Section: Urology

Research

SAFETY AND EFFICACY OF LASER LITHOTRIPSY IN TREATMENT OF URETERIC CALCULI: A STUDY FROM TERTIARY CENTRE

G. V. Charan Kumar[1], Vinay Ausekar[2], Rahul Devraj[3], Vidyasagar[4], Ramreddy[5]

[1]Associate Professor, Department of Urology, Nizams Institute of Medical Sciences, Hyderabad, Telangana, India
[2]Senior Resident, Department of Urology, Nizams Institute of Medical Sciences, Hyderabad, Telangana, India.
[3]Professor, Department of Urology, Nizams Institute of Medical Sciences, Hyderabad, Telangana, India.
[4]Additional Professor, Department of Urology, Nizams Institute of Medical Sciences, Hyderabad, Telangana, India.
[5]Professor & HOD, Department of Urology, Nizams Institute of Medical Sciences, Hyderabad, Telangana, India.

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Corresponding Author:
Dr.G. V. Charan Kumar,
Email:charan.gv@gmail.com
ORCID: 0000-0002-8654-9744

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Abstract

Background: The changes that have taken place in the management of ureteric calculus disease during the last decade have been truly remarkable. Laser lithotripsy is a reliable method of stone disintegration irrespective of the stone composition and hardness. It is carried out through all types of ureteroscopes. Using laser lithotripters, the incidence of trauma to the urothelial mucosa is usually less than other lithotripters. The holmium laser essentially will fragment all calculi regardless of colour and composition, including cystine, calcium oxalate monohydrate and brushite. To study the safety and efficacy of Holmium–YAG (Ho-YAG) laser in the treatment of ureteric stones by laser lithotripsy. **Materials and Methods:** It is a retrospective observational study. Fifty patients aged 18- 65 years who underwent laser lithotripsy from November 2019 to August 2021 at Nizams Institute of Medical Sciences, Hyderabad, were included in the present study. **Result:** In our study group, we had patients in the ages group ranging from 18 to 65 years with a mean age of 39.26+-13.08 years. Most of them were males,n= 33(66%) compared to females n=17(34%). Stone size ranged from 5-20 mm with a mean stone size of 10 mm+-2.97 Duration of surgery ranged from 60 mins &mean duration of surgery was 43.4+-14.55 minutes. Duration of hospital stay ranged from 2-4 days with a mean duration of hospital stay of 2.32+- 0.55 days. Our results showed a stone-free rate for calculi in the proximal and middle ureter -88.88% and 100%, respectively. This is in agreement with the previous reports in the literature regarding the safety & efficacy of ureteroscopic Ho: YAG laser in treating ureteric stones at different locations. **Conclusion:** Lithotripsy using Ho: YAG laser in ureteric stones is more effective at mid ureteric calculi than proximal ureteric calculi. As suggested by our study and the other studies mentioned previously, holmium laser lithotripsy has a reasonable stone-free rate, minor complications and acceptable surgical duration when treating ureteric stones, making it safe and reliable.

INTRODUCTION

The changes that have taken place in the management of ureteric calculus disease during the last decade have been truly remarkable. There are different therapeutic approaches for ureteral stones depending on stone size, location and anatomical variations of the urogenital tract. Ureteroscopy has changed our perception and, eventually, our treatment strategies of ureteral stones. The miniaturisation of the instruments allows easier access within the ureter without prior dilatation in more than 50% of the patients and a more accessible approach to the proximal ureter.[1]

Stone disintegration through a rigid ureteroscope can be achieved with in situ lithotripsy. The spectrum of lithotripters includes ultrasonic lithotripsy, electro-hydraulic lithotripsy, ballistic lithotripsy, pneumatic lithotripsy, and laser lithotripsy. Laser lithotripsy is a reliable method of stone disintegration irrespective of

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the stone composition and hardness. It is carried out through all types of ureteroscopes.[2] Using laser lithotripters, the trauma to the urothelial mucosa is usually less compared to the other lithotripters.[3] Comparative studies of the two lithotripsy sources have shown that the Holmium YAG laser gives superior stone-free rates (97% vs 87%).[4] The holmium laser essentially will fragment all calculi regardless of colour and composition, including cystine, calcium oxalate monohydrate and brushite.[5] Successful fragmentation of calculi is achieved in more than 85% of cases. The results of holmium laser lithotripsy for ureteral calculi have been uniformly excellent.[6,7]

Objectives

To study the safety and efficacy of Holmium–YAG (Ho-YAG) laser in the treatment of ureteric stones by laser lithotripsy.

MATERIALS AND METHODS

It is a retrospective observational study. Fifty patients between the age group of 18- 65 years underwent laser lithotripsy from November 2019 to August 2021 at Nizams Institute of Medical Sciences, Hyderabad. All these patients were included in the study.

Inclusion Criteria

All Patients aged between 18-65 years attending the urology outpatient department at Nizams institute of medical sciences, Hyderabad, with symptoms of ureteric colic and on evaluation diagnosed to have ureteric stones and undergoing laser lithotripsy. In our study, the laser was used for lithotripsy in only mid and proximal ureteric calculi.

Exclusion Criteria

Included age < 18 years, Pregnant Women, Patients with Urosepsis, patients on anticoagulants & antiplatelets, and patients who underwent prior ureteric interventions.

All patients presenting to the urology outpatient department with symptoms suggestive of ureteric stones were evaluated by clinical examination, X-ray KUB and ultrasound KUB, & their demographic data was collected. Patients having ureteric stones and requiring surgical intervention were assessed further by CT KUB (plain). Treatment with laser lithotripsy for ureteric stones was explained to patients, and patients willing to undergo laser treatment for the stone disease were taken into study. Patients those in exclusion criteria are not taken into a research study. Pre-operative work for all patients was done and posted for the procedure provided the urine culture of the patients was negative. Laser lithotripsy was done using the standard operative technique, and postoperative complications, if any, were noted. All patients were reviewed at four weeks, and a repeat CT KUB was done & considered stone free if there is no stone or if the fragment size is < 2 mm. DJ stent removal was done under local anaesthesia.

Data Analysis

Data collected for the individual patient is simultaneously entered into the study proforma & updated. The data is analysed using SPSS software version 27.0. Statistical analysis for continuous data (age, stone size, duration of surgery & duration of hospital stay) were expressed as mean & standard deviation & Chi-square test was applied as appropriate for comparison to nominal data. Nominal data analysis (sex, stone side, stone site, stone-free rate & complications) were presented in numbers & percentages.

RESULTS

The current observational study included patients with ureteral calculi undergoing laser lithotripsy for stone fragmentation. In our study group, we had patients aged 18 to 65 years with a mean age of 39.26+-13.08years. mean-39.2, standard deviation-13.08. The maximum number of patients is between 20 and 50 years of age. Most of them were males, 33(66%) compared to 17(34%) females. Stone incidence was more on the left side, 27 (54%) & the rest, 23(46%), were on the right side. Stone size ranged from 5-20 mm with a mean stone size of 10mm+-2.97.In 16(32%) patients, stone size is less than 9 mm, and in 29 patients(58%), stone size is 9-15 mm. More than 15 mm stone size was seen in 5 patients (10%).

Duration of surgery ranged from <30 mins to >60 mins & Mean Duration of surgery was 43.4+-14.55 minutes. In the majority of 35 patients(70%), the patients' duration of surgery was between 30 and60mins. In 7 patients (14%) duration of surgery lasted more than 60 minutes. In 8 (16%) patients duration of surgery is less than 30 minutes.

Table 1: Distribution according to hospital stay (n=50)

Durationofhospitalstay	Frequency	Percentage
2days	36	72%
3days	12	24%
4days	2	4%
Total	50	100%

[Table 1] summarises the duration of hospital stay. Out of 50 patients, 36 patients had a hospital stay of 2 days. 12 patients had a hospital stay of 3 days, and two patients had a hospital stay of 4 days. Duration of hospital stay ranged from 2-4 days with Mean duration of hospitalstay2.32+-0.55days.

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Table 2: Distribution according complications postsurgery (n=50)

Complications post-surgery	Frequency	Percentage
Fever	4	8%
MucosalInjury	2	4%
Migrationofstone	3	6%
No complications	41	82%

[Table 2] summarises the postoperative complications. In 41 patients (82%), no complications were seen. Four patients (8%) had a fever which subsided on adequate antibiotic and antipyretic therapy 2(4%) patients had grade1 mucosal injury for whom stent removal was done at six weeks. In 3(6%) patients, stone migrated proximally, which was cleared by RIRS in the same setting. Migration of stone in the pelvicalyceal system was only seen for stones in the proximal ureter.

Table 3: Comparison of Size of the stone vs duration of surgery (n=50)

Size of the stone	Duration of surgery		
	<30min	30-60min	>60min
<9mm	5	11	0
9-15mm	3	24	2
>15mm	0	0	5
Total	8	35	7
P<0.001			

The duration of surgery has a significant correlation with the size of the stone. As the stone size increased, the duration of surgery also increased. For less than 9 mm stones duration of surgery is less than 30 minutes in 5 patients and 30- 60 minutes in 11 patients. For 9- 15 mm stones duration of surgery is less than 30 minutes in 3 patients and 30- 60 minutes in 24 patients, and more than 60 minutes in 2 patients. For stones, more than 15 mm duration of surgery is more than 60 minutes in all five patients.

Table 4: Comparison of stone-free rate in the proximal and middle ureter

Site	N=50	STONEFREE	SFR%
Proximal	27	24	88.88
Middle	23	23	100
Overall	50	47	94

In proximal ureteric calculi stone-free rate is 88.88%, and in the mid ureter it is 100%.
In patients with the migration of calculi proximally during laser lithotripsy, RIRS was done.
In the same setting to render all the patients stone free at 4weeksof surgery.

Table 5: SUMMARYOFSTUDIES&THEIR RESULTS CONCERNING STONE FREE RATE(%) AT DIFFERENT LOCATIONS

Study	Proximal	Middle
ShérifMouradM,[8]	66.6	80.9
DevarajanRetal,[9]	89	96
Pang Zet al,[10]	92.6	93.9
JiangHetal,[11]	70.3	97.9
DegirmenciTet al,[13]	81.8	88.8
GiulianelliRet al,[14]	68.13	84.8
Our study	88.8	100

Table 6: Previous studies comaprision of Overall stone free rate

Study	Overallstonefreerate(%)
Scarpa R M et al,[3]	92.6
Shérif Mourad M,[8]	89.2
Devarajan R et al,[9]	90
Jiang H et al,[11]	92.2
Leijte J A et al,[12]	84.8
Giulianelli R et al,[14]	86.1
Our study	94

Table 7: Overall stone free rate comparision

Study	Overallstonefreerate(%)
Devarajan R et al,[9]	9.3
Pang Z et al,[10]	4.8
Leijte J A et al,[12]	12.4
Degirmenci Tet al,[13]	27.5
Giulianelli R et al,[14]	5.92
Ourstudy	18%

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DISCUSSION

Recent improvements in equipment and technologies made great strides in managing patients with urinary calculi.[15]Ho: YAG laser is one of the safest, most effective, and most adaptable lithotripters. Advantages of the holmium laser include its significantly smaller postlithotripsy particles compared with other lithotripters. The Ho: YAG laser produces a weak shockwave, which decreases the likelihood of pushback of the calculi or stone fragments.[16] Ho: YAG laser is a reliable method of stone fragmentation regardless of the stone hardness and composition. It can be conducted through all types of ureteroscope.[17]Compared with pneumatic lithotripsy, Ho: YAG laser causes less injury to the ureter because of the superficial penetration depth of the laser.

The current observational study included patients with ureteral calculi undergoing laser lithotripsy for stone fragmentation. Our results showed a stone-free rate for calculi in the proximal and middle ureter - 88.88%, and 100%, respectively. This confirms previous reports in the literature about the safety & efficacy of ureteroscopic Ho: YAG laser in treating ureteric stones at different locations.

Summary of studies & their results concerning stone free rate (%) at different locations:

In our study, the overall stone-free rate assessed at 4 weeks by imaging (CT KUBplain) was 94% and was almost similar to other studies in the literature ranging from 85 to 96 %, who studied the effect of Ho: YAG laser in the management of ureteric stones. All studies in the literature, including our study showed a better stone free rate in the mid ureter compared to the proximal ureter. Pang Z et al. showed the highest stone free clearance rate in proximal ureter compared to other studies.JiangHetal showed the highest stone-free rate in mid ureter compared to other studies.

Our complication rate was 18% which included 3 – stone migrations (from proximal ureter to kidney) (treated by RIRS), 2- mucosal injury (stent removal done after six weeks), and 4 – febrile UTI (which resolved on longer antibiotic and antipyretic medications). No major complications were noted in our study.

Other studies had complication rates ranging from5% to28%. Devarajan R etal. Had a complication rate of around 9.3 percent. Pang Z et al. had the lowest complication rate of about 4.8 percent. Degirmenci T et al. had the highest complication rate of about 27.5 per cent.

Limitations of this study include that it is a retrospective study and surgery done by different surgeons.

CONCLUSION

Lithotripsy using Ho: YAG laser in ureteric stones is more effective at mid ureteric calculi compared to proximal ureteric calculi.As suggested by our study and the other studies mentioned previously holmium laser lithotripsy has an excellent stone-free rate, minor complications and acceptable surgical duration when treating ureteric stones, making them safe and reliable.Ho:YAG has been proven to disintegrate ureteric calculi irrespective of size, location and it is entirely safe to use without causing any major ureteric injuries.

Semirigid ureteroscopes provide better vision and ensure easy and safe access to stone for fragmentation and dusting. Thus, laser lithotripsy has quickly become a widely used and accepted modality for ureteric calculi and has become an integral part of the day-to-day practice of all urologists.

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