

Comparison of Urinary Tract Infection in Elderly Hip Fracture Patients in a Secondary Care Hospital: Early versus Delayed Insertion of Urinary Catheters

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Background: The elderly population is growing, leading to a rise in hip fractures and associated complications like urinary tract infection (UTI). Limited resources in hospitals can delay surgery for hip fractures, with an increasing risk of UTI. Early urinary catheter insertion from the first day of admission may increase the risk of UTI due to prolonged catheterization but delayed urinary catheter insertion can also increase the risk of UTI due to urinary retention.

Objective: To compare UTI in elderly hip fracture patients in a secondary care hospital between early and delayed urinary catheterization.

Materials and Methods: The present study was a retrospective chart review that included hip fracture patients aged 60 years old and older. Data was collected between January 1, 2018, and December 31, 2022. One hundred ninety-nine patients met the inclusion criteria, with 70 patients in early urinary catheterization group and 129 patients in delayed urinary catheterization group. The comparison focused on UTI between the two groups, with additional analyses of length of hospital stay (LOS) and mortality.

Results: UTI in early urinary catheter insertion group was 22.9% and UTI in delayed urinary catheter insertion was 10.9%, which was significantly different ($p=0.024$). The LOS and mortality between the two groups were not significantly different. However, after adjusting for urinary catheter duration in a multivariate regression analysis, the difference in UTI was no longer statistically significant, while LOS was significantly longer in the early urinary catheterization group.

Conclusion: Early urinary catheterization was initially associated with a higher UTI, but this difference was no longer significant after adjusting for duration of catheter insertion. This suggests that the increased UTI risk observed in the early urinary catheterization group was due to prolonged urinary catheter use. However, early urinary catheterization remained associated with a significantly longer hospital stay, due to extended duration of urinary catheter insertion. These findings highlight the importance of delaying catheter insertion when possible and minimizing duration of urinary catheter insertion to reduce UTI risk and shorten hospitalization in elderly hip fracture patients.

Keywords: Urinary tract infection; Elderly; Hip fracture; Early urinary catheterization; Delayed urinary catheterization

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Nowadays, people have a longer life expectancy, leading to an increase in the proportion of elderly patients, which in turn contributes to a higher incidence of age-related conditions such as hip fractures due to osteoporosis, frailty, and an increased risk of falls⁽¹⁾. Consequently, the incidence of hip fractures among the elderly has also risen. This

problem is important in many countries, including Thailand. Hip fractures can cause many complications in patients such as urinary tract infection (UTI), pneumonia, deep vein thrombosis, pressure sore, and delirium^(2,3).

UTI is one of the important complications, occurring in 12% to 52% of elderly hip fracture patients⁽⁴⁻⁶⁾. These patients have reduced mobility due to pain, which can increase the risk of UTI from urinary retention^(7,8). Prolonged urinary catheterization allows bacteria to ascend the urinary tract and cause infection, which may cause catheter-associated UTI (CAUTI). UTI increases risk of delirium, prolongs length of hospital stay (LOS), raises treatment costs, reduces the quality of life, and increases the risk of sepsis, readmission rates, and mortality⁽⁸⁾. In Thailand, a prospective study showed the prevalence of UTI in hip fracture patients is

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28.3%. Increase risk of impaired functional ability and re-admission compared to those without UTIs⁽⁹⁾.

Waiting time for surgery is one of the factors that increases the risk of UTI. In many hospitals they cannot perform hip fracture surgery promptly due to the high number of elderly hip fracture patients and limited resources in the operating room. This situation causes patients to experience prolonged waiting times for surgery, thereby increasing the risk of UTI. The cause of UTI may be urinary retention as hip fracture patients are often bedridden and unable to sit or walk to the bathroom due to pain. This lack of mobility prevents normal urination, leading to urinary retention and UTI. The study in elderly hip fracture patients showed bacteriuria 29% to 38% before the admission^(10,11). Early urinary catheterization from the first day of admission can reduce urinary retention problems, but if the catheter was retained for many days due to prolonged waiting times for surgery, this can also increase the risk of UTI from the catheter itself. The UTI in patients with urinary catheters from the admission is 10% to 61%^(10,12).

Many hospitals that have longer waiting time for hip fracture surgery still do not have guidelines about timing of urinary catheter insertion, whether to use early urinary catheter insertion upon admission or delayed urinary catheter insertion when the patients cannot void. The present study aimed to compare the incidence of UTI between early and delayed urinary catheter insertion.

Materials and Methods

Patients and study design

The present study was a retrospective study, collected data from one of the secondary care hospital in Bangkok, after receiving Ethical Committee approval (COA S024h/65_EXP). Data were collected from hip fracture patients aged 60 years and above with diagnosed femoral neck fractures (ICD-10 code S72.0) and intertrochanteric fractures (ICD-10 code S72.1) between January 1, 2018, and December 31, 2022. The inclusion criteria were hip fracture patients from low-energy trauma aged 60 years and above. The exclusion criteria were multiple fractures, injury to more than one organ, UTI before admission, history of recurrent UTI, neurogenic bladder, or inability to control bladder function due to abnormal neurological system, anuria, infection in another system, current antibiotic use, immunocompromised host, and incomplete medical records.

The timing of urinary catheter insertion was classified as early when the urinary catheter was

inserted upon admission and delayed when the urinary catheter was not inserted upon admission but inserted when the patient was unable to void. In the present study, “unable to void” referred specifically to the initial urinary catheter insertion when a patient could not void. It did not include cases where a catheter was reinserted after removal. There were no exact criteria for determining the timing of the urinary catheter insertion. The timing was decided by the attending physician. UTI was diagnosed using the Center for Disease Control and Prevention (CDC) criteria.

The objective of the present study was to compare the incidence of UTI in elderly hip fracture patients between early and delayed urinary catheter insertion.

Sample size calculation and statistical analysis

The sample size was calculated by formula for testing two independent proportions, based on a similar previous study⁽⁷⁾. Calculated sample size required 56 patients per group. Continuous variables such as age, body mass index (BMI), waiting time for surgery, duration of surgery, date of urinary catheterization, duration of urinary catheterization and LOS were presented as mean \pm standard deviation (SD). Categorical variables such as gender, American Society of Anesthesiologist (ASA) classification, underlying disease, type of fracture, treatment method, UTI and mortality were presented as number and percentage. An independent t-test was used to compare continuous variables and Pearson's chi-square test, or Fisher's exact test was used to compare categorical variables. A p-value of less than 0.05 was considered statistically significant. The variables with a significant difference ($p < 0.05$) in demographic data would be included in the multivariate regression analysis to adjust for the effects of these variables. Statistical analyses were performed using Stata/BE 17 (StataCorp LLC, College Station, TX, USA).

Results

Two hundred forty-one elderly hip fracture patients met the eligible criteria but 42 patients were excluded with 19 patients due to UTI before admission, one patient had a history of recurrent UTI, two patients had multiple fractures, three patients had anuria, one patient was an immunocompromised host, and 16 patients had incomplete medical records. There were 199 patients left in the study with 70 patients (35.2%) in the early urinary catheterization group and 129 patients (64.8%) in the delayed

Table 1. Demographic and clinical data of early and delayed urinary catheterization groups

	Early urinary catheterization (n=70)	Delayed urinary catheterization (n=129)	p-value
Age (years); mean±SD	77.4 ± 8.7	77.5 ± 8.8	0.931
Gender; n (%)			0.505
Female (n=145)	53 (75.7)	92 (71.3)	
Male (n=54)	17 (24.3)	37 (28.7)	
BMI; mean±SD	21.9 ± 3.5	22.3 ± 3.7	0.513
ASA classification, n (%)			0.225
1	1 (1.4)	3 (2.3)	
2	22 (31.4)	24 (18.6)	
3	45 (64.3)	97 (75.2)	
4	2 (2.9)	5 (3.9)	
IHD; n (%)	8 (11.4)	10 (7.8)	0.388
Old CVA; n (%)	6 (8.6)	25 (19.4)	0.045
HT; n (%)	49 (70.0)	88 (68.2)	0.795
DM; n (%)	24 (34.3)	48 (37.2)	0.682
Dementia; n (%)	5 (7.1)	14 (10.9)	0.395
COPD; n (%)	4 (5.7)	5 (3.9)	0.723
CKD; n (%)	5 (7.1)	16 (12.4)	0.249
Anemia; n (%)	39 (55.7)	74 (57.4)	0.822
Electrolyte imbalance; n (%)	34 (48.6)	40 (31.0)	0.014
Delirium; n (%)	9 (12.9)	8 (6.2)	0.109
Fracture type; n (%)			0.755
Neck	32 (45.7)	56 (43.4)	
Intertrochanter	38 (54.3)	73 (56.6)	
Treatment; n (%)			0.904
Non-operative (n=22)	7 (10.0)	15 (11.6)	
Bipolar (n=75)	29 (41.4)	46 (35.6)	
Cephalomedullary nail (n=100)	34 (48.6)	66 (51.2)	
Proximal femoral locking plate (n=1)	0 (0.0)	1 (0.8)	
THA (n=1)	0 (0.0)	1 (0.8)	
Duration of urinary catheter insertion (days); means±SD	9.5±3.6	4.1±3.1	<0.001

BMI=body mass index; ASA=American Society of Anesthesiologist; IHD=ischemic heart disease; CVA=cerebrovascular accident; HT=hypertension; DM=diabetes mellitus; COPD=chronic obstructive pulmonary disease; CKD=chronic kidney disease; THA=total hip arthroplasty; SD=standard deviation

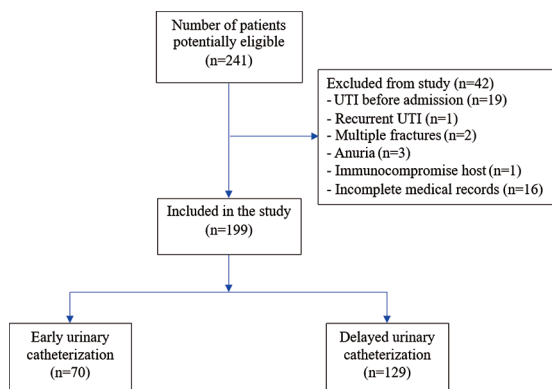


Figure 1. Patient flow charts. This diagram outlines the selection of study participants based on inclusion and exclusion criteria of 241 eligible elderly hip fracture patients, 42 were excluded. The final analysis included 199 patients: 70 (35.2%) in the early urinary catheterization group and 129 (64.8%) in the delayed group.

urinary catheterization group. Patient flow is shown in Figure 1.

The mean age of the patients was 77.4±8.7 years in the early group and 77.5±8.8 years in the delayed urinary catheterization group, with no significant difference. The percentage of female was 75.7% in the early group and 71.3% in the delayed urinary catheterization group, also with no significant difference. Other demographic data are presented in Table 1.

Baseline characteristics, including age, gender, BMI, ASA class, ischemic heart disease (IHD), hypertension (HT), diabetes mellitus (DM), dementia, chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), anemia, delirium, fracture type, and treatment options, were not significantly different between groups. However,

Table 2. Results of the early and delayed urinary catheterization groups

Variable	Early urinary catheterization (n=70)	Delayed urinary catheterization (n=129)	p-value
UTI; n (%)	16 (22.9)	14 (10.9)	0.024
LOS (days); mean±SD	14.4±5.1	14.5±5.3	0.918
Mortality; n (%)	1 (1.4)	4 (3.1)	0.659

UTI=urinary tract infection; LOS=length of stay; SD=standard deviation

Table 3. Univariate and multivariable logistic regression (adjusted for old CVA and electrolyte imbalance, and duration of urinary catheter insertion)

Variable	Univariable OR (95% CI)	Adjusted variable; multivariable OR (95% CI)		
		Old CVA	Electrolyte imbalance	Duration of urinary catheter insertion
UTI	0.41 (0.19 to 0.90)	0.41 (0.19 to 0.91)	0.40 (0.18 to 0.88)	1.06 (0.35 to 3.15)
LOS (<14 days, ≥14 days)	1 (0.55 to 1.82)	1.03 (0.56 to 1.89)	1.24 (0.66 to 2.33)	20.78 (5.44 to 79.33)
Mortality	2.21 (0.24 to 20.15)	1.82 (0.19 to 17.29)	2.31 (0.25 to 21.62)	5.10 (0.39 to 67.22)

CVA=cerebrovascular accident; UTI=urinary tract infection; LOS=length of stay; OR=odds ratio; CI=confidence interval

the history of cerebrovascular accident (old CVA) was significantly higher in the delayed urinary catheterization group at 19.4% compared to the early group at 8.6% ($p=0.045$). Electrolyte imbalance was also more common in the early group at 48.6%, than in the delayed group at 31.0% ($p=0.014$). The duration of urinary catheterization was significantly longer in the early group at 9.5 ± 3.6 days than in the delayed group at 4.1 ± 3.1 days ($p<0.001$).

The present study found that mean time of urinary catheter insertion in the delayed group was 5.1 ± 3.1 days after the admission. The average waiting time for surgery was 6.3 ± 3.2 days in the early group and 6.6 ± 3.8 days in the delayed group, with no significant difference ($p=0.700$). The average waiting time for surgery in both groups was 6.5 ± 3.6 days.

The incidence of UTI was significantly different between the early and delayed urinary catheterization groups, with 22.9% in the early group and 10.9% in the delayed group ($p=0.024$). In the present study, most UTI occurred during the preoperative periods. The average time to UTI diagnosis was 6.53 ± 6.48 days in the early group and 5.13 ± 3.72 days in the delayed group, with no significant difference between two groups ($p=0.378$). LOS and mortality were not significantly different. The results of the present study are shown in Table 2.

Demographic and clinical variables with significant differences were analyzed using multivariable regression. The results are shown in Table 3.

After adjustment using multivariate regression analysis, the results remained consistent when accounting for old CVA and electrolyte imbalance.

However, after adjusting for the duration of urinary catheter insertion, the findings for UTI and LOS changed. The difference in UTI incidence between the early and delayed urinary catheterization groups was no longer significant (OR 1.06, 95% CI 0.35 to 3.15). In contrast, LOS was significantly longer in the early catheterization group (OR 20.78, 95% CI 5.44 to 79.33).

Discussion

The present study showed that the early urinary catheterization group had a higher incidence of UTI. LOS and mortality were not different between the two groups. However, after adjusting for duration of urinary catheter insertion in a multivariate regression analysis, the difference in UTI incidence was no longer statistically significant, while LOS was significantly longer in the early urinary catheterization group.

UTI is one of the important complications in elderly hip fracture patients. Many hospitals cannot perform hip fracture surgery promptly due to the high number of elderly hip fracture patients and limited resources in operating room. This situation causes patients to experience prolonged waiting times for surgery, thereby increasing the risk of UTI. To the author's knowledge, most studies compare UTI between indwelling urinary catheters to intermittent urinary catheters. There is no study comparing UTI between early and delayed urinary catheterization as in the present study.

The present study found that early urinary catheterization was associated with a higher incidence of UTI compared to delayed urinary

catheterization group. This may be due to the prolonged duration of catheterization in the early urinary catheterization group, which increases the risk of bacterial colonization, as supported by previous studies. However, after adjusting for duration of urinary catheter insertion in a multivariate regression analysis, the difference in UTI incidence between the two groups was no longer statistically significant. This suggests that duration of urinary catheter insertion may be a key factor influencing UTI risk, rather than the timing of catheter insertion itself. These findings are consistent with the previous research on CAUTIs. Johansson et al. reported that indwelling urinary catheters resulted in a higher incidence of UTI compared to intermittent catheterization, with risks of 61% and 32%, respectively⁽¹⁰⁾. The sample consisted of 144 patients with an average age was 84 years. All patients were operated on within 24 hours of admission. In contrast, the present study focused on comparing early and delayed urinary catheterization, with average waiting time for surgery in both groups was 6.5±3.6 days. The longer waiting time for surgery in the present study may have influenced UTI incidence, highlighting a key difference in study design. Similarly, Hälleberg Nyman et al. conducted a randomized controlled trial on 170 hip surgery patients, including those with hip osteoarthritis, and found no significant difference in nosocomial UTI rates between intermittent and indwelling urinary catheterization, with an absolute difference of 2.4 (95% CI -6.9 to 11.6)⁽⁴⁾. Unlike Hälleberg Nyman et al.'s study, which included patients aged 50 and older with hip osteoarthritis, the present study was a retrospective analysis focused solely on femoral neck and intertrochanteric fractures, excluding patients with osteoarthritis. This difference in patient populations may contribute to variations in UTI incidence. Thomas et al. reported a retrospective review study of 583 patients with a mean age was 77.3 years, 450 patients were treated with catheters and 416 patients had primarily indwelling catheters. Postoperative urinary retention (POUR) occurred in 98 patients, or 16.8%, but it did not affect LOS ($p=0.2$). Patients with indwelling catheters for more than 24 hours after surgery had a higher incidence of POUR than those whose catheters were removed within 24 hours. Catheter use was associated with 6.6-fold increased risk of UTI (OR 6.6, 95% CI 2.03 to 21.4). However, patients with indwelling catheters did not have a significantly higher incidence of UTI compared to intermittent catheterization, 13.7% and 5.9%, respectively ($p=0.2$)⁽¹³⁾. While Thomas et al.'s

study focused on catheter versus non-catheter use and indwelling versus intermittent catheterization, the present study primarily compared early versus delayed urinary catheterization. The methodological differences between these studies may account for the variations in reported outcomes. The present study highlights the impact of catheter duration on UTI risk. While univariate analysis initially suggested a higher UTI incidence in the early urinary catheterization group, this difference disappeared after adjusting for catheter duration.

In the univariate analysis, LOS did not significantly differ between the early and the delayed urinary catheterization groups. This finding aligns with Thomas et al., who reported no significant difference in LOS between patients with indwelling urinary catheters and those using intermittent catheterization⁽¹³⁾. However, after adjusting for duration of urinary catheter insertion in a multivariate regression analysis, LOS was found to be significantly longer in the early urinary catheterization group. This discrepancy between univariate and multivariate results suggests that duration of urinary catheter insertion may act as an important factor. Patients in the early urinary catheterization group had prolonged catheter use, which could contribute to complications such as CAUTIs, of which may extend hospital stay. In contrast, patients in the delayed urinary catheterization group may have had shorter catheter use reducing the risk of this complication and potentially facilitating earlier discharge.

Mortality was 1.4% in the early urinary catheterization group and 3.1% in the delayed group, which was not significantly different. This finding remained consistent in both univariate and multivariate regression analyses. Kunin et al. conducted a prospective study in geriatric care center, consisting of 191 patients with a mean age of 82.3 years that compared between indwelling urinary catheter and intermittent catheterization. They found that the 6-month mortality rate was 30.2% in indwelling catheter group and 10.1% in intermittent catheterization group, which was significantly different ($p<0.001$)⁽¹⁴⁾. Kunin et al.'s study had different constraints from the present study that included all elderly patients, not just those with hip fractures, and compared indwelling catheter to intermittent catheterization, with a follow-up period of six months for mortality. Although early urinary catheterization was associated with a higher incidence of UTI, this did not increase mortality. This may be because most UTIs in hospitalized patients do not lead

to severe complications. Additionally, mortality in elderly hip fracture patients is influenced by multiple factors beyond catheter use, such as preexisting comorbidities and overall health status.

Based on these findings, the authors recommend delaying urinary catheter insertion until patients are unable to void, as this approach is associated with a lower incidence of UTI and a shorter duration of catheter used compared to early urinary catheterization upon admission. Delaying urinary catheter insertion not only reduces unnecessary exposure to an indwelling catheter but also minimizes the overall duration of catheterization, which is a key risk factor for UTI. However, this strategy must be balanced against the potential risk of urinary retention, which itself may contribute to UTI development.

To implement this, hospitals should establish a delayed urinary catheterization protocol, avoiding routine urinary catheterization upon admission and reserving it for patients with clear signs of urinary retention, such as bladder distension or the inability to void despite adequate hydration and positioning. Additionally, early mobilization and bladder training should be encouraged through effective pain management, as improved mobility can reduce the need for urinary catheterization. When urinary catheterization is required, efforts should focus on minimizing indwelling catheter duration by removing the catheter as soon as the patient regains mobility or can void voluntarily. Establishing a standardized urinary catheter removal protocol can further prevent unnecessary prolonged use and lower the risk of UTI.

The present study had limitations. Firstly, this was a retrospective study with confounding factors that could not be controlled and did not include certain data, such as residual urine. Secondly, the two patient groups were different in proportions. The benefit of the present study is that the results could be applied in hospitals that have limited resources, such as a limited number of operating rooms or long waiting times for surgery exceeding 48 to 72 hours. This could lead to the development of guidelines for caring for elderly hip fracture patients, addressing a more important problem in today's healthcare system.

Conclusion

Early urinary catheterization in elderly hip fracture patients was initially associated with a higher incidence of UTI compared to delayed urinary catheterization. However, after adjusting for urinary catheter duration in a multivariate regression analysis,

this difference was no longer statistically significant. Meanwhile, LOS was significantly longer in the early urinary catheterization group, while mortality remained comparable between the two groups.

These findings suggest that prolonged duration of urinary catheter insertion may be a key factor contributing to UTI risk rather than the timing of insertion alone. Delaying urinary catheterization may still help reduce unnecessary urinary catheter use and its associated risks.

However, the present study has limitations. As a retrospective study, it is subject to potential bias and confounding factors that could have influenced the results. Future prospective studies or randomized controlled trials are needed to confirm these findings and establish clearer guidelines for urinary catheter management in elderly hip fracture patients.

What is already known about this topic?

Intermittent urinary catheterization in elderly hip fracture patients who undergo early surgery can result in a lower incidence of UTI compared to indwelling urinary catheters.

What does this study add?

In elderly hip fracture patients awaiting surgery, delaying urinary catheterization until necessary and minimizing catheter duration reduces UTI incidence and shortens hospital stay compared to early urinary catheterization upon admission.

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Conflicts of interest

The author declares no conflict of interest.

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