NASA TECHNICAL MEMORANDUM

NASA TM-76003

STATE OF THE MITRAL VALVE IN RABBITS WITH HYPOKINESIA

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Translation of "Stan mitral'nogo klapana sertsya krolikov pri gipokineziy," Dopovidi Akademii Nauk URSR, Seriya Geologichni, Khimichni ta Biologichni Nauky, Vol. 36. No. 1, 1974, pp. 72-75

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546 December 1979

STATE OF THE MITRAL VALVE IN RABBITS WITH HYPOKINESIA

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It is known that hypokinesia has become a widespread phenomenon. /72* Numerous clinical observations and experimental data indicate that it causes various disorders in human and animal organisms [1-5] and that it is one cause of the development of cardiovascular insufficiency [6-8].

Quite a number of works have been devoted to study of the morphological changes of the heart in hypokinesia [9-13]. However, no data are found in the literature available to us which refer to study of the effect of hypokinesia on such an important regulator of blood circulation as the valves of the heart.

At the suggestion of Prof. V.Ya. Karupu, the state of the mitral valve of rabbits during hypokinesia was studied.

Mild hypokinesia was induced in 20 sexually mature rabbits kept in narrow cages. After 1, 2, 4 and 7 months, the experimental animals were killed. Six control rabbits were held under vivarium conditions.

Experimental and control animal materials were fixed in formalin and embedded in paraffin. Sections were stained with hematoxylin and eosin according to van Gieson, Veygert, Heidenhain and Mallory and impregnated by the method of Gomori.

The animals lost weight from constant long term study (Fig. 1). The absolute weight of the heart also decreased from normal (6-8.1 g in the test animals and 7.1-8.5 g in the controls). The relative weight of the heart did not undergo particular changes (0.34 in the test and 0.43 in the controls).

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

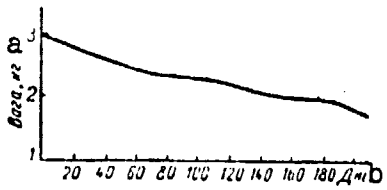

Fig. 1. Weight loss of rabbits during prolonged constant hypokinesia.

Key: a. weight, kg
b. days

In the animals under hypokinesia, disorders of the capillaries and dystrophic changes of all the internal organs, including the heart, increase. Against the background of the changes noted, considerable deviations develop in the structure of the heart valves. The most pronounced changes of the histological structure occur in the mitral valve. Thus, in the first month of the study with restriction of motion, a pronounced edema of the mitral valve tissues is noted. The endothelial cells which cover the atrial and ventricular surfaces of the mitral valve are disorganized and displaced with respect to each other. Their shape is crumpled: from oblong ovals, they are converted into polygons; they become cubic shpaes in places. In some endothelial projection areas, karyopycnosis and karyolysis are observed. At sites of endothelial cell breakdown, there are lumps of chromatin. The soft fibrous tissue of the subendothelial layer is edamatous. At times, disorientation (disorganization of the subendothelial cells is noted, while, in the control group, they basically are parallel to the endothelial layer. With change in the subendothelial layer, irritation of the elastic tissues and a decrease in number of elastic fibers must be noted. Destructive processes (fragmentation) occur in them.

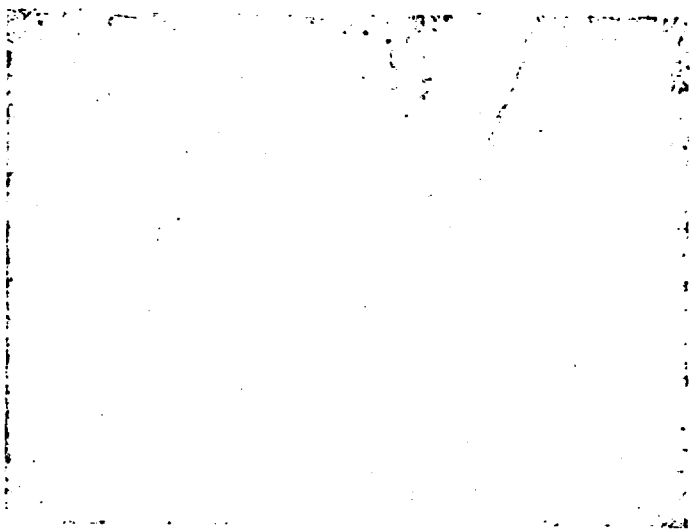

Fig. 2. Section of rabbit mitral valve. 7 months hypokinesia. Accumulation of collagen fibers in subendothelium of atrial portion of valve. Van Gieson's stain. X250.

As a result of hypokinesis, the total number of collagen fibers increases (Fig. 2). The number of them increases particularly in the subendothelial layer of the atrial portion of the valve. These fibers become thicker and homogeneous. They stain intensely with fuchsin; they become brick red in places. The number of connective tissue elements of the cells (fibroblasts,

fibrocytes) decreases. Parts are seen, in large areas of which they are not observed at all. The connective tissue layer of animals under hypokinesia is severely edematous. The muscle cells of the connective tissue layer are increased in size, because of the swelling of their cytoplasm. The boundaries between the smooth muscle cells frequently are difficult to recognize; the cytoplasmic outgrowths of these cells are diffuse and thick. The cytoplasm of the smooth muscle cells is slightly picrinophilic. Cells with vacuolized cytoplasm are noted. Between the smooth muscle cells, there are fibrocytes, fibroblasts and connective tissue fibers, of which a significant number are fibrils. In isolated observations, small blood vessels are found among the muscle fibers, the /75 lumens of which are somewhat constricted.

Fig. 3. Section of rabbit mitral valve. Seven months hypokinesia. Increase thickness of valve section due to marked edema. Enlarged intracellular spaces. Indistinct fibrous structure outlines. van Gieson's stain. X150.

With increase in duration of hypokinesia (4-7 months), deviations of the cytoarchitectonics of the mitral valve increase (Fig. 3, 4). Besides, more pronounced fibrosis of the layers of the valve is noted. Considerable changes are found in the ventricular part of the valve, where the number of collagen fibers increases 2-3 times, compared with the control.

Intensive fuchsinophilia and homogenization of the collagen fibers is traced. At the same time, the number of cell elements of the connective tissue decreases relative to the fibrous structures.

Thus, under experimental hypokinesia, the cytoarchitectonics of the mitral valve undergoes considerable changes, which progress, depending on the increase in duration of the experiment. Edema of the valve tissue appears first, and this leads to dystrophic and destructive changes in the cell elements of the fibers of the valve layers. Here, the proportion

Fig. 4. Section of rabbit mitral valve. Control observations. Normal structure. van Giesen's stain. X150.

between the fibrous structures of the connective tissue and the number of cell elements is disrupted. The latter generally are rarely found, and the collagen fibers become numerous, thick and have altered staining properties. The number of elastic fibers decreases.

Therefore, it can be concluded that, in hypokinesia, there are considerable changes in the valve structure, which result in a decrease in its elastic properties and changes in the proportions between the elastic and collagen fibers of the valves. All this results in limitation of the valve mobility and to cardiac valve insufficiency, which is found clinically.

Such disorders of the valves can be one cause of severe cardiovascular disorders in hypokinesis of various origins.

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