ORIGINAL ARTICLE

Prediction of Preterm Birth by Second Trimester Transvaginal Ultrasound Measurement of Cervical Length. A Prospective Observational Study at a Tertiary Care Hospital

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ABSTRACT

Objective: To determine the predictive value of second-trimester transvaginal ultrasound measurement of cervical length for preterm birth.

Study Design: Prospective observational study.

Place and Duration of Study: This study was conducted at the Department of Obstetrics and Gynecology, Pak Emirates Military Hospital (PEMH), Rawalpindi, Pakistan, a tertiary care facility from April 2023 to September 2023.

Methods: After obtaining written informed consent, 132 pregnant women who met the selection criteria were enrolled. All patients underwent transvaginal ultrasonographic evaluation during the 20th to 24th week. A consultant gynaecologist assessed cervical length three times. The smallest measurement was noted down, and it was further confirmed by a consultant radiologist. All patients were followed up until delivery, and preterm birth was assessed; findings were analyzed statistically. No intervention was done during this study.

Results: The mean age of the patients was 28.5 ± 3.91 years. Cervical shortening (<2.5cm) was seen in 24 (18.2%) patients. Overall, pre-term birth occurred in 27 (20.5%) patients. In patients with cervical shortening, preterm birth occurred in 16 (66.7%) patients. A statistically significant relation existed between cervical shortening and preterm birth (*P*=0.000). The sensitivity, specificity, PPV, and NPV of cervical shortening for determining preterm birth were 59%, 92.5%, 66.5%, and 89.9%, respectively. The Chi-square value was 38.47, which shows a statistically significant relationship between cervical shortening and preterm birth. In other words, cervical is strongly associated with a higher risk of preterm birth in this population.

Conclusion: Cervical length measured by TVS during the second trimester had a moderately high predictive value and specificity for predicting preterm birth.

Keywords: *Cervical Length Measurement, Preterm Birth, Transvaginal Scan (TVS).*

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Introduction

A preterm birth occurs when a pregnancy ends between 28 and 37 weeks of gestation. It is a major contributor to the mortality and morbidity of newborns. There are two types of preterm births: therapeutic and spontaneous.[1] Preterm premature rupture of membranes (PPROM) and spontaneous preterm birth (SPB) are examples of spontaneous preterm labor. In contrast, therapeutic preterm birth refers to pregnancy problems or comorbidities that necessitate termination prior to 37 weeks of

gestation. Strategies to lower prenatal morbidity and mortality, as well as preterm birth rates, center on SPB.[2] Advances in the treatment of preterm and low-birthweight infants have led to a notable improvement in survival rates and a decline in disability rates in recent years. In Pakistan, the rate of preterm birth (PTB) was estimated to be 21.64%.[3]

The gestational age at birth has an inverse relationship with neonatal morbidity and mortality. As of right now, there is no practical way to prolong gestation for preterm newborns that are in labor.[4] Uterine contraction inhibitors are unable to stop delivery if preterm labor has been clinically identified. Recent studies have focused on enhancing the sensitivity and specificity of prediction techniques for PTB.[5]

There is a strong correlation between the risk of PTB and cervical length (CL) during the second trimester; the shorter the CL, the greater the chance of spontaneous PTB (sPTB). The number of sPTBs at less than 33 weeks of gestation may decrease by 30% if women with a singleton pregnancy and short cervical length are treated with vaginal progesterone throughout the second trimester.[6] Although several cut-off values have been proposed, ≤25 mm is commonly used to identify a short cervix.[7] It has been recommended that transvaginal ultrasound (TVS) measurements of CL be included in the standard second-trimester ultrasound examination for the universal screening of singleton pregnancies.[8,9]

The first step in assessing the effectiveness of universal screening is to determine how effectively cervical length, as measured by ultrasound in the second trimester, can distinguish between asymptomatic women with a singleton pregnancy in the general pregnant population who will and will not experience PTB.[10] Numerous studies have been conducted internationally and few local studies are available on the predictive value of transvaginal ultrasound for sPTB which have yielded conflicting results. Keeping this in view, the current study aimed to determine the predictive value of transvaginal ultrasound measurement of cervical length during second trimester for preterm birth. This would help in deciding whether cervical length measurement in the second trimester could be routinely used for predicting preterm births, which could help in reducing further morbidity and mortality associated with it by provision of early intervention.

Methods

It was a prospective observational study. After receiving approval from the Ethical Review Committee of the hospital vide letter no: 477/2022, dated: 1st December 2022. The study was conducted at the Department of Obstetrics and Gynecology, Pak Emirates Military Hospital (PEMH), Rawalpindi, Pakistan over a period of six months from April 2023 to September 2023. The study enrolled 132 pregnant females. The sample size of 261 pregnant females was calculated using the WHO sample size calculator by keeping a 95% confidence level, a 7% margin of error, and taking the expected frequency of preterm birth in Pakistan as 21.64%.[6-8] A non-probability consecutive sampling technique was used.

Inclusion Criteria: women between the ages of 18 and 35 who had a singleton pregnancy and who had regular ultrasound screening for abnormalities and health issues between weeks 20 and 24 of pregnancy were included.

Exclusion Criteria: We excluded women who had a history of cervical surgery, polyhydramnios, uterine anomalies, a history of PTBs, fetal malformations found during the scan, ruptured membranes found during the scan, other clinical signs of miscarriage like bleeding, progesterone use at the time of enrollment, or termination of pregnancy after study registration, and certain medical conditions like diabetes, thyroid problems, high blood pressure, or chronic kidney illness.

Preterm birth is defined as birth before 37 gestational weeks, and spontaneous PTB was defined as birth either after premature prelabour rupture of the membranes or after spontaneous labor, regardless of whether labor was forced.

Every pregnant woman had an ultrasound examination while adhering to stringent hygienic guidelines (aseptic measures). An endovaginal procedure using a high-frequency probe (3-9 MHz) was performed. For their comfort and as a prerequisite for examination, the women were asked to pass urine beforehand. After that, they were positioned in the dorsal lithotomy position, which involves reclining on their back with their legs extended wide. A consultant gynaecologist carried

Table-1: Mean of Quantitative Variables (n=132)	
Variables	**Mean±Standard deviation**
Age (in year)	28.5±3.91
Gestational age (in weeks)	22±1.41
Cervical length (in mm)	33.5±6.86

Table-2: Frequency of qualitative variables (n=132)	
Variables	**Frequency (Percentage)**
Age group	
18 to 25 years	32 (24.2%)
26 to 30 years	59 (44.7%)
31 to 35 years	41 (31.1%)
Gravidity	
Primigravida	48 (36.4%)
Multigravida	84 (63.6%)
Cervical shortening	
Yes	24 (18.2%)
No	108 (81.8%)
Preterm birth	
Yes	27 (20.5%)
No	105 (79.5%)
Type of preterm birth	
Spontaneous	16 (12.1%)
Premature rupture of membranes	11 (8.4%)
Preterm birth in patients with cervical shortening (n=24)	
Yes	16 (66.7%)
No	8 (33.3%)

Sensitivity=TP/TP+FN X 100= 59%, Specificity= TN/TN+FP x 100= 92.5%, PPV= TP/TP+FP x 100= 66.5%
NPV= TN/TN+FN x 100= 89.9%, $X^2 = (16\text{-}4.91)^2 /4.91+(8\text{-}19.09)^2 /19.09+(11\text{-}22.09)^2\ 22.09+(97\text{-}85.91)^2 /85.91=38.47$

out the procedure on all participants, consultant radiologist further confirmed finding. After introducing the probe into the anterior vaginal fornix, the cervix was lightly stroked without using too much force. The picture was enlarged to fill almost 75% of the screen after being carefully rotated to the sagittal region of the cervix. The cervical length (CL) was calculated as the distance between the endocervix and the ectocervix when the endocervix, ectocervix, anterior amniotic sac, and the entire cervical canal were all visible. Only when uterine contractions were absent was measurement conducted. The procedure was repeated thrice, and the smallest reading of CL was used. Cervical shortening was labeled if the CL was <25 mm, confirmed by a gynecologist and a radiologist. All patients were followed up until the delivery without any intervention, preterm birth was assessed, and findings were noted down and subjected to statistical analysis.

Version 25.0 of the Statistical Package for Social Sciences (SPSS) was used to analyze the data. The mean and standard deviation were used to display quantitative data, including age, gestational age, and cervical length. Frequencies and percentages were used to display qualitative data, including age group, preterm birth, and cervical shortening. A *P*-value of ≤ 0.05 was considered significant in the Chi-square test, which assessed the relationship between cervical shortening and premature birth. The transvaginal ultrasound's specificity, sensitivity, NPV, and PPV were calculated using a 2x2 table. Specificity, Sensitivity, NPV, and PPV were calculated by determining false positive (FP), true positive (TP), true negative (FN), and false negative (TN) cases, which were defined as follows:

FP: defined if there was cervical shortening but no PTB
TP: defined if there was cervical shortening as well as PTB
FN: defined if there was no cervical shortening, but PTB
TN: defined if neither cervical shortening nor PTB occurred

Results

A total of 132 patients were enrolled. The mean age of the patients was 28.5 ± 3.91 years. The mean gestational age at presentation was 22 ± 1.41 weeks. The mean cervical length of the patients was 33.5 ± 6.86 mm. (Table-1).

There were 32 (24.2%) females of age group 18 to 25 years, 59 (44.7%) females of age group 26 to 30 years, and 41 (31.1%) females of age group 31 to 35 years. There were 48 (36.4%) patients who were primigravida and majority of the patients were multigravida, that is 84 (63.6%). Cervical shortening was seen in 24 (18.2%) patients. Preterm birth occurred in 27 (20.5%) patients. Spontaneous preterm birth occurred in 16 (12.1%) patients, and PROM occurred in 11 (8.4%) patients. In patients with cervical shortening, preterm birth occurred in 16 (66.7%) patients. (Table-2).

There was a statistically significant relation between cervical shortening and preterm birth, as indicated by a p value of 0.000. The specificity, sensitivity, NPV, and PPV of cervical shortening for determining preterm birth were 59%, 92.5%, 66.5%, and 89.9%, respectively. (Table-3).

Table-3: Relationship between cervical length and preterm birth and predictive value of cervical shortening (n=132)

Cervical shortening	Preterm birth		*Chi-square* value (X^2)	*P*-value
	Yes	No		
Yes	True positive 16 (12.1%)	False positive 8 (6.1%)	38.47	0.000
No	False negative 11 (8.4%)	True negative 97 (73.5%)		

Discussion

The current study findings revealed that in pregnant females during their second trimester, transvaginal ultrasonography revealed that cervical shortening was present in 18.2% of patients, and preterm birth occurred in 20.5% of patients. In patients with cervical shortening, preterm birth occurred in 66.7% of patients, and there was a significant association between the two. The PPV and NPV of cervical shortening for determining preterm birth were 66.5% and 89.9%. Most of the patients in our study were 26 to 30 years old and were multigravida.

Intrauterine pressure progressively increases during the second trimester of pregnancy due to fetal growth and the accumulation of amniotic fluid.[11] This physiological change may contribute to cervical shortening and dilatation, which can result in the protrusion of the fetal sac through the endocervical canal.[12] Once cervical dilatation surpasses a critical threshold, preterm birth (PTB) may ensue, triggered by uterine contractions or rupture of membranes.[13] PTB remains a significant contributor to perinatal morbidity and mortality, with a reported global incidence ranging from 8.7% to 13.4%.[14] A substantial body of evidence has established a strong association between cervical shortening and PTB, and current clinical guidelines recommend cervical length (CL) assessment as a predictive tool.[15] Nevertheless, routine CL measurement throughout the second trimester has not been widely integrated into standard obstetric practice.[16] While initial studies suggested limited prognostic value of transvaginal sonographic (TVS) CL measurement in asymptomatic women, more recent guidelines advocate its use for PTB prediction.[17] Moreover, some investigations propose its inclusion as a standard component of prenatal screening. Accordingly, the present study was undertaken to elucidate the role of second-trimester CL measurement in predicting preterm birth.

Preventive strategies such as vaginal progesterone therapy and cervical cerclage have demonstrated efficacy in reducing the incidence of preterm birth in selected populations, particularly those with a short cervix or a history of preterm labor.[3] More pregnancies can benefit from such preventive

strategies by timely prediction of preterm labour, for which mid-trimester measurement of cervical length is an effective, reliable, and inexpensive method.[4] Additionally, a broader systems-based approach is necessary to address disparities in access to care, particularly in low-resource settings where preterm birth rates are highest and neonatal outcomes are poorest. Health system strengthening, education of care providers, and community-based interventions will be critical components of any comprehensive strategy to reduce the global burden of preterm birth.[3]

The current study findings revealed that shortening of cervical length i.e. <25 mm was significantly associated with preterm birth i.e. PTB occurred in 66.7% patients who had cervical shortening and the specificity, sensitivity, NPV and PPV of cervical shortening for predicting PTB was 59%, 92.5%, 66.5% and 89.9%, respectively. In a study conducted in Sargodha, the authors found that the sensitivity and specificity of cervical shortening for determining PTB were 85.48% and 73.24%, respectively.[18] A study carried out in Islamabad revealed that there was significant correlation between short cervical length and preterm birth.[14] Wang et al. revealed that PTB occurred in 75% of the patients who had short cervical length.[19] In another study conducted in Iran, it was revealed that the specificity, sensitivity, NPV, and PPV of cervical shortening for PTB were 31%, 96.8%, 71.1%, and 85%, respectively.[20] A 2024 meta-analysis involving 447,864 pregnancies found that universal transvaginal cervical length screening was significantly associated with a reduced risk of spontaneous preterm birth before 32 weeks of gestation (OR: 0.84; 95% CI: 0.76–0.94; *P* = 0.002), underscoring the effectiveness of early cervical screening in predicting and preventing preterm delivery.[21] These findings support our study findings that the frequency of preterm birth in pregnant females with cervical shortening, as assessed during the second trimester via TVS, was high and correlated significantly with each other. The predictive value of cervical shortening for PTB was shown to be high, although variable sensitivities have been reported by previous studies. This variation might be because of different cut-off values used in other studies for labeling cervical shortening. The present study demonstrates a statistically significant association between cervical shortening and preterm birth, aligning with most of the literature on this topic. However, Melbye et al. (2019) found no significant association between cervical length and preterm birth risk, suggesting that other factors may be more critical in predicting preterm delivery.[22] Similarly, Sasan F. et al. (2015) questioned the utility of transvaginal ultrasound for predicting labor onset at term, citing measurement difficulties and limited clinical benefit.[23] These contradictory findings highlight the complexity of predicting preterm birth and suggest that cervical length alone may not be a definitive predictor. Factors such as measurement timing, population characteristics, and additional biomarkers may influence the predictive value of cervical length assessments.

Our findings revealed that measurement of cervical length during the second trimester by TVS is a reliable screening tool for predicting PTB and can be routinely incorporated in daily practice to identify such patients earlier who are at high risk for preterm birth and will enable medical professionals to strive to prevent it. Further studies could involve progesterone supplements, a hormone crucial for pregnancy, surgery to seal the cervix (cervical cerclage), and devices implanted in the vagina to support the cervix (pessaries) in patient with short CL to assess efficacy of these methods in preventing preterm birth.

There were certain limitations of the study. Results of this study cannot be generalized because it was a single center study with a small sample size.

Conclusion

The current study concluded that measuring cervical length by TVS during the second trimester had a moderately high predictive value and a high specificity for predicting PTB. Thus, the current study proposed that measurement of cervical length via TVS can be routinely incorporated as a screening tool in pregnant females during their second trimester in order to predict PTB and provide further monitoring and early intervention to such patients. The predictive value can be further improved by reducing the cut-off value for labeling cervical shortening, keeping in view the variation in the distribution of CL in different populations. Future studies must be

carried out on a larger sample size in order to validate the findings of the current study.

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RK: Writing the original draft, proofreading, and approval for final submission
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FSK: Conception and design of the work
RK: Revising, editing, and supervising for intellectual content
FM: Data acquisition, curation, and statistical analysis
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