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ORIGINAL ARTICLE

Urinary tract infection analysis in a spinal cord injured population undergoing rehabilitation—how to treat?

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Study design: Cross sectional study, including 38 outpatients. Standardized questionnaire was used and urine cultures were performed.
Objectives: To study spinal cord-injured (SCI) patients bladder management, clinical aspects that symptomatic urinary tract infection (SUTI) may present and asymptomatic bacteriuria (AB) incidence with its antimicrobial susceptibility profile.
Setting: Spinal cord injury outpatient rehabilitation clinic.
Results: Clean intermittent catheterization is used by 71% of the patients. SUTI may have atypical clinical presentation (shivers, spasticity increase, headaches). In total, 65.7% ($N=25$) of the patients presented AB. Among these, the microorganisms isolated were resistant mainly to Ampicillin, Sulfamethoxazole–Trimethoprim and Norfloxacin, whose resistance rates were, respectively 73.3%, 60% and 33.3%.
Conclusion: Special attention should be given to possible atypical symptoms for SUTI. Although a small amount of urine samples was analyzed, resistance rates against Ampicillin, Sulfamethoxazole–Trimethoprim, Ciprofloxacin and Nitrofurantoin appear to be higher among SCI patients compared to the general population, thus demonstrating the need for continuous monitoring of microorganisms susceptibility, in order to avoid therapeutic failure when dealing with this specific population.
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Keywords: spinal cord injury; rehabilitation; urinary tract infection; bacterial resistance; bacteriuria; antibiotic

INTRODUCTION

The management of urinary dysfunction is important to spinal cord-injured (SCI) patients survival and quality of life. Clean intermittent catheterization (CIC) is the first choice towards avoiding urinary tract infection (UTI)[1] and the use of indwelling catheters seems to predispose to UTI and other complications such as lithiasis, bladder cancer and urethral injuries.[2] In spite of clear recommendations found in literature, few studies have analyzed the practice of these methods in the Brazilian SCI population.

Concerning SCI individuals, it is necessary to discriminate between two possible situations within the urinary tract: asymptomatic bacteriuria (AB)—bacteria isolation in urine sample, in the absence of symptomatology—and symptomatic urinary tract infection (SUTI). Owing to sensory deficit, SUTI symptoms often differ from classical UTI symptoms in patients with urinary tract sensation preserved. Thus, it is appropriate to conduct studies that address the diversity of SUTI's clinical aspects in SCI individuals.

It is also known that patients who daily perform CIC or other invasive bladder drainage method are prone to develop AB and SUTI by multidrug resistant (MDR) bacteria.[2,3] Although many studies[4,5] have analyzed urinary tract pathogen's sensitivity patterns among the general population, this has rarely been done in SCI patients. Although spinal cord injury is a relatively rare condition—incidence from 12.1 to 57.8 per million per year[6] in developed countries—UTI in these patients is often subject to a higher risk of complications.[2]

PATIENTS AND METHODS

This study reported the most used bladder drainage methods by SCI outpatients, assessing SUTI episodes and symptoms. It also analyzed AB (through urine cultures) and reviewed microorganisms sensitivity to different antibiotics. A cross sectional study was performed, including outpatients from the Spinal Cord Rehabilitation Unit at the State University of Campinas, Brazil.

Among the 58 patients being followed at the rehabilitation unit during the research period (July 2010–July 2011), 41 were suited for the eligible criteria, which were the following: spinal cord injury for more than 1 year, more than two SUTI episodes during previous 2 years, age > 18, absence of any suspected symptoms of SUTI (Table 1) at the moment of urine collection, absence of any urinary tract abnormalities or renal/bladder calculi (confirmed by previous ultrasound) and agreement to undergo an interview, followed by urine tests. Patients were excluded if they were undergoing intercurrent antibiotic treatment.

Patients were interviewed once, and American Spinal Injury Association Impairment Scale (AIS)[7] grade was determined, as part of the neurological classification. Two urine samples were collected for urine analysis and urine culture performance right after the interview; patients were asymptomatic for SUTI at the moment. Three patients were excluded: two for presenting symptoms during the interview, the third one had urine culture contamination. Overall, 38 patients joined the study.

The questionnaire applied standardized questions from the international lower urinary tract function spinal cord injury data set,[8] and included general information concerning the patient (age, gender), spinal cord injury (etiology, date) and bladder voiding method. In addition, patients were asked whether they had, at that time, any of the symptoms described in Table 1. They were also asked whether they had presented, in the previous 2 years, such symptoms

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Table 1 Symptoms referred by patients ($N=38$) in their last symptomatic urinary tract infection episodes

Symptoms	N *(%)*
Cloudy urine	30 (78.9)
Foul smelling in the urine	28 (73.6)
Fever	20 (52.6)
Ill feeling	11 (28.9)
Abdominal pain	10 (26.3)
Headache	8 (21.0)
Shivers	8 (21.0)
Specific region discomfort	7 (18.4)
Increased spasticity	3 (7.8)

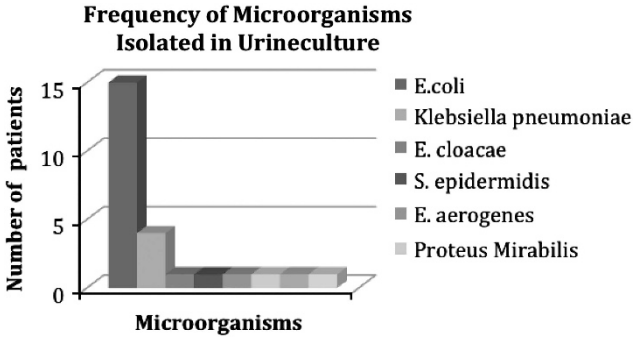

Figure 1 Frequencies of microorganisms isolated in urine cultures ($N=25$) from patients asymptomatic for urinary tract infection.

during their last SUTI episodes. These episodes must have been confirmed with urine culture and treated with antibiotic therapy. The symptoms mentioned on the questionnaire were based on the literature.[9] Patients were asked to add any further symptoms not previously mentioned.

Most patients were incapable of voluntary bladder voiding, so urine samples were obtained by sterile catheterization technique, using new catheters, on the same day of interview. Concerning the minority capable of voluntary voiding, instructions were given in order to obtain non-infected samples (accurate antisepsis, first gush discard and others). Urine cultures were performed, and the ones that presented 10^3 or more colony-forming units per ml were considered positive. Bacteria resistant to three or more of the envisaged antibiotics were considered MDR.[4] Samples that presented growing three or more microorganisms were considered contaminated collections, and were rejected.

Statistical analyses were performed by the software SPSS 17.0 (International Business Machines Corp., Armonk, NY, USA). Categorical variables were laid in percentages; numerical variables were described through their mean value and s.d. For comparison effects, χ^2-test was performed and, when the variable frequency was low, Fisher's exact test was used. Numerical variables were compared by Mann–Whitney nonparametric test. The confidence interval accepted was 95% and *P*-values under 0.05 were considered significant.

This project was submitted and approved by the local ethics committee. Eligible patients were invited to join the study and signed a free and informed consent term after agreeing with the conditions proposed.

RESULTS

Within the studied group, 86.9% of the patients were classified as AIS A, 10.5% as AIS B and 2.6% as AIS D. There were no patients classified as AIS C. Concerning individuals' gender, 86.8% were male and 13.2% were female, with a mean age of 35.6 and 29 years, respectively. Concerning upper limbs condition, 50% were tetraplegics and 50% were paraplegics. Regarding spinal cord injury etiology, automobile accident was the most frequent one (34.2%, $N=13$), followed by motorcycle accident (21.0%, $N=8$), gunshots (18.4%, $N=7$), diving accidents (13.1%, $N=5$), falls (5.2%, $N=2$), vascular malformation (2.6%, $N=1$), surgical iatrogenesis (2.6%, $N=1$) and bone tuberculosis (2.6%, $N=1$).

Referring symptoms presented during patient's last SUTI episodes, frequencies are presented on Table 1. Regarding bladder management profile, CIC was identified as predominating method, adopted by 71% ($N=27$) of our patients. Other methods observed were condom catheter (18.4%, $N=7$), suprapubic drainage (7.8%, $N=3$) and tapping (2.6%, $N=1$).

Concerning AB and urine culture results, 65.7% ($N=25$) were positive and 34.3% ($N=13$) had negative results. Among them, 36% ($N=9$) had MDR bacteria isolated. Regarding the isolated microorganism's frequencies, *Escherichia coli* was identified in 60% ($N=15$) of the samples, followed by *Klebsiella pneumoniae*, whose frequency was 16% ($N=4$), according to Figure 1. *E. coli*'s sensibility profile to several antibiotics is shown in Table 2. These results correlate to the microorganisms isolated from patients presenting AB, once they confirmed the absence of any UTI symptoms mentioned in Table 1, at the moment of urine collection.

Table 2 Isolated *E. coli* ($N=15$) resistance rates against some antibiotics

Antibiotics	*Resistant E.coli* N *(%)*
Ampicillin	11 (73.3)
Sulfamethoxazole–Trimethoprim	9 (60.0)
Norfloxacin	5 (33.3)
Amoxicillin–Clavulanic acid	5 (33.3)
Cefazolin	4 (26.6)
Ciprofloxacin	4 (26.6)
Nitrofurantoin	4 (26.6)
Amicacin	1 (6.6)
Levofloxacin	1 (6.6)
Cefepime	1 (6.6)
Ceftriaxon	0 (0)
Gentamicin	0 (0)

Regarding CIC learning process, it was identified that 86.8% learned it with healthcare professionals (nursing staff or physicians), whereas 13.2% learned with SCI colleagues. Furthermore, it was observed that 47.4% performed bladder-voiding method without assistance; meanwhile 52.6% was assisted by a helper. Possible associations between MDR bacteria isolation and factors as gender ($P=0.62$) and age ($P=0.93$) were analyzed, but no statistically significant associations were identified.

DISCUSSION

The main bladder drainage methods adopted by the patients observed in this study highlights the fact that CIC is the predominant technique (71.0%), followed by condom catheter (18.4%). Romero-Cullerés *et al.*[1] and Vaidyanathan *et al.*[10] also concluded CIC as the predominant method, although they found a large number of patients under indwelling catheters. In this sample, patients undergoing indwelling catheters were not found, probably because this was an outpatient study, while others have included hospitalized patients.[1,10]

Literature indicates CIC as the method associated to the lowest AB and SUTI rates among bladder voiding methods.[3,11] This benefit

depends essentially on the procedure quality, specially diary utilization frequency and proper antisepsis.[12–14] The quality of CICs was evaluated by questioning with whom patients learned to perform it. It was observed that over 86% learned with healthcare professionals. However, 13% have never been instructed by those professionals, pointing to a greater risk of not performing CIC with the expertise required, and consequently enlarging their risk to develop AB and SUTI.

Table 1 showed 'cloudy urine' and 'foul smell in the urine' as the most frequent symptoms during patient's last SUTI episodes (confirmed by urine culture). Massa *et al.*[9] also showed that alteration of urine's appearance have high accuracy (83.1%) and sensitivity (65.5%). These data demonstrate that these symptoms might be rather useful during SUTI's management, especially urine's appearance alteration. Table 1 also demonstrated that SUTI's clinical presentation among SCI patients might be variable, with unspecific symptoms like abdominal pain, headache and spasticity increase, without fever occurrence. As SUTI in these patients is frequently associated with larger complications,[2] any data that improve its diagnosis is valuable.

The high incidence of AB (65%) is commonly observed among patients who daily perform an invasive bladder drainage method, and has been demonstrated by many authors.[1,11,15] The microorganisms isolated were, mainly, Gram-negative bacteria and enterobacteria, being *E. coli* the most frequent one (60%). Romero-Cúlleres *et al.*[1] noticed similar results, with positive urine culture incidence of 71.7% with 49% referent to *E. coli*, also among SCI patients.

Concerning susceptibility to the different antibiotics, 36% of MDR bacteria were observed, with considerable rates against Ampicillin (73%) and Sulfamethoxazole–Trimethoprim (60%). Both Ciprofloxacin and Nitrofurantoine presented rates of 26.6%. A multicentre study (general population) analyzed in 2000 over 38 000 urine samples and found *E. coli*'s resistance rates of 39.1% to Ampicillin, 18.6% to Sulfamethoxazole–Trimethoprim, 3.7% to Ciprofloxacin and 1% to Nitrofurantoine.[4] In addition, Mazulli *et al.*,[16] in a 2002 review study, described resistance rates intervals of 39–45% to Ampicillin, 14–31.4% to Sulfamethoxazole–Trimethoprim, 1.8–16% to Nitrofurantoin and 0.7–10% to fluoroquinolones. Hence, although our study analyzed a smaller amount of urine samples, it points out the higher resistance rates found in the SCI population. Considering that SUTI is one of the most prevalent pathologies among SCI, with frequent empiric treatment, these results suggest the need of continuously updated data on antimicrobial susceptibility patterns.[4,17]

CONCLUSION

Special attention should be given to SUTI's possible atypical symptoms. Although a small amount of urine samples was analyzed, resistance rates against Ampicillin, Sulfamethoxazole–Trimethoprim, Ciprofloxacin and Nitrofurantoin appear to be higher among SCI patients compared with the general population, thus demonstrating the need for continuous monitoring of microorganisms susceptibility, in order to avoid therapeutic failure when dealing with this specific population.

DATA ARCHIVING

There were no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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