ORIGINAL ARTICLE

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Vestibular disorders in migrainous children and adolescents

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Abstract Recurrent vertigo is a special form of migraine in childhood. It is a periodic syndrome of childhood which was previously called migraine equivalent. Thirty young patients (less than 18 years of age) with migraine and vertigo were examined by the authors. The vestibular system of the patients was examined by computer-based electronystagmography. All patients had migraine-related vestibular dysfunction. Most had spontaneous nystagmus and 86.7% had an abnormal bithermal caloric test. Other forms of migraine-associated periodic syndromes – especially abdominal pain – were found in about 25% of the patients. Approximately one-third of the patients had a family history of migraine, and about half of them had motion sickness. The cause of migraine and migraine-related vestibular disorders is still unidentified, but the origin of the attacks is believed to be located in the brainstem, especially in the pons. This fact is congruent with our results indicating that a central vestibular dysfunction can be found in patients with migraine.

Key words Childhood · Headache · Childhood periodic syndromes · Vertigo · Vestibular dysfunction

Introduction

Vertigo is a relatively uncommon complaint in childhood. Nonetheless, the most common cause of episodic vertigo and disequilibrium in children is migraine [1]. Many of these patients eventually develop more typical migraine headaches, and there is frequently a positive family history for migraine as well [2, 3]. In addition, patients often complain about motion sickness since early childhood [2].

Generally, migraine is seen more often in boys than in girls in early childhood. Duration of the headache in children is shorter than in adults, and neurological signs of basilar migraine can often be seen [5]. Special forms of migraine, including a variety of episodic attacks, have previously been described as so-called migraine equivalents in children: paroxysmal torticollis, attacks of abdominal pain with nausea and vomiting, pain of different localization, transient disturbances in mood, acute confusional state, benign paroxysmal vertigo or episodic vertigo [4, 5]. Confusional migraine is a special form of migraine in childhood in which a mild abnormality is observed on electroencephalography (EEG) [5, 6].

Vertiginous migraine represents one type of complicated migraine [5]. The association of vertigo and migraine has different names, such as migraine otique, vestibular migraine, and basilar migraine. The main symptoms of benign paroxysmal vertigo (BPV) in childhood are vertigo

and disequilibrium without hearing loss or tinnitus. BPV often occurs during the first decade of life.

The exact cause of benign paroxysmal vertigo is still unidentified, but it may represent an early manifestation of migraine. In school-age children, idiopathic vertigo may occur in association with migraine. Vertigo attacks, either just before the onset of migraine headache or during the headache phase, are a characteristic feature of basilar migraine [7].

The classic form of BPV has been distinguished from the so-called migrainous vertigo which is observed later (at the age of 5–9 years) and which persists and frequently evolves into migraine. Vertigo can either be a precursor to migraine or a migraine-associated syndrome. The majority of vertiginous children will become adult patients with migraine with or without vertiginous symptoms [8].

Reversible attacks of central nervous system (CNS) dysfunction and stroke can be caused by migraine in children as well. Caplan [9] reported a 6-year-old boy who suffered from severe headache resulting in a serious stroke with pontine and cerebellar lesions seen on magnetic resonance imaging (MRI). According to Caplan's conclusion, basilar migraine is not benign in all cases [9].

In children with migraine, white matter abnormalities on brain MRI may be found. On T2-weighted images, lesions have been seen on many sites in the white matter (both peripheral and periventricular). These lesions seem to be enlarged Virchow-Robin spaces [10]. Many cranial nerve nuclei and pain pathways associated with migraine attacks are located in the brainstem. A positron emission tomography (PET) study demonstrated that certain brainstem areas are active both during a migraine attack and after the resolution of the headache [10]. The theory presuming that the brainstem is a migraine generator is supported by several studies. It was also reported that the diameter of the pons in migrainous children is greater than in normal ones [10].

Vestibular function in migrainous patients was examined by Cass et al. [11]. Dominant clinical features included chronic movement-associated disequilibrium, unsteadiness, motion discomfort, and episodic vertigo as an aura prior to headache. Common vestibular test abnormalities included a directional preponderance on rotational testing, unilateral caloric weakness and vestibular system dysfunction patterns on posturography [11].

Based on the International Headache Society (IHS) opinion [12], migraine-associated vertigo occurs in young adults and in small children. The syndrome is called basilar migraine in young adults, while in small children it is called benign paroxysmal vertigo of childhood. This latter syndrome is considered to be a periodic syndrome of childhood that may be a precursor to migraine or be associated with it. The syndromes of our patients differ from these two groups, both for age of occurrence and for symptoms of vertigo. For these reasons, we believed it was important to publish our findings and observations.

Patients and methods

In the Neurootologic Department of Semmelweis University, 30 migrainous patients under 18 years of age were examined in 1997. These migrainous patients were referred by a pediatric neurologist because of vertigo of unknown etiology.

The examination began with the detailed case history and routine otorhinolaryngological and neurological examinations. In the migrainous patients without vertigo, there were no statokinetic abnormalities; thus they were not sent for neurootological examination.

The cochleovestibular function of all patients was examined by separate cochlear nerve and vestibular function tests. Cochlear function tests included pure tone audiometry and acoustic reflex threshold and decay. The vestibular tests involved statokinetic tests (Romberg, Barany and Babinski-Weil tests), spontaneous nystagmus with electronystagmography (ENG) registration, and positional and positioning nystagmus with Frenzel glasses. The saccadic and smooth pursuit eye movement tests were performed by a computer-based ENG system (ICS Chartr ENG System). Finally, bithermal caloric test was carried out by the computer-based ENG. The ears were stimulated with 25° C and 50° C air insufflation for a duration of 40 s. The complete test can be done in children 5–6 years of age or older.

Results

We studied 30 migrainous children, including 14 boys and 16 girls. The boys had a mean age of 10.8 years (range, 8–15 years); the girls had a mean age of 13.0 years (range, 9–17 years).

The results of the clinical case histories are shown in Table 1. Headache was observed in the family history in 11 cases, and in most cases the mother had recurrent headache as well. Motion sickness was detected in almost half of the patients. Abdominal discomfort was present in 8 patients. The ear drum was normal in all cases. Routine neurological examination did not show any pathological signs (nystagmus was not observed in patients with open eyes). Some mild EEG abnormalities were observed in one case.

Among the 30 migraineurs, 28 suffered from headache; either unilateral or bilateral pulsating headache lasting for a few hours. Two patients had migraine without headache. These patients also had abdominal discomfort which was considered to be aura without headache.

The characteristics of dizziness or vertigo observed in the study group are summarized in Table 2. There was true rotatory vertigo in 18 cases. The duration of the vertiginous attack was a few seconds. Unsteadiness was constant in 12

Table 1 Clinical and family case histories of the 30 migrainous children

Symptoms	Patients, n (%)	
Migraine in family history	11	(36.6)
Motion sickness	14	(46.6)
Abdominal discomfort	8	(26.6)
Headache	28	(93.3)
Headache at the time of vertigo	20	(66.7)
Headache independently of vertigo	8	(26.7)

Table 2 Cochleovestibular findings

Symptoms	Patients, n (%)	
True rotatory vertigo	18	(60.0)
Constant unsteadiness	12	(40.0)
Audiological abnormalities	4	(13.3)
Horizontal spontaneous nystagmus	25	(83.3)
Positional nystagmus	2	(6.7)
Statokinetic test disorders	16	(53.3)
Smooth pursuit eye movement disorder	15	(50.0)
Abnormal bithermal caloric test	26	(86.7)
Pure canal paresis	4	(13.3)
Pure directional preponderance	8	(26.7)
Canal paresis with directional preponderance	14	(46.7)

patients. At the time of the vertigo, most patients had headache.

Four patients had abnormalities in audiologic tests; one was congenitally deaf, independently from migraine and vertigo. Three patients had acoustic reflex abnormalities (in one patient there was reflex decay, in one absence of reflex, and in one elevated reflex threshold).

Horizontal spontaneous nystagmus with closed eyes was registered in 25 cases. Abnormalities (deviation, ataxia) were found in 16 cases during statokinetic tests (Romberg, Barany, Babinski-Weil tests).

Positional nystagmus (direction changed positional nystagmus) was found only in 2 cases. The disturbance of saccadic eye movements or smooth pursuit was seen in 50% of cases.

The results of the bithermal caloric test were abnormal in 86.7% of cases. Pure canal paresis was found in 4 cases, pure directional preponderance was detected in 8 cases, and caloric weakness with directional preponderance was seen in 14 cases (46.7% of all migrainous patients and 53.9% of migrainous patients with pathological bithermal caloric test).

The computer-based ENG system was used to calculate the percentages of caloric weakness and directional preponderance. Both are considered to be normal when lower than 20%. In our study group, the mean value of caloric weakness (greater than 20%) was 39%. In 22 cases a directional preponderance was found. The mean value of the directional preponderance (greater than 20%) was 44.7%.

Discussion

Migraine affects approximately 10% of children and adolescents [10]. Brain imaging studies have a limited clinical value in the evaluation of children with headache and vertigo [10]. The diagnosis of migraine is based on the correct evaluation of case history. Several forms of special types of migraine can be found in children and adolescents. Abdominal discomfort associated with migraine was seen in 26.6% of our vertiginous patients. The manifestations of the migraine-related vestibular symptoms are quite varied, ranging from episodic true vertigo to constant imbalance, movement-associated disequilibrium and motion sickness [11]. Based on the IHS opinion [12], migraine-associated vertigo occurs in young adults and in small children. The syndrome occurring in young adults is called basilar migraine, while that in small children is called benign paroxysmal vertigo of childhood. This syndrome is considered to be a periodic syndrome of childhood that may be a precursor to migraine or be associated with it.

In the authors' experience, one of the most common causes of dizziness in children and adolescents is migraine-related vestibular dysfunction. This is a migraine with special aura, previously called complicated migraine. Dizziness can be felt before the headache as an aura, during the headache and independently of the headache (previously called acephalic migraine, aura without headache) [5]. Motion sickness and labyrinthine hyperesthesia are characteristics of the child with migraine. The patient has nausea after caloric irrigation, but vomitus is rare [5]. In our opinion, the bithermal caloric test is the best means for determining whether a vestibular lesion is peripheral or central, and for establishing the side of the lesion. The Dix-Hallpike-Fitzgerald caloric test using 30° C and 44° C water is usually poorly tolerated by young children, while the air caloric stimulation is more accepted. A common complaint of the children is a fear of moving (e.g. travel, gymnastics, swinging), whereas healthy children generally enjoy playing on a swing.

In our cases most of the patients with migraine had spontaneous nystagmus. Spontaneous nystagmus of vestibular origin is not observed in healthy patients. In addition, half of the patients had abnormalities of saccadic and smooth pursuit eye movements. There was abnormality in bithermal caloric test in 86.6% of the children (most abnormalities were unilateral caloric weakness and directional preponderance). Normally, the caloric responsiveness is symmetrical in the two labyrinths. As in adults, most of the patients had

central vestibular disorders [2] with pure directional preponderance in the caloric test. In childhood, the mixed type of vestibular lesion (both central and peripheral) seems to be a characteristic form of migraine-associated vestibular disease.

Our patients are older than the typical, small patients presenting with BPV, and most of them have not only brief attacks of vertigo, but constant unsteadiness and motion sickness. In addition, the other symptoms of basilar migraine of young adults are absent (no dysarthria, no visual symptoms, no paresthesias, no decreased level of consciousness). The syndromes of our patients are quite different from the two groups (basilar migraine and BPV), for both characteristics of age and vertigo. Based on our findings, we propose the term "migraine-associated vertigo of school-age children" for this symptom. We also propose that this symptom be classified together with BPV of childhood [12].

The nature of migraine and migraine-related vestibular disorders is still unknown, but MRI results of a morphometric study [10] have shown that migraine attacks originate from the brainstem, especially the pons. This fact is congruent with our neurootological results stating that migrainous patients have a central vestibular dysfunction.

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