

BILE-SECRETING FUNCTION OF THE LIVER BEFORE AND AFTER PARTIAL HEPATECTOMY IN ALBINO RATS

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Immediately after resection of the liver a marked inhibition of bile secretion (relative to the weight of the residual part of the liver) is observed. However, 4-5 days after resection the previous level of bile secretion is restored.

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Numerous investigations have been made of the morphological, histochemical, and biochemical changes in the liver during reparative regeneration [1, 3, 6, 7, 9]. Nevertheless, the physiological aspects of this problem have been incompletely studied. This is also true of the external secretory function of the liver, recovery of which at various periods after hepatectomy in animals has been described by only a few investigators [2, 5, 8].

We have determined the degree of disturbance of bile secretion after resection of various lobes of the liver and the rate of its recovery during regeneration.

EXPERIMENTAL METHOD

Experiments were carried out on 90 male albino rats weighing 120-150 g. Laparotomy was performed on all the animals under sodium amytal anesthesia (1 ml of 1% solution/100 g body intraperitoneally), and a thin glass cannula was introduced into the common bile duct and secured. The operation wound was then sutured and bile collected every hour for 8 h. The indices of the intensity of bile secretion were the volume of bile obtained every hour and throughout the experimental period, expressed in mg/100 g body weight, and also the rate of bile secretion, expressed in mg/min/100 g. In addition, in each hourly sample of bile collected from all the rats of a given series the content of water, organic and inorganic substances was determined gravimetrically and the concentration of bile salts (by the method of Shear and Kuhn) and of bilirubin (by the Van der Bergh method as modified by N. P. Skakun [4]), was determined colorimetrically.

The background level of bile secretion (control) and changes in this process after removal of the left lobe of the liver, the central lobes, or the left and central lobes together were determined. The determination was made immediately after resection, 24 h later, and on the 4th-5th day.

The left lobe of the liver constitutes 39-46% of the total liver tissue and the central lobes up to 38-39%. After combined resection of the left and central lobes, up to 63-69% of the liver by weight had been removed.

EXPERIMENTAL RESULTS

Immediately after resection of the liver the level of bile secretion fell sharply in every case, especially after one-stage resection of the left and central lobes. In that case the rate of bile secretion fell on the average from 4.5 ± 0.3 to 1.4 ± 0.2 mg/min/100 g during the first hour of the experiment and from 4.2 ± 0.2 to 1.7 ± 0.2 mg/min/100 g during the 6th and last hour of the experiment. As a result, the total volume of bile secreted by the liver during the experiment fell from 2002 to 894 mg/100 g, or by more than 60%. In turn, after resection of the left lobe or the central lobes only, this index fell to 1294 and 1243 mg/100 g, respectively after removal of approximately the same weight of liver tissue. It thus follows that the relative importance of the left lobe and the central lobes of the liver in the process of bile secretion in albino rats is identical.

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Changes took place under these circumstances in the chemical composition of the bile. In particular, after removal of the left or central lobes of the liver the bilirubin concentration fell appreciably, so that during the 8 h of the experiment only 0.1371 mg/100 g was excreted with the bile in the first case and 0.1499 mg/100 g in the second case compared with 0.2157 mg/100 g.

So far as cholates are concerned, their concentration increased very definitely, especially after one-stage removal of the left and central lobes (on the average from 324-318 to 1295-552 mg%. Nevertheless, because of the sharp decrease in bile secretion, the total content of cholates showed little change. In particular, after resection of the left lobe of the liver (during observation for 8 h) the excretion of cholates was about 5.9561 mg/100 g instead of 6.6715 mg/100 g, while after resection of the central lobes it was 5.5049 mg/100 g, and after resection of the left and central lobes together 6.4056 mg/100 g.

Removal of large areas of liver tissue is thus not accompanied by marked inhibition of cholate formation or excretion. In this respect the liver exhibits considerable powers of compensation. Nevertheless, the process of bilirubin excretion is inhibited.

In experiments carried out 24 h after resection of the liver a clear tendency was observed for restoration of normal bile secretion. After removal of the left lobe the total quantity of bile excreted increased to 1428 mg/100 g, after removal of the central lobes to 1536 mg/100 g, and after resection of the left and central lobes from 804 to 1014 mg/100 g. The concentration of cholates and bilirubin in the bile remained high, as a result of which the total quantity of these products excreted with the bile over a period of 8 h was higher than initially. Whereas before resection this index for cholates did not exceed 6.6715 mg/100 g, 24 h after resection of the left lobe it rose to 11.4808 mg/100 g, after resection of the central lobes to 7.5381 mg/100 g, and after resection of the left and central lobes together, to 8.8285 mg/100 g. In turn, whereas on the average up to 0.2157 mg/100 g bilirubin was excreted with the bile during the 8-h period in the control animals, 24 h after resection of the left lobe this index had risen to 0.3452 mg/100 g, after resection of the central lobes to 0.2742 mg/100 g, and after resection of the left and central lobes together, to 0.3833 mg/100 g.

These results emphasize the great compensatory powers of the liver of healthy animals in the formation and secretion of the most important components of bile—bile salts and bilirubin.

Finally, the results of experiments carried out 4-5 days after resection of the liver demonstrate complete restoration of the normal level of bile secretion even after resection of 53-69% of the liver tissue. The indices of concentration and absolute content of cholates and bilirubin in the bile regained their initial values or exceeded them.

The results of our experiments thus showed that immediately after resection of the liver marked inhibition of bile formation takes place. The degree of this inhibition depends on the extent of resection. Nevertheless, because of the great compensatory powers of the liver and of the body as a whole, normal bile secretion is restored during the next 4-5 days.

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