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CONNECTION BETWEEN MOSAIC PATTERN OF MYOCARDIAL LESIONS AND METABOLIC HETEROGENEITY OF THE MYOCARDIOCYTES

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Uridine-^{3}H (2 μCi/g) was injected intraperitoneally into albino mice followed 1 h later by isopropylnoradrenalin (0.1 mg/g), and after an interval of 10 min the animals were killed. Autoradiographic analysis and polarization-microscopic investigation of sections through the myocardium showed that primarily myocardiocytes with a lower level of RNA synthesis developed contracture lesions.

KEY WORDS: heterogeneity of myocardiocyte nuclei; RNA synthesis; mosaic pattern of myocardial lesions.

Myocardial lesions as a rule are mosaic in pattern. This is true both of metabolic lesions, affecting single cells or groups of cells [2, 5], and also of myocardial infarcts [1], when cells are damaged at different times and the type of lesion varies [6]. The causes of this heterogeneity are not clear. It has been suggested that at each given moment different muscle cells of the heart are in different states, possibly on account of some cyclic pattern of their vital activity [4]. Sarkisov and Vtyurin [3] proved that renewal of the intracellular structures of the myocardial cells takes place in a cyclic manner. It is therefore natural to suppose that the heterogeneity of lesions to myocardiocytes may reflect their metabolic heterogeneity [5].

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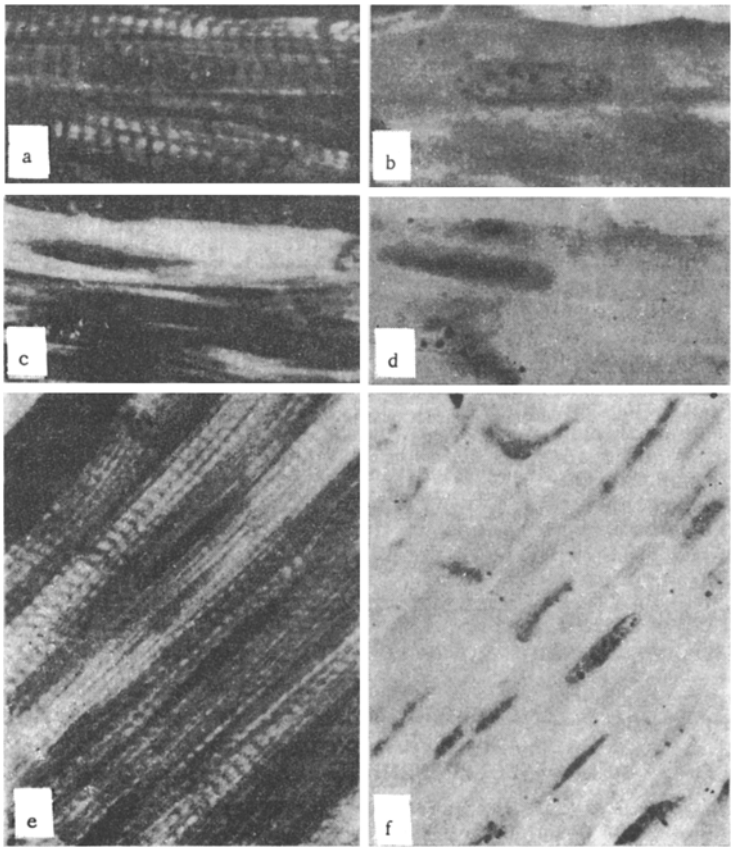

Fig. 1. Distribution of grains of silver among nuclei of normal myocardiocytes and myocardiocytes in a state of contracture after injection of uridine-^{3}H: a) unchanged segment in polarized light; b) the same, in normal light; c) upper segment in state of contracture, lower unchanged (polarized light); d) the same, in normal light; e) area of myocardium in polarized light: some fibers unchanged, some segments in a state of contracture; f) the same in normal light. Hematoxylin–eosin, objective 100×, photographic enlargement 2.7.

To test this hypothesis an investigation was carried out in an attempt to discover whether the vulnerability of the myocardial cells after injection of toxic doses of isopropylnoradrenalin is connected with the level of RNA synthesis in the nuclei of the myocardiocytes.

EXPERIMENTAL METHOD

Experiments were carried out on six male BALB mice weighing 20 g, which were given an intraperitoneal injection of uridine-^{3}H in a dose of 2 μCi/g (specific activity 11 μCi/mmole), followed 1 h later by isopropylnoradrenalin sulfate (0.1 mg/g). The animals were killed 10 min later and the heart fixed with formalin and embedded in paraffin wax in the usual way. Paraffin sections 5-7 μ thick were dewaxed and covered with type M emulsion and exposed for 1 month. After development the sections were stained with hematoxylin–eosin and examined in normal and polarized light.

EXPERIMENTAL RESULTS

Label incorporated into RNA of the nuclei is known to be almost completely preserved in them for the first 2 h [7]. Injury to the cells in the early stages (10 min after injection of the noxious agent) was determined by polarization microscopy. This time is short enough to ensure that the results of the investigation were not influenced by differences in cell metabolism which could arise as a result of the action of the noxious agent. It can accordingly be concluded that incorporation of the radioactive label into the nuclei of the myocardiocytes reflected the pattern which existed at the moment of injury.

TABLE 1. Total Number of Grains of Silver above Nuclei of Myocardiocytes in Normal State and with Lesions of Contracture Type

Animal No.	Normal cells		Injured cells	
	number of nuclei	total number of silver grains	number of nuclei	total number of silver grains
1	20	261	20	16
2	20	301	20	47
3	20	250	20	19
4	20	190	20	25
5	20	216	20	40
6	20	286	20	18

Cells with lesions of the contracture type [5], distinguished by increased anisotropy and by a varied degree of approximation of the A disks could be distinguished in the myocardium 10 min after injection of isopropylnoradrenalin. The number of grains of silver was counted above the nuclei of the myocardiocytes in a state of contracture and those which preserved their normal structure (Fig. 1).

The results are given in Table 1. They show that cells in which RNA synthesis at the time of injury was at a much lower level than in the cells which remained intact underwent changes of the contracture type. The differences were significant with respect to Wilcoxon's criterion.

The experiments thus showed that the population of myocardiocytes is heterogeneous as regards the level of RNA synthesis in their nuclei and that that fraction of the cells in which the level of RNA synthesis is lower is the most likely to undergo changes of contracture type.

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