

Vertigo in children - A review

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ABSTRACT

Vertigo is a morbid symptom in the pediatric age group. It is not an uncommon clinical presentation in children. The etiopathology of vertigo in children is different from that of the adult age group. It is often not easy to evaluate this symptom in pediatric age group. In most cases, the children do not express their symptoms in detail and so clinicians cannot obtain adequate history and determine their exact etiology for vertigo. The benign paroxysmal vertigo is a common etiology in younger children, whereas the vestibular migraine is responsible for vertigo in majority of older children. Hence, pediatricians, otorhinolaryngologists, physicians, and neurologists often face difficulty in establishing the appropriate diagnosis of vertigo in children. The diagnosis of vertigo in children includes a detailed history, clinical examination, complete neurological examination, and audiological assessment. The treatment of vertigo in children includes the treatment of appropriate etiology. The prognosis of vestibular function recovery in children is often variable and unpredictable. Imaging such as computed tomography scan or magnetic resonance imaging is done in selected cases. The objective of this review article is to familiarize the readers with these complex disorders of children and with the current protocols in their management.

Key words: Vertigo, Children, Benign paroxysmal vertigo, Vestibular migraine

Vertigo in children is not a common clinical manifestation but is probably found more often than formerly thought. Vertigo is the illusion of environmental motion characteristically described as whirling or spinning [1]. Children often present as spinning sensation around them. Children cannot often express their symptoms in detail and clinicians cannot always get proper history and determine their exact diagnosis. Vertigo in children usually differs from that of the adult age group due to three important reasons. First, vestibular disorders in children are often neglected, because vertiginous manifestations are often attributed to the absence of coordination or behavioral issues [2]. Second, children usually lack ability to properly communicate their accurate symptoms, which make it difficult to get an accurate diagnosis. Third, although the majority of the diseases that cause vertigo in the adult age group occur in children as well, their frequency may be different, depending on the age of the patient. A classic example is benign paroxysmal positional vertigo (BPPV) which is the most common peripheral vestibular vertigo in adults, but uncommon in children [3]. On the other hand, a common disorder causing vertigo in the pediatric age group may be unique in this population, such as vestibular migraine (VM) and benign paroxysmal vertigo (BPV)

in childhood [4]. There are very few research articles describing vertigo in children, and so this clinical entity is not well known to most clinicians. The purpose of this review article is to review the epidemiology, etiopathology, clinical characteristic, diagnosis, and treatment of vertigo in children.

METHODS OF LITERATURE SEARCH

Multiple systematic methods were used to find current research publications on vertigo in children. We started by searching the Scopus, PubMed, Medline, and Google Scholar databases online. A search strategy using Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines was developed. This search strategy recognized the abstracts of published articles, while other research articles were discovered manually from the citations. Randomized controlled studies, observational studies, comparative studies, case series, and case reports were evaluated for eligibility. There were a total number of articles 68 (18 case reports; 24 cases series; and 26 original articles). This paper focuses only on vertigo in children. This review article describes the epidemiology, etiopathology, clinical characteristics, diagnostic evaluation, and treatment of vertigo in children. This paper provides a better understanding for easy diagnosis of vertigo

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in children which will enable prompt treatment. It will also serve as a catalyst for additional study into a newer diagnostic and treatment protocol for vertigo in children.

EPIDEMIOLOGY

Vertigo in children is little documented in the literature. The prevalence of dizziness and balance disorder is 5.3% in school-aged children. In adolescents, approximately 72% of the students from a 12th standard class reported experiencing at least one episode of vertigo within the past 3 months [5]. A study documented the peripheral causes of vertigo in children, including BPPV, Meniere's disease (MD), viral lesions, and vestibular neuritis [6]. In a study conducted in Scotland, BPV in the pediatric age group is considered a quite common etiology for vertigo, occurring with a prevalence of 2.6% [7]. Otitis media, migraine, and BPPV account for vertigo in 50% of these children [8].

ETIOPATHOLOGY

The etiopathology of vertigo in children is different from that of the adult age group. There are multiple causes of vertigo in the pediatric age group, ranging from trauma, infection, and malignant disorders of the central nervous system through a wide variety of ear disorders, to a group of miscellaneous, often benign, and largely unexplained conditions such as migraine, BPV, and psychosomatic disorders [9]. One study showed that the common causes of vertigo in children include viral infections of the labyrinth, BPV of childhood and migraine whereas less common causes include otitis media, head trauma, BPPV, MD, and brain tumor [10]. The viral labyrinthitis may complicate the course of a few systemic viral infections such as rubella, mumps, influenza, measles, and chickenpox [11]. The virus infections such as adenoviral, enteroviral, and retroviral infections have also been implicated [12]. Acute otitis media may cause vertigo in children. Vertigo in acute otitis media probably results from serous labyrinthitis, which is a type of sterile inflammation secondary to toxic materials that cross the round window secondary membrane or the oval window annulus [13]. Although BPPV is a common clinical entity in a neurotology clinic, it is quite rare in the pediatric age group, probably due to better quality of otoconia, which does not dislodge easily after trauma, infection, prolonged bed rest, or other aggravating factors [14]. One study of the histopathological report of pediatric temporal bones has suggested occurrence of basophilic deposits containing otoconial crystals in 12.7% of the examined cupulae. Most of these basophilic deposits were found in the cupulae of the lateral and posterior semicircular canal and less often on the cupula of the superior canal [15]. These reports implicate that cupular deposits are less commonly seen in the pediatric labyrinth, whereas similar studies on adult temporal bones showed that up to 35% of examined cupulae contained basophilic deposits [16]. Iatrogenic or traumatic perilymph fistula may be found in children which may lead to vertigo. Ocular diseases can manifest vertigo, instability, or dizziness. Hence, complete ophthalmologic examination should

be done, particularly in children with normal neurological and vestibular examination [17]. Children with medulloblastoma of the cerebellum may present with headaches and imbalance, but the experience of true vertigo is uncommon. Other tumors of the brainstem and cerebellum in the pediatric age group may present with vertigo and these tumors are astrocytomas, ependymomas, and hemangioblastomas [18]. Migraine and syncope are frequent causes of dizziness in the pediatric age group [8].

CLINICAL PRESENTATIONS

Episodic vertigo and dizziness are not common symptoms found in children and also have been studied less extensively than in the adult age group [19]. BPV is characterized by brief, acute attacks of intense vertigo associated with nystagmus [4]. The frightened pediatric patient either drops to the floor or clutches the available support for avoiding to fall. The accompanying symptoms include pallor, nausea, and vomiting. However, there is no loss of consciousness or headache. The attack of vertigo last from seconds to minutes and the child is symptom-free between the attacks. The prognosis of BPV is favorable and the disorder disappears spontaneously between the age of 5 and 7 years. However, a majority of children with BPV subsequently develops migraine [20]. In approximately 50% of cases of BPV, there is a family history of migraine. The exact site and origin of vertigo in BPV in children are not completely understood and it has been reported to be found either at the posterior temporal cortex or in the brainstem. Episodic vertigo in the pediatric age group is unusual and therefore not much known to most clinicians. Children with intracranial lesions such as cerebellar or brainstem tumor present with vertigo and papilledema due to intracranial hypertension which follows a brief period of headaches and gait ataxia.

DIFFERENTIAL DIAGNOSIS OF VERTIGO IN CHILDREN

BPV

BPV is one of the most common causes of vertigo in children. Although the exact etiology of BPV is not yet established, it is considered a variant or an equivalent of childhood migraine [21]. Transient ischemia of the vestibular pathway and/or vestibular nuclei are thought to be the cause of BPV [22]. It has no relation or association with BPPV, which is rare in the pediatric age group [23]. The clinical presentations of BPV are characterized by recurrent episodes of vertigo of a few minutes, occurring without warning, and resolve spontaneously in otherwise healthy children [21]. A female child is more affected by BPV than a male child [24]. Although BPV has been reported in pediatric patients between the age of 2–12 years, the majority of them are <4 years of age. Many children of BPV have reported a family history of migraine [25]. On examination, children with BPV show normal hearing and no vestibular deficits. However, children with normal hearing show abnormal auditory brainstem responses (ABR) in

66% of children with BPV [26]. The caloric test and vestibular evoked myogenic potentials are supplementary diagnostic tools used for evaluation and they reveal abnormality in children with BPV [27]. The child with BPV rarely shows cochlear signs.

VM

VM is considered the most common cause of vertigo in children [28]. It is uncommon in children younger than 10 years age. The exact pathogenesis of VM is not yet clear. Genetic susceptibility is thought to be the cause of enhanced sensory excitability which seems to be responsible for VM [29]. The clinical presentations of VM include recurrent vestibular symptoms along with migraine [30]. The duration of vertigo lasts from 5 min to 72 h [30]. In VM, vertigo can occur during, before, or after a migraine headache and *vice versa*. The affected children usually show sensitivity to noise and light. The neurotological examinations are often within normal limits in between the episodes of vertigo. Canal paresis is usually reported in up to one-third of cases [31].

Otitis Media with Vertigo

Otitis media includes the inflammation of the middle ear cleft. It can cause vertigo in children by resulting in labyrinthitis. It is usually associated with hearing loss. Otitis media with effusion can result in vestibular symptoms. A study conducted in Israel among children aged 4–9 years old have found resolution of vestibular symptoms in 96% of the patients after placement of ventilation tube in otitis media with effusion [32]. Suppurative otitis media can cause vertigo by affecting the ipsilateral labyrinthitis function both in chronic and acute suppurative otitis media [33]. In chronic otitis media with cholesteatoma, the ossicle-like stapes is damaged in children more commonly than adult age group [34].

Vestibular Neuritis

It is a common cause of vertigo in children and constitutes 16% of all pediatric cases with giddiness [35]. It is commonly found in children above 5 years of age. The superior vestibular nerve is often inflamed after a viral infection. The children affected with vestibular neuritis often complain of sudden rotatory vertigo lasting from a few hours to a few days along with nausea and vomiting, but not associated with hearing loss [36]. Clinically and caloric tests demonstrate hypofunction of the affected labyrinth.

MD

MD is uncommon in children and constitutes less than 3% of all cases with MD [37]. The etiopathology in MD is attributed to the endolymphatic hydrops. Children with MD present with fluctuating hearing loss, episodic vertigo, aural fullness, and tinnitus on the affected side [38]. The audiometric examination shows a low-frequency hearing loss. The affected children are usually older than 10 years and only a few cases have been reported with children of age <7 years.

BPPV

BPPV is uncommon in the pediatric age group. It is often reported in children older than 5 years of age. Similar adult age group, the posterior semicircular canal is often affected followed by the horizontal semicircular canal. The common comorbidities in children with BPPV are migraine and concussion [39]. Here, vertigo has a positional preponderance and is associated with nausea and vomiting. Vertigo lasts for less than a minute. The nystagmus is often unidirectional, horizontal, and fatigable.

Post-traumatic Vertigo

Post-traumatic dizziness in the absence of hearing loss in children can be due to labyrinthine concussion, whiplash syndrome, vertiginous seizures, basilar artery migraine, or non-specific giddiness [40]. The trauma causing temporal bone fracture may result in inner ear disruption which causes vestibular dysfunction and hearing loss, with or without facial nerve paralysis, and cerebrospinal fluid leak. The perilymphatic fistula may happen even in the absence of temporal bone fracture and is often associated with fluctuating hearing loss. The trauma can cause vertigo along with hearing loss due to ossicular disruption with or without perforation of the tympanic membrane (Table 1).

DIAGNOSIS

The inability of the affected children with vertigo to express the exact characteristics of the symptoms may preclude the diagnosis. In addition, the clinical and neurophysiological pictures, along with vestibular tests, are not uniformly reliable in children. However, the important factor for delay in diagnosis or the misdiagnosis is the absence of awareness about nuances in the symptomatology and management algorithms among the treating doctors. Proper evaluation of dizzy children includes a complete clinical examination of the ears, nose, and throat along with neurological examination, ophthalmological examination, and a general physical examination covering cardiorespiratory and respiratory systems. The prompt identification of neurological or cardiac symptoms or signs associated with vertigo in children is mandatory to rule out life-threatening situations. Out of several

Table 1: Differential diagnosis of vertigo in children

Serial number	Causes of vertigo in children
1	Benign paroxysmal vertigo
2	Vestibular migraine
3	Otitis media with vertigo
4	Vestibular neuritis
5	Meniere's disease
6	Benign paroxysmal positional vertigo
7	Post traumatic vertigo
8	Psychogenic vertigo
9	Epileptic vertigo
10	Unclassified

causes of vertigo in children, otitis media and middle ear effusion are considered frequent causes of vestibular disturbances in children [32]. Middle ear diseases are commonly encountered by otologists and can be easily diagnosed with help of otoscopic examination and audiological evaluations. However, it is often troublesome to make a differential diagnosis of vertigo in children with normal eardrums. The eye movements and nystagmus are observed with help of Frenzel lenses. The Dix-Hallpike maneuver is done to diagnose BPPV. The diagnosis of BPPV is based on the presence of intense vertigo accompanied by a burst of nystagmus with the typical characteristics of latency, crescendo, and transience [41]. The type of nystagmus found, which depends on the semicircular canal involved, is crucial for diagnosis [42]. All children with vertigo require detailed laboratory examination. Whole blood cell count, thyroid function test, urine analysis, biochemical tests, as well as Mantoux test should be performed. X-rays of the chest, electrocardiography, and ultrasonography of thyroid glands are also useful. Serological tests such as complement fixation titers of the plasma antibodies against different common viruses should be performed (Epstein–Barr virus, influenza, herpes simplex viruses, parainfluenza viruses, cytomegalovirus, and adenovirus). Audiological and neurotological assessments include pure tone audiometry, measurement of acoustic immittance, transiently evoked otoacoustic emissions, and ABR recording to help get early diagnosis [43]. Children with vertigo can undergo electronystagmography (ENG) testing. ENG is preferred over Videonystagmography as it is better tolerated by most children.

Infections of the inner ear by a particular virus may be established by serological tests. Hence, the definitive diagnosis should include isolation of the suspected viral pathology within the tissues. However, this may be impractical and the association of the virus with clinical symptoms is almost as good. Serological evidence of recent viral infection is helpful to detect the viral etiology. This is often proved by a significant increase of antibodies against the implicated virus through complement fixation titers during the period of the convalescent phase of the infection in comparison to the antibody titer of the acute phase. The clinical manifestations and laboratory results are compatible with the viral infection and vertigo is usually resolved during the convalescent period. Computed tomography scans of magnetic resonance imaging are usually performed in selected cases of children with vertigo, particularly in cases of vertigo with a history of headache or loss of consciousness, head trauma, otitis media, and central ENG findings [44].

TREATMENT

Vertigo in children respond relatively well to the treatment and they recover quicker than the adult patients. BPV is a self-limiting disorder, the management includes reassurance of the affected children and their parents or caretakers. However, vertigo in children with BPV is not so bothersome, is associated with less vegetative symptoms, and the affected children often return to normal much more quickly in comparison to adult age groups

with vertigo [45]. BPV with a family history of migraine often responds to anti-migraine medications. Triptans and calcium channel blockers are useful treatments as well as prophylaxis for VM in children with satisfactory outcomes [32]. Tricyclics, cyproheptadine, topiramate, and gabapentin are also beneficial in children with VM [46]. At present, the first-line treatment for children with VM is non-pharmacological. Vestibular rehabilitation is useful for controlling the vertigo episodes in VM. Non-pharmacological treatments such as hydration, sleep hygiene, behavioral measures, balanced diet, avoidance of triggering food items, cognitive behavioral therapy, and biofeedback are helpful not only in first-line therapy but also for preventing migraine, as well as the VM [47].

In the case of children, acute otitis media with vertigo may occur due to serous labyrinthitis. Appropriate antibiotics and vestibular suppressants help manage vertigo in children with acute otitis media. Chronic otitis media with cholesteatoma is rare in children; however, it requires immediate mastoid exploration and removal of the disease process with hearing reconstruction. Perilymph fistula is usually treated surgically and some patients may be managed conservatively as these childhood conditions often tend to diminish with time. In the case of chronic suppurative otitis media with cholesteatoma and vertigo, children require mastoid exploration with complete removal of cholesteatoma matrix. It improves both vertigo and hearing [48].

In the case of children with vestibular neuritis, pharmacotherapy with steroids and vestibular rehabilitation are advocated, whereas the role of antiviral therapy remains controversial [49]. Young children with vestibular neuritis show complete recovery in canal functioning in comparison to adolescents [50]. Moreover, the recovery from canal paresis is more likely in pediatric age than in adults, and the overall prognosis of vestibular neuritis in children seems to be better than adult age group [50]. The treatment of children with MD is the same as in adult age and includes a salt-restricted diet, vestibular sedatives, diuretics, intratympanic gentamycin, and rarely endolymphatic sac decompression. Most of the children with BPPV show complete resolution of vertigo with repositioning maneuver and pharmacotherapy has a limited role. Due to recurrence in BPPV, some children may need multiple repositioning maneuvers. Post-traumatic vertigo can result in chronic symptoms. Majority of mild post-traumatic vertigo have good outcome. Vestibular rehabilitation therapy is important for rehabilitating the patient with post-traumatic vertigo and has been shown to be effective in facilitation of vestibular compensation. Surgical intervention may be required for controlling the symptoms consistent with perilymphatic fistulas or Meniere's syndrome [51].

PROGNOSIS

Vertigo in children may further progress if a delay in diagnosis occurs, finally, resulting in medical expenses and parental concerns as well as reduced quality of life [52]. Hence, clinicians must think about different causes of vertigo such as BPV for children who complain of dizziness and need a thorough

examination. BPV is thought to resolve entirely without any long-term sequel [53]. However, a study shows that the development of a migraine is more than 35% of children with BPV. There is a chance of recurrence of symptoms in children with BPPV with repositioning maneuver and the recurrence is around 18%. The odds of recurrence are higher in children with VM or BPV [25].

CONCLUSION

Vertigo in the pediatric age group without evidence of otitis media or middle ear effusion is most commonly due to migraine and BPV. The evaluation of vertigo in children requires complete history taking, audiological evaluation, and vestibular function tests. In a few selected tests, ENG/electroencephalography, hematological evaluation, and imaging of the brain and temporal bone should be needed. The clinicians who deal with vertigo in children should be aware of its differential diagnoses to be able to make the accurate diagnosis and treatment of the children appropriately.

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