OBSTETRICS

# High-dose vs low-dose oxytocin for labor augmentation: a systematic review

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The objective of this systematic review was to estimate the efficacy and safety of high-dose vs low-dose oxytocin for labor augmentation on the risk of cesarean section and on indicators of maternal and neonatal morbidity. We searched PubMed, MEDLINE, EMBASE, and the Cochrane Library for randomized clinical trials published until January 2010. Ten randomized clinical trials, including 5423 women, met the inclusion criteria. High-dose oxytocin was associated with a moderate decrease in the risk of cesarean section (relative risk [RR], 0.85; 95% confidence interval [CI], 0.75–0.97), a small increase in spontaneous vaginal delivery (RR, 1.07; 95% CI, 1.02–1.12), and a decrease in labor duration (mean difference: –1.54 hours, 95% CI, –2.44 to –0.64). While hyperstimulation was increased with high-dose oxytocin (RR, 1.91; 95% CI, 1.49–2.45), there was no evidence of an increase in maternal or neonatal morbidity. We conclude that high-dose oxytocin for labor augmentation is associated with a decrease in cesarean section and shortened labor.

**Key words:** active management, augmentation, oxytocin dose

The rise in cesarean section continues to be a matter of obstetric concern.[1] Recent reports suggest that high cesarean rates may have an adverse impact on maternal and neonatal morbidity and mortality.[2] Dystocia is the leading indication for primary cesarean section.[3,4] Inadequate uterine activity has been described as the most frequent cause of dystocia.

Augmentation of labor with oxytocin is a frequent intervention in modern obstetric practice.[5] When labor fails to progress, oxytocin is administered to augment contractile effort and to correct dystocia with the objective on achieving a normal vaginal delivery.[6] Oxytocin has been demonstrated to increase the frequency and intensity of uterine contractions when spontaneous uterine contraction is inadequate and the progress of labor is slow. Oxytocin protocols can be categorized as high-dose or low-dose protocols depending on the initial dose and the amount and rate of sequential increases in dose. Despite the frequency with which oxytocin is used in clinical practice, there is little consensus regarding the optimal dose of oxytocin for labor augmentation.[7]

Over the last 2 decades, a number of randomized clinical trials have assessed the relative effectiveness of different oxytocin protocols for the treatment of dystocia,[8-34] including varying dose regimens. This systematic review was designed to estimate the efficacy and safety of high-dose vs low-dose oxytocin in the augmentation of labor on method of delivery and on indicators of maternal and neonatal morbidity.

## Materials and Methods

### Data sources

A comprehensive literature search was performed using several search strategies. Published studies were identified through manual searches and through a computerized search of the Cochrane Collaboration Pregnancy and Childbirth Group Trial Register, PubMed, MEDLINE, and EMBASE in any language until January 2010. The key words were: oxytocin, dose, active management of labor (AML), randomized clinical trials, augmentation, and labor. References cited in these articles were manually searched to obtain additional articles.

### Study selection

Two investigators (S-Q.W. and H-P.Q.) independently scrutinized the electronic searches and obtained full manuscripts of all citations that were potentially eligible studies for inclusion.

Included studies had to meet the following criteria. (1) Study design was a randomized controlled trial. (2) Population consisted of pregnant women in spontaneous labor and without prior use of oxytocin. (3) The study contrasted 2 interventions for labor augmentation: high-dose vs low-dose oxytocin. "High dose" was defined as an initial dose of ≥4 mU/min and dose increments of at least 4 mU/min; "low-dose" protocols were defined as those with an initial dose ranging between 1-4 mU/min with increments of 1-2 mU/min. (4) Outcomes measured at least 1 of the following: cesarean section, spontaneous vaginal delivery, operative vaginal delivery, duration of labor, hyperstimulation, postpartum hemorrhage, use of epidural analgesia, maternal blood transfusion, Apgar score, and neonatal complications.

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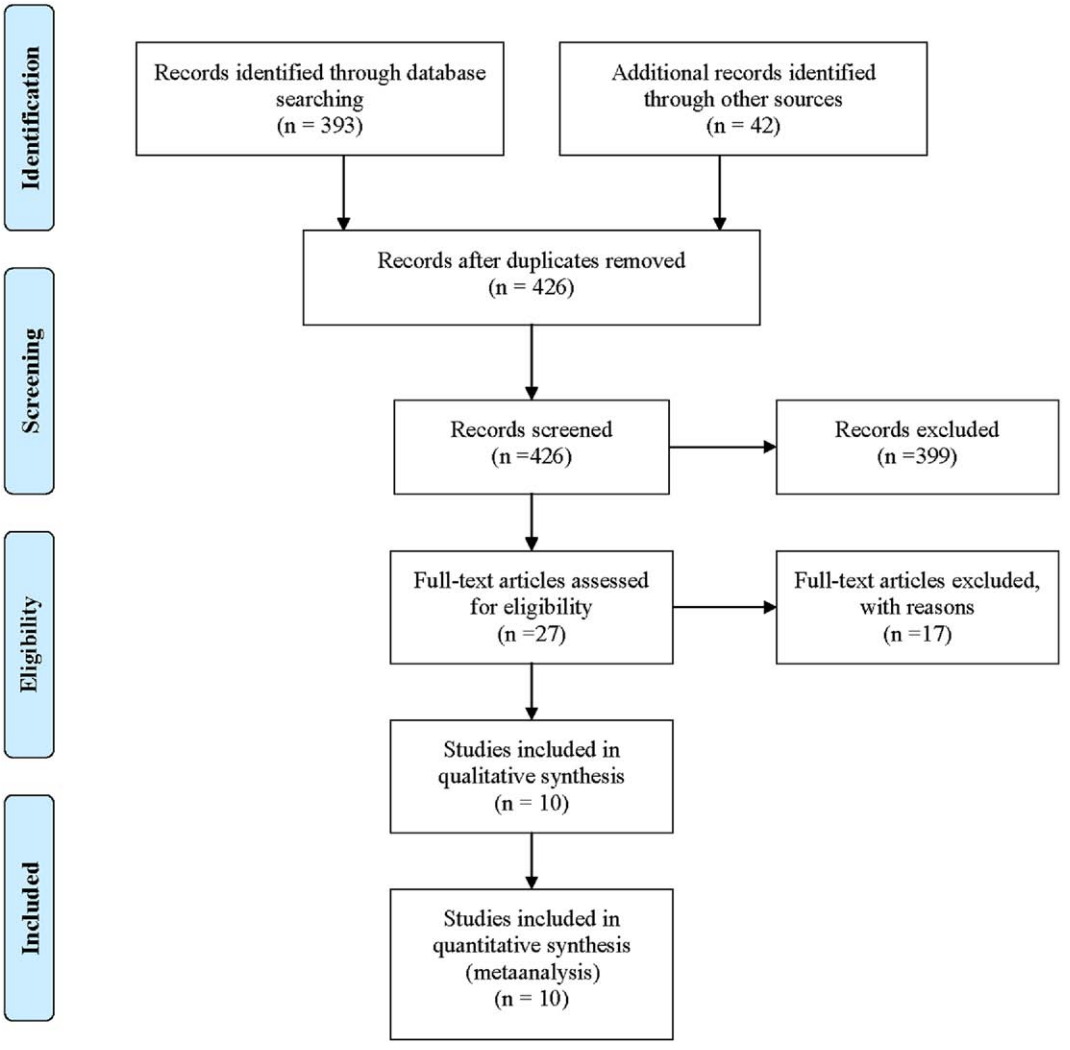
FIGURE 1
**Flow diagram for systematic review**




*Wei. High- vs low-dose oxytocin for labor augmentation. Am J Obstet Gynecol 2010.*

TABLE 1
**Summary of excluded and included randomized controlled trials**

| Randomized controlled trials | Reasons for exclusion or inclusion |
|---|---|
| Blanch et al[8]; Hemminki et al[9]; Hinshaw et al[10]; Hunter[11]; Pattinson et al[12]; Read et al[13]; Shennan et al[14] | Excluded as compared early oxytocin for labor augmentation to routine care |
| Bréart et al[15]; Cammu and Van Eeckhout[16]; Cluett et al[17]; Cohen et al[18]; Hogston and Noble[19]; Serman et al[20]; Somprasit et al[21] | Excluded as compared early oxytocin and early amniotomy to routine care |
| Cummiskey et al[22] | Excluded as compared pulsatile-infusion oxytocin to continuous-infusion oxytocin |
| Lazor et al[23] | Excluded as compared 2 low-dose oxytocin protocols |
| Satin et al[24] | Excluded as compared 2 high-dose oxytocin protocols |
| Bidgood and Steer[25]; Frigoletto et al[26]; Jamal and Kalantari[27]; Lopez-Zeno et al[28]; Majoko[29]; Merrill and Zlatnik[30]; Rogers et al[31]; Sadler et al[32]; Tabowei and Oboro[33]; Xenakis et al[34] | Included as met inclusion criteria: compared policy of high-dose to low-dose oxytocin for augmentation of labor |

*Wei. High- vs low-dose oxytocin for labor augmentation. Am J Obstet Gynecol 2010.*

TABLE 2
**Characteristics of included studies**

| Study | Country | Study design | Total sample size, n | Participants | Mean CD at randomization, cm | Labor progress at randomization | Interventions (detailed drug regimens) |
|---|---|---|---|---|---|---|---|
| Bidgood and Steer[25] | United Kingdom | RCT | 40 | Nulliparae in spontaneous labor at term, vertex presentation | – | Dystocia: progression of CD <0.5 cm/h | High dose: oxytocin infusion started at 7 mU/min increased by 7 mU/min every 15 min, limited by frequency of 7 contractions in 15 min or by abnormality in FHR trace; Low dose: oxytocin infusion started at initial rate of 2 mU/min and increased by 2 mU/min every 15 min until stable phase of uterine activity detected |
| Frigoletto et al[26] | USA | RCT | 1915 | Nulliparae in spontaneous labor, single term fetus, vertex presentation, without medical or obstetric complication | – | Normal | High dose: oxytocin initiated at 4 mU/min and increased by 4 mU/min every 15 min up to maximum 40 mU/min; Low dose: oxytocin initiated at 1-2 mU/min and increased periodically by 1-2 mU/min |
| Jamal and Kalantari[27] | Iran | RCT | 200 | Women with CD ≥3 cm and gestational age ≥37 wk | 3.6 | Ineffective uterine contractions in beginning of active labor | High dose: oxytocin initiated at 4.5 mU/min and increased by 4.5 mU/min every 30 min; Low dose: oxytocin initiated at 1.5 mU/min and increased by 1.5 mU/min every 30 min |
| Lopez-Zeno et al[28] | USA | RCT | 705 | Nulliparae in spontaneous labor at term, cephalic presentation, without previous uterine surgery | 3.2 | Normal | High dose: oxytocin initiated at 6 mU/min and increased by 6 mU/min every 15 min; Low dose: oxytocin initiated at 1 mU/min and increased by 1-2 mU/min every 15 min |
| Majoko[29] | Zimbabwe | RCT | 258 | Nulliparae in spontaneous labor, singleton fetus, cephalic presentation, with normal fetal heart pattern | 6.2 | Normal | High dose: oxytocin initiated at 10 mIU/min and infusion rate doubled every 60 min; Low dose: oxytocin initiated at 4 mIU/min and infusion rate doubled every 30 min |
| Merrill and Zlatnik[30] | USA | RCT | 491 | CD ≥3 cm, at least 10 uterine contractions/h, >24 wk gestation with living fetus | 4.8 | Normal | High dose: oxytocin initiated at 4.5 mU/min and increased by 4.5 mU/min every 30 min; Low dose: oxytocin initiated at 1.5 mU/min and increased by 1.5 mU/min every 30 min |

*Wei. High- vs low-dose oxytocin for labor augmentation. Am J Obstet Gynecol 2010.* *(continued)*

Studies were excluded if the dose of oxytocin in 1 or both groups was not specified. Reporting of time intervals in labor varied across studies. Some reported the total duration of labor by study group,[31,33] others reported the interval from admission to delivery,[25,28] and 1 study reported the interval from the study intervention to delivery.[30] Prolonged labor was defined as total labor duration of >12 hours. Postpartum hemorrhage was defined as blood loss >500 mL.

**TABLE 2**
**Characteristics of included studies** *(continued)*

| Study | Country | Study design | Total sample size, n | Participants | Mean CD at randomization, cm | Labor progress at randomization | Interventions (detailed drug regimens) |
|---|---|---|---|---|---|---|---|
| Rogers et al[31] | USA | RCT | 405 | Nulliparous women at term who had attended for antenatal care, cephalic presentation, without medical or obstetric complication or fetal abnormities | 2.9 | Normal | High dose: oxytocin initiated at 6 mU/min and increased by 6 mU/min every 30 min; Low dose: oxytocin initiated at 1 mU/min and increased by 1 mU/min every 30-40 min |
| Sadler et al[32] | New Zealand | RCT | 651 | Nulliparous women in spontaneous labor, singleton pregnancy, no severe cardiac disease, no uterine scar, and no proven contracted pelvis | 4.5 | Normal | High dose: oxytocin initiated at 6 mU/min and increased by 6 mU/min every 20 min up to 42 mU/min; Low dose: oxytocin initiated at 1 mU/min and increased by 1 mU/min every 20 min up to 8 mU/min, then increased by 2 mU/min up to 20 mU/min |
| Tabowei and Oboro[33] | Nigeria | RCT | 448 | Nulliparae, singleton fetus, cephalic presentation | – | Normal | High dose: oxytocin initiated at 6 mU/min and increased by 6 mU/min every 15 min until either a frequency of 5 contractions/10 min, each lasting at least 40 seconds is achieved or a maximum of 36 mU/min oxytocin infusion rate is reached; Low dose: oxytocin initiated at 2 mU/min and increased by 2 mU/min every 30 min, until a frequency of at least 3 contractions/10 min, lasting at least 40 seconds each is achieved |
| Xenakis et al[34] | USA | RCT | 310 | Nulliparous and multiparous patients in term in active labor | 5.8 | Arrest of dilatation: no cervical change for 2 h after latent phase of labor completed and cervix dilated ≥4 cm; or arrest of dilatation: no change in station of presenting part, at full dilatation, for >1 h | High dose: oxytocin initiated at 4 mU/min and increased by 4 mU/min every 15 min until adequate uterine contractility achieved; Low dose: oxytocin initiated at 1 mU/min increased by 1 mU/min every 30 min up to 4 mU/min, then increased by 1 mU/min |

*CD*, cervical dilatation; *FHR*, fetal heart rate; *RCT*, randomized clinical trial.

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## Tabulation and integration

The quality of the controlled trials was assessed separately by 2 independent reviewers (S-Q.W. and W.D.F.) in duplicate for 4 types of potential bias: selection bias, performance bias, detection bias, and attrition bias–based on the criteria of the Cochrane Handbook for Systematic Reviews of Interventions.[35] Disagreements between evaluators were resolved by discussion with a third reviewer (Z-C.L.) to achieve consensus. In 1 trial,[26] randomization was performed <30 weeks' gestation and approximately one third of the women were excluded

**TABLE 3**
**Oxytocin dose administered for labor augmentation in included trials**

| Study | Oxytocin dose range (mU/min) | | Maximum oxytocin dose (mU/min) (mean or median[a]) | |
|---|---|---|---|---|
| | High dose | Low dose | High dose | Low dose |
| Bidgood and Steer[25] | 7– | 2– | – | – |
| Frigoletto et al[26] | 4–40 | 1,2– | – | – |
| Jamal and Kalantari[27] | 9–90 | 3–30 | 36[a] | 18[a] |
| Lopez-Zeno et al[28] | 6– | 1– | 17.3 ± 9.4 | 10.8 ± 6.7 |
| Majoko[29] | 10-40 | 4–16 | – | – |
| Merrill and Zlatnik[30] | 4.5–80.0 | 1.5–31.7 | 15.6 ± 0.7 | 7.8 ± 0.3 |
| Rogers et al[31] | 6– | 1– | 13 ± 9 | 6 ± 5 |
| Sadler et al[32] | 6– | 1– | 16.2 ± 8.9 | 12.0 ± 7.2 |
| Tabowei and Oboro[33] | 6– | 2– | – | – |
| Xenakis et al[34] | 4–40 | 1–18 | 9.3 ± 5.2 | 4.7 ± 2.9 |

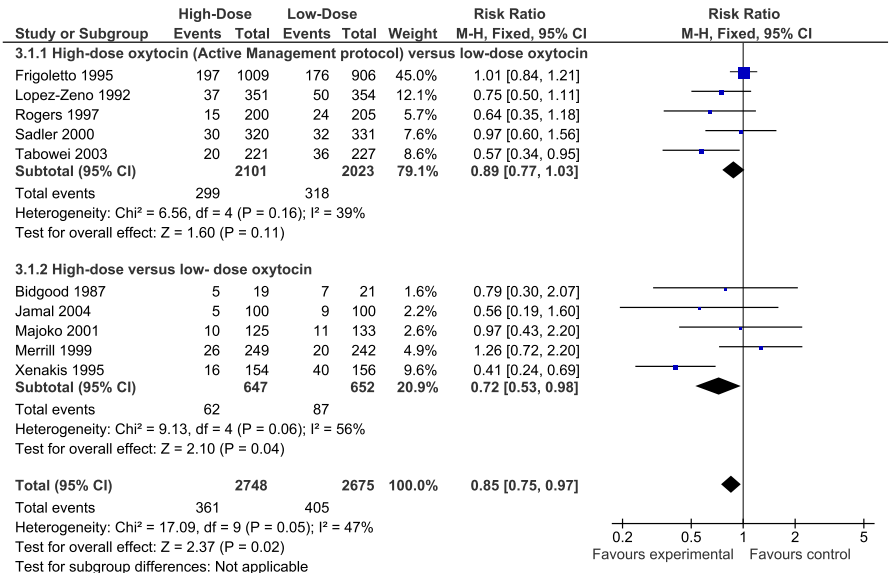
*Wei. High- vs low-dose oxytocin for labor augmentation. Am J Obstet Gynecol 2010.*

from the analysis after randomization as they became ineligible for the intervention. Only cesarean section was reported by intention to treat. This study was only included for the cesarean section outcome. Data were abstracted independently by the 2 reviewers and results compiled.

Of the 10 trials included in the systematic review, 5 studies[26,28,31-33] contrasted AML to a more conservative approach to care, ie, early administration of high-dose oxytocin compared to a delayed low-dose oxytocin regimen. In the remaining 5 studies,[25,27,29,30,34] the contrast consisted of a simple comparison of high-dose to low-dose oxytocin for labor augmentation. For the analysis of our main outcome, cesarean section, studies were stratified according to these 2 types of comparison.

The data were extracted and statistical analysis carried out using Review Manager (RevMan) 5.0 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen). Data on dichotomous outcomes were combined using the Mantel-Haenszel method, and measures of effect are presented as relative risk (RR) with 95% confidence interval (CI). For continuous data, we used the sample size weighted mean difference when outcomes were measured in the same way between trials. We used forest plots to shows the point estimate for each study (with 95% CIs), with a diamond at the bottom representing the pooled point estimate with 95% CIs for each outcome of interest. The presence of significant heterogeneity was explored by the interaction test ($I^2$) statistic.[35] In cases where $I^2$ exceeded 50%, we pooled results using random effects models and explored the results for sources of variation.

**FIGURE 2**
**Effect of oxytocin dose on cesarean section**




*CI*, confidence interval; *df*, degrees of freedom; *M-H*, Mantel Haenszel.

*Wei. High- vs low-dose oxytocin for labor augmentation. Am J Obstet Gynecol 2010.*

## RESULTS

The search strategy resulted in 426 potentially relevant citations. Preferred reporting items for systematic reviews and metaanalyses flow diagram[36] (Figure 1) shows an overview of the study selection process. Twenty-seven relevant randomized controlled trials were retrieved for more detailed assessments (Table 1). Seventeen trials were excluded for the following reasons: 14 trials[10-23] were excluded as early oxytocin administration and/or amniotomy was compared to routine care; a trial[22] comparing pulsatile to continuous oxytocin infusion was excluded; and 2 trials[23,24] comparing 2 high-dose or 2 low-dose oxytocin regimens were excluded. Ten trials,[25-34] including 5423 women, were included in the final analysis. The included trials and characteristics of the women at the time of randomization are summarized in Table 2. All 10 trials that met the eligibility criteria were evaluated by 2 reviewers independently with respect to the 4 criteria

relating to potential bias. The oxytocin dosage was double-masked in only 1 trial[30]–the bags containing high-dose or low-dose oxytocin solutions were prepared by the hospital pharmacy. Randomization blinding, when performed, was achieved by centralization of the process in the hospital pharmacy in 1 study[30] or by sealed envelopes in the remaining studies. Three trials[25,27,34] enrolled women with established delays in labor progress. The remaining trials enrolled women who were in normal spontaneous labor at the time of randomization.

In all studies, the contrast consisted of high-dose oxytocin infusion compared to low-dose oxytocin, as shown in Tables 2 and 3. The high-dose regimens varied across the trials; starting doses ranged from 4–10 mU/min, with increases in dose ranging from 4–7 mU/min and maximum rates ranging from 4–90 mU/min. Low-dose regimens commenced infusion at from 1-4 mU/min, with rate increases ranging from 1–2 mU/min and maximum rates ranging between 1–31.7 mU/min.

The effect of high-dose vs low-dose oxytocin augmentation on the cesarean section rate is presented in Figure 2. High-dose oxytocin augmentation was associated with a moderate reduction in the risk of cesarean section (RR, 0.85; 95% CI, 0.75–0.97). There was no evidence of heterogeneity across trials ($I^2 = 47\%$). In the stratified analysis, the effect of the intervention appeared to be more marked in the stratum of trials involving a simple comparison of high-dose to low-dose oxytocin (RR, 0.72; 95% CI, 0.53–0.98) than in those contrasting AML (including high-dose oxytocin) with a more conservative approach to care (including low-dose oxytocin) (RR, 0.89; 95% CI, 0.77–1.03). Overall, the number needed to treat was 50: for every 50 patients treated by high-dose oxytocin augmentation, 1 cesarean section is avoided.

The effect of high-dose oxytocin augmentation on the rate of spontaneous vaginal delivery is shown in Figure 3. High-dose oxytocin was associated with a small but statistically significant increase in spontaneous vaginal deliveries (RR, 1.07; 95% CI, 1.02–1.12). There was heterogeneity across trials ($I^2 = 58\%$; $P < .01$), but the directions of the association consistently favored the high-dose intervention, with the exception of 1 trial.[32]

Five trials[25,28,30,31,33] reported on the effect of the intervention on mean labor intervals (labor duration,[31,33] time from admission,[25,28] or initiation of oxytocin[30] to delivery). High-dose vs low-dose oxytocin augmentation was associated with a significant shortening of these intervals (weighted mean difference: –1.54 hours; 95% CI, –2.44 to –0.64). However, there was significant heterogeneity across the trials ($I^2 = 96\%$; $P < .01$). Three trials[31-33] reported the proportion with labor duration >12 hours (RR, 0.46; 95% CI, 0.30–0.70). There was significant heterogeneity across the trials for this measure of effect ($I^2 = 53\%$; $P = .12$).

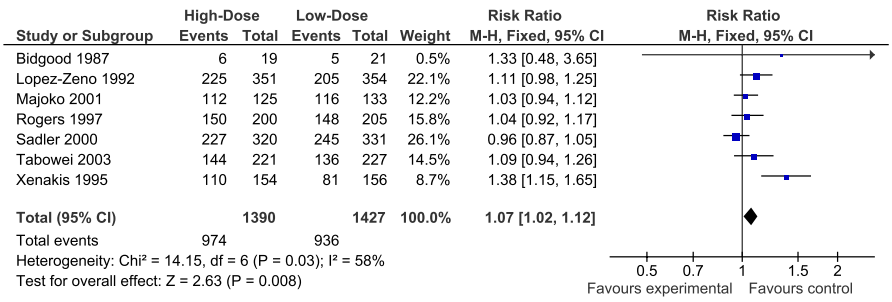
High-dose oxytocin augmentation was associated with a substantially increased risk of hyperstimulation (RR, 1.91; 95% CI, 1.49–2.45). There was no heterogeneity across the trials ($I^2 = 35\%$; $P = .19$) (Figure 4). However, there were no statistically significant differences between high-dose and low-dose oxytocin augmentation groups with respect to the proportion with fetal heart rate abnormalities, fetal distress, or neonatal morbidity indicators (Table 4).

There was no evidence of an effect of high-dose oxytocin augmentation on a range of other adverse maternal process and outcome indicators including use of epidural analgesia, postpartum hemorrhage (>500 mL), maternal blood transfusion, uterine atony, uterine rupture, shoulder dystocia, and chorioamnionitis (Table 4).

## Comment

In this systematic review, we found that high-dose oxytocin augmentation was associated with a statistically significant

**FIGURE 3**
**Effect of oxytocin dose on spontaneous vaginal delivery**




*CI*, confidence interval; *df*, degrees of freedom; *M-H*, Mantel Haenszel.

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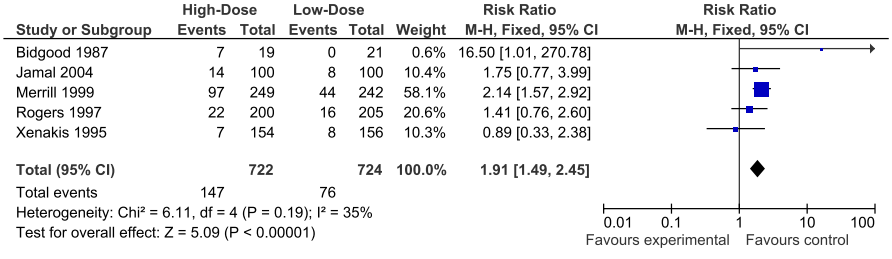
**FIGURE 4**
**Effect of oxytocin dose on hyperstimulation**




*CI*, confidence interval; *df*, degrees of freedom; *M-H*, Mantel Haenszel.

*Wei. High- vs low-dose oxytocin for labor augmentation. Am J Obstet Gynecol 2010.*

TABLE 4
**Effect of high-dose vs low-dose oxytocin augmentation on obstetric and neonatal outcomes**

| Outcome | Studies | High-dose oxytocin | Low-dose oxytocin | RR | 95% CI | Heterogeneity, %[a] |
|---|---|---|---|---|---|---|
| Perinatal mortality | 3[29,30,34] | 8/535 | 7/532 | 1.17 | 0.44–3.11 | 66 |
| Spontaneous vaginal delivery | 7[25,28,29,31-34] | 974/1390 | 936/1427 | 1.07 | 1.02–1.12 | 58 |
| Instrumental delivery | 7[25,28,29,31-34] | 283/1390 | 291/1427 | 1.00 | 0.86–1.15 | 0 |
| Cesarean delivery | 10[25-34] | 361/2748 | 405/2675 | 0.85 | 0.75–0.97 | 47 |
| Labor duration >12 h | 3[31-33] | 75/741 | 156/763 | 0.46 | 0.30–0.70 | 53 |
| Hyperstimulation | 5[25,27,30,31,34] | 147/722 | 76/724 | 1.91 | 1.49–2.45 | 35 |
| Use of epidural analgesia | 4[28,31,32,34] | 630/1025 | 617/1046 | 1.04 | 0.97–1.11 | 3 |
| Postpartum hemorrhage[b] | 4[30-32,34] | 67/923 | 69/934 | 1.00 | 0.73–1.37 | 0 |
| Maternal blood transfusion | 2[28,34] | 2/505 | 2/510 | 1.01 | 0.14–7.14 | 0 |
| Uterine atony | 1[34] | 2/154 | 2/156 | 1.01 | 0.14–7.10 | – |
| Uterine rupture | 1[30] | 0/249 | 1/242 | 0.32 | 0.01–7.91 | – |
| Shoulder dystocia | 2[28,34] | 8/505 | 5/510 | 1.62 | 0.53–4.90 | 0 |
| Chorioamnionitis | 2[30,34] | 33/403 | 44/398 | 0.75 | 0.50–1.14 | 0 |
| Intrapartum meconium | 3[28,29,31] | 73/676 | 92/692 | 0.82 | 0.62–1.09 | 23 |
| FHR abnormality | 3[27,28,30] | 108/700 | 111/696 | 0.96 | 0.76–1.20 | 24 |
| Fetal distress | 4[29,30,32,33] | 19/915 | 15/933 | 1.30 | 0.66–2.54 | 0 |
| Meconium aspiration | 1[29] | 2/125 | 1/133 | 2.13 | 0.20–23.18 | – |
| Apgar score <7 at 5 min | 6[25,29-32,34] | 18/1074 | 15/1089 | 1.18 | 0.61–2.28 | 0 |
| Umbilical artery pH <7.10 | 2[28,30] | 20/607 | 14/597 | 1.42 | 0.72–2.78 | 0 |
| Admission to NICU | 5[28,29,31,32,34] | 65/1150 | 64/1179 | 1.05 | 0.76–1.46 | 0 |
| Very satisfied with labor | 1[32] | 190/243 | 169/225 | 1.04 | 0.94–1.15 | – |

*CI*, confidence interval; *FHR*, fetal heart rate; *NICU*, neonatal intensive care unit; *RR*, relative risk.

[a] Measured by interaction test ($I^2$)– heterogeneity score of >50% suggests high variability between study outcomes, making metaanalysis result unreliable; [b] Postpartum hemorrhage refers to >500 mL.

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reduction in cesarean delivery. Based on the data from these trials, 1 cesarean is avoided for every 50 patients treated by high-dose oxytocin augmentation. High-dose oxytocin was also associated with an increase in spontaneous vaginal deliveries and a shortened labor. While the risk of hyperstimulation was increased with high-dose oxytocin, there was no evidence of an increase in adverse maternal or neonatal outcomes with this approach to care.

A frequent challenge for obstetricians is how to reduce maternal and neonatal morbidity when faced with arrested or protracted progress in labor. Although oxytocin is widely used in obstetric care, there is a lack of consensus with respect to the optimal oxytocin dosage, safety, and efficacy of this intervention. Relative to vaginal delivery, cesarean section has been shown to be associated with a range of serious maternal[37] and neonatal[38] morbidities. The rate of cesarean delivery has been shown to be associated with the need for postpartum antibiotic treatment[2] and an increased risk of disorders of placentation and unexplained stillbirths in subsequent pregnancies.[39] We were unable to demonstrate a reduction in maternal or neonatal morbidity associated with this reduction in cesarean section.

Our results indicate that high-dose oxytocin augmentation is associated with an increased risk of uterine hyperstimulation. Hyperstimulation can be associated with negative effects on fetal oxygen status and fetal heart rate patterns.[40] We have no information on the specific frequency or severity of fetal heart rate tracing abnormalities associated with the hyperstimulation observed in included trials. The results from our study provide no evidence of an increase in adverse maternal or neonatal outcomes associated with high-dose oxytocin use.

Variations of AML are widely used in managing slow progress in labor in the belief that oxytocin augmentation reduces the need for cesarean section.[41] The full package of active management has been recently reported to be associated with a modest, but nonstatistically significant reduction in cesarean deliveries (RR, 0.88; 95% CI, 0.77–1.01).[42] AML includes early administration of high-dose oxytocin augmentation for prolonged labor. In a previous systematic re-

view focusing on the timing for the oxytocin administration (early vs delayed), we failed to demonstrate an effect of early intervention on the rate of cesarean section (RR, 0.87; 95% CI, 0.71–1.06).[43] The results of the current review, including our stratified analysis, suggest that the high-dose oxytocin may be more important in preventing cesarean section than the actual timing of the oxytocin intervention.

A cost-analysis comparing high-dose vs low-dose oxytocin protocols was documented in only 1 trial.[30] The authors estimated an hourly cost for intravenous oxytocin administration with standard maternal and fetal monitoring. For example, if one assumes a cost of $140/h,[30] and assuming that labor was shortened by approximately 1.5 hours with high-dose oxytocin augmentation, the average reduction in the labor and delivery cost for the high-dose group thus would approximate $210/patient. These savings would have occurred secondary to shortening of labor and do not include any estimates of cost reduction secondary to decreased cesarean delivery rates.

Our review has some limitations. First, the decision criteria for cesarean section were not standardized in most studies and could have been applied in an imbalanced fashion across study groups. Second, most of the trials were conducted without blinding, which may have resulted in procedure bias, with the decision to proceed to cesarean section influenced by the provider's knowledge of the oxytocin dose. Third, we have limited data on compliance to the respective protocols in most trials. In addition, most of the trials have no documentation of women's views concerning the treatment administered. It is possible that high-dose oxytocin could be associated with an increase in labor pain; however none of the trials documented this outcome.

In summary, high-dose oxytocin augmentation of labor was found to be associated with a moderate reduction in the rate of cesarean section, a small increase in the rate of spontaneous vaginal deliveries and shortened labor, with potential significant cost savings in clinical care. Further large, simple double-masked trials are needed to determine the safety, effectiveness, acceptability, and cost implications of this approach in obstetric care. In planning oxytocin augmentation for labor management, the maternal and fetal characteristics including medical history, parity, and indicators of maternal and fetal well-being should be considered. Women should be informed of both the potential beneficial effects of high-dose oxytocin augmentation on mode of delivery as well as its possible effects on comfort. ■

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