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Immunological Reaction to Audiovisual Stimulation in Healthy Subjects

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Acoustic and light stimulation of the corresponding analyzers at 1-13 Hz stimulates T-cell immunity. Immunological reaction to audiovisual stimulation depends on the initial level of adaptation stress and changes in the actual self-evaluation after exposure.

Key Words: *psychoneuroimmunomodulation; audiovisual stimulation; immune status; individual features*

Structural and functional integration and mutual modulation of the functions of the immune and neuroendocrine systems are proven [1,5]. Neuroimmune relationships have been studied in normal subjects under conditions of psychological stress and frustration or evaluated on the basis of personality characteristics [9]. Audiovisual stimulation (AVS) modifies the mental status; in particular, relaxation can be caused by rhythmic intermittent stimulation of the visual and acoustic analyzers with light and sound at a frequency of 2-30 Hz. Reports on the shifts in the immune status during relaxation are scanty [10], and these studies were carried out without consideration of individual features.

We investigated the immunological reaction of healthy subjects to AVS with consideration of the initial state of examined subjects.

METHODS

Ten healthy men and women aged 18-33 years took part in the study. During 7 days the volunteers were exposed to 24-min AVS. The frequency of light and acoustic stimulation varied from the α-EEG (9-13 Hz) to δ-EEG (1-3 Hz) ranges. Psychological and immunological tests were carried out before and after of the AVS course. Psychoemotional state was assessed using Spielberger-Khanin self-evaluation score [8] with detection of the personality anxiety and reactive anxiety and by the projective method of color selections [7] evaluating psychoemotional stress at the subconscious level. The immune status was assessed by counting leukocytes and lymphocytes, lymphocyte phenotyping in the modified indirect immunofluorescence test with monoclonal antibodies (Sorbent, Moscow) LT3 ($CD3^+$ lymphocytes), LT4 ($CD4^+$ lymphocytes), LT8 ($CD8^+$ lymphocytes), LT-HLA-DR ($HLA\text{-}DR^+$ lymphocytes) [2]; the concentrations of serum IgG, IgA, and IgM were measured by the traditional Mancini's radial immunodiffusion test. For evaluating the level of adaptation stress (AS), the lymphocyte-neutrophil index (Garcavi's index, GI) was estimated [4] with special evaluation of the training reaction ($0.31<GI<0.52$) and activation reaction ($GI\geq0.52$).

The results were processed by a Statistica software (version 5.0) using Student's *t* test, factor and regression analyses.

RESULTS

Significant shifts in the actual self-evaluation and immune status were observed after the course of AVS:

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the levels of personal anxiety decreased and the content of leukocytes and $CD4^+$ and $HLA\text{-}DR^+$ lymphocytes increased (Table 1).

Individual shifts in the psychoimmunological parameters after AVS were heterogeneous. Factor analysis of shifts in the actual self-evaluation parameters, cell immunity values, and GI was carried out in order to detect the factors promoting the variations in the time course of psychoimmunological parameters and find out the correlations in psychoimmunological changes induced by AVS. Three components contributing to 77.4% sign dispersion were obtained. In the first component (31.9%) the shift in GI characterizing the level of AS possessed the greatest factor loading; shifts in the levels of reactive anxiety and the count of $CD8^+$ lymphocytes were also presented. This factor was interpreted as changes in AS level. The second component (28.1%) included shifts in the subconscious self-evaluation and $CD4^+$ and $HLA\text{-}DR^+$ lymphocyte counts as the values with the highest factor significance and was interpreted as alteration of emotional stress. The third component (17.5%) was represented by the shift in the level of personal anxiety and was denoted as the factor of anxiety alteration. Regression analysis showed that alteration of the immunoregulatory index after AVS positively correlates with changes in AS level (β=0.548, $p<0.05$) and negatively correlates with changes in emotional stress (β=-0.730, $p<0.05$).

Therefore, changes in AS level the largely determine variability of changes in cell immunity and in actual self-evaluation after AVS. We then tried to evaluate the differences in the psychoimmunological reaction to AVS in subjects with initially different AS levels. All examinees were divided into groups with low (GI=0.44, n=5) and high (GI=0.72, n=5) AS. Subjects with low AS (group with training reaction) were characterized by increased absolute counts of leukocytes, lymphocytes, $CD3^+$ lymphocytes, and increased immunoregulatory index without changes in AS level (Table 1). The group with high AS (group with activation reaction) was characterized by a decreased GI, increased content of $HLA\text{-}DR^+$ lymphocytes, and a decreased immunoregulatory index.

According to the factor and regression models, a decrease in GI in subjects with high level of AS was caused by an increase in the content of $CD8^+$ lym-

TABLE 1. Changes in Immune Status and Actual Self-Evaluation after AVS ($M\pm m$)

Parameters	All examinees (n=10)		Subjects with low AS (n=5)		Subjects with high AS (n=5)	
	before AVS	after AVS	before AVS	after AVS	before AVS	after AVS
Leukocytes, g/liter	5.24±0.52	6.81±0.54*	5.28±0.58	8.20±0.68*	4.64±0.72	5.58±0.52
Lymphocytes, g/liter	1.46±0.14	1.58±0.15	1.35±0.16	1.83±0.13**	1.54±0.26	1.50±0.25
%	28.77±2.18	23.57±2.28	25.73±1.65	22.55±1.94	33.26±2.75+	26.40±3.72
GI, units	0.56±0.08	0.40±0.05	0.44±0.01	0.38±0.04	0.72±0.12	0.46±0.09**
$CD3^+$ lymphocytes, %	47.80±2.83	53.90±3.57	49.50±3.75	54.75±5.65	46.40±5.15	55.40±5.62
g/liter	0.72±0.09	0.87±0.11	0.68±0.11	1.01±0.16*	0.75±0.17	0.83±0.15
$CD4^+$ lymphocytes, %	32.80±2.92	39.90±2.65*	32.50±4.33	34.25±2.02	34.80±4.72	43.60±4.31
g/liter	0.48±0.06	0.62±0.07	0.44±0.10	0.64±0.07	0.54±0.10	0.65±0.12
$CD8^+$ lymphocytes, %	29.30±3.58	31.50±3.13	27.75±1.93	26.25±2.56	28.40±6.99	35.20±5.57
g/liter	0.41±0.04	0.49±0.06	0.38±0.06	0.48±0.02	0.40±0.07	0.53±0.12
$HLA\text{-}DR^+$ lymphocytes, %	18.70±2.19	25.1±2.80	14.50±3.59	22.25±5.33	20.60±2.60	28.40±3.54*
g/liter	0.28±0.04	0.40±0.06*	0.21±0.06	0.41±0.09	0.31±0.06	0.43±0.10
$CD4^+/CD8^+$, units	1.28±0.18	1.31±0.08	1.16±0.07	1.35±0.17	1.52±0.33	1.28±0.10
IgG, g/liter	18.81±2.37	19.93±1.79	15.23±3.69	19.59±3.26	23.94±1.23	20.38±2.81
IgA, g/liter	2.79±0.34	2.82±0.39	2.45±0.43	2.89±0.33	3.39±0.40	3.04±0.71
IgM, g/liter	1.96±0.27	1.87±0.29	2.18±0.67	1.80±0.57	1.93±0.16	1.97±0.43
Personality anxiety, score	47.00±2.08	43.70±2.73*	48.50±3.97	45.50±5.95	48.20±1.43	45.00±1.38
Reactive anxiety, score	41.10±3.66	37.80±2.37	40.25±8.32	37.25±4.03	43.20±3.88	39.20±3.73
Total deviations from autogenic norm, score	14.60±2.27	13.20±1.37	12.00±3.16	12.00±2.00	16.40±3.87	14.40±2.32
Autonomic coefficient, score	1.03±0.18	1.38±0.21	1.03±0.20	1.13±0.11	1.14±0.33	1.74±0.35

Note. *$p<0.05$, **$p<0.01$ *vs.* initial status, +$p<0.05$ *vs.* subjects with low AS level.

phocytes and a decrease in the immunoregulatory index. This indicates a possible suppressive direction of immunological reaction to AVS in this group. Increased content of HLA-DR$^+$ lymphocytes in this group caused by changes in emotional strain indicates activation of immunological processes. HLA-DR determinants are expressed on B lymphocytes, monocytes, and T-activated lymphocytes. Stimulation of B-cell immunity is associated with an increase in the concentrations of serum immunoglobulins and a decrease in the T suppressor activity [6], but we did not observe such shifts. Presumably, the counts of activated T cells and monocytes increase in subjects with initially high AS after AVS. The suppressive component of immune reaction (low GI) is probably directed at the B-cell immunity. The mechanism of this reaction can be linked with the effect of opioid peptides, which in physiological doses stimulate T cells and inhibit B cells [3]. They are produced when the state of consciousness is altered (during sleep or psychoemotional stress).

Differences in the immunological reaction to AVS in groups with initially different AS levels can be explained by different CNS excitation threshold for training and activation reactions [4]. Subjects with high AS (activation reaction) are characterized by low excitation threshold, and therefore AVS is sufficient to trigger the mechanisms of specific activation of immunocompetent cells. Subjects with low AS (training reaction) are characterized by high CNS excitation threshold, and the stimulant was not strong enough to modulate their specific resistance.

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