MORPHOLOGICAL ANALYSIS OF THE EXOCRINE PART OF THE REGENERATING PANCREAS

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Determination of the area and number of acini, acinar cells, and their nuclei in the pancreas of partially pancreatectomized rats showed that the observed changes take place in two periods. In the first period (one month) there is an increase in size of the acini because of hypertrophy and hyperplasia of the cells, while in the second period (up to 6 months of observation) the size of the acini comes closer to that in the control because of a decrease in the size and number of the cells.

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The views of those workers [2, 4, 7, 9] who regard processes taking place in the resected pancreas as regeneration hypertrophy [3, 6] can be accepted. However, processes taking place in the acinar cells of the regenerating pancreas have not yet received adequate study, and the present investigation was carried out for this purpose.

EXPERIMENTAL METHOD

Experiments were carried out on male albino rats weighing 105-118 g. Pancreatectomized (resection of about 50% of the pancreas) and control animals were sacrificed in groups of 20 at a time, 6 and 12 h and 1, 2, 3, 5, 15, 30, 90, and 180 days after the operation. Material was fixed in Carnoy's fluid. Paraffin sections were stained with hematoxylin-eosin and by the methods of Ross and Flaherty. Changes in the area and number of structural elements of the pancreas were studied in histological preparations by the method of drawing and weighing. The results given below are based on statistical analysis of the numerical data.

EXPERIMENTAL RESULTS

As Table 1 shows, the area of an acinus was increased 5, 15, and 30 days after partial pancreatectomy. It is interesting to note that the observed increase in area of the acinus on the 5th day of the experiment was due to an increase in the area occupied by the cells in the acinus. On the 15th and 30th days of the experiment, the increase in size of the acinus was due not only to an increase in area of the cells, but also an increase in the area of its lumen.

The state of individual acinar cells in the regenerating pancreas also was analyzed. The increase in area occupied by the acinar cells was found to be due to hypertrophy of individual cells. To begin with (on the 5th day of the experiment) the acinar cell increased in size in its basal part. Later (on the 15th and 30th days of the experiment) the increase in size of the cell was due to enlargment of both its basal and apical parts, but to different degrees. The area of the nucleus was also examined. In the acinar cells of the regenerating pancreas the area of the nucleus was found to be increased on the 2nd, 3rd, 5th, 15th, and 30th days of the experiment.

Analysis of hyperplasia in the exocrine part of the regenerating pancreas revealed an increase in the number of cells per acinus on the 5th and 15th days of the experiment. The number of nucleoli per acinus was also increased at these times.

Hence, after resection of half the pancreas, an increase in size of the structural units (acini) was observed in the regenerating organ on the 5th, 15th, and 30th days of the experiment. This increase is

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TABLE 1. Changes in Area and Number of Structural Elements in Exocrine Parts of Pancreas in Pancreatectomized and Control Rats

Time of observation	Group of animals	Mean area (in μ^2)										Number per acinus			
		acinus		of lumen of acinus		occupied by cells in acinus		of acinar cell		of nucleus		cells		nucleoli	
		numerical value	P	numerical value	P	numerical value	P	numerical value	P	numerical value	P	numerical value	P	numerical value	P
6 h	Experimental	631,1	0,623	15,3	0,921	615,8	0,921	98,2	0,768	18,4	0,844	5,9	0,694	6,8	0,768
	Control	633,3		15,4		617,9		97,4		18,3		6,0		6,9	
12 »	Experimental	642,2	0,286	15,4	1,000	626,8	0,623	98,3	0,768	18,2	0,493	5,9	1,000	6,8	1,000
	Control	628,8		15,4		613,4		97,7		18,1		5,9		6,8	
1 day	Experimental	643,2	0,380	15,5	1,000	627,7	0,380	98,3	0,694	18,6	0,380	6,0	1,000	6,9	1,000
	Control	631,1		15,5		615,6		97,4		18,4		6,0		6,9	
2 days	Experimental	644,7	0,694	15,6	0,768	629,1	0,246	98,4	0,844	20,9	0	6,2	0,179	7,0	0,694
	Control	629,9		15,5		614,4		97,7		18,5		6,0		6,9	
3 »	Experimental	644,8	0,286	15,8	0,623	629,0	0,210	99,6	0,556	20,9	0	6,2	0,623	6,9	1,000
	Control	632,7		15,6		617,1		98,0		18,1		5,9		6,9	
5 days	Experimental	673,1	0,002	15,9	0,106	657,2	0,003	105,2	0,008	22,2	Transgression absent	6,5	0	7,6	0,003
	Control	630,6		15,6		615,0		98,2		18,0		5,9		6,9	
15 »	Experimental	684,4	0	16,4	0,001	668,0	0	110,3	Transgression absent	24,1	То же	6,7	Transgression absent	7,8	0,002
	Control	629,4		15,4		614,0		98,0		18,3		6,0		7,0	
1 month	Experimental	672,3	0,005	17,1	0	655,2	0,008	104,3	0,015	21,5	» »	6,1	0,179	7,1	0,331
	Control	631,2		15,5		615,7		98,2		18,6		5,9		6,9	
3 months	Experimental	641,1	0,380	15,8	0,022	625,3	0,694	98,5	1,000	19,2	0,061	6,0	0,380	6,9	1,000
	Control	629,9		15,3		614,6		98,3		18,6		5,9		6,9	
6 months	Experimental	624,8	0,493	15,5	1,000	609,3	0,844	98,0	0,921	18,4	0,556	5,9	1,000	6,9	0,623
	Control	630,2		15,5		614,7		98,3		18,3		5,9		7,0	

attributed to hypertrophy and hyperplasia taking place in the acinar cells, as other workers have described [1, 4]. However, the workers cited did not obtain data from which a detailed analysis could be made of these processes. The present findings indicate that an increase in area of the nuclei takes place before the increase in area of the cells. Besides these processes of hypertrophy taking place in the acini, hyperplasia was also detected. This was observed in the period of most marked hypertrophy of the structural elements of the regenerating organ.

The early increase in area of the nucleus and of the basal part of the acinar cell indicates preparation of the cell for increased function during structural changes taking place in the regenerating organ. In addition, the early increase in area of the nucleus is evidently associated with an increase in mitotic activity of the acinar cells [8], which some workers [5] regard as the main cause of the increase in mass of the exocrine part of the regenerating pancreas. The present results show that the increase in mass of the exocrine part of the regenerating pancreas is due to hypertrophy and hyperplasia of its structural elements.

The results obtained in the later stages of the present experiments are in agreement with those obtained by Sidorova and Babaeva [10], who describe convergence of areas of the acini in experimental and control animals on the 165th day after pancreatectomy.

Hence, two periods can be distinguished in the changes taking place in the rat pancreas after resection. The first period is marked by an increase in size of the acini, mainly on account of hypertrophy and hyperplasia of the cells and their component elements (lasting one month from the beginning of the experiment). The second period of observation (up to 6 months) is marked by convergence between the area of the acini and their area in the control group, on account of a decrease in the size and number of cells. In other words, normalization of structure of the regenerating gland takes place.

LITERATURE CITED

1. N. D. Aseeva, Regeneration of the Pancreas in Some Vertebrates. Author's Abstract of candidate dissertation, Tashkent (1967).
2. A. G. Babaeva, L. D. Liozner, and V. F. Sidorova, in: Proceedings of the 4th Conference on Regeneration and Cell Multiplication [in Russian], Moscow (1964), p. 9.
3. M. A. Vorontsova, Restoration of Lost Organs in Animals and Man [in Russian], Moscow (1953).
4. N. F. Gusakova, in: Conditions of Regeneration of Organs and Tissues in Animals [in Russian], Moscow (1966), p. 63.
5. K. A. Zufarov and N. D. Aseeva, Uchen. Zapiski Anat., Gistol. i Émbriol. Resp. Srednei Azii i Kazakhstana, No. 2, 198 (1966).
6. L. D. Liozner, Abstracts of Proceedings of the 2nd Conference on Regeneration and Cell Multiplication [in Russian], Moscow (1960), p. 58.
7. S. S. Raitsina, L. M. Farutina, and V. N. Kashintseva, Arkh. Anat., No. 10, 43 (1965).
8. G. G. Samsonidze, M. I. Chichinadze, and A. I. Nikolaishvili, in: Regeneration and Cell Division [in Russian], Moscow (1968), p. 379.
9. G. V. Segida, Byull. Éksperim. Biol. i Med., No. 11, 88 (1962).
10. V. F. Sidorova and A. G. Babaeva, in: Conditions of Regeneration of Organs and Tissues in Animals [in Russian], Moscow (1966), p. 258.