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RESEARCH

A comparative study of mirabegron versus doxazosin in improving ureteral stent-related dysfunction

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Abstract

Objective To compare the efficacy of mirabegron and doxazosin in alleviating ureteral stent-related symptoms and sexual dysfunction.

Method This study included 107 patients who provided informed consent and underwent transurethral ureteral lithotripsy with ureteral stent placement between January 2023 and December 2023. Patients were randomized into two groups receiving either mirabegron (50 mg/day) or doxazosin (4 mg/day). The Ureteral Stent Symptom Questionnaire (USSQ) scores and adverse drug reactions were recorded at baseline (ureteral stent placement), 2 weeks (ureteral stent removal), and 4 weeks (2 weeks after stent removal). The trial was registered with the Chinese Clinical Trial Registry (ChiCTR2500095161).

Results At 2 weeks, the mirabegron group showed a greater improvement in pain during intercourse compared to the doxazosin group (0.379 ± 0.186; $p = 0.043$). This improvement persisted at 4 weeks (0.363 ± 0.186). No significant differences were observed in sexual satisfaction scores between the groups at either time point (2 weeks: 0.175 ± 0.186, $p = 0.350$; 4 weeks: 0.157 ± 0.186, $p = 0.401$). Subgroup analysis revealed that mirabegron provided greater relief of pain during intercourse in women compared to doxazosin (OR = 14.40, 95% CI 1.53-135.51, $p = 0.020$). Additionally, women in the doxazosin group reported significantly lower sexual satisfaction compared to the mirabegron group (OR = 42.00, 95% CI 2.41-825.71, $p = 0.014$).

Conclusions Mirabegron and doxazosin demonstrated similar efficacy in relieving ureteral stent-related symptoms. However, mirabegron offered a clear advantage in improving female sexual function, particularly regarding pain during intercourse and overall satisfaction.

Keywords Mirabegron · Doxazosin · Ureteral stent symptoms · Pain during intercourse · Sexual satisfaction

Introduction

Ureteral stents are widely employed in minimally invasive urological procedures like ureteroscopic lithotripsy, percutaneous nephrolithotripsy, and laparoscopic lithotripsy. These stents facilitate urine drainage from the kidneys, prevent/

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treat ureteral stenosis, and aid in stone clearance [1–3]. However, their presence can induce ureteral stent-related symptoms (SRSs) due to friction with the bladder and urethra. These SRSs encompass irritable bladder symptoms (urgency, frequency, dysuria, hematuria), bodily pain, and sexual dysfunction [4–6]. Notably, SRSs significantly reduce quality of life, affecting up to 80% of patients [7].

Ureteral stents, while a valuable tool in urology, can cause significant discomfort (stent-related symptoms, SRS). Medications remain the mainstay of treatment for SRS, with analgesics, anticholinergics, and alpha-blockers commonly used. Doxazosin, a highly selective alpha-blocker, relaxes the smooth muscle of the bladder neck, prostate, and distal ureter, demonstrating efficacy in treating prostatic hyperplasia and distal ureteral stones [8, 9]. Clinical studies have also shown its effectiveness in improving ureteral stenting symptoms [10]. Mirabegron is a novel, highly selective β3-adrenergic receptor agonist for overactive bladder syndrome. These β3 receptors are highly expressed in bladder smooth muscle. Mirabegron activates these receptors, inducing relaxation of the urethral muscle and relieving symptoms of overactive bladder, such as urinary urgency and frequency. Additionally, it may alleviate pain caused by spasms of the ureter and bladder [11]. Given the similarities between SRS and overactive bladder symptoms, mirabegron has emerged as a potential pharmacologic option for reducing ureteral stenting discomfort. Studies have shown it to be an effective and safe therapy [12].

Mirabegron and doxazosin are both used clinically to improve ureteral stent symptoms, although no prior studies have directly compared their efficacy. This study aimed to compare the efficacy and side effects of mirabegron (50 mg/day) and doxazosin (4 mg/day) in alleviating ureteral stent symptoms, with a particular focus on their impact on ureteral stent-associated sexual dysfunction. The findings from this study can provide valuable insights for guiding clinical decision-making regarding these medications.

Information and methodology

Experimental design

The study (2022/04/05-005) was a prospective, parallel, controlled, double-blind, randomized, single-center clinical trial conducted at the Anning First People's Hospital Affiliated to Kunming University of Science and Technology. This study was approved by the Medical Ethics Committee of the First People's Hospital of Anning City (Ethics Approval No. Lun Audit 2022-096(Section)-01). Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki and adhered to the Consolidated Standards of Reporting Trials (CONSORT) reporting guidelines.

Study participants

Men and women over 18 years of age with imaging (CT or ultrasound) confirmation of ureteral stones indicated for transurethral ureteral lithotripsy with ureteral stent placement were invited to participate.A 26 cm, 4.8 Fr polyurethane ureteral stent was inserted in all patients. Detailed enrollment criteria and stone characteristics are presented in Supplementary Table 1. Following written informed consent, participants underwent screening for additional inclusion and exclusion criteria between January and December 2023 (see Supplementary Table 2). Oral doxazosin(Pfizer, #100996, USA) (4 mg/day)or mirabegron(Huayi, #929547, China)(50 mg/day) was initiated after stent placement (0 week) and continued until discontinued 2 weeks after stent removal. Both medications were taken orally. Ureteral Stent Questionnaire (USSQ) scores and adverse drug reactions were recorded in both groups at ureteral stent placement (0 week), ureteral stent removal (2 weeks), and 2 weeks after stent removal (4 weeks). Specific details regarding the procedures are provided in Fig. 1 and Supplementary Figure 1.

Randomization

The data collector uses random tools (https://online-random.com/cn/) to generate random sequences.Patients were randomly allocated in a 1:1 ratio to receive either mirabegron (50 mg/day) or doxazosin (4 mg/day) using a randomization tool. Both researchers and patients were blinded to the treatment allocation. The medications were dispensed in identical opaque bottles containing 28 capsules each, with no identifying labels except for the instruction "ONE TABLET PER DAY."Allocation concealment and randomization were ensured by the randomization tool. Participants strictly adhered to the assigned medication regimen. Following approval by the ethics committee, participants were provided with detailed information about the study protocol.

Procedure

A flowchart depicting the study design is shown in Fig. 2. Enrolled participants underwent a comprehensive baseline assessment to gather medical history, information on adverse events, and completion of the USSQ as outlined in Supplementary Table 3. In 2003, Joshi et al. [1] developed and validated the Ureteral Stent Symptoms Questionnaire (USSQ), a self-administered, multidimensional instrument that evaluates stent-related morbidity across six domains: urinary symptoms, body pain, general health, work performance,

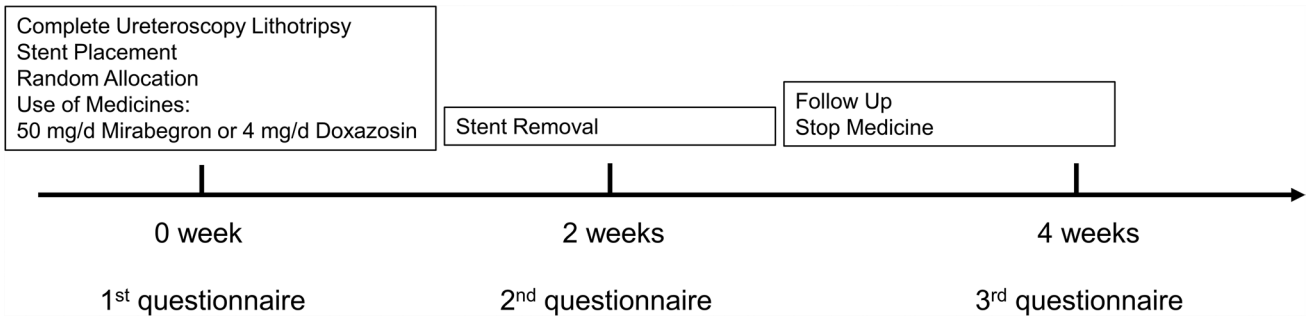


Fig. 1 Process of questionnaire completion and medication after surgery. 0 Week Questionnaire completed 1-2 days before stabilization and discharge from hospital. 2 Weeks Patients completed questionnaire before ureteral stent extract. 4 Weeks Patients completed questionnaire 2 weeks after ureteral stent extract

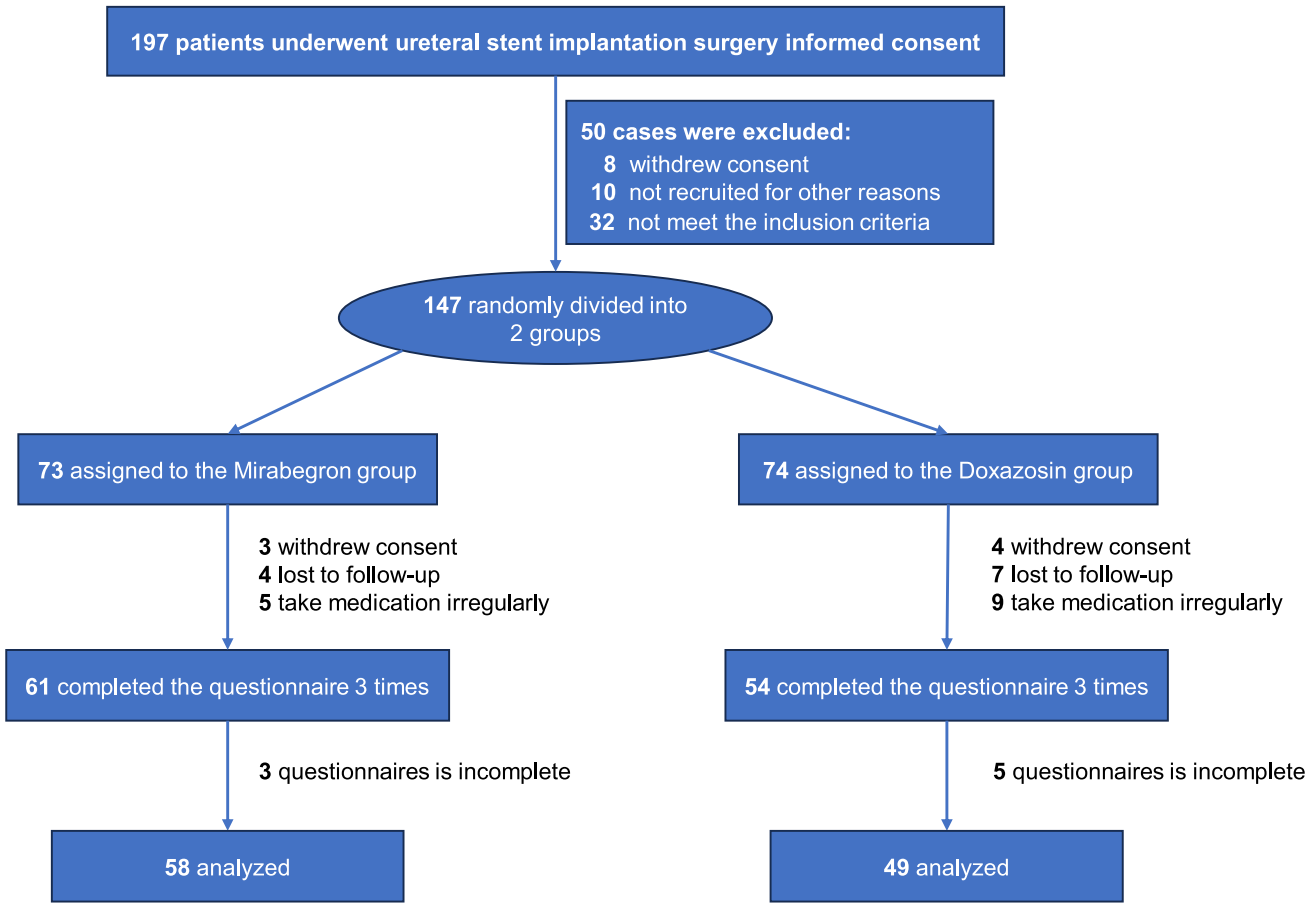


Fig. 2 Participant screening and enrollment process

sexual matters, and additional problems. Prior to initiating this study, we obtained permission from Professor Joshi to use the USSQ.In this study, All collected data points were quantified and subsequently analyzed as endpoints. Notably, pain during intercourse and sexual dissatisfaction with intercourse were identified as the primary outcome variables for this study. The USSQ has been validated in multiple languages to allow for standardized definition and comparison of SRSs across various studies [13, 14]. Furthermore, some of the USSQ items were optimized for quantification purposes within the context of this investigation.

Table 1 Baseline level of study population

	level	Mirabegron	Doxazosin	p	Test	SMD
n		58	49			
Sex, n (%)	Male	33 (56.9)	33 (67.3)	0.364		0.217
	Female	25 (43.1)	16 (32.7)			
Age, y, mean (SD)		44.03 (10.36)	45.76 (9.37)	0.373		0.174
Urinary symptoms, median [IQR]		24.50 [22.00, 31.00]	25.00 [23.00, 28.00]	0.647	nonnorm	0.011
Body pain, median [IQR]		15.50 [12.00, 18.00]	15.00 [12.00, 17.00]	0.234	nonnorm	0.236
General health before stent, median [IQR]		14.00 [12.00, 17.00]	14.00 [11.00, 17.00]	0.841	nonnorm	0.030
Days in bed, median [IQR]		1.00 [0.00, 2.75]	1.00 [0.00, 3.00]	0.658	nonnorm	0.138
Reduced days of activity, median [IQR]		1.00 [0.00, 3.00]	1.00 [0.00, 2.00]	0.536	nonnorm	0.298
Work performance, median [IQR]		10.00 [8.00, 13.00]	10.00 [8.00, 11.00]	0.875	nonnorm	0.020
General bad working score after stent, median [IQR]		24.50 [22.00, 31.00]	25.00 [23.00, 28.00]	0.647	nonnorm	0.011
Active sexuality, n(%)	No	52 (89.7)	42 (85.7)	0.745		0.120
	Yes	6 (10.3)	7 (14.3)			
Time to stop sexuality, n(%)	Before stent	38 (65.5)	29 (59.2)	0.638		0.183
	After stent	14 (24.1)	12 (24.5)			
	NA	6 (10.3)	8 (16.3)			
Pain during sexuality, n(%)	No	46 (79.3)	38 (77.6)	0.331		0.375
	Mild	8 (13.8)	9 (18.4)			
	Moderate	1 (1.7)	2 (4.1)			
	Severe	3 (5.2)	0 (0.0)			
Satisfactory sexuality, n(%)	Yes	18 (31.0)	10 (20.4)	0.446		0.250
	No	7 (12.1)	6 (12.2)			
	NA	33 (56.9)	33 (67.3)			
Addition problems, median [IQR]		6.00 [5.00, 6.00]	6.00 [4.00, 7.00]	0.683	nonnorm	0.100
Another stent inserted, n(%)	Delighted	2 (3.4)	0 (0.0)	0.283		0.508
	Mostly satisfied	11 (19.0)	7 (14.3)			
	Equally satisfied and dissatisfied	16 (27.6)	12 (24.5)			
	Mostly dissatisfied	11 (19.0)	14 (28.6)			
	Unhappy	7 (12.1)	2 (4.1)			
	Terrible	11 (19.0)	14 (28.6)			

Char Characteristics, *IQR* Interquartile range, *SMD* STD mean difference

Statistical analysis

Primary and secondary endpoints were analyzed using a consistent approach. Repeated measures linear mixed models were employed to assess mean change from baseline. Missing data points were handled by including only participants who completed the endpoint section. Age (median 47 years, adjusted to 50 years for this study) and sex were considered as both covariates and subgroup variables in the model evaluation and subsequent subgroup analyses. These variables were dichotomized for the primary outcome measures: pain during sexual intercourse (0: no pain/mild pain; 1: moderate/severe/very severe pain) and dissatisfaction with sexual intercourse (0: satisfied/very satisfied; 1: dissatisfied).

All statistical calculations were performed using the *lm* function within R version 4.2.0 (R Core Team, 2023) and visualized using the *forestploter* package. Additionally, repeated measures linear mixed models analysis were fitted with the same package. The sample size evaluation can be found in the eMethods.

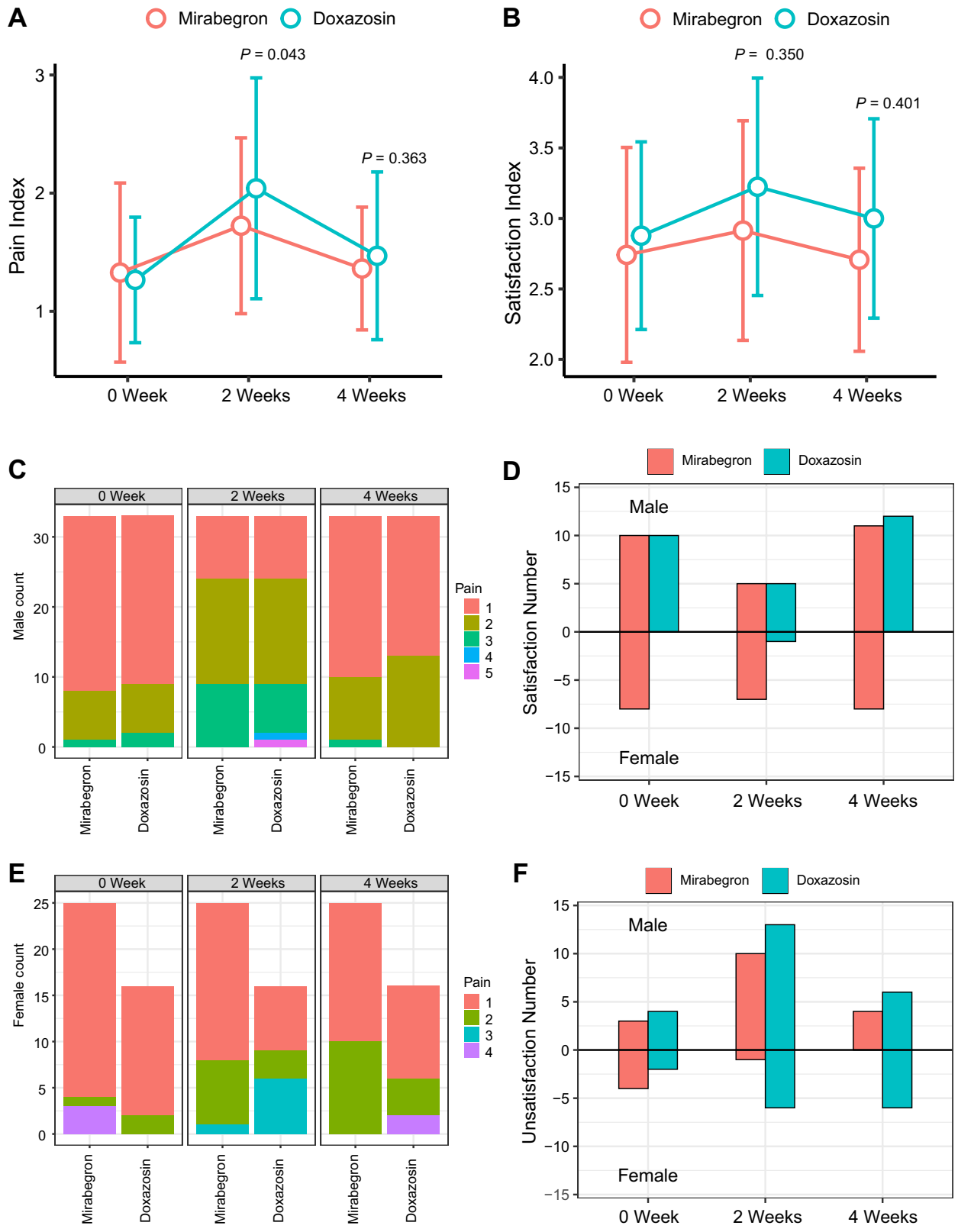
Results

Following an initial screening of 197 patients (Figure 2), 147 were deemed eligible and randomized to receive either mirabegron or doxazosin. Reasons for exclusion included not meeting inclusion criteria (n=32 patients), refusal to participate (n=8 patients), and other factors (n=10 patients). A total of 40 patients withdrew during follow-up (15 from mirabegron and 25 from doxazosin), resulting in a final study population of 107. The mirabegron group comprised 58 patients (33 males, 25 females; mean age 44.03 ± 10.36 years), while the doxazosin group included 49 patients (33 males, 16 females; mean age 45.76 ± 9.37 years). Analyses focused on specific USSQ sub-items that did not show significant overall group differences, including urinary symptoms, bodily pain, daily life impact, work performance, subjective feelings, and willingness to repeat ureteral stent placement (Supplementary Figure 2–7).

Baseline demographic and clinical characteristics were well-balanced between the mirabegron and doxazosin groups (Table 1). Pre-medication scores using the USSQ revealed similar results between the groups for lower urinary tract symptoms (mirabegron: 24.50 [22.00, 31.00], doxazosin: 25.00 [23.00, 28.00]), somatic pain (mirabegron: 15.50 [12.00, 18.00], doxazosin: 15.00 [12.00, 17.00]), general health status (mirabegron: 14.00 [12.00, 17.00], doxazosin: 14.00 [11.00, 17.00]),bedtime frequency (mirabegron: 1.00 [0.00, 2.75], doxazosin: 1.00 [0.00, 3.00]) , reduced activity(mirabegron: 1.00 [0.00, 3.00], doxazosin: 1.00 [0.00, 2.00]), and work performance (mirabegron: 10.00 [8.00, 13.00], doxazosin: 10.00 [8.00, 11.00]). Sexual activity was reported by 10.3% (6 cases) in the mirabegron group and 14.3% (7 cases) in the doxazosin group. Notably, a significant proportion of participants in both groups (mirabegron: 52 cases, doxazosin: 41 cases) abstained from sexual activity, with the majority abstaining before stent placement. Regarding pre-medication sexual function, the mirabegron group reported mild pain (13.8%), moderate pain (1.7%), and severe pain (5.2%) during intercourse, while the doxazosin group reported mild pain (18.4%) and moderate pain (4.1%). Similarly, pre-medication satisfaction with sexual life was comparable between groups (mirabegron: 31% satisfied, doxazosin: 20.4% satisfied). Overall, these baseline characteristics suggest no significant differences between the mirabegron and doxazosin groups.

Ureteral stents and the medications used to manage them can significantly impact a patient's sexual experience, particularly pain during intercourse. This study found mirabegron more effective than doxazosin in alleviating stent-induced pain. At 2 weeks, the mirabegron group showed a significant improvement in pain relief compared to the doxazosin group (0.378 ± 0.186, $p = 0.043$) (Figure 3A). While sexual pain gradually improved in both groups by 4 weeks, the difference became statistically non-significant ($p = 0.363$, Figure 3A). Gender analysis revealed higher pain scores in the doxazosin group for males at 2 weeks, with scores becoming similar in both groups by 4 weeks (Figure 3C). Interestingly, although some females in the mirabegron group initially reported high pain scores, their scores remained only slightly lower than the doxazosin group at both 2 and 4 weeks .with only 1 and 2 patients reporting pain compared to the doxazosin group (Figure 3E). Regarding sexual satisfaction, while the difference between mirabegron and doxazosin at 2 weeks was not statistically significant (0.175 ± 0.186, p = 0.350, Figure 3B), the overall dissatisfaction scores remained lower in the mirabegron group. Both male and female groups reported decreased satisfaction at 2 weeks, with a "concave" trend in the curves (Figure 3B and D). Notably, only females in the mirabegron group showed signs of recovered satisfaction by 4 weeks (Figure 3D). In terms of the number of dissatisfied patients, the doxazosin group consistently had higher numbers of both males and females throughout the study, displaying a "convex" trend in dissatisfaction scores (Figure 3F). Conversely, the mirabegron group, particularly among females, showed a decreasing trend in dissatisfaction over time (non-significant "concave" trend, Figure 3F). These findings suggest that mirabegron may offer a superior benefit for alleviating pain during intercourse and improving sexual satisfaction in females experiencing ureteral stent discomfort.

Subgroup analysis revealed a clear advantage of mirabegron in improving pain and satisfaction with intercourse specifically among women. Given that peak discomfort scores were observed 2 weeks following stent placement, we further analyzed data from this time point. Mirabegron demonstrated a significantly greater effect on pain relief compared to doxazosin in females (odds ratio [OR] 14.00, 95% confidence interval [CI] 1.53–135.51, $p = 0.020$) (Figure 4A). While this effect was not significant across all age groups, mirabegron appeared to be more beneficial for improving sexual satisfaction in patients aged 50 years or younger (OR 7.00, 95% CI 1.49–32.82, $p = 0.014$) (Figure 4B). Although the interaction *p*-value for age did not reach statistical significance ($p = 0.131$), it is highly conceivable that our sample size limited the ability to detect this interaction. Speculatively, younger patients (≤50 years) might be more sexually active and have higher expectations regarding sexual function, potentially explaining the observed trend. Overall,



mirabegron was significantly more effective than doxazosin in improving sexual discomfort during the period of stent placement in women. This finding suggests that female patients experiencing ureteral stents may benefit more from mirabegron in alleviating their stent-related symptoms (Figure 4).

◂**Fig. 3** Comparison of efficacy of the primary outcome over time in the mirabegron and doxazosin groups. (**A**) For dyspareunia, mirabegron was significantly more effective than doxazosin at 2 week (p= 0.043); mirabegron was still more effective than doxazosin at 4 week (p= 0.363). (**B**) In terms of sexual dissatisfaction, the overall sexual dissatisfaction curve was lower in the mirabegron group than in the doxazosin group between 0 and 4 week, However, there was no statistical difference between the two comparisons (p= 0.350). (**C, E**) Pain scores during sexual intercourse at 2 week for both male and female patients. (**D, F**) Intercourse satisfaction and dissatisfaction scores for male and female patients at 2 week

A total of 15 adverse events were reported in this study, affecting six patients (six in the mirabegron group and nine in the doxazosin group). Details are provided in Supplementary Table 4. In the mirabegron group, headache (n=3, 5.2%) was the most frequent adverse event, followed by elevated blood pressure (n=2, 3.4%) and increased heart rate (n=1, 1.7%). The doxazosin group experienced headache (n=1, 2.0%), dizziness (n=1, 2.0%), nausea/vomiting (n=2, 4.1%), elevated blood pressure (n=2, 4.1%), increased heart rate (n=2, 4.1%), and abdominal pain (n=1, 2.0%). Importantly, no serious adverse reactions were observed in either group, and there were no occurrences of facial flushing, gastrointestinal bleeding, or abnormal ejaculation complications.

Discussion

Ureteral stent placement plays a vital role in minimally invasive urologic surgeries. However, ureteral stents frequently cause complications such as infection, encrustation, and a collection of symptoms known as stent-related symptoms [15]. Pharmacological therapy is the cornerstone of managing SRSs [16, 17]. Doxazosin improves symptoms associated with ureteral stenting by relaxing the smooth muscle of the bladder neck and prostatic urethra [10]. Mirabegron acts by relaxing the smooth muscle of the bladder and ureters [18, 19]. This study compared the effects of two medications, the β3-adrenergic receptor agonist mirabegron (50 mg/day) and the α-blocker doxazosin (4 mg/day), on ureteral stent symptoms. We observed a significant difference between the two drugs in their ability to improve women's sexual function during stenting. Building on this finding, we aimed to explore a more rational treatment regimen following ureteral stent placement by comparing the overall efficacy of these medications in alleviating various SRSs.

Ureteral stenting commonly induces symptoms characteristic of overactive bladder (OAB) in a significant portion of patients [20]. These symptoms can include urinary frequency, urgency, nocturia (waking at night to urinate), and incontinence. Several potential mechanisms contribute to OAB during stenting: (1) Foreign body irritation: The physical presence of the stent within the bladder, particularly at its tip in the highly sensitive trigone area, can directly irritate the bladder wall and facilitate overactive reflexes [21–23]. (2) Increased infection risk: Ureteral stents can elevate the risk of urinary tract infections, which in turn trigger bladder mucosal inflammation and contribute to OAB symptoms [24, 25]. (3) Physical disruption of urine flow: The stent disrupts normal urinary flow patterns, potentially causing urine to back up into the bladder and distend its walls. This increased tension can contribute to OAB symptoms [26, 27]. (4) Heightened pain sensitivity: The stent may induce localized pain or discomfort, leading to activation of sensory transmitter fibers and increased activation within the central nervous system (CNS). Additionally, the CNS's inhibitory responses may be diminished. This amplification of nociceptive neural pathways can ultimately decrease the bladder's sensory threshold, resulting in OAB symptoms [28].

OAB significantly reduces the quality of life for women and negatively impacts sexual function [29, 30]. Several mechanisms contribute to female sexual dysfunction after ureteral stenting that leads to OAB. First, women with naturally weak pelvic floor muscles or those already diagnosed with OAB may experience tightness or abnormal functioning of these muscles due to frequent urinary urgency and frequency. This prolonged muscle tension can cause pain, especially during intercourse, when the female urethra is short, and the transmission of pressure and friction from the pelvic floor muscles is more pronounced, increasing pain perception [31–34]. Second, patients who develop OAB after ureteral stenting placement may be more susceptible to urinary tract infections (UTIs). UTIs can lead to inflammation of the bladder and genital region, resulting in pelvic floor hypertonicity, vestibular spongiosis, or decreased vaginal lubrication, all of which have been associated with genital pain during sexual activity, particularly during intercourse. Recurrent UTIs can further exacerbate these issues by lowering estrogen levels and causing vaginal atrophy, potentially contributing to painful intercourse in patients with OAB. Resolution of UTIs or reduction in their recurrence has been shown to significantly improve sexual pain disorders [35–37]. Third, hypertonic pelvic floor muscles in patients with OAB can cause chronic pelvic pain, which can be exacerbated during sexual intercourse. Conversely, improving a patient's bladder pain can significantly reduce tension in the pelvic floor muscle groups, thereby improving the quality of sexual life [36, 38, 39]. Fourth, the chronic lower abdominal discomfort of patients with stents, coupled with anxiety and tension during sexual intercourse, can create a psychological stress cycle that worsens discomfort and pain [1, 25, 40]. Fifth, some studies suggest that OAB symptoms due to ureteral

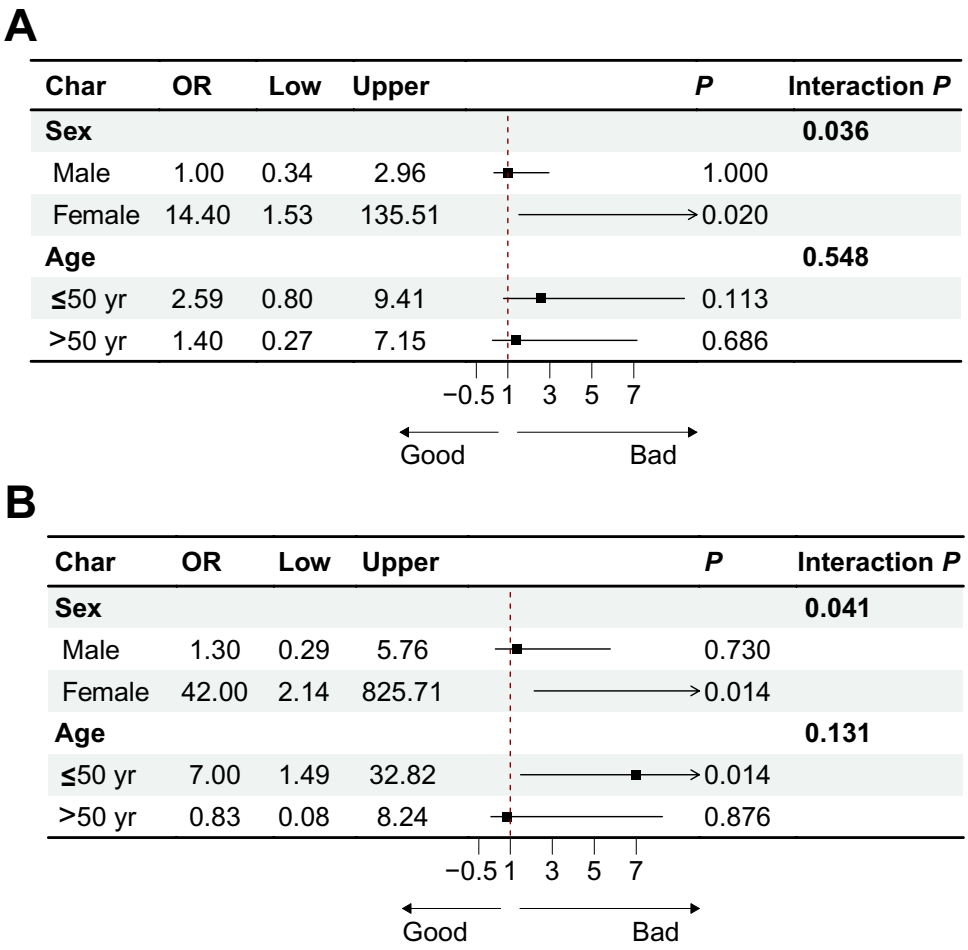


Fig. 4 A subgroup analysis of pain and dyspareunia during sexual intercourse in the mirabegron and doxazosin groups after 2 week of drug administration. Subgroup analyses with dyspareunia (**A**) and dyspareunia (**B**) as primary endpoints. Separate subgroup analyses were performed for sex and age (≤50 years) (mirabegron served as a control). P-value for interaction is the null hypothesis that the treatment effect is the same across subgroups; P-values were not adjusted for multiplicity. Char Characteristics, OR Odd ratio

stenting may affect sexual activity through neurotransmitter pathway disruptions, as common neural pathways control both bladder and sexual function [41]. Finally, systemic adverse effects like anxiety and nervousness associated with doxazosin use may also contribute to discomfort during intercourse in women. In contrast, mirabegron improves bladder storage capacity without causing anticholinergic side effects [42, 43] and has a well-established safety profile [44, 45].

Mirabegron, an OAB medication, offers distinct advantages in treating women's SRS-related dysfunction. Its primary mechanism of action involves acting as an agonist on β3-adrenergic receptors, specifically targeting 97% of them. This results in significantly relaxing the bladder smooth muscle, reducing abnormal contractions and associated pain, and decreasing bladder sensitivity to stimulation [46]. Furthermore, mirabegron may induce relaxation of the reproductive tract musculature, potentially leading to increased blood flow to the female genitalia and stabilization of pelvic floor structures, ultimately improving sexual function in female patients [47]. Secondly, gender differences in pain perception may contribute to the persistence of pain in the female genitourinary region [48]. Therefore, focusing on stabilizing the female bladder and pelvic floor muscles becomes particularly important in this context.

Doxazosin's mechanism of action differs from Mirabegron's. As an α1-adrenergic receptor blocker, doxazosin relaxes the smooth muscles of the urethra, bladder neck, and prostate, leading to improved storage phase lower urinary tract symptoms by reducing voiding pressure and potential reflux [49]. Three subtypes exist within the α1 receptor family: α1A, α1B, and α1D. α1A receptors, primarily located in the smooth muscle of the urethra, bladder neck, and prostate (approximately 70%), are responsible for relieving "posterior pressure". The α1D receptor, situated mainly in the bladder neck (66%), alleviates "anterior pressure". Doxazosin exhibits a blocking ratio of α1A to α1D of 1:1.6 [50]. While doxazosin can effectively reduce detrusor overactivity, its action lacks the specificity of mirabegron and can lead to off-target effects. Consequently, achieving the desired therapeutic effect with alpha-blockers often necessitates higher doses [51], increasing the risk of adverse reactions such as postural hypotension, malaise, headache, and ejaculatory dysfunction [52]. In conclusion, although

both mirabegron and doxazosin demonstrate efficacy in alleviating symptoms associated with ureteral stenting, mirabegron offers a clear advantage in its ability to improve female sexual function. Given the high prevalence of OAB following ureteral stenting, mirabegron emerges as the preferred treatment option for female patients, aiming to improve their quality of sexual life during the perioperative period.

While our study did not reveal a significant difference between mirabegron and doxazosin in improving overall symptoms associated with ureteral stenting, a key finding emerged – mirabegron demonstrated a clear advantage in alleviating sexual pain and improving sexual satisfaction in female patients. This finding provides valuable evidence supporting the use of targeted medications to address specific complications arising from ureteral stenting, such as sexual dysfunction. Our study does have limitations. First, the sample size was modest, potentially introducing bias into the results. Second, the absence of a placebo or other drug control group precludes a direct comparison of the effects of mirabegron with medications having different mechanisms of action. Future studies with larger, multicenter designs could be conducted to comprehensively evaluate the efficacy of various medications in relieving SRSs associated with ureteral stenting. Such studies would provide more robust data to guide clinical decision-making.

Conclusion

Our study found no significant difference between mirabegron and doxazosin in terms of alleviating overall symptoms associated with ureteral stenting. However, mirabegron demonstrated a clear advantage in improving female sexual function, specifically pain and satisfaction. Therefore, for female patients experiencing ureteral stents, we recommend using mirabegron or adding it to their treatment regimen to alleviate SRSs and sexual dysfunction caused by ureteral stents.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00345-025-05663-9.

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Author contributions BT: Conceptualization, Writing - Original Draft; EJ: Methodology, Software, Formal analysis, Visualization, Writing - Review & Editing; YZ: Validation, Investigation, Supervision; XZ:Validation, Investigation, Data Curation; JY: Data Curation, Supervision; LW: Supervision, Project administration, Funding acquisition; Writing - Review & Editing All authors: Approval of the final version of the manuscript.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Conflict of interest The authors declare no competing interests.

Ethical approval The studies involving human participants were reviewed and approved the Medical Ethics Committee of the Anning First People's Hospital Affiliated to Kunming University of Science and Technology (Ethics Approval No. 2022-96 (scientific research)-01). Written informed consent was obtained from all participants.

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