Reference Centile Charts for Ratio of Fetal Transverse Cerebellar Diameter to Abdominal Circumference in a Thai Population

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Objective : To establish the centile chart for the ratio of transverse cerebeller diameter to abdominal circumference throughout pregnancy from 13-40 weeks

Design : Cross-sectional study.

Setting : Department of Maternal - Fetal Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University.

Subjects : The participants are women with gestational age between 13 and 40 weeks who attend Antenatal Clinic, Siriraj Hospital.

Material and Method : A total of 643 pregnant women were recruited in this study. The exclusion criteria were uncertained date of last menstrual period, multiple pregnancies, fetal abnormalities and maternal conditions which could affect fetal growth. Transverse cerebellar diameter and abdominal circumference of all the subjects were measured out by gestational age. The approximately equal numbers of fetuses were measured at each week of gestation. The mean and standard deviation of TCD/AC ratio is estimated at each week of gestation. In addition the 5th, 10th, 50th, 90th and 95th percentiles were calculated at each week of gestation.

Results : Of 643 pregnant women, 149 (23.1%) were scanned before 20 weeks of gestation and 286 (44.5%) were scanned between 20 and 30 weeks of gestation. The last group was intervened after 30 weeks of gestation. TCD/AC ratio slowly declined from early pregnancy until about 20 weeks then remained stable. After 30 weeks of gestation it started to decline again.

Conclusion : The normal reference value of TCD/AC ratio in Thai fetus were shown in this study. This ratio can be used to calculate gestational age in intrauterine growth restriction fetus.

Keywords : TCD/AC ratio, Reference centile chart , Thai fetus

Ultrasound assessment of fetal biometry has become the principal method of both confirming gestational age and monitoring fetal growth and development. Many fetal parameters can be measured with ultrasonography and have been correlated with gestational age. The most frequently used biometric parameters include the fetal biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL).

The cerebellum is a suprasegmental portion of the brain located within the cranial posterior fossa.

The fetal cerebellum can be visualized sonographically as early as 10 to 20 postmenstrual weeks. From second trimester, it grows rapidly within a linear relationship pattern correlating with gestational age. However, as the pregnancy advances, the growth curve of the cerebellum tends to flatten, showing a slower rate of evaluation. Since the cerebellum is located inside the posterior fossa and is surrounded by the dense, petrous ridges and the occipital bone, it should be able to with stand deformation by extrinsic pressure better than the parietal bone. The transverse cerebellar diameter (TCD) can better predict gestational age in cases in which variation of the fetal head shape such as dolichocephaly and brachycephaly or even when

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the fetus is in a direct occiput posterior position[1,2]. The TCD/AC ratio is independent of gestational age and may be useful in assessing fetal growth in pregnancies with unknown dating[3]. Unfortunately, there is no standard reference of TCD/AC for Thai fetuses. So, we design this study to establish the reference ranges of transverse cerebellar diameter/abdominal circumference throughout pregnancy from 13-40 weeks of gestation in order to use these indices in clinical management of Thai patients.

Material and Method
      This study was designed as a cross sectional study. We recruited 643 pregnant women between 13 and 40 weeks of gestation, and attended the antenatal clinic at Siriraj Hospital. The inclusion criteria were pregnant women who had previous regular menstrual period to current pregnancy and uterine size at that time of examination was compatible with menstrual age.
      Exclusion criteria were as follow:
      1. Uncertained date of last menstrual period
      2. Maternal conditions which may affect fetal growth eg, diabetes mellitus, hypertension, etc.
      3. Multiple pregnancies
      4. Fetal or neonatal malformation or abnormal karyotype of fetus detected by ultrasonography or genetic diagnosis.
      Transverse cerebellar diameter and abdominal circumference of all the subjects were measured out randomly assigned gestational age so that approximately equal number of fetuses were measured at each week of gestation.
      All ultrasonographic examinations were performed with Toshiba (ECC CEE, SSA-340A) ultrasound machine with a 3.5 MHz convex transdudcer. Electronic calipers were used and all measurements were obtained in centimeters and each fetus was included only once. The cerebellum was identified in the posterior fossa and measured in an outer to outer fashion. The abdominal circumference was obtained from a transaxial view at the level of the junction of the umbilical vein and left portal vein.
      The mean and standard deviation of TCD/AC ratio is estimated at each week of gestation. In addition the 5th, 10th, 50th, 90th and 95th percentiles were calculated at each week of gestation as well.

Results
      A total of 643 pregnant women were entered in this study. The number of fetuses measured at each week of gestation is shown in Table 1.

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

Gestational age (weeks)	Number of fetuses	Percent
13	9	1.4
14	21	3.3
15	27	4.2
16	27	4.2
17	19	3.0
18	23	3.6
19	23	3.6
20	29	4.5
21	29	4.5
22	25	3.9
23	24	3.7
24	28	4.4
25	24	3.7
26	23	3.6
27	36	5.6
28	26	4.0
29	23	3.6
30	19	3.0
31	27	4.2
32	27	4.2
33	23	3.6
34	30	4.7
35	18	2.8
36	34	5.3
37	20	3.1
38	15	2.3
39	11	1.7
40	3	0.5
Total	643	100.0

      Fig. 1 shows a scatter plot of fetal transverse cerebellar diameter (TCD)/abdominal circumference (AC) ratio in pregnancy. Reference centiles were calcu-
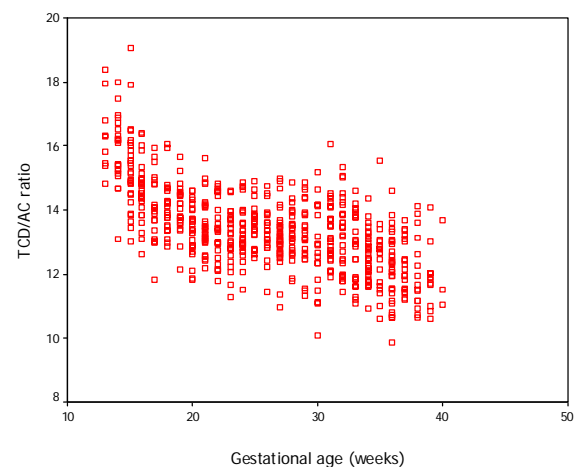

Fig. 1 Scatter plot of fetal transverse cerebellar diameter (TCD)/abdominal circumference (AC) ratio

lated from the estimated means and SDs at each week of gestation. It could be noted that TCD/AC ratio slowly declined from early pregnancy until about 20 weeks then remained stable. After 30 weeks of gestation it started to decline again.

Reference centile of TCD/AC ratio were created for each gestational age. The results are shown in Table 2.

Discussion

The data was collected in a cross-sectional fashion, measuring all the ratio for each fetus, specifically for the purpose of the study. The date of measurement was randomly assigned to each woman, so that approximately the same number of fetuses was measured at each week of gestation. However there were limited number of fetus at early pregnancy and near term.

Normal reference value for TCD/AC ratio have been studied by many investigators. Some investigators have found a high predictive value of TCD/AC ratio in predicting fetus with intrauterine growth restriction. However the ratio may be normal in cases of severe fetal growth restriction[4-7]. At the time of this study, there is no standard reference chart of TCD/AC ratio for Thai fetuses. The findings from this study will help identification and assessment of fetuses and create possibility and early intervention and therapy to prevent fetal morbidity and mortality.

In general, IUGR is usually suspected from a discrepancy between uterine size and gestational age. So, the predictive accuracy of clinical parameters for diagnosis of IUGR is poor. The diagnosis needs to be more precise and objective measure employed to assess the fetus with suspected IUGR. All existing evidence points to ultrasound as this objective modality. Ultrasound parameters for diagnosis of IUGR, AC appears to give the highest accuracy [84-100%][8-10]. However, AC can be used for the diagnosis of IUGR only in case of a known accurate date.

Table 2. Thai fetal TCD/AC ratio

Gestational age (weeks)	Mean	SD	Percentiles				
			5	10	50	90	95
13	16.36	1.18	14.81	14.81	16.31	18.39	18.39
14	15.85	1.09	13.26	14.67	16.08	17.38	17.92
15	15.28	1.32	13.19	13.61	15.20	16.81	18.58
16	14.60	0.92	12.80	13.24	14.53	16.07	16.38
17	14.13	1.05	11.85	12.98	14.06	15.69	15.98
18	14.07	0.81	12.88	13.03	13.92	15.47	16.01
19	14.04	0.77	12.28	13.06	14.04	15.08	15.58
20	13.34	0.75	11.85	12.10	13.38	14.38	14.60
21	13.54	0.83	12.31	12.46	13.38	14.86	15.31
22	13.39	0.95	11.88	12.13	13.38	14.71	14.80
23	13.13	0.84	11.36	11.87	13.15	14.27	14.58
24	13.27	0.81	11.75	12.34	13.06	14.70	14.80
25	13.53	0.63	12.54	12.68	13.62	14.53	14.84
26	13.33	0.75	11.60	12.31	13.35	14.49	14.71
27	13.12	0.81	11.31	12.45	13.03	14.30	14.91
28	13.28	0.74	11.83	12.25	13.32	14.28	14.70
29	13.26	1.02	11.36	11.51	13.28	14.68	14.85
30	12.82	1.34	10.09	11.07	12.90	14.65	15.18
31	13.27	0.96	11.98	12.10	13.08	14.45	15.43
32	13.21	1.14	11.58	11.81	13.20	15.04	15.23
33	12.81	1.09	11.09	11.22	12.93	14.12	14.51
34	12.55	0.77	11.29	11.64	12.47	13.58	14.05
35	12.50	1.13	10.62	10.95	12.71	13.96	15.53
36	12.16	1.03	10.44	10.68	12.22	13.51	14.02
37	12.25	0.79	11.18	11.24	12.06	13.39	13.66
38	12.05	1.16	10.63	10.68	11.68	13.96	14.10
39	11.88	0.99	10.59	10.64	11.84	13.87	14.08
40	12.07	1.40	11.04	11.04	11.51	13.66	1366

When IUGR is suspected, in order to better evaluate fetal biometry, the TCD should also be used. Cabbad and associates found that 22 out of 23 asymmetrically growth-impaired fetuses had a TCD lower than expected but within the normal range suggesting this measurement is useful for estimating of gestational age in these cases[1].

Currently, it has been shown that the TCD/AC ratio is date-independent. The ratio is constant throughout the second and third trimester of normal pregnancy. In a fetus with IUGR, AC is obviously affected, but TCD is not, resulting in an increased TCD/AC ratio. Therefore, an increased TCD/AC ratio can theoretically predict IUGR at any gestation age, even in the condition of an uncertain date. To date there have been only a few reports regarding the efficacy of TCD/AC ratio in predicting IUGR and each consisted of only a small-number of fetuses with IUGR[11].

Although this ratio should be sensitive in detecting the asymmetrically grown fetus, it has yet to be determined if it will be useful in identifying the symmetrically small fetus. Future studies will be needed to assess prospectively the value of this ratio in identifying the fetus with a growth abnormality and determine whether this ratio is more sensitive than current methods of predicting fetal growth abnormalities.

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แผนภูมิค่าเซ็นไทล์ของอัตราส่วนระหว่างเส้นผ่าศูนย์กลางของซีรีเบลลัมต่อเส้นรอบวงท้องทารกเพื่อใช้อ้างอิงในทารกไทย

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วัตถุประสงค์ : 1. เพื่อจัดทำแผนภูมิค่าเซ็นไทล์ของอัตราส่วนระหว่างเส้นผ่าศูนย์กลางของซีรีเบลลัมต่อเส้นรอบวงท้องทารกเพื่อใช้อ้างอิงในทารกไทย
2. เพื่อนำแผนภูมินี้ไปใช้ในการช่วยวินิจฉัยภาวะทารกเจริญเติบโตช้าในครรภ์

ชนิดการวิจัย : การวิจัยแบบตัดขวาง

สถานที่ทำการวิจัย : หน่วยเวชศาสตร์มารดาและทารก ภาควิชาสูติศาสตร์นรีเวชวิทยา คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล

กลุ่มตัวอย่าง : สตรีตั้งครรภ์ในช่วงอายุครรภ์ 13-40 สัปดาห์ ที่มาฝากครรภ์ที่คลินิกฝากครรภ์ ตึกผู้ป่วยนอก โรงพยาบาลศิริราช

การกระทำ : กลุ่มตัวอย่างจำนวน 643 ราย ได้รับการตรวจด้วยคลื่นเสียงความถี่สูงเพื่อวัดเส้นผ่าศูนย์กลางของซีรีเบลลัมและเส้นรอบวงท้องของทารกในครรภ์ เพื่อนำไปหาอัตราส่วน และคำนวณเปอร์เซ็นไทล์ที่ 5th, 10th, 50th, 90th และ 95th ในแต่ละช่วงอายุครรภ์ โดยมีเกณฑ์การคัดออกคือ มารดาเป็นโรคที่มีผลต่อการเจริญเติบโตของทารกในครรภ์, จำวันที่ประจำเดือนมาครั้งสุดท้ายไม่ได้, ตั้งครรภ์แฝด หรือมีภาวะทารกผิดปกติในครรภ์

ผลการวิจัย : กลุ่มตัวอย่างจำนวน 643 ราย ได้รับการตรวจด้วยคลื่นเสียงความถี่สูง ก่อนอายุครรภ์ 20 สัปดาห์และอายุครรภ์ระหว่าง 20 – 30 สัปดาห์ เป็นจำนวน 149 (23.1%) และ 286 (44.5%) รายตามลำดับ ส่วนกลุ่มที่เหลือได้รับการตรวจหลังอายุครรภ์ 30 สัปดาห์

จากการศึกษาพบว่า ค่าอัตราส่วนระหว่างเส้นผ่าศูนย์กลางของซีรีเบลลัมต่อเส้นรอบวงท้องจะค่อย ๆ ลดลงในระยะแรกของการตั้งครรภ์จนกระทั่ง 20 สัปดาห์ จากนั้นจะคงที่จนกระทั่งถึงอายุครรภ์ 30 สัปดาห์แล้วจึงค่อย ๆ ลดลงอีก

สรุป : ผลการศึกษาแสดงแผนภูมิค่าเซ็นไทล์ของอัตราส่วนระหว่างเส้นผ่าศูนย์กลางของซีรีเบลลัมต่อเส้นรอบวงท้องในทารกไทยซึ่งสามารถนำไปใช้ประโยชน์สำหรับเปรียบเทียบการเจริญเติบโตของทารกในครรภ์ในประชากรไทยได้ต่อไป