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Original Study

Risk Analysis for Second Hip Fracture in Patients After Hip Fracture Surgery: A Nationwide Population-Based Study

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A B S T R A C T

Objectives: The current treatment program for fragility hip fractures (HFx) emphasizes a combination of early surgery, rehabilitation, and tertiary prevention strategy for osteoporosis; however, the effect is unclear and little information is available on the risk factors predicting the occurrence of a second hip fracture (SHFx). The aim of this study was to explore the incidence, risk factors, and subsequent mortality of SHFx in patients after their first hip fracture surgery (HFxS).

Design, Setting, and Participants: We performed a nationwide population-based longitudinal observational study using the National Health Insurance Research Database (NHIRD) of Taiwan with a logistic regression model analysis. Of 87,415 patients undergoing HFxS during the period 2004 to 2007, we identified 8027 patients who had sustained an SHFx for analyses.

Measurements: Data collected included patient characteristics (demographics, comorbidities, and concurrent medication use), incidence and hazard ratios of SHFx after HFxS, and subsequent age-specific mortality.

Results: The overall incidence of SHFx was 9.18% and the age-specific mortality was increased 1.6- to 2.2-fold in patients with SHFx compared with those without after HFxS in this 7-year longitudinal study. The identified risk factors included age (AOR = 1.84, 95% CI: 1.24–2.89), female gender (AOR = 1.12, 95% CI: 1.03–2.30), obesity (AOR = 2.89, 95% CI: 1.81–3.01), diabetes (AOR = 3.85, 95% CI: 2.54–4.05), arterial hypertension (AOR = 2.45, 95% CI: 1.83–2.62), hyperlipidemia (AOR = 2.77, 95% CI: 1.27–3.19), stroke/TIA (AOR = 2.85, 95% CI: 2.20–3.23), blindness/low vision (AOR = 3.09, 95% CI: 2.54–3.73), and prolonged use of analgesics and anti-inflammatory medications (all AOR $\geq$ 3.05, all *P* values $\leq$.012). Bisphosphonate therapy after HFxS had a significant negative risk association with the development of an SHFx (20.8% vs 32.3%, *P* = .023; AOR = 2.24, 95% CI: 1.38–2.90).

Conclusion: We concluded that the occurrence of an SHFx and subsequent mortality in patients after HFxS is rather high. An understanding of the risk factors predicting the occurrence of an SHFx provides a valuable basis to improve health care for geriatric populations.

Fragility hip fracture (HFx), one of the most severe consequences of osteoporosis, is a common and increasing cause of hospitalization, morbidity, lifelong disability, and even premature death.[1–6] In a systemic epidemiological review Abrahamsen et al[7] reported that patients are at increased risk for premature death for many years after a fragility HFx, with an excess mortality rate during the first year after fracture ranging from 8.4% to 36.0%. Other studies have indicated that the cumulative mortality rates associated with HFx may be higher than that for other better known life-threatening conditions, such as pancreatic or gastric cancer and myocardial infarction.[8–10] Even though patients survived after HFx, they exhibited decreased quality of life and increased dependence on family, caregivers, and social services. Also, the burden on the society is considerable because of the direct costs of hospital care, rehabilitation, and nursing home facilities.[5] Almost 14% of fragility fractures and 72% of the total

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The authors declare no conflicts of interest.

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cost burden was borne by HFx.[11] As the elderly population increases rapidly worldwide, HFx have already become an important public health and socioeconomic issue. The current treatment program for HFx, therefore, emphasizes a combination of early surgery, rehabilitation, and prophylactic strategies, with the goal of improving the treatment outcome and decreasing the cost burden on the family and society.[12]

During the past decades, many studies have been conducted to find the best prophylactic strategies focusing on primary, secondary, or tertiary prevention of osteoporosis to ensure better management of these disorders and to maximize the chances of substantially alleviating their burden.[4,7–14] Primary prevention is aimed at a fracture risk reduction in the general population. Secondary prevention involves the screening of osteoporosis to identify those who may have a high risk of fragility fractures. Tertiary prevention is a strategy to prevent future fractures in patients who have already sustained a fracture.[13] Given the health care resources constraint, preventing a second hip fracture (SHFx) in patients after hip fracture surgery (HFxS) is a major concern because it is the most devastating fracture for patients, an extremely hard rehabilitation process to go through, and a considerable cost burden on the family and society for that condition.[11,12,14–16] The most common ways to prevent these catastrophic events include lifestyle modification, pharmacologic therapy, and fall-prevention strategies.[16] However, the effect is unclear and little information is available on the demographic data, risk factors, and outcomes of persons who sustained an SHFx when compared with those without.

Based on a nationwide population-based longitudinal observational study design, we aimed to determine the incidence rate, demographic characteristics, and risk associations of patients who developed an SHFx following HFxS. We also explored the age-specific mortality in these patients. The information from this study may be valuable in improving the medical care of elderly patients after HFxS, thereby preventing the occurrence of an SHFx and subsequent mortality.

Materials and Methods

Database

The Taiwan National Health Insurance (NHI) program, officially commenced since March 1995, enrolls nearly all citizens of Taiwan. As from January 2004, 22.3 million Taiwanese residents, with a coverage rate exceeding 98% of the whole population, have been enrolled in this program. The National Health Insurance Research Database (NHIRD), derived from the payment system of the National Health Insurance Administration (NHIA) and maintained by the National Health Research Institute (NHRI) in Taiwan, provides vital information for research purposes. All the identifiers of individual patients are deleted by the NHIA before data are transferred to the NHIRD. Institutional review board approval is pre-approved by the NHRI for de-identified data. Details on the database generation, and monitoring and maintenance of the NHIRD are published online by the NHRI. The database includes patient demographics, disease diagnosis, medical care institutions, medical expenditure, and prescription claims data. Until now, many studies have been ongoing or published using the NHIRD.

Study Design and Participants

This study was a nationwide population-based longitudinal observational study. The study cases and controls were selected from the NHIRD covering the period from January 2004 to December 2007 and followed longitudinally until December 31, 2010. Subjects were identified from the database by using the following criteria: (1) a discharge diagnosis code of HFx (*International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM] diagnosis codes 820.0–820.9), (2) a procedure code of internal fixation or partial hip replacement (ICD-9-CM procedure codes 79.15, 79.35, and 81.52), and (3) patients aged 45 years or older. The first admission date of HFx was defined as the index date. The exclusion criteria were patients with multiple trauma (Diagnosis Related Group [DRG] codes 484–487); primary or secondary diagnoses of endocrine, nutritional, metabolic and immune diseases (ICD-9-CM codes 240.0–279.9); and those in whom surgery was not performed or who died within the first 48 hours (ie, the difference between the date of death and the date of admission = 0–1 days). Patients who were nonresidents of Taiwan and those with a diagnosis of HFx within the previous 2 years of the index date were excluded to avoid confounding effects. At this stage, 90,314 of a total of 141,314 patients with an HFx were included and followed longitudinally until the end of the study. During the follow-up period, patients with an SHFx were selected as the cases (n = 8,764) and those without as the controls (n = 81,550). We excluded patients with concomitant multiple trauma (DRG codes 484–487) and those with primary and secondary diagnoses of cancer (ICD-9-CM codes 140.0–209.9 or V10) in both groups. Finally, 8027 patients with a SHFx were included in the case group and 79,388 without in the control group. The flowchart of the patient-selection process is presented in Figure 1.

Primary and Secondary End Points

Patients were classified as cases and controls based on the occurrence of an SHFx after HFxS. The primary end point of this study was to determine the incidence of an SHFx after HFxS and the risk association among age, gender, selected morbidities, concurrent medication use, and the occurrence of an SHFx. Age was categorized into 8 groups (45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and ≥80 years). The selected comorbidities included metabolic syndrome ([MetS]; obesity, diabetes mellitus, arterial hypertension, and hyperlipidemia), coronary heart disease, myocardial infarction, cardiac dysrhythmia, peripheral arterial occlusive disease (PAOD), kidney dysfunction, stroke/transient ischemic attack (TIA), dementia, Parkinson disease, blindness/low vision, chronic obstructive pulmonary disease (COPD), osteoporosis, and arthritis. The concurrent medication use included calcium/vitamin D, bisphosphonates, hormone replacement therapy (HRT), selective estrogen receptor modulators (SERMs), calcitonin, steroids, acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), cyclooxygenase-2 (COX-2) inhibitors, antidepressants, stimulants, antipsychotics, mood stabilizers, anxiolytics, and depressants. For our secondary end point, information on age-specific mortality in both groups was collected for further analysis.

Statistical Analysis

A χ^2 analysis was used for analyzing categorical data. Univariate and multivariate analyses by using a logistic regression model were performed to detect the predicting factors having a significant relationship with the occurrence of an SHFx after HFxS. Patients without an SHFx were designed as the reference group and the crude and adjusted hazard ratios (HR) were obtained over the 1-year, 3-year, 5-year, and 7-year follow-up periods. Adjusted factors included age, gender, selected morbidities, and medication use history. The survival rate free of occurrence of an SHFx after HFxS was estimated by using the Kaplan-Meier survival method and the log rank test. Statistical significance was defined as $P < .05$. All statistics were 2-sided and performed using the SAS software (version 9.2; SAS Inc., Cary, NC).