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Evaluation of cervical consistency and length by ultrasonography in predicting successful labor induction in first pregnancies

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Abstract

Objective: The aim of our study is to investigate the effectiveness of the cervical consistency index measured by ultrasonography in predicting the success of labor induction and to apply a more objective and painless method instead of the Bishop score.

Methods: A total of 230 primiparous pregnant women were included in our study. Initial Bishop scores, cervical lengths, cervical consistency index measurements, and delivery type of the patients were recorded. Those who responded to induction and delivered vaginally and those who did not respond and gave birth by cesarean section were compared. p value <0.05 was considered statistically significant.

Results: There was no significant cut-off value for CCI parameter (p=0.052) and CL parameter (p=0.890) in predicting successful labor induction in first pregnancies. A significant cut-off value was found for the Bishop parameter (p=0.007). A statistically significant negative and weak correlation was found between Bishop score and CL (r=- 0.328; p<0.001). There was no statistically significant relationship between other parameters (p>0.05).

Conclusion: Measurement of cervical length and cervical consistency index with transvaginal ultrasound in first pregnancies did not find statistically significant results in predicting the success of labor induction.

Keywords: Cervical consistency index, cervical length, normal delivery, labor induction

Introduction

Labor induction refers to techniques that stimulate uterine contractions to provoke about labor before the spontaneous onset of labor.[1] Induction of labor is one of the most commonly performed obstetric procedures.[2] Bishop score is the most common method used before labor induction.[3] However, many studies have concluded that the Bishop score is poor in predicting the success of labor induction.[4] With the development of ultrasound technology, studies on other parameters such as cervical angle, cervical length, head position, head-to-perineal distance or angle of progression have increased.[5-8] Additionally, attention has been paid to evaluating the biomechanical structure of the cervix to predict the success of labor induction.[9] Evaluation of cervical elasticity using ultrasonographic elastography[10, 11]or cervical consistency index (CCI) defined by Parra-Saavedra et al [12] are some of these methods. Anteroposterior cervical diameter was measured before (AP) and after (AP′) application of pressure on the cervix using the transvaginal probe. CCI is calculated as the ratio of AP′ to AP.

Therefore, we planned this prospective study to investigate the relationship between CCI and the success of labor induction.

Methods

This prospective study was approved by the Adana City Training and Research Hospital Ethics Committee, and written informed consent was obtained from all partici-

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pants. The present study was conducted according to the recommendations of the Declaration of Helsinki.

A total of 230 women, aged between 18-45 years, with singleton pregnancy, between 37-42 weeks of gestation, cephalic presentation and cervical bishop score <6 hospitalized in our clinic for labor induction between November 2022 and February 2023 were included in the study. Patients were excluded if they had any of the following: Cervical and/or uterine surgery history, uterine anomaly, fetal macrosomia, intrauterine fetal death, presence of major fetal anomaly, situations where normal delivery is not appropriate (such as placenta previa, active herpes disease), a history of chronic diseases such as hypertension, diabetes mellitus and the onset of active-phase labor. Induction indications were post-term pregnancy, gestational cholestasis, oligohydramnios, and intrauterine growth retardation.

Maternal age, gestational age and body mass index (BMI) were recorded. All measurements were performed with Hitachi Aloka Prosound alpha (Tokyo, Japan) ultrasonography by same experienced obstetrician. Cervical length (CL) was measured by transvaginal ultrasound. Sagittal view of the cervix without compression was obtained by enlarging it to cover at least 2/3 of the screen. CL was measured by combining the internal and external cervical os linearly. The cervical consistency index (CCI) was performed as described by Parra-Saavedra et al[12] Anteroposterior cervical diameter was measured before application of pressure on the cervix and is named AP and after application of pressure on the cervix using the transvaginal probe is named AP′. The index was calculated using the formula: CCI = (AP′/AP) × 100.

Vaginal ovule containing 10 mg Dinoprostone, a prostaglandin E2 analogue, was used for labor induction. Bishop scores, CL and CCI measurements of the patients were recorded before induction. The delivery types of the patients, the birth weight and APGAR scores of the babies, and the neonatal intensive care needs were recorded.

Data were analyzed with IBM SPSS V23. Whether the data were normally distributed or not was analyzed with the Kolmogorov-Smirnov Test. Nonparametric comparisons were made using the Mann–Whitney U test. Values were expressed as median (minimum-maximum) or n (%). ROC Analysis was used to determine the cut-off value for parameters to predict successful labor induction in first pregnancies. Spearmans rho Correlation Coefficient was used in the analysis of non-normally distributed parameters. p<0.05 was considered statistically significant.

Results

A total of 230 patients were enrolled the study. The median (min.-max.) age of patients was 23 (18 - 39) years. The median (min.-max.) body mass index (BMI) of patients was 26 (19 - 43) kg/m2. The median gestational age of patients was 39 (37 - 42) weeks. CL, AP, AP′, CCI and bishop scores were determined for all patients. The medians (min.-max.) of CL, AP, AP′, CCI and bishop scores of patients were 28 (10 - 42) mm, 32 (18 - 55) mm, 19 (10 - 35) mm, 58.58 (32.65 - 98.33) and 3 (1 - 6) respectively (Table 1).

Table 1. The Sociodemographic and obstetric characteristics of the study participants

	n = 230 median (min.-max.)
Maternal age (years)	23 (18 - 39)
Body mass index (kg/m^2)	26 (19 - 43)
Gestational age (weeks)	39 (37 - 42)
AP (mm)	32 (18 - 55)
AP* (mm)	19 (10 - 35)
CL(mm)	28 (10 - 42)
CCI (%)	58.58 (32.65 - 98.33)
Bishop score	3 (1 - 6)
Birth weight (g)	3100 (2100 - 4000)

Abbreviations: CL: Cervical length, AP: Anteroposterior diameter, CCI: Cervical consistency index.

The delivery type of 48 (20.9%) patients was vaginal delivery, while 182 (79.1%) patients were delivered by cesarean section. The median (min.-max.) CCI of the vaginal delivery group was 57.14 (32.65 - 98.33) and the cesarean section group was 63.25 (35.29 - 87.5). There was no statistically significant difference between the groups in terms of delivery types (p = 0.051) (Table 2).

Table 2. Comparison of CCI measurements between cesarean and vaginal delivery patients

	CCI (%) (Median (min.-max))	P
Delivery type		
Vaginal delivery (n=48) (20.9%)	57.14 (32.65 - 98.33)	0.051
Cesarean delivery (n=182) (79.1%)	63.25 (35.29 - 87.5)	

Abbreviations: CCI: Cervical consistency index.

No significant cut-off value was found for the CL parameter in predicting successful labor induction in primigravids (p=0.890). No significant cut-off value was

found for the CCI parameter in predicting successful labor induction in primigravids (p=0.052). A significant cut-off value was found for the Bishop parameter in predicting successful labor induction in primigravids (p=0.007). Those with a Bishop score 94 is considered successful. Sensitivity value was obtained as 35.71%, specificity value as 83.33%, PPV value as 89.04% and NPV value as 25.48% (Table 3) (Figure 1).

Table 3. Determination of cut-off for CL, CCI and Bishop score

	Cut-off	AUC (%95 CI)	p	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
CL	—-	0.494 (0.396 – 0.591)	0.890	—	—-	—-	—-
CCI	—-	0.409 (0.319 - 0.499)	0.052	—-	—-	—-	—-
Bishop score	≥ 4	0.626 (0.542 – 0.709)	0.007	%35.71	%83.33	%89.04	%25.48

Abbreviations: CL: Cervical length, CCI: Cervical consistency index.

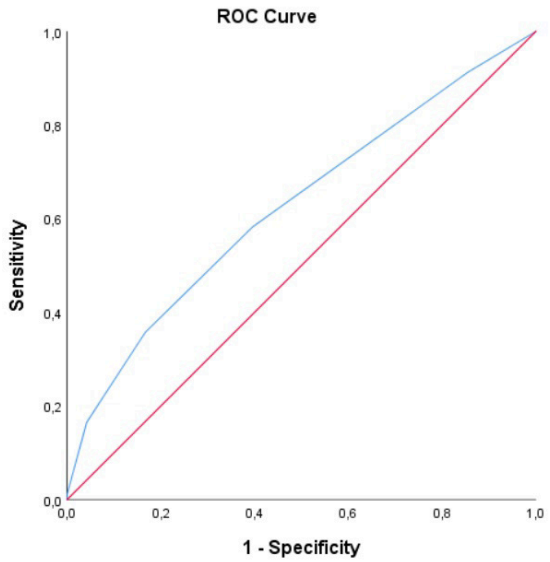

Fig 1. ROC curve for Bishop score

A statistically significant negative and weak correlation was found between Bishop score and CL (r=-0.328; p<0.001). There was no statistically significant relationship between Bishop score and CCI (p>0.050).

Discussion

Labor induction ensures that the delivery takes place at the appropriate time to protect the maternal and fetal health. The mechanisms behind the changes that allow cervical effacement and dilation have not yet been fully elucidated. However, this mechanism has been reported to begin early in pregnancy.[13, 14] It appears to lead to a progressive reduction in cervical stiffness even before cervical shortening occurs. While the Bishop score has been used for years to evaluate the success of labor induction, new techniques are being added with developing technology. The first of these new techniques is CL measured by ultrasonography (USG).[15] Later, uterocervical angles are also evaluated.[16] Recently, elastography has been used to understand the softness, consistency, hardness and elasticity of a tissue.[10] Our study, the cervical consistency index, was designed to evaluate the softness and consistency of the cervical tissue in a different way. Elastography and cervical consistency index are used to evaluate the properties of cervical tissue with different approaches. We conducted our study to evaluate the relationship between CCI and the success of labor induction. In our study, cervical consistency index (CCI) and cervical length (CL) were evaluated by ultrasonography in predicting successful labor induction in primigravids. As a result of our research, it was found that CCI and CL were not successful in predicting labor induction. However, a significant correlation was found in predicting labor induction with Bishop score ≥4. In many studies, it has been stated that Bishop score can be a successful method in predicting labor induction.[3, 17]

A definitive method for assessing cervical consistency cannot be defined. To solve this problem, Parra-Saavedra et al. designed an index that evaluates cervical anteroposterior diameter at rest and at maximum compression with a transvaginal probe. The ratio of the anteroposterior diameter at maximum compression to that at rest was called CCI. Therefore, the index increases in proportion to the resistance of the cervix. Higher CCI values represent harder cervixes. Parra-Saavedra et al. showed that CCI predicts spontaneous preterm delivery and has a better predictive value than cervical length measurements. In the same study, no relationship was found between CCI values and cesarean delivery.[12] It is similar to the result of our study. Another study, which included 464 term pregnant women who were planned to induce labor, aimed to evaluate the relationship between the measured CCI and the risk of cesarean section. In the study, no statistically significant relationship was found between CCI and successful labor induction. They also found that neither the Bishop score nor the CCI showed an association with the outcome of labor induction in logistic regression analysis.[18] In another study, Banos et al. evaluted CCI to predi-

ct spontaneous preterm birth in a low-risk population. In this study they measured the CCI twice in 19th and 24th weeks of gestations and results showed a significant difference in CCI values to predict preterm birth. We think that this result may be due to difference in gestational age that CCI measurements were performed.[19]

Many studies have been conducted to determine successful labor induction by cervical length measurement. In a prospective study involving 165 term pregnant women, no significant difference was found in terms of cervix length between those who were successful in induction of labor and those who were unsuccessful.[20] The success of cervical length measurement in predicting successful induction of labor was found to be moderate in the meta-analysis of 31 studies including 5029 pregnant women by Verhoeven et al.[21]

The main strength of this study is its prospective design, which allowed evaluation of the relationship between CCI and labor induction. The limitations of our study are that our study was conducted in a single center, CCI was measured only before labor induction, that is, additional measurements were not made to see cervical changes during labor. CCI also has some limitations due to its measurement technique. The assessment of the true maximum compressed anterior-posterior diameter may be hampered by patient discomfort. Moreover, the absolute value of tissue stiffness is still unknown and further studies are needed to evaluate complementary properties.

Conclusion

No significant relationship was found for CCI in predicting labor induction in primigravids. More research is needed to better understand the distribution and determinants of CCI.

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