Comparing Neurootological Complaints in Patients at the End of Their Professional Lives (51–60 Years) with Those During the First Phase of Retirement (61–70 Years)

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Abstract: Geriatrics defines the branch of medicine that treats all problems peculiar to old age and the aging, including the clinical problems of senescence and senility. In the full chain of years of the human life, a special period is humans' last decade of professional life (i.e., 51–60 years) and their first decade of retirement (i.e., 61–70 years). For this study aimed at comparing neurootological complaints of persons in this period of their lives, we examined large samples of European neurootological patients: Group A consisted of 1,965 persons aged 51–60 years, and group B consisted of 1,032 persons aged 61–70 years. Of the 11 vertigo and nausea symptoms evaluated, group A demonstrated 2.68 signs and group B 2.49 signs per individual. Acoustic subjective symptoms of tinnitus were exhibited in 55.42% of group A patients, and hearing loss was present in 63.92% of these patients. In group B, 52.62% of patients exhibited tinnitus, and 68.31% of patients had hearing loss. Our experimental neurootometric investigations exhibited the following rates of abnormal test findings in group A: butterfly calorigrams, 71.86%; stepping craniocorpography, 72.01%; and pure-tone audiometry of bone conduction, 37.66% in the right and 47.07% in the left ear. Among group B patients, abnormal test findings were noted as follows: butterfly calorigrams, 69.86%; stepping craniocorpography, 74.03%; and pure-tone audiometry of bone conduction, 44.57% in the right and 55.43% in the left ear.

Key Words: audiometry; craniocorpography; electronystagmography; neurootometric analysis; old age, retirement; vertigo

Gerontology is a scientific specialty concerned with old age, emphasizing the medical, social, and behavioral aspects of aging. Although aging is a lifelong process and varies in its effects from individual to individual, old age formerly was commonly defined as beginning at the age of 65 years. However, currently in many Western societies (e.g., Germany, France, Sweden) the age of retirement is observed to be much lower than 65. In Germany, people usually begin to retire at between 50 and 60 years of age. We can see a steady drop in the number of people still in the workforce during what ought to be the first phase of retirement (generally 61–70), given that, according to laws, people are allowed to retire during those years.

Modern gerontology informs society about how elderly persons are treated within that society and how the elderly deal with the inevitable problems of aging, particularly those involving health and income. Health

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problems normally include losses of hearing, eyesight, and memory, and the increased likelihood of chronic diseases. The losses are gradual and proceed at different rates for each individual. Modern neurootology must deal, in the advanced-age population of patients, with such conditions as presbyvertigo, presbydystaxia, presbyacusia, presbytinnitus, presbygeusia, presbyopia, and presbyosmia.

This study is part of our ongoing neurological research of some 30 years in an effort to understand the aging process from the viewpoint of human neurosensory capacities, especially toward measuring age-related changes in neurosensory reactions. However, we admit that our research is based on patients who come to our institutions for neurootological treatment and diagnosis.

PATIENTS AND METHODS

We chose two samples of patients from our neurootological data bank system (NODEC): group A (N = 1,965), which comprised patients aged 51–60 years, and group B (N = 1,032), which consisted of patients aged 61–70 years. Each of these individuals completed a questionnaire that registered the patient's complaints of vertigo, nausea, hearing problems (e.g., hearing loss, ear surgery, and tinnitus), visual disturbances, taste and smell disturbances, disturbances of the facial nerve or the trigeminal nerve, major disease backgrounds (e.g., trauma, cardiovascular disorders), metabolic diseases (e.g., diabetes mellitus), kidney diseases, and so on. Any ongoing drug treatment also was recorded. All patients were questioned with respect to life habits, such as smoking and alcohol use.

All patients of both groups underwent an ear, nose, and throat inspection and a systematic neurootometric network analysis of equilibriometric pathways and of hearing pathways. We recorded eye movements regularly by means of polygraphic five-channel electronystagmography. At the same time, the patients carried electrodes on their extremities for recording vegetative reactions via electrocardiography (ECG). The rotatory tests proved to be a stronger vestibuloocular test. We used the so-called rotatory intensity-damping test (RIDT) of Claussen, which contains a perrotatory part with supraliminal stimulus and a postrotatory part when braking the rotating chair with a supramaximal stimulus. The perrotatory stimulus amounted to 3 degrees/sec^2 and the postrotatory stimulus to 270 degrees/sec^2.

The so-called vestibular stimulus intensity comparison (VESRIC) can be established. Both responses—the caloric warm response and the perrotatory response—come with characteristics located within the specific normal ranges, above the specific normal ranges (disinhibition), or below the specific normal ranges (inhibition). By testing the retinoocular sensorimotor pathways, we deduce, on the one hand, the optokinetic tracking test and, on the other, optokinetic nystagmus (which, however, is not evaluated in this study).

For testing the stability or instability of humans within different feedback loops of the vestibular spinal pathways, we applied craniocorpography [1], which records the marker positions on head and shoulders. The images received by the light-tracing method of craniocorpography (CCG) or ultrasonographic CCG are radar image patterns of head and trunk floating through time and space, as these recordings classically are taken from above.

The test procedures forming the basis for investigating patients by CCG are the standing Romberg test and the stepping test of Unterberger and Fukuda. The hearing pathways between the inner ear and the temporal lobe are analyzed by a series of different audiometric tests.

In several cases, patients reported to us that they were suffering from tinnitus. At that point, we tried to mask the underlying tinnitus by means of a specific audiometric masking system using frequency and intensity as parameters for measurements. For this study, all the test results were transferred into a special Excel spreadsheet (Microsoft). There, the data were assembled, analyzed, and submitted to numerical statistics. The results were provided in numerical lists and graphic plots, from which we gleaned a limited selection for this study.

RESULTS

The two samples of neurootological patients randomly selected from NODEC were grouped into those between the ages of 51 and 60 years (group A; N = 1,965) and those between the ages of 61 and 70 years (group B; N = 1,032). Thus, a total of 2,997 neurootological patients were included in this clinical survey. Complete individual descriptions of these patients are contained within patient files (Table 1).

Age, height, weight, and blood pressure distribution of a sample of 2,997 neurootological patients in the chosen two age groups were displayed after calculating the mean and the standard deviations of the distributions. The blood pressure amplitude widened with increasing age.

Regarding the history of patients suffering from geriatric complaints, we found the parameter frequencies outlined in Table 2. A comparison between patients in group A and those in group B reveals a slight decrease in the vertigo complaints and of the vegetative or nausea symptoms in the older group. The durations of the single vertigo attacks was slightly reduced with increasing

Table 1. Biographical Data of 2,997 Neurootological Patients Suffering from Geriatric Complaints

			Age (yr)		Height (cm)		Weight (kg)		Systolic Blood Pressure (mm Hg)		Diastolic Blood Pressure (mm Hg)	
Patient Group	**No. of Men**	**No. of Women**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
A: 51–60 years old (n = 1,965)	1,041 (34.74%)	924 (30.83%)	55.16	2.78	166.68	11.68	72.51	11.96	139.79	28.47	86.23	16.77
B: 61–70 years old (n = 1,032)	511 (17.05%)	521 (17.38%)	64.77	2.76	166.02	9.45	70.41	12.27	153.96	29.42	87.15	12.42
Total (N = 2,997)	1,552 (51.79%)	1,445 (48.31%)										

SD = standard deviation.

Table 2. Historical Data of 2,997 Neurootological Patients Suffering from Geriatric Complaints

Symptom	Group A	Group B
Vestibular symptoms		
Rocking	44.78	49.42
Lifting	5.75	5.14
Rotating	42.80	35.08
Falling	25.95	24.42
Blackout	23.97	19.48
Instability	44.68	44.86
Vegetative or nausea symptoms		
Sweating	13.89	12.11
Malaise	34.45	31.98
Retching	4.63	3.00
Vomitus	18.63	16.47
Collapse	8.91	7.46
Duration of single vertigo attacks		
Seconds	40.20	38.76
Minutes	29.16	29.94
Hours	12.11	12.02
Days	4.27	4.46
Weeks	0.56	0.10
Months	0.46	0.48
Visual disturbances		
Loss of acuity	72.72	73.45
Double vision	4.48	4.36
Oscillopsia I	4.58	4.07
Oscillopsia jerking	0.97	1.36
Amaurosis	1.42	1.65
Oscillopsia II	13.64	11.72
Hearing symptoms		
Tinnitus	55.42	52.62
Hearing loss	63.92	68.31
Deafness	7.58	9.11
Ear surgery	6.92	5.23
Humming	3.21	1.55
Whistling	7.28	3.39
Sizzling	1.32	1.36
Noise trauma	3.51	3.39
Cardiovascular background disorders		
Hypertension	17.86	21.71
Hypotension	27.07	19.77
Arteriosclerosis	0.92	2.03
Cardiac insufficiency	16.49	22.00
Myocardial infarction	2.44	2.71

age. A minor decrease in the special visual complaints among the older patients can be found, except for visual acuity problems of the presbyopic type. Hearing complaints remain nearly unaltered between the two age groups. Hypotension was lower in group B than group A, whereas hypertension and cardiac insufficiencies both were increased in frequency among patients in group B as compared to those in group A.

The results of the vestibuloocular pathway tests are represented in Table 3. Comparison between the averages of the central frequencies of spontaneous nystagmus in

Table 3. Statistical Evaluation of the Vestibuloocular Caloric Test with Electronystagmography and Electrocardiography (ECG) Recording of 2,997 Neurootological Patients Who Experienced Geriatric Complaints

	Group A (51–60 yr; n = 1,965)		Group B (61–70 yr; n = 1,032)	
	Mean	**SD**	**Mean**	**SD**
Caloric test (frequencies in Hertz)				
Spon. Ny. right	0.58	0.45	0.62	0.48
Spon. Ny. left	0.45	0.42	0.44	0.41
44°C right	1.29	0.65	1.27	0.62
30°C right	1.49	0.68	1.44	0.65
44°C left	1.38	0.65	1.34	0.60
30°C left	1.49	0.73	1.44	0.72
ECG/min.				
Spontaneous ECG	78.11	13.61	76.58	13.48
44°C right	77.40	14.52	76.16	13.29
44°C left	77.34	14.00	76.04	13.34
30°C right	77.41	13.96	76.05	14.72
30°C left	77.55	14.23	75.93	13.75
RIDT				
ECG rate sitting position	77.05	13.31	73.63	12.75
Perrotatory ECG left	76.53	14.18	73.39	12.20
Perrotatory ECG right	76.17	14.24	72.77	12.71
Postrotatory ECG right	77.39	13.48	74.04	12.68
Postrotatory ECG left	77.27	14.52	74.50	11.60

ECG = electrocardiography; RIDT = rotatory intensity-damping test; SD = standard deviation; Spon. Ny. = spontaneous nystagmus.

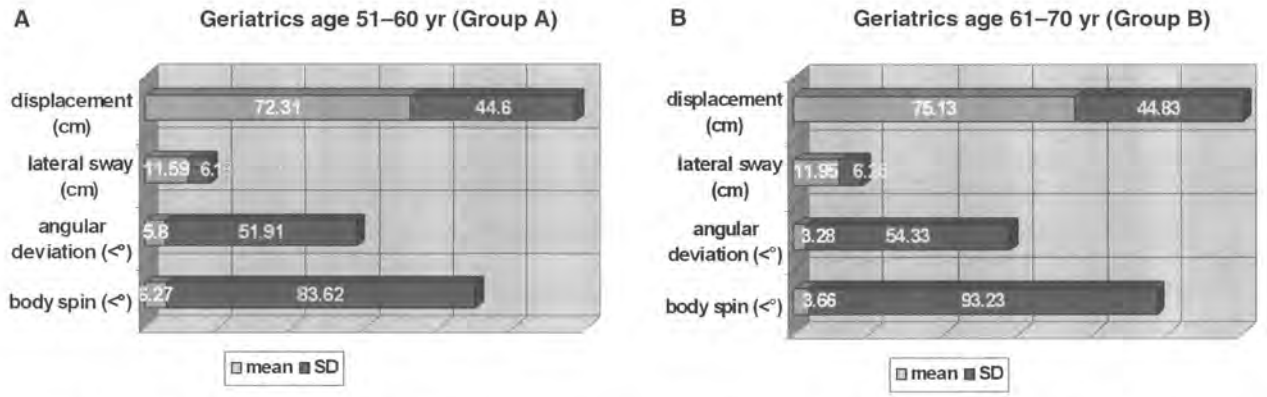

Figure 1. Four principle parameters of the stepping craniocorpography (*CCG*) test, statistically evaluated with mean and standard deviation of 2,997 neurootological patients in (A) group A and (B) group B. The important parameter, lateral sway, which is significant for central disorders, does not differ. However, the values for angular deviation and body spin, which are typical for peripheral lesions, are deteriorating in the older subjects (group B).

the supine position do not show a clear trend in either group. However, caloric responses exhibit a trend toward lower values in group B for all the means and for all the standard deviations. Comparisons between the averaged ECG heartbeat rates show a lowering trend of the spontaneous and caloric stress ECG from group A to group B. Within the groups, an experimental vagal heartbeat reduction is visible as well. The second section of the vestibuloocular sensorimotor analysis was based on the RIDT. Per- and postrotatory nystagmus analyses were performed during the experimental vestibuloocular investigation with ECGs. In comparison to

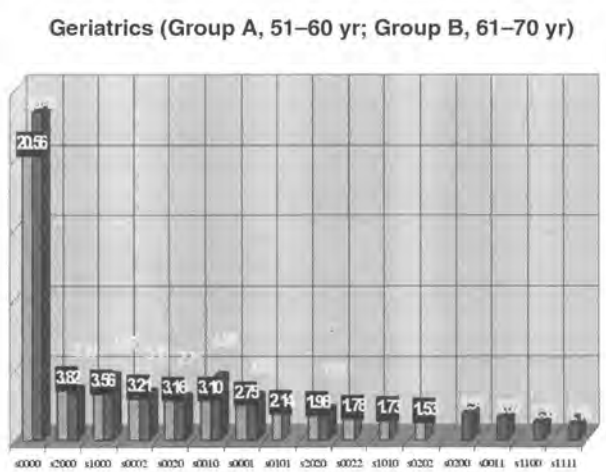

Figure 2. Combining the caloric warm response with the perrotatory part of the rotatory intensity damping test, we have established the so-called vestibular stimulus response intensity comparison (VESRIC). When combining the right-beating nystagmus and the left-beating nystagmus, we get the charts of 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 and the second group the so-called recruiting phenomena. Within the third group are the so-called decruitment phenomena of VESRIC. The bar chart exhibits an overlay of 60% of the 10 most frequent VESRIC patterns between groups A and B. More normal subjects are found in group B. The most frequent matching pathological patterns all belong to vestibular recruitment or decruitment groups.

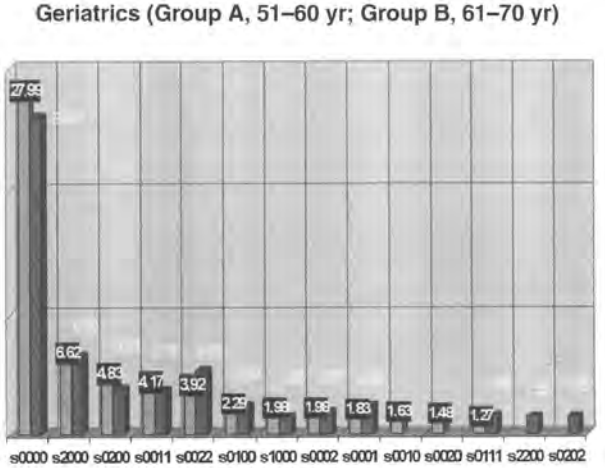

Figure 3. The craniocorpography (CCG) stepping test sorted according to occurrences of the 10 most frequent patterns, which can be graphed or expressed by trinary coding (0 = normal, 1 = inhibited, 2 = disinhibited) with four digits: Pos. I = displacement; Pos. II = lateral sway; Pos. III = angular deviation; Pos. IV = body spin. The bar chart demonstrates that there are more normal subjects in the younger group (group A) than in group B. Among the 10 most frequent trinary- coded stepping CCGs (of 81 possibilities), 80% of the patterns match between the two groups. The pattern "s0200" shows that there is more pure central pathology in group A than in group B. The sum of the two patterns "s011" and "s0022" exhibits that there is a purer peripheral pathology in group B than in group A.

Table 4. Statistical Evaluation of Speech Audiometry in 2,997 Neurootological Patients Who Experienced Geriatric Complaints

	Group A (51–60 yr; n = 1,965)		Group B (61–70 yr; n = 1,032)	
	Mean	**SD**	**Mean**	**SD**
Speech audiometry, right				
Numbers	23.1	24.22	27.57	25.39
Words	73.36	20.49	78.27	22.41
Loss of discrimination	11.34	24.96	14.51	27.57
Speech audiometry, left				
Numbers	26.86	27.16	30.76	26.65
Words	75.73	20.75	80.51	20.69
Loss of discrimination	14.23	28.96	19.33	30.52

the spontaneous ECG, the heartbeat responses during supraliminal stimulation showed a typical vagal heartbeat rate reduction in both groups and reduced values from group A to group B. The heartbeat rate under the influence of a supramaximal stimulus exhibits elevation (synesthesia effect) in group B but less than that seen in group A (Figs. 1–3).

The results of the acoustic analysis of social hearing by means of speech audiometry are given in Table 4. The trend of values accounting to the paired difference between group A and group B can illustrate the deterioration that occurs with advancing age.

DISCUSSION

Statistical evaluation in our neurootological study of 1,965 patients aged 51–60 years (group A) and of 1,032 patients aged 61–70 years (group B) applied also to gerontological aspects. Geriatrics is the branch of medicine that treats all problems peculiar to old age and aging and includes the clinical problems of senescence and senility. *Aging* refers to the gradual changes in the structure of any organism that occur with the passage of time, that do not result from disease or other gross accidents, and that eventually lead to the increased probability of death as the organism grows older.

Closer examination of the details of the two groups reveals that the gender distributions differ greatly. The younger group (A) consisted of nearly 53% male patients, whereas in group B (the older patients), the females predominated, accounting for nearly 50.5% of the group population. During an active professional life, men seem prey to the stress factor such that more of them search for specific neurootological help. The other identification factors as shown in Table 1 exhibit similar heights and weights in the two groups. However, the systolic blood pressure is lower and diastolic blood pressure is higher in group A. These findings demonstrate that group A patients' cardiovascular dynamics are tighter. With advancing age, the spread between the two blood pressure parameters—systolic and diastolic—widens, so that the systolic blood pressure increases while the diastolic blood pressure diminishes. This loosening of the cardiovascular dynamics is discussed later, together with the results of simultaneous ECGs during vestibuloocular stimulation.

Concerning vestibular and equilibrium dysregulation, we found that the incidence rate for subsymptoms of vertigo was lower in group B than group A. Such important parameters as rotating vertigo, falling tendency, blackouts, and all nausea symptoms also followed this trend. We found the duration of a single vertigo attack was shorter in group A than in group B patients.

Visual disturbances (e.g., presbyopia) and general hearing loss (e.g., presbyacusia) increased from group A to group B, which demonstrates the natural trend of the impact of aging on basic human sensory functions. Natural parameters that express disturbances within the visual pathways (e.g., double vision and various kinds of oscillopsia) are reduced from group A to group B. The same holds true for the symptomatology of tinnitus in the field of hearing.

With respect to the subjective symptoms of vestibular, hearing, and vision disturbances, we observed that a principal trend of aging is an increase in typical symptoms, which are recorded in the history. As regards other symptoms that express functional disorders and are influenced by stress, nutrition, and other factors, we observed that after the fifth decade of life, our patients subjectively and statistically appear to be recovering.

In applying objective and quantitative sensorimotor tests (e.g., electronystagmography), we observed no typical trend with respect to spontaneous nystagmus between group A and B individuals. The nystagmus frequencies were calculated in Hertz from the heartbeat rate during 30 seconds into nystagmus frequencies. However, as regards the experimental responses to the nystagmus frequencies, we observed in all four caloric reactions (taking into account means and standard deviations) that the responses were lower in group B than in group A patients. The same effect can be seen in a comparison of the simultaneous ECG responses recorded with or without the stimulus stress of the caloric tests (see Table 3). This downregulation of the heartbeat rate in mean and standard deviation between the younger (group A) and older patients (group B) was a complete trend and was in accordance with the patients' subjective reports (as evidenced in their histories).

In adding the results of binaural vestibuloocular tests

on the rotatory chair, we found an analogous behavior between the perrotatory nystagmus and heartbeat rates recorded during the perrotatory phase of the RIDT. As for caloric stimuli, the perrotatory stimulus had a supraliminal effect, whereas the postrotatory stimulus, which was supramaximal, did not drive the responses down. While supraliminal stimuli exhibit vagal reaction, the direction of the responses during and after the postrotatory supramaximal stimuli pointed toward a sympathetic trend.

Concerning the vestibuloocular tests, we used a ranking for synoptic test schemes that was transferred for the caloric butterfly test and for the VESRIC with a statistical ranking scheme. Obviously, the amount of normal butterflies was increased in group B (the older patients). In the dynamic VESRIC, we observed that the 10 most frequent typical patterns exhibit a rate of matching of only 60%. However, we observed also in this case in the older patient group more completely normal patterns than in the younger group. These two comparisons of synoptic possibilities of reactions in the butterfly chart or the VESRIC exhibit a certain amount of recovery with respect to the total samples in group B with respect to group A.

The second pathway of sensorimotor function, which we intensively investigated in the two groups, was the vestibulospinal pathway. Statistically, we evaluated the most sensitive vestibular test, the stepping test of Unterberger-Fukuda, which was recorded by means of CCG. In terms of the fundamental parameters, we observed in group A (see Fig. 1) that, as compared with group B (see Fig. 2), the most typical parameter for central pathology—lateral sway—was nearly unaltered in mean and standard deviation. However, the more typical parameters for monolateral or peripheral vestibulospinal diseases—angular deviation toward the right or left or body spin toward the right or left—showed an increase. In these cases, the difference was expressed in the standard deviation toward more pathological values in the older group (B) than in the younger group (A). In looking into the trinary coded and synoptically compressed data into a four-parameter figure of the stepping-test CCG (see Fig. 3), we found among the 10 most frequent patterns of 81 possibilities 80% coverage and matching between the most frequent patterns. There we observed that the number of normal responses in the vestibulospinal field was more frequent in the younger (group A) than in the older patients (group B). However, in considering the pathological patterns, we found more central disturbances (type s0200) in the younger group (A), as opposed to the more frequent occurrence rates of peripheral or unilateral pathological findings (trinary codes s0011 and s0022) in the older group (B). Vestibulospinal pathway lesion seemed to give other important additional parameters of pathology. In the area of vestibulospinal pathway pathology, those in the older group (B) showed a trend toward more pathological findings than patients in the younger group (A).

CONCLUSIONS AND COMMENTS

All in all, we can conclude from our data that group A (patients aged 51–60 years) demonstrated several additional factors that caused these patients to appear more diseased and stressed than those in the older patient group. Nonetheless, a great many changes caused by old age emerge by exogenic or endogenic noxae that have an effect over years. Among these are angiocardiopathies, diabetes mellitus, long-term abuse of alcohol and nicotine, frequent stress situations and, last but not least, unwholesome nutrition. Hemorrhagic capillary toxicoses as defined by arteriosclerosis are the result. These, in turn, cause deterioration in the function of the sensory organs. However, the changes occur in great variety and at different stages of life. Some relatively old people are in full possession of their mental strength and have an intact vestibular and audiovisual system, whereas others in their fourth decade or younger already exhibit reduced powers of concentration, responsiveness, and memory.

Concerning the hearing pathways, objective tests are valuable. Age has a slight effect on both latency and amplitude of auditory brainstem evoked potentials (ABEP) wave V. Amplitude decreases and latency increases as a function of age. In subjects with sensorineural hearing loss, the effects of age on latency and amplitude appear to be smaller. Age must be routinely considered in the generation of normal values for the ABEP.

Senility is a general term describing symptoms of degenerative central nervous system processes associated with age. Historically, a distinction was made between presenile and senile dementia. Both are characterized by progressive dementia and dysphasia. The symptom of tinnitus is a potential complication of senility.

Some movement disorders take place in the elderly (e.g., restless leg syndrome, a disorder characterized by disagreeable leg sensation occurring usually prior to sleep onset and causing an almost irresistible urge to move the legs). Sleepwalking consists of a series of complex behaviors initiated during slow-wave sleep and resulting in walking during sleep. Sleep starts are sudden brief contractions of the legs (sometimes also involving the arms and head) that occur at sleep onset. Sleep talking is the utterance of speech or sounds during sleep without simultaneous subjective detailed awareness of the event. Sleep bruxism is a stereotyped movement disorder characterized by grinding or clench-

ing of the teeth during sleep. Rapid-eye-movement (REM) sleep behavior disorder is characterized by the intermittent loss of REM, sleep electromyographic atonia, and the appearance of elaborate motor activity associated with dream mentation. For perhaps the last 10 years, we have even been able to analyze these phenomena by applying our new HUSPATRAC (human space trail–Claussen) program.

Postural instability and falls in the elderly represent a major health care concern. Each year, between one-third and one-half of people older than age 65 experience at least one fall. Falls are the leading cause of injury in this population and the primary cause of accidental death in patients older than 85. Elderly fallers often exhibit low-amplitude high-frequency movements on Romberg examination. Prevention and early rehabilitation and treatment can be influenced by our recent ultrasonographic CCG tests together with HUSPATRAC.

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