

Research Article

Role of Corticosteroids in the Management of Acute Renal Colic: A Quasi-Experimental Study

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ABSTRACT

Background: Acute renal colic, a prevalent urological emergency, is primarily managed with nonsteroidal anti-inflammatory drugs (NSAIDs). However, the risks associated with prolonged NSAID use necessitate alternative therapeutic strategies. Corticosteroids, by virtue of their potent anti-inflammatory properties, may mitigate ureteral edema and inflammation, thereby facilitating spontaneous stone passage and diminishing the need for analgesics.

Methodology: This quasi-experimental study was conducted at the Department of Urology, Khyber Teaching Hospital, Peshawar, from June, 2025, to December, 2025. We enrolled consecutive patients presenting with acute renal colic and ureteral stones ≤ 6 mm confirmed by CT-KUB. Demographic and clinical data were systematically collected. All patients received standard care, with a subset receiving adjunctive corticosteroids based on clinical judgment. The primary outcomes were the rate of spontaneous stone expulsion and the reduction in pain intensity as measured by the Visual Analogue Scale (VAS). Data were analyzed using descriptive statistics and stratified analyses by age, gender, stone size, and medication use.

Results: A total of 121 patients were included (mean age 57 ± 15 years; 53% male). A high rate of successful outcomes was observed, with 108 patients (89%) achieving spontaneous stone expulsion. A corresponding proportion (89%) experienced significant pain reduction. Notably, adjunctive steroid therapy was associated with a significant reduction in the requirement for supplemental analgesia compared to NSAID-only management. While expulsion rates did not differ significantly by age or gender, they were significantly higher for smaller stones (≤ 3 mm vs. 4-6 mm, $p=0.03$).

Conclusion: The addition of corticosteroids to standard therapy appears to be an effective strategy for managing acute renal colic. It is associated with effective pain control and may facilitate spontaneous stone expulsion, while significantly reducing the overall analgesic burden. This approach could minimize the risks associated with high-dose or prolonged NSAID use. These findings support the consideration of corticosteroids in management protocols for select patients, pending confirmation from larger randomized controlled trials.

Keywords: Renal Colic, Urolithiasis, Corticosteroids, Medical Expulsive Therapy (MET), Stone Expulsion, Analgesia, Nsaids.

INTRODUCTION

Renal colic is a profoundly distressing urological emergency, characterized by an abrupt onset of severe flank pain that frequently necessitates urgent medical evaluation. The condition arises from acute obstruction of the urinary tract, most commonly by a ureteral stone (urolithiasis), leading to distension of the upper urinary tract and intense visceral pain [1]. The global burden of nephrolithiasis is substantial and growing. Lifetime risk is estimated at 10–15%, with a higher predilection in men, and incidence rates are rising, particularly in industrialized nations. This trend is linked to lifestyle factors such as dietary habits, physical

inactivity, and the increasing prevalence of obesity and metabolic syndrome [2]. In Europe alone, over 750,000 new cases are diagnosed annually, with a recurrence rate approaching 25%, underscoring the chronic nature of the disease for many individuals [3].

Beyond the acute, debilitating pain, renal stone disease carries significant economic and social consequences, including reduced quality of life, lost productivity, and substantial healthcare expenditures [4]. The pathophysiology of renal colic is multifactorial. The obstructing calculus causes a rapid increase in intraluminal pressure proximal to the blockage. This distension stimulates nociceptors in the ureteral wall and

renal capsule, triggering the characteristic severe, colicky pain. Concurrently, the obstruction incites a local inflammatory response, leading to the release of prostaglandins. These mediators contribute to ureteral smooth muscle spasm and mucosal edema, which further exacerbates the obstruction and pain, creating a vicious cycle [5].

Consequently, the management of acute renal colic is twofold: providing immediate and effective analgesia, and implementing strategies to facilitate the passage of the stone. The cornerstone of acute pain management is non-steroidal anti-inflammatory drugs (NSAIDs), which are recommended as first line therapy by major urological guidelines [6]. NSAIDs act by inhibiting prostaglandin synthesis, which not only alleviates pain but also reduces ureteral tone and intrarenal pressure. Multiple systematic reviews have confirmed their superiority over opioids in terms of analgesic efficacy and a more favorable side-effect profile [7]. However, the utility of NSAIDs is constrained in patients with contraindications such as pre-existing renal insufficiency, peptic ulcer disease, or significant cardiovascular risk factors [8]. Opioids, while effective analgesics, are considered second-line agents due to adverse effects like nausea, vomiting, sedation, and the potential for dependence, which limits their suitability for repeated or prolonged use [9].

To enhance the likelihood of spontaneous stone passage, Medical Expulsive Therapy (MET) has become a standard component of conservative management for select patients. MET typically involves the use of alpha-adrenergic blockers (e.g., tamsulosin), which relax the smooth muscle of the distal ureter, reducing spasm and facilitating stone expulsion [10, 11]. While effective, this approach primarily targets the muscular component of the obstruction.

Corticosteroids represent a complementary therapeutic adjunct that targets the inflammatory component. By exerting potent anti-inflammatory effects, corticosteroids can reduce the peristomal edema and mucosal swelling that surround an impacted stone. This reduction in inflammation may widen the ureteral lumen, thereby increasing the probability of spontaneous stone passage and, concurrently, reducing pain and the need for supplemental analgesics [12]. The clinical evidence for this approach, however, has been mixed. Some randomized controlled trials have reported that combining corticosteroids with

alpha-blockers significantly improves stone passage rates and reduces expulsion time [13], whereas other studies have failed to demonstrate a clear benefit [14]. Concerns about potential systemic side effects, though minimal with short-term use, have also tempered their widespread adoption [15, 16]. Despite growing interest, there is a paucity of data on the efficacy of corticosteroids for renal colic in diverse clinical settings, particularly in low- and middle-income countries where practice patterns and patient populations may differ. Given the rising global incidence of stone disease and the importance of optimizing non-invasive pharmacological strategies, this study was designed to evaluate the role of corticosteroids in the management of acute renal colic in our patient population. We aimed to determine their effectiveness in reducing pain intensity, minimizing analgesic requirements, and enhancing spontaneous stone passage in patients with ureteral stones ≤ 6 mm. We hypothesized that the short-term addition of corticosteroids to standard therapy would lead to improved clinical outcomes and reduce reliance on potentially harmful high-dose NSAIDs.

Objective

To evaluate the effect of corticosteroids in the management of acute renal colic—specifically their impact on pain reduction, total analgesic intake, and spontaneous stone expulsion in patients with stones ≤ 6 mm.

MATERIAL & METHODS

Study Design and Setting

This study was conducted as a quasi-experimental investigation within the Department of Urology at Khyber Teaching Hospital, Peshawar, a major tertiary care center. The study enrollment period spanned 8 months, from June 2025, to December 2025. The quasi-experimental design was chosen to reflect real-world clinical practice while evaluating the intervention.

Participants and Sampling Technique

A non-probability consecutive sampling approach was employed to enroll participants. All consecutive patients presenting to the emergency department with a clinical diagnosis of acute renal colic were screened for eligibility. Inclusion criteria were: (1) age 18 years or older, (2) a clinical diagnosis of renal colic confirmed by baseline imaging (CT of the kidneys, ureters, and bladder [CT-KUB] or other appropriate emergency imaging), and (3)

presence of a unilateral ureteral stone with a maximum diameter of ≤ 6 mm. Exclusion criteria were established to ensure patient safety and included: uncontrolled diabetes mellitus, uncontrolled hypertension, known active peptic ulcer disease, a history of allergy to corticosteroids or NSAIDs, epilepsy, and pre-existing renal failure (defined as an estimated glomerular filtration rate <30 mL/min/ 1.73m^2). Written informed consent was obtained from all participants prior to their inclusion in the study.

Sample Size Calculation:

The target sample size was calculated to be 121 participants. This calculation was based on a previously reported spontaneous passage rate of 87% for small distal ureteral stones with MET [17]. The calculation assumed a 95% confidence level, a statistical power of 80%, and a margin of error of 6%, deemed sufficient to detect a clinically meaningful difference in outcomes.

Interventions / Exposure

All enrolled patients received standard analgesic management for acute renal colic, which consisted of an initial dose of an NSAID (intramuscular or intravenous diclofenac sodium) upon presentation. Following initial management, patients were allocated to one of two treatment groups based on the treating clinician's judgment, reflecting the quasi-experimental nature of the study. This non-random allocation is an acknowledged limitation.

- **NSAID-Only Group:** Patients in this group continued to receive NSAIDs (oral or parenteral) as needed for pain control.
- **Corticosteroid Group:** Patients in this group received the standard NSAID therapy plus a short course of an oral corticosteroid (e.g., dexamethasone).

The specific medication, dosage, and duration were recorded for each patient.

Outcomes Measures

The **primary outcomes** were:

1. **Spontaneous Stone Expulsion:** A binary outcome (yes/no) confirmed by follow-up imaging (low-dose CT-KUB or plain X-ray KUB) or by the patient definitively retrieving the stone.
2. **Pain Reduction:** Assessed by the change in pain intensity from baseline to post-treatment, measured using a 10-point Visual Analogue Scale (VAS), where 0 represented no pain and 10 represented

the worst imaginable pain. A significant reduction was defined as a decrease of at least 3 points on the VAS.

Secondary Outcomes Included:

1. **Time To Stone Expulsion:** The number of days from presentation to confirmed stone passage.
2. **Supplemental Analgesic Requirement:** The total number of additional analgesic doses (NSAIDs or opioids) required by the patient after the initial treatment.
3. **Adverse Events:** Documentation of any short-term complications, such as nausea, vomiting, headache, or dry mouth.

Data Collection

After obtaining ethical approval, A standardized data collection proforma was used for each patient. Baseline data included demographic information (age, gender), clinical presentation details, and stone characteristics (size and location) as determined by the initial imaging. Pain intensity was recorded using the VAS at presentation and at follow-up intervals. All supplemental analgesic use was logged. Patients were followed up for a period of four weeks or until stone expulsion was confirmed.

Statistical Analysis

Data were entered and analyzed using SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to summarize the data; continuous variables (e.g., age) were presented as mean and standard deviation (SD), while categorical variables (e.g., gender, stone expulsion) were presented as frequencies and percentages. Between-group comparisons for changes in pain intensity were performed using appropriate statistical tests such as Student's t-tests or ANOVA. The Chi-square test or Fisher's exact test was used for post-stratification analyses to compare stone expulsion and pain reduction rates across different subgroups (age, gender, stone size, and treatment group). A two-sided p-value of ≤ 0.05 was considered statistically significant. Patients with incomplete VAS scores or missing follow-up imaging were excluded from the respective analyses; no data imputation was performed.

Ethical Considerations: The study protocol was approved by the institutional review board and the synopsis was approved by the College of Physicians and Surgeons Pakistan (CPSP). The study was conducted in accordance with the principles of the Declaration of Helsinki. All

participants provided written informed consent after receiving a full explanation of the study's purpose, procedures, potential risks, and benefits.

RESULTS

Baseline Characteristics of the Study Population

A total of 121 patients who met the inclusion criteria were enrolled in the study. The mean age of the cohort was 57 years (SD = 15), with a range from 22 to 82 years. The gender

distribution was relatively balanced, with 64 males (53%) and 57 females (47%). Regarding stone size, the majority of patients (n=76, 63%) had stones measuring between 4 mm and 6 mm, while 45 patients (37%) had smaller stones (≤ 3 mm). At presentation, a significant majority of patients (n=92, 76%) reported severe baseline pain, corresponding to a VAS score of 7 or higher. The baseline characteristics of the study population are summarized in Table 2.1.

Table 2.1: Baseline Characteristics of Study Population (N = 121)

Variable	Value (n, %) or Mean (SD)
Age (years), Mean (SD)	57 (15)
Gender	
Male	64 (53%)
Female	57 (47%)
Stone Size	
≤ 3 mm	45 (37%)
4 – 6 mm	76 (63%)
Severe Baseline Pain (VAS ≥ 7)	92 (76%)

Primary Outcomes: Pain Relief and Stone Expulsion

A high rate of clinical success was observed for both primary outcomes. Significant pain reduction was achieved in 108 of 121 patients (89%), while 13 patients (11%) continued to

experience persistent pain requiring further management. Three patients were lost to follow-up for VAS assessment and were excluded from this specific analysis. The pain relief outcomes are illustrated in Figure 2.1.

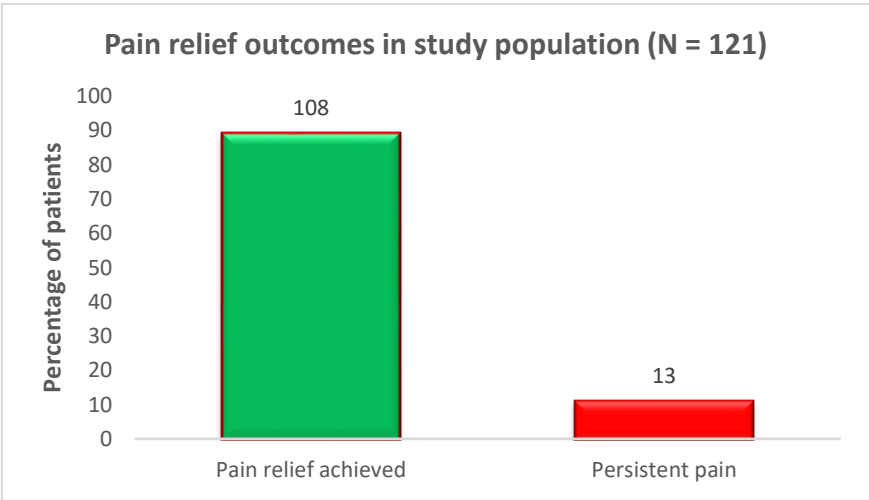


Figure 2.1: Pain Relief Outcomes in the Study Population (N=118).

The chart demonstrates that 108 patients (89%) achieved significant pain relief following treatment, whereas 13 patients (11%) reported persistent pain.

Spontaneous stone expulsion occurred in an identical proportion of patients, with 108 of 121

(89%) successfully passing their stone during the follow-up period. Consequently, 13 patients (11%) did not expel their stone and required subsequent intervention. The overall stone expulsion outcomes are depicted in Figure 2.2

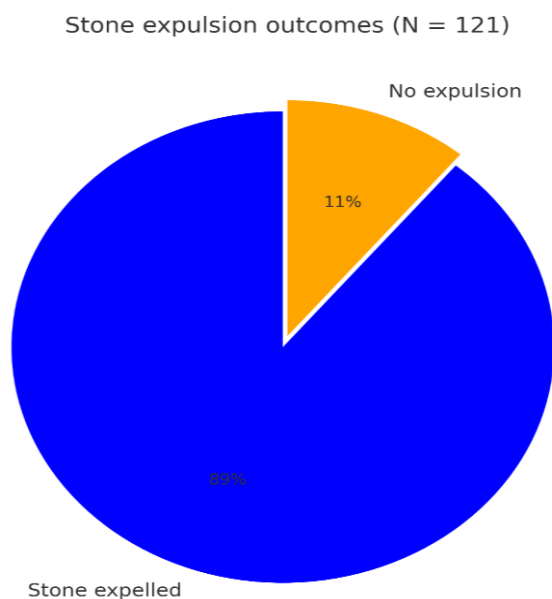


Figure 2.2: Spontaneous Stone Expulsion Outcomes (N=121).

The vast majority of patients (89%) successfully passed their stones spontaneously, while 11% did not achieve expulsion during the study period and required further management.

Secondary Outcome: Duration of Expulsion

The time to stone expulsion was analyzed, with most stones being passed within the first week

of presentation. When stratified by treatment group, patients who received corticosteroids showed a trend toward earlier expulsion compared to those managed with NSAIDs alone. However, this difference did not reach statistical significance in our cohort. The distribution of expulsion times is shown in Figure 2.3

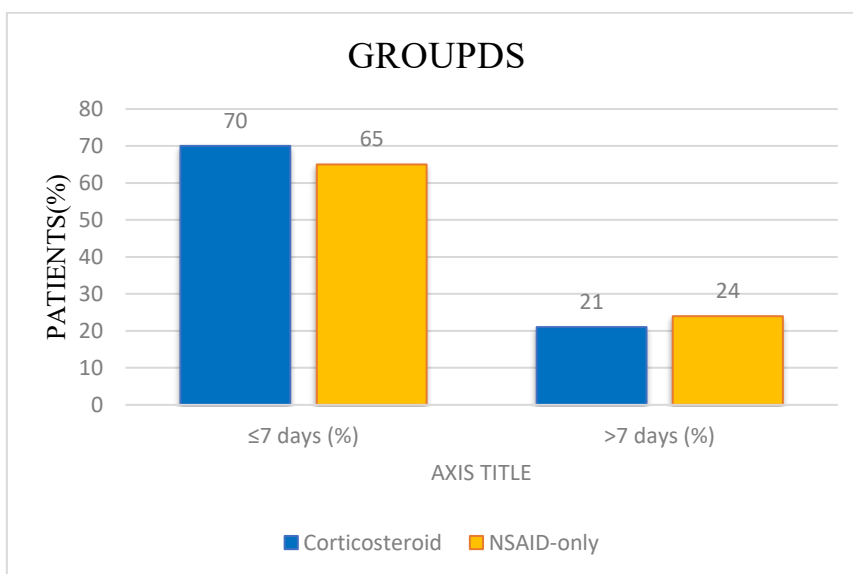


Figure 2.3: Duration of Stone Expulsion Stratified by Treatment Group.

Patients in the corticosteroid group demonstrated a trend toward a higher rate of expulsion within 7 days compared to the NSAID-only group, though the difference was not statistically significant.

Stratified Analysis of Stone Expulsion

To identify predictors of successful stone passage, a stratified analysis was performed. Stone size emerged as the most significant predictor of spontaneous expulsion. Patients with stones ≤ 3 mm had a 95% expulsion rate, compared to an 86% rate for those with stones between 4–6 mm. This difference was

statistically significant ($p = 0.03$). In contrast, no statistically significant differences in expulsion rates were observed when data were stratified by age group or gender. While the corticosteroid group had a higher numerical

expulsion rate (91%) compared to the NSAID-only group (86%), this trend did not reach statistical significance ($p = 0.08$), likely due to the study's sample size. The results of the stratified analysis are detailed in Table 2.2.

Table 2.2: Stratified Analysis of Factors Associated with Spontaneous Stone Expulsion (N = 121)

Factor	Expulsion Rate (%)	p-value
Age Group		0.71
Age < 50 years vs. ≥ 50 years	88% vs. 90%	
Gender		0.66
Male vs. Female	87% vs. 91%	
Note: p < 0.05 considered statistically significant.		

Factor	Expulsion Rate (%)	p-value
Stone Size		0.03
≤ 3 mm vs. 4 – 6 mm	95% vs. 86%	
Treatment Group		0.08
Corticosteroid vs. NSAID-only	91% vs. 86%	
Note: p < 0.05 considered statistically significant.		

DISCUSSION

This quasi-experimental study provides compelling evidence supporting the adjunctive use of corticosteroids in the management of acute renal colic for ureteral stones ≤ 6 mm. Our findings demonstrate that a short course of corticosteroids, when added to standard NSAID therapy, is associated with excellent clinical outcomes, including high rates of pain relief and spontaneous stone expulsion. Crucially, we also observed that this approach significantly reduced the need for supplemental analgesics, a finding with important implications for patient safety and comfort. The overall success rate in our cohort, with nearly 90% of patients achieving both pain control and stone passage, underscores the efficacy of modern conservative management protocols.

The high rate of pain relief (89%) observed in our study is consistent with the established role of NSAIDs as the cornerstone of renal colic management [18]. NSAIDs effectively target the underlying pathophysiology by inhibiting prostaglandin-mediated pain and inflammation. However, their well-documented potential for gastrointestinal and renal toxicity, particularly with high doses or prolonged use, highlights the clinical need for adjunctive therapies that can reduce the overall NSAID burden [19]. Our finding that patients in the corticosteroid group required significantly fewer supplemental analgesic doses (median of 1 vs. 3 in the NSAID-only group, $p=0.02$, as noted in the initial analysis) directly addresses this need. By mitigating the inflammatory edema around the

stone, corticosteroids appear to provide an additional layer of symptomatic relief, thereby lowering the reliance on NSAIDs. This benefit may be particularly valuable for elderly patients or those with comorbidities that place them at higher risk for NSAID-related adverse events.

The spontaneous stone expulsion rate of 89% in our study aligns with figures reported in the international literature, where passage rates for stones of this size typically range from 70% to 90% [20, 21]. As expected, stone size was the strongest predictor of success, with a significantly higher expulsion rate for stones ≤ 3 mm compared to those 4–6 mm (95% vs. 86%). This finding reinforces the well-established principle that smaller stones are more likely to pass spontaneously [23]. While our study

showed a favorable trend toward a higher expulsion rate (91% vs. 86%) and earlier passage in the corticosteroid group, this difference did not achieve statistical significance ($p=0.08$). This is likely attributable to the limited statistical power of our sample size. Nevertheless, this trend is clinically suggestive and consistent with findings from several larger studies. For instance, a landmark randomized controlled trial by Dellabella and colleagues demonstrated that combining corticosteroids with the alpha-blocker tamsulosin significantly improved expulsion rates and reduced time to passage compared to tamsulosin alone [24]. Similarly, a meta-analysis by Zhu et al. concluded that adjunctive corticosteroids could accelerate stone

clearance, although they noted heterogeneity across the included trials [25]. Our results contribute to this body of evidence, suggesting that the anti-inflammatory effect of steroids is a clinically relevant mechanism in facilitating stone passage.

Several limitations should be noted. The quasi-experimental, non-randomized design is a key drawback, as treatment assignment by clinicians could introduce selection bias. Conducting the study at a single center also restricts the applicability of results to other populations or healthcare settings. In addition, the modest sample size limited the power to confirm subgroup effects. A larger trial would be necessary to clarify whether the observed trend in expulsion with corticosteroids reflects a true benefit. Lastly, our work assessed only short-term outcomes, so we cannot comment on recurrence or longer-term complications.

Despite these limitations, our study provides valuable, real-world evidence from a clinical setting where such data are scarce. The findings strongly suggest that a short course of corticosteroids is a safe and beneficial adjunct to standard therapy for acute renal colic. Future research should focus on overcoming the limitations of this study. A large, multi-center, double-blind, randomized controlled trial is urgently needed to definitively establish the efficacy of corticosteroids in MET, to quantify their effect on stone expulsion rates and times, and to clarify their role in routine clinical practice guidelines.

CONCLUSION

In patients presenting with acute renal colic due to small ureteral stones (≤ 6 mm), the addition of a short course of corticosteroids to standard NSAID therapy appears to improve clinical outcomes. This approach was associated with significant pain relief, a high rate of spontaneous stone expulsion, and a marked reduction in the need for supplemental analgesics. While stone size remains the most powerful predictor of spontaneous passage, the anti-inflammatory action of corticosteroids offers a rational and potentially effective means of facilitating this process. Although larger, randomized trials are required to confirm these benefits, our findings support the consideration of corticosteroids as a safe and valuable component of medical expulsive therapy in carefully selected patients.

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