

## ORIGINAL RESEARCH ARTICLE

# Clinical application of airbag bionic midwifery technology in vaginal delivery of pregnancy with scarred uterus

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## Abstract

This was an original article, mainly explored the effect of applying airbag bionic midwifery technology in vaginal delivery of scarred uterus pregnancy. Sixty patients were chosen, and divided into an intervention group (IG) and a control group (CG). The results showed that in contrast to the CG, the IG had shorter first, second and total stages of labor ( $P < 0.01$ ), less amounts of blood loss during delivery and 2 h after delivery ( $P < 0.01$ ), lower visual analogue scale (VAS) score ( $P < 0.01$ ), higher natural delivery rate, lower forceps assisted delivery rate and cesarean section rate ( $P < 0.05$ ), lower incidence of postpartum complications ( $P < 0.05$ ), and higher childbirth satisfaction ( $P < 0.05$ ). We conclude that the implementation of airbag bionic midwifery technology in vaginal delivery of scarred uterus pregnancy has obvious effects, which can effectively promote the success of vaginal delivery, shorten the stages of labor, and alleviate the degree of pain. We recommend its more routine application in obstetric clinical practice. (*Afr J Reprod Health* 2024; 28 [11]: 78-84).

**Keywords:** Vaginal delivery, scarred uterus, pregnancy, airbag bionic midwifery technology, pain

## Résumé

Il s'agissait d'un article original, explorant principalement l'effet de l'application de la technologie de sage-femme bionique airbag lors de l'accouchement vaginal d'une grossesse utérine cicatricielle. Soixante patients ont été choisis et répartis en un groupe d'intervention (IG) et un groupe témoin (CG). Les résultats ont montré que contrairement au CG, l'IG présentait des premier, deuxième et total stades de travail plus courts ( $P < 0,01$ ), moins de pertes de sang pendant l'accouchement et 2 heures après l'accouchement ( $P < 0,01$ ), une échelle visuelle analogique plus basse. (VAS) ( $P < 0,01$ ), taux d'accouchement naturel plus élevé, taux d'accouchement assisté par forceps et taux de césarienne plus faibles ( $P < 0,05$ ), incidence plus faible de complications post-partum ( $P < 0,05$ ) et satisfaction plus élevée à l'accouchement ( $P < 0,05$ ). Nous concluons que la mise en œuvre de la technologie de sage-femme bionique airbag lors de l'accouchement vaginal d'une grossesse utérine cicatricielle a des effets évidents, qui peuvent efficacement favoriser le succès de l'accouchement vaginal, raccourcir les étapes du travail et atténuer le degré de douleur. Nous recommandons son application plus systématique dans la pratique clinique obstétricale. (*Afr J Reprod Health* 2024; 28 [11]: 78-84).

**Mots-clés:** Accouchement vaginal, utérus cicatrisé, grossesse, technologie de sage-femme bionique airbag, douleur

## Introduction

Clinically, scarred uterus is caused by many factors, including previous caesarean section, hysteromyomectomy, history of uterine perforation, as well as previous uterine rupture repair<sup>1</sup>. Among them, the most common reason for a scarred uterus is previous caesarean section<sup>2</sup>. One of the most common reasons for increasing rate of caesarean section rate is the increased risk of a repeat caesarean section after a caesarean section<sup>3</sup>. Therefore, in efforts to decrease caesarean section rate, it is very important to choose a suitable

delivery method for pregnancy after caesarean section.

Over the years, a number of studies have been implemented on the viability and safety of vaginal delivery in scarred uterus, and indicate that vaginal delivery after caesarean section is feasible<sup>4</sup>. The perinatal morbidity of women with repeated caesarean section is obviously higher than that of women with vaginal delivery after caesarean section<sup>5</sup>. The main complications of vaginal delivery after caesarean section are uterine rupture requiring hysterectomy in severe cases, which threatens the life of the mother and child<sup>6</sup>.

However, the success of vaginal delivery after cesarean section is linked to less blood loss, reduced risk of neonatal respiratory diseases and placenta previa, shorter hospital stay, along with faster recovery<sup>7</sup>. Therefore, how to improve the success rates and safety of vaginal delivery in pregnant women with scarred uterus has become an important topic in obstetrics.

Airbag bionic midwifery technology is a novel midwifery technique, which has been utilized in obstetric clinic in China for more than 20 years<sup>8</sup>. Airbag bionic midwifery is the use of special air bags to inflate the cervix and soft birth canal, so that it reaches the size of the fetal head, in order to reduce the descending resistance of the first part, and create good conditions for smooth delivery, which can induce contractions, increase productivity, reduce the resistance of descending part of the fetus, and provide good conditions for natural delivery<sup>9</sup>. With the promotion of the advantages and clinical value of airbag bionic midwifery technology, the control of cesarean section rate has been improved. In recent years, for sake of effectively decreasing cesarean section rate as well as promoting successful vaginal delivery after cesarean section, airbag bionic midwifery technology has begun to be applied to pregnant women with scarred uterus<sup>10</sup>.

In our study, we aimed to investigate the effects of applying airbag bionic midwifery technology in vaginal delivery in women with scarred uteri.

## Methods

The CG accepted routine vaginal delivery, that is, corresponding measures were taken according to the progress of labour, and midwifery measures were reasonably selected based on the maternal situation.

The IG was given airbag bionic midwifery technology during vaginal delivery. The instrument was a fully automatic bionic midwifery instrument (LK-730, produced by Yangzhou Kelan Electronics Co., LTD.), as shown in Figure 1. The parturient was instructed to empty the bladder. The vulva and vagina of parturient were disinfected. After disinfecting the hands, the midwife wore sterile gloves, prepared the airbag bionic midwifery device, and slowly inserted the air bag into the vagina of the parturient to expand vagina.



**Figure 1:** Schematic illustration of a fully automatic bionic midwifery instrument.

When the uterine orifice of parturient was opened to more than 5 cm, the upper part of the vagina was slowly expanded to about 8 cm with the air bag, and then the upper part of the vagina was expanded twice with the manual method, which lasts for 3 to 5 min. Finally, the lower part of the vagina was expanded to about 6.5 cm with the air bag and kept for 3~5 min. During the period, amniotic fluid and uterine contractions were observed, fetal heart rate was monitored, and cesarean section was possible if there were abnormalities.

### Observed indicators

The following indicators were measured in CG and IG: (1) the duration of labour (including first, second and total stage of labour); (2) the amounts of blood loss during and 2 h after delivery; (3) visual analog scale (VAS) score was adopted to assess the degree of pain 1 day after delivery<sup>11</sup>. No pain was 0 points, extreme pain was 10 points, the higher the score indicates the severity of maternal pain; (4) neonatal Apgar score was compared between 2 groups after delivery<sup>12</sup>.

Normal newborns were 10 points, 4-7 points were mild asphyxia, and <4 points were severe asphyxia; (5) the incidence of fetal distress, neonatal asphyxia, and delivery outcomes (including natural delivery, forceps assisted delivery, and cesarean section) in 2 groups was recorded; (6) Incidence of postpartum complications (urinary retention, laceration of the soft birth canal, perineal edema); and (7) a self-made scale was employed for evaluating childbirth

satisfaction, including delivery guidance, service attitude, emergency treatment, operation skills and other aspects, a total of 100 points, scores above 95 were very satisfied, 70 to 94 were basically satisfied, and below 70 were dissatisfied. Total satisfaction rate = very satisfaction rate + basic satisfaction rate.

### **Statistical analysis**

Statistical software SPSS 18.0 was selected to carry out statistical analysis and corresponding processing of relevant data involved in the research process. The statistical data were all represented by (%), and compared by  $\chi^2$  test. The measurement data were all represented by ( $\bar{x}\pm s$ ), and t-test was implemented for comparison.  $P<0.05$  indicated that the difference was statistically significant.

### **Ethical considerations**

This study was approved by the Medical Ethics Committee of the Affiliated Huai'an No. 1 People's Hospital of Nanjing Medical University, and complied with the guidelines of the Declaration of Helsinki. All pregnant women together with their families all gave informed consent and signed informed consent.

## **Results**

### **Duration of labor in 2 groups**

Relative to the CG, the IG had shorter time of first, second along with total stage of labour ( $P<0.01$ , Figure 2 table 1).

### **Amounts of blood loss during and 2 h after delivery in 2 groups**

Relative to the CG, the IG exhibited less amounts of blood loss during delivery as well as 2 h after delivery ( $P<0.01$ , Figure 3).

### **VAS score in 2 groups**

Relative to the CG, the IG exhibited lower VAS score ( $P<0.01$ , Figure 4).

### **Neonatal Apgar score in 2 groups**

No difference was exhibited in neonatal Apgar score between the two groups ( $P>0.05$ , Figure 5).

### **Incidence of fetal distress, neonatal asphyxia, and delivery outcomes in the groups**

Relative to the CG, the IG presented higher natural delivery rate, lower forceps assisted delivery rate and cesarean section rate ( $P<0.05$ ). Meanwhile, no statistical significance was exhibited in the incidence of fetal distress and neonatal asphyxia between 2 groups ( $P>0.05$ , Table 2).

### **Incidence of postpartum complications in 2 groups**

Relative to the CG, the IG had lower total incidence of postpartum complications ( $P<0.05$ , Table 3).

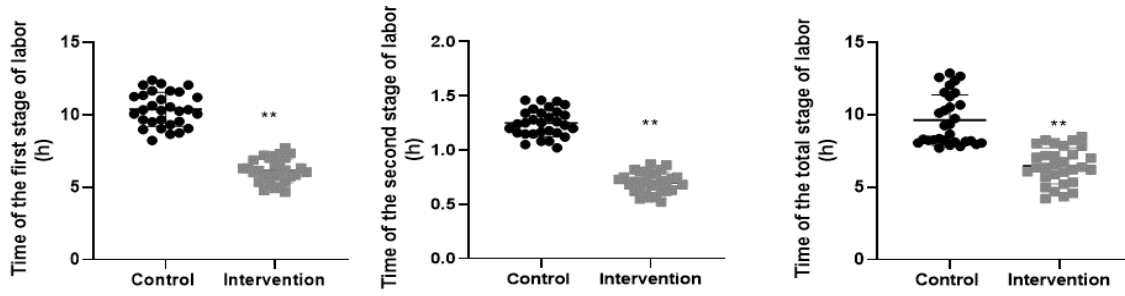
### **Childbirth satisfaction in 2 groups**

In contrast to the CG, the IG exhibited higher childbirth satisfaction ( $P<0.05$ , Table 4).

## **Discussion**

Vaginal delivery is a traditional way of maternal delivery, but this kind of delivery has the characteristics of long time and intense pain, so more and more women select cesarean section<sup>13</sup>. The results of the survey data show that at present, the natural vaginal delivery rate in China has exhibited a downward trend, and the cesarean section rate has been rising, with the current cesarean section rate in urban areas exceeding 40%<sup>14</sup>. With the increasing rate of cesarean section, the occurrence of related complications caused by cesarean section such as pelvic adhesions and postpartum massive hemorrhage is also increasing<sup>15</sup>. Since the inception of the two-child policy in China, improving natural childbirth rate has emerged as one of the important goals of obstetrics<sup>16</sup>. Hence, it is essential to strengthen the in-depth study on the delivery mode of female parturient with full-term scarred uteri and take effective measures to elevate the success rate of vaginal delivery.

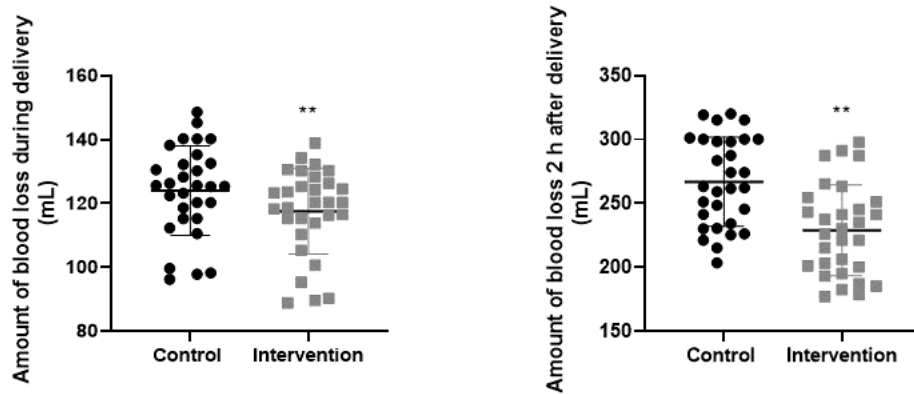
The traditional concept is that pregnant women with scarred uterus have a higher risk of uterine rupture during trial labor when they get pregnant again<sup>17</sup>. Therefore, whether the safety of pregnant women with scarred uterus can be guaranteed during trial labor has always become a focus of attention.



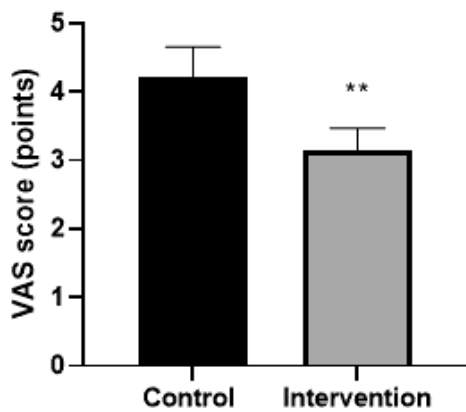
**Figure 2:** Duration of labor in 2 groups. \*\*P<0.01.

**Table 1:** General data of patents in 2 groups

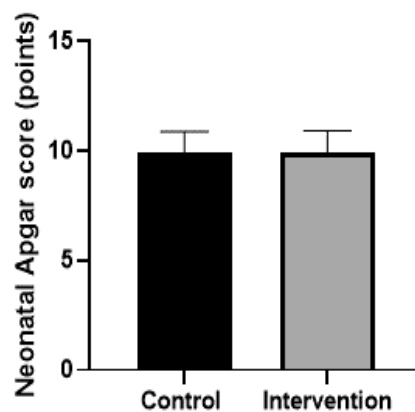
Groups	N	Mean maternal age (years)	Mean gestational age (weeks)	Mean scar thickness (mm)
Control group	30	28.15±2.48	39.14±1.32	3.02±1.08
Intervention group	30	28.23±2.56	39.18±1.35	3.06±1.10
t		0.123	0.116	0.142
P		0.903	0.908	0.888



**Figure 3:** Amounts of blood loss during and 2 h after delivery in the two groups. \*\*P<0.01



**Figure 4:** VAS score in 2 groups. \*\*P<0.01.



**Figure 5:** Neonatal Apgar score in 2 groups

**Table 2:** Incidence of fetal distress, neonatal asphyxia, and delivery outcomes in 2 groups

Groups	N	Natural delivery	Forceps assisted delivery	Cesarean section	Fetal distress	Neonatal asphyxia
Control group	30	18 (60.00)	7 (23.33)	5 (16.67)	2 (6.67)	1 (3.33)
Intervention group	30	29 (96.67)	1 (3.33)	0 (0.00)	1 (3.33)	0 (0.00)
$\chi^2$		11.88	5.192	5.455	0.350	1.017
P		<0.001	0.022	0.019	0.553	0.313

**Table 3:** Incidence of postpartum complications in the groups

Groups	N	Urinary retention	Laceration of the soft birth canal	Perineal edema	Total incidence rate
Control group	30	3 (10.00)	1 (3.33)	4 (13.33)	8 (26.66)
Intervention group	30	1 (3.33)	0 (0.00)	1 (3.33)	2 (6.66)
$\chi^2$					6.405
P					0.011

**Table 4:** Childbirth satisfaction in the two groups

Groups	N	Very satisfied	Basically satisfied	Dissatisfied	Total satisfaction rate
Control group	30	15 (50.00)	7 (23.33)	8 (26.67)	22 (73.33)
Intervention group	30	19 (63.33)	10 (33.33)	1 (3.34)	29 (96.66)
$\chi^2$					6.405
P					0.011

With the continuous acceleration of the development of science and technology, the technology and means to promote the effective contraction of the uterus, and reduce the rate of infection are constantly improving and improving<sup>18</sup>. Therefore, the healing effect of cesarean section uterus has continuously improved, which provides better conditions for women with scarred uterus to achieve vaginal delivery. Airbag bionic midwifery technology is a kind of midwifery technology which conforms to the natural physiological law, does not need to use any drugs for treatment, the operation process is relatively simple, and the application safety is high<sup>19</sup>. When the airbag bionic midwifery is applied in pregnant women during childbirth, its mechanism of action is mainly as follows: (1) The process of inflating the airbag will produce mechanical stimulation of the maternal cervix, and promote the effective expansion of the maternal cervix and vagina; (2) Through the reflex action of uterus and vagina, the body produces more oxytocin, stimulate uterine contraction, and can release prostaglandin more effectively, and finally promote the effective softening and effective

expansion of the cervix, creating good conditions for vaginal delivery and shortening the maternal labor time<sup>20</sup>. In our study, the results indicated that relative to the CG, the IG had shorter time of the first, second and total stage of labor.

This is because of the mechanical stimulation of the air sac on uterine opening by the, so that pregnant women release endogenous oxytocin and prostaglandin, which promote cervical maturity and help shorten the labor process<sup>10</sup>.

Besides, our study manifested that in contrast to the CG, the IG exhibited less amounts of blood loss during delivery as well as 2 h after delivery. This may be because of the timely artificial dilation of the cervix and vagina by airbag bionic midwifery, which reflexively increases the strength of contractions and reduces placental bleeding caused by contractions<sup>22</sup>.

Furthermore, relative to the CG, the IG exhibited higher natural delivery rate and lower forceps assisted delivery rate and cesarean section rate. This is because air bag mechanically expands the vagina, but also presses the rectum, reflexively makes pregnant women to have a sense of

defecation, unconsciously produces a powerful breath holding action, which helps the smooth progress of natural delivery.

In addition, our study manifested that in contrast to the CG, the IG had lower VAS score, suggesting that airbag bionic midwifery could effectively relieve the pain of parturient women, because the airbag bionic midwifery technology can induce contractions through external intervention, shorten the labor process, reduce the fear of parturient women, and thus reduce the pain of labor. In addition, cervical dilation can reduce the resistance of the soft birth canal to the fetal head decline, thereby reducing the pain of labor<sup>23</sup>. Finally, our study unveiled that relative to the CG, the IG had lower incidence of postpartum complications and higher childbirth satisfaction, suggesting that airbag bionic midwifery technology had high application safety, and was accepted by puerperal

## Conclusion

The implementation of airbag bionic midwifery technology in vaginal delivery of scarred uterus pregnancy has obvious effects, which can effectively promote the success ratio of vaginal delivery, shorten the stages of labor, along with alleviate the degree of pain, which is recommended to further promote the application in obstetric clinical practice..

## Strengths and weaknesses

The study participants and treatment modality of this study are innovative and therefore strengths. Limitations include a single-center study with a small sample size and no follow-up. Our study indicates that the implementation of airbag bionic midwifery technology reduces reduce the incidence of a repeat caesarean section, which might provide more choice reference for the delivery method of caesarean section.

## Acknowledgement

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## Contribution of authors

Zhang L, Zhou XY: conceived and designed the study, collected and analysed the data, and

prepared the manuscript. All authors mentioned in the article approved the manuscript.

## References

- 1.Zhang Y, Zhang T, Liu X, Zhang L, Hong F and Lu M. Research trends of pregnancy with scarred uterus after cesarean: a bibliometric analysis from 1999 to 2018. *J Matern Fetal Neonatal Med.* 2022; 35(18):3555-3564.
- 2.Sandall J, Tribe RM, Avery L, Mola G, Visser GH, Homer CS, Gibbons D, Kelly NM, Kennedy HP, Kidanto H, Taylor P and Temmerman M. Short-term and long-term effects of caesarean section on the health of women and children. *Lancet.* 2018; 392(10155):1349-1357.
- 3.Lavender T, Hofmeyr GJ, Neilson JP, Kingdon C and Gyte GM. Caesarean section for non-medical reasons at term. *Cochrane Database Syst Rev.* 2012; 2012(3):Cd004660.
- 4.Wei D, Qian X, Hong Y, Ye R and He D. Effect of midwife intervention coupled with acupressure on the vaginal delivery rate and negative emotion in parturients with scarred uterus re-pregnancy. *Am J Transl Res.* 2021; 13(8):9429-9436.
- 5.Aboshama RA, Taha OT, Abdel Halim HW, Elrehim EIA, Kamal SHM, ElSherbiny AM, Magdy HA, Albayadi E, Elsaid RE, Abdelghany AM, Anan MA and Abdelfattah LE. Prevalence and risk factor of postoperative adhesions following repeated caesarean section: A prospective cohort study. *Int J Gynaecol Obstet.* 2023; 161(1):234-240.
- 6.Klahr R, Cheung K, Markovic ES, Naert M, Rebarber A and Fox NS. Maternal Morbidity with Repeated Cesarean Deliveries. *Am J Perinatol.* 2023; 40(13):1431-1436.
- 7.Larsson C, Matsson A, Mooe T, Söderström L, Tunón K and Nordin P. Cardiovascular complications following caesarean section and vaginal delivery: a national population-based study. *J Matern Fetal Neonatal Med.* 2022; 35(25):8072-8079.
- 8.Zhao S, Wen J, Niu J, Xia J, Zhou L and Zou W. The clinical research into the application of multifunctional airbag abdominal pressure belt in midwifery and in the prevention of postpartum hemorrhage. *J Matern Fetal Neonatal Med.* 2018; 31(1):128-134.
- 9.Cheuk QK, Lo TK, Lee CP and Yeung AP. Double balloon catheter for induction of labour in Chinese women with previous caesarean section: one-year experience and literature review. *Hong Kong Med J.* 2015; 21(3):243-50.
- 10.Ma J, Shao H, Lu X, Zhang B and Zhang G. Safety and efficacy of airbag midwifery in promoting normal vaginal delivery and reducing caesarean section. *Iranian journal of reproductive medicine.* 2012; 10(6):595-600.
- 11.Sung YT and Wu JS. The Visual Analogue Scale for Rating, Ranking and Paired-Comparison (VAS-RRP): A new technique for psychological measurement. *Behav Res Methods.* 2018; 50(4):1694-1715.
- 12.Cnattingius S, Johansson S and Razaz N. Apgar Score and Risk of Neonatal Death among Preterm Infants. *N Engl J Med.* 2020; 383(1):49-57.

13. Karanth L and Abas AB. Maternal and foetal outcomes following natural vaginal versus caesarean section (c-section) delivery in women with bleeding disorders and carriers. *Cochrane Database Syst Rev.* 2021; 12(12):Cd011059.
14. Hou Y, Zhou X, Yao M and Liu S. Fear of childbirth and its predictors in re-pregnant women after caesarean section: a cross-sectional multicenter study in China. *BMC Pregnancy Childbirth.* 2022; 22(1):393.
15. Armbrust R, Hinkson L, von Weizsäcker K and Henrich W. The Charité cesarean birth: a family orientated approach of cesarean section. *J Matern Fetal Neonatal Med.* 2016; 29(1):163-8.
16. Sanés A. [Understanding natural childbirth]. *Rev Enferm.* 2000; 23(6):418-21.
17. Gonzalez N and Tulandi T. Cesarean Scar Pregnancy: A Systematic Review. *J Minim Invasive Gynecol.* 2017; 24(5):731-738.
18. Sánchez-López E, Gómara MJ and Haro I. Nanotechnology-Based Platforms for Vaginal Delivery of Peptide Microbicides. *Curr Med Chem.* 2021; 28(22):4356-4379.
19. Reddy SC and Alias R. Tono-pen measurement of intraocular pressure under topical anaesthesia in full term normal newborns. *International journal of ophthalmology.* 2014; 7(1):92-4.
20. Cohain JS. Episiotomy is obsolete: cinnamon gel applied after episiotomy endangers lives. *J Integr Med.* 2015; 13(4):215-6.
21. Borgia G, Carleo MA, Gaeta GB and Gentile I. Hepatitis B in pregnancy. *World J Gastroenterol.* 2012; 18(34):4677-83.
22. Zhang GJCJoCO, Gynecology. The research on the efficacy and safety of bionic air-bag midwifery. 2010;
23. Owattanapanich N, Lewis MR, Benjamin ER, Wong MD and Demetriades D. Motor vehicle crashes in pregnancy: Maternal and fetal outcomes. *J Trauma Acute Care Surg.* 2021; 90(5):861-865.