ENZYME ACTIVITY OF THE REGENERATING PANCREAS IN RESPONSE TO STIMULATION

E. V. Kadilov and V. V. Kozlova

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Activity of succinate dehydrogenase, lactate dehydrogenase, α-glycerophosphate dehydrogenase, and acid phosphatase was studied after resection of 50% of the pancreas in rats and during stimulation with an extract of the homologous organ as described by V. P. Filatov. During the first days after resection activity of the oxidoreductases fell, then rose gradually to exceed the normal value in some cases, after which the level fell slightly to its initial value on the average by the 30th day. Injection of the tissue extract led to an increase in the enzyme activity over the control in the acinar and insular portions of the gland, so that the characteristic level of activity for intact animals was quickly regained and exceeded from the 15th day of observation.

Reports of the investigations of regeneration of the pancreas tend to consist mainly of a description of the general histological picture of regeneration of the organ [3, 5, 7, 8] or an analysis of the quantitative changes [2, 4, 6, 9]. Metabolism during regeneration of the pancreas has been inadequately studied.

The object of the investigation described below was to study changes in the activity of certain enzymes in the resected pancreas during stimulation.

EXPERIMENTAL METHOD

Experiments were carried out on 80 albino rats weighing 120-140 g. Half the pancreas was removed from the animals. An extract of the homologous organ, prepared by V. P. Filatov's formula in a dilution of 1:1000, was injected in a dose of 0.04 ml/100 g body weight daily into 40 animals of the experimental group from the 1st until the 25th day. The remaining pancreatectomized animals acted as the control. Initial data for the activity of the enzymes studied were obtained from a separate group of intact animals. The rats were decapitated on the 1st, 3rd, 5th, 10th, 15th, and 30th days after the operation. Activity of succinate (SDH), lactate (LDH), and α-glycerophosphate (α-GDH) dehydrogenases in cryostat sections of the pancreas 10μ in thickness was determined by the method of Nachlas et al. [1]. Activity of acid phosphatase (AP) was determined by Gomori's method.

EXPERIMENTAL RESULTS

Oxidoreductases were detected in the intact, control, and experimental animals as granules of di- and monoformazan of different sizes in the cytoplasm of the acinar and insular cells. Weak activity of the enzyme was graded as 1 point, an increase in the intensity of staining of the granules and in the quantity of enzyme activity was assessed as moderate (2 points); high activity was the term given to a considerable content of formazan granules in the cytoplasm of the cells, detectable as diformazan (3 points); a further increase in the quantity and intensity of the granules was described as very high activity and graded as 4 points (Table 1).

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TABLE 1. Activity of Pancreatic Enzymes (in points) in Intact, Control, and Experimental Animals at Various Times of Observation

Enzymes	Intact animals		Control animals												Experimental animals									
			days of observation																					
			1		3		5		10		15		30		1		3		5		10		15		30	
	acinar portion	insular portion	AP	IP	AP	IP	AP	IP	AP	IP	AP	IP	AP	IP	AP	IP	AP	IP	AP	IP	AP	IP	AP	IP	AP	IP
SDH	3	1	2	1	2	3	2	3	2	2	3	3	3	3	2	1	3	2	3	3	2	2	4	4	4	4
LDH	2	1	2	1	2	2	2	2	3	2	3	3	2	2	2	1	3	2	3	2	3	2	3	3	3	2
α-GDH . .	2	3	1	2	2	3	2	3	3	3	3	3	2	3	1	2	2	3	3	4	3	4	3	4	2	3
AP	1	2	2	3	2	3	2	3	2	3	2	3	2	3	2	3	3	3	3	4	3	4	3	4	1	3

Note: AP, acinar portion; IP, insular portion.

The most active enzyme of the acinar epithelium was SDH, and α-GDH was less active. In the insular cells, on the other hand, α-GDH was more active and LDH less active. Besides in the acinar and insular cells, the enzymes were also detected in the epithelial cells of the efferant ducts, in the endothelial and smooth-muscle cells of the blood vessels, and in the cytoplasm of some connective-tissue cells of the stroma. AP was detected as pale and dark brown granules, large and small, in the nuclei and cytoplasm of the acinar and insular epithelium. In the intact animals SDH activity in the acinar epithelium was high, but in the insular epithelium it was weak. Activity of LDH in the acinar cells of the intact animals was moderate, but weak in the insular cells; the distribution of α-GDH activity was the opposite. Activity of AP was weak in the acinar and moderate in the insular cells.

In the zone of resection in both control and experimental animals there was a sharp decrease in SDH, LDH, and α-GDH activity, which was estimated as weak. AP in this zone appeared as numerous dark brown granules in the cytoplasm of the acinar and insular cells, which showed destructive changes. High AP activity was present in the leukocytes and connective-tissue cells. In parts of the gland remote from the zone of resection, SDH activity in the experimental animals on the 15th and 30th days of the experiment was much higher than in the control. The difference was not significant at earlier periods.

Activity of the enzymes in the control animals was much lower than in the intact animals. From the 3rd until the 30th day an increase in SDH activity was found in the insular part of the gland in the control animals, and an even more marked increase in the experimental animals. LDH activity in the acinar epithelium was indistinguishable from the normal in the control animals on the 1st, 3rd, 5th, and 30th days, while in the experimental animals it was considerably higher than the control on the 3rd, 5th, and 30th days. The increase in LDH activity in the acinar portion of the pancreas in the experimental animals took place before the time of its increase in the control animals, and the increase itself was greater. AP activity in the experimental animals was higher in all parts of the organ and at all times than in the controls.

The results of these investigations can be summed up in the conclusion that after removal of 50% of the pancreas activity of the oxidoreductases falls and AP activity rises in the early periods of observation in the zone of resection and in remote parts of the gland. In the control animals, starting from the 15th day, enzyme activity at a distance from the site off resection rises, to reach the level of the enzyme activity in the intact animals in the acinar portion and to exceed their level in the insular portion by the 30th day.

After administration of tissue extract the activity of the enzymes in the acinar and insular cells rose faster than in the control animals, and exceeded the activity of these enzymes in the intact animals with effect from the 15th day of observation.

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