**Stroke Among Patients With Dizziness, Vertigo, and Imbalance in the Emergency Department**

**A Population-Based Study**

Kevin A. Kerber, MD; Devin L. Brown, MD; Lynda D. Lisabeth, PhD; Melinda A. Smith, MPH; Lewis B. Morgenstern, MD

**Background and Purpose**—Dizziness, vertigo, and imbalance are common presenting symptoms in the emergency department. Stroke is a leading concern even when these symptoms occur in isolation. The objective of the present study was to determine the “real-world” proportion of stroke among patients presenting to the emergency department with these dizziness symptoms (DS).

**Methods**—From a population-based study, patients >44 years of age presenting with DS to the emergency department, or directly admitted to the hospital, were identified. Demographics, the frequency of new cerebrovascular events, and the frequency of isolated DS (ie DS with no other stroke screening term or accompanying neurologic signs or symptoms) were assessed. Multivariable logistic regression was used to evaluate the association of age, gender, ethnicity, and isolated DS with stroke/transient ischemic attack (TIA). The association of the presenting symptoms with stroke/TIA was also assessed.

**Results**—Stroke/TIA was diagnosed in 3.2% (53 of 1666) of all patients with DS. Only 0.7% (9 of 1297) of those with isolated DS had a stroke/TIA. Patients with stroke/TIA were slightly older than those without stroke/TIA (69.3 ± 11.7 vs 65.3 ± 12.9, \(P = 0.02\)). Male gender was associated with stroke/TIA, whereas isolated DS was negatively associated with stroke/TIA. Patients with imbalance (dizziness as referent) were more likely to have stroke/TIA.

**Conclusions**—The proportion of cerebrovascular events in patients presenting with dizziness, vertigo, or imbalance is very low. Isolated dizziness, vertigo, or imbalance strongly predicts a noncerebrovascular cause. The symptom of imbalance is a predictor of stroke/TIA. (Stroke. 2006;37:2484-2487.)

**Key Words:** cerebrovascular accident ■ dizziness ■ gait disorders ■ population surveillance ■ vertigo

An estimated 7.5 million patients with dizziness are seen each year in ambulatory care settings in the United States, making it one of the most common principal complaints in the emergency department (ED).

The term “dizziness” is very nonspecific but may refer to vertigo, lightheadedness, presyncope, anxiety, or just not feeling well. Although some physicians consider imbalance to be a more serious symptom of neurologic disease, it is also considered by many authors to be a type of dizziness. Some patients have difficulty describing their specific type of dizziness and oftentimes physicians do not attempt to differentiate among these types. Although the most common causes are benign, the differential diagnosis includes potentially life-threatening stroke. In the acute setting, cerebellar or brain stem infarction must be a leading concern because hydrocephalus or recurrent stroke could follow. Although other focal neurologic symptoms may accompany dizziness, case reports and small series have shown that dizziness can also be the principal or only complaint in patients with stroke. However, to date, no large population-based study has investigated the frequency of stroke among patients presenting to the ED with dizziness.

From a large population-based study, the Brain Attack Surveillance in Corpus Christi (BASIC) project, we sought to determine the “real-world” proportion of stroke/transient ischemic attack (TIA) in patients presenting to the ED with a primary complaint of dizziness or specific types of dizziness (ie vertigo and imbalance).

**Methods**

The methods of the BASIC project were previously reported. This population-based study is an ongoing stroke surveillance study in Nueces County, Texas. All but 5% of the 313,645 residents of Nueces County live in the city of Corpus Christi and the next closest metropolitan areas (San Antonio and Houston, Texas) are more than...
During this study period, 1666 patients were identified with the principal presenting complaint of dizziness (885), vertigo (665), imbalance (78), or more than one of these terms (38). Only 3.2% (53 of 1666) of these patients were validated to have a stroke/TIA by a BASIC neurologist based on international criteria22 after thorough review of all source documentation. Of those with a validated stroke/TIA, the principal presenting complaint was dizziness in 23 cases, vertigo in 18 cases, imbalance in 11 cases, and more than one of these terms in one case. Nearly all (1629 of 1666 [98%]) of the patients identified in this study presented to the ED. Of the 46 validated stroke/TIA cases evaluated in the ED, the ED physician did not make a diagnosis of stroke or TIA in 16 cases (35%). Whereas 17% (9 of 53) of those with stroke/TIA had isolated DS, only 0.7% (9 of 1297) of all patients presenting with isolated DS had stroke/TIA diagnosed. Of patients with isolated DS, 15 of 1297 (1%) were admitted to the hospital with a diagnosis of stroke/TIA by the ED or admitting physician; five of these were validated as stroke/TIA. Ischemic strokes were identified in 33 patients, TIA in 17, intracranial hemorrhage in one, and two were of uncertain type because imaging results were not available. The demographics and clinical characteristics of those with and without a diagnosis of stroke/TIA are shown in Table 1. The group with cerebrovascular events were significantly older (69.3 ± 11.7) compared with the nonstroke/TIA group (65.3 ± 12.9, P = 0.02). Male gender was more common in the stroke/TIA group compared with the nonstroke/TIA group. There was no significant difference in race/ethnicity between the groups.

Most patients without stroke/TIA had isolated DS (80%). The most common diagnoses in patients without stroke/TIA were dizziness not otherwise specified, peripheral vestibular disorders (eg labyrinthitis, benign positional vertigo), metabolic disturbances (eg anemia, hyperglycemia, electrolyte abnormalities), orthostatic hypotension, anxiety, or dizziness associated with headache.

Patients with stroke/TIA were more likely than patients without stroke/TIA to be admitted to the hospital (75% vs 18%, respectively). Hypertension was the most common stroke risk factor followed by history of coronary artery disease, diabetes, previous TIA/stroke, current smoker, hypercholesterolemia, and atrial fibrillation (Table 1). Most patients with stroke/TIA (72%) had at least two stroke risk factors.

Table 2 provides the results of multivariable logistic regression analysis for potential predictors of stroke. Male gender (odds ratio [OR], 2.47; 95% CI, 1.39–4.40) was associated with stroke/TIA, whereas isolated DS had a strong negative association with stroke/TIA (OR, 0.05; 95% CI, 0.02–0.11). In a
TABLE 1. Demographic and Clinical Characteristics of Patients With and Without Cerebrovascular Cause of Dizziness, Vertigo, or Imbalance

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Stroke/TIA (n=53)</th>
<th>No Stroke (n=1613)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean) ± SD</td>
<td>69.3 ± 11.7</td>
<td>65.3 ± 12.9</td>
<td>0.02</td>
</tr>
<tr>
<td>Male</td>
<td>29 (55%)</td>
<td>574 (36%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic white (%)</td>
<td>21 (40%)</td>
<td>545 (34%)</td>
<td></td>
</tr>
<tr>
<td>Mexican American (%)</td>
<td>31 (58%)</td>
<td>954 (60%)</td>
<td></td>
</tr>
<tr>
<td>Other (%)</td>
<td>1 (2%)</td>
<td>95 (6%)</td>
<td></td>
</tr>
<tr>
<td>Stroke risk factors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>38 (72%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>21 (40%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>17 (32%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Previous transient ischemic attack/stroke</td>
<td>15 (28%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Current smoker</td>
<td>12 (23%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>11 (21%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>3 (6%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Heavy alcohol consumption</td>
<td>0 (0%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Total risk factors ≥2</td>
<td>38 (72%)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Isolated dizziness symptoms*</td>
<td>9 (17%)</td>
<td>1288 (80%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Motor deficit</td>
<td>31 (60%)</td>
<td>55 (4%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Sensory deficit</td>
<td>15 (31%)</td>
<td>43 (3%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Language disturbance</td>
<td>10 (21%)</td>
<td>20 (1%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Visual changes</td>
<td>12 (24%)</td>
<td>42 (3%)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Admitted to hospital</td>
<td>40 (75%)</td>
<td>292 (18%)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

*Isolated dizziness symptoms = dizziness, vertigo, or imbalance without other stroke screening terms or accompanying neurologic signs or symptoms. NA indicates not available.

Discussion

In this population-based study, we found that the proportion of stroke/TIA in patients presenting to the ED with DS was low, especially among those with isolated DS. In fact, isolated DS strongly predicted a nonstroke/TIA diagnosis. Patients with cerebrovascular events were older, more often male, and most had two or more stroke risk factors. Overall, patients with stroke/TIA identified in the current study had a stroke risk factor profile similar to a previously reported unselected BASIC study stroke population.25

Only a few studies have looked at the proportion of stroke/TIA among patients with DS presenting to the ED.13,26–29 However, all of these are single-center studies with small sample sizes (range, 24–125 patients). Population-based studies facilitate the ability to generalize results beyond individual tertiary referral centers. Proportion of cerebrovascular events varied in previous studies from 2 to 25%. The higher proportion found in some studies is particularly alarming because the presentation of DS is so common. The study reporting the highest proportion of stroke/TIA focused only on subjects with acute-onset vertigo.13 Some physicians may be more concerned about stroke when the specific complaint is vertigo rather than nonspecific dizziness, but previous stroke predictive models did not separate vertigo from dizziness.30 We found vertigo to be no more predictive of stroke/TIA than the less specific term of dizziness, which emphasizes the importance of research into the presentation of dizziness.

Although age was significantly greater in those with stroke/TIA, the absolute difference was only 4 years. This small difference may be the result of our inclusion criterion of age ≥44 years. If younger subjects were included, this difference may increase because stroke is rare at younger ages whereas dizziness is not.31 Including younger ages would also likely further reduce the already low overall proportion of stroke found among subjects presenting with DS. The difference in gender is consistent with both the established higher age-adjusted risk of stroke among males and the higher frequency of peripheral dizziness among females.31,32

It was not surprising that imbalance was associated with stroke/TIA compared with dizziness, whereas vertigo was not. The most common causes of vertigo and dizziness are benign peripheral vestibular disorders, whereas acute imbalance without vertigo or dizziness is usually caused by a cerebellar stroke, particularly within the superior cerebellar artery distribution33 and not the result of a peripheral vestibular disorder. Vertigo and dizziness can be caused by acute brain stem or cerebellar stroke, but the statistical association of these symptoms with stroke is less than the association of imbalance with stroke as a result of the relative infrequency of stroke causing vertigo or dizziness compared with non-stroke causes (ie peripheral vestibular disorders).

The limitations to this study must be addressed. Like with any observational study, potential for misclassification exists. Most patients were not examined by a neurologist in the ED, and this study was not designed to collect specific features sought by neuro-otology specialists, but rather to report the “real-world” ED experience with this type of acute neurologic presentation. As a result, subtle neurologic findings indicating central nervous system dysfunction may have been missed in some patients.34 In addition, brain MRI was not ordered in most patients, and some recent reports have shown small brainstem or cerebellar strokes identified by MRI in patients with clinical presentations closely resembling periph-
eral vestibular disorders. Therefore, it is possible that some patients classified as “no stroke” may have had small strokes that went unidentified clinically. We categorized patients based on the screening terms that were entered into the ED or hospital log at the time of evaluation. Because no standardized definitions for symptom terminology were used by the hospital employees entering principal complaints at the various sites, caution must be taken when interpreting differences among dizzy terms. Also, symptom onset, duration, aggravating/alleviating factors, and associated auditory symptoms or headache were not systematically collected. Thus, these important clinical features could not be compared between groups. We were unable to adjust for stroke risk factors in assessing associations with stroke/TIA because this information was not collected in the nonstroke/TIA patients. Inclusion of these potential confounders may have altered our results. This patient population, including a large proportion of nonimmigrant Hispanic Americans, the United States’ largest minority population, may not be generalizable to all populations.

The strengths of this study are its population-based design and stroke/TIA diagnosis validations by neurologists using standardized criteria and source documentation. Furthermore, this study provides information on “real-world” experience with terminology and clinical presentations in a representative community.

Although the percentage of patients presenting with DS ultimately determined to be caused by stroke is low, when considering how commonly patients with DS present for evaluation, the absolute number of these patients with stroke etiologies may be high. More detailed population-based studies and prospective clinical studies on the relationship of stroke and DS are critically needed so that stroke can be rapidly identified. Establishing clinical predictors of stroke is also crucial to reducing health expenditures and ED waiting times related to this common ED presentation. This study suggests that of the patients presenting with DS, those with other neurologic symptoms, who are older and male, are at the highest risk for a cerebrovascular etiology.

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Disclosures
None.

References
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