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DYSFUNCTIONAL URINARY VOIDING IN WOMEN WITH FUNCTIONAL DEFECATORY DISORDERS

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Abstract

Background—While pelvic floor dysfunction may manifest with bladder or bowel symptoms, the relationship between functional defecatory disorders and dysfunctional voiding is unclear. Our hypothesis was that patients with defecatory disorders have generalized pelvic floor dysfunction, manifesting as dysfunctional urinary voiding.

Methods—Voiding was assessed by a symptom questionnaire, a voiding diary, uroflowmetry, and by measuring the postvoid residual urine volume in this case-control study of 28 patients with a functional defecatory disorder (36 ± 2 years, Mean ± SEM) and 30 healthy women (36 ± 2 years).

Key Results—Women with a defecatory disorder frequently reported urinary symptoms: urgency (61%), frequency (36%), straining to begin (21%), or finish (50%) voiding, and the sense of incomplete emptying (54%). Fluid intake and output, the minimum voided volume, and the shortest duration between voids measured by voiding diaries were higher ($p < 0.05$) in patients than in controls. Uroflowmetry revealed abnormalities in 7 controls and 22 patients. The risk of abnormal voiding by uroflowmetry was higher in patients (OR 8.0; 95% CI, 2.3–26.9) than in controls. Patients took longer than controls ($p< 0.01$) to attain the maximum urinary flow rate (12 ± 2 versus 4 ± 0s) and to empty the bladder (29 ± 4 versus 20 ± 2s), but the maximum urinary flow rate and postvoid residual volumes were not significantly different.

Conclusions and Inferences—Symptoms of dysfunctional voiding and uroflowmetric abnormalities occurred more frequently, suggesting of disordered urination, in women with a defecatory disorder than in healthy controls.

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Keywords

chronic constipation; defecatory disorders; uroflowmetry; voiding dysfunction; pelvic floor dysfunction

INTRODUCTION

Several studies suggest a link between functional bowel and bladder disorders. Thus, the prevalence of urinary symptoms is higher in slow transit constipation (1) and in irritable bowel syndrome (IBS) than in asymptomatic controls. (2) IBS is also associated with detrusor overactivity (3,4) while patients with idiopathic, chronic constipation had an exaggerated vesical response to bethanechol, suggestive of a hypersensitive bladder. (5) Since the mechanisms responsible for normal and disordered anorectal and bladder storage and emptying are similar, (6–9) an association between defecatory disorders and dysfunctional voiding seems conceivable. However, while defecatory disorders are associated with pelvic organ prolapse and pelvic floor disorders, (10,11) the evidence for an association between dysfunctional voiding and disordered defecation is equivocal. One uncontrolled study observed a strong association between obstructed voiding and defecation (12) while another study observed a larger bladder capacity and reduced bladder sensation but not dysfunctional voiding in defecatory disorders. (13)

It is important to identify an association, if any, between dysfunctional voiding and defecation because coexistent bladder and bowel dysfunctions would substantiate the presence of generalized pelvic floor dysfunction and, if appropriate (i.e., when surgery is not indicated), the need for pelvic floor retraining by biofeedback therapy, which is used to manage bowel and bladder symptoms. (14,15) Our hypothesis was that patients with defecatory disorders have generalized pelvic floor dysfunction, manifest as dysfunctional voiding.

MATERIALS AND METHODS

Participants

Between October 2001 and January 2003, 28 women with symptoms of a functional defecatory disorder (age 36.1 ± 2.1 years, BMI 26.1 ± 0.7 kg/m^2, [Mean ± SEM]) and 30 healthy women (36.0 ± 1.8 years, 26.2 ± 0.9 kg/m^2) consented to participate in this case-control study, which was approved by the Mayo Foundation Institutional Review Board. Each participant had a clinical interview and physical examination. Bowel and bladder symptoms were evaluated by standardized questionnaires. (16,17) Functional defecatory disorders were defined by Rome II criteria for chronic constipation and evidence of disordered defecation on a rectal balloon expulsion test and/or defecography, as detailed below. (18) Irritable bowel syndrome was defined by Rome criteria. (19) Healthy subjects did not have symptoms of functional constipation, functional diarrhea, or irritable bowel syndrome. Additional exclusion criteria for controls were anorectal operations (including hemorrhoid procedures) and anorectal trauma during delivery (i.e., grade 3 or 4 laceration). Participants did not have medical conditions associated with dysfunctional voiding or defecation (e.g., diabetes or neurologic disorders) and had not received pelvic floor retraining. They were not taking medications that could cause bowel or bladder symptoms.

Assessment of anorectal Functions

All patients underwent a detailed clinical assessment, anorectal manometry, and a rectal balloon expulsion test using established techniques. (20–22) The amount of external traction

(in grams) necessary to facilitate rectal expulsion of a 50-mL balloon provided an overall functional assessment of rectal evacuation; values of more than 100 g were considered abnormal. (22) Perineal descent during rectal evacuation was evaluated by clinical examination and also by dynamic magnetic resonance (n=25) or scintigraphic proctography (n=3). (21–23) For dynamic MR proctography, 120 cc of ultrasound gel were added to the rectum. Then, dynamic MR images were acquired every 1.4 to 2 seconds at rest, during defecation, and a post-defecation Valsalva maneuver by a four-element phased-array coil placed around the pelvis in the supine position in an oblique sagittal plane which bisected the anorectum. (21,24) A single radiologist, blinded to clinical history, physical examination and the results of other imaging studies, analyzed all examinations. Based on previous studies at our institution, normal values for perineal descent during simulated evacuation were 1 to 4 cm for scintigraphy and 1.6 to 5.1 cm by MR proctography. Criteria for pelvic organ prolapse simulated evacuation or a Valsalva maneuver were as follows. Small and large cystoceles were defined by descent of the bladder base between 2.1 – 3 and > 3 cm below the pubococcygeal line respectively. Increased urethral mobility was defined by similar parameters, albeit for the vesico-urethral junction, rather than the bladder base. Uterine prolapse was defined by cervical descent more than 3 cm below the pubococcygeal line. Small and large rectoceles were 2 to 4 cm and greater than 4 cm in size respectively. (20,22,23)

Urinary Symptoms

An investigator (CJK) administered a questionnaire pertaining to urinary symptoms (i.e., urinary urgency and frequency, nocturia, hesitancy, need to strain to begin or complete emptying the bladder, weak or prolonged stream, incomplete emptying, interrupted stream). This questionnaire was compiled from several validated instruments, including a urology textbook, the Urogenital Distress Inventory (UDI-6), and the American Urological Association symptom index questionnaire (AUA-7). (17,25,26) Nocturia was defined as being awakened from sleep by the need to void more than twice a night with normal daily fluid intake. Increased urinary frequency was defined as voiding more than 7 times per day with normal fluid intake. For the remaining symptoms, the frequency threshold was once daily. Increased urinary urgency was defined as a recurrent strong desire to void which was difficult to defer due to a fear of leakage or pain. Hesitancy was defined as a feeling of delay while initiating urination. The need to strain to begin or complete emptying the bladder was defined as requiring more than usual bearing down to start or finish urination. A weak or prolonged stream was defined as the sense of a less forceful stream or taking longer than expected to urinate. Incomplete emptying was defined as the sensation of not feeling satisfied after micturition or the need to return to void after urinating. An interrupted stream was defined by the sensation that the urinary stream was starting and stopping while voiding. (14) (27)

In addition to the interview, all subjects completed a bladder diary for 2 typical 24-hour periods beginning after awakening. (28) These diaries were evaluated for fluid intake and output, voided volumes and frequency, interval between voids, leakage, nocturia, and nocturnal enuresis by a urologist (DJL), who was blinded to subject status. Nocturia in this young patient group was defined as arousal from sleep to void more than 2 times per night.

Uroflowmetry

Uroflowmetry was conducted by a standard technique in patients who had a “comfortably full bladder” in full privacy. (29) A urologist (DJL), who was blinded to subject status, interpreted uroflowmetry. Urinary flow pattern, flow rate, duration of voiding, and voided volume were assessed during uroflowmetry. Thereafter, the postvoid residual urine volume was measured by transabdominal ultrasonography (BladderScan BVI3000, Diagnostic

Ultrasound, Redmond, Wa). Voiding dysfunction was characterized by presence of one or more of the following criteria: (30)

1. Abnormal flow patterns (i.e., interrupted, intermittent [or sawtooth], or prolonged flow)
2. Reduced (<15 mL/s) or increased (>40 mL/s) maximum urine flow (8)
3. Prolonged duration (>5 seconds) to maximum flow
4. Increased postvoid residual volume, which was defined by a residual volume >50% of voided volume if the total voided volume was ≤500 mL or a residual volume >250 mL if the voided volume was >500 mL. (8) Since some women are inhibited by having to void in a different environment, the latter criterion sought to ensure that only women with a substantially increased post void residual volume were characterized as abnormal.

Statistical Analysis

Data were summarized as mean ± SEM. Associations between subject status (i.e., patient or control) and results from voiding diaries and uroflowmetry were assessed by the Chi-squared or Fisher's exact test. Linear regression models were used to analyze the extent to which variations in voiding parameters (e.g., the time between voids) could be explained by subject status (i.e., health or defecatory disorders) and separate models were used for each variable. Several regression models were used to assess whether subject status predicted voiding dysfunction by uroflowmetry. A logistic regression model assessed if subject status, adjusted for age, could predict an abnormal voiding pattern. Linear regression models evaluated the proportion of variation in uroflowmetry parameters which could be explained by subject status (partial r-squared) adjusting for age. In addition, a logistic regression model used subject status adjusting for age to predict voiding dysfunction as defined by the presence of one or more of the 4 criteria indicated above. Separate models assessed the risk for voiding dysfunction among all subjects and among subjects without IBS.

Using the overall observed pooled SD in this sample size of 30 healthy subjects and 28 patients, there was approximately 80% power to detect the following differences at a two-sided alpha level of 0.05, i.e., for voiding time (20.0 vs. ≥ 31.4 s), time to maximum flow (4.2 vs ≥ 9.7 s), and maximum flow (31.6 vs. ≥ 40.0 s).

RESULTS

Bowel Symptoms and Anorectal Functions

All patients had a defecatory disorder, as evidenced by Rome II symptom criteria for chronic constipation and objective features of disordered rectal evacuation. Patients had two (n=1), three (n=4), or four or more (n=23) symptoms of chronic constipation per Rome II criteria. These symptoms included excessive straining (27 patients), a sense of anorectal blockage (20 patients), or anal digitation during defecation (14 patients). Twenty three patients had hard stools, 20 patients had a sense of incomplete evacuation after defecation, and 16 had less than 3 bowel movements per week. In addition, 18 patients reported defecating in other than the seated position. The duration of bowel symptoms was < 1 year in 2, 1–5 years in 9, more than 5 years in 8, and since childhood in 9 patients. Eleven patients also had symptom criteria for irritable bowel syndrome. Parity was similar in patients (1.3 ± 0.2, Mean ± SEM) and controls (1.5 ± 0.2). Five patients and 3 controls had a hysterectomy. No patients or controls had endometriosis.

Anal resting pressures were normal in 18 and increased (i.e., ≥ 90 mmHg) in 10 patients. The clinical impression of a defecatory disorder was confirmed by an abnormal rectal balloon expulsion test in 20 patients and by abnormal defecographic findings (i.e., abnormal perineal descent and/or rectal evacuation) in the remaining 8 patients. MR or scintigraphic defecography disclosed normal (n = 16), reduced (n = 6), or increased (n = 6) perineal descent. Among 20 patients with an abnormal rectal balloon expulsion test, 7 also had an anal resting pressure ≥ 90 mmHg, 10 also had reduced evacuation while 3 also had impaired puborectalis relaxation during defecography. Among 8 patients with a normal rectal balloon expulsion test, 3 had reduced rectal evacuation and 5 had increased perineal descent, either with (3 patients) or without (2 patients) a high anal resting pressure. Other MR abnormalities were observed in 12 patients. These findings included small (5 patients) or large (3 patients) cystoceles, modest (6 patients) or markedly (1 patients) increased urethral mobility, increased uterine descent (4 patients), small (4 patients) or large (3 patients) rectoceles, and enteroceles in 3 patients. Ten patients had pelvic organ prolapse affecting 2 or more compartments.

Urinary Symptoms

Of 28 patients, 23 had at least two urinary symptoms and 16 had four or more symptoms of voiding dysfunction (i.e., hesitancy, straining to start or to complete emptying of the bladder, interrupted urinary stream, sensation of incomplete emptying). (Table 1) No patients reported recurrent urinary tract infections. Among 30 controls, 25 had no symptoms and 5 had two symptoms of voiding dysfunction.

Average 24-hour fluid intake over a two day diary (patients: 2869 mL; controls: 2227 mL; p = 0.003, 2-tailed t test) and output (patients: 2507 mL; controls: 2288 mL; p = 0.04) were significantly higher in patients than in controls. Moreover, the minimum voided volume was higher and the shortest intervoiding interval was longer in patients than in controls. (Table 2) In the multiple variable models, subject status predicted a significant proportion of the variation in average voided volume (20%) and intervoid interval (12%).

Uroflowmetry

During uroflowmetry, the voided volume was less than 100 mL in 1 patient, between 100 and 150 mL in 4 controls and 2 patients, between 151 and 200 mL in 3 controls, and more than 200 mL in the remaining 48 subjects. Uroflowmetry revealed one or more abnormalities in 7 of 30 controls and 22 of 28 patients. (Table 3) Subject status (i.e., health versus defecatory disorder) was useful for predicting voiding time and time to maximum flow. In the model to predict overall voiding dysfunction based on the four uroflowmetry parameters, patients with a functional defecatory disorder had an increased odds for voiding dysfunction (odds ratio, 8.0; 95% confidence interval, 2.3–26.9). Twenty eight of 29 subjects with an abnormal uroflowmetry had a voided volume greater than 150 mL, suggesting that these abnormalities were not an artifact related to reduced voided volume. The time required to reach maximum flow rate was longer in 6 out of 7 patients with a sawtooth or interrupted flow pattern, suggestive of abdominal straining. (Figure 1)

We also evaluated whether the association between voiding and defecatory dysfunction was explained by IBS. Among patients with a functional defecatory disorder, the proportion of patients who also had voiding dysfunction was similar among patients with (9/11 patients [82%]) and without IBS (14/17 patients [82%]). Consequently, even among subjects without IBS, patients with a functional defecatory disorder had an increased risk of voiding dysfunction (odds ratio, 8.1; 95% confidence interval, 1.9–34.4).

Three urinary symptoms (i.e., a weak or prolonged stream, the sensation of incomplete emptying, and an interrupted stream) were univariately associated with voiding dysfunction. However, each of these symptoms was only 50% sensitive for identifying voiding dysfunction among subjects (i.e., patients and controls).

DISCUSSION

The evidence for an association between defecatory disorders and voiding dysfunctions is mixed. (12,13) All 28 constipated patients in this study had at least one symptom suggestive of disordered defecation (i.e., anal digitation or sense of anal blockage during defecation or a sense of incomplete evacuation after defecation) {Koch, 1997 #186} and consistent with previous studies, a spectrum of objective features of abnormal evacuation. {Bharucha, 2005 #137} Compared to controls, patients with functional defecatory disorders had a higher prevalence of symptoms and uroflowmetric abnormalities, (i.e., a longer intervoid interval and prolonged time to maximum urinary flow rate) suggestive of dysfunctional voiding. However, the maximum urinary flow rate and residual volume were not significantly different between patients and controls, suggesting that the bladder disturbance was milder than the bowel disturbance. This apparent discrepancy between the severity of bowel dysfunction and bladder dysfunction may reflect more severe posterior than anterior pelvic floor dysfunction. Alternatively, increased outlet resistance may be more likely to impede the evacuation of stool, which is more viscous than urine.

Effective voiding and defecation require increased pressure within the viscus (i.e., bladder or rectum) coordinated with relaxation of the pelvic floor and sphincters. Functional defecatory disorders and dysfunctional voiding are attributed to inappropriate activation of the pelvic floor muscles or urethral sphincter and/or to inadequate propulsive forces. (8,31) However, there are important differences between the mechanisms of voiding and defecation. For example, while approximately 5% of subjects without functional bowel disorders reported straining to begin defecation and 1% reported straining to end defecation, {Bharucha, 2008 #202} urodynamic studies suggest that up to 71% of asymptomatic women strain while voiding, (32) in part because most women can successfully overcome sphincteric resistance with Valsalva maneuver, and in some, to compensate for inadequate detrusor contraction and/or increased outlet resistance to voiding. (33) In contrast to voiding, the relative contributions of increased intra-pelvic pressure (34) and rectal contraction (35) to propulsive forces during defecation are poorly understood. However, because the pelvic floor and abdominal wall muscles may contract simultaneously during excessive straining, (36–38) excessive straining may impede rather than facilitate evacuation of stool from the rectum. In addition to increasing outlet resistance, pelvic floor contraction may inhibit the detrusor and lower rectum and the sense of urgency. (13,39) This effect of pelvic floor contraction, termed the “procontinence” response, may explain why voided volume was higher and the time between voids was longer, as assessed by voiding diaries, in patients than in controls. Alternatively or in addition, it is conceivable that the increased voided volume is explained by higher fluid intake in patients than controls. However, the observed uroflowmetric disturbances cannot be explained by increased fluid intake. Vesicoanal reflexes may also explain why bladder and bowel symptoms coexist. (40) For example, bladder distention increased internal anal sphincter tone in cats. (40,41) Conversely, retained stool may physically impede urination in patients with fecal impaction.

In addition to symptoms of dysfunctional voiding (e.g., weak or interrupted stream, need to strain, and incomplete voiding), patients with dysfunctional voiding also had storage symptoms (ie, urgency and frequency), confirming the results of previous studies. (7,42) In patients with impaired voiding, urinary urgency and frequency may also be explained by coexistent storage disturbances such as detrusor underactivity or overactivity, bladder

oversensitivity, and impaired bladder compliance. (42) However, in this small sample, patients with defecatory and voiding dysfunction did not report an increased prevalence of urinary tract infections, which is associated with dysfunctional voiding, (43) perhaps because the women in this cohort were young and had normal post void residual volumes. While some symptoms were associated with voiding dysfunction in this study, the correlation between symptoms and objective findings of voiding dysfunction was relatively weak, as observed previously. (44,45) Therefore, rather than rely on urinary symptoms alone, uroflowmetry should be performed to evaluate for dysfunctional voiding when necessary, reserving urodynamic studies with or without fluoroscopy for patients with clinically significant urinary symptoms. (7,46) Since uroflow rates and residual urine volume relative to total bladder volume are dependent on voided volume, the Liverpool nomogram is useful for interpreting uroflowmetry, (47) particularly to identify false-positive findings in patients who void less than 150 mL. (48) As observed previously, (49,50) a small proportion, (i.e., 23% in this study), of asymptomatic women have uroflow abnormalities. Therefore, the diagnosis of voiding dysfunction should be based on an integrated consideration of clinical features and uroflowmetry findings, supplemented as necessary by urodynamic studies.

The recognition of dysfunctional voiding and defecation may substantiate the diagnosis of pelvic floor dysfunction and reinforce the need for, and perhaps even predict the response to, pelvic floor retraining (e.g., biofeedback therapy). For example, one study showed that electromyographic biofeedback improved the ability to relax the pubococcygeal muscle in 11 of 15 women in whom dysfunctional voiding was associated with inappropriate pubococcygeal activation. However, electromyographic biofeedback did not prevent inappropriate urethral sphincter activation, which was associated with dysfunctional voiding, in the remaining 4 patients. (8)

This study has its limitations. Further studies are necessary to ascertain whether the findings, which were derived from a relatively small group of Caucasian women at a tertiary referral center, can be generalized to other populations. The urinary symptom questionnaire was administered by an investigator who was not blinded to subject status; the severity of and bother associated with symptoms was not ascertained. Since colonic transit was not assessed in all patients, it is unknown if the relationship between defecatory disorders and urinary disturbances is influenced by delayed colonic transit. While controls did not have symptoms of chronic constipation, they did not undergo anorectal testing; hence asymptomatic pelvic floor dysfunction cannot be excluded. However, if present, asymptomatic pelvic floor dysfunction among controls would tend to attenuate differences between patients and controls.

In summary, these findings demonstrate that functional defecatory disorders are associated with symptoms of dysfunctional voiding and uroflowmetric abnormalities suggestive of disordered urination. Further studies are necessary to clarify whether these observations reflect a cause-effect relationship, i.e., between pelvic floor dysfunction and dysfunctional voiding and defecation. These studies should assess the prevalence of voiding dysfunction in constipated patients without pelvic floor dysfunction (i.e., a “disease control” group) and ascertain if the response to pelvic floor retraining differs in patients who have combined (i.e., bowel and bladder), compared to isolated (i.e., bowel or bladder) dysfunction.

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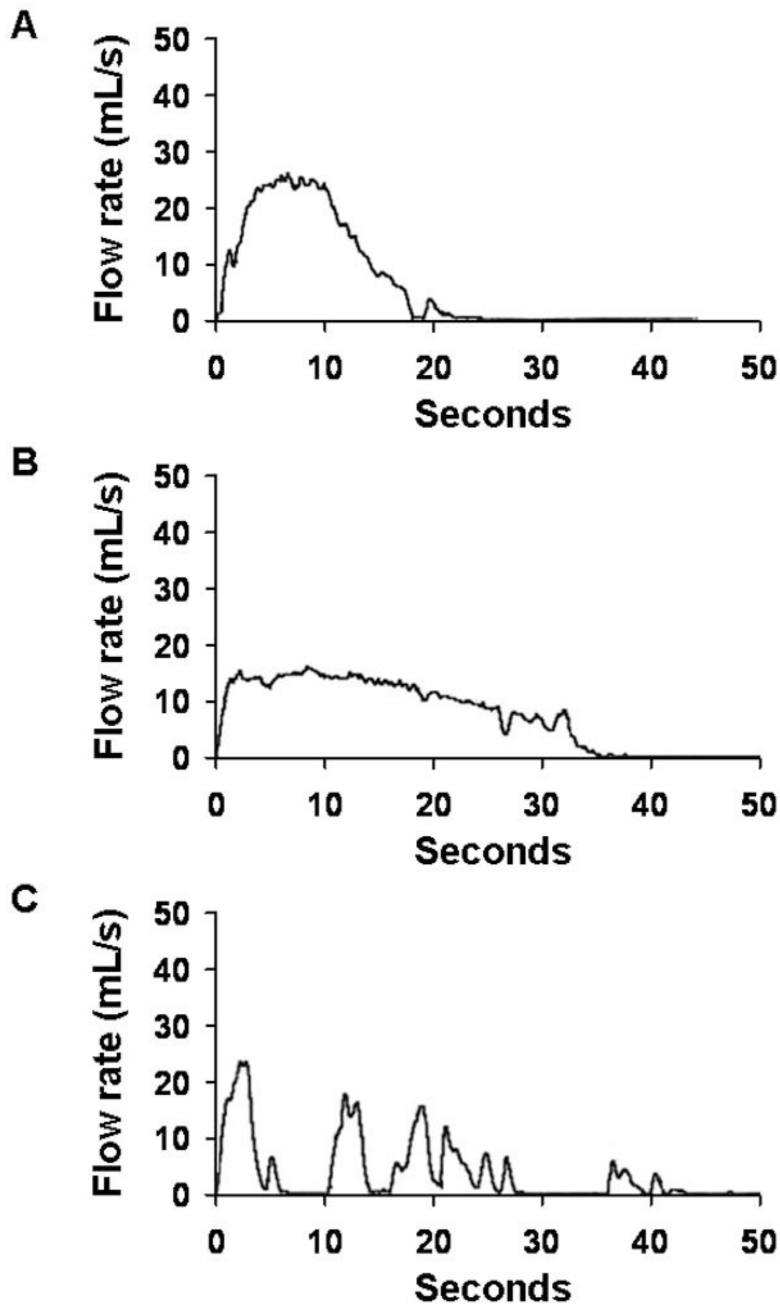

Figure 1. Representative examples of normal (Panel A) and abnormal (Panels B and C) uroflow patterns

Panel A shows a normal bell shaped curve with a maximum flow rate of 26 mL/s. Panel B shows a flattened and prolonged curve with a maximum flow rate of 16.2 mL/s while panel C depicts an interrupted curve with a maximum flow rate of 23.3 mL/s.

Table 1

Comparison of Voiding Symptoms in Patients and Controls

Symptom	Functional defecatory disorders (n=28) No. (%)	Controls (n=30) No. (%)	p-value*
Frequency	10 (36)	5 (17)	ns
Urgency	17 (61)	2 (7)	< .001
Nocturia	6 (21)	0 (0)	< .009
Hesitancy	13 (46)	0 (0)	< .001
Strain to start stream	6 (21)	0 (0)	< .009
Strain to empty	14 (50)	1 (3)	< .001
Weak or prolonged stream	16 (57)	0 (0)	< .001
Incomplete emptying	15 (54)	1 (3)	< .001
Interrupted Stream	12 (43)	1 (3)	< .001

*By chi-squared or Fisher's exact test

Table 2

Comparison of Voiding Diary Variables in Patients and Controls

Variable	Functional defecatory disorders (n=28)*	Controls (n=30)*	Squared partial correlation coefficient
No. of voids/24 hr	7.5 ± 0.4	8.0 ± 0.7	.009
Maximum voided volume, mL	618 ± 42	579 ± 39	.006
Minimum voided volume, mL	201 ± 1	139 ± 12	.20#
Shortest voiding interval, min	130 ± 11	87 ± 11	.12 †
Longest voiding interval, min	290 ± 14	288 ± 15	.0002
No. of nocturnal voids/night	0.5 ± 0.1	0.5 ± 0.2	.004

Values are mean ± SEM

†p<.01,

#p=.002

Table 3

Comparison of Uroflowmetry Results in Patients and Controls

Variable	Functional defecatory disorders (n=28)*	Controls (n=30)*	Squared partial correlation coefficient or c-statistic‡
Abnormal flow pattern (N)†	8	4	0.58‡
Voiding time, s	29 ± 4	20 ± 2	0.08 §
Time to maximum flow s	12 ± 2	4 ± 0	0.22 §
Maximum, flow, mL/s	30 ± 2	31 ± 2	0.005
Postvoid residual volume, mL	53 ± 12	30 ± 6	0.0002

*Values are mean ± SEM except where stated otherwise.

†Number of subjects with interrupted, sawtooth, or prolonged flow.

§ $p < 0.05$