

Stopping Oxytocin in Active Labor Rather Than Continuing it until Delivery: A Viable Option for the Induction of Labor

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ABSTRACT

Objective: Induction of labor (IOL), using intravenous oxytocin, is the artificial initiation of labor before its spontaneous onset for the purpose of delivery of the fetoplacental unit. Although there are various studies looking at dosages of oxytocin, only a few have addressed the issue of discontinuation of oxytocin in the active stage of labor. Thus, our study was conducted to evaluate the need for continuation versus discontinuation of oxytocin during active labor. **Methods:** This prospective, randomized controlled trial included 106 women who needed IOL. Oxytocin infusion was initiated at a rate of 3mIU/min and was incremental until 4–6cm cervical dilation. At this point the patients were randomly assigned into one of two groups. In group one, oxytocin was discontinued, and infusion was continued with 0.9% sodium chloride solution. In group two, oxytocin was continued at the same dose until delivery. **Results:** The duration of oxytocin infusion was 5.5 hours in the oxytocin discontinuation group and 11.0 hours in oxytocin continuation group ($p<0.001$). The total dose of oxytocin was significantly higher in group two (6.1 units vs. 16.5 units; $p<0.001$). The induction-delivery interval was significantly less in group one (9.1 and 11.2 hours in group one and group two, respectively; $p=0.023$). **Conclusion:** Oxytocin discontinuation in the active stage of labor did not prolong the active stage. The total duration of labor and total oxytocin dose were significantly less in the oxytocin discontinuation group. Our results suggest that oxytocin discontinuation is an alternative and viable option particularly in resource poor and economically challenged settings. It not only reduces the need for intense monitoring and prolonged oxytocin use-associated dangers but reduces the total cost of labor management.

Induction of labor (IOL) is the artificial initiation of labor, before its spontaneous onset, for the purpose of delivery of the fetoplacental unit. The common indications for IOL are post-term pregnancy, premature rupture of membranes, fetal compromise, maternal medical conditions (e.g. diabetes mellitus, renal disease, chronic pulmonary disease, hypertension, antiphospholipid syndrome), suspected or proven chorioamnionitis, abruption, and fetal death.¹ Labor is induced in 13–20% of live births. The incidence of IOL in our institute is 23.5%.

Since the 1950s, intravenous oxytocin has been one of the commonly used pharmacological agents for IOL.^{2–6} Oxytocin is the nonapeptide released from posterior pituitary gland and is released in large amounts after distension of the cervix and vagina during labor. It has a half-life of five to 12 minutes, takes 40 minutes to reach steady-state plasma concentration, and has a steady state uterine response

of 30 minutes or longer.^{7,8} It is potent, easy to titrate, and has a short half-life; however, at high doses it has an antidiuretic effect ($>40\mu\text{u}/\text{min}$) and can cause water intoxication in prolonged inductions.⁹ Uterine hyperstimulation and rupture can also occur. If the resting uterine tone stays above 20mmHg, there is a risk of uteroplacental insufficiency and fetal hypoxia.

The actions of oxytocin are mediated by specific high-affinity oxytocin receptors in the uterus that increase 100-fold by 32 weeks gestation and 300-fold at parturition. The sensitivity of the myometrium to oxytocin is governed by the concentration and binding kinetics of its available receptors.¹⁰ The dose response curve varies in different women.¹¹ In cases of prolonged labor induction with oxytocin, women exhibit a decrease in oxytocin binding with its receptors suggesting down-regulation of receptors with repetitive stimulation.¹²

There is no consensus regarding the ideal dosing regimen of oxytocin. It has been seen that induction

with higher dose oxytocin increments does not shorten time to delivery, but is often associated with an increase in uterine hyperstimulation, whereas low dose oxytocin is found to be appropriate and safe for labor induction.¹³

Although there are various studies looking at dosages of oxytocin, few studies have focused on the optimal duration of oxytocin administration. One of these studies by Ustunyurt et al,¹⁴ showed that the duration of active the phase and second stage of labor were longer in the oxytocin discontinued group but this was not statistically significant. Thus, they concluded that discontinuation of oxytocin, once the active phase of labor was established, may be an alternative protocol in developing countries where the facilities for fetal monitoring are limited.

Spiegel et al,¹⁵ compared stoppage of oxytocin at 5cm cervical dilatation versus continuation and showed a shorter active phase of labor and fewer cesarean deliveries in the latter group. Another study by Girard et al,¹⁶ also advocated discontinuation of oxytocin once the active phase of labor was established, which showed a higher rate of cesarean section, postpartum hemorrhage, and fetal heart rate decelerations in the oxytocin continued group.

Thus, we conducted this study to evaluate the need of continuation versus discontinuation of oxytocin in the active stage of labor.

METHODS

We conducted a prospective, randomized controlled trial in the labor ward of the Post Graduate Institute of Medical Education and Research, Chandigarh, India. It included 106 women with a single live fetus and cephalic presentation at 36–42 weeks of gestation who needed IOL. Women with associated medical-surgical disorders, previous uterine scar, and a parity great than three, or who had a fetus with major congenital malformations or intrauterine demise and a persistent non-reassuring fetal heart rate pattern were excluded from the study. Informed written consent was obtained from the subjects.

A difference of at least one hour of active labor was considered significant between the two groups. The sample size was calculated as 86 using public domain statistical software EPI Info (Centers for Disease Control and Prevention, Georgia, US).

Women were divided into one of two groups using computer-generated randomization. The

women were randomized in active labor at cervical dilatation of 4–6cm. In group one, initiation of oxytocin was incremental until the cervix was 4–6cm dilated and was discontinued after that. In group two, infusion of oxytocin was incremental until 4–6cm cervical dilatation and was maintained at the same level throughout the labor.

Oxytocin infusion was initiated at a rate of 3mIU/min and was increased every 30 minutes by 3mIU/min until regular contractions at a rate of 3–5 contractions/10min were achieved. The maximum dose of oxytocin was 42mu/min.¹⁷ Infusion of oxytocin was incremental until 4–6cm cervical dilation, which, along with 3–5 contractions in 10 minutes, marked the active stage of labor. At cervical dilatation of 4–6cm, amniotomy was performed in those with intact membranes and the patients were randomly assigned to the two groups as per protocol. Sealed opaque envelopes were opened for randomization. In group one, oxytocin was discontinued, and infusion was continued with 0.9% NaCl solution. In group two, oxytocin was continued at the same dose until delivery.

Maternal and fetal monitoring was done every 30 minutes. Pelvic examination was carried out before induction of labor and 2–4 times per hour depending on the initial pelvic findings, onset of adequate uterine contractions, or whenever indicated. Cardiotocography was used as and when indicated.

Active pushing was advised when full cervical dilatation was achieved and delivery was not imminent within a waiting period of one hour for multigravida women and two hours for primigravida women in the second stage of labor. Operative vaginal delivery was conducted for obstetric indications.

In group one, if the uterine contractions were inadequate (<3 contractions/10 mins) for two hours or more, or if cervical dilatation did not improve, it was regarded as failure of protocol and oxytocin infusion was restarted. Maternal vital signs, uterine contractions, and fetal heart rate patterns were monitored at regular intervals throughout the labor. Uterine activity was assessed qualitatively by palpation of the fundus of the uterus through the abdomen to get information about the duration, intensity, and frequency of uterine contractions. The palm of the hand was placed lightly on the uterus to record the time of onset and disappearance of the contraction, and the degree of firmness the uterus

achieved during the contraction, gave an idea of its intensity. The number of contractions in a 10 minute period determined the frequency with three to five contractions in 10 minutes considered "adequate uterine contractions," such that the finger could not readily indent the uterus at the acme of contraction.

Uterine hyperstimulation was diagnosed if the number of contractions was more than five in 10 minute intervals (tachysystole) with duration of each contraction of two minutes or more (hypertonus) and if they were associated with fetal distress. The patients with uterine hyperstimulation were managed as per the routine labor ward protocol. This included discontinuing the oxytocin infusion, putting the patient in left lateral position, giving oxygen by ventimask, starting 0.9% normal saline infusion and continuous cardiotocographic tracing. Partograph was maintained for every subject.

Statistical analysis was carried out using SPSS Statistics (SPSS Inc., Chicago, USA) version 15.0. All quantitative variables were estimated using measures of central location (mean, median) and measures of dispersion (standard deviation and standard error). Normality of data was checked by measures of skewness and Kolmogorov-Smirnov tests for normality. For normally distributed data, means were compared by using the Student's *t*-test for two groups. For skewed data, the Mann-Whitney test was applied to the two groups. Qualitative or categorical variables were described as frequencies and proportions. Proportions were compared using chi-square or Fisher's exact test, whichever was applicable. The Kaplan-Meier and log-rank tests calculated the difference between the active stage of labor of the two groups. All statistical tests were two-sided and were performed at a significance level of $\alpha=0.050$.

RESULTS

A comparison of the outcome of labor in the two groups can be seen in Table 1. The mean age of the women was comparable in both group one and two (25.9 and 26.5 years, respectively). With regard to parity in the two groups, 51.0% and 47.2% were nulliparous and 49.0% and 52.8% multiparous, respectively. Oxytocin alone was used for IOL in 88.2% of women in group one and 69.2% of women in group two while cervical ripening with dinaprostone gel followed by oxytocin in 11.8% of women in

Table 1: Comparison of the outcome of labor in women given oxytocin until the active stage of labor only (i.e. discontinuation group/group one) and women given oxytocin until delivery (group two).

Variable	Group one	Group two	<i>p</i> -value
Age (years)	25.96	26.51	0.487
Parity			
Nulliparous	26 (51%)	25 (47.2%)	0.698
Multiparous	25 (49%)	28 (52.8%)	
Method of induction			
Oxytocin	11.8%	30.2%	0.021
Cerviprime+oxytocin	88.2%	69.8%	
Total dose (units)			
Minimum	1.4	2.0	
Maximum	18.9	54.8	
Mean	6.1	16.5	<0.0001
Infusion rate (mu/min)			
Minimum	15	12	
Maximum	42	42	
Mean	30.4	28.5	0.267
Duration of infusion (hours)			
Minimum	2.4	2.5	
Maximum	10.0	25.2	
Mean	5.5	11.0	0.001
Induction delivery interval (hours)			
Mean	9.0	11.2	0.023
Active labor (mean)	7.1	8.5	0.048
After 4–6 cm dilatation	6.3	4.7	0.270
Mode of delivery			
LSCS	0%	1%	0.718
Vaginal	100%	98%	

LSCS=lower segment cesarean section.

p-value<0.005 =significant.

group one and 30.2% of women, in group two. The difference in induction method was statistically significant in both groups ($p=0.021$). The two main indications for induction were hypertensive disorders of pregnancy (33.3% in group one and 41.5% in group two) and intrahepatic cholestasis (19.6% in group one and 17% in group two). Intrauterine growth restriction and oligohydramnios and were comparable in both groups.

The mean duration of oxytocin infusion was 5.5 hours in group one and 11.0 hours in group two ($p=0.001$) as it was continued until delivery in this group while it was stopped in group one at 4–6cm cervical dilatation. Accordingly, total oxytocin units used were more in group one than group two (mean 6.1 and 16.5 units, respectively; $p<0.001$). The maximum dose of pitocin needed for adequate uterine contractions was greater in the discontinuation group (mean 30.4mu/hour;

range 15–42mu/hr) than in the continuation group (28.53mu/hour 12–42mu/hour), but the difference was not statistically significant.

The duration of active labor was less in group one than in group two (7.1 hours vs. 8.5 hours, respectively) and was statistically significant.

The duration of labor after 4–6cm cervical dilatation in the two groups was 6.3 hours in 51 of 53 subjects in group one (96.2%) compared to 4.7 hours in group two (53 of 53 subjects). The induction delivery interval was statistically significant in the two groups (mean 9.1 hours in group one and 11.2 hours in group two; $p=0.023$).

Subgroup analysis between women who needed cervical ripening and those who received only oxytocin did not show any significant difference in the induction delivery interval, duration of oxytocin infusion, or duration of labor.

All women in group one delivered vaginally, and eight had instrumental delivery. In group two, one woman had a cesarean section for cephalopelvic disproportion, and six women underwent instrumental vaginal delivery ($p=0.718$). In group one, instrumental delivery was conducted for fetal bradycardia in six out of eight deliveries, and two deliveries had a prolonged second stage for women in group two. Fetal bradycardia was an indication for instrumental delivery in all cases, but this was not statistically significant.

Mean blood loss and maternal complications such as atonicity of the uterus were not statistically significant in the two groups. Fetal bradycardia was seen in six women in group one (one because of hyperstimulation) and in five women during the second stage of labor. Eight women had a nonreassuring fetal heart rate pattern in group two, out of which five were due to uterine hyperstimulation and second stage decelerations. The difference was not statistically significant.

Birth weight was comparable in the two groups (2.85 and 2.87kg, respectively). Additionally, the need for resuscitation and incidence of neonatal respiratory distress, neonatal hypoglycemia, Apgar scores, and neonatal hyperbilirubinemia were not significantly different between the two groups.

DISCUSSION

IOL is a common practice in obstetrics and the most common pharmacological method used in

last six decades is intravenous oxytocin. The initial dose varies from 0.5–6mu/min with increments of 1–2mu/min (low dose) to 3–6mu/min (high dose) at 15–40 minute intervals.¹⁷ To obtain a reasonably short induction delivery interval, large but variable quantities of oxytocin are required to induce labor, but smaller quantities will maintain the progress of established labor.¹⁸ Therefore, overstimulation of uterine activity might be expected at a time when no more than a maintenance dose of oxytocin infusion is required, which can cause various complications including intrapartum fetal anoxia, uterine hypertonus, and rapid labor. Therefore, the question may arise whether it is necessary to continue oxytocin infusion beyond the active stage of labor.

In our study, the induction delivery interval in the continuation group was significantly less ($p=0.021$) than in the discontinuation group; the mean interval was 9.1 vs. 11.2 hours (range 3.4–21 hours vs. 2.5–25.2 hours). This was also seen by Spiegel et al, in their study (the induction delivery interval was 8 hours vs 7.2 hours in the continuation and discontinuation groups, respectively).¹⁵

The duration of labor after adequate uterine contractions was also shorter in the oxytocin discontinuation group than in the oxytocin continuation group (7.1 hours vs. 8.5 hours; $p=0.048$). This may have been because of desensitization of oxytocin receptors on prolonged exposure to oxytocin in the continuation group leading to a decreased hormonal response.

The labor duration in the active phase (4–6cm cervical dilatation) was longer in the oxytocin discontinuation group (6.3 hours) than the oxytocin continuation group (4.7 hours), which was not statistically significant. Thus, discontinuation of oxytocin did not prolong labor in our study as was shown by Girard et al.¹⁶ Spiegel et al,¹⁵ showed the mean duration to be less in the oxytocin discontinuation group, while Ustunyurt et al,¹⁴ showed it to be similar in the two groups.

The maximum flow rate of oxytocin in the present study was 42mu/min in both the groups. The mean infusion rate was more in oxytocin discontinuation group 30.8mu/min vs. 28.5mu/min in the continuation group ($p=0.267$). This was similar to studies by Spiegel et al,¹⁵ and Ustunyurt et al.¹⁴ While Girard et al,¹⁶ used an even infusion rate of oxytocin (70mu/min) in oxytocin continuation group than the discontinuation group (72mu/min).

The minimum total dose used in the two groups was similar (1.4 vs. 2.0 units). The maximum total dose (18.9 vs. 54.8 units) and mean total (6.1 vs. 16.4 units) used was significantly more in the discontinuation groups. On evaluating the use of total oxytocin dose of greater than five units, of the 14 women who had abnormal fetal heart rate patterns, 10 had received more than five units of oxytocin (5.4–45.1 units). Similarly, in nine of 14 instrumental deliveries, seven out of nine women with atonicity of the uterus and eight of 15 babies having hyperbilirubinemia received more than five units of oxytocin. Such outcomes with the use of high dose have been reported in the literature.¹⁹

In our study, oxytocin was restarted in two out of 53 women in the discontinuation group (3.8%) compared to 7.7% and 6.5% of women in studies by Spiegel et al,¹⁵ and Ustunyurt et al,¹⁴ respectively. Girard et al,¹⁶ restarted oxytocin in 30.4% of subjects. Thus, in our study, 96.2% women continued to have adequate uterine contractions despite discontinuing oxytocin, which, when compared to the aforementioned studies, supports the hypothesis that oxytocin can be stopped in active labor.

Ustunyurt et al,¹⁴ in their study showed that the duration of the active phase of labor and the second stage of labor were longer in the oxytocin discontinuation group, which was not statistically significant. On the other hand, Girard et al,¹⁶ showed that discontinuation of oxytocin at the onset of active phase significantly prolonged labor by a mean of 113 minutes ($p=0.0001$).¹⁶ Therefore, it can be postulated that oxytocin discontinuation in the active stage of labor does not prolong labor and can be considered a viable option as it may reduce the adverse effects of oxytocin infusion over a long period.

The difference of abnormal cardiotocograph patterns among the subjects of two groups was not statistically significant. Similar results were seen in other studies.¹⁴⁻¹⁶

In our study, the mode of delivery was not affected by discontinuation of oxytocin compared to others that showed a higher but statistically significant cesarean delivery rate in the oxytocin continuation group.¹⁴⁻¹⁶ The cesarean rate was less in our study probably due to the smaller total patient number; in our institute, the cesarean rate is around 25–30%.

There was no statistically significant difference in the rate of atonicity and the average amount of blood loss during the third stage of labor in the two groups.

The neonatal outcome was comparable in the two groups in terms of mean birth weight, APGAR scores, neonatal hyponatremia, and neonatal hyperbilirubinemia.

The main limitation of the study was the small number of subjects. Although we could achieve statistically significant results, a greater number of subjects would further help substantiate the results.

CONCLUSION

Discontinuation of oxytocin in the active stage of labor does not prolong labor and has no adverse maternal or neonatal outcome. Therefore, it is an alternative and viable option to discontinue oxytocin in the active stage of labor particularly in resource poor and economically challenged settings. This will not only reduce the need for intense monitoring of labor and the dangers of prolonged oxytocin use but will reduce the total cost of labor management without any deleterious effect.

The study addressed a clinically applicable, important issue in obstetrics. Oxytocin is the ideal and is usually continued until delivery inductor of labor. But if can be stopped once active labor is established, and the outcome of labor is not affected this is a viable option. This may be more cost effective in terms of the need for labor monitoring, manpower, and fewer complications related to oxytocin for both mother and neonate as was seen in this study.

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