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Original Research Article

Comparison of Oxytocin Vs Carbetocin in Prevention of Postpartum Hemorrhage in Caesarean Section

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Abstract

Background: Postpartum hemorrhage (PPH) remains a leading cause of maternal morbidity and mortality, particularly following cesarean deliveries. Effective PPH management relies on uterotonic agents to promote uterine contraction and reduce blood loss. This study compares the efficacy of carbetocin and oxytocin for PPH prevention during cesarean sections.

Aim: To evaluate the effectiveness of carbetocin versus oxytocin in minimizing blood loss, reducing the need for additional uterotonics, and minimizing adverse effects during cesarean deliveries.

Materials and Methods: This comparative study included 100 healthy pregnant women undergoing cesarean sections, divided into two groups: 50 receiving carbetocin (100 µg IV) and 50 receiving oxytocin (10 IU IM and 5 IU in 500 ml Ringer's lactate). Parameters assessed included uterine tone, additional uterotonics, adverse effects, blood transfusions, and pre/postoperative hemoglobin and hematocrit levels.

Results: The study demonstrated that carbetocin was more effective than oxytocin in preventing postpartum hemorrhage (PPH) during cesarean deliveries. The carbetocin group showed superior uterine tone, with only 8% requiring additional uterotonics compared to 20% in the oxytocin group. Blood loss was significantly lower in the carbetocin group, with a mean of 217.6 ml versus 358 ml in the oxytocin group. Additionally, only 2% of patients in the carbetocin group required blood transfusions, compared to 8% in the oxytocin group. Adverse effects were less frequent in the carbetocin group, with headaches reported in 6% compared to 18% in the oxytocin group, and no cases of nausea or vomiting in the carbetocin group. These findings highlight the superior efficacy and safety profile of carbetocin in managing PPH during cesarean deliveries.

Conclusion: Carbetocin demonstrated superior efficacy and safety over oxytocin in preventing PPH during cesarean deliveries. Its prolonged half-life ensures sustained uterine contraction, reducing the need for additional uterotonics, transfusions, and adverse effects, making it a valuable alternative for PPH management in obstetric care.

Keywords: Carbetocin, Oxytocin, Postpartum Hemorrhage, Cesarean Delivery, Maternal Health, Uterotonic Agents, Blood Loss.

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Introduction

Postpartum hemorrhage (PPH) remains a leading cause of maternal morbidity and mortality worldwide, with uterine atony accounting for the majority of cases [1,2]. Uterine atony, as the primary cause of hemorrhage during delivery, underscores the importance of active management of the third stage of labor over expectant management [2]. The administration of uterotonic drugs is central to active management, with oxytocin being the most widely used agent due to its proven efficacy in reducing the incidence of PPH [2]. However, while oxytocin remains the gold standard, growing evidence suggests that carbetocin, a long-acting oxytocin analogue, could serve as a viable alternative for PPH prophylaxis. The debate continues regarding which uterotonic agent is ideal for prophylactic use [3-4]. Oxytocin functions by binding to oxytocin receptors in the uterine myometrium, stimulating smooth muscle contractions. It has a rapid onset but a short

duration of action, necessitating maintenance infusions in the immediate postpartum period [5-6]. Carbetocin, on the other hand, offers a longer half-life of approximately 41 minutes, inducing sustained uterine contractions for up to an hour following a single intravenous dose. [7-8]This eliminates the need for continuous infusion and provides continuous uterine contractions within two minutes of administration, followed by rhythmic contractions lasting 60 minutes [9].

This study aims to compare the effectiveness and safety of oxytocin and carbetocin during cesarean sections, focusing on their role in the prevention and management of PPH.

Material and Methods

This prospective, controlled, comparative clinical study was conducted in the Department of Obstetrics and Gynaecology at Pacific Medical College and Hospital, Udaipur, to evaluate the effectiveness and safety of carbetocin versus oxytocin in preventing postpartum hemorrhage (PPH) during cesarean sections. The study enrolled 100 healthy pregnant women aged 18–50 years, undergoing elective or emergency lower segment cesarean section (LSCS). Participants were selected based on specific inclusion and exclusion criteria, and informed consent was obtained.

Inclusion criteria included women with singleton, term pregnancies delivering live babies by LSCS, irrespective of parity or presentation. Exclusion criteria included twin pregnancies, intrauterine death, preeclampsia, medical illnesses, Rh incompatibility, vaginal bleeding, abnormal placentation, drug hypersensitivity, and vaginal deliveries.

Participants were divided into two groups: Group A received 100 μg of carbetocin intravenously, while Group B received 10 IU oxytocin in 500 ml normal saline intravenously. Parameters assessed included intraoperative blood loss, uterine tone, adverse effects, and postoperative outcomes such as vitals, fundal height, bleeding per vaginum, and hemoglobin/hematocrit levels at 24 hours.

Data were analyzed using SPSS version 24.0, employing Chi-square tests, Fisher's Exact Test, and Student's t-tests. Statistical significance was set at $p<0.05$. The findings aim to guide the selection of uterotonic agents for optimal PPH management during cesarean deliveries.

Results

Table 1 compares demographic and clinical characteristics of the two groups. The mean age of participants in both groups was comparable, with no statistically significant difference ($p = 0.17$). Similarly, gestational age ($p = 0.569$) and parity ($p = 0.868$) did not show significant variation between the groups. The type of LSCS (emergency or elective) was also similar, with 64% of the oxytocin group and 58% of the carbetocin group undergoing emergency LSCS ($p = 0.539$). Preoperative and postoperative vitals, including SPO2, systolic BP, diastolic BP, and pulse, were comparable between the groups at all time points, with no statistically significant differences (all $p > 0.05$). Postoperative hemoglobin and hematocrit levels were also similar, with the mean values showing no significant differences ($p = 0.92$ and $p = 0.95$, respectively). [Table 2]

Carbetocin showed better outcomes regarding uterine tone, with fewer participants having a flabby uterus (8.0% vs. 20.0%, $p = 0.014$). Blood loss was significantly lower in the carbetocin group (217.58 mL vs. 356.0 mL, $p = 0.001$). Fewer participants in the carbetocin group required additional uterotonic agents (4.0% vs. 16.0%, $p = 0.044$), and the need for blood transfusions was lower (2.0% vs. 8.0%, $p = 0.231$), though not statistically significant. [Table 3]

Adverse effects were more frequent in the oxytocin group, with a significantly higher incidence of headache in the carbetocin group (18.0% vs. 4.0%, $p = 0.0026$). Other side effects, such as nausea and vomiting, were observed only in the oxytocin group. The average number of intraoperative pads soaked was similar between the groups, with no statistically significant difference ($p = 0.121$). [Table 4]

Table 1: Comparison of Demographic and Clinical Parameters between Oxytocin and Carbetocin Groups

Parameter	Oxytocin (n = 50)	Carbetocin (n = 50)	Statistical Test	p-value
Age Group (years)				
21–30	25 (50.0%)	20 (40.0%)		
31–35	25 (50.0%)	30 (60.0%)	$\chi^2 = 3.48$	0.17
Mean ± SD	31.14 ± 5.10	31.04 ± 3.11		
Range	21–35	24–35		
Gestational Age (weeks)	38.79 ± 0.86	38.45 ± 0.98	t = 0.57	0.569
Parity	2.50 ± 0.95	2.36 ± 0.92	t = 0.17	0.868
Type of LSCS			$\chi^2 = 0.378$	0.539
Emergency	32 (64.0%)	29 (58.0%)		
Elective	18 (36.0%)	21 (42.0%)		

Table 2: Comparison of Preoperative and Postoperative Vitals

Parameter	Oxytocin (Mean ± SD)	Carbetocin (Mean ± SD)	Statistical Test	p-value
Preoperative Vitals				
SPO2 (%)	97.96 ± 0.66	98.12 ± 0.79	t = 1.08	0.28
SBP (mmHg)	112.56 ± 5.09	112.16 ± 4.44	t = 0.41	0.67
DBP (mmHg)	97.14 ± 23.14	96.92 ± 20.12	t = 0.05	0.96
Pulse (bpm)	89.04 ± 9.63	89.12 ± 10.45	t = 0.04	0.96
Postoperative Vitals (1 hour)				
SPO2 (%)	97.84 ± 9.08	98.40 ± 9.51	t = 0.30	0.76
SBP (mmHg)	122.00 ± 6.18	121.72 ± 6.57	t = 0.21	0.82
DBP (mmHg)	80.24 ± 4.46	79.80 ± 4.02	t = 0.51	0.60
Pulse (bpm)	75.80 ± 5.48	75.44 ± 4.98	t = 0.42	0.67
Postoperative Hemoglobin and Hematocrit				
Hemoglobin (g/dL)	9.87 ± 0.85	9.85 ± 0.98	t = 0.09	0.92
Hematocrit (%)	31.21 ± 2.42	31.24 ± 2.47	t = 0.06	0.95

Table 3: Comparison of Uterine Tone, Blood Loss, and Additional Interventions

Parameter	Oxytocin (n = 50)	Carbetocin (n = 50)	Statistical Test	p-value
Uterine Tone (1 hour)			$\chi^2 = 5.98$	0.014
Flabby Uterus	10 (20.0%)	4 (8.0%)		
Well Contracted	40 (80.0%)	46 (92.0%)		
Blood Loss (mL)	356.0 ± 296.74	217.58 ± 181.98	t = 3.812	0.001
Need for Additional Uterotonic Agents			$\chi^2 = 4.00$	0.044
Yes	8 (16.0%)	2 (4.0%)		
No	42 (84.0%)	48 (96.0%)		
Need for Blood Transfusion			$\chi^2 = 1.14$	0.231
Yes	4 (8.0%)	1 (2.0%)		
No	46 (92.0%)	49 (98.0%)		

Table 4: Comparison of Adverse Effects and Intraoperative Indicators

Parameter	Oxytocin (n = 50)	Carbetocin (n = 50)	Statistical Test	p-value
Adverse Effects				
Headache	2 (4.0%)	9 (18.0%)	$\chi^2 = 5.0026$	0.0026
Nausea	3 (6.0%)	0 (0.0%)	$\chi^2 = 5.128$	0.028
Vomiting	2 (4.0%)	0 (0.0%)	$\chi^2 = 1.032$	0.12
Light-Headedness	2 (4.0%)	1 (2.0%)	$\chi^2 = 1.28$	0.68
Intraoperative Pads Soaked	2.429 ± 1.5413	2.060 ± 1.7072	t = 1.151	0.121

Discussion

Postpartum hemorrhage (PPH) remains a leading cause of maternal morbidity and mortality globally, accounting for approximately 25% of all maternal deaths [1]. Active management of the third stage of labor, particularly with the administration of prophylactic uterotonic agents, has been pivotal in reducing PPH incidence. Oxytocin, a commonly used uterotonic, is the cornerstone of this management approach. However, the search for longer-acting and more effective alternatives has led to the introduction of carbetocin, a synthetic oxytocin analog, as a potential replacement for the prevention of PPH. This study compared the efficacy of carbetocin and oxytocin in cesarean deliveries, contributing to the growing body of evidence on uterotonic agents. In this study, there were no significant differences in baseline characteristics such as age between the two groups. The mean age was 31.14 ± 5.10 years for the oxytocin group and 31.04 ± 3.11 years for the carbetocin group. These findings align with studies by Delorme et al. [10] and Pizzagalli et al. [11], which also reported similar age distributions. The uniformity in demographic variables across groups minimizes confounding effects, enhancing the reliability of the comparisons.

The study observed no significant differences in obstetric characteristics, including gestational age, parity, and type of cesarean section, between the two groups. Uniform obstetric profiles ensure that observed outcomes are attributable to the effects of the uterotonic agents rather than underlying patient factors. Similar trends have been noted in studies such as those by Delorme et al. [10] and Whigham et al. [12].

Carbetocin demonstrated superior intraoperative uterine tone, with only 8% of patients experiencing a flabby uterus compared to 20% in the oxytocin group. This finding is consistent with Larciprete G et al. [13] and Holleboom et al. [14], who reported reduced need for additional uterotonic drugs in the carbetocin group. The longer half-life of carbetocin (40 minutes vs. 3-5 minutes for oxytocin) ensures sustained uterine contractions, explaining its superior efficacy [15].

Mean intraoperative blood loss was significantly lower in the carbetocin group (217.6 mL) than in the oxytocin group (356.0 mL). This aligns with findings by Elbohoty et al. [16] and Gallos et al. [15], highlighting carbetocin's role in reducing PPH. The longer-lasting uterotonic effects of carbetocin likely contribute to this improved control of uterine bleeding.

Fewer patients in the carbetocin group required additional uterotonic drugs (8% vs. 20%, p = 0.044) or blood transfusions (2% vs. 14%, p = 0.231). Similar trends were observed in studies by Elbohoty et al. [16] and Gallos et al. [15]. Carbetocin's potent uterotonic action likely reduces the need for supplementary interventions, optimizing resource utilization and patient outcomes.

Carbetocin exhibited a better safety profile, with fewer adverse effects compared to oxytocin. Headache was more frequent in the carbetocin group (18%), but nausea, vomiting, and lightheadedness were predominantly reported in the oxytocin group. These findings mirror those of Elbohoty et al. [16], emphasizing carbetocin's tolerability. Additionally, carbetocin's heat stability offers logistical advantages in resource-limited settings, making it a practical alternative in such scenarios.

Preoperative and postoperative hemoglobin and hematocrit levels showed no significant differences between the groups, consistent with Delorme et al. [10] and Pizzagalli et al. [11]. While hematological parameters did not differ, carbetocin's superior clinical outcomes, such as reduced blood loss and fewer transfusions, underscore its effectiveness in managing PPH. Several studies, such as those by Delorme et al. [10], Pizzagalli et al. [11], and Whigham et al. [12], have compared oxytocin and carbetocin in cesarean deliveries. While some studies, including Delorme et al. [10], found no significant difference between the agents, others highlighted carbetocin's advantages. Discrepancies may stem from variations in study design, dosing regimens, and outcome definitions. However, the present study, along with meta-analyses like Gallos et al. [15], consistently demonstrates carbetocin's superiority in key clinical outcomes, such as reduced blood loss and improved uterine tone.

Conclusion

Our study highlights carbetocin's superiority over oxytocin in preventing postpartum hemorrhage (PPH) during cesarean deliveries. Carbetocin significantly reduced blood loss, the need for blood transfusions, and additional uterotonic drugs while demonstrating fewer adverse effects compared to oxytocin. Its prolonged half-life (40 minutes vs. oxytocin's 10–15 minutes) ensures sustained uterine contraction, reducing uterine atony and hemorrhage risk. Carbetocin eliminates the need for continuous infusion, simplifying PPH management and reducing logistical challenges. With a favorable safety profile and pharmacokinetics, carbetocin emerges as an effective and practical alternative to oxytocin, particularly in cesarean deliveries, enhancing maternal outcomes and optimizing obstetric care.

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