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Comparative Effect of Low- versus High-Dose Oxytocin Infusion on Maternal Hemodynamic and Hematologic Parameters after Vaginal Delivery: A Randomized Clinical Trial

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ABSTRACT

Background & aim: Postpartum hemorrhage is a major cause of maternal mortality. Although oxytocin is routinely used for prevention, the optimal dose balancing uterine efficacy and maternal hemodynamic stability remains uncertain. This trial compared the effects of low-dose versus high-dose oxytocin infusion on maternal hemodynamic parameters during the first two hours postpartum and hematologic indices up to six hours after delivery.

Methods: This randomized, triple-blind clinical trial was conducted in 2024 among 60 primiparous women undergoing vaginal delivery at a teaching hospital affiliated with Neyshabur University of Medical Sciences, Iran. Participants were randomly allocated 1:1 to low-dose (10 IU) or high-dose (60 IU) oxytocin infusion immediately after delivery. Blood pressure and heart rate were monitored for two hours postpartum, and hemoglobin and hematocrit were measured at admission and six hours postpartum. Data were analyzed using linear mixed-effects models.

Results: Participants had a median age of 21 years (interquartile range, 19.25–25.50 years), with similar baseline characteristics between groups. Hemoglobin and hematocrit decreased significantly from admission to six hours postpartum in both groups ($p < 0.001$), with no significant between-group differences. Maternal heart rate and body temperature also showed no significant differences ($P > 0.05$). Although transient changes in systolic and diastolic blood pressure occurred at 15 minutes postpartum, mixed-effects analysis showed no dose-dependent effects ($P > 0.05$).

Conclusion: Low- and high-dose oxytocin infusion resulted in comparable maternal hemodynamic and hematologic outcomes during the early postpartum period. These findings support using the lowest effective dose to maintain uterine contraction while minimizing potential adverse effects.

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Introduction

Postpartum hemorrhage (PPH) remains a leading cause of maternal mortality worldwide, claiming a maternal life approximately every six minutes (1). Its prevalence and impact vary across regions, socioeconomic contexts, and healthcare quality, accounting for nearly 25% of

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maternal deaths globally (2). Importantly, the latest Mothers and Babies Reducing Risks through Audits and Confidential Enquiries (MBRRACE) report highlights that, despite rare mortality due to hemorrhage, the absolute number of obstetric hemorrhage deaths has not decreased (3). More specifically, recent estimates indicate that PPH affects about 12.6% of women after vaginal birth and results in almost 45,000 maternal deaths each year (4-5). These statistics underscore the urgent need for effective strategies to prevent and manage PPH, aiming to reduce maternal morbidity and mortality worldwide. Effective prevention relies on timely interventions that promote uterine contraction and maintain hemodynamic stability in the immediate postpartum period (6).

To prevent uterine atony, the administration of uterotonic agents immediately after delivery is universally recommended by the World Health Organization (WHO) and the International Federation of Gynecology and Obstetrics (FIGO) (7-8). Among these agents, oxytocin is considered the first-line drug due to its proven efficacy, widespread availability, and relatively favorable safety profile (9). Oxytocin stimulates uterine contractions by binding to G-protein–coupled receptors in uterine smooth muscle, increasing intracellular calcium concentration and generating sustained myometrial contractions (10). However, oxytocin receptors are also expressed in vascular smooth muscle and the myocardium, where their activation can induce systemic vasodilation, decrease vascular resistance, cause hypotension, and provoke compensatory tachycardia (11). These cardiovascular effects are particularly relevant in the immediate postpartum period, as maternal hemodynamic status can already be compromised by blood loss and fluid shifts. Determining the optimal oxytocin dosing strategy that ensures effective uterine contraction while maintaining maternal cardiovascular stability, therefore remains a critical clinical challenge (12).

Despite the widespread use of oxytocin, the optimal prophylactic dose remains unclear (13, 14). Furthermore, major side effects—including hypotension, tachycardia, myocardial ischemia, nausea, and vomiting—are minimized when lower doses are used (14). Previous studies have investigated dose- and rate-dependent effects. For example, Duffield et al. (2017) reported no significant differences in uterine tone or estimated blood loss between high- and low-rate oxytocin infusions during elective cesarean sections (14). Similarly, Tita et al. (2012) found no significant difference in postpartum blood loss between prophylactic oxytocin doses of 10, 40, or 80 international units (IU) in vaginal deliveries, although the 80 IU dose reduced the need for additional oxytocin and the risk of a 6% decline in hematocrit (HCT) (13). More recently, Shea et al. (2025) reported that high-dose oxytocin (80 IU) was associated with lower odds of postpartum hemorrhage, uterotonic use, and blood transfusion compared with low-dose oxytocin (10–30 IU) among 2,404 nulliparous women at term (15). These findings collectively highlight the importance of both dose and infusion rate in modulating maternal hemodynamic responses while promoting effective uterine contraction.

Despite these insights, heterogeneity in dosing regimens, administration techniques, and outcome measures persists, leaving no consensus on the optimal oxytocin protocol for postpartum management. Most studies have primarily focused on uterotonic efficacy and blood loss, while detailed monitoring of maternal hemodynamic and hematologic parameters has been limited. Both under- and overdosing of oxytocin can have serious implications—either increasing PPH risk or causing cardiovascular instability—underscoring the need for further comparative studies (16).

In Iran, national guidelines for midwifery and childbirth services recommend administering 10 IU of oxytocin intramuscularly or via infusion in 500 mL of intravenous fluid immediately after delivery to prevent postpartum hemorrhage (17). Although national guidelines recommend 10 IU of oxytocin after delivery, studies have reported a wide range of prophylactic oxytocin doses, from 2.5 to 80 IU, reflecting variability in dosing practices across different settings. A dose–response meta-analysis of randomized trials showed oxytocin doses used for PPH prevention spanning this range (18).

The objective of this study was to compare the effects of low-dose (10 IU) and high-dose (60 IU) oxytocin infusions administered after delivery on

maternal hemodynamic parameters (blood pressure, heart rate) and hematologic outcomes (hemoglobin and hematocrit changes). Identifying an optimal oxytocin dosing strategy that maximizes uterotonic efficacy while minimizing cardiovascular risk can improve postpartum maternal outcomes and inform evidence-based clinical practice.

Materials and Methods

This randomized, triple-blind clinical trial was conducted in 2024 on 60 primiparous women admitted for vaginal delivery at the maternity ward of a teaching hospital affiliated with Neyshabur University of Medical Sciences, Neyshabur, Iran.

Eligible participants were healthy primiparous women aged 18–45 years with a gestational age of 37–41 weeks, a singleton pregnancy, and cephalic presentation. Women with a history of medical or obstetric disorders, fetal abnormalities, estimated fetal weight >4000 g, chorioamnionitis, or placental abruption were excluded. Participants who developed prolonged labor, underwent cesarean section, or experienced labor or shoulder dystocia, antepartum hemorrhage, or instrumental delivery were also excluded.

Eligible participants were recruited consecutively from women admitted to the maternity ward for vaginal delivery during the study period. Because reliable prior data were unavailable to estimate the effect size for the study outcomes, an a priori sample size calculation was not feasible. Therefore, all eligible women presenting during the study period were enrolled, resulting in 60 participants (30 per group). To provide an exploratory assessment of the adequacy of the achieved sample size, a post-hoc power analysis was performed based on the observed difference in systolic blood pressure at 15 minutes postpartum. With a significance level of 0.05 and an observed effect size of 0.81 (Cohen's d), the achieved sample size provided approximately 84% statistical power.

Eligible participants were randomly assigned to receive either a low-dose (10 IU) or a high-dose (60 IU) oxytocin infusion administered immediately after delivery. Randomization was performed using a blocked randomization method with variable block sizes (4, 8, and 12). The allocation sequence was generated via https://www.sealedenvelope.com/simple-randomiser/ v1/lists under the supervision of a biostatistics consultant. Allocation concealment was ensured by using opaque, sealed, and sequentially numbered envelopes opened according to the order of enrollment. A CONSORT flow diagram illustrating the process of participant selection is provided (Figure 1).

The oxytocin infusions were prepared and labeled in advance according to the allocation sequence. Only the maternity ward staff had access to the dosage codes, ensuring that neither the researcher nor the attending midwife was aware of the group assignments. During delivery, the numbered oxytocin infusions were provided to the midwife sequentially. After placental expulsion, the assigned oxytocin dose was prepared in 500 mL of plain Ringer's solution and administered intravenously at a rate of 30 drops per minute for two hours. Triple blinding was maintained throughout the study for participants, clinicians, researchers, and data analyst.

Data were collected using a structured questionnaire, a vital signs checklist, CBC results, and documentation of medications administered during labor. The questionnaire included demographic characteristics, pregnancy and labor-related information, delivery and neonatal outcomes, and relevant clinical variables. The content validity of the data collection forms was evaluated and confirmed by two obstetricians before study initiation. A complete blood count (CBC) was performed at admission and six hours postpartum to assess hemoglobin (Hb) and HGB levels. Blood pressure was measured using a calibrated mercury sphygmomanometer according to standard clinical guidelines. Calibration of the devices was verified prior to study initiation in accordance with the hospital's scheduled maintenance procedures. Heart rate was assessed manually at the radial artery for one full minute, and axillary temperature was measured using a calibrated mercury thermometer for five minutes. This measurement was routinely monitored according to national postpartum care guidelines. However, for research purposes and standardized comparison between groups, measurements at 15 minutes, 1 hour, and 2 hours

postpartum were predefined for statistical analysis to assess the acute and sustained hemodynamic effects of oxytocin infusion.

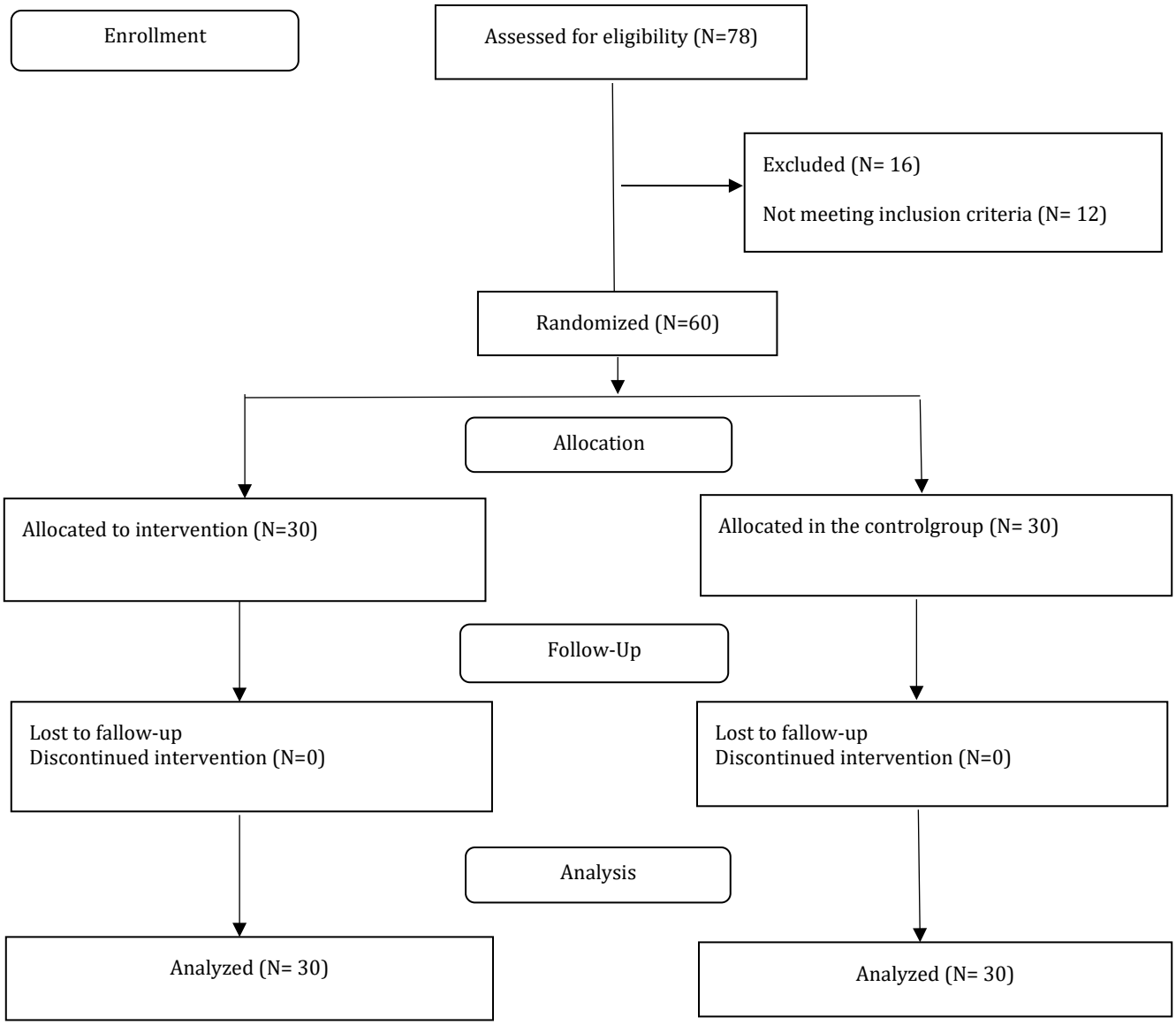

Figure 1. CONSORT Flowchart of the study

All measurements were performed by the principal researcher, an experienced midwife, following a standardized measurement protocol. Using the same trained assessor and standardized procedures for both groups reduced measurement variability and strengthened the reliability of the findings.

Descriptive and inferential analyses were conducted to evaluate the effects of two oxytocin doses on hemodynamic and hematologic parameters over time. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean with standard deviation and median with interquartile range, with the latter providing a

more reliable estimate due to the asymmetric distribution of some variables. The normality of continuous variables was assessed both visually using histograms and Q-Q plots and statistically using normality tests.

Comparisons between the two groups regarding Hb and HCT levels were performed using the independent t-test or its nonparametric equivalent, depending on the normality of the data. Within-group changes before and after delivery were analyzed using the paired t-test or a nonparametric alternative, and the differences in Hb and HCT between postpartum and admission values were calculated and compared across groups. Changes in heart rate and body temperature for both groups were analyzed using the same statistical approach. Differences between groups for systolic and diastolic blood pressure at each time point were assessed using the student's t-test or its nonparametric equivalent, while within-group comparisons across different time points were analyzed using the Friedman test.

Because systolic and diastolic blood pressure were measured repeatedly at three time points, a linear mixed-effects model (LMM) was used to account for within-subject correlation and to evaluate the effects of time, oxytocin dose, and their interaction. Time and group were included as fixed effects, and a random intercept was specified for each participant. LMM was preferred to repeated-measures ANOVA due to its flexibility, avoidance of the sphericity assumption, and better handling of missing data.

The model was specified as:

$$BP_{ij} = \beta_0 + \beta_1(Group_i) + \beta_2(Time_j) + \beta_3(Group_i \times Time_j) + b_i + \varepsilon_{ij}.$$

All statistical analyses were conducted using R software version 4.3.2 for Windows, and a two-tailed P-value of less than 0.05 was considered statistically significant.

Results

The study included 60 women with a median age of 21 years (interquartile range 19.25–25.50). The participants in the low-dose group received a total of 10 IU of oxytocin, and those in the high-dose group received 60 IU over 2 hours. The median Apgar score at 1 minute after birth was 9 (IQR: 9–9). The median Apgar score was 9 (IQR: 9–10) at 5 minutes after birth. The median Apgar score at 10 minutes after birth was 10 (IQR: 9–10). Demographic and clinical characteristics of the participants are presented in Table 1. The two groups did not differ significantly in baseline demographic and clinical characteristics at study entry (Table 1).

Table 1. Demographic and clinical characteristics of the study participants

Variables	Total	10 IU (Dose)	60 IU (Dose)	P-Value
Age, years	22.85±4.70 21.00 (19.25-25.50)	21.90±4.46 20.50 (19.00-23.00)	23.80±4.82 23.00 (20.00-27.25)	0.06
Gestational age (LMP)	39.26±1.17 39.42 (38.70-40.14)	39.16±1.17 39.28 (38.77-39.92)	39.36±1.18 39.63 (38.31-40.28)	0.59
Gestational age (First-trimester ultrasound)	39.18±1.07 39.43(38.21-40.00)	39.27±0.92 39.43 (38.86-40.00)	39.10±1.21 39.36 (37.96-40.14)	0.83
Birth weight (gm)	3181.11±392.46 3175.00 (2892.50-3425.00)	3220.77±406.72 3150.00 (2987.50-3540.00)	3144.29±382.43 3175.00 (2817.50-3350.00)	0.48
Education				
Illiterate	2 (3.70)	0 (0.00)	1 (3.85)	
elementary	21 (38.89)	12 (44.44)	10 (38.46)	
Diploma	21 (38.89)	10 (37.04)	9 (34.61)	0.38[F]
Advanced	10 (18.52)	5 (18.52)	6 (23.08)	
BMI				
Underweight (= < 18.5)	3 (6.38)	2 (9.52)	1 (3.85)	
Normal (18.5-24.9)	19 (40.43)	9 (42.86)	10 (38.46)	
Overweight (25 - 29.9)	16 (34.04)	7 (33.33)	9 (34.61)	
Obese (>=30)	9 (19.15)	3 (14.29)	6 (23.08)	
Amniotic membrane				0.26

Variables	Total	10 IU (Dose)	60 IU (Dose)	P-Value
Ruptured	24 (36.36)	14 (56)	10 (40)	
Intact	26 (39.39)	11 (44)	15 (60)	
Bishop at admission				
Undesirable	13 (38.23)	3 (23.08)	10 (47.62)	0.26F
Medium	18 (52.94)	9 (69.23)	9 (42.86)	
Desirable	3 (8.82)	1 (7.69)	2 (9.52)	
1-min Apgar Score				
5	1 (1.82)	0 (0.00)	1 (3.57)	
8	1 (1.82)	0 (0.00)	1 (3.57)	0.25F
9	50 (90.91)	25 (92.59)	25 (89.29)	
10	3 (5.45)	2 (7.41)	1 (3.57)	
5-min Apgar Score				
5	1 (1.85)	0 (0.00)	1 (3.70)	0.59F
9	28 (51.85)	16 (59.26)	12 (44.44)	
10	25 (46.30)	11 (40.74)	14 (51.85)	
10-min Apgar Score				
5	1 (1.85)	0 (0.00)	1(3.70)	0.59F
9	24 (44.44)	14 (51.85)	10(37.04)	
10	29 (53.70)	13 (48.15)	16(59.26)	
Perineal lacerations				
No	1 (2.00)	0 (0.00)	1 (3.57)	
Episiotomy	32 (64.00)	15 (68.18)	17 (60.71)	0.96F
Degree1	5 (10.00)	2 (9.09)	3 (10.71)	
Degree2	12 (24.00)	5 (22.73)	7 (25.00)	
Method of Analgesia				
Pharmacological	11(19.30)	6 (22.22)	5 (16.67)	0.59
Non-pharmacological	46(80.70)	21 (77.78)	25 (83.33)	
Use of Hyoscine				
No	25 (41.67)	10 (33.33)	15 (50.00)	0.19
Yes	35 (58.33)	20 (66.67)	15 (50.00)	
Use of Oxytocin in labour				0.60
No	26 (43.33)	14 (46.67)	12 (40.00)	
Yes	34 (56.67)	16 (53.33)	18 (60.00)	
Oxytocin Dose				
5	12 (38.71)	6 (40.00)	6 (37.50)	0.89
10	19 (61.29)	9 (60.00)	10 (62.50)	
Use of Pethidine				
No	49 (81.67)	21 (70.00)	28 (93.33)	0.02
Yes	11 (18.33)	9 (30.00)	2 (6.67)	
Use of Promethazine				
No	43 (71.67)	20 (66.67)	23 (76.67)	0.39
Yes	17 (28.33)	10 (33.33)	7 (23.33)	
Use of Ampicillin				
No	54 (90.00)	27 (90.00)	27 (90.00)	0.99
Yes	6 (10.00)	3 (10.00)	3 (10.00)	

Chi-square test was used for P-values; Fisher's exact test for values marked with F

Hb levels at admission and six hours postpartum did not differ significantly between the 10 IU and 60 IU oxytocin groups, and changes over time were comparable. However, Hb significantly from admission to postpartum regardless of oxytocin dose ($p < 0.001$).

HCT showed a similar pattern, with a significant overall decrease after delivery but no significant differences between the dosage groups. A similar pattern was observed for body temperature, there was a significant difference in temporal change. No significant differences were

observed in mean maternal heart rate during labor or 15 minutes after delivery between the two groups, and heart rate changes over time were comparable (Table 2).

Table 2. Maternal hematologic and vital sign parameters and their changes between low- and high-dose oxytocin groups

Variables	10 IU (Dose)	60 IU (Dose)	P-Value	
Hemoglobin				
At admission	13.23±1.55 13.05(12.00-14.30)	13.43±1.16 13.60 (12.55-14.60)	0.58[b]	<0.001[c]
6 hours postpartum	12.56±1.41 12.60 (11.37-13.33)	12.96±1.27 13.20 (11.85-13.93)	0.26[b]	
Hemoglobin changes		0.69[a]		
Hematocrit				
At admission	38.57±3.25 37.80 (36.37-40.57)	38.90±2.88 36.65 (36.75-41.15)	0.68[b]	<0.001[c]
6 hours postpartum	36.79±3.07 36.75(35.07-38.93)	37.15±4.39 37.90 (34.53-40.45)	0.24[b]	
Hematocrit changes		0.74[a]		
Heart rate				
Intrapartum maternal (bpm)	85.35±5.73 83(80.00-91.50)	86.60±6.24 86(80.00-91.00)	0.72[b]	0.38[c]
Maternal (15 min postpartum, bpm)	86.31±8.55 83(80.00-92.50)	87.57±7.37 88(80.00-92.75)	0.35[b]	
Maternal heart rate changes		0.37[a]		
Temperature				
Intrapartum maternal (°C)	36.85±0.36 36.90(36.70-37.00)	36.81±0.18 36.80(36.70-37.00)	0.54[b]	0.03[c]
Maternal temperature (15 min postpartum, °C)	36.61±0.38 36.70(36.35-36.95)	36.69±0.38 36.80(36.57-37.00)	0.31[b]	
Maternal temperature changes		0.30[a]		

a, b: Comparison between independent groups (10 IU vs 60 IU oxytocin) using independent t-test or Mann–Whitney U test, as appropriate based on data distribution
c: Within-group comparisons over time using paired t-test or Wilcoxon signed-rank test, as appropriate

Systolic blood pressure measured 15 minutes after delivery was significantly higher in one group, whereas no significant differences were observed at other time points. The overall mean systolic blood pressure across all time points did not differ between the oxytocin dose groups. For diastolic blood pressure, a significant difference was observed 15 minutes after delivery, but no differences were found at other time points, and overall mean diastolic blood pressure across all measurements did not differ by oxytocin dose (Table 3).

A linear mixed-effects model examining the effects of time, treatment group, and their interaction on systolic blood pressure indicated no statistically significant main effect of oxytocin dose ($t(57) = 1.44$, $P = 0.15$). The 60 IU group showed a trend toward an average 4.18 mmHg higher systolic blood pressure than the 10 IU group, but the interaction between time and dose was nonsignificant, indicating similar patterns of systolic blood pressure change over time for both groups (Table 4).

Table 3. Comparison of systolic and diastolic blood pressure at intrapartum and postpartum time points in the two oxytocin dose groups

Variables	10 IU (Dose)	60 IU (Dose)	P-Value	
Systolic blood pressure				
Intrapartum systolic blood pressure (mmHg)	103.25±8.47 100(100-110)	107.00±11.37 100(100-110)	0.44[a]	
Postpartum maternal systolic blood pressure (15 min, mmHg)	103.10±7.49 100(100-110)	110.86±11.19 110(100-120)	0.01[a]	
Postpartum maternal systolic blood pressure (1 h, mmHg)	103.27±7.82 100(100-110)	106.77±9.75 100(100-120)	0.40[a]	0.12[b]
Postpartum maternal systolic blood pressure (2 h, mmHg)	103.45±8.03 105(100-110)	107.83±9.16 110(100-120)	0.11[a]	
Diastolic blood pressure				
Intrapartum diastolic blood pressure (mmHg)	64±8.21 60(60-70)	64.40±9.61 60(60-70)	0.88[a]	
Postpartum maternal diastolic blood pressure (15 min, mmHg)	63.27±8.05 60(60-70)	67.93±8.61 70(60-70)	0.03[a]	
Postpartum maternal diastolic **blood pressure (1 h, mmHg)**	62.41±6.35 60(60-70)	66.17±8.06 62.50(60-70)	0.06[a]	0.66[b]
Postpartum maternal diastolic **blood pressure (2 h, mmHg)**	61.03±6.18 60(60-65)	64.33±9.44 60(60-70)	0.15[a]	

Table 4. Fixed effects estimate from the linear mixed-effects model for systolic blood pressure

Predictor	Estimate	SE	df	t	P-Value
Intercept	102.47	2.13	156	48.12	< .001[a]
Time 15min1	0.63	1.95	156	0.32	0.75[a]
Time 15min4	0.80	2.35	156	0.34	0.73[a]
Time 15min8	0.98	2.22	156	0.44	0.66[a]
Drug (Dose 60)	4.18	2.89	57	1.44	0.15[a]
Time 15min × Drug60	3.15	2.65	156	1.19	0.23[a]
Time 1 h × Drug60	-0.69	3.21	156	-0.21	0.83[a]
Time 2 h × Drug60	0.20	3.03	156	0.07	0.95[a]

a: P-values were obtained from t-tests for fixed effects using Satterthwaite approximations for degrees of freedom, as implemented in the linear mixed-effects model (nlme package)

Table 5. Fixed effects estimate from the linear mixed-effects model for diastolic blood pressure

Predictor	Estimate	SE	df	t	P-Value
Intercept	10.64	1.91	156	33.63	<0.001[a]
Time 15min	-0.83	1.96	156	-0.42	0.67[a]
Time 1 h	-1.69	1.85	156	-0.91	0.36[a]
Time 2 h	-3.07	2.29	156	-1.34	0.18[a]
Drug (Dose 60)	-0.25	2.58	57	-0.10	0.92[a]
Time 15min × Drug60	4.74	2.68	156	1.77	0.08[a]
Time 1h × Drug60	4.01	2.50	156	1.60	0.11[a]
Time 2 h × Drug 60	3.55	3.14	156	1.13	0.26[a]

a: P-values were obtained from t-tests for fixed effects using Satterthwaite approximations for degrees of freedom, as implemented in the linear mixed-effects model (nlme package)

A linear mixed-effects model confirmed no statistically significant main effect of treatment group (t(57) = -0.10, P = 0.92), and the interaction between time and dose was nonsignificant, indicating that diastolic blood pressure patterns over time were comparable between the two oxytocin dose groups (Table 5).

Discussion

This study evaluated the effect of two different oxytocin infusion doses (10 IU vs. 60 IU) on maternal hemodynamic and hematologic parameters. Hb and HCT at admission and six hours postpartum did not differ significantly between the two groups, and the patterns of change over time were similar. Nevertheless, both Hb and HCT decreased significantly from admission to postpartum, reflecting the expected physiological blood loss associated with delivery. These findings suggest that the effects of these two oxytocin doses on Hb and HCT, as indicators of blood loss, are comparable during the early postpartum period.

These results align with prior research. For instance, a recent systematic review and dose–response meta-analysis by Vanessa Hébert et al. (2025) evaluated varying prophylactic oxytocin doses for the prevention of postpartum hemorrhage following vaginal birth. The authors identified a nonlinear J-shaped relationship between oxytocin dose and the risk of excessive blood loss, suggesting that doses within 4–10 IU provide an optimal balance between efficacy and safety. Lower doses (2.5–3 IU) reduced severe blood loss, while doses ≥20 IU offered no additional benefit and could increase the need for additional uterotonics. Importantly, no dose–response relationship was observed for blood transfusion requirements. This study supports the use of moderate oxytocin doses to achieve adequate uterine contraction while minimizing hemodynamic side effects, although further research across diverse obstetric populations and standardized reporting of maternal safety outcomes was recommended (18).

In contrast, Majibian et al. (2005) conducted a clinical trial comparing low-dose (20 IU) and high-dose (100 IU) oxytocin infusions in women undergoing vaginal or cesarean delivery. Higher oxytocin doses significantly reduced the incidence of uterine atony and the need for manual placenta removal and resulted in smaller declines in HCT, while differences in blood pressure were not statistically significant (19). These findings suggest that higher doses may improve prevention of postpartum hemorrhage without substantially increasing hemodynamic risks. Similarly, Tita et al. (2012) compared oxytocin regimens of 10, 40, and 80 IU after vaginal delivery. Although 80 IU did not significantly reduce the overall need for postpartum hemorrhage treatment compared with 10 IU, it was associated with lower additional oxytocin requirements and a smaller risk of ≥6% HCT decline, indicating modest dose-dependent benefits for uterine tone and blood conservation (13). Notably, in the same trial, higher oxytocin doses were not associated with an increased rate of serious adverse events, supporting the overall hemodynamic tolerability of infusion regimens up to 80 IU when administered over one hour. Although Hb and HCT appeared comparable six hours after delivery, direct measurement of blood loss or longer-term hemodynamic monitoring might reveal differences not captured in this study.

Regarding maternal vital signs, mean heart rate and body temperature during labor and 15 minutes postpartum did not differ significantly between groups, and temporal trends were parallel. These findings are consistent with established physiological ranges in healthy parturients, where heart rate gradually decreases and body temperature remains stable postpartum (1). While oxytocin can have vasodilatory effects at higher bolus doses, moderate infusion rates—as applied in this study—appear hemodynamically safe. Hemodynamic effects of oxytocin are known to be dose- and administration-rate dependent; rapid intravenous boluses have been associated with transient hypotension and tachycardia, whereas slow infusions produce more stable cardiovascular profiles, as demonstrated in anesthesiology-based studies of cesarean delivery (20). A transient elevation in systolic and diastolic blood pressure 15 minutes postpartum was observed in one group; however, overall mean blood pressure across all time points did not differ by dose, and linear mixed-effects modeling confirmed no significant main effect of oxytocin dose or dose × time interaction. These transient fluctuations likely

reflect physiological postpartum cardiovascular adjustments rather than direct dose-dependent effects of oxytocin.

Similar findings were reported by Medha Mohta et al. (2021), who found that infusion rates of 1.25, 2.5, and 5 IU/h after a 1 IU intravenous bolus did not significantly affect maternal heart rate or blood pressure during elective cesarean section under spinal anesthesia, although the dose regimen differed from ours (21). In contrast, a later study by Mohta et al. (2022), following a 3 IU slow bolus, evaluated infusion rates of 2.5, 5, and 10 IU/h in laboring patients. Higher infusion rates, particularly 10 IU/h, were associated with a significantly higher incidence of hypotension compared to 2.5 IU/h, indicating that escalating oxytocin after a bolus may compromise hemodynamic stability (22). These differences likely reflect the effect of the initial bolus commonly used in cesarean deliveries.

Additionally, in the retrospective cohort study by M.A. Frölich et al. (2011), conducted in women with mid-trimester intrauterine fetal demise (IUFD), high-dose oxytocin was administered as an escalating 4-hour infusion from 267 to 1667 milliunits/min with intermittent 1-hour breaks, along with intravenous fluids at 100–125 mL/h. Despite much higher oxytocin doses than in our study, no significant effect on maternal body temperature was observed, supporting the findings of our study regarding hemodynamic and thermal safety (23).

From a clinical perspective, these data suggest that both 10 IU and 60 IU oxytocin regimens are effective and safe for postpartum management, producing comparable effects on maternal hematologic indices and vital signs. Initiating therapy with the lower dose may be preferred to minimize potential side effects, reserving higher doses for cases with increased bleeding risk or inadequate uterine tone.

The strengths of this study include its triple-blind randomized design and repeated assessment of maternal hemodynamic parameters during the early postpartum period. The use of linear mixed-effects models also allowed changes over time and potential dose-related effects to be appropriately evaluated.

Several limitations should also be acknowledged. The sample size of 60 may limit the power to detect subtle differences in vital signs or hematologic changes. Total blood loss, fluid administration, and uterine contraction strength were not directly measured, which could influence Hb and HCT. The observation period was limited to six hours postpartum, and longer-term hemodynamic effects were not assessed. Only two dose levels were evaluated; intermediate or higher doses were not included.

Future research should include larger cohorts to improve statistical power and allow subgroup analyses. Studies should investigate a broader range of oxytocin doses and infusion rates, with extended monitoring beyond six hours to assess longer-term hemodynamic and hematologic effects. Continuous maternal hemodynamic monitoring and direct quantification of blood loss would allow a more precise evaluation of dose-related safety.

Conclusion

Oxytocin doses of 10 IU and 60 IU were associated with comparable maternal hemoglobin, hematocrit, and vital sign changes in the early postpartum period in our study population. The observed physiological decline in hematologic indices occurred in both groups without evidence of dose-dependent differences, and transient blood pressure variations were not clinically significant .Based on these findings, the use of lower oxytocin doses may be considered in healthy women undergoing vaginal delivery, as higher doses did not demonstrate additional hematologic or hemodynamic benefit in this cohort. For midwives and obstetricians, careful monitoring of maternal vital signs remains essential regardless of dose, and individualized dosing strategies should be considered according to clinical risk factors. Further studies in larger and diverse populations are warranted to better define optimal oxytocin dosing.

Declarations

Acknowledgements

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Conflicts of interest

The authors declared no conflicts of interest.

Ethical approval

Written informed consent was obtained from all participants before enrollment. Participants

were informed of their right to withdraw from the study at any time without any consequences. The confidentiality of all participant information was strictly maintained throughout the study.

Code of Ethics

The study protocol was approved by the Ethics Committee of Neyshabur University of Medical Sciences (code: IR.NUMS.REC.1400.036).

Use of Artificial Intelligence

The authors declare that AI-assisted tools were used solely to assess and improve the fluency and clarity of the manuscript.

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Authors' contributions

MZ and EA contributed to the conception and design of the study. MZ, HFL, and ZS contributed to data collection. FK performed the statistical analysis and contributed to data interpretation. EA supervised the study and contributed to the interpretation of the findings. MZ, HFL, and ZS contributed to writing the manuscript. All authors critically reviewed and approved the final version of the manuscript.

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