

REGENERATION OF LIVER TISSUE AFTER PARTIAL HEPATECTOMY IN LABORATORY RATS : ITS EFFECT ON THE COMPOSITION OF BLOOD AND LIVER TISSUE ¹

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Changes in the composition with respect to total proteins, protein fractions and total lipids in the liver tissue and in the blood were studied in laboratory rats after they were partially hepatectomized. On comparing the composition of regenerated liver tissue with that of its normal counterpart, it was observed that total proteins, albumin, globulin and total lipid contents were being restored to normal or nearly normal level during the period of regeneration. Likewise the comparison of the composition of blood of normal and of hepatectomized animals, with that of liver tissue, normal and regenerated, showed similar changes in the blood constituents, thus resembling the change of pattern seen in the liver tissue.

When partial hepatectomy is performed in animals such as laboratory rats, the ensuing proliferative process is due to the "depletion stimulus" resulting from the removal of the liver substance (Drabkin, 1947; Marsh *et al.*, 1955). The composition of blood and regenerating liver tissue was studied in partially hepatectomized animals with a view to find out a correlated chemical description of regenerative growth of the liver tissue. The results of this study are set forth here in this paper.

METHODS

Adult albino rats weighing about 175 to 220 g were used. Records regarding their preoperative weight, postoperative weight etc. were kept. A twenty-four hour fasting period was kept both before the operation for partial hepatectomy and the sacrifice of the animals, after eight days of postoperative period. The median and left lateral lobes were removed at the time of the operation. The portion of the liver tissue thus removed which was analysed served as a control tissue for comparison of chemical composition. In addition to this, second group of control animals from the same litter-mates, was kept along with the experimental group. The animals of this control group were given the same amount of diet, which consisted of 18 per cent of proteins, as was taken by the animals of the experimental group. The animals

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belonging to the control group were sacrificed by decapitation. Blood samples from these two groups, namely, control and experimental, were collected for analysis.

The moisture content was determined in the liver tissues. The total protein contents and protein-fractions were determined in the liver tissue extracts and in the plasma samples by the methods previously reported (Pai, 1953). To compare the results of chemical analysis, the paper electrophoretic separation of the plasma proteins was done and their quantitative estimation was carried out by means of a densitometer, as reported, in a previous communication (Pai, 1958 and unpublished data). The total lipids in the liver tissue and in plasma were estimated by following the method of Folch *et al.*, (1951). The results of these analyses are shown in Table I, II and III.

TABLE I

Composition of liver (g/100 g wet weight) and blood (g/100 ml) of rats

Rats	Moisture	Total protein	Albumin	Globulin	Total lipid
			<i>Liver</i>		
Before hepatectomy (7)	64.00	10.46	5.33	5.13	4.80
	±0.61	±0.34	±0.74	±0.29	±0.38
7 Days after partial hepatectomy (6)	72.25	7.84	3.88	3.72	3.90
	±1.76	±0.53	±0.37	±0.80	±0.52
			<i>Blood</i>		
Before hepatectomy (7)		5.72	3.47	2.22	0.50
		±0.02	±0.01	±0.01	±0.01
7 Days after partial hepatectomy (6)		5.57	3.41	2.15	0.52
		±0.02	±0.03	±0.04	±0.09

The values are mean ± standard error. Figures in parenthesis indicate number of animals used.

TABLE II

Showing maximum, minimum, mean and standard error values for the composition of liver tissue (normal and regenerated) on wet weight and dry weight basis

	Moisture	Wet/dry	g per 100 g of liver tissue (wet weight)			
			TP	Al	Gl	TL
<i>Normal (7 animals)</i>						
Maximum	67.00	3.01	11.30	5.90	5.90	6.00
Minimum	62.5	2.67	9.00	4.70	4.14	3.90
Mean	64.00	2.78	10.46	5.33	5.13	4.80
SE±	0.61	0.03	0.34	0.74	0.29	0.38
<i>Regenerated (6 animals)</i>						
Maximum	75.00	4.00	8.65	4.50	4.15	5.00
Minimum	69.50	3.30	6.60	2.82	3.78	2.80
Mean	72.25	3.64	7.84	3.88	3.72	3.90
SE±	1.76	0.02	0.53	0.37	0.80	0.52
On dry weight basis						
<i>Normal (7 animals)</i>						
Maximum	67.0	3.01	31.30	15.90	15.90	16.20
Minimum	62.5	2.67	27.40	13.25	11.80	11.25
Mean	64.0	2.78	29.52	14.87	14.21	13.31
SE±	0.61	0.03	0.48	0.43	0.57	0.82
<i>Regenerated (6 animals)</i>						
Maximum	75.00	4.00	33.08	17.60	15.40	19.60
Minimum	68.50	3.00	22.00	9.40	12.60	9.35
Mean	72.25	3.64	28.46	14.19	13.93	14.45
SE±	1.76	0.02	2.34	1.72	0.64	0.219

TP = Total proteins. Al = Albumin. Gl = Globulin. TL = Total lipids.

TABLE III

Showing maximum, minimum, mean and standard error values for the composition of blood in control and hepatectomized rats

	TP	Al	Gl	TL
	<i>Control (7 animals)</i>			
Maximum	5.76	3.52	2.28	0.54
Minimum	5.68	3.43	2.18	0.47
Mean	5.72	3.47	2.22	0.50
SE±	0.02	0.01	0.01	0.01
	<i>‡ Hepatectomized rats (6 animals)</i>			
Maximum	5.65	3.60	2.28	0.59
Minimum	5.50	3.22	2.05	0.50
Mean	5.57	3.41	2.15	0.52
SE±	0.02	0.03	0.04	0.09

TP=Total proteins. Al=Albumin. Gl=Globulin. TL=Total protein.

RESULTS AND DISCUSSIONS

The average food intake of the animals was 8.5 g per day. The average gain in weight of the animals in control group was 2.5 g per day and that for the animals in the experimental group was 1.3 g per day. The average liver weight in terms of percentage of body weight for the animals in the control group was 5.5 per cent, the average percentage of liver excised at the time of partial hepatectomy was 60 per cent and the average percentage of liver restored during the period of 8 days after operation, as calculated, was 80 per cent. These figures of restoration of the liver tissue after the partial hepatectomy obtained in this series are comparable to the figures given by other workers (Sutherland, 1956; Newman *et al.*, 1951). Tsubot *et al.*, (1954) reported the chemical composition of regenerating mouse liver following partial hepatectomy. From the Tables it will be seen that the regenerated tissues contained a larger amount of moisture than the normal tissues. The composition with respect to total proteins, albumin, globulin and total lipid content in normal tissues was higher than in the regenerated tissue when considered on wet weight basis which could be explained because of the higher moisture content in the latter than in the former. The regenerated tissue, however, seems to be almost nearing in its compositions to that of the normal tissue at the end of the postoperative period of eight days after the partial hepatectomy. The composition of blood in the normal and in hepatectomized animals when compared with the composition of the liver tissue, both normal and regenerated on the dry weight basis, showed that these

chemical constituents in the blood of hepatectomized animals were also approaching to the normal level.

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