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How often do neurological disorders lead to dizziness in childhood?

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What is already known on this topic?

- *Evaluating a child with dizziness is difficult because dizziness is a non-specific symptom, and the etiology varies from orthostatic hypotension to an intracranial tumor.*
- *Because most of the studies that evaluated the etiology of dizziness were conducted in otolaryngology clinics, the most common diagnoses were related to otological diseases, so determining from the pediatric neurology perspective would be useful. Also, there is little known about the outcome of the disease.*

What this study adds on this topic?

- *The etiology of vertigo and/or dizziness in children includes several non-neurological and neurological disorders that may force clinicians to refer such patients to pediatric neurology clinics. Thorough history and clinical examination considering cardiologic causes and laboratory testing, including serum vitamin B12 levels, could decrease unnecessary referral of these patients and request of expensive laboratory tests, such as magnetic resonance imaging and electroencephalography.*
- *Although the majority of cases with childhood dizziness have good prognosis, some patients especially with vestibular migraine might have ongoing symptoms.*

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ABSTRACT

Objective: The aim of the study was to determine the features and differential diagnosis of childhood dizziness and find out the prevalence of neurological diseases in children who were referred to the pediatric neurology outpatient clinic. A secondary aim was to evaluate the outcome of dizziness after 12 months.

Material and Methods: The records of children with a complaint of dizziness that were referred to the pediatric neurology outpatient clinic were retrospectively reviewed, and detailed medical and family history, clinical characteristics, laboratory investigations including vitamin B12 levels, and neuroimaging tests were analyzed. Patients were grouped as neurological disorders and non-neurological disorders. Neurological disorders included vestibular migraine, benign paroxysmal vertigo, and epilepsy, and non-neurological disorders contained the remaining disorders.

Results: The study consisted of 60 children (36 females, 24 males) with a mean age of 11.7±4.1 years. The most common diagnoses were vestibular migraine (21.7%) and orthostatic hypotension (20%). We found that the incidence of neurological diseases was 40% (vestibular migraine, 21.7%; epilepsy, 10%; benign paroxysmal vertigo, 8.3%). When we compared the neurological disorders with non-neurological disorders, there was a significant difference in terms of age at onset and duration of attacks (p=0.001 for both), whereas no significant difference was detected in terms of gender, frequency of attacks, and vitamin B12 levels. We detected ongoing symptoms in 10% of the patients who were diagnosed with vestibular migraine and psychogenic dizziness.

Conclusion: Both non-neurological and neurological diseases are common in etiology of children with dizziness.

Keywords: Childhood, dizziness, migraine, prognosis

Introduction

Dizziness is a feeling of lightheadedness, unsteadiness, or giddiness or a feeling of floating sensation, whereas vertigo is a subjective sensation of movement defined as turning of the patient or the surroundings. A disturbance in the vestibular system, which has peripheral and central nervous system components, may cause vertigo. Because children are not able to express themselves adequately, clinicians may have difficulty in making a distinction between vertigo and dizziness. Therefore, these two concepts are often used interchangeably.

The prevalence of dizziness and/or vertigo in children varies between 0.7% and 15% (1–3). O'Reilly et al. (4) found the prevalence of balance disorders to be 0.45%, of which 0.4% were unspecified dizziness, 0.03% were peripheral, and 0.02% were central vestibular pathology. To assess a child with dizziness may be difficult because dizziness is a non-specific symp-

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tom, and the etiology varies from orthostatic hypotension to an intracranial tumor (5, 6).

The most frequent diagnoses of childhood dizziness vary according to whether the study originates from pediatric, otolaryngology, or neurology departments (7-10). Because most of the studies that evaluated the etiology of dizziness and vertigo were conducted in otolaryngology clinics, the most common diagnoses in children with a complaint of dizziness and/or vertigo were related to otological diseases, such as otitis media and middle ear effusion (11, 12).

The aim of the study was to determine the features and differential diagnosis of childhood dizziness and find out the prevalence of neurological diseases in children who were referred with a complaint of dizziness to the pediatric neurology outpatient clinic. Also, we wanted to investigate the demographic, clinical, and laboratory characteristics of patients with neurological and non-neurological disorders. A secondary aim was to evaluate the outcome of dizziness after a one year period.

Material and Methods

The records of patients ≤18 years of age that were referred to Medeniyet University Göztepe Training and Research Hospital, Pediatric Neurology Outpatient Clinic between January 2013 and July 2014 with a complaint of dizziness were retrospectively analyzed. Gender; age at vertigo onset; characteristics of vertigo (duration [<1 minute, 1–5 minutes, and >5 minutes]; frequency; accompanying symptoms such as headache, nausea, vomiting, loss of consciousness, darkening of the eyes, pallor); history of motion sickness; and family history of migraine, epilepsy, and cardiac disease were noted. Examinations including physical, neurological, otological, ophthalmological, cardiovascular, and psychiatric were performed if needed. Laboratory investigations (whole blood cell count, biochemical tests, vitamin B12 levels), cranial magnetic resonance imaging (MRI), electroencephalography (EEG) and electrocardiography results were recorded. Vitamin B12 deficiency was defined as vitamin B12 level ≤200 pg/mL.

The diagnosis of vestibular migraine (VM) was made according to the International Headache Society Criteria published in 2013 (13). Benign paroxysmal vertigo (BPV) is defined as a disorder characterized by recurrent brief attacks of vertigo, occurring without warning and resolving spontaneously, in otherwise healthy children (13). Benign paroxysmal positional vertigo (BPPV) was diagnosed based on medical history and a positive finding in Dix-Hallpike maneuver (2, 14). Vestibular neuritis was diagnosed based on sudden onset of severe vertigo, spontaneous horizontal nystagmus, and lack of neurological signs (2). Psychogenic dizziness was diagnosed if no etiology was found by physical, neurological, otological, ophthalmological, or cardiological examinations and no MRI and EEG findings in addition to psychiatric examination. Epileptic vertigo was diagnosed based on the history and EEG findings. Orthostatic hypotension was diagnosed when dizziness occurred during sudden postural change or prolonged standing and accompanied with a decrease of at least 20 mmHg in systolic pressure or 10 mmHg in diastolic pressure within 5 minutes of standing after a period of supine rest (15). We put orthostatic hypotension, vasovagal syncope, hypertension, and arrhythmia under the title of cardiogenic vertigo. Also, we classified the diseases as neurological or non-neurological disorders according to the etiology. Because BPV is considered to be migraine equivalent, neurological disorders included VM, BPV, and epilepsy, and non-neurological disorders contained the remaining disorders. The two groups were compared by means of demographic, clinical, and laboratory findings. In addition, all patients were called back after 12 months to re-evaluate the outcome of dizziness.

We excluded patients with acute otitis media, a perforated eardrum, history of trauma and neurosurgery, history of drug use for a long period, or history of a significant chronic illness and developmental disorders. Patients that were not evaluated after 12 months were also excluded from the study.

The study was approved by the Medeniyet University Göztepe Training and Research Hospital's ethics committee with a report number 2014/0144. The study was conducted in accordance with the Helsinki Declaration.

Statistical Analysis

Statistical data were evaluated using the Statistical Package for the Social Sciences for Windows software package version 15.0, (SPSS Inc., Chicago, IL, USA). Descriptive statistical methods (mean±standard deviation) were used for the assessment of data. During the comparison of two groups, along with the descriptive statistical methods (mean, standard deviation), Student's t-test was performed for the comparison of dual groups and chi-square test was used for the comparison of qualitative data. A two-sided p-value of <0.05 was considered as significant.

Results

The study consisted of 60 patients (36 females, 24 males) with a mean age at onset of 11.7±4.1 years (range, 3.5–18 years). The most common diagnoses were VM in 13 patients (21.7%) and orthostatic hypotension in 12 patients (20%). The etiology of dizziness in the study population is listed in Table 1. When we evaluated all the diagnoses, we found that the incidence of neurological diseases was 40% (VM, 21.7%; epilepsy, 10%; BPV, 8.3%).

The most common associated symptoms with vertigo and/or dizziness were headache in 19 patients (31.7%), nausea and/or vomiting in 18 patients (30%), darkening of the eyes in 13 patients

Table 1. Etiology of dizziness in the study population

Disorder	n (%)
Vestibular migraine	13 (21.7)
Orthostatic hypotension	12 (20)
Psychogenic vertigo	7 (11.7)
BPPV	7 (11.7)
Epilepsy	6 (10)
BPV	5 (8.3)
Vestibular neuritis	4 (6.7)
Vasovagal syncope	3 (5)
Amblyopia	1 (1.7)
Hypertension	1 (1.7)
Arrhythmia	1 (1.7)

BPPV, benign paroxysmal positional vertigo; BPV, benign paroxysmal vertigo.

(21.7%), loss of consciousness in 11 patients (18.3%), pallor in 10 patients (16.7%), photophobia and phonophobia in nine patients (15%), and tinnitus in two patients (3.3%). In nine patients (15%), all three symptoms (headache, nausea and/or vomiting, photophobia and phonophobia) were recorded. The associated symptoms according to different diagnoses are shown in Figure 1. In six patients (10%), no associated symptom was identified. There were seven patients with BPPV whose only symptom was positional vertigo appearing during a change in head position. History of motion sickness was noted in 13 patients (21.7%) that were diagnosed as VM (eight patients), psychogenic dizziness (two patients), BPPV (two patients), and BPV (one patient).

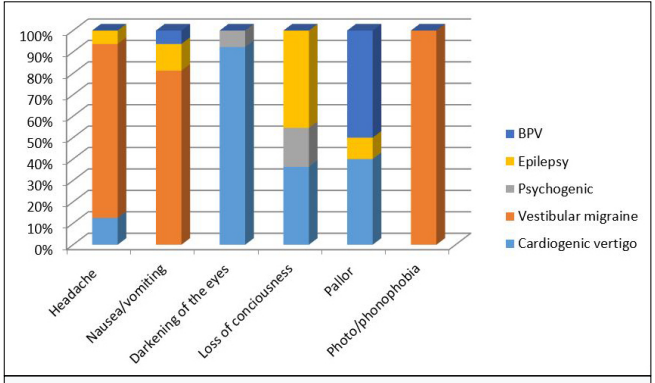

Figure 1. Etiology of dizziness distribution according to associated symptoms

The duration of vertigo attacks was <1 minute in 17 patients (28.3%), 1–5 minutes in 26 patients (43.3%), and >5 minutes in 17 patients (28.3%). The frequency of attacks was ≥1 in a week in 30 patients (50%), 2–3 in a month in 14 patients (23.3%), and ≤1 per month in 16 patients (26.7%). The duration of vertigo and the frequency of attacks according to different diagnoses are shown in Table 2.

Cranial MRI was performed in all patients. Five patients (8.4%) showed abnormal cranial MRI findings that were considered coincidental, arachnoid cyst in four patients and pineal gland cyst in one patient. Electroencephalography was performed in 44 patients, and four of those showed epileptiform discharges that were in occipital regions in two patients, central region in one patient, and temporal region in one patient. Vitamin B12 levels were obtained in 44 patients, and 12 patients were diagnosed with a vitamin B12 deficiency, which ranged between 75 pg/mL and 200 pg/mL (≤200 pg/mL). Treatment of vitamin B12 improved symptoms in 11 patients. Vitamin B12 deficiency was detected in patients with orthostatic hypotension (five patients), VM (three patients), BPV (two patients), and psychogenic dizziness (two patients). All of them benefited from vitamin B12 treatment except a patient with psychogenic dizziness. Whole blood cell count and biochemical tests were normal in all patients.

When we compared the neurological disorders with non-neurological disorders, there was a significant difference in terms of age at onset and duration of attacks (p=0.001 for both), whereas no significant difference was detected in terms of gender, frequency of attacks, and vitamin B12 levels (Table 3).

Table 2. Demographic and clinical features of patients with different etiologies

Demographics	Cardiogenic vertigo (n=17)	VM (n=13)	BPPV (n=7)	Psychogenic (n=7)	Epilepsy (n=6)	BPV (n=5)	VN (n=4)
Age at onset, years (mean±SD)	13.2±3.7	11.5±3	13.6±2.1	13.5±3.5	9.6±4.5	4.1±0.8	9.25±0.9
Gender, n (%)							
Female	11 (64.7%)	7 (53.8%)	3 (42.9%)	6 (85.7%)	4 (66.7%)	3 (60%)	2 (50%)
Male	6 (35.3%)	6 (46.2%)	4 (57.1%)	1 (14.3%)	2 (33.3%)	2 (40%)	2 (50%)
Ongoing symptoms, n (%)	–	4 (30.8%)	–	2 (28.6%)	–	–	–
Duration of attacks, n (%)							
<1 min	8 (47%)	–	1 (14.3%)	3 (42.8%)	2 (33.3%)	2 (40%)	1 (25%)
1-5 min	7 (41.2%)	–	6 (85.7%)	3 (42.8%)	4 (66.7%)	3 (60%)	2 (50%)
>5 min	2 (11.8%)	13 (100%)	–	1 (14.3%)	–	–	1 (25%)
Frequency of attacks, n (%)							
≥1 per week	8 (47%)	4 (30.8%)	7 (100%)	4 (57.1%)	1 (16.7%)	1 (20%)	4 (100%)
2–3 per month	2 (11.8%)	6 (46.1%)	–	1 (14.3%)	1 (16.7%)	4 (80%)	–
≤1 per month	7 (41.2%)	3 (23.1%)	–	2 (28.6%)	4 (66.7%)	–	–

BPPV, benign paroxysmal positional vertigo; BPV, benign paroxysmal vertigo; SD, standard deviation; VM, vestibular migraine; VN, vestibular neuritis.

Table 3. Clinical and laboratory features of neurological and non-neurological disorders

Characteristics		Neurological disorders (n:24)	Non- neurological disorders (n:36)	p
Age at onset, years (mean±SD)		9.6±4.2	13.1±3.5	0.001
Gender, n (%)	Female	14 (58.3%)	22 (61.1%)	0.83
	Male	10 (41.7%)	14 (38.9%)	
Duration of attacks, n (%)	<1 min	4 (23.5%)	13 (76.5%)	0.001*
	1-5 min	7 (26.9%)	19 (73.1%)	
	>5 min	13 (76.5%)	4 (23.5%)	
Vitamin B12 (pg/mL)		343.6±223.1	276.5±143	0.23

SD, standard deviation. *<1 min versus 1–5 min, p=0.8; <1 min versus >5 min, p=0.002; 1–5 min versus >5 min, p=0.001.

After 12 months, all patients were re-examined and the outcomes were evaluated. We detected ongoing symptoms in six patients (10%), who were diagnosed as VM (4 patients) and psychogenic dizziness (2 patients).

Discussion

The etiologies in childhood dizziness differ between various studies. A reason for this is that some studies included patients with dizziness whereas others included children with true vertigo. Another reason for different results depends on whether the study originated from pediatric, otolaryngology, or neurology departments (7). Most of the studies that evaluated the etiology of dizziness were conducted in otolaryngology clinics, so the most common diagnoses were related to otological diseases such as otitis media and middle ear effusion (11, 12). In our study, we included children with normal otoscopic findings to rule out these most common otological diagnoses. Another reason for this may be because of the variety of study designs (16). For instance, because BPV is an age-related condition and the mean age at onset of vertigo and/or dizziness was 11.7±4.1 years in our study, we detected the prevalence of BPV as lower than expected.

In our study, the most common diagnosis was VM. Although our study was performed in a pediatric neurology clinic, orthostatic hypotension was the second common cause. Patients with traumas, another common cause of vertigo, were excluded from the study because they were evaluated in the emergency department. When we evaluated all the diagnoses in children with a complaint of dizziness that were referred to the pediatric neurology outpatient clinic, we found that the incidence of neurological diseases was 40%. This group of patients complained of true vertigo rather than dizziness. Dizziness is a feeling of lightheadedness or a floating sensation, whereas vertigo is a subjective sensation of movement defined as turning of the patient or the surroundings. Therefore, we recommended that the first step was to determine the discrimination between true vertigo and dizziness while evaluating the children with dizziness and/or vertigo.

In a multi-center study, cardiogenic vertigo, the third most common cause of dizziness in children, was detected in 13.4% of the adolescents (17). In our study, there were 12 patients (20%) with orthostatic hypotension, three patients (5%) with vasovagal syncope, one patient with hypertension, and one with arrhythmia. Therefore, about one-fourth of our patients were diagnosed with cardiogenic vertigo, although the study was conducted in a pediatric neurology clinic. The most important common point of these patients was that they described the sensation as dizziness rather than true vertigo, and the symptoms occurred during rapid transition from lying down to standing. In addition, the most common associated symptoms were darkening of the eyes, pallor, and loss of consciousness (especially in patients with vasovagal syncope). We suggested that to prevent unnecessary referral of patients, children with a complaint of dizziness accompanying darkening of the eyes and loss of consciousness should undergo a cardiological examination including measurement of blood pressure while standing up and lying down and electrocardiography.

In previous studies, the incidence of VM was 18–25% (1). We determined that the most common cause of vertigo in children was VM in 22% of our patients, similar to the literature. Gruber et al. (18) determined that nine followed-up patients (100%) with VM had ongoing symptoms after 2 years, although still less than half of them used appropriate acute or prophylactic anti-migraine medications. In our study, two patients out of 13 were treated with topiramate as a preventive anti-migraine medication, whereas 11 patients were treated with conservative measures and acute medications (analgesics). When we evaluated the patients with VM one year later, ongoing symptoms were detected in 31% of them. We thought that it is important to follow these patients more closely to interfere with appropriate treatment in required cases. Adult studies reported reduction in symptom severity and frequency with topiramate, whereas few studies showed the efficacy and safety of topiramate for preventive therapy in children with VM (19-21). In our study, only two patients using topiramate for preventive therapy had good prognosis. We could not make any speculation on this issue, so further studies with a large number of patients determining the efficacy of topiramate in children with VM are needed.

Psychogenic dizziness was reported with an incidence of 5–24% in different studies (2, 6, 16, 18). Similarly to these studies, we detected the incidence of psychogenic vertigo as 12%. These children underwent many examinations such as blood analysis, cranial MRI, and EEG that revealed normal findings. Finally, two patients were diagnosed with depression and five patients with anxiety disorder. After one year of follow-up, we found that 28% had ongoing symptoms. Gruber et al. (18) found that 50% of patients with psychogenic dizziness had ongoing symptoms on follow-up. After the exclusion of organic causes in children with unexplained dizziness, early psychiatric consultation and follow-up should be recommended.

A well-received story will lead us to the laboratory examinations that should be demanded; for example, EEG may be requested in patients with a complaint of loss of consciousness, and detailed cardiological evaluation should be required in patients with a complaint of darkening of the eyes. Vitamin B12 deficiency was detected in 12 patients; symptoms improved in 11 of them with treatment. Because the treatment is beneficial, we recommend investigating vitamin B12 levels, which is an easily accessible laboratory test. Ravid et al. (6) determined that MRI revealed an incidental finding (arachnoid cyst) in 2% of their patients evaluated in a pediatric neurology clinic with dizziness. Similar to the literature, abnormal but incidental MRI findings were detected in 8% of our patients. Causes of central vertigo such as brain tumor or stroke usually admitted to emergency departments with acute neurological deficits. In our study, the patients who applied to our outpatient clinic had normal neurological examinations. Although the neurological examination was normal in all our patients, the reason why all of them underwent cranial MRI was due to the fact that the patients were referred by pediatricians who had already requested imaging from most of them. Therefore, we suggested cranial MRI for selected patients with additional neurological deficits.

In our study group, we found that neurological diseases that lead to childhood dizziness started at an earlier age than non-neurological diseases. Adolescents were more likely to have BPPV, psychogenic dizziness, orthostatic hypotension, and vasovagal syncope. In addition, we detected that the du-

ration of attacks was longer in neurological disorders, whereas it was <5 minutes in the majority of the non-neurological group. These findings might be clues to make the differential diagnosis.

There are potential limitations of this study. One of the most important limitations was the retrospective nature of the data. Although we recalled the patients one year later for re-evaluation, they could not remember certain details of history obtained after a time period. Also, long-term follow-up is needed to get more information about the course of the disease. Large prospective studies and long-term follow-up is needed.

The etiology of vertigo and/or dizziness in children includes non-neurological and neurological disorders that may force clinicians to refer such patients to pediatric neurology clinics. The onset of the disease at an early age and the prolonged duration of the attacks are guiding findings for the pediatricians to refer the patient to the neurology clinic. Thorough history and clinical examination considering cardiologic causes and laboratory testing including serum vitamin B12 levels could decrease unnecessary referral of these patients and request of expensive laboratory tests, such as MRI and EEG.

Ethical Committee Approval: Ethics committee approval was received for this study from the ethics committee of Medeniyet University Göztepe Training and Research Hospital (2014/0144).

Informed Consent: Written informed consent was obtained from all patients who participated in this study.

Peer-review: Externally peer-reviewed.

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