

Vertigo in Children

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Abstract: Vertigo is a subjective feeling of rotation of a space or object, ie a disorder of orientation in space. Vertigo usually starts suddenly, lasts for a short time, does not have to be provoked by the position of the head, and is sometimes accompanied by nausea and vomiting. It occurs more often while a child is playing, rocking, when he is tired or has a fever. The child may be frightened, pale, crying, clinging to surrounding objects so as not to fall or separate from the parent. Sometimes an unusual position of the head is noticed, a possible short-term tilting of the head, which can be accompanied by vomiting, sweating, anxiety and fear.

Keywords: Child, Vertigo, Symptoms, Health.

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INTRODUCTION

Vertigo is defined as an illusion of motion [1]. The CNS coordinates and integrates sensory input from the visual, vestibular, and proprioceptive systems. Vertigo occurs when there is a mismatch of information from two or more of these systems. Vertigo is divided into central and peripheral causes. Central vertigo indicates involvement of the cerebellum or the vestibular nuclei within the pons and medulla. Peripheral vertigo indicates involvement of either the eighth cranial nerve (CN) or the vestibular apparatus of the inner ear, and is usually benign. Benign positional vertigo (BPV), the most common cause of vertigo, results from the inappropriate presence of calcium particles (otoliths) in the semicircular canals. Movement of the head causes these otoliths to inappropriately trigger receptors in the semicircular canal, causing the sensation of vertigo. In Ménière's disease, there is an increase in the volume of endolymph associated with distension of the endolymphatic system (endolymphatic hydrops), causing vertigo, fluctuating sensorineural hearing loss, and tinnitus. Ruptures of the membranous labyrinth are thought to cause the sudden episodic attacks of Ménière's disease.

Vertigo is the sensation of abnormal internal movement or abnormal movement of one's surroundings [2]. The root of the word is based on the

Latin *vertere*, which means to turn. Not surprisingly, vertigo is classically associated with an illusory rotary sensation but it can also present as an abnormal to and fro motion or even a change in orientation relative to the vertical. Dizziness is a much broader, nonspecific term that describes disruption of one's orientation to the environment and includes but is not limited to lightheadedness, imbalance, and faintness.

The cornerstone of the history is to determine whether or not the child is experiencing true vertigo and, if so, how long the actual vertiginous episodes last. It is important to remember that after a bout of vertigo, the patient may experience interictal disequilibrium, which they will equate as being "dizzy," but not truly be vertiginous. Older patients will describe a sense of detachment or disassociation as if they are in a "fog" or as if they are standing or walking "on the deck of a rolling ship on pillows." With younger patients, it is often helpful to investigate whether the sensations they experience are similar to those felt after spinning round and round on a playground. A successful history will make the distinction between a smoldering disequilibrium and true vertigo. A unilateral otologic complaint when it occurs is a very helpful localizing symptom in a dizzy patient: aural fullness, tinnitus, hearing loss, or distortion. By exploring these symptoms, the clinician can often localize the site of the lesion prior to the examination or testing. Both the

presence as well as the duration of vertigo are critical to being able to formulate an accurate diagnosis.

True vertigo, the perception that the environment is rotating relative to the patient or that the patient is rotating relative to the environment, arises in the peripheral or central vestibular system [3]. It can be immensely disturbing, even frightening, to patients and their families. Preverbal children, unable to articulate the sensation, may merely be irritable, vomit, and prefer to lie still. Older children and adults may have difficulty describing the sensation.

True vertigo arises from a disturbance in either the peripheral or central components of the vestibular system. The two peripheral sensory organs of the system (together known as the labyrinth) are the semicircular canals (stimulated by rotary motion of the head) and the vestibule (stimulated by gravity). Both organs lie near the cochlea within the petrous portion of the temporal bone. The proximity of the vestibular and cochlear apparatus explains the frequent association of vertigo with hearing impairment.

Normal Growth

In this growing age of managed care and required medical referrals, it is increasingly likely that children and adolescents will present to primary care settings with concerns related to developmental delay in one or more of their developmental domains as well as general medical issues that may have implications for adaptive functioning [4]. While schools must provide assessment of youth with neurodevelopmental disabilities (as early as age 3 years), the schools have strict guidelines for implementing an Individual Education Plan (IEP). The process usually cannot be completed in a timely manner or the school is unable to provide the type of assessment required (i.e., intellectual, neurodevelopmental, neuropsychological, behavioral, and psychosocial) to address the medical referral question. Youth identified early in life with developmental risks or concerns are often referred to early intervention programs (varying in title by state) to monitor, track, and ensure engagement with appropriate services prior to the time that public educational settings would take over. It may even be the case that youth across the age span with various medical conditions (e.g., head injury, spina bifida, cerebral palsy, diabetes, metabolic conditions, chronic illness, physical disabilities, and brain tumors) are often referred for psychological assessment via primary or specialty care, long before the academic process is involved. Youth who have non-specific delays combined with average to above average intellectual function are often able to adapt to their environments well enough to mitigate significant maturational, academic, social, or emotional deficits until they reach situations that require higher order functioning (e.g., fourth grade academic demands, entering middle school or high school). In order to better understand the

concept of assessment, a discussion related to “normal” neurodevelopment or “normal” development will be helpful.

Neurodevelopment in a broad sense refers to the growth and maturation of the nervous system, as well as sensory and perceptual abilities of the child. Normal growth and development is characterized by individual variations in the rate of progression and achievement of milestones and the sequential nature of this progression. Although largely determined by genetic factors, environmental factors (such as opportunity, nutrition, and social context) also play a significant role in overall development of a child or adolescent. Capute noted that motor milestones are mostly influenced by maturation of the neurological system; on the other hand, social and adaptive skills are influenced largely by environmental factors, such as social expectations, education, and training. The term neurodevelopment encompasses various domains which can be broadly categorized as physical or somatic, neurological, sensory-perceptual, cognitive, and psychosocial or emotional.

Head Injury

Head injury may cause not only cochlear damage with deafness and its associated symptom of tinnitus but may also disturb the vestibular labyrinth causing dizziness [5]. Dizziness is a common symptom after a head injury and may be caused either by damage to the inner ear or to the brain itself; it may occur without skull fracture. However, if the petrous temporal bone is fractured transversely there is likely to be severe inner ear damage and as well as the hearing loss there will be severe prostrating vertigo. This may last many days to several weeks, gradually improving with time. In the younger patient, the recovery is more rapid than in the elderly and someone over the age of 60 years may never completely recover, remaining persistently unsteady especially on sudden movement.

The symptom of positional vertigo may develop after a head injury - placing the head in certain positions usually when lying on one or other side - when certain criteria appertaining to the vertigo and its associated physical signs of positional nystagmus are present the diagnosis of benign paroxysmal positional vertigo may confidently be made and a reassuring prognosis given. The condition is usually self-limiting within a period of 1-2 years. Finally, delayed onset vertigo with a Meniere's-like disorder can occur years after certain temporal bone fractures and post-traumatic vertigo can also be caused by a perilymph leak. Thus a number of mechanisms occur causing post-head injury dizziness.

Head injuries, a blow to the ear canal, sudden impact with water, blast injuries, or the insertion of pointed objects into the ear canal can lead to perforation of the TM, ossicular chain disruption, facial nerve

injury, hearing loss, vertigo, and hematoma of the middle ear [6].

If there is facial paralysis, severe vertigo or subjective hearing loss after ear trauma, urgent otolaryngology consultation is warranted. Middle ear trauma can lead to a perilymphatic fistula which is a breach of the inner ear that causes sensorineural (nerve) hearing loss and vertigo. This hearing loss can be prevented or reversed with emergent surgery. Facial nerve injury in the setting of middle ear trauma also often needs to be addressed with emergent surgical exploration. Other sequelae of middle ear trauma may be treated with observation. Blood collecting in the middle ear space may cause a conductive hearing loss that will resolve with time. Antibiotics are not necessary unless signs of infection appear. The patient needs to be followed with audiometry or by an otolaryngologist until hearing has returned to normal, which is expected within 6–8 weeks. If the conductive hearing loss does not resolve, there may be injuries to the ossicular chain. A CT scan may be needed to evaluate the middle ear structures in this case.

Symptoms [7]

- Room spinning
- Onset during sudden upright posture
- Ringing in the ears
- Vomiting, unsteady gait, or loss of balance
- Recent head trauma
- Hearing loss
- Weakness, diplopia, or dysarthria
- Acuity:
 - Central lesion: usually acute
 - Peripheral lesion: usually insidious onset

Diagnosis [7]

- Nystagmus of peripheral origin:
 - Cerumen or foreign body in ear canal
 - Otitis media/labyrinthitis
 - Cholesteatoma
 - Head trauma
 - Perilymphatic fistula
 - Benign paroxysmal vertigo:
 - Usually age < 4 yr
 - Intense nausea, vertigo, flushing
 - All motor activity stops
 - Attacks last from seconds to minutes
- Nystagmus of central origin:
 - Seizures
 - Basilar artery migraine
 - CNS lesions
 - Demyelinating disorders (e.g., multiple sclerosis)

Dizziness

Children will complain of “dizziness,” their parents may complain of “disequilibrium,” but the

challenge of the clinician is to differentiate vertigo from the other causes of this sensation. Vertigo is the sensation of spinning or movement. It is not relevant if the person is spinning or the room is spinning, and some children will not note spinning at all, but rather the sense that the room is tilting, like being on a boat. The perception of movement helps to differentiate vertigo from nonvertiginous etiologies such as presyncope, ataxia, or orthostatic hypotension. Vertigo can be distinguished from nonvertiginous dizziness based on this history and should be specifically elicited. The type of sensation, when or why it occurs, associated symptoms, frequency, and duration should also be queried. Nausea, vomiting, and nystagmus may be present. Head movement may make the symptoms worse or may trigger the sensation of vertigo.

The symptoms of vertigo localize the problem to the vestibular system; the localization may be peripheral (labyrinth or vestibular branch of the acoustic (VIII) cranial nerve) or central (brainstem vestibular nuclei or, rarely, the temporal lobe). Clinical history and laboratory testing can differentiate peripheral from central causes of vertigo. Peripheral vertigo is intermittent, of short duration, but severe, and always associated with nystagmus. Hearing loss and tinnitus may also be present, but without other neurologic symptoms. Central vertigo is typically more constant but less severe and may cause other neurologic signs and symptoms such as weakness, sensory disturbance, bulbar symptoms (dysarthria, dysphagia), or hyperreflexia.

Pathology

Vertigo is an unpleasant distortion of static gravitational orientation or an erroneous perception of motion of either the person experiencing it or the environment [9]. Vertigo, dizziness, and dysequilibrium are common concerns of patients of all ages. Because vertigo is not a clinical diagnosis, but rather a subjective perception, a thorough patient history is crucial to make the correct diagnosis. Children may find it hard to say how long the episodes last, as well as what provokes or accompanies them. Because patients in this age-group are inexperienced in describing their vestibular concerns as dizziness or vertigo, additional tests become more important. A correct diagnosis based on history and clinical findings is the prerequisite for successful therapy, which is possible for most patients.

The most common causes of acute episodic vertigo are migraine headaches and related syndromes [10]. Benign paroxysmal torticollis of infancy is thought to be a migraine variant that begins in infancy and generally resolves spontaneously by 2 to 3 years of age. It is characterized by episodes of recurrent head tilt, which may last for hours or days and is often associated with vomiting, agitation, pallor, and ataxia. Benign paroxysmal vertigo of childhood is also considered a migraine variant and is typically seen in

children younger than 5 years. These children have the sudden onset of extreme unsteadiness and inability to stand, usually with nystagmus and sometimes with vomiting. The episodes last seconds to minutes. In many cases, the family has a history of migraine headaches, and many of these patients develop more typical migraine headaches in later life. Older children and adolescents may have episodic vertigo as a result of basilar artery migraines. Affected patients often have scintillating scotomas or visual obscuration, oral paresthesias, tinnitus, and occasionally drop attacks with or without loss of consciousness. These early symptoms are commonly but not always followed by a pounding headache. Other causes of acute recurrent vertigo include seizures, perilymph fistula, and benign paroxysmal positional vertigo. Seizures that are associated with vertigo are followed by an alteration or loss of consciousness. A perilymph fistula is an abnormal connection between the inner- and middle-ear spaces. Although some fistulas are congenital, most are acquired from trauma, such as direct penetrating trauma, head trauma, or barotrauma. Flying, diving, coughing, sneezing, or any type of excessive strain or exertion may tear the oval or round window, causing a sudden onset of vertigo associated with hearing loss. Benign paroxysmal positional vertigo (BPPV), although extremely common in adults, is rare in children. BPPV is believed to be caused by otoconia (debris or ear rocks) that have been deposited in a sensitive location in the semicircular canal. Acute episodes of severe vertigo are precipitated by a change of head position and are associated with nystagmus, nausea, and vomiting. The Epley and Semont maneuvers attempt to relocate the otoconia into a less-sensitive location. Vestibular neuritis exhibits similar symptoms to BPPV and, although uncommon in children, should be considered if vertigo is preceded by a viral infection. Neither BPPV nor vestibular neuritis is associated with hearing loss.

Migraines with brain stem aura, commonly known as basilar migraines, are typically characterized by onset in adolescence and occurrence in females more frequently than males [11]. They are frequently accompanied by visual disturbances, ataxia, vertigo, nausea, vomiting, loss of consciousness, and/or drop attacks. Cranial nerve deficits can be observed. In treatment, avoid sumatriptan because it will constrict vessels in an already ischemic area. Hemiplegic migraine must be distinguished from stroke. There is a slow progression of unilateral weakness and/or sensory changes usually preceding the headache. Symptoms may last hours to days, and in recurrent attacks the alternate side may be affected. Associated symptoms include aphasia, paresthesias, and rarely seizures. Permanent deficits can result from repeated attacks. Ophthalmoplegic migraines generally have an age of onset of less than 10 years. Unilateral eye pain is followed by third nerve palsy, a dilated pupil, and downward and outward deviation of the eye. The fourth

and sixth cranial nerves are frequently involved. Ophthalmoplegia resolves in 1 to 4 weeks. Permanent third nerve injury can result from multiple attacks.

The pathology of vertigo involves spatial orientation [12]. Spatial orientation is regulated by the interaction among visual, labyrinthine, and proprioceptive systems. If any one of these systems is interrupted, the patient will report a disorder of sensation of position, spatial orientation, or motion.

The visual system interacts between the visual cortex, optic pathway, and the eyes, which are all part of the visual-spatial orientation. The labyrinthine system is made up of the otoliths and the semicircular canals. The labyrinthine system is driven by changes in the movement of the head, which causes a change in the afferent vestibular nerve impulses. When there is an alteration of input from one of these systems, a perception of motion is noted. There are also proprioceptors in the joints and muscles of the limbs that regulate the body's sense of position.

The brain regulates the sensory input from the proprioceptors in the cerebellum, brainstem, vestibular nuclei, medial longitudinal fasciculus, basal ganglia, red nuclei, cerebral cortex, and temporal and parietal lobes. Vertigo can occur when one or all of the processes of these systems are interrupted. Metabolic, toxic, vascular, neuronal, or psychogenic changes can also affect these systems and thus cause vertigo.

CONCLUSION

Like any healthy person, a child has balance. Balance is enabled by many physiological processes. The brain receives signals from the visual system, so the deciphered signals are converted into impulses of the cerebral cortex. However, young children cannot always speak accurately to describe their feelings. Vertigo in childhood requires a very thorough diagnosis. This is a very sensitive population and in making the diagnosis, the age and maturation of the child must be considered. The child has difficulty describing his ailments and the disease is often not recognized. Vertigo is a very unpleasant disorder, but in many cases it can be treated.

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