

Vestibular Neuritis and Labyrinthitis: Infections of the Inner Ear

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Vestibular neuritis and labyrinthitis are disorders resulting from an infection that inflames the inner ear or the nerves connecting the inner ear to the brain. This inflammation disrupts the transmission of sensory information from the ear to the brain. Vertigo, dizziness, and difficulties with balance, vision, or hearing may result.

Infections of the inner ear are usually viral; less commonly, the cause is bacterial. Such inner ear infections are not the same as middle ear infections, which are the type of bacterial infections common in childhood affecting the area around the eardrum.

Inner ear structure and function

The inner ear consists of a system of fluid-filled tubes and sacs (see diagram on page 2) called the *labyrinth*. The labyrinth serves two functions: hearing and balance.

The hearing function involves the *cochlea*, a snail-shaped tube filled with fluid and sensitive nerve endings that transmit sound signals to the brain.

The balance function involves the vestibular organs. Fluid and hair cells in the three loop-shaped *semicircular canals* and the sac-shaped *utricle* and *sacculle* provide the brain with information about head movement.

Signals travel from the labyrinth to the brain via the *vestibulo-cochlear nerve* (the eighth cranial nerve), which has two branches. One branch (the cochlear nerve) transmits messages from the hearing organ, while the other (the vestibular nerve) transmits messages from the balance organs.

The brain integrates balance signals sent through the vestibular nerve from the right ear and the left ear. When one side is infected, it sends faulty signals. The brain thus receives mismatched information, resulting in dizziness or vertigo.

Neuritis (inflammation of the nerve) affects the branch associated with balance, resulting in dizziness or vertigo but no change in hearing. The term *neuronitis* (damage to the sensory neurons of the vestibular ganglion) is also used.

Labyrinthitis (inflammation of the labyrinth) occurs when an infection affects both branches of the vestibulo-cochlear nerve, resulting in hearing changes as well as dizziness or vertigo.

Bacterial and viral infections

Inner ear infections that cause vestibular neuritis or labyrinthitis are usually viral rather than bacterial. Although the symptoms of bacterial and viral infections may be similar, the treatments are very different, so proper diagnosis by a physician is essential.

Bacterial: In *serous labyrinthitis*, bacteria that have infected the middle ear or the bone surrounding the inner ear produce toxins that invade the inner ear via the oval or round windows and inflame the cochlea, the vestibular system, or both. Serous labyrinthitis is most frequently a result of chronic, untreated middle ear infections (chronic *otitis media*) and is characterized by subtle or mild symptoms.

Less common is *suppurative labyrinthitis*, in which bacterial organisms themselves invade the labyrinth. The infection originates either in the middle ear or in the cerebrospinal fluid, as a result of bacterial meningitis. Bacteria can enter the inner ear through the cochlear aqueduct or internal auditory canal, or through a fistula (abnormal opening) in the horizontal semicircular canal.

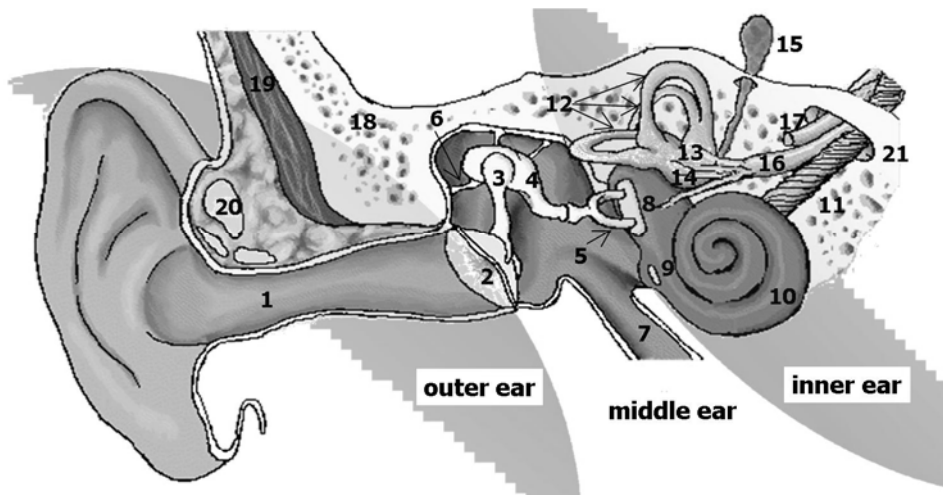
Viral: Viral infections of the inner ear are more common than bacterial infections, but less is known about them. An inner ear viral infection may be the result of a systemic viral illness

(one affecting the rest of the body, such as infectious mononucleosis or measles); or, the infection may be confined to the labyrinth or the vestibulo-cochlear nerve. Usually, only one ear is affected.

Some of the viruses that have been associated with vestibular neuritis or labyrinthitis include herpes viruses (such as the ones that cause cold sores or chicken pox and shingles), influenza, measles, rubella, mumps, polio, hepatitis, and Epstein-Barr. Other viruses may be involved that are as yet unidentified because of difficulties in sampling the labyrinth without destroying it.

Symptoms and onset of viral neuritis or labyrinthitis

Symptoms of *viral neuritis* can be mild or severe, ranging from subtle dizziness to a violent spinning sensation (vertigo). They can also include nausea, vomiting, unsteadiness and imbalance, difficulty with vision, and impaired concentration.



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|--------------------------------|-------------------------|--------------------------------------|
| 1. external auditory canal | 8. oval window | 15. endolymphatic sac |
| 2. tympanic membrane (eardrum) | 9. round window | 16. vestibular nerve |
| 3. malleus | 10. cochlea | 17. facial nerve |
| 4. incus | 11. cochlear nerve | 18. temporal bone |
| 5. stapes | 12. semicircular canals | 19. muscle |
| 6. ligament | 13. utricle | 20. cartilage |
| 7. Eustachian tube | 14. saccule | 21. internal auditory canal to brain |

Sometimes the symptoms can be so severe that they affect the ability to stand up or walk. *Viral labyrinthitis* may produce the same symptoms, along with tinnitus (ringing or noises in the ear) and/or hearing loss.

Acute phase: Onset of symptoms is usually very sudden, with severe dizziness developing abruptly during routine daily activities. In other cases, the symptoms are present upon awakening in the morning. The sudden onset of such symptoms can be very frightening; many people go to the emergency room or visit their physician on the same day.

Chronic phase: After a period of gradual recovery that may last several weeks, some people are completely free of symptoms. Others have chronic dizziness if the virus has damaged the vestibular nerve.

Many people with chronic neuritis or labyrinthitis have difficulty describing their symptoms, and often become frustrated because although they may look healthy, they don't feel well. Without necessarily understanding the reason, they may observe that everyday activities are fatiguing or uncomfortable, such as walking around in a store, using a computer, being in a crowd, standing in the shower with their eyes closed, or turning their head to converse with another person at the dinner table.

Some people find it difficult to work because of a persistent feeling of disorientation or "haziness," as well as difficulty with concentration and thinking.

Diagnosis and treatment

No specific tests exist to diagnose vestibular neuritis or labyrinthitis. Therefore, a process of elimination is often necessary to diagnose the condition. Because the symptoms of an inner ear

virus often mimic other medical problems, a thorough examination is necessary to rule out other causes of dizziness, such as stroke, head injury, cardiovascular disease, allergies, side effects of prescription or nonprescription drugs (including alcohol, tobacco, caffeine, and many illegal drugs), neurological disorders, and anxiety.

Treatment during the acute phase: When other illnesses have been ruled out and the symptoms have been attributed to vestibular neuritis or labyrinthitis, medications are often prescribed to control nausea and to suppress dizziness during the acute phase. Examples include Benadryl (diphenhydramine), Antivert (meclizine), Phenergen (promethazine hydrochloride), Ativan (lorazepam), and Valium (diazepam). Other medications that may be prescribed are steroids (e.g., prednisone), an antiviral drug (e.g., Acyclovir), or antibiotics (e.g., amoxicillin) if a middle ear infection is present. If nausea has been severe enough to cause excessive dehydration, intravenous fluids may be given.

If treated promptly, many inner ear infections cause no permanent damage. In some cases, however, permanent loss of hearing can result, ranging from barely detectable to total. Permanent damage to the vestibular system can also occur. In addition, endolymphatic hydrops (abnormal fluctuations in the inner ear fluid called *endolymph*) can develop several years after either serous or suppurative labyrinthitis.

Testing and treatment during the chronic phase: If symptoms persist, further testing may be appropriate to help determine whether a different vestibular disorder is in fact the correct diagnosis, as well as to identify the specific location of the problem within the vestibular system. These additional tests will usually

include an *audiogram* (hearing test); and *electro-nystagmography* (ENG) or *videonystagmography* (VNG), which may include a *caloric test* to measure any differences between the function of the two sides. *Vestibular evoked myogenic potentials* (VEMP) may also be suggested to detect damage in a particular portion of the vestibular nerve.

Physicians and audiologists will review test results to determine whether permanent damage to hearing has occurred and whether hearing aids may be useful. They may also consider treatment for tinnitus if it is present.

If symptoms of dizziness or imbalance are chronic and persist for several months, vestibular rehabilitation exercises (a form of physical therapy) may be suggested in order to evaluate and retrain the brain's ability to adjust to the vestibular imbalance. Usually, the brain can adapt to the altered signals resulting from labyrinthitis or neuritis in a process known as compensation. Vestibular rehabilitation exercises facilitate this compensation.

In order to develop effective retraining exercises, a physical therapist will assess how well the legs are sensing balance (that is, providing proprioceptive information), how well the sense of vision is used for orientation, and how well the inner ear functions in maintaining balance. The evaluation may also detect any abnormalities in the person's perceived center of gravity. As part of assessing the individual's balancing strategies, a test called *computerized dynamic posturography* (CDP) is sometimes used.

After the evaluation, personalized vestibular rehabilitation exercises are developed. Most of these exercises can be performed independently at home, although the therapist will continue to

monitor and modify the exercises. It is usually recommended that vestibular-suppressant medications be discontinued during this exercise therapy, because the drugs interfere with the ability of the brain to achieve compensation.

The exercises may provide relief immediately, but a noticeable difference may not occur for several weeks. Many people find they must continue the exercises for years in order to maintain optimum inner ear function, while others can stop doing the exercises altogether without experiencing any further problems. A key component of successful adaptation is a dedicated effort to keep moving, despite the symptoms of dizziness and imbalance. Sitting or lying with the head still, while more comfortable, can prolong or even prevent the process of adaptation.

Additional resources

Some helpful documents available from the Vestibular Disorders Association (VEDA):

- *Balancing Act*, 2nd ed. (Book B-1)
- *Secondary Endolymphatic Hydrops* (Pub. F-2)
- *Diagnostic Tests for Vestibular Problems* (Pub. F-6)
- *Vestibular Rehabilitation: An Effective, Evidence-Based Treatment* (Pub. F-7)
- *Vestibular Injury: Compensation, Decompensation and Failure to Compensate* (Pub. F-26)

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