Transvaginal Sonography for Fetal Crown-Rump Length Measurement in a Thai Population

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Abstract

A prospective descriptive cross-sectional study was undertaken at the Department of Obstetrics and Gynecology, Faculty of Medicine, Chulalongkorn University to establish a reference interval for fetal crown-rump length (CRL) in a Thai population using transvaginal ultrasound. This study was performed on normal pregnant women registered at the antenatal clinic in their first trimester. All had a good menstrual history. CRL measurement was obtained by a 5 MHz vaginal probe. All of the newborns were proved to be normal at birth. We constructed and compared CRL (mm) relating to gestational age (GA) (days). Five hundred and forty seven cases were enrolled into the study. CRL was correlated with gestational age. The best fit regression equation was the quadratic model: CRL (mm) = -13.872 – 0.014 GA (day) + 0.0097 GA (day)^2, R = 0.92, $p < 0.0001$). Centiles and a chart for CRL derived from the regression equation are presented. In conclusion, a reference interval for fetal crown-rump length in a Thai population has been established. This data may be useful in the early detection of genetic or environmental disorders affecting fetal growth in the first trimester of pregnancy.

Key word : Reference Interval, Crown-Rump Length, Transvaginal Ultrasound, First Trimester

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Since the introduction of ultrasound into obstetric practice, fetal growth has been extensively studied in the second and third trimesters of pregnancy(1). Few data are available on embryonic/fetal growth before 14 weeks(2,3). The reference interval currently in use for crown-rump length (CRL) measurements was derived from data collected with transabdominal compound B-scan

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equipment(4). Transvaginal sonography, with its high resolution imaging, provides superior resolution with earlier and more accurate identification of fetal structures than transabdominal ultrasound. In view of these advantages, transvaginal sonography is now used in obstetrics for an increasing number of indications especially in the first trimester of pregnancy(5).

Since precise determination of both gestational age and fetal size is a prerequisite for diagnosis of deviations from normality, a reference interval for fetal CRL measurement in the first trimester is clearly required. However, a reference interval derived from transabdominal ultrasound might not be adequate for measurement obtained with the new transvaginal technique. In addition, a reference interval for fetal CRL in each population might not be the same. To our knowledge, there is no report of fetal CRL in a Thai population.

The aim of this study was to establish a reference interval for fetal crown-rump length in a Thai population using transvaginal ultrasound.

MATERIAL AND METHOD

We recruited normal pregnant women registered at the antenatal clinic from January 1996 to April 1998 at the Department of Obstetrics and Gynecology, Faculty of Medicine, King Chulalongkorn Memorial Hospital, Chulalongkorn University, Thailand. All had a reliable menstrual history, with a menstrual cycle length between 28 and 30 days, were certain of the first day of the last menstrual period and were not on oral contraception in the three months before conception. Gestational age was calculated in days from the time since the first day of the last menstrual period (LMP). Any known maternal pathology, multiple pregnancy or threatened abortion were excluded. Sonographic examinations were performed with a 5 MHz high-frequency transvaginal transducer (Aloka SSD 2000, Tokyo, Japan). Ultrasonographic energy was maintained at less than 100 mW/cm2. This study was approved by the ethical committee of the Faculty. After informed consent was obtained, the women were placed in the lithotomy position with an empty bladder. The probe was covered with coupling gel and introduced into a sterile condom that was also lubricated with coupling gel. The CRL was measured along the longest axis with the embryo/fetus in an extended position(6). All measurements (in millimeters) were made directly on the frozen screen by means of calipers applied to the outer margins of the head and the trunk (Fig. 1). An embryo/fetus was studied once. All scans were performed by Maternal–Fetal Medicine specialists between 12.00-14.00 hours. Duration of the ultrasound examination in each woman was approximately 2 minutes.

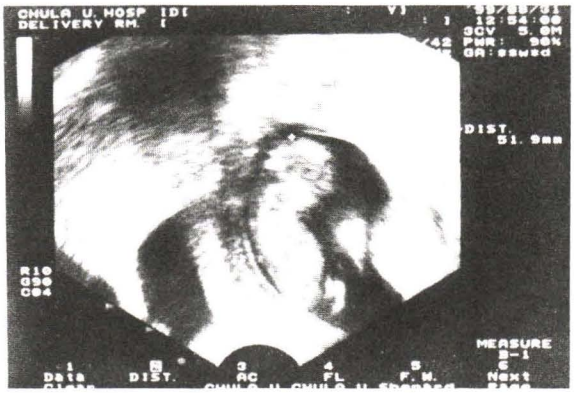

Fig. 1. Transvaginal ultrasound illustrating the method used to obtain fetal crown-rump length measurement.

Pregnancy outcome information was obtained *via* hospital records, telephone and mail surveys. All of the newborns were normal and weighed between the 10th and 90th percentile for our standard.

A personal computer with an SPSS program was used for statistical analysis of the data. Scatter plots of fetal CRL compared with gestational age were obtained. The data was analyzed for mean, standard deviation, the 5th, 50th, and 95th percentile and the best fit regression curve and the correlation coefficient were established.

RESULTS

During the time period of the study, 547 CRL measurements were obtained. The mean age of the women studied was 27.4 years (standard deviation [SD] 5.4, range 15-44), and the mean gestational age was 73.9 days (SD 11.4, range 42-98). CRL measurement ranged from 2.9 to 78 mm.

Fig. 2 represents a scattergram of CRL plotted against gestational age showing a curvilinear relationship between the two variable. Table 1 presents the corresponding CRL for gestational age

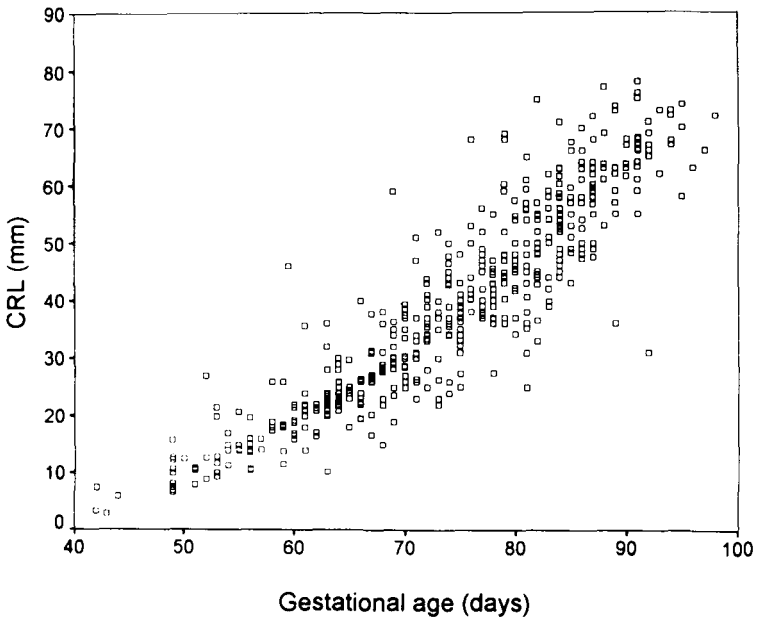

Fig. 2. Relationship between fetal crown-rump length and gestational age.

Table 1. Fetal crown-rump length (mm) based on gestational age (N = 547 cases).

GA (days)	No	Mean	SD	5th Centile	50th Centile	95th Centile
40-44	4	4.9	2.3	2.9	4.7	7.5
45-49	9	10.1	3.1	6.6	10.0	15.8
50-54	18	13.5	4.9	8.0	12.1	27.0
55-59	30	17.3	6.5	10.7	16.0	26.0
60-64	63	22.0	4.7	16.0	22.0	30.0
65-69	72	27.7	6.3	19.0	27.0	37.7
70-74	70	35.2	7.3	24.0	35.0	47.7
75-79	77	43.4	8.6	31.0	42.0	60.3
80-84	106	50.4	8.2	36.1	50.0	63.0
85-89	59	58.3	8.0	47.3	58.0	73.0
90-94	32	65.8	8.2	55.0	67.0	76.0
95-99	7	67.2	6.0	58.0	68.0	74.0

GA = gestational age, SD = standard deviation

and number of cases. CRL was correlated with gestational age. To determine which regression model would best fit the data, the following were tested: straight line, quadratic, cubic, and quaternary. The best fit regression equation was the quadratic model: CRL (mm) = -13.872 – 0.014 GA (day) + 0.0097 GA $(day)^2$, R = 0.92, $p < 0.0001$).

The median, 5th and 95th percentiles of CRL for gestational age derived from the regression equation are given in Table 2 and Fig. 3.

DISCUSSION

The error of CRL measurement by transabdominal ultrasound can be reduced by using a higher frequency transvaginal transducer that produces a better image quality because of the increased resolution[5]. Therefore, earlier and more accurate measurements of CRL can be obtained [2,3,7]. Using the transvaginal probe, sonographic visualization of the fetal CRL in our study can be obtained as early as 2.9 mm.

Table 2. Fetal crown-rump length (mm) based on gestational age derived from regression equation.

GA (Days)	5th Centile	50th Centile	95th Centile	SD
45	0.5	5.1	9.8	2.8
50	4.1	9.7	15.3	3.4
55	8.2	14.7	21.2	3.9
60	12.8	20.2	27.6	4.5
65	17.9	26.2	34.5	5.1
70	23.5	32.7	41.9	5.6
75	29.5	39.6	49.8	6.2
80	36.0	47.1	58.1	6.7
85	43.1	55.0	67.0	7.3
90	50.6	63.4	76.3	7.8
95	58.6	72.3	86.1	8.4
100	67.0	81.7	96.4	8.9

GA = gestational age, SD = standard deviation

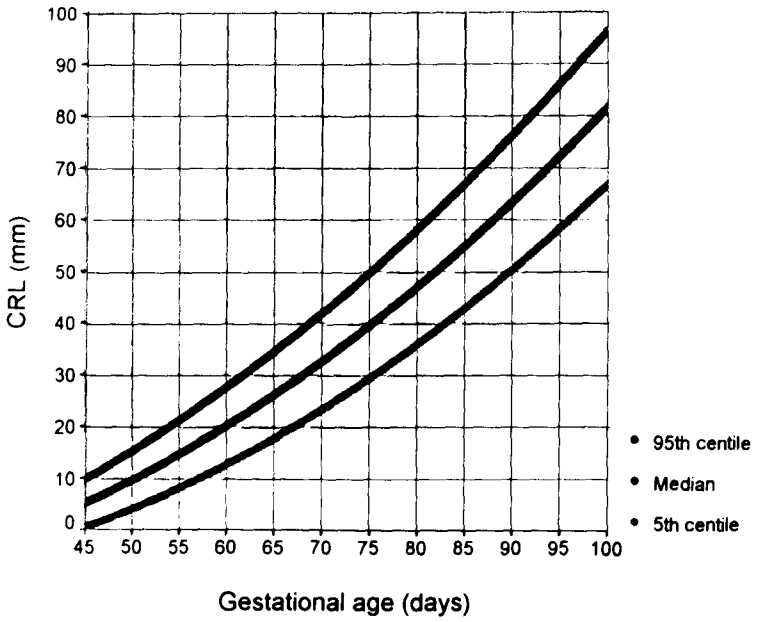

Fig. 3. Reference interval of fetal crown-rump length (CRL) by gestational age (derived from regression equation and expressed as median, 5th and 95th centile).

The results of our cross-sectional study provide normative data of fetal CRL throughout the first trimester of pregnancy. Our results confirm that in early pregnancy a curvilinear relationship exists between gestational age and fetal CRL[2,3,7]. The best fit for CRL growth was a quadratic function. Estimate of CRL measurements with gestational age in our study were observed to be similar to published studies from Caucasean[3] and European[2] populations which were performed by the same methods especially between 42-84 days of gestation. Therefore, any ethnic effect on fetal size is not apparent in early pregnancy and this has been confirmed by Parker et al[8]. They performed

a study in the UK by using a transabdominal ultrasound and found that there were no significant differences between the Asians and European parameters for CRL curve. All Asians in their study had ethnic origins in the Indian subcontinent[8].

The question of whether autosomal trisomies are associated with first-trimester growth restriction is of clinical interest. If they are, then first-trimester measurement of fetal CRL offers an opportunity for identifying high-risk pregnancies. Several reports have noted first-trimester CRL shortening in trisomy 18, trisomy 13 and triploidy compared with normal fetuses, whereas, trisomy 21 cases which were reported were spared this shortening[9-12]. Therefore, in at-risk pregnancies CRL that is shorter than expected significantly increases the odds that aneuploidy is present.

In addition, first-trimester measurement of fetal CRL is generally regarded as the most precise ultrasonographic method of pregnancy dating[13-16]. The margin of error is reported to be 3-5 days (4,13). Therefore, in women with uncertain LMP, fetal CRL measurement in early pregnancy is the most accurate prediction of gestational age. Accurate assessment of gestational age is most helpful to obstetric care, especially in a high risk population, in which menstrual histories are not reliable.

In conclusion, our reference interval for fetal CRL obtained from 547 embryos/fetuses may be useful in evaluating fetal growth and pregnancy dating in early pregnancy. This would facilitate the assessment of fetuses at risk of genetic or environmental disorders affecting growth early in fetal life. In addition, such information may prove to be useful in understanding the problem of recurrent pregnancy loss, especially if early fetal growth restriction is observed before fetal death.

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การวัดความยาว crown–rump ของทารกในครรภ์โดยคลื่นเสียงความถี่สูงทางช่องคลอดในสตรีไทย

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ผู้วิจัยได้ทำการศึกษาที่ภาควิชาสูติศาสตร์–นรีเวชวิทยา คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย เพื่อหาค่าอ้างอิงสำหรับความยาว crown–rump ของทารกในครรภ์โดยการตรวจด้วยคลื่นเสียงความถี่สูงทางช่องคลอดในสตรีไทย สตรีตั้งครรภ์ที่เข้าร่วมการศึกษา คัดเลือกจากสตรีตั้งครรภ์ปกติในระยะไตรมาสแรกของการตั้งครรภ์ ที่มารับการตรวจที่คลินิกฝากครรภ์ โดยมีประวัติประจำเดือนที่แน่นอน การวัดความยาว crown–rump ของทารกในครรภ์ โดยอาศัยหัวตรวจที่มีความถี่ 5 เมกาเฮิทซ์ ทารกทุกรายปกติ ผู้วิจัยได้ทำการเปรียบเทียบความยาว crown–rump ของทารกในครรภ์เทียบกับอายุครรภ์ (วัน) โดยมีสตรีตั้งครรภ์ 547 รายเข้าร่วมการศึกษา พบว่าความยาว crown–rump ของทารกในครรภ์แปรตามอายุครรภ์ โดยมีสมการถดถอยที่เหมาะสมที่สุด เป็นแบบสมการที่มีกำลัง 2 ดังนี้ : ความยาว crown–rump (มม.) = −13.872 − 0.014 อายุครรภ์ (วัน) + 0.0097 อายุครรภ์ (วัน)^2, R = 0.92, p < 0.0001 จากสมการดังกล่าวได้นำมาสร้างเป็นค่าเปอร์เซ็นต์ไทล์และกราฟสำหรับค่าความยาว crown–rump ของทารกในครรภ์ กล่าวโดยสรุปรายงานนี้ได้ทำการหาค่ามาตรฐานที่ใช้เป็นค่าอ้างอิงสำหรับความยาว crown–rump ของทารกในครรภ์ในสตรีไทย ข้อมูลนี้เป็นประโยชน์ในการวินิจฉัยความผิดปกติที่เกิดจากพันธุกรรมและสิ่งแวดล้อม ที่อาจจะมีผลกระทบต่อการเจริญเติบโตของทารกในระหว่างไตรมาสแรกของการตั้งครรภ์

คำสำคัญ : ค่าอ้างอิง, ความยาว crown–rump, การตรวจคลื่นเสียงความถี่สูงทางช่องคลอด, ไตรมาสแรก

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