CLINICAL AND ULTRA SOUND PARAMETERS TO PREDICT THE RISK OF CESAREAN DELIVERY AFTER INDUCTION OF LABOR

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Abstract
OBJECTIVE: to evaluate whether factors in the maternal history and or ultrasound parameters are useful in predicting the risk of cesarean delivery after induction of labor

DESIGN
A randomized controlled trial based in hospital

SETTING
AL-Zahraa maternal and pediatric teaching hospital in AL Najaf

PARTICIPANT
51 women who had undergone induction for labor for different causes 19 case end with caesarian section 37.2% . 32 case end by vaginal delivery . The age height weight and gravidity , gestational age by weeks . Vaginal examination , weight of the fetus estimated .

Our study show that ,parity , gestational age cervical examination weight of the fetus had effecting the result of the induction as vaginal or caesarian delivery.

Aim of study
To evaluate whether factors in the maternal history and or ultrasound parameters are useful in predicting the risk of cesarean delivery after induction of labor.

INTRODUCTION
Between 15 and 25% of all pregnancies in the UK ended as an induction of labor (IOL) (1). According to the national center for Health Statistics , the annual incidence of labor induction or augmentation in the united states almost doubled from 20% in 1989 to 38% in 2002 (4) This increment because:-
1-There can be no doubt that deceive induction for convenience of the practitioners or the patient becoming more prevalent \(^{(2)}\).

2- The most common cause of IOL is post date and pregnancy over estimated more cases of post date diagnosed and mange by IOL\(^{(2)}\).

The incidence is variable between practices. For example at Parkland Hospital approximately 35 percent of labor are induced or augmented, and at the university of Alabama at Birmingham Hospital from 1996 through 1999, 20% of women were given Oxytocin for induction and 35 percent for augmentation \(^{(2)}\).

**COMMON INDICATION FOR INDUCTION OF LABOR** \(^{(5)}\)

1. **MATERNAL MEDICAL PROBLEMS**
   - a. Hypertension
   - b. Diabetes
   - c. Renal Disease
   - d. Sickle Cell Disease

2. **OBSTETRIC COMPLICATION**
   - a. Preterm pregnancy
   - b. Post term pregnancy

3. **FETAL PROBLEMS**
   - a. Fetal demise
   - b. Fetal macrosomia
   - c. Suspected fetal jeopardy
   - d. Fetal growth retardation
   - e. Congenital abnormalities

4. **PATIENT SAFETY**
   - 1. Cervix dilated 4 cm or more
   - 2. History of rapid labors

5. **PATIENT CONVENIENCE**

Induction is indicated when the benefit to either the mother or the fetus outweigh those of continuing the pregnancy.

**COMMON INDICATION** \(^{(1)}\)

- a. Post Date I.E.12 Days Or More Beyond EED
- b. Fetal Growth Restriction
- c. Evidence Of Placental Insufficiency E.G. Oligohydramnios
- d. Pre-Eclampsia
- e. Other Maternal Hypertensive Disorders
- f. Deteriorating Maternal Illnesses
- g. Prolonged Pre-Labor Rupture Of Membranes
- h. Un-Explained Antepartum Haemorrhage
- i. Diabetes Mellitus
- j. Twin Pregnancy Continuing Beyond 38 Wk
- k. RH-Isoimmunization

**METHODS OF INDUCTION OF LABOR**

A- With a favorable cervix

The more favorable cervix the greater the likelihood of efficient labor induction - Artificial rupture of the membranes amniotomy.
Oxytocin infusion may be started with amniotomy, a typical dosage schedule would be 1 μg/min doubling rate of infusion every 20-30 min. until adequate uterine contraction are achieved or a rate of 32 μg/min reached. (3)

B.-With unfavorable cervix:
The main stay of induction of labor with an unfavorable cervix is the use of exogenous prostaglandins, or methods to stimulate the release of prostaglandins.
Labor induction with PGF2α was introduced in the 1960s. Formulation of prostaglandin E2 (PGE2) were developed which largely replace the use of PGF2α.
The most common route of administration is vaginal. (3)
We conducted a prospective observational study between April 2008 to October, 2008, during which we recruited 51

Material & Methods:
Women undergoing induction of labor at Maternity and Pediatric Hospital in AL-Najaf. All recruited women presented with pregnancies greater than 37 wk of gestation with a cephalic singleton fetus.
Data were obtained from the maternal notes on: maternal age, weight, height, parity and gestational age calculated by using the last menstrual period combined with a first trimester scan.
PREDICTION was categorized into nulliparous and multiparous.
Multiparous women were defined as women who had a previous delivery at more than 23 wks of gestation or any live birth.
Body Mass Index BMI was categorized in to thirty or greater and less than 30 kg/m².
An ultrasound scan was then performed to all women: fetal head position categorized in to occipitoposterior, non occipitoposterior, amniotic fluid volume as amniotic fluid index AFI, estimated fetal weight.
Transvaginal ultrasound was then performed on all women: measurement of the cervical length were obtained from the internal to the external os.
All scans were performed immediately before labor induction by the same operator. After ultrasound examination a digital examination was performed as usual to obtain the modified Bishop score.
The labor induction was then commenced with Oxytocin infusion. If labor did not commence within tow hour after arm.
Once in labor the women were managed according to the hospital protocol, and decision were made by the attending clinicians the vaginal examination every 4 hr and the use of Oxytocin infusion for slow progress.
Cesarean delivery was performed as necessary for the abnormal NST. Failed induction (failure of the cervix to reach 4 cm dilation).
STATISTICAL ANALYSIS:
All analysis were performed using SPSS 15 for window.
A logistic regression model was used to develop the risk model to predict cesarean delivery. Both the continuous variables and the dichotomized values were offered to the logistic regression analysis.
The predictors for the final risk model were selected by using a backwards elimination strategy with a statistical significance of P<0.05 at the level 5%.
RESULTS
Total number of 51 women was included in this prospective study. Of these 21 were nulliparous and 30 multiparous.
A total of 19 cesarean delivery (37.2%) were performed.
A total of 32 were delivered vaginally.

Table (1)
shows the indications for induction of labor of (51) women

<table>
<thead>
<tr>
<th>INDICATION FOR INDUCTION OF LABOR</th>
<th>N(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postdates</td>
<td>19(37.25)</td>
</tr>
<tr>
<td>Preterm/term pre labor rupture of membranes</td>
<td>13(25.49)</td>
</tr>
<tr>
<td>Intrauterine growth restriction</td>
<td>8(15.69)</td>
</tr>
<tr>
<td>Hypertensive disease</td>
<td>4(7.84)</td>
</tr>
<tr>
<td>Gestational Diabetes</td>
<td>4(7.84)</td>
</tr>
<tr>
<td>Previous obstetric history</td>
<td>2(3.92)</td>
</tr>
<tr>
<td>Pre-eclampsia</td>
<td>1(1.96)</td>
</tr>
</tbody>
</table>

Table (2)
Indication for Cesarean Delivery and Respective Cervical Dilation at Delivery.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Women Delivered Vaginally(32)</th>
<th>Women Delivered by CD (19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason for CD</td>
<td>No. of Women(%)</td>
<td>Cervical Length(mm) [Median (Range)]</td>
</tr>
<tr>
<td>Fetal distress</td>
<td>9(47.3)</td>
<td>34(25 – 40)</td>
</tr>
<tr>
<td>Failure to progress</td>
<td>4(21.05)</td>
<td>30(28 – 33)</td>
</tr>
<tr>
<td>Prolonged second stage</td>
<td>3(15.79)</td>
<td>35(29-35)</td>
</tr>
<tr>
<td>Unstable lie</td>
<td>1(5.26)</td>
<td>40</td>
</tr>
<tr>
<td>Maternal distress</td>
<td>1(5.26)</td>
<td>30</td>
</tr>
<tr>
<td>Failed IOL</td>
<td>1(5.26)</td>
<td>28</td>
</tr>
</tbody>
</table>

Table (3)
Characteristics of Women for each Predictor by mode of Delivery
Data are presented as mean ± standard deviation, mean(range), or No(%)
### Table (4) Results of Logistic Regression Models

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Adjusted Odd Ratio (95%CL)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Age (yr)</td>
<td>0.975 (0.745 – 1.275)</td>
<td>0.851</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>1.061 (0.832 – 1.353)</td>
<td>0.634</td>
</tr>
<tr>
<td>B.M.I [n(%)]</td>
<td>0.241 (0.016 – 3.639)</td>
<td>0.305</td>
</tr>
<tr>
<td>Parity: nulliparous</td>
<td>0.035 (0.001 – 1.501)</td>
<td>0.080</td>
</tr>
<tr>
<td>Gestational Age</td>
<td>0.348 (0.149 – 0.810)</td>
<td>0.014 *</td>
</tr>
<tr>
<td>Bishope Score (Median (range))</td>
<td>5 (3-7)</td>
<td>0.014 *</td>
</tr>
<tr>
<td>AFI (cm)</td>
<td>1.114 (0.684 – 1.815)</td>
<td>0.664</td>
</tr>
<tr>
<td>Fetal Head Position (op)</td>
<td>9.338 (0.343 – 254.206)</td>
<td>0.185</td>
</tr>
<tr>
<td>Fetal Weight (Kg)</td>
<td>3.19 ± 0.47</td>
<td></td>
</tr>
<tr>
<td>Cervical Length (Cm)</td>
<td>26.97 ± 3.17</td>
<td></td>
</tr>
<tr>
<td><strong>Model 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parity: nulliparous</td>
<td>0.039 (0.003 – 0.592)</td>
<td>0.019 *</td>
</tr>
<tr>
<td>Gestational Age</td>
<td>0.398 (0.203 – 0.779)</td>
<td>0.007 **</td>
</tr>
<tr>
<td>Bishope Score (Median (range))</td>
<td>10.66 (0.021 – 0.533)</td>
<td>0.006 **</td>
</tr>
<tr>
<td>Fetal Weight</td>
<td>22.707 (1.269 – 406.27)</td>
<td>0.034 *</td>
</tr>
<tr>
<td>Cervical Length (Cm)</td>
<td>1.703 (1.160 – 2.500)</td>
<td>0.007 **</td>
</tr>
</tbody>
</table>

**Maternal Age (yr)**
- 28.34 ± 5.32
- 27.47 ± 5.29

**Height (cm)**
- 157.84 ± 5.47
- 157.89 ± 5.48

**B.M.I [n(%)]**
- ≥30: 10 (31.25) 9 (47.37)
- <30: 22 (68.75) 10 (52.63)

**Parity [n(%)]**
- Nulliparous: 12 (37.50) 9 (47.37)
- Multiparous: 20 (62.50) 10 (52.63)

**Gestational Age (weeks)**
- 39.69 ± 2.04
- 39.11 ± 1.28

**Bishop Score [Median (range)]**
- 5 (3-7)
- 4 (3-5)

**AFI (cm)**
- 6.75 ± 2.49
- 7.57 ± 2.28

**Fetal Head Position [n(%)]**
- Occipitoposterior: 5 (15.62) 4 (21.05)
- Non-Occipitoposterior: 27 (84.38) 15 (78.95)

**Fetal Weight (Kg)**
- 3.19 ± 0.47
- 3.22 ± 0.44

**Cervical Length (Cm)**
- 26.97 ± 3.17
- 31.32 ± 4.28
**Statistically significant at the 5% level**

**Statistically significant at the 1% level**

The explorative final model of logistic regression analysis of potential relevant risk factors for the occurrence of cesarean delivery in our studied population revealed that five variables were independent predictors of cesarean delivery; these five factors are listed in Table 4 with their odds and 95% confidence limits.

**Table (5)**
Risk Score and Probability of Cesarean Delivery After Induction of Labour.

<table>
<thead>
<tr>
<th>1. Risk Score</th>
<th>2. Probability of CD(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. -84 to -82</td>
<td>4. 45- 49</td>
</tr>
<tr>
<td>5. -81 to -79</td>
<td>6. 50 - 52</td>
</tr>
<tr>
<td>7. -78 to -76</td>
<td>8. 53 - 55</td>
</tr>
<tr>
<td>9. -75 to -73</td>
<td>10. 56 - 59</td>
</tr>
<tr>
<td>11. -72 to -69</td>
<td>12. 60 - 63</td>
</tr>
<tr>
<td>13. -68 to -66</td>
<td>14. 64 - 67</td>
</tr>
</tbody>
</table>

Probability of having a cesarean delivery

\[=\frac{100}{1+\exp\{-[3.832 + (\text{risk score}/21.135)]\}}\]

**Discussion**

Our prospective study evaluates a combination of ultrasound and clinical parameters to predicts the success of induction of labor in a single obstetric unit. These are ten parameters: maternal age, maternal height, maternal weight (BMI), parity, gestational age, Bishop score, AFI amniotic fluid index, fetal head position, fetal weight and cervical length.

About maternal age

In our study it is statistically a weak predictor has no significant effect. In woman delivered by cesarean section the mean of maternal age was 27.47± 5.29, p value 0.851 which is not significant. Ron, Gonen in prediction of successful induction of labor also founded that the maternal age is a weak predictor (11). Rane SM, Gurgis founded in there study that maternal age is not significant in prediction of successful induction of labor. (8)

About maternal body mass index BMI

In our study BMI had no significant effect on the risk score. The mean of BMI in women delivered by cesarean section was 47.37 for BMI>30. The mean of BMI in women delivered by cesarean section was 52.63 for BMI<30.In contrast, Rane SM study Model for the prediction of successful induction of labor he found that BMI was strong predictor. (8)

Elisabeth P, Patrick study clinical and ultrasound parameters to predict the risk of cesarean delivery after induction of labor, concluded that BMI is a significant predictor that affect the risk score for cesarean delivery. (13)
These differences in results may be due to the limited number of cases in our study because the restricted numbers of cases of induction of labor in our labor ward.

About maternal height
In our study it is a weak predictor. The mean for maternal height in women delivered by cesarean section was 157.89 ± 5.48 and p value was 0.634 which was not significant on risk score. Rane SM, Gurgis founded in there study model for the prediction of successful induction of labor that maternal height was not good predictor for successful induction of labor.(8)

About parity it is statistically significant at the level of 1%.
The mean for parity in women delivered by cesarean section was 52.63 and P value for it was 0.019 which is significant.
Ron, Gonen study, prediction of successful induction of labor.(11)
And Elisabeth P, Patrick study clinical and ultrasound parameters to predict the risk of cesarean delivery after induction of labor, concluded that BMI is a significant predictor that affect the risk score for cesarean delivery.(13)
Both are founded that parity was a powerful predictor for successful induction of labor.

About gestational age
It is statistically significant at the level of 1%. The mean for gestational age in women delivered by cesarean section was 39.11 ± 1.28 and the P value for gestational age 0.851 which is significant predictor. Elisabeth P, Patrick study clinical and ultrasound parameters to predict the risk of cesarean delivery after induction of labor, concluded that BMI is a significant predictor that affect the risk score for cesarean delivery.(13)
Pandas, AT, papageorghis, the prediction of successful induction of labor.(7) Both concluded that gestational age is a good predictor for successful induction of labor.

About Bishop score
In our study it is statistically significant at the level of 1%. The mean for Bishop score in women delivered by cesarean section was 4 and the P value was 0.022 which is significant predictor. Pandas, AT, papageorghis, the prediction of successful induction of labor.(7) Ron, Gonen study, prediction of successful induction of labor.(11) Both these studies concluded that Bishop score is a good predictor for successful induction of labor.

About amniotic fluid index AFI
In our study it is not statistically significant predictor The same result was founded by Elisabeth P, Patrick study clinical and ultrasound parameters to predict the risk of cesarean delivery after induction of labor, concluded that BMI is a significant predictor that affect the risk score for cesarean delivery.(13)

About fetal weight parameter
In our study it is statistically significant at the level of 5% . The mean for fetal weight in women delivered by caesarean section was 3.22± 0.44 and the P value for it was 0.123 which is not significant predictor for successful induction of labor. In contrast Rane SM, Gurgis founded in there study model for the prediction of successful induction of labor that maternal height was not good predictor for successful induction of labor.(8) And Elisabeth P, Patrick study clinical and ultrasound parameters to predict the risk of cesarean delivery after induction of labor, concluded that BMI is a significant predictor that affect the risk score for cesarean delivery.(13) Both studies founded that fetal weight had no significant effect on prediction of successful induction of labor.

About fetal head position parameter.
It is statistically not significant, the mean for fetal head position (occipitoposterior ) in women delivered by cesarean delivery was 21.05 and the P value was 0.185 which is statistically not significant . Elisabeth P, Patrick study clinical and ultrasound
parameters to predict the risk of cesarean delivery after induction of labor concluded that BMI is a significant predictor that affect the risk score for cesarean delivery. Also founded the same result (13).

About cervical length measured by transvaginal ultrasound is statistically significant predictor at the level of 1%. The mean for cervical length in women delivered by cesarean section was 31.32 ± 4.28 and the P value for it was 0.007 which is highly significant predictor for successful induction of labor.

Several other studies have examined the impact of transvaginal ultrasonography of the cervix before induction of labor on the outcome.

Ware V, Rayner B, transvaginal ultrasonographic cervical measurement as a predictor for successful labor induction, concluded that both ultrasonographically measured cervical length and Bishop score predict duration of labor and likelihood of vaginal delivery. (6)
Pandas, AT, Papageorghihs, the prediction of successful induction of labor concluded that transvaginal sonographic measurement of cervical length provides a useful prediction of the likelihood of vaginal delivery induction. (7)

Rane SM, Gurgis founded in there study model for the prediction of successful induction of labor that maternal height was not good predictor for successful induction of labor concluded that in women undergo labor induction pre-induction cervical length measurement have significant effect on the interval between induction and delivery and likelihood of vaginal delivery within 24 hours and the risk of cesarean delivery. (8)

Gaberiel, T, Darnaud study pre-induction sonographic measurement of cervical length provides a useful prediction of the likelihood of vaginal delivery induction. (10) he concluded that the length of uterine cervix measured by transvaginal sonography is a better predictor of the risk of cesarean delivery than Bishop score after induction of labor. (10)

Elisabeth P, Patrick study clinical and ultrasound parameters to predict the risk of cesarean delivery after induction of labor, concluded that BMI is a significant predictor that affect the risk score for cesarean delivery. Also founded the same result. (13)

Ron, Gonen study, prediction of successful induction of labor. (11)
Both these studies concluded that Bishop score is a good predictor for successful induction of labor. (11)

Concluded that transvaginal ultrasonographic evaluation does not improve the prediction of cervical inducibility obtained by the Bishop score. (11)

Table one shows the indications of labor in our obstetric unit. The most common cause for induction of labor in our obstetric unit is post date because of increased diagnosis of post date by routine pregnancy ultrasound scans and the management of post date by induction of labor the same was found by Elisabeth P, Patrick study clinical and ultrasound parameters to predict the risk of cesarean delivery after induction of labor, concluded that BMI is a significant predictor that affect the risk score for cesarean delivery. Also founded the same result. (13)

From those significant independent variables we can calculate probability and risk score of cesarean delivery after induction of labor. When the risk score is high the probability for cesarean delivery is high and vice versa.

**CONCLUSION**
Parity, gestational age, Bishop score, fetal weight and ultrasonic transvaginal cervical length are the most accurate parameters in predicting the risk of cesarean delivery after induction of labor.

A predictive model using these would allow more accurate counseling and better informed consent in the in the decision making process regarding induction of labor.
REFERENCES: