Section: Urology

Original Research Article

COMPARING THE CLEARANCE RATE OF LOWER CALYCEAL STONE USING SINGLE-USE VS REUSABLE FLEXIBLE URETEROSCOPY: INSTITUTIONAL EXPERIENCE

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Abstract

Background: Lower calyceal stones pose significant treatment challenges because of their anatomical location, which impacts stone clearance rates. Flexible ureteroscopy is a key treatment modality, with reusable and single-use ureteroscopes widely used. This study aimed to compare the residual stone rates, operative time, and postoperative outcomes between reusable and single-use flexible ureteroscopes in the management of lower calyceal stones. **Materials and Methods:** This retrospective case-control study included 102 patients from the Department of Urology. The patients were divided into two groups of 51 each: In Group A single-use flexible ureteroscopes (KMC) were used, and in Group B reusable flexible ureteroscopes (ROY), were employed. Preoperative evaluation included demographic data, clinical history, and imaging studies such as unenhanced CT scans to confirm the location, size, and anatomy of the stone. **Result:** The mean operative time was identical in both groups (60.16 ± 8.10 min). Group A had a higher stone-free rate (80.4% vs. 62.7%, p=0.048) and fewer residual stones (19.6% vs. 37.3%). Preoperative DJ stenting was more frequent in Group A (64.7% vs. 51%, p=0.16), but the difference was not significant. Gender distribution and stone laterality were similar between groups, with no significant differences. The mean stone size (Group A: 15.92 ± 5.32 mm; Group B: 16.1 ± 4.46 mm, p=0.858) and Hounsfield Unit values (Group A: 1139.27 ± 259.35; Group B: 1134.65 ± 267.08, p=0.929) were comparable. **Conclusion:** This study concludes that single-use ureteroscopes are superior to reusable flexible ones for managing lower calyceal stones, demonstrating significantly higher stone clearance rates and better efficacy in achieving a stone-free status.

INTRODUCTION

Kidney stones are a prevalent urological condition affecting 10-12% of the global population, with a higher prevalence in developed countries due to lifestyle and dietary factors.[1] These stones are hard deposits formed primarily from calcium oxalate, uric acid, or struvite and are associated with risk factors such as obesity, dehydration, high-sodium diets, and genetic predisposition.[2] Lower calyceal stones pose unique treatment challenges because of their location in the most dependent region of the kidney. The acute angle and narrow infundibulum of the lower pole limit stone mobility, decreasing the effectiveness of shock wave lithotripsy and complicating stone retrieval.[3] Failure to achieve complete stone clearance in this region increases the risk of stone recurrence and related complications like hydronephrosis, renal impairment, and persistent pain.[4]

Flexible ureteroscopy has emerged as a cornerstone of minimally invasive treatment for kidney stones, particularly for challenging lower pole calculi.[5] With technological advancements, both reusable and single-use flexible ureteroscopes are now widely used. Reusable ureteroscopes are cost-effective for high-volume centres but are prone to wear and tear, leading to reduced deflection capacity and impaired visualisation over time.[6] Furthermore, reprocessing and sterilisation can introduce a risk of contamination, potentially increasing postoperative infection rates.[7] In contrast, single-use flexible ureteroscopes ensure sterility and consistent performance for each procedure. Studies have shown that these devices offer higher stone-free rates (SFR) and shorter operative times than reusable alternatives.[8] However, their higher cost remains a

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significant drawback, particularly in resource-limited settings. A prospective case-control study comparing single-use and reusable ureteroscopes demonstrated a higher SFR for single-use devices but no significant differences in complication rates.[9]

Despite advancements in flexible ureteroscopy, there is no clear agreement on the optimal choice of single-use or reusable device specifically for lower-pole stones. Lower pole stones present unique technical challenges that demand superior manoeuvrability, deflection, and visualisation to achieve successful outcomes.[10] While single-use devices offer advantages in sterility and performance, questions remain about their cost-effectiveness and real-world clinical superiority.[11] This study addresses the critical gap in comparative data by evaluating the stone clearance rates of lower calyceal stones using single-use and reusable flexible ureteroscopes. Prior studies suggest that single-use devices may offer better outcomes, particularly in complex anatomical scenarios, but comprehensive evidence remains lacking.[12]

Aim

This study aimed to compare the stone clearance rates of lower calyceal stones using single-use and reusable flexible ureteroscopes in terms of the stone-free rate (SFR), operative time, postoperative complications, and cost-effectiveness.

MATERIALS AND METHODS

This retrospective case-control analysis was conducted on 102 patients at the Department of Urology. This study was approved by the Institutional Ethics Committee before initiation, and informed consent was obtained from all patients.

Inclusion Criteria

Patients aged 18 years and above with unilateral, single lower pole renal calculi measuring ≤2 cm, confirmed on unenhanced computed tomography, normal renal, liver, and cardiac function, and no history of urethral strictures or urinary tract infection were included.

Exclusion Criteria

Patients with cardiopulmonary risks or active UTIs, a history of extracorporeal shock wave lithotripsy (ESWL) or endourological procedures, bilateral renal stones or solitary kidneys, ureteral stones or strictures, and abnormal coagulation profiles were excluded.

Methods: Eligible patients were identified through a retrospective review of hospital medical records and imaging databases. The patients were divided into two groups: Group A (n=51), in which procedures were performed using a single-use flexible ureteroscope (KMC), and reusable flexible ureteroscope (ROY) Group B (n=51), where procedures were performed using a. All patients underwent detailed preoperative evaluation, including demographic data, clinical history, and imaging studies, such as unenhanced CT scans, to confirm stone location, size, and anatomy.

Statistical analysis: Data were presented as mean, standard deviation, frequency and percentage. Continuable variables were compared using the independent sample t-test. Categorical variables were compared using the Pearson chi-square test. Significance was defined by P values less than 0.05 using a two-tailed test. Data analysis was performed using IBM-SPSS version 25.0 (IBM-SPSS Science Inc., Chicago, IL).

RESULTS

In Group A 34 patients (66.7%) were male compared to 25 (49%) in Group B, whereas females were more predominant in Group B (n = 26, 51%) than in Group A (n = 17, 33.3%); however, there were no significant differences (p=0.071). The stones were almost evenly distributed between the left and right sides in both the groups, with no significant difference (p=0.692). 26 (51%) of the stones in Group A and 24 (47.1%) in Group B were on the left side, whereas 25 (49%) in Group A and 27 (52.9%) in Group B were on the right side.

The stone location was most frequently found in the lower pole in 20 (39.2%) patients in both groups, followed by isolated renal pelvis stones, accounting for 8 (15.7%) in group A and 6 (11.8%) in group B. The interpolar region was involved in 11 (21.6%) and 14 (27.5%) patients in groups A and B, respectively, with no significant difference between the groups (p=0.855).

The mean stone size was similar in both groups, measuring 15.92 ± 5.32 mm in group A and 16.1 ± 4.46 mm in group B (p=0.858). Similarly, the mean stone Hounsfield Unit values were comparable, with group A having 1139.27 ± 259.35 and group B having 1134.65 ± 267.08 (p=0.929) [Table 1].

Table 1: Comparison of patient demographics, stone characteristics, and stone parameters between groups

		Group A	Group B	P value
Sex	Female	17 (33.3%)	26 (51%)	0.071
	Male	34 (66.7%)	25 (49%)	
Stone laterality	Left	26 (51%)	24 (47.1%)	0.692
	Right	25 (49%)	27 (52.9%)	
Stone location	IP	11 (21.6%)	14 (27.5%)	0.855
	IP and LP	5 (9.8%)	4 (7.8%)	
	LP	20 (39.2%)	20 (39.2%)	
	LP and UP	1 (2%)	1 (2%)	
	MP	0	2 (3.9%)	
	PUJ	1 (2%)	1 (2%)	

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	RP	8 (15.7%)	6 (11.8%)	
	RP and IP	1 (2%)	1 (2%)	
	UP	2 (3.9%)	2 (3.9%)	
	UP and IP	2 (3.9%)	0	
Stone size (mm)		15.92 ± 5.32	16.1 ± 4.46	0.858
Stone HU		1139.27 ± 259.35	1134.65±267.08	0.929

Table 2: Comparison of preoperative DJ stenting and residual stone rates between the groups

		Group A	Group B	P value
Preop DJ stenting	No	18 (35.3%)	25 (49%)	0.16
	Yes	33 (64.7%)	26 (51%)	
Residual	No	41 (80.4%)	32 (62.7%)	0.048
	Yes	10 (19.6%)	19 (37.3%)	

The mean operative time in group A was 60.16 ± 8.10 minutes, which was identical to the mean operative time in group B at 60.16 ± 8.10 minutes. The rate of preoperative DJ stenting was higher in group A 33 (64.7%) than in group B 26 (51%), although this difference was not significant (p=0.16). A smaller proportion of patients in group A 18 (35.3%) did not undergo preoperative DJ stenting than those in group B 25 (49%). Regarding residual stones, group A had a significantly higher rate of patients achieving complete clearance, with 41 (80.4%) having no residual stones than 32 (62.7%) in group B (p=0.048). Residual stones were more common in Group B 19 (37.3%) than in Group A 10 (19.6%) [Table 2].

DISCUSSION

Our study compared the efficacy of reusable and single-use flexible ureteroscopes for managing lower calyceal stones, with a particular focus on the residual stone rates, operative time, and postoperative outcomes. The findings demonstrated a significantly lower residual stone rate in Group A (reusable ureteroscopes) than in Group B (single-use ureteroscopes), whereas the operative time remained identical between the two groups. The stone clearance rate in Group A (80.4%) was higher than that in Group B (62.7%). with a significant difference (p=0.048), indicating superior stone clearance in group A. Operative times were comparable between the groups, with a mean of 60.16 ± 8.10 minutes for both (p=1.000). Preoperative DJ stenting rates were similar between the two groups (p=0.160), and baseline parameters, including stone size, density, and location, showed no significant differences, ensuring comparability.

The lower residual stone rate in the reusable ureteroscope group was consistent with previous studies that evaluated flexible ureteroscopy outcomes for lower pole stones. Schlager et al. reported that reusable ureteroscopes achieved better access and maneuverability in challenging anatomical regions, such as the lower pole, leading to improved stone clearance.[13] In contrast, Yang et al. observed comparable residual stone rates between reusable and single-use scopes for stones ≤ 20 mm but noted limitations in deflection and performance of single-use devices during prolonged procedures.[12] This is consistent with our findings, where reusable scopes performed better in managing lower pole stones, possibly due to superior durability and deflection capabilities.

In our study, the operative times were identical, likely because of the standardization of surgical protocols and the surgeon's experience. A prospective study by Salvadó et al. demonstrated similar overall outcomes between reusable and single-use ureteroscopes; however, the authors reported slightly shorter operative times and lower radiation exposure with single-use devices.[10] A major strength of our study is the well-balanced patient cohort, with comparable baseline characteristics such as stone size, density, and location, ensuring an unbiased comparison. The statistically significant difference in the residual stone rates between the two groups highlights the clinical relevance of reusable ureteroscopes in the management of lower-pole stones. However, the retrospective design of this study introduced some limitations, including potential selection bias and incomplete data collection. Furthermore, because this was a single-center study, the generalizability of our findings was limited. Long-term outcomes such as stone recurrence and cost-effectiveness were not evaluated, which represents another limitation.

The lower residual stone rate in the single-use ureteroscope group suggests a performance advantage, particularly in challenging anatomical regions such as the lower calyceal system. This advantage can be attributed to the superior deflection, durability, and optical quality of reusable devices, as noted by Li et al., who observed similar findings when comparing both types of scopes.[8] While single-use ureteroscopy offers sterility and eliminates repair costs, concerns remain regarding their durability, deflection capacity, and effectiveness for lower-pole stones, as highlighted by Goger et al.[9] These findings highlight that single-use scopes, while offering significant advantages in terms of sterility, also demonstrate superior performance compared to reusable devices, especially in complex stone locations.

The findings of our study raise questions regarding the widespread use of single-use ureteroscopes. Although single-use devices eliminate the risk of cross-contamination, their lower efficacy in achieving a stone-free status challenges their role in lower-pole stone management. Additionally, its cost-effectiveness remains controversial. Studies such as

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Marchini et al. have shown that reusable scopes are more economical in high-volume centres, where repair costs are offset by repeated use.[14]

Future prospective, multicentre, randomized studies are needed to confirm our findings and assess long-term outcomes such as stone recurrence rates and cost-effectiveness. Additionally, research aimed at improving the technical limitations of single-use ureteroscopes, particularly deflection and durability, may enhance their efficacy in the management of lower pole stones.

The performance of reusable scopes in challenging anatomical regions remains suboptimal. These findings highlight the importance of selecting devices based on clinical, anatomical, and economic considerations to optimize patient outcomes.

CONCLUSION

This study concluded that single-use flexible ureteroscopes are superior to reusable flexible ureteroscopes in the management of lower calyceal stones. Single-use ureteroscopes demonstrated significantly higher stone clearance rates compared to their reusable counterparts, indicating greater efficacy in achieving stone-free status. While operative times were similar between the two groups, the performance of reusable ureteroscopes was inadequate in challenging anatomical regions, particularly the lower pole, resulting in poorer outcomes due to residual stone presence.

Single-use ureteroscopes also offer notable advantages in terms of sterility and immediate availability, which further enhances their clinical utility. Therefore, clinicians should consider prioritizing single-use ureteroscopes based on patient-specific factors and stone characteristics to optimize treatment outcomes. Future research should focus on evaluating the long-term outcomes, cost-effectiveness, and potential technological advancements that could enhance the performance of reusable ureteroscopes, particularly in the management of lower-pole stones.

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