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Original Article

The role of conventional urodynamic in diagnosing specific types of urinary incontinence in women

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ABSTRACT

Objective: To analyze the association between patient history profile, conventional urodynamic variables, and specific types of urinary incontinence (UI) in order to establish the role of urodynamic in differentiating various types of UI in women.

Material and methods: This cross-sectional study enrolled 547 women with UI. All patients were divided into three groups according to the UI type based on questionnaires: stress UI (SUI), mixed UI (MixUI), and urgent UI (UUI). Patient history taking, physical examination, and conventional urodynamics were performed. The association between patient profile characteristics, urodynamic data, and type of UI were assessed using one-way analysis of variance and chi-square tests.

Results: Significant correlations were observed between the age, body mass index (BMI), cystocele, menopausal status, and most urodynamic data in at least one UI group ($p<0.05$). Age differed among all three groups ($p<0.001$), with SUI group consisting the youngest patients. BMI was higher in the MixUI group ($p=0.001$). The maximum cystometric capacity differed among all three groups ($p<0.001$), with the highest in the SUI. The maximum flow rate was higher in the SUI group than that in the UUI group ($p<0.001$). Residual urine, opening detrusor pressure, and pressure transmission ratio were significantly higher in the UUI group. Detrusor overactivity and menopause were less frequently observed in the SUI group. The least pronounced urodynamic SUI was found in the UUI group. Spearman correlation for cystocele was negative in the SUI and positive in the UUI group.

Conclusion: Conventional urodynamics give additional information to correctly diagnose specific types of UI in women.

Keywords: Female; pressure-flow study; urethral pressure profilometry; urinary incontinence; urodynamics.

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Introduction

Urinary incontinence (UI) is defined as any involuntary leakage of urine.[1] Its prevalence in women ranged from 5% to 60% according to different literature sources and increases with age.[2] UI was categorized into three main groups based on the pathophysiological factors: stress, urgency, and mixed.

Stress urinary incontinence (SUI) is characterized by involuntary leakage of urine on effort or exertion or while sneezing or coughing. Urgency urinary incontinence (UUI) is characterized by involuntary leakage accompanied by or immediately preceded by urgency. Mixed urinary incontinence (MixUI) is characterized by involuntary leakage associated with urgency and occurs during exertion, effort, sneezing, or coughing.[1]

Despite the common main complain among all three groups about involuntary leakage of urine, their pathogenesis and treatment are different and closely related to specific types. Taking a detailed patient history has a significant role in accurate diagnosis of UI. In addition, not every symptomatically established diagnosis of SUI necessarily precludes other types of lower urinary tract dysfunctions.[3] Therefore, objective evaluation tests are also used (physical examination, USG, residual urine, and urodynamic testing). Urodynamics (UDS) in particular is mentioned as the "gold standard"

for objective diagnosis of UI.[3,4] One of the main issues in clinically using UDS for women with UI is that actual complaints are not always replicated during UDS testing. Simultaneously, the procedure itself may trigger atypical symptoms. Furthermore, other authors claimed that UDS provides essential information in establishing accurate diagnosis.[5]

Therefore, the association among patient history profile, conventional urodynamic variables, and specific types of UI were analyzed in order to establish the role of urodynamic in differentiating various types of UI in women.

Material and methods

A total of 547 women with UI who were referred to the functional urology department for UDS were enrolled in this cross-sectional study. The study was approved by The Research Ethics Committee of Pauls Stradins Clinical University Hospital Development Society / Nr 210813-17LAll patients were divided into three groups according to their UI type, using the Urogenital Distress Inventory short form questionnaire (UDI-6) and International Consultation on Incontinence Questionnaire short form (ICIQ-UI): the SUI, MixUI, or UUI. Patient history taking, physical examination, and conventional UDS (filling cystometry, pressure-flow study, and urethral pressure profilometry [UPP]) were performed for all study participants by the same physician. For UDS, the MMS Solar Silver urodynamics equipment was used with a 9-Fr triple lumen UDS catheter. Filling cystometry and pressure-flow examination were performed in sitting position, with urinary bladder filling rate of 50 mL/min and strong cough stress provocation repeated three times consecutively every 100 ml of bladder filling. Subjective markers of the first sensation, first desire, normal desire, strong desire (SD), urgency, and cystometric capacity (CC) were recorded. During the pressure-flow examination, the patient urinated in privacy, unaccompanied, in the investigation room. During the UPP procedure, the patient was placed in the lithotomy position, the bladder volume was 100 mL, the catheter movement speed was 2 mm/s, and the filling rate was 2 mL/min. The urethral profile was recorded twice: the rest and stress profiles. The pressure transmission ratio was measured during a cough test, repeated at least 3 times during the stress profile.

Main Points:

- Maximum cystometric capacity is statistically higher for women with isolated stress urinary incontinence but lower for urgency incontinence.
- Lower opening detrusor pressure increase stress urinary incontinence possibility but higher opening detrusor pressure increase urgency incontinence possibility.
- Lower maximum flow rate significantly increase urgency urinary incontinence possibility.
- Pressure transmission ratio is significantly lower for females with isolated stress urinary incontinence.
- Maximum cystometric capacity, opening detrusor pressure, maximum flow rate, pressure transmission ratio, detrusor overactivity, urodynamic stress urinary incontinence are urodynamic values which helps diagnose specific urinary incontinence type in females.

Statistical analysis

The association among patient profile characteristics, urodynamic data, and specific types of UI were assessed with the following methods using the Statistical Package for the Social Sciences (SPSS) software: Spearman correlation; descriptive statistics; Kolmogorov–Smirnov normal distribution test; one-way analysis of variance, Leven and LSD for normally distributed data; Kruskal–Wallis, Bonferroni, and Mann–Whitney tests for non-normally distributed data; and Pearson's chi-squared test for qualitative data.

Results

Statistically significant correlations ($p<0.05$) based on Spearman correlations were observed between the age, BMI, presence of cystocele, menopausal status, and majority of urodynamic data: detrusor overactivity (DO), urodynamic stress urinary incontinence (SUIuds), maximum CC, opening detrusor pressure (pdetopen), maximum flow rate (Qmax), residual urine after pressure-flow study (RU), maximum urethral closure pressure at rest (MUCPrest), functional urethral length at rest (FULrest), and pressure transmission ratio (PTR) in at least one UI group.

Urodynamics variables such as parity, abdominal leak point pressure, maximum urethral closure pressure at cough stress (MUCPstress), and functional urethral length at stress (FULstress) were not significantly associated with specific UI type.

Further analysis was performed on all data with significant association between certain variables and specific UI group (Table 1). Age was statistically different among all three groups ($p<0.001$), and patients in the SUI group were younger than those in the MixUI and UUI groups.

The mean BMI value was higher in the MixUI group than that in the SUI group ($p=0.001$). The mean CC differed among all three groups ($p<0.001$), with the SUI group having the highest and the UUI group having the lowest.

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The Qmax was higher in the SUI and MixUI groups than that in the UUI group (p<0.001). RU, pdetopen, and PTR were higher in the UUI group than that in the other two groups (p<001; p=0.008; p=0.002, respectively).

Two variables, DO and menopause, showed the same effects, creating differences between the SUI and MixUI groups, as well as between the SUI and UUI groups (p=0.006 and p<0.001, respectively). However, both of these variables were less frequent-

Table 1. The association of analyzed variables with specific types of urinary incontinence

Group				
Variable	**SUI group**	**MixUI group**	**UUI group**	**p**
BMI* M(±SD) (kg/m^2)	27.4 (±5.3)	29.8 (±5.9)	28.9 (±5.9)	0.001
Maximum cystometric capacity (mL)* M(±SD)	353.3 (±131.6)	281.7 (±129.0)	279.1 (±125.2)	<0.001
Functional urethral length at rest (mm)* M(±SD)	35.2 (±8.7)	34.2 (±9.2)	36.4 (±8.4)	0.121
Age (years)**				
Me (Q_1-Q_3)	55 (45–64)	62 (53.5–70)	66 (56–70)	<0.001
Parity**				
Me (Q_1-Q_3)	2 (1–2)	2 (1–2)	2 (1–2)	0.265
Maximum flow rate (mL/s)**				
Me (Q_1-Q_3)	21 (15–26)	19 (13–26)	12 (9–18)	<0.001
Residual urine (mL)**				
Me (Q_1-Q_3)	0 (0–0)	0 (0–0)	0 (0–43)	<0.001
Opening detrusor pressure (cmH_2O)**				
Me (Q_1-Q_3)	19 (13–25)	20 (14–30)	25 (16–37)	0.008
Maximum urethral closure pressure at rest (cmH_2O)**				
Me (Q_1-Q_3)	62 (44–79)	59 (44–80)	67.5 (51–94.3)	0.064
Pressure transmission ratio (%)**				
Me (Q_1-Q_3)	62 (42–80)	64 (49–75)	72.5 (63–82.8)	0.002
Detrusor overactivity (%)***	13	26	32	0.006
Urodynamic stress urinary incontinence (%)***	40	38	8	<0.001
Menopause (%)***	61	81	81	<0.001

*Normal distribution, **Not normal distribution, ***Qualitative data. M: mean value; SD: standard deviation; Me: median; Q_1: the first quartile; Q_3: the third quartile

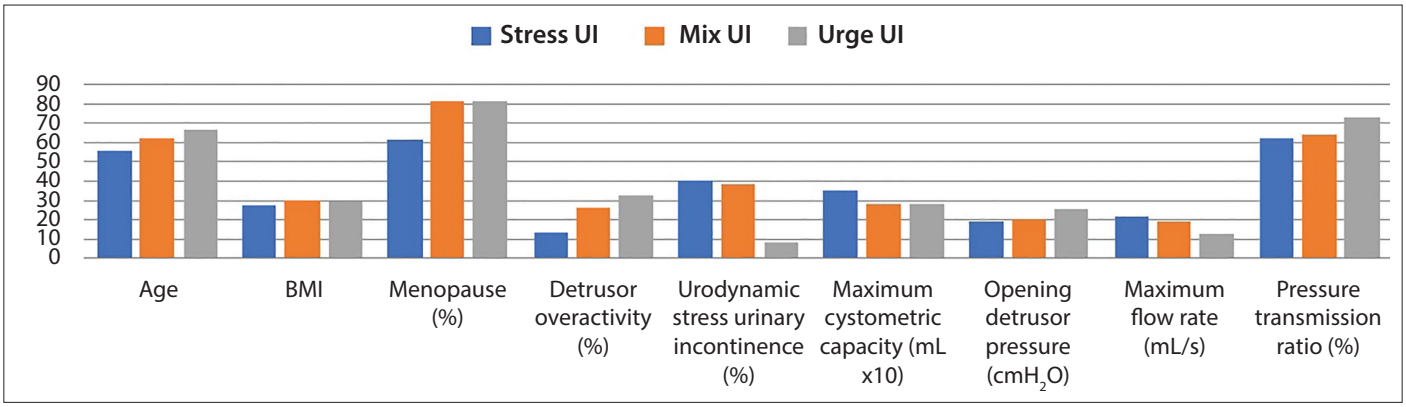

Figure 1. Analyzed variables compared among different urinary incontinence (UI) groups

ly observed in the SUI group. Regarding the SUIuds results, differences were observed between the SUI and UUI, as well as between the MixUI and UUI groups, with the least pronounced incontinence in the UUI group (p<0.001).

Spearman correlation for cystocele was negative in the SUI group: higher grades of cystocele were associated with lower tendency for SUI. Conversely, the correlation in the UUI group was positive, as higher cystocele grade carried a higher risk of UUI. The FULrest did not show any significant differences among the three groups. Based on our results, patient profiling was performed for every specific UI group.

SUI patient profile: Younger patients, with reproductive potential, lower BMI, lower possibility of cystocele, larger CC, higher Qmax rate, less DO during the filling phase of cystometry.

MixUI patient profile: Older patients, more frequently in menopausal period, with higher BMI, lower CC and Qmax, more frequent SUIuds, more frequent DO during the filling phase of filling cystometry than those in the SUI group.

UUI patient profile: Consisted of oldest patients among all three groups, more frequently in menopausal stage as compared to the SUI group, higher BMI than those in the SUI group but lower than those in the MixUI group, more frequently have cystocele, with lowest CC and Qmax among all three groups. They also have the highest RU, pdetopen, and PTR, but less SUIuds as compared to SUI and MixUI groups, and more frequent DO than those in the SUI group (Figure 1).

Discussion

Despite the fact that patients who present with UI have typically arrived at this diagnosis themselves, a successful treatment should be initiated to recognize the precise type of UI. This study primarily aimed to clarify whether UDS testing can provide additional information that helps accurately characterize the type of UI in women. This study has established that patient history, physical examination, and UDS parameters were significantly correlated with the characteristic of each particular type of UI.

Risk factors for the development of any type of UI that are most commonly reported in the literature are age, BMI, race, parity, menopausal status, smoking, diabetes, and hysterectomy.[2,6] In our analysis, factors associated with particular types of UI were age, menopausal status, and BMI. Our data showed that isolated SUI is most common among younger patients (p<0.001), who often still have reproductive potential. Peter F Rosier also reported in the literature[3] that isolated SUI is less common in older women and recommended additional examination to evaluate the urethral and pelvic functionality in this patient group. These reports are in agreement with our results that the occurrence of MixUI increases with age. A group of authors in another cross-sectional study demonstrated a positive association between BMI and UI, without distinguishing particular types of UI.[2] In this study, higher BMI is a more significant risk factor for the development of MixUI and UUI (p=0.001).

Our analysis on urodynamic parameters characterizing the filling phase revealed that the closest to normal were the test data for women with isolated SUI.[1] Our results validate the assumption that UDS cannot adequately confirm the diagnosis in women with clear SUI (if possible to establish from questionnaires and medical history).[7] However, in women with typical SUI, the urination frequency is elevated according to her diary; therefore, urodynamically confirmed good bladder capacity can help confirm that frequent urination is probably a behavioral precaution to prevent leaks, rather than a sign of reduced CC. At the same time, urodynamically confirmed SUI in the filling phase is a parameter that, according to our analysis, reliably proves the presence of SUI (p<0.001) when the selected therapy should be aimed at improving the urethral closure mechanism.

EAU guidelines indicate that UDS is not useful prior to planned surgical sling procedure for uncomplicated SUI.[7] However, every physician performing surgery for UI patients has encountered situations with unsatisfactory results. Therefore, it is possible that UDS testing prior to planned surgery can provide additional clinically significant information about lower urinary tract dysfunction. For example, a published study reported that DO is the only urodynamic risk factor for failure of sling procedure.[8] However, our study showed that DO in the filling phase is significantly more frequent specifically in the group of isolated UUI (p=0.006), where surgical procedures for the treatment of UI would not be recommended due to the type of pathogenesis.

ValUE study analyzing if preoperative UDS affects the treatment outcome concluded that although UDS before stress incontinence surgery did not change the treatment success, UDS increased the confidence regarding the diagnosis.[9] Other authors (multicentric analysis in Italy included 2.053 females with SUI and planned surgery) found that: "The urodynamic observations were not consistent with the pre-urodynamic diagnosis in 1.276 out of 2.053 patients (62.2%). Planned surgery was cancelled or modified in 304 patients (19.2%) due to urodynamic findings."[10] This means that physicians could re-evaluate the treatment algorithm for specific cases based on UDS findings, which may improve the overall treatment outcome.

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Differences in UDS parameters between the SUI and UUI groups confirm the presence of different pathogenetic mechanisms for each specific type of UI. The UUI group had the lowest values of bladder function parameters such as the CC and Qmax, whereas the characteristic parameters for urethral function (pdetopen and PTR) were highest. It confirms the literature report[11] that the mechanism of SUI pathogenesis is based on anatomical changes known as urethral hypermobility (reflected in our results as significantly lower PTR, p=0.002), weak urethral closure mechanism, open bladder neck, and levator ani complex weakness. This again emphasizes the importance of considering the mechanisms of pathogenesis before selecting the appropriate therapy for UI in each patient.

Although another research group who studied the significance of UDS testing for patients with SUI and MixUI concluded that UDS testing does not provide advantages as compared to taking medical history and performing physical examination[5], our data indicate that female patients with MixUI had generally more changes in UDS parameters as compared to those with SUI, which could justify recommending this pharmacological approach during the initial treatment of patients with MixUI, in order to decrease symptoms of overactive bladder. Similar conclusion was attained by scientists in the ValUE study–UDS improves physicians' diagnostic confidence.[9]

Among all UDS tests, UPP is still considered as a test requiring additional clinical value evaluation.[2] As pointed out by *Mcguire*, injections of bulking agent in the midurethral area did not alter the urethral pressure during UPP.[12] We were also unable to find a statistically significant difference in UPP parameters of MUCP and FUL between the pathogenetically different UI groups. Although the most common conclusion from studies analyzing the urethral function during UPP is that the data are clinically irrelevant[3], our results on PTR support the opposite conclusion (PTR was lower in the SUI group, p=0.002, thus pointing to a more pronounced urethral hypermobility); however, we agree that UPP should be used in combination with filling cystometry and pressure-flow examination.[2,3]

In conclusion, we fully agree with *Rosier* who asserted that UDS results must be always considered in the context of patient complaints, clinical symptoms, and other examinations, in order to prescribe the most effective therapy for every patient.[3] The conventional UDS could provide additional information and help diagnose the type of UI in women. Thus, the most effective course of treatment in ambiguous cases is to combine the patient history, physical examination, and UDS testing, i.e., filling cystometry, pressure-flow examination, and UPP. This conclusion is based on our findings that patient age, BMI, presence of cystocele, menopausal status, and majority of UDS data have significant differences among the SUI, MixUI, and UUI groups.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of The Research Ethics Committee of Pauls Stradins Clinical University Hospital Development Society (Nr 210813-17L).

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