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Vertigo in Children

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Abstract: The aim of this study was to search for the reason for vertigo in children who complain of it. We tested 30 children who had been treated by a pediatrician for various diseases. We performed the detailed protocol of anamnesis, videonystagmography, posturography, and additional tests ordered by the pediatrician and then compared the results of these procedures with those of a group of 30 healthy children. Respiratory system infections, gastritis, and spondylosis were diagnosed most often by pediatricians in young people with vertigo. From videonystagmography results, we observed only four types of pathological reactions: positional nystagmus, cervical nystagmus, abnormal eye-tracking test results, and square wave abnormalities. Only 40% of children demonstrated objective signs of vertigo. Posturography results did not provide specific findings as compared with those from the healthy children. We discussed the probable reasons for vertigo, among which psychogenic origin, side effect of medications, hormonal disturbances, spondylosis, and diet errors had to be taken into consideration.

Key Words: children; posturography; vertigo; videonystagmography

Many children complain about vertigo but, in the majority of cases, vertigo seems to be a symptom accompanying other diseases and different from the strictly otoneurological phenomenon. In discussing such typical vestibular childhood diseases as benign paroxysmal vertigo, benign paroxysmal torticollis, basilar migraine, kinetosis, and visual-cliff phenomenon, we must be very mindful of parents' observations regarding other conditions (congenital anomalies, drugs, previous head trauma, and diseases treated currently and in the child's past) that can affect the balance system [1].

The normal situation in our study was that children would present to a pediatrician, and the physician would notice vertigo among numerous other complaints. Because the pediatrician would order a test battery, including otoneurological examination, affected vertiginous children came to our otoneurological laboratory. The goal of our study was to evaluate the reason for vertigo in children who complain of it.

PATIENTS AND METHODS

The 30 children in the group (ages 6–16 years; mean age, 10.2 years) who complained of vertigo were tested otoneurologically. The children were not selected, so various diseases were diagnosed by pediatricians. In affected children who needed treatment (e.g., for respiratory system infections), such treatment was provided. For a control group, we examined 30 healthy children (ages 6–17 years; mean age, 9.8 years). The children from the healthy group were never hospitalized, were never treated for otoneurological signs, and were examined regularly at school by balance testing (which is carried out according to each child's age and during which the child's weight, height, vision, hearing, and skin condition are checked). The children's health was recorded as normal on the percentage scale.

The otoneurological study consisted of detailed anamnesis according to Claussen, otolaryngological examination, videonystagmography (VNG), and posturography. The tests were performed within 3 days of a child's presenting to a pediatrician. The protocol of Claussen's anamnesis included questions about main syndromes, such as headache; syncope; the type, duration, and circumstances accompanying the vertigo; hearing disorders (e.g., hypoacusis, tinnitus); cranial nerve disabilities; previous head and neck injures; other systemic diseases; and drug use. This protocol was enriched by specific questions for children: female children's age at the first, and regularity of, menstruation; diet; strenuous sports; nervousness dependent on a situation at school and at home; and genetic (especially bone and hormone) problems in the family.

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VNG was performed using the Synapsys equipment (Marseille, France). Spontaneous nystagmus with eyes closed, optokinetic nystagmus, eye tracking, positional nystagmus, cervical nystagmus, and gaze nystagmus were assessed. The caloric test was performed according to Brünings (with water at 30°C and 44°C) to search for unilateral labyrinthine weakness or directional preponderance (or both).

Posturography was performed using Freyss's mobile platform (Synapsys). The posturographic test consisted of four sequences: with the platform moving backward-forward while the patient had eyes open and eyes closed, and with the platform moving side to side while the patient had eyes open and eyes closed. During each sequence, we measured four parameters: (1) maximum amplitude, (2) mean amplitudes of the platform deviations, (3) mean velocity of the platform sway, and (4) mean velocity of the head. We estimated the last parameter using a special detector fixed on the head.

Apart from the otoneurological diagnosis, the pediatrician collected the data from the physical examination and additional tests. The most frequent assessments were blood and urine examination, spirography, gastroscopy, radiological testing of the cervical vertebral column, computed tomography or magnetic resonance imaging of the head, and neurological, ophthalmological, and psychiatric examinations.

RESULTS

Table 1 demonstrates the results of anamnesis and the additional tests ordered by the pediatrician to facilitate the pediatric diagnosis. No child had positive anamnesis for meningitis, encephalitis, or ototoxic drugs. Four patients mentioned having had febrile seizures in infancy. In one patient, epilepsy developed a few years later, and three were treated because of respiratory infections at the time of our study.

Table 1. Pediatric Diagnosis Based on Anamnesis and an Otoneurological Anamnesis Protocol and on an Extended Pediatric Examination

Diagnosis	No. of Children
Respiratory infection	9
Chronic gastritis	14
Anorexia nervosa	2
Bronchial asthma	4
Hypertension	2
Vasovagal syncope	1
Posttraumatic syndrome	3
Epilepsy	1
Hyperthyreosis, menstrual problems, diabetes	5
Migraine	1
Reactive neurosis	6
Depression	2
Spondylosis	10

Otolaryngological Examination

We noted no pathology of the ears, including otitis media with effusion. Nine children had rhinopharyngitis, one simultaneously with angina. We observed no congenital anomaly in the otorhinolaryngolical organs.

Videonystagmography

Of the 30 children tested, 18 demonstrated no pathological sign on VNG. The other 12 children had pathological recordings obtained during VNG. Table 2 shows all the pathologies connected with the abnormal findings revealed by the pediatrician and other specialists and on the basis of additional tests. In many of the VNG test

Table 2. Pathological Results on Videonystagmography and Accompanying Pathologies Discovered by a Pediatrician

Videonystagmography	No. of Cases	Other Accompanying Disturbances
Positional nystagmus	9	Hormonal disturbances Lack of micro- and macroelements in blood examination Hydrodynamic disturbance after vomiting Process of maturing (late first menstruation)
Cervical nystagmus	9	Steroid therapy (treatment of bronchial asthma) Strenuous sports or no exercise (obesity) Lack of lordosis Scoliosis Cervical vertebral instability
Pathological eye-tracking test results	3	Hypertension Epilepsy Cortical atrophy on computed tomography scans, posttraumatic syndrome
Square waves during testing of positional, cervical, and caloric nystagmus	3	Migraine Locomotive disease Nervousness

Table 3. Comparison of Mean Values of Parameters Measured During Posturography in Healthy Children and in Those with Vertigo

Sequence of Posturography	Healthy Children	Children with Vertigo	Student's *t*-Test
Platform with forward-backward motion, eyes open			
Maximum amplitude	0.14	0.19	0.09
Mean amplitude	0.10	0.17	0.09
Platform velocity	0.19	0.14	0.0001
Head velocity	0.16	0.15	0.40
Platform with forward-backward motion, eyes closed			
Maximum amplitude	0.25	0.41	0.00001
Mean amplitude	0.13	0.26	0.007
Platform velocity	0.21	0.19	0.15
Head velocity	0.22	0.17	0.18
Platform movable to the sides, eyes open			
Maximum amplitude	0.32	0.43	0.001
Mean amplitude	0.16	0.22	0.19
Platform velocity	0.19	0.15	0.0005
Head velocity	0.17	0.13	0.19
Platform movable to the sides, eyes closed			
Maximum amplitude	0.41	0.50	0.01
Mean amplitude	0.21	0.29	0.14
Platform velocity	0.24	0.18	0.000005
Head velocity	0.21	0.15	0.24

Note: Shading of a field indicates that the differences between the values obtained in healthy children and in children with vertigo were statistically significant.

results (discussed earlier), we observed only four pathological recordings: positional nystagmus, cervical nystagmus, pathological eye-tracking test results, and square waves regularly manifested during positional, cervical, and caloric nystagmus testing.

Posturography

Posturography revealed a few abnormal results (Table 3). The maximum amplitudes were greater than normal (estimated in healthy children) when the platform moved side to side and backward and forward with the patient's eyes closed. We observed another statistically significant difference in velocity of the platform. This parameter was smaller than that in the healthy control group in nearly every sequence of the test.

DISCUSSION

Otoneurological examination in children is difficult, and technical problems are frequent. Duwel and Westhofen [2] recommended videooculography as a method of choice in testing children. We used VNG and noted that the problem was with visuooculomotor reactions, during which not the equipment but both the immaturity of eye movement control and changes of concentration, smiling, and physical activity affected the recordings. Our opinion on this topic was the same as that presented by Cyr [3] and Weeks [4], who stated that controlling the sinusoidal test, calibration, optokinetics, and gaze nystagmus in children is very difficult. Claussen and Claussen [5] compared caloric examination in children 6–10 years old to that in children 11–15 years old. They noted that in children in the younger group, the rotatory test is better accepted and is easier for clinical and statistical evaluation. Melagrana et al. [6] noted lower values of caloric responses and a wider range for normal results in childhood than in adults. Muckelbauer and Haid [7] pointed out the differences between the various parameters among children from 5 to 14 years old. Taking into consideration these suggestions, our study was unexpectedly free from problems with the interpretation of caloric responses to bithermal stimulation: Every child demonstrated clear symmetrical reactions.

Generally, pathological VNG results in children who complained of vertigo were infrequent. After excluding artifacts (repeating visuooculomotor tests several times), only 40% of the study group demonstrated a few pathologies. Positional nystagmus and cervical nystagmus were the most common. In the cases in which the vestibular test results were abnormal, we searched for the causes, taking into consideration other test results collected during pediatric examination, and we observed a correlation between pathological VNG results and the presence of spondylosis. Sahlstrand and Petruson [8] and Asaka [9] observed an exact connection between idiopathic scoliosis of the cerebral vertebral column and abnormalities during electronystagmography study. However, in their studies, positional and spontaneous nystagmus were dominant; in ours, the cervical test was a good indicator of cervical pathology.

The other problem was interpretation of positional nystagmus, present in 30% of our young patients. Many researchers question whether this kind of vestibular reaction is physiological in childhood and may be present in 20% of asymptomatic children [10]. In the literature, positional nystagmus is often connected with benign paroxysmal positional vertigo, but it must be emphasized that Hallpike's maneuver was not included in our VNG study, especially owing to the patients' lack of concentration and eye closing during position changes. Uneri and Turkdogan [11] noted benign paroxysmal positional nystagmus together with spontaneous nystagmus in 59% of children with vertigo, which, in their opinion, suggested a peripheral vestibular pathology. Zhang Zhao [12] demonstrated peripheral pathology in

95% of tested children younger than 13 years; benign paroxysmal positional vertigo or Ménière's disease was suspected in these cases. Migraine was mentioned as the representative of nonspecific vestibulopathy in children, especially when positional nystagmus was accompanied by pathological eye-tracking test results and disequilibrium and when the typical episodic vertigo with headache sensitive to ergotamine appeared [13–15]. In our data, one child demonstrated typical symptoms as mentioned—family history of migraine together with positional nystagmus and eye-tracking disability—so the diagnosis of vestibular migraine was suggested.

Middle-ear diffusion and otitis media are the most-often discussed reasons for vertigo and balance disturbances in children [16–18]. We noted no pathology of the middle ear during routine otolaryngological examination in our children, nor did we observe any indication to perform tympanometry as a confirming test.

Posturography was not specific for vertigo in our children. The increase in maximum amplitude as compared with that in a normal sample in nearly each sequence of the entire examination may have been the effect of the changes in concentration; a small inattention may cause an abnormally greater deviation of the platform. However, the other parameters—mean amplitude of the platform deviations, mean velocity of the platform sway, and head velocities—were in the normal range. Foudriat et al. [19] posited that even a 3-year-old child is able to maintain postural stability in altered sensory environments and that a 6-year-old child can be stable with or without visual control. In our findings, the velocity of the platform was a paradox: It was smaller in patients with vertigo, confirming that they possessed a fairly good ability to control balance on a movable platform. Additional evidence suggests that generally our tested group was free from objectively measured signs of vestibular system diseases.

We wondered why vertigo was most often accompanied by respiratory disorders and gastritis. Further, we questioned why the majority of cases manifested no objective signs of vestibulopathy during otoneurological examination. The possibility of psychogenic dizziness, which confronted Lin et al. [20] in 13% of their patients with vertigo of at least 12 years' duration, must be considered. In the Lin study, pathological recordings on electronystagmography were rare. We agree with the opinion that not only organic etiology but functional complaints must be considered in treating children with vertigo [21]. Such complaints may depend on posttraumatic symptoms (even mild sleep disturbances), depression, neurosis, diet, and the side effects of antibiotics, steroids, and other medication therapy being administered for primary diseases (in our children, consisting of gastritis, bronchial asthma, etc.) [22].

CONCLUSIONS

In the majority of the children we tested, vertigo was of the symptomatic type. Gastritis and respiratory infections were the most frequent diseases that were accompanied by vertigo. Fewer than one-half of those in the tested group demonstrated objective signs of vestibular disability during VNG. Positional and cervical nystagmus were most frequently seen.

Such pathological factors as previous head injury, diseases of the cervical vertebral column, hormonal disturbances, lack of micro- and macroelements in the diet, and side effects of drugs prescribed for other diseases might be responsible for vertigo syndrome in those we tested. A psychogenic origin of vertigo seems to be fairly common in childhood.

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