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Evaluation of Balance Disorders During the First Month After Whiplash Injury

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Apart from cervical pains, dizziness is the most common complaint after whiplash injury of the neck. Dizziness was attributed to lesions of the peripheral vestibular organ and the cervical proprioceptive system and to central pathways in the brainstem, the cerebellum, and the hypothalamus. Soft-tissue hemorrhage, swelling and ruptures of neck muscles and ligaments, and brain edema and hemorrhages were described in laboratory animals after flexion-extension injury to the neck. It is possible that similar damage may be caused by whiplash injury in humans [1–4].

Likely, the effect of these lesions will be noted immediately after the accident and will decrease as a function of passing time. Hemorrhages and tissue swelling may resolve and may be absorbed, and remission of most symptoms may take place. Furthermore, the vestibular system possesses the ability to undergo central adaptation and compensation in recuperating the ability to stay in balance.

Therefore, the reasonable management of this disorder is to evaluate patients immediately after the injury and months or years later. To the best of our knowledge, patients with whiplash injury were not studied during the acute stage after the accident. The purpose of this study was to investigate the auditory and balance system during the first month after whiplash injury to the neck.

PATIENTS AND METHODS

Patients making up the study suffered from whiplash injury of the neck, which was diagnosed at the emergency room in the Sourasky Medical Center in Tel Aviv. These patients were referred for otoneurological evaluation in the hearing and speech unit. Fifty-five patients (23 males and 32 females) consented to participate in the study. Their ages ranged between 14 and 56 years (average, 28 years).

A medical history was recorded, and audiological and balance evaluation were performed 7 days to 3 weeks after the accident. Pure-tone audiometry and auditory brainstem responses (ABR) were recorded in 23 patients. Electronystagmography (ENG) was recorded in 36 patients, and computed dynamic posturography (CDP) was performed in 55 patients.

RESULTS

Table 1 summarizes the symptoms described by the patients. The most common symptoms were dizziness and cervical pain (87%). Headache, tinnitus, hearing impairment, and blurred vision follow in descending order. The incidence of these complaints is similar to that reported by other investigators [2,5].

The hearing of 10 patients (43.5%) of the 23 tested was affected. Most of them had very mild high-tone sensorineural hearing loss. Only a few had a flat audiogram, and one had a low-tone hearing loss. Again, our figures resemble those in previously published reports [5]. Notably, none of the patients suffering from hearing loss had any aural complaints other than tinnitus in four patients.

Table 1. Symptoms Presented by the Patients (N = 55)

Symptoms	No. of Patients (%)
Dizziness	48 (87)
Neck pain	48 (87)
Headache	24 (43)
Tinnitus	12 (22)
Hearing impairment	6 (11)
Blurred vision	5 (9)

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Table 2. Computed Dynamic Posturography Results (N = 55)

CDP Pattern	No. of Patients (%)
Normal	26 (47.3)
VLP	4 (7.3)
MSD	22 (40)
Functional	3 (5.4)

CDP = computed dynamic posturography; VLP = vestibular loss pattern; MSD = multisensory dysfunction.

ABR recordings were essentially normal in all but one of the patients tested. This finding contravenes a disorder of the brainstem auditory pathways.

Sixteen patients (44.5%) of the 36 tested had normal ENG recordings, whereas pathology was found in 55.5% (20 patients), and central disorders were indicated in 47.2% (17 patients). Oculomotor abnormality was found in 14 of these patients, oculomotor and vertical nystagmus in 2 patients, vertical nystagmus alone in 1 patient, and peripheral disorders in 3 patients (8.3%). Two of these patients suffered from canal paresis, and one patient had benign paroxysmal positional vertigo. Notably, 16 of the patients with central ENG pathology had abnormal responses of the occulomotor system. According to Hinoki [1], these forms of abnormal optokinetic nystagmus generally are considered to be due to functional disorders of the central nervous system, particularly the brainstem.

CDP results are summarized in Table 2. A total of 26 of the 55 patients (47.3%) exhibited normal sway patterns on the sensory organization test, and 29 (52.7%) had abnormal scores. The majority of the patients (22; 40%) with abnormal sway scores demonstrated a multisensory deficit pattern that was described mainly in central disorders [6]. Only four patients (7.3%) displayed a vestibular loss pattern; three other patients (5.4%) displayed a functional pattern.

To examine the specificity of the CDP and the ENG tests, the patients were divided into two groups: those complaining of dizziness (N = 30) and those not complaining (N = 6; Table 3). Both tests are highly specific, as four and five patients of the six who did not complain of dizziness (the last two columns in Table 3) had normal patterns in the CDP and ENG tests, respectively. Again, as can be seen in the second and third columns of the table, most of the patients with abnormal results suffered from central dysfunction.

Table 3. Computed Dynamic Posturography and Electronystagmography Results in Patients Complaining (N = 30) and Not Complaining (N = 6) of Dizziness

	Complaining		Noncomplaining	
Test Pattern	CDP	ENG	CDP	ENG
Normal	10	11	4	5
MSD-central	14	16	2	1
VLP-peripheral	4	3		
Functional	2			

CDP = computed dynamic posturography; ENG = electronystagmography; MSD = multisensory dysfunction; VLP = vestibular loss pattern.

Table 4. Comparison of Computed Dynamic Posturography and Electronystagmography Results in Patients Complaining of Dizziness (N = 30)

	CDP Pattern			
ENG Pattern	Normal	MSD	VLP	Functional
Normal	8	1	2	
Central	1	13	1	1
Peripheral	1		1	1

ENG = electronystagmography; CDP = computed dynamic posturography; MSD = multisensory dysfunction; VLP = vestibular loss pattern.

When CDP results were correlated to the ENG results in those patients complaining of dizziness and in whom both tests were performed, the correlation was 73.3% (22 patients; Table 4).

Sensory organization test results of the present study were compared to those of the previous study presented by Cohen et al. [7]. The percentage of abnormal cases declined from 47 to 22%, whereas the number of functional cases increased by sevenfold, from 5 to 35%. Toglia [8] found a decrease of some 20% in ENG abnormalities with relation to the time elapsing between injury and tests. Our results, as revealed by CDP evaluation, imply a much higher decrease in balance disorders, taking into account that most of the functional cases actually are normal. Possibly, the functional changes underlying the balance disorders resolved or underwent central adaptation.

CONCLUSIONS

A high incidence of balance disorders is found as early as less than 1 month after the accident. Although ABR results suggest intact central auditory pathways, ENG and CDP indicate central involvement, especially of the occulomotor system. The correlation between ENG findings and CDP results is approximately 70%. ENG and CDP are highly specific, and CDP seems to be a good tool for the assessment of the functional state of the balance system.

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