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Review Article

Comparative efficacy of solifenacin and tamsulosin in alleviating stent-related symptoms: A systematic review and meta-analysis

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Abstract

Ureteral stents, commonly used in urology, can cause side effects affecting patient quality of life. However, studies on managing lower urinary tract symptoms showed inconsistencies due to the use of various alpha-blockers and antimuscarinic drugs. The aim of this study was to evaluate the effectiveness of combining tamsulosin and solifenacin therapy compared to tamsulosin and solifenacin monotherapy for treating stent-related symptoms. Randomized controlled trials assessing tamsulosin, solifenacin, or their combination for stent-related symptoms treatment were identified through a comprehensive search of four databases (PubMed, Scopus, Web of Science, and Cochrane) from January 2018 to December 2023. Ureteral stent symptom questionnaire (USSQ), international prostate symptom score (IPSS), visual analog scale (VAS), and quality of life (QoL) were pooled for meta-analysis. Eleven studies with a total of 1,627 patients were included in the quantitative analysis. Solifenacin significantly improved urinary symptoms (MD: 15.31; 95%CI: 0.36–30.26; p=0.040) and reduced the IPSS (MD: -2.52; 95%CI: -3.68–-1.36; p<0.00001) compared to the control group. Tamsulosin reduced urinary symptoms on the USSQ (MD: 14.27; 95%CI: 8.68–19.86; p<0.00001), general health problems (MD: 4.53; 95%CI: 2.13–6.94; p=0.0002), and IPSS (MD: -0.95; 95%CI: -1.86–-0.03; p<0.00001) compared to the control group. Solifenacin demonstrated a more significant reduction in the overall IPSS compared to tamsulosin (MD: -1.57; 95%CI: -2.85–-0.29; p=0.020). The combination of solifenacin and tamsulosin resulted in a significantly superior reduction in IPSS compared to solifenacin monotherapies (MD: -2.30; 95%CI: -3.23–-1.37; p<0.00001) and tamsulosin monotherapy (MD: -3.17; 95%CI: -5.07–-1.27; p=0.00001). No significant differences were found between tamsulosin and solifenacin in terms of QoL (MD: 0.12; 95%CI: -0.01–0.26; p=0.070) and VAS (MD: 0.25; 95%CI: -0.95–1.44; p=0.690). In conclusion, solifenacin was more effective than tamsulosin in reducing stent-related symptoms, and the combination of tamsulosin and solifenacin was superior to either monotherapy in alleviating stent-related symptoms.

Keywords: Ureteral stent, tamsulosin, solifenacin, QoL, stent-related symptoms

Introduction

Urinary stents are commonly utilized in urological therapy, with approximately 1.5 million ureteral stents placed annually worldwide [1,2]. These devices are essential for maintaining

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urinary flow, facilitating postoperative recovery, alleviating obstructions, and supporting healing following various urological procedures [3]. Ureteral stents are slender tubes inserted into the ureteral lumen to maintain patency, aid in healing, and facilitate ureteral identification during surgical interventions [4]. Among various types available, the double-J stent is the most frequently employed and remains a cornerstone in urological practice [4]. However, the use of urinary stents is often associated with adverse effects, including lower urinary tract symptoms, hematuria, discomfort, and sexual dysfunction, all of which can significantly impair quality of life [5,6]. Efforts to reduce these complications have primarily focused on optimizing stent materials, lengths, designs, and positioning [6]. Despite these advancements, achieving an ideal stent design remains challenging due to inherent limitations in available size and structural options [6].

Oral pharmacologic therapies, particularly alpha-blockers and antimuscarinics, have shown promising efficacy in managing stent-related symptoms [6]. Tamsulosin, an alpha-1A adrenergic receptor antagonist, functions in inhibiting muscle contraction. This drug specifically targets the smooth muscle of the urethra, bladder neck, and prostate [7]. The mechanism effectively alleviates lower urinary tract symptoms and makes tamsulosin a valuable agent for both the prevention and treatment of urinary retention [7]. Furthermore, tamsulosin is commonly used in the management of urinary calculi and as adjunctive therapy for male sexual dysfunction [7]. Solifenacin, a highly selective anticholinergic agent, functions as an M3 muscarinic acetylcholine receptor antagonist, primarily targeting the detrusor muscle of the bladder [8]. By inhibiting acetylcholine binding to the M3 receptor, solifenacin reduces detrusor contractility, thereby mitigating symptoms such as urinary urgency and frequency [8].

Recent studies have investigated the efficacy of combining alpha-blocker and antimuscarinic therapies compared to alpha-blocker monotherapy [6,9-21]. However, these studies utilized various types of alpha-blockers and antimuscarinic agents, which led to inconsistencies in the findings [6,9-21]. The aim of this study was to provide updated evidence on the efficacy of combined tamsulosin and solifenacin therapy compared to tamsulosin or solifenacin monotherapy for managing stent-related symptoms.

Methods

Study design and setting

The research question of the present study was to compare the efficacy of tamsulosin monotherapy, solifenacin monotherapy, and the combination of both in managing symptoms associated with ureteral stents in patients with lower urinary tract symptoms. The present study adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [8]. A literature search was conducted from January 2024 to October 2024 across four databases (Web of Science, Cochrane, Scopus, and PubMed) using modified search terms. After study selection, data extraction and quality assessment were performed using the Risk of Bias 2.0 (RoB 2.0) tool [22]. The outcomes were measured using the Ureteral Stent Symptom Questionnaire (USSQ), International Prostate Symptom Score (IPSS), Visual Analog Scale (VAS), and Quality of Life (QoL) questionnaire. The meta-analysis was carried out using Review Manager 5.4 software (Cochrane Collaboration, London, United Kingdom).

Search strategy

Four databases were utilized: Web of Science, Cochrane, Scopus, and PubMed. The search was conducted on January 1, 2024. The search strategy incorporated modified terms using Medical Subject Headings (MeSH) terms, with Boolean operators employed to combine relevant keywords, including ("ureteral stent" OR "stent-related symptoms") AND ("tamsulosin" OR "solifenacin" OR "combination therapy") AND "randomized controlled trial" (**Table 1**).

Table 1. Combined keywords employed in each database

Database	Search Strategy
PubMed	("ureteral stent" OR "stent-related symptoms") AND ("tamsulosin" OR "solifenacin" OR "combination therapy") AND "randomized controlled trial"
Scopus	TITLE-ABS-KEY(("ureteral stent" OR "stent-related symptoms") AND ("tamsulosin" OR "solifenacin" OR "combination therapy") AND "randomized controlled trial")

Database	Search Strategy
Web of Science	TS=("ureteral stent" OR "stent-related symptoms") AND ("tamsulosin" OR "solifenacin" OR "combination therapy") AND "randomized controlled trial"
Cochrane Library	("ureteral stent" OR "stent-related symptoms") AND ("tamsulosin" OR "solifenacin" OR "combination therapy") AND "randomized controlled trial"

Eligibility criteria

The inclusion criteria for the present study were based on the population, intervention, comparison, outcome, and study design (PICOS) framework. The population consisted of individuals diagnosed with ureteral stent-related symptoms, characterized by pain, frequent urination, urgency, and hematuria. The intervention consisted of monotherapy with solifenacin, tamsulosin, or a combination of both. The comparator involved evaluating placebo, solifenacin, tamsulosin, or the combination against other medications, as well as comparing monotherapy with combination therapy. The outcomes were measured using the USSQ, IPSS, VAS, and QoL. The study design was limited to randomized controlled trials (RCTs) published in English between January 2018 and December 2023. The exclusion criteria encompassed studies with insufficient data reporting or incomplete publications, those published before January 2018, studies involving patients under the age of 18, individuals with comorbid conditions, and non-RCT study types such as case reports, cohort studies, observational studies, case studies, letters to the editor, and conference abstracts.

Data selection and screening

Duplicates were manually identified and eliminated individually. Abstract screening process was performed by three independent reviewers (DHH, MHW, KAP), who conducted an initial evaluation of the titles and abstracts of all identified studies. Any discrepancies or disagreements between reviewers were resolved through discussion and consensus among the reviewers, with involvement from the entire team when necessary. After the initial title and abstract screening, the full-text screening phase was followed to further evaluate eligibility against the inclusion and exclusion criteria.

Data extraction

Data extracted from each study included the author's name, publication year, patient age, country of origin, sample size, indication for ureteral stent use, administered drugs (placebo, control, tamsulosin, solifenacin, or combination therapy), outcome measurement (USSQ, IPSS, VAS, and QoL), and follow-up duration.

Quality assessment

Three reviewers (DHH, MHW, KAP) independently assessed the risk of bias in the selected studies using the Risk of Bias 2.0 (RoB 2.0) tool [22], evaluating five domains: randomization procedures, intervention variations, outcome data insufficiency, outcome assessment methodologies, and selection/reporting bias. Each domain is rated as low risk, some concerns, or high risk of bias. Low risk indicates a well-conducted trial with minimal bias, allowing for confident interpretation of results. Some concerns suggest minor issues that may introduce bias, but with limited impact on the results, which should be interpreted with caution. High risk indicates significant bias, potentially compromising the reliability and validity of the trial's findings. The overall risk of bias in a study is determined by its performance across all domains. A study is classified as having a low overall risk of bias when most domains show no significant flaws. When one domain presents some concerns, but the remaining domains indicate low risk, the study is considered to have an overall risk of "some concerns." However, a study is assigned a high overall risk if one or more critical domains, such as randomization procedures or outcome data insufficiency, are rated as high risk.

Study variables

Stent-related symptoms are conditions where patients experience complaints similar to lower urinary tract syndromes (LUTS). These symptoms arise due to the presence of a stent placed in the patient, which can trigger such complaints. The assessment of stent-related symptoms is conducted using several variables, including the USSQ, QoL, IPPS, and VAS, which serve as references to evaluate the severity of LUTS caused by stent-related symptoms. Ureteral stent

symptoms and their impact on QoL were assessed using the USSQ, a validated tool covering domains such as urinary symptoms, pain, physical activity, general health, work performance, and sexual matters. Higher scores indicate a greater negative impact on QoL, with results presented as mean or median scores, accompanied by variability measures such as standard deviation (SD) or interquartile range (IQR) [23]. The severity of lower urinary tract symptoms was assessed using the IPSS. Patients rated seven questions on a scale of 0 to 5, producing total scores ranging from 0 to 35. Severity was classified as mild (0–7), moderate (8–19), or severe (20–35). Scores were presented as means or medians, with severity categories summarized in percentages [8,24,25]. Pain intensity was measured using a VAS. Patients marked their pain level on a 10-cm line ranging from "no pain" to "worst pain." Pain levels were categorized as mild (0–3), moderate (4–6), or severe (7–10), with results reported as means or medians alongside SD or IQR [24]. QoL was evaluated based on overall life satisfaction across different cultural contexts, distinct from health-related QoL factors. QoL was assessed using the IPSS/QoL questionnaire. The QoL scale ranged from 0 (Delighted), 1 (Pleased), 2 (Mostly Satisfied), 3 (Mixed), 4 (Mostly Dissatisfied), 5 (Unhappy), to 6 (Terrible), reflecting satisfaction with current health status. The questionnaire also evaluated prior medication use, perceived treatment efficacy (scale: 1 [no relief] to 10 [complete relief]), and interest in minimally invasive treatments as alternatives to or replacements for medications for managing an enlarged prostate [25,26].

Statistical analysis

Meta-analysis was conducted using Review Manager 5.4 (Cochrane Collaboration, London, United Kingdom). The primary outcome was assessed using continuous data with the mean difference (MD) and 95% confidence interval (CI). Statistical significance was defined as a $p<0.05$. Heterogeneity was evaluated using the I^2 statistic, with values classified as high ($I^2>50\%$), moderate (26–50%), or low ($I^2<26\%$). An $I^2>50\%$ indicated heterogeneity, requiring the use of a random-effects model, while $I^2<50\%$ indicated homogeneity, allowing for the use of a fixed-effect model. Continuous data were analyzed using the mean difference, and categorical data were analyzed using the risk ratio.

Results

Study selection and characteristics of the included studies

A total of 178 records were identified from PubMed (n=103), Scopus (n=63), Web of Science (n=7), and Cochrane Library (n=5). After removing duplicates (n=23) and irrelevant records (n=70), 85 records were screened, and 38 were excluded. Of 47 records sought for retrieval, 9 were inaccessible, leaving 38 for eligibility assessment. Further exclusions included lack of comparison medication (n=9), pediatric patients (n=3), case reports or series (n=2), reviews or meta-analyses (n=3), consensus documents (n=2), unrelated conditions (n=4), and not reporting the outcome of interest (n=1). Fourteen studies were ultimately included in the systematic review and meta-analysis (**Figure 1**).

All studies were RCTs involving a total of 1989 patients, with an average age ranging from 30.75 to 47.23 years. The interventions included tamsulosin, solifenacin, and a combination of both, compared to control or placebo groups. Tamsulosin was administered at a dose of 0.4 mg once daily, while solifenacin doses ranged from 5 mg to 10 mg per day. Ureteral stents primarily facilitate the clearance of residual stone fragments, prevent ureteral blockages, ensure adequate drainage from infected or obstructed kidneys, and gradually dilate the ureter in preparation for surgical procedures such as extracorporeal shockwave lithotripsy (ESWL), ureteroscopy (URS), percutaneous nephrolithotomy (PCNL), and ureteroscopic lithotripsy (URSL). Stent lengths typically range from 12 to 30 cm (5–12 inches), with diameters varying from 4.5 to 18 French (Fr) or 0.06 to 0.2 inches. The intervention duration varied between two and four weeks (**Table 2**).

Risk of bias

Among the 14 RCTs evaluated using the RoB-2 tool, 10 studies were classified as low risk of bias. Four studies were categorized as "some concerns" due to specific aspects identified during the evaluation. Overall, 75% of the studies were deemed to have a low overall risk of bias (**Figure 2**).

Table 2. Characteristics of the included studies

Author, year	Country	Age (years), mean±SD	Sample size, n	Indication of the ureteral stent	Diameter/length of ureteral stent	Administered drugs	Duration of intervention	Outcome measurement
Shukla *et al.*, 2018 [9]	India	41.79±15.86	70	URS , PCNL	N/A	Group 1: Control Group 2: Tamsulosin 0.4 mg Group 3: Solifenacin 10 mg Group 4: Solifenacin 5 mg + tamsulosin 0.4 mg	Preoperative day and postoperative day 14	VAS, IPSS score, QoL
Noor *et al.*, 2018 [10]	Pakistan	42.92±7.04	170	URS. PCNL	N/A	Group 1: Tamsulosin 0.4 mg and solifenacin 5 mg Group 2: Solifenacin 5 mg	6th postoperative week	IPSS score
El-Daneen *et al.*, 2019 [11]	Egypt	47.72±11.45	120	URS, PCNL, ureterolithotomy, and ESWL	N/A	Group 1: Tamsulosin 0.4 mg Group 2: Solifenacin 10 mg Group 3: Solifenacin 10 mg + tamsulosin 0.4 mg Group 4: Placebo	Four weeks post-surgery before stent removal and two weeks after	USSQ score
Prakash *et al.*, 2019 [12]	India	39.22±11.92	274	URS, PCNL	N/A	Group 1: Control Group 2: Tamsulosin 0.4 mg Group 3: Solifenacin 5 mg Group 4: Solifenacin 5 mg + tamsulosin 0.4 mg	Preoperative day and postoperative day 14	IPSS score, VAPS, QoL
Balaji *et al.*, 2020 [13]	India	34.73± 1.88	146	PCNL or URSL	5 Fr and 26 cm long DJ stent	Group 1: Placebo Group 2: Solifenacin 5 mg Group 3: Tamsulosin 0.4 mg Group 4: Tadalafil 5 mg	1st week, end of 3 weeks	USSQ score
Sajid *et al.*, 2021 [14]	Pakistan	40.49±5.92	200	Retrograde ureteroscopy	N/A	Group 1: Solifenacin 5 mg + placebo Group 2: Solifenacin 5 mg + tamsulosin 0.4 mg	2 weeks	IPSS score
Anand *et al.*, 2021 [15]	India	39.92±13.03	100	URSL, PCNL	N/A	Group 1: Tamsulosin 0.4 mg Group 2: Tamsulosin 0.4 mg +solifenacin 5 mg	2 weeks	IPSS score
Elsayed *et al.*, 2021 [16]	Egypt	N/A	60	URSL	N/A	Group 1: Tamsulosin 0.4 mg Group 2: Tamsulosin 0.4 mg +solifenacin 5 mg Group 3: Tamsulosin 0.4 mg +trospium 20 mg	1 week	USSQ score
Saleem *et al.*, 2021 [17]	Pakistan	30.75±6.57	274	Ureteric stone procedures	N/A	Group 1: Tamsulosin 0.4 mg Group 2: Solifenacin succinate 5 mg	2 weeks	IPSS score, QoL
Hasbi *et al.*, 2021 [6]	Indonesia	46.75±9.48	50	Retrograde ureteroscopy	N/A	Group 1: Tamsulosin 0.4 mg Group 2: Solifenacin 5 mg + tamsulosin 0,4 mg	4 weeks	USSQ score

Author, year	Country	Age (years), mean±SD	Sample size, n	Indication of the ureteral stent	Diameter/length of ureteral stent	Administered drugs	Duration of intervention	Outcome measurement
Salih *et al.*, 2021 [18]	Egypt	39.0±5.70	252	URS, ESWL, PCNL	6F DJ ureteral stents	Group 1: Control Group 2: Tamsulosin 0.4 mg Group 3: Solifenacin 5 mg Group 4: Tamsulosin 0.4 mg + solifenacin 5 mg	2 weeks	IPSS scores. QoL, VAS
Chandna *et al.*, 2022 [19]	India	35.59±12.16	123	Ureteroscopic lithotripsy, PCNL, or laparoscopic/robotic pyeloplasty	A 26 cm, 4.8 Fr polyurethane	Group 1: Mirabegron 50 mg Group 2: Solifenacin 5 mg Group 3: Tamsulosin 0.4 mg	From insertion until two weeks after stent removal	USSQ score
Hazratullah, *et al.*, 2022 [20]	Pakistan	46.42±14.59	60	Lithotripsy	N/A	Group 1: Tamsulosin 0.4 mg Group 2: Solifenacin 5 mg	2 weeks	VAS
Lad *et al.*, 2023 [21]	India	38.83±9.11	90	Endoscopic procedure	N/A	Group 1: Tamsulosin 0.4 mg Group 2: Tamsulosin 0.4 mg + solifenacin 5 mg	From the day before surgery until the day of stent removal	IPSS score, QoL, VAS

DJ: double-J; ESWL: extracorporeal shock wave lithotripsy; IPPS: international prostate symptom score; PCNL: percutaneous nephrolithotomy; QoL: quality of life; URS: ureteroscopy; URSL: ureteroscopy lithotripsy; USSQ: ureteral stent symptom questionnaire; VAS: visual analog scale

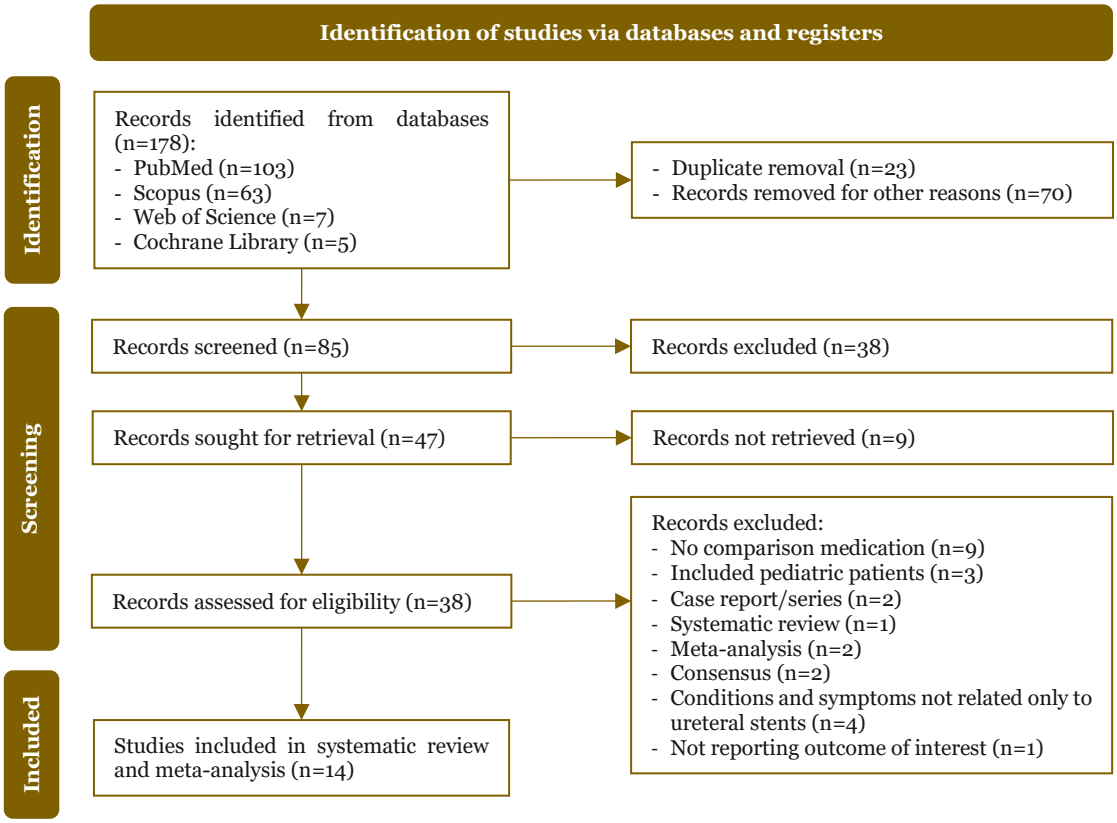

Figure 1. PRISMA flow diagram illustrating the study selection process.

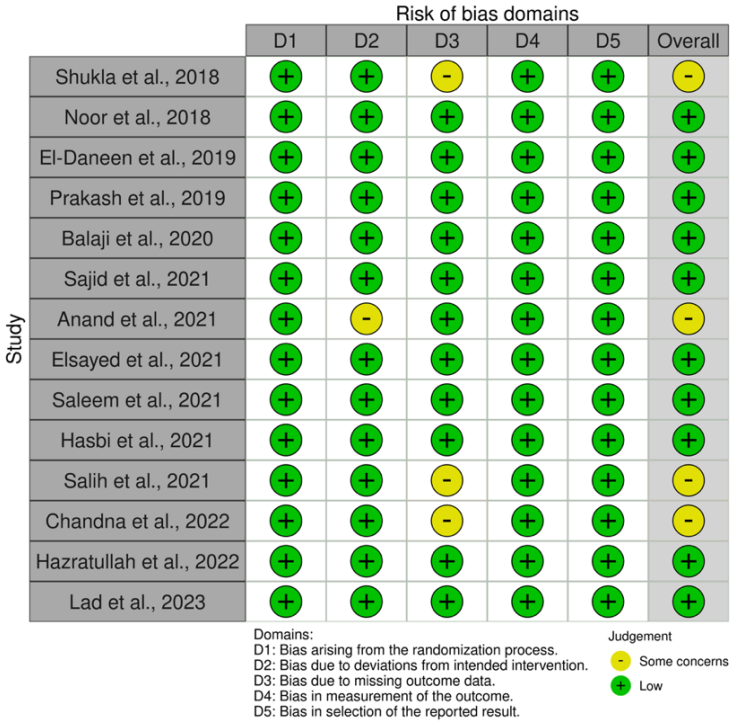

Figure 2. Risk of bias evaluation of the included studies using the RoB-2 tool.

Solifenacin as monotherapy for treating stent-related symptoms

The meta-analysis of three studies [11,13,19] that compared solifenacin with a control group demonstrated a significant reduction in urinary symptoms with solifenacin, based on the USSQ score (MD: 15.31; 95%CI: 0.36–30.26; p=0.040; I^2=99%; Tau^2=171.62; Chi^2=170.59; p-heterogeneity<0.00001). No significant differences were found in pain (MD: 3.21; 95%CI: -1.80–8.23; p=0.210; I^2=92%; Tau^2=17.87; Chi^2=24.56; p-heterogeneity<0.00001), general health

(MD: 2.40; 95%CI: -2.16–6.95; p=0.300; I^2=90%; Tau²=14.29; Chi²=18.84; p-heterogeneity<0.00001), work performance (MD: 0.43; 95%CI: -1.83–2.70; p=0.710; I^2=62%; Tau²=2.31; Chi²=5.23; p-heterogeneity=0.070), or sexual matters (MD: 1.56; 95%CI: -1.31–4.43; p=0.290; I^2=81%; Tau²=4.55; Chi²=10.34; p-heterogeneity=0.006) (**Figure 3**).

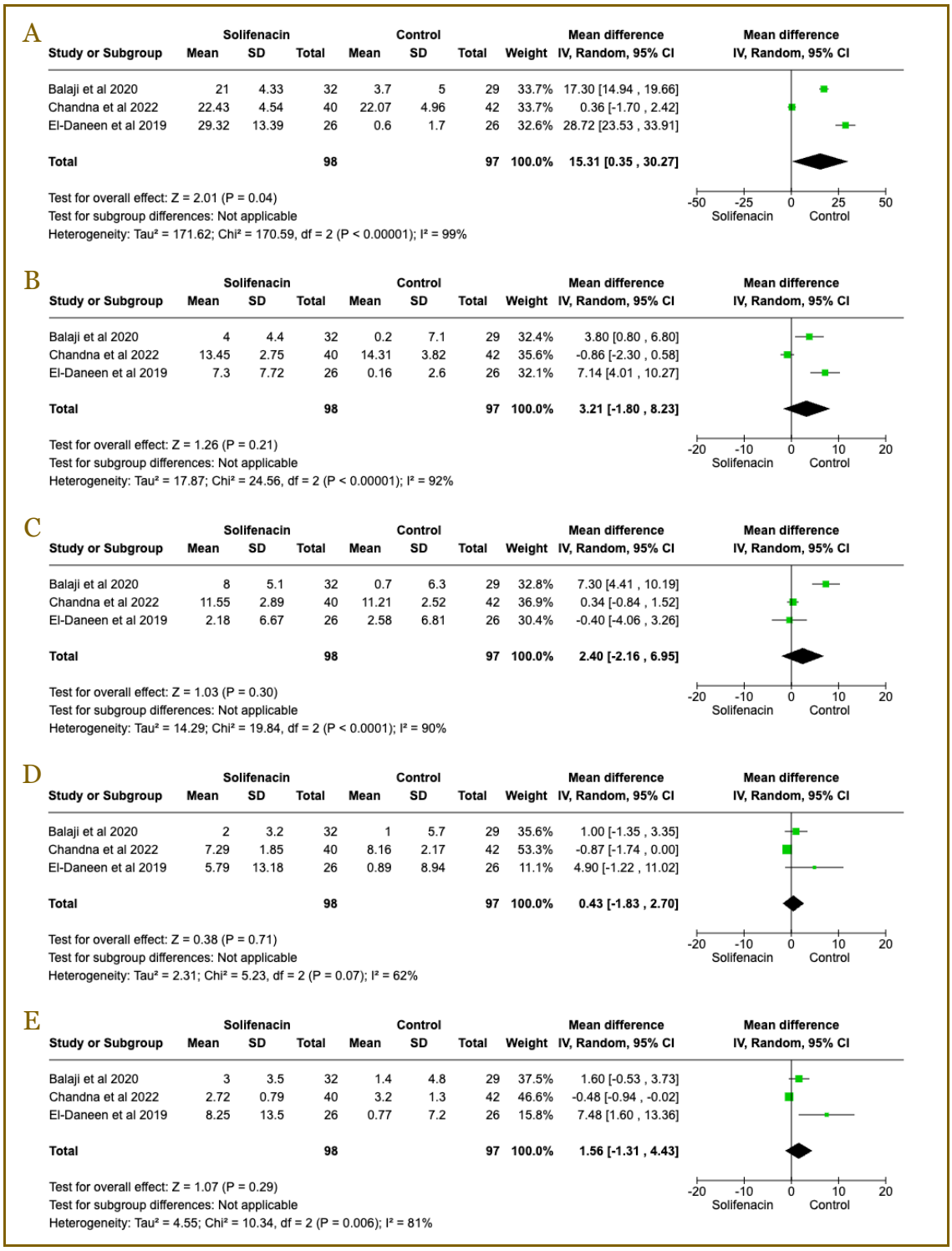

Figure 3. Forest plot comparing solifenacin vs control for USSQ score: A) urinary symptoms; B) pain; C) general health; D) work performance; E) sexual matters.

Two RCTs assessed the outcome using the IPSS [9,12]. The solifenacin group showed a significant reduction in the IPSS score (MD: -2.52; 95%CI: -3.68–-1.36; p<0.00001) compared to the control group, with low heterogeneity (I^2=0%; Tau²=0.00; Chi²=0.54; p-heterogeneity=0.460) (**Figure 4**).

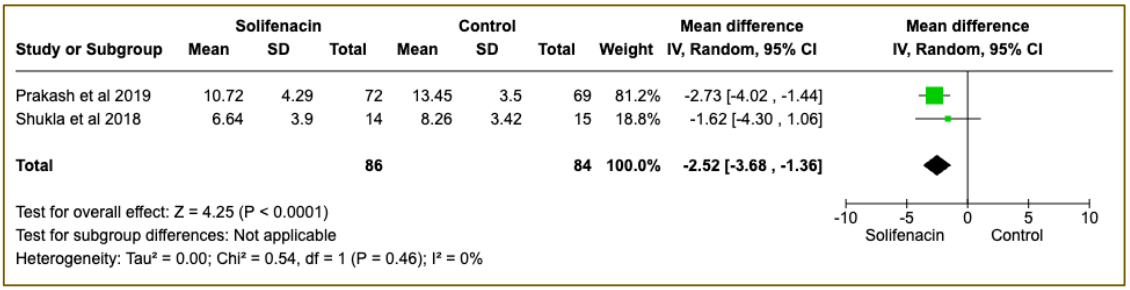

Figure 4. Forest plot comparing solifenacin vs control for total International Prostate Symptom Score (IPSS).

Tamsulosin as monotherapy for treating stent-related symptoms

The meta-analysis of two studies [11,13] comparing tamsulosin to a control group demonstrated a significant reduction in urinary symptoms compared to control group, based on the USSQ score (MD: 14.27; 95%CI: 8.68–19.86; p<0.00001) with moderate heterogeneity (I^2=69%; Tau²=11.60; Chi²=3.27; p-heterogeneity=0.070). A significant association was observed between tamsulosin use and improvement in general health (MD: 4.53; 95%CI: 2.13–6.94; p=0.0002) compared to the control group, with low heterogeneity (I^2=0%; Tau²=0.00; Chi²=0.10; p-heterogeneity=0.75). However, no significant differences were found for pain (MD: 7.54; 95%CI: -8.68–19.86; p=0.170; I^2=91%; Tau²=55.53; Chi²=10.87; p-heterogeneity=0.0010), work performance (MD: 1.77; 95%CI: -10.56–14.10; p=0.780; I^2=91%; Tau²=72.58; Chi²=11.10; p-heterogeneity=0.0009), or sexual matters (MD: -0.86; 95%CI: -3.06–1.34; p=0.440; I^2=0%; Tau²=0.00; Chi²=0.07; p-heterogeneity=0.790) compared to control group (**Figure 5**).

Two RCTs [12,19] assessing the IPSS found that tamsulosin significantly reduced the total IPSS score (MD: -0.95; 95%CI: -1.86–-0.03; p<0.00001) compared to the control group, with low heterogeneity (I^2=0%; Tau²=0.00; Chi²=0.09; p-heterogeneity=0.770) (**Figure 6**).

Solifenacin vs tamsulosin as monotherapy for treating stent-related symptoms

The present meta-analysis of two RCTs [9,12] comparing solifenacin monotherapy to tamsulosin monotherapy, using the IPSS, found that solifenacin significantly reduced the IPSS score (MD: -1.57; 95%CI: -2.85–-0.29; p=0.020). Solifenacin resulted in a lower total IPSS compared to tamsulosin, with low heterogeneity (I^2=0%; Tau²=0.00; Chi²=0.20; p-heterogeneity=0.650). In the present meta-analysis of three RCTs [9,12,17], no significant differences were found between tamsulosin and solifenacin in terms of QoL (MD: 0.12; 95%CI: -0.01–0.26; p=0.070) with low heterogeneity (I^2=0%; Tau²=0.00; Chi²=1.32; p-heterogeneity=0.520). In the present meta-analysis of three RCTs [9,12,20], no significant differences were found between tamsulosin and solifenacin in terms of VAS (MD: 0.25; 95%CI: -0.95–1.44; p=0.690) with high heterogeneity (I^2=84%; Tau²=0.93; Chi²=12.70; p-heterogeneity=0.002) (**Figure 7**).

Combination of solifenacin and tamsulosin compared to solifenacin as monotherapy for treating stent-related symptoms

A meta-analysis of four studies [9,10,12,14] compared combination therapy with solifenacin and tamsulosin to solifenacin monotherapy. Combination therapy significantly reduced the IPSS score (MD: -2.30; 95%CI: -3.23–-1.37; p<0.00001) compared to solifenacin monotherapy, with high heterogeneity (I^2=78%; Tau²=0.60; Chi²=13.44; p-heterogeneity=0.004) (**Figure 8**).

Combination of solifenacin and tamsulosin compared to tamsulosin as monotherapy for treating stent-related symptoms

A meta-analysis of four studies [9,12,15,21] compared the combination of solifenacin and tamsulosin with solifenacin monotherapy, using the IPSS. The combination therapy resulted in a significant reduction in the IPSS score (MD: -3.17; 95%CI: -5.07–-1.27; p=0.00001) compared to solifenacin monotherapy, with high heterogeneity (I^2=91%; Tau²=3.27; Chi²=34.99; p-heterogeneity<0.00001) (**Figure 9**).

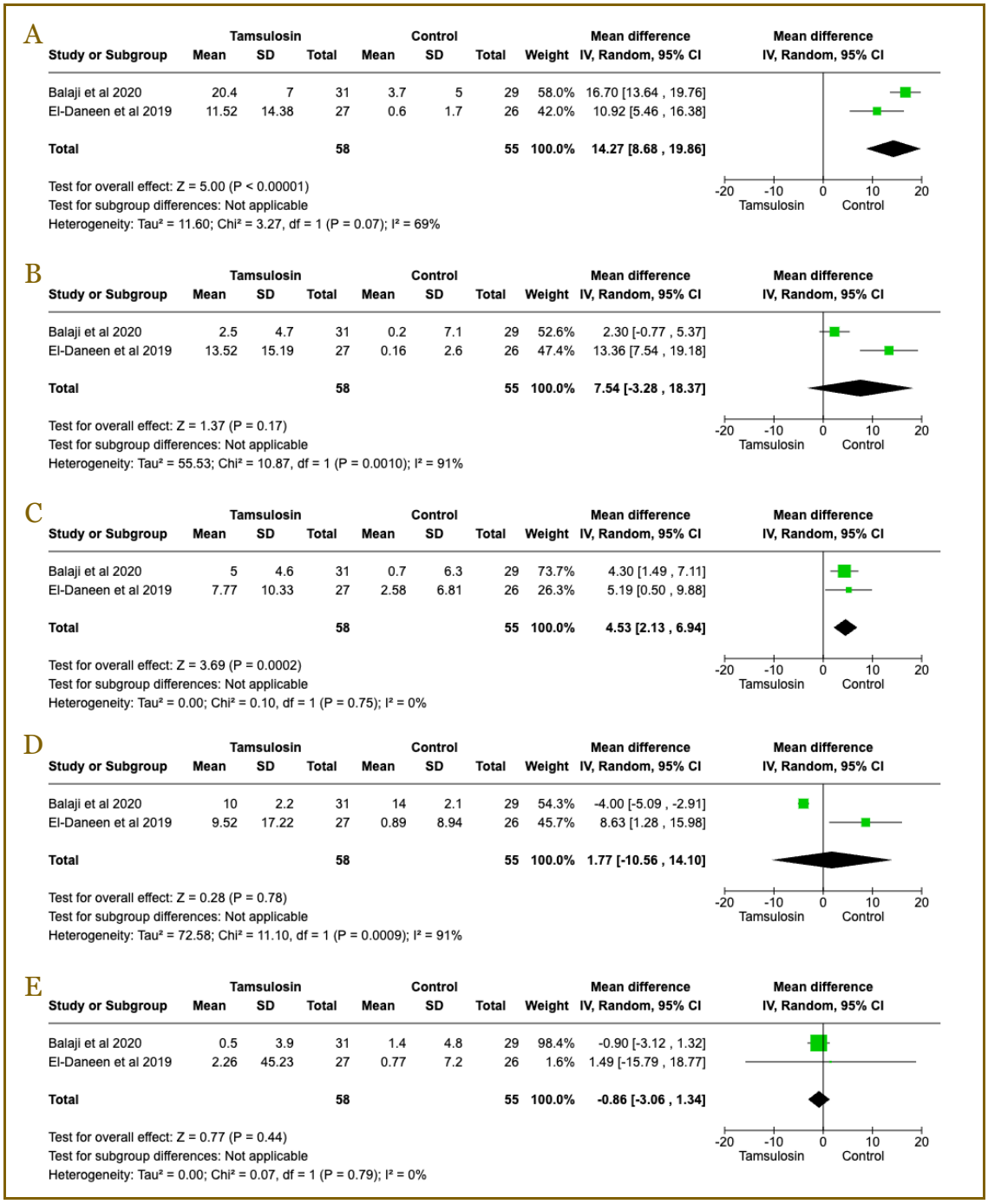

Figure 5. Forrest plot comparing tamsulosin versus control based on the Ureteral Stent Symptom Questionnaire (USSQ) score: A) urinary symptoms, B) pain, C) general health, D) work performance, and E) sexual matters.

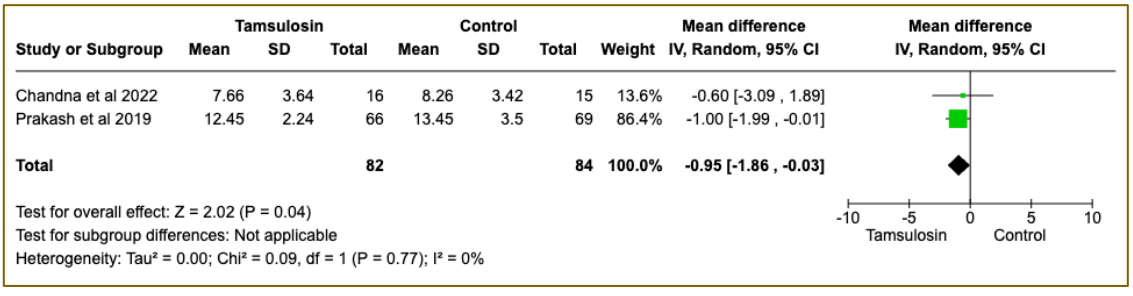

Figure 6. Forest plot comparing tamsulosin versus control based on the total International Prostate Symptom Score (IPSS).

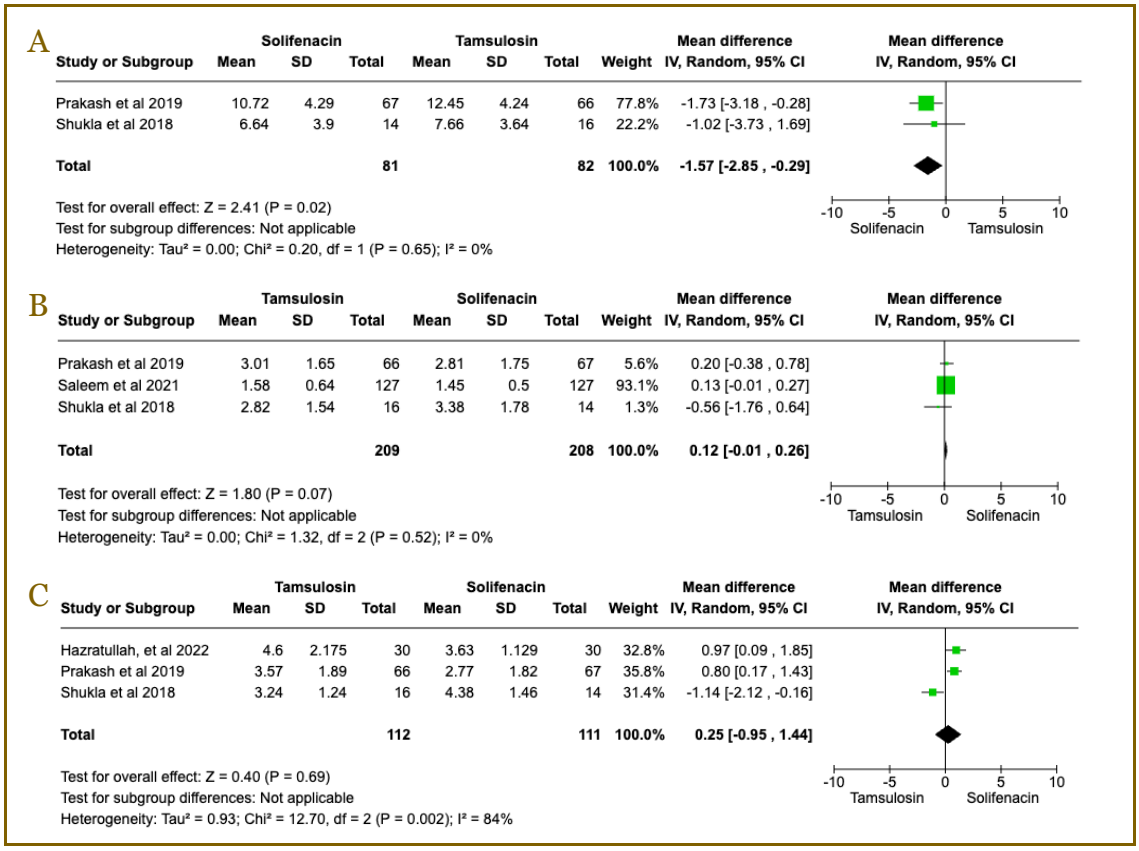

Figure 7. Forest plot comparing solifenacin monotherapy to tamsulosin monotherapy: (A) total International Prostate Symptom Score (IPSS), (B) Quality of life (QoL), (C) Visual Analog Scale (VAS).

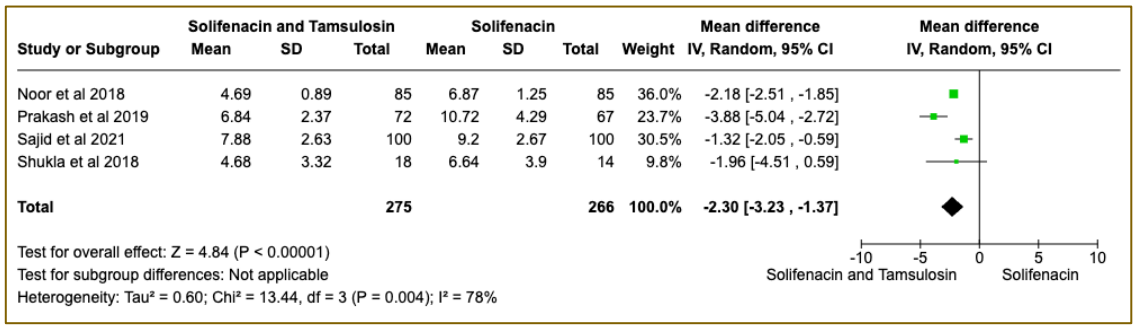

Figure 8. Forest plot comparing combination therapy of solifenacin and tamsulosin to solifenacin monotherapy based on the total International Prostate Symptom Score (IPSS).

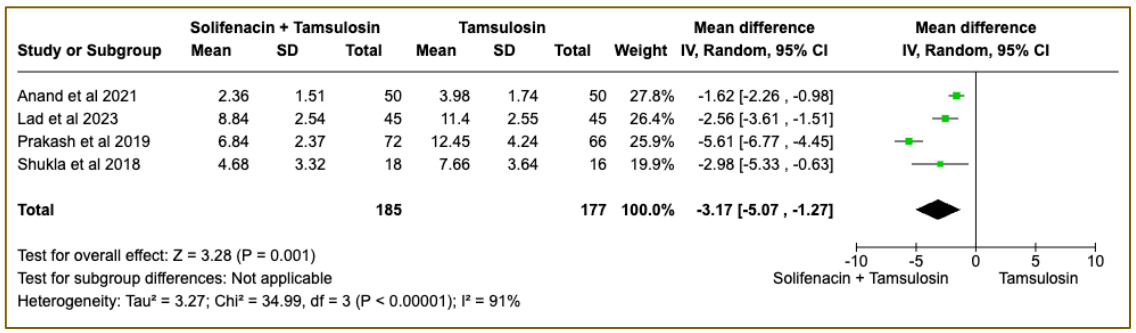

Figure 9. Forest plot comparing combination therapy of solifenacin and tamsulosin to tamsulosin monotherapy based on the total International Prostate Symptom Score (IPSS).

Discussion

The effectiveness of solifenacin, tamsulosin, and combination therapy in managing ureteral stent-related complications was evaluated in the present meta-analysis with outcomes such as USSQ,

VAS, IPSS, and QoL. Solifenacin significantly improved urinary symptoms (p=0.040) and reduced the IPSS (p<0.00001) compared to the control group. Tamsulosin reduced urinary symptoms on the USSQ (p<0.00001), general health problems (p=0.0002), and IPSS (p<0.00001) compared to the control group. Solifenacin demonstrated a more significant reduction in the overall IPSS compared to tamsulosin (p=0.020). The combination of solifenacin and tamsulosin resulted in a significantly superior reduction in IPSS compared to solifenacin monotherapies (p<0.00001) and tamsulosin monotherapy (p=0.00001). No significant differences were found between tamsulosin and solifenacin in terms of QoL (p=0.070) and VAS (p=0.690).

Although limited research exists on the mechanisms behind solifenacin's superiority to tamsulosin, it is hypothesized that solifenacin's antimuscarinic properties play a role. The presence of a ureteral stent may induce spasms at the end of the stent near the bladder, leading to bladder contractions and urinary symptoms. Solifenacin's ability to block muscarinic receptors prevents these contractions, promoting relaxation and reducing stent-related symptoms, in contrast to tamsulosin, which specifically relaxes the bladder neck and prostatic tone without affecting overall bladder contractions [13,21,27]. To date, no systematic reviews or meta-analyses have specifically addressed the combination of tamsulosin and solifenacin for alleviating stent-related symptoms. However, previous studies have shown that solifenacin outperforms tamsulosin in alleviating LUTS associated with stress urinary incontinence and pain following ureterorenoscopy and DJ stenting [13,21,27]. Furthermore, solifenacin has been shown to reduce LUTS [4] and improve sexual functioning in women with LUTS, reflecting its pharmacological effects [28,29].

Bladder smooth muscle cells contain two types of muscarinic receptors: M2 receptors, which are abundant in the detrusor, and the less prevalent M3 receptors, which play a key role in contraction [30]. Both M2 and M3 receptors, located in sensory fibers and the urothelium, regulate smooth muscle contraction and relaxation through the reduction of cyclic adenosine monophosphate (cAMP) and activation of phospholipase C (PLC) and inositol trisphosphate (IP3) signaling pathways [30]. Involuntary bladder contractions, often induced by the distal end of a urinary bladder stent, can be managed with solifenacin, an antimuscarinic agent [27,31]. Solifenacin selectively blocks the M3 muscarinic acetylcholine receptor, reducing frequent urination and urgency by preventing acetylcholine binding and diminishing detrusor muscle contraction [31,32]. The findings of the present meta-analysis align with the pharmacological mechanism of solifenacin, which blocks muscarinic receptors to prevent contractions, promote relaxation, and alleviate ureteral stent-related symptoms [30-32].

The present meta-analysis demonstrated that tamsulosin significantly reduces urinary symptoms and improves general health compared to the control group. Tamsulosin led to significant reductions in urinary symptoms across all USSQ subgroups and total IPSS scores. Tamsulosin, an alpha-blocker, targets uroreceptors to reduce bladder and urinary organ contractions, thereby alleviating stent-related symptoms [11,12]. These results are consistent with previous studies demonstrating tamsulosin's efficacy in improving stent-related symptoms [11,12]. Tamsulosin specifically targets α1A receptors in the bladder neck and prostate stroma, regulating bladder and prostatic tone through norepinephrine release [30]. It is commonly used to treat male lower urinary tract symptoms, regardless of benign prostatic enlargement [30], and is recommended by the European Association of Urology as first-line therapy for men with moderate-to-severe symptoms [4]. Additionally, tamsulosin may help prevent and treat urinary retention, manage urinary calculi, and serve as an adjunctive therapy for male sexual dysfunction [30].

Furthermore, the present meta-analysis found that solifenacin significantly reduced the total IPSS compared to tamsulosin. However, no significant differences were observed between the two drugs for QoL and VAS. These findings suggested solifenacin was more effective than tamsulosin in reducing stent-related symptoms, likely due to its antimuscarinic action on the bladder, which directly targets the bladder, enhancing its ability to alleviate stent-related symptoms compared to tamsulosin. This finding supports prior studies that showed solifenacin was more effective than tamsulosin in reducing LUTS associated with SRS, with both drugs offering clear benefits over placebo [9,11,21]. Additionally, solifenacin significantly reduced pain

compared to tamsulosin in an RCT involving double-J stenting after ureterorenoscopy [10]. Further RCTs are needed to confirm these results, as limited direct comparisons between the two drugs exist in the current literature.

Combination of solifenacin and tamsulosin demonstrated a significantly reduced overall IPSS compared to solifenacin monotherapy. Additionally, the combination of solifenacin and tamsulosin was more effective than tamsulosin monotherapy in decreasing the overall IPSS score. These findings suggested that combining solifenacin with tamsulosin is superior to either monotherapy. This may be attributed to the complementary mechanisms of alpha blockers and antimuscarinics, which target different receptor sites, enhancing the efficacy in alleviating stent-related symptoms. This finding aligns with eleven RCTs showing that combination therapy effectively reduces stent-related symptoms [6,13-21]. It improved obstructive and irritative symptoms [33], quality of life [15], and significantly lowers IPSS [34] compared to monotherapy. Combination therapy also reduces flank pain, dysuria, and urinary tract infections after double-J stent placement [17,34]. The results support using tamsulosin and solifenacin combination therapy over monotherapy, with fixed-dose combinations recommended for managing stent-related issues.

The enhanced efficacy of this combination therapy is likely due to the dual mechanisms of action of the two drugs, which target distinct receptors responsible for LUTS [4,30]. Tamsulosin, a uroselective alpha-adrenergic antagonist, and solifenacin, an antimuscarinic agent, both reduce contractions by inhibiting different receptor sites [4,30]. This dual action significantly diminishes LUTS symptoms by concurrently suppressing the underlying mechanisms [4,30]. The findings of the present meta-analysis suggest that the combination of tamsulosin and solifenacin offers a beneficial approach to managing LUTS associated with ureteral stent symptoms. To improve patient adherence, a fixed-dose combination formulation of tamsulosin and solifenacin is recommended, as it simplifies the treatment regimen and enhances compliance. A fixed-dose combination (FDC) of tamsulosin and solifenacin is recommended to improve patient adherence by simplifying the treatment regimen and enhancing compliance. This FDC is typically administered as a single tablet containing 0.4 mg of tamsulosin and 5 mg of solifenacin, taken once daily, with or without food, and preferably at the same time each day to maintain consistent drug levels. It is indicated for men with LUTS like stent-related symptoms characterized by urgency, frequency, and nocturia. By combining the alpha-1 adrenergic antagonist action of tamsulosin with the antimuscarinic properties of solifenacin, this FDC effectively manages both voiding and storage symptoms in BPH patients. Contraindications include hypersensitivity to any component of the FDC, severe hepatic impairment, significant post-void residual urine volume, or conditions that predispose to urinary retention. The simplified once-daily dosing improves treatment adherence, potentially leading to better clinical outcomes [35].

Several limitations were identified in the present study. First, the sample size was relatively small. Second, variability in follow-up durations across studies may introduce bias. Third, solifenacin dosages differed between studies. Fourth, a comprehensive range of outcome measures was not utilized. Fifth, some studies employed the IPSS to assess populations that included both males and females, despite the absence of prostate organs in females. However, previous research has suggested that the IPSS may also be applicable for evaluating female lower urinary tract dysfunction [34]. Future research should aim to increase sample sizes, standardize follow-up durations, and ensure consistent dosages of solifenacin. Additionally, documenting variations in ureteral stent sizes and materials is essential to assess potential correlations or adverse effects associated with different stent types and dimensions.

Conclusion

Solifenacin monotherapy reduced urinary symptoms associated with stent-related issues, while tamsulosin monotherapy improved both urinary symptoms and overall health, with both therapies demonstrating a reduction in IPSS compared to placebo. Combined solifenacin and tamsulosin therapy was more effective than monotherapy in alleviating ureteral stent-related symptoms. The use of fixed-dose combination medications is recommended to enhance treatment compliance and cost-effectiveness.

Ethics approval

Not required.

Acknowledgments

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Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

Declaration of artificial intelligence use

This study used artificial intelligence (AI) tools and methodologies in the following capacities of which AI-based language models ChatGPT was employed in the language refinement (improving grammar, sentence structure, and readability of the manuscript). We confirm that all AI-assisted processes were critically reviewed by the authors to ensure the integrity and reliability of the results. The final decisions and interpretations presented in this article were solely made by the authors.

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References

1. De Grazia A, Somani BK, Soria F, *et al*. Latest advancements in ureteral stent technology. Transl Androl Urol 2019;8 Suppl 4:S436-S441.
2. Yavuz A, Kilinc MF, Aydin M, *et al*. Does tamsulosin or mirabegron improve ureteral stent-related symptoms? A prospective placebo-controlled study. Low Urin Tract Symptoms 2021;13(1):17-21.
3. Ragab M, Soliman MG, Tawfik A, *et al*. The role of pregabalin in relieving ureteral stent-related symptoms: A randomized controlled clinical trial. Int Urol Nephrol 2017;49(6):961-966.
4. Fischer KM, Louie M, Mucksavage P. Ureteral stent discomfort and its management. Curr Urol Rep 2018;19(8):64.
5. Scotland KB, Lo J, Grgic T, *et al*. Ureteral stent-associated infection and sepsis: Pathogenesis and prevention: A review. Biofouling 2019;35(1):117-127.
6. Hasbi B, Palinrungi M, Kholis K, *et al*. The effectiveness between tamsulosin and solifenacin combined with tamsulosin on treatment of ureteral stent-related symptoms. NMSJ 2021;6(1):1-17.
7. Pramana IB, Oka AA, Duarsa GW, *et al*. The effectiveness of tamsulosin in benign prostate hyperplasia (BPH) patients with lower urinary tract symptoms (LUTS): A multi-centre cohort retrospective study. Indones J Biomed Sci 2020;14(1):17-20.
8. Song Y, Chen G, Huang P, *et al*. Effects of tamsulosin combined with solifenacin on lower urinary tract symptoms: Evidence from a systematic review, meta-analysis, and trial sequential analysis of randomized controlled trials. Front Pharmacol 2020;11:763.
9. Shukla A. To evaluate the effects of tamsulosin, solifenacin, and combination therapy for the treatment of urethral stent-related discomforts. IOSR-JDMS 2018;17:1-16.

10. Noor H, Khalid N, Sohail M, *et al*. Treatment of lower urinary tract symptoms caused by double J stent with solifenacin and combination of tamsulosin plus solifenacin: A comparative study. J Univ Med Dent Coll 2018;9(4):19-24.
11. El-Daneen MS, Ghaith AF, Rageb MM, *et al*. Prospective randomized controlled study evaluating efficacy of alpha-blockers, antimuscarinics or combination therapy in relieving ureteral stent-related symptoms. Med J Cairo Univ 2019;87:169-174.
12. Prakash S, Reddy B, Kumar V, *et al*. To evaluate the effects of tamsulosin, solifenacin, and combination therapy for the treatment of ureteral stent-associated symptoms. ARC J Urol 2019;4(3):12-17.
13. Balaji AR, Patnaik PP, Prakash JVS, *et al*. A study to compare the safety and efficacy of solifenacin, tamsulosin and tadalafil in relieving double-J stent-related symptoms. Open J Urol 2020;10(3):42-51.
14. Sajid MT, Rehman SU, Akmal M, *et al*. Comparison of solifenacin versus combination of solifenacin and tamsulosin in improving unilateral double-J stent related lower urinary tract symptoms. Pak Armed Forces Med J 2021;71(1):45-50.
15. Anand A, Dayapule S, Krishna BM, *et al*. Effects of tamsulosin and tamsulosin+solifenacin combination therapy for the treatment of ureteral stent related lower urinary tract symptoms. Int J Surg Sci 2021;5(4):156-160.
16. Elsayed TO, Fahim HA, Haroun MGM. Tamsulosin versus tamsulosin in combination with solifenacin versus tamsulosin in combination with trospium chloride for treatment of double-J stent-related symptoms. QJM 2021;114 Suppl 1:i373-i374.
17. Saleem R, Jabeen M, Kumar P, *et al*. Comparison of alpha-blockers and antimuscarinics for the treatment of double-j stent-related lower urinary tract symptoms. Int J Endorsing Health Sci Res 2021;9(4):518-524.
18. Salih EM, Koritenah AK, Yehya M, *et al*. The efficacy of alpha-1A blocker (tamsulosin), antimuscarinic (solifenacin) and their combination in the management of double-J stent-related lower urinary tract symptoms: A randomized controlled study. Afr J Urol 2021;27:37.
19. Chandna A, Kumar S, Parmar KM, *et al*. Comparison of stent related symptoms in patients taking mirabegron, solifenacin, or tamsulosin: A double-blinded randomized clinical trial. Urologia 2022;89(4):589-596.
20. Hazratullah H, Rafi A, Khan N, *et al*. Compare mean pain scores between solifenacin and tamsulosin in patients with ureteric stent after ureteroscopic lithotripsy. PJMLS 2022;5(2):457-462.
21. Lad V, Gandhi D, Agarwal G, *et al*. Role of tamsulosin a selective alpha 1a-1d blocker vs. combination therapy of tamsulosin and solifenacin M3 antagonist in DJ stent related morbidity: Obstructive and irritative scores. Int Surg J 2023;10(4):564-568.
22. Sterne JAC, Savović J, Page MJ, *et al*. RoB 2: A revised tool for assessing risk of bias in randomized trials. BMJ 2019;366:l4898.
23. Baghel P, Sahu RD, Gangkok G, *et al*. Linguistic and cultural validation of ureteral stent symptom questionnaire in Hindi. Indian J Urol 2019;35(2):129-133.
24. Delgado DA, Lambert BS, Boutris N, *et al*. Validation of digital visual analog scale pain scoring with a traditional paper-based visual analog scale in adults. J Am Acad Orthop Surg Glob Res Rev 2018;2(3):e088.
25. Urologic Specialists of New England. IPSS drug satisfaction survey. 2023. Available from: https://urologicspecialistsofne.com. Accessed: 1 January 2025.
26. Gewanter RM, Sandhu JS, Tin AL, *et al*. Assessment of patients with prostate cancer and their understanding of the international prostate symptom score questionnaire. Adv Radiat Oncol 2023;8(4):101200.
27. Dellis AE, Papatsoris AG, Keeley FX Jr, *et al*. Tamsulosin, solifenacin, and their combination for the treatment of stent-related symptoms: A randomized controlled study. J Endourol 2017;31(1):100-109.
28. Evrüke İM, Taş İS. The effect of solifenacin treatment for urge urinary incontinence on sexual function in premenopausal and postmenopausal women: A prospective observational study. Cukurova Med J 2023;48(1):200-207.
29. Lim KT, Kim YT, Lee TY, *et al*. Effects of tamsulosin, solifenacin, and combination therapy for the treatment of ureteral stent related discomforts. Korean J Urol 2011;52(7):485-488.
30. Abdelaziz AS, Salama NM, Ghoneem AM. Mirabegron vs. solifenacin in control of endoscopically inserted ureteral stent-related symptoms. World J Urol 2022;40(8):2113-2119.
31. El-Nahas AR, Tharwat M, Elsaadany M, *et al*. A randomized controlled trial comparing alpha-blocker (tamsulosin) and anticholinergic (solifenacin) in treatment of ureteral stent-related symptoms. World J Urol 2016;34(7):963-968.
32. Wang J, Zhou Z, Cui Y, *et al*. Meta-analysis of the efficacy and safety of mirabegron and solifenacin monotherapy for overactive bladder. Neurourol Urodyn 2019;38(1):22-30.
33. Shalaby E, Ahmed AF, Maarouf A, *et al*. Randomized controlled trial to compare the safety and efficacy of tamsulosin, solifenacin, and combination of both in treatment of double-J stent-related lower urinary symptoms. Adv Urol 2013;2013:752382.

34. Liao CH, Kuo HC. Use of the International Prostate Symptom Score voiding-to-storage subscore ratio in assessing lower urinary tract symptoms. Tzu Chi Med J 2014;26(2):61-63.
35. Chapple CR, Cruz F, Cardozo L. Advances in the management of lower urinary tract symptoms: Fixed-dose combination therapies. J Clin Urol 2021;14(3):157-165.