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ORIGINAL ARTICLE

Factors Predicting the Outcome of Retrograde Flexible Ureterorenoscopy for the Treatment of Renal Stones

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Abstract

Background: **Flexible ureterorenoscopy (FURS) is widely used in the surgical treatment of renal stones, due to the tendency toward minimally invasive options. This study was conducted to evaluate factors affecting outcomes of FURS.**

Patients and methods: **A retrospective analysis of patients with renal stones who underwent FURS at Al-Azhar University Hospitals (Al-Hussein and Sayed Galal), Cairo, Egypt. This analysis involved patients who underwent FURS in the period between October 2020 to June 2022, only patients with complete data were involved in this study.**

Results: **Out of 187 patients who underwent FURS for renal stone in the aforementioned period, 152 had complete data. The mean age of patients was 43.7 ± 12.5 years. 58 (38.2%) were females while 94 (61.8%) were males. The mean stone burden was 16.2 ± 5.7 mm. The overall stone-free rate (SFR) was 126/152 patients after 3 sessions of FURS (82.4%), while the SFR after one and two sessions was 104 (68%) patients, and 124 (81%) patients, respectively. Univariate analysis of factors that may affect the SFS demonstrated that stone burden, stone location, stone number, and renal malformations were found to have a significant effect on SFS, while in multivariate analysis stone location was the only predictive factor of SFS.**

Conclusion: **FURS proved of high efficacy and limited major complications in the treatment of renal stones. Multivariate analysis revealed that stone location had a strong predictive value on the SFS, while stone burden had a strong predictive value on the incidence of intra and postoperative complications.**

Keywords: Flexible ureterorenoscopy, RIRS, Stones

1. Introduction

Flexible ureterorenoscopy (FURS) has emerged as a minimally invasive method for treating renal stones. Owing to the complications of percutaneous nephrolithotomy (PCNL) and limitations of extracorporeal shock wave lithotripsy (ESWL), FURS is now frequently used in treating renal stones. The list of conditions for which FURS with laser lithotripsy is indicated has expanded to include ESWL failure, morbid obesity, musculoskeletal abnormalities, and bleeding disorders.[1,2] Many authors evaluated the efficacy of FURS for renal calculi and reported a wide range of stone-free rate (SFR) of 50%−94%[3–5] After FURS, minor complications are frequent, but severe complications including sepsis and severe bleeding can also occur.[6] Breda and Angerri observed that problems occurred in 8% of patients following FURS, with significant complications occurring in 1.9% of cases.[7] There are only a limited number of studies have been conducted to evaluate the parameters affecting FURS outcomes. FURS outcomes could be affected by several factors, such as stone burden, stone location, renal anatomy, use of ureteral access sheath, ureteral stent, and surgeon experience. The aim of this study is to evaluate the clinical outcome of FURS in the treatment of renal stones in a tertiary referral hospital and to determine predictors of SFS, intra and postoperative complications.

2. Patients and methods

This is a case control study that targeted patients who underwent FURS for the treatment of renal

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stones at Al-Azhar University Hospitals (Al-Hussein and Sayed Galal), Cairo, Egypt., during the period between October 2020 to June 2022. Patients with the only complete medical records and follow up were included.

Patient's medical records including preoperative demographics (age, gender, clinical presentation, associated medical co morbidities and history of previous urologic surgery) were tabulated. The collected laboratory data included; (serum creatinine, Hb level and coagulation profile). Stone and kidney characteristics; (side, size, site, number, density, presence and degree of hydronephrosis, presence of renal mal-formation and prior DJ stent) were retrieved from the imaging studies. Intra operative data, included type of anesthesia, surgeon experience (resident, junior staff and senior staff), intra operative complications, post-DJ stent and operative time.

Postoperative data included postoperative hospital stay, postoperative complications, SFS and need for ancillary procedure. Intraoperative complications of FURS were estimated by the modified Satava classification system (SCS),[8] while postoperative complications were estimated by the modified Clavien classification system (CCS).[8] Intraoperative bleeding was classified as significant (if it interfered with vision and necessitated stopping the maneuver) and nonsignificant (did not interfere with vision). SFS was determined according to results of imaging by non contrast computed tomography (CT) after 3 months and were classified into; stone free (SF) (no detected stone(s) and nonsignificant residual <4 mm) and significant residual (>4 mm).

2.1. Statistical analysis

The categorical variables were presented as numbers and percentage while the numerical variables were presented as mean ± SD, or median, range. Univariate and multivariate Logistic regression were performed and the potential risk factors of FURS outcomes were determined.

3. Results

One hundred fifty two out of 187 patients had complete medical records and were included into the study. Regarding preoperative data, the mean age of studied patients was 43.7 ± 12.5 years. The study cohort included 58 (38.2%) females and 94 (61.8%) males. The associated co-morbidities included hypertension, hepatic dysfunction, diabetes mellitus and cardiac problems in 20 (13.1%), 15 (9.9%), 14 (9.2%) and 3 (2%), respectively. 96 (63.1%) patients had no previous urologic surgery, while 28 (18.4%) had previous PCNL, 21 (13.8%) had previous open stone surgery and 19 (12.5%) had previous ureteroscopy (URS). All patients had normal preoperative hemoglobin level. The mean serum creatinine was 1.05 ± 0.397 mg/dl and only 5 patients had INR greater than 1.2. The mean stone burden was 16.2 ± 5.7 mm. In 102 (67.1%) patients the stone HU was more than 1000 while in 50 (32.9%) patients it was less than 1000. 112 (73.7%) patients had single stone while 40 (26.3%) patients had multiple stones. 94 (61.8%) patients had non lower calyceal stone while 58 (38.2%) patients had lower calyceal stone. 97 (63.8%) patients had hydronephrosis in preoperative imaging. Prior DJ stent in 54 (35.5%) patients. Renal mal-formations were detected only in 11 patients.

Most of FURS procedures (65.8%) were performed by senior staff urologists, 41 (27%) patients were performed by junior staff and 11 (7.2%) patients were performed by resident. 144 (94.7%) patients were operated upon under spinal anesthesia while only 8 patients had general anesthesia. Post-DJ stent was used in 142 (93.4%) patients. The mean operative time was 78.2 ± 17.03 min the most common intraoperative complications was non significant bleeding in 39 (25.5%) patients, while significant bleeding was reported in 6. Further intraoperative complications were reported in form of failure to access to stone in 12 (7.8%) patients and perforation of ureteric wall managed by stent in 2 (1.3%) patients. According to the modified SCS, grade 1 was observed in 45 (29.6%) patients, grade 2a was observed in 6 (3.9%) patients, grade 2b was observed in 8 (5.3%) patients while no patients developed higher grade (grade 3) complications.

Postoperative complications occurred in 65 (42.8%) patients including UTI in 26 (17%) patients, renal colic in 20 (13.1%) patients, fever in 8 (5.2%) patients, hematuria in 8 (5.2%) patients, Stein strass in 2 (1.3%) patients and one case with uro-sepsis. According to modified CCS, grade 1 was detected in 36 (23.7%) patients, grade 2 in 26 (17.1%) patients, grade 3 in 2 (1.32%) patients and grade 4 complication was seen in one (0.7%) case. After 3 months the SFR was 68% (104/152 patients) after a single session of FURS. This figure mounted to 81% and 82.4% after 2nd and 3rd session, respectively. 26/152 patients (17.1%) were considered as treatment failure. 21 among whom underwent auxiliary procedures, (11/21 patients underwent ESWL, 6/21 patients underwent URS, 4/21 patients underwent PCNL), while five patients were advised for scheduled follow-up.

The uni- and multivariate analysis considering the possible predictive factors influencing SFS is summarized in (Table 1). Stone burden, stone location, stone number and renal-malformations were found to have a significant effect on SFS as univariate factors ($P < 0.05$), while in multivariate analysis the stone location was the only significant predictor of SFS ($P = 0.019$).

Univariate analysis demonstrated that stone burden and stone number were significantly associated with intraoperative complications ($P < 0.05$). However multivariate analysis revealed that stone burden ($P = 0.011$) was the only significant predictor (Table 2).

On the other hand, univariate analysis demonstrated that stone burden, stone reside and surgeon experience were significant predictive factors for postoperative complications ($P < 0.05$), while only stone burden proved of significance on multivariate analysis ($P = 0.003$, Table 3).

4. Discussion

Urolithiasis is a common condition affecting the urinary system and affects all age groups. The prevalence of stone disease is 5%–12% in males and 4%–7% in women Huang and colleagues.[9] Many authors evaluated the efficacy of FURS for treating renal calculi and reported a wide range of SFR of (50%–94%) Perlmutter and colleagues, Palmore and colleagues and Laclergerie and colleagues.[3–5] In our study the overall SFR was (82.4%) after 3 sessions of FURS while SFRs after one and two session was (68%) and (81%), respectively. This seems to be equal to the SFR recorded by Breda and colleagues[10] who reviewed 51 patients underwent FURS for multiple renal stone, the overall SFR was 92.2%, the SFRs after one and two procedures were 64.7% and 92.2%, respectively. In a large retrospective study evaluating 800 FURS procedures for upper urinary tract stones, the overall SFR was 74.1% Richard and colleagues.[11]

Previous studies have determined several factors affecting the SFS. The Resorlu-Unsal Stone Score (RUSS) included four predictive factors; (stone size >20 mm, lower calyceal location, multiple stones and abnormal renal anatomy) Resorlu and colleagues.[12] According to our univariate analysis the stone burden, stone location, stone number and renal malformations were found to have a significant effect on SFS ($P < 0.05$), while on multivariate analysis the stone location was the only significant predictor ($P = 0.019$). In contrast to our study, Ito and colleagues, found the stone burden was strong predictor for SFS Resorlu and colleagues.[12] On account of they using multiple parameters of stone burden like cumulative stone diameter (CSD), stone surface area (SA), and volume.

Lower calyceal stones represent a challenge in treatment options. Although FURS was introduced

Table 1. Univariate and multivariate analysis of factors that might have influenced the stone free status.

		NO.	Univariate Analysis		Multivariate Analysis	
			OR (95% CI)	*P* value	OR (95% CI)	*P* value
Age	Less than 40 y	66	1		1	
	More than 40 y	86	1.2 (0.6,2.5)	0.517	1 (0.3,3.3)	0.914
History of previous uro-surgery	No	96	1		1	
	Yes	56	1.09 (0.5,2.2)	0.801	1.6 (0.6,4.1)	0.271
Stone burden	Less than 15 mm	81	1		1	
	More than 15 mm	71	3.3 (1.6,6.8)	**0.001**[a]	2.4 (0.3,15.9)	0.334
Stone side	RT	81	1		1	
	LT	71	0.9 (0.1,8)	0.883	1.8 (0.5,5.6)	0.309
Stone location	non lower calyx	94	1		1	
	lower calyx	58	3.4 (1.6,7)	**0.001**[a]	5.1 (1.3,20.3)	**0.019**[a]
Stone number	Single	112	1		1	
	Multiple	40	4.7 (2.1,10.1)	**0.001**[a]	1.2 (0.3,5)	0.739
Renal mal-formation	No	141	1		1	
	Yes	11	4.2 (1.1,15.3)	**0.026**[a]	2.4 (0.5,10)	0.218
Pre DJ stent	No	98	1		1	
	Yes	54	1 (0.4,2.05)	0.9	1.6 (0.5,4.8)	0.353
Surgeon experience	Residents	11	1		1	
	Junior staff	41	1.4 (0,2)	0.274	1.2 (0.4,3)	0.690
	Senior staff	100	1.6 (0.3,1.5)	0.349	1.5 (0.2,1.3)	0.183
Anesthesia	General	8	1		1	
	Spinal	144	2.2 (0.5,9.5)	0.261	3.4 (0.5,20)	0.171

Confidence interval, (CI); Odds ratio, (OR).

[a] Statistically significance.

Table 2. Univariate and multivariate analysis of factors that might have predict the intra-operative complications.

		No.	Univariate Analysis		Multivariate Analysis	
			OR (95% CI)	*P* value	OR (95% CI)	*P* value
Age	Less than 40 y	66	1		1	
	More than 40 y	86	1.55 (0.8,3.0)	0.193	2.0 (0.83,5)	0.116
History of previous uro- surgery	Yes	96	1		1	
	No	56	1 (0.5,2.1)	0.797	1.3 (0.6,2.3)	0.464
Stone burden	Less than 15 mm	81	1		1	
	More than 15 mm	71	3.9 (1.9,7.7)	**0.001**[a]	3.68 (1.34,10.1)	**0.011**[a]
Stone side	Rt	81	1		1	
	Lt	71	1.3 (0.7,2.6)	0.315	1.3 (0.5,3)	0.544
Stone location	non lower calyx	94	1		1	
	lower calyx	58	0.6 (0.3,1.1)	0.141	0.4 (0.1,1.4)	0.206
Stone number	Single	112	1		1	
	Multiple	40	3.9 (1.8,8.3)	**0.001**[a]	2.2 (0.6,8)	0.206
Surgeon experience	Residents	11	1		1	
	Junior staff	41	2 (0.5,7.1)	0.264	1.8 (0.4,7)	0.352
	Senior staff	100	1.4 (0.7,3)	0.304	1.4 (0.6,3.1)	0.356
Anesthesia	General	8	1		1	
	Spinal	144	1.6 (0.3,6.7)	0.508	1.4 (0.2,6.7)	0.663

Confidence interval, (CI); Odds ratio, (OR).
[a] Statistically significance.

to overcome low stone clearance post ESWL, the accessibility to lower pole stone is still difficult. However, access to lower pole stones using flexible URS has improved since the creation of new endoscopes with greater active deflection capabilities and the evolution of surgical procedures (such as stone repositioning) Traxer.[13] In our study, we found that the SFR differed significantly between the non lower calyceal and lower calyceal stones (71.2%) and (28.8%), respectively. This consistent with a retrospective analysis of 100 patients who underwent FURS, the SFR in lower pole stones was 22.2%, which was dramatically lower from the SFR (60%) of other sites ($P < 0.001$) Tonyali and colleagues.[14]

One of the advantages of FURS is safety in treating stones in patients with renal anomalies. Our study involved 11/152 patients with renal malformation, 7 of them were non-SF, but without major intra or postoperative complications. This SFR is worse than that reported by Resorlu and colleagues[12] who had SFR in 10/15 patients had renal malformation.

Our study showed that the intraoperative complications were observed in 59/152 patients (38.8%)

Table 3. Univariate and multivariate analysis of factors that might have predict the postoperative complications.

		No.	Univariate Analysis		Multivariate Analysis	
			OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Age	Less than 40 y	66	1		1	
	More than 40 y	86	1.5 (0.8,3)	0.16	1.5 (0.7,3.2)	0.2
Stone burden	Less than 15 mm	81	1		1	
	More than 15 mm	71	3.6 (1.8,7.1)	**0.001**[a]	3.4 (1.5,7.7)	**0.003**[a]
Stone side	Rt	81	1		1	
	Lt	71	1.1 (0.6,2.2)	0.65	1.5 (0.7,3.2)	0.21
Stone location	non lower calyx	94	1		1	
	lower calyx	58	1.4 (0.7,2.7)	0.28	1.3 (0.5,3.1)	0.52
Stone number	Single	112	1		1	
	Multiple	40	1.7 (0.8,3.5)	0.14	1.4 (0.5,4.2)	0.460
Stone residual	No	126	1		1	
	Significant	26	1.6 (1,2.5)	**0.02**[a]	1.6 (0.98,2.72)	0.06
Surgeon experience	Residents	11	1		1	
	Junior staff	41	1.4 (0.1,0.9)	**0.026**[a]	1.3 (0,1.5)	0.177
	Senior staff	100	1.3 (0,1.4)	0.165	1.5 (0.2,1.3)	0.183
Operative time	Less than 60 min	21	1		1	
	More than 60 min	131	2 (0.7,5.6)	0.163	2.3 (0.6,8.1)	0.188

Confidence interval, (CI); Odds ratio, (OR).
[a] Statistically significance.

and postoperative complications observed in 65/152 patients (42.8%). The only independent factor of complications was stone burden. Both of intra and postoperative complications in our study were significantly higher than the values in the literature Oguz and colleagues, Ozden and colleagues.[6,8] This was due to the fact that we included patients in early learning period of FURS and the majority of complications were mild (grade 1).

Oguz and colleagues, observed 230 patients for intraoperative complications during FURS, they found that, intraoperative complications were observed in 30.4% of the patients. Regarding the modified Satava grading system, grade 1 (15.9%), grade 2a (5.6%), grade 2b (8.9%) of the patients and no grade 3 complications Ogur and colleagues.[6] In a retrospective analysis of 706 FURS procedures by Ozden and colleagues, 215 (30.5%) patients had intra operative complications. Mild bleeding was the most frequent intraoperative complication, occurring in 60 (8.5%) cases, and the only independent risk factor for complications was the presence of residual stones. 190 (26.9%) patients had postoperative complications. Fever needing antipyretic medication was the most frequent postoperative complication, accounting for 8.6% of all cases, while the presence of residual stones and a solitary kidney were independent risk factors Ozden and colleagues.[8]

4.1. Conclusion

FURS proved of high efficacy and limited major complications in treatment of renal stones. Multivariate analysis revealed that stone location had a strong predictive value on the SFS, while stone burden had a strong predictive value on the incidence of intra and postoperative complications.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

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