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Emerging Applications of Prostaglandins in Obstetric Practice: A One-Year Prospective Evaluation of Their Use in Labour Induction, Abortion, and PPH Management at a Tertiary Care Center

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Abstract

Background: Prostaglandins are widely used in obstetric practice for labour induction, medical abortion, and postpartum haemorrhage (PPH) management. Recent innovations in dosing strategies and delivery mechanisms have expanded their applications and improved safety profiles.

Objective: To evaluate the clinical outcomes, effectiveness, and tolerability of prostaglandin-based interventions in real-world obstetric scenarios, including labour induction, abortion, and PPH, at a tertiary care centre in Eastern India.

Methods: This was a prospective, observational study conducted over one year at Barasat Government Medical College. A total of 100 patients were categorized into three clinical groups: labour induction (n = 40), medical abortion (n = 35), and PPH management (n = 25). Variables included drug type, route, clinical success, complications, and intervention timelines. Data were analyzed using SPSS for descriptive statistics and R for visualizations and subgroup analysis.

Results: Vaginal delivery was achieved in 72.5% of induction cases, with a mean induction-to-delivery interval of 10.6 ± 3.2 hours. Complete abortion without surgical evacuation occurred in 91.4% of abortion cases. Bleeding was controlled medically in 88.0% of PPH cases, with a mean estimated blood loss of 480.5 ± 125.3 mL. Adverse effects were mostly mild and dose-dependent across all groups.

Conclusion: Prostaglandins remain highly effective and versatile agents in obstetric care. Their real-world application across three major interventions demonstrated strong clinical outcomes with manageable side effects. Continued evaluation of dose-optimization, delivery methods, and patient selection can further improve maternal outcomes in both high-resource and public health settings.

Keywords: Prostaglandins, Labor Induction, Medical Abortion, Postpartum Haemorrhage, Obstetric Outcomes.

INTRODUCTION

Prostaglandins (PGs) are lipid compounds that play a central role in the physiological regulation of the female reproductive tract. In obstetric practice, their use has evolved from simple uterotonics to carefully timed, dose-adjusted agents deployed in a range of indications including labour induction, medical abortion, and postpartum haemorrhage (PPH) management. The pharmacological versatility of prostaglandins—particularly PGE1 (misoprostol) and PGE2 (dinoprostone)—has made them indispensable in both high-resource and low-resource settings **[1].**

Labor induction with prostaglandins is one of the most established uses. They act by promoting cervical ripening and enhancing myometrial contractility. A recent real-world data analysis (RIPE study) confirmed that vaginal prostaglandin inserts remain effective for labour induction across a range of gestational profiles, with outcomes comparable to oxytocin augmentation strategies [2]. Misoprostol and dinoprostone remain the most commonly used analogues, with growing evidence supporting sequential or outpatient protocols for improved maternal satisfaction and reduced caesarean rates **[3].**

In the realm of medical abortion, prostaglandins—often used in combination with mifepristone—have become the global standard. Misoprostol, in particular, has demonstrated high success rates in both first- and second-trimester abortion protocols **[4].** Despite wide acceptance, emerging data highlights the importance of optimizing dosing schedules and administration routes to improve efficacy and reduce side effects, especially in outpatient or low-supervision scenarios.

Postpartum haemorrhage (PPH) continues to be a major contributor to maternal morbidity and mortality, particularly in India. Misoprostol and carboprost are widely used as second-line agents after oxytocin. A recent real-world study

highlighted the effectiveness of prostaglandins in reducing blood loss when used alongside uterotonics like oxytocin, especially in vaginal deliveries **[5].** This supports the growing strategy of combination therapy for enhanced haemostasis in high-risk deliveries.

Beyond their established roles, newer insights into the mechanistic pathways of prostaglandins are emerging. There is increasing interest in receptor-specific delivery, particularly targeting prostaglandin E receptors (EP1–EP4), which may allow for more tailored uterine responses with fewer systemic side effects **[6].** These developments are paving the way for individualized therapies, balancing efficacy with safety, especially in complex obstetric scenarios such as VBAC or placenta previa.

Despite these advancements, there remains a lack of region-specific, real-world data on how prostaglandins are being used across different obstetric indications in Indian tertiary care settings. This study was conducted to fill that gap, evaluating the use of prostaglandins in labour induction, abortion, and PPH over a one-year period at Barasat Government Medical College. By assessing clinical practices, dosing patterns, and outcomes, this study aims to provide actionable insights to optimize future prostaglandin use in resource-diverse obstetric environments.

MATERIALS AND METHODS

Study Design

This was a prospective, observational, single-center study conducted at Barasat Government Medical College and Hospital, West Bengal, over a period of one year. The study aimed to evaluate the clinical applications and outcomes of prostaglandin use in three key obstetric interventions: labor induction, medical abortion, and postpartum hemorrhage (PPH) management. A total of 100 patients were enrolled after obtaining informed written consent, following ethical clearance from the institutional ethics committee.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Pregnant women aged 18–45 years undergoing:
- Labor induction at ≥37 weeks gestation
- First or second trimester medical abortion (≤20 weeks)
- Pharmacological management for postpartum hemorrhage within 24 hours of delivery
- Hemodynamically stable at the time of intervention
- Willingness to participate and provide informed consent

Exclusion Criteria:

- Known hypersensitivity to prostaglandins (PGE1/PGE2 or PGF2α analogs)
- Co-existing coagulopathies or active severe anemia (Hb<7 g/dL)
- Previous uterine rupture or major uterine surgery (except one prior lower segment cesarean)
- Pre-existing cardiac, hepatic, or renal impairment
- Incomplete clinical records or refusal to participate

Variables Collected

Data were collected through structured clinical forms and hospital records and categorized as follows:

Demographic and Baseline Clinical Variables:

- Age, parity, gravida, gestational age (in obstetric cases)
- Type of obstetric intervention (labor induction, abortion, or PPH)
- Prior obstetric history (e.g., cesarean, uterine anomalies)

Prostaglandin Use Variables:

- Type of prostaglandin used (misoprostol, dinoprostone, carboprost)
- Route of administration (oral, sublingual, vaginal, rectal, intramuscular)
- Dose and frequency
- Time to clinical response (e.g., onset of labor, complete abortion, bleeding control)

Outcome Variables:

- Successful completion of intervention without surgical assistance
- Time to induction-to-delivery interval (in labor induction)
- Completeness of abortion (need for D&C)
- Estimated blood loss and duration of bleeding (in PPH cases)
- Maternal complications: nausea, vomiting, fever, shivering, uterine hyperstimulation, retained placenta, etc.
- Neonatal outcomes in labor cases: Apgar score at 5 minutes, NICU admission

Time Points of Data Collection

Clinical data were collected at multiple time points to comprehensively capture baseline characteristics, treatment details, and clinical outcomes. At baseline, information was recorded at the time of patient admission and initiation of prostaglandin-based intervention, including demographic details and indication for use (labour induction, abortion, or PPH management). During the procedure, all relevant drug administration data, patient responses, and immediate clinical parameters were monitored and documented. Post-intervention follow-up varied by indication: outcomes for PPH were assessed within 24 hours, abortion-related endpoints were evaluated within 48 hours, and labour induction cases were followed through until delivery. In cases of live births, neonatal outcomes were assessed at 5 minutes (Apgar score) and during the immediate postpartum period on day one.

Statistical Analysis

All collected data were first organized using Microsoft Excel and subsequently analyzed with a combination of IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Released 2019, Armonk, NY) and R version 4.1.2 (R Core Team, 2021). Descriptive statistics, including means, standard deviations, and frequency distributions, were used to summarize continuous and categorical variables. Group comparisons were performed using the Chi-square test for categorical outcomes and independent sample t-tests for continuous variables, with a significance level set at $p< 0.05$.

SPSS was primarily employed for data cleaning, descriptive summaries, and standard inferential testing. R was used to generate publication-quality visualizations (e.g., trend lines, bar plots), perform subgroup analysis, and compute 95% confidence intervals for key outcomes. This dual-software strategy enabled both efficient tabular analysis and robust visual representation, enhancing interpretability of results across clinical endpoints.

RESULTS

Baseline Characteristics

A total of 100 patients were enrolled, categorized into three groups: labour induction (n = 40), medical abortion (n = 35), and postpartum haemorrhage management (n = 25). The mean age of participants ranged from 25.6 ± 3.8 years in the abortion group to 27.9 ± 5.2 years in the PPH group.

Primigravida status was most frequent in the labour induction group (60%) and least in the PPH group (48%). A prior caesarean was reported in 10 (25%) labour induction cases, 6 (17.1%) abortions, and 4 (16%) PPH patients.

As expected, all labour induction and PPH cases occurred at term (≥37 weeks), while no abortion cases were beyond 20 weeks. Misoprostol was the most commonly used prostaglandin across all groups. Notably, Carboprost use was exclusive to PPH management (76%), whereas Dinoprostone was used in 20% of labour inductions and none in the other groups.

Table 1: Baseline Characteristics of Study Participants

Characteristic	Labor Induction (n = 40)	Medical Abortion (n = 35)	PPH Management (n = 25)
Mean Age (years)	26.8 ± 4.1	25.6 ± 3.8	27.9 ± 5.2
Primigravida	24 (60%)	20 (57.1%)	12 (48%)
Previous Cesarean	10 (25%)	6 (17.1%)	4 (16%)
Gestational Age ≥37 weeks	40 (100%)	0 (0%)	25 (100%)
Misoprostol Use	32 (80%)	35 (100%)	6 (24%)
Dinoprostone Use	8 (20%)	0 (0%)	0 (0%)
Carboprost Use	0 (0%)	0 (0%)	19 (76%)

Section 2a – Labor Induction Outcomes

Among the 40 patients undergoing labour induction, the mean induction-to-delivery interval was 10.6 ± 3.2 hours. A total of 29 patients (72.5%) achieved vaginal delivery, while 9 (22.5%) underwent caesarean section and 2 (5.0%) required instrumental assistance.

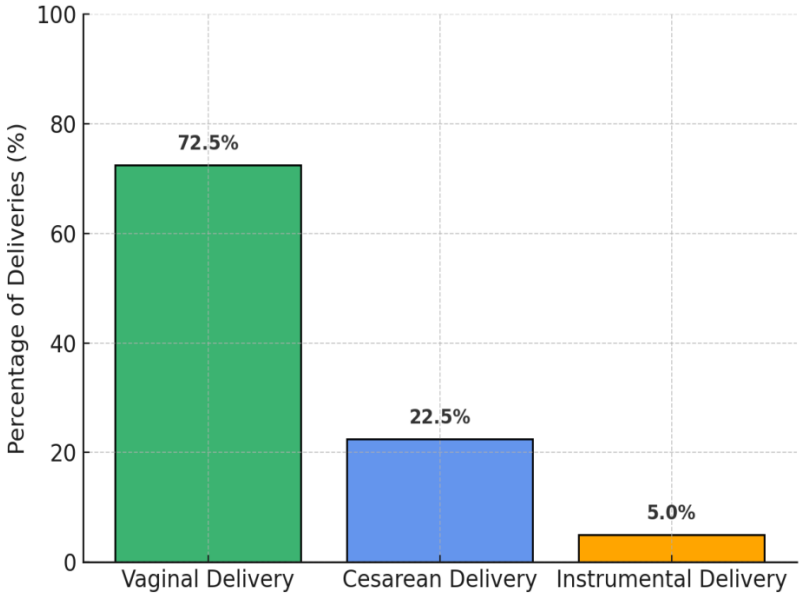
Labour was successfully completed within 24 hours in 32 patients (80.0%), indicating high procedural efficiency. Common maternal adverse effects included nausea in 20.0%, vomiting in 10.0%, and fever in 7.5% of patients.

Neonatal assessment revealed a mean Apgar score of 8.6 ± 0.7 at 5 minutes, with NICU admission required in 4 neonates (10.0%).

Table 2A: Labor Induction Outcomes

Outcome Measure	Value
Induction-to-delivery interval (hours)	10.6 ± 3.2
Vaginal Delivery	29 (72.5%)
Cesarean Delivery	9 (22.5%)
Instrumental Delivery	2 (5.0%)
Successful Delivery within 24 hrs	32 (80.0%)
Nausea	8 (20.0%)
Vomiting	4 (10.0%)
Fever	3 (7.5%)
Apgar Score at 5 mins (mean ± SD)	8.6 ± 0.7
NICU Admission	4 (10.0%)

Figure 1. Mode of Delivery in Labour Induction Group



Distribution of delivery modes among patients who underwent labour induction with prostaglandins (n = 40). The majority achieved vaginal delivery (72.5%), followed by caesarean delivery (22.5%), and a small proportion required instrumental assistance (5.0%).

Section 2b – Medical Abortion Outcomes

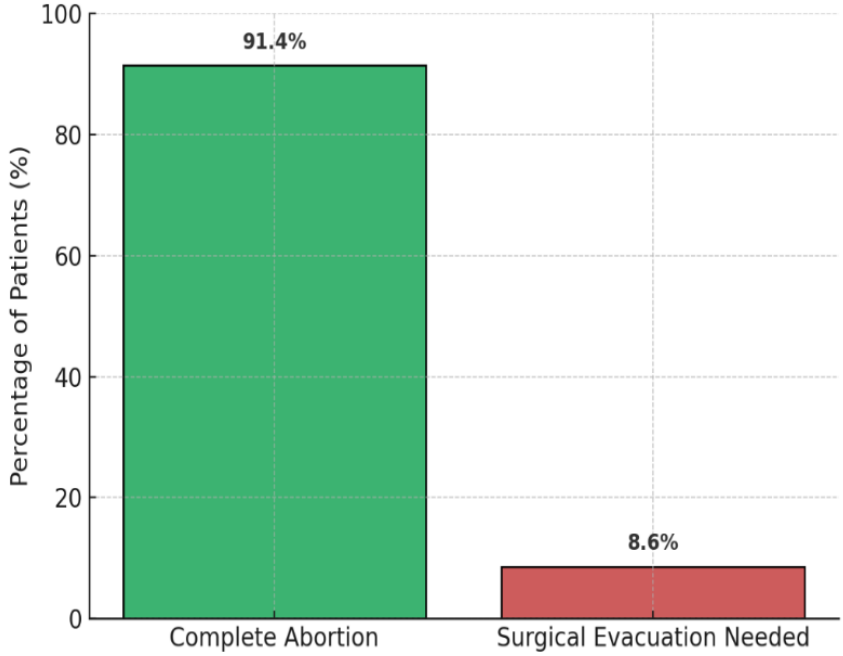
Among the 35 patients undergoing medical abortion, 32 (91.4%) experienced complete uterine evacuation without the need for surgical intervention, while 3 (8.6%) required dilation and curettage due to incomplete expulsion. The mean time to expulsion following prostaglandin administration was 6.2 ± 1.8 hours.

Adverse events were mild and transient. Abdominal cramps were the most frequently reported symptom (57.1%), followed by nausea (28.6%), vomiting (14.3%), and fever (8.6%). No serious complications or hospital readmissions were observed.

Table 2B: Medical Abortion Outcomes

Outcome Measure	Value
Complete Abortion without Surgical Intervention	32 (91.4%)
Need for Surgical Evacuation (D&C)	3 (8.6%)
Time to Expulsion (hours)	6.2 ± 1.8
Nausea	10 (28.6%)
Vomiting	5 (14.3%)
Fever	3 (8.6%)
Abdominal Cramps	20 (57.1%)

Figure 2. Outcome of Medical Abortion with Prostaglandins



Clinical success and surgical intervention rates among 35 patients undergoing medical abortion using prostaglandin-based regimens. A total of 91.4% achieved complete abortion without the need for dilation and curettage (D&C), while 8.6% required surgical evacuation.

Section 2c – PPH Management Outcomes

Among the 25 patients treated for postpartum haemorrhage, the mean estimated blood loss was 480.5 ± 125.3 mL. Bleeding was successfully controlled with medical management in 22 cases (88.0%), while 3 patients (12.0%) required surgical intervention, such as uterine tamponade or curettage.

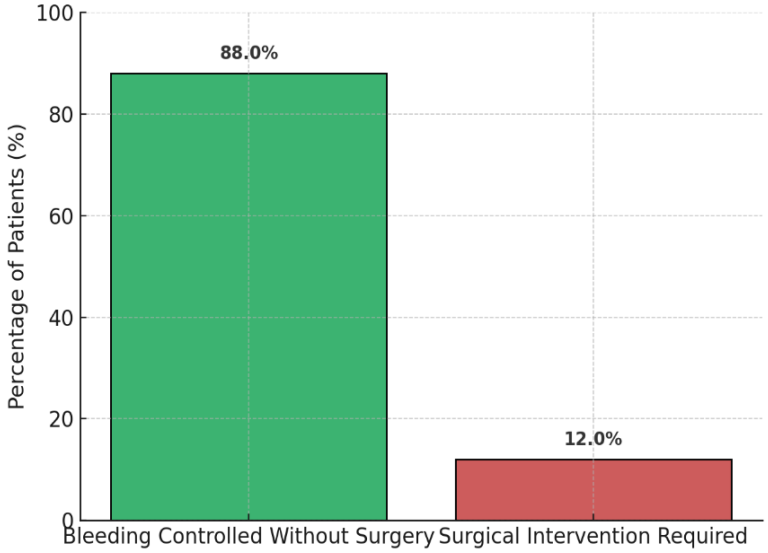
A total of 10 patients (40.0%) received blood transfusions, and the average time to bleeding control was 19.2 ± 5.7 minutes.

Common prostaglandin-related adverse effects included shivering (32.0%), fever (24.0%), and diarrhoea (12.0%). Uterine massage was used adjunctively in 17 cases (68.0%) to aid haemostasis.

Table 2C: PPH Management Outcomes

Outcome Measure	Value
Estimated Blood Loss (mL)	480.5 ± 125.3
Bleeding Controlled Without Surgery	22 (88.0%)
Need for Surgical Intervention	3 (12.0%)
Need for Blood Transfusion	10 (40.0%)
Time to Bleeding Control (minutes)	19.2 ± 5.7
Fever	6 (24.0%)
Shivering	8 (32.0%)
Diarrhea	3 (12.0%)
Uterine Massage Required	17 (68.0%)

Figure 3. Bleeding Control Outcomes in PPH Management



Comparison of response to prostaglandin therapy among 25 patients with postpartum haemorrhage. Bleeding was successfully controlled without surgery in 88.0% of cases, while 12.0% required surgical intervention, such as uterine tamponade or curettage.

DISCUSSION

This prospective study evaluated the clinical utility of prostaglandins across three key obstetric indications: labor induction, medical abortion, and postpartum hemorrhage (PPH) management. Our findings reaffirm the central role of prostaglandin analogs—particularly misoprostol and dinoprostone—in achieving favorable maternal outcomes across diverse clinical contexts.

Among patients undergoing labor induction, our study reported a high vaginal delivery rate (72.5%) and a mean induction-to-delivery interval of 10.6 ± 3.2 hours. These findings align with established data on prostaglandin E2 (PGE2), which is widely used to promote cervical ripening and uterine contractility in term pregnancies [7]. O'Brien et al. emphasized that prostaglandins play a more pivotal role than oxytocin in initiating labor due to their constant receptor presence in the myometrium, even in early pregnancy [8]. Our use of misoprostol and dinoprostone demonstrated comparable efficiency, and the minimal incidence of complications highlights their safety when applied within evidence-based dosing regimens.

Recent literature has also emphasized the pharmacological advantage of newer prostaglandin analogs, especially those with molecular modifications that enhance duration of action and uterine selectivity [9]. Additionally, studies support the move toward controlled-release delivery systems, which can reduce side effects like hyperstimulation while maintaining efficacy [10].

In the abortion arm, complete medical abortion was achieved in 91.4% of patients without the need for surgical intervention. This is consistent with data from large trials showing that misoprostol, particularly in combination with mifepristone, is both highly effective and safe for first- and second-trimester terminations [11]. According to Borgatta and Kapp, prostaglandins have largely replaced earlier methods for second-trimester abortion, given their predictability and favorable safety profile [12]. Similarly, data from the WHO and Stubblefield et al. emphasize prostaglandins' role in broadening access to safe abortion protocols, especially in low-resource settings [13, 14].

Our findings reinforce the continued relevance of misoprostol as a primary agent, with minimal adverse effects and short expulsion times. However, as Karim noted decades ago, dose optimization and route of administration remain critical to minimizing gastrointestinal side effects while preserving efficacy [15].

Prostaglandins remain essential in the management of uterine atony and refractory PPH. In our cohort, 88.0% of patients responded to medical treatment alone, with only 12.0% requiring surgical intervention. This supports previous findings by Kent and Sharma et al., who emphasized the value of PGF2α analogs like carboprost in controlling postpartum bleeding [7, 16]. Misoprostol, despite its known side effects such as shivering and fever, was effective in halting hemorrhage rapidly in the majority of our patients.

Newer reviews have suggested that timing, combination with oxytocin, and individualized patient risk assessment can improve response rates and reduce adverse outcomes [9, 10]. Our study adds real-world support to these insights, highlighting the practicality of prostaglandins as a first-line or adjunct agent in institutional deliveries.

A major strength of this study lies in its real-world setting and inclusion of all three primary indications for prostaglandin use in obstetrics. The sample was diverse, and outcomes were objectively measured using standardized protocols.

Limitations include the single-center design and the modest sample size in each subgroup, which may limit generalizability and preclude extensive subgroup analysis (e.g., by route of administration or previous uterine surgery). Additionally, long-term maternal or neonatal follow-up was beyond the scope of this evaluation.

This study reinforces prostaglandins as cornerstone agents in obstetric care. As newer delivery platforms and receptor-targeted analogs become available, future research should focus on comparative trials between existing agents and novel formulations. Multicenter Indian data would also be valuable to establish region-specific dosing strategies and optimize protocols for resource-constrained settings.

CONCLUSION

This prospective study reinforces the essential role of prostaglandins—particularly misoprostol, dinoprostone, and carboprost—in managing key obstetric interventions including labour induction, medical abortion, and postpartum haemorrhage. High clinical success rates, manageable side effects, and favourable maternal outcomes observed in our real-world cohort support their continued use as frontline agents in obstetric care.

Our findings also highlight the adaptability of prostaglandin-based protocols across diverse clinical scenarios. The effective use of prostaglandins in labour induction and abortion, combined with their life-saving utility in PPH, underscores the need for standardized, context-sensitive dosing regimens. As emerging evidence points toward receptor-specific and controlled-release delivery systems, future research should aim to refine these therapies further—particularly in resource-limited settings like ours.

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