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ANTIBODIES TO MYOFIBRIL ANTIGENS IN COSMONAUTS AFTER SPACEFLIGHTS

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16. Abstract The study of serum samples, obtained from 15 astronauts before and after spaceflights, with the use of the indirect immunofluorescent method showed that in 7 astronauts antibodies to different elements of the human heart muscle appeared after flights. Strong and very strong luminescence of the elements of heart muscle tissue was detected in the astronauts after the third space flight. In a study of the sera on sections of bovine heart muscle tissue the reactions of the sera taken before and after flight were found to show no essential differences.

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ANTIBODIES TO MYOFIBRIL ANTIGENS IN COSMONAUTS AFTER SPACEFLIGHTS

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Today's nomenclature defines as antibodies those substances developed in the /36* organism in response to its own tissue antigens having an organic or tissular specificity [5]. Autoantibodies are discovered in various situations: in insignificant amounts -- in the healthy organism, and in those very ill -- where there has been destruction or impairment of tissues due to the action of external agents, due to the effect of cross reactions among microorganic antigens, and in the case of autoimmune illnesses [5, 9].

Studies of the statokinetic reactions of cosmonauts on the completion of a spaceflight revealed in individual cases a drop in muscle tone, reduction of the hip and calf girth, reduction in body mass, in a context where biochemical changes /37 were not only of a functional type but were likewise based on morphological changes, especially muscular atrophy [1]. The results of studies done in connection with the Apollo and Skylab projects likewise testify to the fact that atrophy of the skeletal musculature is one of the most regular manifestations of the effect of weightlessness. Atrophy of the osteomuscular system in cosmonauts is supported by the clear reduction of the organism's K content, associated with parallel losses of Na, P, Mg and Ca [8, 10], and a change in the blood's protein composition (haptoglobin, α_2-macroglobulin) during the postflight period [2].

On the basis of the literature data one might suppose that during spaceflights the cosmonauts might present autoimmune reactions in response to the destruction of skeletal musculature expressing itself in atrophy. This supposition was likewise borne out by our data which indicated that in the postflight period the cosmonauts presented an increased content of serum immunoglobulin [3] against a background of lower natural resistance in the organism [6].

In recent years wide use has been made of the method of indirect immunofluore-

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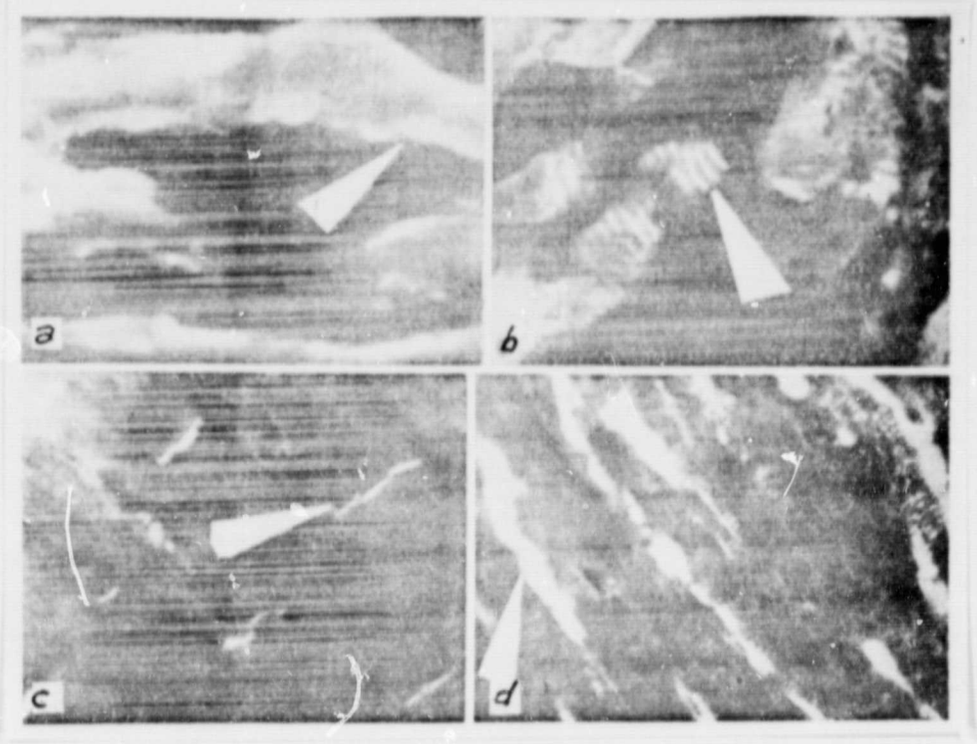
* Numbers in the margin indicate pagination in the original foreign text.



Luminescence of elelents of cardiac tissue. a - luminescence of sarcolemma of human muscle fiber; b - luminescence of discs of human muscle fiber; c - luminescence of inserted platelets of human heart; d - luminescence of fibroblasts of interstitial connective tissue of beef heart. X 40, level 3.

scence for the identification of autoantibodies, a method which makes it possible to establish localization of the antigen against which the autoantibodies are directed. The use of the indicated reaction with immunoglobulin moieties of antiserum against human immunoglobulins excludes nonspecific reactions with tissues due to other serum components. Studies of human heart tissue sections associated with a number of autoimmune diseases have revealed autodies that react with different structures of the myocardial muscle fiber. In practice it is not possible to come up with antibodies that react with antigens of the interstitial connective tissue. At the same time in studying sera with tissues of other biological species, especially sections of beef heart, one can bring out not only antibodies to muscle fiber antigens but likewise antibodies that react with antigens of the cellular elements of the interstitium [4].

The purpose of the present research was to study antibodies to antigens of the

striated musculature in the sera of cosmonauts. The study was carried out on tissue sections of human and beef myocardium, since, as we know, these two species have a morphological and antigenic structure analogous to the skeletal musculature.

Materials and Method

We studied 41 serum samples from 15 cosmonauts who had completed long and short spaceflights of varying duration; 13 serum samples were obtained prior to spaceflight and 28 after flight completion. In the case of 9 cosmonauts the studies were conducted dynamically over a period of 1-5 weeks following completion of a space flight.

The presence of antibodies in the sera of the cosmonauts was determined by the method of indirect immunofluorescence on nonfixed sections of human heart tissue (0 group) and of beef heart tissue, prepared in a cryostat. We used pure antibodies labeled with fluorescein isothiocyanate against human IgG and likewise labeled anti-IgG, anti-IgG+IgM+IgA put out by Behringwerke. The method used in treating these sections is that described by Danilova, Lyampert [4] and Fedorova [7].

The reaction was followed under a luminescent ML-2 microscope with a X 40 objective (aqueous immersion). Photography was done with a level X 3 ocular. Intensity of reaction was noted by means of pluses: ++++ very bright luminescence, +++ bright, ++ moderate, + weak, ± very weak, - none. Reactions with ++ were considered positive if the culture of the serum studied was 1:16.

At the same time in the postflight period we carried out anthropometric measurements of muscular mass and body weight of the astronauts. Measurement results were compared with preflight data.

Results

The anthropometric studies made it possible to establish that during spaceflight, cosmonauts would lose from 1 to 9% of their body mass and the girth of the muscles of/38 the lower extremities (hips and calves) would be reduced on the average by 1.0-5.7 and 0.4-3.6 cm respectively. The changes noted were a function both of the length of flight and of the intensity of physical overload during flight. The parameters indicated returned to their initial values in the course of 5-30 days.

The results of the studies made it possible to establish, that the sera of the cosmonauts reacted with various myocardial structures — sarcolemma (see Figure a), sarcoplasma (see Figure b), inserted platelets (see Figure c), and in addition on the beef heart tissue sections we notice a reaction with cells of interstitial connective tissue (see Figure d).

All the antibodies noted appeared to belong to the IgG class, since luminescence was noted with pure antibodies to IgG and with monospecific antiserum against human IgG. When use was made of the anti-IgG+IgM+IgA serum we noted no additional reactions with components of human or beef myocardial tissue.

Sera obtained in the preflight period either did not react with human heart tissue or the luminescence noted was weak or very weak (+, ±). In the study of sera obtained after completion of spaceflight an intensive reaction (++, +++) was noted in the case of 7 cosmonauts out of the 15 studied (~47%), and here 4 cases presented luminescence of inserted platelets, 4 presented discs, 1 sarcolemma and 2 sarcoplasma. There was no luminescence in connection with the nuclei of muscle fibers. Three astronauts presented strong or very strong luminescence (+++, ++++) of elements of human cardiac tissue, of whom 2 were studied after their third spaceflight. Depending upon the length of the observation period, in 2 cases of the 4 a positive reaction was maintained over a period of a week, in one case over 2 weeks and in /39
one of the 2 cases over 5 weeks. In 2 cosmonauts a positive reaction was noted both before and after flight, in 1 before flight and in 1 after flight. In the serum study with sections of beef heart tissue we did not succeed in discovering any essential differences between serum reactions in samples taken before and after flight.

Evaluation

Thus, in the sera of cosmonauts we discovered antibodies for various structural elements of human cardiac muscle — sarcolemma, sarcoplasma, discs, inserted platelets. After flight antibodies to cardiac tissue were discovered in almost 50% of the sera studied. These antibodies apparently were autoantibodies since they reacted with the antigens of normal human cardiac tissue of the 0 group. As has been established, antibodies to various structures of muscle fiber in the sera of the donors were discovered in a significantly smaller percentage of cases [4].

The frequency of the appearance of antibodies to the cells of interstitial connective beef tissue (10-15%) did not exceed the value obtained in the study of donor sera [7].

Thus, the data obtained indicate the need for further study that would reveal both the role of the breakdown of musculature atrophied under hypodynamic conditions as well as the effect of the antigens of human microflora and of stress factors when there is stimulation of autoimmune reactions in the organism.

Conclusion

In a study of the sera of cosmonauts who had completed spaceflights of various lengths, both long and short, the indirect immunofluorescent method revealed in some of them the presence of antibodies to antigens of different structures of human cardiac muscular tissue, which apparently are autoantibodies, since they react with antigens of normal heart tissue of the 0 group.

REFERENCES

1. Bryanov, I. I. et al., v kn. Kosmicheskiye polety na korablyakh "Soyuz" [in Spaceflights on the "Soyuz" Craft], Moscow, 1976, p 195.
2. Guseva, Ye. V and R. Yu. Tashpulatov, Kosmicheskaya biol., 1, 3-8 (1979).
3. Guseva Ye. V. and R. Yu. Tashpulatov
4. Danilova, T. A. and I. M. Lyampert, Byull. eksper. biol., 3, 68 (1972).
5. Lyampert, I. M., Uspekhi sovr. biol. 81/2, 274 (1976).
6. Tashpulatov, R. Yu. and Ye. V. Guseva, Kosmicheskaya biol., 2, 8-13 (1979).
7. Fedorova, N. M. et al., Vopr. revmat., 2, 36 (1976).
8. Berry, C. A., Aviat. Space Environ. Med. 47, 418-424 (1976).
9. Grabar, P., Clin. Immunol. Immunopath. 4, 453-466 (1975).
10. Whedon, C. S. et al., Aviat. Space Environm. Med. 47, 391-396 (1976).