

The importance of urodynamic investigations in diagnosis of micturition dysfunctions

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Introduction:

Since the 19th century there are the first notifications concerning the urodynamic data and the development of techniques, the necessary equipment and its use in clinical practice, dates since 1960 [46,50].

The first urodynamic investigations performed at the Urology Clinic in Targu Mures were carried out before 1989, and since 1998 a urodynamics laboratory was concept, where Prof. Dr. Oșan Virgil and Dr. Martha Orsolya performed over 1000 urodynamic investigations (uroflowmetry, filling cytomanometry and flow-pressure studies) for the diagnosis of voiding dysfunctions and the establishment of an optimal therapeutic course.

The incidence of urinary incontinence is dispersed among the female population, reaching between 5% and 69% [15,16]. Most of the studies reported a prevalence between 25% to 45% and the most common being urinary stress incontinence, followed by mixed urinary incontinence and then by urgency [17]. Urinary stress incontinence affect about half of patients with urinary incontinence, most of them report a prevalence of 10% -39%, followed by mixed urinary incontinence (7.5% -25%) and urgency urinary incontinence (1% and 7%), while other causes of urinary incontinence were reported with a prevalence of between 0.5% -1% [20]. Most causes of micturition disorder are secondary to outlet obstructions, but in recently, the possibility of using the urodynamic investigations, more and more cases of detrusor contractility dysfunction have been revealed. [38]. In recent years, a prevalence of about 10% has been reported in the presence of detrusor underactivity among young people and 40% in elderly patients [39]. The underactive bladder symptomatology affects approximately 20% of the general population [40].

Urodynamic investigations are very important methods used in the diagnostic protocol for urinary, organic or functional disorders, so that we can assess their function and objectivize the dysfunction of the micturition act. These have become increasingly effective over the years and are particularly useful in establishing appropriate surgical or drug therapies, follow the progression of postoperative patients as well as to assess possible complications after treatments already performed and patient's outcome .

Objectives:

The major objective of this thesis is to highlight the role of urodynamic investigations in urological practice, trying to highlight their importance in both storage and voiding dysfunctions.

Concerning the storage disorder, we proposed to reveal a few elements regarding the importance of urodynamic investigations in the diagnostic protocol of urinary stress incontinence by highlighting both normal detrusor contractility and incontinence threshold as well as associated detrusor contractility disorders.

We attend a particular attention to the voiding dysfunctions pathology and, mainly, the role of urodynamic investigations in the diagnosis of underactive detrusor and the importance of calculating the Bladder Contractility Index (BCI) in the diagnosis of this condition. BCI is a new term in completing the protocol of voiding dysfunction diagnosis based on the results of the urodynamic parameters.

We also tried to highlight the importance of urodynamic investigations in the diagnosis of urinary retention in women and reveal that in most cases the cause was a detrusor contractility dysfunction.

Methods:

In order to reveal the proposed objectives, we performed 3 retrospective studies on different groups of patients, women and men, including 172 patients who were hospitalized and investigated at Urology Clinic Tîrgu Mureş.

1. In the first retrospective study we evaluated the risk factors in the occurrence of stress urinary incontinence and the importance of urodynamic investigations in patients who had indication of surgical treatment. In order to achieve this goal, we evaluated 34 patients using the urodynamical investigations (uroflowmetry and pressure-flow study) concerning the urodynamical diagnosis of stress urinary incontinence threshold and the evaluation of detrusor contractility.

2. In the second retrospective study, we evaluated the role of urodynamic investigations in the diagnosis of urinary retention in women, highlighting the causes of retention, particularly those of detrusor contractility dysfunction. We conducted a pressure-flow study and uroflowmetry in 47 patients and revealed that in most cases, urinary retention was caused by a detrusor contractility dysfunction.

3. In the third retrospective study, we evaluated the role of urodynamic investigations in the diagnosis of underactive detrusor and the importance of the Bladder Contractility Index (BCI) in the protocol of diagnosis of this disease as well as statistical correlations between its value, urodynamic parameters and factors risk of detrusor underactivity in both women and men.

In this study we urodynamically evaluated 91 patients who were diagnosed with underactive detrusor and we analyzed the results obtained by calculating the BCI value using a mathematical formula based on the Qmax value and the detrusor pressure value.

The investigation protocol used in these cases consisted of:

- a) Patient history: family history, associated neurological disorders, colon disorders, symptomatology, surgical history, medication (neurological, psychiatric, etc.), diabetes mellitus etc.;
- b) Clinical examination;
- c) Voiding Diary;
- d) Abdominal ultrasound including the evaluation of post-void residual urine;
- e) Urine examination;
- f) Gynecological and / or neurological examination;
- g) Urodynamic investigations (uroflowmetry and pressure-flow study).

Results:

In the first study, we evaluated 34 patients with urinary incontinence having 64,25 $\pm$ 8,25 (standard deviation) years old and we revealed that vaginal delivery was an important risk factor in the development of stress urinary incontinence (odds ratio = 4.7, $p = 0.003$) and the pregnancy risk is 8.88 times higher (odds ratio = 8.88, $p = 0.002$). Age was the second risk factor in stress urinary incontinence (Odds ratio = 8.14, $p = 0.003$). The risk of stress urinary incontinence in menopausal patients was 6.2 times higher compared to active hormone women ($p = 0.01$) and obesity had a 5.13 higher risk (Odds ratio = 5.13, $p = 0.005$) for this condition. In our study, caesarean section, chronic urinary infections, genital prolapse, or associated neurological conditions were not significant risk factors, with no statistical significance ($p > 0.005$). The post-void residual urine (PVR) was detected in 7 cases (> 50 ml). The mean PVR value was 80 ml $\pm$ 48.99 ml (SD), with limits between 50-160 ml. Uroflowmetry was performed in all patients included in the study. Mean value of Qmax = 16.95 ml / s $\pm$ 7.8 (SD), with values between 2-33 ml / s. In 15 cases, we noticed an abnormal intermittent flow curve, prolonged duration having an average Qmax value of 11.93 ml / s $\pm$ 3.73 SD with extremities between 2-15 ml / s. In the filling phase, the average of urine loss was 55.8 ml $\pm$ 41.6 (SD), with values ranging from 20 to 182 ml. The result of the pressure-flow study in the evacuation phase highlighted a decreased detrusor contraction in 13 cases and normal detrusor contraction in the rest of the cases (21 patients). In the voiding phase the mean detrusor pressure was 27.73 $\pm$ 6.5 SD and in the case of underactive detrusor, mean Pdet was 11.46 $\pm$ 4.7 SD. Regarding the correlation of the underactive detrusor and urodynamic parameters, we revealed that the post-void residual urine

and the abdominal effort used for micturition were statistically correlated with the diagnosis of the underactive detrusor after performing the pressure-flow study (Chi square test, Man Whitney test), $p < 0.005$.

In the second study, we performed pressure-flow study in 47 women with urinary retention, some of whom had a history of neurological disease, diabetes, surgical history, genital prolapse with indication of surgery, advanced age, or outcome flow rate was not sufficient to establish a definitive diagnosis. The patients (only women) had 51.97 ± 16.07 (DS) mean age with extremities between 20 to 78 years. In most cases, voiding symptoms predominated, but some patients did not experience any obvious symptoms, in most of the cases, the PVR was found after abdominal ultrasound for other reasons. The mean value of PVR was 140 ml (between 50 and 260 ml) identified using abdominal ultrasound. Regarding the relationship between the existence of PVR and the bladder capacity, we applied the Mann-Whitney test, which revealed a statistically significant relation, $p = 0.0006$. Statistically, RPM was higher in patients with increased bladder capacity (over 400 ml) compared to those with normal capacity. The maximum urinary flow rate (Q_{max}) was low in most cases (24 patients) and normal in 5 cases. The value is interpreted according to the Abrams nomogram. The mean Q_{max} value was $11.70 \text{ ml / s} \pm 6.82$ SD. The correlation coefficient, $r = -0.32$ and $p = 0.02$ had statistically significant values revealing a correlation between Q_{max} and PVR parameters so that the lower Q_{max} values were correlated with a larger amount of PVR. From a urodynamic point of view, diagnosis of bladder dyssynergia was established in 14 cases, under and acontractile detrusor in 25 cases, outlet obstruction secondary to genital prolapse grade III or IV in 2 cases, obstruction secondary to urinary incontinence surgery (TOT) in 2 cases and urethral stenosis in 4 cases. The result of the pressure-flow study revealed in most cases a detrusor contractility dysfunction being the cause of urinary retention. Using the Mann-Whitney test, we noticed that the value of the PVR was statistically correlated with the diagnosis of neurological bladder (under or acontractile detrusor), $p = 0.02$, and the amount of PVR was significantly higher compared to obstructive cases. We also evaluated the correlation between Q_{max} and the diagnosis of the neurological bladder (under or acontractile detrusor) by applying the Mann-Whitney test, and the result was statistically insignificant, $p = 0.95$ ($p > 0.05$).

In the third study we included 91 patients with underactive detrusor. The average age of the patients was $58.58 \text{ years} \pm 14.07$ SD with extremities between 27 and 82 years. From the patient's history we noticed the following possible causes of underactive bladder: diabetes mellitus in 34 cases (37.4%), pelvic surgery (radical hysterectomy, rectal or sigmoid resection, operated hernia, etc.) in 33 cases (36.3%), psychiatric treatment in 17 cases (%), neurological disorders in 30 cases (33%), age (over 70 years) in 25 cases. The abdominal ultrasound showed complete urinary retention in 10 cases (11%), incomplete chronic urinary retention in 64 cases (69.2%) and the absence of PVR in 17 cases (18.7%). The mean value of the PVR was $153.74 \text{ ml} \pm 87.31$ SD, with limits between 30-400 ml. Uroflowmetry revealed the following results: normal Q_{max} (over 15 ml / s) in 15 cases and a decreased Q_{max} in most cases, 72 patients. The

Qmax median was 7 ml / s, with limits between 2-19 ml / s. The pressure-flow study was performed to all patients enrolled in the study. Median Pdet was 14 cm H₂O with limits between 7 and 30 cm H₂O. The results of the pressure-flow study were used to calculate the Bladder Contractility Index (BCI). The mean BCI score was 55 with a range between 17 and 110. This was calculated in 87 out of 91 patients, and in four cases the value was greater than 100. BCI value tends to decrease with age, this parameter being an important factor that can influence detrusor contractility. The analysis of the data revealed , that there is a statistical correlation between the existence of neurological diseases and diabetes mellitus and a decreases value of BCI, resulting from low values of detrusor pressure and Qmax ($p = 0.04$ and $p = 0.008$). Also, patients who had a pelvic surgical history, psychiatric treatment (antidepressants, benzodiazepine, etc.) or the elderly had low ICV values (below 100), but the results were not statistically correlated with BCI dependence . The Spearman's test revealed a statistical correlation between the BCI value and PVR quantity, $p < 0.0001$.

Conclusions:

1. Stress urinary incontinence is common in middle-aged women, and risk factors such as: aging, pregnancy, vaginal delivery, menopause, obesity, diabetes mellitus or a history of pelvic surgery (hysterectomy) are associated with the occurrence of stress urinary incontinence.
2. The practice of urodynamic investigations in stress urinary incontinence patients proposed for surgical treatment is very important both to highlight potential detrusor contractility dysfunction and to choose the optimal therapeutic alternative, to quantify possible postoperative complications, and to inform patients concerning the possible post-interventional evolution.
3. Uroflowmetry is a non-invasive urodynamic investigation that can be practiced in patients with both urinary storage and voiding symptoms, but has an orientated character and does not provide sufficient information concerning the detrusor contraction.
4. The presence of post-void residual urine in women, in the absence of obvious outlet obstruction, raises the suspicion of a bladder contractility dysfunction that has to be evaluated by performing invasive urodynamic investigations.
5. The low value of Qmax is insufficient to differentiate the diagnosis of outlet obstruction and detrusor contractility dysfunction, so that performing the pressure-flow study has a decisive role.
6. Advanced age, associated neurological diseases (myopathies, cerebral trauma, medullar disease, etc.) and diabetes mellitus represents risk factors in the diagnosis of underactive detrusor.
7. The Value of Bladder Contractility Index (BCI) is easy to calculate using a mathematical formula based on the Qmax value and the detrusor pressure value.

8. When the outlet obstruction is excluded, we can assume that BCI value is an important parameter and criteria that can complete the outcome of the flow-pressure study in the diagnosis of under or acontractile detrusor.

9. We believe that the introduction of this parameter in clinical practice may be an important element in supporting the diagnosis of under or acontractil detrusor, but studies and investigations are still needed to more accurately evaluate, understand and characterize the underactive detrusor.