

Voiding Dysfunction

Rethinking Suprapubic Cystostomy in Voiding Dysfunction: New Trial with Timed Drainage

Hyeung Chul Park, Jeong Hwan Son, Seok Heun Jang

Department of Urology, Bundang Jesaeng Hospital, Seongnam, Korea

Purpose: Today, many patients with voiding dysfunction select suprapubic cystostomy (SPC) instead of clean intermittent catheterization (CIC) for practical reasons. There is thus a need to reconsider SPC as a management for voiding dysfunction. We designed SPC with timed drainage (TSPCD) and evaluated its effectiveness compared with continuous drainage with a urine bag (CSPCD).

Materials and Methods: Between January 2006 and January 2010, a total of 82 patients underwent SPC. Patients undergoing SPC were randomly assigned to CSPCD or TSPCD. Patient characteristics, complications, and the results of urine cultures were compared between the two groups through retrospective chart reviews. Also, preferences for CSPCD and TSPCD in another 15 patients who had experienced both CSPCD and TSPCD were investigated.

Results: The CSPCD and TSPCD groups comprised 46 and 36 patients, respectively. In a comparison of complications between the two groups, the incidence of acute symptomatic cystitis was significantly lower in the TSPCD group than in the CSPCD group (43% vs. 20%, $p=0.032$). The incidence of symptomatic urinary tract infection (UTI) was lower in the TSPCD group. Positive urine culture rates were 89.7% and 72.4% in groups 1 and 2, respectively. There was a significant difference between the two groups ($p=0.004$). In another 15 patients who experienced both CSPCD and TSPCD, 14 patients (93%) stated a preference for TSPCD after converting from CSPCD to TSPCD, and one patient (7%) returned to CSPCD only at night.

Conclusions: In this study, TSPCD had the advantages of less morbidity as UTI and being more preferable by patients with relatively good daily activity compared with CSPCD. TSPCD is an alternative to CSPCD for the treatment of voiding dysfunction.

Key Words: Cystostomy; Dysfunction; Urinary bladder

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Corresponding Author:

Jeong Hwan Son
Department of Urology, Bundang
Jesaeng Hospital, 255-2,
Seohyeon-dong, Bundang-gu,
Seongnam 463-774, Korea
TEL: +82-31-779-0165
FAX: +82-31-779-0929
E-mail: sjhwany@hanmail.net

INTRODUCTION

Today, the prevalence of voiding dysfunction has increased. One of the reasons for this increasing prevalence is the aging of modern society. Aging people have many underlying diseases such as diabetes mellitus, cardiac disease, and cerebral infarction that can cause voiding dysfunction. Another reason for the increasing incidence is the increasing risk of disability due to trauma in everyday life.

The optimal method of bladder management for voiding dysfunction should preserve renal function and minimize

urinary tract complications. Additionally, patients' comfort, convenience, and quality of life are important factors to be considered. Bladder management alternatives include clean intermittent catheterization (CIC), urethral indwelling catheter, suprapubic cystostomy (SPC), and urethral sphincterotomy [1,2].

With the introduction of CIC by Lapedes et al, CIC revolutionized the management of voiding dysfunction [3]. Published guidelines regard CIC as the gold standard for the bladder management of voiding dysfunction [4-6]. However, many patients with voiding dysfunction select

an indwelling catheter instead of CIC for various reasons such as failure of CIC, irreparable urethral damage, progression of the original disease, failure of Crede's maneuver, lack of a caregiver to aid with this technique, or poor upper extremity dexterity [1,7-9].

Considering that many patients with voiding dysfunction currently select SPC, there is a need to find ways to reduce SPC-related complications and to make this daily activity more convenient. We have therefore designed a new trial called SPC with timed drainage (TSPCD).

MATERIALS AND METHODS

This study was intended for patients who underwent and maintained SPC because of voiding dysfunction for more than 6 months from January 2006 to January 2010.

Patients with voiding dysfunction and their caregivers were initially advised to perform CIC after training. After the patients or caregivers had practiced CIC by themselves for 7 days, they made their decision as to whether to continue CIC or switch to another method. If they wanted to continue CIC, they were closely monitored through the outpatient clinic. If they could not continue CIC and wanted to switch to another method, SPC was offered. During the diagnostic workup, patients who had any upper urinary tract abnormality, vesicoureteral reflux, or upper spinal cord injury that caused detrusor hyper-reflexia were excluded because we did not think that TSPCD could be applied in those cases. Inclusion criteria in the urodynamic study were detrusor areflexia, detrusor underactivity, and voiding dysfunction patients who had more than 70% residual urine. At the time of diagnosis, a total of 114 patients were completely educated about CIC. Among them, 56 patients wanted to switch to another method immediately after starting CIC. Additionally, 26 patients underwent SPC later in the course of monitoring through the outpatient clinic (Fig. 1). In total, 82 patients underwent SPC and were

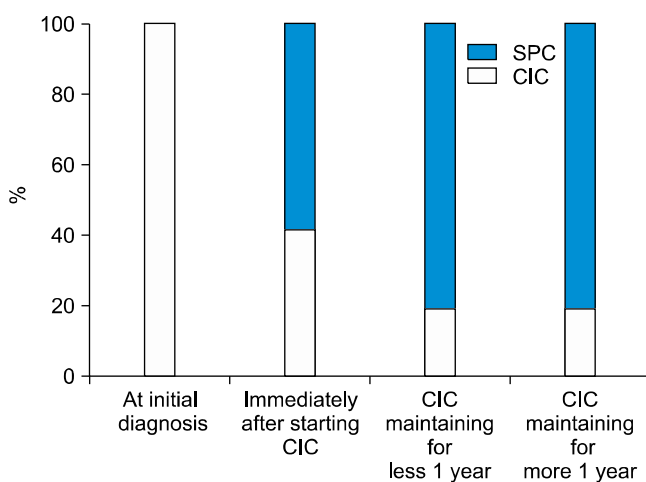


FIG. 1. Longitudinal changes in bladder management for voiding dysfunction in this study. SPC: suprapubic cystostomy, CIC: clean intermittent catheterization.

included in this study.

Patients who underwent SPC were randomly assigned to continuous drainage with a urine bag (continuous suprapubic cystostomy drainage, CSPCD; group 1) or timed drainage at 4-5-hour intervals through a stopper applied on the catheter without a urine bag (TSPCD: timed suprapubic cystostomy drainage, group 2). During the above period, TSPCD was prescribed by one clinician; another clinician prescribed only CSPCD. The SPC catheter was routinely changed every 4 weeks, and incidental changes were made in the case of any catheter-related symptoms and signs. For urine analysis and urine cultures, the first drained urine immediately after SPC catheter change was collected. Each time the catheter was changed, the patients were reminded to perform bladder irrigation twice per week. There were no routine uses of anticholinergics or antibiotics in this study.

Symptomatic urinary tract infection (UTI) was defined by any clinical symptoms and signs (fever, chill, suprapubic pain, flank pain, painful scrotal swelling, etc.) with positive urine culture.

Patient characteristics including World Health Organization (WHO) performance scores and urodynamic parameters, complications, urine analysis, urine cultures, and changes in serum creatinine for the two groups were investigated through retrospective chart reviews.

Also, preferences for CSPCD and TSPCD in another 15 patients who had experienced both CSPCD and TSPCD were investigated. The patients were questioned as to why they preferred each method.

For statistical analysis, the Statistical Package for the Social Sciences SPSS ver. 15 (SPSS Inc., Chicago, IL, USA) program, Student's t-test, chi-square test, and Fisher's exact test were used. Also, the paired t-test was used for changes in urine pH and serum creatinine. Significance was accepted at p-values of less than 0.05.

RESULTS

Group 1 comprised 46 patients, with a mean age at the time of SPC of 70.6 years (range, 47-89 years) and a mean follow-up interval of 23.1 months. Group 2 comprised 36 patients with a mean age at the time of SPC of 62 years (range, 49-93 years) and a mean follow-up interval of 21.4 months. Patient characteristics including mean WHO performance status score and baseline urodynamic parameters were not significantly different between the two groups (Table 1). The indications for SPC are shown in Table 2. The most common indication in this study was diabetic cystopathy.

Table 3 shows the incidence of urological complications in the two groups. Since SPC, 72 episodes of urological complications occurred in 27 patients of group 1, and 31 episodes of urological complications occurred in 12 patients of group 2. The incidence of acute symptomatic cystitis in group 2 was significantly lower than in group 1 (43% vs. 20%, $p=0.032$). Also, the incidences of the other complications were higher in group 1 than in group 2 except for epididymo-orchitis, although these differences were not signifi-

TABLE 1. Characteristics of the patients in the two groups

	Group 1 (CSPCD)		Group 2 (TSPCD)		p-value
	Mean±SD	Range	Mean±SD	Range	
No. of patients	46		36		
Sex ratio (male:female)	1.8:1		1.7:1		0.114 ^a
Mean age (yr)	70.6±9.7	47-89	62±8.9	49-93	0.267 ^b
Mean follow-up (mo)	23.1±10.1	6-34	21.4±9.9	6-35	0.187 ^b
Mean WHO performance scores	1.61±0.75	1-3	1.51±0.69	1-3	0.366 ^b
Baseline urodynamic parameters					
Maximal capacity (ml)	614.3±135.3	335-680	710.3±119.6	352-790	0.121 ^b
Compliance (ml/cmH ₂ O)	70.2±21.6	14.2-90.4	72.7±22.3	15.6-89.5	0.392 ^b
Qmax (ml/s)	2.7±3.5	0-8.7	2.9±3.3	0-7.6	0.457 ^b
Pdet at Qmax (cmH ₂ O)	5.9±8.1	0-24	6.4±8.9	0-27	0.434 ^b
Voided volume (ml)	36.4±46.9	0-112.5	34.9±47.5	0-108.9	0.460 ^b
PVR (ml)	599.8±157.6	309-680	676.9±141.8	336-790	0.173 ^b

CSPCD: continuous suprapubic cystostomy drainage, TSPCD: timed suprapubic cystostomy drainage, WHO: World Health Organization, Qmax: maximal flow rate, Pdet at Qmax: detrusor pressure at maximal flow rate, PVR: postvoid residual, ^a: chi-square test, ^b: Student's t-test

TABLE 2. Indications for SPC in the two groups

Diagnosis	No. of patients (%)	
	Group 1 (CSPCD)	Group 2 (TSPCD)
Diabetic cystopathy	19 (41.4)	15 (41.6)
Inoperable benign prostatic hyperplasia	11 (23.9)	9 (25)
Cerebrovascular accident	7 (15.3)	8 (22.2)
Lower spinal cord injury	3 (6.5)	2 (5.6)
Parkinsonism	2 (4.3)	1 (2.8)
Spinal stenosis	2 (4.3)	1 (2.8)
Prostate cancer	2 (4.3)	0
Total	46 (100)	36 (100)

SPC: suprapubic cystostomy, CSPCD: continuous suprapubic cystostomy drainage, TSPCD: timed suprapubic cystostomy drainage

TABLE 3. Urological complications in the two groups

Complications	Group 1 (CSPCD)		Group 2 (TSPCD)		p-value
	No. of patients (%)	No. of episodes	No. of patients (%)	No. of episodes	
Acute cystitis (symptomatic)	20 (43)	35	7 (20)	12	0.032 ^{a,b}
Acute pyelonephritis	5 (11)	9	1 (2)	2	0.178 ^c
Catheter blockage	7 (15)	10	5 (14)	7	0.561 ^c
Urethral leakage	3 (6)	6	2 (5)	4	0.628 ^c
Bladder stone	4 (8)	6	1 (2)	2	0.382 ^c
Skin infection	3 (6)	4	3 (8)	3	0.542 ^c
Sepsis	2 (4)	2	0	0	0.316 ^c
Epididimo-orchitis	0	0	1 (2)	1	0.447 ^c
Total	27	72	12	31	

CSPCD: continuous suprapubic cystostomy drainage, TSPCD: timed suprapubic cystostomy drainage, ^a: chi-square test, ^b: p < 0.05, ^c: Fisher's exact test

ficant. Total episodes of complications were greater in group 1 than in group 2, numbering 72 and 31 in groups 1 and 2, respectively. In particular, the incidences of bladder stone and sepsis, which were serious complications and re-

quired careful management, were much higher in group 1 than in group 2. But, these differences were not statistically significant (p=0.382, p=0.316).

Table 4 shows the outcome of the urine cultures in both

TABLE 4. Urine culture results in the two groups

Microorganisms ^a	No. of positive urine cultures ($\geq 10^5$ CFU/ml)		p-value ^b
	Group 1 (CSPCD)	Group 2 (TSPCD)	
Gram-negative	77	39	
<i>Pseudomonas aeruginosa</i>	8	3	
<i>Escherichia coli</i>	10	4	
<i>Klebsiella pneumoniae</i>	7	2	
<i>Proteus</i> species	3	1	
<i>Enterobacter</i> species	2	2	
<i>Acinetobacter</i> species	10	3	
<i>Stenotrophomonas</i>	8	8	
<i>Citrobacter</i> species	13	6	
<i>Serratia</i> species	11	6	
<i>Burkholderia</i> species	5	4	
Gram-positive	19	11	
<i>Staphylococcus aureus</i>	3	1	
<i>Enterococcus</i> species	2	1	
<i>Candida</i> species	10	7	
<i>Trichosporon</i> species	4	2	
Total	96	50	
Positive urine culture rate	89.7% (96/107)	72.4% (50/69)	0.004 ^c

CSPCD: continuous suprapubic cystostomy drainage, TSPCD: timed suprapubic cystostomy drainage, CFU: colony-forming unit, ^a: the dominant microorganism is presented for cases of multiple microorganisms, ^b: chi-square test, ^c: $p < 0.05$

groups. A total of 107 and 69 urine cultures were done in groups 1 and 2. Positive urine culture rates were 89.7% (96/107) and 72.4% (50/69) in groups 1 and 2, respectively. More bacteriuria developed in group 1 than in group 2, and the difference was statistically significant ($p=0.004$). Concerning the outcomes of urine cultures, 77 and 39 g negative bacterial cultures were isolated in groups 1 and 2, respectively. More gram-negative than gram-positive bacteria were isolated from urine in both groups.

In group 1, urine pH levels before SPC and at least 6 months after SPC were 6.21 ± 0.17 and 6.51 ± 0.34 ($p=0.096$), respectively; in group 2, these values were 6.65 ± 0.25 and 6.72 ± 0.41 ($p=0.066$), respectively. In group 1, serum creatinine levels before SPC and at least 6 months after SPC were 1.17 ± 0.08 and 1.27 ± 0.11 ($p=0.058$), respectively; in group 2, these values were 1.26 ± 0.19 and 1.06 ± 0.14 ($p=0.072$), respectively. There were no significant changes in urine pH or serum creatinine in the two groups.

In the investigation of preferences for CSPCD and TSPCD, from a group of 15 patients who had experienced both CSPCD and TSPCD, 14 patients (93%) expressed a preference for TSPCD because of greater convenience for daily activity after converting from CSPCD to TSPCD. One patient (7%) returned to CSPCD only at night because of nighttime awakening for drainage. Most of the patients showed relatively good daily activity (1.53 ± 0.74) according to WHO performance status.

DISCUSSION

CIC is still considered the ideal management for voiding

dysfunction if the patient is willing and is physically and mentally able to perform the task or has caregivers who are able to assist [4-6]. This is due to the increasing possibility of complications associated with indwelling catheterization compared with CIC, such as UTI, renal failure, bladder and ureter stones, urethral fistulas, strictures and erosions, and bladder cancer [9-12].

However, at present, SPC is often used to treat voiding dysfunction because of its purported benefits and convenience. Cameron et al reported a trend that during follow-up, 80% of spinal cord injury patients on CIC switched to an indwelling catheter [9]. These trends reflect the fact that CIC requires additional effort that may not be feasible for certain patients in the long term [9]. In this study, 49% of the patients (56/114) gave up CIC immediately after starting CIC, and 23% of the patients (26/114) switched from CIC to SPC in the outpatient clinic after less than 1 year. Only 28% of the patients (26/114) who initially started CIC maintained it, even though this was a short follow-up. The reasons for selecting SPC immediately after starting CIC were patient unwillingness, poor performance, and mental retardation. Reasons for switching to SPC during maintenance of CIC included severe damage to the urethra, worsening of general condition, persistent incontinence, and recurrent epididymitis (Table 5). The main reason for selecting SPC was patient unwillingness. The result reflects the characteristics of modern society, such as the nuclear family, the graying of society, and an increasing desire for independent social activity and daily life.

SPC often causes UTIs such as acute cystitis, acute pyelonephritis, epididymo-orchitis, and even sepsis. Also, SPC can

TABLE 5. Reasons for selecting SPC instead of CIC

Causes	No. of patients
Immediately after starting CIC	56
Patients' unwillingness	37
Poor performance	17
Mental retardation	2
During maintenance of CIC	26
Severe damage to urethra	14
Worsening of general condition	6
Patients' unwillingness	3
Persistent incontinence	2
Recurrent epididymitis	1
Total	82

SPC: suprapubic cystostomy, CIC: clean intermittent catheterization

cause complications such as blocking of the catheter, urethral leakage, bladder stone, and skin infections [1,2,7-14]. However, there was little increase in the risk of complications with SPC compared with CIC in a recent review of contemporary management in which antimuscarinics, frequent catheter changes, and bladder washes were used [1,2,7,8].

In light of these recent trends and practical views, it is necessary to be concerned about how to reduce SPC-related complications. With reduced complications, it is possible to present patients with a more convenient and safe voiding method. In this study, we designed TSPCD as a method that can maintain a physiologic and periodic bladder filling and emptying cycle and thus reduce the chance of ascending infection via the urine-collecting bag. We found that the incidences of UTI and bacteriuria were reduced with TSPCD.

Bacterial adherence to the uroepithelium is recognized as an important mechanism in the initiation and pathogenesis of UTI. There are several anti-adherence mechanisms of UTI, which include the normal bacterial flora, urinary oligosaccharides, uromucoids, bladder mucopolysaccharides, and urinary immunoglobulins, for example. Also, exfoliation of infected epithelial cells and the mechanical effect of flushing during bladder emptying and peristalsis play most important roles in the anti-adherence mechanism [15].

Regarding anti-adherence mechanisms, TSPCD has an effect of maintaining the natural mechanical washout effect during bladder emptying and peristalsis. This effect will be helpful to increase the excretion of infected epithelial cells and reduce the chances for bacterial colonization. Since the introduction of closed drainage systems, the incidence of catheter-associated UTI via ascending routes has been reduced. Barford et al reported in an experimental model that most bacteria gain access to the bladder along the outside of the catheter [16]. However, their study included data from a short period of up to 5 days. They commented that after 4 days significant bacterial growth appeared on the inside of the catheter, and after

long periods, more bacteria can grow inside than outside, which might be due to the absence of immune cells or simply more nutrients in the urine [16]. Therefore, getting rid of the urine bag in cases of a long period catheterization could reduce the chances of bacterial colonization and further ascending infection via the urine bag. TSPCD in comparison with CSPCD, in which the indwelling catheter is always in direct contact with the contracted bladder mucosa, can reduce bladder mucosal damage by diminishing the direct contact between the bladder mucosa and the indwelling catheter. As a result, TSPCD is helpful for maintaining the innate mucosal immune system of the bladder.

The rate of bacteriuria in this study was higher in group 1 than in group 2 (89.7% vs 72.4%). We found a lower rate of positive urine cultures in the TSPCD group than did Kang and Choi (72.4% vs 92.7%) [17]. This result reflects the fact that TSPCD was associated with fewer colonized microorganisms than CSPCD. This result can also be explained by the reasons previously discussed above.

SPC results in a high patient satisfaction rate according to the following literature. The most recent and largest retrospective analysis by Ahluwalia et al examined 219 patients with SPC catheters over 50 months [18]. Overall, with the use of an invalidated questionnaire, their patient cohort had a satisfaction rating of 71% [18]. Sheriff et al also reported a high satisfaction rate with the use of an invalidated questionnaire [19]. Of their patients, 99% and 70% reported a 7/10 and 9/10 satisfaction score, respectively. Also, 82% of their patients reported that SPC insertion had positively improved their quality of life and 79% would strongly recommend this type of long-term bladder drainage to other patients [19].

In this study, although satisfaction between the two groups was not compared by use of a validated questionnaire, a preference for TSPCD in relation to the convenience of daily activity was shown.

Our study had limitations in that it was a retrospective study in one medical center and had a relatively small size, but we saw encouraging results for symptomatic UTI with the new trial. Because of the relatively short-term follow-up, the evidence from our study concerning the incidence of complications other than symptomatic UTI may have been weak. Therefore, additional prospective, randomized trials are needed to ascertain the effectiveness of TSPCD. Future research that includes urodynamic follow-up, upper tract function follow-up, and comparison of satisfaction between CSPCD and TSPCD by validated questionnaire would be able to more clearly ascertain the effectiveness of TSPCD. Another weakness of this study is that the patients included had relatively good daily activity. Their relatively good daily activity may have affected their preference for TSPCD. Further studies of patients with poor daily activity, such as those with higher spinal cord injury or severe cerebrovascular sequelae, would be meaningful.

CONCLUSIONS

CIC is still considered the ideal management for voiding dysfunction. Nevertheless, SPC is currently more frequently used owing to its convenience and the increased failure of CIC. Also, recent retrospective series about complication rates for SPC compared with CIC have demonstrated clinically acceptable results. Therefore, SPC can be considered as an appropriate option for voiding dysfunction. In these circumstances in which SPC is generally accepted as a treatment method, there is a need to focus on ways to reduce the complications related to SPC.

In this preliminary study, we found that TSPCD had the advantages of less morbidity as UTI and being more preferable to patients with relatively good daily activity compared with CSPCD. TSPCD can be considered as an alternative to CSPCD for the treatment for voiding dysfunction, even though more research on this method is needed.

Conflicts of Interest

The authors have nothing to disclose.

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