

## Original Article

# Morbidity of urodynamic testing in patients with spinal cord injury: is antibiotic prophylaxis necessary?

J Pannek\*<sup>1</sup> and M Nehiba<sup>1</sup>

<sup>1</sup>Division of Neuro-Urology, Department of Urology and Neuro-Urology, Ruhr-Universität Bochum, Marienhospital Herne, Germany

**Study Design:** Prospective, non-randomized study.

**Objectives:** To assess the incidence of urinary tract infection after urodynamics in patients with spinal cord injury.

**Setting:** Outpatient clinic of a university hospital in Germany.

**Methods:** Urinary tract infection and clinical symptoms in 109 consecutive outpatients with spinal cord injury following urodynamic evaluation were studied.

**Results:** Data from 72 patients were evaluable. Of these, seven patients (9.7%) developed a significant urinary tract infection. Five of these were symptomatic. Pre-existing asymptomatic bacteriuria was not associated with a higher risk for post-interventional infection. The technique of the bladder management did not correlate with urinary tract infection rates.

**Conclusion:** In this study, symptomatic urinary tract infections after cystometry were not infrequent. Therefore, it seems that antibiotic prophylaxis cannot be omitted in patients with spinal cord injury undergoing urodynamic investigation.

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**Keywords:** urodynamics; urinary tract infection prophylaxis; spinal cord injury; lower urinary tract dysfunction; neurogenic lower urinary tract dysfunction; morbidity

## Introduction

Urodynamic testing is the gold standard for the evaluation of lower urinary tract dysfunction. Several studies demonstrated a low morbidity of urodynamic examinations in patients with lower urinary tract dysfunction without underlying neurologic disorders.<sup>1</sup>

Especially in patients with spinal cord injury, who frequently suffer from neurogenic bladder dysfunction, urodynamic investigations are mandatory.<sup>2</sup> These patients, however, predominantly empty their bladders by intermittent catheterization or reflex voiding. Both techniques carry an elevated risk of urinary tract infections (UTIs).<sup>3</sup> Thus, this patient group is at risk for post-interventional complications. Although the incidence of post-interventional UTIs in patients with incontinence or benign prostatic hypertrophy has been studied in detail,<sup>4,5</sup> data about the above-mentioned high-risk group are scarce. Therefore, we evaluated the incidence of UTIs after urodynamic testing in patients with spinal cord injury.

## Materials and methods

In a prospective study, 109 consecutive patients with spinal cord injury presenting to our outpatient department for standard urodynamic examination were included. All patients underwent catheterization by a specialized urologic nurse with a transurethral double-lumened 8-French catheter under aseptic conditions using a chlorhexidine-containing lubricant after cleansing the external meatus with a standard disinfectant. Urine was obtained and urinalysis including urine culture was performed. Urodynamic testing was performed without antibiotic prophylaxis.

A reagent strip for urine leukocytes and nitrites was handed out to each patient. The use of the reagent strip was explained in detail and a reference table was handed out to each patient. Moreover, each patient received a symptom questionnaire. The questionnaire specifically asked for pain, dysuria, changes in urine composition, incontinence, fever, chills, changes in catheterization frequency, difficulties with reflex voiding and changes of general health perception that may have occurred after the urodynamic examination.

\*Correspondence: J Pannek, Chefarzt Neuro-Urologie, Schweizer Paraplegiker Zentrum, Guido A. Zäch Str. 1, Nottwil CH-6207, Switzerland

All patients were instructed to control their urine by a dipstick testing 5 days after urodynamics. At that time, the questionnaire was completed. The result of the dipstick test and the questionnaire was sent back to us.

Patients with any antibiotic treatment during the observation period were excluded from the study.

For the purpose of the study, we used the term asymptomatic bacteriuria whenever bacteria were found in the urine. A significant UTI was diagnosed if either more than  $10^5$  bacteria/ml and  $>100$  leucocytes/ml were found or any kind of bacteriuria combined with urinary tract symptoms/fever were detected.

## Results

The completed questionnaire and the result of the dipstick test were returned in time by 72 patients.

Mean age of the 51 male and 21 female patients at initial presentation was 36.7 years. A total of 49 patients performed intermittent self-catheterization; the remaining 23 patients emptied their bladders by triggered reflex voiding.

According to the above-mentioned criteria, 7 of the 72 patients (9.7%) developed a significant UTI after urodynamic testing. Five of these patients were symptomatic. The urine cultures of all patients with UTIs after the examination were sterile before the investigations. Comparing the results of the dipstick test at the time of the urodynamic testing with the results of the urine cultures, we did not observe either false-positive or false-negative dipstick tests.

A total of 53 patients had sterile urine at the time of urodynamic evaluation; the remaining 19 patients underwent the procedure despite an asymptomatic bacteriuria.

Of the 53 patients with sterile urine, 32 (60.4%) had sterile urine at the time of evaluation, 14 (26.4%) developed asymptomatic bacteriuria, 2 suffered from significant UTIs and in five patients, symptomatic UTIs occurred. In the 19 patients with asymptomatic bacteriuria before testing, urodynamic investigations did not cause any changes. All patients continued to have asymptomatic bacteriuria. Bacterial contamination of the urine (asymptomatic bacteriuria/UTI) related to urodynamic testing occurred in 39.6% (Table 1).

### Intermittent catheterization

Of the 49 patients performing aseptic self-catheterization, 37 had sterile urine at the time of urodynamic testing, whereas 12 patients underwent the testing despite asymptomatic bacteriuria.

Of the 37 patients with sterile urine, 21 (56.8%) remained without infection, 10 developed asymptomatic bacteriuria, 2 suffered from significant UTIs and 4 patients even developed symptomatic UTIs. Symptoms included fever and haematuria in three patients, increased spasticity in one patient (Table 2).

**Table 1** Results in the entire patient group ( $n=72$ )

5 days after urodynamics	Before urodynamics	
	Sterile	Bacteriuria
Sterile	32	—
Bacteriuria	14	19
UTI	2	—
Symptomatic UTI	5	—

Abbreviation: UTI, urinary tract infection

**Table 2** Results in patients performing intermittent catheterization ( $n=49$ )

5 days after urodynamics	Before urodynamics	
	Sterile	Bacteriuria
Sterile	21	—
Bacteriuria	10	12
UTI	2	—
Symptomatic UTI	4	—

Abbreviation: UTI, urinary tract infection

**Table 3** Results in patients performing reflex voiding ( $n=23$ )

5 days after urodynamics	Before urodynamics	
	Sterile	Bacteriuria
Sterile	11	—
Bacteriuria	4	7
UTI	—	—
Symptomatic UTI	1	—

Abbreviation: UTI, urinary tract infection

### Reflex voiding

Of the 23 patients using reflex voiding, 16 had sterile urine at the time of urodynamics, whereas 7 patients underwent the examination with an asymptomatic bacteriuria (Table 3).

Of the 16 patients with sterile urine, 11 (68.75%) remained without infection, 4 developed asymptomatic bacteriuria and 1 patient developed symptomatic UTI, presenting with increased spasticity and pelvic pain.

In summary, no patient with asymptomatic bacteriuria at the time of urodynamics developed a significant UTI. All patients with UTI after urodynamics presented with sterile urine. Thus, they seemed to have acquired the infection during the urodynamic testing.

Of the seven patients with significant UTI after urodynamics, six performed intermittent catheterization; only one patient used reflex voiding.

## Discussion

Although urodynamic investigations are used with increasing frequency, there is still an ongoing debate if

antibiotic prophylaxis is necessary for this examination. As there is a lack of randomized, prospective studies evaluating this problem, urologists have to rely either on retrospective studies or on the only randomized prospective study published yet. This study, however, included merely 40 patients. Therefore, the authors themselves relate to their results as preliminary.<sup>6</sup> Until today, however, to the best of our knowledge no other prospective studies about this topic exist.

Comparison of the existing body of literature is limited by several factors. The majority of the existing studies evaluated patients with incontinence or benign prostatic hyperplasia. Quek and Tay<sup>7</sup> studied the incidence of UTIs after urodynamic testing in patients that were able to void spontaneously. Without antibiotic prophylaxis, they found a significant bacteriuria in 13.9% of their patients, being symptomatic in 2.1%. However, they excluded all patients with asymptomatic bacteriuria at the time of the urodynamic study from the evaluation.

In a series of 214 women, urodynamic investigations were associated with a high incidence of transient irritative symptoms but a low incidence of bacteriuria (7.9%). The authors concluded that in this population, urodynamic studies are associated with a low level of morbidity.<sup>1</sup> The largest study in patients with other than neurogenic lower urinary tract dysfunction included 822 female patients. The prevalence of UTI before and after urodynamic investigation was 5.1 and 8.4%, respectively. Risk factors were age  $\geq 70$  years, previous continence surgery and UTI before urodynamic investigation bearing the highest risk for urinary post-interventional tract infection.<sup>4</sup>

The incidence of UTI after urodynamics has also been studied in male patients. In 123 patients undergoing pressure-flow studies, 4.1% had a symptomatic UTI requiring antibiotic treatment and 2.5% reported fever.<sup>8</sup>

In contrast to these rather low infection rates, Klingler *et al*<sup>9</sup> found a high rate of UTIs after urodynamic studies especially in men. They included 63 men with benign prostatic hyperplasia and 56 women with stress urinary incontinence. The overall complication rate, including urinary retention, gross haematuria, UTI and fever, was 19.0% (12 of 63) for men and 1.8% (1 of 56) for women. Of the 63 men, 4 (6.2%) had significant UTIs, while only one woman (1.8%) had infections.

Porru *et al*<sup>5</sup> analysed the data of 105 patients, 55 men and 50 women that underwent pressure flow studies. Post-investigational UTI and fever were reported in 3.6% of men and 4% of women. In contrast to other investigators, this group used antibiotic prophylaxis.

In neurogenic lower urinary tract dysfunction, asymptomatic bacteriuria is more frequent. Shekarriz *et al*<sup>10</sup> studied the infection rate after urodynamic studies in 69 paediatric patients. A total of 69% had a neurogenic bladder. Forty-six patients had positive urine cultures. No patient developed symptomatic UTI after the urodynamic studies. They concluded that urodynamic studies were performed safely in the

presence of asymptomatic bacteriuria in the present study. Therefore, the authors did not recommend routine use of urine cultures or prophylactic antibiotics before urodynamic studies in paediatric patients with a neurogenic bladder.

On the other hand, high residual urine or intermittent catheterization are regarded as major risk factors for UTI after urodynamic testing.<sup>11</sup> In a pilot study in spinal cord injury patients, Darouiche *et al*<sup>6</sup> performed a double-blind, randomized prospective study with 40 patients either receiving a 3-day oral course of ciprofloxacin or placebo. No patient who received ciprofloxacin developed symptomatic UTI compared with three of 22 (14%) subjects randomized to the placebo group; the protective efficacy of antibiotic prophylaxis however did not attain statistical significance. Despite the lack of statistical significance, this study, which is the only prospective trial available, demonstrated a trend towards less UTIs under antibiotic prophylaxis. The lack of statistical significance may at least partly be due to the small number of patients included. Thus, the question remains if in high-risk patient groups antibiotic prophylaxis is useful.

Our study could add some important data. First of all, in patients with asymptomatic bacteriuria, urodynamic testing did not cause symptomatic infections. Thus, urodynamic investigation seems to be possible in these patients without additional risks. Moreover, we did not find a significantly different risk for infection in patients with triggered reflex voiding compared to the patients performing intermittent catheterization. Although this result may partly be due to the small study population, this finding is helpful when counselling the patients, as many patients who do not perform catheterization are concerned that doing so during urodynamic investigation may be harmful.

The majority of our patients with UTIs after the investigation had sterile urine cultures when entering our outpatient clinics. Moreover, another 26.4% developed asymptomatic bacteriuria. Although we performed only a single urine testing after urodynamics and theoretically the patients may have acquired the bacterial contamination elsewhere, most probable, the urodynamic testing was the causative factor. As even in healthy female volunteers, a significant bacteriuria occurred in 6.9% of the patients after urodynamics,<sup>12</sup> a certain infection rate seems to be related to the measurement technique itself. To minimize this factor, a strictly aseptic catheterization technique is mandatory. Based on the results of the study, we performed an analysis of the catheterization technique in our department by an independent institute, not revealing any technical errors. Keystone for a low infection rate is an aseptic and atraumatic insertion of the urodynamic catheter. Inadequately sterilized goods or technical problems may have detrimental consequences, like septicaemia.<sup>13</sup> Even if no fever occurs, bacteraemia is possible. Onur *et al* evaluated if bacteriuria leads to bacteraemia after urodynamics and determined bacteraemia in 4 (7%) out of 55 patients.<sup>14</sup> This finding is of

utmost importance for patients with risk factors, for example, patients with artificial heart valves.

In our study, we did not detect any subgroups that are at a significantly elevated risk for UTI after urodynamic evaluation. Furthermore, our catheterization technique seems to be adequate. Therefore, the rate of UTIs (9.7%) requiring antibiotic treatment in our patient group seems to be related to the examination itself. Consequently, our data support the view that infection prophylaxis is justified in spinal cord injury patients undergoing urodynamic evaluation. On the other hand, the use of antibiotic prophylaxis in spinal cord injury patients is not without problems. Over a 6-year period, significant changes in both bacterial spectrum and bacterial resistance in an outpatient population of spinal cord injury patients could be demonstrated. The authors concluded that antibiotic treatment should be limited to symptomatic UTIs and be initiated after sensitivity testing only.<sup>15</sup> Until today, however, no data concerning a safe and effective alternative treatment are available. Thus, antibiotic prophylaxis seems to be the method of choice today.

## Conclusions

Symptomatic UTIs after urodynamic investigations are not infrequent in a high-risk population. Patients with neurogenic bladder that do not perform catheterization do not seem to have a significantly elevated risk for UTI if catheterized for the procedure. Regarding the problems caused by the increasing number of multiresistant bacterial strains, the use of antibiotics should be reduced to a minimum. However, it seems that antibiotic prophylaxis cannot be omitted in patients with spinal cord injury undergoing urodynamic investigation.

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