

Original Article

## Postoperative Urinary Retention in Japanese Elderly Males with a Femoral Neck or Trochanteric Fracture

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We assessed risk factors for postoperative urinary retention (UR) in elderly males with femoral bone fractures: 169 Japanese males (mean age  $81.95 \pm 1.19$  years) who had undergone hip surgery at a municipal hospital (Toyama, Japan). A multiple logistic regression analysis was used to test possible risk factors for UR: age, body mass index, serum albumin, cognitive impairment, activities of daily living (ADL), and history of diabetes mellitus (DM). UR occurred in 24 (14.2%) of the 169 patients. A multivariate logistic regression analysis with age adjustment showed that ADL (odds ratio [OR] 3.88; 95% confidence interval [CI]: 1.2-12.5,  $p=0.023$ ) was significantly associated with the development of UR, and a history of DM showed marginal significance for UR occurrence (OR 0.36, 95%CI: 0.11-10,  $p=0.064$ ). These results suggests that ADL is a risk factor for UR development in elderly males who have undergone surgery for femoral neck or trochanter fractures.

**Key words:** elderly, femoral bone fracture, albumin, urinary retention, activities of daily living

The capital city of Japan's Toyama prefecture is the city of Toyama, with a population of ~400,000 residents (Toyama city official website. <http://www.citytoyamatoyama.jp/kikakukanribu/johotokeika/tokei2018>, accessed Feb 15, 2022.). In rural areas of Japan such as Toyama prefecture, the population of elderly residents has grown rapidly. Individuals aged  $\geq 65$  years comprise over 30% of all residents living in the city of Toyama. Toyama Municipal Hospital, a core institution in Toyama prefecture with approximately

600 beds, serves the residents of the city. A center for elderly patients with bone femoral neck and trochanteric fractures has been installed in the hospital, with advanced technology and dedicated staff to provide surgically intervention for patients with femoral neck and trochanteric fractures in the acute phase. Generalized in-hospital consultation criteria are also available; however, to the best of our knowledge, there are few reports on the risk factors for perioperative complications in elderly patients with femoral fractures, such as postoperative aspiration pneumonia, urinary

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retention (UR), and deep vein thrombosis.

From the perspective of a geriatrician, a new concern has grown in the management of perioperative complications in multidisciplinary program, including holistic care. Elderly (>65-year-old) patients commonly present with a hospital's cases of femoral neck and trochanteric fractures. These patients also often have one or more comorbidities that require multidisciplinary management in addition to the fracture treatment. Femoral neck and trochanteric fractures are among the major diseases that necessitate nursing care [1]. The waiting time (or surgical delay) is a known risk factor for postoperative complications and mortality [2,3]. Longer waiting times also delay patients' rehabilitation [4], which may increase the risk of postoperative complications. The waiting time is strongly associated with the occurrence of UR due to the prolonged use of an indwelling catheter to manage a patient's functional decline from femoral bone fractures.

In Japan, the average waiting time is 4.2 days [2], but at Toyama Municipal Hospital the average waiting time is much shorter at approximately 1.7 days (unpublished data). A cooperative management of hip fracture patients by orthopaedic surgeons and geriatricians has been demonstrated to be effectively reduces the length of hospital stay without affecting major patient outcomes [5,6], and the effectiveness of Toyama Municipal Hospital's multidisciplinary cooperative management reflects that finding. However, both an operative delay and postoperative morbidity can be life-threatening for patients with orthopaedic trauma [7], and among elderly patient populations, UR, aspiration pneumonia, and deep venous embolism are the major postoperative complications [8-11].

The risk factors for these complications were also investigated, and it has been indicated that malnutrition [12], inability to independently engage in activities of daily living (ADL) [13], and cognitive impairment

[14] are relevant risk factors. Acute UR is defined as the sudden inability to urinate. Only a few studies have investigated prognostic factors for UR [15], and interventions for perioperative complications were not conducted in those studies. Our earlier study of a multidisciplinary program (orthopaedic project) demonstrated that risk factors for UR among female patients were inability to independently conduct ADL and cognitive impairment [16]. Other reports have documented an unreported history of diabetes mellitus (DM) as a risk factor for both male and female orthopaedic patients [17].

UR is a predictive factor for the one-year post-discharge mortality of patients who have undergone hip bone surgery [18]. The management of UR during a patient's admission is thus crucial. We conducted the present study to identify risk factors relevant to major postoperative complications, such as UR, in Japanese elderly male patients who have undergone surgery for a femoral neck or trochanter fracture.

## Patients and Methods

**Study population.** The patient flow chart for the study is given in Fig.1. Initially, 897 patients were admitted to Toyama Municipal Hospital during the period from January 1, 2014 to December 31, 2020.

The exclusion criteria were as follows: (1) <65 years old, (2) having had conservative management, (3) multiple trauma, (4) pathologic fracture, (5) with a history of fall or in-hospital fall, (4) no initial measurement of serum albumin, (5) UR secondary to acute prostatitis, and (6) difficulty in catheter insertion due to benign prostatic hyperplasia. A final total of 169 patients were enrolled in the study. The study was conducted according to the guidelines of the Declaration of Helsinki and was approved (no. 2018-06) by the Clinical Research Ethics Committee of Toyama Municipal Hospital.

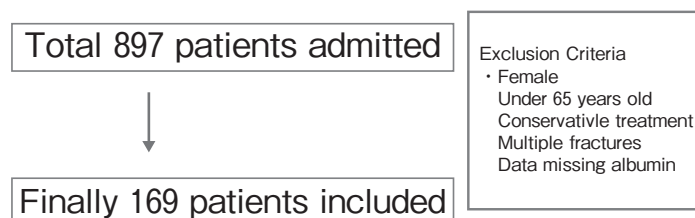


Fig. 1 Patient flow chart.

**Data collection and classification.** Physicians, specialist nurses, pharmacists, and medical personnel entered the patients' data in the medical records. The serum albumin concentration was determined and used in the statistical analysis as a continuous variable. Serum albumin data were used to divide the patients into high-albumin ( $\geq 3.5$  g/dL) and low-albumin ( $< 3.5$  g/dL) groups that were used for the logistic regression analysis as dichotomous dependent variables. The patients' levels of ADL were classified into four categories (J, A, B, C), that were divided into two groups: the nursing-unnecessary group (ambulatory) JA group and the nursing-required (non-ambulatory) BC group [19].

In all patients, a urethral catheter was preoperatively inserted in accord with the UR manual prepared in our hospital to avoid subjectivity of the physicians. UR was defined as a status of micturition difficulty and emptying of up to 400-500 mL urine in the bladder after catheter removal, with symptoms of dysuria or a decrease in the desire to urinate.

**Statistical analysis.** Means and standard deviations of the continuous variables examined (e.g., age, body mass index [BMI], serum albumin level, and history of diabetes mellitus [DM]) were calculated. Student's *t*-test was used to compare pairs of groups. A group comparison of categorical data such as gender, cognitive disorder, and ADL was conducted using the chi-square test. Logistic regression analyses were conducted using binary data (UR-positive and UR-negative)

as dependent variables, with age, BMI, serum albumin level, cognitive disorder, and ADL as independent variables. All statistical analyses were two-tailed and were performed with the use of the freely available EZR (Easy R) software (Saitama Medical Center, Jichi Medical University, Saitama, Japan) [20].

## Results

The characteristics of the enrolled study participants are summarized in Table 1.

The patient population ( $n=169$ ) was divided into UR-negative ( $n=145$ ) and UR-positive ( $n=24$ ) groups. The following were significantly different between the UR-negative and -positive groups: age ( $p=0.024$ ), serum albumin level ( $p=0.361$ ), DM history ( $p=0.466$ ), history of circulatory disease ( $p=0.438$ ), cognitive impairment ( $p=0.076$ ), and ADL ( $p=0.145$ ).

The results of the logistic regression analysis are summarized in Table 2.

The patients' ability to perform ADLs (OR: 3.880, 95%CI: 1.200-12.500,  $p=0.023$ ) was significantly associated with the occurrence of UR after adjusting for age and BMI as covariates. A history of diabetes mellitus had no significant correlation ( $p=0.064$ ) with the occurrence of UR.

Figure 2 provides the receiver operating characteristic (ROC) curve of the logistic regression models, in which UR-positive and UR-negative statuses were set as binary dependent variables, and age, sex, BMI, albu-

**Table 1** Patient Characteristics at Baseline

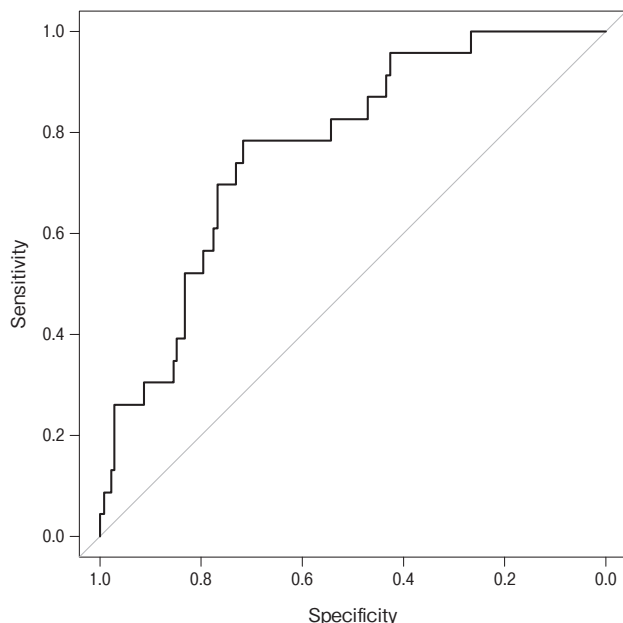
Variable	UR negative N = 145	UR positive N = 24	**P-value
Age (Mean $\pm$ S.D.)	81.40 $\pm$ 7.89	85.29 $\pm$ 6.93	0.024
BMI (Mean $\pm$ S.D.)	20.69 $\pm$ 3.30	21.36 $\pm$ 4.06	0.382
Waiting Time (Day, Mean $\pm$ S.D.)	1.60 $\pm$ 1.71	1.58 $\pm$ 2.15	0.956
Albumin (Mean $\pm$ S.D.)	3.59 $\pm$ 0.52	3.72 $\pm$ 1.17	0.361
Fracture Site, Neck Fracture: N (%)	49 (33)	11 (45)	0.449
Surgery Method, Subcapital Replacement: N (%)	29 (20)	10 (41)	0.034
Cognitive Impairment: N (%)	65 (44)	16 (66)	0.076
ADL, Assistance Required: N (%)	17 (12)	7 (29)	0.145
History of Hypertension: N (%)	72 (49)	13 (54)	0.826
History of Diabetes Mellitus: N (%)	38 (26)	8 (33)	0.466
History of Circulatory Disease: N (%)	45 (31)	10 (41)	0.438
History of Respiratory Disease: N (%)	24 (16)	4 (17)	1
History of Renal Disease: N (%)	17 (12)	3 (13)	1
History of Bone Fracture: N (%)	33 (23)	3 (13)	0.418

\*\**t*-test (Age, BMI, Waiting Time, Albumin), chi-square test (others)  
UR, urinary retention; BMI, body mass index; ADL, activity of daily living.

**Table 2** Results of Logistic Regression Analysis

	Coefficients	S.E.	P-value	Adjusted Odds Ratio	95%CI
Age	0.007	0.003	0.053	1.070	0.999–1.150
BMI	0.003	0.008	0.681	1.030	0.900–1.180
Albumin	0.067	0.041	0.126	1.640	0.871–3.080
Cognitive Impairment	0.056	0.060	0.320	1.750	0.581–5.270
ADL	0.189	0.082	0.023	3.880	1.200–12.500
History of DM	-0.113	0.062	0.064	0.363	0.124–1.060

CI, confidence interval; BMI, body mass index; ADL, activity of daily living; DM, diabetes mellitus.

**Fig. 2** ROC curves of the two logistic regression models.

min, cognitive disorder, and ADL were set as independent variables. The area under the ROC curve (95% confidence interval) was 0.731 (0.614-0.848).

## Discussion

Recent advances in orthopaedics have led to an increase in the number of elderly people who are able to undergo surgery. In Japan, the number of patients with a femoral neck fracture has increased year by year (Ministry of Health Labour and Welfare in Japan, Summary of Patient Survey 2014. [https://www.mhlw.go.jp/english/database/db-hss/sps\\_2014.html](https://www.mhlw.go.jp/english/database/db-hss/sps_2014.html), accessed Feb 15, 2022.). Under such circumstances, the management of postoperative complications is required to improve postoperative prognoses, and investigations of

risk factors underlying such complications are important in this respect. There have been few investigations of perioperative complications in this setting. It is thus critical to understand the risk factors for these complications to easily establish a diagnosis on admission.

Our previous retrospective study suggested that the serum albumin level, cognitive disorder, and inability to independently perform ADLs may be risk factors for postoperative UR in female patients who have undergone surgery for a hip fracture [16]. Our present analyses also demonstrated that inability to independently perform ADLs may be a risk factor for postoperative UR in male patients who have undergone hip-fracture surgeries, as we observed in the female population.

In the present study, the patients' age and the surgical method differed significantly between the UR-positive and UR-negative groups ( $p=0.024$  and  $0.034$ , respectively). However, BMI, waiting time, serum albumin level, fracture site, cognitive impairment, ADL, and history of diseases were not significantly different between the two groups. Although serum albumin and cognitive disorder were not significant in the patient background, our previous study of a female population [16] showed that these factors were significant risk factors for UR. We therefore included these factors in the present logistic regression analyses.

The results of the logistic regression analyses suggested that cognitive disorder (OR: 4.11, 95%CI: 1.53-11.03,  $p=0.005$ ) and inability to independently perform ADLs (OR: 2.61, 95%CI: 1.11-6.18,  $p=0.029$ ) were associated with the occurrence of a UR event, after adjusting for age and BMI as confounding factors. This suggests that cognitive disorder and inability to independently perform ADLs are variables associated with the occurrence of a UR event independently of covariates (here, age and BMI). The association between serum albumin level and the occurrence of a

UR event was marginally significant ( $p=0.057$ ). A patient's serum albumin level can play a role in the occurrence of UR event; another investigation reported that the serum albumin level was significantly lower in patients with postoperative urinary retention (POUR) compared to non-POUR patients [21], which is consistent with our present findings.

Two previous studies suggested an association between UR and catheter insertion. Linsenmayer *et al.* predicted the development of bladder stones based on catheter attachments in individuals with a spinal cord injury; 17 of the 49 (35%) catheterized subjects had bladder stones and 13 of the 17 had catheter attachments [22]. Tobu *et al.* reported that the duration of urethral catheter placement (OR: 0.33, 95%CI: 0.11-0.96) correlated with the development of UR when risk factors for UR in women with a femoral neck fracture were evaluated by multiple logistic regression analyses, suggesting that a permanent urethral catheter should be avoided [11].

These results suggest that UR may be due to catheterization, which may also have an impact on the aggravation of ADL impairment, and that preoperative cognitive disorder has a significant inter-relation with postoperative UR [11]. In addition, cognitive disorder has been suggested to be relevant to the ability of elderly hip fracture patients to engage in ADLs [23]. Together these findings indicate that the multidisciplinary management of both ADL performance and cognitive impairment could be important to improve the postoperative prognosis of elderly hip fracture patients.

Generally, if patients whose ability to perform ADLs is decreased tend to have an increased occurrence of UR, the period of hospitalization tends to increase due to indwelling catheterization. Accurate prediction of UR would thus be important, particularly in patients with a limited ability to perform ADLs.

The associations among serum albumin level, cognitive disorder, and ADL impairment with the waiting time that our present analyses revealed suggest that surgery at an early stage was not relevant to improve function or mortality, but that it was relevant to pain reduction and length of stay. They also suggest that patients' major complications at admission may be medically stable [24].

In the present study, the waiting time until surgery was approximately 1.2 days (unpublished data). Our study included no control group, and thus the waiting

time to the surgery may be extended. In addition, anesthesia has been known to enhance the occurrence of UR events [25,26], and this may also be a factor in the development of UR among patients surgery for a femoral fracture.

Our results also revealed an impairment in ADLs as an important risk factor for UR in elderly male patients with femoral neck and trochanter fractures. A follow-up investigation is necessary to clarify key factors associated with the postoperative prognosis of femoral fracture patients. A multidisciplinary approach for the prevention of UR is of paramount importance in all such cases [15,27]. The multidisciplinary management of UR in patients who have undergone surgery for a femoral bone fracture should also take nursing care in home settings into account, especially for elderly male patients.

The present study had some limitations. First, serum albumin level and cognitive disorder were not significant risk factors in the logistic regression analysis, which might have been due to the relatively small sample size. Further investigation is necessary to elucidate whether these are truly important risk factors in male populations. Second, the patients' preoperative state of micturition and/or urination function was not measured, making it difficult to interpret a causal relationship for the occurrence of UR. Urinary function is usually not measured in clinical settings. A prospective interventional study is required to investigate the association of UR with urination function. Third, patients with lower urinary tract obstruction (bladder outlet obstruction) were not excluded from this study, making it difficult to interpret the mechanism of UR occurrence in terms of the function of the lower urinary tract system.

In conclusion, we retrospectively assessed the risk factors for UR in elderly male patients who had undergone surgery for femoral bone fractures, and the results demonstrated that the inability to independently perform ADLs is an important risk factor for the development of UR. A multidisciplinary management of UR at the postoperative stage may be necessary, taking neurofunctional assistance and home nursing care into account, particularly for elderly male patients who have undergone surgery for a femoral neck or trochanteric fracture.



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