Intrapartum Fetal Abdominal Circumference by Ultrasonography for Predicting Fetal Macrosomia

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Objective: *To evaluate the diagnostic value of sonographic measurement of fetal abdominal circumference (AC) for the prediction of fetal macrosomia.*
Material and Method: *A prospective clinical trial was conducted at Department of Obstetrics and Gynecology, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand. The study consisted of 361 singleton pregnant women who were admitted for delivery at labor room. All women underwent sonographic measurements of the fetal abdominal circumference (AC) during the early intrapartum period. The AC values were correlated to actual fetal birth weight. The cut-off value of AC for predicting of fetal macrosomia was analyzed.*
Results: *Among 361 cases, the mean maternal age was 29.0 $\pm$ 5.5 years (range, 15-46). The median gestational age was 39 weeks (range, 31-42). The mean fetal birth weight was 3,179.83 $\pm$ 450.91gm (range, 1,180-4,560). The prevalence of macrosomia was 11.08% (40/361). A cut-off value of abdominal circumference $\geq$ 35 cm was the best predicting of fetal macrosomia. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were 87.50%, 84.74%, 85.04%, 41.67%, and 98.19%, respectively.*
Conclusion: *The intrapartum fetal AC measurement was useful in predicting of fetal macrosomia. An AC measurement of $\geq$ 35 cm was the best value of fetal macrosomia prediction.*

Keywords: *Fetal abdominal circumference, Intrapartum, Macrosomia, Ultrasonography*

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Fetal macrosomia has been defined as a birth weight of greater than the ninetieth percentile for gestational age after correcting for neonatal ethnicity[1].

Macrosomia is associated with many adverse outcomes, for example prolonged labor, premature labor, increase risk of traumatic damage, increase risk of shoulder dystocia, increase risk of cesarean section, fetal distress, birth asphyxia, brachial plexus injury, stillbirth, cephalhaematoma, etc[1-5]. These adverse outcomes may associate with high rate of perinatal morbidity and mortality.

Until now, there is no definite best method for predicting macrosomia. Without a sure way of predicting the fetal weight, making a sound management decision is difficult. Sonographic measurements for the diagnosis of macrosomia were developed in hopes of improving clinical estimates.

The purpose of this prospective study was to evaluate the diagnostic value of ultrasonographic measurement of fetal abdominal circumference for prediction of fetal macrosomia during intrapartum period.

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Material and Method

The prospective study was conducted at the labor room of Department of Obstetrics and Gynecology, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand between August 2004 and January 2005. This study was approved by the Ethical Clearance Committee of Faculty of Medicine, Ramathibodi Hospital, Mahidol University.

The inclusion criterion for this study was singleton pregnancies in early labor who had been admitted to the labor room. The exclusion criteria were the woman

with multiple pregnancies who had a fetus with a major anomaly, such as omphalocele or hydrops fetalis.

After consent was obtained, sonographic measurements of fetal abdominal circumference were performed two times (AC1 and AC2 values) by the only one investigator (the researcher in the 2nd year OB-GYN resident training) who did not know the patient's data.

The abdominal circumference is the circumference of fetal abdomen in the axial view by ultrasonography through the liver at level of the portal vein, stomach, and vertebral spine.

The averaged abdominal circumference value {(AC1 + AC2)/2} from the two examinations were recorded.

The ultrasonographic examinations were performed by a linear, 3.5-MHz convex array transducer on Hitachi EUB 415 (Tokyo, Japan). After the ultrasound was performed labor management was followed in the labor room's protocol as usual. The examination was performed more or less within 24 hours before delivery, in order to eliminate the possible effect of the time elapsed between ultrasound abdominal circumference examination and delivery for actual fetal weight. The fetal macrosomia is defined as a birth weight of greater than the 90th percentile for gestational age[1].

The maternal demographics and actual fetal birth weight were recorded after delivery. The corrected gestational age of the patient was collected from the last menstrual period and ultrasound for gestational age for corrected expected date. The data were obtained and collected until the end of the study, after which analysis of the abdominal circumference was compared to the actual fetal birth weight, to minimize the risk of bias.

Two-by-two contingency tables (Table 2) were analyzed, and the true and false positive rates for each abdominal circumference were calculated to differentiate between birth weight of macrosomia and the normal one. The receiver operating characteristic (ROC) curve was used to represent the relation between the true positive rate and the false positive rate at different cutoff levels of abdominal circumference values.

All statistical calculations were done using computer programs Microsoft Excel XP version and SPSS statistical program version 10.

Results

This study enrolled 361 singleton pregnant women who were admitted to the labor room. The study population characteristics are shown in Table 1. The mean maternal age was 29.0 $\pm$ 5.5 years (range, 15-46 years). The median gestational age and total antenatal

Table 1. Demographic and characteristic data

		N = 361 cases	Range
Age (years)		29.0 $\pm$ 5.5	15.0-46.0
Median of gestational age (weeks)		39	31-42
Median of total ANC (times)		8	0-15
Birth weight (gm)		3,179.8 $\pm$ 450.9	1,180.0-4,560.0
		Cases	%
Gravida	1	173	47.92
	2	121	33.52
	3	44	12.19
	$\geq$ 4	23	6.38
Para	0	225	62.33
	1	105	29.09
	2	25	6.93
	$\geq$ 3	6	1.66
Thalassemia trait		52	14.40
Diabetic mellitus		17	4.71
Hypertension		16	4.43
Anemia		13	3.60
Thyroid disease		4	1.11
Antepartum hemorrhage		4	1.11
Heart disease		2	0.55

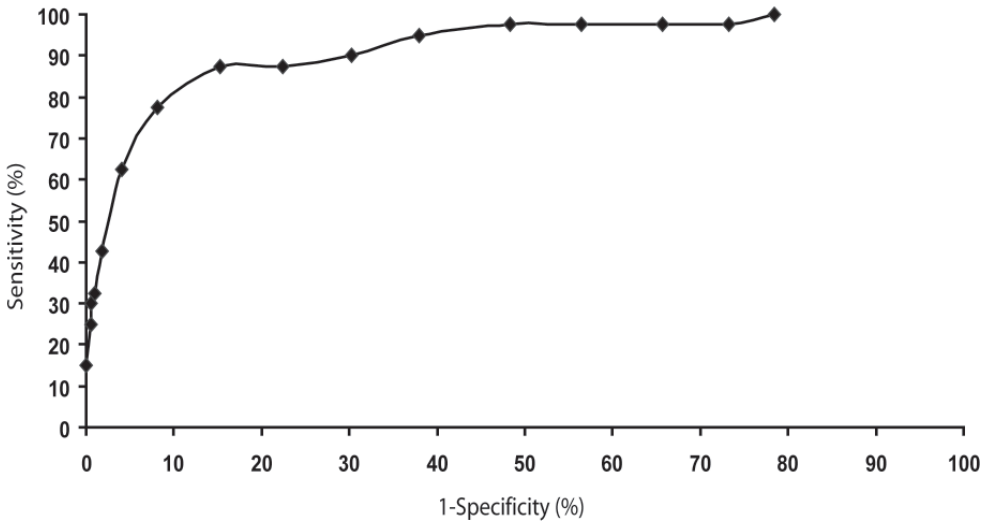

Fig. 1 The ROC curve for ultrasound AC measurements in macrosomic infant

care visits were 39 weeks (range, 31-42 weeks) and eight times (range, 0-15 times), respectively. The mean (± SD) fetal birth weight was 3,179.8 ± 450.9 gm (range, 1,180-4,560 gm). The prevalence of macrosomic neonate was 11.08%(40/361). There were a small number of underlying diseases in this study group as shown in Table 1.

The receiver operating characteristic (ROC) curve for cutoff level of abdominal circumference of 35.0 cm is shown in Fig. 1. A cut-off value of AC > 35 cm was detected to predict macrosomia with the highest sensitivity and specificity.

The Table 3 shows the sensitivity of abdominal circumference of 35.0 cm to identify correctly a macrosomic fetus is 87.50%, specificity is 84.74%, positive predictive value 41.67%, negative predictive value is 98.19%, accuracy is 85.04%,positive likelihood ratio is 5.73, and negative likelihood ratio is 0.15.

Discussion

Macrosomia is a cause of the worst of obstetric emergencies such as shoulder dystocia, birth asphyxia, and postpartum hemorrhage. About half of shoulder dystocia happen to macrosomic infants, yet frequency of macrosomia is less than 10%. Shoulder dystocia cannot always be predicted accurately. However, predicting macrosomia can help to identify the population at the highest risk for shoulder dystocia. Several studies of sonographic measurement for predicting of fetal macrosomia were established[11,13-15].

An engaged vertex in the intrapartum period, the measurement of biparietal diameter may interfere with the accuracy of evaluation. Thus, abdominal circumference was of interested as single parameter for evaluating the fetal size.

From the result of this study (Table 2, 3), we can conclude that a cut-off value of abdominal circumference ≥ 35 cm was detected to predict macrosomia and the ultrasonographic examination of abdominal circumference is a method that is accurate in identifying fetal macrosomia with high sensitivity (87.50%), specificity (84.74%), negative predictive value (98.19%), and accuracy (85.04%).

Table 2. The Abdominal circumference ≥ 35 cm in predicting fetal macrosomia

AC (cm)	Non-macrosomia	Macrosomia
≥35	49	35
<35	272	5

Table 3. The diagnostic value of AC ≥ 35 cm in predicting fetal macrosomia

Sensitivity	87.50%
Specificity	84.74%
PPV	41.67%
NPV	98.19%
Accuracy	85.04%
Prevalence	11.08%
LR+	5.73
LR-	0.15

Although the positive predictive value is low, doctors should be aware that if the abdominal circumference was 35 cm or more, they should use other methods to confirm the diagnosis such as manual examination or fundal height measurement in the decision of management.

This study is a prospective study and assessed in the early intrapartum period. Meanwhile most other studies were retrospective studies and performed within 2-3 weeks before delivery as reported by Jennifer et al[13] and Jazayeri et al[14].

The population used in this study was larger than previous studies[13-15]. Most of other researches included about one hundred samples. In this study, we included 361 samples hoping to decrease the bias of sample distribution.

The investigator in this study was the 2nd year resident training in Obstetric and Gynecologic Department at Ramathibodi hospital under the supervision of a board-certificated maternal-fetal medicine subspecialist. Only one investigator was used to reduce the interpersonal bias. The sonographer thought that the ultrasonography was an easy method and evaluated the fetal size fast.

In conclusion, the ultrasonographic examination of abdominal circumference is a practical method that is relatively accurate in identifying fetal macrosomia in the early intrapartum period. An AC measurement $\geq$ 35 cm was the best predicting value of fetal macrosomia.

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การวัดเส้นรอบวงท้องของทารกในครรภ์ในระยะแรกของการคลอดด้วยเครื่องตรวจคลื่นเสียงความถี่สูงเพื่อทำนายภาวะทารกตัวโต

รัชนิกร เลิศวรวณิช, อภิชาติ จิตต์เจริญ, สมศักดิ์ สุทัศน์วรวุฒิ

วัตถุประสงค์: *เพื่อศึกษาหาค่าเส้นรอบวงท้องของทารกในครรภ์ที่วัดได้จากการตรวจด้วยคลื่นเสียงความถี่สูงที่สามารถทำนายภาวะทารกตัวโตได้*

วัสดุและวิธีการ: *การศึกษาแบบไปข้างหน้าทางคลินิก ณ ภาควิชาสูติศาสตร์-นรีเวชวิทยา คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล กรุงเทพฯ ศึกษาในสตรีตั้งครรภ์เดี่ยวจำนวน 361 รายที่มาคลอดในโรงพยาบาลรามาธิบดี และได้รับการตรวจด้วยคลื่นเสียงความถี่สูงเพื่อวัดเส้นรอบวงท้องของทารกในครรภ์ ในช่วงเริ่มแรกของการเข้าสู่ระยะแรกของการคลอด และนำค่าเส้นรอบวงท้องที่วัดได้ มาคำนวณเพื่อเปรียบเทียบกับน้ำหนักแรกเกิดของทารกเพื่อหาค่าที่สามารถนำมาใช้เป็นจุดตัดเพื่อทำนายภาวะทารกตัวโต*

ผลการศึกษา: *จากผู้เข้าร่วมการศึกษา 361 ราย มีอายุเฉลี่ยของมารดา 29.0 $\pm$ 5.5 ปี (ระหว่าง 15-46 ปี) ค่าเฉลี่ย ของอายุครรภ์ 39 สัปดาห์ (ระหว่าง 31-42 สัปดาห์) ค่าเฉลี่ยของน้ำหนักทารกแรกคลอด 3,179.83 $\pm$ 450.91 กรัม (ระหว่าง 1,180-4,560 กรัม) อุบัติการณ์ของทารกตัวโตในการศึกษานี้เป็น 11.08% (40 / 361) ค่าเส้นรอบวงท้องของ ทารกในครรภ์ที่มากกว่าหรือเท่ากับ 35 เซนติเมตร สามารถนำมาทำนายภาวะทารกตัวโตได้ โดยมีค่า sensitivity, specificity, accuracy, positive predictive value และ negative predictive value เป็น 87.50%, 84.74%, 85.04%, 41.67% และ 98.19%, ตามลำดับ*

สรุป: *การวัดเส้นรอบวงท้องของทารกในครรภ์ในระยะแรกของการคลอดสามารถทำนายภาวะทารกตัวโตได้ เส้นรอบวงท้องที่ได้จากการตรวจด้วยเครื่องตรวจคลื่นเสียงความถี่สูงที่มีค่ามากกว่าหรือเท่ากับ 35 เซนติเมตรนำมาใช้ทำนายทารกตัวโตได้ดีที่สุด*