**A Perspective of Vestibular Neuritis in Pediatrics: A Review of Current Literature**

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|  | **ABSTRACT** |
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| **ARTICLE INFO**  Date Submitted: 12 February, 2021  Date Accepted: 13 September, 2021 | Vestibular neuritis (VN) is a clinical condition characterized by multiple acute and prolonged episodes of vertigo originating from peripheral sources without accompanying auditory symptoms. The purpose of this mini-review is to describe the clinical characteristics, etiology, prevalence, and treatment of VN in children.  VN in children is less common and is associated with lower reported rates of vertigo and imbalance. Various rates ranging from less than 1% to more than 8% are reported by different studies and although it is not the most common etiology of concomitant vertigo and imbalance, it should be considered as the fourth or fifth differential diagnosis. There is much evidence supporting the association between several viral infections and VN. The conservative management is adjusted to the patient’s symptoms and early corticosteroid administration might be beneficial.  VN should always be considered in children presenting with vertigo, especially in those with a history of nasopharyngeal viral infection. Once the diagnosis of VN is confirmed, conservative and symptom-reliving treatments should be considered for the patient. |
| **KEYWORDS**  Vestibular Neuronitis; Child; Vertigo; Review; Otitis Media |
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| **INTRODUCTION** |

Vestibular neuritis (VN) is an acute unilateral vestibular function loss and is a common diagnosis in children (1, 2). VN is usually a benign, self-limiting condition characterized by episodes of persistent vertigo (hours to days), nausea, vomiting, balance impairment, and spontaneous or gas-evoked nystagmus.

VN occurs following epidemic episodes of viral nasopharyngeal infections in children. The manifestations of VN are similar to those of otitis media with effusion in children; including sudden and severe rotatory vertigo, vomiting, and imbalance during a viral infection, which could be often mistaken for gastroenteritis in children (3, 4).

Physical examination of VN patients reveals isolated peripheral vestibular deficit as the tendency to fall forward the affected side when the child stands and closes his eyes (the positive Romberg sign). Nystagmus is also seen. The audio-vestibular assessment would be normal without any hearing impairment. Neurological and otological examinations of these patients are completely normal. Sometimes MRI shows hyper signal flair of the vestibular nerve, which is a very inconsistent sign (5).

A recent study estimated that decreased quality of life due to vestibular disease imposes 64,929 US dollars in a lifetime per patient. Due to the high burden of this disease, diagnosis and treatment of this condition are important priorities in primary care (6, 7). The present study aims to review the current evidence on VN pathophysiology, diagnosis, management, and prognosis.

***VN natural history***

Assessing the prevalence of VN in children is difficult. Overlapping symptoms of vestibular disorders such as dizziness and vertigo with diseases such as migraine, intestinal disorders, and ophthalmologic disorders is one of the primary reasons. Also, children rarely complain of symptoms such as vertigo, and the symptoms of vestibular disorders are often ignored in them. The limited number of centers that perform vestibular tests in children is also another reason. Getting an exact history of children with signs and symptoms of imbalance and vestibular disorders is difficult. All of these reasons limit the number of studies surveying the VN in children and most of our knowledge about VN is more achieved via studies focused on adults (5, 8-10). Most patients with VN present with subacute or acute spontaneous vertigo, accompanied by nausea, vomiting, and balance impairment. Symptoms may develop suddenly or evolve within a few hours. 8.6 % to 24% of patients might be accounted for prodromal dizziness (11, 12). The true vertigo of VN may gradually increase within a few hours and reach a peak on the first day. Vertigo is often portrayed as a rotating sensation that increases significantly with every head movement (11).

But vertigo and imbalance are less common in children than in adults.

***VN*** ***prevalence***

There is a great heterogenicity and controversy about the prevalence of vestibular disorders and VN in children. While almost all evidence shows that the overall prevalence of vestibular disorders in children is less than in adults, various prevalence rates ranging from between 0.4%- 0.45% to 5.3% are noted in the literature (13-15).

A retrospective study of 411 children who were referred to the hospital due to imbalance and vertigo, noted VN as the fourth (4.5%) and the fifth (7.3%) rank in etiologies of vertigo and imbalance in different age groups respectively (16).

In a 5-year study of 2,528 children who underwent vestibular tests, 1,037 were diagnosed with imbalance. Of these 1037 children, 379 (36.5%) also had vestibular impairment. 3.3% of children with both disorders were cases of VN. Vestibular neuritis was the fourth most common cause of vestibular impairment in these children (5).

Another study of 132 children with vestibular disorders who were admitted between September 2003 and September 2007 to The Alfred I. DuPont Hospital, explicated peripheral vestibulopathy as the most common (29.5%) cause of symptoms. Among the causes of peripheral vestibulopathy, VN was reported in two children, and ranked as the fourth etiology (17).

In a similar study of children who were referred to otolaryngology clinics over 14 years, the prevalence of VN (due to infection or otitis media effusion) was 8% of the total number of children and ranked as the sixth cause (18).

Finally, a systematic review concluded that 8.47% of pediatric vertigo cases are VN on average (19).

***VN and viral infections***

Although precedents or concurrent viral diseases are described in VN, there is no convincing evidence of systemic viral infection based on seroconversion (12, 20).

The main hypothesis involves the reactivation of the underlying neurotropic virus. The most common attributable viruses are herpes simplex virus (HSV) type 1 and type 2. This group of viruses tends to invade sensory neurons, establish a latency period in the ganglion cell nucleus, and reactivate later during periods of extreme stress (21, 22).

Several pieces of evidence support the association of other viruses such as a varicella-zoster virus (VZV), cytomegalovirus (CMV), influenza, parainfluenza, coxsackievirus, measles, mumps, rubella, and enterovirus with VN (23, 24).

Upper respiratory tract infections (URIs) usually precede the onset of VN and are considered to cause inflammation of the vestibular nerve, supporting the concept of viral etiology of VN (12, 25, 26).

***Diagnosis and differential diagnosis***

Diagnosis of VN is made by taking a thorough history along with several clinical tests such as the Dix-hallpike maneuver, head-impulse, head-heave, head-shake, and vibration tests (27, 28). The clinical test should be selected according to the patient's history. While for cases of continuous vertigo with spontaneous nystagmus, the head impulse, skew tests, and assessment of the nystagmus is preferred, for those with short episodes of vertigo without spontaneous or gaze-evoked nystagmus, the Dix-hallpike maneuver would be more appropriate (29, 30). Notably, it should be kept in mind that one of the important differential diagnoses of VN is benign paroxysmal positional vertigo (BPPV); in which vertigo episodes are triggered by the head rolling on the bed and last for 20-30 seconds (31, 32). Due to current evidence, the most common cause of vertigo in children is vestibular migraine and BPPV (8, 33-35), and VN is responsible for about 1-5% of pediatric vertigo cases (17, 18, 33, 36).

***Treatment***

VN treatment is mainly symptomatic. Antihistamines, anticholinergics, antidopaminergic, and gamma-aminobutyric acid agonists are the most commonly used medications. Adding vestibular exercise programs and vestibular rehabilitation has been reported to be beneficial in some patients (11).

Corticosteroids may help promote patients’ recovery, especially when administered during the early phases of the disease (37). According to a randomized controlled trial performed by Strupp et al., adding systemic methylprednisolone can significantly improve the manifestations of VN (38).

Children with chronic otitis media need screening to check for vestibular function, especially those who have repeated surgery for drainage tube insertion. Multiple evidence dedicates that these children are at risk of persistent defects in vestibular function, delays in motor development, and poor gaze stability (39, 40).

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| **CONCLUSION** |

VN should always be considered in children presenting with vertigo, especially in those with a history of nasopharyngeal viral infection. Once the diagnosis of VN is confirmed, conservative and symptom-reliving treatments should be considered for the patient.

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**CONFLICT OF INTEREST**

All authors declare no conflicts of interest.

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| **REFERENCES** |

1. Gioacchini FM, Alicandri-Ciufelli M, Kaleci S, Magliulo G, Re M. Prevalence and diagnosis of vestibular disorders in children: a review. International journal of pediatric otorhinolaryngology. 2014;78(5):718-24.

2. Guerra-Jiménez G, Rodríguez AA, González JCF, Plasencia DP, Macías ÁR. Epidemiology of vestibular disorders in the otoneurology unit. Acta Otorrinolaringologica (English Edition). 2017;68(6):317-22.

3. Monobe H, Murofushi T. VN in a child with otitis media with effusion; clinical application of vestibular evoked myogenic potential by bone-conducted sound. International Journal of Pediatric Otorhinolaryngology. 2004;68(11):1455-8.

4. Zannolli R, Zazzi M, Muraca MC, Macucci F, Buoni S, Nuti D. A child with VN. Is adenovirus implicated? Brain and Development. 2006;28(6):410-2.

5. Wiener-Vacher SR, Quarez J, Le Priol A, editors. Epidemiology of vestibular impairments in a pediatric population. Seminars in the hearing; 2018: Thieme Medical Publishers.

6. Agrawal Y, Pineault KG, Semenov YR. Health‐related quality of life and economic burden of vestibular loss in older adults. Laryngoscope investigative otolaryngology. 2018;3(1):8-15.

7. Neuhauser HK, Radtke A, Von Brevern M, Lezius F, Feldmann M, Lempert T. Burden of dizziness and vertigo in the community. Archives of internal medicine. 2008;168(19):2118-24.

8. Balatsouras DG, Kaberos A, Assimakopoulos D, Katotomichelakis M, Economou NC, Korres SG. Etiology of vertigo in children. International journal of pediatric otorhinolaryngology. 2007;71(3):487-94.

9. Rine RM, Wiener-Vacher S. Evaluation and treatment of vestibular dysfunction in children. NeuroRehabilitation. 2013;32(3):507-18.

10. Wiener-Vacher SR, Obeid R, Abou-Elew M. Vestibular impairment after bacterial meningitis delays infant posturomotor development. The Journal of pediatrics. 2012;161(2):246-51. e1.

11. Faan RWBM, Dmsc VHM, Kerber K, Kerber KA. Baloh and Honrubia's clinical neurophysiology of the vestibular system. 2010.

12. Silvoniemi P. Vestibular neuronitis: an otoneurological evaluation. Acta Oto-Laryngologica. 1988;105(sup453):1-72.

13. Li C-M, Hoffman HJ, Ward BK, Cohen HS, Rine RM. Epidemiology of dizziness and balance problems in children in the United States: a population-based study. The Journal of pediatrics. 2016;171:240-7. e3.

14. Bower CM, Cotton RT. The spectrum of vertigo in children. Archives of Otolaryngology-Head & Neck Surgery. 1995;121(8):911-5.

15. O'Reilly RC, Morlet T, Nicholas BD, Josephson G, Horlbeck D, Lundy L, et al. Prevalence of vestibular and balance disorders in children. Otology & neurotology. 2010;31(9):1441-4.

16. Lee JD, Kim C-H, Hong SM, Kim SH, Suh M-W, Kim M-B, et al. Prevalence of vestibular and balance disorders in children and adolescents according to age: a multi-center study. International Journal of Pediatric Otorhinolaryngology. 2017;94:36-9.

17. O’Reilly RC, Greywoode J, Morlet T, Miller F, Henley J, Church C, et al. Comprehensive vestibular and balance testing in the dizzy pediatric population. Otolaryngology-Head and Neck Surgery. 2011;144(2):142-8.

18. Wiener-Vacher SR. Vestibular disorders in children. International journal of audiology. 2008;47(9):578-83.

19. Davitt M, Delvecchio MT, Aronoff SC. The Differential Diagnosis of Vertigo in Children: A Systematic Review of 2726 Cases. Pediatric Emergency Care. 2020;36(8):368-71.

20. Davis LE. Viruses and VN: a review of human and animal studies. Acta Oto-Laryngologica. 1993;113(sup503):70-3.

21. Arbusow V, Schulz P, Strupp M, Dieterich M, Von Reinhardstoettner A, Rauch E, et al. Distribution of herpes simplex virus type 1 in human geniculate and vestibular ganglia: implications for VN. Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society. 1999;46(3):416-9.

22. Roehm PC, Camarena V, Nayak S, Gardner JB, Wilson A, Mohr I, et al. Cultured vestibular ganglion neurons demonstrate latent HSV1 reactivation. The Laryngoscope. 2011;121(10):2268-75.

23. Schwam ZG, Wanna G. Pediatric Vestibular Disorders. Diagnosis and Treatment of Vestibular Disorders: Springer; 2019. p. 353-61.

24. Strupp M, Brandt T, editors. VN. Seminars in neurology; 2009: © Thieme Medical Publishers.

25. Schuknecht HF, Kitamura K. VN. Annals of Otology, Rhinology & Laryngology. 1981;90(1\_suppl):1-19.

26. Taborelli G, Melagrana A, D'Agostino R, Tarantino V, Calevo M. Vestibular neuronitis in children: study of medium and long term follow-up. International journal of pediatric otorhinolaryngology. 2000;54(2-3):117-21.

27. Kim J-S, Zee DS. Benign paroxysmal positional vertigo. New England Journal of Medicine. 2014;370(12):1138-47.

28. Mandalà M, Nuti D, Broman AT, Zee DS. Effectiveness of careful bedside examination in assessment, diagnosis, and prognosis of VN. Archives of Otolaryngology-Head & Neck Surgery. 2008;134(2):164-9.

29. Edlow JA, Newman-Toker D. Using the physical examination to diagnose patients with acute dizziness and vertigo. The Journal of emergency medicine. 2016;50(4):617-28.

30. Tarnutzer AA, Berkowitz AL, Robinson KA, Hsieh Y-H, Newman-Toker DE. Does my dizzy patient have a stroke? A systematic review of bedside diagnosis in acute vestibular syndrome. CmAJ. 2011;183(9): E571-E92.

31. Grill E, Strupp M, Müller M, Jahn K. Health services utilization of patients with vertigo in primary care: a retrospective cohort study. Journal of neurology. 2014;261(8):1492-8.

32. Johns P, Quinn J. Clinical diagnosis of benign paroxysmal positional vertigo and VN. CMAJ. 2020;192(8): E182-E6.

33. Erbek SH, Erbek SS, Yilmaz I, Topal O, Ozgirgin N, Ozluoglu LN, et al. Vertigo in childhood: a clinical experience. International journal of pediatric otorhinolaryngology. 2006;70(9):1547-54.

34. Gruber M, Cohen-Kerem R, Kaminer M, Shupak A. Vertigo in Children and Adolescents: Characteristics and Outcome. The Scientific World Journal. 2012;2012:109624.

35. Swain S, Munjal S, Shajahan N. Vertigo in children: Our experiences at a tertiary care teaching hospital of eastern India. Journal of the Scientific Society. 2020;47(2):74-8.

36. Choung Y-H, Park K, Moon S-K, Kim C-H, Ryu SJ. Various causes and clinical characteristics in vertigo in children with normal eardrums. International journal of pediatric otorhinolaryngology. 2003;67(8):889-94.

37. Brodsky JR, Cusick BA, Zhou G. VN in children and adolescents: Clinical features and recovery. International Journal of Pediatric Otorhinolaryngology. 2016;83:104-8.

38. Strupp M, Zingler VC, Arbusow V, Niklas D, Maag KP, Dieterich M, et al. Methylprednisolone, valacyclovir, or the combination for VN. The New England journal of medicine. 2004;351(4):354-61.

39. Casselbrant ML, Villardo RJ, Mandel EM. Balance and otitis media with effusion. International journal of audiology. 2008;47(9):584-9.

40. Mostafa BE, Shafik AG, El Makhzangy AM, Taha H, Mageed HMA. Evaluation of vestibular function in patients with chronic suppurative otitis media. Orl. 2013;75(6):357-60.