

Original Article

Comparing Ureteral Catheterization's Impact on Flank Pain Post Ureteroscopic Stone Management

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ABSTRACT

Background: Urolithiasis, or kidney stone disease, is a prevalent condition that poses significant challenges in urological practice. The management of ureteral stones, particularly through ureteroscopy, is a common intervention. The use of short-term ureteral catheterization as a postoperative pain management strategy following ureteroscopic stone removal has been a subject of debate, with limited evidence on its efficacy and necessity.

Objective: This study aimed to evaluate the effectiveness of short-term ureteral catheterization in reducing postoperative flank pain compared to non-catheterization in patients undergoing uncomplicated ureterolithotripsy for the management of distal ureteral stones.

Methods: A prospective, randomized, controlled trial was conducted at Liaquat National Hospital, Karachi, from January to July 2013, involving 60 patients aged 15-70 years with distal ureteral stones less than 1.0 cm. Patients were randomized into two groups: Group A received short-term ureteral catheterization, and Group B did not. The primary outcome measured was the reduction in mean pain score by at least 4 points from the baseline at every 6-hour interval for the first 24 hours post-procedure. Statistical analysis was performed using SPSS version 25, applying chi-square tests, independent sample t-tests, and Mann-Whitney tests, with a p-value of less than 0.05 considered significant.

Results: Both groups demonstrated a significant reduction in pain scores at 12, 18, and 24 hours post-operation. However, there was no significant difference in pain reduction between the catheterized (Group A) and non-catheterized (Group B) groups, with p-values of 0.55 for efficacy in pain reduction. The mean age, stone size, and postoperative hospital stay did not significantly differ between the groups, indicating that short-term ureteral catheterization did not offer additional benefits in managing postoperative pain or recovery.

Conclusion: Short-term ureteral catheterization following uncomplicated ureterolithotripsy does not significantly improve pain management compared to non-catheterization. This suggests that routine catheterization may be unnecessary, potentially leading to a paradigm shift in postoperative care for patients undergoing ureteroscopic stone removal. Future studies with larger sample sizes and long-term follow-up are needed to further validate these findings.

Keywords: Urolithiasis, Ureteroscopy, Ureteral Catheterization, Postoperative Pain, Ureterolithotripsy, Randomized Controlled Trial.

INTRODUCTION

Urolithiasis, or kidney stone disease, represents a significant global health challenge, affecting an estimated 4% to 15% of the population at some point in their lifetimes (1). This condition is both chronic and recurrent, leading to a high clinical burden, with recurrence rates of up to 75% within two decades (2, 3). In regions such as Pakistan, urolithiasis has emerged as a major urological issue, presenting morbidity rates on par with diseases like diabetes (4). The management of ureteral stones, which account for about 20% of urolithiasis cases and are predominantly found in the lower ureter, largely depends on the size of the stones. Stones smaller than 4 mm often pass spontaneously, while those larger than 5 mm typically require intervention (5, 6). Medical expulsive therapy

(MET) is usually the first line of treatment; however, when MET fails, alternative methods like shock wave lithotripsy (SWL) and ureteroscopy (URS) are considered, with URS being preferred for stones larger than 10 mm due to its higher success rate (7, 8, 9). Despite ureteroscopy's effectiveness, the procedure is not without risks. Major complications such as ureteral perforations and avulsions, though rare (occurring in approximately 1% of cases), can have significant consequences (10, 11, 12). Advances in surgical techniques and equipment have significantly reduced these risks. The use of adjunctive tools like baskets or graspers alongside the ureteroscope has improved both the safety and efficiency of the procedure, especially in stone fragmentation (13). In cases of complications like ureteral avulsion, surgical solutions such as ureteroneocystostomy or, for more severe cases, renal autotransplantation, are employed.

The formation of calcium stones, the most common type of kidney stones, is influenced by factors such as urinary pH, volume, and the levels of calcium, oxalate, and citrate (14, 15). Idiopathic hypercalciuria is a notable risk factor, with increased levels of calcitriol potentially exacerbating calcium excretion due to genetic factors or dietary habits (16, 17, 18). Although the contribution of hyperoxaluria to stone risk is influenced by diet and metabolism, it is considered to be less significant (19).

Diet plays a critical role in both the risk of developing urolithiasis and its management. Interestingly, a higher intake of dietary calcium has been found to reduce the risk of stone formation, likely because it binds with dietary oxalate, reducing its absorption (20, 21, 22). However, calcium supplements, which are often consumed without meals, do not provide the same benefit (23). The intake of potassium is also important, with higher levels potentially reducing stone formation by decreasing urinary calcium excretion and increasing urinary citrate levels (24). On the other hand, high sodium and animal protein diets may increase the risk by affecting urinary calcium and citrate levels (24).

A study conducted in Texas over a 15-year period highlighted the multifactorial nature of kidney stone disease, identifying multiple risk factors, with hypercalciuria being the most common (25). This complexity underlines the need for a comprehensive approach to management and prevention, involving dietary and lifestyle changes in addition to surgical interventions where necessary. Such an approach demands a deep understanding of the interplay between dietary factors, genetic predispositions, and environmental factors in the formation and recurrence of kidney stones.

MATERIAL AND METHODS

This study aimed to evaluate the efficacy of short-term ureteral catheterization in alleviating flank pain subsequent to ureteroscopic management of distal ureteral stones. Conducted as a randomized control trial, the research took place in the Department of Urology at Liaquat National Hospital, Karachi, spanning a six-month period from January 8, 2013, to July 9, 2013. Participants were individuals aged 15 to 70 years, undergoing ureteroscopy for the treatment of distal ureteral stones less than 1.0 cm in diameter. This group included patients who had not responded to medical expulsive therapy for stones of similar size or were experiencing uncontrolled pain. Exclusion criteria ruled out patients with multiple or impacted ureteral stones, those who sustained clear trauma, mucosal injury, or perforation during the ureteroscopy, patients who underwent bilateral ureteroscopy, and instances necessitating ureteral dilatation during the procedure.

Distal ureteral stones were identified as those located from the inferior border of the sacroiliac joint to the uretero-vesical junction. The methodology for short-term ureteral catheterization involved the placement of a 4f polyurethane ureteral catheter within the ureter for 24 hours following the ureteroscopic procedure. An uncomplicated ureteroscopy was defined as an endoscopic procedure facilitating intracorporeal lithotripsy in the presence of a ureteric stone, devoid of intraoperative complications like ureteral trauma, and without the burden of residual stones. The study defined efficacy as a decrease in the mean pain score by a minimum of 4 points from the baseline at each 6-hour interval for the first 24 hours post-procedure.

The study required a sample size that provided a 90% power of the test and a 95% confidence interval, resulting in a total of 60 patients, evenly divided into two groups. The selection of participants was performed using non-probability consecutive sampling. All eligible patients who provided informed consent were randomized into two groups via a computer-generated list. Group A underwent ureteral catheterization, whereas Group B did not. A semi-rigid ureteroscope (Wolf 7.8f) and intracorporeal pneumatic lithotripsy were utilized for ureteroscopic management in both groups. In Group A, both the ureteral and Foley catheters were removed after 24 hours, while no catheter was employed in Group B. Patient pain was evaluated every 6 hours using the faces pain rating scale.

Data was collected from all consenting and eligible participants. The study adhered to the ethical principles outlined in the Declaration of Helsinki regarding medical research involving human subjects. Ethical approval for the study was obtained from the institutional review board of Liaquat National Hospital, Karachi, ensuring that all procedures performed were in accordance with ethical standards.

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 25. Quantitative variables, such as age, stone size, pain score, and duration of postoperative hospital stay, were analyzed and presented as mean \pm standard deviation (SD). In contrast, qualitative variables, including the requirement for analgesics and efficacy, were expressed as frequencies and percentages. The chi-square test was utilized to compare the efficacy between the two groups, with stratification performed to adjust for variables such as age and stone size. The significance of differences between groups was determined by a p-value of less than 0.05. Furthermore, independent sample t-tests and Mann-Whitney tests were applied to assess the mean age and median stone size between the groups, respectively.

RESULTS

In this randomized control trial conducted to assess the effectiveness of short-term ureteral catheterization in reducing flank pain after ureteroscopic management of distal ureteral stones, a total of 60 patients were analyzed. The overall demographic and stone characteristics are summarized in Table 1, revealing an average age of 31.68 years among the participants. The confidence interval for the mean age ranged from 28.73 to 34.64 years, with a median age of 28 years and a standard deviation of 11.44. The stone size averaged 0.74 cm, with the 95% confidence interval for mean stone size extending from 0.69 to 0.78 cm, a median stone size of 0.7 cm, and a standard deviation of 0.16 cm. The range of stone sizes spanned from a minimum of 0.5 cm to a maximum of 0.9 cm, with an interquartile range of 0.3 cm.

Table 1: Overall Descriptive Statistics of Age and Stone Size (n=60)

Statistic	Age (Years)	Stone Size (cm)
Mean	31.68	0.74
95% Confidence Interval		
- Lower Bound	28.73	0.69
- Upper Bound	34.64	0.78
Median	28.00	0.70
Standard Deviation	11.44	0.16
Minimum	16	0.50
Maximum	57	0.90
Interquartile Range	19	0.30

Table 2: Comparison of Mean Age Between Groups (n=60)

Group	Age (Years) Mean \pm SD	P-Values
Group A	32.37 \pm 11.43	0.648
Group B	31.00 \pm 11.60	

Table 3: Comparison of Efficacy Between Groups for the First 24 Hours

Efficacy	Group A (n=30)	Group B (n=30)	P-Values
Yes (Mean pain reduced by \geq 4 points from baseline)	29 (96.7%)	28 (93.3%)	0.55
No (Mean pain not reduced by \geq 4 points from baseline)	1 (3.3%)	2 (6.7%)	

Table 4: Comparison of Stone Size, Postoperative Pain Scores, and Hospital Stay in Patients

Parameters/Time Interval	Group A (Mean \pm SD)	Group B (Mean \pm SD)	P-Values
Stone Size (cm)	0.76 \pm 0.15	0.72 \pm 0.16	0.33
Pain Score at 6 hours	3.07 \pm 1.46	3.4 \pm 1.40	0.37
Pain Score at 12 hours	1.73 \pm 1.55	2.33 \pm 1.75	0.16
Pain Score at 18 hours	1.47 \pm 1.27	1.87 \pm 1.47	0.26
Pain Score at 24 hours	0.93 \pm 1.14	1.13 \pm 1.25	0.52
Hospital Stay (Days)	1 \pm 0	1 \pm 0	1.00

Comparing the mean age between the two groups revealed no significant difference, as illustrated in Table 2. Group A, which underwent ureteral catheterization, had a mean age of 32.37 years with a standard deviation of 11.43, while Group B, which did not

receive catheterization, had a mean age of 31 years with a standard deviation of 11.60, yielding a p-value of 0.648. This suggests that age did not significantly influence the outcomes between the two groups.

The efficacy of ureteral catheterization in reducing postoperative pain was a primary focus of this study, and the findings are detailed in Table 3. In Group A, 96.7% (29 out of 30) of the patients experienced a reduction in mean pain by at least 4 points from the baseline within the first 24 hours post-procedure, compared to 93.3% (28 out of 30) in Group B, resulting in a p-value of 0.55. This indicates that there was no significant difference in pain reduction between patients who received ureteral catheterization and those who did not.

Additionally, Table 4 presents a comprehensive comparison of stone size, postoperative pain scores at various time intervals, and hospital stay duration between the two groups. The mean stone size was slightly larger in Group A (0.76 cm \pm 0.15) compared to Group B (0.72 cm \pm 0.16), but the difference was not statistically significant (p-value = 0.33). Pain scores were systematically lower in Group A at all measured time points (6, 12, 18, and 24 hours post-procedure) compared to Group B, though these differences did not reach statistical significance, with p-values of 0.37, 0.16, 0.26, and 0.52, respectively. Both groups had an identical average hospital stay of 1 day (\pm 0), indicating that short-term ureteral catheterization did not affect the length of hospitalization (p-value = 1.00).

DISCUSSION

In the conducted prospective, randomized, controlled study, the primary objective was to evaluate the benefits and drawbacks of ureteral catheterization subsequent to uncomplicated ureterolithotripsy, marking a pioneering effort within the Pakistani context to delve into the necessity of short-term ureteral catheterization within the first 24 hours post-ureteroscopy for ureteral stones. This investigation stood out as a significant contribution to the ongoing debate regarding the routine application of stenting or catheterization following ureteroscopic procedures, a topic that has elicited varied perspectives in prior research endeavors.

Historically, the practice of placing ureteral catheters following ureterolithotripsy was advocated by researchers such as Aoyagi et al., which underscored a longstanding recommendation within the medical community. However, this convention was challenged by Hosking et al., who posited that postoperative discomfort could be effectively managed with medication, thereby questioning the necessity of routine catheterization post uncomplicated ureteroscopy. This divergence in the literature underscored the absence of consensus and highlighted the imperative need for more rigorously controlled trials to ascertain the utility of this practice.

The present study sought to measure the efficacy of catheterization through the lens of pain reduction, quantified by a decrease in the mean pain score of at least 4 points at each 6-hour interval within the initial 24 hours post-procedure. The findings indicated a notable reduction in pain across both groups at 12, 18, and 24 hours post-operation, yet failed to demonstrate a significant difference between those who underwent catheterization and those who did not. These observations resonate with the findings of Djaladat et al., who associated the absence of catheterization with increased flank pain due to early ureteral edema, suggesting catheterization as a mitigative measure. Conversely, the stance of Hosking et al., which downplays the necessity of routine catheterization following uncomplicated ureteroscopy, found an echo in our study, particularly given the modest requirement for postoperative analgesics observed.

Further complicating the discourse around ureteral catheterization and stenting are the reports indicating significant symptomatology associated with stent placement, with studies by Akman et al., and Siddiq et al., delineating the discomfort linked to internal stents. Retrospective analyses have suggested that stented patients post-ureteroscopy may experience heightened urinary symptoms and a greater need for narcotics compared to their non-stented counterparts. Nonetheless, the literature remains scant on prospective studies in this domain, though research by Silletti et al. hints at fewer bladder irritative symptoms and overall better tolerance of the procedure in patients without stents following distal ureteroscopy for stone removal.

The study, despite its contributions, is not without limitations. The modest sample size and the singular center origin of the data pose challenges to the broader applicability of the findings. Additionally, the short duration of data collection and the absence of long-term follow-up precluded the documentation of potential long-term complications, delineating a critical area for future research.

This investigation elucidates that while short-term ureteral catheterization presents a simplistic and cost-effective strategy to manage postoperative flank pain following uncomplicated ureterolithotripsy, its efficacy in pain reduction does not significantly surpass that of foregoing catheterization. Accordingly, the routine employment of temporary ureteral catheterization post-uncomplicated ureteroscopic stone management appears unwarranted. This study not only adds to the existing body of knowledge but also beckons further research, particularly studies encompassing larger, multi-center cohorts and extended follow-up periods, to comprehensively evaluate the long-term outcomes and potential benefits of ureteral catheterization in the postoperative care of ureteroscopic stone management.

CONCLUSION

The conclusion of this study underscores that short-term ureteral catheterization post-uncomplicated ureterolithotripsy does not significantly enhance pain management compared to non-catheterization approaches, suggesting its routine use may be unnecessary. This finding holds important implications for human healthcare, potentially leading to a shift in postoperative care practices for ureteroscopic stone management. By eliminating unnecessary catheterization, healthcare providers can reduce patient discomfort, lower the risk of catheter-related complications, and possibly decrease healthcare costs without compromising the effectiveness of pain management. This insight encourages the reevaluation of standard practices and supports a more individualized approach to postoperative care, aligning with the broader goal of improving patient outcomes and satisfaction in urological treatment.

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