Diabetes Comorbidity and Age Influence Rehabilitation Outcomes After Hip Fracture

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OBJECTIVE—To examine the influence of diabetes on length of stay (LOS), functional status, and discharge setting in individuals with hip fracture.

RESEARCH DESIGN AND METHODS—This work included secondary analyses of 79,526 individuals from 915 rehabilitation facilities in the U.S. Patients were classified into three groups using the Centers for Medicare and Medicaid Services comorbidity structure: individuals without diabetes (77.0%), individuals with non-tier diabetes (18.3%), and individuals with tier diabetes (4.7%).

RESULTS—Mean age was 79.4 years (SD 9.6), and mean LOS was 13.3 days (SD 5.3). Tier diabetes was associated with longer LOS, lower functional status ratings, and reduced odds of discharge home when compared with individuals with no diabetes and non-tier diabetes. Statistically significant interactions ($P < 0.05$) were found between age and diabetes classification for LOS, functional status, and discharge setting.

CONCLUSIONS—The impact of diabetes on recovery after hip fracture is moderated by age.

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Diabetes is a frequent comorbid condition in older adults and may complicate recovery from hip fracture (1–3). The Centers for Medicare and Medicaid Services (CMS) prospective payment system for inpatient rehabilitation assigns each patient to a case mix group, and they may also be assigned to a comorbidity tier (4). The comorbidity tier system has four reimbursement-related levels: tier 1 (high cost), tier 2 (medium cost), tier 3 (low cost), and tier 4 (no-cost increase) (5,6). Selected diabetes diagnoses (ICD-9 codes) are classified as tier 3 comorbidities (see below).

We examined CMS-assigned diabetes comorbidity tier status and patient outcomes in a large national sample of people who received inpatient medical rehabilitation after a hip fracture. We hypothesized that individuals with tier 3 comorbid diabetes would have longer lengths of stay, have poorer functional outcomes, and be discharged home less frequently than people with non-tier diabetes or no diabetes.

RESEARCH DESIGN AND METHODS

—Data were from the Uniform Data System for Medical Rehabilitation (UDSMR), which contains patient- and facility-level information, a measure of function, length of stay (LOS), and discharge setting (7–9). Complete information on the variables and protocol for data collection is available in the *Inpatient Rehabilitation Facility-Patient Assessment Instrument* training manual (10) through the CMS and at http://www.udsmr.org.

The sample included 79,526 patients with hip fracture (ICD-9 codes 820.0–820.9 and 821.0–821.39) from 915 rehabilitation facilities across all 10 CMS regions. Criteria developed by CMS for prospective payment were used to exclude patients with an atypical course of rehabilitation (11,12).

Three patient groups were created using the following CMS criteria: *1*) patients with no diabetes, *2*) patients with non-tier diabetes (ICD-9 250.0–250.3), and *3*) patients with tier 3 comorbid diabetes (ICD-9 250.4–250.9, 357.2, and 785.4) (4).

Three outcomes were examined: LOS was calculated as the total number of days spent in the rehabilitation unit or hospital. Functional status was determined using the *Inpatient Rehabilitation Facility-Patient Assessment Instrument* developed by CMS (10,11). The instrument includes six subscales: self-care, sphincter control, transfers, mobility, communication, and social cognition with total values ranging from 18 to 126 (13,14). Discharge setting was dichotomized into patients who returned home versus patients who were discharged to alternate destinations after rehabilitation.

Sociodemographic variables included age in years, sex, race/ethnicity (black, Hispanic, white, other), and marital status (married versus not married). A sum of the remaining nondiabetes comorbidities was calculated as an indicator of combined diseases or chronic conditions.

Data analysis

One-way ANOVA with post hoc and χ^2 tests were used to assess differences among variables across the diabetes groups on the basis of comorbidity status. Age-centered multiple linear regression models were computed to estimate the effects of diabetes status on LOS and functional status ratings. The odds of discharge to home based on diabetes status were computed using an age-centered logistic regression model. The regression models contained relevant covariates. Age by diabetes interaction terms was included in each model.

RESULTS—The mean age was 79.4 years (SD 9.6) with an average LOS of

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13.2 days (SD 5.3). The prevalence of diabetes in the sample was 23.0%, with 18.3% of patients diagnosed with non-tier diabetes and 4.7% with tier-level diabetes. Statistically significant differences ($P < 0.05$) existed across the three groups for sociodemographic variables (age, sex, and race/ethnicity) and for the outcome and clinical variables (LOS, admission and discharge functional status, discharge home status, and sum of comorbidities).

Linear and logistic regression analyses yielded significant diabetes-by-age interactions for the outcomes of LOS, functional status ratings, and discharge setting. The linear regression models demonstrated significant ($P < 0.05$) group-by-age interactions between tier diabetes and no diabetes for both LOS and discharge functional status ratings. There were also significant age-by-diabetes group interactions between the non-tier (OR = 0.98, $P < 0.01$) and no diabetes (OR = 0.98, $P < 0.01$) groups compared with the tier-level diabetes group for the discharge home versus not home variable.

Increasing age was associated with decreased difference for each of the outcome measures (LOS, functional status, and discharge home) across the three diabetes status groups. This moderating effect is demonstrated in Figure 1 for the discharge home variable. Figure 1 shows the expected values for discharge home by age for each of the disability status groups and demonstrates a statistically significant difference ($P < 0.01$) that decreases as age increases. The pattern was similar for LOS and functional status.

CONCLUSIONS—Individuals with diabetes had longer LOS in rehabilitation facilities than individuals without diabetes. Patients with CMS-defined tier comorbid diabetes stayed longer than patients with non-tier diabetes. Similar associations were found for functional status ratings at discharge and for the percent of patients who were discharged home. The results were moderated by age. In each case, the difference among the diabetes groups (no diabetes versus non-tier diabetes versus tier diabetes) was larger in younger subjects and smaller in older subjects.

Limitations

Our dataset did not have information about the length of time someone had diabetes or diabetes-related treatment(s). Our sample included only subjects living at home before hip fracture, and the findings are not generalizable to individuals living in institutional settings. We also lacked information on functional status before the hip fracture.

In summary, diabetes was prevalent in 23% of patients in our sample with hip fracture and was associated with poorer outcomes, particularly in younger individuals. Our findings support the use of the CMS tier comorbidity system for patients with diabetes receiving rehabilitation after hip fracture. The tier diabetes group displayed longer LOS and lower levels of functional status than patients with no diabetes or nontier diabetes. Our findings also suggest that diabetes tier status has an impact that is more pronounced in younger patients. Further research is necessary to better understand the mechanism underlying the moderating effects of age on the recovery of individuals with diabetes after hip fracture.

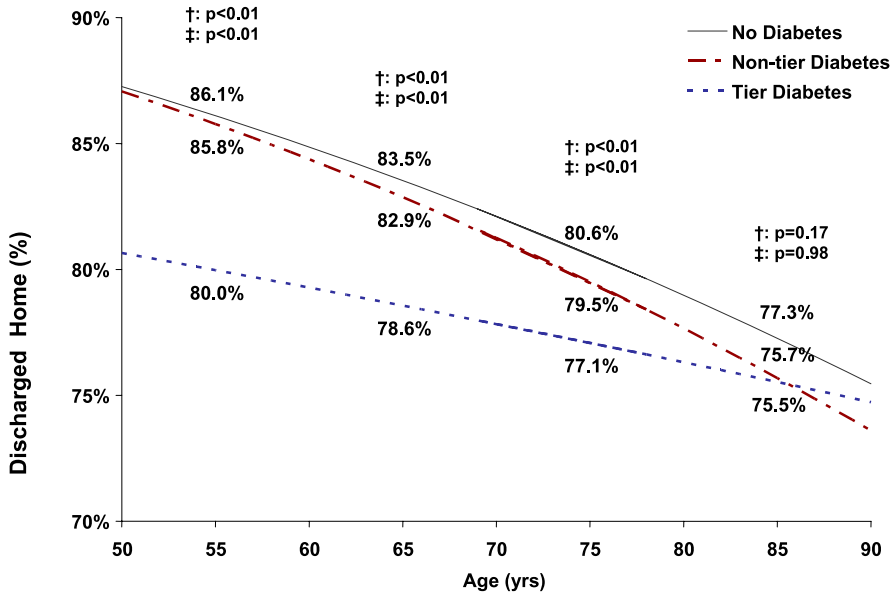

Figure 1—*Predicted percentage of home discharge by diabetes group adjusting for all variables listed in the age-centered logistic regression model with examination of differences at four age-groups from 55 to 85 years. †Differences between tier diabetes and the no-diabetes group. ‡Differences between tier and non-tier diabetes groups. (A high-quality color representation of this figure is available in the online issue.)*

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