TOPICS IN VESTIBULAR PHYSICAL THERAPY

VESTIBULAR REHABILITATION SIG

APTA & Academy of Neurologic Physical Therapy

COVID-19 AND DIZZINESS

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Message from the Chair

Rachel Wellons, PT, DPT, NCS

Greetings! The Vestibular Rehabilitation SIG has been busy since the last newsletter. We hope that you find the information in this newsletter helpful for your practice.

As the COVID-19 Pandemic has continued, patients post COVID-19 infection have been presenting to Vestibular Rehabilitation with dizziness. The Vestibular Rehabilitation SIG is monitoring these new developments and working towards disseminating information to help members. In this newsletter, you'll see several case studies written that can be used as a guide. If you are treating these patients and would be interested in combining forces to research outcomes on a larger scale, please contact me or other members of the Vestibular Rehabilitation SIG.

The Vestibular Rehabilitation SIG has been a leader in telehealth for a long time and those efforts became more valuable during COVID. The Vestibular Rehabilitation SIG Telehealth Taskforce, Linda D'Silva, Karen Skop, Jennifer Penn, Brooke Klatt, and Sarah Gallagher, published a paper entitled "Advocacy for Telehealth Services" A Commentary from the Vestibular SIG Telehealth Taskforce" in the August issue of the Physical Therapy Journal of Policy, Administration, and Leadership.

For our patients' knowledge is power. The Vestibular Rehabilitation SIG offers Fact Sheets to help educate our patients. As knowledge changes our fact sheets must evolve as well. Lisa Heusel-Gillig has led the charge in updating the provider fact sheets on Concussion and BPPV and adding new patient fact sheets about the Importance of Sleep in Individuals with Dizziness. In the New Year, we look forward to new patient fact sheets in Pediatric Vestibular Rehabilitation topics and Dysautonomia and an update of the patient fact sheet on Postural Perceptual Dizziness. Speaking of our Pediatric area of practice, we added a new Leadership Team member, Margot Gray, who is now serving as our Pediatric Liaison.

I am looking forward to the events of CSM 2022. We have decided to have the Vestibular Rehabilitation SIG Business meeting virtually on Monday, January 24th at 8:00 EST, so that we are able to reach as many members as possible. Vestibular programming is once again strongly represented at CSM in San Antonio, with 11 educational sessions along with posters and platform presentations. Details about sessions, presenters, locations can be found in this newsletter. Members of the Vestibular Rehabilitation SIG leadership team will be at the Myelin Melter and the ANPT SIG breakfast if you'd like to network or talk to us about getting involved.

Sara Oxborough is stepping down from coordinator of Abstract of the Week, serving in this position for over 10 years. I look forward to receiving this e-mail weekly and find it helpful in keeping up with the evidence. Andrea Mireau will be stepping into this position. Thank you Sara for your efforts over the years!

Have a safe and happy holiday and I look forward to seeing everyone at CSM.

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Introduction: COVID-19 and Vestibular Physical Therapy

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I imagine today, and for decades to come, if any of us are asked where we were and what we were doing in March of 2020, we will, without hesitation be able to answer. It was a time of great uncertainty as the world changed seemingly overnight to attempt to fight against a novel virus in a way most of us had never known. The Spanish flu pandemic of 1918 was too distant, as were memories of the polio epidemic with the invention of the iron lung in 1929 and efforts to develop vaccines. Whether personally affected by viral infection, fighting on the front lines as healthcare workers, battling life changes with social isolation, managing school or work closures, or adjusting patient care almost instantly to virtual platforms, no one escaped the impact of the novel Coronaviurs-19 (COVID-19).

As health care providers, we found ourselves affected by COVID-19 on all fronts. At home we had concerns over our family's safety and well-being, from their risk of infection to their access to food and other necessities (to include toilet paper). As owners of or employees in physical therapy clinics, we dealt with an instant transition to telehealth as clinic doors were closed. When doors began to re-open, we screened patients, took temperatures, donned masks, gowns, and face shields, and dove headfirst into the world of cleaning supplies: treat, spray, wipe, cover, treat, repeat. We learned to look more into our patients' eyes to "hear them", as their faces were covered by a mask.

Despite the pandemic, or often made worse by the pandemic, there were patients that required our care, and we found our way to deliver. Our patients with Parkinson's needed movement, our patients with orthopedic injuries needed strengthening, and our patients with dizziness needed targeted treatment.

Initial symptoms of COVID-19 infection included dry cough, fever, flu-like symptoms, shortness of breath, and fatigue (1). As more cases emerged, patients began reporting neurologic symptoms such as changes in taste and/or smell (2) and often dizziness (3). As vestibular care providers, we know that dizziness is a vague term that can encompass many underlying pathologies and it was not clear initially if this dizziness could be related to the vestibular system itself or to the many other body systems impacted by the virus, by a change in activity due to illness and/or isolation, or due to the anxiety and stress that came along with all things related to COVID-19.

Dizziness related to a viral infection is not new to those who evaluate and treat persons with vestibular pathology. We tackle the aftereffects of a viral infection commonly, prescribing gaze stability, habituation, balance/gait, and cardiovascular exercises for peripheral vestibular hypofunction (4). Over the course of the past year, case studies have begun to emerge that describe vestibular presentations not unlike other causes of dizziness we have seen in the past. Cases have been published that describe dizziness attributed to benign paroxysmal positional vertigo (BPPV), vestibular hypofunction, and other causes of dizziness such as cardiovascular or pulmonary complications following COVID-19 infection. While the pathogenesis of dizziness attributed to this novel virus or its sequelae is still emerging, the steps to evaluate patients and the clinical tools at our disposal to effectively treat them are unchanged.

In addition to potential acute peripheral causes of dizziness, cases emerged demonstrating prolonged symptoms of lethargy, dizziness, and imbalance. These symptoms often followed relatively mild cases of COVID-19. This presentation has been termed post-acute COVID-19 syndrome. Some similarities such as prolonged dizziness and lightheadedness with exertion have been noted in persons with post-acute COVID-19 syndrome and persons with autonomic dysfunction after viral infections (5). Strategies to treat these persistent symptoms have focused on treatment protocols used for postural orthostatic tachycardia syndrome (POTS).

The story of COVID-19 is far from over and as time goes by, we will continue to learn from our patients and from each other. This special edition of the Vestibular Rehabilitation Special Interest Group newsletter shares cases of dizziness, nausea and vestibular pathology seen in patients during the COVID-19 pandemic. It is through these cases that we can glean insight into treating future patients and forge the foundation of research to support clinical care. As more trends emerge, guidelines for evaluation and treatment of COVID-19 related-dizziness will be established.

The first contribution in this newsletter presented by Branden Dennis PT, DPT, NCS, C/NDT involves a case series of individuals with signs and symptoms of BPPV following COVID-19 viral infection. Next, Carrie W. Hoppes, PT, PhD, NCS, OCS describes a patient with significant nausea and imbalance following her COVID-19 diagnosis. Our third case by Lisa Heusel-Gillig, PT, DPT, NCS and Holly J. Roberts, PT, PhD, NCS, GCS describe a patient with headache, vertigo and dysautonomia leading to a diagnosis of persistent postural perceptual dizziness. Lastly, Stefanie Faull, MS, ATC, SPT provides a summary of the literature on POTS and COVID-19 for those clinicians who may be less familiar with this diagnosis and current treatment recommendations.

While each piece presents a unique clinical case or perspective, there are underlying themes that should serve as reminders to clinicians. The first is to listen to our patients as they describe their symptoms and guide us to a differential diagnosis. Acuity of symptoms, whether constant or intermittent, whether rotational in nature or simply lightheadedness, are all critical pieces of the puzzle. The second reminder brings us back to our basics. Regardless of the underlying cause of dizziness, our job is to perform a thorough evaluation and assessment that leads us toward our treatment plan. Positive positional tests lead us to repositioning maneuvers for BPPV, evidence of vestibular hypofunction lead us toward exercises to improve gaze and postural stability, and an absence of either of these findings leads us to question central and/ or behavioral contributions that may benefit from a habituation approach to symptoms. These principles hold true regardless of the underlying cause of symptom presentation. Lastly, these cases serve as a reminder of the importance of communication with our patients and our ability to provide reassurance and education. It seems only natural that worry and concern may be an underlying factor exacerbating or prolonging symptoms in patients faced with a “novel”, “new” disorder filled with so much “unknown” and “uncertainty.” Bodenheimer and colleagues explain that active patient engagement (6) is associated with positive patient outcomes. Patients that have confidence in their health care providers will be more engaged with their treatment plan. While the virus itself is new, the patient presentation we see in our clinics largely is not. Consider the impact of the words you chose. In the same scenario a patient can hear either “This is a new virus, we don’t know what the outcome will be” or “While the underlying cause of your

vestibular hypofunction may be related to this new virus, we have known how to treat your presentation for decades. I have the experience to help you."

They say that when one sense is lost the remaining ones are heightened. This is not a comment on the lack of taste or smell common to COVD-19, but an opportunity to reinforce our ability as clinicians to listen to our patients. While our mouths have been covered by masks, our ears have stayed available and exposed. We have been forced to speak less and to listen more. The ability to listen to our patients is the strongest most critical tool in our toolkit. Sir William Osler is credited with saying "Listen to your patient, he is telling you the diagnosis." This statement illustrates in just a few words the difference between good clinicians and exceptional ones. Our patients do tell us exactly what they need. If we take the time to listen and hear them, they will lead us toward a diagnosis and treatment plan.

We are pleased to bring you this special edition. We hope that you find this information valuable as you evaluate and treat individuals with complaints of dizziness related to COVID-19.

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Do you have an interesting Clinical Case?

The VR SIG Newsletter is interested in sharing your clinical experience and can provide mentorship to help you write your case up. Contact: Anne Galgon at galgonanne56@gmail.com

The Occurrence of Benign Paroxysmal Positional Vertigo Following Moderate to Severe COVID-19: A Case Series

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Abstract

Background/purpose: COVID-19 proved to be one of the leading causes of hospitalization within the past 18 months. The novelty of the virus has presented an array of impairments that are still not fully understood. The purpose of this report is to illustrate the occurrence of Benign Paroxysmal Positional Vertigo (BPPV) in a series of individuals, who have recovered from moderate to severe COVID-19, and discuss the response to canalith repositioning maneuvers. Case Description: This case series included four individuals, ranging from 33 to 72 years old, who were seen in an inpatient rehabilitation facility. All cases had complaints of vertigo and/or positive positional nystagmus consistent with BPPV and three were treated with canal-specific reposition maneuvers. Outcome was measured by a negative finding on the Dix-Hallpike/Roll Test or denial of vertigo with bed mobility. Outcomes: Three out of four patients reported a reduction in the severity of symptoms and/or complete resolution following intervention. One patient was not provided treatment due to the acuity of his impairments associated with prolonged hospitalization and hypoxic brain injury. Discussion: Several potential theories have been hypothesized that could explain this occurrence. Perhaps, the COVID-19 virus targets the vestibulocochlear nerve similar to a vestibular neuritis. Another potential association could be the multitude of new pharmaceuticals that are being administered to combat COVID-19 and/or positioning protocols utilized within the intensive care unit. In conclusion, there are no definitive correlations between BPPV and COVID-19 but would require more research to investigate if a true relationship exists. Clinical Relevance: This case series is clinically relevant due to the potential for a missed diagnosis of BPPV within this patient population.

Introduction

On March 11, 2020 the World Health Organization (WHO) declared severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), later termed the novel coronavirus disease-2019 (COVID-19), as a global pandemic. COVID-19 has proven to be one of the leading causes of hospitalization within the past eighteen months. The novelty of the virus has presented an array of impairments that are still not fully understood as of yet by the medical community. The most common symptoms associated with infection appear to include fever, chills, cough, dyspnea, muscle/body aches, congestion, diarrhea, and/or loss of taste or smell.(1) Additionally, it has been determined that approximately 30% of COVID-19 cases present with some type of neurological involvement, including but not limited to cerebrovascular disease, impaired consciousness, polyneuropathy, and impaired vision.(2) Recent studies have also proposed that tinnitus and hearing loss may also be associated with COVID-19 infection, thus suggesting potential vestibulocochlear involvement.(3)

Benign Paroxysmal Positional Vertigo (BPPV) is one the most common pathologies that affect the peripheral vestibular system. The rate of incidence within the general population is approximately 64 new cases per 100,000 people per year. The majority of BPPV cases tend to be idiopathic, accounting for approximately 58% of the sample. Other common causes include BPPV induced by post-traumatic head

trauma and vestibular neuritis with an incidence rate of 18.2% and 8.6% respectively.(4) During the first year of the pandemic, clinicians in our rehabilitation hospital noted an increase in COVID-19 patients presenting with signs and symptoms consistent with BPPV. A recent review of the literature has also supported this notion as other institutions are observing this phenomenon as well.5 However, there have been no previous reports of inner ear or vestibulocochlear involvement with earlier detected coronaviruses such as severe acute respiratory syndrome CoV (SARS-CoV) or Middle East respiratory syndrome CoV (MERS-CoV). Even though inner ear dysfunction hasn't been observed, the literature does suggest that these viruses possess neuroinvasive properties.(6) Overall, this is rather concerning due to the potential for missed diagnosis of BPPV or other vestibular-related impairments in the presence of COVID-19. Lastly, BPPV is also a leading cause of imbalance and falls which would further complicate the recovery process of the COVID-19 patient.

The purpose of this case series is to describe the occurrence of BPPV in four individuals who recovered from moderate to severe COVID-19 and to discuss their individual responses to canal repositioning maneuvers. Additionally, we will consider the potential mechanisms associated with the suspected correlation, as well as the limitations in detection and management due to the acuity of the clinical manifestations associated with COVID-19.

Case Descriptions

This case series included four individuals, who were admitted to inpatient rehabilitation at Rusk Rehabilitation of New York University Langone Health, secondary to complications from COVID-19. All patients were previously independent prior to acute hospitalization and referred to inpatient rehabilitation. At the end of this episode of care, all patients were discharged either home or to a sub-acute rehabilitation, where continued services were recommended. Further detail of the history, examination and management of each case are presented below.

Case One:

History of illness: The patient is a 64-year-old male, with a past medical history of diabetes, coronary artery disease, hyperlipidemia, and hypertension, who presented to the acute care hospital with acute hypoxic respiratory failure secondary from sepsis due to COVID-19 infection. He was treated in the intensive care unit which was complicated by acute respiratory distress syndrome, thus requiring intubation, a tracheotomy and mechanical ventilation. A prone positioning plan was initiated to improve ventilation. He received Hydroxychloroquine, oral Azithromycin, and a course of intravenous Vancomycin, Rocephin, Cefepime, and Zosyn. The intravenous Vancomycin was provided over a total of 5 days. Other complications included acute renal failure, encephalitis of unclear etiology with unremarkable lumbar puncture and urinary tract infection (UTI). Following approximately six weeks in the intensive care unit, he was referred to inpatient rehabilitation with a diagnosis of critical illness myopathy/polyneuropathy secondary to complications from COVID-19.
Function mobility on admission: The patient required moderate assistance of two people to complete transfers and was only able to participate in non-functional ambulation via an Arjo walker (Malmö, Sweden) with two-person assistance.
Vestibular related complaints and examination: The patient complained of room spinning vertigo with bed mobility activities. Positional testing revealed negative bilateral roll tests to rule out horizontal canal involvement and positive right Dix-Hallpike with right torsional up beating nystagmus lasting less than 60 seconds.

Diagnosis and intervention: The patient was diagnosed with right posterior canal canalithiasis BPPV. Multiple trials of right canalith repositioning maneuvers were completed over 2 treatment sessions.
Outcome: During follow-up encounters, the patient had complete resolution of symptoms and nystagmus upon reassessment via Dix-Hallpike. The patient completed his rehabilitation stay without recurrence of nystagmus or symptoms.

Case Two
History of illness: The patient is a 57-year-old male with a history of hypertension, hyperlipidemia, diabetes mellitus and sleep apnea. He presented to the acute care hospital and was admitted to the intensive care unit for acute hypoxic respiratory failure. The patient subsequently required intubation, a tracheotomy and mechanical ventilation. A prone positioning plan was initiated to improve ventilation. Primary illness was superimposed with pseudomonas pneumonia, which was treated with Hydroxychloroquine and oral Azithromycin, and a course of intravenous Azithromycin, Vancomycin, Rocephin and Zosyn. Specifically, the patient required intravenous Azithromycin for one day and intravenous Vancomycin for a total of ten days. Other complications included toxic metabolic encephalopathy and bilateral foot drop. Due to prolonged immobility, the patient developed an unstageable sacral pressure ulcer and deep tissue injury to the heel. Following approximately six weeks in the intensive care unit, he was referred to inpatient rehabilitation with a diagnosis of critical illness myopathy secondary to complications from COVID-19.
Function mobility on admission: The patient required maximum assistance of two people with bed mobility and transfers, and was initially unable to participate in ambulation due to significant deconditioning and quadriparesis.
Vestibular complaints and examination: The patient reported room-spinning vertigo with bilateral rolling in bed. Oculomotor exam revealed no spontaneous nystagmus, and normal smooth pursuits and saccades. Bilateral head thrusts (impulses) were negative and the patient denied oscillopsia. The patient had limited cervical rotation so the Roll Test was performed with 90-degree whole body log roll to the right and left. The modified test revealed brisk short duration geotropic nystagmus and symptoms of vertigo, with symptoms greater on left. Dix-Hallpike Test on right and left were not completed by the treating clinician.
Diagnosis and Intervention: Following above modification, the patient was confirmed with a diagnosis of left lateral canal canalithiasis. Treatment involved two repetitions of a right Gufoni (Casani) Maneuver(7) that were completed within one treatment session.
Outcome: Reassessment of bilateral rolling concluded resolution of symptoms and nystagmus. The patient completed his rehabilitation without reoccurrence of symptoms or nystagmus.

Case Three
History of illness: The patient is a 60-year-old male, with a past medical history of cellulitis, benign prostate hypertrophy and gout, who presented to the emergency department with fever, cough, diarrhea, and hypoxia found to be secondary to COVID-19. The patient was admitted to acute hospital services where he received Hydroxychloroquine and oral Azithromycin, and a course of intravenous Azithromycin, Zosyn, Rocephin, and Vancomycin. The patient required intravenous Azithromycin for one day and intravenous Vancomycin for a total of 6 days. Additionally, the patient also received trials of Tocilizumab and Sarilumab. Patient was admitted to the intensive care unit and required intubation, a tracheotomy and mechanical ventilation. A prone positioning plan was initiated to improve ventilation. Numerous trials of decannulation and

recannulation were completed secondary to complications from resection of necrotic lung abscess and evacuation of hematoma. Medical course was further complicated by delirium, left hemothorax, urinary retention and stage IV sacral ulcer status post-surgical debridement. Following approximately 5 weeks in the intensive care unit, he was referred to inpatient rehabilitation with a diagnosis of debility secondary to COVID-19.

Function mobility on admission: Upon admission, the patient completed transfers and ambulated approximately 30 feet with contact guard assistance utilizing a rolling walker. He was also on a strict sidelying protocol due to his stage IV sacral ulcer. As a result, he was not permitted to assume supine.

Vestibular complaints and examination: The patient reported room spinning vertigo with all aspects of bed mobility, particularly with rolling to the right. Prior to testing, the treating clinician received clearance to have the patient sit briefly in short/long sitting within the hospital bed. Due to suspected poor patient tolerance in long sitting, a Sidelying Test(8) was completed and an upward, torsional nystagmus noted, lasting less than 60 seconds was noted in the right side lying position.

Diagnosis and Intervention: The patient was diagnosed with right posterior canal canalithiasis. A right canal repositioning maneuver, with the bed positioned in Trendelenburg, was completed to address the above patient complaints.

Outcome: Based on the chart review, it appears that the patient continued to complain of intermittent vertigo and further repositioning maneuvers were not completed by the primary treating clinician due to prioritization of other limitations and barriers to return home. Recommendation was provided to follow-up with outpatient services to continue treatment for suspected BPPV.

Case Four

History of illness: The patient is a 32-year-old male, with a history of hypertension and bipolar disorder, who presented to the emergency department with complaints of shortness of breath with myalgias and subjective fevers, where he required intubation and mechanical ventilation. He was subsequently admitted to the intensive care unit due to diagnosis of COVID-19 and required a tracheostomy. A prone positioning plan was initiated. The patient was started on Hydroxychloroquine, Tocilizumab, and a multitude of antibiotics, most notably a course of intravenous Azithromyecin and Empiric Vancomycin. The patient received a total of 3 days on intravenous Azythromycin and a total of 16 days on intravenous Vancomycin. Hospital course was complicated by a new onset of bacterial pneumonia secondary to aspiration. Neurology consulted due to encephalopathy with intermittent agitation. Imaging showed numerous punctate foci of susceptibility with predominant involvement of the subcortical white matter and corpus callosum. Ultimately, no further workup was recommended as the patient's presentation was consistent with toxic encephalopathy and delirium. Following approximately four weeks in the intensive care unit, he was referred to inpatient rehabilitation with a diagnosis of hypoxic brain injury secondary to COVID-19.

Function mobility on admission: Patient required total assistance of two people with transfers and was non-ambulatory due to severe cognitive-linguistic impairments, range of motion limitations, and motor control impairments.

Vestibular complaints and examination: Formal vestibular assessment was not completed on this patient due to the acuity of his impairments associated with prolonged hospitalization and hypoxic brain injury, as well as priority being placed on functional mobility-based goals. However, the patient was noted to have upward, torsional beating nystagmus upon transition from short sitting to supine, fatiguing within

approximately 20 seconds.

Diagnosis and Intervention: A definitive diagnosis could not be made in this case due to the lack of appropriateness of assessment secondary to severity of patient impairments. However, based on the characteristics associated with the patient's nystagmus, he likely presented with either left or right posterior canal canalithiasis.

Outcome: The patient was discharged to sub-acute services due to significant level of assistance with mobility and lack of caregiver support within the home environment. Follow-up services were recommended to address suspected BPPV following improvement in medical status and functional capacity.

Discussion

The four cases described above presented with symptoms consistent with BPPV. Positional testing was completed in three of the cases that resulted in a diagnosis of BPPV (two with posterior canal and one with horizontal canal), with two cases experiencing complete resolution with repositioning maneuvers. Co-morbidities required modification of diagnostic and intervention procedures in two cases. With this in mind, one patient had suspected BPPV from nystagmus during functional positional changes, however, further diagnostic testing and intervention was not a priority for the treating clinician due to profound impairments associated with the diagnosis of toxic encephalopathy. By treating the BPPV in the three cases, the physical therapists were able to better address the other impairments and mobility restrictions during the inpatient rehabilitation stay.

Several potential theories have been hypothesized that could explain the presence of BPPV in the setting of COVID-19. Perhaps, the COVID-19 virus targets the vestibulocochlear nerve similar to a vestibular neuritis. It is well known that viral particles typically attack the superior portion of the vestibular nerve during a vestibular neuritis crisis. The superior portion of the vestibular nerve innervates the utricle and the superior and horizontal semicircular canals. As a result, the otoconia theoretically should be more susceptible to detach from the gelatinous layer within the utricle and dislodge into the corresponding semicircular canal. Therefore, the patient would theoretically present with a hypofunction secondary to the direct impact of the vestibular neuritis, as well as posterior canal BPPV.(4) However, we are unable to confirm if our sample exhibited a vestibular hypofunction as formal vestibular assessment was not conducted due to the acuity of patient impairments and other functional limitations that took precedence within the inpatient setting. Additionally, none of the patients included in this study reported any vertiginous episode lasting for a time frame of hours, which would be typically associated with a viral invasion of the inner ear.

Previous authors have postulated as to the exact mechanism of central nervous system invasion. It is theorized that COVID-19 has a high affinity for targeting angiotensin converting enzyme-2 (ACE 2) receptors, which are heavily distributed within lung type 2 alveoli, as well as being commonly expressed in glial cells and neurons. The inflammation associated with systemic involvement is thought to promote vascular leakage, which in turn serves as a viral route of entry into the inner ear.(9) Another potential route of access within the central nervous system has been suggested through transmission through the cribriform plate of the ethmoid bone within the nasal cavity. Previous studies have suggested that intranasal inoculation of SARS-CoV and MERS-CoV within mice has proven able to transmit to the CNS through the olfactory nerves. Once viral access to the CNS is gained, it is postulated the virus can affect other cranial nerves, as well as spread throughout the system to areas such as the thalamus and brainstem.

It has been proposed that SARS-CoV2 may initiate neural invasion through a similar mechanism.(9,10,11) Recent research has also suggested that ACE 2 receptors may be expressed within adult human inner ear tissue. Jeuong et al. has proposed that hair cells and Schwann cells may specifically be prone to damage from COVID-19 due to the presence of ACE 2 receptors, which would correlate with numerous reports of audiovestibular dysfunction with active infection.(12)

Another potential association could be the multitude of new pharmaceuticals currently being utilized to combat COVID-19. With this in mind, Hydroxychloroquine was highly touted as a means of treatment during the early phases of the pandemic. It has been previously established that Quine and its derivatives (which are closely related Chloroquine/Hydroxychloroquine) can prove ototoxic to the inner ear when utilized for its intended purpose as an antimalarial drug. The authors concluded that their review did not find this occurring frequently but did note that off label use is significantly utilized at a higher dosage then normal, which could result in a higher level of ototoxicity.(13) Multiple COVID-19 treatment protocols have also suggested the use of Azithromycin due to its anti-inflammatory properties. However, it has long been known that high dose exposure to macrolide antibiotics can have ototoxic effects as well. These effects appear to typically recede following discontinuation of the drug but irreversible cases have been noted. Additionally, Remdesvir and Tocilizumab have commonly been utilized to combat COVID-19. However, it is not to this author's knowledge of any literature reporting ototoxic effects, though further investigation into this notion is warranted.(14,15) As it relates to the sample, all patients received a course of Hydroxychloroquine and Azithromycin. One patient also received Tocilizumab in addition to the previously mentioned combination of drugs. Lastly, it was confirmed that three of the cases received intravenous antibiotics and one case the delivery method of antibiotics was not confirmed. With this in mind, it is important to consider the possible cumulative effect of a combination of these medications within the treatment regimen.

A final theory that could attribute to BPPV within the COVID-19 population could be associated with the intensive positioning programs that were implemented within the intensive care unit settings. It has previously been shown that prolonged immobility and dependent recumbent positioning, likely due to hypercoagulability, has illustrated a correlation with BPPV.(5,16) All patients included in the sample were immobilized within the intensive care unit for prolonged periods of time. Additionally, a prone positioning plan was implemented within the plan of care of all cases during their admission to the intensive care unit, with one case requiring a strict side lying protocol once referred to inpatient rehabilitation services due to the presence of a pressure ulcer. Therefore, it is entirely imperative to observe the potential association between immobility and positioning with the occurrence of BPPV within the sample.

Conclusion/Clinical Implications

In conclusion, there is no definitive correlation between BPPV and COVID-19 but would inquire more research to investigate if a true relationship exists. However, individuals with moderate to severe impairments post COVID have had BPPV identified during rehabilitation. Patients undergoing lifesaving procedures and interventions after COVID may be more susceptible to acquiring BPPV. Therefore, physical therapists should screen these patients for potential vestibular complaints and provide positional testing and interventions if needed, with consideration of implementing modifications of these procedures due to poor patient mobility, in order to optimize functional recovery.

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Congratulations to Branden Dennis!

He received a Best Vestibular Poster Award for this case series at the 2021 ANPT Annual Meeting

Physical Therapy Management of an Individual with Post-COVID-19 Nausea: A case report

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Abstract

Background: It is not uncommon for patients with COVID-19 to report gastrointestinal (GI) symptoms, and for some this may be the fist sign of illness. Of those with GI symptoms, nausea and vomiting is commonly reported. Case Description: This case study describes the physical therapy management of a 49-year-old female with post-COVID-19 nausea. Her treatment included the 3E's of empathy, education, and exercise. It was important for the patient to be heard and understood, so the patient was permitted to tell her story without interruption. Patient education was strongly grounded in positive expectations of recovery. The importance of sleep, hydration, food intake, and pacing activities throughout the day was stressed. Progressive return to activity was initiated and a habituation-based home exercise program was prescribed. Outcomes: The patient had a variable presentation during the course of vestibular physical therapy. Her Dizziness Handicap Inventory score became worse. However, her ability to assist her children in preparing and leaving for school each morning had improved and she was able to resume driving except at night. Discussion: The underlying cause(s) of this patient's nausea is not known, but likely multi-factorial. Her hospitalizations and self-limiting of activities due to extreme nausea likely resulted in her activity limitations and participation restrictions. A habituation-based approach to vestibular physical therapy, informed by her performance on the Motion Sensitivity Quotient, was used to guide home exercise program prescription. Clinical Relevance: A habituation-based approach with progressive return to activity and education focused on positive expectations for recovery seems promising for treating and individual with post-COVID-19 nausea.

The views and information expressed are those of the author and do not represent the official position of the U.S. Army Medical Center of Excellence, U.S. Army Training and Doctrine Command, Brooke Army Medical Center, Department of the Army, Department of Defense, Defense Health Agency, or U.S. Government.

Introduction

Individuals with COVID-19 may report a variety of symptoms (fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, and/or diarrhea).(1) Of 405 inpatients with confirmed COVID-19, 48% had gastrointestinal (GI) symptoms and for 38% the first sign of illness was a GI symptom.(2) Similarly, of 611 inpatients with COVID-19, 25% had GI symptoms.(3) The most commonly reported GI symptom was nausea/vomiting (18%).3 Of 507 patients with confirmed or highly probable COVID-19, 48% had at least one GI symptom.4 The most commonly reported GI symptom was nausea and/or vomiting (32%).(4) A meta-analysis of 125 articles with 25,252 patients found that 20% had GI symptoms and nausea was common

(10%).(5) Angiotensin converting enzyme type 2 receptors in multiple organs may provide a possible mechanism of action for COVID-19-related GI symptoms.(6) Given the prevalence of GI symptoms that include nausea, and a possible mechanism of action for the reported symptoms, it is possible that clinicians may encounter individuals with COVID-19-related complaints of nausea. The purpose of this case study is to describe the physical therapy management of an individual with post-COVID-19 nausea. Reporting adheres to the CAse Report (CARE) guidelines.(7)

Case study presentation

History

The patient was a 49-year-old female (170 cm, 67.9 kg, body mass index 23.49) who contracted COVID-19 in July 2021 when helping her mother pack and move into the patient's home. Initially, she had a headache and a fever, and she described her symptoms as mild. One-week later she began to have nausea and epigastric pain. Her GI symptoms evolved into constant nausea, and she was unable to tolerate food, resulting in 9 kg of weight loss. She experienced severe nausea and epigastric pain that were associated with vomiting initially, and later constipation. She was seen in the emergency department twice and was admitted to the hospital in August 2021 for two separate weeks. An extensive work up was unremarkable except for increased stool burden on computed tomography of the abdomen/pelvis which was effectively treated with MiraLAX (polyethylene glycol 3350). She was prescribed multiple medications for nausea without relief or with intolerable side effects; finding that alternating Phenergan (promethazine) and Zofran (ondansetron) every 6 hours provided some improvement. The patient reported stress and anxiety because she was unable to work and care for her two children; she was prescribed KlonoPIN (clonazepam), which helped her to feel significantly better and tolerate food. Her past medical history was notable for migraine (though she reported she had not had headaches in the past 3 years), Chiari malformation, and asthma. She also had received a cosmetic Botox (onabotulinumtoxinA) injection prior to her COVID-19 infection. She was referred to vestibular physical therapy for nausea and dizziness.

Physical Therapy Subjective Examination

The patient was seen for an initial evaluation in physical therapy in September 2021. As stated above the patient reported mild COVID-19 symptoms for approximately one week, before experiencing severe nausea and epigastric pain that resulted in hospitalization. Previously, she reported 10/10 dizziness (where 0 is no dizziness and 10 is the worst dizziness) when riding as a passenger in a car. She described the passing cars, noises, lights, and "everything else" as being "too much to handle." Lying on her side (right greater than left) was also rated as 10/10 dizziness. She now reported 1-2 out of 10 dizziness. She was recently prescribed Ativan (lorazepam) and was told to use it sparingly. On the days she took it, she reported feeling somewhat normal, at least to the point that she could shower and prepare food; she also noted the return of her appetite. Based on this response her physician told her that she could take the Ativan regularly (three times per day); this resulted in a dramatic improvement in her symptoms. She stated, "I don't feel perfect, but it feels much more manageable." When asked to rate her difficulty in completing three self-chosen activities, she rated getting up/walking around as 2/10, driving as 2/10, and eating as 3/10 (where 0 is no difficulty and 10 is too difficult to complete). She reported her dizziness and nausea were "horrible" in the morning but improved gradually throughout the day. Her primary goals were to return to driving and to be

able to wake up and start her day more readily. She practiced competitive karate and wanted to be able to return to this activity with her two sons. Her Hospital Anxiety and Depression Scale8 score was 9 (borderline) for depression and 11 (abnormal). Her Dizziness Handicap Inventory Score9 was 26% and her Activities-specific Balance Confidence Scale10 score was 83%. She was currently taking one-half tablet of Ativan three times per day.

Physical Therapy Objective Examination

Bilateral upper and lower extremity strength was normal (5/5). Sensation was intact to light touch throughout the bilateral upper and lower extremities. Reflexes ranged from absent (bilateral patella and right Achille's) to 1 (right triceps and biceps, left Achille's) to 2+ (left triceps and biceps, bilateral brachioradialis). There was no clonus in the wrists on ankles, and Hoffman's and Babinski's signs were not present. A cranial nerve assessment was as follows: I, lost during the initial days of the COVID-19 infection but now normal; II, 20/40 in each eye; III-VII, normal; VIII, hearing was intact to bilateral finger rub. While her vestibulo-ocular reflex (VOR) was normal, it began to reproduce her nausea (very slight). Her ability to cancel the VOR was normal. Cranial nerves IX-XII were also normal. Taste was not tested in the clinic, however, she denied experiencing any change to taste during her illness.

During oculomotor assessment, only vertical saccades slightly increased her symptoms. Convergence was abnormal at 14 cm. The right Dix-Hallpike was negative for nystagmus and symptoms. The left Dix-Hallpike was negative for nystagmus, but the patient reported, it "feels like I'm falling." All other oculomotor and bedside vestibular testing was normal.

Diagnosis and Prognosis

The patient was diagnosed with post-COVID-19 dizziness that was most likely due to limited activity. Her hospitalizations and extreme nausea resulted in activity limitations and participation restrictions; she had not returned to her pre-morbid activity level in her role as a wife and mother. Administration of the Visual Vertigo Analogue Scale11 (VVAS) and Motion Sensitivity Quotient12 (MSQ) was planned for the next visit to inform a habituation-based approach to vestibular physical therapy. Progressive return to activity was initiated. Her prognosis was good, given her relatively young age and strong desire to return to her prior level of function.

<u>Visit Two (Completion of Physical Therapy Initial Evaluation)</u>

Five days later the patient returned to physical therapy. She reported, "it feels like my brain cannot filter out extraneous information." She did not feel well at all and was very nauseous. She started a new medication the previous night, which made her feel sicker, and she woke up feeling "dopey" and "loopy." She had not felt well after eating the radioactive eggs for her GI study. She rated her nausea as 4-5/10 (where 0 is no nausea and 10 is the worst nausea). For the VVAS, she rated "being a passenger in a car" (item 2) at 8.5 cm, "being under fluorescent lights" and "watching traffic at a busy intersection" (items 3 and 4, respectively) as 10 cm, "watching action television" (item 9) as 8.5 cm, and all other items as nearly 0 cm. She reported being bothered by light and motion.

(items 3 and 4, respectively) as 10 cm, "watching action television" (item 9) as 8.5 cm, and all other items as nearly 0 cm. She reported being bothered by light and motion.

For the MSQ see table 1, column 2. The patient was provided with education similar to that for vestibular migraine, stressing the importance of sleep, hydration, food intake (avoiding dietary triggers, alcohol, and caffeine). The importance of pacing activities throughout the day was also discussed. The patient had already tried ginger and peppermint without relief. She was prescribed a home exercise program based on the MSQ and was referred to nutrition care for her concerns of nausea. A follow-up was planned for two weeks.

Table 1. Responses to the Motion Sensitivity Quotient in 49-year-old female with post-COVID-19 dizziness and nausea.

Motion Sensitivity Quotient Item	Initial Assessment	Two-week Follow-up	Four-week Follow-up
Sitting to supine	3/3 ("feels like I will slide off the back of the table" and symptoms continued to worsen with lying supine until she elected to return to sitting after 32 sec)	NIS/3 (she reported feeling like she was in a reverse Trendelenburg position)	3-4/3 ("feels like I am sliding back diagonally with my feet higher than my head" and she reported feeling like she was in a reverse Trendelenburg position
Supine to left side	*Declined*	NIS/NDS ("not really, but my stomach flipped, like a 'blip'" very briefly)	NIS/NDS ("ok, but shaky" very briefly but typically lasting minutes)
Supine to right side	*Declined*	NIS/NDS ("seemed easier" [than supine to left side]	NIS/NDS ("ok, but usually worse" very briefly but typically lasting minutes)
Supine to sitting	*Declined*	0/0	0/0
Left Dix-Hallpike	*Declined*	NIS/NDS ("a little sliding" as if sliding off the plinth in a reverse Trendelenburg position)	NIS/NDS ("rolling up and to the left")
Up from left	*Declined*	0/0	0/0
Right Dix-Hallpike	*Declined*	NIS/NDS (produced the most severe symptoms, like "slowly sliding off the table" in a reverse Trendelenburg position)	NIS/NDS ("less than the left [Dix-Hallpike], but similar")
Up from right	*Declined*	0/0	0/0
Sitting, head tipped to left knee	0/0	0/0	0/0
Head up from left knee	0/0 (caused eructation)	0/0	0/0
Sitting, head tipped to right knee	0/0	0/0	0/0
Sitting head turns	0/0	0/0	NIS/NDS ("mild wobbles at the end")
Sitting head pitches	1-2/2	NIS/NDS ("initially a small 'whoop'" very briefly)	0/0
In stance, 180° turn to left	0/0	0/0	0/0
In stance, 180° turn to right	0/0	0/0	0/0

Scores reported as Severity / Duration. NIS, no intensity score reported by the patient; NDS, no duration score reported by the patient

Visit Three (Two-week Follow-up)

At the two-week follow-up, the patient felt well and much improved. She reported that she was much less nauseous. She found the advice from the dietician to be helpful. She responded very favorably to purchase of a ReliefBand (ReliefBand Technologies LLC; Horsham, PA), a median nerve stimulator for reduction of nausea and emesis. This device enabled her to assist her children in preparing and leaving for school each morning, although she often needed to take a one-hour nap or break afterwards. Overall, she was improving and participating more as a wife and mother. She reported a 1/10 headache, 1-2/10 nausea, and 2/10 fogginess. Occasionally, she reported imbalance; when present, she felt like she veered to the left. She completed the MSQ again (Table 1, column 3), and this time she was able to tolerate performing all 16 items.

The patient was again provided with education similar to that for vestibular migraine, stressing the importance of pacing activities throughout the day. Her home exercise program based on the MSQ was progressed and she was referred to Physical Medicine and Rehabilitation in the hopes of establishing an inter-disciplinary team leader to manage a holistic approach to her care. Her response to the ReliefBand seemed positive, and continued use was encouraged. A follow-up was planned for two weeks.

Visit Four (Four-week Follow-up)

At the four-week follow-up, the patient did not feel well at all, and was very nauseous. She reported a change in her Ativan. She continued to report horrible nausea that required sitting up in bed to sleep, and an inability to lie for very long on her left or right side. She was unable to drive at night due to the intense visual stimuli which she described as feeling like she was driving in a "Star Wars portal." She also noted waking up in the middle of the night with anxiety and variable blood pressure. She noted continued use of the ReliefBand, reaffirming that the device enabled her to assist her children in preparing and leaving for school each morning, although she often needed to take a one-hour nap or break afterwards. Her Dizziness Handicap Inventory Score was 50% (worse than her initial presentation of 26%).

Her presentation seemed similar to post-concussive clinical subtypes (see Figure 1). She reported a 0/10 headache, 3-4/10 nausea, and 2/10 fogginess. She completed the MSQ again (Table 1, column 4), and she was again able to perform all 16 items. Her home exercise program based on the MSQ was progressed to work on the right and left Dix-Hallpike positions. Due to her complaints of being overwhelmed with visual stimuli, and her previous scores on the VVAS, a trial of up to 6 visits in the Computer Assisted Rehabilitation Environment (CAREN) (Motek Medical, Houten, Netherlands) was planned. This is a high-technology modality for delivery of habituation-based therapy for visually-induced dizziness (among many other uses).

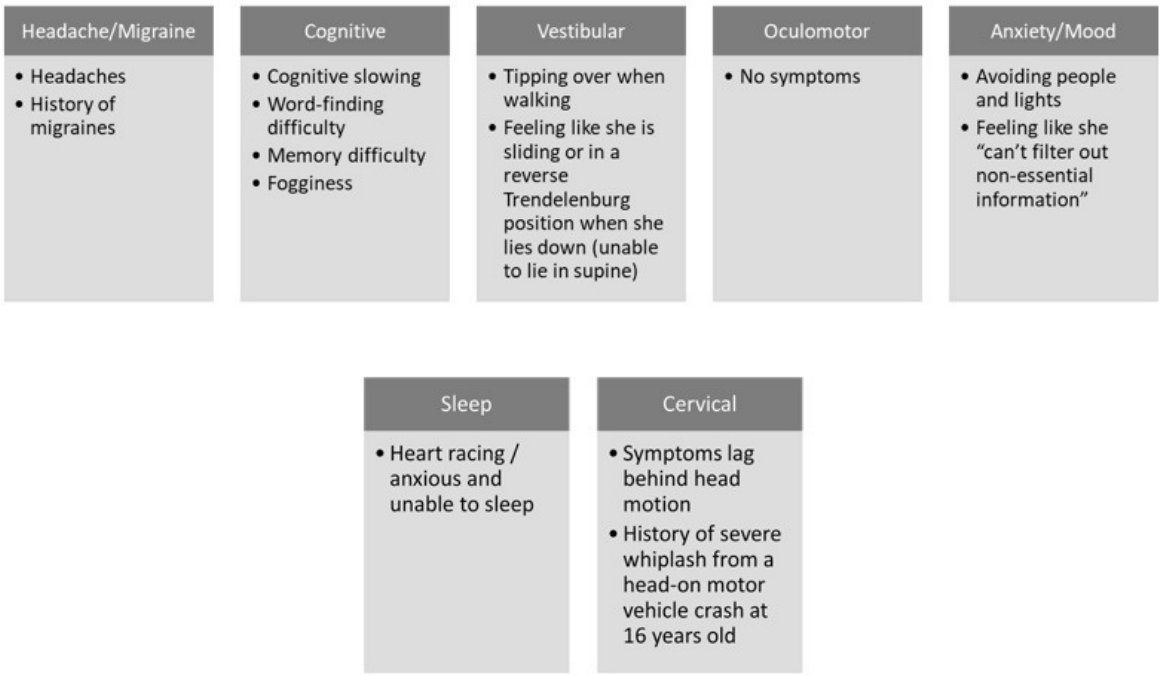

Figure 1. Symptoms reported by a 49-year-old female with post-COVID-19, organized according to post-concussive clinical subtypes.

Interventions

As stated above, a referral was placed by the PT for a nutrition assessment given her nausea and unintentional weight loss. She reported nausea, lack of appetite, and occasional constipation managed with MiraLAX. She reported lying in bed most of the day due to her epigastric pain, and occasionally taking short walks at night. She was told to consume 5-6 small meals daily, spaced about 2-3 hours apart, and provided with comprehensive nutritional education which she found helpful.

A referral was also placed by the PT for physical medicine and rehabilitation assessment, with the hopes of coordinating inter-disciplinary care for the patient. The osteopath only noted tightness in her cervical and thoracic spine. While manipulation and dry needling were mentioned in the plan of care, these were not administered at the time of writing this case study.

She completed a habituation-based home exercise program. The patient also completed her first of six visits to the CAREN. Within the treatment session, her anxiety decreased and her tolerance of being in the virtual reality environment improved. In addition to vestibular physical therapy, the patient was concurrently seeing an acupuncturist (traditional Chinese medicine practitioner) and a holistic chiropractor. She reported that both of these holistic approaches were helpful.

Outcome

The patient had a variable presentation during the course of vestibular physical therapy. Her DHI became worse, increasing from 26% to 50%. However, her ability to assist her children in preparing and leaving for school each morning had improved, although she often needed to take a one-hour nap or break afterwards. Use of the ReliefBand seemed to enable her participation. She was able to resume driving except at night.

The primary outcome measure was the MSQ. Initially, she was only willing to attempt six of the 16 items. She was much-improved at the two-week follow-up and was able to tolerate all 16 items. At the four-week follow-up, however, she continued to report feeling like she was in a reverse Trendelenburg position when lying supine. Due to her extreme nausea, she slept sitting up for the past 4 months. So, it stands to reason that lying supine (flat) may produce an altered perception of horizontal.

Discussion

This case study describes the vestibular physical therapy care of a 49-year-old female with post-COVID-19 dizziness and nausea. The underlying cause(s) of these symptoms is not known, but likely multi-factorial. She received a cosmetic Botox injection approximately one week prior to acquiring COVID-19. Adverse reactions of Botox injection can include headache, vertigo, abdominal pain, nausea, malaise, and anorexia.13 Gastrointestinal symptoms that include nausea are also reported with COVID-19.2-5 Having two separate inpatient stays likelycontributed to general debility. Having self-limited activity due to nausea may also have contributed to her motion sensitivity, which was especially pronounced in supine. Due to her extreme nausea, she had to sleep sitting up for the past 4 months. So, it stands to reason that lying supine (flat) may produce an altered perception of horizontal. This may be similar to the perception of falling forward when working on tolerance to being upright on a tilt table in an acute care setting (which may produce an altered perception of vertical, where a patient reports a sensation of falling forward even though they are ⩽ 90° from vertical).

Regardless of the cause(s), the patient was likely to benefit from an approach often used by this therapist in treating chronic neuromusculoskeletal conditions (such as chronic pain and post-concussive syndrome) – the 3E's of empathy, education, and exercise. It was important for the patient to be heard and understood. In primary care, those with chronic illnesses "repeatedly and persistently described consultations with clinicians where they were not heard and did not receive the information and care they wanted."14 Allowing the patient to tell her story, without interrupting to interject our typical physical therapy qualitative examination questions, can be cathartic. Most importantly, patient education that was strongly grounded in positive expectations of recovery (similar to that following concussion) formed the bedrock of the plan of care. Finally, treatment aimed at encouraging exercise. The MSQ was used to guide habituation-based exercises for addressing activity limitations. The patient was also provided encouragement to progressively resume participation.

Conclusion and Clinical Implication

While this patient's care is ongoing, a habituation-based approach (for movement-based and visually-induced stimuli) with progressive return to activity seems promising. Physical therapists with experience in treating chronic neuromusculoskeletal conditions (such as chronic pain and post-concussive syndrome) can likely apply similar treatment paradigms to individuals with post-COVID-19 dizziness and nausea.

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ICVR Poster Presentation Abstract Submissions

Poster submission portal is open from Feb 9th through March 24th 2022.

Physical Therapy Management of Prolonged Vestibular Symptoms in an Individual post COVID: A Case Study

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Abstract

Background: Since the beginning of the coronavirus disease 2019 (COVID 19) pandemic, individuals who have contracted the virus have suffered a variety of respiratory, cardiac, neurologic and gastrointestinal illnesses. Many have been classified with having long COVID, a condition in which the person recovers from the initial infection, but chronic signs and symptoms linger. Case Description: This case report describes the physical therapy management of a 63 year old male with initial symptoms of headaches, vertigo and dysautonomia, and subsequent persistent postural perceptual dizziness (PPPD). Outcome: The patient improved in all outcome measures including the Dizziness Handicap Inventory, Activities-specific Balance Confidence Scale, and Functional Gait Assessment. Clinical Relevance: This case report demonstrates that a patient with multiple complications following COVID-19, including PPPD, can improve with 3 months of individualized vestibular physical therapy that includes gait, balance, and habituation exercises.

Introduction

Since September 2019, over 236,000,000 people have contracted coronavirus disease 2019 (COVID-19) worldwide. (1) In the United States, more than 700,000 deaths are attributed to COVID-19,(2) and millions of individuals have survived.(3) While a majority of people who contract and survive COVID-19 experience resolution of their symptoms within 14 days, as many as 87% of patients hospitalized with COVID-19 experience persistent symptoms that last more than 6 months after hospital discharge.(4) A recent survey of randomly selected patients from 14 academic health systems who tested positive for COVID-19, but were not admitted to the hospital, revealed that 35% of respondents had not returned to their previous state of health within three weeks of a positive COVID-19 test.(5) The residual symptoms experienced are variable, but many adults with COVID have persistent pulmonary, (6,7) neurologic (8,9) or audio-vestibular symptoms.(10,11)

Although the most common primary complaints of individuals with acute COVID-19 are fever, cough, fatigue, and loss of smell or taste,(12) a subset of patients with COVID-19 report audio-vestibular symptoms as their primary complaint.(10,13) The prevalence of hearing loss, tinnitus, and vertigo may be as high as 7.6%, 14.8%, and 7.2%, respectively.(10) Most case reports involving individuals who report vertigo do not specify the origin of the vertiginous symptoms. However, two case reports have described patients with COVID-19 and concurrent vestibular neuritis.(14,15) One individual was prescribed Cawthorne vestibular rehabilitation exercises and a subsequent regimen of Prednisone when symptoms did not resolve within one day.(14) One individual was referred to physical therapy for vestibular rehabilitation, but the intervention and results of rehabilitation were not described.(15) To our knowledge, there are no published studies describing the rehabilitation of individuals with vestibular hypofunction following a bout of COVID-19.

The purpose of the case report is to describe an individual who suffered a peripheral vestibular neuritis, severe headaches and dysautonomia early in his COVID-19 illness who subsequently developed persistent postural perceptual dizziness (PPPD).

Case Medical History

The patient is a 63 year old male pediatrician with a past medical history of celiac disease, hypertension, asthma, and migraines. Two weeks after his wife tested positive for COVID-19 in April 2020, he experienced anosmia, dysautonomia with syncope as well as a severe, constant headache. When walking in his home, he felt a spinning sensation, "passed out" and fell to the floor. He presented to his primary care physician (PCP) with a decreased pulse rate, increased blood pressure, and fatigue. His PCP diagnosed him with COVID-19 and with the consultation of a cardiologist, prescribed Inderal, then Toprol XL, both beta blockers. Magnetic resonance (MR) imaging of the brain and head MR arthrogram were normal. His neurologist prescribed Fioricet, Topiramate, Botox and Meclizine to relieve what he described as "unrelenting" headaches and dizziness. He was referred to an otolaryngologist and underwent vestibular and hearing testing two months after his initial symptoms began. Videonystagmography testing showed normal smooth pursuit, saccades and optokinetic nystagmus (OKN). Hallpike-Dix testing for benign paroxysmal positional vertigo was negative. The patient had 10-15 degrees of right beating nystagmus in all testing positions. Calorics showed a 29% weakness on the left ear and a cervical vestibular-evoked myogenic potential (cVEMP) was 47% asymmetric on the left side. An audiogram demonstrated 100% speech discrimination on both ears.

The patient was diagnosed with left vestibular neuritis and was referred to a vestibular therapist. At the time, his dizziness symptoms were 8/10. Interventions of Brandt-Daroff exercises and other exercises, increased his symptoms so he discontinued therapy after three visits. He did not remember performing gaze stability exercises. Four months after the initial onset, his positional nystagmus had improved but not completely resolved and cVEMP testing was normal. He still complained of constant dizziness so the otolaryngologist prescribed Valium 2 mg twice a day to supplement the Meclizine.

One year after being treated for his vestibular hypofunction, the patient continued to experience imbalance and vague sense of constant "wooziness" and was referred to the neurotologist at the Emory vestibular clinic. At that time, the patient reported his bradycardia and high blood pressure had resolved significantly, but he still experienced headaches and dizziness that affected his daily life. He was referred to vestibular physical therapy with a diagnosis of left unilateral vestibular hypofunction, motion sensitivity, and persistent postural perceptual dizziness (PPPD).

Vestibular Physical Therapy Evaluation

History: The patient presented for a physical therapy evaluation in July 2021. He is a pediatrician working part-time with assistance from his staff on days he experienced increased symptoms. He reported only one fall to the ground, but stated he had had learned how "to catch himself". He described symptoms when watching certain scenes on TV, working on a computer or smart phone, as well as watching people and objects moving around him. He also complained of dizziness while riding in a car. He experienced fatigue at work and was unable to participate in family activities as much as he wanted to.

Physical Exam: See Table 1 for tests and measures performed at the initial physical therapy evaluation. Patient-reported outcome measures showed low balance confidence and high perceived handicap due to dizziness. Scores on the Visual Vertigo Analog Scale (VVAS) and the Vestibular Rehabilitation Benefit Questionnaire suggested severe symptoms.

A motion-provoked dizziness screen performed standing showed increased symptoms with horizontal and vertical head turns, 360º turns to the right and left, and vestibular ocular reflex cancellation (VORc).

The patient's oculomotor exam (fixation, gaze-evoked nystagmus, saccades, cover/uncover test, near-point convergence) was normal. The head impulse test was normal. The modified Clinical Test for Sensory Integration in Balance (mCTSIB) and instrumented dynamic visual acuity tests (DVA) were normal. The patient ambulated with a slow gait speed and demonstrated a risk for falls based on the Functional Gait Assessment (FGA) score.(16)

Table 1. Physical Therapy Tests and Measures

	Initial Evaluation	Re-evaluation (Week 10)
Patient-Reported Outcome Measures		
Activities-specific Balance Confidence Scale	59.7%	88.9%
Dizziness Handicap Inventory		
Total	64/100	30/100
Functional Subscale	36	14
Emotional Subscale	10	8
Physical Subscale	18	8
Visual Vertigo Analog Scale		
Total	64.7%	18.9%
Supermarket aisles	2.9/10	0.7/10
Passenger in car	7.1/10	2.8/10
Fluorescent lights	6/10	0.8/10
Traffic at busy intersection	7.4/10	3/10
Walking through shopping mall	NA	3/10
Riding down an escalator	NA	NA
Watching a movie in a theater	NA	NA
Walking on a patterned floor	6.9/10	1.4/10
Watching action television	8.5/10	1.5/10
Vestibular Rehabilitation Benefit Questionnaire		
Total	46.4%	25.8%
Symptoms	38%	21.3%
Dizziness	77.8%	55.6%
Anxiety	5.6%	5.6%
Motion-provoked	33.4%	10%
Quality of life	54.7%	30.4%
Performance-based Outcome Measures		
Computerized Dynamic Visual Acuity Test (logmar difference)		
Leftward head turns (NI is < .499 for leftward head turns)	0.28	0.21
Rightward head turns (NI is <.530 for rightward head turns)	0.21	0.13
Functional Gait Assessment	16/30	30/30
Preferred gait speed (meters/second)	0.74	1.16
Modified Clinical Test for Sensory Integration of Balance	120/120	120/120

Based on the physical exam, the patient was diagnosed with a functionally compensated left vestibular hypofunction. He also exhibited motion-provoked and visually induced dizziness that was consistent with PPPD. His history of migraines, fatigue, and dysautonomia were considered comorbidities that may impact his ability to successfully return to his pre morbid social activities and work responsibilities.

The following goals were developed to promote optimization of movement, activities, and participation:

1. Improve the Activities-specific Balance Confidence score to >80%.
2. Improve the Dizziness Handicap Inventory score to <30% and motion sensitivity based on a modified Motion modified Sensitivity Test (mMST)(pre-publication) to mild range (<10%), so that he can independently manage his premorbid COVID-19 work schedule.

3. Reduce VVAS by 50% in order for patient to return to his social activities with his family and friends
4. Increase FGA to >22/30- low fall risk in order to safely play with his grandchildren
5. Normal gait speed for age and gender

Intervention

The patient's exam demonstrated that he had achieved central compensation for his vestibular hypofunction. A plan of care, including in-clinic intervention, written and verbal patient education on PPPD and habituation principles, and a home exercise program were developed to address dynamic gait, sensory integration, and motion intolerance. The patient was prescribed the following daily home exercise program at his first visit:

1. Gait in a hallway with horizontal and vertical head turns every 3 steps- widening base of support as necessary for stability
2. Gait in a hallway alternating eyes open and closed every 3 steps with cues to "feel the ground"
3. Gait in a hallway stepping 5 steps forwards, then 5 steps backwards
4. Standing in an athletic stance with eyes open and closed on firm and compliant surfaces feeling the weight on the balls of his feet
5. Habituation exercises performed in standing: 2 sets of 3 horizontal head turns, 2 sets of 3 vertical head turns; 2 sets of 180º body turns to the right and left, and 3 sets of VORc to address visual motion sensitivity
6. Gait for endurance - walking his two dogs in the neighborhood for at least 20 minutes

Progression:

The patient was seen every two to three weeks for a total of 5 treatment sessions. On the second visit, the home exercises were reviewed, and habituation exercises were progressed. At that time, he could not complete all 10 items of mMST since his symptoms did not return to baseline after the first few items. Other interventions over the next few visits included:

1. Multidirectional stepping while reading instructions on a handout on the wall. The patient performed 32 movements at a time, 2 sets a day, increasing his speed as able. He initially had difficulty processing the written instructions and following through with the movements, but his processing speed and fluidity improved with practice. Head turns were added at the second treatment session.
2. Card scavenger hunt. To simulate meal preparation, the patient matched playing cards placed at various heights in a small area, which facilitated looking up, bending over, and turning.
3. Habituation exercises. Habituation exercises included a balloon and ball toss in front of various backgrounds. He also watched you tube videos for optokinetic stimulation. Rest breaks were allowed when symptoms increased beyond "mild".

At his fourth visit, the patient reported that he missed several days of work and family gatherings due to increased fatigue, dizziness, and imbalance. He also reported sleeping 20 hours one night. The therapist reduced the number of repetitions of his habituation home exercise program as well as reminding him of the importance of pacing his daily activities.

On his fifth session, he was excited that he could perform his daily activities with minimal dizziness by pacing himself throughout the day. He was able to complete the mMST with a score in the moderate range

(29.4%) since his baseline symptoms were minimal and symptom duration was short. See Table 2. All movements were performed in standing with eyes open while facing a plain wall 4 to 6 feet away. As with the original Motion Sensitivity Test, (17) symptoms intensity and duration for symptoms to return to baseline were recorded.

Outcome

The patient attended 5 sessions of physical therapy over 2.5 months. Subjective and objective outcomes were reassessed on the fifth visit. See Table 1. He had not missed any recent recreational activities or work commitments. Goals were achieved except the mMST. He will continue his home exercises and return for one more appointment for re-evaluation in 2 months

TABLE 2. Modified Motion Sensitivity Test-item scores –performed on 5th visit

Movement Baseline-1/10	Intensity[a]	Duration[b]	Score[c]
5 Times Horizontal Head Turns	1	1	2
5 Times Vertical Head Turns	1	2	3
5 Times Right Diagonal Head Turns (upper left quadrant to lower right quadrant)	2	2	4
5 Times Left Diagonal Head Turns (upper right quadrant to lower left quadrant)	1	2	3
5 Times Trunk Bends (Reaching to floor with bent knees)	1	2	3
5 Times Right Quarter Body Turns (Look over right shoulder with trunk rotation, feet planted)	2	2	4
5 Times Left Quarter Body Turns (Look over left shoulder with trunk rotation, feet planted)	2	2	4
1 Time 360 Degree Turn to Right	0.5	1	1.5
1 Time 360 Degree Turn to Left	2	2	4
5 Times Vestibulo-ocular Reflex Cancellation (follow thumbs with left/right head/trunk rotation, 45 degrees each direction)	1	1	2
Motion Sensitivity Quotient[d]			29.4%

[a] Scored 0 to 10; 0=no symptoms, 10=severe symptoms- change from baseline
[b] <5 seconds = 0, 5-10 seconds = 1, 11-20 seconds = 2, 21-30 seconds = 3, >30 seconds=4
[c] Sum of item scores
[d] Intensity + Duration x number of movements with symptoms/14.00
0-10 mild range 11-30 moderate 31-100 severe

Discussion

We described the evaluation, intervention, and outcome for a patient with unilateral vestibular hypofunction, motion sensitivity, and PPPD. The patient presented with significant dizziness, low balance confidence, impaired dynamic visual acuity, impaired functional gait, and slow gait speed. Twelve months after his bout of COVID-19, he had not returned to his premorbid function. After being diagnosed with vestibular neuritis and PPPD and undergoing 10 weeks of individualized vestibular physical therapy, the patient demonstrated clinically meaningful improvements in all outcome measures.

According to Yachou et al, an exaggerated immune response of pro-inflammatory and anti-inflammatory cytokines, known as the cytokine storm, can cause neurological problems after a viral infection. (8) The virus can cause a direct infection of the nerve endings in the tissues of the central nervous systems or peripheral nervous system or it may cross the blood-brain barrier after infecting cells within the circulatory system.(8) In a retrospective chart review of 236,379 COVID-19 survivors, 12.84% were diagnosed with a new neurologic or psychiatric sequelae within six months following their diagnosis of COVID-19.(17) Individuals with a history of COVID-19 were more likely to be diagnosed with a subsequent neurologic condition than individuals who had influenza or another respiratory disorder during the same time period.

The COVID-19 virus can access the central nervous system through the olfactory bulb and may impact the vestibular system.(11) Yilmaz and colleagues assessed vestibular function in 37 non-hospitalized participants with COVID-19 and loss of smell and 30 healthy age-matched controls using the computerized posturography Sensory Organization Test to assess sensory integration, ocular and cervical vestibular-evoked myogenic potentials (oVEMP and cVEMP, respectively) to assess otolith function, and a video head impulse test (vHIT) to evaluate the semicircular canals.(11) They found differences in oVEMP and cVEMP outcomes between the participants with COVID-19 and the healthy controls. Interestingly, the vHIT showed more involvement in the vertical canals than horizontal canal. (11)

COVID-19 is a novel viral infection and its full impact on the nervous and cardiopulmonary systems is still unknown. Patients with a history of COVID-19 who are referred to outpatient vestibular physical therapy should be evaluated with familiar outcome measures, but the physical therapist should pay additional attention to fatigue, heart rate, blood pressure, and respiratory rate during treatment sessions. These symptoms may affect progression of interventions and dosage of home exercises. Patients may require more visits than those with non-COVID-related vestibular diagnoses. This case report demonstrated that an individual with COVID-related symptoms for more than a year improved with five visits of physical therapy. The patient reported increased fatigue that impacted his participation after the fourth visit. His home exercises were modified, and he showed significant improvements on the last visit.

Conclusion

This case report demonstrates that a patient with multiple complications following COVID-19 and a diagnosis of PPPD can improve within 3 months of individualized vestibular physical therapy that includes gait, balance, and habituation exercises. Coordination from his healthcare providers including his PCP, cardiologist, otolaryngologist, neurologists, and physical therapist was instrumental in his recovery.

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Dizziness in the Aftermath of COVID-19: Could it be POTS?

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Abstract
With the advent of COVID-19 came a host of lasting residual effects. Post-COVID-19 syndrome is characterized by symptoms lasting four weeks beyond a patient's initial COVID-19 diagnosis. Patients suffering from post-COVID-19 syndrome may present with a variety of symptoms, but often report dizziness as a chief complaint. The prevalence of COVID-19 in the population in conjunction with frequent complaints of dizziness, suggests that clinicians specializing in the treatment of vestibular disorders are likely to encounter patients following a bout of COVID-19 and differential diagnoses less commonly seen may need to be considered. One such differential is postural orthostatic tachycardia syndrome (POTS). This brief review presents an overview of POTS, identifies the similarities in symptom presentation found between POTS and post-COVID-19 syndrome, and outlines potential treatment considerations.

The views and information expressed are those of the author and do not represent the official position of the U.S. Army Medical Center of Excellence, U.S. Army Training and Doctrine Command, Brooke Army Medical Center, Department of the Army, Department of Defense, Defense Health Agency, or U.S. Government.

Background

A clinician specializing in the treatment of vestibular disorders is no stranger to a chief complaint of dizziness or the extensive list of disorders of which it may accompany. With the emergence and widespread impact of the novel coronavirus, SARS-CoV-2, the resultant COVID-19 disease, and the possibility of long-term side effects of the disease, it is more important than ever for clinicians to be aware of potential differential diagnoses. A factor somewhat unique to COVID-19 is that while initial symptoms may present mildly, more significant residual symptoms have been reported up to several months afterward. This is particularly true in the case of "long haulers," the term ascribed to patients that experience symptoms that persist more than four weeks following the initial COVID diagnosis. The diagnosis reserved for long-haulers is referred to as either "Post-COVID-19 syndrome" or "long COVID-19."(1) Establishing a treatable diagnosis for prolonged symptoms following an initial diagnosis of COVID-19 proves challenging as symptoms vary widely. However, postural orthostatic tachycardia syndrome (POTS) may serve as a valuable differential for a clinician to keep at the top of their list. The purpose of this brief review is to present an overview of the syndrome, the similarities it shares with what the Center for Disease Control and Prevention has described as post-COVID-19 syndrome and describe the details of an associated treatment that may prove successful in resolving symptoms.

Postural Orthostatic Tachycardia Syndrome (POTS)

A form of dysautonomia, POTS is characterized as orthostatic tachycardia in the absence of orthostatic hypotension.(2) Five subtypes of the syndrome have been classified thus far: 1) neuropathic, 2) hyperadrenergic, 3) hypovolemic, 4) autoimmune, and 5) deconditioning.(3) While a full review of each

subtype is outside the scope of this review, the common pathway among most patients suffering from POTS is excessive tachycardia in the setting of cardiovascular deconditioning. While the pathophysiology of POTS is rather heterogenous, experts have proposed several theories involving impaired peripheral autonomic function, cardiovascular deconditioning, excess sympathetic tone, and autoimmune dysfunction.4 Impaired innervation of the veins and a subsequent decrease in response to sympathetic stimulation is often cited as playing a key role in the pathogenesis of POTS. The impaired innervation causes venous pooling in the legs when the patient is in the dependent position and consequently reduces venous return to the heart.(4) Potential mechanisms of POTS are not mutually exclusive but actually have a tendency to overlap, adding a degree of difficulty in constructing a comprehensive framework of the syndrome.

Even though symptoms and physiological mechanisms present as far more complex than an isolated increase in heart rate, the current diagnostic criteria for the syndrome revolves around an increase in heart rate of 30 beats per minute (bpm) or more within the first 10 minutes of standing, in the absence of another overt cause of the orthostatic symptoms or tachycardia, such as acute dehydration, active bleeding, and/or the use of certain medications.(2,5,6) Although distinguishing between POTS and orthostatic hypotension can be challenging, the presence of orthostatic tachycardia despite maintenance of a normal blood pressure serves as a critical component for differentiation.(2,5–7) Commonly described symptoms may include, but are not limited to: lightheadedness, pre-syncope, sleep disturbances, cognitive fatigue or brain fog, and severe chronic fatigue. Onset of the syndrome often occurs following a prolonged period of illness or vaccination, with the Epstein-Barr virus being the virus most commonly associated with the condition.8 Orthostatic intolerance may develop for a number of reasons, but is typically caused by either deconditioning, disrupted circadian rhythm, or dietary deficiencies. When conducting a subjective patient history, conditions that occasionally occur concomitantly and should be heighten the clinician's index of suspicion include, but are not limited to: irritable bowel syndrome (IBS), hypermobility syndromes (such as Ehlers-Danlos), and vascular compression syndromes.(6)

Though POTS is typically considered a diagnosis of exclusion, specific subjective and objective clinical histories should be included within the examination. A recent history of a virus or vaccination (most typically following the Epstein-Barr virus), prolonged bedrest due to illness or injury, and assessment of potential concomitant conditions serves as most valuable subjectively.(8) Objective clinical examination typically includes an assessment of heart rate first while the patient is supine and then at several points over a 10-minute period of standing. A heart rate increase of greater than 30 beats per minute is considered positive for this test. Examination and identification of rashes, Raynaud's phenomenon, and acrocyanosis is also relevant as is auscultation for carotid, renal, and epigastric bruits or cardiac murmurs. Finally, due to the association between POTS and hypermobility, administration of the 9-point Beighton scale, specifically the thumb to forearm measure, may provide confirmation of a suspected diagnosis. Further investigation may include an ECG and/or 24-hour monitoring of cardiac rhythm, tilt-table testing, autonomic testing of the baroreceptor reflex, assessment of intravascular volume and cerebral blood flow, and labs for plasma and urine catecholamines as well as a full immunologic work-up.(6)

Post-COVID-19 Syndrome

While a full review of the pathophysiology and associated treatments of COVID-19 are outside the intent of this document, understanding the equally heterogenous presentation within the patient population is paramount to understanding the significance of recognizing related differential diagnoses. While the SARS-CoV-2 virus is best known for impacting the respiratory system, other organ systems are also known to be involved. Although far from exhaustive, the primary symptoms of COVID-19 as documented by the Centers for Disease Control and Prevention include: fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, and either congestion or a runny nose.(1)

If a patient suffers from the aforementioned symptoms four weeks beyond their initial COVID diagnosis, the new syndrome is termed either "Post-COVID-19 Syndrome" or "long COVID-19."(9) This may include everything from a patient losing his or her sense of smell for prolonged periods of time to complaints of significant gastrointestinal distress, or as is most relevant here, the occurrence of frequent dizziness. Of central importance to this review is the substantial overlap (illustrated in Figure 1) specifically found between postural orthostatic tachycardia syndrome and COVID-19. Although it would be incorrect to assume that every patient suffering from post-COVID syndrome is experiencing POTS, it should be included in the differential, as POTS is often suspected following prolonged viral illnesses and there is a significant portion of shared symptomatology between the two.

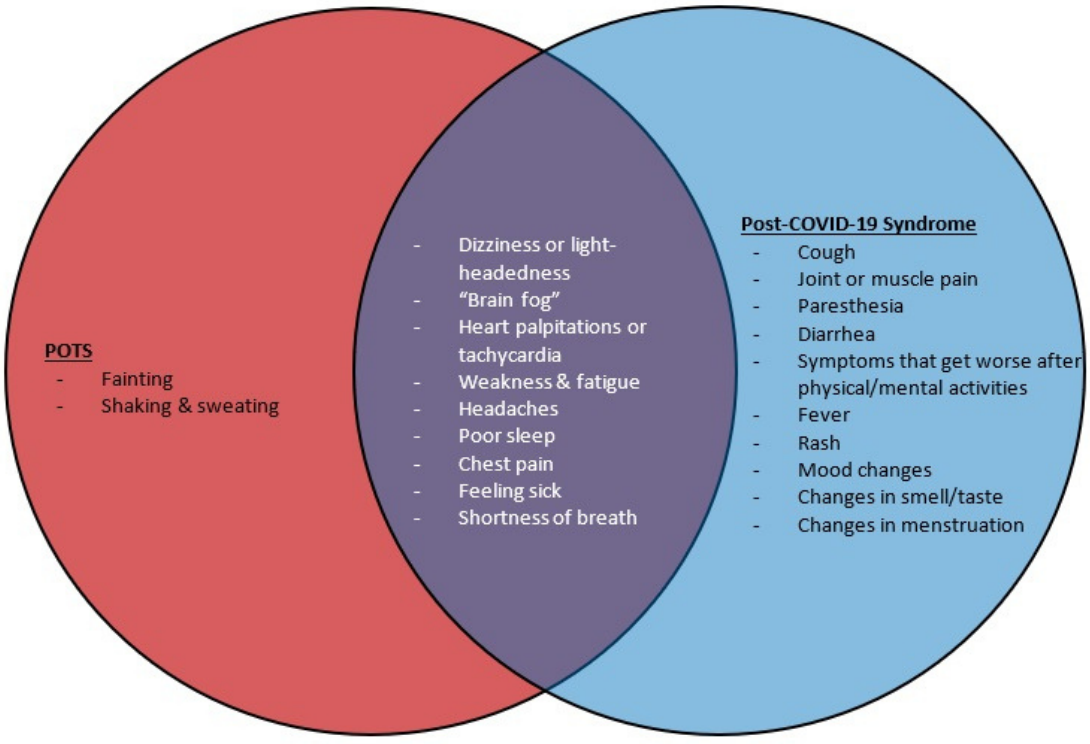

Figure 1. A Venn diagram illustrating the shared symptomatology of POTS and post-COVID-19 syndrome per the National Health Service and the Center for Disease Control and Prevention, respectively.

Treatment

Currently, there is not a standard approach to treating patients post-COVID suffering from POTS due to the variety in subtypes as was detailed above. Treatment needs to be personalized based on the subtype identified. A few potential treatment options include focused hydration, dietary modifications and/or referral to a registered dietician, use of certain medications based on the presenting symptoms, and physical therapy. It is important to note here that physical therapy, though critical to a full recovery, may be delayed for several months before a patient is conditioned to the extent necessary to undergo a traditional PT regimen. As is often the case, patient education, with specific emphasis placed on lifestyle strategies, is critical to successful treatment. This may include recommendations to avoid overheating, elevate the head of the bed, maintain adequate sleep hygiene, focus on aspects of lifestyle management, and participate in a recumbent exercise program.

The Levine Protocol, a variation of the Dallas and Children's Hospital of Philadelphia (CHOP) Protocols, was developed by Benjamin Levine, a cardiologist based in Dallas. All three protocols are exercise-based physical therapy regimens intended to decrease the symptoms of POTS by improving standing and exercise tolerance through habituation. All protocols also start with forms of exercise in a horizontal, or recumbent, position. The Levine protocol is a modified version of the original Dallas/CHOP protocols that includes two additional months of conditioning intended for individuals who are/were bedridden or who are severely exercise intolerant. These protocols are highly specific and structured, but due to their duration (anywhere from three to eight months, depending on symptom severity), they require a motivated and compliant patient, making patient selection critical to success of treatment. Because each protocol is organized in tiers, successful outcomes rely on a therapist distinguishing their patient's position on the spectrum, so that exercise prescription is specific to a patient's particular limitations. In the Dallas/CHOP protocols, months one through three involve horizontal or seated training. Assuming the patient improves, he or she should be progressed to an upright bike in the fourth month. The elliptical and treadmill can be added during the fifth month, although the protocol discourages use of arm motion on the elliptical or an increase in incline on the treadmill until months six through eight, using both as means of further progression in months six through eight. The therapist must be mindful of each patient's initial exercise tolerance and ensure that the prescribed routine is challenging enough to instigate changes in symptoms and subsequent increases in that tolerance.

While there is a paucity in the literature regarding the utilization of the Dallas/CHOP protocols, and no specific information regarding the Levine Protocol, George et al. enrolled 251 patients in a 3-month program involving mild- to moderate-intensity endurance training in which subjects progressed from semi-recumbent to upright exercise while they simultaneously increased salt and water intake. Only 103 of the initial 251 patients completed the program; however, of those 103, 71 percent described no longer experiencing the symptoms deemed characteristic of POTS.(10)

Discussion

So, the real question remains—is there a relationship between COVID-19 and POTS? Based on a review of the current literature, it is reasonable believe there could be. The true value in this relationship may be how it impacts research moving forward. In an interview in April, Dr. Tae Chung, a physician at Johns

Hopkins who created the specialty clinic for patients with POTS post-COVID, noted that he has never seen an influx of patients like the one he has seen since the advent of COVID-19. Along with treating patients with POTS, a primary reason for opening his specialty clinic was to conduct research to further understand the incidence of POTS, whether the incidence is the same following other infections, and if not, what aspect of COVID-19 makes people more susceptible to developing POTS.(11) In an article from late 2020, he writes that although for many patients diagnosed with POTS, it can be challenging to determine the exact cause of the condition, in patients with POTS following COVID-19, the cause is more clear, making it considerably easier to compare patients with those who recovered fully from the virus. He believes that if researchers can understand the relationship between COVID-19 and POTS, deriving the cause of POTS under different circumstances may then also be possible.(7)

Clinical Relevance

The goal of this review is not to suggest that every symptomatic "long-hauler" should be considered a patient with POTS, but rather, given the significant overlap in presentation between the two pathologies, to offer a brief overview of a potential differential diagnosis as well as associated treatment considerations related to the condition. The scarcity in the available literature renders it impossible to recommend any of the above protocols without reservation, however, due the dramatic negative impact POTS may play in a patient's quality of life, it is certainly worth investigating. The likelihood that a patient may seek treatment from a clinician specializing in vestibular disorders is high because post-COVID-19 syndrome and POTS share chief complaints of dizziness and/or lightheadedness. As such, a basic understanding of POTS may serve a clinician well in identifying the root cause and subsequent appropriate treatment for a patient.

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ICVR Poster Presentation Abstract Submissions

Poster submission portal is open from Feb 9th through March 24th 2022.

CSM 2022 Preview

Anne K. Galgon PT, PhD, NCS

Are you thinking about coming to CSM 2022? Here is a preview of what we think you might like.

Do you want to meet and network with vestibular physical therapists, and find out what the VR SIG is doing? There are many places you can find vestibular physical therapists in San Antonio in February.

Vestibular SIG breakfast and networking event: Check this out on Saturday Morning, Feb. 5th at 6:30 am. Location to be announced. Come talk to VR SIG leaders and members of committees and tasks forces. It is a great opportunity to consider how you can contribute to this important area of physical therapy. There will be complimentary breakfast.

ANPT Myelin Melter on Friday night. Come and talk to the leadership and members and take a chance to win prizes at the VR SIG table.

Vestibular Poster Session is on Friday 1-3 pm in the Exhibit Hall. This is always a great place to exchange ideas with researchers and clinicians interested in advancing vestibular physical therapy.

VR SIG Virtual Business meeting will be held before CSM on Jan 24th at 8 pm EST. Our chair, Rachel Wellons, will present VR SIG accomplishments and plans for the future. This would also be a good opportunity to ask questions and meet the leadership team and engaged members. This may be a great way to see faces of people you want to find at CSM. The VR SIG will also hold our annual drawing. Attendees have to opportunity to win great VR related Prizes.
Zoom information is provided below.
Topic: Vestibular SIG Business Meeting
Time: Jan 24, 2022 8:00 pm ET/7:00 pm CT/6:00 pm MT/5:00 pm PT
Join Zoom Meeting
https://us06web.zoom.us/j/89752874613?pwd=Q0FJZmVNT3MvZ3N5YStBWFZxc1dmZz09
Passcode: 120226
Call in number if needed 1.301.715.8592

CSM presentations: Going to presentations is a great way to meet a VR physical therapist. Each year the Vestibular Rehabilitation SIG reviews CSM program content and makes recommendations of presentations that may be of interest to physical therapists who are managing individuals with vestibular related disorders. Below presentations are listed by day, time, program designation, title, speakers and location.
Wednesday, February 2nd (Pre Con)

- 8-5 OR-11264 Post-Concussion Evaluation and Treatment: Implementing the Clinical Practice Guidelines. Arielle Giordano, Catherine Quatman-Yates, Robert Landell, Bara Alsalaheen, Karen McCulloch. Convention Center 004 Mayor Cockrell Room.
- 8-5 NE-10390 Concussion Subtypes; Is It Relevant for Physical Therapists? Laurie King et al. Grand Hyatt – Travis C.

CSM 2022 Preview

Thursday, February 3rd

- 8-10 SP-10822 Dual Task Assessment in Concussion Management: Are We Ready To Jump in With Both Feet? Rebecca Bliss and Bara Alsalaheen. Convention Center, Stars at Night BR 2&3.
- 8-10 RE-10466 ACE Talk: Telehealth and Digital Physical Therapist Practice Now and Beyond. Alan Lee, Anang Chokshi, Matthew Miller, Sang Su Pak, Susan Whitney. Grand Hyatt, Presidio ABC (Balcony).
- 8-10 GR-11064 Conquering COVID-19: Offering Virtual Fall Risk Screening and Fall Prevention Programs for Older Adults. Jennifer Nash, Mindy Renfro, Shannon Martin. Convention Center, 302.
- 11-1 NE-10497 Vestibular Rehabilitation for Peripheral Vestibular Hypofunction: Clinical Practice Guideline Update. Courtney Hall, Eric Anson, Wendy Carender, Carrie Hoppes, Susan Herdman, Susan Whitney. Grand Hyatt, Lone Star Salon ABC.
- 11-1 SP-11387 When Science Meets Practice 3: Psychological Impact on Care provided by physical therapists. Michael Mullaney, Moderator, Platforms, Convention Center, 225
- 3-5 PD-10516 Model of Multi-Disciplinary Management of the Complex Pediatric, Adolescent, and Young Patient Post mTBI. Kelsie Murek and James Cahalin. Convention Center, 214.

Friday, February 4th

- 8-10 GR-10815 Uploading and Upgrading Geriatric Physical Therapy: Understanding and Integrating Telehealth With Vulnerable Older Adults. William Dieter and Katherine Sheehan. Convention Center, 302.
- 11-1 CP-10485 Balance Assessment and Treatment in the Patient with Cardiovascular and Pulmonary Disease. Diane Wrisley, Elder Garavito, Sharan Zigres, Ashley Poole. Convention Center, 213.
- 11-1 AC-10803 Differential Diagnosis and Dizziness in the Hospitalized Inpatient. Daniel Ludwig and Kerry Lammers. Grand Hyatt, Texas Salon BC.
- 11-1 NE-11326 Dispelling the Myths Around Concussion: Using Best Evidence to Improve Care. Anne Mucha, Michael Collins, Victoria Kochick. Grand Hyatt, Texas Salon EF.
- 3-5. NE-11193 Persistent Postural Perceptual Dizziness: Navigating Waters of Uncertainty. Rachel Wellons and Janene Holmberg. Grand Hyatt, Long Star Salon DEF Corridor.
- 3-5. NE-10608 Maximizing Motor Learning, Engagement, and Participation: Applications in Autonomy. Chelsea Richardson, Julie Hershberg, Mike Studer. Grand Hyatt, Texas Salon EF.

Saturday, February 5th

- 8-10. AC-10705 Beyond the Bottle: Alcohol and Acute Mobility Considerations. Kimberly Lemmons, Bethany Spain, and Amanda McDaniel. Grand Hyatt, Texas Salon A
- 11-1. NE-11149 When Your Vestibular System Gets You Down: Treating Vestibular Dysfunction in Individuals with Parkinson Disease. Catherine Printz and Kayla Covert. Grand Hyatt-Texas Salon EF.
- 11-1. NE-11509 Neurology Platform Session 3: Vestibular, SCI, and Multiple Sclerosis. Grand Hyatt, Crockett AB.
- 3-5. NE-11205 Emerging Interventions for Rehabilitation of Mild Neurocognitive Disorders: Evidence From Neuromodulatory and Cognitive-Motor Training Approaches. Tanvi Bhatt, Joe Verghese, Brooke Klatt, and Brad Manor. Grand Hyatt, Texas Salon EF.
- 3-5. NE-10772 Instrumented Assessments of Postural Control Are Coming to the Clinic: Are You Ready? Anat Lubetzky and William Wright. Grand Hyatt, Lone Star Salon DEF Corridor.
- 3-5. SP-10995 Must Haves When Treating Across the Concussion Spectrum. Chelsea Orteco, Catherine Quatman-Yates, Airelle Giordano, Rebecca Bliss. Convention Center, Stars at Night BR 1