Transabdominal Ultrasound Measurement of Pelvic Floor Muscle Mobility in Men With and Without Chronic Prostatitis/Chronic Pelvic Pain Syndrome

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OBJECTIVE To investigate the pelvic floor muscle motion in men with and without chronic prostatitic/chronic pelvic pain syndrome using transabdominal ultrasound. No study has directly evaluated pelvic floor muscle mobility in individuals with and without chronic pelvic pain syndrome.

METHODS A convenience sample of 40 males participated in the study. Subjects were categorized into 2 groups: those with chronic pelvic pain syndrome (n = 20) and those without chronic pelvic pain syndrome (n = 20). The amount of bladder base movement on ultrasound (normalized to body mass index) was measured in all subjects and considered as an indicator of pelvic floor muscle mobility.

RESULTS Statistical analysis (independent *t*-test) revealed significant difference in transabdominal ultrasound measurements for pelvic floor muscle function between the 2 groups ($P = .03$, 95% CI −0.26 to −0.01).

CONCLUSION The results of this study indicate that pelvic floor muscle mobility differs in the 2 groups. UROLOGY 80: 673–677, 2012.

Prostatitis is one of the most frequent urologic syndromes in male individuals and is marked by pain and/or inflammation of the prostate or surrounding tissues. Previous studies have indicated that up to 50% of adult men have had symptoms of prostatitis in their lifetime.[1,2] In new classification of prostatitis proposed by the National Institutes of Health (NIH), this syndrome is classified to 4 categories: (1) Acute bacterial prostatitis, (2) Chronic bacterial prostatitis, (3) chronic prostatitis/chronic pelvic pain syndrome (CPPS), and (4) asymptomatic inflammatory prostatitis.[3,4] CPPS accounts for 90% of cases of prostatitis and is characterized by the complaint of discomfort or pain in the pelvic region for at least 3 months of duration within the last 6 months. The suprapubic or perineal region, testis, tip of the penis, and low back area may be painful. CPPS patients sometimes have urinary symptoms and sexual dysfunction.[2,5]

The symptoms of patients with CPPS are evaluated by the NIH Chronic Prostatitis Symptom Index (NIH-CPSI). This index that addresses 3 different and important aspects of CPPS (pain, urinary function, and quality of life) provides a valid outcome measure for men with CPPS.[3-5]

Despite its detrimental effects on social and work-related activities, the exact cause of CPPS has not yet been determined. Several factors, such as autoimmunity, psychological factors, and dysfunction of pelvic floor muscles (PFMs), have been associated with CPPS.

However, in recent decades the main focus has been placed on PFM and its association with CPPS.[6-8] Because of its close relation and same innervation as pelvic visceral organs (eg, prostate gland) and PFM, the pain of each imitates the pain of the other; this means that increased tension, spasm, and trigger points of PFM mimic the symptoms of real prostatitis.[9]

Some studies have demonstrated PFM tender points in men with CPPS and pain relief after myofascial release of trigger points.[10-14] Medical massage of the abdominal

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integuments has been shown to be effective at improving International Prostate Syndrome Scale and quality of life.[15]

Electromyographic (EMG) studies indicated a decreased PFM endurance in men with CPPS compared with controls.[16] Cornel et al[17] found a decline in EMG activity after biofeedback. However, intra-anal EMG is a highly invasive procedure that may not be desirable in most populations and has been criticized for low reliability.[18]

Real-time ultrasound imaging is a reliable and valid method that has been used recently to evaluate muscle structure, size, motion, and activity. The value of ultrasound imaging is that it allows for real-time study of the muscles as they contract. This is particularly valuable when the function of deep muscles, such as the PFM, is investigated.

Recently there has been more interest in the use of transabdominal (TA) ultrasound to evaluate PFM movement.[19-22] It has been established as a completely safe, noninvasive, and accessible method for visualizing and measuring PFM contraction. This technique is quick and easy to apply, is comfortable for the patient, and is appropriate in specific populations where internal assessment may not be desirable (eg, men, children, adolescents, victims of sexual abuse, some ethnic groups). Because the bladder is supported by PFMs and their fascia, tensioning of the fascia after PFM contraction results in encroachment of the bladder wall. The amount of movement of the bladder base on TA ultrasound is considered an indicator of PFM mobility during muscle contraction in this imaging method.

A significant correlation has been found between the measurements taken using TA and transperineal ultrasound, perineometry, and manual muscle testing for PFM assessment.[20,22] Considerable literature has been devoted to assessment of PFM in women with urologic dysfunctions or lumbopelvic pain using TA ultrasound.[23,24] To our knowledge, no study has directly evaluated PFM mobility in men with and without CPPS using TA ultrasound measurement.

Considering the importance of evidence-based practice, the purpose of this study was to investigate the PFM motion using TA ultrasound in men with CPPS and those with no symptoms of CPPS.

The hypothesis of this study is as follows: The men with CPPS have significantly lower PFM mobility compared with those without CPPS.

MATERIAL AND METHODS

Subjects

This research was reviewed and approved by the human Subject Committee at the University of Social Welfare and Rehabilitation Sciences, Tehran.

A cross-sectional study design was used to compare the PFM function of 40 men divided into 2 groups: those with CPPS (n = 20) and those without CPPS (n = 20). The subject population in this study was a convenience sample made up of subjects between the ages of 25 and 65 years. The subjects with CPPS had been claimed by a urologist to have symptoms of CPPS. All subjects fulfilled a questionnaire containing personal data (age, height, and weight) and an NIH-CPSI questionnaire. Patients were included if they had pelvic pain or discomfort for at least 3 months with no identified pathologic condition to explain the symptoms, and NIH-CPSI >15.[3,4] Asymptomatic males matched in age and body mass index (BMI) were defined as persons with no pelvic pain or history of any other urologic disorder, and with an NIH-CPSI of 0.

Subjects were excluded if they had urinary tract infection, epididymitis, positive cultures for *Chlamydia trachomatis* or *Neisseria gonorrhoeae*, prostatic surgery, genitourinary malignancy, a history of pelvic radiation or genitourinary tuberculosis, or pain from another source in the genitourinary tract (eg, renal calculi).

All participants signed an informed consent form approved by the Human Subjects Committee at the University of Social Welfare and Rehabilitation Sciences before participating in the study. Physical characteristics of the subjects are shown in Table 1.

Table 1. Demographic data of the men in each group (mean ± SD)

Variables	Without CPPS (n = 20)	With CPPS (n = 20)
Age (y)	40.17 ± 6.75	43.94 ± 14.81
Weight (kg)	74.41 ± 14.21	81.63 ± 14.29
Height (cm)	174.53 ± 6.49	174.69 ± 8.86
BMI (kg/m^2)	24.43 ± 4.46	26.63 ± 3.17

Procedure

A diagnostic ultrasound imaging unit set in B-mode (Ultrasonix-ES500, Burnaby, B.C., Canada) with a 3.5-MHz curved (convex) array transducer was used for TA ultrasound measurement of PFM mobility. The detailed procedure to measure PFM motion has been described by others.[19-22,24-26]

A standardized bladder filling protocol was used before imaging to ensure that subjects had sufficient fluid in their bladders to allow clear imaging of the base of the bladder. The participants were asked to fill their bladder by consuming 600-750 mL of water within 30 minutes, 1 hour before the measurement completed half an hour before testing, without voiding until after the ultrasound assessment. The subjects were tested in a crook-lying supine position with one pillow underneath the head and hips and knees flexed at 60° while the lumbar spine was positioned neutrally. The ultrasound transducer was placed in the transverse plane suprapubically and angled in a caudal/posterior direction to obtain a clear image of the inferior-posterior aspect of the bladder. This angle varied depending on the fullness of the bladder and was between 15 and 30°. A marker was first placed on the bladder base at rest. The participants were then asked to perform a voluntary PFM contraction. They were instructed to "draw in and lift the PFM," and to hold the contraction while breathing normally. When the contraction was visualized on the ultrasound screen, the image was captured and the subjects then relaxed the PFM. The marker was then located on the bladder base at the point of maximal displacement during muscle contraction and the amount of bladder base displacement from the resting position at the end of each contraction was measured in millimeters. Subjects held the contraction for no longer than 3 seconds. If the bladder base was found to descend during PFM contraction, the displacement was given a negative value. The ultrasound transducer was not moved during the testing procedure and remained constant between rest and maximal contraction. Three PFM contractions were taken with a rest of 10 seconds between each and the mean of the 3 measurements was used for statistical analysis.

Reliability Assessment

Intratester reliability of the TA ultrasound measurements was assessed in 37 subjects. For this purpose, the examiner initially performed measurements in subjects and then after 30 minutes the measurements were repeated in a blinded fashion and in a random order with the same procedure. The subjects and the order of measurements were randomly selected, different from the first examination sequence, to reduce the memory effect.

All testing procedures were performed in the biomechanics laboratory of the Department of Physical Therapy at the University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.

Data Analysis

There is a considerable body of literature showing that body size has a major role in muscle performance.[21,27] Thus, normalization of muscle strength or function in BMI is suggested when compared between 2 or more groups. Considering that subjects with different BMIs may have different PFM mobility, in this study the calculated TA ultrasound measurement for PFM contraction was normalized to their calculated BMI, as described by Arab et el.[21] The normalized measurement was used in data analysis.

The intraclass correlation coefficient (ICC), 2-way mixed effect model was used to assess intratester reliability of the measurement. The 95% limits of agreements method of reliability assessment with a confidence level of 95% was calculated using a Bland-Altman plot to assess absolute reliability.

Independent *t*-test was used to compare the TA ultrasound measurement of PFM movement in men with and without CPPS.

RESULTS

The demographic data for the 2 groups are displayed in Table 1.

There was no statistically significant difference in subjects' ages ($P = .06$), heights ($P = .87$) and weights ($P = .44$) among the 2 groups.

The ICC (3, 1) was 0.84 for repeat measures of the TA ultrasound for PFM contraction. It indicates high intratester reliability for the measurement. The Bland-Altman plot of agreement in measurement between test and retest is shown in Figure 1. The Bland-Altman plot demonstrated that 95% of the observations fall between the limits of agreement for test and retest.

Descriptive statistics (mean ± SD) for the average normalized and non-normalized TA ultrasound measurement of PFM mobility in 2 groups are presented in Table 2. Figure 2 depicts the plot of normalized ultrasound measurement of PFM mobility in men with and without CPPS. There was significant difference ($P = .03$, 95% CI

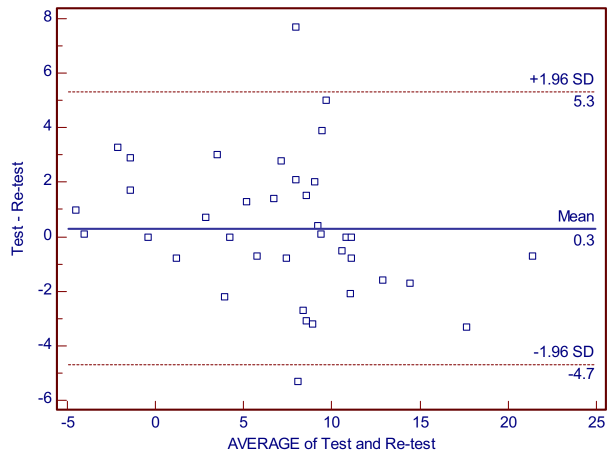

Figure 1. The Bland-Altman plot for TA ultrasound measurements between the test and retest. The mean of the test and retest scores is plotted on the X-axis and the differences between the 2 scores on the Y-axis. The horizontal interrupted lines represent the limits of agreement. (Color version available online.)

−0.26 to −0.01) in TA ultrasound measurements for PFM motion between men with CPPS (0.17 ± 0.19) and those without CPPS (0.31 ± 0.16) (Table 2).

COMMENT

Real-time ultrasound imaging has been recently established as a method to assess muscle structure, mobility, and activation patterns. Ultrasound is frequently used to evaluate the voluntary muscle contraction or automatic muscle function at the unconscious level. However, what we measured in this study was a voluntary contraction and not the automatic recruitment during functional tasks.

The results derived from this study demonstrate high intratester reliability for the TA ultrasound measurements (ICC = 0.84). Similar findings have been reported by others.[19-22] However, the most recent studies assessed the reliability in healthy women or women with urinary disorders. To our knowledge, this is the first study to assess the reliability of TA ultrasound in men. This study suggests TA ultrasound as a reliable method for PFM mobility in men.

Because the bladder is supported by PFM and their fascia, tensioning of the fascia after PFM contraction results in encroachment of the bladder wall. Bladder base movement on TA ultrasound provides information about the functional status of PFM.[28] In this study, the probe was transversely placed on the suprapubic region. The value of this technique is that it allows for visualization of both sides of the pelvic floor at once and any pressure by the ultrasound probe against the abdominal wall, and movement of the abdominal wall, is dissipated by the fluid-filled bladder and provides feedback regarding correct contraction.

The results indicated that men with CPPS have significantly lower PFM mobility compared with those without CPPS when the bladder is full (Table 2). This finding

Table 2. TA ultrasound measurement for PFM mobility in men with and without CPPS

Variables	Without CPPS (Mean ± SD)	With CPPS (Mean ± SD)	*P* Value	95% CI
Bladder base movement on ultrasound (mm)				
Normalized to BMI	0.31 ± 0.16	0.17 ± 0.19	.03	−0.26 to −0.01
Non-normalized to BMI	7.68 ± 3.81	4.55 ± 5.22	.06	−6.41 to 0.14

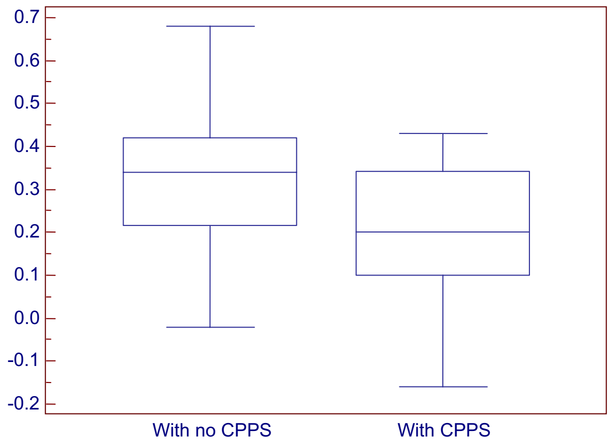

Figure 2. Plot of normalized ultrasound measurement of PFM mobility in men with and without CPPS. (Color version available online.)

complements the results of previous studies indicating that PFM dysfunction is an important factor in CPPS.[10,11]

However, previous clinical studies have used the methods with poor reliability related to PFM findings, such as PFM tenderness or palpation to assess the effect of therapeutic techniques for the treatment of CPPS.[11] Considering the high reliability for TA ultrasound measurement of PFM contraction, it seems that TA ultrasound could potentially be a more objective way to assess PFM mobility.

Investigators have attributed CPPS to the lack of proper PFM function. PFM dysfunction is believed to be associated with increased tension, spasm, and trigger points of PFM.[12-14] Because of the close relation and same innervations of pelvic visceral organs (eg, prostate gland) and PFM, the pain of each imitates the pain of the other.[9] Based on his anatomical studies, Wimpissinger et al[29] showed the importance of the puboprostatic ligaments in urologic dysfunction. We believe that dysfunction of PFM may affect the prostate through the change in tension of the puboprostatic ligaments.

Some studies have demonstrated a reduction in pain after myofascial release for PFM tender points in men with CPPS.[10,17]

Using transperineal ultrasound, Davis et al[8] found changes in PFM morphology in men with CPPS that were related to pain, anxiety, and sexual dysfunction. However, in that study the ultrasound transducer was placed against the perineum while the participants were asked to hold their penis and testicles to allow access to the perineum. This method may be inappropriate for specific populations in which perineal examination may be unpleasant. In TA ultrasound imaging used in our study, the probe was placed transversely on the suprapubic region and the subject was not required to be undressed.

Some investigators stated that muscle dysfunction in patients might be related to pain, called *pain interference*.[30] They proposed that the ability of voluntary contraction in all muscles might be reduced because of the pain sensation. In this study, none of the subjects reported that pain was a limiting factor to produce voluntary muscle contraction.

The amount of pelvic floor elevation on TA ultrasound has been shown to be positively related to the PFM endurance in healthy subjects.[25] Using EMG, Hetrick et al[14] found a decreased endurance time of the PFM in men with CPPS compared with controls. However, the endurance of PFM contraction was not measured in this study.

With regard to the findings in this study showing that individuals with CPPS have significantly lower PFM mobility compared with those without CPPS, evaluation and ultrasound testing the PFM mobility seems beneficial in clinical assessment of individuals with CPPS. It seems reasonable to consider PFM complex when assessing and prescribing therapeutic exercises (pelvic floor physical therapy) for patients with CPPS. This study did not directly assess the effect of pelvic floor therapy—alone or combined with other methods—on CPPS. More clinical studies are needed to determine the diagnostic and therapeutic values of PFM training in patients with CPPS using ultrasound assessment of PFM mobility.

However, we acknowledge several limitations. TA ultrasound measurements are made without reference to a bony landmark and the amount of bladder base displacement are only expressed relative to a moveable starting point.

For visualization of the bladder base, a standardized bladder filling protocol was used before imaging to allow clear imaging of the base of the bladder. However, men with CPPS may have more pain with full bladders and therefore more splinting and less PFM mobility caused by spasm. This can affect the results of the study. We suggest that this study could be done on subjects with a minimally filled bladder.

One of the limitations and weaknesses of this study was the sample size. We excluded the subjects with other types of prostatitis to assess the PFM mobility in a more homogenous population. Thus the accessible population, ie, men with CPPS and no other type of prostatitis, was limited to a relatively small group of patients in the time frame of the study. We suggest that this study could be done on subjects with different types of prostatitis to provide more insight regarding the PFM motion in men with different types of prostatitis.

CONCLUSIONS

The results indicate that individuals with CPPS have significantly lower PFM mobility compared with those without CPPS with a full bladder.

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