RESEARCH PAPER

Intravenous Diluted Oxytocin 2.5 IU as bolus Versus Intramuscular Oxytocin 10 IU for Active Management of the Third Stage of Labour: A Comparative Study

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ABSTRACT

Background: The third stage of labour is a critical period for maternal safety, with postpartum haemorrhage (PPH) being a leading cause of maternal morbidity and mortality worldwide. PPH accounts for over 20% of maternal deaths worldwide, and women in low- and middle-income countries are disproportionately affected. Oxytocin (10 IU, intramuscularly/intravenously) is recommended for the prevention of postpartum haemorrhage for all births (Recommendation 7.1, WHO 2025 PPH prevention guidelines). This study compares the efficacy and safety of diluted low-dose intravenous (IV) oxytocin 2.5 IU versus undiluted intramuscular (IM) oxytocin 10 IU during the third stage of labour.

Objectives: This study aimed to compare total blood loss during the third stage of labour, duration of the third stage of labour, incidence of PPH (≥500 mL), pre- and post-delivery haemoglobin levels, and maternal side effects between the two regimens.

Methods: This study was a prospective, comparative, interventional, quasi-randomized controlled study conducted in the Department of Obstetrics and Gynecology at a tertiary care teaching hospital. Study population: All women admitted for vaginal delivery and fulfilling the inclusion criteria after obtaining informed written consent. N=100; 50 per group. Group A: Received 2.5 IU oxytocin bolus diluted in 10 mL normal saline intravenously. • Group B: Received 10 IU oxytocin intramuscularly in undiluted form. Allocation was done by assigning every alternate eligible patient to the respective study groups. This method represents quasi-randomization.

Results: Mean age of participants was 25.38 years. Group A had a higher percentage of full-term pregnancies (60%) compared to Group B (42%). Both groups had an identical percentage of preterm cases at 10%. Blood Loss: Group B had a significantly higher average blood loss (362.58 mL) compared to Group A (319.40 mL).The p-value of 0.013 was statistically significant. Duration: The duration of the third stage of labor was longer in Group B (6.38 min) than in Group A (4.56 min).With a p-value of <0.001

Conclusion: Group A demonstrated greater effectiveness in reducing the duration of the third stage of labour and minimizing maternal blood loss. While both methods were associated with low PPH rates and no significant difference in observed adverse effects, the IV route provided more favourable outcomes in this study population. The differences in haemoglobin drop and blood loss were statistically significant between the two cohorts.

Keywords: Oxytocin, Labor Stage, Third, postpartum hemorrhage, Injections, Intravenous, Injections, Intramuscular, Delivery, Obstetric, Uterotonic Agents, Hemoglobins, Blood Loss, Surgical, and Maternal Welfare.

How to cite this article: Mahendra G, Nirmala Doraiswamy CK, Sushmita Malagoud Patil. Intravenous Diluted Oxytocin 2.5 IU as Bolus Versus Intramuscular Oxytocin 10 IU for Active Management of the Third Stage of Labour: A Comparative Study. Int J Drug Deliv Technol. 2026;16(76s): 1187-1193. DOI: 10.25258/ijddt.16.76s.106

INTRODUCTION

Postpartum hemorrhage (PPH) remains a leading global cause of maternal morbidity and mortality, accounting for approximately one-quarter of all maternal deaths worldwide. The majority of these fatalities occur in low- and middle-income countries, where access to rapid obstetric intervention can be limited. PPH is most commonly caused by uterine

atony, a condition where the uterus fails to contract sufficiently after the delivery of the placenta to compress the intramyometrial blood vessels. Consequently, the active management of the third stage of labor (AMTSL) has become the gold standard for preventing this life-threatening complication.

The cornerstone of AMTSL is the administration of uterotonic agents, with oxytocin being universally recommended as the first-line drug of choice due to its proven efficacy and favorable safety profile. However, while the effectiveness of oxytocin is well-established, significant debate remains regarding the optimal route and dosage for its administration. In many clinical settings, oxytocin is administered either as an intramuscular (IM) injection or an intravenous (IV) infusion/bolus.

Currently, the 10 International Unit (IU) intramuscular dose is widely utilized, particularly in settings where intravenous access may not be readily available or maintained throughout the third stage. Conversely, intravenous administration is often favored in hospital settings because it allows for a more rapid onset of action. Despite these common practices, clinical trials comparing these routes have yielded varying results regarding their relative efficacy in reducing blood loss and the incidence of PPH.

For instance, research by Adnan et al. (2018) through the LabOR Trial suggests that intravenous oxytocin may be more effective than intramuscular administration in preventing PPH of 500 mL or greater during vaginal delivery. Their findings indicated a significantly lower risk of PPH and a reduced need for additional uterotonic agents when the intravenous route was employed. Similarly, Charles et al. (2019) conducted a three-arm randomized controlled trial comparing IM injection, IV infusion, and IV bolus, finding that the IV routes generally offered superior protection against significant postpartum bleeding compared to IM injection.

However, the question of dosage is inextricably linked to the route. While 10 IU is standard for IM, there is ongoing investigation into whether lower doses administered intravenously specifically diluted doses can achieve comparable or superior clinical outcomes while potentially minimizing side effects. Intravenous boluses of oxytocin, particularly in higher or undiluted doses, have been associated with adverse hemodynamic effects, such as transient hypotension and tachycardia. Therefore, examining a lower, diluted intravenous dose (such as 2.5 IU) against the standard 10 IU intramuscular dose is critical for refining obstetric protocols.

Studies like those by Durocher et al. (2019) have explored whether the route of administration truly impacts postpartum bleeding in a double-blind, randomized controlled setting, emphasizing the need for rigorous evidence to guide clinical practice. They noted that while some studies point toward IV superiority, the practicalities of administration such as the time required to establish IV access must be weighed against the clinical benefits.

This study aims to address these gaps by comparing the efficacy and safety of 2.5 IU of intravenous diluted oxytocin versus 10 IU of intramuscular undiluted oxytocin during the third stage of labor. By evaluating parameters such as total blood loss, the incidence of PPH, and the requirement for rescue uterotonics, this research seeks to determine if a lower-dose IV approach provides a viable and potentially safer alternative to the traditional high-dose IM injection. Such findings are vital for optimizing maternal care and reducing the global burden of postpartum hemorrhage.

METHODOLOGY

Study Design: This study was a prospective, comparative, interventional, quasi-randomized controlled study conducted in the Department of Obstetrics and Gynaecology, Adichunchanagiri Institute of Medical Sciences, B G Nagara, Karnataka, India, from June 2025 to December 2025. The study protocol was approved by the Institutional Ethics Committee, and all procedures were conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines.

Study Population:

All women admitted for vaginal delivery and fulfilling the inclusion criteria after obtaining informed written consent.

Allocation of Participants: N=100; 50 per group.

Group A: Received 2.5 IU oxytocin diluted in 10 mL normal saline intravenously.

• Group B: Received 10 IU oxytocin intramuscularly in undiluted form.

Allocation was done by assigning every alternate eligible patient to the respective study groups. This method represents quasi-randomization.

Inclusion Criteria:

Pregnant women aged 20–40 years.

Gestational age between 30 and 41 weeks.

Singular pregnancy with live birth.

Exclusion Criteria:

History of bleeding disorders or pre-existing severe anaemia.

Placenta previa/abruption.

Multiple gestations (twins/triplets).

High-risk pregnancies.

Previous cesarean section.

Clinical Assessment and Participant Selection: A comprehensive clinical evaluation was performed for all participants admitted for vaginal delivery at our tertiary care teaching hospital. The assessment included a detailed medical and obstetric history (Gravidity and Age), physical examination, and baseline laboratory investigations. Inclusion criteria were pregnant women aged 20–40 years with a singular live pregnancy and a gestational age between 30 and 41 weeks. Women with a history of bleeding disorders, severe anaemia, placenta previa, abruption, multiple gestations, or a previous cesarean section were excluded from the study. Pre-delivery haemoglobin levels were measured for all participants upon enrollment to establish a baseline for maternal outcome comparison.

Study Design and Randomization: This was a prospective, comparative, interventional, quasi-randomized controlled study. A total of 100 participants were enrolled and allocated into two groups (N=50 per group) using an alternate assignment method.

- **Group A:** Participants received 2.5 IU of oxytocin bolus diluted in 10 mL of normal saline, administered as a slow intravenous bolus after delivery of the head and shoulder of the fetus.
- • Group B: Participants received 10 IU of undiluted oxytocin administered via the intramuscular route.

This allocation ensured a direct comparison between a low-dose diluted intravenous route and the standard high-dose intramuscular route for the active management of the third stage of labor.

Third Stage Management and Outcome Measures: The primary focus of the intervention was the management of the third stage of labor, which was conducted according to standardized hospital protocols following vaginal delivery. The following clinical and laboratory parameters were rigorously monitored and recorded:

1. **Duration of Third Stage:** The time interval (in minutes) from the birth of the infant to the complete delivery of the placenta.
2. Quantitative Blood Loss: Total blood loss (in mL) was assessed following placental delivery by the volumetric method.
3. Hemoglobin Analysis: Post-delivery haemoglobin levels (g/dL) were measured to determine the "haemoglobin drop," calculated as the difference between pre-delivery and post-delivery levels.
4. **Incidence of PPH:** Postpartum hemorrhage was defined as blood loss ≥500 mL.
5. **Safety Assessment:** Participants were closely monitored for adverse effects, specifically the incidence of hypotension and nausea.

Statistical Analysis

Statistical analysis for this study was performed to evaluate the clinical parameters of Group A (2.5 IU intravenous diluted oxytocin) and Group B (10 IU intramuscular undiluted oxytocin). Continuous variables, including maternal age, gestational age, haemoglobin levels, and blood loss, were expressed as mean ± standard deviation (SD). Categorical variables, such as gravidity (Obstetric Index), mode of delivery, and incidence of side effects, were reported as frequencies and percentages.

Quantitative assessment of blood loss and the duration of the third stage of labor was also performed to determine clinical efficacy. Comparison of mean haemoglobin drop between the two study groups was conducted using an independent-samples t-test. For the primary outcome of postpartum hemorrhage (PPH) incidence, categorical data were compared to determine frequency within each cohort. Correlation between blood loss volume and haemoglobin drop was observed to align significantly in Group B. A p-value of <0.05 was considered statistically significant for all comparative analyses.

RESULTS:

1. AGE-WISE DISTRIBUTION

Age group	Group A count	%	Group B count	%
20–25	30	60%	27	54%
26–30	16	32%	20	40%
31–35	4	8%	1	2%
36–40	0	0	2	4%
Total	50	100%	50	100%

Minimum age: 20 years
Maximum age: 39 years
Mean age: 25.38 years
Standard deviation:
Group A: s≈3.46 years
• Group B:
This indicates that the ages in **Group B** are slightly more spread out or varied compared to those in **Group A**.

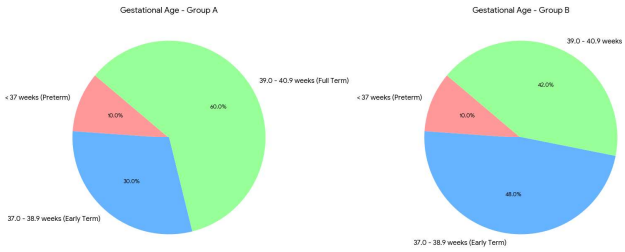
2. **Obstetric index distribution**

Obstetric index	Group A count	Group A %	Group B count	Group B %
G1P0	31	62%	21	42%
G2A1	1	2%	0	0
G2P1	11	22%	24	48%
G3P1A1	2	4%	0	0
G3P2	4	8%	4	8%
G4P2A1	1	2%	0	0
G4P3	0	0	1	2%
Total	50	100%	50	100%

Group A is primarily composed of **G1P0** (62%), indicating a higher proportion of first-time pregnancies compared to Group B.
Group B had a higher percentage of G2P1 (48%) compared to Group A (22%).
Multi-gravida categories like G3P2 are equally distributed at 8% in both groups.

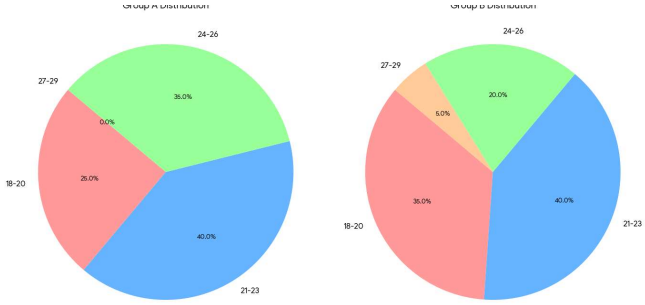
3. Gestational age distribution

Group A Standard Deviation: s≈1.64 weeks
Group B Standard Deviation: s≈1.31 weeks
Key Observations
Full-term pregnancies: Group A had a higher percentage of full-term pregnancies (60%) compared to Group B (42%).
Preterm pregnancies: Both groups had an identical percentage of preterm cases at 10%.



4. Mode of delivery:

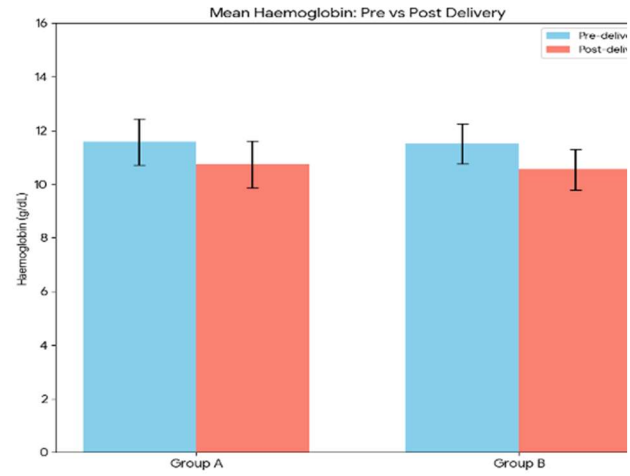
Spontaneous vaginal delivery accounted for 90% of deliveries in each group.
Vacuum-assisted vaginal delivery was slightly higher in Group B (10%) compared to Group A (8%).
Forceps delivery was only observed in Group A (2%).

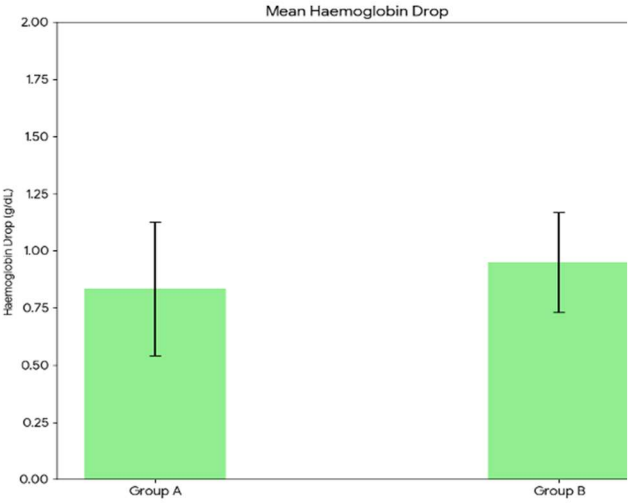


5. Pre- and post-delivery haemoglobin and haemoglobin drop

Group	Parameter	Mean	Standard deviation
Group A	Pre-delivery Hb	11.57	0.85
	Post-delivery Hb	10.73	0.87
	Haemoglobin drop	0.834	0.29
Group B	Pre-delivery Hb	11.50	0.74
	Post-delivery Hb	10.55	0.75
	Haemoglobin drop	0.949	0.22

Independent-samples t-test.
T-Test Results: Haemoglobin Drop
Group A Mean Drop: 0.834 g/dL
Group B Mean Drop: 0.949 g/dL
P-value: 0.0289, indicating a statistically significant difference between the two groups.
Conclusion: Group B experienced a significantly higher drop in haemoglobin compared to Group A.





6. **Blood loss and duration of third stage of labor analysis**

Parameter	Group A	Group B	P-value
Blood loss	319.40 ± 85.15	362.58 ± 84.96	0.013
Duration of third stage	4.56 ± 1.32	6.38 ± 1.39	<0.001
PPH cases	2 (4%)	2 (4%)	1

1. Blood loss: Group B had a significantly higher average blood loss (362.58 mL) compared to Group A (319.40 mL).
The p-value of 0.013 was statistically significant.
2. Duration: The duration of the third stage of labor was longer in Group B (6.38 min) than in Group A (4.56 min).
The p-value of <0.001 indicates a highly significant difference.
3. PPH incidence:

7. **Side effects**

• Side effects of Groups A and B are comparable
• Group A: 2 out of 50 cases had transient hypotension and 1 out of 50 cases had nausea
• Group B: 1 out of 50 cases had transient hypotension and 1 out of 50 cases had nausea

DISCUSSION

This quasi-randomized study provides evidence regarding the comparative efficacy of two distinct routes and dosages of oxytocin for the management of the third stage of labour. Our findings demonstrate that 2.5 IU of diluted intravenous (IV) oxytocin was associated with a shorter third stage and lower maternal blood loss compared with the conventional 10 IU intramuscular (IM) dose.

The mean age of our study population (25.38 years) reflects the reproductive demographic of the study cohort. The mode of delivery was similar between Group A and Group B, with 90% spontaneous vaginal deliveries in each group. However, the groups differed in baseline parity, with a higher proportion of primigravidas in Group A (62% vs 42%). This imbalance should be considered when interpreting the observed differences in outcomes because parity may influence labour-related outcomes.

Our findings regarding the duration of the third stage of labor (4.56 ± 1.32 min for IV vs 6.38 ± 1.39 min for IM; $p < 0.001$) are highly significant. The faster action of intravenous oxytocin is physiologically consistent with the immediate bioavailability of the drug in the systemic circulation compared to the delayed absorption from muscle tissue. These results align with the systematic review by Oladapo et al. (2020), which indicated that intravenous oxytocin administration is associated with a shorter third stage of labor.

The quantitative assessment of blood loss (319.40 ± 85.15 mL in IV vs 362.58 ± 84.96 mL in IM; $p = 0.013$) and the corresponding mean drop in hemoglobin (0.834 g/dL vs 0.949 g/dL; $p = 0.0289$) further highlight the clinical benefit of the diluted IV route. Although both groups remained within manageable limits, the statistically significant reduction in blood loss in the IV group suggests better uterine contractility and quicker placental separation. Interestingly, while the mean values differed, the clinical incidence of PPH (≥500 mL) was identical at 4% in both groups. This suggests that while 2.5 IU IV oxytocin is more "efficient" at a population level, both methods remain safe and effective strategies for preventing severe hemorrhage.

Safety profiles were excellent across both cohorts. The low incidence of side effects, such as hypotension (4% in IV vs 2% in IM) and nausea, confirms that a lower dose (2.5 IU) given

intravenously does not increase maternal risk when appropriately diluted. This supports the move toward lower-dose, high-efficacy protocols that minimize drug exposure while maximizing physiological response.

The clinical implications of this study are significant. Given that PPH remains a leading cause of maternal mortality in low- and middle-income countries, identifying the most efficient route of oxytocin administration is vital. Our findings suggest that in tertiary care settings where IV access is already established for the second stage of labor, the use of 2.5 IU diluted oxytocin is a superior alternative to IM injection.

Limitations of our study include the sample size of 100 participants, which may not capture extremely rare adverse events. Additionally, the quasi-randomized design may introduce bias compared with a randomized controlled trial. The imbalance in parity between the groups is another potential confounder. Future research should focus on multicentre trials and cost-benefit analyses of diluted IV versus IM administration in resource-limited primary health centres where IV access and maintenance may be more challenging.

In conclusion, our study suggests that 2.5 IU of diluted intravenous oxytocin may provide more rapid and effective management of the third stage of labour than 10 IU of intramuscular oxytocin in this study population. The observed reductions in blood loss and duration of the third stage support further evaluation of low-dose IV oxytocin in larger, adequately randomized studies before routine adoption.

CONCLUSION

This study demonstrates that the route and dosage of oxytocin administration may influence the management of the third stage of labour. In this study, 2.5 IU of diluted intravenous oxytocin was associated with a significantly shorter third stage and lower mean blood loss compared with 10 IU of undiluted intramuscular oxytocin. Furthermore, the drop in haemoglobin was statistically lower in the intravenous group, indicating better preservation of maternal haematological status.

No statistically significant difference in postpartum haemorrhage or the observed adverse effects was detected between the groups. The findings suggest that diluted intravenous oxytocin may be an effective option in settings where intravenous access is available; however, larger randomized studies are required before recommending routine adoption.

Conflict of Interest: None declared

Funding: None

Acknowledgments: The authors acknowledge the Department of Obstetrics and Gynaecology and all the pregnant women who participated in the study.

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