

Fetal abdominal circumference in normal pregnancy: Chulalongkorn Hospital population

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Objective : *To establish normative data of abdominal circumference in normal fetus across gestation*

Design : *Descriptive study*

Setting : *Division of Maternal Fetal Medicine, Department of Obstetrics and Gynecology, Faculty of Medicine, Chulalongkorn University*

Subjects and Methods : *Normal pregnant women registered at the antenatal clinic were recruited in their first trimester. The gestational age was confirmed by a consistent crown-rump-length measured at the first visit. The patients were divided into 4 groups and put on ultrasound scan at 4-week interval. Each group had the first measurement at 14, 15, 16 and 17 weeks respectively. The abdominal circumference (AC) was obtained by placing the transducer perpendicular to the fetal spine at the umbilical level which depicted the fetal spine, anterior third of the umbilical vein joining the portal sinus and the fetal stomach in*

the same section. All of the newborn proved to be normal at birth. The data was analyzed for mean, standard deviation, the 5th, 50th, and 95th percentile. The best fit mathematical model was derived using the SPSS computer program.

Results : *134 patients were enrolled and a total number of 815 measurements were obtained. The normative data of fetal AC demonstrated a progressive rising across gestation. The best fit regression equation was : $AC (mm) = 43.8406 - 4.9541 (week) + 0.7024 (week)^2 - 0.0101 (week)^3$, $R^2 = 0.957$*

Conclusion : *The nomogram for fetal AC of our population was established. This could serve as a basis for early assessment of fetal growth restriction.*

Key words : *Abdominal circumference, Nomogram, Fetus.*

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บุญชัย เอื้อไพโรจน์กิจ, ตักนัน มะโนทัย, สมชาย ธนวัฒนาเจริญ, เยื่อน ตันนรินทร์, วณิชยา เศรษฐธนารักษ์, อีระพงษ์ เจริญวิทย์. ความยาวเส้นรอบท้องของทารกในครรภ์ในสตรีครรภ์ปกติ : กลุ่มประชากรของโรงพยาบาลจุฬาลงกรณ์. จุฬาลงกรณ์เวชสาร 2540 พ.ย; 41 (11): 823-31

- วัตถุประสงค์** : เพื่อหาค่ามาตรฐานของความยาวเส้นรอบท้องของสตรีตั้งครรภ์ปกติในโรงพยาบาลจุฬาลงกรณ์
- รูปแบบการวิจัย** : การศึกษาเชิงพรรณนา ศึกษาไปข้างหน้า
- สถานที่** : หน่วยเวชศาสตร์มารดาและทารกในครรภ์ ภาควิชาสูติศาสตร์-นรีเวชวิทยา คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
- ประชากรและวิธีการวิจัย** : สตรีตั้งครรภ์ปกติที่ฝากครรภ์ที่โรงพยาบาลจุฬาลงกรณ์ มีประวัติระดูแน่นอน และจำระดูครั้งสุดท้ายได้ จะได้รับการตรวจยืนยันอายุครรภ์ด้วยการวัด CRL จากคลื่นเสียงความถี่สูงในไตรมาสแรก ผู้ป่วยจะได้รับการแบ่งเป็น 4 กลุ่ม และนัดตรวจทุก 4 สัปดาห์ แต่ละกลุ่มจะได้รับการวัดเส้นรอบท้องของทารกในครรภ์โดยเริ่มที่อายุครรภ์ 14, 15, 16 และ 17 สัปดาห์ตามลำดับ การวัดเส้นรอบท้องได้จากการวางหัวตรวจคลื่นเสียงความถี่สูง ตั้งฉากกับแนวกระดูกสันหลังที่ระดับสะดือทารก โดยจะเห็นกระดูกสันหลังตอนหน้าหนึ่ง ในสามของ Umbilical vein ซึ่งบรรจบกับ Portal sinus และกระเพาะอาหารของทารกในภาพเดียวกัน ทารกแรกคลอดได้รับการตรวจหลังคลอดว่ามีน้ำหนักร้อยในเกณฑ์ปกติ, ข้อมูลได้รับการบันทึกและวิเคราะห์โดยโปรแกรมคอมพิวเตอร์ SPSS เพื่อหามัชฌิมเลขคณิต, ค่าเบี่ยงเบนมาตรฐาน, เปอร์เซนต์ไทล์ที่ 5, 50 และ 95 และค่าสมการ Regression
- ผลการศึกษา** : สตรีมีครรภ์ทั้งหมด 134 ราย ได้รับการตรวจทั้งหมด 815 ครั้ง ความยาวของเส้นรอบท้องมีค่าเพิ่มขึ้นตามอายุครรภ์ที่เพิ่มขึ้น โดยสมการ Regression ที่เหมาะสมที่สุด คือ $AC (mm) = 43.8406 - 4.9541 (week) + 0.7024 (week)^2 - 0.0101 (week)^3$ $R^2 = 0.957$
- สรุป** : ได้รายงานค่าปกติของการเจริญเติบโตของเส้นรอบท้องของทารกในครรภ์ ในกลุ่มประชากรที่ฝากครรภ์ที่โรงพยาบาลจุฬาลงกรณ์ ซึ่งอาจนำไปเป็นเกณฑ์มาตรฐานเพื่อตรวจหาทารกที่มีการเติบโตช้าในครรภ์ในอนาคต

Caring for growth-restricted fetuses has been one of the most common problems encountered in our department for several decades. The inverse relationship between birth weight and survival of the fetus has long been recognized. Prior to modern era of ultrasound, the diagnosis of growth restricted fetuses was usually made in retrospect by examination of the neonates. With the introduction of the ultrasound technology to modern obstetrics, it became possible for the first time to visualize the human fetus and its environment in real-time.⁽¹⁾ It has been well known that the growth-restricted fetus is affected primarily at the storage of glycogen in the liver and the adipose tissue accumulating mainly at the subcutaneous tissue level throughout the fetus. The ultrasound parameter that is most commonly employed to detect a growth-restricted fetus is the AC as it is the first parameter to be involved in the process. The AC growth curve of the normal fetal population is necessary in establishing diagnosis of this condition.^(2,3) We conducted this study to establish normative data of fetal AC in our normal population across gestational age.

Materials and Methods

We recruited normal pregnant women registered at the antenatal clinic from September 1996 to August 1997. All had a good menstrual history and the calculated gestational age using CRL in the first trimester ultrasound was in agreement. The patients were divided into 4 groups A, B, C and D. Each group was given ultrasound scans at 4 week intervals and each group had the first scan at 14, 15, 16 and 17

weeks respectively. The equipment employed in the study was the Aloka SSD 2000, (Tokyo, Japan) with 3.5 and 5.0 MHz curvilinear transducers. With the patient in a supine position, the transducer was placed perpendicular to the fetal spine at the level of the umbilicus so that it simultaneously displayed the fetal spine posteriorly, the anterior third of the umbilical vein joining the portal sinus in a J shape and the fetal stomach on the left side.⁽⁴⁾ The fetal AC was obtained by placing electronic calipers along the outer border of the section obtained. All of the newborn were normal and weighted between the 10th and 90th percentile for our standard. The data was collected and the mean and standard deviations, and the 5th, 50th and 95th percentile for each gestational age were calculated and the best fit regression curve was established using the SPSS computer program.

Results

134 normal pregnant women were enrolled in the study. The total number of measurements were 815. The number of measurements at each gestational age ranged from 2-44 (mean \pm SD = 29.11 \pm 10.76). A normative data of AC at each gestational age is displayed in Table 1. The best fit regression equation obtained from random sampling of single measurements from each patient is presented as:

$$AC(\text{mm}) = 43.8406 - 4.9541(\text{week}) + 0.7024(\text{week})^2 - 0.0101(\text{week})^3 \quad R^2 = 0.957$$

The median, 5th and 95th percentiles of AC derived from the regression equation are given in Table 2.

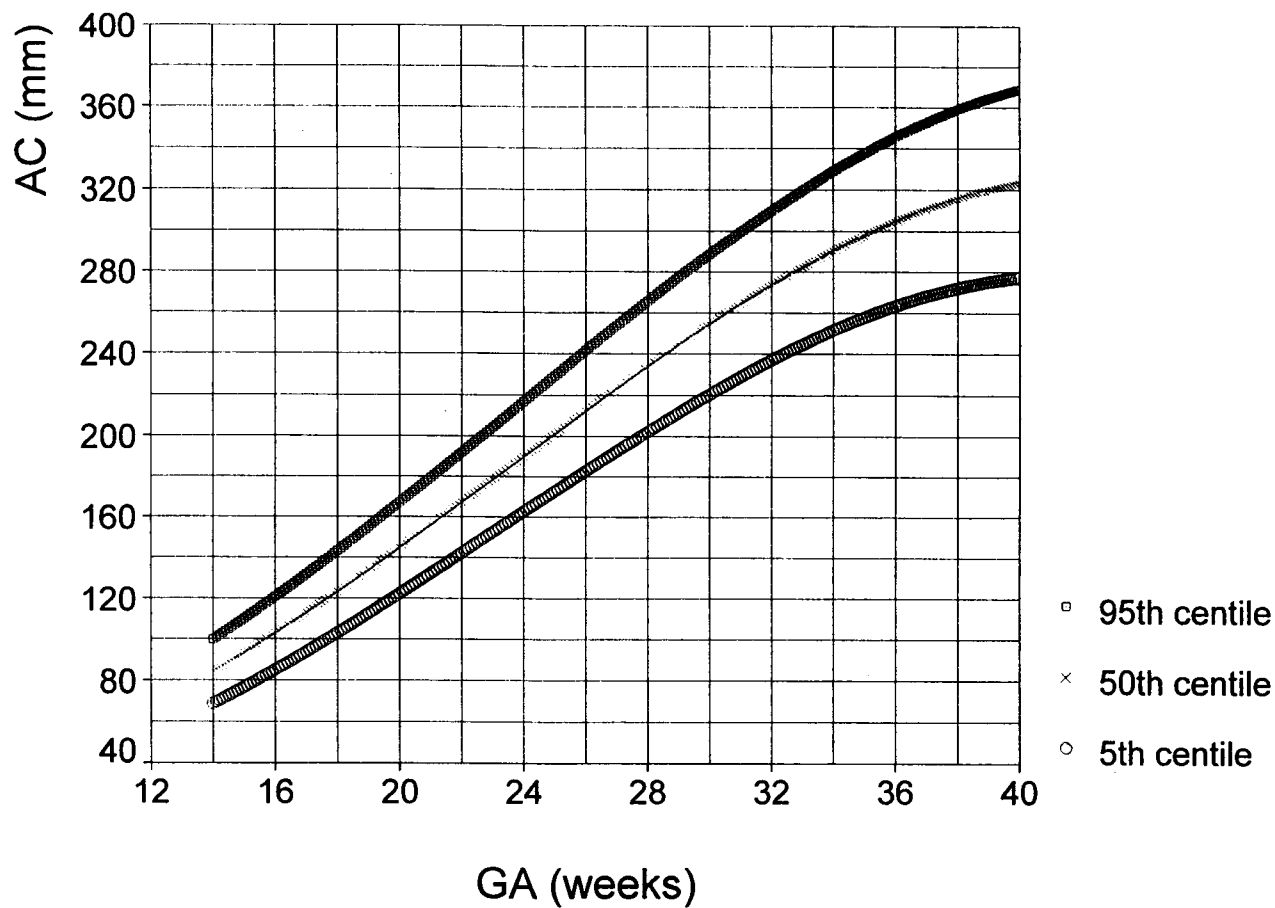


Figure 1. Normal fetal AC from 14 weeks to 40 weeks of gestation

Table 1. Normative data of fetal AC across gestational age.

GA (week)	Mean	SD	Percentile			Count
			5 th	50 th	95 th	
14	88.0	8.3	75.0	87.5	99	33
15	93	14.5	79.5	93	108.5	40
16	107.6	9.8	88	108	123	33
17	119.2	14.1	103	119	143	26
18	132.5	9	117	134	146	35
19	139.6	9	123	140	154	41
20	150.2	10.9	136	148	173	30
21	157.8	10.3	148	157.5	172	26
22	178.5	12.9	156	176	207	35
23	184.2	10.6	168	184	199	44
24	196	22.3	169	194	230	30
25	198.2	13.3	185	198	215	21
26	219.7	13.1	199	218	246	35
27	223.1	14.1	200	223.5	248	42
28	231.6	13.8	209	230	258	35
29	243.6	13.7	228	238	279	19
30	261.8	15.4	237	264	289	31
31	268	17.6	244	266.5	293	44
32	273.6	20.7	236	273.5	305	32
33	284.1	18.5	251	286.5	312	24
34	298.3	18.8	265	300	329	31
35	304.7	20.3	275	301	356	39
36	308.5	27	258	309	336	29
37	314.6	21.1	280	311.5	368	16
38	327	22.5	285	327.5	363	16
39	328.9	17.4	302	333.5	349	22
40	312.5	26.9	279	316.5	338	4
41	340.5	2.1	339	340.5	342	2

Table 2. Normal fetal AC derived from regression equation.

GA (week)	Smoothed percentiles (mm.)		
	5 th	50 th	95 th
14	69	84.4	100
15	76.9	93.5	110.1
16	85.2	103	120.8
17	94	113	132
18	103.2	123.3	143.5
19	112.7	134	155.3
20	122.5	145	167.4
21	132.4	156	179.6
22	142.5	167.3	192
23	152.6	178.6	204.5
24	162.8	189.9	217
25	173	201.2	229.4
26	183	212.3	241.8
27	192.7	223.3	254
28	202.3	234.1	265.9
29	211.6	244.6	277.5
30	220.6	254.7	288.8
31	229.1	264.4	299.6
32	237.2	273.6	310
33	244.8	282.3	319.9
34	251.7	290.4	329.2
35	258	297.9	337.8
36	263.5	304.6	345.7
37	268.3	310.5	352.8
38	272.3	315.6	359
39	275.3	319.9	364.4
40	277.4	323.1	368.8

Discussion

Fetal growth restriction poses a significant clinical risk to the fetal health in utero. It carries up to sevenfold increased risk of perinatal mortality and is particularly dramatic for increased risk of significant perinatal morbidity.⁽⁵⁾ Due to the impossibility of direct examination, including determining fundal height or poor weight gain for prediction of growth restricted fetuses in utero, sonographic evaluation of fetal growth has become an important clinical tool for the obstetrician in the detection of this condition.⁽⁶⁾ It is generally accepted that the AC is decreased in both symmetrical and asymmetrical growth restricted fetuses as this parameter indicates the size of the liver and the amount of subcutaneous tissue in the fetuses which again reflects the functional status of the utero-placental unit.⁽⁷⁾ Since the values of the sonographic parameters of the fetuses vary in different populations and ethnicity, it is generally encouraged for each institution to develop normative data for use with the local population. Our constructed normative growth curve demonstrated a progressive rising across gestational age. On comparing our AC growth curve with Hadlock's and Campbell's,^(8,9) it can be noted that the values are quite comparable up to gestational age of 34 weeks. After 34 weeks of gestation, our AC growth curve seems to show slightly slower growth rate which is not surprising since the birth weights of the newborn in our population are less than those of western populations.⁽¹⁰⁻¹²⁾ The gestational age of the patients enrolled in our study is highly reliable in that all patients were recruited in the first trimester and confirmed by sonographic dating using fetal crown-rump-length. The newborn all

proved to be normal and appropriate in size for their gestational age. Since the number of patients in the last two weeks was quite small because the majority of the patients had been delivered. A smooth percentile derived from regression equation in table 2 should be better employed. Our nomogram of fetal AC could serve as a basis for the early detection of growth restricted fetus so that medical intervention could be implemented early in the course of the process if determined necessary.

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