

ORIGINAL ARTICLE**Psychological Symptoms and Spatial Orientation During the First 3 Months After Acute Unilateral Vestibular Lesion**

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Background and Aims. We undertook this study to assess the correlation between the results of simple tests of spatial orientation and the occurrence of common psychological symptoms during the first 3 months after an acute, unilateral, peripheral, vestibular lesion.

Methods. Ten vestibular patients were selected and accepted to participate in the study. During a 3-month follow-up, we recorded the static visual vertical (VV), the estimation error of reorientation in the yaw plane and the responses to a standardized questionnaire of balance symptoms, the Dizziness Handicap Inventory (DHI), the depersonalization/derealization inventory by Cox and Swinson (DD), the Dissociative Experiences Scale (DES), the 12-item General Health Questionnaire (GHQ-12), the Zung Instrument for Anxiety Disorders and the Hamilton Depression Rating Scale.

Results. At week 1, all patients showed a $VV > 2^\circ$ and failed to reorient themselves effectively. They reported several balance symptoms and handicap as well as DD symptoms, including attention/concentration difficulties; 80% of the patients had a Hamilton score ≥ 8 . At this time the balance symptom score correlated with the DHI. After 3 months, all scores decreased. Multiple regression analysis of the differences from baseline showed that the DD score difference was related to the difference on the balance score, the reorientation error and the DHI score ($p < 0.01$). No other linear relationships were observed ($p > 0.5$).

Conclusions. During the acute phase of a unilateral, peripheral, vestibular lesion, patients may show poor spatial orientation concurrent with DD symptoms including attention/concentration difficulties, and somatic depression symptoms. After vestibular rehabilitation, DD symptoms decrease as the spatial orientation improves, even if somatic symptoms of depression persist. © 2011 IMSS. Published by Elsevier Inc.

Key Words: Derealization, Spatial orientation, Vestibular.

Introduction

Patients attending neuro-otology clinics frequently report psychological symptoms (1,2). Recent studies support that patients with vestibular disease may experience depersonalization/derealization (DD) symptoms more frequently and more severely than healthy subjects (3,4). Although evidence does not support that symptoms of anxiety or depression are a result of vestibular dysfunction (1,5), patients with vestibular

migraine and Menière disease have shown significantly higher prevalence of anxiety and depression than patients with vestibular neuritis and benign paroxysmal positional vertigo (5,6), and depression may correlate positively with the subjective sense of disability (7). Thus, to establish a linkage between vestibular deficit and psychometric findings, the clinical course of the vestibular disease including disability should be considered.

Dissociative experiences are common in the general population (8). They may decline with age, but they are not related to socioeconomic status, gender, education, religion, or nationality (9). Specifically, DD symptoms are commonly described accompanying a wide variety of psychiatric and neurological disorders (10,11). In patients with acquired sensory dysfunction, the prevalence of DD symptoms is

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increased, with a different pattern of symptoms related to each type of sensory dysfunction (4). Patients with vestibular disease may report symptoms of detachment from reality related to spatial disorientation and symptoms of common mental disorders (12). Evidence suggests that DD symptoms in vestibular disease may be a consequence of a sensory mismatch between disordered vestibular input and other sensory signals of orientation. Even more, vestibular patients with recent balance symptoms may report DD symptoms more frequently and more severe than vestibular patients without recent balance symptoms, which suggests that DD symptoms may persist as the clinical recovery is deficient (3,12). However, there are no follow-up studies assessing the relationship between vestibular recovery and psychological symptoms reported during the acute phase of the vestibular deficit.

The present study attempts to assess the correlation between simple tests of spatial orientation and the frequency of common psychological symptoms, including DD symptoms, during a 3-month follow-up after an acute unilateral, peripheral, vestibular lesion.

Subjects and Methods

Subjects

After the research protocol was approved by the Local Research and Ethics Committee, patients with acute, unilateral, peripheral, vestibular lesion were invited to participate at two neuro-otology departments. Patients were eligible for inclusion in the study according to the following criteria: not having experienced vertigo previously and no history/medical record of head trauma, otologic disease, retinal disease, hearing loss, migraine, neurological or psychiatric disorders (submission to psychiatric care or psychopharmacological treatment). Ten patients were accepted to participate. They were five males and five females, 25- to 66-years of age (mean age: 39 ± 14 years). Four subjects had corrected refraction errors. Only one subject reported smoking and two subjects reported occasional alcohol intake.

The vestibular deficit was diagnosed after a neuro-otologic evaluation. The mean time of disease evolution was 4 ± 2 days. All patients had spontaneous vestibular nystagmus in light and normal hearing (audiometry and speech audiometry). The frequency of balance symptoms is described in Figure 1. During bithermal caloric test (at 30°C and 44°C), all subjects showed canal paresis with contralateral directional preponderance. Response asymmetry was from 25–72% ($51 \pm 0.2\%$) (13). During follow-up, all patients performed a standardized vestibular rehabilitation program (Cawthorne & Cooksey exercises) (14,15). Labyrinthine suppressors were administered only when required, during the first 5 days from the beginning of the vertigo.

Cawthorne & Cooksey rehabilitation program is based on a series of exercises of increasing complexity, which include

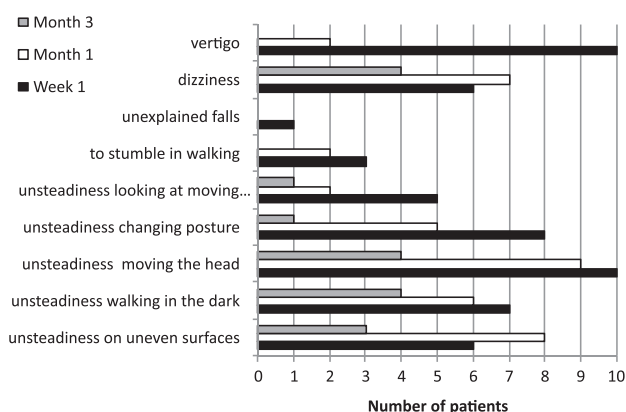


Figure 1. Balance symptoms reported by 10 patients with acute, unilateral, peripheral vestibular lesion during a 3-month follow-up.

movements of the head, tasks requiring coordination of the eyes with the head, total body movements and balance tasks (14,15). All patients were given written instructions with diagrams describing the exercises. After an evaluation of the level of complexity at which to start the program (for each patient), all patients were instructed to carry out the exercises for at least 10 min, twice daily; to keep practicing the same group of exercises for as long as the vertigo persisted and progress to the next level whenever they could tolerate the exercises. Patients were also instructed to use a visual focal point whenever dizziness started. During follow-up, the same physician evaluated exercise performance and compliance to treatment according to patient self-report. All patients reported regular practice of the exercises and made progress during rehabilitation.

Procedures

Spatial orientation tests. At week 1 and at months 1 and 3 of follow-up, we recorded the average of 10 estimations of the static visual vertical in an upright sitting position and the average of 10 estimation errors of a test of updating orientation in the yaw plane.

For the static visual vertical test, the subjects were seated upright without back support, and their heads were stabilized using a chin rest. In front of the subjects was a motorized fluorescent rotating bar, pivoting along the line of sight and fixed against a black background in an otherwise darkened room. In between settings, subjects closed their eyes while the rod was arbitrarily positioned away from earth-vertical by the experimenter. Subjects were asked to adjust the rod by remote control until it appeared subjectively earth-vertical, with no time constraints. When the rod appeared earth-vertical, the subject was instructed to click an enter button, which would automatically calculate the deviation in degrees from the true earth-vertical.

The reorientation test was especially designed to minimize the feeling of laboratory testing and to mimic the daily life situation of orienting ourselves relative to the location of the distinctive features of an unfamiliar room. The test

is described elsewhere (12). In brief, subjects were familiarized with a small room (2 x 2.1 m), which contained four fixed features, each positioned in the middle of each wall. Subjects sat upright on a hydraulic barber's chair positioned in the center of the room. At first, in the light, subjects were asked to remember the location of each of the four features. During the test they wore sound-occluding headphones and an eye mask, and they were exposed to two sets of five manually driven whole body rotations of 45°, 90° or 135°, which were performed to the right or to the left in an unpredictable sequence, balanced for amplitude, direction and order. Between each rotation, 10 sec elapsed to allow for any post-rotatory sensation to fade. After the fifth rotation, the chair was returned to the start position, the eye mask was removed and the subjects had a 2-min rest before commencing the second set of rotations.

The subjects' task was to verbally report, after each rotation, which wall or corner they were facing. The error of each reorientation estimate was calculated by subtracting the reported rotation from the actual rotation. An average estimation error was then calculated for each subject. A previous study showed that 70% of 60 healthy subjects performed the test with no more than two estimation errors with a typical error magnitude of 45°, which was observed on 99% of all errors. The performance on the test was unrelated to the age or the gender of the subjects.

Questionnaires

At the same intervals (week 1 and months 1 and 3), each subject completed seven validated questionnaires:

1. A standardized questionnaire of balance symptoms (16) that includes nine items to report each of the balance symptoms described in Figure 1, with no/yes answers. A "no" response is scored 0 points and a "yes" response is scored 1 point except for vertigo, which is scored 2 points; frequent falls are considered when occurring at least once per month and frequent stumbles when occurring at least once per week. The total score is calculated by adding-up all the points (range 0–10). The authors suggested that a score higher than 3 points could be related to balance disorders (16).
2. The Dizziness Handicap Inventory (DHI) by Jacobson (1990) (17) to evaluate the self-perceived handicapping effects imposed by the vestibular disease. A "yes" response is scored 4 points, "sometimes" is scored 2 points, and a "no" response is scored 0 points. The total score is calculated by adding all the points (range 0–100). There are seven questions that comprise a physical subscale and nine questions each on functional and emotional subscales. The authors suggested that a change of 18 points in the total score is required before it could be stated that there was a significant change in the perceived handicap (17).
3. The 28-item depersonalization/derealization inventory (DD) by Cox and Swinson (2002) (18), which is a tool designed to assess symptoms of depersonalization/derealization in clinically anxiety states, more than in a dissociative disorders context. Severity of each item is coded on a scale where 0 = does not occur, 1 = mild, 2 = moderate, 3 = severe and 4 = very severe. The total score is calculated by adding all the points (range 0–112). The higher scores are related to a higher frequency and/or severity of DD symptoms. No cutoff score has been suggested.
4. The Dissociative Experiences Scale (DES) (19) taps a broad range of dissociative experiences including disturbances in memory, identity, and cognition, and feelings of derealization, depersonalization, absorption, and imaginative involvement. Scores on each of the 28 items may range from 0%—This never happens to you to 100%—This always happens to you, using multiples of ten (e.g., 10, 20, 30%,...). The total score is calculated by dividing the sum of the individual scores by 28 (range 0–100%). A cutoff of 8 is considered to be the low normal range (20).
5. The 12-item General Health Questionnaire (GHQ-12) (21) to identify symptoms of common mental disorders, which was scored using the GHQ method of 0-0-1-1 (range 0–12). A normal score is considered < 3.
6. The Zung Instrument for Anxiety Disorders (22), a 20-item scale with some of the items keyed positively and some negatively on a four-point scale ranging from 1 none or a little of the time to 4 most or all of the time. The final score range from 20–80, a score between 20 and 44 is considered in the normality range, 45–59 is mild to moderate anxiety, 60–74 is severe, and 75–80 is very severe.
7. The 17-item Hamilton Depression Rating Scale (23) evaluates depressed mood, vegetative and cognitive symptoms of depression, and co-morbid anxiety symptoms (23,24). The 17 items are rated on either a 5-point (0–4) or a 3-point (0–2) scale. In general, the 5-point scale items use a rating of 0 = absent; 1 = doubtful to mild; 2 = mild to moderate; 3 = moderate to severe; 4 = very severe. A rating of 4 is usually reserved for extreme symptoms. The 3-point scale items used a rating of 0 = absent; 1 = probable or mild; 2 = definite. The final score range from 0–48, a score between 0–7 points is considered in the normality range (25).

Reliability of the Study Protocol

In order to evaluate the stability of the responses, eight healthy subjects (24–58 years old) accepted to perform the same tests and to reply to all the questionnaires during a similar follow-up of 3 months. Within this control group, the tests and questionnaires showed no significant differences through the follow-up (repeated measures ANOVA, $p > 0.1$).

Results

Week 1

At the beginning of the study, patients showed a mean estimation of the visual vertical of $6.7^\circ \pm 3.2^\circ$ and failed to reorient themselves effectively (mean estimation error $23^\circ \pm 8^\circ$) (Figure 2). All reported vertigo and unsteadiness when moving the head (Figure 1). They had a balance symptom score from 4–10 and a DHI score from 28–92 (Figure 2, Table 1). Their DD score was from 5–74, whereas their DES score was from 0.3–10.7% (Table 1). One patient, a 61-year-old male, failed to attend the appointment to perform the orientation test but completed all the other tests of the protocol with similar responses as the other participants.

Figure 3 shows a summary of the total scores on five of the questionnaires. On the DD inventory, patients reported 4–28 of 28 symptoms (median 14). Apart from “dizziness” (100%) and “feel as if walking on shifting ground” (60%), the most frequent symptoms were numbing of emotions (90%), difficulty focusing attention (80%), feeling of detachment or separation from surroundings (70%), feeling confused or bewildered (70%) and difficulty concentrating (70%). On the DES, patients reported 1–17 of 28 symptoms (median 8). Although the dissociative experiences were sporadic, the most frequent symptoms were missing part of

a conversation (70%), ability to do things that would usually be difficult for them (70%), inability to remember if they have done something or have just thought about doing it (70%) and not being able to remember what happened during all or part of a trip by car, bus or subway (60%).

Three patients had a score ≥ 3 on the GHQ 12, but none had a score ≥ 45 on the anxiety instrument by Zung. However, eight patients had a score ≥ 8 on the Hamilton Depression Scale where the most frequent symptoms reported by the patients were somatic symptoms (e.g., insight, general somatic symptoms, work and activities).

At this time, the balance symptom score correlated with the DHI score (Pearson's $r = 0.8$, $p = 0.01$). This correlation was mainly due to a strong correlation between the balance symptom score and the functional subscale of the DHI (Pearson's $r = 0.9$, $p < 0.01$), although no other significant correlation was observed.

Follow-up

During the follow-up, a gradual decrease of the balance symptoms and signs was observed (Figure 2). At the same time, the psychological symptoms decreased (Figure 3). Although the VV showed improvement more rapidly than the other evaluations (Figure 2), consistent changes on the orientation tests were observed at the end of the third month when patients showed a mean VV of $0.9^\circ \pm 0.3^\circ$ and a mean estimation error of reorientation of $7^\circ \pm 8^\circ$. At this time, their balance symptom score was ≤ 4 (0–4). None reported vertigo, but four patients felt dizzy (Figure 1). At the third month of follow-up, all patients showed a decrease of at least 18 points on the DHI score.

During the 3 months, all patients showed a gradual decrease in questionnaire scores (Figure 3). At the third month, decrease of the DD score was observed on both frequency and severity of the symptoms. Patients reported

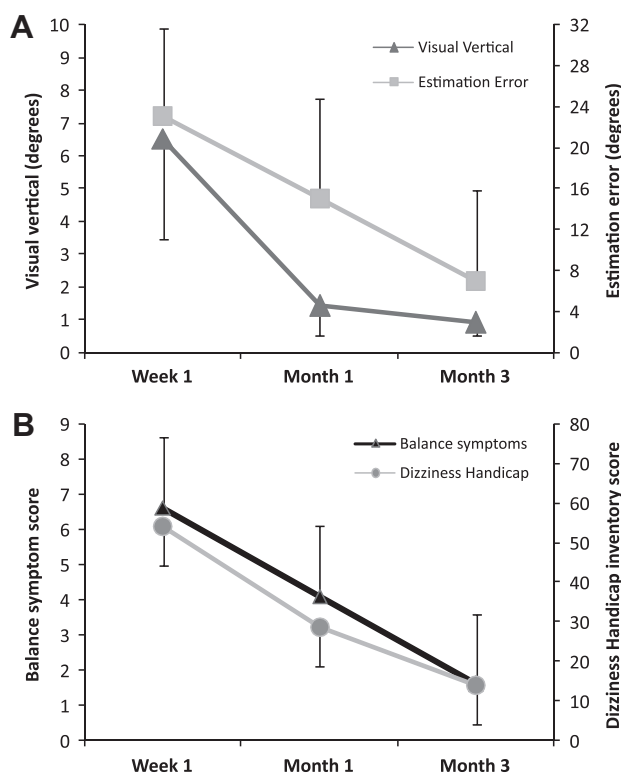


Figure 2. Mean and standard deviation of the (A) subjective visual vertical and the estimation error and (B) balance symptoms and dizziness handicap on a reorientation test during a 3-month follow-up.

Table 1. Mean and SD of the baseline scores and the difference from baseline scores (after a 3-month follow-up) on the seven questionnaires

Questionnaire	Baseline evaluation	Difference after 3 months of follow-up
	Mean \pm SD	Mean \pm SD
Balance symptoms	6.6 \pm 2.0	5 \pm 2.1
Dizziness Handicap Inventory (total score)	54.2 \pm 22.8	40.2 \pm 8.6
Functional	20.8 \pm 9.8	14.8 \pm 4.8
Physical	16.4 \pm 6.3	12.4 \pm 6.1
Emotional	17 \pm 9.4	13 \pm 6.4
Depersonalization/ Derealization Inventory	25.8 \pm 22.3	20.9 \pm 17.4
Dissociative Experiences Scale	4.6 \pm 3.9	3.2 \pm 2.8
General Health Questionnaire-12	3.4 \pm 2.8	2.2 \pm 3.3
Hamilton Depression Rating Scale-17	13.8 \pm 8.4	5.9 \pm 4.2
Zung Instrument for Anxiety Disorders	37 \pm 6.9	3.9 \pm 7.0

SD, standard deviation.

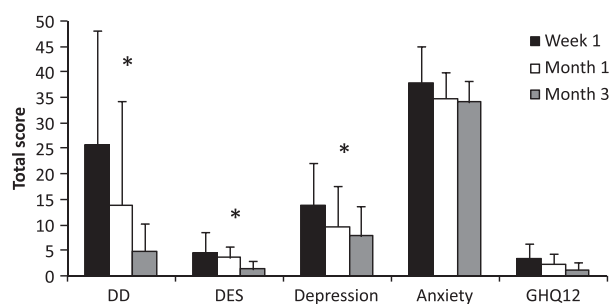


Figure 3. Mean and standard deviation of the mean of the total score on the following inventories: depersonalization/derealization by Cox and Swinson (DD), Dissociation Experiences Scale by Bernstein (DES), 17-item Hamilton Depression Scale, instrument for anxiety disorders by Zung (Anxiety) and the 12-item General Health Questionnaire by Goldberg (12-GHQ). * $p < 0.05$.

0–8 symptoms (median 2) and the most frequent symptom was “difficulty focusing attention” (40%). At this time, on the DES patients reported 0–15 symptoms (median 3 symptoms). The most frequent symptoms were missing part of a conversation (60%) and not remembering what happened during all or part of a trip by car, bus or subway (40%). None of the patients had a score > 3 on the GHQ 12 or ≥ 45 on the Zung anxiety instrument. However, five patients had a score ≥ 8 on the Hamilton Depression Scale.

After the 3-month follow-up there was a decrease of the questionnaire scores (Figure 3). Simple correlation of the score differences from baseline (Table 1) showed that the DD score difference (but not the DES score difference) was related to the difference on the balance symptom score (Pearson's $r = 0.69$, $p < 0.05$) and to the decrease on the estimation error of reorientation (Pearson's $r = 0.63$, $p < 0.05$). However, no correlation was observed between the differences on the DD or DES score and the differences on the VV, DHI (total score and subscales), GHQ12, Hamilton scale or Zung instrument ($p > 0.5$). Also, no significant correlation was observed between the Hamilton scale difference and any of the other total score differences.

Multiple regression analysis showed interaction of the difference from baseline after a 3-month follow-up on the DD score and the difference from baseline (Table 1) on the following measurements (intercept, $F = 13.6$, $p = 0.02$): the balance symptom score (beta value 0.82, 95% CI 0.5–1.13), the estimation error of reorientation (beta value 0.68, 95% C.I. 0.41–0.95) and the DHI total score (beta value 0.27, 95% CI 0.008–0.54) with no influence on the Hamilton Depression Rating Scale.

Discussion

In this study, during the acute phase of a unilateral vestibular deficit, patients were disoriented and reported DD symptoms and depression symptoms including attention/concentration difficulties. Those with multiple balance

symptoms reported more disability. Although the strong loading on derealization items found on the responses to the DD inventory, patients reported a low frequency of other dissociative experiences on the DES, with total scores within the normal range (20). During recovery, spatial orientation improved, most of the balance symptoms disappeared, disability declined and the frequency/severity of the DD symptoms decreased with no evidence of interaction with anxiety. From the beginning of the study up to the end of the follow-up, the total score on the Zung Instrument for Anxiety Disorders was within the normal range (21).

The correlation observed at week 1 between the self-perception of handicap (DHI total score and functional subscale) and the balance symptom score is consistent with previous studies showing that the clinical evaluation of patients with vestibular disease may be related to self-reported disability, particularly for patients with spontaneous nystagmus (26,27). However, the apparent lack of correlation observed on the other variables is inconclusive. This study was designed to evaluate changes within the same group during follow-up of selected patients more than to identify cross-sectional linear relationships in any particular evaluation. Additionally, the low frequency of anxiety symptoms and the high frequency of depression symptoms observed are not representative from the clinical setting (28). Particularly, the total scores on the Hamilton depression rating scale could be explained by the frequency of somatic symptoms according to patient self-report. However, both the low frequency of anxiety symptoms and the persistence of somatic depression symptoms during follow-up suggest that the changes observed in this study on the DD inventory were not primarily related to anxiety or depression.

After a 3-month follow-up, patients had a different level of recovery, which allowed us to observe some relationships. The decrease of the DD score was related mainly to the decrease on the balance symptom score and the decrease on the error of the reorientation estimate; i.e., the larger the decrease of the DD score—the larger the improvement on the balance symptoms and on the reorientation estimate. This finding is consistent with previous cross-sectional reports showing that patients with poor or incomplete recovery who are still disoriented are more prone to manifest derealization symptoms than those patients without recent balance symptoms (3). The results support the hypothesis that, during the acute phase of a unilateral, peripheral, vestibular lesion, the vestibular deficit may have an impact on the multisensory mechanisms involved with perceiving both reorienting in space and reality. This may translate into balance symptoms and derealization symptoms.

The finding of a different rate of recovery of the canal-related orientation test (perceptual, reorientation test) from the otolith-related orientation test (static VV) is consistent with previous studies in patients with vestibular neuritis (29–31). This supports the fact that vestibular compensation

is not a single process that recovers completely at a specific rate but is made up of subprocesses that recover to different levels and at different rates (32). Even more, recordings of dynamic changes of deficits in canal and otolith vestibulo-ocular reflexes to high acceleration have shown a lack of any consistent recovery of the reflex gain after 3 and 450 days postsurgical unilateral vestibular deafferentation, suggesting that any other forms of vestibular compensation or adaptation after unilateral vestibular deafferentation occur downstream of peripheral vestibular afferents (33).

The occurrence of symptoms related to attention/concentration observed during the acute phase of the vestibular deficit is also consistent with cross-sectional studies showing evidence of an association between vestibular function and difficulty concentrating (3,4,12,34) as well as with reports on the adverse effect of vestibular dysfunction on attention processes (35–37). Of note, in this study, during the recovery from the vestibular lesion, the frequency/severity of symptoms related to attention/concentration decreased. This result is in agreement with the hypothesis that the requirement of cognitive resources involved in successful processing and integration of vestibular information would be increased in patients with vestibular dysfunction, and the integration of vestibular information could be associated with the cognitive resources required for adequate spatial orientation (37).

In conclusion, patients with acute, unilateral, peripheral vestibular lesion may show poor spatial orientation concurrent with DD symptoms, attention/concentration difficulties, and somatic depression symptoms, without overt anxiety. After vestibular rehabilitation, DD symptoms decrease as the spatial orientation improves, even if somatic symptoms of depression persist, which is consistent with a relationship between the feeling of detachment from the environment and the vestibular deficit.

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