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Incidence of Postoperative Urinary Tract Infection in Fragility Hip Fracture after Preoperative Urinary Catheter: A Randomized Controlled Trial

Tana Rattanakitkoson, MD, Wachagorn Kompongpapah, MD

Department of Orthopedics, Maharat Nakhon Ratchasima Hospital, Nakhon Ratchasima, Thailand

Purpose: Urinary tract infection (UTI) is a prevalent complication following fragility hip fractures in the elderly, significantly impacting morbidity and mortality. Whether preoperative urinary catheterization mitigates or exacerbates this risk remains a subject of clinical debate. This study evaluates the impact of preoperative urinary catheterization on the incidence of postoperative UTI in patients aged 60 years and older undergoing surgery for fragility hip fractures.
Methods: In this prospective randomized controlled trial, 114 elderly patients were randomized (1:1) into either a preoperative urinary catheter (PUC) group or non-urinary catheter (NUC) group at a single tertiary center. The primary outcome was the incidence of symptomatic UTI (SUTI). Secondary outcomes included asymptomatic bacteremic UTI (ABUTI), acute urinary retention (AUR), postoperative pneumonia, and length of hospital stay (LOS).
Results: Among the 114 patients analyzed, the incidence of SUTI was higher in the PUC group than in the NUC group; however, this did not reach statistical significance. Similarly, the rate of ABUTI was identical in both groups. The NUC group exhibited a higher incidence of AUR (19.30% vs. 8.77%); however, the difference was not statistically significant. Notably, the PUC group experienced a significantly higher rate of postoperative pneumonia and prolonged mean LOS.
Conclusions: Routine preoperative urinary catheterization in elderly patients with fragility hip fractures was associated with a higher clinical trend of symptomatic UTIs, significantly increased rates of postoperative pneumonia, and prolonged hospital stays. The findings show that avoiding routine catheterization may help mitigate systemic complications and facilitate recovery.

Keywords: fragility hip fracture, urinary tract infection, urinary catheterization, postoperative complications

Fragility hip fractures represent a major global public health concern, particularly among the elderly population. Typically resulting from low-energy trauma such as falls, these injuries lead to impaired mobility, prolonged hospitalization, long-term disability, and increased mortality. With the global population aging rapidly, the prevalence of hip fractures continues to rise, placing an increasing burden on healthcare systems[1]. In Thailand, similar trends have been observed, with fragility fractures becoming more frequent in the aging population. Recent studies have reported postoperative urinary tract infection (UTI) as one of the most common complications, affecting approxi-

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Correspondence to: Tana Rattanakitkoson, MD
Department of Orthopedics, Maharat Nakhon Ratchasima Hospital, Nakhon Ratchasima, Thailand
E-mail: thana.kr@cpird.in.th

mately 10% of patients and contributing to longer hospital stays and higher healthcare costs[2,3].

Among postoperative complications, UTIs are particularly frequent and clinically significant. In elderly patients undergoing hip fracture surgery, UTIs are associated with delayed rehabilitation, prolonged hospitalization, and increased mortality[4-7]. The reported incidence ranges from 5% to over 20%, influenced by age, comorbidities, perioperative care, and immobility[3-5,7]. Therefore, the prevention of postoperative UTIs has become a key target in improving surgical outcomes in this vulnerable group. A major contributor to UTI risk is urinary catheterization—a necessary but potentially harmful intervention. Although urinary catheters can help prevent acute urinary retention (AUR) in patients with limited mobility or under neuraxial anesthesia, prolonged indwelling catheterization markedly increases the risk of catheter-associated UTIs (CAUTIs). The infection risk rises substantially with the duration of catheter use, from 3%-10% after two days to almost 100% after one month[8,9]. Current infection-control guidelines recommend minimizing catheter usage and promoting early removal whenever possible[8-10]. Nevertheless, practice varies widely across hospitals, and the balance between preventing AUR and avoiding CAUTI remains uncertain[7,11,12]. This is due to conflicting evidence regarding preoperative catheterization and a lack of randomized controlled trials specifically comparing "catheterization versus no catheterization" in fragility fracture patients, as most existing studies focused only on removal timing[3,11,15].

To address this issue, this study conducted a randomized controlled trial to clarify the impact of preoperative Foley's catheterization versus no catheterization on postoperative urinary tract infections in elderly patients with fragility hip fractures. The primary objective is to compare the incidence of postoperative UTIs between patients aged over 60 years with hip fractures who received preoperative urinary catheterization and those who did not. The secondary objectives are to specifically evaluate the incidence of AUR, determine the impact on the LOS, and assess the occurrence of other postoperative complications, including pneumonia, acute kidney injury, and mortality. The findings are expected to provide evidence-based guidance for perioperative urinary management and improve patient outcomes.

METERIALS AND METHODS

This prospective, single-center, parallel-group randomized controlled trial was conducted at our hospital following ethical approval by the Institutional Review Board (Reference No. 65179) on September 21, 2023. The study adhered strictly to the Declaration of Helsinki. Furthermore, the trial was prospectively registered with the Thai Clinical Trials Registry (TCTR) under identification number TCTR20260208006.

Participants and Randomization

Between October 2023 and May 2024, 120 patients aged 60 years and older admitted to the Department of Orthopedics were screened for eligibility. For this trial, fragility hip fractures were defined as proximal femoral fractures resulting from low-energy trauma, specifically a fall from a standing height or less. The study included patients diagnosed with femoral neck, intertrochanteric, or subtrochanteric fractures requiring surgical intervention. Six patients were excluded based on the following criteria: pre-existing urological conditions (n = 1), a recent UTI (n = 2), and pre-injury bedridden status (n = 3). No patients with open fractures were excluded during this period. The remaining 114 eligible participants gave their informed consent and were randomly assigned to either the preoperative urinary catheter (PUC) (n = 57) or non-urinary catheter (NUC) groups (n = 57) (Fig 1) in a 1:1 ratio. The rationale for selecting a 48-h perioperative catheterization window is supported by clinical evidence indicating that catheter removal within 24 to 48 h postoperatively optimizes the balance between minimizing postoperative urinary retention (POUR) and preventing catheter-associated urinary tract infections[12,16].

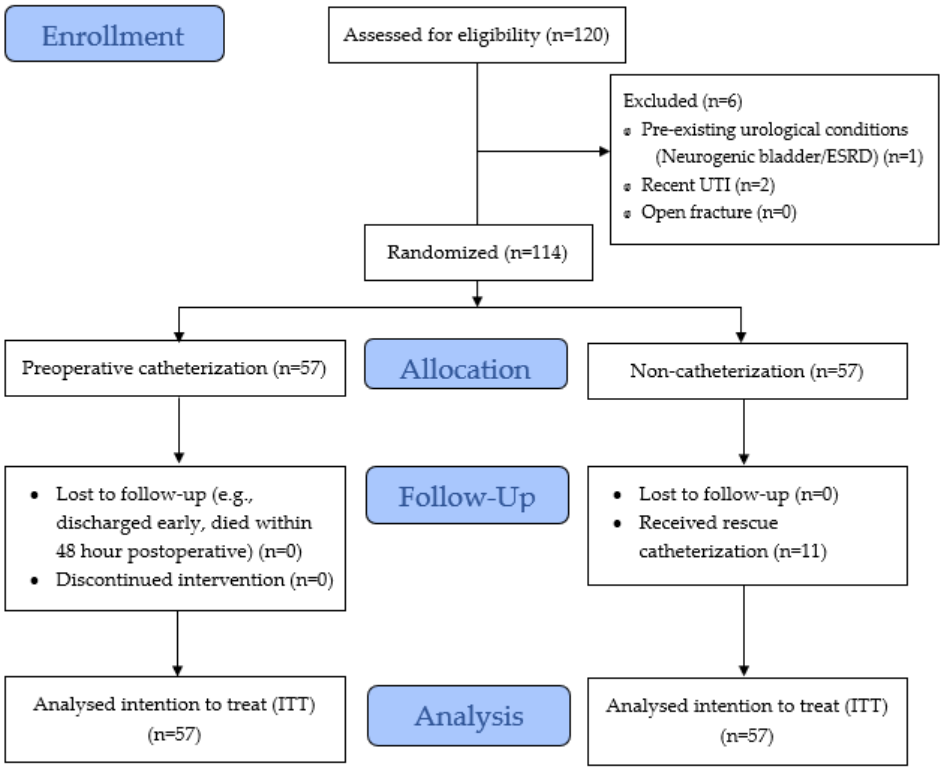

Fig. 1 CONSORT flow diagram.

The randomization sequence was generated using a computer-based random number generator with a block size of four. To ensure allocation concealment, group assignments were placed in sequentially numbered, opaque, sealed envelopes. These envelopes were opened by the ward nurse only after the patient was officially scheduled for surgery and before transport. Although the nature of the intervention precluded blinding of surgeons and patients, the outcome assessors, including laboratory personnel responsible for urinalysis and cultures, remained blinded to the group allocations throughout the study.

Interventions

All participants underwent standard preoperative screening, including urinalysis and urine culture, to confirm the absence of infection. In the PUC group, an indwelling urinary catheter was inserted at the surgical ward on the morning of the scheduled surgery, before the patient was transferred to the operating theater. This timing ensured that the intervention was strictly preoperative. In the NUC group, patients did not receive an indwelling catheter.

To ensure consistency and minimize confounding factors affecting urinary retention, both groups followed a standardized perioperative protocol. Surgical procedures were performed under either general anesthesia or spinal block based on the anesthesiologist's assessment. Postoperative pain management was identical for both groups, comprising around-the-clock intravenous morphine with additional morphine as required for breakthrough pain. Furthermore, all patients received a daily standing order of oral paracetamol for background pain relief, along with calcium and vitamin D supplements as part of standard fracture care. Both groups followed an identical postoperative rehabilitation protocol.

Outcomes and Definitions

The primary outcome was the incidence of UTI monitored throughout the postoperative admission period or upon the presentation of symptoms. To prevent detection bias, outcome

assessors were blinded to the treatment groups (PUC or NUC) during the evaluation of clinical symptoms and microbiology results. UTIs were defined following the CDC National Healthcare Safety Network (NHSN) criteria[9], categorized as follows:

1. SUTI: Defined by the presence of at least one specific symptom (fever > 38.0 ℃, suprapubic tenderness, costovertebral angle pain/tenderness, urinary urgency, frequency, or dysuria) and a positive urine culture (no more than two species; at least one bacterium > 10^5 CFU/ml).

2. ABUTI: Defined as a patient with no signs/symptoms of SUTI, but with a positive urine culture (requirements as above) and matching organism identified in a blood specimen.

AUR was systematically monitored in both groups during the perioperative period. During the preoperative phase, nursing staff conducted assessments, including tracking spontaneous voiding and performing physical examinations for suprapubic distension, every 8 h. If a patient failed to void within 8 h or exhibited clinical signs of bladder distension, a diagnostic in-and-out catheterization was performed. Postoperatively, the PUC group had catheters removed after 48 h, followed by voiding surveillance. In both groups, AUR was clinically suspected if a patient experienced intense suprapubic pain or remained unable to void within 6 to 8 h postoperatively (or post-catheter removal). Diagnosis was confirmed when in-and-out catheterization yielded an evacuated urine volume of ≥ 400 mL[14]. This procedure also served as a rescue maneuver to relieve symptoms and collect urine samples; overall, seven patients in the NUC group required this rescue intervention throughout the study period, with each patient undergoing catheterization only once.

Sample Size and Statistical Analysis

The sample size, calculated using a test comparing two independent proportions in Stata version 15.1 (StataCorp LP, College Station, Texas), was determined based on a similar study. The primary outcome, the UTI rate, was 61% for the study group (PUC group) and 32% for the control group (NUC group)[11]. With a level of significance at 5% and power of 80%, the calculated sample size was 92 (46 per group). The total sample size became 114 (57 per group), yielding a 20% loss to follow-up and dropout rate. Continuous variables, including age, body mass index, time from injury to surgery, operative time, estimated blood loss, and LOS, were reported as either mean and standard deviation or median and interquartile ranges. Categorical variables, including gender, co-morbidities, Charlson comorbidity index (CCI), type of anesthesia, type of surgery, postoperative ambulatory status, postoperative UTI, complications, and mortality, were presented as frequency and percentage. Differences in continuous data were assessed using either Student's two-sample t-tests or the Wilcoxon rank-sum test. Differences in categorical variables were evaluated using the chi-square test or Fisher's exact test for small cell counts. Logistic regression was employed to calculate odds ratios (ORs) with 95% confidence intervals (CIs) for primary and secondary binary outcomes. Any p-values below 0.05 were considered statistically significant. All analyses were performed on an intention-to-treat basis.

RESULTS

A total of 114 participants were included in the study, with 57 patients in each group. The baseline demographic and clinical characteristics were comparable between the PUC and NUC groups (Table 1). The mean preoperative waiting time from injury to surgery was 175.56 ± 89.41 h in the PUC group and 158.19 ± 94.84 h in the NUC group (p = 0.317). Although the PUC group exhibited a higher proportion of CCI scores ≥ 4 (75.44% vs. 66.67%, p = 0.302) and greater estimated blood loss (152.63 vs. 122.89 ml, p = 0.201), these baseline and perioperative characteristics were comparable between the two groups. Regarding postoperative ambulatory status, both groups exhibited similar patterns of recovery, with the majority of patients in both the PUC and NUC groups achieving wheelchair ambulation or walking with gait aids by the time of assessment (p = 0.131).

Table 1 Baseline characteristics of the patients.

	Preoperative Urinary Catheter (PUC) group (N = 57)	**Non-Urinary Catheter (NUC) group (N = 57)**	**p-value**
Gender (n, %)			
Female	44 (77.19)	40 (70.18)	0.395
Age (mean, SD)	78.67 (7.64)	77.82 (8.49)	0.579
BMI (kg/m2)	21.16 (3.92)	21.56 (3.78)	0.586
Co-morbidities (n, %)			
Hypertension	44 (77.19)	36 (63.16)	0.101
Diabetes mellitus	18 (31.58)	14 (24.56)	0.404
Dyslipidemia	23 (40.35)	23 (40.35)	1.000
Chronic kidney disease	10 (17.54)	9 (15.79)	0.802
Cerebrovascular disease	12 (21.05)	7 (12.28)	
Heart disease	10 (17.54)	10 (17.54)	1.000
Pulmonary disease	0	4 (7.02)	0.118
Psychiatric	3 (5.26)	5 (8.77)	0.463
Charlson comorbidity index (n, %)			
1-3	14 (24.56)	19 (33.33)	0.302
≥ 4	43 (75.44)	38 (66.67)	
Type of anesthesia (n, %)			
General anesthesia	23 (40.35)	16 (28.07)	0.167
Spinal block	34 (59.65)	41 (71.93)	
Type of surgery (n, %)			
Fixation	45 (78.95)	42 (73.68)	0.509
Arthroplasty	12 (21.05)	15 (26.32)	
Time from injury to surgery (hours) (mean, SD)	175.56 (89.41)	158.19 (94.84)	0.317
Operative time (minutes) (mean, SD)	53.47 (23.00)	52.18 (20.24)	0.750
Estimated blood loss (ml) (mean, SD)	152.63 (145.52)	122.89 (96.54)	0.201
Postoperative ambulatory status (n, %)			
Bed ridden	3 (5.26)	3 (5.26)	
Wheelchair ambulation	40 (70.18)	30 (52.63)	0.131
Walking with gait aid	14 (24.56)	24 (42.11)	

Abbreviations: BMI: body mass index, PUC: preoperative urinary catheter, NUC: non-urinary catheter

Table 2 Comparison of postoperative urinary outcomes and clinical complications between groups.

	Preoperative Urinary Catheter (PUC) group (N = 57)	**Non-Urinary Catheter (NUC) group (N = 57)**	**OR (95% confidence interval)**	**p-value****
Postoperative symptomatic UTI(SUTI) (n, %)	8 (14.04)	2 (3.51)	4.489 (0.910-22.162)	0.094
Postoperative Asymptomatic Bacteremic UTI (ABUTI) (n, %)	10 (17.54)	10 (17.54)	1.000 (0.381-2.626)	1.000
Acute urinary retention (n, %)	5 (8.77)	11 (19.30)	0.402 (0.130-1.244)	0.176

Table 2 Comparison of postoperative urinary outcomes and clinical complications between groups. (Cont.)

	Preoperative Urinary Catheter (PUC) group (N = 57)	Non-Urinary Catheter (NUC) group (N = 57)	OR (95% confidence interval)	p-value**
Complication (n, %)				
Acute kidney injury	4 (7.02)	7 (12.28)	0.539 (0.149-1.954)	0.528
Septicemia	1 (1.75)	0	N/A*	1.000
Pneumonia	10 (17.54)	0	N/A*	0.001
DVT	2 (3.51)	1 (1.75)	2.036 (0.179-23.111)	1.000
PE	2 (3.51)	1 (1.75)	2.036 (0.179-23.111)	1.000
Alteration of conscious	5 (8.77)	0	N/A*	0.057
Pressure sore	1 (1.75)	1 (1.75)	1.000 (0.061-16.386)	1.000
Wound complication	1 (1.75)	0	N/A*	1.000
MI or CHF	1 (1.75)	0	N/A*	1.000
Length of hospital stay (day) (mean, SD)	14.02 (6.52)	11.79 (4.43)	2.228 (0.159 - 4.297)***	-
Dead (n, %)	4 (7.02)	6 (10.53)	0.642 (0.171 – 2.407)	0.742

Abbreviations: OR: odds ratio, PUC: preoperative urinary catheter, NUC: non-urinary catheter, DVT: deep vein thrombosis, PE: pulmonary embolism, MI: myocardial infarction, CHF: congestive heart failure

*Odds ratio cannot be calculated due to zero events in one group. **p-value calculated by Fisher's exact test.

***Mean difference

Regarding postoperative outcomes (Table 2), the incidence of SUTI was higher in the PUC group than in the NUC group (14.04% vs. 3.51%) but did not reach statistical significance (OR 4.489; 95% CI 0.910-22.162). Similarly, the incidence of ABUTI was identical in both groups (17.54% each, OR 1.000; 95% CI 0.381-2.626), exhibiting no statistical difference. Notably, although the incidence of acute urinary retention was higher in the NUC group than in the PUC group (19.30% vs. 8.77%), this difference did not reach statistical significance (OR 0.402; 95% CI 0.130-1.244).

Furthermore, the PUC group had a significantly longer LOS (14.02 ± 6.52 days) than the NUC group (11.79 ± 4.43 days, mean difference 2.228 days; 95% CI 0.159 - 4.297) and a higher rate of postoperative pneumonia (17.54% vs. 0%, p = 0.001), although an OR could not be calculated due to zero events in the NUC group. Other complications and mortality rates (OR 0.642; 95% CI 0.171-2.407) exhibited no significant differences between the two groups.

DISCUSSION

The findings of this randomized controlled trial underscore that UTI remains a significant and prevalent complication in elderly patients with fragility hip fractures, leading to increased morbidity, prolonged recovery, and substantial healthcare expenditures[7,9]. In this study, the PUC group exhibited a higher incidence of SUTI than the NUC group (14.04% vs. 3.51%; OR 4.489; 95% CI 0.910-22.162). Although this difference did not reach statistical significance, the clinical trend aligns with a recent systematic review by Cacciatore et al.[15], which emphasizes that although urinary catheterization is a standard perioperative procedure in orthogeriatrics, the duration of catheterization is the primary driver of CAUTI.

The clinical implications of surgical delays represent a significant concern within high-volume public healthcare institutions. In the current study, the mean interval from injury to surgical intervention was approximately seven days, a duration that exceeds established international benchmarks. These findings align with the results of Jaruwan[3], stating that delayed surgery in secondary care settings correlates with an elevated risk of UTIs and that the timing of catheterization further influences infection profiles. Furthermore, our observation that prolonged preoperative wait times may exacerbate infection risks is consistent

with the findings of Bliemel et al.[4], who identified operative delays exceeding 48 has a primary predisposing factor for adverse urinary outcomes.

Our analysis revealed no statistically significant difference between the PUC and NUC groups (p = 0.176) regarding POUR, although the NUC group exhibited a higher raw incidence (19.30%). Tantigate et al.[16] reported that even following catheter removal, a subset of fragility hip fracture patients remains at high risk for POUR, necessitating the use of specialized screening tools, such as bladder scans, to prevent unnecessary re-catheterization. Furthermore, the management of bladder function extends beyond retention; Arroyo-Huidobro et al.[17] reported that the perioperative process can trigger or worsen urinary incontinence, significantly complicating rehabilitation.

A major finding in our study was the markedly higher rate of postoperative pneumonia in the PUC group (17.54% vs. 0%, p = 0.001) and a significantly longer LOS (14.02 vs. 11.79 days, mean difference 2.228 days; 95% CI 0.159-4.297). These systemic complications are consistent with the findings of Folbert et al.[18], who identified that pneumonia and UTIs are among the most frequent adverse events during the hospitalization of orthogeriatric patients and are strongly associated with poorer functional outcomes. However, the absence of pneumonia events in our NUC group (zero-cell) requires a cautious interpretation, as it may lead to an overestimation of the effect size. The biological plausibility of a direct causal link between urinary catheterization and pneumonia has not been sufficiently established. Rather, as indicated by the high rate in the PUC group, indwelling catheters may serve as a proxy for more complex postoperative courses. Although both groups achieved similar ambulatory status by the time of assessment (p = 0.131), the presence of a catheter might have hindered early, frequent mobilization in the immediate postoperative period. This lack of physical activity could serve as a major confounding factor; immobility is a primary driver of respiratory stasis and pneumonia, as well as urinary stasis, which exacerbates UTI risk. Furthermore, the slightly higher comorbidity burden (CCI ≥ 4) of the PUC group may have further predisposed these patients to such complications. However, this marked difference should be interpreted with caution, as it may be confounded by baseline patient vulnerabilities, delayed physical activity, or systematic variation rather than a direct catheter-related mechanism. Johansson et al.[11] reported that the avoidance of routine indwelling catheters is effective in reducing UTIs and is also instrumental in facilitating earlier mobilization and shortening the duration of hospitalization. Future studies with larger cohorts are necessary to confirm whether the observed associations with pneumonia and LOS are directly related to the intervention or are secondary to baseline frailty and immobility. Acknowledging these potential performance biases is essential for a balanced interpretation of the impact of preoperative catheterization.

The primary strength of this study lies in its randomized controlled trial design, providing high-level evidence regarding the risks of routine preoperative catheterization. However, a notable limitation is the extended preoperative wait time (7 days). This delay may have influenced the baseline infection risk, rendering these findings particularly relevant for clinical settings operating under similar resource constraints. Furthermore, slight baseline imbalances, such as the higher proportion of complex patients in the PUC group, alongside the "zero-event" pneumonia rate in the NUC group, may lead to statistical instability and an overestimation of secondary outcomes. Therefore, findings regarding pneumonia and LOS should be interpreted with caution, as they may reflect underlying patient frailty rather than the intervention alone. Additionally, a notable limitation of this study is that UTIs were monitored during the hospitalization period only. We explicitly acknowledge that post-discharge UTIs were not captured, which may underestimate the true incidence of postoperative urinary tract infections in this patient population. Finally, as the observed UTI rates were lower than those used for initial sample size calculations, the study may have been underpowered to reach statistical significance for the primary outcome, despite the clinical trend observed.

CONCLUSIONS

The avoidance of routine preoperative urinary catheterization in elderly patients with fragility hip fractures is associated with a lower incidence of SUTIs and postoperative pneumonia, as well as shorter hospital stays. However, the risk of AUR must be carefully monitored and evaluated.

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