

Original Article

Diagnostic Delay in Pediatric Vestibular Disorders

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BACKGROUND: Vertigo and dizziness in children can be multi-factorial. Vestibular function tests allow an improved differential diagnosis and treatment. Delay in diagnosis of the diverse etiologies causing dizziness can adversely affect the health of children and is a matter of concern for their families. This study analyzes the delay in diagnosis and the importance of establishing a diagnosis with detailed history and neuro-otological evaluation.

METHODS: A total of 241 children presenting with vertigo to a tertiary otoneurology clinic between January 2019 and April 2022 were analyzed for the duration between the onset of symptoms and diagnosis, presenting complaints, and characteristic findings.

RESULTS: Two hundred and forty-one patients with a mean age of 12.5 ± 3.02 years (range, 5–16 years) were evaluated. About 39.4% of patients were diagnosed after over a year (with some over 5 years) of suffering from vertigo and only 18.7% of patients were diagnosed correctly within 1 month of symptom onset. The presenting features were variable with 174 (72.2%) complaining of spinning, unsteadiness, and falls seen in 36 + 10 + 37 (34.4%). Vestibular migraine was the most common diagnosis (63.39%), followed by benign paroxysmal positional vertigo (24.48%), of which the posterior canal was most affected (50.85%) followed by horizontal (40.68%) and anterior canal (8.47%). Other etiologies noted were central (14.10%) and peripheral vestibulopathy (17.42%) and variable other causes (6.19%).

CONCLUSION: Many pediatric vertigo and dizziness patients do not reach the correct diagnosis for long durations and are treated as “unspecified dizziness.” A detailed examination with a multidisciplinary approach including vestibular evaluation is advocated to give definitive treatment to these children.

KEYWORDS: Children, neurotology, vertigo, videonystagmography, vestibular migraine

INTRODUCTION

The implications of diagnostic delay in various pediatric conditions like inflammatory bowel disease (IBD), malignancies, brain tumors, and so on are well documented.^{1–3} Vertigo in children is considered an uncommon condition^{4,5} with a reported prevalence of 5.3% of school-going children experiencing dizziness and imbalance.⁶ The first reference in literature on pediatric vertigo was given by Harrison in 1962.⁷ Pediatric vestibular disorders have varied presentations like spinning, unsteadiness, headache, nausea, vomiting, visual disturbances or difficulty in focusing, recurrent falls, and so on.^{8–10} Thus, it is often a challenge to extract clinical history and evaluate a child with vertigo. Vestibular complaints in children are often misdiagnosed and attributed to behavioral disorder.^{4,11} A vertiginous child is usually first examined by a primary physician, often a pediatrician and rarely diagnosed with a vestibular disorder. This delay in reaching a diagnosis and eventually lack of timely treatment severely affect the child’s quality of life. Vertigo can increase the risk of falls and cause difficulty in reading or restriction of physical activity, all of which can affect the academic performance and social development of a child. The fear of not being at par with his peers and social cut-off has also been shown to put the child at risk of depression^{12–14}

Retrospectively tracking the patient’s journey from initial presentation to the Primary Care Physician with dizziness to a definitive diagnosis in a hospital vestibular clinic reveals significant delays. Despite the availability of modern diagnostic tools like videooculography (VOG), video head impulse test (vHIT), dynamic visual acuity (DVA), subjective visual vertical (SVA), and so on, diagnosis of vertigo is primarily based on history and clinical examination. Resultantly, a lot of cases with peripheral vestibular disorders or underlying neurological diseases are missed. Therefore, a multi-disciplinary approach is advised to not only correctly diagnose the

cause of vertigo in a child but to do so timely so as to save these children from permanent vestibular dysfunction.

This study is designed to analyze the diagnostic delay from initial onset to time required to reach a definitive diagnosis in children complaining of dizziness. It also describes the variable presentations and different etiologies found in a large cohort of dizzy children.

MATERIAL AND METHODS

A retrospective study was conducted at Vertigo and Ear Clinic, a tertiary otoneurology clinic in Jaipur, India. Record sheets of 241 pediatric patients who presented with vertigo between January 2019 and April 2022 were analyzed.

Inclusion Criteria

1. Patients aged 16 years or below, complaining of vertigo, unsteadiness, imbalance, or dizziness were included.

Exclusion Criteria

1. Patients with otitis media were excluded.
2. Patients who did not undergo vestibular and audiological tests were excluded.

Methodology

All patients were evaluated with detailed history regarding vertigo attacks, duration, triggers, and associated symptoms like headache, nausea/vomiting, tinnitus, hearing loss, previous medical and family history, and so on. The history was taken using neuroequilibrium cloud platform. These patients were then subjected to clinical examination including otoscopy, pure tone audiometry (PTA), and vestibular tests like VOG with bithermal caloric test, vHIT, DVA, and SVV. All the vestibular tests were done with equipment manufactured by neuroequilibrium. Radiographic imaging was done wherever indicated.

All diagnoses were made based on clinical practice guidelines of Barany Society.¹⁵⁻¹⁷

Statistical Analysis

Complete data were extracted, tabulated, and analyzed. Categorical variables were expressed in numbers and percentages, and continuous variables were expressed as mean \pm standard deviation.

Descriptive statistics were used to analyse the diagnostic delay from initial onset to the time required to reach a definitive diagnosis in children complaining of dizziness. The complete data were extracted, tabulated, and analysed. Categorical variables were expressed in numbers and percentages, while continuous variables were expressed as mean \pm standard deviation. The categorical variables, such as gender, age group and the associated symptoms, were analysed by calculating the frequency and percentage of each category. The number of participants falling into each category was determined, and the corresponding percentage was calculated by dividing the count by the total number of participants. These results were presented in tables to provide a clear overview of the distribution of categorical variables. The diagnostic delay for each participant was determined by subtracting the initial onset time from the time required to reach a definitive diagnosis. All analyses were performed using Statistical Package for Social Sciences version 28.0 (IBM SPSS Corp., Armonk, NY, USA).

All patients' guardians gave written consent for the use of the patients' anonymized clinical data for retrospective research purposes. Ethical review and approval were not required for the study in accordance with the local legislation and institutional requirement as it is a patient record based retrospective analysis.

RESULTS

A total of 241 patients were included in the study. Patient demographics (Table 1) and complaints (Table 2) are described in the following sections.

Figure 1 represents the time duration between the first vertigo attack and the final diagnosis.

It shows 39.4% of patients were suffering from vertigo for more than a year (ranging from 1 year to 11 years) before diagnosis. Only about 18.7% of cases were diagnosed and treated within a month of their first vertigo attack. The median duration was 6 months. Vestibular migraine (VM) was the disease group that showed the highest delay in diagnosis.

Tables 3 and 4 show various disorders and their neuro-otological findings in the study subjects. Vestibular migraine was found to be the most common cause of vertigo in children (154/241; 63.39%). Of these 154 cases, 94 (61.1%) had definite VM while 60 (38.9%) were diagnosed with probable VM. Videonystagmography (VNG) findings revealed 27 (17.5%) patients with VM had spontaneous nystagmus and 6 (3.9%) had positional nystagmus not compatible with benign paroxysmal positional vertigo (BPPV). Vestibular migraine co-existed with various other conditions: 28 patients of VM had BPPV and 7 showed peripheral vestibular deficits, while orthostatic hypotension and idiopathic intracranial hypertension (IIH) were seen in a single case each.

The second most common etiology identified was BPPV. Fifty-nine out of 241 cases had BPPV (24.48%). Twenty-eight of these had

Table 1. Patient Demographics

Total number of patients	241
Male/female	124/117
Mean age of patients	12.5 \pm 3.02 years
Age range	5-16 years

Table 2. Patient Symptoms

Rotating/spinning vertigo	174
Unsteadiness	36
Falling sensation	10
Blackouts	11
Lightheadedness	10
Headache	161
Nausea/vomiting	132
Hearing loss	48
Tinnitus	77
Fall	37
Loss of consciousness	12



Figure 1. Bar graph showing time duration between first vertigo attack and the final diagnosis. Median = 6 months.

associated VM. All positional tests were performed under VOG guidance to diagnose the affected canal and type of BPPV. Posterior canal BPPV was found most commonly in 30/59 (50.85%) patients, followed by 24/59 (40.68%) having horizontal canal BPPV, and the least common was anterior canal BPPV (8.47%). Central causes (14.10%) were diagnosed with the presence of spontaneous or valsalva-induced nystagmus; peripheral vestibulopathy (17.42%) was identified using vHIT, caloric tests, or spontaneous and head-shake-induced nystagmus. The category of unilateral peripheral vestibulopathy included 2 cases of vestibular neuritis and 8 cases of labyrinthitis. We observed 4 cases of Meneire's-migraine syndrome which is quite rare in pediatric patients and 3 cases of vestibular epilepsy.

Table 3. Final Diagnosis

Diagnosis	Number of Patients	Percentage
Vestibular migraine	154	63.39
Benign paroxysmal positional vertigo	59	24.48
Central vestibulopathy	34	14.10
Unilateral peripheral vestibulopathy	42	17.42
Labyrinthitis	8	
Vestibular neuritis	2	
Otolithic disorder	1	
Ototoxicity	1	
Meneire's—migraine disease	4	1.66
Vertiginous epilepsy	3	1.24
Superior semicircular canal dehiscence syndrome	1	0.41
Orthostatic hypotension	1	0.41
Cerebello-pontine angle tumor	1	0.41
Auto-immune inner ear disease	1	0.41
Idiopathic intracranial hypertension	1	0.41
Vestibular paroxysmia	1	0.41
Drug-induced vertigo	2	0.83

Isolated cases of superior semicircular canal dehiscence syndrome, ototoxicity, otolith disorder, autoimmune inner ear disease, CP angle tumor, orthostatic hypotension, IIH, vestibular paroxysmia, and drug-induced vertigo were noted.

DISCUSSION

The prevalence of vestibular disorders in the pediatric population ranges between 0.7% and 15%.¹⁸ Thought to be an uncommon finding, in reality, these children are often overlooked or misdiagnosed. A precise diagnosis is a prerequisite for a successful treatment. We observed that only less than 20% of children are diagnosed correctly within 1 month of the onset of symptoms. In majority of cases, it took more than a year to reach a correct diagnosis with (39.4%) of patients requiring several years to reach the diagnosis. After a thorough literature review, we did not find any study reporting this diagnostic delay. It has been frequently observed that the child first presents to a pediatrician and with the unavailability of diagnostic vestibular tests at their disposal, often leads to misdiagnosis. It is not uncommon that many of these are simply prescribed vestibular sedatives for symptomatic relief and never truly diagnosed. Bhattacharyya et al¹⁹ gave clinical guidelines on BPPV in 2017, which clearly mention that clinicians should avoid vestibular suppressants to treat BPPV. Another possible reason could be difficulty in extracting a detailed clinical history and performing a complete examination in children.²⁰ Lastly, considering the frequency of vestibular disorders in pediatric age group is less compared to adults, the examiner often overlooks the condition in children.²⁰⁻²³

Vertigo and dizziness are just symptoms and not diagnosis. The underlying etiology could be multi-factorial. In our observation, one of the most common causes of vertigo in children is VM and this has been widely reported in the relevant literature.^{5,6,18,24-26} Vestibular migraine is typically characterized by episodic attacks of rotating/spinning type of vertigo lasting for minutes to hours and associated with photo/phono-phobia, nausea, vomiting, and in some patients, aura.²⁷ Similar to the vestibular findings observed by Marcelli et al,²⁸ we saw spontaneous, post headshaking and positional nystagmus not compatible with BPPV, along with reduced bi-thermal caloric responses in patients with VM. Several studies quote BPPV to be rare

Table 4. Diagnostic Test Results

Diagnosis	Spontaneous Nystagmus	Headshake Nystagmus	Positional Nystagmus	Caloric Test- Canal Paresis	Video Head Impulse Test	Other
Vestibular migraine	27	11	6	6	2	
Benign paroxysmal positional vertigo			59	6		
Peripheral vestibulopathy	2	3	-	17	-	
Vestibular neuritis	2	-	-	-	-	
VOR dysfunction	-	-	-	-	2	
Labyrinthitis	2	1	-	4	-	
CP angle tumor	1	-	-	-	-	Magnetic resonance imaging (MRI)-meningioma
AIED	-	-	1	-	-	
Vestibular paroxysmia	-	-	1	-	-	MRI-AICA loop

VOR: Vestibulo-ocular-reflex; CP: cerebellopontine; AICA: Anterior Inferior Cerebral Artery; AIED: Autoimmune inner ear disease.

in children.²⁹⁻³¹ Contrary to their opinion, we found it to be the second most common condition associated with pediatric vertigo. Similar to adults, posterior canal was more frequently involved followed by horizontal and anterior canal. This shows the importance of performing positional tests for each canal—Dix-Hallpike for posterior, supine roll test for horizontal, and supine head hanging test for the anterior canal. We also noted that many of these patients had associated migraine suggesting that VM could be an additional risk factor for BPPV. In their study of 10 pediatric patients with BPPV, Brodsky et al²² reported comparable results. Meniere's disease is rare in childhood,^{18,21} but our study showed 4 cases. Its clinical presentation often overlaps with that of VM, thus making it difficult to diagnose. This study reports a plethora of underlying disorders in dizzy children and the frequencies are comparable to what has been previously quoted in the literature.^{4,6,26,32}

We believe that the seemingly increased prevalence and a distinguishable diagnosis of pediatric vertigo can be attributed to the use of advanced testing tools, especially the use of VOG. But what surfaces from this study is that a large percentage of children are diagnosed after a long duration of suffering from dizziness. These children are usually first attended by pediatricians, and clearly, there is a significant delay in reaching the correct diagnosis. This highlights the importance of a comprehensive diagnostic and treatment protocol for vertigo and dizziness in children.

Limitations

The limitation of this study is that it did not include the effect of treatment and the progress of the patients. Vestibular migraine does not have any confirmatory test. In this study, a comprehensive neurological history and evaluation were done followed by diagnoses on the basis of International Guidelines. However, longer clinical studies to monitor progress and reconfirm the diagnosis would be helpful.

Vertigo and dizziness, per se, are symptoms and not a disease. It is important to correctly and adequately evaluate it to determine the underlying etiology. It is necessary to reach a conclusive diagnosis to reduce the delay in diagnosis and initiate timely and appropriate treatment. Although vestibular migraine is the most common cause,

there are various other conditions in children presenting with vertigo and dizziness.

Ethics Committee Approval: Ethical review and approval were not required for the study in accordance with the local legislation and institutional requirement as it is a patient record based retrospective analysis.

Informed Consent: Written informed consent was obtained from the patients' guardians who agreed to take part in the study.

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