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Spinal anesthesia: should everyone receive a urinary catheter?: a randomized, prospective study of patients undergoing total hip arthroplasty.

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Spinal Anesthesia: Should Everyone Receive a Urinary Catheter?

A Randomized, Prospective Study of Patients Undergoing Total Hip Arthroplasty

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Background: The objective of this randomized prospective study was to determine whether a urinary catheter is necessary for all patients undergoing total hip arthroplasty under spinal anesthesia.

Methods: Consecutive patients undergoing total hip arthroplasty under spinal anesthesia were randomized to treatment with or without insertion of an indwelling urinary catheter. All patients received spinal anesthesia with 15 to 30 mg of 0.5% bupivacaine. The catheter group was subjected to a standard postoperative protocol, with removal of the indwelling catheter within forty-eight hours postoperatively. The experimental group was monitored for urinary retention and, if necessary, had straight catheterization up to two times prior to the placement of an indwelling catheter.

Results: Two hundred patients were included in the study. There was no significant difference between the two groups in terms of the prevalence of urinary retention, the prevalence of urinary tract infection, or the length of stay. Nine patients in the no-catheter group and three patients in the catheter group (following removal of the catheter) required straight catheterization because of urinary retention. Three patients in the catheter group and no patient in the no-catheter group had development of urinary tract infection.

Conclusions: Patients undergoing total hip arthroplasty under spinal anesthesia appear to be at low risk for urinary retention. Thus, a routine indwelling catheter is not required for such patients.

Level of Evidence: Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

Urinary retention is a common complication following any surgical procedure, including total joint arthroplasty¹. Urinary retention is usually treated with intermittent or indwelling urinary catheterization. The use of urinary catheters is associated with an increased prevalence of postoperative urinary tract infection², with the duration of catheterization being the most significant risk factor associated with the development of urinary tract infection³. Intermittent catheterizations have an additive effect on the cumulative risk of urinary tract infection⁴. The development of urinary tract infection, especially in the early postoperative period, can lead to hematogenous bacteremia^{5,6}, seeding of the implant, and subsequent joint infection following total hip arthroplasty⁷⁻⁹.

Urinary catheters are usually used for longer surgical procedures to allow for monitoring of urinary output and to guide fluid resuscitation. The use of neuraxial anesthesia, commonly employed for elective joint arthroplasty, is also considered to be an indication for the use of a urinary catheter. The rationale is that neuraxial anesthesia can result in loss of the ability to sense bladder distention, which may then lead to neurogenic bladder problems¹.

The advantage of using an indwelling catheter is the ability to avoid postoperative urinary retention, which is not a benign problem. Urinary retention is known to lead to atonic bladder, post-void residuals, and predisposition to urinary tract infection¹. Postoperative urinary retention can be defined as the inability to void urine in the presence of a full bladder.

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CONSORT 2010 Flow Diagram

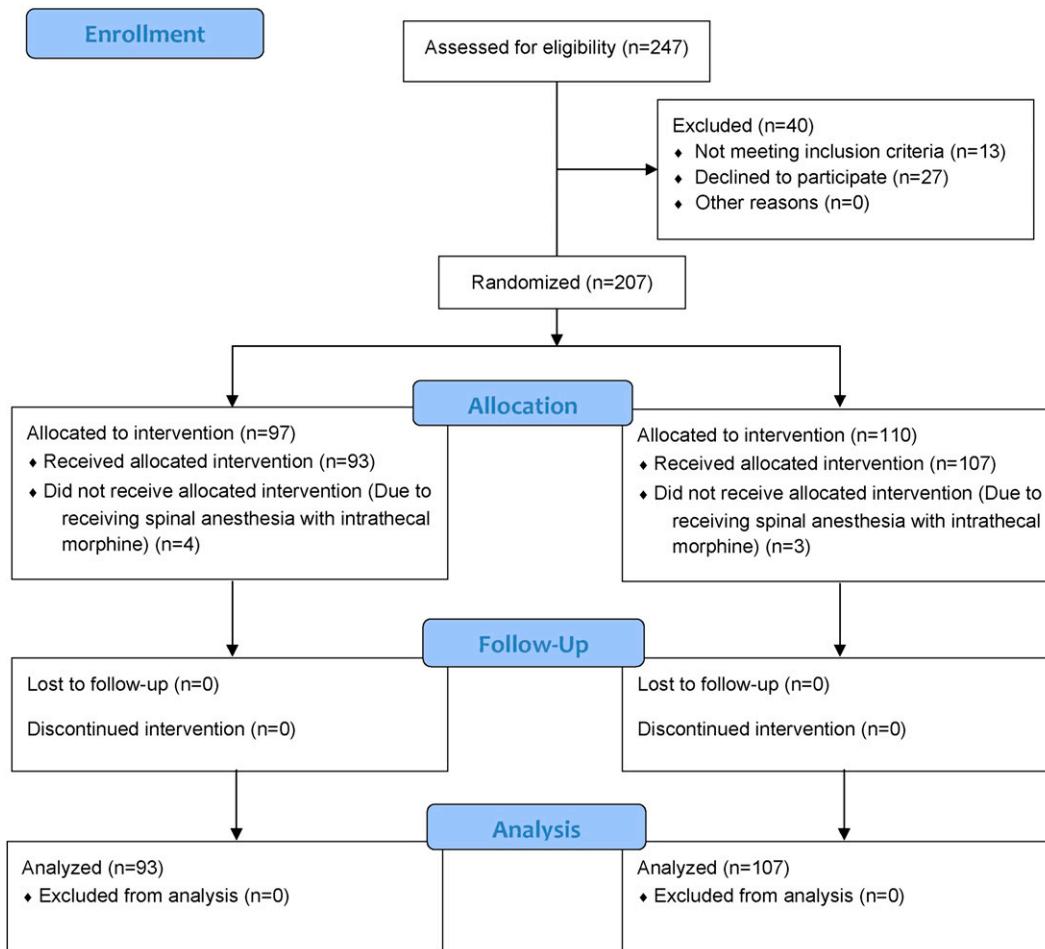


Fig. 1
Flow diagram for total hip arthroplasty enrollment and allocation.

A normal adult bladder can hold approximately 400 to 600 mL of urine. The prevalence of postoperative urinary retention following total joint arthroplasty is not well known but is estimated to be between 0% and 75% after early removal of a catheter or after procedures performed without a catheter^{10,11}.

Currently, there is no standard protocol for the implementation and maintenance of indwelling catheters for elective joint arthroplasty. At many institutions, including ours, indwelling urinary catheters are utilized routinely for patients undergoing neuraxial anesthesia because of the theoretical risk of development of a neurogenic bladder. The hypothesis of the current prospective study was that rates of urinary retention would be low for patients with and without a urinary catheter.

Materials and Methods

Enrollment and Screening

Institutional review board approval was obtained prior to the initiation of this prospective study. Consecutive patients undergoing primary total hip

arthroplasty were approached for participation in the study (Fig. 1). Patients were interviewed and consented for inclusion in the study by trained study personnel. The study was registered at ClinicalTrials.gov (Identifier: NCT01577823). Patients were screened preoperatively and were evaluated for inclusion. Patients with a known history of prostate, urological, or kidney surgery were excluded, as were patients in whom monitoring of urine output during surgery was necessary (including patients with confirmed renal disease, renal failure, chronic renal insufficiency, or an indwelling catheter at the time of surgery). Patients who had a history of benign prostatic hypertrophy and/or were taking medication for this diagnosis were included in the study.

During the period of this study, 247 patients were approached for participation. Twenty-seven patients refused participation, and thirteen patients met the exclusion criteria. A total of 207 patients were enrolled in the study. Seven patients were removed from the study because they had not received the appropriate anesthesia after enrollment (Fig. 1). The study group included 102 men and ninety-eight women with a mean age of fifty-nine years (range, thirty to eighty-seven years). One hundred and seven patients were randomized to receive an indwelling urinary catheter during surgery (control group), and ninety-three patients did not receive a catheter (experimental group).

TABLE I Demographic Data and Outcomes

	Catheter Group (N = 107)	No-Catheter Group (N = 93)	P Value
Age* (yr)	60.1 (30 to 87)	58.7 (33 to 83)	0.37
Male:female ratio (no. of patients)	50:57	52:41	0.20
Body mass index* (kg/m ²)	28.9 (18.7 to 45.5)	29.0 (19.1 to 40.6)	0.93
Intravenous fluids given during surgery* (mL)	1725 (500 to 3000)	1526 (800 to 3300)	0.003
Length of stay* (d)	2.5 (0 to 6)	2.6 (1 to 24)	0.49
Operating room time* (min)	109 (73 to 180)	112 (73 to 332)	0.44
Preoperative urinary tract infection† (no. of patients)	5 (4.7%)	3 (3.2%)	0.73
Benign prostatic hypertrophy (no. of patients)	3 (2.8%)	4 (4.3%)	0.71
Outcomes (no. of patients)			
Postoperative urinary retention	3 (2.8%)	9 (9.7%)	0.07
Urinary tract infection	3 (2.8%)	0 (0%)	0.25

*The values are given as the mean, with the range in parentheses. †Diagnosed during preadmission testing prior to surgery.

All patients followed a uniform preoperative food and liquid intake protocol. No patient ingested any solid food after 9:00 P.M. on the day prior to surgery. No liquids were consumed after 12:00 A.M. on the evening prior to surgery. No patient was permitted to intake any food or liquid on the day of surgery until after completion of the procedure.

Following enrollment, patients were randomized with use of computer randomization either to receive an indwelling urinary catheter (control group) or not to receive an indwelling urinary catheter (experimental group). Randomization was performed under the sole knowledge of research personnel. The patients and the operating surgeons were blinded to the selection group until anesthesia or sedation began in the operating room. All patients received a uniform anesthesia and analgesia protocol, which consisted of spinal analgesia with 15 to 30 mg of 0.5% bupivacaine based on weight. No intrathecal or epidural analgesic was used. All arthroplasties were performed by one of four fellowship-trained total joint arthroplasty surgeons at a high-volume joint arthroplasty center. All surgical procedures were performed through a modified anterolateral approach or a direct anterior approach. Cementless femoral and acetabular components were used in all patients.

Perioperative Course

All patients were evaluated and began walking on the day of surgery. Patients were permitted to bear weight as tolerated. Physical therapy was initiated on the day of surgery, with therapy sessions twice per day until hospital discharge. Perioperative pain management was uniform across groups, with all patients receiving Tylenol (acetaminophen; 650 mg every six hours), Celebrex (celecoxib; 200 mg every twelve hours), and Lyrica (pregabalin; 75 mg every twelve hours) starting two hours prior to surgery and continuing throughout the hospital stay. For breakthrough pain, all patients received immediate-release oral oxycodone (10 mg every four hours as needed) and intravenous ketorolac (30 mg every six hours as needed). No postoperative "patient-controlled analgesia" was utilized.

The catheter group was managed according to the standard postoperative total hip arthroplasty protocol at our institution, which involves removing the indwelling catheter within forty-eight hours postoperatively. Following catheter removal, patients were monitored for symptoms of postoperative urinary retention and urinary tract infection. The experimental group was monitored for postoperative urinary retention on the basis of symptoms and with use of bladder ultrasound scans performed by hospital nursing staff. Patients who had not voided within four hours and had a urine volume of

>400 mL as measured with ultrasound were managed with a one-time catheterization. If the patient had a volume of <400 mL as measured with ultrasound, the bladder scan was repeated in two hours. Straight catheterization was performed up to two times, if necessary, prior to the placement of an indwelling catheter (Fig. 2).

In the control group, patients underwent bladder scanning at eight hours after catheter removal if voiding had not occurred. Patients with a urine volume of >400 mL as measured with bladder ultrasound were managed with a one-time catheterization. Patients requiring recatheterization were considered to have postoperative urinary retention. This process was repeated two times before a final indwelling catheter was placed. In both the control and experimental groups, patients with suprapubic discomfort and the inability to void also underwent bladder ultrasound scanning. A urine sample for culture and analysis was obtained from patients with symptoms suggestive of urinary tract infection and patients experiencing postoperative urinary retention.

All patients were followed carefully during the hospital stay and postoperatively for any signs of urinary problems such as incontinence as a result of neurogenic (atonic) bladder.

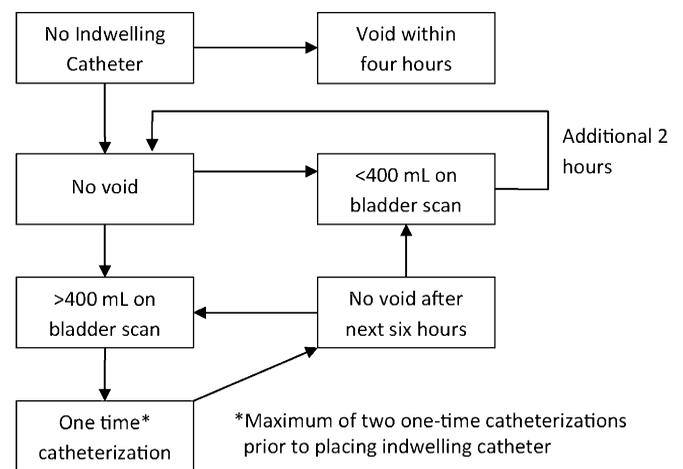


Fig. 2
Flowchart of the urinary retention protocol for the experimental (no-catheter) group.

TABLE II Demographic Differences Between Patients with and without Postoperative Urinary Retention

	Postoperative Urinary Retention (N = 12)	No Postoperative Urinary Retention (N = 188)	P Value
Age* (yr)	55.5 (36 to 70)	59.8 (30 to 87)	0.19
Male:female ratio (no. of patients)	9:3	93:95	0.14
Benign prostatic hypertrophy (no. of patients)	2 (16.7%)	5 (2.7%)	0.06
Preoperative urinary tract infection† (no. of patients)	1 (8.3%)	7 (3.7%)	0.40
Operating room time* (min)	124 (95 to 157)	110 (73 to 332)	0.09
Intravenous fluids given during surgery* (mL)	1617 (1000 to 2900)	1633 (500 to 3300)	0.91
Body mass index* (kg/m ²)	29.4 (19.7 to 37.7)	28.9 (18.7 to 45.5)	0.76
Length of stay* (d)	2.9 (1 to 6)	2.5 (1 to 24)	0.45
Catheter placed (no. of patients)	3 (25.0%)	104 (55.3%)	0.07

*The values are given as the mean, with the range in parentheses. †Diagnosed during preadmission testing prior to surgery.

Data Analysis

Detailed data were collected and recorded in electronic format for later analysis. The data were extracted from clinical records, nursing records, order sets, and billing information. A nurse practitioner followed these patients closely during hospitalization. The data that were used in the analysis included demographic characteristics, questionnaire data, the prevalence of straight catheterization, the prevalence of indwelling catheter placement during the postoperative course, the volume of urine following catheterization, the prevalence of urinary tract infection, the amount of intraoperative fluid given to the patient, the duration of the operation, the length of the hospital stay, and any other complications. The prevalence of postoperative urinary retention was our primary outcome variable, with urinary tract infection analyzed as a secondary outcome. The study was initially powered for retention as the primary outcome. An effect size of 16% based on an average retention rate of 26% was used on the basis of the previous work by Knight and Pellegrini¹², yielding a power of 0.87 for a 100-patient sample size. Categorical variables were analyzed with use of chi-square testing. Continuous variables were analyzed with use of the Student *t* test. Logistic regression was performed. Analysis was performed by an independent statistician.

Results

There was no significant difference between the two groups in terms of age ($p = 0.37$), the prevalence of benign prostatic hypertrophy ($p = 0.71$), body mass index ($p = 0.93$), or sex ($p = 0.20$) (Table I). Of the ninety-three patients in the experimental group, nine patients (9.7%) required straight catheterization. The mean volume of urine in these patients was 643 mL (range, 450 to 800 mL). Eight of the nine patients had a single catheterization. The remaining patient developed overflow on the first night after surgery and required placement of an indwelling catheter. The indwelling catheter was discontinued the following day, and the patient was discharged without further issues. Three patients (2.8%) who were initially randomized to the control group developed postoperative urinary retention following removal of the indwelling catheter. The mean volume of urine at the time of straight catheterization was 838 mL (range, 400 to 1275 mL). Two patients underwent a single, straight catheterization during the evening of Postoperative Day 1. The third patient required three straight catheterizations during the hospital stay, along with a nephrology

consultation because of increased creatinine levels and a urinary tract infection. An indwelling catheter was placed at the time of the third catheterization and was discontinued prior to discharge.

A history of benign prostatic hypertrophy was reported for two (16.7%) of the twelve patients who developed postoperative urinary retention, compared with five (2.7%) of the 188 patients who did not develop postoperative urinary retention; this difference was nearly significant ($p = 0.06$). There was no significant difference between patients who developed postoperative urinary retention and those who did not in terms of the length of stay ($p = 0.45$), age ($p = 0.19$), or sex ($p = 0.14$) (Table II). There were trends toward significance for the variables of benign prostatic hypertrophy ($p = 0.06$), operating room time (0.09), intravenous fluids during surgery ($p = 0.91$), and body mass index ($p = 0.76$). These variables, along with the initial randomized catheter grouping, were entered into a multivariate regression with postoperative urinary retention as the dependent outcome variable (Table III). Benign prostatic

TABLE III Multivariate Logistic Regression for Postoperative Urinary Retention

Predictor	P Value	Odds Ratio	95% Confidence Interval
Age	0.50	0.98	0.92 to 1.04
Male sex	0.27	2.41	0.51 to 11.47
Body mass index	0.88	1.01	0.89 to 1.15
Indwelling catheter	0.16	0.36	0.09 to 1.49
History of benign prostatic hypertrophy	0.06	7.30	0.94 to 56.95
Operating room time	0.23	1.01	0.99 to 1.03
Intravenous fluids	0.52	1.00	1.00 to 1.00
Preoperative urinary tract infection	0.22	4.60	0.40 to 52.80

hypertrophy was the only clinically important variable trending toward significance to be considered as an independent risk factor for postoperative urinary retention (odds ratio = 7.30).

Three patients in the indwelling catheter group had development of a urinary tract infection during the hospital stay, whereas none of the patients in the experimental group had development of such an infection ($p = 0.25$). One of the three patients with a urinary tract infection required a urological consult because of hematuria. One patient in the catheter group was readmitted because of wound cellulitis. Another patient in the catheter group visited the emergency department after discharge because of palpitations and chest pain. One patient in the no-catheter group had development of a pulmonary embolism in the postoperative period. No other complications were observed.

Discussion

Few randomized studies have investigated the prevalence of postoperative urinary retention or urinary tract infection after total joint arthroplasty^{4,12-15}. In the study by Knight and Pellegrini, 119 patients undergoing total hip arthroplasty (seventy-seven), total knee arthroplasty (thirty-two), or bilateral total knee arthroplasty (ten) were randomized either to receive or not to receive a urinary catheter during surgery¹². In that study, the prevalence of postoperative urinary retention was 35% for patients without an indwelling urinary catheter compared with 19% after the discontinuation of indwelling catheter. The majority of patients in the study (ninety-nine patients) received indwelling epidural catheters, retained to provide analgesia during the first forty-eight hours postoperatively, which may explain the high rate of urinary retention. While motor blockade is more intense with intrathecal anesthesia, epidural anesthesia results in a higher parasympathetic blockade with the potential for a higher prevalence of urinary retention^{1,16}. Davis et al., in a retrospective study of sixty-two patients undergoing total hip arthroplasty, reported that the incidence of postoperative urinary retention following spinal anesthesia was significantly lower than that after epidural anesthesia (21.8% compared with 46.7%) ($p < 0.05$)¹⁷.

With advances in the delivery of surgical care and the emphasis on rapid recovery, epidural anesthesia is less commonly utilized for patients undergoing total hip arthroplasty. In addition, emerging evidence supporting the use of multimodal analgesia has led to a reduction in the use of opiates in the postoperative period for patients undergoing joint arthroplasty¹⁸. Therefore, this randomized, prospective study was designed to examine the notion that every patient undergoing spinal anesthesia requires an indwelling catheter, a common practice in the United States. In order to avoid the influence of confounding variables, all patients were subjected to the same anesthesia and analgesia protocols that minimized opiate consumption through the administration of multimodal analgesia. The patients were closely monitored for any potential adverse events.

The study demonstrated a few important findings. It appears that the prevalence of postoperative urinary retention

is relatively low (9.7%) without the use of an indwelling catheter in patients undergoing total hip arthroplasty with use of spinal anesthesia and no intrathecal opiates. This finding is particularly encouraging considering the previous rates mentioned above and the fact that patients with benign prostatic hypertrophy were also included. While this retention rate was not significantly different from that in the control group (2.8%), we emphasize that this difference represents an approximately threefold increase. One must take the increase in retention into account when deciding on standard practice methods. In our practice, we have halted the routine use of catheters in patients undergoing primary hip arthroplasty. Patients undergoing total hip arthroplasty without an indwelling catheter may experience a higher rate of postoperative retention; however, these patients generally can be managed with one-time catheterization with no further urinary complications.

Our study also suggests that urinary tract infection was more likely to develop in patients receiving an indwelling catheter. This issue has been studied previously² and has important implications for patients receiving permanent joint implants. Urinary tract infection is believed to be a predisposing factor for the development of subsequent periprosthetic joint infection^{19,20}. Furthermore, the Infectious Diseases Society of America (IDSA) has shown that urinary tract infection accounts for 40% of all hospital-acquired infections, with immense health-care costs²¹. Patients who have development of a urinary tract infection may require a longer hospital stay and may be subjected to additional workup, as was the case for some of the patients in our series. With hospital-acquired infections being reportable events, and emphasis on minimizing this “quality metric,” the prevention of urinary tract infection will become an important initiative. The study suggests that the orthopaedic community may be able to forgo the use of indwelling catheters in a large majority of patients undergoing arthroplasty with use of spinal anesthesia and resort to intermittent catheterization for those who have postoperative urinary retention.

Despite the randomized, prospective nature of our study, there are some limitations regarding the generalizability of the findings. The present study excluded patients with previous urological, prostate, or kidney surgery in an effort to reduce the potential for putting patients at medical risk as mandated by our institutional regulatory bodies. We did include patients with benign prostatic hypertrophy, who are conventionally believed to be at risk for postoperative urinary retention. Benign prostatic hypertrophy was indeed found to be a risk factor for postoperative urinary retention in the present study. Another perceived weakness of this study may be that we could not identify more risk factors for postoperative urinary retention following total hip arthroplasty. The latter perceived weakness was not the intention of this study. The current study was designed to examine the prevalence of postoperative urinary retention following total hip arthroplasty in patients who did not receive an indwelling catheter and to evaluate whether the routine use of an indwelling catheter in this group of patients was justified. In fact, there is a validated

and standardized questionnaire, namely, the International Prostate Symptom Score (IPSS), which is used to identify patients who are at risk for postoperative urinary retention^{22,23}. Furthermore, there may be factors that make our findings regarding postoperative urinary retention less generalizable. For example, our use of uniform physical therapy twice a day may decrease retention when compared with less-stringent physical therapy regimens. Future studies may be aimed at identifying patients who are at risk for postoperative urinary retention with use of the IPSS or similar instruments. The development of improved screening protocols will enable us to identify patients who are at higher risk for postoperative urinary retention, thereby sparing the others from receiving an indwelling catheter, with all its disadvantages. Finally, the patients in the present study did not receive any intrathecal opiates and the consumption of postoperative opioids was minimized postoperatively. A recent study identified the use of intrathecal morphine as a risk factor for postoperative urinary retention (odds ratio, 1.4; 95% confidence interval, 1.1 to 1.9)²⁴. It is possible that patients receiving intrathecal opiates and/or routine postoperative narcotics may have exhibited a different prevalence of postoperative urinary retention.

The current study provides evidence against the routine use of an indwelling catheter for patients undergoing total hip arthroplasty under spinal anesthesia. With additional studies, it may be possible to identify patients who are at risk for the development of postoperative urinary retention in whom an indwelling catheter can be used. ■

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