Rate of Mortality with Hip Fracture and its Prognostic Factors in an elderly Japanese population

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Abstract

The purpose of this study was to clarify the survival rates and prognostic factors in elderly Japanese patients with hip fractures. This study investigated the outcome of 256 patients aged 60 years and older with surgically treated hip fractures. Information including age, gender, duration of hospitalization, place of residence before fracture and at discharge, and level of mobility before fracture and at discharge was obtained from patient records. The survival of the patients after discharge was determined by mail surveys supplemented with telephone inquiries.

The observed survival rates were significantly lower than the expected survival rates ($p < 0.001$, by Mantel Haenszel test). The short-term mortality rates were 6% for six months and 12.7% for one year, which were lower than previously reported rates in Western countries. Significantly higher hazard ratios (HR) for mortality adjusted for age and gender were observed in patients who had lived in places other than their own home before fracture ($HR = 2.67 (1.63-4.3)$), were discharged to places other than their own home (Nursing home $HR = 2.25 (1.24-4.1)$ or to a non-orthopedic unit ($HR = 5.95 (3.12-11.34)$), those requiring full-time assistance for mobility at discharge ($HR = 5.71 (3.59-9.01)$), and those who had stayed in a hospital for fewer than 40 days ($HR = 2.20 (1.38-3.51)$). After adjusting for the effects of all the potential prognostic factors, discharge to places other than their own home and the lowest level of mobility at discharge remained significant factors causing adverse effects on survival. Therefore, to improve the prognosis, patients should be allowed to recover to a level at which they can ambulate with some assistance, enabling them return to their own homes.

Key words: Hip fracture, Mortality, Prognosis factor, Elderly, Japanese

Introduction

Hip fracture is known to be one of the leading risks for becoming bedridden in elderly people¹⁾, and the medical costs for the treatment of this fracture are already enormous²⁾. It is reported that the incidence of hip fracture in Japan has increased 1.5 fold in the last 5 years³⁾, and 170,000 people per year are forecasted to have a hip fracture within 20 years⁴⁾. The extent of problems caused by this fracture will increase in to the twenty-

first century. The prevention of hip fracture is an urgent problem in our society.

Several studies have indicated that the prognosis for hip fracture among elderly people is unfavorable⁵⁻¹²⁾. Most of these, however, were derived from Caucasian populations. The prognosis for hip fracture and prognostic factors in Japanese patients may be different from those reported in Caucasians, because the incidence of this fracture has been reported to be very different between these two populations¹³⁾. However, it is not fully known to what extent hip fracture worsens the prognosis of patients in comparison with people of the general population, or which factors independently affect the prognosis. To answer these questions, we investigated the survival of patients with surgically treated hip fractures, as well as their characteristics during hospitalization and at discharge.

Received Feb. 4 2000/Accepted Jul. 29 2000

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Study Method

Subjects

The subjects were selected according to inpatient lists of the Fukui Red Cross Hospital, which is located in a city in central Japan with a population of about 260,000. As a general hospital with 600 beds, it serves as a core facility for medical care in the area. The total number of admissions to the hospital between 1988 and 1994 was 4,690 (annual mean: 670). Of these, 286 (annual mean: 40.8) were patients admitted to the orthopedic unit with hip fractures. One hundred ninety-one (67%) of 286 patients were referred by local doctors, and the remainder were self-referred. All hip fracture patients were admitted for surgical treatment.

Data Collection

1) Demographic data and medical history

The following data were obtained from the clinical and nursing records of the 283 subjects: age, gender, marital status, place of residence before fracture, place of residence after discharge from the orthopedic unit, date of fracture, fracture type, date of admission, date of surgery, date of discharge, preoperative period, duration of hospitalization, preoperative laboratory values, medical history of disease, hobbies and levels of mobility before fracture and at discharge.

Age was defined as the age upon admission. The preoperative period was defined as the number of days from the date of fracture to the date of surgery. The duration of hospitalization was specified as the period from the date of admission in the orthopedic unit to the date of discharge from the unit. Preoperative laboratory values included hemoglobin and serum total protein, which were obtained before surgery. The past history of disease included cerebrovascular disease, cardiovascular disease and carcinoma. Kishi's evaluation criteria for ambulatory ability¹⁰ were used to classify the levels of mobility. The levels of mobility before fracture and at discharge were re-categorized into two (Level 1 vs. Levels 2-4) and three groups (Level 1 and 2 vs. Level 3 vs. Level 4), respectively, because of the small sample size of the patients in each level. The levels were as follows: Level 1, being able to ambulate outdoors with or without a cane; Level 2, restricted in outdoor activities but able to ambulate indoors; Level 3, unable to ambulate outdoors and restricted in indoor ambulation; and Level 4, requiring full-time assistance in daily living.

2) Survival status survey

The survey was conducted in June, 1995. A questionnaire was sent to each subject. The subject, or a family member of the subject if he/she had died, was asked to answer the questionnaire and to send it back by mail. The questionnaire assessed survival status of the subject as of June 30, 1995, level of mobility (Level 1 to 4) at the time of survey, and current place of residence. The purpose of the study was explained on the cover page of the questionnaire. Informed consent was regarded as having been obtained when the subject returned the questionnaire. The survival period, from the date of surgery to the date of death or to June 30, 1995, was calculated according to the questionnaire response. Supplementary telephone inquiries were made when questionnaire items were left unanswered or when answers were contradictory.

Statistical analysis

1) Observed and expected survival curves

The observed survival rates were calculated using the Kaplan-Meier method¹⁵. The 1991 life table for the Japanese population¹⁶ was used for calculating the expected survival rates in this study. The two survival curves were compared with the Mantel-Haenszel test¹⁵.

2) Categorization of factors that influence survival rates

According to previous studies, sixteen factors were chosen as potential prognostic factors in this study. Table 1 shows all the factors examined, categories for each factor, and the number of subjects in each category. Fracture type was classified as either intracapsular or extracapsular. Preoperative hemoglobin values were divided into two levels at 11 g/dl, and preoperative serum total protein values were also divided into two levels at 6g/dl. The preoperative period was divided into two levels, 0-4 days and 5 days or more, according to the classification of Kenzora et al¹⁷. In a standard rehabilitation program for patients with surgically treated hip fractures, patients were encouraged to walk with a cane about 40 days after surgery^{18, 19} and were regarded as being healed in 12 weeks. Therefore, we divided the duration of hospitalization into 3 levels: 40 days or less, 40 to 90 days, and more than 90 days of hospitalization. The levels of mobility before fracture and at discharge were re-categorized into two (Level 1 vs. Levels 2-4) and three groups (Level 1 and 2 vs. Level 3 vs. Level 4), respectively, because of the small sample size of patients in each level.

3) Survival analysis

Survival curves for each of the 16 factors were estimated for each category using the Kaplan-Meier method^{20, 21}. The differences in the survival curves between categories for each factor were examined with the Log rank test. For each factor that showed significant difference in the survival curves between categories, the presence of proportionality in a hazard ratio over the survival time was confirmed. Then, the hazard ratios and their 95% confidence intervals were calculated using Cox's proportional hazards model²². The significance of the hazard ratio was examined by Wald's chi-square test. These statistical analyses were done using the Statistical Analysis System (SAS) for Windows (Release 6.11, SAS Institute Inc. Cary NC, USA).

Results

Baseline characteristics of the subjects

From 283 patients enrolled from the in-patient lists, 7 with pathological fractures (other than osteoporosis) and 16 with recurrent fractures were excluded; the remaining 263 patients served as the subjects for the survival survey. Of these, 256 (61 males and 195 females) completed the questionnaire and a response rate of 97.3% was attained. The basic characteristics of the subjects are shown in Table 1. The mean age was 78.8 years (SD 8.5, range 60 to 98) for all subjects, 76.9 years for males and 78.9 years for females. The median observational period was 3.2 years, the range being 0.5 to 7.5 years.

Comparison of the observed and expected survival rates

One hundred seventy-one patients survived in this study.

Figure 1 shows the observed and expected survival rates. The observed survival rate was significantly lower than the expected survival rate ($p < 0.001$, by Mantel Haenszel test¹⁵⁾). The difference between the observed and expected rates gradually increased during the observational period. The mortality rates were 6.6% 6 months after the surgery, 12.7% after 1 year, 31.7% after 3 years, and 46.3% after 5 years.

Analysis of factors affecting prognosis

Among 16 potential prognostic factors, 6 had a significant influence on survival, as shown in the right end column of Table 1: age, duration of hospitalization, place of residence before fracture, place of residence after discharge from the orthopedic unit, level of mobility before fracture, and level of mobility at

discharge from the orthopedic unit. Because no proportionality in hazards over the categories was observed for the level of mobility before fracture, they were excluded from further analysis.

Table 2 shows the hazard ratios adjusted for age and gender calculated from analysis of the 4 prognostic factors. Categories that showed significantly higher hazard ratios than one were: 40 days or less of hospitalization, living in places other than own home before fracture, discharge to a nursing home, discharge to a non-orthopedic unit, and level 4 mobility at discharge. To examine the independent effects of each factor analyzed in Table 2, we calculated multi-adjusted hazard ratios using a model comprising all these factors, in addition to age and gender. The results are shown in Table 3. Duration of hospitalization and

Table 1 Categories of potential prognostic factors for patients with hip fractures and results of the log rank test for the difference in survival curves over the categories

Potential prognostic factor	Mean,SD	Category	Number of patients (%)	p-value ¹⁾
Age	78.8years SD8.5	<=85years	200 (78.1)	0.001
		>85years	56 (21.9)	
Gender		Female	195 (76.2)	0.469
		Male	61 (23.8)	
Type of fracture		Intracapsular	85 (33.2)	0.347
		Extracapsular	171 (66.8)	
Pre-operative hemoglobin	10.9g/dl SD 2.17	>11g/dl	106 (41.4)	0.086
		<=11g/dl	132 (51.6)	
		Missing	18 (7.0)	
Pre-operative serum total protein	6.1g/dl SD 0.71	>6g/dl	143 (55.9)	0.427
		<=6g/dl	71 (27.8)	
		Missing	42 (16.3)	
Pre-operative period	10.2days SD 13.2	<=5days	120 (46.9)	0.534
		>5days	130 (50.8)	
		Missing	6 (2.3)	
Duration of hospitalization	60.7days SD 32.9	<=40days	62 (24.2)	0.001
		>40days, <=90days	161 (62.9)	
		>90days	33 (12.9)	
Place of residence before fracture		Own home	209 (81.6)	0.001
		Others	47 (18.4)	
Place of residence after discharge		Own home	175 (68.4)	0.002
		Other hospital	44 (17.2)	
		Nursing home	24 (9.3)	
		Non-orthopedic unit	13 (5.1)	0.001
Medical history				
Cerebrovascular disease		Absent	216 (84.4)	0.389
		Present	40 (15.6)	
Cardiovascular disease		Absent	178 (69.5)	0.971
		Present	78 (30.5)	
Carcinoma		Absent	230 (89.8)	0.254
		Present	26 (10.2)	
Level of mobility before fracture ²⁾		Level 1	161 (62.9)	0.001
		Levels 2,3,4	95 (37.1)	
Level of mobility at discharge ²⁾		Levels 1,2	139 (54.3)	0.023
		Level 3	56 (21.9)	
		Level 4	61 (23.8)	
Outdoor hobby		Absent	184 (71.9)	0.172
		Present	50 (19.5)	
		Missing	22 (8.6)	
Spouse		Alive	113 (44.1)	0.171
		Dead	143 (55.9)	

1) p-value for the difference in survival

2) Category for level of mobility

Level 1: able to ambulate outdoors with or without a cane

Level 2: restricted in outdoor activities, but able to ambulate indoors

Level 3: impossible to ambulate outdoors and restricted in indoor ambulation

Level 4: requiring full-time assistance in daily living

Table 2 Hazard ratios for each prognostic factor adjusted for age and gender using Cox's proportional hazard model

Prognostic factor	Category	Hazard ratio	p-value ²⁾
		95% CI ¹⁾	
Duration of hospitalization	>40days, <=90days	1	
	<=40days	2.20 (1.38-3.51)	0.0009
	>90days	1.25 (0.71-2.19)	0.45
Place of residence before fracture	Own home	1	
	Others	2.67 (1.64-4.3)	0.0001
Place of residence after discharge	Own home	1	
	Other hospital	1.62 (0.96-2.75)	0.071
	Nursing home	2.25 (1.24-4.10)	0.008
	Non-orthopedic unit	5.95 (3.12-11.34)	0.0001
Level of mobility at discharge ³⁾	Levels 1, 2	1	
	Level 3	0.89 (0.53-1.5)	0.65
	Level 4	5.71 (3.59-9.01)	0.0001

1) Confidence interval

2) Hazard ratio was examined by Wald's chi-square test.

3) Level of mobility at discharge

Level 1, 2: able to ambulate, or restricted in outdoor activities, but able to ambulate indoors

Level 3 : impossible to ambulate outdoors and restricted in indoor ambulation

Level 4 : requiring full-time assistance in daily living

Table 3 Hazard ratios for each prognostic factor adjusted for age, gender and other prognostic factors using Cox's proportional hazard model

Prognostic factor	Category	Hazard ratio	p -value ²⁾
		95% CI ¹⁾	
Duration of hospitalization	>40days, <=90days	1	
	<=40days	1.02 (0.56-1.85)	0.96
	>90days	1.22 (0.66-2.27)	0.52
place of residence before fracture	Own home	1	
	Other hospital	1.11 (0.57-2.17)	0.76
Place of residence after discharge	Own home	1	
	Other hospital	1.31 (0.59-2.96)	0.5
	Nursing home	1.98 (1.11-3.57)	0.02
	Non-orthopedic unit	3.63 (1.53-8.66)	0.004
Level of mobility at discharge ³⁾	Levels 1,2	1	
	Level 3	1.85 (0.98-3.45)	0.058
	Level 4	5.55 (2.93-10.48)	0.0001

1) Confidence interval

2) Hazard ratio was examined by Wald's chi-square test.

3) Level of mobility at discharge

Level 1, 2: able to ambulate, or restricted outdoor activities, but able to ambulate indoors

Level 3 : impossible to ambulate outdoors and restricted in indoor ambulation

Level 4 : requiring full-time assistance in daily living

place of residence before fracture were insignificant. The survival curves are illustrated for the two significant factors; place of residence after discharge (Fig. 2) and level of mobility at discharge (Fig. 3).

Discussion

Among hip fracture patients over 60 years old in Japan, the ratio of females to males was reported to be 2.5 to 1 in 1995³⁾. The ratio of extracapsular to intracapsular fractures was about 2 to 1 studies in Tottori Prefecture⁴⁾. In this study, the ratio of females to males was 3.5 to 1, and the ratio of extracapsular to intracapsular fractures was 2 to 1. The subjects in this study are not considered to be substantially different from the total elderly Japanese population. In addition, the response ratio in the questionnaire survey was high enough to be satisfactory.

As observed in a previous study, the prognoses of elderly patients with hip fractures were also exacerbated in this study. In the present study, however, differences between the observed and expected survival rates gradually increased until the 5th

postoperative year. This observation differed from the results of previous Western studies in which the observed survival curves rapidly decreased between 2 months and 1 year after surgery, and reached a plateau thereafter⁹⁻¹²⁾. Such discordance was thought to be due to lower short-term mortality rates in elderly Japanese patients with hip fractures. In the present study, mortality rates in elderly patients with hip fractures were 6.6% for 6 months, 12.7% for 1 year, and 31.7% for 3 years. These results were similar to those reported by Tashiro et al. (12.9% for 1 year and 30.7% for 3 years)⁶⁾ and by Tamaru et al. (12.9% for 1 year, 30.7% for 3 years, and 39.8% for 5 years)²³⁾. However, previous Western studies reported that the 6-month mortality rates in elderly patients with hip fractures ranged from 21.5 to 25% (approximately 4 times higher than those reported in Japan)^{8, 9, 24, 25)}, while the one-year mortality rates ranged from 26 to 35% (approximately twice as high as those reported in Japan)^{8, 9, 25)}. However, the 3-year mortality rates ranged from 35 to 40%^{9, 26)}, which were similar to those reported in Japan.

Regarding factors that increased mortality rates in elderly patients with hip fractures, previous Western studies reported

Fig. 1 Observed survival rates of 256 patients with hip fractures after surgery compared with the expected survival rates according to the mortality of the general Japanese population of corresponding age and gender. The observed survival rates were calculated using the Kaplan-Meier method. The expected survival rates were calculated using the 1991 life table for the Japanese population.

Fig. 2 The survival curves for different places of residence after discharge from orthopedic units. The survival curves were calculated using the Kaplan-Meier method.

advanced age^{6, 8, 9, 27)}, male gender^{8, 9)}, lateral fractures⁶⁾, shorter preoperative period⁸⁾, poor preoperative physical condition^{5, 6, 9, 27)}, higher dependency in life before discharge^{26, 28)}, and admission to other nursing homes after discharge²⁶⁾. However, the present study revealed that the following two factors independently had adverse effects on mortality rates in elderly patients with hip fractures: the place of residence after discharge (admission to a nursing home or transfer to a non-orthopedic unit) and the level of mobility after discharge (full-time assistance). These results suggest that it is important for elderly patients with hip fractures to be discharged to their own home, after recovering their mobility levels, as much as possible to avoid exacerbation of prognoses. Furthermore, these 2 prognostic factors could explain the results reported previously that the short-term mortality rates in Japanese elderly patients with hip fractures were lower than

Fig. 3 The survival curves of different levels of mobility at discharge
Indoor ambulation group: able to ambulate outdoors with or without a cane, restricted outdoor activities, but able to ambulate indoors
Restricted indoor ambulating group: impossible to ambulate outdoors and restricted indoor ambulation
Full-time assistance group: requiring full-time assistance in daily living

those reported in Western countries. Pages et al. reported that full-time assistance was required in 44.3% of such patients at discharge²⁹⁾. However, full-time assistance was required in only 23.8% of such patients in this study. In addition, it was reported in Western countries that 37% of elderly patients with hip fractures were discharged to their own homes⁸⁾, while 60% of such patients were admitted to nursing homes³⁰⁾. In the present study, however, 68.4% of such patients were discharged to their own homes, and only 9.3% were admitted to nursing homes. That is, it was clarified in this study that the number of elderly patients with hip fractures who required full-time assistance at discharge was approximately 50% of that reported in Western countries, whereas the number of patients discharged to their own homes was approximately twice that reported in Western countries. Based on these observations, it was concluded that short-term mortality rates were lower in elderly Japanese patients with hip fractures in this study compared to those reported in Western countries because the mobility of such patients was higher at discharge, and because the number of those who were discharged to their own homes was higher in Japan than in Western countries.

Why was the mobility level at discharge higher in elderly Japanese patients with hip fractures than in those in Western countries? This was because it was desirable for elderly Japanese patients with hip fractures to be discharged from the hospital after surgery when they recovered their mobility with a cane, and because most Japanese physicians do not usually recommend them to be discharged before they recover satisfactory walking levels^{18, 19)}. As a result, the duration of hospitalization for elderly patients with hip fractures was longer in Japan than in Western countries. In fact, it was reported that the mean duration of hospitalization for such patients ranged from 12.6 to 26.6 days in Western countries^{7, 30)}. In the present study, however, the mean duration of hospitalization for such Japanese patients was 60.7 days, which was approximately 3 to 5 times longer than that in Western countries. In the present study, univariate analysis

revealed that the duration of hospitalization was a factor that worsened the prognoses of such patients. However, multivariate analysis failed to demonstrate that the duration of hospitalization independently worsened the prognoses of such patients. Therefore, it was thought that the duration of hospitalization reflected the results of mobility levels at discharge and the place of discharge. In the present study, we compared the mortality rate and prognostic factors in Japanese elderly patients with hip fractures with those in elderly Western patients. However, this study has several limitations, because diagnostic criteria and techniques, and differences in therapeutic and nursing backgrounds, including postoperative management, were not evaluated.

The results from the present study suggested that it was important for elderly patients with hip fractures to be discharged to their own homes, after recovering their mobility levels, as much as possible to avoid exacerbation of prognoses. In addition, a certain period of hospitalization was required to recover sufficient mobility levels. However, it is a common medical problem of economics in both Western countries and in Japan that prolonged duration of hospitalization increases health care costs. Moreover, it is a common urgent issue to minimize medical care costs by reducing the duration of hospitalization. Therefore, establishing procedures to reduce the duration of hospitalization without increasing the short-term survival rates in elderly patients with hip fractures, which are currently lower than those in Western countries, is an urgent issue in Japan. Furthermore, it is important to clarify the following points: how to provide health care for elderly patients who had to be discharged during the course of a rehabilitation program, for whatever reason, to

recover their walking functions; how to provide care for elderly patients with hip fractures who are admitted to nursing homes to maintain their walking functions; and what kinds of medical services or nursing care services are required to support such patients.

Conclusion

1. The short-term mortality rates in elderly patients with hip fractures were 6.6% for 6 months and 12.7% for 1 year, which were apparently lower than those reported in Western countries. Also, differences between the observed and expected survival rates gradually increased over 5 postoperative years.

2. The level of mobility at discharge (full-time assistance) and the place of residence after discharge (admission to nursing homes, transfer to non-orthopedic units) independently worsened the prognoses of elderly patients with hip fractures.

3. The mean duration of hospitalization was 60.7 days in this study, which was approximately 3 to 5 times longer than that reported in Western countries. Moreover, a multivariate analysis failed to demonstrate that the duration of hospitalization was an independent prognostic factor.

4. Accordingly, to avoid exacerbating the prognoses in Japanese elderly patients with hip fractures, it is important to establish procedures to reduce the duration of hospitalization without worsening short-term mortality rates, which are currently lower than those reported in Western countries.

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