Complex Diagnostics and Therapy of Patients with Neurocirculatory Asthenia by Biological Control of Heart Rate

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A method based on the use of heart rate as the object of voluntary control and regulation by biological feedback was elaborated for complex diagnostics and therapy of patients with neurocirculatory asthenia. Functional therapy with biological feedback (12-15 procedures) corrected psychosomatic disorders and allowed us to decrease therapeutic doses of drugs. The effects of biological feedback on functional reorganization of regulatory mechanisms at the level of corticohippocampolimbic structures of the brain in patients with neurocirculatory asthenia are considered.

Key Words: *neurocirculatory asthenia; biological feedback; CNS*

Neurocirculatory asthenia (NCA) is a disease of regulation associated with functional insufficiency of regulatory mechanisms realized by the cortico-hypothalamo-limbico-reticular complex and characterized by polymorphic and transient psychosomatic disorders. These peculiarities and complexity of quantitative analysis of symptoms hampered the elaboration of reliable diagnostic criteria and effective therapy of the disease. Drug and suggestive therapy used alone are not good enough because they affect different elements of pathogenesis, while in combined therapy, their interaction is not considered, and active participation of patients is ignored.

Here we studied the possibility of voluntary correction of psychosomatic disorders via functional biological control of heart rate (HR) combined with the standard drug therapy and elaborated reliable criteria for efficient therapy.

MATERIALS AND METHODS

We examined 48 patients aged 18-50 years with constitutive paroxysmal NCA (repeated sympathoadrenal, vagoinsular, and mixed crises against the background of permanent vegetative and afferent symptoms) uncomplicated by focal neurological symptoms, coronary and endocrine diseases, psychoses, and epilepsy.

Spielberg—Chaning test for individual and reactive anxiety and the assessment of the latency of psychomotor reactions were used to determine psychoemotional tension and psychophysiological reactivity. Residual tension of facial and brachial muscles was estimated by electromyograms. The state of the autonomic nervous system was analyzed by HR and blood pressure (BP). The results were analyzed by Student's t test. Brain bioelectrical activity before and after the therapy was assessed by analyzing the interaction between electroencephalogram (EEG) components and constructing individual typological graphs using a special algorithm [1].

The patients were divided into the main and control groups of 24 humans each. All patients received vasoactive drugs, nootropics, vitamins, and Relanium (diazepam, drug of choice in vegetative crises) in middle-therapeutic doses. Main group patients were simultaneously treated with the biological feedback (BF) method using a Kardiosignalizator KS-03 device (Biosvyaz'). The patients were examined before the beginning of procedures, immediately after therapy, and 1 month later.

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HR range was estimated before the therapy by recording this parameter in a Kardiosignalizator digital indicator. The mean HR and its upper and lower limits (±10% of the mean) were calculated for each 10-sec interval and set at an indicator (12 vertically positioned light-emitting diodes). Smooth changes in the number of open light-emitting diodes corresponded to HR variations between the upper and lower limits.

The individual range of HR changes corresponding to the satisfactory patient state and sense of comfort was determined. The dynamics of patient's state (satisfactory, moderate decompensation, and severe decompensation in vegetative crisis) and vegetative parameters (BP, HR, and respiratory rate) were compared before and after the patient were trained to maintain HR within the optimum range. In the state of moderate decompensation, the patients were trained to control HR voluntary. This procedure was individual and depended on the type of vegetative reactions (prevalence of sympathetic or parasympathetic reactions). When sympathetic reactions prevailed during decompensation, HR exceeded the upper limit, and a patient received the suggestion to decrease this parameter. When parasympathetic reactions were prevalent, HR was below the lower limit, and the suggestion to increase this parameter was imparted to a patient. When HR considerably varied with inspiration and expiration at the period of decompensation, a physician imparted the suggestion to stabilize HR at the level corresponding to the satisfactory state. These procedures (n=12-15) were performed daily for 35-40 min.

RESULTS

Nineteen patients of the main group could voluntary control HR after 3-4 procedures, and the state of these patients improved. At the end of this therapy, the patients voluntary controlled HR and, therefore, they could prevent or attenuate vegetative crises. Five patients of the main group could stabilize HR within the set limits after 7-8 procedures; however, this ability was unstable and could not be reproduced in crises. Examination of main group patients immediately or 1 month after therapy revealed low incidence of mild vegetative crises, reduced anxiety and blues, discomfort due to sense of physical instability and loss of skin sensitivity disappeared, and sensations of dilating pains in the head, thorax, and abdomen were rare. Relanium was withdrawn (18 of 24 patients of the main group) or its dose was minimized (3 patients). Steady positive effects were observed 1 month after combined therapy.

Improvement in the state of control group patients treated with drugs was insignificant and short-lasting (4-14 days). Diagnostic tests allowed us to compare the efficiency of both types of therapy (Table 1). Two criteria (state of the autonomic nervous system and residual muscle tension) attested to better results of therapy in the main group patients in comparison with the control group. One month after therapy, the state of patients in the main group practically did not change, while in the control group it approached the initial level.

Encephalograms were analyzed taking into account published data on the type of EEG changes in patients with neuroses, because high neurotic level is typical of patients with NCA [2,5]. Considering the studies of temporal structure and statistical analysis of interaction between EEG periods [1,2], we analyzed transition probability matrices of EEG rhythms and constructed individual typological graphs of component interaction in patients of both groups before and after therapy (Fig. 1). During neuroses, EEG can have 2 main structures of component interaction: distinct functional kernel in the range of β- and θ-rhythms [3,5] reflects the type or degree of neurosis with the

TABLE 1. Patient State

Parameter	Group	Day		After 1 month
		admission	discharge	
Individual anxiety according to Spielberg—Chaning test, points	Control	54.1±8*	44.7±6	42.3±9*
	Main	53.3±8	37.2±3	41.1±4
Latency of psychomotor reaction, msec	Control	221.5±18	217.3±6	220.2±12
	Main	221.14±18	212.2±4	217.3±6
Systolic BP, mm Hg	Control	174.0±10	164.0±10	141.0±18
	Main	178.0±12	126.0±12	131.0±15
Residual muscle tension, mV	Control	63.0±18*	55.0±14*	42.0±10*
	Main	64.0±15	28.3±7	33.2±8

Note. All parameters of the main group are statistically significant, $p<0.01$; *$p>0.01$, insignificant.

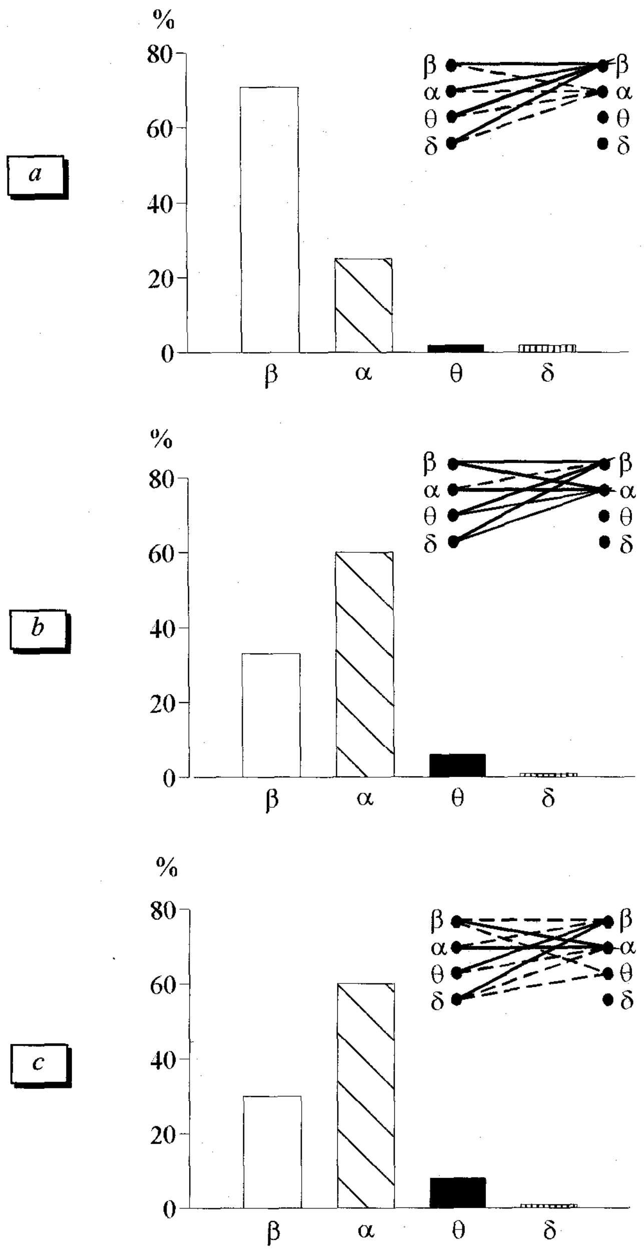

Fig. 1. Rearrangement of EEG rhythms in patient K. with initially dominant β-rhythm during biological control of HR. EEG structure is represented by graphs of transition probability matrices of EEG rhythms and histograms of EEG rhythm power before the therapy with biological feedback of HR (*a*) and after 6 (*b*) and 20 procedures (*c*). Line thickness is proportional to transition probability in ranges of 0.3-0.4, 0.4-0.5, and >0.5.

prevalence of excitatory and inhibitory processes, respectively [5]. In our studies, new functional associations affected neuronal structures that determined the balance between activating and inactivating processes in the CNS. This led to the prevalence of the sympathetic over parasympathetic nervous system and *vice versa*.

The analysis of EEG showed that in 19 of 24 main group patients, the functional kernel was formed in the range of α-rhythm, the interrelation between individual α-waves strengthened, and the structure of interrelations between β-, θ-, and δ-waves shifted from β- to α-rhythms. This corresponded to EEG component interaction typical of healthy individuals. Such functional changes in the pattern were observed only in 4 of 24 patients of the control group.

Hence, our studies showed the efficiency of directional correction of psychosomatic disorders and normalization of the state of patients with NCA via BF-operated HR regulation. The methods for quantitative analyses of the functional state and reserve capacities of the CNS against the background of BF are proposed. NCA is an obstinate disease requiring combined therapy and can serve as the model of disintegration of psychosomatic functions induced by destabilization of central regulatory mechanisms. Reorganization of the system controlling altered visceral functions is effected via activation of brain functional reserves due to introduction of an additional feedback channel into the regulatory circuit. Therefore, we choose HR as one of the most labile dynamic parameters reflecting changes in autonomic functions. There is a close functional association between emotiogenic and autonomic structures in the cortico-hypothalamo-limbico-reticular complex in the CNS. Thus, steady changes in one of the major vegetative parameters lead to changes in others and altered the emotional state of a patient [2,4]. New associations between the limbico-reticular complex and cerebral cortex during BF therapy enable voluntary regulation by the patient of its state. This is a great advantage of our method above hypnosis and neurolinguistic programming, which ignore the role of a patient in therapeutic process. We elaborated a new diagnostic approach to NCA characterized by changes in vegetative parameters and mental and motor functions. Further studies of common principles of the dynamics of this disease and the search for new methods for its correction seem to be of considerable interest.

The results of objective and clinical studies demonstrated the advantages and efficiency of the proposed method for combined therapy and correction of NCA.

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