Diagnostic accuracy of posterior cervical angle, and cervical length in Prediction of Successful labor induction

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Diagnostic Accuracy of Posterior Cervical Angle and Cervical Length in Prediction of Successful Labor Induction

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Abstract

Objective: To study the evaluation of the value of the posterior cervical angle (PCA) and cervical length, measured by transvaginal ultrasonography, compared with the Bishop score in the prediction of successful labor induction.

Background: Induction of labor represents a common procedure in everyday obstetric practice. It is used in 30–40% of women in labor. Induction of labor refers to the initiation of uterine contractions before the spontaneous onset of labor, which may be either elective or indicated.

Patients and methods: A prospective observational study was conducted in the Department of Obstetrics and Gynecology, Shebin El-Kom University Hospitals, from March to December 2020.

Results: Our study included 90 candidates for labor induction, after assessment of PCA and cervical length (by transvaginal ultrasonography) and Bishop score.

Conclusion: In this study, we found that success of labor induction can be highly predicted by transvaginal sonography of cervical length and PCA, as it is more objective and accurate than the Bishop score. This is owing to the significant correlation between successful labor induction and PCA.

Keywords: Bishop score, Induction of labor, Posterior cervical angle, Transvaginal sonography

1. Introduction

Induction of labor (IOL) represents a common procedure in everyday obstetric practice. It is used in 30–40% of women in labor [1]. IOL refers to the initiation of uterine contractions before the spontaneous onset of labor, which may be either elective or indicated [2]. Indications for IOL may include but are not limited to the following maternal or fetal situations, pregnancy-induced hypertension, postdate pregnancy, and logistic factors (e.g. risk of rapid labor and distance from hospital) [3].

Bishop score was first described in 1964, and since then, it has been the mainstay for the assessment of cervical readiness before IOL [4]. Transvaginal ultrasonographic measurement theoretically could represent a more accurate assessment of the cervix than digital examination because the supravaginal portion of the cervix usually comprises ~50% of the cervical length [5].

This portion is difficult to assess digitally. In addition, effacement is subjective and can vary considerably among examiners. Moreover, effacement is difficult to determine in the closed cervix. In contrast, transvaginal ultrasonographic cervical measurement is quantitative and easily reproducible [6].

Posterior cervical angle (PCA) of more than 70 together with a Bishop score of more than 5 had the best accuracy for predicting successful IOL outcome [7]. PCA of more than 99.5 has a greater predictive power for a successful labor induction than cervical length and Bishop score [8]. PCA of more than 120 is associated with positive response to labor induction within 24 h [9].

The aim of this work was to evaluate the value of PCA and cervical length, measured by transvaginal...
ultrasonography, compared with the Bishop score in the prediction of successful labor induction.

2. Patients and methods

The current study was a prospective observational study. It was conducted at the Department of Obstetrics and Gynecology, Menoufia University Hospitals, during the period from March to December 2021. Our study included 90 candidates for labor induction, after assessment of PCA and cervical length by transvaginal ultrasonography and Bishop score.

The sample size was recorded for the study according to the following equation: sample size = \( Z_1 \times \alpha / \sigma \), where \( Z_1 \) = 1.96, \( \alpha \) = 0.05.

Indications for IOL were postdate, premature rupture of membrane, pregnancy-induced hypertension, and gestational diabetes. Misoprostol was used in IOL; we used 25 µg of misoprostol vaginally. The dose was repeated at 6-h interval for 24 h.

Indications of cesarean section were failed induction and fetal distress.

The inclusion criteria included age between 18 and 37 years, a BMI between 20 and 35, singleton pregnancy, cephalic presentation, gestational age after 37 weeks, and normal amniotic fluid volume assessed by the amniotic fluid index.

The exclusion criteria included age younger than 18 years and older than 37 years, amniotic fluid disorders, multifetal pregnancy, evidence of placenta previa or any prenatal bleeding, uterine scar or previous cesarean section, active genital herpes infection, fetal macrosomia, and evidence of intrauterine growth retardation.

The study was approved by the local ethics committee. Written consent was taken from every patient before participation in the study.

All cases in this study were subjected to patient counseling, full history taking, and clinical examination.

We used in this study Voluson (Pro V 730; Health Care, New York, USA) with 8.5–10 MHz vaginal probe.

After emptying bladder, the vaginal probe was gently introduced into the vagina until it reached the posterior fornix and angled toward the patient spine to obtain a sagittal view of the cervix. Calipers were placed at the notches made by the internal and external os, for measuring the cervical length.

The PCA was defined as the angle between the line used for the cervical length measurement and the posterior uterine wall, and it was measured by using the software for measuring angle in an ultrasound image taken in the sagittal plane at the level of internal os.

2.1. Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package, version 20.0. (IBM Corp., Armonk, New York, USA). Qualitative data were described using numbers and percent. The Kolmogorov–Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, SD, median, and interquartile range. Significance of the obtained results was judged at the 5% level.

3. Results

In the final data analysis, 90 candidates for IOL were included. IOL was successful in 60 (66.7%) women and unsuccessful in 30 (33.3%) women.

The maternal age, the mean BMI, and the mean gestational age did not differ significantly between the two groups (Table 1).

The mean ultrasound measurement of the PCA in women delivered vaginally was 99.42 ± 4.46, whereas in women delivered by cesarean was 75.46 ± 11.46. The mean ultrasound measurement of cervical length in women delivered vaginally was 2.89 ± 0.49, whereas in women delivered by cesarean was

Table 1. General characteristics of the studied group.

<table>
<thead>
<tr>
<th>General characteristics</th>
<th>Participant (N = 90)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>28.39 ± 6.86</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>73.81 ± 13.0</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>159.23 ± 3.47</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>29.37 ± 3.42</td>
</tr>
<tr>
<td>GA (weeks)</td>
<td>39.70 ± 1.79</td>
</tr>
</tbody>
</table>

Table 2. Relation between different parameters and successful induction of labor (N = 90) (with the mean value of each parameter).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>NVD (N = 60)</th>
<th>CS (N = 30)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bishop score</td>
<td></td>
<td></td>
<td>6.579</td>
<td>&lt;0.001&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Range</td>
<td>5.0–12.0</td>
<td>4.0–9.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>8.28 ± 1.95</td>
<td>6.23 ± 1.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cervical length (cm)</td>
<td></td>
<td></td>
<td>6.676</td>
<td>&lt;0.001&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Range</td>
<td>2.0–3.90</td>
<td>2.60–4.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>2.89 ± 0.49</td>
<td>3.58 ± 0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior cervical angle</td>
<td></td>
<td></td>
<td>9.413</td>
<td>&lt;0.001&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Range</td>
<td>75.0–120.0</td>
<td>60.0–105.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>99.42 ± 11.46</td>
<td>75.47 ± 11.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Statistically significant at P less than or equal to 0.05.
3.58±0.50. The mean Bishop score in women delivered vaginally was 88.28±1.95, whereas in women delivered by cesarean was 62.23±1.01 (Table 2).

The Bishop score was more than 7 in 36 women who delivered vaginally within 24 h and Bishop score was less than or equal to 7 in 12 women who delivered vaginally within 24 h. The Bishop score was more than 7 in four women who delivered vaginally after 24 h, and the Bishop score was less than or equal to 7 in eight women who delivered vaginally after 24 h. The cervical length was less than or equal to 2.9 in 34 women who delivered vaginally within 24 h, and the cervical length was more than 2.9 in 14 women who delivered vaginally within 24 h. The cervical length was less than or equal to 2.9 in four women who delivered vaginally after 24 h, and the cervical length was more than 2.9 in eight women who delivered vaginally after 24 h. The PCA was more than 90 in 43 women who delivered vaginally within 24 h, and the PCA was less than or equal to 90 in five women who delivered vaginally within 24 h. The PCA was more than 90 in one woman who delivered vaginally after 24 h, and it was less than or equal to 90 in 11 women who delivered vaginally after 24 h (Fig. 1 and Tables 3 and 4).

4. Discussion

To date, Bishop score remains the standard method to predict the duration and outcome of induced labor. However, the preinduction ‘favorability’ of the cervix as assessed by the Bishop score is very subjective, and several studies have demonstrated a poor predictive value for the outcome of induction, especially for women with a low Bishop score [10]. Several ultrasonography parameters have been suggested as substitutes to the traditional Bishop score, particularly cervical length and PCA, as determined by transvaginal ultrasonography before labor induction [8].

The aim of the present study was to evaluate the value of PCA and cervical length, both measured by transvaginal ultrasonography, compared with the Bishop score in the prediction of labor induction outcome.

The present study found that successful IOL correlated significantly with the Bishop score (P < 0.001), ultrasonographic cervical length (P < 0.001), and ultrasonographic PCA (P < 0.001).

These results were in agreement with those of Kim et al. [9], who studied 757 women with singleton pregnancies, cephalic presentation, living fetus, with postdate. The Bishop score was assessed by digital examination, as well as transvaginal ultrasonography measurement of cervical length and PCA was done before labor induction. The agents used for induction if Bishop score was less than 5 was 25 μg misoprostol/6 h in the posterior fornix. Women who had a favorable cervix (Bishop score >5) were induced by amniotomy, followed by oxytocin infusion. They found that the PCA was more accurate than the Bishop score in predicting a vaginal delivery; a PCA of 120 or more is associated with a positive response to labor induction within 24 h.

Similarly, a study by Gianopoulos [10] studied 137 women, and the induction protocol was restricted to two agents only (administration of a cervical ripening agent and oxytocin infusion). They found

<table>
<thead>
<tr>
<th>Vaginal delivery</th>
<th>NVD [%]</th>
<th>P</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 24 h (N = 48)</td>
<td>&gt;24 h (N = 12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bishop score &gt;7</td>
<td>36 (75.0)</td>
<td>4 (33.3)</td>
<td>0.014*</td>
<td>1.000 –</td>
</tr>
<tr>
<td>≤7</td>
<td>12 (25.0)</td>
<td>8 (66.7)</td>
<td>6.0</td>
<td>1.000</td>
</tr>
<tr>
<td>Cervical length (cm)</td>
<td>≤2.9</td>
<td>34 (70.8)</td>
<td>4 (33.3)</td>
<td>0.022*</td>
</tr>
<tr>
<td>&gt;2.9</td>
<td>14 (29.2)</td>
<td>8 (66.7)</td>
<td>4.857</td>
<td>1.257</td>
</tr>
<tr>
<td>Posterior cervical angle</td>
<td>&gt;90</td>
<td>43 (89.6)</td>
<td>1 (8.3)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>≤90</td>
<td>5 (10.4)</td>
<td>11 (91.7)</td>
<td>94.600</td>
<td>10.0–894.71</td>
</tr>
</tbody>
</table>

CI, confidence interval; OR, odds ratio.

* Statistically significant at P value less than or equal to 0.05.

Fig. 1. ROC curve for different parameters to diagnose successful labor induction (SVD). ROC, receiver operating characteristic.

Table 3. Relation between vaginal deliveries with different parameters (N = 60).
that the PCA of more than 120 had the best predictive value for successful labor induction. Moreover, our results agree with Boyle et al. [11], whose results implied that the PCA had a greater predictive power for successful labor induction than the Bishop score, the positive likelihood ratio for a PCA of more than 99.5 was close to 10 (the cut-off above which positive likelihood ratio is considered to be indicating good predictive capacity), and the negative likelihood ratio was less than 0.1. This means that a PCA of more than 99.5 is observed 10 times as frequently in women with successful labor induction as in women with unsuccessful labor induction, and a PCA of less than 99.5 is observed one-tenth as frequently in women with successful labor induction as in women with unsuccessful labor induction.

This agreed with Kim et al. [9], who studied IOL in 105 women. The most common reason for induction was postterm pregnancy; they found that a successful labor induction correlated significantly with the Bishop score and cervical length. Maternal age and gestational age were not significant predictive factors.

However, in contrast to our study, Dasari and Thiyagalingam [12] studied 122 postdated women where transvaginal ultrasonography and diagnostic vaginal examination were performed immediately before labor induction. Sonographic assessment of cervical length, cervical dilatation, and presence of funneling were compared with the components of the Bishop score. They found no sonographic characteristics predicted successful vaginal delivery.

Moreover, Abdelhafeez et al. [13] studied 134 women undergoing labor induction at term caused to several obstetric conditions. All participants were subjected to digital examination, and transvaginal ultrasound for measurement of the cervical length, and detection of funneling. Only obstetric history and digital examination predicted accurately vaginal delivery within 24 h and were independently associated with labor duration. Ultrasound measurement of cervical length failed to predict accurately the outcome of induced labor.

Our results were disagreed also with that of El-Bishry et al. [14] in their study of 166 women induced with prostaglandins, who found the Bishop score to be better than sonographic cervical parameters in predicting successful labor induction.

### 4.1. Conclusion

In this study, we found that success of labor induction can be highly predicted by transvaginal sonography of cervical length and PCA as it is more objective and accurate than the Bishop score. This is owing to the significant correlation between successful labor induction and PCA.

### Conflict of interest

There are no conflicts of interest.

### References


