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RESEARCH ARTICLE

A Novel Technique for Relocating Renal Lower Calyceal Stones During Retrograde Intrarenal Surgery: ‘’Jab and Pull”

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Abstract
Objective : It is advised to move the stones from the lower calyx to the middle or upper calyx using a nitinol basket. In order to protect the flexible ureterorenoscopy and increase the stone-free rate during retrograde intrarenal surgery
In this descriptive study, we presented a method for moving stones to other calyces where the need for deflection is less, using holmium fiber in cases where the nitinol basket is not available.
Materials and Methods: With the “Jab and Pull” method we have described, 32 patients who underwent RIRS for symptomatic (pain or infection) renal lower calyceal stones with a diameter of 4-10 mm in our clinic, between 2012 and 2021 were retrospectively analyzed.
Demographic data, stone size, Hounsfield unit, number of stones, opaque non-opaque status, stone localization, infundibulopelvic angle, perioperative-postoperative complications, and control imaging were evaluated.
Results: The mean age of the patients was 51.12, and the female-male ratio was equal. The median stone size was 8mm (min:5, max:10), and the Hounsfield unit was 805 (±396.72). 75% (24) of the stones were single and 53.1% (17) were opaque. The median infundibulopelvic angle was 38 (min:19 max:52) degrees. 27 (84.4%) patients achieved stone-free status using this method. The renal lower calyx neck of two patients was too narrow, the stones of two patients were too soft, and the stone of one patient was inaccessible, preventing total success in these patients.
Conclusions: In cases where a nitinol basket is needed but cannot be reached during treatment of kidney lower calyx stones, the “jab and pull” method can be considered as an alternative in suitable patients.

Keywords: kidney stone, lower calyx, displacement, basket catheter

INTRODUCTION

The use of minimally invasive surgical procedures began to be applied more commonly than ever during the past two decades due to advancements in endoscopic equipment technology. Parallel to this, as a less invasive management option than the percutaneous approach, retrograde

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intrarenal surgery (RIRS) tended to play a significant role in managing kidney stones with the effective use of holmium laser technology (1). The European Association of Urology (EAU) urolithiasis guidelines recommend both RIRS and extracorporeal shock wave lithotripsy (ESWL) techniques as the first-line therapy options for renal lower-calyceal stones sizing less than 10 mm (2,3). As the ultimate goal of modern endourological applications is to achieve the highest stone-free status possibly in a single session, RIRS seems to be more advantageous than ESWL (4).

Flexible ureterorenoscopic (fURS) holmium laser treatment of lower calyceal stones is possible if the stone is reached with an effective deflection of the scope. Insertion of the holmium laser fiber through the working channel of the flexible scope may even restrict the deflection range, making it more difficult to access such stones(5). This difficulty may affect the stone-free rates and also reduce the durability of the flexible ureterorenoscope due to difficult, forced deflection maneuvers. In such situations, nitinol baskets were used to move the stones from lower calyx to the middle or upper calyceal position to increase the stone-free rates and protect the flexible URS. This maneuver was called a relocation or repositioning (6,7). However, it is clear that the use of a nitinol basket will bring an additional cost for the RIRS procedure(6,8,9).

In this descriptive survey study, we presented a new technique of displacing the symptomatic (pain or infection) lower-pole stones to the middle- or upper-pole calyces with the help of holmium laser fiber in cases where the nitinol basket cannot be manipulated well or additional cost of the baskets becomes a concern for the centers.

MATERIAL AND METHODS

Departmental data of patients undergoing endoscopic flexible ureteroscopy for renal stones between 2012 and 2021 was evaluated in a retrospective manner. All surgeries were performed by a single surgeon. Each patient underwent a preoperative, radiological evaluation consisting of non-contrast computed tomography (NCCT) and kidney-ureter-bladder (KUB) radiography. The opacity status of the stones was determined preoperatively using KUB. Patients in whom the lower calyceal stones were managed with the "jab and pull" technique used were evaluated in detail with respect to patient (age, gender, infundibulopelvic angle), stone (size, Hounsfield unit, number, opacity, location), and procedure (success, complication rates, hospitalization) parameters. Modified Clavien–Dindo classification was used for grading complications. A flowchart is given in Figure 1.

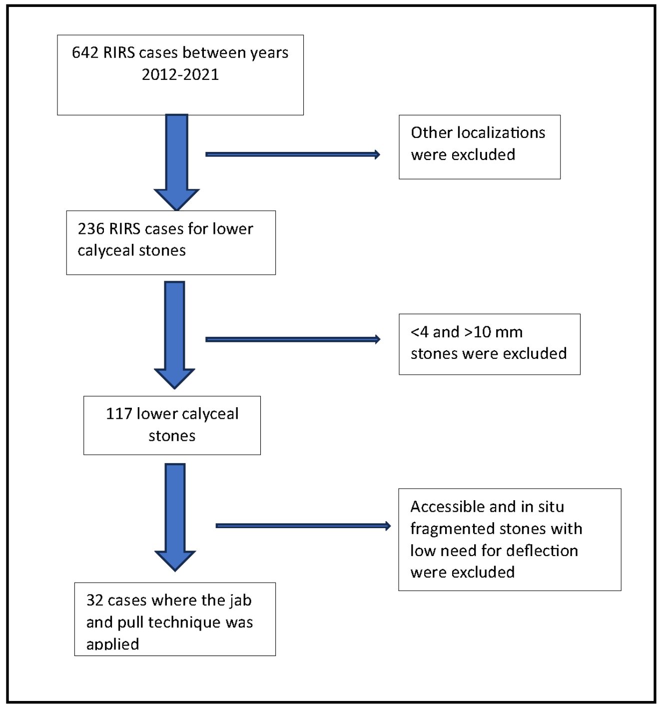

Figure 1. Flowchart of the study

Statistical Analysis

Statistical analyses were conducted using the SPSS-22.0 package program. Categorical variables were given count and percentage. The normality of data distribution was checked with the Shapiro-Wilk test. Normally distributed variables were expressed as mean (±Standart deviation), and the non-normally distributed ones were expressed as median (minimum, maximum).

Operative Technique

Our newly described technique consists of four steps. Following the placement of the ureteral access sheath, displacement of the stone is performed by our technique, and the stone is disintegrated with the help of a Ho-YAG laser. In the last step, a double-J stent is placed.

Placement of Ureteral Access Sheath

After performing semi-rigid ureterorenoscopy to examine the ureteric lumen and to dilate the orifice region, a 0.038-inch, soft-tipped safety guide wire is placed up into the involved renal collecting system under fluoroscopy (Figure 3a). Retrograde pyelography is done to identify the stone(s) and the characteristics of the renal collecting system. Following this procedure, a ureteral access sheath (10.7/12.7 Fr, Cook Medical, Bloomington, IN) is placed over the guide wire under fluoroscopy. A 7.5 F flexible ureterorenoscope (Storz FLEX-X2) is then passed into the renal pelvis through the access sheath. Starting from the upper pole, all calyces are systematically examined to identify radiolucent stones and their locations. In general, both active and passive deflection is required to guide the flexible scope to the stone in the lower-pole calyx (Figure 3b). However, in vitro studies have shown that the angle of deflection is limited when the 200-mm holmium laser fiber is places through the channel of the flexible ureterorenoscopy, which may reduce the performance of in situ stone fragmentation(5). Based on these facts, depending on the extent of reduction in deflection and the position of the stone, access and fragmentation of the stone in the lower pole may not be possible. In these cases, the stone has to be repositioned into a more dependable position for an easy and effective disintegration.

Stone Relocation with the Use of Laser Fiber

The flexible ureterenoscope is extended to its maximum deflection in order to reach the stone. In the upper third of the stone that can be reached, a hole is drilled large enough for the laser fiber to go through it (Figures 2a, 2b, 2c). This hole is used to insert the tip of the laser fiber (Figure 2d) into the stone body for displacement into the renal pelvis or upper pole by using the flexible ureterorenoscope by bringing its tip from deflection into flexion (Figures 2e, 2f, 3c). The crucial point is to be able to access at least a third of the stone's upper portion to perform this transport. Additionally, the lower calyx neck should also be larger than the stone size for an effective relocation.

Fragmentation of the Stone

The holmium laser fiber is withdrawn and removed from the stone. Then, with a laser setting of 0.6 J at 10 Hz, the stone is fragmented into <4 mm size for a successful spontaneous fragment passage after surgery (Figures 2g, 2h, 3d).

Double J Ureteral Stent Placement

Based on the amount of stone load residing at the end of the surgery, the performance of ureteral dilatation during the surgery, and the degree of trauma to the collecting system during manipulation, a double J stent will be placed after the completion of the procedure under fluoroscopy.

Stone-free Assessment

NCCT was used to establish a conclusive assessment of stone-free status 3 months after surgery.

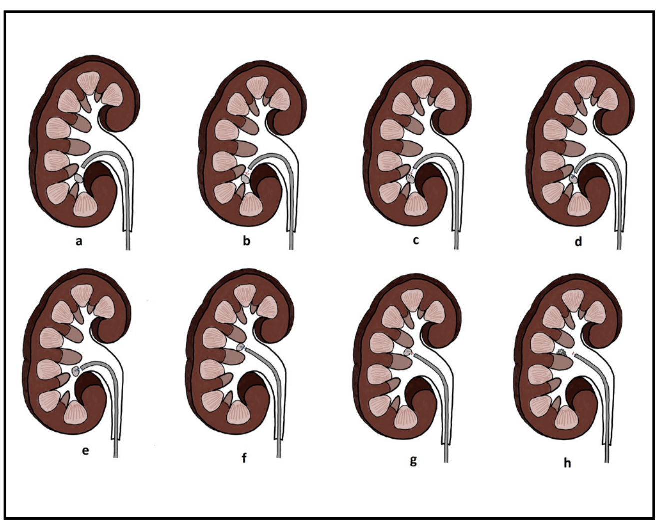

Figure 2.a-h: Explaining the technique with figures. The stone is seen in the lower calyx (a). The laser probe is advanced through the flexible ureterorenoscope (b). A hole is drilled in the upper part of the stone (c). The laser probe is inserted into the hole (d).The stone moves to the upper calyx (e, f). The laser probe is pulled through the stone (g). The stone is fragmented into pieces smaller than one millimeter (h).

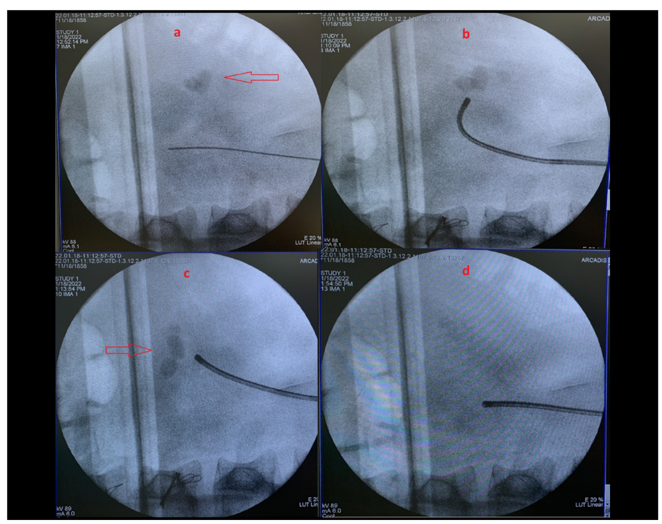

Figure 3.a-d: Fluoroscopy image of the technique. The stone is seen in the lower calyx(a). Angle of flexible ureterorenoscope and stones(b). Relocating stones to the upper calyx(c). Fragmentation of all stones(d).

RESULTS

Thirty-two patients (male/female 1:1) undergoing the "jab and pull" technique for lower pole stones sizing 4–10 mm were included in the study program. Mean age of the patients was 51.12 (±15.18). Stones were on the right side in 17 (53.1%) patients and on the left side in 15 (46.9%) patients. Regarding the stone-related factors, while the mean Hounsfield unit was 805 (±396.72), the median size was 8 mm (min:5, max:10). 75% (24) of the stones were single, and 53.1% (17) of them were opaque. The median infundibulopelvic angle was 38 degrees (min:19, max:52). Patients' characteristics and clinical findings are given in Table 1.

Evaluation of our findings demonstrated that, in 27 of 32 patients, the lower pole stones were disintegrated successfully following relocation into the pelvis or upper calyx using our technique. Regarding the underlying causes of failure in five unsuccessful cases, while the stones could not be displaced from the lower pole due to the narrow calyceal neck in two cases, stones were soft and the upper part was broken while drilling the hole in two other cases. The remaining part of the stone could not be reached for this maneuver. Lastly, the stone escaped to another lower calyx during manipulation, and tip of the scope with the laser fiber could not reach to the stone in this new position in the fifth case.

Table 1. Patients' Characteristics and Clinical Findings

		Count	% or ±SD
Gender	Male	16	50%
	Female	16	50%
Age		51.12	±15.18
Lateralization	Right	17	53.1%
	Left	15	46.9%
Presence of Hydronephrosis		8	25%
The success of the technique	Yes	27	84.4%
	No	5	15.6%
Number of Stones	Single	24	75%
	Mutiple	8	25%
Hounsfield Unit		805.78	±396.72
Opacity	Opaque	15	46.9%
	Non-Opaque	17	53.1%
Length of stay in hospital (day)		2	±0
Operative Time (min)		54.31	±9.24
		Median	**Min-Max**
Charlson Comorbidity Index		1.75	0-5
Infundibulopelvic Angle (°)		38	19-52
Size (mm)		8	5-10

DISCUSSION

Optimum treatment of renal lower calyceal stones is still to be defined due to certain factors such as stone size, calyceal anatomy and associated comorbidities(10). While ESWL and RIRS are defined as first options in the treatment of renal lower calyceal stones sizing smaller than 1 cm, percutaneous nephrolithotomy (PCNL) is being offered as second-line therapy(2,3).

However, accumulated data has clearly shown that flexible ureteroscopic laser disintegration could also be applied effectively in patients with bleeding diathesis, unfavorable intrarenal anatomy, morbid obesity, or ESWL-resistant stones(8). While Margaret P et al. found no significant difference in stone free rates in cases undergoing RIRS or ESWL for lower calyceal stones smaller than 1 cm, Sener E et al. found RIRS to be more effective for this aspect (4,11).

Although flexible scopes could be used effectively in the management of such stones, prolonged use and forced deflection may damage these devices any time during such manipulations(12). Moreover, passing a basket or laser fiber through the working channel of these fine instruments will certainly reduce the degree of deflection. Studies have clearly shown that the loss in the deflection angle is higher when one uses a 200-mm holmium laser fiber compared to the use of 3,2 Fr nitinol basket (5). Based on these facts, endourologists began to reposition (displace) the stones located in lower-calyceal position during and place them into middle or upper calyx in an attempt to increase the disintegration rate and reduce the extent of possible scope damage caused by forced manipulations (7). A nitinol basket has been generally recommended for this particular maneuver. With this aim, the lower calyx stone(s) is grasped with a nitinol basket and repositioned into the pelvis, middle calyx, or upper calyx of the involved kidney – a maneuver that protects the instrument by decreasing tension applied(8).

Additionally, moving the stone from the lower calyx to middle/upper calyx provides higher stone-free rates (6). In their original study, Schuster et al. demonstrated higher stone-free rates in the medium-sized (1–2 cm) lower-pole stones replaced and fragmented by using a basket than the stones fragmented in situ (13). In addition, in a study performed by Golomb et al. on 480 patients with lower-pole stones, the authors reached a stone-free rate of 94% using the basket and displacement technique in all cases (14). Finally, in a study published by Preminger G et al., the team examined 112 patients with lower-pole stones, in whom the stones were moved to another calyx with a basket during RIRS, and they found 85% of the cases to be stone-free(15).

On rare occasions, the stone grasped with the nitinol basket may be stuck in the calyx neck during the maneuver, and excessive, uncontrolled traction may break the basket. The flexible ureterorenoscope is removed from the body in this instance after the distal end of the basket catheter is cut. The stone that has become lodged in the basket is then broken up by entering from the side of the basket using a flexible ureterorenoscope, releasing the basket from the jammed location. In situations where this method is unsuccessful, percutaneous nephrolithotomy could be the option to remove the stone and basket fragments from the body (9,16).

With the new technique described in this study, 27 patients with lower calyceal stones sizing 4–10 mm were managed by moving the stones from the lower calyces to the middle and upper calyces without using a basket for displacement. All cases were completely stone-free, as demonstrated with NCCT performed at the postoperative 3-month follow-up evaluation. No complications were found in the complication evaluation based on the Modified Clavien Dindo classification. In the absence of a nitinol basket use, we think that this technique may be performed in cases in which the upper portion of the stone is accessible and the calyx neck is not narrow. We believe that this technique will decrease the operational time and cost of the procedure, due to the lack of need for a basket, and increase the success rates by enabling the surgeons to disintegrate the stones in a more effective manner.

Limitations

It is impossible to claim that our study is without flaws. It should be noted here that, because it is a retrospective study with a limited sample size, the results may not be very generalizable. Second, the study did not compare its findings to the basket displacement, which is the most popular technique for moving stones. Future studies should incorporate this kind of comparison. It should also be noted that there are baskets with a thickness of less than 3.2 Fr that improve the deflection angle. This method also needs to be compared using baskets of different thicknesses. Lastly, the inability to perform stone analysis in any of the patients due to laboratory inadequacies is one of the shortcomings of the current study.

CONCLUSIONS

Regarding the treatment of lower-calyx stones, our newly defined "jab and pull" method could be applied successfully in cases where the nitinol basket cannot be passed into the stone site for various reasons during RIRS procedure. Our current results have demonstrated that this technique can be considered as an alternative in selected cases to increase the stone-free rates and reduce the possibility of scope deterioration due to excessive (forced) deflection. However, we believe that further studies with larger series of patients are needed to support the clinical effectiveness of our technique.

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