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Short Communication

Not So Benign Paroxysmal Positional Vertigo in the Emergency Department

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Abstract

Background: Benign paroxysmal positional vertigo (BPPV) is an inner-ear disorder that is the most common cause of peripheral vertigo. Many patients have mild to moderate illness and can be treated in outpatient settings. In those with severe symptoms, BBPV can have a dramatic effect on independence, quality of life, and daily functioning.

Objective: This study aimed to determine the prevalence of inpatient treatment in patients who present to the emergency department (ED) with severe BPPV symptoms.

Methods: This was a retrospective analysis of adult patients diagnosed with BPPV. Consecutive patients were seen over a nine-month period at seven affiliated EDs. Data collected included clinical features, demographics, diagnostic testing, treatment, and disposition. Patients who required hospital admission were compared to those discharged from the ED.

Results: 400 adult ED patients were included in the study; 68 (17.0%) were admitted, and 332 (83.0%) were discharged home. Admitted patients were less likely to have positional testing performed in the ED and were more likely to undergo computed tomography (CT) imaging of the head (69.1% vs. 32.5%, *P*<0.001). Vestibular suppressant drugs were given to 95.0% of all BPPV patients in the ED while canalith repositioning maneuvers were used in only 4.0%. Patients were admitted because of difficulty with balance and gait (77.9%), persistent vomiting (20.6%), and/or waiting for magnetic resonance imaging (19.1%). Twenty-eight (7.0%) patients returned within 14 days for continued symptoms.

Conclusions: BPPV is a common entity in older adults and may have a protracted course and a high risk of recurrence. Overall, 17.0% of adults presenting to the ED were admitted, generally because of difficulty with gait and persistent vomiting. When positional testing was not performed at the bedside, patients were often subjected to unnecessary and expensive investigations. Canalith repositioning maneuvers, such as the Epley maneuver, were used in only 4.0% of ED patients with BPPV. Although repositioning maneuvers can dramatically improve vertigo, some patients still experience residual dizziness at least one month after repositioning. Vestibular suppressant drugs are commonly prescribed in the ED and can be associated with significant adverse reactions.

Keywords: paroxysmal positional vertigo, prognosis, treatment, diagnostic imaging

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1 INTRODUCTION

Vertigo is characterized by a rotatory or spinning feeling provoked by head position changes[1]. It may be described as tilting, spinning, swaying, or feeling unbalanced[2]. Due to the highly variable description of vertigo symptoms, they are often combined into one common descriptor, 'dizziness', a very frequent complaint that accounts for over three million emergency department visits annually[1-3]. Vertigo can originate from a central origin (central nervous system)

or peripheral origin (labyrinth and vestibular nerve). Benign paroxysmal positional vertigo (BPPV) is a disorder of the vestibular proprioceptive system and a common cause of peripheral vertigo. Epidemiologic studies have estimated that BPPV accounts for about a quarter of all dizziness complaints, and its cumulative incidence in the general population is 10%[3]. It is particularly common among older patients; those older than 60 years old have a 7-fold higher prevalence of BPPV than younger adults[2].

BPPV is commonly attributed to calcium debris (otoconia or canalithiasis) freely floating within the semicircular canals[2]. This disorder was first characterized by Adler in 1897. Dix and Hallpike first used the term *benign paroxysmal positional vertigo in 1952.* Their terminology described the benign features of this peripheral vertigo and defined the positional test still used today for diagnosis[3]. Fortunately, most affected patients have only mild to moderate illness and are easily treated at the bedside by performing a simple head-hanging maneuver (e.g., Epley maneuver)[2,3]. In those with severe symptoms, however, BBPV can have a dramatic effect on independence, quality of life, and daily functioning. In addition to the uncomfortable dizziness, this disorder can negatively affect a person's gait and balance, leading to a higher risk of falling[4]. This study aimed to determine the prevalence of inpatient treatment in patients who present to the emergency department (ED) with severe BPPV symptoms.

2 METHODS

2.1 Study Design/Setting

We retrospectively analyzed adult ED patients diagnosed with BPPV. Consecutive patients were seen at seven EDs over a nine-month study period (Oct 2018-June 2019). Affiliated institutions included three university-affiliated hospitals and four rural medical centers spanning 13 counties in West Michigan. Board-certified or board-eligible emergency physicians staff the emergency departments in all the participating hospitals.

2.2 Inclusion/Exclusion Criteria

The inclusion criteria were adult patients (age >18) who presented to the emergency department with a diagnosis of dizziness (ICD-10 code, R42) or BPPV (ICD-10 code, H81). Only one visit was included for review if a patient had multiple ED visits to any hospital during the study period. The exclusion criteria were: (1) patients with a history of psychiatric disorders; (2) patients with other dizziness conditions that cause secondary BPPV, such as Ménière's disease; (3) patients with symptoms and history of BPPV but with no objective recordable nystagmus (sub-clinical BPPV) on the first presentation; and (4) patients with central nervous system pathologies that caused positional vertigo and nystagmus. The sample size meets the minimum requirements of statistical analyses according to the power calculation.

2.3 Data Collection

Data abstracted from the ED medical records included clinical features, demographics, diagnostic testing, treatment, and final disposition. Hospital records were used to determine hospital course, complications, and morbidity if any patient required admission. To ensure coding accuracy, we took several steps. Data was collected by residents and medical students trained in research methodology using a set of mock case records and blinded to the study objectives. Standardized abstraction forms were used to guide data collection. Before beginning the data collection, all investigators met and reviewed the coding scheme and data abstraction. One investigator ensured that study definitions were uniformly applied and supervised data abstraction. The inter-rater agreement for this sample of datasheets was determined using kappa statistics. To ensure quality control of collected data, the principal investigator periodically reviewed the collected data to reduce inter-observer variations or errors in data transcription.

2.4 Statistical Analyses

Our primary outcome measure was the prevalence of severe BPPV requiring inpatient treatment. These admitted patients were then compared to those discharged from the ED. Microsoft Excel (Microsoft Corp, Redmond, WA, USA) was used to create a the database. All statistical analyses were performed using SAS statistical software (SAS Institute, Cary, NC, USA). One researcher performed a blinded chart review by randomly selecting 10% of the medical records to determine the inter-rater consistency of data collection. This was quantitatively assessed by using the Kappa reliability test. Baseline characteristics were reported as means [± standard deviations (SD)] or proportions. The two patient groups (outpatient vs inpatient) were then compared across key demographic and outcome variables using chi-squared and T-tests.

3 RESULTS

3.1 Demographics

Overall, 400 consecutive ED patients were included in the study. The mean age was 59.8y (SD 13.7); 38.0% were >64. The average duration of BPPV symptoms before ED evaluation was 33.7h (SD 38.1). Elderly patients took longer to present to the ED and often endorsed dizziness or imbalance without the rotatory or spinning feeling of vertigo. Table 1 summarizes the demographic characteristics and treatment outcomes of admitted patients and those discharged from the ED.

3.2 Diagnostic Testing

A total of 40.3% (161/400) had CT (computed tomography) imaging of the head. These X-rays were all non-diagnostic. Older adults had CTs ordered more frequently than younger patients (62.5% vs 26.6%, $P<0.001$). Only 13.3% (53/400) of all patients had a

Table 1. Demographics and Treatment Outcomes of 400 adult ED Patients with BPPV

	Outpatient Tx (*n*=332)	Inpatient Tx (*n*=68)	*P* Value
Mean age (SD)	58.2±13.3		<0.001
Gender (% male)	133 (40.1%)	34 (50.0%)	<0.001
Race (% white)	310 (93.4%)	58 (85.3%)	0.025
Duration of sx (hours)	35.2±39.0	26.3±33.9	0.081
Medical comorbidities	208 (62.7%)	61 (89.7%)	<0.001
Past hx of BPPV	23 (6.9%)	9 (13.2%)	0.081
Dix-Hallpike test	47 (14.8%)	6 (8.8%)	0.047
CT head	108 (32.5%)	53 (69.1%)	<0.001
ED LOS (hours)	2.6±2.0	4.9±1.8	<0.001
ED medical treatment	313 (94.3%)	67 (98.5%)	0.148
meclizine	286 (86.1%)	53 (77.9%)	0.087
scopolamine	65 (19.6%)	8 (11.8%)	0.13
Ondansetron	96 (28.9%)	19 (27.9%)	0.868
benzodiazepines	66 (19.9%)	35 (51.5%)	<0.001
diphenhydramine	18 (5.4%)	6 (8.8%)	0.282
corticosteroids	12 (3.6%)	3 (4.4%)	0.503
Canalith repositioning	13 (3.9%)	3 (4.4%)	0.692
IV fluids	181 (54.5%)	67 (98.5%)	<0.001
Returned to ED	26 (7.0%)	2 (2.9%)	0.206

Table 2. Diagnostic Bedside Tests for Vertigo and Dizziness with Video Examples[25-27]

Dix-Hallpike test – Used to diagnose posterior BPPV. The patient is rapidly moved from a sitting to the supine position with the head turned 45 degrees to one side and the neck extended 20 degrees backward. A positive test is indicated by the patient's endorsement of vertigo or the clinician's observation of torsional or up-beating nystagmus. If no nystagmus exists, the same procedure is repeated on the opposite side.

Side-lying test – Used to diagnose posterior or anterior BPPV. The patient is seated on the examination table, the head is turned 45° to one side, and the patient lies on the opposite shoulder while the head is extended approximately 20 degrees. This position is held for 20 seconds while the clinician observes for nystagmus. If no nystagmus exists, the same procedure is repeated on the opposite side.

Supine head roll test – Used to diagnose lateral or horizontal BPPV. The provider places the patient supine and flexes the neck 30 degrees. Then, the head is turned 90 degrees to one side for one to two minutes and rotated in the opposite direction. The clinician's observation of nystagmus indicates a positive test.

HINTS exam – An acronym of Head Impulse, direction-changing Nystagmus, and a Test of Skew) is used to diagnose posterior circulation strokes in patients with acute vertigo. A positive HINTS examination involves a normal head impulse test, direction-changing nystagmus, and the presence of a skew deviation.

Dix-Hallpike maneuver documented in the ED medical record. No other diagnostic bedside tests for dizziness were performed (Tables 1 and 2).

3.3 Treatment

Vestibular suppressant medications were given to 95.0% (380/400) of all BPPV patients in the ED (Table 1). The most commonly used drugs were meclizine and scopolamine. Canalith repositioning maneuvers were documented in only 4.0% (16/400), with excellent results in 62.5% of these patients (10/16). A total of 68 patients (17.0%) were admitted to the hospital because of difficulty with balance and gait (77.9%), persistent vomiting with dehydration (20.6%), and/or waiting for magnetic resonance imaging (19.1%).

3.4 Admitted Patients

Patients admitted to the hospital were more likely to be older (67.7 vs. 58.2y), male (50.0% vs. 40.1%), non-Caucasian (14.7% vs. 6.6%), and have more comorbidities (89.7% vs. 62.7%). These patients were also more likely to undergo computed tomography (CT) of the head (69.1% vs. 32.5%) (Table 1). The average hospital length of stay was 3.3 (SD 2.8) days. Overall, 28 (7.0%) of patients returned within 14d for continued symptoms of vertigo. The reliability of data collection showed excellent agreement (k=0.88).

4 DISCUSSION

This is one of the first clinical research studies to examine the prevalence of severe BPPV in adult ED patients

Table 3. Differential Diagnosis of BPPV[2,3,6,23-25]

- Labyrinthitis or vestibular neuritis
- sMénière's disease
- Acoustic neuroma and meningioma
- Vascular loop syndrome
- Vestibular migraine
- Parkinson disease
- Positional nystagmus of central origin
- Cerebellar stroke
- Lesion of the nodulus from conditions such as multiple sclerosis, Chiari malformation, ischemia, and cerebellar degeneration
- Vertebral artery insufficiency
- Orthostatic hypotension
- Cervical vertigo, or head extension vertigo
- Peripheral neuropathy
- Aminoglycoside toxicity
- Superior canal dehiscence syndrome
- Vestibular paroxysmia
- Persistent postural-perceptual dizziness (PPPD)
- Head trauma and post-concussion syndrome

Table 4. Key Features of BPPV[1-3,5,7]

- Sudden episodes of vertigo triggered by head movements (e.g., rolling over in bed, looking up/down).
- More common in older adults, but it can affect people of all ages.
- Brief duration of vertigo (typically less than a minute).
- Associated with positional nystagmus (involuntary eye movements).
- No hearing loss or tinnitus (unlike Ménière's disease).
- No neurological symptoms like weakness or double vision (suggests a peripheral cause).
- BPPV may be associated with nausea, vomiting, and difficulties with balance.
- Diagnostic tests: Dix-Hallpike (posterior BPPV), Supine Roll Test (lateral BPPV).
- Neuroimaging is reserved for cases with neurological signs, persistent symptoms, or atypical presentations.

requiring inpatient treatment. Overall, 17.0% of adults were admitted, generally because of difficulty with gait and persistent vomiting. In addition, this disorder can present atypically in some adults, have a more-protracted course, and a higher risk of recurrence[4]. Although BPPV is the most common cause of positional vertigo, other conditions can trigger BPPV or present with similar symptoms.

BPPV is often linked to other medical conditions that affect the inner ear, nervous system, or metabolic health (Table 3). It frequently coexists with Ménière's disease, where inner ear damage may predispose patients to recurrent BPPV[2]. Similarly, vestibular migraines and head trauma (including concussions) can trigger or worsen BPPV by disrupting inner ear function[3]. Osteoporosis and vitamin D deficiency are associated with a higher risk of BPPV due to abnormal calcium metabolism affecting otoconia stability[3]. Additionally, conditions like vestibular neuritis, diabetes, cardiovascular disease, and autoimmune disorders may contribute to recurrent BPPV episodes by impairing microvascular circulation or causing inflammation in the inner ear[1,2]. While BPPV is a peripheral vestibular disorder, differentiating it from central causes of vertigo, such as stroke or multiple sclerosis, is crucial to avoid misdiagnosis and ensure appropriate treatment[3-5].

Diagnosing BPPV and distinguishing it from other conditions that cause vertigo requires a systematic clinical approach using specific diagnostic maneuvers and differentiating clinical features (Table 4). Li and colleagues have shown that misdiagnosis and improper treatment of BPPV may result in considerable and unnecessary costs to patients[5]. A simple diagnostic test, such as the Dix-Hallpike maneuver, could lead to a diagnosis of BPPV in the ED and often avoid non-diagnostic CT imaging of the head and unnecessary admissions to the hospital. Only 13% of our study population had a Dix-Hallpike test performed at the bedside. In comparison, 33% of patients managed in the outpatient setting vs 69% of patients managed in the inpatient setting had CTs of the head obtained, regardless of age. Brain imaging is indicated only in patients with symptoms of peripheral vertigo that are confounded by additional atypical neurologic symptoms[6,7]. The preferred modality to evaluate central causes of vertigo is magnetic resonance imaging, as CT imaging is less sensitive and often non-diagnostic[1,2].

In select elderly patients with BPPV, the Dix-Hallpike test may be challenging to perform due to various orthopedic or vascular comorbidities[8]. Diagnostic maneuvers such as the supine roll or side-lying tests may be more comfortable for these adults because the exam table supports the neck and head. Table 2 describes the bedside tests that can be used for BPPV, their applications, and YouTube video links to view maneuvers.

According to evidence-based treatment guidelines, no medications are endorsed for the treatment of BPPV[7,8]. Instead, the recommended therapy is canalith repositioning procedures (CRP), such as the Semont or Epley maneuver. These procedures are a series of head movements that allow displaced otoconia from the affected semicircular canal to be relocated back into the utricle using gravity, relieving the bothersome symptoms[9,10]. The termination of the Dix-Hallpike maneuver is the beginning of the Epley maneuver, so clinicians must know how to perform both maneuvers to diagnose and treat BPPV effectively. CRP may result in complete relief of vertigo and nystagmus in 85% of patients after one treatment and up to 92% with two treatments[4,9]. A Cochrane review of randomized controlled trials in 2012 demonstrated the Epley maneuver's effectiveness in treating BPPV (odds ratio, 4.4)[10]. No serious complications were documented. However, several studies reported minor adverse effects such as dizziness, cervical strain, and disequilibrium in some patients. In addition, performing CRP quickly after the onset of vertigo may be a significant factor in preventing BPPV recurrence[11]. Of note, repeated lack of response to CRP should generally prompt consideration of alternative diagnoses that may closely mimic BPPV[7].

In our community, ED clinicians overprescribe medications for BPPV despite the patient's comorbidities or age. CRP maneuvers were used in less than 4% of patients. In a few instances, individuals might benefit from antiemetics (ondansetron) or a short course of vestibular suppressants (meclizine, scopolamine). These include adults who become vertiginous after a repositioning maneuver, those with severe vertigo and vomiting, and those who are physically unable to undergo CRP maneuvers[4]. However, use of pharmacologic therapy should be limited to the first 2-3 days after the onset of vertigo because of their adverse effects (sedation, urinary retention, psychomotor retardation) and potential interactions with other pharmacological treatments[13]. In addition, vestibular suppressants may even delay recovery[12]. In most BPPV patients, physical activity and vestibular rehabilitation exercises are strongly advised for more complete and rapid vestibular compensation[12].

Although repositioning maneuvers can dramatically improve vertigo, some patients still experience lightheadedness, drowsiness, fogginess, or disorientation at least one month after successful treatment[14]. These symptoms are referred to as "residual dizziness." Other investigators have reported that residual dizziness was 56%-63% in older patients[14-17]. Advanced age, anxiety, moderate to severe dizziness, and a longer duration of vertigo are associated with the onset of residual dizziness[17]. Persistent imbalance and dizziness can poorly affect quality of life by contributing to social isolation, loss of independence, and frequent falls.

While BPPV can be successfully treated, patients may experience a recurrence in the future. BPPV recurrence is defined as the return of nystagmus and positional vertigo at least one month following successful treatment[18]. Reported recurrence rates vary considerably, ranging from 14% to 50%[19]. Several recent meta-analyses on the risk factors of BPPV recurrence have been published[19-21]. Patients with cardiovascular disease, hypertension, hyperlipidemia, and diabetes mellitus have a higher risk of BPPV recurrence. Other risk factors include advanced age, female gender, migraine, head trauma, vitamin D deficiency, Meniere's disease, osteoporosis, bilateral BPPV, and cervical osteoarthrosis[19-21]. Awareness of these risk factors is essential in evaluating, counseling, and treating BPPV patients.

Before the use of the Epley maneuver, BPPV was often treated surgically. Today, surgery remains an option in 1 to 5% of patients with intractable symptoms[22,23]. Semicircular canal occlusion, vestibular nerve section, singular neurectomy, transtympanic aminoglycoside application, and labyrinthectomy are all possible surgical options[22,23]. These interventions have high success rates but can result in hearing loss, postoperative dizziness, and/or imbalance[23].

5 LIMITATIONS

Given the retrospective nature of this study, there is likely some variability in clinical assessment and documentation by ED clinicians. Thus, documentation of clinical findings may not have been consistent. Our sample population was drawn from thirteen counties located in the Midwestern United States. We had a combination of rural and urban settings for this community-based study. However, patient demographics and treatment considerations might differ in other settings. However, this study should add to previous research and highlight the prognosis of BPPV, especially in older patients. Finally, the small number of admitted patients in our population limited the precision of our findings.

6 CONCLUSIONS

Despite the limitations described, BPPV is a frequent entity in adults and may have a protracted course and a high risk of recurrence. Overall, 17.0% of adults presenting to the ED with vertigo were admitted, generally because of difficulty with gait and persistent vomiting. Admitted patients were more likely to be older, male, non-Caucasian, and have more associated comorbidities. When positional testing was not performed at the bedside, patients were often exposed to unnecessary and expensive investigations. Canalith repositioning maneuvers, such as the Epley maneuver, were used in only 4.0% of ED patients with

BPPV. Although repositioning maneuvers can dramatically improve vertigo, some patients experience residual dizziness at least one month after repositioning. Vestibular suppressant medications are commonly given in the ED and can be associated with significant adverse reactions.

Acknowledgements

Not applicable.

Conflicts of Interest

The authors declared no conflict of interest.

Ethics Statement

The Institutional Review Board (IRB) at Corewell Health approved the protocol for the affiliated institutions (#2018-523). A waiver of consent was provided for this retrospective chart review.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author Contribution

The authors contributed to the study's conception and interpretation and were involved in revising the manuscript. Jones JS, Ambrose L, and Moaddel V designed the study and interpreted the data, and Tapia A and Burkard D drafted the manuscript. Moaddel V, Tapia A, Pillay Y, Peterson T, Sapp T, and Emmerich B contributed to data acquisition and analysis. Jones JS and Ambrose L oversaw supervision and project administration. Seamon J revised the manuscript critically for important intellectual content. All authors approved the final version of the manuscript.

Abbreviation List

BPPV, Benign paroxysmal positional vertigo
CRP, Canalith repositioning procedures
CT, Computed tomography
ED, Emergency department
ICD-10, International classification of diseases, tenth revision
PPPD, Persistent postural-perceptual dizziness
SAS, Statistical analysis system
SD, Standard deviation

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