

# INFLUENCE OF INJURY TO THE INTEGRITY OF THE FRONTAL CEREBRAL CORTEX ON THE COLLATERAL CIRCULATION OF THE TONGUE

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The problem of collateral circulation was thoroughly explored by V. N. Tonkov [1] and his co-workers. In particular, the collateral circulation of the tongue was studied by V. V. Kuntzevitch [2]. However, the influence of injury of the nervous system on the collateral circulation of the tongue has not been studied. Such a study would have practical significance. In addition, the tongue, being an organ consisting of two symmetrical halves, is very convenient for demonstrating changes in the circulatory bed occurring with unilateral injury to the nervous system.

In this communication are given the results of investigation of the collateral circulation of the tongue with injury of the integrity of the frontal cerebral cortex of the dog in the region of the pre-motor zone.

## EXPERIMENTAL METHOD

The experiments were carried out on 20 dogs.

The cortex of the right cerebral hemisphere was injured with either a sharp spoon or by the application of thermocautery; to avoid formation of a large scar tissue on the injured surface of the brain a fibrinous hemostatic film was applied.

Two weeks post-operatively when the dogs were recuperating from the sequelae of the operation both lingual arteries were cut near the frenum of the tongue. In this the operative technique differed from similar experiments of V. V. Kuntzevitch, who cut the lingual artery at its entrance to the tongue.

At intervals varying from one month to two years following section arteriography was carried out in living animals with introduction of sergosin.

At the conclusion of the investigation the arterial channels of the carcasses of dogs were injected with Prives' contrast medium (an orange lead dye in turpentine) with subsequent roentgenography.

As a control, 10 dogs had their lingual arteries severed but without a break in the integrity of the cerebral cortex.

In these experiments the usual collateral circulation was studied.

## EXPERIMENTAL RESULTS

The usual collateral circulation after severing the lingual artery near the frenum of the tongue, i.e., the middle third of the tongue, develops by formation of numerous anastomoses between the branches of the lingual artery of the first order (Figure 1).

If both lingual arteries are severed collateral circulation develops in the arteries of both halves of the tongue (Figure 2).

Under conditions of injury to the integrity of the cortex of the right frontal cerebral hemisphere, collateral circulation develops differently: predominantly by formation of anastomoses between the branches of

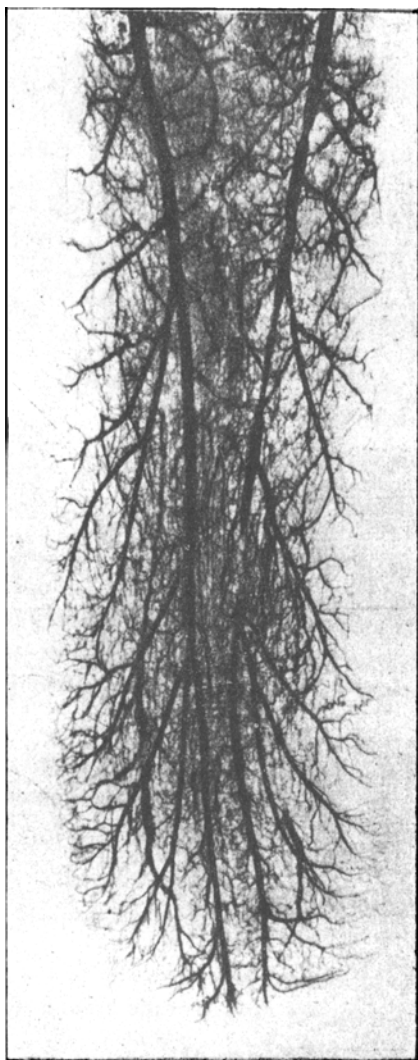


Figure 1. Arteriogram of dog's tongue after section of the right lingual artery. The undamaged left lingual artery and the sectioned right are visible. First order branches, between which anastomoses developed, forming the arterial net, proceed laterally from both ends of the sectioned artery.

teral circulation, but less marked than with the removal of the frontal part. At the termination of these experiments it may be possible to relate the injury to the process of collateral circulation with a definite zone of the cerebral cortex. In the meantime, there remains the undoubted fact of the influence of the cortex of the pre-motor zone on the development of collateral circulation.

#### LITERATURE CITED

- [1] V. N. Tonkov, in Book: Works of Fifth All-Union Conference on Anatomy, Histology and Embryology, Leningrad, pp. 269-274 (1951).
- [2] V. V. Kuntsevich, in Book: Works Dedicated to the Fourtieth Anniversary of the Work of Prof. V. N. Tonkov, Leningrad, pp. 114-120 (1937).

the lingual artery of the first order; the anastomoses between the interlacings of the lingual arteries are poorly marked. The general number of arterial anastomoses is decreased (Figure 3).

The density of the arterial net and the tempo of development of collateral circulation are different on both sides of the tongue. While on the right side, which is connected with the uninjured hemisphere, anastomoses between the branches of the first order develop through almost the entire length of those branches, on the left side, corresponding to the injured hemisphere, the area of distribution and the number of such anastomoses are diminished. On the right side between the branches of the first order near the edge of the tongue a significant (marginal) anastomosis is revealed; on the left side it has not formed yet. Therefore the collateral circulation of the tongue connected by cross-innervation with the injured hemisphere develops slower than on the other side which is connected with the uninjured hemisphere. This lag in the tempo of development of the collateral circulation is more evident when the results of the first (injured cortex) and second (uninjured cortex) series of experiments are compared.

Besides experiments with removal of the cerebral cortex, experiments were carried out with trepanation of the skull and dissection of the dura mater, and also without its dissection. It was found that after these operations the collateral circulation develops the same way as it does in absence of injury to the integrity of the cortex.

Therefore the noted retardation and difficulty in the development of collateral circulation are directly connected with the injury to the cortex of the cerebral hemisphere.

Experiments were also carried out with the removal of the parietal cortex. Preliminary data indicate that after this operation some changes are noted in the process of development of colla-

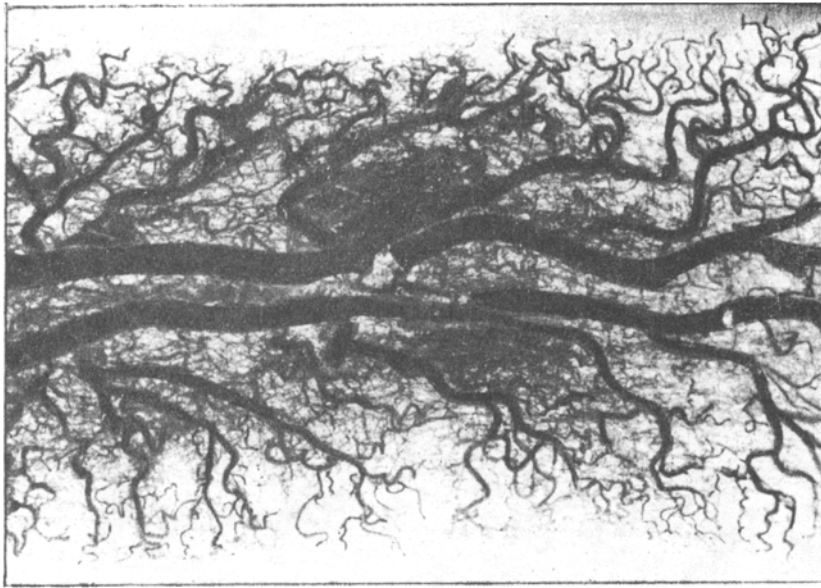


Figure 2. Arteriogram of dog's tongue after section of both lingual arteries.

An enlarged view of the sectioned regions of both lingual arteries and the anastomoses that develop between their ends. These anastomoses take the form of two tangles which stand out sharply against the background of the arterial bed of the tongue. The "tangles" of anastomoses appear similar on both halves of the tongue. There are anastomoses also between first order branches but their number is less. The greatest number of anastomoses is situated between the ends of the sectioned stalks of the lingual arteries.

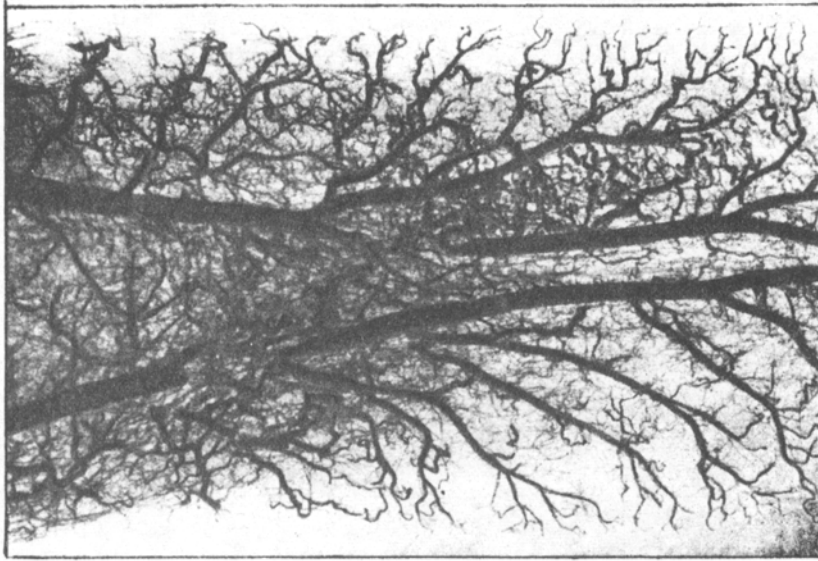


Figure 3. Arteriogram of dog's tongue after injury to cortex of frontal lobe of the brain and section of both lingual arteries.

A dense net of anastomoses is visible on the right side between first order branches and there is a large "marginal" anastomosis between them. On the left side the number of anastomoses is considerably less; the large "marginal" anastomosis is absent.