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URODYNAMIC CLASSIFICATION OF PATIENTS WITH SYMPTOMS OF OVERACTIVE BLADDER

ADAM J. FLISSER, KONSTANTIN WALMSLEY AND JERRY G. BLAIVAS*

From the Departments of Obstetrics and Gynecology and Urology, Joan and Sanford Weill College of Medicine, Cornell University, Brady Department of Urology, New York Presbyterian Hospital, Weill Cornell Medical Center and Department of Urogynecology, Lenox Hill Hospital, New York, New York

ABSTRACT

Purpose: We describe a new classification of patients with overactive bladder symptoms.

Materials and Methods: The office records of 132 patients who presented for evaluation of symptoms of urinary frequency, urinary urgency and/or urge incontinence, and who underwent videourodynamics were identified. All patients completed a 24-hour voiding diary and 24-hour pad test. Data collection included age, sex, hormone status, number of voids and incontinence episodes per 24 hours, functional bladder capacity, pad weight and associated genitourinary conditions. Videourodynamics were reviewed and patients were divided into 4 clinical categories, including type 1—no evidence of involuntary detrusor contractions on videourodynamics, type 2—involuntary detrusor contractions present, and patient aware and able to abort them, type 3—contractions present, patient aware and able to contract the sphincter but not abort contractions and type 4—contractions present and patient unaware but unable to contract the sphincter or abort contractions.

Results: Average patient age ± SD was 64 years ± 13. There were an average of 13 ± 5 voids and 3 ± 5 incontinence episodes per 24 hours. Average functional bladder capacity was 306 ± 146 cc and average pad weight was 94 ± 165 gm. Associated diagnoses included benign prostatic hypertrophy in 28% of cases, sphincteric incontinence in 17%, idiopathic urge incontinence in 29% and uterovaginal or bladder prolapse in 17%. Another 11% of patients had bladder outlet obstruction, impaired detrusor contractility or neurogenic bladder conditions. Of the cases 72 (55%), 32 (25%), 23 (17%) and 5 (4%) were categorized as classes 1 to 4, respectively. ANOVA revealed no statistically significant differences in the number of voids or incontinence episodes, functional bladder capacity or pad test when individual categories were compared to each other.

Conclusions: This overactive bladder classification stratifies patients according to degrees of awareness, and control of bladder and sphincter function. It may prove useful as a guide for prognosis and therapy. Patients can be stratified into clinical groups based on the presence or absence of involuntary detrusor contractions, the ability to abort contractions and the ability to contract the urinary sphincter in response to contractions. Limiting the definition of overactive bladder to apply only to patients with no proved infection or other pathological condition would have eliminated more than 75% of those in this sample with symptoms of urinary urgency, frequency and/or urge incontinence.

KEY WORDS: bladder, urodynamics, urination disorders, classification

Overactive bladder was recently defined by the involuntary detrusor contraction (ICS) as "urgency, with or without urge incontinence, usually with frequency and nocturia . . . if there is no proven infection or other obvious pathology."[1] If strictly applied, this definition leaves no term to describe identical symptoms in the presence of pathological conditions. In contrast, we consider overactive bladder to be a symptom complex (syndrome) and a generic term to describe a condition (involuntary detrusor contractions). Symptoms include urinary frequency and/or urgency, urge incontinence and bladder pain. The syndrome and condition have a broad differential diagnosis.

We believe that cystometrography, particularly as part of a multichannel urodynamic study, is an essential part of the diagnostic evaluation in its role of defining underlying pathophysiology and directing treatment.[2] Essential to the diagnosis of overactive bladder syndrome is some combination of urinary frequency, urgency, urge incontinence and pain. Cystometrography acts as a diagnostic test to identify etiologies such as involuntary detrusor contractions or low bladder compliance as well as a provocative test to determine whether patient symptoms are reproducible by bladder filling or involuntary detrusor contractions and whether bladder emptying and the cessation of involuntary detrusor contractions is associated with relief. It is our opinion that cystometry provides valuable information for managing overactive bladder even when it fails to demonstrate involuntary detrusor contractions. Cystometry can classify overactive bladder based on objective and mutually exclusive findings and, most importantly, independent of the capacity of the physician or medical science to describe or identify the underlying etiology of patient symptoms.

In some patients involuntary detrusor contractions are comparable to neurological reflexes that occur in the absence of voluntary control. Other patients with urgency and urge incontinence have no involuntary detrusor contractions and there is a wide range of intermediate levels of control and

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awareness.[3] Information obtained during videourodynamics, especially during the voiding phase of cystometrography, can be critical in determining which of the many causes of the symptoms of urgency, frequency or urge incontinence afflicts a particular patient. In the belief that videourodynamics may be useful for classifying patients with symptoms of overactive bladder we retrospectively reviewed patient records to determine whether they could be classified into mutually exclusive categories.

MATERIALS AND METHODS

The research protocol was approved by the institutional review board. Office records of 132 patients who presented for evaluation of a chief complaint of urinary urgency, urinary frequency and/or urge incontinence between 1999 and 2001, and who completed a videourodynamics were reviewed. Most patients also completed a 24-hour voiding diary (120) and 24-hour pad test (62). Data collection included age, sex, hormone status, number of voids and incontinence episodes per 24 hours, functional bladder capacity, pad weight and associated genitourinary diagnoses, including prolapse, stress urinary incontinence, neurogenic bladder and benign prostatic hyperplasia (BPH).

Videourodynamics were performed with a 7Fr dual lumen vesical catheter and a 9Fr rectal balloon catheter at medium filling using radiographic contrast material (200 ml. iothalamate meglumine 60% mixed with 800 ml. water) with the patient seated. Before the examination patients were asked to void and post-void residual urine was measured with the catheter. During bladder filling patients were instructed neither to void nor inhibit voiding but simply to report sensations to the examiner. If involuntary detrusor contractions were detected, patients were asked to describe what they felt and try to abort the detrusor contraction voluntarily by contracting the sphincter.

Videourodynamics were reviewed and patients were divided into clinical categories, including type 1—no evidence of involuntary detrusor contraction on videourodynamics, type 2—involuntary detrusor contractions present, and patient aware and able to abort them, type 3—contractions present, and patient aware and able to contract the sphincter but not abort contractions and type 4—contractions present, and patient unaware and unable to contract the sphincter or abort contractions (figs. 1 to 4). In all cases a history was obtained, and physical examination, validated questionnaire and videourodynamic studies were done. Statistical analysis of the data was performed using ANOVA to compare differences in means between the groups, and between each group and the overall sample.

RESULTS

Average patient age ± SD was 64 ± 13 years. There were an average of 13 ± 5 voids and 3 ± 5 incontinence episodes per 24 hours. Average functional bladder capacity was 306 ± 146 cc and average pad weight was 94 ± 165 gm. Associated diagnoses included BPH in 28% of cases, sphincteric incontinence in 17%, idiopathic urge incontinence in 29% and uterovaginal or bladder prolapse in 17%. Another 11% of patients had bladder outlet obstruction, impaired detrusor contractility or neurogenic bladder conditions. Of the patients 72 (55%), 32 (25%), 23 (17%) and 5 (4%) were categorized as classes 1 to 4, respectively. There were no statistically significant differences in the number of voids or incontinence episodes, functional bladder capacity or pad test when individual categories were compared to each other. Patients could be stratified into clinical groups based on the presence or absence of involuntary detrusor contractions, the ability to abort contractions and the ability to contract the urinary sphincter in response contractions. Using our criteria 72 (54.5%), 32 (25.3%), 23 (17.4%) and 5 patients (3.8%) were categorized as classes 1 to 4, respectively.

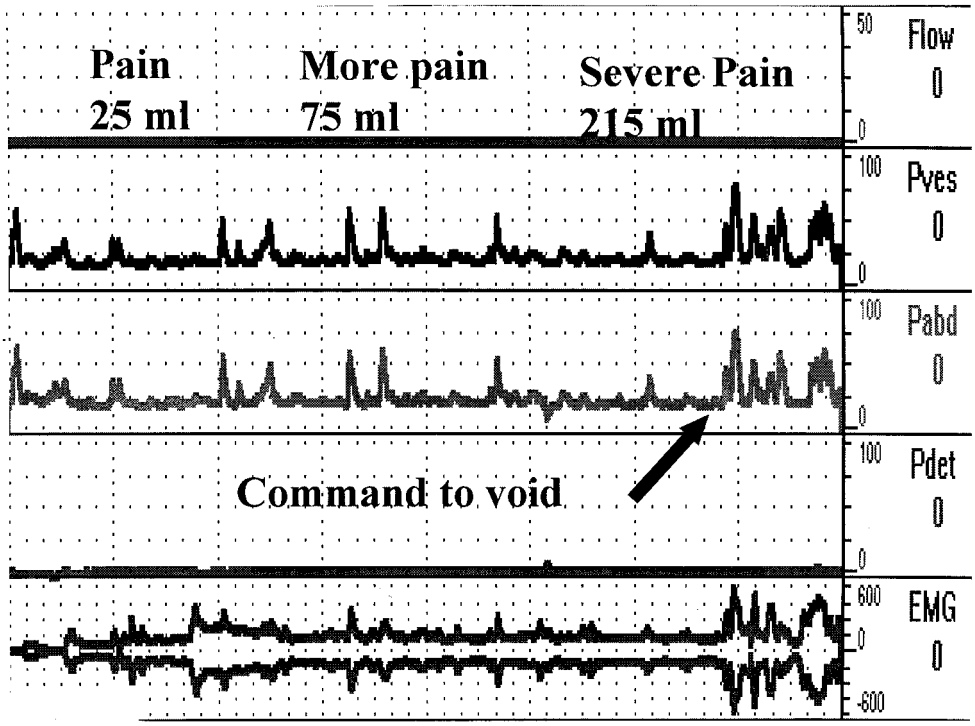

FIG. 1. Type 1 overactive bladder in 43-year-old woman who complained of urgency, frequency and bladder pain, and voided more than 30 times in 24 hours. Urodynamic tracing shows small capacity, hypersensitive bladder with flat detrusor tracing and inability to initiate voluntary detrusor contraction (*IDC*). There were neither voluntary nor involuntary detrusor contractions. *Flow*, urinary flow in ml. per second. *Pves*, vesical pressure in cm. H_2O. *Pabd*, abdominal pressure in cm. H_2O. *Pdet*, detrusor pressure in cm. H_2O. *EMG*, electromyography.

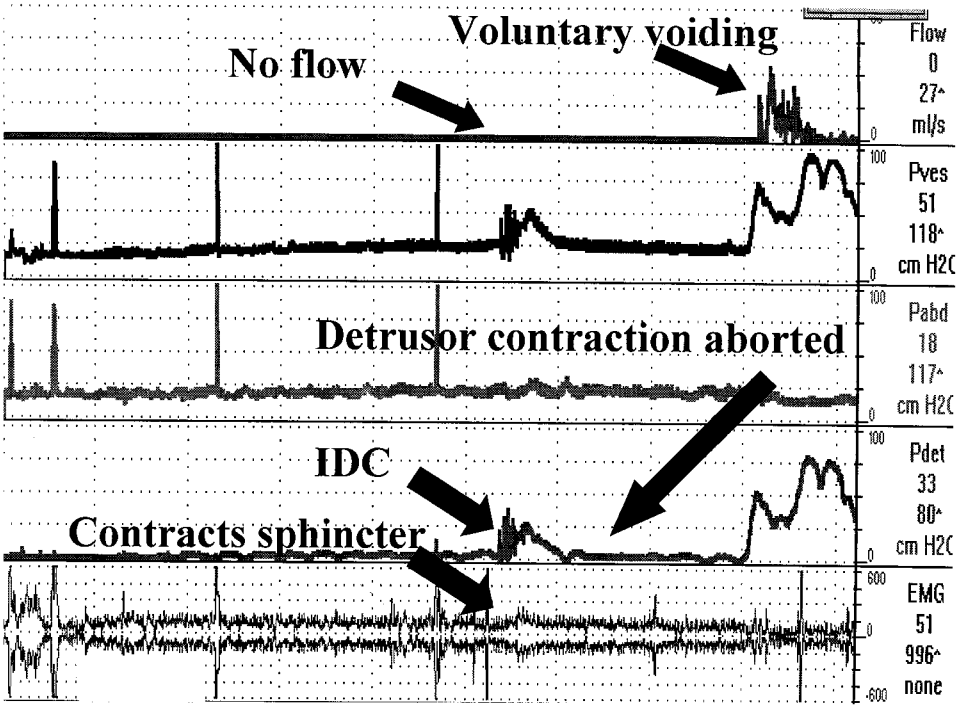

FIG. 2. Type 2 overactive bladder in 55-year-old woman with urgency and frequency. Urodynamics reveals involuntary detrusor contractions, which patient perceived as urge to void. She was able to suppress this urge and contracted urinary sphincter to maintain continence. At study end she voided voluntarily. *Flow*, urinary flow in ml. per second. *Pves*, vesical pressure in cm. H_2O. *Pabd*, abdominal pressure in cm. H_2O. *Pdet*, detrusor pressure in cm. H_2O. *EMG*, electromyography.

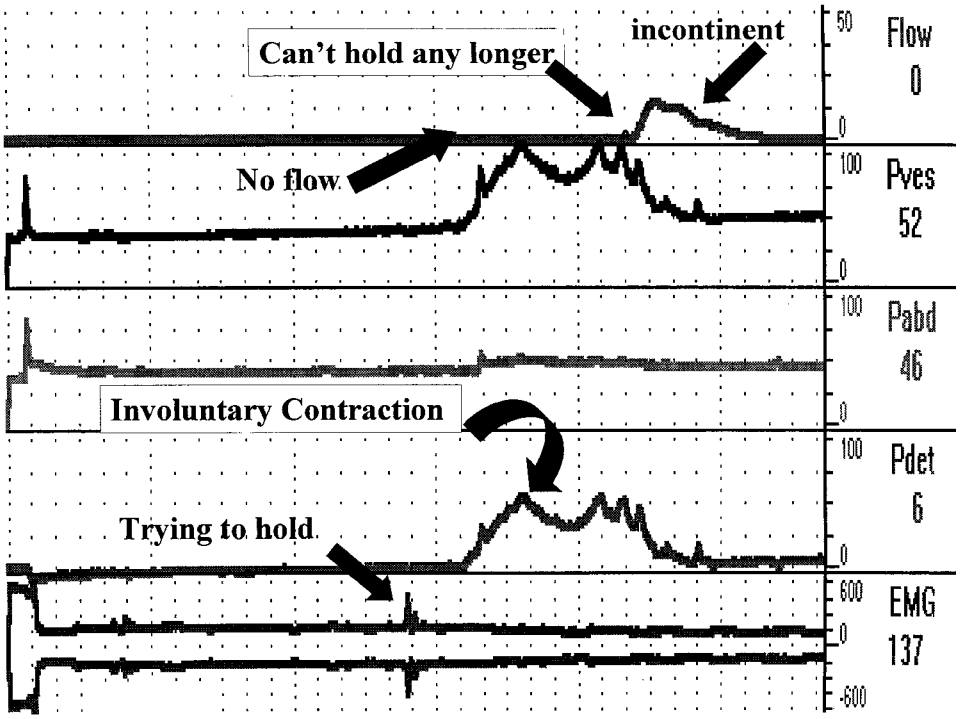

FIG. 3. Type 3 overactive bladder. Urodynamics demonstrates involuntary detrusor contraction (*IDC*) in 46-year-old woman. Involuntary detrusor contraction was perceived as urge to void. She maintained continence temporarily by contracting sphincter but then voided uncontrollably. *Flow*, urinary flow in ml. per second. *Pves*, vesical pressure in cm. H_2O. *Pabd*, abdominal pressure in cm. H_2O. *Pdet*, detrusor pressure in cm. H_2O. *EMG*, electromyography.

DISCUSSION

The incidence of the broad category of conditions termed overactive bladder has been estimated at 16% of the population older than 40 years, of whom 60% consulted a physician due to symptoms.[4] The National Institutes of Health funded MESA study showed that 37.6% of women older than 60 years experienced urinary incontinence with at least 65% of this group describing urge incontinence as part of the symptoms.[5] A study of 55 to 90-year-old women at a continence clinic showed that 48% of patients reported urge or mixed

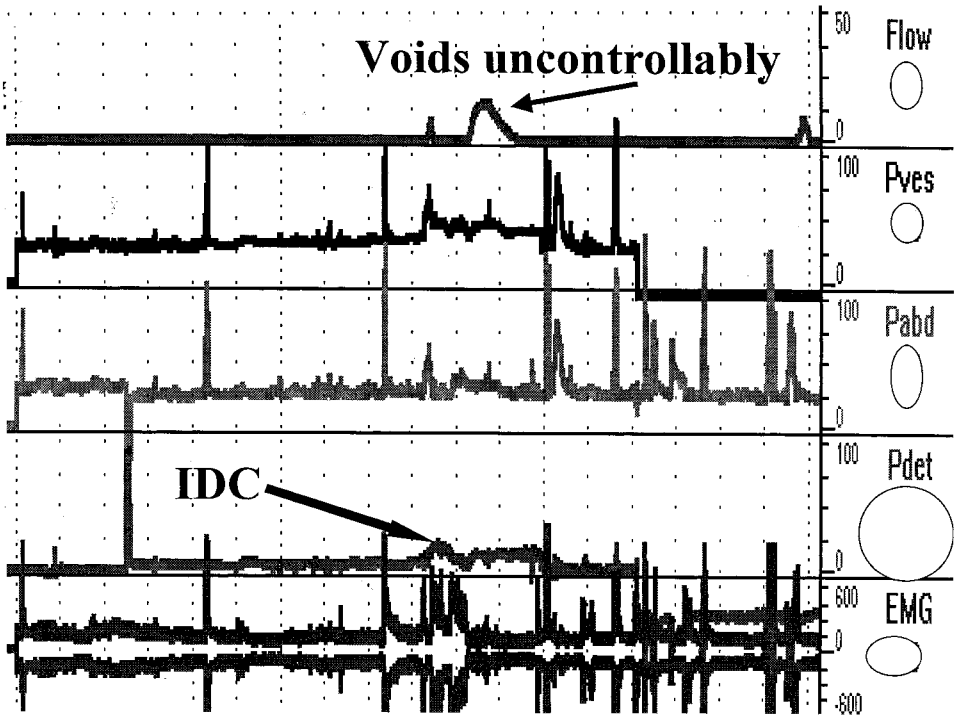

FIG. 4. Type 4 overactive bladder in 82-year-old woman who underwent urodynamics due to urinary urgency, frequency and urge incontinence. Involuntary detrusor contraction occurred. Patient was unaware of it and voided uncontrollably, unable to stop urinary stream. *Flow*, urinary flow in ml. per second. *Pves*, vesical pressure in cm. H_2O. *Pabd*, abdominal pressure in cm. H_2O. *Pdet*, detrusor pressure in cm. H_2O. *EMG*, electromyography.

incontinence.[6] The United States Census Bureau reported that the population of the United States was 281,421,906 in 2000 with 12.4% of the population (34 million people) 65 years old or older.[7] Accordingly it is estimated that more than 16 million people in the United States have overactive bladder. To our knowledge optimal methods of diagnosis and management remain to be developed. It is already known that the terms associated with this spectrum of disorders, including overactivity, instability and hyperreflexia, do not independently divide patients into useful clinical groups.[8,9] To date classification systems have also failed to become widely applied in clinical practice.

Classification systems. For a classification system to be maximally effective classes must be mutually exclusive, defined as simply as possible and clinically useful. Previous classifications of overactive bladder included etiology based terminology, such as that used by the ICS. Fall et al noted that the limitations of our diagnostic ability, especially in the detection and diagnosis of subtle neurological conditions, undermines the success of any etiology based scheme.[10] They stated that "available methods for the detection of neurogenic disorders are inadequate, a fact which must result in frequent misclassifications."[10] Furthermore, the bladder is subject to pathophysiological input from a number of different systemic sources, including the neurological influences of 3 sets of nerves, namely parasympathetic and sympathetic nerves from the sacral and thoracolumbar pathways, and sacral somatic nerves.[11] It is also subject to muscle activity, making myocyte function another potential source of a pathological condition.[12] Thus, diagnostic classification schemes based on identifying pathological conditions are faced with a multiplicity of potential agents and systems with which to categorize patients into discrete and useful groups. Other etiology based systems face similar difficulty. For example, Stephenson and Wein described "phasic contractions-unstable bladder" according to congenital, idiopathic middle-aged onset and older patients with degenerative instability,[13] while Bosch suggested division based on pathophysiological causes, including afferent neuropathy to behavioral causes.[14]

Cystometric classifications. Fall[10] and Geirsson[15] et al reviewed the records of 501 patients after evaluation for overactive detrusor function. The 4 criteria used to divide patients into groups were phasic detrusor contractions, the perception of fullness, outcome of a 2-minute voiding inhibition test and the ice water test. Of the patients 90% could be classified into these divisions. They noted highly significant differences in patients with uninhibited overactive bladder (impaired sensation of fullness, positive ice water test and uninhibited micturition reflex) compared with those classified with phasic detrusor instability (normal or increased sensation and phasic detrusor activity during filling). Patients in the uninhibited overactive bladder group were less able to inhibit voiding and had lower maximum cystometric capacity ($p < 0.001$).

These researchers found that their urodynamic classification divided patients into groups with objective and statistically significant differences, in contrast to the concurrent ICS definitions, which do not produce distinct clinical groups.[10] Furthermore, their system predicted a higher success rate in patients treated with electrical stimulation for urge incontinence.[16] Patients with phasic detrusor instability responded at a higher rate than those with uninhibited overactive bladder. This system is an example of a successful urodynamics based classification system with clinical import. While it in part depends on urodynamic tests similar to ours (the 2-minute inhibition test and ability to abort involuntary detrusor contractions), it also relies on the ice water test as a diagnostic criterion.

van Waalwijk van Doorn et al constructed a detrusor activity index to quantify detrusor overactivity measured by ambulatory monitoring.[17] Patients were pre-classified by computer questionnaire as having an overactive or not overactive bladder, excluding those with known mixed incontinence. They then underwent conventional and ambulatory urodynamics. Patients in whom conventional urodynamics and the questionnaire were consistent were used to form representative values for voiding behavior, detrusor activity, drinking behavior and other variables. This group con-

structed an algorithm that resulted in a numerical value of between 0 and 1, which correlated with the likelihood of overactive detrusor.

Arbitani reviewed classification systems for overactive bladder.[18] He also mentioned Stephenson and Wein, who described "phasic contractions-unstable bladder" according to congenital, idiopathic middle-aged onset and older patients with degenerative instability,[13] as well as Bosch, who suggested division based on pathophysiological causes, including afferent neuropathy to behavioral causes.[14] However, these 2 systems have the shortcomings of etiology based sorting. When the etiology of patient symptoms is unclear, which is common, the patient cannot be objectively categorized, undermining the value of the system. Whether one proposes a basic dysfunction of various levels of the nervous system, a myogenic cause based on detrusor muscle cells or any other mechanism a practical classification is limited by the advance of diagnosis in this specific area.[18]

In our study videourodynamics successfully classified 100% of patients who presented with the symptoms of frequency, urgency or urge incontinence based only on urodynamic findings. It avoided the limitations of etiology based classification, while introducing the limitations of urodynamic diagnosis. We have previously reported that urodynamic technique is a critical part of the successful use of videourodynamics for diagnosis.[19] Using our methods we reliably documented involuntary detrusor contractions when conventional urodynamics failed to reveal them. Therefore, our inclusive classification system decreases the potential handicap of the current technology. Conversely our system depends on the sensitivity and limitations of urodynamic testing. The reproducibility of various aspects of a cystometrogram is still being evaluated and there is debate about its potential impact on the usefulness of urodynamic testing. We consider that our urodynamic examination reveals particular patient characteristics at testing. We realize that at future times with or without treatment the patient may show different findings at urodynamic examination, much as individual strength and appearance may vary after a period of physical conditioning. Therefore, the variability inherent in urodynamic testing is part of this classification scheme and its implications.

In our study using the chief complaint as an inclusion criterion potentially excluded patients with genuine overactive bladder problems but who may have presented with the chief concerns of prolapse, infection or pelvic pain. Patients who present with complicated mixed incontinence or multiple problems may focus on a chief complaint which, while it is of greatest concern to them, prevents convenient labeling. In addition, patients who have idiopathic detrusor contractions but do not present with symptoms of overactive bladder may be indistinguishable by urodynamic testing from those in our study, although they are not classified by our approach. They represent a population with the clinical finding of overactive bladder as defined by the ICS, and they may hold useful clues to the validity and usefulness of urodynamic testing in patients with overactive bladder. It is vital to note that had we limited the study to patients with overactive bladder as defined by the ICS, we would have been forced to exclude 75% of our sample, including those who concurrently had BPH, bladder outlet obstruction, neurogenic bladder and impaired detrusor contractility.

In addition, research has already shown that detrusor instability improves in many patients with mixed incontinence when sphincteric incontinence is treated. We are hopeful that this classification may indicate which patients with detrusor instability and overactive bladder may improve if the underlying pathological condition is treated. Thus, there may be prognostic value to determining the degree of control and awareness of detrusor activity in patients with overactive bladder.

CONCLUSIONS

Dividing patients with overactive bladder into categories defined by videourodynamic findings is possible. Patients separated into categories by this approach appear to have few significant differences in objective urinary complaints or in bladder function parameters. Future analysis of treatment success rates may add validity to a urodynamic classification of overactive bladder.

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EDITORIAL COMMENT

Overactive bladder as currently defined by the ICS is a general symptom term. This syndrome may have various causes. Detrusor overactivity is the term to describe conditions with involuntary detrusor contractions. The clinician needs further detailed division into subgroups to guide investigation and treatment. There are obvious problems to constructing a classification that is accurate and clinically useful because a large variety of voiding dysfunctions exist. This fact mirrors the complexity of neuromuscular control of the lower urinary tract. Our knowledge of these control systems is frag-

mentary, and so there are tremendous difficulties in designing a classification based on pathophysiology.

These authors recognize and emphasize the functional aspect of abnormal urodynamic findings. At our current level of knowledge is seems most logical to classify overactive detrusor dysfunctions by the combination of presenting signs rather than by etiological speculations, as suggested by many groups, or by the detection or not of a neurological condition, as in the ICS system. It should be noted that currently the ICS with its terminology founded on the traditional view emphasizes that the extent of neurological investigation influences the distribution of neurogenic versus idiopathic detrusor overactivity. Defining and further exploring functional subgroups is an important prerequisite to developing a classification and eventually identifying possible neuronal sites and causes of dysfunctions.

We previously suggested a classification based on urodynamics. Interestingly there is a good concordance between the current study and our observations. Type 2 patients were aware of bladder filling and able to abort phasic contractions, equivalent to our phasic detrusor instability group (with the same denomination in the current ICS terminology). Type 3 patients had awareness and were able to contract the sphincter but could not abort involuntary detrusor contractions. This group of subjects was approximately similar to our uninhibited overactive bladder subgroup with preserved sphincter control, a category defined by Geirsson et al (reference 15 in article). In type 4 involuntary detrusor contractions were present and patients were unaware and also unable to contract the sphincter or abort contractions, as in our uninhibited overactive bladder subgroup. This dysfunction conforms to the terminal detrusor overactivity category according to the ICS. In our experience this dysfunction is the most prevalent one in old age.

As indicated by Flisser et al, we used the bladder cooling test in our diagnostics. This test is simple and robust. The bladder cooling reflex is a neonatal segmental reflex that is under descending inhibitory control in normal adults but may be unmasked by specific lesions. Urodynamically exploring this reflex system, which is separate from the micturition reflex, improves diagnostic precision. The bladder cooling test is typically positive in our uninhibited overactive bladder functional subtype, comparable to types 3 and 4. Flisser et al included electromyography recordings and videourodynamics, bringing another dimension to the diagnostics that is especially valuable to assess the coordination of bladder/urethral activity. By adding further tests to describe function refinement and increased accuracy of classification should be expected.

In agreement with the observations of the current group it can be postulated that overactive bladder results in principle from a disturbed neuronal control of the bladder, while the precise etiology is often unclear. In patients with a common urodynamic pattern it can be expected that functionally close pathway systems are affected. A careful description and analysis of combinations of findings may offer clues on the physiological background of a specific pattern. In view of the symptom pattern disturbed perception of bladder fullness, lack of voluntary inhibition, normal micturition reflex threshold and coordinated micturition we have previously suggested that patients with uninhibited overactive bladder (type 4) have suprapontine dysfunction. Many patients with overactive bladder, like normal individuals, manage to delay micturition voluntarily, while these subjects fail. Another group (type 3), including 22% of patients with uninhibited overactive bladder in the study of Geirsson et al (reference 15 in article), were unable to abolish the involuntary detrusor contraction but able to prevent leakage by contracting the external sphincter. From this observation it can be learned that, contrary to common belief, voluntary contraction of the sphincter and detrusor inhibition depend on separate control systems for the striated sphincter and the detrusor with normal coordination governed by a central neuronal program.

Studies in line with the current one are important to increase the clinical usefulness of urodynamics and establish relevant background data when trying to identify physiological and pathophysiological mechanisms. They are also needed to contribute to an adequate basis for further efforts to develop definitions and terminology in the future.

Magnus Fall
Department of Urology
Sahlgrenska University Hospital
Goteborg, Sweden