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Original Research Article

Transperineal ultrasonography in stress urinary incontinence

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ABSTRACT

Background: The aim of our study is to assess, using transperineal ultrasonography, amount of bladder neck mobility using rotational angles; represented by the difference in the anterior (α angle) and posterior urethral angles (β angle) and proximal pubourethral distance at rest and straining, in stress urinary incontinence and control group, to ascertain if there are significant differences in their values between the groups.
Methods: In all, 24 women with SUI (SUI group) and 20 continent women (control group) were included. Transperineal ultrasonography was performed at rest and straining (Valsalva manoeuver), and the threshold value for the urethral angles (α and β angles) and proximal pubourethral distance for each group were estimated.
Results: A significant difference was found in calculating the numerical value of the increment of both α and β angles in both groups, at rest and at straining (rotation angle α and rotation angle β (Rα and Rβ)). Higher rotation angles were seen in the SUI group for both the α angle and the β angle compared with those of the control group; mean (SD) Rα SUI 29.37±7.46 vs. controls 10.83±3.46°; and Rβ SUI 27.97±7.47 vs. controls 13.00±3.16°; $p<0.01$. There was also significant difference in proximal pubourethral distance (<0.01) during resting and straining phases in patients with SUI.
Conclusions: Rotational angles and pubourethral distance helps in evaluation of stress urinary incontinence and reduces the need of urodynamic studies.

Keywords: Pubourethral distance, Rotational angles, Stress urinary incontinence, Transperineal ultrasonography

INTRODUCTION

Stress urinary incontinence (SUI) is a distressing common problem that causes social morbidity and affects the wellbeing both physically and psychologically.[1] The precise anatomical and physiological mechanisms involved in urinary incontinence are poorly understood. Urinary continence occurs because maximum urethral pressure remains greater than intravesical pressure during bladder filling, and increase in intra-abdominal pressure are transmit- ted equally to the bladder and proximal urethra. The vesical neck and proximal urethra are normally intra-abdominal structures that lie above a well-supported pelvic diaphragm and they are positioned in such a way to promote the equal distribution of forces to the bladder and urethra during increases in intraabdominal pressure.[2] Poor anatomical support of the bladder neck, bladder base and proximal urethra, resulting in descent and hyper- mobility outside the intra-abdominal transmission zone, is considered the pathological basis of stress urinary incontinence.[3] Upon straining proximal urethra exhibits rotational movement in posteroinferior direction. Transperineal ultrasound is a new diagnostic modality using this principle to evaluate following parameters; alpha angle, beta angle and proximal pubourethral distance.[4] Many articles have presented different measurements for normal and abnormal urethral angles. These variations are due to differences in the ultrasound technique (transperineal, introital, translabial, transvaginal) and the amount of bladder filling.[5]

Aim and objectives

This study aims to evaluate the urethral mobility represented by the difference in α and β angles and proximal pubourethral distance at rest and on stress in 24 women with Stress urinary incontinence and 20 normal subjects as controls. The significant difference of angles of rotation (Rα and Rβ) between the groups determined the urethrovesical junction mobility.

METHODS

This was a single center prospective study conducted at obstetrics and gynaecology department of IKDRC-ITS, Ahmedabad. An informed written consent was obtained from all participants. The study enrolled 24 women with SUI, confirmed by clinical examination and 20 women with no history of urinary incontinence. Both groups were recruited from the gynaecological outpatient clinic. Cases had involuntary leakage of urine on stress (cough, sneezing). Women of the control group were urine-continent women with no previous pelvic surgery. Women with history of urge incontinence, mixed incontinence, those with neurological disease (e.g. diabetic neuropathy, multiple sclerosis, spinal cord injury. etc) and pregnancy were excluded from this study. Complete history and physical examination were performed including age, parity, past medical, obstetrical, gynaecological, drug and surgical history, urogynecological symptoms (e.g. urinary frequency, urgency, dysuria, nocturia, pad usage, defecation difficulty, feeling of lump, precipitating factors of stress urinary incontinence like coughing, sneezing, lifting heavy weight, study of symptom's duration, severity, number of incontinence episodes,). All the participants had negative urine cultures before transperineal ultrasonography. Transperineal ultrasonography was performed using a Voluson E10 machine (GE medical systems, Milwaukee, WI, USA) mounted with a 3.5 MHz electronic microconvex array probe. The patient lied in lithotomy position and transperineal ultrasonography was performed with the urinary bladder half full. The probe was covered with sterile glove and placed in interlabial region in sagittal plane after applying gel. Pubic symphysis was considered as reference point and images of symphysis pubis, bladder, and urethra were obtained at rest and while straining.

Parameters measured

The proximal pubo-urethral distance was measured at rest and during straining (Figure 3). The posterior urethro-vesical angle 'β-angle', defined as the angle between the proximal urethra and the posterior vesical wall was measured at rest and during straining (Figure 1-2). The angle of urethral inclination 'α-angle', also called the urethropelvic angle, the angle between the axis of the proximal urethra and the central axis of the symphysis pubis at rest and during straining (Figure 1-2). Urethral mobility: the differences in α and β angles in both groups, at rest and straining, were considered as the rotation angles (Rα and Rβ).

Statistical analysis

Data were analyzed using SPSS version 20 and Microsoft office Excel 2013. Numeric data were expressed as mean +SD. Student t-test was used to compare between numeric data, p value less than 0.05 were considered significant.

RESULTS

The study included 24 women having SUI, as confirmed clinically and 20 women as controls. The mean age of cases was 47.17±10.60 years, while that of controls was 44.90±8.61 years. The age of the SUI group and the control group was matched with no significant difference (p=0.55) (Table 1).

Body mass index (BMI) was 22.40±1.46 kg/m2 for cases compared to controls 22.45±1.54 kg/m2 (p=0.535). The BMI of the SUI group and the control group was matched with no significant difference (p=0.91) (Table 1).

Table 1: Age and BMI in SUI and control groups.

Variables	SUI cases (N=24)	SUI control (N=20)	P value
Age	47.17±10.60	44.90±8.61	0.55 (NS)
BMI	22.40±1.46	22.45±1.54	0.91 (NS)

The median parity of 24 women with SUI was 3 (range: 1-5), while that of controls was 2 (range: 0-3). The analysis of the result of transperineal ultrasonography revealed that at rest, the mean α angle of the SUI group was 66.28±6.53°, which was significantly higher than that of the control group at 46.72±2.77° ($p<0.01$). Similarly, α angle at straining (Valsalva manoeuvre) was also significantly higher in the SUI group vs. the control group, at a mean of 95.65±10.72 vs. 95.65±10.72°, ($p<0.01$). (Table 2). The mean β angle in the SUI group at rest was 123.48±8.31°, which was significantly higher than that of the control group at 107.57±2.04° (p<0.01). Similarly, at straining (Valsalva manoeuvre), the mean β angle was significantly higher in the SUI group vs the control group, at 151.46±7.80 vs. 120.57±2.64° (p<0.01) (Table 2).

Table 2: Urethral angles, the rotation angles and proximal pubourethral distance at rest and straining in the SUI and control groups.

Variables	SUI cases (N=24)	SUI control (N=20)	P value
α angle at rest	66.28±6.53	46.72±2.77	<0.01
α angle at straining	95.65±10.72	57.55±4.59	<0.01
Rα, difference in α angle at rest and at straining	29.37±7.46	10.83±3.46	<0.01
β angle at rest	123.48±8.31	107.57±2.04	<0.01
β angle after valsalva manoeuvre	151.46±7.80	120.57±2.64	<0.01
Rβ, difference in β angle at rest and at straining	27.97±7.47	13.00±3.16	<0.01
Proximal pubourethral distance (at straining)	2.57±0.45	1.59±0.28	<0.01

A significant difference was found in calculating the numerical value of the increment of both α and β angles in both groups, at rest and at straining [rotation angle α and rotation angle β (Rα and Rβ). Higher rotation angles were seen in the SUI group for both the α angle and the β angle compared with those of the control group mean (SD) Rα SUI 29.37±7.46 vs. controls 10.83±3.46°; and Rβ SUI 27.97±7.47 vs. controls 13.00±3.16°; p<0.01 (Table 2). There was also significant difference in proximal pubo-urethral distance (p<0.01) during resting and straining phases in patients with SUI. No significant difference was found in resting and straining phases for any of the measured parameters in the control cases (Table 2-3).

Table 3: Proximal pubourethral distance on resting and straining in the SUI and control groups.

Variables	At resting	At straining	P value
SUI cases (N=24)	1.58±0.27	2.57±0.45	<0.01
SUI control (N=20)	1.51±0.27	1.59±0.28	0.59 (NS)

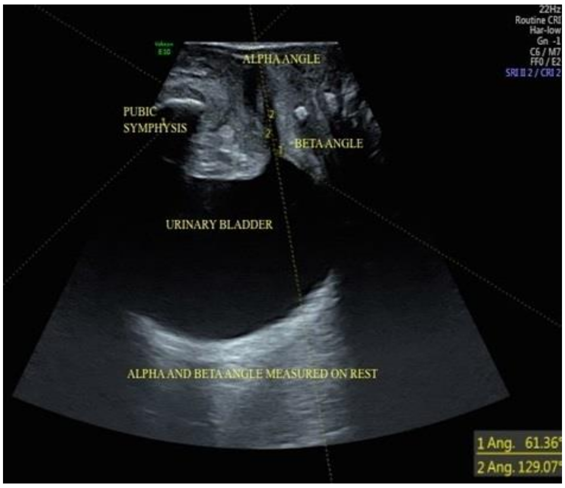

Figure 1: α and β angles measured by transperineal ultrasonography during rest.

DISCUSSION

Urinary incontinence is a significant health problem; with an overall prevalence of approximately 40%.[6] There are several imaging modalities for assessment of urinary incontinence. MRI and urodynamic study are inconvenient and expensive to the patients.[7] While transperineal ultrasonography is a good modality for documentation of anatomical and physiological parameters of pelvic floor before and after surgery for stress incontinence.[8] There has been many studies on transperineal ultrasonography, the angle of inclination (α angle) and posterior urethrovesical angle (β angle) in normal subjects and in patients with SUI. SUI patients undergo significant urodynamic changes upon straining.[3] There has been no clear-cut numerical values for normal and abnormal as ultrasound examination can be translabial, transperineal, introital and transvaginal and the amount of bladder filled during examination varies between different studies.

In present study α angle of the SUI group was 66.28±6.53°, which was significantly higher than that of the control group at 46.72±2.77° (p<0.01). Similarly, the α angle at straining (Valsalva manoeuvre) was also significantly higher in the SUI group vs. the control group, at a mean (SD) of 95.65±10.72 vs. 95.65±10.72°, (p<0.01).These results are in agreement with Yang and Huang, who found significantly higher rotational angles in 764 SUI group as compared to 36 healthy continent patients by transvaginal ultrasonography.[9] Wasan Ismail Al-Saadi, who on prospective study found that α angle was significantly higher in the SUI group at both rest and straining (Valsalva manoeuvre); mean (SD) 64.37 (12.79) and 83.80 (14.22)°, respectively compared with that in the control group; mean (SD) 43.90 (1.52) and 54.43 (2.59)°, respectively.[10] Minardi et al conducted prospective study on 36 patients with SUI and 14 healthy controls.

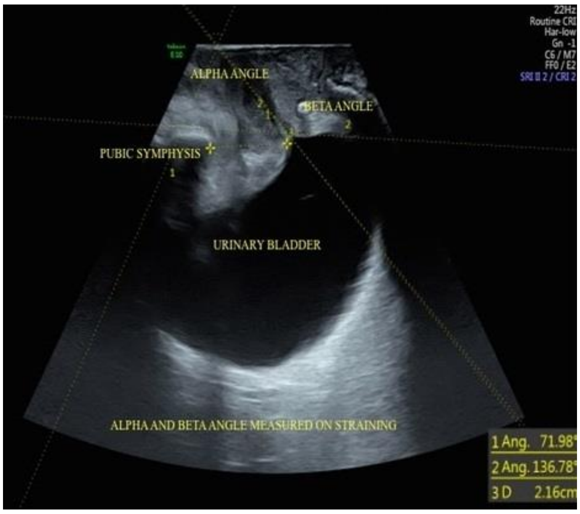

Figure 2: α and β angles measured by transperineal ultrasonography during straining.

On introital and translabial ultrasound the results of the study simulated that of our present study. It showed higher α angle values in cases of SUI 118.2 (24.3) vs. 102.7 (11.0)° controls.[11] On the other hand, Sweed MS in a case control study on 40 SUI patients and 40 controls found that there was no significant difference in the dynamic angle of urethral inclination between patients with SUI and control group (p=0.101), yet, the angle of urethral inclination differed significantly in resting and straining phases in SUI patients (p<0.001).[12] Antovska found no statistical difference in value of α angle on rest and stress; 67.2 (4.5) and 66.9 (3.3)° in 132 patients with SUI.[13] The posterior urethrovesical angle (also referred to as the retrovesical angle or β angle) was measured by transperineal ultrasound. Sendag et al using perineal ultrasound, found that posterior urethrovesical angle was significantly different both at rest and on straining in patients with SUI and they concluded that a β angle of >120° correlates with poor support to the urethrovesical junction.[3] Similar results were shown by Sweed MS, the dynamic posterior urethral angle (reflecting urethral mobility) was also significantly different between patients with SUI (185.6±21.7°) and control group (101.7±21.2°) (p<0.001).[12] Pregazzi et al in a study on twenty-three incontinent women and 50 controls suggested a significant role of the urethral angle in maintaining female continence.[14] Kolbi et al compared perineal ultrasound with urethrocystography in 30 patients with genuine stress incontinence and found that the β angle was (129.1±23°) on rest, β angle was (151.3±21.9°) on straining (p < 0.001) which is in agreement with our result.[15] Alper et al measured β angle at rest and on straining by transperineal and transvaginal ultrasound in cases of SUI and concluded that transperineal is better than transvaginal route. Transvaginal route prevents free movement of bladder in cases of bladder neck descent and probe themselves moves during stress. They did not find any statistical significance of posterior urethrovesical angle between SUI and control groups at rest. However, a significant difference was seen on stress.[16] Several other authors agree with this conclusion that posterior urethrovesical angle has significant difference on resting and straining in SUI patients but with variable numerical values of the β angle as reported by Liqaa R Al-Khuzaee et al, Gungor et al.[17,18] Hajebrahimi S et al. found beta angle to be significantly wider in SUI patients, when compared to controls, both at rest and during straining, while, the alpha angle varied significantly only during Valsalva.[19] In the present study, a significant difference was found in calculating the numerical value of the increment of both α and β angles in both groups, at rest and at straining (rotation angle α and rotation angle β (Rα and Rβ)). Higher rotation angles were seen in the SUI group for both the α angle and the β angle compared with those of the control group; mean Rα SUI 29.37±7.46° vs. controls 10.83±3.46°; and Rβ SUI 27.97±7.47° vs. controls 13.00±3.16°; p<0.01. Similar results were found by Wasan Ismail Al-Saadi, mean Rα angle 19.43 (12.76) and 10.53 (2.98)°, Rβ angle 28.30 (12.96) and 16.33 (10.8)°.[10] Use of rotation angles will overcome the variability in mode of ultrasound used introital, transperineal, translabial and transvaginal. The proximal pubourethral distance was similar in both SUI group and control group, but there was a significant difference during stress in SUI group. No significant difference was found in resting and straining phases in the control group. Similar results were seen by Demirci et al in 35 patients with stress urinary incontinence and 20 continent controls.[20]

Limitations

This study had few limitations, that is relatively small sample size and threshold value of the urethral rotation angles could not be calculated.

CONCLUSION

Transperineal ultrasonography is simple and noninvasive modality that allows assessment and diagnosis of patients with SUI. Evaluation of urethral rotation angles and proximal pubourethral distance is a useful tool in diagnosis and in turn reduces the need for sophisticated urodynamic studies.

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