# REFLEX EFFECTS ON CIRCULATION IN THE POSTERIOR HYPOTHALAMUS AND CEREBRAL CORTEX

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Stimulation of mechanoreceptors of the gastro-intestinal tract and stimulation of the femoral nerve as a rule results in an increase in the blood flow in the posterior hypothalamus, while the blood flow in the somatosensory and visual areas of the cortex is unchanged or varies in different directions. The latent period of changes in the blood flow in the posterior hypothalamus is shorter than in the somatosensory and visual areas of the cortex.

Investigations in the writer's laboratory and elsewhere have demonstrated the constancy of the blood supply to the brain, which is independent of fluctuations in systemic arterial pressure. However, the blood flow varies from zone to zone. These variations in the zonal blood flow depend on changes in the functional activity of these zones [1, 6, 8, 11, 12].

The object of this investigation was to study the relationship between the zonal circulation in the cerebral cortex and posterior hypothalamus during reflexes evoked by stimulation of mechanoreceptors of the gastro-intestinal tract and stimulation of the femoral nerve with square pulses.

## EXPERIMENTAL METHOD

Experiments were carried out on 50 cats and 15 rabbits under nembutal anesthesia (20 mg/kg, intraperitoneally).

The blood flow was recorded by Gibbs' thermoelectric method in the writer's modification [4, 9], which greatly increases the sensitivity of the thermoelectrodes.

Needle electrodes were fixed into the posterior hypothalamus of the right side, and the flat thermoelectrode was implanted in the ipsilateral somatosensory cortex. In some experiments the blood flow was investigated in the visual cortex of the same hemisphere. The electrodes were introduced with the aid of a stereotaxic apparatus and Jasper's atlas for the cat and Sawyer and Everett's atlas for the rabbit [10, 13]. The experiments began after the sensitivity of the electrodes had been tested. Sensitivity was judged from the effect of inhalation of a gas mixture containing 7-10% $CO_2$ on the brain vessels, which usually produces vasodilatation in the brain and an increase in its blood supply [1, 11], and from the action of simultaneous occlusion of both common carotid arteries on the blood supply to the brain, which causes a marked decrease in the blood flow both in the hypothalamus and in both investigated areas of the cortex [2, 5].

## EXPERIMENTAL RESULTS

After dilatation of the rectum for 1 min under a pressure of 50-100 mm Hg, the blood supply to the investigated part of the hypothalamus increased in every case. The change in blood supply began immediately after the beginning of stimulation (the latent period did not exceed 2-3 sec). This increase in blood flow was observed even in the isolated cases when the systemic arterial pressure fell, althought as a rule it rose.

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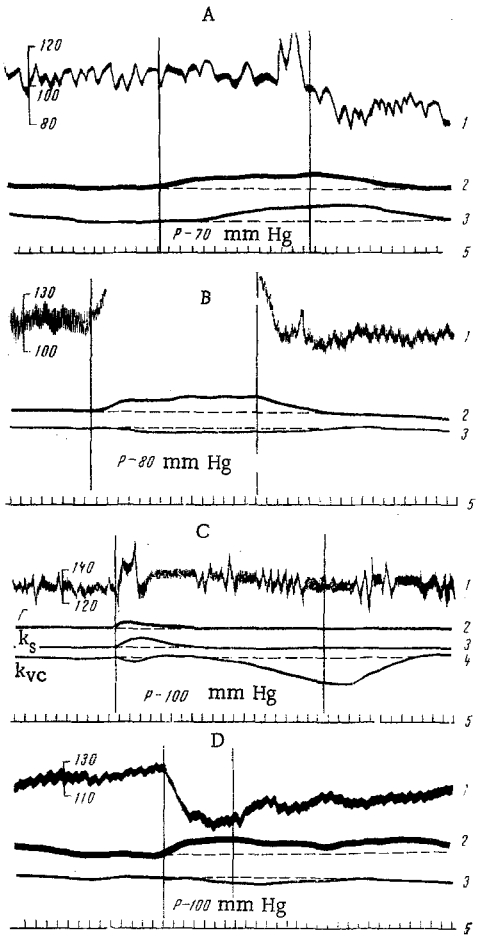


Fig. 1. Different types (A, B, C, D) of changes in blood supply of investigated areas of the brain during distention of the rectum. 1) Systemic arterial pressure; 2) blood flow in posterior hypothalamus; 3) blood flow in somatosensory cortex; 4) blood flow in visual cortex; 5) time marker; vertical lines denote beginning and end of stimulation.

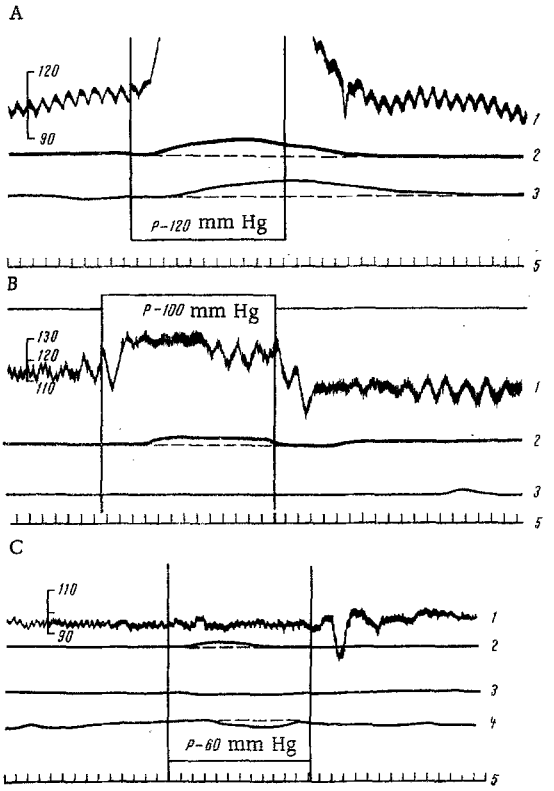


Fig. 2. Changes in blood supply of investigated areas of the brain during distention of a segment of large (A) and small (B) intestine and of the stomach (C). Legend as in Fig. 1.

Changes in the blood flow in the somatosensory cortex usually began later than in the hypothalamus (latent period 5-8 sec). The blood flow in this zone was increased in the majority of cases (about 60%), and in a minority of cases it was reduced (about 30%) or remained unchanged (about 10%). In cases when the animal responded to stimulation by movement, the blood supply to the somatosensory areas increased.

The blood supply to the visual cortex in most cases was unchanged, and sometimes it was reduced after a short latent period (2-4 sec; Fig. 1).

Distention of segments of the large or small intestine (5-10 cm long), and stomach also evoked pressor responses similar to those in response to distention of the rectum. In all cases, the blood flow in the posterior hypothalamus increased, while the blood supply to the somatosensory and visual areas of the cortex was either increased or decreased, or remained at the initial level (Fig. 2).

Stimulation of the femoral nerve with square pulses (100 Hz, 1 msec, 3-10 V, 30-45 sec) increased the blood flow in the posterior hypothalamus (latent period up to 2-3 sec). The blood supply of the somatosensory cortex was reduced in more than half the cases (about 60%), it was increased in about 30%, and remained at the initial level in about 10% of cases. Changes in the blood flow in this part of the cortex began later (latent period 5-7 sec) than in the investigated region of the hypothalamus.

If motor excitation developed in response to stimulation of the nerve, the blood flow in the somatosensory cortex increased. These changes in blood supply took place against the background of an increasing systemic arterial pressure (Fig. 3).

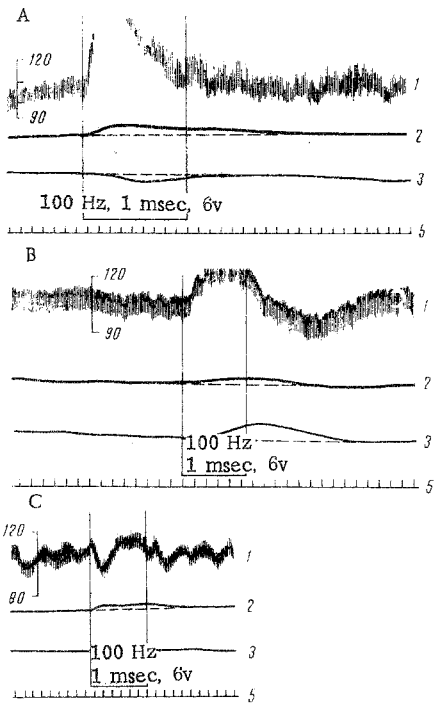


Fig. 3. Different types (A, B, C) of changes in blood supply of investigated areas during stimulation of femoral nerve. Legend as in Fig. 1.

The increase in blood flow in the posterior hypothalamus was due not only to the effect of an increase in blood pressure, but also to active changes in vascular tone in this area. This is confirmed by the fact that, in one or two cases the systemic arterial pressure fell or remained unchanged, while the blood supply to the posterior hypothalamus was increased under these circumstances (Figs. 1D, 2C, 3C).

The absence of changes in the blood supply of the somatosensory cortex observed in some experiments in response to the stimuli applied may perhaps be due to closure of vasomotor reflexes at the hypothalamic level [3, 7]. In other cases, the reflex response was formed with the participation of the cortex, the functional state of which varied in the course of the experiment and thereby led to varied changes in blood flow in the investigated zones.

The absence of changes in blood supply of the visual cortex or the decrease in its blood flow may be attributed to the fact that this zone does not participate in the formation of a reflex response to stimulation of mechanoreceptors of the gastro-intestinal tract or to stimulation of the femoral nerve.

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