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BEHAVIORAL TREATMENT OF SENSORY URGENCY IN FEMALE URETHRAL SYNDROME

by

Doris E. Blendinger

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

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This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

BEHAVIORAL TREATMENT OF SENSORY URGENCY

IN FEMALE URETHRAL SYNDROME

by

Doris E. Blendinger

Advisor: W. Crawford Clark

Frewen's theoretical model has suggested an association between learned response of frequent urination and symptomatology of the urethral syndrome. Treatment of choice for reducing urologic symptoms is behavior modification, also called bladder drill, which teaches patients to successively increase their inter-voiding intervals (IVI). Decreasing the high rate of micturition increases the functional capacity of the bladder and tends to diminish the neural activity of the autonomically mediated smooth muscles of the bladder.

Twelve female out-patients (mean age 42.0 years), diagnosed as having sensory urgency, were evaluated at pre-, post-treatment (mean treatment time of 0.9 years) and at follow-up (mean of 2.1 years past treatment) on five

components: urlogic measures, effects of medication intake, discriminability and criterion measures of bladder pressure to volume voided, and verbal pain reports. Psychological symptomatology was assessed at follow-up. Bladder drill resulted in a significant reduction of day-time frequency and nocturia associated with larger mean volumes voided. Negative factors with respect to treatment success included symptom severity and medication intake.

The patient's ability to discriminate bladder pressure sensations relating to volumes voided was assessed by use of Sensory Decision Theory (SDT). Discriminability, P(A), remained relatively unchanged across treatment status, with non-medicated patients being significantly better discriminators than medicated patients. The frequency of high bladder pressure reports was reduced (higher criterion, B) following treatment, patients indicating less bladder discomfort.

Verbal pain reports, assed by the McGill Pain Questionnaire (MPQ), showed a significant decrease in number of words chosen (NWC) and scaled scores (SS) across treatment status and reflected an improvement in the patient's emotional state and decreased perception of pain. Higher scores were associated with increased bladder symptomatology following treatment and medication intake. The MPQ best described the urethral symptomatology by a cluster of 23 descriptors chosen by at least 30% of patients at

pre-treatment. The most frequent pain descriptors were pain evaluative words and the largest reduction following treatment occurred in the affective category.

The Brief Symptom Inventory (BSI) assessed the psychologic symptomatology at follow-up and represents limited information. Non-medicated patients indicated "super-normal" scores, while medicated patients (who obtained poorer treatment results) exhibited moderate psychologic distress.

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I. INTRODUCTION

Rationale and Hypotheses Tested

Many adult women are plagued with a cluster of chronic urologic symptoms, including frequency, urgency, urge incontinence and nocturia. Pain may be a major component of this condition and is perceived as an aching, burning sensation, or as a chronic dull pressure, in the suprapubic, vaginal, perineal and low-back area. The symptom-complex can be exceedingly perplexing to the patient, who may find temporary relief from the discomfort by voiding, but symptoms may immediately recur with greater intensity. The necessity to be near a bathroom may force the patient to drastically alter her lifestyle, being unable to carry out various types of work or attend social functions. When extensive medical and urodynamic evaluations rule out a wide spectrum of urologic pathology or neurological disorder, this symptom-complex is diagnosed by such generic terms as urethral syndrome, sensory urgency, trigonitis, non-bacterial cystitis, interstitial cystitis, and others.

Over the last decade, behavioral urology has become a rapidly growing discipline, integrating urology and behavioral science. Much of its foundation is based on the learning theory of behavior modification, focusing on urologic syndromes that appear to result from abnormal behavior patterns. It aims at modifying current, observable

patterns of micturition that interfere with the patient's daily functioning and assumes that these maladaptive behaviors are learned in much the same fashion as adaptive behaviors (Abel and Blendinger, 1986).

The theoretical model of behavior modification for treatment of the urethral syndrome, also called bladder drill, was developed by Frewen (1982). Treatment is based on the hypothesis that frequent urination itself is a causative factor that contributes to the patient's urge to void. Persistent frequency of micturition over a long period of time reduces the volumetric threshold for the urge to void. Greater urges to void are perceived with increased bladder contractions, leading to progressively smaller bladder volumes and intervoiding intervals (IVI), with or without incontinence, and may eventually result in detrusor instability. The complex symptomatology of the urethral syndrome may therefore arise because of hypersensitivity of the bladder to stretch (sensory urgency), or it may occur with detrusor instability (motor urgency). Changes in the vesical pressure of the bladder as a function of volume during the filling/storage phase and during the expulsive phase can be measured by cystometry. After the bladder is emptied and residual urine has been removed by use of a catheter, water is introduced into the bladder by retrograde filling. The standard zero reference point for pressure in the empty bladder is the level of the superior edge of the symphysis pubis. Intravesical bladder pressure is recorded in

centimeters of water. Bladder instability may be characterized by the presence of spontaneous detrusor contractions, or contractions exceeding 15 cm of water when the patient has been asked to inhibit micturition (Bates, 1971; Drach, Gleason and Bottacini, 1979).

Frewen's treatment regimen (1979) attempts to normalize bladder functions by teaching patients to successively prolong IVIs. The purpose of increasing IVIs by gradual steps is to decrease the frequency of voidings, to increase bladder capacity and to reduce the neural activity of the autonomically mediated smooth muscles of the bladder.

Perceived Pain by Sensory Urgency Patients. In recent years, Sensory Decision Theory (SDT) methodology (McNicol, 1972) has been used extensively in laboratory pain research and in the evaluation of chronic pain patients (Clark and Yang, 1983). They have often observed that the perceptual report of pain contains both discriminative and attitudinal components which can be quantified only indirectly. SDT yields two independent non-parametric indices of these components: the sensory-discriminative index, P(A), measures the accuracy by which an individual distinguishes among various stimulus intensities; the psychological or attitudinal criterion index, B, measures the willingness or reluctance for reporting the experience as painful. While previous SDT studies have relied almost entirely on laboratory research and the clinical pain perceptions were inferred, the present study is designed to measure and

analyze bladder pressure sensations of sensory urgency patients directly. The following hypotheses will be tested:

(1) That bladder drill is an effective treatment approach to combat the symptom-complex of the urethral syndrome (sensory urgency syndrome);

(2) That the medication status affects bladder discriminability and the report of pain;

(3) That sensory discrimination of bladder pressure for volumes voided and the criterion for bladder pressure sensations influence treatment outcome;

(4) That alterations in the verbal pain reports relate to alterations in the symptomatology of the urethral syndrome;

(5) That psychological symptomatology is related to treatment outcome at follow-up.

Previous literature related to hypotheses 1, 3, 4, and 5 are critically reviewed below. There is no literature relating SDT methodology to the direct estimation of sensation magnitudes in chronic pain patients, in this case estimating bladder pressure sensations in relationship to bladder volumes in sensory urgency patients, which represents a unique contribution to the literature.

II. REVIEW OF RELATED LITERATURE

Effects of Bladder Drill on Urologic Measures With and Without the Influence of Medication

Clinical studies describing bladder drill to combat symptoms of the urethral syndrome have generally adopted Frewen's model with two treatment objectives in mind: 1) to reach and maintain voiding intervals of 3 to 4 hours; and 2) to eliminate all abnormal urinary symptoms.

The literature has generally included symptoms of frequency, nocturia, urgency, urge incontinence and stress incontinence as part of the urethral symptomatology. Frequency of micturition, a key element of the urethral syndrome, has been defined as the desire to void every two hours or less during the day and is accompanied by a reduction in the functional capacity of the bladder (Whiteside, 1979). Other symptoms may be as troublesome. Patients may complain of nocturia, the arousal from sleep every night by the desire to void which is usually accompanied by a higher rate of day-time frequency. Nocturia is defined as abnormally high when it occurs more than once per night. A failure to observe an association between increased nocturia along with increased day-time frequency may be because the patient restricts fluid intake during the afternoon to avoid night-time micturition. The reverse, a high rate of nocturia along with a normal day-time

frequency may be seen in individuals with poor sleeping habits in general. Urgency is defined by the subjective feeling of impending micturition that permits no delay in voiding and may be sensory or motor in origin, the former often associated with pain or fear of leaking. If detrusor contractions cannot be inhibited by the patient, whether perceived or not, urge incontinence ensues as an uncontrollable loss of urine (Blaivas, 1982), and defines the hallmark of an unstable bladder (Whiteside, 1979). Stress incontinence, in contrast to urge incontinence, refers to the involuntary loss of urine with movements that increase the internal abdominal pressure, such as coughing, laughing or sneezing, in the absence of detrusor contractions and a desire to void (Blaivas, 1983; Charlton, 1984).

It is not necessary for all of the symptoms to be present for a diagnosis of urethral syndrome, but increased day-time frequency is usually present in all. Changes in the symptomatology as a function of treatment outcome have been reported in the literature generally as the percent of patients being afflicted with any one symptom pre- versus post-treatment.

The effectiveness of bladder drill was studied by Jarvis and Millar (1980), who compared treatment results with waiting controls in women with detrusor instability. Patients were randomly assigned to either an in-patient bladder drill group or a control group. Control patients were advised that they should be able to hold their urine for 4 hours, be

continent and were sent home. Except for a sedative to induce sleep, no drugs altering bladder functions were provided. Both groups of 30 patients were re-assessed at 6 months. In the bladder drill group, a total of 83% of patients were free of daytime-frequency and 89% of nocturia. Continence was acquired by 90% of patients with urgency incontinence and 86% with stress urinary incontinence. It is of interest to note that 23% of control patients were also continent and symptom-free. Results indicated statistically significant between-group differences on all urologic symptoms measured, i.e. diurnal frequency, nocturia, urgency, urge incontinence and stress incontinence.

In a similar study, Pengelly and Booth (1980) compared patients treated by bladder drill for urethral syndrome to patient controls, matched for sex, age, initial cystometry and pre-treatment symptoms. Drug therapy was either stopped prior to treatment or held constant during bladder drill. After a period of 3 months, 76% of treated patients and 32% of control patients were either improved or cured symptomatically. The ability to eliminate all abnormal urologic symptoms was seven times higher among bladder drill patients as compared to controls. An objective cure, defined by the return to a stable detrusor function on cystometry, was evident in 32% of the bladder drill patients, but not in any control patients. Improved cystometry was arbitrarily defined as a reduction of more than 25% in the height of unstable contractions or an increase of more than 25% in the

bladder volume at which these contractions first occurred. Thus, 12% of the bladder drill group and 16% of control patients indicated improvements. The authors associated poor results with a history of nocturnal enuresis after the age of 10 years, an isometric contraction of >100 cm of water during voluntary interruption of micturition on cystometric testing, and failure to show improvement within the first two weeks of treatment.

The outcome of bladder drill without any medication was also evaluated. Frewen (1982) reported treatment results in 90 patients with detrusor instability. Within a 3 months period, a total of 86.6% of patients achieved the desired 3 to 4 hour inter-voiding interval. The remainder, with the exception of 2, were free from urge incontinence, but experienced residual urgency of micturition. The objective cure, a return to a stable bladder, was measured by cystometry and found in only 53% of patients. The presence or absence of bladder stability, however, showed no relationship to symptomatic cure. The author felt that the symptom of frequency by itself responded best to treatment, while a long-term existence of detrusor instability had a tendency to sustain the urgency-incontinence problem. Nocturia, on the other hand, was the first symptom to disappear ... "based on the principle that if the patient looks after her bladder during the day, the night will look after itself" (Frewen, 1982, p. 1849).

Jarvis (1982) also assessed bladder drill for patients

with primary sensory urgency (bladder stability) without additional medication. A total of 33 patients indicated symptoms of diurnal and nocturnal frequency, urgency, urge and stress incontinence, and all patients developed suprapubic pain during urodynamic testing. Bladder drill training was initally provided in the hospital (5 to 14 days), continued at home, and results evaluated 6 months later. Sixty-one percent of patients were improved and no longer experienced urgency or incontinence and 39% were not improved including 2 patients who relapsed after discharge from the hospital. Of the improved patients, 55% were considered cured of all symptoms. Furthermore, 65% of 23 patients experiencing stress incontinence at intake were also cured of this symptom.

Several studies dealt with the influence of medication on the urethral symptomatology in conjunction with bladder drill. Frewen (1978) assessed bladder training along with a sedative and anticholinergic drug in 40 women with detrusor instability. Criteria of cure were that within a period of 3 months, patients should be subjectively cured of all urinary symptoms and demonstrate a return to normal detrusor function on cystometry. A return to bladder stability followed the subjective cure by at least 1 to 3 months and could be documented in 82.5% of the patients. Seven patients were to some extent symptomatically improved, but viewed as treatment failures, since they did not meet the required criteria.

Two studies classified patients by detrusor behavior

on cystometric testing into 3 groups: 1) bladder stability; 2) reduced detrusor compliance (changes in bladder pressure created by changes in bladder volume); and 3) detrusor instability. Elder and Stephenson (1980) evaluated treatment outcome in 21 women over a period of 12 months following bladder drill in conjunction with treatment by an anticholinergic and a sedative. Of the total patient population, 52% were cured and 33% improved of urge incontinence, viewed as the most troublesome symptom by the authors. In addition, nocturia was cured in 71%, diurnal frequency decreased in 57% and urgency decreased in 48% of 21 patients. Reversion to bladder stability was documented in 28% and confined to those patients with reduced detrusor compliance who were symptomatically cured. Even though no urodynamic change was present in the 7 patients with detrusor instability, 3 of these patients were symptomatically cured.

In a later study, Holmes, Stone, Bary, Richards and Stephenson (1983) provided 56 patients with an anticholinergic and a sedative as an adjunct to bladder drill therapy. Medication intake was stopped after 3 months of treatment and patients re-assessed urodynamically and symtomatically. Follow-up evaluations were obtained between 1 and 5 years. Patients with stable bladders responded best to treatment, 100% maintaining bladder stability and 94% being symptomatically improved. Only one patient subsequently relapsed when drug therapy was withdrawn. Of the detrusor compliance group, 90% indicated symptomatic improvement, but

42% of these patients relapsed on withdrawal from medication; this relapse was unrelated to urodynamic improvements toward bladder stability. Of those patients with idiopathic detrusor instability, 90% were symptomatically improved following treatment, but 44% subsequently relapsed. A return to bladder stability was present in 30% of these patients, while 40% refused follow-up on urodynamic assessments.

A comparison between bladder drill alone and bladder drill in conjunction with anticholinergic medication in 92 detrusor instability patients was pursued by Fantl, Hurt and Dunn (1981). Unlike other studies, dysuria, the sensation of painful micturition, was reported in 3% of patients. Cure was defined by the abolishment of incontinence and acquired voiding intervals of 3 - 5 hours without associated symptoms. Patients treated by bladder drill together with anticholinergic medication indicated a slightly higher, but not significantly different cure rate of 83%, as compared to 79% of those patients receiving bladder drill alone. Follow-up time was from 6 months to 6 years.

A single study assessed outcome of bladder drill without medication versus drug therapy alone in two groups of women with detrusor instability (Jarvis, 1981). Patients were matched by age, years of symptoms, and urologic symptomatology. Following a 3 months treatment, 76% of bladder drill patients were symptom-free and 84% achieved continence, whereas 48% of the medicated patients were symptom-free and 56% were continent, yielding statistically

significant between-group differences in favor of bladder drill. A major difference between the two forms of treatment were the side effects of drugs, such as dizziness, headache and vomiting, that occurred in 56% of patients. Of these patients, 20% decided to cease treatment on their own accord. None of the bladder drill patients discontinued their program.

In summary, bladder drill in the above studies have generally focused on increasing the inter-voiding interval up to 3 or 4 hours with the expectant result of normalizing micturition and thus eliminating the complex symptomatology of the urethral syndrome. Bladder training not only rendered many patients symptom-free, it also produced cystometric evidence of cure.

On the basis of cystometric observations during the filling phase of the bladder, it is possible to differentiate among several urinary tract abnormalities responsible for the urethral syndrome. One can distinguish between the normal or stable bladder, the poorly compliant bladder, the unstable bladder and the hypersensitive bladder, all of which may be present with an increased urgency-frequency syndrome. Studies cited above have generally shown that bladder stability promised best treatment results. Symptomatic cure or improvements were also seen in patients with reduced bladder compliance and bladder instability and these results were unrelated to a return of bladder stability as tested by cystometry. In no case did a return to a stable bladder

occurr in patients without symptomatic improvements.

Medication, in form of an anticholinergic or sedative, did not seem to influence treatment outcome significantly when provided in conjunction with bladder drill. When medication therapy alone was compared to bladder drill alone, treatment results indicated significant differences in favor of bladder drill on 2 counts: 1) more patients in the bladder drill group experienced reduced urologic symptoms; and 2) patients experiencing unpleasant side effects caused by drugs felt the need to terminate their treatment. This was not the case in patients treated by bladder drill.

When treatment outcome of bladder drill was compared to control patients who received no treatment, a therapeutic change in form of a placebo effect was evident in a relatively high percentage of patients. However, improvements in urethral symptoms by placebo effects were significantly below the treatment goals achieved by patients having received bladder drill therapy.

Critique. Studies reviewed above suggest a number of clinical and experimental issues:

(1) Most of the bladder drill studies have assessed pre- and post-treatment urologic symptoms on a nominal scale, by counting the presence or absence of a target symptom (Kazdin, 1982). Patients were reported as cured when all their abnormal symptoms were abolished. Those patients whose abnormal symptoms were reduced, but not abolished, were

reported as improved. There are several reasons, why it is unclear how an improved state should be interpreted: a) in most cases, symptoms, generally including diurnal frequency, urgency, nocturia, and incontinence were not defined; b) generally studies do not measure how often a symptom occurs within that patient during any given period. Precise definitions of urologic symptoms and measurements are essential to determine the contribution of each symptom, interrelationship and predictive value for cure or relative improvement. In order to assess the magnitude of change that contributes to the inference concerning the role of bladder drill treatment, it is necessary to state boundaries of what is being measured. Clearly, nominal data of symptom frequency should be expanded to include information on interval and ratio scales whenever possible. The exact time of IVIs and bladder volumes voided in cc are such measures which include an absolute zero point; and c) many of the studies are descriptive in nature and lack statistical analyses for determining the significance of change.

(2) None of the studies cited above have evaluated the sensory perception of bladder pressure for the urge to void in the every-day environment of the patient. Yet, a reduced volumetric threshold for bladder pressure sensations is known to be a key element in the urethral syndrome. Measurements of bladder volumes in the familiar home environment of the patient is an easy, non-invasive procedure that can provide valuable information on changes in urgency thresholds and

related stability of the bladder, indicative of ongoing treatment success or failure.

(3) A major shortcoming in these studies has been the absence of pain assessments related to the urethral syndrome. Dysuria, often the result of an inflammation of the urethra, is a painful and burning sensation experienced during micturition. The existence of dysuria in the absence of infection was documented in just one bladder drill study, by Fantl, et al (1981), where 3 of 92 patients complained of a painful discharge. Stamm (1981) reported the presence of dysuria in 50% of women with cystitis. The other 50% of patients who complained of painful voiding lacked significant bacteriuria for a diagnosis of cystitis, and 30% of these women had sterile cultures of urine. In another study, 40% of 98 clinical cases with dysuria were not due to urinary tract infection (Rasanathan, 1979). Bates (1979) observed a relationship between the urethral syndrome and pain, primarily in patients with sensory urgency. In addition to the occurrence of painful urination, patients often complain of pain sensations in and around the urethra during the normal filling of the bladder. A first attempt to quantify verbal pain reports was made by Abel, Blaivas and Blendinger (1983), who found a high incidence of pain associated with the urge to urinate in patients diagnosed with sensory urgency. Preliminary findings suggested a significant reduction in pain reports following bladder drill.

Sensory Perception of Bladder Volumes

Few clincal studies using bladder drill for the urethral syndrome contain reports of sensory perception of bladder pressure which is related to volume. As part of a standard urologic examination, cystometry permits the assessment of 2 such measures: 1) the First Desire to Void is the subjective report by the patient to the smallest volume of water installed by retrograde bladder filling that elicits the first urge to micturate; and 2) the Maximum Cystometric Capacity which is the highest volume tolerated at which the patient indicates a very strong desire to void. Normal bladder volumes for the First Desire to Void have been estimated to range from 150 to 250 cc and the Maximum Cystometric Capacity from 450 to 550 cc (Harrison, 1976).

Koefoot and Webster (1983) found functional bladder capacity in urethral syndrome patients to be generally low, with a mean of 250 cc and a wide range of 100 to 1,050 cc. Jarvis and Millar (1980) recorded bladder capacities of no less than 650 cc in patients under anesthesia. The difference in lowest bladder volumes of 100 cc measured without anesthesia versus 650 cc under anesthesia, and the wide range in functional bladder capacities suggest that the ability of the bladder to expand normally is present, but inhibited by the sensory experience of pain.

Cystometric measures of detrusor instability patients were compared between bladder drill versus drug therapy during a 4 week period by Jarvis (1981). Prior to treatment,

patients taking drugs suspected of affecting the lower urinary tract function were excluded. In the bladder drill group, the First Desire to Void revealed a significant volumetric increase, from 87 cc to 152 cc, while the Maximum Capacity rose from 381 cc to 470 cc. Patients on anticholinergics and tricyclic antidepressants showed similar improvements with an increase from 79 cc to 140 cc in the First Desire to Void and a Maximum Capacity that rose from 353 cc to 446 cc. In a later study, Jarvis (1982) used First Desire to Void of less than 75 cc and Maximum Capacity of less than 400 cc as a diagnostic criteria for defining patients with primary sensory urgency. During cystometric evaluations, these patients requested bladder filling to be ceased due to painful urgency. Statistically significant cystometric improvements in the volumetric threshold were evident 6 months following bladder drill. The mean First Desire to Void had risen from 40 cc to 93 cc, remaining abnormally low, and the mean Maximum Capacity from 279 cc to 463 cc, approaching normal bladder volumes.

Mahady and Begg (1981) used First Desire to Void of less than 200 cc and a Maximum Cystometric Capacity of less than 500 cc as their criteria for including patients with detrusor instability in their study. Bladder training was provided and monitored over a period of 4 years. A total of 90% of patients were cured from urge incontinence and 77% of patients who were cured of all urinary symptoms underwent follow-up cystometry. The volumetric threshold for the First

Desire to Void of 147 cc at pre-treatment rose to 228 cc, 240 cc, 245 cc and 252 cc, assessed at yearly intervals over a 4 year period. Maximum Capacity was near normal at pre-treatment levels of 450 cc and remained essentially unchanged, possibly due to a ceiling effect. However, bladder instability, as measured by isometric contractions at Maximum Cystometric Capacity decreased significantly from an average of 17 cm water to 12 cm, 10 cm, 7 cm and 6 cm over the 4 years. Thus, unstable bladders, which by definition have cystometric contractions above 15 cm of water, reversed toward the stabilization of detrusor functions.

Two experimental studies assessed bladder sensation thresholds in urethral syndrome patients. Kiesswetter (1977) evaluated mucosal sensitivity of exteroceptive receptors in the urinary bladder and posterior urethra in 40 patients with sensory urgency. Electrosensitivity thresholds were determined by the subjective perception to electrical stimulation of increasing amplitudes delivered to the bladder and posterior urethra via catheter. Electrosensitivity of the bladder was normal, but markedly diminished at the posterior urethra, suggesting that the site of the hypersensitivity seen in sensory urgency patients was around the posterior urethra. Correlations between sensitivity thresholds of the posterior urethra and the First Desire to Void, however, showed no consistent relationship with bladder volumes below 100 cc as anticipated by the author.

Powell and Feneley (1980) found significant correlations

between low electrosensitivity thresholds and low bladder volumes for the First Desire to Void, as well as Maximum Cystometric Capacity in patients with sensory urgency, when a higher intensity of electrical stimulation was supplied. In contrast to patients with sensory urgency, no relationship was found between electrosensitivity scores and the perception of bladder volumes in patients with detrusor instability (motor urgency).

Critique. Psychophysical methods have been employed to study virtually all sensory modalities, and pain researchers have used them extensively in the laboratory. The assessments of sensitivity in the studies cited above have relied on classical psychophysical methodology, whose validity has been questioned. By means of the Signal Detection Theory, or more specific, Sensory Decision Theory, Clark (1974) demonstrated that pain thresholds possess both a sensory component and an attitudinal or emotional component which can be measured independently. The threshold of a pain report is not a pure measure of sensory sensitivity, but is heavily influenced by psychological or attitudinal variables (Clark & Yang, 1983). The index of discriminability (d' or P(A)) reflects the accuracy by which an individual is able to distinguish among various stimulus intensities and is related to the functioning of the neurosensory system. High values suggest normal sensory perception of stimulus intensities, low values suggest that the sensory perception is diminished. The other index of perceptual performance is the report criterion (Lx

or B) which measures the individual's reponse bias and reflects the willingness or reluctance for reporting a sensory experience as painful. Whereas a patient with a minor ailment fiercely complains of pain sets a low criterion for reporting pain, an individual with a stoic attitude toward pain sets a high criterion.

Previous research has also shown that discriminability, P(A), was reduced by the effects of intravenous injections of morphine and to a lesser extent diazepam, but not by saline injections (Yang, Clark, Ngai, Berkowitz and Spector, 1979). Both drugs increased the subject's response criterion, higher B, fewer pain reports. The combination of a decrease in P(A) and an increase in B suggests that these drugs possess an analgesic action, whereby less sensory information arrived centrally. A reduced discriminability, P(A), may be evidence for an attenuation in the neural activity of the sensory system by the analgesic effect of a drug, or by an increased level of neural noise produced by chronic pain. A more stoical attitude toward painful stimuli, higher B, may be explained by the analgesic action, or by the perception of chronic pain patients, who may view experimental pain stimuli as innocuous in contrast to their own chronic pain.

Clark (1969) demonstrated that a placebo, accepted as a powerful analgesic, raised the pain threshold. SDT analysis demonstrated that the response bias for reporting pain was increased, but showed no effect on the discriminability of painful stimuli. The analgesic effect, typically produced by

the placebo, was a psychological response to the experimental situation, and was not due to a change in neurosensory activity that would be responsible for reducing discriminability. Clark and Goodman (1973) in a related study, demonstrated that suggestion alone could produce this type of effect.

Although research has generally focused on the assessment of experimental pain in healthy volunteers, a few recent studies have explored pain perception in chronic pain patients. Yang, Richlin, Brand, Wagner and Clark (1985) compared chronic low back patients, who had suffered from herniated lumbar discs, myofascial syndrome or osteoarthritis for a period of at least 6 months, to normal controls in their ability to judge the intensity of radiant heat stimuli. Based on SDT analyses, poorer discriminability (lower P(A)) was seen in chronic pain patients than in healthy volunteers. This sensory loss is considered to be due to the attenuation of afferent input. A more stoical criterion (higher B) for reporting pain was found among chronic pain patients, suggesting that the thermal stimuli were perceived as innocuous by the patients relative to their own clinical pain. The pain threshold determined by the method of constant stimuli yielded higher thresholds for reporting pain by chronic pain patients. This threshold was highly correlated with the patient's criterion for reporting pain, B, but unrelated to discriminability, P(A). These findings agree with Naliboff, Cohen, Schandler and Heinrich (1981), who

found a discrimination deficit for mildly painful thermal stimuli among low back pain patients, but not among individuals without chronic pain, i.e. respiratory patients and non-patient controls. No group differences were found for the pain report criterion, B, however. The method of limits yielded higher radiant heat threshold for the chronic low back patients and the chronic respiratory patients, as compared to controls.

Changes in pain perception before and after treatment were studied in chronic pain patients suffering from myofascial pain dysfunction by Malow and Olson (1981). They applied SDT methodology to compare pain responses of improved and unimproved patients to the Forgione-Barber focal pressure stimulator. There were no pre-treatment differences in pain sensitivity or report criterion between improved and unimproved patients, nor was there a difference between pre- and post-sensitivity of the unimproved group. However, the improved group significantly increased the discriminative ability, with higher P(A), at post-treatment. Improvement was also associated with a significant decrease in the pain report criterion, i.e. a higher B.

In summary, reduced volumetric thresholds of the bladder in urethral syndrome patients for the First Desire to Void and Maximum Capacity were diminished at pre-treatment and increased significantly, approaching normal levels, at post-treatment. This effect was demonstrated regardless of the influence of drugs. Maximum Capacity was generally low

and varied widely across patients. With the removal of pain symptoms and the hypersensitivity of the bladder by anesthesia, Maximum Cystometric Capacities in these patients were reported as above normal. The electrosensitivity threshold further documented the existence of a hypersensitive posterior urethra and low volumes for the First Desire to Void in sensory urgency patients, but not in those with detrusor instability.

Because SDT is unique in its ability to separate the sensory and psychological components, an SDT analysis was undertaken for the assessment of bladder-pressure sensations in urethral syndrome patients.

Verbal Pain Report

Clinical pain is often persistent, intense, beyond the patient's control, and accompanied by a high level of anxiety. Assessment of the subjective and multidimensional nature of pain requires a valid and reliable instrumentation, which was made available through the development of the McGill Pain Questionnnaire (MPQ) by Melzack and Torgenson (1971). A factor analytic study of pain descriptors with low back pain patients by Prieto, Hopson, Bradley, Byrne, Geisinger, Midax and Marchisello (1980) has supported the existence of various pain dimensions, sensory, affective and pain evaluative, as initially described by the MPQ.

The relationship between descriptors of pain and the degree to which the pain experience fits the diagnosis was studied by several investigators. Dubuisson and Melzack

(1976) used multiple discriminant analysis to identify diagnosis-specific constellations of pain descriptors. With 77% accuracy they were able to describe the unique pain patterns of 7 different disease states, including cancer pain, degenerative joint pain, menstrual pain, phantom-limb pain, tooth pain and post-herpetic pain. By use of the MPQ, Melzack, Terrence, Fromm and Amsel (1986) were able to develop a differential diagnosis between patients suffering from trigeminal neuralgia and atypical facial pain. Reading (1982) compared MPQ profiles between women experiencing acute or chronic pelvic pain. Chronic pain patients displayed greater use of affective and evaluative word groups; in contrast, acute pain patients used sensory word groups more often, paying more attention to the sensory input from the dammaged perineum rather than attending to their reaction of their pain.

Burckhardt (1984) assessed pain responses in an in-patient and out-patient arthritis population who used a similar set of words, regardless of the severity of their disease. The word 'aching' was chosen most frequently to describe their discomfort. Findings were congruent to those by Reading (1982) between acute and chronic pain patients. Acute arthritis pain patients used sensory words more often, while chronic arthritis pain patients chose affective and evaluative descriptors more frequently.

According to Brown, Nemiah, Barr, and Barry (1954), dramatic and exhaustive descriptions of pain are

characteristic of patients whose pain symptoms are poorly explained by an organic disease. Leavitt, Garron, d'Angelo & McNeill (1979) concluded that patients with demonstrable organic back problems tend to use fewer and less diverse words in describing their pain than patients without demonstrable organic back disease.

Psychological Symptomatology

Although it is obvious that physical causes might produce emotional changes, it has long been known that physical symptoms can also signify more underlying psychological conflicts (Pennebaker, 1982). A psychosomatic etiology in females for the urethral syndrome, based on clinical impressions, has been suggested by several authors (Frewen, 1972; Elder and Stephenson, 1980; Pengelly and Booth (1980); Mahady and Begg, 1981; Jarvis (1982). The power of suggestion alone, a placebo effect, seemed sufficient to produce symptomatic cure in 23% control patients in the study by Jarvis and Millar (1980) and improvements in 32% of patients in the study by Pengelly and Booth (1980).

A number of studies (Hafner, Stanton and Guy, 1977); Crisp and Sutherst, 1983; Ferrie, Smith, Logan, Lyle and Paterson, 1984; Morrison, Eadie, McAlister, Glen, Taylor and Rowan, 1986) have shown an above average level of neuroticism in patients with urgency and urgency incontinence according to Eysenck personality tests. The average neuroticism score was unrelated to the response to treatment, whether treatment involved pharmaceutical therapy or other forms of treatment

(Morrison, et al, 1986). Carson, Segura and Osborne (1980) evaluated 56 urethral syndrome patients, using the Minnesota Multiphasic Personality Inventory (MMPI). When compared to medical controls, urethral syndrome patients scored significantly higher on the hypochondriasis, hysteria and schizophrenia scales, along with normal scores on the depression scales. The authors interpreted the combination of hypochondriasis and hysteria as somatization, or a psychophysiological conversion reaction in response to tension and anxiety in these patients. Elevation on the schizophrenia scale were viewed as severe internal conflicts, self-dissatisfaction and social alienation.

Implications of a psychosomatic issue in urethral syndrome patients should not be ruled out. However, pain patients are not necessarily hypochondriacs. These patients have symptoms, and if they persist chronically, may be reason enough to be reflected in elevated scores on psychological tests.

III. METHODS

Subjects

Twelve caucasian female out-patients, diagnosed as having sensory urgency, entered a bladder drill program to combat their urologic symptoms and agreed to serve as research participants in this study. Three additional patients refused their participation in research and one moved to a distant state.

Diagnosis. Extensive medical assessments prior to the behavioral treatment program were provided by the Department of Urology, Columbia-Presbyterian Medical Center, New York. Assessments included urologic history and voiding symptomatology, physical examination and routine biochemical tests. Urodynamic testing evaluated urine flow rate, cystometry, urethral pressure profile, and synchronous voiding cystourethrography, utilizing fluoroscopy and videotaping. The latter procedure required the passing of a catheter through the urethra into the bladder. Retrograde bladder filling with a dye allowed X-ray examinations of the bladder during filling, at capacity and during micturition.

A diagnosis of sensory urgency was established based on the absence of any apparent pathological or neurological etiology, but with persistent symptoms of frequent and/or painful urination, as documented by the following criteria:

Sensory Urgency. Patients described a minimum of a one year history of persistent bladder discomfort, with

symptom-free intervals not exceeding two consecutive weeks. Two or more of the following symptoms were also present:

(1) daytime urinary frequency of at least every two hours;

(2) a minimum of at least two nighttime voidings;

(3) feelings of a constant urge to void;

(4) persistent suprapubic pain or discomfort;

(5) a constant burning sensation in the urethra;

(6) a need to plan the day around the availability of a bathroom;

(7) a feeling of urgency of micturition most of the time.

Exclusion Criteria

(1) past hospitalization for psychiatric symptoms;

(2) urinary incontinence which occurs more than once a month;

(3) chronic urinary retention;

(4) urinary tract infection;

(5) previous open bladder or open urethral surgery;

(6) previous radiotherapy to the bladder:

(7) bladder stones;

(8) bladder or urethral cancer;

(9) detrusor instability;

(10) bladder outlet obstruction;

(11) diabetes.

Procedures

Prior to treatment onset, patients recorded their

micturition patterns along with their subjective bladder pressure sensations at voiding during a 24-hour period. They also completed a pain questionnaire once midway between two voidings, during a time-frame chosen by the patient. Details of data collection and a description of these parameters are presented below. Barium dispenser cups (Solo Cup Co., Model 140BC 14 oz/440 cc's, Chicago, IL) were provided for measurements of urinary volumes.

Bladder drill sessions were provided by a psychiatrist in his private office. The behavioral treatment protocol, described in detail by Abel and Blendinger (in press) included the following aspects:

(1) an explanation of Frewen's theory of frequency of urination (Frewen, 1979);

(2) training in systematic muscle relaxation;

(3) progressive increases of each patient's intervoiding interval (IVI), towards a goal of achieving IVIs of 3 hours, as follows: average IVIs <15 min were increased by 5 min per IVI; IVIs of 15 to 30 min were increased by 10 min; IVIs of 30 to 60 min were increased by 15 min; and IVIs >60 min were increased by 30 min. Patients successful 80% of the time in the maintenance of their IVI category for the duration of 7 days were moved up into the next higher IVI category.

(4) Reinforcement for treatment compliance consisted of pleasurable events within the patient's

environment, such as watching a particular TV program or enjoying a favorite desert. Reinforcers were chosen, administered and recorded by the patient.

(5) Discussion of maintenance strategies to insure continued use of the above steps prior to termination of the program.

Post-treatment assessments were obtained during the last treatment session, an average of 10.8 mos later (Table 1), and were identical to pre-treatment measures. At follow-up, patients also completed a symptomatic distress scale and answered questions concerning their urologic history and drug intake since their last treatment session in addition to the standard measures. An average of 25.1 mos had elapsed since their last treatment session.

Micturition Patterns and Bladder Volumes. Pre, post and follow-up voiding patterns were recorded by the patient at home on a standard form which required the following entries: (1) time of actual urination during the waking period for assessing voiding frequency as IVIs; (2) frequency of nocturia, the arousal from sleep by the need to void; (3) quantity, measured in cc's of each urination voided for the waking period, yielding both a mean and total volume for day-time voidings. Data were computed for each patient separately on all measures for data analyses.

Pharmaceutical Interventions. Medication intake by

patients was not part of the study and was held under the control of the physician. It involved either an anticholinergic medication, a benzodiazepine, an antidepressant, an analgesic or no medication at all.

Subjective Bladder Pressure Scale. Data of volumes voided (stimuli), along with their corresponding bladder pressure reports (response) served as basis for the sensory decision theory (SDT) analysis. On the stimulus side, a more objective measure would have been actual bladder pressures assessed by cystometry. Since this was not available, volumes were used to approximate this information. On the response side, the patient rated the intensity of subjective bladder pressure sensations prior to each urination. Patients were asked to choose any number on a visual analog scale from 0 to 10, based on the following guidelines:

0 = no bladder pressure;

5 = amount of pressure that usually causes you to go to the bathroom;

10 = severe pressure, you cannot hold it anymore and you must urinate.

A higher volume voided was viewed as a higher-intensity stimulus (signal), producing more bladder pressure on the average than a lower-intensity stimulus. Likewise, a lower volume voided represented a lower-intensity stimulus, regarded as relatively innocuous, or a blank. All observations during a 24-hour period for each patient separately were divided by the median value into high and low

mean volumes voided. Data were analyzed in the rating task and considered correct, or a hit, when a higher volume was rated with a high score, and incorrect, or a false alarm, when a low volume was given a high score (Table 1). Misses and correct rejections were not analyzed, since they are the compliments of hits and false alarms and add no further information.

The sensitivity threshold, the patient's ability to discriminate among bladder pressure intensities relating to volume voided, was assessed by the non-parametric index, P(A). P(A) was chosen for analysis, because it is less variable than the parametric index, d', especially with a small number of observations. The cummulative probability of hits and false alarms for each stimulus-response relationship was computed for each patient and occurrence separately, as described by McNicol (1972). Discriminability, P(A), represents the area under the receiver operating characteristic curve, with values of .5 signifying chance discrimination, and P(A) values of 1.0 perfect discrimination.

The other nonparametric SDT index, B, measures the criterion or response bias by which the patient estimated the degree of bladder pressure at voiding. It reflects the willingness or reluctance of the patient to emit a particular response regardless of stimulus intensity. As described by McNicol (1972), B was computed as the average over median response from 0 (zero) to the total number of response

Table 1

Stimulus-Response Matrix for Bladder Pressure Relating to Volume in a Binary Decision Task

	Response	
	Pain or High Bladder Pressure	No Pain or Low Bladder Pressure
Stimuli		
Higher Intensity Stimulus or Higher Bladder Volumes	Hit	Miss
Lower Intensity Stimulus or Lower Bladder Volumes	False Alarm	Correct Rejection

categories, which in this case ranged from a subjective pressure score of 0 to 10. B is therefore defined as the criterion by which cumulative hit and cumulative false alarm probabilities are equal, or the point at which half of the responses to both low and high stimulus intensities fall into a higher response category and half to a lower response category. A low B value indicates a low criterion, equivalent to a frequent report of high bladder pressure, while a high B value reflects a high criterion, or a low frequency of high bladder pressure reports.

Verbal Pain Report. The McGill Pain Questionnaire (MPQ) devised by Melzack (1975) was utilized to assess verbal reports of bladder pain sensations (Appendix B). The MPQ was selected for this study because of the instrument's wide use in the assessment of clinical pain. It consists primarily of 3 major pain groups, labeled sensory, affective and evaluative that are used by the patient to describe the subjective pain experience. These verbal descriptors were originally grouped into 16 subclasses. An additional 4 subclasses, the miscellaneous category, were added later to produce the 20 descriptor subclasses and a total of 78 pain words, which currently comprise the major components of the MPQ (Melzack, 1975). Descriptors in each subclass, except for the miscellaneous category, are scaled according to a relative pain intensity and provide for standardized result.

Each patient completed the MPQ once at pre-treatment, post-treatment and follow-up. The MPQ was completed about

midway between two voidings, the time of day chosen by the patient. Instead of the standard procedure (Melzack, 1975) which permits the patient to choose just one item within each of the 20 subclasses, the MPQ was modified to a "free-choice" method. This format is less restrictive by allowing patients to respond "yes" to as many items as seem appropriate and thus did not eliminate potentially important information in the description of verbal pain.

To determine the quantitative measure of the MPQ, the following scoring method was applied: (1) each pain descriptor marked "yes" was counted toward the total number of words chosen within each pain dimension, sensory, affective and evaluative; (2) scaled scores were assigned to the highest pain intensity word selected in each of the 16 subclasses chosen, if any, by the patient. This resulted in both a total for words chosen within each pain dimension, sensory, affective and evaluative, as well as a total for scaled scores for these 3 pain classes. The miscellaneous category was not assessed due to the absence of scaling and common intensity dimensions of those pain words.

Psychological Symptomatology. The Brief Symptom Inventory (BSI) developed by Derogatis (1982) is a 53-item self-report psychiatric inventory. Incorporated later in the study, patients received the BSI during follow-up assessments only, and were requested to complete the questionnaire at the time they completed the MPQ. Each item is ranked on a 5-point scale of distress and provides nine primary symptom scales:

somatization, obsessive-compulsiveness, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism. The test also assesses three global scores. Since they tend to be highly correlated (Derogatis, 1978), only one, the General Symptom Index (GSI), was chosen for analysis, due to its overall assessment of symptoms and intensity of distress.

Data Analysis

Two sets of hypotheses were analyzed: The relation of bladder drill on urologic measures, on discriminability and the criterion, and on verbal pain reports; and the effect of bladder drill on the inter-relationship of these measures. First, to evaluate result of treatment outcome, the above measures were analyzed separately, using pre-, post-treatment and follow-up scores in a repeated measure ANOVA. Multiple a posteriori comparisons of these ANOVA's were tested for the critical differences between means for significance ($p < .05$) in *a priori* (planned) *t*-tests, using the least significant difference test (LSD) (Kirk, 1968). Second, to analyze the interrelationship of these measures, Pearson's product-moment coefficients were computed for estimating the relative agreement between these measures. Psychological data assessed at follow-up were correlated with other measures at follow-up. Since drug treatment may have influenced the results, non-medicated patients were compared to medicated patients. To assess these between-group differences, Fisher's t-tests were calculated for urologic variables, SDT variables

and verbal pain reports across treatment status, and BSI scores at follow-up.

IV. RESULTS

The results of this investigation will be reported in five sections commencing with the urological measures, followed by medication intake, discriminability and criterion measures, verbal pain reports, and the psychological symptomatology at follow-up.

Urologic Measures

Post-treatment data were collected at the last bladder drill session, at an average of 11 sessions and 0.9 years of treatment time, and follow-up data were collected at an average of 2.1 years past the last bladder drill session (Table 2). The patients' median age was 42.0 years at treatment onset. No significant interactions were found between changes in the urethral symptomatology and age at symptom onset, years of symptoms, age at treatment onset, duration of treatment time, or number of treatment sessions.

From a clinical point of view, the criterion of cure was defined by the average intervoiding interval (IVI) of no less than 3 hours during the waking period of the day. Table 3a presents raw data of urologic measures, including intervoiding intervals (IVI), mean and total day-volumes voided. Four patients (33.3%) were considered completely cured having reached the desired mean IVI of 3 hours at post-treatment. An additional six patients (50.0%) showed an

Table 2

Details of Patient Information

	Mean	SD	Median	Range
Age at symptom onset	28.3	16.3	26.0	3.0 - 60.0
Symptoms in years	13.3	14.6	8.5	1.0 - 47.0
Age at treatment onset	41.6	15.4	42.0	22.0 - 69.0
Age at last treatment session	42.5	15.7	43.5	23.0 - 71.0
Age at follow-up	44.6	15.6	44.5	24.0 - 73.0
Number of treatment sessions	10.9	5.1	8.5	3.0 - 20.0

Table 3a

Raw Data of Urologic Measures by Patient and Treatment Status

	A	B	C	A	B	C	A	B	C
	Pre			Post			Fwup		
Patient ID									
1	100	159	1588	139	251	1755	134	285	1995
2	72	65	872	129	163	1140	155	167	1223
3	136	189	1415	202	274	1640	128	192	1628
4	107	79	785	165	372	1488	248	244	1103
5	87	124	1423	130	180	1710	123	179	1788
6	53	140	2370	156	305	2280	112	108	1020
7	127	145	1223	182	310	2170	173	284	1980
8	29	23	750	30	25	700	40	29	860
9	131	101	850	221	150	750	151	167	1170
10	116	83	788	180	303	1818	220	312	1718
11	122	165	1295	105	150	1350	80	106	1533
12	88	71	856	125	150	1202	93	76	833

A = Intervoiding intervals in min

B = Mean day-volumes voided in cc

C = Total day-volumes voided in cc

Table 3b

Percent of Increase or Decrease in Urologic Measures by Patient and Treatment Status

	% Post-Pre			% Fwup-Pre		
Patient ID	A	B	C	A	B	C
1	39	58	11	34	79	26
2	79	151	31	115	157	40
3	49	45	16	-6	2	15
4	54	371	90	131	209	41
5	49	45	20	41	44	26
6	194	118	-4	111	-23	-57
7	43	114	77	36	96	62
8	3	9	-7	38	26	15
9	69	49	-12	15	65	38
10	55	265	131	90	276	118
11	-14	-9	4	-34	-36	18
12	42	111	40	6	7	-3

A = Intervoiding intervals in min

B = Mean day-volumes voided in cc

C = Total day-volumes voided in cc

increase of 39-194% in comparison to their baseline IVIs, as listed in Table 3b, for a total of 83.3% patients who were either cured or improved. One patient failed to increase her IVI and another patient got worse. At follow-up, two patients (16.7%) voided at IVIs of more than 3 hours and increased IVIs in seven additional patients (58.3%) ranged from 15-115%, for a total of 9 patients who were cured or improved (75.0%). Three patients were viewed as treatment failures in the long-term assessments, since two patients were within 10% of their baselie IVIs and one patient was worse.

Nocturia is usually defined by a minimum of 2 night-time voidings which was the case in 7 patients at pre-treatment. At post-treatment, 4 patients were cured, voiding no more than once per night, and 3 patients had improved, but still voided more than twice per night. At follow-up, one patient previously cured was classified as improved.

Bladder capacity was assessed by measuring mean and highest volumes voided by the patient and was considered normal for volumes equal or greater than 400 cc (Charlton, 1984). At pre-treatment, no patient exhibited normal bladder capacity. At post-treatment 10 ptients increased their mean volumes by 45-371% and seven of these patients had reached maximum bladder capacities of more than 400 cc. Two patients remained unchanged. At follow-up bladder volumes remained increased by 26-276% in eight patients, two patient reverted to baseline levels and two additional patients voided less

Table 4a

Mean Scores of Urologic Measures as a Function of Treatment Status

		Treatment status		
Measures		Pre	Post	Fwup
IVI (min)	M	97.3	147.0	138.1
	SD	33.1	50.3	57.6
Nocturia (frequency)	M	2.3	1.2	1.4
	SD	1.9	1.5	1.3
Mean day-vol voided (cc)	M	112.0	219.4	179.1
	SD	49.4	98.5	89.5
Total day-vol voided (cc)	M	1184.6	1500.3	1404.3
	SD	478.2	498.2	407.0

Table 4b

Mean Difference Scores of Urologic Measures as a Function of Treatment Status

	Treatment status		
Measures	Post-Pre	Fwup-Pre	Fwup-Post
IVI (min)	49.7***	40.8**	-8.9
Nocturia (frequency)	-1.2***	-0.9**	0.3
Mean day-vol voided (cc)	107.4***	67.1*	-40.3
Total day-vol voided (cc)	315.7	219.7	-96.0

* $p<.05$

** $p<.01$

*** $p<.001$

than their previous baselines volumes. Total volumes voided were increased by most patients across treatment status which was an expected finding.

Mean values of urologic measures relating to the urethral syndrome across treatment status, pre- vs post-treatment and follow-up for the total group were assessed statistically and are presented in Table 4a, along with mean difference scores of changes in Table 4b. Results were computed by repeated measures ANOVA for each urologic measure separately and indicated significant improvement in the urologic symptomatology both at post-treatment and follow-up. ANOVA for IVI showed a significant gain, $F(2,22) = 8.9$, $p.001$, with an increase of $M = 49.7$ min, $t(11) = 47.7$, $p<.001$, between voidings for the period pre- to post-treatment and $M = 40.8$ min, $t(11) = 35.8$, $p<.01$, from pre-treatment to follow-up.

In order to assess nocturia statistically, every occurrence of night-time voiding was counted. ANOVA yielded significant results in nocturia, $F(2,22) = 7.7$, $p<.002$, for reducing night-time voidings by $M = -1.2$ episodes, $t(11) = 1.2$, $p<.001$, from pre- to post-treatment and of $M = -0.9$ episodes, $t(11) = 0.9$, $p<.01$, from pre-treatment to follow-up.

The amount of urine voided was assessed in cc's and calculated as mean and total volumes voided for daytime micturition. A significant improvement across treatment status was observed in mean volume voided, F (2,22) = 10.5,

$p<.001$, with an increase of M = 107.4 cc, $t(11) = 90.0$, $p<.001$, at post-treatment, equal to almost twice the volume voided per urination at pre-treatment. Though reduced at follow-up, the increase of M = 67.08 cc, $t(11) = 49.2$, $p<.05$, from pre-treatment remained significant. ANOVA for total volume voided showed no significant changes across treatment status, $F(2,22) = 3.0$, $p<.08$.

These results support the hypothesis that bladder drill is an effective form of treatment for reducing day-time frequency and nocturia and for substantially increasing mean bladder volumes voided. Follow-up data demonstrated that patients were able to maintain treatment gains long after bladder drill therapy had been terminated. Total volumes voided showed a substantial, but not significant, increase across treatment status. This finding was important, since the reverse, a reduction in total volumes voided, also could have explained fewer day-time voidings. Less total volumes voided would have been related to the patient's compensatory behavior of reducing liquid intake in order to void less often and is antithetical to the rationale of bladder drill training.

Relationship of urologic measures to each other across treatment status. Tables 5a, 5b and 5c show correlations of urologic measures at pre-treatment, post-treatment, and follow-up, respectively. Significant positive correlations were apparent at pre-treatment (Table 5a) between mean day-volume and: IVI and total day-volume voided; thus,

Table 5a

Correlations Between Urologic Measures at Pre-treatment

	Noct. (freq.)	IVI	Mean day-vol
IVI (min)	.40		
Mean day-vol (cc)	-.37	.58*	
Total day-vol (cc)	-.35	.34	.67**

* $p<.05$

** $p<.01$

Table 5b

Correlations Between Urologic Measures at Post-treatment

	Noct. (freq.)	IVI	Mean day-vol
IVI (min)	-.87***		
Mean day-vol (cc)	-.70**	.66**	
Total day-vol (cc)	-.55*	.36	.76**

* p<.05

** p<.01

*** p<.001

Table 5c

Correlations Between Urologic Measures at Follow-up

	Noct. (freq.)	IVI	Mean day-vol
IVI (min)	-.64**		
Mean day-vol (cc)	-.65**	.82***	
Total day-vol (cc)	-.43	.29	.75**

* p<.05

** p<.01

*** p<.001

patients with larger mean volumes per urination had higher intervals between micturition which was an expected relationship. Larger mean volumes voided were also associated with larger total volumes. Nocturia indicated no association with other urologic measures. Therefore, either higher IVIs, or higher total day-volumes which relate to a greater amount of liquid intake, could not explain a lower rate in night-time voidings.

Urologic measures at post-treatment (Table 5b) and follow-up (Table 5c), showed a parallel pattern to each other. All measures were highly correlated, with the exception of total day-volume voided, indicating no relationship with IVI at post-treatment and with nocturia and IVI at follow-up. Mean volume voided indicated the expected positive relationship with IVI and total volume voided, as was seen at pre-treatment. On the other hand, a higher rate of nocturia was, following treatment, associated with reduced IVIs, and lower mean and total day-volumes voided.

In summary, a relationship was present between greater mean volumes voided, greater IVIs and reduced nocturia at post-treatment and follow-up. These relationships may simply reflect the degree of bladder wellness in a coordinated physiological pattern, based on the neural stimulation and the functional capacity of the bladder. Higher rates in nocturia were associated with reduced IVIs and lower mean volumes voided at post-treatment and at follow-up, as was anticipated.

Relationship of pre-treatment urologic measures to post-treatment and follow-up measures. Next, in order to view the relationship between status at intake and the effects of treatment, pre-treatment urologic measures were used as predictors in determining their relationship to post-treatment and follow-up measures. Results between pre-treatment and post-treatment correlations are presented in Table 6a. Pre-treatment IVI showed a positive relationship with post-treatment IVI, accounting for 58% of variance, and a negative relationship with post-treatment nocturia, accounting for 29% of the variance. Patients with higher IVIs at intake had therefore higher IVIs and reduced nocturia at post-treatment. Pre-treatment nocturia indicated highly negative significance with all urologic measures at post-treatment and could explain a common variance with post-treatment nocturia of 72%, with IVI of 66%, with mean day-volume voided of 79% and with total day-volume voided of 49%. A negative relationship between pre-treatment mean day-volume and post-treatment nocturia accounted for 24% of variance and a positive relationship between pre-treatment mean day-volume and post-treatment total day-volume shared a variance of 36%, suggesting that higher mean volumes voided at pre-treatment would lead to reduced frequency of night-time voidings and higher total bladder volumes voided at post-treatment. Larger pre-treatment total day-volumes also covaried positively with larger post-treatment total day-volume, accounting for 48% of common variance.

Table 6a

Correlations Between Pre- and Post-treatment of Urologic Measures

	Post-treatment			
Pre-treatment	IVI	Noct. (freq.)	Mean vol	Total vol
IVI (min)	.76**	-.54*	.44	.18
Nocturia (frequency)	-.81***	.85***	-.89***	-.70**
Mean day-vol (cc)	.46	-.49*	.43	.60*
Total day-vol (cc)	.12	-.36	.32	.69**

* $p<.05$

** $p<.01$

*** $p<.001$

A similar pattern emerged with correlations of pre-treatment and follow-up urologic measures, as listed in Table 6b. Higher pre-treatment IVI appeared to relate to reduced nocturia at follow-up, with 61% of the variance explained, and higher IVIs at follow-up with 24% of the variance explained. Unlike post-treatment correlations, pre-treatment IVI showed a significant positive relationship with follow-up measures of mean volume voided, accounting for 35% of variance, and total volume voided, accounting for 31% of the variance. Pre-treatment nocturia continued to predict poor outcome in follow-up measures of nocturia with 53%, of IVI with 55% and of mean day volume with 50% of the variance explained. Pre-treatment mean day volume showed a significant inverse relationship to follow-up nocturia with 30% of variance and a positive correlation with follow-up mean day volume voided, accounting for 42% of the variance explained, suggesting that pre-treatment mean volume voided was unrelated to IVI at follow-up, but could predict the long-term treatment outcome of nocturia and mean volume voided. Pre-treatment total day-volume voided did not predict other urologic measures at follow-up.

Overall, these results showed that both IVI and nocturia were strong predictors for treatment outcome. Patients with generally higher IVIs at treatment onset were able to sustain this advantage at post-treatment and follow-up and also experienced reduced frequency of night-time voidings. Nocturia, on the other hand, strongly influenced a negative

Table 6b

Correlations Between Pre-treatment and Follow-up of Urologic Measures

	Follow-up			
Pre-treatment	IVI	Noct. (freq.)	Mean vol	Total vol
IVI (min)	.49*	-.78***	.60*	.56*
Nocturia (frequency)	-.74**	.73**	-.71**	-.35
Mean day-vol (cc)	-.01	-.55*	.65**	.32
Total day-vol (cc)	-.24	-.20	-.03	.23

* $p<.05$

** $p<.01$

*** $p<.001$

treatment outcome, affecting the rate of night-time voidings, as well as IVIs and mean bladder volumes voided at post-treatment and follow-up. In essence, patients with less severe urologic symptoms were better able to normalize bladder functions than patients who experienced more severe symptoms. Both short- and long-term treatment outcome could undoubtedly be predicted by the degree of symptom severity, defined in this study by both IVI and nocturia.

Medication Intake

Intake of those medications known to influence bladder functions and/or the central nervous system (CNS) are presented by patient ID and treatment status in Table 7. As described in the method section, medication intake was not part of the protocol and varied across patients and treatment status. After the data were collected, however, it was apparent that patients on medication intake at pre-treatment tended to continued some form of medication therapy at post-treatment and follow-up and that the medication intake should be treated as an independent variable. Two patient groups were formed: the non-medicated group included 8 patients not on medication and the medicated group included 4 patients taking at least one drug, an anticholinergic, a benzodiazepine, an antidepressant or an analgesic across treatment status. Fisher's t-tests were calculated for between-group differences at pre-treatment, post-treatment and follow-up, separately. As is apparent in Table 7, case # 9 used an anticholinergic drug at post-treatment only and was

Table 7

Medication Intake by Patient and Treatment Status

	Medication (a)											
	A	B	C	D	A	B	C	D	A	B	C	D
	Pre-treatment				Post-treatment				Follow-up			
Patient ID												
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	B	-	-	-	-	C	D	-	-	C	D
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	A	-	C	-	-	-	C	-	-	-	C	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	A	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	C	-	A	B	C	-	A	B	C	-
12	A	B	C	-	-	B	C	-	A	B	C	D

(a) A = Anticholinergics

B = Benzodiazepines

C = Antidepressants

D = Analgesics

otherwise drug-free. In order to evaluate the potential influence of this case on other measures, 3 separate analyses were computed; case # 9 was treated as: 1) part of the medicated group during post-treatment only, creating 7 cases in the medicated group and 5 cases in the non-medicated group; 2) not being part of the study at all; and 3) not using any medication at post-treatment, leaving her in the non-medicated group throughout the analyses. A comparison of these approaches showed no differences in outcome. Case # 9 was therefore treated as a non-medicated patient across treatment status. T-test between the non-medicated and the medicated group failed to show differences on any of the urologic measures across treatment status.

Discriminability and Criterion Measures of Bladder Pressure

The SDT index P(A) measured the patient's ability to discriminate high from low bladder pressure intensities. The signal-plus-noise and noise distributions were obtained for each patient separately by the median of volumes voided, as listed in Table 8. Volumes above the median are equivalent to signal-plus-noise and below the median equivalent to noise alone. Prior to data analysis, values of P(A) were transformed into 2-arcsin square root P(A), in order to reduce possible skewness of the data. P(A) represents a proportion of the area under the receiver-operating characterstic curve. P(A) is not normally distributed, since

Table 8

Median and Range of Bladder Volumes Voided by Patient and Treatment Status

	Bladder Volumes Voided Median and (Range)		
	Pre	Post	Fwup
Patient ID			
1	165 (75-250)	240 (120-480)	274 (150-420)
2	60 (30-135)	163 (90-240)	150 (105-330)
3	150 (50-300)	238 (125-500)	150 (75-390)
4	60 (30-130)	350 (250-625)	210 (165-375)
5	100 (50-250)	200 (90-350)	150 (45-350)
6	90 (30-300)	300 (90-600)	120 (30-210)
7	150 (90-250)	300 (120-500)	300 (120-420)
8	20 (10- 60)	23 (10- 70)	32 (15-105)
9	100 (30-220)	150 (100-200)	150 (50-350)
10	75 (45-180)	320 (20-500)	390 (90-630)
11	200 (50-330)	150 (50-400)	100 (5-400)
12	65 (23-128)	150 (87-365)	60 (30-180)

it ranges from 0.5 to 1.0 and not from minus to plus infinity. The 2-arscsin scores, as well as scores of P(A), were analyzed by ANOVA and their values compared. There were no statistical differences between the area values and the transformed scores, probably in the absence of extreme P(A) scores. P(A) scores were used for further analyses.

The other SDT index, B, measured the patients' criterion for bladder pressure. As described earlier, the rating scale from 0 to 10 was used by patients to describe a given bladder pressure sensation, 5 indicating normal bladder pressure for the urge to void and higher numbers indicating greater pressure. A lower B was associated with more frequent reports of high bladder pressure and a higher B with fewer reports of high bladder pressure.

Discriminability, P(A), and the criterion index, B, for bladder pressure reports are presented in Table 9. ANOVA for testing P(A) across treatment status showed that the mean discriminability improved at post-treatment, although it did not reach significance across treatment status, $F(2,22) = 1.7$, $p<.21$. ANOVA for criterion B was not significantly different in the mean response for the group across treatment status, $F(2,22) = 0.7$, $p<.53$, even though B values at post-treatment were slightly more conservative with fewer high bladder pressure reports. Thus, patients maintained a similar ability to discriminate among various stimulus intensities of bladder volumes voided and maintained a similar attitude, reporting bladder pressure

Table 9

Mean (SD) Discriminability, P(A), and Criterion, B, for Bladder Pressure Sensations by Treatment Status

		Treatment status		
Variable		Pre	Post	Fwup
P(A)	M	0.78	0.82	0.79
	SD	0.16	0.11	0.14
B	M	4.2	4.7	4.4
	SD	1.2	1.7	1.6

slightly more often than expected for the normal urge to void.

Relationship of urologic measures to discriminability, P(A), and criterion, B. Table 10 depicts correlations between urologic measures and P(A), and criterion B across treatment status. A significant positive relationship between P(A) and IVI at post-treatment and follow-up suggested that increased discriminability of bladder pressure was associated with higher IVIs between voidings. This finding, as well as a negative relationship between P(A) and nocturia at post-treatment and a positive relationship between mean volume voided and total volume voided at follow-up identified an increased ability to discriminate bladder pressure with reduced urologic symptomatology.

The criterion index B showed no relationship with urologic measures, except for covarying positively with Vol total at post-treatment.

Discriminability and criterion measures between non-medicated and medicated patients. Differences between the non-medicated and medicated group on measures of discriminability, P(A) and the criterion index, B, across treatment status were calculated with the t-test and are presented in Table 11. The ability to discriminate bladder pressure sensations for volumes voided was significantly better in the non-medicated group at both pre-treatment, $t(10) = 5.04$, $p<.001$, and follow-up assessments, $t(10) = 3.47$, $p<0.01$. There were no differences of mean volumes

Table 10

Correlations of Urologic Measures With Discriminability, P(A), and Criterion, B, Across Treatment Status

Urologic measures	Treatment status	P(A)	B
IVI	pre	.37	-.34
	post	.72**	.17
	fwup	.69**	-.15
Nocturia	pre	-.29	-.18
	post	-.50*	-.25
	fwup	-.39	.40
Vol Mean	pre	-.12	-.03
	post	.39	.47
	fwup	.75**	.11
Vol Total	pre	-.42	.20
	post	.02	.52*
	fwup	.55*	.28

* $p<.05$

** $p<.01$

Table 11

Means (SD) of Discriminability, P(A), and Criterion, B, in Non-medicated and Medicated Patients Across Treatment Status

		Non-Medicated Patients (N = 8)	Medicated Patients (N = 4)	t-test
Measures				
Treatment status				
P(A)	Pre	0.88 (0.1)	0.60 (0.1)	5.04***
	Post	0.85 (0.1)	0.76 (0.1)	1.35
	Fwup	0.86 (0.1)	0.65 (0.1)	3.47**
B	Pre	4.39 (1.0)	3.74 (1.6)	0.87
	Post	4.85 (1.8)	4.35 (1.5)	0.47
	Fwup	5.00 (1.4)	3.19 (1.5)	2.08

* $p<.05$

** $p<.01$

*** $p<.001$

voided between medicated and non-medicated patients. Results were therefore not due to a greater range of stimulus intensities and a better ability to identify high or low stimulus events for precessing more sensory information correctly. The non-medicated group showed almost identical discrimination scores across treatment status, while the medicated group showed poor discrimination, low P(A) scores for bladder pressure sensation at pre-treatment and at follow-up, and increased sensory discrimination, higher P(A) scores at post-treatment. Criterion measures, B, showed no significant differences between groups across treatment status. At follow-up, non-medicated patients voided at the normal urge equal to a rating of 5, while the medicated patients reported a greater frequency of high bladder pressure. This difference just failed from reaching significanc, $\underline{t}(10) = 2.08$, $p<.07$. Except for the non-medicated group at follow-up, criterion scores were generally just below a rating of 5, suggesting a slightly higher frequency of bladder pressure reports on the average, as compared to the normal urge to void.

In summary, P(A) for the whole group did not indicate changes across treatment status, suggesting that patients, whether they were good or bad discriminators, maintained the same degree of discriminability for bladder pressure relating to volumes voided. A positive relationship between P(A) scores and IVI, mean volumes and total volumes voided, and a negative relationship between P(A) scores and nocturia at

post-treatment and follow-up suggested that an increased ability to discriminate bladder pressure was associated with reduced urologic symptomatology. Signficiantly better P(A) means were observed among non-medicated patients, suggesting that patients on medication intake had a reduced accuracy for discriminating among bladder pressures for volumes voided. An increase in P(A) scores at post-treatment by medicated patients is viewed as a treatment effect of bladder drill training, overriding the influence of medication and diminished afferent information for bladder awareness.

The criterion index, B, showed no significant differences across treatment status for the total group with slightly lower, more frequent high bladder pressure reports, than would be associated with the normal urge to void. At follow-up, differences between non-medicated patients with normal scores and medicated patients with reduced scores equal to frequent high bladder pressure reports just failed from reaching significance.

Verbal Pain Report

Responses to the McGill Pain Questionnaire (MPQ) were used to assess bladder pressure sensations midway between two voidings. Repeated measure ANOVAs were calculated for mean number of words chosen (NWC) for the sensory, affective and evaluative dimensions and their scaled values across treatment status, as listed in Table 11a, along with their difference scores, as listed in Table 11b. Although there was

Table 12a

Mean Number of Words Chosen and Their Scaled Scores of the McGill Pain Questionnaire as a Function of Treatment Status

			Treatment status		
Variables			Pre	Post	Fwup
Sensory:	NWC	M	9.67	7.50	6.50
		SD	3.06	6.42	6.39
	SS	M	14.42	10.58	12.61
		SD	5.79	7.09	13.53
Affective:	NWC	M	2.58	1.00	0.75
		SD	2.47	1.35	1.14
	SS	M	5.42	2.92	2.25
		SD	4.54	3.84	3.42
Evaluative:	NWC	M	4.00	2.25	1.58
		SD	1.35	1.22	1.24
	SS	M	3.91	2.45	2.08
		SD	0.67	1.64	1.37

NWC = Number of words chosen

SS = Scaled scores

Table 12b

Difference Scores of Mean Number of Words Chosen and Their Scaled Scores of the McGill Pain Questionnaire by Treatment Status

		Treatment status		
Variables		Post-Pre	Fwup-Pre	Fwup-Post
Sensory:	NWC	-2.17	-3.17	-1.00
	SS	-3.84	-1.81	2.03
Affective:	NWC	-1.58*	-1.83**	-0.25
	SS	-2.50*	-3.17*	-0.67
Evaluative:	NWC	-1.75***	-2.42***	-0.67
	SS	-1.46**	-1.85***	-0.38

NWC = Number of words chosen

SS = Scaled scores

*** $p<.001$

** $p<.01$

* $p<.05$

a steady decline, the sensory dimension showed no significant differences for number of words chosen (NWC), $F(2,22) = 2.1$, $p<.14$, nor did its scaled scores (SS), $F(2,22) = 0.8$, $p<.47$. The affective dimension for NWC showed a main effect, $F(2,22) = 5.9$, $p<.01$, with $M = -1.58$ fewer words chosen between pre- and post-treatment, $t(11) = 1.2$, $p<.05$, and $M = -1.83$ fewer words between pre-treatment and follow-up, $t(11) = 1.7$ $p<.01$. ANOVA of SS for the affective dimension was significant, $F(2,22) = 4.2$, $p<.05$, across treatment status with $M = -2.50$ fewer descriptors between pre- and post-treatment, $t(11) = 2.4$, $p<.05$, and $M = 3.17$ fewer words between pre-treatment and follow-up, $t(11) = 2.4$, $p<.05$. The evaluative dimension for NWC yielded a significant ANOVA, $F(2,22) = 21.3$, $p<.001$, patients selecting $M = -1.75$ fewer pain descriptors for the period pre- to post-treatment, $t(11) = 1.4$, $p<.001$ and $M = -2.42$ less words between pre-treatment and follow-up, $t(11) = 1.4$, $p<.001$. ANOVA of SS for the evaluative dimension showed a similar trend, $F(2,22 = 10.5$, $p<.001$, with a significant decline in $M = -1.46$ words selected, pre- to post-treatment, $t(11) = 1.2$, $p<.01$, and also fewer words $M = -1.85$ between pre-treatment and follow-up, $t(11) = 1.6$, $p<.001$.

Verbal descriptors for bladder pressure sensations. A descriptive analysis of the MPQ by the percentage of patients that checked words of the MPQ across treatment status is listed in Table 13. The possibility of performing a

Table 13

Percent of Patients Checking Words of the McGill Pain Questionnaire (MPQ) Across Treatment Status

MPQ Words	Pre	Post	Fwup
Sensory descriptors			
1. flickering	0.0	16.7	8.3
2. quivering	8.3	0.0	8.3
3. pulsing	33.3	8.3	0.0
4. throbbing	25.0	8.3	8.3
5. beating	0.0	0.0	0.0
6. pounding	0.0	8.3	0.0
7. jumping	0.0	16.7	0.0
8. flashing	0.0	8.3	0.0
9. shooting	33.3	16.7	8.3
10. pricking	50.0	16.7	8.3
11. boring	8.3	8.3	25.0
12. drilling	16.7	0.0	8.3
13. stabbing	25.0	8.3	16.7
14. lancinating	0.0	0.0	8.3
15. sharp	50.0	16.7	8.3
16. cutting	25.0	8.3	8.3
17. lacerating	8.3	8.3	0.0
18. pinching	16.7	8.3	0.0
19. pressing	66.7	50.0	66.7
20. gnawing	25.0	25.0	25.0

Table 13 (continued)

MPQ Words	Pre	Post	Fwup
21. cramping	16.7	8.3	16.7
22. crushing	0.0	8.3	8.3
23. tugging	16.7	16.7	8.3
24. pulling	16.7	25.0	41.7
25. wrenching	16.7	0.0	8.3
26. hot	16.7	25.0	8.3
27. burning	41.7	41.7	25.0
28. scalding	8.3	16.7	0.0
29. searing	8.3	0.0	8.3
30. tingling	41.7	16.7	25.0
31. itchy	8.3	0.0	0.0
32. smarting	33.3	33.3	16.7
33. stinging	16.7	16.7	8.3
34. dull	41.7	41.7	25.0
35. sore	50.0	50.0	33.3
36. hurting	66.7	50.0	33.3
37. aching	41.7	58.3	58.3
38. heavy	41.7	33.3	50.0
39. tender	50.0	58.3	33.3
40. taut	33.3	25.0	25.0
41. rasping	0.0	0.0	0.0
42. splitting	0.0	0.0	8.3

Table 13 (continued)

MPQ Words	Pre	Post	Fwup
Affective descriptors			
43. tiring	50.0	33.3	25.0
44. exhausting	41.7	8.3	0.0
45. sickening	25.0	25.0	25.0
46. suffocating	0.0	0.0	0.0
47. fearful	16.7	16.7	8.3
48. frightful	8.3	0.0	0.0
49. terrifying	16.7	0.0	0.0
50. punishing	16.7	0.0	8.3
51. gruelling	25.0	8.3	8.3
52. cruel	8.3	8.3	0.0
53. vicious	8.3	8.3	0.0
54. killing	0.0	0.0	0.0
55. wretched	41.7	0.0	0.0
56. blinding	0.0	0.0	0.0
Evaluative descriptors			
57. annoying	91.7	67.7	66.7
58. troublesome	91.7	58.3	50.0
59. miserable	83.3	16.7	25.0
60. intense	83.3	33.3	16.7
61. unbearable	50.0	16.7	16.7

discriminant analytic study was entertained, but discarded on the basis of the small sample size for reliability and stability of the discriminant function (Kerlinger & Pedhazur, 1973). The key words that would best describe the urethral syndrome patient, were therefore viewed as descriptors chosen by at least 30% of patients at pre-treatment. Thus, patients chose a total of 23 descriptors, 15 from the sensory dimension: 'pulsing,' 'shooting,' 'pricking,' 'sharp', 'pressing,' 'burning,' 'tingling,' 'smarting,' 'dull,' 'sore,' 'hurting,' 'aching,' 'heavy,' 'tender,' and 'taut'; 3 from the affective dimension: 'tiring,' 'exhausting,' and 'wretched'; and all 5 descriptors from the evaluative dimension: 'annoying,' 'troublesome,' 'miserable,' 'intense,' and 'unbearable' to describe their bladder pressure sensations. Thus, evaluative words, in relationship to number of words within each dimension, occupied the most frequent position on the list at pre-treatment status. At post-treatment, the sensory words 'pulsing,' 'shooting,' 'pricking,' 'sharp,' 'tingling' and 'taut', the affective words 'exhausting' and 'wretched', and the evaluative words 'miserable' and 'unbearable' showed a sharp decrement, leaving nine sensory, one affective and three evaluative descriptors. At follow-up, NWC were even further reduced to six sensory descriptors which included 'pulling', previously not among high frequency words, to zero of the affective descriptors and to two evaluative descriptors.

Relationship between MPQ scores and urologic measures. Correlations between MPQ scores and urologic measures failed to show significant relationships at pre-treatment and follow-up. At post-treatment, NWC of the sensory category covaried positively with nocturia, $r = .57$, $p<.05$, and inversely with IVI, $r = -.56$, $p<.05$. A positive correlation was also found between SS of the sensory category and nocturia, $r = .59$, $p<.05$, and a negative correlation with IVI, $r = -.65$, $p<.01$. Patients with a higher night-time frequency and shorter intervals between voidings tended to chose a higher number, as well as higher intensity words of the sensory dimension at post-treatment.

Relationship of MPQ scores with discriminability, P(A), and criterion, B. No significant correlations were found between MPQ scores in the sensory, affective or evaluative dimension and discriminability, P(A), nor between MPQ scores and the criterion, B.

MPQ scores between non-medicated and medicated patients. Means and SD of MPQ scores between non-medicated and medicated patients are presented in Table 14 and mean differences compared by use of Fisher's t-test with df = 10. Although the non-medicated group selected a similar number of words at pre-treatment as did the medicated group, they diverged at post-treatment and reached significant differences at follow-up. The non-medicated group showed fewer NWC in the sensory category, $t(10) = -3.04$, $p<.01$, and SS of the sensory category, $t(10) = -3.26$, $p<.01$,

Table 14

Means (SD) of the McGill Pain Questionnaire (MPQ) in Non-Medicated and Medicated Patients Across Treatment

		Non-Medicated (N = 8)		Medicated (N = 4)		t-test
MPQ Measures: Treatment status						
Sensory NWC:	Pre	9.3	(3.5)	10.5	(2.1)	-0.65
	Post	5.5	(3.2)	11.5	(9.7)	-1.64
	Fwup	3.5	(3.2)	12.5	(7.3)	-3.04**
Sensory SS:	Pre	13.3	(5.9)	16.8	(5.6)	-0.99
	Post	7.9	(4.9)	15.9	(8.4)	-2.12
	Fwup	6.0	(4.8)	25.8	(16.5)	-3.26**
Affective NWC:	Pre	2.5	(2.7)	2.8	(2.3)	-0.16
	Post	0.8	(1.2)	1.5	(1.7)	-0.90
	Fwup	0.3	(0.5)	1.8	(1.5)	-2.70*
Affective SS:	Pre	5.3	(5.3)	5.7	(3.0)	-0.12
	Post	1.8	(2.7)	5.1	(5.3)	-1.48
	Fwup	0.7	(1.3)	5.4	(4.4)	-2.89**
Evaluative NWC:	Pre	3.9	(1.6)	4.3	(0.5)	-0.44
	Post	1.9	(1.4)	3.0	(0.0)	-1.62
	Fwup	1.1	(1.0)	2.5	(1.3)	-2.06
Evaluative SS:	Pre	3.9	(0.8)	4.0	(0.3)	-0.15
	Post	1.9	(1.8)	3.5	(0.7)	-1.69
	Fwup	1.5	(1.3)	3.2	(0.7)	-2.49*

* p<.05

** p<.01

NWC = Number of Words Chosen

SS = Scaled Scores

less NWC in the affective category, $\underline{t}(10) = -2.70$, $\underline{p}<.05$, and SS of the affective category, $\underline{t}(10) = -2.89$, $\underline{p}<.01$, and reduced SS in the evaluative category, $\underline{t}(10) = -2.49$, $\underline{p}<.05$, as compared to the medicated group. The non-medicated demonstrated a continous drop in pain words chosen from pre- to post-treatment to follow-up. The medicated group showed a slight increase of NWC in the sensory dimension at post-treatment and at follow-up, while the affective and evaluative dimensions indicated a decline in NWC across treatment status.

In summary, the total patient population responded to the MPQ with a significant reduction of NWC and SS in the affective and evaluative dimensions, at both post-treatment and follow-up. NWC and SS in the sensory dimension were increased by the medicated patients at post-treatment and follow-up, creating a smaller and not significant decrease in NWC and SS in this dimension for the entire group. The strongest decline in NWC and SS for the group was observed in the evaluative category, suggesting that treatment resulted in reducing the pain intensity of the patients' perception of bladder pressure more than sensory or affective aspects of the perceived pain.

The 23 most often used words at pre-treatment status to describe bladder pressure sensations were chosen from all three dimensions, sensory, affective and evaluative. The evaluative category dominated the patients' choice and described her perceived bladder discomfort as being primarily

intense in nature. At post-treatment and follow-up, fewer descriptors in all three dimensions were observed, leaving none in the affective category at follow-up which reflected the reduced emotional component of perceived bladder discomfort following treatment.

As was suggested by positive correlations of post-treatment nocturia and negative correlations of IVI with NWC and SS of the sensory dimensions, patients still plagued by urethral symptoms following treatment, chose more words from the sensory dimension, as compared to the affective and evaluative dimensions.

Comparisons between MPQ means of non-medicated and medicated patients indicated similar MPQ scores at pre-treatment, a greater decline of pain descriptors among non-medicated patients at post-treatment, and significant between-group differences at follow-up across all measures. These results were surprising, since they suggested that drug treatment, designed to reduce the urethral symptomatology and perceived pain, appeared ineffective in reducing the patient's bladder pressure sensations, as expressed by the MPQ. Relative to treatment results by non-medicated patients, medicated patients faired less well when verbal pain was assessed.

Psychologic Symptomatology.

The Brief Symptom Inventory (BSI) assessed patients' psychological status by self-report at follow-up. Data were

computed for all nine dimensions and GSI and transformed into T-scores for comparison with norms of female non-psychiatric patients. The standardized scales of T-scores have a mean of 50 and a standard deviation of 10.

Table 15 represents mean and SD for the total group. Results indicated that none of the dimensions or the global score were above 1 SD of the norms and therefore there was no psychopathology. The most obvious characteristics of this group of patients were the very low scores on somatization, phobic anxiety, paranoid ideation and psychoticism, which may suggest the absence of any psychiatric illness or simply a denial of those traits.

Relationship of BSI scores and urologic measures at follow-up. Two BSI factors, phobic anxiety and psychoticism showed a significant association with poor outcome on the urethral symptomatology at follow-up. Patients with higher scores of phobic anxiety experienced reduced IVIs, $r = -.66$, $p<.01$, reduced mean day-volume, $r = -.77$, $p<.01$, and total day-volume voided, $r = -.53$, $p<.05$. Higher scores on psychoticism were also related to shorter IVIs, $r = -.69$, $p<.01$, and decreased mean day-volume voided, $r = -.59$, $p<.05$.

BSI scores between non-medicated and medicated patients at follow-up. Means and SD of the BSI by medication intake at follow-up is presented in Table 16. A distinct pattern was observed: non-medicated patients obtained better than normal scores on the BSI. Phobic anxiety

Table 15

Brief Symptom Inventory (BSI) Scaled Scores and Standard Deviations at Follow-up

BSI Factor	Mean	SD
Somatization	39.4	29.7
Obsessive-Compulsive	56.0	19.9
Interpersonal Sensitivity	45.0	28.0
Depression	50.8	25.3
Anxiety	47.9	29.5
Hostility	52.6	18.1
Phobic Anxiety	31.7	33.3
Paranoid Ideation	36.1	32.0
Psychoticism	37.9	33.8
Global Severity Index	56.3	10.4

Table 16

Means (SD) of the Brief Symptom Inventory (BSI) in Non-Medicated and Medicated Patients Across Treatment

BSI Factor	Non-Medicated Patients (N = 8)	Medicated Patients (N = 4)	t-test
Somatization	34.6 (29.0)	49.0 (32.9)	-0.78
Obsessive-Compulsive	49.1 (21.3)	69.8 (4.5)	-1.87
Interpersonal Sens.	33.6 (28.0)	67.8 (2.1)	-2.38*
Depression	41.8 (26.5)	68.8 (6.7)	-1.97
Hostility	46.6 (19.7)	64.5 (2.5)	-1.76
Anxiety	37.5 (31.6)	68.8 (2.1)	-1.93
Phobic Anxiety	14.5 (26.9)	66.0 (5.7)	-3.71**
Paranoid Ideation	30.1 (32.3)	48.0 (32.3)	-0.90
Psychoticism	22.1 (30.6)	69.5 (4.1)	-3.01**
Global Severity Index	52.1 (10.1)	64.8 (3.8)	-2.36*

* $p<.05$

** $p<.01$

appeared unusually low, as if denying feelings of fear toward people, public places and travelling which are normally associated with the urethral syndrome. On the other hand, BSI scores by medicated patients were elevated by 1 SD on most symptoms: obsessive-compulsiveness, interpersonal sensitivity, depression, hostility, anxiety, phobic anxiety and psychoticism. Thus, medicated patients saw themselves as obsessive-compulsive, feeling inferior to others, shying away from public places and the interaction with people, alienating themselves socially, and as being tense and depressed. Scores of symptoms of somatization and paranoid ideation were normal. The fact that somatization was within normal range, was unexpected, since this dimension tends to reflect psychological distress from the perception of bodily dysfunction arising from autonomic mediation. The GSI, the best indicator for combining number of symptoms and intensity of distress, was within normal range for the non-medicated group and reflected the psychopathologic status with higher scores of the medicated patients.

Relationship between BSI scores and discriminabilty, P(A), and criterion, B, at follow-up. Table 17 portrays correlations of BSI factors and discriminability, P(A), and criterion, B, at follow-up. A total of 5 factors and the global score GSI were inversely related with P(A), implying poorer discriminability by patients who were psychologically more distressed, as manifested by symptoms of somatization, interpersonal sensitivity, hostility, phobic anxiety and

Table 17

Correlations Between BSI Scores and Discriminability, P(A), and Criterion, B, at Follow-up

BSI Factor	P(A)	B
Somatization	-.58*	-.32
Obsessive-Compulsive	-.52	-.13
Interpersonal Sensitivity	-.65**	-.38
Depression	-.48	-.44
Hostility	-.50*	-.43
Anxiety	-.46	-.22
Phobic Anxiety	-.81***	-.38
Paranoid Ideation	-.09	-.36
Psychoticism	-.80***	-.32
Global Severity Index	-.61*	-.16

* $p<.05$

** $p<.01$

*** $p<.001$

psychoticism. As anticipated, these results were similar with those found in medicated patients with reduced P(A) scores. The criterion measure, B, was not related to psychological symptoms at follow-up.

In summary, the BSI failed to indicate elevated scores, when non-medicated and medicated groups were combined. When separated by medication intake, it became clear, that non-medicated patients showed normal or 'super-normal' scores and medicated patients demonstrated elevated scores on most BSI dimensions. BSI factors were related to poor treatment outcome, based on urologic measures and poor discriminability for bladder pressure sensations, but remained unaffected by the criterion, B.

V. DISCUSSION

Summary of Findings

Results can be summarized by five major findings related to the hypotheses tested:

(1) Frewen's theoretical model of behavior modification for reducing the symptomatology of the urethral syndrome was supported by this thesis. Bladder drill resulted in larger mean day-volumes voided and reduced rates of nocturia. These gains were maintained at follow-up assessments over an average of 2.1 years. Four of 12 patients were cured, defined by having reached 3-hour IVIs, and an additional 6 patients were improved following treatment.

This study demonstrated that symptom severity as indicated by both a high rate of day-time frequency (low IVI) as well as a high rate of nocturia should be regarded as negative factors with respect to treatment success. Furthermore, in this study nocturia was not the first symptom to disappear, as was suggested by Frewen's study (1982).

(2) Medication intake was associated with three findings: (a) reduced P(A) scores by medicated patients; (b) medication was ineffective for removing the discomfort of the bladder symptomatology as measured by the MPQ at post-treatment and at follow-up; and (c) a strong relationship to psychological distress existed at follow-up, as expressed by the BSI.

(3) The patients' ability to discriminate bladder pressure sensations relating to volumes voided, P(A), and the criterion, B, were analyzed first for the total group and then by medication intake. P(A) for the total group remained relatively unchanged across treatment status, as was the case with the criterion measure, B. At post-treatment and at follow-up, discriminability was related to urologic measures, suggesting that increased discriminability, higher P(A) scores, were associated with treatment success. The criterion measure, B, was slightly elevated across treatment status, patients reporting bladder pressure more often than expected for the normal urge to void. This was anticipated, since bladder drill requires patients to withold from frequent voidings which is equivalent to increasing bladder pressure.

Medication intake separated patients into 2 groups: non-medicated patients, who were good discriminators and medicated patients, who were poor discriminators. Discriminability, P(A), was the only pre-treatment measure that indicated a significant between-group difference. Patients on medication were able to increase their discriminative ability at post-treatment, an effect that was lost at follow-up. Apparently, awareness training of bladder pressure sensations associated with bladder drill produced a temporary capability of overriding the suppressive effects of medication on discriminability. The criterion measure, B, although not significantly different between groups, showed an increase in higher bladder pressure reports (lower

criterion, B) by medicated patients at follow-up.

(4) The MPQ for verbal pain reports of bladder pressure and other sensations yielded four findings. First, the number of words chosen (NWC) and scaled scores (SS) of the affective and pain evaluative categories showed significant reductions at post-treatment and at follow-up. Bladder drill and the alleviation of urethral symptoms therefore produced a decline in the patient's negative emotional state and perception of pain. The pain evaluative category showed the strongest decline, suggesting that bladder drill was successful in reducing the intensity of the patient's perceived bladder discomfort. Although the sensory category showed reduced NWC for the non-medicated patients, a significant reduction for the total patient group was lost by an increase of NWC by medicated patients at post-treatment and follow-up. Second, the higher NWC of the sensory category, as well as a selection of higher intensity words chosen within that category, was associated with reduced treatment gains, as indicated by patients with relatively higher rates of nocturia and shorter IVIs at post-treatment. Third, the MPQ best described the urethral symptomatology by a cluster of 23 descriptors which were chosen by at least 30% of the patients at pre-treatment status. Evaluative words, in relationship to number of words within each category, occupied the most frequent position on the list at pre-treatment. The largest reduction of pain words, based on the percentage of original descriptors chosen, occurred in the affective category.

Sensory and evaluative categories indicated an equal decline in NWC at post-treatment and follow-up. Sensory words were predominately chosen by medicated patients. Although non-medicated and medicated patients did not differ in total NWC or SS of the MPQ at pre-treatment, at post-treatment and at follow-up non-medicated patients chose fewer words. Thus, medicated patients did moore poorly than non-medicated patients according to the MPQ.

(5) The psychological symptomatology, as assessed by the BSI, indicated normal or better than normal scores for the total patient group at follow-up. However, when medicated and non-medicated groups were analyzed separately, non-medicated patients indicated "super-normal" scores, with an unusually low score on phobic anxiety. Medicated patients, on the other hand, were 1 SD above the mean on most dimensions, suggesting psychopathology. Higher BSI scores were also present in patients with reduced discriminability, P(A), at follow-up, while the criterion, B, remained unaffected by a psychological symptomatology.

Implications

The intent of behavioral urology is to develop treatment strategies that will maximize the patient's success in overcoming maladaptive voiding patterns that interfere with the daily functioning of the patient's life. It seeks to identify, measure, and modify current, observable components of inappropriate, as well as appropriate, behaviors and

underlying mechanisms linking behavioral processes to urologic disease states. To understand the intricate web of factors that contribute to the presence and maintenance of the complex symptomatology of the urethral syndrome and to develop a behavioral treatment program for its cure, it is necessary to identify: (1) physiological components (the organic symptomatology of the urethral syndrome, as assessed by urodynamic tests of bladder functions); (2) medication components (medication intake to reduce urologic symptoms, relieve bladder pain and related discomfort); (3) behavioral components (increasing inter-voiding intervals and changing the patient's response of voiding to an empty bladder to the signal for not voiding); (4) psychophysical components (bladder awareness assessed as sensory thresholds, discriminability and criterion measures of bladder pressure sensation; (5) verbal pain components (the intensity, location and quality of the pain experience); and (6) affective components (depression, anxiety and social withdrawal associated with the disease).

Physiological components. An accurate diagnosis for the urethral syndrome is the necessary first step in order to rule out biochemical, neurological or organic conditions which could be responsible for frequency of micturition and related pain symptoms. Once bladder physiology has been evaluated and a diagnosis has been reached, the patient can be referred for behavioral treatment.

For comparison of treatment results with earlier

research (which focused primarily on the clinical outcome of treatment) urologic measures were reported from both a clinical and a statistical point of view. In the final analysis, the most important factor of any treatment is to determine whether the patient has attained the specific goals that define 'cure' of her disease. A descriptive report of treatment results, with labels such as 'cured,' 'improved,' 'no change' and 'worse', serves that purpose, but only in a qualitative manner. This form of reporting, however, fails to quantitate symptom severity and changes in the various symptoms during the course of treatment. It is not sufficient to increase IVI, while ignoring other physiological symptoms that may be equally important in determining the success of treatment outcome. The high rate of nocturia at pre-treatment in this patient population was as good a predictor for treatment failure as was a high IVI for treatment success. In this study bladder drill failed to improve nocturia as was the case in Frewen's (1982) patient population.

None of the earlier studies have attempted to measure volumes voided by the patient at home, perhaps because it was viewed as counter-productive to bladder drill training (Frewen, 1982). Since volume measurements may be cumbersome to patients it is not usually recommended that bladder volumes be assessed on a daily basis. On the positive side, however, they can provide valuable information on the functional bladder capacity and the volume at which the normal urge to void occurs. Thus, they serve as diagnostic

and prognostic pre-treatment measures, as occasional evaluations to monitor treatment progress, and as a basis for terminating treatment. In addition, some patients may be motivated by the knowledge of their scores which indicate progress.

Based on measurements of IVI, a total of four patients were cured and an additional six patients were improved. Bladder volumes voided also serve to define an additional measure of success, as was apparent in this study, where 58.3% of the patients voided volumes above 400 cc at post-treatment. Although bladder volumes, estimated from volumes measured at home are informative, one ought to keep in mind that these values do not reflect bladder capacity accurately. An underestimation of actual capacity of the bladder is caused by the amount of residual urine left at each voiding. Bladder drill attempts to teach patients to empty their bladders completely. Whether patients are successful in this task cannot be determined without invasive urodynamic testing.

In the present study, medicated patients did not differ from non-medicated patients at intake on urologic measures or verbal pain measures. However, immediate post-treatment results and especially long-term follow-up assessments demonstrated that medicated patients faired less well in the attempt to overcome the symptomatology of the urethral syndrome than did non-medicated patients. This finding is congruent with the study by Jarvis (1981), whose patients,

matched for age and symptomatology prior to treatment, showed that bladder drill alone produced significantly better results than bladder drill in conjunction with medication. Patients on medication experiencing severe side effects terminated treatment on their own accord, which did not occur in the bladder drill group. By contrast, Fantl et al (1981) reported a slightly higher but not significantly different cure rate in patients who received both bladder drill and medication, as compared to patients receiving bladder drill alone. In addition, Holmes et al (1983) demonstrated that the withdrawal from medication immediately following bladder drill produced a recurrence of symptoms, dependent upon the severity of the patient's initial symptomatology.

Changes in micturition patterns require the willingness, motivation and full participation of the patient, who, as is typical for a behavioral treatment program, is to a great extent responsible for the acquisition of the behavior change and treatment goal. There may be several reasons why medications may prevent the patient from acquiring and maintaining the same degree of bladder wellness as is the case with patients on bladder drill alone: a) medicated patients may continue to rely too heavily on the effects of drugs and other outside sources (e.g. physician or therapist) for a cure, which, when removed, produce the recurrence of symptoms; b) drugs, such as anticholinergics and benzodiazepines, designed to suppress urethral symptoms, inhibit neurosensory impulses and bladder contractions, which

are the very symptoms a patient is asked to inhibit on her own volition. If a drug is the inhibiting factor on detrusor activity and related urethral symptoms and not the direct mental control of the patient, medication may possibly prevent the acquisition of the necessary learned response acquired through bladder drill.

Psychophysical components. Almost two decades ago, Clark (1969) introduced Signal Detection Theory (SDT) to laboratory research on human pain and the evaluation of chronic pain patients. Whereas SDT typically uses two (or more) stimulus intensities of precisely known physical energy to represent signal-plus-noise and noise alone, the present study used volumes voided to estimate bladder pressures, with pressures above the median representing signal-plus-noise and pressures below the median noise alone. The method of using SDT to assess physical measures of chronic pain indirectly can be applied to relationships where a subjective experience is related to physical/physiological units, e.g. pressure, volume, rate, etc.

SDT yields two independent indices, discriminability, P(A), as the sensory component, and the criterion measure, B, as the emotional or attitudinal component. The discriminability index, P(A), a non-parametric measure, is related to the functioning of the neurosensory system. In this study, high P(A) values at pre-treatment (good discriminability) were associated with good treatment outcome and low P(A) values with poor treatment outcome.

Attenuation of P(A) values occurs when less afferent neurosensory information is being transmitted via the central nervous system to higher centers. Since the P(A) score was the only significant difference between medicated and non-medicated patients at pre-treatment, medication intake was viewed as the relevant factor for suppressing discriminability. In the present study patients receiving medications were pooled due to the small sample size. Thus, it is not clear which medications were responsible for reducing discriminability.

The frequency of high bladder pressure reports was reduced (higher criterion, B) at post-treatment and at follow-up in relationship to pre-treatment measures. This was unexpected, since bladder drill requires the patients to reduce the frequency of voiding, and hence increase bladder pressure. In spite of higher volumes voided following positive treatment results, less bladder discomfort was reported, which could have been due to physiological and/or psychological changes. Although there were no significant between-group differences, the non-medicated group, according to the criterion, indicated normal bladder pressure sensations at follow-up. The medicated group had a lower criterion, i.e. they perceived greater bladder pressure sensations and this was supported by the treatment failure as measured by the increased urethral symptomatology. The more frequent report of higher bladder pressure (low B) by medicated patients at follow-up agrees with higher

symptomatology scores on the BSI. Accordingly, the criterion measure and BSI scores reflect an emotional response of the patient's failure in learning to regulate her bladder physiology.

Verbal pain components. Verbal reports of bladder discomfort and pain were assessed by the McGill Pain Questionnaire (MPQ). Medicated patients were no different on MPQ scores than non-medicated patients at intake. This finding is similar to Burckhardt's (1984) arthritis patients, who showed no differences on MPQ scores between in-patients and out-patients, regardless of the severity of their disease.

Despite an overall reduction of pain words by both groups, medicated patients chose pain descriptors more often in all three categories, sensory, affective and evaluative at post-treatment, and with significantly higher scores at follow-up, than did non-medicated patients. The intensity of the patient's reaction to bladder discomfort was consistent with the severity of the urethral symptomatology, as assessed by urologic measures. Shorter IVIs and and a higher rate of nocturia at post-treatment was associated with higher scores in the sensory category. These findings are supported by Reading's study (1982) where acute pain patients paid more attention to the sensory aspect of their pain than to the pain intensity, as measured by the pain evaluative category or their emotional reaction to their pain, as measured by the affective dimension.

The divergence between urological and verbal pain measures at follow-up, with an increase in urethral symptoms and a decrease in MPQ scores, may be due to the following: (1) During the training phase, the patient suppresses sensory impulses and contractions of the bladder in order to increase IVIs. While this behavior creates the desired change in the physiological system along with an overall reduction of pain symptoms, it is generally responsible for a greater amount of bladder discomfort. At follow-up, the patient is no longer in the treatment phase and is not required to suppress bladder contractions and the related urge to void; therefore the patients feels less bladder discomfort and appears to have lost some of the treatment gains. This view is substantiated by the fact that non-medicated patients showed a lower criterion, more pain reports, at post-treatment and a more normal, higher criterion related to the normal urge to void at follow-up. 2) A second explanation for the divergence in urological and pain symptoms at follow-up may reflect a physiological issue. Pain symptoms, once they become indicative of pathology, may lag behind the acquisition of bladder wellness, comparable to continued bladder instability seen in patients who nonetheless were able to achieve the desired voiding patterns. These issues should be further investigated, as well as the continued existence of pain at follow-up, which may reflect a chronic pain syndrome, rather than pain symptoms.

Affective components. Investigation of psychological

involvement in urethral syndrome patients was attempted at follow-up only and hence represents limited information. The BSI scores of non-medicated patients were normal or beyond (super-normal). In contrast, medicated patients (who had poorer treatment results) exhibited psychological distress. It is not possible to separate cause and effect in this instance. The psychological symptomatology could be a reflection of the emotional frustration induced by the continued presence of urethral symptoms, or a tendency for psychopathology could cause the somatic problems. In support of present findings, Hafner (1977) and Frewen (1978) found deep emotional and interpersonal problems to interfere with a successful outcome of bladder drill. By contrast, Morrison, et al (1986) found no relationship between neuroticism and type of treatment, i.e., medication versus bladder drill, or response to treatment.

Limitations

Generalizations of the present study should be made with caution due to the small sample size which may have created biased results. Repeated measure ANOVAs were used to analyze the multiple single-case experiment which was contrasted by a between-group design to assess the influence of medication. The between-group design provided important details of patient data, not readily available by the single-case design. Unfortunately, the sample size did not permit more elaborate statistical analyses, such as multiple regression

procedures for pinpointing the most relevant predictor variables for treatment success.

Another shortcoming in this study was the absence of urodynamic tests obtained at post-treatment and follow-up. Assessments of bladder functions would have provided valuable information for determining the effects of bladder drill on bladder physiology. A comparison of changes in the urethral symptomatology as a result of bladder drill to urodynamic assessments has been done by some (Mahady and Begg, 1981) and should be essential in future research.

Suggestions for Future Research

This study has grouped issues relating to the behavioral treatment of the urethral syndrome under 6 major components: physiological, medication, behavioral, psychophysical, verbal pain and psychological. Much of the current data have yielded interesting answers to hypotheses tested, and also presented unresolved issues with a fertile ground for future research. Beyond the necessity of replicating present findings, the following issues should be considered further.

At present, symptom severity in the urethral syndrome patient is viewed on a continuum that originates with high frequency of micturition and leads to sensory urgency and detrusor instability with or without incontinence. This view is primarily based on retrospective treatment results in bladder drill training, where patients with symptoms of frequency alone and a stable bladder recovered far better

than patients with detrusor instability (Frewen, 1979; Elder and Stephenson, 1980; Holmes et al, 1983). Whether the normal course in deteriorating bladder functions is as stated above, whether sensory urgency is synonymous with interstitial cystitis (and bladder wall lesions) and associated pain, or whether detrusor instability without pain follows a different course of deteriorating bladder physiology, should be entertained as possibilities. A differential diagnosis, however, requires hospitalization and cystoscopy under full anesthetia to rule out the presence of interstitial cystitis, a procedure that is costly, uncomfortable and time-consuming. The use of valid and reliable instrumentations for the assessment of pain may aid in a differential diagnosis and reduce the need for a hospital stay.

A definition of what constitutes symptomatic cure in urethral syndrome patients was suggested by Frewen (1982) as having reached IVIs of 3-4 hours. He found that the presence or absence of detrusor instability did not influence the patient's progress and a return to normal voiding patterns, and that a symptomatic cure always antedated a return to bladder stability. The acquisition of a behavior change in voiding patterns may reduce, but not necessarily eliminate other abnormal symptoms, as was seen in this study and reported by many other researchers. In order to establish guidelines for future research of what constitutes symptomatic cure, it may be beneficial to include and publish strictly defined urologic measures of IVI, nocturia, mean and

maximum volumes voided in addition to information obtained on detrusor stability during urodynamic assessments.

Urethral symptoms are known to show not only great inter-individual differences, evident by substantial standard deviations within a patient group, but large intra-individual differences as well. A patient may vary greatly in the symptom severity from one day to the next. It is therefore advisable to assess symptoms over two 24-hour periods, rather than just one, to obtain an estimate of reliability and a more accurate assessment.

The very nature of what is considered 'normal' in micturition patterns of women is not known and would be worthwhile to assess. Data of a large control group of non-medicated women with a healthy urologic history would provide important guidelines for comparing abnormal symptoms in various urologic disease states and would serve as a baseline against which treatment interventions and outcomes can be compared.

During cystomteric evaluations the subjective reports of the patient to the smallest volume of water perceived represents the First Desire to Void, and the highest volume of water tolerated represents the Maximum Capacity during retrograde bladder filling. The number of retrograde bladder fillings, i.e. the number of trials, during a single urodynmic assessment is not sufficient to warrant the use of the SDT methodology.

A limitation not relevant to this study, but in

consideration for future research, relates to the SDT methodology. SDT research requires many trials in order to gain sufficient data to plot a Receiver-Operating Characteristic curve and to estimate the indexes of discriminability and criterion. Although the validity of psychophysical methods for assessing thresholds of the First Desire to Void and Maximum Capacity have been criticized these measures are not suited for SDT research.

In the present era of fast-food, fast money and a quick fix for everything, the need for prolonged therapy is sometimes overlooked. Symptom improvements within the first two weeks have been viewed as an important indicator for treatment success (Pengelly and Booth, 1980), while patients with detrusor instability and a greater symptom severity have generally represented a less favorable treatment outcome. Mahady and Begg (1981) followed patients over a 4-year period and demonstrated complete relief of symptoms in 90% of patients and a reversal to detrusor stability in 77% of patients. The other 10% remained incontinent and plagued by severe emotional problems.

Previous research has suggested and documented both the presence and the absence of psychological stability in urethral syndrome patients. It is important to document the existence of psychological problems for several reasons: a) a clinical impression by itself may not be accurate and represent a biased viewpoint; b) psychological pathology could be important in the presence and maintenance of the

urethral symptomatology and predict treatment outcome; c) psychological variables may reflect no more than an enormous frustration expressed by the patient, after years of various treatment failures.

Since bladder drill is considered a psychological approach to treatment, future research may determine whether personality variables such as Rotter's (1954) concept of locus of control, the patient's level of motivation, perceived self-efficacy, or other variables predict treatment success or failure.

The present research has focused primarily on the sensory components of the urethral syndrome and has introduced: a) the SDT methodology for direct assessment of bladder pressure relating to volumes voided; and b) the assessment of verbal pain reports by use of the MPQ. However, the physiological, behavioral and affective components should be regarded as equally important in future research towards the development of the most effective treatment program.

Appendix A

Glossary of Terms

Urological terms:

cc	: cubic centimeter, or 1 ml
Day-vol	: Day-volume, volume voided during the waking period of the day
IVI	: Inter-voiding interval, time between voidings
Noct	: Nocturia, night-time voidings

Signal detection theory:

SDT	: Signal detection theory, or sensory decision theory
P(A)	: Discriminability or sensitivity
B	: Criterion or response bias

Verbal pain report:

MPQ	: McGill pain questionnaire
NWC	: Number of words chosen
SS	: Scaled scores

Psychological symptomatology:

GSI	: Global severity index measuring a person's current distress level

Appendix B

McGill Pain Questionnaire

1. flickering
2. quivering
3. pulsing
4. throbbing
5. beating
6. pounding
7. jumping
8. flashing
9. shooting
10. pricking
11. boring
12. drilling
13. stabbing
14. lancinating
15. sharp
16. cutting
17. lacerating
18. pinching
19. pressing
20. gnawing
21. cramping
22. crushing
23. tugging
24. pulling
25. wrenching
26. hot
27. burning
28. scalding
29. searing
30. tingling
31. itchy
32. smarting
33. stinging
34. dull
35. sore
36. hurting
37. aching
38. heavy
39. tender
40. taut
41. rasping
42. splitting
43. tiring
44. exhausting
45. sickening
46. suffocating
47. fearful
48. frightful
49. terrifying
50. punishing
51. gruelling
52. cruel
53. vicious
54. killing
55. wretched
56. blinding
57. annoying
58. troublesome
59. miserable
60. intense
61. unbearable
62. spreading
63. radiating
64. penetrating
65. piercing
66. tight
67. numb
68. drawing
69. squeezing
70. tearing
71. cool
72. cold
73. freezing
74. nagging
75. nauseating
76. agonizing
77. dreadful
78. torturing

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