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Recurrent Stroke Risk Is Higher Than Cardiac Event Risk After Initial Stroke/Transient Ischemic Attack

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Background and Purpose—Patients with ischemic stroke and transient ischemic attack (TIA) are at risk for recurrent cerebrovascular and cardiac events. Understanding which of these adverse events is more likely to occur next is instructive for preventive therapy planning.

Methods—Subjects (n=1923) were identified from a sample of hospital discharges from administrative claims for the Michigan Medicare population from January 2001 to June 2001 using *International Classification of Diseases*, 9th Revision codes for ischemic stroke/TIA. Outcomes (cardiac events, myocardial infarction [MI], percutaneous transluminal coronary angioplasty [PTCA], coronary artery bypass grafting [CABG] and ischemic strokes) were identified for 2001 to 2003. Comparison between cardiac and stroke as secondary events were made using cumulative incidence estimates.

Results—Over the follow-up period, 172 patients had a cardiac event (62.8% MI, 7.6% CABG, 14.5% PTCA, 9.3% MI and PTCA, and 5.8% MI and CABG) and 239 had a stroke as their first event. Cardiac event at 2 years had occurred in 7.7%, and stroke occurred in 11.8%.

Conclusion—The risk of stroke after initial stroke/TIA is higher than the risk of cardiac events. The propensity after stroke/TIA to have the first recurrent ischemic event in the brain, rather than in the heart, has implications for prophylactic therapy selection. (*Stroke*. 2005;36:1285-1287.)

Key Words: cerebrovascular diseases ■ ischemic attack, transient ■ stroke

Ischemic stroke and transient ischemic attack (TIA) patients are at risk for recurrent ischemic cerebrovascular and cardiac events. Almost one-third of patients with minor stroke or TIA who are asymptomatic from a cardiac perspective have occult coronary artery disease exceeding the prevalence in age-matched controls.¹ There is little information in the literature on risk of subsequent ischemic events after an initial cerebral ischemic event. Previous research has included prevalent stroke cases rather than reporting on events subsequent to incident stroke.²

An understanding of which adverse event is more likely to occur first, stroke or cardiac, after initial stroke/TIA is instructive for prevention efforts. We assessed the risk of the first adverse event after initial ischemic stroke/TIA in the Michigan Medicare population and sought to identify independent predictors of each.

Materials and Methods

Baseline data for this analysis were obtained through retrospective medical record abstraction from a sample of acute care hospitals' discharges in Michigan from January 1, 2001 to June 30, 2001. Cases were identified using Center for Medicare & Medicaid Services administrative claims for *International Classification of Diseases*, 9th Revision (ICD-9) codes corresponding to ischemic stroke (ICD-9-CM codes: 433.xx-436.xx) and TIA (435.xx [except 435.2]). Sampling was performed according to published procedures.³ Data abstraction was performed for all cases to identify risk factors and demographics. Those with a history of stroke/TIA were excluded (n=2936).

Outcomes, including cardiac events, such as myocardial infarction, percutaneous transluminal coronary angioplasty, and coronary artery bypass grafting (ICD-9-CM codes: 36.xx, 410.xx [except 410.x2]), and ischemic strokes, were identified for January 1, 2001 to June 30, 2003. Outcomes were identified using all primary and secondary diagnosis codes. The use of all codes compared with primary diagnosis codes only for ischemic stroke has been shown to

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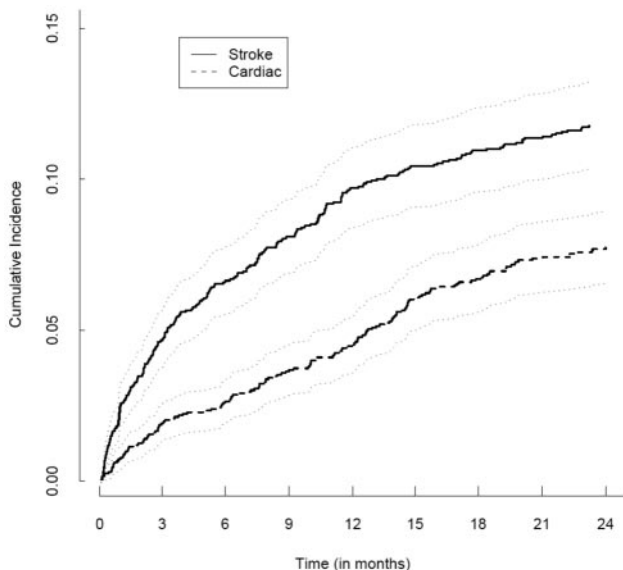
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Cumulative incidence curves depicting strokes and cardiac ischemic events.

improve sensitivity of stroke diagnosis without sacrificing specificity.⁴ Comparison between cardiac and stroke events after an incident stroke/TIA were made using cumulative incidence calculation. Cox proportional hazard models were used to identify independent predictors of each outcome. Independent variables included were: age, gender, race, diabetes, hypertension, atrial fibrillation, congestive heart failure, and valvular heart disease.

Results

There were 2044 first-ever ischemic strokes/TIAs during the study time period. Out-of-state beneficiaries (121) were excluded because of lack of follow-up, leaving 1923 cases for analysis. Mean age was 77 (standard deviation 8.8). Eighty-two percent were white and 55.5% were female.

During the follow-up period, 172 had a cardiac event and 239 had a stroke as their first event, with 10 patients having a stroke and a cardiac event on the same day. At all time points, recurrent strokes were in excess of ischemic cardiac events (Figure). Stroke and cardiac events had occurred, respectively, in 2.5% and 0.8% at 30 days, 6.6% and 2.6% at 6 months, and 11.8% and 7.7% at 2 years. Acute MI was the most common cardiac event (Table 1).

For the predictive modeling, 7 individuals were excluded because of race other than black or white, leaving 1916 for analysis. Diabetes and white race were independently asso-

TABLE 1. Cardiac Events Types (N=172)

	No.	%
MI	108	62.8
CABG	13	7.6
PTCA	25	14.5
MI and PTCA	16	9.3
MI and CABG	10	5.8

CABG indicates coronary artery bypass grafting; MI, myocardial infarction; PTCA, percutaneous transluminal coronary angioplasty.

TABLE 2. Multivariable Models for Stroke and Ischemic Cardiac Events: Hazard Ratios With 95% Confidence Intervals

	Stroke	Cardiac Event
Age	1.01 (0.99, 1.03)	1.00 (0.98, 1.02)
Female	0.83 (0.64, 1.07)	1.21 (0.89, 1.64)
Black	0.78 (0.48, 1.29)	0.51 (0.26, 1.00)*
Diabetes	1.03 (0.77, 1.37)	1.70 (1.24, 2.33)*
Hypertension	1.24 (0.87, 1.78)	1.05 (0.70, 1.59)
Atrial fibrillation	0.73 (0.49, 1.07)	1.15 (0.76, 1.82)
Congestive heart failure	1.31 (0.94, 1.82)	1.33 (0.91, 1.94)
Valvular heart disease	1.15 (0.88, 1.51)	1.04 (0.75, 1.43)

*P<0.05.

Referent group for black was white; referent group for female was male.

ciated with an ischemic cardiac event (Table 2). None of the variables was independently associated with stroke.

Discussion

This analysis demonstrates that ischemic stroke after initial ischemic stroke/TIA is more common as a first adverse event than an ischemic cardiac event. This is true across all time points over a 2-year follow-up period.

The results in this study using a fee-for-service Medicare population are similar to those found in previous work using a managed care Medicare population.² Our study expands on previous data by reporting outcomes of incident cerebrovascular events and by including TIA cases and revascularization procedure outcomes. Percutaneous transluminal coronary angioplasty and coronary artery bypass grafting are meaningful and prevalent outcomes of coronary artery disease, both clinically and economically.

Strategies to reduce the risk of stroke and ischemic cardiac events have much in common; however, there are differences in treatments. If stroke patients at particularly high risk for a coronary event could be identified, more aggressive preventive strategies could be undertaken which may improve outcome.^{5,6}

Although there were no independent predictors of the first recurrent event being stroke, diabetes was predictive of a cardiac event as the first adverse event in those with stroke/TIA. Black race was found to be protective of a first cardiac event, a finding that is consistent with the lower incidence of acute MIs in blacks or, alternatively, may represent less frequent revascularization procedures among blacks.⁷

Our predictive modeling was limited by the variables in our data set. We were not able to include smoking and hyperlipidemia. The use of Medicare administrative claims data to identify outcomes also has limitations, although overall accuracy is high for both stroke and acute MI.^{8,9}

Risk of stroke after initial stroke/TIA is higher than the risk of cardiac events. The propensity after stroke/TIA to have the first recurrent ischemic event in the brain, rather than in the heart, has implications for prophylactic therapy selection.

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