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Original Article

Stone Clearance Rate Between Extracorporeal Shock Lithotripsy (ESWL) V/S Retrograde Intrarenal Surgery (RIRS) in Patients with Lower Calycx

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ABSTRACT

One of the techniques used most frequently to treat urolithiasis is shockwave lithotripsy (SWL). Extracorporeal shock wave lithotripsy (ESWL) and retrograde intra-renal surgery (RIRS) are recommended treatments for inferior calyceal (IC) calculi measuring 1-2cm. **Objective:** To compare the rate of stone clearance between extracorporeal shock wave lithotripsy (ESWL) and Retrograde Intrarenal Surgery (RIRS) in patients with lower calycx calculi. **Methods:** The randomized control trial of six months was conducted at LUH Jamshoro. Informed consent was gained when the procedure, risks, and advantages of the study were explained. The patients were divided into one of two groups at random: group A (ESWL) or group two (RIRS). A week later, the patient underwent a contrast-enhanced computed tomography (CT) scan, and the kidney stone was noted as having been removed. **Results:** The group A's mean age (SD) was 46.50 ± 14.73 whereas group B's mean age (SD) was 42.37 ± 16.07. The stone clearance was observed in 13 (43.3%) of group A's cases compared to 1 (3.3%) of group B's, with a highly significant p-value of (p=0.0001). **Conclusions:** In terms of stone removal among patients with lower calycx, a significantly significant difference among the use of extracorporeal shock wave lithotripsy and retrograde intrarenal lithotripsy was seen.

INTRODUCTION

The third most frequent condition affecting the urinary tract is urolithiasis. Open stone surgery is no longer as common due to the development of lithotripsy using shock waves and minimally invasive techniques like endoscopic surgery [1]. Among urologic patients, urinary stones are a significant cause of illness and distress. The first-line therapeutic techniques for the therapy of ureteral stones now considered by many are ureteroscopy and shock-wave lithotripsy, although the precise function of laparoscopic ureterolithotomy is still unclear [2]. The pain that urolithiasis patients experience, together with job loss and morbidity, have serious socioeconomic repercussions [3]. With the potential for problems, interventional nephron-lithotripsy (PCNL) is regarded as the gold standard for treating big and/or difficult kidney stones [4]. Retrograde intrarenal surgery (RIRS), also known for its adaptable uretero-reno scopy (fURS), is not as invasive, has fewer side effects, and is particularly helpful in patients with complex kidney anatomy, those taking anticoagulants, and those who have bleeding diathesis [4, 5]. The two major least-invasive therapeutic stone removal methods available today for kidney stones between 1 and 2 cm in diameter are the use of extracorporeal shock wave lithotripsy (ESWL) or retrograde intrarenal surgery (RIRS). The therapy cycle and

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reduced calyceal calculi in the kidney are longer with ESWL, despite the fact that its effectiveness is still unknown. With the introduction of holmium laser lithotripsy, contemporary flexible ureteroscopes, and its inherent orifice transluminal endoscopic surgical origin, RIRS has been gaining favor among urologists and becoming a commonly accepted alternative to ESWL in the therapy of renal stones. However, it's still uncertain which modality is better, and the debate rages on [6]. The study of Vilches *et al.*, reported the stone clearance rate between ESWL & RIRS as (0% v/s 42.3%) [7]. whereas Kumar *et al.*, found as 73.80% vs 86% [8]. Bas *et al.*, reported 86.5% vs 91.5% stone clearance rate [9] while another study documented the stone clearance rate to be 67.7% vs 86.5% in ESWL & RIRS groups [10]. Two different studies noted the stone clearance rates between ESWL and RIRS groups to be 76% vs 73.68% and 48.5% vs 83% respectively [11, 12]. Extracorporeal lithotripsy with shock waves (ESWL), which achieves average stone-free rates (SFR) of about 80% [13], is generally agreed to be the preferred treatment for kidney stones smaller than 2 cm. However, considering the limited effectiveness of ESWL when removing stones in such a position, with an SFR of 40-62% [14], Lower-pole kidney stone treatment is a disputed area in endourology. In contrast, percutaneous nephrolithotomy (PCNL), with a rate of 90–100% in this patient population, results in an improved SFR in treating lower-pole stones. Unfortunately, the adoption of this approach in these situations is constrained by its higher risk of complications, perioperative morbidity, hospital days, anesthetic requirements, and expense [14, 15]. In this setting, flexible ureteroscopy (URS) has been steadily gaining ground over the past fifteen years for the management of renal calculi thanks to technological advancements that have led to improved visualization devices (digital camera), larger the distal deflecting angles, the efficient intracorporeal laser lithotripsy, and different techniques for the elimination of stones with a smaller diameter [16]. Retrograde intrarenal surgery (RIRS), which is a substitute for the management of lower-pole renal stones, has an SFR that is equal to or better than ESWL, according to comparative studies against other techniques, in prospective research on calculi less than 1 cm and retrospective research on calculi among 10 and 20 mm being available [17, 18]. Although studies have compared the extracorporeal shock wave lithotripsy (ESWL) versus retrograde intrarenal surgery (RIRS) for the treatment of lower calycx. Consequently, it is crucial to contrast these two methods. The goal of this study was to provide an efficient and pragmatic surgical technique for surgical decision making to reduce the complications. Therefore, this study was designed to assess statistically significant difference between these two techniques to generate local data and further strategies could be made to improve the outcome in such patients by adopting the superior approach as first choice of treatment in future Thus, the objective was to compare the stone clearance rate between extracorporeal shock wave lithotripsy (ESWL) v/s retrograde intrarenal surgery (RIRS) in patients with lower calycx.

METHODS

The randomized control trial of six months (from June 14, 2022 to December 13, 2022) was conducted at Department of Urology, LUMHS, Jamshoro. By using W.H.O sample size calculator using stone clearance rate (0% v/s 42.3%) 7 RIRS versus ESWL, Power of Test (1-β) = 90%, level of significance (1-α) 5% then the estimated sample size came out to be n=15 in each group. But we took n = 30 patients in each group in order to meet the statistical assumption of normality thru non-probability, consecutive sampling. The inclusion criteria of the study were patients between age group 20-60 years, both gender and the patients with stone size ≤ 1 cm and the patients presented with lower calycx and underwent surgery while the exclusion criteria were culture positive (urine c/s > 10% c/c), patients with abnormal coagulopathy state (increased PT & PTT), patients recently using NSAIDs, lactating or pregnant women, upper urinary tract anatomy such as horseshoe kidney, ectopic kidney and pelvi-ureteric junction obstruction and axial skeletal abnormality such as scoliosis and kyphosis. Prior to taking part in the trial, all subjects who met the inclusion criteria and presented themselves to the Department of Urology at LUMHS, Jamshoro, gave their consent. After describing the potential benefits and hazards of the surgery to each patient and close relative in advance, everyone received a written consent. Predesigned proforma recorded age, gender, contact number, and admission date. Before operation, a comprehensive history and physical exam were done. Patients were blinded and randomised to group A (ESWL) or group B (RIRS) using computer-generated sequential numbers in sealed envelopes. Electromagnetism powered ESWL. Fluoroscopy targeted the stone and 3000 shock waves were transmitted at 60–90 per minute. Shock wave energy was increased until patients were comfortable with stone fragmentation. To optimize ESWL, all patients were properly hydrated. Fluoroscopy was used occasionally during the treatment to check stone cleavage and retarget. Nursery was used. All patients received weight-based analgesia in supine posture. All patients were discharged with an oral painkiller and specific alpha-1 D adrenergic blocker to promote stone clearance. After preventive antibiotics, RIRS patients had general Anaesthesia lithotomy. Aseptic cystoscopy and hydrophilic guide wire 0.038 inch coiled in kidney. Fluoroscopy was used to pass C

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arm ureteral access sheath through guide wire to pelvis and perform retrograde pyelogram to assess anatomy. Start irrigation with flexible scope (6.5Fr tip and 7.5Fr base). DJS passed after holmium laser 30W laser fibre vaporized the stone. Contrast CT after 1 week showed renal stone removal. A custom proforma captured the data. The study was relevant, targeted, and employed suitable exclusion criteria to control bias and confounders. SPSS version 26.0 input and analyzed the data. Qualitative variables were computed using frequency and percentage, whereas numerical variables were calculated using mean ± standard deviation. ESWL and RIRS stone removal rates were compared using chi-square test. The two groups were contrasted by age, gender, and residential status using suitable Chi-square / Fisher's exact test to evaluate how this affected outcome with $p \leq 0.05$ was consideration for significance.

RESULTS

In order to contrast the stone clearing rate among extracorporeal shock wave lithotripsy (ESWL) vs. retrograde intrarenal surgery (RIRS) for individuals with lower calycx, a total of 60 patients 30 in both groups as group A (ESWL) and group B (RIRS) were included in this randomized control trial. Group A's mean age (SD) was 46.50 ± 14.73 whereas group B's mean age (SD) was 42.37 ± 16.07. The age, gender, and residence status were broken down in order to assess the statistical difference in significance between the two groups (Table 1-4).

Table 1: Comparison of stone clearance between groups n=60

Group	Stone Clearance		p-value
	Yes	No	
Group A (N=30)	13(43.3%)	17(56.7%)	0.0001
Group B (N=30)	1(3.3%)	29(96.7%)	

Applied Chi-square test

Table 2: Stratification of age group with stone clearance between groups n=60

Age Group [In Years]		Stone Clearance		p-value
		Yes	No	
20 – 40 (N=26)	Group A	1(9.1%)	10(90.9%)	0.423
	Group B	0(0.0%)	15(100.0%)	
>40 (N=34)	Group A	12(63.2%)	7(36.8%)	0.001
	Group B	1(6.7%)	14(93.3%)	

Applied Fisher's exact test

Table 3: Stratification of gender with stone clearance between groups n=60

Gender		Stone Clearance		p-value
		Yes	No	
Male (N=36)	Group A	9(52.9%)	8(47.1%)	0.002
	Group B	1(5.3%)	18(94.7%)	
Female (N=24)	Group A	4(30.8%)	9(69.2%)	0.067
	Group B	0(0.0%)	11(100.0%)	

Applied Fisher's exact test

Table 4: Stratification of residential status with stone clearance between groups n=60

Residential Status		Stone Clearance		p-value
		Yes	No	
Urban (N=33)	Group A	8(42.1%)	11(57.9%)	0.005
	Group B	0(0.0%)	14(100.0%)	
Rural (N=27)	Group A	5(45.5%)	6(54.5%)	0.027
	Group B	1(6.3%)	15(93.8%)	

Applied Fisher's exact test

DISCUSSION

The third most frequent condition affecting the urinary tract is urolithiasis. Open stone surgery has lost some of its utility due to minimally invasive treatments like endoscopic surgery and the development of lithotripsy using shock waves. Among urologic patients, urinary stones are a significant reason for morbidity and distress. The first-line therapeutic techniques for the therapy of ureteral stones now considered by many are ureteroscopy and shock-wave lithotripsy, although the precise function of laparoscopic ureterolithotomy is still unclear. In the case of a failed ureteroscopy and ureteric stones where open surgery is being considered, laparoscopic ureterolithotomy is predominantly appropriate. Laparoscopic ureterolithotomy has been proven in numerous trials [19-21] to be a safe and successful choice for treating ureteral stones, either as a main procedure for big impacted crystals or as a salvage procedure when shock wave lithotripsy or ureteroscopy failed. One of the most painful diseases, urolithiasis has an average lifetime incidence of 10%, albeit this varies depending on demographic shifts [22]. Although the kidney is the most common site, the entire urinary tract can host it. Among the treatment options are extracorporeal lithotripsy with shock waves (SWL), interventional nephrolithotomy (PNL), mini-PNL, flexible ureterorenoscopy (F-URS), laparoscopy, and open surgery. Medical attention and observation are further options. Due to advancements in endourologic technology, open surgery is currently only used to treat 1-2 percent of kidney stones [23]. Kidney stones are among the most common disorders seen in urology practices. In recent years, urological practices have tended to be minimally invasive, with one of the milestones of minimally invasive treatments being percutaneous nephrolithotomy (PCNL). Open surgery still has an option in the form of shock wave lithotripsy. Despite the fact that PCNL has the best success rate of first-line therapies, its comparatively higher invasion and rate of complications have led to a quest for alternate treatments [24]. It quickly came into the spotlight when retrograde intrarenal surgery was introduced. The results of our investigation are comparable to those of several studies carried out globally.

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In our study, mean age in group A (ESWL) was 46.50 ± 14.73 and group B (RIRS) was 42.37 ± 16.07 years. Another study noted mean age as 33.1 ±1.3 and 33.4 ± 1.4 years [8]. In the study of Bas *et al.*, the mean age of the patients was 46.4 ± 15.1 and 47.2 ± 14.2 years [9]. Ozturk *et al.*, noted as 44.2 years in SWL and 52 years in RIRS [11]. The mean age in the study of Singh *et al.*, was 34.5 ± 13.07 (SWL) and 37.65 ± 11.8 years (RIRS) [12]. In this study, 17 (56.7%) males and 13 (43.3%) females were included in group A while 19 (63.3%) males and 11 (36.7%) females were included in group B respectively. Kumar *et al.*, reported to have 50% males in SWL group and 46.5% males in RIRS group [8]. As per the study of Bas O, *et al.*, there was 53.84% males in group I and 63.82% males in group II [9]. The study of Ozturk *et al.*, recorded to have 123 (55.65%) males and 98 (44.35%) females in SWL group while 22 (57.89%) males and 16 (42.11%) females in RIRS group [11]. There were 57.14% males and 42.86% females in SWL while 22 (62.85%) males and 13 (37.15%) females in RIRS [12]. In present study, in comparison of both groups, stone clearance was noted in 13 (43.3%) in group A whereas 1 (3.3%) in group B having highly significant p-value i.e. (p=0.0001). The study of Vilches *et al.*, reported the stone clearance rate between ESWL & RIRS as (0% v/s 42.3%) [7], Whereas Kumar *et al.*, found as 73.80% vs 86% [8]. Bas *et al.*, reported 86.5% vs 91.5% stone clearance rate [9] while another study documented the stone clearance rate to be 67.7% vs 86.5% in ESWL & RIRS groups [10]. Two different studies noted the stone clearance rates between ESWL and RIRS groups to be 76% vs 73.68% and 48.5% vs 83% respectively [11, 12]. In the study by Saygın *et al.*, the stone-free clearance for the lower calyx stones in ESWL and RIRS was 33.3% and 83.3% respectively [25] while in the study by Rasheed *et al.*, [26] the post ESWL, 99 (68%) patients were found to be stone free and 47 (32%) patients remain suffered with residual stones whereas in the study by Rehman *et al.*, [27] the stone clearance rate after RIRS was found to be 78.67% and on the other hand by contrast it is observed as 96.88% with less effective ESWL for lower pole renal stones identified by Sabnis *et al.*, [28] although the findings of the former study by Saleem *et al.*, [29] shown the success rate for stone clearance in ESWL was 65.5% and is consistent with the current study.

CONCLUSIONS

In terms of stone removal among patients with lower calycx, a significantly significant difference comparing the use of extracorporeal shock wave lithotripsy and retrograde intrarenal lithotripsy was seen.

Authors Contribution

Conceptualization: ZHR, KQS
Methodology: ZHR, SM, SAS
Formal Analysis: ZHR, KQS
Writing-review and editing: A, SM, SAS, FQS, SZAS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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