ROLE OF THE LIMBIC CORTEX IN REGULATION OF THE LYMPH FLOW AND LUMEN OF THE LYMPHATIC VESSELS

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Stimulation of the anterior limbic cortex in dogs with square electric pulses and chemical agents in acute experiments caused changes in the lymph flow, in the tone of the thoracic duct and the cervical lymphatic trunk, and in the arterial pressure and respiration. Stimulation of the posterior part of the limbic cortex caused no significant changes in the lymph flow. Three functional zones, with different effects on the lymph flow from the thoracic duct, are distinguished in the anterior part of the limbic cortex.

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The limbic cortex influences somatic, visceral, and behavioral responses. Experimental stimulation of the limbic gyrus modifies the activity of the cardiovascular system, respiration, and motor activity of the gastro-intestinal tract [1, 5-9, 11]. In man this region has been found to influence the blood pressure, pulse rate, and respiration [10].

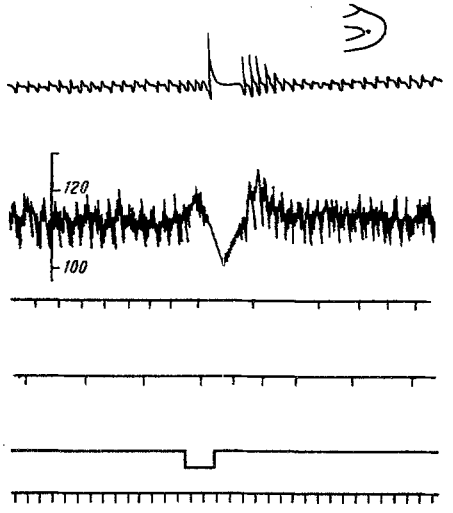

Fig. 1. Electrical stimulation of anterior part of limbic cortex (8 mA, 50 Hz, 5 msec). From top to bottom: respiration, arterial pressure, flow of perfusion fluid from cervical lymphatic trunk, lymph flow from thoracic duct, marker of stimulation, time marker 5 sec. On the right, above: dot represents place of stimulation on medial surface of hemisphere.

A previous investigation [2, 3] yielded data showing the influence of the motor cortex and cerebellum on the lymph flow and tone of the lymphatic vessels.

The object of the present investigation was to study the effect of stimulation of the limbic cortex on the lymph flow and tone of the lymphatic vessels.

EXPERIMENTAL METHOD

Experiments were carried out on adult dogs anesthetized with morphine and hexobarbital. The medial surface of the cerebral hemisphere was exposed by removal or aspiration of the anterior or posterior part of the opposite hemisphere. Cortical areas 24, 32, 23, 29,

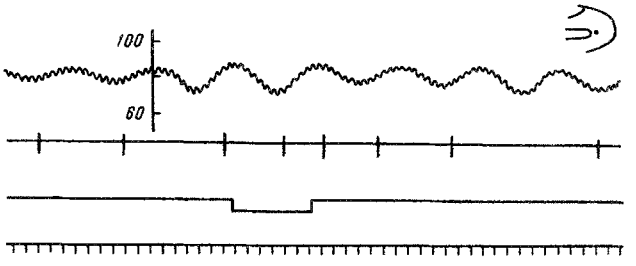

Fig. 2. Electrical stimulation of anterior part of limbic cortex (10 mA, 50 Hz, 5 msec). From top to bottom: arterial pressure, flow of perfusion fluid from thoracic duct, marker of stimulation, time marker 5 sec.

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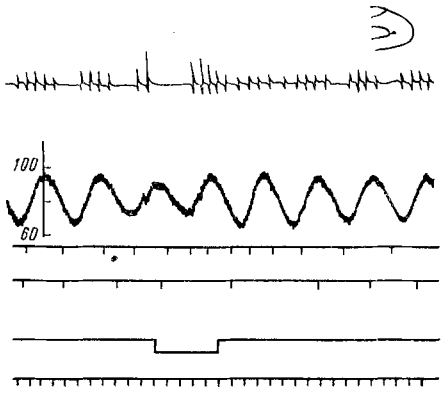

Fig. 3. Electrical stimulation of anterior part of limbic cortex (8 mA, 50 Hz, 5 msec). Legend as in Fig. 1.

30, and 31 (from the Atlas of Gurevich and Bykhovskaya [4]) were stimulated by square pulses (25-75 Hz, 0.5-10 msec, 5-14 mA) for a period of 10-30 sec. A piece of filter paper soaked in 2-2.5% acetylcholine solution was applied to various points of areas 24 and 32.

The arterial pressure, respiration, lymph flow from the thoracic duct, and the flow of perfusion fluid from the thoracic duct at the cervical lymphatic trunk were recorded on a kymograph.

Altogether 32 experiments were carried out, in the course of which 2-5 observations were made.

EXPERIMENTAL RESULTS

During electrical stimulation of various parts of the anterior limbic cortex, changes in the lymph flow were observed in different directions. Stimulation of part of the cortex surrounding the genu of the corpus callosum in 76% of cases caused an increase in lymph flow (on the average by 150%) (Fig. 1), in 9% of cases the lymph flow was reduced, and in 15% it was unchanged. The flow of perfusion fluid from the cervical lymphatic trunk was reduced, and that from the thoracic duct was increased, indicating changes in their lumen (Fig. 2).

Stimulation of part of the limbic gyrus lying basally to the cruciate fissure caused a decrease in the lymph flow in 62% of cases (Fig. 3). Compared with its initial level, the lymph flow was reduced to 59%. In 13% of cases the lymph flow was slightly increased, and in 25% it was unchanged.

During stimulation of the zone of cortex lying between the two areas mentioned above, in 50% of cases the lymph flow either increased or decreased, while in 50% of cases it was unchanged.

Pressor and depressor responses of the arterial pressure occurred on stimulation of these zones. Respiration was deepened, and the respiration rate sometimes increased and sometimes decreased.

Stimulation of area 23 and the posterior part of the limbic cortex (areas 29, 30, 31) produced no significant changes in the lymph flow.

Application of a 2-2.5% solution of acetylcholine to areas of the anterior limbic cortex reduced the lymph flow from 0.19 ± 0.01 to 0.11 ± 0.01 ml/min ($P < 0.05$). Changes in the lymph flow during stimulation of these cortical zones were due to changes in the lumen of the thoracic duct.

From these results, three functional zones can be distinguished in the anterior part of the limbic cortex on the basis of their efferent influence on the lymph flow. Electrical stimulation of the first zone increases the lymph flow, stimulation of the second zone reduces it, and stimulation of the third zone has a mixed effect. Differences in the effect of stimulation of these zones on the lymph flow are probably associated with differences in their influence on the innervation of the lymphatic vessels. These zones coincide with those distinguished by Beller [1] in the anterior part of the limbic cortex on the basis of their efferent influence on intestinal motor activity.

After bilateral vagotomy in the neck, stimulation of zones of the anterior limbic cortex caused a decrease in the lymph flow and a pressor or, less frequently, a mixed depressor-pressor response of the blood pressure. Preliminary intravenous injection of atropine (0.2-0.5 mg/kg) only slightly modified the response of the lymph flow, and injection of dihydroergotamine (4-8 mg/kg) completely abolished the changes in the lymph flow described above.

The principal conductors of descending influences from the limbic cortex on the lymphatic vessels are evidently sympathetic nerve fibers.

It can be concluded from these results that the anterior limbic cortex participates in regulation of the lymph flow.

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