ISSN: 2320-7159
IJMR
INTERNATIONAL JOURNAL OF MEDICAL RESEARCH

ORIGINAL RESEARCH ARTICLE

Comparative Efficacy of Intramuscular Oxytocin and Carboprost Tromethamine in Postpartum Hemorrhage Prophylaxis: A Randomized Controlled Trial

Hiren Kathiriya[1*], Rajkumar P Patange[2]

[1,2]Department of Obstetrics and Gynecology, Krishna Institute of Medical Sciences Deemed University, Karad, Maharashtra, India

*Hiren Kathiriya (Email: hirenkathiriya21@gmail.com)

DOI: https://doi.org/10.55489/ijmr.1201202453

Citation: Kathiriya H, Patange RP. Comparative Efficacy of Intramuscular Oxytocin and Carboprost Tromethamine in Postpartum Hemorrhage Prophylaxis: A Randomized Controlled Trial. Intl J Med Res 2024;12(1):3-10. DOI: 10.55489/ijmr.1201202453

Received: November 12, 2023
Accepted: December 13, 2023
Published: January 01, 2024

Funding: Non-Declared.

Conflict of interests: The authors have declared that no conflict of interests exists.

Publisher: Medsci Publications, India

ABSTRACT

Background: Postpartum hemorrhage (PPH) remains a leading cause of maternal mortality worldwide, despite the preventive benefits of active management in the third stage of labor. Oxytocin is widely used for PPH prevention; however, its effectiveness is sometimes limited, necessitating alternative or additional uterotonics. Carboprost tromethamine, a prostaglandin analogue, offers potential advantages, but comparative studies are limited. This study aimed to compare the efficacy of intramuscular oxytocin (10 units) versus intramuscular carboprost tromethamine (125 µg) in reducing blood loss during the third stage of labor and in minimizing the need for additional uterotonics.

Methods: In a randomized controlled trial, 266 women undergoing vaginal delivery were assigned to receive either oxytocin (Group A) or carboprost tromethamine (Group B) as PPH prophylaxis. Primary outcomes included the duration of the third stage of labor and estimated blood loss, with secondary outcomes of additional uterotonic requirement, hemoglobin change, and side effects.

Results: Mean third-stage duration was significantly shorter in the carboprost group (6.18 min) than the oxytocin group (6.71 min, $p < 0.05$). Mean blood loss was also significantly lower with carboprost (183.44 ml) compared to oxytocin (285.77 ml, $p < 0.001$). Additional uterotonics were needed less frequently in the carboprost group (3%) versus the oxytocin group (15.8%, $p < 0.05$). Diarrhea was more common in the carboprost group.

Conclusion: Carboprost tromethamine demonstrated superior efficacy in reducing blood loss and third-stage duration compared to oxytocin, with a manageable side effect profile. These findings support carboprost as an effective alternative for PPH prophylaxis.

Keywords: Postpartum hemorrhage, Oxytocin, Carboprost tromethamine, Third stage of labor, Uterotonics, Blood loss

INTRODUCTION

The third stage of labor, which starts with the delivery of the baby and ends with the expulsion of the placenta and membranes, is considered one of the most critical phases in childbirth. The average duration of this stage is approximately 15 minutes, regardless of whether the mother is experiencing her first childbirth or subsequent ones.[1] One of the most feared complications during this stage is postpartum hemorrhage (PPH), a condition that significantly contributes to maternal morbidity and mortality. In India, a woman dies every four minutes due to childbirth complications, and the maternal mortality rate is estimated at 212 per 100,000 live births, with 30% of these deaths attributed to PPH.[2][3]

PPH remains a challenge in modern obstetrics due to its sudden onset and potentially life-threatening outcomes. Although unpredictable, the risk of PPH can be minimized with appropriate management and preventive measures. The introduction of uterotonic drugs in managing PPH has been a pivotal advancement in obstetrics, contributing to the reduction in maternal mortality.[4] Globally, PPH accounts for approximately 28% of maternal deaths, with its prevalence varying by region; for example, in Indonesia, PPH is responsible for around 30.3% of maternal deaths.[5][6]

Clinically, PPH is defined as blood loss of 500 ml or more following vaginal delivery and 1,000 ml or more after a cesarean section. Any blood loss causing hemodynamic instability post-delivery is also categorized as PPH.[7][8] Uterine atony, the failure of the uterus to contract effectively after delivery, is the most common cause of PPH, accounting for around 70% of cases.[9][10] To reduce the likelihood of PPH, uterotonic agents are commonly used in the active management of the third stage of labor. These agents work by promoting uterine contractions, aiding the natural process of contraction and retraction that occurs during this stage.[11]

The main uterotonic drugs available include oxytocin, carbetocin, ergot alkaloids (e.g., ergonovine, syntometrine), and prostaglandins (e.g., misoprostol, carboprost).[12] Oxytocin is the most widely used uterotonic for PPH prevention and is known to reduce blood loss when administered following delivery.[13] However, due to its short half-life (less than 10 minutes), oxytocin requires continuous intravenous administration to maintain its effects, and its usage can sometimes lead to complications like water intoxication due to its antidiuretic properties.[14]

Other uterotonics, such as carbetocin-a long-acting synthetic analogue of oxytocin-have been studied and shown to be effective in PPH prevention. Ergot alkaloids and prostaglandins also play a role, although they come with potential side effects, including nausea, vomiting, and, in severe cases, hypertension, postpartum eclampsia, and pulmonary edema.[15,16,17] The active management of the third stage of labor through these uterotonic agents can reduce the incidence of PPH by up to 40%.[2]

Carboprost tromethamine, a 15-methyl PGF2α analogue, has shown promising results as a prophylactic agent for PPH. Administered as a single intramuscular injection in a prophylactic dose, it is associated with fewer adverse effects than other uterotonics, such as oxytocin, and avoids complications like hypertension and pulmonary edema often seen with other drugs.[18]

This study aims to assess the efficacy of carboprost tromethamine compared with intramuscular oxytocin in PPH prevention. It seeks to explore carboprost's potential as a safer and equally effective alternative for active management during the third stage of labor, with the goal of reducing maternal morbidity and mortality associated with PPH.

MATERIALS AND METHODS

The study was conducted in the Obstetrics and Gynecology Department of Krishna Hospital, Karad, a tertiary care facility serving a broad population from surrounding areas. The study took place over a two-year period, from September 2021 to August 2023. This was a randomized controlled trial. The study included pregnant women admitted to the hospital's labor room who were anticipated to have a vaginal delivery.

Eligibility criteria: Participants were women with a singleton pregnancy beyond 37 weeks of gestation who anticipated a vaginal delivery and provided written informed consent for the study. Exclusion criteria included patients undergoing cesarean section, women with hemoglobin levels below 7 g/dL, and those with obstetric complications such as placental abruption, placenta previa, placenta accreta, malpresentation, or coagulation abnormalities. Women with a history of medical disorders like asthma, epilepsy, or hypersensitivity to the study drugs were also excluded.

Sample Size: Based on a previous study by Patil AS et al[19], where the mean duration of the third stage of labor was 7.02 ± 2.6 minutes for oxytocin and 6.05 ± 1.7 minutes for carboprost, the sample size was calculated using the formula:

Sample size (n) = (Za+Zb)2 (S1*2+S2*2)/(M2-M1)2

The calculated sample size was 130 participants in each group.

Intervention Groups

Eligible participants were randomly assigned to one of two intervention groups:

- Group O (Oxytocin Group): Received 10 units of oxytocin intramuscularly at the time of delivery.
- Group C (Carboprost Group): Received 125 mcg of carboprost intramuscularly at the time of delivery.

Randomization: All eligible women who met the inclusion criteria were informed about the study, and those willing to participate were included. Participants were then randomly assigned to either Group O or Group C using a computer-generated random number table. Enrolment continued until the required sample size of 130 was achieved. Additional 3 sample in each group collected to compensate any loss of sample.

Baseline Assessment: A comprehensive general and systemic examination was performed for all participants, including assessments of the cardiovascular and respiratory systems, and abdominal and vaginal examinations. Relevant laboratory investigations, such as pre-labor hemoglobin and hematocrit levels, were conducted.

Intervention: In Group O, participants received 10 units of oxytocin intramuscularly one minute after delivery of the anterior shoulder. In Group C, participants received 125 mcg of carboprost intramuscularly under the same conditions.

Follow-up Assessment: Blood loss during the third stage of labor was measured using a blood collection bag (BRASSS-VDRAPE). Blood clots and soaked swabs were weighed separately, and the volume was calculated by subtracting the known dry weight. PPH was defined as blood loss exceeding 500 ml during the third stage of labor, and additional oxytocics were administered if blood loss surpassed this threshold. Blood loss volume, the duration of the third stage (measured from oxytocic administration to placental expulsion), third stage complications (e.g., retained placenta), and need for additional oxytocics were recorded. Hemoglobin and hematocrit were re-evaluated 72 hours post-delivery to assess the objective measure of PPH. Participants were monitored for two hours post-delivery for vital signs, vaginal bleeding, and side effects such as nausea, vomiting, shivering, fever, and diarrhea.

Ethical Considerations: The study received approval from the Institutional Ethics Committee. Participation was voluntary, and informed consent was obtained from all participants before enrollment.

Statistical Analysis: Data were computerized and analyzed using SPSS version 16. Outcome measures such as blood loss, third stage duration, and side effects were compared between groups. Qualitative variables were compared using the chi-square test, and quantitative variables were analyzed with the t-test. A p-value of <0.05 was considered statistically significant at a 95% confidence interval.

RESULTS

The mean maternal age was similar between groups, with 22.8 ± 2.8 years in Group A and 22.5 ± 2.8 years in Group B (p = 0.383). Parity distribution was also comparable, with no statistically significant difference (p = 0.854). The majority of participants in

both groups were "booked" cases and resided in rural areas, showing no significant differences in registration status (p = 0.325) or residence (p = 0.712). Educational levels were similar across both groups, with the majority of participants having primary or secondary education (p = 0.936) (table 1).

Table 2 compares clinical variables between the two groups. There were no significant differences in the type of labor, with a comparable distribution of spontaneous, augmented, and induced labor types (p = 0.585). The gestational age was similar, with most deliveries occurring between 38-40 weeks (p = 0.567), and mean birth weights were also comparable (Group A: 2720 ± 480 g, Group B: 2740 ± 400 g; p = 0.712). Other clinical factors, such as episiotomy rates and occurrence of cervical or vaginal lacerations, showed no statistically significant differences between the groups (p = 0.711 and p = 0.606, respectively).

Table 1: Comparison sociodemographic profile of the study participants

Variables	Group A (oxytocin) (n=133)	Group B (carboprost) (n=133)	P value
Maternal Age in years (Mean ± SD)	22.8 ± 2.8	22.5 ± 2.8	0.383
Parity			
Primi	57 (42.9)	56 (42.1)	0.854
Gravida 2	61 (45.9)	59 (44.4)	
Gravida 3 or more	15 (11.3)	18 (13.5)	
Registration status			
Booked	121 (91)	116 (87.2)	0.325
Unbooked	12 (9)	17 (12.8)	
Residence			
Urban	61 (45.9)	64 (48.1)	0.712
Rural	72 (54.1)	69 (51.9)	
Literacy Level			
Illiterate	25 (18.8)	21 (15.8)	0.936
Upto primary school	51 (38.3)	56 (42.1)	
Secondary school	32 (24.1)	32 (24.1)	
Higher secondary school	14 (10.5)	15 (11.3)	
Graduate and above	11 (8.3)	9 (6.8)	

Table 2: Comparison of the clinical variables of the study participants

Variables	Group A (Oxytocin (n=133)	Group B (Carboprost) (n=133)	P value
Type of Labour			
Spontaneous	62 (46.6)	69 (51.9)	0.585
Augmented	56 (42.1)	53 (39.8)	
Induced	15 (11.3)	11 (8.3)	
Gestational age in weeks			
37-38 weeks	22 (16.5)	17 (12.8)	0.567
38-40 weeks	109 (82)	115 (86.5)	
>40 weeks	2 (1.5)	1 (0.8)	
Birth weight (mean± SD) in gm	2720±480	2740±400	0.712
Episiotomy done	74 (55.6)	71 (53.4)	0.711
Cervical/vaginal lacerations	7 (5.3)	9 (6.8)	0.606

Comparison of outcome shows that the Group B (carboprost) had significantly lower mean blood loss (183.44 ± 77.43 ml) compared to Group A (oxytocin), which had a mean blood loss of 285.77 ± 99.65 ml (p < 0.001). The duration of the third stage of labor was shorter in Group B (6.18 ± 1.67 minutes) than in Group A (6.71 ± 2.18 minutes; p = 0.027). Although hemoglobin levels and decreases after delivery were similar across groups, additional use of uterotonics was significantly lower in Group B (3%) compared to Group A (15.8%; p < 0.001) (table 3).

Table 4 compares side effects experienced by participants in both groups. Diarrhea was significantly more common in Group B (9.8%) than in Group A (1.5%; p = 0.003). Other side effects, including nausea, shivering, and elevated temperature, did not show statistically significant differences between groups. Vomiting and headache occurred at low frequencies but were reported only in Group B and Group A, respectively.

Table 3: Comparison of outcome variables of the study participants

Outcome Variables	Group A (Oxytocin) (n=133)	Group B (Carboprost) (n=133)	P value
Hemoglobin prior to delivery in g/dl	9.76±1.33	9.70±1.47	0.727
Hemoglobin after delivery in g/dl	9.19±1.36	8.96±1.30	0.159
Blood loss in ml (Mean ± SD)	285.77±99.65	183.44±77.43	<0.001
Decrease in Hb after delivery in g/dl (Mean ± SD)*	0.74±1.93	0.57±1.90	0.469
PPH cases (blood loss >500 ml)	3 (2.3)	1 (0.8)	0.315
Cases who required blood transfusion	5 (3.8)	2 (1.5)	0.268
Additional use of uterotonics (%)	21 (15.8)	4 (3)	<0.001
Duration of third stage in min (Mean ± SD)	6.71±2.18	6.18±1.67	0.027
Maternal mortality	0 (0)	0 (0)	-

Table 4: Comparison of side effects among participants of both the groups

Side effects	Group A (Oxytocin) (n=133)	Group B (Carboprost) (n=133)	P value
Nausea	5 (3.8)	4 (3)	0.734
Vomiting	0 (0)	3 (2.3)	-
Shivering	4 (3)	6 (4.5)	0.519
Diarrhoea	2 (1.5)	13 (9.8)	0.003
Temp >37.5C	1 (0.8)	3 (2.3)	0.315
Headache	3 (2.3)	0 (0)	-

Table 5: Comparison of risk factors among participants of both the groups

Risk factors for postpartum hemorrhage	Group A (oxytocin) (n=133)	Group B (carboprost) (n=133)	P value
Multiple pregnancies	7 (5.3)	5 (3.8)	0.554
Polyhydramnios	5 (3.8)	1 (0.8)	0.215
Grand multiparity	1 (0.8)	0 (0)	-
Past history of PPH	9 (6.8)	5 (3.8)	0.273
Prior cesarean delivery	5 (3.8)	7 (5.3)	0.554
At least one risk factor for PPH	21 (15.8)	18 (13.5)	0.603

The prevalence of risk factors, such as multiple pregnancies, polyhydramnios, grand multiparity, a history of PPH, and prior cesarean delivery, was similar in both groups. Overall, there was no statistically significant difference in the presence of any PPH risk factors between Group A and Group B (p = 0.603) (table 5).

DISCUSSION

Postpartum hemorrhage (PPH) remains one of the leading causes of maternal mortality globally, claiming approximately 1,500 lives every day due to complications from pregnancy and childbirth.[20] The introduction of active management strategies during the third stage of labor, particularly the prophylactic administration of oxytocin immediately following fetal delivery, has shown promise in reducing the incidence of PPH by about 40%.[21] International health bodies, including the World Health Organization (WHO), the International Federation of Gynecologists and Obstetricians (FIGO), and the International Confederation of Midwives (ICM), recommend routine active management of the third stage of labor for all singleton vaginal deliveries in hospitals to curb the risks of PPH.[22, 23]

While prophylactic agent endorsed by WHO for preventing and managing excessive bleeding after childbirth, its effectiveness can be limited by factors such as dosage, receptor saturation, and potential side effects at higher doses, including hypotension and water intoxication. In contrast, carboprost tromethamine, a synthetic analogue of PGF2α, has demonstrated strong uterotonic effects, and studies show it can significantly decrease the need for surgical interventions in cases of uterine atony that do not respond to oxytocin. [24] The study presented here aim eveness of intramuscular

oxytocin (10 units) and carboprost tromethamine (125 μg) in preventing PPH. With 266 women randomly assigned to two groups (133 per group), various parameters, including the duration of the third stage of labor, blood loss, and side effects, were compared.

Baseline Characteristics and Study Population: In this study, the mean ages of women in the oxytocin and carboprost tromethamine groups were 22.8 and 22.5 years, respectively, with no statistically significant differences in age distribution between the groups ($p>0.05$). This finding aligns with those of other studies, including those by Patil et al [25] and Madhulika et al [26], which found no significant age between oxytocin andtromethamine groups. Parity was also comparable, with over 80% of women in each group being either primigravida or second gravida. Other characteristics such as area of residence, registration status, and literacy levels were similarly distributed between groups, minimizing potential confounding factors related to demographic or baseline health status.

Duration of the Third Stage of Labor: The study found that the mean duration of the third stage of labor was shorter in the carboprost tromethamine group (6.18 minutes) compared to the oxytocin group (6.71 minutes), a statistically significant difference ($p<0.05$). These findings are in line with other research, such as Sunil Kumar et al [27] and Abdel Aleem et al [28], which reported shorter third-stage durations with comethamine compared tohis difference highlights carboprost tromethamine's efficiency in inducing uterine contractions promptly, which may reduce the risk of PPH.

Blood Loss During Third Stage of Labor: Mean blood loss in the oxytocin group was 285.77 ml, whereas it was significantly lower at 183.44 ml in the carboprost tromethamine group ($p<0.001$). Similar findings have been documented by studies including those by Sunil Kumar et al [27]. and Madhulika et al [26], where carboprost tromethamine resulted in notably reduced blood loss duringtage of labor. This clinically significant, as it reduces the likelihood of progressing to PPH and the need for additional uterotonic interventions.

Requirement of Additional Uterotonics: Carboprost tromethamine also demonstrated a lower need for additional uterotonics, with only 3% of women in the carboprost group requiring additional agents, compared to 15.8% in the oxytocin group ($p<0.05$). Studies such as Madhulika et al [26]. and Sunil Kumar et al [27]. support these results, showing a reduced need for supplementary uterotonics when carboprost tromesed as a primary propht. This reduced requirement signifies a potential cost benefit and decreased treatment complexity for healthcare providers managing PPH risk in postpartum women.

Hemoglobin Levels and Blood Transfusion Requirements: Both groups exhibited a decline in mean hemoglobin levels postpartum; however, the decrease was not statistically significant between the groups, suggesting that blood loss management in both treatment approaches is effective. Additionally, while a small percentage of patients required blood transfusions in both groups, the difference was not statistically significant. These findings suggest that, while carboprost tromethamine reduces blood loss, both drugs are comparable in terms of their impact on hemoglobin levels and transfusion needs.

Side Effects: Notably, carboprost tromethamine was associated with a higher incidence of diarrhea, with 13 cases compared to only 2 in the oxytocin group. The increased risk of gastrointestinal side effects with carboprost tromethamine aligns with findings from other studies, including those by Sunil Kumar et al [27]. and Lamont et al [29], which also report higher rates of diarrhea in patients treated with carboprost tromethamine. While carboprost tromethaminet uterotonic effede effects are an important consideration in clinical decision-making, particularly for patients with pre-existing gastrointestinal concerns.

Strength and limitations of the study

The study's strengths lie in its randomized design, which allowed for a direct comparison between the efficacy of intramuscular oxytocin and carboprost tromethamine for postpartum hemorrhage (PPH) prophylaxis, minimizing selection and treatment biases. The large sample size improved the reliability of the findings and the study's power to detect significant differences in outcomes like blood loss and third-stage labor duration.

Additionally, the inclusion of a diverse population across age and parity provided comprehensive insights applicable to various patient groups. However, the study has limitations, including its single-center setting, which may limit the generalizability of results to other regions or healthcare settings with different PPH management protocols. Also, while side effects were documented, further investigation into long-term maternal outcomes would offer a more complete understanding of the drugs' safety profiles.

CONCLUSION

In conclusion, carboprost tromethamine is a potent uterotonic agent that is highly effective in reducing blood loss and shortening the duration of the third stage of labor compared to oxytocin. Despite its association with a higher rate of gastrointestinal side effects, its ability to limit blood loss and reduce the need for additional uterotonics makes it a valuable option in managing the risk of PPH. This study supports the growing body of evidence suggesting that carboprost tromethamine is a favorable alternative to oxytocin for PPH prophylaxis, particularly in cases where rapid uterine contraction and minimal blood loss are priorities. Further research may help refine the optimal dosing strategies for carboprost tromethamine to balance efficacy with a manageable side-effect profile, potentially expanding its role in the global effort to reduce maternal mortality due to PPH.

Conflict of Interest:

The authors declare that there are no conflicts of interest associated with this study.

Institutional Ethical Review Board Approval:

Ethical approval was obtained from the Institutional Ethical Committee of Krishna Institute of Medical Sciences University, Karad.

Acknowledgments:

The authors extend their gratitude to the Department of obstetrics staff and patients at Krishna Institute of Medical Sciences University for their cooperation during this study.

Authors' Contributions:

All the authors have contributed equally in the study design, conceptualization, data collection, analysis, manuscript drafting, and critical revisions. All authors reviewed and approved the final manuscript.

Data Availability:

The data supporting this study are available from the corresponding author upon reasonable request. Due to participant privacy concerns, the data are not publicly accessible.

BIBLIOGRAPHY

1. Mukherje J, Ganguly RP, Saha SK Maternal mortality due to hemorrhage with emphasis on post-partum haemorrhage. J ObstetGynecol India.2001;51(5):130- 33
2. Christopher B. Lynch, Moore Keith. A textbook of postpartum hemorrhage, a comprehensive guide to evaluate management and surgical intervention. FOGSI publication 2006; 8.
3. Park K. Preventive medicine in obstetrics, pediatrics and geriatrics, chapter 9 in textbook of preventive and social medicine, 22ndedition. Jabalpur, M/S Banarri Das Bharot, 2013; 516-519.
4. Moir JC 1955. The history of present-day use of ergot. Can med ASS J.72: 727-34.
5. Seow KM, Chen KH, Wang PH, Lin YH, Hwang JL. Carbetocin versus oxytocin for prevention of postpartum hemorrhage in infertile women with twin pregnancy undergoing elective cesarean delivery. Taiwan J Obstet Gynecol. 2017;56(3):273-5.
6. Kemenkes RI [Ministry of Health, Republic of Indonesia]. Pusat Data dan Informasi [Center of Data and Information]. 2014.

7. Leduc D, Senikas V, Lalonde AB, Ballerman C, Biringer A, Delaney M, et al. Active Management of the Third Stage of Labour: Prevention and Treatment of Postpartum Hemorrhage. J ObstetGynaecol Canada. 2009;31(10):980-93.
8. World Health Organization. WHO recommendations for the prevention and treatment of postpartum haemorrhage. Geneva, Switzerland: WHO Press; 2012. Available at: http://apps.who.int/iris/bitstream/10665/75411/1/978 9241548502_eng.pdf
9. Gizzo S, Patrelli TS, Gangi S Di, Carrozzini M, Saccardi C, Zambon A, et al. Which uterotonic is better to prevent the postpartum hemorrhage? Latest news in terms of clinical efficacy, side effects, and contraindications: A systematic review. Reprod Sci. 2013;20(9):1011-9.
10. Alwani M, Singh S, Thakur R, Mishra S. A randomized study comparing rectally administered misoprostol after spinal anesthesia versus intramuscular oxytocin for prevention of postpartum hemorrhage in caesarean section. Int J Reprod Contraception, Obstet Gynecol. 2014;33(3):512-5.
11. ElbohotyAEH, Mohammed WE, Sweed M, BahaaEldin AM, Nabhan A, Abd-El-Maeboud KHI. Randomized controlled trial comparing carbetocin, misoprostol, and oxytocin for the prevention of postpartum hemorrhage following an elective cesarean delivery. Int J Gynecol Obstet. 2016;134(3):324-8.
12. Samimi M, Imani-Harsini A, Abedzadeh-Kalahroudi M. Carbetocin vs. syntometrine in prevention of postpartum hemorrhage: a double blind randomized control trial. Iran Red Crescent Med J. 2013;15(9):817-22.
13. Roach MK, Abramovici A and Tita AT: Dose and duration of oxytocin to prevent postpartum hemorrhage: a review. Am J Perinatol: Dec 3, 2012 (Epub ahead of print).
14. Rath W. Prevention of postpartum haemorrhage with the oxytocin analogue carbetocin. Eur J ObstetGynecolReprod Biol. 2009;147(1):15-20.
15. Gibbins KJ, Albright CM and Rouse DJ: Postpartum hemorrhage in the developed world: whither misoprostol? Am J ObstetGynecol 208: 181-183, 2013.
16. WHO department of making pregnancy safer 2009. WHO recommendations for treatment of PPH and retained placenta. WHO: Geneva. 2013. available from www.who.int.
17. Chelmow D. Postpartum hemorrhage prevention: clinical evidence. BMJ 2011; 1- 6.
18. Hofmeyr GJ, Gulmezoglu AM. New development in the management of postpartum hemorrhage. In: Bonner J, editor. Recent advances in obstetrics and gynaecology. 21st ed. London: Churchill Livingstone; 2000. p. 56–66.
19. Ambika S. Patil, Vibhavaree Dadavate and Vidya A. Thobbi. Carboprost versus oxytocin for active management of third stage of labour. Al Am een J Med Sci 2016; 9(3):196-201
20. Lamba A et al. Int J Reprod Contracept Obstet Gynecol. 2016; 5(7):2151-2154.
21. Bai J, Sun Q, Zhai H, et al. A comparison of oxytocin and carboprost in prevention of PPH in high risk patients in caesarean section. Exp Ther Med. 2014;7:46–50.
22. Management of the third stage of labour to prevent postpartum haemorrhage (joint statement). The Hague and London: International Confederation of Midwives and International Federation of Gynaecology and Obstetrics, 2003.
23. Buttino L Jr, Garite TJ. The use of 15 methyl F2 alpha prostaglandin (Prostin 15 M) for the control of postpartum hemorrhage. Am J Perinatol. 1986; 3:241-243.
24. Managing complications of pregnancy and childbirth: A guide for midwives and doctors. Geneva: World Health Organization, United Nations Population Fund, United Nations Children's Fund and The World Bank, 2003. (WHO/ RHR/00.7).
25. Patil AS, Dadavate V, Thobbi VA. Carboprost versus oxytocin for active management of third stage of labour. Al Am een J Med Sci 2016; 9(3):196-201
26. Madhulika, Sushma Singh, Smita Rai. Comparison of carboprost with oxytocin in third stage of labour. Int J Clin Obstet Gynaecol 2019;3(5):318-321. DOI: 10.33545/gynae.2019.v3.i5e.371
27. Sunil Kumar KS, Shyam S, Batakurki P. Carboprost Versus Oxytocin for Active Management of Third Stage of Labor: A Prospective Randomized Control Study. J ObstetGynaecol India. 2016;66(Suppl 1):229-234. doi:10.1007/s13224-016-0842-x
28. Abdel-Aleem H, Abol Oyoun EM, Moustafa SA, et al. Carboprost trometamol in the management of the third stage of labor. Int J Gynaecol Obstet. 1993;42:247–50.
29. Lamont RF, Morgan DJ, Logue M, Gordon H. A prospective randomised trial to compare the efficacy and safety of hemabate and syntometrine for the prevention of primary postpartum haemorrhage. Prostaglandins Other Lipid Mediat. 2001; 66:203-210.