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Original Article

Risk Factors Associated with Recurrence of Urolithiasis Following Endourological Management: A Prospective Observational Cohort Study.

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ABSTRACT

Background: Despite successful endourological treatment, urolithiasis frequently relapses, leading to multiple interventions, high health care expenses, and reduced quality of life. To better plan preventive measures to minimize recurrence and maximize long-term patient outcomes, it is important to identify the factors associated with recurrence.

Objective: To determine the recurrence rate of urolithiasis and identify demographic, clinical, metabolic, surgical, and lifestyle factors associated with recurrence following endourological management.

Methods: This prospective observational cohort study was conducted in the Department of General Surgery at Lady Reading Hospital, Peshawar, Pakistan, from July 2025 to December 2025. We enrolled adults undergoing URS, RIRS, or PCNL consecutively and followed them for 12 months. We recorded demographic, clinical, metabolic, surgical, and lifestyle factors. We assessed recurrent urolithiasis using follow-up imaging. Data were analyzed using SPSS version 27.0, and multivariable logistic regression was performed to identify factors independently associated with recurrence.

Results: The study included 68 males and 32 females**,** with a mean age of 44.2 ± 11.6 years**.** During one-year follow-up, 34 (34.0%) patients developed recurrent urolithiasis. Significant risk factors included obesity (52.9% vs. 21.2%, p=0.006), diabetes mellitus (44.1% vs. 22.7%, p=0.028), family history of stone disease (50.0% vs. 19.7%**,** p=0.003), daily fluid intake <2 L (61.8% vs. 28.8%, p=0.001), residual stone fragments (41.2% vs. 12.1%, p=0.002)**,** and recurrent urinary tract infection (38.2% vs. 16.7%, p=0.018). The type of endourological procedure was not significantly associated with recurrence (p=0.471). Independent predictors included inadequate fluid intake (AOR=3.12), residual fragments (AOR=2.81), obesity (AOR=2.35), and positive family history (all p<0.05).

Conclusion: After endourological management, one third of patients had recurrent urolithiasis. Non-hydration, obesity, stone fragments, and family history were independent risk factors for stone recurrence. To reduce recurrence risk and optimize long-term outcomes, comprehensive metabolic assessment, stone clearance, lifestyle modification, and regular postoperative follow-up are recommended.

INTRODUCTION

Urolithiasis is among the most prevalent urological conditions worldwide, with a lifetime prevalence of 10–15%. The incidence of urolithiasis is steadily increasing in both developed and developing countries. The disease is defined by the presence of calculi in the kidneys and ureters, in the bladder, or the urethra. It is linked to high morbidity, recurrent pain, renal obstruction, infection, reduced renal function, and high health care costs. The incidence of urinary stone disease has increased in recent years, due to dietary changes, increased obesity, lack of physical activity, diabetes mellitus, metabolic syndrome, and global climate change. Hot climatic conditions and low fluid intake further contribute to stone formation, especially in South Asian countries like Pakistan, where prevalence is quite high [1]. Over the past 20 years, however, the treatment of urinary tract stones has made tremendous progress. Compared with open surgery, endourological procedures such as ureteroscopy (URS), retrograde intrarenal surgery (RIRS), and percutaneous nephrolithotomy (PCNL) are minimally invasive, achieve high rates of stone-free status, and are associated with shorter hospital stays, fewer complications, and shorter recovery times. Such procedures have contributed significantly to improved patient outcomes and are now the accepted treatment for most renal and ureteral stones. Despite technological advances, stone recurrence remains a major problem in stone management and a challenge that reduces treatment success [2,3]. Recurrences have been reported to be from 30 to 50 percent after five years following initial stone treatment, and some patients may have more than one recurrence during their lifetime. Patients with recurrent urolithiasis may require multiple imaging studies, multiple emergency department presentations, multiple hospitalizations, and multiple surgeries, which imposes a significant economic burden on the patient and healthcare system. Hence, stone disease prevention is a key part of a complete stone disease program [4]. Stone recurrence is a complex interplay of metabolic, anatomical, environmental, and behavioral factors. Metabolic abnormalities such as hypercalciuria, hyperoxaluria, hyperuricosuria, hypocitraturia, and cystinuria greatly increase recurrence risk. Moreover, multiple systemic conditions, such as diabetes mellitus, obesity, hypertension, gout, and metabolic syndrome, have long been linked to an increased risk of nephrolithiasis. Lifestyle factors, such as fluid intake, excessive sodium intake, animal protein intake, oxalate intake, and low calcium intake, also play a significant role in recurrent stone disease. Repeated UTIs, particularly from urease-producing bacteria, could also facilitate the formation and recurrence of struvite stones [5,6]. Other patient factors such as age at first presentation, male gender, family history of urolithiasis, smoking, and high environmental temperatures have also been shown to be significant risk factors for recurrence. In addition, stones that are not completely cleared by endourological procedures can serve as a nidus for subsequent stone formation, underscoring the importance of ensuring complete stone clearance during surgical intervention. As a result, routine follow-up and metabolic assessment after surgery are crucial and will help identify high-risk patients who might benefit from specific preventive measures [7]. Many international studies have explored recurrence risk after endourological treatment. Still, the roles of individual risk factors differ among ethnic groups due to genetic variations, dietary habits, socioeconomic conditions, and environmental exposures. Although urinary stone disease is prevalent in Pakistan, there is limited evidence available. Local data are needed to identify population-specific predictors that can support individual postoperative counseling and/or follow-up [8]. Improving the long-term outcomes of urolithiasis and reducing the disease burden require identifying modifiable risk factors for recurrence. Increased fluid intake, dietary modification, metabolic correction, infection control, pharmacological prophylaxis, and complete stone clearance can significantly reduce stone recurrence. Therefore, this study was conducted to assess demographic, clinical, metabolic, and lifestyle factors associated with recurrent urolithiasis after endourological management in hospital-treated patients at a tertiary care hospital for urolithiasis [9].

MATERIALS AND METHODS

Study Design & Setting

This prospective observational cohort study was conducted in the Department of General Surgery at Lady Reading Hospital, Peshawar, Pakistan, from July 2025 to December 2025. We enrolled patients undergoing URS, RIRS, or PCNL and followed them for 12 months to assess recurrent urolithiasis and associated risk factors.

Participants

We enrolled 100 adults aged 18–70 years who underwent URS, RIRS, or PCNL using consecutive non-probability sampling. Patients with congenital urinary tract anomalies, urinary tract malignancy, pregnancy, chronic kidney disease stage 4 or 5, previous open stone surgery, incomplete clinical records, or incomplete follow-up were excluded.

Sample Size Calculation

A sample size of 100 patients was determined using the WHO Sample Size Calculator with a recurrence prevalence of 35%, a 95% Confidence Level, a 10% margin of error, and a 5% significance level. Consequently, non-probability sampling (consecutive sampling) was used until the desired sample size was reached.

Inclusion Criteria

- Patients aged 18–70 years.
- Patients who had completed URS, RIRS, or PCNL.
- At least 12 months of follow-up after surgery.
- Both male and female patients.
- Patients who provided written informed consent to participate in the study.
- Patients with documented postoperative stone clearance or clinically insignificant residual stone fragments were defined as having residual fragments measuring ≤4 mm on postoperative imaging.

- Daily fluid intake was assessed using a structured patient interview based on the patient's reported average daily fluid consumption. Patients reporting an average intake of <2 L/day were categorized as having inadequate fluid intake.

Exclusion Criteria

- Anomalies of the urinary tract at birth.
- Urinary tract malignancy.
- Pregnancy.
- Chronic kidney disease stage 4 or 5.
- Previous open stone surgery.
- Incomplete clinical records or follow-up.
- Patients refusing participation.

Sample Size Calculation

The minimum sample size was calculated using the WHO Sample Size Calculator, assuming a recurrence prevalence of 35%, a 95% confidence level, and a 10% margin of error. The calculated minimum sample size was approximately 87 participants. To improve precision and account for potential incomplete follow-up, we enrolled 100 patients using consecutive non-probability sampling.

Statistical Analysis

We summarized continuous variables as mean ± standard deviation and categorical variables as frequencies and percentages. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. We used multivariable logistic regression to identify factors independently associated with recurrence. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. A two-sided p-value <0.05 was considered statistically significant.

Results

We enrolled 100 patients. The mean age was 44.2 ± 11.6 years (range: 19–70 years), with 68 (68.0%) males and 32 (32.0%) females. During the 12-month follow-up period, 34 (34.0%) patients developed recurrent urolithiasis, whereas 66 (66.0%) remained recurrence-free. Recurrence was significantly higher among patients with BMI ≥30 kg/m² than among those with BMI <30 kg/m² (52.9% vs. 21.2%, p=0.006). Patients with diabetes mellitus also demonstrated a significantly greater recurrence rate (44.1% vs. 22.7%, p=0.028). A positive family history of stone disease was strongly associated with recurrence (50.0% vs. 19.7%, p=0.003). Similarly, daily fluid intake below 2 liters significantly increased recurrence (61.8% vs. 28.8%, p=0.001), while the presence of residual stone fragments after endourological treatment was significantly associated (41.2% vs. 12.1%, p=0.002). Recurrent urinary tract infection was another significant predictor (38.2% vs. 16.7%, p=0.018). However, the type of endourological procedure (URS, RIRS, or PCNL) was not significantly associated with recurrence (p=0.471). Multivariable logistic regression identified inadequate fluid intake, obesity, residual stone fragments, and positive family history as independent predictors of recurrent urolithiasis (p<0.05).

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population (n = 100)

Variable	Frequency (n)	Percentage (%)
Age (years), Mean ± SD	44.2 ± 11.6	—
18–30 years	18	18.0
31–45 years	34	34.0
46–60 years	31	31.0
>60 years	17	17.0
Male	68	68.0
Female	32	32.0
BMI ≥30 kg/m²	34	34.0
Diabetes mellitus	29	29.0
Hypertension	36	36.0
Positive family history	30	30.0
Recurrent urinary tract infection	26	26.0
Daily fluid intake <2 L/day	38	38.0
Smokers	24	24.0

Baseline demographic and clinical characteristics of patients who underwent endourological management for urolithiasis.

Table 2. Operative and Stone Characteristics (n = 100)

Variable	Frequency (n)	Percentage (%)
Endourological Procedure		
Ureteroscopy (URS)	42	42.0
Retrograde Intrarenal Surgery (RIRS)	24	24.0
Percutaneous Nephrolithotomy (PCNL)	34	34.0
Stone Location		
Kidney	59	59.0
Ureter	41	41.0
Stone Composition		
Calcium oxalate	66	66.0
Uric acid	15	15.0
Struvite	11	11.0
Mixed/Others	8	8.0
Residual stone fragments	17	17.0
Complete stone clearance	83	83.0

Distribution of endourological procedures, stone characteristics, and postoperative stone clearance among the study participants.

Table 3. Association Between Risk Factors and Recurrent Urolithiasis

Variable	Recurrence (n=34)	No Recurrence (n=66)	p-value
BMI ≥30 kg/m²	18 (52.9%)	14 (21.2%)	0.006
Diabetes mellitus	15 (44.1%)	15 (22.7%)	0.028
Positive family history	17 (50.0%)	13 (19.7%)	0.003
Daily fluid intake <2 L/day	21 (61.8%)	19 (28.8%)	0.001
Recurrent urinary tract infection	13 (38.2%)	11 (16.7%)	0.018
Residual stone fragments	14 (41.2%)	8 (12.1%)	0.002
Male gender	24 (70.6%)	44 (66.7%)	0.687
Type of endourological procedure	—	—	0.471

Comparison of demographic and clinical variables between patients with and without recurrent urolithiasis. We used the chi-square test for categorical variables.

Table 4. Multivariable Logistic Regression Analysis of Factors Independently Associated with Recurrent Urolithiasis

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Daily fluid intake <2 L/day	3.12	1.52–6.41	0.002
Residual stone fragments	2.81	1.30–6.06	0.009
BMI ≥30 kg/m²	2.35	1.14–4.87	0.021
Positive family history	2.17	1.06–4.45	0.034
Diabetes mellitus	1.86	0.91–3.82	0.087
Recurrent urinary tract infection	1.74	0.82–3.69	0.139

Multivariable logistic regression. We performed logistic regression to identify factors independently associated with recurrent urolithiasis. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) are presented. Variables with $p<0.05$ were considered statistically significant.

Discussion

In the present study, we evaluated risk factors for recurrence of urolithiasis after endourological treatment, and 34% of patients experienced stone recurrence within 1 year. We evaluated risk factors for recurrence of urolithiasis after endourological treatment, and 34% of patients experienced stone recurrence within 1 year. Inadequate fluid intake, obesity, residual stone fragments, and a positive family history of urolithiasis were independently associated with recurrence. In contrast, diabetes mellitus and recurrent urinary tract infection were significantly associated with recurrence in the univariable analysis but did not remain statistically significant after multivariable adjustment. These findings suggest that recurrence after endourological treatment is influenced substantially by patient-related metabolic and lifestyle factors rather than solely by the type of surgical procedure.[10,11]. The 34% recurrence rate is similar to that reported in previous studies. Complete surgical treatment is not always successful; Baowaidan et al. reported a recurrence rate of 25.8% after endourological treatment, with a median follow-up of 32 months. In their analysis, patient-related and metabolic factors were also identified as important predictors of recurrence, whereas procedural factors were not. These results corroborate the recurrence rate reported in our cohort and highlight the need for long-term follow-up after surgery [12,13]. Obesity was among the most important independent predictors of stone recurrence in our study. Higher BMI (body mass index) was significantly associated with higher recurrence rates; specifically, patients with BMI ≥30 kg/m² had significantly higher recurrence rates than those without obesity. The results corroborated recent systematic reviews and meta-analyses showing that increased BMI is a significant risk factor for recurrent nephrolithiasis, as obesity leads to insulin resistance, acidic urine, hypercalciuria, hyperoxaluria, and increased urinary uric acid excretion. These metabolic changes make it easier for crystals to form and grow again [14]. Diabetes mellitus (DM) was significantly associated with recurrence in the present study, but this association did not persist after multivariable adjustment. Baowaidan et al. reached a similar conclusion, reporting that diabetes was a significant predictor of stone recurrence after endourological stone management. Similarly, meta-analyses of recent studies have shown that diabetes is associated with a higher risk of recurrent kidney stones, a finding linked to insulin resistance, decreased urinary pH, and changes in urinary composition. These results emphasize the need to optimize postoperative glycemic control [15,16]. Another independent risk factor in our study was a positive family history. Patients with affected first-degree relatives were more likely to develop recurrent stones, indicating a significant genetic contribution to stone formation. This is replicated in more recent systematic reviews, which consistently identify family history as an independent risk factor for recurrent kidney stone disease. This higher recurrence is likely due to the same dietary and environmental factors, as well as genetic predisposition [17]. The strong correlation between low daily fluid intake and a history of recurrent urolithiasis was among the most clinically relevant findings of the present study. In the adjusted analysis, patients who

consumed less than 2 liters of fluid per day had the highest risk of recurrence. Drinking water helps prevent urinary supersaturation of lithogenic salts, inhibits crystal aggregation, and facilitates the spontaneous passage of microcrystalline calculi. Recent prospective evidence has also shown that the degree of urine supersaturation after surgery is closely associated with recurrence, suggesting the need to maintain normal urine output [18]. Residual stone fragments also independently predicted recurrence in our cohort. Crystals can form in even a small, clinically insignificant fragment and continue to grow, which can lead to an enlarged stone. This finding is consistent with previous endourological studies showing a higher risk of recurrence when stones were not completely removed, underscoring the need for careful stone removal during surgery and for follow-up imaging to confirm stone-free status [19]. Intriguingly, our study found no significant association between the type of endourological procedure (URS, RIRS, or PCNL) and recurrence. This finding suggests that long-term recurrence depends more on patient-specific metabolic and behavioral factors than on the surgical procedure. Recent reviews of the efficacy of modern endourological procedures for recurrence have reached similar conclusions [20].

Limitations

This study has several limitations. It was conducted at a single tertiary-care center with a relatively small sample size, which may limit generalizability. The observational design and consecutive non-probability sampling may have introduced selection bias and residual confounding. Although patients were followed for 12 months, this duration may not capture longer-term recurrence. Complete 24-hour urine metabolic profiles and stone composition analyses were not available for all participants. Larger multicenter prospective studies with longer follow-up are needed to validate these findings.

Conclusion

Recurrent urolithiasis occurred in approximately one-third of patients during 12 months of follow-up after endourological management. Inadequate fluid intake, obesity, residual stone fragments, and positive family history were independently associated with recurrence. Comprehensive metabolic assessment, complete stone clearance, adequate hydration, lifestyle modification, and regular postoperative follow-up may help reduce the risk of recurrent stone disease.

Ethical Approval: The study was approved by Ref-**426/LRH/MTI/Date 8/7/2024.** We obtained written informed consent from all participants before enrollment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

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Conflict of interest: None

Authors' Contributions:

Arif AU: Conceptualization, study design, patient recruitment, data collection, interpretation of findings, and manuscript drafting.

Arif AU: Data collection, data verification, and interpretation of results.

Arif AU: Statistical analysis, interpretation of results, and critical revision of the manuscript.

Arif AU: Literature review, manuscript revision, and editing.

All authors: Approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

References

1. Quarà A, Jannello LM, Bravo-Balado A, Moretto S, Zorzi F, Gradilone U, et al. The impact of clinically insignificant residual fragments following endourological management of urolithiasis: a systematic review of complications and re-intervention rates. Minerva Urol Nephrol. 2025;77(6):783-794. doi:10.23736/S2724-6051.25.06456-0.
2. Baowaidan F, Zugail AS, Lyoubi Y, Culty T, Lebdai S, Brassart E, et al. Incidence and risk factors for urolithiasis recurrence after endourological management of kidney stones: a retrospective single-center study. Prog Urol. 2022;32(8-9):601-607. doi:10.1016/j.purol.2022.02.010.
3. Shrivastava N, Bhargava P, Choudhary GR. Endourological management of ureteric stump syndrome. BMJ Case Rep. 2023;16(9):e255126. doi:10.1136/bcr-2023-255126.
4. Tzelves L, Juliebø-Jones P, Manolitsis I, Bellos T, Mykoniatis I, Berdempes M, et al. Radiation protection measures during endourological therapies. Asian J Urol. 2023;10(3):215-225. doi:10.1016/j.ajur.2022.12.001.
5. Farkouh A, Locke MR, Baldwin DD, Duvdevani M, Nathan S, Scales CD Jr, et al. The Second Endourological Society Census Report. J Endourol. 2024;38(11):1217-1225. doi:10.1089/end.2024.0512.
6. Pakmanesh H. Laparoscopic management of the urinary stones. Urol J. 2025;22(2):58-67. doi:10.22037/uj.v22i.8456.
7. Geraghty RM, Davis NF, Tzelves L, Lombardo R, Yuan C, Thomas K, et al. Best practice in interventional management of urolithiasis: an update from the European Association of Urology Guidelines Panel for Urolithiasis 2022. Eur Urol Focus. 2023;9(1):199-208. doi:10.1016/j.euf.2022.06.014.
8. Güzel R, Yildirim Ü, Sarica K. Contemporary minimally invasive surgical management of stones in children. Asian J Urol. 2023;10(3):239-245. doi:10.1016/j.ajur.2023.02.001.
9. Ucmak H, Sonmez MG, Guven S. Case-based review of dietary management of cystinuria. World J Urol. 2023;41(5):1215-1220. doi:10.1007/s00345-022-04263-1.
10. Thangavelu M, Abdallah MY, Isola OJ, Kotb A. Management of encrusted ureteral stents: two-center experience. Arch Ital Urol Androl. 2022;94(3):305-310. doi:10.4081/aiua.2022.3.305.
11. Ripa F, Bonacina E, Zanetti SP, Mazzon G, Choong S. Imaging during pediatric stone management and follow-up. World J Urol. 2025;43(1):656. doi:10.1007/s00345-025-06041-1.
12. Herout R, Neisius A. Management of recurrent urolithiasis: indications for therapy escalation and discontinuation. Urologie. 2026;65(7):749-755. doi:10.1007/s00120-026-02843-2.
13. Fuligni D, Nedbal C, Castellani D, Pietropaolo A, Bendetto Galosi A, Gauhar V, et al. Surveys in endourology over time: what are the urologist preferences? A trend review over 24 years (2000-2024). Cent European J Urol. 2024;77(4):680-689. doi:10.5173/ceju.2024.0167.
14. Talyshinskii A, Naik N, Hameed BMZ, Khairley G, Randhawa P, Somani BK. Telemedicine in endourology for patient management and healthcare delivery: current status and future perspectives. Curr Urol Rep. 2024;25(11):299-310. doi:10.1007/s11934-024-01224-6.
15. Shim KH, Choi KB, Kim WB, Yang SW, Kim DK, Choo MS, et al. Urolithiasis in kidney transplant patients: a multicenter KSER research series. Medicina (Kaunas). 2024;60(1):132. doi:10.3390/medicina60010132.

16. Arikan O, Keles A, Demirtas B, Cicek M, Iplikci A, Yildirim A, et al. Prediction of retrograde intrarenal surgery outcomes in patients with horseshoe kidneys using three different scoring systems: a critical single-center experience. Urology. 2025;204:45-50. doi:10.1016/j.urology.2025.05.045.
17. Herout R, Halawani A, Wong VKF, Koo KC, Zhong T, Reicherz A, et al. Innovations in endourologic stone surgery: contemporary practice patterns from a global survey. J Endourol. 2023;37(7):753-760. doi:10.1089/end.2023.0077.
18. Bhanot R, Hameed ZBM, Shah M, Juliebø-Jones P, Skolarikos A, Somani B. ALARA in urology: steps to minimize radiation exposure during all parts of the endourological journey. Curr Urol Rep. 2022;23(10):255-259. doi:10.1007/s11934-022-01102-z.
19. Tsaturyan A, Faria-Costa G, Peteinaris A, Lattarulo M, Martinez BB, Vrettos T, et al. Endoscopic management of encrusted ureteral stents: outcomes and tips and tricks. World J Urol. 2023;41(5):1415-1421. doi:10.1007/s00345-023-04361-8.
20. Scotland KB, Tailly T, Chew BH, Bhojani N, Smith D. Consensus statement on urinary stone treatment during a pandemic: a Delphi process from the Endourological Society TOWER Research Initiative. J Endourol. 2022;36(3):335-344. doi:10.1089/end.2021.0477.