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SALYUT-6-SOYUZ: OUR COMMENTARY

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16. Abstract

The article discusses the physical exercise and medical monitoring programs conducted during the record setting 175 day space flight by V. Lyakhov and V. Ryumin.

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The new record for prolonged stay in space set by V. Lyakhov and V. Ryumin was 175 days. It is natural that the main medical problem in such a lengthy flight consisted of maintaining the good state of health of the cosmonauts, and of helping them to continually keep their working capacity.

The medical control over the state of health of V. Lyakhov and V. Ryumin was carried out by four shifts of physicians of the Flight Control Center with consultation support by the Center for Control of Medical Support to Cosmonauts which is made up of a group of experts. If necessary, they are capable of rapidly giving recommendations on all questions of medical support for the crew.

The medical specialists not only focused attention on the peculiarities of the physiological reactions of the cosmonauts, they also concentrated on maintaining the necessary hygienic conditions of living in orbit. For this purpose sanitary-bacteriological studies were made, almost daily throughout the whole flight calculations were made of the volume of liquid drunk, consumption of the food ration, time of rest, sleep, work, and physical training.

The flight of the orbital complex took place in a favorable radiation situation. The summary dose of radiation was 6-7.5 rem (roentgen equivalent, man--unit for measuring radiation dose). This is a small fraction of the permissible level.

The gas medium in the living modules corresponded to the calculated amounts and was close to the earth's atmosphere. The on-board systems maintained the air temperature desirable for the crew, its maximum fluctuations were in the range from 15.4 to 21.8 degrees.

On a lengthy space voyage the organization of cosmonauts' spare time acquires especially great importance. In the rest period earth provided the crew with psychological support. Operators, and pilot-cosmonauts of the USSR who were well known to them held easy, unconstrained and interesting communications sessions with Lyakhov and Ryumin. The musical accompaniment of the communications sessions, broadcasting--direct and in recording--of the programs "Mayaka," radio meetings with families, comrades, radio concerts, concerts from Ostankino, and finally, the latest word in television "earth-on board" played their role in the psychological support of the crew.

In order to prevent the undesirable effect of space flight factors on the bodies of the cosmonauts a set of preventive measures were used on board the station. For example, in order to provide in weightlessness the effect of support on a load in the direction of the longitudinal axis of the body, the cosmonaut dressed in a special suit is pulled to the running track of comprehensive training equipment by rubber cords. The training equipment permits the cosmonaut to walk, run, jump, and thus preserve the coordination structure of motions that are characteristic for terrestrial conditions. The lengthy use of this training equipment on the station "Salyut-6" showed the reliability of its design, its good operating qualities, as well as the effectiveness of the recommended sets of exercises. In addition, the cosmonauts used a bicycle ergmeter.

Both cosmonauts had an excellent understanding of the importance and need for physical exercise. Not once without serious reasons did they omit their training sessions, even on the days of active rest V. Lyakhov and V. Ryumin used the training equipment. The intensity of the loads was higher than in the previous expeditions.

The cosmonauts used a vacuum device made in the form of crimped trousers "chibis" ["lapwing"]. It makes it possible to create reduced pressure as compared to the surrounding on the lower part of the body. This permits in zero gravity redistribtuion of the blood as normally on earth, and prevents disruption of circulation.

When returning to earth it is very important to preserve (more accurately-- somewhat increase) the content of liquid in the blood channel and tissues. Therefore before descent water-saline additives were included in the food ration.

The set of preventive resources included also a loading suit "pingvin-3", a muscle electric stimulator "tonus-2", and after landing-- an anti-overloading suit.

During the entire flight the caloricity of the diet was roughly 3000 calories. Total water consumption per day was 2-3.5 liters.

The state of health of both crew members invariably remained good with the exception of temporary exacerbation during the adaptive reactions to weightlessness. In the first three days vestibular disorders were observed in the commander linked to the feeling of considerable blood congestion to the

head and reduction in performance capacity. Starting with the fourth day, including during the emergence into open space, V. Lyakhov felt good. Adaptation to weightlessness occurred smoothly in the flight engineer.

From the 19th day the crew members practically stopped feeling blood congestion to the head. In the telereports, especially on the second-tenth days of the flight one could notice a certain puffiness of the faces and the voices of the cosmonauts acquired nasal tones. By the way, the vestibular disorders often accompanied by unpleasant reactions occur at least in every third cosmonaut roughly an hour after emergence into zero gravity and usually pass by the fifth day of the flight.

Arterial pressure and body temperature throughout the entire flight did not go beyond the normal limits. According to the data of dynamometry conducted on the 157th day the strength in the commander's wrist muscles did not differ from the pre-flight amounts, and the flight engineer's rose by 14 kilograms for the right hand and by 13 for the left.

Before the blast-off V. Lyakhov weighed 81.7 kilograms, and on the day of landing 5.5 kilograms less. For the flight engineer, starting with the 163rd day of flight his weight was 1.6 kilograms higher than the initial, and after landing corresponded to the pre-flight amount. By the way, of the six cosmonauts that were in orbit for 96, 140 and 175 days, only Valeriy Ryumin preserved his weight from the blast-off to landing.

Comprehensive medical examinations were made and the physicians tried to obtain detailed information about the cardiac activity, blood vessels and lungs. The on-board instruments and especially "Polinom-2M" which one can say without exaggeration that the cosmonauts mastered brilliantly, made it possible to have on earth the following physiological indices: electrocardiogram, rate of cardiac contractions, arterial pressure, per-minute volume of heart, phases of cardiac contraction, venous pressure, tone of vessels in different regions of the body, and state of pulmonary ventilation. In 6 months 14 medical experiments were conducted and over 166 studies. The voluntary and patient participation of V. Lyakho and V. Ryumin in the medical studies, sometimes complicated and not always pleasant, eased the concern of the physicians.

However, it would be incorrect to think that the cosmonauts and medical specialists did not experience difficulties. They occurred at times as a consequence of the insufficient ability of the physicians to evaluate and analyze a number of conditions of the organism of a healthy man in a space flight. This is a question of, for example, the peculiarities of the cardiac bioelectrical activity. From flight to flight the Soviet and American specialists have encountered unusual electrocardiograms of the cosmonauts, primarily during the flight, less often--after its end. In particular, one of the components of the electrocardiogram was altered in shape and amplitude which was noted even now on the 62nd and 83rd days of the flight. A new method for astronautics of continuous and lengthy recording of the electrocardiogram with the help of a portable instrument "Kardiokasseta" helped to reveal the nature of these deviations. The consultants came to the conclusion that electrocardiogram changes have a transient nature, and possibly are linked with position and metabolic shifts in the myocardium. On the whole the electrocardiograms of the cosmonauts were evaluated as a variant of the norm. For preventive purposes medication was prescribed.

The physicians analyzed the current state of health of the crew members and made a forecast for the future. With the passage of time the confidence became ever more stronger that V. Lyakhov and V. Ryumin demonstrated a somewhat greater resistance to weightlessness.

Before the walk in space the space medicine specialists came to a unified opinion that the crew was capable of fulfilling the important and complicated work to free the docking assembly from the radiotelescope antenna.

The condition of V. Lyahkov and V. Ryumin after landing completely satisfied the physicians. Already three minutes after landing of the crew the physicians were near them. The first medical examination took place in 30 minutes after landing. The condition of the cosmonauts was active, somewhat euphoric, they felt the increased weightiness of surrounding objects, they took a vertical position uncertainly, and vestibular disorders were observed in the craft commander. The pulse rate at rest was within 100-112 beats per minute, and arterial pressure was insignificantly increased only in the commander.

Rapid and complete restoration of the functions of the cosmonauts' bodies

was not doubted. The acute stage of becoming accustomed to terrestrial conditions was completed in only three days.

The record flight was successfully completed. This significant event indicates the correct strategy of the medical support for long space flights. It includes: selection and training of the crews, optimization of the living medium, daily control over the state of health, and if necessary rendering medical assistance, and carrying out preventive and restorative measures.

There is no doubt that the main components of this system will preserve their value also in the future, although we are actively working on its further perfection.