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EFFECTS OF HYPOKINESIA AND HYPODYNAMIA ON THE
INTRAORGANIC ARTERIES OF THE HEART

L. A. Aleksina

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EFFECTS OF HYPOKINESIA AND HYPOKYNAMIA ON THE
INTRAORGANIC ARTERIES OF THE HEART

L. A. Aleksina
Department of Normal Anatomy, Pavlov
First Medical Institute, Leningrad

Research on the cardiovascular system in hypokinesia and hypodynamia has been /92 the subject of a great many publications by foreign and domestic authors (Yu. V. Vanyushina, 1963; P. V. Buyanov et al, 1966; V. S. Geyorgiyevskiy et al., 1967; Yu. V. Latova, 1967; Torphy, 1966; Vogt, Mack Jonson, 1966; Vogt, Jonson, 1967, etc.). However the overwhelming majority of these works have to do with changes in the function of the cardiovascular system. Very few deal with morphology. Thus, the appearance of necrotic foci in the rat myocardium when the animals have been immobilized for 24 hours was observed by Renaud (1959). Myocardial damage and development of atherosclerotic changes in physically inactive humans was noted by Raab, Silva, Marchet, Kimura, Starcheska (1960). I. K. Krasnykh (1969) established reduction in cardiac size for persons exposed to 70-73 hour hypokinesia.

In view of the great importance of hypodynamia and hypokinesia as a factor exhibiting a negative effect on the human organism, and also the paucity of morphological works available on the subject, the department of normal anatomy of the First Leningrad Medical Institute, under the direction of Prof. M. G. Prives, began in 1965 a systematic study of the effect of hypodynamia and hypokinesia on the organism and on its systems.

The present research is only the first link in this study as it affects the arteries of the heart.

For research material we used the hearts of 20 rabbits; 5 were the control and 15 were kept in small cages. The animals' mobility was severely limited. Hypokinesia lasted 2-12 weeks.

During the first days of hypodynamia and hypokinesia the rabbits appeared rest-

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Fig. 1. Myocardial capillaries of left ventricle in normal rabbit.

Fig. 2. Myocardial arteriole of left ventricle in normal rabbit.

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Fig. 3. Myocardial capillaries of left ventricle of rabbit heart following 2 weeks' hypokinesia and hypodynamia.

Fig. 4. Myocardial arteriole of left ventricle of rabbit heart following 10 weeks' hypokinesia and hypodynamia.

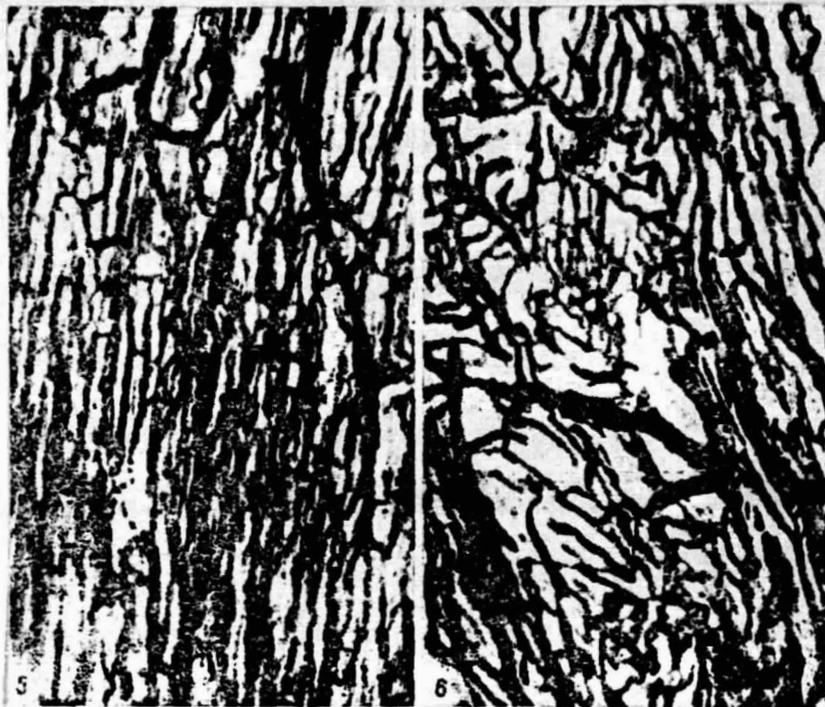


Fig. 5. Myocardial capillaries of left ventricle of rabbit heart following 10 weeks' hypokinesia and hypodynamia.

Fig. 6. Same following 12 weeks' hypokinesia and hypodynamia.

less and when the cages were opened at feeding time they tried to get out. Later on they "came to terms" with their situation and showed little reaction to their environment. It should be noted, that rabbits subjected to hypodynamia and hypokinesia are very prone to bronchial diseases and require great care and proper food.

Cardiac arteries were studied by injecting an India ink-gelatin mass into the coronary arteries. Following fixation in 10% formaline solution the heart was divided by cutting it into 4 sections (2 atria and 2 ventricles). Then 120 micron longitudinal and transverse sections were made on a refrigerating microtome. The sections were cleared by the Malygin method and the cleared preparations studied under a microscope at low magnification (ob. 8, oc. 10). More than 1,000 sections were examined. A filar micrometer was used to measure the vascular widths.

In the control specimens of cleared sections of the heart the myocardial capillaries lay along the muscle fibers (Fig. 1), their lumina measured 4-5 microns, the arterioles ran a course perpendicular to that of the muscle fascicules (Fig. 2).

Following the effect of hypodynamia and hypokinesia the picture of the cardiac arterial bed was changing. After 2 weeks' restriction of motor activity the myocardial capillaries contracted significantly to 1-3 microns and began to show sinuosity. During the same period of hypodynamia and hypokinesia the arterioles were dilated to 34 microns (Fig. 4). /94

As the period of hypodynamia and hypokinesia grew, there was gradual dilatation of the myocardial capillaries to 10 microns, the parallelism between the course of the capillaries and muscle fibers was disrupted and there appeared sinuosity and uneven vascular perfusion (Fig. 5).

Following 12 weeks' hypodynamia and hypokinesia (Fig. 6) all the changes described above were intensified. There was disruption of myocardial architectonics.

Thus, the degree of change in the vascular bed is a function of the length of mobility restriction. During the early periods of hypodynamia and hypokinesia the cardiac capillaries contract but later on they dilate. There was a change in the direction they took, sinuosity appeared and architectonics were altered.

The possibility of changes of a morphological type appearing in the vascular bed of the heart should be kept in mind in the case of patients committed to longterm bedrest and likewise in space flights where restricted mobility combines with weightlessness.

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