
Intermittent catheterization practices following spinal cord injury: a national survey

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Objective: To identify intermittent catheterization (IC) practices and factors associated with urinary tract infection (UTI) in community-dwelling people living with spinal cord injury (SCI) in Canada.

Study design: A national survey employing a 36-item self-report questionnaire that was mailed to members of the Canadian Paraplegic Association (CPA).

Results: There were 912 respondents with SCI of either traumatic or nontraumatic etiology. Fifty-five percent of the respondents used IC. The mean age of users (47 ± 14 years) was significantly younger than non-users (53 ± 13 years) and a greater percentage of males (57%) than females (50%) used IC. Of those who used IC, 26% use hydrophilic catheters either exclusively or sometimes. The mean frequency of UTIs in the past 12 months for IC users was 2.6 ± 2.6 . Among IC users,

females had a significantly greater number of UTIs than males ($p = 0.003$). Linear regression analysis revealed that the variables of sex, number of catheterizations per day, age, and tetraplegia versus paraplegia were individually correlated with infection rate but collectively only explained a small proportion of the variance. Time lost from social activities due to UTIs was associated with compromised quality of life more so than the actual number of UTIs or days lost from work.

Conclusion: The survey identifies existing IC practices and confirms previous reports of UTI rate being dependent on frequency of catheterization and reduced infection rates in individuals using hydrophilic catheters. UTI rates were significantly associated with several clinical and demographic variables but only poorly modeled by the IC practices and lifestyle variables investigated in this study.

Key Words: spinal cord injury, intermittent catheterization, urinary tract infection, neurogenic bladder dysfunction

Introduction

Intermittent catheterization (IC) is the preferred means of bladder emptying for many individuals with voiding difficulties as a result of spinal cord injury (SCI).¹⁻³ Innovations in the development of new biomaterials for catheter construction,⁴ new techniques of managing catheter use,⁵⁻⁷ and the introduction of hydrophilic

(water attracting),⁸⁻¹⁰ anti-bacterial or other coatings,⁴ all call for rigorous clinical evaluation.¹¹ In order for this to occur, the current status and characteristics of catheter use needs to be established, i.e. how patients actually perform IC as distinct from what evidence-based best practices might recommend.¹² Similarly, the occurrence of symptomatic urinary tract infection (UTI) of individuals living in the community and not benefiting from the scrutiny of ongoing formal clinical investigation, needs to be determined.

The present study was designed to survey IC use in the SCI population across Canada. In particular we sought to characterize respondents who currently use IC, to describe the current practices with IC use, and to identify clinical, practice-related, or demographic factors related to the presence of UTI. Additionally, we sought to determine the perceived impact of UTI on the quality of life in users of IC.

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Methods

A new 36-item questionnaire was developed to elicit information on clinical and demographic data, techniques and use of IC, genital care, occurrence of UTI, and consequences of UTI. The self-report survey was jointly developed by the sponsor Coloplast A/S, Denmark and an epidemiologist (MGW). English and French versions were prepared. The format of the questionnaire involved multiple-choice closed-ended questions, requiring categorical responses. The questionnaires were confidential i.e., there was no respondent-identifying information. The questionnaire and the study protocol were approved by the University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB).

The provincial chapters of the Canadian Paraplegic Association (CPA) were partners in the study and mailed the questionnaires to all their members between 2005-2006. Nine of the ten chapters participated and 6849 questionnaires were distributed; the French version was sent to members in Quebec and the English version to members in the rest of Canada. The participating chapters were Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland. A stamped addressed return envelope was provided to each member. The CPA membership includes individuals with spina bifida, multiple sclerosis, and other diagnoses as well as those with SCI. Here we report only the responses from individuals with SCI and include those with traumatic as well as non-traumatic etiology. Response data were screened to ensure the absence of any respondent-identifying information, to ensure confidentiality, and entered into a database for subsequent analysis using Statistical Package for the Social Sciences (SPSS) software.

Statistical analyses

The data were characterized initially by conventional parametric or nonparametric descriptive statistics, e.g., frequency distributions, medians, means, and estimates of variance. Tests for normality were applied and, where appropriate, the data were square root transformed to normalize the distribution. Relationships between predictor variables and the outcome variables, i.e., 'number of UTIs in past 12 months' and 'impact of UTIs on quality of life', were investigated first by Chi Square analysis or simple linear regression. Logistic regression and multiple linear regression, using forward selection and backward elimination, were used to model the multivariable relationship between the predictor variables and the 'number of UTIs in past

12 months' and factors associated with the 'impact of UTIs on quality of life'.

Results

Irrespective of diagnosis, 1600 surveys were returned and 1540 surveys were entered into the database, yielding a national response rate for the entire survey of 22.5%. Surveys were excluded because they were blank, spoiled, or because the recipient had died. Of the 1540, 912 respondents identified themselves as being individuals with SCI. Since the number of people with SCI who are members of CPA (the denominator) is unknown, the response rate for this group could not be calculated. The mean age of respondents was 50 years (range from 9 to 91 years). The clinical characteristics of respondents are shown in Table 1. Not all respondents completed all questions and this resulted in missing data for some variables.

Fifty-five percent (55%) of all respondents use IC regularly. Those who use IC were significantly younger than those who did not, 47 versus 53 years respectively ($p < 0.001$). The clinical characteristics of IC users and non-users are reported in Table 2. More individuals with traumatic SCI manage their neurogenic bladders using IC than do individuals with non-traumatic etiology ($p = 0.002$). More respondents with paraplegia were users of IC (64%) than were individuals with tetraplegia ($p < 0.001$).

The majority of IC users (73%) use "clean" technique;^{13,14} the remaining 27% use "sterile" technique. Hydrophilic catheters were used by 15% of all IC users; 74% only used uncoated catheters and 11% reported using both hydrophilic and uncoated. For more than 90% of users, there is only one person, self or other,

TABLE 1. Respondent characteristics

	N	%
Sex		
Male	659	74
Female	230	26
Cause of urinary dysfunction		
Traumatic SCI	780	86
Non-traumatic SCI	132	15
Tetraplegic or paraplegic		
Paraplegic	520	62
Tetraplegic	320	38
Lesion complete or incomplete		
Complete	452	55
Incomplete	375	45

TABLE 2. Characteristics of IC users

	Non-users		Users	
	N	%	N	%
Sex				
Male	286	43	373	57
Female	114	50	116	50
Cause of urinary dysfunction				
Traumatic SCI	332	43	448	57
Non-traumatic SCI	75	57	57	43
Tetraplegic or paraplegic				
Paraplegic	186	36	334	64
Tetraplegic	179	56	141	44
Lesion complete or incomplete				
Complete	187	41	265	59
Incomplete	164	44	211	56

involved in catheterizing; 81.9% self-catheterize; 56.7% of individuals with tetraplegia self-catheterize and 92.5% of individuals with paraplegia perform their own IC. Table 3 summarizes current IC practices. Most respondents catheterize between four to six times a day regardless of whether they use hydrophilic or uncoated catheters. The majority of individuals using hydrophilic catheters

(54%) or uncoated catheters (53%) use their catheter only once. Users of uncoated catheters had a large percentage (30%) who reused their catheters more than nine times. Close to 80% of all individuals who reuse their catheters do not disinfect them between uses. Less than 50% of respondents routinely perform genital and/or peritoneal cleansing prior to introduction of the catheter.

TABLE 3. IC practices

	SCI				Catheter type	
	Paraplegia	Tetraplegia	Total %		Uncoated	Total %
Number of daily catheterizations						
1	8	9	3.6	2	15	4.0
2 to 3	31	27	12.4	10	37	11.0
4 to 6	238	88	69.8	49	253	70.4
More than 6	53	13	14.1	12	51	14.7
Number of times each catheter is used typically						
1	169	85	53.8	40	191	53.0
2 to 4	34	11	9.5	12	29	9.4
5 to 9	29	13	8.9	10	34	10.1
More than 9	100	31	27.8	12	108	27.5
Disinfect catheter between catheterizations						
No	121	40	78.5	26	125	79.1
Yes	34	10	21.5	5	35	20.9
Genital hygiene						
No	166	62	48.5	36	173	48.3
Sometimes	38	10	10.2	11	31	9.7
Always	125	69	41.3	28	154	42.0
Catheterization						
Self	309	80	81.9	62	302	83.3
Others	25	61	18.1	13	60	16.7

Urinary tract infections (UTIs)

The mean frequency of self-reported UTIs in the past 12 months (symptomatic but not necessarily confirmed by significant bacteriuria), for those who use IC, was 2.6. For those respondents who use hydrophilic catheters it was 2.46 and for those who use uncoated catheters it was 2.62. Females had more UTIs than males, 3.2 and 2.4 respectively ($t = -2.97$; $p = 0.003$). Twenty-three percent (23%) of respondents reported no infections in the past 12 months. The most frequent rate of infection was one to two infections per year (35%); 20% of respondents reported occurrence of more than four UTIs in the past year.

There were several significant univariable associations between IC practice variables and the variable 'number of UTIs in last 12 months'. Individuals who catheterized only once per day had the highest number of infections. Specifically, 38% of respondents who catheterized once per day had five or more UTIs per year. For those who catheterized more frequently than once a day, the percentage was significantly less ($X^2_9 = 18.5$; $p = 0.03$). Self-catheterization, versus catheterization by others, was associated with a reduced rate of infection ($X^2_3 = 7.84$; $p = 0.05$). There was a greater percentage of individuals who self-catheterize who had no infection (23.7%) compared to those individuals who have caregivers do their catheterization for them (18.0%). There was also a smaller percentage of respondents that self-catheterize who had five or more infections (19.6%) compared to those who had other people do their catheterization (32.6%). The practice of genital and/or peritoneal cleansing was associated with a reduced rate of infection ($X^2_6 = 13.91$; $p = 0.03$). Use of alternative prophylactic agents, e.g., cranberry juice, Vitamin C, extra fluid intake was positively related to infection rate ($X^2_3 = 19.52$; $p < 0.001$) whereas, catheter reuse, catheter disinfection, and prophylactic use of antibiotics were not significantly associated with UTI rate. Respondents indicated that the health care services most frequently contacted for UTI were the Family Physician (77.6%), Specialist, e.g., Urologist (13.1%) and Hospital Emergency Room (12.7%).

An attempt was made to build a multivariable linear regression model to predict infection rate using the clinical and IC practice variables that had significant univariable associations with UTI rate. The forward solution model that provided the best prediction: y (UTI rate) = $2.58 + 0.63 (x_1) + 0.85 (x_2) - 0.47 (x_3) - 0.17 (x_4) + 0.62 (x_5)$, where x_1 is alternative prophylaxis, x_2 is sex, x_3 is number of IC per day, x_4 is age, and x_5 is self catheterization, only explained a very small percentage (6%) of the variance ($R^2 = 0.06$; $p < 0.001$). Multiple logistic regression also failed to identify clinical and practice variables that successfully predicted an appreciable amount of the variance in UTI rates. The rate of UTIs is thus only poorly predicted by the variables captured within the survey.

Impact of UTIs on quality of life

The impact that UTIs have on respondents' lives was as follows: 23% felt ill for an average of 4 days or longer with a UTI; 15% had missed work or school due to UTIs; 34% had refrained from social activities due to UTIs; 71% reported that UTIs had negatively impacted their quality of life (score greater than or equal to 1 on a 10-point scale (from no impact to major impact)).

There were several significant univariable associations of demographic, clinical, and lifestyle variables with negative impact of UTIs on quality of life. Respondents who reported impact were on average older, mean of 50 years, than those who did not report impact, mean of 46 years ($t = -4.02$; $p < 0.001$). Males reported less impact of UTIs on quality of life than did females, i.e., 2.7 versus 3.7 on the 10-point scale ($t = -3.1$; $p = 0.002$). There was a positive relationship between number of UTIs and impact of UTIs on quality of life, ($r = 0.59$; $p < 0.001$).

Several other variables were significantly associated with the impact of UTIs on the quality of life response; these included 'number of days ill per UTI episode' ($r = 0.36$; $p < 0.001$), 'number of days lost to UTIs in past 12 months' ($r = 0.42$; $p < 0.001$), 'number of times refrained from social activities for UTI in past

TABLE 4. Impact of UTIs on quality of life

Variable	Beta	Standard error	p-value
(Constant)	-	2.192	0.000
UTI (square root transformed)	1.522	0.119	0.000
Times refrained from social activities	1.409	0.174	0.000
Number of days ill due to UTI episode	0.327	0.064	0.000
Number of days lost due to UTIs in 12 months	0.112	0.055	0.044

12 months' ($r = 0.54$; $p < 0.001$), and 'number of days hospitalized for UTIs in last 12 months' ($r = 0.20$; $p < 0.001$). These variables were used to build a linear regression model of urological factors associated with reduced quality of life. The multivariable model that best describes the impact of UTIs on quality of life is shown in Table 4. The R-square for this model was 0.55, which indicates that 55% of the variability in the impact of UTIs on quality of life was explained by the model. The impact of UTIs on quality of life appears to be quite well predicted by this model.

Discussion

This national survey was undertaken to identify infection rates and current practices in urological care employed by individuals with voiding dysfunction as a consequence of SCI. This is the first survey of its kind and, as with any self-report methodology, there are potential limitations with respect to the accuracy of recall, and the objectivity of reporting. Self-reported rates of symptomatic infection, for example, are not subject to the rigorous diagnostic criteria usually applied in clinical studies. In the present case, many determinations of the presence of infection were based on clinical symptoms alone or with dipstick verification rather than urinalysis. Offsetting some of the limitations of self-report are the large number of respondents and the internal consistency of reporting, both of which lend credibility to the results. The intent of the study was to generate information useful for the design of future clinical trials with respect to expected rates of infection and current IC practices which are thought to influence outcomes.

Fifty-five percent (55%) of responders reported using IC and the majority of these use conventional polyvinyl chloride (PVC) catheters and employ a gel lubricant to aid insertion. Twenty six percent of those performing IC used hydrophilic catheters either regularly or occasionally. Hydrophilic catheters are typically made of polyurethane and are pre-gelled (e.g. with polyvinylpyrrolidone (PVP)) thereby obviating the need for self-lubrication with water-soluble gel. Hydrophilic catheters were developed to reduce urethral microtrauma and infection through better retention of the lubricating surface on insertion. When lubrication fails and microtrauma to the urethra occurs, the mucosal barrier against infection is compromised. There is empirical evidence of reduced infection rates in individuals with SCI using hydrophilic catheters^{8,9,15,16} and the present results showing a 9% reduction in infection rate are consistent with this. The reason why only a relatively small percentage (15%)

of IC respondents routinely use hydrophilic catheters is unclear. Lack of patient education, higher costs to the patient, and health insurance funding constraints stand out as likely considerations. Many patients had received advice regarding best practices in urological care in rehabilitation centres shortly after their injury, thus many years prior to this survey, and may not have had access to more current information.

The results of the present survey showed a significant relationship between number of catheterizations per day and UTI rate, with the infection rate reducing as the number of catheterizations per day increased. This is consistent with previous suggestions that the frequency of catheterization influences the occurrence of symptomatic bacteriuria by increasing the time that colonized urine resides in the bladder (in case of infrequent catheterization) or by increasing the risk of urethral damage when too frequent catheterization occurs.⁸ The data also confirm previous reports¹⁷ that having caregivers perform IC increases the risk of infection. The involvement of others is usually borne out of necessity in the case of patients with tetraplegia and compromised upper limb function. Neurological level of injury and severity of injury (complete or incomplete), and hence degree of independence, have individually been identified as risk factors for UTI.^{18,19}

UTI in patients with SCI most commonly results from ascending transurethral invasion of the bladder by pathogenic organisms normally present in the gut.²⁰⁻²² Ascending infection is preceded by colonization of the introitus or peri-urethral area or migration of bacteria within the urinary collection system.^{23,24} Identical bacterial species have been isolated from urine and from perineum, labia, dorsum of penis and peri-anal area in patients with SCI and it is well recognized that the introduction of catheters increases the bladder colony count.²⁵ Bacterial colonization of the skin and urethra are the primary sources of bladder inoculation by catheters; personal hygiene would therefore appear to be an important consideration in mitigating the risk of infection. In the present survey the practice of genital and/or peritoneal cleansing was indeed associated with a reduced infection rate, although the reduction in risk was not large. Perhaps surprisingly this finding differs from previous observations that meatal hygiene and perineal washing were ineffective in reducing catheter-associated bacteriuria²⁶ and that meticulous bathing of the perineum with soap had only temporary effects on reducing gram-negative colonization of the perineum.²⁷ Cleansing with antiseptic agents such as chlorhexadine and providone-iodine has been reported to be more effective than simply washing with soap.²⁸

With respect to other identified risk factors for UTI, the present survey results reaffirmed that gender is significantly associated with risk of symptomatic UTI, with females experiencing higher infection rates than males. This has usually been attributed to the shorter length of the female urethra. Similarly, the results confirmed previous reports that prophylactic use of antibiotics was not associated with reduced infection rates.^{29,30} Paradoxically, there was a significant positive correlation between use of alternative prophylactic agents such as cranberry juice, Vitamin C supplement, and extra fluid intake, and rate of UTI. Reconciliation of this paradox comes from the fact that significant correlation between a clinical variable and UTI rate does not define a causal link although it would fulfill the criteria for a "risk"; associations do not imply causality among variables. Thus the alternative prophylaxis and UTI correlation does not imply that taking alternative prophylactic agents increase the risk of UTI; instead it is more likely that individuals with the frequent occurrence of UTIs were attempting to reduce their high infection rate by employing the alternative prophylactic measures.

Multiple linear regression modeling to identify a set of predictors of infection rate was ineffective using the clinical, practice and demographic variables captured in the present survey. These variables were chosen based on previously identified risk factors, and in several instances had statistically significant univariate associations, but collectively failed to explain more than 6% of the variance in UTI rates. This raises the question of what other factors may have been influencing infection rates. Other considerations include genotypes with susceptibility to UTI as well as immunocompetence i.e. host defense mechanisms, which may or may not be compromised by SCI depending on the level and extent of injury.³¹ Comorbidities and structural factors, such as whether or not external sphincterectomy had been done, together with health service delivery factors such as access to effective primary care, and pharmacotherapeutic strategies e.g. type of antibiotics prescribed and the extent of antimicrobial resistance developed, all influence UTI occurrence and rates of infection.

Conclusion

The survey results indicate that 55% of respondents use intermittent catheterization regularly. Use of hydrophilic catheters versus uncoated catheters is associated with a reduction in infection rate. UTI rates are, however, multi-factorial and only partially

accounted for by the demographic, clinical, and lifestyle variables investigated in this study. UTIs have an impact on quality of individuals' lives in terms of their refraining from social activities, number of days ill and number of days lost from work; this is moderately well predicted by the multivariable regression model that was developed. This study illustrates the extent of IC use in community dwelling individuals with SCI living in Canada. It also identifies the extent and clinical correlates of UTI associated with IC, and helps identify areas for future research or knowledge mobilization in this area.

Disclosure

Coloplast A/S, Denmark sponsored the survey and assisted with questionnaire development and distribution. Coloplast A/S did not participate in data collection, management, analysis or interpretation. No individuals independent or associated with Coloplast A/S, will receive any financial or other remuneration linked to the outcome of this study. □

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