

INFLUENCE OF REMOVAL OF THE CORTEX OF THE LARGE CEREBRAL HEMISPHERES ON THE BILE-FORMING FUNCTION OF THE LIVER

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I. P. Pavlov, in formulating the conception of a cortex regulation of all the manifold functions of the organism, wrote: "The more complete the nervous system of an animal organism the more centralized it is; the higher its branches the greater the degree of control and regulation of the whole activity of the organism, despite the fact that this by no means appears clearly and openly" [11].

This concept of I. P. Pavlov was experimentally substantiated and was further developed in the works of his disciples and followers. In this connection three trends were apparent in studying and demonstrating the influence of the higher regulatory center on the course of the function of the organism.

In the works of Academician K. M. Bikov et al. [3] the conditioned reflex influence of the cortex on the internal organs is studied. M. K. Petrova, M. A. Usievich, I. T. Kurtsin et al. [4, 5, 14, 15, 16] have studied the dependence of the pattern of physiological processes on the functional state of the cortex.

E. A. Asratyan and co-workers investigated the unconditioned reflex functions of the cortex of the large hemispheres, adopting for this purpose the method of comparative study of the character of the unconditioned reflexes in normal conditions and after surgical removal of the cortex. It was established that after decortication the unconditioned reflex reactions of the dogs significantly diminished in accuracy, fineness, dynamism and adjustment to change. Changes of this type were found in the erector and locomotor reactions [1, 2], in the character of the adjustment of the reaction of the salivary and gastric glands to the kind, quality and quantity of stimuli [9, 10, 12], in the pattern of somatic unconditioned reflexes [13], in the regulation of the constancy of the internal medium of the organism [8, 17], and in the regulation of the oxidizing processes [6].

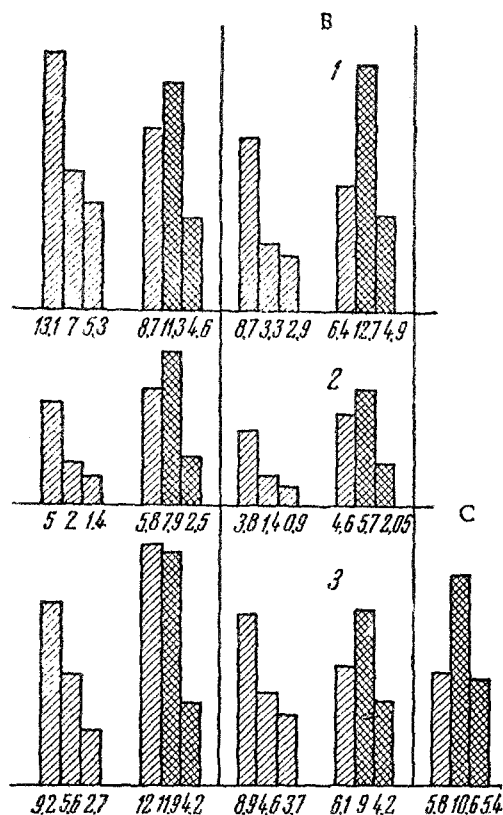
As proposed by E. A. Asratyan, we traced the influence of the removal of the cortex of the larger hemispheres on the bile-forming function of the liver.

The object of the present work was to make a comparative analysis of the bile-forming function of the liver in normal dogs and in dogs after removal of the cortex of one hemisphere, and finally after removal of the cortex of both cerebral hemispheres.

EXPERIMENTAL METHOD

The experiments were conducted on three dogs with chronic fistulas of the gall bladder, according to Schiff, with 20-30 tests at a time on each animal.

In the study of the bile-forming function of the liver the dogs received a standard food 16-17 hours before the experiment. Before commencement of the experiment (half an hour) the fistula was opened and the gall bladder was emptied of the bile accumulated in it. The experiment continued for 6 hours. Fluctuations in the progress of bile formation were determined by comparing the amounts and qualities of the bile during two hours of secretion. In each experiment we fixed three two-hour periods. Each two-hour portion of bile was subjected to analysis for bile acid content, bilirubin, solid residue and ash value. The bile acids were determined according to the method of Shira and Kuna, the bilirubin according to Van den Bergh.



Amount of bile secreted during two-hour periods of the experiment in normal conditions (a) and after decortication (b removal of the cortex of one hemisphere, (c) removal of the cortex of both hemispheres). Light columns - spontaneous bile formation, dark columns - after "load" of dried bile. Dogs: 1) Tsigan, 2) Foksik, 3) Murka.

of the experiment the formation of bile occurred most intensively; in the second two hours it fell by almost half in the last two hours it was about one third of the amount of bile formed during the first two hours of the experiment (see Graph).

In experiments with a functional "load" of the liver the size and duration of the cholagogic effect of the dried bile was established. As a result of introducing dried bile at the end of the second hour, the bile formation in the dogs in the second period did not decrease; in two animals it considerably exceeded the secretion in the first period, and in a third (Murka) it remained equal to it. The cholagogic effect of the dried bile lasted for about two hours, for in the third period the amount of bile formed was about one third of the amount obtained in the first period. This corresponds to the ratio obtained in the 1st and 3rd periods with spontaneous bile formation.

After removal of the cortex of one hemisphere, bile formation on an empty stomach did not change, but in conditions of a functional "load" a disturbance in the regulation of the activity of the liver was detected; the cholagogic effect of the dried bile considerably rose. In the dog Tsigan before removal of the cortex the amount of bile two hours after administration of the cholagogue rose to 124% and after removal of one of the hemispheres the cholagogic effect to 200%. In the dog Murka, before the operation following administration of dried bile, the amount of bile in the second two hours equalled the amount secreted in the first period. After removal of

As well as bile formation on an empty stomach, or so-called "spontaneous" bile formation, the functions of the liver were studied in the conditions pertaining on "loading" the animal with dried bovine bile. In this variant of the experiments the first two hours served as a control of the state of bile-forming function, then the animal was given 1 g dried bile orally, and in the next two two-hour periods the effect of bile expulsion was observed.

After clarifying the picture of bile formation, the cortex was removed from one of the large hemispheres of the brain.

The operation of decortication was performed by Prof. E. A. Asratyan. In the dogs Tsigan and Murka 22 g of brain mass each and in Foksik 19.5 g was removed.

After unilateral decortication of Foksik two weeks passed before the tests, and tests were conducted on the dog Tsigan three months later and Murka one month later. In the first dog the experiments lasted 18 days, in the second two months and in the third four months. In Murka 5 months after the first operation the cortex of the second hemisphere was removed. The tests were conducted 9 days after the second operation.

After unilateral decortication the condition of the dogs was quite good. No convulsive fits were observed. Murka died on the 21st day after the second operation from a cerebral abscess. Pathoanatomical autopsy showed that the cortex had been fully removed. No histological investigations were conducted.

EXPERIMENTAL RESULTS

The following pattern of bile formation on an empty stomach was manifest: in the first two hours

Amount of Bilirubin, Bile Acids, Solid Residue and Ash Value In Two-Hour Fractions
of Bile
(Average Figures)

Dogs	Bilirubin in mg			Bile acids in g			Solid residue in g			Ash value in g		
	I	II	III	I	II	III	I	II	III	I	II	III

On empty stomach

Tsigan	8.38	5.88	6.37	1.05	0.61	0.26	1.53	0.71	0.48	0.14	0.06	0.04
Foksik	2.14	1.36	1.20	0.51	0.21	0.11	0.75	0.23	0.14	0.07	0.02	0.016
Murka	6.06	4.65	3.27	1.12	0.38	0.18	0.14	0.37	0.19	0.11	0.04	0.03

With a functional "load."

Tsigan	7.55	8.14	5.84	0.72	0.9	0.41	1.09	1.27	0.55	0.09	0.11	0.04
Foksik	1.08	1.92	0.9	0.58	0.04	0.29	0.81	1.09	0.38	0.08	0.11	0.03
Murka	2.52	4.16	2.98	1.49	1.01	0.35	1.26	1.01	0.4	0.15	0.12	0.05

Empty stomach after removal of the cortex of one hemisphere

Tsigan	5.61	1.91	1.36	0.61	0.18	0.16	1.11	0.4	0.26	0.11	0.03	0.02
Foksik	1.33	0.59	0.3	0.56	0.14	0.1	0.64	0.23	0.11	0.06	0.02	0.01
Murka	1.5	2.39	2.74	0.86	0.35	0.28	0.98	0.44	0.38	0.11	0.05	0.04

With functional "load" after removal of the cortex of one hemisphere

Tsigan	6.1	18.92	4.95	0.21	1.15	0.35	0.9	1.58	0.61	0.08	0.16	0.06
Foksik	1.05	2.05	0.62	0.46	0.71	0.25	0.76	1.08	0.34	0.07	0.09	0.03
Murka	5.31	8.73	4.7	0.55	0.6	0.4	0.81	0.97	0.51	0.08	0.09	0.05

With a functional "load" after removal of the cortex of both hemispheres

Murka	6.2	8.8	6.32	0.58	1.17	0.56	0.81	1.22	0.71	0.08	0.12	0.07
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the cortex of the right hemisphere it rose in the second period to 140% and after removal of the cortex of the second hemisphere, to 180%. Consequently decortication led to an increase in the sensitivity of the liver to the cholagogue. In addition, the reaction to it was of longer duration: the cholagogic effect in the dogs Tsigan and Murka continued even in the third period of the experiment.

The investigation of the composition of the bile before and after decortication deepened and confirmed the conclusions made on the basis of the investigation of the quantity of bile. After comparing the absolute amount of bilirubin, bile acids, solid residue and ash value derived during the two-hour periods of the experiment, it can be concluded that after decortication the curve of secretion on an "empty stomach" does not change * and the cholagogic effect of the dried bile is more powerful and sustained (see Table).

As the results of the investigations show, the bile formation function of the liver changed after removal of the cortex of the large hemispheres. The influence of the higher sections of the central nervous system on the work of the liver could be revealed with a functional "load" of dried bile, which in the given case was a test for the determination of the degree of fineness of the adjustment of hepatic activity.

*An exception was shown in secretion of bilirubin on an empty stomach by the dog Murka; after decortication it was the reverse of what it was pre-operation (see Table).

In accordance with the concept of E. A. Asratyan concerning the many-storied or many-branched character of the reflex arc, the higher branch of the arc of the unconditioned reflex is located in the cortex. This cortical branch acts as the representative of the unconditioned reflex in the cortex.

In our experiments, even after unilateral decortication, the bile formation function of the liver differed greatly from the normal, when specifically stimulated by dried bile, which, confirming the idea expressed above, can be considered as a new experimental proof of the theory of I. P. Pavlov concerning unconditioned reflex regulation by the cortex of all phenomena occurring within the body.

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* In Russian.