Transvaginal Sonographic Measurements of Crown-Rump Length as a Predictor of Gestational Age

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Abstract : *The relation between fetal crown-rump length (CRL) and gestational age was determined by crossed sectional analysis of 251 normal fetuses (6-14 weeks) using transvaginal sonography. Mathematical modelling of the data demonstrated that the CRL growth curve is nonlinear. Predicted menstrual age values in days for specific CRL measurements in millimeters were calculated and are reported in tabular forms. The variability (± 2 SD) associated with predicting menstrual age from CRL is ± 5.8 days between 6-14 weeks. CRL can be used as an adjunct in estimating menstrual age, and may be useful in predicting fetal outcome of threatened abortion in the first trimester. Predicted CRL values at various points in gestation were comparable to the results of other investigators. (Thai J Obstet Gynaecol 1993;5:1-5.)*

Key words : crown-rump length (CRL), gestational age, ultrasound

After the sonographic appearance of the fetal pole, one can establish fetal age to within 3-5 days by measurement of the fetal crown-rump length (CRL)[1-4]. This is the earliest and most accurate way to assess gestational age during pregnancy. The measurement is most accurate between 8 and 12 weeks when the long axis of the fetus is clearly visualized[4]. Results of CRL measurements in a western population have been published by several workers. Unfortunately, no report of the growth of fetal CRL in pregnant Thai women has been conducted, and some evidence has demonstrated that the size of Thai babies is somewhat lower than that of western ones[5,6], and some sonographic parameters are shorter than ones of western population, e.g. fetal femur length[7]. The CRL normogram of previous studies, therefore, may not be appropriate for evaluating Thai pregnancy and we need our own data to have the standard values for the Thai population. Moreover, CRL measurements in previous studies were achieved by using transabdominal sonography of which

the imaging is poorer than transvaginal sonography[8]. We, therefore, decided to measure the fetal CRL using transvaginal sonography in pregnant northern Thai women to create a normogram of fetal CRL for our population.

Patients and Methods

The studied patients consisted of 251 normal pregnant women attending the antenatal clinic at Maharaj Nakorn Chiang Mai Hospital from March 1,1991 to September 30, 1992. The subjects had to meet the following criteria : firstly, gestational age between 6-14 weeks; secondly, history of regular menstruation and knowledge of the exact dates of the last menstrual period; thirdly, singleton pregnancy without medical or obstetrical complications or fetal congenital anomalies; fourthly, the gestational age calculated from date consistent with clinical estimation and Dubowitz scores, subsequently assessed. The measurement was performed only once for each patient.

The fetal CRL, and the long axis of the fetal pole were measured by means of electronic calipers from the top of the crown (head) to the bottom of the rump and the average length from three seperate best images were used as recommended by Robinson and Fleming[4]. All examinations were performed by the author who did not know the menstrual age of the patients, using the real-time transvaginal sector scan with 5.0 MHz

(Aloka, Model SSD 650). The collected data were stored in a microcomputer and subsequently analyzed.

Results

A total of 251 measurements of CRL were obtained from 251 normal Thai pregnant women from the 40th to the 100th day calculated from the last menstrual period, at least 20 measurments for each week of gestation. The distribution of CRL for each day of gestation between 6-14 weeks is presented in Fig. 1. There is progressive increase of CRL throughout the first trimester. The linear quaudratic function was the best model for describing the relation between CRL(mm) and gestational age (days) ($r^2 = 0.92.71$, SE=4.39157, p=0.0000). The correlation was formulated, gestational age (days) =25.66177+
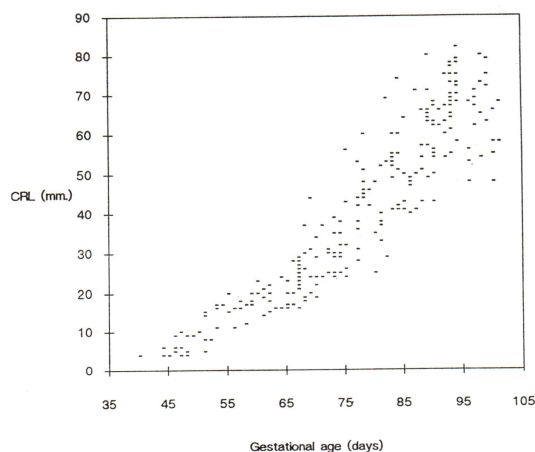

Fig. 1 The distribution of CRL for each gestational day.

Table 1 Predicted gestational age (days) from crown-rump length with upper and lower limit (95% confidence interval)

CRL mm.	GA days	Lower limit	Upper limit	CRL mm.	GA days	Lower limit	Upper limit
4	43	39.22	46.78	44	81	79.00	83.00
5	45	41.30	48.70	45	82	80.00	84.00
6	47	43.36	50.64	46	82	79.98	84.02
8	50	46.51	53.49	47	83	80.96	85.04
9	51	47.58	54.42	48	83	80.94	85.06
10	53	49.65	56.35	49	84	81.91	86.09
11	54	50.72	57.28	50	84	81.87	86.13
12	55	51.79	58.21	51	85	82.85	87.15
14	58	54.93	61.07	52	85	82.81	87.19
15	59	55.99	62.01	53	86	83.76	88.24
16	60	57.07	62.93	54	86	83.72	88.28
17	61	58.13	63.87	55	87	84.68	89.32
18	62	59.19	64.81	56	87	84.62	89.38
19	63	60.24	65.76	57	88	85.58	90.42
20	64	61.31	66.69	58	88	85.53	90.47
21	65	62.36	67.64	60	89	86.42	91.58
22	66	63.42	68.58	61	90	87.36	92.64
23	67	64.47	69.53	62	90	87.31	92.69
24	67	64.53	69.47	63	91	88.24	93.76
25	68	65.58	70.42	64	91	88.18	93.82
26	69	66.64	71.36	65	91	88.13	93.87
27	70	67.68	72.32	66	92	89.07	94.93
28	71	68.72	73.28	67	92	88.99	95.01
29	71	68.76	73.24	68	93	89.93	96.07
30	72	69.81	74.19	69	93	89.86	96.14
31	73	70.85	75.15	70	93	89.79	96.21
32	74	71.87	76.13	71	94	90.72	97.28
33	74	71.91	76.09	72	94	90.65	97.35
34	75	72.94	77.06	73	95	91.58	98.42
35	76	73.96	78.04	75	95	91.44	98.56
36	76	73.98	78.02	77	96	92.28	99.72
37	77	75.00	79.00	78	96	92.21	99.79
38	78	76.00	80.00	79	97	93.14	100.9
39	78	76.03	79.97	80	97	93.007	100.9
40	79	77.03	80.97	82	98	93.91	102.1
41	79	77.03	80.97	83	98	93.84	102.2
42	80	78.03	81.97	85	99	94.68	103.3
43	81	79.03	82.97	86	99	94.61	103.4

$8.61475 \sqrt{CRL} - 0.00086015 (CRL)^{(2)}$. Predicted gestational age values, calculated from the equation, for specific CRL measurements are indicated in Table 1 and Fig. 2.
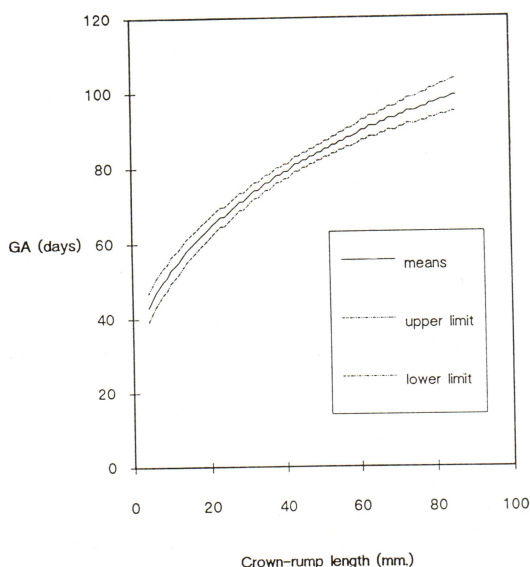

Fig. 2 Predicted gestational age from CRL and 95% confidence interval.

The variability (± 2 SD) associated with predicting gestational age from CRL is ± 5.8 days between 6-14 weeks.

In comparison with other studies, the CRL growth pattern was consistent with sonographic studies of the western investigators[1-4].

Discussion

The initial accuracy of the CRL was felt to be extremely high, approaching ± 2.7 days, and was therefore recommended as the best measurement to establish the gestational age[4]. Since then, other observers have evaluated the CRL and found it to be somewhat less accurate. Although still one of the best estimates, with an accuracy of ± 5-7 days, the CRL is comparable with a second trimester biparietal diameter measurement[3,9]. Robinson and Fleming[4] noted that variations in CRL can be attributed to 1) biologic variations in fetal size, 2) variation in the timing of ovulation and fertilization, and 3) errors in the measurement techniques. The variations of CRL due to errors in measurement technique in this study may be reduced by transvaginal sonography and being performed by only one sonographer. This study indicates that the biological variation of the fetal CRL growth is progressive with gestational age, the 95% confidence interval is wider at the end of the first and early second trimesters.

When measuring the CRL, it is very important to avoid including the yolk sac in the measurement, this will artificially lengthen the measurement and lead to an overestimation of gestational age. This error could be corrected with transvaginally examination due to the better imaging. The CRL should be used only until the fetal head is identified. As the fetus continues to grow beyond 12 weeks, it is more likely to flex and extend, making the CRL measurement less accurate.

In comparison with other studies, the CRL growth pattern was consistent with sonographic studies of

western investigators[1-4]. However, the values of this study are somewhat lower than the western ones, this may be due to the racial factor.

Due to the fact that this normogram was created from the various unselected socio-economic population and adequate sample size for each gestational week, calculated from the variability of a previous study[4], so we believe that this series can be effectively used as a standard one for application with northern Thai women. This CRL normogram is more appropriate for application with pregnant northern Thai women than western ones.

In addition to the prediction of gestational age, CRL can be used as prognostic factor in threatened abortion. It was previously demonstrated that the CRL growth delay in first trimester abortion with the presence of fetal heart beat would predict poor pregnancy outcome[10].

Acknowledgements

References

1. Bovicelli L. Estimation of gestational age during the first trimester by realtime measurement of fetal crown-rump length and biparietal diameter. JCU 1981;9:71-5.

2. Drumm JE, Mackenzie G. The ultrasonic measurement of fetal crown-rump length as a method of assessing gestational age, Br J Obstet Gynaecol 1976;83:417-21.

3. Kopta MM, May RR, Crane JP. A comparison of the reliability of the estimated date of confinement predicted by crown-rump lenght and biparietal diameter. Am J Obstet Gynecol 1983;145:562-6.

4. Robinson HP, Fleming JEE. A critical evaluation of sonar "Crown-rump length" measurements. Br J Obstet Gynaecol 1975;82:702-10.

5. Thaithumayanon P, Bhongvej S, Chittnand S. Intrauterine growth in Thai population. J Pediatr Soc Thailand 1984;23:99-105.

6. Nondasuta A, Chaturachinda K, Watana-Kasetr S. Birthweight in relation to maternal height and weight. J Med Assoc Thailand 1986;69:243-7.

7. Tongsong T, Wanapirak C, Takapijitr A. Ultrasound fetal femur length in normal pregnant Thai women. Thai J Obstet Gynaecol 1991;3:79-83.

8. Dodson MG. Transvaginal ultrasound. New York : Churchill Livingstone, 1991: 10-2.

9. Smazal SF, Weisman LE, Hoppler KD, et al. Comparative analysis of ultrasonographic methods of gestational age assessment. J Ultrasound Med 1983;2: 147-51.

10. Mantoni M. Ultrasound signs in threatened abortion and their prognostic significance. Obstet Gynecol 1985;65:471-5.