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RESEARCH

Effect of cervical length on the induction of labor in postterm pregnancy

Servikal uzunluğun postterm gebelikte doğum indüksiyonuna etkisi

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Abstract

Purpose: This study aims to investigate the effect of cervical length measured before induction of labor on the duration of labor and oxytocin dose administered for induction during labor in post-term pregnant women.
Materials and Methods: Eighty-seven post-term pregnant women were included in this prospective study. Cervical length was measured before the induction of labor with oxytocin. The relationship between cervical length and the time until delivery and total oxytocin dose parameters were examined. The effect of confounder factors was determined by logistic regression analysis.
Results: Sixty-five (74.71%) of the patients gave birth by normal vaginal delivery and 22 (25.29%) by cesarean section. It was found that parity, bishop score, cervical length and fetal weight variables predicted oxytocin dose by 67% (R-square = 0.675). Patients with a cervical length of >32mm measured before induction were more likely to have a cesarean section than those with a cervix shorter than 32 mm (OR:3.7). Parity had the greatest effect among these variables (β = -.40, p <.001).
Conclusion: Cervical length is a useful marker in predicting the success of labor induction with oxytocin in post-term pregnant women. The total oxytocin dose used in labor induction is related to cervical length.

Keywords:. Cervical length, labor induction. postterm pregnancy, transvaginal ultrasound

Öz

Amaç: Çalışmanın amacı postterm gebelerde doğum indüksiyonu öncesi ölçülen servikal uzunluğun, doğum zamanına ve travay boyunca indüksiyon için verilen oksitosin dozuna olan etkisini araştırmaktır.
Gereç ve Yöntem: Prospektif olarak yapılan bu çalışmaya postterm 87 gebe dahil edilmiştir. Gebelere oksitosin ile doğum indüksiyonu öncesinde servikal uzunluk ölçümü yapılmıştır. Servikal uzunluğun doğuma kadar geçen süre, toplam oksitosin dozu parametreleri ile ilişkisi incelenmiştir. Konfonder faktörlerin etkisi logistik regression analizi ile belirlenmiştir.
Bulgular: Hastaların 65'i (%74.71) normal vajinal yolla, 22'si (%25.29) sezaryen ile doğum yapmıştır. Parite, Bishop skoru, servikal uzunluk ve fetal ağırlık değişkenleri oksitosin dozunu %67 oranında predikte ettiği saptandı (R-square = 0.675). İndüksiyon öncesi ölçülen servikal uzunluğu >32 mm olan hastaların, serviksi 32 mm'den kısa olanlara göre sezaryen olma olasılığı daha yüksek olarak saptandı (OR:3.7). Bu değişkenlerden en büyük etkiyi parite göstermekteydi (β = -.40, p <.001).
Sonuç: Servikal uzunluk; doğum eylemi indüksiyonu, toplam oksitosin dozu ve doğum süresi için iyi bir ultrasonografik belirleyicidir. Klinik uygulamalarda yaygın kullanılmamasına rağmen zaman geçtikçe indüksiyon başarısı açısından kullanımı yaygınlaşacaktır.

Anahtar kelimeler: Doğum indüksiyonu, postterm gebelik, servikal uzunluk, transvajinal ultrason

INTRODUCTION

Post-term pregnancies are defined as pregnancies continuing beyond 42 weeks of gestation. Maternal and obstetric complications increase in post-term pregnancies[1,2]. The main ones are: fetal loss, "increase in cesarean delivery rates", postpartum hemorrhage, perinatal morbidity and mortality[3,4]. Current guidelines recommend induction of labor between 41 and 42 weeks of gestational age[5,6]. For this reason, induction of labor is widely used in obstetric practice and the frequency of use has increased significantly compared to the past decades[7].

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Common indications for induction of labor are premature rupture of membranes, diabetes mellitus accompanying pregnancy, hypertensive disorders of pregnancy, intrauterine growth restriction or gestation period exceeding 41 weeks[8]. Induction of labor is associated with increased operative delivery rates, abnormal fetal heart rate traces, tachysystole, uterine rupture, iatrogenic preterm delivery, prolonged hospitalization and additional health costs[9]. Therefore, it is of great importance for the clinician to be able to differentiate patients who will respond to the induction of labor. In this sense, the most commonly used method today is the scoring system introduced by Bishop for clinical use in 1964 [10].

The sonographic measurement of cervical length is currently used as part of the obstetric evaluation. Most importantly, it is evaluated between the 16th and 24th weeks of gestation to predict the possibility of preterm delivery[11,12]. Transvaginal ultrasonographic measurement of the cervix can provide a more accurate and objective evaluation than digital examination of the cervix in predicting the success of delivery. Especially because the supra-vaginal part of a closed cervix usually makes up approximately 50% of the cervical length, evaluation of this area with digital examination will be very difficult[13]. The advantages of sonographic measurement of cervical length can be listed as providing objective data to evaluate the cervix, minimizing the patient's discomfort compared to digital examination during its application, and being an easily reproducible method.

In this study, the effectiveness of cervical length measured before induction in predicting induction success in postterm pregnant women was investigated.

MATERIALS AND METHODS

This study was designed as a prospective cohort study. Singleton pregnant women who underwent induction of labor due to post-term pregnancy between May 2020 and October 2020 were included in the study. The study was approved by the Kütahya Health Sciences University ethics research board (Decision No: 2020 / 08-09). The study was performed in line with the principles of the Declaration of Helsinki. It was approved by the local Institutional Review Board.

Inclusion criteria in the study are single pregnancy, pregnancy confirmed by first-trimester ultrasonography and a gestational age of 41 weeks or more according to the last menstrual period, those with the cephalic presentation, pregnant women with an intact amniotic membrane, live fetus, no chronic maternal illness or contraindication to induction of labor. Exclusion criteria were determined as a fetus with malformation, abnormal fetal presentation, previous uterine surgery, short maternal stature, placental location or invasion anomaly, antepartum bleeding with an unknown cause.

All ultrasound examinations were performed with a Voluson 730 (multifrequency transvaginal ultrasound of 3-9MHz, General Electric, Milwaukee, WI, USA) ultrasound device. All ultrasound examinations were performed by a single obstetrician (C.S.). After the selected pregnant women were admitted to the hospital, ultrasound scanning was first performed using the transabdominal route. During the ultrasound, fetal biometric parameters such as estimated fetal weight (EFW), amniotic fluid index (AFI) and placental localization were determined. After the transabdominal ultrasound, the patient was asked to urinate and evaluated with transvaginal ultrasound on the gynecological exam chair. After the ultrasound probe was placed in the posterior fornix, the internal os, cervical canal and external os were observed. (Figure-2) The distance between the internal and external os was measured three times and the shortest length was recorded. Bishop score was evaluated and recorded by a different Gynecology and Obstetrics specialist from the person who performed the ultrasound in order to avoid having a biased perspective. After the examinations, the patient's blood and urine tests were performed and she was admitted to the delivery room. Then, oxytocin infusion was applied to the patient. The elapsed time from the beginning of induction of labor until vaginal delivery or cesarean, total oxytocin dose received, fetal birth weight and APGAR score were recorded.

Failed labor induction is defined as the inability to achieve regular uterine contractions (e.g., every 3 minutes) and cervical change after at least 6-8 hours of maintenance dose of oxytocin administration and artificial rupture of membranes. The definition of 'non-progressive labor' is as follows: the cervical opening is less than 1/2 cm for four hours during the active phase of labor (cervical dilation >5 cm).

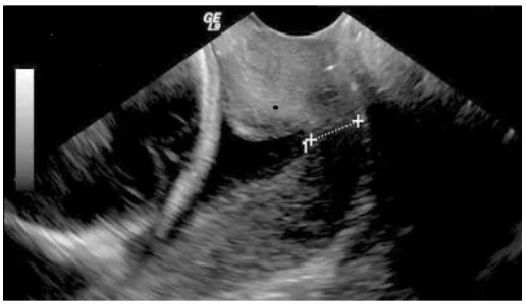

Figure-2. Cervical length assessment.

Oxytocin infusion protocol

Following a basic examination after the hospitalization of post-term pregnant women, oxytocin infusion was started in the regular dose regimen according to the American College of Obstetricians and Gynecologists (ACOG) guidelines[14]. Labor induction protocol was applied as follows; 5 IU synthetic oxytocin (Synpitan forte, Deva Company, Istanbul, Turkey) was dissolved in 500 mL lactated Ringer's, and it was administered as an intravenous infusion starting at 2 mIU / min and increasing 2 mIU / min. Dose of infusion was increased every 15 minutes until effective uterine contractions were achieved. Oxytocin infusion dose was not increased above 40 mIU / min.

Statistical analysis

The G * Power 3.1 statistical analysis program (Erdfelder, Foul & Buchner, Düsseldorf, Germany) was used to calculate the power of the study. The total number of variables was determined as 6. The α error probability, effect size f2 value and power of the study were 0.05, 0.15 and 0.95, respectively. The total required sample size was calculated as 74.

All data collected for statistical analysis were analyzed using the Statistical Package 346ort he Social Sciences, version 23, SPSS Inc., Chicago, IL (SPSS). Continuous and categorical variables were given as median, mean ± standard deviation and number (%). The normal distribution of the data was evaluated with the Kolmogorov-Smirnov test. The Student T, the Mann Whitney U, the Chi-Square, the Fisher Exact, the Linear regression analysis and the logistic regression analysis tests were used. A p value of less than 0.05 was considered statistically significant in all tests.

RESULTS

A total of 87 post-term patients participated in the study. The mean age of the patients was 26.5 ± 4.9. Other demographic characteristics are shown in Table-1.

Table 1. Demographic characteristics

Variable	
Age (years)*	26.5 ± 4.9
Parity**	0 (0, 3)
Number of abortions**	0 (0, 2)
BMI (kg/m^2)*	27.5 ± 2.0
Gestational age at the start of induction (weeks)**	41 (40, 41)
Cervical length at the start of induction (mm)*	32.2 ± 5.1
	± 1.6
Total oxytocin dose (mU)	16400 (1780, 33800)
Time from the start of induction to delivery (hours)	13.2 ± 3.5
Birth weight (g)	3173 ± 297

BMI, body mass index;; Data are expressed as mean ± standard deviation *, median [minimum-maximum] ** or number (%) ***.

Fifty (57.4%) of the pregnant women were nulliparous and 37 (42.6%) were multiparous. There was no difference in cervical length between the multiparous (32.08 ± 5.23) and nulliparous (32.36 ± 5.05) women (p = 0.803). A significant difference was found in terms of total oxytocin dose (multiparous: 9280 (1780-29580), nulliparous: 19610 (8780-33800)) and delivery time (hour) (multiparous: 10.92 ± 2.53, nulliparous: 14.86 ± 3.30) (respectively, p <0.001, p <0.001).

Sixty-five patients (74.71%) gave birth by normal vaginal delivery and 22 (25.29%) by cesarean section. Caesarean indications were: non-progressive labor for 14 patients (16.1%), fetal distress for 2 patients (2.3%), failed induction for 6 patients (6.9%).

When the effect of age, body mass index (BMI), parity, Bishop score, cervical length and fetal weight on "total oxytocin dose" was evaluated, no significant effect of age and BMI was found on oxytocin dose. It was determined that parity, Bishop score, cervical length and fetal weight variables predicted oxytocin dose by 67% (R-square = 0.675). Parity had the greatest effect among these variables (β = -.40, *p* <.001). Bishop score, cervical length and fetal weight variables affect respectively (β = -0.35, p <.001; β = 0.26, p <0.001; β = 0.17, p = .028). Parity and BISHOP score had a negative effect on the total oxytocin dose required for labor induction, while cervical length and fetal weight had a positive effect."The patients were divided into two groups: those with cervical length > 32 mm and those with ≤32 mm and adjusted Ors were calculated to exclude the effect of confounder factors (The cutoff value was determined according to the maximum + LR value by ROC analysis, sensitivity 63.6%, specificity 58.4%, + LR = 1.53). The probability ratio of cesarean section was found to be 3.7 in patients with a cervical length > 32 mm compared to patients with a cervical length less than 32 mm (Table 2).

Table 2. Adjusted odds ratio for cesarean section

	Cervix ≤32 mm	95%CI	Cervix >32 mm	95%CI
Cesarean delivery in labor	Ref	Ref	3.73	1.07-12.91; p = 0.038

Ref, reference; Adjusted for age, parity, BISHOP score, fetal weight and Body Mass Index.

No significant effect of age and BMI was detected in the univariate analysis performed for the period from the beginning of induction to birth. It was determined that the model consisting of Bishop score, parity, cervical length and birth weight variables affects the time from induction to delivery by 67% (R=0.822, R square 0.67). Among these variables, the effect of bishop score and parity was negative (beta -0.35, -0.40, respectively), and the effect of cervical length and birth weight was positive (beta 0.27, 0.18, respectively). (Figure-1).

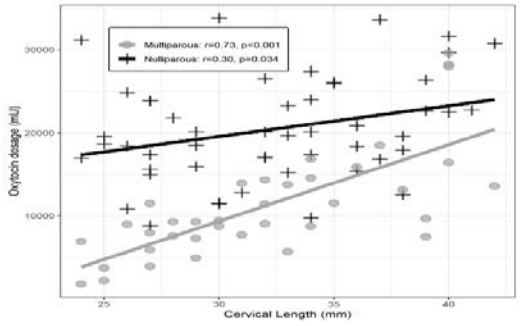

Figure 1. The correlations between the oxytocin dosage during labor and cervical length in multiparous and nulliparous women.

DISCUSSION

In this study, the effects of parameters such as cervical length, Bishop score, BMI, parity, fetal birth weight on oxytocin infusion dose and duration of labor on the induction of labor with oxytocin infusion in post-term pregnancies were evaluated. It has been determined that cervical length measured before induction of labor affects the duration of labor and the dose of oxytocin administered for induction during labor. In addition, it was determined that cervical length and Bishop score predicted the duration of labor and success, but they did not have superiority over each other. The cervical length of more than 32 mm before the induction of labor significantly increased the rate of failed induction and cesarean section. No complications due to labor induction were observed among the pregnant women in our study.

Predictive models created to predict cesarean section risk before induction of labor include maternal and fetal features such as maternal BMI, height and fetal weight[15,16]. Bishop scoring, which is used for the character of the cervix before birth, is frequently used in today's practice. However, it has been found that the sonographic methods used for the evaluation of cervical length are also very useful in predicting the risk of cesarean section and are more appropriate in terms of patient comfort than the vaginal examination performed for Bishop score measurement[17,18].

The effect of cervical length on the duration of labor has been evaluated by many researchers. The results of the present study show that both Bishop score and cervical length are good indicators for predicting the success of successful labor induction in post-term

pregnancies. In addition, in this study, it was concluded that neither Bishop score nor cervical length has any superiority over the other in predicting the induction response. In a Cochrane review, it was shown that Bishop score and cervical length values predicted successful induction, but one method was not superior to the other[19]. Consistent with the present study, Gokturk et al. (in their study with 178 patients) found that cervical length and Bishop score predicted successful labor induction for term pregnant women who were given oxytocin infusion for delivery and did not have superiority over each other[20]. Tan et al. found that cervical length and the Bishop scoring system predicted successful labor induction in term and post-term pregnancies. In addition, it was stated that the pain tolerability of the patient was better than with the vaginal examination performed for cervical length measurement and Bishop score[18].

According to the current study findings, parity was found to be a factor that significantly reduced oxytocin dose and duration of labor. According to the results of their study which compared induction with oxytocin and misoprostol on 144 post-term patients, Akay et al. found that parity was the most important factor affecting induction success[21]. In another study conducted on 212 term pregnant women, Vires et al. emphasized that parity affects the success of labor induction[17].

Oxytocin is frequently used in the induction of labor in the United States[14]. In the present study, oxytocin dose, a parameter not mentioned before in the literature, and its relationship with cervical length, parity, Bishop score and fetal weight were examined and found to be significantly related. In addition, our study showed that cervical length and Bishop score are also effective in predicting these parameters. The cesarean rate was significantly higher in post-term pregnant women with a cervical length of 32 mm and above before labor induction. In a study conducted with 197 patients in Portugal, it was observed that when the cervical length measured before labor induction was 30 mm and above it significantly increased the cesarean rate[22]. In the study of Sevrin et al., labor induction was performed on 95 post-term pregnant women and 18 patients (excluding fetal complications (n = 10)) had a cesarean section due to failed induction. Among these patients, the success of labor induction was found to be less in pregnant women with a cervical length of 30 mm or more[23]. Another study that is consistent with our findings is the study by Pappillon-Smith. The success of labor induction significantly decreases in term pregnant women whose cervical length measured before induction is 34 mm and above[24].

BMI is an important parameter for the success of labor induction that varies among patients. In the literature, it has been shown that BMI increases cesarean rates in labor induction of term pregnant women[25,26]. The most recent research in this area is Carlhall et al.'s study with 15,259 primiparous patients. They found that cesarean rates increased significantly as a result of labor induction in term pregnant women with a BMI of 40 (obese) [15]. In the present study, it was determined that BMI was not effective in predicting the success of labor induction. The reason for this is thought to be the fact that the BMI of the pregnant women in our study was between 21 and 30. Maged et al. induced labor in 144 non-obese (BMI <30) and 144 obese (BMI≥30) term pregnancies and found that cesarean rates were significantly higher in the obese group[27].

Another parameter mentioned in the literature for predicting the success of labor induction is the fetal weight. In this study, fetal weight was found to have a significant effect on the duration of labor and oxytocin dose, but a fetal weight of 4000 g and below was not found significant in predicting successful labor induction. In this study, the relationship of some maternal and fetal factors with the duration of labor, the success of labor induction and the total oxytocin dose used in induction were examined. Parity, cervical length, Bishop score and fetal weight were found to be significantly associated with total oxytocin dose. To the best of our knowledge, there is no previous study on oxytocin dosage in the literature.

Clinical and ultrasound parameters were evaluated by only one clinician (C.S) to reduce the margin of error that may occur due to the different interobserver reproducibility problems. However, our study has some limitations. The relatively small sample size may be insufficient to evaluate the effect of some maternal and ultrasonographic variables on obstetric and perinatal outcomes.

In conclusion; cervical length is a useful marker in predicting the success of labor induction with oxytocin in post-term pregnant women. The total oxytocin dose used in labor induction is related to cervical length. Although cervical length before induction is used in many centers today, its routine

clinical application has not yet been included in the guidelines. Using this parameter before labor induction can help us estimate the labor time more accurately and consequently better inform patients about the induction process.

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