Five-Year Survival in a Cohort of Hip Fracture Patients: The Predictive Role of Pre-fracture Health Status

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Abstract The aim was to assess the outcome of surgery at 5 years after hip fracture. In this prospective study, we analyzed 5-year survival of a cohort of 105 hip fracture patients as a function of preoperative health. The main outcome measurements were the status of the patient, dead or alive, and the SF-36 of their pre-fracture status as recalled during their hospital stay. In the fifth year post-hospitalization 58 patients were alive. There was a significant association between the recall SF-36 general health score and being alive in the fifth year ($P=0.0004$) and with survival in general ($P=0.0001$). This and prior studies support the concept of stratifying hip fracture patients according to pre-fracture

health status when assessing outcomes of fracture repair or other interventions. This study further demonstrates the utility of the SF-36 for this purpose.

Key words hip fracture · survival · elderly · pre-fracture status · functional recovery

Hospital admission rates for hip fracture have increased significantly since 1988. In 1999, there were approximately 338,000 admissions for hip fracture [1]. In the year 2000, the hip fracture admission rates per 100,000 population were 526 for men more than 65 years and 1,198 for women more than 65 years [2]. Even if many of the preventive measures that have been tested were effective and universally implemented, the increasing number of elderly citizens will surely increase the number of admissions for hip fracture in the future. From 2000 to 2040, the number of people age 65 or older is projected to increase from 34.8 million to 77.2 million. For the cohort more than 85, the relative growth rate is even faster [3]. In 2000, 12% of the population were more than 65, and 1.5% were more than 85 years. By 2040, it is projected that 20% of the population will be more than 65, and 3.9% will be more than 85 years. A further consideration is that recent studies have shown that the rate of hip fracture is increasing [2, 4].

These data predict that our society will require a considerable reallocation of healthcare resources to meet the need. Ideally, this reallocation will be, at least in part, based upon evidence from assessment of the past and current experience in hip fracture care and treatment. In the past, many of the earliest clinical reports describing the outcomes after the treatment of hip fractures described operative approaches and analyzed hip fracture populations as relatively homogeneous cohorts [5–10]. Several studies have reported disappointing outcomes with large percentages of these hip fracture patients exhibiting considerable morbidity

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in spite of what appeared to be successful surgical treatment [11–14]. During the later 1990s, attention shifted in an attempt to predict survival and functional outcomes based upon various factors, including not only the fracture but also characteristics of the patients themselves [15–28]. These studies have suggested that survival and functional recovery could be correlated to factors such as chronological age, gender, pre-morbid health, and preoperative functional status. Several recent reports, however, now suggest that better outcomes can be achieved if the surgical treatment is tailored to the patient's preoperative health and function [15, 21, 29, 30]. This suggests that reliable and validated assessments of preoperative health with demonstrated correlation to outcome after hip fracture are thus necessary.

The SF-36 is a validated patient-based health assessment with proven efficacy in evaluating outcomes in orthopedic patients [20, 31]. In this study, the SF-36 was used for the assessment of preoperative health status of a relatively healthy cohort of hip fracture patients. The purpose of this paper is to report on the 5-year survival after the surgical treatment of this hip fracture cohort and to assess whether the SF-36 can predict which patients are most likely to survive.

Materials and methods

This study was approved by the Hospital Institutional Review Board (IRB) protocol IRB # 25006.

Patient population

The 105 patients who are the subject of this study had been enrolled in a randomized trial to improve recovery after a hip fracture. All were more than 65 years of age when the hip fracture occurred. The average age at the original enrollment was 79 ± 8 years. There were 22 men and 83 women. Ninety-eight were Caucasians, six African-Americans and one of Asian descent. Ninety-seven spoke English as their first language. All patients underwent surgical repair of their hip fracture, which included closed reduction and pinning of non-displaced femoral neck fractures, hemiarthroplasty for displaced femoral neck fractures, or open reduction and internal fixation with a sliding hip screw for intertrochanteric fractures. Of the 105 patients enrolled, three patients had bilateral fractures occurring on separate occasions resulting in 108 total fractures. There were 44 femoral neck fractures and 64 intertrochanteric fractures. Eight patients were treated with closed reduction and pinning, 36 received hemiarthroplasties, and 64 were treated with open reduction and internal fixation using sliding hip screws. Patients with subtrochanteric fractures, reverse oblique fractures, and pathological fractures from metastatic disease were excluded. In the original study, 51 had been randomized to the control group and 54 to the intervention group.

Study procedures

While in the hospital after the operation, all patients completed the SF-36 (version 1) survey questionnaire [31] and other questionnaires. The SF-36 was answered in two

forms; one was answered as the patient assessed their condition at that time in the first week postoperation; the other was a recall of their status before the fracture. This latter form asked about their status in the 4 weeks before the fracture and is referred to as the recall SF-36. The participants were followed for one full year after hip fracture repair. The details of the study during that year have been reported elsewhere [29, 32]. At the 1-year point, an attempt was made to contact each patient, to establish their status, to complete a short follow-up questionnaire, and to obtain completion of the SF-36 health survey questionnaire as to their status at 1 year. These 105 patients enrolled were then contacted between 4 and 5 years after the hip fracture repair, and this comprises the cohort on which this study reports.

For the purpose of this study, we created two terms to identify the follow-up of these patients. The first term was the number of “years followed” and was defined as the number of years from enrollment to the point of last contact or the date of death if the patient died after the first year. If the patient's location was not known at the 1-year contact point, the patient was counted as lost at the last contact, and that is the time for which they had been followed. The second term is the number of years traced, which is defined as the number of years from enrollment to the point at which the patient was lost, the patient died, or the patient's status was discovered (although the patient may not have been contacted). Thus, if the patient's location was not known at the 1-year contact point, the patient was counted as lost at the last contact, and that is the time for which they had been followed. However, if the patient's status was reestablished at a later time, that was the time traced. The time traced can therefore be greater than the time followed. To trace those lost, the national death index was monitored at regular intervals.

Statistical analyses

One-way analysis of variance or Kruskal–Wallis tests were performed as appropriate to compare three-group statistics and *t*-tests or Mann–Whitney to compare two groups. We also ran stepwise logistic regression to examine the prediction of status in the fifth year and a Cox regression to test the association of variables with survival. Variables that had shown an association with mortality or survival in the group comparisons were entered into the multivariable analyses as independent variables.

Results

Patient characteristics and disposition at 5 years

The Sf-36 recall and baseline values did not differ with statistical significance between the control and intervention groups, $P > 0.05$, nor were the differences clinically significant. The standard demographics such as research group, control or intervention, or comorbidity were not associated with the outcome at 5 years, $P > 0.05$. Other baseline variables that were associated with the outcome are discussed below.

In the fifth year contact period of the 105 people, 31 people had died since the original enrollment (30%), and a further 16 were lost to follow-up (15%); 58 people were known to be still alive (55%). There was no difference between men and women in the number dead or the number lost. However, whereas 10 of 22 men were dead (45%), only 21 of 83 women had died (25%). The average years followed were 3.1 ± 2.1 , and the average number of years traced were 3.9 ± 2.0 . The tracing took longer, as the death index was checked at least 6 months after the last attempted contact.

The average age at the original enrollment was 79 ± 8 years. The average age at the last birthday before death or when determined lost or last contacted was 83 ± 8 years. Enrollment age, age at last birthday, or years traced between men and women were not different. During the 5-year follow-up, four patients were found to be mentally impaired and subsequently lost to follow-up. The cause of death was missing in most cases, but included stroke and heart disease according to reports obtained from relatives. Seventy-seven of the original 105 lived in New York, two in Connecticut, and the rest were unrecorded. Of those lost to follow-up, four were known to have moved away. At death or contact, 6 were definitely in nursing homes, 31 lived alone, 12 with spouses, and 2 with other people.

SF-36 scores by disposition at 5 years

At the time of recruitment, there were no differences in the subscale scores between the three groups of those living at 5 years, those dead and those lost, but the sample sizes are small, and the standard deviations are large (see Table 1). A high value on the SF-36 indicates a better status. In general, those who were still alive after 5 years scored highest at recruitment on physical function, physical role, emotional role, vitality, and general health. The pain scores were compatible in all three groups. Those who were lost scored highest of the three groups on social function. Those who died were the group scoring highest on mental health.

When those alive and those lost at 5 years of follow-up were classed together and their scores compared to those who died, the dead were older at the time of recruitment ($P=0.02$). Physical role ($P=0.04$), physical function

($P=0.04$), and general health also scored lower in those that died. When the lost were omitted from the analysis and those alive were compared to those that died, age ($P=0.03$), physical function ($P=0.02$), physical role ($P=0.02$), and general health ($P=0.03$) scores were higher in those still known to be alive.

Value of the SF-36 in predicting outcomes

Forward logistic regression was run with alive/lost or dead as the dependent variables. The model was statistically significant but was only 72% correct in prediction. It correctly predicted 74% of the alive or lost cases and 68% of those who died. The variables entered were age ($P=0.007$) and the SF-36 general health subscale score ($P=0.004$). When a Cox regression was run with years traced as the independent variable, again age ($P=0.007$) and general health ($P=0.001$) were associated with survival. If general health was removed from the model, then physical role ($P=0.05$) was entered.

Discussion

We studied a cohort of 105 patients to determine the cohort's survival at 5 years after undergoing hip fracture repair. Physical role and general health status before the hip fracture as determined by the SF-36 were found to be associated with survival for five or more years after hip fracture repair, suggesting that the pre-fracture health status is a key determinant of post-fracture survival.

There are a number of published studies that have directly addressed life after a hip fracture. The Longitudinal Study of Aging reported on a prospective cohort of elderly citizens recruited between 1984 and 1991 who were more than 70 years of age [12]. They were followed for a median of 831 days. The analysis demonstrated that a hip fracture was associated with a substantial functional decline. After a hip fracture, there was a statistically significant increase in the number of hospitalizations, medically associated costs and an increase in the number of functional status dependencies. The study concluded that reducing the incidence of hip fracture could lower the subsequent mortality, morbidity, and use of medical resources. However, the study analysis could not show direct cause and effect between the decline in health and the fracture, and the authors had to acknowledge that the hip fracture may have been a result of an underlying problem that leads to the decline. This finding of functional decline after hip fracture was corroborated in a prospective study that examined the 6-year survival rate after hip fracture in white women age 70 and older from 1984 to 1986 [11]. The presence of comorbidities and functional impairments before fracture increased the mortality rate. There was an immediate increase in mortality after a hip fracture in the medically ill, but only a slow increase in those with no comorbidities and little impairment. The recovery of patients after hip fracture was recorded in an additional prospective study using both the SF-36 and the Cummings scales [20]. The values at successive time periods were compared to pre-

Table 1. Age at enrollment and recall SF-36 values of pre-fracture status, grouped by outcome in the fifth year

Variable	Alive		Dead		Lost	
	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)
Age (in years)	58	78 (8)	31	82 (7)	16	77 (7)
SF-36 scales						
Physical function	57	56 (36)	29	41 (29)	16	49 (34)
Physical role	57	81 (33)	29	60 (43)	16	70 (40)
Emotional role	57	93 (26)	29	85 (32)	15	91 (20)
Social function	57	86 (23)	28	84 (24)	15	90 (25)
Pain	57	84 (24)	29	82 (24)	15	80 (23)
Mental health	57	76 (20)	29	79 (22)	15	73 (24)
Vitality	57	65 (22)	29	55 (23)	15	61 (25)
General health	57	75 (21)	28	62 (26)	15	71 (20)

fracture recall values. The Cummings and all the SF-36 subscales, except physical role, had reached more than 90% of their 1-year values by 6 months. There was a statistically significant improvement in the physical-role subscale between 6 and 12 months. Thus, some recovery occurred after 6 months post-fracture. When a cohort of 23 patients, all more than 100 years old, who sustained a hip fracture between 1990 and 2000 were followed, those with two or more comorbidities had an increased risk of dying in the first 6 months [21]. All patients suffered a reduction in their functional abilities. However, five patients lived more than 3 years, one lived more than 6 years, and two were still alive when the report was written.

There are at least four reports of predictions of outcomes after hip fracture. The first is a prospective study of hip fracture patients more than 65 years of age. The patients were all able to walk before fracture. Two weeks after the fracture, information was gathered on activities of daily living (ADLs) and instrumental activities of daily living (IADLs) pre-fracture. The best predictor of mortality at 1 year was the inability to stand up [15]. The authors felt that the ADL score reflected the frailty of the patient. It should be noted, those that died in the hospital and those lost up to 2 weeks post-fracture were excluded by the design of this study. The second study was a retrospective analysis of patients more than 60 years old who were admitted for hip fracture to hospitals in Edmonton, Canada, from 1994 to 2000 [16]. The primary outcome of interest was inpatient mortality. The inpatient mortality rate was 6.3% overall; 4.7% for women, and 10.2% for men. The 1-year mortality rate was 30.8%; 37.5% for men and 28.2% for women. The factors placing patients at greater risk for mortality both in hospital and at 1 year after fracture were age, being male, long-term care residence, and pre-fracture comorbidities. More recently, cognitive function at the time of fracture was found to be an important predictor of survival and return to function in 213 elderly hip fracture patients who were followed for more than 4 years [22]. Ishida et al. [27] studied patients more than 90 years of age and found several predictors of survival, including dementia and the number of vertebral fractures.

Of the 105 patients enrolled in this study, 58 (55%) were alive at five-plus years. This represents 62% of those whose disposition was definitely known. If we assume that those lost in fact died in the same proportion, then 62% can be assumed to have survived to at least 4 years. At the last contact, 45 people were living in the community, compared to 6 who were in a skilled nursing facility. This suggests a generally active lifestyle for most of the survivors. Interestingly, the higher score for social role by those that were lost to contact confirms the statement by many who dropped out during follow-up, i.e., they were “too busy” to answer any more questions or return for follow-up.

Our study suffers from some limitations. We did not stratify our results by the type of hip fracture that may independently affect outcome. First, our sample size was small. Second, we had planned originally to follow everyone for 6 years, but increasing concerns about privacy were expressed by several patients, and the very active lifestyles of

other participants made it increasingly difficult to maintain contact for follow-up. Many patients had moved away and of those doing well, many just refused further participation in the study because of the inconvenience. Third, the cohort was originally enrolled in a clinical trial, and the participants were not mentally impaired when enrolled, were living in the community, and had to be able to answer simple questions. Thus, our study population is not representative of all hip-fracture patients. However, a plus is that the SF-36 subscores should be more sensitive than asking about ADLs, which is what has been used in many prior studies [15]. ADLs suffer from a ceiling effect, but in this population, it may be sufficient to record when the ADL decreases, and it is certainly easier to record the ADL than the SF-36.

Despite some limitations, our finding that pre-fracture general health predicts outcome is consistent with prior studies that found comorbidities predicted the post-fracture outcome [11, 16, 21]. In addition, the other pre-fracture factors found to be associated with mortality, pre-fracture comorbidity, long-term care residence, functional impairment, ADLs, and IADLs [11, 16, 23, 27, 33] all suggest that, rather than the fracture being the cause of a decline, it is often one part of a general decline in the patient's function and is not in itself a foreshadowing of functional loss. This and prior studies support the concept of stratifying hip fracture patients according to pre-fracture health status when assessing outcomes of fracture repair or other interventions. Whether a patient who sustained a hip fracture was a “fit elderly” versus an “un-fit elderly” before fracture is clearly an important determinant of prognosis for recovery of function and survival that may be independent of treatment. All future studies should assess patient health and function in the years before fracture. This study demonstrates the usefulness of the SF-36 for this purpose.

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