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Incidence, Morbidity and Mortality in Patients Older than 50 Years with Second Hip Fracture in a Jeju Cohort Study

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Purpose: Although the incidence of a second hip fracture is relatively well described, mortality and morbidity after a second hip fracture are seldom evaluated. The purpose of this study was to determine the incidence, morbidity, and mid-term mortality of a second hip fracture and evaluate the cause of death after a second hip fracture.

Materials and Methods: Information on patients older than 50 years, who sustained a subsequent hip fracture, were obtained from the records of eight Jeju Island hospitals between 2002 and 2011 to calculate the incidence, morbidity, and mortality of hip fractures in this age group. All patients were followed a minimum of 2 years. A systemic search for death certificates at the National Statistical Office was conducted for patients who were lost to follow-up.

Results: Of 2,055 hip fractures (419 men and 1,636 women), 98 were second hip fractures (13 men and 85 women) during the study period. The mean ages of the patients at the time of the first and second fractures were 78.8 and 80.8 years, respectively. The incidence of a subsequent hip fracture among the first hip fracture was 4.8%. Mean mortality rates at 6 months, 1 year, 2 years, and 5 years were 10.5%, 15.2%, 23.5%, and 42.0% respectively. Cumulative mortality after the second hip fracture at the 5 years follow-up was 41.8%.

Conclusion: Our results demonstrate that a secondary fracture prevention program is necessary to prevent second hip fractures in elderly patients.

Key Words: Hip fractures, Second hip fracture, Incidence, Mortality

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INTRODUCTION

Osteoporosis is a common skeletal disease in the elderly, and osteoporosis-related fractures are one of the most serious medical problems that pose a considerable socioeconomic burden[1-3]. Of them, hip fractures are a major health concern and are more serious than other osteoporotic fractures in elderly in terms of decreased mobility[4], diminished quality of life[5], and excess mortality[4,6]. In addition, medical expenses for hip fractures are the highest compared to those of other

osteoporotic fractures[7].

Second hip fractures can occur after prior hip fractures. The estimated incidence of a second hip fracture among survivors is 2-20%, depending on the length of follow-up[8,9]. A number of studies have reported that sustaining an osteoporotic fracture increases the risk of subsequent fracture[10,11]. Several studies have reported that patients who had a second hip fracture are associated with higher mortality, more comorbidities, and decreased independence than those of patients with a unilateral hip fracture[12,13].

Although several factors such as female sex, living institution, osteoporosis, low vision, dementia, dizziness, cardiac disease, and respiratory disease have been suggested as risk factors after hip fracture[13], the overall risk of a second hip fracture is at least two-fold higher compared to the risk of the first[14,15]. The incidence, risk factors, and short-term mortality of a second hip fracture have been reported, but mid- to long-term mortality rates after a second hip fracture are seldom reported.

The purpose of this study was to determine the incidence, morbidity, and mid-term mortality of a second hip fracture and evaluate the cause of death after a second hip fracture.

MATERIALS AND METHODS

The design and protocol of this study were approved by the institutional review board at each hospital, and informed consent was waived. Participants were drawn from a cohort that has been monitored since 2002 to determine the incidences of hip fractures and mortality and morbidity rates after hip fracture[5,16]. This larger cohort was recruited from Jeju Island, the largest Korean island, which is located southwest of the Korean peninsula. In 2011, Jeju Island had a population of 576,156 including 74,985 men and 90,481 women aged 50 years or more, and 12.1% were aged 65 years or more (9.3% of men and 14.9% of women). Eight hospitals (one university hospital and seven general hospitals) are on the island with orthopedic departments and emergency admission facilities. The medical records and radiography of the eight hospitals between January 2002 and December 2011 were reviewed to identify patients with hip fractures.

Patients who met the diagnostic criteria for femoral neck and intertrochanteric fractures in the International Classification of Diseases 10th revision (ICD-10; S720 and S721) and were older than 50 years at the time of the fracture were recruited. Exclusion criteria were nonresidents of Jeju Island, pathological bone fractures (e.g., metastasis), isolated fractures of the greater or lesser trochanter, and fractures of the subtrochanteric region due to a high energy injury[16].

Hospital data evaluations were performed 6 and 12 months after discharge from the hospital, and every 6 months thereafter. We determined the diagnosis at admission, mechanism of injury, and procedures performed during hospitalization from the medical records.

1. Detailed Study Groups

Ninety-eight patients (13 men and 85 women) participated in the study. Information regarding pre-injury functional status was obtained by interviewing patients or family members. Patient characteristics included in an analysis of risk factors for mortality following a second hip fracture were: age, sex, preoperative and postoperative activities, medical comorbidities, fracture type, surgery or not, and type of fracture repair (hip arthroplasty or internal fixation). Medical comorbidities were assessed using the modified Charlson's Comorbidity Index[17], which was calculated by summing points awarded for disease conditions as follows: 1 point for myocardial infarction, congestive heart failure, deep vein thrombosis, peripheral vascular disease, dementia, chronic obstructive pulmonary disease, arthritis, ulcers, or diabetes; 2 points for cancer or stroke; and 3 points for cirrhosis. Thus, possible total scores ranged from 0 to 15, and higher scores indicated poorer health status[17].

Mortality status was identified using hospital records and/or by interview with the patient's family. A systemic search for death certificates at the National Statistical Office was conducted for patients lost to follow-up.

Post-injury functional outcomes were evaluated using activity levels[18], which were defined as follows: Grade I, normal; Grade II, essentially independent outdoors but requiring help with some activities; Grade III, independent indoors but always requiring help outdoors; Grade IV, not independent indoors but able to walk independently; and Grade V, confined to a bed or chair and not ambulatory. Patients unable to attend follow-up evaluations were interviewed by telephone. Care was taken during follow-up evaluations to interview the caregiver interviewed previously during the patient's

hospitalization. This clinical information was collected by one orthopedic surgeon and two nurses.

2. Statistical Analyses

Cumulative mortality rates were calculated at the 3-month, 6-month, 1-year, 2-years, and 5-yearrs follow-up visits. Age, sex, medical comorbidities, fracture type, surgery or not, and type of fracture repair (hip arthroplasty or internal fixation) were assessed to investigate possible relationships between these variables and a second hip fracture. The chi-square test or Fisher's exact test was used to analyze categorical variables and the *t*-test was used for numerical variables. The analysis was carried out using PASW Statistics software ver. 18.0 (IBM Co., Armonk, NY, USA). All reported *P*-values are two sided, and *P*-values <0.05 were considered significant.

Table 1. Demographic Data in the Patients Following a Second Hip Fracture

Variable	Data
Number of patients (hips)	98
Sex (man:woman)	13 (13.3):85 (86.7)
Age (yr)	80.8 (54-94)
Period of hospital follow-up (yr)	5 (2-9)
Diagnosis	
Neck	45 (45.9)
Intertrochanter	53 (54.1)
Management	
Conservative	10 (10.2)
Operation	88 (89.8)
Arthroplasty	56 (57.1)
Internal fixation	32 (32.7)
Cause of death (hips)	41
Pulmonary complications	15 (36.6)
Congestive heart disease	10 (24.4)
Lover disease	4 (9.7)
Cancer	3 (7.3)
Unknown	9 (22.0)

Values are presented as number only, number (%), or mean age (range).

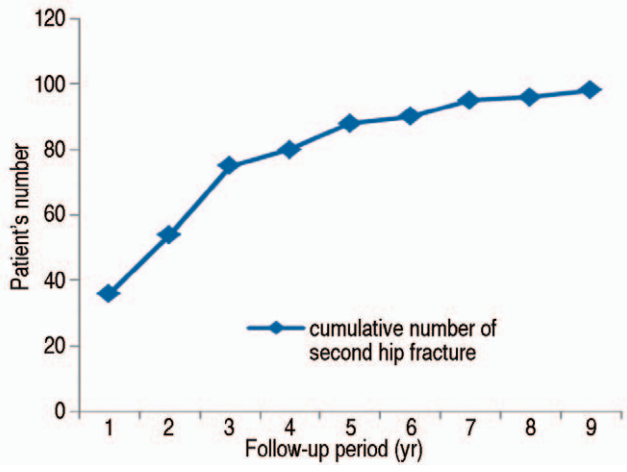

Fig. 1. Cumulative numbers of second hip fractures.

RESULTS

A total of 2,055 hip fractures were enrolled. Of them, 98 patients (13 men and 85 women) experienced a second hip fracture between 2002 and 2011. There were femoral neck fractures in 45 hips (45.9%) and intertrochanteric fractures in 53 hips (54.1%). Sixty-four hip fractures occurred in the same diagnostic area as the first hip fracture. The mean age of the patients at the time of the second hip fracture was 80.8 years (range, 54-94 years). All patients were followed for a mean of 5 years (range, 2-9 years) (Table 1).

The incidence of a second hip fracture was 4.7% (98/2,055 hips). Second hip fractures occurred in 75 (76.5%) hips within 3 years and tended to decrease (Fig. 1).

Forty-one patients (four men and 37 women) died during the follow-up period. The cumulative mortality rate after fracture was 8.2% at 3 months (eight hips), 10.5% at 6 months (10 hips), 15.2% at 1 year (15 hips), 23.5% at 2 years (23 hips), and 41.8% at 5 years (41 hips) (Fig. 2).

Univariate analysis for risk factors for a second hip fracture showed that sex (*P*=0.103), age (*P*=0.976), type of fracture repair (*P*=0.521), pre-injury activity (*P*=0.123), and medical comorbidities using the modified Charlson's Comorbidity Index (*P*=0.324) were not associated with risk factor and surgical treatment (*P*=0.000) was only significant (Table 2). However, this finding might be a confounding factor for a second hip fracture because patients who undergo conservative treatment after a hip fracture have high mortality and little chance to survive over the long-term. The causes of death were pulmonary complications in 15 cases, congestive heart disease complications in 10, liver disease in four, cancer in three, and unknown in nine (Table 1).

Of the 57 patients that remained alive at the final follow-up, 21 of 45 patients (46.6%) who had pre-injury outdoor activity levels (Grade I and II) achieved outdoor activity at a mean of 5 years after the second hip fracture (range, 2-9 years) (*P*<0.001).

DISCUSSION

Although the incidence of hip fracture in several advanced countries has tended to decrease, hip fracture incidence in South Korea has been increasing steeply during the last decades[16,19-21]. In addition, the incidence of a first hip fracture in the Jeju cohort (0.2%; 304/165,466 in 2011) was much lower than the incidence of a second hip fracture (4.8%). Although mortality rates after a first hip fracture have been reported, few data are available on mid- to long-term mortality and morbidities after a second hip fracture. In this prospective cohort observational study, we found that the 5-year cumulative mortality rate after a second hip fracture was 41.8%.

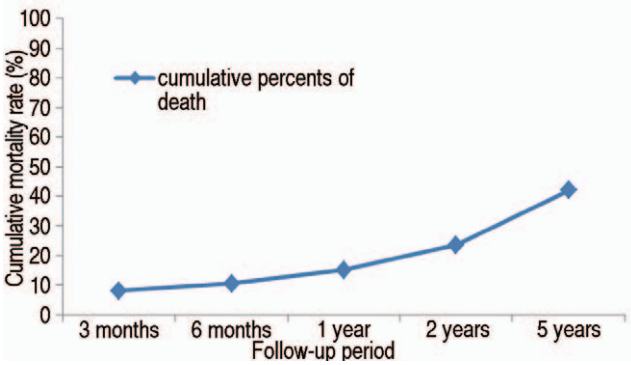

Fig. 2. Cumulative mortality rate after a second hip fracture.

The mid-term cumulative crude mortality rate after a second hip fracture in this cohort study was similar to our previous study after a first hip fracture in the same cohort[5]. Lee et al.[5] performed a prospective cohort study to evaluate morbidity and mortality in 790 patients older than 50 years who sustained a femoral neck or intertrochanteric fracture from 2002 to 2006. They reported that accumulated mortality after the first hip fracture was 16.7% at 1 year and 45.8% at 5 years. In our study, the cumulative mortality rate continued to increase throughout the study period, and the mean crude mortality rates in patients older than 50 years at 1 and 5 years after the second hip fracture were 15.2% and 41.8%, respectively (Table 3). When we compared those previous studies regarding mortality after a second hip fracture[8,9], our findings regarding crude mortality rates concurred with values reported previously. Ryg et al.[9] performed a nationwide population-based cohort study on 169,145

Table 2. Risk Factors for a Second Hip Fracture

Factor	First hip fracture (n=1,859)	Second hip fracture (n=98)	*P*-value
Male:female	393:1,466	82:290	0.103
Age (yr)	78.82±10.01	78.86±8.62	0.976
Diagnosis			1.000
Neck	946	186	
Intertrochanter	913	186	
Operation			0.000
Yes	1,667	96	
No	192	2	
Operation name			0.521
Arthroplasty	782	42	
Internal fixation	880	54	
Preoperative activity			0.123
Grade I-II	1,376	68	
Grade III-V	483	33	
Medical comorbidity	1.25±1.2	1.36±1.3	0.324

Values are presented as number only or mean±standard deviation.

Table 3. Comparison of Cumulative Mortality between Primary Hip Fractures and Second Hip Fractures in the Jeju Cohort

Fracture	6 Month	1 Year	2 Years	5 Years	7 Years	8 Years
First hip fracture (%)	11.4	16.7	25.2	45.8	54.2	60
Second hip fracture (%)	10.5	15.2	23.5	41.8	-	-

-, not available.

cases with a first hip fracture and reported that patients with a second hip fracture had substantial mortality rates of 27% and 64% in men and 21% and 58% in women after 1 year and 5 years, respectively. Their data were similar to mortality rates published previously and observed in the cohort after a first hip fracture (32.9% vs. 63.4% in men and 23.9% vs. 56.2% in women)[9,22].

Surgical treatment was the only risk factor associated with a second hip fracture in our study. However, patients who undergo conservative treatment after a hip fracture have high mortality and little chance to survive over the long-term[5]. Patients who undergo surgical treatment survive but have more chance to suffer a second hip fracture[23]. Therefore, surgical treatment might be a confounding factor for a second hip fracture. Liu et al.[24] performed a systemic review and metanalysis of risk factors for a second hip fracture using 13 case-control studies. They suggested that possible risk factors for a second hip fracture were female sex, living institution, osteoporosis, low vision, dementia, dizziness, cardiac disease, and respiratory disease. However, in that study, medical comorbidities were not an associated risk factor for a second hip fracture.

Activity levels after the second hip fracture revealed increased mobility limitations and disability in the cohort at the latest follow-up. Patients who survived the second hip fracture had poor functional outcomes. Twenty-four of 45 patients (53.3%) who had pre-injury outdoor activity levels (Grade I and II) did not achieve independent outdoor activity at a mean of 5 years after the second hip fracture. This finding agrees with a previous study regarding mobility after a first hip fracture. Lee et al.[5] reported that 67.9% (199/293) of patients capable of independent outdoor activity before fracture retained this ability at a mean of 6 years after the first hip fracture.

This study had several limitations. First, the Jeju cohort population comprised only 1.1% of the total registered population of South Korea. Therefore, this study was not large enough to generalize as nationwide data. However, we evaluated the epidemiological data prospectively during a mean follow-up of 5 years. Second, sex-specific mortality after the second hip fracture could not be evaluated because the proportion of men was too small. Third, walking ability as morbidity was evaluated over an extended period (range, 2-9 years). However, several studies have reported that functional recovery can be largely achieved during the first 4-6 months after a hip fracture[25-28]. Therefore, the activity evaluation bias in this study may have been minimized because all patients were followed for a minimum 2 years postoperatively. Fourth, in univariate analysis, surgical treatment (P=0.000) is only significant factor for second hip fracture. However, this finding is difficult to accept as an important risk factor. Mostly the reason of conservative treatment in patients with hip fracture was poor general condition and had high rate of early mortality. Therefore, second hip fractures occur in survivors from hip fracture. In addition, patients with surgical treatment might be susceptible to second hip fracture because of more severe fracture. However, severity of fracture in this study did not evaluate. These confounding factors might be influenced on this finding. Finally, antiosteoporosis medications are generally recommended to prevent second hip fractures[29,30]. The evaluations of type and duration of antiosteoporosis medications are helpful to understand this study. However, we did not evaluate postoperative antiosteoporotic medications in this study group.

CONCLUSION

The incidence of a second hip fracture was 4.8%. The cumulative mortality rate after the second hip fracture at the 5-year follow-up was 41.8%. Therefore, our results demonstrate that a secondary fracture prevention program is necessary to prevent second hip fractures in elderly patients.

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