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Posttraumatic Balance Disorders

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Abstract: Head trauma is being more frequently recognized as a causative agent in balance disorders. Most of the published literature examining traumatic brain injury (TBI) after head trauma has focused on short-term prognostic indicators and neurocognitive disorders. Few data are available to guide those individuals who see patients with balance disorders secondary to TBI. Our group has previously examined balance disorders after mild head trauma. In this study, we study all classes of head trauma. We provide a classification system that is useful in the diagnosis and management of balance disorders after head trauma and we examine treatment outcomes. As dizziness is one of the most common outcomes of TBI, it is essential that those who study and treat dizziness be familiar with this subject.

Key Words: classification system; dizziness; head trauma; traumatic brain injury

Closed-head injury (CHI) and associated traumatic brain injury (TBI) are becoming increasingly more common in modern society. Faster motorized vehicles, bigger, stronger athletes, and the continued desire to push things to the extreme are just some of the many reasons why more individuals are affected by CHI now than in the past. TBI is the second most common neurological disorder, with a yearly incidence of more than 500 in 100,000 individuals [1]. CHI and associated TBI cost the United States more than $40 billion annually. Because of the frequency of dizziness associated with CHI, understanding the diagnosis and treatment of dizziness associated with head trauma is important for otolaryngologists.

TBI can be divided into three classes [2]. Mild TBI is characterized by a mild head injury, a Glasgow Coma Score (GCS) of 13–15, and absent or very transient loss of consciousness (LOC). In moderate TBI, the GCS is 9–13 and an affected individual has sustained a moderate head injury. In this type of TBI, intracranial pressure monitoring or ventilator support are not needed and LOC is of not more than 8 hours' duration. Severe TBI is associated with significant head trauma and a GCS of less than 8 or the need for intracranial pressure monitoring or ventilator support after the head injury. In severe head trauma, LOC usually exceeds 8 hours.

We previously published data characterizing a dizziness classification scheme for individuals after mild head trauma [3]. In the current study, we further define that classification system for all types of blunt head trauma. We first detail the diagnostic categories for dizziness after head trauma in the acute or subacute stage. After that, we detail our methodology for diagnosis of affected patients. We conclude with our management recommendations.

PATIENTS AND METHODS

Active-duty military members who had sustained a CHI in combat, a motor vehicle accident, an altercation, or a sporting event were eligible for participation in the study. We excluded from this study those who suffered a blast injury; a separate detailed study of those patients is under way in our laboratory. Also excluded from the study were patients with a temporal bone fracture or an open-head injury or those seen in clinic more than 12 weeks after the head trauma.

All the subjects underwent a comprehensive neuro-otological vestibular evaluation that included recording a detailed history and undergoing a head and neck examination with an additional vestibular physical examination.

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Table 1. Differential Diagnosis: Diagnostic Characteristics of Each Entity Seen in Posttraumatic Balance Disorders

Entity	History	Physical Examination	Vestibular Tests
Positional vertigo	Positional vertigo	Nystagmus on Dix-Hallpike test or modified Dix-Hallpike test result	No other abnormalities
Exertional dizziness	Dizziness only during and/or right after exertion	Abnormalities in challenged gait testing	No other abnormalities
Migraine-associated dizziness	Episodic vertigo with periods of unsteadiness; headaches	Abnormalities in challenged gait testing; possible abnormalities on head impulse testing; normal static posture tests	VOR gain, phase, or symmetry abnormalities; high-frequency VOR abnormalities; mild central findings on rotation chair testing; normal posturography
Spatial disorientation	Constant feeling of unsteadiness worsened by standing but still present when sitting or lying down; drifting to one side while walking; shifting weight when standing still	Abnormalities on standard gait tests; possible abnormalities on head impulse testing; abnormalities on static posture test results	VOR gain, phase, or symmetry abnormalities; high-frequency VOR abnormalities; central findings on rotation chair testing; abnormal posturography

VOR = vestibuloocular reflex.

Testing included computed dynamic posturography (Neurocom Inc., Clackamas, OR); sinusoidal harmonic acceleration rotational chair testing for gain, phase, and symmetry, along with step velocity testing for vestibular time-constant determination; and high-speed head velocity testing for gain, phase, and symmetry (Micromedical Inc., Chatham, IL). In addition, all the patients completed two standardized balance instruments, the dizziness handicap index and the activity-specific balance confidence scale [4,5]. Finally, all patients had their gait judged by a physical therapist using the dynamic gait index.

We divided patients into four diagnostic categories. These four categories were benign positional vertigo (BPV), posttraumatic migraine-associated dizziness (PTMAD), posttraumatic exercise-induced dizziness (PTEID), and posttraumatic spatial disorientation (PTSD). The diagnostic criteria are shown in Table 1. Essentially, BPV is diagnosed by a positive result on a Dix-Hallpike test with no other abnormalities. PTMAD displays a classic migraine history and signs of a vestibuloocular reflex abnormality but no evidence of postural instability. In PTEID, the history of experiencing dizziness only with exertion makes the diagnosis, whereas PTSD may or may not include headaches but does exhibit a vestibuloocular reflex abnormality and postural instability. The details of the classification scheme are shown in Table 1.

Outcome criteria included return to work (full military duty) and time to symptom resolution. We compiled statistics with a standard computerized statistical package using a set of analyses of variance, with $p < .05$ determined as the level of statistical significance. The study was approved by the institutional review board at the Naval Medical Center San Diego.

RESULTS

We included 77 patients in the study. Fifty-eight (75%) had mild head trauma, 10 (13%) had moderate head trauma, and 9 (12%) had severe head trauma. The numbers of patients in the moderate and severe group were limited by the inclusion criteria for the study. Those in the mild injury group included 49 men and 9 women, with an average age of 33 years. The other two groups consisted exclusively of men, and each group had an average age of 22 years. The distribution of dizziness type for all patients is shown in Figure 1. As can be seen, PTMAD is the most common diagnostic category in the patients with mild and moderate TBI, whereas

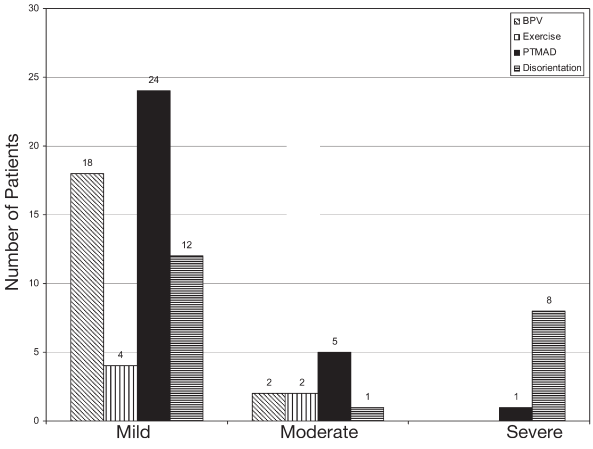

Figure 1. Distribution of dizziness types. Number of individuals in each group with each diagnostic category of posttraumatic balance disorders. (*BPV* = benign positional vertigo; *PTMAD* = posttraumatic migraine-associated dizziness.)

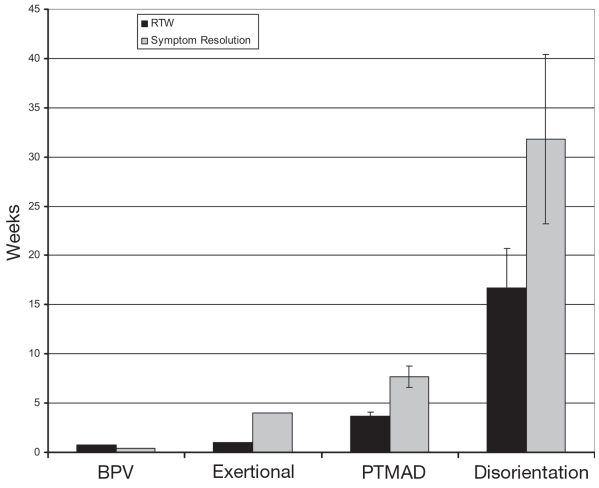

Figure 2. Outcome data for each posttraumatic balance disorder diagnosis. The *y*-axis is in weeks after presentation to our clinic. (*BPV* = benign positional vertigo; *PTMAD* = posttraumatic migraine-associated dizziness; *RTW* = return to work.)

spatial disorientation is the most common disorder in the patients with severe TBI.

Because patient outcome was based on dizziness type rather than on TBI severity, we evaluated the group as a whole in examining outcome data. Functional outcome for all four diagnostic groups—BPV, exertional dizziness, PTMAD, and spatial disorientation—is shown in Figure 2. Return to work was characterized as the number of weeks required for an individual to return to regular military duties, whereas symptom resolution was defined as the time in weeks at which affected patients judged that all symptoms had resolved. In both measures, those in the spatial disorientation group demonstrated significantly longer times ($p < .01$). For return-to-work data, no significant difference was noted among the other three disorders, whereas for resolution-of-symptom data, those in the BPV group showed significantly shorter times than those seen in patients in the exercise-induced or migraine-associated dizziness group ($p < .05$).

DISCUSSION

Mild head trauma and CHI are often associated with balance disorders. We have been able to characterize these balance disorders into four different diagnostic categories. When we evaluated a small group of mild patients, we divided the group into those having BPV, PTMAD, and PTSD. As we evaluated a larger group of patients (and added the moderate and severe head-trauma groups), it became clear that there was a fourth diagnostic disorder: PTEID. It is important to keep in mind that these diagnostic categories are applicable only to acute CHI patients (seen within 12 weeks after head injury). We excluded from this study patients with penetrating head trauma or blast injury. The literature contains a great deal of information examining the effects of CHI; however, little work details the impact of CHI on the vestibular system [6–9]. Indeed, none of these studies details a classification scheme or discusses the treatment of these disorders. In classifying these disorders, as with many balance disorders, history and office physical examination alone can provide the diagnosis in most cases, especially if careful attention is paid to the details of a patient's balance complaints.

The secondary goal of this study was to discuss the treatment methods used with affected patients. Our results demonstrate that regardless of the degree of head trauma, the type of posttraumatic dizziness can guide patient outcome and treatment.

Those individuals with posttraumatic BPV can be treated with a standard Epley procedure for posterior-canal BPV and with a logrolling procedure for lateral-canal BPV. We perform the procedures in the standard manner [10,11]. After the procedure, we use a soft collar to remind the patient not to move the neck, and we require that the patient not lie flat. The duration of this restriction is 48 hours for posterior-canal BPV and 72 hours for lateral-canal BPV. We prefer that our military patients not go to work while head motion is restricted. Because of this self-imposed requirement, our results indicate that return to work for BPV is not significantly quicker than that for PTMAD or PTEID, but the resolution of symptoms for the first group is significantly quicker.

Our treatment for PTMAD has been documented elsewhere [12]. Briefly, the treatment is initiated by putting the patient on an antimigraine medicine to control the symptom fluctuation and then administering vestibular rehabilitation. In this group of patients, we restricted our medical therapy to one of the following: verapamil (180–240 mg/day), gabapentin (100–200 mg bid), or topiramate (25–100 mg bid). We treated patients with one medicine for 3 weeks and switched if the medicine did not result in a reduction in symptoms. The rehabilitation was provided by a physical therapist and was customized for each patient. A detailed description of the rehabilitation is beyond the scope of this review but is discussed in our previous work [12].

For the group of patients with exercise-induced dizziness, our rehabilitation physical therapists designed a customized program that involves gradual increases in the type and degree of exercises combined with standard vestibular rehabilitation. Like the program for PTMAD, this program must be individualized and progressed for each patient over time. Normally, these patients' disorders can be managed with initial twice-weekly visits

and exercises at home between visits. This regimen is followed by weekly visits with home exercises until symptoms resolve and the patient is able to do routine physical exercise (as required by fitness standards for active-duty military personnel).

The PTSD patients present the most difficult challenge. As can be seen from Figure 2, even with vigorous vestibular rehabilitation, these patients still demonstrate vestibuloocular reflex abnormalities after 8 weeks of therapy. Nevertheless, these individuals can respond to therapy. Unlike those patients in the PTMAD and PTEID groups, patients with PTSD often require daily therapy for several weeks. As with the other groups, the therapy must be individualized and requires that an experienced vestibular rehabilitation physical therapist be involved in planning the exercise regimen. In many of these patients, we employed a computerized balance platform and a computerized dynamic activity board (Neurocom Inc.) or an unstable balance platform (SportKAT Inc., San Diego, CA) combined with a dynamic visual acuity task. We trained individuals for two 45-minute sessions 4 days per week for up to 3 weeks. We combined this therapy with standard vestibular rehabilitation and at least 30 minutes of cardiovascular exercise each day (stationary bicycle or elliptical trainer).

SUMMARY

CHI, and resultant TBI, is often associated with dizziness. Most of the literature on this disorder focuses on cognitive deficits; little work documents the diagnosis and treatment of associated balance disorders. In this study, we reviewed the diagnosis and treatment of the categories of balance disorders seen after CHI. We described diagnostic criteria and a diagnostic scheme. We documented that treatment and prognosis depend more on a patient's particular diagnosis than on the degree of head injury. Finally, we described the treatment of these disorders, emphasizing the need for vestibular rehabilitation guided by an experienced physical therapist. Patients with posttraumatic dizziness are a challenging group of individuals. Often, due to cognitive deficits, they do not get the care they need for their vestibular disorder. However, with teamwork among otolaryngologists, audiologists, physical therapists, neurologists, and rehabilitation medicine specialists, these patients can be returned to full-duty status.

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