International Journal of Gerontology 15 (2021) 45–48
https://doi.org/10.6890/IJGE.202101_15(1).0009

International Journal of Gerontology

journal homepage: http://www.sgecm.org.tw/ijge/

Original Article

Delirium in Patient with Hip Fracture is Related High Mortality: A National Cohort Study

Yong-Chan Ha [a], Jun-Il Yoo [b *], Ki Soo Park [c,d], Rock Bum Kim [e], Sung-Hyo Seo [c]

[a] *Department of Orthopaedic Surgery, Chung-Ang University College of Medicine, Seoul, Republic of Korea,* [b] *Department of Orthopaedic Surgery, Gyeongsang National University Hospital, Jinju, Republic of Korea,* [c] *Institute of Health Sciences, Gyeongsang National University, Jinju, Republic of Korea,* [d] *Department of Preventive Medicine, Gyeongsang National University School of Medicine, Jinju, Republic of Korea,* [e] *Regional Cardiocerebrovascular Disease Center, Gyeongsang National University Hospital, Jinju, Republic of Korea*

ARTICLE INFO

Accepted 25 August 2020

Keywords:
hip fracture,
mortality,
delirium,
nationwide study

SUMMARY

Purpose: The purpose of this study was to analyze the association between mortality and the prevalence of delirium in patients with hip fracture using national claim data.
Method: This cohort study was conducted from 2010 to 2013, including diagnostic criteria for hip fractures (femoral neck fractures or femur fractures) over 50 years of age. Operational definitions of delirium include disease code and drug use. The mortality rate was calculated using the Charlson's comorbidity index and statistically analyzed using the Cox proportional hazards regression analysis.
Results: A total of 1,587 patients, 209 patients (13.2%) had delirium during hospitalization (66 (31.6%) in males, 143 (68.4%) in females). After adjusting for the comorbidity index, the mortality rate in patients with postoperative delirium was 1.42 times higher than for the patients without delirium during over a mean 17-month follow-up (HR = 1.42, 95% CI; 1.07–1.87, p = 0.007). During the follow-up duration at four years, the cumulative mortality rates were higher in the delirium group (24.3% at one year, 31.8% at two years, 35.8% at three years, and 37.8% at four years, respectively) than in the non-delirium group (14.8% at one year, 21.7% at two years, 24.9% at three years, and 25.5% at four years, respectively).
Conclusion: In this nationwide study, the prevalence of delirium during the hospital stay after hip fracture surgery was 13.2% and the mortality rate in patients with postoperative delirium was 1.42 times higher than for the patients without delirium during a mean 17-month follow-up.

1. Introduction

The aging of the world's population has been a global trend and the increased life expectancy of the elderly population has resulted in increasing numbers of osteoporotic fractures.[1–3] Among these osteoporotic fractures, hip fractures are most important and serious events because of high mortality, decreased morbidity, and reduced health related quality of life.

Delirium is the most common complication of hip fractures and the prevalence of delirium in elderly patients with hip fractures varies from 4% to 53%.[4,5] Delirium after hip fractures is a crucial risk factor which influences longer hospitalization, worsening functional ability, increasing healthcare costs, and high mortality.[2,6,7]

So far, most reported studies regarding prevalence and prognosis of delirium after hip fracture have been performing mostly small-scale retrospective hospital-based studies for several decades.[6,8,9] Thus, we designed the large-scale population based study using the nationwide claim database.

The purpose of this study was to assess the prevalence of delirium, long-term mortality during four years follow-up period, and the association between mortality and delirium in patients with a hip fracture.

* Corresponding author. Department of Orthopaedic Surgery, Gyeongsang National University Hospital, 90 Chilamdong, Jinju, Gyeongnamdo 660-702, Republic of Korea.
E-mail address: furim@hanmail.net (J.-I. Yoo)

2. Materials and method

2.1. Data source

This study used data derived from the Korean National Health Insurance (KNHI) claims database 2002–2013. The National Health Insurance Corporation collects cohort data representative of the country's population. The health insurance sample cohort covers 1,025,340 subjects (2.2% of the population) based on a random stratification according to sex, age, and income level of the population (47,851,928 subjects). The database includes information pertaining to reimbursement for each medical service including basic patient demographics, clinic or hospital identifiers, disease code, costs incurred, results of health screening, individual/family health history, health behavior, and information related to cause of death.[10]

Ethical approval for this study was granted by the institutional review board of Chung-Ang University Hospital (IRB No. C2014086 (1282)). The requirement for informed consent was waived because the study was based on routinely collected administrative and claims data.

2.2. Subjects

This study cohort was constructed by the inclusion criteria of diagnosis of hip fracture (femoral neck fracture or intertrochanteric

fracture) 2010–2013, and age 50 or older. Hip fractures require hospitalizations and surgical intervention, and are recorded prospectively nationwide using ICD-10 codes. To identify osteoporotic hip fractures, selected ICD-10 codes, a minimum cutoff value of 50 years, and a maximum cutoff value of 100 years were used.[1,3,18–20] First, hip fracture was defined as those requiring hospitalization with diagnosis of femoral neck fractures (ICD-10 S720) or intertrochanteric fracture (ICD-10 S721). We limited the cohort to those patients that underwent one of the following seven procedures: open reduction of fractured extremity — femur, closed pinning — femur, external fixation — pelvis/femur, closed reduction of fractured extremity — pelvis/femur, bone traction, skin traction, or hemiarthroplasty — hip, described as elsewhere.[11,12] If an individual was admitted more than once within six months for a hip fracture, this was considered as the same event. Second hip fractures were defined as subsequent hospitalization for operation with a primary diagnosis of femoral neck fracture and intertrochanteric fracture and occurred six months or more after the original admission.[1,3]

2.3. Definition of delirium

We evaluated four different algorithms to identify delirium: (1) ICD diagnosis codes alone; (2) antipsychotics use alone; (3) either ICD diagnosis codes or antipsychotics use; and (4) both ICD diagnosis codes and antipsychotics use. For algorithms based on ICD diagnosis codes, delirium was considered present if any of the following 32 explicit (i.e., including the term “delirium”) or implicit ICD-9 diagnosis codes (e.g., “encephalopathy”) were used among the in-hospital discharge codes.

For algorithms based on antipsychotics use, delirium was considered present if any antipsychotic drugs were used; in our study, we found that only haloperidol, olanzapine, and quetiapine had been prescribed. We did not examine other drugs that could influence risk of delirium (e.g., benzodiazepine or dexmedetomidine).[13]

2.4. Mortality after postoperative delirium in patient with hip fracture

NHIS data were merged with national mortality data from the National Statistical Office to determine the survival of each patient after postoperative delirium during the follow-up.[14]

2.5. Adjustment of comorbidity index

Medical comorbidities were based on the modified Charlson’s Comorbidity Index, calculated as the sum of points awarded for disease conditions as follow: 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 0–15, and higher scores indicated poorer health status.[15]

2.6. Statistical analyses

To analyze the relation between recurrence of osteoporotic fracture and death, the elapsed month from occurrence to death was calculated, and the recurrence was calculated from the occurrence of the final episode until death. The cumulative incidence is defined as the probability that a particular event, such as the occurrence of a specific disease, has occurred. It was calculated by dividing the number of new re-fractures over a period by the number of subjects at the beginning of this study.

The mortality risk was calculated using the Cox proportional hazards regression model and the survival rate was calculated using the life table. All database management and analyses were performed using SAS statistical package version 9.4 (SAS Institute, Cary, NC, USA).

3. Results

Among the total of 1587 patients with hip fracture, there were 461 males and 1126 females. In the total of 1587 patients, 209 patients (13.2%) had delirium during hospitalization (66 (31.6%) in males, 143 (68.4%) in females). As age increased, the incidence of delirium significantly increased (p = 0.002). There was no statistically significant difference between the incidence of delirium and income (p = 0.10) and comorbidity score (p = 0.14) (Table 1).

In an analysis of mortality, mortality was 1.28 times higher in females and 2.61 times higher in females older than age 65. After adjusting for the comorbidity index, the mortality rate in patients with postoperative delirium was 1.42 times higher than for the patients without delirium during a mean 17-month follow-up (HR = 1.42, 95% CI; 1.07–1.87, p = 0.007) (Table 2, Figure 1).

During the follow-up duration at four years, the cumulative mortality rates were higher in the delirium group (24.3% at one year, 31.8% at two years, 35.8% at three years, and 37.8% at four years, respectively) than in the non-delirium group (14.8% at one year, 21.7% at two years, 24.9% at three years, and 25.5% at four years, respectively) (Table 3).

Table 1
Characteristics of subjects according to the presence of postoperative delirium.

Variables	Delirium group (n = 209)	Non-delirium group (n = 1378)	p-value
Gender			0.414
Men	66 (31.6)	395 (28.7)	
Women	143 (68.4)	983 (71.3)	
Age group (year)			0.002
50–54	3 (1.4)	38 (2.8)	
55–59	2 (1.0)	49 (3.6)	
60–64	3 (1.4)	74 (5.4)	
65–69	10 (4.8)	113 (8.3)	
70–74	28 (13.4)	225 (16.3)	
75–79	44 (21.1)	288 (20.9)	
80–84	53 (25.4)	283 (20.5)	
85–	66 (31.6)	307 (22.3)	
Income quintile			0.104
1	47 (22.5)	379 (27.5)	
2	13 (6.2)	132 (9.6)	
3	23 (11.0)	160 (11.6)	
4	33 (15.8)	22 (16.5)	
5	93 (44.5)	480 (34.8)	
Comorbidity score	1.13 ± 1.38	0.98 ± 1.45	0.136

Table 2
Mortality analysis for hip fracture.

	Hazard ratio	95% confidence interval		p value
Gender (ref = men)	1			
Women	1.284	1.137	1.469	0.004
Age (ref ≤ 65 years)				
≥ 65 years	2.608	1.800	3.779	< .0001
Delirium (ref = no)				
Yes	1.416	1.071	1.872	0.015

* Adjusted for Charlson’s comorbidity score.

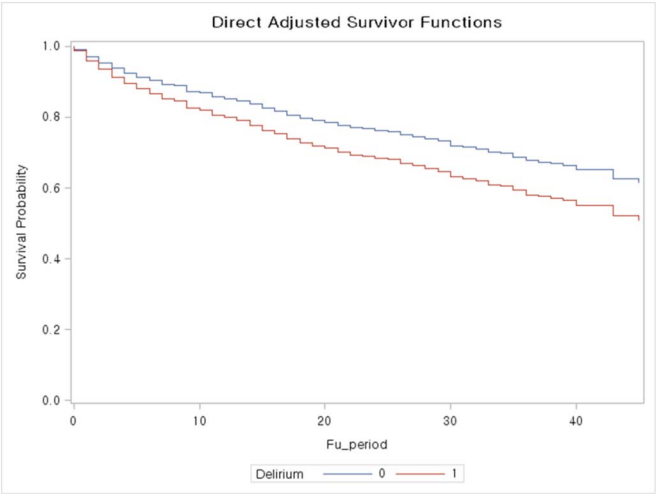

Figure 1. The mortality rate in patients according the presence of post-operative delirium.

4. Discussion

Delirium after hip fractures is a crucial complication because of high prevalence and mortality, decreasing morbidity, longer hospitalization, and hospital costs. This population based study demonstrated that the prevalence of delirium during the hospital stay after hip fracture surgery is 13.2% and the mortality rate in patients with postoperative delirium is 1.42 times higher than for the patients without delirium during a mean 17-month follow-up (HR = 1.42, 95% CI; 1.07–1.87, p = 0.007).

Prevalence of delirium after hip fractures varies 4%–53%. In this study, prevalence of delirium was 13.2% in patients older than age 50 with a hip fracture. The reasons of differences of prevalence of delirium are various because of differences of patients characteristics including age, gender, and other demographics including pre-existing cognitive impairment and medical comorbidities in each study.[16] Smith, et al. analyzed a 6704 people (2090 people with post-operative delirium) using 32 studies and reported nearly a two-times greater probability of post-operative delirium for those age 80 and older.[17] Oh, et al. performed the prospective cohort study using 431 acute hip fracture patients and found that the overall incidence of postoperative delirium was 34%, with males more likely to experience postoperative delirium (44.8%) than females (30.2%) (p = 0.004).[18]

Bellelli G, et al. evaluated the association between the number of days with delirium and six-month mortality in elderly adults after hip fracture surgery using the prospective cohort study with 199 hip fracture patients. They found that each day of postoperative delirium in the orthogeriatric unit increased the hazard of dying at six months by 17% (hazard ratio = 1.17, 95% confidence interval = 1.07–1.28).[19]

Lee, et al. performed the study using 232 elderly patients with hip fracture for evaluating the mortality of prolonged delirium in elderly patients after hip fracture surgery. They reported that the non-delirium group, 73.5% (95% confidence interval, 51.8%–95.2%) in the transient delirium group, and 63.6% (95% confidence interval, 35.2%–92.1%) in the prolonged delirium group.[20] In our study, during the follow-up at four years, the cumulative mortality rates were higher in the delirium group (24.3% at one year, 31.8% at two years, 35.8% at three years, and 37.8% at four years, respectively) than in the non-delirium group (14.8% at one year, 21.7% at two years, 24.9% at three years, and 25.5% at four years, respectively). It has been observed that the mortality rate is continuously increased in the delirious group even after a long follow-up.

Table 3
Cumulative mortality rates during follow-up (2010 to 2012).

	Year	Mortality rates (%)			
		1 year	2 year	3 year	4 year
Non-delirium	2010	16.61	24.72	32.84	35.06
	2011	15.90	25.43	28.32	28.32
	2012	12.43	15.75	15.75	15.75
	Average	14.8	21.7	24.9	25.5
Delirium	2010	18.60	30.23	41.86	48.84
	2011	23.40	29.79	31.91	31.91
	2012	29.31	34.48	34.48	34.48
	Average	24.3	31.8	35.8	37.8

This study has several limitations. First, many risk factors such as immobility, sensory impairment, activities of daily living, electrolyte imbalance, and malnutrition were not considered, because the study was based on the National Claims Registry. Second, the prevalence rate of delirium was underestimated. In this study, delirium was diagnosed only by disease code and drug use. Thus, hypoactive delirium is likely to be excluded from the study. Third, mortality from a specific medical condition or non-medical usage was not analyzed. Additional research studies investigating postoperative delirium and mortality based on large-scale registry data are needed. Finally, the number of hip fracture patients may be underestimate because that only surgical patients were included in the operational definition.

Nevertheless, the national health insurance sample cohort data were used to analyze the association between mortality and the prevalence of delirium in patients with hip fracture using the national claims data.

In this nationwide study, the prevalence of delirium during the hospital stay after hip fracture surgery was 13.2% and the mortality rate in patients with postoperative delirium was 1.42 times higher than for the patients without delirium during a mean 17-month follow-up.

Acknowledgements

This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: HC15C1189). And this work was carried out with the support of “Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ014155052019)” Rural Development Administration, Republic of Korea.

References

1. Lunenfeld B, Stratton P. The clinical consequences of an ageing world and preventive strategies. *Best Pract Res Clin Obstet Gynaecol.* 2013;27:643–659.
2. Mears SC, Kates SL. A guide to improving the care of patients with fragility fractures, edition 2. *Geriatr Orthop Surg Rehabil.* 2015;6:58–120.
3. Colón-Emeric CS, Saag KG. Osteoporotic fractures in older adults. *Best Pract Res Clin Rheumatol.* 2006;20:695–706.
4. Bruce AJ, Ritchie CW, Blizard R, et al. The incidence of delirium associated with orthopedic surgery: a meta-analytic review. *Int Psychogeriatr.* 2007; 19:197–214.
5. Chaudhry H, Devereaux PJ, Bhandari M. Cognitive dysfunction in hip fracture patients. *Orthop Clin North Am.* 2013;44:153–162.
6. Kim JY, Yoo JH, Kim E, et al. Risk factors and clinical outcomes of delirium in osteoporotic hip fractures. *J Orthop Surg (Hong Kong).* 2017;25:

2309499017739485.
7. Kukreja D, Günther U, Popp J. Delirium in the elderly: current problems with increasing geriatric age. *Indian J Med Res.* 2015;142:655–662.
8. Mosk CA, Mus M, Vroemen JP, et al. Dementia and delirium, the outcomes in elderly hip fracture patients. *Clin Interv Aging.* 2017;12:421–430.
9. de Jong L, van Rijckevorsel VAJIM, Raats JW, et al. Delirium after hip hemiarthroplasty for proximal femoral fractures in elderly patients: risk factors and clinical outcomes. *Clin Interv Aging.* 2019;14:427–435.
10. Kim L, Kim JA, Kim S. A guide for the utilization of health insurance review and assessment service national patient samples. *Epidemiol Health.* 2014;36:e2014008.
11. Yoo JI, Ha YC, Park KS, et al. Incidence and mortality of osteoporotic refractures in Korea according to Nationwide Claims Data. *Yonsei Med J.* 2019;60:969–975.
12. Ha YC, Kim TY, Lee A, et al. Current trends and future projections of hip fracture in South Korea using nationwide claims data. *Osteoporos Int.* 2016;27:2603–2609.
13. Kim DH, Lee J, Kim CA, et al. Evaluation of algorithms to identify delirium in administrative claims and drug utilization database. *Pharmacoepidemiol Drug Saf.* 2017;26:945–953.
14. Statistics Korea. *Causes of Death Statistics in 2019*. Daejeon, Korea: Statistics Korea; 2020. Available at http://kostat.go.kr/portal/eng/pressReleases/8/10/index.board?bmode=read&bSeq=&aSeq=385629&pageNo=1&rowNum=10&navCount=10&currPg=&searchInfo=&sTarget=title&sTxt=. Accessed November 11, 2020.
15. Kim KH. Comorbidity adjustment in health insurance claim database. *Health Policy and Management.* 2016;26:71–78. [In Korean, English abstract]
16. Schor JD, Levkoff SE, Lipsitz LA, et al. Risk factors for delirium in hospitalized elderly. *JAMA.* 1992;267:827–831.
17. Smith TO, Cooper A, Peryer G, et al. Factors predicting incidence of postoperative delirium in older people following hip fracture surgery: a systematic review and meta-analysis. *Int J Geriatr Psychiatry.* 2017;32:386–396.
18. Oh ES, Sieber FE, Leoutsakos JM, et al. Sex differences in hip fracture surgery: preoperative risk factors for delirium and postoperative outcomes. *J Am Geriatr Soc.* 2016;64:1616–1621.
19. Bellelli G, Mazzola P, Morandi A, et al. Duration of postoperative delirium is an independent predictor of 6-month mortality in older adults after hip fracture. *J Am Geriatr Soc.* 2014;62:1335–1340.
20. Lee HB, Oldham MA, Sieber FE, et al. Impact of delirium after hip fracture surgery on one-year mortality in patients with or without dementia: a case of effect modification. *Am J Geriatr Psychiatry.* 2017;25:308–315.