Comprehensive Management of Dysfunctional Voiding

Seth L. Schulman, MD†‡; Carol K. Quinn, CRNP‡; Natalie Plachter, CRNP‡; and Chris Kodman-Jones, PhD‡

ABSTRACT. Objective. Dysfunctional voiding is a major problem leading to daytime-wetting and recurrent urinary tract infection (UTI). Our center is devoted to treating children with dysfunctional voiding. We offer a multidisciplinary approach with a pediatric nephrologist, nurse practitioners, and a psychologist. This article is the first to describe the efficacy of this approach on a large population of American children.

Patients. Between 1992 and 1995, 366 children with symptoms of voiding dysfunction were referred for urodynamic studies. Criteria were based on the child's age, symptoms, and failure to respond to empirical therapy. Females made up 77% of the population, and the mean age at referral was 8.5 years (range, 4 to 18 years). Day-wetting occurred in 312 (89%), night-wetting in 278 (79%), recurrent UTI in 218 (60%), and vesicoureteral reflux (VUR) in 48 (20%) of those undergoing voiding cystourethrography.

Results. A minimum of 6 months' follow-up data (mean, 22 months) is available on 280 children (77% studied). Urge syndrome was the predominant urodynamic finding in 52%, followed by bladder sphincter dysfunction in 25%. Treatment consisted of antibiotic prophylaxis (59%), anticholinergic medication (49%), biofeedback (25%), and psychological counseling (15%). Of the 222 children with daytime-wetting (45%), 100 are cured (off all medication, no wetting) and 82 (37%) are improved (on medication or >50% reduction in symptoms). Improvement or cure was seen in 69% of children with night-wetting. Of the 199 children with UTI, 127 (64%) never developed another infection. Vesicoureteral reflux resolved in 16 of 30 (53%) children undergoing repeat voiding cystourethrography.

Conclusion. Our comprehensive approach demonstrates a favorable outcome that promises to reduce the medical and psychological morbidity seen in patients with voiding dysfunction. Pediatrics 1999;103(5). URL: http://www.pediatrics.org/cgi/content/full/103/3/e31; urinary incontinence, urinary tract infections, vesicoureteral reflux, biofeedback.

ABBREVIATIONS. UTI, urinary tract infection; VUR, vesicoureteral reflux; EMG, electromyogram; VCUG, voiding cystourethrography.

PERSISTENT daytime-wetting, frequent urinary tract infection (UTI) and, in some cases, vesicoureteral reflux (VUR) are common manifestations or sequelae of voiding dysfunction. Primary care practitioners commonly encounter children with these complaints and usually refer them to urologists. Treatment is directed to correcting the voiding dysfunction by retraining the child through either pharmacologic and/or nonpharmacologic means, but treatment is time-consuming. Surgical intervention (ie, urethral dilatation) is no longer acceptable.

In 1973, Hinman and Baumann described neurogenic voiding disturbances in children without neurologic lesions.1 This was elaborated by Allen, who reviewed 21 children with severe obstructive uropathy without an anatomic or neurologic cause.2 Children who wet themselves have significant psychological morbidity.3 In rare cases, chronic renal insufficiency may ensue.4 Although this may represent the extreme, more attention is now directed to management of voiding dysfunction. We report our success in managing children with voiding dysfunction by using a comprehensive program designed specifically to treat this problem.

METHODS

In March 1992, we created a center for the purpose of treating children with dysfunctional voiding. Personnel include a board-certified pediatric nephrologist, two pediatric nurse practitioners, and a family systems psychologist. Between March 1992 and December 1995, >500 children with symptoms of dysfunctional voiding were referred to our center. The primary complaints were daytime-wetting and recurrent UTI. Children with isolated nocturnal enuresis, frequency without wetting, isolated VUR, and anatomic or neurologic abnormalities were excluded. Figure 1 is an algorithm describing our methodology. The nephrologist who obtained a history, physical examination, and renal ultrasound evaluated each child. In those with a history of febrile UTI, a voiding cystourethrogram (VCUG) was obtained. A total of 366 children were referred for urodynamic studies. Children who were too young or who refused to undergo studies, or had infrequent voiding treated successfully with behavior modification, were not included in this study.

Urodynamic studies were performed using a Urolab (Life-Tech, Houston, TX) that included a cystometrogram, a patch electromyogram, recordings and a uroflow. Patients were catheterized with a 6 or 7 French double-lumen catheter and filled with saline at room temperature at a rate of 10 mL/minute. No sedation was administered. Patients were asked to document their first sensation of urge and extreme urgency, at which time most studies were stopped. Patients were asked to void with the catheter in place. Voiding pressures, pelvic floor activity, flow rate, and flow times were assessed. A postvoid residual was measured, and the study was repeated. The second flow was measured after removal of the catheter.

Patients were categorized into those having urge syndrome (frequent uninhibited detrusor contractions manifest by frequency with imperative urge and hold maneuvers such as squatting to...
prevent leakage); bladder/sphincter dysfunction (poor relaxation of the pelvic floor musculature diminishing and prolonging flow); lazy bladder syndrome (abnormally capacious bladder with straining and increased pelvic floor activity on voiding, culminating in a large postvoid residual); or a normal study as defined by van Gool and outlined in Table 1. For cases in which there was overlap, the diagnosis was based on the predominant finding. Although treatment was individualized, most children demon-

![Diagram of methodology]

**Fig 1.** Algorithm describing methodology. Note that various treatments may be used after the urodynamic study, ie, those with urge syndrome and an abnormal flow may receive anticholinergic medication and biofeedback.

<table>
<thead>
<tr>
<th>Term</th>
<th>Filling</th>
<th>Voiding</th>
<th>Post void Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>No detrusor instability. Urge expressed after half expected capacity</td>
<td>Rapid, steady flow rate with short flow time and EMG silence, indicative of pelvic floor relaxation. No abdominal straining</td>
<td>None</td>
</tr>
<tr>
<td>Urge syndrome</td>
<td>Multiple uninhibited detrusor contractions with increased EMG activity and expressions of urgency</td>
<td>Usually normal</td>
<td>None</td>
</tr>
<tr>
<td>Bladder/sphincter dysfunction</td>
<td>Usually normal</td>
<td>Increased EMG activity causing diminution or interruption of the urinary flow</td>
<td>Variable</td>
</tr>
<tr>
<td>Lazy bladder syndrome</td>
<td>Abnormally capacious bladder with little or no expression of urge</td>
<td>Prolonged, decreased flow with abdominal straining and bursts of EMG activity</td>
<td>Always</td>
</tr>
</tbody>
</table>
strating urge syndrome received anticholinergic medications such as oxybutynin or hyoscyamine; those with recurrent infections received antibiotic prophylaxis. Bladder/sphincter dysfunction was managed by outpatient biofeedback sessions. This involved at least one 6-hour session of repeated coached voiding aimed at assisting relaxation of the pelvic floor in front of a portable uroflow machine.

Approximately 15% of the children were referred early for psychological intervention when the child’s motivation was considerably low, when family conflict was high, or when co-morbid psychosocial issues were present such as attention deficit and sensory integration disorders. Some parents request psychological intervention because of failure to motivate their child to comply with treatment. In some cases, the staff worked with pediatricians, teachers, school nurses, and extended family to incorporate treatment plans.

The family systems therapy approach combined child behavior management and conflict resolution strategies needed to address the motivational issues. Uroflows and postvoid residual ultrasound studies were used to track children with chronic residuals who needed concrete reminders about how their bodies were progressing. A psychoeducational format was used in every initial interview to ensure that the child had a clear picture of how the kidneys and bladder worked and what the test results taught the staff about how their bodies are not functioning optimally. Treatment sessions usually were scheduled monthly and lasted 6 to 10 months.

All children were given voiding diaries and encouraged to void at regular intervals. Finally, any patient with constipation or encopresis was treated with a high fiber diet, stool softeners and, in some cases, enemas. Specific treatment for the urinary symptoms was undertaken after the patient’s constipation or encopresis resolved.

The outcome was evaluated in 280 children followed at least 6 months (mean, 22 months). This represented 77% of those studied. Patients were considered cured if they were no longer having episodes of wetting for at least 2 months and were on no medications. They were considered improved if wetting was reduced by at least 50% even if medication was required. Patients experiencing relapses were not considered cured or improved. Patients were also monitored for subsequent UTI. Nuclear VCUGs were obtained yearly to monitor those with VUR. Parents not returning for follow-up were contacted by telephone or mail and asked about their child’s progress. Their responses are included in our report.

Means between groups were compared statistically using Student’s t test. Analysis was used to compare differences between groups. A P value of <.05 was considered statistically significant. Data were stored and analyzed on a Medlog database (Information Analysis Corporation, Incline Village, NV).

RESULTS

The clinical characteristics of the 366 patients studied are shown in Table 2. Most were girls. The mean age at referral was 8.5 years (range, 4 to 18 years). The primary complaints were daytime-wetting (89%), night-wetting (79%), and recurrent UTI (60%), of which almost all were associated with symptoms and half with fever. Constipation or soiling was seen in 30%. VCUGs were performed in 240 children, of whom 48 (20%) had reflux. As expected, there is a strong relationship between gender and UTI (78% of girls vs 14% of boys; P < .0001). Most children had a history of increased urinary frequency, and many (45%) had a positive family history of wetting. Most of the children came from two-parent households (84%) and were considered average to excellent students (91%) by their parents.

The predominant urodynamic finding was urge syndrome (52%), followed by bladder/sphincter dysfunction (25%). Some did not demonstrate any urodynamic abnormalities (17%), and a small proportion had lazy bladder syndrome (4%). Studies in 3 children were uninterpretable. Anticholinergic medications were used in 49% and antibiotic prophylaxis in 59%. Biofeedback was used in 25% of children, and 15% received psychological counseling.

Of the 222 children with daytime-wetting followed at least 6 months, 100 (45%) were cured and another 82 (37%) improved. Less favorable results were seen in the 163 children who also had night-wetting; 29% were cured and 40% improved. Of the 199 children with recurrent infections, 127 (64%) had no subsequent infections.

The outcome of patients with VUR is summarized in Table 3. Most of these patients had low-grade unilateral reflux. As expected, those individuals did well and 83% resolved. Overall, 53% of the patients restudied showed resolution of reflux within 2 years.

DISCUSSION

Our program is the first of its kind in the United States to document outcome in a large population of patients. Before referral, primary care practitioners usually try to relieve symptoms by increasing the child’s voiding frequency, reducing inflammation (avoiding soap in the perineum), and treating constipation. The pediatric nephrologist’s role is to screen new referrals and to exclude neurologic (eg, tethered cord syndrome) and anatomic (eg, ectopic ureter) causes for wetting and recurrent infections. A detailed, age-appropriate explanation regarding the maturation of bladder function is given. This pediatrician supervises all aspects of the team’s functions, interprets urodynamic studies, and continues to follow many patients at subsequent visits. Pediatric nurse practitioners coordinate follow-up visits, perform all the studies, and arrange biofeedback sessions.

A family systems psychologist intervenes in cases

### TABLE 2. Demographic and Clinical Characteristics of Referral Population

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients referred</td>
<td>366</td>
</tr>
<tr>
<td>Females (%)</td>
<td>77</td>
</tr>
<tr>
<td>Mean age at referral (y)</td>
<td>8.5</td>
</tr>
<tr>
<td>Age range (y)</td>
<td>4–18</td>
</tr>
<tr>
<td>Daytime wetting (% of total population)</td>
<td>89</td>
</tr>
<tr>
<td>At least seven episodes/wk (%)</td>
<td>52</td>
</tr>
<tr>
<td>Three to six episodes/wk (%)</td>
<td>31</td>
</tr>
<tr>
<td>Fewer than three episodes/wk (%)</td>
<td>17</td>
</tr>
<tr>
<td>Night-wetting (% of total population)</td>
<td>79</td>
</tr>
<tr>
<td>Six or seven nights/wk (%)</td>
<td>70</td>
</tr>
<tr>
<td>UTI (% of total population)</td>
<td>60</td>
</tr>
<tr>
<td>Associated with any symptoms (%)</td>
<td>94</td>
</tr>
<tr>
<td>Associated with fever (%)</td>
<td>45</td>
</tr>
<tr>
<td>VCUGs performed</td>
<td>240</td>
</tr>
<tr>
<td>VUR (number/% studied)</td>
<td>48/20</td>
</tr>
<tr>
<td>Constipation/encopresis (%)</td>
<td>50</td>
</tr>
</tbody>
</table>

### TABLE 3. Characterization and Outcome of Patients With Vesicoureteral Reflux

<table>
<thead>
<tr>
<th>Reflux Type</th>
<th>Number Studied (%)</th>
<th>Number Resolved (% Resstudied)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral grades I-II</td>
<td>22 (46)</td>
<td>10 (83)</td>
</tr>
<tr>
<td>Bilateral grades I-II</td>
<td>13 (27)</td>
<td>1 (14)</td>
</tr>
<tr>
<td>Unilateral grades III-V</td>
<td>7 (15)</td>
<td>4 (57)</td>
</tr>
<tr>
<td>Bilateral grades III-V</td>
<td>6 (13)</td>
<td>1 (25)</td>
</tr>
</tbody>
</table>
for which the staff notes the child’s motivation is considerably low because of a number of extraneous issues, whether family-related or child-specific. These children either ignore or cannot detect bladder signals accurately, which hampers motivation. Our staff has observed problematic behaviors arising from their poor experiences with having never been in complete charge of their urine or stool. Prevalence of attention deficit/hyperactivity disorder is currently being determined within this clinic population.

The center uses the multidisciplinary approach of van Gool and colleagues, using a combination of anticholinergic medication, antibiotic prophylaxis, biofeedback, and psychological counseling. In that model, all patients had a medical and psychological evaluation, and many were admitted to hospital for 1 week of intensive biofeedback sessions. Although this would be ideal, the impracticality of inpatient biofeedback, both economically and socially, in the United States has made it necessary to emphasize outpatient treatment. In most cases, patients required two to four sessions lasting 6 hours each.

Our study is similar to that of 70 children reported by Hellström and associates. They demonstrated normal micturition in 51% and 76% of cases after 1 and 3 years, respectively. They also reported a reduction in symptomatic UTI. We have studied a much larger number of children and, in addition, we also show improvement in VUR.

Symptoms of dysfunctional voiding are relatively common. Hellström described the voiding behavior in >3500 school children and found that 6% of girls and 3.8% of boys had daytime-wetter. Greater than 8% of the girls had a history of UTI. Chandra and colleagues reported bowel or bladder dysfunction in 65% of children between 5 and 9 years of age with UTI and 23% of those without. The psychological morbidity of day-wetting at school is significant and is listed by children after the death of a parent or going blind as the third most stressful event.

Several investigators have studied the relationship between voiding dysfunction and VUR.

Eighteen percent of children enrolled in the International Reflux Study Consortium had symptoms of voiding dysfunction despite apparent attempts to exclude them. Williams and associates reported a similar rate of reflux in their population (29% vs 20%). Fifty-three percent of our patients with VUR no longer demonstrated this finding after treatment for their voiding dysfunction. These results are similar to those shown by Homsy, who found that 78% of children improved to grade I or to no reflux after treatment with anticholinergic therapy.

Thirty percent of our patients had concomitant bowel complications. The co-morbidity of voiding dysfunction and soiling secondary to constipation has been well described. The relationship may be attributable to the child’s inability to relax the pelvic floor musculature for fear of passing a large bolus, leading to stool and urinary retention or direct compression on the bladder neck enhancing the risk of uninhibited detrusor contractions. Aggressive bowel treatment programs have been shown to decrease urinary symptoms significantly. We feel it is imperative to obtain a meticulous bowel history and treat affected patients before starting definitive therapy for the voiding dysfunction.

Our study has three obvious limitations. First, there is no control population treated only by bladder retraining alone. It would be difficult to randomize these children prospectively without some form of treatment bias. However, in a retrospective study, we reported that a group of girls undergoing therapy at our multidisciplinary center did significantly better compared with control subjects treated conventionally before the start of our program. Second, several patients did not return for follow-up care. We contacted >80% of these patients by telephone or mail, and although some parents were dissatisfied because the problem persisted, most (77%) stopped attending the center because their children’s symptoms resolved and they felt additional visits or studies were unnecessary. Finally, our outcome data may be exaggerated if patients who experienced relapses after discharge from our center chose not to notify us.

CONCLUSION

We report a high success rate in the reduction of daytime-wetting and recurrent UTI using a multidisciplinary approach to the treatment of voiding dysfunction. Using various personnel able to spend more time treating this condition should prove to be a cost-effective solution to a problem with psychological and medical consequences.

ACKNOWLEDGMENT

We thank Bernard S. Kaplan, MB, BCh, for his editorial assistance.

REFERENCES

13. Gool JD van, Hjälmsé K, Tamminen-Möbius T, Öblin H. Historical


Comprehensive Management of Dysfunctional Voiding
Seth L. Schulman, Carol K. Quinn, Natalie Plachter and Chris Kodman-Jones
Pediatrics 1999;103;e31
DOI: 10.1542/peds.103.3.e31

Updated Information & Services
including high resolution figures, can be found at:
http://pediatrics.aappublications.org/content/103/3/e31

References
This article cites 17 articles, 2 of which you can access for free at:
http://pediatrics.aappublications.org/content/103/3/e31#BIBL

Subspecialty Collections
This article, along with others on similar topics, appears in the following collection(s):
Urology
http://www.aappublications.org/cgi/collection/urology_sub

Permissions & Licensing
Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
http://www.aappublications.org/site/misc/Permissions.xhtml

Reprints
Information about ordering reprints can be found online:
http://www.aappublications.org/site/misc/reprints.xhtml