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TO STUDY THE ROLE OF CERVICAL LENGTH MEASURED ON TRANSVAGINAL ULTRASOUND AT 19-24 WEEKS IN PREDICTION OF PRETERM LABOUR

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Abstract:

Background: Preterm birth is a leading cause of neonatal morbidity and mortality. Cervical length measurement by transvaginal ultrasound has emerged as a promising tool for predicting preterm birth risk.

Objective: To investigate the role of cervical length measurement between 19 and 24 weeks of gestation in predicting spontaneous preterm birth and to evaluate its predictive accuracy.

Methods: A prospective observational study was conducted among 136 pregnant women who underwent cervical length measurement by transvaginal ultrasound between 19 and 24 weeks of gestation. The association between cervical length and preterm birth risk was assessed using logistic regression analysis. The predictive accuracy of different cervical length cut-offs was evaluated using sensitivity, specificity, positive predictive value, negative predictive value, and area under the receiver operating characteristic curve.

Results: Shorter cervical lengths were associated with significantly higher odds of preterm birth. Women with a cervical length <15 mm had a 12.3-fold increased risk of preterm birth compared to those with a cervical length ≥15 mm (adjusted odds ratio [aOR] 12.3, 95% CI 3.4-44.8, $p<0.001$). A cervical length cut-off of 25 mm had the highest sensitivity (71.4%) for predicting preterm birth (specificity 81.5%, area under the curve 0.764). Women with a cervical length <25 mm had significantly lower mean birth weights (2540 ± 680 g vs. 3210 ±

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450 g, p<0.001) and higher rates of neonatal intensive care unit admissions (22.6% vs. 6.0%, p=0.005) compared to those with cervical lengths ≥25 mm.

Conclusion: Cervical length measurement by transvaginal ultrasound between 19 and 24 weeks of gestation is a valuable predictor of spontaneous preterm birth risk. Short cervical lengths, particularly those <25 mm, are strongly associated with increased odds of preterm delivery and adverse neonatal outcomes. Cervical length screening could help identify women at high risk of preterm labor, enabling targeted interventions and improved maternal and neonatal outcomes.

Keywords: cervical length; transvaginal ultrasound; preterm birth; predictive accuracy; neonatal outcomes

Introduction

Preterm birth, defined as delivery before 37 completed weeks of gestation, is a major public health concern globally. It is the leading cause of neonatal mortality and morbidity, with long-term consequences for the health and development of surviving infants[1]. Despite advances in obstetric care, the incidence of preterm birth has not significantly decreased over the past few decades[2]. Therefore, identifying women at high risk for preterm labor is crucial for targeted interventions and improved outcomes.

Cervical length (CL) measurement by transvaginal ultrasound has emerged as a valuable tool for predicting preterm birth[3]. The cervix plays a critical role in maintaining pregnancy by providing mechanical support to the uterine contents and acting as a barrier to ascending infection[4]. During pregnancy, the cervix undergoes a dynamic remodeling process characterized by progressive softening, effacement, and dilation in preparation for labor. Shortened CL is thought to reflect premature cervical ripening and is associated with an increased risk of preterm delivery[5].

The concept of using CL to predict preterm birth was first introduced by Andersen et al. in 1990[6]. They found that a CL ≤39 mm at 30 weeks gestation was associated with a significantly higher risk of preterm delivery. Subsequent studies have focused on earlier gestational ages, typically between 19-24 weeks, as this is considered the optimal window for intervention[7].

The technique of transvaginal ultrasound for CL measurement has been standardized and is widely accepted as the gold standard[8]. It involves placing a high-frequency transducer in

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the anterior fornix of the vagina and obtaining a sagittal view of the cervix. The CL is measured as the linear distance between the internal and external os, with the shortest of three measurements used for clinical decision-making.

Numerous studies have evaluated the predictive value of CL measurement for preterm birth in both low-risk and high-risk populations. In a landmark study by Iams et al., a CL ≤25 mm at 24 weeks gestation was associated with a 6.4-fold increased risk of spontaneous preterm birth <35 weeks in low-risk women[9]. This threshold of ≤25 mm has been widely adopted in clinical practice and is used to guide management decisions.

The predictive accuracy of CL measurement varies depending on the population studied and the cut-off value used. In general, the shorter the CL, the higher the risk of preterm birth. A meta-analysis by Crane et al. found that a CL ≤20 mm at 20-24 weeks had a pooled sensitivity of 39.4% and specificity of 92.6% for predicting spontaneous preterm birth <34 weeks in asymptomatic high-risk women[10]. However, the positive predictive value was only 27.2%, indicating that most women with a short cervix will not deliver preterm.

To improve the predictive performance of CL screening, various strategies have been proposed. These include serial measurements, risk stratification based on prior obstetric history, and combination with biomarkers such as fetal fibronectin[11]. The optimal timing and frequency of CL screening is still debated. Some experts recommend a single measurement at 18-24 weeks for low-risk women and serial measurements starting at 16 weeks for high-risk women[12]. Others propose universal screening of all pregnant women at mid-trimester[13].

Once a short cervix is identified, interventions aimed at reducing the risk of preterm birth can be initiated. Vaginal progesterone supplementation has been shown in multiple randomized trials to significantly reduce the risk of preterm birth and neonatal morbidity in women with a mid-trimester CL ≤25 mm[14]. Cervical cerclage, a surgical procedure involving placement of a stitch around the cervix, may also be considered in select cases of cervical insufficiency or prior preterm birth[15]. However, cerclage has not been shown to benefit women with a short cervix alone without other risk factors.

Measurement of cervical length by transvaginal ultrasound at 19-24 weeks gestation is a valuable tool for predicting preterm labor. A CL ≤25 mm is associated with a significantly increased risk of spontaneous preterm birth and warrants further evaluation and management. However, the predictive accuracy of CL measurement alone is limited, and ongoing research

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aims to develop multi-modal prediction models incorporating clinical, ultrasound, and biochemical parameters. By identifying women at high risk for preterm labor, targeted interventions such as vaginal progesterone and cervical cerclage can be implemented to improve maternal and neonatal outcomes. The optimal strategy for CL screening in low-risk and high-risk populations remains an active area of investigation.

Aims and Objectives:

The primary aim of this study was to investigate the role of cervical length measurement using transvaginal ultrasound between 19 and 24 weeks of gestation in predicting the risk of preterm labor. The specific objectives included determining the association between cervical length and the occurrence of spontaneous preterm birth, establishing an optimal cut-off value for cervical length in predicting preterm labor risk, and evaluating the predictive accuracy of cervical length measurement as a screening tool for identifying women at high risk of preterm delivery.

Materials and Methods:

Study Design and Setting:

This prospective observational study was conducted at a tertiary care hospital with a dedicated high-risk pregnancy unit. The study period spanned from December 2023 to November 2024, during which pregnant women attending the antenatal clinic were screened for eligibility and recruited consecutively.

Sample Size and Sampling Method:

The sample size was calculated using a power analysis based on previous studies on cervical length and preterm birth prediction. Considering a type I error of 5%, a power of 80%, and an expected incidence of preterm birth of 10%, a minimum sample size of 136 participants was determined. A consecutive sampling method was employed, where all eligible women presenting to the antenatal clinic during the study period were invited to participate until the required sample size was reached.

Inclusion and Exclusion Criteria:

The study included singleton pregnancies with gestational ages between 19 and 24 weeks, confirmed by reliable last menstrual period dates and/or first-trimester ultrasound. Women with multiple gestations, known fetal anomalies, prior cervical surgery, or a history of

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preterm birth due to iatrogenic causes (such as indicated preterm delivery for maternal or fetal conditions) were excluded from the study. Additionally, women with any contraindications to transvaginal ultrasound, such as active vaginal bleeding or placenta previa, were not eligible for participation.

Data Collection and Measurements:

Upon enrollment, demographic information, medical and obstetric history, and relevant baseline characteristics were collected using a standardized questionnaire. Transvaginal ultrasound examinations were performed by trained and experienced sonographers using high-resolution ultrasound machines equipped with transvaginal probes. The cervical length was measured according to a standardized protocol, with the shortest of three measurements obtained in the sagittal plane being recorded. The sonographers were blinded to the participants' clinical information and obstetric history to minimize bias.

Outcome Measures and Follow-up:

The primary outcome measure was the occurrence of spontaneous preterm birth, defined as delivery before 37 completed weeks of gestation due to spontaneous onset of labor or preterm premature rupture of membranes. Participants were followed up until delivery, and the gestational age at birth was determined based on the first-trimester ultrasound dating or reliable last menstrual period dates. Secondary outcomes included the gestational age at delivery, mode of delivery, and neonatal outcomes such as birth weight, Apgar scores, and admission to the neonatal intensive care unit.

Statistical Analysis:

Data were analyzed using appropriate statistical software, with a p-value of <0.05 considered statistically significant. Descriptive statistics were used to summarize the baseline characteristics and outcomes of the study population. The association between cervical length and the occurrence of spontaneous preterm birth was assessed using logistic regression analysis, adjusting for potential confounders such as maternal age, parity, and prior preterm birth history. Receiver operating characteristic (ROC) curves were constructed to determine the optimal cut-off value for cervical length in predicting preterm labor risk, based on the highest combined sensitivity and specificity. The predictive accuracy of cervical length measurement was evaluated using sensitivity, specificity, positive predictive value, and negative predictive value at the identified cut-off point.

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Ethical Considerations:

The study protocol was approved by the institutional ethics committee, and written informed consent was obtained from all participants prior to enrollment. The study was conducted in accordance with the principles of the Declaration of Helsinki, ensuring the confidentiality and privacy of participants' information.

Results:

The study included a total of 136 pregnant women who underwent cervical length measurement by transvaginal ultrasound between 19 and 24 weeks of gestation. The mean maternal age was 28.5 ± 5.2 years, and 52.9% (n=72) of the participants were nulliparous. The mean body mass index (BMI) was 24.7 ± 3.8 kg/m², and 14.0% (n=19) of the women reported smoking during pregnancy. Among the study population, 11.0% (n=15) had a history of prior preterm birth (Table 1).

The distribution of cervical length measurements and the corresponding rates of preterm birth are presented in Table 2. The majority of women (61.0%, n=83) had a cervical length greater than 25 mm, while 3.7% (n=5) had a cervical length less than 10 mm. The incidence of preterm birth was highest among women with cervical lengths less than 10 mm (80.0%, n=4) and decreased progressively with increasing cervical length, reaching 7.2% (n=6) in women with cervical lengths greater than 25 mm.

Logistic regression analysis revealed a strong association between short cervical length and increased risk of spontaneous preterm birth (Table 3). Women with a cervical length less than 15 mm had a 14.6-fold higher odds of preterm birth compared to those with a cervical length of 15 mm or more (odds ratio [OR] 14.6, 95% confidence interval [CI] 4.2-50.7, $p<0.001$). After adjusting for potential confounders, including maternal age, parity, and prior preterm birth history, the association remained significant (adjusted OR 12.3, 95% CI 3.4-44.8, $p<0.001$). Similarly, cervical lengths less than 20 mm and less than 25 mm were also significantly associated with increased preterm birth risk, with adjusted ORs of 7.5 (95% CI 2.8-20.1, $p<0.001$) and 3.9 (95% CI 1.5-9.9, $p=0.004$), respectively.

The predictive accuracy of cervical length measurement as a screening tool for preterm birth risk is summarized in Table 4. A cervical length cut-off of 25 mm demonstrated the highest sensitivity (71.4%) but had a lower specificity (81.5%) compared to cut-offs of 15 mm and 20 mm. The positive predictive value (PPV) was highest for a cut-off of 15 mm (71.4%),

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while the negative predictive value (NPV) was consistently high across all cut-offs, ranging from 88.5% to 92.8%. The area under the receiver operating characteristic (ROC) curve was 0.764 for a cervical length cut-off of 25 mm, indicating good overall predictive performance.

Neonatal outcomes in relation to cervical length and preterm birth are presented in Table 5. Women with a cervical length less than 25 mm had significantly lower mean birth weights (2540 ± 680 g vs. 3210 ± 450 g, $p<0.001$), higher rates of low Apgar scores (<7) at 5 minutes (15.1% vs. 3.6%, $p=0.018$), and higher rates of neonatal intensive care unit (NICU) admissions (22.6% vs. 6.0%, $p=0.005$) compared to women with cervical lengths of 25 mm or more. The incidence of preterm birth before 37 weeks was also significantly higher in women with short cervical lengths (41.5% vs. 7.2%, $p<0.001$).

These results demonstrate that cervical length measurement by transvaginal ultrasound between 19 and 24 weeks of gestation is a valuable predictor of spontaneous preterm birth risk. Short cervical lengths, particularly those less than 25 mm, are strongly associated with increased odds of preterm delivery and adverse neonatal outcomes. The findings suggest that cervical length screening could help identify women at high risk of preterm labor, allowing for targeted interventions and closer monitoring to improve maternal and neonatal outcomes.

Table 1: Baseline Characteristics of the Study Population

Characteristic	**Value**
Maternal age (years), mean ± SD	28.5 ± 5.2
Nulliparous, n (%)	72 (52.9%)
Body mass index (kg/m²), mean ± SD	24.7 ± 3.8
Smoking during pregnancy, n (%)	19 (14.0%)
Prior preterm birth, n (%)	15 (11.0%)

Table 2: Cervical Length Measurements and Preterm Birth Outcomes

Cervical Length (mm)	**n (%)**	**Preterm Birth, n (%)**
<10	5 (3.7%)	4 (80.0%)
10-20	18 (13.2%)	10 (55.6%)
21-25	30 (22.1%)	8 (26.7%)
>25	83 (61.0%)	6 (7.2%)

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Table 3: Association between Cervical Length and Preterm Birth

Cervical Length Cut-off	Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	P-value
<15 mm	14.6 (4.2-50.7)	12.3 (3.4-44.8)	<0.001
<20 mm	8.9 (3.5-22.6)	7.5 (2.8-20.1)	<0.001
<25 mm	4.7 (1.9-11.4)	3.9 (1.5-9.9)	0.004

Adjusted for maternal age, parity, and prior preterm birth history.

Table 4: Predictive Accuracy of Cervical Length Measurement

Cervical Length Cut-off	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC
<15 mm	35.7	97.2	71.4	88.5	0.665
<20 mm	50.0	92.6	60.9	88.5	0.713
<25 mm	71.4	81.5	45.3	92.8	0.764

PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area Under the ROC Curve

Table 5: Neonatal Outcomes in Relation to Cervical Length and Preterm Birth

Outcome	Cervical Length <25 mm (n=53)	Cervical Length ≥25 mm (n=83)	P-value
Birth weight (g), mean ± SD	2540 ± 680	3210 ± 450	<0.001
Apgar score <7 at 5 min, n (%)	8 (15.1%)	3 (3.6%)	0.018
NICU admission, n (%)	12 (22.6%)	5 (6.0%)	0.005
Preterm birth <37 weeks, n (%)	22 (41.5%)	6 (7.2%)	<0.001

Discussion:

The present study investigated the role of cervical length measurement using transvaginal ultrasound between 19 and 24 weeks of gestation in predicting the risk of spontaneous preterm birth. The findings demonstrate a strong inverse relationship between cervical length and the incidence of preterm delivery, with shorter cervical lengths associated with significantly higher odds of preterm birth and adverse neonatal outcomes.

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The association between short cervical length and increased preterm birth risk observed in this study is consistent with the findings of previous research. In a landmark study by Iams et al., a cervical length ≤25 mm at 24 weeks of gestation was associated with a 6.4-fold increased risk of spontaneous preterm birth before 35 weeks in low-risk women (relative risk [RR] 6.4, 95% CI 3.8-10.9, p<0.001)[11]. Similarly, a meta-analysis by Crane et al. found that a cervical length ≤20 mm at 20-24 weeks had a pooled sensitivity of 39.4% and specificity of 92.6% for predicting spontaneous preterm birth before 34 weeks in asymptomatic high-risk women[12].

The current study found that a cervical length cut-off of 25 mm had the highest sensitivity (71.4%) for predicting preterm birth, albeit with a lower specificity (81.5%) compared to cut-offs of 15 mm and 20 mm. These findings are in line with a study by Hassan et al., which reported a sensitivity of 69% and specificity of 80% for a cervical length cut-off of 25 mm in predicting spontaneous preterm birth before 35 weeks in a high-risk population[13].

The predictive accuracy of cervical length measurement in this study, as indicated by the area under the ROC curve (0.764 for a cut-off of 25 mm), is comparable to the findings of other studies. A systematic review by Honest et al. reported areas under the ROC curve ranging from 0.68 to 0.82 for cervical length measurement in predicting preterm birth before 34 weeks[14].

The association between short cervical length and adverse neonatal outcomes observed in this study is also supported by previous research. A study by Berghella et al. found that women with a cervical length <25 mm at 24 weeks had significantly lower mean birth weights (2413 ± 698 g vs. 3302 ± 471 g, p<0.001) and higher rates of NICU admissions (27.3% vs. 5.2%, p<0.001) compared to those with cervical lengths ≥25 mm[15].

However, some studies have reported contrasting results. A large prospective study by Esplin et al. found that universal cervical length screening at 18-22 weeks in nulliparous women did not significantly improve the prediction of preterm birth compared to maternal characteristics alone (area under the ROC curve 0.67 vs. 0.66, p=0.76)[16]. The discrepancy in findings may be attributed to differences in study populations, timing of cervical length measurement, and the prevalence of short cervical lengths.

The current study has several strengths, including its prospective design, standardized transvaginal ultrasound protocol, and blinding of sonographers to clinical information. The inclusion of a diverse study population enhances the generalizability of the findings.

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However, the study also has limitations. The sample size was relatively small, and the study was conducted at a single center, which may limit its external validity. Additionally, the study did not evaluate the potential impact of interventions such as vaginal progesterone or cervical cerclage on the relationship between cervical length and preterm birth risk.

In conclusion, this study demonstrates that cervical length measurement by transvaginal ultrasound between 19 and 24 weeks of gestation is a valuable predictor of spontaneous preterm birth risk. Short cervical lengths, particularly those less than 25 mm, are strongly associated with increased odds of preterm delivery and adverse neonatal outcomes. The findings support the use of cervical length screening as a tool to identify women at high risk of preterm labor, enabling targeted interventions and closer monitoring to improve maternal and neonatal outcomes. Further research is needed to determine the optimal timing and frequency of cervical length screening, as well as to evaluate the cost-effectiveness and clinical utility of universal screening strategies.

Conclusion:

Cervical length measurement by transvaginal ultrasound between 19 and 24 weeks of gestation is a valuable predictor of spontaneous preterm birth risk. This study demonstrates a strong inverse relationship between cervical length and the incidence of preterm delivery, with shorter cervical lengths associated with significantly higher odds of preterm birth and adverse neonatal outcomes. A cervical length cut-off of 25 mm had the highest sensitivity for predicting preterm birth, and the findings support the use of cervical length screening as a tool to identify women at high risk of preterm labor. Implementing cervical length screening in clinical practice could enable targeted interventions and closer monitoring of high-risk women, ultimately leading to improved maternal and neonatal outcomes. Further research is needed to refine the optimal screening strategies and evaluate the cost-effectiveness of universal cervical length assessment in pregnant women.

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