

Blood loss is frequently observed as a result of industrial, transport, or domestic injury [8] and is an important factor in lowering the reactivity of the organism [2, 3, 5, 11, 12]. However, despite an extensive literature on the effect of blood loss on reactivity, the problem of the effect of blood loss on liver function has been inadequately studied.

In the present investigation the effect of moderate blood loss on the bile-forming, bile-secreting, and certain other indices of the liver function was studied.

#### EXPERIMENTAL METHOD

Experiments were carried out on 10 adult dogs weighing from 18 to 26 kg. Under intravenous thiopental anesthesia a fistula of the gall bladder was formed by Schwann's method. Two or three weeks after the operation, bile was collected from all the animals for 3-4 days (every hour for 3 h). The following determinations were made on all the hourly samples of bile: the total volume of bile collected, the cholesterol concentration by the method of Engel'gardt and Smirnova, the concentration of bile acids by the method of Shire and Cooney, and the bilirubin concentration in the bile by Van den Bergh's method. The blood cholesterol level was determined, the blood sugar was estimated by the Hagedorn - Jensen method, and the concentrations of potassium and sodium in the blood and the bile were determined by flame photometry. After the background had been established, blood was taken from the femoral vein of the experimental animals at the rate of 4-5 ml/min. The volume of blood removed was 15% of the total blood volume (based on the assumption that the total blood in the body is  $\frac{1}{43}$  or 7.7% of the body weight) [1, 4, 9]. Repeated investigations were resumed 24 h after the blood loss and continued for 3 days.

At the end of the experiment the animals were sacrificed and pieces of liver were taken for investigation of the tissue respiration, the results of which were compared with those obtained in experiments on 10 healthy control animals. The absorption of oxygen by the liver tissue was measured in a Warburg's apparatus at 37° (for 1 h) in phosphate-saline buffer (pH 7.2) containing glucose.

#### EXPERIMENTAL RESULTS

The results obtained are given in the table.

The volume of bile during the first day after blood loss in all three portions showed a statistically significant decrease of 2-3 mL. Whereas before blood loss the total volume of bile was  $29 \pm 0.9$  mL, 24 h after blood loss it was  $21 \pm 1.4$  mL ( $P < 0.001$ ). Two days after blood loss the volume of bile secreted began to increase and was  $25 \pm 0.9$  mL ( $P < 0.001$ ), although on the 3rd day after blood loss it had not yet reached its initial level ( $27 \pm 1.2$  mL).

The loss also affected the composition of the bile: the concentration of cholesterol, bile acids, and bilirubin was lowered by a statistically significant amount during the first day after blood loss (see the table) and it remained at this level for 3 days. The low cholesterol concentration observed in the blood and bile after blood loss demonstrated a disturbance of cholesterol synthesis in the liver. The most marked fall after blood loss took place in the concentration of bile acids (see the table), and a smaller fall was observed in the bilirubin. The blood sugar level after blood loss fell by a statistically significant amount and remained low throughout the period of observation. This persistent hypoglycemia in these experiments evidently indicated adrenal insufficiency. This conclusion was supported by the changes in mineral metabolism of the blood and bile, characteristic of blood loss. For instance, the blood potassium concentration rose from 20 to  $26 \pm 1.7$  mg% ( $P < 0.001$ ), while the sodium concentration fell from 352 to  $313 \pm 4.6$  mg% ( $P < 0.001$ ), in full agreement with results obtained by other authors [2]. The disturbance

Concentration of Cholesterol and Sugar in the Blood and of Cholesterol, Bile Acids, and Bilirubin in the Bile before and after Blood Loss (results of 10 experiments, in mg%)

Time after blood loss (in days)	Blood cholesterol		Blood sugar		Bile cholesterol*		Bile acids		Bile bilirubin *	
	M±m	P	M±m	P	M±m	P	M±m	P	M±m	P
Control (before blood loss)	160±1.4	—	100±0.7	—	40±0.3	—	1810±50	—	31±0.8	—
1	122±2.7	<0.001	84±2.7	<0.001	38±0.5	<0.001	1397±83	<0.001	29±0.7	>0.05
2	121±3.0	<0.001	85±2.5	<0.001	37±0.06	<0.001	1506±50	<0.001	29±0.5	>0.05
3	122±3.0	<0.001	86±2.4	<0.001	38±0.5	<0.001	1582±26	<0.001	28±0.5	<0.001

\*Mean of determinations in three portions of bile.

of the ratio between the electrolytes in the bile took the form of an increase in the potassium concentration by 6 mg% ( $P < 0.001$ ) and a decrease in the sodium concentration by 50 mg% ( $P < 0.001$ ).

A factor of considerable importance in the mechanism of the disturbance of the carbohydrate, mineral, and lipid metabolism, and the bile-forming and bile-secretory function of the liver is the hypoxia which is observed after a blood loss of 15%, as the author demonstrated previously [6]. It has also been shown that bile formation is closely dependent on the blood supply to the liver cells [7]. A disturbance of these conditions may account for the decrease in the volume of bile secreted after blood loss, discovered in these experiments. This hypothesis is supported by the decrease in the oxygen consumption of the liver tissue observed after blood loss, falling on the average from 1.8 to 1.4 mm<sup>3</sup>, i.e., by 22% below the control level.

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