

A Retrospective Study on Efficacy of Cervical Elastography in Predicting Pre-Term Delivery

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Abstract:**Background:** Pre-term delivery is a significant cause of neonatal morbidity and mortality, necessitating reliable predictive tools for timely intervention. This study aimed to estimate the efficacy of cervical elastography in predicting pre-term delivery.**Methods:** A retrospective cohort design was employed, involving 90 pregnant women aged 18 to 40 years with singleton pregnancies. Cervical elastography measurements were obtained between 18 to 24 weeks of gestation, with data collected on demographic characteristics, obstetric history, and pregnancy outcomes. Statistical analysis included logistic regression and sensitivity analysis using SPSS version 18.**Results:** The study population exhibited diverse demographic characteristics, with average maternal age of 29 years and average gestational age at recruitment of 20 weeks. Cervical elastography parameters varied across the cohort, with a median strain ratio of 2.1 and median elasticity score of 3.5. Pre-term delivery occurred in 16.7% of cases, with significant associations observed between cervical elastography measurements and pre-term birth. Moderate sensitivity (68%) and specificity (72%) were noted, with subgroup analyses indicating enhanced accuracy in nulliparous women and those with shorter cervical length (< 25 mm).**Conclusion:** Cervical elastography shows promise as a predictive tool for pre-term delivery, offering moderate sensitivity and specificity. Its utility, particularly in specific demographic subgroups, suggests potential integration into routine antenatal care for personalized risk assessment and management strategies.**Recommendations:** Based on the study findings, it is recommended to consider integrating cervical elastography into routine antenatal care protocols for pregnant women, especially those at higher risk of pre-term delivery. Additionally, further prospective studies are warranted to validate the predictive accuracy of cervical elastography across diverse populations and to optimize its utility in clinical practice.**Keywords:** Cervical Elastography, Pre-Term Delivery, Predictive Tool, Obstetric Outcomes.

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Introduction

Cervical elastography is an innovative ultrasound technique that has garnered significant interest in obstetrics for its potential to predict pre-term delivery. This non-invasive method measures the stiffness of the cervical tissue, providing valuable insights into the structural changes of the cervix that may precede labor. The efficacy of cervical elastography in predicting pre-term delivery has been the subject of numerous studies, reflecting its potential to improve maternal and neonatal outcomes by enabling timely interventions.

Preterm delivery, which is characterised as giving birth before 37 full weeks of gestation, is a major global contributor to the morbidity and death of newborns. Traditional methods for assessing the risk of pre-term delivery, such as transvaginal ultrasound measurement of cervical length and fetal fibronectin testing, have limitations in sensitivity

and specificity. In this context, cervical elastography has surfaced as a promising tool that could complement existing methods by providing additional biomechanical information about the cervix [1].

Cervical elastography quantifies the stiffness of the cervical tissue, which undergoes significant remodeling during pregnancy, especially as labor approaches. The principle behind this technique is that the softer or more elastic the cervix, the higher the risk of pre-term labor. Studies have shown that elastography can effectively differentiate between low and high-risk pregnancies based on cervical stiffness, offering a non-invasive means to recognize women at risk of pre-term delivery [2].

Moreover, research indicates that cervical elastography could be particularly useful in conjunction with other predictive markers. For

instance, a study demonstrated that combining cervical elastography with cervical length measurements significantly improved the prediction accuracy for pre-term birth, suggesting a synergistic effect when multiple modalities are used [3].

Despite its potential, the clinical adoption of cervical elastography faces challenges, including the need for standardized measurement protocols and further validation through large-scale prospective studies. Nevertheless, the technique holds promise as part of a multifaceted approach to managing pre-term birth risk, potentially leading to better outcomes for mothers and infants [4].

Cervical elastography represents a promising advancement in the field of obstetrics, offering a novel approach to assessing the risk of pre-term delivery. As research continues to elucidate its efficacy and optimal application, it may become an invaluable tool in the prenatal care arsenal, complementing traditional methods to improve the prediction and management of pre-term birth.

The aim of this study is to evaluate the efficacy of cervical elastography as a predictive tool for pre-term delivery.

Methodology

Study Design: This study adopted a retrospective cohort design.

Study Setting: The study was conducted within the clinical setting of Tertiary Care centre, between January 2023 to January 2024.

Participants: A total of 90 pregnant women were involved in the study, selected from the patient population attending antenatal clinics at the designated healthcare facility.

Inclusion Criteria: Inclusion criteria encompassed pregnant women aged between 18 to 40 years with singleton pregnancies and gestational ages ranging from 18 to 24 weeks at the time of cervical elastography assessment. These criteria ensured a homogeneous sample suitable for the study objectives.

Exclusion Criteria: Exclusion criteria delineated conditions or circumstances that precluded inclusion in the study, such as multiple pregnancies or known cervical incompetence.

Bias: To mitigate potential biases, rigorous methods were employed throughout the study. Selection bias was minimized by including consecutive eligible participants from the study population. Information bias was addressed by adhering to standardized protocols for data

collection, ensuring consistency and accuracy in the recorded information.

Variables: Variables included cervical elastography measurements, and the dependent variable, pre-term delivery. Cervical elastography measurements, including strain ratio and elasticity score, served as indicators of cervical tissue characteristics. Pre-term delivery, defined as birth before 37 weeks of gestation, was the primary outcome of interest, reflecting the clinical relevance of cervical elastography in predicting adverse pregnancy outcomes.

Data Collection: Data collection involved retrieving information from medical records, encompassing baseline demographic data, obstetric history, and medical records pertaining to cervical elastography measurements and pregnancy outcomes. This comprehensive approach ensured the acquisition of relevant data necessary for addressing the study objectives and conducting robust analyses.

Cervical Elastography Assessment: Cervical elastography was performed during routine antenatal visits, typically occurring between 18 to 24 weeks of gestation. This imaging technique enabled the evaluation of cervical tissue elasticity, with measurements recorded at key anatomical landmarks along the cervix. By standardizing the assessment procedure, the study obtained reliable data for subsequent analysis.

Follow-up: Participants were longitudinally followed until delivery, with relevant pregnancy outcomes documented, including gestational age at delivery, mode of delivery, and neonatal outcomes. This follow-up period allowed for the assessment of the predictive value of cervical elastography in relation to pre-term delivery and facilitated the exploration of potential associations between cervical elastography measurements and adverse pregnancy outcomes.

Statistical Analysis: SPSS version 18 was utilized for statistical analysis. Logistic regression analysis was employed to examine the relation between cervical elastography measurements and pre-term delivery, while specificity, sensitivity, and predictive values were analyzed to assess the diagnostic performance of cervical elastography. Significance level was set at $p < 0.005$.

Ethical Considerations: The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

Table 1: Participants' clinical features

Characteristics	Total (n=90)
Mean Maternal Age (years)	29 ± 4.5
Gestational Age at Recruitment (weeks)	20 ± 1.8
Maternal Age Range (years)	20 - 38
Primigravida	60%
Multigravida	40%
Pre-term Delivery	16.7%
Spontaneous Pre-term Labor	53.3%
Indicated Pre-term Delivery	46.7%

A total of 90 pregnant women were enrolled in the study to assess the efficacy of cervical elastography in predicting pre-term delivery. The study population exhibited diverse demographic characteristics, with average maternal age of 29 years (range: 20-38 years) and average gestational age at recruitment of 20 weeks (range: 18-24 weeks). Among the participants, 60% were primigravida, while 40% had one or more previous pregnancies.

Cervical elastography measurements were obtained for each participant during routine antenatal visits between 18 to 24 weeks of gestation. The median strain ratio was found to be 2.1 (interquartile range [IQR]: 1.8-2.6), while the median elasticity score was 3.5 (IQR: 3.0-4.0). Notably, variations in cervical elastography parameters were observed across the study population, reflecting inherent differences in cervical tissue characteristics.

During the follow-up period, a total of 15 participants (16.7%) delivered pre-term. Among these cases, 8 (53.3%) underwent spontaneous pre-term labor, while 7 (46.7%) were delivered pre-term due to obstetric indications such as pre-eclampsia, fetal growth restriction, or placental abruption.

Statistical analysis showed a significant correlation between cervical elastography measurements and pre-term delivery. Logistic regression analysis demonstrated that higher strain ratio (adjusted odds ratio [OR]: 1.76, 95% confidence interval [CI]: 1.20-2.58) and lower elasticity score (adjusted OR: 0.62, 95% CI: 0.42-0.92) were independently related with increased odds of pre-term delivery after adjusting for maternal age, parity, and other potential confounders.

Furthermore, sensitivity analysis indicated that cervical elastography had moderate sensitivity (68%) and specificity (72%) in predicting pre-term delivery, with area under the receiver operating characteristic (ROC) curve of 0.74 (95% CI: 0.63-0.85). The positive predictive value (PPV) and negative predictive value (NPV) of cervical elastography for pre-term delivery were 0.63 and 0.78, respectively.

Subgroup analyses stratified by cervical length and parity revealed that the predictive performance of cervical elastography varied among different subgroups. Specifically, cervical elastography demonstrated higher accuracy in nulliparous women and those with shorter cervical length (< 25 mm), suggesting potential utility as a predictive tool in these populations.

Discussion

The study encompassing 90 pregnant women aimed to evaluate cervical elastography's effectiveness in predicting pre-term delivery, revealing insightful findings. Participants exhibited varied demographic characteristics, with an average maternal age of 29 years and an average gestational age at recruitment of 20 weeks. Cervical elastography measurements, obtained between 18 to 24 weeks of gestation, unveiled a median strain ratio of 2.1 and a median elasticity score of 3.5, highlighting inherent disparities in cervical tissue characteristics among the cohort.

During the follow-up period, 16.7% of participants delivered pre-term, with a notable proportion attributed to spontaneous labor. Statistical analysis indicated a significant association between cervical elastography measurements and pre-term delivery, with higher strain ratios and lower elasticity scores independently linked to increased odds of pre-term birth.

Sensitivity analysis underscored moderate predictive accuracy, with cervical elastography demonstrating promising sensitivity (68%) and specificity (72%). Subgroup analyses further delineated its utility, showcasing enhanced accuracy in nulliparous women and those with shorter cervical lengths, hinting at its potential as a predictive tool in specific populations. These findings advocate for the integration of cervical elastography into antenatal care protocols, offering valuable insights into pre-term delivery risk assessment and personalized management strategies.

A number of studies have explored the utility of cervical elastography and related measurements in predicting pre-term delivery. In a study

highlighting the clinical use of cervical shear wave elastography in DCDA twin pregnancies, it was discovered that cervical stiffness and gestational age significantly correlated, with the preterm group having lower mean SWE values [5]. Another study evaluated the predictive effect of volume, length, uterocervical angle, and pre-induction cervical elastography for labour induction, but found no significant predictive value [6].

A study that investigated the predictive power of cervical length measures and phosphorylated insulin-like growth factor-binding protein-1 (pIGFBP-1) for preterm labor suggested that pIGFBP-1 had a high negative predictive value [7]. Cervical length measurements are still the most accurate way to predict preterm delivery, although research has shown that 3-dimensional ultrasonography can estimate cervical volume as well [8].

A study on transvaginal sonographic cervical length during mid-trimester highlighted its reliability in predicting pre-term delivery in singleton pregnancies [9]. A study concluded that higher strain and elastography index were associated with preterm delivery, suggesting elastography's reliability in this context [10]. These studies collectively underscore the potential of cervical elastography and related metrics in enhancing pre-term delivery predictions in the Indian healthcare setting.

Conclusion

The study provides compelling evidence supporting the potential utility of cervical elastography as a non-invasive tool for predicting pre-term delivery in pregnant women. The significant association between cervical elastography measurements and pre-term birth, along with moderate sensitivity and specificity, underscores its clinical relevance in antenatal care settings. Moreover, subgroup analyses highlight its differential predictive performance across varying demographic and clinical profiles, offering valuable insights into its tailored application. These findings advocate for further research validation and integration of cervical elastography into routine obstetric practice, fostering personalized risk assessment strategies and potentially mitigating adverse pregnancy outcomes associated with pre-term delivery.

Limitations: The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: Based on the study findings, it is recommended to consider integrating cervical elastography into routine antenatal care protocols

for pregnant women, especially those at higher risk of pre-term delivery. Additionally, further prospective studies are warranted to validate the predictive accuracy of cervical elastography across diverse populations and to optimize its utility in clinical practice.

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