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Abstract

Introduction: Seasonal variation of benign paroxysmal positional vertigo (BPPV) presentation has been reported, with higher rates of presentation in months associated with times of lower serum vitamin D levels. The purpose of this study was to examine the association between the timing of hip fracture in patients with BPPV.

Methods: A retrospective review (2013 to 2019) of adult patients was performed at a tertiary care academic center to identify patients with hip fracture due to ground level fall (ICD-10 code S72) and a previously established diagnosis of vestibular disorder (ICD-10 codes H81-83, A88.1, and R42). Included patients were matched by age and sex to control for patients who had hip fracture without a vestibular diagnosis. Patient charts were reviewed, and demographic and clinical data were extracted related to hip fracture and prior vestibular diagnosis. Groups were subdivided based on whether patients had a hip fracture from January to June versus July to December. Fisher's exact test was used to evaluate for a difference in seasonal variation between groups.

Results: There were 201 patients with vestibular disorders of whom 27 patients carried the diagnosis of BPPV, with a mean age of 80.4 years. The rates of hip fracture among patients with BPPV was higher in the period extending from January to June (63.0%) versus July to December (37.0%), [odds ratio 1.59, 95% CI 0.66-4.00]. The rate of hip fracture was not significantly different between these time periods for the control group (51.7% versus 48.3%) or the vestibular group (53.2% versus 46.8%).

Conclusion: These results offer preliminary evidence that, in addition to an increased presentation for BPPV during months associated with decreased serum vitamin D, injuries due to BPPV may be increased as well. The present study is limited by the statistical power afforded by the small number of patients with BPPV and hip fracture that were identified.

Keywords

vestibular diseases, dizziness, vertigo, BPPV, falls, hip fracture

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Seasonal Variation of Hip Fractures in Patients With Benign Paroxysmal Positional Vertigo

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Abstract

Introduction: Seasonal variation of benign paroxysmal positional vertigo (BPPV) presentation has been reported, with higher rates of presentation in months associated with times of lower serum vitamin D levels. The purpose of this study was to examine the association between the timing of hip fracture in patients with BPPV.

Methods: A retrospective review (2013 to 2019) of adult patients was performed at a tertiary care academic center to identify patients with hip fracture due to ground level fall (ICD-10 code S72) and a previously established diagnosis of vestibular disorder (ICD-10 codes H81-83, A88.1, and R42). Included patients were matched by age and sex to control for patients who had hip fracture without a vestibular diagnosis. Patient charts were reviewed, and demographic and clinical data were extracted related to hip fracture and prior vestibular diagnosis. Groups were subdivided based on whether patients had a hip fracture from January to June versus July to December. Fisher's exact test was used to evaluate for a difference in seasonal variation between groups.

Results: There were 201 patients with vestibular disorders of whom 27 patients carried the diagnosis of BPPV, with a mean age of 80.4 years. The rates of hip fracture among patients with BPPV was higher in the period extending from January to June (63.0%) versus July to December (37.0%), [odds ratio 1.59, 95% CI 0.66-4.00]. The rate of hip fracture was not significantly different between these time periods for the control group (51.7% versus 48.3%) or the vestibular group (53.2% versus 46.8%).

Conclusion: These results offer preliminary evidence that, in addition to an increased presentation for BPPV during months associated with decreased serum vitamin D, injuries due to BPPV may be increased as well. The present study is limited by the statistical power afforded by the small number of patients with BPPV and hip fracture that were identified.

Introduction

Benign paroxysmal positional vertigo (BPPV), especially recurrent BPPV, is associated with low serum vitamin D levels and osteoporosis.[1,2,3] Seasonal variation of presentation with BPPV has been reported, with higher rates of presentation in months associated with times of lower serum vitamin D levels.[4,5,6] Increased rates of BPPV symptoms may lead to increased rates of falls and hip fractures. The purpose of this study was to examine the association between the timing of hip fracture in patients with BPPV compared to control patients. We hypothesized that rates of hip fracture would be higher among patients with BPPV during periods associated with decreased vitamin D levels.

Methods

Institutional review board approval was obtained from the University of Nebraska Medical Center (IRB #500-19-EP). A retrospective review (2013 to 2019) of adult patients was performed at a tertiary care academic center to identify patients with hip fracture due to ground level fall (ICD-10 code S72) and a previously established diagnosis of vestibular disorder (ICD-10 codes H81-83, A88.1, and R42). Patient charts were reviewed, and demographic and clinical data were extracted related to hip fracture, vestibular diagnosis, comorbidities, and usage of classes of medications associated with hip fracture. Included patients were matched 2:1 by age and sex to control for patients who met the same ICD-10 criteria for hip fracture but without vestibular diagnosis. Charts of patients in the control group were reviewed and patients with hip fractures due to causes other than ground level falls were excluded. Groups were subdivided based on whether patients had a hip fracture during the period extending from January to June versus July to December based on prior research.[5] Fisher's exact test was used to evaluate for a difference in seasonal variation between groups. Statistical analysis was performed in R version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria).

Results

There were 201 patients with vestibular disorders of whom 27 patients carried the diagnosis of BPPV. After excluding 9 patients who did not meet the inclusion criteria, 45 patients were included in the control group. Demographic details are shown in Table 1. The rates of hip fracture among patients with BPPV were higher in the period extending from January to June (63.0%) versus July to December (37.0%) [odds ratio 1.59, 95% CI 0.66-4.00] (Figure 1). The rate of hip fracture was not significantly different between these time periods for the control group (51.7% versus 48.3%) or the overall vestibular group (53.2% versus 46.8%). Nearly two-thirds of the BPPV patients sustained hip fracture during months associated with lower serum vitamin D levels. The difference compared to the control group did not reach statistical significance, $p = 0.32$. Differences in comorbidities between the BPPV group and control group were not statistically significant except for osteoporosis, which was higher in the BPPV group ($p = 0.03$). No statistically significant differences were found between groups for medication usage.

Discussion

Among patients with BPPV, a higher incidence of hip fracture was seen during the seasonal period associated with low serum vitamin D levels. This seasonal increase of hip fractures correlates with increased rates of presentation for BPPV during the same season that has been previously associated with lower serum vitamin D.[4,5,6]

Emerging evidence suggests an association between BPPV, especially recurrent BPPV, and other conditions including low serum vitamin D. Serum levels of vitamin D have been found to be significantly lower in patients with recurrent BPPV compared to those with non-recurrent BPPV.[1,2] Vitamin D deficiency is associated with migraine activation,[7] and high rates of migraine and migraine symptoms have been found in patients with recurrent BPPV,[8] possibly due to vasospasm of the labyrinthine arteries causing ischemic damage and release of otoconia from macular beds.[9]

Table 1.
Patient Demographics, Comorbidities, and Medication Usage

Characteristic	n	%	n	%	p value*
	BPPV group, n = 27		Control group,n = 45		
Sex					> 0.99
Male	3	11.1%	4	8.9%	
Female	24	88.9%	41	91.1%	
Age at fracture, years (mean ± SD)	80.4 ± 9.9		81.1 ± 9.8		0.71†
BMI, kg/m2 (mean ± SD)	27.8 ± 8.0		24.9 ± 5.0		0.10†
Race					0.70
White	27	100.0%	42	93.3%	
Black	0	0.0%	2	4.4%	
Native American or Alaska Native	0	0.0%	1	2.2%	
Asian or Pacific Islander	0	0.0%	0	0.0%	
Other/Unknown	0	0.0%	0	0.0%	
Ethnicity					0.38
Hispanic	1	3.7%	0	0.0%	
Not Hispanic	26	96.3%	44	97.8%	
Unknown	0	0.0%	1	2.2%	
Comorbidities					
Obesity	8	29.6%	7	15.6%	0.23
Diabetes	6	22.2%	9	20.0%	> 0.99
Heart Disease	9	33.3%	25	55.6%	0.09
Kidney Disease	0	0.0%	4	8.9%	0.29
Osteoporosis	9	33.3%	5	11.1%	**0.03**
Dementia	3	11.1%	9	20.0%	0.52
Medications at admission					
Benzodiazepines	4	14.8%	14	31.1%	0.16
Antihistamines	8	29.6%	13	28.9%	> 0.99
Antipsychotics	0	0.0%	4	8.9%	0.29
Antiepileptics	2	7.4%	4	8.9%	>0.99
Antidepressants	9	33.3%	18	40.0%	0.62
Anticoagulants	6	22.2%	10	22.2%	>0.99
Antihypertensives	12	44.4%	30	66.7%	0.09

* Fisher's exact test used to compare categorical data. † Independent samples t-test. **Bold** p values indicate statistical significance.

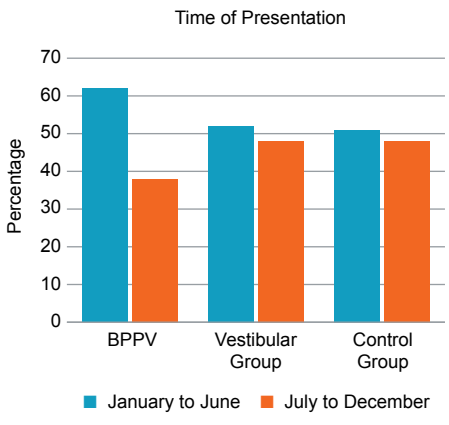

Figure 1. Seasonal variation of presentation by group.

The present study sought to identify whether BPPV was associated with increased rates of injury during periods associated with lower serum vitamin D, specifically hip fracture due to ground level fall. The increased rate of hip fracture during the seasonal period associated with low serum vitamin D levels provides evidence that beyond an increase in the frequency of symptoms, there is an increase in morbidity among patients with BPPV compared to matched controls. While other comorbidities were not significantly different, we found a significant increase in osteoporosis among the BPPV group compared to the control group. BPPV is associated with osteoporosis and osteopenia, which are related to vitamin D metabolism but do not account for a seasonal variation in symptoms.[5,10,11] Supplementation with vitamin D in patients has been found to decrease the recurrences of BPPV.[12] This understanding provides a theoretical framework for screening for patients at higher risk of BPPV symptoms, and potentially treating patients with vitamin D deficiency. The retrospective nature of the present study did not allow for an examination of patients' serum vitamin D levels and its temporal association with their hip fractures.

This study was not powered to identify a statistically significant result due to the low number of patients with both BPPV and hip fracture. These results offer preliminary evidence that in addition to an increased

presentation for BPPV symptoms during months associated with decreased serum vitamin D, injuries due to BPPV may be increased as well. Future studies should examine other sources of injury associated with BPPV and the reduction in these injuries that may be possible through supplementation in patients with documented deficiency of Vitamin D and calcium. ■

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