Dynamic Urethral Pressure Measurements in the Diagnosis of Incontinence in Women

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Summary. A group of 72 female patients whose incontinence had persisted despite various therapies was selected for an extensive urodynamic study. Overt neuropathy was absent in the patient group. An objectified history was taken and the patients were categorized accordingly. Filling cystometry and flow studies were performed in supine and standing positions, combined with continuous measurement of urethral pressure from three points within the urethra and EMG of the urethral and anal sphincters. Urethral pressure profiles were taken at rest and under stress conditions. The history indicated stress incontinence in 23 patients, urge incontinence in 33 and mixed incontinence in 16. Cystometry and urethral profile measurement alone confirmed the history in 80% of the stress and urge patients. Urethral pressure registration during filling, however, showed that a pathologic urethral function was involved in 40 patients (14 stress, 16 urge and 10 mixed incontinents) and, as a result, changed the therapeutic approach in these cases. This pathology was not clear from the EMG recordings or the urethral pressure profiles. Continuous measurement of the urethral pressure dynamics during cystometry can unveil pathology of the urethral function as the basic cause of incontinence and thus prevent inadequate therapies from being used for these patients.

Female urinary incontinence offers both a diagnostic and a therapeutic problem in a significant fraction of patients. The right classification of the type of incontinence, essential in the choice of the therapeutic modality, is hampered by the unreliability of anamnestic data, failure to demonstrate the incontinence during investigation, or false results due to patient stress. The International Continence Society's Standardization Report [2] - the recommendations of which are followed here - defines the different types of incontinence on the basis of detrusor activity and patient sensation associated with the incontinence.

In general, the urethral contribution to incontinence is thought to be of a passive nature except during abdominal straining [19], although it is recognized that urethral pressure changes associated with the incontinence may be found [5, 13]. Continuous urethral pressure measurement during filling cystometry, however, has led to the suggestion that in a number of patients urethral functional pathology may cause incontinence [18] and might explain therapy failures. The diagnostic value of continuous urethral pressure measurement during the normal urodynamic filling and voiding tests is presented in this paper.

Materials and Methods

Incontinent female patients who had failed to respond to earlier conservative or surgical therapy were referred for extensive urodynamic investigation. They were entered consecutively into a prospective study. The group of 72 patients ranged in age from 15 to 72 years (average 46 years). The patients were free of urinary tract infection and their uroradiologic and cystoscopic examinations were unremarkable.

The history was taken following a standardized questionnaire [8], on the basis of which a diagnosis of genuine stress incontinence, urge incontinence or mixed incontinence was proposed. The patients were divided into subgroups according to this anamnestic diagnosis.

The patient was then prepared for urodynamic investigation. She was first asked to empty the bladder in private in a normal toilet. This voiding was not metered or influenced in any way by special orders to the patient. Next, the bladder was catheterized transurethrally to measure any residual urine and to ensure an empty bladder at the start of urodynamics.

An extensive urodynamic investigation then followed. This included:

- Electromyography of the urethral and anal sphincters by coaxial needle electrodes placed perineurally and perianally under oscillographic and loudspeaker control
- Rectal pressure measurement with a fluid-coupled open catheter connected to an external pressure transducer
- Urine flow measurement by a rotating disc flowmeter
- Transurethral bladder filling and intravesical and urethral pressure measurement by a specially designed catheter with four semiconductor pressure sensors

The registrations were recorded on an 8-channel ink-jet recorder.
Intravesical and Urethral Pressure Recording

The catheter that was used for intravesical and urethral pressure recording and bladder filling was specially designed. Figure 1 is a schematic drawing of this catheter. The filling lumen is connected to a peristaltic pump. Four semiconductor pressure transducers are available; the one on the tip of the catheter is used to record the intravesical pressure during cystometry and voiding and the urethral pressure profile at the start of the investigation. The three pressure sensors on the catheter shaft are used for profile measurements, too, especially to compare the urethral stress profile to the intravesical pressure as recorded by the tip transducer.

With the catheter in a fixed position during the filling and voiding phases, these three sensors lie within the urethra, the middle one being positioned at about the maximum closure pressure location of the resting profile. Thus, variations in urethral pressure during these phases are recorded.

Urodynamic Protocol

The bladder was filled with room-temperature saline at an intermediate rate (about 50 ml/min). Both supine and standing cystometries were performed. The patient was free to void upon desire at the first filling in both positions but was asked to inhibit voiding at the second to enable urethral pressure profile recording at cystometric capacity. Recordings of urethral pressure profiles were made by mechanically withdrawing the catheter at 2.5 mm/s.

The investigation started with the patient in a supine position. With the bladder empty, two urethral pressure profiles were recorded on the tip transducer: one while the patient was relaxed and another while she was exerting abdominal pressure.

Next, the bladder was filled to 100 ml and the same pressure profiles were recorded again but now on the three urethral pressure sensors. Another pressure profile was taken while the patient coughed at regular intervals. Electronic subtraction of the intravesical pressure as measured by the tip sensor now recorded a stress closure pressure profile.

The catheter was then placed in a fixed position so that the middle urethral sensor was located at the point of the maximum closure pressure of the rest profile and the filling cystometry was started.

The first desire to void was noted, and on the first filling the patient was encouraged to void if she felt the need. In those patients who did void, a second filling was performed and the patient asked to inhibit voiding up to the cystometric capacity. In the other patients the filling was stopped if feelings of discomfort were expressed. During the filling phase, with the catheter in the fixed position, the urethral responses to coughing were also recorded at bladder volumes of 250 and 500 ml and at capacity. Urethral pressure profiles at capacity were recorded on the urethral sensors again in the conditions of rest, abdominal pressure and coughing.

The bladder was then emptied by catheter, filled again to 100 ml, the pressure catheter fixed in the same position as described earlier, and the patient brought to a standing position. The pressure recordings on coughing were registered, and a filling cystometry in a standing position was performed in the same manner as described for the supine position. At cystometric capacity, standing urethral pressure profiles were recorded while the patient was again relaxed, exerting abdominal pressure and coughing.

Evaluation of the urodynamic investigations was performed at first as a classical filling and voiding study, taking into account the results of the urethral profile measurements. In a second stage the continuous registrations of urethral pressures during filling were also evaluated.

Results

The questionnaire [8] that was used to obtain a standardized specific history has a double scoring system: an urge score and a stress score. When these scores are combined, a tentative diagnosis can be selected from three possibilities: urge incontinence, urethral insufficiency or mixed incontinence [8]. The present group of 72 patients could thus be subdivided according to their anamnestic diagnosis. On this basis, 33 patients (46%) presented with urge incontinence, 23 (32%) with urethral insufficiency and 16 (22%) with mixed incontinence.

The cystometries and urethral pressure profile recordings were evaluated and a urodynamic diagnosis made following the definitions of the ICS [2]. The crucial observation in the urodynamic investigation according to these definitions is the presence of uninhibited detrusor contractions. This finding occurred in 21 of the patients in this study. Three patients had normal urodynamics, in 32 patients genuine stress incontinence was demonstrated, and in 16 patients who expressed urge sensation correlated to their incontinence, no uninhibited detrusor contractions could be provoked. Overflow incontinence was not found in the investigated group.

In Table 1 the urodynamic diagnoses are compared to the anamnestic subgroups. Reflex incontinence was found in two patients in the stress group: detrusor contractions with loss of urine were recorded but no voiding desire was sensed by the patients. The urodynamic urge incontinence group was subdivided into 19 patients with motor urge incontinence and 16 with sensory urge incontinence. Six patients from the urge group and 7 from the mixed group lost urine during the investigation without urge sensation or detrusor contraction and thus were urodynamically diagnosed as genuine stress incontinent. Six out of the 13 patients from the urge-incontinence group and 3 of the 6 from the mixed-incontinence group in whom motor urge incontinence was found had a stress component in their incontinence as well.