Is Neurogenic Bladder a Risk Factor for Febrile Urinary Tract Infection After Ureteroscopy and, if so, Why?

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OBJECTIVE To characterize the rate of febrile urinary tract infections (UTIs) after ureteroscopy in patients with neurogenic bladder compared with those with physiologically normal bladders. Although generally considered safe and effective, there is a growing body of evidence suggesting that patients with neurogenic bladder are at an increased risk of infectious complications following ureteroscopy.

METHODS We performed a retrospective chart review of those undergoing ureteroscopy in a single academically affiliated hospital system between June 2013 and May 2016. Information regarding neurogenic bladder status, culture results, bladder management, and the presence of upper tract decompression was collected. Postoperative febrile UTI was defined as a hospital admission within 1 week of surgery because of fever not attributable to another source.

RESULTS Of 467 ureteroscopies, 44 (9.5%) were performed in the setting of neurogenic bladder. Febrile UTI rates were higher in patients with neurogenic bladder compared with control patients (9% vs 1.4%, $P = .01$) with significantly higher rates in those dependent on bladder catheterization. Interestingly, the presence of a nephrostomy tube in patients with physiologically normal bladders increased the risk of postoperative febrile UTI to levels comparable with patients with neurogenic bladder who were catheter dependent (10.5% vs 12.5%, respectively).

CONCLUSION Although infectious complications in the neurogenic population are likely multifactorial, the reliance on catheterization and thus colonization appears to be a significant factor and extends to non-neurogenic patients. These data suggest that bacterial colonization may be the significant underlying risk factor for febrile UTI after ureteroscopy. UROLOGY ■■: ■■–■■, 2017. © 2017 Elsevier Inc.

Neurogenic bladder may arise from a number of disease states that influence both the neural and motor components of the micturition pathway. Patients with neurogenic bladder suffer from uncoordinated voiding that can result in urinary stone formation, chronic bacteriuria, and symptomatic urinary tract infections (UTIs), sequelae that may be exacerbated by bladder catheterization to treat poor emptying. The lifetime risk of genitourinary stone formation in those with neurogenic bladder is estimated to be as high as 38%, which is significantly higher than the 5%-10% expected rate in the general population.[1,2]

Currently, ureteroscopy is one of the most common interventions used to treat ureteral and kidney stones. Although ureteroscopy is considered safe and efficacious, there is a small but growing body of evidence suggesting that ureteroscopy in patients with neurogenic bladder is associated with longer operative times, lower stone clearance rates, and higher complication rates.[3] A common postoperative complication of ureteroscopy is febrile UTI, which occurs in 2%-4% of the general population undergoing such procedures.[4] This rate, however, has been shown to be as high as 23% in patients with neurogenic bladder.[3,5-7] One hypothesis for this phenomenon is that patients with neurogenic bladder have higher rates of chronic bacterial colonization that serve as a reservoir of organisms that can cause UTI when the natural defenses in the urothelium are disturbed (eg, instrumentation or high pressure irrigation). However, the exact pathophysiology remains unclear and the studies to date have included only small cohorts.

Given the paucity of studies examining the risk of febrile UTI after ureteroscopy in patients with neurogenic bladder, we sought to characterize the rate of infectious complications in patients with neurogenic bladder compared with those with physiologically normal bladders. Further, we sought to identify whether it is the neurogenic bladder itself or the neurogenic bladder in the context of bacterial colonization caused by genitourinary tract instrumentation and

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catheterization that predicts infectious complications after ureteroscopy.

METHODS

After institutional review board approval, we retrospectively reviewed a cohort of patients from a single academically affiliated hospital system (4 surgeons) who underwent ureteroscopy between June 2013 and May 2016. Records were selected based on current procedural terminology codes for ureteroscopy: 52351-52356. Demographic information, including age, gender, and stone size, were obtained. Additionally, we reviewed the electronic health records of each patient to identify those with concurrent neurogenic bladder and their respective bladder management protocols (eg, intermittent catheterization and indwelling catheter). We used the common definition of "any person with a neurologic condition affecting bladder function" to identify cases of neurogenic bladder. We additionally identified which patients had undergone upper tract decompression with ureteral stents or nephrostomy tubes before ureteroscopy. There were no exclusion criteria.

The standard practice at our institution was to obtain a urinalysis and urine culture from all prospective cases within 14 days of ureteroscopy. In patients with prior infections treated with ureteral stenting or nephrostomy tube placement, a full 2-week course of antibiotic therapy was administered before ureteroscopy. In these patients, repeat bacterial cultures were obtained before ureteroscopy. In patients with indwelling catheters (suprapubic or nephrostomy), urine specimens were obtained after catheter clamping for 15 minutes. In situations where multiple organisms were identified on a preoperative culture, our laboratory routinely speciated and sensitized all isolates before urologic surgery. In cases of a positive preoperative culture (bacteria or fungal), targeted antibiotic treatment was initiated within a minimum of 3 days before the procedure. At the time of the procedure, further intravenous antibiotics to ensure gram-positive and gram-negative coverage were employed. When feasible, these were different antibiotics than those given preoperatively (when applicable). Rigid or flexible ureteroscopy during the study period was performed with a holmium : yttrium-aluminum-garnet laser (when required), active (high-pressure) irrigation, and ureteral access sheaths whenever feasible and appropriate. Postoperatively, ureteral stents were placed to ensure adequate drainage of the renal unit.

Postoperative febrile UTI was defined as a hospital admission within 1 week of surgery because of fever (38.5°C or higher) unrelated to another source. All fevers were documented in a hospital setting. After blood and urine cultures were obtained, the patients were started on broad-spectrum antibiotics that were appropriately narrowed as susceptibility results became available. To compare the rates of postoperative febrile UTI between groups, a Fisher exact test was performed and a 2-sided *P* value of less than .05 was considered statistically significant. A subgroup analysis was performed on patients who were catheter dependent for bladder management or preinstrumented with either ureteral stents or nephrostomy tubes to determine whether upper tract instrumentation increased the risk of febrile UTI after ureteroscopy. For the purposes of our study, controls are patients without a neurogenic bladder diagnosis.

RESULTS

During the study period, a total of 467 ureteroscopies were performed in 402 patients. Specifically, there were 34 patients with neurogenic bladder who underwent 44 ureteroscopy procedures and 368 control patients who underwent 423 ureteroscopy procedures. Of those with a neurogenic bladder, 32 (72%) ureteroscopies were performed in patients who required catheterization for bladder management. Twenty of the ureteroscopies (45%) were in patients with indwelling suprapubic catheter and 12 (27%) were in patients undergoing intermittent catheterization. In the control group, only 3 ureteroscopies (0.7%) were performed in persons managing their bladder with an indwelling Foley catheter at the time of the procedure. The mean age of the neurogenic bladder and control groups was comparable as was the mean stone size in terms of maximal dimension (Table 1). Between neurogenic patients and controls, the rates of preinstrumentation with ureteral stents (4% vs 28%, *P* = .12) and nephrostomy tubes (13.6% vs 4.5%, *P* = .02) were slightly higher in the neurogenic group. The most common associated diagnosis in those with neurogenic bladder was spinal cord injury (36%) (Supplementary Table S1). The American Society of Anesthesiologists' physical status classification was not different between controls with and without ureteral stents or nephrostomy tubes (data not shown).

When compared with controls, the rate of postoperative febrile UTI was higher in patients with neurogenic bladder (9.0% vs 1.4%, *P* = .01). However, the risk of febrile

Table 1. General cohort characteristics

	Neurogenic Bladder (n = 34)	Control (n = 368)	*P* Value
Number of ureteroscopies	44	423	—
Mean age (y)	45	49	.20
Mean stone size (mm)	9.6	9.2	.56
Nephrostomy tube (%)	6 (13.6)	19 (4.5)	.02
Ureteral stent (%)	18 (40.1)	121 (28.6)	.11
Bladder catheterization (%)	32 (72.7)	3 (0.01)	<.001

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