Prospective evaluation of clinical and ultrasonic feto-maternal parameters as predictors of caesarean delivery after induction of labour

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Abstract  
Objectives: A prospective study was conducted in the department of obstetrics & Gynaecology, Kamla Nehru State Hospital for mother and child, Indira Gandhi Medical College, Shimla from 1st July 2010 to 30th April 2011 on 150 pregnant women. The aim was to evaluate the clinical and ultrasonic feto-maternal parameters which can predict the success of induction of labour.  
Methods: Gestational age, maternal height, weight, BMI, Bishop score, investigations including ultrasound, transabdominal scan to assess the fetal biometric parameters (BPD, HC, AC and FL), EFW, AFI & fetal head position and transvaginal scan to measure cervical length and cervical funnelling in all recruited subjects before initiating induction of labour (IOL) was done. After delivery, the women were allotted to one of the following groups:  
Group 1: women having caesarean delivery for non-progress of labour and failed induction of labour (non-successful IOL group),  
Group 2: women having normal vaginal delivery (successful IOL group). Their clinical and ultrasonic parameters were compared.  
Results: Out of 150 pregnant women, 32 underwent caesarean delivery (21.33%). The t-test was used for quantitative data and Pearson Chi square or fisher’s exact test was used for categorical databases. The four variables which can significantly predict the failure of IOL in the present study were nulliparity, Bishop Score of < 3, Occipito-posterior fetal head position on TAS and Birth weight ≥ 2.5 Kg.  
Conclusion: Clinical parameters nulliparity, Bishop score < 3, birth weight ≥ 2.5 kgs and ultrasonic parameter i.e. Occipito-posterior fetal head positions are the 4 most significant parameters to predict the failure of IOL. Out of these parameters, the three best predictors were parity, birth weight and fetal head position. This can be useful in pre-induction counseling.  
Keywords: Bishop score, Nulliparous women, Labour induction, Occipito-posterior fetal head position

1. Introduction  
Passage through the birth canal is the shortest but probably the most hazardous journey made by any individual in his or her life. Hypoxia, trauma and infection are inherent risks. The risks are increased if they are associated with preterm and post-term birth, prelabour rupture of membranes or antepartum haemorrhage and when labour is induced as a consequence of medical or obstetric disorders of pregnancy.  
The frequency of induction of labour has increased over the last two decades and now accounts for up to 20%. Among these, 20% end up with emergency caesarean delivery2. Labour induction was started in view of benefits of delivery to the mother or fetus outweighing the potential risks of continuing the pregnancy.  

2. Materials and methods  
This is a prospective observational study conducted in the Department of Obstetrics and Gynaecology, Kamla Nehru State Hospital for mother and child, Shimla from 1st July 2010 to 30th April 2011 which included 150 pregnant women who fulfilled the following criteria

2.1 Inclusion Criteria  
1. Women willing to participate in the study.
2. Gestational age between 36-42 weeks as determined by last menstrual period or by ultrasound scan up to 20 weeks.
3. Singleton viable fetus.
4. Cephalic presentation.
5. No contraindication to vaginal delivery.

2.2 Exclusion Criteria
1. Women with an intrauterine fetal death, known lethal fetal anomaly.
2. Multifetal gestation.
3. Abnormal placenta.
4. PROM > 12 hours.
5. Women with previous caesarean section and previous uterine surgeries.
6. Any other indication for caesarean delivery.

A written informed consent was taken. Detailed history was taken and specifically maternal age (years), parity, gestational age as calculated from first day of last menstrual period (LMP) and/or ultrasound performed up to 20 weeks was noted. A thorough general physical examination, systemic examination and obstetric examination were conducted with special reference to maternal height, weight, BMI, Bishop score. Investigations including ultrasound, transabdominal scan to assess the fetal biometric parameters (BPD, HC, AC and FL), EFW, AFI & fetal head position and transvaginal scan performed in dorsal position using 6 MHZ curvilinear probe to measure cervical length and cervical funnelling in all recruited subjects before initiating induction of labour was done.

The labour induction was done as per the hospital protocol (misoprostol/ARM+oxytocin/dinoprostone gel). Patients were monitored by WHO partogram. The outcome of labour, delivery and neonate’s details was obtained from the clinical notes after delivery. Based upon delivery outcome, women were allotted to two groups:
Group 1: women having caesarean delivery for non-progress of labour and failed induction of labour (non-successful IOL group)
Group 2: women having normal vaginal delivery (successful IOL group)
The two groups will be compared for their clinical and ultrasonic parameters to give a probability score which will predict the caesarean delivery after induction of labour.

2.3 Statistical analysis of the data
The percentage of each qualitative variable and the mean, standard deviation, minimum and maximum values for the quantitative variables were measured.

Data were entered into statistical software package SPSS version 17. The t-test was used for quantitative data and Pearson Chi square or fisher’s exact test was used for categorical databases. Multivariable logistic regression was performed using all the significant variables with p value < 0.05 in the univariate test.

3. Results
Out of the subjects who were enrolled initially, 22 were excluded for fetal distress and a total of 150 subjects who fulfilled the inclusion and exclusion criteria and planned for IOL were recruited in the study. During the study period the incidence of IOL in our institution was 20%. Of the 150 women, 32 underwent caesarean section (Group 1) and 118 underwent normal delivery (Group 2). The total caesarean section rate in our institution during the study period was 19.86% and of the present study was 21.33%. Indication for caesarean section were non progress of labour and failure of IOL (p=0.045).

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Baseline characteristics of both the groups are presented in table 2. There were no statistically significant differences in age, maternal height, weight and BMI, gestational age (Table 2). Nulliparity was significantly associated with failure of IOL as more than 90% of group 1 was constituted by nulliparous women (p<0.001). The mean Bishop score in group 1 was 2.68 and in group 2 was 3.83. There was significant correlation of a score of ≤ 3 with failure of IOL (p=0.045).

Table 1: Indication of induction of labour

| Indication of induction of labour | Group 1 n (%) | Group 2 n (%) |
|----------------------------------|---------------|---------------|
| Postdated pregnancy              | 24 (75)       | 106 (70.66)   |
| IUGR                             | 4 (12.5)      | 22 (14.66)    |
| PIH                              | 4 (12.5)      | 20 (13.22)    |
| PROM                             | 0             | 2 (1.33)      |

Table 2: Characteristics of women involved in the study

| Parameter                        | Group 1          | Group 2          | p value |
|----------------------------------|------------------|------------------|---------|
| Age (yrs)                        | 25.56±3.25       | 28.00±3.25       | 0.57    |
| Height (cms)                     | 157.71±13.25     | 158.05±13.25     | 0.49    |
| Weight (Kgs)                     | 65.12±13.25      | 64.16±13.25      | 0.79    |
| BMI (kg/m²)                      | 26.01±3.25       | 24.48±3.25       | 0.28    |
| Parity [n (%)]                   |                  |                  |         |
| Nulliparous                      | 30 (93.75)       | 55 (46.61)       | <0.001  |
| Multiparous                      | 2 (6.25)         | 63 (53.38)       |         |
| Gestational age (wks)            | 40±1             | 40±2             | 0.06    |
| Bishop score [n (%)]             |                  |                  |         |
| ≤ 3                              | 14 (43.75)       | 6 (5.08)         | 0.045   |
| ≥ 3                              | 18 (56.25)       | 112 (94.91)      |         |

Table 3: Comparison of ultrasound parameters between the two groups

| Parameter                        | Group 1, n (%) | Group 2, n (%) | p value |
|----------------------------------|----------------|----------------|---------|
| TAS Fetal head position          |                |                |         |
| Occipitoposterior                | 15 (46.87)     | 8 (6.77)       | <0.001  |
| Non Occipitoposterior            | 17 (53.12)     | 110 (93.22)    |         |
| TVS Cervical length (mm)         |                |                |         |
| mean±SD                          | 21.68±4.53     | 20.36±4.76     | 0.096   |
| Cervical funnelling (mm)         |                |                |         |
| mean±SD                          | 1.625±2.13     | 1.948±2.60     | 0.617   |
Table 3 shows the comparison of ultrasonic parameters between the two groups. Presence or absence of occipito-posterior position was noted and compared between the two groups. 15 (46.87%) subjects and 8 (6.77%) subjects in group 1 and 2 respectively had occipito-posterior fetal head position at the beginning of IOL. 17 (53.12%) subjects in group 1 and 110 (93.22%) in group 2 had non occipito-posterior fetal head position. The occipito posterior fetal head position was strongly associated with unsuccessful outcome in the present study (p=0.001). Though the mean cervical length was slightly shorter and fetal tunneling was more pronounced in group 2 who had normal vaginal delivery, but this difference did not reach any statistical significance (Table 3).

Table 4: Comparison of labour characteristics between the two groups

| Parameter                        | Group 1 n (%) | Group 2 n (%) | p value |
|----------------------------------|---------------|---------------|---------|
| Induction delivery interval      |               |               |         |
| < 18 hrs                         | 0             | 0             | <0.001  |
| > 18 hrs                         | 32 (100)      | 118 (100)     |         |
| Duration of rupture of membrane  |               |               |         |
| < 10 hrs                         | 30 (93.75)    | 1 (0.84)      | < 0.001 |
| > 10 hrs                         | 2 (6.25)      | 117 (99.15)   |         |
| Third stage duration (mins)      | 5.56±0.66     | 5.39±0.70     | 0.189   |

Table 4 shows comparison of labour characteristics between the two groups. Subjects who had caesarean delivery took significantly longer induction to delivery interval (24.18±4.573 hours) as compared to subjects who had normal vaginal delivery (9.69±2.825 hours). An IDI of ≥ 10 hours has a significant negative correlation with failure of IOL. Induction to delivery interval of ≥ 18 hours was strongly associated with failure of IOL. A cut off value of 18 hours has a 100% sensitivity and specificity to predict failure of IOL. In the present study duration of more than 10 hours of rupture of membranes has a strong negative correlation with success of IOL. A value of 10 hours is taken as cut off as it has a sensitivity of 100% and a specificity of 93.7% to predict failure of IOL. Mean birth weight in group 1 was 2.93±0.398 kgs and in group 2 was 2.64±0.316 kgs (Table 5). Significant number of women in group 1 who had caesarean delivery had neonatal birth weight above 2.7 Kg which was statistically significant as compared to group 2 women who had normal vaginal delivery (p<0.001). Thus in the present study neonatal birth weight had a negative correlation with success of IOL.

Table 5: Comparison of neonatal birth weight between the two groups

| Baby weight | Group 1 n (%) | Group 2 n (%) | p value |
|-------------|---------------|---------------|---------|
| < 2.5 kg    | 4 (12.5)      | 18 (15.25)    |         |
| 2.5-3.5 kgs | 13 (40.62)    | 84 (71.76)    | <0.001  |
| 3.1-3.5 kgs | 14 (43.75)    | 15 (12.71)    |         |
| > 3.5 kgs   | 1 (3.12)      | 1 (0.84)      |         |

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| > 3.5 kgs   | 1 (3.12)      | 1 (0.84)      |         |

4. Discussion

The frequency of induction of labour and intrapartum/emergency caesarean delivery has increased has increased over the last two decades and is found to be associated with higher risk of fetal and maternal morbidity4. Antenatal detection of women likely to end up in failed IOL and consequent emergency caesarean section is essential for their appropriate management and pre-induction counselling. Maternal parity, Bishop score, fetal head position on TAS and birth weight have been found to be best predictors defining the risk of caesarean delivery in pregnant population undergoing IOL.

The incidence of IOL in the present study is about 20%. The women in the present study were in the age group of 18-38 years with the mean age of 25 years. No correlation has been found between any particular maternal age group and success of IOL. Primigravidae and nulliparous women were significantly more prone to have failure of induction and requiring emergency intrapartum caesarean section in the present study. Similar results have been shown by David and Johnson in 1977 in their two year study, where they concluded that IOL in nulliparous women, especially those with an unfavourable cervix is associated with increased risk of caesarean delivery4. There was no correlation between gestational age, BMI and success of IOL (p=0.065). Literature at maternal height is an independent predictor of labour induction success, as taller women are more likely to have vaginal delivery. Similarly maternal weight has been shown to be associated with success of IOL. However our study fails to show any such correlation between these clinical parameters as the number of women recruited with BMI <19 and >35 are very less to produce any statistical results.

Our study has once again confirmed the existing data and has shown a positive correlation between Bishop score and success of IOL among women in two study groups. Recent studies have shown that bishop score alone is a poor predictor of success of IOL as it is subjected to a higher intra and interobserver variations9,10. This can be explained by the virtue of fact that different induction protocols were followed in different studies. Mean EFW and AFI was not found to be a significant risk factor in the present study. 45% of group 1 women who had caesarean delivery had occipito-posterior fetal head position on TAS examination as compared to 6% women in group 2 who had normal vaginal delivery, thus fetal head position being the significant parameter for predicting success of IOL. Also along with other factors like transvaginal cervical length and posterior cervical angle, it has a strong positive predictive value for success of IOL11. Though the cervical length was found to be slightly shorter in group 2 women, no significant difference was found between the two groups. However most studies have demonstrated the association between cervical length and duration of latent phase of labour9,11. In the study birth weight has been found to be an independent risk factor for caesarean delivery as in many other studies as well9,10.

5. Conclusion

a. Clinical parameters viz: nulliparity, Bishop score < 3, birth weight ≥ 2.5 kgs and ultrasonic parameter i.e. Occipito-Posterior fetal head position are the 4 most significant parameters to predict the failure of IOL.

b. Out of these parameters, the three best predictors i.e. parity, birth weight and fetal head position on TAS were used to construct a ‘Risk model’ which can predict success/failure of IOL in 85% of women accurately. This risk model will help us in pre-induction counselling of antenatal women and enable them...
to make choices about their own mode of delivery, thus, will help to reduce the incidence of emergency/intrapartum caesarean deliveries and associated maternal and perinatal mortality and morbidity.

c. IDI ≥ 18 hrs and DROM ≥ 10 hrs can predict the failure of IOL with 100% accuracy

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