

# A stone pushed back to the collecting system – long therapeutic path in centers with limited access to flexible instruments

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**Introduction** Availability of flexible ureteroscopes is still limited in many countries and centers. Under such circumstances treating small stones pushed from the ureter to the kidney that pose a risk of symptomatic recurrence is controversial as it may require a number of surgical procedures to remove. The aim of this study was to assess the type and number of procedures used to treat stones relocated from the ureter to the collecting system in a high volume urological center with limited access to flexible instruments.

**Materials and methods** Patients treated for ureteral stones in years 2013–2016 were retrospectively reviewed. All procedures performed after stone relocation were counted. Final stone status was determined by ultrasonography and radiography.

**Results** Out of 75 patients with a stone relocated to the collecting system full follow-up was available for 66. In three patients (4%) the stone remained in the collecting system untreated. Seven patients (11%) passed their stones spontaneously. Active treatment was successful in 45 (68%), while it failed in 11 (17%) patients. Extracorporeal shock wave lithotripsy was used 132 times, semi-rigid ureteroscopy 21 times and percutaneous nephrolithotripsy 22 times – 175 procedures altogether (2.6 procedures/patient + accessory procedures such as JJ removal). Shockwave lithotripsy was effective in 7/41 patients, semi-rigid ureteroscopy in 18/21 and percutaneous nephrolithotripsy in 22/22 patients.

**Conclusions** Treating small stones relocated from the ureter to the collecting system in centers not equipped with flexible endoscopes is inefficient, time-consuming or too invasive. Cost-effectiveness analysis should follow this study to obtain evidence for public health payers to change their policies.

**Key Words:** stent ↔ ureteral stone ↔ stone free rate

## INTRODUCTION

Results of proximal ureteral stone treatment depend on available equipment, especially access to flexible instruments. Studies comparing semi-rigid (SR-URS) and flexible ureteroscopy (F-URS) show highly favorable stone-free rates (SFRs) after F-URS (91–93%) and only modest SFRs after SR-URS (68–76%) [1, 2]. Endoscopic manipulations often result in accidental relocation of ureteral stone to the collecting system, where it still can be

removed with F-URS, but usually not with a semi-rigid instrument. Although F-URS is a standard procedure in highly developed countries [3], until now many urological departments in countries with lower paid health systems are not equipped with flexible scopes. Thus this scenario remains a common problem as it is believed to be associated with numerous additional procedures and extra costs to remove a small stone from the kidney. Exact data on the number and type of procedures used in such instances and related complications

is not available while it is necessary to argue on the cost-effectiveness of F-URS.

The aim of this study was to evaluate methods used in the treatment of stones relocated from the ureter to the collecting system and their effectiveness when F-URS is not available.

## MATERIAL AND METHODS

Medical records of patients with ureteral and ureteropelvic junction stones incidentally or intentionally relocated to the collecting system were reviewed retrospectively in a single department. All procedures in the period of 2013–2016 were reviewed and only stones sized >4 mm were considered. The primary procedure was semi-rigid ureteroscopy or double-J stent (DJ) placement only carried out to treat ureteral lithiasis or related complications. Procedures used afterwards to remove relocated stones included extracorporeal shockwave lithotripsy (SWL), percutaneous nephrolithotripsy (PNL), SR-URS. At that period of time F-URS was available only temporarily at our department and it was used on a regular basis at two out of ten urological departments in our city. Patients treated with F-URS were excluded from the analysis.

All procedures were performed by urologists or by supervised urologists in training. The choice of procedures used for treating relocated stones was left to the urologist's and patient's discretion. Stone size, its radio-opacity and location in the collecting system as presented on tomography or intravenous urography were used to aid the decision. The European Association of Urology Guidelines on Urolithiasis were followed [3]. Patients with intentional stone relocation and same session PNL were excluded. Surgical protocols and clinical data from medical records were retrospectively analyzed. All surgical procedures performed from the time of stone relocation until the last follow-up studies were identified and counted. Final stone status was assessed by ultrasonography and kidney ureter bladder radiography. Stone-free status was defined as no visible stone fragments on those imaging studies.

SWL treatment was performed for radiopaque stones as an outpatient procedure using an electromagnetic lithotripter (Modulith SLX, Karl Storz, Germany). Before treatment, an intravenous dose of acetaminophen or non-steroidal anti-inflammatory drug was administered. No sedation and/or general anesthesia was needed. Stone targeting was done by fluoroscopy. Therapy was started at 12 kV and then increased gradually to 17 kV. A maximum of 3,000 shocks were delivered for each session (90–120 shocks/min) or until complete fragmentation of the stone had

occurred. Effects of the procedure were assessed 2 weeks later.

The URS procedure was performed using an 6/7.5F or 8/9,8F semi-rigid ureteroscope (Olympus, Japan). The holmium laser (Lumenis Versa Pulse 30 Watt, Lumenis Ltd., Yokneam, Israel) was used for intracorporeal lithotripsy. The power setting of holmium laser was 0.6 to 1.2 J. The pulse rate was set between 5 and 15 Hz. A double-J stent was placed after surgery. Stent was removed 2 weeks after surgery or as otherwise indicated.

PNL was performed in a prone position with a large cushion under abdomen. The tract was dilated with Alken metal dilators under x-ray guidance (Uroskop Omnia, Siemens, Germany) and 26F rigid nephroscope (Olympus Medical Systems, Tokyo, Japan) was used in all cases. Ultrasonic energy probe (Calcuson 27610020, Karl Storz, Germany) was used to shatter stones. Postoperative kidney drainage was assured by means of nephrostomy removed as soon as urine passage through the ureter was confirmed.

Continuous variables were presented as medians accompanied by ranges or interquartile ranges (IQR). Impact of continuous and categorical variables on stone free rates were evaluated with Mann-Whitney test and chi-square test respectively. For all statistical analyses a 2-sided P value <0.05 was considered statistically significant. Statistical analysis was performed with STATISTICA 12 (StatSoft, USA).

## RESULTS

In the years 2013–2016, 75 intentional or incidental procedures of pushing the ureteral stone back to the collecting system were identified in the records of the department. Follow-up was available for 70 patients. Four patients were treated with F-URS and excluded leaving 66 patients for analysis. Ureteral stone relocation was reported during URS (n = 58) or double-J stent placement (n = 8). Patients and stones characteristics are presented in Table 1.

In three patients (4%) the relocated stone remained in the collecting system symptomless and untreated. Seven patients (11%) passed their stone spontaneously. In 56 patients relocated stones were actively treated: in 45 cases removed (68%) and in 11 cases treatment failed (17%). Single procedure (SWL, URS or PNL) was performed in 15 patients, while in 41 patients more than one procedure was performed. Mean number of interventions in the whole group was  $2.6 \pm 2.1$  (range 0–10) and for those patients who underwent any procedure after stone relocation it was  $3 \pm 2$ . SWL was used in 41 (62%) patients with me-

dian number of 3 sessions per patient (1–9, IQR – 2). For 13 patients it was the only technique, while in 28 patients SWL was followed or preceded by other techniques (Table 2). Seven patients treated with SWL only were finally stone free, so overall success rate for SWL was 17%.

SR-URS was used in 21 patients (32%), including 5 patients as a primary treatment and 16 cases after failed SWL or other procedures. In 18 patients, treatment with SR-URS was effective (86%).

PNL was used as a primary method in 11 patients, while also in 11 it was used after failed SWL or URSL. Stone-free status was achieved after PNL in 22/22 patients (100%).

One case of ureteral stricture (after URS) and one case of severe bleeding (after PNL) requiring nephrectomy for this reason, were reported as serious complications.

There was no statistical difference in stone diameter, primary location, time from stone relocation to the first auxiliary procedure, and time with indwelling DJ stent between patients who achieved SFS and those who did not.

## DISCUSSION

In this retrospective study follow-up of 66 patients after endoscopic relocation of ureteral stone to the collecting system is presented. With mean number of 2.6 additional procedures per patient (not to mention minor procedures as stent change or removal) final SFR of 79% is a poor outcome taking into account published results of SR-URS, SWL or PNL [4–15].

One of the main reasons of long total treatment time and such results was the efficacy of SWL reaching only 17% which is much lower than efficacy provided by the literature [4, 5]. Although not analyzed in this study, we might suppose that patients were not selected for SWL according to known criteria such as stone-to-skin distance, body mass index or stone radiodensity and stone localization in the collecting system [9, 16, 17]. Results of SWL are also affected by case selection, personnel training and their involvement. All of those factors were not analyzed here as this was beyond the scope of this study. The main aim was to calculate real life numbers and effectiveness of procedures chosen according to availability and in line with the guidelines.

High PNL efficacy is indisputable also in our group, but this procedure bears the risk of serious complications [18] of which one also occurred in this short series. PNL was used for treating stones which could obstruct the ureter again when stone size

**Table 1.** Baseline demographic and clinical characteristics of patients with ureteral stones pushed back to the collecting system

Variable	
Group size; n	66
Gender (Male/Female); n	35/31
Age, mean (IQR); years	55 (24.2)
Follow-up time, mean (IQR); weeks	43.1 (33.2)
Primary procedure	
SR-URS + DJ; n	58
DJ placement; n	8
Intentional relocation	39 (59%)
Incidental relocation	27 (41%)
Stone size, median (IQR); mm	9 (7)
Stone size 5–10 mm; n (%)	42 (64%)
Stone size 11–20 mm; n (%)	24 (36%)
Primary stone position; n (%)	
Lower ureter	8 (12%)
Middle ureter	3 (5%)
Upper ureter	29 (44%)
Ureteropelvic junction	26 (39%)

DJ – double J stent, IQR – interquartile range, SR-URS – semi-rigid ureteroscopy

**Table 2.** Treatment modalities and their combinations used for management of stones relocated from the ureter to the collecting system

Procedure	Patients, n	Stone-free, n
Single SWL	2	1
Multiple SWL	11	5
SWL + SR-URS	15	13
SWL + PNL	10	10
Single SR-URS	4	4
SR-URS + SWL	1	1
SR-URS + PNL	1	1
Single PNL	9	9
PNL + SWL	1	1
PNL + SR-URS	1	1

SR-URS – semi-rigid ureteroscopy; PNL – percutaneous nephrolithotripsy; SWL – extracorporeal shock wave lithotripsy

or localization prevented from SWL or when other methods proved to be ineffective. SR-URS could be used only when the stone migrated to the ureter again or kidney anatomy and stone localization was favorable and its efficacy was high at those circumstances.

The method of choice for treating proximal ureteral stones and small renal stones nowadays is flexible ureteroscopy [3, 11]. However, high costs prevent

from widespread use of this technique in developing, low and middle income countries. Our country belongs to the group of high income countries according to the World Bank. However, 1000 euros paid by the national health payer is too little to trigger the fast proliferation of this method. It means that in a majority of urological departments in our country patients with relocated ureteral stones probably follow similar long, expensive and risky therapeutic paths. Comparison of F-URS and non-F-URS cost-effectiveness in such indication will be the aim of another analysis.

## CONCLUSIONS

Treating small stones relocated from the ureter to the collecting system in centers not equipped with flexible endoscopes is inefficient, time-consuming or too invasive. Data provided by this study is another argument for implementing flexible ureteroscopy in all departments dealing with urolithiasis irrespective of the healthcare system [19, 20].

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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