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Use of BPPV processes in Emergency Department Dizziness Presentations: A Population-Based Study

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Abstract

Objective—A common cause of dizziness, benign paroxysmal positional vertigo (BPPV), is effectively diagnosed and cured with the Dix-Hallpike test (DHT) and the canalith repositioning maneuver (CRM). We aimed to describe the use of these processes in Emergency Departments (ED), to assess for trends in use over time, and to determine provider level variability in use.

Design—Prospective population-based surveillance study

Setting—EDs in Nueces County, Texas, January 15, 2008 to January 14, 2011

Subjects and Methods—Adult patients discharged from EDs with dizziness, vertigo, or imbalance documented at triage. Clinical information was abstracted from source documents. A hierarchical logistic regression model adjusting for patient and provider characteristics was used to estimate trends in DHT use and provider level variability.

Results—3,522 visits for dizziness were identified. A DHT was documented in 137 visits (3.9%). A CRM was documented in 8 visits (0.2%). Among patients diagnosed with BPPV, a DHT was documented in only 21.8% (34 of 156) and a CRM in 3.9% (6 of 156). In the hierarchical model (c statistic = 0.93), DHT was less likely to be used over time (odds ratio, 0.97, 95% CI [0.95, 0.99]) and the provider level explained 50% (ICC, 0.50) of the variance in the probability of DHT use.

Conclusion—BPPV is seldom examined for, and when diagnosed, infrequently treated in this ED population. DHT use is decreasing over time, and varies substantially by provider.

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Implementation research focused on BPPV care may be an opportunity to optimize management in ED dizziness presentations.

Introduction

Benign Paroxysmal Positional Vertigo (BPPV) is a common disorder that can be disabling.[1] The most frequent type of BPPV, posterior canal BPPV, is diagnosed by the simple bedside Dix-Hallpike test (DHT) and then treated by the canalith repositioning maneuver (CRM) (i.e., Epley maneuver).[2, 3] In 2008, two guideline statements on the management of BPPV were published in support of the DHT and CRM (collectively referred to as BPPV processes).[2, 3]

Little is known about BPPV processes in routine care and no study has assessed their use since the guidelines were published. Data from 2003 in Germany found that most BPPV patients presented to a medical provider but only 27% underwent positional testing, and only 10% were treated with the CRM.[1] From a single U.S. center, only 11% of patients with dizziness of possible vestibular origin had positional testing in 2003.[4]

In this study, we sought to describe BPPV process use from 2008 to 2011 in a population-based ED dizziness surveillance study in the U.S. The Emergency Department (ED) is an important area of focus because it is the site for nearly one-fifth of U.S. vertigo and dizziness presentations.[5] We additionally sought to identify the extent to which variation in practice among providers explains DHT performance and also to assess for changes in DHT use over time. This information is important for informing efforts to achieve efficient and effective care of patients with dizziness.

Methods

Study design and Setting

The Dizziness Evaluation and Treatment in Corpus Christi, Texas (DETECT) project is an ED dizziness surveillance study in Nueces County, Texas. Patients presenting to any of the six adult care EDs in the county between January 15, 2008 and January 14, 2011 were identified. Corpus Christi makes up > 95% of the Nueces County population and is an urban environment on the Texas Gulf Coast. The population of the county is approximately 300,000. It is a non-immigrant community, with very little migration of individuals.[6] The community is about 200 miles from Houston and 150 miles from San Antonio and the surrounding counties are sparsely populated. The study was approved by the University of Michigan Institutional Review Board (IRB) and by the IRBs of the Corpus Christi hospitals.

Identification and Classification of Dizziness Presentation Subjects

Adult patients aged 18 years or older presenting to the ED with dizziness symptoms were prospectively identified using active surveillance. A trained research associate screened an ED triage log, which contained clinical information from the time of the first interaction in the ED, for any of the following symptoms documented as the patient's reason for visit (RFV): dizziness, vertigo, or imbalance. For all identified visits, the complete ED record was obtained. The treating physicians' documentation of the patient encounter was recorded on standardized complaint-specific, paper templates produced by T-Systems, Inc. These are a set of 60 different symptom specific templates. Utilizing the pre-printed items on the template, ED providers document characteristics of the patient presentation and assessments rendered using circles, checks, and backslashes. Each section of the template also has blank space where physicians can hand write additional information.

Dizziness was determined to be a principal reason for the visit when at least one of the dizziness symptoms (i.e., dizziness, vertigo, imbalance) was also recorded in the ED physician's note as one of the top three complaints, or when a dizziness diagnosis (e.g., dizziness not otherwise specified [NOS], vertigo NOS, BPPV, vestibular neuritis) was documented by the ED physician. Exclusion criteria included out of county residents, institutionalized persons, dizziness caused by trauma, and dizziness that was not a principal reason for the visit. Patients admitted to the hospital were also excluded because we discovered through quality assurance measures that the initial RFV information is often later replaced by the final diagnosis when patients are admitted. Repeat visits over the study time period were identified by matching visits on the following variables: first name, last name, date of birth, social security number, and medical record number. At least 3 out of the 5 items must have been identical to be considered a match.

Data collection and methods of measurement

The research associate, who was blinded to the current study question, underwent training and certification in the collection of data. Information on demographics, history of present illness, past medical history, examination findings, diagnostic tests, treatments, diagnoses, neurology or otolaryngology consultations (by phone or in-person), and admission status was abstracted from the ED record. Providers were assigned unique codes so that provider level variability could be assessed. Visits that also included mid-level providers (i.e., residents, nurse practitioners, physician assistants) were recorded. The type of dizziness symptom was categorized using an a priori determined hierarchy from highest to lowest: "vertigo," "imbalance," and "dizziness." Symptoms were categorized as episodic when recurrent events were documented in the history of present illness. Diagnoses were abstracted from the physician form. The first listed diagnosis was considered to be the primary diagnosis.

Based on a preliminary review of records, the following wording was determined to be considered a DHT: "Dix-Hallpike test", "Dix-Hallpike maneuver," "Dix-Hallpike," "Hallpike's test," "Hallpike maneuver," "Hallpike," and descriptions in the examination section such as "positive vertigo when laying back." Wording that was considered a CRM included the following: "repositioning maneuver," "otolith repositioning maneuver," "Epley-Hallpike maneuver," and "Epley." In these cases, the side tested or treated, test result or response, and the basis for the result or response (i.e., nystagmus-based, symptom-based, or unknown) were also abstracted.

Statistical analysis

Demographics and other clinical information were summarized using descriptive statistics. In cases of repeat visits, only the demographic data from the first visit was used to calculate population summary statistics. An adjusted hierachical mixed effects (i.e., both fixed and random effects) logit model was used to assess associations with DHT documentation, and particularly to describe the variance explained at the provider level (i.e., the variance explained by individual provider practices). The hierarchical model enabled the calculation of the intraclass correlation coefficient (ICC) which is a summary statistic that estimates the proportion of variance in DHT utilization explained by the provider practice patterns. Repeat visits were excluded from the model. The dependant variable was performance of the DHT (0/1). Fixed effects independent variables included month of the visit (month 1–37), patient characteristics (age [continuous], gender, race-ethnicity), episodic symptoms (yes or no), type of dizziness symptom (vertigo, imbalance, versus dizzy NOS as referent), mid-level provider (yes or no), and hospital (1–6). A random physician level intercept (random effect) was included to account for the influence of physican practice patterns. Because the dependent variable in this model was dichotomous, the ICC was calculated by dividing

interprovider variance in the log odds of DHT by the sum of the interprovider variance and the variance in the logistic distribution (π^2/3).[7] The model was used to generate predicted probabilities of having a DHT by selected covariates while holding all other covariates at their means.The ability of the model to discriminate patients receiving the DHT from those who did not was evaluated using the c-statistic. All analyses were performed using Stata, version 11.0 (StataCorp, College Station, TX).

RESULTS

Using active surveillance of symptoms documented at ED first encounter, 5,963 visits with dizziness, vertigo, or imbalance as a presenting symptom were identified between January 15, 2008 and January 14, 2011. Excluded were 303 not eligible, 1,786 not meeting the criteria for principal dizziness and 352 that resulted in hospital admission. Thus, the final population of principal dizziness visits was 3,522, representing 3,184 unique individuals (338 repeat visits).

Characteristics of the final cohort are presented in Table 1. The median age was 52.2 years (IQR, 37.0 to 66.6 years) and 64.8% were female. Sixty-seven percent were Mexican American. The most common dizziness symptom documented in the ED physician note was dizziness NOS followed by vertigo and imbalance. More than one type of dizziness symptom was documented in 66.4% of visits. The symptoms were documented as episodic in 42.1% of the visits (1,484). Most visits resulted in more than one diagnosis made by the ED physician. A neurology or otolaryngology consultation was performed in 0.5% (18) of visits. Dizziness or vertigo NOS was at least one of the diagnoses in 81.7% (2,879) of visits, was the primary diagnosis in 71.7% (2,525), and was the only diagnosis in 22.9% (807). A peripheral vestibular diagnosis (i.e., benign paroxysmal positional vertigo, vestibular neuritis, labyrinthitis, Meniere's disease, or "peripheral vertigo") was recorded on the ED physician's note in 13.9% (491) visits, of which BPPV was documented in 4.4% (156).

Table 2 presents details about BPPV process documentation. The DHT was documented in 3.9% (137 of 3,522) of all visits. Even when the population was restricted to episodic presentations or visits that received a BPPV diagnosis, a substantial majority did not have the DHT documented. The CRM was performed in 0.2% (8 of 3,522) of all visits. Of the visits receiving a BPPV diagnosis, the CRM was performed in 3.9% (6 of 156). Of visits with a documented positive DHT and a BPPV diagnosis, the CRM was performed in 6.9% (2 of 29). None of the visits with documentation of a BPPV process or a BPPV diagnosis had a neurology or otolaryngology consultation documented.

For comparison purposes, a head CT was performed in 33.0% (1,162 of 3,522) of visits. A head CT was performed in 32.9% (488 of 1,484) of episodic symptom presentations, 36.5% (179 of 491) of visits receiving a peripheral vestibular diagnosis, and 29.5% of visits with a BPPV diagnosis (46 of 156).

From the hierarchical model (c statistic of 0.93), the DHT was less likely to be utilized over time (Table 3). For every increase in month, the odds of utilization of the test decreased by 3% (OR 0.97, 95% CI, 0.95 to 0.99). Additional associations with DHT were episodic symptom presentation (OR 2.19, 95%CI 1.43 to 3.36), and a symptom of vertigo compared to the referent symptom of dizziness (OR 3.95, 95% CI, 2.20 to 7.08). A substantial proportion of the variation in the documentation of the DHT was explained at the physician level. In the model there were a total of 73 unique providers who saw a median of 25 patients (IQR, 5–72). The intraclass correlation coefficient (ICC) for the physician level was 0.50, meaning that half of the variation in the probability of DHT utilization was due to physician practice difference and the other half was due to random variation.

Discussion

This is the first study to describe the use of BPPV processes since the 2008 guidelines and the first assessment of BPPV processes in the ED using a population-based design. The study design and this particular community avert biases inherent to single center studies or studies that include large academic medical centers. As a result, the findings provide an example of "real world" community-based ED practice.

In this large sample of dizziness visits, we found that the DHT is documented in about 4% of presentations and the CRM in 0.2%. We also found that the frequency of DHT use has actually decreased since the publication of the clinical guidelines in 2008. Although we do not know what the optimal frequency of BPPV processes use should be within a broad dizziness sample, findings from this study suggest that these processes are underutilized in the ED. First, the DHT was infrequently documented among episodic presentations (6.0%). Second, both BPPV processes were infrequently documented even in patients who received a BPPV diagnosis (DHT documented in 21.8%, and the CRM in 3.9%).

An additional unique aspect of this study was the assessment of the variation in DHT use by providers. Variation in utilization is a measure used to gauge opportunities to improve healthcare efficiencies and outcomes,[8, 9] particularly when pertaining to evidence-based processes. Substantial variation that is not explained by clinical factors is generally considered unwanted.[10, 11] In this study, 50% of the variation in DHT documentation was attributable to providers. From our model which demonstrated excellent discrimination, provider variation in practice had a dominant contribution to DHT use even after adjusting for important patient factors. The finding of substantial provider level variation further highlights the lack of broad diffusion of BPPV processes to the frontline of care.

There are several potential reasons why care for dizziness patients in this community seemed to differ with published guidelines including lack of familiarity or awareness, lack of agreement with guidelines, lack of self-efficacy, clinical inertia, and environmental barriers. Frontline providers may not be aware of the guidelines because they were published in specialty journals.[2, 3] Providers may not agree with the guidelines if for example BPPV patients from the clinical trials do not adequately represent the BPPV patients in routine care. When compared with patients in the clinical trials, patients in routine care could be more symptomatic (particularly those presenting to the ED) and thus less tolerant of the positions required to perform the processes, or may have more movement restricting co-morbidities. Disagreement with guidelines could also occur if providers have unknowingly applied BPPV processes without benefit in conditions that can mimic BPPV symptoms (e.g., vestibular migraine[12]) or in the less common variant of BPPV, horizontal canal (HC) BPPV, to which standard BPPV processes do not apply.[2, 3] Self-efficacy may be reduced as providers have reported difficulty recalling the steps of the processes.[13] Clinical inertia may also be a contributing factor. Finally, important environmental barriers to BPPV processes may exist. Specifically in the ED, gurneys are generally smaller and have more obstacles (e.g., metal poles at the head of the bed) than exam tables used in outpatient practice.

Neurology and otolaryngology societies issued the guideline statements for BPPV diagnosis and treatment.[2, 3] However, physicians from these specialties were rarely involved in the ED care of the patients in this study. This could be due to the lack of emergency physicians seeking consultation or a lack of the availability of these specialists in the ED setting. In the future, it may be advantageous if neurologists and otolaryngologists take steps to make themselves available to their ED colleagues specifically in cases of potential BPPV.

Further research to disseminate and implement BPPV processes should be a priority because BPPV is common (lifetime prevalence of 2.4%)[1] and optimal frontline management has the potential to improve patient outcomes and additionally lead to more efficient healthcare delivery. BPPV patients do not typically require additional tests or medicines.[2] Head CT use in this setting provides an example of how optimal management could influence efficiencies. These low yield tests in dizziness presentations are costly and associated with increased length of stay in the ED.[14] Yet even when we limit our population to only visits that received a BPPV diagnosis, a head CT was performed in nearly 1 out of 3 visits, whereas a DHT was documented in only about 1 out of 5 of visits and a CRM documented in 1 out of 20 visits.

This study has important limitations. Because of our case capture method, our results only generalize to patients documented with dizziness at triage and subsequently discharged from the ED. It remains possible that processes were performed but not documented. In other clinical contexts, medical record documentation has been shown to agree relatively well with actual performance of various clinical processes.[15, 16] Our sample was broadly inclusive such that BPPV processes were likely not relevant for many of the patients' clinical circumstances. We chose to include a broad sample because there is no validated method to identify definitive or even possible BPPV cases from medical record review. Prior studies suggest that the use of documented diagnoses in routine care may not be accurate for dizziness presentations.[17, 18] If we had restricted our sample to only those visits receiving a BPPV diagnosis, we would not have included the majority of visits with DHT documentation (only 34 of the 137 visits with a DHT had a BPPV diagnosis) or 2 of the 8 visits with a CRM. Similarly, restricting the sample to only patients with documented episodic symptoms would have excluded 35% of the DHT documentations. Although this was a population-based emergency department study, the practice patterns in this community may not generalize to other communities.

Conclusions

The DHT and CRM were used infrequently in this population of ED dizziness presentations. DHT use is decreasing over time, and varies substantially by provider. Dissemination and implementation research focused on BPPV care may be an opportunity to optimize the efficiency and effectiveness of care in ED dizziness presentations.

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Table 1

Patient demographics and clinical characteristics

	N, %, unless otherwise specified N = 3,522
Age, years, median, IQR [a]	52.2 (37.0 to 66.6)
Female [a]	2,064 (64.8%)
Ethnicity [a]	
Mexican American	2,130 (66.9%)
Non-Hispanic White	849 (26.7%)
Other	205 (6.4%)
Dizziness Symptom	
Dizziness NOS, any	3,223 (91.5%)
Vertigo	1,441 (40.9%)
Imbalance	882 (25.0%)
More than one	2,340 (66.4%)
Episodic symptoms documented	1,484 (42.1%)
Diagnosis	
Dizziness or Vertigo NOS, any	2,879 (81.7%)
Peripheral vestibular, any	491 (13.9%)
BPPV, any	156 (4.4%)
Number of diagnoses [b]	
0	3 (0.1%)
1	1,052 (29.9%)
2	1,361 (38.6%)
3	693 (19.7%)
4	290 (8.2%)
5	123 (3.5%)

IQR, interquartile range; NOS, not otherwise specified

[a] Summary statistics for demographic information were calculated using only data from initial visits (i.e, the 338 repeat visits were excluded).

[b] Median number of diagnoses, 2 (IQR, 1 to 3)

Table 2

Information regarding testing and management processes documented in visits to the ED for dizziness and subsequently discharged.

Total	**All visits N, % N=3,522**	**Visits for episodic presentations N, % N= 1,484**	**Visits with BPPV diagnosis N, % N= 156**
Dix-Hallpike Test			
Documented	137 (3.9%)	89 (6.0%)	34 (21.8%)
Results [a]			
Positive [b]	94 (2.7%)	67 (4.5%)	29 (18.6%)
Negative	37 (1.1%)	22 (1.5%)	3 (1.9%)
Unknown	6 (0.2%)	0 (0.0%)	2 (1.3%)
Canalith Repositioning Maneuver			
Documented as done [c,d]	8 (0.2%)	4 (0.3%)	6 (3.9%)
Additional mention [e]	9 (0.3%)	8 (0.5%)	9 (5.7%)
Consultations			
Neurology	16 (0.5%)	8 (0.5%)	0 (0.0%)
Otolaryngology	2 (0.1%)	2 (0.1%)	0 (0.0%)
Head CT	1,162 (33.0%)	488 (32.9%)	46 (29.5%)

CT = computerized tomography

[a] Positive or negative results were based on nystagmus in 15.3% (21 of 137), symptoms only in 11.7% (16 of 137), and unknown (e.g., described as "positive" or "negative" or results not reported) in 73.0% (100/137). None of the visits with positive test results described the characteristic nystagmus pattern of BPPV (i.e., up-beat torsional nystagmus).

[b] When the test was positive, the side affected was documented in 47.9% (45 of 94) of visits.

[c] The side that the maneuver was performed on was only documented in one visit.

[d] The patient's response to the maneuver was reported in 6 visits and all responses were based on symptoms (3 with documented improvement and 3 with no improvement).

[e] In these 9 additional visits, the maneuver was mentioned but not documented as performed. One of these indicated that instructions for the maneuver were provided, whereas the others suggested follow-up care for the maneuver.

Table 3

Hierarchical model of the association of factors with documentation of the Dix-Hallpike test in this emergency department dizziness population (n= 3,133 unique individuals).[a]

	OR, 95% CI, unless otherwise specified
Fixed Effects Parameters	
Age	1.00 (0.99,1.02)
Female	1.15 (0.74,1.79)
Race-ethnicity	
Non-Hispanic White	Ref
Mexican-American	1.12 (0.68, 1.87)
Other	0.65 (0.21, 2.05)
Episodic presentation	2.17 (1.42, 3.33)
Symptoms	
Dizziness NOS	Ref
Imbalance	2.04 (0.97, 4.31)
Vertigo	4.88 (2.94, 8.11)
Month	0.97 (0.95, 0.99)
Mid-level provider	1.32 (0.75, 2.31)
Hospital	
1	Ref
2	0.40 (0.11, 1.45)
3	0.00 (0.00, 0.00)
4	0.87 (0.18, 4.27)
5	1.17 (0.27, 5.12)
6	0.81 (0.12, 5.30)
Random Effects Parameter	
Provider, ICC [b]	0.50

OR, odds ratio; CI, confidence interval; ICC, intraclass correlation coefficient. Mid-level provider = resident, physician assistant, or nurse practitioner

[a] c-statistic = 0.93, indicating excellent model discrimination. The number of individuals in final model is reduced from total population of 3,522 due to exclusion of repeat visits (338) and missing data on provider (26) and race-ethnicity (25). The model included 73 unique providers who saw a median of 25 patients (IQR, 5–72)

[b] ICC equal to 0.50 means that 50% of the variation in the probability of DHT utilization was explained at the provider level (i.e., due to physician practice differences) and the other half was due to random variation.