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ORIGINAL ARTICLE

Clinical symptoms of equilibrium disorders in patients with whiplash syndrome

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Abstract
Introduction and objective: There are many entities that cause equilibrium disorders. Whiplash syndrome is becoming an important entity as a trigger of equilibrium disorders because of an increase in traffic accidents. There are many hypotheses on the generation of vertigo and dizziness in whiplash syndrome. The objective of this study is to describe and analyze the clinical symptoms of patients who suffered whiplash.
Material and method: Thirty six patients with equilibrium disorders who suffered whiplash syndrome were studied prospectively. None of these subjects had cranial trauma or a history of vestibular pathology prior to the traffic accident. We conducted an exhaustive anamnesis, Videonystagmography, and cervical magnetic resonance. Patients were classified by type of equilibrium symptom and degree of cervical lesion.
Results: A percentage of 55.5 of patients had a sensation of dizziness associated with postural and cephalic movements, 38.8% had disequilibrium continuously, and 16.7% (6 cases) had vertigo. Three of this last group had a diagnosis compatible with benign positional vertigo but this diagnosis was confirmed in only 2 patients; 2 patients had labyrinth commotion; and 1 patient had vertigo of unknown origin.
Conclusions: In patients with whiplash, the most frequent equilibrium symptom is the sensation of fleeting dizziness associated with head movements, while only a small group suffer from vertigo. Although vestibular tests are normal in most patients, we cannot rule out the existence of otolithic lesions.

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PALABRAS CLAVE
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Vértigo;
Mareo;
Videonistagmografía;
Vértigo posicional paroxístico benigno

Expresión clínica de las alteraciones del equilibrio en pacientes con síndrome de latigazo cervical

Resumen
Introducción y objetivo: Entre las enfermedades que pueden producir trastornos del equilibrio, el síndrome de latigazo cervical (LC) adquiere cada vez mayor relevancia, al aumentar su frecuencia por los accidentes de tráfico. Hay varias hipótesis en cuanto a la generación de mareos y vértigos en relación con el LC. El objetivo de este estudio es describir y analizar la sintomatología clínica que refieren estos pacientes.
Material y método: Estudio prospectivo de 36 pacientes, con LC por accidente de tráfico, que fueron remitidos a la unidad de otoneurología por afección relacionada con el equilibrio. Ningún paciente había sufrido traumatismo craneoencefálico ni afección vestibular previamente al accidente. Se practicó anamnesis exhaustiva, videonistagmografía y resonancia magnética cervical. Se clasificaron los casos de acuerdo con el tipo de sintomatología del equilibrio y el grado de lesión cervical.
Resultados: El 55,5% de los pacientes presentaron sensación de mareo fugaz, en su mayoría en relación con cambios posturales y movimientos cefálicos. Un 38,8% presentó sensación de inestabilidad continua; 6 (16,7%) casos tuvieron vértigo, 3 de ellos compatible con vértigo posicional paroxístico benigno, 2 con conmoción laberíntica y un caso no pudo filiarse a ningún diagnóstico.
Conclusiones: En el síndrome de LC el síntoma más frecuente, en relación con el equilibrio, es la sensación de mareo fugaz asociado a movimientos cefálicos; sólo un pequeño grupo padece vértigo. Aunque las pruebas vestibulares son normales en la mayoría de los pacientes, no podemos descartar que haya una lesión otolítica.

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Introduction

Great controversy has existed, and still exists, with respect to the possibility that cervical condition can produce symptoms of vertigo. A frequent case of cervical injury is whiplash. Most publications about whiplash refer to trauma symptoms, and there is scant literature on neuro-otological symptoms.

Whiplash is a result of insults to the cervical region, mainly road traffic accidents, which imply an acceleration and deceleration mechanism of energy transferred to the neck (Quebec Task Force 1995).[1] The mechanisms of injury depend on the type of impact at the time of the accident.[2,3] The sudden movement of acceleration or stoppage of the trunk leads to a tilt of the head in the opposite direction, with a corresponding bending of the cervical spine, which then injures the soft tissues of the neck because the movement stresses the muscles and ligaments of the neck beyond their normal range of motion. The impact can cause injury to the bone or soft tissue which can produce a large number of clinical manifestations. Lesions in the brain stem and peripheral vestibular organs have also been observed.[4-7]

The average incidence of whiplash in Western countries is 100 new cases per 100 000 population per year.[3]

The predominant clinical manifestations are cervicalgia, scapulalgia, headache, and altered balance.[2,4,5] These alterations in balance are a frequent cause of consultation at the otoneurology unit of our department.

Dizziness and vertigo have been reported in 25%-50% of cases, depending on the series. Hearing disorders and tinnitus have been described in 14 and 5% of cases, respectively.[4-6]

There are several hypotheses regarding the generation of dizziness and vertigo. Some studies attribute them purely to cervical lesions, others to central nervous system injuries, vestibular dysfunction, or the co-existence of all these.[4-9]

We have studied a number of patients who suffered whiplash due to a traffic accident and were referred to the otoneurology consultation for symptoms associated with balance disorders.

Material and method

At our third-level hospital, we conducted a prospective study of 36 patients with whiplash syndrome by traffic accident. It excluded those who had suffered head trauma in the accident and those who had previous vestibular disorder.

In all cases we recorded the anamnesis, carried out clinical neuro-otological exploration, studied hearing, and made a caloric test with videonystagmograph recording. In addition, cranial and cervical MRI were performed.

The anamnesis was thorough, compiling the following information: position of the patient in the vehicle, place of collision on the car, number of occupants, time passed since the accident until the onset of symptoms, pattern of dizziness-instability-vertigo symptom as described by the subject, coincidence of hearing loss and tinnitus in relation to the accident and duration of symptoms.

Table 1 Quebec classification

Grade	Clinical presentation
0	No cervical symptoms or physical signs
1	Cervical symptoms (pain, rigidity or pain on exploration) with no physical signs
2a	Pain at some points, normal cervical mobility
2b	Pain at some points, restricted cervical mobility
3	Cervical symptoms and neurological signs: diminution or absence of deep tendon reflexes, weakness and sensory deficit
4	Cervical symptoms and cervical fracture or luxation

Descriptions referred by the patients regarding the symptoms related to balance were grouped into 3 main blocks: dizziness, vertigo, and continued instability.

We consider vertigo when a patient related a frank hallucination of movement, with a sensation of spinning of the subject or the surroundings.[10] We considered dizziness when the sensation was similar to travelling on a boat, giddiness, or a heavy or numb head. We considered continued instability when patients reported the sensation of lack of balance or a sensation of insecurity when walking or a feeling of walking on cotton wool. These 3 symptoms were sub-classified in accordance with their duration and triggering factors.

The neuro-otological clinical examination consisted of: exploration of cranial nerve pairs, cerebellar exploration (nose-index test, diadochokinesia test), exploration of balance through Romberg and Unterberger test, exploration of spontaneous nystagmus, exploration of positional nystagmus with Dix-Hallpike test. In this test, the nystagmus response was evaluated with the naked eye, except in the cases when the patient related vertigo and it did not match with nystagmus, in which we also used Frenzel glasses.

For tonal audiometry, a clinical audiometer, Interacoustics A/S AC40 model, was used with TDH 39 headphones (air duct calibration, ISO 389/ANSI S3.6-1996) and a bone duct conductor Radioear B71 (bone duct calibration, ISO 7566/ANSI S3.43-1992). The videonystagmography was conducted with an Ulmer Synapsis videonystagmograph using an infrared monocamera with a 1/3 inch automatic iris CCD, 320 000 pixel definition, autofocus and 2 infrared lamps.

We used the Quebec classification[1] to distribute the patients depending on the severity of their cervical lesion (Table 1).

Results

Most patients were between 20 and 40 years of age. The male to female ratio was 1. In the accident, the collision of the vehicle was frontal in 14% of cases, lateral in 14%, and with rear impact in 72% of cases. The position of the patient in the car was as driver in 65.7% of cases, front passenger in 25.7%, and in the rear seat in 8.6%

Table 2 Degree of cervical lesion according to the Quebec classification

Degree	Cases, n (%)
I	4 (11.2)
II	8 (22.2)
III	17 (47.2)
IV	7 (19.4)

Table 3 Classification according to balance symptoms

Symptoms	Patients (n)
A. Fleeting sensation of dizziness	20 (55.5%)
A1. Only when lying down or standing up	2
A2. Only when moving the neck rapidly, up, down, or sideways	5
A3. When moving the head rapidly and lying down, standing up and bending over	13
A4. In other situations, walking or driving	
B. Continuous sensation of instability	14 (38.8%)
B1. CI + FSD when lying down, standing up or moving the head rapidly	6
B2. CI + FSD when moving the neck	3
B3. CI with no relation to head movement	3
B4. CI which increases with any movement	2
C. Intense dizziness with vomiting (3 days in bed)	3 (8.3%)
D. Vertigo	6 (16.7%)

CI indicates continuous instability; FSD, fleeting sensation of dizziness.

The period since the impact until the presentation of symptoms was diverse, from seconds to weeks. In 48% of cases, symptoms appeared within the first 2 hours after the accident.

According to the classification of Quebec, 19.4% of cases presented grade IV, that is to say with a musculoskeletal injury in addition to cervical symptoms; 47.2%, grade III, 22.2% grade II, and finally, 11.2%, grade I (Table 2).

The distribution by symptoms, taking into account that each patient could present more than one, was as follows:

- 20 (55.5%) presented a fleeting sense of dizziness that was triggered by movements of the head and/or the body. They were episodes of dizziness with duration of seconds. Their persistence after the accident was from 1 to 6 weeks (Table 3).
- 3 (8.3%) presented episodes of intense dizziness with vegetative character, but which could not be considered as frank vertigo.
- 14 (38.8%) had a sensation of ongoing instability as the primary symptom. They felt insecure when walking or standing for several hours a day. Within this group of patients, some of them, in addition, had a fleeting

Tabla 4 Clinical and otoneurological description of the 6 cases with vertigo

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
T. start	2 h	24 h	Hours	15 days	Hours	5 days
Episodes	1	1 time	Various/ day	Various/ day	Various/ day	1-2 week
Duration of crises	3 h	3 h	Seconds	Seconds	Seconds	Minutes
Triggering factor	No	No	Turning the head	Turning the head	Both LP	Lying position.
Remits in LP	—	—	Solución con Epley	Solución con Epley	Cede a los 4-5 días	Persiste a los 4 meses
Evolution	—	—	Solution with Epley	Solution with Epley	Remits after 4-5 days	Persists after 4 months
Dix-Hallpike	—	—	+	+	—	—
Romberg	—	—	—	—	Doubtful	—
Unterberger	—	—	—	—	—	—
Videonystagmography	NT	NT	NT	NT	NT	NT
Audiometry	NT	NT	NT	NT	NT	weak NSH LE
Diagnostic	LS	LS	BPPV	BPPV	BPPV (?)	NSV

BPPV, benign paroxysmal positional vertigo; LE, left ear; LP, lateral position; LS indicates labyrinthine shock; NSH, sensorineural hypoacusis; NSV, non specific vertigo; NT, normal test.

sensation of dizziness in relation to cranial movements and/or postural changes, which lasted several months after the accident.

— 6 (16.7%) presented vertigo.

Of the 6 patients with vertigo, 3 presented clinical symptoms compatible with benign paroxysmal positional vertigo (BPPV), but only in 2 cases did the Dix-Hallpike test show positional nystagmus. Two cases presented a single crisis of intense vertigo, lasting hours, in the first hours after the accident. These were attributed to labyrinthine commotion. One case was diagnosed as non-specific vertigo, presenting episodes of vertigo lasting minutes, triggered in the supine position and not in the lateral position (Table 4).

With regard to neuro-otological tests, we found that 4 patients had evidence of altered Romberg and Barany tests, without clear lateralization, the rest of the neuro-otological tests were normal. Of these, 3 patients were in the group with continued instability and one in the group with fleeting dizziness.

Regarding the videonystagmography examination, only 1 patient presented bilateral hyporesponse to caloric tests and altered rotation testing.

Discussion

The incidence of whiplash syndrome as a result of road accidents in western countries is around 100 new cases per 100 000 inhabitants per year, although widely differing results have been identified.[3]

There might be 3 types of lesions that could explain the alteration of balance in the whiplash phenomenon.[3,4,6] A serious injury in the peripheral vestibular organs, another in the nerve tracts that carry proprioceptive information to the cervical area and, finally, injuries to the oculomotor system (hypothalamus, cerebellum, and brainstem).

The male/female distribution in the Quebec series[1] was 1.5/1. At the time of the accident, 76.3% were driving the vehicle. In our study the male/female ratio was similar (1/1), and also most of our cases were driving at the time of the accident (65.7%).

In connection with vertigo and dizziness as major symptoms of whiplash syndrome, they have been reported in 25%-50% of cases depending on the study.[4-6] The problem with these studies is that they include dizziness, vertigo, and instability as a single symptom.

In our study, all cases came to the otoneurology unit for some symptom related to balance. The description of symptoms by patients was very diverse and we grouped these into 3 categories: vertigo, dizziness, and continued instability. In addition, we made sub-groups according to the descriptions observed to allow all the study subjects to be allocated. In this way, we could investigate the symptoms more thoroughly. We have observed that over half our cases had fleeting dizziness (55.5%), 38.8% presented continuing sense of instability and only 6 (16.7%) patients reported symptoms compatible with vertigo. Costeverld et al,[5] in one of the published studies with more cases of whiplash syndrome (n=262), noted that 85% referred to alteration of balance, vertigo in 50% and non-specific dizziness in 35%.

In our study the triggering factor of fleeting dizziness was, on the one hand, cervical motion, so we could think primarily of a problem of proprioceptive sensitivity but it also occurred with sudden changes in posture, especially when rising and bending, so it might be thought to be due to cervical movements included in such actions or that there was involvement of the central or peripheral vestibular system. Patients reporting an on-going sense of instability did not relate any type of head movement in particular and we believe this may be due both to impairment of cervical proprioceptive sensitivity and to central vestibular involvement.

Out of our 6 cases of vertigo, 2 corresponded to BPPV with positive Dix-Hallpike test, a third related a typical BPPV clinical presentation which had already remitted and the Dix-Hallpike test was negative, 2 patients had presented a single intense crisis of vertigo with a duration of 2 h, with accompanying tinnitus and were diagnosed as labyrinthine shock, and sixth case presented episodes of vertigo which could not be specified. The diagnosis of labyrinthine shock was based on a clinical history of a bout of vertigo with peripheral features, but the caloric test, conducted some months after the accident, was normal. Vibert et al[4]

published a case similar to ours which could be studied immediately after the accident; showing spontaneous nystagmus and unilateral caloric areflexia; the nystagmus disappeared a few weeks later and the caloric response improved. The last case, which we could not specify, presented episodes of vertigo in the supine position, with duration of minutes, which remitted in lateral decubitus. Careful testing for canalithiasis, using Frenzel glasses, was normal. We agree with Vibert et al[4] that translatory movement of the head may generate a displacement of the otoliths and a shearing of ciliate cells in the utricle and saccule affecting the feeling of dizziness-vertigo, especially if related to movement.

We could conclude that most of the balance symptoms presented by patients with whiplash are feelings of dizziness and instability and only a small group suffer vertigo. The vestibular tests are normal in most patients, but if they were done in the hours or days following the accident the results could be different. Although it appears that the main causes of the symptoms are primarily the cervical proprioceptive system and the central nervous system, we cannot rule out the possibility that otolithic injuries have greater relevance than was expected. It would be interesting to continue with studies that could evaluate the patient in moments nearer to the whiplash.

Conflict of interests

The authors have indicated there is no conflict of interest.

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