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Original Study

Geriatric Rehabilitation and Discharge Location After Hip Fracture in Relation to the Risks of Death and Readmission

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A B S T R A C T

Objectives: To investigate the effects of geriatric rehabilitation on short-term risk of death and readmission after a hip fracture were investigated in a nationwide cohort. In addition, the association of discharge location (nursing home or patient's home) with the short-term risk of death was assessed.
Design, Setting, and Participants: The cohort consisted of 89,301 individuals at least 50 years of age, with a first hip fracture registered in the Swedish quality register RIKSHÖFT, the years 2004–2012.
Measures: Short-term risk of death and readmission to hospital after discharge was compared at 8 hospitals, where most patients received inpatient care in geriatric wards, and those treated at 71 regular hospitals.
Results: The risks of death within 30 days of admission were 7.1% in patients admitted to geriatric ward hospitals and 7.4% in those treated at regular hospitals (multivariable-adjusted hazard ratio [HR] 0.91, 95% CI 0.85–0.97), whereas the odds of readmission within 30 days of discharge were 8.7% and 9.8%, respectively (multivariable-adjusted odds ratio 0.86, 95% CI 0.81–0.91). The risk of death was influenced by discharge location and inpatient length of stay (LOS). Thus, for patients discharged to short-term nursing homes with a LOS of at most 10 days, each additional day of LOS reduction increased the risk of death within 30 days of discharge by 13% (HR 1.13, 95% CI 1.08–1.18). This association was reduced in patients discharged to permanent nursing homes (HR 1.04, 95% CI 1.02–1.07), and not significant in those discharged to their own home (OR 1.00, 95% CI 0.91–1.10).
Conclusion: The risks of death and readmission were lower in patients with hip fracture who received care in hospitals with geriatric wards. The risk of death after discharge increased with shorter LOS, especially in patients discharged to short-term nursing homes.

The number of persons older than 80 years is increasing; it is expected to triple, reaching 392 million, by 2050.[1] As a result, more elderly people will be affected by late-onset diseases, with an enormous projected increase in health care consumption.[2] These predicted demographic changes will compound the already severe economic situation with respect to health care in many countries.[3] As a result, the number of available hospital beds and length of stay (LOS) in hospital have decreased in many countries.[4,5] Given these changes, adequate evaluation of adverse effects in current health care settings is of importance.

The hip fracture has been suggested to be especially suitable for the monitoring of health care quality and effectiveness.[6] Indeed, we recently found that a shorter LOS in hospital after hip fracture was associated with an increased risk of death after discharge.[7] Hypothetically, early discharge to nursing homes, with less well-educated personnel, may be an underlying explanation for the greater risk of death. It would also be of interest to evaluate whether discharge to short-term nursing homes or permanent nursing homes is associated with a different outcome. The type of inpatient care provided to patients with hip fracture may also influence functional outcome and the risk of adverse events. Currently, clinical intervention studies, although limited by their modest size, indicate that interdisciplinary

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rehabilitation in geriatric wards during hospitalization may improve functional capacity and physical performance.[8–12] However, we lack evidence of whether such rehabilitation also may affect the risks of death and readmission after hip fracture.

In the present study, we thus investigated whether inpatient care in hospitals, where most patients were given inpatient care at geriatric wards after hip fracture, influenced the short-term risks of death and readmission. We also evaluated whether discharge to nursing homes, compared with patients' own homes, affected the short-term risk of death.

Material and Methods

Study Population

We included 89,301 individuals with a first hip fracture registered between 2004 and 2012 in RIKSHÖFT, a Swedish quality register for patents with hip fractures. RIKSHÖFT has been described in detail previously.[13,14] This study was approved by the regional ethics board in Umeå and by the National Board of Health and Welfare in Sweden.

We collected data on ward assignment and LOS during in-hospital care from the National Patient Register (NPR), which is controlled by the National Board of Health and Welfare and contains information for all hospitals in Sweden. Data on treatment at 79 hospitals until discharge were collected for patients included in the study. In 8 of these hospitals, most patients received inpatient care in geriatric wards; these hospitals were defined as "geriatric ward hospitals" for the present study. The risks of death and readmission were compared between patients who received care at the geriatric ward hospitals and those treated at the other 71 hospitals. Information about prefracture and postdischarge living situation (patients' own homes or nursing home) was collected from the RIKSHÖFT register. From this register, we also retrieved baseline information about walking ability (walking aid[s], walker, wheelchair/bedridden), fracture type (femoral neck fracture with/without dislocation, basocervical fracture, 2-/multiple-fragment trochanteric fracture, subtrochanteric fracture), surgery type (pin/screw/nail-plate insertion, nailing, hemiprosthesis, total hip prosthesis, other), and the American Society of Anesthesiologists (ASA) physical status classification (healthy, well-controlled disease, minor/major effect of disease, moribund). Other diagnoses of interest in the study cohort between January 1, 1997, and December 31, 2012, were extracted from the NPR using International Classification of Diseases (ICD) version 10 codes: dementia (ICD-10 codes F00, F01, F03), myocardial infarction (ICD-10 code I21), ischemic stroke (ICD-10 code I63), chronic obstructive pulmonary disease (ICD-10 code J44), and renal failure (ICD-10 codes N17, N18). The NPR has been validated in detail, with positive predictive values (PPVs) of 85% to 95%.[15–17] Notably, the PPV for hip fracture in this register exceeds 95%.[18] All data were linked to cohort subjects using the unique personal identification numbers assigned to all Swedish citizens.

Statistical Analysis

Differences between continuous variables were investigated using the *t*-test for independent samples, and those between categorical variables were investigated using the χ^2. First, we compared the risks of death and readmission after treatment in geriatric ward hospitals and regular hospitals. Cox proportional hazard models were used initially to evaluate these associations, and the proportional hazards assumption was evaluated by estimating Schoenfeld residuals using the "estat phtest" command in the Stata software program (Stata Corp, College Station, TX). With respect to the comparison of treatment at geriatric ward and other hospitals, the test indicated that the proportional hazard assumption was violated when the outcome was readmission within 30 days of discharge ($\chi^2 = 7.15$, $P = .007$). This association was therefore evaluated using logistic regression. For the outcome of death within 30 days of admission, the proportional hazard assumption was not violated, and this association was evaluated using a Cox proportional hazard model. For each participant, we calculated the time at risk until the date of the outcome, the end of the follow-up period, or, in a few cases, December 31, 2012, whichever occurred first.

We also used Cox regression to evaluate the rate of death within 30 days of discharge to nursing homes or patients' own homes. In this analysis, we calculated the time at risk (from discharge until date of death or 30 days after discharge) for each participant. Given that we previously found a strong association between short LOS and greater short-term mortality,[7] this analysis evaluated effect modification by LOS; a product interaction term was computed between the variables of interest (LOS and discharge location). The linearity for the association obtained in the Cox regression models was further evaluated using a proportional hazards model with restricted cubic splines, including 5 knots (5th, 27.5th, 50th, 72.5th, and 95th percentiles), as recommended by Harrell.[19] The linearity for the association obtained in the logistic regression model was evaluated using a logistic regression model, with restricted cubic splines and 3 knots. For the outcome of death within 30 days of admission, statistical models were adjusted for diagnoses up to the date of admission; for outcomes related to discharge, models were additionally adjusted for previous diagnoses up to the date of discharge. Fully adjusted statistical models were adjusted for age (continuous), sex (male/female), living independently before fracture (yes/no), walking ability before fracture (5 categories), diagnoses (6 different), ASA score at admission (5 categories), types of hip fracture (6 categories), and type of surgery (5 categories). Stata (version 12.1; Stata Corp) and SPSS (version 21; IBM, Armonk, NY) software were used for the analyses.

Results

Study Cohort

The study cohort included 89,301 patients (68% women) with a mean age of 81.9 (range 50–107) years at baseline. During a mean hospital LOS of 13.0 (range 0–1062) days, 3629 patients died; 6523 patients died within 30 days of admission. Furthermore, 8206 patients were readmitted within 30 days of discharge, followed by a new period of inpatient care. At the geriatric ward hospitals, a mean of 68% (range 54–77) of patients were actually given specific care in geriatric wards. In hospitals providing regular care, 9% (range 0–44) of patients underwent rehabilitation in geriatric wards after hip fracture (Figure 1). Compared with patients treated at regular hospitals, those who received care at geriatric ward hospitals had a longer mean LOS (by 2.4 days) and worse ASA score; fewer of these subjects lived at home before fracture (all $P < .001$; Table 1). Small but significant differences in most other characteristics were also observed between patients receiving care at geriatric ward and regular hospitals (Table 1).

Geriatric Ward Hospitals and the Risks of Death and Readmission

Within 30 days of admission, 1321 (7.1%) patients died in geriatric ward hospitals and 5202 (7.4%) died in regular hospitals ($P = .21$). After adjustment for age, sex, ASA score, and living situation, geriatric ward hospital admission was associated with a lower risk of death within this period (hazard ratio [HR] 0.91, 95% confidence interval [CI] 0.85–0.97) compared with regular hospitals. Further adjustment for diagnoses at baseline, walking ability, fracture, and surgery type did