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Original Article

Minimally invasive percutaneous suprapubic cystolithotripsy: an effective treatment for bladder stones with urethral strictures

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Abstract: To compare the therapeutic efficacy of minimally invasive percutaneous cystolithotripsy (MPCCL) with open surgery on bladder stones with urethral strictures. We reviewed the clinical characteristics and outcomes of 37 patients with bladder calculi with urethral strictures in our institute between March 2004 and December 2012. Of them, 21 patients were treated with MPCCL, and 16 underwent open surgery. The mean stone size was 5.53 cm (range 1.1-7.8 cm); 12 patients had single stones, and 25 patients had multiple stones. Transurethral cystolithotripsy in all of the patients failed because of the urethral strictures. MPCCL was performed through a 20 F peel-away sheath. Fragmentation and removal was performed with an 8-9.8 F ureteroscope and the Swiss Lithoclast. Each patient was cleared their stone burden with a single procedure, and there were no major complications. The mean operative time in the MPCCL group was 18.2 (11-35) minutes, while it was 32.3 (23-52) minutes (P=0.023) in the open surgery group. In the open surgery group, urinary leakage occurred in 3 patients (P=0.045) and a wound infection developed in 5 patients (P=0.012). The mean urethra catheter time was 2.5 days in the MPCCL group and 8.6 days in the open surgery group (P=0.016). The mean hospital stay in the MPCCL group was 2.6 days, whereas it was 3.5 days in the open surgery group (P=0.018). Compared with open surgery, MPCCL is a highly effective and safe technique for bladder stones in patients with urethral strictures.

Keywords: Bladder stones, urethral strictures, percutaneous cystolithotripsy

Introduction

Bladder stones account for 5% of urinary stones and often occur because of bladder outlet obstruction, infection, neurogenic voiding dysfunction or foreign bodies [1]. This disease is more prevalent in children, especially in developing countries [2-4]. In adults, bladder calculi are often secondary to urologic problems such as bladder-outlet obstruction, infection, urethral strictures, or neurogenic bladder dysfunction.

The treatment options available for vesical calculi are open cystolithotomy, transurethral cystolithotripsy, shockwave lithotripsy and percutaneous cystolithotripsy. Open surgery has inherent problems of a long scar, prolonged catheterization, extended hospitalization, and the risk of wound infection. Transurethral cystolithotripsy also requires special instruments that are associated with a risk of trauma, which could lead to urethral strictures. Transurethral treatment is restricted in children due to the narrow urethra caliber and in adults due to urethral strictures.

In recent years, with the development of endoscopy, percutaneous techniques for treating bladder calculi in both children and adults have emerged [5]. Here we report our experiences in treating patients with urethral strictures and large bladder calculi using minimally invasive percutaneous cystolithotripsy (MPCCL) or open surgery.

Materials and methods

We managed 37 patients who presented with bladder stones that coexisted with urethral

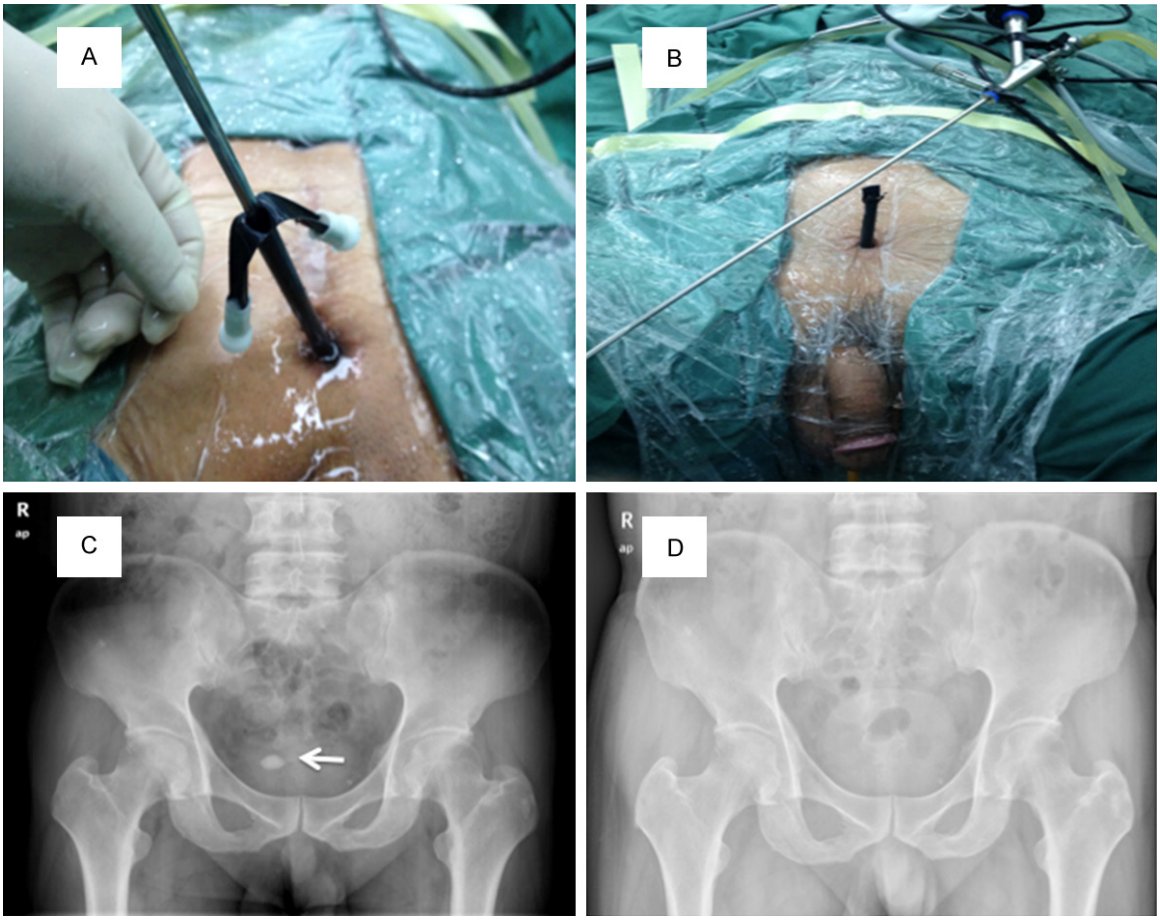

Figure 1. A, B: A 20 F peel-away sheath was placed in the abdominal wall as a working tract, using an 8-9.8 F ureteroscope combined with the Swiss Lithoclast for stone fragmentation. C, D: The preoperative and postoperative plain radiograph of pelvis for a patient with bladder stone and urethral strictures.

strictures from March 2004 to December 2012 at our hospital. Patients were excluded if they had previous lower abdominal surgery that might complicate percutaneous assess to the bladder. Informed consent to perform MPCCL or open surgery was obtained from each patient. Of all of the patients, 21 in the MPCCL group underwent MPCCL, whereas 16 in the open surgery group underwent open cystolithotripsy. All of the patients were evaluated preoperatively based on their medical history and clinical examination. In addition, the patients underwent the following laboratory investigations: bleeding and coagulation profile, renal profile, urinalysis and formal urine culture preoperatively. Preoperative radiological evaluation including plain X-ray and ultrasonography to determine the size and location of the stone were performed in each case. Thirteen patients (seven patients in MPCCL group, six patients in open surgery group) had prior urethrotomies, and all of participants were not neuropaths. This retrospective study was exempt from review by the ethics committee of Nanjing Drum Tower Hospital.

Our MPCCL method was based on the procedure described by Salah *et al*. [2] with modifications regarding the working tract as described below. The MPCCL was performed under general anesthesia or a subarachnoid block. A 12 F catheter was gently inserted into the bladder, and 350-500 mL normal saline was instilled until bladder engorgement. In the lithotomy position, a 16-gauge needle was placed into the distended bladder at the midline, 1-2 cm above the pubic bone. Once suitable placement was confirmed with return of urine, a 0.028-inch guide wire (nitinol-black and white, Optimed, Germany) was passed through the needle tract into the bladder. Dilatation was

Table 1. Patient characteristics and results (NS, not significant)

Variable	MPCCL	Open surgery	P
No. patient	21	16	
Male	21	16	
Mean (range) age, years	72.6 (53-85)	72.3 (50-81)	0.783
Cause of stricture			
Blunt trauma	19	14	0.511
Infection	2	2	0.992
Mean (range) stone diameter, cm	5.47 (1.1-7.8)	5.65 (2.4-7.2)	0.894
Mean (range) operative time (for stone removal), min	18.2 (11-35)	32.3 (23-52)	0.023
Mean estimated blood loss, mL	18.6 (15-35)	32.6 (20-45)	0.035
Mean (range) catheter time, days	2.5 (2-3)	8.6 (6-11)	0.016
Mean (range) hospitalization, days	2.6 (2-4)	3.5 (2-5)	0.643
Clavien-Dindo surgical complications			
Grade I	1	5	0.030
Fever (%)	1 (4.7)	5 (31.2)	0.030
Urinary leakage (%)	0 (0)	3 (18.7)	0.045
Wound infection (%)	0 (0)	5 (25)	0.012
Serum creatinine, umol/L	83 (52-129)	87 (46-108)	0.763
Stone composition			
Calcuim oxalate	11	8	0.518
Ammonium acid urate	3	2	0.823
Calcium phosphate	3	2	0.784
Cystine	4	4	0.951

then performed around the guide wire with a 20 F percutaneous nephrolithotomy (PCNL) dilator, and then a 20 F peel-away sheath was placed in the abdominal wall as a working tract (**Figure 1A**, **1B**). Thereafter, one 8-9.8 F ureteroscope (Wolf, Germany) was introduced into the bladder, and the stones were fragmented using the Swiss Lithoclast (EMS, Switzerland). Small stone fragments were easily flushed with irrigation, whereas the larger fragments were retrieved using grasping forceps. Care was taken during the entire procedure not to overdistend the bladder to prevent irrigating fluid from entering the preperitoneal space, which could result in postoperative ileus and abdominal distension. At the end of the procedure, one 16 F suprapubic catheter was left in situ and fixed to the skin; it was removed the day after the MPCCL procedure. The mean urethral catheter time was 2.5 days after the MPCCL procedure.

Open removal of bladder stones was performed under general anesthesia. An incision was made in the lower abdomen to access the bladder, and then the bladder was opened and the stones were removed. The bladder was sutured with absorbable stitches, and a catheter was inserted into the bladder via the urethra. The mean catheter time was 8.6 days after the operation, depending on the size of the bladder incision.

In all cases, plain X-ray/ultrasonography was performed 2 days postoperatively to determine the presence or absence of the stone fragments (**Figure 1C**, **1D**). The operative time, hospital stay, duration of catheter placement and morbidity were compared. The postoperative surgical complications were classified by Clavien-Dindo classification [6]. Patients were followed up for median 12 months (range 6-22). Mann-Whitney test and Fisher's Exact Test were applied to analyze the data statistically.

Results

All of the stones were successfully treated in a single session. No intra-operative or post-operative complications (**Table 1**) were recorded in the MPCCL patients except for transient hematuria in 3 patients, which did not require special

treatment. The mean operative time in the MPCCL group was 18.2 (11-35) minutes, whereas in the open surgery group, it was 32.3 (23-52) minutes (P=0.023). In the open surgery group, urinary leakage occurred in 3 patients (P=0.045) and a wound infection developed in 5 patients (P=0.012). The mean urethral catheter time was 2.5 days (range 2 to 3) in the MPCCL group, whereas it was 8.6 days (range 6 to 11) in the open surgery group (P=0.016). According to Clavien-Dindo classification, Grade I was only one patients in MPCCL group, while it was 5 patients in open surgery group. There was no significant difference in the mean hospital stay in the two groups. However, MPCCL was significantly less postoperative surgical complications (**Table 1**).

Discussion

Recently, multiple techniques and modalities have become available for managing bladder stones. Open surgery is the traditional strategy for treating bladder stones [7]. However, it has become increasingly less popular due to increased morbidity and prolonged urethra catheter time as mentioned above. Docimo SG *et al*. [8] compared percutaneous cystolithotomy a with traditional open methods and demonstrated similar stone-free and recurrence rates with significantly less postoperative pain for the PCCL patients. In our research, compared to the open group, the MPCCL group had less morbidity (fever, wound infection and urinary leakage) and shorter catheter time (2.5 days versus 8.6 days). This could be associated with our minimal surgical access.

With the development of endoscopy, the majority of cases have been managed transurethrally due to the use of a natural tract for access and its ability to be performed as a minimally invasive procedure. However, the transurethral method is not always possible; for example, urethral strictures make this procedure difficult to perform. In addition, the risk of urethral injury and subsequent stricture increases when a lengthy transurethral approach is performed for large or multiple bladder stones. The stone-free rates may also be low with massive stone burdens. Kumar A. *et al*. reported that the twin amplatz way of dealing with large bladder stone is first option for female patient [9]. But this was not good clinical choice for patient with urethral strictures.

More recently, PCCL has been described as an alternative for bladder stones that are not appropriate for urethral access [8]. Compared with the transurethral approaches, the percutaneous method exerts minimal trauma on the urethra and bladder, causing less morbidity and is associated with reduced hospital stay and is more efficacious in dealing with large bladder stones [10]. Some relative contraindications to PCCL include previous lower abdominal or pelvic surgery and a history of bladder cancer [11]. In these cases, the risk of injury to the bowel or internal organ can be avoided by using an ultrasound or fluoroscopy to guide the puncture.

In this study, the procedure to obtain access was performed with a distended bladder to avoid bowel injury without any ultrasonic or fluoroscopic guidance, and no obvious complications were observed. Additionally, patients and doctors avoided radiation exposure. However, Salah MA *et al*. [3] reported that 155 children bladder stones were treated safely and successfully with PCCL under fluoroscopic guidance.

Our report confirmed the successful experience of others regarding the use of a percutaneous method for treating bladder stones [12-17]. One of the differences between our technique and other techniques described in previous reports is the use a 20 F peel-away working sheath combined with 8-9.8 F ureteroscope. Elbahnasy AM *et al*. [12] and Tan YK *et al*. [14] used a self-retaining laparoscopic trocar and a laparoscopic entrapment bag for working access, respectively. Our working access was smaller in diameter than that described in the above reports, which would cause less trauma. We also fragment bladder stones with the pneumatic Swiss Lithoclast because it rapidly fragments all stones regardless of their density. We hypothesized that this would make the procedure more efficient as fragments would be flushed from bladder through the sheath during lithotripsy. Furthermore, with the inflow of fluid into the bladder and the overflow out through the space between the sheath and the ureteroscope during the procedure, the bladder pressure was not high and small stone fragments were easily flushed out of the bladder with the outflow. Additionally, the larger fragments were withdrawn using grasping forceps through the sheath.

Recently study show that more patients with stone were presenting with an underlying bleeding disorder or need for regular thromboprophyaxis [18]. However, we did not find any bleeding disorder and also did not use regular thromboprophyaxis in perioperative period in our study.

We have used MPCCL as an alternative to open surgery in patients with urethral strictures who could not be treated transurethrally. This is a reported 100% success rate in adult patients with urethral strictures. Because each stone fragment is a nidus for new stone formation and urinary infection in patients with urethral stricture, we attempted to remove all of the fragments if possible. We did not encounter any complications related to bleeding, bladder trauma, or extravasation in any of our MPCCL cases. Our operative time for the MPCCL group averaged 18.2 minutes, which is shorter than in other PCCL series, whereas our average stone burden was 5.47 cm, which is also smaller than the burden in the earlier reports [14]. No stone recurrence had occurred after a median follow-up 12 months (range 6-22).

In conclusion, compared with open surgery, MPCCL is an effective and safe treatment option for bladder stones in patients with urethral strictures. It is minimally invasive and avoids long incisions and urethral manipulation. In combination with the pneumatic Swiss Lithoclast, MPCCL could also be used to manage very hard stones. We believe that this technique is especially useful in situations in which the transurethral approach in contraindicated, such as in patients with benign prostatic hyperplasia (BPH) or in children.

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GL, and YD collected the data, performed the statistical analysis, and wrote the manuscript. SZ, XZ and DY collected the data and participated in the writing of the manuscript. SZ, QZ, XF, XL and HG participated in the study design and in the writing of the manuscript. All authors approved the final version of the manuscript.

Disclosure of conflict of interest

None.

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