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Editorial Board Member of *World Journal of Clinical Cases*, Moises Rodriguez-Gonzalez, MD, Adjunct Professor, Senior Researcher, Department of Pediatric Cardiology, Hospital Universitario Puerta del Mar, Cadiz 11009, Spain. doctormoisesrodriguez@gmail.com

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WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

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Prospective Study

Birth ball on promoting cervical ripening and its influence on the labor process and the neonatal blood gas index

Hai-Chuan Shen, Huan Wang, Bo Sun, Lan-Zhi Jiang, Qian Meng

ORCID number: Hai-Chuan Shen 0000-0002-1868-221X; Huan Wang 0000-0003-4505-884X; Bo Sun 0000-0002-9938-6876; Lan-Zhi Jiang 0000-0002-1675-3408; Qian Meng 0000-0003-1192-8739.

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Hai-Chuan Shen, Huan Wang, Bo Sun, Lan-Zhi Jiang, Qian Meng, Obstetrical Department, Lianyungang Maternal and Child Health Hospital, Lianyungang 222000, Jiangsu Province, China

Corresponding author: Qian Meng, PhD, Chief Physician, Obstetrical Department, Lianyungang Maternal and Child Health Hospital, No. 669 Qindongmen Street, Haizhou District, Lianyungang 222000, Jiangsu Province, China. lygmq6326@163.com

Abstract

BACKGROUND

Term pregnancy-induced labor refers to the use of artificial methods to induce uterine contractions and terminate pregnancy after 37 wk. It is a common method to prevent overdue pregnancy and to deal with high-risk pregnancies. In addition, it can alleviate maternal complications and cause the fetus to leave the adverse intrauterine environment early, which is beneficial to the outcome of pregnancy.

AIM

To explore the effect of a birthing ball on labor by inducing cervical ripening and its influence on labor and the neonatal blood gas index.

METHODS

Twenty-two women who were scheduled to undergo labor induction and delivery in the obstetrics department of our hospital were randomly divided into two groups: the delivery ball group (childbirth ball combined with COOK balloon induction) and the conventional group (COOK balloon induction alone). The cervical Bishop score before and after intervention, duration of labor at each stage, mode of delivery, neonatal umbilical venous blood pH, oxygen partial pressure (PO_2), carbon dioxide partial pressure (PCO_2), and the 1-min Apgar score were recorded.

RESULTS

After the intervention, the cervical Bishop score of the delivery ball group (7.84 ± 1.52) was significantly higher than that of the conventional group (7.32 ± 1.29) ($P < 0.05$), and the cervical Bishop scores of the two groups after intervention were significantly higher than those before intervention ($P < 0.05$). After the intervention, the first stage of labor (510.9 ± 98.7 min), the second stage of labor (43.0 ± 8.5 min), and the total duration of labor (560.0 ± 120.9 min) in the delivery ball group were lower than those in the routine group, with a first stage of labor

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of 602.1 ± 133.2 min, a second stage of labor of 48.4 ± 9.1 min, and a total duration of labor of 656.8 ± 148.5 min ($P < 0.05$). There was no significant difference in the time of the third stage of labor between the two groups ($P > 0.05$). There was no significant difference in the pH, PO_2 , and PCO_2 values of newborns between the delivery ball group and the conventional group ($P > 0.05$). The 1-min Apgar score of the delivery ball group was higher than that of the conventional group (9.10 ± 0.38 points *vs* 8.94 ± 0.31 points, $P < 0.05$). The natural delivery rate of the delivery ball group was higher than that of the conventional group (91.00% *vs* 78.00% , $P < 0.05$).

CONCLUSION

The use of a birthing ball combined with a COOK balloon for inducing labor has a better effect on promoting cervical ripening, shortening the time of labor, and improving the Apgar score of newborns.

Key Words: Childbirth ball; Induction of labor; Promotion of cervical ripening; Labor; Blood gas index; COOK balloon

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Core Tip: Through a group of prospective studies that divided 22 parturient into delivery ball group (delivery ball combined with COOK balloon induction) and routine group (induction with COOK balloon alone), it was confirmed that the use of midwifery ball combined with COOK balloon to induce labor promotes the cervix mature, shorten the delivery time, and improve the Apgar score of newborns have a good effect.

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INTRODUCTION

Cervical maturity is a key factor in the application of induced labor technology, and many methods, each with their own advantages and disadvantages[1,2], can promote cervical ripening. These include the use of medicines such as oxytocin, dinoprostone suppositories, or misoprostol, and mechanical methods, such as the COOK balloon, low water bag, or Foley catheter methods. A COOK balloon dilates the cervix by generating mechanical pressure on the cervix through a double balloon to soften and shorten the cervix and is widely used in clinical practice[3].

A childbirth ball, a type of soft inflatable rubber ball with a diameter of 1 m, was first used in the rehabilitation treatment of children with nerve injury[4-7]. It was also found to accelerate the labor process of pregnant women and was applied in obstetrics. It has a certain auxiliary effect in relieving the degree of pain and tension in pregnant women, guiding the fetus into the basin, and rotating[8]. However, there have been few studies on whether it can promote cervical ripening.

Our study explored the effect of a birthing ball by promoting cervical ripening and its influence on the labor process and the neonatal blood gas index in inducing labor to provide a reference for clinical work.

MATERIALS AND METHODS

Information

Two hundred parturient with planned induced labor in the obstetrics department of our hospital were selected and randomly divided into a birthing ball group (combined

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with COOK balloon induction) and a conventional group (COOK balloon induction alone), with 100 parturient in each group. The enrollment period was from July 2016 to May 2019. The inclusion criteria were as follows: (1) Patients with a single fetus, head position, non-clinical, and reactive in the nonstress test of fetal heart rate monitoring; (2) Patients with complete membranes, immature cervix, and Bishop score ≤ 6 ; (3) Gestational age > 38 wk; (4) A depth of amniotic fluid > 5.0 cm; and (5) Communication with the family members of puerpera and signed informed consent before induction of labor. The exclusion criteria were as follows: (1) Severe heart, lung, liver, or kidney diseases; (2) Immune dysfunction; (3) Twin or multiple pregnancy; (4) Placenta previa; (5) Scarred uterus; and (6) Reproductive tract infection.

In the birthing ball group, the maternal age ranged from 22 to 38 years, with an average age of 27.7 ± 3.0 years; gravidity was 2.85 ± 1.30 times; parity was 0.89 ± 0.40 times; average height was 160.2 ± 4.4 cm; and prenatal body mass index (BMI) was 28.9 ± 2.4 kg/m². The gestational age of induced labor was 40.2 ± 1.1 wk. In the conventional group, the maternal age ranged from 22 to 39 years old, with an average age of 28.0 ± 2.9 years old; gravidity was 3.01 ± 1.43 times; parity was 0.93 ± 0.38 times, average height was 159.8 ± 4.0 cm, and prenatal BMI was 29. The gestational age of induced labor was 39.9 ± 9 wk. There were no significant differences in baseline data between the two groups ($P > 0.05$) (Table 1).

Methods to promote cervical ripening

A COOK balloon was used alone in the conventional group to induce labor. The parturient was placed in the lithotomy position after emptying the bladder, and the vulva and vagina were routinely disinfected. A speculum was used to expose and fix the cervix. The COOK balloon, clamped with toothless oval forceps at the distal end, was placed into the uterine cavity. The balloon catheter was fixed, and 20 mL of normal saline was slowly injected into the valve marked with "U" at the top of the balloon catheter. Twenty milliliters of normal saline were injected into the valve marked with "V" after pulling the catheter into the vagina as well as out of the cervix to fix the two balloons on both sides of the cervix. Normal saline was injected to a volume of 60–80 mL after removing the speculum and fixing the distal end of the balloon catheter on the inner thigh. Oxytocin (2.5 U), used to induce uterine contraction, was injected intravenously within 30 min of balloon placement, with an initial dropping rate of 8 drops/min. The dropping rate was adjusted according to the degree of uterine contraction, increasing by 4–5 drops/min each time, with a maximum dropping rate of 60 drops/min. During the procedure, uterine contractions, fetal heart rate, abdominal pain, and vaginal bleeding were closely monitored. The COOK balloon was removed after 12 h. For removal, the normal saline in the balloon was slowly emptied, and the balloon catheter was then extracted to check for cervical maturity.

In the birthing ball group, a COOK balloon was used to induce labor. The method of COOK balloon induction was the same as that used in the conventional group. After removing the balloon, the mother and fetus were evaluated. The mother sat on a fixed delivery ball holding a railing with both hands and gently swung the body for 30 min. She could move freely on the delivery ball for 30 min when the occipital posterior position or occipital transverse position occurred during the second stage of labor.

The balloon was immediately removed when uterine contraction was too strong, or if rupture of the fetal membrane or fetal distress occurred during the period when the COOK balloon was placed. The induction of labor was considered to have failed if the fetus did not enter the birth canal in 3 d, and if cesarean section was conducted in time to terminate the pregnancy.

General information

The cervical Bishop score, duration of each stage of labor, mode of delivery, pH value of neonatal umbilical vein blood, partial pressure of oxygen (PO₂), partial pressure of carbon dioxide (PCO₂), and the 1-min Apgar score were compared between the two groups before and after intervention.

After delivery of the fetus, 1 mL of neonatal cord blood was taken by a blood gas needle with anticoagulant to detect the pH value, PO₂, PCO₂, and other blood gas indices within 3 min. The detection instrument used was a GEM Premier 3500 automatic blood gas analyzer.

Bishop scoring standard of the cervix[9]: (1) The score of cervix orifice size was 0 points when the orifice was 0 cm, 1 point when the orifice was 1–2 cm, 2 points when the orifice was 3–4 cm, and 3 points when the orifice was ≥ 5 cm; (2) Cervical canal regression: 0 points in the range of 0%–30%, 1 point in the range of 40%–50%, 2 points in the range of 60%–70%, and 3 points in the range of $> 80\%$; (3) Exposure position: 0

Table 1 Comparison of baseline data between the two groups of mothers

Group	n	Age (yr)	Pregnancy times (times)	Parity (times)	Average height (cm)	Prenatal BMI	Induced labor pregnancy week (wk)
Delivery ball group	100	27.7 ± 3.0	2.85 ± 1.30	0.89 ± 0.40	160.2 ± 4.4	28.9 ± 2.4	40.0 ± 1.1
Regular group	100	28.0 ± 2.9	3.01 ± 1.43	0.93 ± 0.38	159.8 ± 4.0	29.2 ± 2.0	39.9 ± 0.9
<i>t</i>		-0.719	-0.828	-0.725	0.673	-0.960	0.704
<i>P</i> value		0.473	0.409	0.469	0.502	0.338	0.483

points within the range of approximately 3, 1 point within the range of approximately 2, and 2 points within the range of approximately 1; (4) Cervical hardness: hard, 0 points; medium, 1 point; and soft, 2 points; and (5) The position of the uterine orifice: posterior, 0; middle, 1; and anterior, 2.

Statistical analysis

SPSS software (version 21.0) was used for statistical analysis. The measurement index of the Bishop score of the cervix and the duration of labor in each stage are expressed as mean ± SD. Independent sample *t*-tests were used to compare the two groups and χ^2 tests were used to compare counting data. Statistical significance was set at $P < 0.05$.

RESULTS

Comparison of Bishop scores between the birthing ball group and the conventional group

After the intervention, the Bishop score of the birthing ball group was significantly higher than that of the conventional group ($P < 0.05$), with a significant increase compared to the Bishop score before the intervention ($P < 0.05$) (Table 2).

Comparison of duration of labor between the birthing ball group and the conventional group

After the intervention, the total duration at the first and second stages in the birthing ball group was lower than that in the conventional group ($P < 0.05$), without a significant difference at the third stage ($P > 0.05$) (Table 3).

Comparison of neonatal blood gas indices between the birthing ball group and the conventional group

In comparison, there was no significant difference in pH, PO₂, and PCO₂ between the two groups ($P > 0.05$). The 1-min Apgar score of the birthing ball group was higher than that of the conventional group ($P < 0.05$) (Table 4).

Comparison of delivery mode between the birthing ball group and the conventional group

The natural delivery rate of the birthing ball group (91.00%) was higher than that of the conventional group (78.00%) ($P < 0.05$) (Table 5).

Comparison of complication rates between the birthing ball group and the conventional group

There was no significant difference in the complication rate between the birthing ball group (5.00%) and the conventional group (11.00%) ($P > 0.05$) (Table 6).

DISCUSSION

If complications occur in late pregnancy, such as prolonged pregnancy, gestational hypertension, gestational diabetes, or issues in the fetus and its appendages, or if cervical maturity does not reach the standard for induced labor, it is necessary to implement intervention measures to promote cervical maturity and terminate

Table 2 Comparison of cervical Bishop score between birthing ball group and conventional group (mean \pm SD, points)

Group	<i>n</i>	Before intervention	After the intervention	<i>t</i>	<i>P</i> value
Delivery ball group	100	3.71 \pm 1.10	7.84 \pm 1.52	-22.012	0.000
Regular group	100	3.50 \pm 1.25	7.32 \pm 1.29	-21.266	0.000
<i>t</i>		1.261	2.608		
<i>P</i> value		0.209	0.010		

Table 3 Comparison of duration of labor between birthing ball group and conventional group (mean \pm SD, min)

Group	<i>n</i>	First stage of labor	Second stage of labor	Third stage of labor	Total labor
Delivery ball group	100	510.9 \pm 98.7	43.0 \pm 8.5	6.1 \pm 1.1	560.0 \pm 120.9
Regular group	100	602.1 \pm 133.2	48.4 \pm 9.1	6.3 \pm 1.3	656.8 \pm 148.5
<i>t</i>		-5.501	-4.337	-1.174	-5.065
<i>P</i> value		0.000	0.000	0.242	0.000

Table 4 Comparison of neonatal blood gas indexes between birthing ball group and conventional group (mean \pm SD)

Group	<i>n</i>	pH	PO ₂ (mmHg)	PCO ₂ (mmHg)	1-min Apgar (Scores)
Delivery ball group	100	7.34 \pm 0.05	27.51 \pm 3.61	42.70 \pm 4.86	9.10 \pm 0.38
Regular group	100	7.33 \pm 0.05	26.83 \pm 2.76	43.84 \pm 4.40	8.94 \pm 0.31
<i>t</i>		1.414	1.496	-1.739	3.263
<i>P</i> value		0.159	0.136	0.084	0.001

PO₂: Oxygen partial pressure; PCO₂: Carbon dioxide partial pressure.

Table 5 Comparison of delivery methods between delivery ball group and routine group, *n* (%)

Group	<i>n</i>	Natural childbirth	Cesarean section
Delivery ball group	100	91 (91.00)	9 (9.00)
Regular group	100	78 (78.00)	22 (22.00)
χ^2		6.452	
<i>P</i> value		0.011	

Table 6 Comparison of complication rate between birthing ball group and conventional group

Group	<i>n</i>	Soft birth canal laceration	Fetal distress	Amniotic fluid pollution	Contractions	Complication rate (%)
Delivery ball group	100	1	2	1	1	5 (5.00)
Regular group	100	4	4	3	0	11 (11.00)
χ^2						2.446
<i>P</i> value						0.118

pregnancy[10]. The induction of labor with a COOK double balloon, a commonly used mechanical cervical ripening method in clinical practice, can gradually expand the cervix through the pressure generated by the balloon inside and outside the cervix but will not excessively stimulate the uterus. This avoids the complications of cervical laceration, inconvenient movement, severe pain, or placental abruption, and is especially suitable for those with low placental function, fetal growth restriction, or

oligohydramnios[11]. However, the COOK balloon, a physical method to promote cervical ripening, has a poor effect in promoting endogenous prostaglandin synthesis, sometimes leading to the failure of inducing labor[12]. Therefore, in the clinic, we often need to include other methods to induce labor, such as artificial rupture of the membrane and intravenous drip of oxytocin[13].

A childbirth ball, a common auxiliary tool used in the process of natural childbirth, can assist the movement of pregnant women to promote the uterus to leave the spine and tend to the abdominal wall, making the fetal longitudinal axis consistent with the birth axis to shorten the labor process time and improve the success rate of vaginal trial production, as many studies have shown[13]. Our study found that the natural delivery rate of labor induction with childbirth balls combined with COOK balloons was higher than that of the conventional COOK balloon group, and the duration of labor at the first, second, and total stages of labor was lower in the childbirth ball group than in the conventional COOK balloon group. These results suggest that labor induction with childbirth balls combined with COOK balloons is better than that with COOK balloons alone in promoting natural labor and shortening the labor process, which is consistent with the conclusions of existing clinical studies[14]. This is because the childbirth ball can relax the muscles to reduce the resistance of the soft tissue of the pelvic floor and increase the compliance of the fetus in the birth canal to promote the decline and rotation of the fetal head in the pelvis so that the connection between the fetal head and the pelvis is good, and the exposed part can produce compression on the uterine orifice to flex and cause uterine contraction, which is conducive to cervical dilatation and smooth delivery of the fetus[15]. In addition, studies have found that mental stress, one of the main factors affecting the success rate of vaginal trial production[16], can be relieved by childbirth balls, which may be another mechanism of promoting natural childbirth and shortening the labor process[17].

Cervical maturity can directly affect the success rate of induced labor; for example, good receptivity of the cervical canal and soft texture are conducive to the smooth delivery of the fetus[18]. The Bishop score is typically used to evaluate cervical maturity[17]. At present, clinical research on the application of delivery balls in obstetrics mainly focuses on promoting natural childbirth and shortening the time of the labor process, but few studies have examined their impact on cervical maturity. The cervical Bishop score in the two groups after intervention was significantly higher than that before intervention, and as we found, it was higher in those who used a delivery ball combined with COOK balloon induction than those who used the COOK balloon alone. Therefore, the combined usage of both methods is better to promote cervical ripening. The mechanism involves continuous mechanical compression and expansion of the COOK balloon into the cervical canal, which makes part of the cervix compound endogenous prostate to soften the cervix and then stimulate the cervical Frankenhauser nerve plexus to release oxytocin to promote uterine contraction[18]. During the interval of uterine contraction, the childbirth ball can assist pregnant women in relaxing their muscles while sitting, standing, kneeling, and other postures. The inclination of the body is consistent with that of the pelvis when they are semi-sitting and lying, which can cause compression of the exposed part on the cervix to promote the synthesis of endogenous prostaglandins and then the ripening and softening of the cervix[19].

The neonatal Apgar score is a common tool for the clinical evaluation of neonatal health[20]. Blood gas analysis can evaluate the health status of newborns by detecting umbilical artery blood gas indicators accurately reflecting the tissue metabolism status of newborns, as well as some abnormalities, including anoxia and acidosis[19,20]. There were no significant differences in pH, PO₂, and PCO₂ between the two groups. The Apgar scores of newborns whose birth was induced with a childbirth ball combined with a COOK balloon were higher than those of newborns whose birth was induced by a conventional COOK balloon alone, which suggests that the induction of labor by the childbirth ball combined with the COOK balloon will not affect the blood gas index and acid-base balance of the newborn and will better ensure good physiological indices of the newborn. Because childbirth balls can not only shorten the duration of labor but also reduce abnormalities such as intrauterine distress and asphyxia, they are more conducive to ensuring the health of newborns.

CONCLUSION

In conclusion, labor induction with a childbirth ball combined with a COOK balloon has better outcomes than labor induction with a COOK balloon alone in promoting

cervical ripening, shortening the labor process time, and improving the neonatal Apgar score.

ARTICLE HIGHLIGHTS

Research background

Term labor induction is a common method for preventing early pregnancy and coping with high-risk pregnancies. It can alleviate maternal complications and improve pregnancy outcomes.

Research motivation

This study explores the role of midwifery balls in promoting cervical maturation and its influence on the process of labor induction and neonatal blood gas index, and provides references for clinical work.

Research objectives

This study aimed to explore the role of midwifery balls in promoting cervical ripening during delivery and its influence on delivery and neonatal blood gas index.

Research methods

A randomized study was conducted on 22 women scheduled to undergo labor induction in the obstetrics department of our hospital.

Research results

After the intervention, the cervical Bishop score of the delivery ball group was significantly higher than that of the conventional group, and the cervical Bishop scores of the two groups after intervention were significantly higher than those before the intervention. After the intervention, the first stage of labor, the second stage of labor, and the total duration of labor in the delivery ball group were lower than those in the conventional group, with first stage of labor of 602.1 ± 133.2 min, a second stage of labor of 48.4 ± 9.1 min, and a total duration of labor of 656.8 ± 148.5 min. There was no significant difference in the time of the third stage of labor between the two groups).

Research conclusions

The use of a birthing ball combined with a COOK balloon for the induction of labor has a better effect on promoting cervical ripening, shortening the time of labor, and improving the Apgar score of newborns.

Research perspectives

The use of a midwifery ball combined with a COOK balloon to induce labor can have a wider clinical application and better improve the recovery of the parturient.

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