Retrograde intrarenal surgery by flexible ureteroscope in patients with spinal deformities

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Objective: To present our experience with retrograde intrarenal surgery (RIRS) for managing renal stones in patients with spinal deformities.

Design: We retrospectively reviewed the records of patients.

Methods: We retrospectively reviewed the records of seven patients with congenital scoliosis ($n = 5$), spina bifida ($n = 2$) who had undergone RIRS for renal stones. Stone-free status was determined by CT 30 days after the procedure and was defined as the absence of stones in the kidney or residual fragments ≤ 1 mm.

Results: Mean patient age was 27 years (18–45 years), and mean stone size was 176 mm (143–340 mm). The average operative time was 38 minutes (25–53 minutes), and postoperative hospital stay was 1 day (1–2 days). A stone-free status was obtained in six (85.7 %) patients, and one patient was considered to have treatment failure. This patient was managed by a repeat RIRS. A Double-J stent was placed at the end of the procedure in all (100 %) patients. No severe complications, either from anesthesia or the surgical procedure, were observed, and no blood transfusion was reported.

Conclusions: The good clearance rate with a low incidence of complications shown by the present study has demonstrated that RIRS is a safe and effective procedure for renal stones in patients with spinal deformities.

Keywords: Flexible ureteroscope, Laser lithotripsy, Renal stone, Spinal deformity, Urolithiasis

Introduction

Stone disease is seen frequently and recurs in patients with spinal deformities due to immobilization and voiding dysfunction. Abnormal posture, associated pulmonary problems and additional diseases make medical and surgical treatments difficult.^{1–3} In these patients, common treatment modalities are shockwave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), and open surgery. Although PCNL is an effective treatment, this procedure may cause severe blood loss, adjacent organ injuries, and life-threatening medical complications. Ureteroscopic management of renal calculi provides an alternative to PCNL or SWL, potentially achieving higher stone-free rates than SWL with lower morbidity than PCNL for normal patients.^{1,4} In the literature, there are a few studies about RIRS in patients having renal stones with spinal deformities. In

this study our aim was to present the results of RIRS in patients with spinal deformities.

Methods

We retrospectively reviewed the records of seven patients with spinal deformities who had undergone RIRS for renal stones at the urology department of Gazi University Medicine School. Patient assessment included medical history, physical examination, urinalysis, urine culture, complete blood cell count, serum biochemistry, coagulation tests, intravenous urography, and/or computerized tomography (CT) scan. Evaluation of the respiratory and cardiovascular systems (chest radiography or CT scan, pulmonary function tests, and echocardiography) was performed whenever needed (Fig. 1A). Patients with positive urine cultures were adequately treated with appropriate antibiotics, and all patients had a negative urine culture before surgery. Patients with bleeding diathesis and abnormal renal anatomy were excluded from the

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Figure 1 Direct urinary system graphy (A) and intraoperative image (B) of a patient with spinal deformity.

study. Stone size was determined by measuring the longest axis on preoperative radiologic investigation.

All procedures were performed by two surgeons (FP and SY) using a 7.5F flexible ureteroscope (Karl Storz GmbH & Co. KG, Tuttlingen, Germany). Under general anesthesia, patients were placed in the lithotomy position on an endoscopy table with fluoroscopic imaging capability (Fig. 1B). After passing a 0.035-inch safety guidewire into the renal pelvis, a ureteral access sheath (9.5/11.5F or 12/14F) was placed to allow for optimal visualization, to maintain low intrarenal pressure, and to facilitate extraction of stone fragments. The stones were fragmented with a holmium:yttrium-aluminum-garnet laser until they were deemed small enough to pass spontaneously. We maintained the laser energy at 0.6 to 1.2 J and frequency at 5 to 10 Hz, depending on the clinical situation. Basket extraction of residual fragments was not routinely performed; however, some residual fragments were removed by tipless nitinol baskets (1.5F Halo, 2.2F N-Circle, or 1.7F N-Gage, Cook Medical, Bloomington, IN, USA) for stone analysis. Postoperatively, a Double-J stent was placed based on surgeon's decision. Intraoperative and postoperative data and presence of technical difficulties were evaluated in all patients.

All patients underwent renal ultrasonography as a routine study the day after RIRS to ensure the absence of hydronephrosis and a radiographic study at stent extraction. Stone-free status was determined by low-dose protocol CT scan 1 month after the procedure and was defined as the absence of stones in the kidney or residual fragments ≤ 1 mm. After the first follow-up, patients were seen every 3 months during the first year, and every 6 months thereafter. At each visit, urinalysis and abdominal ultrasonography were performed to evaluate for urinary tract infections, hydronephrosis,

and residual stones and/or fragments. Medical therapy and dietary planning were provided postoperatively in the outpatient setting when appropriate.

Results

A total of seven patients, four males and three females, were included in the present study. Of these, five patients (three male, two female) had congenital scoliosis, two patients (one male, one female) had spina bifida. A reduced forced vital capacity by spirometry was seen in four patients because of the scoliosis (Table 1).

All procedures were performed under general anesthesia. RIRS was performed in the lithotomy position in all patients. Dilation of the ureteral orifice was required only in two (28.5%) patients, and ureteral-access sheaths were placed in all (100%) patients. A stone-free status was obtained in six (85.7%) patients. In one patient a double J catheter had to be placed 2 weeks prior to RIRS because of failure of passage of the flexible URS due to the narrow ureteropelvic junction. No complications, either from anesthesia or the surgical

Table 1 Preoperative characteristics of patients

No. patients	7
Male/female	4/3
Mean age (range)	27 (18–45) years
Spinal deformities	n (%)
Congenital scoliosis	5 (71.4%)
Spina bifida	2 (28.5%)
Stone side	n (%)
Left	3 (42.8%)
Right	4 (57.1%)
Stone location	n (%)
Pelvis	3 (42.8%)
Mid/upper pole calices	3 (42.8%)
Lower pole calices	1 (14.2%)
Mean stone size (range)	10.63 (7.8–13.6) mm
History of failed SWL	7 (100%)
Reduced vital capacity	4 (57.1%)

SWL = shockwave lithotripsy.

Table 2 Perioperative and postoperative findings of patients

	n (%)
Lithotomy position	7 (100%)
Dilation of the ureteral orifice n (%)	2 (28.5%)
Use of ureteral-access sheath n (%)	7 (100%)
Mean operative time (range)	38 (25–53) min
Mean fluoroscopy time (range)	27 (23–42) sec
Hospitalization time (range)	1 (1–2), 1.1 ± 0.3 days
Initial stone-free rate n (%)	6/7 (85.7%)

procedure, were observed, and no blood transfusion was reported (Table 2).

Discussion

Prevalence of stones in patients with normal spines was 0.24% compared with 1.40% and 4.03% among those with spinal curvature and spinal dysraphism, respectively. Urolithiasis is a common condition in patients with spinal deformities, especially in patients with neurogenic voiding dysfunction.^{1,5} Two of our patients had voiding dysfunction as a consequence of spina bifida. Two patients had hypercalcemia and one had struvite stone due to chronic urinary infection. We were not able to document cause of stones in the rest of the two patients. Management of urinary tract stones in these patients is a challenging problem, because of recurrent stone formation, technical difficulties, and higher rate of complications in this population. These factors make minimally invasive procedures more important.⁶

In these patients, treatment alternatives such as SWL, PCNL, and open surgery are applied. The major problems of these patients are positioning problems beside the recurrence of the stone formation. Furthermore, because of positioning problems related to the musculoskeletal anomalies, such as scoliosis and pelvic tilt, and consequent difficulties in the accurate location of shockwaves on renal calculi, these patients might be at greater risk of development of renal parenchymal and vascular damage after SWL. The difficulty of the position is not only for SWL, but also for URS and PCNL. Despite its effectiveness, serious complications, such as blood loss, adjacent organ injuries, and life-threatening medical complications, have been identified as a result of PCNL and occur at a reported rate of up to 83%. This procedure may be challenging and risky in patients with spinal deformities because of anesthesiologic and cardiorespiratory issues, patient position on the operating table, and percutaneous access modality.^{7,8} In Symons and co-workers series, morbidity and mortality of the procedure was significant, with two postoperative deaths. In these patients, SFR is low both in PCNL and SWL. The stone-free rate was only 62% in Symons series

for PCNL.⁹ Kara and colleagues treated four of five patients who had scoliosis with PCNL. The outcome was complete stone clearance in three (60%) patients with no injuries of surrounding organs or anesthesia-related complications.³ Neuwirth *et al.* showed a poor overall stone-free rate of approximately 50% in patients treated with ESWL.¹⁰ Soon later, Lazare and colleagues reported a 73% stone-free rate in 32 spinal cord injury (SCI) patients in 41 kidneys with a mean stone burden of 2.9 cm.¹¹

The role of RIRS has broadened in the last decade with improvements in flexible ureteroscopes, instruments, and user experience. Today, ureteroscopic management of renal calculi provides an alternative to SWL or PCNL, potentially achieving higher stone-free rates than SWL with lower morbidity than PCNL. Recent studies reported stone-free rates above 90% for retrograde ureteroscopic management of renal stones and as high as 85% for management of lower pole stones.^{7,12}

In the present series, RIRS was unsuccessful initially in only one case with a narrow UPJ resulting in failure to pass the flexible URS. However, in the second RIRS procedure after two weeks following double J catheter placement the stones could be broken. Thus a stone-free rate could be reached in each of the patients. No major complications were seen and no blood transfusions were required. We had no problems associated with narrow lower-pole infundibulopelvic angle resulting in failure of RIRS and requiring PCNL as a result as was reported in another study.¹

We believe that, when considering renal stones in patients with spinal deformities, stone size should not be the only factor in deciding the best treatment. The choice of treatment should be determined by the stone size, stone location, stone numbers, kidney pelvicaliceal system anatomy, patient medical condition, patient choice, and urologist experience. This series have some limitations, including its retrospective nature and relatively small number of patients. Although this is the small report in the literature, larger patient numbers are needed to more clearly analyze the efficacy and safety of this procedure in this population.

In this study, we showed that RIRS technique is successful in a specific group of patient; the patients with spinal deformity. The previous studies mostly include the patients who have traumatic spinal cord injuries. These previous studies are about the PCNL or rigid URS techniques. Resorlu *et al.* and Guamas-Kartalas reported case series about the treatment of urinary system stone diseases in patients with spinal deformities. In our case series, we treated all of the patients successfully with RIRS which is a less invasive technique and

has less complications.^{1,13} In our study, SFR was higher than the previous studies. By using laser lithotripsy and miniaturized devices, and more flexible uretheroscopes, SFR is being increased in urinary system stone diseases in patients who have spinal deformities or normal anatomy.

Positions of patients increases complications during procedures in with spinal deformity cases. A retrospective chart review was performed on 130 ureteroscopic procedures in 102 ureteral stone patients. Patients were divided into two groups: Those with normal spinal anatomy and those with spinal abnormalities including spinal hardware or moderate to severe scoliosis. Parameters evaluated included patient demographics, stone burden, intraoperative complications (including urinary extravasation, bleeding, or need to abort procedure), and stone-free status. Nine patients had spinal hardware or significant spinal deformities including moderate to severe scoliosis. When comparing both the intraoperative complications as well as stone-free status, there was a difference between those patients with spinal abnormalities and those without. Of 90 URS performed for stones in normal anatomy patients, the stone-free rate was 61%, compared with 35.7% in patients with spinal deformities. There were 13 total complications: 40% in spinal deformity patients compared with 6.1% in normal anatomy patients.¹⁴ In our study, the patients with renal stones, not ureteral stones were evaluated, and the results of the treatments were more successful.

Advances in the flexible endoscopic and laser conductance technology have provided us with the high rate of success seen in the present series with a special patient profile. In our patients who have spinal deformities, with renal stone diseases who have spinal deformities, RIRS was found to be an efficacious and safe method is an efficacious and safe method with high high SFR and low complication rate. Further studies with larger patient number are needed to confirm our findings.

Disclaimer statements

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