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간호학박사 학위논문

Risk Factors for Fall-Related
Serious Injury in Tertiary Hospital
Patients:
A Cross-Sectional Retrospective Analysis

상급종합병원 입원환자의 낙상 관련 심각한
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A Cross-Sectional Retrospective Analysis

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Risk Factors for Fall–Related Serious Injury in Tertiary Hospital Patients:

A Cross–Sectional Retrospective Analysis

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Abstract

The purpose of this study is to identify the risk factors of serious fall-related injuries by analyzing the differences between two fall groups: one with serious fall-related injuries and one without such injuries. Applying a cross-sectional retrospective study, we analyzed the degree of fall-related injury and the risk factors related to serious falls by conducting a complete survey of the medical records of fall patients reported throughout the year of 2017 at a tertiary hospital in Seoul, Korea. Among the patients with reported falls, 188 sustained no injury (63.1%), 72 sustained minor injury (24.2%), and 38 patients' sustained serious injury (12.8%).

The serious fall-related injuries included eight lacerations requiring sutures (2.7%), 23 fractures (7.7%), five brain injuries (1.7%), and two deaths (0.7%). Analysis results indicated that taking anticoagulants/antiplatelet drugs ($p = 0.016$) and falling history ($p = 0.038$) were statistically significant between the group of patients with serious injury related to falls and the group without serious injury. Logistic regression revealed that taking anticoagulant/antiplatelet drugs was the factor that is most significantly correlated with serious injuries related to falls ($OR = 2.299$, $p = 0.022$).

Results show that it is necessary to develop a patient-tailored fall prevention activity program.

Key words: falls, fall assessment, serious injury, inpatients fall risk assessment

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This doctoral dissertation reinforced the literature review conceptual framework and discussion to the content of the published paper. These contents were prepared in the form of a doctoral degree dissertation for Seoul National University, College of Nursing.

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CHAPTER I. INTRODUCTION

1. Background

Falls are one of the most frequently occurring adverse events of hospitals, and inpatient falls are a significant burden on medical institutions as they lead to increased hospital stays, additional medical expenses, and litigation due to medical malpractice (Hendrich et al., 2003; Oliver et al., 2004).

Falls are not common among young people. Fall-related injuries occur in approximately 25% to 55% of patients admitted to hospitals that care for older adults in Korea, and 1.2% to 16.2% of falls involve serious injuries such as fractures, cerebral hemorrhage, and death (Aryee et al., 2017; Kang & Song, 2015; Jang & Lee, 2014). Fall-related injuries lead to extended hospital stays and increased medical expenses (Wong et al., 2011), and may lead to complaints such as mental distress and medical litigation for patients and their families (Toyabe, 2014). From a perspective of nursing workforce policy, falls as patient outcome are the main issue in the performance of nurse staffing policy.

The Centers for Disease Control and Prevention (2014) reported that millions of people fall each year, of which one in five suffers serious injuries, including death. In particular, in the case of the United States, the direct medical expenses from falls in the elderly amount of \$31 billion per year, and hospital expenses account for two-thirds of the total, indicating that falls in the elderly are serious and costly injuries (Burns et al. 2016).

Patient Safety Act was implemented in Korea in July 2016 and the patient safety reporting and learning system was introduced. Medical institutions reported that

patient safety accidents and falls accounted the most with 44.3% to 50.1% of the total reported numbers. When looking at the degree of risk by type of accident reported during the year 2019, it was found out that deaths from falls accounted for 22.4% of all accidents, long-term damage or side effects accounted for 78.4%, and permanent damage or side effects accounted for 16.7% (Korea Institute for Healthcare Accreditation, 2019).

Falls in hospitals can be predicted through the identification of fall risk targets by medical staff and prevented through fall prevention activities. Fall risk factors are divided into internal and external factors. Intrinsic factors include fall-related disease, old age, medicines to be taken, and fear of falls. External factors include the physical environment such as inappropriate lighting, slippery floors, inappropriate shoes, the use of walking aids, and unorganized surroundings, and the situational environment such as length of stay (Lee et al., 2015).

To reduce fall-related injuries, it is necessary to predict the incidence of falls and to perform fall prevention activities that consider the characteristics of the patient (Halm & Quigley, 2011). Nurses routinely use a fall risk assessment tool (e.g., Morse Fall Scale), which has been verified for reliability and validity, and perform fall-prevention activities according to the evaluation results. However, the number of reported falls and injuries related to falls continues to increase, even in patients determined to have a low fall risk (Jang & Lee, 2014; Lee et al., 2015; Heinze et al., 2009).

In recent years, studies have been conducted to clarify the risk factors related to falls; age, fracture risk, use of anticoagulants, surgery during hospitalization, male, history of falling, a history of joint replacement surgery, and use of antipsychotics

have been reported (Aryee et al., 2017). Other fall risk assessment tools include the Ability-specific Balance Competence Scale (ABCS), which identifies the risk factors of age (>85), bone/orthopedic conditions, anti-coagulation, and surgery during hospitalization, and the St. Thomas Risk Assessment Tool in Falling Elderly Inpatients (STRATIFY) examines excitement, visual impairment, frequent toilet access, and walking ability. The fracture risk assessment tool (FRAX™) is available to evaluate the risk factors of age, previous fracture, parents' history of hip fracture, smoking, steroid use, heavy drinking, and rheumatoid arthritis. Using various tools, or using them together, is recommended (Toyabe, 2014), but the predictive power of combining such tools to evaluate a patient's risk for fall-related injury has not been verified.

In Korea, studies have shown that advanced age, requiring the emergency room, and non-use of ambulatory aid are related to fall-related injuries (Cho & Lee, 2017), but studies analyzing various risk factors of serious injuries related to falls are insufficient. Therefore, in order to reduce the number of serious injuries related to falls in hospitalized patients in a tertiary hospital, it is necessary to identify the risk factors for serious injuries related to falls that are applicable to domestic conditions, and to develop and apply a serious injury assessment tool for falls that reflects the risk factors.

The purpose of this study is to use clinical data of patients reported as falls to determine the degree of fall-related injuries and to identify risk factors for serious injuries related to falls as evidence for interventions to prevent serious injuries related to falls. We identified factors that should be examined in addition to the limited scope of the Morse assessment to differentiate risks for serious injury from

falls in hospitals.

2. Purpose

The aims of this study are to identify the degree of fall-related injury and the risk factors of severe fall-related injury. The specific research goals are as follows.

- (1) Determine the degree of damage related to falls.
- (2) Identify the general, clinical, and fall-related characteristics of the patients.
- (3) Compare the differences in general, clinical, and fall-related characteristics between the group with serious injuries related to falls and the group without serious injuries.
- (4) Analyze factors that affect serious injuries related to falls.

3. Terminology

1) Falls

A fall is defined as a sudden drop to the floor or a place lower than the current position due to an unintended posture change; for the purposes of this study, it does not include sudden falls due to a stroke or fainting or falls due to a strong external force (wind, being pushed by others, etc.) (Tinetti & Williams, 1997). In this study, inpatients have experienced as defined above and the staffs reported the falls to the Quality Assurance department of the hospital. .

2) Degree of Injuries Related to falls

In this study, data were collected by dividing fall-related injuries into five stages: no harm, minor injury, moderate injury, severe injury, and death. No harm means no damage to the patient. Minor injury means that the patient was injured but required additional observation, medication, or primary treatment. Moderate injury refers to a case that included an unplanned extended hospital stay, surgery, treatment, and so on. Severe injury pertains to a case of permanent injury such as brain injury or disability. Death refers to a case of death as a direct result of a fall (Healey et al., 2007).

Based on previous studies, if the collected data indicated no harm or minor injury, the fall was defined as being without serious injury, and if the collected data indicated moderate injury, severe injury, or death, the fall was defined as having serious injury (Capone et al., 2013).

3) Factors associated with injuries related to falls

(1) General characteristics of patient

Previous studies have reported the relationship between injuries related to falls with these variables, such as age, gender, treatment unit and length of stay (Hitcho et al., 2004; Jung & Lee, 2019; Yoon et al., 2018; Cho & Lee, 2017).

In this study, the general characteristics of patients with reported falls are age, sex, length of stay, and inpatient treatment unit.

(2) Clinical characteristics of patient

Many studies have found that injuries related to falls were highly associated with patient's disease's specific characteristics as risk factors, but have not shown

consistent results yet.

Most of previous studies shared common opinion that patients with injuries related to falls were smoking, alcohol, taking steroid, rheumatoid arthritis, history of fracture, urinary impairment (Toyabe, 2014), osteoporosis (Kim & Lee, 2019; Jo & Kim, 2019), taking antipsychotic drugs (Mion et al., 2012), visual impairment (Choi et al, 2017), cognitive impairment (Krauss et al., 2007), lower extremities weakness (Choi et al., 2017), history of surgery(Quigley et al., 2009), bleeding tendency (Bradley et al., 2010), bone meta/ bone tumor, taking anticoagulant/antiplatelet drugs (Aryee et al., 2017). These observed and indicated clinical characteristics of the patients with reported falls from previous studies are also consistent with this study.

(3) Fall-related characteristics of patients

Fall risk factors are divided into internal and external factors. External factors include the physical environment such as inappropriate lighting, slippery floors, inappropriate shoes, the use of walking aids, unorganized surroundings, and the situational environment (Lee et al., 2015; Cho & Lee, 2017; Choi et al., 2017). Other risk factors were nurse's shift (Krauss et al., 2007; Yoon et al., 2018), caregiver's presence (Cho & Lee, 2017; Choi et al., 2017), history of falling, intravenous therapy at the time of fall, and degree of fall risk (Yoon et al., 2018).

Nurse's shift, caregiver presence, history of falling, intravenous therapy at the time of fall, use of walking aid, degree of fall risk, and environmental factor are the fall-related characteristics of the reported patients in this study which were also based on the previous studies.

CHAPTER II. LITERATURE REVIEW

1. Fall definition and classification

The definition of fall is defined differently by scholars. The World Health Organization (2018) defined a fall as “intentionally placing the body on the ground, on the floor, or on a lower level, irrespective of the injury”. Another definition is "a fall is an unintentional sudden fall to the floor, regardless of damage" (Staggs et al., 2015).

National Institute for Health and Care Excellence (NICE) excludes the furniture, walls, or other structures in the definition of falls (NICE, 2013). There are accidental falls and predictable physiological falls (anticipated physiological falls) and unanticipated physiological falls in a hospital setting (Morse, 2008). Accidental falls are caused by external environmental risk factors and are mainly caused by a patient's misjudgment or loss of balance during movement, such as slipping, stumbling over, or stumbling. Accidental falls can be prevented by eliminating environmental obstacles (such as scattered or tangled wire lines on the floor), explaining the unfamiliar hospital environment to patients, and teaching how to use a walker, etc. Predictable physiological falls include sensory impairment, impaired balance, gait and mobility, impaired cognition/confusion associated with multidrug use, experience of falls, and elimination dysfunction of the patient. On the contrary, unpredictable physiological falls are associated with unpredictable intrinsic factors such as stroke, heart attack, and convulsions. In addition, behavioral falls occur when the patient has a behavioral problem and voluntarily moves the body from a high level to a low level (Neily et al., 2013). Assisted fall occurs when the patient begins

to fall or when the patient touches the floor or other unintended surface despite the help of someone else. Because these assisted falls did not prevent the patient from reaching the floor or other unintended surfaces, the assisted falls were an accident, not a near miss (AHRQ, 2018).

2. Fall-related injuries

In a study of 120 patients who fell at a general hospital, the incidence of physical damage after falls was 66 (55.5%). The levels of injury were 25 lacerations (20.8%), 22 abrasions (18.3%), 14 fractures (11.7%), 4 hematomas (3.3%), and 1 patient (0.8%) was admitted to the intensive care unit due to fatal injury. After the falling accident, 68 patients (56.7%) were observed, 20 patients (16.7%) received simple treatments such as dressing, 19 patients (15.8%) needed wound suture, 8 patients (6.7%) were taken for surgery, 4 patients (3.3%) wore braces, and CPR was done in 1 case (0.8%). After the incident of falling, 40.8% of the patients were under observations, 34.2% undergone a CT, 22.5% had X-ray, 2.5% had MRI (Kang & Song, 2015).

In a study of 416 patients who fell in the tertiary general hospital, the incidence of injury after fall was 104 (25%). Minor injuries such as abrasion were found in 99 cases (23.8%), and severe injuries such as cerebral hemorrhage and fracture were found in 5 cases (1.2%). Post-fall treatment was observed in 335 patients (80.5%), simple dressing in 38 cases (9.1%), suture in 7 cases (1.7%), surgery in 4 cases (1%), and cast/splint in 3 cases (0.7%) (Jang & Lee, 2014).

In United States, a study of 117 adults with fall-related injuries at a tertiary university hospital reported that minor injuries were mostly acquired after the fall. 16 patients (13.7%) were moderately injured, 2 (1.7%) were severely injured, and 1 (0.9%) died. Lacerations, bruises, and abrasions were the most common injuries (63 patients, 53.8%) and 11 patients (9.4%) had bleeding. The face was the most common injuries area, arms, legs, and head were also common (Aryee et al., 2017).

In a study of Capone et al (2013), 7,297 fall-patients were recorded for 7 years

in a general hospital, 57 suffered moderate or severe injuries. There were 26 (46%) moderate injuries, 29 (50%) severe injuries, and 2 (4%) deaths. The types of injury were fractures in 40 (70%), lacerations in 8 (14%), cerebral hemorrhage in 6 (10%), and other 3 (6%).

In a study of 57 patients with severe injuries after falls in three acute hospitals in St. Louis, 16 (28.1%) had a hip or pelvic fracture, 12 (21.1%) had an upper extremity fracture, and 12 (21.1%) had a lower extremity. Fracture, 7 (12.3%) death, 4 (7.0%) subdural hematoma, 2 (3.5%) facial fracture, 2 (3.5%) hip or pelvic fracture with upper extremity fracture, one (1.8%) had a vertebral fracture and one (1.8%) had another injury requiring surgery. Twenty (35.1%) patients underwent surgery, and 5 (8.8%) were re-hospitalized to treat the injury. Severe injuries resulted in an extended hospital stay by 6.3 days and an increase in medical bills of \$13,316 (Wong et al., 2011).

As a result of analyzing 2,174 fall reports collected from 32 Korean hospitals, the most common fall result was no injury (59.5%), minor injury 34.8%, severe injury including fracture or head injury 5.6%, and death 0.1%. The most common types of injury after fall were bruises and abrasions (20.4%), followed by lacerations in 5.3%, swelling in 5.1%, others in 4.2%, fractures in 3.8%, and head injuries in 1.8%. Treatment according to injury after fall was in the order of observation 67.6%, diagnostic test 27.7%, simple dressing 11.8%, followed by surgery in 1.8% (Choi et al., 2017).

A study in a hospital to identify potential risk factors for severe fall-related injuries found that the most common serious fall-related injuries were bleeding or laceration (53.6%), fracture or dislocation (15.9%), and hematoma or contusion

(13%) (Fischer et al, 2005).

3. Factors associated with injuries related to falls

In acute care and long-term care hospitals, screening tests should be performed to identify patients at risk of falling (NICE, 2013; Wallis & Campbell, 2011; Moyer, 2012; College of Occupational Therapists, 2015). Screening tests include experiences of falls, unstable gait, impaired balance or mobility, and clinical judgment to determine risk factors for falls. Fall experience is an important factor in screening tests for risk factors (NICE, 2013; Wallis & Campbell, 2011; Moyer, 2012; College of Occupational Therapists, 2015; Ambrose et al, 2015; Ambrose et al, 2013; Boelens et al., 2013; Callis, 2016; Deandrea et al, 2013; Vieira et al., 2011; Zhao & Kim, 2015). Flaherty and Josephson recommend to ask questions about falls, slips, tripping, and fear of falling (Gillespie et al., 2012).

At the time of hospitalization and changes in patient conditions that may affect the risk of falls (e.g. delirium, newly prescribed medications, etc.), fall screening was recommended (NICE, 2013; Moyer, 2012; College of Occupational Therapists, 2015).

After comprehensively evaluating the individualized risk factors for falls in hospitalized patients, health care practitioners should identify the risk factors and confirm whether treatment, improvement, or management is possible during the expected hospitalization (NICE, 2013). When inpatients are judged to be at risk of falling, medical staff conduct a comprehensive assessment to identify individualized fall risk factors (Ambrose et al, 2013; Zhao & Kim, 2015). Medical staff should collect detailed information about the fall experience, such as the frequency of falls and the situation when the fall occurs, to patients who have experienced falls within the last one year (NICE, 2013; Moyer, 2012; College of Occupational Therapists,

2015). In addition, medical staff should ask specific questions about the factors causing falls (e.g., dizziness, palpitations, etc.), environmental factors, anxiety or fear of falls, and damage caused by falls (Ambrose et al, 2015).

Doctors should work with prescribing physicians to identify multi-drug or medications that can increase the risk of falls, review medications, and identify side effects associated with the risk of falls. While some studies have reported that discontinuation of medication is not associated with falls (Moyer, 2012; Darowski & Whiting, 2011; Zia et al., 2015), other studies have either reduced prescriptions for medications that increase the risk of falls to reduce falls and damage caused by falls, if the patient's condition permits. It was reported that it should be stopped gradually (NICE, 2013; Gillespie et al. 2012, Xu et al, 2012). When deciding whether to use medicines, it is important for doctors to consider the benefits of disease treatment versus the risk of falls (Zia et al, 2015). The Screening Tool of Older People's Prescriptions (STOPP)/Screening Tool to Alert to Right Treatment (START) criteria, a tool to screen inappropriate prescriptions for the elderly, can improve prescription patterns and reduce falls in acute and long-term care hospitals (Hill-Taylor et al., 2016). Multi-drug use has been highlighted as a risk factor for falls in various reviews (Vieira et al., 2011; Xu et al, 2012; Bunn et al., 2014).

In order to improve treatment compliance and effectiveness, exercise interventions should be individualized according to patient characteristics (NICE, 2013; Mulligan et al., 2014), and exercise experts such as physical therapists should especially support patients at risk of falling due to comorbid diseases (Stubbs et al., 2015; Mulligan et al., 2014; Martin et al., 2013). According to previous studies, exercise intervention was reported to have a positive effect on Parkinson's disease

(Allen et al., 2011; Mansfield et al., 2015; Shen et al., 2016), multiple sclerosis (Sosnoff & Sung, 2015; Gunn et al., 2015), visual impairment (Gleeson et al., 2014) and adults aged 40-65 (Ferreira et al., 2012). It also showed positive effects on those with knee arthritis (Mat et al., 2015) and the elderly (Cadore et al., 2013). In the case of discharge from hospital after rehabilitation for stroke, there is insufficient evidence that exercise prevents or reduces falls (Verheyden et al., 2019), but it has been shown that exercise intervention is positive for patients with cognitive impairment (Burton et al., 2015; Chan et al., 2015; Guo et al., 2014) and incontinence (Booth et al., 2015; Jensen & Padilla, 2011). Various exercise programs should be provided 2-3 times a week for more than 6 months to maintain or improve muscle strength and balance (Silva et al., 2013). In order to see the positive effect of exercise, exercise should be practiced continuously and with sufficient frequency (Sherrington et al., 2011).

The hip joint protector is made of hard plastic shields or foam pads, and is used to reduce the impact during a fall and to avoid serious harm such as fracture and related pain, loss of mobility, and death (Papaioannou et al., 2015; Santesso et al., 2014). Studies in long-term care hospitals report conflicting findings (Combes & Price, 2014) or low effects (i.e., protecting about 11 out of 1,000 patients) (Santesso et al., 2014) on the use of hip joint protectors to reduce hip fractures. These results appear to be related to the patient's movement and wearing problems (Wallis & Campbell. 2011; Santesso et al., 2014; Combes & Price, 2014). In evaluating the results of the study, hip braces are highly likely to reduce the risk of hip fractures in the elderly for long-term care hospitals without increasing the risk of falls (Santesso et al., 2014). These devices are suitable for those with history of fractures or

osteoporosis, and for patients with a high risk of fracture and who wander freely (NICE, 2013; Wallis & Campbell, 2011; Papaioannou et al., 2015; Neyens et al., 2011).

The pacemaker should be considered in patients with cardio inhibitory carotid sinus hypersensitivity who experienced an unexplained fall (NICE, 2013). Pacemaker application in the fall-occurring group with cardio-suppressed carotid sinus hypersensitivity (Kenny et al., 2014; Newbury et al., 2001) significantly reduced fainting without cognitive impairment (RR 0.48, 95%CI 0.32 to 0.73).

In the hospitals, it is important to address environmental factors that increase the risk of falls (Papaioannou et al., 2015; Choi et al., 2011; Giles et al., 2015) and fractures (Papaioannou et al., 2015). For example, the risk of tripping, inappropriate shoes, the need for assistance when moving (Ambrose et al., 2015; Ambrose et al., 2013; Boelens et al., 2013; Deandrea et al., 2013; Zhao & Kim, 2015; Rice et al., 2015; Giles et al., 2015) and physical/structural environmental defects (Ambrose et al., 2015; Ambrose et al., 2013; Zhao & Kim, 2015; Rice et al., 2015)

Previous studies have proposed a hospital wide approach to reduce falls and damage caused by falls. The institutional-level approach includes addressing fall prevention activities related to the physical environment, safety culture within the institution, and treatment and techniques (Stubbs et al., 2015). Another approach is a systematic approach to managing organizations (operations, policies and procedures), staff (staff, caregivers and patients), safe facilities and environmental management (Taylor & Hignett, 2016).

Previous studies that analyzed risk factors for fall-related injuries have shown that ABCS (Age > 85, Bones-orthopedic conditions, anti-coagulation and recent

surgery) alone lacks the predictive power necessary to identify patients who are risky for injurious falls, recent surgery was protected, and joint replacement, psychotropic agents, the male sex and history of fall were significantly associated with injuries falls (Aryee et al., 2017).

Characteristics of adults hospitalized with and without cancer were compared to determine factors of serious injuries after fall events. More patients with cancer who had a serious injury received corticosteroids and were treated on a palliative care unit are associated with severe damage and more patients without cancer had higher prevalence of stroke and diabetes history and were treated on a surgical unit (Capone et al., 2013). In addition, it was reported that the higher the age (Chelly et al., 2008; Krauss et al., 2007), and the greater the risk of fall-related injuries when there is no supportive person at the time of the fall (Krauss et al., 2007).

The relationship between the type of drugs taken and the fall-related injury was found that the incidence of fall-related injuries was high when taking selective serotonin reuptake inhibitors (SSRIs), two or more antipsychotics, narcotic drugs, and diuretics (Mion et al., 2012).

STRATIFY (St. Thomas Risk Assessment Tool in Falling elderly inpatients: history of falling, agitation and excitement, blindness, frequent toilet access, walking ability) and fracture risk assessment tool FRAXTM (fracture risk assessment tool: Age, previous fracture, parental hip fracture history, smoking, steroid use, heavy drinking, rheumatoid arthritis) could identify patients prone to severe injuries after falls (Toyabe, 2014).

Patient characteristics, fall situation, and results of injuries revealed in the prospective explanatory study of inpatient falls were as follows. The average age of

patients was 63.4 years, many falls were unassisted (79%) and occurred in the patient's room (85%), during the evening/overnight (59%) and during walking (19%). Half of the falls were elimination-related, which was more common in patients over 65 years old and elimination-related falls increased the risk of fall-related injuries. The medical and neurology services had the highest falls rates, and the highest patient-to-nurse ratios. (Hitchcock et al., 2004).

In particular, the risk factors for severe injuries related to falls were reported to be women, and patients who exercise without assistant or any support person at the time of the fall (Krauss et al., 2007; Bradley et al., 2010).

In Korea, factors affecting injuries after falls of inpatients in a tertiary hospital have shown that it was significantly lower for patients aging 60-69-year-olds than those of 70-79-year-olds and fall related injuries of the patients in the emergency center were significantly higher compared to those of internal medicine department. In terms of fall risk factors, using a brace was significantly lower than any other physical factor (Cho & Lee, 2017). In another study, as a risk factor for falls in patients admitted to a tertiary hospital, it occurred most often in the ward at night, and fell mainly due to dizziness, and most of the state of consciousness was clear and systemic weakness. Ages over 81 years of age, no surgery, poor joint motion, mobility problems, use of equipment, comorbid diseases, and use of two or more drugs were found to be high (Cho et al., 2019).

According to Kim and Lee, there were statistically significant differences between age and bone density disorder as factors influencing falls in hospitalized patients with dementia. In particular, the risk of falls was more than twice as high for the elderly aged 80 or older based on patients aged 60-69, and more than three times

higher for patients with bone density disorders (Kim & Lee, 2019).

As a result of the fall characteristics and risk factors of inpatients in general hospitals with more than 500 beds in Korea, the incidence rate of falls over 60 years old was 70.2%, especially those aged 70-79 years old, and the fall incidence time occurred most during night working hours. Risk factors included age 65 or older, experience of falling during the hospitalization period, physical mobility impairment requiring partial assistance, dizziness, unstable gait, general weakness, use of walking aids, vision impairment, delirium, lack of understanding one's limitation, diseases of the nervous system, and taking the central nervous system drugs (Choi et al, 2017).

In a study on the incidence of falls and risk factors in hospitalized patients, falls were the most common among men, over 70 years old, in the room of internal medicine patients' ward, and night shift nurses. As risk factors, CCI (Charlson Comorbidity Index), which reflects the severity of comorbidities and diseases, and the patient's departments have significant differences in injuries (Yoon et al., 2018).

On the other hand, factors affecting moderate to severe injuries in elderly with falling who visited the emergency room were as follows. The general characteristics were increased age, and the physical and disease-related characteristics were high blood pressure, osteoporosis, comorbid diseases, drug use, and usual drinking history. As factors influencing the severity of injury, the elderly over 85 years old were higher than those aged 65-74 and those who took 1-2 drugs were higher than those who did not (Jo & Kim, 2019).

Electronic health records were used to identify factors related to falls among patients admitted to hematology units. Clinical factors such as self-care nursing,

leukopenia, hypoalbuminemia, and treatment factors such as use of narcotics, antipsychotics, steroids, and patient factors such as low education were significant risk factors. Besides, fall were also associated with increased length of hospital stay and healthcare costs (Jung & Lee, 2019).

CHAPTER III. THEORETICAL FRAMEWORK

1. The conceptual framework

The conceptual framework of this study is formulated as Figure 1 and the theoretical substruction of this study is shown. The conceptual framework of this study includes serious injuries related to falls, independent variables (general characteristics, clinical characteristics, and fall-related characteristics) as relevant factors for serious injuries related falls. Therefore, the conceptual framework of this study was constructed based on literature review, researcher's experience and previous studies.

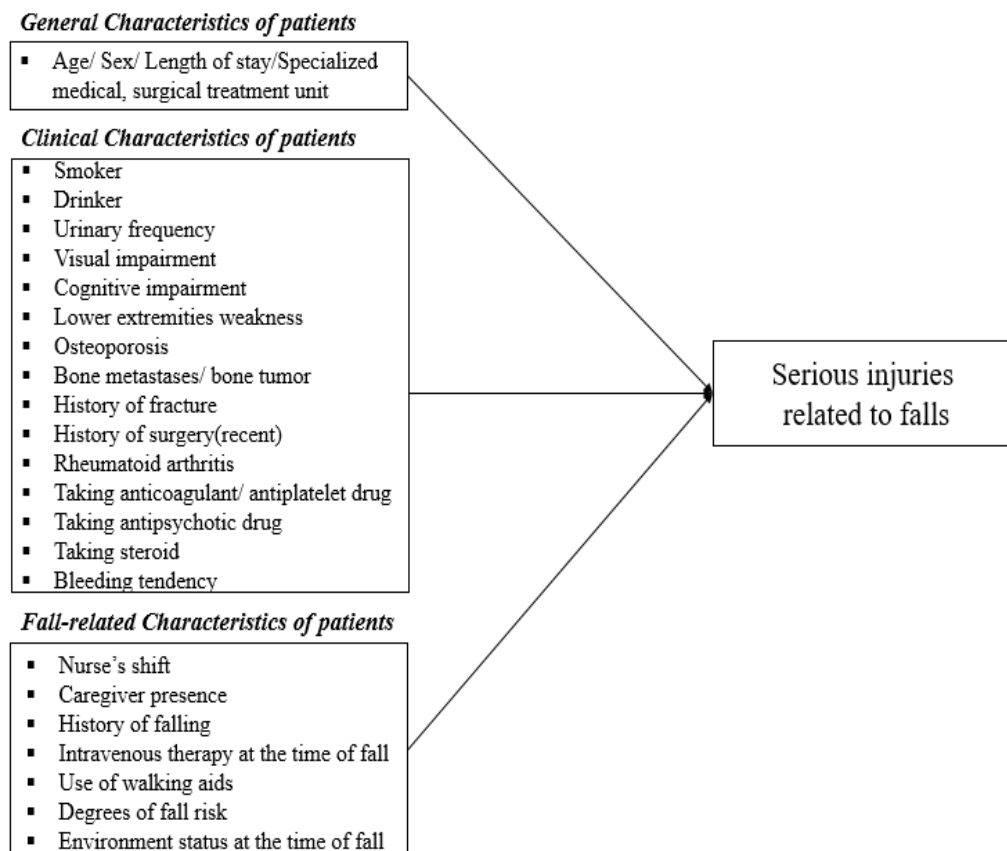


Figure 1. Conceptual frame work of the study

CHAPTER IV. METHODS

1. Study design

This study is a cross-sectional retrospective design that analyzed the degree of fall-related injury and the risk factors related to serious fall injuries among hospitalized patients.

2. Participants

The participants of the study were 298 patients who have met the criteria for selection among the total number of adult patients over 19 years of age reported as falls at S University Hospital from January to December 2017. The inclusion criteria were as below:

1) Inclusion and exclusion criteria

- (1) Those aged ≥ 19 years were included as adults.
- (2) Exclusion criteria were children's ward, psychiatric ward, intensive care unit, emergency room, outpatient fall patients, and those who were not evaluated on the Morse Fall Scale.

2) Sample size

The power analysis was calculated with G*Power 3.1.9.2. Concerning power, the sample size was calculated considering the use of multinomial logistic regression statistical method, 294 samples were derived by selecting Odds Ratio(OR) 1.4, Pr

($Y=1|X=1$) H_0 0.5, significance level 0.05, and power 0.8 (Cho & Lee, 2017).

In this study, a total of 298 patients with fall report for the whole year of 2017 were selected.

3. Measurements

1) Degree of injuries related to falls

Data were collected by dividing fall-related injuries into five stages: no harm, minor injury, moderate injury, severe injury, and death. If the collected data indicated no harm or minor injury, the fall was defined as without serious injury, and if the collected data indicated moderate injury, severe injury, or death, the fall was defined as having serious injury. Degree of injuries related to falls was identified in fall reports reported by nurses.

2) General characteristics of patients with reported falls

The general characteristics of all the patients with reported falls were age, gender, length of stay, and treatment unit. These were collected through the patients' electronic health records.

3) Clinical characteristics of patients with reported falls

The clinical characteristics of all the patients with reported falls were smoker, drinker, urinary frequency, visual impairment, cognitive impairment, lower extremities weakness, osteoporosis, bone metastases/bone tumor, history of fracture, surgery during hospitalization, rheumatoid arthritis, taking anticoagulant/antiplatelet drugs, taking antipsychotic drugs, taking steroids, and bleeding tendency. These

were collected through the patients' electronic health records. The clinical characteristics were investigated by judging the presence or absence of all except the bleeding tendency. The presence or absence of bleeding tendency was investigated as follows as a basis for judgment.

Bleeding tendency was defined as a glomerular filtration rate of 50 or less, prothrombin time of 50% or less, platelets of 50,000 or less, or blood clotting disorders, by consultation from a group of experts.

The detailed standards of bleeding tendency were determined for every medical department. It was defined by the nephrologist as the dialysis patients with a platelet count of 15,000 or less or a GFR of 45 or less among patients with kidney disease taking antiplatelet or anticoagulant drugs. In cardiology, it was specified as patients taking two or more anti-platelet drugs or anticoagulants, and in hemato-oncology, it referred to when blood clotting time was 50% or less, platelets were 50000 or less, or had coagulation disorders. The gastroenterologist mentioned the bleeding tendency as the blood clotting time was 50% or less or the platelets were less than 50000, and the neurologist was defined it as to taking antiplatelet drugs and anticoagulants.

Based on this, the final criteria for bleeding tendency included patients taking antiplatelet/anticoagulant drugs, having a blood coagulation disorder, blood clotting time of 50% or less, platelets of 50000 or less, and dialysis patients with a GFR of 45 or less.

4) Fall-related characteristics of patients

Previous studies presented that nurse's shift, caregiver's presence, history of

fall, intravenous therapy at the time of fall, use of walking aid, degree of fall risk, and environmental factors are the characteristics of patients with reported falls. These reported fall-related characteristics were identified from nurses' fall reports.

4. Data collection

Using a case study form developed by three researchers, the data were collected from electronic health records and fall reports. The case study form is divided into the patient's general characteristics, fall-related characteristics, and clinical characteristics. General characteristics consist of age, gender, and length of stay. Fall-related characteristics consist of the existence or absence of serious injury, degree of injury related to falls, type of injury related to falls, caregiver presence, history of falling, intravenous therapy at the time of fall, use of ambulatory aid, degree of fall risk, and existence or absence of environmental factors. Clinical characteristics include smoker, drinker, urinary frequency, visual impairment, cognitive impairment, lower extremities, weakness, osteoporosis, bone metastases/bone tumor, history of fracture, surgery during hospitalization, rheumatoid arthritis, taking anticoagulant/antiplatelet drugs, taking antipsychotic drugs, taking steroids, and having a bleeding tendency. In order to minimize errors and reduce deviations in the process of collecting data among researchers, data were collected using a structured checklist. They also collected data on five cases and the contents were crosschecked to ensure reliability.

5. Ethical considerations

This study was approved by Seoul National University Institutional Review

Board which the authors belong to (approval number 1805-134-948). Prior approval for access to medical records was obtained from the medical records management department and data were collected. The data were managed carefully so that no other than the researcher could access it. Information that can distinguish the subject's identity was replaced with symbols, and the data file was stored in a locked cabinet using the researcher's encrypted computer to protect the subject's information.

6. Data analysis

All statistical analyses were performed using SPSS version 22 (IBM, Armonk, New York).

- 1) To explore participants' fall-related injuries, descriptive statistics such as frequency (percentage) were used.
- 2) To explore participants' general characteristics, clinical characteristics, fall-related characteristics between with serious injuries and without serious injuries, descriptive statistics such as frequency (percentage) and means (standard deviations) were used.
- 3) To examine the differences between group with serious injuries and group without serious injuries, t-tests, chi-square tests were conducted.
- 4) To evaluate the factors influencing fall-related serious injuries, multivariate logistic regression analyses which included clinical characteristics and fall-related characteristics were used and the model suitability test of Hosmer-Lemeshow was performed.

CHAPTER V. RESULTS

1. Participant's fall-related injuries

The fall incidence report rate of hospital is calculated as the number of fall incidence reports per 1,000 hospital stays. In 2017, the total number of hospital stays in the ward was 429,683 days, and the fall incidence report rate was 0.69.

Table 1 shows the consequences of the falls. Among the 298 patients with reported falls, 188 had no related injury (63.1%), 72 patients had minor injury (24.2%), 31 patients had moderate injury (10.4%), and 5 patients had severe injury (1.7%); 2 of the patients had fatal injuries (0.7%). Of the 38 patients with serious (moderate to fatal) injuries (12.8%), 8 involved lacerations requiring sutures (2.7%), 23 involved fractures (7.7%), and 5 had brain injuries (1.7%), whereas 2 falls led to the patients' deaths (0.7%).

Table 1. Consequences of fall (N = 298)

Characteristics	Classification	n (%)
Fall	Without serious injury	260 (87.2)
	With serious injury	38 (12.8)
Degree of injury related to falls	None	188 (63.1)
	Mild	72 (24.2)
	Moderate	31 (10.4)
	Severe	5 (1.7)
	Death	2 (0.7)

Type of injury related to falls	Brain injury	5 (1.7)
	Fracture	23 (7.7)
	Laceration	8 (2.7)
	Abrasion	49 (16.4)
	Bruise	43 (14.4)

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2. General characteristics of patients with reported falls

The average age of 38 fall-related patients with severe injuries was 65.92 years, 8 patients (21.1%) were over 75 years old, and 30 patients (78.9%) were under 75 years old. Among them, 18 (47.4%) were male and 20 (52.6%) were female. The average hospital stay was 11.81 ± 10.68 days. As for the distribution of patients by department, there were 25 patients from internal medicine (65.8%), of which gastroenterology got the most with 8 patients (21.1%), followed by oncology patients with 5 patients (13.2%). There were 13 surgical patients (34.2%), of which 7 patients (18.4%) were from general surgery, followed by 3 patients (7.9%) from obstetrics and gynecology (Table 2).

The average age of 260 fall-related patients without severe injuries was 63.68 years old, 72 patients (27.7%) were over 75 years old, and 188 patients (72.3%) were under 75 years old. Among them, 150 (57.7%) were male and 110 (42.3%) were female. The average length of stay was 16.22 ± 21.33 days. Among 180 internal medicine patients (69.2%), oncology patients obtained the longest stay with 56

(21.5%), followed by hematology patients with 31 (11.9%). The number of surgical patients was 80 (30.8%), general surgery patients were 27 (10.4%), followed by neurosurgery patients with 18 (6.9%).

The general characteristics of the fall group with serious injuries and the fall group without serious injuries were examined by age, gender, hospital stay, and department, but there was no statistically significant difference (Table 2).

Table 2. General Characteristics of Patients with reported falls (N=298)

Characteristics		Total (N = 298)	With serious injuries (n = 38)	Without serious injuries (n = 260)	P
Age(years, mean \pm SD)		63.97 \pm 14.98	65.92 \pm 12.70	63.68 \pm 15.28	0.390
	≤ 54	69 (23.2)	6 (15.8)	63 (24.2)	0.337
	55-64	69 (23.2)	10 (26.3)	59 (22.7)	
	65-74	80(26.2)	14(36.8)	66(25.4)	
	≥ 75	80 (26.8)	8 (21.1)	72 (27.7)	
Sex	Female	130 (43.6)	20 (52.6)	110 (42.3)	0.231
	Male	168 (56.4)	18 (47.4)	150 (57.7)	
Length of stay (day, mean \pm SD)		15.66 \pm 20.33	11.81 \pm 10.68	16.22 \pm 21.33	0.212
Treatment Unit	Surgical	93 (31.2)	13 (34.2)	80 (30.8)	0.669
	Urology	3 (1.0)	0 (0.0)	3 (1.2)	
	Obstetrics & gynecology	9 (3.0)	3 (7.9)	6 (2.3)	
	Plastic & reconstructive surgery	1 (0.3)	0 (0.0)	1 (0.4)	
	Neurosurgery	19 (6.4)	1 (2.6)	18 (6.9)	
	Surgery	34 (11.4)	7 (18.4)	27 (10.4)	

Characteristics	Total (N = 298)	With serious injuries (n = 38)	Without serious injuries (n = 260)	<i>P</i>
Otorhinolaryngology	5 (1.7)	0 (0.0)	5 (1.9)	
Orthopedic surgery	10 (3.4)	2 (5.3)	8 (3.1)	
Thoracic & cardiovascular surgery	12 (4.0)	0 (0.0)	12 (4.6)	
Medical	205 (68.8)	25 (65.8)	180 (69.2)	
Infectious diseases	4 (1.3)	0 (0.0)	4 (1.5)	
Endocrinology	1 (0.3)	0 (0.0)	1 (0.4)	
Gastroenterology	36 (12.1)	8 (21.1)	28 (10.8)	
Cardiology	13 (4.4)	1 (2.6)	12 (4.6)	
Neurology	15 (5.0)	4 (10.5)	11 (4.2)	
Nephrology	18 (6.0)	3 (7.9)	15 (5.8)	
Hospitalist	7 (2.3)	0 (0.0)	7 (2.7)	
Rehabilitation medicine	2 (0.7)	1 (2.6)	1 (0.4)	
Oncology	61 (20.5)	5 (13.2)	56 (21.5)	
Hematology	32 (10.7)	1 (2.6)	31 (11.9)	
Pulmonology	16 (5.4)	2 (5.3)	14 (5.4)	

Abbreviation: SD, Standard deviation.

3. Clinical characteristics of patients with reported falls

The clinical characteristics of the fall group with severe injuries related to falls and the injuries without severe injuries were investigated through the medical records of the patients. Features related to falls are smoking, alcohol dependency, urinary frequency, visual impairment, cognitive impairment, lower limb weakness, osteoporosis, bone metastases/bone tumors, history of fracture, history of recent

surgery, rheumatoid arthritis, taking anticoagulant/antiplatelet drug, taking antipsychotic drugs, taking steroids, and bleeding tendency were investigated. There was no significant difference in clinical characteristics between the severely injured group and the non-injured group. The only statistically significant difference in the characteristics of fall patients between the serious injury group and the group without serious injury was taking anticoagulant/antiplatelet drugs ($p = 0.016$) (Table 3).

Table 3. Clinical characteristics of patients with reported falls (N = 298)

Characteristics	Total (N = 298)	With serious injuries (n = 38)	Without serious injuries (n = 260)	<i>P</i>
	n (%)	n (%)	n (%)	
Smoker (y)	39 (13.1)	5 (13.2)	34 (13.1)	0.999
Drinker (y)	31 (10.4)	6 (15.8)	25 (9.6)	0.255
Urinary frequency (y)	32 (10.7)	5 (13.2)	27 (10.4)	0.578
Visual impairment (y)	20 (6.7)	3 (7.9)	17 (6.5)	0.729
Cognitive impairment (y)	59 (19.8)	5 (13.2)	54 (20.8)	0.271
Lower extremities weakness (y)	101 (33.9)	17 (44.7)	84 (32.3)	0.131
Osteoporosis (y)	12 (4.0)	2 (5.3)	10 (3.8)	0.678
Bone metastases/bone tumor (y)	39 (13.1)	6 (15.8)	33 (12.7)	0.607
History of fracture (y)	26 (8.7)	4 (10.5)	22 (8.5)	0.757
History of surgery (y)	46 (15.4)	3 (7.9)	43 (16.5)	0.168
Rheumatoid arthritis (y)	1 (0.3)	0 (0.0)	1 (0.4)	0.999
Taking anticoagulant/ antiplatelet drug (y)	91 (30.5)	18 (47.4)	73 (28.1)	0.016*
Taking antipsychotic drug (y)	93 (31.2)	12 (31.6)	81 (31.2)	0.999
Taking Steroid (y)	77 (25.8)	12 (31.6)	65 (25.0)	0.387
Bleeding tendency (y)	70 (23.5)	11 (28.9)	59 (22.7)	0.396

* $P < 0.05$; SD, standard deviation; y, yes.

4. Fall-related characteristics of patients

Through the fall occurrence reports, nurse's shift, presence of the caregiver at the time of the fall, history of falling, intravenous therapy at the time, an assistive device was used, degree of fall risk, and environmental status at the time of the fall were analyzed. There was no statistically significant difference in the fall-related characteristics between the serious injury group and the group without serious injury except for history of falling ($p = 0.038$) (Table 4).

Table 4. Fall-related characteristics of patients (N = 298)

Characteristics		Total (N = 298)	With serious injuries (n = 38)	Without serious injuries (n = 260)	<i>p</i>
		n (%)	n (%)	n (%)	
Nurse's shift	Day	97 (32.6)	12 (31.6)	85 (32.7)	0.942
	Evening	83 (27.9)	10 (26.3)	73 (28.1)	
	Night	118(39.6)	16 (42.1)	102(39.2)	
Caregiver presence	Yes	97 (32.6)	17 (44.7)	80 (30.8)	0.092
History of falling	Yes	51 (17.1)	11 (28.9)	40 (15.4)	0.038*
Intravenous therapy at the time of fall	Yes	156 (52.3)	21 (55.3)	135 (54.9)	0.700
Use of ambulatory aid	Yes	52 (17.4)	7 (18.4)	45 (17.3)	0.874
Degree of fall risk ^a	No	94 (31.5)	13 (34.2)	81 (31.2)	0.821
	Low	121 (40.6)	16 (42.1)	105 (40.4)	
	High	83 (27.9)	9 (23.7)	74 (28.5)	
Environment status at the time of fall	None	241 (80.9)	27 (71.0)	214 (82.3)	0.175
	Obstacle	33(11.1)	5 (13.2)	28 (10.8)	
	Improper floor condition	12 (4.0)	3 (7.9)	9 (3.5)	
	Improper shoes	12 (4.0)	3 (7.9)	9 (3.5)	

^aMorse fall scale: No (0–24), Low (25–44), High (≥ 45); * $P < 0.05$; SD, standard deviation.

5. Factors associated with serious injury related to falls

In table 2, 3, and 4, all variances with p-value < .20 or less, (a total 6 variables) were included and as the result of the regression analysis were as follow.

Taking anticoagulants/antiplatelet drugs and fall history are included as independent variables of logistic regression, as they were the two statistically significant differences between the group with serious injury related to falls and the group without serious injury. Lower extremity weakness, history of surgery, caregiver presence, and environmental conditions at the time of fall were added as independent variables and analyzed. Taking anticoagulant/antiplatelet drugs was again found to be the factor that significantly affected serious injuries related to falls ($p = 0.022$) (Table 5).

Table 5. Factors associated with serious injury related to falls.

Variables	B	SE	Wald	p	OR	95% CI	
						Lower	Upper
Lower extremities weakness	0.391	0.377	1.079	0.299	1.479	0.707	3.095
History of surgery	-0.691	0.646	1.146	0.284	0.501	0.141	1.776
Taking anticoagulant /antiplatelet drug	0.833	0.364	5.222	0.022 *	2.299	1.126	4.696
Caregiver presence	0.563	0.367	2.359	0.125	1.756	0.856	3.603
History of falling	0.641	0.417	2.364	0.124	1.899	0.839	4.299
Environment status at the time of fall	0.378	0.206	3.361	0.067	1.460	0.974	2.187

* $P < 0.05$; CI = confidence interval; OR = odds ratio; Hosmer-Lemeshow (goodness-of-fit test) $\chi^2 = 8.015$, $p = 0.331$; Nagelkerke $R^2 = 0.106$, correct classification (%) = 86.8%.

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VI. DISCUSSION

The purpose of this study is to identify the risk factors of serious fall-related injuries by analyzing the difference between the fall group with serious injuries related to falls and falls without related serious injuries. The general characteristics of the participants were compared, including age, gender, treatment unit, and length of stay.

The mean ages of the group with serious fall-related injury and the group without serious fall-related injury were 65.9 and 63.9 years, respectively, and there was no significant difference as a result of comparing the age group. However there was statistically significant difference among the elderly with dementia who were hospitalized and with the age of 80 years than those aging from 60 to 69 (Kim & Lee, 2019) and the results were quite different from the report where elderly aged 70 to 79 fell at a tertiary hospital and had more serious injuries after falls than those with 60 to 69 years of age (Cho & Lee, 2017). In addition, previous studies discuss the different risk factors of varying ages like over 65 years (Choi et al., 2017), over 75 years (Krauss et al., 2016), over 70 years (Yoon et al., 2018), over 81 years (Cho et al., 2019) over 85 years (Jo & Kim, 2019). It is estimated that the rate of hospitalization for elderly patients increases as time goes by with aging. In the future, repeated studies on various discrepancies with age are needed.

There were 18 men (47.4%) and 20 women (52.6%) in the fall group with serious injuries related to falls, and 150 men (57.7%) and 110 women (42.3%) in the fall group without serious injuries related to falls; there was no significant difference between sexes, in this study which is consistent with previous studies (Aryee et al.,

2017; Bradley et al., 2010). The fall group with serious injurious falls stayed in the hospital longer than the fall group without serious injurious falls (11.8 vs. 16.2 days), which also confirms the results of previous studies (Bradley et al., 2010; Jung & Lee, 2019).

In the group with serious injuries related to falls, 25 are from internal medicine (65.8%), 13 surgical (34.2%), while the group without serious injuries got 180 (69.2%) from internal medicine, and 80 from surgical (30.8%), there was no significant difference. A prior domestic study of adult patients showed that patients at the emergency center had a high risk of fall-related injury, but there was no difference between internal medicine and surgery (Cho & Lee, 2017), which is consistent with the results of this study in general ward patients. However, it was said that falls occur frequently in internal medicine system (Yoon et al, 2018).

It can be seen that care is required regardless of treatment and to prevent serious injuries related to falls.

The variables of this study included many items suggested by the fracture risk assessment tool (FRAX™) (Toyabe, 2014) for assessing the risk of injury related to falls (history of fracture, smoker, taking steroids, drinkers, and rheumatoid arthritis) and several variables were used in previous studies (drinker, urinary frequency, visual impairment, cognitive impairment, lower extremity weakness, osteoporosis, bone metastases/bone tumors, surgery during hospitalization, taking antipsychotic drugs, bleeding tendency, and taking anticoagulant/antiplatelet drugs). Fracture risk factors, such as history of fracture, smoking, use of steroids, drinkers, rheumatoid arthritis, osteoporosis, and bone metastases/bone tumors, were not significant and were consistent with the results of Aryee et al (2017).

However, Toyabe et al (2014) recommended that STRATIFY, a fall risk assessment tool, and FRAX™, a fracture risk assessment tool, be evaluated together to predict serious injury. It is believed that it is difficult to predict the risk of serious injury related to falls using the Morse Fall Scale, which is currently in use as the standard assessment tool in hospital settings. In this study, there was no significant difference between the serious injuries related to fall and the non-serious injuries related to fall according to degrees of fall risk evaluated by MFS. Recently, the Korean version of the effective adult fall evaluation scale (FAS-K) was developed for inpatients in general hospitals in Korea. Through a comparative study with MFS, which is widely applied and analyzed as the most effective predictor of fall risk for inpatients in adults, the predictability and effectiveness of this tool reflecting the characteristics of domestic clinical sites were verified at the practical level and an in depth study is needed to figure out its usefulness(Choi et al., 2019).

After consulting an expert in each department, we determined the criteria for the bleeding tendency as patients having a glomerular filtration rate of 50 or less, prothrombin time of 50% or less, platelets of 50,000 or less, and blood coagulation disorder. The bleeding tendency was slightly higher in the fall group with serious fall-related injuries, but there was no significant difference (28.9 vs. 22.7%). This was consistent with the results reported from previous studies that the bleeding tendency was not associated with fall-related injury (Bradley et al., 2010).

Anticoagulant therapy was examined in combination with anticoagulant and antiplatelet drugs. There was a significant difference in the fall group of 18 patients (47.4%) with serious fall-related injury and 73 fall patients (28.1%) without serious fall-related injury. As a result, patients taking anticoagulants or antiplatelet drugs had

2.299 times higher incidence of serious fall-related injury than those who did not, which can be considered as a predictor of serious fall-related injury. This was different from the study by Aryee et al, which reported that taking anticoagulants could not predict the risk of fall-related injury (Aryee et al., 2017). This result suggests that medical staff should be particularly diligent regarding fall prevention for patients who are taking anticoagulants or antiplatelet drugs.

Three patients (7.8%) in the fall group with related serious injuries had a surgery during hospitalization compared to 43 patients (16.5%) in the group without fall-related serious injuries. Falls present a risk of opening the surgical site if the sutures have not yet been removed following major surgery on the abdomen, chest, and lower extremities (Quigley et al., 2009). Fortunately, in these cases, the body areas injured by falls were not the surgical sites. In this study, as the patient's condition changes after surgery, the fall risk assessment was re-evaluated, so it is thought that the postoperative fall prevention activities were actively performed.

Taking antipsychotics did not show any significant difference with or without serious injury (31.6% vs. 31.2%), which is inconsistent with the results of a study by Mion et al., who found out that taking antipsychotics was also a risk factor for fall-related injuries (Mion et al., 2012). Taking two or more antipsychotics was reportedly related, which we did not find, although some patients in this study were taking several drugs for conditions such as insomnia, delirium, depression, and schizophrenia. It is believed that the association was found in the earlier study because the use of antipsychotics was the only factor investigated. On the other hand, there was also a result which shows that taking antipsychotics is a significant risk factor for the patient factors related to falls admitted to the hematology ward (Jung

& Lee, 2019).

This study also investigated whether taking steroids is associated with the risk of fracture due to the nature of the drug since it is also included in the fracture risk assessment tool. Twelve patients (31.6%) in the fall group had serious injuries related to falls, and 65 (25%) in the fall group without serious injury related to the fall. There was no difference between the groups, but previous studies showed that in cancer patients, taking steroids is a risk factor for fall-related injury (Capone et al., 2013; Jung & Lee, 2019)

As for the serious injuries related to falls, understanding the fall situation was considered important, and as the characteristics of the fall, the caregiver presence, intravenous therapy at the time of fall, the risk degree of fall, the use of ambulatory aid, the environmental factor, and the history of falling were investigated. In the fall group with serious injuries related to falls, 17 (44.7%) were in the presence of a caregiver at the time of the fall, and 80 (30.8%) in the fall group without serious injuries related to the fall. If there was no caregiver, the incidence of serious injury was higher (30.8% vs. 44.7%), but there was no significant difference. Krauss et al. reported that serious injury occurs when no one is there as support at the time of the fall, which is not consistent with the results of this study (Krauss et al., 2007). This is thought to be due to the lack of understanding of the role of the caregiver in preventing falls and injury, although education is being given to residents to prevent falls. Therefore, it is thought that the participation of the caregiver in fall prevention activities in the future can effectively prevent fall-related injuries.

In connection with history of falling, 11 (28.9%) in the fall group with serious injuries related to falls, while 40 (15.4%) in the fall group without serious injuries

related to falls were reported. In the fall group with serious injuries related to falls, there were many cases with a history of falling, and a significant difference was found compared to the fall group without related serious injury, which is consistent with the results of previous studies (Aryee et al, 2017; Choi et al., 2017). Therefore, patients who have previously experienced a fall may be more likely to suffer a more serious injury after a fall, highlighting the need for fall prevention. In this study, there were 11 cases of patients with repeated falls: One patient reported four falls, one reported three, and nine reported two. Six of them were found to have suffered fall-related injuries such as skull fractures, bruises, abrasions, and bleeding gums.

There was no significant difference between the two groups in the use of ambulatory aids such as wheelchairs and walkers (18.4% vs. 17.3%). This result conflicts with another study which reported that non-use or the use of the ambulatory aid was related to fall-related injuries (Cho & Lee, 2017; Choi et al., 2017).

In most previous studies, there were many findings that fall occurs frequently at night (Choi et al., 2017; Yoon et al., 2018; Cho et al, 2019), but in this study there was no significant difference between nurses' shifts.

In addition, the fall incidence rate of inpatients in an general hospital in the suburbs of a large city is 1.38 to 1.99 per 1,000 hospital stays (Yoon et al., 2018), 0.55 in a study of 18 general hospitals (Choi et al., 2017), and 0.93 to 1.51 at a tertiary hospital in a satellite city area in Korea (SNUBH, 2020). Although it was reported as 0.69, direct comparison is difficult because there were departments excluded from the subject in this study.

The limitation of this study is that it cannot be generalized because the data were analyzed for only a year of reported falls and adult patients in a hospital.

Moreover, the degree of injuries related falls would vary depending on the size of the hospital and the patient's specific disease. In particular, it is very important to distinguish between accidental factors such as external environmental risk factors and predictable physiological factors and unpredictable intrinsic factors.

Despite these limitations, the present study has several strengths.

First, by identifying risk factors for serious injuries related to falls, we were able to take a step closer to preventing death or severe injury.

Second, fall prevention education to patients and caregivers should be offered to patients taking anticoagulant/antiplatelet drugs to prevent serious injury related to falls. It is thought that patients with a high probability of falls can be provided with customized education programs that can prevent falls and minimize fall-related injuries in the clinical fields.

Third, it is believed that it can bring social benefits such as shortening hospital stays and reducing medical expenses by preventing serious fall injuries.

Based on the above research results, the following suggestions are recommended.

First, it is suggested to conduct repeated studies to identify the risk factors that cause serious injuries related to falls.

Second, it is necessary to study the risk factors for patients admitted to each department, especially in the emergency room, hematology ward, oncology ward, and cardiology ward.

Third, it is necessary to investigate the cause of the severity of the fall in a long period of time by discriminating between external environmental risk factors,

predictable physiological falls, and unpredictable intrinsic factors.

VII. CONCLUSION

Falls in hospitalized patients can cause serious injuries such as fractures, cerebral hemorrhage, and death. In addition, fall-related injuries lead to extended hospital stays, and increased medical expenses. They can also cause misery for the patients and their families and can lead to civil complaints, such as medical lawsuits. Therefore, it is necessary to have means of predicting the risk of serious fall-related injuries and provide preventive interventions. In this study, the characteristics between the groups with and without serious fall-related injuries were compared to identify the risk factors for serious fall-related injuries.

A cross-sectional retrospective descriptive research study was conducted to analyze the medical records of adult patients over 19 years of age with reported falls at the Seoul National University Hospital from January to December 2017. Anticoagulant/antiplatelet drugs were found to be predictors of serious fall-related injuries. These results suggest that patients taking anticoagulant/antiplatelet drugs should be designated as a high-risk group for serious injuries related to falls requiring active interventions for injury prevention.

Hospitals use a fall risk assessment tool that has proven validity and reliability, yet it is inadequate for predicting falls and serious fall-related injuries. To predict falls and injuries related to falls, hospitals must include evaluations of diverse characteristics and factors to determine the degree of risk of falls and injury in addition to the basic fall risk assessment tool. The study of fall risks will serve as a basis to develop a measuring tool for nursing care needed to prevent falls in hospitals.

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APPENDIXES

Appendix 1. Permission if Institutional Review Board

서울대학교의과대학/서울대학교병원
의학연구윤리심의위원회



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심의결과통보서

IRB No.	H-1805-134-948		제출경로	서울대병원	
수신	책임연구자	정현명	소속	간호본부	직위
	의뢰기관				
연구과제명	상급종합병원 입원환자의 낙상관련 심각한 손상의 위험요인 분석				
Protocol No.			Version No.	1	
생명 윤리법에 따른 분류	<input checked="" type="checkbox"/> 인간대상연구 <input type="checkbox"/> 인체유래물연구 <input type="checkbox"/> 배아줄기세포주이용연구 <input type="checkbox"/> 배아연구 <input type="checkbox"/> 체세포복제배아연구 <input type="checkbox"/> 단성생식배아연구 <input type="checkbox"/> 배아생성의료기관 <input type="checkbox"/> 인체유래물은행				
연구종류	임상 ■ 시험의 연구	<input type="checkbox"/> 증례보고 <input type="checkbox"/> 생체학적 연구 <input type="checkbox"/> 단면조사연구 <input type="checkbox"/> 조사, 설문, 인터뷰 연구 <input type="checkbox"/> 환자군 연구 <input type="checkbox"/> 환자-대조군연구 <input type="checkbox"/> 인체유래물저장소 연구 <input type="checkbox"/> 등록(레지스트리) 연구 <input type="checkbox"/> 시판후사용성적조사 <input type="checkbox"/> 전향적 코호트 연구 <input checked="" type="checkbox"/> 후향적 코호트연구 <input type="checkbox"/> 기타			
			<input type="checkbox"/> 임상 시험	연구 대상	<input type="checkbox"/> 의약품 <input type="checkbox"/> 생물학적제제 <input type="checkbox"/> 건강기능식품 <input type="checkbox"/> 의료기기 <input type="checkbox"/> 기타
	Phase	<input type="checkbox"/> 제1상 <input type="checkbox"/> 제1/2상 <input type="checkbox"/> 제2상 <input type="checkbox"/> 제2/3상 <input type="checkbox"/> 제3상 <input type="checkbox"/> 제4상 <input type="checkbox"/> 생물학적동등성 <input type="checkbox"/> 기타			
	식약처 승인 대상 여부	<input type="checkbox"/> 식약처승인대상 <input type="checkbox"/> 승인 제외 대상			
	임상시험 목적	<input type="checkbox"/> 학술용 <input type="checkbox"/> 국내(MFDS) 허가용 <input type="checkbox"/> 해외 허가용			
	연구계획서승인일	2018년 05월 25일 (정기보고주기 : 12개월)			
승인유효 만료일	2019년 05월 24일		심의대상	연구계획서의 의뢰서(신규)	
심의종류	신속심의		심의일자	2018년 05월 25일	
접수일자	2018년 05월 21일		심의결과통보일	2018년 05월 25일	
심의목록	1. 연구계획서 심의의뢰서(신규) 2. 연구계획서 - 연구계획서-IRB (1.0) 3. 연구대상자 동의연제사유서 4. 증례기록서 5. 연구책임자의 최근 이력				
심의결과	승인				
연구의 위험도	최소위험 연구(minimal risk)				
심의의견	[연구대상자에게 최소한의 위험만이 있는 연구로 신속심의 대상이며, 연구대상자 동의 연제 사유가 합당합니다. IRB의 승인 기준에 부합하여 승인합니다.] - 김문숙 공동연구자의 연구윤리교육 이수 유효기간 만료일이 2018년 7월 17일이며 기간내 교육 갱신 권고드립니다.				

의 학 연구 윤 리 심 의 위 원 회 위 원 장

본 통보서에 기재된 사항은 IRB의 기록된 내용과 일치 함을 증명합니다.
 본 기관 IRB는 생명윤리 및 안전에 관한 법률, 약사법, 의료기기법 및 ICH-GCP 등 관련 법령을 준수합니다.
 본 연구와 이해관계(Conflict of Interest)가 있는 위원 이 있을 경우 연구의 심의에서 배제하였습니다.

Appendix 2. Data Collection Tool (Case Record Sheet)

중 폐기특지

일반적 특성				낙상 관련 특성					
나이	성별	재원일수	진료과	낙상과거력	보호자 동반	보행 보조기구 사용	낙상 전 낙상위험 사정 점수	낙상 당시 수액 주입	낙상 당시 환경 상태

임상적 특성									
골다공증	골전이/ 골종양	골질 과거력	출혈경향	최근 수술	항응고제/ 항혈소판제 복용	항정신병약 복용	스테로이드 복용	인지장애	시력장애

임상적 특성				
흡연	알코올 의존	류마티스 관절염	배뇨장애	하지위약

Appendix 3. SNUH Fall Report

보고서 및 보고자 정보				
환자 정보				
등록번호		환자명		
성별		나이		
진료과		소속병동		
진단명				
발생일시		보호자 동반여부		
발견자				
낙상장소				
낙상 당시 상황				
환자상태				
활력징후	낙상전		낙상후	
낙상 전	의식상태		인지상태	
	감정상태		감각장애	
	운동/활동		보행보조기구	
	투약상태			
	기타			
	최근 낙상위험 사정 접수			
	낙상 당시 수액 주입			
낙상당시 환경상태				
부적절한 바닥	부적절한 신발	장애물	해당없음	
침상난간	종류			
	난간상태			
	올리지 않은 이유			
시행된 중재				
낙상으로 인한 결과				

국문 초록

상급종합병원 입원환자의 낙상 관련 심각한 손상의 위험요인 분석

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지도교수 김 진 현

의료기관 내 낙상은 골절, 뇌출혈, 사망과 같은 심각한 손상을 유발하기도 하며 낙상관련 손상은 재원일수 연장, 의료비 증가를 가져오고 환자와 가족의 정신적 고통, 의료소송과 같은 민원을 유발할 수 있다. 따라서 낙상관련 심각한 손상 위험을 예측하여 예방적 중재를 제공하는 것이 중요하기에 본 연구에서는 낙상관련 심각한 손상이 발생한 군과 발생하지 않은 군 간의 특성을 비교하여 낙상관련 심각한 손상의 위험요인을 찾고자 하였다.

본 연구는 후향적 서술적 조사연구로 2017년 1월부터 12월까지 S대학교병원에서 낙상으로 보고된 19세 이상 성인환자의 의무기록을 대상으로 하였다. 선행 연구결과를 토대로 일반적 특성(나이, 성별, 재원일수, 진료과), 임상적 특성(흡연, 알코올 의존, 배뇨 장애, 시력 장애, 인지 장애, 하지 위약, 골다공증, 골전이/골종양, 골절 과거력, 최근 수술, 류마티스성 관절염, 항응고제/항혈소판제 복용, 항정신병약 복용, 스테로이드 복용, 출혈 경향), 낙상관련 특성(낙상 당시 환경상태, 보행보조기구 사용, 보호자 동반, 낙상

당시 수액주입, 낙상 과거력)을 조사하였다. 연구 결과 낙상관련 심각한 손상이 있는 낙상군과 낙상관련 심각한 손상이 없는 낙상군에서 유의한 차이를 보인 특성은 항응고제/항혈소판제 복용과 낙상 과거력이었다. 낙상관련 심각한 손상에 대한 예측요인은 항응고제/항혈소판제 복용으로 항응고제/항혈소판제를 복용하는 경우 낙상관련 심각한 손상 위험이 2.299배 더 큰 것으로 나타났다.

본 연구 결과를 토대로 항응고제/항혈소판제를 복용하는 환자는 낙상관련 심각한 손상의 고위험군으로 지정하여 손상 예방을 위한 적극적인 중재가 필요할 것으로 생각된다.

주요어 : 낙상, 낙상 사정, 심각한 손상, 입원환자 낙상 고위험군 평가

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