

VESTIBOLOGY

Vertigo in childhood: proposal for a diagnostic algorithm based upon clinical experience

La vertigine nell'infanzia: un algoritmo diagnostico alla luce dell'esperienza clinica

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SUMMARY

The aim of this paper is to analyse, after clinical experience with a series of patients with established diagnoses and review of the literature, all relevant anamnestic features in order to build a simple diagnostic algorithm for vertigo in childhood. This study is a retrospective chart review. A series of 37 children underwent complete clinical and instrumental vestibular examination. Only neurological disorders or genetic diseases represented exclusion criteria. All diagnoses were reviewed after applying the most recent diagnostic guidelines. In our experience, the most common aetiology for dizziness is vestibular migraine (38%), followed by acute labyrinthitis/neuritis (16%) and somatoform vertigo (16%). Benign paroxysmal vertigo was diagnosed in 4 patients (11%) and paroxysmal torticollis was diagnosed in a 1-year-old child. In 8% (3 patients) of cases, the dizziness had a post-traumatic origin: 1 canalolithiasis of the posterior semicircular canal and 2 labyrinthine concussions, respectively. Menière's disease was diagnosed in 2 cases. A bilateral vestibular failure of unknown origin caused chronic dizziness in 1 patient. In conclusion, this algorithm could represent a good tool for guiding clinical suspicion to correct diagnostic assessment in dizzy children where no neurological findings are detectable. The algorithm has just a few simple steps, based mainly on two aspects to be investigated early: temporal features of vertigo and presence of hearing impairment. A different algorithm has been proposed for cases in which a traumatic origin is suspected.

KEY WORDS: Vertigo • Benign paroxysmal vertigo • Head trauma • Diagnostic algorithm • Vestibular migraine

RIASSUNTO

In questo articolo vengono analizzate, alla luce dell'esperienza clinica e della conoscenza della Letteratura più recente in merito, tutte le caratteristiche anamnestiche della vertigine in età pediatrica, con lo scopo di costruire un semplice algoritmo diagnostico applicabile ai casi di vertigine in età pediatrica. Lo studio si basa sull'analisi retrospettiva dei reperti clinici e strumentali di 37 bambini sottoposti a completa valutazione otoneurologica per riferita sintomatologia vertiginosa. Tutte le diagnosi sono state confermate applicando i più recenti criteri diagnostici internazionali. Nella nostra casistica la più comune causa di vertigine in età pediatrica è risultata quella di origine emicranica (38%), seguita dalla nevrite vestibolare (16%) e dalla vertigine psicogena (16%). La vertigine parossistica benigna dell'infanzia è stata diagnosticata in 4 pazienti (11%), mentre il torcicollo parossistico in 1 bambino di un anno. In un 8% (3 pazienti) la vertigine aveva un'origine post-traumatica. La Malattia di Ménière è stata diagnosticata in 2 casi (5%). Una vestibolopatia bilaterale di origine sconosciuta è stata riconosciuta come causa di una dizziness cronica in un paziente. In conclusione, questo algoritmo può rappresentare un ottimo strumento per guidare il sospetto clinico del medico verso una corretta formulazione della diagnosi nel bambino vertiginoso senza chiari segni di coinvolgimento neurologico. L'algoritmo ha pochi semplici step, basati principalmente su due aspetti fondamentali: andamento temporale della vertigine e presenza di sintomi uditivi. Un algoritmo differente è stato costruito per i casi di vertigine post-trauma cranico.

PAROLE CHIAVE: Vertigine nell'infanzia • Vertigine parossistica benigna dell'infanzia • Trauma cranico • Algoritmo diagnostico • Vertigine emicranica

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Introduction

Vertigo is relatively rare in childhood, in contrast to adults; an erroneous perception of movement can be due, in the child as in the adult, to an anomaly in the normal function of the three major sensory systems that supply this information: the visual system, vestibular system, and somatosensory system. The main epidemiological studies demonstrate a prevalence of dizziness during childhood

from 0.45 to 15%¹⁻⁶; this wide range is obviously related to differences in study design, method of data collection, and inclusion and exclusion criteria. At the same time, a remarkable disparity between children and adults regarding different pathologies is noticeable underlined: in example, benign paroxysmal positional vertigo (BPPV) is the most frequent cause of vertigo in adults, but is not common in children^{4,6,7}. These aspects explain why the prevalence of different pathologies appears to change dramatically as the

child's age increases (i.e. somatoform disorder and vestibular migraine are more common in adolescence than in younger children)⁷. A recent review analysed 9 studies (724 subjects) confirming that benign paroxysmal vertigo (BPV) (15.68%), vestibular migraine (VM) (27.82%), vestibular neuritis (VN) (9.81%) and psychogenic disorders (8.28%) are the most frequent causes of vertigo, while Menière's Disease (MD), BPPV and orthostatic hypotension are rare in childhood⁸.

However, prevalence studies may be affected by several variables: firstly, the child often may find it difficult to exactly describe the dizzy symptomatology (true vertigo, unsteadiness, imbalance, light-headedness) and, because of this, any complaint of dizziness should be considered in the broad context of the dizzy child for diagnostic purposes; secondly, some peripheral vestibular disorders may be very short-lived because of rapid and early compensation; finally, balance disorders in children can appear with various features and lead to delays in postural-motor control development and recurrent falls. Furthermore, vertigo in children constantly creates a profound sense of anxiety both in parents and physicians leading to an excessive number of prescriptions for functional testing and imaging examinations that are often unsuitable for a proper therapeutic approach.

In this paper, we present our series of paediatric patients, with particular attention given to clinical aspects and diagnostic challenges. The aim of this study is to analyse, after clinical experience (a series of patients with established diagnoses) and review of the literature, all relevant anamnestic features in order to propose a simple diagnostic algorithm for vertigo in childhood. This proposed algorithm can be easily employed before starting clinical and instrumental examination.

Materials and methods

This study is a retrospective chart review. Our series of patients was obtained applying a filter by age to our digital archive (Microsoft Access[®] – Microsoft[®]), starting from January 2011 to December 2013. Of 591 patients, 37 children were enrolled for our study. With the aim to include all types of pathologies causing dizziness, no true exclusion criteria were applied: only patients with established neurological disorders or genetic diseases were excluded. The database contained all clinical data regarding age at first visit, type and number of vertigo spells, associated symptoms and general health problems. All patients underwent a complete bedside otoneurological examination (search for spontaneous, positional nystagmus, head shaking test and head impulse test were performed). The Dix-Hallpike test was used to detect a positioning nystagmus. Ocular movements examination (horizontal and vertical eye movements, horizontal and vertical gaze tests, smooth pursuit, saccades) was performed with a software-guided infrared eye-tracking system (HORTMANN Vestlab 100 - Vide-

onystagmography System[®], GN Otometrics[®], Taastrup, Denmark). Bithermal caloric test was performed with the Fitzgerald-Hallpike parameters: 125 cc of water (44°C for the hot stimulus and 30°C for the cold stimulus) administered in the outer ear canal within 30 sec; canal paresis (CP) was considered significant if > 25%. Vestibular evoked myogenic potentials (VEMPs) were performed with a binaural air-conducted 500 Hz filtered tone burst (MK12, Amplifon[®], Milan, Italy) decreasing from 130 dB SPL to 110 dB SPL and detected on the sternocleidomastoid muscle (cVEMPs). The Romberg and Unterberger tests with and without vision were used to clinically assess postural control and gait. Static posturography was performed with a force platform using dedicated software. BPV and paroxysmal torticollis (PT) were diagnosed according with the International Headache Society (ICHD-III beta) diagnostic criteria⁹. The 1995 Committee on Hearing and Equilibrium guidelines for the diagnosis and evaluation of therapy in Menière's disease (MD)¹⁰ were employed to classify MD. A "definite" or "possible" vestibular migraine (VM) was diagnosed according to the revised HIS criteria¹¹ and more recently to the 2012 Barany Society classification¹². The ICD-10 criteria were applied (together with psychiatrists) to diagnose somatoform vertigo. Chronic subjective dizziness was diagnosed according to the Mayo Clinic criteria¹³. Audiological assessment through tympanometry and pure tone audiometry was performed in the majority of cases. Further tests such as auditory brainstem response (ABR), electroencephalography (EEG), computerised tomography and MRI scan of the brain were carried out where indicated (patients in which a migraineous origin of the dizziness was suspected are usually referred by us to the neurology clinic to exclude central pathologies).

Results

The cohort included 37 children and adolescents, 21 males (age range 1-17, mean age 12.1 years) and 16 females (age range 8-16, mean age 13.4 years). Family history for migraine was found in 18 patients (48%). One 16-year-old girl was on medication (anxiolytic) and was referred to us by the Psychiatry Unit. Panic disorder (PD) and generalised anxiety disorder (GDA) were already diagnosed in 1 and 2 subjects, respectively. Two patients suffered from febrile seizures. Two children suffered from head trauma approximately 1 month before. Of the 37 cases, 16 were reported to suffer from headaches.

Eye movement examination was reliable in 31 patients and showed mildly broken smooth pursuits in 6 VM patients and a typical positional paroxysmal nystagmus in one child; no spontaneous nystagmus was detected in any case, and no abnormalities of the saccades or during doll's eyes manoeuvres were found. A head shaking nystagmus was present in 3 cases; clinical head impulse test (cHIT) was reliable and clearly positive in 3 patients.

The bithermal caloric test was performed in 33 patients and showed a significant CP in 6 patients affected by VN (5 unilateral, 1 bilateral), while 5 cases (suffering from migraine) showed asymmetry of the caloric response that was not classifiable as a clear CP according to Jongkees' formulae. Since we consider that audiological assessment is a key point in the evaluation of a dizzy child, tympanometry and pure tone audiometry was performed in 35 of 37 patients. In the majority of cases tests were within normal limits, while in 5 cases some audiological abnormalities were found: in 2 cases hearing loss affected unilaterally of low frequencies and in 2 cases it involved high frequencies (1 case unilaterally, 1 case bilaterally); 1 patient, diagnosed with homolateral delayed endolymphatic hydrops (DEH), reported the onset of deep sudden sensoryneural hearing loss 9 years before. Posturography was performed in 32 patients and was pathological in 4 cases. VEMPs were performed in 33 patients and were evocable in 29 (78%): the presence of chronic middle ear effusion was excluded.

The most common aetiology for dizziness was vestibular migraine (14 patients, 38%), followed by acute labyrinthitis/neuritis (6 patients, 16%) and somatoform vertigo (6 patients, 16%). According to IHS criteria for childhood periodic syndromes, BPV was diagnosed in 4 patients (corresponding to 11%) and paroxysmal torticollis was diagnosed in a 1-year-old child.

As expected, the mean age of the group with vestibular migraine was older (13.6 years) than that of the children with BPV or PT (7 years). In 3 patients, the dizziness had a post-traumatic origin: in 1 case we diagnosed a BPPV (typical paroxysmal nystagmus) and in 2 patients dizziness was caused by labyrinthine concussion. According to

AAO-HNS criteria, there were 2 cases (5%) of MD, one of which was homolateral DEH. In the latter case, a bilateral vestibular failure of unknown origin caused chronic dizziness in an 8-year-old child. No MRI abnormalities of the brain or the inner ear were found in our series. The diagnoses are summarised in Figure 1.

Discussion

Vertigo in childhood is often characterised by nuanced and short-lasting symptoms. Furthermore, some aspects of the pathology, such as gait disorders or balance alterations, can be attributed to mild problems of coordination or small delays in the motor development (motor milestones). In addition, in our clinical experience, children are often treated at the same time by different types of specialists including paediatricians, psychiatrists, neurologists, otolaryngologists and ophthalmologists. Moreover, the considerable neural plasticity in childhood justifies a better tolerability to vertigo with shorter duration of symptoms and a relatively self-limiting nature of the syndrome compared with adults. Nevertheless, vertigo in children must be given adequate consideration since it can be the only symptom of a broad spectrum of diseases, including central nervous system neoplasms or malformations of the inner ear. Vertigo and dizziness, especially in childhood, can produce an excessive number of prescriptions for useless and expensive testing without obtaining any help in therapeutic decision-making. This is often due to the anxiety resulting from a lack of knowledge; a clear diagnostic protocol or algorithm is also missing.

Vestibular migraine, BPV, VN and somatoform vertigo are the most common causes of vertigo in children^{7 8 14}. Several studies show some differences regarding the prevalence of the single pathologies causing dizziness (CSD and somatoform vertigo are often underestimated), but the majority of authors agree that BPPV and MD are infrequent causes of vertigo in children^{7 15}; on the other hand, others believe that the incidence of MD in children might be underestimated¹⁶, but the overlapping symptomatology between MD and VM could explain this discrepancies. Some vestibular manifestations can appear while getting up in the morning or lying down on the bed, suggesting positional paroxysmal vertigo or orthostatic hypotension. In our series, BPPV was diagnosed in only one case (post-traumatic BPPV after a minor head injury); only two girls reported symptoms suggesting orthostatic hypotension, but no drop in blood pressure was detected. However, vestibular migraine and somatoform vertigo are quite common in children and are often associated, especially in females: in a recent study, the prevalence rate for somatoform disorder in children and adolescents was 2.5% based on ICD 10 criteria, whereas the rest of the psychogenic causes were depression, panic disorder and obsessive-compulsive disorder¹⁷. CSD is now defined as a psychiatric disorder that has 3 features: (1) persistent non-vertiginous dizziness lasting

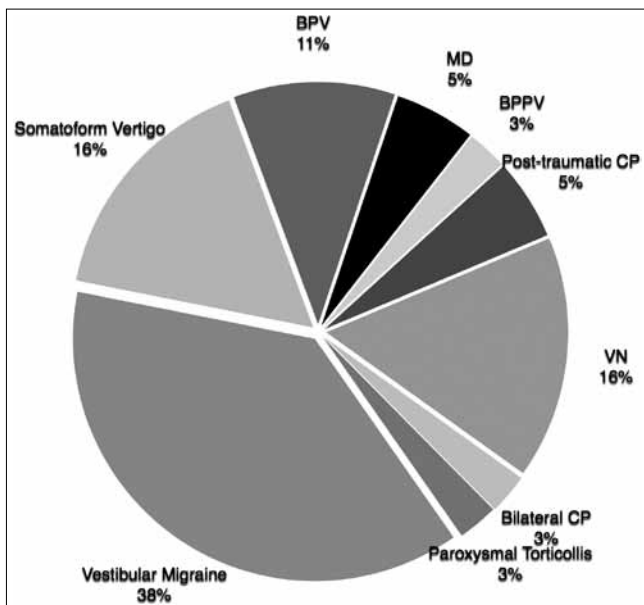


Fig. 1. Frequency of vertigo syndrome in children. CP: canal paresis; VN: vestibular neuritis; BPPV: benign paroxysmal positional vertigo; BPV: benign paroxysmal vertigo; MD: Menière's disease.

3 months or more; (2) hypersensitivity to motion stimuli; (3) difficulty with precision visual tasks; patients may also give histories of past episodes of vertigo, suggesting that a pre-existing vestibular disorder could act as a triggering event¹³. A typical VM vertigo attack is characterised by rotatory vertigo lasting minutes to hours and followed or accompanied by headache and sensitivity to light and noise. In children as in adults, vestibular symptoms of migraine may be precritical, critical and postcritical (respectively before, during and after vestibular symptoms)¹⁸. Motion sickness, even associated with labyrinthine hyperaesthesia is an important characteristic of the child with migraine¹⁹. BPV in childhood is defined as a heterogeneous disorder that is characterised by recurrent brief episodic attacks of vertigo occurring without warning and resolving spontaneously in otherwise healthy children; it is part of the “Childhood Periodic Syndromes” and is now considered as a migraine precursor^{9,20}. Marcelli et al. reported either peripheral or central vestibular findings (spontaneous-positional nystagmus, post head-shaking nystagmus, BPPV, vibration-induced nystagmus, absence of vestibular evoked myo-

genic potentials) in 73% of VM patients¹⁸. In our series, a slight canal paresis was documented in 5 (35%) cases and central ocular findings (broken pursuits) in 6 (42%) of the VM patients. Only 1 of the VM patients had non-evocable cVEMPs. In 10% of cases aged 5 or 6 years, the dizziness seems to be caused by visual problems²¹; in our series, no visual problems were observed (only one child was sent to the ophthalmologist because of a squint). In case of multiple short attacks of rotatory vertigo, diagnosis of vestibular paroxysmia should be considered; in our series, no MRI findings suggesting a neuromuscular conflict with the 8th nerve were reported²².

An excessive number of MRI (or CT) scans is often performed in vertiginous children: this is probably due to poor knowledge and/or to medico-legal motivations. These scans seem to be negative in 57% of all cases and positive in the majority of patients (83%), but only where neurological signs were detected during anamnesis or clinical examination³.

In order to provide better clinical orientation, we propose a diagnostic algorithm based on the clinical history that

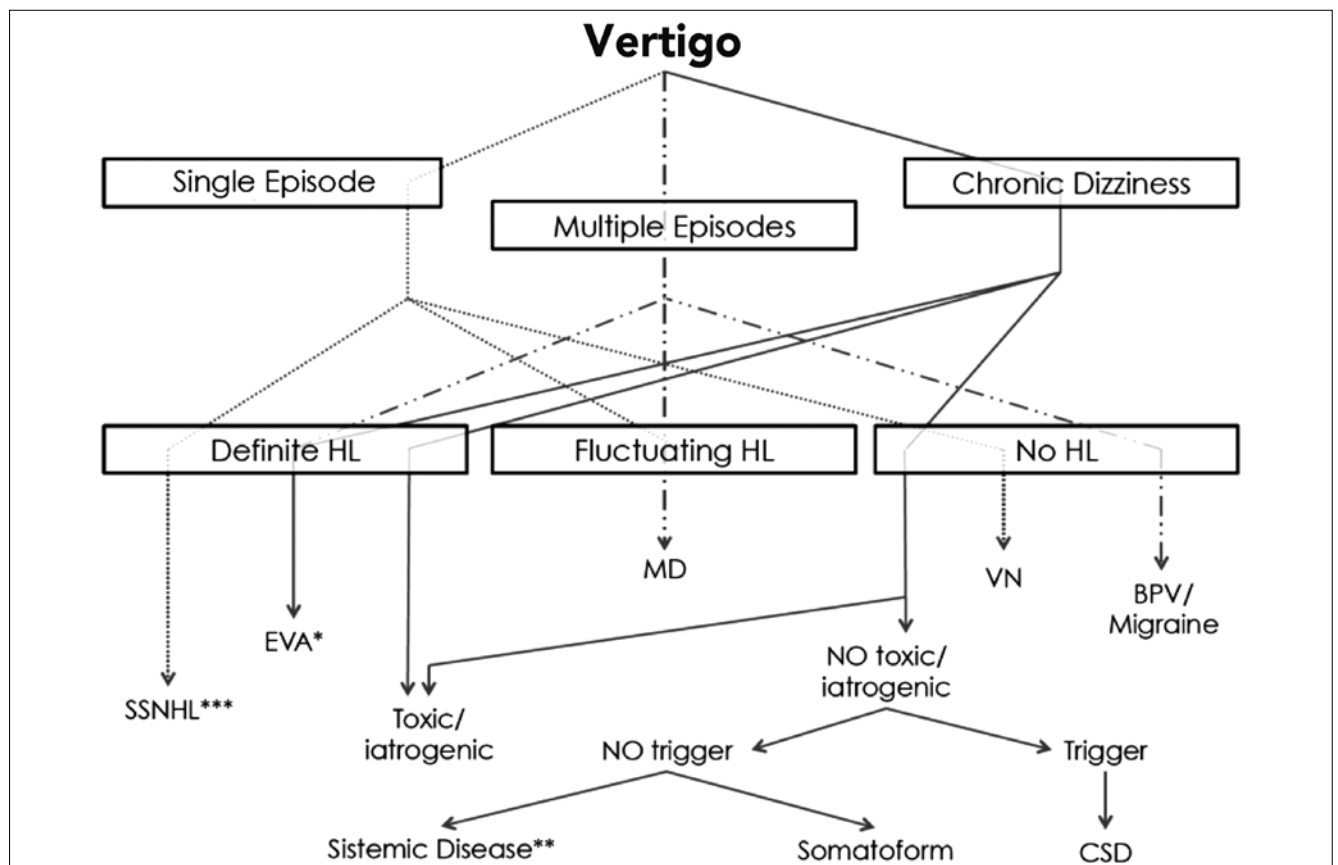


Fig. 2. Diagnostic algorithm for paediatric vertigo based on clinical history; the two main checkpoints of the anamnesis should consider temporal features (number of acute episodes/chronic dizziness) and hearing impairment. BPPV: benign paroxysmal positional vertigo; CSD: chronic subjective dizziness; SSNHL: sudden sensory-neural hearing loss; EVA: enlarged vestibular aqueduct; MD: Menière's disease; trigger: single or multiple event causing development of CSD; VN: vestibular neuritis; BPV: benign paroxysmal vertigo; HL: hearing loss; * includes genetic syndromes and inner ear malformations; ** diabetes, hypothyroidism, electrolytic disturbances; *** a vascular cause should also be considered (heart malformations).

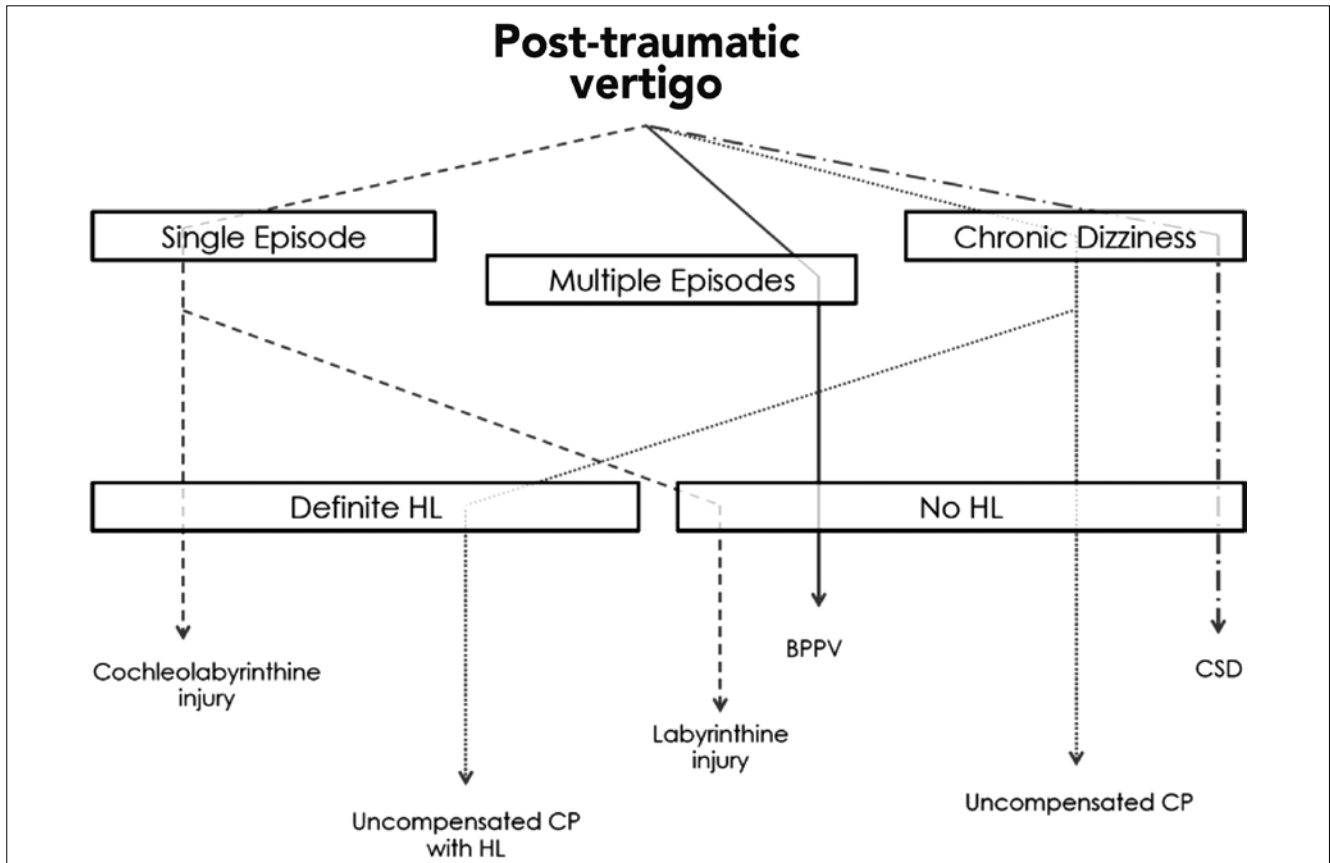


Fig. 3. Diagnostic algorithm based on anamnesis for post-traumatic complaints of dizziness. CP: canal paresis; BPPV: benign paroxysmal positional vertigo; CSD: chronic subjective dizziness; HL: hearing loss.

can be employed in all young dizzy patients (without neurological signs and/or loss of consciousness). On the basis of both literature and clinical experience, we retain that a diagnostic algorithm could be based mainly on two aspects of early clinical investigation: temporal features (number of acute episodes/chronic dizziness) and presence (or absence) of hearing loss (HL) (Figs. 2, 3). Separate considerations should be made for cases in which a traumatic origin is supposed; for this reason a different algorithm, leading to different diagnoses (such as post-traumatic BPPV or cochlear-labyrinthine concussion), has been proposed (Fig. 3). We underline the importance of considering psychogenic disturbances as important causes of chronic dizziness: symptoms should be checked basing on the CSD diagnostic criteria, taking in account any previous disease (or acute event) acting as a trigger. Before that, an iatrogenic origin should be excluded (Fig. 2). In this study the employment of the algorithm provided a diagnosis that has been compared with specific diagnostic criteria and with a negative brain scan. This study has the following limitations: (1) the video-HIT device was available only for the last two years and was not used in all patients; (2) this is a retrospective chart review suggesting a diagnostic algorithm that must be validated.

Conclusions

We retain that this algorithm will be a good method for guiding diagnosis in dizzy children where no neurological findings are detectable: the algorithm has only few simple steps and does not require any medical device, helping the clinician to distinguish the symptoms and guide clinical suspicion to a correct diagnostic assessment. Further investigations (preferably prospective and controlled studies) are required to confirm its reliability in reducing the number of MRI scans in cases in which a clear diagnosis is not reached.

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