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Requirement of ESWL after ureterorenoscopy and lithotripsy in the management of upper ureteric stone: comparison between Holmium Yag laser and pneumatic lithotripsy in a referral hospital, Bangladesh

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Article Info

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Received : 10 December 2021
Accepted : 22 January 2022
Available Online : 15 May 2022

ISSN: 2224-7750 (Online)
2074-2908 (Print)

DOI: https://doi.org/10.3329/bsmmuj.v15i2.60865

Keywords: EWSL, pneumatic lithotripsy, laser lithotripsy, ureteric stone.

Cite this article:
Chowdhury MA, Waheed SMS, Rakib MA, Hossain F. Requirement of ESWL after Ureterorenoscopy and lithotripsy in the management of upper ureteric stone: Comparison between Holmium Yag laser and pneumatic lithotripsy in a referral hospital, Bangladesh. Bangabandhu Sheikh Mujib Med Univ J. 2022; 15(2): 111-114.

Available at:
www.banglajol.info

A Journal of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

Abstract

Various methods have been employed for the removal of ureteric calculi all over the world. Both Ureteroscopic Pneumatic and Laser lithotripsy are popular procedures for this purpose. However proximal migration of stone fragments are not uncommon in these procedures while treating upper ureteric stones. Extra corporeal shock wave lithotripsy (ESWL) may require to fragment those proximally migrated stones after the ureteroscopic Pneumatic or Laser lithotripsy. To compare the requirement of ESWL in the management of ureteric stone between Holmium Yag Laser and Pneumatic Lithotripsy. This study included 100 patients with upper ureteric stones who underwent ureteroscopic lithotripsy at the Department of Urology, CMH, Dhaka, between October 2010 and September 2012. Laser lithotripsy was used in 50 patients (Group A), and pneumatic lithotripsy was used in the remaining 50 patients (Group B). In each case, the same ureteroscope, video monitor, baskets, or irrigation devices were used. A kidney ureter and bladder radiograph and ultrasonograph were performed on patients one month and three months after lithotripsy. Patients with migrated fragments or insufficient clearance underwent a supplementary procedure such as ESWL. Mean age was 41.9±10.9 years and 41.3±12.3 years in Group A and Group B respectively. Males were predominant in both groups. Mean stone size was 1.36 ± 0.36 cm in Group A and 1.37± 0.36 cm in Group B. Complete stone clearance was 94.0% in Group A and 76.0% in Group B. EWSL requirement rate was significantly higher in Group B (24.0%) than Group A (6.0%). Peri procedural complications like hemorrhage was significantly higher in Group B and mucosal disruption/perforation was almost same in both the groups. EWSL requirement rate was comparatively higher in pneumatic lithotripsy than laser lithotripsy.

Introduction

Urinary stones have been a source of concern for humans since the beginning of time. They are the third most common urinary tract disorders, after urinary tract infections and prostatic pathologies.[1] Urinary stones affect 2 to 20% of the world's population.[2] They are fairly common and are usually accompanied by severe flank pain and hematuria. The rate of spontaneous passage of ureteric stones varies with stone size; approximately 80% of stones smaller than 4 mm pass spontaneously, while only 21% of stones larger than 6 mm pass spontaneously.[3] Failure of conservative treatment, a single obstructed kidney, intractable pain, urosepsis, and patient preference are all indications for surgical intervention.[2]

Upper ureteric stone treatment is based on several general factors such as stone size and symptoms. The majority of ureteral stones are now removed using a minimally invasive endourological procedure. Small stones can be extracted, but stones larger than 5mm in diameter require intracorporeal fragmentation before removing the resultant fragments. The advancement of ureteroscopy and related working elements to manipulate or fragment uretral calculi has significantly increased treatment options for urologists.[4] A variety of lithotriptors, including ultrasonic, electro hydraulic, pneumatic, and laser lithotriptors, can be used for stone fragmentation. Both pneumatic lithotripsy and Holmium:YAG lithotripsy have shown promising results. The jack hammer's simple principle has enabled pneumatic lithotripsy to be a safe and effective

method of stone treatment.[5,6] As a result, the pneumatic lithoclast has become a popular tool for fragmenting urinary stones. It does, however, have some drawbacks. Semirigid probes necessitate a rigid or semirigid ureteroscope, and there is a high risk of calculus retrograde displacement.[7,8] Because of its excellent stone fragmenting properties, the holmium:YAG laser is now a well-established modality for intracorporeal lithotripsy.[9] When compared to mechanical stone fragmentation instruments, Holmium laser light can be transmitted through a thin, flexible fiber. Because holmium:YAG lithotripsy relies on a photothermal mechanism for stone fragmentation, the risk of retrograde stone propulsion is reduced, but it can cause thermal injury to the ureter if used incorrectly. Endoscopic treatment of ureteral stones should be evaluated based on the efficacy and overall success rate of the various procedures.

The aim of this study was to compare the requirement of ESWL in the management of ureteric stone between Holmium Yag Laser and Pneumatic Lithotripsy.

Methods

This comparative study was carried out in the Department of Urology, CMH, Dhaka from October 2013 to September 2015 over a period of two years. The study included 100 patients with upper ureteric stones who underwent ureteroscopic lithotripsy at the above institution. The patients were split into two groups. A Holmium:YAG laser was used on 50 patients in Group A (Laser lithotripsy), and pneumatic lithotripsy was performed on another 50 patients in Group B. The two procedures were compared in terms of stone clearance rate, complications and extracorporeal shock wave lithotripsy (ESWL) requirement in case of migrated fragments or insufficient clearance.

Results

Table-I

Demographic profile of the patients (N=100)

		Group A (Laser lithotripsy)	Group B (Pneumatic lithotripsy)	p value
Age (years)	≤30	9 (18.0)	13 (26.0)	0.804ns
	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	41.9±10.9	41.3±12.3	
Gender				0.288ns
Male		36 (72.0)	31 (62.0)	
Female		14 (28.0)	19 (38.0)	

Unpaired t and Chi-Square test was done

The mean age was 41.9±10.9 years and 41.3±12.3 years in Group A and group B respectively. Males were predominant in both groups. There were no significant differences in age and gender between the two groups. (Table-I)

Table-II

Distribution of patients by stone size (N=100)

	Group A (Laser lithotripsy)	Group B (Pneumatic lithotripsy)	p value
Stone size (cm)			0.934ns
Mean±SD	1.36±0.36	1.37±0.36	
Min – max	0.80 – 2.00	0.80 – 2.00	
Stone density (HU)			
Mean±SD	697 ± 88	695 ± 89	0.943ns
Min – max	540 – 910	530 – 900	

Unpaired t test was done

The mean stone size was 1.36±0.36 cm in Group-A and 1.37±0.36 cm in Group-B. The range of the stone size was 0.8 cm to 2.0 cm in both groups. The Mean density (HU) of stone was 696.66±87.89 in Group-A and 695.40±89.42 in Group-B. There were no significant differences in size and density of stone between the two groups.(Table-II)

Table-III

Peri procedural complications

Complications	Group A (Laser lithotripsy)	Group B (Pneumatic lithotripsy)	p value
Hemorrhage	1 (2.0)	8 (16.0)	0.035
Mucosal disruption/ perforation	4 (8.0)	5 (10.0)	0.205

Fisher's Exact test was done

Post-operative haematuria occurred in 2.0% of Group A patients and 16.0% of Group B patients. Mucosal abrasion/ disruption occurred in 8.0 % of Group-A patients and 10.0 % of Group-B patients. (Table-III)

Table-IV

Complete stone clearance in two procedures (N=100)

Complete stone clearance	Group A (Laser lithotripsy)	Group B (Pneumatic lithotripsy)	p value
Yes	47 (94.0)	38 (76.0)	0.0001s
No	3 (6.0)	12 (24.0)	

Fisher's Exact test was done

Complete stone clearance was significantly higher in Group A than Group B. (Table-IV)

Table-V

ESWL required after Laser and Pneumatic of lithotripsy

ESWL required	Group A (Laser lithotripsy)	Group B (Pneumatic lithotripsy)	p value
Yes	3 (6.0)	12 (24.0)	0.0001s
No	47 (94.0)	38 (76.0)	

Fisher's Exact test was done

Significantly higher number of patients required ESWL due to stone migration in Group B than Group A. (Table-V)

Discussion

The goal of surgical treatment for ureteral calculi patients is to achieve complete stone clearance with minimal complication. Through a ureteroscope, a variety of lithotripters can be used. Despite some advantages and disadvantages,[10] the Holmium laser and pneumatic lithotripters are the most widely used in numerous centers for the treatment of upper ureteral stones.[11]

The present study was designed to compare laser lithotripsy with pneumatic lithotripsy in treatment of upper ureteric stone. This study included one hundred patients. The patients were split into two groups. Laser lithotripsy was performed on 50 patients in Group A (LL), and pneumatic lithotripsy was performed on another 50 patients in Group B (PL). In terms of ESWL requirements and complications, two procedures were compared.

In this study, mean age of patients was 41.9 ± 10.9 years in Group A and 41.32 ± 12.33 years in Group-B. There was no significant difference in the ages between two groups. This is consisted with other reports in the literatures.[12,13]

In the present series, size of the stones ranges from 0.8 cm to 2 cm**.** The mean size of stone was 1.36±0.36 cm and 1.37±0.36 cm in Group-A andGroup-B respectively.There was no significant difference in the size of stones between the two groups. In the study of Sun et al.[14], mean stone size was 12 ±2.3 mm in LL group and 11 ±2.5 mm in PL 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.[15]**.** In other studies, mean size of stone ranged from 9 to 16 mm.[9,12]

In this study, density of stones ranges from 530HU to 900 HU**.** The mean density of stones was 696.66±87.89 HU in Group-A and 695.40±89.42 HU in Group-B. There was no significant difference between the two groups. According to EAU guidelines, the density of the stone is an important variable in determining the method of stone removal.[16]

In this study, complete stone clearance was significantly higher in group-A (94.0%) than in Group-B (76.0%). Whereas proximal migration of fragments was occurred significantly lower in Group-A (6.0%) than Group-B (24.0%). Maghsoudi et al[17] concluded that the overall stone free rate in Hol:YAG laser lithotripsy was better than pneumatic lithotripsy, in their study, stone fragmentation was 90.2% in LL Group and 73.2% in PL group ($P < 0.05$). Sun et al[14] revealed that stone free rate was 95.7% in LL Group and 69.7% in PL group. Bapat et al.[15]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.

Proximal stone migration is the most disadvantage of the pneumatic lithotripsy and reported in the 2-17% of cases in the study by Fong et al.[12] Jeon and associates[4] 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 4.0% in the LL group.

Stone fragments migrated into the kidney with pneumatic lithotripsy was 13.9% in a study by Bapat et al[15] whereas stone fragments migrated proximally only in 1.9% patients in laser group. Sun et al[14] found proximal migration of stone fragments in 19.1% cases in PL group. It was significantly higher than laser group.

Significantly higher number of patients required ESWL due to stone migration in Group B than Group A.

Post-operative haematuria was occurred in one (2.0%) patient in Group A and in 8 (16.0%) patient in Group-B. Mucosal abrasion/disruption was occurred in 4 (8%) patients in group-A and 5 (10%) patients in Group-B. In Bapat[15] study, Ureteral perforation, which was mucosal, occurred in 2.9% patients in LL Group and 4.6% patients sustained ureteral perforation in PL group. In one study Sun et al[14] reported 5 ureteral perforations out of 141 patients. In another study, Monohor et al[18] found no significant difference of mucosal perforation/disruption between laser and pneumatic lithotripsy.

Conclusion

Rate of EWSL requirement is comparatively higher in pneumatic lithotripsy than laser lithotripsy.

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