Original Article

Comparative Efficacy and Safety of Hand-Held and Conventional Intra-Corporeal Pneumatic Lithotripsy in the Treatment of Ureteric Stones

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ABSTRACT

Objective: To evaluate hand-held vs conventional intra-corporeal pneumatic lithotripters for the treatment of ureteric stones in terms of effectiveness and safety.

Study Design: A comparative study

Place and Duration of Study: This study was conducted at the Department of Urology, Institute of Kidney Disease (IKD) Peshawar, from 1st Oct 2010 to 1st Oct 2011.

Methods: This study was carried out from October 1, 2010, to October 1, 2011, at the Urology Department, IKD Peshawar. Examined were 100 adult patients with ureteric calculi measuring at least 0.7 cm. Using two distinct pneumatic lithotripters, ureteroscopy and lithotripsy were performed on each patient. There was follow-up. The following factors were evaluated: stone location, size, laterality, degree of fragmentation, rate of clearance, and complications.

Results: Mean stone size was 16.8±0.62mm in Group A and 18.0±0.69mm in Group B. In Group A stone clearance was 96% (48/50) while it was 92% (46/50) in Group B. Group A lithoclast was able to break 49/50 stones while Group B could break 44/50 stones. Group A lithoclast was able to break 46/50 stones into fragments ≤4mm while Group B could break 40/50 stones into such fragments. Proximal migration occurred in 1 case in Group A while in 6 cases in Group B. 4 and 1 stone in Group A and B, respectively, required ESWL and 2 stones in Group B required open ureterolithotomy as auxiliary procedure. There were 2 perforations in Group "B". Intra operative bleed, post operative pain and hematuria were more common in Group "B" while fever was more common in Group "A".

Conclusion: Hand-Held pneumatic lithoclast is more efficient and safe as compared to conventional pneumatic Lithoclast in the treatment of ureteric stones.

Key Words: Ureteric stones, Ureterorenoscopy, Pneumatic Lithoclast.

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INTRODUCTION

Ureteric stones are a major burden.[1] Extra-corporeal shockwave lithotripsy (ESWL), ureteroscopy (URS) with intracorporeal lithotripsy (ICL) and open or laparoscopic ureterolithotomy are the treatment options for failure of expectant approach.[1,2] URS with ICL gives success rates up to 100%.[3-5]

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The process may not work as intended if the stone cannot be reached, cannot be broken up, migrates upward, or cannot be passed through.Six ICL + URS includes risks, just like any other surgical surgery. The most dangerous consequence is ureteric avulsion, which is followed by ureteric perforation and vision-obscuring intraoperative haemorrhage[6]. Post-operative consequences include fever, hematuria, and loin discomfort. Pneumatic lithotripsy breaks stones by striking them directly with a metallic probe. A conventional lithoclast consists of a sizable cylinder filled with compressed air that is connected to a mechanism that controls the release of air pressure by applying pressure to a foot paddle[7-8]. A pressure tube connects the pressure-releasing device to the hand piece. In the Lithoclast's hand piece, ballistic energy is produced by compressed air. A carefully timed burst of compressed air accelerates a projectile directed to within one micrometre of accuracy to a high speed. The bullet strikes the probe's base, propelling it forward and making a strong impact on the stone surface[9]. The Hand-held lithoclast is a pneumatic lithotripter working

by the same principal but the compressed CO2 is contained within a small cylinder which fits in a hand-held device having a trigger. Pressing the trigger releases powerful jet of compressed CO2 which moves the metallic probe forward producing the stone breaking impact (No foot pedals, power cords, consoles or external gas supplies, making the device completely portable)[10].

Many have compared various modalities like ESWL, laser lithotripsy and more invasive options with pneumatic lithotripsy.[11-12]

No doubt laser has proved to be superior in terms of efficacy and safety but the cost effectiveness is an issue in developing countries. Pneumatic lithotripsy is the most accepted disintegration technique having high stone clearance rates, low complication rates and significantly lower costs. Pneumatic lithotripsy is also going through evolution and different types of air compression devices are available[13].The Institute of Kidney Diseases (IKD) Peshawar is a center of excellence in the region. It manages a huge burden of ureteric stones by URS with ICL using pneumatic lithotripsy. In this study we have compared two different pneumatic lithotripters for the treatment of ureteric stones. The comparison was made in terms of efficacy and safety[14].

METHODS

The Institute of Kidney Diseases (IKD) Hayatabad Peshawar examined 100 adult patients with ureteric stones > 0.7 cm from October 1, 2010 to October 1, 2011 utilising history, physical examination, supportive therapy, and diagnostic tests. KUB ultrasound and X-ray were needed. IVU assessed radiolucent stones. The patients were lottery-selected into two groups. URS with ICL using a hand-held lithoclast was Group "A." Participants in Group "B" underwent standard Lithoclast therapy. An experienced urologist performed lithotomy position under spinal or general anaesthesia. All induction patients got intravenous antibiotics. Karl-Storz, Germany, supplied the 8Fr semi-rigid ureteroscope with a 4Fr operational channel. The 500mm-long, 1.0mm-diameter hand-held pneumatic lithoclast probe LMA-Stone Breaker employs a compact disposable cylinder filled with pressurised CO2. A typical pneumatic lithotripter, the Swiss Lithoclast has a 605-mm probe and 1.0-mm diameter. The stone was detected via normal ureteroscopy, and the intention was to break it into 4 mm fragments that could pass alone. After surgery, a 6Fr Cook JJ stent was always utilised to stent the ureter. After a full day, a basic X-ray KUB assessed stone fragmentation and the JJ stent, which was remained in place for two weeks. Patients got weekly checkups until stones disappeared. The requirement for an extra or auxiliary procedure or the stone's proximal migration was considered failure, however the lithotripters in question did not fail if they could not reach the calculus using URS. A proforma listed everything. Data was analysed using SPSS 22. The two groups were compared using Student-t, Kendall's tau B, and Chi-Square, and a p-value of 0.05 was significant. Data was presented in tables and graphs.

RESULTS

We examined 100 patients. Profiles were similar for both groups. Mean patient ages in Group A and B were 38.52±14.73 and 35.46±13.95 years, respectively. Group A included 36 males and 14 females, while Group B had 34 males and 16 females. 29 right and 21 left calculi were found in both groups. Group A patients had 12 upper, 12 middle, and 26 lower ureter stones. Group B patients included 5 upper, 12 middle, and 33 lower ureter stones (Table 1). The mean stone size was 16.8±0.62mm in Group A and 18.0±0.69mm in Group B. Group A 20, 26, and 4 included 7-10mm, 11-15mm, and 16-20mm stones. In B, 18, 24, and 8 stones were 7-10mm, 11-15mm, and 16-20mm (Table 2). One patient in Group A had no hydronephrosis, whereas 19, 22, and 8 had mild, moderate, and severe. However, Group B contained 3, 23, 19, and 5 individuals with no, mild, moderate, and severe hydronephrosis (Table3). Group A has 96% stone removal (48/50) and Group B 92% (46/50).

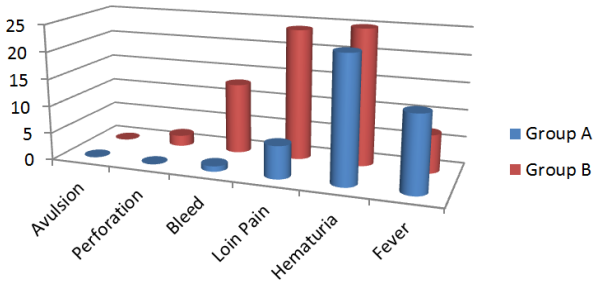

Figure No. 1: Comparison of Safety

Table No. 1: Stone Location Group A Vs Group B

		Device Used		
		LMA Stone Breaker	Swiss Lithoclast	Total
Location of Stone	Proximal Ureter	12	5	17
	Middle Ureter	12	12	24
	Distal Ureter	26	33	59
Total		50	50	100

Group A lithoclast broke 49/50 stones and Group B 44/50. Group A lithoclast managed to shatter 46/50 stones into ≤4mm pieces, but Group B only managed 40/50. Only one stone in Group A moved proximally, whereas six in Group B did. 4 stones in Group A and 1 in Group B needed ESWL, while 2 stones in Group B

needed open ureterolithotomy. All 6-Fr Double J stents were passed. Two Group "B" ureters pierced. Other problems in groups "A" and "B" were per-operative bleed 1 and 13, loin discomfort 6 and 24, fever 14 and 7, and hematuria 23 and 25.

Table No. 2: Comparison of Size of stones Treated

		Device Used		
		LMA Stone Breaker	Swiss Lithoclast	Total
Size of Stone	7-10mm	20	18	38
	11-15mm	26	24	50
	15-20mm	4	8	12
Total		50	50	100

Table No. 3: Degree of Hydronephroses associated with Stones treated

		Device Used		
		LMA Stone Breaker	Swiss Lithoclast	Total
Degree of Hydronephrsis	No Hydronphrosis	1	3	4
	Mild	19	23	42
	Moderate	22	19	41
	Severe	8	5	13
Total		50	50	100

Table No. 4a: Comparison of Ability to break the stones

		Device Used		
		LMA Stone Breaker	Swiss Lithoclast	Total
Able to Break the Stone	Yes	49	44	93
	No	1	6	7
Total		50	50	100

Table No. 4b: Comparison of Ability to make Effectively smaller fragments

		Device Used		
		LMA Stone Breaker	Swiss Lithoclast	Total
< 4 mm Fragments	Yes	46	40	86
	No	4	10	14
Total		50	50	100

DISCUSSION

Ureteric stones can be treated expectantly or some intervention, in the form of extra-corporeal shock-wave lithotripsy (ESWL), ureteroscopy and intra-corporeal lithotripsy (URS and ICL) and ureterolithotomy, is required[15]. URS and ICL is the most amazing form of therapy. ICL can be done using LASER, ultrasonic vibration, electro-hydraulic and pneumatic lithoclasts. Pneumatic lithoclast works by transmitting energy (Produced by sudden release of compressed CO_2 or Air), through a projectile, to a probe which breaks the stone by directly hitting it like a hammer[16]. A variety of pneumatic lithoclasts are available. We have compared two different types of pneumatic lithoclasts in terms of efficacy and safety. The basic principle of the two types is almost the same[17]. The main difference is that the conventional lithoclast is a device with limited portability as it is plugged to electric supply, has a huge cylinder attached to it and a foot paddle as well. The LMA-Stone Breaker is totally portable as it is hand-held device with a built-in cylinder and a built-in trigger. Additionally, the CO_2 gas-driven system provides higher probe tip velocity at impact to break even the hardest stones[18]. It requires fewer shocks to fragment stones, and minimal probe movement reduces stone retropulsion. It is shown in clinical studies to be atraumatic to surrounding tissue. Both the groups were comparable. A total of 100 patients were treated, 50 patients in each group[19]. Mean age of the patients in Group A and B was 38.52±14.73 and 35.46±13.95 years respectively and was comparable with the other research groups. There were 36 male and 14 female patients in Group A while 34 male and 16 female patients in Group B. Mean stone size was 16.8±0.62mm in Group A and 18.0±0.69mm in Group B. In Group A 20, 26 and 4 stones ranged from 7-10mm, 11-15mm and 16-20mm in size. While in B, 18, 24 and 8 stones were 7-10mm, 11-15mm and 16-20mm in size. Both the groups had 29 right sided calculi while 21 left sided calculi. In Group A patients, 12, 12 and 26 stones were located in upper, mid and lower ureter respectively[20]. While in Group B patients, 5 stones were in upper ureter, 12 in the mid ureter and 33 stones in lower ureter. These figures show comparison of our study population to international research. In Group A 1 patients had no hydronephrosis while 19, 22 and 8 had mild, moderate and severe hydronephrosis respectively[21]. On the other hand in Group B, 3, 23, 19 and 5 patients had no, mild, moderate and severe hydronephrosis respectively. So the profile was quite comparable for both the groups. In Group A stone clearance was 96% (48/50) while it was 92% (46/50) in Group B. Group A lithoclast was able to break 49/50 stones while Group B could break 44/50 stones (p-Value = 0.050). Group A lithoclast was able to break 46/50 stones into fragments ≤4mm while Group B could break 40/50 stones into such fragments (p-Value = 0.08)[22]. The difference in the clearance rates may be related to the powerful nature of the lithoclast in Group A as it is able to break the hardest of stones. But the real difference seems to be in relation to the ability of

Group A lithoclast as it was successful in not even breaking the stones but breaking them into much smaller particles as compared to the conventional lithoclast (Table 4a and 4b)[23]. These smaller particles can pass with greater ease and hence better clearance rates in a shorter period of time. For its powerful nature, LMA-Stone Breaker is used by some surgeons in per-cutaneous nephrolithomy because it can break hard and large stones in a shorter period of time. Inspite of superiority in power, proximal migration occurred in only 1 case in Group A while 6 stones migrated proximally in Group B.[24] This may be attributed to the fact that stones were successfully broken into small fragments before they could migrate proximally as conventional lithoclast needed more number of strikes to break stone. Proximal migration of stone was less in Group A despite the fact that more stones were located in upper ureter in this group. 4 and 1 stone in Group A and B, respectively, required ESWL and 2 stones in Group B required open ureterolithotomy as auxiliary procedure. Again more invasive auxiliary procedure were less frequent in Group A. 6Fr Double J stent was passed in all cases. There were no cases of ureteric avulsion in any group (Figure 1). Two ureters were perforated in Group "B". The Group A stone breaker is a powerful lithoclast yet there were no ureteric perforations[25]. This complication can occur due to many factors but in the authors opinion it is mostly related to the ureterorenoscopy (URS) and/or difficult access rather than lithoclasty.[26] Other complications noted in group "A" and "B", respectively were, per-operative bleed 1 and 13 (p-Value = 0.001), post-operative loin pain 6 and 24 (p-Value = 0.000) and post-operative hematuria 23 and 25 (p-Value = 0.68). This shows that Group A lithoclast is less traumatic as it can quickly convert a stone into smaller fragments requiring less number of shocks and minimizing the chances of collateral damage. Post-operative fever was noted in 14 patients in Group A as opposed to 7 patients in Group B(p-Value = 0.086). All the patients with fever were managed successfully with antibiotics (Oral/Intravenous) and no patient needed re-hospitalization[27]

CONCLUSION

Hand-Held pneumatic lithoclast is more efficient and safe as compared to conventional pneumatic Lithoclast in the treatment of ureteric stones. However, more structured research, such as Randomized Control Trials, should be conducted to clarify the picture.

Author's Contribution:

Concept & Design of Study:	Akhtar Nawaz Orakzai
Drafting:	Bakhtawar Gul Wazir, Noor Muhammad
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Revisiting Critically:	Akhtar Nawaz Orakzai, Bakhtawar Gul Wazir
Final Approval of version:	Akhtar Nawaz Orakzai

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