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Original Article

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

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Abstract:

Background: Various parameters have been proposed to establish gestational age by ultrasound. However the most popular method remains the estimation of gestational sac size, CRL, BPD, HC, AC and femur length. Aim of the present study was to correlate HC with menstrual age by ultrasonogram in Bangladeshi population and to compare with other established obstetric tables. **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 358 subjects and three methods. 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. **Results:** In this study gestational age was determined on the basis of head circumference and a correlation was established between weeks of gestation calculated from LMP and estimated gestational age. A strong positive significant correlation was found between weeks of gestation and predicted gestational age measured from HC in Hadlock chart (r=09963. p<0.001), in Campbell chart (r=0.9959, p<0.001) and in Hansemann chart (r=0.9962, p<0.001). **Conclusion:** This study was designed to correlate the fetal HC with gestational age by using real time ultrasound in Bangladeshi population and were compared with other established parameters and found that HC verses gestational age curve, correlate better with Hadlock than Campbell and Hansmann chart/table.

Key words: Gestational age, LMP, HC (head circumference) and Hadlock, Campbell, Hansman chart/table

Introduction:

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 days in Bangladesh, ultrasound is also 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, CRL, BPD, HC, AC and femur length[1]. Gestational age in second and third trimaster of pregnancy is usually calculated by measurement of biparietal diameter (BPD), femur length (FL), head circumference (HC) and abdominal circumference (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 accuracy of fetal age predictions using BPD in third trimester is somewhat limited. The variation of BPD increases while there is change of head shape like dolichocephaly or brachycephaly and can be associated with breech fetuses, multiple pregnancy or oligohydramnios[3]. In such situation BPD would be falsely small or large while HC will remain unaltered. So HC is more accurate guide to the gestational age in late pregnancy[4].

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The obstetrical tables used in our country are produced from the data collected in the population of developed countries which may very from out population. The most popular tables for measurement of obstetrical data in out country is Hadlock[5], Campbell[6], Hansemann[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 fetal head circumference 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 ultra sonic evaluation of pregnancy profile with well known first day of last menstrual period, regular menstrual cycle and single tonepregnancy. 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 that is LMP. Gestational age was determined on the basis of head circumference and a correlation was established between weeks of gestation calculated from LMP and estimated gestational age which measured from Hadlock[5], Campbell[6] and Hansman[7] charts/ Tables.

Results:

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 years with standard deviation (SD) 0.23.

In this study gestational age was determined on the basis of head circumference and a correlation was established between weeks of gestation calculated from LMP and estimated gestational age (Table I).

Table I: Distribution of Mean±SD, percentile of estimated HC at different weeks of gestation. (n=358)

Week of gestation	Number of fetuses (n=358)	HC (mm)				
		Mean	±SD	10th	15th	90th
15	12	111.63	3.02	107.65	111.00	115.70
16	14	123.12	5.69	116.50	121.50	132.25
17	15	136.40	3.72	131.36	137.00	142.00
18	13	149.27	7.24	139.82	148.60	161.84
19	13	161.48	4.74	153.00	162.00	167.60
20	14	173.97	10.72	155.50	174.10	187.55
21	12	186.86	6.27	174.54	187.80	194.35
22	11	198.86	7.85	185.92	197.30	207.48
23	13	210.25	5.40	201.50	211.30	218.00
24	13	220.91	3.72	215.12	220.60	226.20
25	12	231.41	5.30	224.06	231.00	239.49
26	14	240.91	6.56	232.00	240.55	252.00
27	13	249.92	4.74	242.00	251.00	255.42
28	13	258.72	3.19	253.92	258.00	263.18
29	13	266.92	4.38	258.68	269.00	271.84
30	15	275.65	7.52	266.68	273.50	287.80
31	14	283.70	4.34	277.00	285.15	289.60
32	14	290.67	2.71	286.75	290.50	294.40
33	15	297.99	5.28	291.66	297.60	306.48
34	14	306.80	5.57	299.50	306.75	316.30
35	13	313.38	4.74	305.28	312.80	319.04
36	14	321.20	4.49	314.85	321.10	328.50
37	12	327.22	5.80	319.00	327.50	335.31
38	13	331.84	4.23	326.04	332.50	337.80
39	12	336.35	4.18	330.30	336.50	341.68
40	11	340.15	2.74	335.40	340.60	344.16
41	8	343.75	3.92	339.00	343.00	350.00
42	8	345.88	3.40	339.00	346.50	350.00

The result from the study was compared with Hadlock chart[5], Campbell chart[6], and Hansemann chart[7] and results are shown in Table II and Figure 1, 2 and 3.

In Hadlock chart/table[5] it was found that the estimated gestational age measured from HC had a very close relation with the weeks of gestation (LMP), which was 2-3 days less from weeks of gestation (LMP) during 15-39 weeks.

In Campbell chart[6], it was found that the estimated gestational age mesured from HC varies 2-7days less from the weeks of gestation (LMP) between 15-27weeks and after 27 weeks of gestation it varies 3-15 days less from weeks of gestation (LMP).

In Hansemann chart[7], the estimated gestational age measured from HC between 15-41weeks had a close relation with the weeks of gestation (LMP), which was 1-10 days less from the weeks of gestation.

Table II shows that a strong positive significant correlation was found between weeks of gestation and predicted gestational age measured from HC in Hadlock chart (r=09963. p<0.001), in Campbell chart (r=0.9959, p<0.001) and in Hansemann chart (r=0.9962, p<0.001); also as shown in Figure 1, 2 and 3 respectively).

Table II: Comparison of HC scenario among Hadlock, Campbell and Hansmann chart

Parameters	Hadlock	Campbell	Hansmann
HC(mm) measurement	Available 56 to 357mm	Available 110 to 348mm	Available 50 to 343mm
Estimated gestational age	2 to 3 days less from menstrual age upto 36 weeks.	1-5days less from menstrual age upto 27weeks and 3-15days less after 27weeks.	1-10days less from menstrual age upto 41weeks
Correlation(r)	0.9963	0.9959	0.9962
R^2	0.9989	0.9975	0.9989

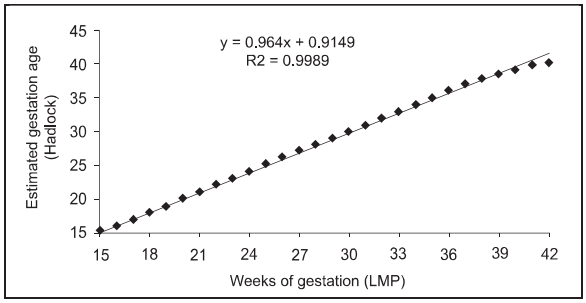


Figure 1: The scatter diagram shows significant relationlship (r=0.9963) between estimated gestational age measured by HC in Hadlock chart and weeks of gestation (LMP)

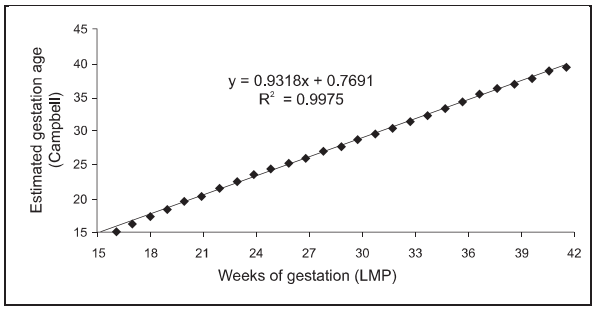


Figure 2: The scatter diagram shows significant relationlship (r=0.9959) between estimated gestational age measured by HC in Campbell chart and weeks of gestation (LMP)

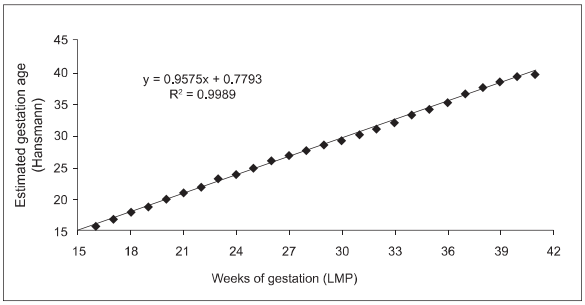


Figure 3: The scatter diagram shows significant relationlship (r=0.9962) between estimated gestational age measured by HC in Hansmann chart and weeks of gestation (LMP)

Discussion:

Ultra sound 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 management 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 meanstrual age and head circumference (HC) and to elucidate correlation of head circumference of our population with different established obstetrical tables such as; Hadlock[5], Campbell[6], Hansmann[7] of developed countries.

Fetal head 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[10].

Biparietal diameter (BPD) is only a single dimension of the head and is frequently not truly, representative of the total fetal head and brain size. This narrow BPD gives a false impression of subnormal head size. The head circumference measurement seems to be more representative of brain size even in normal weight dolichocephalic fetuses[11].

Law and MacRae[4] measured the head circumference of 594 fetuses and the result compared with the biparietal diameter. In a satisfactory significant proportion of cases, the head circumference was more closely related than the biparietal diameter to the gestational age of the fetus as calculated from the mother's menstrual history. It was observed in the study that the head circumference is the more accurate index of the age of the fetus and its growth potentials then is the biparietal diameter, and that use of the head circumference should, inconsequence replaces that of the biparietal diameter in obstetric scanning. In this study weeks of gestation was observed by measuring HC between 15 to 42 weeks and found a very close relation with the gestational age which were 2-3days less from menstrual age in Hadlock chart[5] and there was a significant ($p<0.001$) positive correlation $r=0.9963$ and R square=0.9989 between weeks of gestation (LMP) and estimated gestational age.

The estimated gestational age measured from HC in Campbell chart[6] showed that the estimated weeks of gestation gradually increase up to 27 weeks of gestation which varies 1-5 days less from weeks of gestation and after 27 weeks of gestation it varies 3-15 days less from weeks of gestation. There is a significant ($P< 0.001$) positive correlation ($r=0.9959$ and r squire= 0.9975) between weeks of gestation (LMP) and estimated gestational age.

It was observed in Hansemann chart[7] that the estimated gestational age measured from HC was gradually increases up to 41weeks and it varies 1 to 10 days less from weeks of gestation. There was a significant ($P<0.001$) positive correlation (r=09962 and R2= 09989) 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 these countries 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 HC from the weeks of gestation (LMP) were less in Hadlock chart[5] than Campbell[6] and Hansman[7].

The hypothesis test result indicates that the gestational age and estimated gestational age measures by head circumference of Bangladeshi population better corresponds to Hadlock system[5] 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 fetal head circumference with gestational age by using real time ultrasound in Bangladeshi population and were compared with other established parameters and found that HC verses gestational age curve, correlate better with Hadlock than Campbell and Hansmann chart/table.

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