CHANGES IN OPTICAL DENSITY OF MITOCHONDRIA IN THE GASTRIC MUCOSA AND LIVER IN NEUROGENIC DEGENERATION

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In response to stimulation of the duodenal region and hypothalamus, a decrease in optical density and in contractility of the mitochondria is observed in the gastric mucosa and liver cells.

It has been shown by electron microscopy that one of the earliest signs of neurogenic degeneration is the appearance of structural changes in mitochondria in the tissues of various organs [2,3]. However, not all mitochondria on electron micrographs showed injury, but only some of them.

It was therefore decided to examine the mean changes in mitochondrial function in tissues of the same organs in the early stages of development of neurogenic degeneration. This was done by means of a cytobiochemical analysis, using spectrophotometric determination of the optical density of mitochondria isolated from homogenates of the gastric mucosa and the liver.

EXPERIMENTAL METHOD

Experiments were carried out on male rabbits weighing 2.8-3.5 kg. Degenerative changes were produced in two ways: by a reflex method of traumatization of the duodenal region [1] and a central method – electrical stimulation of the posterior hypothalamus through implanted electrodes [4]. In both cases stimulation took place for 15 min, after which the animals were killed by injection of air into an auricular vein. Intact animals were used as controls. A weighed sample of tissue (1.5 g) was homogenized in the cold. Mitochondria were isolated from the homogenate by the method of Hogeboom and Schneider [6]. The optical density was measured with a type SF 4-A spectrophotometer at 520 mμ in 0.15 M KCl solution by Cleland's method [5]. Before determination of the optical density began, 0.1 ml of K-phosphate buffer, pH 7.4, was added to the cell containing 0.1 ml of mitochondrial suspension. The optical density was measured every 2-5 min. At 30 min, 0.05 ml of ATP solution (0.005 M ATP + 0.05 M $MgCl_2$) was added to the cell, after which measurements were repeated during the next 30 min.

The optical density of the mitochondria in the control and experimental samples was estimated by calculating the extinction per milligram protein as determined by the biuret reaction. The contractility of the mitochondria was estimated from the change in optical density on addition of ATP.

EXPERIMENTAL RESULTS

During traumatization of the duodenal region for 15 min, the optical density of mitochondria isolated from homogenates of the gastric mucosa and from the liver fell sharply (Table 1).

As swelling continued, the optical density of the mitochondria of the stomach and liver fell almost equally in the control and experimental animals. However, the reaction of the mitochondria to ATP was appreciably smaller in the stimulated animals (Table 1).

Stimulation of the posterior hypothalamus also lowered the optical density and contractility of mitochondria of the gastric mucosa and liver, although to a lesser degree than stimulation of the duodenum (Table 1).

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TABLE 1. Changes in Optical Density of Mitochondria in Gastric Mucosa and Liver during Stimulation of Duodenal Region and Hypothalamus

Time of determination	Stomach			Liver		
	control (12 experiments)	stimulation of		control (11 experiments)	stimulation of	
		duodenal region (8 experiments)	hypothalamus (10 experiments)		duodenal region (7 experiments)	hypothalamus (10 experiments)
Initial value	0,67 (0,76—0,58)	0,4 (0,58—0,22)	0,49 (0,68—0,30)	0,69 (0,86—0,52)	0,56 (0,79—0,33)	0,56 (0,69—0,43)
After 30 min	0,57 (0,63—0,49)	0,29 (0,41—0,17)	0,45 (0,63—0,27)	0,63 (0,78—0,48)	0,38 (0,53—0,23)	0,53 (0,65—0,41)
2 min after addition of ATP	0,73 (0,85—0,61)	0,36 (0,49—0,23)	0,56 (0,76—0,36)	0,75 (0,90—0,60)	0,51 (0,69—0,33)	0,66 (0,80—0,52)

Limits of variations of indices given in parentheses.

Hence, during application of an extreme stimulus, leading eventually to degenerative changes in various organs, for a period of only 15 min, i.e., in the very early stages, not only structural [2,3], but functional changes were observed in the mitochondria.

The structural changes were manifested on the electron micrograph as swelling of the mitochondria, disturbance of their internal structure, and a decrease in electron density of their matrix. The functional changes were manifested as a decrease in optical density and contractility of the mitochondria.

LITERATURE CITED

1. I. S. Zavodskaya, Farmakol. i Toksikol., No. 2, 37 (1955).
2. I. S. Zavodskaya and A. A. Manina, Byull. Éksperim. Biol. i Med., No. 3, 75 (1967).
3. A. A. Manina and I. S. Zavodskaya, in: Problems in Pharmacology and Experimental Pharmacotherapy [in Russian], Leningrad (1966), p. 22.
4. E. V. Moreva, in: Problems in Pharmacology and Experimental Pharmacotherapy [in Russian], Leningrad (1966), p. 26.
5. K. W. Cleland, Nature, 170, 497 (1952).
6. G. H. Hogeboom, W. C. Schneider, et al., J. Biol. Chem., 172, 619 (1948).