ธีระ ทองสง, ชเนนทร์ วนาภิรักษ์, อัจฉราวรรณ แย้มโพธิ์ใช้. ความสัมพันธ์ระหว่างอายุครรภ์กับเส้นรอบวงศีรษะทารกจากการวัดด้วยคลื่นเสียงความถี่สูง. จุฬาลงกรณ์เวชสาร 2534 พฤษภาคม ; 35(5) : 265-271

ศึกษาวัดเส้นรอบวงศีรษะทารก (head circumference) ด้วยคลื่นเสียงความถี่สูง ในระยะก่อนคลอดทั้งหมด 1251 ครั้ง ในสตรีตั้งครรภ์คนไทย 450 คน จากอายุครรภ์ 14-40 สัปดาห์ อายุ 16-39 ปี ซึ่งทราบอายุครรภ์แน่นอน นำค่าเส้นรอบวงทั้งหมดที่วัดได้มาหาค่ามัชฌิมเลขคณิต ความเบี่ยงเบนมาตรฐาน ค่าเปอร์เซนไตล์ที่ 5, 50 และ 95 สำหรับแต่ละอายุครรภ์ พบว่าความสัมพันธ์ของเส้นรอบวงศีรษะทารกและอายุครรภ์มีความสัมพันธ์กันแบบ linear quadratic function ($r^2 = 0.97, p = 0.001$) อาศัยสมการความสัมพันธ์นี้นำมาหาค่าทำนายอายุครรภ์จากความยาวเส้นรอบวงซึ่งได้นำเสนอไว้ในรูปตาราง นอกจากนั้นได้เปรียบเทียบค่าเส้นรอบวงในแต่ละอายุครรภ์ระหว่างการศึกษานี้กับรายงานอื่น ๆ พบว่ารูปแบบการเติบโตไม่ต่างจากรายงานจากประเทศทางตะวันตก แต่ค่าของทารกไทยมีค่าต่ำกว่าเล็กน้อย รายงานนี้อาจมีคุณค่าในการช่วยประเมินหาอายุครรภ์ การเจริญเติบโตของทารกไทย ร่วมกับตัววัดอื่น ๆ

The head circumference measurement can be substituted for the biparietal diameter (BPD). Although mean gestational age numbers are equally reliable, the range of gestational ages is larger.(1) The accuracy of HC measurements has been compared with that of BPD. In general, the head circumference is no more accurate than the BPD as a predictor of gestational age.(1) However, when unusual head shapes occur, the head circumference is of greater value. Since the BPD is a linear measurement taken from one temporoparietal table to the other, it is accurate only if the head is appropriate. Some evidence indicates that the HC is a more useful index of fetal maturity in cases in which variations in the head shape (e.g. dolichocephaly, brachycephaly) adversely affect the accuracy of the BPD in predicting fetal age.(2)

The objectives of this study may be summarized as: firstly, to determine the normal relationship between HC and gestational age ($\pm$ 2 S.D.) measured at a specific level in the fetal brain using real-time ultrasound; secondly, to compare these values in our population with the western data; and thirdly, to provide baseline data for use in predicting menstrual age, estimating fetal weight and intrauterine growth retardation.

Patients and Methods

The study consisted of 450 normal pregnant women attending the antenatal clinic at Maharaj Nakorn Chiangmai between 14 and 40 weeks. The subjects had to meet the following criteria: firstly, history of regular menstruation and knowledge of the exact date of the last menstrual period; secondly, single pregnancy without medical or obstetrical complication, no evidence of intrauterine growth retardation and congenital anomalies; thirdly, attending the antenatal clinic within the first trimester of pregnancy and menstrual age consistent with clinical estimation; and fourthly Dubowitz scores must be assessed and the scores must confirm gestational age calculated from date.

All examinations were performed by using a linear array real-time scanner with a 3.5 MHz transducer (Aloka model SSD 630, 650). The measurement of HC was made from the same axial image used to measure the BPD. Proper imaging required that the fetal head be in an occiput transverse position.(3) Series of axial scans were made through the fetal brain, begining at the vertex and progressing caudally. Gain settings were adjusted so that the width of the skull table nearer the transducer was 3 mm.(4) At each measurement, the midline echo of the fetal skull, cavum septum pellucidum and thalamus were clearly visible on the scan display, and measurement was made along the outer perimeter of the calvarium with electronic elipse calipers, an accurate the modern technique. Each measurement was obtained from the average of the three best measurements during each examination.

All examinations were performed by two of the authors (T.T., C.W.) who did not know the menstrual age of the patients. Dubowitz scores were assessed by only one pediatrician who had no information about the obstetric data of the patients. The collected data were stored in a microcomputer and subsequently analyzed.

Results

A total of 1,251 measurements of HC were obtained from 450 pregnant Thai women; 240 patients had one measurement each and the remaining 210 had serial measurements. The mean HC and standard deviation for each gestational week are calculated and shown in table 1, and figure 1. Additionally, the 5^{th}, 50^{th} and 95^{th} percentiles are also shown in table 1 and Figure 1. There is progressive linear increase from the first trimester toward term. Linear qauadratic function could be considered an optimum model for predicting menstrual age from HC (r^2 = 0.97, p = 0.001). The regression equation for these data is gestational age (weeks) = 10.69689 + 0.24104 (HC in cms) + 0.01782(HC^2). Predicted menstrual age values for specific HC measurements are indicated in table 2. For HC (cm.) as a dependent variable and gestational age (weeks) as an independent variable, the equation (r^2 = 0.97, p = 0.000) is HC (cms) = − 14.88262 + 1.99846 (GA in weeks) − 0.01993 (GA^2). The predicted HC value for a given gestational week based on the quadratic function was determined and shown in table 3. In comparison with other studies, the HC growth pattern was consistent with sonographic studies of the western investigators but our values are somewhat lower.

Table 1. Mean fetal HC with SD, 5^{th}, 50^{th} and 95^{th} percentile for GA.

GA week	No. of exam. (n.)	Mean (cm.)	SD (cm.)	5^{th} percentile	50^{th} percentile	95^{th} percentile
14	39	10.25	0.82	9.0	10.2	11.2
15	40	10.71	0.68	9.6	10.7	11.9
16	40	11.42	0.11	9.5	11.3	13.4
17	44	13.47	0.90	11.5	13.5	15.0
18	43	14.54	1.14	12.9	14.4	16.8
19	49	16.18	1.72	13.8	15.9	17.8
20	50	16.54	1.02	14.0	16.7	17.6
21	50	18.14	1.21	15.8	18.2	20.0
22	41	18.84	1.17	16.7	18.8	20.9
23	40	20.39	1.31	18.2	20.2	22.5
24	45	21.08	1.03	18.5	21.1	22.7
25	44	22.14	1.03	19.6	22.1	23.7
26	44	23.48	1.41	20.6	23.4	25.6
27	48	24.62	1.24	22.0	24.5	26.5
28	47	25.55	1.41	23.0	25.5	28.7
29	49	26.93	1.43	24.1	27.0	29.8
30	48	27.53	1.23	24.3	27.5	29.0
31	58	28.47	1.30	26.0	28.4	30.7
32	49	28.78	1.11	26.6	28.8	30.6
33	50	29.74	1.17	27.5	29.7	31.7
34	50	29.97	1.09	28.1	29.9	32.1
35	49	30.89	1.29	28.3	30.8	33.2
36	47	31.23	1.07	28.9	31.2	32.7
37	56	31.29	1.23	29.2	31.3	33.2
38	48	32.11	1.05	30.1	32.2	34.0
39	42	32.67	1.23	30.7	32.6	34.7
40	41	32.95	1.03	30.8	32.9	34.5

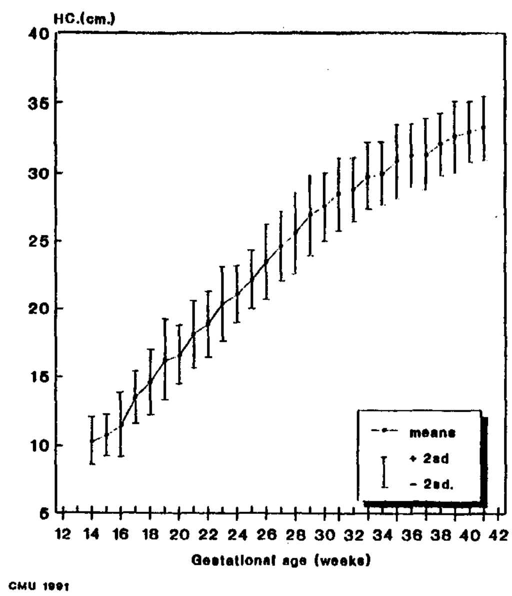

Figure 1. Correlation between HC. and GA. in normal pregnant Thai women.

Table 2. Predicted Menstrual Age for Head Circumferences.

HC (cms)	GA (weeks)	HC (cms)	GA (weeks)
8.0	13.8	22.0	24.5
8.5	14.0	22.5	25.1
9.0	14.3	23.0	25.7
9.5	14.6	23.5	26.2
10.0	14.9	24.0	26.7
10.5	15.2	24.5	27.3
11.0	15.5	25.0	27.9
11.5	15.8	25.5	28.4
12.0	16.2	26.0	29.0
12.5	16.5	26.5	29.6
13.0	16.8	27.0	30.2
13.5	17.2	27.5	30.8
14.0	17.6	28.0	31.4
14.5	17.9	28.5	32.0
15.0	18.3	29.0	32.7
15.5	18.7	29.5	33.3
16.0	19.1	30.0	34.0
16.5	19.5	30.5	34.6
17.0	19.9	31.0	35.3
17.5	20.4	31.5	36.0
18.0	20.8	32.0	36.7
18.5	21.3	32.5	37.4
19.0	21.7	33.0	38.1
19.5	22.2	33.5	38.8
20.0	22.6	34.0	39.5
20.5	23.1	34.5	40.2
21.0	23.6	35.0	41.0
21.5	24.1	35.5	41.7

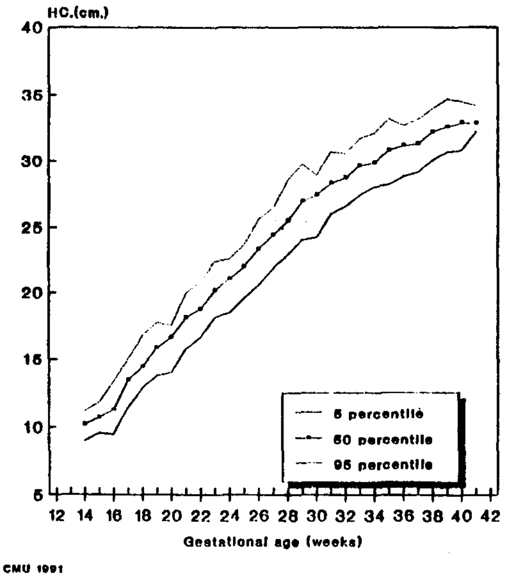

Figure 2. Percentile chart of HC. and GA. in normal pregnant Thai women.

Table 3. Comparison of Predicted Mean HC (cm.) Among Different Studies.

GA week	Hadlock (1)	Merz (4)	Campbell (5)	This study
14	9.8	9.7	11.0	9.2
15	11.1	11.1	12.2	10.6
16	12.4	12.4	13.3	12.0
17	13.7	13.7	14.4	13.3
18	15.0	15.0	15.5	14.6
19	16.3	16.3	16.7	15.9
20	17.5	17.5	18.0	17.1
21	18.7	18.8	19.2	18.3
22	19.9	19.9	20.3	19.4
23	21.0	21.1	21.5	20.5
24	22.1	22.2	22.7	21.6
25	23.2	23.3	23.8	22.6
26	24.2	24.4	25.0	23.6
27	25.2	25.4	26.0	24.5
28	26.2	26.4	27.0	25.4
29	27.1	27.4	27.9	26.3
30	28.0	28.3	28.8	27.1
31	28.9	29.2	29.6	27.9
32	29.7	30.1	30.4	28.7
33	30.4	30.9	31.1	29.4
34	31.2	31.7	31.8	30.0
35	31.8	32.5	32.5	30.6
36	32.5	33.2	33.0	31.2
37	33.0	33.9	33.6	31.8
38	33.6	34.6	34.0	32.3
39	34.1	35.2	34.5	32.7
40	34.5	35.8	34.8	33.2

Discussion

In our experience, establishing or verifying menstrual age is still the most common indication for an obstetric ultrasonography. The fetal biparietal diameter (BPD) is a reliable parameter that is most commonly used for that purpose. Since the BPD is a linear measurement taken from one temporoparietal table to the other, it is only accurate if the head is the appropriate ovoid shape. If the head is unusually rounded (brachycephalic) or unusually elongated (scaphocephalic or dolichocephalic), the standard BPD measurement would over- or under-estimate the head size. Some investigators found that if the cephalic index (BPD/occipitofrontal diameter × 100) is abnormal, i.e. greater than 86 or less than 70, the BPD measurement is no longer a reliable parameter.[7,8]

The earliest prenatal use of HC measurement was as part of the HC/AC ratio for the detection of an abnormal growth pattern such as asymmetrical IUGR.[9] More recently, several authors have indicated that the HC measured in utero is a good index of menstrual age with variability that is generally equal to that based on the BPD.[1,10] In the last six weeks of pregnancy, the head circumference is actually a better indicator of menstrual age than BPD,[1] primarily because it is a more shape-independent measurement than BPD and thus not as significantly affected by the molding that often occurs in the third trimester of pregnancy.

The limitations of this study may be summarized as follows: firstly the variation between two ultrasonologists, secondly we could not longitudinally examine every patient; and thirdly, technical difficulty was encountered in some measurements because of poorly defined margins.

Our fetal HC growth patterns agree relatively well with those of western investigators, but our values are somewhat lower. We hope that the values from this large series provide useful baseline data for the evaluation of fetal HC growth in our population, since it is more appropriate for application with Thai women than those of Caucacian studies. These data may be useful as an adjunct parameter in predicting menstrual age, especially in cases of abnormal head shape, and adjunct to evaluate fetal growth or fetal size. Additionally, fetal HC is useful in diagnosis of some abnormalities, e.g. hydrocephalus.

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