Upper third ureteric calculi in preschool age children: preliminary experience with flexible ureteroscopy and Holmium laser lithotripsy

ABSTRACT

Aims: to evaluate the efficacy and safety of flexible ureteroscopy with holmium laser for the treatment of preschool age children ≤ 6 years with upper third ureteric stones.

Patients & Methods: Nine preschool children with a male/female ratio of 4/5 (mean age 3.6 years; range 2–6 years) with upper third ureteric stones < 2 cm who were treated with flexible ureteroscopy (FURS) and LASER lithotripsy between October 2020 to October 2022 in the department of urology, Faculty of Medicine Tanta University were studied. Ultrasonography, plain abdominal radiograph film, and low-dose non-contrast computerized tomography (NCCT) were obtained from all patients. Pre-operative ureteric stent was applied in all patients 2 weeks prior to their undergoing ureteroscopy as a routine. Patient demographics, stone size, post operative stenting, use of ureteral access sheath, stone-free rate, operative time, complication rates, and follow-up were evaluated. Low-dose non-contrast computed tomography (CT) was performed one month postoperatively to all children and they were considered stone-free if there were no residual fragments < 2 mm postoperatively.

Results: Nine preschool patients (4 boys and 5 girls) who were children, with a mean age of 3.6 years (whose ages had ranged from 2 years to 6 years old), underwent FURS and holmium laser lithotripsy. The mean stone size was 11.1 mm (8 mm -16mm). Preoperative ureteric stenting was routine in all patients. The mean operative time was 55.1 minutes (range 36-78 minutes). Ureteral access sheaths were placed in 7 (77.77%) patients. The success rate for the first month was 88.88%. No major complications were reported e.g., ureteral perforation and/or mucosa avulsion. Minor complications occurred in 1 patient (11.1%).

Conclusion: The management of upper third ureteric stones < 2cm in pediatric preschool population using flexible ureteroscopy is a safe and effective option.

***Keywords**: Flexible ureteroscopy, preschool children, laser lithotripsy, ureteric stone.*

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1. INTRODUCTION:

"Urolithiasis is the third most common problem of the urinary tract. It has been stated that ureteral stones account for 33% to 54% of urinary tract stones" (1). The disease incidence has risen annually over the last two decades in the United States with accompanied increase in hospitalization and surgical interventions (2). "Although the incidence of stone disease is lower in children than in adults, childhood stone disease continues to be a serious health matter, mainly in endemic areas" (3). "It has been documented that urolithiasis appears to be higher among boys in the first decade of life and among girls in the second decade of life, then the incidence shifts towards a male predominance which is sustained throughout adulthood" (4). Promoters of urinary tract stones increase stone crystallization by several mechanisms leading to stone formation. They include urine pH., metabolic and structural abnormalities, urinary tract infection (UTI), and drugs. It has been documented that usually, stones that measure greater than 4 mm (> 4mm) do require definite treatment and are difficult to be expelled spontaneously (5). "There is not enough information as to which form of therapy is better suited to the management of ureteral stones in children. The low prevalence of urinary stones in children may be the cause. For years, extracorporeal shockwave lithotripsy (SWL) and ureteroscopic management have been used to treat urinary stones in pediatric populations" (6). "The increasing availability of smaller size endoscopes and wide application of flexible ureteroscopy and laser lithotripsy in adults have made FURS for urolithiasis a suitable and more attractive option in children; however, the safety and efficacy of

FURS in preschool patients have been yet poorly investigated" (7). In this study, we aimed to determine the effectiveness, and possible complications of FURS in pediatric patients in preschool age with proximal ureteral stone disease.

2. MATERIALS AND METHODS:

2.1 Patients:

We treated nine preschool patients with proximal ureteric stones (defined as from the ureteropelvic junction till the upper border of sacroiliac joint) < 2 cm with flexible ureteroscopy and Holmium laser in the period between October 2020 to October 2022. There were 4 boys (44.44%) and five girls (55.55%). The mean age was 3.6 years and the ages had ranged between 2 years and 6 years old. The mean stone size was 11.1mm (and the stone sizes had ranged between 7 mm and 1.6mm). They all had unilateral stones. We excluded patients with distal ureteric obstruction. One child had a history of unsuccessful SWL. Preoperative careful medical history, clinical examination, urine analysis and urine culture, a plain abdominal radiograph, urinary ultrasound, low-dose non-contrast computerized tomography (NCCT) were obtained from all patients. Urinary tract infections were treated first to make sure that the FURS would be performed in sterile urine. The size of the stone was defined in millimeters by measuring the longest diameter of the stone as determined by CT scan.

Our protocol was preoperative ureteral stenting by JJ ureteral stent two weeks prior to the flexible ureteroscopy for all the patients. The length of the stent was determined by the equation: age in years plus 10.

2.2 Surgical technique:

Perioperative third generation cephalosporins antibiotics were administered to all patients. All the procedures were performed under general anesthesia in lithotomy or frog-leg positions. Lead aprons were placed over the patients to minimize the risk of radiation exposure. Ureteroscopy with the semi-rigid 6 Fr ureteroscope (Karl-Storz) was performed to examine the urethra, and the urinary bladder to identify the ureteric orifice, insertion of 2 guide wires and removal of the JJ stent. The access sheath (10/12 Fr, ReTrace Access Sheath, Coloplast Corp, USA) was typically used. The sheath was placed over a guidewire under fluoroscopic guidance with a safety wire outside the sheath then we inserted the FURS (OTU, USA) through the sheath. If UAS did not pass easily, we shifted to flexible ureteroscope insertion without UAS if possible. After identification of the stone, we connected the holmium: yttrium–aluminum-garnet (VersaPulse™ Lasers, Holmium Laser 100 W) laser fiber through the working channel and started to dust the stone. We adopted the dusting technique with frequency of 15-20 Hz and energy of 0.6-1 J. We continued the fragmentation until the fragments had become almost less than 3 mm and could pass spontaneously. A pigtail stent was placed in selected patients with residual calculi and ureteral wall injury at the end of the procedure. The operative time was calculated from the time when the patient was positioned for the surgery to when the drapes were taken off.

Vital signs of the patients and urine volume and color were monitored, and a urethral catheter was left overnight. The postoperative complications were reported via the Clavien-Dindo Classification of Surgical Complications into 5 grades (8). All patients were seen for clinical examination weekly for 4 weeks. The patients underwent non-contrast computed tomography urogram (CTU) for evaluation of significant residual stones and urine analysis one month later. Double J

(DJ) ureteric stent retrieval was performed if no residual stones were found in the ureter.

2.3 Statistical Analysis:

The primary end point of the study was to evaluate the stone free rate and complication rate of the flexible ureteroscopy in preschool children with upper third ureteric stone.

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. **(**Armonk, NY: IBM Corp**)**. Distributed data were expressed as range (minimum and maximum), mean.

3. RESULTS:

A total of 9 patients (5 girls and 4 boys) with a mean age of 3.6 years (2-6 years) was included in the current study. One patient had a history of failed SWL (11.11%). They all had unilateral upper third stones with 3 cases on the right side (33.33%) and 6 on the left (66.66%). Two cases had radiolucent stones (22.22%). The mean stone size was 11.1 (ranged from 7mm to 16 mm). JJ stent was inserted in all patients 2 weeks earlier. The UAS was able to be placed in 7 patients only (77.77%), while the FURS was inserted over the guide wire successfully in the other two patients (22.22%). The stone was reached in all cases with no other dilatation. The mean operative time was 55 min (ranged from 36 mins to 78 mins).

A total of eight patients (88.88%) became stone free after a single session of FURS and laser lithotripsy and none of them had residual stones observed by CT scan one month later. Residual calculi were observed only in one patient during post-operative CT scan that migrated to the kidney. The residual stone was 5 mm in upper calyx and the patient referred to SWL. There were no major complications; complication was

reported in one patient (11.11%) who had fever and UTI post operatively and who was treated with antibiotics and hydration.

Factors as sex, age, operative time, stone laterality, size, and density were assessed for their correlation with the stone free rate, and none was found to be significantly associated with stone free rate

Postoperative DJ stent was inserted in 7 patients (77.77%). The mean hospital stay was 1.22 days, and this had ranged between 1 day and 2 days. Three patients complained from stent-related symptoms such as dysuria, pain in the bladder and genital region during the weekly follow up visits, and they were managed by oxybutynin once daily. Unplanned emergency admission was occurred to one patient 2 weeks post operative due to stent-related UTI and fever. This was treated by hydration and third generation cephalosporins and removal of the stent as soon as possible.

4. DISCUSSION:

“The ideal management of ureteric calculi depends on many factors, including the stone size, site, composition, patient characteristics, treatment cost, and available equipment and surgeon skills. The increasing availability of smaller size endourological equipment has made it possible to manage paediatric stones using endoscopic techniques. Limitations and the technical difficulties were first found with the rigid URS including the difficulty to introduce a straight URS through the curves and tortuous anatomy of ureter. The response to this need to reach the upper ureter was the introduction of FURS” (9). “Shock wave lithotripsy (SWL) has been the criterion standard for pediatric large proximal ureteral stones for a long time (10); however, the long-term effects on developing kidneys and the need for general anesthesia are considered limitations” (11).

“Multiple studies had shown that FURSL for the management of urinary calculi in the paediatric population is an effective and safe procedure” (7,12). However, there is a lack of studies evaluating the efficacy and safety of RIRS in preschool age children.

“Pre-stenting was found to increase the success rate of URS and to provide lower but insignificant complication rates in cases of ureteral stones in the pediatric population” (13). “We adopted the pre-stenting technique in all patients to avoid the need for active ureteral dilatation and to facilitate the UAS insertion. However, some colleagues are convinced that there is no need for dilatation of the vesical orifice of the ureter before each ureteroscopy” (14,15). “The use of a UAS during RIRS has been associated with reduced intrarenal pressure, decreased operative time, and improved SFR in adult patients” (16). Singh et al described their experience using “ureteral access sheaths in 8 pediatric patients, with a 100% stone-free rate and no postoperative ureteral strictures after a short follow-up of 10 months” (17). We preferred to use UAS whenever possible in our cases and inserted the sheath in 7 patients. The stone free rate was 88.88% (8/9). In a study by Tan et al (11), postoperative imaging was available, and this revealed that 20 (95.2%) of the 21 patients treated ureteroscopically were rendered stone free but 2 calculi were present in the kidney. Another study that analyzed the data of 251 pediatric URS cases reported that the stone free rate was 94% for stented cases with ureteral stones and 79.5% for non-stented cases with ureteral stones (13).

Galal et al reported that “the main FURS complications in children with ureteral calculi were clinically insignificant hematuria, renal colic, and fever” (18). We experienced 1 case with UTI and fever that was managed medically. In a study by Erkurt et al on 65 children who were treated by FURS, they did not observe any hydronephrosis or recurrent urinary

infections in any of the patients, which may reflect ureteral stricture or vesicoureteral reflux (7).

Stent placement after ureteroscopy is still controversial as some authors suggest it can be omitted in select cases (19). The pain, dysuria, hematuria, irritative urinary symptoms and unplanned readmissions were found to be more common in the stented patients (20). However, Stent placement is still routinely common practice as reported in an analysis including 11885 patients from 32 countries, the authors identified that a stent was placed in 63.2% after ureteral stone treatment (21). The use of fluoroscopy in urological procedures has some risks such as malignancy inducement from radiation exposure of the patient, surgeon, and operation room staff (22). Limiting fluoroscopy time and subsequentially the radiation dose is important. Additionally, shielding from radiation exposure is an extremely effective form of protection (23). We used lead aprons over children to minimize the risk of radiation exposure and we reduced the fluoroscopy time as much as possible.

The main limitation of this study is the relatively small sample size. In addition, the usual competitor of FURS, SWL, was not included in this study. Therefore, large-scale randomized trials with longer follow up are encouraged to be designed so that the above conclusions can be verified with an increased statistical power.

5. CONCLUSION:

Using the flexible ureteroscopy and holmium laser lithotripsy is a safe and effective technique for the management of the upper third ureteral stones < 2 cm in preschool age children.

Ethical Approval

The study was approved by the ethical research committee of the faculty of medicine - Tanta University under the code: 34219/10/20.

Consent

The legal guardians of all patients were informed about the surgical technique, and they all signed consent forms on behalf of the patients.

Abbreviations:

SWL: shock wave lithotripsy
FURS: flexible ureteroscopy
UTI: urinary tract infection
UAS: ureteral access sheath

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