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Does Cervical Length Predict the Successful Labor Induction in Term Nulliparous Women Who Had Unfavorable Cervix?

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ABSTRACT

The aim of this study was to determine the predictive value of cervical length (CL) measurement in the result of labor induction in term nulliparous women who had a strict cervix.

A total of 78 pregnancies were evaluated prospectively. Dinoprostone ovule was used for the induction of labor in all cases. Low dose oxytocin was administered for augmentation of the labor. Statistical analyses were performed using SPSS Version 24. A p-value <0.05 was determined as to be statistically significant.

Dinoprostone's indication for labor induction was seen in 57.7% of cases at post-term pregnancy and unsafe fetal well-being observed in the remaining 42.3% of the patients. 59% of patients delivered their babies vaginally, and we performed a cesarean section in 41% of patients. The most cesarean indication was fetal distress (40.6%). The arrest of labor was considered in 31.2% of the patients and failed labor induction was observed in 28.1% of the patients. A significant correlation was found between CL and successful labor induction. The Area Under the Curve (AUC) for CL was: 0.6975 (95% CI: 0.5816-0.8134). The sensitivity and specificity of CL≤ 20 mm were 94% and 45%, respectively, while the positive and negative predictive values associated with it were 57% and 90%. Sensitivity was 23%, and specificity was 84% at the CL≥ 30 mm cut-off point. There was no significant difference between umbilical cord pH and the route of delivery (p: 0.185).

Our study indicates that CL measurement is a highly effective method to predict labor induced, particularly in nulliparous and having unfavorable cervix.

Key Words: Cervix, Cesarean, Dinoprostone, Labor induction, Ultrasonography

Introduction

Induction of labor at term is preferable in expectant management with various medical indications due to a substantial reduction in perinatal mortality (1,2). Although it has been performed in %20 of all deliveries, %10-15 of women need a cesarean section (3,4). Labor induction in the presence of an unripe cervix is difficult and time-consuming. Furthermore, it is associated with increased cesarean section and instrumental delivery rates.

A pre-induction cervical assessment has been established with the Bishop's score in several years. Although digital evaluation of the cervix is safe and there is no need for the specific equipment, it is accuracy is very controversial even among experienced obstetricians. Also, Bishop's score has a weak predictive value for the induction of labor (5). Numerous medications such as prostaglandins, oxytocin, and mechanical dilators can be used for the ripening of the cervix. Recently, prostaglandin E2 (PGE2) preparation which is applied locally, particularly dinoprostone, have widely used for the induction of labor (6). Transvaginal ultrasound is a novel and potentially more accurate tool to evaluate the status of the cervix and may give more accurate prediction for successful labor induction instead of Bishop's score. Although the value of cervical length to predict vaginal birth was studied in recent years, the current data display some inconsistencies. Some of the studies included both nulliparous and multiparous women. Furthermore, some of the reports included women who had either favorable or unfavorable cervix. In our study, we aimed to recruit a homogenous population, and we

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evaluated only nulliparous patients with a strict cervix.

The aim of this study was to assess the value of pre-induction transvaginal cervical length measurement in nulliparous term women who had unfavorable cervix.

Materials and Methods

This prospective study was conducted in Van Education and Research Hospital, Department of Obstetrics and Gynecology, between August 2019 and March 2020. Written informed consent was obtained from all of the participants, and the local ethics committee approved the study.

The inclusion criteria for the study were singleton pregnancy, live fetus, cephalic presentation, estimated fetal weight (EFW) between 5 to 95 percentiles, absence of fetal anomaly, and gestational age between 37+0 to 42+0 weeks, intact membranes and Bishop's score ≤5. The Bishop's score was evaluated by the experienced obstetricians or midwives. Amniotic fluid volume was measured before labor in all of the patients, and oligohydramnios was defined as the deepest vertical fluid volume <2 cm. The average amniotic fluid volume was between 2 to 8 cm. Maternal characteristics such as maternal age, number of gravity, gestational age, smoking, and body mass index (BMI) also recorded. Labor induction indications such as post-term pregnancy, oligohydramnios, reduced fetal movement (<10 fetal movements in 24 hours), and unsafe fetal well-being (Biophysical profile≤ 6) were also determined.

Transvaginal ultrasound (TVS) examination of cervical length (CL) was carried out by G.T., who had received The Fetal Medicine Foundation Certificate of Competence in Cervical Assessment. The probe was placed in the vagina approximately 3 cm proximal to the cervix while the bladder was empty. Fundal or suprapubic pressure was avoided. CL measurement was determined in a sagittal plane. Calipers were placed between the uttermost points of the internal and external cervical os. Three measurements were obtained with Voluson E8 (Kreztechnick AG, Zipf, Austria) equipped with a 5-7 MHz probe. The shortest measurement was recorded in the absence of uterine contractions.

Ten mg dinoprostone vaginal ovule (Propess, Ferring Controlled Therapeutics, England) was administered to all of the participants for labor induction. Patients were examined every three hours, and cervical changes were recorded. Also, fetal heart rate and uterine activity was monitored. If the patient's Bishop's score ≥6, the dinoprostone the ovule was removed. If the patient had adequate uterine contractions, spontaneous labor was followed up. 5 U of oxytocin diluted in 500 ml saline and administered to patients via an infusion pump whose uterine contractions were insufficient.

Low-dose oxytocin protocol was applied for labor augmentation. 1-2 mu/min oxytocin was started and increased by two mu/min in every 15 minutes until sufficient uterine contractions were obtained. No more than oxytocin above 20 mu/min level was administered. Sufficient uterine activity was considered as more than 200 Montevideo units. In the active phase of labor, a cervical examination was carried out until the beginning of the second stage of labor. Continuous fetal heart rate monetarization was applied to patients during the active phase of labor. Amniotomy was performed when the cervical dilatation was more than 6 cm. The arrest of labor was defined as absent of cervical change for more than 4 hours despite presence of adequate contractions in the first stage of labor. The prolonged second stage of labor was defined as not the occurrence of vaginal birth within 3 hours. Fetal distress was defined as the presence of late decelerations or recurrent variable decelerations with loss of variability in cardiotocography. Dinoprostone ovule was removed after 24 hours, and we did not use the second dinoprostone ovule in patients whose cervix remains unfavorable. We determined these patients as failed labor induction. We performed a cesarean section for these patients. The primary outcome was defined as vaginal birth in 48 hours. The interval between administration of dinoprostone to birth, cesarean section indications, operative delivery, and neonatal outcomes such as APGAR score, birth weight, umbilical cord pH, and need for neonatal intensive care unit (NICU) were also recorded.

The statistical analysis of patients was performed using statistical software Statistical Package for the Social Sciences (SPSS version 24 Inc, IL, USA). Receiver operator characteristic (ROC) curves were constructed for different CL cut-offs. The area under the curve (AUC) was then calculated, and values and confidence intervals (CIs) established. Sensitivity and specificity at different CL cut-offs were calculated. A p-value <0.05 was determined as to be statistically significant.

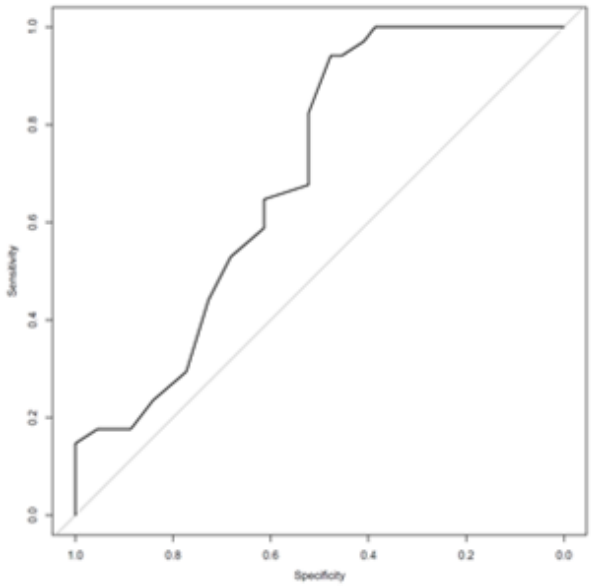

Fig. 1. Diagnostic performance of CL measureent for predicting vaginal birth

Results

We enrolled 78 nulliparous women for the study. The mean age of the patients was 25.7±5.5, and the mean BMI was 23.8±3.7. The mean gestational age at labor induction was 25.2±6.4 weeks, and mean CL was 25.2±6.4 mm. 9% of cases were using cigarette. Dinoprostone's indication for labor induction was seen in 57.7% of cases at post-term pregnancy and unsafe fetal well-being observed in the remaining 42.3% of the patients. Oligohydramnios was detected in 65,4% of cases, and amniotic fluid volume was normal in %34.6 of women. The demographic and clinical features of patients were demonstrated in Table 1.

We used low dose oxytocin induction in 61.5% of the cases, and the mean labor interval was 1395±564 minutes. 59% of patients delivered vaginally, and we performed a cesarean section in the remaining 41% of patients. The most prevelant cesarean indication was fetal distress (40.6%). The arrest of labor was considered in 31.2%, and failed labor induction was seen in 28.1% of women. Maternal and neonatal outcomes were demonstrated in Table 2.

A significant association was found between CL and successful labor induction. The AUC for CL was: 0.6975 (95% CI: 0.5816-0.8134). Diagnostic performance of CL measurement to predict vaginal birth was shown in Figure 1. We used three cut-off points for CL as ≤20 mm, ≤25 mm, and ≥30 mm. CL was ≤20 mm in 24 (30.7%) cases, and the majority of these cases (87.5%)

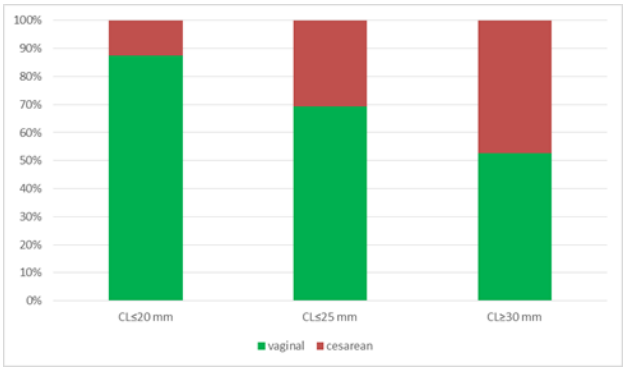

Fig. 2. Comparison of vaginal birth and cesarean section ratios based on cervical length

delivered vaginally. We performed a cesarean section only in 3 (12.5%) cases. We had 39 (50%) patients whose CL was ≤25 mm, and 27(69.2%) of these cases delivered vaginally, and the remaining 12 (30.8%) women need a cesarean section. CL was measured ≥30 mm in 19(24.3%) patients, and almost half of cases (47.3%) needed cesarean section, and 52.7% of cases achieved vaginal birth. A comparison of vaginal and cesarean birth ratios, according to CL, was shown in Figure 2.

The sensitivity and specificity of CL≤ 20 mm were 94% and 45%, respectively, while the positive and negative predictive values associated with it were 57% and 90%. If we determine cut off as ≤ 25 mm, sensitivity was 64%, and specificity was %45. The positive and negative predictive values were 56% and %69, respectively. When CL ≥ 30 mm sensitivity was as low as 23%, and specificity was 84%. The positive predictive value was %53, and the negative predictive value was 58%. Mean CL was 23.2 mm in the vaginal birth group while it was 28.7 mm in the cesarean section group, and it was significantly different between groups (p= 0,02). The diagnostic performance of different CL cut off points was summarized in Table 3.

Mean APGAR cores at minute-1 and minute-5 were 7.3±0.8 and 8.7±0.6, respectively. Mean umbilical cord pH was 7.24±0.11, and %9 of babies needed to NICU. The majority of these cases required NICU for neonatal transient tachypnea. The mean NICU admission interval was 1.1±0.4 days. We compared umbilical cord pH according to the route of delivery, and there was no detectable significant difference (p= 0.185).

Discussion

Induction of labor is a widely accepted procedure in obstetric practice, within the %20 incidence of all deliveries (7). Although it has a common use,

Table 1. Demographic and Clinical Characteristics of 78 Patients

	Mean±SD (range) or (%)
Age	25.7±5.5 (19-39)
Gestational age	40.7±1.2 (37-41.5)
BMI	23.8±3,7 (19-33.5)
Cervical length (mm)	25.2±6.4 (14-39)
Smoking	Yes: 7 (9)
	No:71 (91)
Dinoprostone indication	Postterm pregnancy:45 (57.7)
	Unsafe fetal wellbeing:33 (42.3)
Oligohydramnios	Yes:27 (34.6)
	No:51 (65.4)

(SD: Standart Deviation)

Table 2. Maternal and Neonatal Outcomes of Patients

	Mean±SD (range) or (%)
Oxytocin induction	Yes:48 (61.5)
	No: 30 (38.5)
Labor interval (min)	1395±564 (360-3430)
Delivery route	Vaginal:46 (59)
	Cesarean: 32 (41)
Cesarean indication	Fetal distress:13 (40,6)
	Arrest of labor:10 (31.2)
	Unsuccessful labor induction:9 (28.1)
APGAR (min 1)	7.3±0.8 (5-9)
APGAR (min 2)	8.7±0.6 (6-10)
Cord Ph	7.24±0,.1 (6.98-7.46)
NICU admission	Yes:7 (9)
	No:71 (91)

NICU: neonatal intensive care unit, SD: Standart Deviation

Table 3. Sensitivity, Specificity, PPV, and NPV of Various Cervical Length Cut off Values to Predict Vaginal Birth

	Sensitivity	Specificity	PPV	NPV
CL ≤20 mm	0.94	0.45	0.57	0.90
CL ≤25mm	0.64	0.61	0.56	0.69
CL ≥30 mm	0.23	0.84	0.53	0.58

PPV: positive predictive value, NPV: negative predictive value

there is no distinct method to determine the most appropriate candidates to predict successful vaginal delivery. The traditional way of predicting whether induced labor will result in a successful vaginal delivery is the Bishop's score. Bishop's score is simple, and there is no need for equipment, but the assessment is subjective, and its accuracy is weak (8). In recent years many studies evaluated the performance of ultrasonographic cervical assessment to predict labor induction.

There are a few publications in the literature which investigate association of CL measurement and labor induction in only nulliparous women. Kehila *et al.* evaluated 77 nulliparous women beyond 41 weeks of gestation and compared Bishop's score versus transvaginal ultrasonographic CL. They found that CL assessed by transvaginal sonography as the only independent predictor of successful cervical ripening and vaginal delivery. The best cut-off point was 34.6 mm for predicting successful

cervical ripening and 32.5 mm for predicting vaginal delivery. They demonstrated that 90% of cases were delivered vaginally, with CL was <32.5 mm, and only 50% when the cervical length was >32.5 mm (9). Daskalakis et al. published the results of 137 nulliparous women whose CL measurements performed before the labor of induction. They compared transvaginal CL versus Bishop's score and found that the Bishop score was not predictive of the mode of delivery. Moreover, women with a cervical length <27 mm were more likely to deliver vaginally. The sensitivity of a successful labor induction was 76%, and the specificity was 75.5% at this cut-off value (10). CL measurement also contributes to select patients who require prostaglandin administration before the labor of induction. Park et al. evaluated 154 nulliparous women beyond 37 weeks of gestation who required the labor of induction. They randomly assigned patients to receive prostaglandin for labor induction based on CL measurement or Bishop's score. They showed that %36 of the transvaginal CL group required prostaglandin; however, 75% of Bishop's score groups needed prostaglandins, which was significantly different (11). Keepanasseril et al. compared Bishop's score versus transvaginal CL measurement to predict successful labor induction in 138 term nulliparous women. They demonstrated that Bishop's score had no significant effect to predict. Also, they showed that the most appropriate cut off was 30 mm. In this value, sensitivity was 84,9%, and specificity was 90,6% (12).

In parous women, measurement of CL seems to have a poor predictive value compared to nulliparous women. There is conflicting data in the literature in this group. Cubal et al. evaluated the usefulness of CL measurement and Bishop's score in nulliparous and multiparous women. They suggested that Bishop score and cervical length are good predictors of successful labor induction, particularly in nulliparous women. However, CL measurement had no significant effect in the multiparous group (13). Roman et al. evaluated 106 nulliparous and multiparous women whose Bishop's score <5. They found that compared with the Bishop score, CL by ultrasound is not a better predictor for the outcome of labor induction in an unfavorable cervix (14).

In contrast, Rane et al. evaluated 604 nulliparous and multiparous women before the induction of labor. They showed that in the prediction of vaginal delivery within 24 hours, CL measurement sensitivity was 89% compared to Bishop's score as 65%. They concluded that sonographic parameters were superior to the Bishop's score to predict labor induction (15). Uyar et al. studied the effect of CL in 189 nulliparous or multiparous women. They revealed that transvaginal cervical length were better predictors than the Bishop score in determining the success of labor induction (16).

Transvaginal ultrasonographic CL measurement is not only an accurate and straightforward method. It is a well-tolerated tool to predict the success of labor of induction. Tan et al. analyzed 249 women before the labor of induction and revealed that CL measurement is superior to predicting the labor of induction compared to Bishop's score. Moreover, they performed a10-point visual analog scale (VAS) to patents and showed that CL measurement was significantly less painful than digital examination for Bishop score assessment (17).

Verhoeven et al. reviewed 31 publications, including 5029 nulliparous or multiparous pregnancies. They showed that Sensitivity of CL in the prediction of cesarean delivery ranged from 14% to 92%, and specificity ranged from 35% to 100%. The sensitivity and specificity were 82% and 34%, respectively, at a 20 mm cut-off point. Similarly, The sensitivity and specificity were 64% and 74% respectively at 30 mm cut-off. They concluded that measuring CL before induction of labor, which is easily performed, has limited value in predicting labor outcome, and its accuracy is too limited to justify routine use in clinical practice (18). Kehila et al. summarized the importance of CL measurement in the prediction of labor induction outcome. They concluded that it is difficult to compare different published studies because of majör differences in series characteristics. Nevertheless, it appears clearly that ultrasonographic CL measurement is a useful and probably better predictor than Bishop's score, particularly in nulliparous women (19).

Our study indicates that CL measurement is a highly effective method to predict the result of the induction of labor. Most of the patients whose CL ≤20 mm can achieve a vaginal birth after induction of labor. We have numerous differences from the other studies in the literature associated with this topic. Firstly, we included the only term, nulliparous pregnancies, who had a strict cervix. Furthermore, we did not include SGA and LGA babies who can alter the probability of successful vaginal delivery. Secondly, we determined different CL cut off points instead of calculating the best cut-off mark. We selected these cut off points, which are widely accepted to define the

short cervix. Also, CL measurements were performed by only one physician who had received The Fetal Medicine Foundation Certificate of Competence in Cervical Assessment. We administered a dinoprostone ovule for induction of labor and used low-dose oxytocin protocol for augmentation. Thus, we composed a highly uniform study group. The main limitation of our study was limited number of patients since we used strict criteria in patient recruitment.

Based on the results of our study, we indicate transvaginal CL measurement is a very reliable and simple method to predict successful induction of labor in nulliparous and with an unfavorable cervix.

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