Medis: Jurnal Inovasi Kesehatan dan Medika Nusantara
Volume: 1, Nomor: 3, (2026), September: 438 - 454
Website: https://ejournal.ojs-lppm.com/index.php/Medis/article/view/441
E-ISSN: 3124-8918

Efficacy and Safety of Alpha-Blockers for Distal Ureteral Stones: A Systematic Review and Meta-Analysis of Evidence From 2016 to 2026

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Info Artikel
Received: *27 Agustus 2026*
Revised : *04 September 2026*
Accepted: *16 September 2026*
Published: *23 September 2026*

Keywords: *alpha-blockers, ureteral stones, medical expulsive therapy, stone expulsion, safety.*

Abstract
Ureteral stones are common and frequently involve the distal ureter, while the effectiveness and safety of medical expulsive therapy with alpha-blockers remain uncertain because recent trials have used diverse comparators and included patients with different stone characteristics. This systematic review and meta-analysis evaluated the efficacy and safety of alpha-blockers in adults with distal ureteral stones. A systematic search of PubMed, Scopus, and ScienceDirect was conducted for studies published from January 2016 to January 2026. Eligible comparative clinical studies in adults with distal ureteral stones were included, and quantitative synthesis was performed using risk ratios with 95% confidence intervals. Eighteen randomized controlled trials involving 5,301 participants were included. Alpha-blockers significantly increased stone expulsion compared with comparator treatments (RR 1.20, 95% CI 1.08–1.33; p = 0.0007), although substantial heterogeneity was observed (I^2 = 74%). Alpha-blockers were associated with higher risks of dizziness, orthostatic hypotension, and retrograde ejaculation, whereas the difference in headache was not significant. The findings indicate that alpha-blockers improve stone expulsion in adults with distal ureteral stones, but their benefits should be balanced against adverse effects and differences among individual agents. Further comparative trials with standardized stone-size stratification and safety reporting are warranted.

Kata Kunci*:* penghambat alfa, batu ureter, terapi ekspulsif medis, pengeluaran batu, keamanan.

Abstrak
Batu ureter merupakan kondisi urologis yang umum dan banyak ditemukan pada segmen ureter distal, sementara efektivitas dan keamanan terapi ekspulsif medis menggunakan penghambat alfa masih menjadi perdebatan karena penelitian terbaru menggunakan pembanding yang beragam dan melibatkan karakteristik batu yang berbeda. Tinjauan sistematis dan meta-analisis ini bertujuan mengevaluasi efektivitas dan keamanan penghambat alfa pada orang dewasa dengan batu ureter distal. Penelusuran sistematis dilakukan pada PubMed, Scopus, dan ScienceDirect untuk publikasi Januari 2016 hingga Januari 2026. Studi komparatif pada pasien dewasa dengan batu ureter distal yang melaporkan luaran efektivitas atau keamanan disertakan, kemudian dilakukan sintesis kuantitatif menggunakan rasio risiko dengan interval kepercayaan 95%. Sebanyak 18 uji terkontrol acak dengan 5.301 peserta disertakan. Penghambat alfa meningkatkan angka pengeluaran batu secara bermakna dibandingkan terapi pembanding (RR 1,20; IK 95% 1,08–1,33; p = 0,0007), dengan heterogenitas yang cukup besar (I^2 = 74%). Penggunaan penghambat alfa meningkatkan

risiko pusing, hipotensi ortostatik, dan ejakulasi retrograd, sedangkan perbedaan sakit kepala tidak bermakna. Hasil menunjukkan bahwa penghambat alfa meningkatkan pengeluaran batu ureter distal, tetapi manfaat tersebut perlu dipertimbangkan bersama risiko efek samping dan perbedaan antarobat. Penelitian komparatif selanjutnya dengan stratifikasi ukuran batu dan pelaporan keamanan yang seragam masih diperlukan.

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Publisher: Lembaga Penerbit Penelitian Multidisipliner

INTRODUCTION

Ureterolithiasis is a common urological condition characterized by the migration of calculi from the kidney into the ureter. It affects millions of individuals worldwide and has demonstrated increasing incidence and prevalence, thereby imposing a substantial burden on healthcare systems. Its occurrence is influenced by various factors, including race, sex, body weight, fluid intake, and climatic conditions (Fukuhara et al., 2016). Approximately 20% of urinary tract stones are ureteral stones, and approximately 70% of these are located in the distal ureter (Xu et al., 2019).

The likelihood of spontaneous ureteral stone passage is influenced by both stone-related and patient-related factors. Stone-related factors include stone size, number, and anatomical location, whereas urinary tract factors include ureteral spasm, mucosal edema or inflammation, and ureteral anatomy. Medical expulsive therapy (MET) is a non-invasive therapeutic strategy intended to facilitate spontaneous stone passage, shorten the time to stone expulsion, and potentially reduce pain and the need for additional interventions (Gur, 2021; Abdelaal & El-Dydamony, 2023). Alpha-blockers are among the pharmacological agents commonly used as MET to increase the stone expulsion rate and reduce the time required for stone passage (Sharma et al., 2021).

Several randomized controlled trials and meta-analyses have previously evaluated the use of alpha-blockers for ureteral stones; however, several uncertainties remain. Earlier evidence has largely focused on placebo or conservative therapy, whereas more recent studies have employed a broader range of active comparators. In addition, variations in stone size, type of alpha-blocker, comparator treatment, and outcome assessment may contribute to differences in reported efficacy and safety outcomes. Previous meta-analyses have demonstrated benefits associated with alpha-blockers, but the magnitude of treatment effects may vary according to stone characteristics and the quality of available evidence (Hollingsworth et al., 2016; Campschroer et al., 2018).

Given these gaps in the evidence, an updated synthesis of contemporary evidence incorporating recent studies and a broader range of comparator treatments is warranted. Therefore, this study aimed

to evaluate the efficacy and safety of alpha-blockers as a pharmacological class compared with placebo, standard or conservative therapy, and active non-alpha-blocker treatments in adults with distal ureteral stones, with a particular focus on stone expulsion rates and treatment-related adverse events.

RESEARCH METHODS

This study was conducted as a systematic review and meta-analysis in accordance with the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020). The PICO framework was used to formulate the research question in a structured manner, with the population consisting of adults with distal ureteral stones, the intervention consisting of alpha-blockers administered as medical expulsive therapy, the comparators consisting of placebo, standard or conservative therapy, or active non-alpha-blocker medications, and the outcomes consisting of stone expulsion and treatment-related adverse events (Page et al., 2021; Shrestha, 2019).

Eligible studies included comparative studies involving adult patients with distal ureteral stones who received alpha-blockers and reported efficacy or safety outcomes. Alpha-blockers included tamsulosin, silodosin, and other alpha-adrenergic antagonists administered as medical expulsive therapy. Studies were included in the quantitative synthesis when sufficient comparative data were available for stone expulsion or treatment-related adverse events. Case reports, case series without a comparator group, systematic reviews, meta-analyses, animal studies, and in vitro studies were excluded. Studies evaluating alpha-blockers exclusively for indications other than stone expulsion, involving pediatric populations without separately extractable adult data, or lacking sufficient data for the outcomes of interest were also excluded.

A literature search was conducted in PubMed, Scopus, and ScienceDirect for studies published between January 2016 and January 2026. Only full-text articles published in English were considered. The reference lists of eligible studies and relevant review articles were also manually screened to identify additional potentially relevant studies. The search strategy combined terms related to ureteral stones and alpha-blockers, including “Ureteral Calculi,” “ureteral stone,” “ureterolithiasis,” “ureteric calculi,” “Adrenergic alpha-Antagonists,” “alpha blocker,” and “alpha adrenergic antagonist.”

All retrieved records were exported to Rayyan.ai in RIS, CSV, and BibTeX formats for reference management and screening. Duplicate records were removed before screening. Two reviewers independently screened the titles and abstracts, followed by full-text assessment of potentially eligible studies. Any disagreements between the reviewers were resolved through

discussion. The study selection process was summarized using a PRISMA flow diagram.

Data were extracted using a standardized Microsoft Excel spreadsheet. The extracted information included author names, study design, type and dosage of medication, sample size, mean age, stone size, and sex distribution. The risk of bias of randomized controlled trials was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, which evaluates bias arising from the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of the reported results.

Quantitative synthesis was performed to evaluate the efficacy and safety of alpha-blockers. For dichotomous outcomes, pooled effect estimates were calculated as risk ratios (RRs) with 95% confidence intervals (CIs). A random-effects model was applied when clinical or statistical heterogeneity was present, whereas a fixed-effect model was used when heterogeneity was minimal. Heterogeneity was assessed using the Chi-square test and the I^2 statistic. Leave-one-out sensitivity analysis was performed, where appropriate, to assess the robustness of the pooled estimates. All meta-analyses were conducted using Review Manager (RevMan), version 5.4.8.

RESULTS AND DISCUSSION

Results

Study selection

A total of 318 records were identified through database searching, including PubMed (n = 33), ScienceDirect (n = 222), and Scopus (n = 63). After removing 11 duplicate records, 307 records were screened based on their titles and abstracts. Of these, 241 records were excluded because they were not relevant to the review question. Subsequently, 66 full-text reports were sought for retrieval, with no reports unavailable for retrieval. All 66 reports were therefore assessed for eligibility. Of these, 48 reports were excluded for the following reasons: wrong population (n = 10), wrong study design (n = 9), wrong outcome (n = 7), and wrong intervention (n = 22). Ultimately, 18 studies were included in the systematic review and meta-analysis. The study selection process is presented in the PRISMA flow diagram (Figure 1).

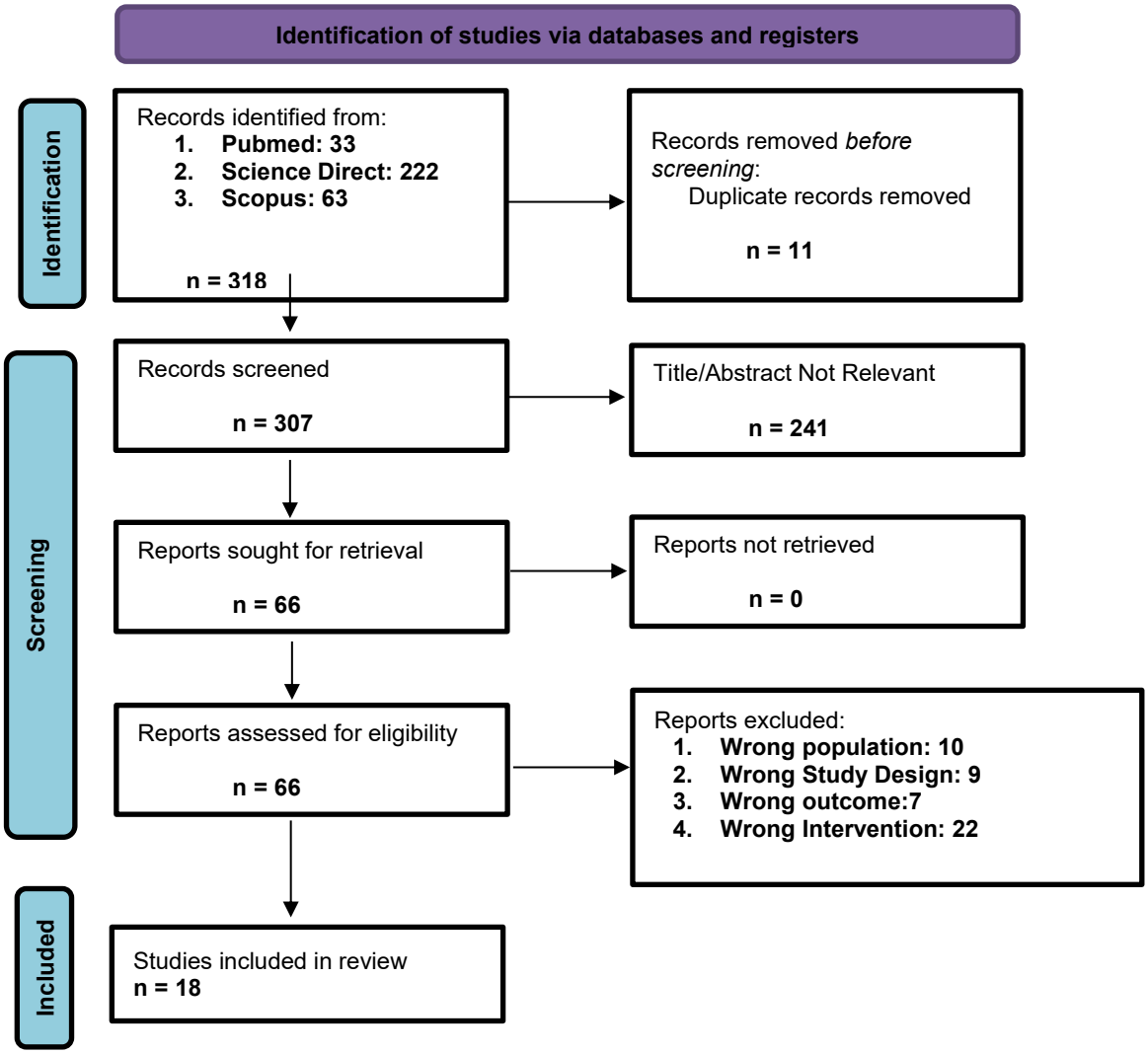


Figure 1. *Prisma Flow Chart*

Study characteristics

A total of eighteen studies evaluating medical expulsive therapy in adult patients with distal ureteral stones were included in the systematic review. The included studies evaluated alpha-blockers, particularly tamsulosin and silodosin, either alone or compared with placebo, control treatment, or other pharmacological interventions. All included studies were RCTs and included adult patients with distal ureteral stones of varying stone sizes.

Not all included studies contributed data to every quantitative analysis because outcome reporting differed across studies. The main characteristics of the included studies, including study, intervention, sample size, patient age, and stone size, are summarized in Table 1.

Table 1. *Study characteristics*

Study	Intervention	No of Patients	Age Mean (SD)	Stone Size (mm) Mean (SD)
Abdelaal, 2023 (Abdelaal & El-Dydamony, 2023)	Tamsulosin 0,4mg Silodosin 8mg Tadalafil 5mg	50 50 50	38.7 41.3 41.9	6.7± 1.3 6.9 ± 1.6 6.9 ± 1.5
Abdel Kader, 2023 (Abdel-Kader et al., 2024)	Silodosin 8mg Mirabegron 50mg Combination both	35 35 35	36.65 ± 6.81 38.62 ± 7.88 37.81 ± 8.11	7.44 ± 1.32 7.11 ± 1.25 7.54 ± 1.25
Bayratkar, 2017 (Bayraktar & Albayrak, 2017)	Tamsulosin 0.4mg Sexual Activity Standard Medical Therapy	60 66 64	34.4 ± 13.5 38.66 ± 14.1 36.92 ± 12.4	7.09 ± 1.4 7.01 ± 1.4 7.1 ± 1.3
Diab, 2025 (Diab et al., 2025)	Silodosin 8mg Tadalafil 5mg Combination both	42 44 42	39.2 ± 7.9 35.7 ± 6.8 37.5 ± 7.7	6.5 (5.2 – 9) 6.5 (5.2 – 9) 6.5 (5.2 – 9)
El Hadj Sidi,2023 (El Hadj Sidi et al., 2023)	Placebo Silodosin 8mg Silodosin + Tadalafil	40 40 40	36 ± 7 39 ± 8 37 ± 8	6.8 ± 1.2 6.7 ± 1 6.7 ± 1.1
Elsherief, 2025 (Mahmoud Mohammed Ahmed Elsherief et al., 2025)	Placebo L-arginine 1000mg Tamsulosin 0.4mg	51 51 51	37.3 ± 7.5 35 ± 7.57 46.1 ± 8.7	6.7 ± 1.54 6.8 ± 1.29 6.6 ± 1.58
Falahatkar, 2021 (Falahatkar et al., 2021)	Tamsulosin 0.4mg Tadalafil 10mg Placebo	44 44 44	37±11.35 37.36±12 36.9±11.53	6.93±1.46 6.86±1.65 6.88±1.48
Furyk, 2016 (Furyk et al., 2016)	Tamsulosin 0.4 mg Placebo	198 195	45.5 (35–55) 46 (37–55)	4.0 (3–5) 3.7 (3–5)
Gur, 2021	Dexketoprofen 50mg	50	38 (31.5-48)	5.75 (4.7-8.1)

(M. Gur et al., 2021)	Tamsulosin 0.4mg Silodosin 8mg Tadalafil 5mg	48 49 46	41 (30.2-51.7) 41 (33-50.5) 39 (31.75-48)	6.2 (4.62-7.6) 6.2 (5.1-7.55) 6.1 (5.17-7.3)
KC Hari, 2016 (Hari Bahadur et al., 2016)	Tamsulosin 0.4mg Tadalafil 10mg	41 44	31.37±11.98 32.05±13.34	7.09±1.2 7.13±1.5
Kucukpolat, 2022 (Kucukpolat et al., 2022)	Tamsulosin 0.4mg Deflazacort 30mg Combination both Control	37 26 37 34	39.2 (18 – 60) 35.6 (19 – 59) 40.4 (23 – 59) 45.5 (29 – 64)	6.5 (4– 10) 5.6 (4 – 10) 5.62 (4 – 10) 6.34 (4 – 10)
Nuraj, 2017 (Nuraj & Hyseni, 2017)	Tamsulosin 0.4mg Diclofenac 75mg	52 52	35.5 ± 11.0 35.4 ± 10.8	6.5 ± 1.6 6.6 ± 1.5
Samir, 2020 (Samir et al., 2020)	Silodosin 8mg Verdenafil 5mg Combination both	30 30 30	38.67 ± 6.82 37.63 ± 8.77 36.90 ± 9.23	7.47 ± 1.33 7.07 ± 1.23 7.50 ± 1.28
Samir, 2023 (Samir et al., 2024)	Silodosin 8mg Mirabegron 57mg Control	59 57 60	38.6 ± 11.1 39.5 ± 10.5 41.7 ± 11.7	7.3 ± 1.4 7.2 ± 1.6 7.3 ± 1.4
Shalaby,2022 (Shalaby et al., 2022)	Tamsulosin 0,4mg Control	40 40	34.5 (28, 45) 38 (29.5, 46)	6 (4.5–7.5) 6 (5–8)
Turgut,2020 (Turgut & Sarıer, 2021)	Masturbate Tamsulosin 0.4mg Control	43 41 44	37 ± 5 37.6 ± 4.6 38.4 ± 6.8	6.93 ± 1.1 7.1 ± 0.9 6.87 ± 1.1
Wang,2016 (Wang et al., 2016)	Control Tamsulosin 0.4mg	61 62	51.51 ± 10.03 51.42 ± 8.68	6.46 ± 1.31 6.47 ± 1.39
Ye,2018 (Ye et al., 2018)	Tamsulosin 0.4mg Placebo	1642 1654	40.1 (11.6) 40.7 (12.3)	5.8 (1.9) 5.7 (1.8)

Risk of bias assessment

The methodological quality of the included randomized controlled trials was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool. The assessment included bias arising from the randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selection of reported results. Overall risk-of-bias judgments were categorized as low risk, some concerns, or high risk. The detailed risk-of-bias assessment is presented in Figure 2.

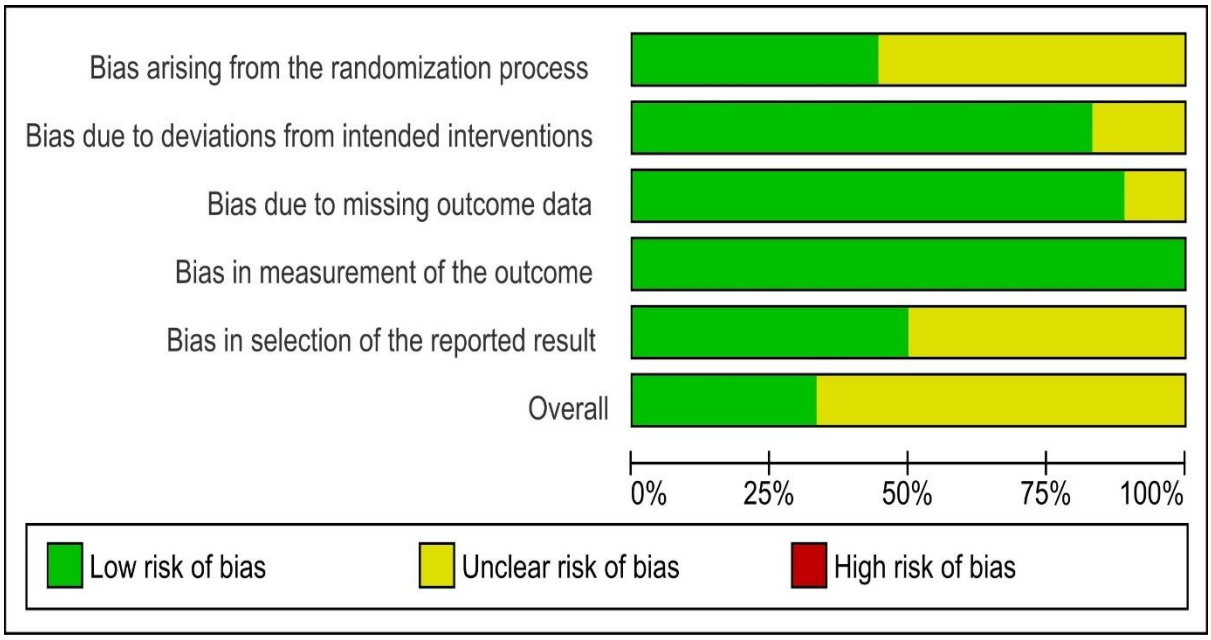


Figure 2. *Risk Of Bias (ROB-2)*

Stone expulsion rate

Eighteen studies involving 5,301 patients were included in the meta-analysis of stone expulsion rate. Stone expulsion occurred in 2,128 of 2,671 patients receiving alpha-blocker therapy and in 1,847 of 2,630 patients in the control groups. The pooled analysis using a random-effects model demonstrated that alpha-blocker therapy was associated with a significantly higher stone expulsion rate compared with control (RR 1.20, 95% CI 1.08–1.33; $p = 0.0007$). Substantial heterogeneity was observed among the included studies ($Tau^2 = 0.03$; $Chi^2 = 66.48$, $df = 17$, $p < 0.00001$; $I^2 = 74\%$), indicating considerable variability in treatment effects across studies. The forest plot for stone expulsion rate is presented in Figure 3.

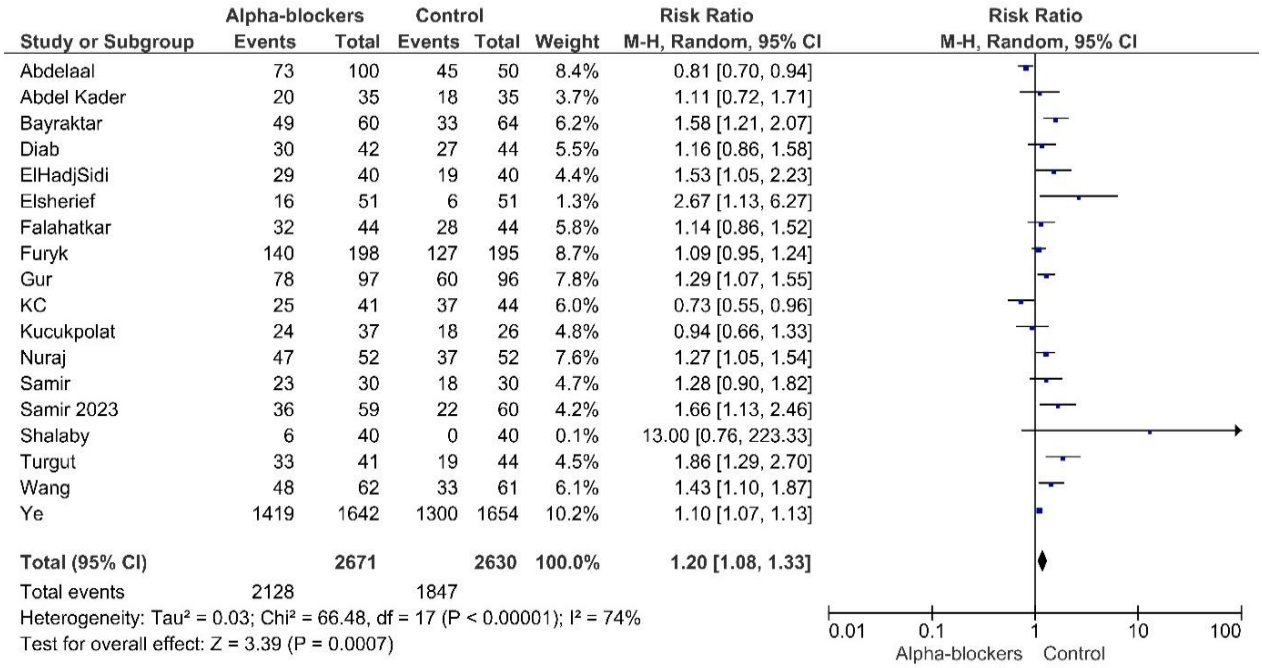


Figure 3. *Forest plot of the pooled risk ratio for stone expulsion following alpha-blocker therapy compared with comparator treatment*

Safety outcomes

1. Dizziness

Ten studies involving 1,157 patients were included in the meta-analysis of dizziness. Dizziness occurred in 99 of 600 patients receiving alpha-blocker therapy and in 71 of 557 patients in the control groups. The pooled analysis demonstrated a significantly higher risk of dizziness with alpha-blocker therapy compared with control (RR 1.33, 95% CI 1.01–1.77; p = 0.04). No statistical heterogeneity was observed across the included studies ($Chi^2 = 8.54$, df = 9, p = 0.48; $I^2 = 0\%$), indicating consistent treatment effects among studies. The forest plot for dizziness is presented in Figure 4.

2. Retrograde Ejaculation

Six studies involving 3,729 patients were included in the meta-analysis of retrograde ejaculation. Retrograde ejaculation occurred in 144 of 1,859 patients receiving alpha-blocker therapy and in 48 of 1,870 patients in the control groups. The pooled random-effects analysis demonstrated a significantly higher risk of retrograde ejaculation with alpha-blocker therapy compared with control (RR 13.37, 95% CI 1.69–105.62; p = 0.01). However, substantial heterogeneity was observed across the included studies ($Tau^2 = 5.05$; $Chi^2 = 28.39$, df = 5, p < 0.0001; $I^2 = 82\%$), indicating considerable variability in the magnitude of the treatment effect between studies. The forest plot for retrograde ejaculation is presented in Figure 5.

3. Headache

Eleven studies involving 4,664 patients were included in the meta-analysis. The outcome occurred in 152 of 2,299 patients receiving alpha-blocker therapy and in 151 of 2,365 patients in the control groups. The pooled fixed-effect analysis showed no statistically significant difference between alpha-blocker therapy and control (RR 1.02, 95% CI 0.83–1.25; p = 0.87). Moderate heterogeneity was observed across the included studies ($Chi^2 = 19.83$, df = 10, p = 0.03; $I^2 = 50\%$), indicating some variability in treatment effects between studies. The forest plot for headache is presented in Figure 6.

4. Orthostatic Hypotension

Nine studies involving 931 patients were included in the meta-analysis of orthostatic hypotension. Orthostatic hypotension occurred in 53 of 488 patients receiving alpha-blocker therapy and in 19 of 443 patients in the control groups. The pooled fixed-effect analysis demonstrated a significantly higher risk of orthostatic hypotension with alpha-blocker therapy compared with control (RR 2.28, 95% CI 1.38–3.78; p = 0.001). Low-to-moderate heterogeneity was observed across the included studies ($Chi^2 = 13.52$, df = 8, p = 0.10; $I^2 = 41\%$), suggesting some variability in treatment effects between studies. The forest plot for orthostatic hypotension is presented in Figure 7.

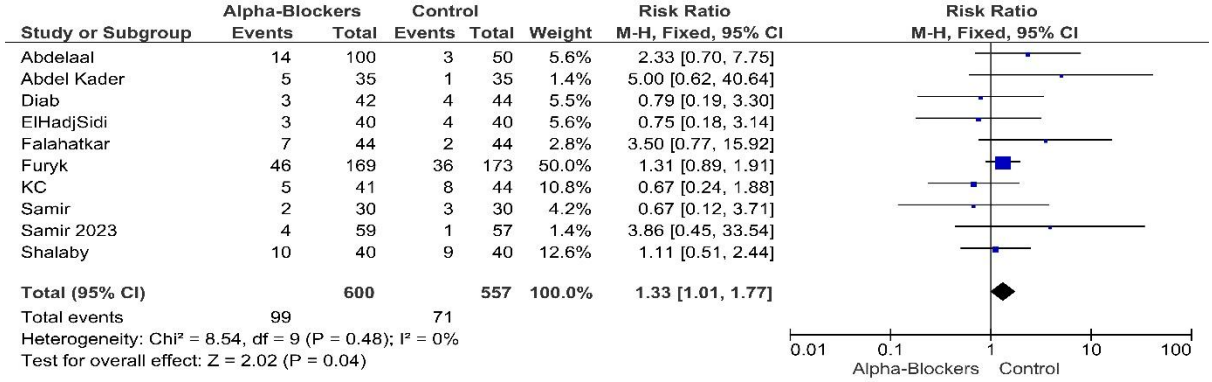


Figure 4. *Forest plot of the pooled risk ratio for dizziness associated with alpha-blocker therapy compared with comparator treatment*

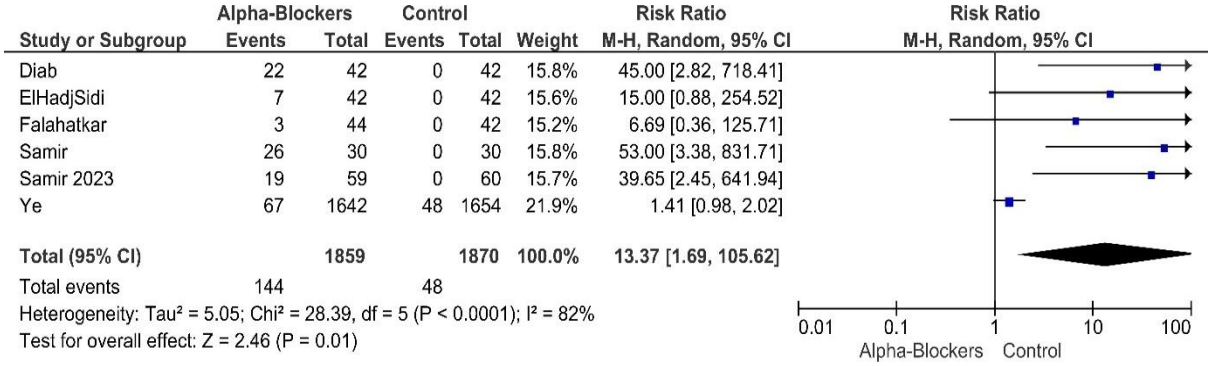


Figure 5. *Forest plot of the pooled risk ratio for retrograde ejaculation associated with alpha-blocker therapy compared with comparator treatment*

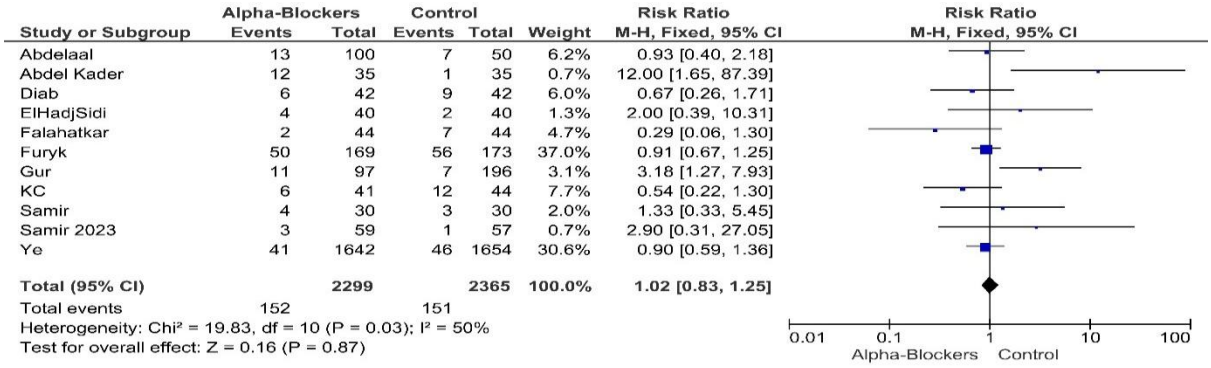


Figure 6. *Forest plot of the pooled risk ratio for headache associated with alpha-blocker therapy compared with comparator treatment*

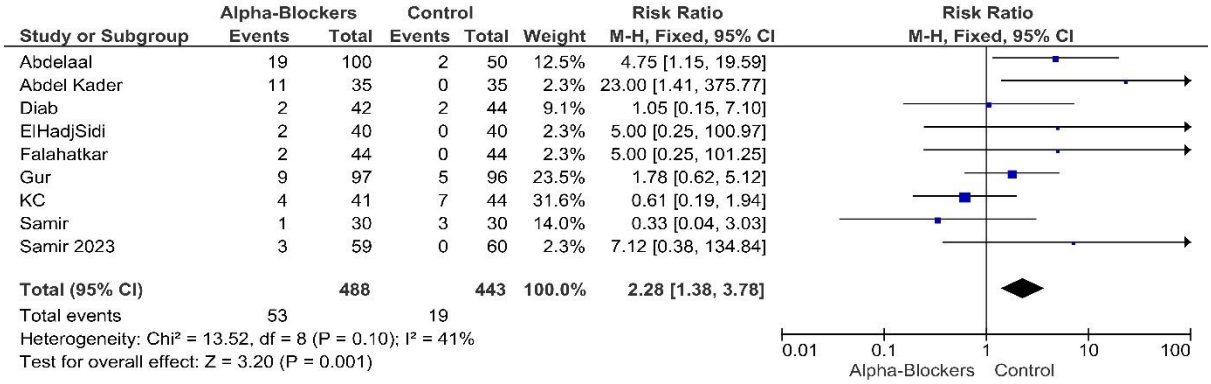


Figure 7. *Forest plot of the pooled risk ratio for orthostatic hypotension associated with alpha-blocker therapy compared with comparator treatment*

Publication bias

Publication bias was assessed by visual inspection of the funnel plot (Figure 8) and Egger's regression test. Visual assessment of the funnel plot suggested mild asymmetry, with one study appearing as an outlier from the main cluster. However, Egger's regression test did not show statistically significant funnel plot asymmetry (Intercept = 0.864, SE = 0.532; t = 1.62, df = 16; p = 0.124), indicating no significant evidence of publication bias or small-study effects, although these cannot be completely excluded.

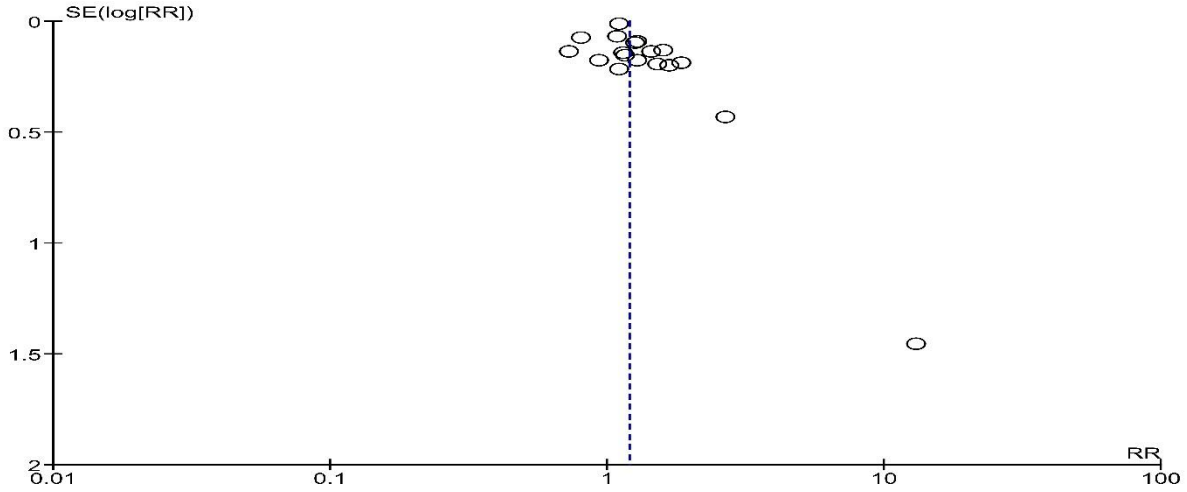


Figure 8. *Funnel plot for assessment of publication bias*

Discussion

The meta-analysis findings indicate that alpha-blockers increased the relative stone expulsion rate by approximately 20% compared with comparator treatments (RR 1.20; 95% CI 1.08–1.33). This finding is comparable to the recent meta-analysis by (Almaghthawi et al., 2026), which included 29 randomized controlled trials involving 4,256 patients and reported an RR of 1.25 (95% CI 1.20–1.32). The heterogeneity observed in both analyses was also similar, with an I^2 of 74% in the present study and 75% in (Almaghthawi et al., 2026), indicating that variability in treatment effects across studies remains an important characteristic of the contemporary evidence.

Previous meta-analyses have generally reported larger treatment effects. Hollingsworth et al. (2016), in a meta-analysis of 55 randomized controlled trials involving 5,990 patients, reported an RR of 1.49 (95% CI 1.39–1.61) for stone expulsion. Similarly, (Campschroer et al., 2018) reported an overall RR of 1.45 (95% CI 1.36–1.55) across 67 studies involving 10,509 participants. However, when the Cochrane analysis was restricted to higher-quality trials with placebo controls, the effect estimate decreased to an RR of 1.16 (95% CI 1.07–1.25), which is closer to the findings of the present study. These differences suggest that study quality, comparator type, and the baseline probability of spontaneous stone passage may influence the magnitude of the observed treatment benefit.

Stone size is an important factor that may explain the heterogeneity observed in the present analysis. (Hollingsworth et al., 2016) reported a relatively modest benefit for smaller stones (RR 1.19; 95% CI 1.00–1.48), whereas larger stones demonstrated a greater likelihood of passage with alpha-blocker therapy (RR 1.57; 95% CI 1.17–2.27). (Campschroer et al., 2018) similarly reported an RR of 1.06 for stones ≤5 mm compared with an RR of 1.45 for stones >5 mm. (Almaghthawi et al., 2026)

reported a comparable pattern, with an RR of 1.06 for stones <5 mm and 1.35 for stones measuring 5–10 mm. Overall, the clinical benefit of alpha-blockers appears to be greater for distal ureteral stones with an intermediate likelihood of spontaneous passage, particularly stones measuring approximately 5–10 mm.

The pooled effect of alpha-blockers as a pharmacological class should be interpreted in consideration of differences among individual agents. (Jung et al., 2022) reported that silodosin was associated with a higher stone expulsion rate than tamsulosin (OR 2.42; 95% CI 1.91–3.06). Ebrahimpour et al. (2025) reported a similar finding, demonstrating the superiority of silodosin over tamsulosin (OR 2.24; $p < 0.001$). In addition, (Sharma et al., 2021), in a network meta-analysis, identified silodosin as one of the most effective individual agents for distal ureteral stone expulsion. Therefore, pooling different alpha-blockers into a single pharmacological category may contribute to heterogeneity and potentially obscure clinically relevant differences among individual agents.

The safety findings indicate that the benefits of alpha-blockers should be considered alongside their potential adverse effects. Alpha-blocker therapy was associated with increased risks of dizziness, orthostatic hypotension, and retrograde ejaculation, whereas no significant difference was observed in the risk of headache. These findings are consistent with the meta-analysis by (Yan et al., 2024), which compared alpha-blockers with mirabegron and reported increased risks of orthostatic hypotension and retrograde ejaculation, although the increase in dizziness was not statistically significant. These findings underscore the importance of evaluating the balance between therapeutic benefits and potential risks, particularly in patients who may be susceptible to hemodynamic symptoms or sexual adverse effects.

From a clinical perspective, the findings support the use of alpha-blockers as one of the medical expulsive therapy options for adults with distal ureteral stones who are appropriate candidates for conservative management. However, the results do not support the assumption that all alpha-blockers have equivalent efficacy. Stone characteristics, choice of medication, type of comparator, and safety profile should be considered when selecting therapy. The findings also highlight the need for future head-to-head studies with stratification according to stone size and more standardized reporting of adverse events.

Limitations

This study has several limitations. The substantial heterogeneity observed in stone expulsion outcomes may have been influenced by differences in stone size, type of alpha-blocker, comparator

treatment, follow-up duration, and patient characteristics. The comparator groups were also heterogeneous, including placebo, conservative therapy, and active non-alpha-blocker treatments; therefore, the pooled estimates represent the overall class effect rather than a uniform comparison with placebo. Pooling different alpha-blockers also limits the ability of this study to determine the relative superiority of individual agents. In addition, differences in stone size and methods of outcome assessment may have influenced the reported rates of spontaneous stone passage. The inconsistent reporting of adverse events and the relatively small number of events in some analyses, particularly retrograde ejaculation, may also have resulted in less precise effect estimates.

CONCLUSION

Alpha-blocker therapy significantly increases stone expulsion in adult patients with distal ureteral stones compared with comparator treatments. However, this benefit is accompanied by increased risks of dizziness, orthostatic hypotension, and retrograde ejaculation, whereas the risk of headache does not differ significantly. Given the heterogeneity across studies and differences in efficacy and safety among individual agents, the findings should be interpreted as representing the overall class effect of alpha-blockers rather than evidence that any particular agent is consistently superior. Future head-to-head studies with stratification by stone size, standardized comparator groups, and consistent safety reporting are warranted to identify the patient populations most likely to achieve an optimal benefit–risk balance.

RECOMMENDATIONS

Future research should employ direct comparative designs evaluating individual alpha-blockers, with more rigorous stratification according to stone size and location, as well as standardized outcome definitions and adverse-event reporting systems.

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