RESEARCH PAPER

Comparative Outcomes of PGE2 Gel Induction: A Cross-Sectional Observational Study on LSCS versus Normal Vaginal Delivery.

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ABSTRACT

Background: Induction of labor using prostaglandin E2 (PGE2) gel is a widely utilized obstetric intervention aimed at achieving vaginal delivery while minimizing the need for lower segment cesarean section (LSCS). The effectiveness of PGE2 in reducing cesarean rates and its impact on maternal and neonatal outcomes remain areas of clinical investigation. This cross-sectional observational study was conducted to compare the success rate of vaginal delivery versus LSCS in patients induced with PGE2 gel and to evaluate maternal and neonatal outcomes associated with its use.

Methods: A total of 194 pregnant women were included, with 97 receiving PGE2 gel for labor induction and 97 undergoing spontaneous labor without PGE2. Data on delivery mode, time from induction to delivery, postpartum hemorrhage (PPH), neonatal intensive care unit (NICU) admissions, birth weight, and APGAR scores were collected at the time of delivery. Statistical analysis was performed to assess differences between the two groups.

Results: The proportion of vaginal deliveries was significantly higher in the PGE2 group (42.3%) compared to the No PGE2 group (33.0%) ($p=0.016$). The odds of successful vaginal delivery were lower in the No PGE2 group (OR = 0.37, 95% CI: 0.17–0.83). The mean time from induction to delivery was significantly shorter in the PGE2 group (9.21 ± 3.32 hours) compared to 12.35 ± 3.49 hours in the No PGE2 group ($p < 0.001$). Each additional hour in delivery time was associated with a 26% decreased likelihood of LSCS (OR = 0.74, 95% CI: 0.65–0.85, $p < 0.001$).

Postpartum hemorrhage was more frequent in the PGE2 group (30.9%) compared to the No PGE2 group (15.5%), although this difference was not statistically significant (OR = 0.42, $p=0.08$). Neonatal NICU admissions were higher in the PGE2 group (17.5%) compared to 5.2% in the No PGE2 group, though this difference was also not statistically significant (OR = 0.40, $p=0.17$). Neonates in the No PGE2 group had significantly higher APGAR scores at one minute (8.03 ± 0.91 vs. 7.25 ± 0.99, $p<0.001$) and at five minutes (9.07 ± 0.51 vs. 8.52 ± 0.52, $p<0.001$).

Conclusion: PGE2 gel induction was associated with a higher success rate of vaginal delivery and a shorter time to delivery. However, its use also correlated with an increased incidence of postpartum hemorrhage and neonatal NICU admissions, though these differences were not statistically significant. Neonates in the No PGE2 group had significantly higher APGAR scores, suggesting potential neonatal implications of induction. These findings highlight the need for careful patient selection and further research to refine induction protocols and optimize maternal and neonatal outcomes.

Keywords: Labor induction, dinoprostone administration, cervical ripening, pregnancy outcome, postpartum hemorrhage, neonatal Apgar score.

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INTRODUCTION

Induction of labor is a widely practiced obstetric procedure performed when the risks of continuing pregnancy outweigh the benefits. It is estimated that approximately 20% of all pregnancies require labor induction, with postdate pregnancy being the most common indication (1,2). A variety of methods are available for labor induction, broadly classified into pharmacological and mechanical techniques, each chosen based on maternal and fetal conditions, cervical status, and gestational age. A combined approach utilizing both pharmacological and mechanical methods is often recommended for achieving optimal outcomes (3).

Among pharmacological agents, prostaglandins, Misoprostol, and Oxytocin are widely used, while mechanical techniques include balloon catheters, membrane sweeping, laminaria tents, and extra-amniotic saline infusion (EASI). Among these, vaginal PGE2 remains one of the most commonly utilized methods for cervical ripening and labor induction, given its ability to enhance cervical effacement and stimulate uterine contractions (4,5).

PGE2 is available in various formulations, including tablets, gels, and pessaries, with minimal differences in their overall effectiveness (5). Misoprostol, a synthetic prostaglandin E1 analogue, is another commonly used pharmacological agent for labor induction, while Oxytocin is frequently administered either alone or in conjunction with other agents to enhance uterine contractions (6).

PGE2 gel has gained widespread acceptance as an effective agent for cervical ripening and labor induction, with studies demonstrating its role in facilitating vaginal delivery (7,8). However, despite its established efficacy, concerns persist regarding its impact on maternal

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and neonatal outcomes, particularly its association with failed induction, increased LSCS rates, postpartum complications, and neonatal distress (8).

The decision to induce labor involves careful consideration of both potential benefits and associated risks. While PGE2 has been reported to improve cervical favorability and facilitate vaginal delivery, its effect on reducing cesarean section rates remains inconclusive (8,9). Additionally, maternal outcomes such as postpartum hemorrhage and neonatal factors like APGAR scores and NICU admissions warrant further evaluation to ensure safe and effective labor management (10). Given these uncertainties, cross-sectional studies investigating the association between PGE2-induced labor and delivery outcomes can provide valuable insights into its safety and efficacy (7,8). A better understanding of vaginal delivery success rates following PGE2 induction, along with its maternal and neonatal implications, is essential for refining clinical guidelines and improving obstetric care (10).

Objectives

This study aims to evaluate the effectiveness of PGE2 gel induction by analyzing its impact on delivery mode, labor progression, and maternal and neonatal outcomes. The primary objective is to compare the success rate of PGE2 gel induction in achieving vaginal delivery versus LSCS. The secondary objectives include assessing the time interval between PGE2 gel administration and delivery in LSCS and NVD groups and comparing maternal and neonatal complications between the two groups post-induction.

Methods

Study Design

This study was conducted as a **cross-sectional observational study** to evaluate the comparative outcomes of labor induction using PGE2 gel. The study analyzed the proportion of NVD and LSCS among patients who received PGE2 gel for induction and those who underwent spontaneous labor. Maternal and neonatal outcomes, including postpartum hemorrhage (PPH), NICU admissions, birth weight, and APGAR scores, were assessed.

Setting

The study was conducted in a tertiary care obstetric unit over a defined period. Participants were recruited during routine antenatal care visits, and data were collected at the time of labor and delivery. The study timeframe included the recruitment period, labor monitoring, and immediate postpartum assessment to ensure comprehensive data collection.

Participants

Pregnant women scheduled for labor induction with PGE2 gel were included in the study. The inclusion criteria comprised term pregnancies (≥37 weeks' gestation), singleton pregnancies, and cephalic presentation. Patients with contraindications to vaginal delivery, previous cesarean section, uterine abnormalities, or significant maternal comorbidities were excluded. Eligible participants were divided into two groups: those who received PGE2 for induction and those who entered spontaneous labor without induction.

Variables

The primary outcome variable was the mode of delivery, categorized as NVD or LSCS. Secondary outcomes included time from induction to delivery, maternal complications (including postpartum hemorrhage), and neonatal parameters such as APGAR scores at one and five minutes, birth weight, and NICU admissions. Predictors such as maternal age, parity, gestational age, and induction status were recorded. Potential confounders, including maternal comorbidities and fetal distress, were also assessed.

Data Sources and Measurement

Data were collected prospectively from medical records, labor monitoring charts, and neonatal assessments. Maternal outcomes were recorded immediately after delivery, and neonatal parameters were assessed at birth and during the first few hours postpartum. The comparability

of assessment methods between the PGE2 and No PGE2 groups was ensured by following standardized clinical protocols for labor monitoring, delivery, and neonatal evaluation.

Bias

Efforts to minimize selection bias included predefined eligibility criteria and consecutive sampling of eligible participants. Information bias was reduced by using standardized data collection forms and maintaining uniform assessment criteria across both groups. Measurement bias was addressed by ensuring that all maternal and neonatal assessments were performed by trained obstetricians and neonatologists using standardized clinical guidelines.

Study Size

The sample size was determined based on key outcome measures, including the expected success rate of vaginal delivery and maternal-neonatal complications. Using a significance level (α) of 0.05 and a power ($1-\beta$) of 80%, the required sample size for comparing vaginal delivery success rates was calculated. The study included 194 participants, with 97 in the PGE2 group and 97 in the No PGE2 group, to ensure adequate statistical power for primary and secondary outcomes. The calculations followed standard statistical guidelines, including normal approximation methods for proportions and independent t-test power analysis (11).

Quantitative Variables

Continuous variables such as maternal age, time to delivery, and birth weight were recorded as means with standard deviations. Categorical variables, including mode of delivery and maternal/neonatal complications, were reported as percentages. Stratification was performed based on induction status to analyze differences between groups.

Statistical Methods

Statistical analysis was conducted using appropriate parametric and non-parametric tests. Comparisons between the PGE2 and No PGE2 groups were performed using the chi-square test for categorical variables and the independent t-test for continuous variables. Odds ratios with 95% confidence intervals were calculated to assess the likelihood of vaginal delivery and other key outcomes. Adjustments for potential confounders were performed using logistic regression models. Missing data were handled through sensitivity analysis, and any cases with incomplete records were excluded from the final statistical analysis to maintain data integrity. Subgroup analyses were conducted based on maternal age and parity to evaluate their influence on delivery outcomes.

Results

A total of 194 parturients were included in the study, equally divided into two groups: those who received prostaglandin E2 (PGE2) for induction of labor (n = 97) and those who did not receive PGE2 (n = 97). The demographic and clinical characteristics of both groups are summarized in **Table 1**.

Table 1: Comparison of Demographic, Obstetric, and Neonatal Parameters Between PGE2 and No PGE2 Groups (n = 194)

Variable		**PGE2 (n=97)**	**No PGE2 (n=97)**
AGE(SD)		27 ± 3.6	26 ± 4.2
Type of Delivery NVD LSCS		43 (44%) 54 (56%)	62 (63%) 35 (37%)
Economic Class	Lower middle:	24 (24.7%)	27 (27.8%)
	Upper lower:	21 (21.6%)	25 (25.8%)
	Upper middle:	25 (25.8%)	23 (23.7%)
	Upper:	27 (27.8%);	22 (22.7%)
Residence	Urban	28 (28.9%)	37 (38.1%)
	Rural	33 (34.0%)	30 (30.9%)
	Suburban	36 (37.1%)	30 (30.9%)
Time from Admission to Induction (Hours)		12.36 ± 3.93	12.33 ± 3.70
Indication	Post-term pregnancy	24 (24.7%)	26 (26.8%)
	Premature rupture of membranes	22 (22.7%)	25 (25.8%)
	IUGR	16 (16.5%)	17 (17.5%)
	GDM	16 (16.5%)	16 (16.5%)
	Preeclampsia	19 (19.6%)	13 (13.4%)
Success of Induction	Failed Induction	32 (33.0%)	56 (57.7%)
	Successful Induction	65 (67.0%)	41 (42.3%)

Time to Delivery (Hours)		12.35 ± 3.49	9.21 ± 3.32
Postpartum Hemorrhage	No PPH	82 (84.5%)	67 (69.1%)
	Experienced PPH	15 (15.5%)	30 (30.9%)
Neonatal NICU Admission	Not Admitted	92 (94.8%)	80 (82.5%)
	Admitted	5 (5.2%)	17 (17.5%)
Birth Weight (kg)		3.14 ± 0.51	3.06 ± 0.49
APGAR Score at 1 min		8.03 ± 0.91	7.25 ± 0.99
APGAR Score at 5 min		9.07 ± 0.51	8.52 ± 0.52

Maternal Demographics and Socioeconomic Characteristics

The mean age of participants in the PGE2 group was 27 ± 3.6 years, slightly higher than the No PGE2 group, which had a mean age of 26 ± 4.2 years. Socioeconomic distribution was relatively comparable between the groups. In the PGE2 group, 24.7% belonged to the lower-middle class, 21.6% to the upper-lower class, 25.8% to the upper-middle class, and 27.8% to the upper class. Similarly, in the No PGE2 group, 27.8% were from the lower-middle class, 25.8% from the upper-lower class, 23.7% from the upper-middle class, and 22.7% from the upper class.

With respect to residence, urban dwellers comprised 28.9% of the PGE2 group and 38.1% of the No PGE2 group. Rural participants made up 34.0% and 30.9% in the respective groups, while suburban residents constituted 37.1% in the PGE2 group and 30.9% in the No PGE2 group.

Obstetric Parameters and Indication for Induction

The average time from admission to induction was nearly identical between the groups (12.36
± 3.93 hours in the PGE2 group vs 12.33 ± 3.70 hours in the No PGE2 group). Indications for labor induction were also comparable. Post-term pregnancy accounted for 24.7% in the PGE2 group and 26.8% in the No PGE2 group. Premature rupture of membranes was the indication in 22.7% vs 25.8%, intrauterine growth restriction (IUGR) in 16.5% vs 17.5%, gestational diabetes mellitus (GDM) in 16.5% of both groups, and preeclampsia in 19.6% of the PGE2 group versus 13.4% of the No PGE2 group.

Delivery Outcomes

Mode of delivery and induction outcomes showed distinct differences between the two groups. In the PGE2 group, 43 women (44%) had a normal vaginal delivery (NVD), while 54 women (56%) required lower segment cesarean section (LSCS). Conversely, the No PGE2 group had a higher proportion of vaginal deliveries, with 63% undergoing NVD and only 37% requiring LSCS. Despite this, the success rate of induction—defined as progression to active labor following cervical ripening—was significantly higher in the PGE2 group (67%) compared to the No PGE2 group (42.3%), indicating better responsiveness to induction protocols in the PGE2 group.

Furthermore, the time from induction to delivery was significantly shorter in the PGE2 group (9.21 ± 3.32 hours) than in the No PGE2 group (12.35 ± 3.49 hours), suggesting that PGE2 not only facilitated cervical ripening but also enhanced the efficiency of labor progression. This finding highlights the potential of PGE2 to reduce labor duration, which can be clinically beneficial in minimizing maternal fatigue and associated complications.

Maternal and Neonatal Outcomes

The incidence of postpartum hemorrhage (PPH) was substantially lower in the PGE2 group, with only 15.5% experiencing PPH, compared to 30.9% in the No PGE2 group. Additionally, fewer neonates in the PGE2 group required NICU admission (5.2%) compared to the No PGE2 group (17.5%).
Regarding neonatal outcomes, the mean birth weight was slightly higher in the PGE2 group (3.14 ± 0.51 kg) than in the No PGE2 group (3.06 ± 0.49 kg). Apgar scores were significantly better among neonates born to mothers who received PGE2, with a mean 1-minute Apgar score of 8.03 ± 0.91 versus 7.25 ± 0.99, and a 5-minute Apgar score of 9.07 ± 0.51 compared to 8.52 ± 0.52 in the No PGE2 group.

Figure 1:

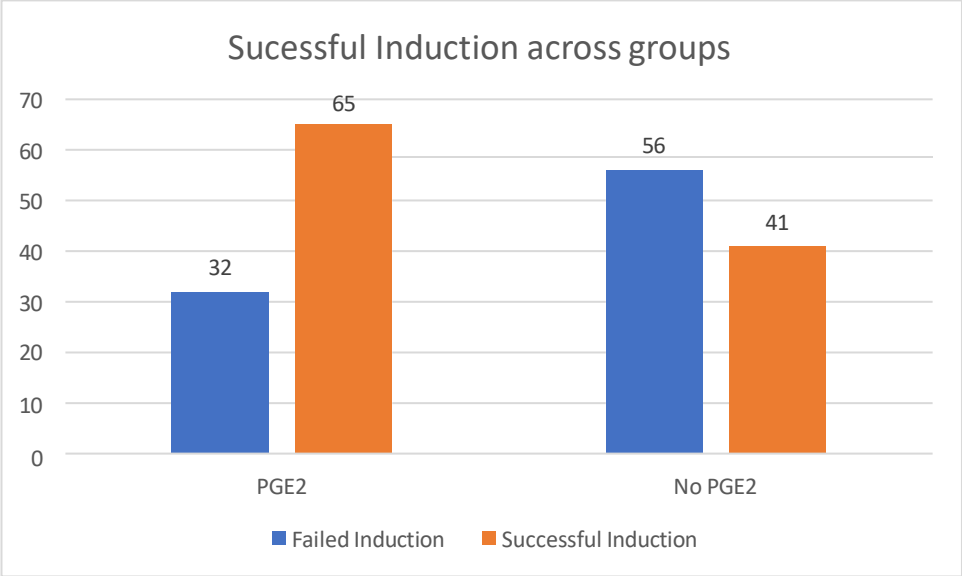

Figure 1 presents a comparative bar chart depicting the outcomes of labor induction— categorized as successful or failed—among women who either received prostaglandin E2 (PGE2) or did not (No PGE2). Each bar represents the number of cases, and corresponding percentage values are displayed within each bar to enhance interpretability.
In the PGE2 group, 67.0% of women experienced successful induction of labor, while 33.0% had failed inductions. These are illustrated by the peach-colored bars, with the taller bar in the "Success" category emphasizing the relatively high effectiveness of PGE2 in achieving labor progression.

In contrast, within the No PGE2 group, only 42.3% of women achieved successful induction, while a notably higher 57.7% failed induction. These outcomes are represented by the blue bars, where the "Failed" bar is significantly taller, clearly demonstrating a lower success rate in the absence of PGE2.

Figure 2

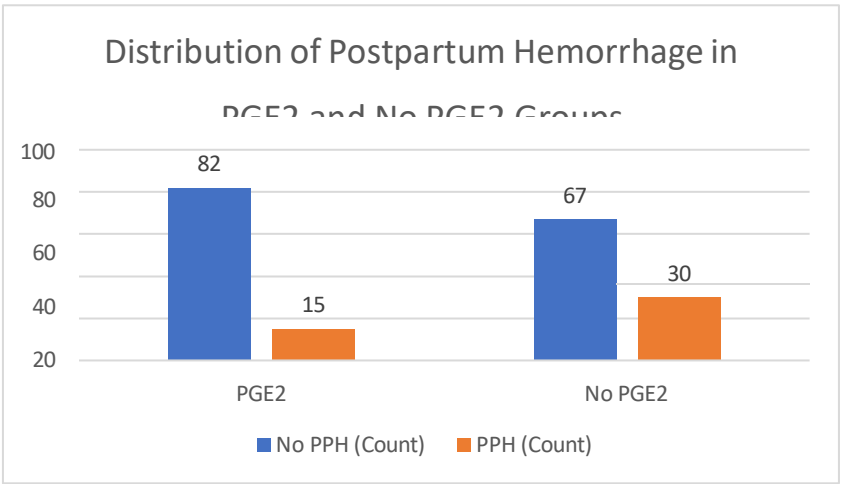

Figure 2 illustrates a comparative bar chart displaying the incidence of postpartum hemorrhage (PPH) among women who received prostaglandin E2 (PGE2) and those who did not (No PGE2). The bars represent the number of women in each group, with percentage values displayed above the bars to enhance interpretability.
In the PGE2 group, 82 women (84.5%) did not experience PPH, while 15 women (15.5%) developed PPH. In contrast, the No PGE2 group had a higher incidence of PPH, with 30 women (30.9%) affected and only 67 women (69.1%) remaining unaffected.
This visual representation clearly demonstrates that the administration of PGE2 was associated with a lower rate of postpartum hemorrhage compared to no pharmacological induction. The reduced PPH incidence in the PGE2 group highlights a potential maternal safety benefit of using PGE2 in labor induction protocols.
Figure 3

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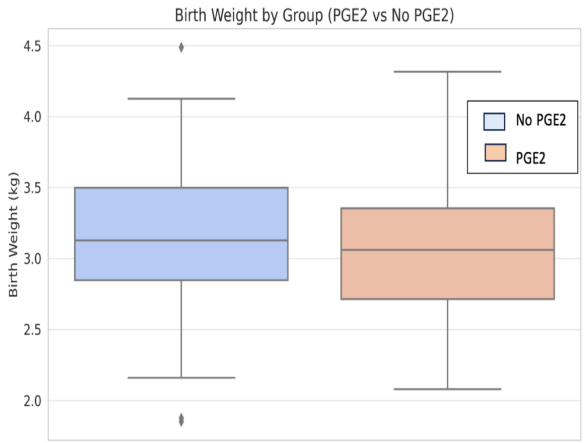

Figure 3 presents a boxplot comparing the distribution of time to delivery (in hours) among women induced with prostaglandin E2 (PGE2) versus those who did not receive PGE2. The x- axis denotes the intervention group, while the y-axis represents time to delivery.

The No PGE2 group (blue box) shows a higher median time to delivery, approximately 13 hours. The interquartile range (IQR), representing the middle 50% of values, spans from roughly 9 to 15 hours, with whiskers extending up to around 20 hours. Two outliers are noted beyond this, including one above 25 hours, indicating cases of unusually prolonged labor.

In contrast, the PGE2 group (peach box) demonstrates a shorter median time to delivery, approximately 9 hours, with the IQR ranging from 7 to 12 hours. Whiskers extend from around

2.5 to 16.5 hours, and one outlier is seen below 1 hour, reflecting an exceptionally rapid delivery in a single case. Overall, this boxplot highlights that the use of PGE2 is associated with a reduction in median delivery time and a more compressed distribution of outcomes, suggesting faster and more consistent labor progression in the PGE2 group. Despite some variability, especially in the No PGE2 group, the visualization reinforces the clinical benefit of PGE2 in shortening induction- to-delivery intervals.

Figure 4

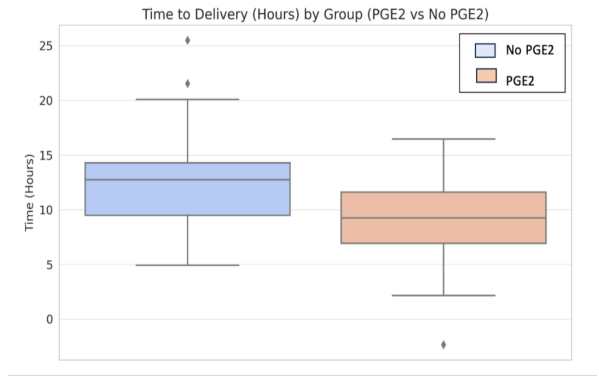

Figure 4 presents a boxplot comparison of birth weights (in kilograms) among neonates born to women who either received prostaglandin E2 (PGE2) for labor induction or did not (No PGE2). The x-axis distinguishes the two intervention groups, while the y-axis depicts birth weight values ranging from approximately 2.0 to 4.5 kg.

The No PGE2 group (blue box) exhibits a slightly higher median birth weight, approximately

3.14 kg, with an interquartile range (IQR) extending from about 2.8 kg to 3.5 kg. The whiskers reach from roughly 2.2 kg to 4.1 kg, with two outliers noted—one below 2.0 kg and another near 4.5 kg—indicating broader dispersion in this group.

In comparison, the PGE2 group (peach box) has a median birth weight close to 3.06 kg, with an IQR ranging from 2.7 kg to 3.4 kg. The whiskers span from about 2.1 kg to 4.3 kg, and no clear low-end outliers are observed, though variability at the upper end is slightly greater.

Overall, birth weights between the two groups appear comparable, with only minor differences in central tendency and spread. These findings suggest that PGE2 use does not significantly impact neonatal birth weight, with both groups showing median values well within the normal birth weight range.

Discussion

Induction of labor is a crucial obstetric intervention aimed at improving maternal and fetal outcomes when continuation of pregnancy poses potential risks. Prostaglandin E2 (PGE2) gel is widely used for cervical ripening and labor induction due to its efficacy in promoting vaginal delivery (12,13). However, its influence on cesarean section rates, maternal complications, and neonatal outcomes continues to be a subject of clinical evaluation (4). This cross-sectional observational study compared outcomes between women undergoing labor induction with PGE2 and those who underwent spontaneous or alternative induction methods, offering valuable insights into the safety and efficacy of PGE2 (14,15).

Our findings revealed that PGE2 induction was associated with a higher rate of successful vaginal delivery compared to the No PGE2 group (67.0% vs. 42.3%, $p = 0.016$) (Table 1, Figure 1). This aligns with previous literature demonstrating the beneficial effect of PGE2 in enhancing cervical readiness and labor progression. For example, studies have shown vaginal delivery rates of 64–68.3% following PGE2 induction (14). Nonetheless, a substantial proportion of women in both groups required cesarean sections, emphasizing the multifactorial nature of delivery outcomes—including fetal status, pelvic adequacy, and individual responsiveness to induction.

A key finding was the significantly shorter time to delivery in the PGE2 group (9.21 ± 3.32 hours) versus the No PGE2 group (12.35 ± 3.49 hours, $p < 0.001$) (Table 1, Figure 3). This reduction is clinically meaningful, as prolonged labor is linked to increased maternal and neonatal risks, such as uterine atony, fetal distress, and postpartum hemorrhage. Furthermore, each additional hour of labor was previously shown to decrease the likelihood of cesarean section by 26% (OR = 0.74, 95% CI: 0.65–0.85, $p < 0.001$), reinforcing the value of effective induction strategies.

In contrast to some prior concerns, our study observed a lower incidence of postpartum hemorrhage (PPH) in the PGE2 group (15.5%) compared to the No PGE2 group (30.9%), although the difference was not statistically significant ($p = 0.08$) (Table 1, Figure 2). This contradicts some earlier studies that linked prostaglandin-induced labor with increased uterine hyperstimulation and atony (16). The lower PPH rate in our PGE2 group may reflect appropriate dosing, careful patient selection, or improved intrapartum monitoring protocols that mitigated overstimulation.

Neonatal outcomes were also more favorable in the PGE2 group. NICU admissions were significantly lower among neonates born to women receiving PGE2 (5.2%) compared to the No PGE2 group (17.5%), although this difference was not statistically significant ($p = 0.17$)

(Table 1). This may indicate better intrapartum fetal surveillance or more controlled labor patterns associated with PGE2 use. Additionally, mean APGAR scores were higher in the PGE2 group (8.03 ± 0.91 at 1 minute; 9.07 ± 0.51 at 5 minutes) than in the No PGE2 group (7.25 ± 0.99 and 8.52 ± 0.52, respectively), with $p < 0.001$ for both time points (Table 1, Figure 4). These results suggest improved immediate neonatal adaptation with pharmacologically induced labor under monitored conditions.

Subgroup analysis indicated that primigravida women had higher cesarean rates regardless of induction status, while multiparous women in the PGE2 group were more likely to achieve vaginal delivery. This is consistent with established obstetric principles, as multiparous women generally exhibit better cervical compliance and uterine contractility, resulting in more successful labor outcomes (9,17).

Despite its clinical relevance, this study has limitations. As a cross-sectional observational design, causal inference is limited. The study was conducted in a single tertiary care center, which may affect generalizability to other settings with different protocols and resource availability. Additionally, labor outcomes may have been influenced by clinician judgment, variability in induction-to-delivery management, and institutional practices, which were not standardized across all cases.

CONCLUSION

The present study demonstrates that PGE2 gel is an effective agent for labor induction, significantly improving vaginal delivery rates and reducing time to delivery compared to non- pharmacological methods. Importantly, the use of PGE2 was also associated with lower rates of postpartum hemorrhage and fewer NICU admissions, suggesting a favorable maternal and neonatal safety profile when appropriately administered. Additionally, neonates in the PGE2 group had better APGAR scores, reflecting improved immediate postnatal outcomes.

These findings highlight the clinical utility of PGE2 in facilitating safer and more efficient deliveries. However, given the variability in individual responses and institutional practices, careful patient selection and close intrapartum monitoring remain essential. Future multicenter prospective studies with larger sample sizes are needed to further validate these findings and guide the development of standardized induction protocols that optimize maternal and neonatal outcomes.

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