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Clinical and Transperineal Ultrasound Findings in Females with Stress Urinary Incontinence Versus Normal Controls

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Abstract: Study was aimed at comparing clinical and transperineal ultrasound findings of females with stress urinary incontinence and normal controls. Between 2004 and 2005, 40 women with stress urinary incontinence (mean age 47.5 years) diagnosed by history via ICIQ-SF (International consultation on Incontinence Questionnaire-Short Form) and 40 healthy female volunteers without any incontinence or LUTS (mean age 42.1 years) underwent transperineal ultrasonography for determination of posterior urethrovesical (beta) angle, bladder neck funneling and hypermobility of urethra. These findings were compared between patients and controls with regard to clinical data. Beta angle wider than 130°, bladder neck funneling and hypermobility of urethra with transperineal ultrasonography were more common among cases than controls. LR (Likelihood Ratio) for urinary incontinence of these parameters was 2.5, 2.1 and 2, respectively. Perineal ultrasonography is highly associated with clinical findings. Hypermobility of urethra had highest sensitivity for diagnose of stress urinary incontinence but the specificity of bladder neck funneling in perineal sonography was higher.

Key words: Perineal sonography, female urology, urethrovesical angle, bladder neck funneling

INTRODUCTION

It is suggested that observations using perineal ultrasound can be used to identify the functional situation of female pelvic floor to maintain Stress Urinary Incontinence (SUI) (Artibani *et al*., 2002). Urethral hyper mobility and Intrinsic Sphincteric Deficiency (ISD) are two principal pathophysiologic mechanisms underlying SUI.

Intraabdominal pressure is transmitted equally to bladder and proximal urethra because of well established retropubic position of urethra. Hammock-like musculofascial pelvic diaphragm provides the backboard needed to support proximal urethra against opening (funneling), descent and rotation (Sampselle and Delancey, 1998). Genitourinary prolapse and other conditions that result in poor anatomic support may create SUI by prohibiting compression of anterior against posterior urethral wall (inducing hyper mobility) during increased intra-abdominal pressure (Sampselle and Delancey, 1998).

There are several diagnostic and classifying modalities of SUI. Physical examination is the most prevalent method used for diagnosing SUI. The aim of physical examination in women with SUI includes detection of vaginal atrophy, genitourinary prolapse and/or urethral hyper mobility. Cystourethrography, pelvic floor ultrasonography and MRI are imaging methods used for SUI. No standard imaging modality is mandatory in initial evaluation of patients with urinary incontinence. Imaging using any of these methods is indicated in selected cases (Artibani *et al*., 2002). imaging is going to obtain substantial popularity in urinary incontinence as well as some doubts on its accuracy in this regard (Brandt *et al*., 2009; Hosker, 2009; Dalpiaz and Curti, 2006).

Pelvic ultrasonography allows morphological and dynamic assessment of bladder and urethra. Anterior urethrovesical angle, funneling of bladder neck, urethral hypermobility and bladder base position can be evaluated using pelvic floor ultrasonography. This method is, however, required to be standardized (Artibani *et al*., 2002). In recent years ultrasound studies have predominated but there is little information on normal values and confusion on methodology and measurements. As indicated in the latest available systematic review, There are yet little data and there is a need to find in the near future more standard and

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objective parameters for the diagnosis of urinary continence (Dalpiaz and Curti, 2006).

The aim of this study is to determine the role of pelvic ultrasonography in the process of diagnosis and to compare this method to ICIQ-SF (International Consultation on Incontinence Questionnaire-Short Form) and pelvic examination.

MATERIALS AND METHODS

Eighty women including 40 with stress urinary incontinence diagnosed by history via ICIQ-SF and physical examination and 40 continent women as control group were studied. This cross sectional study was done in female urology and ultrasound clinics of Tabriz university of Medical sciences, from March 2004 to August 2005. Women with the history of surgery for incontinence and/or vaginal surgery were excluded.

Both groups were matched by age, parity and menopausal status. Mean age among cases was 47.54±11.23 years (Mean±SD) and mean age among control group participants was 42.11±17.86 years. Mean parity was 5±2.44 and 3.5±2.6 for case and control groups respectively (p = 0.093).Twenty patients of case group and 12 patients of control group had reached the menopause (p = 0.05).

ICIQ-SF was filled in for all participants in the study. General physical examination and vaginal examination was done on all patients with emphasis on urethral hypermobility, genitourinary prolapse, vaginal atrophy and urine leakage with stress test. For all patients with urinary incontinence standard urodynamic study was required to establish the diagnosis of SUI if necessary, as described by the International Continence Society (1980).

In order to document the physical examination findings with evaluating urethrovesical junction by pelvic ultrasonography, a 3.5 MHz probe, covered with a sterile glove, was placed on saggital axis of perineum in the supine position with the comfortably full bladder (200-300 mL). The frozen image was placed on one side of monitor screen. The inferior edge of symphysis pubis, the bladder, urethrovesical junction and urethra were seen. The patient or continent control was asked to do Valsalva maneuver and again the image was frozen and placed on the other half of the monitor screen. Beta angle (posterior urethrovesical angle) was measured electronically at rest and on straining. Posterior urethrovesical angle was defined as angle between proximal and distal urethra. Then with the same bladder volume and same position the funneling of bladder neck and bladder base descent was measured by 5 MHz probe at the resting and Valsalva maneuver. All measurements were performed by the same investigator.

Present local ethics committee approved the study and written informed consent was obtained from all participants. Data were analyzed using SPSS 13 statistical software package (version 13; SPSS Inc., Chicago, IL, USA). Statistical significance level was considered to be 0.05.

RESULTS

Thirty five out of forty patients in case group had genuine stress incontinence and the rest suffered from mixed incontinence. Mean ICIQ-SF and QOL scores were 7.8 and 6.4 respectively in case group, compared to zero in control group. Table 1 describes prevalence of different grades of cystocele and rectocele.

Mean post voiding residue was 30.26±5.25 mL among incontinent patients compared to 31.99±2.25 mL in continents. Mean bladder base angle was 152.74±16.69 in cases versus 139.42±20.58 in controls (p<0.01). Bladder base descent with Valsalva maneuver was larger in incontinent patients (15.64±9.65 mm) than continent controls (8.13±9.16 mm) (p<0.01). Bladder neck funneling was detected in 52.5 and 15% of cases and controls respectively (p<0.01). Table 2 shows distribution of beta angel wider than 130°, bladder neck funneling and hyper mobility of urethra for two groups. In 85% of women with incontinence and 55% of normal continents beta angle was wider than 130° (p<0.001).

Table 3 describes sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV)

Table 1: Distribution of different grades of cystocele and rectocele in study and control groups

	Cystocele			Rectocele		
Group	Grade I	Grade II	Grade III	Grade I	Grade II	Grade III
Study (20)	8	16	2	12	8	2
Control (20)	12	7	2	5	6	3

Table 2: Relative frequency of beta angle>130, bladder neck funneling and urethral hypermobility in study and control groups

Results	Beta angle >130 (%)	Bladder neck funneling (%)	Hyper mobility of urethra (%)
Cases	85	52.5	75
Controls	55*	15*	42*

PV<0.01

Table 3: Sensitivity, specificity, PPV and NPV of beta angle, bladder neck funneling and urethral hypermobility as diagnostic tests for urinary incontinence

Variables	Sensitivity	Specificity	PPV	NPP	LR*
	(%)				
Beta angle >130°	64.2	75.0	85	55.0	2.5
Bladder neck funneling	77.7	64.0	52	15.0	2.1
Hyper mobility of urethra	63.8	69.6	75	52.5	2.0

*Likelihood ratio. PPV and NPV can be valid only for given proportions

of urethral hyper mobility, bladder neck funneling and wider than 130° beta angle for SUI. Mean of bladder neck funneling in patients with urethral hyper mobility was 27±3.35 mm. It was 22±3.05 mm for those without hyper mobility.

DISCUSSION

Perineal sonography is feasible and may be a good method to detect pathophysiology of SUI considering lack of X-ray exposure and production of dynamic images. Perineal sonography is superior to preceding imaging modalities. Urethrovesical junction is best evaluated by perineal sonography without any contrast material which is needed for cystourethrography. Contrary to MRI it is an inexpensive modality. With regard to all advantages perineal sonography has practically replaced all the traditional imaging techniques in this field (Demicri and Fin, 1996).Urethral hyper mobility and bladder neck funneling were also significantly different in patients with SUI compared to patients with continence, but no statistically significant correlation was observed between bladder neck funneling and urethral hypermobility.

Lavanga *et al*. (2000) reported a significant degree of urethral axis rotation in 448 patients with incontinence compared to 450 healthy individuals. They advocate translabial sonography as a rapid, simple, reliable and noninvasive method for routine use before and after surgery in incontinent patients.

We also found a significantly wider beta angle in patients with SUI in transperineal ultrasound. The same result was shown in Fink group study. In their study funneling of bladder neck was a good morphologic sign of urinary incontinence and was seen in more than half of 186 cases with incontinence. This study showed a significant correlation between clinical and sonographic findings in incontinent patients (Fink *et al*., 1998).

This result was in line with others in 2003. Perineal sonography in 30 incontinent women and 17 age-matched controls showed posterior urethrovesical angle (beta angle) being significantly wider in study group, both at rest and on straining positions. The angle between the vertical axis and urethral axis (alpha angle) was significantly different only on Valsalva maneuver (Sendag *et al*., 2003).

Both transperineal and transvaginal sonography were employed by Alper *et al*. (2001) to measure posterior urethra-vesical junction in 50 incontinent and 50 continent women. In the study group, mean beta angles was 94.9±10.9 at rest and 102.7±16.1 on Valsalva maneuver by perineal sonography ($p<0.001$). The degree of posterior urethro-vesical angel change with staining was significantly different ($p<0.05$) between study and control groups by transperineal sonography. It was not significantly different as measured by transvaginal sonography.

Pregazzi *et al*., carried out perineal ultrasound evaluation in 23 incontinent patients and 50 controls (Pregazzi *et al*., 2002). They found significant differences between incontinent women and continent controls with regard to bladder neck descent and alpha and beta angles during Valsalva maneuver.

In the present study the beta angle was significantly wider in study group than control group at resting and Valsalva maneuver ($p<0.01$). A strong correlation was found in bladder neck funneling in study group versus control group ($p<0.05$).

In conclusion, perineal sonography is highly associated with clinical findings. It can well evaluate the morphology of lower urinary tract including position of bladder neck and bladder base at rest and straining, rotation of alpha and beta angles and differentiate between anatomic incontinence and Intrinsic Sphincteric Deficiency (ISD). Hyper mobility of urethra has the highest sensitivity in diagnosis of stress urinary incontinence where the specificity of bladder neck funneling in perineal sonography is more than others, with 76% positive predictive value. Beta angle with likelihood ratio of 2.5 seems to be more informative compared to other parameters to confirm SUI.

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