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Original research article

Stone retropulsion during ureteroscopy: Hospital-based study

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Abstract

Background and Objectives: For ureteric stones that do not respond to medical expulsive therapy or shockwave lithotripsy, ureteroscopic lithotripsy is regarded the first-line treatment. The goal of this study was to examine a modified strategy for stone entrapment using the Dormia basket to avoid proximal stone migration during ureteroscopic pneumatic lithotripsy of ureteric stones.

Material and Method: Our analysis included all cardiac patients who underwent ureteroscopic pneumatic lithotripsy for ureteric stones 15 mm in size. Study was done between July 2022 to June 2023. Study was conducted at the Department of Urology and Cardiology, St John's Medical College Hospital, Bengaluru, Karnataka, India. The study had two limbs that were conducted over two consecutive periods; the first arm included 70 patients was used, and the second arm included 80 patients.

Result: Gender, age, and stone properties were comparable in both groups. Lower ureteric stones were the most common, accounting for 16.7% of all cases, whereas upper ureteric stones were discovered in 16.7% and 17.4% of cases, respectively. There was a considerable difference in operative time, with the mean operative time in Group 1 being 50 minutes against 56 minutes in Group 2. The complications were modest and comparable between groups. Although there was no difference in hospital stay between the groups, the cost analysis favored Group 2.

Conclusion: We discovered that our modified-basket stone entrapment technique outperformed in preventing stone retropulsion during ureteroscopic pneumatic lithotripsy. Our basket alteration was proven to be practicable, efficient, safe, reproducible, and cost-effective in reducing proximal stone migration. This method is very useful in low-cost situations.

Keywords: Stone entrapment, stone retropulsion, lithotripsy, pneumatic

Introduction

Urinary stone patients who have not responded to medical expulsive therapy or shockwave lithotripsy (SWL) are good candidates for ureteroscopic lithotripsy, which is a type of lithotripsy that is performed through the ureter [1, 2]. The improvements in ureteroscope design and construction, in addition to the advancements in stone retrieval tools, are largely responsible for the high success rate of ureteroscopic stone extraction that has been documented. Stones that are retropelled or migrate upward during ureteroscopic lithotripsy lower the success percentage of the procedure. To a large extent, the retropulsion velocity is determined by the lithotripter and ureteric stone kinetic energy. Proximal stones migrate at a quicker pace than distal stones do [3, 4].

In the event that a stone or a fragment of a stone moves, it is possible that additional procedures, such as flexible ureteroscopy, or secondary operations, such as SWL, along with the costs connected with them, will be required [5]. This is due to the fact that untreated stone fragments have the potential to act as nidi for the production of following stones. The N-Trap, the Back stop, and the Accordion are just a few of the many different kinds of barriers that have been developed to combat this problem [6]. The total cost of the operation is increased as a result of all of these tools. After receiving laser lithotripsy, there is a very low chance that a stone will be dislodged and sent back into the urinary tract. As laser lithotripsy has become more widespread, the requirement for additional equipment to prevent retropulsion during the procedure has decreased at many different institutions. However, because of the prohibitively high cost, countries that have few resources have been unable to implement it on a wider scale [7]. There are not enough resources available in many hospitals in developing nations for the acquisition and ongoing maintenance of laser equipment. In order to prevent the stones from being thrown back into the urinary tract during ureteroscopic pneumatic lithotripsy, our team suggests reviving an older approach that involves dismantling a Dormia basket [8, 9].

During ureteroscopic pneumatic lithotripsy, our facility uses a modified basket stone entrapment method to limit proximal stone migration. This is done in order to reduce complications. We might be able to avoid the expensive expense of anti-retropulsion equipment this way, as well as address the paucity of laser lithotripters at facilities in low-income areas, if we take this course of action [10, 11].

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Material and Methods

Our analysis included all cardiac patients who underwent ureteroscopic pneumatic lithotripsy for ureteric stones 15 mm in size. Study was done between between July 2022 to June 2023. Study was conducted at the Department of Urology and Cardiology, St John's Medical College Hospital, Bengaluru, Karnataka, India. The study had two limbs that were conducted over two consecutive periods; the first arm included 70 patients was used, and the second arm included 80 patients.

Preoperative assessment

To locate and measure the stones, a non-enhanced multi-detector CT scan was performed. Sensitivity, culture, and a urine analysis were performed, as well as any other standard laboratory testing. Prior to surgery, a prophylactic antibiotic was given to each patient. To be considered a success, the operation had to be completed without resorting to any sort of further procedures or the retropulsion of stone fragments. Retropulsion was considered when the stone or shards rose out of the ureteroscopy viewing area. Patient characteristics, stone criteria, operation time, intraoperative complications and postoperative success rates were recorded and analyzed.

Statistical analysis

The average is shown for the results. The statistical analysis was performed on Microsoft Windows using SPSS 11.0 for the social sciences. Statistical significance was determined using Student's t-test, chi-square, and Fisher's exact tests. The cutoff for statistical significance was set at P 0.05.

Result

Table 1 displays the distribution of ages, genders, and stone properties among the two groups. The most common type of ureteral stone was found in the lower ureter (representing groups 1 and 2), while the most common type of mid-ureteral stone was found in the upper ureter. Analysis of chemical composition found that 51.3% and 51.1% of stones in groups 1 and 2, respectively, were calcium oxalate.

Table 1: Stone and demographic data of patient

Sr. No.	Variables	Group 1	Group 2
1.	No. of patients	70	80
2.	Patient Gender		
	Male	46	53
	Female	24	27
3.	Patient age (in years)	36	37
4.	Stone size (mm)	14.1	14.0
5.	Stone Location in ureter		
	Upper	12	13
	Middle	14	16
	Lower	44	51
6.	Stone content		
	Ca-Oxalate	38	50
	Urate	17	20
	Mixed stones	7	5
	Triple Phosphate	8	5
7.	Stone Opacity		
	Radiolucent	30	30
	Radio-opaque	40	50
8.	Laterality (n)		
	Left	34	36
	Right	36	44

In both Group 1 (57%) and Group 2 (58.1%), the majority of the stones were visible on a radiograph. The median operative time for Group 2 was 50 minutes, while the median for Group 1 was 56 minutes. Six patients in Group 1 experienced retropulsion (four upper and two middle ureteric stones), and after MET failure, SWL was performed in four and flexible ureteroscopy was necessary for two. Two patients in Group 2 had retropulsion (one with a middle ureteric stone and one with an upper ureteric stone), both of whom benefited with MET.

Table 2: Result summary

Sr. No.	Variables	Group 1 (70)	Group 2 (80)
1.	Operation time (min)	50.0	56.0
2.	Success rate (%)	65	82
3.	Complications (%)	8	11
	Minor (%)	0	3
4.	Hospitalized	16.0	16.0

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The Dormia was successfully removed under direct visualization in four cases where the wires were accidentally torn, and a new device was implanted without causing any damage to the ureter. In this study, there was no statistically significant difference in length of hospital stay between the groups.

Discussion

One of the most popular treatments for ureteral stones is ureteroscopy, which typically results in a stone-free rate of 95% and low morbidity. Longer operational times, more often occurring residual stones, and the necessity for auxiliary operations may result from proximal stone migration, along with increased morbidity and cost. The retropulsion rate of pneumatic lithotripters is known to be higher than that of laser lithotripters. Several maneuvers, such as the reverse Trendelenburg position and reduced irrigation pressure and flow rate, have been described to minimize proximal stone migration; however, these approaches may impair surgeon comfort and visibility [12, 13].

Increasing the success rate of pneumatic lithotripsy requires the use of anti-retropulsion devices because of the scarcity of flexible ureteroscopes. Entrapment net, Accordion, BackStop, lidocaine jelly, and thermophilic polymers are just few of the devices developed to reduce the risk of proximal stone migration during ureteroscopic lithotripsy [14].

To prevent proximal stone migration during ureteroscopic pneumatic lithotripsy, we compared to the Dormia basket stone entrapment device. With an SFR of 85.2% and a retropulsion rate of 7.1%, pneumatic lithotripsy was performed by Tunc *et al*. for ureteric stone breakdown in 156 patients in 2007. On the other hand, Sözen *et al*. reported a 95% SFR and a 2% migration rate after using pneumatic lithotripsy on 500 patients. There was no usage of anti-retropulsion equipment by either of them [15, 16].

In the current investigation, we modified the process of disassembling a Dormia basket in order to avoid retropulsion of stones during pneumatic lithotripsy. Although many urologists may employ this method, the outcomes of its application have not been adequately reported. In 2008, Kesler *et al*. reported a comparable method with an SFR of 87% using a nitinol stone retrieval basket made by Escape TM (Boston Scientific) that is specifically intended to trap calculi and permit simultaneous laser lithotripsy. In many cases, such as with impacted stones, the device is unable to adequately manage the stone interaction. The process will be more costly due to the use of this device rather than the conventional nitinol wire baskets [17-19].

In the current investigation, the SFR with basket stone entrapment was 97.7% with no need for extra operations, while the SFR was 91.7%. But in their research employing and N-Trap, Shabana *et al*. found success rates of 97.1% and 95.7%, respectively. It is common knowledge that serves as a 'backstop' and should not be used to remove stones [20, 21]. So, the increased frequency of stone fragments in Group 1 of our present investigation may be due to the fact that smaller bits (3 mm) may escape. Minor complications have been recorded between 0% and 15.4% of the time during ureteroscopy. Perforation and avulsion of the ureter are serious complications that should be avoided at all costs. Retrograde pyelography performed at the conclusion of the technique revealed slight mucosal abrasion in nine individuals in Group 1 and 12 in Group 2, but no serious ureteric injuries were reported [22, 23].

Ureteric injuries were recorded in 9.2% of patients overall by Shabana *et al*., with ureteric perforation occurring in 6% of those cases. Desai *et al*. found only five cases (10%) with slight mucosal abrasion and no serious consequences. The stated outcomes are unclear since the corresponding studies do not provide a clear description of clinically significant remaining pieces [24]. One-twelfth of patients in a study was used as the anti-retropulsion device had residual fragments of >3 mm, but no further maneuvers were necessary. In contrast, 2.9% and 4.3% of patients and N-Trap groups, respectively, reported residual fragments. Only two Group 2 cases had any remnants of fragments after our analysis. The rate at which stones are repelled by irrigation fluid depends in part on its pressure. With our basket entrapment method, the stone is safely contained within the Dormia basket, preventing it from escaping into the irrigation fluid and obstructing the view [23-25].

Recent anti-retropulsion devices for intracorporeal lithotripsy have a good track record of safety and efficacy. There are benefits and drawbacks to each gadget, and it's important to weigh those against the price tag. These modern tools have a high percentage of success, but they come at a higher price. Due to the necessity of using both devices in Group 1, the total cost for each patient in that group was $466 more than it was for those in Group 2. Patients in Group 1 also incurred additional expenses due to ancillary procedures [26, 27].

Although the American Urological Association currently recommends ureteroscopy for proximal ureteric stones, which eliminates the need for anti-retropulsion devices, our method is useful in situations where neither flexible ureteroscopy nor laser lithotripsy are available, as is the case in many centers in developing countries.

Conclusion

In order to minimize proximal stone migration during ureteroscopic pneumatic lithotripsy, entrapping the stone in a recycled basket is a practical, efficient, safe, and cost-effective option. The process is very

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important for low-cost healthcare facilities to consider. Our method of basket stone entrapment is risk-free, repeatable, simple to execute, and very effective for all types of stones, whatever their hardness, at no extra expense, which is a significant factor for individuals in developing nations and with low means. Our current study has some limitations, such as its retrospective character and its relatively small sample size. We encourage more randomized prospective trials to confirm the efficacy and safety of this method in the clinic.

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Conflict of interest: Nil.

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