Utilization of Flexible Ureteroscopy in Renal Stones Management in Pediatrics: Single Tertiary Center Experience

Global Pediatric Health
Volume 10: 1–4

DOI: 10.1177/2333794X231199637
journals.sagepub.com/home/gph
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Abstract

Objectives. To assess the effectiveness and safety of flexible ureteroscopy in children treated at our center during the last 5 years. *Methods.* Retrospectively, we have studied 41 children that suffered 51 stone episodes, and FURS for renal calculi <2 cm. Preoperative, operative, and postoperative data were gathered. *Results*. The mean age of the 41 kids who experienced 51 stone episodes was 9.6 [2.8] years (4.2-16 years). The mean stone diameter was 12.8 [3.3] mm (6-20 mm). The mean operative time was 79.9 [19.9] minutes. The mean hospital stay was 27.6 [12.9] hours. The SFR after the first session was 64.7% and 80.4% after the second session. The overall complications had been recorded in 25 cases (49%) with low morbidity (Clavien grade I-III). *Conclusions.* Pediatric FURS is a minimally invasive option with a high SFR and a low percentage of high-grade complications in the management of pediatric renal stones.

Keywords

flexible ureteroscopy, renal Stones, pediatrics, laser

Received July 10, 2023. Received revised August 12, 2023. Accepted for publication August 21, 2023.

Introduction

Pediatric stones are a significant clinical disorder in urology practice. The incidence of urolithiasis varies in different countries. It increases in Western countries than in Asian countries. Some countries with hot dry climates show an increase in stone prevalence reaching 20.1% in Saudi Arabia. Children form 2% to 3% of the total percentage of stone formers.[1]

Extracorporeal shockwave lithotripsy (SWL) has traditionally been used to treat urinary stones in children. Because of technology changes and miniaturized instruments, flexible ureteroscopy (FURS) has been used as an alternative way to treat children with urinary stones. It is less invasive in comparison to percutaneous nephrolithotomy. The bleeding risk associated with PCNL has encouraged surgeons to use flexible ureteroscopy in children.[2,3]

This research aims to evaluate the efficacy and safety of FURS in treating children in our center during the last 5 years.

Patients and Methods

Retrospective data were gathered for all pediatric children less than 16 who underwent flexible ureteroscopy in our facility during the previous 5 years (from the start of 2018 to the end of 2022). The patient files were inspected. The inclusion criteria of the research were children who had been diagnosed with renal stones less than or equal to 20 mm in the largest diameter and had been managed with FURS. The exclusion criteria were urinary tract abnormalities, renal insufficiency, preexisting ureteral stricture, active bleeding or coagulopathy, and/or musculoskeletal deformities.[4,5]

All patients had a preoperative Computed tomography of the urinary tract (CT KUB) to assess stone number, size, density, location, and associated pathology. UTI was initially treated according to culture and sensitivity. The operation with potential consequences was explained to the patient's parents or supervisors, who had given their consent.[6]

Procedure

Under general anesthesia and broad-spectrum antibiotic cover, a cystoscopy was done. A guide wire was passed

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through the ureter. For a preschooler, a pediatric cystoscope 8 Fr was utilized to visualize the ureteric orifice and pass a guide wire.

Each child had a JJ stent, that was left in place for 2 weeks. Placement of JJ stent is preoperatively a planned event for passive ureteral dilation. After the removal of the stent, a semirigid ureteroscopy 7.5 Fr was used for passive ureteral dilation and evaluation of the ureter's distensibility.[7,8]

A ureteral access sheath (UAS) was introduced through the ureter just below the ureteropelvic junction under the C-arm. The UAS had a 10/12 F size. In every instance, the introduction of an access sheath was tried. If the ureter was tight or small, and UAS was difficult to be inserted, the flexible ureteroscope was introduced without UAS.[7,9]

Pediatric Flex X2 Storz flexible ureteroscope 7.5 Fr was used. Inspection of the whole pelvicalyceal had been carried out to count and locate the stones.[7,9]

Two hundred microns of Holmium laser fiber was used to dust or fragment the stones. A nitinol basket (1.9 microns) was employed to transfer the stones or stone fragments from the lower calyx to the upper calyx. If the stone could not be relocated, the stone had been fragmented in place. The basket was used to remove the small stone fragments. In the end, a ureteric JJ stent was implanted for everyone and removed 2 to 4 weeks later.[8,9]

Patients left the hospital on the same day or a day after surgery and followed up in the outpatient clinic. Perioperative and postoperatively possible complications were recorded and graded according to the Clavien–Dindo system.[6,10]

Follow-up: The clinical assessment, laboratory tests, and bedside ultrasound were conducted before release to identify any potential complications. Abdominal ultrasonography was carried out 2 to 4 weeks postoperatively to assess possible complications, residual stones, and the type of second procedure that might be required. If there were leftover stones or fragments of more than 2 mm, a second procedure was performed in the same setting of stent removal.[11,12]

Patients' records were collected in accordance with inclusion and exclusion criteria. Data were gathered using Microsoft Excel and analyzed using SPSS version 21.

Ethics Approval and Consent to Participate

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. The patients' parents or supervisors have given their written informed consent and the patient's information was kept confidential. The committee for human research at our institute gave its approval to the study protocol.

Table 1. Patient Demographics and Presentation.

Variable	Result
Age (years), mean	9.6 [2.8] (4.2-16 years)
Gender	
Male	27 (52.9%)
Female	24 (47.1%)
Presentation	
Lion pain	19 (37.3%)
Renal colic	10 (19.6%)
Hematuria	8 (15.7%)
UTI	6 (11.8%)
Pyelonephritis	5 (9.8%)

Table 2. Stone Data.

Stone size	12.8 [3.3] mm
Stone density	870 [233] HU
Single stone	38 (74.5%)
Multiple stones	13 (25.5%)
Renal pelvis stone	32 (62.7%)
Lower calyx stone	6 (11.8%)

The Tabuk Institutional Review Board at General Directorate of Health Affairs in Tabuk Region gave its approval for this study (IRB No: TU-077/023/202).

Results

After reviewing all patients' files, 46 kids planned to do FURS during the study period. One child with renal insufficiency and another with musculoskeletal deformity had been excluded. The introduction of a flexible ureteroscope failed in 3 patients due to their tight ureters and shifted to another maneuver of treatment. Four patients experienced recurrent attacks of stones and had 2 sets of separate FURS. Six patients experienced bilateral attacks of stones. In the end, 51 procedures of FURS were carried out in 41 patients.

The mean age was 9.6 [2.8] years and ranged between 4.2 and 16 years. Twenty-seven cases were males and 24 cases were females. Nineteen cases were complaining of lion pain, 10 cases were complaining of renal colic, 8 cases were complaining of hematuria, 6 cases were complaining of recurrent UTI, and 5 cases presented with pyelonephritis (Table 1).

The mean stone diameter was 12.8 [3.3] mm and ranged between 6 and 20 mm. The average stone density was 870 [233] HU. 13 cases (25.5%) had multiple stones, and 38 cases (74.5%) had single stones. Thirty-two cases (62.7%) had renal pelvis stones, and 6 cases (11.8%) had lower calyceal stones (Table 2).

Table 3. Operative and Postoperative Data.

Operative time	79.9 [19.9] min
Intraoperative complications	17.6%
Postoperative complications	31.4%
Use of access sheath	41.2%
Mean hospital stay	27.6 [12.9] hours
SFR after first FURS	64.7%
SFR after second FURS	80.4%

The mean operative time was 79.9 [19.9] minutes. The operative time started from the introduction of the ureteroscope to the JJ stent insertion at the end. Access sheath was used in 21 cases (41.2%). A JJ stenting was done for all cases and was usually removed within 1 month postoperatively. The intraoperative complications were mild bleeding in 7 cases and ureteral mucosal trauma in 2 cases. Pyelonephritis, Stein Strasse, and mild hematuria were the postoperative complications in 3 cases, 4 cases, and 9 cases, respectively. Forty-eight cases (94%) left the hospital the same or the next day postoperatively, only 3 patients who developed pyelonephritis were kept in the hospital for 3 days more. The mean hospital stay was 27.6 [12.9] hours (Table 3).

After the first FURS, 33 cases (64.7%) were stone free. Eight cases had residual stones, which were removed 1 month after the initial FURS. Thus, after the second FURS, 41 cases (80.4%) were stone free. The stone-free was considered if the residual fragments were less or equal to 2 mm. The remaining 10 cases had failed to be managed by FURS; they had been shifted to another maneuver. Three cases had been shifted to extracorporeal shock waves and 7 cases to mini-percutaneous nephrolithotomy (PCNL).

Discussion

Recently, the treatment of children with urinary stones has been changed. Extracorporeal shock wave lithotripsy is an effective, non-invasive modality. It requires multiple sessions with additional general anesthesia and additional radiation. On the other hand, mini PCNL has a better SFR with a single session. It is an invasive procedure that may be associated with serious complications such as bleeding, perforation, and urosepsis. Mini PCNL is more effective in treating pediatric stones more than 2 cm. After the miniaturization of the instruments, the flexible ureteroscope was been considered a good choice in the management of pediatric stones. It has a high success rate with a less invasive procedure.[2,3]

Suliman et al[11] employed FURS in pediatric stones with an SFR in the first session reaching 75% and a total SFR reaching 89%. While Chandramohan et al[5] employed FURS in preschool pediatric stones with an SFR reaching 76.3% for stones less than 20 mm. In our study, the SFR reached 64.7% after the first session and 80.4% as a total SFR. Our results were similar to the previous results and results of Ripa et al[8] showing an SFR of 76.9% after the first session and a total SFR of 84.9%. Nerli et al[13] published their results for FURS in pediatric patients. He used FURS in 80 children with upper urinary calculi with an overall SFR of 90% after a single session.

For preoperative JJ stenting, Chandramohan et al[5] had preoperative stenting in all patients. Similarly, all children included in our study had preoperative JJ stenting. A preoperative JJ stenting dilates the ureter for easy insertion of UAS. Erkurt et al[14] had a UAS placement in 94.1% of the pre-stented patients. But in our study, only 41.2% of patients had a UAS placement. This is because of failure of UAS introduction or surgeon preference. UAS allows multiple ureteroscopic entries, decreases intrapelvic pressure, and facilitates stone extractions.

Chandramohan et al[5] did 67 FURS in preschool children with an operative time of 55.2 minutes and a hospital stay of 61 hours. In our study, we did 51 FURS in pediatric patients up to 16 years of age; the mean operative time was 79.9 minutes and the mean hospital stay was 27.6 hours. A postoperative stenting was routinely carried out for all patients to keep ureter patent, decrease incidence of complications and allow easy passage of stone fragments postoperatively.

Intraoperative complications had been noted in 9 cases (17.6%) and postoperative complications had been recorded in 16 cases (31.4%). The overall complications had been recorded in 25 cases (49%) with low morbidity (Clavien grade I-III). Suliman et al[5,11] reported fewer complications in 3.6% with less morbidity, while Chandramohan et al reported complications in 41.3% (Clavien grade I-III).

Limitations of this study include the lack of power analysis for sample size calculation and justification. There is a lack of Long-time follow-up for these children. The study is retrospective, so another prospective study with a control group is needed.

Conclusion

Pediatric flexible ureteroscopy is a good, and amenable option in the management of pediatric renal stones <2 cm in size. In addition to its minimally invasive nature, it also shown a high success rate, a low complication rate with quick recovery after surgery. However, additional prospective randomized controlled studies are needed to compare with other treatment modalities

and highlight the impact of other relevant parameters, such as patient-related factors, and stone-related factors on the SFR. We believe that these procedures are best carried out in tertiary facilities with high endourology volume rate for best results.

Author Contributions

All author has shared all steps of research from data collection, analysis, reporting, writing, and bibliography.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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