NUCLEO-CYTOPLASMIC AND NUCLEOLO-NUCLEAR RATIOS IN ISLET CELLS OF THE REGENERATING PANCREAS

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The study of nucleo-cytoplasmic and nucleolo-nuclear ratios in the pancreatic islet cells of adult rats 6 and 12 h and 1, 2, 3, 5, 15, 30, 90, and 180 days after resection of half the pancreas showed that the course of regeneration in the islet cells possesses its own distinctive pattern and differs significantly from the processes taking place in the acinar cells.

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Investigations [1-9] have shown that regeneration of the pancreas takes place by regeneration hypertrophy [3]. However, none of these investigations included a close study of the islet cells by the detailed analysis of nucleo-cytoplasmic and nucleolo-nuclear ratios, and the present investigation was carried out for this purpose.

EXPERIMENTAL METHOD

Experiments were carried out on male albino rats weighing 110-116 g. The animals undergoing operation (resection of half the pancreas) and control animals were sacrificed in groups of 10 at a time 6 and 12 h and 1, 2, 3, 5, 30, 90, and 180 days after the operation. The material was fixed by Carnoy's method. Paraffin sections were stained with hematoxylin and eosin and by the methods of Ross and Flaherty. The areas of the nucleoli, nuclei, and cytoplasm of the islet cells in the sections of the pancreas were determined by tracing their outlines, cutting them out, and weighing them. The number of nucleoli per nucleus

TABLE 1. Nucleo-Cytoplasmic and Nucleolo-Nuclear Ratios in Islet Cells of Pancreas in Pancreatectomized and Control Rats

Time of observation	Group of animals	Mean area (in μ^2)			Ratio		Number of nucleoli per nucleus
		Of nucleolus	of nucleus	of cytoplasm	Nucleolo-nuclear	Nucleo-cytoplasmic	
6 h	Experimental	1,5	16.8	64.0	0.089	0.26	1.4
	Control	1.6	17.5	63.7	0.091	0.26	1.4
12 »	Experimental	1.5	17.0	63.2	0.090	0,27	1.4
	Control	1.6	17.3	62.8	0 092	0.28	1,4
1 day	Experimental	1.6	17.6	63,3	0.091	0,28	1,4
	Control	1.5	17.3	63.0	0,087	0,28	1.4
2 days	Experimental	1.6	18,3	63,3	0.087	0.29	1.4
	Control	1.5	17.4	62.9	0.086	0.28	1.3
3 »	Experimental	1.8+	19.0	63.2	0.095	0,30	1,6
	Control	1.6	17,8	63,0	0.090	0.28	1,4
5 days	Experimental	2.0+	22,3+	61,5+	0.090	0.36+	1.8+
	Control	1.6	17.8	62.8	0.090	0,28	1,4
15 »	Experimental	2.1+	23,1+	61.4+	0.091	0,38+	1.6+
	Control	1.6	17.6	62,8	0,091	0,28	1.3
1 month	Experimental	1.8+	20.2+	62,4	0.090	0,32+	1.4
	Control	1,6	17.7	63.1	0.090	0,28	1.4
3 months	Experimental	1.7	18.7	62.9	0,091	0,30	1,4
	Control	1.6	18,3	62,8	0,087	0.29	1,5
6 months	Experimental	1.6	18,4	63.0	0.087	0.30	1.4
	Control	1.6	18,2	62.8	0.088	0.29	1.5

Note. The + sign indicates that differences between the experimental and control groups are statistically significant.

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was calculated and the nucleolo-nuclear and nucleo-cytoplasmic ratios in the islet cells were determined. The results given below are based on the statistical analysis of the numerical data.

EXPERIMENTAL RESULTS

As Table 1 shows, the nucleo-cytoplasmic ratio in the islet cells of the regenerating pancreas was increased on the 5th, 15th, and 30th days of the experiment. The increase in this parameter on the 5th and 15th days of the experiment was due, on the one hand, to an increase in area of the nucleus (by 27 and 31%, respectively) and, on the other hand, to a decrease in the area of the cytoplasm (by 11 and 9%, respectively). The increase in the nucleo-cytoplasmic ratio on the 30th day of the experiment was due entirely to an increase in area of the nucleus (by 10%). Meanwhile, this ratio remained unchanged on the 3rd day of the experiment, although the mean area of the nucleus at this time showed a tendency to increase (by 8%). Consequently, the changes in the nucleo-cytoplasmic ratio in the islet cells of the regenerating pancreas were mainly due to an increase in size of the nucleus, although the increase in area of the nucleus was not always accompanied by an increase in the nucleo-cytoplasmic ratio. A decrease in the mass of cytoplasm was also concerned in the increase in this parameter. Analysis of the nucleolo-nuclear ratio showed that this parameter remained unchanged throughout the experiments. When separate measurements were made of the area of the nucleus and area of the nucleolus, the rate of their increase was about the same in each case. The changes in size of the nucleus have already been discussed above. So far as the area of the nucleolus is concerned, this was increased on the 3rd, 5th, 15th, and 30th days of the experiment. Meanwhile an increase in the number of nucleoli per nucleus was found on the 5th and 15th days of the experiment. As the results show, the increase in this parameter coincided with a sharp increase in size of the nuclei on the 5th and 15th days of the experiment. Consequently, the nucleolo-nuclear ratio in the islet cell of the regenerating pancreas remained unchanged as a result of the identical rate of change in area of the nucleolus and nucleus.

Changes taking place in the course of regeneration hypertrophy of the pancreas have been inadequately studied. This is particularly true of the islet part of the gland. Admittedly changes in the nucleo-cytoplasmic ratios in this part of the pancreas are associated with an increase mainly in the size of the nucleus, as is observed also in the acinar part of the organ [6], but this is not a general rule.

The results show that, by contrast with the acinar part of the gland, the increase in area of the nucleus in the islet cells is not always accompanied by an increase in the nucleo-cytoplasmic ratio in the experimental animals. Another interesting feature is that this ratio in the islet cells is subjected to the influence of a decrease in the area of the cytoplasm, whereas in the acinar cells the area of the cytoplasm increases. The nucleolo-nuclear ratio in the regenerating islet cells remained unchanged as a result of the identical rate of change in the size of the nucleus and nucleoli, whereas in the acinar cells the decrease in this ratio which is observed is determined by the greater increase in area of the nucleus. A further contribution toward preservation of the stability of this parameter in the islet cells was made by an increase in the number of nucleoli per nucleus, which was not observed in the acinar cells.

Hence, the course of regeneration in the islet cells follows its own pattern which differs significantly from that of regeneration in the acinar cells.

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