Fall 10-26-2021

Case Series: Demonstration of the Criticality of Early Identification for Vestibular Labyrinthitis

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For Fulfillment of Doctor of Audiology Degree

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Case Series: Demonstration of the Criticality of Early Identification for Vestibular Labyrinthitis

October 2021

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Introduction: labyrinthitis occurs when both branches of the vestibulocochlear nerve swell, specifically the vestibular and cochlear portions. Diagnosed by the process of elimination, labyrinthitis can have detrimental auditory and vestibular effects when identified untimely. When diagnosed early, labyrinthitis can be resolved with rest, medication, and vestibular rehabilitation therapy. Case Presentation: A young adult presented to the clinic with a heavy head sensation, lack of concentration, and blurry vision that escalated to left ear fullness, unilateral tinnitus, and an untriggered persistent headache. Discussion: This patient was undiagnosed for three months due to the unavailability of vestibular testing in the emergency room where he initially received treatment. No clinical screening tool was discovered that could be used by urgent and emergency care clinicians for rapid identification and classification of vestibular disorders. Conclusion: Further research is needed to improve early identification of vestibular problems.

Case Presentation 1

An Adult Male with Chronic Labyrinthitis

Introduction

Commonly peripheral in nature, there are several causes of dizziness and vertigo, one of which is labyrinthitis (1). Labyrinthitis, generally triggered by an inner-ear viral infection, affects the labyrinth and causes both branches of the vestibulocochlear nerve in the inner ear to swell (2). Although rare, labyrinthitis can sometimes emerge from a bacterial infection. Often, in these cases, it is caused by a complication of otitis media or meningitis (3). The swelling of both branches may produce clinical symptoms such as hearing loss, tinnitus, vertigo, nausea, and nystagmus. To be classified as labyrinthitis, and not vestibular neuritis, a patient must present with hearing loss, tinnitus, or both (4). Labyrinthitis is typically unilateral, but, rarely, can affect both ears. It is diagnosed empirically, by process of elimination, and paired with examinations such as an audiological evaluation (e.g., diagnostic audiogram), videonystagmography (VNG), magnetic resonance imaging (MRI) of the brain, and other vestibular tests (3).

There are two potential phases of labyrinthitis. The acute phase is when symptoms present themselves suddenly, typically with severe dizziness, when waking up in the morning. By comparison, the chronic phase is when a person is presumed to be recovering from labyrinthitis, however the timeline of recovery is gradual (4). Treatment during the acute phase may include prescription medications for nausea or dizziness. Additional medications like steroids may be used to treat inflammation and reduce the chance of permanent inner ear damage. Some pharmaceuticals are prescribed prophylactically to allow individuals to function during the chronic phase. Permanent hearing loss can occur, or symptoms may persist, if labyrinthitis is not treated promptly (3). Assessments during the chronic phase may include a

VNG, audiogram, and vestibular evoked myogenic potentials (VEMPs) that can be used to detect the damage specifically on the site of lesion on the vestibulocochlear nerve. When symptoms persist, vestibular rehabilitation therapy may be a recommended course of treatment (4).

Case Presentation

A young adult male presented with a heavy head sensation, lack of concentration, and blurry vision upon awakening in the morning. These symptoms caused him to panic, followed by a visit to the emergency room. There, he was treated for a panic attack and not a vestibular condition. Approximately one week later, the patient reported a second episode that lasted for 10 days as a persistent dull headache, chronic rocking sensation, left ear fullness, and occasional lightheadedness. He returned to the emergency room and was given a head computerized tomography (CT) and chest x-ray, which were both interpreted as negative. A week later, he experienced a unilateral tinnitus that he described as a "buzzing sound" that was worse in the morning. Four weeks following his initial symptoms, an audiological evaluation was conducted, which demonstrated normal-hearing thresholds (Figure 1).

Six weeks following his initial symptoms, the patient was seen for an initial physical therapy evaluation. A Dix Hallpike maneuver was administered and classified as negative. Seven weeks after the initial symptoms, electromyography with nerve conduction velocities, MRI, and magnetic resonance angiography (MRA) were conducted, and revealed normal results. Two months after his initial symptoms, he was seen for VNG and binaural bi-thermal caloric irrigation. During this appointment, the patient reported that his unilateral tinnitus was minimal but present. He denied all other otological symptoms. Binaural, bi-thermal caloric irrigation

revealed a 17% left-sided weakness, which was classified as a borderline weakness. As a result, the recommendation was for the patient to continue with vestibular retraining therapy.

Outcome

Additional vestibular examinations were administered. Data from cervical vestibular evoked myogenic potentials (cVEMPs), which are short-latency, vestibular-dependent reflexes that are recorded by way of the sternocleidomastoid muscles in the neck, were classified as negative. Video Head Impulse Testing (vHIT), an ear-specific assessment that identifies disorders of the vestibulo-ocular reflex and identifies the affected ear in cases of peripheral vestibular disorders, demonstrated inconsistent overt saccades to leftward stimulation but provided no other significant findings. Rotatory chair testing (RCT), conducted to determine if the peripheral inner-ear or neurological vestibular system is the cause of a balance disorder, was within normal limits. Computerized dynamic posturography (CDP), which uses a platform to objectively measure the functionality of a patient's sensory inputs, produced a composite score of 20 (Figure 2). For CDP, a score of 70 or greater is considered within normal limits. During the alignment portion of the CDP testing, there was a noticeable left-sided weakness. The patient was referred for vestibular rehabilitation training due to acute labyrinthitis.

Discussion

It is estimated that 5% of all dizziness, and 15% of all vertigo is caused by either vestibular neuritis or labyrinthitis (5). Although more common in adults, labyrinthitis and vestibular neuritis can occur in children as well. Labyrinthitis is considered an otological emergency because prompt treatment results in less damage to the vestibulocochlear nerve (5).

Notwithstanding the fact that labyrinthitis can resolve on its own, differentiating the cause can prevent long-lasting symptoms.

Inopportunely, there is no specified test battery for labyrinthitis. Currently, due to the rapid on-set of symptoms, most patients do not seek specialty care. Because case history can only lead to diagnosis 75% of the time (1), a screening tool for labyrinthitis should be developed. Most medical settings use the Dix-Hallpike maneuver to assess vertigo symptoms (1), but the Dix-Hallpike is primarily designed to rule out benign paroxysmal positional vertigo (BPPV). Hence, absence of a screening tool for labyrinthitis causes delays in identification and referral for definitive care. Patients who are not diagnosed in a timely manner may suffer increased damage to the vestibular and cochlear nerve, including permanent hearing loss and severe balance problems (5).

Altogether, this case demonstrates how, for cases of labyrinthitis, delays in diagnosis and treatment can occur due to the need for multiple appointments. These delays position the patient for poor outcomes and unnecessary stress. It may be possible to streamline care for these patients if a simple screening tool could be developed for use during initial encounters.

Conclusion

Audiologists and otolaryngologists are usually not the triage provider for patients with labyrinthitis or vestibular neuritis symptoms. Further research on a screening tool should be conducted to improve identification of patients with labyrinthitis, including diagnosis and treatment.

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An Adult Male with Labyrinthitis and COVID-19 Antibodies

Abstract 2

Introduction: Labyrinthitis is fundamentally a combination of symptoms that include vestibular neuritis, hearing loss, or tinnitus and is commonly attributed to a viral infection, seldomly bacterial. Labyrinthitis is often treated symptomatically and by vestibular therapy; however, patients identified with a 100% caloric-irrigation loss are likely to never fully recover. Case Presentation: An older adult male presented with a history of benign paroxysmal positional vertigo and magnetic resonance imaging significant for an increased signal of the right vestibule and semi-circular canals. The patient was found positive for COVID-19 antibodies, which stems from a human infection caused by the novel coronavirus strain SARS-CoV-2. Discussion: Given scarce research on COVID-19 as a potential cause of vestibular neuritis or labyrinthitis, it is reasonable to believe that the virus may contribute to vestibular outcomes. Conclusion: Further research is needed to determine if vestibular neuritis or labyrinthitis are outcomes of COVID-19 infection.

Case Presentation 2

Adult Male with Labyrinthitis and COVID-19 Antibodies

Introduction

An inflammation of the labyrinth that results from a bacterial or viral infection, vestibular labyrinthitis accounts for approximately 5% of all dizziness complaints and produces decreased hearing acuity as well as dizziness and vertigo (1). Vestibular labyrinthitis is most frequently caused by a viral infection. As such, viral infections of the inner ear can be produced by a contagion that has afflicted other parts of the human body (2).

Spread by person-to-person contact, COVID-19 is an infectious disease caused by the novel coronavirus strain SARS-CoV-2. This viral infection spreads and exhibits itself in a variety of ways in humans and can affect both the upper and lower respiratory tract (2). Although COVID-19 most often affects the respiratory tract, there is evidence to support that it can enter the central nervous system and advance by axonal transport (2). Therefore, the pathophysiology of COVID-19 induced vestibular labyrinthitis may be similar to any other viral infection.

A study in Wuhan, China reported that dizziness was a presenting symptom in 8% of all confirmed COVID-19 patients (3). A patient who tested positive for COVID-19 was treated for symptoms indicative of vestibular neuritis (3). Hence, it is apparent that COVID-19 is able to cause auditory and vestibular symptoms, unlike other forms of SARS. Another report suggested that COVID-19 can produce vestibular neuritis or labyrinthitis (4).

Case Presentation

An older male adult presented to the clinic with dizziness. His previous health history was significant for migraine headaches and left benign paroxysmal positional vertigo (BPPV).

He had received treatment for right-side BPPV by a physical therapist, yet symptoms persisted. Two months later, he had a magnetic resonance imaging (MRI) that showed increased signal of the right vestibule and semi-circular canals, suggesting labyrinthitis. Two weeks later, he completed an audiological examination and a COVID-19 antibody test that revealed he was positive. His audiometric test data revealed a sloping severe sensorineural hearing loss bilaterally with threshold asymmetry at 2000 Hz and decreased hearing sensitivity in the right ear.

Videonystagmography (VNG) was significant for left beating nystagmus in all positions except for right side when vision was denied. Bi-thermal air caloric irrigations revealed an 88% right unilateral weakness (Figure 1), with no waveform reversal observed during ice water caloric testing (Figure 2). Given the timeline of this condition, clinical symptoms and test results appeared to point to COVID-19-induced vestibular neuritis as the basis of his complaints.

Three months later, the patient returned for a follow up appointment because his symptoms persisted. He reported that his dizziness had worsened, resulting in a fall one week prior to his appointment. Another MRI was ordered with a computerized tomography (CT) scan. The MRI confirmed an increased signal for the right vestibule and semi-circular canals that was more prominent than the previous imaging study. Another VNG was scheduled in an attempt to monitor whether his vestibular rehabilitation therapy (VRT) had improved functioning of the right vestibular nerve. Results of these test data were unavailable.

Follow-up

The patient was initially recommended to continue with VRT. Vestibular rehabilitation therapy is non-invasive, cost effective, and sometimes the only type of management for individuals with vestibular neuritis or labyrinthitis. Positive VRT outcomes occur through a

process known as compensation, which is when the processing centers in the brain adapt to altered signals resulting from labyrinthitis. In some instances, patients with persistent debilitating symptoms may receive little to no benefit from VRT.

Discussion

The most common causes of vestibular labyrinthitis and neuritis are viral infections that result from a systemic virus. Influenza, measles, mumps, mononucleosis, chicken pox, and COVID-19 are examples of systemic viruses. As such, COVID-19 is a systemic virus that may behave similar to viruses that attack the auditory mechanisms and produce vestibular labyrinthitis or neuritis (4). Because our patient's illness began during the COVID-19 pandemic, and elective clinical procedures were restricted, VNG testing was not readily accessible in most parts of the country. In this case, early identification might have provided a prompter diagnosis of vestibular labyrinthitis and greater success with VRT due to more timely intervention (3).

In a case of labyrinthitis, early diagnosis and treatment is imperative. Labyrinthitis may be an acute phase or a chronic phase illness. Symptoms for our case persisted for several months, classifying this as a chronic phase condition. In isolation, it is possible that his COVID-19 infection contributed to damage of his vestibular nerve (4). Although labyrinthitis may subside on its own, such as acute phase disease, early identification should make the condition less likely to be long-lasting with a possibility of more favorable outcomes (2). In this case, it is possible that the caloric weakness of 100% in our patient's right ear may have been avoided.

One investigation reported dizziness in 17% of patients with COVID-19, and the importance of evaluating patients with neurological symptoms (3). Such a study supports a relationship between COVID-19 and auditory-vestibular disorders. Thus, there appears to be

evidence that COVID-19 is capable of damaging human cranial nerves, so it is plausible that COVID-19 may be the cause of our patient's vestibular labyrinthitis (4).

Conclusion

A male individual had extensive caloric weakness of his right ear that should have been identified sooner to avoid aggressive vestibular decline. More studies are needed in order to understand the degree to which COVID-19 can cause damage to the auditory-vestibular systems. Access to screenings and tools for early identification of labyrinthitis and neuritis might avoid poorer outcomes in patients who present for emergency, urgent, and even primary care services.

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Figure 1 (Case 1)

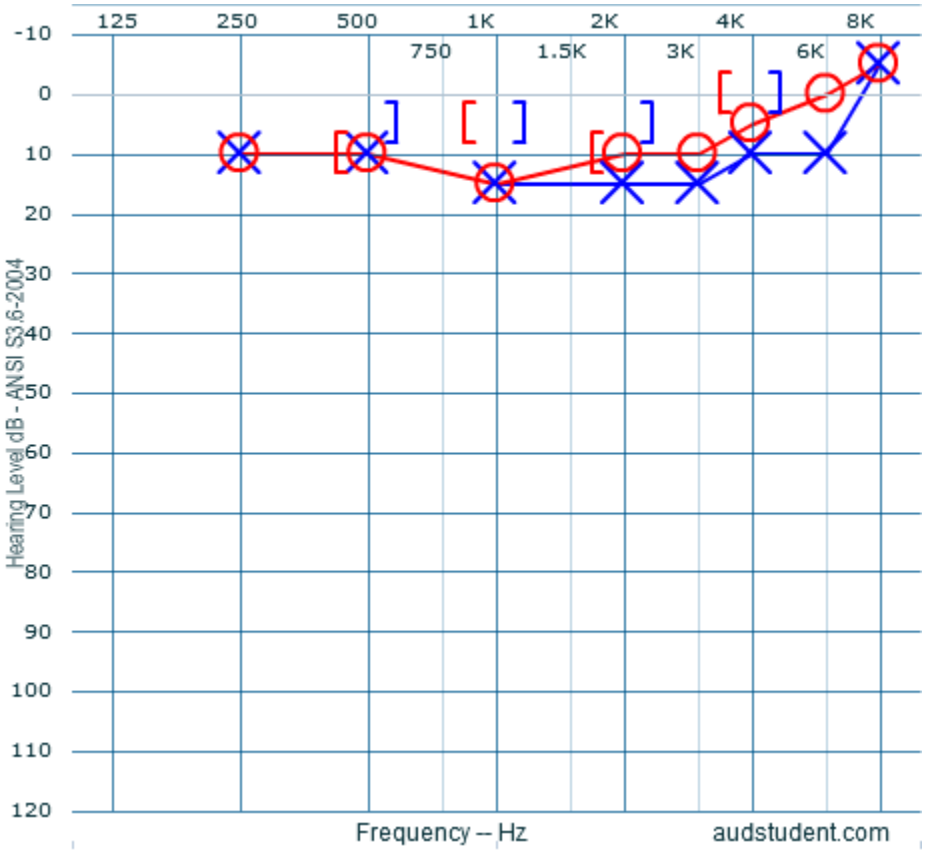

Figure 1. Audiometric data for left and right ear, including air and bone conduction thresholds.

Figure 2 (Case 1)

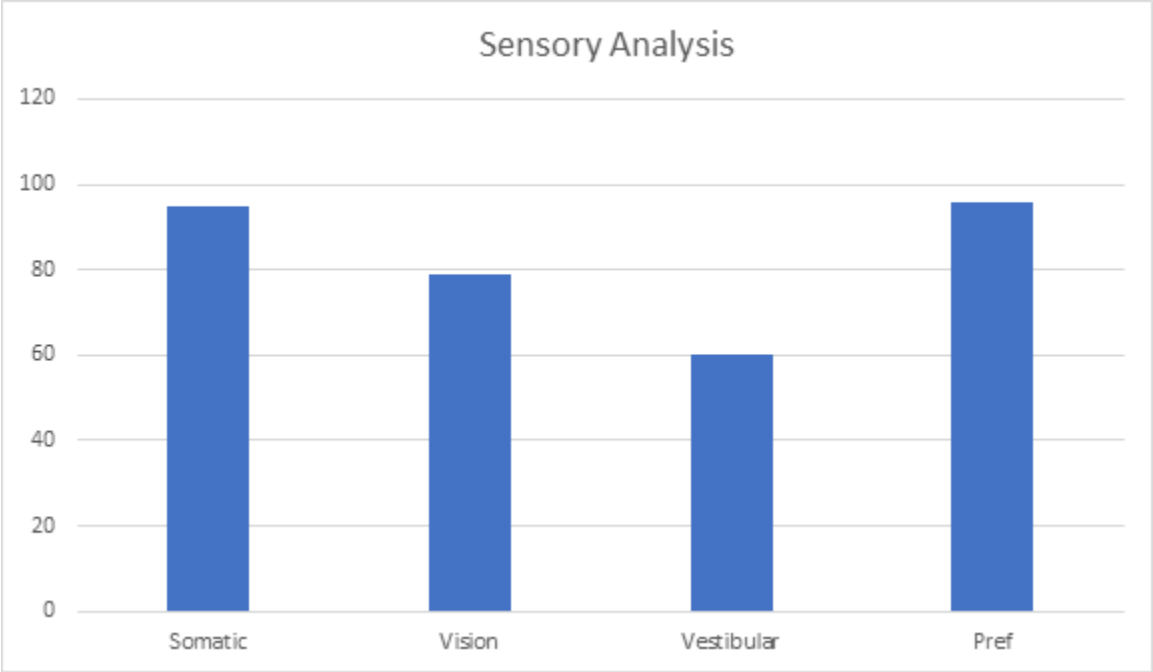

Figure 2. Computerized dynamic posturography sensory analysis data - composite score was 20 (70 or greater is within normal limits).

Figure 1 (Case 2)

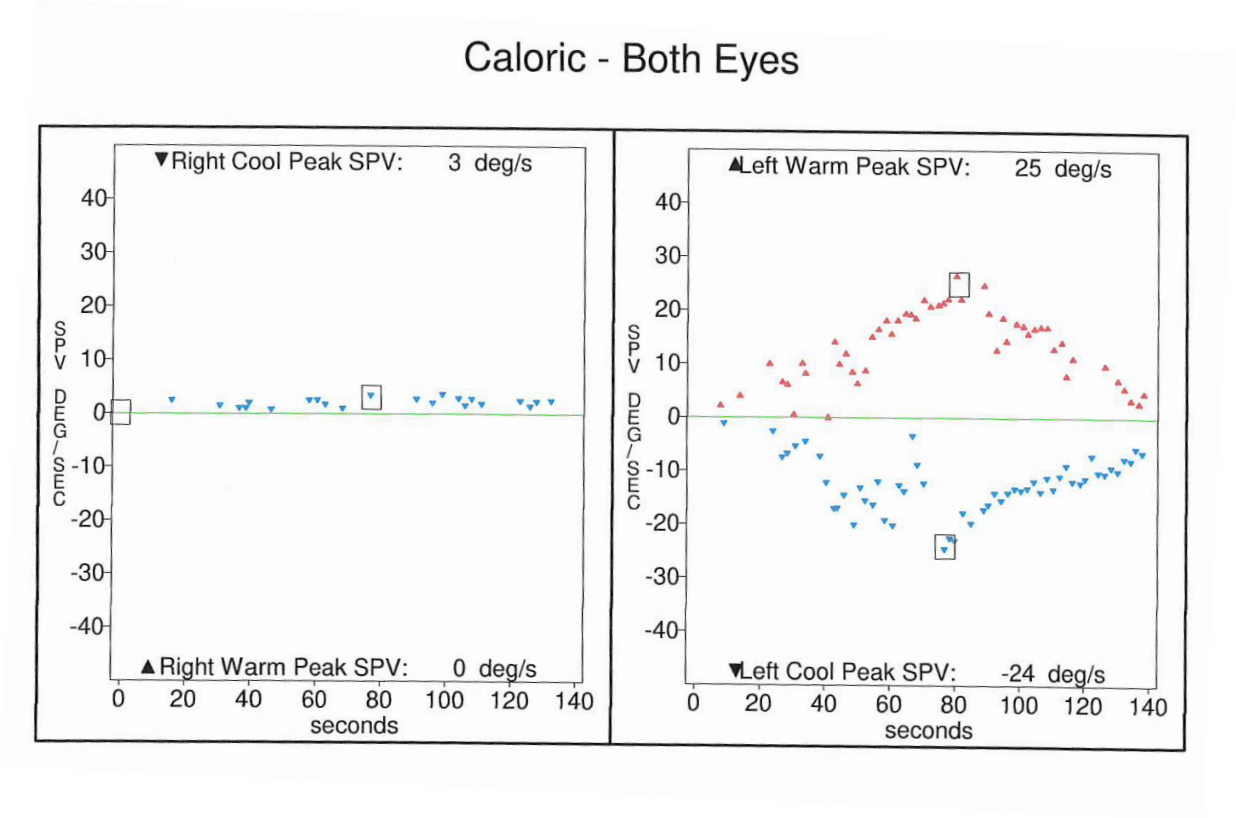

Figure 1. Bithermal air caloric irrigation data for the left and right ear. A total response of 3°/second in the right ear and 49°/second response in the left ear.

Figure 2 (Case 2)

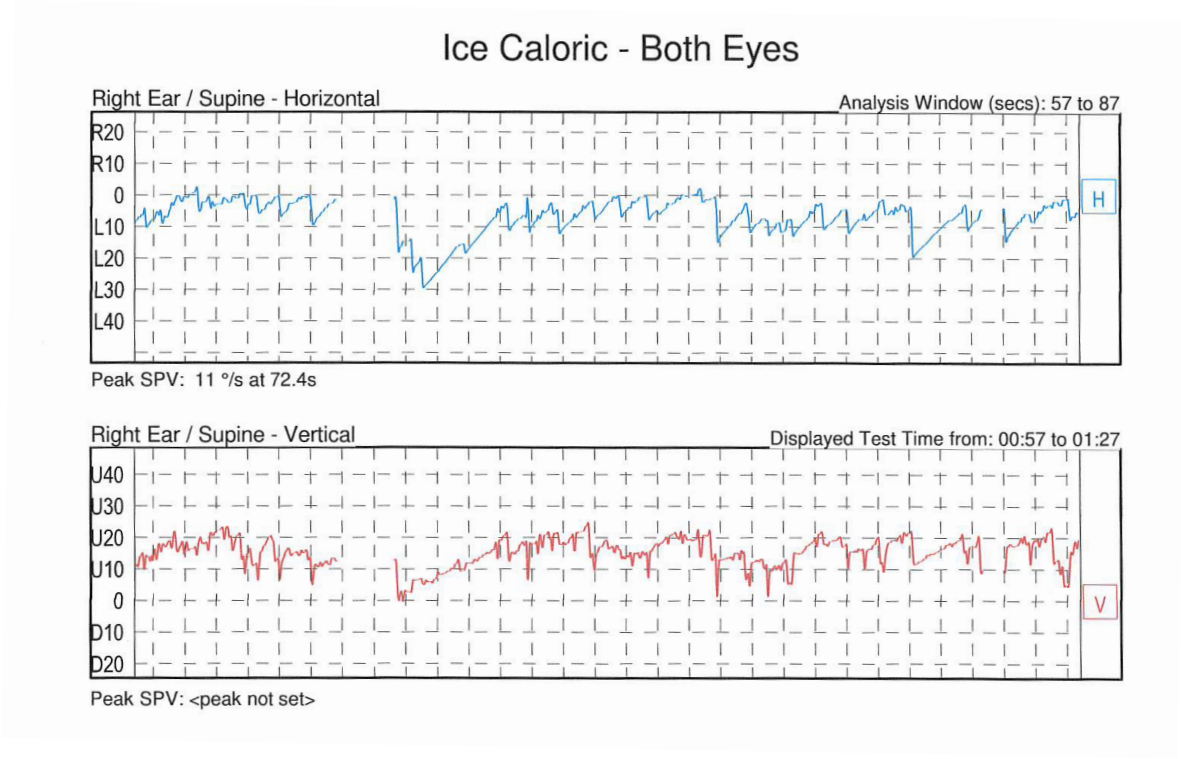

Figure 2. Horizontal and vertical ice-water caloric irrigation data for the right ear. This study was ordered to rule out spontaneous nystagmus at the right ear. There was not a reversal of the waveform which indicates no response and a complete unilateral weakness of the right ear.