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Retrograde Intrarenal Surgery versus Extracorporeal Shock Wave Lithotripsy in the Treatment of Lower Calyceal Favorable Renal Stones Up to 20 mm

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ABSTRACT

Article information

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Background: The treatment of renal stones remains a challenge for urologist. The size usually defined the optimal procedure. The introduction of new non-invasive modalities adds to the challenge.

The Aim of the work: The current work aimed to compare between efficacy and safety of retrograde intrarenal surgery [RIRS] and extracorporeal shock wave lithotripsy [ESWL] in the treatment of lower calyceal favorable renal stones up to 20 mm.

Patients and Methods: This prospective randomized comparative study included 90 subjects with lower pole stones less than 20 mm. they were randomized into 2 equal groups: Group [A] underwent RIRS using disposable flexible ureteroscope. Group B included 45 patients treated by ESWL. All were submitted to preoperative workup consisting of complete general and urological evaluation, laboratory investigation and radiological investigations. The primary outcome was the stone free rate at the end of the third postoperative month. The secondary outcomes included postoperative complications, need for retreatment, mortality, the cost and satisfaction.

Results: Both groups were comparable regarding patient characteristics and preoperative data. The operative time was significantly shorter in ESWL than RIRS groups [51.02±7.08 vs 60.51±10.47 minutes]. Double-J was higher among the RIRS group [43 vs 2 patients]. The stone-free rate [SFR] was significantly higher among RIRS than ESWL [84.4% vs 62.2%]. The hospital stay was shorter, and stenting was significantly lower among ESWL than RIRS group. Fever, hematuria, and mucosal injury were lower, but perinephric hematoma, renal colic and ecchymosis were significantly higher in ESWL group. Voiding symptoms was significantly higher in the RIRS group. The need for retreatment was significantly higher in ESWL group, but the cost was significantly lower, and no mortality was reported in the study

Conclusion: Retrograde intrarenal surgery has a better stone free rate than ESWL, with comparable postoperative rate of complications. But its higher cost is a limiting step for its use with readily available noninvasive ESWL treatment.

Keywords: Renal; Extracorporeal Shock Wave Lithotripsy; Non-Invasive- Retrograde Surgery; Lower Calyx; Small Stone.

INTRODUCTION

The urinary tract stones are a common benign disease of the urological system. It was seen in about 12% of patients and has a 50% recurrence rate [1]**.** Many factors are responsible for the increased rate of urolithiasis. These may include - but not limited to - higher rate of metabolic syndrome, changes in lifestyles with dominance of sedentary lifestyle, dehydration, low water intake and low volume of urine [2]**.**

The treatment option for urinary stones is usually determined according to the size and site of the stone. However, controversy about the best treatment option for stones of intermediate size [< 20 mm] at the lower pole is still controversial [3].

One of the major problems making it difficult to have an optimal treatment option is the availability of many treatments. However, many factors govern the choice of the standard option. These factors include for example the cost, body mass index, patient & surgeon preferences, renal anatomy [especially with presence of any anomalies]. All these factors must be considered at deciding the treatment option of the lower pole renal stones [4].

According to the recent Guidelines of the European Association of Urology [EAU], the percutaneous nephron-lithotomy [PCNL], the retrograde intrarenal surgery [RIRS] and extracorporeal shockwave lithotripsy [ESWL] are the recommend treatment options for the lower pole renal stones between 10 and 20 mm. It also recommends ESWL and endourology [PCNL, RIRS] to treat lower pole renal stones between 10 and 20 mm when there are no associated unfavorable factors, but unfavorable factors was present, the endourology is the preferred option of treatment [5].

ESWL gained wide acceptance by many surgeons and is usually accepted by patients. This attributed to advantages, being a non-invasive procedure with low morbidity, and performed as an outpatient procedure [6]. However, it had its own drawbacks, like lower stone clearance rate, repeated sessions, especially for lower pole and hard stones [7].

Endourology is the available alternative because of the reduced need of repeated sessions, and the shorter time to achieve the stone-free rate status [8].

Flexible ureteroscopes became very useful tools in the management of upper urinary tract lesions [9]. So that, flexible ureterorenoscopy [F-URS] nowadays can be used in management of most of the kidney stones and large proximal ureteral stones [10], especially after introduction of holmium: YAG laser into the market and worldwide accepted use of this laser during URS which makes the stone clearance better for the renal stones up to 20mm**,** which is recommended by European association of urology guidelines 2015 [11].

THE Aim of The Work

The objective of this study is to compare between efficacy and safety of retrograde intrarenal surgery and extracorporeal shock wave lithotripsy in the treatment of lower calyceal favorable renal stones up to 20 mm in terms of stone disintegration and clearance.

PATIENTS AND METHODS

This prospective randomized comparative study was conducted at Urology department Al-Azhar university [new Damietta] patients attending our Urology Outpatient clinic were enrolled in the study and systematically randomized into 2 groups: Group [A] included 45 patients, who underwent RIRS using disposable flexible ureteroscope [FURS] was done. Group B included 45 patients who were submitted to ESWL.

Patient was included if he/she had a stone less than 2 cm in the lower calyx. However, we excluded pregnant women, those with morbid obesity, patients with uncorrectable coagulation disorders, subjects with urinary tract obstruction distal to the stone, patients with untreated urinary tract infection, and patients with comorbid conditions preventing general anesthesia or lithotomy positioning.

Ethical aspects: Informed consent was signed by all registered patients before surgery after the benefits and risks [including perforation, infection, etc….] of the procedure have been explained. The study protocol was reviewed and approved by the local research ethics committee of Damietta Faculty of Medicine, Al-Azhar University, Egypt.

All patients were subjected to complete general and urological evaluation with special attention to bleeding disorders, anticoagulant, contrast medium reactions, history of urinary tract infections, and history of previous renal surgery, hypertension, and diabetes mellitus. The patient's weight and height were measured, and body mass index [BMI] was calculated. The laboratory work-up included urine analysis and culture/sensitivity, liver function tests, random blood sugar, complete blood count [CBC], coagulation profile, blood urea nitrogen and serum creatinine. The radiological evaluation included plain abdominal X-ray for kidney, ureters, and urinary bladders [KUB], pelvi-abdominal ultrasonography, non-contrast Computed Tomography [NCCT] and intravenous urography [IVU].

Stone and kidney characteristics were categorized on the basis of pre-treatment NCCT and IVU findings. The stone size was determined by measuring the longest diameter on preoperative radiologic investigation. The favorable renal stones were detected by intravenous urography and NCCT. All of the procedures were carried out by the same surgical team [one surgeon and one assistant] who were already experienced in ESWL and fixed for all FURS procedures.

Operative technique

Preoperative broad-spectrum antibiotics were administered two hours before surgery. The operative time was defined as the total time after the induction of anesthesia in RIRS or sedation in ESWL till the end of the procedure in each group. All procedures were completed under general, spinal anesthesia OR sedo-analgesia. The intraoperative monitoring included pulse oximetry, heart rate [HR], systolic blood pressure [SBP] and diastolic blood pressure [DBP].

In group A, all procedures were done by disposable flexible ureteroscope [Uscope UE3011 [PusenTM]. Under general or spinal anesthesia, the patient was placed in the lithotomy position on a fluoro-endoscopic. Saline 0.9% was used for irrigation at height of 40-50 cm from the level of the operating table and positive pressure was used to augment the vision. A hybrid guide wire [which is flexible, hydrophilic tip to minimize trauma to upper urinary tract and permit easy manipulation in the ureter]. It is 0.035 0-.038-inch x 150 cm, and it was introduced gently by semirigid ureteroscope. For better delineation of the pelvi-calyceal system and orientation of the calyces, we did pyelogram at first. For optimal visualization, a ureteral access sheath was placed over a [0.035] safety guidewire which was introduced into the renal pelvis. The sheath is maintained just below the UPJ to facilitate frequent in and out movement of the scope and maintain adequate system fullness with irrigation fluid without undue rise of intrapelvic pressure. The ureteric orifice was dilated with Teflon dilator in cases of difficult negotiation of the orifice. When it was not possible to place an access sheath, a Double-J stent was placed, and the patient was postponed for a second stage procedure after 2 weeks. The flexible ureterorenoscope was introduced upward to the pelvis and under fluoroscopic guidance we direct the flexible end of the flexible ureterorenoscope toward the targeted lower calyx with main two movement of the endoscope, forward and backward of deflection mechanism, supination, and pronation of operator's hand and to- and fro-movement inside the ureteral access sheath till reaching the stone. Stones disintegrated using holmium laser either in situ or after moved to the renal pelvis by 1.9 fr. Zero-tip national dormie basket, the laser fiber was back loaded while the scope is straight and then the scope is tilted toward the stone in the lower calyx. Holmium: YAG laser [230 m caliber fiber] was used for stone dusting to avoid expensive auxiliary procedures.

At the beginning of laser lithotripsy, the laser parameters were 0.8 J/15 Hz. When the stone size had decreased to about 10 mm, these parameters were changed to 0.3 J/10 Hz to avoid the pneumatic effect of the laser, which could result in the stone migrating to another calyx. The Double-J stent inserted routinely at the end of the procedure.

In group B [ESWL procedures], all patients received intravenous sedoanalgesia in the form of 5 mg Nalbuphine HCL [Nalufin®] and/or Tenoxicam [Epicotel®] vial/iv or spinal anesthesia. Intravenous fluid administration was given to all throughout the procedure and all procedures were completed in the supine position with water cushion adjusted below the flank in posterior approach and above the flank in anterior approach. Fluoroscopy was used for radio-opaque stone localization and fluoroscopy time was increased with the increase in stone burden. Ultrasonography was used for radiolucent stone localization.

At Al-Azhar stone lithotripsy unit, there is the most recent lithotripsor of Dorneier [DELTA III [Dornier, Germany]] which designed as a third-generation lithotripter. The shock wave generated in a cylindrical electromagnetic coil surrounded by a copper membrane; it is radiated perpendicular to the cylinder axis and then focused by a parabolic metal refractor [aperture 84.5 degrees, diameter 30 cm]. Shock waves source and height adjustable coupling cushion may rotate up to +63° / -63° degrees of therapy treatment positions through motorized orbital movement to optimize the line of the shock wave with penetration depth 170 mm. The coupling was achieved by elevation of the water cushion to standard position automatically, until it touches the failure, which contains a thin layer of bubble-free water or bubble free gel covering the target area of the patient body. The quality of the coupling can be easily monitored by the doctor at any time of the procedure. We confirmed the positioning of the stone and monitored the progress of fragmentation by fluoroscopy and snapshot imaging at intervals of 300-500 shocks. The procedure was ended when satisfactory fragmentation [when fragments became nearly ≤4 mm] was seen on fluoroscopy or maximum energy level was reached [260 joule].

All treatment parameters [e.g., procedural time, number and energy of SWs per session, number of sessions] were recorded. At the end of session and on discharge, patients were instructed to drink liberal fluids. Oral analgesia [diclofenac potassium OD], Alpha blocker [Tamsulosin0.4 capsule/24hs for a week] and antibiotic [ciprofloxacin/12hs for 5days] was also prescribed to be taken if needed. They were also instructed to document passage of fragments and re-check if they developed hematuria with clots, fever, and sever colic.

Patients were clinically evaluated in the first postoperative day. Then, all were reviewed two weeks after the session to assess if there is any hematuria, passage of fragments, fever, and colic. At the follow-up visit, clinical evaluation, urine analysis, plain X-ray KUB and renal ultrasound or NCCT were performed. Disintegration and clearance were noted, and a decision was given regarding the need for further session if fragments were 4 mm or greater. Successful treatment was considered if the KUB revealed stone free or presence of fragments ≤ 4 mm [primary end point]. For patients who needed more than one session, the duration between each session was 2 weeks to give chance for tiny fragments to pass. Three sessions of SWL with no evidence of disintegration or fragmentation was considered unsuccessful result and another treatment modality was chosen for the patient [failure of treatment]. The stone free rate [SFR] was defined based on NCCT that was performed at the end of the third month after the last SWL session.

Statistical analysis of data: The collected data were of categorical or numerical variables. The first was presented by the relative frequencies and percentages. However, the mean and standard deviations were calculated for presentation of the second type. The association between groups for categorical variables was determined by the Chi square or Fisher Exact tests. The comparison between two means was performed by the student "t" test. P value < 0.05 was set as the marker of significance. All statistical procedures were performed by the statistical package of social science [SPSS] version 16 [SPSS Inc., Chicago, USA].

RESULTS

In the current work, patient age ranged between 29 to 66 years. The majority of patients were males. Both groups were comparable as regard to patient demographics and preoperative data. In addition, there was no significant differences between RIRS and ESWL regarding lower pole calyx size and infundipulopelvic angles [Table 1].

The operative time was significantly shorter in ESWL than RIRS groups [51.02±7.08 vs 60.51±10.47 minutes]. Double-J was higher among RIRS than ESWL [43 vs 2 patients]. All patients in RIRS group operated under anesthesia but anesthesia required only for 12 patients in ESWL group. Ureteral access sheath used for 32 patients in RIRS compared to none in ESWL groups [Table 2].

Regarding the primary outcome, the SFR was significantly higher among RIRS than ESWL [84.4% vs 62.2%]. The hospital stay was shorter, and stenting was significantly lower among ESWL than RIRS group [0.77±0.31, 17.8% vs 1.96±0.21 and 86.7%]. Fever, hematuria and mucosal injury were lower in ESWL than RIRS groups. However, perinephric hematoma, renal colic and ecchymosis were significantly higher in ESWL. But voiding symptoms was higher in RIRS group [68.89% vs 17.78%]. The need for retreatment was significantly higher in ESWL group, but the cost was significantly lower, and no mortality was reported in the study [Table 3].

Table [1]: Patient demographics among study groups

		Group 1 [Flexible]	Group 2 [ESWEL]	Test	P
Age [years]		52.20±7.43	50.02±5.98	1.53	0.13
Sex	Male /Female	29/16	27/18	0.18	0.64
BMI [kg/m^2]		26.35±1.76	25.71±1.74	1.73	0.09
Comorbid conditions	Diabetes mellitus	6 [13.33%]	8 [17.78%]	0.338	0.561
	Hypertension	8 [17.78%]	11 [24.44%]	0.6	0.438
	Chronic liver disease	5 [11.11%]	7 [15.56%]	0.385	0.535
	Previous renal surgery	7 [15.56%]	6 [13.33%]	0.09	0.764
Clinical Presentation	Renal colic	9 [20%]	11 [24.44%]	0.257	0.612
	hematuria	3 [6.67%]	2 [4.44%]	0.212	0.645
	Accidentally discovered	33 [73.33%]	32 [71.11%]	0.055	0.814
Preoperative laboratory investigation	Creatinine	1.12±0.21	1.09±0.22	1.25	0.21
	Pus cells in urine	17.98±9.16	20.29±11.62	1.05	0.29
	Hemoglobin	13.62±1.29	13.30±1.09	1.27	0.20
Side of the stone	Rt/Lt/Bilateral	22/19/4	24/18/3	0.25	0.87
Laterality	Uni-/bi-lateral	41/4	42/3	0.15	0.69
Multiplicity	Single/multiple	32/13	30/15	0.20	0.64
Number of stones		1.47±0.76	1.56±0.72	0.57	0.56
Largest diameter		14.40±3.16	14.53±3.04	0.20	0.83
HUF		1157.33±415.34	1172.44±441.04	0.848	0.536
Radiopacity	Opaque/radiolucent	39/6	41/4	0.45	0.50
Lower pole calyx size		9.29±0.24	9.38±0.22	0.428	0.352
Infundipulopelvic angle		79.69±7.14	81.31±8.12	1.246	0.206
Infundibulum width		6.03±0.71	6.26±0.78	1.09	0.28
Skin stone distance		90.44±8.05	92.42±4.99	1.40	0.16

BMI: Body mass index; HUF: Hounsfield unit; Rt: Right; Lt: Left

Table [2]: Operative data among study populations

		Group 1 [Flexible]	Group 2 [ESWL]	Test	P
Operative time [minutes]		60.51±10.47	51.02±7.08	***5.03***	***<0.001****
Localization method	Fluoroscopy/US	45/0	43/2	2.01	0.15
Double-J	Yes/No	43/2	2/43	***74.71***	***<0.001****
Anesthesia/analgesia		45/0	12/33	***52.10***	***<0.001****
Type of anesthesia	Spinal/general	36/9	8/4	0.95	0.32
Ureteral access sheath	Yes/No	32/13	0/45	***49.56***	***<0.001****
Number of waves		-	3034 ± 88.3	-	-

US: Ultrasound; * indicates significant difference

Table [3]: Postoperative data among study populations

		Group 1 [Flexible]	Group 2 [ESWEL]	Test	P
Hospital stay		1.96±0.21	0.77±0.31	***20.73***	***<0.001****
Complications	Stone migration	5 [11.1%]	9 [20.0%]	1.35	0.24
	Stenting	39 [86.7%]	8 [17.8%]	***42.79***	***<0.001****
	Fever	21 [46.7%]	6 [13.3%]	***11.90***	***0.001****
	Hematuria	45 [100.0%]	29 [64.4%]	***19.45***	***<0.001****
	Mucosal injury	4 [8.89%]	0 [0.0%]	***4.18***	***0.041****
	Perforation	3 [6.7%]	0 [0.0%]	3.10	0.08
	Extravasation	1 [2.2%]	0 [0.0%]	1.011	0.315
	Stent migration	0 [0.0%]	1 [2.2%]	1.01	0.32
	Myocardial infarction	0 [0.0%]	0 [0.0%]	-	-
	Perinephric hematoma	0 [0.0%]	1 [2.2%]	***5.29***	***0.021****
	Steinestrass	3 [6.7%]	0 [0.0%]	1.011	0.315
	Renal colic	27 [60.0%]	14 [31.1%]	***7.57***	***0.006****
	Voiding symptoms	31 [68.89%]	8 [17.78%]	***23.29***	***<0.001****
	Ecchymosis	0 [0.0%]	5 [11.1%]	***5.29***	***0.021****
Mortality		0 [0.0%]	0 [0.0%]	-	-
SFR		38 [84.4%]	28 [62.2%]	***5.68***	***0.017****
Need for re-treatment		8 [17.7%]	17 [37.8%]	***18.51***	***<0.001****
Physician satisfaction		43 [95.6%]	42 [93.3%]	0.21	0.64
Patient satisfaction		43 [95.6%]	42 [93.3%]	0.21	0.64
Overall cost		16955.11 ± 831.82	5398.67 ± 982.19	***60.23***	***<0.001****

SFR: Stone free rate; * indicates significant difference

DISCUSSION

Renal stones represent a common medical condition, and their treatment is costly. Nowadays the available and recommended treatment options include ureteroscopy, percutaneous nephrolithotomy and shock wave lithotripsy. The selection of treatment modality depends on different factors [e.g., stone size, location and patient characteristics] [12].

Treatment of LPS is more complicated due to the challenging of the anatomical structure. The optimal treatment modality remains controversial and depends on many factors [e.g., the stone size, calyceal anatomy, body built, and associated comorbidities]. At the current time, the available treatment options for stones < 20 mm in size include shockwave lithotripsy [SWL], retrograde intrarenal surgery [RIRS], and percutaneous nephrolithotomy [PCNL] [13].

Over the last three decades, there is a dramatic increase I the use of minimally invasive procedures, such as PCNL, ESWL, and RIRS through the sustained high incidence and recurrence of the renal stones [14].

Since the first introduction of PCNL by **Fernström and Johansson** [15] in 1976, it has been considered as the standard surgical procedure for stones > 2 cm [16]. After that, ESWL was introduced in 1984 after **Chaussy *et al.*** [17]. SWL is a potentially noninvasive technique that has been used as a first treatment option for small renal stones [< 2 cm] not within the lower pole of the kidney. **Türk *et al*.** reported that the rate of success of SWL to clear renal stones depends on different factors [e.g., the lithotripter efficacy, stone factors [size, location, and composition], and patient factors [18].

In addition, the RIRS gained wide acceptance in the 1990s. This was ascribed to the introduction of holmium: yttrium aluminum garnet laser system. RIRS becomes more popular with the development of the more durable models [e.g., Flex-X from Karl Storz Endoscope, Tuttlingen, Germany and URF-P from Olympus, Tokyo, Japan]. Also, the recently introduced compact aperture digital videoscope and disposable videoscope increased the popularity of RIRS [19].

This study may be helping urologists make better treatment decisions by providing them a comparison of RIRS versus ESWL in the treatment of lower pole renal stone less than 2 cm.

The current study aimed to compare different modalities for the treatment of the lower calyceal favorable renal stones up to 20 mm. The first modality is the retrograde intrarenal surgery [flexible ureteroscopy], and the second modality is the extracorporeal shock wave lithotripsy [ESWL].

Both groups were comparable [i.e., there was no significant differences] regarding patient age, sex, body mass index, past history, preoperative renal colic, hematuria and accidental discovery of the stone. In addition, no differences were reported for all preoperative laboratory investigations, stone characteristics and post-operative patient and urologist satisfaction. On the other side, the intrarenal surgery [flexible ureteroscopy] was associated with significantly higher stone free rate and significantly lower need of re-treatment. However, it had a higher cost, longer operative time, longer duration of postoperative hospital stay, all patients need anesthesia, majority of the patients need ureteral access sheath. The advantages of ESWL include shorter operative time, lower need for double-J stent, the minority of patients need anesthesia, and a low cost when compared to flexible ureteroscopy. However, the stone free rate is lower and the need for retreatment is higher.

Regarding operative time, the current study agrees with **Javanmard *et al*.** aimed to compare outcomes of retrograde intrarenal surgery [RIRS] with extracorporeal shock wave lithotripsy [SWL] for stones ≤ 2 cm. There was no statistically significant difference between the groups regarding demographics, stone parameters including location, number and size. The study showed that the ESWL procedure have a significantly shorter operative time compared to RIRS procedure [48.2 ± 14.6 vs. 79.9 ± 14.1 min, p=0.001] [20].

Also, in concordance with the current study **Singh *et al*.** [21] aimed to assess objective and subjective outcomes of retrograde intrarenal surgery [RIRS] and extracorporeal shock wave lithotripsy [SWL] for the treatment of intermediate size [1-2 cm] inferior calyceal [IC] stones in a prospective randomized fashion. Both groups were well-matched in baseline data, the study showed that SWL procedure need significantly longer operative time compared to RIRS surgery. However, **Kumar *et al*.** [22] compared the shock wave lithotripsy, retrograde intrarenal surgery and MINIPERC for the treatment of 1 to 2 cm radiolucent lower calyceal renal calculi was done to evaluate the safety and efficacy of these procedures, the study showed that the baseline data were similar in all groups, the study revealed that the operative time was non-significantly short in ESWL compared to RIRS procedure, but RIRS need more time for fluoroscopy, which make the entire procedural time was significantly longer in RIRS.

Perhaps stone free rate [SFR] is one of the first points to consider when choosing among treatments for renal stones, as each has its own advantages and disadvantages. SFR is the key estimating factor for the effectiveness of stone treatment option [5]**.** Also, the complication and auxiliary procedure rates may be important factors.

Regarding stone free rate, results of the current work are in line with **Breda *et al*.** [23] who reported that, retrograde intrarenal surgery [RIRS] is an attractive and reasonable treatment choice for residual stone fragments, as it could be used for removal of multiple fragments and inspect the entire renal collecting system at the same time.

Danilovic *et al*. [24] **and Ghani and Wolf** [25] and reported a stone free rate from 55% to 75% for RIRS when used for stones ≤ 20 mm in largest diameter. This stone free rate is lower than the current study. However, **Torricelli *et al*.** [26] reported a stone free rate between 35.0% and 40.0% for shock wave lithotripsy for renal stones up to 20 mm. These values are also lower than the current study. However, it keeps the significant increase of higher stone free rate with RIRS than ESWL as in the current study.

Some studies reported a rate of 80% to 88% for single stone minimally invasive surgery that dropped to 50% to 70% for lower pole stones in another study [23, 27, 28]**,** so some people pointed out that when applying ESWL treated the lower pole renal stones, the SFR was dependent on anatomic Favorable features [29].

Different authors reported that, RIRS became a more feasible alternative to ESWL in the term of SFR [20,22,30]**.**

Chung *et al*. [16] in their meta-analysis on fourteen studies comparing ESWL versus RIRS. They demonstrated that the SFR of ESWL was lower than that of RIRS and complications were comparable between both maneuvers. **Fabrizio *et al***. [31] reported an SFR of 77% in patients with LP stone larger than 6 mm after RIRS.

In another series, **Grasso and Ficazzola** [32] showed an SFR after RIRS of 82, 71, and 65% for patients with lower pole stones 1–10, 11–20, and 20 mm, respectively. A more recent study compared the outcome of PCNL and RIRS for 15–20 mm lower pole renal stones. In the PCNL group, the SFR was 92.8% and this rate rose to 97.6% after a second intervention. In the RIRS group, the SFR was 89.2% after a single procedure.

In our study, we achieved comparable results with an SFR of 84.4 and 62.2% after RIRS and ESWL, respectively. Substantial variations exist in the reported SFR because of inconsistencies in the definition of 'stone-free', which reflect variations in the type of imaging used to assess the presence of stones postoperatively and the timing of the assessment. In our study, we controlled all patients with a CT scan at 3 months. The higher stone free rate in RIRS could be explained by the fact that, during RIRS, any narrowing was dilated and used Zero- tip or tipless dormia basket or grasper and stones were cleared. On the other side, ESWL is an external non-invasive treatment and could not dilate any narrowing and is not able to clear a residual stone inside that calyx. The current study revealed that the ESWL group has significantly shorter hospital stay compared to RIRS group. Results of the current study are in accordance with **Danilovic *et al*.** [23] who reported that hospitalization duration was significantly longer in the RIRS than ESWL group.

In the current work, the RIRS had significant increase of stenting, post-operative fever, hematuria, mucosal injury, and voiding symptoms. However, ESWL had higher rates of perinephric hematoma, postoperative renal colic, and ecchymosis. **Zhang *et al*.** [33] concluded that, the overall complication rates were comparable between available treatment options for lower pole calculi. These results are in line with the current study, as many complications were minor and treated conservatively, except residual stones in ESWL that may need a second line of treatment. On the other hand, RIRS provided a lower retreatment rate while ESWL had a higher retreatment rate, the results were in line with many authors [33,34].

Junbo *et al.* [5] reported that, ESWL had many advantages. However, its disadvantages had led urologists and some surgeons who previously preferred it to change their minds and turn to PCNL and RIRS in order to get a one-use treatment option [no need for other settings as ESWL].

The cost of renal stone treatment usually includes the cost of the primary intervention, convalescence, treatment of complications, and the cost of repeated procedures. In the current work intrarenal surgery is significantly higher in cost the shock wave lithotripsy.

Irrespective of the significant increase of direct cost of flexible ureteroscopy, **Wymer *et al.*** [12] considered it as a cost-effective treatment for renal stones < 0.2 cm, when take into consideration the overall success rate [stone free rate] and cost of retreatment. However, our results contradict these results as ESWL remains the cost-effective treatment for lower pole renal stones. In the current work, the overall satisfaction of both the urologist and patient were lower in ESWL than RIRS group. However, the difference did not reach statistical significance.

In conclusion, retrograde intrarenal surgery has a better stone free rate than ESWL, with comparable postoperative rate of complications.

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REFERENCES

1. Liu Y, Chen Y, Liao B, Luo D, Wang K, Li H, Zeng G. Epidemiology of urolithiasis in Asia. Asian J Urol. 2018 Oct;5[4]:205-214. doi: 10.1016/j.ajur. 2018.08.007.

2. Wong YV, Cook P, Somani BK. The association of metabolic syndrome and urolithiasis. Int J Endocrinol. 2015; 2015:570674. doi: 10.1155/ 2015/570674.

3. Kim BS. How to determine the treatment options for lower-pole renal stones. Ann Transl Med. 2016 Aug;4[16]:317. doi: 10.21037/atm.2016.06.21.

4. Chaussy CG, Tiselius HG. How can and should we optimize extracorporeal shockwave lithotripsy? Urolithiasis. 2018 Feb; 46[1]:3-17. doi: 10.1007/ s00240-017-1020-z.

5. Junbo L, Yugen L, Guo J, Jing H, Ruichao Y, Tao W. Retrograde Intrarenal Surgery vs. Percutaneous Nephrolithotomy vs. Extracorporeal Shock Wave Lithotripsy for Lower Pole Renal Stones 10-20 mm: A Meta-analysis and Systematic Review. Urol J. 2019;16[2]:97-106. doi: 10.22037/uj.v0i0. 4681.

6. Pricop C, Radavoi GD, Puia D, Vechiu C, Jinga V. Obesity: A Delicate Issue Choosing The ESWL Treatment For Patients With Kidney And Ureteral Stones? Acta Endocrinol [Buchar]. 2019 Jan-Mar; -5[1]:133-138. doi: 10.4183/aeb.2019.133.

7. Knoll T, Buchholz N, Wendt-Nordahl G. Extracorporeal shockwave lithotripsy vs. percutaneous nephrolithotomy vs. flexible ureterorenoscopy for lower-pole stones. Arab J Urol. 2012 Sep; 10[3]:336-41. doi: 10.1016/j.aju.2012.06.004.

8. Kilic Ö, Akand M, Van Cleynenbreugel B. Retrograde intrarenal surgery for renal stones - Part 2. Turk J Urol. 2017 Sep; 43 [3]: 252-260. doi: 10.5152/tud.2017.22697.

9. Alenezi H, Denstedt JD. Flexible ureteroscopy: Technological advancements, current indications and outcomes in the treatment of urolithiasis. Asian J Urol. 2015 Jul; 2 [3]:133-141. doi: 10.1016/j.ajur. 2015.06.002.

10. Mi Y, Ren K, Pan H, Zhu L, Wu S, You X, et al. Flexible ureterorenoscopy [F-URS] with holmium laser versus extracorporeal shock wave lithotripsy [ESWL] for treatment of renal stone <2 cm: a meta-analysis. Urolithiasis. 2016 Aug; 44[4]:353-65. doi: 10.1007/s00240-015-0832-y.

11. Alkan E, Sarıbacak A, Ozkanli AO, Basar MM, Acar O, Balbay MD. Flexible Ureteroscopy Can Be More Efficacious in the Treatment of Proximal Ureteral Stones in Select Patients. Adv Urol. 2015; 2015:416031. doi: 10.1155/2015/416031.

12. Wymer KM, Sharma V, Juvet T, Klett DE, Borah BJ, Koo K, et al. Cost-effectiveness of Retrograde Intrarenal Surgery, Standard and Mini Percutaneous Nephrolithotomy, and Shock Wave Lithotripsy for the Management of 1-2cm Renal Stones. Urology. 2021 Oct; 156:71-77. doi: 10.1016/j.urology.2021. 06.030.

13. Tsai SH, Chung HJ, Tseng PT, Wu YC, Tu YK, Hsu CW, Lei WT. Comparison of the efficacy and safety of shockwave lithotripsy, retrograde intrarenal surgery, percutaneous nephrolithotomy, and minimally invasive percutaneous nephrolithotomy for lower-pole renal stones: A systematic review and network meta-analysis. Medicine [Baltimore]. 2020 Mar; 99 [10]: e19403. doi: 10.1097/MD. 0000000000019403.

14. Kim CH, Chung DY, Rha KH, Lee JY, Lee SH. Effectiveness of Percutaneous Nephrolithotomy, Retrograde Intrarenal Surgery, and Extracorporeal Shock Wave Lithotripsy for Treatment of Renal Stones: A Systematic Review and Meta-Analysis.

Medicina [Kaunas]. 2020 Dec 30; 57 [1]: 26. doi: 10.3390/medicina57010026.

15. Fernström I, Johansson B. Percutaneous pyelolithotomy. A new extraction technique. Scand J Urol Nephrol. 1976; 10 [3]: 257-9. doi: 10.1080/ 21681805.1976.11882084.

16. Chung KJ, Kim JH, Min GE, Park HK, Li S, Del Giudice F, et al. Changing Trends in the Treatment of Nephrolithiasis in the Real World. J Endourol. 2019;33[3]:248-253. doi: 10.1089/end.2018.0667.

17. Chaussy C, Schüller J, Schmiedt E, Brandl H, Jocham D, Liedl B. Extracorporeal shock-wave lithotripsy [ESWL] for treatment of urolithiasis. Urology. 1984 May; 23[5 Spec No]:59-66. doi: 10.1016/0090-4295[84]90243-7.

18. Türk C, Petřík A, Sarica K, Seitz C, Skolarikos A, Straub M, Knoll T. EAU Guidelines on Interventional Treatment for Urolithiasis. Eur Urol. 2016 Mar; 69 [3]: 475 - 82. doi: 10.1016/j.eururo. 2015.07.041.

19. De S, Autorino R, Kim FJ, Zargar H, Laydner H, Balsamo R, et al. Corrigendum re: "Percutaneous Nephrolithotomy Versus Retrograde Intrarenal Surgery: A Systematic Review and Meta-analysis" [Eur Urol 2015;67:125-37]. Eur Urol. 2016 Apr;69 [4]: e85. doi: 10.1016/j.eururo.2015.12.046.

20. Javanmard B, Kashi AH, Mazloomfard MM, Ansari Jafari A, Arefanian S. Retrograde Intrarenal Surgery Versus Shock Wave Lithotripsy for Renal Stones Smaller Than 2 cm: A Randomized Clinical Trial. Urol J. 2016 Oct 10;13[5]:2823-2828. PMID: 27734422.

21. Singh BP, Prakash J, Sankhwar SN, Dhakad U, Sankhwar PL, Goel A, Kumar M. Retrograde intra-renal surgery vs extracorporeal shock wave lithotripsy for intermediate size inferior pole calculi: a prospective assessment of objective and subjective outcomes. Urology. 2014 May;83[5]:1016-22. doi: 10.1016/j.urology.2013.12.026.

22. Kumar A, Kumar N, Vasudeva P, Kumar Jha S, Kumar R, Singh H. A prospective, randomized comparison of shock wave lithotripsy, retrograde intrarenal surgery and miniperc for treatment of 1 to 2 cm radiolucent lower calyceal renal calculi: a single center experience. J Urol. 2015 Jan; 193 [1]: 160-4. doi: 10.1016/j.juro.2014.07.088.

23. Breda A, Ogunyemi O, Leppert JT, Schulam PG. Flexible ureteroscopy and laser lithotripsy for multiple unilateral intrarenal stones. Eur Urol. 2009; 55[5]:1190-6. doi: 10.1016/j.eururo.2008.06.019.

24. Danilovic A, Cavalanti A, Rocha BA, Traxer O, Torricelli FCM, Marchini GS, Mazzucchi E, Srougi M. Assessment of Residual Stone Fragments After Retrograde Intrarenal Surgery. J Endourol. 2018 Dec;32[12]:1108-1113. doi: 10.1089/end.2018.0529.

25. Ghani KR, Wolf JS Jr. What is the stone-free rate following flexible ureteroscopy for kidney stones? Nat Rev Urol. 2015 Jul; 12 [7]: 363. doi: 10.1038/nrurol.2015.133.

26. Torricelli FCM, Monga M, Yamauchi FI, Marchini GS, Danilovic A, Vicentini FC, et al. Renal Stone Features Are More Important Than Renal Anatomy to Predict Shock Wave Lithotripsy Outcomes: Results from a Prospective Study with CT Follow-Up. J Endourol. 2020 Jan;34[1]:63-67. doi: 10.1089/end.2019.0545.

27. Galvin DJ, Pearle MS. The contemporary management of renal and ureteric calculi. BJU Int. 2006 Dec; 98 [6]: 1283-8. doi: 10.1111/j.1464-410X.2006.06514.x.

28. Kijvikai K, Haleblian GE, Preminger GM, de la Rosette J. Shock wave lithotripsy or ureteroscopy for the management of proximal ureteral calculi: an old discussion revisited. J Urol. 2007 Oct;178[4 Pt 1]: 1157-63. doi: 10.1016/j.juro.2007.05.132.

29. Lin CC, Hsu YS, Chen KK. Predictive factors of lower calyceal stone clearance after extracorporeal shockwave lithotripsy [ESWL]: the impact of radiological anatomy. J Chin Med Assoc. 2008; 71 [10]:496-501. doi: 10.1016/S1726-4901[08]70157-6.

30. Ozgor F, Sahan M, Yanaral F, Savun M, Sarilar O. Flexible ureterorenoscopy is associated with less stone recurrence rates over Shockwave lithotripsy in the management of 10-20 millimeter lower pole renal stone: medium follow-up results. Int Braz J Urol. 2018 Mar-Apr; 44[2]:314-322. doi: 10.1590/S1677-5538.IBJU.2017.0483.

31. Fabrizio MD, Behari A, Bagley DH. Uretero-scopic management of intrarenal calculi. J Urol. 1998 Apr;159[4]:1139-43. PMID: 9507817.

32. Grasso M, Ficazzola M. Retrograde uretero-pyeloscopy for lower pole caliceal calculi. J Urol. 1999; 162 [6]: 1904–8. doi: 10.1016/S0022-5347[05] 68065-2.

33. Zhang W, Zhou T, Wu T, Gao X, Peng Y, Xu C, et al. Retrograde Intrarenal Surgery Versus Per-cutaneous Nephrolithotomy Versus Extracorporeal Shockwave Lithotripsy for Treatment of Lower Pole Renal Stones: A Meta-Analysis and Systematic Review. J Endourol. 2015 Jul; 29[7]:745-59. doi: 10.1089/end.2014.0799.

34. Bozzini G, Verze P, Arcaniolo D, Dal Piaz O, Buffi NM, Guazzoni G, et al. A prospective randomized comparison among SWL, PCNL and RIRS for lower calyceal stones less than 2 cm: a multicenter experience: A better understanding on the treatment options for lower pole stones. World J Urol. 2017 Dec;35[12]:1967-1975. doi: 10.1007/ s00345-017-2084-7.

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