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Comparative Evaluation of Swiss LithoClast 2® versus Holmium:YAG Laser Lithotripsy for Impacted Upper-Ureteral Stones

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ABSTRACT

***Purpose*: We prospectively compared the results of the Swiss LithoClast® 2 System with the holmium: yttrium-aluminum-garnet (Ho:YAG) laser for ureteral lithotripsy for management of upper ureteral stones.**

***Materials and Methods*: Fifty patients were randomized to two groups: LithoClast classic 2 (n = 25) and Ho:YAG laser (n = 25) between January 2005 and January 2007. Procedure selection was decided by random chit allotment. All patients who successfully had ureteral dilatation (up to 10F) were included in the study. An 8/9.8F semirigid ureteroscope was used in all procedures with LithoClast 2, and either an 8F or 7F was used in patients who underwent laser lithotripsy. Patients were analyzed for fragmentation time, stone-free rate, stone up-migration, intraoperative complications, and auxiliary procedures.**

***Results*: Average stone size was 9.63 ± 2.46 mm^2 and 10.17 ± 2.28 mm^2 with overall stone-free rates of 84% and 88% ($P = 0.41$), respectively, for laser and LithoClast 2 groups. Stone up-migration was 24% and 16% ($P = 0.82$), mean stone fragmentation time was 9.82 ± 7.58 and 7.86 ± 3.25 minutes ($P = 0.12$), and stone fragments requiring ancillary procedures were 16% and 12% ($P = 0.99$), respectively, in laser and LithoClast 2 groups. Postoperative hematuria (up to 72 hours) was significantly ($P = 0.04$) prolonged in the laser group (36%) compared with the LithoClast 2 group (8%). Three patients in the LithoClast 2 group had instrument breakage.**

***Conclusion*: Both Ho:YAG laser and LithoClast 2 were equally efficient in managing ureteral stones with effective stone clearance, minimum morbidity, and reduced stone up-migration.**

INTRODUCTION

PNEUMATIC LITHOTRIPSY has been the most widely used method of stone disintegration.[1,2] There is always the risk of fragment up-migration, however, in whatever mode of endoscopic lithotripsy is chosen for management of upper ureteral stones. Recently, there has been an upsurge in the use of the laser for disintegration,[3,4] because it has produced fewer complications in terms of perforation (1%), and there has been a low incidence of stone up-migration.

EMS Medical Systems (Nyon, Switzerland) has introduced the Swiss LithoClast® System 2, which works on the principle of simultaneous fragmentation and ureteral suction. We prospectively compared the results of the LithoClast 2 with those of the holmium:yttrium-aluminum-garnet (Ho:YAG) laser for ureteral lithotripsy in patients with upper ureteral stones to assess the efficacy of the LithoClast 2 *v* the laser in terms of up-migration, fragmentation time, stone-free rate, requirement of auxiliary procedures, and postoperative complications.

MATERIALS AND METHODS

Fifty patients were randomized to two groups: LithoClast 2 (n = 25) and Ho:YAG laser (n = 25) between January 2005 and January 2007. Procedure selection was decided by random allotment of chits. All patients who successfully underwent ureteral dilatation (up to 10F) were included in the study. An 8/9.8F rigid ureteroscope was used with the LithoClast 2 and

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Table 1. Stone Parameters with Demography

	Laser (n = 25)	*Lithoclast® 2* (n = 25)	P *value*
Age (years)	36.69 ± 9.61	37.63 ± 10.8	0.37
Male : female	16 : 9	20 : 5	0.11
Average stone size (mm)	9.63 ± 2.46	10.17 ± 2.28	0.21

either a 7F or 8F semirigid ureteroscope was used with the laser. **A 200μ fiber** was used with laser settings of a maximum of 1.2 joule and a frequency of not more than 15 Hz.

Patients with renal insufficiency, abnormal anatomy, associated renal stones, active kidney infection, previous renal decompression (percutaneous nephrostomy), large stone burden (>20 mm), presence of pacemakers, and previous failed pneumatic lithotripsy were excluded from the study. In addition, patients who needed an intraoperative accessory procedure, such as use of a basket and forceps retrieval, were excluded from the study.

Patients were analyzed for fragmentation time, stone-free rate, stone up-migration, intraoperative complications, and need for auxiliary procedures. All patients underwent indwelling Double-J stent placement; the stent was removed after 4 weeks. The catheter was removed on postoperative day 1. All patients were evaluated at 1 month and 3 months. Intravenous urography was performed at 3 months to assess functional status and also to delineate the ureteral anatomy.

Statistical analysis

The Student *t* test was applied to assess the significance of means of the two groups. A 2 × 2 contingency table analysis was prepared to analyze the occurrence of the event. The test used was chi-square.

RESULTS

Stone parameters and demography are shown in Table 1. Average stone size was comparable in each group. The overall stone-free rates were 84% and 88%, respectively, in the laser and LithoClast 2 groups (Table 2).

Stone up-migration was higher in the laser group (Table 3), Four patients in the laser group needed an ancillary procedure (Table 2). One patient had a 1.5 cm hard stone with moderate to gross hydronephrosis. This patient subsequently underwent percutaneous lithotripsy, because the stone migrated into the lower calix. Three patients in the LithoClast 2 group had an ancillary procedure (Table 2). Stone fragmentation/disintegration time was significantly higher in the laser group (Table 2).

Prolonged postoperative hematuria (up to 72 hours) was observed in the laser group compared with the LithoClast group and was statistically significant ($P = 0.04$). Three patients in the laser group had hematuria up to 96 hours. All occurrences of hematuria were managed conservatively.

Three patients in the LithoClast group had instrument breakage; the proximal end of the pneumatic probe broke while fragmenting the stone. This occurred during procedures in the first 15 patients. All patients showed prompt excretion and adequate drainage at 3 months, as evidenced by intravenous urography. None of the patients exhibited any evidence of ureteral stricture.

DISCUSSION

Although there are several options for management of upper ureteral stones, shockwave lithotripsy is considered the first-line choice for management of upper ureteral stones smaller than 1 cm.[5] No guidelines exist for management of impacted upper ureteral stones larger than 1 cm. Endoscopic intervention is often necessary.

Although the various endoscopic modalities for fragmenting stones have their advantages and disadvantages,[6–8] the holmium laser and pneumatic lithotripters are most widely used for management of upper ureteral stones.[1–3] There is always the risk, however, of fragment up-migration necessitating the use of Dormia basket Dretler Stone Cone [9] or use of an antegrade occlusion balloon catheter.[10]

Laser has revolutionized the management of impacted upper ureteral stones.[3,4] Recently, EMS Medical Systems introduced the Swiss LithoClast® classic 2 (Fig. 1A and B), which works on the principle of simultaneous fragmentation and ureteral suction using variable air pressure (0–3 bar) and variable frequency (2–12 Hz). A foot pedal (Fig. 2) allows the controlled use of frequency impulses, which helps in stabilization of the stone

Table 2. Comparative Results

Parameters	*Ho : YAG laser* (n = 25)	*Lithoclast® 2* (n = 25)	P *value*
Stone-free rate	21 (84%)	22 (88%)	0.41
Fragmentation time (mean ± SD)	9.82 ± 7.58 min	7.86 ± 3.25 min	0.12
Fragments requiring ancillary procedure	4 (16%) • PCNL (1) • SWL (3)	3 (12%) • SWL (2) • RIRS (1)	0.99

Ho : YAG = holmium : yttrium-aluminum-garnet; PCNL = percutaneous nephrolithotomy; SWL = shockwave lithotripsy.

TABLE 3. COMPLICATIONS

Study groups	*Fragment up-migration*	*Mucosal perforation/ disruption*	*Instrument breakage*	*Postoperative hematuria*
Laser (n = 25)	6 (24%)	2 (8%)	0	9 (36%)
Lithoclast® 2 (n = 25)	4 (16%)	3 (12%)	3 (12%)	2 (8%)
P value	0.82	0.34	0.02	0.04

for adequate fragmentation. Hand control facilitates controlled suction during fragmentation, which balances the movement of the stone and helps in fragmentation of the stabilized stone, thereby preventing up-migration. Excessive suction, however, obliterates the view and may damage the mucosa. The major disadvantage of the LithoClast 2 is that it can be used only with an 8F ureteroscope.

Use of the Swiss LithoClast 2 is contraindicated in some patients, such as those with active bleeding disorders, solitary functioning kidney, creatinine level of 3 mg/dL or higher, pregnancy, age younger than 18 years, ureteral stricture, and presence of a pacemaker.

Depending on the stone size, location, and mobility, either a low frequency or a higher frequency can be applied. The major advantage is the ability to choose freely between lower or higher pulse rates without the help of a third person, which is not the case when the Ho:YAG laser is used. Stone movement is not controlled by the operator and requires a third person to adjust the pulse frequency. Advantages of the laser include its use in slender scopes (6F, 7F),[11] in patients with a bleeding disorder,[12] and in children.[13,14]

Although the laser produces a lower perforation rate (1%), it can cause superficial mucosal perforation when in contact with the mucosa. Also, it is evident that fragmentation time (9.82 ± 7.58 min) and postoperative hematuria (36%) are significant in the laser group (Tables 2 and 3), which may be caused by prolonged contact time and excessive heat generation. Although mucosal disruption and perforation are equal in both groups, postoperative hematuria is significantly higher in the laser group (P = 0.04). Three (12%) patients in the laser group had hematuria up to 96 hours, and these patients had fragmentation times of 12, 14, and 19 minutes, respectively. We found that the patients in the LithoClast 2 group had less postoperative hematuria (8%) because the LithoClast produces lesser contact time (7.86 ± 3.25 min) and minimal or no heat production. The result is that impacted stones can be effectively treated. Although none of the patients had any stricture at the site of previous impaction at 3 months, long-term follow-up is necessary to substantiate the results.

CONCLUSION

The Ho:YAG laser and the LithoClast 2 are equally efficient in the management of ureteral stones. They have comparable

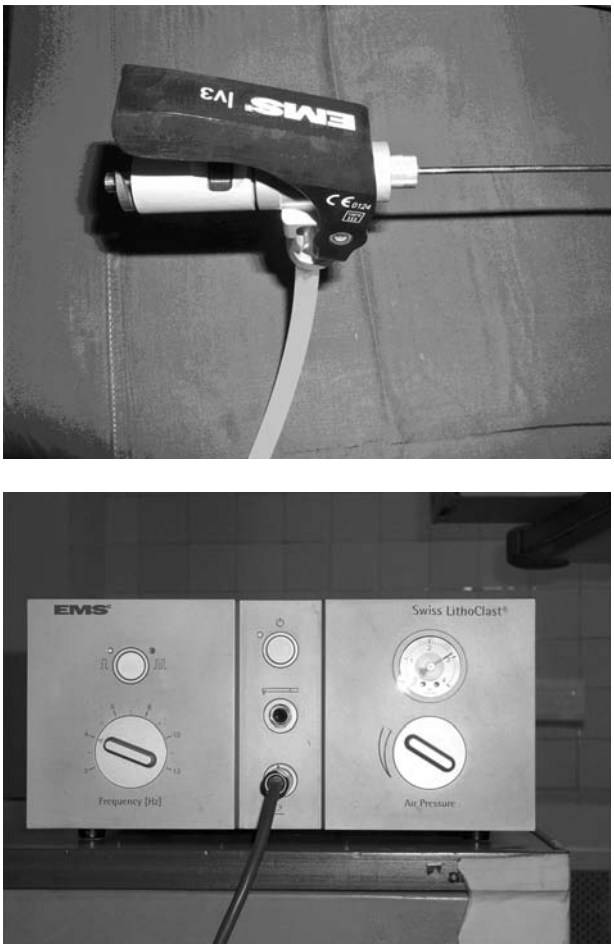

FIG. 1. The LithoClast® 2 System includes a probe with suction (**a**) and an energy source (**b**).

FIG. 2. Frequency impulses can be controlled with a foot pedal.

stone clearance rates, morbidity, and stone up-migration rates. We believe the LithoClast 2 is an effective alternative to the Ho:YAG laser for management of ureteral stones.

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ABBREVIATIONS USED

Ho:YAG = holmium:yttrium-aluminum-garnet.