OBSTETRICS

Uterocervical Angle Measurement for Prediction Spontaneous Preterm Birth in Twin Pregnancy

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ABSTRACT

Objectives: This study's objective determined the predictive value of the uterocervical angle in predicting preterm birth in twin pregnant women at 16-23^{+6} weeks of gestation.

Materials and Methods: A diagnostic study was conducted in twin pregnant women at 16-23^{+6} weeks of gestation who had prenatal care at the King Chulalongkorn Memorial Hospital between March 2019 and February 2020. Uterocervical angle and cervical length were assessed at 16-23^{+6} weeks of gestation. Optimal cut-off for the uterocervical angle was obtained to calculate the predictive values for preterm birth.

Results: A total of 84 pregnant women were included in this study. Thirty-eight cases (47.5%) developed preterm birth. Women who delivered < 37 weeks had significantly higher uterocervical angles compared to those who delivered ≥ 37 weeks (109.32 degrees vs. 96.41 degrees, p = 0.016). The optimal cut-off of the uterocervical angle was 102 degrees. Sensitivity specificity, positive predictive value, and negative predictive value were 65.8%, 61.9%, 61.9%, and 68.4%, respectively.

Conclusion: The uterocervical angle was an easy technique that could be one of the screening tools to predict preterm birth among twin pregnant women who had an angle equal to or greater than 102°, with a sensitivity, positive predictive value, and a negative predictive value of more than 60%.

Keywords: cervical length, preterm birth, second trimester, uterocervical angle, twin pregnancy.

การทำนายภาวะคลอดก่อนกำหนดโดยวัดมุมระหว่างมดลูกส่วนล่างและปากมดลูก โดยการตรวจอัลตราซาวด์ทางช่องคลอดในสตรีตั้งครรภ์แฝด

ปาณิสรา นิยมแย้ม, ธีระภัทร เจริญวิทย์, บุญชัย เอื้อไพโรจน์กิจ

บทคัดย่อ

วัตถุประสงค์: วัตถุประสงค์หลักเพื่อหาค่าคาดทำนาย (Predictive value) จากการวัดมุมระหว่างมดลูกส่วนล่างและปากมดลูก โดยการตรวจอัลตราซาวด์ทางช่องคลอดในสตรีตั้งครรภ์แฝดที่มีอายุครรภ์ 16 - 23^{+6} สัปดาห์ ต่อการเกิดภาวะคลอดก่อนกำหนด วัตถุประสงค์รองคือ หาค่าคาดทำนาย (Predictive value) จากการวัดความยาวปากมดลูก โดยการตรวจอัลตราซาวด์ทางช่องคลอดในสตรีตั้งครรภ์แฝดที่มีอายุครรภ์ 16 - 23^{+6} สัปดาห์ ต่อการเกิดภาวะคลอดก่อนกำหนด และหาค่าคาดทำนาย (Predictive value) จากการวัดมุมระหว่างมดลูกส่วนล่างและปากมดลูก โดยการตรวจอัลตราซาวด์ทางช่องคลอดในสตรีตั้งครรภ์แฝดที่มีอายุครรภ์ 16 - 23^{+6} สัปดาห์ ต่อการเกิดภาวะเจ็บครรภ์คลอดก่อนกำหนด

วัสดุและวิธีการ: รูปแบบการศึกษาเป็นการศึกษาแบบ Diagnostic study ทำการศึกษาในหญิงตั้งครรภ์แฝดที่มีอายุครรภ์ระหว่าง 16 – 23+6 สัปดาห์ ที่มารับการตรวจฝากครรภ์ที่โรงพยาบาลจุฬาลงกรณ์ ระหว่างเดือนมีนาคม พ.ศ. 2562 ถึงธันวาคม พ.ศ.2563 โดยการตรวจคลื่นเสียงความถี่สูงทางช่องคลอดเพื่อวัดมุมระหว่างมดลูกส่วนล่างและปากมดลูก และวัดความยาวปากมดลูกที่ช่วงอายุครรภ์ระหว่าง 16 - 23^{+6} สัปดาห์ ติดตามหญิงตั้งครรภ์จนคลอด เก็บข้อมูลการคลอด นำค่าการวัดมาหาค่าที่เหมาะสมในการทำนายภาวะคลอดก่อนกำหนดและเพื่อคำนวณหาค่าพยากรณ์การเกิดภาวะคลอดก่อนกำหนด

ผลการศึกษา: หญิงตั้งครรภ์แฝดที่นำมาวิเคราะห์ทั้งหมด 80 ราย พบการคลอดก่อนกำหนด 38 ราย (47.5%) เมื่อเปรียบเทียบกับหญิงตั้งครรภ์แฝดที่คลอดครบกำหนด พบว่าหญิงตั้งครรภ์ที่คลอดก่อนกำหนดมีค่าของมุมระหว่างมดลูกส่วนล่างและปากมดลูกมากกว่าอย่างมีนัยสำคัญทางสถิติ (109.32 ± 19.12 องศา กับ 96.47 ± 26.57 องศา, P=0.016) และค่ามุมระหว่างมดลูกส่วนล่างและปากมดลูกที่เหมาะสมในการทำนายภาวะคลอดก่อนกำหนด เท่ากับ 102 องศา เมื่อใช้ค่ามุมระหว่างมดลูกส่วนล่างและปากมดลูกในการทำนายการเกิดภาวะคลอดก่อนกำหนดพบค่าความไว ค่าความจำเพาะ ค่าทำนายผลบวก และค่าทำนายผลลบ เท่ากับร้อยละ 65.8, 61.9, 61.9, และ 68.4 ตามลำดับ

สรุป: การวัดมุมระหว่างมดลูกส่วนล่างและปากมดลูกโดยการตรวจคลื่นเสียงความถี่สูงทางช่องคลอดเป็นเทคนิคหนึ่งที่สามารถนำมาใช้คัดกรองหญิงตั้งครรภ์แฝดที่มีความเสี่ยงการเกิดภาวะคลอดก่อนกำหนดได้ โดยที่มุมระหว่างมดลูกส่วนล่างและปากมดลูกมากกว่าหรือเท่ากับ 102 องศาจะมีค่าความไว ค่าความจำเพาะ ค่าทำนายผลบวกและค่าทำนายผลลบที่มากกว่า 60%

คำสำคัญ: ความยาวของปากมดลูก, คลอดก่อนกำหนด, การตั้งครรภ์ในไตรมาสที่สอง, มุมระหว่างมดลูกส่วนล่างและปากมดลูก, ครรภ์แฝด

Introduction

The incidence of twin pregnancy has rapidly increased for many years due to advanced maternal age and increased use of assisted reproductive technology[1]. Twin pregnancy has a 50% risk of having a preterm birth, of which 10% occur before 32 weeks, and are related to a higher risk of neonatal death and long-term complications, especially neurodevelopmental disability[2-4]. Over the past few years, the rate of preterm births in twin gestation at the King Chulalongkorn Memorial Hospital, Bangkok, was 40.2%[5].

Previous studies have investigated screening tests for preterm births in twin gestation, including ultrasound to measure the cervical length and the fetal fibronectin test. Unfortunately, these screening tests have poor diagnostic performance[6-11]. It has been shown that during pregnancy, there are cervical changes due to the weight of the fetus, placenta, and amniotic fluid, which press down on the lower part of the uterus and cervix. These changes result in subsequent alterations of the cervical length and the angle between the lower uterine segment and the cervix[12-14]. It has been found that a pessary could narrow the uterocervical angle and subsequently prevent preterm birth[15,16]. According to Dziadosz et al[17], a wide uterocervical angle increases the risk for preterm birth. Thus, investigations of the uterocervical angle measurement may be helpful in predicting preterm birth among twin pregnant women.

This study investigated the performance of uterocervical angle at 16-23+6 weeks of gestation in predicting preterm birth in twin gestation.

Materials and Methods

This study was conducted at the Department of Obstetrics and Gynecology, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand, from March 2019 - February 2020. The study was approved by the Research Ethics Committee of the Faculty of Medicine, Chulalongkorn University. Written informed consent was obtained from all the patients before any procedures were done.

Twin pregnant women with a gestational age of 16-23[+6] weeks were invited to participate in this study. The exclusion criteria were monochorion-monoamnion pregnancy, complications specific to monochorionicity (i.e., twin-twin transfusion syndrome (TTTS), and twin anemia-polycythemia sequence), a complication from twin pregnancy (i.e., fetal demise in one twin, and selective reduction of one twin), cervical cerclage, use of vaginal Arabin pessary, placenta previa, lethal fetal anomalies, and medically indicated preterm birth.

The sample size calculation was based on the sensitivity of the uterocervical angle measurement used to improve the prediction of preterm birth in twin gestation by Knight et al[18] (sensitivity = 0.8). At the King Chulalongkorn Memorial Hospital, the incidence of preterm birth in twin pregnancies was 40.2%. Based on this calculation, the number of participants needed was 70. When a 20% attrition rate of the follow-up participants was included in the calculation, the total sample size was increased to 84 pregnant women.

The primary outcome was to investigate the clinical performance of uterocervical angle in predicting preterm birth at a gestational age of 16-23[+6] weeks in twin pregnancy. The secondary outcome was to determine the clinical performance of the cervical length in predicting preterm birth. The cervical length and uterocervical angle measurements were performed by a single doctor (maternal-fetal medicine fellow monitored by maternal-fetal medicine staff) using the ultrasound machine GE Voluson E10 and IC5-9-D Endovaginal transducer (4-9 MHz). The cervical length and uterocervical angle were measured by transvaginal ultrasound as per the standard technique[19]. Briefly, the cervix should be measured along its longitudinal axis. The cervix should involve approximately 50–75% of the image. Excessive pressure on the cervix by the transvaginal probe should be avoided, as the cervix artificially appears to be longer, and the presence of a funnel will be obscured. The cervical length is the distance from the internal os to the external os. Three cervical length measurements were assessed, and the shortest value was used in the analysis[20].

The uterocervical angle is between the lower uterine segment and the cervical canal[17]. The first line

is traced from the internal os of the cervix to the external os of the cervix. The second line is then drawn straight along the lower uterine segment. The angle between the two lines is then measured using a program in the ultrasound machine, as shown in Fig. 1. Three measurements were obtained, and the average value was used for analysis. The varying values were typically no more than 10% for all measurements.

Statistical analysis

The data were analyzed with the SPSS software version 22.0 for Windows and presented as the mean, standard deviation, median, interquartile range, sensitivity, specificity, positive predictive value, and negative predictive value. Kappa coefficient was performed. The optimal cut-off values for the uterocervical angle were calculated using the receiver operator characteristic curve. We used a chi-square test, Fisher's exact test for categorical variables, and an independent t-test for continuous variables. Mann-Whitney U test was used for nonparametric variables. A p-value of < 0.05 was considered to be statistically significant.

Fig. 1. The uterocervical angle (UCA) is between the lower uterine segment and the cervical canal. The UCA is 85.44 degrees.

Results

A total of 84 twin pregnant women were enrolled in this study. Four cases were excluded: one case had the fetal demise of one twin, one case had TTTS, one case had severe preeclampsia, one case was lost to follow-up. This left 80 twin pregnant women for analysis. Thirty-eight cases (47.5%) developed preterm birth. The cervical length and uterocervical angle were measured three times, and the kappa coefficient for intraobserver variability was 0.968 and 0.987, respectively. There were no statistically significant differences between the characteristics of term and preterm births in twin gestation, including age, the number of pregnancies, use of assisted reproductive technology, history of preterm birth, body mass index, and underlying disease (hypertension and diabetes) (Table 1).

Gestational age at the time of the transvaginal ultrasound for the cervical length and uterocervical angle assessment showed that the cervical length was not statistically significant in the two groups (Table 2). The uterocervical angle of the preterm group was significantly more expansive than the term group (109.32 o vs. 96.41 o, p = 0.016)

The receiver operator characteristic curve was performed to evaluate delivery prediction before 37 weeks. The area under the curve for the uterocervical angle was 0.653 (p = 0.019, 95% confidence interval 0.529-0.776) (Fig. 2.). The optimal performance of the uterocervical angle was found at 102°, which had a sensitivity of 65.8%, a specificity of 61.9%, a positive predictive value of 61.9%, and a negative predictive value of 68.4%.

Table 1. Demographic characteristics of the twin pregnant participants in the study.

Characteristic	Gestational age ≥ 37 weeks (n = 42)	Gestational age < 37 weeks (n = 38)	p value
Maternal age (years)	32.79 ± 4.16	32.47 ± 4.34	0.744[§]
Nulliparous	32 (76.19%)	26 (68.42%)	0.437[†]
ART	21 (50.00%)	18 (47.36%)	0.814[†]
Chorionicity			0.026[†]
- MCDA	9 (21.42%)	17 (44.74%)	
- DCDA	33 (78.58%)	21 (55.26%)	
Prior spontaneous preterm birth	0	1 (2.63%)	0.475[‡]
BMI at prepregnancy (kg/m^2)	22.54 ± 4.04	23.17 ± 4.17	0.492[§]
Hypertensive disorder	5 (11.90%)	6 (15.79%)	0.614[†]
Diabetes/gestational diabetes	5 (11.90%)	5 (13.15%)	0.866[†]
GA at delivery (weeks)	37.02 ± 0.98	34.34 ± 3.12	0.001[†]

Data are presented as n (%) or mean ± standard deviation.
[†] chi-square test, [‡] Fisher's exact test, [§] Student's t-test
ART: assisted reproductive technology, MCDA: monochorionic diamniotic, DCDA: dichorionic diamniotic, BMI: body mass index, GA: gestational age

Table 2. Characteristics of uterocervical angle and cervical length in twin pregnancy.

Characteristic	Birth ≥ 37 weeks (n = 42)	Birth < 37 weeks (n = 38)	p value
GA at ultrasound screen (weeks)	19.85 (17.14 - 23.85)	20.42 (17.14 - 23.85)	0.904[§]
UCA (degree)	96.41 ± 26.57	109.32 ± 19.12	0.016*
CL (mm)	38.98 ± 5.13	39.67 ± 6.19	0.587*

Data are presented as mean ± standard deviation or median (interquartile range)
[§] Mann-Whitney U Test, * Student's t-test
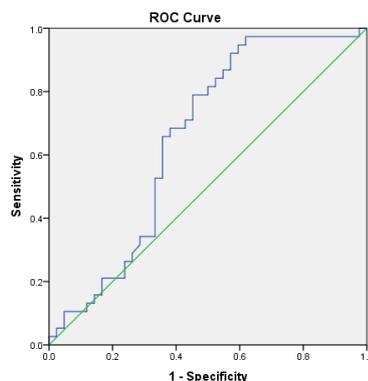GA: gestational age, UCA: uterocervical angle, CL: cervical length

Fig. 2. Receiver operating characteristic (ROC) curves of the uterocervical angle are used to predict spontaneous preterm birth in twin pregnancy.

Discussion

The preterm birth rate for twin pregnancies was approximately 50%, resulting in increased perinatal morbidity and mortality[2-4]. Recent studies have investigated the mechanism of the cervical changes during pregnancy, which found that the physical body changes of the pregnant women affected the cervical length and the uterocervical angle[12-14]. In particular, they found that pessary use caused the uterocervical angle to narrow down, which increased the effectiveness of preventing preterm birth[15,16]. According to The American College of Obstetricians and Gynecologists guidelines, there is currently no recommendation for cervical length screening for all twin pregnant women with no history of preterm delivery[22].

The cervical length measurement investigation in this study found that there was no significant difference between the 2 groups. These results were similar to Hester et al[23] who measured the cervical length at 16-20 weeks of gestation to predict preterm birth in twin pregnancies. They found that cervical length in preterm birth < 34 weeks was not statistically significant (37.2 vs. 40.7, p = 0.66). The cervical length was a poor predictor for preterm birth in twin pregnancy. Knight et al[18] compared the uterocervical angle and cervical length to predict preterm birth between the gestational ages of < 28 weeks and < 32 weeks in twin pregnant women. They found that a uterocervical angle > 110 o had a sensitivity of 80%, specificity of 82%, and a negative predictive value of 97.1% to predict preterm birth at gestational age before 32 weeks. This result was similar to the prediction of preterm at gestational < 28 weeks when the uterocervical angle was > 114o; the sensitivity was 80%, specificity was 84%, and the negative predictive value was 99%. When the two studies were compared, it was found that the uterocervical angle widened significantly, which may affect the preterm birth rate. Our results had lower sensitivity, specificity, and negative predictive value than the studies mentioned above. This may be due to the study's primary outcome that used uterocervical angle and cervical length to predict preterm birth < 37 weeks. The strength of this study was that it was a diagnostic study that a single operator conducted. However, the limitation of this study was its small sample size. Additional studies with a larger sample size may detect other factors significantly associated with predicting preterm birth.

Conclusion

In conclusion, the uterocervical angle was an easy technique that could be one of the screening tools used to predict preterm birth among twin pregnant women with an angle equal to or greater than 102o. This technique had a sensitivity of 65.8%, a positive predictive value of 61.9%, and a negative predictive value of 68.42%.

Acknowledgement

Potential conflicts of interest

The authors declare no conflicts of interest.

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