The initial period of adaptation of the human body to weightlessness is often accompanied by a specific form of motion sickness (MS). The development and intensity of this syndrome are very closely connected to the physical activity of the cosmonauts [1, 2].

Humans placed into chambers rotating with a constant angular velocity for a prolonged time (slowly rotating chambers, SRC) also develop motion sickness [5]. Active movements, including head movements, cause MS and exacerbate its symptoms, both in SRC and during space flights. Therefore, the course of MS occurring during the flight is similar to that of the sickness induced by prolonged rotation; these two types of cases are also phenomenologically similar [3].

Prophylactic use of pharmaceuticals can significantly accelerate the adaptation of humans to conditions evoking the development of MS symptoms. The features of the adaptation period allow the assumption that a reduced scheme of administration, namely the use of the preparation during the first day of exposure to rotation, will prove efficient.

METHODS

The spaceflight-specific form of MS was modeled by confining the test subjects to a slowly rotating Jupiter-2 chamber. The intensity of the treatment was adjusted individually by the following means:

— Choosing the angular velocity of chamber rotation according to the individual proneness of the test subjects to MS, which was determined by the vestibular test for accumulation of Coriolis acceleration (TCCA) and a control exposure to rotation in the Jupiter-2 chamber;

— Setting the number, rate, direction, and angle of head tilt upon graduated head movements using a special appliance (UDDG) during exposure of the test subjects to rotation in the Jupiter-2 chamber; and

— Adjusting the rate of free volitional movements of the test subjects during rotation (the researcher controlled the movements audiovisually).

ECG was recorded four or more times per hour during the rotation and express analysis of the ECG pattern was performed; in addition, the heart rate, respiration rate, and blood pressure were recorded tachocardiographically. The MS’s severity was assessed by questioning the test subjects periodically about the presence and strength of symptoms and ranking the answers on a quantitative scale; average scores were calculated for every hour of exposure [4].

Eight male volunteers of ages ranging between 25 and 31 years were involved in the experiment; a medical test was performed to ensure that their health was sufficient for the study. TCCA in a vestibulometric chair was performed several days before the beginning of the study in order to assess the initial vestibular resistance. Afterwards, pairs of test subjects were exposed to a control five-hour rotation in the Jupiter-2 chamber, and the intensity of MS symptoms caused by rotation with angular velocity chosen after the TCCA was assessed.

Approximately three weeks after the control rotation, the participants were subjected to a 5-h rotation preceded by administration of the P-4 preparation for the assessment of the efficiency of the medication.

Individual tolerance to the preparation and the possible side effects were assessed 1.5 weeks prior to the rotation test.

Three to four weeks after the 5-h rotation preceded by P-4 administration the test subjects took part in two seven-day experiments (including a four-day rotation in the Jupiter-2 chamber) with a two-month interval between the experiments.
The preparation P-4 used as a prophylactic treatment contains scopolamine, sidnocarb, stugeron, and pyridoxal phosphate. Lactose was used as a placebo. The preparation P-4 and placebo were administered in identical capsules following the double-blind scheme of the experiment.

In the case of 5-h rotation, the preparation was administered 1.5 h before the exposure to rotation and 2 h after the exposure started. In experiments involving several days of exposure to rotation, the test subjects received the preparation 1.5 h before the start of the exposure on the first day of rotation and twice a day on all the following days. During one of these experiments, the first two capsules contained P-4 and all the following capsules contained lactose (placebo), and during the other experiment all capsules contained placebo.

RESULTS AND DISCUSSION

A strong set of MS symptoms was observed in all test subjects during the TCCA test (rotation in a vestibulometric chair); the score was higher than 8.

First-degree vestibular instability was detected in two subjects according to the results of the TCCA test and the control rotation in the Jupiter-2 chamber (rotation rate, 9 rpm); third-degree vestibular instability was detected in the remaining six subjects (rotation rate, 6 rpm).

Estimation of the Individual Efficiency of P-4 Preparation in a 5-h Rotation Test

Pronounced symptoms of MS were observed in all participants of the study during the control rotation (Table 1); both basic and additional symptoms appeared during the first hour of rotation.

Nausea was the soonest to appear and was observed in most subjects. Of all the additional symptoms, hyper-salivation and a feeling of fever occurred most often. Motion sickness of the second to fourth degree developed in the subjects, with a gastrointestinal type of disease prevailing and the individual assessment scores ranging from 7.8 to 19.6.

The clinical presentation of MS was much less pronounced after P-4 treatment than during the control rotation. All the subjects reported the positive effect of the prophylactic treatment.

Decreased motility was not observed. The score of nausea intensity decreased significantly, and vomiting attacks did not occur.

The maximum intensity of other symptoms also decreased, and therefore the total hour’s score was lower than during the corresponding period of control rotation.

In general, the average individual scores reported by the subjects ranged from 1.8 to 6.4, this being indicative of MS of degrees 0–II. The individual coefficient of medication efficiency was 3.0 for two of the subjects and 5.0 in the remaining six subjects (the average value in the group was 4.5 or 100%); this proves the high efficiency of the prophylactic medication. Previous research had shown that dryness of the mouth is a negligible side effect of P-4.

The preparation was administered to the subjects at the preliminary stage of the experiment for the assessment of individual tolerance and side effects.

Three of the eight subjects noticed slight dryness of the mouth, and light somnolence was reported in three cases; the subjects did not report systemic effects or changes in working capacity.

Some subjects reported a more pronounced dryness of the mouth during a 5-h rotation after P-4 administration, and the same subjects who reported a feeling of tiredness and slight somnolence under laboratory conditions reported these symptoms between the second and fourth hours of rotation; this was probably a side effect of the preparation due to an individual reaction.