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Effects of High Risk Pregnancy Factors on Pelvic Floor Muscle Weakness and Changes of PG, ACTH and CRP

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Abstract

Objective: To investigate the effects of different delivery modes on perinatal pelvic floor muscle strength, PG, ACTH and CRP of high-risk pregnant women. **Methods:** 380 high-risk pregnant women who gave birth in our hospital from March 2021 to February 2022 were selected as subjects, including 100 vaginal natural delivery, 156 forceps assisted delivery and 124 cesarean section. Pelvic floor pressure, PG, ACTH, CRP, IL-6, TNF-α and IL-4, IL-10 levels were evaluated and compared. The perinatal occurrence of pelvic floor functional disease (PFD) in high-risk pregnant women in each group was analyzed and evaluated. **Results:** There were statistical differences in the amount of postpartum blood loss ($P < 0.0001$, $F = 99.01$), postpartum blood loss 24 h ($P = 0.0004$, $F = 19.54$) and hospital stay ($P < 0.0001$, $F = 70.81$) among the three groups of high-risk women in natural vaginal delivery, forceps delivery and cesarean section. In addition, there were 72, 134 and 70 cases of abnormal pelvic floor fatigue in natural vaginal delivery, forceps assisted delivery and cesarean section ($P < 0.0001$, $\chi^2 = 30.16$). There were 36, 79 and 21 cases of muscle injury, respectively ($P < 0.0001$, $\chi^2 = 34.16$). There were 49, 98 and 43 cases of dysmuscular contraction, respectively ($P < 0.0001$, $\chi^2 = 21.94$). There were 65, 120 and 41 cases with vaginal dynamic pressure < 80 cm H_2O ($P < 0.0001$, $\chi^2 = 56.86$), respectively. There were 78, 138 and 80 cases of Class I muscle fiber damage, respectively ($P < 0.0001$, $\chi^2 = 24.47$). There were 67 cases, 132 cases and 66 cases of Class II muscle fiber damage, respectively ($P < 0.0001$, $\chi^2 = 30.42$). Pairwise comparison among the three groups showed statistically significant differences. There were 15, 42 and 5 cases of SUI among the three groups, and there was a significant difference among the three groups ($P < 0.0001$, $\chi^2 = 29.90$). There were 68 cases of POP, 126 cases of POP, 30 cases of POP, and there was significant difference among the three groups ($P < 0.0001$, $\chi^2 = 66.57$). There were 54 cases of DRA, 88 cases of DRA and 85 cases of DRA, and there were significant differences among the three groups ($P = 0.0476$, $\chi^2 = 6.089$). There were 36, 77 and 5 cases of vaginal imperfecta, respectively, with significant difference among the three groups ($P < 0.0001$, $\chi^2 = 67.85$). Serum stress index PG ($P < 0.01$, $F = 292.3$), ACTH ($P < 0.01$, $F = 277.3$), proinflammatory factor CRP ($P < 0.01$, $F = 570.8$), IL-6 ($P < 0.01$, $F = 322.1$), TNF-α ($P < 0.01$, The levels of IL-4 ($P < 0.01$, $F = 122.1$) and IL-10 ($P < 0.01$, $F = 564.6$) were lower than those of vaginal natural delivery group and forceps assisted delivery group. **Conclusion:** Forceps delivery has higher damage to pelvic floor muscle strength and incidence of PFD than vaginal delivery and cesarean section. Cesarean section can enhance perinatal stress and inflammatory response of high-risk pregnant women.

Keywords

High-Risk Pregnant Women, Pelvic Floor Muscle Strength, Stress Response, Inflammatory Response

1. Introduction

High-risk pregnant women refer to those with high-risk pregnancy factors, which may lead to dystocia or endanger the safety of mother and child. With the improvement of economic level and the full liberalization of the two-child policy, the number of high-risk pregnant women has increased significantly, which directly affects the delivery mode and the incidence of postpartum complications [1] [2]. Among them, pelvic floor functional disease is the most common complication of postpartum mothers.

Pelvic floor disorders (PFD), which include urinary incontinence, anal incontinence and pelvic organ prolapse, are associated with childbirth [3]. With the enlargement of uterus during pregnancy and the chronic pull of gravity on pelvic floor tissue, the pelvic floor soft tissue is damaged to a certain extent. There are many risk factors leading to PFD, such as old age, obesity, vaginal delivery, menopause, long-term increase in abdominal pressure, etc. Pregnancy and delivery are independent risk factors for PFD [4].

Weakness of the Pelvic floor muscle (PFM) is associated with stress incontinence [5]. Stress urine incontinence (SUI) has a widespread negative impact on public health, leaving sufferers with feelings of embarrassment and low self-esteem, and social isolation [6]. It has been reported that the prevalence of SUI in female population is 10% - 40%, 18% - 75% in the later period of pregnancy, and about 1/3 in the postpartum period [7] [8]. PFM weakness plays an important role in the occurrence of SUI, anal incontinence and pelvic organ prolapse (POP) [9]. Studies have shown that PFM weakness is related to fetal incontinence [10], which is also a risk factor for SUI and can be changed during pregnancy [9]. PFM has been shown to be weakened during pregnancy [11], and PFM weakness is associated with incontinence in pregnant women [10]. Pregnancy and childbirth are important factors for pelvic floor dysfunction [12]. Delivery mode, advanced age, fertility, increased pregnancy and high body mass are associated with pelvic organ prolapse in the early postpartum period [13].

Different delivery methods have different degrees of damage to pelvic floor muscles, and the cesarean section rate has gradually increased in recent years [14]. Studies have shown that the impact of cesarean section on early pelvic floor muscle strength is less than that of normal delivery [15]. In addition, after cesarean section, high stress and chronic inflammation of the pelvis and spine during pregnancy lead to low back pain, and postoperative incision pain and traction pain aggravate the stress state of the pregnant women [16]. This study analyzed and compared the effects of cesarean section and vaginal delivery on perinatal pelvic floor muscle strength, stress and inflammatory response of high-risk pregnant women, and provided theoretical basis for the prevention and treatment of PFD.

2. Materials and Method

2.1. Objects

380 high-risk pregnant women who gave birth in our hospital from March 2020 to March 2022 were randomly selected as the study objects. Inclusion criteria: 1) All were single pregnant women; 2) An in-patient delivery in our hospital meets at least one of the following risk factors: age ≥35 years, adverse pregnancy history, scarred uterus, abnormal fetal position, or pregnancy complications. Exclusion criteria: women with coagulation dysfunction; Parturients with other organic diseases; Parturients with mental or nervous system diseases; Women who did not cooperate with the completion of the study data collection. All the pregnant women had survived single birth, no history of pelvic organ prolapse and urinary incontinence, no history of pelvic surgery, and no serious internal and surgical complications. All pregnant women included in the study were informed and agreed to participate in this study, which was reviewed and approved by the Medical Ethics Committee of Haikou Fourth People's Hospital.

Subjects with statistical comparability (expectant pregnant women) were divided into three groups with inclusion criteria:

1) Full-term primipara without pregnancy complications and complications;

2) No anemia before operation;

3) The newborn birth weight of 2.5 Kg - 4 Kg;

4) No previous history of uterine-related surgery; According to the pregnant women's delivery opinions, the study subjects were divided into routine delivery group, delivery analgesia instrument group, and epidural anesthesia group. The analgesia effect, labor time, intrapartum blood loss, neonatal Apgar score, post-

partum complications, postpartum pelvic floor muscle function, and postpartum depression score of the three groups were recorded, and statistical analysis was conducted.

The selected subjects were divided into the following 3 groups according to different delivery methods: vaginal natural delivery group (100 cases): age 23 - 41 years old, average age 32.82 ± 4.21 years old; BMI of 21.2 - 35.0 kg/m^2, average BMI of 27.1 ± 3.5 kg/m^2; There were 73 cases of primipara and 27 cases of parturient. There were 39 cases aged ≥35 years, 16 cases had adverse pregnancy history, 10 cases had scar uterus, 54 cases had abnormal fetal position, and 41 cases had pregnancy complications. Forceps assisted delivery group (156 cases): age 26 - 41 years old, mean age 33.64 ± 4.30 years old; BMI of 21.3 - 35.2 kg/m^2, average BMI of 27.2 ± 3.2 kg/m^2; there were 118 primipara and 38 parturients. There were 63 cases aged ≥35 years, 29 cases had adverse pregnancy history, 8 cases had scar uterus, 76 cases had abnormal fetal position, and 61 cases had pregnancy complications. In the cesarean section group (124 cases), age ranged from 25 to 40 years, mean age 34.21 ± 4.72 years; BMI of 21.6 - 35.2 kg/m^2, average BMI of 27.4 ± 3.0 kg/m^2; 98 cases of primipara and 26 cases of parturient; There were 48 cases aged ≥35 years, 18 cases had adverse pregnancy history, 15 cases had scar uterus, 60 cases had abnormal fetal position, and 52 cases had pregnancy complications.

2.2. Pelvic Floor Muscle Function Assessment

With reference to the training materials for the Prevention and Treatment of pelvic floor Dysfunction for Chinese women compiled by Wang Xiaoguang and others, the pelvic floor pressure detection instrument (French PhENIX USB2 therapeutic instrument) was used for detection. The routine examination of pelvic floor function was performed on the parturients of vaginal natural delivery, forceps assisted delivery and cesarean section, and the pelvic floor muscle strength was detected. The comprehensive muscle strength of pelvic floor muscles is divided into 0 - 5 grades: 0 - 3 grades are abnormal, 4 - 5 grades are normal; The normal value of dynamic pelvic floor pressure is 80 - 150 cm H_2O, and less than 80 cm H_2O is abnormal. Pelvic floor muscle fibers can be divided into class I muscle fibers and class II muscle fibers.

2.3. Stress Index Detection

Fasting venous blood of the subjects was collected 72 h after delivery, and centrifuged at 3000 r/min for 10 min. The supernatant was taken and the stress index prostaglandin was determined by enzyme-related immunosorbent assay (ELISA) (Biyuntian) PG and adrencocorticotropic hormone (ACTH) levels.

2.4. Detection of Inflammatory Factors

Fasting venous blood of the subjects was collected 72 hours after delivery, centrifuged at 3000 r/min for 10 min, and the supernatant was taken. Serum levels of inflammatory factor C-reactive protein (CRP), interleukin-6 (IL-6), tumor necrosis factor-*α* (TNF-*α*) and anti-inflammatory factors interleukin-4 (IL-4) and interleukin-10 (IL-10) were determined by enzyme-linked immunosorbent assay (ELISA) kit. All ELISA kits were purchased from Biyuntian.

2.5. PFD Diagnosis

Pelvic organ prolapse (POP) refers to the deviation of pelvic organs from normal anatomical position due to the defect or relaxation of pelvic floor supporting tissue, which is classified by the latest international POP-Q quantitative staging system [17]. Stress urinary incontinence (SUI) refers to a sudden increase in abdominal pressure resulting in involuntary discharge of urine, using the diagnostic criteria of the International Committee on Urinary Incontinence. The separation of rectus abdominis (DRA) was detected by traditional finger measurement, and the separation of rectus abdominis more than 2 cm with umbilicus as the central point was diagnosed as DRA [18] [19]. Malclosure of the vaginal opening means that the vaginal opening is relaxed and the transverse diameter of the vaginal opening is greater than 2 cm [20].

2.6. Statistical Analysis

SPSS21.0 statistical Software (SPSS, Inc, Chicago, IL, USA) and GraphPad Prism 8.0 software (GraphPad Software Inc., San Diego, CA, USA) were used for statistical analysis and mapping of data. Shapiro-Wilk test was used to test the normal distribution. Use cases of counting data (n) were represented. Chi-square test was used for comparison of counting data between groups, mean ± SEM was used for measurement data. One-Way ANOVA analysis of variance was used for comparison between groups, and Tukey's multiple comparisons test was used for post hoc comparison. P is a bilateral test, and $P < 0.05$ indicates statistically significant difference. Measurement data were expressed in the form of mean ± standard deviation, P was a bilateral test, and $P < 0.05$ meant that the difference was statistically significant.

3. Results

3.1. Comparison of Perinatal Conditions of High-Risk Pregnant Women with Different Delivery Modes

In this study, a total of 380 high-risk pregnant women were included as research objects, of which 100 were vaginal natural delivery, 156 were forceps assisted delivery and 124 were cesarean section. A comparative analysis of their general obstetric conditions showed that there were no significant differences in age, BMI, delivery time, gestational age and neonatal weight among high-risk women in vaginal delivery, forceps delivery and cesarean section ($P > 0.05$), indicating a certain comparability. However, intrapartum blood loss, postpartum blood loss 24 h and hospital stay of vaginal delivery and forceps assisted delivery were significantly lower than those of cesarean delivery ($P < 0.05$).

3.2. Influence of Different Delivery Methods on Perinatal Pelvic Floor Muscle of High-Risk Pregnant Women

The pelvic floor function of 42d postnatal natural delivery, forceps assisted delivery and cesarean section were routinely examined by the pelvic floor pressure testing instrument to detect the pelvic floor muscle strength. The results showed that the abnormal pelvic floor fatigue, muscle injury, muscle contraction disorder, the proportion of women with vaginal dynamic pressure < 80 cm H_2O and the muscle strength impairment of class I and Class II muscle fibers in the forceps assisted delivery group were significantly higher than those in the vaginal natural delivery group. Vaginal natural delivery group and forceps assisted delivery group were significantly higher than cesarean section group ($P < 0.05$).

3.3. Relationship between Different Delivery Modes and Perinatal PFD in High-Risk Pregnant Women

Subsequently, we conducted PFD screening on the 3 groups of high-risk pregnant women, and the results showed that compared with the vaginal natural delivery group, the occurrence of PFD in the forceps assisted delivery group, such as SUI, POP, DRA and vaginal imclosure, were statistically different ($P < 0.05$). The incidence of SUI, POP, DRA and vaginal imclosure in cesarean section group were significantly lower than those in vaginal natural delivery group and forceps assisted delivery group ($P < 0.05$).

3.4. Effects of Different Delivery Modes on Perinatal Stress and Inflammatory Response of High-Risk Pregnant Women

In addition, in this study, serum stress indicators prostaglandin (PG) and adrencocorticotropic hormone (adrencocorticotropic hormone) were analyzed at 72 h postpartum. ACTH) and serum inflammatory factor C-reactive protein (CRP), interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α) and anti-inflammatory factors interleukin-4 (IL-4) and interleukin-10 (IL-10) were detected and analyzed. ELISA showed that serum PG and ACTH levels and serum inflammatory factors CRP, IL-6 and TNF-α levels in forceps assisted delivery group and cesarean section group were significantly higher than those in vaginal natural delivery group. Compared with forceps assisted delivery group, the levels of serum PG, ACTH, CRP, IL-6, TNF-α, IL-4 and IL-10 in cesarean section group had statistical significance ($P < 0.05$). These results indicate that cesarean section enhances perinatal stress and inflammatory response in high-risk pregnant women.

4. Discussion

Rectum, urethra, fascia, muscle, vagina and other tissues are located in the pelvic floor tissue, thus exerting a certain load-bearing effect on various tissues and organs in the pelvic cavity [21]. After pregnancy and delivery, pregnant women may suffer pelvic floor injury, resulting in functional pelvic floor diseases (PFD) such as POP, SUI and postpartum urinary incontinence [22]. In recent years, with the change of fertility policy and people's lifestyle, the high-risk factors during pregnancy have also changed, which directly affects the delivery mode and the incidence of postpartum complications [1] [2]. In recent years, the rate of cesarean section in China has increased sharply [23]. Post-operative women have low back pain due to high stress and chronic inflammation of the pelvis and spine during pregnancy, and post-operative incision pain and traction pain aggravate the stress state of the women [16]. In this study, we compared and analyzed the effects of vaginal natural delivery, forceps assisted delivery and cesarean section on perinatal pelvic floor injury, stress and inflammatory response of high-risk pregnant women.

When a woman gives birth vaginally, the vagina can be stretched, causing nerve tears, pelvic floor muscle fibers to tear, the birth canal to stretch and the perineum to tear. This study tested pelvic floor muscle strength of high-risk pregnant women at 42 days postpartum. The abnormal pelvic floor fatigue, muscle injury, muscle contraction disorder, the proportion of women with vaginal dynamic pressure < 80 cm H_2O and the muscle strength impairment of class I and Class II muscle fibers were all lower than those with vaginal delivery (vaginal natural delivery and forceps assisted delivery). However, there were no significant differences in age, BMI, birth time, gestational age and neonatal weight. It can be seen that vaginal delivery is one of the important factors of pelvic floor muscle (PFM) injury, which is consistent with previous research results [24]. In addition, we found in our study that the number of PFD cases in vaginal natural delivery and forceps assisted delivery, especially those in high-risk women with forceps assisted delivery, such as SUI, POP, DRA and vaginal imclosure, were significantly higher than those in cesarean section, which was similar to the findings of Xiao Xia *et al.* [25]. This may be due to the fact that the fetus does not need to pass through the vagina during cesarean section, avoiding damage to the soft tissues of the pelvic floor, and the incidence of PFD is lower than that of vaginal natural delivery. The improper use of instruments and forceps may cause damage to pelvic floor tissue, resulting in perineal laceration or extension, tear of pelvic fascia and anal lifter muscle, weakening or defect of pelvic floor tissue, and uterine prolapse due to excessive abdominal pressure pushing the uterus that has not yet been regenerated to the vagina [25]. Studies have shown that forceps or vacuum vaginal delivery can significantly damage PFM strength and increase the risk of PFD [26]. Vaginal delivery is an independent risk factor for the occurrence of PFD in primipara after a short period of time. Although cesarean section reduces the risk of pelvic floor injury, it is not completely protective [27]. Cesarean section is a protective delivery method for PFM in the near postpartum period, but it may not be effective for late postpartum women [28].

In addition, the results of this study showed that for high-risk pregnant women, vaginal natural delivery and forceps assisted delivery had less intrapartum blood loss, 24 h postpartum blood loss and hospital stay than cesarean delivery. However, cesarean section is also likely to cause other serious complications. Due to invasive operation, cesarean section causes excessive bleeding in patients and changes in the reproductive tract ecological environment of patients, which reduces the immune function of patients and makes them prone to postoperative puerperal infection [29]. Labor plays an important role in the expression of inflammatory and/or oxidative stress responses [30]. Elevated levels of prostaglandin biosynthesis during vaginal delivery stimulate myometria contraction and cervical dilation, accompanied by high fluctuations in cytokines such as interleukin-1β (IL-1β), IL-6, and tumor necrosis factor-A (TNF-a) [31]. It is well known that oxidative stress increases during normal pregnancy, and women experience different levels of oxidative stress during cesarean section and vaginal delivery [3] [32]. Hung *et al*.'s study showed increased placental oxidative stress in women who delivered vaginally-compared to women who delivered by cesarean section [3]. In this study, we found that the levels of postpartum stress indicators serum PG, ACTH and pro-inflammatory factors CRP, IL-6 and TNF-α were higher than those of forceps assisted delivery > vaginal natural delivery, while the levels of anti-inflammatory factors IL-4 and IL-10 were higher than those of cesarean < forceps assisted delivery > vaginal natural delivery. These results indicate that the mode of delivery is related to postpartum stress and inflammatory response of high-risk pregnant women.

5. Conclusion

In summary, cesarean section of high-risk women can reduce PFM injury, reduce the occurrence of PFD such as SUI, POP, DRA and vaginal imclosure, and vaginal delivery (vaginal natural delivery and forceps assisted delivery) can reduce bleeding, shorten hospital stay, and alleviate stress and inflammatory reactions. According to the conditions of high-risk pregnant women, reasonable selection of delivery methods should be made, while appropriate use of instrument forceps, effective preventive measures should be taken to strengthen the protection of the pelvic floor, reduce the rate of vaginal instrument midwifery, and avoid excessive extension of the pelvic floor, so as to reduce the damage to the pelvic floor tissue and postpartum infection.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Jin, Y., Jiang, Y., Yuan, Y.F., *et al*. (2013) Influencing Factors of Pregnant Women's Choice of Delivery Mode in Hunan Province. *China Maternal and Child Health Care*, **28**, 5010-5012.

[2] Teng, X.H. and Pan, S.L. (2017) Relationship between Pregnant Women's Age and Pregnancy Risk Factors and Pregnancy Outcome. *Journal of Practical Obstetrics and Gynecology*, **33**, 692-696. (In Chinese)

[3] Hung, T.H., Chen, S.F., Hsieh, T.T., *et al.* (2011) The Associations between Labor and Delivery Mode and Maternal and Placental Oxidative Stress. *Reproductive Toxicology*, **31**, 144-150. https://doi.org/10.1016/j.reprotox.2010.11.009

[4] Strinic, T., Bukovic, D., Roje, D., *et al.* (2007) Epidemiology of Pelvic Floor Disorders between Urban and Rural Female Inhabitants. *Collegium Antropologicum*, **31**, 483-487.

[5] Gao, L., Wang, S., Zhang, D., *et al.* (2022) Pelvic Floor Muscle Strength in the First Trimester of Primipara: A Cross-Sectional Study. *International Journal of Environmental Research and Public Health*, **19**, Article 3568. https://doi.org/10.3390/ijerph19063568

[6] Gumussoy, S., Ozturk, R., Kavlak, O., Hortu, İ. and Yeniel, A.Ö. (2021) Investigating Pelvic Floor Muscle Strength in Women of Reproductive Age and Factors Affecting It. *Clinical Nursing Research*, **30**, 1047-1058. https://doi.org/10.1177/10547738211000350

[7] Davenport, M.H., Nagpal, T.S., Mottola, M.F., *et al.* (2018) Prenatal Exercise (Including But Not Limited to Pelvic Floor Muscle Training) and Urinary Incontinence during and following Pregnancy: A Systematic Review and Meta-Analysis. Br *British Journal of Sports Medicine*, **52**, 1397-1404.

[8] Capobianco, G., Madonia, M., Morelli, S., *et al.* (2018) Management of Female Stress Urinary Incontinence: A Care Pathway and Update. *Maturitas*, **109**, 32-38. https://doi.org/10.1016/j.maturitas.2017.12.008

[9] Blomquist, J.L., Carroll, M., Munoz, A. and Handa, V.L. (2020) Pelvic Floor Muscle Strength and the Incidence of Pelvic Floor Disorders after Vaginal and Cesarean Delivery. *American Journal of Obstetrics and Gynecology*, **222**, 62.E1-62.E8. https://doi.org/10.1016/j.ajog.2019.08.003

[10] Rathore, A., Suri, J., Agarwal, S. and Mittal, P. (2021) Antenatal and Postnatal Assessment of Pelvic Floor Muscles in Continent and Incontinent Primigravida Women. *International Urogynecology Journal*, **32**, 1875-1882. https://doi.org/10.1007/s00192-021-04846-3

[11] Palmezoni, V.P., Santos, M.D., Pereira, J.M., *et al.* (2017) Pelvic Floor Muscle Strength in Primigravidae and Non-Pregnant Nulliparous Women: A Comparative Study. *International Urogynecology Journal*, **28**, 131-137. https://doi.org/10.1007/s00192-016-3088-3

[12] Xie, X.H. (2017) Analysis of Pelvic Floor Dysfunction and Correlation between Pelvic Floor Muscle Strength and Obstetric Delivery Factors in Different Delivery Modes. *Shenzhen Journal of Integrated Chinese and Western Medicine*, **27**, 120-121.

[13] Dilebel, A., Liu, N. and Gulina, A. (2018) Effects of Different Delivery Methods on Pelvic Floor Muscle Strength in Early Postpartum Period. *Journal of Xinjiang Medical University*, **41**, 692-696. (In Chinese)

[14] Qi, S. (2013) Changes of Postpartum Pelvic Floor Muscle Strength and Its Influencing Factors. Zhengzhou University, Zhengzhou.

[15] Shi, Y.M., Feng, B.W., Zhang, J.H., *et al.* (2017) Effects of Different Delivery Methods on Pelvic Floor Muscle Strength in Early Postpartum Period. *China Maternal and Child Health Care*, **32**, 704-706.

[16] He, J.Q., Qiu, Y.F., Shu, D.X., *et al*. (2018) Relationship between Pain Stress Index and Emotional State during Cesarean Section. *Chinese Journal of Preventive Medicine*, **19**, 958-960. (In Chinese)

[17] Mattison, M.E., Simsiman, A.J. and Menefee, S.A. (2006) Can Urethral Mobility Be Assessed Using the Pelvic Organ Prolapse Quantification System? An Analysis of the Correlation between Point Aa and Q-Tip Angle in Varying Stages of Prolapse. *Urology*, **68**, 1005-1008. https://doi.org/10.1016/j.urology.2006.05.030

[18] Mota, P., Pascoal, A.G., Sancho, F., Carita, A.I. and Bø, K. (2013) Reliability of the Inter-Rectus Distance Measured by Palpation. Comparison of Palpation and Ultrasound Measurements. *Manual Therapy*, **18**, 294-298. https://doi.org/10.1016/j.math.2012.10.013

[19] Chen, Y., Bai, W.W., Xiang, D.J., *et al*. (2020) Clinical Application of Ultrasound in Diagnosis of Rectus Abdominalis Dissociation in Pregnant Women. *Journal of Southeast University* (*Medical Edition*), **39**, 200-203. (In Chinese)

[20] Wei, L.Y., Jiang, L.W., Jiang, H., *et al*. (2017) Clinical Effect of Electroneuromuscular Stimulation on Vaginal Imclosure. *Chinese and Foreign Women's Health Study*, **2**, 96-97.

[21] Wang, C., Wang, Q., Zhao, X., *et al*. (2022) Effects of Different Delivery Modes on Pelvic Floor Function in Parturients 6-8 Weeks after Delivery Using Transperineal Four-Dimensional Ultrasound. *Disease Markers*, **2022**, Article ID: 2334335. https://doi.org/10.1155/2022/2334335

[22] Thibault-Gagnon, S., Yusuf, S., Langer, S., *et al*. (2014) Do Women Notice the Impact of Childbirth-Related Levator Trauma on Pelvic Floor and Sexual Function? Results of an Observational Ultrasound Study. *International Urogynecology Journal*, **25**, 1389-1398. https://doi.org/10.1007/s00192-014-2331-z

[23] Lv, Y.Z. (2013) Effects of Different Delivery Methods on Maternal and Infant Perinatal Complications. *China Health and Nutrition*, **23**, 1713-1714. (In Chinese)

[24] Memon, H. and Handa, V.L. (2012) Pelvic Floor Disorders following Vaginal or Cesarean Delivery. *Current Opinion in Obstetrics and Gynecology*, **24**, 349-354. https://doi.org/10.1097/GCO.0b013e328357628b

[25] Xiao, X., Wei, R.M., Lv, L.Q., *et al*. (2015) Study on the Effect of Three Different Delivery Methods on Pelvic Floor Muscle Strength of Primipara. *China Maternal and Child Health Care*, **30**, 4458-4460.

[26] Barbosa, A.M., Marini, G., Piculo, F., *et al*. (2013) Prevalence of Urinary Incontinence and Pelvic Floor Muscle Dysfunction in Primiparae Two Years after Cesarean Section: Cross-Sectional Study. *Sao Paulo Medical Journal*, **131**, 95-99. https://doi.org/10.1590/S1516-31802013000100019

[27] Elenskaia, K., Thakar, R., Sultan, A.H., Scheer, I. and Beggs, A. (2011) The Effect of Pregnancy and Childbirth on Pelvic Floor Muscle Function. *International Urogynecology Journal*, **22**, 1421-1427. https://doi.org/10.1007/s00192-011-1501-5

[28] Handa, V.L., Blomquist, J.L., McDermott, K.C., *et al*. (2012) Pelvic Floor Disorders after Vaginal Birth: Effect of Episiotomy, Perineal Laceration, and Operative Birth. *Obstetrics & Gynecology*, **119**, 233-239. https://doi.org/10.1097/AOG.0b013e318240df4f

[29] Wu, WW., Wu, H.B., Zhu, X.Y., *et al*. (2017) Analysis of Influencing Factors and Drug Resistance of Pathogenic Microorganisms in Puerperal Infection after Vaginal Trial Delivery and Cesarean Section. *China Maternal and Child Health Care*, **32**, 898-900.

[30] Hu, Y., Huang, K., Sun, Y., *et al*. (2017) Placenta Response of Inflammation and Oxidative Stress in Low-Risk Term Childbirth: The Implication of Delivery Mode. *BMC Pregnancy Childbirth*, **17**, Article No. 407. https://doi.org/10.1186/s12884-017-1589-9

[31] Malamitsi-Puchner, A., Protonotariou, E., Boutsikou, T., *et al*. (2005) The Influence of the Mode of Delivery on Circulating Cytokine Concentrations in the Perinatal Period. *Early Human Development*, **81**, 387-392. https://doi.org/10.1016/j.earlhumdev.2004.10.017

[32] Gitto, E., Reiter, R.J., Karbownik, M., *et al*. (2002) Causes of Oxidative Stress in the Pre- and Perinatal Period. *Biology of the Neonate*, **81**, 146-157. https://doi.org/10.1159/000051527