Neurourology and Urodynamics 12:235–239 (1993)

Bladder Instability in Women: A Premature Activation of the Micturition Reflex

P.E. Papa Petros and U. Ulmsten

Department of Gynaecology, Royal Perth Hospital, Perth, Western Australia, Australia (P.E.P.P.); Department of Obstetrics and Gynaecology, Uppsala University, Akademiska Sjukhuset, Uppsala, Sweden (U.U.)

Urethrocystometry was performed during a provocative handwashing test in 163 patients, 115 of whom had a prior history of urge incontinence. Almost invariably, a rise in detrusor pressure, when present, followed a fall in urethral pressure, and both were preceded by urge symptoms. This pattern appears to conform to the concept of "urethral instability", "detrusor instability" and urge incontinence being different manifestations of a prematurely activated micturition reflex. © 1993 Wiley-Liss, Inc.

Key words: urge incontinence diagnosis, bladder instability, urethral resistance, handwashing cystometry

INTRODUCTION

Previous cystometric studies when interpreted with regard to a recently introduced theory [Petros and Ulmsten 1990] had led us to hypothesize that "detrusor instability" as measured is actually the second limb of a prematurely activated micturition reflex. The aim of this study was to test the theory's statement that noninflammatory non-neurogenic urge incontinence/bladder instability is most likely a premature activation of the micturition reflex.

MATERIALS AND METHODS

In all, 163 patients were studied. Mean age was 54, range 25–82. Mean parity was 3, range 0–6. Of these, urge incontinence, defined according to the ICS [1988], was the presenting symptom in 115 patients. Genuine stress incontinence [ICS, 1988] was the presenting symptom in 48 patients.

Test Schedule

The patients emptied their bladder first thing in the morning, took a vitamin B tablet containing 50 mg of riboflavine so as to stain the urine dark orange, drank 1–2

Received for publication April 24, 1992; accepted November 19, 1992.

Address reprint requests to P.E. Papa Petros, Suite 14A, Surgicentre 38 Ranelagh Cres., South Perth, Western Australia, 6151, Australia.

glasses of water prior to departure, and presented for testing with a tolerably full bladder. Where possible, a further 1 or 2 glasses of water were ingested on arrival.

The patient was initially tested for stress incontinence by placing a perineal pad over her vulva, and asking her to cough 10 times. Then she was asked to perform, if possible, 10 star jumps (scissor jumps). The pad was examined at the end of each test and weighed if there was any staining. Then the patient lay in the supine position. A short relevant neurological examination was performed. The urethral pressure profile was recorded on an Ormed 5000 system using a laterally oriented double-pressure transducer (Gaeltec). The transducer was then oriented posteriorly, and the cough transmission ratio determined using a mechanical puller. The transducer proximal to the examiner was positioned in the midurethra. With the transducers in situ, the patient was asked to stand at an adjoining sink. The pressure transducer was checked for correct positioning in the midurethra, and strapped in place. The patient was asked to wash her hands for 60 sec. Initially, she was asked to "hold on," if she felt the onset of urge symptoms. If there was no urine loss by the midpart of the test, she was asked to "let go." Any urine loss was noted on the pad and subsequently weighed. Finally, the transducers were removed, and a flow test was performed including an attempt to "cutoff" in midstream. A Foley catheter was then inserted into the bladder so as to measure residual urine. The balloon was filled with 10 ml of radiopaque dye, and standing lateral radiographs were taken in the resting and straining positions. At a later date, simultaneous with urethrocystometry, a circumferential EMG electrode (gain 2 sec, voltage 0.5 mV) was positioned in the posterior part of the vagina, and the patient was asked to bear down and "cutoff." The electrode was then moved to the anterior part of the vagina. The bearing down and "cutting off" maneuvers were repeated. A cystourethroscopy was performed to exclude any inflammation or other pathology and to test for any defects in the voluntary and involuntary closure mechanisms as described [Petros and Ulmsten, 1990].

Explanatory note. As concerns urine loss during the testing process, we considered any urine loss as noted by pad staining during provocative testing to be abnormal. In almost all instances, the reference to "fall in urethral pressure" signifies at least a 20-cm H_2O fall in pressure in a sustained pattern, as usually seen during normal micturition. Otherwise, the definitions and descriptions used here conform to the standards of the ICS [1988].

Pad Test Results

A total of 163 patients were studied. All but 13 of these had some history of SI, although urge incontinence (UI) was the major presenting symptom in 115 patients; i.e., this group gave a history of actually having lost urine prior to arrival to the toilet. Of these 115 patients, 52 actually lost urine during the test. Their range of bladder volume was 32–1,500 ml, mean 453 ml. Sixty-three patients with a prior history of UI did not leak urine on provocation. The mean volume of the 63 patients who did not leak urine was 353 ml, range 62–1,068 ml. There were 48 patients with no history of urge incontinence. Their mean bladder volume was 469 ml (range 87–835 ml). Of these, 5 lost urine during the handwashing test, i.e., the false-positive rate was 11%.

Urge Symptoms

These were noted on provocative testing in all but 7 of the patients who had a prior history of urge incontinence. Almost invariably, these began within seconds of

commencement of the handwashing test. Generally the urge symptoms preceded the fall in the intraurethral pressure.

Urodynamic Patterns During Urine Loss in the 52 Patients With a Prior History of UI

Ten out of 52 patients with a prior history of UI leaked with closure pressures greater than 10 cm H_2O. In 5 of these patients, the closure pressure registered was 20–40 cm H_2O. In every one of these 10 patients, the pattern of urine loss was exclusively that of urethral relaxation. There was no pattern of detrusor contraction following the relaxation. By contrast, 40 of the remaining 41 patients who lost urine with a closure pressure of 0 did so with detectable pattern of detrusor contraction (Fig. 1) which followed the urethral relaxation, usually by some seconds.

Urodynamic Patterns During Provocation in 63 Patients With No Urine Loss and Prior History of UI

Decreased urethral pressure was noted in 39 of 63 patients. Increased bladder pressure following a decreased urethral pressure in a pattern similar to that in Figure 1 was noted in 15 of 63 patients. There was neither an increase in bladder pressure nor a decrease in urethral pressure in 9 of 63 patients. Thus, taking urethral relaxation as an objective index of premature activation of the micturition reflex, the detection rate in the 115 patients with a prior history of urge symptoms was 79%. The detection rate for detrusor contraction for the same group was 48%.

Urodynamic Patterns During Provocation in the 48 Patients With No Prior History of UI

Genuine stress incontinence. There were 16 patients with genuine stress incontinence, and 2 of 16 had a significant fall in urethral pressure on provocation with handwashing, with no actual urine loss. Thus the false-positive rate was 12.5%.

Mixed group. In the 32 patients with both stress incontinence and urge symptoms (but no incontinence in association with those urge symptoms) there was no alteration in urethral pressure in 5 patients, and 5 patients actually lost urine. The remainder demonstrated a fall in the urethral pressure, with 5 patients also demonstrating a rise in detrusor pressure as per Figure 1.

DISCUSSION

Our results show a consistent pattern of urethral relaxation, r to r1, followed by detrusor contraction, c to c1 (Fig. 1), exactly as seen in normal micturition [Ulmsten, 1977; Tanagho, 1978]. We propose that "bladder instability," "detrusor instability," "urethral instability," urge incontinence, urge symptoms without urine loss, are all different manifestations of a prematurely activated micturition reflex. Because of the almost universal use of filling cystometry in urodynamic assessment, we feel obliged to explain why our results appear to differ from those generally obtained using this process; i.e., with filling cystometry, urethral relaxation often follows detrusor contraction. We therefore emphasize that filling cystometry was not performed on our patients. They arrived for testing with a full bladder.

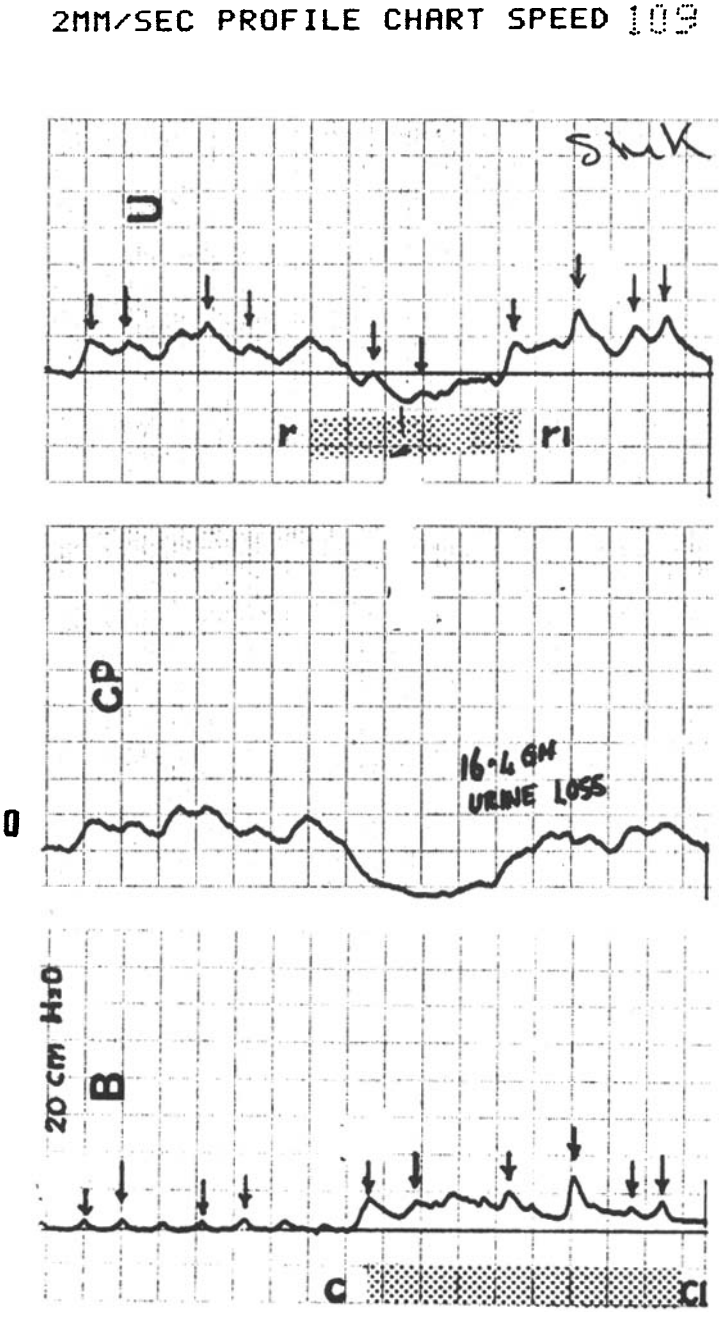

Fig. 1. "Bladder instability" is a premature activation of the micturition reflex. This is an actual graph of a provocative handwashing ("sink") test. The **top graph,** U, represents the recorded maximal intraurethral pressure, taken at the midpoint of the urethra. B, the **bottom graph,** represents the bladder pressure. The **middle graph,** CP, represents the electronically subtracted closure pressure; "r" to "r1" represent the fall in the urethral pressure (U); c to c1 represent the phasic contraction of the bladder.

We consider that filling cystometry works, at least in part, by directly stimulating bladder smooth muscle, and that this is why urethral relaxation may actually follow detrusor contraction. The shape of smooth muscle cells and absence of alignment of contractile proteins enables smooth muscle to function while undergoing greater changes in length than does skeletal muscle, a necessary property in organs such as bladder with variable capacities. Such smooth muscles have the following characteristics [Creed, 1979]: (1) instability of the membrane potential gives rise to all-or-none action potentials, (2) the action potential spreads throughout the muscle because of low-resistance pathways between cells; and (3) the spontaneous activity can be modified by nerves. These can be excitatory or inhibitory.

Stretching of smooth muscle causes membrane depolarization. If the discharge is fast enough, it leads to summation of individual contractions [Keele, 1971]. We hypothesize that the mechanism for urine loss with filling cystometry is at least in part initiated by detrusor spasm activating subsequent reflex urethral relaxation. This is a reverse of the normal micturition reflex. By contrast, our patients presented with a bladder volume consistent with what their bodily mechanisms could control. Therefore their bladder smooth muscle was not subjected to an artificially high volume which could cause spasm. Urine loss was induced by hand-washing, a more natural provocation. We consider that this works by lifting off the inhibitory mechanisms for the micturition reflex at the level of the brain.

Comparison of Fall in Urethral Pressure With Rise in Detrusor Pressure

We interpret the smaller number of detrusor contractions registered in comparison to urethral relaxation, to the ability of the body's control mechanisms to suppress the micturition reflex between the first part of the reflex, urethral relaxation, and the second part, detrusor contraction.

Leakage With a Closure Pressure Greater Than 0 cm H_2O

This is consistent with the concept that the function of the periurethral striated muscle is to create a water-tight seal [Petros and Ulmsten, 1990]. The first part of the micturition reflex involves relaxation of the urethra. Loss of the water tight seal would permit urine leakage along the inserted transducer which would act as a splint.

REFERENCES

Creed K (1979): Functional diversity of smooth muscle. Br Med Bull 3:243–247.

International Continence Society (Abrams P, Blaivas J, Stanton S, Andersen J) (1988): Standardisation of terminology of lower urinary tract function. Scand J Urol Nephrol Suppl 114.

Keele CA, Neil E (1971): The autonomic nervous system. In Keele CA, Neil E (eds): Samson Wright's Physiology, 12th Ed. London: Oxford University Press, pp 383–396.

Petros P, Ulmsten U (1990): An integral theory of female urinary incontinence. Acta Obstet Gynecol Scand Suppl 153 69:7–30.

Tanagho EA (1978): The anatomy and physiology of micturition. Clin Obstet Gynaecol 5:1,3–25.

Ulmsten U, Asmussen M, Lindstrom K (1977): A new technique for simultaneous urethrocystometry and measurements of the urethral pressure profile. Urol Int 32:88–92.