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Patterns of Oxytocin Use in those Undergoing Trial of Labor After Cesarean Delivery

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Abstract

Introduction: Oxytocin use in the management of TOLAC is controversial. Data assessing the relationship between oxytocin use and adverse outcomes is scant.

Methods: Chart review of 159 patients with one prior cesarean undergoing TOLAC divided into those who were: (1) induced with oxytocin (IND, n=44), (2) augmented with oxytocin (AUG, n=37) and (3) managed expectantly after presenting in labor (SPON, n=78). Following obtained: maternal baseline characteristics, amount administered and duration of oxytocin use if used, incidence of adverse outcomes. Chi-square and ANOVA were used for statistical analysis.

Results: Baseline characteristics between groups were similar. Two cases of uterine ruptures and one of hemorrhage occurred in the IND group. All three cases had an initial Bishop score less than 5. Average total amount of oxytocin administered and duration of oxytocin use in this subgroup were 4412 milliunits and 12.7 hours. Five patients underwent cervical ripening balloon placement followed by oxytocin for induction. In this subgroup, none experienced adverse outcomes and three of the five had a successful TOLAC. Average total amount of oxytocin administered and duration of oxytocin use were 1988 milliunits and 7.3 hours. One case of uterine dehiscence necessitating surgical intervention occurred in the SPON group. There were no complications in the AUG group. No significant differences were noted among the groups regarding other outcomes including cesarean delivery rate.

Conclusion: Induction of labor in the presence of an unfavorable cervix and prior cesarean is associated with adverse outcomes. Cervical ripening balloon has a role in achieving a successful TOLAC.

Keywords: Cesarean delivery; TOLAC; Oxytocin

Introduction

In 2006, the national cesarean delivery rate increased to 31.1% while the vaginal birth after cesarean (VBAC) delivery rate decreased to 8.5% [1] in spite of data indicating that the VBAC success rate ranges from 60 to 80% [2]. Advantages associated with vaginal delivery compared to repeat cesarean delivery include decreased risk of injury to organs adjacent to the uterus. However, there is an increased risk of excess blood loss and endometritis associated with trial of labor after cesarean (TOLAC) especially in those cases that result in a repeat cesarean delivery [3]. Additionally, TOLAC is linked with an increase in the risk of uterine rupture leading to increases in maternal and neonatal morbidity. Several large studies of women with a prior low transverse uterine incision reported a uterine rupture rate of approximately 0.5-0.9% after TOLAC [4,5].

An area of controversy stems from use of oxytocin in patients undergoing TOLAC. One study found that there was no increased risk in uterine rupture in those undergoing induction of labor versus those who went into labor spontaneously in the presence of a prior cesarean scar. This study did indicate though that an initial unfavorable cervix was associated with an increased risk of rupture compared with those who presented in spontaneous labor [6]. However, this study did not specifically assess rates and duration of oxytocin exposure in relation to favorability of the cervix, a key predictor of successful labor induction. Another study found that women who underwent TOLAC and who encountered labor dystocia in the active phase of labor were more susceptible to experiencing uterine rupture than those who did not experience labor dystocia [7]. This study also did not assess specifics of oxytocin use in TOLAC management. In regards to uterine rupture, in a larger study of 33,000 patients, uterine rupture rates in those who presented in spontaneous labor, who underwent labor augmentation and who underwent labor induction with oxytocin were 0.4%, 0.9% and 1.1%, respectively [8]. This study, similar to the other two, did not assess specifics of oxytocin use. The number of studies evaluating oxytocin use in those undergoing TOLAC is scant. Hence, the purpose of this study was to evaluate patterns of oxytocin use in those who underwent TOLAC and to clarify the association between use of oxytocin and uterine rupture, specifically focusing on duration of oxytocin exposure and amount of oxytocin administered.

Materials and Methods

This study was an Institutional Review Board-approved retrospective cohort study. Charts of 159 patients who presented and underwent TOLAC at Staten Island University Hospital (SIUH), a teaching community hospital, between 2011 and 2015 were reviewed. Inclusion criteria were: singleton gestation between 37 and 42 weeks

gestation, no prior vaginal delivery, one prior low transverse uterine incision, parity ≤ 4. Gestational age was based on the date of last menstrual period and prenatal ultrasonographic examination at less than 20 weeks. Exclusion criteria were previous transfundal uterine surgery, previous classical, low vertical or T-shaped uterine incision, fetal malpresentation or suspected cephalopelvic disproportion, evidence of fetal compromise at presentation and any condition in which vaginal delivery was contraindicated (i.e., placenta previa). Criteria for attempting VBAC at SIUH were the same as that of the inclusion criteria for this study with the exception that patients with at least one prior vaginal delivery are allowed to attempt a VBAC according to hospital policy. 1111 patients met criteria for attempting VBAC and 625 patients proceeded to do so. 159 out of the 625 patients had no history of a prior vaginal delivery. This is all represented in Figure 1.

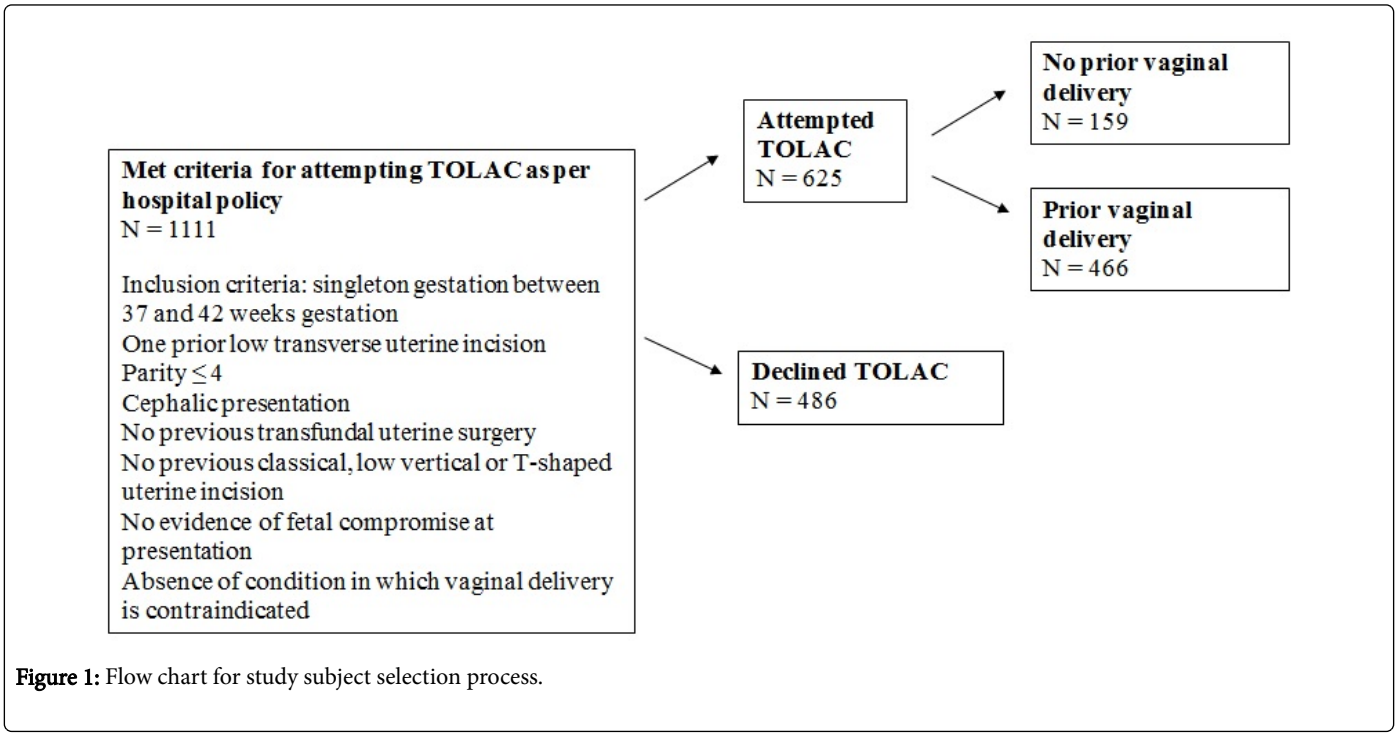

Figure 1: Flow chart for study subject selection process.

Baseline characteristics recorded were age, parity, gestational age on presentation, body mass index, ethnicity, indication for prior cesarean delivery and Bishop score on admission. Calculation of the Bishop score was based on cervical dilation, effacement, station, position and cervical consistency. The maximum Bishop score was thirteen.

Group assignment was determined by the course of management undertaken: induction of labor with oxytocin, augmentation of labor with oxytocin and expectant management of labor. Participants were continuously monitored for uterine activity and fetal heart rate until delivery. For the purposes of this study, expectant management was defined as management not involving use of oxytocin.

Information regarding fetal heart rate tracing abnormalities (recurrent variable decelerations, recurrent late decelerations, prolonged decelerations and absent variability) were obtained from clinical staff notes written every fifteen to thirty minutes during the entire intrapartum course. As per hospital policy, if oxytocin was administered, it was administered at a starting rate of 1 milliunit/min and increased every 30 minutes by 1 milliunit/min until contractions were occurring every 2-3 minutes. Additionally, if the provider chose to induce labor in those with a prior cesarean, as per hospital policy, the provider was allowed to place a cervical ripening balloon prior to starting oxytocin. Indications for induction of labor were in accordance with those espoused by the American College of Obstetricians and Gynecologists. Oxytocin was administered for labor augmentation if no cervical change was noted for 4 hour.

The following were also obtained from the charts: duration of oxytocin use, amount of oxytocin administered, use of cervical ripening balloon, mode of delivery (vaginal versus repeat cesarean), indication for repeat cesarean delivery after failed TOLAC, associated estimated blood loss, presence of meconium, epidural use, incidence of fetal heart rate abnormalities and complications (uterine rupture, symptomatic uterine dehiscence, hemorrhage) and neonatal outcomes (birth weight, Apgar scores at 1 and 5 minutes, NICU admission and arterial cord pH). The amount of oxytocin was calculated by multiplying the rate of oxytocin (milliliters/minute) by the duration (in minutes) that oxytocin was administered for at the particular rate and adding these products for the entire duration if the rate of oxytocin was changed during the time that the oxytocin was administered.

Chi Square and ANOVA were used for statistical analysis with the assistance of SPSS software.

Results

Between 2011 and 2015, 625 patients underwent TOLAC of which 159 met inclusion criteria. 78 were expectantly managed after having presented in spontaneous labor (SPON), 44 underwent labor induction with oxytocin (IND) and 37 underwent labor augmentation with oxytocin (AUG). Baseline characteristics are outlined in Table 1. No significant differences were noted between the three groups with respect to maternal age, parity, gestational age on presentation, body mass index, ethnicity and indication for prior cesarean delivery. As

expected, Bishop score among the three groups (SPON, IND, AUG) were significantly different (9.4 versus 4.7 versus 8.1, p<0.01). Indications for labor induction were premature rupture of membranes, oligohydramnios, postdates and hypertensive disorders.

Maternal outcomes are outlined in Table 2. A significantly higher percentage of women in the AUG group received an epidural for pain management compared with the SPON group (94.6% *vs.* 76.9%, p<0.05). There were no significant differences with respect to cesarean delivery rate, incidence of fetal heart rate abnormalities, presence of meconium and complications and estimated blood loss among the groups.

	SPON (n=78)	IND (n=44)	AUG (n=37)	P value
Age	28.9 ± 5.2	28.7 ± 4.7	29.9 ± 6.0	0.54
Parity				0.63
Para 1	65 (83%)	36 (82%)	33 (89%)	
Para >/=2	13 (17%)	8 (18%)	4 (11%)	
Gestational Age	39.5 ± 1.0	39.7 ± 1.6	39.8 ± 0.8	0.46
Body mass index	24.7 ± 5.1	26.6 ± 6.2	25.0 ± 5.3	0.22
Bishop score	9.4 ± 2.2	4.7 ± 3.0	8.1 ± 2.2	<0.01
Ethnicity				0.24
Caucasian	57 (73%)	23 (52%)	27 (73%)	
African American	8 (10%)	8 (18%)	3 (8%)	
Hispanic	5 (6%)	5 (11%)	3 (8%)	
Other	3 (4%)	2 (5%)	0	
Indication for primary cesarean delivery				0.4
Non-repetitive	48 (62%)	33 (75%)	25 (68%)	
Labor dystocia	30 (38%)	11 (25%)	12 (32%)	

Continuous variables are presented as mean ± standard deviation. Categorical factors are presented as number and associated percentage.

Table 1: Baseline characteristics.

There were two cases of uterine dehiscence in the SPON group and two cases of uterine rupture and one of hemorrhage in the IND group. Duration of labor was significantly longer in the IND group than in the SPON group (12.7 *vs.* 9.6 h, p<0.01). Duration of oxytocin use and amount of oxytocin administered were significantly longer and higher in the IND group than in the AUG group (8.9 *vs.* 4.4 hours, 2663 *vs.* 865 milliunits, p<0.01).

Table 3 serves to elucidate outcomes in the IND group. Five patients in the IND group initially underwent labor induction with the use of a cervical ripening balloon. Three out of five of these patients subsequently had a successful TOLAC.

Mean duration of oxytocin use and amount of oxytocin administered in the subset of patients induced with the cervical ripening balloon initially AND who had a successful TOLAC were 2547 milliunits of oxytocin (range 1341-9400 milliunits) and 8.7 hours (range 1-13 hours), respectively.

	SPON (n=78)	IND (n=44)	AUG (n=37)	P value
Vaginal delivery (number of patients)	62 (79%)	30 (68%)	24 (65%)	0.52
Cesarean delivery (number of patients)	16 (21%)	14 (32%)	13 (35%)	
Indication for repeat cesarean delivery				0.11
Failed induction of labor	0	4 (29%)	1 (8%)	
Abnormal fetal heart rate tracing	6 (38%)	6 (43%)	2 (16%)	
Labor dystocia	8 (50%)	3 (21%)	10 (76%)	
Chorioamnionitis	1 (6%)	0	0	
Elective	1 (6%)	1 (7%)	0	
Intrapartum course (hours)	9.6 ± 4.4	12.7 ± 6.5	12.2 ± 5.2	<0.01*
Duration of oxytocin use (hours)		8.9 ± 6.0	4.1 ± 2.2	<0.01
Amount of oxytocin administered (milliunits)		2663.7 ± 2774	866.9 ± 799.3	<0.01
Epidural use	60 (77%)	39 (89%)	35 (95%)	<0.01**
Fetal heart rate abnormalities	46 (59%)	27 (61%)	21 (57%)	0.85
Presence of meconium	17 (22%)	5 (11%)	11 (30%)	0.13
Estimated blood loss (milliliters)	474 ± 355	498 ± 310	535 ± 280	0.67
Complications				0.42
Uterine rupture	0	2 (4.5%)	0	
Hemorrhage	0	1 (2.3%)	0	
Symptomatic uterine dehiscence	2 (2.5%)	0	0	

Continuous variables are presented as mean ± standard deviation. Categorical factors are presented as number and associated percentage.
*Difference between IND and SPON groups.
**Difference between AUG and SPON groups.

Table 2: Maternal outcomes in all group.

Overall, for the five patients in the ripening balloon group, average oxytocin amount administered was 1988 milliunits and duration of exposure was 7.3 hours, respectively; no complications were encountered. Given the small sample size, these differences were not significant.

The patients who were induced with oxytocin alone AND who did not experience maternal complications received an average of 2591 milliunits of oxytocin (range 4-11040 milliunits). Average duration of oxytocin exposure in this subgroup was 8.8 hours. The 3 patients in the IND group who only received oxytocin AND who experienced complications received, on average, 4412 milliunits of oxytocin (range 60-5190). Average duration of oxytocin exposure in this subgroup was 12.7 hours.

	Oxytocin only (no complications encountered) (n=36)	**Oxytocin only (complications encountered) (n=3)**	**Cervical ripening balloon followed by oxytocin use with successful TOLAC (n=3)**
Duration of oxytocin use (hours)	8.8 ± 5.9	12.7 ± 9.9	8.7 ± 6.7
Amount of oxytocin administered (milliunits)	2591 ± 2818	4412 ± 4358	2547 ± 2569
Bishop score	5.0 ± 3.2	1.7 ± 2.9	3.7 ± 0.6
Number and percentage of patients with successful TOLAC	27 (75%)	0	--
There were no complications in those induced with the cervical ripening balloon followed by oxytocin. Categorical factors are presented as number and associated percentage.			

Table 3: Maternal outcomes in IND group.

	SPON (n=78)	**IND (n=44)**	**AUG (n=37)**	**P value**
Birth weight (g)	3376 ± 378	3399 ± 460	3448 ± 337	0.66
APGAR score ≥ 9 at:				
1 minute	68 (87%)	37 (84%)	32 (86%)	0.36
5 minutes	73 (94%)	39 (88%)	37 (100%)	0.66
Arterial cord pH	7.2 ± 0.1	7.2 ± 0.1	7.3 ± 0.1	0.32
Admitted to NICU	13 (17%)	9 (20%)	3 (8%)	0.29
Birth weight and arterial cord pH are presented as mean ± standard deviation. Categorical factors are presented as number and associated percentage.				

Table 4: Neonatal outcomes.

Average Bishop score in the subgroup that underwent ripening balloon placement and received oxytocin AND who had successful TOLAC, average Bishop score in the subgroup that underwent induction with oxytocin alone AND experienced complications and average Bishop score in the subgroup that underwent IOL with oxytocin alone AND did not experience complications were 3.7, 1.7 and 5.1, respectively.

Neonatal outcomes were not significantly different between the three groups (Table 4).

Discussion

The National Institute of Health's (NIH) VBAC calculator determines the chance of TOLAC success based on the following parameters: maternal age, height, weight, body mass index, ethnicity, history of prior vaginal delivery, history of vaginal delivery since cesarean and whether or not the indication for prior cesarean was arrest of dilation or descent [9]. This calculator does not take into account Bishop score, an indicator of favorability of the cervix and subsequently, a marker of success of achieving a vaginal delivery. An unfavorable cervix has been defined as a Bishop score of 6 or less in most studies while a score of 8 or more has been associated with a probability of vaginal delivery after labor induction with oxytocin that is equivalent to that associated with having presented in spontaneous labor.

The use of oxytocin in the management of TOLAC has been controversial. Furthermore, there is a significant lack of evidence supporting the safety and specifics pertaining to oxytocin use in the management of those undergoing TOLAC. No study to date has evaluated the relationship between the duration of oxytocin use, the amount of oxytocin administered, initial Bishop score and adverse outcomes in those attempting to have a successful VBAC.

Bishop score was significantly different among the three groups and this is reflected in intrapartum course duration, duration of oxytocin administration and amount of oxytocin administered. Duration of oxytocin administration and amount of oxytocin administered was significantly longer and greater in the IND group than the AUG group. However, there was no difference in cesarean delivery rate, indications for repeat cesarean delivery rate if indicated and fetal heart rate abnormalities among the three groups. In regards to complications, although not significant, there were two cases of uterine rupture and one of hemorrhage in the IND group as compared to none in the other two groups. In the IND group, the cases of uterine rupture occurred after these two patients were undergoing induction for postdates with the use of oxytocin only. There were two cases of symptomatic uterine dehiscence in the SPON group, one of which occurred within twelve hours of delivery (patient had significant abdominal pain and associated tenderness) and the other which occurred approximately two weeks after delivery (patient had presented with fevers, chills and serosanguineous discharge from skin incision). Symptomatic uterine dehiscence is described as such given that at the time of delivery, in our institution, manual exploration of the uterus is not performed after successful VBAC in the asymptomatic patient. This alludes to the possibility of the presence of an undetected uterine dehiscence. However, repair of the asymptomatic uterine dehiscence has not been found to improve maternal outcomes.

The findings that are especially compelling in this study pertain to the cases of uterine rupture. Although not statistically significant, the presence of two cases of uterine rupture in the IND group compared to none in the other groups is striking, driving us to focus more on the use of oxytocin in the IND group. A total of 44 patients underwent induction of labor with oxytocin of which 5 underwent cervical ripening balloon placement prior to initiation of oxytocin infusion.

The research on use of cervical ripening balloons in the management of TOLAC is limited. In a multicenter retrospective study by Sarreau et al. [10], 81 out of 151 patients who underwent single balloon catheter placement had a vaginal delivery. However, there were two cases of uterine rupture in this group. In this study, the balloon was inflated with 30 to 80 milliliters of sodium chloride solution and was left in place for up to 24 hours. In a metanalysis of 13 studies [11] evaluating four different types of cervical ripening balloons for induction in those with a prior cesarean, 1278 patients underwent placement and 8 cases of uterine rupture were reported (0.62%). The vaginal delivery rate was 58%. In a study that specifically looked at efficacy of the double balloon catheter for cervical ripening in those with a prior cesarean, in 24 patients who underwent placement, there were no complications and vaginal birth rate was 75% [12]. In our study, we found that there were no cases of uterine rupture in those who underwent initial induction of labor with placement of the double balloon cervical ripening catheter.

In regards to use of oxytocin for labor induction in our study, average amount of oxytocin administered and duration of oxytocin use in those underwent initial induction of labor with the double balloon catheter and who had a vaginal delivery were 2547 milliunits and 8.7 h, respectively. Overall, for the five patients in the ripening balloon group, average amount of oxytocin administered and duration of oxytocin use were 1988 milliunits and 7.3 hours. This is in sharp contrast to the average amount of oxytocin administered and duration of oxytocin use in those who experienced complications which were 4412 milliunits and 12.7 hours.

Limitations of this study are its retrospective nature and its small sample size, prohibiting us from making far more definitive conclusions regarding an amount or duration threshold at which oxytocin administration should cease. Nonetheless, based on our data, oxytocin administration for labor augmentation appears to be a reasonable means of effecting a vaginal delivery. However, administration of oxytocin for labor induction should be performed with caution. The use of a cervical ripening balloon for initial induction of labor in those with a prior cesarean appears to be a useful adjunct to oxytocin administration. Future directions for research point in the realm of continuing to elucidate the interplay between oxytocin use and cervical ripening balloon placement.

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