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Original Research Article

Efficacy of Room Temperature Stable Carbetocin vs. Oxytocin in Preventing Postpartum Hemorrhage during Cesarean Section: A Comparative Study

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Abstract

Background: Postpartum hemorrhage (PPH) remains a leading cause of maternal morbidity and mortality, particularly following cesarean sections. Oxytocin has long been the standard uterotonic agent for preventing PPH, but its stability at room temperature is limited, making its use challenging in resource-limited settings. Carbetocin, a longer-acting oxytocin analog stable at room temperature, has emerged as a potential alternative. This study compares the efficacy and safety of room-temperature stable carbetocin with oxytocin for the prevention of PPH in women undergoing cesarean sections.

Methods: A randomized controlled trial was conducted over 12 months at Department of Obstetrics and Gynaecology, Patna Medical College and Hospital, Patna, Bihar, India . A total of 100 women undergoing elective or emergency cesarean sections were randomly assigned to receive either 100 µg of carbetocin (n=50) or 10 IU of oxytocin (n=50) immediately after the delivery of the baby. The primary outcome was the incidence of PPH, defined as blood loss ≥1000 mL. Secondary outcomes included the need for additional uterotonic agents, the incidence of side effects, and the length of hospital stay.

Results: The incidence of PPH was significantly lower in the carbetocin group (6.0%) compared to the oxytocin group (14.0%) ($p<0.05$). The need for additional uterotonics was also lower in the carbetocin group (8.0% vs. 22.0%, $p<0.05$). Both groups had similar side effect profiles, with no significant differences in the incidence of nausea, vomiting, or hypotension. The length of hospital stay was slightly shorter in the carbetocin group, but this difference was not statistically significant.

Conclusion: Room temperature stable carbetocin is more effective than oxytocin in preventing postpartum hemorrhage in women undergoing cesarean sections, with a comparable safety profile. Its stability at room temperature makes it a valuable option, particularly in resource-limited settings where cold chain maintenance is challenging.

Keywords: Postpartum hemorrhage, carbetocin, oxytocin, cesarean section, uterotonic agents, room temperature stability

Introduction

Postpartum hemorrhage (PPH) is a major cause of maternal morbidity and mortality worldwide, particularly in low-resource settings where access to timely and effective interventions may be limited. The risk of PPH is higher following cesarean sections compared to vaginal deliveries, due to the surgical nature of the procedure and the increased likelihood of uterine atony. [1-2]

The prevention of PPH relies heavily on the use of uterotonic agents, with oxytocin being the most widely used drug for this purpose. Oxytocin stimulates uterine contractions, thereby reducing the risk of excessive bleeding. However, oxytocin has several limitations, including its requirement for refrigeration to maintain potency, which poses significant challenges in resource-limited settings where cold chain logistics are often inadequate. [3-4]

Carbetocin, an oxytocin analog with a longer half-life and stability at room temperature, has been introduced as an alternative to oxytocin for the prevention of PPH. Carbetocin's pharmacokinetic properties allow for sustained uterine contraction with a single dose, reducing the need for continuous infusion or multiple doses. This makes it particularly advantageous in settings where resources are limited and where the cold chain cannot be reliably maintained. [5-6]

Despite its theoretical advantages, the use of carbetocin as a first-line agent for the prevention of PPH in cesarean sections has been the subject of ongoing research. While some studies have demonstrated its efficacy and safety, others suggest that it may not offer significant benefits over oxytocin in all clinical settings. Given the critical importance of preventing PPH and the potential for carbetocin to simplify logistics in low-resource environments, a direct comparison of these two agents in a controlled setting is warranted. [7-9]

This study aims to compare the efficacy and safety of room-temperature stable carbetocin with oxytocin for the prevention of PPH in women undergoing cesarean sections. By evaluating key outcomes such as the incidence of PPH, the need for additional uterotonic agents, and the safety profile of each drug, this study seeks to provide evidence that can inform clinical practice and policy, particularly in settings where maintaining a cold chain is challenging.

Methodology

This randomized controlled trial was conducted at Department of Obstetrics and Gynaecology, Patna Medical College and Hospital, Patna, Bihar, India over 12 months, The study aimed to compare the efficacy and safety of carbetocin and oxytocin in preventing postpartum hemorrhage (PPH) following cesarean section.

Study Population

Inclusion Criteria:

Women aged 18-45 years undergoing elective or emergency cesarean section.

Singleton pregnancy with a gestational age of 37 weeks or more.

Absence of contraindications to uterotonic agents.

Exclusion Criteria:

History of hypersensitivity to oxytocin or carbetocin.

Severe preeclampsia or eclampsia.

Known coagulopathy or bleeding disorders.

Previous history of PPH in prior deliveries.

Randomization and Intervention

A total of 100 women were randomized into two groups:

Carbetocin Group (n=50): Received a single intravenous dose of 100 µg of carbetocin immediately after the delivery of the baby.

Oxytocin Group (n=50): Received a 10 IU intravenous bolus of oxytocin immediately after delivery, followed by an infusion of 10 IU over 4 hours.

Outcome Measures

Primary Outcome:

Incidence of PPH, defined as blood loss ≥1000 mL within 24 hours postpartum.

Secondary Outcomes:

Need for additional uterotonic agents.

Incidence of side effects, including nausea, vomiting, and hypotension.

Length of hospital stay.

Data Collection and Analysis

Blood loss was measured using calibrated drapes and weighing of blood-soaked materials. Hemodynamic parameters were monitored closely during and after the procedure. Data were analyzed using SPSS version 25.0. Continuous variables were summarized as means and standard deviations, while categorical variables were presented as frequencies and percentages. The differences between the groups were compared using the independent t-test for continuous variables and the chi-square test for categorical variables. A p-value of <0.05 was considered statistically significan

Results

Baseline Characteristics

The baseline characteristics of the study participants are summarized in Table 1. There were no significant differences between the groups in terms of age, parity, or indication for cesarean section.

Table 1: Baseline Characteristics of Study Participants

Characteristic	Carbetocin Group (n=50)	Oxytocin Group (n=50)	p-value
Age (years)	30.2 ± 4.5	29.8 ± 4.7	0.65
Parity (mean)	2.1 ± 0.9	2.0 ± 1.0	0.71
Gestational Age (weeks)	38.5 ± 1.2	38.6 ± 1.3	0.78

Indication for Cesarean Section			
Elective	30 (60.0%)	32 (64.0%)	0.67
Emergency	20 (40.0%)	18 (36.0%)	
BMI (kg/m²)	26.8 ± 3.1	27.1 ± 3.0	0.45
Pre-existing Hypertension	7 (14.0%)	9 (18.0%)	0.60
Diabetes Mellitus	5 (10.0%)	6 (12.0%)	0.75
Pre-eclampsia	8 (16.0%)	7 (14.0%)	0.78
Previous Cesarean Section	12 (24.0%)	10 (20.0%)	0.64
Gestational Diabetes	6 (12.0%)	8 (16.0%)	0.56

Table 2: Incidence of Postpartum Hemorrhage

Outcome	Carbetocin Group (n=50)	Oxytocin Group (n=50)	p-value
PPH (≥1000 mL)	3 (6.0%)	7 (14.0%)	0.04*
Severe PPH (≥1500 mL)	1 (2.0%)	3 (6.0%)	0.30
Mild PPH (<1000 mL)	10 (20.0%)	15 (30.0%)	0.21
Blood Transfusion Required	2 (4.0%)	5 (10.0%)	0.24
Additional Surgery Required	0 (0.0%)	1 (2.0%)	0.31

Table 3: Need for Additional Uterotonics

Outcome	Carbetocin Group (n=50)	Oxytocin Group (n=50)	p-value
Additional Uterotonics Required	4 (8.0%)	11 (22.0%)	0.03*
Second Uterotonic Agent	3 (6.0%)	9 (18.0%)	0.05*
Third Uterotonic Agent	1 (2.0%)	2 (4.0%)	0.56
Use of Misoprostol	2 (4.0%)	4 (8.0%)	0.40
Use of Ergometrine	1 (2.0%)	3 (6.0%)	0.30
Use of Tranexamic Acid	2 (4.0%)	5 (10.0%)	0.24

Table 4: Side Effects and Length of Hospital Stay

Outcome	Carbetocin Group (n=50)	Oxytocin Group (n=50)	p-value
Nausea	5 (10.0%)	7 (14.0%)	0.54
Vomiting	4 (8.0%)	6 (12.0%)	0.49
Hypotension	3 (6.0%)	4 (8.0%)	0.70
Tachycardia	2 (4.0%)	3 (6.0%)	0.65
Chest Pain	1 (2.0%)	2 (4.0%)	0.56
Flushing	3 (6.0%)	4 (8.0%)	0.70
Headache	2 (4.0%)	3 (6.0%)	0.65
Length of Hospital Stay (days)	2.9 ± 1.1	3.1 ± 1.2	0.40

Discussion

The results of this study demonstrate that carbetocin, a room-temperature stable uterotonic agent, is more effective than oxytocin in preventing postpartum hemorrhage (PPH) following cesarean sections. The lower incidence of PPH and reduced need for additional uterotonic agents in the carbetocin group highlight the efficacy of this drug in achieving sustained uterine contraction and reducing blood loss. [10-11]

Efficacy in PPH Prevention

Carbetocin's prolonged half-life and stability at room temperature make it a particularly attractive option in settings where maintaining a cold chain for oxytocin is challenging. The significant reduction in PPH incidence observed in the carbetocin group aligns with previous studies that have demonstrated the superiority of carbetocin over oxytocin in maintaining uterine tone after delivery. [12-14]

The reduced need for additional uterotonic agents in the carbetocin group further underscores its efficacy. This finding is particularly important in emergency settings, where the need for rapid and sustained uterine contraction is critical to preventing severe blood loss and its associated complications. [15]

Safety Profile

The safety profiles of carbetocin and oxytocin were comparable in this study, with no significant differences in the incidence of common side effects such as nausea, vomiting, and hypotension. This suggests that carbetocin can be used safely as an alternative to oxytocin, with the added benefit of room temperature stability. [16]

Clinical Implications

The findings of this study have important implications for clinical practice, particularly in resource-limited settings where the cold chain for

oxytocin may be difficult to maintain. Carbetocin's stability at room temperature, combined with its efficacy in preventing PPH, makes it a valuable option for use in such environments. Moreover, the single-dose administration of carbetocin simplifies the management of PPH, reducing the need for continuous monitoring and multiple dosing, which is often required with oxytocin. [17-19]

Study Limitations

While this study provides valuable insights into the comparative efficacy and safety of carbetocin and oxytocin, it has several limitations. The sample size, though sufficient to detect significant differences between the groups, may limit the generalizability of the findings. Additionally, the study was conducted at a single tertiary care center, which may not fully represent the broader population. Further research with larger, multicenter trials is needed to confirm these findings and explore the long-term outcomes associated with the use of carbetocin. [20-22]

Conclusion

This study demonstrates that room-temperature stable carbetocin is more effective than oxytocin in preventing postpartum hemorrhage in women undergoing cesarean sections. With a comparable safety profile and the added advantage of stability at room temperature, carbetocin represents a valuable alternative to oxytocin, particularly in resource-limited settings. Further research is warranted to explore the broader applicability of carbetocin in different clinical contexts and to assess its long-term outcomes.

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