Urinary retention after total joint arthroplasty of hip and knee: Systematic review

Yong-Han Cha, Young-Kyun Lee, Seok-Hyung Won, Jung Wee Park, Yong-Chan Ha and Kyung-Hoi Koo

Abstract

Purpose: Postoperative urinary retention (POUR) is a common complication after total joint arthroplasties (TJAs). The POUR is managed with urinary catheterization, which is associated with a risk of urinary tract infection and subsequent periprosthetic joint infection. The purpose of this review was to afford a comprehensive understanding of POUR and its management. Methods: We identified 15 original articles concerning POUR after TJA, which were published from January 2010 to February 2019. The diagnostic method, incidence, risk factors, and management of POUR of the 15 studies were reviewed. Results: The incidence of POUR was ranged from 4.1% to 46.3%. Ultrasound was used for the detection of POUR among the total of the 15 studies. The following factors of old age, male gender, benign prostatic hypertrophy, history of urinary retention, spinal/epidural anesthesia, excessive fluid administration, patient-controlled analgesia, the use of opiates, underlying comorbidities, and poor American Society of Anesthesiologists (ASA) grade were risk factors for POUR. Most of the studies did not use indwelling catheterization during surgery. The POUR patients were managed with intermittent catheterization. The most common volume criterion for bladder catheterization was 400 mL. In inevitable use of an indwelling catheter, it should be removed within 48 h. Conclusions: This review provided an up-to-date guide for the detection and management of POUR.

Level of Evidence: Level III.

Keywords

complication, incidence, risk factor, total joint arthroplasty, urinary retention

Date received: 23 October 2019; Received revised 23 December 2019; accepted: 19 January 2020

Introduction

Urinary retention is defined as the inability to void urine despite the full bladder. Postoperative urinary retention (POUR) is a common complication following hip and knee arthroplasty. Delayed diagnosis of POUR leads to atomic bladder and permanent impairment of detrusor function. Urinary retention is managed with urinary catheterization, which is associated with a risk of urinary tract infection (UTI). Furthermore, UTI can lead to hematogenous bacteremia and subsequent periprosthetic joint infection (PJI) in the early postoperative period after total joint arthroplasty (TJA).

1 Department of Orthopaedic Surgery, Eulji University Hospital, Daejeon, South Korea
2 Department of Orthopaedic Surgery, Seoul National University Bundang Hospital, Seongnam, South Korea
3 Department of Orthopaedic Surgery, Chung-Ang University College of Medicine, Seoul, South Korea
4 Seoul National University College of Medicine, Seoul, South Korea

Corresponding author:
Jung-Wee Park, Department of Orthopaedic Surgery, Seoul National University Bundang Hospital, 166 Gumi-ro, Bundang-gu, Seongnam 463-707, South Korea.
Email: jwepark@gmail.com
To avoid possible risk of UTI and PJI, arthroplasty surgeons should have a comprehensive understanding of POUR and its management. To our knowledge, only one review on the effect of anesthetic and analgesic techniques on POUR was published in 2010 in an anesthesiology journal.1 Thereafter, no comprehensive review about POUR was published in the literature. The POUR is practically important to orthopedic surgeons especially after the introduction of clinical pathways and fast-track protocol of TJAs. To date, the indication and protocol of bladder catheterization in the POUR patients remain controversial.

In this review, we updated the published evidence on the incidence, diagnostic method, risk factors, and management of POUR after TJAs.

Materials and methods

We performed the current systematic review according to the preferred reporting items for systematic reviews and meta-analyses guidelines.8

Study eligibility criteria

Studies were selected on the basis of the following criteria: (1) study population: patients who underwent total hip arthroplasty or total knee arthroplasty; (2) studies defining POUR; (3) studies reporting the incidence and/or risk factors of POUR; and (4) studies written in English.

Studies were excluded if (1) they failed to meet the criteria above; (2) patients underwent total ankle arthroplasty; and (3) studies confined to comparing the effects of anesthesia and drugs.

Search methods for identification of studies

We carried out a comprehensive search on PubMed, Cochrane Collaboration Library, and EMBASE to identify relevant studies from January 2010 to February 2019. We used the following search terms: “POUR arthroplasty.” Two researchers reviewed the titles and abstracts of all potentially relevant studies independently, as recommended by the Cochrane Collaboration.9 Any disagreement was resolved by the third reviewer. After full-text review, articles were assessed according to the predefined inclusion and exclusion criteria, and then eligible articles were selected. The reviewers were not blinded to authors or institutions.

Data extraction

The following data were extracted from the articles, authors, date of publication, design of the study (retrospective or prospective), participant features (number, mean age, and gender), factors related with surgery (use of preoperative urinary catheter, hip or knee arthroplasty, type of anesthesia, and pain management methods), and factors related with urinary retention (diagnosis method, incidence, risk factors, and complications after urinary retention).

Ethics statement

This study protocol was exempted for review by the Seoul National University Bundang Hospital Institutional Review Board (X-1907-550-907) in accordance with the exemption criteria. The present study was exempted from institutional review board review because it did not involve human subjects.

Results

Search results

The initial search resulted in 174 references from the selected databases. After the screening of titles and abstracts, 152 were excluded because they were duplicates, unrelated articles, case reports, or review articles. The remaining 22 studies were thoroughly assessed for full-text review. After the review, seven studies, which were not eligible for this systemic review, were excluded. Finally, 15 studies (10 prospective studies and 5 retrospective studies), involving 6397 patients, were included in this review (Figure 1). The main features and results of the 15 studies are presented in Table 1.2,10–23

Diagnostic criteria and incidence of POUR

In all of the 15 studies, the diagnosis of POUR was made by ultrasound. Each study adopted various volume criteria from 350 mL to 700 mL for the diagnosis of POUR. The most frequent volume criteria were 400 mL (five studies) followed by 500 mL (two studies) and 600 mL (two studies). The incidence of POUR varied widely from 4.1% to 46.3%.

Risk factors of POUR

In this review of 15 studies, male gender, benign prostatic hypertrophy, or history of urinary retention appeared as risk factors in eight studies.10,12,14,16–18,22,23 Five studies reported old age as a risk factor for POUR.2,16,17,21,22 Age-related degenerative neuropathy seemed to be the reason for this causality. In three studies, the use of spinal/epidural anesthesia appeared as a risk factor compared with general anesthesia.10,13,15 Administration of excessive fluid was a risk factor in three studies.16,18,21 Other risk factors were patient-controlled analgesia, underlying comorbidities,2 and poor ASA grade.16

Indication of catheterization

Miller et al. reported that only 1% of POUR patients were treated with indwelling catheters and most of POURs were treated by one-time intermittent catheterization with no
further urinary complications. In the study by Markopoulos et al., all POUR patients recovered and none of them were discharged with an indwelling catheter. In the study by Bjerregaard et al., 40% of patients had POUR and 8.2% required repeated intermittent catheterization, but only 0.9% necessitated an indwelling catheter. However, in other studies, the rate of indwelling catheter application ranged from 16.8% to 36.2%. There was a consensus that indwelling catheterization should not be used or at least should be limited in all of the studies. Each study adopted various threshold volumes ranging from 350 mL to 700 mL for the bladder catheterization. Five studies used 400 mL as the volume criteria.

Detection and management of POUR

Patients, who have a risk of developing POUR, should be screened before TJA and should be closely monitored during and after the operation. Ultrasound should be used for the diagnosis of POUR.

Once POUR has occurred, the patient should be treated with intermittent catheterization. Indwelling catheters and/or pharmacological treatments are used, only in cases of persistent POURs despite repeated intermittent catheterization. If an indwelling catheter is inevitably used, it should be removed within 48 h.

Discussion

Patients undergoing TJAs have a greater incidence of POUR compared with other surgical procedures. In 2010, Balderi and Carli reviewed POUR after TJAs. In their review, the incidence of POUR ranged from 0% to 75%. At that time, clinical practice of bladder management in TJA patients included either preoperative insertion of an indwelling catheter or postoperative intermittent in-and-out catheterization. Both catheterization and ultrasound were used for the diagnosis of POUR at the time.

In our review, the POUR incidence ranged from 4.1% to 46.3%. Ultrasound replaced bladder catheterization for the diagnosis and management of POUR, and routine use of indwelling catheter was abandoned. Once POUR had occurred, the patients were treated with intermittent catheterization.

The reasons for the wide range in the POUR incidence were author-specific diagnostic criteria, different characteristics of TJA patients, the type of anesthesia, postoperative analgesia protocol, and the use of indwelling urinary catheterization during surgery.

Urinary catheterization is an invasive procedure, which is associated with complications including urethral trauma, infection, and patient’s discomfort. Ultrasound bladder scan has been introduced as a noninvasive diagnostic and monitoring tool of POUR. In all of 15 studies published since 2010, ultrasound was used instead of catheterization.

Normal capacity of adult bladder ranges from 400 mL to 600 mL, and bladder volume exceeding 600 mL has been considered to be pathological. Overdistention of the bladder can cause urologic adverse events. Because of this, an appropriate threshold volume for catheterization should be determined. Nevertheless, the threshold volume varied

Figure 1. Systematic review flowchart following the PRISMA guideline. PRISMA: preferred reporting items for systematic reviews and meta-analyses.
| Year | Author            | Design      | Use of indwelling catheter | Number of patients | Mean age (years) | Gender (M/F) | Hip/ knee | G/S or E/C | Pain management | Number of POUR patients | Risk factors for POUR                                                      | Complications and infection                                      |
|------|-------------------|-------------|-----------------------------|-------------------|-----------------|---------------|------------|------------|----------------|----------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------|
| 2011 | Balderi et al.2   | Retrospective | X                           | 286               | 70              | 105/181       | 133/153    | 286/0/0   | PCA morphine, epidural infusion (bupivacaine, entyraly) | US 500 cc              | Age, more comorbidities (CCI, no regression)                                  | 6(0.1%): repeated intermittent catheterization                     |
| 2011 | Griesele et al.10 | Retrospective | X                           | 1031              | 62              | 477/554       | 605/426    | 106/843/82 | Oral oxycodone, PCA morphine | US                   | Male, total hip replacement, intrathecal morphine International Prostate Symptom Score (IPSS) | 48(16.8%): indwelling catheter N/D                                    |
| 2012 | Kieffer and Knae11 | Prospective  | X                           | 100               | 68 (median)    | N/D           | 45/55      | 0/100.00  | US 446 (43.3%) | 286/0/0      | Male, total hip replacement, intrathecal morphine International Prostate Symptom Score (IPSS) | N/D                                                                                 |
| 2013 | Miller et al.17   | Prospective  | O or X                      | 200               | 59              | 102/98       | 200/0      | 0/200.00  | Acetaminophen, celecoxib, pregabalin | US 400 cc              | Age, male, ASA grade, benign prostatic hypertrophy(J = 0.06)                  | 2(1%): indwelling catheter 1(0.5%): UTI N/D                              |
| 2014 | Fernandez et al.23| Retrospective | X                           | 420               | 66.9           | 200/220      | 178/242    | 152/260/0 | Morphine, paracetamol, ibuprofen | US 400 cc              | Male, age N/D                                                                   | 2(1%): UTI N/D                                                        |
| 2015 | Bjorregaard et al.13 | Prospective  | X                           | 1054              | 67, 68         | 421/633      | 580/474    | 118/936   | Spinal anesthesia | US 600 cc              | Age, male, ASA grade, benign prostatic hypertrophy(J = 0.06)                  | 2(1%): UTI N/D                                                        |
| 2015 | David et al.14    | Prospective  | X                           | 80                | 65             | 33/47        | 80/0       | 0/0.80    | PCA, US 700 cc | 29 (36%)               | Male (no regression)                                                        | 136(16.2%): indwelling catheter 1(0.5%): UTI N/D                          |
| 2015 | Hollman et al.15  | Prospective  | O or X                      | 376               | 68             | 374/0        | 374/0      | 234/140  | PCA, US 300 cc | 150 (39.9%)            | PCA, spinal anesthesia, age >70                                         | 13(4.1%): indwelling catheter 1(0.5%): UTI N/D                          |
| 2015 | Huang et al.16    | Prospective  | O or X                      | 314               | 67.2           | 71/243       | 0/314      | 314/0.00  | acetaminophen, celecoxib, diclofenac | US 400 cc              | Male, age N/D                                                                   | 2(1%): indwelling catheter 1(0.5%): UTI N/D                              |
| 2015 | Tischier et al.17 | Prospective  | X                           | 942               | 66.8           | 287/555      | 441/401    | 0/842.0   | Acetaminophen, celecoxib, pregabalin, US 79 (9.3%) | Benign prostatic hypertrophy (J = 0.06) | Male, age N/D                                                                   | 20(11.5%): repeated intermittent catheterization 14(8%): indwelling catheter |
| 2015 | Lawrie et al.18   | Prospective  | X                           | 174               | 66             | 68/106       | 67/106     | 0/174.0   | Acetaminophen, paracetamol, oxycodone, IV ketorolac | US 400 cc              | Volume of IV fluid, history of urinary retention N/D | 20(11.5%): repeated intermittent catheterization 14(8%): indwelling catheter |
| 2018 | Kort et al.19     | Retrospective | X                           | 638               | 69.3           | 229/418      | 323/315    | 181/457.0 | Tramadol, oxycodone | US 600 cc              | Bladder volume of >200 mL at the recovery room N/D | 65(21%): UTI in non-POUR group p = 0.05)                                   |
| 2018 | Scholten et al.20 | Prospective  | X                           | 306               | N/D            | N/D          | N/D        | N/D        | Paracetamol, gabapentin, NSAIDs, oxycodone | US 400 cc              | Preoperative postvoiding residual urine volume >150 cc N/D | 65(21%): UTI in non-POUR group p = 0.05)                                   |
| 2019 | Halaw et al.21    | Prospective  | O or X                      | 358               | 61.7           | 171/187      | 187/191    | 24/0/328  | Acetaminophen, oxycodone, acetaminophen | US 350 cc              | Hip age >60, intraoperative fluid >150 cc, catheter use Knee: catheter | N/D                                                                                 |
| 2019 | Markopoulos et al.22 | Prospective  | X                           | 218               | 69.3           | 105/113      | 111/106    | 0/2/18.0  | Acetaminophen, tramadol | US 9 (4.1%)              | Age, benign prostatic hypertrophy | No infection All normalization                                             |

M: male; F: female; G: general anesthesia; S: spinal anesthesia; E: epidural anesthesia; C: combined general and spinal anesthesia; PCA: patient controlled analgesia; US: ultrasound; N/D: no description; POUR: postoperative urinary retention; UTI: urinary track infection; NSAID: nonsteroidal anti-inflammatory drug; IV: intravenous; CCI: Charlson comorbidity score; min: minute.
from 350 mL to 700 mL in the 15 studies, and there is no consensus about the threshold volume, yet.\textsuperscript{13}

According to the literature, myriad factors have been known to be associated with the development of POUR after TJAs. Well-known factors include old age, male gender, history of previous urological disease, the amount of intravenous fluid administration, type of anesthesia, anesthetic agents, and the use of opiates in the postoperative period.\textsuperscript{1}

Recently, ultrasound studies have reported that the occurrence of POUR can be predicted with the measurement of pre- and postoperative bladder volume. Scholten et al. reported that the preoperative residual volume was a risk factor for POUR. The POUR occurred in 15\% when the residual urine was >150 mL.\textsuperscript{20} Kort et al. showed that bladder volume >200 mL in the recovery room was a risk factor for POUR.\textsuperscript{19} Keita et al. identified bladder volume >270 mL at the postanesthesia care unit as a predictive factor for POUR after orthopedic, abdominal, and urologic surgeries.\textsuperscript{28}

The International Prostate Symptom Score (IPSS) has been suggested as a predictor of POUR after TJAs.\textsuperscript{29} Although IPSS was less costly than the ultrasound scan, it was not useful in predicting POUR in other studies.\textsuperscript{30,31}

Patients who have a risk of developing POUR should be screened before TJA and should be closely monitored during and after the operation. Recent studies reported that monitoring with the use of an ultrasound scan decreases the incidence of POUR and recommended the ultrasound scan at 6–8 h after the start of anesthesia.\textsuperscript{15,19,25} In all studies, POUR patients were treated with intermittent catheterization. In case of inevitable use of an indwelling catheter, it should be removed within 48 h, because the duration of catheterization is closely related with the development of UTI.\textsuperscript{24} Scholten et al. described the indwelling catheter as an inconvenience in the early mobilization of the patient and could cause delayed rehabilitation by hindering the patients’ mobility and increasing the length of hospitalization.\textsuperscript{20} In addition, the use of α-blockers or 5α-reductase inhibitors may be used as a method of pharmacological treatment.\textsuperscript{20}

There are some limitations to this review. First, we could not assess differences according to patient’s constitution, ethnics, and surgical protocols. Second, we could not analyze the differences between anesthetic agents and postoperative pain control agents. Third, we could not differentiate urinary retention after revision arthroplasties from that after primary arthroplasties. POUR might differ according to the type of arthroplasty—primary arthroplasty versus revision. Among the 15 studies which were included in this review, 13 studies\textsuperscript{10–21,23} enrolled patients undergoing primary arthroplasty. The remaining two studies\textsuperscript{2,22} seemed to include revision arthroplasties and primary arthroplasties. However, the authors did not document the number of revision patients. Nevertheless, this review provides an up-to-date guide for the detection and management of POUR.

**Author contributions**

Yong-Han Cha and Young-Kyun Lee contributed equally to this study and should be considered as co-first authors.

**Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

**ORCID iD**

Yong-Han Cha \( \text{ORCID} \) https://orcid.org/0000-0002-7616-6694

Jung Wee Park \( \text{ORCID} \) https://orcid.org/0000-0002-4515-1895

**References**

1. Balderi T and Carli F. Urinary retention after total hip and knee arthroplasty. *Minerva Anestesiologica* 2010; 76: 120–130.

2. Balderi T, Mistrasletti G, D’Angelo E, et al. Incidence of postoperative urinary retention (POUR) after joint arthroplasty and management using ultrasound-guided bladder catheterization. *Minerva Anestesiologica* 2011; 77: 1050–1057.

3. Donovan TL, Gordon RO, and Nagel DA. Urinary infections in total hip arthroplasty. Influences of prophylactic cephalosporins and catheterization. *J Bone Joint Surg Am* 1976; 58: 1134–1137.

4. Lo E, Nicolle L, Clasen D, et al. Strategies to prevent catheter-associated urinary tract infections in acute care hospitals. *Infect Control Hosp Epidemiol* 2008; 29(1): S41–50.

5. Wymenga AB, van Horn JR, Theeuws A, et al. Perioperative factors associated with septic arthritis after arthroplasty. Prospective multicenter study of 362 knee and 2,651 hip operations. *Acta Orthop Scand* 2001; 72: 665–671.

6. Wroblewski BM and del Sel HJ. Urethral instrumentation and deep sepsis in total hip replacement. *Clin Orthop Relat Res* 1980; (146): 209–212.

7. Ollivere BJ, Ellahsee N, Logan K, et al. Asymptomatic urinary tract colonisation predisposes to superficial wound infection in elective orthopaedic surgery. *Int Orthop* 2009; 33: 847–850.

8. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol* 2009; 62: e1–34.

9. Beaudet K. The cochrane collaboration and meta-analysis of clinical data. *Am Orthop J* 2010; 60: 6–8.

10. Griesdale DE, Neufeld J, Dhillon D, et al. Risk factors for urinary retention after hip or knee replacement: a cohort study. *Can J Anaesth* 2011; 58: 1097–1104.
11. Kieffer WK and Kane TP. Predicting postoperative urinary retention after lower limb arthroplasty. *Ann R Coll Surg Engl* 2012; 94: 356–358.

12. Miller AG, McKenzie J, Greenky M, et al. Spinal anesthesia: should everyone receive a urinary catheter?: a randomized, prospective study of patients undergoing total hip arthroplasty. *J Bone Joint Surg Am* 2013; 95: 1498–1503.

13. Bjerregaard LS, Bogo S, Raaschou S, et al. Incidence of and risk factors for postoperative urinary retention in fast-track hip and knee arthroplasty. *Acta Orthop* 2015; 86: 183–188.

14. David M, Arthur E, Dhuck R, et al. High rates of postoperative urinary retention following primary total hip replacement performed under combined general and spinal anaesthesia with intrathecal opiate. *J Orthop* 2015; 12: S157–160.

15. Hollman F, Wolterbeek N, and Veen R. Risk factors for postoperative urinary retention in men undergoing total hip arthroplasty. *Orthopedics* 2015; 38: e507–511.

16. Huang Z, Ma J, Shen B, et al. General anesthesia: to catheterize or not? A prospective randomized controlled study of patients undergoing total knee arthroplasty. *J Arthroplasty* 2015; 30: 502–506.

17. Tischler EH, Restrepo C, Oh J, et al. Urinary retention is rare after total joint arthroplasty when using opioid-free regional anesthesia. *J Arthroplasty* 2016; 31: 480–483.

18. Lawrie CM, Ong AC, Hernandez VH, et al. Incidence and risk factors for postoperative urinary retention in total hip arthroplasty performed under spinal anaesthesia. *J Arthroplasty* 2017; 32: 3748–3751.

19. Kort NP, Bemelmans Y, Vos R, et al. Low incidence of postoperative urinary retention with the use of a nurse-led bladder scan protocol after hip and knee arthroplasty: a retrospective cohort study. *Eur J Orthop Surg Traumatol* 2018; 28: 283–289.

20. Scholten R, Kremers K, van de Groes SAW, et al. Incidence and risk factors of postoperative urinary retention and bladder catheterization in patients undergoing fast-track total joint arthroplasty: a prospective observational study on 371 patients. *J Arthroplasty* 2018; 33: 1546–1551.

21. Halawi MJ, Caminiti N, Cote MP, et al. The most significant risk factors for urinary retention in fast-track total joint arthroplasty are iatrogenic. *J Arthroplasty* 2019; 34: 136–139.

22. Markopoulos G, Kitridis D, Tsikopoulos K, et al. Bladder training prior to urinary catheter removal in total joint arthroplasty. A randomized controlled trial. *Int J Nurs Stud* 2019; 89: 14–17.

23. Fernandez MA, Karthikeyan S, Wyse M, et al. The incidence of postoperative urinary retention in patients undergoing elective hip and knee arthroplasty. *Ann R Coll Surg Engl* 2014; 96: 462–465.

24. Ares O, Arnold WV, Atilla B, et al. General assembly, prevention, host related local: proceedings of international consensus on orthopedic infections. *J Arthroplasty* 2019; 34: S3–s12.

25. Daurat A, Choquet O, Bringuier S, et al. Diagnosis of postoperative urinary retention using a simplified ultrasound bladder measurement. *Anesth Analg* 2015; 120: 1033–1038.

26. Zhang W, Liu A, Hu D, et al. Indwelling versus intermittent urinary catheterization following total joint arthroplasty: a systematic review and meta-analysis. *PLoS One* 2015; 10: e0130636.

27. Baldini G, Bagry H, Aprikian A, et al. Postoperative urinary retention: anesthetic and perioperative considerations. *Anesthesiology* 2009; 110: 1139–1157.

28. Keita H, Diouf E, Tubach F, et al. Predictive factors of early postoperative urinary retention in the POSTANESTHESIA care unit. *Anesth Analg* 2005; 101: 592–596.

29. Elkhodair S, Parmar HV, and Vanwaeyenbergh J. The role of the IPSS (International Prostate Symptoms Score) in predicting acute retention of urine in patients undergoing major joint arthroplasty. *Surgeon* 2005; 3: 63–65.

30. Sarasin SM, Walton MJ, Singh HP, et al. Can a urinary tract symptom score predict the development of postoperative urinary retention in patients undergoing lower limb arthroplasty under spinal anaesthesia? A prospective study. *Ann Roy Coll Surg Engl* 2006; 88: 394–398.

31. Kotwal R, Hodgson P, and Carpenter C. Urinary retention following lower limb arthroplasty: analysis of predictive factors and review of literature. *Acta Orthop Belgica* 2008; 74: 332–336.