Al-Azhar University Journal
for Medical and Virus Research
and Studies

Ureteroscopic Lithotripsy Using Pneumatic Lithoclast for Treatment of Middle and Lower Ureteral Calculi: A prospective Study

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Abstract

Ureteral calculi is a common disease in urology that require active therapy owing to its increased prevalence, high occurrence rate, and numerous complications. Ureteroscopy is a common urologist's procedure for both diagnostic and therapeutic interventions. URS with PL is a safe and efficient procedure for managing patients who had urolithiasis especially those who had middle & lower ureteral calculi. This study compares safety and efficacy of ureteroscopic lithotripsy assisted pneumatic lithoclast in treatment of middle and lower ureteral stones. Sixty individuals were enrolled in this prospective comparative clinical research from June 2021 to June 2023. Two groups of patients were created [lower ureteric stones group (A) and middle ureteric stones group (B)]. Both groups were treated by semi-rigid ureteroscopic lithotripsy using pneumatic lithoclast. The study inclusion criteria were fulfilled by 60 patients. The mean age was 39.5 ranging from 20-56 years, 16 female patients (26.6%) and 44 male patients (73.3%). The mean size of stone for group (A) was 10.5 mm ranging from 5.9-19 mm and for group (B) was 19 mm ranging from 6-20 mm. The mean H.U for group (A) was 1012.6 ranging from 250-1700 and for group (B) was 1080 ranging from 550-1735. Free rate of stone was 93.3% in group (A) and was 86.6% in group (B). The mean time of operation for group (A), 32.59 min ranging from 18-46 min and for group (B), 33.94 min ranging from 18-60 min. Group (A) showed statistically significant higher rate of one intraoperative complication compared to group (B). Group (B) showed statistically significant higher rate of more than one intraoperative complications compared to group (A). Ureteroscopy with pneumatic lithoclast is a secure and efficient procedure for treatment of ureteric calculi located in middle and lower parts of the ureter. However there were minor complications. We need further studies with larger scales for conforming our results.

Keywords: Pneumatic lithotripsy, Ureteroscopy, Stone free rate, Ureteral calculi.

1. Introduction

Urolithiasis is a common urologic disease that requires active therapy owing to its increased prevalence, high occurrence rate, and numerous complications [1]. It is the

third most prevalent disease of the urinary system. Males affected 4 times than females [2]. The most commonly used therapeutic methods during the treatment of urolithiasis patients are laparoscopic ureterolithotomy, open ureterolithotomy, percutaneous nephrolithotripsy, ureteroscopy, and extracorporeal shock wave lithotripsy (ESWL) [3]. The optimal choice of treatment is determined by a number of variables such as stone size, composition, location as well as clinical factors, equipment availability, and surgeon skills [4]. Ureteroscopy assisted pneumatic lithotripsy developed in 1990 and it's considered as most successful method for treating ureteral calculi [5]. Various forms of energy for fragmentation of the stones are available as laser, ultrasonic, pneumatic, and electro hydraulic. It has been found that pneumatic lithotripsy is a successful, safe and economical mode of therapy [6]. The solid probe of pneumatic lithotripter fragments the stone by oscillatory movement. It is the least morbid and most effective method for all kinds of calculi in middle and lower thirds of the ureter. Even the device is appropriate for all ureteric segments; however in the upper ureteral stone although small, there is a chance of pushback to the kidney[7]. Its advantages involve easy to use, maintain, no disposable parts and comes in both rigid and flexible fibers and in contrast to ultrasonic or laser lithotripters, it has no thermal sequelae. The drawbacks involve propensity to push the calculi or broken calculi towards the upper ureter and the flexible fibers may have few decrease in force in comparison with standard rigid probes [8]. Nowdays, ureteroscope is a common urologist's procedure for both diagnostic and therapeutic interventions. Regardless of the position of ureteral calculi, access and conclusive treatment is typically obtained with a low risk of complications [9].

2. Patients and Methods

This a prospective comparative clinical study was performed at Al-Zahraa university hospital and Kafr Elsheikh general hospital from June 2021 to June 2023 on 60 patients [30 patients (group A) had lower ureteric stones and another 30 patients (group B) had middle ureteric stones] they were treated by semirigid ureteroscopic lithotripsy using pneumatic lithoclast. All patients of either gender were over 18 years with only single calculi middle or lower ureter of 6 to 20 mm in size, no obstruction distal to the calculi, had normal renal function and failure of medical treatment for at least 4 weeks after the patients were diagnosed as ureteral stones. Excluding all patients with abnormal renal function, solitary obstructive kidney, uncorrected bleeding disorders, urosepsis, multiple stones and persistent pain.

2.1 All patients were subjected to the following:

- Written informed permission was taken from every individual participated in this research and it had accepted by ethical committee.
- Full detailed history taken.
- Physical examination including: General examination, (local) abdominal examination, per rectal (P/ R) or per vaginal (P/ V) & bimanual examination.
- Laboratory investigations as random blood sugar, complete blood count (CBC), blood urea, serum creatinine, serum uric acid, tests for liver function, coagulation profile, urine analysis and culture & sensitivity if needed.
- Radiological investigations to determine site, size and laterality of ureteric stones: Including

pelviabdominal ultrasound (US), {kidney, ureter, and bladder (KUB) plain radiograph} & non-contrast computed tomography (NCCT).

2.2 Procedure

Started with diagnostic cystoscopy at which the bladder cavity was examined, once the ureteric orifice was identified, a guide wire (0.035-inch) was inserted into the target orifice under fluoroscopic imaging using C-arm. Intramural dilatation of the ureters (with a balloon dilator) was done to enable the removal of broken pieces of stone from the distal ureter. The upper urinary tract was accessed retrogradely along the weaker guide wire with the aid of video guidance of semi rigid Karl storz ureteroscope (9.5 French). Visual identification of ureteric stone was done under fluid irrigation by normal saline, to preserve clear view of ureteroscope. Stone fragmentation was performed using pneumatic lithotripsy (Swiss Lithoclast). Bursts of compressed air push the metal projectile in the hand piece of lithoclast against the head of a metal probe. The fragments of the stone then extracted by the usage of dormia basket or stone grasper forceps.

2.3 At the End of procedure:

Retrograde URS carried out in a few patients to demonstrate whether there's any residual stone migrated proximally or extravasation. Ureteral stenting by either ureteric catheter or JJ (6 Fr) stent was done if residual fragments, mucosal tear, bleeding were present, longer operative time taken or if the calculi migrated proximally. Stone-free rate is considered when there was insignificant residual stone < 3 mm detected on KUB or NCCTU 1st day post-operatively.

2.4 Statistical analysis

Chi-square test used to compare two groups using qualitative data; when the predicted count in any cell was less than 5; the Fisher exact test was used instead of it. An independent T-test was used to compare two groups with quantitative values and a parametric dispersion; a Mann-Whitney test was used to compare two groups with quantitative data and a non-parametric distribution. The confidence interval was set at 95% and the acceptable margin of error at 5%while the allowable margin of error was set at 5%. $P< 0.05$ interprets to significant.

3. Results

60 patient in total treated by semi-rigid ureteroscope using pneumatic lithotripsy; 30 cases of them had lower third ureteric stones (Group A) and the other 30 cases had middle third ureteric stones (Group B). As show in table 1 no relation found in between the two groups concerning to the demographic data.As show in table 2 there's no statistically major changes found regarding to stone side ($p = 0.547$), stone size ($p = 0.921$) & the mean Hounsfield unit ($p = 0.497$). As show in table 3 group (A) had statistically significant higher rate of one intraoperative complications compared to group (B) ($p = 0.016$) especially bleeding ($p = 0.031$), while group (B) had statistically significant higher rate of more than one intraoperative complications compared to group (A) ($p = 0.038$) as associated mucosal injury with bleeding was significant higher in group (B) ($p = 0.028$). As show in table 4 no major difference in the researched groups concerning to operative time. As show in table 5 there's no significant difference in the two groups regarding ureteral stenting. As show in table 6 in group (A), 25 cases (83.3%) were stone free after one session (23 cases (76.7%) of them were completely free & two cases (6.7%) had insignificant residual stone which passed by medical expulsive treatment "MET"), the other 3 cases (10%) had significant residual (> 3 mm) that not

passed by medical expulsive treatment and were managed by another URS's second session after which became free of stone. While in group (B), 23 cases (76.7%) were free of stone after first session (19 cases (63.3%) were completely free & 4 cases (13.3%) had insignificant residual stones which passed by medical expulsive treatment "MET"), the other 3 cases (10%) had significant residual (> 3 mm) that not passed by medical expulsive treatment and were managed by another second session of URS after which became stone free. Therefore the total stone free rate for group (A) patients was (93.3%) while it was (86.6%) for group (B) patients. There's no significant variation found in the researched groups. As show in table 7 no major difference in the two groups concerning to stent duration. As show in table 8 no relation found variation among two groups concerning to postoperative complications.

Table 1: Demographic data in between the two groups.

Variables		Lower ureteric stones group Group (A)		Middle ureteric stones group Group (B)		Test value	P-value
		No.	%	No.	%		
Sex	Male	19	63.3%	25	83.3%	X2= 3.068	0.080 (NS)
	Female	11	36.7%	5	16.7%		
Age (years)	Mean ± SD	37.43 ± 8.87		41.70 ± 10.4		T= 1.710	0.093 (NS)
	Median	36.0		43.0			
	Range	20.0 - 56.0		23.0 - 65.0			

Table 2: Stone characteristics in the studied groups.

Variable		Lower ureteric stones group Group (A)		Middle ureteric stones group Group (B)		Test value	P-value
		No.	%	No.	%		
Side	Left	13	43.3%	15	50.0%	X2 = 0.363	0.547 (NS)
	Right	17	56.7%	15	50.0%		
Stone size (mm)	Mean ± SD	10.5 ± 3.35		19.0 ± 3.39		Z MWU = 0.099	0.921 (NS)
	Median	10.35		10.0			
	Range	5.90 – 19.0		6.0 – 20.0			
Hounsfield unit	Mean ± SD	1012.6 ± 379.5		1071.43 ± 279.63		T = 0.684	0.497 (NS)
	Median	1042.5		1080.0			
	Range	250.0 – 1700.0		550.0 – 1735.0			

Table 3: Evaluation of intra-operative complications in between the two groups.

Variable	Group (A)		Group (B)		Chi-Square Test	
	No.	%	No.	%	(X2)	P-value
No intraoperative complications	14	46.7%	12	40.0%	0.068	0. 794 (NS)
One intraoperative complications	7	23.3%	0	0.0%	5.822	0. 016 (S)
Bleeding	6	20.0%	0	0.0%	4.630	0.031 (S)
Difficult Access	1	3.3%	0	0.0%	0.351	0.500 FET (NS)
More than one intraoperative complication	9	30.0%	18	60.0%	4.310	0. 038 (S)
Mucosal injury + Bleeding	3	10.0%	10	33.3%	4.812	0. 028 (S)
Mucosal injury + bleeding + difficult access + residual stone	1	3.3%	2	6.7%	0.351	0.500 FET (NS)
Mucosal injury + bleeding + difficult access + residual stone + false passage	2	6.7%	2	6.7%	0.0	1.00 (NS)
Mucosal injury + bleeding + difficult access + residual stone + accidental stone migration	1	3.3%	2	6.7%	0.351	0.500 FET (NS)
Bleeding + difficult access + residual stone	0	0.0%	1	3.3%	0.351	0.500 FET (NS)
Mucosal injury + bleeding + residual stone	2	6.7%	1	3.3%	0.351	0.554 (NS)
Failed procedure	2	6.7%	4	13.3%	0.741	0.335 FET (NS)

Table 4: Operative time in the two researched groups.

		Lower ureteric stones group Group (A)	Middle ureteric stones group Group (B)	Test value	P-value
Operative time (min.)	Mean ± SD	32.59 ± 9.32	33.94 ± 9.99	T = 0.515	0.609 (NS)
	Median	32.5	33.5		
	Range	18.0 – 46.0	18.0 – 60.0		

Table 5: Comparison of ureteral stenting between the two studied groups.

Variable	Group (A)		Group (B)		Chi-Square Test	
	No.	%	No.	%	Test value (X2)	P-value
Ureteric catheter	8	26.7%	6	20.0%	0.093	0.760 (NS)
DJ stenting	21	70.0%	24	80.0%	0.356	0.551 (NS)
DJ stenting in both 2 sessions of URS	1	3.3%	1	3.3%	0.0	0.500 FET (NS)
DJ stenting in 1st session & Ureteric catheter in second session	1	3.3%	2	6.7%	0.351	0.500 (NS)

Table 6: Stone free rate in the studied groups.

Variable			Lower ureteric stones group Group (A)		Middle ureteric stones group Group (B)		Test value	P-value
			No.	%	No.	%		
Stone free rate	Free after one session	Completely free	23	76.7%	19	63.3%	X2 = 1.714	0.634 (NS)
		Residual stone passed by (MET)	2	6.7%	4	13.3%		
	Free after two sessions	Need another session	3	10.0%	3	10.0%		
Total stone free rate			28	93.3%	26	86.6%		

Table 7: Stent duration in two researched groups.

Variable		Lower ureteric stones group Group (A)	Middle ureteric stones group Group (B)	Test value	P-value
Stent duration (days)	Mean ± SD	19.86 ± 10.08	21.48 ± 9.78	Z MWU = 0.304	0.761 (NS)
	Median	23.0	23.5		
	Range	3.0 – 30.0	3.0 – 40.0		

Table 8: Comparison of post-operative complications among the studied groups.

Variables	Lower ureteric stones group Group (A)		Middle ureteric stones group Group (B)		Chi-Square Test	
	No.	%	No.	%	Test value(X^2)	P-value
No postoperative complications	6	20.0%	4	13.3%	0.120	0.734^{FET} (NS)
One postoperative complication	7	23.3%	5	16.7%	0.104	0.747 (NS)
Loin pain	2	6.7%	3	10.0%	0.00	0.500^{FET} (NS)
Suprapubic pain	5	16.7%	2	6.7%	0.647	0.421 (NS)
More than one postoperative complication	15	50.0%	17	56.7%	0.067	0.796 (NS)
Infection + suprapubic pain + lion pain + hematuria	1	3.3%	3	10.0%	0.00	0.635 ^{FET} (NS)
Suprapubic pain + lion pain + hematuria	3	10.0%	5	16.7%	0.577	0353 ^{FET} (NS)
Suprapubic pain + hematuria	1	3.3%	3	10.0%	1.071	0.301 (NS)
Suprapubic pain + lion pain	4	13.3%	2	6.7%	0.741	0.389 (NS)
Infection + suprapubic pain + hematuria	1	3.3%	1	3.3%	0.00	0.500 ^{FET} (NS)
Infection + suprapubic pain + lion pain	1	3.3%	1	3.3%	0.00	0.500 ^{FET} (NS)
Infection + lion pain + hematuria	2	6.7%	0	0.0%	2.069	0.15 (NS)
Lion pain + hematuria	2	6.7%	2	6.7%	0.00	1.0 (NS)

4. Discussion

Urologists may now access the calculi anywhere in the urinary system owing to advances in endoscope design and downsizing [10]. Various treatment options for treatment of ureteric calculi which include; laparoscopic ureterolithotomy, open ureterolithotomy, percutaneous nephrolithotripsy, ureteroscopy combined with intracorporeal lithotripsy, and extracorporeal shock wave lithotripsy (ESWL). Nowdays, ureteroscopy is a common urologist's approaches and the gold standard for treatment of ureteral stones[3].

Methods used during intracorporeal lithotripsy involve; electrohydraulic, ultrasound, pneumatic, and laser. These instruments were inserted into a ureteroscope working channel to break up the calculi into extractable pieces. When selecting a particular lithotripter, the operator must evaluate the potential side effects of the particular lithotripsy technique in addition to the characteristics of the calculi [6]. The solid probe of pneumatic lithotripter fragments the stone by oscillatory movement. It is the least morbid and most effective method for all kinds of calculi in middle and lower thirds of the ureter [7].

Our study's objective is to assess safety and effectiveness of ureteroscopic lithotripsy assisted pneumatic lithoclast in treatment of middle and lower ureteral stone. A study done by Hong & Park, [11] who intended to evaluate the efficacy of ureteroscopic lithotripsy assisted pneumatic Swiss lithoclast in the management of ureteric stones, concurs with our research findings.

Regarding main presentation in group (A), all 30 cases (100%) had loin pain, 28 cases (93.3%) had LUTS and 10 cases (33.3%) of them had hematuria. In group (B), all 30 cases (100%) had loin pain, 29 cases (96.7%) had LUTS and 10 cases (33.3%) of them had hematuria. Our results supported with Hong & Park., [11] who reported that there's no variation in between the researched groups concerning to pain & hematuria.

Regarding kidney function tests the mean blood urea was 32.03 ± 7.89 mg/dl for group (A) and was 31.93 ± 8.51 mg/dl for group (B) while the mean serum creatinine was 1.12 ± 0.31 mg/dl for group (A) and was 1.05 ± 0.28 mg/dl for group (B). Also, Osorio et al., [12] found that there was no significant effect of kidney function caused by ureteral calculi.

In our research the degree of hydroureteronephrosis (HUN) in group (A) was, 12 cases (40%) had minimal
HUN, 15 cases (50%) had moderate HUN, and 3 cases (10%) had marked HUN. In group (B) was, 15 cases
(50%) had minimal HUN, 14 cases (46.7%) had moderate HUN, and one case (3.3%) had marked HUN [p =0.505]. Our result was in agreement with Hong & Park., (11) who reported that there's no variation among the studied groups concerning to degree of HUN.

Our current study showed that as regards to stone side laterality; in group (A), 13 (43.3%) had stones in the left side and 17 cases (56.7%) had stones in the right side while in group (B), half of cases (50%) had stones in the left side and the other half (50%) had stones in the right side[p=0.547]. Our research findings disagree with Nawaz et al., [13] who reported that out of total of 100 patients, 58 patients had right side calculi and 42 had left side calculi, 24 patients had mid ureteric stone and 52 had lower ureteric stone.

Mean size of stone was 10.5 ± 3.35 mm in group (A) and was 19.0 ± 3.39 mm in group (B) [p=0.921]. The mean hounsfield unit was 1012.6 ± 379.5 in group (A) and was 1071.43 ± 279.63 in group (B) [p=0.497]. A study reported by Hong & Park., [11] who stated that there's no variation among the studied groups in relation to the characteristics of the stone.

Regarding one intraoperative complications in group (A): 7 cases (23.3%) had one intraoperative

complications; 6 cases (20.0%) of them had bleeding and one case (3.3%) had difficult access) while in group (B), none of them had one intraoperative complications. Group (A) showed significant higher rate of one intraoperative complications compared to group (B) (p = 0. 016) especially bleeding (p = 0.031). Regarding associated more than one intraoperative complication, mucosal injury & bleeding was occurred in 3 cases (10.0%) in group (A) and in 10 cases (33.3%) in group (B). Group (B) showed significant higher rate of more than one intraoperative complication compared to group (A) (p = 0.038) as mucosal injury & bleeding was significant higher in group (B) (p = 0.028). Our results also were consistent with Nawaz et al., [13] who reported that no major intraoperative complications occurred during this study as avulsion and intussusception. Our results also supported by Hong & Park., [11] who reported that there's no variation among the researched groups in relation to ureteral perforation and stent indwelling while a significant variation was found among the researched groups regards to migrated stone. Darwish et al., [14] also reported that of the 263 patients, Intraoperative complications occurred in 61/263 (23.2%) procedures (in nine procedures, there were more than one complication) which include mucosal abrasions, intraoperative hematuria, perforation and false passage. Kamadjou et al., [15] found that complications are frequently accompanied with URS, as any surgical procedure and involve residual stone fragments, stone migration, stent pain, stricture ureter, ureteric injury, infection & hematuria. In that previous study, the incidence of complications developed post URS was minimal (3.43%) {2 developed fever, 2 had septic shock & 2 experienced ureteral rupture}.

Regarding failed procedure in group (A), 2 cases (6.7%) had failed procedure (one case (3.3%) of them the calculi migrated upward which managed by one session of ESWL and the other case (3.3%) had large impacted stone and managed by open ureterolithotomy after failed sessions of URS) while in group (B), 4 cases (13,3%) had failed procedure (one case (3.3%) of them the calculi migrated upward which managed by two sessions of ESWL, 2 case (6.7%) of them had large impacted stone and managed by open ureterolithotomy after failed sessions of URS and the last case (3.3%) the stone migrated upward and managed by flexible URS after failed two sessions of ESWL). Hong & Park., [11] reported that; in 22 cases, residual stones larger than 2 mm were found two weeks post-operative. Four of the failed cases were linked to ureteral perforation during lithotripsy, whereas the remaining eighteen cases were caused by upward migration of the calculi during the procedure. Out of eleven cases, four of them the stones not fragmented. 2 failed cases were lost to follow up and the other 20 failed patients achieved a stone-free condition with medical expulsive therapy (3 cases) or an auxiliary SWL (15 cases) or repeated ureteroscopic lithotripsy (2 cases).

Usually, DJ stenting was inserted at the end of the procedure. The placement of DJ stent ensures patency of urine flow from the kidney to the bladder. Obstruction to urine flow may result from edema of the ureteral wall, residual or retained stone fragment. Therefore DJ stents were inserted to lower the occurrence of possible complications. Ureteric stenting may not always be required post ureteroscopy, as in cases of minimal ureteral trauma and shorter time of operation. [16]

Our study showed that ureteric catheter were used in 8 cases (26.7%) in group (A) and in 6 cases (20%) in group (B) [p=0.760], while 6 Fr DJ stenting were used in 21 cases (70%) in group (A) and in 24 cases (80%) in group (B) [p=0.551]. Regarding to patients who need another second session of URS, 1 patient (3.3%) underwent 6 Fr DJ stent fixation in both sessions of both groups [p=0.500] while 6 Fr DJ stent fixation in the 1st session and ureteric catheter fixation in the second

session was occurred in 1 patient (3.3%) in group (A) and 2 patients (6.7%) in group (B) [p=0.500]. Darwish et al., (14) reported that out of 263 patients, 21 procedures required JJ stenting, whereas ureteral catheter was placed in 2 procedures and in the remaining procedure, the ureter was left non-stented. Kamadjou et al., [15] reported that of the 175 patients, double J stents were inserted in 132 (75.43%) post-operative and this is nearly matched with our results (70% in group A & 80% in group B).

Ureteric stent was kept in place from 2 to 8 weeks for DJ stented procedures, and 3 to 5 days for ureteral catheter stented procedures based on postoperative ureteral condition. Ureteral perforations were managed with stent indwelling for 4 to 8 weeks without open surgery [11]. In our current study the mean stent duration was 19.86 ± 10.08 days in group (A) and was 21.48 ± 9.78 days in group (B) [p=0.761]. Li et al., [17] reported that a 6 Fr pigtail stent is preferred to be placed and left for 3 to 4 weeks to prevent postoperative ureteric obstruction by stone fragments or blood clots. Darwish et al., [14] found that the mean stent duration was 42.4 days for total stented procedures, 68.5 days for DJ stented procedures and 3.3 days for ureteral catheter stented procedures.

In order to avoid surgical complications, ureteral stenting is frequently used after ureteroscopic lithotripsy. Some investigators found that uncomplicated ureteroscopy can be done without routine stenting with little patient discomfort and a low occurrence of complications postoperatively. [18] Mendez-Probst et al., [19] noted that Patients without stents developed less postoperative discomfort and had lower risk for complications than those who had stents. Consequently, stents-related symptoms as hematuria, voiding dysfunction, flank and bladder pain, and stent migration could be prevented. Tang et al., [20] also reported that there are several factors that increase the incidence of complications postoperatively in patients who do not have stents, such as a longer operating time (especially more than 45 minutes), impacted calculi with an edematous wall, managing larger calculi, ureteral stricture, and a recent history of UTIs.

Our study showed that the mean operative time was 32.59 ± 9.32 min in group (A) and was 33.94 ± 9.99 min in group (B) [p=0.609]. Our results were consistent with Nawaz et al., (13) who found that the mean time of operation was 33.5 min. Our results disagree with Li et al., [17] who found that the mean time of operation was 41 ± 12.4 min. It also disagree with Darwish et al., [14] who reported that the mean ± SD operative time was 54.77 ± 22.68 min which revealed that the longer operative time was significantly associated with more incidences of intraoperative complications. Kamadjou et al., [15] reported that the duration of the surgery ranged from 20-130 min, with a mean duration of 58.64 ± 22.57 min.

Our study showed that 6 cases (20%) in group (A) and 4 cases (13.3%) in group (B) had no post-operative complications. 7 cases (23.3%) In group (A) [2 cases (6.7%) of them had loin pain and 5 cases (16.7%) had suprapubic pain] and 5 cases (16.7%) in group (B) [3 cases (10.0%) of them had loin pain and 2 cases (6.7%) had suprapubic pain] had one postoperative complications. 15 cases (50%) In group (A) and 17 cases (56.7%) in group (B) had more than one postoperative complication. Our results showed that as regarding the overall post-operative complications in group (A), 5 cases (16.7%) had infection, 15 cases (50%) had loin pain, 16 cases (53.3%) had suprapubic pain and 10 cases of them (33.3%) had hematuria while in group (B), 5 cases (16.7%) had infection, 16 cases (53.3%) had loin pain, 17 cases (56.7%) had suprapubic pain and 14 cases of them (46.7%) had hematuria. Li et al., (17) reported that there was high grade fever, leukocytosis in 59 (12.1%), flank pain, 158 (32.3%), gross hematuria 21 (4.3%), minimal perforation 13 (2.7%)

which were reported as post-operative complications from all cases.

SFR is affected by multiple factors as stone location, impaction, stone burden, method of lithotripsy and type of ureteroscope. In our research the overall free rate of stone was 93.3% for group (A) and was 86.6% for group (B) without significant variation (P= 0.634). Ijaz et al., [7] study the overall rate of success was 88.57% and was 100% for middle and lower ureteral calculi. Darwish et al., [14] who reported the Initial and final stone free rates (SFR) were 83.3 and 100% for middle and lower ureteric stone respectively which are treated by URS with pneumatic lithoclast. Also, Nawaz et al., [13] reported that the overall success rate was
90%. However, the success rate for middle and lower ureter was 83.3% and 96.1% respectively. Jeon et al., [21]
reported that the overall rate of success quoted for pneumatic lithotripsy ranges from 70.7 - 96.8 %. The rate of success decreased as the stone size increased ($P < 0.001$) and as the degree of hydronephrosis increased. Our research findings also closely match with Khan et al., [22] who concluded that ureteroscopic lithotripsy with pneumatic lithoclast can effectively treat majority of middle and distal ureteral calculi.

Summary and Conclusion:

Ureteroscope with pneumatic lithoclast is a secure and efficient procedure for treatment of ureteric calculi located in middle and lower parts of the ureter. However there was minor complication; we need further studies with larger scales for conforming our results.

Limitation:

Our study had several limitations. This design might aid to exclude basis of the skills and variations in experience among many surgeons. The number of patients in the current study very limited and had strict inclusion criteria for the selection of patients.

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