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ORIGINAL ARTICLE

Urethral versus suprapubic catheter: choosing the best bladder management for male spinal cord injury patients with indwelling catheters

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Objective: Bladder management for male patients with spinal cord injury (SCI) challenges the urologist to work around physical and social restrictions set forth by each patient. The objective of this study was to compare the complications associated with urethral catheter (UC) versus suprapubic tube (SPT) in patients with SCI.

Methods: A retrospective review of records at Long Beach Veterans Hospital was carried out to identify SCI patients managed with SPT or UC. Chart review identified morbidities including urinary tract infection (UTI), bladder stones, renal calculi, urethral complications, scrotal abscesses, epididymitis, gross hematuria and cancer. Serum creatinine measurements were evaluated to determine whether renal function was maintained.

Results: In all, 179 patients were identified. There was no significant difference between the two catheter groups in any areas in which they could be compared. There were catheter-specific complications specific to each group that could not be compared. These included erosion in the UC group and urethral leak, leakage from the SPT and SPT revision in the SPT group. Average serum creatinine for the UC and SPT groups was 0.74 and 0.67 mg per 100 ml, respectively.

Conclusion: SCI patients with a chronic catheter have similar complication rates of UTIs, recurrent bladder/renal calculi and cancer. Urethral and scrotal complications may be higher with UC; however, morbidity from SPT-specific procedures may offset benefits from SPT. Serum creatinine was maintained in both groups. Overall, bladder management for patients with chronic indwelling catheters should be selected on the basis of long-term comfort for the patient and a physician mind-set that allows flexibility in managing these challenges.

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Introduction

Selecting optimal bladder management for male patients with spinal cord injury (SCI) often challenges the urologist to work around the physical and social restrictions set forth by each individual patient. Although patients may present with similar spinal level injuries, their eventual urological management may be vastly different.

Ideally, patients with SCI retain some bladder sensation and voiding function, so that they may urinate without any intrusive devices; however, this is often not the case and the urodynamic characteristics of each SCI patient largely determine the form of bladder management.[1,2]

For SCI patients with functional bladder abnormalities, the goal of the urologist is to select the management with the least morbidity, but which is also manageable for the SCI patient in the long term.[3] Efforts are made to minimize the use of long-term indwelling catheters (various types of urethral catheter (UC) and suprapubic catheter (SPT)) secondary to well-documented complications such as recurrent urinary tract infection (UTI), stones, epididymitis, urethral erosion, fistula formation and cancer.[4–6] When an indwelling catheter cannot be avoided, however, it is not clear which form of management has the least morbidity for the SCI patient.

The Spinal Cord Injury Unit at the Long Beach Veterans Administration Medical Center has accumulated

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comprehensive medical records with close urological follow-up for over 600 SCI patients who were injured between 1945 and 2007. We retrospectively reviewed these patient records to compare urological complications associated with long-term use of an indwelling UC versus an indwelling SPT.

Materials and methods

A total of 281 patients managing their bladder with an indwelling catheter were identified. Out of this patient pool, 219 patients had a long-term UC for their bladder management and 62 patients were identified with an SPT. We included patients in the study who have had either form of an indwelling catheter for a minimum of 1 year and who have had close urological follow-up. The initial decision for the use of either catheter for bladder management was determined by a combination of patient preference, patient resources and bladder characteristics. All patients received a foley type of catheter of varying caliber, with a distal inflatable balloon. All catheters were drained by gravity only; there were no attempts to cycle the bladder with filling and emptying to mimic normal bladder function. Of patients with UCs, 86 patient records were discarded secondary to a lack of sufficient urological record, either from infrequent follow-up or transfer of care to another facility. From the SPT group, 16 patient records were omitted for the same reasons.

From the SPT group, we also identified 13 patients whose earlier bladder management was an indwelling UC. Their data were included in both the SPT and UC groups, but was also examined separately from the rest of the patients.

We also included deceased patients in our study to determine whether complications associated with indwelling catheters contributed to the cause of death.

Statistical analysis was completed using a table analysis χ^2 and Fisher's exact test to compare specific complications between the two catheter groups.

Overall, comprehensive chart reviews were performed for 133 patients in the UC group and 46 patients from the SPT group.

Charts were reviewed to identify morbidities including UTI rates, bladder stones, renal calculi, urethral complications, scrotal abscesses, epididymitis, gross hematuria and cancer. Overall average serum creatinine was calculated to determine the preservation of renal function in catheterized patients.

Results

Charts of 179 patients who were injured between 1945 and 2007 were reviewed. Records were available for an average of 11.7 years for the urethral UC group, and 10.9 years for the SPT group. Demographic data of patients are listed in Table 1. The average age for the UC and SPT groups was 63 and 59 years, respectively. The average age at injury for the UC and SPT groups was 30 and 28.6 years, respectively. The average time the patients used a UC or an SPT was 23.4 and 14.3 years, respectively. There was only one female patient regularly followed up with a UC at our institution.

Table 1 Patient demographics

Demographic	*Urethral catheter (%)*	*Suprapubic catheter (%)*
Total	133	46
Age (years)	63.1	59.9
Male	132	46
Female	1	0
Age at injury (years)	30	28.6
Level of injury	Cervical: 60 (45) Thoracic: 63 (47) Lumbar: 5 (4) MS: 5 (4)	Cervical: 30 (65) Thoracic: 12 (26) Lumbar: 3 (7) MS: 1 (2)
Years since injury	35.5	31.2
Years of catheter type	23.4	14.3
Other urologic procedures	TURP: 14 (11) Sphincterotomy: 34 (26) Cystoplasty: 1 (0.7)	TURP: 2(4) Sphincterotomy: 9 (20) Cystoplasty: 1 (2) Bladder neck closure: 10 (22)

Abbreviations: MS, multiple sclerosis; TURP, transurethral resection of prostate.

Complications

Overall comparison of complications between the UC group and SPT groups is shown in Table 2.

For the 13 patients who changed their form of indwelling catheter from UC to SPT, the reason for their change in management and their complication rates are listed in Table 3.

Urinary tract infections

We subcategorized our patients into five different classes of UTI: (1) <1 symptomatic UTI per year: defined as having symptoms requiring oral antibiotic treatment, (2) >1 symptomatic UTIs per year, (3) febrile UTI: defined as having a documented temperature above 101.2 °F and requiring antibiotics, (4) urosepsis : defined as a documented fever and hypotension requiring admission to the hospital for IV antibiotic treatment and (5) pyelonephritis: defined as documented radiological evidence of pyelonephritis in conjunction with fever >101.2 °F.

Overall, 93.2% of patients in the UC group and 97.9% of patients with an SPT had at least one symptomatic UTI. Febrile UTI was observed in 15.8 and 15.2% of patients with UC and SPT, respectively. Urosepsis was observed in 15.0 and 10.9% of patients with UC and SPT, respectively. Finally, the incidence of pyelonephritis in the UC and SPT groups was 2.3 and 4.3%, respectively.

As listed in Table 2, when comparing the rates of symptomatic UTI <1 a year, UTI $\geqslant 1$ a year, as well as those of febrile UTI, urosepsis and pyelonephritis between the UC and SPT groups, no statistically significant differences were observed.

As it has been well documented that urine of patients with chronic indwelling catheters is often colonized with

Table 2 Complications of urethral catheters and suprapubic catheters

Complication	*Urethral catheter,* N = *133 (%)*	*Suprapubic catheter,* N = *46 (%)*	P-*value*
UTI	124 (93)	45 (98)	0.46
	<1/year: 83 (62)	<1/year: 31 (67)	0.54
	>1/year: 40 (30)	>1/year: 14 (30)	0.96
	Febrile: 21 (16)	Febrile: 7 (15)	0.93
	Pyelo: 3 (2)	Pyelo: 2 (4)	0.46
	Urosepsis: 20 (15)	Urosepsis: 5 (11)	0.62
Bladder stones	50 (38)	19 (41)	0.66
Renal calculi	42 (32)	12 (26)	0.48
Urethral stricture	4 (3)	0 (0)	0.57
Urethral fistula	3 (2)	0 (0)	0.57
Scrotal abscess	4 (3)	0 (0)	0.57
Epididymitis	13 (10)	2 (4)	0.36
Gross hematuria	27 (20)	9 (20)	1.00
Cancer	1 (0.8)	2 (4)	0.16
	TCC: 0 (0)	TCC: 1 (2)	0.26
	SCC: 0 (0)	SCC: 1 (2)	0.26
	Adeno: 1 (0.8)	Adeno: 1 (0)	0.45
Catheter specific complications	Urethral erosion: 30 (23)	Urethral leak: 2 (4)	NA
		Leakage around SPT: 12 (26)	
		SPT revision: 6 (13)	

Abbreviations: Adeno, adenocarcinoma; SCC, squamous cell carcinoma; TCC, transitional cell carcinomca.

Table 3 Patients switching from urethral catheter to suprapubic catheter

Total patients		13	
Mean age (years)		57.7	
Injury level (%)		Cervical: 7 (54)	
		Thoracic: 4 (31)	
		Lumbar: 1 (7)	
		MS: 1 (8)	
Mean time with urethral catheter (years)		18.1 (range 1–39)	
Mean time with SPT (years)		5.6 (range 5–8)	
Complications	*Urethral (%)*	*SPT (%)*	*P-value*
UTI	13 (100)	13 (100)	1.00
Bladder stone			
Renal stone	6 (46)	6 (46)	1.00
Urethral stricture			
Urethral fistula	4 (31)	3 (23)	1.00
Scrotal abscess			
Epididymitis	1 (8)	0 (0)	1.00
Hematuria			
Cancer	3 (23)	0 (0)	0.22
Catheter-specific problems	1 (8)	0 (0)	1.00
	1 (8)	0 (0)	1.00
	1 (8)	0 (0)	1.00
	0 (0)	0 (0)	1.00
	Erosion: 4 (31)	Revision: 2 (15)	N/A
	Leakage: 7 (54)	SPT leakage: 4 (31)	
Reason for change to SPT (%)		Fistula: 3 (23)	
		Personal preference: 3 (23)	
		Leakage: 3 (23)	
		Erosion: 3 (23)	
		Bladder neck contracture: 1 (8)	

Abbreviations: MS, multiple sclerosis; SPT, suprapubic catheter; UTI, urinary tract infection.

multiple organisms, we did not attempt to identify the causative organism for each treated UTI.[7]

Bladder stones

The incidence of bladder stones in these patients was subcategorized into a single incidence of bladder stone, and recurrent bladder stones were defined by the presence of bladder stones on more than one cystoscopic examination.

For the UC group, the incidence of recurrent bladder stones was 38.0%, as opposed to the SPT group, for which it was 41.3%. Again, the difference in the incidence of bladder stones, single or recurrent between a UC and an SPT, was not statistically significant.

Renal calculi
The presence of renal calculi was determined by examining records of CT studies, IVP, operative reports and renal ultrasound studies. Of the patients in the UC group, 31.6% experienced renal calculi and 26.1% of patients with SPT had renal calculi. There was no statistically significant difference in the incidence of renal calculi between the UC and SPT groups.

Urethral stricture, urethral fistula, scrotal abscess and epididymitis
In our study, urethral strictures, urethral fistulas and scrotal abscesses were only observed in patients with indwelling UCs. It was noted that one out of the three patients with a urethral stricture changed to an SPT because of complications and all three of the patients with urethra-cutaneous fistulas changed because of complications.

Although urethral stricture, fistulas and scrotal abscesses were only seen in the UC group, there was no statistically significant difference in the incidence of the aforementioned complications between the two groups.

Epididymitis was observed in both groups (9.8 and 4.3% of patients in the UC and SPT groups, respectively), and the incidence was not statistically significant.

Gross hematuria
Gross hematuria was noted in 20.3% of patients with UC and in 19.6% of patients with an SPT. There was no significant difference in the incidence of gross hematuria between the two groups.

Table 4 Mortality demographics (including patients who switched from urethral catheter to suprapubic catheter)

	Urethral catheter, N = 133 (%)	*Suprapubic catheter, N = 46 (%)*	P-*value*
Total	43 (32)	12 (26)	0.43
Age at death (years)	70.3	62.7	
Time of catheter (years)	28.3	18.0	

Cancer
In our study, we identified one patient with primary adenocarcinoma from the UC group. From the SPT group, we identified one patient with both TCC and SCC of the bladder. This particular patient developed TCC and SCC after switching to an SPT catheter after years of external condom catheter use.

Overall, the incidence of SCC, TCC or adenocarcinoma of the bladder did not differ significantly between the two groups.

Serum creatinine
On an average, there were 5.68 serum creatinine measurements per year of chronic catheterization in the 133 patients managed with UC, and 5.7 serum creatinine measurements per year of catheterization in the 46 patients managed with an SPT.

The average serum creatinine for the UC and SPT groups was 0.74 and 0.67 mg per 100 ml, respectively.

Complications unique to UCs and SPTs
Complications were also noted that are specific to each type of catheter, namely, traumatic penile urethral erosion in UCs and leakage around the SPT. As these are specific to the type of catheter used, the rates of each could not be compared.

Patients who changed from UCs to SPTs
The analysis of the 13 patients who changed their management from UC to an SPT is shown in Table 3. Similar to our earlier analysis, there were no significant differences in the incidence of UTI, urosepsis, bladder or renal calculi. The reasons for the change in bladder management are listed as well.

Cause of death
Included in our study were 43 deceased patients who used chronic UC and 12 patients who died with an SPT in place. The cause of death was available for 37 of these patients. The demographics and causes of death of the patients in the two groups are listed in Tables 4 and 5. The most commonly identified cause of death in both groups was pneumonia. Death from urosepsis or suspected urosepsis was observed in six patients from the UC group, and in two patients from the SPT group.

Table 5 Cause of death

Cause of death	*Urethral catheter, N = 43 (%)*	*Suprapubic catheter, N = 12 (%)*	P-*value*
GU sepsis/infectious	6 (14)	2 (17)	1.00
Non-GU sepsis/infectious	3 (7)	2 (17)	0.30
Respiratory failure/pneumonia	11 (26)	3 (25)	1.00
MI/cardiac cause	2 (5)	2 (17)	0.20
ESRD	2 (5)	0 (0)	1.00
Neuro causes/stroke	1 (2)	0 (0)	1.00
GI bleed	1 (2)	0 (0)	1.00
GU malignancy	0 (0)	1 (8)	0.22
Non-GU malignancy	1 (2)	0 (0)	1.00
Unknown	16 (37)	2 (17)	0.30

Abbreviations: ESRD, end stage renal disease; GI, gastrointestinal; GU, genitourinary; MI, myocardial infarction.

Discussion

The goal of this retrospective review is to compare the urological complications in SCI patients managed with indwelling UC and SPT.

The current trend in managing patients who require an indwelling drainage device is to place an SPT to avoid morbidities specifically associated with an indwelling UC, such as ventral urethral erosion and urethral fistula formation.[1]

The problem with this approach is that SPT has its own set of complications including leakage from the SPT site, leakage from urethra or the need for revision of the tube and the complications associated with a surgical procedure. Procedures that may be needed in patients with SPT, such as bladder neck closure because of urethral leakage and SPT site revision because of leakage around the SPT, have been shown to have a 14–31% complication rate.[8,9] Whether these complications outweigh the potential problems from the UC is unknown. This study found the differences to be insignificant, likely because of the fairly small numbers of patients involved. Moreover, as spinal cord injuries occur at a 4:1 male-to-female ratio, and as the overwhelming majority of the Veterans Administration patients are male, extrapolation of these complications to all patients with an indwelling catheter cannot be made.[2] The review of the one female patient revealed only <1 UTI per year, and no other catheter-related complications.

Gynecological literature explores complications from indwelling catheters in females reporting higher incidences of UTI with UC than with SPT; however, the study only explores short-term catheterizations postoperatively.[10]

Furthermore, we showed that there are no statistically significant differences between the two groups in terms of common complications including UTI rates, bladder stones, renal calculi, scrotal abscesses, epididymitis, gross hematuria and cancer.

Although urethral and scrotal complications were only seen in patients with UC, this remained without statistical significance likely because of a small sample size, which can be an inherent limitation to a retrospective study. However, it would be expected that as an SPT avoids contact with the structures adjacent to the urethra, there would be fewer complications in that area and this has been shown in earlier studies.[11] With a larger number of patients, it is reasonable to expect that this would become significant.

A more devastating complication of bladder cancer has been associated with chronic indwelling catheter use. Rates of squamous cell carcinoma developing in patients with chronic catheters have been estimated to be 2.3–10%,[12–14] with the rates of squamous changes in bladder mucosa as high as 80%. In our study, the overall incidence of both squamous cell carcinoma and transitional cell carcinoma was 0.6%. We had one patient (0.8%) who developed adenocarcinoma of the bladder from the UC group. All of these were again insignificant.

We did not review the incidence of squamous changes in bladder mucosa; however, this has been reported to be as high as 80% in some studies.

Both methods of chronic bladder catheterization seem to preserve renal function. Although a more thorough analysis of serum creatinine measurements is required, the overall average serum creatinine of both catheter groups suggests a preservation of renal function with either form of bladder management.

Conclusion

Male SCI patients who need to resort to the use of a chronic indwelling catheter, whether it is a UC or an SPT, have similar complication rates in terms of UTI, recurrent bladder and renal calculi and development of cancer. Complications associated with the urethra and scrotum may be higher with an indwelling UC; however, morbidity associated with SPT-specific procedures, such as bladder neck closure and SPT revision, may offset the benefits derived from using an SPT. Overall, bladder management for patients who require chronic indwelling catheters should be selected on the basis of long-term comfort for the patient and a physician mind-set that allows flexibility in managing these challenges.

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