ORIGINAL ARTICLE

Comparison of Effectiveness of Intracorporeal Holmium Laser Versus Pneumatic Lithotripsy in Management of Ureteric Stone

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ABSTRACT

Background: Renal stone has worldwide prevalence of between 2 and 20%. Pakistan is part of the Afro-Asian stone forming belt, where the prevalence of renal stone is very high. An impacted stone that has not changed its radiological position for more than two months has virtually no chances of spontaneous passage .With the introduction of different type of ureteroscopes and lithotripters the management of distal and mid ureteric stones has changed dramatically. Currently the two most effective lithotripters used are pneumatic and holmium laser. Holmium laser is considered superior to all other forms of lithotripsy.

Aim: To compare the effectiveness of holmium laser and pneumatic lithotripsyin terms of complete ureteric stone clearance.

Methodology: Randomized controlled trial study was done in Institute of Kidney Disease (Team-C) Peshawar from 01-03-2015 to 01-08-2015 which includes 264 (132 in each group). After the approval of Hospital Ethical Committee, informed consent taken from every patient. All the patient with ureteric stone from 18-60 years of age and mean 40.58±11.4 and 40.39±11.9 years. The stone size was 9-20mm. The patients were diagnosed on contrast radiography with failure of medical treatment.

Results: A total of 264 patients (female, n=80 and male, n=184; Group PL (Pneumatic lithotripsy), n=132; Group LL (Laser lithotripsy), (n=132) were included. Mean ages of patients in PL and LL groups were 40.58±11.4 and 40.39±11.9 years respectively. Stone surface areas were 13.04±1.53mm^2, 13.90+0.92mm^2 in PL and LL groups respectively. Besides, in the LL group, we detected proximal (29%), midureteral (23.3%) and distal (47.7%) ureter stones. Stone-free rates of 77% and 78% were achieved in the management of proximal ureter stones in the PL and LL groups respectively. Overall success rate was 72.5%.

Conclusion: It is concluded that the treatment of Laser lithotripsy patients with proximal ureteric stones has yielded superior results as compared to the Pneumatic lithotripsy group.

Keywords: Laser lithotripsy, Pneumatic lithotripsiy, Ureteroscopy

INTRODUCTION

Renal stone has worldwide prevalence of between 2 and 20%.[1] Pakistan is part of the Afro-Asian stone forming belt, where the prevalence of renal stone is very high. An impacted stone that has not changed its radiological position for more than two months has virtually no chances of spontaneous passage.[2] The management of ureteric stones has evolved in the past 50 years from, medical expulsive therapy, open surgery, ureteroscopy and intracorporeal lithotripsy to extracorporeal shock wave lithotripsy.[3] Indications of surgical intervention include failure of conservative treatment, solitary obstructed kidney, impaired renal functions, bilateral ureteric stones intractable pain, urosepsis and patient's choice[4].

With the introduction of different type of ureteroscopes and lithotripters the management of distal and mid ureteric stones has changed dramatically[3]. Currently the two most effective lithotripters used are pneumatic and holmium laser.[4] Holmium laser is considered superior to all other forms of lithotripsy.[5] In one study the immediate stone free rate between laser versus pneumatic for all types of stones was 92% vs 82.1% respectively. In the same study the immediate stone free rate for laser versus pneumatic lithotripsy for proximal, middle and distal ureteric stones was 100% vs 42.9%, 96% vs 83.3% and 96% vs 83.3%% respectively.[6] Mean duration of lithotripsy for laser versus pneumatic lithotrites varies from 13.7-32.2 min vs 7.9-28.4 minutes respectively.[5] In another study the stone-free status at 4 weeks was 95% for pneumatic lithotripsy and 84% for holmium laser. The non-fragmentation rate was 10% for holmium laser and 1% for pneumatic lithotripsy.[7]

The objective of the study was to compare the effectiveness of holmium laser and pneumatic lithotripsy in terms of complete ureteric stone clearance.

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MATERIAL AND METHODS

This was a randomized controlled trial carried out at Institute of Kidney Disease (Team-C) Peshawar with a period of 6 months from 01-03-2015 to 01-08-2015. A total patients 264 (132 in each group) were admitted above 18-60 years of age. This study was conducted after approval from College of Physicians and Surgeons, Karachi, Pakistan and the hospital ethical committee. Eligible candidate was selected from outpatient department and emergency department after their screening through the inclusion and exclusion criteria. Informed written consent

was obtained from the patients. Blood and urine investigation, including serum urea and creatinine levels were carried out followed by ultrasound of pelvis, abdomen and x-ray K.U.B. All investigations were performed in the same laboratory using the same protocol to avoid any bias. This data was recorded on a separate proforma for each patient. Patients were randomly allocated into two groups A and B. Group A (control group pneumatic lithrotripsy), Group B (case holemium laser), patient was assessed for stone clearance and regular follow up for four weeks. Chi square test was used to compare efficacy between the two groups. The p value ≤ 0.05 was considered significant. Stratification of effect modifiers like age, gender, site of stone and duration were evaluated and post stratification Chi-square test was used for significance.

RESULTS

A total of 264 patients (female, n=80 and male, n=184; Group PL, n=132; Group LL, n=132) were included in our study. Mean ages of the patients in the PL and LL groups were 40.58±11.4 and 40.39±11.9 years, respectively. Stone surface areas were 13.04±1.53mm^2, 13.90+0.92mm^2 in PL and LL groups respectively. Besides, in the LL group, we detected proximal (29%), midureteral (23.3%) and distal (47.7%) ureter stones. Stone-free rates of 77% and 78% were achieved in the management of proximal ureter stones in PL and LL groups respectively. Overall success rate was 72.5%. Apart from midureteral stones stone-free rates were higher for distal and proximal ureteral stones, being more improved in PL group without any statistically significant intergroup difference in success rates. Lengths of the hospital stay were 2.08±0.7, and 1.53±0.89 days in Groups PL, and LL, respectively. The patients in the LL group were hospitalized for a statistically significantly short time. Medical expulsive treatment was applied for patients who were unable to pass their stone fragments and they were monitored at weekly intervals using KUB films, and ultrasonograms. Major complications such as ureteral avulsion, sepsis, urinoma or hematuria requiring treatment were not observed in any patient. Stone migration was also observed in the PL (n=12; 9.1%), and LL (n=8; 6.5%) groups. Stone migration rates were somewhat lower in LL group without any statistically significant intergroup difference (p 0.069).

Table 1: Stratification of PL and LL in gender distribution (n=264)

Gender	Groups		Total
	PL	LL	
Male	92(50%)	92(50%)	184 (50%)
Female	40(50%)	40(50%)	80 (50%)

Table 2: Age wise distribution of patients between PL and LL(n=264)

Age (years)	Groups	
	PL	LL
18-30	23 (8.71%)	20 (7.57%)
31-40	33(12.5%)	30(11.36%)
41-50	51(19.31%)	51(19.31%)
51-60	25(9.46%)	31(11.74%)
Mean ±SD	40.58±11.4	40.39±11.9

P = 0.802

Table 3: Comparative stone clearance between URS-PL and URS-LL(n= 264)

Stone Clearance	Groups		P value
	PL	LL	
Yes	101.6 (77%)	102.9 (78%)	0.020
No	30.4 (23%)	29.1 (22%)	

Table 4: Gender-wise stone clearance between PL and LL(n=264)

Gender	Treatment group	Efficacy	
		Yes	No
Male	PL	68.7 (67%)	33.53 (33%)
	LL	69.9 (68%)	33 (32%)
Female	PL	28.4 (71%)	11.6 (29%)
	LL	28.8 (72%)	11.2 (28%)
Total		191.4 (72.5%)	72.6 (27.5)

Table 5: Age-wise stone clearance between PL and LL(n=264)

Age (years)	Groups	Stone clearance		P Value
		Yes	No	
18-30	PL	15(5.68%)	8(3.03%)	0.486
	LL	15 (5.68%)	5(1.89%)	
31-40	PL	19 (7.19%)	14(5.30%)	0.306
	LL	21 (7.95%)	9 (3.40%)	
41-50	PL	39 (14.77%)	12 (4.54%)	0.462
	LL	42(15.90%)	9 (3.40%)	
51-60	PL	15(5.68%)	10 (3.78%)	0.089
	LL	25(9.46%)	6 (2.27%)	
Total		191(72.34%)	73(27.65%)	

Table 6: Stratification of Pl and LL in stone clearance according to different stone size

Stone size	Treatment Groups	Efficacy	
		Yes	No
09mm	PL	10 (40%)	8 (32%)
	LL	6 (24%)	1 (4%)
10mm	PL	4 (36.36%)	3 (27.27%)
	LL	3 (27.27%)	1 (9.09%)
11mm	PL	3 (18.75%)	2 (12.5%)
	LL	6 (37.5%)	5 (31.25%)
12mm	PL	20 (43.47%)	4 (8.69%)
	LL	19 (41.30%)	3 (6.52%)
13mm	PL	8 (29.62%)	4 (14.81%)
	LL	12 (44.44%)	3 (11.11%)
14mm	PL	12 (30%)	4 (10%)
	LL	22 (55%)	2 (5%)
15mm	PL	5 (17.85%)	5 (17.85%)
	LL	15 (53.57%)	3 (10.71%)
16mm	PL	6 (26.08%)	5 (21.73%)
	LL	8 (34.78%)	4 (17.39%)
17mm	PL	3 (25%)	3 (25%)
	LL	4 (33.33%)	2 (16.66%)
18mm	PL	3 (21.42%)	3 (21.42%)
	LL	6 (42.85%)	2 (14.28%)
19mm	PL	1 (14.28%)	2 (28.57%)
	LL	3 (42.85%)	1 (14.28%)
20mm	PL	2 (22.22%)	2 (22.22%)
	LL	3 (33.33%)	2 (22.22%)

P = 0.158, 0.553, 0.838, 0.775, 0.432, 0.148, 0.551, 0.558, 0.333, 0.270 and 0.764

DISCUSSION

The overall probability of urinary stones development in an individual varies in various parts of the world. The prevalence of urolithiasis in developed countries is about 10-15%[8] and in the developing countries, it is the most

widely recognized disease in our daily urological practice.[9] Our country is situated in the center point of stone belt. No part of the human urinary tract is insusceptible to stone formation. The stones found in kidneys, ureters, bladder, even the urethra and in the upper part of ureter are called proximal ureteric stone. Technically proximal ureteric stone is characterized "as the stone in ureteral section in between ureteropelvic junction and the upper border of the sacroiliac joint.[10]

The treatment of stone disease has gone for quite a long time from herbal medicine to the tremendous improvement in modern day endourologic and extracorporal shock wave lithotripsy modalities of management. Various studies have addressed the effectiveness of different sources of energy to disintegrate stones in the ureter. There are a few intracorporeal lithotripsy (URSL) alternatives, for example, electro hydraulic lithotripsy, ultrasonic lithotripsy, pneumatic, and holmium laser lithotripsy. Among these treatment options we use laser lithotripsy, successfully for ureteral stone treatment. As per the literature the success rate of laser lithotripsy appears to be higher than 90%. URS-PL can be a modality management for most upper urinary tract stones, due to its simplicity, non-invasiveness and minimal morbidity. In any case, a few stones are difficult to fragment by URS-PL or the fragments may remain in the urinary tract even after successful fragmentation of the stone.

In a study conducted by Razaghi et al for stones between 1-2cm size, the LL group showed an efficacy of stone clearance for upper ureteric stone to be 82.1% which approximate our stone clearance results in terms of efficacy which is 84.1%. However the mean stone size in his study (10mm+5.6SD) is smaller than our study results which is (11.80mm+1.40 SD).[11]

Our study results shows comparable results in terms of mean stone size, mean age and efficacy of stone clearance to a national study showing efficacy of 80.85% in terms of stone clearance LL in the proximal part of ureter.[12] Cheung in 160 patients showed stone clearance rates of more than 90% for URS-PL and Laser Lithotripsy.[13] By Ghoneim et al., reported a stone-free rate of SWL in the treatment of impacted proximal ureteral stone to 90% and 86.7% in the stented and non-stented group with an overall stone-free rate of 88.3%.[14] Aboumarzouk showed that stone free status for laser was 87.7% in sixty-four patients[15] while Ahmad showed that stone clearance was 88% for ureteric stones treated by URS-PL.[16] Ahmed et al showed in 99 patients that stone free rate was 66% for upper ureteric stones at end of 4 weeks for laser lithotripsy ($p < 0.05$)[16] while Hafez and colleagues showed the stone free rate at 3 months after the last URS-PL treatment session as 79.2%.[17] Takazawa showed the overall stone free rate after one session of laser lithotripsy was 80.4%.[18] Lee et al found that the patients have a higher satisfaction with URS-PL versus URS-LL.[19] Results from a meta-analysis of five studies indicated that ureteroscopically treated patients needed more auxiliary procedures than those who underwent URS-PL.

The current study has certain limitations especially that we cannot evaluate the hardness of stone on CT scan estimating the house field (HU) units of stone thickness, before leaving upon the ideal methodology of management because it may a confounding component in particularly in PL group. Also follow-up of our patients in both groups was a very short time period. This study is implicated on urologists, surgical specialists, nephrologists, & general clinical practitioners who run over the patients experiencing from proximal ureteric stones. There are some unanswered inquiries with respect to the viability of stone clearance that out of 264 patients, a portion of patients had the option to effectively clear the stone while others couldn't make it regardless of comparable stone size in both of the treated groups.

CONCLUSION

It is concluded that the treatment of Laser lithotripsy patients with proximal ureteric stones has yielded superior results as compared to the Pneumatic lithotripsy group with proximal ureteric stones of size 9-20mm.

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