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Research Article

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The value of transperineal ultrasound as compared to urodynamic test in assessment of stress urinary incontinence

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Abstract

Background: *The value of imaging modalities especially transperineal ultrasound in assessment and categorization of pelvic floor disorders in women remains ambiguous. The aim of this study was to compare the diagnostic value of transperineal ultrasound with urodynamic test in assessment of stress urinary incontinence.*

Methods: *This cross-sectional study was conducted on women referred to pelvic floor clinic at Mahdieh hospital with the complaint of stress urinary incontinence. Along with physical examination, urodynamic test and pelvic floor ultrasound were requested for all participants.*

Results: *The patients were divided into two groups with pelvic organ prolapse (n=25) and without pelvic organ prolapse (n=18). There was no difference between the two groups with and without pelvic organ prolapse in β angle greater than 120 degrees during rest and maneuvering Valsalva, and the rate of bladder neck funneling. In the groups with and without prolapsed, the sensitivity and specificity of β angle greater than 120 degrees measuring by ultrasound at rest to determine stress urinary incontinence were 80.0% and 60.0% in the group with prolapsed and 70.0% and 50.0% in those without prolapse. The pointed values for β angle greater than 120 degrees during Valsalva maneuver were 93.3% and 40.0% in those without prolapsed and 80.0% and 12.5% in those without prolapse respectively. The evaluation of bladder neck funneling by ultrasound could diagnose stress urinary incontinence with a sensitivity of 10.0% and a specificity of 62.5% in the group without pelvic organ prolapse and with a sensitivity of 53.8% and a specificity of 80.0% in those with pelvic organ prolapse respectively.*

Conclusion: *The use of ultrasound alone is not sufficient to diagnose stress urinary incontinence, especially in cases where there is no evidence of pelvic organ prolapse, and thus comprehensive use of physical examinations and imaging techniques for such a diagnosis is recommended.*

Keywords: Urinary incontinence, Stress incontinence, Increased intra-abdominal pressure, Ultrasound.

Introduction

Urinary incontinence is a relatively common disease among women that affects the lives of patients physically, socially and psychologically. The most common form of urinary incontinence is stress urinary incontinence, which especially affects young women [1]. Stress incontinence refers to the involuntary leakage of urine during periods of increased intra-abdominal pressure (sneezing, coughing, or activity) [2]. This disease is an interesting disease due to its various effects on women. Stress incontinence is divided into two main groups according to the causative agent as duct hypermobility and internal sphincter deficiency [3]. There is no unfortunately standard test that can completely differentiate between the two categories.

The urodynamic test has been the most common diagnostic test in the study of women with stress urinary incontinence to date [4]. Although urodynamic studies are very useful in assessing the function of the lower urinary tract, they are not able to provide information about the pathological changes. However, this method alone cannot help determine the types of stress incontinence. It is also an expensive method that is not available in all centers. Other imaging techniques used to examine the lower urinary tract include Magnetic resonance imaging (MRI), cystourethrography, and transperineal ultrasound. Ultrasound has emerged as a complementary diagnostic method among all imaging techniques in the last two decades due to the creation of dynamic images, the ability to see the base of the bladder, the junction of the urethra to the bladder, the urethra and the pubis symphysis [5,6]. Ultrasound is a safe, non-invasive, sensible and accessible method that can be easily used in most medical centers. Ultrasound results in the examination of the lower urinary system include quantitative and qualitative findings. Quantitative parameters included alpha and

beta angles, the degree of descent of the bladder neck and the location of the internal opening of the urethra; while qualitative parameters include bladder neck funneling and position and mobility of the urethra and bladder [7,8].

Many studies have used the use of transperineal ultrasound in the evaluation of stress urinary incontinence [9,10], but the values obtained from the data of this diagnostic method still need further observation and standardization. None of the studies that have used transperineal ultrasound to diagnose or evaluate stress urinary incontinence have ever compared it as a diagnostic method with the standard urodynamic testing. The aim of this study was to compare the diagnostic value of transperineal ultrasound as a cheap, convenient and accessible method with urodynamic test in assessment of urinary incontinence. The various ultrasound parameters measured in this study included measurements of the posterior urethrovesical β angle at rest and during Valsalva maneuver and bladder neck funneling.

Materials and Methods

This cross-sectional study was conducted on women referred to pelvic floor clinic at Mahdieh hospital with the complaint of stress urinary incontinence with a positive cough test and normal urinalysis and urine culture. The pregnant women and up to 6 weeks after delivery, and those with underlying diseases of the nervous system such as diabetic neuropathy, multiple sclerosis, spinal cord injury or trauma, stroke, Alzheimer or Parkinson diseases were all excluded from the study. The study protocols were ethically approved by the Shahid Beheshti University of Medical Sciences and written consent was obtained from all participants to participate in the study. All participants were assessed regarding medical history, systemic physical examination and also genital examination in lithotomy position. The patients were then asked to cough or performed a Valsalva maneuver, and then urinary incontinence during coughing (positive cough sign) was recorded. In addition, during the Valsalva maneuver, the herniation of the pelvic organs in the anterior or posterior wall of the vagina was evaluated and based on the pop-Q system, the type, level and degree of wall defects in the anterior or posterior were determined. In addition, urine test and urine culture were initially requested for all patients, and if the tests were normal for patients with complaints of stress urinary incontinence, urodynamic test and pelvic floor ultrasound were requested. The study endpoint was to determine the value of transperineal ultrasound as compared to urodynamic test in diagnosis of stress urinary incontinence.

For statistical analysis, results were presented as mean ± standard deviation (SD) for quantitative variables and were summarized by frequency (percentage) for categorical variables. Continuous variables were compared using t test or Mann-Whitney test whenever the data did not appear to have normal distribution or when the assumption of equal variances was violated across the study groups. The especial formula for determining diagnostic performance considered to determine the value of transperineal ultrasound to discriminate stress urinary incontinence from normal condition considering urodynamic test as the gold standard. In this regard, sensitivity was defined as the ability of transperineal ultrasound to correctly identify those with urinary incontinence (true positive rate), whereas specificity was defined as the ability of ultrasound to correctly identify those without stress urinary incontinence (true negative rate). Also, positive predictive value (PPV) was a parameter to determine the probability of having urinary incontinence by using transperineal ultrasound and negative predictive value (NPV) was also used to determine the probability of being healthy with regard to urinary incontinence. The ROC curve analysis was also considered to determine the best cutoff values of study parameters to predict stress urinary incontinence. P values of ≤ 0.05 were considered statistically significant. For the statistical analysis, the statistical software SPSS version 23.0 for windows (IBM, Armonk, New York) was used.

Results

Of 150 female patients referred to the pelvic floor clinic of Mahdieh Hospital, 85 patients complained of stress urinary incontinence, of which 42 patients were excluded from the study due to non-referral and lack of follow-up. The remaining 43 patients with complaints of stress urinary incontinence underwent transperineal ultrasound and urodynamic test and were divided into two groups with pelvic organ prolapse (n=25) and without pelvic organ prolapse (n=18). As shown in Table 1, no difference was found in baseline characteristics including mean age, mean body mass index (BMI) and gravid between the two groups. As indicated in Table 2 with respect to ultrasound and urodynamic findings, there was no difference between the two groups with and without pelvic organ prolapse in β angle greater than 120 degrees during rest and maneuvering Valsalva, and the rate of bladder neck funneling. Abnormal urodynamic test was found in 60.0% of women with pelvic organ prolapse and 55.0% of those without pelvic organ prolapse indicating no difference (p=0.889). In the group without pelvic organ prolapse, the measurement of β angle using ultrasound (as compared to urodynamic test) at rest as well as during Valsalva maneuver could predict stress urinary incontinence with the sensitivities of 70.0% and 80.0% and the specificities of 50.0% and 12.5% respectively. But, in the group with pelvic organ prolapse, higher diagnostic values were revealed for ultrasound to predict incontinence (Figures 1A and 1B). In this regard, the evaluation of bladder neck funneling by ultrasound could diagnose stress urinary incontinence with a sensitivity of 10.0% and a specificity of 62.5% in the group without pelvic organ prolapse and with a sensitivity of 53.8% and a specificity of 80.0% in those with pelvic organ prolapse respectively. Using the ROC curve analysis and to determine the best cutoff points for β angle to predict stress urinary incontinence, the best cutoff value of 114 degrees (yielding sensitivity of 80.0% and specificity of 55.6%) at rest and 129 degrees (yielding sensitivity of 80.0% and specificity of 45.0%) during Valsalva maneuver were obtained.

Table 1: Baseline characteristics in the groups with and without pelvic organ prolapse.

Characteristics	with pelvic organ prolapse (n=25)	Without pelvic organ prolapse (n=18)	P value
Mean age, year	46.1±6.1	49.7±7.1	0.58
Mean body mass index, kg/m^2	29.5±4.4	29.0±4.0	0.45
Mean gravid	3.7±1.8	4.8±2.3	0.44
Menopausal status, %	5 (20.0)	5 (27.8)	0.45

Table 2: The diagnostic findings in the groups with and without pelvic organ prolapse.

Characteristics	with pelvic organ prolapse (n=25)	Without pelvic organ prolapse (n=18)	P value
Beta angle>120 at rest	16 (64.0)	11 (61.1)	0.92
Beta angle>120 at Valsalva maneuver	20 (80.0)	15 (93.3)	0.92
Mean Beta angle at rest	121.0±25.9	124.2±22.9	0.55
Mean Beta angle at Valsalva maneuver	137.7±24.5	142.5±24.2	0.87
Bladder neck funneling	10 (40.0)	4 (22.2)	0.37
Abnormal urodynamic test	15 (60.0)	10 (55.0)	0.88

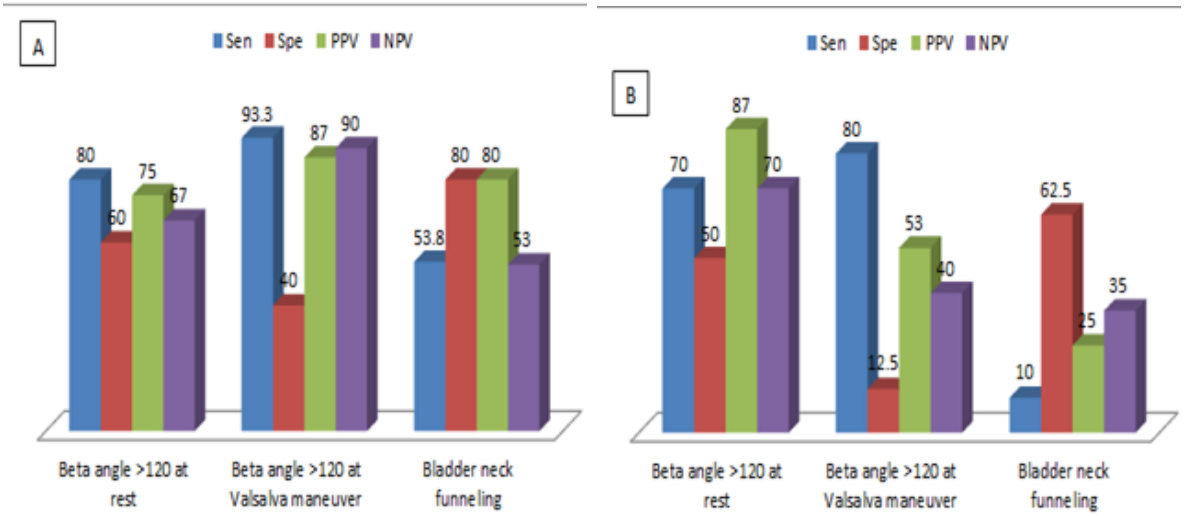

Figure 1: The value of ultrasound (as compared to urodynamic test) in diagnosing stress urinary incontinence in the groups with (A) and without (B) pelvic organ prolapse.

Discussion

Urinary incontinence is a stressful disease for women with and overall prevalence of about 40%. In addition to physical examination, various imaging techniques can be used to diagnose patients with pelvic floor disorders [11]. To date, the mechanism of stress urinary incontinence has not been clearly identified. Anatomical support of the urethra and closure of the urethra are the main mechanisms of urinary retention under stress [12]. If there is a defect in these factors, incontinence occurs with increasing intra-abdominal pressure. Eurodynamic testing has been used to diagnose SUI for decades. However, using this expensive technique to identify different types of urinary incontinence has not been entirely satisfactory. Much research has been done to answer the question of whether ultrasound as a non-invasive diagnostic method, available and free of X-rays can be one of the priorities of stress urinary incontinence examination [13]. In this regard, evaluation of bladder neck mobility is one of the essential evaluations in patients with urinary incontinence. The modalities used to assess the mobility of the bladder neck included urodynamics and MRI, both of which were expensive and low patient acceptance [14]. For this reason, ultrasound can be the main modality in examining the anatomy and function of the lower urinary system, in addition to physical examination. Transperineal ultrasound provides good images of the bladder, urethral vesicle junction, and pubic symphysis. This imaging technique is able to show real time images of incontinence defects. As indicated in our study, considering introduced cutoff values for β angle along with the assessment of bladder neck funneling could effectively

diagnose urinary incontinence especially in those without underlying without pelvic organ prolapse. Sendag et al. examined the role of transperineal ultrasound in patients with stress urinary incontinence by measuring resting angles of alpha and beta at rest and Valsalva. In their survey, the sensitivity and specificity of the sonographic feature when the beta angle was considered more than 120 degrees was equal to 53% and 100%, respectively [15]. Koelbl et al compared transperineal ultrasound with urethrocystography in 30 patients with stress incontinence indicating high value of beta angle at rest as well as at Valsalva in those with urinary incontinence [16]. AL Khuzaee et al also examined the importance of urethral angles in the evaluation of patients with stress urinary incontinence and showed that the sensitivity and specificity of the beta angle of more than 120° at rest were 95% and 97.4°, respectively, which in our study were reported to be lower. In a study by Gungor et al, the beta angle (PUVA) of more than 120° in the Valsalva state was associated with poor bladder neck support and the development of stress urinary incontinence [17]. We also consider the beta angle in the Valsalva state to be more than 120° with poor support of the urethroscopic junction as an abnormal angle. In the present study, using the ROC curve, we found the threshold values of the beta angle at rest more than 114 degrees with a sensitivity of 80 and a specificity of 56%, and in the status of Valsalva more than 129 degrees with a sensitivity of 80% and a characteristic of 45%. In general, ultrasound findings and especially bladder neck funneling in the group with prolapse had higher sensitivity, specificity and positive and negative predictive value. Thus, transperineal ultrasound can be applied as a useful tool in predicting stress urinary incontinence with acceptable accuracy especially in the group suspected to pelvic organ prolapse. However, it should be borne in mind that given the differences in cut-offs obtained in the present study compared to other studies, it seems that these threshold levels should be considered in our patients community, in other words, determining the reference cut-offs for each community will belong to that community. However, the use of ultrasound alone in the diagnosis of the disorder is not very reliable and the final diagnosis requires a comprehensive clinical, physical and imaging evaluation.

Conclusion

Urethral rotation angles are new parameters in ultrasound that have been used in patients with stress urinary incontinence. Transperineal ultrasound along with history, clinical examination and urodynamic examination has increased the diagnostic accuracy of functional and structural urinary disorders. History and clinical examination should precede all imaging modalities. Although ultrasound is an easy, inexpensive, affordable, and practical method, our data do not support the use of ultrasound as a useful and reliable diagnostic method in the evaluation of urinary incontinence in those without pelvic organ prolapse. More extensive and complete research is needed to determine which techniques and measurements by ultrasound provide more accurate information.

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