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Involuntary Detrusor Contractions: Correlation of Urodynamic Data to Clinical Categories

Lauri J. Romanzi, Asnat Groutz, Dianne M. Heritz, and Jerry G. Blaivas*

Weill Medical College, Cornell University, New York, New York

Data regarding the prevalence and urodynamic characteristics of involuntary detrusor contractions (IDC) in various clinical settings, as well as in neurologically intact vs. neurologically impaired patients, are scarce. The aim of our study was to evaluate whether the urodynamic characteristics of IDC differ in various clinical categories. One hundred eleven consecutive neurologically intact patients and 21 consecutive neurologically impaired patients, referred for evaluation of persistent irritative voiding symptoms, were prospectively enrolled. All patients were presumed by history to have IDC, and underwent detailed clinical and urodynamic evaluation. Based on clinical evaluation, patients were placed into one of four categories according to the main presenting symptoms and the existence of neurological insult: 1) frequency/urgency; 2) urge incontinence; 3) mixed stress incontinence and irritative symptoms; and 4) neurogenic bladder. IDC was defined by detrusor pressure of ≥ 15 cm H_2O whether or not the patient perceived the contraction; or < 15 cm H_2O if perceived by the patient. Eight urodynamic characteristics of IDC were analyzed and compared between the four groups. IDC were observed in all of the neurologically impaired patients, compared with 76% of the neurologically intact patients ($P < 0.001$). No correlation was found between amplitude of IDC and subjective report of urgency. All clinical categories demonstrated IDC at approximately 80% of cystometric capacity. Eighty-one percent of the neurologically impaired patients, compared with 97% of the neurologically intact patients, were aware of the IDC at the time of urodynamics ($P < 0.04$). The ability to abort the IDC was significantly higher among continent patients with frequency/urgency (77%) compared with urge incontinent patients (46%) and neurologically impaired patients (38%). In conclusion, when evaluating detrusor overactivity, the characteristics of the IDC are not distinct enough to aid in differential diagnosis. However, the ability to abort IDC and stop incontinent flow may have prognostic implications, especially for the response to behavior modification, biofeedback, and pelvic floor exercise. *Neurourol. Urodynam. 20:249–257, 2001.*

Key words: detrusor overactivity; detrusor instability; detrusor hyperreflexia; neurogenic bladder; lower urinary tract symptoms; urodynamics

INTRODUCTION

The International Continence Society [Abrams et al., 1988] defined overactive detrusor function as ''involuntary detrusor contractions during the filling phase,

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*Correspondence to: Jerry G. Blaivas, M.D., 400 East 56 Street, New York, NY 10022.

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which may be spontaneous or provoked and which the patient cannot completely suppress.'' Further differentiation was made between ''detrusor instability'' in which the involuntary detrusor contractions (IDC) occur in neurologically intact patients, and ''detrusor hyperreflexia'' in which the overactivity is associated with neurological disorder. Most recently, Abrams and Wein [1999] called for a review of these definitions. However, a formal consensus is still lacking, and there is a lack of agreement about even the basic techniques for measuring and defining IDC [Blaivas, 1999].

Although they may occur in a wide variety of voiding disorders, it is often assumed that IDC represent a single clinical entity without respect to associated conditions. Data regarding prevalence and urodynamic characteristics of IDC in different clinical settings, as well as in neurologically intact vs. neurologically impaired patients, are scarce. The aim of our study was to evaluate whether the urodynamic characteristics of IDC differ in various voiding symptoms, as well as to compare IDC in neurologically intact vs. neurologically impaired patients.

MATERIALS AND METHODS

We prospectively studied 132 consecutive patients (75 women and 57 men) referred for evaluation of persistent irritative voiding symptoms (urinary frequency, urgency and/or urge incontinence). All patients were presumed, by history, to have IDC and underwent detailed clinical evaluation, which included a complete history and physical examination, urinary questionnaire, 24-hour voiding diary, 24-hour pad test, urine culture, uroflowmetry, postvoid residual urine volume, video urodynamics, and urethrocystoscopy. Multichannel video urodynamics were performed according to the recommendations of the International Continence Society [Abrams et al., 1988] except for cystometry. Contrary to the above recommendations, the patients were not instructed to try to inhibit micturition during the filling phase, but rather to report sensations to the examiner. The cystometrogram was performed using radiographic contrast and a 7F double lumen catheter via constant infusion at a medium filling rate, with rectal pressure monitoring. Perineal surface electrodes were used for electromyography (EMG). At capacity, patients were asked to void and pressure flow studies with simultaneous video fluoroscopy of the bladder outlet and EMG activity were performed.

Based on the clinical evaluation, patients were placed into one of four categories according to the main presenting symptoms and the existence or absence of neurological insult:

1. Frequency/urgency (N = 37): Clinically continent patients with frequency/urgency.
2. Urge incontinence (N = 56): Urge incontinent patients. Urge incontinence was defined as involuntary loss of urine associated with a strong desire to void.
3. Stress incontinence (N = 18): Patients with mixed stress incontinence and irritative symptoms. Stress incontinence was defined as involuntary loss of urine during physical exertion.
4. Neurogenic bladder (N = 21): Neurologically impaired patients.

The neurologically intact patients (N = 111) were further subdivided according to the urodynamic diagnosis of bladder outlet obstruction into obstructed (N = 22) and unobstructed (N = 89) patients.

IDC was defined by detrusor pressure of $\geq$15 cm H_2O whether or not the patient perceived the contraction or $<$15 cm H_2O if perceived by the patient. For the purpose of data analysis, we assessed the following parameters in each of the clinical categories and subsets:

1. cystometric capacity (Ccap): volume at which patient feels he/she can no longer delay micturition,
2. bladder volume at time of IDC (Icap),
3. detrusor pressure at time of IDC (Pdet@IDC),
4. awareness of IDC,
5. ability to abort IDC,
6. incontinence during IDC,
7. ability to stop incontinence flow via contraction of the external sphincter,
8. ratio of Icap to Ccap (I/Ccap).

Further comparison was made between the severity of urgency as a symptom and the amplitude of IDC during the urodynamic evaluation. Symptom severity was assessed by a 1 to 10 bothersome scale. Results were analyzed and compared in the study population as a whole, in each of the four diagnostic categories and between men and women.

Results were analyzed statistically by the Fisher Exact test and Spearman correlation analysis. Values of $P < 0.05$ were considered significant.

RESULTS

One hundred and eleven consecutive neurologically intact patients and 21 consecutive neurologically impaired patients were prospectively enrolled. All patients had irritative voiding symptoms; however, some had stress incontinence as the main symptom. Involuntary detrusor contractions were observed in all of the neurologically impaired patients, compared with 76% of the neurologically intact patients ($P < 0.001$). Further analysis of the neurologically intact patients demonstrated IDC in 89% of the patients with mixed stress incontinence and irritative symptoms, 89% of the clinically continent patients with frequency/urgency, and 63% of the urge incontinent patients. No correlation was found between amplitude of IDC and subjective report of urgency in the entire study population, nor within any of the four clinical categories, nor when the data were separated by gender.

Results of the examined urodynamic parameters with respect to clinical category are presented in Table I. All clinical categories demonstrated IDC at approximately 80% of cystometric capacity (Fig. 1). Detrusor pressure during IDC was higher in patients with frequency/urgency and neurologically impaired patients, but statistical significance was not established (Fig. 2).

Eighty-one percent of the neurologically impaired patients, compared with 97% of the neurologically intact patients, were aware of the IDC at the time of urodynamics ($P < 0.04$). The ability to abort the IDC when it occurred during urodynamics was significantly higher among continent patients with frequency/urgency (77%) compared

TABLE I. Urodynamic Characteristic of Involuntary Detrusor Contractions in Patients With Irritative Symptoms

Main presenting symptom	Frequency / urgency (N = 37)	Urge incontinence (N = 56)	Stress incontinence (N = 18)	Neurogenic bladder (N = 21)
IDC (%)	89	63	89	100
Mean cystometric capacity (mL)	493	273	283	432
Mean volume at IDC (mL)	410	234	249	307
I/C ratio (%)	81	87	87	76
Pdet@IDC (cm H_2O)	56	40	31	50
Awareness of IDC (%)	94	100	94	81
Ability to abort IDC (%)	77	46	50	38
Incontinence during IDC (%)	50	89	81	71
Ability to stop incontinence (%)	55	42	43	27

IDC: involuntary detrusor contractions; I/C ratio: ratio of bladder volume at IDC to cystometric capacity; Pdet@IDC (cm H_2O): detrusor pressure at IDC.

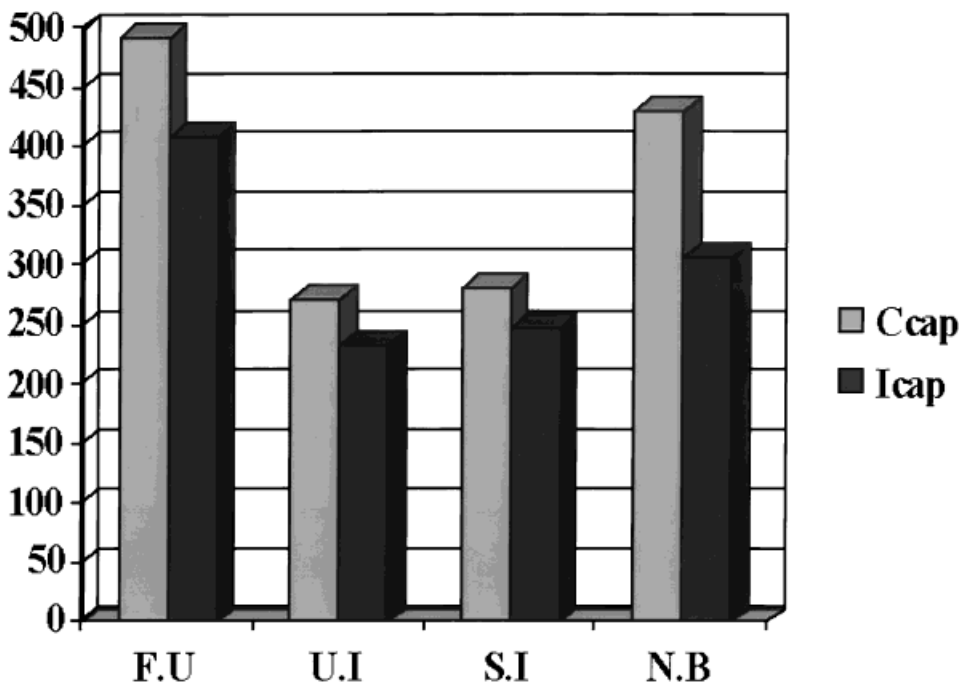

Fig. 1. Bladder volumes (mL) during involuntary detrusor contraction (Icap) and at cystometric capacity (Ccap). F.U: continent patients with frequency/urgency; U.I: urge incontinent patients; S.I: patients with mixed stress incontinence and irritative symptoms; N.B: neurologically impaired patients.

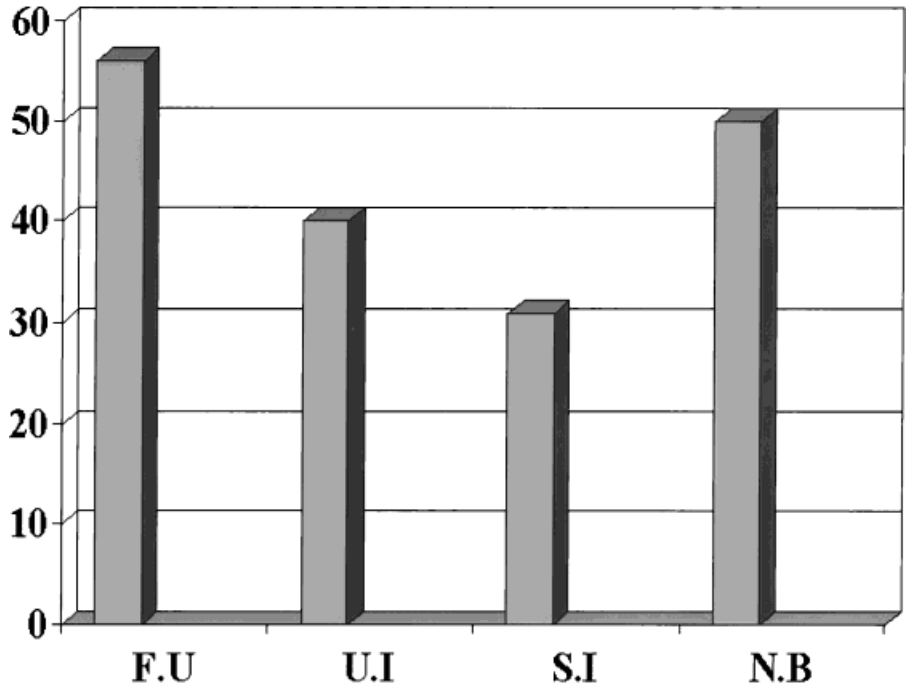

Fig. 2. Detrusor pressure (cm H_2O) generated during involuntary detrusor contraction. F.U: continent patients with frequency/urgency; U.I: urge incontinent patients; S.I: patients with mixed stress incontinence and irritative symptoms; N.B: neurologically impaired patients.

with urge incontinent patients (46%) and neurologically impaired patients (38%). Data are presented in Figure 3.

Involuntary urinary incontinence during IDC was demonstrated in 89% of the urge incontinent patients, 81% of the stress incontinent patients, 71% of the neurologically impaired patients, but only 50% of the clinically continent patients with frequency/urgency ($P < 0.003$). Further analysis of the ability to stop the incontinent flow failed to reveal any statistically significant differences among the four clinical groups (Fig. 4).

Comparison of urodynamically obstructed versus non-obstructed patients revealed significantly higher cystometric capacities (mean, 562 mL), higher volumes at time of IDC (mean, 479 mL), and higher detrusor pressures during IDC (mean, 61 cm H_2O) among obstructed patients.

DISCUSSION

In 1985, Coolsaet proposed a standardized method of evaluating phasic detrusor activity (or detrusor overactivity), in which the detrusor pressure during IDC, bladder volume at which IDC occurs, awareness of and ability to abort IDC, presence or absence of urinary incontinence during IDC, and ability to abort IDC-related incontinent flow are assessed [Coolsaet, 1985]. In the present study, we utilized this method to compare the urodynamic characteristics of IDC in four clinical categories of overactive bladder.

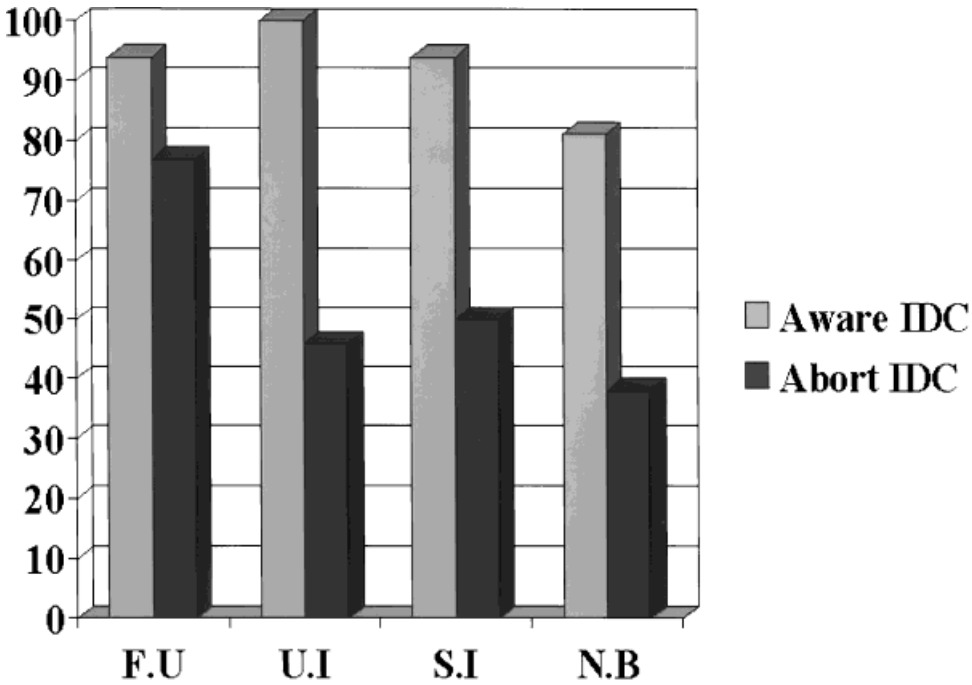

Fig. 3. Awareness of and ability to abort involuntary detrusor contractions. F.U: continent patients with frequency/urgency; U.I: urge incontinent patients; S.I: patients with mixed stress incontinence and irritative symptoms; N.B: neurologically impaired patients.

All patients complained of irritative symptoms, although some had stress urinary incontinence as the main bothering symptom. Patients were divided into four clinical groups according to the main presenting symptom and the neurologic status. Overall, IDC were demonstrated by urodynamics in 76% of neurologically intact patients and 100% of neurologically impaired patients (all of whom were presumed by history to have IDC). Further analysis of the neurologically intact patients according to the main presenting symptom revealed IDC in 89% the patients with mixed stress incontinence and irritative symptoms, 89% of the continent patients with frequency/urgency, and 63% of the urge incontinent patients. Clinical studies have previously shown that up to 30% of women with stress incontinence will have a contributing component of detrusor instability, and that patient history is notoriously ''false negative'' for the presence of detrusor instability [Webster et al., 1984]. Our data support the concept of a high rate of IDC among stress incontinent women who also have irritative complaints, and expand the application to patients, male and female, with urge incontinence, frequency/urgency, and neurogenic bladder. Although we did not find any urodynamic parameters that may distinguish detrusor overactivity among the clinical groups, some urodynamic characteristics of IDC may have prognostic and therapeutic significance.

The International Continence Society [Abrams et al., 1988] defined detrusor hyperreflexia as detrusor overactivity secondary to neurologic disease. While semantically useful in terms of accurate communication and meta-analysis, there has been little evidence documenting clinical or pathological differences between neurogenic and non-neurogenic detrusor overactivity. A similar decrease in concentration of

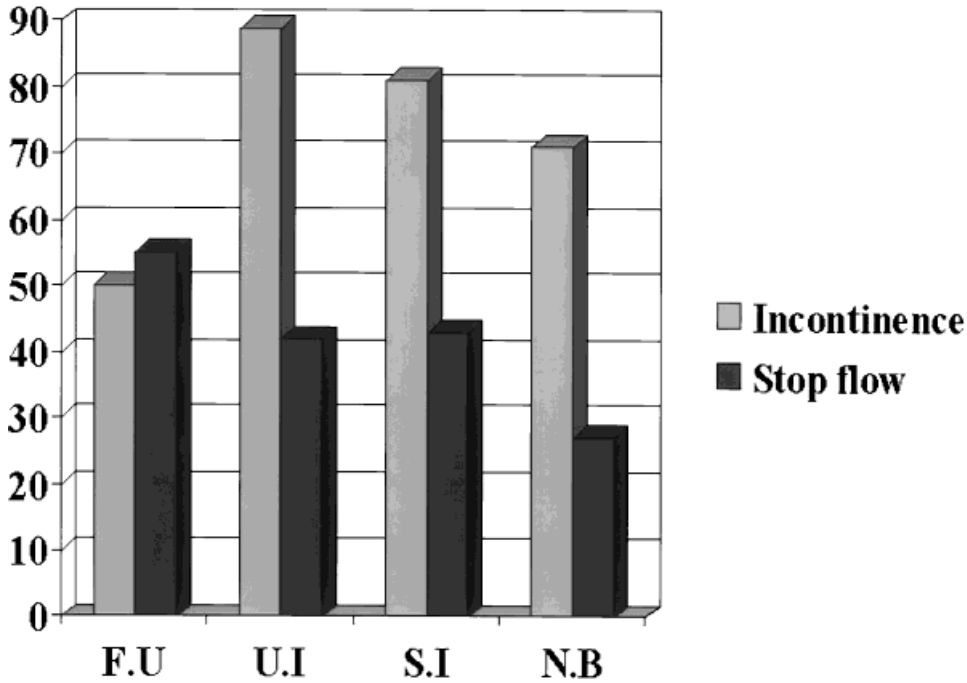

Fig. 4. Incontinence during detrusor overactivity and ability to stop incontinent flow. F.U: continent patients with frequency/urgency, with or without obstructive symptoms; U.I: urge incontinent patients; S.I: patients with mixed stress incontinence and irritative symptoms; N.B: neurologically impaired patients.

muscarinic receptors and in vasoactive intestinal peptide was demonstrated in bladders from both categories [Kinder et al., 1985; Maggi and Meli, 1986]. In a study that specifically excluded patients with bladder outlet obstruction, Cucchi [1996] found that neurologically intact patients with detrusor instability generated greater bladder contractility than normal men and neurogenic patients with detrusor hyperreflexia. The parameters upon which this conclusion was made were bladder wall work force and isometric pressure. In our series, detrusor pressure during IDC did not differ significantly in neurologically impaired vs. neurologically intact patients. While acknowledging that detrusor pressure alone is a less accurate measure of bladder contractility than those utilized by Cucchi [1996], we do believe that our data sheds doubt on the concept that there is a significant physiologic/urodynamic difference in the expression of detrusor overactivity between neurologically intact and neurologically impaired individuals.

The salient clinical complaint among clinically continent patients with frequency/urgency was the concern that they were in the process of developing incontinence, although incontinence was not part of their current clinical complaints. We believe that the data support the patient's concern, given that the proportion of these patients who actually experienced incontinence with IDC at time of urodynamics was 50%. Without the hallmark symptom of urge incontinence and the full benefit of thorough clinical and urodynamic evaluation, many of these patients might easily be miscategorized as sensory urgency, or ''prostatism'' [Andersen, 1982].

Bladder outlet obstruction is urodynamically defined as high detrusor pressure associated with low flow rate during the voluntary voiding phase of the urodynamic study. Obstructed patients in this series had statistically higher cystometric capacities, higher volumes at time of IDC, and higher detrusor pressures during IDC. In other words, not only were their voluntary detrusor contractions during the emptying phase of high intensity (which, by definition, they must be), but the involuntary detrusor contractions during the filling phase were of high intensity pressures as well. This may be due to the hypertrophy most often found in obstructed detrusor, and/or it may be the bladder's way of warming up towards pushing urine past the obstruction. We might surmise that, with the obstruction gone, thereby excluding the necessity of such high-pressure contractility, the reactive IDC would resolve. Indeed, this is exactly what occurs in the model of detrusor instability associated with obstructive benign prostatic hypertrophy (BPH), in which the vast majority of patients will see a concomitant cure of the associated detrusor instability with successful BPH therapy.

Another interesting finding was the proportion of patients with neurogenic bladder dysfunction who actually perceived their IDC (81%), with 38% able to abort the IDC and 27% able to abort incontinent flow when it occurred. These 21 neurogenic patients included cases of encephalopathy, multiple sclerosis, a variety of spinal cord lesions and tethered cord. Their awareness tended to take the form of mild autonomic dysreflexia, which the patient would report as his or her usual symptom for which they would void or catheterize in daily life. We did not anticipate such a high rate of awareness in patients with established neurologic disease. The ability to abort the IDC and incontinent flow raises intriguing questions regarding the possibility of developing behavior modification methods that capitalize on these abilities when present, as an alternative to established pharmacologic and surgical treatments.

The results of our study suggest that the characteristics of the cystometric tracing are not distinct enough to aid in differential diagnosis of detrusor overactivity. The characteristics may, however, serve as a screening process for therapeutic options. Common sense would support the concept that patients who are able to stop incontinent flow and abort IDC voluntarily may fare well with bladder retraining, pelvic floor exercise, and behavior modification alone, while those who are unable or partially able (i.e., can stop flow but cannot abort IDC) might require anticholinergic medication to achieve continence. The true utility of urodynamic evaluation may lie in the assessment of these parameters, rather than in the mere documentation of the presence or absence of detrusor overactivity.

CONCLUSIONS

When evaluating patients with detrusor overactivity, the characteristics of the cystometric tracing are not distinct enough to aid in differential diagnosis. However, the clinical characteristics of the cystometric tracing during episodes of IDC are important parameters that may have prognostic and therapeutic significance. Additionally, the ability to abort IDC and stop incontinent flow may have implications for response to behavior modification, biofeedback, and pelvic floor exercise.

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