Impact of Diabetes on Prolonged Hospital Stay among Native Hawaiians and other Pacific Islanders with Ischemic Stroke

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Abstract

Recent evidence suggests that minority groups have prolonged hospital stays after ischemic stroke. However, disparities in the hospital stay after ischemic stroke among Native Hawaiians and other Pacific Islanders (NHPI) have not been studied. A retrospective study on consecutive patients hospitalized for ischemic stroke at a single tertiary center in Honolulu between 2008 and 2010 was performed. Logistic regression analyses were performed to assess the independent predictors of prolonged hospital stay (hospitalization > 12 days after admission) after ischemic stroke. A total of 740 patients (whites 22%, Asians 53%, NHPI 21%, others 4%) hospitalized for ischemic stroke were studied. NHPI were significantly younger (59 ± 14 years vs 72 ± 13 years) and had significantly higher prevalence of female sex (51% vs 38%), no insurance (10% vs 4%), diabetes (53% vs 18%), hypertension (82% vs 62%), obesity (55% vs 20%) and prolonged hospital stay (20% vs 11%), and lower prevalence of residence outside of O'ahu (12% vs 23%) compared to whites. Univariate analyses showed that NHPI were more likely to have prolonged hospital stay (OR 1.87, 95% CI: 1.01, 3.49) compared to whites. After adjusting for age, sex, race, risk factors, health insurance status, and geographical factor, diabetes (OR 1.76, 95% CI: 1.07, 2.89) was the only independent predictor of prolonged hospital stay. NHPI are associated with prolonged hospitalization after ischemic stroke. However, this effect was attenuated by the impact of diabetes. Further prospective studies are needed to understand the relationship between diabetes and prolonged hospital stay after ischemic stroke.

Keywords

Native Hawaiians, Pacific Islanders, Ischemic stroke, hospital stay, health disparities

Introduction

Stroke occurs in approximately 800,000 people annually in the United States and is the leading cause of disability among adults.[1] Recent evidence suggests that the burden of ischemic stroke is not borne equally by all, with racial minority groups reported to have a higher burden of stroke risk factors and younger age of stroke onset compared to non-Hispanic whites.[2-10] Furthermore, minority groups with ischemic stroke have been reported to have longer hospital stay compared to non-Hispanic whites.[11] However, the impact of race on hospital stay after ischemic stroke among Native Hawaiians and other Pacific Islanders (NHPI) has not been studied. Therefore, we sought to assess racial differences and other correlates of hospital length of stay among a patient population admitted for acute ischemic stroke. We hypothesized that NHPI with ischemic stroke will have a higher rate of prolonged hospital stay compared to whites.

Methods

The Queen's Medical Center (QMC) is a 505-bed medical center located on O'ahu, the largest hospital in the state of Hawai'i and the tertiary referral center for the Pacific Basin (Hawai'i, American Samoa, the Commonwealth of the Northern Mariana Islands, Micronesia, and the US territories of Guam). QMC has the only Joint Commission-certified Primary Stroke Center and the only Neuroscience Intensive Care Unit for the state of Hawai'i. Approval from the QMC Research and Institutional Review Committee was received to conduct a retrospective review of the prospectively collected QMC Get With the Guidelines-Stroke (GWTG-Stroke) database. Waiver of consent was obtained to conduct this study. The institutional stroke database, GWTG-Stroke registry, a national quality improvement initiative and stroke registry used by many participating hospitals nationwide,[12] was accessed to identify all patients hospitalized at QMC with a diagnosis of ischemic stroke between January 1, 2008 and August 31, 2010. Patient demographics, cardiovascular risk factors, health insurance status and the geographic location of their residence (O'ahu, other Hawaiian islands or others) were obtained from review of the electronic medical record. The race and ethnicity information were collected from the hospital's administrative database, and were obtained during the registration or admission process using two-part questions. First question was whether or not they are Native Hawaiian or Part-Hawaiian. The second question was an open-ended question to list one race that the patient most closely associated with, based on patient self-identification or family's identification if the patient was incapacitated. Each Asian race (ie, Japanese, Chinese, Filipinos, etc) was aggregated into one category called "Asian," and the Native Hawaiian/Part-Hawaiian and the Pacific Islander race were aggregated into one category, "NHPI," to increase the statistical power of analysis. Because of the low number of black and American Indian/Alaska native patients, these racial groups were combined with the "other" group. For the study, race was categorized as NHPI, Asian, white, or "other" race. Health insurance status was dichotomized to "no insurance" vs "insurance present." Location of residence was dichotomized to "O'ahu" vs "Others" (any other location except the island of O'ahu, including outer Hawaiian islands (Hawai'i, Maui, Kaho'olawe, Lana'i, Moloka'i, Kaua'i, Ni'ihau), mainland United States and foreign country). The patients were considered to be obese if body mass index (BMI) was greater than or equal to 30 kg/m^2.[13] Prolonged hospital stay was defined as greater than 12 days to be consistent with prior literature.[14]

Statistical Analysis

Data were analyzed using commercially available statistical software (SPSS 20.0, Chicago, IL). Patient characteristics were summarized using descriptive statistics appropriate to variable type. In the univariate analyses, the effect of race on the prevalence of each cardiovascular risk factor, health insurance status,

geographical location of residence, prolonged hospital stay, and in-hospital mortality for each racial group was assessed by performing a separate logistic regression analysis for each categorical variable after entering race (whites as a reference group) as the covariate. For normally distributed continuous variables (age and hospital LOS), analysis of variance (ANOVA) was used to compare each race to the reference group (whites). A final model for prolonged hospital stay was created using the logistic regression model, adjusted for age, sex, race, insurance status, and Hawaiian island of residence and cardiovascular risk factors. The odds ratio (OR) and 95% confidence interval (CI) were calculated from the beta coefficients and their standard errors. Age was used as a continuous variable with a constant OR for each year. Levels of $P < .05$ were considered statistically significant.

Results

Between 2008 and 2010, a total of 740 patients (whites 22%, Asians 53%, NHPI 21%, others 4%) hospitalized for ischemic stroke at QMC were identified. Unadjusted comparison between NHPI and whites showed that NHPI were significantly younger (59 ± 14 years vs 72 ± 13 years) and had significantly higher prevalence of female sex (51% vs 38%), no health insurance (10% vs 4%), diabetes (53% vs 18%), hypertension (82% vs 62%), obesity (55% vs 20%) and prolonged hospital stay (20% vs 11%), and lower prevalence of residence outside of O'ahu (12% vs 23%) compared to whites (Table 1).

Unadjusted and multivariable regression models predicting prolonged hospital stay are presented in Table 2. Unadjusted analysis of prolonged hospital stay showed that NHPI race (OR 1.87, 95% CI: 1.01, 3.49) and Other race (OR 2.69, 95% CI: 1.06, 6.86) were more likely to have prolonged hospital stay compared to whites. When adjusted for age, NHPI race (OR 1.73, 95% CI 0.90, 3.31) no longer became a significant predictor of prolonged hospital stay. In the full model, the only independent predictor of prolonged hospital stay after ischemic stroke was diabetes (OR 1.76, 95% CI: 1.07, 2.89).

Discussion

Although NHPI who were hospitalized for ischemic stroke had a higher prevalence of prolonged hospital stay compared to whites, this association was attenuated by the impact of diabetes, which was the only independent risk factor for prolonged hospital stay. Overall, NHPI were more than a decade younger and had a higher prevalence of cardiovascular risk factors, a finding similar to the results of other observational ischemic stroke studies that compared non-Hispanic whites to other minorities such as Maoris, Hispanics and blacks;[4-7,15,16] and supports the idea that minority racial groups overall have a younger age of stroke onset and a higher burden of cardiovascular risk factors compared to whites.[17] In the multivariable model, prolonged hospital stay was largely driven by the impact of diabetes, which was highly prevalent among the NHPI. The results of this study are similar to the prior studies that have shown the significant impact of diabetes or hyperglycemia on prolonged hospital stay in patients with ischemic stroke,[18,19] CHF exacerbation,[20] cardiac surgery,[21] and other acute medical conditions.[22]

The exact mechanism of how diabetes affects the hospital stay after ischemic stroke is unclear and may be multi-factorial. Since diabetic patients with ischemic stroke have been shown to have worse disability and overall functional outcome than non-diabetic patients,[23-27] they may require longer hospital stay for inpatient rehabilitation treatments prior to hospital discharge compared to non-diabetic stroke patients. Animal studies also suggest that diabetes impairs cortical plasticity and functional recovery after ischemic stroke,[28,29] and support the idea that diabetic stroke patients may have slower or less optimal neurological recovery compared to non-diabetic stroke patients. Furthermore, diabetic patients are at higher risk for nosocomial infection such as urinary tract infection and pneumonia.[30,31] Nosocomial infections that are acquired during hospitalization may also contribute to the prolonged hospital stay in some of the stroke patients. In fact, a prior study showed that diabetes and in-hospital infection are both independent predictors of prolonged hospital stay after ischemic stroke.[18] Unfortunately, the institutional stroke registry does not have the in-hospital infection and complication data to address this possibility.

This study has several limitations. First, the data on the pattern of the ischemic strokes and intracranial/extracranial vascular anatomy were not available, and thus it is unclear if there are racial disparities in stroke etiologies (ie, lacunar strokes, intracranial/extracranial large artery diseases and cardioembolic strokes) that may have impacted the hospital length of stay. Second, the clinical data on glycemic control, diabetes-related complications, and hospital-acquired infection were not available and were not included in the final model. Thus, a potential difference in the duration of diabetes and the degree of glycemic control between different races could not be assessed. Third, the institutional database did not exclude repeat hospitalizations, and it is possible that individual patients were included in the database more than once. Lastly, due to the single-center study design, the results of this study may not be generalizable to other populations. Overall, QMC captures approximately 21% of all ischemic stroke hospitalization for the state of Hawai'i (data from Hawai'i Health Information Corporation). Because our institution is a tertiary referral center, there may have been a referral bias toward more severe stroke patients with more extensive co-morbidities that may have impacted the hospital length of stay.

Conclusion

NHPI are associated with prolonged hospitalization after ischemic stroke. However, these racial differences were not independently significant when the impact of diabetes was taken into account. Further prospective studies are needed to understand the relationship between diabetes and prolonged hospital stay after ischemic stroke.

Table 1. Clinical characteristics of ischemic stroke patients (2008-2010)				
	Whites†	**Asians**	**NHPI**	**Others**
No. of patients	166	389	154	31
Age, years	72 ± 13	72 ± 14	59 ± 14*	57 ± 16*
Female	63 (38)	208 (54)*	79 (51)*	10 (32)
No insurance	6 (4)	27 (7)	15 (10)*	0 (0)
Residence outside of O'ahu	38 (23)	26 (7)*	19 (12)*	3 (10)
Risk factors				
Diabetes mellitus	30 (18)	125 (32)*	81 (53)*	9 (29)
Hypertension	103 (62)	289 (74)*	126 (82)*	21 (68)
Atrial fibrillation/atrial flutter	30 (18)	63 (16)	19 (12)	2 (7)
Congestive heart failure	5 (3)	10 (3)	7 (5)	0 (0)
Previous stroke or TIA	15 (9)	47 (12)	19 (12)	2 (7)
CAD or prior MI	42 (25)	70 (18)	31 (20)	4 (13)
Smoking	21 (13)	55 (14)	30 (20)	8 (26)
Obesity	26 (20)	32 (11)*	68 (55)*	5 (23)
Hospital LOS, days	9 ± 20	7 ± 6	11 ± 21	10 ± 12
Prolonged stay (>12 days)	19 (11)	45 (12)	30 (20)*	8 (26)*
Mortality	10 (6)	38 (10)	10 (7)	2 (7)

†Asians, Native Hawaiians and other Pacific Islanders (NHPI), and Others were compared to whites (reference group). TIA, transient ischemic attack; CAD, coronary artery disease; MI, myocardial infarction; Obesity = body mass index ≥ 30 kg/m2; LOS, length of stay. Data are n (%) or mean ± SD. *P < .05 compared to whites.

Table 2. Multivariable models for Prolonged Hospital Stay (>12 days)			
	Model 1 Unadjusted OR (95% CI)	**Model 2 Adjusted for Age OR (95% CI)**	**Model 3 Fully Adjusted OR (95% CI)**
Race†			
Asians	1.01 (0.57, 1.79)	1.01 (0.57, 1.79)	0.90 (0.47, 1.70)
NHPI	1.87 (1.01, 3.49)*	1.73 (0.90, 3.31)	1.57 (0.74, 3.34)
Others	2.69 (1.06, 6.86)*	2.45 (0.93, 6.41)	2.72 (0.92, 8.02)
Age		0.99 (0.97, 1.01)	0.99 (0.97, 1.01)
Female			0.87 (0.54, 1.41)
No insurance			1.45 (0.60, 3.48)
Residence outside of Oahu			0.94 (0.45, 1.99)
Diabetes mellitus			1.76 (1.07, 2.89)*
Hypertension			0.77 (0.45, 1.31)
Atrial fibrillation/atrial flutter			1.24 (0.66, 2.34)
Congestive heart failure			1.77 (0.59, 5.37)
Previous stroke or TIA			1.06 (0.51, 2.17)
CAD or prior MI			1.08 (0.60, 1.92)
Smoking			0.88 (0.45, 1.72)
Obesity			0.63 (0.34, 1.17)

Logistic regression model for prolonged hospital stay after ischemic stroke. † Asians, Native Hawaiians and other Pacific Islanders (NHPI), and Others were compared to whites (reference group). *Odds ratios (OR) were statistically significant at P < .05. TIA, transient ischemic attack; CAD, coronary artery disease; MI, myocardial infarction; Obesity = body mass index ≥30 kg/m^2.

Conflict of Interest

None of the authors identify any conflict of interest.

Disclosure

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