Assessing Uterocervical Angle and Cervical Length For Early Prediction of Preterm Delivery

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ABSTRACT
Threatened preterm labor is characterized by the presence of uterine contractions without accompanying cervical changes, occurring prior to 37 weeks of gestation. This study aimed to assess the effectiveness of uterocervical angle (UCA) alone and in combination with cervical length (CL) in forecasting preterm delivery in cases of threatened preterm labor. A prospective observational cohort study was performed involving 178 pregnant women presenting with threatened preterm labor. UCA and CL were measured via transvaginal ultrasonography and patient characteristics were documented from medical records. Participants were monitored until delivery to determine the occurrence of preterm birth. Diagnostic parameters, including sensitivity, specificity, likelihood ratios and predictive values (positive and negative) for UCA alone and UCA combined with CL, were calculated for predicting preterm birth. Preterm birth occurred in 26.40% of women with threatened preterm labor. For a UCA threshold of $\geq$110.91 degrees, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were 67.4%, 41.6%, 30.9% and 75.4%, respectively. When combining UCA $\geq$110.91 degrees with a CL <3.5 cm, the sensitivity, specificity, PPV and NPV were 51.20%, 70%, 37.9% and 77.5%, respectively. The combined assessment of UCA and CL demonstrated higher specificity and NPV compared to UCA alone. UCA measured via transvaginal ultrasonography, when supplemented by CL evaluation, enhances diagnostic accuracy in predicting preterm birth in threatened preterm labor due to its adequate sensitivity and high NPV.

INTRODUCTION

Preterm birth remains a significant obstetric challenge. According to the American College of Obstetricians and Gynecologists (ACOG), preterm deliveries contribute to 70% of early neonatal fatalities and 25-50% of infant deaths under one year of age. In the United States, the prevalence of preterm birth is 12%, a figure comparable to that observed in our institution. The World Health Organization reports that approximately half of all preterm births result from spontaneous preterm labor[1,2]. Threatened preterm labor refers to the occurrence of labor pains before 37 weeks of gestation without cervical changes. Around 25-30% of cases of threatened preterm labor progress to preterm delivery[3,4]. At present, no specific guidelines exist for managing threatened preterm labor. In Thailand, vaginal or speculum examinations are routinely conducted in pregnancies presenting with suspected labor pains before 37 weeks to assess cervical dilation and determine whether preterm or threatened preterm labor is occurring. While ACOG does not recommend the use of tocolytic drugs for pregnancies with labor pains and cervical dilation <2 cm, one study indicated that among pregnancies with labor pains and cervical dilation <3 cm that did not receive tocolytics, 21.2% of births were preterm, 14.7% of neonates required neonatal intensive care unit (NICU) admission, and 10 neonates died[5,6]. An effective method to distinguish false labor from early preterm labor is needed. A more recent approach involves the measurement of the uterocervical angle (UCA) via transvaginal ultrasonography (TVS), which has been identified as a promising screening tool for predicting preterm birth during the second trimester[7,8]. Additionally, the UCA angle becomes more acute after the insertion of a vaginal pessary to prevent preterm birth in women at risk for spontaneous preterm birth[9,10]. This method is simple, inexpensive and safe for both the mother and fetus. However, there is limited evidence regarding the use of UCA measurement in managing threatened preterm labor[11,12]. Therefore, the aim of this study is to evaluate whether UCA measurement via TVS can predict the risk of preterm birth in cases of threatened preterm labor and to identify factors associated with preterm birth in these cases.

MATERIALS AND METHODS

The study enrolled women diagnosed with threatened preterm labor. Patients were counseled and invited to participate. Eligibility criteria included a diagnosis of threatened preterm labor, defined as regular uterine contractions occurring at least once every 10 minutes, persisting for over 30 minutes, without cervical dilation, prior to 37 weeks of gestation. Additional criteria required participants to have a singleton pregnancy and be aged over 18 years. Women were excluded if they presented with placenta previa, pathologies associated with contact bleeding (e.g., endocervical polyps, infections, or bleeding tumors), or suboptimal imaging due to anatomical limitations such as compression of the lower uterine segment or cervical canal by masses. Further exclusions applied to those who withdrew consent, lacked delivery outcome data, or experienced medically indicated preterm birth due to conditions such as severe intrauterine growth restriction, prolonged preterm premature rupture of membranes, severe preeclampsia, or non-reassuring fetal status. Upon obtaining informed consent, demographic data were extracted from antenatal medical records. UCA and CL were measured using ultrasound machines equipped with transvaginal probes. The UCA was defined as the angle between the cervical canal and the lower uterine segment. Visualization included the anterior uterine wall, internal and external cervical os and the isthmus. Two intersecting lines were drawn: one connecting the internal and external os and another parallel to the anterior uterine wall. The angle formed at the internal os represented the UCA. Statistical analysis was conducted using SPSS version 23. Descriptive data were summarized as frequencies, percentages, means with standard deviations, or medians with interquartile ranges (IQR). Preterm birth was defined as delivery before 37 weeks. Receiver operating characteristic (ROC) curve analysis was used to determine optimal UCA cut-off values. Logistic regression, Pearson's chi-square and Fisher's exact test were used for categorical data, with statistical significance set at p <0.05.

RESULTS AND DISCUSSIONS

The demographic and clinical variables are presented in (Table 1). Regarding maternal age, there was no significant difference between the term and preterm groups. Both groups had similar values for UCA. In contrast, gestational age TVU was significantly lower in the preterm group (33.8±1.9 weeks) compared to the term group (35.1±1.6 weeks, p<0.01). Similarly, CL was significantly shorter in the preterm group (3.0±0.4 cm vs. 3.4±0.4 cm in the term group, p<0.01). Body mass index (BMI) at conception was slightly higher in the preterm group (21.0±1.6 kg/m² vs. 20.3±1.4 kg/m² in the term group, p<0.05), although BMI at delivery did not differ significantly between the groups. Regarding delivery outcomes, a significantly higher proportion of women in the preterm group had cesarean sections. Gestational diabetes mellitus was more prevalent in the term group (16% vs. 6%, p<0.05), while hypertension rates were not significantly different between the groups.

Table 1: Patient Parameters Under Study

Variables	Term (N=130)	Preterm (N=47)	p-value
Age (weeks)., Mean±SD	28.7±5.4	30.2±6.6	0.13
UCA (degree)., Mean±SD	113.1±6.0	113.0±7.0	0.93
GA at TVU (weeks)., Mean±SD	35.1±1.6	33.8±1.9	<0.01
CL (cm)., Mean±SD	3.4±0.4	3.0±0.4	<0.01
BMI at conception (kg/m2)., Mean±SD	20.3±1.4	21.0±1.6	<0.05
BMI at delivery (kg/m2)., Mean±SD	24.5±1.4	24.7±1.4	0.4
Nulliparous., n (%)	67	22	<0.05
Prior spontaneous preterm., n (%)	8	4	0.25
Prior D and C., n (%)	9	2	<0.05
Prior cervical conization., n (%)	0	1	0.68
Prior LEEP., n (%)	0	0	-
Abnormal Pap., n (%)	2	0	0.34
Normal labor., n (%)	82	29	<0.05
Cesarean section., n (%)	35	14	<0.05
Primary Cesarean., n (%)	24	7	<0.05
Repeated Cesarean., n (%)	11	7	0.35
Smoking., n (%)	1	1	-
Gestational diabetes mellitus., n (%)	16	6	<0.05
Hypertension., n (%)	5	2	0.26

Table 2: Independent Predictors for Preterm Labour by Logistic Regression (N=178)

Variables	Odds Ratio	95% CI	p-value
UCA≥110.91 degrees	1.14	0.32-4.06	0.74
CL<3.5 cm	1.96	0.55-6.74	0.31
UCA≥110.91 degrees+CL<3.4 cm	1.29	0.25-6.09	0.76

Table 3: Diagnostic Accuracy of UCA and CL for Predicting Preterm Labour

Parameters	Sensitivity	Specificity	PPV	NPV
UCA≥110.91 degrees	67.40	41.60	30.90	75.40
CL<3.5 cm	73.70	44.00	31.40	79.80
UCA≥110.91 degrees+CL <3.4 cm	51.20	70.00	37.90	77.50

Logistic regression analysis (Table 2) was performed to identify independent predictors for preterm labor. The variables analyzed included UCA, CL and the combined measure of UCA ≥110.91 degrees and CL <3.4 cm. UCA ≥110.91 degrees had an odds ratio (OR) of 1.14 (95% CI 0.32-4.06, p=0.74), suggesting no significant association with preterm labor. Similarly, CL <3.5cm showed an OR of 1.96 (95% CI 0.55-6.74, p=0.31), indicating no significant predictive value for preterm labor. When UCA ≥110.91 degrees was combined with CL <3.4cm, the OR was 1.29 (95% CI 0.25-6.09, p=0.76), which further reinforced the lack of predictive power of these parameters in isolation or combination. The diagnostic accuracy of UCA and CL for predicting preterm labor was evaluated in terms of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) (Table 3). For UCA ≥110.91 degrees, sensitivity was 67.4%, specificity was 41.6%, PPV was 30.9% and NPV was 75.4%. For CL <3.5cm, sensitivity was 73.7%, specificity was 44.0%, PPV was 31.4% and NPV was 79.8%. The combined measure of UCA ≥110.91 degrees and CL <3.4 cm showed a sensitivity of 51.2%, specificity of 70.0%, PPV of 37.9% and NPV of 77.5%, indicating a moderate ability to predict preterm labor.

Our results indicated that a TVS-UCA measurement of ≥110.91 degrees showed a sensitivity of 67.4% and a specificity of 13.6% in predicting preterm birth in patients with threatened preterm labor. In a review of the literature on TVS-UCA as a screening tool for preterm birth (before 37 weeks), one study found that a TVS-UCA >95 degrees and a UCA >105 degrees, measured during the second trimester, were significantly associated with preterm births at <37 weeks and <34 weeks, respectively[7]. This study reported a sensitivity and specificity of 53% for TVS-UCA, which were higher than those observed in our study. These findings align with other research conducted during the first and second trimesters, which also demonstrated the potential of UCA as a useful screening tool for predicting preterm delivery[8,12]. TVS-CL is widely utilized as a cervical marker for predicting preterm birth in both the second and third trimesters[7,16]. In our study, the diagnostic performance of TVS-CL was found to be superior to that of TVS-UCA. However, combining both parameters appears to enhance the accuracy of cervical condition assessment for preterm prediction. While the sensitivity of TVS-UCA combined with TVS-CL was lower, the specificity increased. This finding has potential clinical implications, but further research is necessary. The TVS-UCA measurement is easy to perform and incurs no additional costs beyond the TVS-CL measurement. The high NPV observed for TVS-UCA combined with TVS-CL suggests that this approach could be useful in clinical practice for managing threatened preterm labor, aiding in decisions regarding admission and the use of tocolytic agents. The mean UCA in this study was higher than that reported in previous studies. A prospective cohort analysis on threatened preterm labor between the 20th and 31st weeks found an average UCA of 103

degrees, with no significant difference in UCA between preterm and term groups[17]. Another study recorded TVS-UCA and TVS-CL as routine screenings between the 18th and 23rd weeks of gestation, finding a mean UCA of 101.7 degrees for spontaneous preterm deliveries and 103.6 degrees for term deliveries[18]. This suggests that TVS-UCA measurements may vary with gestational age and tend to increase with advancing pregnancy. The cut-off value of TVS-UCA in our study differs from those used in previous research[7,8], where cut-off values were set at 95 and 105 degrees. This variation could be attributed to differences in the trimesters studied and the characteristics of the participants. Our participants were primarily in the third trimester and experiencing threatened preterm labor. It is known that cervical shape and length change gradually from the first to the third trimester. For instance, the mean cervical length (CL) has been reported to shorten from 38.30±7.28 mm at 20 weeks to 37.03±4.82 mm at 28 weeks[19]. The UCA is also thought to vary with gestational age, but normal UCA values for the third trimester remain unreported. This study has some limitations. The sample size was calculated to determine the sensitivity of UCA, so a larger sample size would be needed to identify differences between TVS-UCA measurements for preterm and term birth groups. This limitation led to a non-normal distribution of UCA and CL values, necessitating the use of non-parametric statistical methods for analysis. Additionally, the study did not categorize preterm births into early preterm and late preterm categories, which may limit the ability to compare our results with studies focused on TVS measurements during the second trimester.

CONCLUSION

With its reasonable sensitivity and high negative predictive value (NPV), the measurement of uterocervical angle (UCA) via transvaginal ultrasonography (TVS) serves as a valuable tool for predicting preterm birth in cases of threatened preterm labor. Additionally, the combined evaluation of UCA and cervical length (CL) offers further predictive insights, aiding clinicians in making informed decisions regarding the administration of tocolytic agents in managing threatened preterm labor.

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