International Journal of Pediatric Otorhinolaryngology 87 (2016) 148–153

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: http://www.ijporlonline.com/

Balance disorders in childhood: Main etiologies according to age. Usefulness of the video head impulse test

Patricia Alejandra Sommerfleck [a, *], María Emilia González Macchi [a], Romina Weinschelbaum [b], Maximiliano Damián De Bagge [a], Patricia Bernáldez [a], Sergio Carmona [b]

[a] Otorhinolaryngology Department, Hospital de Pediatría "Prof. Dr. Juan P. Garrahan", Argentina
[b] Neuro-otology Department, INEBA Instituto de Neurociencias de Buenos Aires, Argentina

ARTICLE INFO

Article history:
Received 24 March 2016
Received in revised form
3 June 2016
Accepted 4 June 2016
Available online 7 June 2016

Keywords:
Balance-disorder
Childhood
Video-head-impulse-test

ABSTRACT

Balance disorders are common in adult patients but less usual in the pediatric population. When this symptomatology appears in children it is a cause for concern, both for parents and health-care professionals.

Objectives: To explain the balance disorders in children describing a case series and to discuss the main etiologies found according to age.

Study design: A retrospective, observational, descriptive, and cross-sectional study was conducted.

Population: Patients aged 1–18 years who consulted because of balance disorders at the otolaryngology department of a pediatric tertiary-care hospital between March 2012 and July 2015.

Results: Two hundred and six patients were included in the study. Median age was 10 years. The most common diagnoses were vestibular migraine in 21.8% of the children, ataxia in 9.22%, benign paroxysmal vertigo of childhood in 7.77%, and post-traumatic vertigo in 6.31%.Overall, 61 videonystagmographies– of which 46 were normal - and 55 video head impulse tests - which were normal in 45 and showed abnormalities in the vestibulo-ocular reflex gain in 10 - were performed.

Conclusions: In a child with balance disorders, the medical history and neurotological examination are essential. Vestibular migraine is the most commonly found disorder in every age group, and most of the patients have a family history of migraine. Ancillary studies, especially the video head-impulse test, provide important data to confirm the diagnosis.

1. Introduction

Balance disorders are very common in adult patients [1], but less usual in the pediatric population [2]. When this symptomatology appears in children it is a cause for concern, both for parents and health professionals [3,4].

The diagnosis of patients with vertigo is mainly based on the medical interview. This step is often difficult and demands a lot of patience when dealing with children. On the one hand, what the child says is usually imprecise as he or she cannot explain what has happened, and on the other hand the parents, who have not actually experienced the episode, may distort it according to their interpretation and concerns [5,6]. Thus, the medical interview, which is a basic tool, often becomes biased in children, especially younger ones. Making an accurate diagnosis requires a targeted anamnesis, a careful neurologic and physical examination, and audio-vestibular testing [7–9]. To correctly perform the usual balance tests active collaboration of the patients is necessary and therefore a pleasant and playful relation with the child should be established. There are significant differences in this population. The physical and instrumental exploration of a pre-school child is not the same as that of a school child or adolescent. The prevalent pathologies are not the same either.

The aim of this study was to describe our series of children with balance disorders with a focus on the prevalent etiologies and dividing the sample into age groups.

* Corresponding author.
E-mail addresses: p.sommerfleck@gmail.com (P.A. Sommerfleck), mariaemiliagonzalezmacchi@hotmail.com (M.E. González Macchi), romiwein@yahoo.com (R. Weinschelbaum), maxiddb@gmail.com (M.D. De Bagge), patriciacbernaldez@hotmail.com (P. Bernáldez), scarmona@ineba.net (S. Carmona).

http://dx.doi.org/10.1016/j.ijporl.2016.06.020
0165-5876/

2. Material and methods

A retrospective, observational, descriptive, and cross-sectional study was conducted in patients aged 1–18 years seen at the otolaryngology department of a pediatric tertiary-care hospital between March 2012 and July 2015 because of balance disorders (vertigo, dizziness, instability). They came to the department spontaneously or were referred from other hospital areas, such as neurology, emergency, cardiology, or pediatric clinical medicine.

All the patients underwent a full anamnesis as well as a physical and otoneurological examination (otomicroscopy, throat swab test, anterior rhinoscopy, Romberg, Bárány, Unterberger, and head-impulse test; evaluation of smooth pursuit and sacadic movements, and nystagmus, evaluation of dysmetria and adiadochokinesia and hearing testing).

The age distribution in this study is the one used by the World Health Organization (WHO) [10].

In July 2014 videonystagmography became available at our institution (*Ecleris* model: VNG-PLUS with double camera) to evaluate ocular movements: the optokinetic system and saccadic movements, positional testing and nystagmus evaluation without eye fixation.

In September 2014 we included the video head impulse test in the evaluation (*ICS Impulse*) provided by Otometrics for the special use in children. This test is based on the vestibulo-ocular reflex. This consists of a compensation of the head movements by the extraocular muscles, in which the vision remains fixed on an object, despite rapid head movements. The patient is asked to fix his or her eyes on a target while rapid horizontal low-amplitude head movements are generated (to evaluate the horizontal canals) at an angle of approximately 15° randomly to the right and left, thereby stimulating the function of the horizontal semicircular canal on the side towards which we perform the movement. At the same time, the stimulated vestibular system activates the extraocular muscles of both eyes (the medial rectus in the ipsilateral eye and lateral rectus in the contralateral eye, thereby inhibiting the antagonist muscles) to contract in a direct proportion to the head turn, and both eyes move to compensate and keep the vision fixed on the object. In a patient with vestibular dysfunction, this reflex is altered and diminished. As the vestibular system is not stimulated, there is no excitatory signal to the extraocular muscles, which remain still in relation to the head while the gaze moves away from the object on which it was fixed.

Since the advent of this new technology, we have been able to choose which procedure to perform according to the signs and symptoms of our patients: videonystagmography in positional vertigo and central disorders and vHIT in all patients to differentiate peripheral from central syndromes.

The data obtained were collected in an Excel 2010 data base and analyzed using the SPSS statistical package (version 15.0).

3. Results

Two hundred and six patients aged 1–18 years were included in the study; 99/206 (48%) were girls and 107/206 (52%) boys. Median age was 10 years.

The most frequent causes of balance disorders found in our series of children are shown in Tables 1 and 2.

Of all patients in this series 87/206 (42.23%) reported vestibular symptoms and headaches. Both the headache and the vertigo are non-specific symptoms that may be associated with different disorders. The Committee for Classification of Vestibular Disorders of the Bárány Society and the Migraine Classification Subcommittee of International Headache Society defined criteria to categorize headaches within vestibular migraine (VM) [11](see Table 3).

Table 1
Peripheral causes of balance disorders.

Etiology	Number of patients	Percentage
Post-traumatic vertigo	13	6.31
BPPV	8	3.88
Labyrinthitis	6	2.91
Vestibular neuritis	4	1.94
OME	4	1.94
Vertigo of non-specific cause	16	7.77
kinetoses	2	0.97
Autoimmune hearing loss	1	0.48
Complicated cholesteatoma	1	0.48
CI recalibration	1	0.48
Bilateral vestibulopathy	1	0.48
Dehiscence of the SSC	1	0.48
Total	58	28.15

BPPV: benign paroxysmal positional vertigo. OME: otitis media with effusion. CI: cochlear implant. SSC: superior semicircular canal.

Table 2
Non-peripheral causes of balance disorders.

Etiology	Number of patients	Percentage
Headache	87	42.23
Ataxia	19	9.22
BPVC	16	7.77
Emotional origin	9	4.37
Seizures	7	3.40
CNS tumor	4	1.94
Syncope	2	0.97
Instability	3	1.46
Dizziness	1	0.48
Total	148	71.84

BPVC: benign paroxysmal vertigo of childhood; CNS: central nervous system.

In this series, 34/87 (39.08%) met the diagnostic criteria of defined VM and 11/87 (12.64%) met the criteria of probable VM, totaling 45/87 (51.72%) patients with VM accounting for 21.85% (45/206) of the total sample. In five patients (5.75%) the diagnosis has not yet been established, and 37/87 (42.53%) did not meet any VM criteria.

A family history of migraine was found in 75.5% (34/45) of the patients who met the VM criteria had that history. Those with defined VM diagnosis: 26/34 (76.5%) and in the group of patients with probable VM: 8/11 (72.7%).

3.1. Patients 1–5 years old

Overall 54/206 (26.21%) patients between the ages of 1 and 5 years were evaluated; 23 (42.6%) were girls and 31 were boys (57.4%). (Fig. 1 and Table 4).

To make a diagnosis in children so young a detailed interview with the parents is essential objectively looking for specific symptoms. In cases, such as laberynthitis, OME, and seizures, diagnostic tests will confirm the diagnosis while in cases such as BPVC the interview will be the diagnostic tool of choice. When a child presents with ataxia, the symptoms are better defined and the onset of the disorder is acute. Cerebellar ataxias a neurological sign that points to an alteration of the coordination of voluntary movements and postural control, that may be associated with other signs of cerebellar dysfunction such as intentional tremor, dysmetria, nystagmus, dysarthria, and hypotonía. Of the patients who were diagnosed with ataxia eight had post-viral ataxia, two intermittent ataxia, one ataxia telangiectasia, and one ataxia with

Table 3
Vestibular migraine diagnostic criteria.

1. Vestibular migraine
A. At least 5 episodes with vestibular symptoms of moderate or severe intensity, lasting 5 min to 72 h
B. Current or previous history of migraine with or without aura according to the International Classification of Headache Disorders (ICHD)
C. One or more migraine features with at least 50% of the vestibular episodes:
– Headache with at least two of the following characteristics: one sided location, pulsating quality, moderate or severe pain intensity, aggravation by routine physical activity
– Photophobia and phonophobia,
– Visual aura
D. Not better accounted for by another vestibular or ICHD diagnosis
2. Probable vestibular migraine
A. At least 5 episodes with vestibular symptoms of moderate or severe intensity, lasting 5 min to 72 h
B. Only one of the criteria B and C for vestibular migraine is fulfilled (migraine history *or* migraine features during the episode)
C. Not better accounted for by another vestibular or ICHD diagnosis

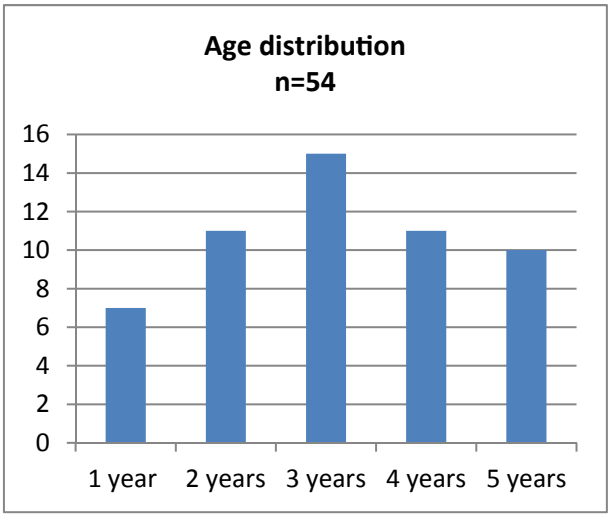

Fig. 1. Patient distribution 1–5 years old.

Table 4
Main causes of balance disorders in 1–5-year-old patients.

Etiology	Number of patients	Percentages
BPVC	16	7.77
Ataxia	12	5.82
Post-traumatic vertigo	6	2.91
Headache*	5	2.43
Labyrinthitis	4	1.94
OME	4	1.94
Seizures	4	1.94
Instability	2	0.97
Kinetoses	1	0.48
Total	54	26.21
*Headache		
Defined VM	0	0%
Probable VM	2	0.97%
Under study VM	0	0%
Did not meet the VM criteria	3	1.46%
Total	5	2.43

vitamin E deficiency. All of them were followed-up at the department of neurology.

Because they were too young, none of these patients underwent a videonystagmography. In three cases a video head impulse test could be performed showing results within normal parameters in two patients with headaches and one with benign paroxysmal vertigo of childhood.

3.2. Patients 6–11 years old

Overall, 82/206 (39.8%) patients aged 6–11 were evaluated. Forty-four (53.65%) of them were girls and 38 (46.35%) were boys. Fig. 2 and Table 5.

Thirty-five videonystagmographies were performed in this group of patients. In 28/35 patients results were normal and 7/35 patients presented with abnormalities: 4/7 in caloric tests, 1/7 in nystagmus exploration, 1/7 presented alterations in smooth pursuit movements, and 1/7 with positional tests that showed alteration of the right posterior semicircular canal (BPPV) (See Table 6).

Of 33 video head impulse tests were performed, four were abnormal (See Table 7 and Fig. 3).

3.3. Patients 12–18 years old

Overall, 70/206 patients were between 12 and 18 years old; 32 (45.71%) of them were girls and 38 (54.29%) were boys. Fig. 4 and Table 8.

Videonystagmography was performed in 26 patients in this group. The results were normal in 18 patients. Abnormalities were found in eight 8: in 2/8 on the caloric testing, in 3/8 on exploration of ocular movement, and in 3/8 on positional testing. (Table 9).

Of 19 video head impulse tests performed, six were pathological (See Table 10 and Fig. 5).

4. Discussion

The literature on balance disorders in children is scarce and mostly based on the description of the different disorders without

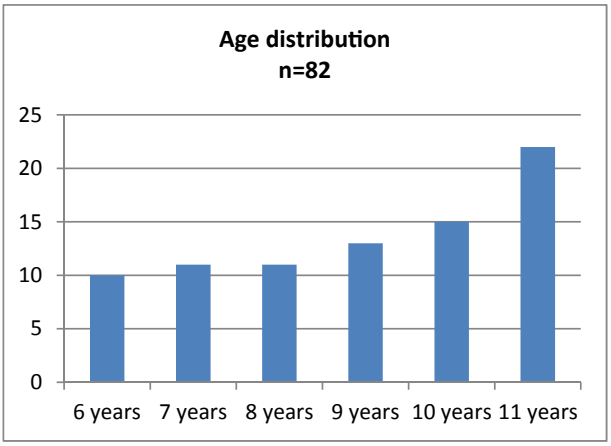

Fig. 2. Patient distribution 6–11 years old.

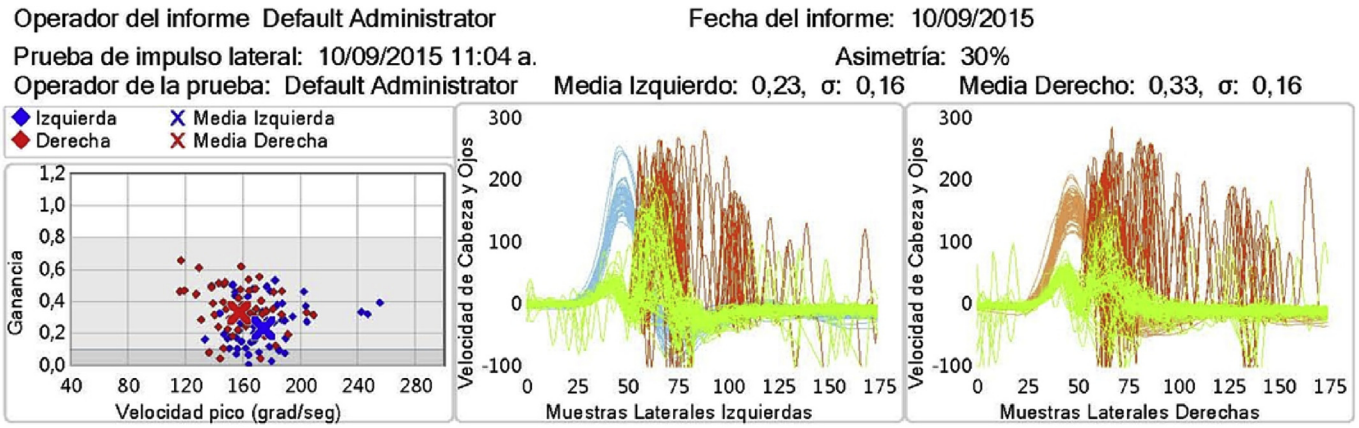

Fig. 3. vHIT in a patient with bilateral vestibulopathy. A decreased gain of the bilateral vestíbulo-ocular reflex is seen. Normal gain = 1 (the degree of head movement to one side is equal to the degree of eye movement to the opposite side). The waves observed during and after the movement are a corrective saccade to compensate for the vestíbulo-ocular reflex deficit.

Table 5
Main causes of balance disorders in 6–11-year-old patients.

Etiology	Number of patients	Percentages
Headache*	48	23.3
Post-traumatic vertigo	5	2.43
Labyrinthitis	2	0.97
Anxiety disorder	4	1.94
Ataxia	3	1.46
Vertigo of non-specific cause	10	4.85
Bilateral vestibulopathy	1	0.48
BPPV	1	0.48
Dehiscence of the SSC	1	0.48
Autoimmune hearing loss	1	0.48
Vestibular neuritis	1	0.48
CNS tumors	2	0.97
kinetoses	1	0.48
Syncope	1	0.48
Instability	1	0.48
Total	82	39.8
*Headache		
Defined VM	20	9.7
Probable VM	3	1.46
Under study for VM	5	2.43
Did not meet the VM criteria	20	9.7
Total	48	23.3

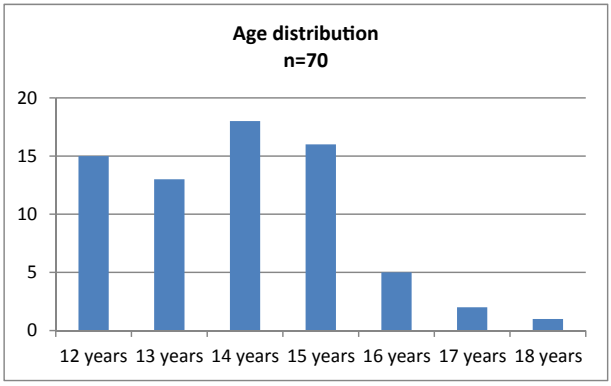

Fig. 4. Patient distribution 12–18 years old.

case studies. This study presents a series of 206 patients followed-up for 3 years at a department of otolaryngology.

Headache is one of the most common reasons for neuro-pediatric consultation in childhood and even more so during adolescence. Before puberty, boys are affected more frequently than girls. But after puberty, headaches predominantly occur in girls [12]. They are the main reason for consultation in all age groups [13,14]. In this study, analyzing children who consulted because of headache associated with dizziness we found that 45/206 (21.85%) met the criteria for VM. However, not all patients who present with headache and vertigo have vestibular migraine. Notably, in children between 1 and 5 years of age who do not

Table 6
Pathological findings on videonystagmography tests in 6–11-year-old patients.

Alteration	Patient diagnosis
Right vestibular hyporeflexia 50%	Right peripheral vestibular syndrome
Right vestibular hyporeflexia	Right peripheral vestibular syndrome
Right vestibular hyporeflexia	Right peripheral vestibular syndrome
Left vestibular hyporeflexia 51%	Left vestibular neuritis
Upwards vertical nystagmus	Vestibular migraine
Abnormal smooth pursuit movements	Headache (not meeting the VM criteria)
Positive Right Dix-Hallpike test	RPSC BPPV

RPSC BPPV: Right posterior semicircular canal benign paroxysmal positional vertigo.

Table 7
Pathological findings on video head impulse test in 6–11-year-old patients.

VOR gain right ear	VOR gain left ear	Patient diagnosis
0.56	1.05	Vestibular migraine
0.33	0.23	Bilateral vestibulopathy
0.84	0.51	Vestibular neuritis
1.07	0.28	BPPV

Table 8
Main causes of balance disorders in 12––18-year-old patients.

Etiology	Number of patients	Percentages
Headache*	34	16.5
BPPV	7	3.4
Ataxia	4	1.94
Emotional origin	6	2.91
Post-traumatic vertigo	2	0.97
Vestibular neuritis	3	1.46
CNS tumors	2	0.97
Seizures	3	1.46
Non-specific vertigo	4	1.94
Complicated cholesteatoma	1	0.48
Syncope	1	0.48
Instability	1	0.48
Dizziness	1	0.48
CI recalibration	1	0.48
Total	70	33.98
*Headaches		
Defined VM	14	6.8
Probable VM	6	2.91
Under study VM	0	0
Did not meet the VM criteria	14	6.8
Total	34	16.5

present with this condition, benign paroxysmal vertigo of childhood is the most frequent pathology which is also considered to be a manifestation of migraine [15–21].

Benign paroxysmal vertigo of childhood is a typical disorder in children with an onset around 3–4 years of age. The episodes appear without a triggering factor, are acute, without aura, and are of short duration. The child is forced to interrupt his or her activities only to return to play as if nothing happened after the episode. Otoneurological examination is completely normal in the interictal period. Impairment of consciousness or auditory symptoms are not observed [22].

An adequate description of vertigo is difficult to obtain in young children. Therefore, it is necessary to closely observe signs such as instability, fear of walking, crying, inability to stand or search for support, and pallor. Vomiting may be associated. Nystagmus may be seen during the episode [23].

Benign paroxysmal vertigo of childhood is classified within the classification of migraine of the International Headache Society (IHS)3rd *edition of the international classification of headaches version beta March 2013 (*Table 11*)* [24]

Headache is a common reason of consult. As there is no diagnostic biological marker, a classification with precise criteria is of

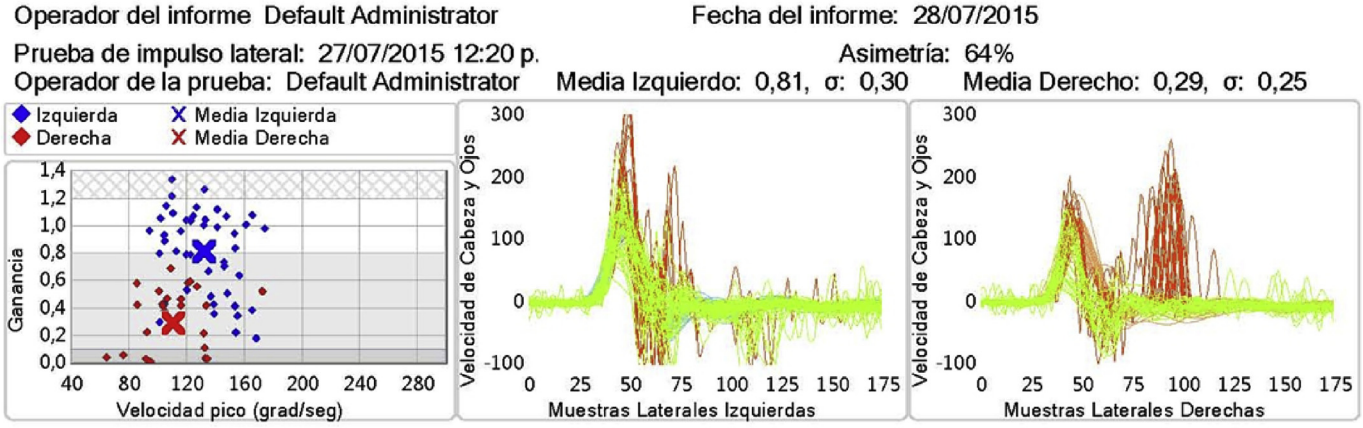

Fig. 5. vHIT in a patient with right vestibular neuritis. A decreased gain in the vestibulo-ocular reflex is observed (in this case in the right ear) with a gain asymmetry of 64%.

Table 9
Abnormal results on videonystagmography in 12–18-year-old patients.

Abnormality	Patient diagnosis
Left directional preponderance	Left peripheral vestibular syndrome
Left directional preponderance	Post-traumatic vertigo
Horizontal left-beating nystagmus	Vestibular neuritis
Smooth pursuit disorder	Ataxia
Smooth pursuit disorder	Refractory epilepsy
Positive Right Dix-Hallpike test	RPSC BPPV
Positive Right Dix-Hallpike test	RPSC BPPV
Positive Right Dix-Hallpike test	RPSC BPPV

RPSC BPPV: Right posterior semicircular canal benign paroxysmal positional vertigo.

Table 10
Abnormalities on video head-impulse test in 12–18-year-old patients.

VOR gain right ear	VOR gain left ear	Patient diagnosis
0.82	0.32	Vestibular neuritis
0.29	0.81	Vestibular neuritis
0.64	0.95	Non-specific vertigo
0.62	0.97	Vestibular migraine
0.52	1.09	Vestibular migraine
0.72	1.05	Vestibular migraine

utmost importance.

As to the outcome of benign paroxysmal vertigo of childhood, a trend towards a decrease of episodes is seen although some cases progress to migraine in adolescence.

Dividing the patients into three age groups allowed for the definition of the main diagnosis in each. In patients under 5 years of age ataxia (mainly post-viral) and benign paroxysmal vertigo of childhood were most frequently found. These children also more often presented with acute otitis media and labyrinthitis, a possible complication of acute otitis media. Diagnosis may be difficult to make, especially in patients who do not walk yet [25] or toddlers, and is often missed and not included in the published series.

In the second group of children, between 6 and 11 years of age, VM, either defined or probable, is the most common etiology, found in 11.16% of the patients. Benign paroxysmal positional vertigo and ataxia are less common in this age group. These patients present with a broader range of diagnoses that require a detailed study. Children of this age begin to state their ideas and complaints better. It is important to pay attention to what they say and not to underestimate information provided by them.

Table 11
Diagnostic criteria (1.6.2) of benign paroxysmal vertigo of childhood.

A. At least five attacks fulfilling criteria B and C.
B. Vertigo occurring without warning, maximal at onset and resolving spontaneously after minutes to hours, without loss of consciousness.
C. At least one of the following associated symptoms:
1. Nystagmus. 2. Ataxia. 3. Vomiting.4. Pallor. 5. Fearfulness.
D. Normal neurological examination and audiometric and vestibular functions between attacks.
E. Not attributed to another disorder.

Patients between 12 and 18 years of age most often present with disorders that are more similar to those found in adults. Again, VM is the most commonly found etiology in 9.71% of the cases. In this age range the benign paroxysmal positional vertigo appears. Anxiety disorders should be considered, as this is a typical manifestation during adolescence.

Comparing our series with others published in the literature, some differences were found. In 2008, Wiener-Vacher published a series of 2000 patients seen over a period of14 years [3] in whom migraine associated with vertigo was the most commonly found etiology in 25% of the cases, followed by benign paroxysmal positional vertigo(20%) and post-traumatic vertigo (10%). However, in that study neither ataxia nor age distribution were considered. Another study, published by Manrique Lipa [7]et al. assessed 125 patients seen over 12 years dividing them into age groups. Results differed from the ones found in the present study. The authors found that in their series benign paroxysmal positional vertigo was the most frequent condition and evaluated whether it is associated with common migraine or not. Herraiz et al. [4] evaluated 76 patients over 8 years and also found benign paroxysmal positional vertigo to be the most common diagnosis. Neither other central pathologies nor age distribution were assessed. Soto Varela et analyzed the medical records of 145 pediatric patients seen over 15 years. In this study vertigo associated with migraine was the most frequently found etiology (32% of the cases). Klaus states that vertigo and balance disorders in childhood are not so uncommon and that approximately 25–50% of the cases are related to migraine (VM, benign paroxysmal positional vertigo) [26]. The remaining publications reviewed were outlines of the main causes of balance disorders together with a literature review.

In our experience, the use of the video head-impulse test in the study of pediatric patients was crucial to confirm the diagnosis. As mentioned before, the medical interview is important but difficult in these patients. The video head-impulse test provides objective data and is reproducible, non-invasive, and easy to perform in this population [27]. It is addition to the physical examination reliably defining the origin of the lesion (central or peripheral).

5. Conclusion

In a child with balance disorders the medical history and a thorough oto-neurological examination are essential. State-of-the-art technologies useful to identify the lesion and make the diagnosis and eventually to determine the treatment.

Vestibular migraine is the disorder commonly found in all age groups and most patients have a family history of migraine.

References

[1] H.K. Neuhauser, M. vonBrevern, A. Radtke, F. Lezius, M. Feldmann, T. Ziese, et al., Epidemiology of vestibular vertigo: a neurotologic survey of the general population, Neurology 65 (6) (2005) 898–904.
[2] F.M. Gioacchini, M. Alicandri-Ciufelli, S. Kaleci, G. Magliulo, M. Re, Prevalence and diagnosis of vestibular disorders in children: a review, Int. J. Pediatr. Otorhinolaryngol. 78 (2014) 718–724.
[3] S. Wiener-Vacher, Vestibular disorders in children, Int. J. Audiol. 47 (2008) 578–583.
[4] C. Herraiz, F.J. Hernández, M.C. Tapia, P. De Lucas, R. Arroyo, Trastornos del equilibrio en la infancia, ActaOtorrinolaring Esp. 49 (2) (1998) 363–368.
[5] R. Erazo Torricelli, Vértigo en el niño, Medicina 67 (6/1) (2007) 631–638.
[6] D.L. McCaslin, G.P. Jacobson, J.M. Gruenwald, The predominant forms of vertigo in children and their associated findings on balance function testing, Otolaryngol. Clin. N. Am. 44 (2011) 291–307.
[7] R.D. Manrique Lipa, A. Soto Varela, S. Santos Pérez, R.K. Manrique Lipa, A.I. Lorenzo Lorenzo, T.L. Caballero, Alteraciones del equilibrio en pacientes menores de 16 años distribuidos por grupos de edad, ActaOtorrinolaringológica Española 59 (9) (2008) 455–462.
[8] P. Femia, B. González del Pino, N. Pérez Fernández, Exploración Vestibular de niños con alteraciones del equilibrio (I): métodos de la exploración clínica e intrumental, ActaOtorrinolaringol. Esp. 62 (4) (2011) 311–317.
[9] R. Niemensivu, E. Kentala, S. Wiener-Vacher, Pyykkö. Evaluation of vertiginous children, Eur. Arch. Otorhinolaryngol. 264 (2007) 1129–1135.
[10] www.unicef.org/spanish/index_53571.html.
[11] T. Lempert, J. Olesen, J. Furman, J. Waterston, B. Seemungal, J. Carey, A. Bisdorff, M. Versino, S. Evers, D. Newman-Toker, Vestibular migraine: diagnostic criteria. Consensus document of the barany society and the international headache society, J. Vestib. Res. 22 (2012) 167–172.
[12] H.A. Arroyo, Cefalea en la infancia y adolescencia. Clasificaciónetiopatogénica, Rev. Neurol. 37 (4) (2003) 364–370.
[13] J.R. Brodsky, B.A. Cusick, G. Zhou, Evaluation and management of vestibular migraine in children: experience from a pediatric vestibular clinic, Eur. J. Paediatr. Neurol. 20 (1) (2016 Jan) 85–92.
[14] S. Carmona, O. Bruera, Prophylatic treatment of migraine and migraine clinical variants with topiramate: an update, Ther. Clin. Risk Manag. 5 (2009) 661–669.
[15] D. Perez Plasencia, L.D. Beltrán Mateos, A. Del Cañizo Alvarez, J.A. Sancipriano, E. Calvo Boizas, J.J. Benito González, Vértigo Benigno Paroxístico de la Infancia, ActaOtorrinolaringEsp 49 (2) (1998) 151–155.
[16] E.M. Sanz, R. Barona de Guzmán, Vertigo paroxístico benigno infantil: categorización y comparación con el vértigo posicional paroxístico benigno del adulto, ActaOtorrinolaringol. Esp. 58 (7) (2007) 296–301.
[17] V. Marcelli, A. Russo, E. Cristiano, A. Tessitore, Benign paroxysmal vertigo of childhood: a 10-year observational follow-up, Cephalalgia 35 (6) (2015) 538–544.
[18] S. Tarantino, A. Capuano, R. Torriero, C. Citti M;Vollono, S. Gentile, F. Vigevano, M. Valeriani, Migrraine equivalents as part of migraine syndrome in childhood, Pediatr. Neurol. 51 (5) (2014) 645–649.
[19] G. Ralli, F. Atturo, C. de Filippis, Idiopathic benign paroxysmal vertigo in children, a migraine precursor, Int. J. Pediatr. Otorhinolaryngol. 73 (1) (2009) 16–18.
[20] K.C. Teixeira, M.A. Montenegro, M.M. Guerreiro, Migraine equivalents in chilhood, J. Child. Neurol. 29 (10) (2014) 1366–1369.
[21] G. Batson, Benign paroxysmal vertigo of childhood: a review of the literature, Paediatr. Child. Health 9 (1) (2004) 31–34.
[22] A. Batuecas-Caletrío, V. Martín-Sánchez, C. Cordero-Civantos, L. Guardado-Sánchez, M.R. Marcos, A.H. Fabián, Benito González JJ, Santa Cruz-Ruiz S. Is benign paroxismal vértigo of childhood a migraine precursor? Eur. J. Paediatr. Neurol. 17 (4) (2013) 397–400.
[23] J. Campistol Plana, Trastornos paroxísticos no epilépticos en la infancia, Cap 50 (2014) 255–258 (Editorial Viguera).
[24] Headache Classification Committee of the International Headache Society, The international classification of headache disorders, 3rd edition (beta version), Cephalalgia 33 (2013) 629–808.
[25] S. Pellegrini, M.E. González Macchi, P.A. Sommerfleck, P.C. Bernáldez, Diecisiete casos de complicaciones intratemporales de otitis media aguda en niños en dos años, ActaOtorrinolaringolEsp 63 (1) (2012) 21–25.
[26] Klaus Jahn, Vertigo and balance in children – diagnostic approach and insights from imaging, Eur. J. Paediatr. Neurol. Soc. 15 (2011) 289–294.
[27] S.S. Hamilton, G. Zhou, J.R. Brodsky, Video head impulse testing (vhit) in the pediatric population, Int. J. PediatrOtorhinolaryngol 79 (8) (2015 Aug) 1283–1287.