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Is Uterocervical Angle Associated with Gestational Latency after Physical Exam Indicated Cerclage?

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Abstract

Objective—Prediction of gestational latency after placement of physical exam indicated cerclage (PEIC) is limited. Uterocervical angle (UCA) has been associated with spontaneous preterm delivery in the general population. Our objective was to examine whether UCA is associated with gestational latency in women with PEIC.

Study Design—This retrospective cohort included women with a singleton gestation who had PEIC placed at a single tertiary care center between January 2010 and September 2015. Ultrasound images of the cervix obtained prior to placement of PEIC were reviewed. Spearman's correlation coefficient for the relationship between UCA and gestational latency was estimated. UCA was dichotomized at 95° and 105°. Survival analyses were performed and Cox proportional hazard ratios were calculated.

Results—Sixty women met the inclusion criteria. Median gestational latency was 93 days (IQR 39–121 d). There was no significant correlation between UCA and gestational latency (Spearman's rho 0.08, $p = 0.54$). Survival analyses demonstrated no significant difference in gestational latency stratified by UCA;:: 95° (HR 1.19, 95% CI 0.70–2.04) or UCA;:: 105° (HR 0.95, 95% CI 0.56–1.63). Findings persisted after adjusting for potential confounders (aHR 1.29, 95% CI 0.74–2.23 for UCA;:: 95° and aHR 1.04, 95% CI 0.60–1.82).

Conclusion—UCA is not associated with gestational latency in women with PEIC.

Keywords

physical exam indicated cerclage; uterocervical angle; transvaginal ultrasound; gestational latency

Cervical insufficiency, defined as painless cervical dilation in the second trimester, is one etiology of both pregnancy loss and spontaneous preterm birth. In patients who experience cervical insufficiency, placement of a physical exam indicated cerclage (PEIC) may be considered with the goal of pregnancy prolongation.¹ Studies suggest a prolongation of pregnancy and increased gestational age at delivery when PEIC is placed compared with

expectant management.²⁻⁶ However, gestational latency after cerclage placement varies widely with a third of women delivering by 28 weeks' gestation despite this intervention.⁵ Given the variation in potential outcomes, informed decision making is challenging for both patients and physicians.

Recent data have suggested that the anterior uterocervical angle (UCA), defined as the angle between the lower uterine segment and the cervix, measured by transvaginal ultrasound is predictive of spontaneous preterm birth in a general population of women with singleton pregnancies. Dziadosz et al found an association between increased UCA and spontaneous preterm birth in a general population.⁷ However, the role of UCA in predicting preterm birth in other populations, such as those at high risk of preterm birth, has received less attention. Knight et al examined the role of UCA in patients with a transvaginal cerclage (history-indicated, ultrasound-indicated, or PEIC) and found that the UCA most proximate to delivery after cerclage placement was a modest predictor of preterm birth.⁸ However, the clinical utility of this measurement is limited; an accurate predictor of preterm birth identified prior to the decision to place a PEIC would have more potential to inform counseling and patient-decision making. Therefore, the objective of this study is to evaluate whether UCA measured by transvaginal ultrasound prior to PEIC placement is associated with gestational latency.

Materials and Methods

This is a retrospective cohort study of women who had a PEIC placed at Northwestern Memorial Hospital between July 2010 and September 2015. Subjects were identified by a search of the CPT billing code 59320 and charts were reviewed to confirm accuracy. Women were included if a transvaginal ultrasound had been performed no more than 3 weeks prior to placement of the PEIC with images available for review, and information related to delivery of the index pregnancy available. Women were excluded if they were pregnant with more than one fetus, if the pregnancy had been reduced to a singleton pregnancy, or if the PEIC was a revision of a cerclage placed earlier in the pregnancy.

At our institution, transvaginal cervical length is routinely assessed at the time of the fetal anatomic survey in the method of Iams et al.⁹ Women identified to have a short cervix, defined as <2 cm, underwent a digital cervical exam. Women identified to have a dilated cervix were referred to labor and delivery for evaluation by a Maternal Fetal Medicine subspecialist for possible physical-exam indicated cerclage placement. Women found to be eligible for PEIC were counseled regarding their options, including expectant management, PEIC placement, and pregnancy termination. If the patient was elected for PEIC placement, it was routinely performed under spinal anesthesia via the McDonald technique by a Maternal-Fetal Medicine physician using Mersilene tape. At the beginning of this study period, a randomized controlled trial evaluating the effects of perioperative indomethacin and antibiotics at the time of PEIC placement on gestational latency was being performed,¹⁰ and women who underwent placement of PEIC after August 2013 were empirically placed on perioperative indomethacin and antibiotics based on the results of this trial.

Data were abstracted from the maternal medical record, including maternal age at time of PEIC placement, race/ethnicity, parity, gestational age at the time of PEIC placement, body mass index (BMI) at cerclage placement, cervical dilation noted at time of PEIC placement, clinical exam evidence of membrane prolapse, whether inadvertent rupture of membranes at time of PEIC placement occurred, and gestational age at delivery. Perinatal death prior to discharge was abstracted from the paired neonatal record.

Cervical ultrasound images were reviewed blinded to patient outcomes. The UCA, defined as the angle between the anterior lower uterine segment and the cervical canal, was measured by the first author using the angle between line connecting the internal and external cervical os and the line connecting the internal os and the anterior lower uterine segment as has been previously described.⁷ The cervical length and presence of sludge were also recorded.

The primary outcome was gestational latency after PEIC placement. This was defined as the number of days between placement of PEIC and delivery. A Spearman's correlation coefficient for the relationship between UCA and gestational latency was estimated. Based on previously identified cutoffs predictive of preterm birth, UCA was then dichotomized at 95° and 105°. Survival analyses were performed and Cox proportional hazard ratios calculated for the outcome of gestational latency at each of these cut-offs in bivariable analyses. Multivariable analyses were performed including all potential confounders with a $p < 0.25$ in bivariable analyses. Sensitivity analysis was performed for patients with UCA measured within one day of PEIC placement.

All data analyses were performed using Stata version 14.0 (StataCorp, College Station, TX). Two-tailed Student's *t*-tests or Mann–Whiney *U*-tests were utilized to compare continuous variables, while chi-square tests or Fisher exact tests were utilized to compare categorical variables. Kaplan–Meier figures were generated to illustrate time to delivery. Hazard ratios were generated from Cox proportional hazards models. Statistical significance was defined as $p < 0.05$. This study was approved by the Northwestern Institutional Review Board prior to its initiation.

Results

A total of 143 women underwent PEIC placement during the study period. Of these women, 60 met inclusion criteria (Fig. 1). There were 35 (58%) and 22 (37%) women with an obtuse UCA defined as a UCA;:: 95° and UCA;:: 105°, respectively. Baseline characteristics stratified by UCA are shown in Table 1. There were no significant demographic and obstetric characteristic differences between women with an obtuse (UCA;:: 95°) versus a normal UCA. Women with an obtuse UCA had similar cervical characteristics at the time of PEIC (e.g., no differences in cervical dilation, cervical length, or membrane prolapse), aside from a decreased incidence of sludge in women with an obtuse UCA. Rupture of membranes at the time of PEIC was uncommon and did not differ by UCA cohort. These findings were similar when an obtuse UCA was defined as;:: 105°, although notably there were no differences in the presence of sludge between women when UCA was dichotomized at 105°(18.2 vs. 36.8%, $p = 0.16$).

The median gestational latency for all subjects was 93 days (IQR 39–121 d). There was no significant correlation between UCA and gestational latency (Spearman's ρ 0.08, p = 0.54). Similarly, there was no difference in median gestational latency when stratified by UCA;:95° (91 d [IQR 46–121] vs. 94 d [IQR 32–124], p = 0.80) or UCA;:105° (108 days [IQR 76–121] vs. 87 d [IQR 32–121], p = 0.37). Correspondingly, gestational age at delivery did not differ when stratified by UCA;: 95° (33.6 wks [IQR 27.4–39.0] vs. 35.4 wks [IQR 25.7–39.0], p = 0.89) or UCA;:105° (37.4 wks [IQR 30.3–39.0] vs. 33.6 wks [IQR 26.0–39.0 wks]).

Survival analyses demonstrated no significant difference in gestational latency stratified by either UCA;: 95° (HR 1.19, 95% CI 0.70–2.04) or UCA;: 105° (HR 0.95, 95% CI 0.56–1.63) (Fig. 2). These findings persisted after adjusting for maternal age, race/ethnicity, and the presence of sludge of cervical ultrasound (aHR 1.45, 95% CI 0.80–2.67 for UCA;: 95° and aHR 1.10, 95% CI 0.60–1.99 for UCA;: 105°). Forty-three patients had UCA measured within one day of PEIC placement. When sensitivity analysis was performed on this group, their results were not different than the cohort at large (aHR 1.14, 95% CI 0.61–2.11 for UCA;: 95° and aHR 1.06, 95% CI 0.58–1.97 for UCA;: 105°).

Discussion

In this cohort, UCA as measured by transvaginal ultrasound prior to placement of PEIC was not significantly associated with gestational latency. These data suggest that UCA does not inform expected outcomes after PEIC. These findings are consistent with those of Knight et al.⁸ While they found that an obtuse UCA performed later in gestation after cerclage placement was associated with a decrease in gestational age at delivery, the UCA measured prior to cerclage indication was not associated with gestational age at delivery.

Our observed absence of a correlation between UCA and gestational length is surprising given that prior work has demonstrated an obtuse UCA is predictive of spontaneous preterm birth.⁷ The rationale for the predictive value of UCA is that mechanical function of the cervix is affected by increased tension and stress of the gravid uterus on the internal os. However, the mechanism by which cervical insufficiency leads to preterm delivery and pregnancy loss may not be related to mechanical relationship of the lower uterine segment to the cervix, but rather an intrinsic structural weakness of the cervix itself.

One significant strength of this study is that, to the best of our knowledge, this is the largest sample of PEIC and UCA examined to date. Additionally, CL is routinely obtained at our institution with sonographers trained in CL measurement, minimizing selection bias. Despite these strengths, this study is limited by its small sample size due to the infrequency of PEIC placement. A posthoc power calculation demonstrated that, using an α of 0.05 and with a gestational latency of 94 days in the control group (SD = 0.45), we were sufficiently powered to identify a difference in mean gestational latency of 35 days. More subtle differences are unable to be detected using this cohort. Additionally, this study did not include women diagnosed with cervical insufficiency who opted for expectant management or pregnancy termination. This may have selected against inclusion of more advanced

phenotypes, as women who opted against cerclage may have had more clinically concerning exam findings such as more advanced dilation or more significant prolapsing membranes.

The observed absence of an association between UCA and gestational latency after PEIC emphasizes the importance of identifying additional predictors of gestational latency after PEIC placement to better counsel patients with the diagnosis of acute cervical insufficiency.

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Fig. 1.
Patient flow diagram.

Fig. 2. Survival curves of gestational latency after cerclage placement stratified by uterocervical angle (UCA).

Table 1

Demographic and clinical characteristics stratified by UCA

Characteristics	UCA ≥ 95° N = 35	UCA < 95° n = 25	p-Value
Maternal age (y)	29.8 ± 5.0	32.4 ± 6.3	0.09
Race/ethnicity			0.22
Non-Hispanic white	8 (22.9%)	6 (24.0%)	
Non-Hispanic black	17 (48.6%)	12 (48.0%)	
Hispanic	1 (2.9%)	4 (16.0%)	
Other/Unknown	9 (25.7%)	3 (12.0%)	
Nulliparous	16 (45.7%)	10 (40.0%)	0.66
BMI at time of PEIC (kg/m ²)	28.4 (23.8–33.3)	29.3 (25.2–33.6)	0.57
Gestational age at time of PEIC	20.3 (20.9–21.9)	21.3 (20.0–22.4)	0.69
Cervical dilation at time of PEIC (cm)	1.0 (1.0–1.5)	1.0 (1.0–1.5)	0.86
Sonographic CL prior to PEIC (cm) (n = 54)	1.5 (1.0–2.0)	2.0 (1.5–2.0)	0.59
Sludge noted on CL US	7 (20.0%)	11 (44.0%)	0.05
Membrane prolapsed	8 (22.9%)	7 (28.0%)	0.65
Perioperative indomethacin and antibiotics	16 (45.7%)	16 (64.0%)	0.20
Rupture of membranes at PEIC	1 (2.9%)	1 (4.0%)	1.00

Abbreviations: BMI, body mass index; CL, cervical length; PEIC, physical exam indicated cerclage; UCA, uterocervical angle; US, ultrasound.

Note: Data reported as mean ± standard deviation, median (interquartile range), or n (%).