Original Article

Predicting Spontaneous Preterm Birth: A Prospective Study of Uterocervical Angle and Cervical Length Assessment through Transvaginal Sonography

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Abstract

Objectives: This study uses transvaginal ultrasound (TVS) in the second trimester to measure both AUCA and cervical length (CL) to see if either can predict spontaneous preterm labor.

Methodology: This prospective study was conducted at the department of Radiology, PESSI Islamabad from April 2023 to December 2023. The departmental Ethics committee approved the study. 140 first-time pregnant women (primigravidas) carrying a single baby (singleton) with no complications during their pregnancy. Between 16 and 24 weeks, a transvaginal ultrasound (TVS) was performed to measure the angle of the uterus where it meets the cervix (anterior uterocervical angle, UCA) and the length of the cervix (CL). The women were monitored until they gave birth to record their gestational age at delivery.

Results: Out of the 140 pregnant women who met the criteria and joined the study, 40 women delivered preterm (sPTBs), 22 of these women had cesarean sections after going into labor and 18 women had normal vaginal deliveries. Similarly, 100 women delivered at full term, 16 of these women had cesarean sections and rest of the 84 women had normal vaginal deliveries. On average, the women in the preterm birth group delivered their babies at 34.8 weeks' gestation. The study found a connection between a wider UCA in the second trimester and a higher chance of preterm birth (PTB) before 37 weeks. Among 140 women, 42 had a UCA wider than 95 degrees. Out of these 42 women, 34 delivered preterm. Out of 140 women, 20 had a CL shorter than 2.5 cm. Among them, 16 delivered preterm, while only 4 delivered at term. Women with a CL less than 2.5 cm had a much higher rate of preterm birth compared to those with a CL of 2.5 cm or more.

Conclusion: The study found a new way to measure risk of preterm birth using ultrasound. This method, called the uterocervical angle (UCA), seems to be more accurate than the traditional method of measuring cervical length (CL). There's a strong link between a wider UCA angle (obtuse UCA) and a higher chance of having a spontaneous preterm birth.

Keywords: Premature Birth, Labor, Preterm, Gestational Age.

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Introduction

The World Health Organization (WHO) defines a preterm birth as a baby born alive before 37 weeks of pregnancy.[1] In 2014, an estimated 14.84 million babies were born too early, and this number is unfortunately on the rise.[2] Globally, around 10.6% of births are preterm, with rates varying between 8.7% and 13.4% across different regions. Notably, preterm birth rates differ significantly by country, and there's a worrying upward trend in most industrialized nations.[3]

Pakistan faces a significant challenge with preterm births. A comprehensive review suggests a national prevalence rate of 18.9% based on a fixed-effect model, 16.8% based on a random-effects model and 18.89% using a fixed effect heterogeneity model.[4] A regional study ranks Pakistan as the third-highest country in preterm birth (PTB).[5] UNICEF estimates roughly 860,000 premature births annually in Pakistan, with nearly 102,000 newborns tragically lost due to complications.[6]

The cervix is like a window into a woman's risk of

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spontaneous preterm birth. By studying its physical changes, doctors can get clues about the underlying processes leading to early labor.[7] During pregnancy, the cervix faces pressure from nearby organs and the growing uterus. This unique combination of pressure and a woman's individual anatomy can affect the shape and function of the opening of the cervix (internal os). Doctors can use ultrasound to measure certain aspects of the cervix, such as its length (cervical length or CL) and the angle between the cervix and uterus (uterocervical angle), to assess its health.[8]

Traditionally, ultrasound measurement of cervical length (CL) has been used to predict preterm birth in the first and second trimesters. While research shows promise for this method, evidence on its effectiveness for routine screening in the second trimester is mixed. As a result, researchers are exploring new options.[9] Recently, the angle between the front wall of the uterus and the cervix (anterior uterocervical angle or AUCA) has emerged as a potential predictor of spontaneous preterm birth (sPTB).[10]

Researchers believe the angle formed by the front of the uterus and the cervix (anterior uterocervical angle or AUCA) might influence the pressure on the cervix. A wider angle could allow more direct force on the opening of the cervix (internal os), potentially increasing the risk of preterm birth. Conversely, a narrower angle may offer some protection.

This study uses transvaginal ultrasound (TVS) in the second trimester to measure both AUCA and cervical length (CL) to see if either can predict spontaneous preterm labor

Methodology

This prospective study was conducted at the department of Radiology, PESSI Islamabad from April 2023 to December 2023. The departmental Ethics committee approved the study.

The study involved pregnant women carrying a single baby with no complications. They were referred for a transvaginal ultrasound (TVS) between 16 and 24 weeks of pregnancy. After getting an informed consent from all participants, researchers collected data on their medical history and relevant tests. A radiology consultant performed the ultrasounds

Pregnant women between 19 and 34 years' old, Carrying a single baby (singleton pregnancy) were included in the study Similarly, Women younger than 19 or older than 34 , With any signs of preterm labor (maternal or fetal) , Pregnant with multiples (twins, triplets, etc.) ,With excess amniotic fluid (polyhydramnios), with a history of cervical surgery, With certain medical conditions like diabetes, thyroid problems, high blood pressure, or chronic kidney disease, with a previous history of preterm birth (PTBs) and Women with abnormalities of the uterus were excluded from the study.

All pregnant women underwent the ultrasound exam following strict hygiene protocols (aseptic precautions). A high-frequency probe (3-9 MHz) inserted into the vagina (endovaginal) was used on a Philips iU22 ultrasound machine (Philips Healthcare, Netherlands). The women were asked to empty their bladder beforehand for comfort during the exam. They were then positioned lying on their back with legs spread apart (dorsal lithotomy position).

The radiologist documented the UCA value according to established ultrasound imaging protocols used in similar research.[11]

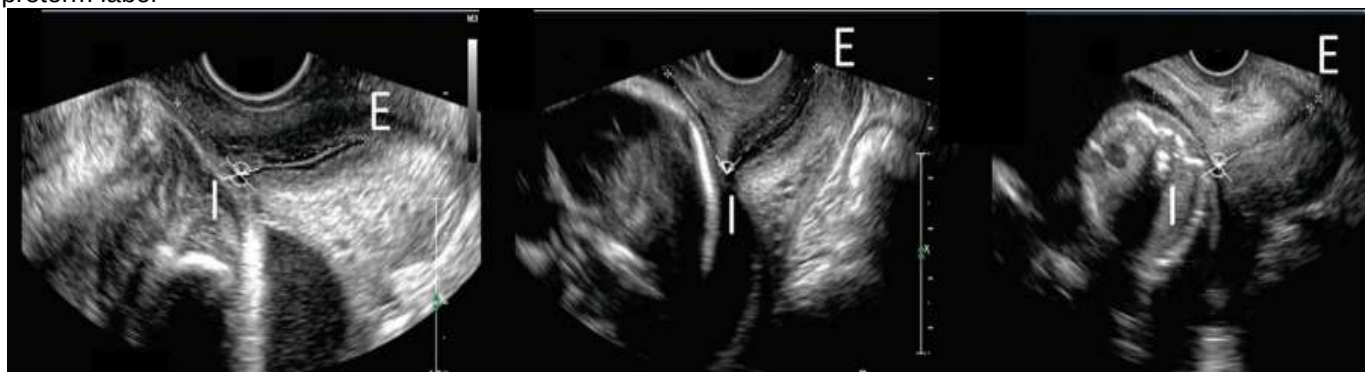

Figure 1: Two lines drawn electronically on the ultrasound image. The first line connects the internal os (I), which is the opening of the cervix inside the uterus, to the external os (E), which is the opening of the cervix in the vagina. The second line starts at the internal os (I) and follows along the lower curve of the front inner uterine wall for 3 centimeters

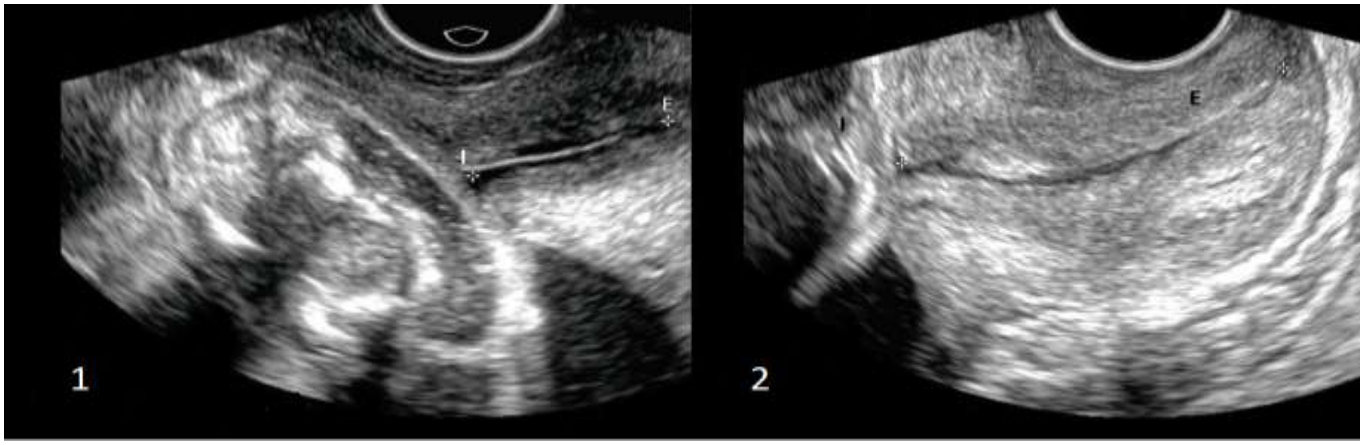

Figure 2: A transvaginal ultrasound image showing how cervical length is measured. The length is the distance between the inner opening (I) and outer opening (E) of the cervix.

A software program called SPSS (version 24.0) to analyze the data collected to compare measurements between different groups (like those with short vs. normal cervix length), used Student's t-test, to compare the means (averages) of two groups and analysis of variance (ANOVA) to compare the means of three or more groups. A p value less than 0.05 was set as significant.

Results

Out of the 140 pregnant women who met the criteria and joined the study, 40 women delivered preterm (sPTBs), 22 of these women had cesarean sections after going into labor and 18 women had normal vaginal deliveries. Similarly, 100 women delivered at full term, 16 of these women had cesarean sections and rest of the 84 women had normal vaginal deliveries.

On average, the women in the preterm birth group delivered their babies at 34.8 weeks' gestation, divided the 40 women who delivered preterm into two groups based on how early the babies were born. Very preterm (less than 34 weeks): There were 12 babies in this group. Moderately preterm (34 to 37 weeks): There were 28 babies in this group.

Outcomes of preterm neonates: 14 babies (out of the total 40) needed immediate care in a neonatal intensive care unit (NICU). 8 babies had a low Apgar score (below 7) at 1 minute after birth, indicating they may have needed extra medical attention. Unfortunately, 1 baby did not survive. The details are given in the figure 3.

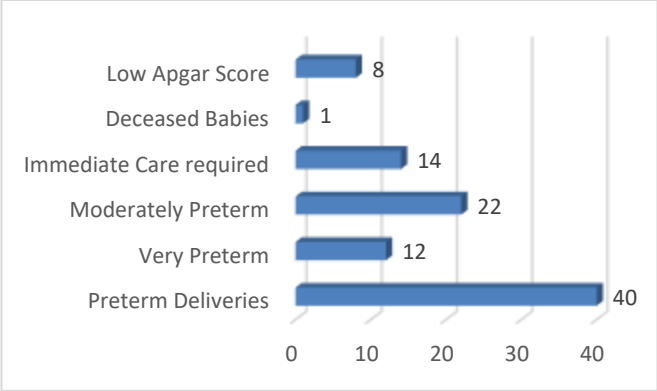

Figure 3: Distribution of Outcomes.

The study found a connection between a wider UCA in the second trimester and a higher chance of preterm birth (PTB) before 37 weeks. Among 140 women, 42 had a UCA wider than 95 degrees. Out of these 42 women, 34 delivered preterm. The average UCA in the preterm group (103.7 degrees) was significantly wider compared to the term group (88.4 degrees).

Within the preterm group, there was a trend towards a wider UCA in women who delivered very preterm (before 34 weeks) compared to those who delivered moderately preterm (34-37 weeks). However, this difference wasn't statistically significant.

The chance of very preterm birth (before 34 weeks) was highest (80.0%) in women with a UCA wider than 105 degrees. Similarly, the chance of moderately preterm birth (34-37 weeks) was highest (74.6%) in women with a UCA between 95 and 105 degrees.

An analysis using a statistical method showed that a UCA wider than 95 degrees was a strong predictor of preterm birth before 37 weeks. The results are shown in table I.

Table I: Details of the preterm and full term births according to UCA.

UCA		Births at 37 weeks	Spontaneous Preterm births in less than 37 weeks	
			Births at less than 34 weeks	Births at 34-37 weeks
≥95 degrees	≥105 degrees	1.0%	80.0%	6.2%
	95-105 degree	1.8%	8.0%	74.6%
≤ 95 degrees		90.0%	8.0%	14.8%

The study found a connection between shorter cervical length (CL) measured in the second trimester and an increased chance of preterm birth (PTB) before 37 weeks.

Out of 140 women, 20 had a CL shorter than 2.5 cm. Among them, 16 delivered preterm, while only 4 delivered at term. Women with a CL less than 2.5 cm had a much higher rate of preterm birth compared to those with a CL of 2.5 cm or more.

On average, pregnant women who delivered at term had a significantly longer CL (3.2 cm) compared to those who delivered preterm (3.0 cm). Although CL showed a link to preterm birth, it wasn't a perfect predictor.

The study found a link between the shape of the cervix and uterine junction (UCA) and cervical length (CL) in the second trimester, and how long women carried their pregnancies. There was a strong negative correlation between UCA and gestational age at delivery ((p=<0.001)). This means a wider UCA (larger angle) was associated with earlier deliveries (shorter gestational age). On the other hand, there was a moderate positive correlation between CL and gestational age at delivery (p=<0.001). This means a longer cervical length was associated with later deliveries (longer gestational age). The study also examined the relationship between the two measurement techniques, UCA and CL. The researchers found a weak negative correlation between UCA and CL, with a Spearman's correlation coefficient of -0.261 (p-value < 0.001).

Discussion

Preterm birth (PTB) is a serious concern as it increases the baby's risk of health problems after birth (neonatal mortality and morbidity).[12,13] One possible cause of PTB, especially spontaneous PTB (sPTB), is weakness in the cervix. Normally, the cervix acts like a strong barrier between the uterus (where the baby grows) and the vagina (birth canal). This strength comes from a network of protein fibers called collagen in the cervix.[14]

Cervical incompetence happens when the cervix makes softer too early in pregnancy. This softening process makes the cervix less firm and resistant to stretching or opening (deformation). It's caused by a change in the arrangement of collagen fibers and an increase in water content within the cervix tissue.

Measuring CL with TVS is a common screening test for PTB risk. A shortened cervix (less than 2.5 cm) is considered a significant indicator of possible preterm labor. There are two main theories about why a shortened cervix might be linked to PTB: Proximal cervical effacement theory suggests that muscle fibers near the opening of the cervix (internal os) weaken and become part of the lower uterine segment, shortening the cervix as a whole. Some experts believe that a shortened cervix might simply be a sign of underlying issues that lead to PTB, rather than the direct cause itself.

This study found that a cervical length less than 2.5 centimeters (cm) was associated with preterm birth before 37 weeks of pregnancy. However, it wasn't very effective in identifying all the women at risk. Only a few of the women who delivered preterm had a short cervix. This study aligns with other research[17-21] that found measuring cervical length (CL) has limitations in predicting preterm birth (PTB). While a short cervix can be a risk factor, it doesn't always indicate PTB. Here's what other studies have shown:

Even if a woman's cervix is shorter than expected (less than 2 cm), there's a chance she may still carry the pregnancy to term. Studies report sensitivity as low as 23% and 60%.

Some women may have a short cervix but not deliver preterm. This can lead to unnecessary worry or interventions.

Research suggests that a wider Uterocervical Angle (UCA) measured during a mid-pregnancy ultrasound might be a sign of an increased risk of spontaneous preterm birth (PTB).[22] The UCA reflects the shape where the cervix meets the lower part of the uterus. A wider angle seems to act like a stronger mechanical barrier, helping to prevent preterm birth.[23] This study found that women who delivered preterm (before 37 weeks) had a wider angle between their cervix and

uterus (UCA) in the second trimester compared to women who delivered at full term. There was a clear link between a wider UCA and a higher chance of spontaneous preterm labor (PTB).

Our results suggest that a UCA wider than 105 degrees was strongly associated with very preterm birth (before 34 weeks). Similarly, a UCA between 95 and 105 degrees was significantly associated with moderately preterm birth (34 to 37 weeks). In these cases, the test correctly identified almost 8 out of 10 women who would deliver moderately preterm. It correctly identified almost all the women who wouldn't deliver moderately preterm within this UCA range. Our study suggests that a softening cervix might play a role in preterm birth.

It is evident that when the cervix softens, it may become harder for the upper cervical fibers near the opening (internal os) to maintain a sharp angle. This sharp angle normally acts like a barrier against preterm birth. This theory aligns with our findings and those of other studies[19,24] that link a wider angle (obtuse angle) at the cervix with an increased risk of spontaneous preterm birth (PTB). We also propose that a wider angle might be an early sign of the internal os becoming part of the lower uterine segment, which is a normal change that happens during pregnancy but can happen too early in some cases leading to PTB.

Our study found a link between the shape of the cervix and uterus (UCA) in the second trimester and how long women carried their pregnancies. The wider the angle (obtuse angle, greater than 95 degrees), the higher the chance of preterm birth (delivery before 37 weeks). Interestingly, UCA seemed to be a more informative measure than cervical length (CL) for predicting preterm birth in this study. Here's why we found a stronger negative correlation between UCA and gestational age at delivery. The measurement of UCA also had a higher variability (coefficient of variation) compared to CL. This might seem counterintuitive, but it can also indicate that UCA is more sensitive to changes that could signal a risk of preterm birth. Overall, this study suggests that measuring UCA with ultrasound during pregnancy may be a valuable tool for assessing the risk of preterm birth, especially when compared to traditional cervical length measurements.

This study focused on the link between Uterine Cervical Angle (UCA) and preterm birth risk. However, it's important to consider other factors that might influence cervical health. Several things, like ethnicity and socioeconomic background, can potentially affect the cervix, including its length (CL) and shape (UCA). For example, studies have shown racial differences in cervical length during pregnancy, with Black women having a higher chance of having a short cervix compared to other ethnicities.[26] Another study found shorter cervical length measurements in an Indian population compared to others.[27] While the impact of ethnicity on UCA hasn't been explored yet, it's an important area for future research. Understanding these factors can help us develop more accurate risk assessments for preterm birth.

Identifying pregnant women at high risk of preterm birth early in their pregnancy allows doctors to take steps to try to prevent it. These steps might include surgery to stitch the cervix closed (cervical cerclage), supplements of progesterone, a hormone important for pregnancy and devices placed in the vagina to support the cervix (pessaries).

This research suggests that UCA has promise as a predictor of preterm birth. Future studies could explore Including a larger and more diverse group of participants, investigating the link between UCA, progesterone use, and preterm birth risk and utilizing advanced imaging techniques like cervical elastography and subglandular ADC measurement to refine preterm birth prediction.

Conclusion

Our study suggests that measuring the Uterine Cervical Angle (UCA) during pregnancy shows promise as a new way to identify women at risk of spontaneous preterm birth (sPTB). Compared to the traditional method of measuring cervical length (CL), UCA appeared to be a more informative predictor in this study. However, there's room for improvement. Combining UCA with other factors, such as CL, a woman's background information (demographics), and her pregnancy history, might lead to even better detection rates for sPTB. Identifying women at high risk early in pregnancy allows researchers to take steps to try to prevent preterm birth. This can significantly improve the health outcomes of newborns (neonates).

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