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Induction of Labor Versus Spontaneous Labor for Women with a Prior Cesarean Delivery

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ABSTRACT

Background: This study aimed to compare perinatal outcomes between women undergoing induction of labor and those undergoing spontaneous labor in the setting of vaginal birth after caesarean (VBAC). Therefore, we could determine safety and effectiveness of labor induction using balloon catheter or oxytocin under our protocol and the best induction time.

Methods: This was a retrospective cohort study of candidates for VBAC at a tertiary teaching hospital in China from March 2018 to January 2019.This study include the women with singleton gestations and one prior cesarean delivery who intended VBAC after several regular VBAC counselings. Maternal characteristics and perinatal outcomes were obtained from medical records. We analyzed the successful vaginal birth rate of induction group and spontaneous group at 37-37+6, 38-38+6, 39-39+6, 40-40+6 and 41-41+3 weeks.

Results: The rate of successful vaginal birth of spontaneous group was 83.92% (329/392) and that of induction group was 76.11% (137/180), there is significant difference between two groups. The rate of uterine rupture or uterine dehiscence of spontaneous group was 0.77% (3/392) and that of induction group was 1.11% (2/180), the difference is statistically significant. The rate of postpartum hemorrhage was significantly different in two group (1.28% vs. 2.22% $P < 0.05$). The rate of blood transfusion was also different (0.51% vs. 1.67% $P < 0.05$). Of 392 candidates VBAC in spontaneous group, 165 cases occurred at 39-39+6weeks and 98 cases at 40-40+6 weeks. Of 180 cases in induction group, 40 occurred at 39-39+6weeks and 106 at 40-40+6weeks. The rate of success vaginal birth of 39-39+6weeks was lower than 40-40+6weeks (72.5% vs 75.47% $P<0.05$) in induction group.

Conclusion: Our study indicates that management of candidates for VBAC with induction resulted in a high VBAC rate and favorable perinatal outcomes. Induction using a balloon catheter or oxytocin in women with previous CS seems to be safe under our protocol. There is a higher success rate of vaginal birth in 40-40+6 weeks induction group than other gestational week's groups.

Keywords: Vaginal birth after caesarean (VBAC), Induction, Perinatal outcome

ABBREVIATIONS

VBAC：Vaginal birth after caesarean; TOLAC: Trial of labor after cesarean; CS: Cesarean section; PROM: Premature rupture of membranes; ARM：Artificial rupture of membranes; GDM：Gestational diabetes mellitus; C: Catheter; O: Oxytocin

BACKGROUND

The cesarean section (CS) rate of China fluctuates around 20-50% in recent twenty years. And China decided to end one-child policy in January 2014, allowing couples to have a second baby. Previous CS has been the most common indication for caesarean delivery [1,2]. To reduce CS rate, VBAC is an alternative advocated in most developed countries [3], which lead to a sharp increase in the demand of VBAC in China.

Despite this trend, the risk of uterine rupture slows down the step of VBAC. Uterine rupture is a rare but serious complication of VBAC, which poses a significant risk to maternal and neonatal health [4].Most obstetric units in China do not offer labor after cesarean delivery because of limited availability of resources required for emergency cesarean delivery. Undoubtedly, the professional liability climate is another reason why obstetricians and hospitals may hesitate to offer labor after cesarean delivery, even in fully equipped facilities [5].

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Our institution has adopted a restrictive VBAC policy for last decade with the intention of minimizing the risk of uterine rupture. Induction of labor after previous caesarean section (CS) is a challenge for obstetricians due to the increased risk of uterine rupture [6,7,8]. Observational studies have shown that women who are induced after a prior cesarean have a lower chance of success vaginal delivery [9,10,11]. But labor induction do give women who desired VBAC an opportunity of vaginal birth. This is particularly important if labor induction is performed as in case of approximately 20% of women attempting VBAC [12,13]. Patients attempting labor induction after CS should be offered not only a safe, but also an effective method at the appropriate time [14].

The primary aim of this study was to determine safety and effectiveness of labor induction after CS using balloon catheters or oxytocin or both. Primary outcomes include success of vaginal labor rate of uterine rupture, rate of postpartum hemorrhage and blood transfusion, rate of neonatal admissions etc. The secondary aim was to identify the appropriate time of labor induction.

Some studies chose expectant management as control because the actual alternative to induction is not spontaneous labor but expectant management. Our study excluded all women who abandoned their VBAC plan during induction or expectant period. We also excluded women who were forced into surgery before spontaneous labor according to our medical advice (including oligo-/polyhydramnios, macrosomia, placenta previa, prenatal fever, fetal distress, placental abruption). Therefore, the same people were included in expectant management group and spontaneous labor group in our study. We choose the spontaneous labor as contrast group because of clear inclusion criteria and clear gestational age.

METHODS

We performed a retrospective cohort study at our hospital affiliated to the Tongji Medicine University. We included all singleton pregnancies delivered between March 2018 and January 2019 who underwent VBAC and divided them into spontaneous group and induction group according to whether using induction or not. Women who underwent labor induction were divided into 5 comparison groups based on the induction time: 37-37+6, 38-38+6,39-39+6,40-40+6,41-41+3. Gestational age was based on the best obstetric estimate (last menstrual period compared with ultrasonography). Women who underwent induction during each gestational age window were compared with the women of spontaneous group.

Our institution is a tertiary care center in which an obstetric team and an anesthesiologist are available 24 h per day. We could deliver a baby by an emergency CS within a few minutes. During the study period, the annual number of births at our institution increased steadily up to 20000 last year and the rates of induced vaginal birth fluctuated between 30%-50% every month. We are quite familiar with our induction protol.

The VBAC policy at our institution is as follows: When one woman with one prior low-transverse cesarean deliveries visit our team with the desire of VBAC, counseling about the risks and benefits of labor after cesarean. We excluded women with multiple gestation, two or more prior cesarean deliveries, or a prior classical or T-shaped uterine incision. After the counseling, we obtained a written informed consent for VBAC from all participants. Then we will make following appointments at 30 weeks and 36 weeks to rule out nonecephalic presentation, macrosomia and previous caesarean scar defect. We planned to monitor the obstetric complications and fetal growth. If a medical indication to delivery arose (e.g. premature rupture of membranes, late term (41 weeks of gestation) or pregnancy-induced hypertension etc.), we planned to provide an induction plan. If the patients expressed a strong preference for spontaneous delivery without medical interventions, the patient and her attending physician discuss the allowed duration of expectancy of spontaneous onset of labor. After the expectancy period, the patients can choose an elective cesarean delivery and drop out the study. We performed labor induction either by using a transcervical balloon catheter for cervical ripening, or by administrating oxytocin depending on the Bishop score and membrane rupture status. The Bishop score is an obstetric cervix scoring method assessing the following parameters on digital vaginal examination: Cervical dilation, effacement, position and consistency and fetal position. It is an accurate, effective cervical evaluation method prior to induction of labor [15]. In patients with a Bishop score >6 with intact membranes or with ruptured membranes, oxytocin is used. We administrated 5 IU oxytocin in 500 ml of a sodium chloride and glucose solution as follows: Begin with 12ml/h and increased the dosage every 15 min by 21ml/h until development of regular contraction or until reaching the maximum dosage of 120 ml/h, for maximum of 8 h. In patients with a Bishop score <6 and intact membranes, we inserted the balloon catheter trans cervically and inflated it with sterile 0.9% saline solution (maximum 80ml in each balloon of a double device COOK catheter).The catheter remained in place until spontaneously expelled or until start of active labor or rupture of membranes. If neither happened, the catheter was removed after 12 h and oxytocin or artificial rupture of membrane (ARM) was administered depending on the Bishop score. Moreover, ARM was performed when progressive cervical dilatation was missing. If there are no signs of labor onset after 6-8 h of oxytocin infusion for consecutive 2 days after membrane rupture, failure of induction is confirmed, and surgery procedure is provided.

The primary outcome of the study was successful vaginal delivery, either spontaneous or assisted. We defined assisted vaginal delivery as vaginal delivery using forcep. We

assessed the following adverse maternal outcomes: postpartum haemorrhage, defined as a total blood loss of >500ml in the case of vaginal delivery and a total blood loss of >1000ml in the case of CS. In addition, uterus rupture was defined as disruption of the uterine muscle extending to and involving the uterine serosa the bladder or broad ligament [16]. The uterine dehiscence (incomplete uterine rupture) was noted when the surgeon identified a thin or incomplete uterine rupture (absence of myometrium between the amniotic membrane and peritoneum). We assessed the following fetal outcomes: fetal weight, the rate of APGAR score <7, neonatal admission after birth.

Unpaired t test analyses were performed, using SPSS software version 22 (SPSS Inc., Chicago, IL, USA).

RESULT

Patients' basic characteristics

We summarized the patient's group basic characteristics in **Table 1**.

Table 1. Patient's basic characteristics and materno-fetal outcomes in the cohorts.

Spontaneous group	Induction group
Age (year) 32.27 (±3.5)	32.88 (±3.1)
Height (cm) 161.3 (±4.5)	161.9 (±4.7)
BMI (kg/m^2) 22.34 (±3.42)	22.62 (±3.46)
Parity 1.05 (±0.22)	1.03 (±0.18)
Gravidity 2.81 (±1.03)	2.88 (±1)
Duration from last CS (years) 4.95 (±2.57)	5.34 (±3.1)
Previous vaginal delivery 18 (4.59%)	8 (4.44%)
Gestation at labor (induction) (weeks) 39.2 (±1.47)	39.93 (±1.11)
Indication of previous CS	32 (17.78%)
Failed to progress 62 (15.82%)	23 (12.78%)
Malpresentation 55 (14.03%)	38 (21.11%)
Fetal distress 86 (21.94%)	13 (7.22%)
Macrosomia 19 (4.84%)	50 (27.78%)
Patient's request 99 (25.26%)	23 (12.78%)
Others (FGR, placenta Previa, etc.) 71(18.11%)	

DISCUSSION

In this study, we aimed to assess the maternal and neonatal outcomes of women opting for VBAC managed with induction or spontaneous labor to identify the successful vaginal birth rate of induction and the proprite induction weeks. Under our strict supervision and careful selection, the rate of successful vaginal birth among all VBAC candidates (466/572, 81.46%) was higher than the reported success rates in previous study of 60-80% [17]. The vaginal birth rate of induction group is 76.11% (137/180) and that of spontaneous group is 83.92% (329/392). Statistically, the differences between the two groups are significant.

Some studies previously reported incidence rates of uterine rupture are 0.6-1.2% [18,19]. Observational studies have also consistently shown an increased rate of uterine rupture among women desiring VBAC with induced or augmented labor [20]. A large multicenter study of VBAC found a rate of uterine rupture of 0.4% for spontaneous labor, 0.9% for augmented labor and 1.1% for induction with oxytocin [8]. According to our result, the rate of uterine rupture or uterine dehiscence of spontaneous group was 0.77% (3/392), and that of induction group was 1.11% (2/180), the difference is statistically significant **(Tables 2-4)**.

However, patients attempting VBAC need to be counseled about the advantages and disadvantages. Nearly 15% women abandon their VBAC plans after first visit. 25% women choose to drop out of TOLAC at the last moment because of all kinds of reasons including fear and pain, even though we suggest TOLAC to them **(Table 5)**. Some candidates dropped out of VBAC because of our medical suggestions. The common reasons that ruled women out of TOLAC included: macrosomia, previous caesarean scar defect, cephalopelvic disproportion, placenta previa. The sensitivity and specificity of our evaluation system is 81.47% and 88% **(Table 6)**.

Table 2. Maternal and neonatal outcomes.

	Spontaneous group 392 cases	**Induction group 180 cases**
Vaginal delivery(%)	83.93% (329)	76.11% (137)
Caesarean section	16.07% (63)	23.89% (43)
Vaginal assisted delivery	2.6% (10)	1.67% (3)
Uterine rupture	2 (0.51%)	2 (1.11%)
Uterine dehiscence	1 (0.26%)	0
Postpartum hemorrhage	5 (1.28%)	4 (2.22%)
Blood transfusion	2 (0.51%)	3 (1.67%)
Birth weight (g) mean(SD)	3332.9 (±347.48)	3412 (±466)
Birth weight>4000	12 (3.06%)	11 (6.11%)
APGAR-Score <7	4 (1.02%)	1 (0.56%)
Neonatal admissions, n(%)	10 (2.56%)	7 (3.8%)

Table 3. Indication for induction.

PROM, n(%)	77 (42.8%)
Late-term, n(%)	34 (18.9%)
(Gestation) diabetes, n(%)	35(19.4%)
Fetal distress,n(%)	3(1.7%)
Gestational hypertension/preeclampsia,n(%)	4(2.2%)
Oligo-/polyhydramnios,n(%)	18(10%)
Others	9(5%)

Table 4. Mode of induction (%).

Catheter (+ARM)group	3.33%(6/180)
Oxytocin (+ARM) group	75.56%(136/180)
C+O (+ARM) group	21.11%(38/180)

Table 5. Successful TOLAC rate of two groups.

Gestational week	Spontaneous Group (329/392)	Induction Group (137/180)
37-37+6	23/26	2/3
38-38+6	73/92 (79.34%)	10/13
39-39+6	142/165 (86.06%)	29/40 (72.5%)
40-40+6	81/98 (82.65%)	80/106 (75.47%)
41-41+3	10/11	16/18

Table 6. The sensitivity and specificity of our evaluation system.

	Suggested VBAC	Suggested CS
Vaginal birth	466a	3b
CS	106c	22d

Sensitivity=a/a+c=81.47%, specificity=d/b+d=88% (women who were suggested CS did not join our study)

We detected a vaginal delivery success rate of 76.11% in induction group. 31.73% of all VBAC candidates accepted induction. Common methods for labor induction are balloon catheters and oxytocin as they are considered safe. But oxytocin may be less effective for women with an unfavorable Bishop score [21]. An eligible alternative is mechanical induction of labor using a balloon catheter. In our cohort, oxytocin administration accounted for 75.56% and balloon catheter for 24.45%.

Of 392 candidates VBAC in spontaneous group, most of spontaneous vaginal birth occurred at 39 weeks (165 cases) and 40 weeks (98 cases), which means if we choose waiting other than induction until after 40 weeks, we could get more spontaneous VBAC, which is in line with health economic principles.

We divided candidates of induction group to five subgroups according to gestational weeks and found that most of induction occurred in 40-40+6weeks (106/180). We detected a vaginal delivery success rate of 75.47% in 40-40+6weeks group and 72.5% in 39-39+6weeks group. There was significant difference statistically.

The study was conducted in a single center with a limited sample size; therefore, our results should be generalized to other clinical setting with caution. Additionally, the number of patients indeed using the double-balloon catheter was not large enough to detect differences between balloon catheter and oxytocin. Further limitations arise due to the retrospective design of our study.

CONCLUSION

This study demonstrated favorable maternal and neonatal outcomes for women with induction using oxytocin or balloon catheter. Although the risks and the benefits of such a restrictive VBAC induction policy are not fully investigated, and its application may reduce repeated caesarean section rates.

ETHICS APPROVAL & CONSENT TO PARTICIPATE

Our study has been approved by Medical Ethics Committee of Shanghai First Maternity and Infant Hospital. And we have obtained a written informed consent for VBAC from all participants

CONSENT FOR PUBLICATION

We have got agreement of publication from our hospital Science and Education Division.

AVAILABILITY OF DATA AND MATERIAL

This was a retrospective cohort study of candidates for VBAC at a tertiary teaching hospital in China from March 2018 to January 2019.

COMPETING INTERESTS

The authors declare that they have no competing interests.

FUNDING

Not applicable.

AUTHORS' CONTRIBUTIONS

Pro. JZ was a major contributor in design of study. Dr. YM was responsible for data review and article writing.

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