E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/15.02.82

Research Article

Role of Transvaginal Sonographic Measurement of Uterocervical Angle in The Prediction of Preterm Labour

Dr Tomesh Shrimali[1], Dr. Shruthi S. S[2], Dr Sharda Patra[3]
[1]Dept of obg Lady Hardinge Medical College, New Delhi
[2]Assistant Professor, Dept of Obstetrics and Gynaecology ESICMC & PGIMSR, Bangalore.
[3]Unit Head, Dept of Obstetrics and Gynaecology Lady Hardinge medical college, New delhi
Received: 12.05.25, Revised: 14.06.25, Accepted: 21.07.25

ABSTRACT
Background: Spontaneous pre-term labour (sPTL) remains the leading cause of neonatal morbidity and mortality despite advances in perinatal care. Trans-vaginal sonographic (TVS) cervical length (CL) has modest predictive value. Recent work suggests that the uterocervical angle (UCA)—the angle between the lower uterine segment and the cervical canal—may better capture the vector of intra-uterine force.
Methods: In this prospective observational study we enrolled 100 consecutive women with singleton pregnancies at 16–24 weeks who had ≥ 1 historical risk factor for sPTL (prior sPTB, prior PPROM or mid-trimester loss). After exclusions, 96 women underwent standardized TVS assessment of CL, cervical width (CW) and UCA. Participants were followed until delivery. Primary outcome was birth < 37 weeks. Diagnostic accuracy was assessed with ROC analysis; optimal cut-offs were determined by Youden index.
Results: Twenty women (20.8 %) delivered pre-term. Mean (±SD) UCA was significantly wider in the pre-term versus term group (113.5 ± 17.9° vs 91.6 ± 14.0°, p < 0.001), whereas mean CL did not differ (3.20 ± 0.61 cm vs 3.35 ± 0.55 cm, p = 0.14). An obtuse UCA > 98.5° predicted sPTB with sensitivity 85 %, specificity 79 %, AUC 0.86 and odds ratio 21.3 (95 % CI 6.9-65.0). CW > 3.05 cm was a moderate predictor (AUC 0.74). Combining UCA > 98.5° and CW > 3.05 cm improved sensitivity to 90 % but reduced specificity to 54 %.
Conclusion: In high-risk singleton gestations the mid-trimester UCA outperforms traditional CL screening and, in combination with CW, yields the highest overall sensitivity for sPTB. Routine measurement of UCA at the anatomy scan may enable targeted prophylaxis.

Keywords: Uterocervical Angle; Cervical Length; Pre-Term Birth; Trans-Vaginal Ultrasound; Cervical Width.

INTRODUCTION

Pre-term birth (PTB), defined by the World Health Organization as delivery before 37 completed weeks, complicates 11 % of pregnancies worldwide and accounts for > 1 million neonatal deaths annually [1]. In India alone an estimated 3.5 million infants are born pre-term each year [2]. PTB survivors face lifelong sequelae including cerebral palsy, chronic lung disease and neuro-developmental impairment [3, 4]. Despite improved neonatal care, PTB incidence continues to rise, partly due to assisted reproduction and multifetal gestations [5].

Identification of women at greatest risk for spontaneous PTB (sPTB) is central to prevention. Epidemiologic risk factors—prior sPTB, short inter-pregnancy interval, smoking and low socio-economic status—lack sensitivity; maternal risk scores miss up to 70 % of sPTB [6]. Biochemical tests such as cervico-vaginal fetal fibronectin offer high negative predictive value yet limited positive value, and costs constrain universal use [7]. Consequently, ultrasound-based biophysical markers have become pivotal.

Trans-vaginal cervical length (CL) measurement pioneered by Iams et al. revolutionised screening, but its predictive performance remains modest; only 20–30 % of women with CL < 25 mm at 20–24 weeks deliver pre-term [8]. Moreover, CL measurement is susceptible to probe pressure artefact and inter-observer variability.

Biomechanical modelling suggests that the force exerted by the growing uterus on the cervix depends not only on CL but also on the inclination of the uterine corpus relative to the cervical canal. A narrow anterior UCA directs uterine pressure perpendicular to the internal os, reinforcing closure, whereas an obtuse UCA transmits a shearing vector that promotes funneling and effacement. Early retrospective studies reported that a UCA ≥ 95° in mid-trimester confers a three- to five-fold increases

in sPTB risk [9–11]. However prospective data in high-risk Indian populations are scarce.

We therefore undertook a prospective observational study to (i) establish normative mid-trimester UCA values in high-risk singleton pregnancies, (ii) compare the diagnostic accuracy of UCA, CL and cervical width (CW) for predicting delivery < 37 weeks, and (iii) explore whether combining these parameters improves risk stratification.

MATERIALS AND METHODS

Study Design and Setting: Prospective cohort conducted at the Department of Obstetrics & Gynaecology, Lady Hardinge Medical College & Smt Sucheta Kriplani Hospital, New Delhi (November 2018 – March 2021).

Participants: Pregnant women with singleton gestations between 16–24 weeks and ≥ 1 risk factor (previous sPTB, PPROM, or mid-trimester loss) were eligible. Exclusion criteria: placenta praevia, major fetal anomaly, cervical length < 15 mm, uterine malformation, fibroid > 5 cm, multiple gestation, medical comorbidity requiring indicated pre-term delivery.

Ultrasound Protocol: All scans were performed with a 6.5 MHz trans-vaginal probe after bladder emptying. CL was measured from internal to external os in the sagittal plane avoiding fundal pressure. CW was the maximum antero-posterior cervical diameter at the internal os. UCA was obtained by tracing a line through the cervical canal and a second line along the lower anterior uterine segment 3 cm cephalad; the enclosed acute angle was recorded. Three measurements were averaged. Sonographers were blinded to clinical data.

Follow-Up and Outcomes: Routine obstetric care continued. Primary outcome was spontaneous delivery < 37 weeks. Secondary outcomes included PPROM and delivery < 34 weeks.

Statistical Analysis: Continuous variables were compared with Student's t-test or Mann-Whitney U. Categorical data used χ^2. ROC curves determined optimal cut-offs. Diagnostic indices and 95 % confidence intervals (CI) were calculated. Multivariate logistic regression assessed independent predictors. Analyses used SPSS v25; $p < 0.05$ was significant. The study had institutional ethics approval and written informed consent.

RESULTS

Descriptive Findings

Ninety-six women completed follow-up; 20 (20.8 %) delivered pre-term (6 < 34 weeks, 14 between 34–37 weeks). Baseline socio-demographics and obstetric history were comparable between groups. Mean gestational age at scan was 20.6 ± 2.3 weeks.

Mean UCA was 96.1 ± 17.3° (range 58–146°). Mean CL and CW were 3.32 ± 0.56 cm and 2.98 ± 0.47 cm, respectively.

Women who delivered pre-term had significantly wider UCA (113.5°) and greater CW (3.33 cm) but similar CL (3.20 cm) to term controls.

Diagnostic Performance

ROC analysis identified optimal thresholds of UCA > 98.5°, CW > 3.05 cm and CL < 3.25 cm (Table 3). UCA showed the largest area under the curve (AUC 0.861), followed by CW (0.741) and CL (0.433). Combining UCA and CW improved sensitivity to 90 % albeit with reduced specificity (Figure 2).

Tables and Figures

TABLE 1. BASELINE MATERNAL & OBSTETRIC CHARACTERISTICS BY DELIVERY OUTCOME (N = 96)

Characteristic	Pre-term (n = 20)	Term (n = 76)	*p*
Maternal age, y (mean ± SD)	25.8 ± 3.4	24.5 ± 3.1	0.04
Lower socio-economic status, n (%)	9 (45 %)	37 (49 %)	0.33
≥ 1 prior spontaneous PTB, n (%)	17 (85 %)	53 (70 %)	0.09
≥ 2 prior spontaneous PTB, n (%)	5 (25 %)	1 (1 %)	0.19
Prior PPROM, n (%)	5 (25 %)	27 (36 %)	0.19
Prior mid-trimester loss, n (%)	7 (35 %)	23 (30 %)	0.34

TABLE 2. MID-TRIMESTER CERVICAL ULTRASOUND MEASUREMENTS (16–24 WKS)

Parameter (unit)	Pre-term (n = 20)	Term (n = 76)	*p*
Cervical length, cm	3.20 ± 0.61	3.35 ± 0.55	0.14
Cervical width, cm	**3.33 ± 0.57**	2.89 ± 0.40	< 0.001
Uterocervical angle, °	**113.5 ± 17.9**	91.6 ± 14.0	< 0.001

TABLE 3. PREDICTIVE PERFORMANCE OF INDIVIDUAL ULTRASOUND MARKERS FOR BIRTH < 37 WKS

Marker (cut-off)	Sens %	Spec %	PPV %	NPV %	Accuracy %	OR (95 % CI)
Cervical length < 3.25 cm	55	43	20	79	45	0.94 (0.35–2.53)
Cervical width > 3.05 cm	70	63	33	89	64	4.00 (1.44–11.11)
UCA > 98.5°	**85**	**79**	51	**95**	**80**	**21.25 (6.95–65.01)**

TABLE 4. PREDICTIVE PERFORMANCE OF COMBINED MARKERS

Combination (criteria)	Sens %	Spec %	PPV %	NPV %	Accuracy %	OR (95 % CI)
CL < 3.25 & CW > 3.05 cm	75	32	22	83	41	1.39 (0.45–4.24)
CL < 3.25 & UCA > 98.5°	90	32	26	92	44	4.15 (0.98–17.61)
UCA > 98.5° & CW > 3.05 cm	**90**	**54**	34	**95**	**62**	**10.54 (2.84–39.19)**

Figure 1. ROC Curve for Uterocervical Angle (>98.5°) in Predicting Preterm Birth

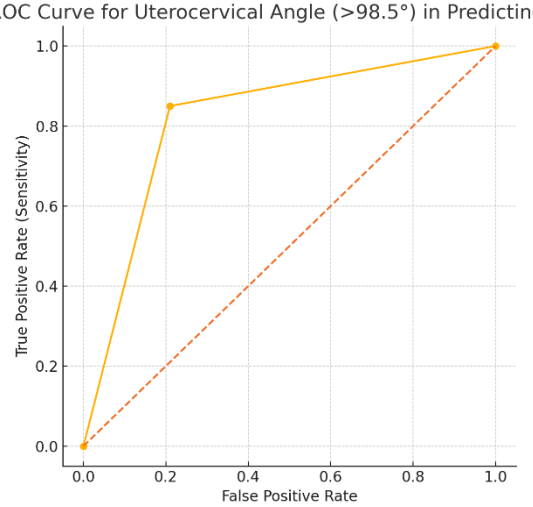
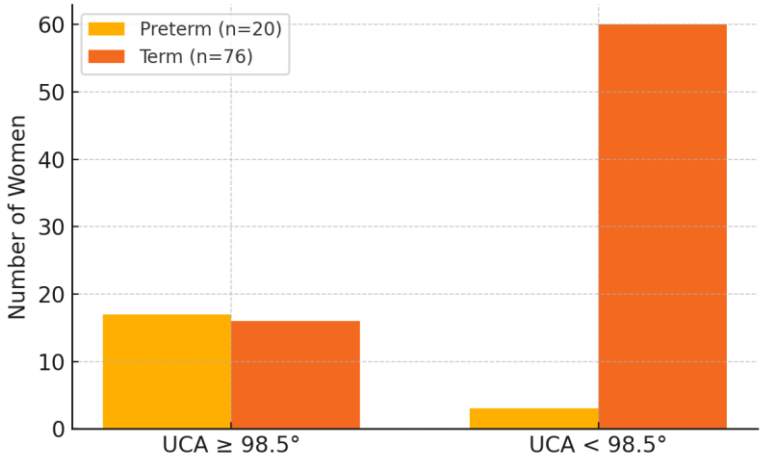


Figure 1 (ROC curve) and Figure 2 (bar chart of outcome by UCA category) are displayed above.

Figure 2. Distribution of UCA Categories by Delivery Outcome



DISCUSSION

Our prospective study demonstrates that a mid-trimester UCA exceeding 98.5° is a robust, independent predictor of spontaneous pre-term birth in high-risk singleton pregnancies, outperforming the traditional CL threshold of 25 mm. The AUC of 0.86 and odds ratio > 20 indicate excellent discrimination, consistent with earlier retrospective work in low-risk Caucasian cohorts [9–11, 13]. Importantly, we extend these findings to an Indian population characterised by higher background PTB rates and multiparity.

Biomechanically, an obtuse UCA allows the vector of uterine fundal pressure to act parallel to the cervical canal, facilitating funneling and shortening even when CL remains within the "normal" range. Our data confirm this paradigm: although mean CL was similar in outcome groups, UCA differed by > 20°. This supports Dziadosz et al. who reported superior predictive value of UCA > 105° compared with CL < 25 mm (sensitivity 81 % vs 62 %) [10]. We observed slightly lower specificity, perhaps owing to ethnic differences in pelvic geometry or operator learning curves.

Cervical width has received scant attention; nonetheless we found CW > 3.05 cm to be an independent, moderate predictor (AUC 0.74). The cervix widens as the stromal collagen network remodels, so CW may integrate microstructural change not captured by CL. Combining UCA and CW yielded sensitivity of 90 % and negative predictive value of 95 %, a profile desirable for screening. While specificity fell to 54 %, false-positive women could undergo serial surveillance rather than immediate intervention, minimising overtreatment.

Our results contrast with those of Chen et al. who found no association between UCA and PTB in a mixed-risk cohort [14]. Differences may reflect methodological heterogeneity: we standardised measurement at peak uterine quiescence, used a fixed 3 cm uterine segment line and averaged three readings, reducing random error.

Strengths include prospective design, homogenous high-risk sample, single-centre imaging protocol and complete follow-up. Limitations are modest sample size, absence of biochemical markers (e.g., fetal fibronectin) for comparison, and lack of inter-observer reproducibility testing. The threshold derived herein (98.5°) should be validated externally; wider cut-offs (95–105°) have been reported [9, 10, 12]. Finally, our study did not evaluate the impact of prophylactic interventions triggered by UCA screening, such as progesterone or cerclage, which warrants future randomised trials.

Clinical translation is straightforward: UCA measurement adds < 30 seconds to routine TVS, requires no additional equipment and is learnt easily. Integrating UCA into existing CL-based algorithms could refine risk stratification, reserving costly prevention for women most likely to benefit. Machine-learning models combining UCA, CW, CL and cervico-vaginal biomarkers may further improve prediction.

CONCLUSION

In high-risk singleton pregnancies, a mid-trimester uterocervical angle wider than 98.5° is the single best ultrasonographic predictor of spontaneous pre-term birth, outperforming cervical length. When combined with cervical width, sensitivity approaches 90 % with an excellent negative predictive value. Given its simplicity, reproducibility and negligible incremental cost, routine UCA measurement at the 18–24-week anatomy scan could markedly enhance early identification of women who may benefit from targeted prophylaxis and intensified surveillance. Larger multicentre studies should validate the optimal threshold and clarify the clinical utility of UCA-guided interventions.

REFERENCE

1. World Health Organization (WHO). (1977). Recommended definitions, terminology and format for statistical tables related to the perinatal period and use of a new certificate for cause of perinatal deaths. *Acta Obstetricia et Gynecologica Scandinavica, 56*(3), 247-253. https://doi.org/10.3109/00016347709162009 Capes Periodicals
2. Liu, L., Johnson, H. L., Cousens, S., Perin, J., Scott, S., Lawn, J. E., … Black, R. E. (2012). Global, regional, and national causes of child mortality: An updated systematic analysis for 2010 with time trends since 2000. *The Lancet*, *379*(9832), 2151-2161. https://doi.org/10.1016/S0140-6736(12)60560-1 The Lancet
3. Liu, L., Oza, S., Hogan, D., Chu, Y., Perin, J., Zhu, J., … Black, R. E. (2016). Global, regional, and national causes of under-5 mortality in 2000-15: An

updated systematic analysis with implications for the Sustainable Development Goals. *The Lancet, 388*(10063), 3027–3035. https://doi.org/10.1016/S0140-6736(16)31593-8 The Lancet

4. Saigal, S., & Doyle, L. W. (2008). An overview of mortality and sequelae of preterm birth from infancy to adulthood. *The Lancet, 371*(9608), 261–269. https://doi.org/10.1016/S0140-6736(08)60136-1 The Lancet
5. Mathews, T. J., Menacker, F., & MacDorman, M. F. (2004). *Infant mortality statistics from the 2002 period linked birth/infant death data set* (National Vital Statistics Reports No. 53). National Center for Health Statistics. **No DOI assigned**.
6. Steer, P. (2005). The epidemiology of preterm labour. *BJOG: An International Journal of Obstetrics & Gynaecology, 112*(Suppl. 1), 1–3. https://doi.org/10.1111/j.1471-0528.2005.00575.x Eureka Mag
7. Bouyer, J., Papiernik, E., Dreyfus, J., Collin, D., Winisdoerffer, B., & Gueguen, S. (1986). Maturation signs of the cervix and prediction of preterm birth. *Obstetrics & Gynecology, 68*(2), 209–214. https://doi.org/10.1097/00006250-198608000-00010
8. Berghella, V., Tolosa, J. E., Kuhlman, K., Weiner, S., Bolognese, R. J., & Wapner, R. J. (1997). Cervical ultrasonography compared with manual examination as a predictor of preterm delivery. *American Journal of Obstetrics and Gynecology, 177*(4), 723–730. https://doi.org/10.1016/S0002-9378(97)70259-X ScienceDirect
9. Mella, M. T., & Berghella, V. (2009). Prediction of preterm birth: Cervical sonography. *Seminars in Perinatology, 33*(5), 317–324. https://doi.org/10.1053/j.semperi.2009.06.007 Kudos
10. Iams, J. D., Goldenberg, R. L., Meis, P. J., Mercer, B. M., Moawad, A., Das, A., … Roberts, J. M. (1996). The length of the cervix and the risk of spontaneous premature delivery. *The New England Journal of Medicine, 334*(9), 567–572. https://doi.org/10.1056/NEJM199602293340904 New England Journal of Medicine
11. Yost, N. P., Bloom, S. L., Twickler, D. M., & Leveno, K. J. (1999). Pitfalls in ultrasonic cervical length measurement for predicting preterm birth. *Obstetrics & Gynecology, 93*(4), 510–516. https://doi.org/10.1016/S0029-7844(98)00438-4 OUCI
12. Sochacki-Wójcicka, N., Wójcicki, J., Bomba-Opoń, D., & Wielgoś, M. (2015). Anterior cervical angle as a new biophysical ultrasound marker for prediction of spontaneous preterm birth. *Ultrasound in Obstetrics & Gynecology, 46*(3), 376–379. https://doi.org/10.1002/uog.14801 Obstetrics & Gynecology
13. Dziadosz, M., Bennett, T. A., Dolin, C., West Honart, A., Pham, A., Lee, S. S., … Miller, E. (2016). Uterocervical angle: A novel ultrasound screening tool to predict spontaneous preterm birth. *American Journal of Obstetrics and Gynecology, 215*(3), 376.e1–376.e7. https://doi.org/10.1016/j.ajog.2016.03.033 AJOG
14. Knight, J. C., TenBrink, E., Onslow, M., & Patil, A. S. (2017). Uterocervical angle measurement improves prediction of preterm birth in twin gestation. *American Journal of Obstetrics and Gynecology, 216*(1), 91–92. https://doi.org/10.1016/j.ajog.2016.11.034