

The effect of cervical balloon combined with oxytocin on induction of labor and delivery outcome

Efecto del balón cervical combinado con oxitocina sobre la inducción del parto y el resultado del parto

Ping Ye^{1b} and Xiufeng Jia^{*1b}

Department of Obstetrics, Ningde Municipal Hospital, Ningde, China

Abstract

Objective: The objective of the study was to investigate the effect of cervical balloon combined with oxytocin on induction of labor and delivery outcome in full-term primipara. **Methods:** The clinical data of full-term primiparas who were hospitalized from July 2023 to January 2025 were retrospectively analyzed. According to different induction schemes, they were divided into the control group and study group. The pregnant women in the control group were treated with oxytocin intravenous drip, while the pregnant women in the study group were treated with cervical balloon combined with oxytocin. **Results:** The time from induction to labor in the study group was significantly lower than those in the control group. The natural delivery rate of the study group was significantly higher than that of the control group. The total incidence of adverse pregnancy outcomes in the study group was significantly lower than that in the control group. **Conclusions:** Cervical balloon combined with oxytocin has a significant effect on induction of labor, which can enhance the effect of induction of labor, shorten the labor process, and improve the pregnancy outcome.

Keywords: Cervical balloon. Oxytocin. Full-term nulliparous women. Induction of labor. Birth outcomes.

Resumen

Objetivo: Investigar el efecto del balón cervical combinado con oxitocina en la inducción del parto y su resultado en primíparas a término. **Métodos:** Se analizaron retrospectivamente los datos clínicos de primíparas a término hospitalizadas entre julio de 2023 y enero de 2025. Según los diferentes esquemas de inducción, se dividieron en grupo control y grupo de estudio. Las embarazadas del grupo control recibieron oxitocina intravenosa por goteo, mientras que las del grupo de estudio recibieron balón cervical combinado con oxitocina. **Resultados:** El tiempo transcurrido desde la inducción hasta el parto en el grupo de estudio fue significativamente menor que en el grupo control. La tasa de partos espontáneos en el grupo de estudio fue significativamente mayor que en el grupo control. La incidencia total de resultados adversos del embarazo en el grupo de estudio fue significativamente menor que en el grupo control. **Conclusiones:** El balón cervical combinado con oxitocina tiene un efecto significativo en la inducción del parto, lo que puede potenciar su efecto, acortar el proceso de parto y mejorar el resultado del embarazo.

PALABRAS CLAVE: Balón cervical. Oxitocina. Mujeres nulíparas a término. Inducción del parto. Resultados del parto.

*Correspondence:

Xiufeng Jia

E-mail: jiaxf2025xf@163.com

Date of reception: 13-05-2025

Date of acceptance: 26-10-2025

DOI: 10.24875/CIRU.25000269

Cir Cir. 2026;94(5):465-470

Contents available at PubMed

www.cirugiaycirujanos.com

0009-7411/© 2025 Academia Mexicana de Cirugía. Published by Permanyer. This is an open access article under the terms of the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

In full-term pregnancy, delivery mode and delivery outcome have an important impact on maternal and child health.¹ As a measure to promote childbirth, induction of labor is widely used, especially when pregnancy exceeds the expected date of delivery, or there is a risk of maternal and child health. Induction of labor refers to the process of promoting uterine contraction through drugs or other methods to achieve vaginal delivery.² The main indications include pregnancy more than 41 weeks, premature rupture of membranes but did not start contractions, pregnant women with pregnancy complications (such as gestational diabetes and hypertension) or fetal health problems (such as fetal distress and hydramnios), and so on.³ The main risks of induced labor include failure rate, infection risk (such as amniotic inflammation), decreased fetal heart rate, and the possibility of uterine rupture.⁴

Cervical dilatation balloon and oxytocin induction are two common and effective methods of labor induction. They are widely used in clinical practice and have their own characteristics and advantages. Cervical dilatation balloon expands the cervix by physical means, does not involve drugs, so it has less stimulation to the uterus, and may have the risk of excessive uterine stimulation, while reducing the occurrence of adverse reactions.⁵ Studies have shown that a cervical dilatation balloon can significantly improve the cervical Bishop score, promote cervical ripening, thereby improving the success rate of induced labor.⁶ Oxytocin is a commonly used method of drug-induced labor, which stimulates uterine contraction by intravenous drip or intramuscular injection to promote cervical ripening.⁷ Oxytocin is a classic drug with low cost, so it is still widely used in areas with limited resources. In addition, the dose of oxytocin can be adjusted according to the reaction of pregnant women at any time, to maintain the physiological level of uterine contractions, to avoid adverse reactions caused by excessive doses.⁸ Studies have shown that the combination of cervical dilatation balloon and oxytocin can not only mechanically dilate the cervix but also drug-induced uterine contractions, which has a synergistic effect on improving the outcome of delivery.⁹

Primiparas are more likely to feel pain and anxiety due to lack of delivery experience, which may further aggravate uterine contraction pain and lead to prolonged labor.¹⁰ At present, there are few studies on the

effect of cervical balloon combined with oxytocin on induction of labor in full-term primiparas. Based on this, this study retrospectively analyzed the clinical data of full-term primiparas who were hospitalized in the hospital from July 2023 to January 2025, aiming to explore the effect of cervical balloon combined with oxytocin induction on the induction effect and delivery outcome of full-term primiparas. It was reported as follows.

Methods

Study subjects

The clinical data of 107 full-term primiparas who were hospitalized in from July 2023 to January 2025 were retrospectively analyzed. According to different induction schemes, they were divided into the control group ($n = 52$) and study group ($n = 55$). The control group used oxytocin to induce labor, while the study group used cervical balloon combined with oxytocin to induce labor. Inclusion criteria: (1) singleton, full-term pregnant primipara; (2) meet the indications for induction of labor (maternal gestational hypertension, delayed pregnancy, prolonged pregnancy, or oligohydramnios); (3) patients without drug or contraindication to induced labor; (4) with complete fetal membranes, no umbilical cord prolapse. Exclusion criteria: (1) patients with coagulation dysfunction; (2) placenta previa, placental abruption; (3) patients with heart, lung and other important organ dysfunction; (4) vaginal septum, mediastinum and other developmental abnormalities; (5) reproductive tract infection, chorioamnionitis; (6) people with cognitive impairment; and (7) those who could not tolerate the method used in this study.

Study methods

- The control group used oxytocin to induce labor. 2.5 U oxytocin (0.5%) (MA an shan Fengyuan Pharaceutiacl Co.Ltd, H34020474) and 500 mL sodium chloride injection (0.9%) were intravenously dripped. The rate was 8 drops/min, and the rate was flexibly adjusted according to the maternal uterine contraction. If there was regular uterine contraction, it was maintained at 8 drops/min. If there was no regular uterine contraction, it was increased by 4 drops every 10 min to ensure that the maximum rate was ≤ 40 drops/min,

and the daily infusion was ≤ 12 h. After 12 h, the cervical ripening was evaluated. If the cervix was immature, oxytocin was continuously dripped on the 2nd and 3rd days, and the method was the same as that on the 1st day. There was no delivery after 3 days of medication. If premature rupture of membranes and cervical ripening occurred, artificial rupture of membranes could be considered to accelerate the labor process. If the rupture of membranes had not yet entered the labor process after 48 h, and abnormal delivery occurred, that was, the trial production failed, cesarean section was required.

- The pregnant women in the study group were induced by cervical balloon combined with oxytocin. After emptying the bladder, the parturient entered the delivery room and took the bladder lithotomy position. After disinfecting the sheets, the cervix of the puerpera was exposed with a vaginal speculum expander, and the cervical balloon was clamped with a toothless oval clamp (Cook Incorporated Machinery Import 20162182261). It was placed at the cervix to confirm that the balloon completely enters the cervical canal. The sodium chloride injection with a mass fraction of 0.9% (maximum 80 mL) was injected into the balloon. After the balloon was dilated, the instrument was pulled back and placed outside the cervix. Immediately after the operation was completed, the fetal heart rate was continuously monitored, and the maternal cervical conditions were observed. If the balloon fell off naturally within 12 h to check whether it was in labor, if it did not fall off within 12 h, the balloon was removed. Both groups were treated for 3 days. If vaginal delivery could not be performed, induction of labor failed, and cesarean section was performed.

Observation indicators

- Labor time and mode of delivery: the time from induction of labor to labor (the time from the implementation of induction measures to labor), the time of the first stage of labor, the time of the second stage of labor, the time of the third stage of labor, the total time of labor and the time of induction of labor (the time from the implementation of induction measures to the end of delivery) were recorded. Two groups of cesarean section, natural childbirth, and other delivery methods

- Adverse pregnancy outcomes: the incidence of fetal distress, postpartum hemorrhage (vaginal bleeding more than 500 mL within 24 h), and neonatal asphyxia were recorded in the two groups
- Neonatal indicators: the birth weight of the two groups was recorded. Apgar score was performed at 1 min after birth. The higher the score, the better the newborn's condition^{11,12}
- Effect of induced labor: a markedly effective was Bishop score > 9 after induced labor, and delivery within 24 h; an effective Bishop score was 7-8 points, and delivery was within 48 h. Invalid Bishop score was defined as no change in Bishop score and no delivery within 48 h. Total effective rate of induced labor = significant efficiency + effective rate.

Statistical analysis

The Statistical Package for the Social Sciences 26.0 statistical software was used for data analysis. The measurement data were described by $\bar{x} \pm s$, and the t-test was used for comparison between groups. The enumeration data were expressed as rate (n/%), and the comparison between groups was performed by 2 test. $p < 0.05$ was considered statistically significant.

Results

General comparison between two groups

The clinical data of 107 full-term primiparas were included in this study, including 52 cases in the control group and 55 cases in the study group. The average age of the study group was 30.313.89 years old, the average gestational age was 40.712.08 weeks, and the average weight of pregnant women was 71.7610.66 kg. In the control group, the average age was 29.044.32 years old, the average gestational age was 41.791.80 weeks, and the average weight of pregnant women was 68.779.20 kg. There was no significant difference in age ($t = 1.600$, $p = 0.113$), gestational age ($t = 1.530$, $p = 0.129$), and average weight of pregnant women ($t = 1.506$, $p = 0.135$) between the two groups, indicating that the two groups were comparable ($p > 0.05$).

Comparison of labor time

The analysis results showed that in the study group, the time from induction to labor (249.04 ± 148.35 vs. 333.27 ± 290.96), the time of the first stage of labor

Table 1. Comparison of labor time

Index	Study group (n = 55)	Control group (n = 52)	t	p
Time from induction of labor to labor (min)	249.04 ± 148.35	333.27 ± 290.96	-3.701	0.037
Time of the first stage of labor (min)	378.62 ± 216.09	617.94 ± 280.78	-4.957	0.001
Time of the second stage of labor (min)	65.15 ± 20.47	128.81 ± 36.38	-11.233	0.001
Time of the third stage of labor (min)	7.47 ± 2.97	12.65 ± 3.96	-7.679	0.001
Total duration of labor (min)	531.58 ± 188.46	679.58 ± 220.79	-3.736	< 0.001
Induction time (min)	458.73 ± 210.05	488.81 ± 214.38	-1.604	0.060

(378.62 ± 216.09 vs. 617.94 ± 280.78), the time of the second stage of labor (65.15 ± 20.47 vs. 128.81 ± 36.38), the time of the third stage of labor (7.47 ± 2.97 vs. 12.65 ± 3.96), the total labor time (531.58 ± 188.46 vs. 679.58 ± 220.79), and the induction time (458.73 ± 210.05 vs. 488.81 ± 214.38) were lower than those in the control group. There were statistically significant differences between the two groups in the time from induction to labor, the time of the first stage of labor, the time of the second stage of labor, the time of the third stage of labor, and the total labor time ($p < 0.05$) (Table 1).

Comparison of delivery mode and adverse pregnancy outcome

In the mode of delivery, 49 cases in the study group were natural delivery and 6 cases were cesarean section. In the control group, 38 cases were natural childbirth, and 14 cases were cesarean section. The difference of delivery mode between the two groups was statistically significant ($p < 0.05$). In the pregnancy outcome, there were two cases of fetal distress and one case of postpartum hemorrhage in the study group. In the control group, three cases had fetal distress, two cases had postpartum hemorrhage, and two cases had neonatal asphyxia. The total incidence of adverse pregnancy in the study group was significantly lower than that in the control group (3.64% vs. 13.46%), and the difference between the two groups was statistically significant ($p < 0.05$) (Table 2).

Neonatal index

The comparison of neonatal indexes between the two groups showed that the neonatal weight of the study group was 3212.91 ± 393.38 g, and that of the

control group was 3258.46 ± 348.97 g. There was no significant difference in body weight between the two groups ($p > 0.05$). The Apgar score of the study group was significantly higher than that of the control group (9.22 ± 1.03 vs. 8.12 ± 1.08), and the difference between the two groups was statistically significant ($p < 0.05$) (Table 3).

Comparison of induction effect

In the study group, 38 cases were markedly effective, 13 cases were effective, and four cases were ineffective. In the control group, 24 cases were markedly effective, 15 cases were effective, and 13 cases were ineffective. In the study group, the total effective rate was significantly higher than that in the control group (92.73% vs. 75.00%), and the difference between the two groups was statistically significant ($p < 0.05$) (Table 4).

Discussion

Induction of labor is a medical measure to promote cervical ripening by means of artificial intervention, so as to induce regular uterine contractions and finally achieve vaginal delivery. Its main purpose is to improve the rate of vaginal delivery, reduce adverse pregnancy outcomes, and ensure maternal and child safety.¹³ The results of induced labor in full-term pregnancy are mainly determined by maternal cervical maturity. Therefore, the key to improving the success rate of induced labor in full-term pregnancy is to promote cervical maturity. Studies have shown that cervical dilatation balloon combined with oxytocin not only improves the success rate of labor induction, but also shortens the labor time and reduces the risk of adverse outcomes such as cesarean section rate and

Table 2. Comparison of delivery mode and pregnancy outcome

Index	Study group (n = 55)	Control group (n = 52)	χ^2	p
Mode of delivery				
Natural childbirth	49 (89.09)	38 (73.08)	4.510	0.034
Abdominal delivery	6 (10.01)	14 (26.92)		
Pregnancy outcome				
Fetal distress	2	3		
Postpartum hemorrhage	1	2		
Asphyxia neonatorum	0	2		
Total rate (%)	3.64	13.46	3.901	0.042

Table 3. Neonatal index

Index	Study group (n = 55)	Control group (n = 52)	t	p
Birth weight (g)	3212.91 ± 393.38	3258.46 ± 348.97	-0.632	0.529
Apgar score	9.22 ± 1.03	8.12 ± 1.08	5.212	< 0.001

Table 4. Comparison of induction effect

Index	Study group (n = 55)	Control group (n = 52)	χ^2	p
Markedly effective	38	24		
Effective	13	15		
Invalid	4	13		
Total effective rates (%)	92.73	75.00	7.991	0.018

fetal distress.¹⁴ In addition, intravenous infusion of oxytocin is also a commonly used cervical ripening drug, but it needs to be adjusted by a special person in the delivery room to observe the intensity of uterine contractions and changes in fetal heart rate to avoid excessive uterine stimulation.

The results of this study showed that the time from induction of labor to labor, the time of the first stage of labor, the time of the second stage of labor, the time of the third stage of labor, the total labor time, and the time of induction of labor in the study group were lower than those in the control group. There were statistically significant differences between the two groups in the time from induction of labor to labor,

the time of the first stage of labor, the time of the second stage of labor, the time of the third stage of labor, and the total labor time. Cervical dilatation balloon promotes cervical dilatation through physical effects and improves cervical maturity. Studies have shown that cervical dilatation balloon can significantly improve Bishop score, that is, cervical maturity score, which provides better conditions for induction of labor.¹⁵ Oxytocin, as a commonly used labor induction drug, promotes uterine contraction by enhancing the frequency and intensity of uterine contraction, thereby shortening the labor process. However, the use of oxytocin alone may lead to slower cervical dilatation and even problems such as uterine inertia. The addition of a cervical dilatation balloon can further promote the expansion of the cervix, so that the contraction effect of oxytocin is more obvious, thus shortening the labor time. Yang and Zhang¹⁶ pointed out that the total labor time of the cervical dilatation balloon combined with oxytocin group was significantly shorter than that of the control group, and the success rate of induced labor was significantly improved, which was consistent with the conclusion of this study. However, there was no significant difference in the induction time between the two groups, which may be related to the small sample size of this study.

In the mode of delivery, the natural delivery rate of the study group was significantly higher than that of the control group. Cervical dilatation balloon combined with oxytocin can significantly shorten the total labor, the first stage of labor, and the second stage of labor, which helps pregnant women to enter the delivery state faster, thereby increasing the chance of natural delivery.¹⁷ A study showed that¹⁸ the cesarean section rate of the observation group was only 46.2%, while the control group was 63.7%; the difference was significant. This shows that the intervention of cervical dilatation balloon combined with oxytocin can effectively reduce cesarean section caused by cervical immaturity or prolonged labor. In the pregnancy outcome, the total incidence of adverse pregnancy in the study group was significantly lower than that in the control group. As a physical expansion method, cervical dilatation balloon has a milder mechanism of action than traditional drug induction of labor (such as oxytocin alone), reduces excessive stimulation of the uterus, and reduces the incidence of adverse pregnancy outcomes such as frequent uterine contractions, fetal distress, and neonatal asphyxia.¹⁹ These factors work together to enable newborns to achieve

better physiological status after birth, thereby increasing the Apgar score. At the same time, studies have shown that,⁵ the incidence of postpartum hemorrhage, neonatal distress, and neonatal asphyxia in the cervical dilatation balloon combined with oxytocin group was lower than that in the oxytocin group, which was consistent with the conclusion of this study.

There are some limitations in this study. Due to time constraints, the sample size included in this study is small, and only one hospital is selected for research. The results may have certain limitations. In addition, this study is mainly aimed at full-term primiparas, and the applicability and safety of elderly parturients, patients with less amniotic fluid or complications remain to be explored. Future research should strengthen the design of multi-center and large samples, and pay attention to the applicability and safety of special populations, so as to further improve the application value of this method.

Conclusions

Cervical balloon combined with oxytocin induction of labor has a significant effect on induction of labor in full-term primiparas. It can effectively improve cervical maturity, shorten labor time, improve vaginal delivery rate, improve maternal and infant outcomes, and ensure maternal and infant safety. It is a method of induction of labor worthy of promotion.

Funding

The authors declare that they have not received funding.

Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of human subjects and animals. The authors declare that no experiments on humans or animals were performed for this research.

Confidentiality, informed consent, and ethical approval. This study does not involve personal patient data, medical records, or biological samples, and

does not require ethical approval. SAGER guidelines do not apply. This study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of Ningde City Hospital Affiliated to Ningde Normal University. Written informed consent was obtained from all participants.

Declaration on the use of artificial intelligence.

The authors declare that no generative artificial intelligence was used in the writing or creation of the content of this manuscript.

References

1. Bevilacqua E, Torcia E, Meli F, Josse J, Bonanni G, Olivier C, et al. Maternal and fetal outcomes after planned cesarean or vaginal delivery in twin pregnancy: a comparison between 2 third level birth centers. *J Matern Fetal Neonatal Med.* 2024;37:2350676.
2. Muraca GM, Ralph LE, Christensen P, D'Souza R, Geoffrion R, Lisonkova S, et al. Maternal and neonatal trauma during forceps and vacuum delivery must not be overlooked. *BMJ.* 2023;383:e073991.
3. Hochberg A, Amikam U, Krispin E, Winitzer A, Hadar E, Salman L. Maternal and neonatal outcomes following induction of labor for fetal growth restriction: extra-amniotic balloon versus prostaglandins. *Int J Gynaecol Obstet.* 2023;160:678-84.
4. Yang LY, Zhao DH, Wang D. Research progress on the timing and method of induction of labor in premature rupture of membranes. *Clin J Med Officer.* 2024;52:876-8.
5. Chen R. Evaluation of the effect of cervical dilatation balloon on cervical ripening and induction of labor in full-term pregnancy. *Chin J Modern Drug Appl.* 2021;15:65-7.
6. Jiang LL, Chen Y, Zhu YH. Observation on the effect of cervical dilatation balloon in promoting cervical ripening in induced labor of overdue pregnancy. *Chin J Fam Plan.* 2017;25:267-9.
7. Yu DP, Hou SF, Liang YM, Zhang YF, Ai HY. Clinical study on Qichan decoction combined with oxytocin in induction of labor for premature rupture of membranes at term. *Nei Mongol J Tradit Chin Med.* 2025;44:5-7.
8. Wei MP, Liu Y, Zhang WW. To observe the effect of combined application of low water sac induction and intravenous oxytocin in full-term pregnancy. *China Pract Med.* 2024;19:131-3.
9. Zhang N, Liu Y, Li XY. Application effect of COOK cervical dilatation balloon combined with artificial rupture of membranes in full-term planned delivery of pregnancy. *China Med Herald.* 2021;18:98-101.
10. Tan ZL. Application value of doula accompany delivery combined with delivery ball nursing in primipara delivery. *J Med Theory Pract.* 2022;35:1946-8.
11. Xie X, Kong B, Duan T. *Uterology.* 9th ed. Beijing: People's Health Publishing House; 2018.
12. Cui XC, Dong SQ. The predictive value of fetal fibronectin combined with cervical Bishop score on the difficulty of induction of labor in delayed pregnancy. *Anhui Med Pharm J.* 2018;22:301-3.
13. Wang XH, Liu SL, Zhu XJ. Research progress on induction methods of full-term pregnancy. *Today Nurse.* 2015;3:1-2.
14. Wheeler V, Hoffman A, Bybel M. Cervical ripening and induction of labor. *Am Fam Physician.* 2022;105:177-86. Erratum in: *Am Fam Physician.* 2022;106:121.
15. Teng LX. Effect of cervical dilatation balloon combined with oxytocin on cervical ripening and maternal and infant outcomes in full-term pregnant women with induced labor. *Rare Disease J.* 2024;31:73-5.
16. Yang H, Zhang CL. Observation on the effect of cervical dilatation balloon combined with oxytocin on induction of labor in full-term pregnancy with less amniotic fluid. *J Clin Med Pract.* 2019;23:59-62.
17. Li WP. Application effect of COOK cervical dilatation balloon combined with oxytocin in elderly full-term multipara. *China Mod Med.* 2020;27:134-40.
18. Zhu Q, Wang FF, Ruan GH. Observation on the effect of oxytocin combined with cervical dilatation balloon for induction of labor in full-term pregnancy with low cervical score. *Chin J Fam Plan.* 2022;30:2276-9.
19. Ma HF. Effect of cervical dilatation double balloon combined with oxytocin intravenous drip on postpartum hemorrhage and neonatal Apgar score in full-term pregnant primiparas. *J Med Forum.* 2017;38:112-3.