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Original Article

Management of Indiana pouch stones through a percutaneous approach: A single center experience

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ABSTRACT

Objective: We present our experience of the treatment of reservoir stones using a percutaneous approach in patients with Indiana pouch urinary diversions.

Material and methods: Patients who were treated percutaneously for Indiana pouch reservoir stones between January 2008 and December 2018 were identified from the hospital database, and their data were retrospectively analyzed. Patient charts were reviewed for stone burden, surgery details, and postoperative complications. The Indiana pouch was punctured under a direct ultrasound guidance, and a 30F sheath was placed into the pouch. A urologist removed the stones by inserting a rigid nephroscope through the sheath. A Foley catheter was left in the pouch through the percutaneous tract and opened to drainage.

Results: Seven patients (mean age: 47.3±14.7 years) were included. All patients were stone free after the procedure. The median stone number was 3 (range: 1-8). The mean maximum stone diameter was 24.4±4.9 mm (range: 19-33 mm). Six patients were successfully treated in one session, whereas 1 patient required two treatment sessions. The median postoperative hospital admission was 1 day (range: 1-5 days). The Foley catheters were removed after a median of 18 days (range: 10-19 days). No major complications were reported.

Conclusion: The percutaneous approach for Indiana pouch reservoir stones treatment ensures direct and safe management without major periprocedural complications.

Keywords: Indiana pouch; lithotripsy; reservoir stones; urinary diversion; urolithiasis.

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Introduction

Patients with any form of benign and malignant bladder diseases are primarily managed with cystectomy followed by bladder reconstruction as it is an established treatment option. The incidence of urolithiasis has been reported as 9-11% in non-continent diversions and 5-27% in continent diversions.[1-5] The factors contributing to stone formation in patients with urinary diversions include urinary stasis, recurrent infections, increased calcium excretion, and non-absorbable sutures.[6] In most cases, the stones are composed of magnesium ammonium phosphate (struvite), which reflects the presence of recurrent infection by urea splitting bacteria. There is no known standard treatment for reservoir stones. Open surgical and percutaneous techniques have been reported.[7-13] Data are limited regarding the percutaneous method for the treatment of Indiana pouch stones and are primarily limited to case reports. The aim of the current analysis was to present our experience of treating reservoir stones in patients with urinary diversions of the Indiana pouch using a percutaneous approach.

Material and methods

Data collection

The institutional review board approved the study (University of Wisconsin Madison Health Sciences IRB, 07.05.2018, Submission ID number: 2016-0418). A retrospective search of the hospital database was performed to identify patients treated percutaneously for Indiana pouch reservoir stones between January 2008 and December 2018. In total, 135 patients underwent Indiana pouch creation at

our institution during the study period. Seven patients with reservoir stones were identified. The medical records and picture archiving and communication system images of the patients were also reviewed. All patients were evaluated preoperatively through non-contrast computed tomography (CT) to assess the stone burden. Data regarding medical history; surgical history; periprocedural complications; postprocedure stone-free status; and laboratory studies, including pre- and postprocedure creatinine, chemical analysis of the stones, and urine culture were collected. Complications within 30 days were generally considered periprocedural. However, we searched for complications within 6 months of the procedure dates to identify any potential delayed complications.

Surgical technique

All the patients provided informed consent for the procedures. The procedures were performed under general anesthesia in an operating room. CT examinations were reviewed before each operation to evaluate the pouch anatomy. Specifically, the locations of the stones and adjacent visceral organs including the bowel were identified. The laboratory results, including platelet number, prothrombin time, and international normalized ratio, were within the acceptable limits for an interventional procedure. A preoperative negative urine culture test was not required. The patient was placed supine on the operating table, and the right lower quadrant was then prepped and draped in the routine sterile manner. The Indiana pouch was catheterized using a 14 French (F) Foley catheter through the catheterizable stoma and was filled with dilute water-soluble contrast. The contrast was added as it facilitated wire manipulations in the pouch and guided fluoroscopic localization of the nephroscope in the pouch. Ultrasound (US) was used to visualize the pouch and an appropriate skin entry site was identified. Care was taken to avoid the inferior epigastric vessels and the adjacent bowel. An 18-gauge needle (Cook, Bloomington, IN) was inserted into the pouch by an interventional radiologist under a direct US guidance (Figure 1). An Amplatz wire (Cook, Bloomington, IN) was inserted through the needle and looped within the pouch (Figure 2). The needle was exchanged for a Lieberman B sheath (Cook, Bloomington, IN). A second Amplatz wire was looped within the Indiana pouch and retained as a safety wire. The Lieberman B catheter was exchanged for an Ultraxx™ balloon set (Cook, Bloomington, IN). The balloon was inserted over the first wire and inflated. A 30F sheath was inserted over the fully inflated Ultraxx™ balloon into the pouch. The balloon was deflated and removed over the wire. A urologist inserted a rigid nephroscope through the sheath and identified the stones. If the stone was large, it was fragmented using a CyberWand Dual Ultrasonic Lithotriptor System (Olympus, Southborough, MA, USA). A Perc-N-Circle basket (Cook, Bloomington, IN) was used to extract multiple fragments. A flexible nephroscope was then introduced, and the entire pouch was inspected to confirm that all

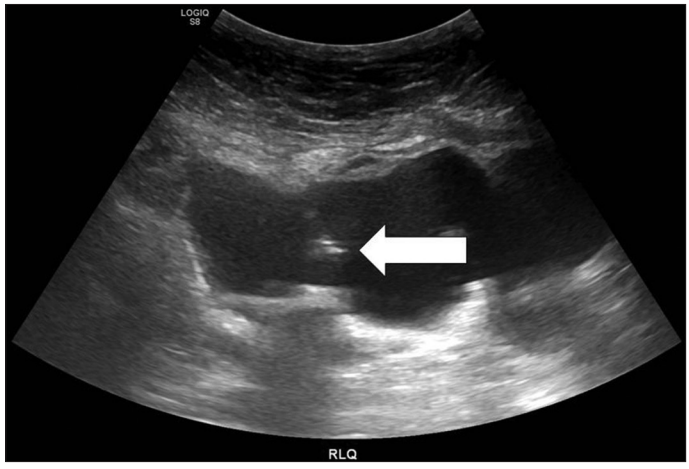

Figure 1. Ultrasound image showing a needle tip (arrow) in the distended Indiana pouch during US-guided puncture of the pouch

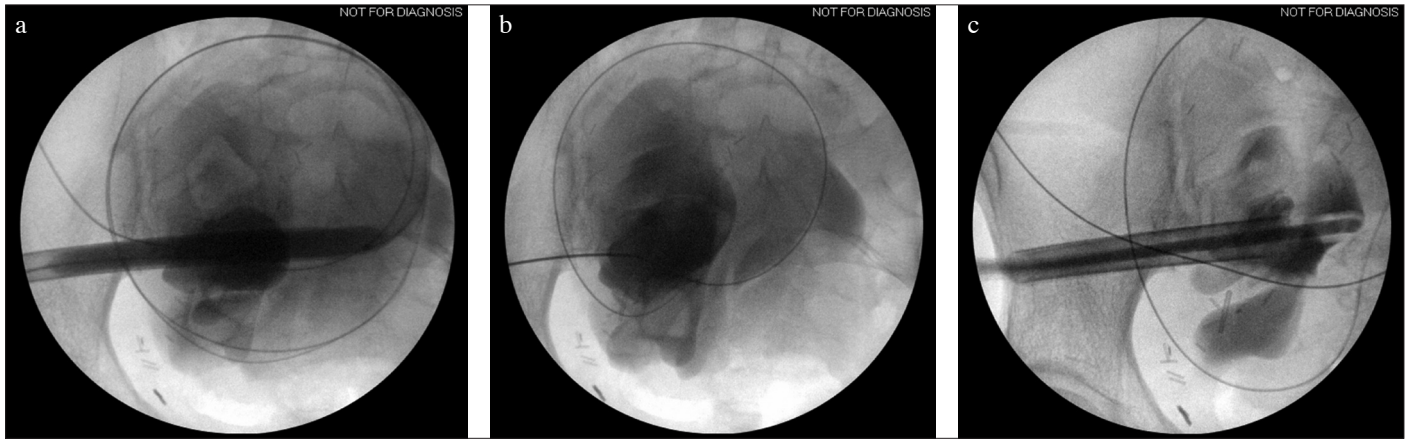

Figure 2. a-c. Needle with guidewire looped in the Indiana pouch (a). Sheath inserted into the pouch over the balloon (b). Rigid scope inserted through the sheath (c)

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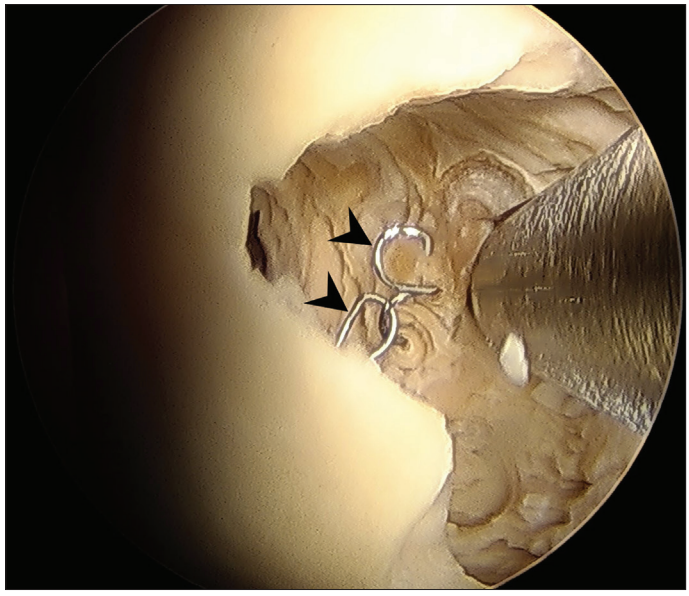

Figure 3. Intraoperative photograph of surgical staples (arrowheads) with stone formation

Table 1. Patient demographics and clinical data

Characteristics	
Age (years)[a]	47.3±14.7
Gender (n)	
Male	2 (28.6%)
Female	5 (71.4%)
Urinary diversion indication (n)	
Bladder cancer	5 (71.4%)
Vaginal melanoma	1 (14.3%)
Trauma	1 (14.3%)
Stone number[b]	3 (1-8)
Maximum stone diameter (mm)[a]	24.4±4.9
Operative time (minutes)[b]	183 (143-213)
Hospitalization time (days)[b]	1 (1-5)
Drain size (n)	
24F	4 (57.1%)
22F	3 (42.9%)
Drain indwelling period (days)[b]	18 (10-19)

[a]Mean±standard deviation, [b]Median and range in parenthesis, n: Numbers and percentages in parenthesis

stones were removed. Fluoroscopy was also used to detect residual radiopaque stones. Of note, all stones removed from the patients were radiopaque based on preoperative CT evaluation. At the end of the procedure, a Foley catheter was placed through the access sheath into the lumen of the pouch, and the access sheath was then removed. The Foley balloon was inflated with 10 mL of sterile water, pulled up against the abdominal wall, and secured in place. Both the stomal catheter and percutaneous access catheter were opened to drainage. The extracted stones were analyzed for composition as part of the routine procedure at our institution.

Statistical analysis

Statistical analyses were performed using the Statistical Package for Social Sciences version 15.0 (SPSS Inc.; Chicago, IL, USA) software for Windows. Data were presented as frequencies for categorical variables and as mean and standard deviation or median and ranges for continuous variables.

Results

The demographic, clinical, and laboratory data of the study population are summarized in Table 1. The mean age of the study population was 47.3±14.7 years (range: 29-69 years), and five women and two men were included. The mean interval period between the urinary diversion and percutaneous intervention was 95.7±52.2 months (range: 22-164 months). The indication for urinary diversion was carcinoma of the bladder in five patients, vaginal melanoma in one patient, and trauma in one patient. Five patients were asymptomatic and two patients had recurrent urinary tract infections. Five of the seven patients had a positive preoperative urine culture. Five patients had multiple stones, and the median stone number was 3 (range: 1-8). The mean maximum stone diameter was 24.4±4.9 mm (range: 19-33 mm).

All the patients were treated using a single access gained by the described method. They underwent a successful puncture and stone removal of the Indiana pouch. The estimated blood loss was minimal in all cases. The median procedure time was 183 minutes (range: 143-213). Overall, 6 of the 7 (86%) patients were successfully treated in one session, whereas 1 patient (14%) required two treatment sessions. The patient who required two procedures had a high stone burden, and a postprocedure day 1 CT was obtained due to high a suspicion for residual stones. The CT demonstrated three remnant stones within the pouch. The patient underwent a second-look procedure through the original access site 14 days after the first operation, and the complete removal of the stones was achieved. In four patients, postoperative imaging with CT demonstrated no residual stones. In two patients, postoperative cross-sectional imaging was not available, but surgical reports and fluoroscopy during the operation revealed no residual stones. The study population characteristics on a case-by-case basis is presented in Table 2.

At the end of the procedure, a 24F (n=4) or 22F (n=3) Foley catheter were placed through the percutaneous access site. The Foley catheter removal date for one patient could not be found.

Table 2. Case-by-case demonstration of the study population

Age (years)	Sex	Diversion indication	Diversion treatment interval (months)	Complaints	Stone[a]	Largest stone, (mm)	Stone free status	Preoperative creatinine (mg/dL)	Post operative creatinine (mg/dL)	Drain size (Fr)	Drain indwelling period (days)	Stone composition
39	F	Bladder tumor	89	None	3	21×17×21	Y	0.8	0.9	24	18	C2H2CaO5 +CaP
69	F	Bladder tumor	164	None	8	25×18×17	Y[a]	0.7	1.0	24	17	MgNH4PO4 + CaP
56	F	Vaginal melanoma	163	None	2	28×24×33	Y	1.1	1.1	22	NA	MgNH4PO4 + CaP
59	F	Bladder tumor	22	None	1	22×23×26	Y	0.8	1.1	22	18	MgNH4PO4 + CaP + C5H7N5O3
33	F	Bladder tumor	56	None	3	18×22×23	Y	0.6	0.6	24	10	MgNH4PO4 + CaP + C5H7N5O3
29	M	Trauma	88	Recurrent infection	5	15×14×19	Y	1.0	1.1	22	19	MgNH4PO4 + CaP + C2CaO4
46	M	Bladder tumor	88	Recurrent infection	1	17×14×21	Y	1.0	1.1	24	18	MgNH4PO4 + CaP+ C2CaO4

[a]Stone-free status was obtained after the second session; F: female; M: male; Y: yes; NA: not available; C2H2CaO5: calcium oxalate monohydrate; CaP: calcium phosphate; MgNH4PO4: magnesium ammonium phosphate (struvite); C5H7N5O3: ammonium urate; C2CaO4: calcium oxalate

The other Foley catheters were removed after a median of 18 days (range: 10-19 days). The median post operative hospital admission was 1 day (range: 1-5 days).

The continent mechanism of the pouch remained intact in all patients. One patient experienced a grade I complication and suffered from flank pain and fever 14 days after the procedure but responded well to antibiotic treatment.[14] The patient's urine culture was positive for *Pseudomonas aeruginosa* and *Klebsiella pneumonia*.

In one patient, the stones were formed on surgical staples (Figure 3). The stone analysis revealed magnesium ammonium phosphate + calcium phosphate + calcium oxalate stones for two patients; magnesium ammonium phosphate + calcium phosphate + ammonium urate stones for two patients; magnesium ammonium phosphate + calcium phosphate for two patients; and calcium oxalate monohydrate + calcium phosphate for one patient.

Discussion

The efficacy and safety of open surgical and percutaneous techniques for the removal of stones in reconstructed bladders have been reported in several studies.[7-13] The success rate of open surgery for stone removal is high, but it has potentially higher morbidity and complication rates compared to the percutaneous techniques since a large incision is required.[7] The morbidity and complication rates in open surgery may further increase in patients with recurrent stones due to tissue adhesions, postoperative scar, and anatomical alterations after repeated surgeries.[15] Open pouch stone removal has also been reported to cause loss of continence function in up to 25% of patients.[7]

Minimally invasive methods have become a more common approach, as they offer lower morbidity and complication rates with high stone-free success rates.[8,16] Minimally invasive methods include transstomal and percutaneous approaches. Excessive manipulation during the transstomal intervention might destroy the continence mechanisms, thereby rendering it a high-risk procedure. This subject of intervention has not been well studied, but Metcalfe et al.[17] reported the incidence of incontinence after transstomal endoscopic interventions as 1.5%. The transstomal technique also has the risk of stomal stricture and stenosis in the long term. Furthermore, since the stoma or urethra is small in diameter, the introduced camera or stone removal devices may have limited efficacy. It is often difficult to visualize an entire pouch through a continent stoma and to manage large stones, thereby increasing the possibility of leaving stone fragments within the pouch. The transstomal approach should therefore be reserved for patients with large-caliber valves and small stone burdens. With a percutaneous approach, there is a minimal risk of damage to the continent function of the reservoir as the stoma remains intact. Importantly, incontinence was not observed in any of our percutaneously treated patients.

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In a similar study carried out by Natalin et al.[9] Indiana pouch stones were managed with a double percutaneous approach. Authors used two percutaneous access sites into the pouch and removed the stones using a laparoscopic entrapment bag through the trocar site. Their technique was efficient with 100% stone-free outcome and no related complications. Lam et al.[11] reported that the combination of percutaneous endourologic and laparoscopic techniques for reservoir stones led to a 100% stone-free outcome and no periprocedural complications. They directly inserted a laparoscopic trocar through the previous suprapubic cystostomy scar through one percutaneous access site into the reservoir. In our study, we utilized a single access site that was acquired under a US guidance. Fernandez et al.[18] reported that interventional radiologists provide percutaneous access into the urinary system more commonly in patients with urinary diversions. Importantly, US guidance allowed to identify and avoid the inferior epigastric vessels and bowel. After gaining the initial access, we dilated the tract using a balloon dilatator to minimize the risk of injury to the vessels and wall of the reservoir.

The ideal time to remove the catheter from the percutaneous access site has not been defined in literature. The percutaneous catheters were left in place in this study to maximize pouch drainage and minimize the chance of a urinary leak until removed at the patients' 2-week urology clinic follow up. Of note, none of our patients had a urinary leak.

The treatment of reservoir stones is a challenge in patients with reconstructed bladders hence requiring a multidisciplinary approach. In our cases, percutaneous stone removal was performed with the assistance of interventional radiologists and urologists to attain percutaneous access and the stone removal, respectively. We believed that this approach yielded a maximum benefit to the patients' management. With the help of direct visualization and skills and equipment of interventional radiologists, percutaneous access to the reconstructed bladder could be achieved with minimal trauma to the reconstructed bladder as well as to the adjacent hollow viscera. By inserting the surgical instruments through the percutaneous access, urologists could effectively remove the stones.

This study has some limitations. It is a retrospective study with a relatively small number of patients. Additional studies with larger populations are needed to validate these findings. Postoperative imaging to evaluate for residual stones was not available for two patients; however, operative notes and fluoroscopic examination during the operation revealed no residual stones.

In conclusion, the treatment of reservoir stones in patients with reconstructed bladders can be challenging. US-guided percutaneous access into the reconstructed bladder may be achieved with minimal trauma to the reconstructed bladder while avoiding an injury to the adjacent hollow viscera. This analysis confirms that a percutaneous approach for Indiana pouch reservoir stones provides a direct and safe treatment method without significant periprocedural complications.

Ethics Committee Approval: Ethics committee approval was received for this study from the University of Wisconsin Madison Health Sciences IRB (Submission ID number: 2016-0418).

Informed Consent: Written informed consent was vaiwed from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - M.Ö., J.C.M., P.F.L., M.G.K.; Design - M.Ö., J.C.M., M.G.K.; Supervision - M.Ö., M.G.K.; Resources - M.Ö., J.C.M., P.F.L., S.Y.N., S.P.H., S.L.B., M.G.K.; Materials - M.Ö., J.C.M., P.F.L., S.Y.N., S.P.H., S.L.B., M.G.K.; Data Collection and/or Processing - M.Ö., M.G.K.; Analysis and/or Interpretation - M.Ö., M.G.K.; Literature Search - M.Ö.; Writing Manuscript - M.Ö., M.G.K.; Critical Review - M.Ö., J.C.M., P.F.L., S.Y.N., S.P.H., S.L.B., M.G.K.; Other - M.Ö., J.C.M., P.F.L., S.Y.N., S.P.H., S.L.B., M.G.K.

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