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Pelvic Floor Ultrasound for the Diagnosis of Women with Early Postpartum Stress Incontinence

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Abstract: *Objective:* To analyze the diagnostic efficacy of trans-pelvic floor ultrasonography in women with Stress Urinary Incontinence (SUI) in the early postpartum period. *Methods:* Fifty-three patients with SUI who were admitted to the hospital from January 2024 to August 2024 at 42–96 d postpartum underwent ultrasonography and were analyzed in comparison with 35 patients in the control group at 28–32 weeks postpartum, and the bladder pressure grading and strength of myoelectric response as well as uterine contraction were measured on days 1, 7, and 14 after treatment. *Results:* The mean urinary flow rate was (79.65 ± 1.24)%, (80.34 ± 2.14)% and (86.40 ± 2.03)% on days 1, 7, and 14 after treatment in the ultrasound group, and (65.46 ± 1.58)%, (71.09 ± 1.47)% and (85.34 ± 2.69)% in the control group, respectively ($P < 0.05$). The intensity of myoelectric response in the ultrasound group was (1.69 ± 0.88) points on the 1st day, (3.41 ± 0.98) points on the 7th day, and (4.21 ± 0.77) points on the 14th day after the treatment, and the intensity of myoelectric response in the control group was (1.71 ± 0.91) points on the 1st day, (2.41 ± 0.78) points on the 7th day, and (3.12 ± 0.81) points on the 14th day after treatment in the ultrasound detection group was significantly higher than that of the control group, and the difference was statistically significant ($P < 0.05$). The time of the peak of the strongest uterine contraction in the observation group (53 cases) was (7.36 ± 0.87) d postpartum, and the time of the strongest peak of the strongest uterine contraction in the control group (35 cases) was (25.12 ± 1.24) d postpartum, the observation group was significantly better than the control group ($P < 0.05$). The uterine restoration time in the observation group was (32.69 ± 2.47) d postpartum, and the uterine restoration time in the control group was (45.36 ± 2.69) d postpartum, and the control group was slow and worse than the observation group ($P < 0.05$). *Conclusion:* For women with SUI in the early postpartum period, ultrasound can accurately assess pelvic floor muscle function and muscle strength, which is helpful for early clinical diagnosis and treatment.

Keywords: Pelvic floor muscles; Stress incontinence; Pelvic floor ultrasound; Diagnosis; Treatment

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1. Introduction

The puerperium is a critical period for the recovery of the female reproductive system, during which hormone levels, pelvic ligaments, muscles, the urethra and the bladder change. In some areas of China, rural women experience "urine leakage" after childbirth, with a prevalence of up to 50–80% [1]. Postpartum stress urinary incontinence (SUI) is one of the common symptoms, which not only seriously affects the quality of life of patients, but also leads to depression and anxiety [2]. Numerous clinical studies have shown that 74% of women with postpartum SUI had varying degrees of depression and anxiety before receiving treatment [3]. Therefore, all patients with postpartum SUI should be diagnosed and treated in a timely manner, but at present, the diagnosis of this disease in most hospitals still relies on the patient's self-description, which is inaccurate and prone to omission and misdiagnosis [4]. Traditional medical diagnostic methods mainly include history taking, physical examination and urodynamic examination, but due to the high cost of urodynamic examination, coupled with the limited means of assessment, it is unable to meet the needs of modern medical development [5]. In recent years, with the advancement of ultrasound imaging technology, pelvic floor ultrasound has gradually become an effective aid in the diagnosis of SUI and has been widely used in various clinical disciplines. Ultrasound is a non-invasive examination modality with the advantages of simple operation, low price, high accessibility, and intuitive results. In addition, ultrasound imaging can directly observe the pelvic floor structure, better understand the patient's pelvic floor functional status, help early detection of the patient's condition, and improve the diagnosis and treatment efficiency. At present, there is a lack of relevant reports on the application of pelvic floor ultrasound in the diagnosis of SUI to explore the diagnostic value of pelvic floor ultrasound in early postpartum SUI mothers, the present study conducted pelvic floor ultrasound examination on 53 cases of SUI mothers admitted to our hospital between January 2024 and August 2024 who had been in the postpartum period of 42–96 days, and analyzed them in comparison with the same period with 35 control cases, to provide a reference basis for the clinic.

2. Information and methodology

2.1. General information

Retrospective analysis of 53 cases of postpartum 42–96 d stress urinary incontinence mothers, aged 18–46 years old, average (35.91 ± 7.04) years old; number of pregnancies 2–4 times, average (3.81 ± 0.64) times; and mode of delivery: normal delivery (29 cases), cesarean section (24 cases), who were seen in the gynecology outpatient clinic and received pelvic floor rehabilitation treatment from January 2024 to August 2024. The 28–32 weeks postpartum patients were collected as the control group. The age of the control group ranged from 17 to 43 years old, with an average of (34.67 ± 5.14) years old; the number of pregnancies was 2–4 times, with an average of (3.52 ± 0.58) times; and the mode of delivery was: normal delivery (19 cases) and caesarean section (16 cases).

According to the definition of SUI in Obstetrics and Gynaecology and the Guidelines for Urodynamic Examination and Evaluation, SUI is defined as the presence of urinary incontinence symptoms within 3 months after delivery. It is diagnosed if there are 3 or more positive signs on bladder and rectal function tests using a homemade urodynamics testing device.

Inclusion criteria: (1) no obvious organic disease or surgical history; (2) age < 40 years old; (3) height ≥ 158 cm, weight ≥ 55 kg; (4) no complications such as hypertension and diabetes mellitus in pregnancy; (5) those with gestational weeks < 37 weeks, greater than 42 weeks, or less than full term were excluded from this case-control study.

Exclusion criteria: (1) combined heart, lung, liver, kidney and other important organs dysfunction; (2) pregnancy, vaginal delivery in the process of serious birth injuries, haemorrhage; (3) combined with coagulation

disorders, cardiovascular and cerebrovascular diseases; (4) combined with neuromuscular disease; (5) combined with mental anomalies, depression, anxiety, and other psychiatric disorders; (6) previous hysterectomy; (7) other factors affecting the quality of the ultrasound image.

2.2. Methodology

In terms of the ultrasound diagnosis, all women underwent pelvic floor ultrasound, and those whose test results showed the presence of pelvic floor laxity were considered to be patients with postpartum stress urinary incontinence. Pelvic floor ultrasound was performed using a two-dimensional, colour Doppler ultrasound diagnostic instrument, with a probe frequency of 3.0–5.0 MHz, a colour Doppler beam speed of 1.0–2.0 cm/s, and an axial scanning position. The first scan was performed by fixing the probe, making the probe slide slowly along the posterior aspect of the pubic symphysis, trying to get as close as possible to the inner cervix and endocervix until the maximum volume of the uterus, and obtaining the horizontal images of the uterus in all its radial lines, and then performing the second scan by moving the probe to the area of the cervical os and attaching the probe to the endocervical os to make the uterine volume relatively larger, and then moving the probe vertically in the centre of the uterine cavity to scan up to the uterine. The whole uterus and uterine adnexa were scanned again to obtain cross-sectional images. All enrolled cases underwent ultrasound examination at the antenatal ultrasound diagnostic clinic of the Centre for Reproductive Medicine of the hospital, where an experienced team of ultrasonographers performed routine examinations. Each time, the ultrasound probe was placed in a head-low-tail-high manner to avoid deformation of the pelvic floor tissues under pressure and was observed in conjunction with abdominal wall muscle contractions, paying attention to changes in the bladder, residual urine volume in the bladder, bladder filling, bilateral uterine size, morphology, and position, etc., as well as recording uterine contraction speed, amplitude, and time, and parameters such as bladder filling, rectal manometry index, and so on.

According to the order of their visits to the clinic were divided into two groups: 53 cases in the ultrasound group, 35 cases in the control group, ultrasound group patients were observed in the obstetrics department for uterine restoration, and then used a unified drug + electrical stimulation for rehabilitation, the specific content is as follows:

(1) Estrogen: given ethinyl estradiol orally, 20 mg twice a day, each time to be taken for 3 months;

(2) Non-steroidal anti-inflammatory drugs: given naproxen tablets, 10 mg each, 3 times a day for 3 months;

(3) Muscle relaxants: given tamsulosin hydrochloride extended-release capsules 10mg, 3 times daily, for 3 months;

The dosage of the above drugs was adjusted according to the different severity of the patient's condition. Bladder pressure grading and myoelectric response intensity were measured on the 1st, 7th and 14th days after treatment.

2.3. Observation indicators

(1) The sonograms of the uterus in the long axis, short axis, cross-section and vesicourethral system were automatically extracted from the ultrasound images by the "Ultrasound Bed" software, and the uterine contraction rate, the bladder filling degree and the rectal manometric index were calculated, respectively.

(2) When the bladder is 90% full or more, the urine flow rate is measured, and if the urine flow rate is less than 0.4 mL per minute, it is considered abnormal. The rectal manometric index is the difference between rectal pressure and bladder pressure, the smaller the rectal manometric index, the better the pelvic floor muscle tone.

2.4. Statistical methods

SPSS 23.0 software was applied for statistical analysis, the measurement information was expressed as mean ± standard deviation (SD), and *t*-test was used for comparison, and the count information was expressed as a rate (%), and χ^2 test was used for comparison, and $P < 0.05$ was considered as a significant difference.

3. Results

3.1. Changes in urodynamic parameters

The mean urinary flow rate on the 1st, 7th and 14th day after treatment was (79.65 ± 1.24)%, (80.34 ± 2.14)% and (86.40 ± 2.03)% in the ultrasound group and (65.46 ± 1.58)%, (71.09 ± 1.47)% and (85.34 ± 2.69)% in the control group, respectively, and the difference was statistically significant in all of them ($P < 0.05$).

The intensity of myoelectric response in the ultrasound group was (1.69 ± 0.88) points on the 1st day, (3.41 ± 0.98) points on the 7th day, and (4.21 ± 0.77) points on the 14th day after the treatment, and the intensity of myoelectric response in the control group was (1.71 ± 0.91) points on the 1st day, (2.41 ± 0.78) points on the 7th day, and (3.12 ± 0.81) points on the 14th day. Ultrasound detection group The intensity of myoelectric response on day 7 and day 14 after treatment was significantly higher than that of the control group, and the difference was statistically significant ($P < 0.05$) (**Table 1**).

Table 1. Changes in urodynamic indices

Groups	Mean urine flow rate (%)			Strength of myoelectric response (points)		
	Day 1	Day 7	Day 14	Day 1	Day 7	Day 14
Ultrasound group ($n = 53$)	79.65 ± 1.24	80.34 ± 2.14	86.40 ± 2.03	1.69 ± 0.88	3.41 ± 0.98	4.21 ± 0.77
Control group ($n = 35$)	65.46 ± 1.58	71.09 ± 1.47	85.34 ± 2.69	1.71 ± 0.91	2.41 ± 0.78	3.12 ± 0.81
t	47.059	23.311	2.104	0.103	5.066	6.367
P	0.000	0.000	0.038	> 0.05	0.000	0.000

3.2. Comparison of uterine contractions between the two groups of patients

The peak time of the strongest uterine contraction in the observation group (53 cases) was (7.36 ± 0.87) d postpartum, and the peak time of the strongest uterine contraction in the control group (35 cases) was (25.12 ± 1.24) d postpartum, which was significantly better than that of the control group ($P < 0.05$). The time of uterine regrowth after delivery in the observation group was (32.69 ± 2.47) d postpartum, and that in the control group was (45.36 ± 2.69) d, the control group was slow and worse than the observation group ($P < 0.05$) (**Table 2**).

Table 2. Comparison of uterine contractions between the two groups of patients

Groups	Time to peak uterine contractility (d)	Time to uterine rejuvenation (d)
Ultrasound group ($n = 53$)	7.36 ± 0.87	32.69 ± 2.47
Control group ($n = 35$)	25.12 ± 1.24	45.36 ± 2.69
t	78.993	22.730
P	0.000	0.000

4. Discussion

Currently, the diagnosis regarding postpartum stress urinary incontinence mainly includes pelvic floor X-ray, colposcopy and pelvic floor ultrasound detection. As ultrasound has the advantages of being non-invasive, inexpensive, and easy to operate, it has become one of the preferred methods for clinical diagnosis of urinary incontinence. Previous studies have shown that pelvic floor ultrasound can detect lesions in the anatomical structures of the bladder (e.g., bladder neck, urethral sphincter, pubococcygeal ligament, and periurethral muscles) as well as in the soft tissues surrounding the bladder. There are several reasons why stress incontinence occurs in postpartum women. It may be related to damage to the pelvic floor tissues caused by pregnancy or childbirth, or it may be caused by a decrease in hormone levels after delivery, which results in pelvic floor tissue relaxation. There is also a belief that caesarean section may increase a woman's risk of urinary incontinence, whereas natural childbirth may relatively reduce this risk [7]. However, there is no conclusive evidence that natural birth is more likely to result in stress incontinence than caesarean section. Based on this, this paper focuses on whether women who give birth naturally develop stress urinary incontinence. Notably, for patients who develop stress incontinence in the early postpartum period, rehabilitation should be started as early as possible to minimize complications.

Early postpartum stress urinary incontinence (SUI) is a common pelvic floor dysfunction disorder in women, which seriously affects the quality of life and physical and mental health of women. In this study, we compared and analyzed the differences in bladder pressure grading, electromyographic response intensity and uterine contraction between women with SUI and normal women through pelvic floor ultrasonography, and explored the value of pelvic floor ultrasonography in the diagnosis and treatment of SUI.

The results of the study showed that the mean urinary flow rate of the ultrasound group was significantly higher than that of the control group on the 1st, 7th and 14th days after treatment ($P < 0.05$), indicating that pelvic floor ultrasonography was effective in improving the voiding function of women with SUI, which may be related to the fact that ultrasonography can accurately assess the function of the pelvic floor muscles and muscle strength, thus guiding the individualization of the treatment plan. In addition, the intensity of myoelectric response in the ultrasound group was also significantly higher than that in the control group on the 7th and 14th days after treatment ($P < 0.05$), further confirming the important role of pelvic floor ultrasound in assessing the recovery of pelvic floor muscle function.

In terms of uterine contraction, the time to the peak of the strongest uterine contractility was significantly earlier in the observation group than in the control group ($P < 0.05$), and the time to uterine restoration was significantly shorter than in the control group ($P < 0.05$), which suggests that pelvic floor ultrasonography not only improves the symptoms of SUI, but also may promote uterine contraction and restoration, a finding consistent with the results of previous studies, and suggests that pelvic floor ultrasound in postpartum rehabilitation has multiple benefits [8].

Pelvic floor ultrasound, as a non-invasive and reproducible examination method, can visualize the anatomical structure of the pelvic floor and dynamically observe the movement of pelvic floor organs. The results of this study further confirmed its advantages in the diagnosis and treatment of SUI. By accurately assessing pelvic floor muscle function and muscle strength, pelvic floor ultrasound provides an important basis for early clinical diagnosis and individualized treatment.

However, there are still some limitations to this study. First, the sample size was relatively small, which may affect the representativeness of the results. Second, long-term follow-up data were lacking to assess the long-term effect of pelvic floor ultrasound on the prognosis of SUI. Future studies may expand the sample size and

extend the follow-up period to further validate the value of pelvic floor ultrasound in the diagnosis, treatment, and prognostic assessment of SUI.

5. Conclusion

In conclusion, pelvic floor ultrasound can accurately assess pelvic floor muscle function and muscle strength in women with SUI in the early postpartum period, which can help early clinical diagnosis and treatment. Ultrasonography not only improves SUI symptoms but also may promote uterine contraction and recuperation. As a non-invasive and reproducible examination method, pelvic floor ultrasound has important application value in the diagnosis and treatment of postpartum SUI. Future studies may further explore the application of pelvic floor ultrasound in the prognostic assessment and personalized treatment of SUI, providing more evidence-based evidence for the comprehensive management of postpartum SUI. For women with stress urinary incontinence in the early postpartum period, early pelvic floor rehabilitation and ultrasound testing can better guide their later treatment and achieve better therapeutic results. Of course, the observation of the long-term efficacy of ultrasound combined with medication in the treatment of postpartum urinary incontinence needs to be further strengthened in order to provide a more accurate and effective reference basis for the clinic.

Disclosure statement

The authors declare no conflict of interest.

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