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ORIGINAL ARTICLE

Rehabilitation Outcomes of Stroke Patients With and Without Diabetes

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Abstract

Objective: To investigate the relation of diabetes comorbidity and the rehabilitation outcomes of patients with stroke.

Design: Secondary data analysis.

Setting: Inpatient rehabilitation facilities.

Participants: Patients with stroke (N=35,243) who received inpatient rehabilitation in 2004 through 2008.

Interventions: None.

Main Outcome Measures: FIM, length of stay, and discharge destination.

Results: Mean age ± SD of the sample was 71.0±13.2 years. The percent of the sample of Medicare beneficiaries was 53.8%, whereas 46.2% had other sources of funding. Of the patients in the sample, 34.5% had a comorbidity of diabetes, with 17.2% classified as tier-eligible and 82.8% as nontier eligible. Findings included that patients in this sample with diabetes were admitted for rehabilitation services at a younger age than those without diabetes and support previous studies in which tier-eligible diabetes comorbidities moderated by patient age were found to be significant predictors of stroke rehabilitation outcomes. Furthermore, similar findings remained regardless of payer source.

Conclusions: This study provides additional evidence that diabetes as a comorbidity is significantly related to stroke rehabilitation outcome, but the relation is moderated by patient age.

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It has been estimated that people with diabetes have an increased risk of stroke 2 to 4 times that of people without diabetes.[1] Furthermore, previous research suggests that comorbid conditions, such as diabetes, impact functional status, disability status, and increase medical expenditures.[2] In efforts to explore the impact of diabetes on rehabilitation outcomes, retrospective data analysis has been used. When the impact of diabetes on stroke rehabilitation outcomes was initially investigated, dichotomous coding for the presence or absence of diabetes resulted in findings that suggested there was no impact on outcome measures.[3] However, when Graham et al[4] analyzed the relation of diabetes and outcomes for patients with stroke who received postacute rehabilitation, diabetes was coded by tier or nontier comorbidity status. Tier and nontier comorbidity status is a categorization provided for by Centers for Medicare and Medicaid to identify comorbidities that increase costs of patient care. Using this categorization, specific comorbidities are assigned to stratified tiers, which constitute different payment adjustments. This system is based on 4 tiers: tier 1 (high cost), tier 2 (medium cost), tier 3 (low cost), and no tier.[5] However, the mere presence of a specific comorbidity does not indicate the tier status of the comorbidity. For instance, the comorbidity of diabetes without mention of complication (International Classification of Diseases, 9th Revision [ICD-9] 250.0) is not tier eligible. However, comorbidities of diabetes with renal manifestations (ICD-9 250.4) or diabetes with peripheral circulatory disorders (ICD-9 250.7) are tier eligible. All diabetes codes that are tier eligible are categorized as tier 3. Accounting for tier and nontier status, previous researchers concluded that diabetes status by age demonstrated significant interaction effects, resulting in overall poorer rehabilitation outcomes for patients with diabetes in the youngest age groups.[4] Given the important clinical, educational, and policy implications of these findings, it is important to continue to investigate the

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relation of diabetes and rehabilitation outcomes for patients with stroke. The purpose of this study was to examine the rehabilitation outcomes for stroke patients with and without diabetes using a national patient database.

Methods

Secondary data analysis was used to conduct this study. Data were obtained from a national provider of postacute rehabilitation services. The original database included all patient encounters consisting of 574,938 records for services received at inpatient rehabilitation facilities across the United States from 2001 through 2008. Stroke cases were identified as patients with diagnosis codes of 01.1 (left body cerebrovascular accident [CVA]), 01.2 (right body CVA), 01.3 (bilateral involvement), 01.4 (no paresis), or 01.9 (other CVA). The database was reduced to include first admission only for each stroke patient. Since the prospective payment system (PPS) went into effect in 2002, the decision was made to analyze patient data beginning with 2004, 2 full years after the implementation of PPS, in order to minimize effects of the new payment system. Exclusions consisted of those patients with an initial admission date prior to January 1, 2004, those missing pertinent demographic information, such as date of birth, and those with extreme values with regard to age and length of stay. This yielded a final dataset of 35,243 stroke patients who received inpatient rehabilitation services at 75 facilities from 2004 through 2008.

Stroke patients' diabetes status was determined by the presence of ≥1 of the diabetes ICD-9 codes indicated as comorbidities by Graham et al,[4] which distinguished between nontier and tier-eligible diabetes. ICD-9 codes 250.0 through 250.3 were classified as nontier comorbidities, whereas codes 250.4 through 250. 9, 357.2, and 785.4 were classified as tier-eligible comorbidities. For the purpose of analysis, stroke patients' diabetes status was coded as no diabetes (n=23,088), nontier diabetes (n=10,066), or tier diabetes (n=2089). This 3-level diabetes group variable was statistically analyzed as the independent variable, with tier diabetes serving as the reference category. Additional variables obtained from the stroke dataset for analysis included age, sex, race (white, black, Hispanic, other), rehabilitation services used (physical, occupational, speech), type of stroke (right, left, bilateral, no paresis, other), funding source (Medicare/non-Medicare), number of comorbidities (sum of other, nondiabetes, comorbidities; range 0−10), functional status, as measured by the FIM, length of stay (number of days a patient spent in the inpatient rehabilitation facility), and discharge disposition (home, skilled nursing facility, acute unit, other).

Data analysis was performed using SAS 9.2[a], and all statistical tests were performed at the 2-sided .05 level of statistical significance. Univariate descriptive statistics were used to analyze the patients' demographic characteristics and outcomes by diabetes status for all patients, and also separately by Medicare status. Diabetes group differences were analyzed using chi-square tests for categorical variables and 1-way analysis of variance for continuous variables. Logistic regression was used to analyze interaction effects of diabetes status with age and associations with discharge destination, dichotomized as home versus all other (skilled nursing facility, acute unit, other). Linear regression was similarly used to analyze diabetes and age interactions and associations with length of stay and total FIM at discharge. Post hoc tests of mean differences were corrected using the Tukey-Kramer adjustment. Logistic regression results included odds ratio (OR) and 95% confidence interval (CI) and were adjusted for age, race (white, nonwhite), sex, comorbidities sum, and total FIM at discharge. Linear regression coefficients with 95% CI were adjusted for age, race (white, nonwhite), sex, comorbidities sum, and total FIM at admission. Percent discharge home, length of stay, and FIM at discharge were also analyzed separately for Medicare and non-Medicare beneficiaries.

List of abbreviations:

CI	**confidence interval**
CVA	**cerebrovascular accident**
ICD-9	**International Classification of Diseases, 9th Revision**
OR	**odds ratio**
PPS	**prospective payment system**

Results

Table 1 presents the patient characteristics stratified by diabetes status. Of particular note, 12,155 (34.5%) of 35,243 patients in this sample had a comorbidity of diabetes. Also, 53.8% of the patients were Medicare recipients, whereas 46.2% were non-Medicare beneficiaries.

Patient outcomes including initial FIM, discharge FIM, FIM gain, length of stay, and discharge destination were stratified by diabetes status (table 2). Among all study subjects, 69.5% were discharged home, with tier-eligible diabetics seeing the lowest FIM gain on discharge (mean ± SD, 22.4±13.8).

Table 3 presents total FIM at discharge results. Predicted values of discharge FIM total by age and diabetes group are illustrated in figure 1, whereas table 4 tabulates select values by diabetic group for specific patient ages. Similarly, decreasing slopes for total FIM at discharge for the nontier and nondiabetes groups with increasing age are evident in figure 1. However, the tier-eligible group begins at a lower level and exhibits less decline with increasing age than the other 2.

Percent home discharge results showed a strong tier diabetes effect relative to nondiabetes (OR=2.17; 95% CI, 1.15−4.03), but after additionally adjusting for covariates, results were no longer significant (OR=1.42; 95% CI, 0.65−3.06). No tier diabetes effect was evident when we analyzed length of stay, and the diabetes by age interaction was not related to length of stay, after adjusting for covariates ($P>.05$).

Rehabilitation outcomes for Medicare patients (n=18,989) and non-Medicare patients (n=16,284) were also analyzed. The average age of the Medicare patients on admission was 75.4 years, whereas the average age of the non-Medicare patients was 65.9 years. Although significant differences between tier diabetics, nontier diabetics, and nondiabetics were observed across all payer sources combined, among only Medicare patients there was no difference in average FIM gain at discharge ($P>.05$), and no difference in average initial FIM among non-Medicare patients ($P>.05$). The length of stay and percent discharge home results were similar for both Medicare and non-Medicare groups, and did not differ from results observed across all payer sources. Among Medicare patients, no tier diabetes effect on discharge FIM total was evident relative to nontier diabetes, and the interaction with age was not significant ($P>.05$) (table 5). However, relative to the no diabetes group, there was a tier diabetes effect on discharge FIM total, accompanied by a significant interaction with age ($P<.05$) (see table 5).

Among non-Medicare patients, a significant tier diabetes effect on total FIM at discharge was observed relative to nondiabetics, but no interaction with age was observed (see table 6).