

EFFECT OF STIMULATING THE CHEMORECEPTORS OF THE LIVER  
AND THE MECHANICAL RECEPTORS OF THE RECTUM ON THE  
PHAGOCYtic ACTIVITY OF LEUCOCYTES

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In line with the work of other authors, our investigations [3, 4] showed that the nervous system, especially its higher portions, plays a significant role in the regulation of the phagocytic activity of leucocytes. Further development of this work required study of the participation of the receptors of various organs in the reflex control of phagocytosis.

In this work we studied the effect of stimulating the chemoreceptors of the liver and the mechanical receptors of the rectum on the phagocytic activity of the leucocytes in the blood.

EXPERIMENTAL METHOD

The chemoreceptors of the liver were stimulated by the method proposed by O. S. Merkulova [7]. The mechanical receptors of the rectum were stimulated by increasing the pressure in it to 80 mm of mercury. 26 rabbits were used in the experiment.

For 2-3 days in advance, the phagocytic activity of the leucocytes was determined for all the rabbits. The blood for the investigation was taken from the ear vein in the morning (before feeding). Inactivated 10<sup>9</sup> emulsion of staphylococcus aureus was the material for phagocytosis.

The experiments were carried out in the following manner. One ml of 4% solution of sodium citrate, 2 ml of blood and 1 ml of killed staphylococcus aureus culture were poured into small test tubes with the greatest possible speed at room temperature. Then the test tubes were placed for 30 minutes in a thermostat at a temperature of 37°, after which smears were made of the contents of each test tube and stained. 100 leucocytes were counted in each smear. At this time, the phagocytic leucocytes were noted and their percentage was determined. The average of these experiments carried out with the contents of two test tubes (two smears from each) was taken. The number of bacteria ingested by 100 leucocytes was counted in the same smear. At the same time, only those bacteria were counted which were within the protoplasm of the leucocytes.

In the experiments in which the chemoreceptors of the livers were stimulated, the rabbits were tied to the operating table and their abdominal cavity was opened. In 30 minutes their blood was drawn again and the phagocytic activity of the leucocytes was determined again. Then cotton, moistened with a 1:1000 solution of acetyl choline, was placed on the surface of the right lobe of the liver. The stimulation lasted one minute. Blood was drawn again after this: at once, after 5, 10, 30 and 60 minutes. The phagocytic activity of the leucocytes was determined in each sample.

The data of Table 1 indicate that operative interference raises the phagocytic activity of the leucocytes, even though to an insignificant extent. Stimulation of the chemoreceptors of the liver decreases it significantly. The greatest decrease in their activity occurs immediately after the stimulation, then the activity of the leucocytes grows gradually and by the 60th minute after the end of the stimulation it returns to the original level and exceeds it in some cases.

TABLE 1

Changes in the Phagocytic Activity of Leucocytes During Irrigation of the Receptors of the Liver

Rabbit No.	Phagocytic activity of the leucocytes						
	before stimulation		after one-minute stimulation of liver receptors				
	av. for 2 days (and on day of expt. prior to laparotomy)	on day of expt. after 30 min rest	at once	after 5 min	after 10 min	after 30 min	after 60 min
1	15/23	16/26	10/14	11/15	13/18	15/22	17/25
2	14/19	16/22	8/12	10/13	12/16	14/20	15/23
3	16/19	17/21	9/10	11/14	12/15	16/21	17/19
4	16/24	17/28	10/12	12/14	14/16	16/21	17/26
5	17/25	18/28	12/17	13/20	14/23	17/24	17/25
6	17/26	18/28	10/14	11/16	13/20	15/21	17/26
7	16/25	17/26	8/13	9/13	10/15	13/18	18/29
8	15/24	16/24	9/12	10/14	12/17	14/21	15/22
9	15/20	16/24	8/10	10/13	11/14	15/19	16/24
10	17/26	18/27	9/13	10/16	12/18	15/23	17/29
11	16/25	18/28	8/12	10/13	12/16	15/21	19/34
12	13/16	14/17	7/8	8/10	10/12	13/14	14/22

Thus, the decrease in the phagocytic activity of the leucocytes caused by stimulation of the liver receptors has a temporary, quickly changing character.

The phenomenon we established, as became clear, is reflex in nature. This was proved by experiments with preliminary novocainization of the liver surface: cotton, moistened with 2% novocaine solution, was laid on the surface of the liver for 5 minutes; then the same area of the liver was subjected to the action of acetyl choline solution.

The results of these experiments are shown in Table 2.

TABLE 2

The Effect of Stimulating the Chemoreceptors of the Liver on the Phagocytic Activity of the Leucocytes After Preliminary Novocainization of the Liver Surface.

Rabbit No.	Phagocytic activity of the leucocytes			
	average for 3 days	after 5 min. of novocaine action	after 2 min. of acetyl choline action	
			immediately	after 30 min
13	13/15	12/15	12/14	13/14
14	16/18	15/18	16/16	15/17
15	18/21	17/20	17/20	16/19

It can be seen in Table 2 that the novocainized liver surface, as a rule, weakens the phagocytic activity of the leucocytes, in truth, quite insignificantly; the activity decreases due to a decreased number of phagocytic leucocytes. We consider that this is also the result of stimulation of the chemoreceptors of the liver, since administration of acetyl choline solution on the anesthetized liver surface does not cause characteristic changes in the phagocytic activity of the leucocytes.

In the second group of experiments the effect of stimulating the mechanical receptors of the rectum on the phagocytic activity of the leucocytes was studied. The experiments in this series were carried out as follows. After two determinations of the phagocytic activity of leucocytes, a small balloon was introduced into the rectum in order to stimulate its receptors. The phagocytic activity of the leucocytes was determined 4 times in the course of 40 minutes (immediately, after 5, 20, and 40 minutes). During the next 5 minutes the mechanical receptors of the rectum were stimulated by increasing the pressure in the balloon to 80 mm of mercury.

The phagocytic activity of the leucocytes was determined immediately after the stimulation was stopped and after 5, 10, 30, and 60 minutes. The data which were obtained are shown in Table 3.

TABLE 3

The Effect of Stimulating the Mechanical Receptors of the Rectum on the Phagocytic Activity of the Leucocytes

Rabbit No.	basic for 2 days	Phagocytic activity of leucocytes								
		after insertion of balloon into the rectal ampulla				after stimulation of the receptors of the rectum				
		immediately	after 5 min	after 20 min	after 40 min	immediately	after 5 min	after 10 min	after 30 min	after 60 min
16	17/29	22/34	24/38	21/31	19/27	21/31	24/36	23/32	20/28	16/25
	18/29	24/42	26/45	21/36	18/31	21/35	23/39	23/37	21/33	18/30
17	15/23	20/33	23/44	20/37	16/31	21/41	23/42	21/40	18/31	16/21
	15/22	21/38	22/43	21/38	17/30	22/42	24/43	23/41	18/35	16/24
18	15/26	20/36	23/41	18/36	16/30	21/37	24/43	21/36	17/31	16/22
19	15/26	18/33	20/36	17/32	16/26	18/31	22/36	21/42	19/35	16/27
20	12/21	14/22	15/24	13/21	12/18	15/24	18/30	16/27	14/24	12/21
21	11/20	14/24	15/29	14/22	12/21	14/24	17/30	16/29	13/28	11/20
22	18/35	21/44	23/47	20/42	19/35	22/43	24/45	23/41	21/42	18/34
23	17/36	24/52	27/56	23/42	17/32	—	25/51	24/49	20/45	17/38
24	12/14	7/12	7/10	11/15	8/10	—	13/19	8/11	9/11	10/13

It can be seen from Table 3 that the introduction of a balloon into the rectal ampulla itself causes an increase in the phagocytic activity of the leucocytes. This increase is undoubtedly a consequence of the stimulation of the rectal interoceptors and anal exteroceptors (pain factor). The results of isolated stimulation of the mechanical receptors of the rectum cause a noticeable increase in the phagocytic activity of the leucocytes. Its maximum increase occurs at the 5th minute after the end of the stimulation, then the activity gradually falls to the original level.

Thus, in these experiments, in contrast to the experiments in which the chemoreceptors of the liver were stimulated, interoceptive stimulation caused an increase in the phagocytic activity of the leucocytes. Only rabbit No. 24 was an exception, in which both introduction of the balloon into the rectal ampulla and the direct stimulation of the mechanical receptors caused a decrease in the phagocytic activity of the leucocytes, and in both cases the activity did not return to the original level.

In two control experiments it was possible to show that after preliminary novocainization of the rectal mucosa, an increase in the pressure of the balloon introduced into the ampulla did not produce the characteristic changes in the phagocytic activity of the leucocytes.

Undoubtedly, reflex changes in the functional condition of the autonomic nervous system occur during interoceptive stimulation [1, 6]. At the same time, the facts we established regarding the increased sugar content of the blood during stimulation of the rectal mechanical receptors and the decreased sugar content during stimulation of the chemoreceptors of the liver can be of major significance [2, 5].

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