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EFFECT OF PROLONGED HYPOKINESIA ON TISSUE BLOOD FLOW

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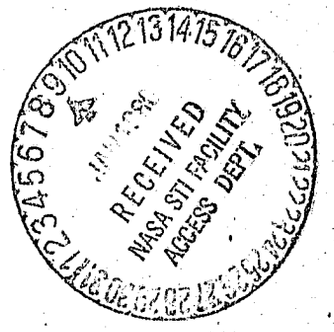

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EFFECT OF PROLONGED HYPOKINESIA ON TISSUE BLOOD FLOW

By

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Prolonged limited motor activity affects different indices of /79* circulation. This is expressed most often in an increase in the number of cardiac contractions (N. A. Agadzhanyan et al.; N. V. Pisarenko, et al.), reduction in the beat and per-minute volume of the heart (P. V. Buyanov et al., 1966, 1967; L. I. Kakurin; A. P. Pekshev), pulse pressure (V. S. Georgiyevskiy and V. M. Mikhaylov), blood flow rate (O. D. Anashkin), mass of circulating blood (M. P. Kolpakov et al; Gauer et al.; Stevens)and in certain other changes.

One of the very important indices of hemodynamics is the tissue blood flow. The supply of oxygen to the tissues, the elimination of carbon dioxide and other types of exchange depend on its quality.

*Numbers in margin indicate pagination in original foreign text.

The idea on perfusion of tissues based on arterial pressure indices is not always correct, since in a number of pathological conditions adequate central hemodynamics is not accompanied by the proper microcirculation.

Such methods of studying tissue blood flow as capillaroscopy and intra vitam microscopy of tissues do not always yield a fairly objective idea about the observed phenomenon. In addition, these methods are visual and to a certain measure subjective.

One can judge more accurately about the state of tissue blood flow based on an investigation of resorption of a radioactive indicator. The rate of decrease in radiation intensity over the tissue depot indicates the vascular permeability and tissue perfusion in the given region (Keti test).

Study Technique

Work was done on 15 rabbits of both sexes weighing 1930-2480 g. Hypokinesia was created by keeping the animals for 90 days in cages with limited space.

Na-I^{131} was used as an indicator. Studies were made with the help of a scintigrator made in the A. L. Polenov Neurosurgical Institute. The scintigrator included the following blocks: sensitive sensor with sodium crystal activated by thallium, and photomultiplier (FEU-29), amplitude analyzer AADO-1, scaler type "Floks" and power block PAA-1.

A cylindrical collimator 15 mm in diameter and 43 cm long was used.

The radio indicator (5 μCi in 0.5 ml of physiological solution) was administered into the femoral muscle of the rabbit on the level of the third retrofemur to depth of 8 mm.

The rate of impulse counting was recorded directly after

injection and for every subsequent 15 min. until a leveling was found in the concentrations at the site of the initial administration and above other fields, which indicated the resorption of the indicator.

The dynamics of resorption of the radio-active indicator in the studied and control groups is presented in the figure.

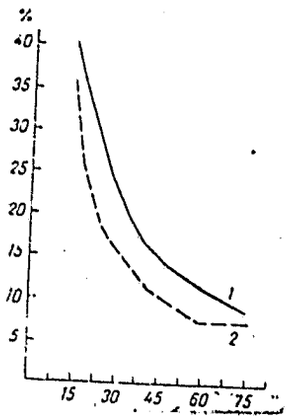
The section of the descending curve parallel to the x-axis indicates the leveling of the isotope concentrations at the site of its initial administration and above other fields, i.e., the practical resorption of the indicator.

In our observations the concentration leveling occurred in the studied animals in 75 min. , and in the control--in 60 min.

To evaluate the reliability of the differences in the condition of tissue blood flow in the studied and control groups the precise method of Fisher was employed for a four-field table with the use of V. S. Genes' table (Ye. V. Gubler and N. A. Genkin). Unidirectional effects in the samples in which the differences between them can be considered significant were comprised of amounts equal or exceeding the mean in the control group. Here the differences in both the studied groups were reliable.

Thus, the tissue blood flow was considerably altered under /80
the influence of hypokinesia. What are the causes of this phenomenon? Apparently, the previously studied factors, such as beat and per-minute volume of the heart, volume of circulating blood, decrease in pulse pressure and rate of blood flow could not help but affect the quality of the tissue perfusion. However, we found an additional factor which, in our opinion, also affects the conditions of microcirculation.

In our studies we determined the number of erythrocytes and the hematocrit.



Dynamics of Re:orption of Radio-Active Indicator in Hypokinesia (1) and in Control Animals (2).
On y-axis--radiation (in % of initial); on x-axis--time (in min.).

By knowing the number of erythrocytes in 1 mm^3 and the hematocrit index one can determine the erythrocyte volume.

$$\text{erythrocyte volume} = \frac{\text{hematocrit index} \times 10}{\text{number of erythrocytes}} \mu m^3.$$

Before hypokinesia the erythrocyte volume was equal to 78 μm^3, and after 3-month hypokinesia--107 μm^3 (normally it equals 80-90 μm^3).

Thus, the erythrocytes that are considerably increased in volume, in our opinion, impair capillary blood flow.

Conclusions

1. Hypokinesia lasting 90 days slows down tissue blood flow.
2. One of the factors that have a negative effect on tissue blood flow, is an increase in the dimensions of erythrocytes.
3. Disruption in tissue blood flow needs the appropriate correction.

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