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Original article

Risk of mortality following hip fracture in Japan

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Abstract
Background. Excessive mortality and morbidity are serious problems after hip fracture in the elderly.
Methods. Hip fractures in persons aged 50 years or older were prospectively registered in Japan in 2000. Questionnaires regarding both the first onset and the second 120-day period after hip fracture were obtained from 759 patients, 546 of whom were female and 213 male.
Results. Their average age at the time of fracture was 80 years. Altogether, 68 people (9%) died within 120 days after fracture; and 25 patients died within 30 days. Those dying within 120 days and those alive after hip fracture were compared. By univariate analysis, risk factors were poor walking ability, need for a walking aid, low body mass index, history of falls, and lack of active exercise; however, none of these factors was identified as a risk factor by multivariate analysis. By multivariate analysis, the five risk factors associated with mortality were male sex, older age, high American Academy of Anesthesiology (ASA) grade, dementia, and residence in an institution.
Conclusions. During the treatment and rehabilitation period special attention should be paid to patients with chronic diseases and reduced mental status.

Introduction

Hip fracture is a common and important cause of mortality and morbidity among older people.[1–4] Poor prefracture health status, acute effects of the fracture, or a combination of these factors could increase mortality after hip fracture.[5] We reported the mortality rates at 120 days and 1 year after hip fracture to be 6% and 9%, respectively, in 1992.[6] Mortality in this context was not considered a serious problem at that time. However, many authors have reported the mortality rate after hip fracture to be as high as 20%–30%.[3,7–10] Many patients have died because of their poor general condition despite the fact that primary treatment after hip fracture had been considered successful.

Risk factors associated with mortality after hip fracture have been reported to include the following: race, old age, presence of dementia, male sex, serious concomitant illness, chronic renal failure, congestive heart disease, chronic obstructive pulmonary disease, low body mass index (BMI), low handgrip strength, not walking outdoors before fracture, poor walking ability 2 weeks after fracture, past history of hip fracture, and marked delirium at the time of hospital admission.[1,5,6,11–13]

The present study was undertaken to identify the risk factors associated with mortality following hip fracture within 120 days in Japan using the Standard Audit of the hip Fracture in Europe (SAFE).

Material and methods

Patients aged 50 years or older who sustained hip fractures were registered prospectively at the beginning and end of 2000 in Aichi Prefecture. This study was approved by the Ethics Committee of Nagoya University, and all patients had given their informed written consent. Four university hospitals and affiliated hospitals located in Aichi Prefecture (about 7 million population) collaborated in this study. All patients were informed as to the purpose of the study and consented to participate. The SAFE questionnaires were distributed first at the time of the hip fracture, the second 120 days after fracture, and the third at reoperation. Pathological fracture was excluded in this study. A total of 845 questionnaires were completed at the first registration and 759 at the second registration; 86 patients did not want to complete the second questionnaire despite their initial

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consent. All patients were alive 120 days after hip fracture according to the medical records at the acute hospital or other institutions. A total of 759 patients were thus included in this study.

The first questionnaire focused on the following items: place of residence at the time of hip fracture, name, age, sex, date of fracture, type of fracture, method of treatment, length of hospital stay, walking ability, activities of daily living, history of fall, cognitive function by Mini-Mental test,[14] and physical status according to the American Academy of Anesthesiology (ASA).[15] The second questionnaire was answered by the patients themselves or by their relatives. Patients were transferred to rehabilitation units or directly back to their own homes within 120 days from presentation to the emergency hospital. Walking ability or a need for walking aids was addressed 120 days after fracture. Mortality was identified from the responses from all the patients or their relatives.

Statistical analysis was performed using both univariate and multivariate analyses. Relative risk of mortality was calculated using SAS version 6 LOGIST (SAS Institute, Cary, NC, USA). $P < 0.05$ was considered statistically significant.

Results

The average age was 80 years (women 81 years, men 74 years) (Table 1). Female patients numbered 595 and male patients 164. There were 370 cervical fractures and 389 trochanteric fractures.

Regarding the place of residence before fracture, 78% of patients had been living in their own homes, 11% in a geriatric institution or nursing home, and 7% in a geriatric or rehabilitation hospital. Concerning their walking ability before fracture, 58% of patients had been able to walk independently outside the house, 12% outside the house with aids, 9% independently inside the house, and 13% inside the house with aids; 7% of the patients could not walk at all.

A total of 68 persons (9%) died within 120 days after fracture. The causes of death were as follows: pneumonia in 25 patients, cardiac failure in 13, renal failure in 7, acute myocardial infarction in 2, and cancer in 2. In 19 patients the cause of death was unreported. Altogether, 25 patients (37% of those dying) died within 30 days. The average interval from injury to surgical treatment was 7.3 days. A total of 30 patients (4.0%) were treated conservatively. There was no significant mortality difference between the patients operated on within 24 h and those operated on later. By univariate analysis, risk factors were poor walking ability, use of a walking aid, lower BMI, history of falls, and lack of active exercise, which were not found to be risk factors by multivariate analyses (Table 2). Age, ASA status, and cognition showed linear correlations. By multivariate analyses, five statistically significant risk factors were identified: male sex, older age, high ASA grade, dementia, residence in an institution. These five risk factors were also significant by univariate analysis (Table 3).

Discussion

Fracture is often not recorded on death certificates even when death occurs soon after fracture. Studies of mortality after hip fracture are misleading unless they include deaths after discharge from the initial admission and consider all causes of death.[8] Mortality is much higher among people after hip fracture and remains elevated for many months thereafter. In the present study, the mortality rate within 120 days of hip fracture was 9% in 2000, with one-third of the patients dying within 30 days of the fracture. This mortality rate in a Japanese population was lower than those reported in North America and Europe.[3,7–9,16] Todd et al. reported the mortality rate at 90 days to be 18% of 580 consecutive patients, differing significantly among hospitals (5%–24%).[16] Lower mortality may be associated with the cumulative effects of several aspects of organization of treatment and management of hip fracture, including thromboembolic prophylaxis, antibiotic prophylaxis, and early mobilization. However, we could not find any reason for the lower mortality following hip fracture in Japan in the present study.

There was no significant difference in mortality between the patients operated on within 24 h and those operated on later in the present study. The length of the waiting period did not significantly affect the mortality rate in one study[17] or in the current study. Delayed operation is likely to result in longer hospitalization, decubitus ulcer formation, and possible infection such as pneumonia or urinary tract infection. It probably increases the total hospital stay as well as the cost of treating these complications.

Many authors reported that operative methods were not associated with the mortality risk as in the present study.[18,19] Röder et al. reported that a strengthened rehabilitation program for hip fracture patients did not significantly affect either mortality or activities of daily living.[20]

Nutritional supplementation for elderly hip fracture patients may be useful for decreasing some complications. However, this reduction does not result in improved functional recovery, nor does it decrease mortality.[21]

Many authors have reported the risk factors for mortality to be the place of residence before fracture, a displaced fracture, use of long-term care services,

Table 1. Patient population

Factor	%	Factor	%
Age at fracture (years)		3: Symptomatic illness present, but minimum restriction on life	31.1
50–59	3.4	4: Symptomatic illness causing severe restriction	12.9
60–69	12.3	5: Moribund	0.1
70–79	24.8	Type of fracture	
80–89	44	Undisplaced intracapsular. Garden grade 1 or 2	12.5
90+	15.5	Displaced intracapsular. Garden grade 3 or 4	31.6
Sex		Basocervical	7.9
Female	78.4	Trochanteric two fragments	31.2
Male	21.6	Trochanteric multi-fragments	11.7
Fracture side		Subtrochanteric	5.2
Right	43.6	Primary operation	
Left	56.4	Single screw, pin, or nail	0.3
BMI		Two screws, pins, or nails	2.7
<21	33.5	Three or more screws, pins, or nails	10
21–24	32.6	Single screw, pin, or nail with side plate	40.3
>24	33.8	Intramedullary nail	10.3
Admitted from		Hemiarthroplasty	26.7
Own home	77.7	Total hip replacement	4.3
Sheltered housing	3.2	Conservative	4
Institutional care	3.5	Other	1.3
Nursing home	4.7	Mental test (0–10 points) mimimum 0, maximum 10	
Permanent hospital inpatient	3.7	0	10.9
Rehabilitation unit	1.2	1	4.8
Acute hospital	1.5	2	5.4
Other	3.2	3	6.9
Living with		4	5.5
Alone	9.2	5	4.6
Spouse and relatives	68.3	6	6.7
Institutional care	22.5	7	5.9
Walking		8	9.6
Could walk alone outdoors	58.2	9	10.9
Could walk outdoors only if accompanied	12.4	10	28.9
Could walk alone indoors but not out of doors	8.7	History of fall within 2 years	
Could walk indoors only if accompanied	13.8	None	51.7
Unable to walk	6.9	1–3	28.8
Walking aids		4 or more	19.6
Can walk without aids	52.6	Fear for fall	
One aid (stick, crutch, tripod, or hemiwalker)	21.7	Yes	62.2
Two aids (stick, crutch, tripod, or hemiwalker)	1.4	No	37.8
Frame	13.6	Walking exercise within 1 year	
Wheel chair/bedbound	10.7	Walking hard	26.7
ASA grade		Walking normal	33.2
1: Completely fit and healthy	24.4	Walking little	40.1
2: Some illness but this has no effect on normal daily activity	30.8		

presence of dementia, two or more selected chronic diseases, not walking outdoors before the fracture, and low hand grip strength.[1,5,11–13,15,22,23] Here, by multivariate analyses, five statistically significant risk factors were identified: male sex, older age, high ASA grade, dementia, residence in an institution. Poor walking ability, need for a walking aid, low BMI, history of falls, and no active exercise were risk factors by univariate analysis but not by multivariate analyses. These results were almost identical to those of our previous study.[6]

We did not investigate the predictive value of the details of the present/past history such as the presence of heart disease or laboratory data such as albumin and hemoglobin obtained from hospital charts. Further investigation of this issue is needed to prevent excess mortality.

A drawback of the present study is that answers were obtained from 90% of those at the initial registration, despite which some of the patients did not want to answer the second questionnaire regardless of their initial consent. We examined all patients who were alive 120 days after hip fracture by the medical records at the acute hospital or other institutions. Therefore, these patients were included in the present study. A cognitive

Table 2. Univariate analysis for mortality within 120 days after hip fracture

Variable	Odds ratio	95% Confidence interval
Age (years) (control age 50–69)		
70–79	3.99	0.88–18.15
80–89	6.63	1.57–28.04*
90+	11.9	2.7–52.3*
Sex (control = female)		
Male	2.15	1.26–3.65*
Fracture side (control = left)		
Right	1.12	0.67–1.85
Admitted from (control = own home with someone)		
Living alone	0.25	0.03–1.83
Institution	3.64	2.11–6.29*
Walking (control = could walk outdoors)		
Could not walk outdoors	3.32	1.92–5.73*
Walking aids (control = no walking aids)		
One aid or two aids	1.36	0.61–3.05
Frame	2.16	0.93–5.03
Wheel chair	3.98	1.81–8.77*
ASA (control = ASA 1)		
ASA 2	1.61	0.48–5.44
ASA 3	3.1	1.01–9.53*
ASA 4	13.7	4.5–41.4*
ASA 5	57	7.4–441.1*
Primary operation (control = single screw, pin, or nail with slide plate)		
Single (or two) screw, pin or nail	0.47	0.06–3.64
Three or more screws, pins or nails	10.5	0.44–2.51
Intramedullary nail	1.18	0.51–2.72
Hemiarthroplasty	0.54	0.25–1.13
Total hip replacement	0.33	0.04–2.51
Conservative	2.39	0.96–5.96
Other	4.94	0.43–56.3
Mental test (control = cognitive test 7 or more)		
0 point	21.8	8.1–58.2*
1–4 points	8.52	3.31–22.02*
5–6 points	3.42	0.90–12.56

* Statistically signficant

Table 3. Multivariate analysis for mortality within 120 days after hip fracture

Variable	Odds ratio (95% CI)
Male	3.53 (1.84–6.76)*
Age (years)	
70–79	3.23 (0.65–16.06)
80–89	5.07 (1.08–23.78)*
90+	7.62 (1.52–38.19)*
ASA	
2	1.28 (0.35–4.62)
3	2.2 (0.67–7.25)
4	7.98 (2.41–26.47)*
5	19.4 (2.2–168.6)*
Mental test	
0 point	8.9 (2.90–27.34)*
1–4 points	4 (1.39–11.50)*
5–6 points	2.62 (0.66–10.48)
Admitted from institution	2.43 (1.29–4.59)*

* Statistically signficant

test was performed after the hip fracture. Therefore, it was not cognitive ability before the fracture but after the fracture that was significant. There was a possibility of delirium or confusion after the fracture, which could lead to transient impairment of brain function. Dementia did not significantly affect complications or functional gain in elderly patients operated on for intracapsular hip fracture.[24] We need further investigations into cognitive function before fracture.

To reduce the mortality rate associated with hip fracture, patients living in their own homes before fracture should be returned there, and those living in institutions should have their cognitive function improved. We suggest that active intervention to maintain/improve cognitive function and promotion of care in the patients' own homes would decrease mortality. Further interventional study is needed to demonstrate this suggestion. Univariate analysis suggested that improved walking ability, reduced use of walking aids, increased

BMI with nutritional supplementation, prevention of falls, and establishing a habit of exercise can probably contribute to decreasing the mortality rate after hip fracture.

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