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Can uterocervical angles successfully predict induction of labor in nulliparous women?

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ABSTRACT

Purpose: Induction of labor is a common practice in obstetrics. In recent years, a newer ultrasonographic parameter called the uterocervical angle (UCA) has been identified as a predictive tool for births. Our purpose is to investigate the role of UCA in predicting successful induction of labor.
Methods: The nulliparous term pregnancies (n:150) were grouped into successful/failed inductions of labor based on their progress into the active phase of labor after the administration of prostaglandin E2 (dinoprostone). The pre-induction cervical length (CL) and UCA were compared in the two groups. The study population was further grouped according to their modes of delivery and pre-induction UCAs were compared among the subgroups.
Results: The mean UCAs were not significant among the successful induction and failed induction groups (105.46 ± 20.54 degrees in the successful group and 110.57 ± 13.46 degrees in the failed group). However, UCAs significantly varied among the modes of delivery subgroups. The median UCA was significantly higher in patients who delivered vaginally after a successful induction of labor than in patients who delivered via cesarean section. The median UCA value was lowest in patients who had a successful induction of labor but ended up having a cesarean section (Fig. 2). Further, the duration of the active phase of labor negatively correlated with the UCA but not the CL (rho=-0.23, $p = 0.02$). There was also a negative correlation between the CL and the UCA in patients who delivered vaginally after successful induction of labor (rho= -0.21, $p = 0.03$).
Conclusion: The UCA is a promising ultrasonographic marker in obstetrics. Although the pre-induction UCA did not predict the outcome of labor induction, patients with broader pre-induction UCAs were prone to have a shorter duration of active phase. The pre-induction CL and UCA are inversely corraleted in nulliparous women who delivered vaginally after a successful induction of labor.

Introduction

Induction of labor (IOL) is a common practice in obstetrics and is used in around 20–30% of deliveries [1]. IOL by cervical ripening aids women who have unfavorable (unripe) cervixes when there is a risk of maternal or fetal complications [2]. The cervical ripening is vital for a successful delivery and an unfavorable cervix increases the rate of cesarean sections (CS) as well as the rate of induction failure [3]. Although the prefered method of delivery is vaginal, after induction, complications can further impede the delivery, leading to a failed labor induction. Previous studies have reported several risk factors for failed IOL including low Bishop-scores (<6), nulliparity, gestational age <41 weeks, large for gestational age and maternal obesity [4–6].

In order to evaluate the cervix prior to induction, transvaginal sonography is prefered over the traditional Bishop score as it is reproducible [7,8] and easy to learn [9]. Morever, initial changes and length of the cervix can be evaluated by TVS even when there is no cervical dilation during the manual examination [10,11].

In recent years, a new ultrasonographic parameter called the uterocervical angle (UCA) has been identified as a predictive tool for estimating preterm births [12–14]. The UCA is defined as the angle formed between the anterior uterine wall and the endocervical canal. Basic physics play an important role in determining the UCA and prediction of labor. The force that a

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uterus exerts on the cervix varies depending on the UCA. For example, the force of the uterus on an acute UCA fortifies the closure of the endocervical canal, whereas the same uterine force applied on an obtuse angle can facilitate the opening of the cervix resulting in a quicker emptying of the uterine contents into the vagina. Studies in literature report that the risk of preterm labor increases as the UCA increases [12–14].

To the best of our knowledge the efficiency of the UCA has not been evaluated in term pregnancies undergoing IOL. Therefore, the aim of our study is to investigate the role of UCA in predicting successful IOL.

Material and methods

This prospective cohort study was conducted at Kanuni Sultan Suleyman Training and Research Hospital, a University affiliated tertiary hospital in Turkey, between February 2017 and February 2018. The study was approved by the ethics committee and was also registered with ClinicalTrials.gov (NCT03308656). Informed consent was obtained from all participants before their enrollment into the study.

Inclusion criteria were as follows: gestational age >37 weeks, nulliparity, singleton pregnancy with a vertex presentation, unfavorable cervix (defined as Bishop score less than 6) and absence of labor (defined as the presence of regular uterine contractions). Exclusion criteria were as follows: previous cesarean delivery, previous uterine surgery, previous cervical surgery (LEEP, conization), macrosomia (>4500 g r), major fetal congenital abnormality or fetal death and any contraindications to vaginal birth (e.g. active genital herpes, placenta praevia).

All women that met the inclusion criteria and accepted to participate in our study, underwent cervical assessment by both Bishop score and transvaginal ultrasound examinations. Prior to the IOL, all examinations were performed by an attending ObGyn (B.A.C). The cervical length (CL) was measured tracing a single straight line from the internal to external os. UCA measurements were obtained by placing the first ray from the internal os to the external os through the endocervical canal and by placing the second ray to delineate the lower uterine segment [15]. The ultrasonographic measurements were performed using a 8.5-MHz transvaginal transducer (ATL 5000 HDI, Philips, Eindhoven, The Netherlands). UCA and CL were measured before the IOL. The demographic [age, body mass index (BMI)] and obstetric (gestational age) data of the participants, indications for labor induction, CL, UCA and neonatal birth weights were recorded.

After the ultrasound evaluation of the participants, IOL began by administrating a vaginal insert of prostaglandin E2 (PGE2) (dinoprostone; Propess 10 mg, Ferring pharmaceuticals, Germany) to the vaginal posterior fornix [2]. This process is continued until the desired cervical ripening has been achieved (defined as Bishop score >7) or until 24 h have elapsed. Fetal heart monitoring was performed 1 h after the dinoprostone placement and every 6 h thereafter. The vaginal dinoprostone was removed for the following reasons; uterine tachysystole, non-reassuring fetal heart rate, successful cervical ripening and/or 24 h after the insertion. The participants which responded successfully to the IOL were transferred to the delivery room, and if necessary, augmentation of labor with oxytocin was performed. The decision of administering oxytocin was made according to the uterine contraction patterns. Oxytocin was administered intravenously as a diluted solution using a constant-infusion pump. The initial dose was set at 5.3 mU/min, and was then increased by one-half of the previous infusion rate every 30 min up to a maximum dose of 40 mU/min until the time of delivery.

Our study population was grouped according to successful/failed IOL based on entering the active phase of labor within 24 h of administering prostaglandin E2. The successful group continued with the augmentation of contractions via intravenous oxytocin while the failed group ended up having a CS. The subgroups for mode of delivery consisted of vaginal delivery after a successful induction, CS after a successful induction and CS after a failed induction. The pre-induction CL and UCA were compared in these three subgroups. A correlation analysis was conducted in patients who delivered vaginally to reveal the relationship of UCA during the different phases of labor (duration of induction, duration of active phase and time to delivery). Also, a correlation analysis was performed between the UCA and the CL in patients who delivered vaginally after a successful IOL.

The primary outcome of this study was to evaluate UCA degrees in cases with failed and successful inductions of labor. The secondary outcome was to assess correlations between the UCA and the different phases of labor (duration of induction, duration of active phase and time to delivery).

Statistical analyses were performed using SPSS software (Version 20.0.1; SPSS Inc., Chicago, IL, USA) and GraphPad Prism 7.0d (GraphPad Software, California, USA). The Shapiro-Wilk test was used for the normality and the distribution of variables. The chi-square and Fisher's exact tests were used for comparison between categorical variables. Numerical variables were compared using independent samples *t*-test or a Mann-Whitney U test. The Kruskal-Wallis and/or ANOVA tests were used to compare pre-induction CL and UCA values among different modes of delivery. Linear regression was done by the least squares method, and Spearman correlation coefficient was used to explore the relationship between the continuous variables including the UCA and the duration of active phase. The binary logistic regression model was used for analyzing parameters for a successful induction. The dependent variable was the successful induction of labor. The independent variables were BMI, gestational age, fetal birth weight, pre-induction CL and pre-induction UCA. Also, a multiple regression analysis was carried out to examine the contribution of UCA, CL, BMI, gestational age, fetal birth weight to the duration of active phase. A $p < 0.05$ value was considered statistically significant.

Results

253 women were evaluated for the IOL and 158 of them were included in our study. Eight participants were excluded from the study due to undergoing emergency CS due to fetal distress. Four of these participants underwent CS during the IOL and the other four participants had CS during the active phase of labor. The final analysis was carried out on 150 participants (Fig. 1). The maternal indications for the IOL were; cholestasis of pregnancy, diabetes mellitus, cardiac disease or any other maternal illness, postterm pregnancies (beyond 41 gestational weeks), hypertensive disorders including preeclampsia and gestational hypertension and prelabor rupture of membranes (PROM) cases. The fetal indications for the IOL were fetal growth restriction and/or oligohydramnios (defined as amniotic fluid index less than 5 cm at term). Among 150 participants, 35 women had failed IOL and 115 women successfully completed the IOL via entering the active phase of labor. In the successful group, 97 women delivered vaginally and 18 women ended up having a CS (Fig. 1).

Comparison of the successful IOL group and the failed IOL group is outlined in Table 1. There was no significant difference between the groups in terms of age, gestational age, BMI, indications for induction and fetal birth weight (Table 1). The mean CL was 33.33 ± 5.61 mm in the successful group and was 34.94 ± 3.94 mm in the failed group (Table 1). Further, the mean UCA was 105.46 ± 20.54 degrees in the successful group and was 110.57 ± 13.46 degrees in the failed group (Table1). The study population was also compared according to the mode of delivery