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Vanderbilt Audiology Journal Club: Relationships Among Vestibular Disorders

1. What is the most likely reason it be difficult to arrive at a diagnosis of MARD?

A. The statement above is incorrect. It is very easy to get a diagnosis of MARD.
B. Specialists that diagnose anxiety, migraine, and ear-related disorders are in separate fields.
C. The patient would have too many copays seeing all these specialists.
D. Specialists do not know how to diagnose more than one disorder.

2. Which sensory system do patients with MARD typically preference?

A. Proprioceptive cues
B. Vestibular cues
C. Visual cues
D. Somatosensory cues

3. What is the most likely suggested pathophysiology of MARD?

A. Dysfunction of monoaminergic pathways important for migraine, anxiety, and central vestibular system.
B. Abnormal firing of GABA-controlled pathways, blocking signal transmission to the ears.
C. Basilar-type migraine, with lack of blood flow to the brain and the ears.
D. All of the above

4. According to Zhu et al. the current method of establishing a single diagnosis of dizziness disorders explains _____% of dizzy patients.

A. 15%
B. 41%
C. 68%
D. 87%

5. Dizziness is a common symptom. It has a 1 year prevalence of ____%

A. 1%
B. 5%
C. 10%
D. 14.8%

6. Which two dizziness disorders are commonly linked with other dizziness disorders?

A. Superior canal dehiscence and Meniere's disease
B. Vestibular neuritis and vestibular migraine
C. Multisensory system impairment and BPPV
D. PPPD and BPPV

7. Which of the following sequence of onsets of dizziness disorders is most likely to occur?

A. SCD that evolves into vestibular neuritis and finally becomes Meniere's disease.
B. Vestibular neuritis that transitions into BPPV and finally becomes PPPD.
C. BPPV that is followed by Meniere's disease and finally SCD.
D. Meniere's disease that evolves into SCD and finally becomes vestibular neuritis.

---

8. According to data derived from patients completing the Dizziness Symptom Profile (DSP), what percentage of patients present with multiple vestibular diagnoses?

A. 1%
B. 32%
C. 68%
D. 100%

---

9. Which of the following was the most common co-occurring diagnosis based on the DSP data?

A. Benign Paroxysmal Positional Vertigo
B. Vestibular Migraine
C. Meniere's Disease
D. Superior Canal Dehiscence

---

10. Which of the following six common vestibular disorders is the most likely to have vestibular migraine as a co-occurring disorder?

A. Meniere's Disease
B. Persistent Postural-Perceptual Disorder
C. Vestibular Neuritis
D. Superior Canal Dehiscence

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Vanderbilt Audiology Journal Club: Vestibular Topics

12/11/2019

Kelsey Hatton, AuD
Gary Jacobson, PhD
Richard A. Roberts, PhD

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Recognizing the presence of multiple co-existing dizziness diagnoses

Kelsey Hatton, AuD
Gary P. Jacobson, PhD
Richard A. Roberts, PhD

Department of Hearing and Speech Sciences
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Primary reference sources for Vandylive

Primary references:

- Furman JM, Balaban CD, Jacob RG and Marcus DA. 2005. Migraine-anxiety related dizziness (MARD): a new disorder? J Neurol Neurosurg Psychiatry 76: 1-8.
- Zhu RT, Tompaey VV, Ward BK, Van de Berg R, de Heyning. 2019. The interrelations between different causes of dizziness: A conceptual framework for understanding vestibular disorders. Ann Otol Rhinol Laryngol, 1-10. DOI 10.1177000348941984014.

Secondary reference:

- Van Leeuwen RB, Colijn C, van Wensen E, and Bruintjes TD. 2017. The Dizzy patient: Consider a second diagnosis. The Neurologist. 22: 69-71.
- Jacobson G, et al. 2018. Development and preliminary findings of the Dizziness Symptoms Profile (DSP). Ear & Hearing, 40(3):568-576.

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Learning outcomes:

- Describe challenges and features of the disorder referred to as (Migraine-anxiety related dizziness (MARD): a new disorder?
- Describe the interrelationships between the most common dizziness disorders.
- Describe how the Dizziness Symptom Profile (DSP) can enable clinicians to recognize the presence of co-occurring vestibular disorders and discuss the finding that vestibular migraine is the most common co-occurring diagnosis.

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Introduction

Gary Jacobson, Ph.D.

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Article 1: “Migraine-anxiety related dizziness (MARD): a new disorder?”

Kelsey Hatton, Au.D.

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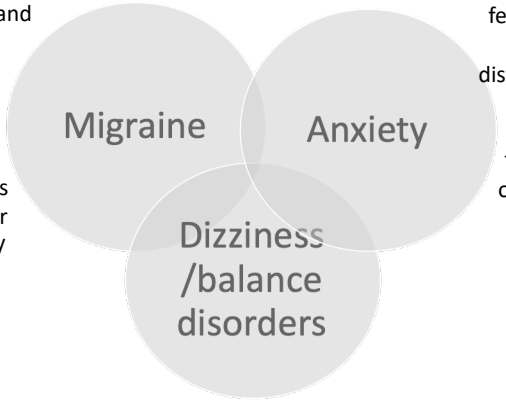
MARD

Migraine without aura - characterized by headache with specific features and associated symptoms.

Migraine with aura- characterized by transient focal neurological symptoms that usually precede or sometimes accompany the headache.



Anxiety - disorders that share features of excessive fear/worry/anxiety and related behavioral disturbances. Significant distress from anxiety that causes impaired functioning for social, occupational, or other important areas.

Dizziness - the sensation of disturbed or impaired spatial orientation without a false or distorted sense of motion.

(Migraine: ICHD-3 Manual, Anxiety: DSM-5, Dizziness: ICVD)

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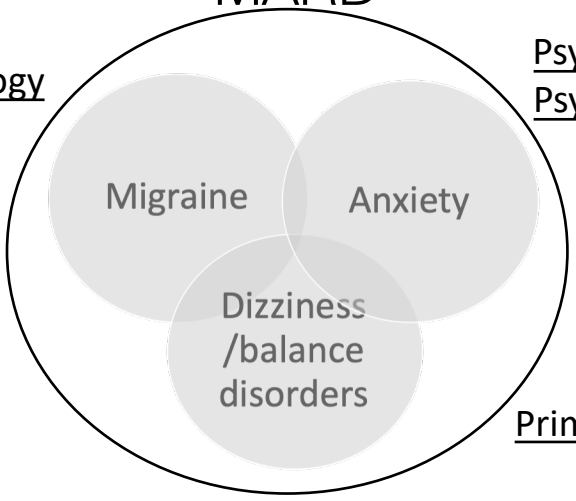
MARD

Neurology

Psychiatry/ Psychology



Primary Care

Otology/Audiology

(Migraine: ICHD-3 Manual, Anxiety: DSM-5, Dizziness: ICVD)

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Migraine

Prevalence & impact

- In the US, migraine/severe headache prevalence is 14.2% with 39 million adults and children (as young as 18 months) affected
  - Childhood periodic syndromes of BPV, cyclic vomiting, and abdominal migraine are often precursors to migraine.
  - 1 in 4 US households include someone with migraine, 90% of migraine sufferers have a family history of migraine
- Worldwide, it is the 6th most disabling disease
  - Healthcare costs are estimated to be 70% higher for a family with a migraineur than a family with no migraineurs. 157 million workdays lost to migraine in the US
- It is estimated almost 50% of those with frequent/severe migraine do not receive professional treatment

(Leonardi et al 2015, Langhagen et al 2016, Migraine Research Foundation -2019)

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Migraine

Potential etiology

- Trigeminal activation
  - Monoaminergic pathway using serotonin
  - Neuropeptide release of CGRP (pain reception)
  - Vasodilation
- Thalamic-cortical processing
- Cortical spreading depression
  - suspected in migraine generally but not very likely for vestibular migraine

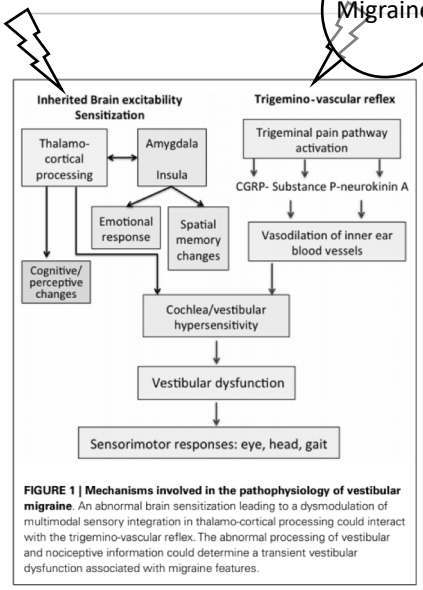

FIGURE 1 | Mechanisms involved in the pathophysiology of vestibular migraine. An abnormal brain sensitization leading to a dysmodulation of multimodal sensory integration in thalamo-cortical processing could interact with the trigemino-vascular reflex. The abnormal processing of vestibular and nociceptive information could determine a transient vestibular dysfunction associated with migraine features.

(Espinoza-Sanchez & Lopez-Escamez 2015, Furman et al 2005)

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Anxiety

Prevalence & impact

- In the US and worldwide, up to 33.7% of the population are affected by an anxiety disorder during their lifetime.
  - prevalence rates are similar across many countries, despite different environs
  - For all anxiety disorders, reported heritability is approximately 30% to 50%
- Anxiety disorders are the most common mental diseases
  - Substantial under-recognition and under-treatment of these disorders have been demonstrated. Worldwide anxiety disorders are recognized for about ~50% of cases with anxiety, and ~1/3rd of identified patients are offered drug treatment.
- Patients with migraine with a comorbid anxiety disorder spend $4634 more per year in healthcare than those without comorbid anxiety

(Minen et al 2016, Bandelow & Michaelis 2015)

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Anxiety

Potential etiology

- A "threat circuit" in the brain connects the dorsomedial prefrontal cortex, insula, and amygdala.
  - This system heavily depends on dopamine, norepinephrine, and serotonin- all monoamine neurotransmitters
- "Anxiety disorders can be characterized by increased vigilance to situations that are perceived as threatening, with concomitant maladaptive and prolonged activation of the threat circuit."

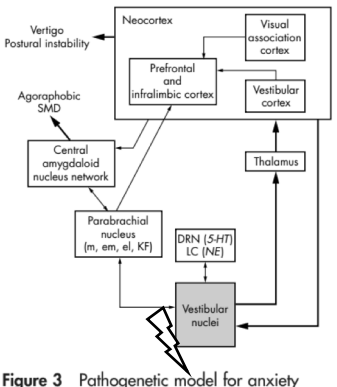

Figure 3 Pathogenetic model for anxiety related dizziness. This simplified representation

(Giacobbe & Flint 2018)

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Prevalence & Etiology

- Dizziness and vertigo are estimated to occur in 20-56% of people during their lifetime.
- Benign paroxysmal positional vertigo (BPPV), vestibular neuritis, Ménière's disease, and vestibular migraine comprise of 33% to 70% of diagnoses made in dizziness clinics.
  - BPPV: lifetime prevalence 2.4%
  - Vestibular migraine: lifetime prevalence of 1%
  - Ménière's disease: lifetime prevalence of 0.2% - 0.5%,
  - Vestibular neuritis: 3.5 cases per 100,000 people annually
- Pathophysiology differs by balance disorder

(Teggi et al 2016, Zhu et al 2019)

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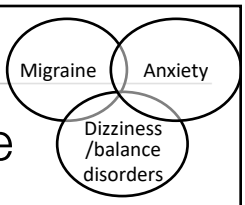

Overlapping Prevalence

- M + D: Migraine prevalence is 14% and vertigo prevalence is 7% in the general population.
  - Random simultaneous occurrence would be 1%, but 3.2% of the population have migraine and dizziness.
- M + A: 51-58% of migraine patients are estimated to have comorbid anxiety disorder.
  - Patients with Generalized Anxiety Disorder are 3.86x more likely to also have migraine.
- D + A: Annual prevalence of anxiety in populations without balance disorders ranges from 9.5%-14.5%, but studies show anxiety symptoms occur in 15%-76% of patients with balance disorders.

(Leonardi et al 2015, Minen et al 2016, Furman et al 2005, Kozak et al 2015)

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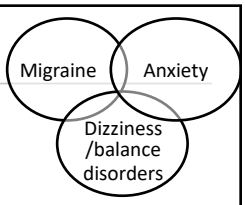

Overlapping Etiology

- Anxiety and migraine
  - serotonergic dysfunction (monoaminergic pathways use serotonin)
  - dysregulation of the hypothalamic-pituitary-adrenal axis
  - hormonal influences
  - psychological factors
- Dizziness and anxiety
  - periaqueductal grey area (monoaminergic pathway- serotonin, epinephrines)
  - altered somatosensory input
- Dizziness and migraine
  - Trigeminal activation (monoaminergic pathway using serotonin)
  - Thalamo-cortical-vestibular pathway excitation
- Proposed combination for al 3:
  - The underlying neural circuitry includes the parabrachial nucleus, the vestibulothalamocortical and ceruleovestibular pathways, and serotonergic neurotransmission.

(Minen et al 2016, Furman et al 2005)

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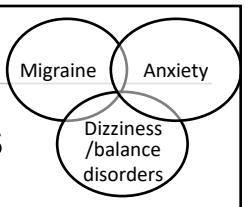

Distinguishing Features

- Each patient might present with different primary symptoms. However, when combining visual, somatosensory, and vestibular cues - a common feature in MARD is visual dependence.
  - Patients with MARD have more than just preference, but a dependence on visual cues for balance.
  - Visual dependence can lead to sensitivity/discomfort with busy visual environments
  - Visual dependence can also lead to severe disorientation when lacking vision orientation
  - Example: patient may report seeing patterns, computer screens, driving on highways, shopping in stores, being in shower/dark provokes symptoms and fear/anxiety

(Minen et al 2016, Furman et al 2005)

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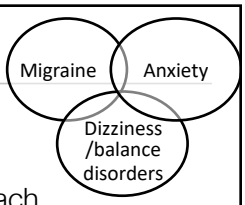

Treating MARD

- Patients benefit from a coordinated or team approach.
- Vestibular Rehabilitative Therapy tends to help all patients, regardless of primary symptoms.
- Visual-vestibular integration exercises may help re-balance visual preference.
- Beta blockers were noted to be unhelpful while calcium channel blockers, benzo-, triptan-, and SSRI class medications can be effective
  - Dizziness + anxiety: antidepressants or SSRI
  - Dizziness + migraine: prophylactic or abortive migraine medications, diet/sleep/exercise changes
  - Migraine + anxiety: antidepressants and antiepileptics

(Minen et al 2016, Furman et al 2005)

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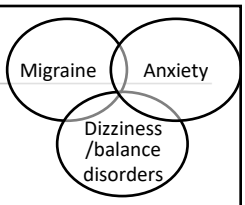

Conclusions

- Co-occurring prevalence is higher than prevalence of each individual disorder alone
- A common pathophysiology is suspected for all 3 conditions (monoaminergic pathway dysfunction)
- Audiologist's role: encouraging patient advocacy to discuss anxiety and migraine with their medical team
  - Vestibular rehabilitative therapy has been found to be effective each disorder individually, and should help for patients with MARD

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References

- Bandelow B, Michaelis S (2015). Epidemiology of anxiety disorders in the 21st century. Dialogues Clin Neurosci. Sep;17(3):327-35.
- Espinoza-Sanchez JM, Lopez-Escamez JA (2015). New insights into pathophysiology of vestibular migraine. Front in Neuro. Feb; (6) doi: 10.3389/fneur.2015.00012
- Furman JM, Balaban CD, Jacob RG, Marcus DA (2005). Migraine-anxiety related dizziness (MARD): a new disorder? J Neurol Neurosurg Psychiatry. Dec, p1-8. doi: 10.1136/jnnp.2004.048926
- Giacobbe P, Flint A (2018). Diagnosis and Management of Anxiety Disorders. Continuum (Minneap Minn). Jun;24(3, BEHAVIORAL NEUROLOGY AND PSYCHIATRY):893-919.
- Kozak, H. H., Dündar, M. A., Uca, A. U., Uğuz, F., Turgut, K., Altaş, M., … Aziz, S. K. (2018). Anxiety, Mood, and Personality Disorders in Patients with Benign Paroxysmal Positional Vertigo. *Noro psikiyatri arsivi*, *55*(1), 49–53. doi:10.5152/npa.2016.18143
- Leonardi M, Raggi A, Grazzi L, D'Amico D. (2015). Disability, ICF biopsychosocial model and burden of migraine. J Headache Pain. 16(Suppl 1):A2. doi: 10.1186/1129-2377-16-S1-A2. No abstract available.
- Langhagen T, Landgraf MN, Huppert D, Heinen F, Jahn K.(2016). Vestibular Migraine in Children and Adolescents. Curr Pain Headache Rep. 20(12):67. Review.
- Minen MT, Begasse DDO, Kroon VDA, Powers S, Schwedt TJ, Lipton R, Silbersweig D(2016), Migraine and its psychiatric comorbidities. J Neurol Neurosurg Psychiatry. Jul;87(7):741-9. doi: 10.1136/jnnp-2015-312233. Epub 2016 Jan 5.
- Teggi, R., Manfrin, M., Balzanelli, C., Gatti, O., Mura, F., Quaglieri, S., … Bussi, M. (2016). Point prevalence of vertigo and dizziness in a sample of 2672 subjects and correlation with headaches. Prevalenza dei sintomi vertigine e instabilità in un campione di 2672 soggetti e correlazione con il sintomo cefalea. *Acta otorhinolaryngologica Italica : organo ufficiale della Societa italiana di otorinolaringologia e chirurgia cervico-facciale*, *36*(3), 215–219. doi:10.14639/0392-100X-847
- Migraine Research Foundation (https://migraineresearchfoundation.org/about-migraine/migraine-facts/)
- ICHD-3 (https://ichd-3.org/1-migraine/)
- DSM-5 (https://psychiatryonline.org/pb-assets/dsm/update/DSM5Update_October2018.pdf)
- ICVD (Bisdorff AR, Staab JP, & Newman-toker DE (2015). "Overview of the International classification of vestibular disorders." Neurol Clin. Vol 33; p541-550.)

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Article 2

Zhu RT, Tompaey VV, Ward BK, Van de Berg R, de Heyning. 2019. The interrelations between different causes of dizziness: A conceptual framework for understanding vestibular disorders. Ann Otol Rhinol Laryngol, 1-10. DOI 10.117700034894198401 4.

Gary Jacobson, Ph.D.

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Introduction

- Dizziness is a common symptom
  - 1 year prevalence: 14.8%
- Majority of patients receive a single diagnosis
- The proportion of patients receiving 2 or more diagnoses is 3.7%
- Depending on the characteristics of the sample selected the range of percentage of patients receiving more than 1 diagnosis is 0% to 30%
  - Most common diagnoses are BPPV, vestibular neuritis, Meniere's d, vestibular migraine

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Introduction

- It is not uncommon for patients can present with a set of symptoms that cannot be explained by a single diagnosis
- Even though it has been known based on experience over decades that it is possible to have multiple co-existing diagnoses there has not existed a study attesting to this assertion. In the authors words:
- *"…we hope to move away from an exclusionary approach where 1 diagnostic entity is held responsible for symptomatology, to a more inclusive approach whereby multiple diagnoses are entertained and treated, recognizing the blurred lines and overlapping pathology that reflect underlying synergy between different causes of dizziness."*

Purpose of the review

- "To summarize the relationships in this interconnected web of diagnostic entities…"

Methods

- Narrative review of literature on the topic of multiple co-existing dizziness diagnoses
- Pubmed was the source of articles
- Prospective, retrospective, observational, cross-sectional investigations incorporating questionnaires, surveys, telephone interviews, chart reviews and database analyses
- Search terms: dizziness, vertigo, epidemiology, cause, differential diagnosis, cohort, diagnosis and multiple diagnoses
- Articles were included if they described the epidemiology of co-occurrences and overlapping symptomatology of different vestibular disorders
- Descriptive statistics were used to report the findings

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Methods (continued)

- Search terms e.g.
  - Meniere's d.
  - Vestibular migraine
  - Vestibular neuritis
  - Superior canal dehiscence
  - Head trauma
  - Depression
  - Anxiety
  - Aging
  - Persistent, postural perceptual dizziness
  - Bilateral vestibular hypofunction

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Current method for establishing the diagnosis of dizziness disorders (single diagnosis) explains ~41%

- Benign Paroxysmal Positional Vertigo (BPPV): 17%
- Vestibular Migraine: 10%
- Vestibular Neuritis: 7-10%
- Meniere's Disease: 2%
- Bilateral Vestibular Hypofunction: 1%
- Persistent, Postural-Perceptual Disorder: <1%
- Superior, Semicircular Canal Dehiscence: <1%
- Total: ~41%

Sample of the more common overlapping diseases/disorders

- Vestibular migraine + Meniere's d.
- Vestibular migraine + BPPV
- Vestibular migraine + bilateral vestibulopathy
- Migraine + SCD
- BPPV + Meniere's d.
- Vestibular neuritis + BPPV
- 3PD + other diagnoses
- Anxiety + dizziness

Table 1: Shows the percent (%) overlap in vestibular disorders supported by the literature

Diagnosis	BPPV	VM	MD	BVP	SCDS	VN	PPPD	Anxiety	Head Trauma	Aging
BPPV		38-55	.8-9.8			5.2		28		
VM	42		25-38					81.8		
MD	4-70	25-81								
BVP		50	16							
SCDS		25-47								
VN	9.8									
PPPD	13-15	26	5							
Anxiety	2.3									
Head Trauma	23-28	41.4	9.6							
Aging	39-42	13.2	12.5							

Results: Vestibular Migraine + Meniere's d.

- VM among the most common vestibular disorders
  - Lifetime prevalence = 1%
  - Prevalence of migraine = 15-17% of women and 5%-8% of men
- MD prevalence rate =
  - .2% - .5% (female – male prevalence ratio of 1.89:1.0).
- The co-occurring mechanisms underlying both diseases are not certain although the interconnections between the two are known
- 81% of patients with MD had a history of migraine symptoms compared to 33% of normals
- Lifetime prevalence of migraine 56% of patients with MD compared to 25% of those patients without MD
  - 95% of patients with MD had 1 migrainous symptom
  - 48% of patients met diagnostic International Headache Society criteria for VM
  - 38% of patients with VM reported reported classic symptoms of MD during attacks of vertigo

Results: Vestibular neuritis and BPPV

- 2nd most common vestibular disease
- 3.5 cases per 100,000
- Long term follow-up
  - 9.8% of patients with vestibular neuritis also had BPPV
  - These patients had a more complicated course
  - 5.2% of patients with BPPV from VN were diagnosed at an earlier age, had canal paresis, needed more therapy
  - Had a higher rate of recurrence compared with patients who had idiopathic BPPV .

Results: Vestibular migraine and BPPV

- BPPV is the most common disorder affecting the peripheral vestibular system.
  - It affects 17% of individuals with vertigo
  - Onset age is 5th – 7th decades
  - It occurs more commonly for women
- Most cases of BPPV are idiopathic in origin
- The connection between VM and BPPV is 38%-55%
- The authors reference an investigation of where 508 outpatients were evaluated in a balance clinic
  - 1/3 had a migraine history
  - Prevalence of BPPV was 42% in that subgroup

Results: Meniere's d and BPPV

- Studies support the relationship between BPPV and MD
- BPPV occurs concomitantly in patients with MD an MD is a risk factor for developing persistent vertigo for patients with BPPV.
- Gananca et al. and Li et al.: 3.7% of patients with MD had BPPV
- Center of gravity of these values ranges from 3.7% - 8.4%
- Female to male ratio was 27:2
- Compared to idiopathic BPPV patients with MD and BPPV = longer durations of sx, more often affected horizontal canal (BPPV on that side), required more therapy sessions to improve and had a larger proportion of relapses

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Results: Vestibular migraine and bilateral vestibulopathy

- Bilateral vestibulopathy is a common vestibular impairment with a prevalence 28:100,000. Since neither the VOR nor the VSR are functioning normally these patients are unsteady during ambulation especially on compliant surfaces and in darkness.
- The prevalence is believed to be 28 per 100,000 in the USA or 1% of patients seen in clinic
- The authors reference one study showing that 50% of patients with idiopathic BPPV had migraine, vs, 11% of patients who had non-idiopathic BPPV

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Results: Migraine and SCD

- This is a relationship that I would not have predicted.
- The authors report the prevalence of SCD to be .5%-1.4%
- In the authors' words:
- *"Many patients with SCD also complain of migraine* ***though a causal link has yet to be proven"***
- Higher prevalence of migraine headache associated with dizziness among women with SCDS occurring in 47% of patients
- Another reported investigation patients with SCD who underwent surgical repair 25% noted an improvement in migraines after surgery

PPPD and other diagnoses

- 13% of patients with PPPD had another vestibular pathology (e.g. BPPV)
- 26% of patients with PPPD had migraine headache, 15% had BPPV and 5% had Meniere's Disease
- Relapses of episodic PPPD can be caused by vestibular migraine or Meniere's disease

Anxiety and dizziness

- According to the authors, anxiety may have an important place in the initiation, maintaining and exacerbation of vestibular disorders
- Patients may have an antecedent history of vestibular impairment (e.g. BPPV or MD) that evolves into an anxiety disorder, or…
- The patient may have a preexisting anxiety disorder (e.g. GAD or panic), experience vertigo and then develop chronic dizziness
- Anxiety is a common finding in multiple disorders including MD, BPPV, VM, and PPPD.
- There has been an interest in identifying a link between anxiety and dizziness
  - 28% of patients with BPPV also experienced anxiety
  - 2.3% of patients with anxiety disorder had BPPV
  - 81% of patients with migraine demonstrated anxiety
- General results suggest that anxiety and other psychiatric conditions in patients with dizziness are common.

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Clinical case illustrating how easy it is possible develop 3 overlapping vestibular disorders:

- 62 year old patient was awakened with severe vertigo lasting days. He has improved to the point that he can move around in his home without assistance. After 2 weeks he was gradually returning to baseline
- However, the initial spell of long duration vertigo was replaced with intense spells of vertigo lasting seconds to a minute. These spells are clearly triggered by changes in head position.
- The patient has been reticent to walk outside for fear of becoming symptomatic (e.g. falling, walking like a drunk in public). He notices now that his spells are not vertigo but instead a constant rocking sensation that is not visible to others. He is uncomfortable in environments that are visually active. This is a 24:7 problem without any relief.

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Conclusions

- There appear to be primary diagnoses including vestibular neuritis, Meniere's disease, vestibular migraine or, SCD…
- …That can be transformed into, or provoke, other dizziness diseases e.g. BPPV or, PPPD or, unsteadiness
- Therefore it is important to consider the possibility of a patient manifesting up to 3 (or even 4) co-occurring dizziness/vertiginous disorders.

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Conclusions

- Investigators are now looking at vestibular function as a series of overlapping symptoms and multiple dizziness diagnoses in the same manner that we know that there are multiple contributors to falls e.g. vision, cardiovascular disease, proprioception, and spinal disease
- The greatest number of overlapping diagnoses involve migraine and vestibular migraine which often co-occur with:
  - BPPV: 55% of the time
  - Meniere's disease: 81% of the time
  - SCD: 47.4% of the time
  - Head trauma dizziness: 41.4% of the time

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Co-occurring Vestibular Diagnoses Identified with the Dizziness Symptom Profile (DSP)

Richard A. Roberts, Ph.D.

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Summary to this point

- Dr. Hatton: Furman et al. (2005)
  - Physiologic support for the overlap of Migraine, Anxiety, and Dizziness
- Dr. Jacobson: Zhu et al. (2019)
  - Interrelations among various vestibular (and non-vestibular) disorders
- This reinforces that clinicians should consider the possibility of interrelations during assessment and management of patients with dizziness

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Zhu et al. (2019) 18 epidemiologic reports

- 1 telephone survey of patients; 1 used patient report questionnaire
- Majority of diagnosis data from physician perspective
- 3.7% had multiple diagnoses (1,263/33,968)
  - If 96.3% of patients do only have one diagnosis then why is this important?
  - Others suggest 5 – 35% of patients have >1 diagnosis
- Others have reported relationship between two disorders, but more than two is rarely discussed until Zhu et al. (2019)

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Purpose

- Previously collected diagnosis data-set for Dizziness Symptom Profile (DSP) investigation
  - Patient perspective
  - Collected to compare patient-generated differential to physician-generated differential (overall agreement was 70.2%)
  - Data was not generated to investigate interrelations among vestibular disorders so less risk of investigator bias
- Are interrelations among vestibular disorders reported by Zhu et al. and others from primarily a physician-perspective supported in a patient-generated data sample?

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Dizziness Symptom Profile (DSP) Jacobson et al. (2018)

- 31-item self report questionnaire completed by patient
- Factor analysis supported the presence of 7 factors:
  - Benign paroxysmal positional vertigo (BPPV)
  - Meniere's disease
  - Persistent postural-perceptual dizziness (PPPD)
  - Superior canal dehiscence
  - Vestibular migraine
  - Vestibular neuritis
  - Unspecified unsteadiness
- Differential Diagnosis – Possible disorders that could be causing symptoms
- Investigation 3 indicated the differential diagnosis created by the DSP agreed with differential diagnosis created by the ear specialist 70.3% of the time

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DSP Investigation 3

- Subjects were recruited from patients seen for evaluation of dizziness, vertigo, and/or unsteadiness at the Balance Disorders Laboratory at Vanderbilt University Medical Center
- 195 consented subjects
- Mean age = 58.51 years, (SD 16.07, 74 male)
- Only the DSP results were used in the current investigation
- No restriction on number of diagnoses endorsed

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The Dizziness Symptom Profile

The following pages contain statements with which you can agree or disagree. To what extent do you personally agree or disagree with these statements in regards to your dizziness? Use the following scale: 0 = Strongly disagree, 1 = Disagree, 2 = Not sure, 3 = Agree, 4 = Strongly Agree

		Strongly Disagree		Not Sure		Strongly Agree
1	My dizziness is intense but only lasts for seconds to minutes.	0	1	2	3	4
2	I have had a single severe spell of spinning dizziness that lasted days or weeks.	0	1	2	3	4
3	I have spells where I get dizzy and also have irregular heartbeats (palpitations).	0	1	2	3	4
4	I hear my voice more loudly in one ear compared to the other.	0	1	2	3	4
5	I am unsure of my footing when I walk outside.	0	1	2	3	4
6	I get dizzy when I turn over in bed.	0	1	2	3	4
7	I get dizzy when I am in open spaces and have nothing to hold onto.	0	1	2	3	4
8	I have a roaring sound in one ear only before or during a dizziness attack.	0	1	2	3	4
9	I am depressed much of the time.	0	1	2	3	4
10	I lost hearing in one ear after an attack of spinning dizziness.	0	1	2	3	4
11	I had a big dizzy spell that lasted for days where I could not walk without falling over.	0	1	2	3	4
12	I get dizzy when I sneeze.	0	1	2	3	4
13	There are times when I get dizzy and also have a headache.	0	1	2	3	4
14	I get dizzy when I strain to lift something heavy.	0	1	2	3	4
15	I get short-lasting, spinning dizziness that happens when I bend down to pick something up.	0	1	2	3	4

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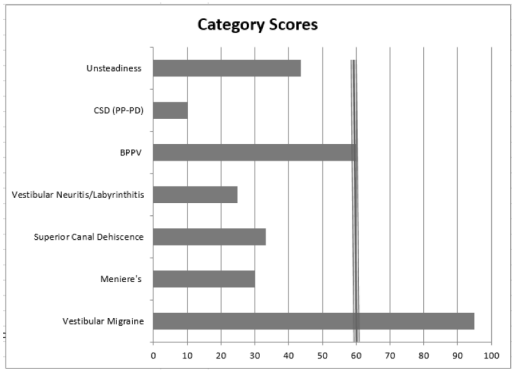

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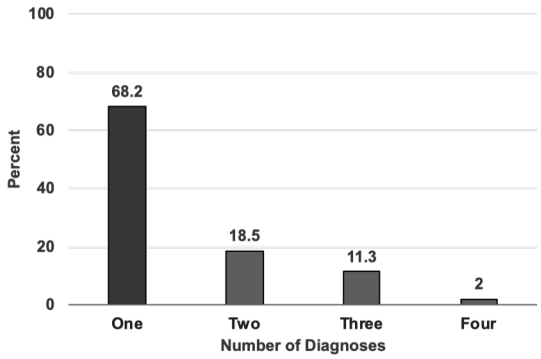
Number of Diagnoses



133 endorsed 1 diagnosis (68%); 62 (32%) endorsed two or more

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Number of Diagnoses

- Zhu et al. (2019) 3.7%
- Range among other published data: 5.4 – 35.1%
- Reconsider Zhu et al. data using data from 8 studies that included multiple diagnosis data 1,263/9,096 = 13.9%
- Our data fall within range and are in very close agreement with others who report 30.1 – 35.1% (Uneri & Polat, 2008; van Leeuwen et al, 2017)
- Higher percentage in dizziness specialist centers

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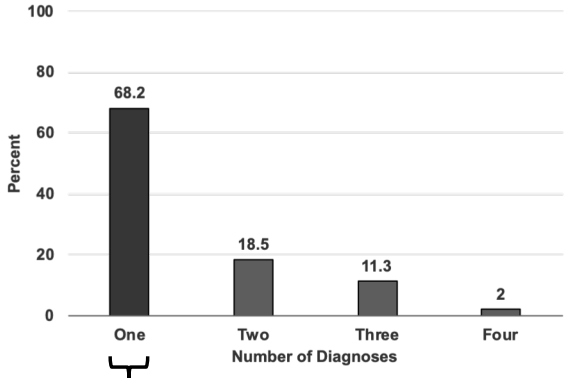
Single Diagnosis Data



100%, n =133

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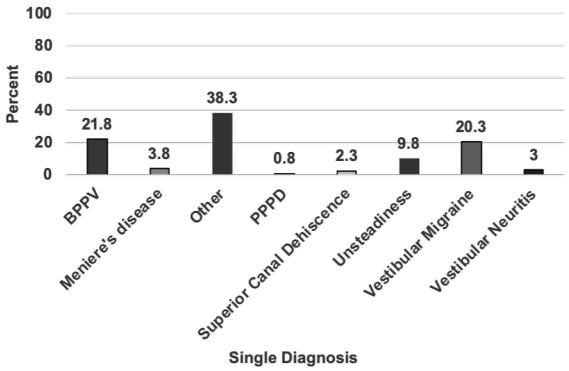
Single Diagnosis Data



- "Other", "BPPV", and "Vestibular Migraine" account for 80.4%
- BPPV and Vestibular Migraine are usually among the most common vestibular disorders

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Single Diagnosis Data

- "Other" is interesting because it was the most commonly endorsed 38.3%
- Some other studies report similar non-specific categories
  - 11 – 21% of total diagnoses (Muelleman et al, 2017; van Leeuwen et al., 2017)
- Point is multiple investigations on diagnosis data indicate a large percentage of patients will have a non-specific diagnosis.
  - Supports the challenge healthcare providers experience with assessment/management of this population.

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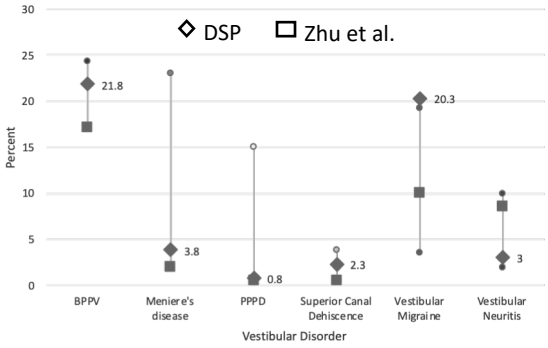
Single Diagnosis Data



- Agreement with Zhu et al. for "Meniere's disease," "Persistent Postural-Perceptual Dizziness," and "Superior Canal Dehiscence."
- Within range of other reports for "BPPV" and "Vestibular Neuritis"
- Higher than Zhu et al. for "Vestibular Migraine" but within 1% of Muelleman et al. (2017)
- High level of consistency between physician diagnosis data and data obtained from patient self-report

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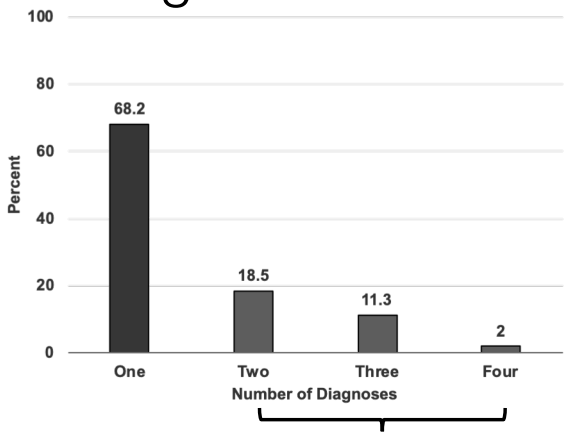
Multiple Diagnoses Data



100% n = 62

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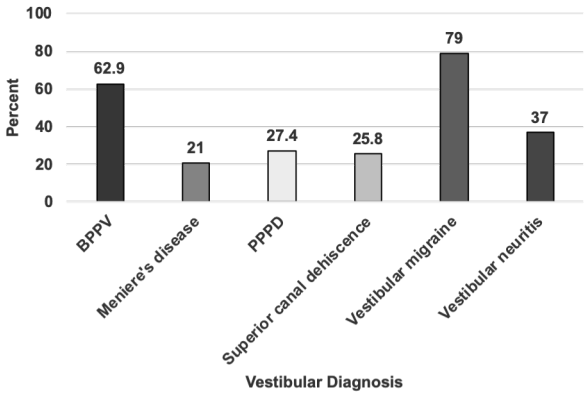
Multiple Diagnoses Data

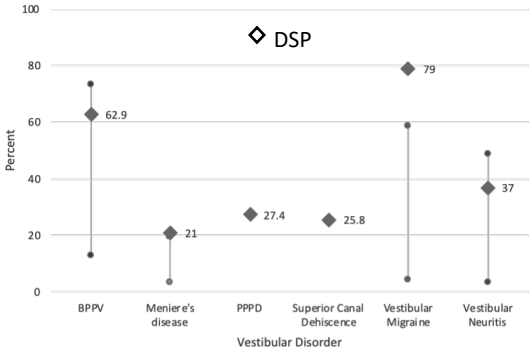


- "BPPV" and "Vestibular Migraine" most common
- BPPV and Vestibular Migraine are usually among the most common vestibular disorders

CONTINUED

Multiple Diagnoses Data

Comparison Studies/Subjects with Multiple Diagnoses	
Uneri & Polat, 2008	211 of 601
Roland et al, 2015	41 of 429
Muelleman et al, 2017	356 of 2,079
Van Leeuwen et al, 2017	187 of 621



- No comparison data for "Persistent Postural-Perceptual Dizziness" or "Superior Canal Dehiscence"
- Data in agreement with literature except for "Vestibular Migraine" where we observed this disorder 20.5% more often than Roland et al. (2015).

Co-occurring Diagnoses Data

Core Diagnosis	Co-Occurring Diagnoses											
	BPPV		Meniere's Disease		PPPD		Superior Canal Dehiscence		Vestibular Migraine		Vestibular Neuritis	
	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP
BPPV			0.8 – 9.8						38 - 55		5.2	
Meniere's Disease	4 - 70								25 - 61			
PPPD	13 - 15		5						26			
Superior Canal Dehiscence									25 - 47			
Vestibular Migraine	42		25 - 38									
Vestibular Neuritis	9.8											

- Adapted from Zhu et al. (2019)

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Co-occurring Diagnoses Data

Core Diagnosis	Co-Occurring Diagnoses											
	BPPV		Meniere's Disease		PPPD		Superior Canal Dehiscence		Vestibular Migraine		Vestibular Neuritis	
	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP
BPPV			0.8 – 9.8	15.4		17.9		23.1	38 - 55	69.2	5.2	28.2
Meniere's Disease	4 - 70	46.2				23.1		7.7	25 - 81	69.2		30.8
PPPD	13 - 15	41.2	5	23.5				17.6	26	47.1		29.4
Superior Canal Dehiscence		56.3		6.3		18.8			25 - 47	87.5		12.5
Vestibular Migraine	42	55.1	25 - 38	16.3		16.3		28.6				24.5
Vestibular Neuritis	9.8	47.8		21.7		21.7		8.7		56.5		

- Our data extends that reported by Zhu et al. to additional core and co-occurring diagnosis percentages for six vestibular disorders

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Co-occurring Diagnoses Data

Core Diagnosis	Co-Occurring Diagnoses											
	BPPV		Meniere's Disease		PPPD		Superior Canal Dehiscence		Vestibular Migraine		Vestibular Neuritis	
	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP
BPPV			0.8 – 9.8	15.4		17.9		23.1	38 - 55	69.2	5.2	28.2
Meniere's Disease	4 - 70	46.2				23.1		7.7	25 - 81	69.2		30.8
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Vestibular Migraine	42	55.1	25 - 38	16.3		16.3		28.6				24.5
Vestibular Neuritis	9.8	47.8		21.7		21.7		8.7		56.5		

- Agreement between Zhu et al. and DSP with core diagnosis of “Meniere’s Disease” and co-occurrence of “BPPV”, as well as with co-occurrence of “Vestibular Migraine”

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Co-occurring Diagnoses Data

Core Diagnosis	Co-Occurring Diagnoses											
	BPPV		Meniere's Disease		PPPD		Superior Canal Dehiscence		Vestibular Migraine		Vestibular Neuritis	
	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP
BPPV			0.8 – 9.8	15.4		17.9		23.1	38 - 55	69.2	5.2	28.2
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Vestibular Neuritis	9.8	47.8		21.7		21.7		8.7		56.5		

- We found fewer subjects with a core diagnosis of “Vestibular Migraine” and co-occurring diagnosis of “Meniere’s Disease.”

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Co-occurring Diagnoses Data

Core Diagnosis	Co-Occurring Diagnoses											
	BPPV		Meniere's Disease		PPPD		Superior Canal Dehiscence		Vestibular Migraine		Vestibular Neuritis	
	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP
BPPV			0.8 – 9.8	15.4		17.9		23.1	38 - 55	69.2	5.2	28.2
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Vestibular Migraine	42	55.1	25 - 38	16.3		16.3		28.6				24.5
Vestibular Neuritis	9.8	47.8		21.7		21.7		8.7		56.5		

- Most often, we found a higher percentage of co-occurring vestibular diagnoses than reported by Zhu et al.

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Co-occurring Diagnoses Data

Core Diagnosis	Co-Occurring Diagnoses											
	BPPV		Meniere's Disease		PPPD		Superior Canal Dehiscence		Vestibular Migraine		Vestibular Neuritis	
	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP	Comp	DSP
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Vestibular Migraine	42	55.1	25 - 38	16.3		16.3		28.6				24.5
Vestibular Neuritis	9.8	47.8		21.7		21.7		8.7		56.5		

- Similar to Single Diagnosis and Multiple Diagnoses data, we saw the highest percentage of co-occurrence for "Vestibular Migraine" **(47.1 – 87.5%)** and "BPPV" (**41.2 – 56.3%)**
- **87.5%** of our subjects with "Superior Canal Dehiscence" also had "Vestibular Migraine"

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"Vestibular Migraine" and "BPPV"

	Most Common Patterns	Percentage (n = 195)
Two Diagnoses	BPPV + Vestibular Migraine	4.6%
Three Diagnoses	BPPV + Meniere's Disease + Vestibular Migraine BPPV + Vestibular Migraine + Vestibular Neuritis	1.5% 1.5%
Four Diagnoses	BPPV + Meniere's Disease + SCD + Vestibular Migraine BPPV + PPPD + SCD + Vestibular Migraine BPPV + SCD + Vestibular Migraine + Vestibular Neuritis Meniere's Disease + PPPD + Vestibular Migraine + Vestibular Neuritis	0.5% 0.5% 0.5% 0.5%

- "Vestibular Migraine" and "BPPV" most frequently endorsed in common patterns of multiple diagnoses

CONTINUED

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"Vestibular Migraine" and "BPPV"

	Most Common Patterns	Percentage (n = 195)
Two Diagnoses	BPPV + Vestibular Migraine	4.6%
Three Diagnoses	BPPV + Meniere's Disease + Vestibular Migraine	1.5%
	BPPV + Vestibular Migraine + Vestibular Neuritis	1.5%
Four Diagnoses	BPPV + Meniere's Disease + SCD + Vestibular Migraine	0.5%
	BPPV + PPPD + SCD + Vestibular Migraine	0.5%
	BPPV + SCD + Vestibular Migraine + Vestibular Neuritis	0.5%
	Meniere's Disease + PPPD + Vestibular Migraine + Vestibular Neuritis	0.5%

- "Vestibular Migraine" endorsed in all of these most common patterns

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"Vestibular Migraine" and "BPPV"

	Vestibular Migraine	BPPV
Single Diagnosis	20.3%	21.8%
Multiple Diagnoses	79%	62.9%
Two Diagnoses	55.6%	55.6%
Three Diagnoses	90.9%	72.7%
Four Diagnoses	100%	75%

- Similar rates of "Vestibular Migraine" and "BPPV" for subjects with Single Diagnosis and Two Diagnoses.

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"Vestibular Migraine" and "BPPV"

	Vestibular Migraine	BPPV
Single Diagnosis	20.3%	21.8%
Multiple Diagnoses	79%	62.9%
Two Diagnoses	55.6%	55.6%
Three Diagnoses	90.9%	72.7%
Four Diagnoses	100%	75%

- Higher rate for "Vestibular Migraine" in subjects with Multiple Diagnoses and, specifically, within the Three Diagnoses and Four Diagnoses groups.

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Vestibular Migraine

- Our results indicate **Vestibular Migraine** is the most common endorsed disorder among our 195 subjects who completed the DSP
- The importance of considering vestibular migraine was recognized by Zhu et al. (2019)
  - Advocated screening for migraine symptoms during initial and follow-up visits with all patients presenting with a complaint of dizziness.
- The reason why vestibular migraine is so common remains elusive
  - Dysmodulation of neurotransmitters implicated in migraine pathophysiology and which are also found in vestibular system
  - Reciprocal modulating neural connections between vestibular nuclei and trigeminal nucleus caudalis

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Conclusions

- Results support and extend the work of Zhu et al. (2019), but using data from a patient-completed questionnaire, the DSP.
- Most patients have a single vestibular disorder (68.2% in the current study; BPPV and Vestibular Migraine most common)
- A percentage of patients with vestibular disorders may present with co-existing vestibular disorders (31.8% in the current study)
- "Vestibular Migraine" is common as a single diagnosis and was also the most common co-occurring diagnosis.
- As the number of co-occurring diagnoses increased, so did the percentage that vestibular migraine was endorsed.
- Consideration of managing additional disorders in addition to the core disorder would be expected to improve patient care and reduce healthcare costs.
- Additional work is needed to more clearly identify why these relationships exist and specifically why vestibular migraine appears to be so prominent as an interrelated disorder.

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Summary, Q & A