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Comparison of Oxytocin versus Carbetocin in Vaginal Delivery - A Randomised Controlled Study

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Abstract: ***Background: Postpartum hemorrhage (PPH) is a leading cause of maternal mortality globally, especially in low - resource settings. Oxytocin is widely used to prevent PPH but has limitations, including its short half - life and need for continuous infusion and refrigeration. Carbetocin, a long - acting synthetic analogue of oxytocin, addresses these issues by offering a longer half - life and stability at room temperature, making it suitable for use in diverse clinical settings. However, data comparing oxytocin and carbetocin in vaginal deliveries is limited. Aim and Objectives: This study aimed to compare the efficacy of intravenous oxytocin (10 IU) versus intravenous carbetocin (100 mcg) in reducing postpartum blood loss and preventing PPH in vaginal deliveries with high - risk factors. Material and Method: A randomized controlled study was conducted at a tertiary care hospital in Rajasthan, India. A total of 120 women with at least one high - risk factor for PPH were randomized into two groups. Group A received 10 IU of oxytocin, and Group B received 100 mcg of carbetocin at delivery. The primary outcome was blood loss during the postpartum period, while secondary outcomes included hemoglobin drop, need for additional uterotonics, and blood transfusion. Results: The average blood loss was significantly lower in the carbetocin group (181.33 mL) compared to the oxytocin group (256.75 mL, p=0.02). The hemoglobin decrease was smaller in the carbetocin group (1.08 g/dL vs.1.34 g/dL, p=0.0001). Fewer patients in the carbetocin group required additional uterotonics (13.33% vs.30%, p=0.046) and blood transfusions (0% vs.10%, p=0.036). Conclusion: Carbetocin is more effective than oxytocin in reducing postpartum blood loss and the need for additional interventions in vaginal deliveries, making it a preferred option for PPH prevention in high - risk cases.***

Keywords: Postpartum Hemorrhage (PPH), Oxytocin, Carbetocin, Vaginal Delivery, Uterotonics, Blood Loss Reduction, High - Risk Pregnancy, Hemoglobin Drop, PPH Prevention

1. Introduction

Postpartum hemorrhage (PPH) is a major cause of maternal morbidity and mortality worldwide, particularly in resource - limited settings. PPH is defined as blood loss greater than 500 mL after vaginal delivery or more than 1000 mL following cesarean delivery. It is responsible for approximately 25% of maternal deaths globally, with incidence in countries like India reaching as high as 38%, often occurring within four hours of delivery. primary cause of PPH, accounting for nearly 90% of cases, is uterine atony, where uterus fails to contract adequately after childbirth.

Active management of third stage of labor, especially through use of uterotonic agents, is essential for reducing blood loss and preventing PPH. Oxytocin, a widely used uterotonic agent, is generally effective but has limitations, such as its short half - life and requirement for continuous intravenous (IV) administration. Additionally, Oxytocin requires temperature - controlled storage, which poses challenges in resource - constrained settings.

In response to these limitations, Carbetocin, a synthetic analogue of Oxytocin, has been developed. Carbetocin has a longer half - life, allowing for single - dose administration, and remains stable at room temperature, which makes it ideal for low - resource settings. Although Carbetocin's efficacy in reducing blood loss has been demonstrated in cesarean deliveries, its role in vaginal deliveries remains underexplored.

Objectives

This study aims to compare efficacy of Carbetocin and Oxytocin in preventing PPH during vaginal delivery, particularly in women with a high risk for PPH. Specifically, study will investigate:

1) Effect of Oxytocin on postpartum blood loss.
2) Effect of Carbetocin on postpartum blood loss.
3) Relative efficacy of Oxytocin and Carbetocin in PPH management.

Hypothesis

Given its pharmacological profile, Carbetocin is hypothesized to be more effective than Oxytocin in preventing postpartum blood loss during vaginal delivery.

2. Materials and Methods

This randomized controlled study was conducted at Sardar Patel Medical College and PBM Hospital in Bikaner, Rajasthan, India. The study spanned over one year and included a sample of 120 women selected based on predefined criteria.

The study population comprised of women admitted to the labor room for vaginal delivery, with gestational ages between 37 and 42 weeks, who had at least one risk factor for PPH.

Inclusion Criteria:

Women in labor between 37 and 42 weeks of gestation. Singleton fetus in vertex presentation. Induction or augmentation of labor. Presence of at least one PPH risk

factor (e. g., prolonged labor, anemia, macrosomia, or prior PPH history)

Exclusion Criteria:
Intrauterine fetal demise, abnormal fetal presentations (e. g., breech, hand prolapse), history of cesarean section, hypertension, heart disease, or epilepsy

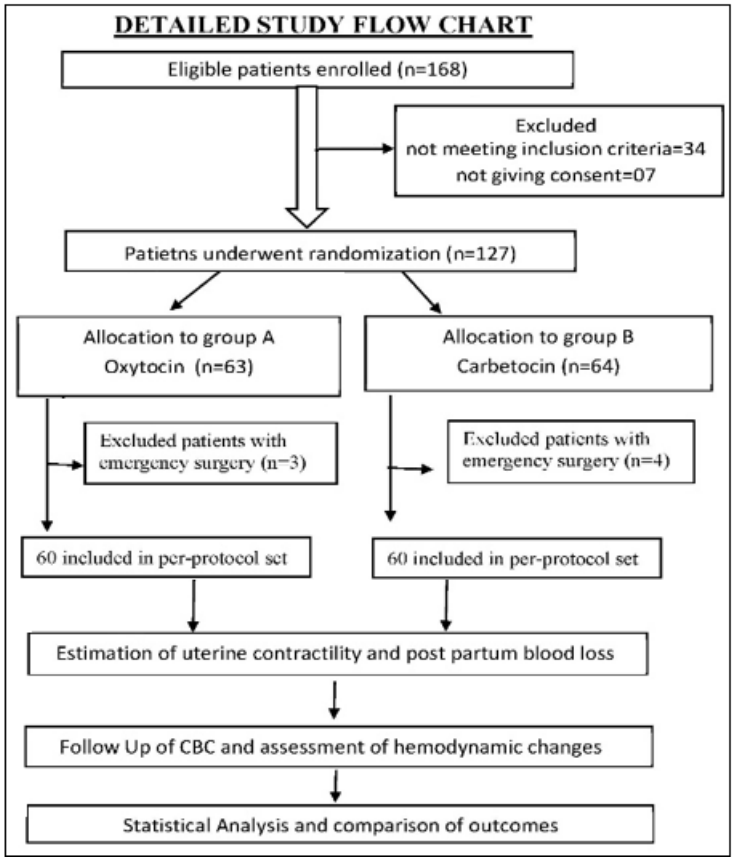
Randomization
Patients were randomized using block randomization into two groups. Group A received a continuous infusion of 10 IU Oxytocin in 500 mL normal saline over one hour. Group B received a single IV bolus dose of Carbetocin (100 mcg) in 10 mL normal saline over one minute.

Outcome:
The primary outcome was postpartum blood loss within the first hour after delivery. The secondary outcomes were hemodynamic changes (mean arterial pressure and heart rate), requirement for additional uterotonic agents and need for intravenous fluids or blood transfusions pre and post - delivery hemoglobin levels.

Quantitative blood loss was assessed following the ACOG guidelines using calibrated drapes and weighing blood - soaked materials (1 gram = 1 mL blood loss).

3. Statistical Analysis

Data were analyzed using SPSS (version 26). Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as percentages. The t - test and chi - square test were used for statistical comparisons, with significance set at $p < 0.05$.



4. Results

The demographic characteristics, including age, socioeconomic status, and booking status, were similar between the groups (p= 0.072). Most participants were between 21 and 30 years of age, with no significant difference in parity or mode of delivery (p = 0.855).

Parameter	Oxytocin (Group A)	Carbetocin (Group B)	p - value	Significance
Average Blood Loss (ml)	256.75 ± 209.55	181.33 ± 132.08	0.02	Significant
Mean Hb Decrease (gm/dl)	1.34 ± 0.35	1.08 ± 0.28	0.0001	Highly Significant
Additional Uterotonic Needed (%)	30%	13.33%	0.046	Significant
Blood Transfusion Needed (%)	10%	0%	0.036	Significant

This table shows that Carbetocin (Group B) had advantages over Oxytocin (Group A) with less blood loss, lower Hb decrease, and fewer additional interventions needed.

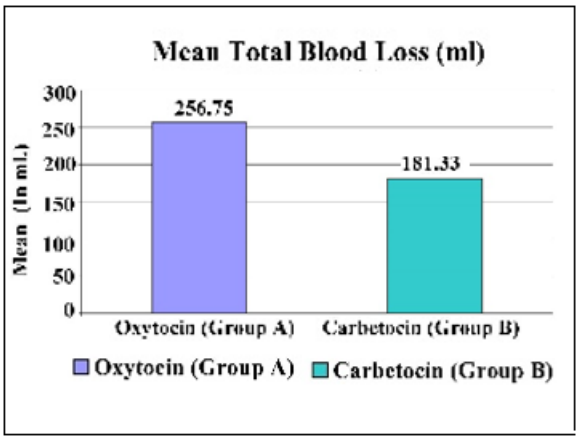


Figure 1

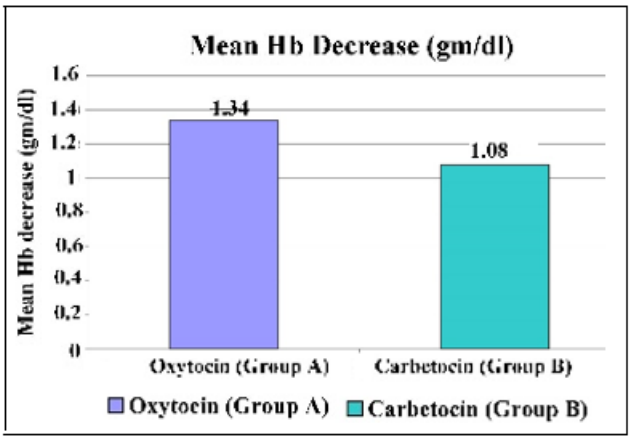


Figure 2

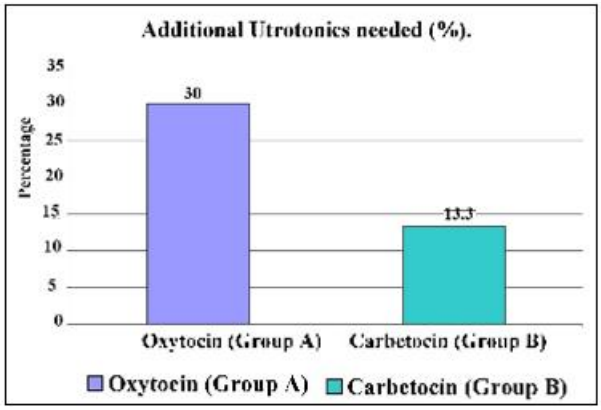


Figure 3

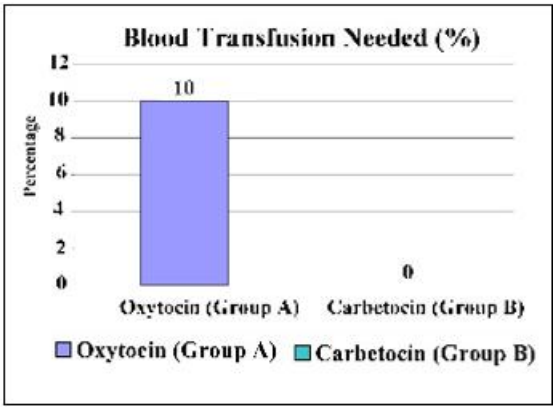


Figure 4

Oxytocin Group (Group A): The mean blood loss was 256.75 mL (SD = 209.55). Carbetocin Group (Group B): The mean blood loss was significantly lower at 181.33 mL (SD = 132.08), with a statistically significant difference (p = 0.02). Mean hemoglobin decrease was 1.34 gm/dL (SD = 0.35) in Oxytocin group. Mean hemoglobin decrease was 1.08 gm/dL (SD = 0.28) Carbetocin group, a statistically significant difference (p = 0.0001).30% of patients required in Oxytocin group. Only 13.33% required additional agents (p = 0.046) Carbetocin group.10% required blood transfusions in Oxytocin group. None required transfusions (p = 0.036) in Carbetocin group. Carbetocin showed more stable mean arterial pressure (MAP) compared to Oxytocin, with significant differences in MAP post - administration (p = 0.0001).

5. Discussion

This study found that Carbetocin was more effective than Oxytocin in preventing PPH among high - risk vaginal deliveries. The Carbetocin group exhibited significantly lower mean blood loss, smaller decreases in hemoglobin, and reduced requirements for additional uterotonic agents or transfusions. There was no significant difference in demographic profile, age and parity among both the groups in our study. These results are consistent with previous studies, such as Terblanche et al. (2021) and Jin et al. (2016), both of which demonstrated Carbetocin's superior performance in cesarean deliveries.

6. Clinical Implications

The study supports Carbetocin as an ideal choice for managing PPH, especially in low - resource settings due to its room temperature stability and single - dose administration. This simplifies PPH management, particularly in high - pressure labor settings. Carbetocin's stable effects on MAP and heart rate suggest a potential advantage in patients who are vulnerable to significant blood pressure fluctuations, such as those with pre - existing cardiovascular conditions. While Carbetocin is more expensive than Oxytocin, its ability to reduce complications, transfusions, and extended hospital stays may make it cost - effective over time, particularly in low - resource settings where complications can have far - reaching consequences.

7. Limitations of the Study

Conducting the study in a single tertiary care hospital limits the generalizability of the findings. The study excluded women with cesarean sections, hypertension, and other conditions, limiting the broader applicability of the results. This study primarily evaluated immediate postpartum outcomes and did not track long - term outcomes, such as late PPH or maternal recovery. The study did not include a detailed cost - benefit analysis of Carbetocin versus Oxytocin, which would be useful for assessing its economic viability in low - resource settings.

8. Conclusion

This study demonstrates that Carbetocin is more effective than Oxytocin in preventing PPH in high - risk vaginal deliveries. Carbetocin led to lower mean blood loss, reduced hemoglobin decrease, and a decreased need for additional uterotonic agents and transfusions, making it a more effective option for managing PPH. Given its single - dose administration and stability at room temperature, Carbetocin is a practical choice in low - resource settings where maintaining a cold chain is challenging.

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