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A cross-sectional study on incidence and indications for induction of labor and the factors associated with failure of induction

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ABSTRACT

Background: Induction fails in about 20% of induced pregnancies and has no universally accepted definition. Failed induction is the failure to establish labor or inability to achieve the active stage of labor, considering the definition of induction of labor (IOL). It needs to be differentiated from the failure of progress of labor. There is no evidence to recommend treatment for failed induction, but usually, delivery by cesarean section will be required. **Aims and Objectives:** The study was designed to start induction for an indication that justifies operative delivery in cases of failure. **Materials and Methods:** A prospective observational study was done over a period of 1 year among antenatal women confirmed to be at term with cephalic presentation in the absence of active labor with unscarred uterus. **Results:** The incidence of IOL was found to be 25.97% and failure was observed in 50 (21.83%) of those included in the study. Among those with failure, failed pre-induction ripening was seen in 26 (11.3%) and failed induction in 24 (10.4%). Although many variables were found to be associated with the outcome of labor, a statistically significant association was observed with premature rupture of membranes, pre-induction Bishop score, and birth weight of the baby. **Conclusion**: The study helps in better clinical judgment of patients who will have a successful induction or a failed induction and the patients could be counseled accordingly. This judgment will also help to avoid unnecessary inductions in those who have the risk factors for failed induction unless the induction is absolutely necessary.

Key words: Pre-induction ripening; Failed pre-induction cervical ripening; FIOL; Bishop score; Premature rupture of membranes

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INTRODUCTION

Induction of labor (IOL) is the artificial initiation of labor before its spontaneous onset, to deliver the fetoplacental unit. IOL is done when the benefit of delivery is more than the continuation of pregnancy.[1] The incidence of induction varies between the demographic location and institution. It has been on a rise in recent years, about 20% in all settings.[2,3] Cervical ripening is defined as a prelude to the onset of labor, by which the cervix becomes soft and compliant, either naturally or by physical or pharmacological intervention.[4] Starting with a favorable cervix ensures the success of labor induction. When there is an indication for induction and cervix is unfavorable (Bishop score <6), agents for cervical ripening may be used.[5] Intracervical prostaglandin E2 (PGE2) gel in a 2.5 mL pre-loaded syringe which contains 0.5 mg of dinoprostone repeated every 6 h up to a maximum of three doses (1.5 mg of dinoprostone) within a 24 h period can be used for cervical ripening. PGE2 gel not only ripens the cervix but also induces labor and reduces the risk of failed induction.[6]

Induction fails in about 20% of the induced pregnancies.[7] Failed induction has no universally accepted definition. Failed induction is the failure to establish labor or inability to achieve the active stage of labor, considering the definition of IOL. It needs to be differentiated from the

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failure of the progress of labor. There is no evidence to recommend treatment for failed induction, but usually, delivery by cesarean section will be required. It is therefore essential to start induction for an indication that justifies operative delivery in cases of failure. Several factors are considered as predictors of induction failure such as Bishop score <4, nulliparity, gestational age <41 weeks, maternal age >30 years, pregnancy complicated by pre-eclampsia, premature rupture of membranes (PROM), isolated oligohydramnios, gestational diabetes, and hypertension.[8-11]

Aims and objectives

In spite of extensive studies, uncertainties remain about the ideal dose, timing, application, and of why intracervical PGE2 fails to induce labor in certain women. This study will attempt to identify those factors and will enrich the researcher and institution with a better clinical judgment on assessing the patients who may have a failed IOL and thereby to have data when counseling women for induction. The objectives of the current study were to estimate the incidence of IOL, determine the common indications for IOL, assess the maternal and perinatal outcomes in induced labor, and evaluate the factors associated with failed induction and failed pre-induction cervical ripening.

MATERIALS AND METHODS

A hospital-based prospective observational study was done among patients admitted for labor to the Department of Obstetrics and Gynaecology in a teaching institute for 1 year. Antenatal mothers with singleton pregnancy at the period of gestation confirmed to be at term with cephalic presentation in the absence of active labor with unscarred uterus were included in the study. Those patients with extensive transfundal uterine surgery, fetal distress, and those with contraindication for vaginal delivery were excluded from the study. Universal sampling method was used to select the sample. A total of 982 patients were admitted for labor during our study period, of which 255 were planned for IOL. Of these, only 229 patients who fulfilled our inclusion criteria and consented to the study were included.

On admission, a detailed history and clinical examination were done. Bishop score at the time of admission was assessed. The women who met the inclusion criteria were taken into the study. In our institution, pre-induction ripening (PIR) of the cervix with intracervical PGE2 is done for those with a Bishop score of s<4, repeated to a maximum of three doses at 6th hourly intervals. PIR was considered to have failed, if a Bishop score of >6 was not achieved after three doses of intracervical PGE2 gel (0.5 mg of dinoprostone). In a favorable cervix (Bishop score >5), amniotomy followed by titrated oxytocin drip was administered for induction, 6 h after the last dose of PGE2 gel. Failure to achieve a cervical dilatation of more than 3 cm irrespective of the effacement after 6 h of oxytocin drip was considered as failed induction. The predictors of such failed PIR and failed induction were studied.

The data collected were entered in MS Excel and statistical analysis was done using SPSS software version 23. Continuous variables were represented as "Mean (SD)," and categorical variables were represented as "Frequency (percentage)." Chi-square test or Fisher's exact test was used to assess the differences in categorical data. Student unpaired t-test was used to assess the differences in means of two independent data. Analysis of variance test was used to assess the difference in means of two or more independent data. The P<0.05 will be considered as significant.

RESULTS

A total of 982 patients were admitted for labor, of which 255 (25.97%) underwent IOL and only 229 met inclusion criteria. Majority 122 (53.28%) of the participants were aged 25–29 years and almost 92 (40.17%) were either overweight or obese. Of those people induced 166 (72.49%) were primigravida and 148 (64.63%) were at the gestational age of 40–41 weeks. The incidence of failed pre-induction cervical ripening (FPIR) was 11.3% (26 patients) of those who underwent IOL, which contributed to majority (52%) of those who did not have a successful induction. The incidence of failed induction was 10.4% (24 patients), which was 48% of those who did not have a successful induction. The overall incidence of IOL was found to be 25.97% and of those induced and included in the study, the failure was observed in 50 (21.83%) of the patients. Group A were those who failed induction and pre-induction cervical ripening, while Group B comprised those who had successful induction (Figure 1).

Of those who had failed PIR around 10 (38.46%) had gestational diabetes mellitus (GDM) followed by 7 (26.92%) with hypothyroidism (Figure 2). 12 (50%) of those who had failed induction had GDM followed by 7 (29.16%) of hypothyroidism. All the patients who presented with PROM had failed induction. There was only one patient who presented with chronic hypertension and seizure disorder and had failed PIR. 88 (85.43%) of those who did not have any medical issues had a successful induction (Table 1).

The major indication of IOL was found to be medical disorder 62 (27.07%) followed by 38 (16.59%) PROM and 37 (16.15%) post-date. 122 (53.28%) of those who

underwent IOL belonged to 25–29 years. In Group A, there was a slight predominance of 8 (62.50%) and 6 (54.55%) of failed induction observed in 21–24 and 30–35 age groups, respectively, compared to 25–29 years who had a majority 17 (56.67%) of failed PIR. There was only one patient aged >35 years who had failed PIR. Of 134 who had a normal body mass index (BMI), 110 (82.09%) had a successful IOL. 21 (28%) and 4 (23.53%) of those belonging to overweight and obesity category fell into Group A. Only 1 patient had BMI <18.5 and had failed PIR while 3 (75%) of those with obesity also had failed PIR in Group A. The incidence of failed induction and failed PIR was distributed equally among the rest of the groups. Maximum incidence of IOL was in the gestational age of 40–41 weeks 148 (64.63%). It was observed that the incidence of successful IOL increases with gestational age. It was also seen that the incidence of failed PIR lowered with increase in gestational age (Table 2).

The incidence of failed IOL was 30 (46.88%), 15 (11.36%), and 5 (3.76%), respectively, in those who had pre-induction bishop score of 0–2, 3–4, and 5–6, respectively, and found to be statistically significant. 11 (73.33%) and 4 (80%) of those who had bishop score of 3–4 and 5–6 had failed induction and 21 (70%) with bishop score 0–2 had failed pre-induction ripening. Thus, it was observed that the incidence of failed induction increased with increase in bishop score and while failed PIR was mostly observed with 0–2 bishop score and the results were statistically significant. The mean pre-induction bishop score was found to be 3.51±1.27 in those groups who had successful induction while 2.52±1.66 in those where induction failed and the difference was found to be highly statistically significant (<0.001). Among Group A, 3.08±1.76 was the mean bishop score in those who had failed induction, whereas those with failed PIR had a mean bishop score of 2±1.41 and this difference in mean values was also found to be statistically significant (0.0202).

Patients in the failure of induction group had a relatively longer induction delivery interval, mean 18.96±5.56 h compared to those in the successful induction arm who had a mean induction delivery interval of 14.5±6.72 h. The mean induction delivery interval in those patients who had a Bishop score of 0–2 was 17.9 h, which was longer when compared to those who had a mean duration of 9.63 h if the pre-induction score was 5–6. This shows that starting with a Bishop score of <4 has a prolonged induction delivery interval compared to starting with a Bishop score of >4 which was statistically significant (P<0.001). The induction delivery interval was also longer in failed induction compared to failed PIR.

Neonatal intensive care unit (NICU) admission was seen in 10 (20%) of those in Group A and 24 (13.41%)

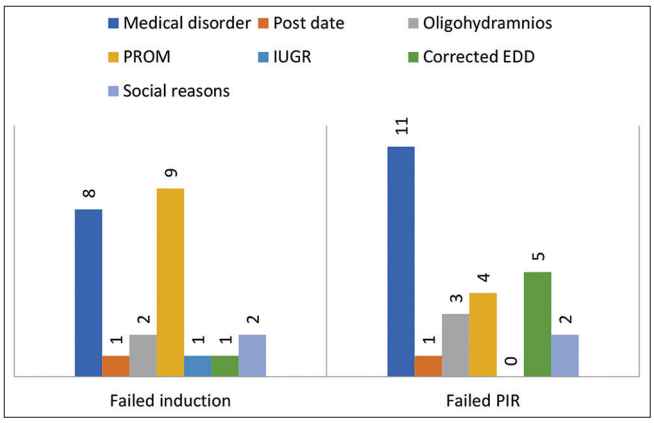

Figure 1: Factors associated with failed induction of labour

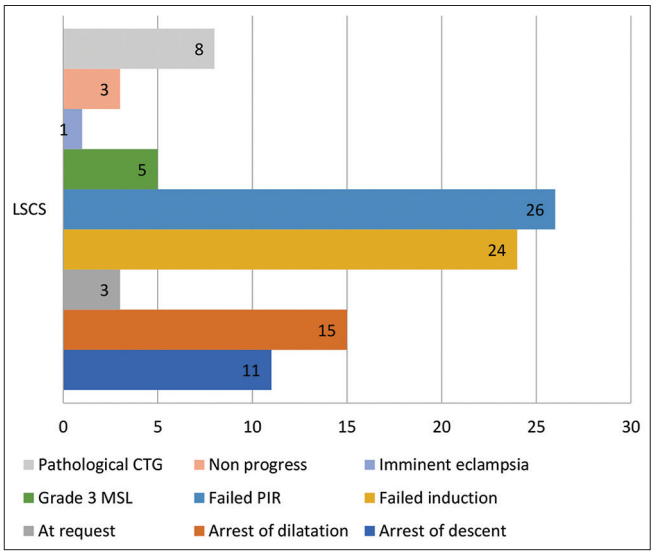

Figure 2: Indications for lower segment cesarean section in induction of labor

in Group B. Failure of induction was most common in <3 kg birth weight babies while FPIR was relatively on the higher side in mothers with babies weighing more than 3 kg. The mean birth weight in the failure of induction group was 3.11±0.38 kg and in the successful induction group was 3.19±0.44 kg. 16 (32%) of the babies in the failure of induction group had a birth weight of more than 3.5 kg whereas only 25 (13.97%) of the babies in the successful induction group had a birth weight of more than 3.5 kg (Table 3).

Except for 1 (1.61%) patient who had failed PIR (Table 4), 62 (98.39%) of multigravida had successful induction while 25 (14.97%) and 24 (14.37%) of the primigravida had failed PIR and failed induction, respectively. Majority 120 (52.40%) of the patients planned to induce had normal vaginal delivery, which was followed by 96 (41.92%) subjected to lower segment cesarean section and 13 (5.67%) had assisted vaginal delivery.

Table 1: Medical conditions associated with the outcome of induction of labor

Medical condition associated	Outcome of induction of labor, n (%)		
	Group A		Group B
	Failed PIR	Failed induction	Successful IOL
GDM on MNT	6 (8.70)	11 (15.94)	52 (75.36)
GDM on OHA	0 (0)	1 (33.33)	2 (66.67)
GDM on insulin	4 (50)	0 (0)	4 (50)
Pre-GDM	0 (0)	0 (0)	1 (100)
Hypothyroid	7 (15.56)	7 (15.56)	31 (68.88)
Gestational HTN	1 (20)	0 (0)	4 (80)
Pre-eclampsia	0 (0)	1 (16.67)	5 (83.33)
Chronic HTN	1 (100)	0 (0)	0 (0)
PROM	0 (0)	3 (100)	0 (0)
Seizure disorder	1 (100)	0 (0)	0 (0)
ASD	0 (0)	0 (0)	1 (100)
Obstetric cholestasis	1 (33.33)	1 (33.33)	1 (33.33)
Nil	8 (7.92)	5 (4.95)	88 (87.13)

GDM: Gestational diabetes mellitus, MNT: Medical nutritional therapy, OHA: Oral hypoglycemic agents, HTN: Hypertension, PROM: Premature rupture of membranes, ASD: Atrial septal defect, IOL: Induction of labor, PIR: Pre-induction ripening

Table 2: Maternal factors associated with the outcome of induction of labor

Maternal factors	Group A n (%)	Group B n (%)	P-value
Maternal age			
21–24 years	8 (16)	46 (25.70)	0.8444
25–29 years	30 (60)	92 (51.40)	
30–35 years	11 (22)	39 (21.79)	
>35 years	1 (2)	2 (1.11)	
Gestational age in weeks+days			
37–37+6	4 (30.76)	9 (69.23)	0.076
38–38+6	10 (34.48)	19 (65.52)	
39–39+6	11 (28.21)	28 (71.79)	
40–41	25 (16.89)	123 (83.11)	
Body mass index - Mean (SD)*	24.45 (3.59)	24.15 (3.51)	0.3876
PROM			
Yes	12 (33.33)	24 (66.67)	0.034
No	38 (19.69)	155 (80.31)	
Pre-induction Bishop score – Mean (SD)*	2.52 (1.66)	3.15 (1.27)	<0.001

*t-test was used, *P*<0.05 is considered to be significant, PROM: Premature rupture of membranes

Table 3: Intra-natal and post-natal outcomes associated with induction of labor

Intra-natal and post-natal outcome	Group A	Group B	P-value
Birth weight			
<3 kg	16 (18.18)	72 (81.82)	0.013
3–3.5 kg	18 (18)	82 (82)	
>3.5 kg	16 (39.02)	25 (60.98)	
APGAR score			
≤7	12 (18.18)	54 (81.82)	0.253
>7	38 (23.31)	125 (76.69)	

P<0.05 is considered to be significant

Table 4: PGE2 gels and oxytocin requirement in each group

No. of. PGE2 gels	Oxytocin requirement	Group A n (%)	Group B n (%)
1	Required	1 (2.56)	38 (97.44)
	Not Required	0 (0)	26 (100)
2	Required	5 (10.42)	43 (89.58)
	Not Required	0 (0)	14 (100)
3	Required	14 (31.82)	30 (68.18)
	Not required	25 (71.43)	10 (28.57)
0	Required	5 (22.73)	17 (77.27)

PGE2: Prostaglandin E2

DISCUSSION

The incidence of IOL in our institution was 25.97% which was comparable with that of the incidence of induced labor in developing countries, though the World Health Organization global survey showed an average of 1.4–6.8%.[12] The incidence of failure to achieve a successful induction was 21.83% which includes 10.4% and 11.3% of those who had failed induction and failed PIR, respectively. This was comparable to the overall failed induction rate of 20% in a study by Michelson et al., and many other studies.[13] In this study, the most common indications for induction were associated maternal risk factors (27.07%) and PROM (16.59%) followed by post-dated pregnancy (16.15%). Few other studies revealed the common causes to be hypertensive disorders (32%)[14] and post-term pregnancy (22–60%).[14-16] Nulliparity was significantly associated with predicting a failure of induced labor, which was similar to the findings of many studies.[17-19]

Maternal age of more than 30 years was not found to be significantly associated with predicting failed IOL. In the study by Rayamajhi et al., and few other studies, age more than 30 years had an increased risk (28.8%) of having failed IOL compared to others.[17,20] The reason attributed may be higher prevalence of maternal complications in increased maternal age and hence higher rate of IOL, with a higher rate of failed IOL.[21] In this study, BMI was not found to be a significant predictor of failure of induction. However, studies by Wolfe KB et al., Ennen et al., Nuthalapaty et al., Weiss et al., showed a significant correlation between maternal obesity and failed IOL.[22-24] A higher BMI is associated with a higher fetal weight and pregnancy-related complications, both conditions being linked to an increased risk of cesarean section. However, this relation has not been shown regarding the successes of induction.

According to our study, the pre-induction Bishop score was a significant predictor of outcome of induced labor.

This is in accordance with several extensive studies which have shown the same. Rayamajhi RT et al., and Maria Olender concluded that the Bishop score was the most accurate predictive factor of vaginal delivery after IOL.[17] This supports the scientific findings of different literature that the conditions of the cervix at the start of induction are an important predictor, with the modified Bishop score being a widely used scoring system. IOL results in high failure rate if the cervix is not ripe.[23,24]

There was no significance between the gestational age at induction and prediction of failure of IOL as well as between the failed induction and failed PIR group. In the study by Park it was shown that earlier gestational age was found to be a significant predictive factor for failed IOL.[25] In this study, gestational diabetes was associated with 44% of those who had a failure of induction, 29.05% of those who had successful induction, and 29.25% of those who were induced. In studies by Ennen et al., and Pevzner L et al., it was shown that diabetes mellitus was a risk factor associated with failed IOL.[9,21]

From this study, it is observed that those patients who were ready for oxytocin induction earlier had a successful induction. In patients who progressed well after 1 dose of Cerviprime gel, the requirement of oxytocin was comparably more successful (21.22%) than the failure of induction group (2%). In a study by Alfirevic et al.,[26] oxytocin alone versus intracervical PGE2 showed that oxytocin alone for IOL was associated with an increased failure of induction and an increased cesarean section rate. No significant association was found between pre-labor rupture of membranes (PROM) and success of IOL. In study by Caliskan E et al., and Mbele et al., it was shown that women with PROM and unfavorable Bishop score had a successful vaginal delivery following induction.[27,28] There was no difference in the rate of NICU admission, and no incident of hyperstimulation or tachysystole in the patients who had IOL in our study. All patients who were induced were monitored carefully for these adverse effects. There was no increased incidence of post-partum hemorrhage associated with IOL.

Limitations of the study

Single center study.

CONCLUSION

The incidence of failure of IOL was 21.83%. IOL in a setting of unfavorable cervix, especially in nulliparous women, can result in failed induction and failed PIR and increased induction delivery interval. Increased birth weight of the baby was also found to be associated with failure of induction. Maternal BMI, advanced maternal age, gestational age, associated maternal medical illness, and PROM were not significantly found to be associated with either failed induction or failed PIR. No significant maternal or neonatal complications were associated with failed induction. The study helps in better clinical judgment of patients who will have a successful induction or a failed induction and the patients could be counseled accordingly. This judgment will also help to avoid unnecessary inductions in those who have the risk factors for failed induction unless the induction is absolutely necessary.

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Nil.

CONSENT

An informed written consent was obtained from all participants before including in the study and the purpose of the study was explained well in the local language. The data collected from the participants were used only for study purposes and confidentiality was maintained. The option to drop out of the study at any given point in time without any loss of penalty and uncompromised patient care was explained to the patient.

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Authors Contribution:
KN- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article; **MMR-** Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision.

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