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ORIGINAL ARTICLE

Uterocervical Angle Assessment in the Second Trimester of Pregnancy as a Predictor for Preterm Delivery

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ABSTRACT

Background: The wide uterocervical angle (UCA) has been identified as a predictor of preterm delivery, and the goal of this study is to see how accurate UCA is at predicting spontaneous preterm birth in the second trimester. The aim of study is early prediction of preterm labor by uterocervical angle measurement using transvaginal sonography (TVS) in the second trimester of women at low risk for spontaneous preterm birth (SPB).
Methods: This is a prospective cohort study including seventy pregnant women in the second trimester (16-28weeks). They were classified into to preterm (group 1) and term (group 2) according to delivery of 28 and 42 women in each group, respectively. TVS was performed for all participants with measuring UCA.
Results: This study shows that all ultrasonographic parameters showed the mean UCA was 124.74±19.69 and 85.95±8.32 degrees in preterm and full-term delivery, respectively, it had statistically highly significant difference ($p < 0.001$). **Conclusions:** An elevated risk of spontaneous preterm birth was linked to a wide UCA found during the second trimester. The uterocervical angle may be utilised as a screening tool for spontaneous preterm birth, according to this study.
Keywords: Preterm labor; Uterocervical angle; Second trimester.

INTRODUCTION

One of the most serious obstetric issues is preterm birth. Preterm delivery is responsible for 70 percent of early neonatal mortality and 25–50 percent of infant deaths under one year, according to the American College of Obstetricians and Gynecologists (ACOG). According to the World Health Organization, spontaneous preterm labour accounts for nearly half of all premature births **[1]**.
Preterm labour is defined as labour pains that develop before 37 weeks of pregnancy and are accompanied by cervical changes. Around 25–30% of premature labour that is threatening leads to preterm delivery **[2]**.
A large UCA was assumed to be connected with a more direct, linear discharge of uterine contents onto the cervix; a smaller UCA, on the other hand, results in a lesser direct force on the internal os, which may be protective against cervical deformation **[3]**.
During pregnancy, a transvaginal sonographic examination (TVU) can be used to check for UCA. According to a prior study, UCA is linked to the gestational age at delivery [**4**]. Other sonographic parameters, such as cervical length, have also been proposed to identify women who are at an elevated risk of premature birth **[5]**.
Furthermore, the UCA has been observed to become narrower following the application of a vaginal pessary to avoid spontaneous preterm birth in patients at risk **[6]**. It's a simple, low-cost procedure that's safe for both the mother and the fetus. However, there is no evidence that UCA measurement has ever been used in the management of imminent preterm labour **[4]**

METHODS

This prospective, cohort study involved pregnant women in the second trimester who attended for follow-up between 16 and 28 gestational weeks. The study was performed in Maternity Hospital, Faculty of Medicine, Zagazig University at the period from July 2021 to January 2022.

The Institutional Review Board (IRB) approval was obtained from Zagazig University for this study with IRB number 7032.

Written informed consent was obtained from all participants. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

This study's inclusion criteria were: Adult age > 18 years, fetus shows activity and viability, intact fetal membranes and women have sure reliable gestational age between 16 - 28 gestational weeks. While cases with uncertain GA, pregestational or gestational diabetes and women with cervical or uterine masses or diseases, women with high risk for sPTB, women with previous cervical surgery, women with placenta previa, fetal problems or any complicated pregnancy were excluded.

Sample collection:

Seventy pregnant women in the second trimester were classified into two equal groups after delivery: Group (1) included 28 women delivered preterm pregnancy and group (2) included 42 women delivered term pregnancy.

Methodology:

Complete gynecologic, obstetric history, medical history were obtained, and general examination was done for each participant.

Ultrasonographic examination:

The ultrasound machine is the On-platform ultrasound system, Mindray Resona 7 and GE Logiq P7 2020 with a transvaginal probe (4 active probe ports, Vaginal RIC5-9H). Measurements were performed at gestation age from 16-28 weeks. Measuring the cervical length and uterocervical angle by the standard method *(Hallandale Beach, FL 33009, Miami, USA)*. Obstetric abdominal ultrasound using for measurement of fetal biometry: biparietal diameter, head circumference, abdominal circumference and femur length, then expected fetal weight, placental site and amniotic fluid volume and amniotic fluid index were calculated.

Procedures

The UCA was calculated by drawing a triangular image of the lower uterine region and the cervical canal.

The internal cervical os is connected to the external cervical os by the first line. The internal os was defined as the place where the endocervical mucosa meets the anterior and posterior lips of the cervix, whereas the external os was defined as the point where the anterior and posterior lips of the cervix meet.

A third line was drawn 3 cm anteriorly from the internal cervical os to the site of the inner lower uterine segment. A single sonographer performed all of the UCA measurements included in the study analysis.

Along with the pregnancy and delivery status, the participants' demographic data, estimated delivery date, obstetric difficulties, and risk factors for sPTB are documented.

Follow-up

Pregnant women were investigated in the beginning of 2nd trimester and followed up every two-weeks till birth.

STATISTICAL ANALYSIS

The collected data were coded, entered, presented, and analyzed by computer using a data base software program, Statistical Package for Social Science (SPSS) version 26. Qualitative data were represented as frequencies and percent and Chi square (X2) test was used to detect relation between different qualitative variables. For quantitative variables mean ± standard deviation (SD) and range were computed and Independent t-test (t) was used for detection of difference between different quantitative variable. The results were considered statistically significant and highly statistical significant when the significant probability (P value) was < 0.05 and <0.001 respectively. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated at 95% CI to measure the validity.

RESULTS

The study included seventy pregnant women in the second trimester. Their mean ages were 25.93±6.29 and 26.02±6.56 years of preterm and term groups, respectively. The mean fetal ages were 31.89±3.47 and 38.88±1.21 weeks in preterm and term groups, respectively. Statistically, the mother age showed insignificant difference in comparison between the two groups while fetal age was significant. The body mass index (BMI), blood pressure and mode of delivery of participated women were statistically insignificant difference (p >0.05), table (1).

The ultrasonographic parameters showed statistically significant difference (p <0.05); cervical length had a mean of 3.39±0.99 cm and 5.08±0.83 cm in preterm and full-term groups, respectively, while cervicouterine angle was 124.74±19.69 and 85.95±8.32 degrees in preterm and full-term delivery, respectively, it had statistically highly significant difference (p <0.001), table (2) and figure (1).

The value of Sensitivity of CU angle at a cut off 92.5 was (89.3%), specificity= (76.2%), predictive value for positive (PVP) = (71.4%), predictive value for negative (PVN) = (91.4%), and (81.4%) accuracy, table (3).

Table 1: Baseline characteristics of the two studied groups

Women age	**Preterm**		**Term**		**t-test**	**P value**
Mean ± SD (years)	25.93±6.29		26.02±6.56		-0.060	0.952
Gestational age						
Mean ± SD (weeks)	31.89±3.47		38.88±1.21		-12.005	**<0.001***
BMI						
Mean ± SD (kg/m^2)	24.43±2.98		26.6±6.7		-1.610	0.112
Blood pressure						
SBP (mmHg)	112.86±12.12		114.76±11.09		-0.678	0.500
DBP (mmHg)	73.21±7.22		73.33±7.5		-0.066	0.948
Mode of delivery	**No.**	**%**	**No.**	**%**	**χ^2-test**	**P value**
Vaginal delivery	16	57.1	21	50		
Cesarean delivery	12	42.9	21	50	0.344	0.558

χ^2: Chi square test, t: student t-test, p >0.05:
Statistically non-significant.

Table 2: Ultra sonographic parameters of the two studied groups.

Group / Findings	**Preterm delivery group**	**Term group**	**Significance**	
			t	**P**
Cervical length (cm)				
• Range	2.2-5.9	2.2-5.72		
• Mean ± SD	3.39±0.99	5.08±0.83	-7.683	**<0.001***
UCLA (mm)				
• Range	25.8-62.3	39.8-59.2		
• Mean ± SD	45.51±5.68	42.48±8.33	1.683	0.097
UCTA (mm)				
• Range	21.1-43.1	21.1-40.8		
• Mean ± SD	29.60±5.84	32.32±6.13	-1.851	0.069
CU angle (º)				
• Range	71.8-100.3	81.6-147.2		
• Mean ± SD	124.74±19.69	85.95±8.32	11.366	**<0.001***

t: 2-tailed test, P <0.05: significant, UCLA: Uterine corpus longitudinal axis, UCTA: Uterine corpus transverse axis, CU: cervicouterine.

Table 3: The validity of CU angle in predicting preterm delivery

Cut off	**AUC**	**95%CI**	**Sensitivity**	**Specificity**	**PPV**	**NPV**	**Accuracy**
92.5	0.938	0.87-1.00	89.3%	76.2%	71.4%	91.4%	81.4%

Figure 1: Showing uterocervical angel

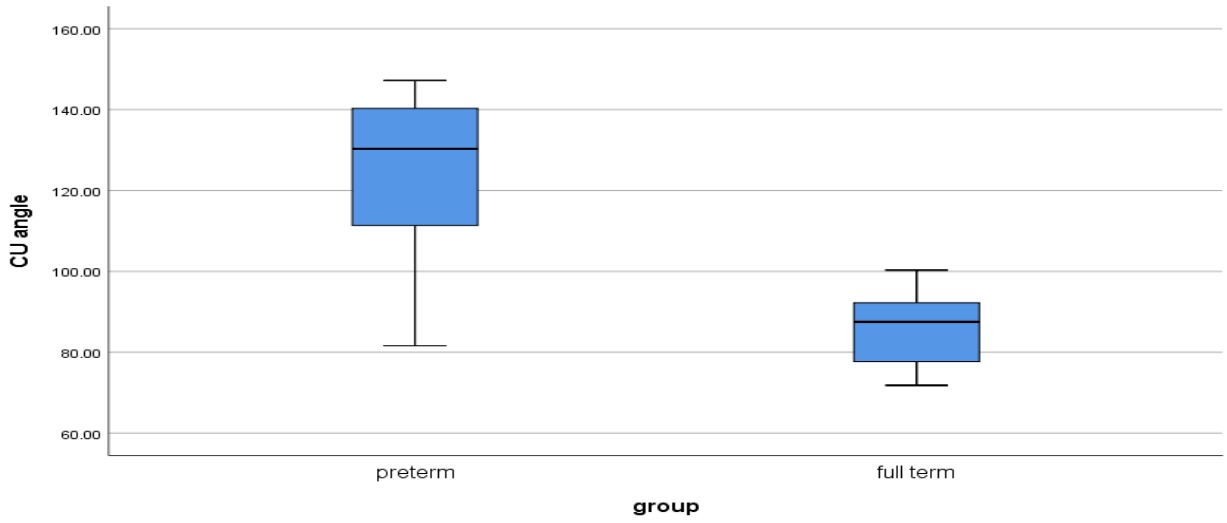

Figure 2: Box blot comparing CU angle between preterm and full term groups

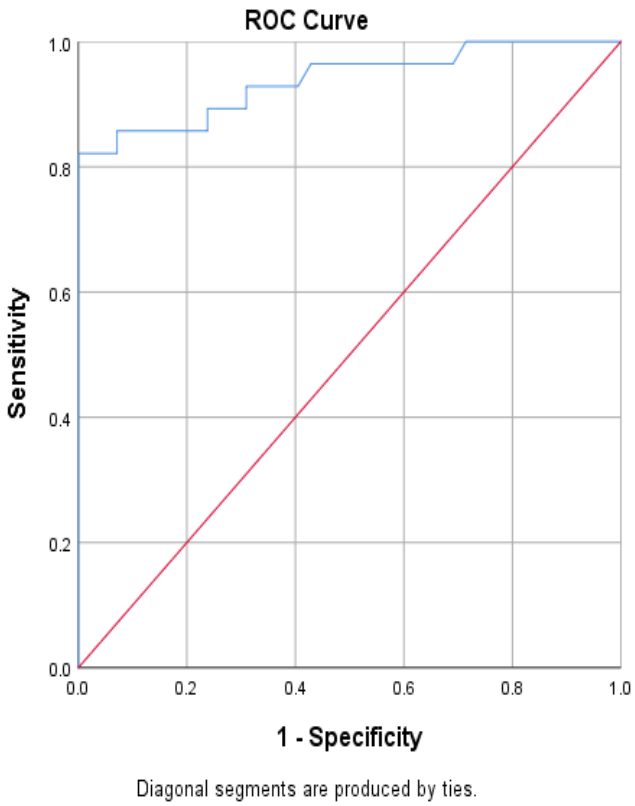

Figure 3: ROC curve illustrating the validity of CU angle in predicting preterm labor

DISCUSSION

Preterm birth (sPTB) is the leading cause of newborn morbidity and mortality **[7, 8],** and it is critical to identify pregnant women who are at risk of sPTB as soon as possible **[9].** SPTB can have a variety of causes, and labour can be induced by a variety of mechanisms that are still unknown. As a result, straightforward diagnostic, therapeutic, or preventive methods for the entire population are difficult to come **[10].**

The anterior uterocervical angle (UCA), defined as the angle between the lower anterior uterine wall and the cervix, may predict sPTB, according to new research **[11, 12].**

The angle between the uterus and the cervix may be connected to the gestational age of the baby at the time of delivery **[4].** Ultrasonographic measurement of cervical length (CL) in the second trimester of pregnancy, along with maternal history, has been shown to assist identify women at risk for SPTB **[13]**. Lack of information about the effect of UCA in sPTB motivate us to investigate this angle in the second trimester by ultrasonography.

In the current study, the mean fetal ages were 31.89±3.47 and 38.88±1.21 weeks in preterm and term groups, respectively. Statistically, the mother age showed insignificant difference in comparison between the two groups. The body mass index (BMI), blood pressure and mode of delivery of participated women were statistically insignificant difference ($p > 0.05$).

Kitipoonwongwanid and Soongsatitanon **[14]** had similar values; BMI 22.8 ± 4.5 and 22.2 ± 4.9 kg/m^2 in term and preterm groups, respectively ($p = 0.33$). Similarly, Makled et al. **[15]** found that the mean BMI was 26.1 ± 0.46 kg/m^2, ranged from 21 – 29 kg/m^2. It was 25.9 ± 4.4 kg/m^2 and 26.1 ± 1.46 kg/m^2 in preterm and term groups.

Makled et al. **[15]** reported that vaginal delivery was 66.1% and 75% in preterm and term groups with statistically non-significant difference ($P = 0.21$). CS was performed in 33.9% and 25% in preterm and term groups, respectively. This was similar to

Kitipoonwongwanid and Soongsatitanon **[14]** had women with vaginal delivery were 66.7% and 74.6% in term and preterm groups, respectively. Women having CS were 33.3% and 25.4% (p = 0.225).

The gestational age at delivery of preterm and term groups were 31.89±3.47 and 38.88±1.21 weeks, respectively that showed statistically significant difference.

In agreement with the current study findings, Makled et al. **[15]** had a mean GA at delivery of 34.9 ± 4.2 weeks and 38.4 ± 1.6 weeks with statistically highly significant difference (P <0.001). In parallel to ours, Kitipoonwongwanid and Soongsatitanon **[14]** had a mean GA at delivery of 39.2 ± 1.0 and 35.7 ± 1.5 weeks in term and preterm groups, respectively.

In the present study, the cervical length had a mean of 3.39±0.99 cm and 5.08±0.83 cm in preterm and full-term groups, respectively, while cervicouterine angle was 124.74±19.69 and 85.95±8.32 degrees in preterm and full-term delivery, respectively, it had statistically highly significant difference (p <0.001).

In concordance with our results Farràs-Llobet et al. **[10]** discovered that a larger UCA is linked to a higher risk of preterm birth and that maternal factors influence UCA. They looked studied the UCA's capacity to predict spontaneous preterm birth between 34 and 37 weeks of pregnancy. A prospective cohort study of singleton pregnancies at a gestational age of 19.0 to 22.6 weeks. In the second trimester, the preterm group had a higher mean UCA than the control group.

Makled et al. **[15]** confirmed our results as they found that the mean UCA was 105.16 ± 21.6 and 94.5 ± 22.7 degrees in preterm and term groups, respectively with statistically significant difference (p = 0.015). They found 52.8% of their cohort preterm group ≥ 105 degrees and 47.2% <105 degrees, while only 22.9% had ≥ 105 degrees in full-term group and 77.8% had angle <105 degrees of the same group. They found also that cervical length was less than or equal to 25 mm in 9.1% of women of preterm group and none of the term group had CL <25 mm with statistically highly significant difference (p <0.001) in comparison between the two groups, while CL > 25 mm were found in 90.9% of preterm group and in 100% of the term group. Many studies confirmed these results **[4, 14, 16]**. Others are contradictory to past research **[11, 17].** The disparity could be owing to a small sample size of pregnant women who gave birth at 34 weeks.

In the current study, the value of Sensitivity of CU angle at a cut off 92.5 was (89.3%), specificity= (76.2%), predictive value for positive (PVP) = (71.4%), predictive value for negative (PVN) = (91.4%), and (81.4%) accuracy.

This came in agreement with Makled et al. **[15]** who found that in UCA, the AUC, 95% CI was 0.96 (0.92-0.99) with statistically highly significant difference (p =0.001) at a cut off value of 105 degrees with sensitivity of 86.8% and specificity of 89.%.

Also, Dziadosz et al. **[16]** carried out a cohort study and found a UCA cut-off >105° that yielded a detection rate of 81% with a false-positive rate of 35% for sPTB at <34 weeks.

In contrast, Kitipoonwongwanid and Soongsatitanon **[14]** had a mean uterocervical angle of 88.7 ± 21.4 and 95.1 ± 21.1 degrees in term and preterm groups, respectively with highly significant difference (P <0.001). They proposed a cut off value of >95 degrees as a predictive for preterm labor with sensitivity of 74.6%, and specificity of 64.6% which was less than our results.

The study's limitation was the minimal number of pregnant women samples in each group, which may have hampered statistical analysis. More pregnant women's instances should be studied in the future.

CONCLUSION

The triangular section between the lower uterine segment and the cervical canal is interpreted as the uterocervical angle, a new ultrasonographic marker. An elevated risk of spontaneous preterm birth was linked to a broad UCA found during the second trimester. The uterocervical angle evaluated in the second trimester may be utilized as a screening tool for spontaneous preterm birth, according to this study.

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