

EFFECT OF EXPERIMENTAL MYOCARDIAL INFARCTION ON BILE FORMATION BY THE LIVER

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In the early stages of development of experimental myocardial infarction in dogs, the volume of bile falls sharply. Parallel with this, the concentration of bile acids and bilirubin is lowered. The cholesterol concentration in the bile is increased. In this investigation the little-studied problem of the state of the liver in myocardial infarction was examined.

EXPERIMENTAL METHOD

Experiments were carried out on 12 dogs. Under thiopental anesthesia, a Schwann fistula was formed into the gall bladder. Bile was collected from all the animals 12-14 days after the operation for a period of 4-5 days in three separate hourly portions to determine the background. Blood was taken from the femoral vein in a volume of 1-2 ml. The total volume of bile was measured and the concentration of bile acids in it determined as in [7], the cholesterol concentration by the method of Engel'gardt and Smirnova, bilirubin as described in [2], and protein by means of a type RPL-2 precision refractometer, using Presnyakov's table for the calculation. The total protein content in the blood was determined, the ECG recorded in three standard leads, and changes in the heart muscle were studied histologically.

After establishment of the background in 8 dogs, under thiopental anesthesia and controlled respiration the anterior descending coronary artery was ligated along with its venae comitantes. Thoracotomy and pericardiotomy were performed on 4 dogs without ligation of the coronary vessels.

The above-mentioned indices were studied periodically until they returned to normal (Table 1).

EXPERIMENTAL RESULTS

The volume of bile in all three portions on the second day after ligation of the coronary artery was sharply reduced and it remained at a low level when tested subsequently. It returned to normal on the 20th-30th day.

The protein concentration in the bile and blood of the experimental animals remained unchanged. The slight decrease in its mean values compared with the control was not statistically significant.

The concentration of bile acids before the operation was 744 mg% in the first portion of bile, 704 mg% in the second, and 696 mg%, in the third (mean for 3 h 715 mg%), while on the second day after the operation it fell to 594, 598, and 612 mg%, respectively (mean concentration for 3 h 114 mg%, $P < 0.001$). The concentration of bile acids remained below its initial level on the 5th day after ligation of the coronary artery ($P < 0.001$). On the 10th day, a higher concentration of bile acids than before the operation was found in all portions. On the 20th day, the concentration of bile acids was between 1871 and 1922 mg% above its initial level ($P < 0.001$), after which it fell to reach the initial level by the 30th day of the investigation.

Parallel with the change in the concentration of bile acids in the bile, the bilirubin concentration also changed. On the second day after ligation of the coronary artery, the mean difference between its value and the initial level was 14 mg% ($P < 0.01$), falling to 7 mg% ($P < 0.02$) on the 5th day. Later the bilirubin concentration in the bile increased: on the 10th day of investigation, it exceeded its initial value on the average by 14 mg% ($P < 0.001$), and on the 20th day by 38 mg% ($P < 0.001$). By the 30th day, the normal bilirubin concentration was restored.

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TABLE 1. Dynamics of Changes in Indices in Dogs with Myocardial Infarct (mean value for three portions of bile)

Day after infarction	Statistical index	Volume of bile (in ml)	Proteins (in g%)		Bile acids (in mg%)	Bilirubin (in mg%)	Cholesterol (in mg%)
			Blood	Bile			
Initial data	<i>M</i> <i>m</i> ± <i>P</i> <	6,9 0,65	7,65 1,50	5,85 1,80	715 33	25 0,74	23 2,5
2nd day	<i>M</i> <i>m</i> ± <i>P</i> <	1,6 0,41 0,001	6,01 0,42 0,20	2,67 0,40 0,45	114 11,1 0,001	11,0 2,0 0,001	45 5,1 0,01
5th »	<i>M</i> <i>m</i> ± <i>P</i> <	2,3 0,40 0,001	6,82 0,03 0,5	4,78 0,43 0,5	486 21 0,001	18 2,6 0,01	68 3,0 0,001
10th »	<i>M</i> <i>m</i> ± <i>P</i> <	4,9 0,55 0,01	7,13 0,57 0,5	4,78 0,06 0,5	780 32 0,05	39 3,7 0,001	79 2,4 0,001
20th »	<i>M</i> <i>m</i> ± <i>P</i> <	6,3 0,60 0,5	7,67 0,16 0,5	5,87 0,18 0,5	2617 163 0,001	63 4,0 0,001	93 8,2 0,001
30th »	<i>M</i> <i>m</i> ± <i>P</i> <	6,3 0,26 0,5	6,75 0,30 0,5	4,71 0,30 0,5	589 46 0,01	24 3,4 0,5	26 1,8 0,5

At all times of the investigation, the cholesterol concentration in the bile was increased, the actual increase above the initial level being 15-76 mg% ($P < 0.001$). The cholesterol concentration in the bile did not return to its initial level until the 30th day.

In the animals undergoing pericardiotomy without ligation of the coronary vessels, the decrease in the volume of bile and the other indices investigated compared with the initial data was very small. Ligation of the coronary vessels was accompanied by the appearance of persistent and definite indices of insufficiency of the coronary circulation, as shown by the ECG (decrease in voltage of the waves, inversion of the T wave, widening of the Q-T interval and QRS complex, the appearance of a deep Q_1 wave, and displacement of the S-T segment). Degenerative changes in the myocardium were also confirmed by histological investigation.

The changes in the indices of liver function of the experimental dogs during the first days after the development of a myocardial infarct were evidently connected with disturbances of the circulation of the blood, and primarily with a decrease in the minute volume and slowing of the blood flow velocity. This caused the development of circulatory anoxia, to which the function of the parenchymatous cells of the liver are highly sensitive [1,3]. Changes in the liver parenchyma lead to a disturbance of the pigment function [4-6], and a decrease in the concentration of bile acids and cholesterol [7]. The restoration of the normal volume of bile and the normal concentration of its components in the later stages of the investigation (10-20 days) must be regarded as a manifestation of compensatory and adaptive mechanisms.

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