Depressive Disorders in Relation to Neurootological Complaints

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Abstract: Depression is a state of depressed mood characterized by feelings of sadness, despair, and discouragement. Depression ranges from normal feelings of "the blues" through dysthymia to major depression. Endogenous depression has been identified with a specific symptom complex: psychomotor retardation, early morning awakening, weight loss, excessive guilt, and lack of reactivity to the environment. Reactive depression is precipitated by a stressful life event. In the field of depression, we found an overlapping activity between psychiatry and neurootology. Our sample comprises 134 patients (53 [39.55%] male, 81 [60.45%] female) who were classified either by psychiatrists or by neurologists as suffering from depression. By evaluating our neurootological history data bank (Neurootological Data Evaluation–Claussen [NODEC]) as regards 6 important vertigo symptoms, we found that patients presented with a frequency of 2.10 signs per patient. When we extended the list to 11 vertigo and nausea signs, we found 2.93 signs per patients. All patients underwent an objective and quantitative neurootometric analysis. The following rates of abnormal findings were observed: butterfly calorigram of polygraphic electronystagmography, 69.40%; stepping craniocorpograms, 69.40%; and bone-conduction pure-tone audiometry of the right ear, 28.36%, and of the left ear, 36.57%.

Key Words: audiometry; craniocorpography; depression; electrocardiography; electronystagmography; neurootometric analysis; vertigo symptoms

Depression is a disease that belongs in the practices of psychiatrists, psychologists, and psychosomatically oriented family physicians. Depression also occurs among patients especially seeking help from a neurootologist when they present with vertigo or tinnitus. More generally, modern medicine acknowledges depression as a mental disorder characterized by feelings of worthlessness, guilt, sadness, helplessness, and hopelessness, experienced either as individual symptoms or in combination with others.

In contrast to normal sadness or the grief that accompanies the loss of a loved one, clinical depression is sadness without any apparent reason and is persistent and severe. Depression may be accompanied by a variety of related symptoms, including disturbances in sleep and eating, loss of initiative, self-punishment, withdrawal and inactivity, and loss of pleasurable feelings. We know very well that psychiatry differentiates two major forms of depressive disorders. In one form, depressive disorders are marked only by episodes of depression. In the other form (i.e., manic or bipolar depressive illness), mania and depression alternate. Neurootologists know that many people thus afflicted, when feeling specific vertigo sensations or tinnitus, also seek the help of a neurootologist. Therefore, we selected for our study a sample of typical patients who presented also

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with a diagnosis of depression, a diagnosis that had been made externally by both psychiatrists and family physicians. Data for this group of 134 patients were collected for this sample in a special study in which the objective was to determine how much vertigo, dizziness, hearing loss, and tinnitus occur in combination with significant objective and quantitative findings within our neurootometric tests.

PATIENTS AND METHODS

From our neurootological data bank and from archives of the Neurootologisches Forschungsinstitut der 4-G-Forschung e.V. in Bad Kissingen, we chose 134 patients suffering from depressive disorders that they also connected with such neurootological complaints as vertigo, dizziness, hearing loss, and tinnitus. We describe the sample according to their biographical data (e.g., age, height, and weight distribution, and blood pressure).

We reported and recorded the complaints of the patients by means of our systematic NODEC. The NODEC chart contains a questionnaire for different complexes of neurootological complaints classified into categories of vertigo, nausea, hearing disorders (e.g., loss of hearing, surgery to the ear, or tinnitus), visual disturbances, taste and smell disorders, and disturbances of other cranial nerves (e.g., facial nerves and the trigeminal nerves). Also, listed within this questionnaire are major background disorders (e.g., trauma to the head), including cardiovascular disorders and metabolic diseases (e.g., diabetes mellitus, kidney disorders). Patients' therapeutic drug habits are evaluated together with questions regarding harmful lifestyle choices (e.g., smoking and drinking).

All patients included in this study underwent systematic neurootometric and equilibriometric analyses. They contained a neurosensory network analysis through polygraphic five-channel electronystagmography (ENG) together with simultaneous electrocardiographic (ECG) recordings of the heart rhythm. These electrophysiological data were recorded within our neurootometric vestibular laboratories. Additionally, the vestibular spinal pathways were analyzed by means of ultrasound computerized craniocorpography (US-COM-CCG), recording head and shoulder movements from above. For this purpose, test persons were marked on the head and shoulders with ultrasound markers. The images received had the appearance of a radar picture of a head and trunk floating through time and space. The stimulus procedures underlying this investigation were the standing test of Romberg [1] and the stepping test of Unterberger [2] and Fukuda [3].

The equilibriometric measurements were experimental neurophysiological investigations in which ENG represents only the recording part. For providing stimulus to the patients, we used the most common vestibuloocular test (i.e., Barány's calorization). The maximum responses to the four caloric partial tests and the spontaneous nystagmus were plotted onto the Claussen butterfly chart. This chart allows for the discrimination of 81 different test responses, of which some occur in frequencies of more than 1% and some in frequencies of less than 1%; several never have been found among our patients.

For establishing comparisons between various stimulus intensities, the so-called vestibular stimulus response intensity comparison (VESRIC) was used. For this test, the caloric warm response is defined to be stimulated with the weaker stimulus acting on one inner-ear receptor. It is a ramp-shaped stimulus. The perrotatory stimulus, however, is a step-shaped stimulus and is applied simultaneously to the right and to the left inner-ear vestibular apparatus. Therefore, this stimulus is, by definition, stronger. In comparing the test results of the weaker supraliminal caloric warm test with a stronger supraliminal perrotatory nystagmus response, an individual VESRIC can be established. By doing so, we can find out how individual vestibuloocular circuitries respond to a change of stimulus intensity. The most frequent combinations of the VESRIC patterns for both ears are also given for the patients in this study in a table of trinary test results.

For testing the vestibuloocular system from both ears (i.e., the right inner ear and left inner ear), the patient sits on an electronically programmable rotatory chair that is accelerated. The test is called the *rotatory intensity-damping test* (RIDT) of Claussen. The patient is also connected to seven electrodes around the eyes for a five-channel ENG and electrodes at the limbs for a three-channel ECG and then is connected to amplifiers and the recording devices. The test results of the RIDT are measured from the registration and thereafter are plotted numerically and graphed into the L-chart of the RIDT.

The hearing pathways are analyzed by means of pure-tone audiometry of the hearing threshold in all patients. In this analysis, we always add the pure-tone analysis of the discomfort threshold for measuring the audiometric dynamics of the inner ear. Tinnitus is masked according to frequency and intensity. The social hearing of the test persons is investigated by means of standard speech audiometry, with hearing threshold for numbers and monosyllable words. The results of our investigations of depressive patients are transferred into the spreadsheets of the Microsoft Excel program. There the data are analyzed according to the capabilities of modern Excel programs, using numerical statistics and graphical displays.

RESULTS

For this study, we examined a group of 134 patients (53 male [39.55%], 81 female [60.45%]) who were enrolled for care at our center and who complained of depressive disorders in relation to neurootological complaints (e.g., vertigo, dizziness, hearing loss, and tinnitus). According to our statistics, we have complete individual descriptions within the patient files. A NODEC comprising a list and a statistical analysis of the entire sample of 134 patients has been established. Such statistics as age, height, and weight have been recorded to describe the group of persons within the study (Table 1). The subjective history of the patients in this study having depressive disorders in relation to their aforementioned neurootological complaints and the duration of their vertigo attacks, visual disturbances, hearing loss, and tinnitus were systematically catalogued. Also, we evaluated basic mechanisms of underlying pathology, such as former traumas and cardiovascular disorders and reports about phobias. The results of these evaluations appear in Table 2.

The results of the polygraphic ENG together with the three-channel ECG represented the experimental investigations using the caloric test (Table 3). Figure 1 shows a list of the most frequent butterfly charts. The results of the VESRIC are shown in Figure 2 with respect to the 12 most frequent patterns (of 81 possible VESRIC codes) describing the cybernetic status of vestibuloocular pathway regulation.

CCG served for objectively and quantitatively measuring the responses of the vestibular spinal standing test and stepping test (Table 4). The investigation of the hearing pathways was evaluated by speech audiometry with respect to the three most socially important audiometric parameters (Fig. 3).

DISCUSSION

The medical term *depression* is not easy to pinpoint in every diagnosis. In our study, we adopted the diagnosis from other physicians who investigated the patients prior to our evaluations. Depression is a state of depressed mood characterized by feelings of sadness, despair, and discouragement. Depression ranges from normal feelings of "the blues" through dysthymia to major depression. It in many ways resembles the grief and mourning that follow bereavement. Often, it engenders feelings of low self-esteem, guilt, and somatic symptoms, such as eating and sleep disturbances.

Endogenous depression is any depression that is not reactive. The term implies that some intrinsic biological process rather than environmental influences is the cause. Reactive depression is precipitated by a stressful

Table 1. Biographical Data of 134 Neurootological Patients After Experiencing Depressive Disorders

				Blood Pressure	
	Age (yr)	Height (cm)	Weight (kg)	Systolic (mm Hg)	Diastolic (mm Hg)
Mean	48.82	166.87	70.88	134.37	88.57
SD	12.15	7.70	11.04	34.47	15.46

SD = standard deviation.

Table 2. Subjective History of Study Patients' Pathological Complaints (n = 134)

Complaint	Percentage of Patients Affected
Vestibular symptoms	
Instability	55.22
Blackout	25.37
Falling	29.85
Rotating	38.81
Lifting	8.21
Rocking	52.99
Vegetative or nausea symptoms	
Collapse	10.45
Vomitus	16.42
Retching	2.24
Malaise	36.57
Sweating	17.16
Duration of single vertigo attack	
Days	5.97
Hours	14.93
Minutes	34.33
Seconds	35.82
Visual disturbances	
Oscillopsia II	15.67
Amaurosis	0.75
Oscillopsia I	4.48
Double vision	9.70
Loss of acuity	65.67
Hearing symptoms	
Ear surgery	4.48
Deafness	7.46
Hearing loss	55.22
Tinnitus	52.24
Former head and neck traumas	
Home accident	15.67
Sports accident	1.49
Working hazard	5.22
Traffic accident	12.69
Cardiovascular background disorders	
Cardiac insufficiency	17.16
Arteriosclerosis	2.24
Hypotension	27.61
Hypertension	17.16
Subjective reports about phobias	
Anxiety at downward gazing	1.49
Agoraphobia	1.49
Phobia within groups	1.49
Suffocation	0.75
Claustrophobia	1.49
Anxiety	5.97

Table 3. Electronystagmography and Electrocardiography (ECG) Data of 134 Patients with Depressive Disorders

	Nystagmus Analysis in Caloric Tests (Hz)						ECG Analysis in Caloric Tests (rate/min)				
	Sp. Ny. Right	Sp. Ny. Left	44°C Right	44°C Left	30°C Right	30°C Left	Sp.	44°C Right	44°C Left	30°C Right	30°C Left
Mean	0.58	0.44	1.35	1.51	1.54	1.55	81.25	81.02	80.87	80.32	81.38
SD	0.53	0.42	0.66	0.60	0.67	0.75	14.68	15.58	15.31	14.91	14.48

SD = standard deviation; Sp. Ny. = spontaneous nystagmus; Sp. = spontaneous recording.

life event. Even a reactivated depression is characterized by a sad or hopeless mood, pessimistic thinking, a loss of enjoyment and interest in one's usual activities and pastimes, reduced energy and vitality, increased fatigue, slowness of thought and action, loss of appetite, and disturbed sleep and insomnia.

In one form of dysthymic disorder, "masked depression," either the patient or the physician may not readily recognize the mood disturbance. The patient complains of chronic symptoms of a somatic nature, insomnia, and loss of pleasure in everything. Many patients presenting with repeated complaints of physical symptoms to physicians who are not psychiatrists are, in fact, suffering from chronic depression.

Tinnitus is a subjective complaint. The same level of tinnitus may be described by one patient as intolerable and by another as barely noticeable. Neurootological experience shows that persons with severe tinnitus experience excessive stress. As a result, patients may demonstrate a cluster of hysterical defenses or a serious degree of depression. Tinnitus thus can be a stress-related disorder. Just as a state of stress can be responsible for the onset or exacerbation of a tinnitus episode or even of disequilibrium, tinnitus can incite or exacerbate stress. Thus, affected patients can get into a vicious cycle: This applies also to patients suffering from vertigo or hearing loss.

By means of our special neurootological investigations and methods, we tried to control for various aspects of the characteristics of the selected 134 patients in relation to depressive disorders. The patients' mean age is in the latter part of the fifth decade of life. Comparison of height and weight revealed a tendency toward a slight overweight (see Table 1). Among the vertigo symptoms, the feeling of instability is the leading subsymptom, occurring in more than 55%, followed by the feeling of rocking (as if the patient were in a boat) in approximately 53%. Remarkable is that the subsymptom of a lifting sensation (as if riding on a flying carpet and the like) statistically occurs nearly twice as frequently in average neurootological data banks (8.2%).

Among the nausea symptoms, the weaker nausea signs, such as malaise without vomiting, is much more

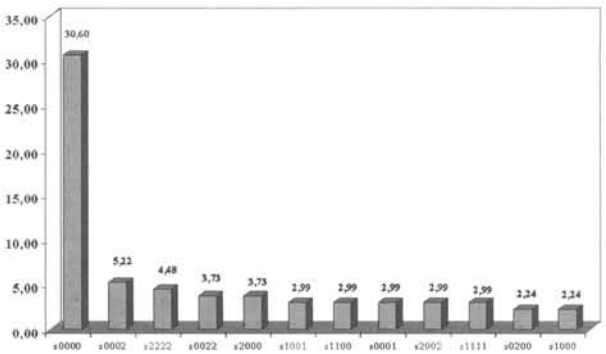

Figure 1. Caloric butterfly test sorted according to the occurrences of the 12 most frequent of 81 possible patterns, which can be graphed or expressed by trinary coding (0 = normal; 1 = inhibited; 2 = disinhibited) with four digits (pos. I = right warm; pos. II = right cold; pos. III = left warm; pos. IV = left cold).

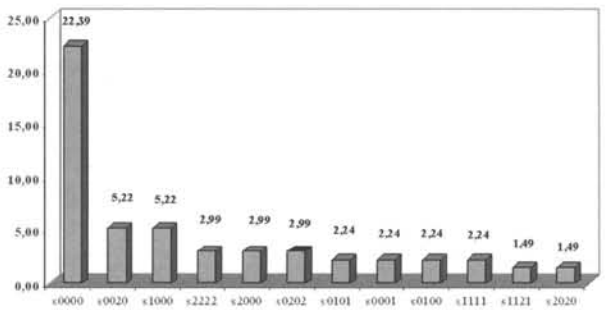

Figure 2. Dynamic vestibular stimulus response intensity comparison (VESRIC) sorted according to the occurrences of the 12 most frequent patterns. Combining the caloric with the perrotatory part of the rotatory intensity-damping test (RIDT) with the caloric warm response, we can establish the so-called VESRIC. When combining the right beating nystagmus and the left beating nystagmus characteristics, we get the charts of the VESRIC, which can be graphed or expressed by trinary coding (0 = normal, 1 = inhibited, 2 = disinhibited) with four digits (pos. I = right warm; pos. II = perrotatory right; pos. III = left warm; pos. IV = perrotatory left). The test results can be categorized into three groups with three subdivisions within each group. The first group contains the parallel behavior. The second group contains the so-called recruiting phenomena. Within the third group are the so-called decruitment phenomena of VESRIC.

Table 4. Ultrasound Computerized Craniocorpography (CCG) Data of 134 Patients with Depressive Complaints

	Stepping CCG				Standing CCG	
	Displacement (cm)	Lateral Sway (cm)	Angular Deviation (degrees of angle)	Body Spin (degrees of angle)	Longitudinal Sway (cm)	Lateral Sway (cm)
Mean	78.44	10.57	−3.95	−5.08	7.17	4.85
SD	36.70	5.04	44.42	74.46	5.21	2.97

SD = standard deviation.

frequent than in average NODEC samples. Also, the number of subjectively reported collapses (more than 10%) is high. The duration of single vertigo attacks shows a tendency to longer episodes; the vertigo does not occur as a momentary flash.

As regards visual disturbances, we noted an unusually high incidence of visual abnormalities, such as illusions of movements (oscillopsia) and, especially, double vision. Among the hearing symptoms, some 52% of the sample complained of tinnitus. Thus, tinnitus together with vertigo are important subjective complaints within this group of 134 patients complaining of depressive disorders.

The patients' case histories show a startling statistic: Home accidents outnumber traffic accidents in this specific group, and equally remarkable is that the relation between hypotension (27.61%) and hypertension (17.16%) is the reverse of that normally found in patients of this age (usually around 50%). Among the reported phobias, general anxiety occurred frequently, rivaling the occurrence of all the other subsymptoms.

An evaluation of the caloric vestibuloocular nystagmus test showed that the central nystagmus frequency (see Table 3) had a tendency toward higher values, indicating an increased lability of this vestibuloocular regulation process. ECG analysis revealed that downregulation of the ECG under the influence of caloric vestibuloocular stimulation is very low, if not abolished, in comparison to the situation during spontaneous recording (see Table 3). This tendency is underscored in Figure 1, in evaluating the 12 most frequent caloric butterfly patterns in trinary coding. Of 81 possible caloric butterfly patterns, the most frequent is the normal pattern in approximately 30%. This means, conversely, that 7 of 10 patients have a pathologically dysregulated vestibuloocular caloric response. In the details of the list, we find in first position the normals (s0000), followed by s0002, s2222, s0022, s2000, and s1001, five patterns with typical central disturbances mainly of dysregulations within the brainstem. Pattern s2002, lying in pathological position eight in the ranking, points toward a supratentorial dysregulation in the temporal lobe.

In analyzing the cardiac responses during perrotatory and postrotatory stimulations with rotations toward the right and left, we again observe (Fig. 4) that downregulation of the heart rate is incomplete or lacking with respect to the sitting spontaneous situation. Conversely, upregulation in the sense of a sympathetic tonus during the postrotatory nystagmus phase is much too small. All this points to a significantly reduced vegetative reactivity within this group of patients.

In combining results of the caloric test with ipsidirectional test results of the rotatory intensity-damping

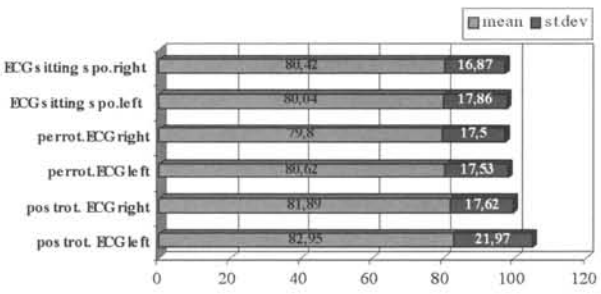

Figure 3. Speech audiometry evaluated according to the three important parameters: recognition of numbers and of words and loss of discrimination for the left ear. The parameters are statistically evaluated with respect to mean and standard deviation.

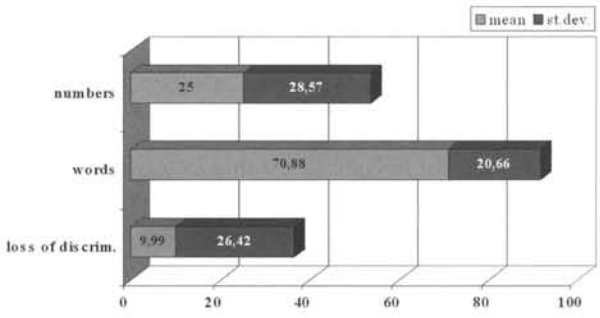

Figure 4. Per- and postrotatory electrocardiogram (*ECG*) analysis during the experimental vestibuloocular investigation rotatory intensity-damping test of 134 patients suffering from depressive disorders. The parameters are evaluated according to mean and standard deviation.

during the perrotatory phase (see Fig. 2) in the VESRIC, we find only 22.39% of normal reactions within the tests of the vestibuloocular nystagmus–regulating system. The third pathological pattern (s2222) points toward a generalized central disinhibition. The second pathological pattern (s1000) exhibits a peripheral vestibular recruitment. However, the patterns s0020, s2000, s0101, s0001, and s0100 reflect typical decruitment behaviors. Such an accumulation of decruitment phenomena in a ranking of the most frequent VESRIC patterns is very unusual. It points toward a labile regulation disturbance within central pathways, which easily can fall into states of blockades.

Evaluation of the stepping CCG (see Table 4) exhibits a reduced displacement (a little lateral sway, as if the patients are afraid to move too much and too far). All in all, the stepping test is pathological in some 70% of patients. During the standing test, the longitudinal head sways are much longer than the lateral sways. Speech audiometry shows in the right and in the left ear a major spread for the loss of discrimination.

CONCLUSION

In summarizing the results of this study, we came to the conclusion that some prominent findings include a high occurrence rate for the subjective complaint of instability and the sensation of rocking in the field of vertigo and a very high score for malaise in nausea. The subjective impressions of oscillopsia and double vision are also higher than in other groups of patients with neuro-otological complaints. More than one-half of all patients complained of tinnitus. We saw a high incidence of home accidents in this study group, which is contrary to the usual occurrence of traffic accidents. A reverse relation also exists between hypotension and hypertension. The vestibuloocular nystagmus tests exhibited a high rate of occurrence of centrally deregulated caloric butterfly patterns and, at the same time, a rigidity with respect to the usually occurring vagal heart-regulating reflexes. This also repeats within perrotatory and postrotatory heart rate regulation.

When taken together, the vestibuloocular nystagmus responses due to monaural (caloric) and binaural (perrotatory) stimulations, the so-called decruitment phenomena, are unusually frequent in our statistics, which suggests a central tendency in the tested persons to overshoot downregulations in their vestibuloocular nystagmus.

The CCG evaluation of the stepping test also exhibits a restriction in movement as to longitudinal displacements. There, we find only minor incidences of broad sway patterns of the cerebellar pontomedullary dysregulation type. In comparing this with vestibuloocular nystagmus dysregulation, we were led to conclude that the majority of pathological processes must occur in the upper brainstem together with supratentorial structures.

The results of this study are being followed by further investigations of expressive movement patterns by means of a modern CCG evaluation technique (i.e., the human space trail [Claussen's HUSPATRAC]).

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