Accuracy of cystourethrometric findings in detecting urodynamic stress incontinence in women

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ABSTRACT

الأهداف: التعرف على مدى فعالية معايير تخطيط المثانة المتزامن مع تخطيط الإحليل، وتحديد أكثر هذه المعايير دقةً عند التحري عن النساء اللاتي يعانين من سلس البول الجهدي (stress incontinence).

الطريقة: أُجريت دراسة مقارنة بين مجموعة التحكم ومجموعة الدراسة (دراسة حالة – شاهد) في عيادات تخطيط الجهاز البولي بمستشفيات حلب الجامعية، حلب، سوريا وذلك خلال الفترة من يناير 2008م إلى يونيو 2010م. شملت هذه الدراسة 76 سيدة قمن بزيارة عيادات التخطيط وكن يشتكين من الأعراض التالية: تكرار التبول، أو سلس البول الإلحاحي، أو سلس البول الجهدي، أو اجتماع هذه الأعراض معاً، وتم تقسيمهن إلى مجموعتين وهما: المجموعة المُصابة بسلس البول الجهدي (مجموعة الدراسة = 52 سيدة) والتي ثبت إصابتها بهذا المرض بعد دراسة ديناميكية البول، ومجموعة التحكم الغير المُصابة بسلس البول الجهدي (مجموعة التحكم = 24 سيدة) وذلك وفقاً لدراسة ديناميكية البول. لقد تم عمل مقارنة بين المجموعتين اعتماداً على نتائج تخطيط ديناميكية البول المُتمثل في تخطيط المثانة مع الإحليل.

النتائج: أشارت نتائج تخطيط ديناميكية البول بأن المعايير التالية: ضغط إغلاق الإحليل الأقصى أثناء الجلوس، وعامل النقل أثناء الجلوس، وتغير ضغط إغلاق الإحليل الأقصى عند الانتقال من وضعية الاستلقاء إلى وضعية الجلوس، والنسبة المئوية لهذا التغير كانت أقل بكثير في المجموعة المُصابة بالسلس الجهدي من المجموعة الغير المُصابة وذلك من الناحية الإحصائية. وكان المعياران الأخيران هما الأكثر دقة في تحري سلس البول الجهدي، حيث كان لكل منهما حساسية تصل إلى أكثر من 90% ونوعية تصل إلى أكثر من 70% وذلك عند القيم القاطعة التي تصل إلى 8 سم ماء أو أقل لتغير ضغط إغلاق الإحليل الأقصى عند الانتقال من وضعية الاستلقاء إلى وضعية الجلوس، و إلى 11.2% أو أقل للنسبة المئوية لهذا التغير. أما من الناحية السريرية فكانت المجموعتان متشابهتان فيما يتعلق بالعمر، وعدد الولادات، ومؤشر كتلة الجسم، وانقطاع الطمث، وانطباع السيدة حول شدة سلس البول، ودرجة القيلة المثانية (cystocyle).

خاتمة: أشارت الدراسة إلى فعالية معايير تخطيط المثانة المتزامن مع تخطيط الإحليل عند التفريق بين النساء اللاتي يشتكين من سلس البول الجهدي والنساء اللاتي لا يشتكين من هذا المرض، ولقد كانت أكثر هذه المعايير دقة هي: تغير ضغط إغلاق الإحليل الأقصى عند الانتقال من وضعية الاستلقاء إلى وضعية الجلوس، والنسبة المئوية لهذا التغير.

Objectives: To determine the most accurate of cystourethrometric parameters in detecting urodynamic stress incontinence (USI) in women.

Methods: A case-control study was carried out in the Urodynamic Units in Aleppo University Hospitals, Aleppo, Syria, between January 2008 and June 2010. Seventy-six women suffering from either urgency, urge incontinence, stress incontinence, or mixed symptom, and attended to the urodynamic units were included in this study. Two groups were recruited, USI group (study group; n=52), who had the diagnosis of USI by the urodynamic study and non-USI group (control group; n=24), who did not have this diagnosis by urodynamic study. Comparison between the 2 groups in urodynamic findings was carried out.

Results: In the urodynamic study, maximal urethral closure pressure (MUCP) in the sitting position, transmission ratio (TR) in the sitting position, MUCP change (changing position from supine to sitting), and MUCP change% (percentage of maximal closure pressure change with position) were statistically lower in the USI group compared to control group. The most accurate parameters in detecting USI were MUCP change and MUCP change%, with a sensitivity of more than 90% and specificity of more than 70% at cut off values of ≤8 cm H_2O for MUCP change and ≤11.2% for MUCP change%. Both groups were comparable with regard to age, parity, body mass index, presence of menopause, patient's impression of the severity of incontinence, and stage of cystocyle.

Conclusion: Cystourethrometric parameters such as MUCP sitting, TR sitting, MUCP change, and MUCP change% measurement could be of value in distinguishing between USI women and non-USI women.

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Stress urinary incontinence (SUI) is the most common type of urinary incontinence in women.[1] It is diagnosed by the urodynamic study, which distinguishes between cough induced instability and urodynamic stress incontinence (USI),[2-7] defined as involuntary urine leakage during stress without detrusor contractility.[4] Although, this diagnosis may be easy using multichannel cystometry in those with positive stress test, but it becomes impossible in SUI women with negative stress test on conventional urodynamics. On the other hand, defining the real cause of stress incontinence is very important before any surgery for stress incontinence, and this could be achieved more precisely using cystourethrometry and ambulatory urodynamics in addition to cystometry.[5,7,8] Although, several researches noticed significant differences in cystourethrometric values between SUI women and non-SUI women,[9-13] but they could not define a specific cystourethrometric value to be used to diagnose USI. However, Dörflinger's study noticed that the change of maximal urethral closure pressure (MUCP) during changing position from sitting to standing was lower in USI women, and concluded that this change could be used to diagnose USI.[8] Based on this knowledge, our study was designed to determine the most accurate cystourethrometric parameters in detecting USI in patient with positive stress test using the conventional urodynamics. For this purpose, we compare several urethral pressure profile parameters between USI and non-USI women.

Methods. A case-control study was carried out in the urodynamic units in Aleppo University Hospitals Aleppo, Syria, between January 2008 and June 2010. Seventy-six women suffering from either urgency, urge incontinence, stress incontinence, or mixed symptom and attended to the urodynamic units were included in this research. Two groups were recruited, USI group (study group; n=52), who had the diagnosis of USI by the urodynamic study, and non-USI group (control group; n=24), who did not have this diagnosis by the urodynamic study. We excluded patients in both groups when they had (i) history of recurrent urinary infections, (ii) prolapse ≥1 centimeter below the hymen, (iii) current pregnancy, (iv) previous surgery for stress urinary incontinence, (v) presence of unstable urethra on urethral pressure profile, and (vi) residual volume more than 50 ml. We assessed all patients with standard history, physical examination, and urodynamic study. Each patient was asked to fill up a 48-hour frequency-volume chart and their impression of the severity of incontinence according to the scale (0= no incontinence, but just urgency, 1= few drops every day, 2= one pad completely wet every day, 3= 2 pads completely wet, 4= 3 pads completely wet, 5= completely wet all the day). Physical examination was performed with woman in the semi-recumbent position in a urodynamics chair at a 45° angle. Vaginal support was assesed using the Pelvic Organ Prolapse Quantification System (POP-Q).[2,4] The urodynamic study included uroflowmetry, multi-channel cystometry, and cystourethrometry. Cystometry was estimated using triple-lumen 7Fr catheter in the sitting position. The intra-abdominal pressure was measured transvaginally. Cystourethrometry was performed in both supine and sitting positions at a bladder volume of 200 ml using a triple-lumen 7Fr catheter equipped with dual external transducers. Urodynamic stress incontinence was determined using the definition of the International Continence Society.[2,3] We compared the following urodynamic parameters between study group and control group: bladder capacity at first desire to void (FDV), bladder capacity at strong desire to void (SDV), bladder compliance, maximal urethral closure pressure at rest in the supine position (MUCP supine) and the sitting position (MUCP sitting), functional urethral length in the sitting position (FUL sitting), transmission ratio in the sitting position (TR sitting), change of maximal closure pressure with position (MUCP change = MUCP sitting - MUCP supine), and percentage of maximal closure pressure change with position (MUCP change%=100 x MUCP change/ MUCP supine).

The Research and Ethics Committee of Aleppo Faculty of Medicine, Aleppo, Syria approved the study and written consent from the patients was obtained.

Statistical analysis. Student's t-test and Chi-square test were used to calculate the significance of the results. Sensitivity and specificity of cystourethrometric parameters in detecting USI were calculated. Using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) Version 12.0 to perform the analysis, the measured data were expressed as the means ± standard deviation. A p-value <0.05 was considered statistically significant.

Results. Seventy-six women who attended the urodynamic units were enrolled in this study. The urodynamic characteristics of subjects participated in this study are summarized in **Table 1**, which shows significant differences between the study group and the control group regarding MUCP sitting (p<0.001), TR sitting (p<0.001), MUCP change (p<0.001), and MUCP change% (p<0.001). These values were statistically lower in the study group compared with the control group. The specificity and sensitivity of these 4 values in detecting USI were computed (**Table 2**). A specificity of >70% in detecting USI could be obtained at cut-off values of ≤76 cm H_2O for MUCP sitting, ≤8 cm H_2O for MUCP

change, ≤11.2% for MUCP change%, and ≤57.5% for TR sitting. At these cut off values the most sensitive parameters were MUCP change and MUCP change%. The clinical characteristics of patients participated in this study are presented in **Table 3**. It was found that the study group and control group were comparable with regard to age (p=0.075), parity (p=0.16), Body mass index (p=0.2), presence of menopause (p=0,33), durance of incontinence (p=0.65), patient's impression of the severity of incontinence (p=0,22) and stage of cystocyle (p=0,137). Only 21.2% of patients in the study group had a history of pure stress incontinence. On the other hand, 29.2% in the non-USI group had a history of pure stress or mixed incontinence. Based on these results, we obtained the accuracy of the parameters that were significantly different between the 2 groups, and assessed the most accurate of these parameters in detecting USI by calculating the areas under the ROC curves (AUC). **Table 4** and **Figure 1** show that MUCP

Table 1 - Urodynamic characteristics of patients in the study group and the control group.

Characteristics	Study group (n=52)	Control group (n=24)	*P*-value
FDV (ml)	143.9 ± 86.1	105.9 ± 69.9	0.06
SDV (ml)	351.9 ± 110.9	331.8 ± 103.6	0.21
Compliance (ml/cm H_2O)	95.7 ± 48.9	88.7 ± 47.9	0.56
$Pdet_{Qmax}$ (cm H_2O)	19.9 ± 12.3	20.2 ± 12.9	0.95
Qmax (ml/sec)	25.6 ± 7.1	23.3 ± 4.3	0.15
Residual volume (ml)	5.7 ± 9.6	3.7 ± 9.4	0.39
FUL sitting (mm)	30.9 ± 6.2	28.4 ± 5.6	0.09
MUCP supine (cm H_2O)	66.9 ± 22.9	78.3 ± 24.9	0.06
MUCP sitting (cm H_2O)	68.9 ± 25.5	97.3 ± 35.9	<0.001
TR sitting %	45.3 ± 17.3	66.0 ± 22.9	<0.001
MUCP change (cm H_2O)	1.94 ± 16.1	19 ± 18.2	<0.001
MUCP change%	3.5 ± 19.6	24.4 ± 21.0	<0.001

FDV - bladder capacity at first desire to void, SDV - bladder capacity at strong desire to void, $Pdet_{Qmax}$ - detrusor pressure at maximal flow, Qmax - maximal flow rate without catheter, FUL sitting - functional urethral length in the sitting position, MUCP supine - maximal urethral closure pressure at rest in the supine position, MUCP sitting - maximal urethral closure pressure at rest in the sitting position, TR sitting - transmission ratio in the sitting position, MUCP change = (MUCP sitting - MUCP supine). MUCP change% = (100 × MUCP change/MUCP supine). TR sitting - transmission ratio in the sitting position.

Table 2 - Sensitivity and specificity of cystourethrometric parameters in detecting urodynamic stress incontinence according to this study.

Parameters	Cut-off value	Sensitivity (%)	Specificity (%)
MUCP sitting (cm H_2O)	≤74.0	63.5	79.2
	≤76.0	65.4	70.8
	≤82.0	76.9	66.6
MUCP change (cm H_2O)	≤3.5	61.5	83.3
	≤4.5	71.2	79.2
	≤6.5	88.5	75.0
	≤8.0	90.4	70.8
MUCP change%	≤6.9	67.3	75.0
	≤11.2	90.4	70.8
	≤14.4	92.3	66.7
TR sitting	≤48.0	61.5	75.0
	≤57.5	76.9	70.8
	≤62.0	86.5	58.3

TR sitting - transmission ratio in the sitting position, MUCP sitting - maximal urethral closure pressure at rest in the sitting position, MUCP change - MUCP sitting - MUCP supine, MUCP supine - maximal urethral closure pressure at rest in the supine position, MUCP change% - 100 × MUCP change/MUCP supine

Table 3 - Clinical characteristics of patients in the study group and the control group.

Characteristics	Study group (n=52)	Control group (n=24)	*P*-value
Age (years)	43.9 ± 8.1	47.8 ± 9.3	0.075
Number of labors	7.0 ± 3.2	8.1 ± 3.1	0.167
Body mass index (Kg/m^2)	31.7 ± 7.7	29.4 ± 5.6	0.20
Menopause	10 (19.2)	6 (25.0)	0.33
Durance of incontinence (years)	5.4 ± 6.2	4.7 ± 4.9	0.65
Patient's impression*	2.7 ± 1.4	2.2 ± 1.8	0.22
Number of urgency each day	4.9.2 ± 4.6	5.8 ± 5.1	0.49
Number of urge incontinence each day	3.6 ± 4.3	3.4 ± 4.5	0.84
History of pure stress incontinence	11 (21.2)	1 (4.2)	<0.001
History of mixed incontinence	41 (78.8)	6 (25.0)	
Stage of cystocyle†			0.137
Stage (0)	9 (17.3)	5 (20.8)	
Stage (I)	27 (50.0)	12 (50.0)	
Stage (II)	16 (30.8)	7 (29.2)	

Values are presented as mean±SD and number (percentage)
USI - urodynamic stress incontinence. *patient's impression of the severity of incontinence. †stage of cystocyle measured with Pelvic Organ Prolapse Quantification System.[2,4]

Table 4 - Area under the curve of several cystourethrometric parameters.

Variable	Area	Asymptotic Sig.	Asymptotic 95% confidence interval	
			Lower bound	Upper bound
MUCP sitting	0.770	0.000	0.661	0.879
TR sitting	0.766	0.000	0.641	0.891
MUCP change	0.821	0.000	0.706	0.936
MUCP change%	0.802	0.000	0.686	0.919

From the confidence intervals we can see that MUCP sitting, and TR sitting were inferior to the other two parameters in detecting USI because the entirety of their intervals lies below the others.
TR sitting - transmission ratio in the sitting position, MUCP sitting - maximal urethral closure pressure at rest in the sitting position, MUCP change - MUCP sitting - MUCP supine, MUCP supine - maximal urethral closure pressure at rest in the supine position, MUCP change% - 100 × MUCP change/MUCP supine

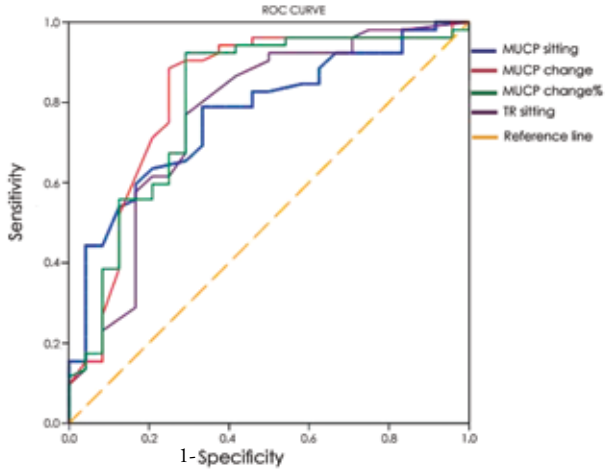

Figure 1 - Receiver operating characteristic (ROC) curve for some of the urethral pressure profile parameters. In this figure, the most accurate parameters in detecting USI were MUCP change and MUCP change%. TR sitting - transmission ratio in the sitting position, MUCP sitting - maximal urethral closure pressure at rest in the sitting position, MUCP change - MUCP sitting - MUCP supine, MUCP supine - maximal urethral closure pressure at rest in the supine position, MUCP change% - 100 × MUCP change/MUCP supine

change and MUCP change% were more accurate than MUCP sitting, and TR sitting in detecting USI.

Discussion. The present study showed that maximal urethral closure pressure was significantly lower in USI patients compared with non-USI group (p<0,001), which agreed with many other studies,[10,11,4-17] but was in contrast with Bai et al[18] who found this difference not significant. Our study noticed also that transmission ratio in the sitting position was significantly lower in the USI patients when compared with non-USI patients (p<0,001), and this was in agreement with previous studies, which found that the mobility of urethra measured using Q-tip test was higher between SUI women compared with controls.[16,18] On the other hand, this study found that functional urethral length was lower in USI group, but this difference was not significant (p=0.09), and this disagreed with other studies in which significant differences are found.[11,17,18] This may be due to the small sample size of our study and because the controls in previous studies have no history of stress incontinence unlike in our study, 29% of controls had stress incontinence in their history. The data presented in this study indicated that MUCP changed less when changing position from supine to sitting in USI patients, and that the most accurate of the cystourethrometric parameters in detecting USI were MUCP change and MUCP change%. However, our result confirmed a previous study which suggested a new parameter to be used to diagnose USI by noticing the change of MUCP during changing position from sitting to standing.[8] These findings should be considered in light of a number of limitations because of the small number of subjects that limit the statistical power. Moreover, we cannot exclude the possibility of misdiagnosis of USI in the control group, since 29% of the controls had stress incontinence history, and since that many previous researches on ambulatory urodynamics showed that 10-20% of women with stress incontinence symptoms and negative stress test on conventional urodynamics had USI on ambulatory study.[5,7] This may explain the low specificity of our results concerning cystourethrometric parameters. For future studies , we suggest to use wider samples in which the controls have no stress incontinence symptoms, or to study the relation between the presence of USI on ambulatory urodynamics and MUCP change.

In conclusion, cystourethrometric parameters such as MUCP sitting, TR sitting, MUCP change, and MUCP change% measurement could be of value in distinguishing between USI women and non-USI women. The most accurate of these parameters which may help in diagnosing GSI are MUCP change, and MUCP change% with a sensitivity of more than 90% and specificity of more than 70% at cut off values of ≤8 cm H_2O for MUCP change and ≤11.2% for MUCP change%.

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Ethical Consent

All manuscripts reporting the results of experimental investigations involving human subjects should include a statement confirming that informed consent was obtained from each subject or subject's guardian, after receiving approval of the experimental protocol by a local human ethics committee, or institutional review board. When reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed.