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URODYNAMIC STUDIES IN THE DIAGNOSIS AND TREATMENT OF URINARY DISORDERS

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Abstract. The problem of urination disorders is relevant for both women and men. Disorders of the lower urinary tract and urination disorders cause severe physical and moral suffering caused by deep mental trauma, sexual conflict, the development of neurosis and neurasthenia. In recent years, a large number of works have appeared indicating an increase in the number of sick women with disorders of the act of urination in the absence of pathological changes in urine tests. This feature has served as a reason for many researchers to consider the cause of dysuria to be neuro-endocrine disorders in the body of women, circulatory disorders in the pelvic organs and various changes in the psyche of patients.

Keywords: urinary tract infection, overactive bladder, benign prostatic hyperplasia, urinary incontinence, infravesical obstruction, ultrasound examination, lower urinary tract.

Relevance. Urination is a complex reflex act that is ensured by the synchronous contraction of the detrusor muscle and relaxation of the bladder sphincters. It is a voluntary act that begins with the relaxation of the urethral sphincter, followed by bladder emptying through detrusor contraction. Normal urination is possible only with the anatomical and functional integrity of the bladder, its sphincters, and the neural structures regulating the process of micturition.

The functional characteristics of a normal bladder include:

1. Cystometric capacity of 400–500 ml;
2. Sensation of bladder filling;
3. The ability to accumulate urine without significant increase in intravesical pressure;
4. Complete emptying during urination due to the detrusor's capacity for prolonged contraction;
5. Voluntary control despite autonomic regulation.

According to Yu.A. Pytel and co-authors, three aspects of the functional activity of the bladder and urethra can be distinguished: ensuring urine passage from the terminal ureteral sections, storing urine within the bladder lumen, and evacuating it through the urethra. A number of researchers believe that relatively low intravesical pressure plays a decisive role in urine evacuation from the ureters due to the active suction effect of the bladder.

In both reservoir and evacuatory functions, the bladder and urethra operate as a single functional system, despite differences in innervation and tissue composition. Their coordination depends on the tone of the detrusor and the function of the sphincter apparatus. This interaction ensures

stable hydrodynamic conditions for a certain period of time. Their functions are coordinated in such a way that urine accumulation occurs at low intravesical pressure (not exceeding 15 cm H₂O) and high intraurethral pressure.

The main anatomical structures involved in normal urodynamics are the detrusor muscle, urethra (the prostatic and membranous parts in men, the proximal two-thirds in women), and the urethral sphincter. Bladder emptying—urination—is a controlled process consisting of three phases: opening, emptying, and closure. The emptying phase is considered the result of precisely coordinated detrusor contraction and pelvic floor muscle relaxation.

Thus, the act of urination is carried out not only by the bladder and urethra but also by the muscles of the abdominal wall and pelvic floor. It is regulated by a multicomponent neurohumoral mechanism, primarily controlled by the nervous system. Absolute or relative inability to empty the bladder may result from decreased contractility and/or increased resistance to urine flow due to infravesical obstruction. The inability to achieve adequate bladder contraction may also result from temporary or permanent disturbances in any of the neuromuscular mechanisms initiating and maintaining normal detrusor activity. True detrusor areflexia often has a neurogenic origin; however, delayed urination reflex in neurologically intact muscles can occur as a secondary reflex response to painful stimuli, particularly in the pelvic and perineal regions.

Purpose of the study. To improve the diagnostic and therapeutic outcomes of patients suffering from various urination disorders through the use of urodynamic research methods.

Materials and methods. To achieve the stated objectives, a total of 125 patients were examined who received outpatient or inpatient treatment in the urology department of the Andijan State Medical Institute clinic from 2020 to 2023.

The study included:

- 15 patients with obstructive diseases of the lower urinary tract (acute urinary retention),
- 30 patients with benign prostatic hyperplasia (BPH),
- 15 patients with urethral stricture,
- 20 patients with chronic prostatitis,
- 30 female patients with various forms of urinary incontinence (UI),
- 15 female patients with chronic recurrent cystitis.

The study was based on the examination results of 60 men aged 20–85 years and 45 women aged 32–75 years.

For conducting echo-urodynamic studies, the “URO-COLOR-VIDEO 2100” system was used in combination with ultrasound devices Aloka SSD-256 (Japan) or Acuson 128 XPS/10 (USA). The “SONY” video system (VHS, Super-VHS) and the “Philips” telemonitor made it possible to simultaneously visualize the ultrasound image together with urodynamic parameters. Transrectal (in men) and transvaginal (in women) ultrasonographic visualization was carried out using linear and convex probes operating at a frequency of 5 MHz.

Segmental magnification of the video image and data processing were performed using the Micrograf Designer software, which allowed measurement of the urethral diameter with an accuracy of up to 0.01 cm.

Identifying risk factors for the development of urinary retention (ishuria) is one of the key aspects in preventing postoperative acute urinary retention. Determining these factors helps

predict the likelihood of occurrence and develop preventive measures for this serious complication in different patient groups.

To systematize the symptoms of urination disorders, the International Prostate Symptom Score (IPSS) and Quality of Life (QoL) scales were applied. To assess lower urinary tract function, uroflowmetry was performed twice for each patient before surgery at different bladder filling levels.

For comparing uroflowmetry parameters at different volumes, a special Uroflowmetric Index (UFI) developed at our clinic was used.

Results of the study. A total of 30 female patients presenting with complaints of urinary incontinence were examined. The mean age of the patients was 51.05 ± 10.76 years. During the gynecological examination and anamnesis collection, 15 patients (50%) were diagnosed with stress urinary incontinence, 10 patients (33.3%) with urge urinary incontinence, and 5 patients (16.6%) with a mixed form combining episodes of both stress and urge incontinence.

An assessment was conducted to determine the distribution of various forms of urinary incontinence during different stages of the climacteric period. Among patients in the perimenopausal stage, 20% had the stress form, 33.3% had the urge form, and 26% had the mixed form. In the postmenopausal group (1–5 years), the proportion of urge incontinence was 12.5%, stress incontinence 45.83%, and mixed form 2.08%. In patients with a postmenopausal duration of 6–10 years, 13.7% had the urge form and 48.27% the stress form. For those with 11–15 years of postmenopause, the ratio of urge to stress forms was 42.86% and 28.57%, respectively. In women with 16–20 years of postmenopause, the distribution was 30% stress, 40% urge, and 10% mixed form. After 20 years of postmenopause, the urge form predominated — 71.4%, compared to 7.14% for stress and 7.14% for mixed incontinence.

Urodynamic studies revealed distinct functional criteria for each type of urinary incontinence. Patients with mixed incontinence tended to be of older age, showed a smaller maximum cystometric volume, higher maximum urethral pressure, lower maximum urine flow rate, and higher intravesical and detrusor pressures, with noticeable fluctuations in detrusor pressure. The advanced age of patients with urge incontinence confirms the impact of aging processes on both the body and the lower urinary tract, contributing to more frequent episodes of involuntary urination.

It was also observed that as urogenital disorders became more severe, detrusor tone significantly decreased, while maximum bladder capacity increased. This supports earlier data indicating that estrogen deficiency adversely affects the bladder muscle. However, this does not apply to patients with urge incontinence, since detrusor instability makes tone assessment unreliable.

In the group of patients with moderate urogenital disorders (mainly stress urinary incontinence), the urethral resistance index was the lowest — 0.116 ± 0.016 , whereas in women of reproductive age, the normal range is 0.15–0.25.

The most significant urodynamic indicators for diagnosing stress urinary incontinence in women during the climacteric period include:

- Large cystometric capacity,
- Markedly reduced detrusor tone,
- Decreased detrusor pressure and its low contribution to total bladder pressure during voiding,
- Reduced maximal urethral pressure and shortened urethral length.

The diagnostic criteria for urge urinary incontinence are:

- Uncoordinated detrusor pressure fluctuations exceeding 15 cm H₂O,
- Reduced maximum cystometric volume,
- Increased urethral resistance index.

Analysis of reproductive history among the examined women revealed no significant differences in the number of births (average 2.2 ± 0.7 , range 0–3), birth weight of newborns (average 3.6 ± 1.45 kg), or percentage of obstetric forceps deliveries (11.4%). Therefore, these factors could not be associated with the development of overactive bladder (OAB). The onset of menopause and the development of estrogen deficiency appear to be the primary contributors to OAB.

In patients with sensory urgency, the average physiological bladder volume was 218.5 ml, slightly higher than in those with subthreshold fluctuations of maximum urethral and/or detrusor pressure (210.0 ml), and significantly higher than in patients with urethral instability (193.3 ml). However, these differences were not statistically significant.

In contrast, a statistically significant difference was found in the maximum cystometric volume among patients with detrusor instability compared to those with subthreshold detrusor/urethral pressure fluctuations and cystalgia. The average values were 346.9 ml, 514.9 ml, and 571.0 ml, respectively. Statistically significant differences in maximum cystometric capacity were also found between patients with urethral instability alone and those with combined urethral instability, detrusor overactivity, and sensory disorders.

Conclusion. Urodynamic examination should be regarded not merely as an auxiliary diagnostic tool but as an integral and essential component of the diagnostic algorithm for patients with various diseases manifested by lower urinary tract dysfunction symptoms. This method allows for clear differentiation between the filling and voiding phases of the bladder and helps determine the appropriate treatment strategy.

A comparison between the EUDI (echo-urodynamic investigation) technique and conventional urodynamic studies (pressure/flow analysis) demonstrated the superiority of EUDI in visualizing the act of urination. The sensitivity of this method was found to be 89.1% (compared to 92% for KUDI), specificity – 81.8% (vs. 85.7%), and accuracy – 87.7% (vs. 91.2%).

Postoperative urinary retention (ischuria) was observed in 10.1% of patients. The likelihood of urinary retention increases with age and is 3.4 times more frequent in men over 49 years old.

Thus, incorporating urodynamic examination into standard diagnostic protocols significantly enhances the effectiveness of detecting lower urinary tract pathologies, optimizes therapeutic approaches, reduces the risk of postoperative complications, and improves patients' overall quality of life.

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