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A METHOD FOR IMPROVING THE PROFESSIONAL PERFORMANCE AND RELIABILITY OF PERSONS DRIVING HIGH-SPEED VEHICLES

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Abstract.
Recently, due to the emergence of a variety of modifications of air, land, water vehicles and an increase in their speed and maneuverability, the number of people with severe manifestations of motion sickness has also increased. The relevance of this problem is dictated by the fact that, despite significant achievements in the field of preventive medicine, a significant number of people prone to motion sickness have been observed to date. Thus, among persons using land modes of transport, the percentage of sick people reaches 15.0%, air modes 20.0%, while using water modes of transport, the number of sick people reaches 30.0%. The significance of this problem is dictated by the fact that the psycho-physiological capabilities of our body do not keep pace with the rapidly increasing speed-maneuvering characteristics of vehicles.

Key words. Motion sickness syndrome, ladasten, preventive medicine, high-speed maneuverable vehicles, statokinetic stability.

Introduction.
At present, the problem is of particular importance for persons directly driving high-speed vehicles. This is due to the fact that a good functional state and a high level of performance largely determine the accuracy and timeliness of the performed control movements. While the price of a mistake is commensurate with the loss of health or life of an auto-moto-bicycle racer, hang glider, snowboarder, parachutist, surfer, yachtman, etc. The significance of this problem is dictated by the fact that the psycho-physiological capabilities of our body do not keep pace with the rapidly increasing speed-maneuvering characteristics of vehicles. As a result, a person is sometimes affected by an excessive complex of angular, linear, and centripetal accelerations, causing vestibulo-somatic / vegetative / sensory reactions, which in turn worsen not only well-being, but also the results of professional activity. Thus, it was established that pronounced accelerations negatively affect the bioelectric activity of the brain and conditioned reflex activity, spatial orientation, and accuracy of control movements. They increase the number of gross errors and kurtosis of reactions, thereby negatively affecting the safety of movement [1-15].

Aim. The purpose of this work was to study the effectiveness of the combined use of special physical exercises and the drug ladasten in increasing the vestibular stability of persons driving high-speed and highly maneuverable vehicles.

Materials and methods.
The studies were carried out in the first half of the day, on the basis of the Department of Otorhinolaryngology of the Military Medical Academy named after. CM. Kirov (St. Petersburg).

The subjects were men aged 19-20 years with a diagnosis of "healthy", the tolerance time of continuous cumulation of Coriolis accelerations (hereinafter referred to as CCA) of which was less than 2 minutes. Before the start of the experiment, all subjects were familiarized with the plan of the upcoming research, the methods used and the research protocol. Voluntary written consent to participate in the research was obtained. After that, the persons of the experimental group performed special physical exercises for a week, while taking the drug ladasten. Persons in the control group did not exercise, they took coated starch tablets. After the course application of physical exercises and ladasten, all subjects were re-examined in the original volume. Then the examination in the same volume was repeated after one, two, or three weeks. In the course of the research, the duration of the tolerance of NCFA performed on an electro-rotating chair with program control was determined. The results were evaluated according to the traditional method of S.S. Markaryan [11]. At the same time, the degree of severity of the sensory, vegetative, and somatic components of vestibular reactions was assessed, expressed in the form of physiological manifestations and subjective sensations: the severity of a feeling of heat, heaviness in the head, dizziness, discomfort in the stomach, hypersalivation, hyperhidrosis, defensive movements, duration of postrotational nystagmus. To quantify the degree of their severity, in a preliminary series of studies involving 72 people, a scoring system was developed: 0 - no sensations; 1 - weakly expressed; 2 - strong feelings. Special physical exercises: subjects in a standing position with their eyes open, under a metronome, during the first two minutes performed head movements: head turns to the right - to the left, head tilts forward - backward, then right - left. Each type of movement was performed for 30 seconds, followed by a pause of 5 seconds, followed by head tilts in the prescribed sequence. For the first minute, the subjects performed head tilts while standing in one place, and then while walking. Special physical exercises were performed with a daily increase in training time by 10.0 seconds. The drug ladasten, as well as starch tablets, was taken in the first half of the day, per os, 100 mg each, during the week. The static stabilometric test of complex functional computer stabilography (hereinafter referred to as CST CFKS) was performed using a stabilograph ST-02, immediately after graduation from NKUK. The subjects performed two trials: the first with open eyes and a gaze hold on an object 5.0 meters away. The second is with closed eyes. The duration of each test is 20.0 seconds, the interval between them is 1.0 minutes. When performing tests, indicators of the average rate of increase in the length and area of the statokinesiogram, the amplitude of oscillation (hereinafter - AK) and the coefficient of asymmetry (hereinafter - KA), the projection of the common
center of gravity (hereinafter - POCG) in the sagittal and frontal planes and directions, respectively, were recorded. Statistical processing of the obtained data was performed using the Anova software package. For each sample of indicators, the numerical characteristics of the distribution were calculated. The significance of differences between the compared samples was assessed using Student's parametric t-test.

Results.

The results obtained in the course of the studies carried out allow us to conclude that the weekly combined use of special physical exercises and the pharmacological drug ladasten significantly improves the tolerance of NCAA by the persons of the experimental group. At the same time, a significant decrease in the severity of the sensory, vegetative, and somatic components of vegetative reactions was noted (Table 1). Thus, in the individuals of the experimental group, there was an increase in the tolerability of the NCAA by 53.1% compared with the baseline. Indicators characterizing the feeling of heat decreased by 60.0%, heaviness in the head by 60.0%, dizziness by 50.0%, discomfort in the stomach by 60.0%. At the same time, there was a decrease in the severity of hypersalivation by 46.7%, hyperhidrosis by 50.0% and the severity of protective movements by 50.0%. The observed positive dynamics of indicators as a whole indicates that the persons of the experimental group began to better endure NCUC on an electro-rotating chair.

The positive dynamics of the studied indicators in the experimental group are consistent with the positive dynamics of the indicators obtained during the test with open eyes in the SST of the CPKS after the NCUK (Table 2).

In the process of research, the duration of the achieved positive effect was also determined. To do this, after a course of special physical exercises in combination with the drug ladasten, the initial examination was repeated after one, two, or three weeks. Analysis of the data obtained allows us to say that the greatest value of the time of tolerance to the NCAA in the subjects of the experimental group was noted immediately after a week of special physical exercises in combination with the drug ladasten. After that, the achieved values began to gradually decrease and by the end of the third week they practically returned to their original values: “Before” - (98.1±5.6), “After” - (150.2±7.4*), “In one week” - (145.8±7.8*), “In two weeks” - (129.3±8.1*), “In three weeks” - (99.4±6.5) after course impact.

<table>
<thead>
<tr>
<th>Investigated indicators</th>
<th>Experimental groups</th>
<th>Control groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Transfer time NKUK (sec.)</td>
<td>98.1±5.6</td>
<td>150.2±7.4*</td>
</tr>
<tr>
<td>Feeling hot (points)</td>
<td>0.5±0.03</td>
<td>0.2±0.05*</td>
</tr>
<tr>
<td>Feeling of heaviness in the head (points)</td>
<td>1.0±0.07</td>
<td>0.4±0.03*</td>
</tr>
<tr>
<td>Dizziness (points)</td>
<td>0.8±0.06</td>
<td>0.4±0.07*</td>
</tr>
<tr>
<td>Discomfort in the stomach (points)</td>
<td>0.5±0.06</td>
<td>0.2±0.08*</td>
</tr>
<tr>
<td>Hypersalivation (points)</td>
<td>1.5±0.06</td>
<td>0.8±0.07*</td>
</tr>
<tr>
<td>Hyperhidrosis (points)</td>
<td>1.2±0.07</td>
<td>0.6±0.08*</td>
</tr>
<tr>
<td>Defense moves (points)</td>
<td>0.6±0.08</td>
<td>0.3±0.06*</td>
</tr>
<tr>
<td>Duration of nystagmus (sec.)</td>
<td>17.5±1.4</td>
<td>11.3±1.8*</td>
</tr>
<tr>
<td>Number of test subjects</td>
<td>64</td>
<td>64</td>
</tr>
</tbody>
</table>

*Note: significance of differences: * p<0.05 compared to baseline.

Table 1. Psychophysiological indicators of the subjects "Before" and "After" the course of physical exercises in combination with the pharmacological drug ladasten (X±m).

<table>
<thead>
<tr>
<th>Investigated indicators</th>
<th>Experimental groups</th>
<th>Control groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Open eye test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length increase rate (mm/s)</td>
<td>38.9±1.7</td>
<td>35.4±1.6*</td>
</tr>
<tr>
<td>Area increase rate (mm²/s)</td>
<td>67.5±3.1</td>
<td>61.0±3.3*</td>
</tr>
<tr>
<td>AK POCT, frontal plane (mm)</td>
<td>7.3±0.5</td>
<td>6.2±0.6*</td>
</tr>
<tr>
<td>AC POCT, sagittal plane (mm)</td>
<td>7.4±0.4</td>
<td>6.3±0.5*</td>
</tr>
<tr>
<td>KA, frontal direction (%)</td>
<td>7.2±0.6</td>
<td>6.1±0.5*</td>
</tr>
<tr>
<td>CA, sagittal direction (%)</td>
<td>7.3±0.4</td>
<td>6.4±0.6*</td>
</tr>
<tr>
<td>Eyes closed test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length increase rate (mm/s)</td>
<td>44.3±4.5</td>
<td>44.8±4.6</td>
</tr>
<tr>
<td>Area increase rate (mm²/s)</td>
<td>64.6±4.2</td>
<td>62.5±4.5</td>
</tr>
<tr>
<td>AK POCT, frontal plane (mm)</td>
<td>8.0±0.8</td>
<td>7.9±0.9</td>
</tr>
<tr>
<td>AC POCT, sagittal plane (mm)</td>
<td>7.3±0.5</td>
<td>7.2±0.8</td>
</tr>
<tr>
<td>KA, frontal direction (%)</td>
<td>7.2±0.8</td>
<td>7.3±0.7</td>
</tr>
<tr>
<td>CA, sagittal direction (%)</td>
<td>7.3±0.8</td>
<td>7.2±0.7</td>
</tr>
</tbody>
</table>

*Note: significance of differences: * p<0.05 compared to baseline.
Discussion.

The vestibular stability of a person largely depends on the adequacy of his psychophysiological reserves, which, under excessive influence of dynamic factors of movement, play a significant role in matters of professional performance, safety, and reliability of persons whose activities are related to the management of high-speed vehicles. One of the factors negatively affecting the level of vestibular stability is hypoxia. It has been proven that ischemic changes lead to functional insufficiency and deterioration of coherence in the work of various structures of the central nervous system and analyzers (visual, vestibular, auditory, etc.) that display space [9,10,14,15]. In this regard, one of the effective directions in the pathogenetic correction of an insufficient level of vestibular stability, improving the functioning of the central nervous system and analyzers, is physical exercise in the form of regular and adequately selected loads [4,7,13,15]. The mechanism of action of the drug ladasten is associated with increased release of dopamine from presynaptic terminals, blockade of its reuptake and increased biosynthesis due to the expression of the tyrosine hydroxylase gene, as well as with its modulating effect on the GABA-benzodiazepine-chlorionoform receptor complex, which eliminates the decrease in benzodiazepine reception that develops during stress [15]. The improvement of vestibular stability under the influence of the combined action of physical training and ladasten is based on the optimization of activity, primarily of the central nervous system, in combination with a change in the sensitivity thresholds of analyzers that display space. Which ultimately contributes to the optimization of the activity of the functional systems of the human body under conditions of excessive exposure to alternating accelerations [2,4,5,9,12,14].

Conclusion.

1. Weekly performance of special physical exercises in combination with the drug ladasten significantly increases the time of tolerance to the NCAA, while reducing the severity of the sensory, vegetative, and somatic components of vestibular reactions.
2. The greatest value of the NCUK tolerance time was noted immediately after the course of physical exercises in combination with ladasten.
3. A significant positive effect from the combined use of physical exercises and the drug ladasten lasts up to two weeks.

REFERENCES
фактом что, несмотря на значимые достижения в области профилактической медицины, до настоящего времени отмечается значительное количество лиц подверженных укачиванию. Так, среди лиц, использующих наземные виды транспорта, процент укачиваемых достигает 15,0%, воздушные виды 20,0% при использовании водных видов транспорта число укачиваемых достигает 30,0%. Значимость этой проблемы продиктована тем фактом, что психофизиологические возможности нашего организма не успевают за стремительно возрастающими скоростно-меневренными характеристиками транспортных средств передвижения.

Ключевые слова. Синдром укачивания, ладастен, профилактическая медицина, скоростно-меневренные транспортные средства передвижения, статокинетическая устойчивость.