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Extractable fragment versus dusting during ureteroscopic laser lithotripsy in children: Prospective randomized study

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Summary

Introduction and objectives
Complete eradication of stone fragments is an important goal during stone management in children. The mode of fragmentation employed to clear stones during ureteroscopic laser lithotripsy raises concerns related to operative time, associated morbidity, costs, and especially potential endoscope damage. The purpose of this study was to evaluate the outcomes of fragmentation into extractable pieces and stone dusting during ureteroscopic laser lithotripsy in children.

Material and methods
One hundred children with ureteral stones undergoing ureteroscopic holmium laser lithotripsy were prospectively randomized into two groups: group I in which stones were fragmented to dust ($n = 50$), and group II in which lithotripsy resulted in extractable fragments ($n = 50$). Different Holmium laser settings were applied during ureteroscopic lithotripsy for each group: low power (500 mJ) and high frequency (12–15 Hz) for lithotripsy to dust. High power (1000–1500 mJ) and reduced frequency (8–10 Hz) for lithotripsy to extractable fragments. The fragmentation time, operating time, stone-free rate, and perioperative complications were compared (Figure).

Results
The mean age of the patients was 6.8 (1–12) years and 8.2 (1–15) years, in groups I and II respectively. The mean fragmentation time and operating time were statistically significantly lower in group II ($p = 0.008$ and 0.0069 respectively). Minor complications occurred in eight cases (5 in group I and 3 in group II) in the form of hematuria and urinary tract infection. No major complications were encountered in either groups.

Conclusions
Fragmenting stones into extractable pieces has a significantly shorter fragmentation time and operative time than stone dusting, with similar stone-free and complication rates. Ureteroscopic laser lithotripsy treatment resulting in extractable fragments seems to be an effective and time-saving procedure in children.

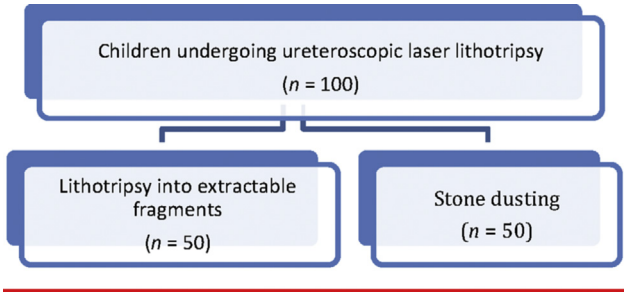

Figure Study cases.

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Introduction

The continuous advances and improvements in ureteroscopic equipment and the armamentarium as a result of size reduction and improved vision has rendered ureteroscopic treatment for urolithiasis in children much easier and more common [1,2]. The standard preference in ureteroscopic lithotripsy is use of the Ho:YAG laser, which can effectively break stones into fragments small enough to remove or pass spontaneously. The safety and efficacy of Ho:YAG lithotripsy in children has been proven by several workers [3,4]. The Ho:YAG laser produces very small stone fragments [5,6].

Complete eradication of stone fragments is an important goal during stone management in children. The mode of fragmentation employed to clear stones during ureteroscopic laser lithotripsy raises concerns related to operative time, associated morbidity and costs, and especially potential endoscope damage [6].

There is no consensus on how to achieve optimal stone clearance once the primary stone has been fragmented with lithotripsy. Ureteric calculi can be fragmented into either extractable fragments, thereby increasing the immediate stone-free outcome, or into small dust-like particles, which do not require removal. This can theoretically decrease operative times and lower the risk of ureteral trauma by minimizing the repetitive introduction and removal of the ureteroscope. The purpose of this study is to evaluate outcomes of fragmentation into extractable pieces and stone dusting during ureteroscopic laser lithotripsy in children.

Material and methods

We prospectively studied 100 children (61 boys and 39 girls), less than 15 years old undergoing ureteroscopic laser lithotripsy in the Urology Department of Alexandria University, from April 2012 to July 2014. All patients had ureteral stones of diameter 12 mm or smaller.

The information recorded included patient demographics, stone size and location, presence of associated metabolic or anatomic abnormalities, type of endoscopic equipment used and energy source, operative technique, and postoperative outcome. The study was approved by the Institutional Review Board at the Faculty of Medicine, Alexandria University.

All children with ureteral stones were prospectively randomized into two groups; in group I (50 children), lithotripsy was applied until dust was obtained, in group II (50 children), calculi were divided into extractable fragments. Medical expulsive therapy (MET) was not used in the perioperative period.

The presentation of ureteric stones in children of both groups was abdominal pain, which was the most common symptom, occurring in 62%. Urinary tract infection (UTI) was also common, affecting 20% of children. The classic unilateral colicky flank pain occurred in only about 15% of cases, and gross hematuria in 12%. All patients underwent kidney, ureter, and bladder (KUB) X-ray (KUB) and ultrasonography (USG) of the abdomen. USG demonstrated the presence of an extended pyelocalyceal system with a dilatation of the ureter above the stone. Low-dose noncontrast computed tomography (NCCT) was performed only in the patients with radiolucent stones.

Technique of ureteroscopy

All ureteroscopic procedures were performed by one surgeon. Under general anesthesia, the patient was placed in the lithotomy position. Routine prophylactic antibiotics were administrated; all procedures were viewed on video camera. Fluoroscopic monitoring was available. All patients underwent initial cystoscopy to place a safety- or working guidewire. After the guidewire was successfully negotiated beyond the stone and into the proximal ureter or collecting system. Ureteroscopy was performed with a 6.9F Storz semirigid ureteroscope with a safety wire in place in all cases.

A ureteroscope was introduced into the urethra, avoiding damage to the penile urethra. Ureterovesical junction (UVJ) dilatation was omitted in all cases. Ureteroscope pass UVJ helped by firstly a hydrodilatation guided safety-wire, and finally with oscillated movements allowing a rotation of the tip of the instrument, looking for the center of the ureter. The ureteroscope advanced through the ureter with fine movements of the surgeon's hand. During the lithotripsy process we used a Auriga XL Ho:YAG Laser (Lynton Lasers, Holmes Chapel, UK).

Switching between the two lithotripsy modalities was performed by changing the laser settings: low power (500 mJ) and high frequency (15 Hz) for lithotripsy into dust and high power (1000—1200 mJ) and reduced frequency (8—10 Hz) for lithotripsy in extractable fragments. The stones were fragmented until they could be removed with grasping instruments or were deemed small enough to pass spontaneously. Follow-up imaging consisted of renal tract ultrasonography and plain abdominal film of the kidneys, ureters, and bladder. A stone-free status was conferred by the absence of any stone fragments on follow-up imaging at 1 week to allow the ureter to recover from any postoperative edema as a result of ureteroscopic manipulation and fragmentation and give enough time for any fragments to clear spontaneously. A double-J stent was routinely indwelled in both groups. Fragmentation time, operating time, stone-free rate, and perioperative complications were compared.

Depending on the results of a pilot study performed in our department dealing with the stone-free rate of ureteroscopic laser lithotripsy, we calculated a sample size that was sufficient for our study. This study was designed to detect a 10% difference between the stone-free rate in the two fragmentation methods with 80% power assuming a significant difference level of 0.05 and a two-sided statistical test. The sample size was estimated to be 90 patients (45 patients in each group). We aimed to enroll 100 patients to take into account dropout cases. All patients and radiologists were unaware of the study groups (blinded) except for the treating physician. Statistical analysis was performed using the Fisher exact test and the Student t test with statistical significance determined as $p < 0.05$.

Results

The mean age of the patients was 6.8 (1—12) years and 8.2 (1—15) years, in groups I and II respectively. The mean stone size was statistically similar in groups I and II (Table 1).