Bladder neck closure and suprapubic catheter placement as definitive management of neurogenic bladder

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Objective: Surgical management for neurogenic bladder may require abandonment of the native urethra due to intractable urinary incontinence, irreparable urethral erosion, severe scarring from previous transurethral procedures, or urethrocutaneous fistula. In these patients, bladder neck closure (BNC) excludes the native urethra and provides continence while preserving the antireflux mechanism of the native ureters. This procedure is commonly combined with ileovesicostomy or continent catheterizable stoma, with or without augmentation enterocystoplasty. Alternatively, BNC can be paired with suprapubic catheter diversion. This strategy does not require a bowel segment, resulting in shorter operative times and less opportunity for bowel-related morbidity. The study purpose is to examine preoperative characteristics, indications, complications, and long-term maintenance of renal function of BNC patients.

Methods: A retrospective review of medical records of 35 patients who underwent BNC with suprapubic catheter placement from 1998 to 2007 by a single surgeon (LKL) was completed.

Results: Neurogenic bladder was attributable to spinal cord injury in 71%, 23% had multiple sclerosis, and 9% had cerebrovascular accident. Indications for BNC included severe urethral erosion in 80%, decubitus ulcer exacerbated by urinary incontinence in 34%, urethrocutaneous fistula in 11%, and other indications in 9%. The overall complication rate was 17%. All but two patients were continent at follow-up. Forty-nine per cent of patients had imaging available for review, none of which showed deterioration of the upper tracts.

Conclusions: Our results suggest that BNC in conjunction with suprapubic catheter diversion provides an excellent chance at urethral continence with a reasonable complication rate.

Keywords: Bladder, Urethra, Surgical treatment

Introduction

There are numerous options for the management of the lower urinary tract in patients with neurogenic bladder. Management ranges from the simplicity of an indwelling urethral catheter to the complexity of enteric reconstruction with a continent stoma. Selection of the appropriate approach requires consideration of patient motivation together with cognitive and manual abilities. Caretaker ability and availability, patient preference, and medical comorbidities are also considerations.¹

Many patients with neurogenic bladder require abandonment of the native urethral due to intractable urinary incontinence, urethral erosion beyond repair due to long-term indwelling catheters, scarring from

previous transurethral procedures, or urethrocutaneous fistula. In this subset of patients, bladder neck closure (BNC) excludes the irreparable native urethra and provides urethral continence. This procedure must be combined with some form of urinary diversion, such as ileovesicostomy or continent catheterizable stoma, with or without augmentation enterocystoplasty.² Another simpler option in patients with adequate bladder capacity is pairing of BNC with permanent suprapubic catheter (SPC) diversion.³ This management technique has not been thoroughly studied.

We present a series of patients undergoing BNC with SPC as the permanent method of urinary diversion without any additional enteric bladder reconstruction. The purpose of this study is to examine preoperative characteristics, indications, complications, and long-term maintenance of renal function.

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Methods

A retrospective review of paper charts and electronic medical records of patients who underwent BNC with SPC placement from 1998 to 2007 by a single surgeon (LKL) was undertaken. Internal board review approval was obtained at the University of Alabama at Birmingham before the study commenced. All patients had previously unreconstructed bladders. Patients were excluded from the review if they underwent or had previously undergone any urinary diversion other than SPC. We reviewed the study population and analyzed the demographics, underlying pathologies, indications, complications, length of stay, and long-term renal function.

Our standard technique of BNC for women is as follows. First, the patient is positioned in supine position. The indwelling catheter is copiously irrigated with antibiotic solution to remove any debris. The lower abdomen is prepped and draped into a sterile field. A midline suprapubic incision is made and carried sharply to fascia. The fascia is opened in the midline and the rectus bellies separated. The peritoneum is swept gently cephalad to expose the anterior bladder and a self-retaining retractor is placed in the wound. The bladder is opened with cautery in the midline and this incision is carried caudad to the bladder neck. The urethral orifices are identified and the bladder neck is transected well inferior to the orifices (see Fig. 1). The urethral stump is closed with 2-0 chromic sutures in an interrupted figure-of-eight fashion. The posterior bladder is partially mobilized off of the anterior vaginal wall to allow for cephalad mobilization of the

bladder neck away for the remnant urethra. The bladder neck and anterior cystotomy are then closed together with 3-0 chromic suture in a running fashion through mucosa and muscle. A cystotomy is made off midline to accommodate the SPC, which is placed and brought out through the rectus belly and fascia. The size of the suprapubic tube is either a #22 or a 24 Fr catheter. A 3-0 chromic pursestring suture is used to secure the SPC to the bladder wall. A second layer of 2-0 chromic gut suture is used to close an additional layer of tissue over the bladder neck and cystotomy suture line in an interrupted figure-of-eight fashion. The pelvis is copiously irrigated and fascia and skin are closed. A Jackson-Pratt drain is typically left in the deep pelvis until discharge from the hospital. Where the urethra is irrecoverably damaged, closure via the transvaginal approach is the preferred approach because it has low morbidity and is tolerated by these severely disabled patients.

Urethrocleisis and urethral preservation provide a better option only in a select group of patients.⁴

The procedure for men follows essentially the same course. The bladder is opened and the ureteral orifices are visualized. The bladder neck is divided from the posterior prostate and a cephalad plane is developed anterior to the vasa and seminal vesicles to mobilize the bladder superiorly (see Fig. 2). Interposed tissue is used to separate the bladder neck from the urethral stump in redo bladder neck closures.

Figure 1 Identification of Ureteral Orifices before bladder neck transection.

Figure 2 Separation of bladder neck from prostatic urethra during bladder neck closure.

Results

We reviewed the records of 35 patients. Of these, 11 (31%) were male and 24 (69%) were female. Average age at the time of BNC was 44.7 years (range 25–78). Average follow-up for all patients was 27.0 months. Average length of stay, including preoperative hospital days, was 4.1 days. Abdominal BNC was used in 31 patients (89%) and transvaginal BNC was used in 4 women (11%). Spinal cord injury was the most common cause of neurogenic bladder in 27 (77%). In other patients, five (14%) had multiple sclerosis, three (9%) had cerebrovascular accident, and one (3%) had myelomeningocele as their underlying pathology. One patient had multiple sclerosis superimposed on a preexisting spinal cord injury (see Tables 1–3 for demographic details).

Indications for BNC included severe urethral erosion in 28 (80%), decubitus ulcer exacerbated by urinary incontinence in 14 (40%), urethrocuteaneous fistula in 4 (11%), severe incontinence in absence of urethral erosion in 3 (9%), penile skin breakdown in 1, and urethral stricture in 1 (3%). Most patients had multiple indications for surgery. Previous methods of bladder management included indwelling urethral catheter in 30 (86%), condom catheter in 1 (3%), and suprapubic tube in 4 (11%). None of the patients had been previously augmented or reconstructed prior to BNC. Prior to undergoing the procedure, preoperative urodynamic evaluation is essential to determine if the patient: 1, has low leak point pressures and BNC is indicated; 2, has detrusor overactivity and may need anticholinergics; and 3, has low bladder capacity and poor wall compliance and needs concomitant bladder augmentation.

Overall complication rate was 16.7%. This comprised one intraoperative complication of excessive hemorrhage

(2000 cc) in a patient with a prominent venous plexus over the anterior vagina. We identified six postoperative complications in five patients. One morbidly obese female had a superficial wound infection and approximately 1 month later had displacement of her SPC out of the bladder for over 24 h before presentation. Her SPC tract had closed and she had established urinary leakage from the urethra upon presentation and the tract could not be reestablished with endoscopy. Subsequent attempt at BNC had to be aborted due to extensive scarring and inflammation in the pelvis, and she continues to have urethral incontinence despite replacement of her SPC. Two females had superficial wound infections treated with drainage and antibiotics. One male recanalized his urethra and was treated with reoperative abdominal BNC. One female who initially underwent transvaginal BNC developed a vesicovaginal fistula and underwent redo transvaginal BNC. She refistulized and developed uterine bleeding; eventually she underwent an abdominal BNC, hysterectomy, and omental flap interposition and is currently continent. Other follow-up procedures included cystolitholapaxy in one patient with bladder stones, endoscopic or operative replacement of SPC in three patients, including one at the bedside and two performed in the operating room. One patient with a low-capacity bladder and severe irritative bladder symptoms developed intractable suprapubic pain and incontinence via her SPC tract and eventually underwent cystectomy with ileal conduit diversion. Overall, eight follow-up procedures were required in seven patients (20%). After any necessary reoperation, all but one patient was rendered continent (97%). Three patients (8.6%), as described above, required reoperation to achieve continence.

Table 1 Patient demographics and outcomes

Number of patients	Age (mean) (years)	Length of stay (days)	Follow-up (mean) (months)	Abdominal BNC (%)	Transvaginal BNC (%)
35	44.7	4.1	27.0	89 (<i>n</i> = 31)	11 (<i>n</i> = 4)

Table 2 Patients with underlying conditions for neurogenic bladder

Spinal cord injury	Multiple sclerosis	Cerebrovascular accident	Myelomeningocele
27 (77%)	5 (14%)	3 (9%)	1 (3%)

Table 3 Patient indications for BNC

Urethral erosion	Decubitus ulcer	Urethrocuteaneous fistula	Severe incontinence	Penile skin breakdown	Urethral stricture
28	14 (40%)	4 (11%)	3 (9%)	1 (3%)	1 (3%)

We examined the maintenance of renal function during follow-up by comparing the most recent available serum creatinine levels with preoperative creatinine levels. These values were extracted from the electronic medical record. Preoperative values were obtained from laboratory results from preadmission blood draws or admission laboratory panels. Postoperative values were obtained from the most recent available laboratory results. Values were excluded if they were associated with an acute illness upon review of the medical record. A total of 15 patients had serum creatinine results drawn greater than 6 months postoperatively. Of these patients, average follow-up (calculated from the date of operation to the date of the most recent available creatinine value) was 34 months. The greatest net increase in serum creatinine was 0.5 in one patient. Another patient had a net increase of 0.3. All other patients had an increase of 0.1 or less, and some had a decrease in their serum creatinine. There was no trend toward deterioration of renal function as the average change in serum creatinine was zero.

We also examined the renal function of our study population with review of available results of upper tract imaging. Seventeen patients (49%) had either renal ultrasounds or nuclear medicine comprehensive renal function examinations available for review. Average upper tract imaging follow-up (calculated from date of operation to date of the most recent study) was 25 months. No patients showed evidence of upper tract deterioration. All reviewed ultrasounds showed no evidence of hydronephrosis or progressive scarring. All renal scans showed effective renal plasma flow normal for age and symmetric function, except in four patients with stable renal functional asymmetry that existed before BNC.

Discussion

Our results show that BNC in conjunction with SPC diversion provides an excellent chance at urethral continence with a reasonable complication rate. This approach carries several advantages. The operative approach is straightforward and can be done without violation of the peritoneum. No need for enteric reconstruction obviates the need for a bowel anastomosis, thus reducing the possibility of bowel complications and prolonged 'nothing by mouth' status. Hospital stays are reduced compared to enteric reconstruction.⁵ Average length of stay in this study was 4.1 days. In addition, an SPC provides a 'low-maintenance' diversion for patients and caretakers. It avoids need for dexterity required for intermittent catheterization and ostomy management; care essentially involves monthly catheter changes that can usually be accomplished by

a family member or caretaker at home or by home health nursing personnel.⁶

Despite its advantages, BNC with SPC also carries disadvantages that warrant mention. This procedure is less likely to be successful in patients with very low bladder capacity. Patients with very low capacity will likely require enteric augmentation to establish any reasonable storage capacity, so more extensive reconstruction is likely a better alternative. This procedure should be used cautiously when maximal bladder capacity greater than 125 cc cannot be maintained unless concomitant augmentation is performed. Patient education is also crucial for success. Patients must be educated on the importance of early replacement of SP catheter in case of displacement. One of our patients who suffered breakdown of her BNC could have likely avoided this complication if her SPC had been replaced in a timely fashion. In addition, tube displacement can lead to obstructive renal failure if the BNC remains intact. An indwelling catheter also introduces an increased risk of infections, bladder calculi, and older studies have questioned the possible increased risk of malignant change in the bladder mucosa.⁷ A more recent study demonstrated that the presence of a neurogenic bladder, not the indwelling catheter, may be the risk factor for bladder cancer.⁸

While previous series reports have included patients with BNC with SPC urinary diversion, this is the first report to our knowledge examining patients who underwent BNC with SPC as the only type of urinary diversion in both males and females with neurological impairment. Stapp *et al.*⁹ presented an abstract at the American Urological Association (AUA) annual meeting in 1999 that reviewed 29 patients with 'devastated outlets' who underwent BNC with various means of urinary diversion including SPC ($n = 15$), continent stoma ($n = 13$), and ileovesicostomy ($n = 1$). Of these patients, 97% were continent at mean follow-up of 65 months, with 17% (five patients) eventually requiring revision of their BNC to achieve continence. This study was completed before botulinum toxin became widely used, and none of these patients had botox administered. Botulinum toxin is now used frequently and may benefit many patients and they may not need this surgery, or it may enhance the bladder capacity prior to BNC surgery.

Shpall and Ginsburg¹⁰ reported on 39 patients who underwent BNC with simultaneous lower urinary tract (LUT) reconstruction including ileovesicostomy, augmentation cystoplasty with continent stoma, or revision of previous continent stoma. The complication rate was 31%, including vesicovaginal fistula in six, stomal dysfunction in six, wound infection in one, and retained sponge in

one. The complication rate of the present study was 17%. The increased complication rate in Shpall's series is attributable to stomal dysfunction, a potential complication that is avoided with BNC and SPC diversion.

Andrews and Shah⁴ reviewed long-term results of females with long-term Foley catheters and incontinence attributed to a patulous urethra. Patients were treated using techniques including urethral reconstruction by urethrocleisis, transvaginal BNC, and suprapubic BNC, rendering 16 patients dry after 22 procedures. Four of eight patients who underwent transvaginal closure developed fistulae and required reclosure. Two of six patients who underwent urethrocleisis had persistent incontinence and required suprapubic BNC. Of the patients who underwent suprapubic BNC, all were dry and none required additional procedures in a mean of 4.6 years of follow-up.

O'Connor *et al.*¹¹ reviewed a cohort of 35 patients with intractable urinary incontinence secondary to severe posterior urethral/bladder neck damage who underwent suprapubic BNC. The success of procedure was assessed in addition to evaluating for early and late complications. After a mean follow-up of 79 months, they found high success rates and acceptably low complication rates with suprapubic bladder neck closure for the treatment of severe urinary incontinence secondary to a devastated bladder outlet.

Our complication rate of 20% (including recurrent bladder outlet fistulae) compares favorably to the above-mentioned studies. A large portion of the complications in these studies are attributable to use of bowel for augmentation and/or LUT reconstruction. Avoiding bowel surgery in our operative technique probably accounts for our lower complication rate. Our overall complication rate of 20% is still fairly high. We can lower the complication rate by meticulous attention to surgical detail, and gaining experience should provide insight and prevent making repetitive errors.

There is an obvious limitation in our study, due to its retrospective nature. In addition, the referral area for our institution covers a huge geographic area, and many of our neurogenic bladder patients must travel quite a long distance in addition to having limited social and economic resources. Hence, patients often are lost to follow-up early in their postoperative course, or go back to their local urologists for postoperative care. These factors have contributed to a rather short average follow-up in our series.

Conclusions

In conclusion, we report the short-term complication rates and long-term functional outcomes in patients

who have neurogenic bladder and underwent suprapubic tube placement with BNC. Spinal cord injuries account for the majority of cases of neurogenic bladder. BNC with SPC diversion is a viable management solution for select patients with neurogenic bladder and urethral incontinence, especially those with urethras that are damaged beyond repair. This procedure provides durable urethral continence with short operative times, short hospital stays, and low risk of progressive renal dysfunction. Patients must be carefully selected, but BNC with SPC can provide an excellent management solution for neurogenic bladder from a wide variety of causes.

There are a large number (~11 000) of new spinal cord injuries per year in the United States.¹¹ Demographics are as follows: 78% are male, 22% are female, 63% white, 22% black, 12% Hispanic, and 2% other. Average age at injury = 38 years. Etiology = motor vehicle crash accounts for 50%, falls for 38%, acts of violence for 14%. There is no anticipated decline of spinal cord injuries in the United States.¹² Management of neurogenic bladders will continue to have an important role in the urologist's armamentarium and we propose BNC with SPC as an option for bladder management in properly selected patients.

References

- McGuire EJ, Savastano JA. Urodynamics and management of the neuropathic bladder in spinal cord injury patients. *J Am Paraplegia Soc* 1985;8(2):28–32.
- Chao R, Mayo ME, Bejany DE, Bavendam T. Bladder neck closure with continent augmentation or suprapubic catheter in patients with neurogenic bladders. *J Am Paraplegia Soc* 1993;16(1):18–22.
- Hulecki SJ, Hackler RH. Closure of the bladder neck in spinal cord injury patients with urethral sphincteric incompetence and irreparable urethral pathological conditions. *J Urol* 1984;131(6):1119–21.
- Andrews HO, Shah PJ. Surgical management of urethral damage in neurologically impaired female. *J Urology* 1998;82(6):820–4.
- Dmochowski RR, Weld KJ. Effect of bladder management on urological complications in spinal cord injured patients. *J Urol* 2000;163:768–72.
- Cole EE, Adams MC, Brock JW, Pope JC. Outcome of continence procedures in the pediatric patient: a single institutional experience. *J Urol* 2003;170(2 pt 1):560–3.
- West DA, Cummings JM, Longo WE, Virgo KS, Johnson PE, Parra RC. Role of chronic catheterization in the development of bladder cancer in patients with spinal cord injury. *Urology* 1999;53:292.
- Kalisvaart JF, Katsumi HK, Ronningen LD, Hovey RM. Bladder cancer in spinal cord injury patients. *Spinal Cord* 2010;48(3):257–61. Epub 2009 Sep 15.
- Stapp EC, Eschelle A, Anthony B. Suprapubic bladder neck closure: effective management of the devastated outlet. Presented at the Annual Meeting of the American Urologic Association, March 1999.
- Shpall A, Ginsburg D. Bladder neck closure with lower urinary tract reconstruction: technique and long-term follow up. *J Urol* 2004;172:2296–9.
- O'Connor R, Stapp E, Stone A. Long-term results of suprapubic bladder neck closure for treatment of the devastated outlet. *Urology* 2005;66(2):311–5.
- National Spinal Cord Injury Statistical Center. Spinal cord injury statistics. National Spinal Cord Injury Statistical Center; University of Alabama, June 2008.