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The Use of Neuroimaging Studies and Neurological Consultation to Evaluate Dizzy Patients in the Emergency Department

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Abstract

Background and Purpose: Dizziness is a frequent reason for neuroimaging and neurological consultation, but little is known about the utility of either practice. We sought to characterize the patterns and yield of neuroimaging and neurological consultation for dizziness in the emergency department (ED). **Methods:** We retrospectively identified consecutive adults presenting to an academic ED from 2007 to 2009, with a primary complaint of dizziness, vertigo, or imbalance. Neurologists reviewed medical records to determine clinical characteristics, whether a neuroimaging study (head computed tomography [CT] or brain magnetic resonance imaging [MRI]) or neurology consultation was obtained in the ED, and to identify relevant findings on neuroimaging studies. Two neurologists assigned a final diagnosis for the cause of dizziness. Logistic regression was used to evaluate bivariate and multivariate predictors of neuroimaging and consultation. **Results:** Of 907 dizzy patients (mean age 59 years; 58% women), 321 (35%) had a neuroimaging study (28% CT, 11% MRI, and 4% both) and 180 (20%) had neurological consultation. Serious neurological disease was ultimately diagnosed in 13% of patients with neuroimaging and 21% of patients with neurological consultation, compared to 5% of the overall cohort. Headache and focal neurological deficits were associated with both neuroimaging and neurological consultation, while age ≥60 years and prior stroke predicted neuroimaging but not consultation, and positional symptoms predicted consultation but not neuroimaging. **Conclusion:** In a tertiary care ED, neuroimaging and neurological consultation were frequently utilized to evaluate dizzy patients, and their diagnostic yield was substantial.

Keywords

dizziness, vertigo, neuroimaging, referral and consultation, emergency medicine

Introduction

Dizziness is one of the most common triage complaints in the emergency department (ED), accounting for approximately 3% of visits.[1] Most cases of acute dizziness or vertigo are related to benign causes, such as peripheral vestibular dysfunction.[1-5] However, a small proportion of cases are due to central causes, particularly posterior fossa strokes, which if missed, could lead to severe disability or death.[1,2,6,7]

This general concern for uncommon but serious causes of dizziness often leads to extensive workups for acutely dizzy patients in the ED that include neuroimaging studies or neurological consultation.[8,9] However, little is known about the prevalence or utility of either practice, and there are no

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published data about the clinical factors that are associated with requests for imaging or consultation. A better understanding of the factors associated with these management decisions and the usefulness of these costly and time-consuming tests is a necessary step toward improving the overall efficiency and cost-effectiveness of these evaluations.

Therefore, we analyzed consecutive patients presenting to our ED with acute dizziness from 2007 to 2009, in order to better characterize the existing practice patterns and the diagnostic yield of imaging and neurological consultation in these patients.

Methods

Study Design and Participants

We retrospectively identified consecutive patients presenting to the University of California, San Francisco (UCSF) ED from January 1, 2007, to December 31, 2009, with a primary complaint of dizziness. The UCSF is a tertiary care medical center and certified primary stroke center with around-the-clock access to advanced neuroimaging and neurology consultation. Study participants were identified by searching the nursing triage chief complaint field of the UCSF ED clinical database—which contains the patient's triage complaint verbatim—for a presenting complaint of "dizzy," "dizziness," "vertigo," "spinning," "imbalance," or "disequilibrium." We excluded patients younger than 18 years of age and those whose primary complaint was not one of the predetermined search terms (i.e., no mention of dizziness or related search terms in the documentation). Patients with multiple ED visits for dizziness were included only once at the time of first visit during the study period. This study was approved by the UCSF Committee on Human Research.

Data Collection and Processing

All eligible charts were reviewed by 1 of the 6 neurologists. Clinical information was collected using a standardized data abstraction form that was developed and refined after several rounds of trial abstractions prior to the start of data collection. All variables were defined a priori in a written data dictionary available to all abstractors during the data collection process. Any questions that could not be answered after referencing the data dictionary were resolved by consensus.

Predictors

Demographic characteristics, relevant medical comorbidities, associated symptoms, use of antithrombotic medications, neurological examination findings documented by the ED clinician, and the ED evaluations were abstracted from clinical records.

Final Diagnoses

Two abstractors were randomly selected to review each chart independently and to assign a final, specific diagnosis for the cause of dizziness, with a third neurologist resolving any disagreements. The adjudicated diagnosis was based on all available medical center data, including notes from subsequent hospitalizations, clinics visits, and ED visits, if applicable. In total, a prespecified list of 33 possible diagnoses encompassing 6 broad categories of disease was available to the abstractor. A serious neurological diagnosis was defined as any of the following diagnoses: ischemic stroke, transient ischemic attack (TIA), intracranial hemorrhage, brain neoplasm, demyelinating disease, seizure, and brain abscess or meningitis.

Neuroimaging

Computed tomography (CT) studies were performed on a 64-section multidetector CT scanner (LightSpeed VCT; General Electric Healthcare, Chalfont St. Giles, UK). Magnetic resonance imagings (MRIs) were performed on 1.5 or 3 T whole body scanners with echoplanar capabilities using the following systems: General Electric Signa MR750 (3 T; General Electric Healthcare, Chalfont St. Giles, UK), General Electric Twinspeed (1.5 T; General Electric Healthcare, Chalfont St. Giles, UK), Philips Intera (1.5 T; Philips Healthcare, Andover, MA), or Philips Achieva (1.5 T; Philips Healthcare, Andover, MA). Each study was individually protocolled by a neuroradiologist and all brain MRIs included a T2-weighed sequence and diffusion-weighted imaging to assess for acute infarction. Imaging findings were abstracted from the final radiology reports. Only studies performed from the ED were included in this analysis, and only findings determined to be responsible for the patient's presentation by the reviewing neurologist after review of the entire medical chart, including records from subsequent hospitalizations, ED visits, and clinic encounters, if applicable, were considered abnormal. Potential abnormal findings included acute infarction, hemorrhage, demyelination, tumor, or infection.

Consultation

An in-house neurology resident was available for consultation 24 hours a day throughout the study period. During normal business hours, a neurology attending was also available to see patients in the ED with the neurology resident. At other times, the neurology attending was available to discuss cases by telephone and to see the patient the next day if the patient was admitted to the hospital. We collected information on whether neurology consultation was obtained and whether the patient was seen by a neurology resident, neurology attending, or both.

Data Analysis

Descriptive statistics with exact binomial confidence intervals were used to calculate the proportions of our outcomes of interest. Characteristics of patient subgroups were compared

Table 1. Characteristics of 907 ED Patients With Dizziness Stratified by Whether Neuroimaging Was Obtained in the ED

	Received Neuroimaging (n = 321)	Did Not Receive Neuroimaging (n = 586)	Total (n = 907)	*P* Value[a]
Age, y, mean (SD)	65 (18)	56 (19)	59 (19)	**< .001**
Women, n (%)	182 (57)	347 (59)	529 (58)	.48
Race, n (%)				**< .01**
White	147 (46)	278 (47)	425 (47)	
Asian	108 (34)	138 (24)	246 (27)	
Black	26 (8)	83 (14)	109 (12)	
Hispanic	12 (4)	31 (5)	43 (5)	
Other	28 (9)	56 (10)	84 (9)	
Comorbidities, n (%)				
Hypertension	190 (59)	257 (44)	447 (49)	**< .001**
Hyperlipidemia	114 (36)	137 (23)	251 (28)	**< .001**
Diabetes	55 (17)	76 (13)	131 (14)	.09
CAD	42 (13)	49 (8)	91 (10)	**.03**
Atrial fibrillation	37 (12)	40 (7)	77 (8)	**.02**
Current smoker	21 (7)	49 (8)	70 (8)	.36
Prior stroke	35 (11)	19 (3)	54 (6)	**< .001**
Migraines	29 (9)	25 (4)	54 (6)	**< .01**
CHF	7 (2)	18 (3)	25 (3)	.53
Prior TIA	6 (2)	4 (1)	10 (1)	.18
Medications, n (%)				
Antiplatelet	87 (27)	125 (21)	212 (23)	.06
Anticoagulant	30 (9)	25 (4)	55 (6)	**< .01**
Associated symptoms, n (%)				
Nausea or vomiting	174 (54)	247 (42)	421 (46)	**< .01**
Lightheadedness	84 (26)	215 (37)	299 (33)	**< .01**
Headache	97 (31)	93 (16)	190 (21)	**< .001**
Gait disturbance	98 (31)	55 (9)	153 (17)	**< .001**
Visual D/O besides diplopia	45 (14)	54 (9)	99 (11)	**.03**
Sensory disturbance	32 (10)	36 (6)	68 (8)	**.05**
Psychiatric complaints	14 (4)	52 (9)	66 (7)	**.01**
Tinnitus	19 (6)	35 (6)	54 (6)	1.00
Confusion	25 (8)	15 (3)	40 (4)	**< .01**
Hearing loss	13 (4)	23 (4)	36 (4)	1.00
Speech disturbance	18 (6)	7 (1)	25 (3)	**< .001**
Diplopia	17 (5)	6 (1)	23 (3)	**< .001**
Unilateral weakness	13 (4)	4 (1)	17 (2)	**< .01**
Dizziness features, n (%)				
Prior dizziness	115 (36)	180 (31)	295 (33)	.12
Positional symptoms	108 (34)	158 (27)	266 (29)	**.04**
Acute symptoms (≤ 1 day)	188 (59)	350 (60)	538 (59)	.78

Abbreviations: CAD, coronary artery disease; CHF, congestive heart failure; ED, emergency department; SD, standard deviation; TIA, transient ischemic attack; D/O = disorder.

[a] Clinical factors significantly ($P < .05$) associated with acquisition of neuroimaging are in boldface.

using the *t* test or Fisher exact test, as appropriate. For the univariate analysis, logistic regression was used to evaluate the association of clinical factors—age ≥60 years, prior dizziness spells, positional symptoms, acute symptoms (present for ≤1 day), associated headache, isolated dizziness symptoms, history of hypertension, history of diabetes mellitus, history of coronary artery disease, prior stroke, history of atrial fibrillation, and focal neurological signs on the ED physicians' examination—with neuroimaging and with neurological consultation. All predictors that were significantly associated with the outcome in univariate analysis ($P < .10$) were selected for inclusion in the final multivariable model. Significance in the multivariate model was defined as a P value of <.05.

In addition, we performed a mixed-effects logistic regression to determine whether there was significant heterogeneity in requests for neuroimaging or neurological consultation at the ED attending level after adjusting for patient level characteristics. We also assessed for secular trends in the frequency of neuroimaging or neurological consultation over time using the date of the ED visit as a predictor variable in a separate univariate logistic regression analysis. Statistical analyses were performed with Stata (Version 11.2, College Station, Texas).

Table 2. Characteristics of 907 ED Patients With Dizziness Stratified by Whether a Neurology Consult Was Obtained

	Received Neurology Consult (n = 180)	Did Not Receive Neurology Consult (n = 727)	Total (n = 907)	*P* Value[a]
Age, y, mean (SD)	63 (18)	58 (19)	59 (19)	< .001
Women, n (%)	97 (54)	432 (59)	529 (58)	.18
Race, n (%)				.48
White	94 (52)	331 (46)	425 (47)	
Asian	51 (28)	195 (27)	246 (27)	
Black	16 (9)	93 (13)	109 (12)	
Hispanic	8 (4)	35 (5)	43 (5)	
Other	11 (6)	73 (10)	84 (9)	
Comorbidities, n (%)				
Hypertension	107 (59)	340 (47)	447 (49)	**< .01**
Hyperlipidemia	70 (39)	181 (25)	251 (28)	**< .001**
Diabetes	29 (16)	102 (14)	131 (14)	.48
CAD	19 (11)	72 (10)	91 (10)	.78
Atrial fibrillation	18 (10)	59 (8)	77 (8)	.46
Current smoker	12 (7)	58 (8)	70 (8)	.64
Prior stroke	18 (10)	36 (5)	54 (6)	**.01**
Migraines	17 (9)	37 (5)	54 (6)	**.03**
CHF	3 (2)	22 (3)	25 (3)	.45
Prior TIA	5 (3)	5 (1)	10 (1)	**.03**
Medications, n (%)				
Antiplatelet	51 (28)	161 (22)	212 (23)	.09
Anticoagulant	12 (7)	43 (6)	55 (6)	.73
Associated symptoms, n (%)				
Nausea or vomiting	102 (57)	319 (44)	421 (46)	**< .01**
Lightheadedness	49 (27)	250 (34)	299 (33)	.08
Headache	50 (28)	140 (19)	190 (21)	**.01**
Gait disturbance	67 (37)	86 (12)	153 (17)	**< .001**
Visual D/O besides diplopia	28 (16)	71 (10)	99 (11)	**.03**
Sensory disturbance	19 (11)	49 (7)	68 (8)	.08
Psychiatric complaints	6 (3)	60 (8)	66 (7)	**.02**
Tinnitus	13 (7)	41 (6)	54 (6)	.48
Confusion	8 (4)	32 (4)	40 (4)	1.00
Hearing loss	6 (3)	30 (4)	36 (4)	.83
Speech disturbance	16 (9)	9 (1)	25 (3)	**< .001**
Diplopia	14 (8)	9 (1)	23 (3)	**< .001**
Unilateral weakness	10 (6)	7 (1)	17 (2)	**< .001**
Dizziness features, n (%)				
Prior dizziness	67 (37)	228 (31)	295 (33)	**.01**
Positional symptoms	68 (38)	198 (27)	266 (29)	**< .01**
Acute symptoms (≤ 1 day)	110 (61)	428 (59)	538 (59)	.61

Abbreviations: CAD, coronary artery disease; CHF, congestive heart failure; ED, emergency department; SD, standard deviation; TIA, transient ischemic attack; D/O, disorder.

[a] Clinical factors significantly ($P < .05$) associated with obtainment of a neurology consultation are in boldface.

Results

Study Participants

We identified 907 patients that met our eligibility criteria. The mean age was 59 (SD 19) years, and 58% were women. Demographic characteristics, vascular risk factors, antithrombotic medication use, associated neurological symptoms, and symptom features are shown in Tables 1 and 2. On the initial neurological assessment by the ED clinician, 176 (19%) patients had a focal neurological sign (excluding nystagmus). The most common examination abnormalities were gait disturbance (8%), limb ataxia (3%), and sensory defects (2%). Nystagmus was documented as present in 4% of patients.

Most patients had a final diagnosis of a benign condition such as peripheral vertigo or orthostatic hypotension, although 49 (5.4%) patients did suffer a serious neurological disorder (Table 3). The most common serious neurological diagnoses were ischemic stroke (n = 24), TIA (n = 8), and brain neoplasm (n = 6). Only 2 of 169 patients presenting with isolated dizziness (no concomitant neurological symptoms) had a serious neurological diagnosis.

Table 3. Radiographic Findings among 321 Dizzy Patients Evaluated by Neuroimaging

Imaging Technique	Number (%)
CT head	252 (100)
Normal	236 (94)
Infarction	8 (3)
Neoplasm	4 (2)
Intracranial hemorrhage	3 (1)
Infection	1 (0)
Demyelination	0 (0)
MRI brain	104 (100)
Normal	95 (91)
Infarction	5 (5)
Neoplasm	2 (2)
Intracranial hemorrhage	2 (2)
Infection	0 (0)
Demyelination	0 (0)

Abbreviations: CT, Computed tomography; MRI = magnetic resonance imaging.

Neuroimaging

Neuroimaging was obtained in 321 (35%) patients, consisting of 252 (28%) head CTs and 104 brain MRIs (11%); 35 (4%) patients had both studies. Serious neurological disease was ultimately diagnosed in 13% (n = 42) of patients with neuroimaging in the ED. A relevant abnormal finding/findings was seen in 7% (n = 25) of studies overall. The yield of CT for detecting a relevant abnormal finding was 6% (95% CI, 3%-9%), compared to 9% with MRI (95% CI, 4%-15%; $P = .31$; Table 3). Infarction (52%), neoplasm (24%), and intracerebral hemorrhage (20%) accounted for almost all pertinent findings.

In univariate analysis, focal neurological signs, headache, age, prior stroke, hypertension, atrial fibrillation, coronary artery disease, diabetes mellitus, positional symptoms, and acute symptoms ($\leq$24 hours) were associated with requests for neuroimaging, while isolated dizziness was inversely associated (Table 4). However, after multivariable analysis, only age, prior stroke, headache, and focal neurological signs were independently associated with acquisition of neuroimaging, while isolated dizziness was independently associated with not obtaining neuroimaging.

There were 45 attending emergency physicians who cared for patients with dizziness (mean cases per physician = 20, range 1-56). Neuroimaging rates by physician ranged from 0% to 100% (15%-64% for physicians who cared for $\geq$20 patients). After adjusting for patient characteristics associated with requests for neuroimaging in our cohort (age, prior stroke, headache, focal neurological signs, and isolated dizziness), there was no significant variability in neuroimaging frequency by provider ($P = .37$). The rate of neuroimaging did not change over time during the study period (P for trend = .32).

Neurological Consultation

A resident neurologist evaluated 180 (20%) of the dizzy patients in our cohort, and 34 of these patients were also seen by an attending neurologist in the ED (n = 34, 19%). Of patients seen by a neurologist, 21% were ultimately diagnosed with a serious neurological disease, compared to 2% who were not seen by a neurologist (OR 17.4, 95% CI 8.8-34.5). Similar to the overall cohort, these diseases consisted mostly of acute cerebrovascular events (n = 32; 84%), specifically ischemic stroke (n = 21), TIA (n = 8), and intracerebral hemorrhage (n = 3). Other serious neurological diagnoses in patients consulted on by a neurologist were brain neoplasm (n = 2), demyelinating disease (n = 2), and seizure (n = 2).

In univariate analysis, focal neurological signs, headache, age, prior stroke, hypertension, and positional symptoms were associated with requests for neurology consultation, while isolated dizziness was inversely associated. However, after multivariate analysis, only focal neurological signs, headache, and positional symptoms were independently associated with acquisition of neurological consultation, while isolated dizziness was independently associated with not obtaining consultation (Table 4).

Neurological consultation rates by physician ranged from 0% to 100% (7%-36% for physicians who cared for $\geq$20 patients). After adjusting for patient characteristics associated with acquisition of neurological consultation (positional symptoms, headache, focal neurological signs, and isolated dizziness), there was significant variability in neurology consultation frequency by provider ($P = .03$). The rate of neurological consultation did not change over time during the study period (P for trend = .25).

Discussion

In a large series of consecutive dizzy ED patients, we found that use of both neuroimaging studies and neurological consultation was common. The overall diagnostic yield of neuroimaging in our cohort was 7%. Conversely, neurological consultation, although obtained less frequently than neuroimaging, was more strongly associated with serious neurological disease, although this is likely due at least in part to confounding by indication and may also reflect practice variation among clinicians.

The high rate of serious neurologic disease seen among patients for whom a neurological consult was obtained may be partly due to the fact that some neurologists may have been called after a definitive diagnosis of a serious neurological disease had already been made (either clinically or through neuroimaging), or because some patients were felt to require admission to the hospital. Furthermore, rates of requests for neurological consultation varied significantly among emergency physicians, suggesting that there may be some degree of practice variation that may not be explained by differences in patient level characteristics. Nevertheless, given the overall rates, our findings suggest that when ED physicians request neurological consultation for patients with dizziness, neurologists should maintain a high index of suspicion for serious disease.

Table 4. Predictors of Neuroimaging and Neurology Consultation for 907 ED Patients With Dizziness

	Univariate		Multivariate	
Clinical Variable	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value[a]
For neuroimaging				
Focal neurological signs[b]	5.12 (3.61-7.28)	**< .001**	2.45 (3.28-7.06)	**< .001**
Headache	2.30 (1.66-3.18)	**< .001**	2.65 (1.81-3.86)	**< .001**
Age ≥ 60	2.51 (1.89-3.32)	**< .001**	2.45 (1.70-3.52)	**< .001**
Prior stroke	3.65 (2.07-6.46)	**< .001**	2.27 (1.17-4.41)	**.02**
Hypertension	1.86 (1.41-2.45)	**< .001**	1.35 (0.94-1.93)	.10
Atrial fibrillation	1.78 (1.12-2.83)	**.02**	1.07 (0.61-1.87)	.90
Coronary artery disease	1.65 (1.07-2.55)	**.03**	1.32 (0.77-2.26)	.31
Positional symptoms	1.37 (1.02-1.84)	**.04**	1.28 (0.91-1.78)	.15
Acute symptoms (≤ 24 hours)	1.43 (0.99-2.04)	**.06**	1.37 (0.92-2.06)	.13
Diabetes mellitus	1.39 (0.95-2.02)	**.09**	0.87 (0.59-1.44)	.73
Isolated dizziness symptoms	0.26 (0.17-0.41)	**< .001**	0.30 (0.18-0.49)	**< .001**
Prior dizziness	1.26 (0.94-1.68)	.12	N/A	N/A
For neurology consultation				
Focal neurological signs[b]	5.08 (3.53-7.30)	**< .001**	4.59 (3.15-6.69)	**< .001**
Headache	1.61 (1.11-2.34)	**.01**	1.71 (1.12-2.58)	**.01**
Age ≥ 60	1.75 (1.24-2.44)	**< .01**	1.44 (0.96-2.15)	.08
Prior stroke	2.13 (1.19-3.83)	**.01**	1.36 (0.72-2.60)	.35
Hypertension	1.67 (1.20-2.32)	**< .01**	1.46 (0.98-2.16)	.06
Atrial fibrillation	1.26 (0.73-2.18)	.46	N/A	N/A
Coronary artery disease	1.07 (0.63-1.82)	.78	N/A	N/A
Positional symptoms	1.62 (1.15-2.28)	**< .01**	1.56 (1.08-2.26)	**.02**
Acute symptoms (≤ 24 hours)	1.16 (0.76-1.77)	.60	N/A	N/A
Diabetes Mellitus	1.18 (0.75-1.84)	.48	N/A	N/A
Isolated dizziness symptoms	0.42 (0.25-0.71)	**< .001**	0.56 (0.32-0.97)	**.04**
Prior dizziness	1.30 (0.92-1.82)	.16	N/A	N/A

Abbreviations: OR, odds ratio; CI, confidence interval; N/A, not applicable; ED, emergency department.
[a] Clinical factors that were significantly associated with the outcome in univariate analysis ($P < .10$) were included in the final multivariable model. Significant predictors ($P < .10$ at the univariate level and $P < .05$ at the multivariate level) are in boldface.
[b] On initial ED examination.

We observed a rate of CT use (28%) that was comparable to previous reports, but our rate of MRI use was unusually high (11%).[8–10] For example, an analysis of 20 795 adults presenting with dizziness to a large, Northern California, integrated health program found that 27% had a head CT and 3.1% had a brain MRI.[10] Similarly, a cross-sectional study using data from the National Hospital Ambulatory Medical Care Survey (NHAMCS) of patients given a final ED diagnosis of benign positional vertigo or acute peripheral vestibulopathy demonstrated that 28% of patients presenting in the early 2000s received neuroimaging (mostly CT, as only 0.6% had an MRI).[9] This study also showed that the use of neuroimaging has rapidly increased over the past two decades, with utilization rates rising 169% from 1995 to 2004.[9] The higher use of MRI in our cohort may be due to increased availability of these studies, a sicker patient population, or different practice patterns at UCSF, which is an academic, tertiary-care medical center and a certified primary stroke center.

Previous studies on the yield of neuroimaging to evaluate dizziness have been conflicting and difficult to interpret. A Finnish study of 79 dizzy patients suspected to have central lesions based on clinical observations demonstrated etiological findings in 40% of MRIs and 29% of CTs.[11] However, this study only included patients expected to have a serious neurological disease, and brain atrophy was considered a causal imaging finding for a substantial proportion of positive cases—7 of 17 CT findings and 5 of 13 MRI findings.[11] If atrophy were removed as a relevant finding, then 17% of CT scans and 25% of MRIs would have revealed an etiological abnormality. A more recent prospective analysis of 200 patients with a chief complaint of acute dizziness or vertigo in a Buffalo ED found no acute abnormalities on CT imaging.[12] However, these authors applied very strict eligibility criteria by excluding patients with focal neurological deficits, headache, or trauma.[12] In our cohort, the yield of neuroimaging (particularly MRI) to evaluate dangerous causes of dizziness was modest but not altogether different from the diagnostic yield (14%) of chest CT to rule out coronary disease and pulmonary embolism for patients with acute chest pain, which is a symptom complex of similar frequency, resource utilization, and illness severity.[13,14] Furthermore, there did not appear to be significant variation

in the use of neuroimaging among physicians after adjusting for patient level factors; alternatively, we may not have had the statistical power to detect such variation.

Advanced age, headache, prior stroke, and focal examination deficits were independently associated with the acquisition of neuroimaging, while headache, positional symptoms, and focal examination deficits were associated with requests for neurological consultation. These clinical predictors are concordant with the finding that old age, prior stroke, and focal neurological deficits are consistent risk factors for serious neurological diagnoses in dizzy patients.[2,3,15] A headache in a dizzy patient may serve as a red flag to frontline providers who are screening for central lesions such as a hemorrhagic stroke or brain tumor, or it may be a marker of more severe illness, which may be more likely to prompt extensive workups.

Isolated dizziness was much less likely to lead to neuroimaging and neurological consultation as compared to dizziness with accompanying neurological symptoms. Although isolated dizziness has been inversely associated with acute stroke or TIA in dizzy patients,[6] there are numerous examples in the literature of patients presenting with isolated dizziness or vertigo from ischemic stroke or other serious neurological diagnoses, including 2 cases from our cohort.[7,16] Therefore, although isolated dizziness is usually not due to serious neurological disease, physicians should maintain a broad differential diagnosis in these patients, and comprehensive evaluations should be considered.

Our study has several limitations. First, the high diagnostic yield of neuroimaging and neurological consultation may have resulted from confounding by indication (eg, sicker patients more likely to harbor a serious neurological disease preferentially imaged or received neurological consultation). Second, it was conducted at a single, academic, tertiary care medical center with around-the-clock access to neuroimaging—including MRI—and neurological consultation, thus our results may not apply to settings without similar capabilities. Third, data were collected retrospectively, so the yield of imaging and neurological consultation in dizzy patients may be overestimated. However, since these evaluations were dependent on the clinical suspicion of the emergency physician and were performed as part of usual care, our results are likely representative of real-world practice patterns. Fourth, neuroimaging studies were not re-reviewed by a neuroradiologist but instead were assessed by abstracting neurologists based on the clinical neuroradiology report. Fifth, we do not have information on the timing of neuroimaging in relation to neurological consultation, and thus it is unclear what percentage of patients seen by neurologists had already been diagnosed with a serious neurological disease by imaging.

In summary, neuroimaging and neurological consultation were routinely performed in our center to evaluate ED patients with dizziness, and their diagnostic yields were substantial, particularly for neurological consultation, which was associated with serious neurological diseases in 21% of patients. Though the high yield of neurological consultation may be partially explained by selection bias, neurologists should consider that the rate of serious neurological disease may be high among the subset of dizzy ED patients whom they are called on to evaluate. Prospective analyses are needed to better determine which patients may benefit the most from these interventions.

Declaration of Conflicting Interests

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