

Study of the Risk Factors for Cesarean Delivery among Pregnant Women Requiring Induction of Labor in a Tertiary Care Institute

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ABSTRACT

Background: Labor induction is the most commonly performed intervention in obstetrics and is usually carried out for maternal, fetal, and placental conditions when the benefits to either mother or fetus outweigh those of continuing the pregnancy. Labor induction process in itself is not without complications and is associated with a higher risk of maternal and fetal complications. However, in carefully selected high-risk pregnant women, labor induction is associated with higher chance of vaginal delivery with least maternal and fetal complications. The present study was conducted to identify the factors which determine the risk of failed induction and to compare the maternal and fetal outcome between spontaneous and induced labor pregnant women.

Materials and methods: This retrospective study was done in a teaching institute of Chennai for a period of 6 months. The required medical and obstetrical details were obtained from case records. Chi-square test was used to compare the proportions of various clinical parameters between cesarean and vaginal deliveries. Binary logistic regression method was applied for estimating factors that were associated with higher chances of cesarean delivery.

Results: Among 292 deliveries, 35.95% women required labor induction and 27.73% women had spontaneous labor; 50% of labor-induced women had successful vaginal delivery compared to 79% of women who had spontaneous labor with insignificant maternal and neonatal complications. Women with unfavorable preinduction Bishop score were at higher risk for cesarean delivery in labor-induced women. The risk factors such as advanced age, nulliparity, neonatal birth weight >3.5 kg, and labor induction for oligohydramnios, glucose intolerance, hypertension, premature rupture of membranes, and low-risk pregnancy at 40 weeks were not associated with higher chance of cesarean delivery.

Conclusion: To curtail the increase in cesarean delivery rate, there is definite need for labor induction. Labor induction should be considered in pregnant women with medical and obstetric complications after assessing the clinical condition. Mechanical methods and sweeping of membranes may be attempted in women with unfavorable Bishop score prior to pharmacological methods of cervical ripening.

Keywords: Bishop score, Induction of labor, Pregnant women, Retrospective study, Risk of cesarean delivery.

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INTRODUCTION

Induction of labor implies stimulation of uterine contractions before the spontaneous onset of labor with or without ruptured membranes. Labor induction is usually carried out for maternal, fetal, and placental conditions when the benefits to either mother or fetus outweigh those of continuing the pregnancy. Its incidence varies between institutional practices ranging from 20 to 35%.¹

Decision to terminate pregnancy either by direct cesarean or vaginal delivery should be individualized based on current clinical condition. The pregnancies that are complicated with high-risk medical and obstetric conditions, late preterm, and early term delivery are recommended if there are medical and obstetric indications.²

In low-risk pregnant women, expectant management beyond the due date has been associated with increased incidence of maternal and perinatal complications.¹

Hence, there is a need for termination of pregnancy beyond expected dates. The recommendations by the American College of Obstetrician and Gynecologist (ACOG)² and Federation of Obstetrics and Gynecological Societies of India³ are to plan induction of labor in low-risk pregnancies after completion of 39 weeks. However, guidelines by the World Health Organization⁴ and National Institute for Health and Care Excellence⁵ recommend induction of labor for low-risk pregnant women should be carried out after 41 completed

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weeks. Hence, the gestational age cutoff for inducing low-risk pregnant women continues to be a clinical dilemma, and protocol differs between the institutes.

Labor induction process in itself is not without complications for mother and fetus. It is associated with a higher risk of emergency cesarean delivery, uterine hyperstimulation, postpartum hemorrhage (PPH), and fetal heart rate abnormalities.⁶ However in carefully selected high-risk pregnant women, labor induction is associated with higher chance of vaginal delivery with least

maternal and fetal complications. So, whenever the pregnant women are planned for labor induction on clinical grounds, appropriate discussion and counseling of the patient and family members are of utmost important with respect to benefit and risks of obstetrical outcomes.

The present study was conducted to know the factors which were associated with high risk of cesarean delivery in labor-induced pregnant women and to compare the maternal and fetal outcome between spontaneous labor and induced labor pregnant women.

MATERIALS AND METHODS

This retrospective study was conducted in the ESIC Medical College and PGIMS, Chennai, for a period of 6 months from January 2016 to June 2016 after obtaining ethical committee approval with Institute Ethics Committee No. IEC/2019/1/14.

The objectives of the study were:

- To estimate the proportion of pregnant women requiring labor induction.
- To assess the success rate of vaginal delivery among induced pregnant women and to identify the factors which determine the risk of failed induction.
- To compare maternal and neonatal outcome among pregnant women who had induced and spontaneous labor.

Being a retrospective study, the demographic and obstetrical details were obtained from case records. All pregnant women who required labor induction and had spontaneous onset of labor were included. The pregnant women with high-risk obstetrical and medical complications for whom direct cesarean delivery was planned have been excluded from the study.

Labor induction for all low-risk pregnant women was carried out after 39 completed weeks of pregnancy according to the institute protocol. Pregnant women with medical and obstetrical complications were planned for induction of labor after assessing the clinical condition. Induction was resorted with prostaglandin E2 gel intracervically, 3 doses 6–8 hours apart. Oxytocin injection was used for induction and augmentation of labor. Misoprostol and Foley's catheter were not used. Pregnant women were monitored vigilantly for progress of labor. Details regarding mode of delivery, indications for cesarean delivery, and maternal and perinatal outcome were recorded.

Statistical Analysis

For qualitative data, proportions were shown by frequency and percentage. For quantitative data description, mean and standard deviation were calculated. Chi-square test was applied to compare the proportions of various clinical parameters between cesarean and vaginal deliveries. Using binary logistic regression method, all risk factors were estimated (beta coefficient) and expressed as odds ratio (OR) with 95% confidence interval. The statistical significance was considered at $p \leq 0.05$. The data analysis was performed using IBM SPSS Statistics software version 21.

RESULTS

The retrospective data of 301 deliveries which had happened during study period have been collected. The record of nine cases with incomplete data have been omitted from this study. Among total 292 pregnant women, 105 (35.95%) women had required induction of labor and 81 (27.73%) women had spontaneous

labor. About 106 (36.30%) women had direct cesarean delivery due to high-risk obstetrical conditions such as malpresentations, abnormal placentation, complicated postcesarean pregnancy, and superimposed medical conditions (Table 1).

Favorable factors affecting labor induction success well studied till date include young age, multiparity, body mass index (BMI) <30, ripe cervix, and birth weight less than <3.5 kg. Due to unavailability of BMI data in the present study, it was not analyzed.

Among 105 labor induced, 99 (94.3%) women were aged below 35 years and 6 (5.7%) women were aged more than 35 years. Majority 82 (78.1%) were nulliparous and 23 (22%) women were multiparous. Preinduction Bishop score was unfavorable (<5) in 65 (62%) women and favorable (>5) in 40 (38%) women.

The cesarean delivery rate among women aged less than 35 years was 48.4% as compared to 66% in the age-group more than 35 years. Though the cesarean delivery rate was seen comparatively higher in elder group of women in this study, this difference was not found statistically significant ($p = 0.657$); 45 (55%) nulliparous women were found with higher proportion of cesarean delivery as compared to the multiparous women 7 (30.4%) which was found statistically not significant ($p = 0.066$).

The proportion of cesarean section delivery was found higher (69.2%) in the group having poor preinduction cervical ripening Bishop score compared to the those with preinduction Bishop score of more than five (17.5%). It was found statistically significant ($p = 0.0001$). This implies that success of labor induction is directly associated with favorable Bishop score.

Neonatal birth weight less than 3.5 kg and the proportion of cesarean delivery were found higher (50.5%) as compared to neonatal birth weight more than 3.5 kg (40%). This difference was found statistically insignificant at $p = 0.605$.

The factors affecting the success rate of labor induction are shown in the below table (Table 2).

The common indications for labor induction in our study include glucose intolerance, oligohydramnios, premature rupture of membranes (PROM), hypertension complicating pregnancy, and induction for low-risk pregnancy at 40–40⁺⁶ weeks.

Cesarean delivery rate in women who had labor induction for oligohydramnios and glucose intolerance was 56 and 65%, respectively. The number was 35% for PROM and 39% for low-risk labor-induced women, and all hypertensive women had cesarean delivery. When statistically analyzed, none of the indications for labor induction was significantly associated with the risk of cesarean delivery (Table 3).

When the same data were analyzed using adjusted OR, the risk factors (advanced age, nulliparity, neonatal birth weight >3.5 kg) and indication for labor induction (PROM, oligohydramnios, glucose intolerance, hypertensive disorders, and low-risk pregnancy at 40–40⁺⁶ weeks) were found statistically insignificantly associated with increased cesarean delivery rate.

Only the unfavorable Bishop score (less than five) was significantly associated with risks of cesarean delivery ($p = 0.0001$). It is illustrated in table given below (Table 4).

Table 1: Delivery outcomes from the study

Outcomes of delivery	Total deliveries (n = 292)	Percentages
Spontaneous labor	81	27.73%
Induced labor	105	35.95%
Direct cesarean section*	106	36.30%

*Excluded from the study

The given below Table 5 shows the maternal and perinatal outcomes between women who had spontaneous and induced labor. Among 81 women who had spontaneous labor, 64 (79.01%) had vaginal delivery. In 105 induced women, 53 (50.47%) had vaginal

delivery. It suggests that spontaneous labor is associated with higher success rate of vaginal delivery ($p = 0.0001$).

The common maternal complications observed were PPH and wound infection. The incidence of PPH was found to be same

Table 2: Factors affecting success rate of labor induction

Characteristics	Variable	Cesarean delivery (n = 52)	Vaginal delivery (n = 53)	Total (n = 105)	Pearson Chi-square value (df)	p value
Age	<35 years	48 (48.4%)	51 (51.5%)	99 (94.3%)	0.198 (1)	0.657 (NS)
	>35 years	4 (66.6%)	2 (33.3%)	6 (5.7%)		
Parity	Multiparous	7 (30.4%)	16 (69.5%)	23 (21.9%)	3.371 (1)	0.066 (NS)
	Nulliparous	45 (55%)	37 (45%)	82 (78.1%)		
Bishop score	<5	45 (69.2%)	20 (30.7%)	65 (62%)	26.479 (1)	0.0001***
	>5	7 (17.5%)	33 (82.5%)	40 (38%)		
Birth weight	<3.5 kg	48 (50.5%)	47 (49.5%)	95 (90.5%)	1.003 (1)	0.605 (NS)
	>3.5 kg	4 (40%)	6 (60%)	10 (9.5%)		

*** $p < 0.0001$, highly significant; NS, not significant

Table 3: The outcome of Induction of labor based on indications

Indications	Parameter	Cesarean delivery (n = 52)	Vaginal delivery (n = 53)	Total (n = 105)	Pearson Chi-square value (df)	p value
PROM	YES	6 (35.2%)	11 (64.7%)	17 (16.1%)	1.034 (1)	0.309 (NS)
	NO	46 (52.2%)	42 (47.7%)	88 (83.8%)		
Oligohydramnios	YES	10 (55.5%)	8 (44.5%)	18 (17.1%)	0.092 (1)	0.762 (NS)
	NO	42 (48.2%)	45 (51.7%)	87 (83%)		
Glucose intolerance	YES	17 (65.3%)	9 (34.6%)	26 (24.7%)	2.685 (1)	0.101 (NS)
	NO	35 (44.3%)	44 (55.6%)	79 (75.3%)		
Hypertension	YES	3 (100%)	0 (0%)	3 (2.9%)	1.412 (1)	0.235 (NS)
	NO	49 (48%)	53 (52%)	102 (97.1%)		
Induction at 40–40 ⁺ 6 weeks (low risk)	YES	16 (39%)	25 (61%)	41 (39%)	2.317 (1)	0.128 (NS)
	NO	36 (56.2%)	28 (43.7%)	64 (51%)		

NS, not significant

Table 4: Adjusted odds ratio for variables studied in induced labor group

Variables	Odds ratio	p value	95% CI for EXP(B)	
			Lower	Upper
Bishop score (>5)	16.563	0.0001***	4.175	65.710
Parity (nulliparous)	1.549	0.615	0.281	8.540
Age (>35 years)	0.196	0.153	0.021	1.829
Birth weight (>3.5 kg)	0.476	0.383	0.09	2.528
PROM (YES)	1.870	0.723	0.059	59.410
Oligohydramnios (YES)	1.814	0.731	0.061	54.058
Glucose intolerance (YES)	0.612	0.766	0.024	15.52
Hypertension (YES)	0.000	0.999	0.000	—
Low-risk induction at 40–41 weeks (YES)	1.633	0.766	0.064	41.391
Constant	175550504	0.999	—	—

*** $p < 0.0001$, highly significant

Table 5: Outcome depending on mode of onset of labor

Outcomes	Cesarean delivery (n = 69)	Normal delivery (n = 117)	Total (n = 186)	Chi-square test	p value
Induction	52 49.52%	53 50.47%	105	14.757 [†] (1)	0.0001***
Spontaneous	17 20.98%	64 79.01%	81		

*** $p < 0.0001$, highly significant; [†]Continuity correction

in both the groups, two (1.9%) women in induced group and two (2.46%) in spontaneous group. Wound infection was found in two (1.9%) women in induced labor and one (1.23%) woman in spontaneous delivery group. The occurrence of maternal complications in induced labor group compared to spontaneous labor was statistically not significant ($p = 1.000$).

About 45 (42.85%) of the newborn in induction group required neonatal intensive care unit (NICU) admission compared to 29 (35.80%) of the newborn in spontaneous labor group, comparatively more number in induction labor group. However, it was found statistically not significant ($p = 0.410$). The most common indication was hyperbilirubinemia and respiratory distress syndrome. The occurrence of neonatal complications and duration of NICU stay were found statistically not significant between both the groups. It is illustrated in the below table (Table 6).

DISCUSSION

In our study, labor induction in women >35 years was statistically not associated with higher rate of cesarean delivery. Similar results were observed by Cnattingius et al.⁷ However, a recent study by Bergohlt et al. reported that advanced age is associated with increased risks of cesarean section and concluded that absolute risks of cesarean section increase when nulliparous women had induction of labor.⁸

It has been reported that 97% success rate of vaginal delivery in multipara and 76% in nulliparous women when labor induction was carried out.⁹ Present study observed 69.5% success rate of vaginal delivery in multiparous women and 45% in nulliparous women. Ehrenberg et al. observed increased risk of cesarean delivery in labor-induced nulliparous women.¹⁰ Labor induction in nulliparous women was statistically not associated with risks of cesarean delivery in the present study. It is a favorable finding similar to results obtained by a recent multicentric trial by Grobman et al. which reported lower cesarean delivery rate in terms of low-risk labor-induced women.¹¹

When preinduction Bishop score was less than 5, it was significantly associated with risks of cesarean delivery. Similar results were observed in study by Johnson et al.¹² They concluded that significant parameters influencing higher cesarean section rate were unfavorable Bishop score.

Among labor-induced group, when the neonatal birth weight was more than 3.5 kg, 40% women had cesarean delivery and 60% woman had vaginal delivery. In our study, neonatal weight >3.5 kg was statistically not associated with the risks of cesarean delivery, which was different from the results obtained by a retrospective cross-sectional study by Bettinelli et al. They reported that maternal age <35 years, birth weight <3.5 kg, multiparity, and high Bishop score are protective factors for vaginal delivery.¹³

When labor induction was carried out for PROM, it was statistically not associated with the risks of cesarean delivery. A cohort study by Puhl et al. also observed similar findings when labor induction performed in pregnant women with PROM and premature preterm rupture of membranes.¹⁴

Our study has shown that labor induction for oligohydramnios was not statistically associated with high risk for cesarean deliveries. A study by Manzanares et al.¹⁵ and Melamed et al.¹⁶ reported higher rate of cesarean section when labor was induced for isolated oligohydramnios.

A large population study by Rosenberg et al. has shown significant association between cesarean deliveries in women with presentational as well as gestational diabetes mellitus.¹⁷ In our study, the risk of cesarean section was statistically not associated, which is similar to results obtained by Grabowska K et al.¹⁸ They concluded that gestational diabetes mellitus women could have higher risk of cesarean section; however, when labor induction was carried out in them, it was not associated with the risks of cesarean delivery.

American College of Obstetrician and Gynecologist recommendation is to plan termination of pregnancy for mild preeclampsia and gestational hypertension at 37 weeks of gestation and for severe preeclampsia at 34 weeks of gestation.

Table 6: Maternal and neonatal outcome in spontaneous and induced labor

Characteristics	Category	Induction labor n = 105		Spontaneous labor n = 81		Total	Pearson Chi-square	
		N (column %)	(row %)	N (column %)	(row %)		value (df)	p value
Maternal complications	PPH	2 (1.9%)	50%	2 (2.46%)	50%	4	0.000 [†]	1.000 (NS)
	Wound infection	2 (1.9%)	67%	1 (1.23%)	33%	3		
NICU Adm.	NO	60 (57.14%)	54%	52 (64.19%)	46%	112	0.678 (1)	0.410 (NS)
	YES	45 (42.85%)	61%	29 (35.80%)	39%	74		
	Hyperbilirubinemia	16 (15.23%)	76%	5 (6.17%)	24%	21		
	Respiratory distress syndrome	11 (10.47%)	42%	15 (18.51%)	58%	26		
	Low birth weight	10	77%	3	23%	13		
	Hypoxic ischemic Encephalopathy	2	50%	2	50%	4		
	Hypoglycemia	2	100%	0	0%	2		
	Sepsis	0	0%	2	100%	2		
Duration of NICU stay	Birth defects	4	67%	2	33%	6		
	1–2 days	13	52%	12	47%	25	11.370 (10)	0.329 (NS)
	3–7 days	29	67%	14	33%	43		
	13–21 days	3	50%	3	50%	6		

NS, not significant; [†]Continuity correction

It has been observed that expectant management beyond above gestational age is associated with increased maternal and neonatal complications.¹⁹

A retrospective database study by Zhang et al. showed that more than half of the women with preeclampsia and eclampsia had cesarean delivery.²⁰ Our study did not show a significant association between hypertensive disorders of pregnancy and cesarean delivery despite all hypertensive women had a cesarean delivery.

It has been stated that as the pregnancy advances beyond due date, the risk of neonatal morbidity and mortality increases.¹ American College of Obstetrician and Gynecologist and FIGO recommendations are to plan for elective delivery for low-risk women after completion of 39 weeks. In our study, labor induction for low-risk pregnant women at 40–40⁺⁶ weeks was statistically not associated with risks of cesarean delivery. This has been a favourable outcome which was similar to findings of recent retrospective cohort study.²¹ A recent multicentric trial observed similar findings. They reported that labor induction in low-risk nulliparous women at 39 weeks results in a lower frequency of cesarean delivery.¹¹

Guerra et al. observed 88.2% success rate of vaginal delivery in electively labor-induced low-risk pregnancies with increased maternal and neonatal complications.²² A recent retrospective study by Panicker et al. have observed 74.69% success rate of vaginal delivery among labour induced women.²³ In our study, the success rate of vaginal delivery in induced labor group was 50.47% compared to 79.01% in spontaneous delivery group and was found to be statistically significant. The occurrence of maternal and perinatal complications between induced and spontaneous labor group was statistically not significant. A study by Osmundson et al.²⁴ and Gibson et al.²⁵ observed favorable perinatal outcome in induced labor of nulliparous women.

Major limitation of present study was retrospective. Expected significant associations for a few variables (birth weight, oligohydramnios, hypertensive disorders of pregnancy) were not obtained in this study. The given sample size may not be enough to prove it. We may recommend further prospectively designed research for analyzing the same for the better management for pregnant women.

CONCLUSION

To curtail the increase in cesarean delivery rate, there is definite need for induction of labor. The factors associated with risk of cesarean delivery such as advanced age, nulliparity, neonatal birth weight >3.5 kg, and labor induction for medical and obstetrical conditions (oligohydramnios, glucose intolerance, hypertension, PROM, and low-risk pregnancy) were not associated. Induction of labor could be offered to such pregnant women after assessing the clinical condition with appropriate counseling. Women with unfavorable preinduction Bishop score were at higher risk for cesarean delivery. Mechanical methods and sweeping of membranes may be attempted prior to pharmacological methods of labor induction in such pregnant women. The proportion of vaginal delivery rate was higher in women who had spontaneous labor compared to induced labor women with insignificant maternal and neonatal complications between both groups.

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