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Incidence and Risk Factors for Inpatient Falls in an Academic Acute-care Hospital

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Abstract

Objective: The aims of this study were to assess the frequency of inpatient falls and to evaluate potential risk factors in an academic hospital.

Methods: An electronic audit of the inpatient database at the Tama-Nagayama Hospital of Nippon Medical School from April 2004 through March 2005 was performed. Inpatient falls were registered regularly with incident reports submitted by nurses and other hospital employees discovering the fall. All inpatients were analyzed for potential risk factors using univariate and multivariate logistic regression analysis.

Results: Of the 8,537 patients, 109 (1.3%) fell. Multivariate logistic regression analysis showed that inpatient falls were significantly associated with a patient age of 51 to 70 years (odds ratio, 2.4; 95% CI, 1.3～4.7) or of 71 to 90 years (odds ratio, 4.2; 95% CI, 2.4～8.1); with a hospital stay of 15 to 21 days (odds ratio, 3.4; 95% CI, 1.6～7.0), 22 to 28 days (odds ratio, 4.3; 95% CI, 1.8～9.5), or 29 days or longer (odds ratio, 13.8; 95% CI, 8.3～24.1); with admission to the surgery (odds ratio, 2.0; 95% CI, 1.1～3.5), orthopedics (odds ratio, 2.5; 95% CI, 1.1～4.9), neurosurgery (odds ratio, 3.0; 95% CI, 1.5～5.9), or urology service (odds ratio, 3.9; 95% CI, 1.8～8.2); and with no surgical procedure (odds ratio, 1.6; 95% CI, 1.0～2.6).

Conclusions: The present study demonstrates that patient-related factors, such as age and length of stay, and treatment-related factors, such as no surgical procedure and admission to the surgery, orthopedics, neurosurgery, or urology service, are independent risk factors for inpatient falls. The results suggest that fall-prevention programs should target patients with these risk factors.

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Key words: inpatient fall, risk factors, academic hospital, incident, quality management

Introduction

Falls are the most common type of inpatient accident[1,2]. Many hospitals routinely report inpatient falls, because falls can result in serious physical and emotional injury, poor quality of life, increased length of stay in the hospital, and increased costs[3]. Up to 30% of hospital falls lead to physical injury, with 4% to 6% resulting in serious injury[4,5]. Owing to

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the risk of significant injury and increased costs, reduction of falls is a priority for hospital quality and patient safety.

While most research on falls has been conducted in elderly populations in community and long-term care facilities, less is known about falls among acute-care hospital inpatients. Previous studies of hospital falls show notable variations: 2% to 15% of inpatients experience at least one fall[1,2,6–9], and the range of published fall rates is wide (0.3～19/1,000 patients/day)[1,4,6–8,10,11]. Although comparing fall rates among various hospitals may be helpful, these studies have been limited in several ways, including variations in study design, setting, patient population, and definitions of risk factors. Many researchers have investigated symptoms that may contribute to falls in these environments: gait and balance disorders[4,12–14], dizziness or vertigo[15], visual deficits[16], incontinence [17], cognitive impairment, and sedation[12,17,18]. However, these data are not readily available for comparison across care units or hospitals, because they must be extracted from medical or nursing records. For this reason further research is needed to confirm potential risk factors for falls in acute-care hospital inpatients by analyzing routinely collected information.

The development of successful hospital-based interventions to decrease fall rates and fall-related injury requires large, well-designed studies to characterize the nature of inpatient falls. In the present study, we assessed the frequency of inpatient falls and evaluated potential risk factors in an academic hospital by using routinely collected information.

Patients and Methods

This study was conducted at the Tama-Nagayama Hospital of Nippon Medical School, a 400-bed academic teaching hospital in Tokyo. Twelve clinical services were included in this study: Internal Medicine, Surgery, Pediatrics, Obstetrics and Gynecology, Orthopedics, Neurosurgery, Emergency Care Unit, Urology, Gastroenterology, Psychology, Ophthalmology, and Otolaryngology. This study received approval from the institutional review board of our university hospital.

All inpatient data from April 2004 through March 2005 were obtained from an inpatient database at the Tama-Nagayama Hospital of Nippon Medical School. The information about each patient was collected on a data sheet, which was completed by a full-time technician at discharge, and saved in a computerized database. The data included demographic, admission, and discharge information and clinical characteristics.

An inpatient fall was defined as an incident in which a patient suddenly and involuntarily came to rest upon the ground or other surface[17] and was registered regularly with an incident report submitted by the nurse or other hospital employee discovering the fall. The inpatients were divided into two groups: patients who fell compromised the study group, and the other patients compromised the control group.

For univariate and multivariate analysis, the clinical services were divided into 10 categories: Internal Medicine, Surgery, Pediatrics, Obstetrics and Gynecology, Orthopedics, Neurosurgery, Emergency Care Unit, Urology, Gastroenterology, and others, which included Psychology, Ophthalmology, and Otolaryngology. Because these last three services did not have attached beds or large numbers of inpatients, they were examined as a single category.

To assess the association between the presence of inpatient falls and each of a set of discrete variables, chi square analysis was performed. Independent 2-sample *t*-tests were used to compare patients in 2 groups with respect to age at admission and length of hospital stay. The magnitude of the associations between potential risk factors and falls was quantified with the use of the odds ratio. Logistic regression analysis was used to calculate odds ratios with 95% confidence intervals (CIs).

For multivariate analysis, age at admission was subdivided into 20-year intervals, except for the first interval, which included all patients younger than 11 years. Similarly, length of hospital stay was divided into intervals of 7 days, except for the last interval, which included more than 28 days. Stepwise logistic regression analysis was used to identify significant

independent risk factors associated with inpatient falls. The independent variables initially included in the multivariate logistic model were as follows: age (6 categories), sex, length of hospital stay (5 categories), type of treatment (surgical procedure or no surgical procedure), clinical service (10 categories), and admission mode (normal, emergency, re-admission, or transfer). For the final model, all independent variables were selected by a stepwise procedure (JMP version 4. SAS Institute Japan, Tokyo). The level of statistical significance used was a probability value of less than 0.05.

Results

From April 2004 through March 2005, we examined 8,537 inpatients at the Tama-Nagayama Hospital of Nippon Medical School. Of these patients, 109 (1.3%) fell. **Table 1** shows the clinical characteristics and univariate associations among patients who fell and those who did not fall. The mean age at admission was 50.0 ± 25.2 years. The mean length of hospital stay was 16.5 ± 32.3 days. Sixty-five percent of patients did not undergo a surgical procedure.

Univariate analysis (**Table 1**) showed that gender was significantly associated with the incidence of inpatient falls ($p<0.001$). Of the patients who fell, a significantly higher percentage (64.2%, n=70) were male. Patients who fell had a significantly higher mean age ($p<0.001$). The length of hospital stay was associated with falls ($p<0.001$). Patients who fell stayed in the hospital significantly longer (60.5 ± 64.7 days) than did patients who did not fall (15.9 ± 31.3 days). Inpatient falls were significantly associated with the clinical service. The neurosurgery, internal medicine, orthopedics, and urology services had higher fall rates. The admission mode was also associated with falls. Patients transferred from other hospitals had a significantly higher rate of falls ($p< 0.001$). Patients who underwent surgery had a slightly but not significantly lower rate of falls.

A multivariate logistic regression model was constructed with patient-, medication-, or care-related risk factors. The independent variables of the final model, which was selected by a stepwise procedure, were as follows: age (2 categories), sex, length of stay (3 categories), type of treatment (surgical procedure or no surgical procedure), and clinical service (4 categories). The results of multivariate logistic regression analysis are shown in **Table 2**.

The factors that were significantly associated with an increased risk of inpatient falls included a patient age of 51 to 70 years (odds ratio, 2.4; 95% CI, 1.3～4.7) or 71 to 90 years (odds ratio, 4.2; 95% CI, 2.4～8.1); a hospital stay of 15 to 21 days (odds ratio, 3.4; 95% CI, 1.6～7.0), of 22 to 28 days (odds ratio, 4.3; 95% CI, 1.8～9.5), or 29 days or longer (odds ratio, 13.8; 95% CI, 8.3～24.1); surgery (odds ratio, 2.0; 95% CI, 1.1～3.5); the orthopedics (odds ratio, 2.5; 95% CI, 1.1～4.9), neurosurgery (odds ratio, 3.0; 95% CI, 1.5～5.9), or urology service (odds ratio, 3.9; 95% CI, 1.8～8.2); and no surgical procedure (odds ratio, 1.6; 95% CI, 1.0～2.6; **Table 2**).

Discussion

This article documents the experience with inpatient falls at a single academic acute-care hospital. In the present study, we assessed the frequency of inpatient falls and evaluated potential risk factors by using routinely available data. Our study, like previous studies[1,2,4,6–8,19,20], identified several risk factors associated with falls. A predictive model was created with stepwise logistic regression to identify patients most at risk of falling. Ten variables were independently associated with an increased risk of inpatient falls: a patient age of 51 to 70 years or 71 to 90 years; a hospital stay of 15 to 21 days, 22 to 28 days, or 29 days or longer; the surgery, orthopedics, neurosurgery, or urology service; and no surgical procedure.

The incidence of inpatient falls at our hospital was 1.3%. This rate is significantly lower than rates reported at rehabilitation hospitals, long-term care institutions, and psychogeriatric hospitals, which have inpatient fall rates of 6% to 15%[2,6–8,19,21]. For patients with psychiatric illness, falls are the most common complication of the hospital stay. Falls also represent a significant problem for elderly patients in long-term care institutions[12]. However, our hospital

Table 1 Clinical characteristics and univariate association with in-patient falls

characteristics	Total n = 8,537	Fall down n = 109 (1.3%)	No fall down n = 8,428 (99.7%)	Odds ratio	95% CI	Statistical significance (p)
Gender						
Male	3,999 (46.8%)	70 (1.8%)	3,929 (98.2%)	2.1	(1.4 ～ 3.1)	<0.001
Female	4,538 (53.2%)	39 (0.9%)	4,499 (99.1%)	1		Reference
Age (yr, mean ± SD)	50 ± 25.2	67.6 ± 17	47.7 ± 25.2			<0.001
Admission mode						
Normal	3,949 (46.3%)	43 (1.1%)	3,906 (98.9%)	1		Reference
Emergency	1,280 (15.0%)	11 (0.9%)	1,269 (99.1%)	0.7	(0.4 ～ 1.5)	0.234
Re-admission	2,416 (28.3%)	35 (1.5%)	2,381 (98.5%)	1.3	(0.8 ～ 2.1)	0.207
Transfer	892 (10.4%)	20 (2.2%)	872 (97.8%)	2.1	(1.2 ～ 3.5)	0.007
Length of stay (days, mean ± SD)	16.5 ± 32.3	60.5 ± 64.7	15.9 ± 31.3			<0.001
Surgical procedure						
Yes	3,013 (35.3%)	33 (1.1%)	2,980 (98.9%)	0.8	(0.5 ～ 1.2)	0.328
No	5,524 (64.7%)	76 (1.3%)	5,448 (98.7%)	1		Reference
Clinical services						
Internal Medicine	951 (11.1%)	31 (3.3%)	920 (96.7%)	21.2	(7.6 ～ 88.4)	<0.001
Surgery	1,030 (12.1%)	24 (2.3%)	1,006 (97.7%)	15	(5.2 ～ 63.2)	<0.001
Pediatrics	859 (10.1%)	3 (0.4%)	856 (99.6%)	2.2	(0.4 ～ 11.9)	0.333
Obstetrics and Gynecology	1,888 (22.1%)	3 (0.2%)	1,885 (99.8%)	1		Reference
Orthopedics	410 (4.8%)	11 (2.7%)	399 (97.3%)	17.4	(5.4 ～ 77.0)	<0.001
Neurosurgery	302 (3.5%)	12 (4%)	290 (96%)	26.1	(8.2 ～ 114.8)	<0.001
Emergency Care Unit	1,455 (17.0%)	9 (0.6%)	1,446 (99.4%)	3.9	(1.2 ～ 17.7)	0.041
Urology	528 (6.2%)	11 (2.1%)	517 (97.9%)	13.4	(4.2 ～ 59.4)	<0.001
Gastroenterology	403 (4.7%)	4 (1%)	399 (99%)	6.3	(1.4 ～ 32.1)	0.0161
Others	707 (8.3%)	1 (0.1%)	706 (99.9%)	0.9	(0.1 ～ 7.0)	0.921

had a lower rate of falls than did other acute-care hospitals, which have reported fall rates of 1.6% to 2.3%[1,4,9]. One possible explanation for our lower fall rate is that 22% of our patients had been admitted to the Obstetrics and Gynecology service, which is a service with a low risk of inpatient falls[18]. Comparisons of fall rates among various hospitals may be affected by such differences in the composition of clinical services. In addition, the methods of sample collection might have a significant effect on the rate of falls. In the present study, falls were registered regularly with incident reports submitted by nurses and other hospital employees who discovered the fall, so we may not have examined all falls that occurred during the study period. The accuracy of fall reports is unknown.

The multivariate logistic regression models in this study clearly demonstrate that the length of hospital stay is the single greatest risk for inpatients falls. A hospital stay of 29 days or longer is associated with an almost 14-fold increase in the risk of falling compared with the reference categories. Several studies also have demonstrated that length of hospital stay is an independent risk for inpatients falls[9,21,22].

Our analysis of patient-related characteristics has shown that a patient age of 51 years or more was a significant predictor of inpatient falls. This result is consistent with previous results in several settings[19,21,23,24]. In fact, numerous studies have demonstrated that the economic impact of falls in older persons is a matter of increasing concern to public health practitioners and planners[25,26].

Differences in the risk of inpatient falls among clinical services have been demonstrated; patients admitted to the neurology service have a high risk of falling[7,27]. Consistent with earlier studies, the present study found that patients admitted to the neurosurgery service had an almost 3-fold increase in the risk of falls. In addition, admission to the surgery, orthopedics, or urology service was

Table 2 Multivariate analysis of risk factors for in-patient falls: Results of forward stepwise logistic regression analysis (n = 8,537)

Variable	Odds ratio	95% CI	p value
Reference category*	1		Reference
Age			
51 ～ 70 years	2.4	(1.3 ～ 4.7)	0.006
71 ～ 90 years	4.2	(2.4 ～ 8.1)	<0.001
Length of stay			
15 ～ 21 days	3.4	(1.6 ～ 7.0)	0.001
22 ～ 28 days	4.3	(1.8 ～ 9.5)	0.045
>28 days	13.8	(8.3 ～ 24.1)	<0.001
Clinical services			
Surgery	2	(1.1 ～ 3.5)	0.017
Orthopedics	2.5	(1.1 ～ 4.9)	0.016
Neurosurgery	3	(1.5 ～ 5.9)	0.002
Urology	3.9	(1.8 ～ 8.2)	0.001
No surgical procedure	1.6	(1.0 ～ 2.6)	0.035

*The reference category comprises in-patients under 51 years old, with length of stay less than 15 days, with an operating procedure, and without received treatment by Surgery, Orthopedics, Neurosurgery, and Urology.

associated with inpatient falls. Interestingly, although several surgical departments, such as neurosurgery, surgery, orthopedics, and urology, had higher fall rates, patients who underwent a surgical procedure had a significantly lower risk of falling. It seems that regardless of the surgical procedure, the patients admitted to services with higher fall rates in this study may have had more severe illnesses or a greater prevalence of balance and weakness problems that could account for the higher fall rates. However, we could not investigate the reasons in detail because our retrospective study was limited by a database that could not provide information about disease severity or the prevalence of balance and weakness problems.

Fall-prevention strategies should be linked to the patient characteristics that cause a patient to fall and circumstances surrounding these falls. Therefore, on the basis of our results, strategies should target patients with these risk factors.

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