Original Article - Lower Urinary Tract Dysfunction

Investig Clin Urol 2021;62:569-576.
https://doi.org/10.4111/icu.20200523
pISSN 2466-0493 • eISSN 2466-054X

INVESTIGATIVE AND CLINICAL UROLOGY
ICUROLOGY

Preventive effects of tamsulosin for postoperative urinary retention after lower limb arthroplasty: A randomized controlled study

Chang Il Choi[1], Jong Keun Kim[1], Min Soo Choo[2], Seong Ho Lee[1], Jun-Dong Chang[3], Jun Hyun Han[1]

[1]Department of Urology, Hallym University Dongtan Sacred Heart Hospital, Hwaseong, [2]Department of Urology, Seoul Metropolitan Government Seoul National University Boramae Medical Center, Seoul, [3]Department of Orthopaedic Surgery, Hallym University Dongtan Sacred Heart Hospital, Hwaseong, Korea

Purpose: This prospective, randomized, controlled study investigated the use of tamsulosin, a selective alpha-blocker, as a prophylactic medication to prevent postoperative urinary retention (POUR) following lower limb arthroplasty.

Materials and Methods: The criterion for diagnosing POUR was used a postoperative bladder volume over 400 mL with incomplete emptying. Patients who underwent primary total hip or knee arthroplasty were randomly assigned at a 1:1 ratio to tamsulosin treatment and non-treatment groups at a single center from September 2018 to November 2018. The treatment group received 0.2 mg of tamsulosin orally once at night for 3 days starting on postoperative day 1. During this 3-day period, an indwelling Foley catheter was maintained. The incidence of POUR according to tamsulosin treatment following lower limb arthroplasty was the primary outcome.

Results: In total, 100 patients were enrolled, of whom 5 discontinued participation. POUR was diagnosed in 20 of the remaining 95 patients (21.1%). The treatment group contained 48 patients, of whom 6 (12.5%) developed POUR, whereas POUR occurred in the 14 of the 47 patients (29.8%) in the non-treatment group. Tamsulosin treatment reduced the risk of POUR by two-thirds (odds ratio [OR], 0.337; 95% confidence interval [CI], 0.117–0.971; p=0.044). The risk reduction associated with tamsulosin treatment remained robust post-adjustment for potential covariates (OR, 0.250; 95% CI, 0.069–0.905; p=0.038).

Conclusions: Tamsulosin administration immediately after lower limb arthroplasty reduced the incidence of urinary retention and diminished the need for long-term catheterization.

Keywords: Adrenergic alpha-antagonists; Aged; Arthroplasty; Urinary retention

INTRODUCTION

Lower limb arthroplasty is a common operation in elderly patients with degenerative arthritis, and one of the most frequent complications after total joint arthroplasty is postoperative urinary retention (POUR) [1]. POUR refers to a condition in which after surgery, a patient cannot urinate even when the bladder is completely filled [2]. This condition causes considerable distress in patients who undergo surgery, and sometimes it is not appropriately recognized. A failure to promptly detect and treat POUR can lead to bladder overdistention, which in turn increases the need for

Received: 10 November, 2020 • **Revised:** 12 March, 2021 • **Accepted:** 27 May, 2021 • **Published online:** 3 August, 2021
Corresponding Author: Jun Hyun Han https://orcid.org/0000-0002-8452-1916
Department of Urology, Hallym University Dongtan Sacred Heart Hospital, 7 Keunjaebong-gil, Hwaseong 18450, Korea
TEL: +82-31-8086-2730, FAX: +82-31-8086-2728, E-mail: junuro@naver.com

subsequent long-term catheterization after joint replacement surgery [3].

POUR has also been shown to prolong the length of hospital stay and to increase the risk of urinary tract infections (UTIs), which in turn result in a higher risk of infectious prosthetic joint complications. Indwelling catheter use can cause postoperative UTIs, and this risk increases with longer durations of catheter indwelling [4]. UTIs can cause hematogenous bacteremia, which results in seeding of the prosthetic implants and ultimately leads to surgical infections after lower limb arthroplasty [5,6]. Therefore, perioperative pharmacological therapy using alpha-adrenergic antagonists has been considered as a way to reduce POUR [7,8]. Increased sympathetic activity contributes to POUR development after surgery, and treatment with alpha-adrenergic antagonists decreases the resistance of the proximal urethra and bladder neck and helps to restore postoperative urination. Tamsulosin treatment has recently been reported to be effective in preventing POUR after spine surgery, pelvic surgery, and herniorrhaphy [7,9,10].

In our previous study, we retrospectively explored predictive factors for POUR after lower limb arthroplasty and identified intraoperative volume overload and older age as independent risk factors for POUR [11]. This prospective randomized controlled study investigated tamsulosin, an alpha-adrenergic antagonist, as a prophylactic treatment for the prevention of POUR after lower limb arthroplasty.

MATERIALS AND METHODS

The Institutional Review Board of the Hallym University Dongtan Sacred Heart Hospital approved the protocol for the present study (approval number: HDT 2015-009). This prospective, randomized, single-blind trial was carried out between September 2018 and November 2018. The study was conducted in a way that aligned with the Declaration of Helsinki. The study protocol adhered to the SPIRIT recommendations [12,13], and the study was reported in accordance with the CONSORT guidelines [13].

Of the patients hospitalized for lower limb arthroplasty, those who volunteered to participate in this trial and provided written informed consent were enrolled in this study. Patients over the age of 18 who underwent primary total hip or knee arthroplasty were included. Patients undergoing revision surgery were excluded. Patients taking medications for lower urinary tract symptoms or who had previously undergone prostatectomy were excluded from the study. Patients who preoperatively needed urinary diversions such as an indwelling urethral catheter or suprapubic cystostomy were also excluded, as were patients with a history of pelvic organ prolapse, urinary incontinence, or urinary retention. In addition, patients with orthostatic hypotension or dizziness were excluded.

1. Randomization

The research coordinator randomly assigned all eligible patients at a 1:1 ratio to either the tamsulosin treatment or non-treatment group using a computer-generated randomization table. The investigators were blinded to the treatment allocation until the trial was completed and the database was locked.

2. Intervention

Patients in the treatment group received 0.2 mg of tamsulosin administered orally once at night for 3 days, starting on postoperative day 1. A 16-Fr Foley catheter was inserted in the operating room immediately prior to surgery. According to our previous study, the indwelling Foley catheter was maintained for 3 days postoperatively [11]. The patient-controlled analgesia regimens were typically an established Intravenous set consisting of fentanyl citrate (2 mg) or an epidural set consisting of fentanyl citrate (0.5 mg) and ropivacaine hydrochloride monohydrate (0.2%).

3. Outcome assessment

The primary outcome was the incidence of POUR depending on whether patients received tamsulosin treatment following lower limb arthroplasty. The definition of POUR was clinical evidence of over 400 mL of residual urine volume by bladder ultrasound after a postoperative trial without a urethral catheter. The patients were checked using bladder ultrasound to determine whether they were unable to void or showed incomplete emptying in spite of a desire to void at least 4 hours after urinary catheter removal. In patients without a voiding sensation following removal of the Foley catheter, bladder ultrasound was used to check the residual urine volume at 6 hours later. If the residual urine volume exceeded 400 mL, urethral catheterization was performed. Those patients were classified as having POUR.

We collected data on parameters that could affect POUR, including patients' demographic characteristics and perioperative findings, such as sex, body mass index, American Society of Anesthesiologists classification of physical status, type of surgery, volume of estimated blood loss, operative duration, anesthetic duration, volume of intraoperative intravenous fluid, volume of transfusion, and type of patient-controlled analgesia.

https://doi.org/10.4111/icu.20200523

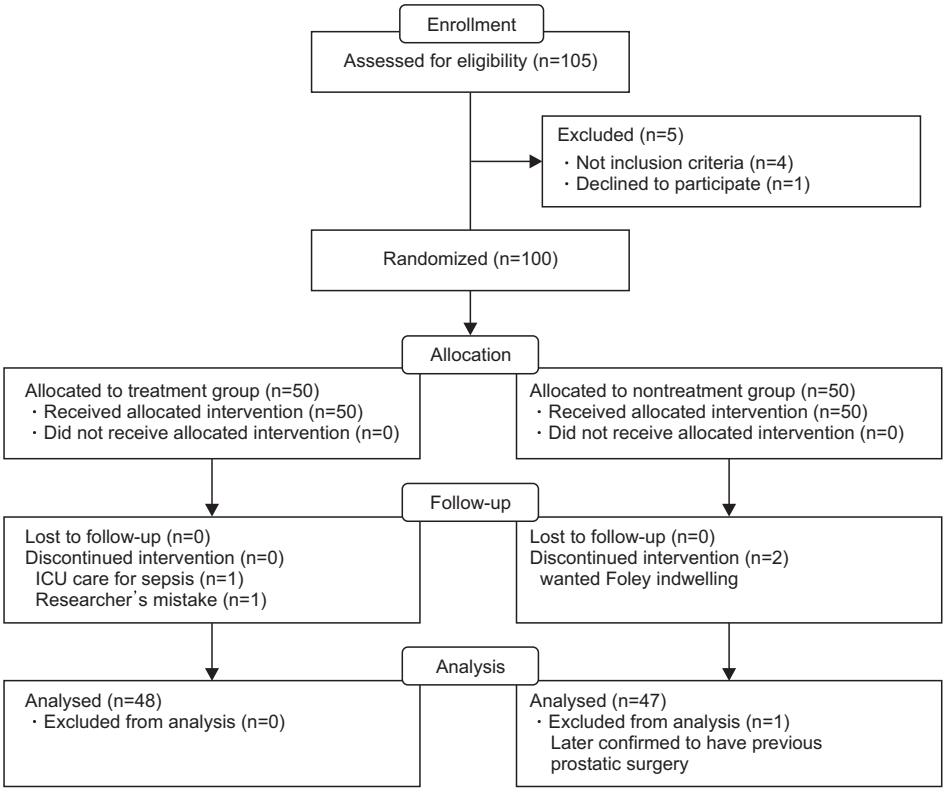

Fig. 1. Flow diagram depicting the allocation of study patients. ICU, intensive care unit.

4. Statistics

As the primary outcome, the incidence of POUR after knee or hip arthroplasty was utilized for power analysis. The sample size was calculated using our published data and the pooled data from previous studies conducted with tamsulosin. The prior data from our institution indicated that the POUR rate after lower limb arthroplasty was 27.4% [11]. Previous studies reported the POUR rate after genitourinary surgery in tamsulosin-treated patients to be 5.3% [7,8,10]. The required sample size was calculated to be at least 45 for each group, with a type I error rate of 0.05 and an 80% power in a two-sided test, and an overall dropout rate of 10%. The Pearson chi-square test was performed to compare the difference in POUR incidence between the treatment and non-treatment groups. The associations of POUR with various clinical factors were analyzed using a multivariate backward stepwise logistic regression model to adjust for other related covariates. Backward elimination was conducted and variables with a p-value >0.2 were removed. The Hosmer–Lemeshow test was used to evaluate the regression model's goodness of fit. Another comparative analysis between the two groups was performed using the Pearson chi-square or Student t-test for categorical and continuous variables, respectively. A two-tailed p-value <0.05 was considered to indicate statistical significance. The statistical analysis was performed using SPSS for Windows version 24.0 (IBM Corp., Armonk, NY, USA).

RESULTS

In total, 100 patients were enrolled, of whom 5 discontinued participation. One patient was treated in the intensive care unit for sepsis, including a UTI, and had an indwelling Foley catheter for a long time. Two patients requested an indwelling urethral catheter for another health problem, and the catheter was therefore not removed at 3 days postoperatively. One was later confirmed to have undergone previous prostatic surgery. There was one patient who did not receive any medication due to a mistake made by a research assistant. Data from 95 patients were analyzed. None of the patients discontinued the study due to medication-related adverse events (Fig. 1).

Patients' baseline demographic characteristics and perioperative clinical data are summarized in Table 1. Sixty-five and 30 patients underwent hip and knee arthroplasty, respectively, and the two groups did not show any significant differences. The mean age of the participants in the two groups was similar. The two groups also showed no significant differences in sex, body mass index, comorbidities, operative duration, and intraoperative fluid administration.

Ninety-five patients underwent lower limb arthroplasty, of whom 20 (21.1%) developed POUR. The treatment group

Table 1. Baseline characteristics and perioperative parameters

Variable	Non-treatment	Treatment	p-value[a]
No. of patients	47	48	
Age (y)	70.8±14.4	65.8±16.8	0.124
Sex			0.877
Male	14 (29.8)	15 (31.3)	
Female	33 (70.2)	33 (68.8)	
Body mass index	24.1±3.9	25.0±4.6	0.306
Comorbidity			
Diabetes mellitus	11 (23.4)	8 (16.7)	0.412
Hypertension	26 (55.3)	27 (56.3)	0.927
Cardiovascular disease	3 (6.4)	2 (4.2)	0.629
Cerebrovascular accident	12 (25.5)	16 (33.3)	0.404
Hyperlipidemia	3 (6.4)	3 (6.3)	0.979
Arthroplasty			0.609
Knee	16 (34.0)	14 (29.2)	
Hip	31 (66.0)	34 (70.8)	
Emergency operation (vs. elective)	4 (8.5)	4 (8.3)	0.975
ASA classification			0.284
Physical status 1	1 (2.1)	6 (12.5)	
Physical status 2	36 (76.6)	32 (66.7)	
Physical status 3	10 (21.3)	10 (20.8)	
Anesthesia method			0.465
General	7 (14.9)	10 (20.8)	
Spinal	6 (12.8)	3 (6.3)	
Epidural	34 (72.3)	35 (72.9)	
Operative duration (min)	130.9±89.6	108.9±57.5	0.157
Anesthetic duration (min)	225.2±97.9	204.2±60.4	0.211
Total EBL (mL)	596.8±496.8	512.1±306.3	0.321
EBL (mL/min)	5.13±3.02	5.28±2.69	0.799
Total intraoperative fluid administered (mL)	1,504±1,025	1,329±456	0.288
Rate of intraoperative fluid (mL/min)	12.82±5.25	13.83±5.13	0.348
PCA			0.322
None	2 (4.3)	0 (0.0)	
Intravenous	32 (68.1)	36 (75.0)	
Epidural	13 (27.7)	12 (25.0)	

Values are presented as number only, mean±standard deviation, or number (%).
ASA, American Society of Anesthesiologists; EBL, estimated blood loss; PCA, patient-controlled analgesia; POUR, postoperative urinary retention.
[a]:p<0.05 for POUR (-) vs. POUR (+).

contained 48 patients, of whom 6 (12.5%) were diagnosed with POUR, whereas POUR occurred in 14 of the 47 patients (29.8%) in the non-treatment group (Fig. 2). Tamsulosin treatment decreased the likelihood of developing POUR after lower limb arthroplasty by two-thirds (odds ratio [OR], 0.337; 95% confidence interval [CI], 0.117–0.971; p=0.044). The effect of tamsulosin remained consistent when the effects of potential covariates were adjusted (OR, 0.250; 95% CI, 0.069–0.905; p=0.038). Also, 38 patients (40%) were over 76 years, these patients could be associated with increased risk for POUR in multivariate analysis (OR, 3.667; 95% CI, 1.032–13.024; p=0.045) (Table 2).

DISCUSSION

Acute POUR is a frequently encountered complication, with an estimated incidence in general surgical patients of 2.1% to 36.6% [2,14,15]. POUR has a variety of adverse implications for patients and may affect surgical outcomes.

The pain or discomfort associated with POUR appears to be caused by bladder distention. Sympathetic stimulation in response to pain can give rise to hemodynamic changes such

https://doi.org/10.4111/icu.20200523

as dysrhythmias and asystole [16]. Long-lasting ischemia of the bladder as a result of persistent over-distension can lead to longer-term bladder dysfunction and chronic kidney disease [17]. POUR may also have indirect sequelae, including delays in discharge from the hospital and iatrogenicUTIs, both of which can lead to increased hospital costs [18].

Because of differences in diagnostic criteria, few studies have reported post-void residual volume cut-off values, and there are currently no standard recommendations. Bladder volumes of 400 to 600 mL have been used as a criterion for the diagnosis of POUR [2,19-21]. We used a postoperative bladder volume over 400 mL with acute urinary retention symptoms as the criterion for diagnosing POUR. The reported incidence of POUR after lower limb arthroplasty ranges widely, from 10.7% to 77.8% [22]. The reported incidence of POUR after lower limb arthroplasty is up to 20 times greater than its incidence following any other procedure [23]. In our previous study, POUR occurred following lower limb arthroplasty in approximately 27% [11]. The present study found an incidence of POUR after lower limb arthroplasty of 21.1%. The incidence of POUR in the tamsulosin treatment group was 12.5%, while it was 29.8% in the non-treatment group. The OR for POUR in the treatment group was 0.337, reflecting a statistically significant difference. When the effects of potential covariates were adjusted, it was found that tamsulosin treatment lowered the risk of POUR to 0.25 times that of the untreated group, indicating that tamsulosin treatment for 3 days after lower limb arthroplasty was effective in reducing POUR.

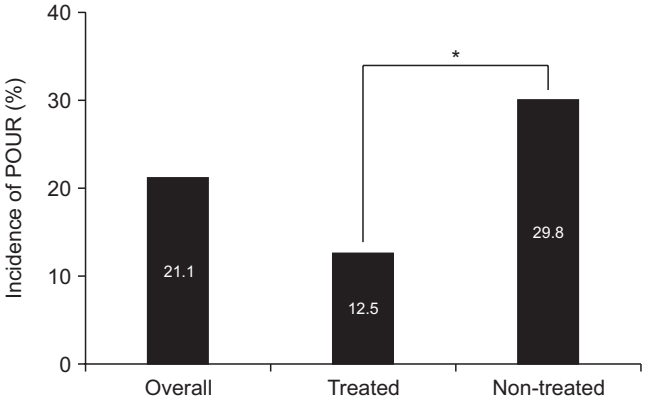

Fig. 2. Incidence of POUR among patients who underwent lower limb arthroplasty. Ninety-five patients underwent lower limb arthroplasty, of whom 20 (21.1%) had postoperative urinary retention (POUR). Of the 48 patients in the treatment group, 6 (12.5%) developed POUR after hip or knee arthroplasty, versus 14 of the 47 patients (29.8%) in the non-treatment group. *p<0.05.

Sympathetic, parasympathetic, and efferent somatic fibers supply the bladder. Visceral afferent fibers, also referred to as stretch receptors, arise from the bladder wall. Micturition, which is a physiologically intricate process, can be divided into the storage and voiding phases. Sympathetic innervation mediates the storage phase, whereas parasympathetic fibers are responsible for the voiding phase. Brainstem centers further govern micturition, which is a spinal reflex. Although the pathophysiology of POUR is not thoroughly understood, the greater length of time needed to recover bladder function after lower limb joint arthroplasty may be explained by the fact that lumbar spinal anesthesia involves a lower level of sensory and motor blockade than occurs with thoracic spine anesthesia [23]. Furthermore,

Table 2. Significant predictive factors for acute postoperative urinary retention after lower limb arthroplasty by Cox univariate and multivariate analyses

Variable	Univariate			Multivariate		
	p-value	Odds ratio	95% confidence interval	p-value	Odds ratio	95% confidence interval
Tamsulosin	0.044	0.337	0.117–0.971	0.038	0.250	0.069–0.905
Age >76 y	0.003	4.958	1.698–14.490	0.045	3.667	1.032–13.024
Sex, male	0.547	1.412	0.460–4.337			
Body mass index >25 kg/m^2	0.058	0.342	0.113–1.037			
Diabetes mellitus	0.016	3.879	1.291–11.650	0.055	4.056	0.969–16.972
Cerebrovascular accident	0.302	2.667	0.414–17.169			
Hip lesion	0.711	0.821	0.290–2.328			
Emergency operation	0.008	0.125	0.027–0.581	0.062	5.697	0.914–35.504
General anesthesia (vs. spinal)	0.030	3.500	1.125–10.886	0.146	3.512	0.647–19.071
EBL >500 mL	0.057	0.280	0.075–1.040			
Anesthetic time >215 min	0.695	0.808	0.278–2.350			
Operative time >120 min	0.415	0.628	0.205–1.922			
Intravenous PCA (vs. epidural)	0.009	4.000	1.409–11.354	0.717	1.327	0.288–6.104

ASA, American Society of Anesthesiologists; EBL, estimated blood loss; PCA, patient–controlled analgesia.

systemic opioid analgesia to manage pain can lead to a delayed perception of the need to void [23]. The capacity of the normal bladder is 400 to 600 mL. The physiology of micturition can be disrupted in the perioperative period due to anesthesia, the surgical procedure itself, and intraoperative physiological stressors. It is known that several drugs used in the perioperative period (e.g., anesthetic agents, analgesics, and sedatives) interfere with the micturition pathway [17,23]. Opioids, which are frequently used for analgesia both intraoperatively and postoperatively, trigger urinary retention as a result of parasympathetic inhibition, which blunts the sensation of bladder fullness, and increased sympathetic activity, which increases sphincter tone. It has been reported that neuraxial opioids lead to a higher incidence of urinary retention than intravenously administered opioids. Neuraxial local anesthetics augment the risk of POUR by interfering with both the efferent and afferent micturition pathways. General anesthetics also predispose patients to urinary retention by causing smooth muscle relaxation, thereby decreasing bladder contractility. They can also cause autonomic dysregulation of bladder tone. Longer-acting agents also pose a higher risk of causing bladder dysfunction due to prolonged over-distention [17,22,23].

The physiological response to surgical stress increases sympathetic tone, causing the detrusor muscle to relax and the internal urethral sphincter to close. Therefore, stimulation of the alpha receptor in the internal urethral sphincter increases the pressure in the bladder neck, leading to POUR [2]. Administration of tamsulosin could preserve the micturition reflex by inhibiting the increase in sympathetic nerve activity, thereby preventing POUR. Furthermore, tamsulosin is an α1-blocker with a particularly high affinity for α1A receptors, which predominate (from both numerical and functional standpoints) in the prostate and urethra, and the α1D receptors in the bladder [24]. The α1A adrenoceptor subtype in the smooth muscles of the prostate and urethra is responsible for the dynamic component of obstruction and related voiding symptoms [25]. Tamsulosin is an effective add-on treatment for acute urinary retention [24]. Men catheterized for acute urinary retention who are treated with tamsulosin are less likely to need re-catheterization and have more successful voiding post–catheter removal. The side-effect profile of tamsulosin was found to be similar to that of placebo, and consistent with known pharmacology [24,25]. Prior studies varied significantly regarding the length of tamsulosin administration [7,26,27]. We planned a 3-day treatment regimen of tamsulosin as a period during which steady therapeutic levels could be reached [27], there is little interference from postoperative stress and anesthesia-related effects [28,29], and the patient is immobilized postoperatively [30].

This study has limitations as a single-center, single-surgeon investigation and its relatively small sample size. Specific information about preoperative voiding function was unavailable. Despite the limitations of our study sample, we excluded patients with a history of urinary system disease before surgery and minimized selection bias by randomizing other preoperative factors. Further large-scale research, including placebo medication and measurements of preoperative urinary function, should be carried in the future.

CONCLUSIONS

Based on the findings of this study, short-term perioperative treatment with tamsulosin can reduce the incidence of urinary retention and the need for catheterization after lower limb arthroplasty. In particular, perioperative tamsulosin medication helps to prevent POUR and long-term catheterization after lower limb arthroplasty in patients over 76 years old.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

ACKNOWLEDGMENTS

This research was supported by Hallym University Research Fund 2018 (HURF-2018-42). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

AUTHORS' CONTRIBUTIONS

Research conception and design: Jun Hyun Han. Data acquisition: Chang Il Choi, Jong Keun Kim, Min Soo Choo, and Jun Hyun Han. Statistical analysis: Jong Keun Kim and Chang Il Choi. Data analysis and interpretation: Jong Keun Kim and Chang Il Choi. Drafting of the manuscript: Chang Il Choi, Jong Keun Kim, Min Soo Choo, and Jun Hyun Han. Critical revision of the manuscript: Seong Ho Lee, Jun-Dong Chang, and Jun Hyun Han. Obtaining funding: Jong Keun Kim and Jun Hyun Han. Administrative, technical, or material support: Jun Hyun Han. Supervision: Jun Hyun Han. Approval of the final manuscript: all authors.

REFERENCES

1. Lawrie CM, Ong AC, Hernandez VH, Rosas S, Post ZD, Oro-

https://doi.org/10.4111/icu.20200523

zco FR. Incidence and risk factors for postoperative urinary retention in total hip arthroplasty performed under spinal anesthesia. J Arthroplasty 2017;32:3748-51.
2. Baldini G, Bagry H, Aprikian A, Carli F. Postoperative urinary retention: anesthetic and perioperative considerations. Anesthesiology 2009;110:1139-57.
3. Michelson JD, Lotke PA, Steinberg ME. Urinary-bladder management after total joint-replacement surgery. N Engl J Med 1988;319:321-6.
4. Pulido L, Ghanem E, Joshi A, Purtill JJ, Parvizi J. Periprosthetic joint infection: the incidence, timing, and predisposing factors. Clin Orthop Relat Res 2008;466:1710-5.
5. Berbari EF, Hanssen AD, Duffy MC, Steckelberg JM, Ilstrup DM, Harmsen WS, et al. Risk factors for prosthetic joint infection: case-control study. Clin Infect Dis 1998;27:1247-54.
6. Ollivere BJ, Ellahee N, Logan K, Miller-Jones JC, Allen PW. Asymptomatic urinary tract colonisation predisposes to superficial wound infection in elective orthopaedic surgery. Int Orthop 2009;33:847-50.
7. Madani AH, Aval HB, Mokhtari G, Nasseh H, Esmaeili S, Shakiba M, et al. Effectiveness of tamsulosin in prevention of post-operative urinary retention: a randomized double-blind placebo-controlled study. Int Braz J Urol 2014;40:30-6.
8. Mohammadi-Fallah M, Hamedanchi S, Tayyebi-Azar A. Preventive effect of tamsulosin on postoperative urinary retention. Korean J Urol 2012;53:419-23.
9. Basheer A, Alsaidi M, Schultz L, Chedid M, Abdulhak M, Seyfried D. Preventive effect of tamsulosin on postoperative urinary retention in neurosurgical patients. Surg Neurol Int 2017;8:75.
10. Poylin V, Curran T, Cataldo T, Nagle D. Perioperative use of tamsulosin significantly decreases rates of urinary retention in men undergoing pelvic surgery. Int J Colorectal Dis 2015;30:1223-8.
11. Choo MS, Lee SH, Lee YG, Chang JD, Han JH. Clinical factors influencing postoperative urinary retention after lower limb arthroplasty. Int J Clin Exp Med 2017;10:7105-10.
12. Chan AW, Tetzlaff JM, Altman DG, Laupacis A, Gøtzsche PC, Krleža-Jerić K, et al. SPIRIT 2013 statement: defining standard protocol items for clinical trials. Ann Intern Med 2013;158:200-7.
13. Schulz KF, Altman DG, Moher D; CONSORT Group. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. BMJ 2010;340:c332.
14. Wu AK, Auerbach AD, Aaronson DS. National incidence and outcomes of postoperative urinary retention in the Surgical Care Improvement Project. Am J Surg 2012;204:167-71.
15. Lee KS, Lim KH, Kim SJ, Choi HJ, Noh DH, Lee HW, et al. Predictors of successful trial without catheter for postoperative urinary retention following non-urological surgery. Int Neurourol J 2011;15:158-65.
16. Kamphuis ET, Ionescu TI, Kuipers PW, de Gier J, van Venrooij GE, Boon TA. Recovery of storage and emptying functions of the urinary bladder after spinal anesthesia with lidocaine and with bupivacaine in men. Anesthesiology 1998;88:310-6.
17. Buckley BS, Lapitan MC. Drugs for treatment of urinary retention after surgery in adults. Cochrane Database Syst Rev 2010;(10):CD008023.
18. Choi S, Awad I. Maintaining micturition in the perioperative period: strategies to avoid urinary retention. Curr Opin Anaesthesiol 2013;26:361-7.
19. Kowalik U, Plante MK. Urinary retention in surgical patients. Surg Clin North Am 2016;96:453-67.
20. Lamonerie L, Marret E, Deleuze A, Lembert N, Dupont M, Bonnet F. Prevalence of postoperative bladder distension and urinary retention detected by ultrasound measurement. Br J Anaesth 2004;92:544-6.
21. Rosseland LA, Stubhaug A, Breivik H. Detecting postoperative urinary retention with an ultrasound scanner. Acta Anaesthesiol Scand 2002;46:279-82.
22. Kotwal R, Hodgson P, Carpenter C. Urinary retention following lower limb arthroplasty: analysis of predictive factors and review of literature. Acta Orthop Belg 2008;74:332-6.
23. Balderi T, Carli F. Urinary retention after total hip and knee arthroplasty. Minerva Anestesiol 2010;76:120-30.
24. Lucas MG, Stephenson TP, Nargund V. Tamsulosin in the management of patients in acute urinary retention from benign prostatic hyperplasia. BJU Int 2005;95:354-7.
25. Sato S, Hatanaka T, Yuyama H, Ukai M, Noguchi Y, Ohtake A, et al. Tamsulosin potently and selectively antagonizes human recombinant α(1A/1D)-adrenoceptors: slow dissociation from the α(1A)-adrenoceptor may account for selectivity for α(1A)-adrenoceptor over α(1B)-adrenoceptor subtype. Biol Pharm Bull 2012;35:72-7.
26. Akkoc A, Aydin C, Topaktas R, Kartalmis M, Altin S, Isen K, et al. Prophylactic effects of alpha-blockers, Tamsulosin and Alfuzosin, on postoperative urinary retention in male patients undergoing urologic surgery under spinal anaesthesia. Int Braz J Urol 2016;42:578-84.
27. Ghuman A, de Jonge SW, Dryden SD, Feeney T, Buitrago DH, Phang PT. Prophylactic use of alpha-1 adrenergic blocking agents for prevention of postoperative urinary retention: a review & meta-analysis of randomized clinical trials. Am J Surg 2018;215:973-9.
28. Chong C, Kim HS, Suh DH, Jee BC. Risk factors for urinary retention after vaginal hysterectomy for pelvic organ prolapse. Obstet Gynecol Sci 2016;59:137-43.
29. Kamilya G, Seal SL, Mukherji J, Bhattacharyya SK, Hazra A. A

randomized controlled trial comparing short versus long-term catheterization after uncomplicated vaginal prolapse surgery. J Obstet Gynaecol Res 2010;36:154-8.

30. Chua MJ, Hart AJ, Mittal R, Harris IA, Xuan W, Naylor JM. Early mobilisation after total hip or knee arthroplasty: a multicentre prospective observational study. PLoS One 2017;12:e0179820.

https://doi.org/10.4111/icu.20200523