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Uterocervical Angle versus Cervical Length in the Prediction of Spontaneous Preterm Birth in Symptomatic Singleton Pregnancy

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ABSTRACT

Background: Screening tests for predicting preterm birth, such as measurement of cervical length, uterocervical angle (UCA) have been proposed in response to the significant impact of preterm birth.

Objectives: To compare the uterocervical angle with the cervical length for predicting impending preterm delivery in symptomatic cases.

Patients and methods: A prospective observational investigation carried out on 30 females admitted to hospital with preterm labor during gestational age in between 28+0w and 35+0w of pregnancy at Obstetrics and Gynecology Department, Menoufia University Hospital. All patients were subjected to verbal consent, detailed history, examination and investigation then measurement of UCA and CL (cervical length). Management of patients with tocolytic drugs and corticosteroids.

Results: Mean of CL was 3.1, and mean of UCA was 113.65±19.01, Preterm birth occurred in 24/30women. Study revealed no significant difference in age, occupation, medical disorders and the body mass index in women who had PTB. Mean uterocervical angle was significantly higher in those who had preterm birth. However; the cervical length was insignificantly shorter in groups who delivered PTB. The UCA significantly expected the occurrence of preterm birth. The CL had non-significant role in the prediction of preterm birth.

Conclusion: UCA is a sonographic marker for predicting preterm birth in symptomatic cases. A cutoff value of 104.5° was identified as significantly associated with increased PTB risk, potentially guiding early interventions such as progesterone therapy or cervical cerclage.

Keywords: Cervical length, Gestational age, Uterocervical angle, Preterm birth.

INTRODUCTION

Preterm labor is a leading reason of newborn death and morbidity with long term neurological and developmental complication [(1)]. Preterm birth (PTB) is defined as birth prior to thirty-seven weeks of pregnancy [(2)]. Screening tests for predicting preterm birth, such as measurement of cervical length, have been proposed in response to the significant impact of preterm birth [(3)].

Cervical length alone has moderate accuracy in expecting PTB among symptomatic females; for example, a cut-off of twenty-five millimeters has roughly seventy percent sensitivity to expecting births occurring before thirty-seven weeks, with an associated false positive rate of about thirty percent [(4)]. Transvaginal ultrasound is the standard for the evaluation of cervical length (CL) and the prediction of PD Nevertheless its sensitivity is relatively low (60%) [(5)]. The uterocervical angle is described as the angle formed among the lower anterior uterine segment and the endocervical canal. [(6-8)].

The present study was conducted in Menoufia University Hospital, to assess the efficiency of measurement of CL and UCA in prediction of PTB between 28th and 35th week of gestation and the frequency of preterm labor.

PATIENTS AND METHODS

Prospective observational research performed on thirty cases with single pregnancies among 28+0 and 35+0 weeks, calculated by Statistics Department and our study was carried out at the Departments of Obstetrics and Gynecology in Menoufia University Hospital during the period from August 2023 to December 2024. Sample size estimation was based on review of past literature by **Khamees *et al.*** [(9)], who found that a uterocervical angle of 105° or more predicted preterm birth with sensitivity of 86.1% while a cervical length of 25 mm or less had sensitivity of 27.8%. The least sample size calculated using Statistics and Sample size pro program version 6 was 30 subjects with drop out of 25%. The power of study was 80% and confidence level was 95%. Pregnant patients with PTB were identified by US with single operator and a clinical diagnosis of threatened preterm delivery (as much as 3 uterine contractions in thirty minutes, cervical dilation below three centimetres, effacement under eighty percent and integral membranes) were consecutively chosen, and were prospectively enrolled in the research when they were at the Obstetric Emergency Department.

Each woman was assessed as follows; clinical examination, complete history taking, routine antenatal laboratory investigations involving (urine analysis, full blood count, and blood group and Rh typing), transvaginal US examination to take measurement of CL and UCA.

The participants were treated according to the hospitals protocol including administration of tocolytics. Patients were monitored until delivery and

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gestation result information were gathered and recorded.

The uterocervical angle is the triangular segment assessed among the cervical canal and the lower uterine segment, producing a measurable angle at the intersection of a 1st straight line connecting the internal cervical os to the external cervical os. The 2nd line has been drawn from the inferior aspect of the anterior uterine wall, passing via the end of the 1st line at the internal cervical os and to the point of the internal inferior uterine segment at an ideal distance of three centimetres.

Inclusion criteria: Pregnant women between 28 and 35 weeks gestation confirmed by first-trimester ultrasound, with clinical signs of threatened preterm delivery (≤ three contractions/30 minutes, cervical dilation <3 cm, effacement <80%), singleton pregnancy, and intact membranes.

Exclusion criteria: Placenta previa, multiple gestation, fetal anomalies, polyhydramnios, preterm membrane rupture, cervical trauma history, induced abortion, maternal cardiac issues, or active infections.

Study population and setting:

Singleton pregnancies with intact membranes admitted for symptoms of threatened preterm labor (28+0 to 35+0 weeks) were prospectively enrolled from an obstetric emergency unit.

Patient Evaluation Included: Medical History: Demographics (age, weight, BMI). Obstetric history (parity, deliveries, abortions, cesareans, preterm labor). Systemic diseases, current meds, and gynecologic history. Clinical E Examination: General, abdominal, and speculum. Investigations: CBC, fasting blood sugar, urine analysis, liver and kidney function tests. Ultrasound: All patients had routine ultrasound at admission to assess fetal viability, biometry, major abnormalities, amniotic fluid volume, placental location, and cervical length, using the Versana Balance device. UCA and CL were measured via transvaginal sonography. The cervix was assessed longitudinally from the external to internal os, with calipers placed accordingly; in cases of funneling, calipers were placed at the funnel's apex. UCA was measured as the angle among the cervical canal and lower uterine segment, using two rays—one along the cervical canal and the other extending 3 cm into the lower uterine segment—with the angle calculated utilizing a protractor during a 3–5 minutes exam [7].

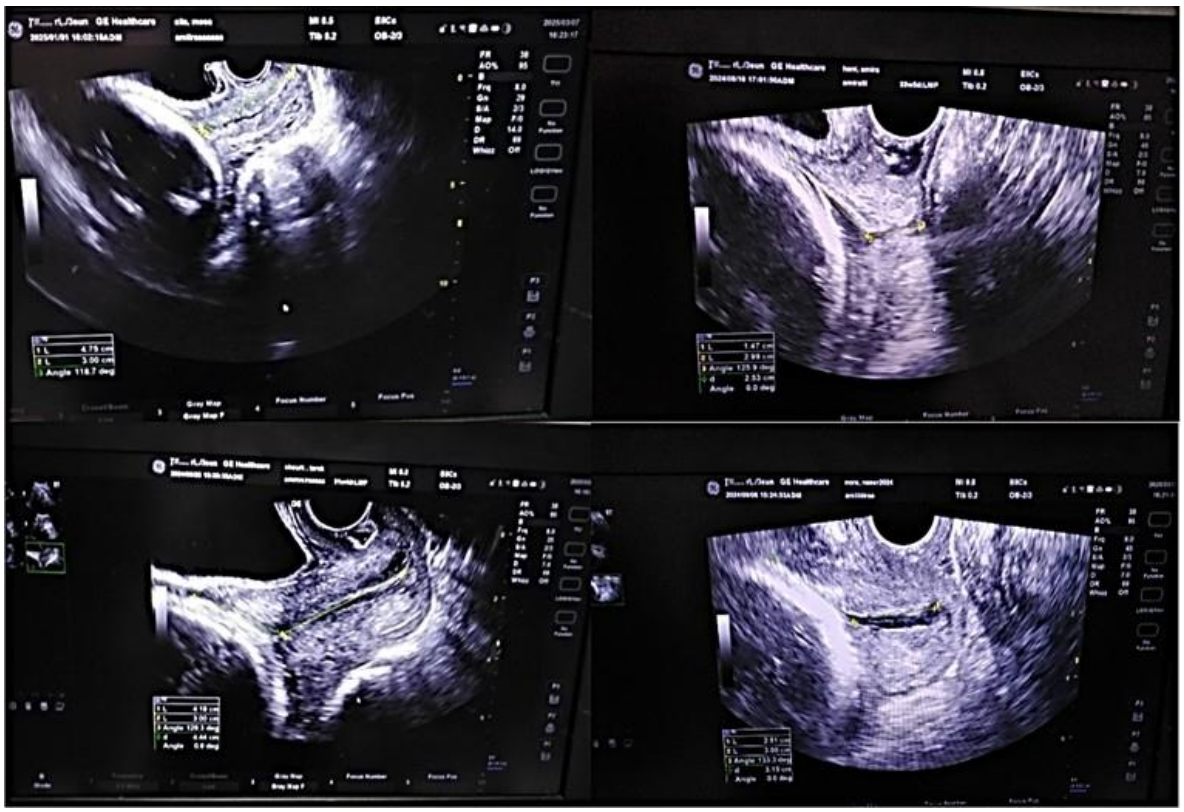

Figure (1): Ultrasound of UCA and CL.

Stabilization protocol: All patients received 17 alpha hydroxyprogesterone (200 mg IM, repeated after 12 hrs) and nifedipine (10 mg x5 doses, 20-min intervals). Antenatal corticosteroids and IV fluids were also administered.

If contractions persisted (≥2 every 10 min) 3 hours after last nifedipine dose, additional tocolytics like magnesium sulfate (1 g/hr infusion) and indomethacin suppositories (100 mg every 12 hrs for 48 hrs) were used.

Maintenance Therapy: Daily 17 alpha hydroxyprogesterone (200 mg IM), slow-release nifedipine (20 mg every 6–12 hrs), and IV fluids (500 cc Ringer's + 500 cc saline twice daily) until discharge.

Main outcome measures: 1- Primary outcome: Investigate diagnostic accuracy of the cervical length and uterocervical angle in the prediction of PTB.
2- Secondary outcome: inhibition of uterine contraction, arrest of cervical changes and increasing time interval between time of start of tocolysis and time of delivery.

Ethical considerations:

Ethical approval has been gained from the Ethics Committee of the Faculty of Medicine, Menoufia University. The researcher adhered to the International Guidelines for Research Ethics, including the Declaration of Helsinki. Written informed consent has been gained from all participants following clearly explaining the goal and potential benefits and hazards of the research. Participants' anonymity and confidentiality were guaranteed and strictly maintained.

Statistical analysis

The information gathered were tabulated and examined by SPSS statistical package version 26 on IBM compatible computer. 2 kinds of statistics have been performed: Descriptive statistics: have been represented as percentage and number (% and No) for qualitative information, mean, standard deviation (SD), and range for normally distributed quantitative information and median, interquartile range (IQR) and range for not normally distributed quantitative information.

Analytic statistics: Chi-squared test (χ^2) has been utilized to examine correlation among qualitative parameters. Fisher exact test (FE) has been utilized to examine correlation among qualitative parameters whenever any of expected cells is below 5.

Student t test (t): was utilized for comparison of quantitative parameters among 2 groups of normally distributed information. Mann-Whitney U test: was utilized for comparison of quantitative parameters among 2 groups of not normal distributed data. Receiver operator characteristic (ROC) curve with respective points of maximal accuracy for sensitivity and specificity have been generated to recognize biomarker performance. P value < 0.05 was considered significant.

RESULTS

Throughout the investigation duration, females presented to the Obstetric Emergency Unit of our Department with symptoms of threatened preterm labor, singleton pregnancy and intact membranes were included. Our study revealed that mean of age of participants were 26.87±4.25, most of them between were 18-25 years with ratio 43.3%. Mean of BMI was 28.23±3.6 most of them were obese (30-39.9) with ratio of 43.3 % and most of them were not working (93.3%) and most of them had no medical diseases (86.7 %). Subgroup analysis, revealed no significant difference in age, occupation, medical disorders, and the BMI (assessed as weight in kilograms divided by the square of height in meters), in females who had preterm delivery in comparison with those who delivered at term **(Table 1)**.

Table (1): Demographic data of the studied participants (n=30) and their relation to time of delivery

	Variable	No. of studied participants=30		Preterm (n=24)	Term (n=6)	Test of significance	P value
		No.	%	No. (%)	No. (%)		
Age (Years)	**Mean ±SD**	26.87±4.25		26.21±4.23	29.50±3.45		
	Range	20-38		20-38	25-35	t=1.99	0.077
Age groups (Years)	**18-25**	13	43.3	12 (50.0)	1 (16.7)		
	26-30	12	40.0	9 (37.5)	3 (50.0)		
	31-35	4	13.3	2 (8.3)	2 (33.3)	χ^2=3.92	0.270
	>35	1	3.3	1 (4.2)	0 (.00)		
Weight (Kg)	**Mean ±SD**	75.30 ±10.40		75.29±10.85	75.33 ±9.27		
	Range	60-95		60-95	63-85	t=0.01	0.993
BMI (Kg/m^2)	**Mean ±SD**	28.23 ±3.60		28.21 ±3.60	28.33 ±3.93		
	Range	22-34		22-34	23-33	t=0.07	0.945
BMI classification	**Normal (18.5-24.9)**						
	Overweight (25-29.9)	5	16.7	4 (16.7)	1 (16.7)		
	Obese (30-39.9)	12	40.0	10 (41.7)	2 (33.3)	FE=0.16	1.000
		13	43.3	10 (41.7)	3 (50.0)		
Occupation	**Working**	2	6.7	2 (8.3)	0 (0.00)		
	Not working	28	93.3	22 (91.7)	6 (100.0)	FE=0.54	1.000
History of medical disorders	**Absent**	26	86.7	1 (4.2)	1 (16.7)		
	Present	4	13.3	23 (95.8)	5 (83.3)	FE=1.21	0.366

The results showed that most of participants were P2 with ratio 36.7 and mostly with absent Hx of PTB (66.7%) and absent Hx of abortion (90%). Mean of GA was 32.20±1.90. Most of PTB underwent C.S (63.3%) with mean of time of delivery of 35.20±1.79 **(Table 2)**.

Table (2): Obstetric history among the studied participants (n=30) with their relation to time of delivery

Variable	No. of studied participants=30		Preterm (n=24)	Term (n=6)	Test of significance	P value
	No.	No. (%)	No. (%)	No. (%)		
Parity						
PG	5	16.7	4 (16.7)	0 (0.00)		
P1	6	20.0	6 (25.0)	3 (50.0)		
P2	11	36.7	8 (33.3)	2 (33.3)	χ^2=4.38	0.497
P3	3	10.0	1 (4.2)	0 (.00)		
P4	4	13.3	4 (16.7)	0 (.00)		
P5	1	3.3	1 (4.2)	1 (16.7)		
History of preterm labor						
Present	10	33.3	10 (41.7)	0 (.00)	FE=3.75	0.074
Absent	20	66.7	14 (58.3)	6 (100.0)		
History of abortion						
Absent	27	90.0	21(87.5)	6(100.0)		
Once	2	6.7	2 (8.3)	0 (.00)	FE=0.83	1.000
Twice	1	3.3	1 (4.2)	0 (.00)		
Gestational age (Weeks)						
Mean ±SD	32.20 ±1.90		32.00 ±2.00	33.00 ±1.26	t=1.52	0.154
Range	28-35		28-35	31-34		
Mode of delivery						
NVD	11	36.7	16(66.7)	3 (50.0)	FE=0.57	0.641
CS	19	63.3	8 (33.3)	3 (50.0)		
Time of delivery (Weeks)						
Mean ±SD	35.20 ±1.79		34.71±1.65	37.17±0.41	t=4.59	0.001*
Range	29-38		29-36	37-38		

Our results showed that the mean uterocervical angle was significantly greater in those who had preterm birth. Nevertheless; the cervical length was insignificantly shorter in the group of participants who delivered preterm in comparison with those who delivered at term **(Table 3 and figure 2).**

Table (3): CL and UCA in relation to time of delivery among the studied participants (n=30)

Variable	Preterm (n=24)	Term (n=6)	Test of significance	P value
	No. (%)	No. (%)		
CL (cm) **Median (IQR)** **Range**	3 (2.2-3.98) 1-7	4.25 (2.83-4.7) 1.7-5	U=1.38	0.169
No. of cases by CL **≤ 2.5 cm** **>2.5 cm**	9 (37.5) 15 (62.5)	1 (16.7) 5 (83.3)	FE=0.94	0.633
UCA **Mean ±SD** **Range**	119.02 ±16.59 81-145	92.17 ±11.70 75-106	t=6.53	<0.001*
No. of cases by UCA **≤ 114.5°** **>114.5°**	9 (37.5) 15 (62.5)	6 (100.0) 0 (.00)	FE=7.50	0.017*

Table 4 illustrated that CL of 3.95 cm or less had a sensitivity of seventy-five percent, specificity of sixty-seven percent, PPV of ninety percent, and NPV of forty percent. Also demonstrated that uterocervical angle of 104.5 degrees or more at AUC of 0.903 had a sensitivity of 79%, negative predictive value (NPV) of fifty percent, specificity of 83%, and positive predictive value (PPV) of 95%. The UCA significantly expected the prevalence of preterm birth. The CL had non-significant role in the prediction of preterm birth.

Table (4): Diagnostic accuracy of CL and UCA in prediction of preterm birth

	UCA	CL (cm)
AUC	**0.903**	**0.684**
95% CI	**0.788-1.000**	**0.440-0.928**
P value	**0.003***	**0.169**
Cutoff value	**≥ 104.5**	**≤ 3.95**
Sensitivity (%)	**79**	**75**
Specificity (%)	**83**	**67**
Accuracy (%)	**80**	**73**
PPV (%)	**95**	**90**
NPV (%)	**50**	**40**

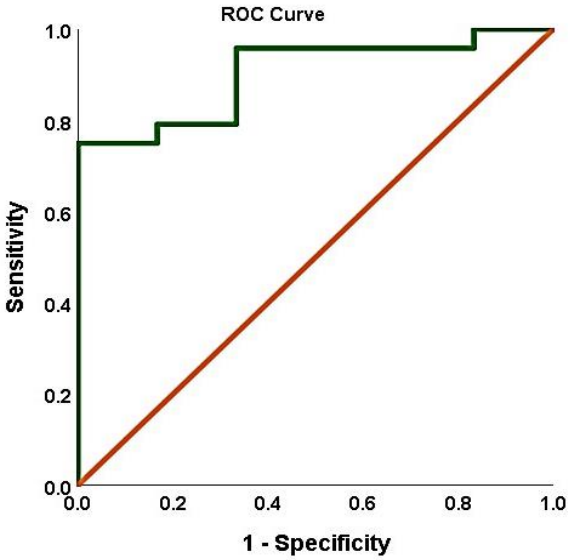

Figure (2): ROC curve of UCA as a predictor of preterm birth.

DISCUSSION

Preterm labor, which affects approximately 12% of pregnancies, remains one of the most critical challenges in obstetrics due to its association with neonatal morbidity, mortality, and potential long-term complications. It is clinically characterized by regular uterine contractions leading to cervical changes between 20 and 37 weeks of gestation. Accurate prediction and timely intervention are hindered by the limited reliability of current diagnostic tools [(8)].

Transvaginal ultrasound measurement of cervical length (CL) has been widely explored as a screening method. More recently, the uterocervical angle (UCA)—defined as the angle between the cervical canal and the anterior uterine wall—has emerged as another potential predictor of spontaneous preterm birth (sPTB) [(8)].

This study, conducted at Menoufia University Hospital, aimed to evaluate the predictive value of both UCA and CL in women presenting with signs of threatened preterm labor between 28 and 35 weeks of gestation. A total of 30 women with singleton pregnancies and intact membranes were enrolled. Both UCA and CL were measured using transvaginal ultrasound. Management included the administration of corticosteroids and tocolytics as per standard protocols. Cervical length was determined by measuring the distance from the internal to the external os, while the UCA was calculated by identifying the angle formed at the junction of the cervical canal and anterior uterine wall.

Of the 30 women, 24 experienced preterm birth. No significant differences were found in demographic or obstetric characteristics between those who delivered preterm and those who carried to term. However, the UCA was significantly wider in the preterm group, whereas CL did not show a meaningful difference. A UCA of ≥104.5° demonstrated a sensitivity of 79% and a positive predictive value (PPV) of 95%, suggesting it may serve as a more effective predictor of preterm birth than cervical length.

A growing body of literature supports the role of UCA as a reliable indicator of preterm delivery risk. For instance, **Benito-Vielba *et al.*** [(8)] reported that a UCA greater than 117° was effective in identifying women at high risk of sPTB and performed better than CL in predictive accuracy. Similarly, **Khamees *et al.*** [(9)] found that a UCA exceeding 105° was strongly associated with delivery before 37 weeks and offered superior diagnostic value compared to cervical length.

Singh *et al.* [(10)] also emphasized the utility of UCA as a promising screening tool for sPTB, particularly when used in combination with other parameters like CL. **Makled *et al.*** [(11)] advocated for the integration of UCA into clinical practice, noting its usefulness in managing high-risk cases.

Further supporting these findings, **Luechathananon *et al.*** [(12)] demonstrated that UCA measured via transvaginal ultrasound has acceptable sensitivity and high negative predictive value (NPV), making it a valuable tool in assessing risk during episodes of threatened preterm labor. Their results also showed that UCA and CL, when used together, can aid decision-making regarding the administration of tocolytics.

However, some studies present contrasting views. **Reyna-Villasmil *et al.*** [(13)] observed that although UCA is elevated in women who experience imminent preterm delivery, its predictive value may not surpass that of cervical length in symptomatic cases. **Ibrahim *et al.*** [(14)] suggested that combining UCA with fetal fibronectin (fFN) and CL may improve predictive performance, especially in identifying women at risk before 34 or 37 weeks of gestation.

Khazardoost *et al.* [(15)] proposed that a combination of UCA, anterior uterocervical angle (AUA), and cervical consistency index (CCI) in the second trimester enhances the ability to predict sPTB. Similarly, **Hamzaoğlu *et al.*** [(16)] recommended using both UCA and myometrial thickness (MT) as potential sonographic markers for preterm delivery.

Nguyen *et al.* [(17)] pointed out that UCA measured during the second trimester, especially values equal to or greater than 95° between 16+0 and 23+0 weeks, could help predict preterm birth even in low-risk pregnancies. They also highlighted that combining UCA with CL yields stronger predictive outcomes. More recently, **Dhruw *et al.*** [(18)] also supported UCA as an innovative tool for early detection of sPTB risk.

Together, these findings suggest that UCA may offer a valuable addition to existing prediction models for preterm birth, potentially enhancing risk assessment in both high-risk and low-risk populations. It may be

especially useful when integrated with other diagnostic tools.

Nevertheless, not all evidence supports the superiority of UCA. **Daskalakis *et al.* [19]** cautioned against incorporating UCA into clinical protocols prematurely, noting that further research is needed to confirm its diagnostic accuracy and establish standardized cut-off values. **Gründler *et al.*[20]** also found that UCA did not significantly predict PTB in women at risk between 20 and 31 weeks, whereas cervical length showed moderate but meaningful predictive power.

In this study, rigorous efforts were made to ensure data integrity. All ultrasound evaluations were performed by a single experienced operator, and outcome assessments were consistently conducted by the same observer throughout the study period and as a secondary outcome for our study was inhibition of uterine contraction, arrest of cervical changes and increasing time interval between time of start of tocolysis and time of delivery to allow enhancing lung maturity of preterm babies by giving standard dose of corticosteroids to improve outcome of preterm babies and decrease complication of prematurity.

CONCLUSION

The uterocervical angle (UCA) may serve as a valuable US indicator for predicting preterm birth in high-risk cases. A threshold value of 104.5° may be utilized as a cutoff, above which the risk of PTB is significantly increased, warranting prophylactic interventions like cervical cerclage or progesterone treatment. Our research recommends that uterocervical angle is a new screening instrument for PTB prediction and demonstrates superior predictive value compared to cervical length (CL).

LIMITATIONS

1. Small sample size, which was affected by loss of patients after discharge after improving and that our study needs more time of follow up of patients as it is prospective study, which also affects reliability of the derived metrics (sensitivity, specificity, cut-off).

2. Further research in larger numbers is required to measure the diagnostic accuracy of this index, with a particular focus on establishing optimal cutoff values and evaluating PTB rates at specific gestational weeks.

3. The study's management protocol (tocolytics, corticosteroids) could influence the true rate of PTB and thus the observed predictive values, making it harder to determine the natural predictive power of UCA/CL. This is an inherent challenge in symptomatic PTB studies, and we can't ignore the ethical issues in our study and can't let the patients under the risk of PTB without treatment.

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