 29(4):36-38.