OBSTETRICS

Does midtrimester cervical length aid in predicting vaginal birth after cesarean?

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OBJECTIVE: A longer midtrimester cervical length (CL) is associated with an increased chance of cesarean delivery, but CL has not been used to predict the chance of successful trial of labor after cesarean delivery (TOLAC). The objective of this study was to identify whether midtrimester CL improves the prediction of vaginal birth after cesarean delivery (VBAC) among women undergoing a TOLAC.

STUDY DESIGN: Women with 1 prior cesarean and a singleton gestation in the vertex position who had a routine CL assessment between 18 and 24 weeks and chose to undergo a TOLAC were identified. Midtrimester CL and characteristics identifiable in early prenatal care that have been used in a validated predictive model for VBAC (ie, age, body mass index, race/ethnicity, prior vaginal delivery, prior VBAC, and indication for prior cesarean delivery) were abstracted from the medical record. Multivariable regressions with VBAC as the dependent variable, with and without CL, were created and their predictive capacity compared using receiver-operating characteristic curves and reclassification tables.

RESULTS: Of the 678 women who met inclusion criteria, 517 (76.3%) experienced a VBAC. Mean midtrimester CL was lower in women who achieved a VBAC compared with those who required a cesarean delivery in labor (4.3 ± 0.8 cm vs 4.7 ± 0.8 cm, $P < .001$). In a multivariable logistic regression, midtrimester CL (centimeters) was significantly associated with a reduced chance of VBAC (adjusted odds ratio [aOR], 0.60; 95% confidence interval [CI], 0.47−0.76). Although the addition of CL improved the area under the receiver-operating characteristic curve (aOR, 0.695 [95% CI, 0.648−0.743] vs aOR, 0.727 [95% CI, 0.681−0.773]; $P = .03$), it did not significantly enhance the clinical value of the model, as quantified by net reclassification improvement ($P = .11$).

CONCLUSION: Shorter midtrimester CL is associated with a greater chance of vaginal birth after a TOLAC. However, midtrimester CL does not significantly improve the clinical value of a previously developed VBAC prediction model.

Key words: cervical length, prediction, trial of labor after cesarean delivery, vaginal birth after cesarean delivery

Counseling women regarding the route of delivery after a prior cesarean delivery remains an obstetric challenge. If a vaginal birth after cesarean delivery (VBAC) could be ensured, then a trial of labor after cesarean delivery

(TOLAC) would yield the best maternal and neonatal outcomes. However a TOLAC followed by an intrapartum repeat cesarean delivery increases maternal and neonatal morbidity more than an elective repeat cesarean delivery. Accordingly, predictive models for a VBAC have been developed to inform this decision making, although these models do not predict with certainty who will have a VBAC.[1-9]

Several studies have provided evidence that cervical changes begin to occur in the second trimester that can be ascertained sonographically and that have relevance for pregnancy outcomes. For example, cervical shortening is associated with an increased risk of preterm birth.[10-14] Conversely, longer second-trimester cervical lengths (CLs) increase the risk for labor dystocia and cesarean delivery.[15,16] Whether this same association exists in women

undergoing TOLAC has not been examined.

Indeed, if this association were to exist, second-trimester CL may be useful to incorporate into counseling with regard to the chance of TOLAC success. Moreover, because CL screening has become increasingly performed during antenatal care, the availability of this measurement is becoming more readily available. The objective of this study was to determine whether second-trimester cervical length is associated with the chance of VBAC among women undergoing TOLAC and whether incorporating CL into an existing and validated prediction model for VBAC will improve its prediction.

MATERIALS AND METHODS

This was a retrospective cohort study of all women with a singleton gestation undergoing cervical length surveillance as

TABLE 1
Patient characteristics stratified by route of delivery

Characteristic	VBAC (n = 517)	Failed TOLAC (n = 161)	P value
Maternal age, y	32.1 ± 5.2	32.1 ± 5.3	.843
Race/ethnicity			.007
White	212 (45.0%)	51 (35.2%)	
Black	69 (14.7%)	33 (22.8%)	
Latina	147 (31.2%)	41 (28.3%)	
Asian	26 (5.5%)	17 (11.7%)	
Other	17 (3.6%)	3 (2.1%)	
BMI, kg/m²	30.5 ± 5.3	32.9 ± 5.9	< .001
Prior vaginal delivery	173 (33.5%)	30 (18.6%)	< .001
Prior VBAC	127 (24.6%)	13 (8.1%)	< .001
Prior cesarean for arrest disorder	205 (40.2%)	82 (51.3%)	.014
Gestational age at TVUS	20.3 ± 1.0	20.3 ± 1.0	.696
Gestational age at delivery	38.9 ± 2.5	39.4 ± 1.4	.015
Birthweight, g	3297 ± 573	3417 ± 531	.019

BMI, body mass index; *TOLAC*, trial of labor after cesarean delivery; *TVUS*, transvaginal ultrasound; *VBAC*, vaginal birth after cesarean delivery.

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a part of their routine antenatal care between 18 0/7 and 23 6/7 weeks' gestation from December 2010 until January 2014. Cervical length images were obtained by sonographers according to the methods described by Iams et al.[13] Women were included in the study if they were at least 18 years of age, had 1 prior low transverse (or an unknown scar that was presumed to be low transverse) cesarean delivery, and underwent a TOLAC at Northwestern University, Chicago, IL). Women were excluded if they had an antenatal fetal demise.

Charts of eligible women were abstracted for demographic and clinical characteristics previously identified to be predictive of VBAC. These data included maternal age, body mass index (BMI), race/ethnicity, prior vaginal delivery, prior VBAC, and the indication for the prior cesarean delivery. Two multivariable logistic regressions for VBAC were developed: one included these independent variables and the other included these variables as well as cervical length. Receiver-operating characteristic (ROC) curves were created for both equations and areas under the curves (AUCs) were compared.

Because AUC comparisons alone do not necessarily convey whether differences in predictive accuracy are clinically meaningful, net reclassification tables, based on route of delivery, were created. Specifically, clinically useful discriminatory points for chance of VBAC were determined from the literature.[17-19] A less than 60% predicted chance of VBAC was considered a low probability of VBAC because of the evidence that, in these women, maternal morbidity is higher with a TOLAC than with an elective repeat cesarean delivery. A 70% or greater predicted chance of VBAC was considered a high probability of VBAC, given that maternal morbidity is lower with a TOLAC than with an elective repeat cesarean delivery. Women with a 60-69% predicted chance of VBAC were considered to be at intermediate probability.

For the net reclassification table, an increase in the predicted probability of VBAC among women who experienced a VBAC and a decrease in the predicted probability of VBAC in women who experienced a failed TOLAC were considered improvements in prediction. The converse for each scenario represented a worse reclassification. The sum of differences in the proportion of improved and worsened reclassification was calculated using the methods described by Pencina et al.[20]

Stata version 13 (StataCorp, College Station, TX) was used to perform the statistical analyses. All tests were 2 tailed and a value of *P* < .05 was used to define statistical significance. The Institutional Review Board of Northwestern University approved this study.

RESULTS

Of the 18,529 women with a singleton gestation who underwent routine cervical length screening, 2310 (12.5%) had a prior cesarean delivery. The demographic and clinical characteristics of the 678 women who underwent a TOLAC (29.4%), stratified by route of delivery, are shown in Table 1. Five hundred seventeen (76.3%) experienced a VBAC. Consistent with prior studies, women who achieved a VBAC were more likely to be white, have a lower BMI, have had a prior vaginal delivery, and were less likely to have had their prior cesarean for an indication of arrest of labor.[1-9] Also, the mean cervical length of women who achieved a VBAC was significantly shorter than that of women who experienced a failed TOLAC (4.3 ± 0.8 cm vs 4.7 ± 0.8 cm; *P* < .001).

The 2 multivariable regressions for VBAC, one with just the traditionally identified predictive factors and one with CL included as well, were created. The results of these tables are presented in Table 2. The CL was found to be independently associated with VBAC, such that for every additional centimeter of cervical length, there was a 40% reduction in the odds of VBAC.

ROC curves were created for each of these prediction models (Figure). The AUC for the model with cervical length (0.727; 95% confidence interval [CI], 0.681–0.773) was significantly greater than that of the model without cervical length (0.695; 95% CI, 0.648–0.743; *P* = .03). Reclassification tables were then