BLOOD SUPPLY OF "TYPICAL" NEURONS OF CERTAIN NUCLEI IN THE RETICULAR FORMATION OF THE BRAIN STEM

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Few investigations have been made of the blood supply of the nerve cells of the reticular formation [2, 6].

In this paper, information is given about the blood supply of the nerve cells in the medial and lateral parts [1, 4, 10, 12, 13] of the reticular formation of the brain stem. The choice rested on a group of medium-sized triangular cells "typical" of this formation [1], with numerous long, thin dendrites, a large and clearly outlined nucleus, tigroid with a gryochromic type of structure, and tiny chromatin granules.

EXPERIMENTAL

The relationship of these nerve cells to the capillaries was studied in continuous series of brain sections from 10 adult cats in the medial part of the reticular formation (the oral and caudal nuclei of the pons and the gigantocellular nucleus of the medulla) and in its lateral part (the parvocellular nucleus). Histological preparations were used in which the blood vessels of the brain, injected intravitally with a 4% solution of gelatin in ink, and the nerve cells stained by Nissl's method were visible together. The relationship of the nerve cells to the capillaries was studied in a block of brain substance surrounding the cell for a distance of 25 μ, for it is now generally accepted that only capillaries within a radius of 25 μ from all its surfaces are concerned with the blood supply of a nerve cell [3, 5-9]. Because the medium-sized nerve cells measure 15-20 μ in diameter the thickness of the sections was 60, 70, and 80 μ.

The relationship of the nerve cells to the capillaries was studied with respect to five criteria: the length of the capillary net within this volume of brain substance; the presence or absence of contact between the capillary and the body of the nerve cell; the disposition of the tangential capillary on the body of the nerve cell, and the shape of the capillary segments taking part in the blood supply of the nerve cell.

EXPERIMENTAL RESULTS

The following values were obtained for these criteria of the blood supply to the nerve cells in the medial part of the reticular formation: the length of the capillaries taking part in their blood supply in the oral nucleus of the pons varied from 150 to 260 μ (mean 212 μ, modal group 220-230 μ). In the caudal nucleus of the pons the limits of variation were 170-260 μ and in the gigantocellular nucleus of the medulla 180-260 μ, and the mean lengths of the capillaries were 210 and 217 μ and the modal groups 220-230 and 230 μ respectively. In these nuclei the length of the capillaries running near the bodies of these nerve cells and taking part in their blood supply thus varied within identical limits. The frequency of contact between the nerve cells and capillaries was 70-71%, i.e., three-quarters of the cells were in contact with capillaries. The length of the segments of the capillaries lying on the body of the nerve cells varied from 10 to 35 μ with a mean value of 17-20 μ. In most cases, the capillaries passing near the bodies of the nerve cells were acurate in shape. The nerve cells lay at an angle to the surrounding capillaries, and in the case of contact between capillary and cell body, the capillary segment was a straight line. Usually the capillaries ran parallel to one side of the cell for a short distance, or stayed close to the cell. In the latter case the segment of the capillary in contact with the body of the nerve cell was longer and more complex in its shape (see figure, a).

The blood supply of the medium-sized triangular nerve cells in all the investigated nuclei of the medial part of the reticular formation of the brain stem was thus identical: the length of the capillaries

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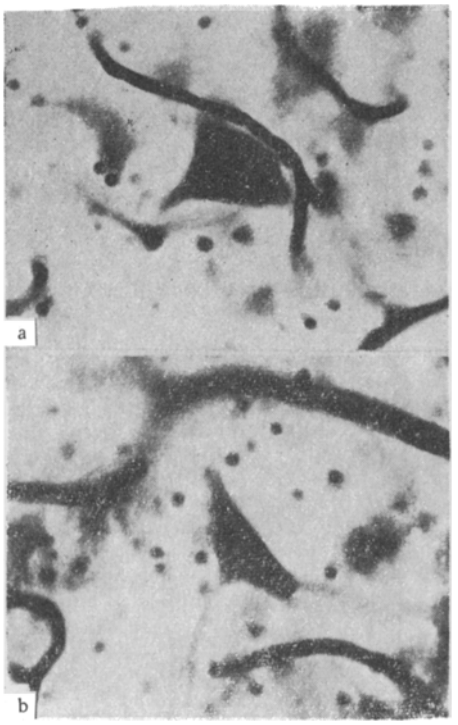

Blood supply of nerve cells of the reticular formation of the brain stem in the oral nucleus of the pons (a) and the parvocellular nucleus (b). Gelatin solution in ink is visible in the brain vessels and the nerve cells are stained by Nissl's method. 400×.

running close to their bodies and the length of the contact between cells and capillaries varied within the same limits: the shape of the capillaries taking part in supplying them with blood and their arrangement on the body of the nerve cells also were identical.

The study of the relationship between the medium-sized nerve cells and the capillaries in the parvocellular nucleus of the lateral part of the reticular system of the brain stem showed that the length of the capillaries surrounding the cell varied within limits of 110-200 μ , with a mean aalue of 160 μ (modal group 160-170 μ). The frequency of contact between nerve cells and capillaries was 27%, i.e., only a quarter of the cells made contact with capillaries. The segments of the capillaries lying on the cell bodies were straight and varied in length from 10 to 35 μ, with a mean value of 11-15 μ. In most cases the capillaries running close to the nerve cells were straight and lay a short distance from the cell body and at an angle to it (see figure, b).

The results of this investigation showed that the morphologically similar cells in the medial and lateral parts of the reticular formation differ in their blood supply. The capillary network by the side of the cell body in the lateral part is less well developed: the capillaries taking part in supplying the cells with blood are shorter, the relevant segments of these capillaries are simpler in shape, and the length of contact between the capillaries and the body of the nerve cells is also short. The criterion of the presence or absence of contacts between the nerve cells and capillaries also reveals considerable differences in the blood supply of these two groups of cells.

Although the nutrition of the nerve cell from a capillary lying a short distance from it is carried out by the astrocytic glia, investigations undertaken recently (including electron-microscopic studies [11]) have demonstrated that direct contact between nerve cell and capillary is possible,and this is clearly of special importance to the metabolism of the cell. In nuclei functioning intensively for long periods, the number of nerve cells in contact with capillaries increases sharply [7]. N. G. Palenova, for example, compared the relationship between nerve cells and capillaries in the nuclei of the phrenic nerve and the anterolateral group of the cervical portion of the spinal cord, innervating the muscles of the shoulder girdle, and found a higher incidence of contact between cells and capillaries in the nucleus of the phrenic nerve which functions continuously, than in the anterolateral group of nerve cells of the spinal cord.

The study of the blood supply of "typical" nerve cells of the reticular formation this indirectly confirms the conclusion reached by physiologists, namely that the medial and lateral parts of the reticular formation of the brain stem have different functions. The nerve cells of its lateral, sensory part have a less highly developed capillary network.

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