Title

Rate and Predictors of Serious Neurologic Causes of Dizziness in the Emergency Department

Journal

Mayo Clinic Proceedings, 87(11)

ISSN

0025-6196

Authors

Navi, Babak B
Kamel, Hooman
Shah, Maulik P
et al.

Publication Date

2012-11-01

DOI

10.1016/j.mayocp.2012.05.023

Peer reviewed

MAYO CLINIC

Rate and Predictors of Serious Neurologic Causes of Dizziness in the Emergency Department

Babak B. Navi, MD; Hooman Kamel, MD; Maulik P. Shah, MD; Aaron W. Grossman, MD, PhD; Christine Wong, MD; Sharon N. Poisson, MD, MAS; William D. Whetstone, MD; S. Andrew Josephson, MD; S. Claiborne Johnston, MD, PhD; and Anthony S. Kim, MD, MAS

Abstract

Objective: To describe the rate and predictors of central nervous system (CNS) disease in emergency department (ED) patients with dizziness in the modern era of neuroimaging.

Patients and Methods: We retrospectively reviewed the medical records of all adults presenting between January 1, 2007, and December 31, 2009, to an academic ED for a primary triage complaint of dizziness, vertigo, or imbalance. The final diagnosis for the cause of dizziness was independently assigned by 2 neurologists, with a third neurologist resolving any disagreements. The primary outcome was a composite of ischemic stroke, intracranial hemorrhage, transient ischemic attack, seizure, brain tumor, demyelinating disease, and CNS infection. Univariate and multivariate logistic regression were used to assess the association between clinical variables and serious CNS causes of dizziness.

Results: Of 907 patients experiencing dizziness (mean age, 59 years; 58% women [n=529]), 49 (5%) had a serious neurologic diagnosis, including 37 cerebrovascular events. Dizziness was often caused by benign conditions, such as peripheral vertigo (294 patients [32%]) or orthostatic hypotension (121 patients [13%]). Age 60 years or older (odds ratio [OR], 5.7; 95% confidence interval [CI], 2.5-11.2), a chief complaint of imbalance (OR, 5.9; 95% CI, 2.3-15.2), and any focal examination abnormality (OR, 5.9; 95% CI, 3.1-11.2) were independently associated with serious neurologic diagnoses, whereas isolated dizziness symptoms were inversely associated (OR, 0.2; 95% CI, 0.0-0.7).

Conclusion: Dizziness in the ED is generally benign, although a substantial fraction of patients harbor serious neurologic disease. Clinical suspicion should be heightened for patients with advanced age, imbalance, or focal deficits.

 ■ Mayo Clin Proc. 2012;87(11):1080-1088

From the Department of Neurology and Neuroscience, Weill Cornell Medical College, New York, NY (B.B.N., H.K.); Department of Neurology (M.P.S., A.W.G., S.N.P., S.A.J., S.C.J., A.S.K.), Department of Emergency Medicine (W.D.W.), and Department of Epidemiology and Biostatistics (S.C.J.), University of California, San Francisco; and Department of Neurology, California Pacific Medical Center, San Francisco (C.W.).

Dizziness is one of the most common presenting symptoms in the emergency department (ED) and is a frequent reason for neurologic consultation.[1-3] Despite this high prevalence, evaluating dizziness symptoms remains a challenge for many physicians, particularly since symptoms are often poorly characterized by patients and physicians alike and can incorporate a multitude of related symptoms, such as vertigo, lightheadedness, balance disturbance, anxiety, and general malaise.[4,5] Previous studies have found that acute dizziness is most often caused by benign conditions, such as peripheral vertigo, orthostatic hypotension, and psychogenic disorders, whereas serious neurologic conditions, such as stroke and brain tumors, are rare.[6-10]

However, dizziness due to serious neurologic disease could be underestimated because most previous studies took place before the advent of modern diagnostic neuroimaging or did not include detailed medical record review by a neurologist.[6,8-10] Furthermore, many previous analyses were limited by small sample sizes or by the inclusion of patients with chronic dizziness in ambulatory care settings or were larger studies that used national administrative databases that were valuable in measuring the impact of dizziness presentations on EDs but were limited by a lack of available clinical detail.[2,3,6,8,9,11] Therefore, the magnitude of the risk of serious causes of acute dizziness in the ED and the question of which clinical variables predict central nervous system disease remain poorly understood.

The objective of this study was to better characterize the clinical presentation, evaluation, diagnosis, and disposition of patients presenting with acute dizziness to a tertiary care ED with around-the-clock access to advanced neuroimaging and in-hospital neurology consultants. We also sought to assess the overall rate and predictors of serious central nervous system diseases in these patients.

PATIENTS AND METHODS

Study Design and Setting

We conducted a retrospective medical record review of consecutive patients presenting with dizziness, vertigo, or imbalance to the University of California San Francisco Medical Center, San Francisco, California, a tertiary care university hospital and an accredited primary stroke center with approximately 38,000 ED encounters annually. The ED is staffed 24 hours a day by resident and attending emergency medicine physicians and has around-the-clock access to in-hospital neurology consultants and emergency computed tomography (CT) and magnetic resonance imaging (MRI). The University of California San Francisco Committee on Human Research approved this study and waived informed consent.

Study Population

Patient triage complaints were documented verbatim by ED nurses in real time and then were transferred to a clinical database by an analyst. We retrospectively searched this electronic database for all patients 18 years or older who visited the ED between January 1, 2007, and December 31, 2009, with a triage symptom containing any of the following search terms: *dizzy, dizziness, vertigo, spinning, imbalance,* or *disequilibrium*. We excluded patients whose primary symptoms did not include any of the specified search terms as determined by an independent review of the clinical documentation by 2 neurologists (B.B.N., H.K., M.P.S., A.W.G., C.W., or S.N.P.). Patients with multiple eligible ED visits during the study period were included only once at the time of the first visit during the study period.

Data Collection and Processing

Medical record reviews were conducted according to the standard of published recommendations.[12] All medical records that met the inclusion criteria were randomly assigned (by a computerized random number generator) to 1 of 6 data abstractors who reviewed them electronically. All the abstractors were neurologists: 4 were board-certified vascular neurology and neurocritical care fellows and 2 were third-year neurology residents. Data were collected using a standardized data abstraction form (see the Supplemental Figure available online at http://www.mayoclinicproceedings.org) that was developed after several rounds of pretesting. The candidate form was refined by having each abstractor apply the same candidate form to the same set of sample medical records and then incorporating feedback to optimize ease of use, the availability of data elements, and the reliability of the data abstraction by consensus. The candidate form was then finalized and applied in the final data abstraction process. Individual abstractors entered data into a password-protected electronic study database. All the variables were defined in advance of medical record reviews in a written data dictionary that served as a reference for abstractors. Any questions about data elements that could not be answered with the assistance of the data dictionary were resolved by consensus. Variables that were missing from or not mentioned in the clinical documentation were considered to be not present.

Baseline Measurements

We collected information on age, race, sex, time of visit, duration of the episode in days, previous episodes, positional symptoms, medical comorbidities, associated symptoms, use of antithrombotic medications, triage vital signs, neurologic examination findings, presence of orthostasis, ED evaluation, and ED treatments. Associated symptoms included unilateral weakness, speech difficulty, gait impairment, headache, tinnitus, hearing loss, diplopia, changes in vision besides diplopia, vertigo, confusion, sensory impairment, nausea or vomiting, chest pain, symptoms of an upper respiratory tract infection, dyspnea, syncope, light-headedness, and psychiatric symptoms.

Recorded comorbidities included migraine, recent trauma, hypertension, dyslipidemia, coronary artery disease, diabetes mellitus, congestive heart failure, previous stroke, previous transient ischemic attack (TIA), smoking in the past 5 years, and previous psychiatric disease consisting of any history of a mood, thought, or personality disorder. Orthostasis was defined either clinically or by a decrease in systolic or diastolic blood pressure of greater than 20 or 10 mm Hg, respectively. Heart rate and systolic and diastolic blood pressures were recorded. Examination findings by the ED physician were documented and consisted of the following: encephalopathy, aphasia, dysarthria, nystagmus, ophthalmoparesis, visual field abnormality, facial weakness, limb weakness, limb ataxia, sensory impairment, and gait disorder. The result of the Dix-Hallpike maneuver, if performed, was also collected. For the associated symptoms and examination data, no distinction was made between acute and chronic processes.

Electrocardiographic, laboratory, and radiographic information was abstracted from official reports. White blood cell counts and hematocrit, sodium, blood urea nitrogen, creatinine, glucose, and troponin values were collected on all patients when available. Abstracted brain imaging data included information from CT and MRI performed in the ED. Brain imaging study findings were considered ab-

normal if there was evidence of acute infarction, hemorrhage, demyelination, tumor, or infection and the abstracting neurologist believed that the radiographic finding was responsible for the patient's presentation. Treatments initiated in the ED, including anticholinergic, benzodiazepine, antiemetic, antiplatelet, and anticoagulant medications, as well as the Epley maneuver, were abstracted. Information on disposition was collected, and for patients admitted to the hospital from the ED, the primary admitting service and the length of stay were collected as well.

Outcome Measures

A final, specific diagnosis for each patient was assigned by 2 separate neurologists independently from all available clinical data, including notes from subsequent hospitalizations, clinic visits, and ED visits when available. When a choice between a more specific or more general diagnosis was available, abstractors were instructed to choose the broader and more encompassing diagnosis unless clear evidence existed for the more specific disease entity. Any disagreement in assigning the final diagnosis was resolved by a third and final reviewer. Cases in which the 2 reviewers disagreed on eligibility were excluded. Group meetings were held approximately bimonthly to resolve questions and review coding rules.

In total, 32 predefined specific diagnoses encompassing 6 broad categories of disease were available as choices for the medical record abstraction. The broad diagnostic categories were serious neurologic diseases, peripheral neurologic diseases, other neurologic diseases, psychiatric diseases, serious cardiac diseases, and other medical conditions. The primary outcome was the broad diagnostic category of serious neurologic disease, which was defined by a prespecified composite of the following specific diagnoses: ischemic stroke; TIA; intracerebral, subarachnoid, subdural, and epidural hemorrhage; brain neoplasm; demyelinating disease; seizure; and brain abscess or meningitis. A κ analysis was performed to determine the degree of agreement between the 2 independent abstractors for diagnosis of the primary outcome.

Data Analysis

Descriptive statistics were used to calculate point estimates and confidence intervals around the proportions of patients with specific clinical factors and diagnoses. Based on the results of previous studies and expected rates of outcomes, the following clinical factors were chosen a priori as potential predictors of outcomes: age, imbalance as the reference triage symptom, isolated dizziness symptoms (eg, no other associated neurologic or systemic symptoms), positional symptoms, previous stroke, diabetes mellitus, Dix-Hallpike maneuver, and focal examination abnormalities (any neurologic sign besides nystagmus).[6-8,10,13] Logistic regression was used to evaluate the association between these prespecified factors and the primary outcome. Of these 8 prespecified factors, those that were significantly ($P<.10$) associated with the outcome in univariate analysis (age, imbalance as the triage symptom, isolated dizziness, previous stroke, and focal examination abnormalities) were forced into the final multivariate model. All the data analyses were performed using a commercially available software program (Stata, version 11.2; StataCorp LP, College Station, TX).

RESULTS

Between January 1, 2007, and December 31, 2009, 1907 adult patients reported dizziness or a related search term in their triage symptoms. After excluding patients in whom dizziness was not a primary symptom, 907 patients (0.8% of approximately 113,375 ED encounters during the study period) fulfilled the study eligibility criteria and were included in the final analysis, including 628 patients (69%) with a triage symptom of "dizzy" or "dizziness," 240 (26%) with "vertigo" or "spinning," and 39 (4%) with "imbalance" or "disequilibrium." Patients had a mean ± SD age of 59±19 years, and 529 (58%) were women (Table 1). Vascular risk factors, such as hypertension (447 patients [49%]), hyperlipidemia (251 patients [28%]), and diabetes (131 patients [14%]) were common. The median duration of symptoms was 1 day (interquartile range, 0-2 days), and 295 patients (33%) reported previous episodes of dizziness. Symptoms were worse with head movement in 266 patients (29%). The most common associated symptoms were nausea/vomiting (421 patients [46%]), light-headedness (309 patients [34%]), and headache (190 patients [21%]); isolated dizziness occurred in 169 patients (19%) (Table 2).

The mean ± SD heart rate, systolic blood pressure, and diastolic blood pressure were 77±16 beats/min, 142±27 mm Hg, and 77±14 mm Hg, respectively; 4% of patients (34) were documented as orthostatic. A neurology consultation was obtained for 180 patients (20%). Focal neurologic signs were documented on the ED physician's examination for 19% of patients (176), with gait disturbance, limb weakness, and limb ataxia being the most common deficits (Table 3). Nystagmus (which was not considered a focal neurologic sign) was present in 81 patients (9%). Laboratory evaluation was common (703 patients [78%]). Electrocardiography was performed in 621 patients (68%); a concerning finding,

TABLE 1. Characteristics of 907 Patients Presenting to the Emergency Department With Dizziness[a,b]

Characteristic	Serious neurologic diagnoses (n=49)[c]	Other diagnoses (n=858)[d]	Total (N=907)	*P* value
Age (y), mean ± SD	71±13	58±19	59±19	<.001
Women	17 (35)	512 (60)	529 (58)	.001
Race/ethnicity				.07
White	28 (57)	397 (46)	425 (47)	
Asian	18 (37)	228 (27)	246 (27)	
Black	3 (6)	106 (12)	109 (12)	
Hispanic	0	43 (5)	43 (5)	
Other	0	84 (10)	84 (9)	
Comorbidities				
Hypertension	36 (73)	411 (48)	447 (49)	.001
Hyperlipidemia	24 (49)	227 (26)	251 (28)	.001
Diabetes	7 (14)	124 (14)	131 (14)	>.99
CAD	10 (20)	81 (9)	91 (10)	.02
Atrial fibrillation	8 (16)	69 (8)	77 (8)	.06
Current smoker	6 (12)	64 (7)	70 (8)	.26
Previous stroke	8 (16)	46 (5)	54 (6)	.006
CHF	1 (2)	24 (3)	25 (3)	>.99
Previous TIA	1 (2)	9 (1)	10 (1)	.43
Migraines	3 (6)	51 (6)	54 (6)	>.99
Recent trauma	3 (6)	46 (5)	49 (5)	.74
Psychiatric history	3 (6)	118 (14)	121 (13)	.19
Medications				
Antiplatelets	18 (37)	194 (23)	212 (23)	.04
Anticoagulants	6 (12)	49 (6)	55 (6)	.11

[a] CAD = coronary artery disease; CHF = congestive heart failure; NOS = not otherwise specified; TIA = transient ischemic attack.

[b] Data are presented as No. (percentage) of patients unless indicated otherwise.

[c] Serious neurologic diagnoses encompass a composite of ischemic stroke, TIA, intracerebral hemorrhage, subarachnoid hemorrhage, subdural hemorrhage, epidural hemorrhage, brain neoplasm, seizure, demyelinating disease, and brain abscess/meningitis.

[d] Other prespecified diagnoses include peripheral vertigo NOS, benign paroxysmal positional vertigo, vestibular neuronitis, Meniere disease, concussion, migraine, gait disorder NOS, orthostasis/presyncope, syncope, dizziness NOS, psychiatric disorder NOS, arrhythmia, acute coronary syndrome, stable angina, congestive heart failure exacerbation, hypertensive emergency, drug or substance ingestion/withdrawal, hypoglycemia, electrolyte disorder, anemia or gastrointestinal bleeding, systemic infection, and other.

such as ST-segment changes or T-wave inversions, atrial fibrillation/flutter, or second- or third-degree heart block, was reported in 57 (9%), 42 (7%), and 3 (<1%) patients, respectively.

Neuroimaging in the ED was performed in 321 patients (35%) and consisted of 252 head CTs (28%) and 104 brain MRIs (11%); 35 patients (4%) had both tests. Of these 356 imaging studies, 25 (7%) showed a relevant finding; 9 of the 104 MRIs (9%) and 16 of the 252 CT scans (6%) had a relevant abnormality. Patients evaluated by brain MRI were typically older (mean age, 66 years) and often had vascular risk factors, such as hypertension (59 patients [57%]), diabetes mellitus (17 patients [16%]), and atrial fibrillation (12 patients [12%]). Symptomatic treatment was prescribed for 369 patients (41%), with anticholinergic therapy (199 patients [22%]) being the most frequent. Most patients (681 [75%]) were discharged. Of the 204 patients (22%) admitted to the hospital, 139 (68%) were admitted to an intensive care unit (12 patients) or a telemetry ward (127 patients). The most common admitting services were medicine (83 patients [41%]), cardiology (65 patients [32%]), and neurology (48 patients [24%]). Median length of hospital stay was 2 days (interquartile range, 1-3 days; range, 0-55 days). In a random sample of 50 patients (6% of the cohort), 37 (74%) had another hospital, ED, or clinic encounter at the medical center after the index ED visit included in the medical record review. The mean time from index ED visit to final encounter reviewed was 331 days (median, 246 days; range, 0-1471 days).

Most cases of dizziness were attributed to peripheral vestibular dysfunction (294 of 907 patients

TABLE 2. Associated Symptoms in 907 Patients Presenting to the Emergency Department With Dizziness[a,b]

Symptom	Serious neurologic diagnoses (n=49)[c]	Other diagnoses (n=858)[d]	Total (N=907)	*P* value
Nausea or vomiting	19 (39)	402 (47)	421 (46)	.30
Light-headedness	19 (39)	290 (34)	309 (34)	.44
Headache	9 (18)	181 (21)	190 (21)	.72
Gait disturbance	23 (47)	130 (15)	153 (17)	<.001
Visual disturbance besides diplopia	7 (14)	92 (11)	99 (11)	.48
Dyspnea	4 (8)	76 (9)	80 (9)	>.99
URI symptoms	2 (4)	67 (8)	69 (8)	.58
Sensory disturbance	6 (12)	62 (7)	68 (8)	.26
Chest pain	2 (4)	67 (8)	69 (8)	.58
Psychiatric symptoms	1 (2)	65 (8)	66 (7)	.25
Tinnitus	6 (12)	48 (6)	54 (6)	.06
Syncope	3 (6)	47 (5)	50 (6)	.75
Confusion	3 (6)	37 (4)	40 (4)	.47
Hearing loss	1 (2)	35 (4)	36 (4)	.72
Speech disturbance	10 (20)	15 (2)	25 (3)	<.001
Diplopia	7 (14)	16 (2)	23 (3)	<.001
Unilateral weakness	9 (18)	8 (1)	17 (2)	<.001

[a] NOS = not otherwise specified; URI = upper respiratory tract infection.
[b] Data are presented as No. (percentage) of patients.
[c] Serious neurologic diagnoses encompass a composite of ischemic stroke, transient ischemic attack, intracerebral hemorrhage, subarachnoid hemorrhage, subdural hemorrhage, epidural hemorrhage, brain neoplasm, seizure, demyelinating disease, and brain abscess/meningitis.
[d] Other prespecified diagnoses include peripheral vertigo NOS, benign paroxysmal positional vertigo, vestibular neuronitis, Meniere disease, concussion, migraine, gait disorder NOS, orthostasis/presyncope, syncope, dizziness NOS, psychiatric disorder NOS, arrhythmia, acute coronary syndrome, stable angina, congestive heart failure exacerbation, hypertensive emergency, drug or substance ingestion/withdrawal, hypoglycemia, electrolyte disorder, anemia or gastrointestinal bleeding, systemic infection, and other.

[32%]) or other generally benign conditions, such as orthostatic hypotension (121 patients [13%]) or migraines (37 patients [4%]); 199 cases (22%) could not be further characterized (Table 4). Conversely, the primary outcome of serious neurologic disease was uncommon (49 patients [5%]). This included 37 cerebrovascular events such as ischemic strokes (24 patients [3%]), TIA (9 patients [1%]), and intracerebral hemorrhage (8 patients [1%]). Other serious neurologic diseases included brain neoplasm in 6 (1%), seizure in 4 (<1%), and demyelinating disease in 2 (<1%). There was 72% agreement on the diagnosis of a serious neurologic disease between the 2 abstractors, corresponding to a κ of 0.64 (95% confidence interval, 0.47-0.72). Only 2 patients with serious neurologic diagnoses had isolated dizziness (no associated neurologic symptoms); 1 patient had an intracerebral hemorrhage, and 1 had a TIA. Of the patients with ischemic stroke, only 1 was caused by a cervical artery dissection. Of the 180 patients who had a neurology consultation in the ED, 38 (21%) had a serious neurologic diagnosis, compared with 11 of the 727 patients (2%) not evaluated by neurology ($P<.001$). A few patients had other serious medical conditions, such as a systemic infection (34 [4%]), cardiac arrhythmia (22 [2%]), electrolyte disturbance (14 [2%]), or hypertensive emergency (10 [1%]).

In the univariate analysis, serious neurologic diagnoses were more likely in patients with focal examination abnormalities, age 60 years or older, imbalance as the triage symptom, and previous stroke and less likely in patients with isolated dizziness. However, in the multivariate analysis, only focal examination abnormalities, age 60 years and older, imbalance as the triage symptom, and isolated dizziness remained statistically significant predictors (Table 5).

DISCUSSION

In this large cohort of patients presenting to the ED with dizziness, 49 (5%) had serious neurologic diseases, most of which were acute cerebrovascular events. However, important medical causes of dizziness were more common, occurring in 154 patients (17%). Dizziness was usually attributed to benign conditions, such as peripheral vestibular dysfunction or orthostatic hypotension, and many

TABLE 3. Evaluation and Treatment of 907 Patients With Dizziness in the Emergency Department[a,b]

Variable	Serious neurologic diagnoses (n=49)[c]	Other diagnoses (n=858)[d]	Total (N=907)
Focal examination findings[e]	31 (63)	145 (17)	176 (19)
Gait disturbance	18 (37)	91 (11)	109 (12)
Limb weakness	10 (20)	35 (4)	45 (5)
Limb ataxia	10 (20)	19 (2)	29 (3)
Facial weakness	5 (10)	15 (2)	20 (2)
Sensory disturbance	3 (6)	15 (2)	18 (2)
Dysarthria	4 (8)	7 (1)	11 (1)
Encephalopathy	2 (4)	9 (1)	11 (1)
Ophthalmoparesis	4 (8)	1 (<1)	5 (1)
Aphasia	1 (2)	1 (<1)	2 (<1)
Visual field disturbance	1 (2)	1 (<1)	2 (<1)
Nystagmus	6 (12)	75 (9)	81 (9)
Dix-Hallpike maneuver documented	4 (8)	145 (17)	149 (16)
Abnormal	1 (2)	81 (9)	82 (9)
Laboratory analysis	47 (96)	656 (76)	703 (78)
Complete blood cell count	47 (96)	606 (71)	653 (72)
Metabolic panel	47 (96)	608 (71)	655 (72)
Cardiac enzymes	31 (63)	337 (39)	368 (41)
Electrocardiogram[f]	38 (78)	583 (68)	621 (68)
Normal sinus rhythm	29 (59)	476 (55)	505 (56)
ST-segment changes or TWIs	3 (6)	54 (6)	57 (6)
Atrial fibrillation or flutter	6 (12)	36 (4)	42 (5)
Sinus tachycardia	0	14 (2)	14 (2)
Second- or third-degree heart block	0	3 (<1)	3 (<1)
Neuroimaging	42 (86)	279 (33)	321 (35)
Head CT	37 (76)	215 (25)	252 (28)
Brain MRI	15 (31)	89 (10)	104 (11)
Treatment[g]	13 (27)	356 (41)	369 (41)
Anticholinergic drugs	2 (4)	197 (23)	199 (22)
Benzodiazepine	2 (4)	141 (16)	143 (16)
Antiemetic agents	3 (6)	99 (12)	102 (11)
Epley maneuver	1 (2)	44 (5)	45 (5)
Antiplatelets	8 (16)	35 (4)	43 (5)
Anticoagulation	0	0	0

[a] CT = computed tomography; MRI = magnetic resonance imaging; NOS = not otherwise specified; TWI = T-wave inversion.

[b] Data are presented as No. (percentage) of patients.

[c] Serious neurologic diagnoses encompass a composite of ischemic stroke, transient ischemic attack, intracerebral hemorrhage, subarachnoid hemorrhage, subdural hemorrhage, epidural hemorrhage, brain neoplasm, seizure, demyelinating disease, and brain abscess/meningitis.

[d] Other prespecified diagnoses include peripheral vertigo NOS, benign paroxysmal positional vertigo, vestibular neuronitis, Meniere disease, concussion, migraine, gait disorder NOS, orthostasis/presyncope, syncope, dizziness NOS, psychiatric disorder NOS, arrhythmia, acute coronary syndrome, stable angina, congestive heart failure exacerbation, hypertensive emergency, drug or substance ingestion/withdrawal, hypoglycemia, electrolyte disorder, anemia or gastrointestinal bleeding, systemic infection, and other.

[e] On the emergency department physician's examination; acute and chronic abnormalities are included. Some patients had more than one finding.

[f] Acute and chronic abnormalities are included.

[g] Some patients had more than one treatment in the emergency department.

TABLE 4. Final Diagnoses for 907 Patients Presenting to the Emergency Department With Dizziness[a]

Diagnosis[b]	Patients, No. (%)
Serious neurologic diseases	49 (5)
Ischemic stroke	24 (3)
Transient ischemic attack	8 (1)
Brain neoplasm	6 (1)
Intracerebral hemorrhage	5 (1)
Seizure	4 (<1)
Demyelinating disease	2 (<1)
Subarachnoid hemorrhage	0
Subdural hemorrhage	0
Epidural hemorrhage	0
Brain abscess/meningitis	0
Peripheral neurologic diseases	294 (32)
Peripheral vertigo NOS	185 (20)
BPPV	78 (9)
Vestibular neuronitis	27 (3)
Meniere disease	4 (<1)
Other neurologic diseases	388 (43)
Dizziness NOS	199 (22)
Orthostasis/near syncope	121 (13)
Migraine	37 (4)
Syncope	20 (2)
Concussion	11 (1)
Gait disorder NOS	0
Psychiatric conditions	22 (2)
Psychiatric disorder NOS	22 (2)
Serious cardiac diseases	35 (4)
Arrhythmia	22 (2)
Hypertensive emergency	10 (1)
Acute coronary syndrome	2 (<1)
Heart failure exacerbation	1 (<1)
Stable angina	0
Other medical conditions	119 (13)
Drug or substance ingestion/withdrawal	46 (5)
Systemic infection	34 (4)
Electrolyte disorder	14 (2)
Other	11 (1)
Anemia or gastrointestinal bleeding	10 (1)
Hypoglycemia	4 (0.4)

[a] BPPV = benign paroxysmal positional vertigo; NOS = not otherwise specified.
[b] The broad diagnostic categories and individual diagnoses were prespecified.

cases of dizziness remained uncharacterized (199 [22%]) despite extensive ED evaluations and detailed case review by 2 neurologists.

Although most cases of dizziness were due to benign conditions, nearly a quarter of the patients were admitted to the hospital, most had laboratory and cardiac rhythm analyses, and 332 (37%) underwent neuroimaging. These findings are consistent with a high level of concern for ruling out serious disease in ED patients with dizziness, a finding that is concordant with a previous analysis that found that ED patients with dizziness have similarly high resource utilization, ED length of stay, and illness severity as ED patients presenting with chest pain.[14]

Our results are also consistent with those of previous studies, which found low rates of serious neurologic diagnoses in ED patients with dizziness.[3,6-10,13] A prospective analysis of 413 adults with dizziness presenting to a Hong Kong ED found a central neurologic cause in 6% of patients, although this study may have underestimated the number of patients with posterior fossa lesions since diagnoses were made using CT only.[10] Similarly, a population-based study of 1666 mostly Mexican American patients presenting with dizziness to EDs in Corpus Christi, Texas, demonstrated an incidence of stroke or TIA of 3.2% (this study assessed for acute cerebrovascular disorders only).[7] In addition, a meta-analysis of relevant studies published between 1966 and 1996 reported a 6% frequency of central neurologic diseases in ED patients with dizziness, most of which were cerebrovascular in origin.[8]

Rates of serious neurologic causes of dizziness in our cohort were similar to those in older studies despite more frequent use of advanced neuroimaging and neurologic consultation in our patients. This finding suggests that more frequent use of neuroimaging may not significantly augment ED physicians' clinical acumen. Alternatively, secular trends in stroke incidence or differences in case definition (eg, we excluded patients whose primary symptom was not dizziness) may have offset the increased diagnostic sensitivity of modern neuroimaging or around-the-clock access to neurologic consultation.[15-17]

Vascular risk factors and other concomitant neurologic symptoms, particularly gait difficulties, were more common in patients with serious neurologic diagnoses. Independent predictors of serious neurologic diseases were imbalance as the reference triage symptom, age 60 years or older, and a focal abnormality on the emergency physician's examination. These clinical factors have all been associated with central processes previously and should continue to serve as important factors when determining the necessary extent of neurologic evaluation in the patient experiencing dizziness.[6,7,10,11] In addition, previous stroke was associated with serious

TABLE 5. Predictors of Serious Neurologic Disease in 907 Patients Presenting to the Emergency Department With Dizziness[a]

	Univariate analysis		Multivariate analysis[b]	
Clinical variable	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Focal examination abnormality	8.5 (4.6-15.4)	<.001	5.9 (3.1-11.2)	<.001
Age ≥60 y	6.2 (2.8-13.6)	<.001	5.7 (2.5-13.4)	<.001
Imbalance as triage symptom	6.2 (2.8-13.8)	<.001	5.9 (2.3-15.2)	<.001
Previous stroke	3.4 (1.6-7.6)	.006	2.0 (0.8-5.0)	.13
Isolated dizziness	0.2 (0.0-0.7)	.004	0.2 (0.0-0.7)	.02
Positional symptoms	0.7 (0.3-1.3)	.33	NA	NA
Diabetes mellitus	1.0 (0.4-2.2)	>.99	NA	NA
Dix-Hallpike maneuver	0.2 (0.0-1.2)	.12	NA	NA

[a] CI = confidence interval; NA = not applicable; OR = odds ratio.

[b] Age 60 years or older and predictors that were significantly associated with serious neurologic disease in the univariate analysis (*P*<.10) were selected for the final multivariate model.

neurologic disease in univariate analysis but not in the multivariate model, perhaps owing to confounding with age or focal neurologic symptoms. Conversely, patients with isolated dizziness were considerably less likely to have a serious neurologic disease. However, 2 patients did present with acute cerebrovascular diseases in this manner, echoing the many examples in the literature of posterior fossa strokes presenting as positional vertigo without concomitant brainstem findings.[18-20] Hence, physicians should not automatically dismiss the possibility of a central neurologic process in patients with dizziness without associated neurologic symptoms.

The strengths of this study include its large sample size; independent adjudication of final diagnoses by 2 neurologists, with a third resolving any disagreements; detailed analysis of patients' risk factors, associated symptoms, examination findings, and medical and neurologic evaluations; and the potential for improved outcome ascertainment given the around-the-clock availability of modern neuroimaging and neurologic consultation.

This study has several important limitations. First, it was performed at a single tertiary care academic medical center, and, thus, the results may not apply to community hospitals or ambulatory care settings. Second, although medical records were independently reviewed by 2 neurologists using all available data, including subsequent outpatient clinic notes, missed diagnoses or delayed complications at other medical centers may not have been captured in this analysis. In addition, final diagnoses were determined retrospectively and were based on available documentation of the clinical encounter. Furthermore, there was no standardized protocol in the ED for the evaluation of patients experiencing dizziness. Therefore, misclassification of final diagnoses and the potential for underestimating the frequency of delayed presentations of serious neurologic disease is possible. Similarly, because neuroimaging was performed in 321 patients (35%) based on the clinical suspicion of treating physicians, some unusual presentations of serious neurologic disease may have been missed. However, a recent study using administrative data from 31,159 adults discharged from California EDs with a primary diagnosis of dizziness or vertigo found a cumulative incidence of only 0.63% and 0.32% for cerebrovascular and cardiovascular events, respectively, during the 180 days after discharge, which suggests that the observed rates of serious disease in the present cohort are unlikely to be gross underestimates.[21]

CONCLUSION

In summary, most cases of acute dizziness or vertigo in the ED are due to benign conditions, such as peripheral vertigo, orthostatic hypotension, and uncharacterized dizziness. However, a small proportion of patients with dizziness harbor serious neurologic disease. Physicians in the ED should maintain a high index of suspicion for serious causes, particularly if patients are older, report imbalance, or have a focal neurologic deficit. Future studies should investigate the ability of objective clinical predictors to identify serious neurologic diseases in patients with dizziness.

SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at http://www.mayoclinicproceedings.org.

Abbreviations and Acronyms: **CT** = computed tomography; **ED** = emergency department; **MRI** = magnetic resonance imaging; **TIA** = transient ischemic attack

Grant Support: This study was supported by a grant from the American Heart Association.

Correspondence: Address to Anthony S. Kim, MD, MAS, Department of Neurology, University of California, San Francisco, 675 Nelson Rising Ln, Room 411B, Box 0663, San Francisco, CA 94158 (akim@ucsf.edu).

REFERENCES

1. Burt CW, Schappert SM. Ambulatory care visits to physician offices, hospital outpatient departments, and emergency departments: United states, 1999-2000. *Vital Health Stat 13*. 2004;Sep(157):1-70.
2. Kerber KA, Meurer WJ, West BT, et al. Dizziness presentations in U.S. emergency departments, 1995-2004. *Acad Emerg Med*. 2008;15(8):744-750.
3. Newman-Toker DE, Hsieh YH, Camargo CA Jr, et al. Spectrum of dizziness visits to US emergency departments: cross-sectional analysis from a nationally representative sample. *Mayo Clin Proc*. 2008;83(7):765-775.
4. Newman-Toker DE, Cannon LM, Stofferahn ME, et al. Imprecision in patient reports of dizziness symptom quality: a cross-sectional study conducted in an acute care setting. *Mayo Clin Proc*. 2007;82(11):1329-1340.
5. Stanton VA, Hsieh YH, Camargo CA Jr, et al. Overreliance on symptom quality in diagnosing dizziness: results of a multicenter survey of emergency physicians. *Mayo Clin Proc*. 2007; 82(11):1319-1328.
6. Herr RD, Zun L, Mathews JJ. A directed approach to the dizzy patient. *Ann Emerg Med*. 1989;18(6):664-672.
7. Kerber KA, Brown DL, Lisabeth LD, et al. Stroke among patients with dizziness, vertigo, and imbalance in the emergency department: a population-based study. *Stroke*. 2006; 37(10):2484-2487.
8. Kroenke K, Hoffman RM, Einstadter D. How common are various causes of dizziness? a critical review. *South Med J*. 2000;93(2):160-168.
9. Madlon-Kay DJ. Evaluation and outcome of the dizzy patient. *J Fam Pract*. 1985;21(2):109-113.
10. Cheung CS, Mak PS, Manley KV, et al. Predictors of important neurological causes of dizziness among patients presenting to the emergency department. *Emerg Med J*. 2010;27(7):517-521.
11. Skiendzielewski JJ, Martyak G. The weak and dizzy patient. *Ann Emerg Med*. 1980;9(7):353-356.
12. Lowenstein SR. Medical record reviews in emergency medicine: the blessing and the curse. *Ann Emerg Med*. 2005;45(4): 452-455.
13. Hoffman RM, Einstadter D, Kroenke K. Evaluating dizziness. *Am J Med*. 1999;107(5):468-478.
14. Dallara J, Lee C, McIntosh L, et al. ED length-of-stay and illness severity in dizzy and chest-pain patients. *Am J Emerg Med*. 1994;12(4):421-424.
15. Carandang R, Seshadri S, Beiser A, et al. Trends in incidence, lifetime risk, severity, and 30-day mortality of stroke over the past 50 years. *JAMA*. 2006;296(24):2939-2946.
16. Kleindorfer DO, Khoury J, Moomaw CJ, et al. Stroke incidence is decreasing in whites but not in blacks: a population-based estimate of temporal trends in stroke incidence from the Greater Cincinnati/Northern Kentucky Stroke Study. *Stroke*. 2010;41(7):1326-1331.
17. Rothwell PM, Coull AJ, Giles MF, et al. Change in stroke incidence, mortality, case-fatality, severity, and risk factors in Oxfordshire, UK from 1981 to 2004 (Oxford Vascular Study). *Lancet*. 2004;363(9425):1925-1933.
18. Johkura K. Central paroxysmal positional vertigo: isolated dizziness caused by small cerebellar hemorrhage. *Stroke*. 2007; 38(6):e26-e28.
19. Lee H, Sohn SI, Cho YW, et al. Cerebellar infarction presenting isolated vertigo: frequency and vascular topographical patterns. *Neurology*. 2006;67(7):1178-1183.
20. Norrving B, Magnusson M, Holtas S. Isolated acute vertigo in the elderly; vestibular or vascular disease? *Acta Neurol Scand*. 1995;91(1):43-48.
21. Kim AS, Fullerton HJ, Johnston SC. Risk of vascular events in emergency department patients discharged home with diagnosis of dizziness or vertigo. *Ann Emerg Med*. 2011;57(1): 34-41.