Reference Centile Chart for Fetal Liver Length of Thai Fetuses

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Objective : *To create a reference centile chart for fetal liver length of Thai fetuses.*
Design : *Prospective, cross-sectional study.*
Setting : *Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Faculty of Medicine Siriraj Hospital, Mahidol University.*
Material and Method : *A total of 752 pregnant women, who attended the antenatal clinic at Siriraj Hospital, Mahidol University, Bangkok, were recruited between 13-40 weeks of gestation. Each fetus was measured only once for the purpose of this study. Using real-time ultrasound with a 3.5 MHz convex transducer, the authors measured fetal liver length. The mean and standard deviation (SD) were estimated at each week of gestation using linear regression modeling.*
Results : *A total of 750 fetuses were measured for fetal liver length. Linear regression models were fitted to estimate the mean and 95% confidence interval for liver length at each gestation age. The centile chart of liver length was also presented.*
Conclusion : *A reference centile chart for fetal liver length of Thai fetuses has been created.*

Keywords : *Fetal liver length, Centile chart*

J Med Assoc Thai 2004; 87(7): 750-4

Recent advances in real-time ultrasound technology allow very detailed examination of the fetal anatomy. Normal reference values of Thai fetuses have been established throughout gestation for various fetal body dimensions such as biparietal diameter (BPD)[1-3], head circumference (HC)[4], abdominal circumference (AC)[5,6]and femur length (FL)[7]. To date, the utility of fetal liver length by ultrasound examination plays a major role in assessment and management of medical or obstetric complications during pregnancy with aberrant fetal growth pattern,e.g., intrauterine growth restriction (IUGR)[8], gestational diabetes(GDM)[9] and twin to twin transfusion syndrome[10]. Several reports have used fetal liver length for assessment and surveillance of fetal anemia from various causes, e.g., isoimmunized pregnancy[11-13]and homozygous alpha-thalassemia-1[14]. Several groups in Western countries have published normal reference values for their own fetal liver length. Unfortunately, there is no standard reference of this for Thai fetuses. In this study, the authors established reference ranges throughout pregnancy from 13-40 weeks of gestation for clinical utilization.

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Material and Method

Study Population

A total of 752 pregnant women, who attended the antenatal clinic at Siriraj Hospital, Mahidol University, Bangkok, were recruited in their first trimester. Each pregnancy was a singleton, without medical, surgical or antenatal obstetric complications. History of regular menstruation and exact date of last menstruation period were also noted. The crown-rump length (CRL) measurement was performed on every case to confirm gestational age. If the gestational age calculated from the last menstrual period and from the ultrasonographic CRL measurement was less than 5 days different, the assigned gestational age would be based on the last menstrual period[15]. If the difference was more than 5

days, the authors assigned the gestational age from that calculated by ultrasonographic measurement.

Each woman had three ultrasonographic measurements at the first visit, at 18-20 weeks along with fetal anomaly scan, and at randomly assigned gestational age for liver measurement. The fetal biometric measurements such as biparietal diameter, head circumference, abdominal circumference and femur length were routinely obtained during every scan to ensure appropriate fetal growth. If fetal malformation, abnormal karyotype, intrauterine growth restriction, fetal macrosomia or severe oligohydramnios was detected, the case would be excluded from the analysis.

Study Measurement

Sonographic measurement of the fetal liver length was performed using the following technique, which is similar to that described by Vintzileous et al [16]. First, the fetal aorta was identified in a longitudinal plane; the transducer then was moved parallel to this plane until both the right hemidiaphragm and the tip of the right lobe of fetal liver were visualized. Finally, the fetal liver length was measured from the right hemidiaphragm to the tip of the right lobe. Measurements were not obtained when the fetus was in an unfavorable position (ie. back up, right side down). The ultrasonographic measurement of the fetal liver was made by ALOKA Dynaview 2, SSD 1700 with 3.5 MHz convex transducer. Freeze-frame capability was available and on screen calipers were used for the measurements.

Statistical Analyses

For each week of gestation, mean, standard deviation (SD), and centiles were calculated. Linear regression analysis and ANOVA to test the regression line were used to estimate the predicted values and their 95% confidence intervals of fetal liver length for each gestational age. This was based on the assumption that the data in each gestational age are normally distributed.

Results

A total of 752 pregnant women were recruited. Fetal liver length data were available from 750 measurements only due to unfavorable position in 2 fetuses. No cases with the abnormalities described previously were encountered. The number of fetuses measured at each gestation age is shown in Table 1.

Fig. 1 shows a scatter plot diagram of fetal liver length by weeks of gestation. The mean, SD, 5^{th}, 50^{th}, and 95^{th} percentiles of fetal liver length were calculated for each week of gestation. The data are displayed in Table 2.

The linear regression analysis was performed and the regression equation for predicting fetal liver length is……

$$\text{Liver length (mm.)} = 1.528 \times \text{GA (week)} - 5.676$$

Predicted values from the regression analysis and their 95% confidence intervals were estimated and plotted against the actual data as shown in Fig. 2.

The newborns were normal and weighted between 10^{th} and 90^{th} percentile based on the authors' standard.

Table 1. Number of fetuses measured at each week of gestation

Gestational age (weeks)	Number of fetuses	Percentage
13	24	3.2
14	26	3.5
15	33	4.4
16	31	4.1
17	19	2.5
18	28	3.7
19	25	3.3
20	32	4.3
21	35	4.7
22	29	3.9
23	28	3.7
24	30	4.0
25	25	3.3
26	26	3.5
27	38	5.1
28	29	3.9
29	26	3.5
30	23	3.1
31	28	3.7
32	30	4.0
33	28	3.7
34	33	4.4
35	23	3.1
36	40	5.3
37	26	3.5
38	20	2.7
39	12	1.6
40	3	0.4
Total	750	100.1

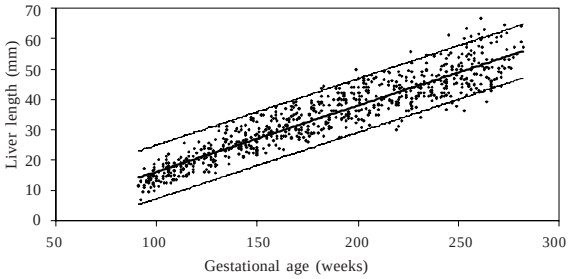

Fig. 2 The fetal liver length data, predicted value and their 95% confidence interval

Table 2. Fitted centiles of Thai fetal liver length

GA (weeks)	Mean	SD	5th Centile	50th Centile	95th Centile
13	12.59	2.08	7.52	13.00	16.70
14	14.75	2.54	10.45	14.60	19.58
15	16.62	2.48	12.44	16.50	21.41
16	18.44	2.46	14.62	18.50	23.88
17	21.18	2.53	16.00	21.00	26.00
18	21.80	3.74	16.03	21.50	30.46
19	25.61	3.27	19.43	25.20	32.28
20	25.98	3.00	21.19	25.75	31.44
21	27.76	4.47	21.84	27.60	35.12
22	30.04	3.49	23.65	30.00	36.60
23	31.00	3.65	23.67	31.25	37.39
24	32.24	3.98	26.30	31.95	39.09
25	33.58	4.21	26.57	35.00	39.44
26	35.36	4.43	28.57	34.50	44.12
27	37.75	4.40	27.40	38.60	43.68
28	38.55	5.04	29.50	40.00	48.35
29	41.46	4.97	31.96	43.00	47.65
30	41.93	4.88	32.68	40.70	49.32
31	41.42	4.72	30.45	42.65	48.55
32	42.70	4.74	36.15	41.50	53.62
33	44.73	4.11	36.56	44.05	53.33
34	45.59	4.70	37.51	45.80	54.37
35	48.02	5.85	38.12	49.80	60.10
36	49.83	6.18	41.33	49.10	60.95
37	51.76	7.31	40.45	50.35	65.40
38	49.76	5.79	42.95	48.05	60.97
39	55.05	4.44	50.10	54.40	64.50
40	60.06	3.49	57.30	58.90	64.00

Discussion

In this report the authors defined sonographically derived liver length measurements in normal Thai fetuses between 13-40 weeks of gestation. The data suggest that liver length demonstrates linear growth throughout gestation. The growth rate of the fetal liver length, calculated from the changes observed per week in the mean values, was found to be 1.528 mm per week between 13-40 weeks gestation.

Fetal liver length has several applications in clinical practice such as in evaluation of fetal growth in cases with intrauterine growth restriction (IUGR)[8], gestational diabetes (GDM)[9], or in twin to twin transfusion syndrome[10] and in surveillance of fetal anemia, e.g., in isoimmunized pregnancy[11-13] or in pregnancy with an homozygous alpha-thalassemia-1 fetus[14]. In general, the fetal liver is the earliest and most severely affected organ in fetal growth abnormalities. The direct ultrasonographic measurement of the fetal liver adds another parameter that could be used in the evaluation of early stages of abnormal fetal growth. A number of reports have indicated that the average birth weight of Thai fetuses is lower than that of Western populations[17,18]. Moreover, several data have confirmed that a different standard of ultrasound-based fetal growth is needed for different populations[19,20] . Therefore, it is very important to create a new chart of the fetal liver length that can be used more appropriately for Thai fetuses.

Compared to the normal reference values from aWestern population between 20-41 weeks' gestation[16], our resulting centile lines are lower. This may be due to racial differences between populations. This finding is consistant with the previous studies and emphasizes the need to construct separate fetal biometry charts for each specific population.

Since the number of pregnant women in the last two weeks of gestation in the studied population was quite small due to the prior deliveries of the majority of the women, the reference centile chart for these gestational ages might not be sufficiently accurate. Further studies are needed for a more reliable centile chart for late gestation.

In conclusion, the authors have established a reference chart for Thai fetal liver length between 13-40 weeks' gestation.

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ตารางอ้างอิงสำหรับขนาดทารกในครรภ์: ขนาดความยาวตับ

ชยวัฒน์ ผาติหัตถกร, ประเสริฐ ศันสนียวิทยกุล, พรพิมล เรืองวุฒิเลิศ, ดิฐกานต์ บริบูรณ์หิรัญสาร

ได้ทำการศึกษาแบบตัดขวางเพื่อสร้างตารางอ้างอิง สำหรับความยาวตับ (Liver length) ของทารกไทย ซึ่งวัดจากการตรวจด้วยเครื่องตรวจคลื่นเสียงความถี่สูง โดยทำการศึกษาสตรีตั้งครรภ์ปกติจำนวน 752 ราย อายุครรภ์ระหว่าง 13-40 สัปดาห์ ทำการวัดความยาวตับของทารกในครรภ์แต่ละรายที่อายุครรภ์ต่าง ๆ กัน โดยการสุ่มเพื่อการศึกษาครั้งนี้โดยเฉพาะ สามารถวัดความยาวของตับได้ทั้งหมด 750 ราย ทำการวิเคราะห์ข้อมูลโดยหาสมการถดถอยเชิงเส้น สำหรับค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐานของความยาวตับในช่วงอายุครรภ์ต่าง ๆ จากนั้นจึงทำการสร้างตารางอ้างอิงจากสมการทั้งสองในรายงานนี้ได้นำเสนอตารางอ้างอิงสำหรับขนาดความยาวของตับทารกไทยในครรภ์ และทำการเปรียบเทียบข้อมูลจากแหล่งอื่น พบว่าขนาดความยาวตับทารกไทยจะเล็กกว่าของทารกในประเทศทางตะวันตก แสดงถึงความสำคัญของเชื้อชาติต่อขนาดของทารกในครรภ์ ดังนั้นจึงมีความจำเป็นที่จะต้องสร้างตารางอ้างอิงเฉพาะสำหรับแต่ละภูมิภาค