Original Article

Transureteral Lithotripsy of Ureteral Calculi in Children with Holmium: Yttrium Aluminium Garnet Laser

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Abstract

Introduction: Surgical management of pediatric urinary calculi evolved dramatically over the past two decades. However, with the miniaturization of equipment and with improvisation of endourologic techniques, access to the entire pediatric urinary system is possible. Ho: YAG laser provides more maneuverability during transuretereal lithotripsy (TUL) than the pneumatic system which uses a metal probe, especially when used in pediatrics urinary systems. In this study, we report our experience about treatment of pediatric ureteral stone with HO: YAG laser.

Methods: Between 2008 -2011, 41 children ≤ 12 years of age with ureteral stones were included in our study. Using K.U.B, sonography, and intravenous urogram, diagnoses were established for all patients. 6F or 8F wolf semi rigid ureteroscope was used for ureteroscopy under general anesthesia and stone fragmentation was implemented by Ho: YAG laser. For the evaluation of stone free rate, we used the following day & week confirmatory KUB, and sonograms additional to the direct visualization of the ureter during ureteroscopy. The patients were scheduled to be followed by control sonograms 2 weeks and 2 months after the operation to rule out past operational ureteral stenosis.

Results: From our 40 patients whose ages were in the range of 8 months and twelve years of old with a mean age 3.5 years, 18 patients (45%) had distal ureteral stones, ten (25%) in mid ureter, and twelve of them (30%) had the stone in their proximal ureter. The mean diameter of stones was 9.3 mm (3.5-11 mm). Three patients had encrusted double j stents (DJS). Our overall stone free rate was 89.35% at the end of 1 week. The complications were fever in 5 patients (12.5%) and ureteral stricture due to ureteral perforation in one patient, while one patient had long hospital stay due to refractory pain and nausea. The mean time of post-surgical hospital stay was 42 hours, while for only 20% of patients (8 patients) and in the rest of patients (30 patients) this period was only 24hours.

Discussion: Endoscopic lithotripsy in children has gradually become a major technique for the treatment of ureteral stones. This progression has been on the basis of the development of appropriate endoscopes and effective working instruments. The stone-free rate following urteroscopic lithotripsy for ureteral stones has been reported in as high as 98.5-100%. In this study, overall stone free rate was 89.35%. The complications after ureteroscopic laser lithotripsy are uncommon and usually related to passage of the ureteroscope than from laser action. Fever was the most common complication which occurred in 5 (12.5%) of our patients despite the fact that all patients were hospitalized the day before the procedure and were under parenteral antibiotic therapy. Postoperative stenting after ureteroscopic lithotripsy remained controversial. Most children were able to tolerate the attached string and the stent could be removed 5-7 days after without the use of an additional anesthetic. We used suitable ureteral catheters for 24 hours in all patients.

Conclusion: Although HO: YAG laser lithotripsy is safe in children, we need more controlled trials to show the best method of lithotripsy in pediatric ureteral stones.

Keywords: holmium: YAG laser; lithotripsy; pediatric

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Introduction

Surgical management of pediatric urinary calculi has evolved dramatically over the past two decades. Shock wave lithotripsy (SWL) is currently the procedure of choice in treating most upper urinary tract calculi. However, with the miniaturization of equipment and with improvisation of endourologic techniques, access to the entire pediatric urinary system is possible (1).Nowadays, these techniques are being used in patients with pervious history of PCNL (Percutaneous Nephrolithotomy) or ESWL (Extracorporeal Shock Wave Lithotripsy) in medical centers, but achieving a common consensus about the most efficient therapeutic technique demands more studies (1). There are different types of lithotripters for fragmentation of stones during ureteroscopy from which the pneumatic and laser lithotripters have been with the best outcomes (2).Holmium neodymium-doped yttrium aluminium garnet (Ho: YAG) laser provides more maneuverability during TUL (Transe Urethral Lithotripsy) than the pneumatic system which uses a metal probe, especially when used in urinary systems of children (3-9). There is no general consensus about the best way of surgical intervention in the treatment of pediatric urinary system stones (1). In this study we report our experience about treatment of pediatric ureteral stone with HO: YAG laser.

Methods

Between 2008 and 2011, 41 children ≤ twelve years of age and with ureteral stones were included in our study. Using K.U.B (Kidney, Urinary, Bladder), sonography, and intravenous urogram, diagnoses were established for all patients. 6F or 8F wolf semi rigid ureteroscopes were used for ureteroscopy under general anesthesia. Routine blood tests and urine analyses and cultures were obtained. After proper access and visualization of the stones, stone fragmentation was implemented by Ho: YAG laser. In this study, holmium laser apparatus with trademark DEKA, was used and fiber diameter of 325 nm and frequency at 5-12 HZ and power at 0.5- 1.5 W was applied according to the stone hardness. We didn't use active dilation technique in any of our patients to achieve access to the ureter. For the evaluation of stone free rate, we used the following day & week confirmatory KUB and sonography in addition to the direct visualization of the ureter during ureteroscopy. In all our patients, we inserted suitable ureteral catheters for 24 hours after completion of the procedure and in cases of impacted stones, or ureteral trauma a DJS was placed for 2 weeks. The patients were scheduled to be followed by control sonograms 2 weeks and 2 months after the operation to rule out past operational ureteral stenosis.

Results

From our 40 patients, ten (30%) were female and twenty nine (70%) were male. Their ages were in the range of 8 months and twelve years old with a mean age of 39.85 months (3.5 years) (variance 204.03). 18 patients (45%) had distal ureteral stones, ten (25%) in mid ureter, and twelve of them (30%) had the stone in their proximal ureter. The mean diameter of stones was 9.2 mm (3.5-11 mm) and variance 2.85. Three patients (7.5%) had encrusted double j stents (DJS) which underwent transuretereal lithotripsy (TUL), and had a stone free rate of 100%, and missed double DJSs were extracted. Our overall stone free rate was 89.35% at the end of 1 week, and in 2 cases access to ureter could not be feasible. One of the patients eventually became a candidate for open surgery, and another underwent DJS insertion for passive dilation. The complications were fever in 5 patients (12.5%), and ureteral stricture due to ureteral perforation in one patient (2.5%). In

Table 1. Comparison of the results of our survey with three other previous studies

Study	Number of Operations/ No. of Patients	Average Age(y) (Variance)	Mean Stone Size(mm) (Variance)	Active Ureteral Dilation	Stone Free Rate
Al-Busaidy et al.	47/43	6.2	12.6	0%	93%
Bassiri et al.	66/66	9	8	37.9%	88%
Raza et al.	52/35	5.9	9.4	3.9%	79%
Our Study	38/40	3.5 (204.03)	9.3 (2.85)	0%	89.35%

85% of the patients there was no sign of any complications. One patient had long hospital stay due to refractory pain and nausea. The mean time of post-surgical hospital stay was 42 hours which only 20% of patients (8 patients) had a more than 24 hours post- surgical hospital- stay period and in the rest of the patients (31 patients), this period was 24hours. In one of cases there were three stones in the lower ureter. Perforation occurred in this patient during Ho: YAG laser lithotripsy. In the follow up, severe and long stricture occurred in the lower ureter, and the patient underwent ureteral stricture repair with Boari Flap.

Discussion

Endoscopic lithotripsy in children has gradually become a major technique for the treatment of ureteral stones. This progression has been on the basis of the development of appropriate endoscopes and effective working instruments. Currently, calculi throughout the entire upper urinary tract can be treated endoscopically in children using semi-rigid or flexible ureteroscopes with proven effectiveness and safety (4, 9, 13). The stone-free rate following urteroscopic lithotripsy for ureteral stones has been reported in as high as 98.5-100% (9). In this study, the overall stone free rate was 89.35%. Among the currently available lithotripsy devices, laser lithotripsy has gained the most popularity. The safety and efficacy of Holmium: YAG laser lithotripsy makes itself the intracorporeal lithotriptor of choice (13). The energy necessary to fragment the stones is delivered via small flexible fibers, allowing the use of semi-rigid or flexible instruments. Laser fragmentation is precise, producing easily passable calculus fragments (13). The practice of routine dilatation of the ureteral orifice and intramural ureter prior to performing ureteroscopic procedure remains controversial in children. There is a belief that a controlled dilatation using the balloon dilator or a gradually dilating catheter may be less traumatic to the ureter than dilatation with the ureteroscope itself. In most contemporary studies, dilatation of the vesicoureteral junction is usually not necessary to successfully accomplish the planned ureteroscopic procedure (9& 12). We agree with others that temporary (1-2 weeks) insertion of DJS provides a safe and effective alternative in achieving access to pediatric ureter without active dilatation (9&13). We didn't use active dilatation in our patients, and in only 2 cases did we insert DJS for passive dilatation, and repeated the procedure after 2 weeks. The complications after ureteroscopic laser lithotripsy are uncommon and are usually related to passage of the ureteroscope than from the laser action (13). In one of our patients, there were 3 calculi in distal ureter occurring during lithotripsy ureteral perforation, and finally resulted in severe ureteral stricture which was repaired with Boari Flap. Fever was the most common complication and occurred in 5 (12.5%) of our patients despite the fact that all patients were hospitalized the day before the procedure and were under parenteral antibiotic therapy, like other studies which have shown similar results for complications. Postoperative stenting after ureteroscopic lithotripsy remains controversial. Most pediatric urologists prefer to stent the ureter after endoscopic manipulation (6). Although the rationale for stent placement has traditionally been based on an expectation of potential decrease in stricture formation, postoperative pain, and acute pyelonephritis, ureteral stents can actually cause significant pain and bladder spasms (13). Postoperative stent placement (for 1-2 weeks) is usually at the discretion of the surgeon, and is often based on the difficulty and complexity of the specific cases. Most children are able to tolerate the attached string and the stent can be removed 5-7 days later without the use of an additional anesthetic. We have used suitable ureteral catheters for 24 hours in all patients. Although HO: YAG laser lithotripsy is safe in children, we need more controlled trials to show the best method of lithotripsy in pediatric ureteral stones.

Conclusion

Miniaturization of endourologic armamentarium has improved the tools and increased the chances of their use in the treatment of pediatric urinary stones. Application of HO: YAG laser with flexible fibers improves the chances of treatment in these patients. More controlled trials and comparative studies of HO: YAG laser with other therapeutic modalities like pneumatic and ESWL are mandatory for reaching a decision making conclusion.

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