

Original Article

Usage of Forceps and Dormia basket in the Management of Ureteric Stone: Comparison between Holmium: YAG Laser and Pneumatic Lithotripsy in a Referral Hospital, Bangladesh

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Abstract

Now lithoclasthas become more popular tool than various intracorporeal lithotripters for the treatment of ureteric stones. Recently the Holmium:YAG laser has been used with a wide range of potential urological applications, including intracorporeal lithotripsy of ureteric stones. This study was conducted to compare the use of Forceps and Dormia basket in the management of ureteric stone between Holmium: YAG Laser and Pneumatic Lithotripsy. It was a longitudinal follow-up comparative study conducted at Combined Military Hospital, Dhaka. All the respondents were admitted patients in Combined Military Hospital Dhaka, under Urology Ward. A total of 100 patients were enrolled for this study under convenient purposive sampling method. They all were admitted with the complaints of upper ureteric stone who underwent ureteroscopic lithotripsy from October 2010 to September 2012. In 50 patients, Laser Lithotripsy (LL) was used and in other 50 patients Pneumatic Lithotripsy (PL) was used. Same ureteroscope, video monitor, baskets and irrigation devices were used in both the samples. Patients were followed up after 1st and 3rd months interval. Lithotripsy follow-up was done with radiograph and ultrasonography of kidney, ureter and bladder. Patients with migrated fragments or incomplete clearance were underwent an auxiliary procedure such as shock wave lithotripsy. Mean stone size was  $1.36 \pm 0.36$  cm in group Laser lithotripsy (LL) and  $1.37 \pm 0.36$  cm in group Pneumatic lithotripsy (PL). The immediate stone clearance rate was significantly higher in Group LL (94.0%) than Group PL (76.0%). Proximal migration of fragments were 6.0%

in LL group and 24.0% in PL group. Use of stone retrieval equipment (baskets, forceps) was 16.0% and 64.0% in LL and PL group respectively ( $p < 0.05$ ). On the other hand stone fragments clearance requiring auxiliary procedures were 6% and 24% in LL and PL group respectively. The mean lithotripsy time was  $40.46 \pm 19.25$  min and  $36.86 \pm 14.83$  min the LL and PL group respectively. Use of stone retrieval equipment (baskets, forceps) was significantly lower in Holmium: YAG assisted ureteroscopy than pneumatic lithotripsy group.

**Keywords:** Pneumatic lithotripsy (PL), Laser lithotripsy (LL), Forceps/Dormia basket.

INTRODUCTION

To prevent irreversible damage of the kidney, due to renal obstruction caused by ureteral calculi, care must be taken. Conservative treatment may be provided to the patients with stone  $\leq 5$  mm in size.<sup>1</sup> Whereas chance of spontaneous passage for larger stones and more proximal stones diminishes considerably and thus intervention is required. Treatment decision of upper ureteric stones is based on several general aspects such as stone size and symptoms. Currently most ureteral stones are removed by minimally invasive endourological procedure. Small stones may be extracted but stones of  $>5$ mm in diameter require intracorporeal fragmentation before removing the resultant fragments.<sup>1</sup> The advancement of ureteroscopy and related working elements to manipulate or fragment ureteral calculi has significantly increased treatment options for urologists.<sup>2</sup> For stone fragmentation, a variety of lithotriptors can be used, including ultrasonic, electro hydraulic, pneumatic and laser lithotriptors. Pneumatic lithotripsy and Holmium:YAG lithotripsy are most preferred and frequently used in intracorporeal lithotripsy during endoscopic management of ureteral stone.<sup>3</sup>

Young in 1912 was the first to perform ureteroscopy, inserted a cystoscope in a child with posterior urethral valve<sup>4</sup>. Goodman in 1977 was the first to performed rigid ureteroscopy.<sup>5</sup> Different lithotriptors can be used for intracorporeal lithotripsy including electrohydraulic (EHL), ballistic (pneumatic), ultrasonic (US), laser (Ho: YAG). In the last few years lasers have been increasingly replacing others for intracorporeal lithotripsy.<sup>6,7</sup>

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European Association of Urology (EAU) recommends Holmium YAG laser as gold standard procedure for intracorporeal lithotripsy.<sup>8</sup> The reason behind is, its advantageous property of breaking all type of stone irrespective of their composition as compared to other lithotripters and because of weaker shock waves there is lower risk of stone migration.<sup>9</sup> However, Pneumatic lithotripsy was first introduced in 1992 in Switzerland.<sup>10</sup> Advantage of pneumatic lithotripter when compared to other lithotripters is its lower risk of perforating ureter and no thermal damage.<sup>11</sup> Only concern with pneumatic lithotripter is stone migration, that ranges between 1.6% and 17.3% particularly with upper ureteral calculus<sup>12,13</sup>. Dormia basket and forceps are important part of ureteroscopic stone extraction in different lithotripsy. In Bangladesh Armed Forces no study is available comparing these two process. Hence the aim of this study is to compare usage of Forceps and Dormia basket in the management of ureteric stone between Holmium Yag Laser and Pneumatic Lithotripsy.

## MATERIAL AND METHODS

It was a hospital based longitudinal follow-up comparative two sample size cross sectional study conducted in Combined Military Hospital Dhaka. All the respondents were admitted patients in Combined Military Hospital Dhaka, under Urology ward. Total 100 patients were enrolled for this study under convenient purposive sampling method. They all were admitted with the complaints of upper ureteric stone who underwent ureteroscopic lithotripsy from October 2012 to September 2015. In 50 patients, laser lithotripsy (LL) was used and in other 50 patients pneumatic lithotripsy (PL) was used. Same ureteroscope, video monitor, baskets and irrigation devices were used in both the samples. Patients were followed up after 1<sup>st</sup> and 3<sup>rd</sup> month interval. After lithotripsy follow up was done with radiograph and ultrasonography of kidney, ureter and bladder. Patients with migrated fragments or incomplete clearance were underwent an auxiliary procedure such as shock wave lithotripsy.

Patients were randomly selected into two groups as per availability of instrument and other facilities. In Group LL Holmium: YAG laser was used on 50 patients and in group PL pneumatic lithotripsy was performed on another 50 patients. Two procedures were compared in term of stone fragmentation, stone clearance rate, duration of lithotripsy and use of basket and forceps. Patients were followed up

after 1<sup>st</sup> and 3<sup>rd</sup> month's interval. After lithotripsy follow up was done with radiograph and ultrasonography of kidney, ureter and bladder. Patients with migrated fragments or incomplete clearance were underwent an auxiliary procedure such as shock wave lithotripsy.

Ethical clearance was obtained from respective authority. Only willing respondents were included in the study. Before commencing the operation details of both the procedure was narrated to each patients. No influence or pressure was exerted during the study.

## RESULTS

**Table- I: Distribution of the respondents by age and sex (n=100)**

	LL (n=50)	PL (n=50)	p value
<b>Age (years)</b>			
≤30	9 (18.0)	13 (26.0)	0.521
31 – 40	16 (32.0)	10 (20.0)	
41 – 50	12 (24.0)	12 (24.0)	
>50	13 (26.0)	15 (30.0)	
Mean±SD	41.90±10.97	41.32±12.3	0.804
Min-max	22 – 60	20 - 60	
<b>Gender</b>			
Male	36 (72.0)	31 (62.0)	0.288
Female	14 (28.0)	19 (38.0)	

The mean age was 41.90±10.97 years in LL group and 41.32±12.33 years in PL group respectively. Only nine patients (18%) in LL group and 13 patient (26%) in PL group were below 30 years of age. There was no significant difference in age between two groups. There was no significant difference in gender between two groups.

**Table-II: Distribution of ureteric stone by their Size (n=100)**

Size of the stones	LL (n=50)	PL (n=50)	p value
0.5 – 1.0	15 (30.0)	15 (30.0)	1.000
1.1 – 1.5	23 (46.0)	23 (46.0)	
1.5 – 2.0	12 (24.0)	12 (24.0)	
Mean±SD	1.36±0.36	1.37±0.36	0.934
Min – max	0.80 – 2.00	0.80 – 2.00	

The mean stone size was 1.36±0.36 cm in LL group and 1.37±0.36 cm in PL group. The range of the stone size was 0.8cm to 2 cm in both groups.

**Table-III: Distribution of ureteric stone by their density in HounsfieldUnit (HU) (n=100)**

Density of the stones	LL (n=50)	PL (n=50)	p value
525 – 575	5 (10.0)	5 (10.0)	1.000
576 – 625	7 (14.0)	7 (14.0)	
626 – 725	21 (42.0)	22 (44.0)	
726 – 775	9 (18.0)	8 (16.0)	
776 – 825	4 (8.0)	4 (8.0)	
>825	4 (8.0)	4 (8.0)	
Mean±SD	697 ± 88	695 ± 89	0.943ns
Min – max	540 – 910	530 – 900	

The Mean density (HU) of stone was 696.66±87.89 in LL group and 695.40±89.42 in PL group.

**Table-IV: Distribution of operating period by LL and PL(n=100)**

Time (minutes)	LL (n=50)	PL (n=50)	p value
≤ 30	24 (48.0)	18 (36.0)	0.173
31 – 60	20 (40.0)	29 (58.0)	
>60	06 (12.0)	03 (6.0)	
Mean±SD	697 ± 88	695 ± 89	0.297ns
Min – max	540 – 910	530 – 900	

The Mean duration (min) of lithotripsy was 40.46±19.25 in LL group and 36.86±14.83 in PL group. In majority of the cases stone were broken within an hour in both groups. Only in 12.0% patient's lithotripsy time was more than 60 min in laser group and only in 6.0% patients lithotripsy time was more than 60 min in PL group.

**Table-V: Distribution of forceps/Dormia basket usage for stone fragments retrieval by LL and PL (n=100)**

Fragments retrieval	LL (n=50)	PL (n=50)	p value
Yes	8 (16.0)	32 (64.0)	<0.0001
No	42 (84.0)	18 (36.0)	

Forceps/Dormia baskets were required for retrieval of stone fragments in 8 (16.0%) cases in LL group and 32 (64.0%) cases in PL group and rest of the cases stone fragments were washed out spontaneously. This association was statistically significant (Chi square= 24.000, df =1, p< 0.0001)

**Table VI: Distribution of peri procedural complications by Laser and Pneumatic Lithotripsy group (n=100)**

Complications	LL (n=50)	PL (n=50)	p value
None	39 (78%)	32 (64%)	0.069
Abrasion	6 (12%)	8 (16%)	
Hemorrhage and Abrasion	1 (2%)	8 (16%)	
Hemorrhage & perforation	4 (8%)	2 (4%)	

For all the complications p value was 0.069, which is not significant.

**Table VII: Distribution of per operative proximal stone fragment migration by Laser and Pneumatic Lithotripsy group (n=100)**

Proximal stone fragment migration	LL (n=50)	PL (n=50)	p value
No migration	47 (94%)	38 (76%)	0.012*
With migration	3 (6%)	12 (24%)	

In 6% cases stone fragments were migrated proximally in LL group and in PL group it was 24% of cases. In this study complication rate was found comparatively higher in PL group than LL group. Significant association was found on proximal migration of fragmented stone between PL and LL (Chi-square=6.353, df=1 and p value = 0.002, which is significant).

## DISCUSSION

The goal of the surgical treatment for patients suffering from ureteral calculi is to achieve complete stone clearance with minimal complication. A variety of lithotripters can be used through an ureteroscope. Although there are some advantages and disadvantages,<sup>14</sup> the Holmium laser and pneumatic lithotripters are most widely used in different centers for the management of upper ureteral stones.<sup>15</sup> The present study was designed to compare laser lithotripsy with pneumatic lithotripsy in treatment of upper ureteric stone.

In this study, mean age of patients was  $41.90 \pm 10.97$  years in LL group and  $41.32 \pm 12.33$  years in PL group. There was no significant difference in the ages between two groups. Similar finding also seen in the other studies.<sup>16,17</sup>

In the present series, size of the stones ranges from 0.8 cm to 2 cm. The mean size of stone was  $1.36 \pm 0.36$  cm and  $1.37 \pm 0.36$  cm in LL group and PL group respectively. No significant difference in the size of stones was observed between the two groups. In the study of Sun et al.<sup>18</sup> mean stone size was  $11 \pm 2.5$  mm in PL group and  $12 \pm 2.3$  mm in LL group. Mean stone size was 11.5 mm in LL group and 12.3 mm in PL group in the study of Bapat et al.<sup>19</sup>. In other studies, mean size of stone ranges from 9 to 16 mm.<sup>16</sup>

In this study, density of stones ranges from 530HU to 900 HU. The mean density of stones was  $696.66 \pm 87.89$  HU in LL group and  $695.40 \pm 89.42$  HU in PL group. No significant difference was found between the two groups. EAU guideline suggested that density of the stone is an important variable to decide the method of stone removal.<sup>20</sup>

In our study, mean operation time was  $40.46 \pm 19.25$  minutes and  $36.86 \pm 14.83$  minutes in LL group and PL group respectively. No significant difference between the groups was found. In the study of Bapat et al.<sup>19</sup> mean operation time was  $38.85 \pm 8.99$  min for PL group and  $45.61 \pm 11.30$  min for the LL group. They also found no significant difference in operation time between two groups which was similar to our study. But Sun et al.<sup>18</sup> in their study found significant difference in operation time in favour of laser lithotripsy. Operation time for laser lithotripsy was  $49.8 \pm 26.4$  min and  $76.9 \pm 48.3$  min in PL group.

In the present study, Forceps/Dormia baskets were required for retrieval of stone fragments in 8 (16%) cases in LL group and in 32 (64%) in PL group. Requirement of Forceps/Dormia baskets were significantly higher in PL group than LL group. Sun et al.,<sup>12</sup> reported that the stone should be fragmented in to pieces <3 mm to pass spontaneously. Jeon et al., in their study found that the Hol:YAG laser virtually vaporizing the stone and the stone is fragmented into very small sizes, ranging from 1-2 mm which is also supported by another study by Vassar et al.,<sup>21</sup>

In this study, complete stone clearance was significantly higher in LL group(94.0%) than in PL group(76.0%). Where as proximal migration of fragments was occurred

significantly lower in LL group(6.0%) than PL group (24.0%). In one study, Maghsoudiet al.<sup>22</sup> revealed that stone fragmentation was 90.2% in LL group and 73.2% in PL group ( $P < 0.05$ ). They concluded that the overall stone free rate in Hol:YAG laser lithotripsy was better than pneumatic lithotripsy. Sun et al.<sup>18</sup> reported stone free rate 95.7% in LL group and 69.7% in PL group. Bapat et al.<sup>19</sup> found complete clearance of stone in 166(86.1%) patient out of 193 patients in PL group, whereas in LL group they noticed complete stone clearance in 195 (97.01%) out of 201 patients.

In this study, proximal migration of fragments was occurred in three (6%) cases in LL group and twelve (24%) cases in PL group. Proximal stone migration is the most disadvantage of the pneumatic lithotripsy and reported in the 2-17% of cases in the study of Fong et al.<sup>23</sup> Jeon and associates<sup>1</sup> reported that the main cause of failure in ureteroscopic lithotripsy was the proximally migrated stone/ fragments. They found upward migration of stone fragments occurred in 19.2% in the pneumatic lithotripsy group while in 4.0% in the LL group. Stone fragments migrated into the kidney with pneumatic lithotripsy was 13.9% in one study by Bapat et al.<sup>19</sup> whereas stone fragments migrated proximally in only 1.9% patients in laser group. Sun et al.<sup>17</sup> found proximal migration of stone fragments in 19.1% cases in PL group. It was significantly higher than laser group.

The discussion may be concluded with the comment that LL has better outcome than PL in upper ureteric stone management.

## CONCLUSIONS

According to this study findings it can be concluded that use of stone retrieval equipment(baskets, forceps) were significantly lower in Holmium:YAG assisted ureteroscopy than pneumatic lithotripsy. If budget and other conditions permits, in ureteric stone operations laser Lithotripsy may be conducted for all patients.

## REFERENCES

1. Preminger, G.M., et al. 2007 guideline for the management of ureteral calculi. J Urol, 2007. 178: 2418. <https://www.ncbi.nlm.nih.gov/pubmed/17993340>
2. Jeon SS, Hyun JH, Lee KS. A comparison of holmium: YAG laser with Lithoclast lithotripsy in ureteral calculi fragmentation. Int J Urol 2005;12: 544-547.

3. Razzaghi MR, Razi A, Mazloomfard MM, GolmohammadiTaklimi A, Valipour R, Razzaghi Z. Safety and efficacy of pneumatic lithotripters versus holmium laser in management of ureteral calculi: a randomized clinical trial. *Urol J.* 2013;10:762-6.
4. Türk C, Knoll T, Petrik A, Sarica K, Skolarikos A, Straub M, Seirz C. EAU Guidelines on Urolithiasis. European Association of Urology 2013.
5. Young HH, McKay RW. Congenital valvular obstruction of the prostatic urethra. *Surg. Gynecol Obstet* 1929;48:509.
6. Goodman TM. Ureteroscopy with pediatric cystoscope in adults. *Urology.* 1977;9:394.
7. Breda A, Ogunyemi O, Leppert JT, Schulam PG. Flexible ureteroscopy and laser lithotripsy for multiple unilateral intrarenal stones. *Eur Urol.* 2009; 55: 1190-6.
8. Bader MJ, Eisner B, Porpiglia F, Preminger GM, Tiselius HG. Contemporary management of ureteral stones. *Eur Urol.* 2012;61:764-72.
9. Zarrabi A, Gross AJ. The evolution of lasers in urology. *Ther Adv Urol.* 2011;3:81-9.
10. Denstedt JD, Eberwein PM, Singh RR. The Swiss Lithoclast: a new device for intracorporeal lithotripsy. *J Urol.* 1992;148:1088-90.
11. Piergiovanni M, Desgrandchamps F, Cochand-Priollet B, Janssen T, Colomer S, Teillac P, et al. Ureteral and bladder lesions after ballistic, ultrasonic, electrohydraulic, or laser lithotripsy. *J Endourol.* 1994;8:293-9.
12. Murthy PV, Rao HS, Meherwade S, Rao PV, Srivastava A, Sasidharan K. Ureteroscopic lithotripsy using miniendoscope and Swiss lithoclast: experience in 147 cases. *J Endourol.* 1997;11:327-30.
13. Menezes P, Kumar PV, Timoney AG. A randomized trial comparing lithoclast with an electrokinetic lithotripter in the management of ureteric stones. *BJU Int.* 2000;85:22-5.
14. Hofbauer J, Hobarth K, Marberger M. LithoClast: New and inexpensive mode of intracorporeal lithotripsy. *J Endourol* 1992;6:429-432
15. Erhard MJ, Bagley DH. Urologic applications of the holmium laser: Preliminary experience. *J Endourol* 1995;9:383-386.
16. Fong Y, Ho Sh, Peh H, Ng F, Lim P, Quek P, et al. Extracorporeal shockwave lithotripsy and intracorporeal lithotripsy for proximal ureteric calculi. *Ann Acad Med Singapore* 2004;33:80-3.
17. Naqvi S, Khaliq M, Zafar M, Rizivi S. Treatment of ureteric stones, comparison of laser and pneumatic lithotripsy. *BJU* 1994;77:694-8.
18. Sun Y, Wang L, Liao G, Xu C, Gao X, Yang Q, Qian S. Pneumatic lithotripsy versus Laser Lithotripsy in the endoscopic Treatment of Ureteral Calculi. *J Endourol* 2001; 15: 587-590
19. Bapat SS, Pai KV, Purnapatre SS, Yadav PB, Padye AS. Comparison of Holmium and Pneumatic Lithotripsy in Managing Upper-Ureteral Stones. *J Endourol* 2007; 21:1425-1427.
20. Türk C, Knoll T, Petrik A, Sarica K, Straub M, Seitz C. Guidelines on urolithiasis. EAU guide line 2012 Feb: 934-1034
21. Vassar GJ, Chan KF, Teichman JM et al. Holmium:YAG lithotripsy: photothermal mechanism. *J. Endourol.* 1999; 13 : 181-90.
22. Maghsoudi R, Amjadi M, Norizadeh D, Hassanzadeh H. Treatment of ureteral stones: A prospective randomized controlled trial on comparison of Ho:YAG laser and pneumatic lithotripsy. *Indian J Urol* 2008; 24(3): 352-354.
23. Fong Y, Ho Sh, Peh H, Ng F, Lim P, Quek P, et al. Extracorporeal shockwave lithotripsy and intracorporeal lithotripsy for proximal ureteric calculi. *Ann Acad Med Singapore* 2004;33:80-3.