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Efficacy and safety of ureteroscopy using holmium-YAG laser lithotripsy in treatment of pediatric ureteral stones.

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Abstract

Background: Endoscopic lithotripsy in pediatrics has increasingly used for the treatment of ureteral stones especially with the accessibility of smaller instruments. The safety and efficacy of Holmium: YAG laser lithotripsy makes it the intracorporeal lithotripter of choice.
Aim of Study: To assess the effectives of ureteroscopy using Holmium: YAG lithotripsy in the treatment of ureteric stone in pediatrics.
Patients and Methods: 30 children (20 boys and 10 girls) with ureteric stones were treated by semirigid ureteroscope using Holmium: YAG laser lithotripsy between October 2018 to May 2020. Mean patient age 3.6 years (range 8 months to 14 years). Mean stone size 12.8 mm (range 7-20 mm).
Preoperative evaluation done including urinalysis, abdominal ultrasonography, plain radiography and blood investigations such as complete blood count and renal function test. Non contract abdominal CT scan used in some cases.
Results: The stone free rate was 100% in one session. The mean operative time was 37.3 (25-60 minutes). No significant intraoperative or postoperative complications were encountered.
Conclusion: Ureteroscopy using Holmium: YAG lithotripsy is safe and effective in treatment of ureteric stone in pediatrics.

Keywords: Ureteric stone, Holmium: YAG laser, Ureteroscopy.

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Introduction

The prevalence of nephrolithiasis in the United States increased from 5% to 9% [1]. During this time, disproportionate increases in the incidence of nephrolithiasis of 5% to 10% per year have been reported for youth. Among all age groups the greatest increases in kidney stone disease have been observed among adolescents, particularly females [2]. Kidney stone disease that begins during childhood has a high risk for recurrence. Approximately 50% will develop a recurrent stone within 3 to 5 years of the index stone; Clinical Presentations are age-dependent, flank pain and haematuria common in older children while non-specific symptoms are common in young children [3]. Nonvisible haematuria could be the sole indicator [4].

A detailed medical history and physical examination are essential [5]. A history of prematurity, urinary tract abnormalities, UTIs, intestinal malabsorption are increased risk for stone formation. Due to high stone recurrence rates, all children with a urinary calculus must be undergoing a complete metabolic evaluation [6]. Radiographic evaluation must be safe and precise. Initial assessment with renal ultrasound or abdominal plain film alone, renal ultrasound plus abdominal film, or CT is currently practiced, with Intravenous Pyelography (IVP) having fallen out of favour [7].

Conservative managements

The management starts with maintaining an adequate level of oral fluid intake. Calcium restriction in the growing child should be avoided because the risk for poorly mineralized bones [8]. Medical expulsion therapy using α-blockers has shown to facilitate ureteral stone passage. Whereas α-blockers seem to be most effective for adults with ureteral stones greater than 5 mm, the size of the stone for which α-blockers provide the greatest benefit for pediatric patients is unknown. Large, more proximal stone burden can negatively impact the likelihood for passage in young patients [9].

Shock-wave lithotripsy of ureteral stones

Stone factors such as size, location, multiplicity, radiopacity, composition as well as patient factors including patient body mass index, and collecting system anatomy may be useful in anticipate successful outcome. Ureteral calculi more than 1 cm have a lower response with SWL [10]. Cystine, calcium oxalate monohydrate and Matrix calculi respond poorly to SWL [11].

Endourology

Clinical scenarios, including fever, nausea and vomiting or pain not respond to conservative managements, demand endourological treatment. Small retrospective series suggest ureteral calculi larger than 5 mm are likely to need

endourologic treatment [12]. The goals of surgical intervention are to achieve stone clearance with the minimal number of procedures [13]. Stone clearance is generally considered the most important clinical outcome of surgery. There is no clear definition of residual piece that regarded clinically significant for children [14]. The smaller size of children's ureters may preclude direct access with an ureteroscope. A ureteral stent may need to be placed if the ureteroscope cannot be introduced to allow for passive dilation of the ureter [15].

Historically, Simi-rigid uretroscopy started in 1912 when Hugh Hampton Young inadvertently introduced a 12F pediatric cystoscopy into a severally dilated ureter of a child who had posterior urethral valves [16]. In 1988, Ritchey et al. used ureteroscopy for the treatment of ureteric stones in pediatric [17]. In the early 2000's, with improvements in the instruments, several researches reported success rates from 84% to 100% after a single ureteroscopy session [18].

Aim of Study

To assess the efficacy and safety of ureteroscopy using Holmium: YAG lithotripsy in the management of ureteric stone in pediatrics.

Patients and Methods

From October 2018 to May 2020, 30 (20 males, 10 females) patients with ureteric stones were treated by semi rigid ureteroscope using Holmium: YAG laser lithotripsy at Urology Department of Al Sadar medical city in Al Najaf. The mean stones size 12.8 mm ranging from 7-20 mm. Mean patient age 3.6 years (range 8 months to 14 years).

Preoperative patient's assessment includes history, Physical examination, routine blood tests like complete blood count and renal function, Urine tests, Ultrasound, KUB and CT scan in some cases. Informed consent has been taken from patient's caregiver after explaining the procedure and its possible outcome and complications.

Equipment's were:

- Camera, monitor, and light source
- Three Ureteroscope size: 6 to 7.5 Fr, 6.5 to 8.5 Fr and 8 to 9.8 Fr.
- A 550 Microm reusable laser fiber
- A 0.035-inch guidewire (PTFE coated wire)
- Holmium YAG laser lithotripsy system with a wavelength of 2100 nm
- Normal saline (0.9%) as an irrigation fluid.

Patients were routinely given intravenous antibiotic preoperatively and surgery done under general anesthesia in lithotomy position, dilate the ureteric orifice by hydrodilation and semi rigid ureteroscopy were installed over a guidewire. When reaching the stone, disintegration was completed by using Holmium -YAG laser, a 550 microm laser fiber with energy of 0.5-1.5 J and frequency 5-15 Hz and laser setting adjusted during the operation according to the stone hardness and effectivity of lithotripsy.

After completing disintegrate the stones into small non-significant fragments under direct vision, DJ stents were inserted and to be removed after one month cystoscopically. A Foley's catheter was removed at next morning in most patients. On 1st postoperative day, both plain abdominal X-rays (KUB) and abdominal ultrasonography were performed to assess stone free status, DJ positioning and any possible early complications. Most patients were discharged on 1st postoperative day. Operative time, any perioperative and postoperative complications and the stone free rate were recorded. Postoperative follow up at 3, 6, 12 months postoperatively, each visit include clinical assessment, urinalysis and abdominal ultrasound.

Results

The stone free rate was 100% in one session. The mean operative time was 37.3 (25-60 minutes). No significant intraoperative or postoperative complications were encountered (Tables 1-4).

Variable	Number of patients	%
Male	20	66.70%
Female	10	33.30%
Age (years)		
Younger than 2 years	13	43.30%
2-5 years	11	40%
5< years	6	16.70%

Table 1: Patient's characteristics.

Stone characteristics	Number	%
Laterality		
Right	17	######
Left	12	40%
Bilateral	1	3.30%
Size of stone mm		
7-14 mm	22	######
>15 mm	8	######
Site		
Upper Ureter	5	######
Mid Ureter	9	30%
Lower Ureter	16	######

Table 2: Stone characteristics.

Presentation	Number	%
Hematuria	6	20%
Fever	9	30%
Vomiting	3	10%

Loin pain	12	40%

Table 3. Clinical presentation.

Stone characteristic	Parameters/No.	Mean operative time (min)	P value
size	7-14mm/22	27.68	<0.002
	<15mm/8	43.37	
site	Upper ureter/5	38.4	0.09
	Mid ureter/9	32.66	
	Lower ureter/16	29.7	

Table 4: Operative time and its relation to stone characteristics.

Variable	No.	%
stone free	30	100
Hospital stays(mean) days	1-4 (1.6)	
Complications		
Hematuria	4	13
Fever	3	10
Extravasation	1	3.3

Table 5: Outcome and complications.

Discussion

As incidence of urolithiasis in children is increasing, it becomes a more important health problem with developments of the ureteroscopes and the laser lithotripters, ureteroscopy become an attractive choice for pediatric ureteral stones [19,20]. In our study, all patients were treated in one session, with success rate of 100%. Sherjeel Saulat et al found complete stone clearance was achieved in all patients with ureteric stone using holmium laser lithotripsy with a success rate of 100% while success rate was 84.8% in a study by Leijte JA et al. [21,22].

The mean operative time in our study was 37.3 mins which significantly affected by stone size. (P value <0.002). In the study by Ibrahim Uygun et al. mean operative time was 56 minutes, this is because of larger stone size and number (multiple stones size more than 20), while in study by C. Esposito et al. the median operative time was 29.8 mins (range 20-95) [23,24]. Complication rate was 14.8% in Yucel et al. study (mean age 7.6 years and a mean stone size of 6.6 mm.) while it was 8.4% in study by Dogan et al. (mean age; 7.5 years and a mean stone size of 8.9 m) [25,26]. We had complication rate of 26.6%. This relatively higher complication rate in our study is due to younger patients (mean age 3.6 years) with larger mean stone size (mean 12.8 mm). Most of the patients were discharged in 24 hours; the average hospitalization time was (1-4) days with mean of 1.6 days.

Conclusion

Ureteroscope is safe and effective for treating ureteric stones in children. The Holmium: YAG laser is effective method of stone fragmentation regardless of its composition. Hydrodilation of the ureteric orifice is effective in most cases and aggressive dilatation is not necessary especially with availability of smaller size ureteroscopes.

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