

Application of virtual reality technology combined with moderate perineal protection in natural childbirth

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ABSTRACT

Objectives: To explore the application effect of virtual reality (VR) combined with moderate perineal protection on singleton primipara delivery.

Material and methods: The study utilised a two-group design intervention and a randomised clinical trial. A total of 200 singleton primiparas who had a regular prenatal examination in a third-class hospital (between 1 September 2018 and 30 December 2018) and were willing to give birth naturally were randomly divided into treatment (traditional prenatal health mission combined with desktop VR health education system mode) and control (traditional health education mode) groups. The delivery conditions of the two groups were surveyed, recorded, analysed and compared.

Results: There was no significant difference in the time of the second stage of labour between the treatment and control groups, and the comparison of neonatal Apgar scores and neonatal weight between the two groups showed that the different modes of prenatal education had no effect on newborns ($p > 0.05$). The amount of postpartum haemorrhage in 2 h and the pain score in the treatment group were significantly lower than in the control group, and the degree of perineal injury in the treatment group was not as serious as that in the control group. Meanwhile, there was a statistically significant difference in the anxiety score, self-efficacy score and quality of life satisfaction between the treatment and control groups ($p < 0.05$).

Conclusions: VR technology combined with moderate perineal protection could improve the delivery outcome of a primipara, maternal self-confidence of delivery and the quality of vaginal delivery; effectively alleviate the anxiety of a primipara; have no adverse effects on both mothers and newborns; and be widely used in clinical settings.

Keywords: virtual reality technology; moderate perineal protection; natural labour; self-efficacy

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INTRODUCTION

With the implementation of the two-child policy, the number of births in most cities in China has increased sharply [1]. Since childbirth is a natural event, all deliveries should ideally be spontaneous [2]. Childbirth is a natural physiological process that every parturient has to go through [3]. Although labour is a natural phenomenon, its accompanied pain is severe in more than half of pregnant women [4]. About 5–40% of pregnant women fear childbirth in western countries, and a recent study reported that Chinese pregnant women have moderate levels of childbirth fear and anxiety [5]. It is estimated that out of every five pregnant women, one has a fear of natural childbirth, and, in most women, fear of birth leads to increased anxiety,

pain and prolonged labour [6]. Depression and anxiety are common mental disorders during pregnancy and after childbirth worldwide [7]. In addition, during childbirth, perineal trauma may occur, either spontaneously or after episiotomy. Perineal injuries are a common occurrence during childbirth, affecting approximately 90% of women to varying degrees during natural vaginal delivery [8]. In the face of the current grim situation, the goals of midwifery staff are to change traditional concepts, reduce intervention during delivery, create a non-invasive and comfortable delivery process and promote natural delivery. McCandlish [9] proposed the moderate perineal protection technique. In 2010, the China Maternal and Child Health Association also proposed the 'China Action to Promote Natural Childbirth', stating

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that efforts should be made to promote moderate perineal protection delivery technology in China. In February 2016, our hospital began to gradually promote moderate perineal protection.

Virtual reality (VR) is a rapidly improving emerging technology [10]. Virtual reality technology refers to the use of computer technology to form a realistic virtual world. Users can participate in the virtual world and interact through certain input or output devices, and they can control objects in the virtual world with their real-world actions and behaviours [11]. Virtual reality technology has made great advances in recent years, and it is increasingly being used in healthcare settings [12, 13]. Little is known about childbirth fear and childbirth preparation experiences among primigravid women before childbirth in low-resource settings [14]. With the help of VR technology for prenatal health education, pregnant women can be immersed in or participate in the virtual delivery room environment, interact with the VR system and achieve immersive feelings and experiences in mutual response and feedback. In this study, a randomised clinical trial was conducted to explore the effect of VR technology health education combined with appropriate perineal protection on parturients with a natural delivery so as to provide data support to promote the use of VR technology in medicine.

MATERIAL AND METHODS

Research objective

Primigravid women with singleton pregnancies who underwent routine antenatal examination in third-class hospitals between 1 June 2018 and 31 December 2018 were selected as the study group. The inclusion criteria were as follows: parturients with single full-term pregnancies, a normal external pelvic measurement, no obvious cephalopelvic disproportion, no complications in pregnancy and delivery and aged 20–34 years. The exclusion criteria were as follows: an estimated fetal weight of ≥ 4000 g and fetal biparietal diameter of > 9.7 cm indicated by B-ultrasound, a mental illness or communication disorder and the use of analgesia during labour. The 200 selected subjects were equally divided into the treatment group and the control group by a random number table. All the parturients and their family members had signed informed consent forms, and this study has been approved by the medical ethics committee of our hospital.

Research methods

Both groups of parturients were fully evaluated for fetal size, maternal pelvic conditions and maternal mental state, and fetal heart rate was closely monitored before delivery to ensure a safe and natural delivery. The nurses communicated effectively with the puerpera before surgical hand disinfection to obtain their support and cooperation.

Both groups of parturients adopted the moderate perineal protection technique during delivery: when the fetal head is exposed, the midwife places one hand on the head and applies appropriate pressure when the head is delivered so as to prevent the fetal head from being delivered at an excessive speed. In contrast, the conventional supporting and pressing of the perineum intends to let the fetal head fully expand the perineum and comply with the physiological process of fetal delivery, so as to assist fetal delivery. Moderate perineal protection delivery is completed with the cooperation of pregnant women and midwives. Midwives should have good communication skills and rich experience in delivery, be able to accurately identify changes in the childbirth process and help pregnant women deliver the fetus smoothly between contractions.

Treatment group:

Traditional health education is carried out in combination with VR technology. Using the virtual delivery room SpaceMax software, the real scene shooting in the delivery room is added to the system to bring the 3D interactive virtual scene to life, including characters, sites, objects, environments, time and voices. Various scenes in the delivery room and precautions during delivery are preset; pregnant women experience the operation through the computer VR system.

Control group:

Carry out traditional health education, which includes watching videos and looking at pictures in the simulated labour room, experiencing the delivery bed and various auxiliary delivery instruments during labour and listening to the explanation of midwives. Both groups of parturients received routine clinical treatment and nursing after delivery.

Observation indexes

1. The delivery outcome: This includes the time of the second stage of labour, postpartum haemorrhage in 2 h, neonatal Apgar score and neonatal weight.
2. The level of pain: A visual analogue scale (VAS) was used, consisting of a 10 cm horizontal line with pain descriptors indicating 'no pain' on the left and 'the worst pain imaginable' on the right. One centimetre represents one point, and the total score is 0–10 points. The higher the score, the stronger the degree of pain [15].
3. The level of anxiety: A visual analogue anxiety scale (VAS-A) was used to measure the accuracy and sensitivity of anxiety levels during labour [16]. The VAS-A is a 10 cm horizontal line with 0 on the left, representing 'no anxiety', and 10 on the right, representing 'the most severe anxiety'. The pregnant women draw lines representing the intensity of their anxiety, and the total score is 0–10.

Table 1. Comparison of general data of pregnant women between the two groups [$\bar{x} \pm s$, n (%)]

General information		Groups		χ^2/t	P
		Treatment group (100)	Control group (100)		
Average age [year]		30.29 \pm 1.14	30.35 \pm 1.07	0.275	0.789
Gestational week [week]		38.41 \pm 0.96	38.63 \pm 1.18	0.809	0.434
Weight index [kg/m ²]		23.39 \pm 2.52	22.76 \pm 1.97	1.762	0.256
Educational background	High school and below	9 (9%)	10 (10%)	0.992	0.083
	College and Bachelor degree	78 (78%)	75 (75%)		
	Bachelor degree or above	13 (13%)	15 (15%)		
Place of residence	Countryside	17 (17%)	19 (19%)	0.007	0.904
	Town	83 (83%)	81 (81%)		
Medical insurance	Have	90 (90%)	91 (91%)	1.310	0.861
	Don't have	10 (10%)	9 (9%)		

Table 2. Comparison of delivery outcomes between the two groups ($\bar{x} \pm s$)

Group	Cases	The time of the second stage of labor [min]	The amount of postpartum hemorrhage in 2h [mL]	Pain [score]	Neonatal Apgar score [score]	Neonatal weight [g]
Treatment group	100	95.23 \pm 10.12	151.28 \pm 50.73	3.73 \pm 1.87	8.82 \pm 0.49	3604.4 \pm 321.9
Control group	100	98.58 \pm 12.03	248.95 \pm 39.67	5.97 \pm 2.66	8.78 \pm 0.57	3672.6 \pm 294.8
t		2.002	0.013	-2.231	1.428	-0.635
P		0.815	0.008	0.00	0.669	0.527

4. General self-efficacy: The general self-efficacy scale is used to measure general self-efficacy and has good reliability and validity [17]. There are 10 items on the scale, with a total score of 10–40. The higher the score, the higher the level of self-efficacy.
5. Quality of life: The self-made quality of life satisfaction scale is used for evaluation. The scores range from 0 to 100 and include particularly satisfied, relatively satisfied and dissatisfied. If dissatisfied, the score does not exceed 60 points; if relatively satisfied, the score is 60–80 points; if particularly satisfied, the score exceeds 80 points. Total satisfaction rate = special satisfaction rate + comparative satisfaction rate.

Statistical method

The SPSS 19.0 statistical software was used to process and analyse the data. The T-test and the χ^2 test were used for counting data. A value of $p < 0.05$ means that the difference was statistically significant.

RESULTS

Comparison of general data between two groups of parturients

There was no significant difference in average age, gestational age, body mass index, education, place of residence and medical insurance between the two groups ($p > 0.05$)

(Tab. 1). This suggests that the data from the two groups were comparable.

Comparison of delivery outcomes between the two groups

The time of the second stage of labour between the treatment group and the control group was not significantly different ($p > 0.05$). The amount of postpartum haemorrhage in 2 h and the pain score in the treatment group were significantly lower than those in the control group ($p < 0.05$). The comparison of neonatal Apgar scores and neonatal weight between the two groups showed that the different modes of prenatal education had no effect on newborns ($p > 0.05$) (Tab. 2).

Comparison of the rate of lateral episiotomy and the degree of perineal laceration between the two groups

The complete rate of lateral episiotomy and the rate of grade I laceration in the treatment group were higher than those in the control group, and the rate of grade II and above laceration was lower than that in the control group. There were two cases of grade III laceration in the control group, and there was no grade IV laceration in both groups. The difference between the two groups was statistically significant ($p < 0.05$) (Tab. 3).

Table 3. Comparison of lateral episiotomy rate and perineal laceration degree between the two groups [n (%)]

Group	Cases	Degree of perineal trauma				
		Integrity	I degree	II degree	III or IV degree	Lateral episiotomy
Treatment group	100	9 (9.00)	80 (17.00)	1 (1.00)	0 (0.00)	11 (11.00)
Control group	100	3 (3.00)	59 (59.00)	5 (5.00)	2 (2.00)	31 (31.00)
χ^2		16.83				
P		< 0.01				

Table 4. Comparison of general self-efficacy and anxiety scores between the two groups ($\bar{x} \pm s$)

Group	Cases	Anxiety level		Self-efficacy		Quality of life satisfaction	
		Before education	During labor	Before education	During labor	Before education	During labor
Treatment group	100	3.53 \pm 1.42	3.63 \pm 1.42	28.08 \pm 2.82	30.27 \pm 2.74	65.10 \pm 2.76	85.05 \pm 4.72
Control group	100	3.18 \pm 1.33	6.58 \pm 1.33	28.23 \pm 2.30	23.52 \pm 2.14	63.98 \pm 3.38	73.12 \pm 3.46
t		0.763	0.175	2.871	3.560	2.213	4.558
P		0.947	< 0.001	0.875	< 0.001	0.798	< 0.001

Comparison of the quality of life satisfaction, scores of general self-efficacy and anxiety between the two groups

There was no significant difference in the quality of life satisfaction and the scores of anxiety and self-efficacy before education between the two groups ($p > 0.05$). The anxiety score of the treatment group was lower than that of the control group, while the quality of life satisfaction and the self-efficacy score of the treatment group were higher than those of the control group ($p < 0.05$) (Tab. 4).

DISCUSSION

Application of VR technology in health education

Not only can the application of VR technology in obstetric health education increase interest in and improve the effectiveness of the education, but it is also more conducive to the collection of users' feedback and further improvements of the education system. Fateme utilised a Solomon four-group design intervention and a randomised clinical trial to prove that medical treatment using VR technology, as well as distraction and drowning in VR, reduced pre-operative anxiety in children [18]. Generally, creators can generate medical and nursing content in the form of 3D modelling and live shooting and create scientific and standardised health education content in combination with technical conditions and medical and nursing theory in order to achieve the expected education objectives. Virtual reality technology can bring abstract knowledge to life by integrating vision, hearing and touch [19]. This study uses novel VR technology to achieve a sense of immersion, human-computer interaction and entertainment. It can help

pregnant women understand the delivery environment and experience the delivery process in advance; improve the initiative and effectiveness of pregnant women and their spouses; and promote health education based on information technology. It also shows that pregnant women and their spouses have high acceptance and evaluation of the system. With the deepening of research and the increase of the patient population and demand content, the system should be updated and improved to add more functional modules and enhance interest.

VR technology combined with moderate perineal protection can alleviate pain

Natural delivery is a normal physiological process. Due to the severe pain caused by the regular contraction of the uterus and the long labour process, many pregnant women are afraid of natural delivery. It is reported that labour pain can cause maternal sympathetic excitement and increase the release of catecholamines in the body, which inhibits uterine contraction, prolongs the labour process, causes an acid-base imbalance, decreases uterine blood flow and causes fetal distress [20–22]. For pregnant women, especially primiparas, childbirth pain causes strong psychological and physiological stress responses, resulting in slower expansion of the uterine orifice and a prolonged labour process, which makes it difficult to deliver smoothly [23]. Virtual reality technology can distract patients, reduce pain and relieve discomfort in nursing operations. Virtual reality technology can provide an effective non-pharmacological means for reducing acute and traumatic injury pain [24]. In this study, delivery pain in the treatment group was significantly less than that in the control group ($p < 0.05$); it is suggested that

the use of VR technology combined with moderate perineal protection can reduce pain during parturition.

VR technology combined with moderate perineal protection can improve the outcome of delivery

Clinically, in order to shorten the second stage of labour and avoid severe perineal laceration, lateral episiotomy is one of the most commonly used operations during delivery [25]. However, studies have shown that lateral episiotomy can lead to massive bleeding, intense pain, increased probability of infection, poor scar healing and other consequences, which have a serious impact on the postpartum quality of life of pregnant women, and lateral episiotomy has no significant improvement on the outcome of newborns [26]. Therefore, the rate of lateral episiotomy and perineal laceration should be reduced to the greatest extent. In this study, there was no grade IV perineal laceration in either group, indicating that VR technology combined with moderate perineal protection not only reduces the rate of lateral episiotomy and the degree of perineal injury but also does not increase the risk of severe perineal laceration.

VR technology combined with moderate perineal protection can improve self-efficacy and reduce anxiety

Among the four factors of delivery, maternal psychology is one of the important influencing factors [27]. Self-efficacy has been related to decreased pain perception during labour [28]. In this study, the anxiety score of the treatment group was lower than that of the control group, and the self-efficacy score of the treatment group was higher than that of the control group ($p < 0.05$). During childbirth, pregnant women often have anxiety. In this study, the pain degree of pregnant women in the treatment group was reduced, the anxiety level was reduced and the sense of self-efficacy was enhanced. With the help of VR technology, the treatment group gives play to its sense of immersion, human-computer interaction and entertainment; improves the enthusiasm of pregnant women and the effectiveness of prenatal education; promotes full communication between midwives and pregnant women; increases maternal self-confidence in childbirth; alleviates childbirth pain, anxiety and tension; enhances self-efficacy; and enables pregnant women to have a good childbirth experience in a relatively relaxed environment.

Deficiencies in this study

There were some limitations in this study; a professional psychological scale was not used to objectively evaluate the psychological state of pregnant women. In future research, this should be addressed.

CONCLUSIONS

Based on the moderate perineal protection technique, this study conducted VR technology health education for pregnant women in the treatment group, deepened the understanding of the pregnant women and their families about natural childbirth, recognised the benefits of natural childbirth for mothers and infants, improved and relieved the delivery anxiety to a certain extent, established confidence in natural childbirth and alleviated pain during childbirth. Moderate perineal protection also reduces the rate of perineal lateral resection and the degree of perineal wound laceration and plays a certain role in the prevention of postpartum haemorrhage. It provides a positive childbirth experience for puerpera, making it worthy of clinical application.

Article information and declarations

Data availability statement

All data generated or analyzed during this study are included in this published article.

Ethics

This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Heze Jia Zheng Vocational College. Written informed consent was obtained from all participants.

Author contributions

Xie JQ: conception and design; Zeng QX: administrative support; All authors: provision of study materials or patients, collection and assembly of data, data analysis and interpretation, manuscript writing, final approval of manuscript.

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Conflict of interest

The authors declare that they have no competing interests.

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