CASE REPORT

Endoscopic Management of Urolithiasis on a Pediatric Patient with a Solitary Kidney and an Ileal Conduit

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Management of nephrolithiasis in patients with urinary diversions pose a unique therapeutic challenge for the following reasons: 1) retrograde ureteral access is difficult to perform through a bowel diversion and 2) percutaneous renal access becomes challenging because of inability to do a retrograde pyelogram. For this reason, image-guided access through a combined ultrasound and fluoroscopic guidance are both necessary. This clinical problem becomes even more complicated when dealing with a solitary functioning kidney. Treatment should be precise in order to avoid any complications that may progress to renal failure. Presented here is a 15-year-old male adolescent who had previously undergone a radical cystectomy with an ileal conduit for a rhabdomyosarcoma of the bladder last 2008, and complained of flank pain, fever and foul-smelling urine. Imaging studies showed left obstructive hydronephrosis with ureterolithiasis and nephrolithiasis, and an atrophic contralateral kidney. A preliminary nephrostomy tube drainage was done to recover renal function, followed later by percutaneous endoscopic stone management. Discussed here are the challenges involved in his therapy as well as the advantages of a stepwise approach including the short-term outcomes.

Key words: Percutaneous nephrolithotomy (PCNL), ileal conduit, pediatric, solitary kidney

Introduction

Urinary calculi are a potential complication of urinary diversions necessitating recurring treatments. In the pediatric patient, repeated treatment entails recurrent exposure to anesthesia and potential for progressive renal deterioration. The ideal treatment is a minimally invasive approach that limits further renal damage while achieving a high stone-clearance. This is especially important when dealing with solitary kidneys because treatment failure necessarily leads to a decline in renal function. Presented here is a case of a 15-year-old male with an ileal conduit who developed pyohydronephrosis due to an obstructing ureterolithiasis alongside nephrolithiasis. The authors describe a stepwise approach that limits renal damage while achieving a high success rate.

The Case

A 15-year-old male adolescent came to the emergency department due to a left-sided flank pain, fever and foul-smelling urine of one week duration. History revealed recurrent urinary tract infections for the past year. His medical history was significant for a previous radical cystectomy with ileal conduit creation last 2008 followed by adjunctive chemotherapy for rhabdomyosarcoma of the bladder, which is currently in remission.

He had undergone extracorporeal shockwave lithotripsy for left-sided nephrolithiasis last 2019. On physical examination, he was tachycardic and febrile. The abdomen was not distended, ileal conduit was viable with cloudy yellow urine output, with midline laparotomy scar, normoactive bowel sounds, tympanitic, soft, non-tender, no guarding, but with left-sided costovertebral angle tenderness. Hematologic examination showed hemoglobin of 13.5 mg/dL, leukocytosis 11,720 mm^3, and azotemia (creatinine 5.59 mg/dL from 1.49 mg/dL four months prior). Empiric intravenous antibiotics were started. Unenhanced CT of the KUB showed an atrophic right kidney, bilateral nephrolithiasis, an obstructing left proximal ureterolithiasis with left hydronephrosis. Left-sided pelvocalyceal and ureteral fluid were also hyperdense suggesting an inflammatory process (Figure 1). A percutaneous left-sided nephrostomy tube was placed under ultrasound guidance draining purulent urine. There was subsequent improvement of creatinine levels (1.61 mg/dL). Urine culture later yielded Proteus mirabilis, thus he was shifted to an antimicrobial appropriately based on the sensitivity studies. When repeat blood and urine cultures were negative, he underwent percutaneous nephrolithotripsy (PCNL) in combination with an antegrade flexible ureterolithotripsy and insertion of indwelling ureteral stent.

Operative Technique

With the patient in the prone position, antegrade pyelogram was performed through the previously inserted nephrostomy tube which was located in the inferior calyx. An appropriate site was chosen in the upper posterior calyx. A bullseye technique was utilized to advance the percutaneous access needle into this desired calyx. Once the correct entry into the calyx was ascertained, a PTFE-nitinol guidewire with hydrophilic tip was advanced into the ureter until its tip entered the ileal conduit. This was later exchanged for a PTFE-stainless steel wire with a flat-wire coil and the tract was dilated up to 30Fr followed by insertion of the renal sheath (Figure 2). A 26Fr nephroscope was then introduced revealing the irregularly golden-brown nephrolithiasis. This was fragmented and cleared using an ultrasonic lithotripter. The nephroscope was then advanced into the ureter but the authors were unable to visualize the ureteric stone. They therefore inserted an 11/13Fr ureteral access sheath. A 7.5Fr flexible ureterenoscope was inserted antegradely allowing them to visualize the proximal ureterolithiasis which was fragmented and then dusted using 50W Holmium laser lithotripsy. A 6Fr x 24 cm indwelling ureteral stent was then inserted followed by a 14Fr nephrostomy tube. Fluoroscopic imaging showed no residual radioopaque calculi.

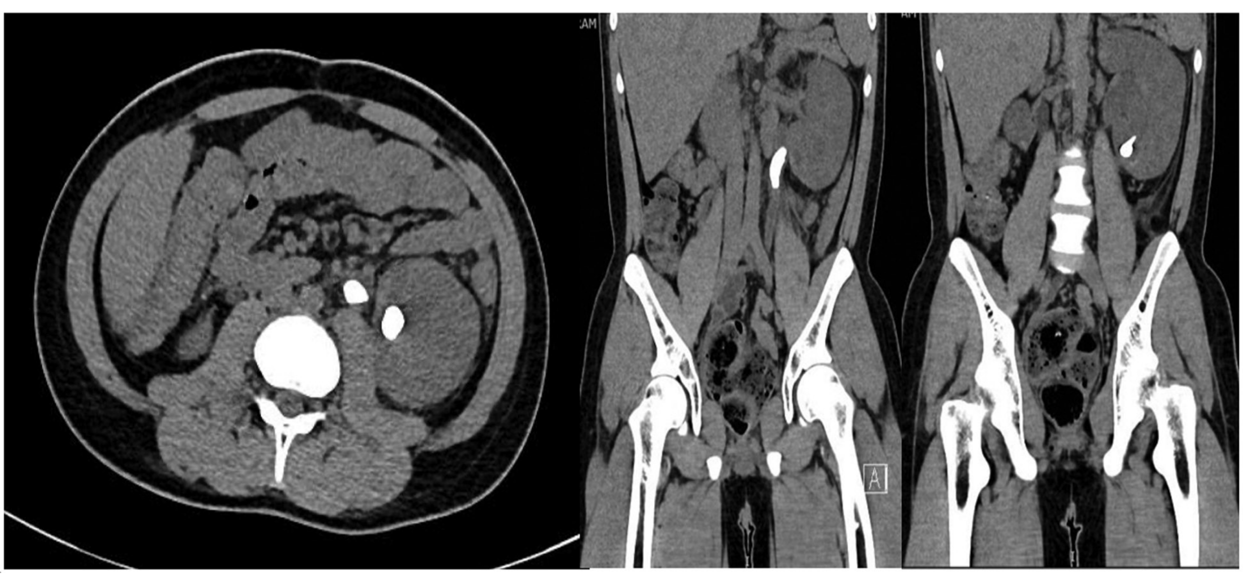

Figure 1. Unenhanced CT scan showing the left sided nephrolithiasis and pelvolithiasis. Note the atrophic right kidney

Figure 2. Fluoroscopic images showing the access through the upper posterior calyx (Left & Middle); Post-operative image showing no residual stone.

Clinical Outcome

The operative time was 225 minutes with an estimated blood loss of 350 mL. Postoperatively the creatinine increased to 4.74 mg/dL, and the hemoglobin dropped to 8.4 g/dL. Increase in creatinine was attributed to renal injury from access, decrease in renal blood flow, and release of endotoxins from the stone fragmentation. These were then managed with intravenous hydration and blood transfusion with two units of packed red cells. After completion of antibiotic therapy, he was discharged in good condition on postoperative day 8 with oral antibiotic prophylaxis. Postoperative imaging showed no residual stone on ultrasound and fluoroscopy (Figure 3). On three months follow-up, the creatinine returned to baseline at 1.91 mg/dL and patient underwent endoscopic removal of double j stent through the ileal conduit. He is currently doing well.

Discussion

Urolithiasis is a known long-term complication of patients with urinary diversion. Depending on the type of diversion, incidence ranges from three to 43%.[1,2] The increased risk of stone formation is due to metabolic, infectious, and structural

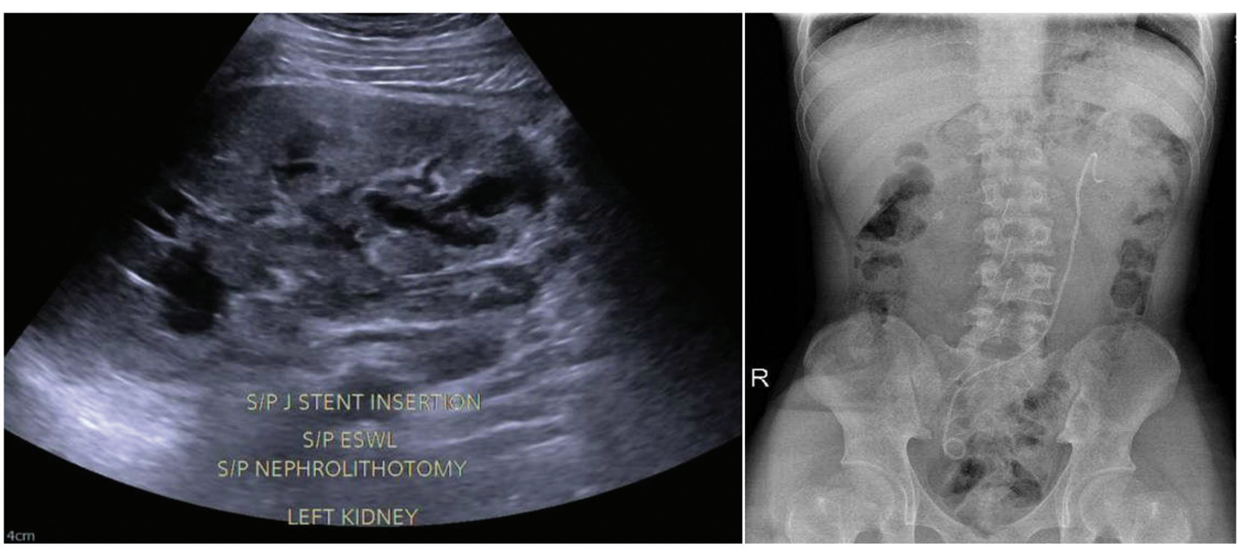

Figure 3. Follow up imaging showing stone free status on ultrasound and no radio-opaque stone KUB X-ray.

changes and it can occur from the upper urinary tract down to the conduit or reservoir.[1] The diagnostics done for urolithiasis are similar wherein unenhanced CT imaging is recommended. The case presented is a pediatric patient with an ileal conduit, solitary kidney which developed acute pyohydronephrosis secondary to obstructive stones. The goal of therapy included achieving maximal stone clearance while preserving renal function with minimal complications. He was then started on empiric intravenous antibiotics and prompt renal decompression, whether via an indwelling ureteral catheter or nephrostomy tube insertion.[3] Once he was stabilized, the source of obstruction was addressed. The ideal approach to complex urolithiasis is endoscopic stone intervention.[4,5] This may take the form of retrograde endoscopic lithotripsy or percutaneous nephrolithotripsy. The choice of approach is influenced by different stone characteristics such as location, total stone burden, and density. This is further affected by the individualized characteristics; such as the patient's age, the anatomical complexity of urinary diversion and his age, and his solitary kidney status. All of which make surgical management complex.

Stone burden in the present case has been increasing these past decades.[5] However, the pediatric population constitutes only 2-4.3% of the stone-former population and is attributed to similar factors: urinary tract infection, metabolic, and structural changes.[6] These same factors also play a role in the high recurrence rate in this population.[6] With this in mind, maximal stone clearance in a single procedure is ideal as to decrease repeated exposure to anesthesia and possible renal damage from recurrent interventions in the developing kidney. Indications for PCNL in the pediatric population is similar to the adult with PCNL being recommended for stone burden of 20 mm or more.[5] There is concern regarding the possibility of kidney injury and its long-term effect on renal function in this age group. In a review by Sabnis et al, there was no significant change in radioisotope scans and GFR before and after PCNL.[6] More recent reports have similar clearance rates and complications.[7,8]

Renal stones can be managed via retrograde endoscopic access however this is difficult in patients with urinary diversions. As mentioned, stone-free rates within a single procedure is ideal, especially in the pediatric age group. In a review by Seth et al, PCNL had the highest stone-free rate in a single procedure compared to ureteroscopy which was attributed to the difficulty in establishing retrograde access.[1] Difficulty in establishing a retrograde access is mainly due to the long tortuosity of the ileal segment, possible ureteroileal anastomotic strictures, and difficulty identifying the ureteral orifice. It was reported that in cases wherein the ureteroileal anastmosis was identified and accessed up, half would still need simultaneous PCNL[9], supporting that PCNL as the approach of choice for urinary diversions. The 2021 EAU guidelines recommend PCNL for large renal stones and ureteral stones that cannot be accessed by the less invasive retrograde approach.[5]

PCNL is the treatment of choice for the case presented, however concern regarding renal injury is paramount due to atrophic contralateral kidney. Treatment options are similar for those with normal and solitary kidneys with the choice of treatment approach dependent on stone location and size.[4] Complication is magnified in solitary kidneys due to its hypertrophy and dilatation leading to a more significant hemorrhage and lack of a compensatory contralateral kidney.[10] Reports comparing PCNL in solitary and bilateral kidneys show comparable stone free clearance, complication rates, and long-term follow up have stable or improved renal function.[11-13]

Increasing stone-free rates is important to minimize further subsequent procedures and repeat exposure to anesthesia as previously mentioned. PCNL is the approach of choice for patients with complex stones or those with large stone burden.[4,5] It is approached via a rigid-only antegrade approach, providing high stone-free rates, but with the possibility of using multiple tracts or second look procedures which could lead to more complications.[14] Cracco made a systematic review comparing rigid-only PCNL to combined rigid and flexible nephroscopy/ureteroscopy.[14]

Their review showed higher stone-free rates when flexible nephroscopy or ureteroscopy was used in conjunction with rigid PCNL. The addition of flexible endoscopy decreases the need for a secondary access and need for second look procedures. Complication rates are comparable to PCNL using an exclusively rigid nephroscope. This was attributed to less blood loss resulting from a single access site. The authors were able to utilize a flexible ureteroscope together with 50W Holmium laser lithotripsy to treat the upper ureteric stone which was inaccessible from above using the rigid nephroscope thus limiting trauma to the solitary kidney.

Conclusion

Pediatric patients with a solitary kidney and ileal conduit, presenting with a large stone burden are difficult to manage. A well-planned staged percutaneous and endoscopic stone intervention using a combination of antegrade rigid and flexible endoscopy vis-à-vis the utilization of different types of intracorporeal lithotripters (ultrasonic and laser energy) is key to the success of the treatment. The authors demonstrated that in spite of the complexity, patients with this condition may be treated successfully with an antegrade endoscopic approach with good safety outcomes.

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