rise of BP (Fig. 3), up to 26 ± 2 mm Hg (in animals with intact nerves it was 17 ± 4 mm Hg), and this was maintained in the period between pressings of the lever. Under these circumstances (just as in intact rats) hypertensive responses of the order of 35-60 mm Hg were observed in response to application of pulses of current. Characteristically a marked rise of BP was observed as soon as the animals saw the lever, pressing of which led to the sending of square pulses into the hypothalamus (Fig. 3).

The results thus showed a difference in the mechanisms of the rise of BP during exposure to emotiogenic stimuli of different genesis. Whereas in positive emotions the baroreceptor reflex prevents hypertension, in rats, just as in cats [2-4] with denervated mechanoreceptor zones of the carotid sinuses and aortic arch, aversive emotiogenic stimulation does not cause BP to rise. This suggests that the maintenance of hypertension during aversive emotiogenic stimulation is one function of the baroreceptor reflex.

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EFFECT OF CONTRALATERAL COOLING OF THE CEREBRAL CORTEX ON INTRAVITAL MORPHOMETRIC CHARACTERISTICS OF THE PIAL VASCULAR NETWORK OF THE ASSOCIATION AND PROJECTION AREAS IN CATS

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Unilateral local injury to the cortex is accompanied by modification of its integrative activity and activation of interhemispheric interactions, leading to compensation and restoration of the disturbed functions [5, 7]. During the formation of a new pattern of adequate blood supply to the cortex differences are found in the character of changes in the volume velocity of the blood flow in individual areas [12, 13]. In the modern view, it is the system of pial vessels that is responsible for the precise correlation of function and blood flow, manifested at all levels of structural organization of the cortex [6, 9, 10, 11]. Close attention is currently being paid to its intrinsic organization [3, 4, 8]. However, structural and functional relations in the organization of the cortex and pial network have so far received little study. This is particularly true of the structure and properties of the pial system in morphologically and functionally different cortical regions belonging to association and projection systems of the brain [1, 2]. Yet it is these properties which largely determine the dynamic and reserve capacity of the vascular system of these formations during compensatory reorganization of cortical activity after injury.

The aim of this investigation was to determine the principal morphometric parameters and structural characteristics of the pial vascular system in the cortical association and projection areas of the cat under normal conditions and the dynamics of its state in the intact hemisphere during contralateral injury.

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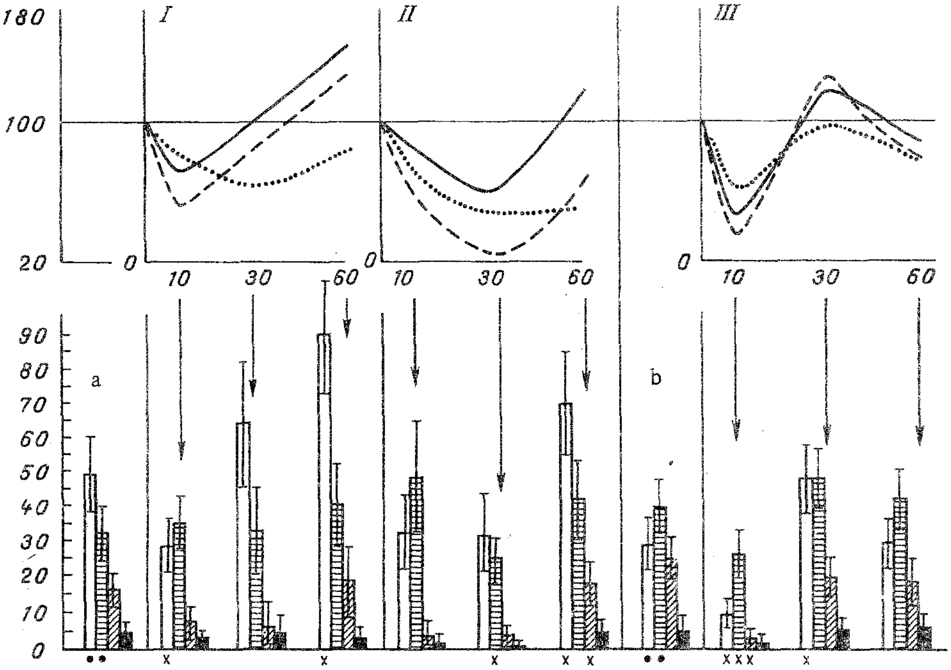

Fig. 1. Changes in principal morphometric parameters and structure of pial network in regions of right hemisphere during local cooling of left hemisphere. Abscissa, time (in min); ordinate, changes in parameters (in % of initial value). I) Changes in length of vascular bed (continuous line), area occupied by vessels (dashed line), and mean diameter of vessels (dotted line) in right parietal region during cooling of left parietal region; II) changes in same parameters in right PR during cooling of left somatosensory area; III) changes in same parameters in right somatosensory area during cooling of left parietal region. a, b) Original histograms for right parietal and somatosensory regions respectively (in ratio of length of vessels 5-15, 16-50, 51-100 μ and over 100 μ in diameter as a percentage of total length of vascular bed). Later histograms showed distribution of length of vascular bed with respect to above groups of vessels of different diameter during cooling of left hemisphere. Initial length of bed taken as 100%. ×) Changes relative to original state are significant. [Solid circles not explained in Russian original — Editor].

EXPERIMENTAL METHODS

Experiments were carried out on 37 cats anesthetized with pentobarbital (40 mg/kg, intraperitoneally). The parietal region (PR) in the middle third of the suprasylvian gyrus or the somatosensory areas (SA) of the left hemisphere (area S1) was cooled to 22-23°C for 1 h by means of a thermode applied to the dura mater. The surface of these same regions of the right hemisphere, covered with mineral oil and maintained at a temperature of 37°C, was photographed by means of the LYUMAN-IZ microscope (DRSh-250 lamp, dark field, epiobjective, magnification 9×) with series of 5-7 frames every 10 min. The area of the field of vision was 2 mm^2. Only those experiments in which the average arterial pressure remained unchanged at 120 ± 6.7 mm Hg and the respiration rate remained at 15.1 ± 2.2 cycles/min were taken into consideration. At the end of the experiment function tests were undertaken to verify that regulation of the vessels remained adequate. The negatives were analyzed quantitatively on the Leitz TAS system by automatic image analysis [14], with determination of the following parameters: mean diameter of the vessels in μ; length of the vascular bed in mm/mm^3 of tissues; the ratio of the area occupied by vessels to the total area of the field in %. Histograms of distribution of the length of the vascular bed with respect to diameter of the vessels also were constructed, with a 5-μ step.

RESULTS

Differences were observed between the principal morphometric parameters of thepial network of PZ and SA under normal conditions. For instance, the length of the vascular bed was

103.33 ± 1.64 mm/mm^3 (n = 133) and 146.33 ± 5.12 mm/mm^3 (n = 44) respectively. The differences are significant ($P < 0.001$). The relative area of the vascular bed in the field measured was 16.42 ± 1.82 and 23.90 ± 1.84% ($P < 0.01$). Differences in the mean diameter of the vessels (60.55 ± 3.32 and 72.24 ± 7.99 μ respectively) are not significant. The ratios between these parameters in the regions investigated agree exactly with data in the literature on the distribution of the density of capillaries in the cortex [15] and on the zonal cortical blood flow in the conscious cats at rest [6].

Vessels 5-15 μ in diameter constituted 48% of the total length of the vascular bed in the PR network and 30% in SA (Fig. 1a, b) whereas vessels 16-50 μ in diameter accounted for 32 and 42% respectively. Differences in the structure of the pial network with respect to these two groups of vessels are significant ($P < 0.05$). Since vessels of different caliber as a rule are heterogeneous from morphological, regulatory and functional aspects [9, 11], the differences observed in their distribution in those parts of the pial network that supply the association and projection areas are an indication of qualitative differences in the properties of the network and in the mechanisms regulating the blood supply to the regions. In PR most vessels are almost devoid of smooth-muscle cells, they are controlled by metabolic influences, and they are actually the nutritive component of the vascular bed. In SA vessels 16-50 μ in diameter (those most reactive to myogenic and neurogenic influences) are not only relatively larger than in PR, but, taking into account the difference in the total length of the vascular bed, they are twice as numerous per cubic millimeter.

It will be clear from Fig. 1 that prolonged local cooling of the left hemisphere caused phasic changes in the state of the pial network in PR and SA of the right hemisphere. The first phase was marked by a decrease in the values of the principal morphometric parameters, i.e., by a decrease in the blood supply to these regions. The histograms show a decrease in the relative number of vessels over 50 μ in diameter, i.e., vasoconstriction, and a decrease in the length of vessels under 15 μ in diameter. Since the total length of the vascular bed was reduced, this means a decrease in the number of the smallest functioning vessels. Although the duration and intensity of the changes differed in PR and SA, the latter exhibiting greater reactivity of its network, and depended on the location of the cooled region, the responses as a whole were similar in type in these regions, and similar in direction with changes taking place at the site of injury [6], and they pointed to depression of activity of the intact hemisphere. This is in agreement with the results of direct measurements of electrical activity obtained under identical conditions [5, 7]. In the next phase, while cooling of the left hemisphere continued, the values of all three principal parameters of the pial network in SA returned to their initial levels 30 min after the beginning of cooling, and after 60 min the shape of the histogram was virtually restored, with only indistinct signs of reconstriction (Fig. 1), evidence of the "elasticity" of the system. Under comparable conditions in PR (Fig. 1) only the length of the vascular bed was increased, due to a sharp and prolonged increase in the length of the small vessels themselves. This response was evidently characteristic of PR, for it was exhibited much more actively in response to cooling of the corresponding contralateral region. These changes coincided with an increase of electrical activity in PR and its restoration in SA [5, 7]. During unilateral local injury to the cortex the specific participation of the pial system in the formation of vascular responses of the association and projection areas of the intact hemisphere is thus exhibited.

The parietal association cortex is known to play a special role in compensatory and restorative processes in the cortex; this is due to the polymodality of its neurons, and to their extensive transcortical interhemispheric, collosal connections [1, 2, 5, 7]. As the results of the present investigation showed, while the initial level of its blood supply is lower than in SA, the structure of its pial network determines the long-term increase in the total exchange surface.

Analysis of the results of this investigation and data in the literature suggest that the "vascular mechanisms" of the adequate blood supply to the cortex at the level of the single functional module [10, 11], which have so far been discovered, are supplemented and integrated by mechanisms of adequate blood supply to integral structural formations of the cortex, embodied in the structure of more extensive regions of the pial network. Since this network obeys the general rules of the architectonics of the vascular bed, and since its structure also is connected with a most important feature of the cerebral circulation, namely the development of a collateral circulation, the spatial relationships in the localization of cortical functional zones and the course of the pial vascular bed assume particular importance.

The fact will be noted that "zones of mixed blood supply" between territories of the principal cerebral arteries [3, 4, 8] coincide with the cortical projection areas. The parietal association cortex, formed in carnivores as a single, structurally differentiated formation [2], is located in the distal part of the ramification of the middle cerebral artery.

In our view the results of this investigation reveal a close connection in the organization of the cortex and pial system and demonstrate their functional unity during unilateral injury to cortical areas, promoting compensation and restoration of disturbed functions.

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BLOOD AGGREGATION STATE AND THE MICROCIRCULATORY SYSTEM IN EXPERIMENTAL ATHEROSCLEROSIS AND ITS SPONTANEOUS REGRESSION AND DURING HEMOPERFUSION

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Changes in the rheologic properties and aggregation state of the blood not only affect the onset and course of diseases such as atherosclerosis and ischemic heart disease, but they are also a fundamental stage in the pathogenesis of these diseases [2, 6, 7]. According to some investigators [4], the rheologic parameters of the blood flow in the microcirculatory system depend on the hematocrit index, the deformability of erythrocytes, the size and stability of blood aggregates, dimensions of blood vessels, viscosity of plasma, and possible changes in its composition.

The aim of this investigation was to study the aggregation state of the blood and the microcirculatory system in rabbits during development of experimental atherosclerosis and its spontaneous regression, and after hemoperfusion of the animals.

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