ORIGINAL RESEARCH ARTICLE

Clinical value of perineal ultrasound in diagnosis of pelvic floor dysfunction in women

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Abstract

This study evaluates the clinical utility of transperineal 3D ultrasound in diagnosing pelvic floor dysfunction (PFD) and assessing uterine morphological changes in women. A total of 150 women with PFD and 100 healthy controls were examined. Measurements included anterior-posterior diameter, transverse diameter, and bladder neck and cervical mobility during Valsalva movement. No significant differences were found in demographic indicators between the groups. However, the observation group showed larger pelvic diaphragm fissures at rest, during tension, and anal contraction compared to controls, while anal levator muscle thickness was significantly lower. During Valsalva, bladder neck mobility and cervical descent were more pronounced in the PFD group, with statistically significant differences ($p < 0.05$). These findings indicate that transperineal 3D ultrasound provides an accurate, efficient, and detailed visualization of pelvic floor structures, aiding in diagnosis and treatment planning for PFD. The technique holds promise for broader clinical application. *(Afr J Reprod Health 2025; 29 [2]: 42-48).*

Keywords: female pelvic floor dysfunction diseases; perineal 3D ultrasound examination; uterine morphology changes; clinical value

Résumé

Cette étude évalue l'utilité clinique de l'échographie transpérinéale 3D pour diagnostiquer le dysfonctionnement du plancher pelvien (VFI) et évaluer les changements morphologiques utérins chez les femmes. Au total, 150 femmes porteuses de VFI et 100 témoins sains ont été examinés. Les mesures comprenaient le diamètre antéro-postérieur, le diamètre transversal, ainsi que la mobilité du col de la vessie et du col vésical pendant le mouvement de Valsalva. Aucune différence significative n'a été trouvée dans les indicateurs démographiques entre les groupes. Cependant, le groupe d'observation a montré des fissures du diaphragme pelvien plus grandes au repos, pendant la tension et la contraction anale par rapport aux témoins, tandis que l'épaisseur du muscle releveur anal était significativement plus faible. Pendant Valsalva, la mobilité du col vésical et la descente cervicale étaient plus prononcées dans le groupe PFD, avec des différences statistiquement significatives ($p < 0,05$). Ces résultats indiquent que l'échographie transpérinéale 3D fournit une visualisation précise, efficace et détaillée des structures du plancher pelvien, facilitant ainsi le diagnostic et la planification du traitement du VFI. La technique est prometteuse pour une application clinique plus large. *(Afr J Reprod Health 2025; 29 [2]:42-48).*

Mots-clés: maladies liées au dysfonctionnement du plancher pelvien chez la femme ; échographie périnéale 3D ; modifications de la morphologie utérine ; valeur clinique

Introduction

Female Pelvic Floor Dysfunction (FPFD) is a group of diseases mainly caused by the following factors of pelvic support structure such as defects, degeneration, injury and dysfunction. The common ones include stress urinary incontinence, pelvic organ prolapse, sexual dysfunction, chronic pelvic pain, and fecal incontinence[1]. Pelvic floor dysfunction disorders are caused by pregnancy, childbirth, aging, obesity, cough, constipation and other reasons resulting in pelvic floor muscle injury, which in turn affects the function of the pelvic floor around[2]. The pelvic floor has the functions of support, support, reduction and pacification, which can support several organs in the pelvic cavity, such as the bladder, urethra, uterus, vagina and rectum, to maintain the tension of the soft tissues at the bottom of the basin as well as the strength and elasticity of the pelvic floor muscles. It is crucial to ensure the

following kinds of activities for women, such as enhancing sexual response and urinary system function during vaginal delivery and sexual intercourse[3]. The pelvic outlet is provided with multiple layers of soft tissues such as muscles and fascia, which can close the pelvic outlet and support and maintain the normal position of pelvic organs such as bladder, uterus and rectum in order to exercise their inclusive function. When the pelvic floor opening is damaged by external force, the body structure cannot be configured for normal use. Therefore, this disease seriously affects the quality of life of women, and it requires early diagnosis and prompt treatment. At present, the diagnostic methods include pelvic floor Computed Tomography (CT), nuclear magnetic resonance imaging (MRI), ultrasound, and other methods. Transperineal ultrasound is currently a common imaging diagnosis and treatment method for female pelvic floor dysfunction, and ultrasound is widely used in diagnosis and treatment[4]. With recent advancements o in science and technology, people have great demand for higher living standards and healthy lifestyles. Three-D ultrasound has gradually increased its clinical application on account of its high economic efficiency, wound-free and radiation-free scanning. and imaging technology.

The objective of this study was to explore the clinical value of transperineal 3D ultrasound in the diagnosis and treatment of female pelvic floor dysfunction and evaluate the uterine morphological changes that take place during this process, which is conducive to early and accurate diagnosis of pelvic floor dysfunction, and provide a key basis for the formulation of clinical treatment plans, so as to improve the diagnosis and treatment level of female pelvic floor dysfunction and improve the quality of life of patients. It has important clinical practice significance.

Methods

General material

A total of 150 patients with pelvic floor dysfunction who were admitted to the Department of Gynecology of General Hospital of Ningxia Medical University from January 2020 to August 2021 were randomly allocated as the study group, while 100 healthy women without pelvic floor dysfunction at the same time were included in the control group. The diagnostic criteria of pelvic floor dysfunction mainly include two aspects: one is based on the patient's symptoms, such as urinary incontinence (stress, urgency, etc.), abnormal bowel movement (incontinence or difficulty), pelvic organ prolapse and sexual dysfunction; The second is to comprehensively determine the functional status and structural abnormalities of pelvic floor muscles, nerves and organs through physical examination (perineal appearance, pelvic internal palpation to evaluate organ prolapsion and muscle contraction force) and auxiliary examination (urodynamics, anorectal manometry, pelvic floor electromyography, etc.).In the observation group, there were 53 cases of pelvic floor organ prolapse, 57 cases of stress incontinence, and 40 cases of both. As shown in Table 1, there was no significant difference in general information between the two groups within the statistical scope ($P > 0.05$).

Criteria of inclusion and exclusion

The inclusion criteria included the following: (1) All subjects in the observation group met the relevant conditions for pelvic floor dysfunctioz[5]: The diagnosis was confirmed by asking questions about the medical history, examinations, clinical manifestations and differential diagnosis and treatment. We investigated whether there were clinical manifestations of organ prolapse and urinary incontinence, including foreign body sensation when walking and urine overflow. The diagnosis and treatment can be further clarified through pad test, urodynamic examination and gynaecological examination. In addition, the pap smear was used to evaluate the exfoliated cells of the cervix to identify organ prolapse and tumor. (2) No patient Had past history of cesarean section and other uterine operations, and none had complications during pregnancy. (3) Only patients with complete information were included. (4) The patient and close relatives provided informed consent and voluntarily accepted the diagnosis, treatment, and the follow-up visit lasting for 8 weeks after the diagnosis and treatment.

The exclusion criteria included the following: (1) patients refused to sign the informed consent form; (2) patients with other malignant tumors; (3) the pelvic organ prolapse grades were all Stage 0[6]; and (4) case information is incomplete.

Process

1. Emptying the bladder was requested before examination to avoid the full bladder pushing the

uterus and adnexa farther[7]. The frequency used was 5.00 ~ 6.25 MHz, at the transmitting angle of probe is 175°, and the swing angle of 146°. During the examination, bladder stone position was taken, a small amount of coupling agent was added to the vaginal probe coat for disinfection condom, and disinfectants were applied inside and outside the probe. The probe was placed close to the patient's perineum and the position of the probe was adjusted to obtain a clear and satisfactory image. Transvaginal ultrasound was suitable for married women because the probe could be placed in the vagina during the examination. For women with uterine bleeding during menstrual periods, more attention were paid to aseptic operation, and examination was performed only after disinfection. The subject was then asked to cooperate with the maximum Valsalva maneuver. Thereafter, the 3D imaging mode was activated and pelvic floor scanning was performed in three states, namely, resting state, Valsalva maneuver. and anal retraction maneuver. Three D ultrasound images were obtained, and the test results were recorded and analyzed, which were judged jointly by more than two senior specialists, and the results were consistently considered valid.

The precautions were as follows[8]:

1. As with routine vaginal ultrasonography, the patient needed to empty the bladder early and a double-layer condom was used to wrap the probe during the examination to avoid cross infection.
2. For suspected endometrial polyps and submucosal fibroids, it is recommended to examine within 3 days after menstruation.
3. In the case of suspected cesarean section diverticulum, examination is recommended during postmenstrual spotting, during which a small amount of menstrual blood may remain in the diverticulum, which can provide a strong basis for diagnosis.
4. Unmarried women with hymen atresia and vaginal deformity are not suitable for this procedure.

Observed indicators

These included:

(1) Demographic data of the two groups were compared: age, average parity, etc.;

(2) Compared with the observation group and the control group, the following image characteristics: were compared : anteroposterior diameter ofs the pelvic diaphragmatic hiatus, transverse diameter of the pelvic diaphragmatic hiatus and levator ani muscle thickness, were analyzed and compared.

(3) Compared with the observation group and the control group, the bladder neck movement and cervical position under Valsalva maneuver state were compared.

Statistical analysis

SPSS20.0 statistical software was used for statistical analysis. The measurement data were expressed as ($\bar{x} \pm s$) in accordance with the normal distribution and the homogeneity of variance. The mean t test of two independent samples was applied. If the variance was not homogeneity, the corrected t test was used. If it does not conform to the normal distribution, the rank sum test is applied. Count data were expressed as number of cases or percentage (%) using a nonparametric test.

Ethical considerations

This study was reviewed and approved by the Ethics Committee of our hospital, and all the patients and their families received informed consent. This study was conducted in compliance with the Declaration of Helsinki and all applicable ethical guidelines. This study was conducted in compliance with data protection regulations. The use of personal data was approved by the Ethics Committee, ensuring that all data was anonymized and securely stored.

Results

Comparison of socio-demographic indices of the two groups

As shown in Table 1, the differences in demographic indicators between the two groups by analogy were not statistically significant ($P > 0.05$),.

Comparison of image characteristics of transperineal 3D pelvic floor ultrasound between the two groups

The anterior-posterior and transverse diameters of the pelvic hiatus in the control group under three states, resting state, tension state and anal contraction state, were both smaller than those in the observation group.

Table 1: Comparison of various indexes of the two groups ($\bar{x} \pm s$)/n(%)

Characteristics	Control group (n=100)	Observation group (n=150)	t/χ^2	*P*
Age (years)	40.22±5.30	39.33±3.33	0.754	0.456
Number of births			3.862	0.278
0	15 (15.00)	35 (23.33)		
1	36 (36.00)	41 (27.33)		
2	29 (29.00)	40 (26.67)		
≥3	20 (20.00)	34 (22.67)		

Table 2: Comparison of image characteristics of transperineal 3D pelvic floor ultrasound between the two groups ($\bar{x} \pm s$)

Image Characteristics	State	Control group (n=100)	Observation group (n=150)	t	*P*
Anteroposterior diameter of pelvic diaphragmatic hiatus (cm)	Resting	4.08±0.19	5.66±0.16	22.384	0.000
	Anal contraction	4.07±0.20	4.36±0.11	26.321	0.000
	Tension	4.88±0.19	6.32±0.51	21.365	0.000
Transverse diameter of pelvic diaphragmatic hiatus (cm)	Resting	4.00±0.15	4.93±0.31	15.334	0.000
	Anal contraction	3.99±0.11	4.89±0.18	14.365	0.000
	Tension	4.05±0.21	5.01±0.19	13.354	0.000
Levator ani muscle thickness (cm)	Resting	0.92±0.18	0.50±0.17	10.354	0.000
	Anal contraction	0.88±0.13	0.59±0.22	9.324	0.000
	Tension	0.91±0.17	0.55±0.21	7.364	0.000

Table 3: Comparison of the bladder neck mobility and cervical decline in Valsalva action state in the two groups ($\bar{x} \pm s$)

Characteristics	Control group (n=100)	Observation group (n=150)	t	*P*
Bladder neck mobility (cm)	23.88±5.31	15.32±4.34	5.357	0.000
Cervical descent (cm)	18.35±6.18	10.67±4.19	6.324	0.000

The thickness of the levator ani was larger relative to that in the observation group, and the difference had reference value within the statistical scope ($P < 0.05$), as shown in Table 2.

Comparison of the bladder neck mobility and cervical decline in Valsalva action state in the two groups

In the Valsalva maneuver state, the bladder neck mobility and cervical descent in the observation group were greater than those in the control group, and the difference was statistically significant ($P < 0.05$), as shown in Table 3

Discussion

Pelvic floor dysfunction, also known as pelvic floor muscle defects or pelvic floor supporting tissue relaxation, causes weak pelvic floor support due to various causes. It results in pelvic organ displacement and linkage, triggering abnormal position and function of other pelvic organs, which is collectively known as pelvic floor dysfunction disease[9]. There are many causes of pelvic floor dysfunction, and studies have shown that it is related to age, genetics, drugs, lifestyle and other factors[10]. A well-established factor is now recognized to be associated with pregnancy and delivery. Pregnancy and vaginal delivery are important causes of pelvic floor dysfunction in women of reproductive age. Its diseases mainly include several categories. These include pelvic organ prolapse and uterine prolapse bulging of the anterior vaginal wall, bulging of the posterior vaginal wall; . urinary incontinence; fecal incontinence, including fecal incontinence or constipation; sexual dysfunction, including anorgasmia, dyspareunia, and vaginismus; and chronic pelvic pain[11]. The illness does not only

affect the normal life of patients, but also cause great harm to physical health. Therefore, achieving early diagnosis and early treatment of the disease can help to avoid the deterioration of the disease, reduce the incidence of adverse consequences, and improve the quality of life of patients.

In recent years, advances in science and technology have brought about the development of imaging technology. For example, pelvic floor CT, MRI, ultrasound and other methods can be used for the diagnosis of female pelvic floor dysfunction. Pelvic floor CT is a common diagnostic method, but it is usually not used for the examination of pelvic floor dysfunction because the pelvic floor structure cannot be displayed at the same time, and there is ionizing radiation and cumbersome operation. Pelvic floor MRI is currently the most direct imaging examination method to show the pelvic floor anatomy and determine pelvic floor muscle dysfunction. Its high-resolution and high-contrast soft tissue development can provide the anatomical details of pelvic floor tissue. Multi-slice and multi-directional imaging can evaluate the pelvic organs through non-invasive examination. This permits the evaluation of the function of pelvic floor organs through pelvic floor static and dynamic imaging, which can provide a more comprehensive and accurate diagnosis with good tissue resolution. However, it is not applicable to those with metal substances in the body, and has the drawbacks of high price and long examination time[12].

In contrast, 3D ultrasound has the advantages of no ionizing radiation, non-invasive, economic, real-time dynamic observation, etc., and has high resolution for soft tissues, clear display of the anatomical structure of the pelvic floor, and high repeatability, so ultrasound examination is usually used for the examination of pelvic floor function[13]. The results of this study indicate that the anteroposterior and transverse diameters of the pelvic diaphragmatic hiatus in the control group were smaller than those in the observation group at rest, tension, and anal contraction. The levator ani muscle thickness was also significantly in the control group was greater than that in the observation group. These results suggest that patients with pelvic floor dysfunction have poor pelvic floor support system function and abnormal pelvic floor structure. The observation and measurement of pelvic septal hiatus in the transverse pelvic floor section is the key to the diagnosis of pelvic floor dysfunction. It is an important indicator to measure whether pelvic floor function is normal, and it can be used as the diagnostic basis for clinical diagnosis of pelvic floor dysfunction[14].

Du Haiwen *et al.*[15] showed that the feasibility study of transperineal and transvaginal 3D ultrasound in the assessment of female anal sphincter is of clinical application. In this study, patients were observed using bladder neck mobility and cervical position. Increased bladder neck mobility refers to bladder neck mobility exceeding the normal range and often suggests the development of stress urinary incontinence. Not only the phenomenon of urinary incontinence, but this also increases the mental burden of patients, resulting in anxiety, irritability, tension, restlessness or depression and other negative emotions[16].

The downward movement of the bladder neck can be assessed by measuring the relevant data of the anterior pelvic cavity and bladder (such as the posterior horn of the vesicourethral), the location and function of the cervix can be observed through the middle pelvic cavity, the perianal muscle groups such as the rectum and levator ani muscle can be observed through the posterior pelvic cavity, and the causes of pelvic floor dysfunction in patients can also be judged to a certain extent (such as the correlation between overactive bladder and detrusor thickness)[17]. The effect caused by the change in the position of the cervix did not produce a significant change in the previous period. Later, due to cervical ptosis can cause backache, lower abdominal bulge, especially for pregnant women. Huang Hu[18] and other studies suggest that transperineal real-time 3D ultrasound can clearly and dynamically observe the pelvic floor structure during pregnancy, and can be quantitatively evaluated, which is conducive to the production and prognosis of pregnant women. 3D ultrasound of the perineum dynamically obtains the pelvic floor axial plane structure and image through multiplanar imaging, which can achieve early detection and early diagnosis, and then help patients with clinical symptoms or mild clinical symptoms in time to restore pelvic floor function as soon as possible, avoid disease progression, and lay a good foundation for the physical health of women [19]. Real-time 3D ultrasound of the perineum can complete the examination in a noninvasive state, fully and completely display the pelvic floor structure, maximize patient comfort, and avoid

changes in the structure and location of pelvic floor organs, which has a high clinical application value [20].

Study strengths and limitations

We conclude that transperineal real-time 3D ultrasound can directly reflect the structure and function information of female pelvic floor, real-time observation of pelvic floor muscles, provide a reliable basis for clinical diagnosis of pelvic floor dysfunction, facilitate early treatment and intervention measures to control the development of the disease, and is of great significance to ensure the physical health of women. However, this study still has certain limitations. For example, it is a single-center study with a small sample size and has not discussed the population of different age stages. Moreover, this technology is still in the stage of continuous development and improvement, and more clinical studies are needed to further verify its value. With the advancement of technology and in-depth research, three-dimensional perineal ultrasonography for diagnosing pelvic floor dysfunction of total hysterectomy is expected to be more widely used and promoted in gynecological clinical practice and provide better medical services for patients.

Conflict of interests

The authors declare no competing interests.

Authors' contributions

Yan Zhu and Jiajia Liu contributed equally to the conceptualization and design of the study. Linlin Guo conducted the data collection and statistical analysis. Wen Wang contributed to the ultrasound imaging and interpretation. Haiyan Wang provided oversight for the study, supervised the research process, and critically reviewed the manuscript. All authors contributed to drafting and revising the manuscript and approved the final version for submission.

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References

1. Louis-Charles K, Biggie K, Wolfinbarger A, Wilcox B **and** Kienstra CM. Pelvic Floor Dysfunction in the Female Athlete. ***Curr Sports Med Rep.*** 2019;18(2):49-52.
2. Oliveira DA, Parente MPL, Calvo B, Mascarenhas T **and** Natal Jorge RM. A holistic view of the effects of episiotomy on pelvic floor. ***Int J Numer Method Biomed Eng.*** 2017;33(12)
3. Preda A **and** Moreira S. Incontinência Urinária de Esforço e Disfunção Sexual Feminina: O Papel da Reabilitação do Pavimento Pélvico [Stress Urinary Incontinence and Female Sexual Dysfunction: The Role of Pelvic Floor Rehabilitation]. ***Acta Med Port.*** 2019;32(11):721-726.
4. Benezech A, Cappiello M, Baumstarck K, Vitton V, Grimaud JC **and** Bouvier M. Rectal intussusception: can high resolution 3D ano-rectal manometry compete with conventional defecography? ***Neurogastroenterol Motil.*** 2017;29(4)
5. Lian W **and** Wang M. Effect of Vaginal Delivery on Pelvic Floor Function in Primiparous Women and Related Interventions. ***Electron J Clin Med Lit.*** 2018;5(17):99, 101.
6. Li H. Effect of pelvic floor muscle training on pelvic floor function and quality of life in patients with pelvic floor dysfunction. ***Matern Child Health Care China.*** 2018;33(4):748-751.
7. Li P. Effect of postpartum pelvic floor rehabilitation time selection on urinary incontinence and pelvic floor muscles. ***Med Dietotherapy Health.*** 2020;(15):107, 109.
8. Ning Q. Effect of 3D ultrasonography in the diagnosis and treatment of early pelvic floor dysfunction. ***Imaging Res Med Appl.*** 2022;6(8):173-175.
9. Egorov V, Lucente V, Van Raalte H, Kalighatgi S, Kim J, Terry C **and** Sarvazyan A. Biomechanical mapping of the female pelvic floor: changes with age, parity and weight. ***Pelviperineology.*** 2019;38(1):3-11.
10. Bauer A. Dysfunctional voiding: update on evaluation and treatment. ***Curr Opin Pediatr.*** 2021;33(2):235-242.
11. Guo H **and** Zhang P. Progress in mesh for the diagnosis and treatment of pelvic floor dysfunction. ***Ind Text.*** 2021;39(8):1-6.
12. Li P, Peng L, Zhang Q, Zhang X **and** Li X. Value of transperineal ultrasound in the diagnosis and treatment of female pelvic floor dysfunction. ***Imaging Res Med Appl.*** 2020;4(11):56-59.
13. Mona N. Clinical value of 3D ultrasonography in the diagnosis and treatment of female pelvic floor dysfunction. ***Shanxi Med J.*** 2019;48(4):429-431.
14. Zhang C **and** Ge H. Pelvic floor characteristics and risk factors of puborectalis muscle injury in early women after vaginal delivery under 3D ultrasonography. ***Chin Sexology.*** 2019;28(6):97-100.
15. Du H, Chen B, Zhou M, Zhang X **and** Li X. Feasibility study of transperineal and transvaginal 3D ultrasound

in the assessment of female anal sphincter. ***J Clin Ultrasound Med.*** 2021;23(9):646-649.

16. Yang J, Ding J, Ma Y, Li X **and** Zhang X. Effect of comprehensive pelvic floor muscle training combined with humanistic care on improving bladder dysfunction and postoperative depression after radical resection of cervical cancer. ***Clin Res.*** 2021;29(11):185-186.
17. Feng H. Clinical value of transperineal 3D ultrasound pelvic floor ultrasonography and MRI in the diagnosis and treatment of female pelvic floor dysfunction. ***Chin J CT MRI.*** 2021;19(3):118-120.
18. Huang H, Yu B, Zhao Y, Li X **and** Zhang X. Application value of transperineal 3D ultrasonography in pelvic floor of pregnant women during pregnancy. ***J Med Res.*** 2021;50(7):117-120.
19. Wang G, Fan L, Wu X, Li X **and** Zhang X. Analysis of the value of transperineal real-time 3D ultrasonography in the diagnosis and treatment of female pelvic floor dysfunction. ***Mod Med Imaging.*** 2021;30(12):2352-2354.
20. Wu S, Zhang M, Huang Z, Li X **and** Zhang X. Application value of transperineal 3D/four-dimensional pelvic floor ultrasound in the diagnosis and treatment of female urethral diverticulum. ***Chin J Ultrasound Imaging.*** 2020;29(9):777-780.