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Corresponding Author
Y. Anil Reddy,
Department of Urology, Mamata Super Specialty Hospital, Khammam, Telangana, India

Author Designation
[1]Assistant Professor,
[2]Professor and Head,
[3,4]Post Graduate,

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A Comparative Analysis of the Demographics in the Treatment of Ureteral Stones: Ho: YAG Laser Lithotripsy versus Pneumatic Lithotripsy

[1]Yeruva Anil Reddy, [2]J. Sasi Kumar, [3]C.H. Vamseedhar Reddy and [4]Sagar Soitkar

[1-4]Department of Urology, Mamata Super speciality Hospital, Khammam, Telangana, India

ABSTRACT

The study aimed to compare the outcomes of pneumatic lithotripsy (PL) and holmium laser lithotripsy (LL) in the management of ureteric stones and assess their impact on patient demographics, operative parameters, and stone-free rates. Study Period: December 2018 to December 2020, Inclusion Criteria: Patients aged above 15 years with ureteral stones >6 mm, located in the upper and lower ureter. Exclusion Criteria: Pregnancy, age <15 years, uncorrected coagulopathy, concomitant stones at other sites, loss to follow-up, ureteral stricture, acute renal failure, sepsis. Demographics: LL group (n = 44) had a mean age of 35.2 years, while PL group (n = 44) had a mean age of 37.2 years. Both groups were comparable in terms of age, stone size, laterality, and comorbidities. Gender Distribution: LL group had 56% males and 44% females, while PL group had 49% males and 51% females. Stone Size: LL group had an average stone size of 9.24 mm, while PL group had 8.21 mm. Operative Time: LL group had a longer operative time (32.43 mins) compared to PL group (26.12 mins) ($p<0.001$). Hospital Stay: Mean hospital stay was shorter in LL group (1.65 days) compared to PL group (2.16 days) ($p = 0.0006$). Stone-Free Rate (SFR): LL group achieved a higher SFR (95.2%) compared to PL group (89.4%) ($p<0.001$). Holmium laser lithotripsy demonstrated advantages in stone-free rates and shorter hospital stays, albeit with longer operative times, compared to pneumatic lithotripsy in the management of ureteric stones. The choice between these modalities should consider clinical priorities and cost-effectiveness, especially in developing countries. Further research and analysis are warranted to guide clinical decision-making.

INTRODUCTION

The advancement of ureteroscopy and related working instruments to manipulate or fragment ureteral calculi has significantly increased treatment options for urologists[1]. Gradual decrease in the calibre of ureteroscopes, improvements in the capabilities, and effectiveness of stone fragmentation systems, advancement in the design of the graspers preventing migration of stone fragments have increased the success rate of endoscopic management of ureteral stones and contributed to its widespread application for stone fragmentation, a variety of lithotriptors can be used, including ultrasonic, electrohydraulic, pneumatic and laser lithotriptors. Lithoclast lithotripsy and Holmium:YAG lithotripsy have reported favourable outcomes. A rather simple principle of the jackhammer has enabled Lithoclast lithotripsy to be a safe and effective method for stone treatment[2]. Thus the Lithoclast has become a widespread tool for fragmentation of urinary stones. However, it has some disadvantages. Semi rigid probe requires a rigid or at least a semi rigid uretero scope and there is a high possibility of undesired retrograde displacement of the calculus.

The Holmium: YAG laser has excellent stone fragmenting properties and as a result, it is now a well-established modality for intracorporeal lithotripsy. Holmium laser light can be transmitted through a thin, flexible fibre compared with instruments for mechanical stone fragmentation[3]. Holmium:YAG lithotripsy depends on photo thermal mechanism for stone fragmentation, thus the risk of retrograde stone propulsion could be minimized but it may cause thermal injury to the ureter if used carelessly. Many studies comparing PL and LL, as for safety, efficacy and complications in the management of endoscopic ureteral stones are available[4].

Pneumatic lithotriptor (PL) is preferred by many urologists because of its lower cost, easy instillation, and higher success rates. However higher rates of stone migration constitutes its disadvantage[5]. Although laser lithotriptor (LL) is quite effective in the management of both proximal ureter stones, and impacted stones, it is more expensive relative to pneumatic lithotriptor. In this study, our aim was to compare PL and Ho:YAG LL in the treatment of ureteral stones with different locations and to identify the risk factors for complications.

MATERIAL AND METHODS

The present comparative observational study with 88 patients of either sex aged above 15 years and having ureteral stones attending Department of Urology OPD of Mamata Super specialty Hospital, Khammam were included in the present study. The study was conducted from December 2018 to December 2020.

Inclusion criteria:

- Those who are diagnosed Patients of either sex aged above 15 years and having ureteral stones >6 mm
- Stones of upper and lower ureter

Exclusion criteria:

- pregnancy,
- children age <15 yrs
- uncorrected coagulopathy,
- concomitant stones at other sites (e.g., bladder, renal)
- lost to follow up
- ureteral stricture,
- Acute renal failure
- sepsis

The patients were selected after they were diagnosed as having ureteric calculus on the basis of a detailed history, through physical examination and both routine and supportive investigations like ultrasonography and KUB radiography. The patients were asked details of history regarding symptoms particularly pain and hematuria.

A detailed general survey and per abdominal examination was carried out. Hb% urine routine, urine culture and sensitivity blood urea, serum creatinine, ultrasonography, KUB radiograph, NCCT were obtained. Ethical clearance has been obtained from research and dissertation committee/ethical committee of the institution for this study.

General anesthesia or spinal anesthesia was used. Patients underwent both laser as well as pneumatic lithotripsy. Postoperative care was meticulously followed: intake and output charts and vital signs charts were maintained. Patients were given antibiotics, analgesics

Most of the operated patients had uneventful recovery. 88 Patients were advised to come for follow-up on OPD days. Follow up period was 4 weeks. They patients were asked for symptoms like pain, hematuria and urinary tract infection. The double j stent was removed after 4 weeks.

Statistical analysis: Data on means and standard deviation are supplied (SD). Calculated values between tested confidence intervals differed from each other. Simple linear correlations were employed in correlation analysis. Using SPSS 15.0, all statistical analyses were performed (SPSS Inc., Chicago, USA).

RESULTS

The present study show that in group PL, the lowest age was 18 and the highest age was 61 with mean of 37.2. While in Group LL the minimum was 18 while the maximum was 60 with mean of 35.2.

Total number of male patients in group LL was 23 while group PL had 23. Total number of female patients in group LL was 18 while in group B were 24. Thus group LL had 56% male and 44% female patients while group PL had 49% male and 51% female patients. Present study shows comparison of male and female population between the two groups. Out of total 46 males in the study population, 23 (50%) were in group LL while 23 (50%) were in group PL. Out of total 42 females in the study population, 18 (42.80%) were in group LL while 24 (57.20%) were in group PL (Table 1) In group LL, 25 (61%) patients had renal calculus on right side and 16 (39%) patients had calculus on left side. While in group PL, 30 (46.8%) patients had calculus on right side and 25 (53.2%) patients on left side (Fig 1).

Operative time in group LL ranged from 15 min to 90 min while operative time in group PL ranged from 15 min to 40 min. The mean operative time for group LL was 32.43 min while in group B was 26.12 min with p<0.001 indiacting statistical significance between two groups (Table 2). The mean hospital stay in group LL was 1.65 days with standard deviation of 0.661. mean hospital stay in group PL was 2.16 days with standard deviation of 0.677. Using statistical analysis, the mean hospital stay in Group B was significantly more than that in Group A as the p value was 0.0006. (Table 3). In LL group a total of 95.2 % patients had Stone free status post surgery while in group PL 89.4% patients had Stone free status post surgery. With a p<0.001 which is statistically significant.

DISCUSSION

The management of stone disease has been revolutionised. The miniaturisation of scopes and sophistication of medical instrumentation is driving urological practice into a high-technological performance with its economic impact, particularly in developing countries. URS with lithotripsy is the benchmark treatment for large mid-ureteric stones. Despite the availability of several energy sources, pneumatic and laser energy are favoured for their high SFRs (>90%) and lower morbidity rates[6].

Recently, there has been a trend favouring the use of laser energy to treat ureteric stones. This shift may be driven by the laser's high SFR, capability to fragment all types of stones, lower incidence of stone migration, multi-purpose laser machines installed in medical facilities, and even the marketing effect of lasers influencing requests by patients[7].

In the absence of objective benefits both for the patient and the community, this represents a huge financial burden. In our present study, we attempted to evaluate the results of both pneumatic and holmium laser lithotripsy in the management of ureteric stones in a tertiary care hospital. In this study ursl was done using 8fr and 4fr urteroscopes using 365 micron laser fibre in LL group and pneumatic lithotripser in the PL group. In our study patients were given a pre-operative dosage of injection ceftriaxone 1 gm as a stat dosage as a regular protocol I our hospital according to the local microbial prevalence l sensitivity pattern.

In this study, mean age of patients in LL group was 35.2 yrs while in PL was 37.2 yrs. Hence age group was comparable in both groups without any statistical difference. As age less than 15 years were excluded from the study. The mean age in both groups was in the range of 35-38 years. Also, in the recent study done by Razzaghi *et al.* it was shown that the highest prevalence of renal calculus disease was seen in the age group of 35-45 years which was comparable to this study (8-10). Similar characteristics were also seen in study conducted by Garg *et al.* And Manohar *et al.*[11].

There were no statistically significant differences in demographic data regarding stone size, laterality, and number in both groups. Comorbidity distribution for hypertension and diabetes were comparable in the two groups .The gender distribution was comparable between the two groups with 56% male in LL and 49% males in PL group while female population was 44% in LL 51 % in PL group . Overall, this study had 46 male patients and 42 female patients indicating increased prevalence of ureteric calculus disease in male population. The average stone size in LL group is 9.24 mm whereas the average stone size in PL group is 8.21 mm .Similar demographic characteristics were also found in study conducted by Kassem *et al*[12].

Operative time was longer when Laser lithotripsy was used, which is comparable with other studies[13,14]. The mean operative time for LL group in this study is 32.43 mins where as the mean operative time for PL group in this study is observed as 26.12 mins. The difference Iin duration of the surgery between two is statistically significant (p<0.001). Similar results are observed in other studies done by Garg *et al*[15]. We believe this difference is related to the increased time required for the fragmentation/dusting technique used with the laser,.

Due to the small laser fibre size compared with the pneumatic probe, better irrigation and consequently vision can be achieved in the laser group. There is no significant difference in the amount of irrigational fluid required for both the procedures which varied between 5.2 to 11.2 litres. Upward migration of a ureteric stone is a common complication when using a pneumatic energy source[16] and is one of the arguments favouring the use of laser lithotripsy over pneumatic lithotripsy. Stone migration was seen in 2 patients of LL group where as stone migration is observed in 4 patients of PL group accounting for 4.8% and 8.5 % respectively. Lower Stone migration rates in laser lithotripsy group can be attributed to the advancements in laser technology's where the newer

equipments are reported to have lower retropulsion rates. The stone migration rates in this study are comparable with other studies done by Binbay *et al*[17,18]. In conclusion, the management of ureteric stones has evolved with the advent of laser lithotripsy, which offers advantages such as high success rates, reduced stone migration, and versatile equipment. However, it comes with longer operative times. Pneumatic lithotripsy remains a viable option. Deciding between them should consider clinical priorities and cost-effectiveness, particularly in developing countries.

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