

RESEARCH ARTICLE

The Role of Intraoperative Urinary Catheters on Postoperative Urinary Retention after Total Joint Arthroplasty: A Multi-Hospital Retrospective Study on 9,580 Patients

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Received: 03 June 2020

Accepted: 02 December 2020

Abstract

Background: Urinary catheters (UC) are used by some surgeons during total joint arthroplasty (TJA). This study investigated the impact of intraoperative urinary catheters on postoperative urinary retention (POUR) following TJA cases.

Methods: We conducted a retrospective comparative study across 11 medical centers on 9,580 TJA patients. Visits to urgent care or the emergency department within 7 and 30 postoperative days were reviewed. Medical records over a 12-month period for all patients older than 18 years old were used to gather demographic and surgical data as well as the incidence of urinary tract infection (UTI). Chi-squared tests (RStudio) were used to determine statistical significance against *P-Values* ($P < 0.05$).

Results: 13 (0.14%) patients returned within 7 days for POUR. POUR was more common in males [10 (0.3%) vs. 3 (0.1%) females, ($P = 0.01$)]. There was no difference in POUR when comparing total hip and knee arthroplasty procedures [0.16% vs. 0.12%, ($P = 0.60$)]. Of all operations, 25% had intraoperative UC use. There was no difference in POUR between the UC and no UC groups [0.21 vs. 0.11%, ($P = 0.26$)]. However, there was an increase in UTI in UC vs. no UC use within 7 postoperative days [0.92 vs. 0.43%, ($P = 0.005$)] and 30 postoperative days [2.60 vs. 1.50%, ($P < 0.001$)].

Conclusion: In our study, there was no difference in POUR rates between the intraoperative UC vs. no UC groups. Therefore, the use of intraoperative UC may not decrease the rate of POUR following TJA procedures. Additionally, UTI risk was higher in the UC group which may be attributable to other factors, especially when comparing female vs. male patients.

Level of evidence: II

Keywords: Indwelling urinary catheter, Postoperative urinary retention, Perioperative management, Total joint surgery, Urinary tract infection

Introduction

Urinary retention is an undesirable and potentially avoidable condition following total joint arthroplasty (TJA) (1). Incidences of postoperative urinary retention (POUR) after joint replacement vary from seven to 84% in the immediate postoperative

course (2-4). POUR risk factors in orthopedic patients include increased age, hypertension, diabetes mellitus, male sex, and history of urinary flow obstruction (2, 5, 6-8). Certain techniques, such as epidural anesthesia and prolonged anesthetic administration (greater than

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two hours), have been associated with higher POUR rates (9-10). Delayed mobilization, higher readmission rates, and longer hospital stays from POUR can result in increased financial burden for patients and hospitals alike (11-12). Moreover, POUR can lead to urinary tract infection (UTI) if catheters remain in place for more than two days (13).

Indwelling urinary catheters (UC) are occasionally used during TJA, as a measure to reduce the risk of bladder distension and to accurately measure urine output. The aim of this study was to evaluate the incidence of POUR after TJA comparing two cohorts of patients: intraoperative UC use vs. no UC use. Other adverse events, such as postoperative urinary tract infection (UTI) and intraoperative bladder injury, were included in our analysis.

Materials and Methods

Following Investigational Research Board approval, we retrospectively reviewed medical records for all TJA cases from 11 medical centers across a large health care organization. From July 1, 2017 to June 30, 2018, a total of 9,580 TJAs were performed.

Our methodology was based on our group's prior investigation on other types of surgical patients (14). We gathered age, sex, body mass index (BMI), procedure (Total Knee Arthroplasty vs. Total Hip Arthroplasty), discharge date, and any encounters within seven days to urgent care or the emergency room for POUR. Intraoperative was defined as the period from wheels in to wheels out of the operating room. All intraoperative urinary catheters were either removed in the operating room, the post-anesthesia care unit (PACU) or prior to discharge if they required hospital admission.

A bladder scanner protocol was used for all patients with clinical suspicion for urinary retention. A urinary catheter was placed for residual measurements over 300ml. POUR was defined if the patient required urinary catheterization, either an indwelling or non-indwelling urinary catheter.

A patient visit within 7 or 30 postoperative days to the emergency room, urgent care, or outpatient clinic in the region's network with a diagnosis code of N39.0 (ICD-10) was considered a postoperative UTI. A positive urine culture may have been included in the diagnosis, but it was not required in our UTI definition. Intraoperative UC use and anesthesia type (general vs. regional/spinal) were also recorded. Due to the transition from paper to electronic medical records, if patient anesthesia data was not captured, it was marked as unknown. An in-depth chart review was performed on those returning with POUR.

Mean and standard deviation (SD) of age and BMI were calculated for all patients. Relative risk ratios were calculated to compare between the two cohorts of UC vs. no UC. N-1 two proportion/chi-squared tests (RStudio) were used to compare POUR returns between collected variables ($P < 0.05$).

Results

There were 9,580 consecutive TJAs were performed over the 12-month period, including 3,045 (32%) hip and 6,535 (68%) knee procedures. Most patients (83%) were discharged within 24 hours, with 28% discharged on the same day and 55% staying overnight; 13% of patients were discharged in two days while only four percent of patients stayed in the hospital greater than three days. Of all 9,580 TJA patients, the average age was 67.0 [SD \pm 9.5] years old, and average BMI was 30.5 [SD \pm 5.5] kg/m². Comparing procedure type, knee patients were older [67.6 vs. 65.8 years, ($P < 0.0001$)] and had higher BMIs [31.1 vs. 29.2 kg/m², ($P < 0.0001$)] than hip patients. There were 3,756 (39%) male and 5,824 (61%) female patients, and Females were older than males [67.6 v 66.1 years, ($P < 0.0001$)], while both sexes had the same average BMI of 30.5 kg/m². The demographics and perioperative data for all TJA patients are summarized [Table 1].

There were 2,387 (25%) TJA operations with intraoperative UCs placed. When comparing procedure type, UCs were placed more frequently in total hip

Table 1. Demographics and perioperative data on 9,580 total hip and knee arthroplasty patients

Variables	Hip (n=3,045)	Knee (n=6,535)	P-value
Age (year)	65.8 [\pm 10.7]	67.6 [\pm 8.8]	< 0.0001
BMI (kg/m ²) †	29.2 [\pm 5.5]	31.1 [\pm 5.4]	< 0.0001
Intraoperative UC (n) ‡	798 (26.0)	1,589 (24.0)	0.05
Urgent care or emergency department POUR* return within seven days (n)	5 (0.16)	8 (0.12)	0.60 (NS)
Anesthesia Type, n (%) ¶			
General	788 (25.9)	879 (13.5)	< 0.0001
Regional/Spinal	2,136 (70.2)	3,683 (56.4)	< 0.0001
UTI, n (%) §			
Hospital return within seven days	14 (0.5)	39 (0.6)	0.40 (NS)
Hospital return within 30 days	50 (1.6)	120 (1.8)	0.50 (NS)

*POUR: postoperative urinary retention; †BMI: body mass index; ‡UC: urinary catheter; §UTI: urinary tract infection; ||NS: not significant. ¶121 total hip and 1973 total knee arthroplasty patients were marked as "Unknown" anesthesia type and therefore excluded for anesthesia comparisons

Table 2. POUR and UTI returns for 3,045 total hip arthroplasty patients based on urinary catheter use

Variables	UC (n=798) ‡	no UC (n=2,247)	P-value
Age (year)	68.3 [±10.7]	64.9 [±10.6]	< 0.0001
BMI (kg/m ²) †	29.1 [±5.5]	29.2 [±5.5]	0.66 (NS) ‖
Urgent care or emergency department POUR* return within seven days (n)	3 (0.4)	2 (0.1)	0.08 (NS)
UTI, n (%) §			
Hospital return within seven days	7 (0.9)	7 (0.3)	0.04
Hospital return within 30 days	21 (2.6)	29 (1.3)	0.01

*POUR: postoperative urinary retention; †BMI: body mass index; ‡UC: urinary catheter; §UTI: urinary tract infection; ‖NS: not significant

arthroplasty (THA) than total knee arthroplasty (TKA) procedures [26.0 vs. 24.0%, ($P=0.046$)]. Overall UC use for males and females was nearly the same [24.1% vs. 25.4, ($P = 0.15$)]. Similarly, there was no difference in UC use between males and females for both THA [25.0 vs. 27.1%, ($P=0.21$)] and TKA procedures [23.6 vs. 24.7%, ($P=0.32$)]. However, older patients that received hip [68.3 vs. 64.9 years, ($P<0.0001$)] or knee [68.3 vs. 67.3 years, ($P<0.0001$)] procedures were more likely to have UC use. There was no association between BMI and urinary catheter use. Patient outcomes were compared with regards to UC placement for THA and TKA procedures, respectively [Tables 2; Table 3].

There were 13 (0.14%) TJA patients that unexpectedly returned to urgent care or the emergency department for POUR within seven postoperative days. In comparing POUR returns by procedure type, five (0.16%) THA and eight (0.12%) TKA replacement patients returned within seven days ($P = 0.60$). Of these 13 patients, there were 10 males [66.1±13.6 years] and three females [65.0±11.4 years]. Overall, males (0.3%) had a higher incidence of POUR than females (0.1%) across all TJA operations ($P = 0.01$).

For all TJA cases, there was no difference in POUR rates when comparing intraoperative UC vs. no UC [0.21 vs. 0.11%, ($P = 0.26$)]. Of the 13 patients with POUR, four out of 10 (40%) males and one out of three (33%) females had UC use. When comparing POUR for UC vs. no UC by sex, there were no differences found in males [0.44 vs. 0.21%, ($P = 0.24$)] and females [0.07 vs. 0.05%, ($P = 0.75$)]. When comparing by procedure type, there were no differences in POUR for UC vs. no

UC for THA [0.40 vs. 0.10%, ($P=0.08$)] or TKA [0.10 vs. 0.10%, ($P=0.96$)] procedures. The majority of TJA cases used regional/spinal anesthesia (60.7%, $n = 5,819$) and general (17.4%, $n = 1,667$). The remaining patients (21.9%, $n = 2,094$) had unknown anesthesia. Perioperative data for the 13 patients returning for POUR were summarized [Table 4]. There were 53 (0.6%) patients that were diagnosed with a UTI within seven postoperative days, while 170 (1.8%) patients were diagnosed within 30 days. While there was no difference in females and males for UTI seven-day returns ($P=0.43$), females were almost twice as likely as males to return within 30 days [2.2 vs. 1.2%, ($P<0.001$)] for a UTI. By procedure type, there was no difference between THA and TKA patients in UTI rates within seven days [0.5 vs. 0.6%, ($P = 0.40$)] and 30 days [1.6 vs. 1.8%, ($P=0.50$)]. UTIs were more common in patients in the UC group, both within seven days [0.92 vs. 0.43%, ($P=0.01$)] and 30 days [2.60 vs. 1.50%, ($P<0.001$)], compared with the non-UC group.

Moreover, UC vs. no UC use showed significantly higher rates of UTI in females within seven days [0.95% vs. 0.48%, ($P = 0.047$)] and 30 days [(3.11 vs. 1.82%, ($P=0.003$))], and males within seven days [0.88 vs. 0.35%, ($P = 0.043$)]. There was no difference in 30-day UTI returns for males with or without UC [1.77 vs. 1.02%, ($P = 0.07$)]. The outcomes of male and female TJA patients were compared [Table 5]. Overall, there were no bladder injuries from surgery that resulted in a seven-day postoperative return. Risk ratios between patients in the UC and no UC groups were calculated [Table 6].

Table 3. POUR and UTI returns for 6,535 total knee arthroplasty patients based on urinary catheter use

Variables	UC (n=1,589) ‡	no UC (n=4,946)	P-value
Age (year)	68.3 [±9.0]	67.3 [±8.7]	< 0.0001
BMI (kg/m ²) †	31.1 [±5.8]	31.1 [±5.3]	1.00 (NS) ‖
Urgent care or emergency department POUR* return within seven days (n)	2 (0.1)	6 (0.1)	0.96 (NS)
UTI, n (%) §			
Hospital return within seven days	15 (1.0)	24 (0.5)	0.04

*POUR: postoperative urinary retention; †BMI: body mass index; ‡UC: urinary catheter; §UTI: urinary tract infection; ‖NS: not significant

Table 4. Data on 13 total joint arthroplasty patients returning with POUR

Variables	Patient												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Demographics													
Age (year)	74	90	84	74	77	70	72	72	66	67	61	66	65
Sex (M/F)	M	M	M	F	M	M	M	M	M	M	F	F	M
BMI (kg/m ²) †	30	29	24	29	25	33	32	24	29	30	42	30	33
Intraoperative Data													
Procedure type	Hip	Hip	Hip	Knee	Knee	Knee	Knee	Hip	Knee	Hip	Knee	Knee	Knee
Anesthesia type	R/S	R/S	R/S	R/S	R/S	R/S	R/S	R/S	R/S	R/S	G ¶	G	G
Intraoperative UC ‡ (Y/N)	Y	N	Y	Y	Y	N	N	Y	N	N	N	N	N
Postoperative Data													
Day of discharge after surgery (#)	2	1	2	2	2	1	1	1	1	0	1	0	0
Day of urgent care or emergency department POUR* return (#)	7	7	6	6	4	1	3	1	4	1	7	1	3
UTI §													
Day of hospital return after surgery (#)	7	9	-	22	14	-	-	-	-	-	-	-	-
Hospital return within seven days (Y/N)	Y	N	N	N	N	N	N	N	N	N	N	N	N
Hospital return within 30 days (Y/N)	Y	Y	N	Y	Y	N	N	N	N	N	N	N	N

*POUR: postoperative urinary retention; †BMI: body mass index; ‡UC: urinary catheter; §UTI: urinary tract infection; ¶ R/S: Regional/spinal; ¶ G: General

Table 5. Demographics and perioperative data comparison by sex for 9,580 total hip and knee arthroplasty patients

Variables	Male (n=3,756)	Female (n=5,824)	P-value
Age (year)	66.1 [±9.6]	67.6 [±9.3]	< 0.0001
BMI (kg/m ²) †	30.5 [±5.0]	30.5 [±5.8]	1.00 (NS) ¶
Intraoperative UC (n) ‡	906 (24.1)	1481 (25.4)	0.15 (NS)
Urgent care or emergency department POUR* return within seven days (n)	10 (0.3)	3 (0.1)	0.01
UTI, n (%)§			
Hospital return within seven days	18 (0.5)	35 (0.6)	0.43 (NS)
Hospital return within 30 days	45 (1.2)	125 (2.2)	<0.001

*POUR: postoperative urinary retention; †UC: urinary catheter; ‡UTI: urinary tract infection; §CIUC: cumulative incidence in UC group; ¶CINO UC: cumulative incidence in no UC group; ¶RR: risk ratio calculated by (CIUC) / (CINO UC)

Discussion

Urinary catheters are used in TJA to avoid bladder over distension and reduce the risk of POUR. However, indwelling catheters increase the risk of postoperative UTI and can be avoided in many cases. Our large review of 9,500 TJA operations across 11 hospitals helps broaden our understanding of POUR risk factors beyond existing studies that are restricted to small patient populations from separate hospitals (6, 15). Our analysis supports previous studies that identify the male sex as a POUR risk factor. In our review, 77% of patients returning for POUR were male (n = 10), which is over three times higher than females (n = 3). Prior research shows that males have

higher urinary retention rates, citing odds ratio (OR) of 3.9 (6); males over 70 years are at even greater risk for POUR (10, 16-17). Benign prostate hyperplasia (BPH) likely plays a role in the higher POUR rates in males, with studies finding predictive value in international prostate symptom scores (IPSS) to determine a patient's risk of POUR (18-20). It is important to note that there are various criteria that researchers used to clinically define urinary retention (16). Definitions of POUR include characterization of bladder volume (>400 - 600 mL), duration after surgery (between six to eight hours), and ultrasound diagnosis (2-5). Across all of our facilities,

Table 6. Calculated Relative Risks Ratios for Overall Sample (N=9,850) and By Sex (Male vs. Female)

Variables	CI _{UC} † §	CI _{NO UC} † †	RR † †
Overall, n (%)			
Urgent care or emergency department POUR* return within seven days	0.2	0.1	1.9
Hospital UTI return within seven days ‡	0.9	0.4	2.3
Hospital UTI return within 30 days	2.6	1.5	1.7
Males, n (%)			
Urgent care or emergency department POUR return within seven days	0.4	0.2	2.1
Hospital UTI return within seven days	0.1	0.3	0.3
Hospital UTI return within 30 days	0.3	0.2	1.3
Females, n (%)			
Urgent care or emergency department POUR return within seven days	0.1	0.0	1.5
Hospital UTI return within seven days	-	-	-
Hospital UTI return within 30 days	0.1	-	-

we use the definition of post void residual >300 mL for the diagnosis of urinary retention as an indication for urinary catheter insertion. In our study, we did not find an association between intraoperative UC placement and increased POUR after TJA.

There are conflicting reports in the literature, which make it difficult to interpret findings whether intraoperative indwelling urinary catheters are a POUR risk factor (21, 22). Therefore, routine use of intraoperative catheters needs to be evaluated by orthopedic teams after careful review of POUR outcomes on an institution-specific basis. This will help the surgeons decide on selecting the appropriate cases for a urinary catheter insertion. Our findings are not able to support claims that anesthesia choice influences POUR. Across TJA operations, we found no difference in POUR returns based on anesthesia type. Past studies have shown that anesthesia is an independent POUR risk factor after TJA (16, 18, 23). Specifically, it was found that spinal anesthesia with intrathecal morphine (ITM) increased urinary retention (6, 24-26).

The relationship between catheterization and infection rates has also been raised. Urinary catheters are increasingly recognized as having the potential to harm patients by causing UTI, catheter-associated urinary tract infection and the potential of drug-resistant infections and orthopedic prosthetic infections (13). Our study demonstrated that UC use results in a twofold increase of seven and 30-day returns when compared to no UC use. Moreover, there were roughly twice as many females that had UTI returns within a 30-day period compared to males. One TJA study found that UTI prevalence was five times higher in the indwelling catheter group (12).

Intraoperative urinary catheters have been used to decompress the bladder for greater surgical visibility (19). Without evidence of bladder injury in our dataset, we are unable to weigh in on its relationship to urinary catheters. Case reports detail only isolated cases of

bladder perforation that were caused by the unexpected migration of medial acetabular screws or prosthetics during total hip arthroplasty (27-28). With little existing research on bladder injury, surgical teams should determine if there are other perioperative factors, such as history of intrapelvic surgery, which may increase perforation risk (19).

There are limitations in our study. Due to its retrospective nature, our review lacks randomization during comparison between UC vs. no UC groups. Additionally, it is possible that there were deviations in the urinary retention protocol during patient discharge across hospital sites. Next, although outliers were removed from our analysis, it is possible that miscoded diagnoses or clerical errors could skew our data. Due to data extraction from a closed healthcare system, patient returns to urgent care or the emergency department at out-of-network facilities would not be captured. Finally, our data lacks information by patient on whether intraoperative urinary catheters were removed in the operating room or post-anesthesia care unit, as well as if additional urinary catheters were placed in the post-anesthesia care unit. Future research should investigate if in-and-out catheters in the PACU influence POUR return rates.

It is important that upcoming studies explore the various factors that can impact POUR. Data on primary vs. recurrent total joint replacement, BPH diagnosis, operating duration, and use of intrathecal morphine or oral opioids, all of which may potentially affect POUR rates, would be valuable topics of investigation. Moreover, a better understanding of the paper anesthesia records marked as unknown would be beneficial. It would also be helpful to analyze if patients had a preoperative history of recurrent UTIs and if prophylactic antibiotics were prescribed to certain patients, which may impact the postoperative UTI rates.

Urinary retention after TJA surgery is an adverse postoperative event. In our study, there was no difference

in POUR rates between the intraoperative UC vs no UC groups. Therefore, the use of intraoperative UC may not decrease the rate of POUR following TJA procedures. Additionally, UTI risk was higher in the UC group which may be attributable to other factors, especially when comparing female vs. male patients. An institution-specific algorithm to define high-risk patients for POUR will be advantageous to orthopedic surgeons in deciding whether an intraoperative urinary catheter should be used or not.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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