Correlation between lower uterine wall thickness measured by transabdominal ultrasonography and cervical length measured by transvaginal ultrasonography in Thai pregnant women

Wanitchar Woraboot, Prapat Wanitpongpan*, Amprapha Phaophan

Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Abstract

Background: Preterm labor is one of major obstetric challenges and can be predicted by cervical length at mid-trimester. In some settings, transvaginal ultrasound is not available and the screening and prevention of preterm labor will be suboptimal. We hope to find a correlation between other marker i.e. lower uterine wall thickness measured by transabdominal ultrasonography and cervical length measured by transvaginal ultrasonography in Thai pregnant women during 16–32 weeks of gestation.

Methods: This study was a cross-sectional study. 166 singleton pregnant women were invited to participate in the study between June 2015 and December 2015. Transabdominal ultrasonography was performed to measure the lower uterine wall thickness and transvaginal ultrasonography was performed to measure the cervical length. The Spearman’s rank correlation was used to evaluate the correlation between the two parameters. The inter-observer variation was assessed by using Bland–Altman plot. The outcomes of all pregnancies were followed and only those who delivered at term were included for the calculation of normal value of lower uterine wall thickness.

Results: There was a highly positive correlation between lower uterine wall thickness and cervical length ($r_s = 0.767$, $n = 166$, $p < 0.001$). For those who had short cervical length (defined as less than 30 mm) at GA 16–24 weeks ($n = 10$), the mean corresponding lower uterine wall thickness was 4.4 mm (SD 0.50). The inter-observer variation of the measurement of lower uterine wall thickness and cervical length were small. The lower uterine wall thickness tended to be slightly thinner when the gestation advanced. (mean 5.4 mm at 16–20 weeks and 5.1 mm at 28–32 weeks).

Conclusion: There was a highly positive correlation between lower uterine wall thickness measured by transabdominal ultrasonography and cervical length measured by transvaginal ultrasonography in Thai pregnant women.

Keywords: Cervical length; Lower uterine wall thickness; Preterm labor

1. INTRODUCTION

Preterm birth is defined as delivery before 37 completed weeks of gestation and is associated with increased risk of neonatal morbidities and mortality. Every year, approximately 15 million babies are born prematurely and this number continues to rise.1 Although many preterm births occurred without any risk factors, previous studies2-5 showed that history of prior preterm birth and short cervical length (CL) are the strongest predictors of this condition. Many guidelines and recommendations6-11 have been issued regarding the universal screening of cervical length in all singleton pregnancies and preventive therapy with progesterone is recommended when the short CL is identified. Transvaginal ultrasound is a gold standard for cervical length measurement and can be performed in most obstetric offices. However, in some resource-restricted settings where transvaginal ultrasound is not available the screening and preventive strategies of preterm labor would inevitably be suboptimal.

The pathways of preterm labor are different from those of term labor in terms of cascades of prostaglandins production, cervical ripening and uterine contractions.12 Short CL is the result of the changes in cervical connective tissue either at term or prematurely. Lower uterine wall lies closely to the cervix and we hypothesized that the changes that originated in the cervix could possibly involve the adjacent lower uterine wall as well. The lower uterine wall can be measured precisely using transabdominal ultrasound which is readily available in almost all clinical settings. We aimed to study the normal value of lower uterine wall thickness and the correlation between the lower uterine wall thickness and cervical length with the hope to find a surrogate marker of a short CL in order to overcome the obstacle mentioned above.

2. METHODS

We conducted a cross-sectional study from June to December
2015. Thai pregnant women without any risk factors of preterm labor eg. previous preterm birth, previous cervical surgery, uterine anomaly etc., with gestational age between 16 and 32 weeks who booked for antenatal care at Siriraj Hospital were invited to participate in the study. The exclusion criteria were multi-fetal pregnancy, previous uterine or cervical scar, age <18 years old, fetal anomaly and existing medical disorders.

The study protocol was approved by the institutional ethical committee and all participants provided their written informed consents before enrolling into the study. The investigators were trained for the precise measurement of lower uterine wall thickness and cervical length before the beginning of the study. The lower uterine wall thickness was carefully measured by the first author (W.W.) using 5 MHz transabdominal ultrasound probe attached to Voluzon E8 ultrasound platform (General Electric, Zipf, Austria). After voiding, the participants lay on the couch and the ultrasound probe was placed in sagittal plane just above the pubic symphyses. The picture of a deflated urinary bladder, sagittal plane of the cervix and the lower uterine wall could be obtained. The picture was enlarged until the lower uterine wall and the cervix fitted the borders of the screen. The lower uterine wall at the same horizontal plane with the dome of the urinary bladder was selected for measurement (Fig. 1). The first caliper was placed just beneath the peritoneum that covered the lower uterine wall and the other was placed at the interface between amniotic fluid and the decidua. Care was taken not to include the surrounding tissues into the measurement. The measurement was performed 3 times and the thinnest value was used for analysis. For cervical length measurement we followed the instruction of ISUOG 2015.13 The transvaginal probe of the same ultrasound machine was introduced in the anterior fornix of the vagina without exerting undue pressure on the cervix. The length from internal os to external os was measured in linear fashion for 3 times and the shortest value was used for analysis (Fig. 2).

Demographic data, obstetric history, lower uterine wall thickness and cervical length were recorded for statistical analysis. The outcomes of the pregnancies were followed and all the data were recorded for later analysis. We randomly selected 45 participants for the assessment of the inter-observer variation of measurement of lower uterine wall thickness and cervical length between the first author (W.W.) and the second author (P.W.). Both investigators were blinded from the results of the measurement of the other.

2.1. Statistical analysis

The data were prepared and analyzed using PASW statistics 18.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean and standard deviation (SD) or median and range as appropriate. Number and percentage were used for categorical data. Categorical variables were compared using Chi-square test. Spearman’s rank correlation was used for the assessment of the correlation between lower uterine wall thickness and CL. Bland–Altman plot was used to demonstrate the inter-observer variation in the measurements of lower uterine wall thickness and CL. All tests of significance were two tailed and p value < 0.05 was considered significant.

3. RESULTS

During the study period 166 pregnant women met the inclusion criteria and agreed to participate in the study. Pregnancy outcomes were available in 154 cases. Demographic data and obstetric history are shown in Table 1. Short CL (<30 mm) at 16–24 weeks were found in 10 women (6.0%) and preterm birth rate in this study was 6.49%.

The mean of lower uterine wall thickness at 16–20 weeks, 20+1–24 weeks, 24 +1–28 weeks and 28 +1–32 weeks were 5.42 ± 0.89 mm, 5.5 ± 1.33 mm, 5.35 ± 1.25 mm, and 5.10 ± 1.21 mm respectively (Table 2).

There was a highly positive correlation between lower uterine wall thickness and CL (r.s = 0.767, n = 166, p < 0.001) as demonstrated in Fig. 3.

In the short CL group, the mean and median of lower uterine wall thickness was 4.4 mm (SD 0.5) and 4.2 mm (3.6–5.5) respectively.

The reliability of the measurement of lower uterine wall thickness and CL between 2 operators was high as demonstrat-
ed by Bland–Altman plot (Figs. 4 and 5) (mean difference was 0.014 mm for the measurement of lower uterine wall thickness and 0.06 mm for CL measurement and almost all of the measurements fell in limits of agreement). The line of equality was within 95% confidence interval of the mean difference. Also, a one-sample \( t \)-test of bias revealed non-significant bias for the two operators.

4. DISCUSSION

Our study aimed to assess the correlation between lower uterine wall thickness measured by transabdominal ultrasonography and CL measured by transvaginal ultrasonography in singleton pregnancies who had no risk factors of preterm labor. Our study showed the mean thickness of lower uterine wall during 16–32 weeks of gestation was only slightly thinner with time.
The thinning process is thought to be a physiological change of the uterine wall that has been stretched little by little by the growing gestational products. However, it’s possible that differentiation of myometrial cells, progesterone, expression of genes that control contractile activity of the uterus and other mechanisms act in concert to maintain the uterine quiescence of the uterus and preclude overstretching of the uterine wall.14 We found a highly positive correlation between lower uterine wall thickness and CL at 16–32 weeks of gestation (r = 0.767). Although we do not see the exact mechanisms to explain our finding, we believe that it’s reasonable to imply that when the cervix is long the lower uterine wall would be thick, and when the cervix gets shorter the lower uterine wall would change in the same direction i.e. thinner. We hope that this could be the preliminary step of finding a surrogate marker of short CL for prediction of pregnant women at risk of preterm labor in the settings where transvaginal ultrasonography is not available. In this study we found 10 participants whose cervices at 16–24 weeks were shorter than 30 mm. The mean and median of lower uterine wall thickness of these participants were 4.2 and 4.4 mm which were close to the 10th percentile value of lower uterine wall thickness at 16–20 and 20+1–24 weeks (4.16 and 3.93 mm respectively). We believe that the results of our study support the hypothesis that the processes that shorten the cervix involve the lower segment of the uterus as well. However, whether the lower uterine wall thickness could be used as a substitution of CL measurement in order to predict population at risk of preterm labor needs to be investigated. The lower uterine wall thickness of 4.20 mm is also not appropriate to be used as a cutoff due to the small number of sample size. Further studies might shed some light on the exact mechanisms and proper cutoff.

We chose 30 mm as a cutoff of short CL for Thai pregnant women because there was a study that showed ethnic variation of this biological marker.15 In that study, Thai women’s cervices were a little longer than those of western population and were concordant with other studies from Asian countries.16-18

The lower uterine wall thickness can be distinctly demonstrated by transabdominal ultrasonography. Because the consensus or standard guideline regarding measurement of the lower uterine wall thickness does not exist, we improvised the techniques from the previous study.19 We did not choose the full bladder technique because of the variation in sense of full bladder among individuals which could lead to different bladder volume and different point of measurement. Moreover, holding urine for a long time in pregnant women is not advised due to the risk of urinary tract infection. We chose the self-emptying technique instead of indwelling the catheter technique because it was less invasive and more practical. From our experiences, the lower uterine wall thickness measurement in pregnant women after emptying their bladder is feasible and highly reproducible. One obstacle that precluded the precise measurement was the less clear pictures that resulted from the thick abdominal wall of obese or high BMI participants. We believed that the measurement technique used in this study was easy to follow, required minimal training and was feasible in almost all obstetric settings. However, the erroneous variation in measuring of small objects exists and could lead to a different interpretation. Thus, consensus on the measurement techniques, the clarity of the pictures and careful measurement are crucial for successful outcomes.

The incidence of preterm birth in our study was lower than previously reported because we excluded the population at risk of preterm labor from the beginning. The actual rate of preterm birth in our center has been around 12–13%.

The strength of our study was the preliminary study about the correlation of lower uterine wall thickness and CL in singleton pregnancies and the promising result. However, the strength was lessened by the small number of cases with short CL which made the cutoff less reliable. We believe that the effective prevention of preterm birth is a very hard work and requires collaborations from every level of maternal health care providers. We hope that the results of our study would encourage investigators to study more to bring about the clearer insights about preterm labor and better preventive strategies in the future.

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REFERENCES


