Preinduction Ultrasonographic Measurements as a Predictor of Successful Induction of Labour in Prolonged Pregnancy in Primigravidas

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Abstract

Objective: To determine if ultrasonographic measurements as the cervical length, the fetal occiput position, the estimated fetal weight and whether the head is well flexed or not are good predictors for successful labour induction in prolonged pregnancy in primigravidas.

Design: Prospective cohort study.

Setting: Kasr El-Aini Hospital.

Patients and Methods: This study included 100 primigravidas >41 weeks with singleton vertex presentation, not in labour, with Bishop score ≤5 where previous uterine scar; previous operations on the cervix (e.g. cervical amputation); obstetric or medical complication with pregnancy (e.g. diabetes) were excluded. All patients were subjected to history taking, abdominal and vaginal examinations including Bishop score. The position of the occiput, estimated fetal weight and flexion of the head by abdominal ultrasonography and cervical length measurement by Transvaginal ultrasound were recorded. Labour Induction was done according to standard Kasr El Aini guidelines for induction. The primary outcome was successful attempt for vaginal delivery. Secondary outcomes were induction to delivery interval (IDI) and Apgar score at 1 and 5 minutes.

Results: In our study, there was a highly significant difference between cervical length in successful group (Mean=14.34mm) and failed group (Mean=28.25mm). There was significant difference in estimated fetal weight by ultrasound in the successful group (Mean=3235.33gm) and failed group (Mean=3700gm). The number of cases with occipito-anterior position was higher in successful group in comparison with the failed group and the difference was statistically significant (p-value:0.0001). Flexed head position showed the highest percentage of successful labour induction in comparison with deflexed and extended positions, and the difference was statistically significant (p-value:0.002).

Conclusion: In women undergoing induction of labour, prediction of outcome can be provided by determining sonographically the preinduction cervical length, occipital position and degree of flexion of the head which were superior to Bishop score.

Key Words: Induction of labour – Prolonged pregnancy – Ultrasonographic measurements.

Introduction

PROLONGED pregnancy is a real problem in modern obstetrics. It causes an anxiety among pregnant women [1]. The definition of post-term pregnancy is the pregnancy that has extended to or beyond 42 weeks (294 days) of gestation [2]. Prolonged gestation complicates 5% to 10% of all pregnancies and confers increased risk to both the fetus and mother [3]. Postterm pregnancy is associated with higher rates of stillbirth, macrosomia (birth weight >4000gm), birth injury and meconium aspiration syndrome [3].

Induction of labour at 41 weeks is associated with less intrapartum fetal compromise, meconium-stained liquor (MSL) and macrosomia (>4000gm) [4]. Induction of labour is performed in about 20% of all pregnancies and successful induction is reported to be related to cervical characteristics, or “ripeness” [8].

To date, Bishop score remains the standard method to predict the duration and outcome of induced labour. 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 in women with a low Bishop score [6].

In women undergoing induction of labour, preinduction sonographic assessment of cervical length
and occipital position is superior to the Bishop score in the prediction of outcome of labour [7].

The aim of the study was to determine if some ultrasonographic measurements as the cervical length, the fetal occiput position, the estimated fetal weight and degree of flexion of the head (whether the head is well flexed or not) are good predictors for successful induction of labour in cases of prolonged pregnancy in primigravidas.

**Patients and Methods**

This was a prospective cohort study carried out from March 2012 to October 2012 at the casualty department of Obstetrics and Gynecology, Faculty of Medicine, Cairo University, was approved by the institutional review board. One hundred consecutive primigravidas during the study period, with well-dated postterm pregnancies ≥41 weeks were admitted and recruited after giving a written consent for termination of pregnancy via induction of labour.

The inclusion criteria included a singleton pregnancy with a gestational age correctly dated by either a first trimester measurement of crown-rump length or a second trimester (before 20 weeks) ultrasound examination with no gross fetal anomalies found with a cephalic, vertex presentation (brow and face presentation excluded). All patients were not in labour and with a Bishop score <5 and a reactive fetus. Exclusion criteria included a contraindication to vaginal delivery; previous uterine scar; previous operations on the cervix (e.g. cerclage, cervical amputation or conization); obstetric or medical complication with pregnancy (e.g. diabetes or hypertension).

All patients were subjected to full history taking, abdominal examination (for assessment of fundal level, fetal back position) and vaginal examination (to exclude cephalopelvic disproportion, confirm presentation and position). Digital examination and scoring of the cervix was done using the modified Bishop score.

All ultrasound measurements were performed by using MEDISON SONACE X-4-EXP, ultrasound machine equipped with a 3.5-MHz convex transabdominal probe and 7.5-MHz vaginal probe. Ultrasound examinations were done by a single operator to avoid interobserver variability. Fetal biometry with calculation of the fetal weight using the Hadlock formula was done, with special concern to the position of the occiput and degree of head flexion. Transvaginal ultrasound was done for assessment of cervical length where the following steps were taken: patient was asked to empty the bladder. The probe was slided into the vagina only a few centimeters and then rocked in the anteroposterior direction to visualize the cervix, checking for the anterior and posterior lips and the line of the internal cervical canal in the midline sagittal plane. The probe was then slowly withdrawn back a little with the lightest touch to avoid compression artifacts. Measurement was made from internal to external os and repeated three times taking the shortest best measurement. Any funneling (or membrane protrusion more than 5mm down the canal) was also recorded.

Based on sonographic landmarks—such as the fetal orbits for occipito-posterior position, cerebellum and occiput for occipito-anterior position and midline cerebral echo for occipito-transverse position—the fetal occipital position could be depicted.

Flexion of the fetal head could be depicted directly while tracking the fetal spine in the sagittal plane towards the fetal head in occipito-anterior position. Various degrees of deflexion of the head were noted as a result of movement of the depicted biparietal diameter from an imaginary line parallel to the pelvic inlet, to any angle up to 90 degrees; the latter representing an acutely hyper-extended fetal head.

Induction of labour was done according to standard Kasr El Aini guidelines for induction of labour. We started induction by prostaglandin E1 (misoprostol) using an initial dose of 50 microgram (2 vaginal tablets of vagiprost® 25 microgram each tablet, manufactured by ADWIA CO. S.A.E Egypt). Six hours later, reassessment of the cervix was done unless the clinical condition necessitated earlier assessment. A second dose and a third dose of 25 micrograms of misoprostol was given in cases of unfavorable cervix with failed ripening; each 6 hours apart. If no cervical ripening after the third dose of misoprostol, the patient was delivered by Caesarean section.

In cases that achieved cervical ripening with misoprostol, oxytocin infusion was started using 5 units in 500ml of normal saline or Ringer’s solution, 6 hours following the last dose of misoprostol-starting with a rate of 10-15 drops/minute. Infusion rate was increased (by doubling drops/minute) at intervals of 30 minutes, until there were 3 good contractions in 10 minutes, each lasting 45-60 seconds.

During the period of induction, the fetal heart rate was monitored continuously, by means of
electronic fetal heart rate monitoring (Cardiotocography). Also, maternal monitoring was done including blood pressure measurements every 2 hours and frequent clinical evaluation (according to the condition). When a non reassuring fetal heart rate (FHR) was detected, closer monitoring of fetal heart rate was performed with simultaneous adequate conservative measures in the form of stoppage of oxytocin infusion, change in maternal position to the left lateral and oxygen administration. CS was intended to be done if persistent non-reassuring FHR was present after performing the previous maneuvers.

All patients received antepartum analgesia during the period of induction in the form of pethidine 50mg/4 hourly IM. Deliveries were performed in the operating theater and a pediatrician and anesthetist were attending.

Women’s characteristics of age, height, BMI, gestational age, and initial Bishop Score were recorded. The primary outcome was successful attempt for vaginal delivery. The secondary outcomes were induction to delivery interval (IDI) and neonatal outcome in terms of Apgar score 1 and 5 minutes and neonatal birth weight. Using the definition of Watson et al., [8], an induction attempt was considered successful if the patient reached the active phase of labour as demonstrated by progressive dilatation and effacement of the cervix and followed by vaginal delivery. All women's data were recorded in a special input form.

Statistical analysis:

Data were statistically described in terms of Mean±Standard deviation (±SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student $t$-test for independent samples. For comparing categorical data, Chi square ($\chi^2$) test was performed. Exact test was used instead when the expected frequency is less than 5. p-values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

One hundred primigravidas consented to participate in the study. The mean age of the studied group was 22.21 years. The range of gestational age was 40.7-42.60 weeks with the mean age being 41.4 weeks. The BMI ranged between 22.72-28.37 with a mean BMI of 24.78. The mean Bishop score was 3.15. The cohort of enrolled women was divided into two groups according to the result of induction by prostaglandin E1 (Misoprostol) into Group A (successful induction of vaginal delivery; n=92) and Group B (failed induction; n=8). Table (1) illustrates the maternal clinical data and fetal outcome in both groups; there was evidence of statistically significant difference between both groups in terms of mean gestational age and BMI which were significantly higher in group B that failed to achieve vaginal delivery. On the other hand, there was no evidence of statistically significant difference between both groups as regards age and initial Bishop score. Apgar scores at 1 and 5 minutes were significantly higher in group A while neonatal birth weight was lower in this group. There was a highly significant difference between cervical length in the successful group (Mean= 14.34mm) and failed group (Mean=28.25mm).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Successful induction n=92</th>
<th>Failed induction n=8</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>22.28 (3.256)</td>
<td>21.38 (1.847)</td>
<td>.601</td>
<td>.440</td>
</tr>
<tr>
<td>Gestational age (week)</td>
<td>41.42 (0.38)</td>
<td>41.76 (0.51)</td>
<td>5.677</td>
<td>.019*</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>74.12 (3.08)</td>
<td>76.50 (2.93)</td>
<td>4.425</td>
<td>.038*</td>
</tr>
<tr>
<td>BMI</td>
<td>24.67 (1.12)</td>
<td>25.94 (1.71)</td>
<td>8.458</td>
<td>.004*</td>
</tr>
<tr>
<td>Cervical length by TVS (mm)</td>
<td>14.34 (5.66)</td>
<td>28.25 (9.513)</td>
<td>39.373</td>
<td>.0001</td>
</tr>
<tr>
<td>Apgar score 1 minute</td>
<td>6.10 (0.97)</td>
<td>5.38 (0.92)</td>
<td>4.096</td>
<td>.046*</td>
</tr>
<tr>
<td>Apgar score 5 minutes</td>
<td>8.97 (0.86)</td>
<td>8.00 (0.93)</td>
<td>0.93</td>
<td>.003*</td>
</tr>
<tr>
<td>Neonatal birth weight (g)</td>
<td>3016.85 (513.942)</td>
<td>3580.00 (327.109)</td>
<td>5.840</td>
<td>.018*</td>
</tr>
</tbody>
</table>
The occurrence of occipito-anterior position was significantly higher in Group A in comparison to the failed induction group. Also, flexed head position showed the highest percentage of successful labour induction in comparison with deflexed and extended positions with a statistically significant difference (Table 2).

Table (2): Relation between preinduction sonographic variables (fetal occiput position and degree of flexion) and outcome of induction.

<table>
<thead>
<tr>
<th>Ultrasound variable</th>
<th>Group</th>
<th>Total</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Successful, n=92)</td>
<td>(Failed, n=8)</td>
<td></td>
</tr>
<tr>
<td>Position of the fetal head:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOA</td>
<td>44</td>
<td>1</td>
<td>45</td>
</tr>
<tr>
<td>LOP</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>LOT</td>
<td>15</td>
<td>0</td>
<td>15 &lt;0.05</td>
</tr>
<tr>
<td>ROA</td>
<td>24</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>ROP</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>ROT</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Degree of flexion:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deflexed</td>
<td>13</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Flexed</td>
<td>77</td>
<td>2</td>
<td>79</td>
</tr>
<tr>
<td>Extended</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Fig. (1): Transvaginal cervical length measurement from the internal to external cervical os.

A strong positive correlation was found between the cervical length and the induction to delivery interval \(r=0.477\). Other variables such as ultrasound estimated fetal weight and neonatal birth weight showed a weak correlation. Bishop’s score, on the other hand, showed negative correlation (inverse correlation) with induction to delivery interval \((-0.045\)).

Table (3): Correlation between Bishop score, sonographically measured cervical length, and fetal weight and induction to delivery interval.

<table>
<thead>
<tr>
<th>Induction to delivery</th>
<th>Correlation coefficient (r)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bishop score</td>
<td>-0.045</td>
<td>.337</td>
</tr>
<tr>
<td>Cervical length</td>
<td>0.477 (**)</td>
<td>.0001</td>
</tr>
<tr>
<td>U/S Estimated fetal weight</td>
<td>0.066</td>
<td>.265</td>
</tr>
<tr>
<td>Neonatal birth weight</td>
<td>0.157</td>
<td>.068</td>
</tr>
</tbody>
</table>

\(r = \) Correlation coefficient \(p = \) Probability

\(* *\) Correlation is significant at the 0.01 level (1-tailed).

Discussion

To date, Bishop score remains the standard method to predict the duration and outcome of induced labour. 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 in women with a low Bishop score [6].

Many have evaluated and confirmed the validity of the Bishop score. Among the factors considered in assigning the score, the strongest association with successful labour seems to be with cervical dilation. The Bishop score has been criticized for not attributing more significance to cervical dilation. However, despite this criticism, none of the modifications to the original scoring system have been shown to improve predictability [9].

In the present study, 92 cases delivered vaginally after successful induction of labour. Eight cases (8%) delivered by cesarean section due to failure of progress of labour. There was a poor relationship between a high Bishop score and successful induction where many cases \((r=-0.045)\) with poor Bishop score responded to induction of labour while some cases with high Bishop score did not respond to induction of labour. This is in contrast to what was revealed by Yanik et al., in 2007 who demonstrated that Bishop score significantly predicts the success of induction and the mode of delivery while transvaginal ultrasonography (TVUS) cervical length did not [10].

Measurement of cervical length was successfully achieved in all cases. The technique at term is more difficult, especially when the head is engaged and the alignment of the cervix is distorted.

Cervical length measurement was found to be the most significant parameter for the prediction of successful labour induction and showed a positive correlation to the induction to delivery interval \((r=0.477)\) in contrast to the Bishop score which showed a non-significant negative correlation according to the results of the present study.

This agrees with the study done by Laencina et al., who also found cervical length measurement as a better predictor than the Bishop score for successful induction [11]. Also, Daskalakis et al., in 2006 found that cervical length proved to be an independent predictor of a successful labour induction in nulliparas [12].
Bastani et al., reported that cervical length measured by transvaginal ultrasonography has the potential to replace the traditional Bishop score, provided that such a facility is available when needed [13]. Also Tan et al., demonstrated that transvaginal sonography is significantly less painful than digital examination for Bishop score assessment [14].

In women undergoing induction of labour, the predictive value of cervical length is clearly superior to that of the Bishop score [15]. The sensitivity of sonographic assessment in the prediction of Cesarean section (CS) and likelihood of vaginal delivery within 24 hours of induction was higher than that of the Bishop score by about 20% [16].

Pandis et al., demonstrated that sonographically measured cervical length was better than the pre-induction Bishop score in predicting the likelihood of vaginal delivery within 24h of induction [17]. Torbjorn et al., found that univariable regression analyses of successful induction were significant for ultrasound measured cervical length <25mm [18].

Strobel et al., examined 97 singleton pregnancies at 41 to 42+2 weeks and reported that cervical length provided a significant prediction of spontaneous onset of labour and delivery within the subsequent 1-2 days but not within 4 days in either nulliparous or parous women [19].

Other studies for example Tan et al., however, found ultrasound measurements of cervical length and the Bishop score to be of similar value in predicting a Cesarean delivery [14]. Also, Roman et al., 2004 in their study of 106 postterm cases found that cervical length was not better indicator than the Bishop score in determining the delivery mode [20].

On the other hand, Rozenberg et al., (2005) in their study of 166 women induced with prostaglandins found the Bishop score to be better than cervical length for predicting successful outcome of induced labour [21]. Also Groeneveld et al., found that transvaginal ultrasonographic measurement of cervical length was not a significant independent predictor of vaginal delivery within 96 hours, where they chose a longer interval (96 hours) between start of induction and vaginal delivery and multiparous patients were included in their study. In their study, a maximum of 36-48 hours was given from start of induction to delivery [5].

There are number of maternal characteristics associated with successful induction such as height, weight, BMI and gestational age.

Our study showed that a lower BMI was associated with more successful induction. This agrees with the study done by Park et al., who stated that the mean BMI was significantly lower in women who had successfully induced labour and only BMI provided a significant contribution in predicting successful labour induction [22]. Also Uyar et al., concluded that BMI and transvaginal cervical length were better predictors compared to the Bishop score in determining the success of labour induction [23].

Peregrine et al., studied induction of labour in 267 women at 36 or more weeks of gestation. Logistic regression analysis was used to determine which factors best predicted the risk of cesarean delivery. They found that parity (p<0.001), BMI (p<0.001), height (p=0.05), and ultrasonic transvaginal cervical length (p<0.001) are the most accurate parameters in predicting the risk of cesarean delivery after induction of labour [24].

Successful induction was also affected by certain fetal characteristics such as ultrasound estimated fetal weight, position of the occiput and degree of flexion of the head as displayed in our study. The rate of successful induction was 97.8% in the left occipito-anterior position and 100% in the right occipito-anterior position while only 50% in left occipito-posterior positions. Fetuses with well-flexed heads and smaller estimated fetal weight were associated with higher rate of successful induction and this difference was statistically significant (p-values 0.002 and 0.018 respectively).

A deflexed head is more commonly associated with the development or persistence of occipito-posterior positions which are associated with more failed labour induction [25].

This agrees with Peregrine et al., who demonstrated the ease of use of transabdominal ultrasonography in determining fetal head position before induction of labour and found that 96% of patients with occipito-posterior position have failed induction and delivered by CS [26]. Other studies, however, stated that determination of position of the head before induction of labour did not predict the course of labour, probably because the fetal head may rotate during labour even after premature rupture of membranes [27].

Rane et al., have also demonstrated the additional significant contribution of occipital position in predicting the outcome of induction of labour. Although occipital position is related to cervical length, being shorter in occipito-anterior and occipito-transverse than in occipito-posterior posi-
tions, the occipital position enhances the effect of cervical length in the prediction of outcome [16].

Rane et al., also found that cervical length and parity provide independent prediction of induction-to-delivery interval and the likelihood of vaginal delivery within 24 hours of induction [28]. This is also similar to the conclusions stated by De Gennaro et al., [29].

Also Rane et al., have established a series of models that classified women into high-and low-risk groups for Caesarean section and provided individual patient predictions for outcome of induction of labour [16]. For example: In a 35-year-old nulliparous woman with BMI > 30 and the sonographic findings of cervical length of 30mm, and fetal OP position, the likelihood of Cesarean section is 87%. On the other hand, in a 25-years-old-parous woman with BMI <30 and cervical length of 10mm, and fetal OA position the likelihood of vaginal delivery within 24h is 95% and the likelihood of Cesarean section is 2.5% and this is highly consistent with our study.

In conclusion, preinduction sonographic measurements of cervical length, fetal occiput position and flexion of the head in postterm pregnancy are superior to Bishop score in prediction of the outcome of induction according to our findings. Thus, these can provide physicians with more precise information to plan further management of pregnancy.

It is recommended that cervical length measurement by transvaginal ultrasound should be done before induction of labor as it is highly correlated with success of labor induction.

References
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