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Original Article

Influence of bladder management on epididymo-orchitis in patients with spinal cord injury: clean intermittent catheterization is a risk factor for epididymo-orchitis

JH Ku[1], TY Jung[1], JK Lee[1], WH Park[2] and HB Shim*[,1]

[1]*Department of Urology, Seoul Veterans Hospital, Seoul, Republic of Korea;* [2]*Department of Urology, College of Medicine, Inha University, Seoul, Republic of Korea*

Study design: Retrospective study, based on cases of spinal cord injury (SCI).
Objectives: To establish hazard ratios for risk of epididymo-orchitis in SCI.
Setting: South Korea.
Methods: A total of 140 male patients injured before 1987 were eligible for this investigation and have been followed up on a yearly basis from January 1987 to December 2003.
Results: The average age at which the lesion occurred was 24.8 years old (range, 18–53). The average time since SCI was 16.9 years (range, 1–37). A total of 34 lesions (24.3%) were complete and 106 (75.7%) were incomplete. Over the 17 years, 39 patients (27.9%) were diagnosed with epididymo-orchitis. Epididymo-orchitis was more common for patients with a history of urethral stricture (66.7 *versus* 25.2%, $P=0.014$). We also found that epididymo-orchitis was more common for patients on clean intermittent catheterization (CIC) than with indwelling urethral catheterization (42.2% *versus* 8.3%, $P=0.030$). In multivariate analysis, patients on CIC had a 7.0-fold higher risk (odds ratio, 6.96; 95% confidence interval, 1.26–38.53; $P=0.026$); however, a history of urethral stricture lost statistical significance ($P=0.074$). For other variables, no positive association with epididymo-orchitis was observed.
Conclusions: In this study, CIC was an independent risk factor for the development of epididymo-orchitis in patients with SCI. In addition, our findings suggest that urethral stricture may be a contributing factor for the development of epididymo-orchitis in these patients. Correct instructions about CIC are of utmost importance.
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Keywords: spinal cord injury; urinary catheterization; epididymo-orchitis; neurogenic bladder

Introduction

Improvement in the management of neurogenic bladder has dramatically reduced the number of deaths from urinary complications. Modern urologic teaching has supported the removal of indwelling urinary catheters in patients with spinal cord injury (SCI). Retrospective analyses of the urologic status of Vietnam War veterans with SCI have consistently shown decreased renal death as compared with previous spinal cord-injured populations, this being attributed to catheter-free status.[1,2] Clean intermittent catheterization (CIC) is the safest bladder management method in spinal cord-injured patients in terms of urological complications.[3] However, many factors should be considered when electing bladder management, including patient convenience and prevention of other potential urological complications as well as renal function preservation.

The consequences of genital infection on procreation are dramatic, including an increase in the incidence of azoospermia.[4] Epididymo-orchitis is one of the common genital infections in SCI. Although the exact mechanism involved in the development of epididymo-orchitis is currently unknown, the process is believed to be common to patients on CIC, as previous studies have highlighted a strong occurrence of epididymo-orchitis after several years of CIC.[5,6] However, the literature on the influence of bladder management method on epididymo-orchitis is sparse. Furthermore, the results have exhibited clinical differences from setting to setting among these patients.[3] We decided to establish by formal statistical analysis hazard ratios for risk of epididymo-orchitis in spinal cord-injured patients including Korean War veterans (1950–1953) with prolonged follow-up.

*Correspondence: HB Shim, Department of Urology, Seoul Veterans Hospital, 6-2, Doonchon-2-dong, Kangdong-gu, Seoul 134-791, Republic of Korea

Materials and methods

We retrospectively reviewed the medical records of all patients with post-traumatic SCI, who had received continuous long-term urologic care at our hospital from January 1987 to December 2003. The criteria for inclusion in this study are as follows: (1) male patients, (2) age at injury: 18 years or above, (3) a discernible neurologic lesion, (4) traumatic SCI, (5) either spontaneous voiding or neurogenic bladder managed by CIC, suprapubic cystostomy or indwelling urethral catheter, (6) injured before 1987, and (7) patients who are followed up from 1987 to 2003. If patients missed two or more consecutive annual visits, or underwent ileal conduit or bladder augmentation, they were excluded from the study. A total of 140 patients were eligible for this investigation and have been followed up on a yearly basis.

To minimize confusion due to this necessary variable patients were assigned a predominant method of bladder management based on the chart documented technique used for the majority of time since the injury, as described by Weld and Dmochowski.[3] Bladder management methods included spontaneous voiding in 47 cases, CIC in 33, suprapubic cystostomy in 36, and chronic urethral catheterization in 24. Those with an indwelling catheter (suprapubic cystostomy or urethral catheterization) routinely underwent catheter exchange monthly. Plain film radiographs of the kidneys, ureters, and bladder were routinely performed to check for the presence of stones at each annual evaluation and whenever stones were clinically suspected throughout the year. The presence or absence of vesicoureteral reflux was determined by the video portion of urodynamic studies and/or voiding cystourethrography.

Overall comparisons for categorical variables were conducted using Fisher's exact test, χ^2 test, or the Armitage test to determine differences among groups. Multivariate logistic regression analysis was performed to examine the relation of each variable with epididymo-orchitis, as measured by the adjusted odds ratio, and 95% confidence interval was presented to indicate the precision of effect estimates. Potential confounding variables were included in multivariate models for adjustment. The final parsimonious model for epididymo-orchitis contained patient age at injury, duration of SCI, injury characteristics (level and completeness), types of bladder drainage, urinary stones, and vesicoureteral reflux. In this model, age at injury and duration of SCI were categorized into two groups according to median values of each variable, respectively. A probability of less than 5% was considered to be statistically significant and all statistical tests were two sided. Statistical analyses were performed using a commercially available analysis program, Statistical Package for Social Sciences, version 10.0 (SPSS, Chicago, IL, USA).

Results

Baseline clinical characteristics are summarized in Table 1. The average age at which the lesion occurred was 24.8 years old (median, 24; range, 18–53). The average time since SCI was 16.9 years (median, 18; range, 1–37). The duration of SCI was longest in the suprapubic cystostomy group and shortest in the urethral catheterization group ($P=0.033$). A total of 34 lesions (24.3%) were complete and 106 (75.7%) were incomplete. An equal proportion of patients with injury level were included in each group.

Over the 17 years, 39 patients (27.9%) were diagnosed with epididymo-orchitis. Epididymo-orchitis was more common for patients with a history of urethral stricture (66.7 *versus* 25.2%, $P=0.014$). We also found that epididymo-orchitis was more common for patients on CIC than with indwelling urethral catheterization (42.2 *versus* 8.3%, $P=0.030$). In multivariate analysis, patients on CIC had a 7.0-fold higher risk (odds ratio, 6.96; 95% confidence interval, 1.26–38.53, $P=0.026$); however, a history of urethral stricture lost statistical significance ($P=0.074$). For other variables, no positive association with epididymo-orchitis was observed. Results of logistic regression analyses for epididymo-orchitis are presented in Table 2.

Urethral stricture developed in 0.0% (0 of 24 patients) on chronic urethral catheterization, in 4.3% (two of 47) who voided spontaneously, 18.2% (six of 33) on CIC, and 2.8% (one of 36) on suprapubic systostomy ($P=0.015$, Figure 1).

Discussion

Long-term survival of patients with SCI is dependent on regular and close follow-up to detect complications and coexistent urologic conditions, combined with proper management. Since immediate postinjury care and long-term rehabilitation have advanced, renal failure is no longer the leading cause of death among persons with SCI.[7] CIC is an established technique for managing neuromuscular dysfunction of the lower urinary tract in patients with SCI. However, although CIC is generally considered safe, it may cause some urethral complications that can make further catheterization more difficult.

To date, because many studies have reported the results within several years after injury, it is not known which factors may contribute to the development of epididymo-orchitis long after injury. In addition, factors that control the development of epididymo-orchitis after SCI remain uncertain since various causal elements may have different roles in the causal pathway depending on the duration after injury. In the present study, CIC was an independent risk factor for the development of epididymo-orchitis. Mirsadraee *et al*[8] revealed that the presence of a history of muscular spasm decreased the risk of epididymo-orchitis, while other historical risk factors showed no clear relationship with epididymo-orchitis. Furthermore, contrary to our study, Weld and Dmochowski[3] demonstrated that the urethral catheterization group had a significantly higher incidence of epididymitis and urethral stricture disease than all other management groups including the CIC group.

Table 1 Clinical parameters

Parameters	*UC*	*SV*	*CIC*	*SPC*	P-*value*
No. of patients	24	47	33	36	
Age at injury (years)	22 (19–39)	23 (18–40)	23 (18–53)	23.5 (18–50)	0.491†
Age group at injury					0.254‡
<24 years	18 (75.0%)	25 (53.2%)	21 (63.6%)	18 (50.0%)	
⩾24 years	6 (25.0%)	22 (46.8%)	12 (36.4%)	18 (50.0%)	
Duration of SCI (years)*	19 (7–34)[a]	17 (2–35)[a,b]	19 (2–37)[a,b]	11.5 (1–35)[a]	0.033†
Duration group of SCI					0.687‡
<18 years	8 (33.3%)	25 (53.2%)	10 (30.3%)	24 (66.7%)	
⩾18 years	16 (66.7%)	22 (46.8%)	23 (69.7%)	12 (33.3%)	
Level of injury					0.659‡
Cervical	7 (29.2%)	15 (31.9%)	3 (9.1%)	14 (38.9%)	
Thoracic	13 (54.2%)	24 (51.1%)	24 (72.7%)	17 (47.2%)	
Lumbar	4 (16.7%)	8 (17.0%)	6 (18.2%)	5 (13.9%)	
Completeness of injury					0.373‡
Incomplete	20 (83.3%)	34 (72.3%)	25 (75.8%)	27 (75.0%)	
Complete	4 (16.7%)	13 (27.7%)	8 (24.2%)	9 (25.0%)	
Mechanism of injury					0.139‡
Traffic accident	9 (37.5%)	21 (44.7%)	14 (42.4%)	18 (50.0%)	
Fall	3 (12.5%)	18 (38.3%)	6 (18.2%)	11 (30.6%)	
Gunshot wound	8 (33.3%)	6 (12.8%)	10 (30.3%)	5 (13.9%)	
Others	4 (16.7%)	2 (4.3%)	3 (9.1%)	2 (5.6%)	

UC, urethral catheterization; SV, spontaneous voiding; CIC, clean intermittent catheterization; SPC, suprapubic cystostomy; SCI, spinal cord injury
*Years from the injury to the start of the study (1987)
[a,b]The same letters indicate nonsignificant difference between groups based on multiple comparison test
†Kruskal Wallis test
‡Armitage test
Data presented are median (range) or number (%)

It is difficult to interpret, but a number of possible explanations for our results exist. It must be remembered that differences remain between the studies in terms of study design, age groups evaluated, exclusion criteria, and follow-up duration. However, our findings are supported by the results indicating that some patients may develop urethral stricture as a result of frequent urethral trauma.[9] Persistent attempts at blind catheterization usually lead to further urethral bleeding and creation of a false passage in the urethra, while the late sequela of these forced blind attempts at urethral catheterization is formation of a urethral stricture at the site of the previous urethral trauma.[10,11] Several studies show that repeat catheter introduction induces local traumatic reactions of the urethral wall, especially in male patients who have performed catheterization for more than 1 year.[12–14] A review of 21 patients who had been performing CIC for over 5 years showed a rate of urethral stricture of 19% and of epididymitis of 28.5%.[5] Although urinary tract infection was not included in our statistical analysis, it is well known that CIC involves a lower incidence of urinary tract infections than indwelling catheterization. Thus, our findings suggest that urethral stricture may be a contributing factor for the development of epididymo-orchitis in spinal cord injured patients, although it was not a statistically independent risk factor.

Although urethral complications may not in themselves represent high morbidity, they may easily lead to more serious problems such as life-threatening urosepsis and, in general, may cause added difficulty in daily patient care. Unfortunately, in some patients, urethral trauma from repeated catheterizations and mechanical problems related to manual dexterity may preclude use of clean intermittent catheteriztion, and continuous urinary drainage must be instituted. However, our findings do not represent that urethral catheterization is superior to CIC. CIC is superior for preserving bladder compliance and preventing upper tract complications that may develop due to low compliance.[15] Consequently, the introduction of CIC has greatly enhanced the long-term survival of individuals with SCI.

Using hydrophilic catheters for CIC may induce lower rates of bacteriuria and long-term urethral complications such as urethral stricture[16] and thus, would reduce the risk of epididymo-orchitis.[17,18] However, a comparative study is necessary to definitely determine the placement of the hydrophilic catheter. Preferably,

Table 2 Multivariate risk factors of epididymo-orchitis

Parameters	*Incidence*	P-*value*	*Adjusted OR (95% CI)*	P-*value*
Age at injury (years)		0.658*		
<24	24/82 (29.3%)		1.000	
⩾24	15/58 (25.9%)		0.600 (0.253–1.425)	0.247
*Duration of SCI (years)**		0.899*		
⩾18	19/67 (28.4%)		1.000	
<18	20/73 (27.4%)		1.014 (0.412–2.500)	0.975
Level of injury		0.118†		
Cervical	8/39 (20.5%)		1.000	
Thoracic	22/78 (28.2%)		1.483 (0.526–4.180)	0.456
Lumbar	9/23 (39.1%)		2.803 (0.774–10.151)	0.116
Completeness of injury		0.518*		
Incomplete	31/106 (29.2%)		1.000	
Complete	8/34 (23.5%)		0.652 (0.240–1.768)	0.401
Bladder stone		0.954*		
No	28/101 (27.7%)		1.000	
Yes	11/39 (28.2%)		1.437 (0.535–3.856)	0.472
Renal stone		0.654*		
No	34/119 (28.6%)		1.000	
Yes	5/21 (23.8%)		1.210 (0.341–4.298)	0.768
Urethral stricture		0.014‡		
No	33/131 (25.2%)		1.000	
Yes	6/9 (66.7%)		4.046 (0.873–18.751)	0.074
VUR		0.060*		
No	31/123 (25.2%)		1.000	
Yes	8/17 (47.1%)		1.762 (0.307–10.099)	0.525
Bladder management		0.030†		
UC	2/24 (8.3%)		1.000	
SV	13/47 (27.7%)		4.488 (0.842–23.927)	0.079
CIC	14/33 (42.2%)		6.962 (1.258–38.527)	0.026
SPC	10/36 (27.8%)		4.122 (0.710–23.912)	0.114

OR, odds ratio; CI, confidence interval; SCI, spinal cord injury; VUR, vesicoureteral reflux; UC, urethral catheterization; SV, spontaneous voiding; CIC, clean intermittent catheterization; SPC, suprapubic cystostomy
*χ^2 test
†Armitage test
‡Fisher's exact test

correct instructions about CIC are of utmost importance for reducing urethral complications and subsequently epididymo-orchitis. Spinal cord-injured patients are often prone to be mentally and/or physically limited. Therefore, it demands specially trained medical resources as well as enough time to give the patients the relevant information and to train them to acquire a proper CIC technique. Wyndaele[19] suggested that the most important measures were a good education of all factors involved in intermittent catheterization, good patient compliance, the use of proper materials, and the application of a good catheterization technique.

To our knowledge, this study included patients with the longest duration of SCI to investigate risk of epididymo-orchitis. However, the retrospective nature of our study subjects it to several limitations. First, because of constraints with our existing database, the present study was unable to address the influence of other factors, including bladder characteristics. Second, this study was unable to control for the fact that initial bladder management methods after injury could have influenced variables used as outcome measures in the analysis. Third, the issue of urinary tract infection was not addressed in this study, since there is no consensus as to the definition of a symptomatic urinary tract infection, or when or which urinary tract infections should be treated in spinal cord-injured patients.[20] However, because methods of urinary drainage were considered and such methods are important risk factors for urinary tract infection, the potential impact of

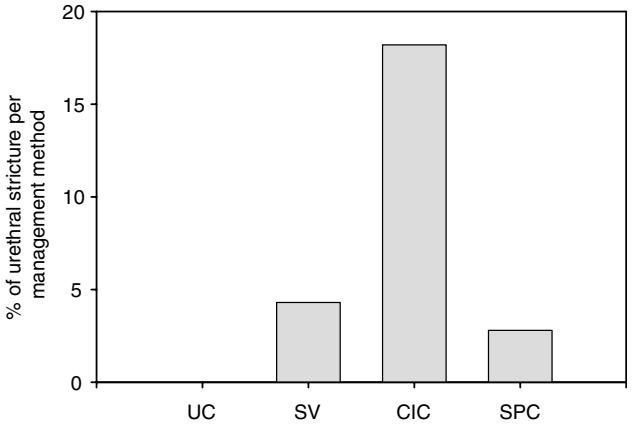

Figure 1 Percent of patients with urethral stricture by bladder management method ($P = 0.015$). UC, urethral catheterization; SV, spontaneous voiding; CIC, clean intermittent catheterization; SPC, suprapubic cystostomy

urinary tract infection is likely to have been appropriately adjusted for this study. Fourth, some of the insignificant variables, particularly those with *P*-values closer to 0.05 might have had statistical association if our study had covered a larger patient group. Additional research, including prospective randomized trials, is needed to clarify the association. Finally, our study is limited because each patient was categorized by a predominant bladder management, defined as the method used for the majority of time since injury. Most likely, the strict categorization of patients into a single predominant bladder management group introduced experimental error. However, the large number of patients and short period of nondominant bladder management relative to the overall follow-up interval helped to minimize the influence of this variable.[3]

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