The Miniaturization of Instruments and Laser Lithotripsy have Improved Urolithiasis Treatment without Requiring Fluoroscopic Control in Preschool Children

Cerrahi Aletlerin Minyatürleştirilmesi ve Lazer Litotripsi Okul Öncesi Çocuklarda Floroskopik Kontrole Gerek Olmadan Ürolityazis Tedavisini İyileştirmiştir

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ABSTRACT

Aim: To present the outcomes of retrograde intrarenal surgery (RIRS) and laser lithotripsy for the treatment of calculi of preschool age children.
Patients and Methods: The records of 28 patients ≤6 years old who underwent endoscopic procedures for treatment of stones at the our hospital from 2013 to 2016 were reviewed retrospectively. In the treatment of renal and upper ureteral stones, laser lithotripsy was used with flexible ureterorenoscope (URS) without ureteral dilatation. The information recorded included patient demographics, stone size and location, operative technique and postoperative outcomes.
Results: A total of 32 lithotripsy procedures to treat 34 stones were performed in 28 children 18 (64%) males and 10 (36 %) females; 22 (78.5%) single and 6(21.5%) multiple stones; median age, 45,8±9,36 months (10-72). Stones were located in the kidney in 21 cases (75%), the upper ureter in 7(25%). Mean stone size was 12,07-+1,74(9-15) mm. Four (14.2%) of these patients also had bladder stone accompanying it. The stones of these patients were also fragmented using laser with flexible URS. Anesthesia duration was 26-105 min (mean, 59,64±22,39). In fourteen patients with narrow ureteral orifices urethral JJ stents were placed firstly and flexible URS were done easily after 2 weeks. We did not use fluoroscopy; thus radiation free treatment was reached all patients. Follow-up ranged from 2 months to 3 years (mean, 24 months). Complete stone clearance was achieved at the end of the procedure in 26 (92.8%) patients. No major complications were encountered during or after the procedure, although 2 minor complications (7.1%) occurred. The mean duration of hospitalization was 2,21±0,87 days (range, 1-4 days). Recurrence of urolithiasis was a long-term complication in two patients; These cases were subsequently treated smilarly with flexible URS. No other long-term complications were revealed by ultrasonography.
Conclusions: Our results suggest that flexible URS is a safe and effective minimally invasive treatment modality for renal stones in preschool children.

Key Words: Renal stones, fleksible ureterorenoscopy, laser lithotripsy, preschool children

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ÖZET

Amaç: Okul öncesi çağdaki çocuklarda taşların tedavisinde retrograd intrarenal cerrahi ve lazer litotripsi sonuçlarını sunmak.
Hastalar ve Yöntemler: 2013-2016 yılları arasında hastanemizde taş tedavisi için endoskopik girişimler uygulanmış 6 yaş ve altı 28 hastanın kayıtları geriye dönük olarak incelendi. Renal ve üst üreter taşlarının tedavisinde, üreteral dilatasyon olmadan fleksibl üreterorenoskop(URS) ile lazer litotripsi kullanıldı. Hastalarin demografik, taş büyüklüğü ve yeri, operatif teknik ve ameliyat sonrası bilgileri kaydedildi.
Bulgular: On sekiz erkek (% 64) ve 10 kız (% 36) olmak üzere toplam 28 çocuğun 34 taşı için toplam 32 litotripsi işlemi uygulandı; 22 çocukta (% 78,5) tek ve 6 çocukta (% 21,5) çok sayıda taş tespit edilirken ortalama yaş, 45,8 ± 9,36 ay (10-72) bulundu. 21 hastada (% 75) taş böbreklerde, 7 hastada (% 25) üst üreterde tespit edildi. Taş boyutu 12,07±1,74 (9-15) mm idi. Bu hastaların dördünde (% 14.2) beraberinde mesane taşı da vardı. Hastaların taşları lazer ile fleksibl URS kullanılarak kırıldı. Anestezi süresi 26-105 dakika arasında(ortalama, 59,64 ± 22,39 dakika) bulundu. Dar üreteral orifisi olan 14 hasta da önce üreteral JJ stent yerleştirildi ve 2 hafta sonra kolayca fleksibl URS yapıldı. Hastalarımızda floroskopi kullanmadık böylece hastalarda radyasyona maruz kalmadan tedavileri gerçekleştirildi. Takip süresi 2 ay ile 3 yıl arasında değişmekteydi (ortalama 24 ay). İşlem sonunda 26 hastada (% 92.8) tam taşsızlık sağlandı. İşlem sırasında veya sonrasında majör komplikasyon görülmedi, ancak 2 minör komplikasyon (% 7.1) meydana geldi. Ortalama hastanede kalış süresi 2,21 ± 0,87 gün (1-4 gün) idi. Geç dönem komplikasyon olarak taşın tekrarı iki hastada görülürken; bu vakalar daha sonra aynı şekilde fleksibl URS ile tedavi edildi. Ultrasonografi ile başka geç dönem komplikasyon saptanmadı.
Sonuç: Bulgularımız fleksibl URS'nin okul öncesi çocuklarda böbrek taşları için güvenli ve etkili bir minimal invaziv tedavi yöntemi olduğunu göstermektedir.

Anahtar Sözcükler: Böbrek taşları, fleksibl üreterorenoskop, lazer litotripsi, okul öncesi çocuklar

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INTRODUCTION

In the last decade, technological advancement and miniaturization of instruments have changed the management of urinary stone disease. Since the initial report, percutaneous nephrolithotomy (PCNL) has been accepted as a well-established, minimally invasive procedure in children and adults for the treatment of urolithiasis. However, PCNL may cause some problems in infants and preschool-age children because of the small size and mobility of the pediatric kidney, friable renal parenchyma, and the small size of the collecting system. Small-volume, nonstaghorn stones can be effectively managed with the retrograde intrarenal surgery (RIRS) with good outcomes without the need for open surgery or PCNL (1). With increasing experience of RIRS in adults, recently, a few reports of successful ureterorenoscopic management of renal stones in children have been published(1-6)**.** Stone disease in very young children is often associated with anatomical and metabolic abnormalities or infectious diseases, and the risk of recurrence is high. These factors make minimally invasive procedures more important in this age group (2-4). We present our experience related to RIRS on the treatment of urinary stones in preschool-age children.

PATIENTS and METHODS

This is a retrospetive study including 28 preschool children who underwent RIRS for the treatment of urinary stones at the our hospital from 2013 to 2016. The information about patient demographics, stone size and location, operative technique and postoperative outcomes was obtained from the files-records. Pretreatment evaluation included a careful medical history, clinical examination, routine blood tests, urine analysis and urine culture, plain film, ultrasonography, and intravenous urography. Renal sintigraphy and computed tomography were not done routinely but were performed whenever needed. If there was an urinary tract infection, antibiotic tretment accordant to urine culture and antibiotic sensitivity test was administered. Before surgery, we made sure that urine was free of infection. In spite of clean urine, perioperative wide spectrum antibiotics were prophylactically administered to all patients.

After general anesthesia, the patients were placed into lithotomy position. Firstly, semirigid URS or cystoscopy was performed to place a hydrophillic guide wire (0.035 inch) into the stone side ureter and renal collecting system. The aim was to dilate and observe the distal part of the ureter. After this dilatation, flexible URS (7.5 F, FLEX-X:Karl Storz,Tutlingen' Germany) was inserted over the guide wire into the ureter. Flexible URS was advanced up to the stone. Holmium: YAG laser (StoneLight® Holmium Laser System; AMS Inc., Minnetonka, MN, USA) was used to fragmentate the stones with laser fibers (200. µm).

In case of the narrow the ureteral orifice precluding the first entrance, appropriate 3-4 F JJ stent was inserted primarily. After 2 weeks, adequate ureteral dilatation occurred and procedures were performed. Based on the stone features, laser fibers generating 0.5-1.5 Joules at a frequency of 5-12 Hz were used. We did not use ureteral access sheat and fluoroscopy for flexible URS avoing our patients and the surgical team from radiation exposure.

Stone extraction was not routinely. The stones were fragmented until they were deemed small enough to pass spontaneously. Then, all stone particles were left for spontaneous passage. Ureteral catheters or preferably JJ catheters were placed routinly following the procedure to provide ease in passage of stone fragments or in cases of intraoperative occurrence of edema, mucosal damage or ureteral perforation. On the first day postoperatively, urethral catheters were removed, and 2 or 4 weeks after the procedure the JJ catheters were removed. The patients were assessed radiologically, and those who did not develop any immediate post-procedure complications were discharged after 24 h of monitoring. All patients were evaluated at the postoperative first and third months by urinalysis, plain abdominal X-rays, and ultrasonography. When large residual stones were observed(>4mm), a second laser lithotripsy with flexible URS was undertaken. Stone-free status was determined by the absence of residual fragments on follow-up imaging. After treatment, all patients were followed every 6 months by urinary ultrasonography for recurrence of urolithiasis and long-term complications.

RESULTS

A total of 32 lithotripsy procedures to treat 34 stones were performed in 28 children of median age, 45,8±9,36 month (10-72 month). There were 18 (64%) males and 10 (36 %) females; 22 (78.5%) single and 6(21.5%) multiple stones. Stones were located in the kidney in 21 cases (75%), the upper ureter in 7(25%). Four (14.2%) of these patients also had bladder stone accompanying it. Mean stone size was 12,07±1,74(9-15) mm. The general characteristics of the stones are summarized in Table 1. The most common complaints of the patients were pain (n=23, 82.1%), hematuria (n=10, 35.7%), nausea and vomiting (n=11, 39.2%) while urinary tract infection was found in 2 cases (7.1%). The youngest patient in the series was the patient who applied with anuria due to bilateral renal pelvic stone. This patient was initially followed by percutaneous nephrostomy due to impaired renal function and bilateral hydroureteronephrosis. After kidney function was improved, bilateral laser lithotripsy was applied to the patient using flexible URS. The patient was stone free after the second session. Another interesting patient was 6-year-old whit renal stone recurrence after left PCNL. In this patient, the stone was broken again with the flexible URS. This patient JJ insertion for minor leakage. Both of these two patients were being followed for metabolic disease (due to cystinosis). There were two patients who underwent flexible URS but lithotripsy could not be done because of lower caliceal stones in which , the region could not be reached due to narrow infindibulopelvic angle. JJ catheter was inserted firstly in these two patients and SWL treatment was applied. Anesthesia duration was 26-105 min. (mean, 59,64±22,39). Because of the narrow ureteral orifices, JJ stents were placed in 12 patients. Routine procedures could be made 2 weeks later with enough dilatation of , these orifices. Follow-up ranged from 2 months to 3 years (mean 24 months). Complete stone clearance was achieved at the end of the procedure in 26 (%92.8) patients. No major complications were encountered during or after the procedure, although 2 minor complications (7.1%) occurred. There was one minor abdominal leakage, one suspicious ureteral puncture with a laser fiber and one renal puncture with guide-wire, all of which treated with JJ stent placement. The mean duration of hospitalization was 2,21±0,87 days (range, 1-4 days). Recurrence of urolithiasis was a long-term complication in two patients; no other long-term complications were revealed by ultrasonography.

Table 1. Stone side, size and charecteristics of children.

Number	28
Mean age (month)	45.82±19.36 (10-72)
Male/female	18/10
Stone size(mm)	12.07±1.74 (9-15)
Stone side	Right:16 Left: 11 Bilitarel:1
Stone location	Pelvis:14* Upper ureter: 7** Upper calix:4 Middle calix:2 Lower calix: 2 Upper +lower calix: 3 *3 bladder stone **1 bladder stone
Operation time(min)	59.64±22.39 (26-105)
Hospital stay(day)	2.21±0.87 (1-4)
Success rate	26/28 (92,7%)
Major complication	0
Minor complication	2(7.3%)

DISCUSSION

Despite extracorporeal shock-wave lithotripsy(SWL) is still considred the first treatment for Stones ≤2 cm and PCNL is suggested for > 2cm and complex stones' RIRS' is increasingly used also in the pediatric population. Although stone-free rates are greater than 85% after a single PCNL in children, complications including urosepsis, bleeding requiring transfusion, renal pelvis perforation, and injury to adjacent organs are not uncommon. The morbidity associated with RIRS is considerably less than that with PCNL, and the flexible URS allows access to the polar regions(7,8). Treating ureteral stones with ureteroscopy in children was not made popular until Ritchey et al. and Shepard et al. successfully described its use in 1988(9,10). Because of significant improvements in the miniaturization and durability of endoscopic equipment, ureteroscopy has become a more attractive option.

Use of ureteral access sheaths and small flexible ureteroscopes has made possible treatment of renal calculi that would have previously required SWL or PCNL(3,4;7,11). Ultrasonic, pneumatic, electrohydraulic, and laser energy sources are used as lithotripter in urinary system stone treatment. Although pneumatic lithotripters are reliable and effective, their use is limited due to their high stone migration rate and size. Laser lithotripters are now more preferred because of the more effective, shorter stone break, the absence of stone migration, and the higher Stone free rate. Lasers for kids The biggest advantage is that it can be ultra-thin, flexible and flexible for all endoscopic lithotripsy procedures, whether rigid or flexible URS (1,2). We have been using a holmium laser lithotripter for pediatric stone treatment since 2011 and this treatment is effective and reliable for childhood stones.

Minor and major complications occur during and after endoscopic lithotripsy procedures in 0–17 % of patients(4,7). In our series, minor complications (7.1%) developed in two of the 28 patients and these patients were treated without problems with the JJ stent. If there is a narrow ureteral orifice using semirigid or flexible URS, we have primarily inserted a JJ stent. We preferred to perform the decompression of the urinary system and to perform the re -procedure 2 weeks after the orifice was expected to dilate. Especially when we place ureter stent(JJ) for flexible URS and then use this method instead of using dilators, both the operation time and the complications decrease compared to those that occur during dilatation for the first time. Of note, these operations do not require x-ray. The combined use of small-sized tools and laser bring stone free rate to a very high level. Unsal et al. reported that the success rate for kidney stones <10 mm was significantly higher than that for stones ≥10 mm during RIRS (100 % vs. 81.8 %) in 16 children ≤7 years old(7). In Uygun study, the stone-free rate in <7 year old children versus those ≥7 years old was not significantly different (8). A total of 65 patients with a mean age of 4.31 ± 1.99 years (6 months–7 years) have been included in a flexible URS series by Erkurt et al. conducted on pre-school children. Mean stone size and mean operative time were 14.66 ± 6.12 mm (7–30 mm) and 46.47 ± 18.27 min, respectively. In 5 (7.69%) patients, the initial procedure failed to reach the renal collecting system and ended with the insertion of a pigtail stent. Stone-free rates were 83.07 and 92.3% after the first and second procedures, respectively. Postoperative hematuria developed in 6 (9.2 %) patients, post-operative urinary tract infection with fever was encountered in 10 (15.4 %) patients, and ureteral wall injury was seen in 2 (3 %) patients (5). A total of 16 patients (9 boys and 7 girls; mean age, 4.2 years) have undergone 17 procedures in a series by Ünsal et al., mean stone size was 11.5 mm (8-17 mm). Flexible URS and laser lithotripsy were performed in all cases. Ureteral orifice was required to be dilated in 5 cases (29.4%) and ureteral access sheaths were placed in 3 (17.6%). With a mean follow-up of 10.3 months, 88% of the children were stone free. The success rate for stones smaller than 10 mm was 100% and 81.8% for stones 10 mm or larger in size (p <0 .05). There were no major complications, but there was 1 case of perforation and extravasation at the ureterovesical junction after balloon dilation, which was managed with stent placement (3, 7).RIRS is an effective treatment option in preschool patients weighing <20kg, resulting in a low complication rate (37.5%)(3 postoperative hematuria, 2 urinary tract infctions with fever and one hydrocalyx were observed) and a success rate of 81.3% after a single procedure in Berrettini et al. Study(6). However, ureteral access sheath was used and ureteral dilation was performed on these last series, and the patients were exposed to radiation. We did not use ureteral access sheath and our preschool age patient were not exposed to radiation.

This retrospective study consisted of patients under the age of ≤6 years. This series also has a stone free rate of over 92%, and patient age and stone size appear to be ineffective during lithotripsy if you have enough surgical experience and up-date equipments. The reason for the high success rate of this study is that it is more up-to-date than the above studies and therefore technologically smaller and flexible tools (URS ans laser) are used(11).

CONCLUSIONS

This series also demonstrates the ease of use of these instruments, both by pediatric surgeons and urologists. Treatment of childhood urinary stone disease is now easier and less invasive with both semirigid and flexible URS devices being reduced to smaller sizes and the use of laser lithotripsy therewith. Therefore, parallel to technological developments, less invasive methods should be preferred as far as possible in childhood stone therapy.

Conflict of interest

No conflict of interest was declared by the authors.

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