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Research Paper

Outcome of Retrograde Intrarenal Surgery in Management of Renal Stone below 15 mm

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ABSTRACT:

BACKGROUND:

To investigate the Outcome and complication of retrograde intrarenal surgery for renal stone below 15mm, and evaluate our experience with this type of surgeries.

OBJECTIVE:

To evaluate our experience with flexible ureteroscope in treatment of renal stone below 15 mm and focusing on the operative time, stone free rate and possible complication.

PATIENTS AND METHODS:

From August 2019 to December 2020 a 44 patient were selected to perform retrograde intrarenal surgery for renal stone below 15mm, using flexible ureteroscope with holmium laser.

RESULTS:

This cross sectional study show mean stone diameter 11.75±1.658 mm. mean operative time 54.66±17.089 min, while the mean lasing time 41.70 ±17.814 min, and the primary stone free rate 77.3%, Follow up done to the patient for duration of 3 months to reach a total stone free rate 88.6%, the complication rate was 18.2% sub classified with Clavien-Dindo Classification to show 7 patients (15.9%) of them were clavien grade 1, while 1 patient (2.27%) were clavien grade 2, no major complication found during the course of the study.

CONCLUSION:

RIRS using flexible ureteroscope with holmium laser is minimally invasive surgery with both safe and effective results and with acceptable hospitalization period and lower complication rate.

KEYWORDS: Renal stone, flexible ureteroscopy, Outcome, lithotripsy.

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INTRODUCTION:

The kidney measure 10 to 12 cm in length, 5.0 to 7.5 cm in width, and 2.5 to 3.0 cm in thickness. The adult male kidney weighs approximately 125 to170 gm; the kidney is 10 to 15 gm smaller in females. The right kidney is relatively shorter and wider because of compression by the liver [(1)].

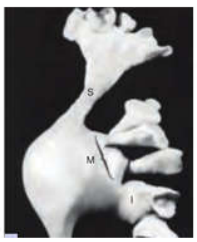
Sampaio and Mandarim-deLacerda [(2)] done detailed studies ofrenal calyceal endocast and described calyces into groups, irrespective of the side of the kidney.

1. Sampaio Group A1: (45 %) The mid zone which connected by minor calyces that are dependent on superior or inferior groups.
2. Sampaio Group A2 : (17 %) The mid zone which connected by minor calyces that CROSS and are dependent of superior and inferior major calyces.
3. Sampaio Group B1: (21 %) The mid zone which connected by minor calyces draining into a mid zone major calyx.
4. Sampaio Group B2 : (17 %) The mid zone has minor calyces that connected directly into the pelvis.

Sampaio Group A1

Sampaio Group A2

Sampaio Group B1



Sampaio Group B2

Renal stone specifically refers to stones in the kidney; most of renal stone contain calcium. Renal colic caused by dilation, stretching because of the acute ureteral obstruction[3], a decreased fluid intake, with a subsequent low volume of urine production, produces high concentrations of stone forming solutes in the urine. This is very important environmental factor in renal stone formation. The true nature of the tubular defect or dysfunction that lead to stone formation has not been described, most articles on the etiology and prevention of urinary tract stone disease directed toward the role of high urinary levels of calcium, oxalate, and uric acid in calculi formation, as well as low urinary citrate levels.

Ureteroscopy is can be defined as upper urinary tract endoscope done most commonly with an endoscope pass through urethra, bladder, and then directly into the upper urinary tract, technical development have led to wider indications while lower peri operative complication resulting in more effective access to the upper tract, the development of flexible ureteroscope was first reported by Marshall in 1964. He described the entrance of a 9 F endoscopy made by American Cystoscopy Makers (*Pelham Manor, NY*) into the ureter to diagnose an impacted ureteral calculi, flexible ureteroscopy specifications in 1990 included a 10 F outer diameter, a standard 3.6 F working channel, and single direction active tip deflection. Access sheath was not required as direct guide wire, the development of smaller diameter (< 8 F) flexible ureteroscope in 2001 offered better active tip deflection and significant advancement in the management and diagnosis of ureteroscope, in 2014, New digital imaging replaced fiberoptic for small diameter flexible ureteroscopy. The digital imaging remove the circle "insect vision" development of quartz bundle gives a clear rectangular vision that has twenty times the resolution of fiberoptics, small diameter, more tip deflection, with standard 3.6 F working channel[4].

Laser lithotripsy with Holmium: YAG laser became the standard for calculi lithotripsy during flexible ureteroscope due to its effectiveness and safety [5] .The H: YAG laseris effective for all composition of calculus. Stones are fragmented by a photothermal phenomena, the laser being absorbed by water in calculi, creating a vaporization pressure that fraqment the calculi [6,7,8]. The last generation of laser lithotripters give three parameters: Pulse energy (J), pulse frequency (Hz) with pulse duration.

AIM OF THE STUDY:

Evaluation the our experience with flexible ureteroscope in management of renal calculi below 15 mm and focusing on the operative time, stone free rate andpossible complication.

PATIENTS AND METHODS:

The study conducted at AlShahid-Ghazi Hariri Surgical Specialties Hospital / Baghdad medical city, 44 patient were electively selected to be included in this prospective clinical study for the (Outcome of retrograde intrarenal surgery for renal stone below 15 mm.), for the duration from July 2019 to December 2020.

Inclusion criteria

1. Single renal stone below 15 mm.
2. High density stone.

Exclusion criteria

1. Renal stone 15 mm and above .
2. Multiple renal stone with stone burden below 15 mm.
3. Active U.T.I **.**
4. Ureteric stricture and PUJO .
5. Poor compliant patients.

Preoperative workup : All patient selected for the study submitted to a detailed History associated with both general and focused urological examination , also allpatient were sent for laboratory test which include : General urine examination, Biochemistry (Random blood sugar, blood urea nitrogen and serum creatinine), Complete blood count , Erythrocyte sedimentation rate, C.reactive Protein, Bleeding profile, Blood group and crossmatch, Virology screen, patients after march 2020 were sent for PCR for covid19.

Radiological investigation: Kidney-ureter-bladder X-ray, Ultrasonography for the abdomen and pelvis, Native computerized tomography of abdomen and pelvis, With / without intravenous pyelogram (I.V.P).

Patients with chronic Medical disease like Hypertension and Diabetes mellites were sent for Medical consultation to stabilize their condition preoperatively, Patient with coagulopathy were sent for hematological consultation preoperatively, Getting anesthesiologist approval before surgery with written Informed consent has been taken from the patient for the outcome, another mode of treatment and possible complications, **All patient were admitted for retrograde JJ stent before the procedure by 2 -3 weeks.**

Intra-operative: All patients received prophylactic antibiotic pre-operatively by 30 min, 3rd generation cephalosporin (ceftriaxone vial 1 gm 1x1 I.V), Patients underwent the procedure under G.A and then they were put in lithotomy position**:**

1. cystoscope for JJ stent removal .

2. semi-rigid ureteroscope 8 Fr. To access the targeted ureteric orifice to reach the PUJ, record the distance between the external meatus and the URS base and then insertion of 2 Guide wire (working and safety) (PTFE)
3. Ureteric access sheath (10 – 12 Coloplast^{TM}) were inserted over the working guide wire to the same level that pointed at the semi-rigid URS todecrease the rate of over advancement of UAC, removal of the access sheath obturator.
4. Flexible Ureteroscope (PUSEN^{TM}, 9 French (Fr)) inserted through the access sheath, in which the dominant hand used to control the lever ofthe scope and rotating movement while the back and forth movement of the scope done by the other hand.
5. Checking of the entire kidney starting with upper pole down to the lower pole reaching to the stone, continuous irrigation was mandatory for good vision with normal saline (0.9%) under 40 cmH2O.
6. Lithotripsy was done under Dusting mode (Holmium-YAG laser using 200u 0.6 – 0.8 joule, 8 - 10 Hz) and the setting of laser was changed according to the progress of lithotripsy.
7. Re-locating and Removal of stone fragment by basket.
8. Re-checking the kidney for any missed renal stone or fragments, and removal of the UAC and the scope under vision to diagnose any missed injury to the ureter during the insertion.
9. Insertion of JJ stent over safety pre-existing guide wire. 11.Insertion of Foley's catheter to drain the urinary system .

Overall procedure time recorded as time from putting the patient in lithotomy position to insertion of urethral catheter .

Lasing time recorded as total time of using the laser lithotripsy.

Post operative:

1. Patients followed by charting of Vital sign(Blood pressure, pulse rate, body temperature)
2. All patient sent for (K.U.B and abdominal Ultrasonography post operatively to check the primary stone free rate and probable complication.
3. Urethral catheter removed after 8 hours or until hematuria resolved in some cases
4. Patients routinely discharged at post op. day 1 except for patient with complication who kept in hospital.
5. Follow up done at 10 – 14 days post-operatively for further assessment andJJ stent removal for stone free patient while keeping the JJ stent for furtherperiod in patient with residual stone and scheduled for frequent visit of maximum 3 month to assess the stone clearance after commencing treatment By medical treatment for radiolucent stone and ESWL forradiopaque stone.
6. Primary stone clearance defined as no visible stone or insignificant residualstone < 4mm by direct vision intra-operatively or by day 1 post-operatively(K.U.B) and ultrasonography.
7. Overall stone clearance defined as no visible stone or insignificant residualstone < 4mm. by K.U.B , ultrasonography and CT scan after 3 months of follow up.

RESULTS:

A total of forty four patient underwent forty four intrarenal surgery for single renal stone under 15 mm, this cross sectional study included 25 **male** (56.82%) with 19 **female** (43.18%), the **mean patient age** was **44.48±13.0104** year range **(18-75)**, **20.5%** of the sample patient had **Hypertension**, **13.6%** had **Diabetes mellitus** and **4.5 % coagulopathy,** 16 patients (36.4%) had **previous ESWL** treatment and 7 (15.9%) of patients had **history of previous open renal surgery**, **Mean stone diameter** was 11.75±1.658 mm. range (8-14) mm, **21** patients **(47.7%) right sided stone** while **23 (52.27 %)** was **left sided stone, 27** patients **(61.4%)** was **opaque** while **17** patients **(38.6%)** was **lucent stone.**

27 patients **(61.4%)** was **opaque** while **17**patients **(38.6%)** was **lucent stone.**

Mean operative time was **54.66 ± 17.089 min. range (30-85) min,** which was statistically significant in relation to the stone size **(P value = 0.001)** while **mean lasing time** was **41.70 ± 17.814 min. range (15-75) min.** the study show significant relation between lasing time and calculi size While there is no statistical significancy between lasing time and stone location , laterality or with opacity of the stone.

The **primary stone free rate** was **77.3% (34/44 patients) (P value = 0.001)** and done by direct vision of the renal collecting system by the FURS at the end of the procedure and by renal ultrasonography and (K.U.B) at day 1 postoperatively.

The **primary stone free rate** for renal stone below 10 mm was 100% while for stone size (11-14) was 68.75% , **statistically significant as (P value = 0.04)** .

The **Primary stone free rate in relation to the calculi location** was 85.71% in renal-pelvic stones , 87.5% in upper calyces stones, 60% in mid calyces stones and 78.94% for the lower calyces stones, **Statistically not significant (P value = 0.61)**.

Primary stone free rate in relation to opacity of the stone show 74.07% stone free for the opaque stone while show 82.35% for the lucent stone, **Statistically not significant (P value = 0.71), Primary stone free rate in relation to the laterality of the stone** show 51.85% stone free for the right renal stone while show 86.95% stone free for the leftrenal stone, **Statistically not significant (P value = 0.15).**

Patients with complete stone free rate or insignificant residual stones werescheduled for JJ stent removal after 2 weeks postoperatively, Patients with residual stone fragment (n.=10) were treated with ESWL for radiopaque stone (n.=7) while medical treatment for radiolucent residual stones (n.=3) , and all of them scheduled for follow up with imaging study by renal ultrasonography and K.U.B at 2 weeks, 4 weeks, 6 weeks and 3 months as overall succuss rate was 79.54 %, 81.81 %, 84.1%, and 88.6% respectively, JJ stent was removed a soon as complete stone free rate done for them.

Our study show **the stone free rate in relation to previous ESWL** treatment as **68.75%** while the **stone free rate for the non previous ESWL** was **82.14%** , and it was **statistically not significant (P value= 0.45).**

Overall stone free rate at the end of the follow up period (3 months) was **88.6% (39 / 44)** patients, **statistically significant (P value = 0.001).**

Overall stone free rate In stone size below 10 mm was 100% while in **stone size (11-14) mm was 84.37% , statistically not significant (P value=0.30).**

Overall stone free rate in relation to stone location was 100% for pelvic stone, 87.5% for upper calyces, 90% for mid calyces and 84.21% for the lower calyces stones, **statistically not significant (P value=0.91).**

Overall stone free in relation to opacity of stones show 88.88% stone free rate for the radiopaque stones while 88.23% for the radiolucent stones, **statistically not significant (P value = 0.95)**.

Overall stone free rate in relation to the laterality show 80.95% for the right renal stones while show 95.65% for the left renal stones, **statistically not significant (P value = 0.17).**

The **lower pole stone free rate for stone diameter below 10 mm was 100%** while the study show **80% as lower calyces stone free rate for stone diameter (11-14) mm** , and it was **statistically not significant (P value = 0.98).**

The 5 cases who still had residual stone after the procedure and 3 months follow up, **2** of them planed for second session FURS and ***3*** of them kept on conservative treatment as they were asymptomatic.

Perioperative and postoperative complication occurred in **8 patients (18.2%)**, Complication were **Renal colic** in 1 patient clavien 1 (2.27%), **Fever** in 2 patients clavien 1 (4.5%), **Hematuria** in 3 patients clavien 1 (6.8%), **Ureteric mucosal injury grade 1** in 1 patient (2.27%) all treated conservatively with no need for Blood transfusion or surgical intervention, **non obstructive pyelonephritis** in 1 patient (2.27%) clavien 2, who admittedto the ward for intra-venous antibiotic and discharged well after completing the treatment in 5 days, ***mean hospital stay was 1.34±0.834 day range (1-5) days.***

DISCUSSION:

Our study show the mean ***AGE*** for the patients ***44.48±13.0104 year*** range ***(18-75)*** year that resemble to ***CC Ho et al***[9] reported the mean age in his study as ***43.4 year and*** **G Herrera-Gonzalez et al**[10] reported that mean age in his thesiswas **51.31 ± 15.6 year.**

mean stone diameter as 11.75±1.658 mm with range ***(8-14) mm***, which goes with ***G Herrera-Gonzalez et al***[10] mean stone diameter was 11.93 ± 8.2 mm and ***El-Nahas et al***[11] mean stone diameter ***13.1 ± 2.4 mm .***

Mean operative time **54.66 ± 17.089** min , while Mean lasing time was **41.70 ± 17.814 min.** and both was statistically significant in relation to stone size **(P value = 0.001), while *Y Xiao et al*** [12] show Mean operative time ***50 ± 20 min*** in which hefound larger stone led to longer operative time, ***Mahmood SN et al*** [13] the average operative time was ***32.47± 10.09*** minutes, this study is sheath less while our study done with uretric access sheath, ***Lai D. et al***[14] mean operative time was ***84.4 ± 21.3 min*****,** may be due to larger stone size and multiplicity of stones .

the **primary stone free rate** was **77.3%** which was statistically significant (**P value = 0.001**) , this result similar to ***M Grasso et al***[15] found primary stone free rate was **76%.** ***A Skolarikos et al*** [16] Primary stone free rate was **80%** for stone less than 15 mm, while ***Y Xiao et al*** [12] show primary stone free rate as **61.5%** mostly due to considering the insignificant residual stone less than 2 mm.

the ***Overall stone free rate*** at the end of the follow up period (3 months) was ***88.6% (39 / 44)*** patients, ***statistically significant (P value*** = 0.001) resemble with ***A Skolarikos et al (CROES study)*** [16] reported stone free rate 80% while ***MS Pearle***[17] show overall success rate **50%** may be due to different methods and

technique in multicenter study***, and D Lai et al***[14] show overall stone free rate was **95%** may be due to longerfollow up period (12 month).

the ***overall stone free rate in relation the stone location*** as pelvic stone 100% stone free rate, upper calyces 87.7% , middle calyces 90% and the lower calyces stones was 84.21% stone free rate, and it was ***statistically not significant (P value = 0.91)*** and resemble to **Mahmood SN et al**[13] show stone free rate was renal pelvis (93%), upper/middle calyx stones (86.66%) and lower calyx stones (84%), and ***CC Ho et al***[9] the stone free rate in relation to stone location: upper pole 29%, mid pole 80% and lower pole stones as 60% .

The ***total lower pole stone free rate*** as **84.21 %,** and it iscomparable to ***J Kourambas et al***[18] ***and GM Preminger et al***[19] both studies show lower pole stone free rate as **85%** after 3 months follow up, and ***M GRASSO et al***[15] show total lower pole stone free rate as **95%** after 3 month of follow up .

the ***average hospital stay was 1.34±0.834 day range (1-5) days*** which resemble to ***A Skolarikos et al (CROES study)***[16] reported hospital stay as ***1.5 ± 2.3days,*** and ***JH Amón et al***[20] hospital stay **2.1 days range (1-4)**.

Complication in this study occurred in **8 patients (18.2%)**, **Renal colic** in 1 patient clavien 1 (2.27%), **Fever** in 2 patients clavien 1 (4.5%), **Hematuria** in 3 patients clavien 1 (6.8%), **Ureteric mucosal injury grade 1** in 1 patient (2.27%), and its comparable to **Mahmood SN et al**[13] show overall complication rate was **17.03%** mainly presented with **fever, *JH Amón et al***[20] show complication rate ***20%*** all calvien 1, ***A Skolarikos et al (CROES study)***[16] show complication rate as **11%** for the below 10 and (10-15) mm stone groups, which consist of (hematuria 1.3%, fever 5.6%, sepsis 1.5% others 2.6%), While these studies below show a lower complication rate **G Herrera-Gonzalez et al**[10] show complication rate as **5.6%,** and ***H Goldberg***[21] show **5.4%** complication rate for the below 15 mm group.

CONCLUSION:

RIRS using flexible ureteroscope with holmium laser are minimally invasive surgery with both safe and effective results, Acceptable hospitalization period and Lower complication rate.

Recommendation

Include more patients and elongate the follow up period, Include a multi-center study, Considering the FURS as primary procedure for renal stone below 15 mm and further researches to compare with other modality of renal stone treatment.

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