EFFECT OF STRONG ELECTRICAL STIMULATION ON CONTENT OF CATECHOLAMINES AND GLYCOGEN IN RAT LIVER

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Electrical stimulation of rats for 3 h causes a sharp decrease in the catecholamine content in the liver. The liver glycogen content falls appreciably after stimulation for 15 min and even more considerably after stimulation for 3 h.

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Degeneration of the liver developing in rats as a result of electrical stimulation for 3 h is reflex in character, the efferent part of the reflex evidently being formed by sympathetic nerves [3]. Catecholamines are known to have an important role in metabolism of carbohydrates, lipids, and proteins [4]. However, no attempt has yet been made to study the content of catecholamines in the liver tissue of rats during prolonged and strong stimulation. Procedures stimulating sympathetic nerves cause activation of the adenylcyclase–phosphorylase enzyme system and, consequently, cause glycogen breakdown [5]. The liver glycogen level can thus be regarded as an index of the influence of the sympathetic nervous system and adrenalin on liver tissue.

The object of the present investigation was to study the content of catecholamines (noradrenalin and adrenalin) and the glycogen level in the liver tissue during prolonged electrical stimulation of animals.

EXPERIMENTAL METHOD

Experiments were carried out on adult male rats weighing 190-250 g, after preliminary fasting for 24 h. The rats were immobilized and stimulated through electrodes implanted into the forelimbs, using square pulses generated by an electronic stimulator (50/sec, 10 msec, 5-7 V) for 3 h [2]. Intact rats served as controls. Immediately after the experiment ended the animals were decapitated and the liver was removed, washed with physiological saline to remove blood, and placed in liquid oxygen. The organ was ground to powder, and a weighed sample (200 mg tissue) was transferred into 5% trichoroacetic acid and homogenized. Catecholamines were determined fluorometrically by Euler's method as modified by V. A. Govyrin [1]. The liver glycogen content of rats stimulated for 3 h or 1 or 15 min was determined by van der Kley's method [6].

EXPERIMENTAL RESULTS

The noradrenalin and adrenalin content in the liver of the intact animals agreed with data in the literature [7].

A sharp decrease (by 80%) in the noradrenalin content was observed in the liver of rats stimulated for 3 h compared with the control (Fig. 1). In some experimental animals the noradrenalin level fell so low that it could not be determined by the method used. The adrenalin content in the liver also fell sharply (Fig. 1).

The glycogen content in the liver fell significantly in rats stimulated for 15 min, and after stimulation for 3 h this index fell even more sharply (Fig. 2).

Stimulation of the animals for 3 h thus led to a sharp decrease in the level of both catecholamines and glycogen in the liver tissue.

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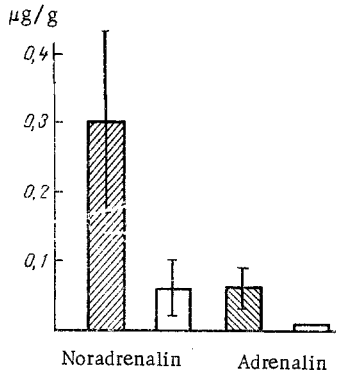

Fig. 1

Fig. 1. Effect of electrical stimulation of rats for 3 h on catecholamine content (in μg/g fresh tissue) in liver. Shaded columns represent control, unshaded columns experiment.

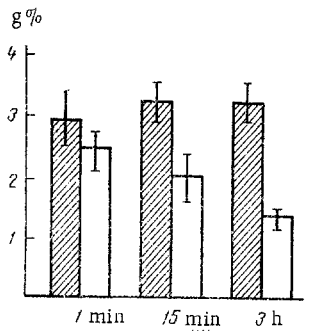

Fig. 2

Fig. 2. Glycogen content (in g%) in liver of rats stimulated for different periods. Legend as in Fig. 1.

The decrease in content of noradrenalin and adrenalin can be regarded as the result of exhaustion of their reserves in the liver tissue. The exhaustion evidently results from increased release of catecholamines from the tissue depots under the influence of the strong stream of sympathetic impulses arising during intensive stimulation of the animals. This suggestion is confirmed by the observed changes in the liver glycogen level after stimulation for only 15 min.

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