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Original Research

Upper urinary tract stone characteristics and outcome of retrograde intra renal surgery with laser lithotripsy in a Nigerian tertiary hospital: a retrospective study.

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Abstract

Background: This study is therefore aimed at assessing upper urinary tract stone characteristics, the outcome of retrograde intrarenal surgery with laser lithotripsy, and factors predicting stone-free status.

Methodology: This was a retrospective cross-sectional study carried out on all patients who had retrograde intra-renal surgery with laser lithotripsy for upper urinary tract stones from 2021-2023 at the Urology unit, department of Surgery, University of Benin Teaching Hospital. Electronic medical records were retrieved with data on demographics, serum calcium level, and non-contrast computed tomography scans assessing stone size, location, laterality, multiplicity, density, and renal anatomy.

Results: The data Thirty- three patients were extracted and analysed with a mean age of 43,70+/- 11.44 years, 54.5% of patients were male. The mean duration of admission was 2.4+/-1.5 days. The mean body mass Index was 26.84+/- 4.37 kg/m2. All patients had flank pains; 7(41.2%) patients had bilateral renal stones. The majority of renal stones 8(47.1%) were located in the lower pole of the kidney. A greater proportion of calculus was ureteric 23(69.7%), mean stone size was 13.2+/- 15.2mm, while mean stone density was 817+/- 285.5 HU. Fifteen participants (45.5%) had multiple stones. Stone clearance assessed on imaging was 75.8%. Age, sex, stone size, density and location, and multiplicity of stones were statistically significant determinants of stone clearance (p= 0210, 1.000, 0.220, 0.380. 0.366 and 1.000) respectively, similarly, no statistically significant predictors of stone clearance were found in this study.

Conclusion: The study revealed a predominance of upper urinary tract stones in males, with most patients being overweight. There was a weak correlation between stone density and serum calcium level in this study. Findings in this study revealed no statistically significant determinant or predictors of stone clearance.

Keywords: Upper Urinary Tract; Stones; Lithotripsy; Retrograde Intrarenal Surgery; Outcome; Nigeria.

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Quick Response Code:

Introduction

Urinary stones have become an increasing urological burden Worldwide. Mankind has been afflicted by urinary stones for centuries dating back to 4000 B.C, making it the most common disease of the urinary tract.[1] Globally, kidney stone disease prevalence and recurrence rates are increasing, with limited options for medical treatment.[2] It affects about 12% of the global population at some stage in their lifetime.[3] It affects all ages, sex, and race, but occurs more frequently in males than females with peak incidence in the age range between 20-49 years.[4,5] If preventive measures are not instituted the rate of recurrence is 10-23% per year, 50% in 5-10 years, and 75% in 20 years[4]. Recent studies have indicated that the prevalence of urolithiasis has been increasing in the past decades in both developed and developing countries, this trend is believed to be due to changes in lifestyle modifications such as lack of physical activity, dietary habits, and global warming.[6-8] Based on variations in the mineral composition of stones, kidney stones are mostly classified into five types which include calcium stones (80% of all urinary calculi), calcium oxalate and phosphate, struvite or magnesium ammonium phosphate stones(10-15%), uric acid stones(3-10%), cystine stones (<2%) and drug-induced stones (1%).[9]

The surgical treatment of stone disease has been known since the time of Sushruta who described in detail the anatomy and surgery for the same in his writings. Since then surgeries for renal stones have evolved with Fitzpatrick et al in England suggesting the combination of extended pyelolithotomy and multiple radial nephrotomies for the treatment of large staghorn stones, while Smith and Boyce popularized anatrophic nephrolithotomy for the treatment of staghorn stones.[10] Advances in technology have birthed interest in minimally invasive surgery with urologists endeavoring to develop instruments and techniques for treatment of stone disease.[11] Treatment for renal stones has witnessed 47% more procedures being performed over the last decade,[12] this has paralleled the increasing burden of renal stones. Renal stones that were historically treated with open surgeries are presently managed by means of minimally invasive treatment modalities such as extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery(RIRS) and laparoscopic interventions.[13] In the European Association of Urology (EAU) guideline on urolithiasis published in 2020, RIRS for kidney stones is considered a first-line treatment option for renal stones in all locations and compositions, apart from stones with a diameter larger than 2cm, in which case it is a second line.[14] In the American Urological Association (AUA) guideline of 2016, RIRS is considered the first line for non-lower pole stones less than 20mm and lower pole stones between 10-20mm. It is considered a good option due to its lower complication rate than PCNL, although stone free rate for PCNL is higher.[15] The indications of RIRS using a flexible Ureteroscope (URS) with laser lithotripsy were broadened to include ESWL failure, residual from single PCNL, morbid obesity, musculoskeletal deformities, bleeding diathesis, and occupation that requires complete stone clearance. [16-18]

Larger calculi >2cm have been traditionally treated with PCNL with stone-free rates (SFR) of 95%. However, the complication rate makes it less attractive, with transfusion rate and hospital stay higher when compared to RIRS, [19,20] and emerging evidence demonstrating similar stone-free rates with both procedures.[21] Stone-free rates for RIRS for stones >2cm can be as much as 91%, this can be achieved with a 2-stage RIRS procedure [21]. Although PCNL may be a high-risk strategy for patients with comorbidity, outcomes with stones up to 3cm are encouraging. EAU guidelines support the use of RIRS in this setting [20]. The advantage of potentially benefitting from bilateral simultaneous RIRS is on the rise for patients requiring treatment for bilateral stone, with the benefit of a single general anesthetic procedure, reduced cost, reduced overall length of stay, and an evidently good outcome with SFR approaching 90%.[22,23] With the incidence of obesity on the increase and its widely accepted association with stone disease, PCNL proves to have higher complication rates while ESWL with a lesser SFR,

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makes RIRS with laser lithotripsy more favorable according to the American Urological Association (AUA) and EAU guidelines[19,20].Though RIRS with laser lithotripsy, is a breakthrough treatment in renal stone management, it is associated with complications such as ureteric injury, with long-term development of stricture, ureteric avulsion injury is also an occurrence though rare, intraoperative hemorrhage is also a complication inhibiting visibility, the most common complication is pyelonephritis presenting with fever in the postoperative period[24]. Other complications would include stone migration and obstruction due to steinstrasse [25]. Although RIRS with laser lithotripsy is not novel worldwide, it is still evolving in Nigeria, most centers offering this procedure are private Hospitals. The University of Benin Teaching Hospital (UBTH) is the foremost government-owned hospital offering Laser lithotripsy in the management of urinary stones. This study therefore intends to evaluate upper urinary stone characteristics, the outcome of RIRS and laser lithotripsy, and factors predicting stone-free status in UBTH as one of the few established government-owned tertiary institutions providing this high-end skilled surgery in the southern part of Nigeria.

Methods

Study setting: This study was conducted in the Urology unit, Department of Surgery, University of Benin Teaching Hospital (UBTH), Benin City, Edo State. It is a multi-specialty tertiary health care facility, attending to the needs of patients in Edo State and other neighboring states like Delta, Bayelsa, Ondo, and Kogi States, it has over 900-bed capacity [26].

Study design: This is a retrospective descriptive cross-sectional study.

Study Population: All patients with renal and ureteric calculi less than 2cm, who had retrograde intrarenal surgery and laser lithotripsy over a 2-year period, from November 2021 to December 2023. Their data were retrieved from their case notes, electronic medical records [EMR], and operative records. Patients whose records were incomplete were excluded. Data was collected with a pro forma. The study was approved by our institution's research and ethics committee.

Methods

All the patients who had lithotripsy had preoperative computed tomography, urine microscopy, culture, and sensitivity (MCS), Full blood count (FBC), and Electrolyte urea and creatinine (E/U/Cr) prior to the procedure. Stone size was assessed based on the widest diameter.

Preoperative antibiotics were administered after administration of epidural anesthesia or induction of general anesthesia. With patients in the Lithotomy position, a semi-rigid ureteroscopy (9.5 Fr Karl Storz ureterorenoscope with a 5Fr working channel) was performed routinely to passively dilate the ureters and to place a hydrophilic safety guidewire (0.038- inch) that was advanced to the renal pelvis with fluoroscopic assistance if the stones were renal. If the stone is ureteric after passing the semi-rigid ureteroscope, stone fragmentation was done with a holmium- YAG laser using a laser machine (Quanta system, Litho machine 35W model) in combination with 274um laser fiber. For renal stones, a ureteral access sheath (UAS) was passed via the hydrophilic safety guide wire, and a flexible ureterorenoscope (9.5Fr with a 3.6Fr working channel) was inserted into the renal pelvis or calices via UAS. Kidney stones were fragmented with a holmium-YAG laser using a laser machine (Quanta system, Litho machine 35W model) in combination with 274um laser fiber. The laser settings include for fragmentation: high energy (1-2J), low frequency(3-5Hz); dusting: low energy (0.2-0.5J), high frequency(10-20Hz); Pop-corn effect: high energy(1J), high frequency (10-20Hz). A flexible ureterorenoscope was used to reassess residual fragments after the procedure and findings were documented as perceived stone clearance. Following lithotripsy, a 5/26 or 6/26 double J(JJ) stent was placed for 2-3 weeks, unless there was a complication in which case the double J stent is placed for 4-6 weeks, to allow smaller fragments to pass with ease and allow the antegrade flow of urine despite postoperative edema. Post-operatively plain x-ray of the kidney ureter and bladder (KUB) was done to confirm stent position and assess residual stone fragments. Four weeks post-operatively plain x-ray, abdominopelvic ultrasonography, or non-contrast computed tomography was used to assess residual fragments.

Statistical analysis: Data were analyzed using SPSS version 25.0. categorical data were presented in percentages while continuous data were presented as mean +/- std. When categorical data were not normally distributed, they were presented as median +/- range. The Pearson correlation coefficient was used to establish the correlation between calcium and stone size and density. Fisher's exact or chi-square was used to assess factors determining stone clearance where appropriate and independent predictors of stone clearance were determined in a multivariate regression analysis. P-value less < 0.05 was considered significant.

Results

Table 1: Socio-demographic characteristics of respondents

Variable	Frequency n = 33	Percent (%)
Age group (years)		
20 – 29	4	12.1
30 – 39	8	24.2
40 – 49	9	27.3
50 – 59	11	33.3
60 and above	1	3.0
Mean ± SD Age (years)	43.70 ± 11.44	
Sex		
Male	18	54.5
Female	15	45.5
Level of Education		
Primary	1	3.0
Secondary	12	36.4
Tertiary	20	60.6
Religion		
Christianity	32	97.0

Islam	1	3.0
Occupation		
Skill 1	11	33.3
Skill 2	5	15.1
Skill 3	15	45.5
Skill 4	2	6.0
Ethnic group		
Bini	10	30.3
Urhobo/Isoko	7	21.3
Esan	6	18.2
Igbo	6	18.2
Afemai	2	6.0
Yoruba	1	3.0
Ika	1	3.0
Residential location		
Outside Edo State	15	45
Within Benin City	11	33
Outside Benin City	7	21
Mean ± SD Duration of Admission (Days)	2.4 ± 1.5	
Minimum Duration (Days)	1	
Maximum Duration (Days)	7	

Eleven (33.3%) study participants were aged 50 to 59 years while 9 (27.3%) were between 40 – 49 years. The mean ± SD age of the study participants was 43.70 ± 11.44 years. More than half, 18 (54.5%) of the study participants, were male while 15 (45.5%) were female.

Twelve (36.4%) study participants had a secondary level of education, while 20 (60.6%) had a tertiary level of education.

Using the international classification of occupations, 11 (33.3%) persons belonged to class 1 while 15 (45.5%) belonged to class 3.

Ten (30.3%) study population were from the Benin ethnic group, while 7 (21.3%) were from the Urhobo/Isoko ethnic group. The majority, 32 (97%) study participants were Christians, and only 1 (3%) was Muslim. Fifteen (45.5%) study participants live outside Edo State while 11 (33.3%) live within Benin City.

The Mean ± SD duration of admission of study participants was 2.4 ± 1.5 days.

Table 2: Anthropometric Characteristics of the study population

Variables	Mean ± SD
Mean ± SD Weight (Kg)	70.33 ± 8.66
Mean ± SD Height (m)	169.19 ± 10.48
Mean ± SDBMI (Kg/m^2)	26.84 ± 4.37

The Mean ± SD weight (kg) of the study population is 70.33 ± 8.66 while the mean ± SD height (m)of the study population is 169.19 ± 10.48. The Mean ± SD BMI **(**Kg/m^2**)** of study population is 26.84 ± 4.37

Table 3 Symptoms Reported and Signs Elicited from Study Participants

Variables	Frequency (%) (n=33)
Flank Pain	
Yes	33 (100.0)
No	0 (0.0)
Hematuria	
Yes	5 (15.2)
No	28 (84.8)
Fever	
Yes	6 (18.2)
No	27 (81.8)
Urinary symptoms	
Yes	0 (0.0)
No	33 (100.0)
Nausea and vomiting	

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Yes	1 (3.0)
No	32 (97.0)
Costovertebral tenderness	
Yes	0 (0.0)
No	33 (100.0)
Ballotable Kidney	
Yes	0 (0.0)
No	33 (100.0)
Pedal swelling	
Yes	0 (0.0)
No	33 (100.0)
Mean ± SD Duration of flank pain	18.8 ± 30.0
Median (Range) duration of flank pain	10 (0.25-120) weeks
Mean ± SD Duration of haematuria	6.6 ± 9.8
Median (Range) Duration of haematuria	2 (1-24) weeks
Mean ± SD Duration of fever	4.5 ± 3.8
Median (Range) Duration of fever	3 (2-12) weeks

Regarding the symptoms reported, 5 (15.2%) participants had hematuria; 6 (18.2%) participants had a fever; 1 (3.0%) participant had nausea and vomiting; none of the participants had flank pain, urinary symptoms, Costovertebral, Ballotable kidney, and pedal swelling.

The mean ± SD duration of flank pain was 18.8 ± 30.0 weeks; the median (range) duration of flank pain was 10 (0.25-120) weeks.

The mean ± SD duration of haematuria was 6.6 ± 9.8; the median (range) duration of haematuria was 2 (1-24) weeks.

The mean ± SD duration of fever was 4.5 ± 3.8; the median (range) duration of fever was 3 (2-12) weeks.

Table 4: Location and Characteristics of Renal Stones

Variables	Frequency (%) (n=33)
Laterality (n=17)	
Right	4 (23.5)
Left	6 (35.3)
Right and left	7 (41.2)
Bilaterality (n=33)	
Yes	7 (21.2)
No	26 (78.8)
Location in Kidney (n=17)	
Upper pole calyx	3 (17.6)
Middle pole calyx	4 (23.5)
Lower pole calyx	8 (47.1)
Middle/Lower pole calyx	2 (11.8)
Ureteric stone (n=33)	
Yes	23 (69.7)
No	10 (30.3)
Ureteric stone location (n=23)	
Right	10 (43.5)
Left	13 (56.5)
Ureteric Stone Position (n=23)	
Distal	11 (47.8)
Mid	8 (34.8)
Upper	4 (17.4)
Renal Pelvis (n=33)	

Yes	3 (9.1)
No	30 (90.9)
Renal Pelvis Location (n=3)	
Right	2 (66.7)
Left	1 (33.3)
Mean ± SD Stone Size (mm)	13.2 ± 15.2
Mean ± SD Stone Density (HU)	817.6 ± 285.5
Multiple stones (n=33)	
Yes	15 (45.5)
No	18 (54,5)

Seven (21.2%) participants had their renal stones located on the right kidney only while 7 (41.2%) were located on both the right and left; 10 (30.3%). Three (17.6%) participants had renal stones located in the upper pole calyx while 4 (23.5%) had renal stones in the middle pole calyx.

The majority, 23 (69.7%) participants had ureteric stones; 10 (43.5%) participants had ureteric stones located in the right. Three (9.1%) participants had stones in the renal pelvis while 2 (66.7%) had a right renal pelvis stone. The Mean ± SD Stone Size (mm) was 13.2 ± 15.2; 11.8+/- 4.8 for the right side and 11.2+/-3.3 for the left side. The Mean ± SD stone density (hu) was817.6 ± 285.5 with a mean density of 723+/-361.3 and 905+/- 379.9 for right and left respectively. Fifteen (45.5%) participants have multiple stones.

Table 5: Correlation between Calcium Level and Stone Size and Density

	Size of Stone (mm)	
	The correlation coefficient, r	**p-value**
Calcium (mmol/l)	-0.378	0.203
	Density of Stone (HU)	
	The correlation coefficient, r	**p-value**
Calcium (mmol/l)	0.078	0.800

A Pearson's correlation was run to determine the correlation between the size and density of stones and calcium level. There was a weak, negative correlation between the size of the stone and the calcium level (r= -0.378) of study cases. This relationship was not statistically significant (p = 0.203).

There was a very weak, positive correlation between the density of stones and calcium level (r= 0.078) of study cases. This relationship was not statistically significant (p = 0.800).

Table 6: Stone Clearance of Study Participants

Variables	Frequency (%) (n=33)
Stone clearance with imaging	
Complete	25 (75.8)
Partial	8 (24.2)
Post Op CT	
Yes	3 (9.1)
No	30 (90.9)
Perceived stone clearance	
Complete	30 (91.0)
Partial	3 (9.0)

The majority of 25 (75.8%) participants had complete stone clearance with imaging; 3 (9.1%) participants had post-op CT while 30 (91,0%) had perceived complete stone clearance.

Table 7: Factors Affecting Stone Clearance with Imaging among Study Participants

Variables	Stone Clearance		Test statistics	p-value
	Complete Freq. (%)	Partial Freq. (%)		
Age group (years)				
20 – 29	2 (50.0)	2 (50.0)	Fisher exact test= 5.545	0.210
30 – 39	7 (87.5)	1 (12.5)		
40 – 49	5 (55.6)	4 (44.4)		

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50 – 59	10 (90.9)	1 (9.1)		
60 and above	1 (100.0)	0 (0.0)		
Sex				
Male	14 (77.8)	4 (22.2)	Fishers exact test=0.088	1.000
Female	11 (73.3)	4 (26.7)		
Mean ± SD Stone Size (mm)	12.0 ± 7.9	12.1 ± 4.5	t=1.595	0.220
Mean ± SD Stone Density (HU)	920.6 ± 307.4	839.6 ± 223.1	t=0.803	0.380
Ureteric Stone				
Yes	20 (80.0)	5 (20.0)	Fisher exact test= 1.011	0.366
No	5 (62.5)	3 (37.5)		
Renal pelvis				
Yes	2 (66.7)	1 (33.3)	Fishers exact test=0.149	1.000
No	23 (76.7)	7 (23.3)		
Multiple stones				
Yes	13 (76.5)	4 (23.5)	Fishers exact test=0.010	1.000
No	12 (75.0)	4 (25.0)		

Two (50.0%) participants aged 20 to 29 years had complete stone clearance compared with 7 (87.5%) who were between 40 – 49 years. This difference was not statistically significant (p= 0.210).

Fourteen (77.8%) males had stone clearance were male compared with 11(73.3%) females with complete clearance. This difference was not statistically significant (p= 1.000).

The mean ± SD Stone Size (mm) for participants with complete stone clearance was 12.0 ± 7.9 mm compared with 12.1 ± 4.5 mm in persons with single partial stone clearance. This difference was not statistically significant (p=0.220).

The mean ± SD Stone density for participants with complete stone clearance was 920.6 ± 307.4 Hu compared with 839.6 ± 223.15 Hu in persons with single partial stone clearance. This difference was not statistically significant (p=0.380).

Fifteen (100.0%) participants with ureteric stones had complete stone clearance compared with 5 (83.3%) without ureteric stones. This difference was not statistically significant (p= 0.286).

Two (66.7%) participants with renal pelvis had complete clearance compared with 18 (100.0%) without a renal pelvis. This difference was not statistically significant (p=0.143)

Thirteen (76.5%) participants with multiple stones had complete clearance compared with 12 (75.0%) without multiple stones. This difference was not statistically significant (p= 1.000).

Table 8: Predictors of Stone Clearance among Study Participants

Variables	**B (regression coefficient)**	**p-value**	**Odds ratio**	**95% C.I. for Odds ratio**	
				Lower	**Upper**
Age (years)	-0.051	0.336	0.951	0.858	1.054
Sex					
Male	-0.765	0.513	0.465	0.047	4.616
Female*			1		
Size of Stone (mm)	-0.107	0.326	0.898	0.725	1.113
Density of Stone (HU)	0.002	0.458	1.002	0.997	1.007
Ureteric Stones					
Yes*			1		
No	0.256	0.884	1.291	0.042	40.121
Renal Pelvis					
Yes*			1		
No	-0.385	0.850	0.681	0.013	36.266
Multiple Stones					
Yes*			1		
No	-0.043	0.969	0.958	0.112	8.177

*Reference category, R^2 (coefficient of determination) = 15.2% to 21.2%

There was no significant predictor of stone clearance among study participants.

Discussion

There is an ever-increasing burden of renal stones albeit the development of RIRS and laser lithotripsy in the management of renal stones over the past 20 years, has made the management of this condition safer and more acceptable. [27,28] This modality has witnessed an expanding role in the management of renal calculus with variable outcomes as measured by stone-free rate (SFR). It can be used concomitantly in the management of both ureteral and renal calculi.[24]

This study noted that the mean age at occurrence of renal stones is in the 5th decade of life (43.70 +/- 11.44), this was in keeping with similar studies conducted in the past. [24,25,29-31] The study also documented more males had RIRS with laser lithotripsy for stone disease [25,32], inferring a higher stone burden in males as documented in the literature [4]. Data suggests a positive relationship exists between high plasma androgen concentrations and the incidence of kidney stones. [33]

The findings in this study also corroborate the fact that obesity is one of the etiologic factors in renal stone formation. [4,5] As shown in Table 2, the mean body mass index (BMI) shows the majority of participants were overweight. Clinical characteristics of the study participants revealed that they were symptomatic, with flank pain being the commonest symptom (100% of participants), with 18.2% and 15.2% of participants having fever and hematuria, respectively. The mean duration of presentation with flank pain was 18.8 weeks, reasons for the delay were however unclear, it may be due to the severity of pains or poor health-seeking behavior among participants.

The majority of participants with renal stones were bilateral 41.7%, similar percentage had calculi in the lower pole of the kidney. Thus, the majority of the kidney stones in this study were located in the lower pole as documented in the literature [34], which may likely be due to the effect of gravity. The majority of participants (69.7%) had ureteric stones. Many participants had multiple calculi but since it was a retrospective study, a thorough stone workup was not carried out for most participants, particularly in those with bilateral stones. The mean stone size of 13.2mm in this study supports the use of RIRS and laser lithotripsy considering EAU guidelines of 2020 on urolithiasis which indicates the use of RIRS for renal stones less than 20mm. [14] Irrespective of size and composition, the AUA guideline of 2016 [15] does not contrast with the findings in this study. Non-contrast computed tomography (CT) is the gold standard for the diagnosis of renal stones as well as stones in the other parts of the urinary tract. With sensitivity and specificity of 94% and 97% respectively, structures as small as 1mm can be identified.[35] Research has shown that it is possible to determine the attenuation of stone using CT through a Hounsfield unit (HU) and this in turn resolves composition.[36] The mean Hounsfield unit (HU) in this study was 817.6=/-285.5, 723HU and 905HU for right and left side of the kidneys and ureters respectively, which is in keeping with HU value ranges for calcium oxalate monohydrate (783-1010) and calcium oxalate dihydrate (873-1218), in an observational prospective study which used spectral analysis to determine stone composition in Mexico, [37] also in concordance with a study in Baghdad in which calcium stones(oxalate and phosphates were within HU range of 600-1700.[38] The mixed composition of most stones is a potential drawback to using this modality to assess stone composition. Another drawback documented in the literature is that it is operator dependent.[37] In this work, as shown in Table 5, using Pearson correlation, there was a weak negative correlation between size and calcium level ($r=0.378$; $p=0.203$). A search in the literature did not reveal any previous study correlating calcium level to the size of calculus. The negative linear correlation maybe due to the presence of mixed-composition stones. However, there was a weak positive correlation between the density of stone and calcium level ($r=0.078$; $p= 0.800$) which was statistically not significant. Similar studies documented a statistically significant positive correlation between Hounsfield unit values and serum calcium levels. [39,40] The small sample size in this study may have contributed to the statistically insignificant finding in this study.

Stone clearance is one of the ways to assess successful outcomes after RIRS, one of the metrics to measure the stone-free rate is to assess for residual stone fragments, it is considered that fragments of 4mm or less are accepted as clinically insignificant. [41] Residual fragments are detected by imaging using ultrasonography, kidneys, ureters, and bladder (KUB) radiography, or computed tomography (CT) [34]. Though CT is considered the most accurate imaging technique but there are concerns about exposure to radiation. [35] In this study only 9.1% of study participants had post-operative CT evaluation, several factors may have been responsible ranging from avoidance of repeated exposure to radiation and socioeconomic status. The stone-free rate (SFR) observed on imaging was 75.8%, measured after a single session of RIRS with laser lithotripsy. This was in keeping with SFR achieved in a multicenter study conducted in Europe in which they achieved a stone-free rate of 73.6% in the first procedure, though fragments of less than 2mm were considered insignificant [29] in this study fragments less than 4mm was considered as insignificant. Similar findings were reported by Elsherif et al [18], with a stone-free rate of

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75%. Mahmood et al [25] achieved SFR of 84% similar to an SFR of 87.09% achieved by Sharma et al. [24] The stone-free rates vary with a range between 50% to 94.2% as reported in the literature. [42] This wide range is attributed to the use of different modalities such as endoscopy, ultrasonography, plain radiograph, and CT at different times after the procedure to determine stone-free status. [43]

Controversies exist in the literature as to factors predicting stone-free rates following stone surgeries. Some authors have proved that factors like a stone burden, multiplicity of stones, and location of stones could predict stone-free rates, the growing concerns about stone-free status have led to the development of nomograms that could predict stone clearance preoperatively. [44] In our study, patient demographic characteristics like age, sex, and other factors such as stone size, stone density, stone location, and stone multiplicity were assessed using a univariate analysis. They were all found to be statistically insignificant factors in determining stone clearance. Similarly, this variable was statistically insignificant in predicting stone clearance in a multivariate analysis. In keeping with the findings in this study is the report by Sasidharan et al [45] who found that different age group, gender, BMI, urine culture, or hydronephrosis was not associated with stone clearance. Corroborating these findings was the study by Ergani et al, who determined that age, gender, side, number, size, and Hounsfield unit of the stone, presence of hydronephrosis, and its degree did not affect the stone-free rate. [46] Perlmutter et al [47] evaluated the impact of stone location on the success of flexible ureteroscopy and lithotripsy, there was no significant difference in stone clearance rate between stone locations. In contrast, Basheer et al [48] found that stone-free patients had significantly lower stone size, stone density, multiple stones, and lower pole stones following RIRS than those with residual stones. Interestingly Tonyali et al [49] found out that the location of the stone in the lower calyx could be considered the most significant predictor of stone-free status after a single session of RIRS.

Conclusion:

There was a predominance of upper urinary tract stones in males, with most patients with stones noted to be overweight. The study also revealed some correlation between stone density and serum calcium level. However, no determinant or predictor of stone clearance rate was found.

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Nil

Conflicts of interest

There are no conflicts of interest to declare.

References

1. 1, Lopez M, Hoppe B. History, epidemiology, and regional diversities of urolithiasis. Pediatric Nephrology 2008, 25; 1: 49-59
2. Knoll T. Epidemiology, pathogenesis, and pathophysiology of urolithiasis. European Urology Supplements. 2010,9;12:802-806
3. Chauhan CK, Joshi MJ, Vaidya ADB. Growth inhibition of Struvite crystals in the presence of herbal extract Commiphora wightii. Journal of Materials Science. 2008; 20:1.89-92
4. Moe OW. Kidney stones: Pathophysiology and Medical management. The Lancet, 2006; 367(9507): 333-344
5. Edvardsson VO, Indriadson OS, Haraldsson G, Kjartansson O, Palsson R. Temporal trends in the incidence of kidney stone disease. Kidney International, 2013;83:1, 146-152
6. Singh KB, Sailo S. Understanding epidemiology and etiologic factors of Urolithiasis: an overview. Scientific Visualisation, 2013, 13; 4:169-174

7. Sofia NH, Walter TM. Prevalence and risk factors of kidney stone. Global Journal for Research Analysis, 2016; 5(3): 183-187
8. Romero V, Akpinar H, Assimos DG. Kidney stones: a global picture of prevalence, incidence and associated risk factors. Reviews in Urology, 2010. 12;2(3):e86-e89
9. Barbasa C, Garciaa A, Saavedraa L, Muros M. Urinary analysis of nephrolithiasis markers. Journal of Chromatography B. 2002;781(1-2):433-455. doi: 10.1016/s1570-0232(02)00557-3
10. Shah J, Whitefield HN, Urolithiasis through the ages. BJU International. 2002;89(8):801-810
11. Fitzpatrick JM, Sleight MW, Braack A, et al. Intrarenal access: effects on renal function and morphology. British Journal of Urology. 1980; 52(6):409-414
12. Rukin N, Siddiqui Z, Chedgy E, Somani BK. Trends in upper tract stone disease in England: evidence from the hospital episodes statistics database. Urol Int. 2017; 98:391-396
13. Van Cleynenbreugel B, Kilie O, Akand M. Retrograde intrarenal surgery for renal stones – part 1. Turk J Urol. 2017; 43:112-121
14. Geraghty R, Abourmarzouk O, Rai B, Biyani CS, Rukin NJ, Somani BK. Evidence for ureterorenoscopy and laser fragmentation (URSL) for large renal stones in the modern era. Current Urology Reports 2015; 16:1-6
15. Herrero MR-M, Doizi S, Keller EX, De Coninck V, Traxer O. Retrograde intrarenal surgery: An expanding role in treatment of urolithiasis. Asian Journal of Urology. 2018; 5:264-273
16. Wong MYC. Flexible ureteroscopy is ideal choice to manage 1.5cm diameter lower pole stone. J Endourol 2008; 22:1845-1846
17. Wen CC, Nakada SY. Treatment selection and outcome: renal calculi. Urol Clin North Am 2007;34: 409-419.
18. Elsherif EA, Abdelaleem EM, Omar MK, Abdelghaffar MA, Badawy AA. Role of retrograde intrarenal surgery in management of renal stones: single center experience. Menoufia Medical Journal. 2022; 35:2076-2080
19. Assimos D, Krambeck A, Miller NL, Monga M, Mured MH, Nelson CP, et al. Surgical management of stone: American Urological Asssociation/Endourological Society Guidelines 2016. Part 1. J.Urol. 2016; 196(4): 1153-1160. Doi 10.1016/j.urol.2016.05.090. EPUB 2016 May 27. PMID; 27238616. Available at: https://www.auanet.org/education/guidelines/surgical-management-of-stones.
20. Turk C, Petrik A, Sariea K, Seitz C, Skolarikos A, Straub M, et al. EAU Guidelines on diagnosis and conservative management of Urolithiasis. Eur Urol, 2016; 69 (3): 468-474.
21. Geraghty R, Aboumarzouk O, Rai B, Biyani CS, Rukin N, Somani BK. Evidence for ureteroscopy and laser fragmentation for large renal stones in the modern era. Curr Urol Rep. 2015;16:54
22. Rai BP, Ishii H, Jones P, Chapman RA, Stlzenburg JU, Somani BK. Bilateral simultaneous ureteroscopy for bilateral stone disease: a systematic review. Can J Urol. 2016, Apr 23(2):8220-6. PMID 27085827.
23. Ge H, Zheng X, Na Y, et al. Bilateral same Session Ureteroscopy for treatment of Ureteral Calculi: A Systematic Review and Meta- analysis. J Endourol. 2016;30:1169-1179
24. Sharma A, Dhar T. Outcome of retrograde intrarenal surgery in the management of urolithiasis in a tertiary care centre in North India. Int Surg J. 2022;9(2):331-335
25. Mahmood SN, Babarasul MH, Fakhralddin SS, Tawfeeq HM. Retrograde intrarenal *surgery* for the treatment of renal stones in patients with solitary kidney: Does access sheath matter? Afr J Urol. 2021;27:35
26. All Posts by University of Benin Teaching Hospital (UBTH) Medical World Nigeria. MWN www.medicalworldnigeria.com Retrieved 2018-10-23.
27. Oberlin DT, Flum AS, Bachrach L, Matulewicz RS, Flury SC. Contemporary surgical trends in the management of upper tract calculi. J Urol 2015;193:880-884
28. Lee MC, Bariol SV. Evolution of stone management in Australia. BJU Int 2011; 108(Suppl. 2): 29-33

29. Alkan E, Arpali E, Ozkanli AO, Basar MM, Acar O, Balbay MD. RIRS is equally efficient in patients with different BMI scores. Urolithiasis. 2015; 43(3): 243-248
30. Kursag Z, Serhat T, Nihat K, Nevzat CN Can T, Hassan B et al. Retrograde Intrarenal Surgery versus Percutaneous Lithotripsy to Treat Renal Stones 2-3cm in Diameter. BioMed Research International. 2015;914231 https://doi.org/10.1155/2015/914231
31. Alazaby H, Khalil M, Omar R, Mohey A, Gharib A, Abo-Taleb A. Outcome of retrograde flexible ureterorenoscopy and laser lithotripsy for treatment of multiple renal stones. Afr J, Urol. 2018;24: 146-151
32. Ho CCK, Hee TG, Hong GE, Singam P, Bahadzor B, Md Zainuddin Z. Outcome and Safety of Retrograde Intrarenal Surgery for Stones Less Than 2cm in size. Nephro-Urol Mon.2012;4(2): 454-457
33. Naghii MR, Babaei M, Hedayati M. Androgens involvement in the Pathogenesis of Renal Stones Formation. PLoS ONE 2014; 9(4): e93790. doi:10.1371/journal.pone.0093790
34. Donaldson JF, Lardas M, Scrimgeour D, et al. Systematic review and meta-analysis of the clinical effectiveness of shock wave lithototripsy, retrograde intrarenal surgery and percutaneous nephrolithotomy for lower pole renal stones. Eur Urol 2015;67:612-616
35. Assi Z, Platt JF, Francis IR, Cohan RH, Korobkin M. Sensitivity of CT Scout Radiography and Abdominal Radiography for Revealing Ureteral Calculi on Helical CT. Ann. J. Roentgenol. 2000;175:333-337
36. Turk C, Petrik A, Sarica K, Seitz C, Skolarikos A, Stroub M, et al. EAU guidelines on diagnosis and conservative management of urolithiasis. Eur. Urol. 2016;69: 468-474
37. Rodriquez-Plata IT, Medina-Escobedo M, Basulto-Martinez M, Avila-Nava A, Gutierrez-Solis AL, Mendez-Dominguez N, et al. Implementation of a Technique Based on Hounsfield Density to Determine Kidney Stone. Tomography 2021;7:606-613
38. Ahmed RS, Hamood HQ, Khalaf MS. Determination of Urinary Stones Chemical Composition by Computed Tomography Density. Annals of Romanian Society for Cell Biology.2021;25(6):14401-14410
39. Alharbi AS, Gameraddin M, Shrwani ZJ, Sindi MA, Alsaedi HI, Qurashi AA, et al. Assessment of Hounsfield Units and Factors Associated with Fragmentation of Renal Stones by Extracorporeal Shock Wave Lithotripsy: A Computerized Tomography Study. Tomography 2024;10: 90-100
40. Silva TR, de Lima ML. Correlation between Hounsfield Unit Value and Stone Composition in Nephrolithiasis. Medical Express 2016; 3(3): M160303
41. Buldu I, Tepeler A, Karatag T, Ozyuvali E, Elbir F, Yordam M, et al. Which factors affect hospital readmission and rehospitalization after flexible ureterorenoscopy for kidney stone? World J Urol. 2016;34 (9): 1291-1295
42. Breda A, Ogunyemi O, Leppert JT, Lam JS,Schulam PG. Flexible ureteroscopy and laser lithotripsy for multiple unilateral intrarenal stones. Eur Urol 2009;55:1190-1196
43. Schoenthaler M, Wilhelm K, Katzenwadel A, Ardelt P, Wetterauer U, Traxer O, et al. Retrograde intrarenal surgery in treatment of nephrolithiasis: is a 100% stone free rate achievable? J Endourol 2012; 26: 489-493
44. Jones P, Pietropaolo A, Chew BH, Somani BK. Atlas of Scoring Systems, Grading Tools, and Nomograms in Endourology: A Comprehensive Overview from the TOWER Endourological Society Research Group. J Endourol. 2021;35: 1863-1882
45. Panda S, Singh VD, Sasidharan S, Tomar L, Dhillon H et al. Correlation between preoperative variables of the patients and management outcome after PCNL surgery: an observational study. Eur J Pharmaceut Sci. 2020;7(10): 403-411
46. Ergani B, Ozbilen MH, Yalcin MY et al. The effect of hydronephrosis grade on stone free rate in retrograde intrarenal stone surgery with flexible ureterorenoscopy. Am J Clin Exp Urol. 2021;9(2): 194-201

47. Perlmutter AE, Talug C, Tarry WF, et al. Impact of stone location on success rate of endoscopic lithotripsy for nephrolithiasis. Urology. 2008; 71(2): 214-217
48. Basheer NE, Mahmoud MF, Hamoud WS, Ahmed EG, Mohamed AA. Predicting stone free rates after retrograde intrarenal surgery using RIRS scoring system versus Resorlu Unsal stone score. Arab Journal of Urology.2024;22(2): 102-108. doi:10.1080/20905998.2023.2252227
49. Tonyali S, Yilmaz M, Karaaslan M, Ceylan C, Isikay L. Prediction of stone free status after single session retrograde intrarenal surgery for renal stones. Turk J Urol 2018;44(6): 473-477